

Research Paper

Design Diversity in Early Residential Complexes in Tehran (1950-1970); Lessons to Learn

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Abstract

During 1950 to 1970, some of the first residential complexes in Tehran were developed to accommodate low and middle-income people. Although they were among the first residential complexes designed and built in the country, various quantitative and qualitative measures had been considered in their design to satisfy the target residents' needs and to meet the projects' goals. What could be the reason for satisfaction, despite they were among the early experiences of residential complexes design in country? The main reason for the success of these complexes was due to perfect design considerations; i.e. correct selection of design patterns which are less frequent in recent housing complexes. Some of these design considerations include providing public, semi-public and private open spaces, paying attention to pedestrians, sustainability and respect for the surrounding urban and climatic environment. This paper reviews some examples of early housing complexes in Tehran, including Chaharsad-Dastgah, Narmak, Nazi-Abad, Shahr-Ara, Behjat-Abad, Farah, Kan and Chaharom-e-Aban, to help recognize past achievements and reapply them in designing new housing complexes.

Keywords: Affordable housing, Tehran, Housing complex, Density, Low-income, Neighbourhoods.

1. INTRODUCTION

In the mid-1940s, Iranian cities, especially Tehran, faced an increased migration from rural areas. As a result of a high demand for housing, mass building production was prioritized in the second Pahlavi era, and supply of new towns and housing complexes for immigrants and low-income populations had expanded (Einifar & Aghalati, 2011). Public sector investment was initially seen as the only solution to the affordable housing problem of low-income people and government employees. However, the private sector later entered the field. A range of projects with various design patterns were implemented for the first time in the country which later merged into surrounding urban areas. Some of them are currently among the highest quality neighbourhoods in their area. According to previous studies, there are high levels of sense of belonging among residents in complexes such as *Narmak* and *Shahrara* (Azizi, 2006; Moidfar & Moghaddam, 2011). Although these projects might have some disadvantages, environmental qualities seen in most of them are missing in today's designs of large housing complexes in different

parts of Iran, such as *Navvab*¹ district development and *Maskan-e Mehr*² projects, which are implemented for low and middle income groups. According to Etemad (Etemad, 2013), recent residential projects, such as *Navvab*, have fundamental design problems, such as the lack of public open spaces, green pedestrian axes, green spaces or parks, which in addition to socio-cultural consequences, could lead into a sense of insecurity for residential complexes (Research group of Rahpo Sakht Sharestan, 2014). Etemad also argued that the lack of attention to urban context in *Navvab* led to the isolation of the complex from the city fabric so that sometimes no space was left for designing a suitable urban environment. In some cases, the lack of proper design of rear spaces have turned those into wasteful, insecure places (Etemad, 2013). Another research indicated

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¹ *Navvab* project was one of the largest development projects in the heart of Tehran, which its construction began in 1990.

² *Maskan-e Mehr* housing plan was approved in 2007 to provide housing for low-income groups throughout the country. Dwelling units built in this plan, are mostly located in the outskirts of the cities, Because the value of land in these areas was less and the government reduced the cost of housing to a large extent by removing or reducing the value of land from the cost of housing.

that the lack of urban facilities and educational and cultural uses in *Maskan-e Mehr* projects has transformed these complexes into single-function areas. The establishment of housing complexes without required uses and related functions, in some cases, has led to the creation of dead spaces and unsafety, so that early occupants face severe problems in these recent settlements (Research ... , 2014). Some of other environmental issues that we encounter in design of recent residential complexes such as *Maskan-e Mehr* and *Navvab* projects (Etemad, 2013) include ignoring the natural topography or solar radiation and wind direction in locating buildings, short distances between residential blocks that cause unwanted shading, and a lack of buffer spaces between buildings and highways and major power lines (Research ... , 2014).

This study is an attempt to identify values and environmental qualities in the design of early housing complexes, which have been omitted in recent residential complexes. We hope that these lessons will be learned and used in the design of future housing projects.

2. METHODS OF RESEARCH (Appendix A)

The research method in this paper is firstly based on direct analysis of housing complexes by observation of existing conditions of these complexes, in order to explore the architectural features of the samples. These projects are also studied in terms of location, density, access network, spatial organization, and several other characteristics based on information collected from documents, and aerial images from 1971. Ten important early housing complexes in Tehran during a period of 20 years, including Chaharsad-Dastgah, Narmak, Nazi-Abad, Shahr-Ara, Kan (south and north), Farah, Chaharom-e-Aban (south and north), and Behjat-Abad, are selected and analysed in this paper. These projects were built in Tehran during 1950-1970s and located next or up to 10 kilometres away from Tehran at that time (Figure 1).

2.1. Chaharsad-Dastgah

Chaharsad-Dastgah, in the east side of Tehran, is among the very first housing projects constructed in Tehran in the 1940s. Chaharsad-Dastgah, which in Persian translates into "400 units", was initiated with the aim of promoting affordable housing supported by Rahni - bank¹ (mortgage bank). The purchased land was originally located on the fringes of the city near the Doshan-Tappeh area with asphalt road access from Tehran. Chaharsad-Dastgah was designed and realized to accommodate 374 residential units for a population of nearly 1900 in a total area of about 12 hectares ("Iranian Rahni - bank buildings," 1972). As it was impossible to buy lands closer to Tehran, the selected project location was originally about three kilometres away

from the eastern border of the city, with no primary urban infrastructure. For this reason, infrastructural facilities including a power distribution network, water supply, wells, pumping and water treatment stations were gradually provided for the residential complex.

