

## Article

# A Virtual Reality-Based Exploration of Chilean Apartment Models with Features from the Surrealist Illustrations of Roberto Matta

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## Abstract

Surrealism proposed expanding reality with dreamlike expressions. Chilean architect Roberto Matta embraced this movement in the 1930s when he was working with Le Corbusier and created imaginative apartment illustrations. Based on listings of new real estate projects in Chile, this research developed virtual reality (VR) models of apartments that integrate features from Matta's drawings, and they were examined concerning housing demands. This study's methodology involved the interpretation of Roberto Matta's illustrations in three-dimensional environments, the characterization of the real estate supply, and a summary of current apartment designs and their spatial distribution. Subsequently, two real estate-inspired VR apartment models were created that integrated features of Matta's drawings. Later, a qualitative pilot study was carried out, applying VR-assisted interviews with five participants. They were asked about the association of the models with domestic spaces, functionality, and connection to social interest. Results show the positive appreciation of spaciousness and the novelty of architectural elements, but also a resistance to complex shapes. Participants associated the VR models with wealthy young artists and recreational spaces. The models developed have novel features and layouts that can suggest residential possibilities.

**Keywords:** surrealism; housing; apartments; Matta; virtual reality; Chile



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## 1. Introduction

In the first half of the 20th century, the surrealist movement encouraged artistic expression that drew upon the subconscious and imagination to expand reality, standing in contrast to the prevailing dominance of rationalism and abstraction [1]. Chilean architect Roberto Matta joined the surrealists while working at Le Corbusier's studio in Paris, which spearheaded modern architecture with the development of large-scale urban and housing projects [2,3]. At this crossroads, Matta created several illustrations of residential environments with surrealist characteristics that appealed to a heightened sensory experience, and later he began a distinguished artistic career. Subsequent architects have regarded these drawings as a significant inspiration for new dwelling proposals [4–6].

Housing production requires adaptation to diverse local conditions, and the varying uses of emerging social groups should be considered [7,8]. This was particularly evident during the COVID-19 pandemic due to the increased number of functions that had to be performed within homes, such as remote work, recreation and study, as well as different emotional states [9,10]. For this reason, this study seeks to identify the most sensorily engaging residential characteristics for occupants using the research by design approach [11]. This involved developing apartment virtual models based on prevalent Chilean real estate typologies, integrating aspects of Roberto Matta's illustrations, and reviewing visitors' appreciation of the models.

The study's methodology began with a review of new real-estate properties for sale on Chilean web portals. General characteristics, floor plans, and images of apartments were compiled, followed by a synthesis of the designs. Previously, Roberto Matta's illustrations were interpreted using parametric design in a process of three-dimensional recreation, and a document analysis of statements and background information was performed [12]. These data were used to create three-dimensional models that were then examined with virtual reality (VR) immersion to identify relevant characteristics. Some attributes were then integrated into two real estate apartments of different sizes, and their formal and functional consistency was verified. Finally, a qualitative pilot study was conducted with five participants. This pilot study involved immersive sessions where participants navigated the models using Head-Mounted Devices (HMDs). In these sessions, VR-assisted interviews [13] were conducted focusing on space perception, social interest criteria, and questions of usability. Lastly, participant accounts were recorded and transcribed, and examined using content analysis. The results include a review of recent apartment designs for sale in Chile, a selection of architectural attributes of Roberto Matta's illustrations, the development of integrated virtual models combining real estate designs with surrealist aspects from Matta's drawings, and opinions on these models as experienced virtually.

## 2. Literature Review

### 2.1. Roberto Matta's Residential Illustrations

Roberto Matta was born in Santiago, Chile, in 1911 into a traditional family with European roots and stood out early for his artistic inclinations [2,3]. He trained as an architect in Chile in the early 1930s, at a time when the initial concepts of modern architecture were being introduced into the country [4]. After completing his university studies, Matta moved to Paris and joined the studio of Le Corbusier, who was then focused on developing urban plans with large housing projects, grounded in a rational approach to residential density, sun exposure, and transportation [14]. During the same period, Matta came into contact with the surrealists and was invited to exhibit his work and contribute to the magazine *Minotaure* [2]. The surrealist movement, led since the 1920s by poet André Breton in Paris, drew on concepts from psychoanalysis to promote the expression of the subconscious, imagination, and dreams as a way to expand reality [1]. Related to studies of Sigmund Freud and other authors on the relevance of subliminal experiences in personal life [15]. This occurred amidst the emergence of early 20th-century artistic movements that challenged the rationality and abstraction stemming from the Industrial Revolution. Initially manifesting in written works, surrealism later expanded into painting, set design, music, and cinema before declining in the 1950s. Its connection to architecture was limited, although surrealist environments most likely influenced some modern architectural works.

While collaborating with Le Corbusier, Matta created several drawings influenced by Surrealism [4,13,16]. He later abandoned architecture to pursue a significant artistic career. Among his initial works, some illustrations of residential environments have been identified, including one titled "Projet—maquette d'appartement" (Project—apartment

model). This piece accompanied an article published in *Minotaure* No. 11, in which he suggests novel architectural sensations [17].

In subsequent years, Matta referred to his time working with Le Corbusier and meeting the surrealists as the source of an emotional sensibility, that drove his artistic development [3]. Some architects also highlighted these drawings as references for new home designs, particularly in works of Antonio Bonet [5,6] and academic exercises [18]. Promoting a sensitive understanding of the housing experience, that can inform the design of homes more attuned to the interests of occupants and the concerns of contemporary architectural thought [19,20]. Thus, the residential illustrations created by Roberto Matta in the 1930s can be seen as a significant expression of the surrealist questioning of modern housing design.

## 2.2. Housing in Chile

As in many developing countries, Chile faces a significant housing deficit resulting from the need to replace deteriorated buildings and the urgent demand to accommodate new residents driven by demographic growth and social changes [21]. Approximately 150,000 dwellings are produced annually, slightly more than half of which are built with state funding through specific programs and regulations targeting lower- and middle-income sectors. The remaining units are privately financed for middle- and upper-income segments and are subject to broader regulations. In both cases, housing is predominantly developed in large-scale residential complexes, comprising mainly of one- or two-story single-family homes, as well as multi-family buildings ranging from 4 to 20 or even 30 floors. These projects are executed by construction companies and real estate developers [22].

