BioGecko
Vol 12 Issue 03 2023
ISSN NO: 2230-5807

Using the Pattern of Social Housing and Sustainable Architecture in Designing Residential Complexes for Low-Income Groups

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Abstract
If a residential complex has suitable design, its public space can be transformed into areas for interaction among residents. Nowadays, sustainable development has become an important topic in meeting urban needs, aimed at achieving a happier society and a healthier environment. It should be noted that according to the Iranian Constitution, providing human housing is a public right for members of society, which has become a fundamental problem for low-income groups such as young people due to soaring land prices, building materials, economic recession, unemployment rate, and declining employment growth with consideration of these factors. Given the above-mentioned inconsistencies, investigating the principles of people-oriented design of residential complexes to achieve sustainable development is of particular importance in this research. By considering the land in the Tehranpars region (redevelopment area) of Tehran and the general principles of social housing and affordable housing design patterns, emphasis has been placed on reducing and eliminating housing and urbanization problems in Iran.

Keywords; Cheap housing, cultural interactions, sustainable architecture, low-income groups, indigenous knowledge

Introduction

Iran faces the problem of rapid population growth and population concentration in urban centers, with a population growth rate of 1.4% and an urban population of 74% (Sadovnikova N, et. al., 2022; Phan NH., 2021). As a result, providing housing has become a pervasive and universal issue. Housing is a broad and complex issue. It is a physical place and a basic need for households as shelter, home, and residence (Delalpour Mohammadi, 1996; Albarq AN, & Suleiman AK, 2021), for which various measures have been taken to improve and bring it closer to human psychological and physical comfort. After the industrial revolution and the formation of the era of sustainability, architects and urban planners sought to address and control issues and problems related to living complexes. These problems are caused by neglecting multiple issues that have turned the depletion of energy and natural resources and environmental degradation into a pervasive and common problem among developing countries (Shia, 2012). In other words, due to the increasing urban population and the shortage of undeveloped lands, the pattern of housing production in cities has changed, and it has expanded in the form of apartment residential complexes, which has led to a reduction in social interactions among residents. If a residential complex has appropriate design, its public space can be transformed into areas for resident interaction. Nowadays, sustainable development has become an important topic in meeting urban needs, aimed at achieving a happier society and a healthier environment. At the global level, planners have addressed construction management and prioritized sustainability criteria by providing a sustainable planning framework. The human home is located in residential blocks behind uniform windows that are identical to others, not only difficult to distinguish for guests but also for family members (Mohammadkhani, 2018, p. 235-225). As a result of such planning and design, these stereotypical mass constructions place people in masses next to each other, and instead of forming

positive and purposeful social groups, a mass of individuals is formed who being together only leads to overcrowding, congestion, and chaos (Mortazavi, 2011).
The concept of social sustainability in residential complexes is the satisfaction of residents with their home and complex lifestyle. Creating this suitable space will increase the productivity of residential complexes. The goal of sustainable architecture is to improve the quality of living environments and enhance interpersonal communication. This research focuses on the most important theoretical and design issues, which include architectural design of residential spaces with a pattern of social housing and a sustainable approach for low-income groups. Various approaches such as coexistence among different members in urban neighborhoods and suburbs have many supporters in European countries (Hatami, 2009). The overall design is based on the principles of social housing architecture, affordable housing, attention to sustainable approaches including environmental, cultural, social, economic, and climatic issues, and ultimately considers earth-oriented architecture. This has been selected in the Tehran District 21 area, according to the proposed plan range and development plan of the Ministry of Roads and Urban Development and the district municipality, which is compatible with city laws.

Theoretical foundations

One famous type of housing in Iran during the 14th century AD, which became popular after traditional courtyard houses were abolished, is known as row houses. Essentially, this type of housing is based on dividing residential land into individual pieces and ownership, and if it only includes one residential unit, it is called a detached or independent house. In this type of housing, which is now commonly referred to in local dialects and the like, one residential unit, no matter how many floors it has, belongs only to one family and there is no possibility of multiple families using it. In Iran, due to changes in consumption patterns in the field of housing and the unsuitability of detached houses considering their high maintenance costs, another type of housing and row houses are created with changes in urban planning laws and increased density. This new type of housing has many architectural and urban problems and challenges. In the same residential areas, by increasing the density, units are built that share a very small courtyard (usually the passage and parking place for personal cars) and instead of one previous family, several families now reside there. Although this type of housing, which has separating walls from other residential units, is not exclusive and independent, it is classified as semi-detached. Unfortunately, in Iran due to the non-compliance with human standards of housing, urban planning, and the prevalence of unplanned semi-detached housing, many social and economic problems have arisen, such as insufficient parking, lack of proper ventilation and lighting in most buildings, and issues related to urban infrastructure such as sewage and surface waters. Another type of housing that has not been given much attention in Iran is the terraced houses. This type of housing is widely used on sloped and uneven lands, where a residential plot of land is divided into two or three separate units that have separate entrances and independent access from both the northern and southern sides using the slope of the land. Alternatively, the lower unit's backyard may serve as the upper unit's roof, or the upper unit may have a courtyard.
Finally, clustered housing is a special type of residential unit in which apartment units have a shared courtyard and can even be constructed as single units on each floor (i.e. they can enjoy the benefits of both semi-detached and detached homes). These units also have sufficient open spaces, green areas, and parking facilities (Kashani Nasab, 2022).
In the research by Nayarki and Sanayeian (2015), the investigation of architectural patterns with a social sustainability approach in residential complexes showed that even the most ordinary natural elements, such as a tree or a small open space, can be enjoyable. Research has shown that viewing natural landscapes reduces psychological stress. When there is suitable plant cover in the