The network of the access roads was formed so that primary streets ran north-south and secondary streets (access to residential units), with an 8 to 15-metre width, ran east-west (Ajdari 1947) (Figure 2). The east-west design of secondary streets made it possible for most units to take advantage of south-facing windows to receive sunlight, which seems to be the basic primary design on the creation of the plots. Another point that may be exclusive is the placement of building's mass, adjacent to the streets. This organization made it possible to harmonize the project with the cityscape as well as to create private backyards (Figure 3), which, of course, are not visible today. The courtyards were located in the middle of the lot with service zones such as a kitchen and bathroom at one end (Figure 4). The main north-south street, which was 20 metres wide, passed through the middle of the neighbourhood ("Iranian Rahni - bank buildings," 1972). In the middle of the main street, a wide west-east boulevard was designed with community facilities located at its two ends. Additionally, there was a fairly large square located in the middle of the eastern part of the boulevard. This east-west axis is considered as one of the important features of the general layout of this neighbourhood that still exists. The community facilities that were around the square and the boulevard include commercial, administrative, service, educational, and health units. Despite the fact that this complex was in outskirts of the city, but due to the coordination, size and orientation of residential plots, floor area ratio and specially street's layout with the urban context, and also the lack of fence and gate, it has been able to gradually integrate with its surrounding in future growth of the city (Figure 2). Another important feature was using the traditional Iranian architectural elements such as "Eyvan" (Balcony), "Hayat" (courtyard) & "Bahar - Khab" (terrace) in architectural design of houses (Bani Masoud, 2009).

The plots had a floor to area ratio of 35%, dwelling density of 31 units per hectare, and population density of 160 per hectare at the time of construction. Thus, the project was considered as an example of low density housing complex². To meet economic efficiency criterion, and for better marketability, residential units of this neighbourhood were designed as independent but attached (row or terraced) houses. The houses, located on plots of approximately 170 square metres, included four types of two, three, four, and five bedroom units on one or two floors with or without a basement (Ajdari 1947). Although the residential units of this housing complex were designed in several types, the repetition rule is clearly visible through the independent but continuous arrangement of units and the south-facing orientation.

¹ In 1938, the bank was formed to lend funds with the aim of purchasing, constructing, completing, repairing, and granting credit to construction companies. Since 1946, as the necessity of construction of residential units was considered by the government, the bank pioneered the construction of low-cost buildings.

² The density of housing complexes can be divided into three groups: low density (between 5 to 30 units per hectare), medium density (between 37 to 93 units per hectare), and high density (between 94 and 1250 units per hectare) (Pourdeihimi, 2012).

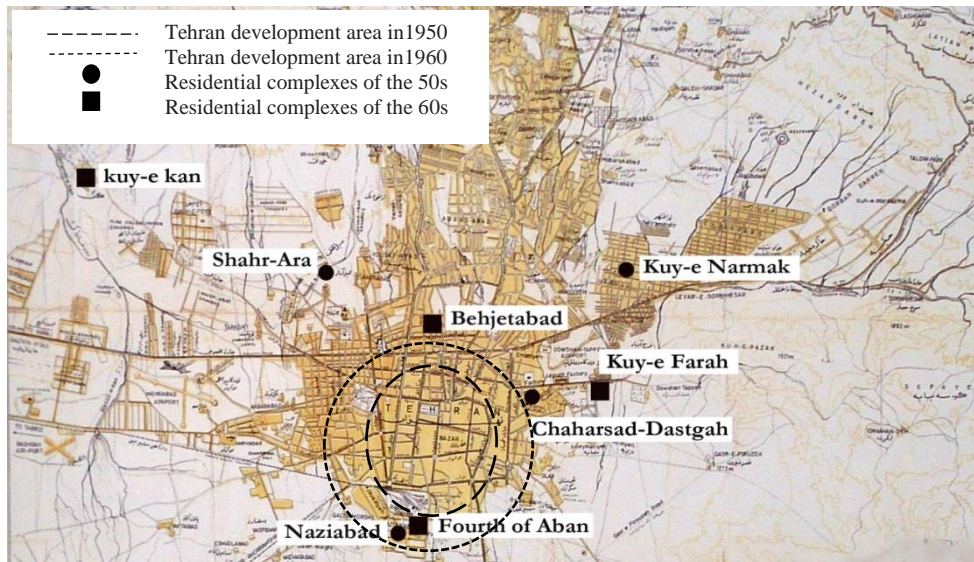


Fig 1. The location of projects relative to Tehran in 1950-1970s. Source: Edited by authors, (Shirazian, 2015)



Fig 2. Chaharsad-Dastgah housing complex. Source: Edited by authors, based on 1971 aerial photo, (National Cartographic Center of Iran, 2017)

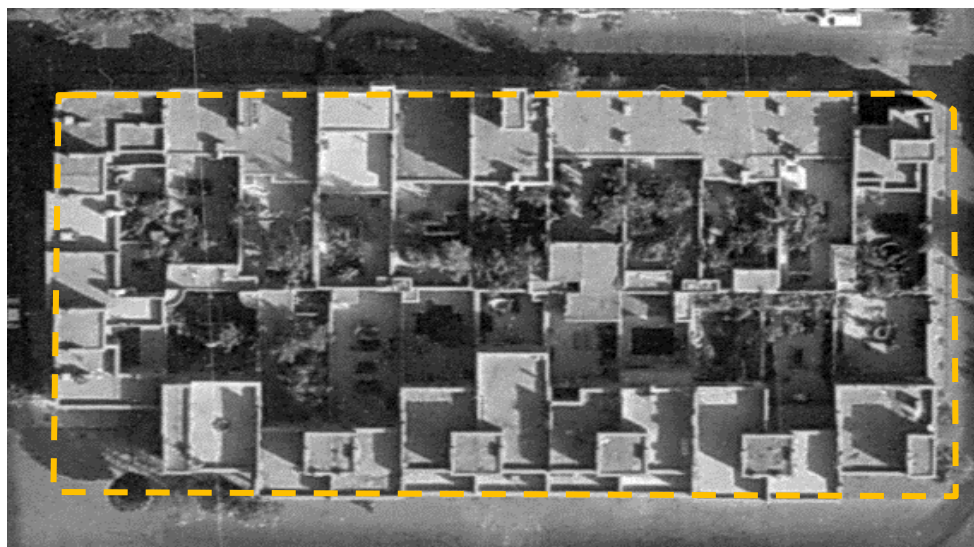


Fig 3. The spatial organization of houses in Chaharsad-Dastgah, 1971. Source: Edited by authors, (National Cartographic Center of Iran, 2017)