Chilean housing is typically characterized by mixed brick masonry and reinforced concrete structures, with a smaller proportion of light wood or metal framing [23]. In recent decades, the construction of high-rise buildings in urban centers has increased as a result of rising land costs [24]. Concurrently, there has been greater use of reinforced concrete, driven by more exacting seismic building regulations and additional thermal improvements. This has led to the standardization of housing and apartment designs to ensure mass production [25], and in response to the increasing financialization of homeownership, which promotes housing as a commodity [26]. Despite efforts to encourage territorial adaptation through regulations for different climate zones, significant social segregation across urban areas in large cities remains evident [24].

State-backed programs drive the development of housing complexes for low-income populations across different regions of the country and promote the use of industrialized systems and strict building and design regulations [21]. Some public initiatives are aimed at vulnerable groups, such as people without income, rural residents, extended families, the elderly, those with physical disabilities, and indigenous communities. State-sponsored projects involve special calls to apply for housing subsidies, dimensional considerations in designs, and additional government financial contributions, although not exceeding 5% of total dwelling cost [27].

In the private housing sector, specific offerings target independent adults in central urban areas and new family groups in peri-urban zones [22]. This category also includes certain rural homes and seasonal residences. Additionally, individual homeowners often expand existing dwellings on the outskirts of cities to accommodate family growth, or to create spaces for outdoor activities, work or leisure.

The houses and apartments in Chile often take the shape of rectangular volumes, with some partial protrusions or recesses mostly dedicated to main entrances, and regular openings on exposed vertical envelopes [25,27]. Interior layouts have predominantly aligned bedrooms on one side with a central hallway or staircase, along with bathrooms

and storage on the opposite side, all typically fronted by an integrated living-dining room, and a separate or integrated kitchen. Variation is largely contingent upon the number of bedrooms per dwelling—usually one to four—as well as an apartment’s orientation and floor level, or the number of floors and lot placement for houses (usually in the center of the site and occasionally adjacent to one side).

The sizes and construction quality tend to match residents’ financial capacity. State-funded housing has an average total area of 81 m<sup>2</sup>, with a minimum of 55 m<sup>2</sup>, and privately funded homes up to 140 m<sup>2</sup> receive a tax exemption. Hence, this results in a diversity of sizes within these dimensions, with more elaborate finishes to larger sizes [23]. However, there is little diversification of designs, despite the growing demand for climatic and social adaptation in mass housing [21,27].

### 2.3. Virtual Reality Models for Real Estate Designs

Housing designs are typically represented graphically by floor plans to prepare for their construction, but also occasionally to review them with prospective residents. For the latter, easily understandable techniques are used, among which computer-generated three-dimensional models have stood out in recent years. These models make it possible to develop appearance and interaction similar to reality. Views of digital models with these properties are often termed virtual reality, especially when immersive devices are incorporated that closely approximate a bodily experience within spaces [28]. These representation techniques have demonstrated an important capability for the understanding of architectural designs [29]. Nonetheless, their production implies meticulous work, instances of interaction are complex to implement, perception of materials and physical conditions can be limited, and measurement distortion has been found when using these techniques [30].

The integration of virtual reality models in real estate housing designs, particularly for potential buyers to motivate sales, has been experimented with and implemented commercially in recent years. This activity may complement or precede property visits, occasionally with immersive devices. Some studies have confirmed the motivation of prospective homeowners to visit dwellings or the willingness to purchase after interacting with virtual reality models, especially in high-demand markets with regular or low prices [31]. Virtual tours of apartment interiors have also been evaluated with independent participants who expressed an inverse correlation between fidelity (visual details) and interaction (real-time movement). This is relevant because detailed geometry or texturing can weaken visualization speed, and therefore the sense of presence, which constitutes a significant capacity in comprehension of designs [32].

Uzoma’s study [29], based on experiences and interviews with real estate agents, noted that virtual reality (VR) models require a preliminary learning process but have a positive impact on participant satisfaction and associated sales effectiveness. These benefits are not merely transactional but also emotional, given the significance of participants’ housing decisions, VR models offer them greater clarity and confidence. Wu et al.’s work [33] also demonstrates improved communication between designers and potential occupants through VR experiences and high usability in user experience reviews of interior space designs.

Interactions with VR models of environments based on surrealist works have also been shown to produce a high degree of engagement [34] and contribute to participants’ spatial perception of artistic concepts. Although several encounters using new digital media with surrealist features have been carried out, due to the mixture of figurative elements such as those mentioned in Tang and Misri [35], this same experience has not been implemented with residential conditions. Likewise, the use of virtual media is considered to be an appropriate extension for the spatial experience of surrealist attributes [36]. Table 1

summarizes these previous experiences on immersive media in architectural design and surrealist art.

**Table 1.** Works on immersive media in architectural design and surrealist art.

References	Subject	Contribution
[28]	VR to view digital modes	Spatial experience
[29]	VR in architectural designs	Capability of understanding
[30]	VR on higher education	Challenges in development, interaction and distortion
[31]	VR in real estate marketing and sales	Motivation and willing to purchase
[32]	VR in real estate	Geometric details challenges
[33]	VR in interior designs	Communication and usability
[34]	VR in surrealist works	Engagement and spatial perception
[35]	Digital media with surrealist features	Link with IA, VR and AR
[36]	Digital media with surrealist features	Immersive media enable a reimagining of surrealist ideas

Therefore, based on the possibility that Roberto Matta’s residential illustrations can suggest new features of housing design related to emerging social demands, this research aimed to develop virtual models integrating characteristics of recent real estate designs in Chile with attributes from his drawings and study their appreciation using virtual reality devices.

### 3. Materials and Methods

To create and assess the integrated models of apartments with features of Matta’s drawings, an exploratory process was implemented using the research by design approach [11]. This involved the development of digital representations, quantitative analyses of real estate apartments’ characteristics, and a pilot qualitative study applying VR-assisted interviews [13]. The previously explained tasks aimed to formulate and review residential features, ultimately converging in the identification of architectural characteristics of housing typologies. The first phase of the methodology included model development and the second stage consultation. The integrated models were based both on the documentation of real estate offerings and the spatial interpretation of Roberto Matta’s illustrations, as shown in Figure 1 with examples of the current departments (left up), of the original drawings (left down), and the models made (right center), which are also exposed in Figures 2 and 3. These coalesced in the creation of three-dimensional representations that combined characteristics from both sources. In the second stage, a pilot qualitative study using virtual reality was implemented with five participants, followed by an analysis of their accounts and the identification of architectural characteristics. As noted in [13], pilot studies are not only useful for testing feasibility but can also generate valuable insights when contributing to the development of innovative or underexplored research approaches. In the context of research by design [11], knowledge emerges through iterative and experimental processes such as the one presented in this article. The following sections detail each methodological phase, corresponding to initial data collection, model development, VR setting and participant selection, and analysis techniques.