environment, it receives much attention. Facilitating access for both riders and pedestrians, how to reach blocks, and not getting lost in finding paths in residential complexes are also important and effective in increasing the sense of attachment to the place. The higher the quality of public spaces in residential complexes, the more opportunity there is for social interactions through collective activities such as meeting, chatting, playing, sports, etc. These spaces become livable and civilizing places as a result of the aforementioned activities. According to their research findings, the quality of the physical environment depends on factors that are achieved through multiple factors, some of which are related to the structure of the environment, such as diversity, compatibility of uses, safety, security, appropriate density and capacity. If the physical infrastructure meets these needs and the desired qualitative characteristics of users, it can play a key role in creating an enjoyable and attractive environment. To ensure the necessary qualities, the designer can identify the aforementioned factors and elements in a two-way interaction with users in the planning and design process and guide the plan towards achieving them, i.e. creating opportunities for selected activities and choices.

In a study titled "Explaining the Mutual Influence of Environmental-Behavioral Indicators on Optimizing Housing Patterns in Historical Residential Environments", Zahiri-Fard (2015) concluded that humans engage in behavior to meet their needs. These behaviors require space, and humans create spaces to better and more desirably respond to their needs through these behaviors. Responding to needs such as freedom in architectural space leads to the creation of public spaces such as open and communal spaces, while personal and private spaces are provided in areas such as private spaces. Additionally, for interaction with other individuals, humans create public spaces that may be open or semi-open. Each of these spaces forms systems of various activities that meet needs. The more needs are met at a desirable level, the more desirable the quality of life is felt, and the higher the quality of life is felt, the greater the satisfaction and various levels of tranquility are experienced. It can be said that if any of these needs are disrupted in any way, it creates a feeling of danger and stress in humans. Whether architectural space cannot meet the needs or whether any need is endangered by other threatening factors, humans become emotional. This emotion leads to adding environmental burden and making the environment dangerous, causing humans to react to an environment they feel is dangerous, inducing environmental stress. This is where the impact of the environment and architectural space on humans can be seen. Therefore, we need spaces that respond to our needs appropriately, and the sign of suitable response to these needs is behaviors that take shape from humans.