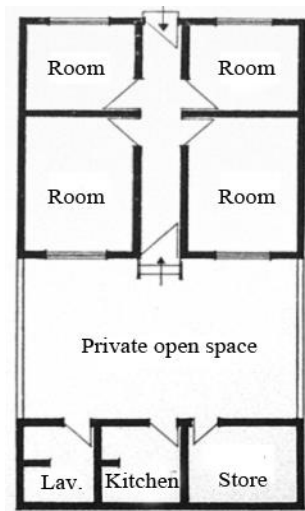


Fig 4. The plan of one storey houses in Chaharsad-Dastgah, Source: (Kiakojoury, 1972)

2.2. Narmak

The construction of the Narmak housing project began in the 1950s for the purpose of accommodating middle-class populations outside city boundaries on an area of nearly 400 hectares. This neighbourhood was designed for a population of about 35,000 with 10,000 independent residential plots of between 200 and 500 square metres area (R. Habibi & De Meulder, 2016; Khodayar, 1955). One of the main objectives of Bank-e-Sakhtemani¹ in this project was to provide as many houses as possible for people, especially government employees. To this purpose, residents had to pay a maximum of 10% of the construction cost of a residential unit (which was provided by the government). The residents were also charged an additional 10% to support the new infrastructure construction since the project was located outside of Tehran² (Moinfar, 1955). Due to the project's significant size and spatial organization, Narmak was designed to be part of the future development of Tehran. Thus, connection with Tehran's major roads and surrounding lands without any gates or access restrictions was part of the design requirements.

The design of the Narmak project is based on a network of primary and secondary streets with a main square at the centre of the complex (Figure 5). The subdivision of residential lots in Narmak, similar to Chaharsad-Dastgah, is based on the orientation that receives maximum daylight. The streets and alleys that provide access to residential units are east-west oriented to allow residential units to face towards the sun. However, unlike Chaharsad-Dastgah, community facilities of the

¹ Bank-e-Sakhtemani (The Construction Bank) was one of the most active financial institutions in the building industry, which was established during the administration of *M. Mosaddegh* and was later removed from the banking system of the country

² Since the project's land was provided by the government, the applicants paid 40 Rials per square metre for the land (according to Bank-e-Sakhtemani Journal [No. 1-3], the price per square metre of land at the time in Tehran was about 450 Rials) and they built the residential unit themselves or through Bank-e-Sakhtemani.

complex, such as squares, are located along North-South streets. An important design feature of Narmak is the creation of these public and semi-public functions in the neighbourhood, which will be explained later. The layout of the Narmak project contains 19 areas and about 60 semi-private housing clusters (S. M. Habibi, Ahari, & Emami, 2010). The primary and secondary streets within the various areas carry the main traffic load and the alleys within housing clusters provide access to residential units. Thus, housing clusters of the complex have minimal contact with surrounding streets which provides residents with greater comfort. In order to provide semi-public open spaces, the housing cluster has a small square with green space in the middle and two to six dead-end alleys at the cluster corners and edges (R. Habibi & De Meulder, 2016) (Figure 5). Narmak was the first instance of this street layout in Iran, although it was appropriate for housing complexes, this layout was later adopted only in some few other housing projects such as Nazi Abad. This street layout, although different from its context, has completely integrated the complex with the city by removing boundaries and by allowing for the penetration of the city's streets into the complex, while providing a fairly comfortable environment for its inhabitants

Figure 6 shows the aerial view of one of the fore-mentioned housing clusters. The cluster is about 7.2 hectares with two dead-end alleys and two north-south streets, which are connected to primary streets in the northeast of the central square. About 140 residential units with a floor area of about 28,000 square metres are located in this housing cluster (dwelling density of 52 units per hectare).

The design proposal included a marketplace, a bath house, a school, and a dedicated water well in each district of the housing complex. Except for the commercial and administrative area, located at the central square of the complex (now Haft - Hawz Square), the services needed for housing clusters were organized around them. Factories, workshops, and a gym were designed in the north, and a large park was designed in the eastern part of the complex (S. M. Habibi et al., 2010). The project's residential units, like other neighbourhoods in Tehran, were designed and constructed independently but connected, in one or two floors.

In early days, the complex was far from the city, but due to size of the complex and also the street's layouts it is now fully integrate with its surrounding (Figure 2)

The main difference in the spatial organization of residential units in Narmak compared to Chaharsad-Dastgah was the location of building mass in the northern part of each plot (Figure 6). The decision to locate the mass on the north, the reasons of which is not quite clear, gradually involved not only the residential units of Tehran but the entire country. The design of the residential building's mass was far from the traditional pattern of Iranian houses, and closer to modern designs. The creation of a space called "dining room" or "bedroom" was a sign of this change because in traditional Iranian houses, rooms were multi-functional and served no unique purpose (Saremi, 1988).