Figure 1. Methodological schema.

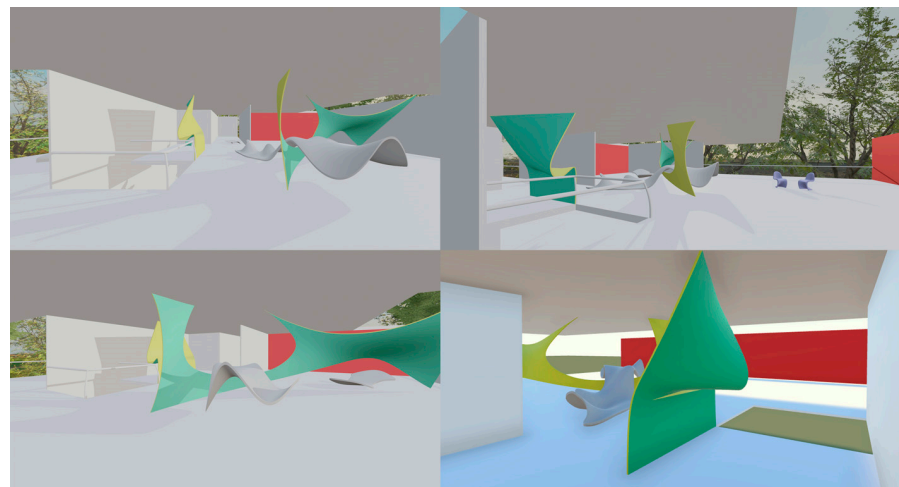


Figure 2. 3D model produced from Matta's illustrations.



Figure 3. Apartment types gathered; (left) conventional; (center) loft and (right); butterfly ((up); indoor views from portalinmobiliario.com; (below) schematic plans).

### 3.1. Real Estate Analysis

The survey of real estate offerings was conducted through a three-phase review of commercial information available online. In the first stage websites selling residential properties in Chile were identified. From these, the five portals with the highest number of listings on a single reference date were selected, as their records are updated daily in response to market dynamics. The number of housing projects was then recorded by region, city, municipality, and/or neighborhood. In the second phase, from each website, the three projects from the municipality/neighborhood with the greatest number of units and the most detailed information were selected; all were multifamily high-rise buildings. For each selected project, available units were recorded according to their official name and listed features, including interior floor area, number of bedrooms, and type. Types were classified as “conventional” (single-story with contiguous bedrooms), “butterfly” (single-story with separate bedrooms mirroring each other), and “loft” (duplexes with bedrooms on the second floor) (Figure 3). These characteristics are primarily based on size and amenities—factors related to cost—as well as intended occupant profile. The “conventional” type is oriented towards standard family households with one or more residents with a domestic hierarchy, ranging from one- to three- or four-bedroom units, with one larger bedroom. The “butterfly” type is intended for two or more individuals with similar status and features two similar bedrooms with ensuite bathrooms. The “loft” type is for more diverse occupants, usually with one or two bedrooms and more open-plan layouts. In the third phase, for each of the three types, five unit designs were selected that were close in size to the overall average floor area and for which floor plans and interior views were available. Detailed measurements of rooms, openings, and furnishings were recorded. Using this information, average measurements were used to create schematic floor plans.