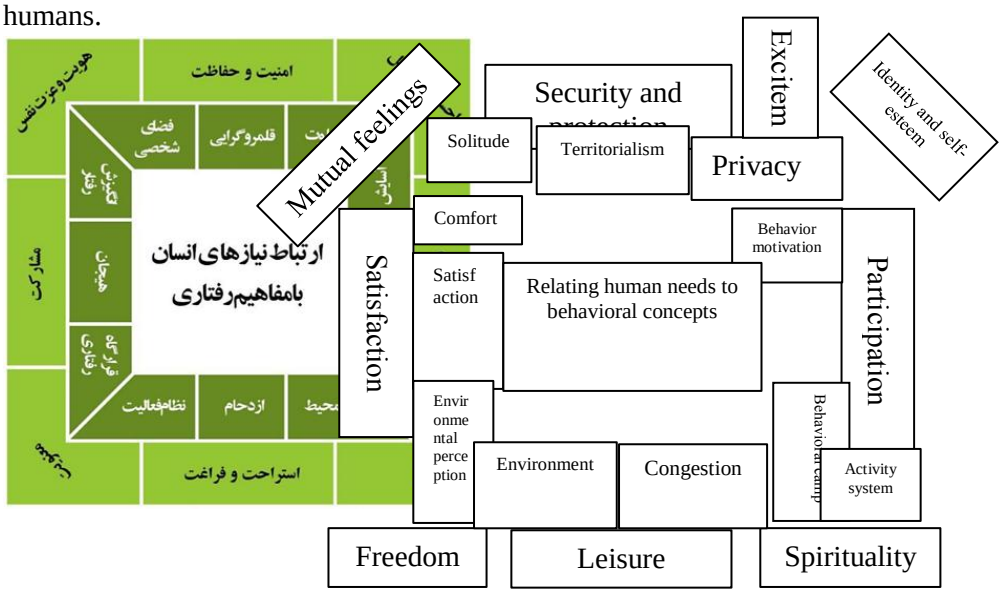


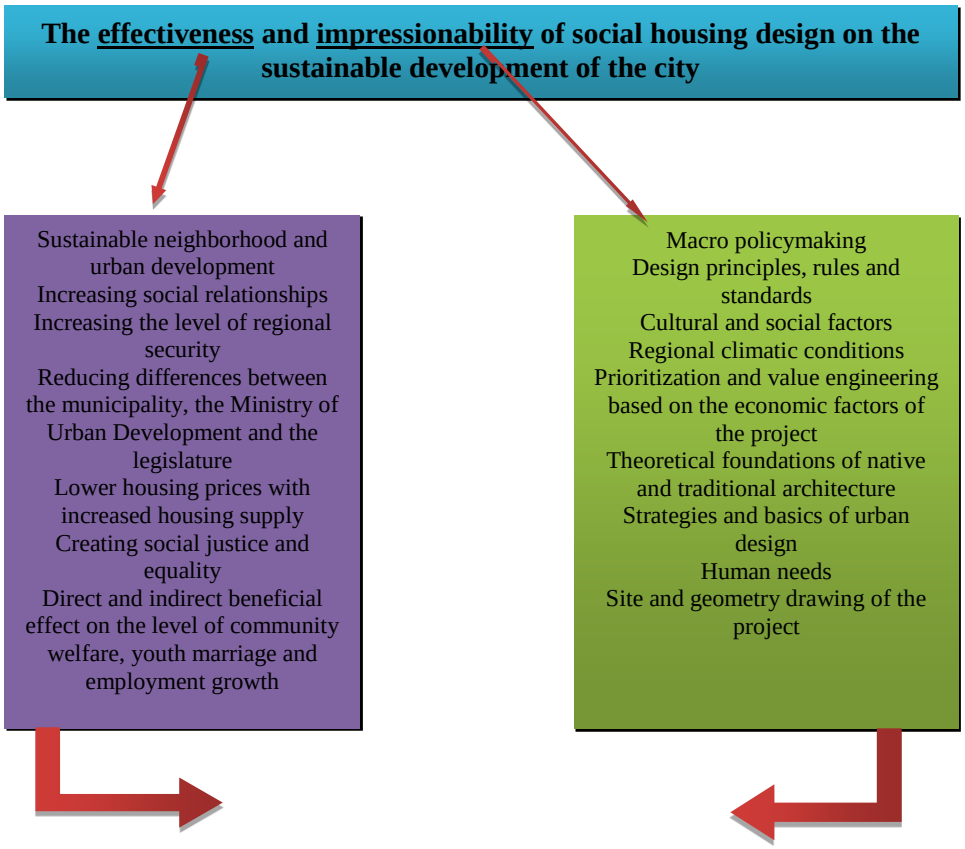
Figure 1. Typology of housing in quantitative and qualitative dimensions

Behaviors and behavioral concepts in humans create tension and take shape to meet human needs. Suitable or unsuitable environmental conditions affect the emergence, intensification, or weakening of needs and contribute to human behavior in meeting them. Since behavior in the environment is a topic in environmental psychology, it is necessary to understand human needs and define them. In this regard, the hierarchy of human needs by Abraham Maslow is one of the most widely used models in environmental design (Friedman, 2017). In the discussion of behavioral workshops, the most important factor is human motivation and needs. Humans utilize the environment to meet their needs. To examine human needs that impact their behavior in the environment, we need a psychological model.

Table 1. Human needs in theorists' models (Gert Danielsen, 2005, 5)

Abraham Mazlo	John Burton	Marshall Rosenberg	Max-Nif
Food, water, shelter	Distributive justice	Physical education	Livelihood
Safety and security	Security and safety	Interdependence	Protection
Belonging and love	Belonging and love	Completeness	Affection
Self-esteem	Self-esteem	Autonomy	Understanding
Personal satisfaction	Personal satisfaction	Play	Creation
	Identity	Celebration and mourning	Identity
	Cultural security	Intimacy and spiritual empathy	Leisure time, laziness
	Freedom		Freedom
	Participation		Participation

Based on the conducted studies and the review of previous research, the conceptual model of the present study is as follows:



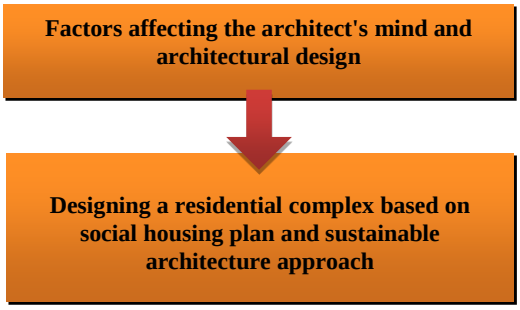


Figure (2) conceptual model of research, source: author

Method

The research methodology of this study is descriptive-analytical in terms of its applied purpose and in terms of its nature and how it is carried out. Additionally, the research method used is historical-interpretive and qualitative, which are common strategies in architecture. Computer simulation method has also been utilized.