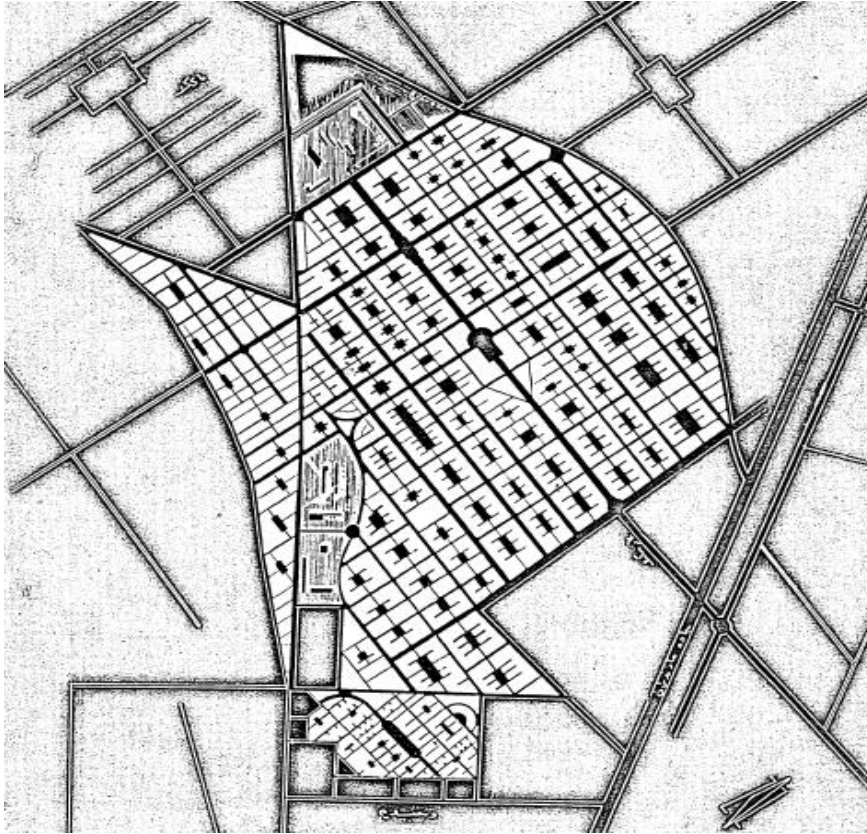


Fig 5. Site plan of Narmak housing complex, Source: journal of Bank-e-Sakhtemani (1955, no. 1)



Fig 6. One of Narmak's neighbourhoods with a square and four dead-end alleys. Source: Edited by authors, based on 1971 aerial photo, (National Cartographic Center of Iran, 2017)

2.3. Nazi-Abad

The north-eastern part of Nazi-Abad¹ complex, was

¹ The Nazi-Abad housing complex was built in 1955, with an area of 300 hectares for low income populations. The land of this complex was developed after the demolition of the brick kilns of the outskirts of Tehran. The initial design of the Nazi-Abad complex was very similar to

originally supposed to be developed with 400 residential units, similar to other Nazi-Abad neighbourhoods. However, in 1958, design and construction of a different type of housing complex was approved, which included eight residential building blocks in four storeys in a gated area (Moinfar, 1958) (Figure 8).

Narmak, which was created by locating a central square among adjacent housing clusters and the repetition of this pattern based on a grid.

Unlike previous cases, the land of this complex maintains some distance from peripheral main streets, and a row of urban houses is located between the complex and the surrounding main streets (Figure 7). Thus, this housing complex is completely separated from its peripheral context, and this separation could be the reason for installation of its fences and gates. fences and gates were the main barriers for integration, since a layer of rural houses existed between the complex and streets and also vast open spaces were present among the residential blocks. As visible in the 1971 aerial photograph, 10 residential buildings of this complex had been built by that time, and the construction of 6 other buildings in the western part was still under progress. Residential buildings are stretched east-west, facing south and north, and located at least 35 metres from each other to benefit from maximum sunlight.

Inside the complex, a peripheral vehicle access road was designed, which becomes wider when approaching the residential buildings to accommodate car parking areas (Figure 7). The pedestrian paths are also separated from the vehicle access roads, located between buildings and have diverse design characteristics which are visible in the 1971 aerial image (Figure 7). Except for the ground floor residential units of some buildings that have private open spaces, the remaining open spaces are generally designed for all residents of the complex as community open spaces functions as a semi-private open space. The population and unit density and floor area ratio of this complex is almost half of that of the Nazi-Abad neighbourhoods¹.

All residential buildings (or blocks) in this complex have four storeys (to eliminate the need for using elevators). These buildings are designed in three types of 4, 6, and 8 units per floor. Initially, all buildings in this complex were supposed to include 32 units with 8 residential units per floor (with a floor area of approximately 2,400 square metres) (Moinfar, 1958), but later only four buildings were constructed according to the original design, and others were designed and implemented in smaller sizes. In the primary design, each floor of these buildings consisted of eight residential units, which were completely identical, with two rooms of approximately 45 square metres and a terrace of 15 square metres (Figure 8). Residential units on each floor are organized to fully utilize the sunlight from the south, and a semi-open access hall is located on the northern part of each building to provide greater independence for residential units. Thus, each residential unit has views to the community open space through the southern terrace, and is connected to the access hall from the north. There is also a semi-independent staircase in the middle of each building that links the floors of the building.

According to what was mentioned, the Nazi-Abad housing complex might be considered as the first prototype of semi-independent low-rise social housing units in the form of blocks or buildings with a corridor at height, in Iran.

2.4. Shahr-Ara

Shahr-Ara housing complex was built in Tehran between 1958-1959. Shahr-Ara has an area of about 10 hectares with about 800 residential units (a total density of about 80 units per hectare). Shahr-Ara's site plan is based on a grid of intersecting streets. Shahr-Ara is a neighbourhood without any fences and guards, and has a direct connection with other peripheral urban neighbourhoods (Figure 9). Shahr-Ara's buildings are arranged along a single row which is adjacent to the street on the north, and is provided with green and public spaces on the south which makes the streets more private and quieter, given that the entrance of the residential blocks is from the north and through the vehicular access road, there is no access to this public space from the south. As a result, this space mainly works as a public urban open space. Due to the 25-metre distance between each row of buildings, and their short height (three storeys) and proper orientation, residential units take advantage of daylight from the north and south. Access to residential units is provided from the northern street. Shahr-Ara has a community shopping centre, a pedestrian walkway and a park, which is about 17,000 square metres, in the south (S. M. Habibi et al., 2010). It is considered as a medium density complex with a floor to area ratio of 60%, and a dwelling density of 80 residential units per hectare. Although Shahrara was on the outskirts of the city at the beginning of its construction, and the adjacent lands to it were unbuilt, due to the appropriate residential plots size and orientation and mainly streets' layouts, it has been able to integrate with its surrounding later on, and could keep its semi-privacy over the time.