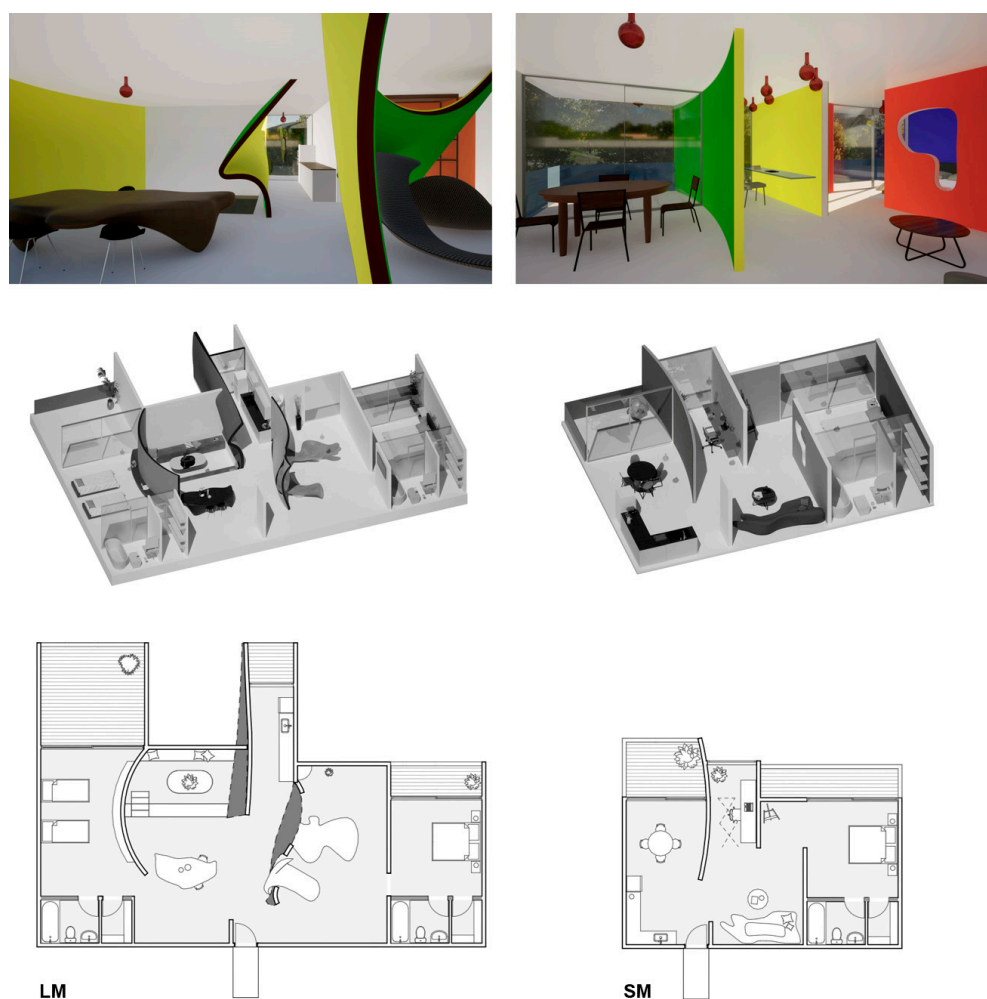
### 3.2. Surrealist Models

In a previous study conducted by the authors [11], Roberto Matta’s graphic work from the 1930s was examined, leading to the identification of six housing-related illustrations. Although all of them were produced in a small format and using different techniques, these works share similar content, with a horizontal arrangement of vertical elements with several colored surfaces and curved figures, some resembling deck chairs or stairs. The images were analyzed for their architectural characteristics and graphic elements, and their space layouts were interpreted through perspective restitution. This technique infers the location and dimensions of the depicted elements represented by projecting the edges of the drawn figures, thereby establishing the assumed position of the observer. The results informed the creation of a three-dimensional model for each illustrated environment (Figure 3). These digital models serve as the basis for VR-assisted interviews aimed at identifying residential characteristics. Interview data from these sessions were recorded, transcribed, and coded using content analysis in NVivo 14 software. The coding considered spatial attributes, identification of architectural elements, furnishings, materiality, associations with building types, and social groups. The analysis revealed that the layout of the walls and the presence of curved pieces were the most prominent features, contributing to a sense of spaciousness and visual interest.

### 3.3. Development of Integrated Models

Subsequently, integrated VR models were developed based on the dimensions and elements identified in Matta’s illustrations and the three apartment types identified in the real estate survey. With these data, new environments were planned that coherently combined both sources in average spatial dimensions. Then, two digital 3D models were

created primarily based on size, one with a larger and another with a smaller floor area, which reflects the range present in both the real estate typologies and the illustrations. The larger model incorporated butterfly-type apartment designs with two bedrooms, while the smaller one was a single-story loft type with one bedroom. This takes into consideration the fact that conventional typologies also have one and two bedrooms. In both models, private and collective spaces were arranged functionally, with typical furnishings and decor, while also incorporating room enlargements, outdoor spaces, some reduced and curved walls, separate large windows, and complex features akin to surrealist environments. In the larger model, the living room floor was lowered, and spaces were separated, similar to the lower openings and components found in Matta's drawings. The models were created using Rhinoceros 3D software (Rhino 8), with visualizations in Twinmotion software (2023 version). This involved first developing the floor and roof plans, followed by the interior divisions, and finally the smaller elements and exterior background (Figure 4). Throughout models' development, the research team conducted iterative discussions to refine designs. These adjustments were based on a comparison of the floor plans and interior views of the digital models and corresponding views of Matta's illustrations and the selected real estate projects. Specifically, modifications were made to room separations, balconies, element curvatures, and the incorporation of everyday elements, thus culminating in the final models used in the virtual reality sessions.



**Figure 4.** Integrated VR models; (left) large model; (right) small model ((up): indoor views; (below) isometrics).



### 3.4. Virtual Reality Sessions

The initial step for the VR-assisted interview sessions involved refining the models for virtual experiences with specialists of the Virtual Reality Lab of the Faculty of Architecture and Urbanism at the Universidad de Chile (LabRV), where the sessions would be held. To this end, the specialists reviewed the models using various devices and immersion procedures, and suggested modifications and additions to certain aspects, as well as the interaction sequence. The approach used in previous activities with VR models, was adapted for these interviews. This process began with a general explanation of the project, signing informed consent forms, and recording participants' health conditions.

The pilot qualitative study applied VR-assisted interviews [32], which involved accompanying participants as they navigated the virtual models wearing Head-Mounted Devices (HMDs), specifically Meta Quest Pro headsets. Members of the research team assisted participants with their spatial navigation, and initially inquired about their spontaneous understanding of the environment. Next, participants were asked about specific spatial and functional characteristics, their evaluation of the configuration, and any associations they made with particular places or types of people. Afterward, without the Head-Mounted Devices (HMDs), semi-structured interviews were conducted on their assessment of the spaces, potential uses for the hybrid models, and their overall experience. This process transitioned from more direct perceptions to more general and personal impressions and inferences.

Participants were selected based on their capability and interest in purchasing housing in Chile, specifically professionals aged 25 to 45. A convenience sampling method was employed. The sample consisted of five individuals, three women and two men. Four of them, three women and one man, took part in the virtual experience and interviews with both models in one session. The other male participant was interviewed in two separate sessions. Previously, ethics approval was sought from the Scientific Ethics Board of Universidad del Bío Bío. Informed consent was obtained from each participant, which was subsequently reviewed by the institutional unit.

The VR-assisted interviews were documented with audio recordings, video recordings of the VR model interactions, and photographs of the experience, excluding participants' faces. The audio recordings were subsequently transcribed using Pinpoint (from Google), an automated tool, and then reviewed by a research assistant to check the accuracy. Next, the interviews were coded and analyzed. NVivo 15 software was employed to systematize the data.

Content analysis was the strategy to analyze the interview data. The primary tree code was developed through literature review, mainly from [37]. The tree code for the small VR model consisted of different categories. The introductory category "Basic recognition" included Appreciations, Free description, and Space recognition. Then, the theme "Evaluation" was an umbrella to encompass six categories. The first one, "Spatial attributes", involved Space layout/distribution, Flexibility, Flow, Separation, Form, Lighting, and Size. The second one, "Architectural elements" included Parapet/sill, Ceiling, Colors, Walls, Office partition, Bedroom wall, Terraces, View, Openings, and Windows/window wall. The third category, "Materials", was focused on Identified materials, and their Evaluation. The fourth one, "Furniture", centered on Identified furniture, their Design and Functionality. Here Lamps, Kitchen cabinets/furniture, and Sofa were codified. The fifth, "Domestic spaces evaluation", focused on the Dining room's balcony, Bedroom's balcony, Bathroom, Kitchen, Dining room, Bedroom, Office, Living room, and Walk-in closet.

Another theme was "Associations", grouped into two categories. The first one, "Activities", involved Quotidian and Social activities. The second, "Scale and social order", was associated with different population characteristics. These included Artistic related

people, Age, Gender, Family typology, Occupation, and Socioeconomic status. The category included associations with different Places too.

Once participants finished navigating the VR model, a semi structured interview was applied, with the aim of evaluating the experience and the projections. For the Post-experience evaluation, the tree code included Spatial perception, Emotions, and Sensations. The “Projections” incorporated valuable elements of the VR model, and whether participants would be willing to inhabit or purchase the dwelling represented in the VR model if this materialized. Finally, “Sensations” involved description of the experience, and experienced sensations and emotions, knowing it was inspired by Roberto Matta’s illustrations. This last part of the experiment was performed to triangulate information with the data collected previously.