Results

Residential design standards

[1] Construction of single-family units (one residential unit) and multi-family units (multiple residential units) is allowed provided that the minimum construction area is between 120 to 150 square meters and 500 square meters, respectively.

[2] Compliance with a minimum plot size of 500 square meters is conditional on the construction of at least 4 residential units.

[3] The maximum ground floor area should not exceed 65% of the total land area in this type of building.

[4] The maximum area in all floors except the ground floor should not exceed 80% of the total land area.

[5] The floor area ratio to the total floor area in such buildings is allowed up to 120% for medium density, 220% for high density, and 50% for low density, provided that the open space is equal to a maximum of 30% of the total land area.

[6] If an apartment building is constructed on these plots, the maximum number of floors will be three and there will be no need for an elevator.

[7] At least one parking space must be considered for each residential unit.

[8] Courtyard area for light:

[9] If these types of buildings are constructed on columns (pilots), and the ground floor is only used for parking and stairs, and the height of the ground floor does not exceed 2.5 meters, it will not be considered as a permissible number of floors and floor area.

[10] Constructing a basement will not be counted as a permissible number of floors and floor area if its height from the entrance door of the building is not more than an average of 120 centimeters.

General principles and relationships between spaces

1. This stage mainly involves problems arising from pedestrian and vehicular communication networks, lack of necessary facilities for using public transportation, and ultimately the communication path between the destination and communication networks. In the case of residential environments, this stage can be examined in terms of accessibility from the public communication network to the residential environment and vice versa, as well as the communication path between the

public and private transport stops to the entrances.
2. Entering this stage generally includes the form and function of the internal and external communication location, which for residential environments includes the passage communication location, courtyard or parking area with the interior space of the residential building.
3. After entering the building, the stage of using the desired environment is addressed, which for residential environments includes communication corridors, vertical access to floors through stairs and elevators, access to residential units, use of residential unit spaces, safety in case of danger, emergency response, and responding to the psychological needs of residents.
Housing forms in Iran, especially in urban environments, have various types that can be classified into the following categories:
- Old residential buildings with traditional and indigenous architectural forms
- Single-unit residential buildings with non-traditional and non-indigenous architectural forms
- Multi-unit residential buildings
- Large residential complexes in residential townships (Kashani Nasab, 2022).

Residential Areas
We call a number of compatible spaces and functions that have architectural interdependence and are located in a specific section of the architectural design map of the project as residential areas, including:
• Private areas such as: bedroom, bathroom, study room
• Family areas such as: dining room, kitchen, hall, living room
• Reception areas such as: reception room, lunchroom
• Service areas such as: parking, garage, storage room
• Open space areas such as: barbecue area, terrace (Kashani Nasab, 2022).

Construction regulations of residential complexes
1. The total area of the floor space of all residential units combined is allowed to be a maximum of 120% of the land area.
2. The gross land per unit of housing is at least 100 square meters.
3. The smallest residential unit should not be less than 80 square meters.
4. The maximum allowable occupancy area on the ground floor is equivalent to 35% of the total land area. The areas occupied by guardhouses, greenhouses, showers and dressing rooms, toilets, swimming pools, and covered recreational areas for children are not included in the above range.
5. The construction of a parking lot is mandatory, equivalent to at least 75% of the number of residential units.
6. The minimum net parking area per car is 5.12 square meters.
7. The minimum width of access roads to parking spaces should be 5.5 meters.
8. The total area under occupation of residential buildings on the ground floor, plus the area occupied by car pathways and parking lots, should not exceed 60% of the total land area if the parking lots are located in open spaces.

The location of the building on the ground
In normal conditions, the location of a building should be in the northern part of the land. In exceptional cases such as the presence of existing trees or the land being located in the eastern or western direction, and other similar situations, the necessary decision will be made by the architecture council based on the placement of nearby buildings. If for any reason it's not possible to use one hundred percent of the allowable density of the building in the northern part of the land, or if the

owner does not want to construct the entire allowable density in that area, they can use the remaining density to construct one or more independent single-story units on the southern, eastern, or western side.

Compliance with height restrictions

Buildings on streets with a width of 30 meters or more do not need to adhere to any height restrictions up to 30 meters. Buildings on streets with a width of less than 30 meters should not exceed the width of the street in height. In case of exceeding the height limit, the building must step back by that amount. For buildings with two or more facades with passages less than 30 meters, a 45-degree view is allowed and an allowable height of pilot + two floors is permitted. From the third floor, the building must step back 1.6 meters from the passage. According to the length of the increased passage, if the height exceeds 32 meters again, it must step back 4 meters per floor. If the width of the street is between 12 and 30 meters, there are no height restrictions. If the width of the street is between 7 and 12 meters, for every additional height increase over 32 meters, 4 meters of setback is required per floor.