The residential blocks of this complex, are 3 storeys tall (without elevators) and each contain 6 residential units. The blocks are connected with each other and clustered east to west in rows of four to seven, parallel to streets. Access to residential units is provided by shared staircases and corridors in each block (Figure 10). The residential blocks contain the two types of 60 sq. m. and 80 sq. m. units. Shahr-Ara is among the first housing complexes in Iran that was built by the private sector (Saeednia, 1991). Thus, Shahr-Ara may be considered as the first housing complex comprised of low-rise non-independent housing complex (so-called "walk up apartments") built by the private sector in Iran.

¹ A large part of the community open space is located almost at the centre of the complex. This complex also included two schools, one for girls and one for boys.



Fig 7. Nazi Abad housing complex, 1971. Source: Edited by authors, (National Cartographic Center of Iran, 2017)

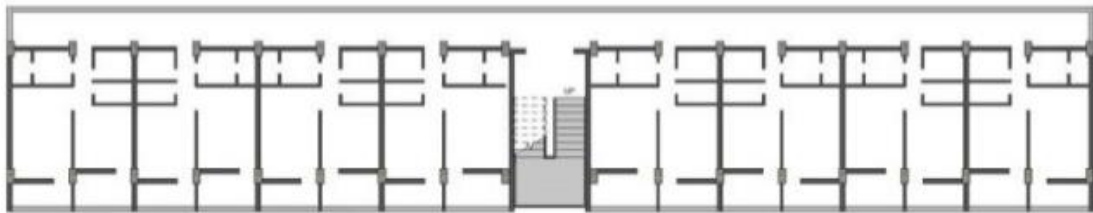


Fig 8. A typical floor plan of Nazi-Abad residential complex. Source: Edited By authors, (Moinfar, 1958)



Fig 9. Shahr-Ara housing complex, 1971. Source: Edited by authors, (National Cartographic Center of Iran, 2017)

2.5. Kan Housing Complex (The Southern Part)

Due to interest in independent residential units at the time, and in order to attract more buyers, 200 semi-detached independent houses (Talebi, Eisa, & Farzian, 2014) on about 100,000 square metres of land was designed and realized in the southern part of Kan. This district is now called Devist - Dastgah (200 housing units). Today, there are only a few original houses remained. The rest of the houses have been replaced with four or five-story urban residential buildings.

As shown in Figure 11, in its southern part, the Kan housing complex has a grid network of access roads. One or two-storey independent residential units of this part were designed and constructed based on east-west rows in

the form of semi-detached units (twins). In other words, the houses were connected only from one side, this organization became less frequent in subsequent projects in Iran. Every two rows of residential units (in the north and south) have access to the same street. The building mass of each plot is located in the northern portion of it, so each house has a private courtyard in southern part of the plot. There is also a green common open space with an area of about 12,000 square metres in southern Kan housing complex, which still exists. This complex has no fence or guard, but due to the layout of its streets and their connections to main streets around, looks well defenced and yet integrated with its surrounding over the time (Figure 11).



Fig 10. Shahr-Ara housing complex. Source: By authors (2017)



Fig 11. Southern Part of Kan Housing Complex, 1971. Source: Edited by authors, (National Cartographic Center of Iran, 2017)

2.6. Kan Housing Complex (The Northern Part)

In the northern part of Kan Housing Complex, 4-storey residential buildings were designed and built in an open area of approximately 22 hectares. Unlike the southern part, the northern part is composed of attached apartment buildings to accommodate more residential units. The northern part of this housing complex consists of residential buildings that are designed based on a hierarchical pattern of access roads. The secondary dead-end streets are branched from the middle longitudinal main road, as well as the peripheral roads. At their ends, the dead-end streets have more space to accommodate car park areas (Figure 12). Also, the entrance into the residential buildings is on the dead-end streets. The northern part of Kan is located in an almost rectangular area at the northwest-southeast direction, with the main access street being located at its centre.

The public space between the buildings is dedicated to pedestrians, while some residential units have private outdoor space on the ground floor on the southern side, which of course, have a proprietary fence and makes these units very different from other units. The public open space between buildings seems to have been abandoned in some areas and the residents also did not develop a sense of attachment to it. There are community facilities in the north of the residential buildings and several schools and a shopping centre at the end of the middle axis (Bahrambeygui, 1977). The northern part of Kan, despite

the lack of fence, do not simply allow the passing cars inside due to its separated main street access and also the presence of dead end streets around the site, so the complex is rather separated from the surrounding urban context.

125 four storey residential blocks are attached and located at the east-west direction with 40 metres north-south space from each other. Because of the lack of their adaptation to the direction of the street and the shape of the land, they seem to be formed only with respect to the direction of the sun's movement. That's why the building rows are designed in a variety of two to ten units per storey. The number of blocks connected to each other (single, triple, quadruple, and quintuple) distinguishes the design of this complex from the others. Each building in this complex consists of two residential units per storey. The residential blocks of this complex have four storeys with 8, 16, 24 or 32 units (Figures 12-13). On each floor, both residential units share a staircase, so they do not have an independent access to the street. The entrance to each building is located on the northern side and below the staircase.

This complex is also considered as a medium density low-rise non-independent housing complex with a floor area ratio of 40% and a dwelling density of 45 units per hectare. One of the design features of this complex is the small covered area which has led to a large part of the land being unused.