The same analytic process was performed with the large VR model, with some variants based on the spatial features, such as differences in the domestic spaces, such as the number of balconies, bedrooms, bathrooms, sunken living room, office, and sculpture.

### 3.5. Analysis of the Integrated Models

In line with this study’s objective of assessing surrealist-inspired residential configurations, the spatial evaluation of the integrated models required tools capable of linking geometric form with perceptual and experiential qualities, as later contrasted with participants’ VR interviews. The analysis compared the integrated models with both the illustration-based models and the selected real estate floor plans, focusing on the definition and scale of spaces, functional allocation, adjacencies, spatial hierarchy, structural organization, and connectivity patterns [38].

Two complementary methods were applied. First, isovist analysis [39] was used to represent the visual field from specific vantage points. This method is particularly suited to this research because surrealist-derived geometries—such as curved walls, partial partitions, and expanded terraces—can alter visual openness, directionality, and sequencing. These variations influence perceptions of spaciousness, enclosure, and surprise, aligning with Surrealism’s intention to expand reality through altered spatial experience.

Second, space syntax techniques, specifically visibility graph analysis [40,41], were employed to assess each model’s relational structure and its potential to shape movement, co-presence, and integration between private and collective areas. This approach highlights how the hybrid layouts reinterpret conventional apartment circulation—often compact and axial—into more fluid and varied pathways that encourage exploration, frame unexpected views, and redefine spatial boundaries.

Together, these methods operate at two levels: isovists capture the instantaneous perceptual envelope from within a space, while space syntax reveals the underlying relational network that structures movement and interaction. This dual perspective provides an evidence-based link between the formal properties of the integrated models and the valued spatial conditions identified in VR sessions, clarifying their potential to enrich residential design beyond conventional typologies.

## 4. Results

### 4.1. Survey of Property Listings

The survey of websites offering newly built residential properties in Chile was conducted on 4 June 2024, and identified five sites with a combined total of 3248 project listings. On four of these platforms, the county with the greatest number of listings was the same (Nuñoa), while on one site, it was the second, preceded by another nearby (Santiago). The first three projects with more offers presented on each website (fifteen in total) were selected for a detailed review. They were found to include 59 conventional-type apartments with

an average floor area of 77.17 m<sup>2</sup>, 25 butterfly units averaging 61.95 m<sup>2</sup>, and 16 loft-type dwellings averaging 96.89 m<sup>2</sup>. Overall, floor areas ranged from 34.85 m<sup>2</sup> to 156.23 m<sup>2</sup>, and apartments had one to three bedrooms. These values are consistent with national housing records. For five sample units of each type with more offers, average total lengths were recorded at 11.16 m, 8.47 m, and 6.32 m, and average lateral dimensions at 5.7 m, 6.0 m, and 5.8 m for conventional, butterfly, and loft dwellings, respectively. The number of parallel transverse spaces varied between 4.2 (conventional), 3 (butterfly), and 1.8 (loft), thus evidencing a rectangular layout with axial circulation and a larger side with large windows, while the opposite side typically featured the entrance and bathrooms, like examples in the literature. Ceiling heights were consistently 2.4 m per floor. The images provided predominantly featured central views of living rooms or main bedrooms towards large windows, with furniture and decor. Floor plans were synthesized using average sizes and wall layouts, which demonstrated spatial regularity with axial tensions and fragmented yet continuous lateral openings.

#### *4.2. Review of Residential Illustrations*

Based on the collection and perspectival interpretation of Roberto Matta's residential illustrations from the 1930s, a planimetric review of measurements and elements was conducted. This revealed an average area of 138.37 m<sup>2</sup>, with an average front length of 13.53 m and side length of 13.18 m, primarily due to a longer central portion with an average lateral dimension of 7.56 m. Ceiling height averaged 3 m, and there was an average of 6.3 parallel transverse spaces, with 2.3 lateral openings, and 2.6 overhead openings, in addition to various minor elements, in particular recurring lounge chairs and curved walls. These measurements represent a 30% to 90% increase compared to the units surveyed and typical apartments in Chile. Although the planimetric structures look similar, interior walls were less extensive, and the overall perimeter and interior spatial arrangements varied more. Bathrooms and functional spaces were largely absent, with one side open for circulation and the opposite more elaborate with partial openings.

In the previous immersive sessions with the virtual models based on Matta's illustrations, participants expressed favorable impressions about the spaciousness and openings. Of the architectural elements, participants highlighted terraces and walls. Based on the initial spaces where the walkthroughs began, participants imagined outdoor rooms, since the original illustrations only show a fraction of the images. Regarding furnishings, participants recognized low forms like lounge chairs and a few domestic elements. Also, they perceived little about materiality or residential architecture, and tended to interpret the environment as recreational, public, and associated with wealthy young artist-type occupants.

#### *4.3. Development of Integrated Models*

To create VR models of residential environments that reflected both the conditions of real estate listings and characteristics of Roberto Matta's illustrations, the previously identified dimensions, attributes, and configurations were considered (Table 2). From this base, two models were generated with different sizes and provisions: a larger two-bedroom unit of approximately 120 m<sup>2</sup>, and another smaller one-bedroom unit of approximately 80 m<sup>2</sup>. Together, they represented the variety of available real estate listings and served as a manageable comparative sample for VR-assisted interviews. The models were developed by an independent architect, with review sessions with researchers to evaluate the balance of source integration and approximation to real estate designs and Matta's illustrations, based on architectural plans and central views. The process consisted first of incorporating housing conditions based on the apartments studied and modifying parts to align with the surrealist environments by moving rooms, extending spaces, reducing walls and inserting

elements similar to illustrations according to a functional organization. The design elements incorporated were based on content analysis carried out from the VR interviews, selected according to their relevance and applying them according to a distribution of domestic spaces, in locations relevant to functionality and slight adaptations of forms.