Building density

• Low density: For a land plot of 1500 square meters with a density of 100%, for every 5% decrease in the ground floor occupancy area, 10% will be added to the density. The minimum ground floor occupancy area is 20%, and the maximum net occupancy area is 45% without including 20% staircase area. For land plots larger than ten thousand square meters, the density is 180%, and 15% of the area is allocated for walkways and ground floor occupancy area is calculated relative to the remaining area. The gross area of a residential unit is 160 square meters, and the minimum gross area is 110 square meters.

• Medium density: For a land plot of one thousand square meters, the density is 135%, and for every 5% decrease in the ground floor occupancy area, 10% will be added to the density. The minimum ground floor occupancy area is 25%, and the maximum net occupancy area is 45% without including 20% staircase area. For land plots larger than seven thousand square meters, the density is 180%, and 12% of the area is allocated for walkways and the ground floor occupancy area is calculated relative to the remaining area. The gross area of each unit is 110 square meters, and the minimum gross area is 75 square meters.

• High density: For a land plot of 50 square meters, the density is 240%, and for every 5% decrease in the ground floor occupancy area, the density increases by 10%. The minimum ground floor occupancy area is 30%. For land plots larger than 5000 square meters, the density is 150%, and 10% of the total area is allocated for walkways, with a maximum ground floor occupancy area of 50%. The gross average area of a residential unit is 60 square meters, and the minimum area is 90 square meters.

Light and urban spaces

Light creates various effects on urban spaces during different times of the day. In the past, the use of light was a common element to create diversity in urban spaces. For example, since white reflects the color of the sky and incorporates a halo of its colors, some of the large urban buildings or the general structure of a village were made white so that, with regard to the color of the sky, which takes on various colors from mild yellow to bright blue, orange, etc. from sunrise to sunset, changes would occur in the texture of the city or village, and a variety of subtle colors would be included. Another method was to create a continuous play of light and shadow by covering parts of alleys and urban paths, thus creating diversity in the path for pedestrians and eliminating the sense of lengthiness and tediousness in their journey.

Physical planning of the project

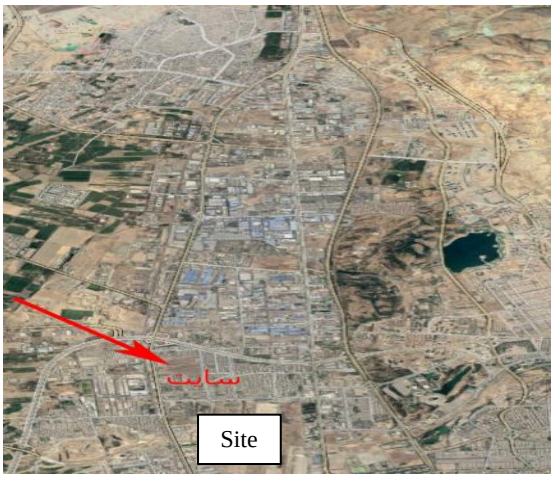
Every architectural project is designed to achieve specific goals and carry out certain activities. The necessary spaces for each project are determined based on the type of activities and their categorization. The dimensions and specifications of the spaces are determined according to the type and volume of activities, furniture and equipment used, and existing standards. The list of required spaces for each project, along with the number, area, and main features of each space, is recorded in a physical plan table (Table 2).

Table 2. Physical planning of the residential complex based on the social housing plan of the Ministry of Roads and Urban Development of Iran

Space name	**per capita (m^2)**	**number of people**	**Space area (m^2)**	**The number of spaces**	**Total area (m^2)**
Unit in floors	50 per unit	50 households	2500	8 floors	20000
Residential unit	25	2	50	400	20000
Kitchen	3	2	6	400	2400
Bathroom and toilet	4	1	4	400	1600
Bedroom	5	2	10	400	4000
Balcony	-	-	1.5	400	600
Entrance corridor	1.5	1	1.5	400	600
dining and living rooms	3	9	27	400	10800
Net surface area of each floor (m^2)	**The total area of the net surface of the floors**	**Gross floor area of each floor (m^2)**	**Gross area of floors (m^2)**	**Building infrastructure area (m^2)**	**Total surface area of the infrastructure (m^2)**
2500 ✖8	20000	1250 ✖8	10000	3750 ✖8	30000

Specifications of the selected land (project site) and detailed plan map of the municipality

The selected land (project site) in District 21 of Tehran, according to the proposed plan and the development plan of the Ministry of Roads and Urban Development and the district municipality, has been chosen for the construction of social housing with residential use. The approximate area of the site is 8,000 square meters, which is rectangular in shape, with one side facing Yas Boulevard in western Tehran with 100 meters and the other side facing Niyayesh Street with 80 meters. This selection is in line with the goal of designing a residential complex in the new urban fabric, and the site has a responsive and optimized performance (see Figure 3 and 4).