Fig 12. Northern Part of Kan Housing Complex, 1971. Source: Edited by authors (National Cartographic Center of Iran, 2017)



Fig 13. One of the residential buildings of the Kan. Source: By authors (2017)

2.7. Behjat-Abad Housing Complex

Behjat-Abad is among the early, semi-public sector high-rise housing complexes in Iran, built by the Housing Organization in the mid-1960s. In early 1961, there were slum dwellers living in Behjat-Abad's undeveloped land who were later transferred to Nohom-e-Aban (now Sidadhom-e-Aban), a newly built housing complex, before the construction of Behjat-Abad. The location of this complex was near the city at the time so residents could have easy access to major shops, such as Quds (formerly known as Kourosh), Shar-o-Roosta, recreational facilities, and various important civic spaces, like Vali-Asar Street & Square. However, the land price was rather expensive. This, including the area of the apartment units could be the reasons why Behjat-Abad complex which was originally designed for the low-income class, was not accepted by people at that time.

Behjat-Abad housing complex was designed and constructed in Fourteen 13-storey residential blocks (about 42 metres high) in an area of about 3 hectares (Figure 14). Based on the design of the complex, the buildings are situated next to each other without any special network arrangement just in a way to create the least amount of disturbance in terms of light, vision and landscape.

Inside the complex, there are two main separated streets, starting at the entrance on the south and extending toward north from both east and west sides of the site. Parking lots located adjacent to each residential block, branched from these primary streets. Central part of the site is dedicated to pedestrian, with a large outdoor swimming pool (to be used just by residents), green spaces and pedestrian routes (Figure 15).

Behjat-Abad has a supermarket and a playground and it has been a walled and gated complex from the date of its initial use.

The Residential blocks designed in three types, with slight differences. They all have 12 residential storeys with two dwelling units in each floor and a ground floor.

Most of the ground floor area is semi-open and the rest is dedicated to the entrance of the block. Vertical access including elevators and stairs are located in the middle of each block, so dwelling units utilize the sun light from three sides.

Behjat-Abad is the first high-rise non-independent housing complex in Tehran, and probably in Iran. It seems that the use of high-rise complexes was to create more residential units in a limited area of expensive land next to the city. For this reason, the Behjat-Abad complex with a floor area ratio of 215% and dwelling density of 127 units per hectare is denser than all the other complexes studied, and is one of the first housing complexes with more than 5 storeys, which includes elevators.

2.8. Kuy-e-Farah (Parastar) Housing Complex

Kuy-e-Farah (Parastar) housing complex is located about three kilometres east of Chaharsad-Dastgah, in an area of 22 hectares. The complex includes 632 independent residential units constructed by the investment from semi-public sector ("Iranian Rahni - bank buildings," 1972). Similar to Chaharsad-Dastgah and Shahr-Ara, the vehicular access network in Kuy-e-Farah is based on a grid (Figure 16). The overall design of the complex is very similar to that of Chaharsad-Dastgah with a fairly wide north-southern street. In this design, each secondary access road serves the two rows of houses on the north and south of the street and is such that it does not cause traffic inconvenience while allowing for vehicular access by the residents. The complex has a community centre surrounded by retail shops, with an east-west public pedestrian boulevard in the middle that cuts through the centre ("Iranian Rahni - bank buildings," 1972) (Figure 16). This major walkway connects the north-south vehicular access road to the east of the complex, ending in a small square. Nevertheless, the walkway does not make a strong connection with the entire complex. In the east and west of this complex, there were also places to build

schools ("Iranian Rahni - bank buildings," 1972).

Residential units with one or two floors are independent and arranged next to each other based on east-west rows (row house) without any light disturbance (Figure 16), similar to the existing conditions of most of Tehran's neighbourhoods. The built area (covered area) is typically located on the north of each plot with an open space on the southern side. This complex with a floor area ratio of 60% and 29 residential units per hectare is considered as a low density housing complex. Today, only a handful of houses, along with the walkway and the

central community space of the complex are still preserved.

This complex has no enclosure and entrance gate, and like Narmak and Shahr-Ara complexes, has integrated with surrounding areas over the time, due to its' street layouts. In Figure 17, one type of the two-storey houses of this complex are shown, in which the kitchen, family, dining and living spaces are located on the ground floor and private spaces, including bedrooms and bathrooms, are on the upper floor.



Fig 14. Behjat-Abad Housing Complex. Source: By authors, based on 1971 aerial photo Google Earth (2016)



Fig 15. Behjat-Abad Housing Complex. Source: ("Tehran a capital in research of itself," 1973)