**Table 2.** Features of real estate apartments, models based on matta’s illustrations and integrated models.

	Conventional	Butterfly	Loft	Models Based on Matta Illustrations	Integrated Models (SM–LM)
Number recorded	59	25	16	6	2
Average floor area	77.17	61.95	96.89	138.37	63.5–127.9
Average total lengths	11.6	8.47	6.32	13.53	11–17.65
Average width	5.7	6.0	5.8	7.56	5.6–7.65
Number of transverse spaces	4.2	3	1.8	6.3	4–5
Ceiling height	2.4	2.4	2.4	3.2	2.8

Both models adopted a longitudinal configuration, with parallel rooms, outdoor extensions, and openings on one long side, and the entrance, bathrooms, and circulation on the opposite side. They incorporated similar conditions from both sources, though with reduced dimensions compared to the illustrations and larger than in real estate units. Additionally, spatial separations suggested in Matta’s drawings were translated into rooms with residential functions like bedrooms, dining room, kitchen, and living room with furnishings incorporated, as well as bathrooms consistent with real estate designs. Also, one or two curved walls, spacious terraces, and several complex-shaped furniture pieces resembling surrealist illustrations were incorporated. Large windows were used in some rooms, as in the real estate designs, although smaller openings were excluded, bathroom walls were made translucent, and there was less decoration present than in commercial designs. In the larger model, bedrooms with ensuite bathrooms and storage were placed at both longitudinal ends, akin to the butterfly apartment type, but accompanied by a central separate living room, dining room, and kitchen, as with the conventional unit type, and with partial separations like the loft dwelling type. In the smaller model, a bedroom was placed at one end, with an antechamber-living room, desk, and kitchen-dining area, thus resembling a one-bedroom conventional unit in terms of amenities, but greater in size and featuring partial separations like loft units.

#### 4.4. Immersive VR Sessions

Participants experienced the two integrated models during immersive sessions using HMDs, after carrying out some adjustments according to the suggestions of LabRV technicians and initial tests. Specifically, a general forest background was incorporated, which mirrors the textures of the apparent openings in Matta’s illustrations and is also a common environment used in the real estate projects surveyed. Corners and surface treatments were also fine-tuned to approximate a realistic presentation. Additionally, a fixed starting position and virtual navigation path were established to simulate a pedestrian walking.

Immersive sessions were conducted with the five individuals: three men and two women, ranging in age from 27 to 45, and identified as P1 to P5 in chronological order (Figure 5). All had different backgrounds and life paths; four were Chilean and one a foreigner, and all had technical or professional training, two in architecture, but from different contexts and roles than the researchers. Each session began with a health check and orientation about the HMD use and lasted approximately one and a half hours. Informants were free to leave the session, remove the equipment, or sit as needed. Audio transcriptions of approximately 15,000 words in length were generated from each session. These were

processed, coded by architectural attribute and participant response, and relevant extracts were selected.



**Figure 5.** VR sessions.

The participants recognized the VR models as residential environments. For example, when P1 was asked about the Large Model (LM), she stated: “I see a living room, a bookcase, a kitchen, a large window, a dining room? A curved wall, a bedroom, a child’s bedroom. A balcony, a window, a bathroom.” This confirms that she identified furniture and functional spaces associated with a home.

Regarding the evaluation of the models, various aspects were analyzed. The first was the colors. Regarding the LM, P4 stated, “They’re fine. They feel pleasant.” Regarding the Small Model (SM), P1 stated, “Oh, I really like the color combination.” For P2, regarding the SM colors: “They’re avant-garde, yes, because they’re not classic colors.” Therefore, it can be inferred that although the participants found the colors unusual, they generally rated them positively. The second aspect considered was the spatial layout of the models, which produced two contrasting impressions. On the one hand, in the experience linked to the LM, P1 expressed: “Oh, I think it’s all crowded.” She had this impression after seeing the curved piece and the rest of the common areas. On the other hand, P2 considered that “The size and layout are well done.” Regarding the layout of the SM, P1 stated: “I like the walls and the layout. That hallway, wall, and hallway, I think, are what I like the most.” In contrast, P3 offered a more critical view, saying: “I don’t like that feeling of having a perpendicular wall right at the foot, advancing toward you. And this space with the easel, of course. Imagine being there, looking at those two spaces.” The participant did not like the layout of the spaces or the perspective it creates. As can be seen, there were contrasting assessments of the layout of both models. The third aspect analyzed was lighting. A variety of opinions were expressed in this regard. Regarding the LM, P1 said

“I feel like it has little light. (...) There’s a huge wall that runs through it, there’s another space without windows, which has a recessed space, and the only light that enters the entire space is the light coming from the kitchen, which is a very small window.”

P1 experiences a strong feeling of confinement and darkness, linking this perception to the lack of windows and the cramped spaces. P2, for his part, mentioned: “I really liked the bathrooms (...) the good thing is that they get natural light.” Here, the participant, although not referring to the artificial lighting design, considers the capture of natural light through the translucent wall to be innovative. Meanwhile, P1 particularly valued the natural lighting in the SM, who noted: “I imagine the light enters in a very beautiful way;



it's a very bright space." The participant likes the esthetic and functional aspects of this model's lighting.

A fourth aspect analyzed was architectural elements. In the LM, the balconies caught the participants' attention. In this regard, P4 said they were "Super spacious and well-lit" and highlighted "The view". P2, on the other hand, stated: "Here's the balcony. I also like that it has a glass balcony, that glass parapet." In this sense, he values the use of glass in the parapet, highlighting its contribution to the visual openness of the space. In contrast, P5 said "It's a very large balcony (...). I find it very dangerous for children. (...) If it's going to be here, it should have protection (...) the glass can break, they can fall over there." Thus, she raised doubts about the coherence between certain esthetic elements and their functionality, especially when living with children. The balconies in the SM were valued as an element that added spaciousness and avant-garde style to the design. P2 noted, "I find the terraces to be more contemporary than anything." Similarly, P3 stated, "It has a good view, very good." Participants' testimonies show that architectural conditions, such as view and materiality, cannot be separated from function.

Another element explored was spatial fluidity. Regarding the LM, P1 mentioned architectural elements that, in her opinion, enhance this aspect: "The wall and the large window in the kitchen, which makes entering a little more fluid". Likewise, P3 valued the connection with the exterior: "I'm in the bathroom. I value not losing that connection with the exterior, having natural light and being able to see this sequence of spaces from here." Regarding the SM, P1 stated: "I think moving within a space, which allows you to walk and move your body much more fluidly, makes it much more livable." P1 and P3 expressed appreciation for the models in this regard.