Total 3. Aerial map of the 21st district of Tehran - Tehransar, source: www.google.com/maps

Figure 4. Aerial map of the chosen site of the project, on Yas Blvd. in West Tehransar, source: www.bahesab.ir

Determining climate design measures

Translation:

1. Prediction of relatively compact and dense plans.
2. Avoidance of predicting large windows.
3. Prediction of low-priority spaces such as storage as thermal insulation in building walls or cold parts.
4. Prediction of building materials with high heat capacity.
5. Use of reflective or matte colors on exterior surfaces of buildings.
6. Placing water bodies between suitable natural airflow and complexes, if available.
7. Design of narrow and shaded streets in the northwest-southeast or northeast-southwest direction.
8. Use of evergreen plants such as cypress in landscaping in all directions.
9. Orientation of buildings between 25 to 35 degrees southeast.
10. Use of wooden networks separate from the facade in all directions and movable shading in the south direction.
11. Use of heavy and rough-surfaced materials with delays of more than 8 hours on external building structures.
12. Use of canopy-covered porch roofs or balconies to create complete shade on external surfaces, glass windows, openings, and sun-facing walls.
13. Use of inward-focused shapes in design.
14. Expansion and extension of plans in the east-west axis with a ratio of 1 to 3.1 to 6.1.

15. Prediction of appropriate shades for windows that both guide winter sunlight radiation into indoor spaces and prevent summer sunlight radiation from entering these spaces (Kashani Nasab, 2022).

Project site Analysis:

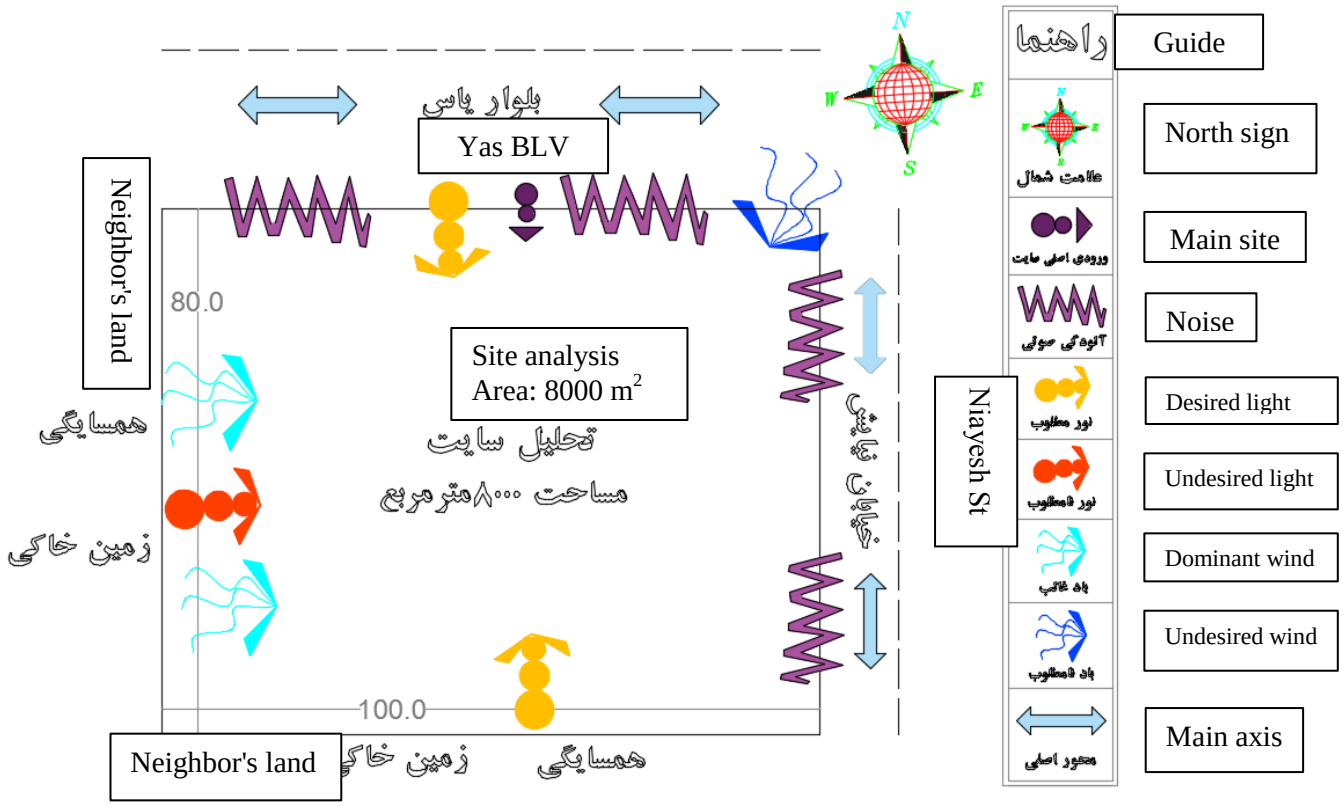


Figure 5. A graphic analysis of the project site, drawing with AutoCAD software, source: the author

Based on site analysis in Figure 5, it is concluded that the best location for building placement in the intended site is in which part of the land and, according to this location, the formation of uses and spaces have been considered in project design.