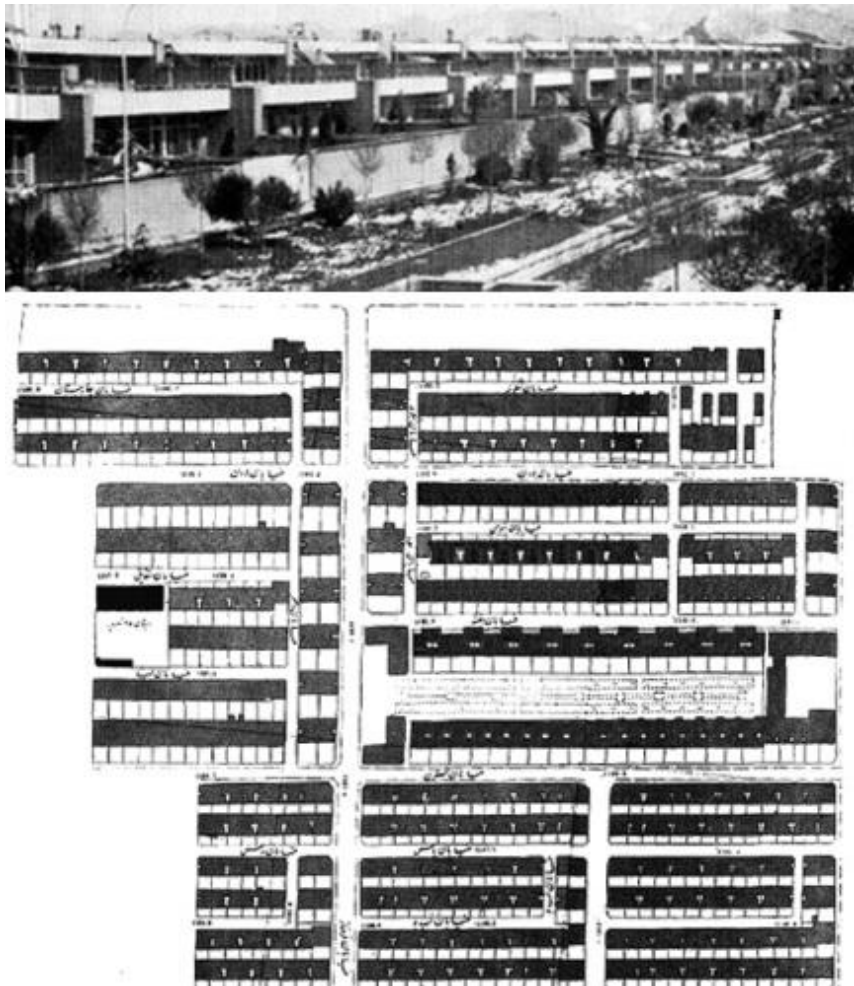


Fig 16. Above: East-west public pedestrian boulevard in the middle of the complex, in the Bottom: Site plan of Farah Housing Complex. Source: ("Iranian Rahni - bank buildings," 1972)



Fig 17. First and second floor plan (type A) of Kuy-e Farah houses. Source: Edited by authors ("Iranian Rahni - bank buildings," 1972)

2.9. Chaharom-e-Aban Housing Complex (The Northern Part)

Chaharom-e-Aban housing complex was built for low-income residents in 1969 in Nazi-Abad, an area also used for brick kilns and brick production factories. The complex was planned in two stages ("Iranian Rahni - bank buildings," 1972). The first stage included an area of about 22,000 square metres in the north, and the second stage included an area of about 48,000 square metres in the south.

The vehicular access road in the northern part of the complex is consisted of primary peripheral and a northern - southern road in the middle of the complex. Eastern - western secondary roads are located on the north side of residential block rows. There are green open spaces on the south side of the residential blocks with a community space in the middle of the complex. Parking areas are planned along the access roads. Parking lots are created from the expansion of access roads. Thus, a variety of public and semi-public open spaces are created for the complex. The residential blocks with four storeys height (with no elevators) classified the development as a low-rise non-independent housing complex. On each storey, there are two residential units with a shared staircase of about 60 square metres (Figure 19). The eight residential blocks are arranged in an east-west direction, parallel with each other, so that they are approximately 15 metres apart from each other and have open green spaces separate them (Figure 18). From the eight residential blocks, seven of them were assigned to teachers and one building was assigned to railway workers.

The complex does not have any gate and enclosure except separation walls on the north and east side of the plot. moreover, southern green spaces lead to the separation of this complex from southern part of urban fabric, so only the residents usually enter to the complex site. According to what explained above, although the orientation and height of the residential blocks and orientation of inside streets coordinate with the surrounding, because of relatively large distance between blocks and peripheral walls, the complex do not integrate with urban context around as much as other complexes such as Narmak, Chaharsad-Dastgah, Shahrara or Farah do.

The northern part of the complex has a floor area ratio of 70% and a dwelling density of 105 units per hectare, which is considered as a rather high density housing complex.

2.10. Chaharom-e-Aban Housing Complex (The Southern Part)

The southern part of Chaharom-e-Aban housing complex was built with after a short delay in 1970 on an area of about 48,000 square metres (Figure 20). The planning and design of this part is very similar to that of the northern part. Main access to the southern part is

through a peripheral vehicular road, but access to residential blocks is also drawn to the inside of the site through a hierarchical network. This way, the east-west dead-end streets are branched from the main northern and southern streets towards. A north-southern spacious pedestrian walkway is located in the middle of the complex, which links the east-west secondary sidewalks among the rows of residential blocks. Parking areas are attached to the middle of the dead-end streets. Thus Similar to the northern part, vehicular access road is separated from the north-south spacious pedestrian walkway. Public and semi-public spaces is provided for residential units as well. Nevertheless, none of the residential units have a private open space.

There are 15 residential blocks in this complex, located in parallel rows along an east-west orientation, facing access roads from one side and green spaces from another. Thus, residential blocks are designed in single-rows, distanced 20 metres from each other, in a way that they are located between open and green spaces (Figure 20). In addition to its residential section, the complex has a sports park¹. Residential blocks in the southern part of the complex are five storey buildings without elevators, and each of them has two different residential units.

The complex does not have any gate and enclosure except separation walls on the south and east side of the plot, so the complex is separated from its adjacent urban context in these parts and because of relatively large distance between blocks and peripheral walls, this complex like the northern part, do not integrate with urban context as much as others mentioned before.

These units are approximately 75 square metres (Figures 20-21) and share a staircase. Therefore, the residential units do not have independent access. It should be noted that the residential and public buildings, open and green spaces are still in place. The southern part of the complex with a floor area ratio of 90% and dwelling density of 100 units per hectare is considered as a rather high density medium-rise non-independent complex.

¹ The park includes two football pitches, two volleyball and basketball courts, two adult and children pools and a family centre (with a kindergarten, classes for fighting illiteracy, professional workshops, women's health centre, and a library) and the required services.