Other aspects explored were the functions participants assigned to the different spaces and the social groups they associated the models with. Participants referred to the activities that could be carried out in the models. Regarding the LM, P2 said "You can lead a family life here." P3 associated the space with leisure activities and tranquility: "I see this space more as a place to rest, to read, to listen to music, to do something quiet, something for leisure." P5 offered a more functional perspective: "Over there [in the twin-bedded room] they had those desks, so they study (...). And the dining room, where they eat, and the kitchen." P4, on the other hand, imagined social uses, noting: "A party. It's really big, the window is really pretty." Participants associated the model with everyday family, functional, and social activities. They were also asked about the models' potential occupants. In this respect, the LM was associated with families due to its layout and number of bedrooms. P3 said that "I imagine a couple, a family." In contrast, P5 problematized the possibility of children specifically occupying the two-bed dormitory: "I find it crazy that a child would live here, because I still find the layout not suitable for a children's apartment." P5 did not imagine children living there, as she considered some design elements unsafe for them. The association with high socioeconomic status was common, where the design, materials, and spaciousness were interpreted as indicators of exclusivity. In this regard, P4 said she associated it "with a high-end apartment, because it has a lot of surface area and spatial elements that are not within a budget," and with people "totally ABC1[high-income class]. Because there are no apartments of this size and with this type of visual arts on the market at an affordable price." They also classified potential occupants of the LM as people with an interest in art. In this regard, P3 noted: "I imagine people more connected to culture or art, or more open-minded, right? Not very traditional." In short, the LM was associated with families, but also with single people or couples without children, belonging to the high-income sector, who were interested in art.

Regarding the potential occupants of the SM, P3 associated it with: "Young people. Yes, with a couple or a single person, young." The responses of the other participants

were similar. P4 stated, “It’s more for a couple or a single person. Because it only has one bedroom, it doesn’t have many places to store things. And because everything is very open. . . less private than the other one.” This model was primarily associated with middle- and upper-middle-class sectors. P2 stated, “I think this apartment meets what the emerging middle class is looking for.” Some people associated the SM’s design with a more artistic profile, both due to its colors and the break with traditional esthetics. In this regard, Participant 1 said that “It’s too artistic for a space with children. Clearly, someone who would also find it interesting to have a housing structure very different from a traditional home.” Thus, the SM was associated with young people living alone or as a couple, who have an interest in the artistic field and belong to the middle or upper-middle class. Finally, regarding projections, when asked whether they would purchase the home represented by the LM, the responses varied. Two participants indicated they would not purchase it, and three indicated they would, highlighting aspects of quality and spaciousness. Regarding living in the LM, two participants indicated they would not live there, while two indicated they would if modifications were made. For example, P2 said “I would make modifications, but I would live there. (. . .) I would modify those walls at the entrance.” Similarly, P4 stated: “Yes, it’s super spacious, it’s very big, maybe it needs an extra bedroom. But yes.” Finally, one participant indicated that she would live in the LM, without mentioning modifications. Thus, opposing views are evident, with some people rejecting living in the home represented by the LM due to its design, while others would accept living there.

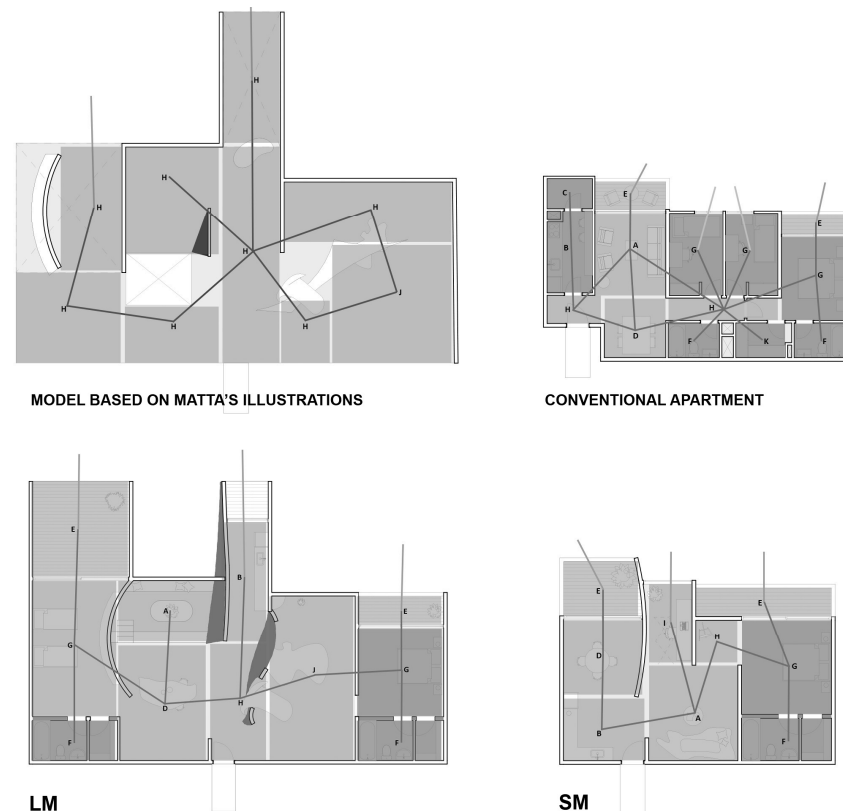
Projections regarding the SM are also diverse. Regarding purchasing it, one participant indicated that she would not buy the dwelling represented by the model, while the others said they would, considering some caveats. For example, P2 expressed interest, albeit with esthetic changes: “Yes, exactly, I would change the colors. The color of the living room.” P5 considered the monetary factor, saying: “If it were within a reasonable price, yes.” While P4 stated: “I would buy it to rent it out now.” Thus, the majority of responses indicated they would buy the dwelling; however, each participant had different criteria based on which they would decide to purchase the SM. In terms of living in the SM, all responses were positive, albeit with different modification criteria. For example, P4 conditioned his response on the type of family; he said “No, not with children. If I were single, yes. But I think it would take a lot of closets to store things.” For her part, P5 indicated that she would make adjustments: “With changes, yes. For example, netting on the balconies, maybe some changes to the color palette, but yes, I really liked the apartment.” In short, all responses indicated that they would live in the SM, but would take into account the type of family or whether they could make changes to the space.