Project design procedure

The project design process is illustrated in Figures 6 to 10.

Figure 6. An alternative with a separate plan of residential blocks to plan the subject of the project

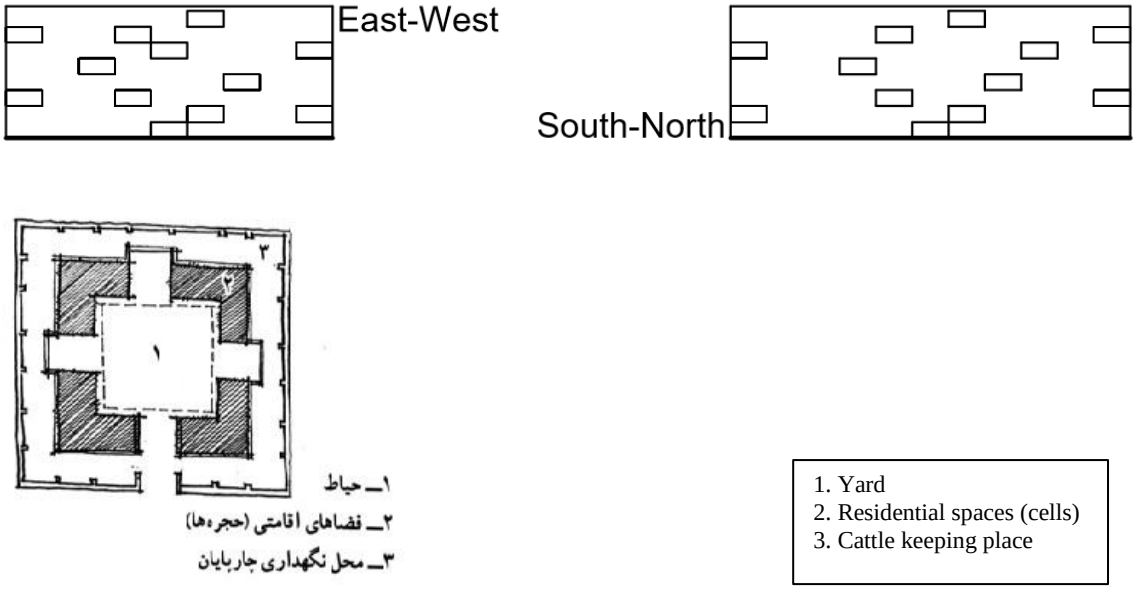


Figure 7. Initial ideas to show the process of project formation

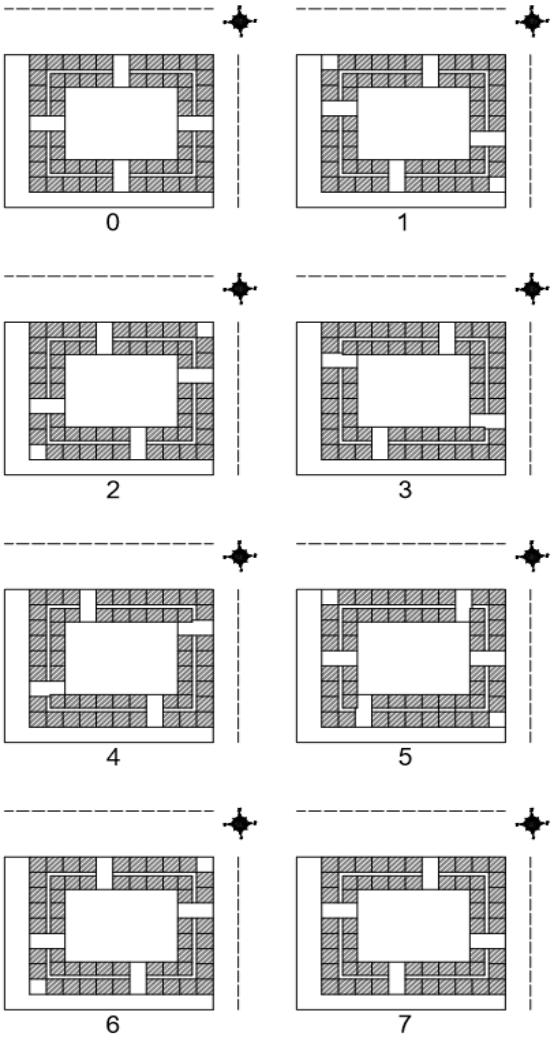


Figure 8. Concept and marking of the project

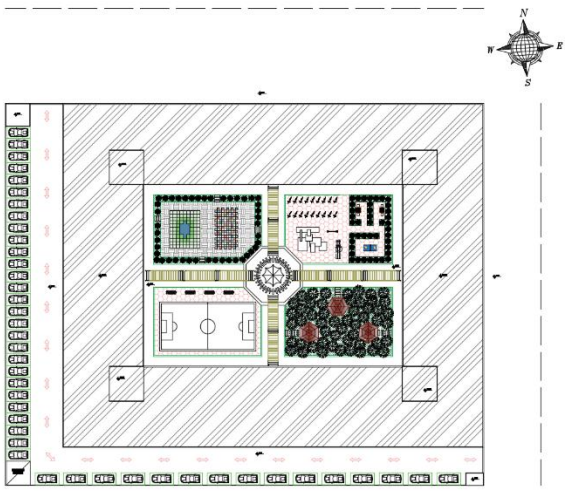
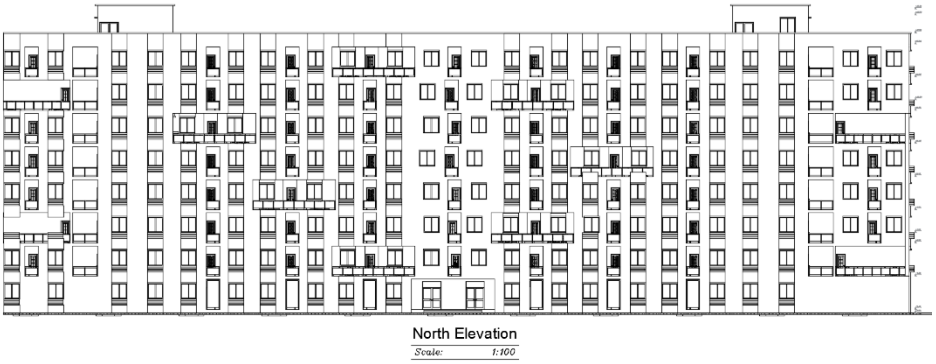
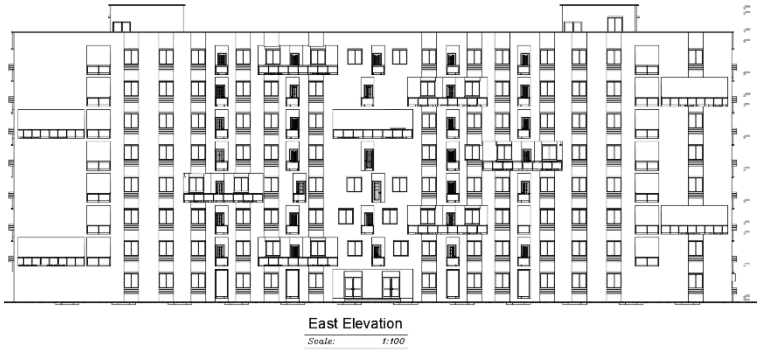


Figure 8. Project plan site



(A)



(B)

Figure 9- a) Northern main view, b) Eastern main view

Figure 10. A collection of external renderings of the project

Conclusion

The conclusion drawn from the findings is that in order to design an affordable and sustainable residential complex, important principles must be considered. These principles can be divided into several main categories including: 1. Attention to economic principles, 2. Attention to environmental principles, 3. Attention to climate principles, 4. Attention to economic principles, 5. Attention to physical regulations and standards, 6. Attention to cultural principles, 7. Attention to social principles, and 8. Attention to practical, technical, and operational principles.

The main idea of the plan is based on contextualism, a linear and chess-like modular network, square-shaped divisions, the use of site lines, utilization of wind for increased desirability and creation of air currents, attention to desired and direct light, and the use of shading in the building's site area during certain times of the day. The readability of spaces in the plan, creation of four vertical structural unit centers that create communication between floors and lobby spaces on each floor, the fullness and emptiness of floor spaces that led to the creation of covered courtyard communal areas at heights, and the main idea of transferring sunlight and its radiation from the external environment to the interior of the site are emphasized. The building's form, along with its minimal and affordable yet beautiful and sustainable façade, has been able to free the project from the overall structure of typical residential complexes.

Among other things, reducing the difference in levels and density, anti-thesis for the prominent presence of the previous residential buildings' thesis, transferring semi-open and semi-closed surfaces on floors, considering safe and calm environments, and creating multi-sided group spaces that increase social interaction and, as a result, improve the efficiency of promoting apartment living culture are some of the ideologies emphasized in the plan.

It is worth noting that with the site area limited to 8,000 square meters, it is important to make optimal use of the available space. Symmetry, homogeneity, people-oriented design, bright brick and cement facades along with suitable flower boxes for the climate, and ultimately considering a terrace for each unit are among the features that increase desirability of this complex. Controlling traffic, adhering to dimensions and standards, having an executable mindset in the plan, coordination with approved types by the Ministry of Housing and Urban Development and the Planning Organization for the construction of social housing plans, as well as providing some service - welfare facilities, economic feasibility, and increasing the building's lifespan are some other points of the project plan.

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