#### *4.5. Analysis of Spatial Configuration*

The integrated models possess characteristics similar to both the 3D interpretation of Matta’s illustrations and the real estate apartments in terms of layout, sizes, spaces, and elements. The environments in the two sets exhibit longitudinal organization with several adjacent, mostly rectangular spaces of similar dimensions, and length-to-width ratios ranging from 1:1 to 4:1. However, the integrated models have differences regarding real estate designs, such as a higher proportion of spaces with partial partitions, which reflects compositions interpreted from the drawings. Larger spaces are centrally located, whereas in real estate designs they are placed at one end, and in Matta’s illustrations, they are placed on the front side. Additionally, the spatial positions, adjacencies, and collinearity are more diverse in the integrated models than in the more homogenous real estate designs, and similar to the drawings. Also, circulation paths are wider and more dispersed with inclined axes, and balconies are larger and more separated. A main fan-shaped circulation

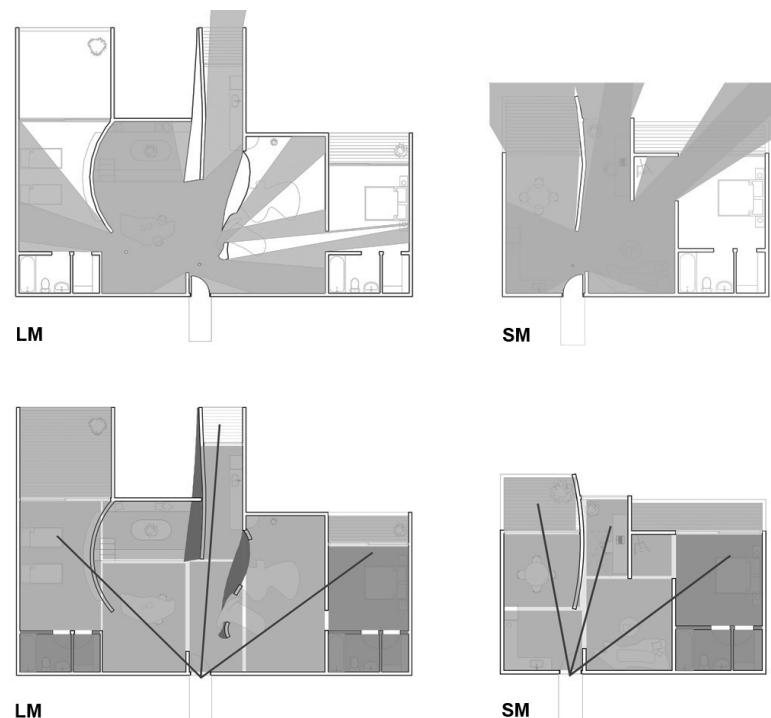
path leads from the entrance towards interior and exterior spaces, unlike the organization with a central axis found in real estate units.

These differences are evident in the central isovist diagrams of the four representative models (Figure 6). In the integrated models, isovists from the main entrance provide greater visual openness and directional variety, in contrast to the more constrained and centralized configurations of the real estate-based models. Similarly, differences in adjacency, spatial hierarchy, and circulation patterns can be understood as distinct architectural genotypes [37], thus reflecting patterns of spatial organization that condition each design's potential habitability.



**Figure 6.** Floor plans with room types and topological organization ((**up left**); 3D environment based on Mattà's illustration; (**up right**), conventional apartment; (**below left**); large model; (**below right**), small model).

These characteristics reflect the hybrid nature of the integrated models and partially coincide with the participants' assessments in the virtual sessions. The positive appraisal of spaciousness and the relationship with the exterior environment is associated with the larger size and reduced internal compartmentalization, the greater variety of spatial distribution, and the fan-shaped circulation directed towards views of exterior surroundings (Figure 7). This also includes recognition of the models as residential environments with novel spatial arrangement, connections, and elements. These conditions are consistent with Hillier's [39] assertions, which maintain that spatial configuration generates specific experience and use conditions, not merely as a consequence of functional requirements, but as an autonomous relational structure.



**Figure 7.** Schema of isovists (**Up**) and space flow (**Below**) in large model (**Left**) and small model (**Right**).

## 5. Discussion

This work details the development of virtual reality models that integrate characteristics of real estate listings of new apartments in Chile with features derived from the illustrations of architect Roberto Matta, created during his transition from modernist architecture to surrealism. This research design process is complemented with VR-assisted interviews. The experience demonstrates the potential for generating new forms of residential architecture based on artistic references and user participation, enabled by advanced visualization technologies. It involved the integration of features and a collective review process in order to determine new architectural characteristics. Participants' recognition of the virtual reality models as housing environments suggests the coherent adoption of residential features, while at the same time, their identification of novel features reflects the incorporation of artistic elements. The positive assessment of some of these new features also promotes the design's potential, although some critical comments on specific concerns need addressing.

This experience has several limitations due to the small sample size and specific definitions adopted during the process, thus underscoring the exploratory nature of the study. Nonetheless, it aims to propose avenues for future development that combine experimental design capabilities, artistic critique, the participation of potential users, and new communication media to expand residential architecture. These proposals require further study under conditions that are broader and closer to their actual material realization to verify applicable characteristics. Also, they can be combined with studies of the behavior and perceptions of current apartment users to better understand spatial affordances as a future research project.

Similarly, the perceptions and configurations suggested through the models indicate significant possibilities, particularly concerning the fan-shaped layout that tends to create a sense of spatial extension. This design organization could be applied in current projects to create a more spacious feel, although it may imply larger built-up areas. This sensation is in line with the surrealist intention to expand reality by promoting personal sensations,

which could help to counteract the standardization and alienation often found in mass housing. It is meaningful that the models evoked recreational and emotional impressions from the participants, as this suggests new dimensions in the everyday residential dwelling experience. Consistent with contemporary concerns in housing and current architectural thought [19–21,24]. However, the participants also manifested practical concerns and perceptual disorientation arising from the more complex shapes and unusual spatial relationships in the models. The dilemma between the positive perception of spaciousness and openness versus the anxiety of complexity reflects the tension between domestic rituals and the symbolic meaning of housing, which is oriented toward personal settlement but sustained by daily activities.

These possibilities suggest a greater connection between residential designs and natural environments, which can contribute to their cultural appropriation but also lead to larger urban dimensions and sprawl, making housing policies and financial accessibility more difficult. They also present regularity and separations that facilitate the industrialization of housing. It is also important to note that references to materiality, corporeality, or social dimensions, which are found in surrealist writings, as well as the more convoluted and contradictory elements, were largely absent from model development and participants' accounts. This indicates that the more conceptual and spatial aspects of surrealism could constitute its most valuable legacy, at least in rethinking domestic space. This seems to connect essentially with the subconscious perceptions declared by psychoanalysts. In any case, the study suggests specific characteristics of housing design related to new appreciations for residential living. Although these implications must be supported by more comprehensive evaluations to develop generalizations and applications in residential designs. Hence, this research offers new avenues for interpreting the housing experience and the contribution of art and technology to residential design. It is also a novel example of interdisciplinary study using digital technologies for cultural exploration [42]. Thus, this work contributes to testing mixed exploratory techniques in housing design, with implications for understanding the living sense, as well as the application of artistic experiences and virtual representation tools.

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