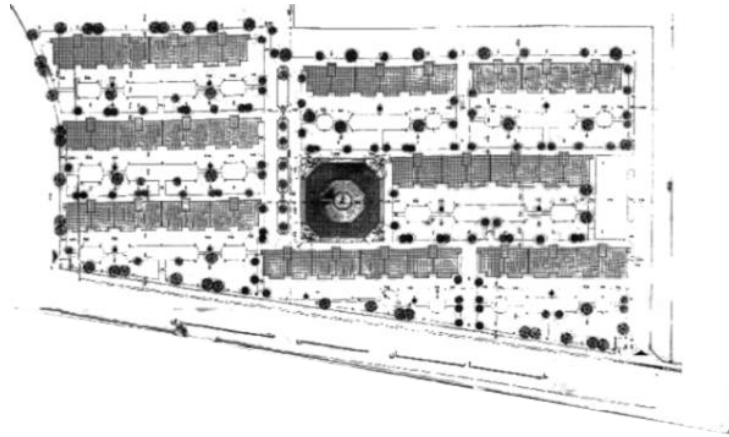


Fig 18. Site plan of the northern part of the Chaharom-e-Aban Housing Complex. Source: ("Iranian Rahni - bank buildings," 1972)

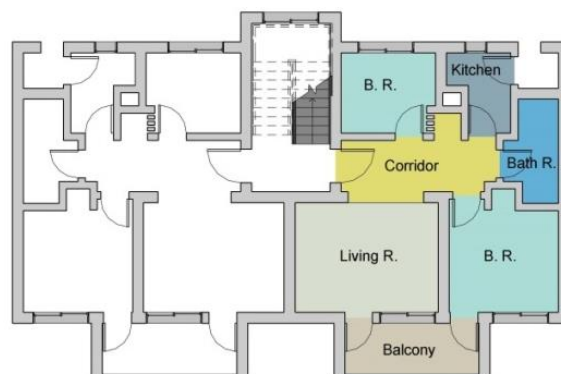


Fig 19. Two-bedroom apartment floor plan. source: Edited by authors, ("Iranian Rahni - bank buildings," 1972)

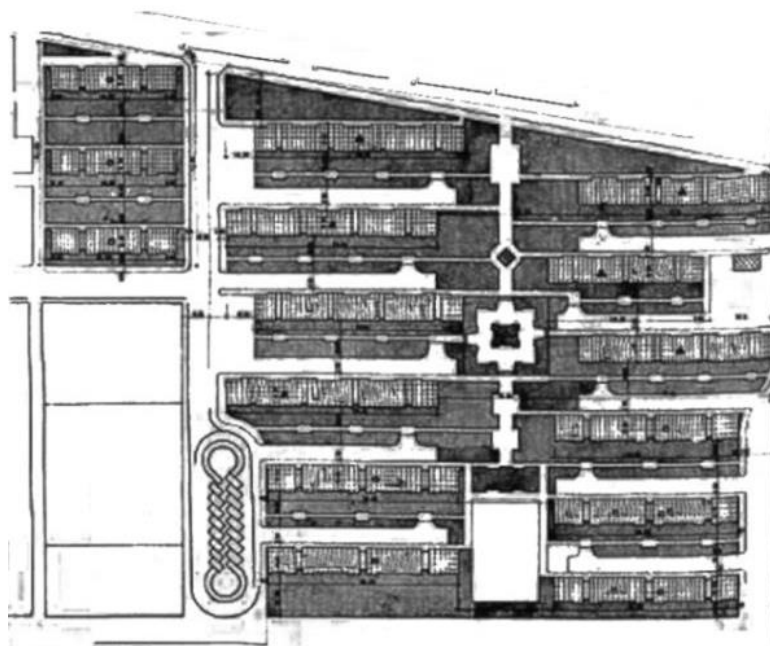


Fig 20. Above: Typical floor plan of one of the residential buildings in the Chaharom-e-Aban (southern part), in the bottom: Site plan of the southern part of the Chaharom-e-Aban Housing Complex. Source ("Iranian Rahni - bank buildings," 1972)

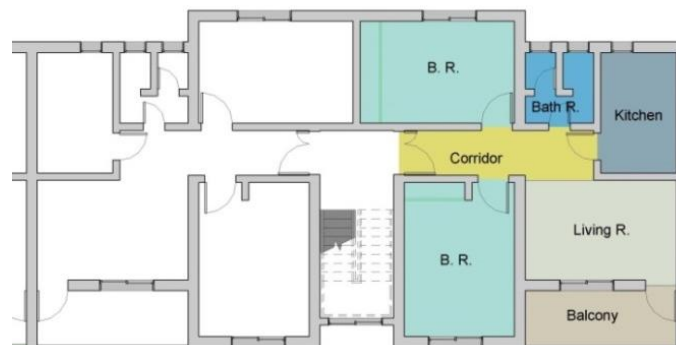


Fig 21. Two-bedroom apartment floor plan (Type B) in the southern Chaharom-e-Aban Source: Edited by authors, ("Iranian Rahni - bank buildings," 1972)

3. SUMMARY

The ten housing complexes studied in this article cover a total area of about 500 ha. of housing construction over a period of twenty years (1951-1971), which accounts for 5% of the total urban land of central Tehran in the early 1960's (10,000 hectares) (Table 1), which shows an extensive city development plan in that period of time.

Compared to the location of Tehran, these housing complexes were built near the city (on the edge), in its outskirts (up to 3 km) or far away (up to 10 km). Tehran covered a total length of 10 km at that time. Of the approximately 500 hectares of land allocated to these complexes, about 10 hectares was near the city (with a maximum distance of about 5 km from the city centre), 50.5 hectares on the outskirts (with a maximum distance of about 8 km from the city centre), and 432 hectares far away (about 15 km from the city centre) (Table 1), which shows the development of affordable housing mainly occurred outside the city.

The highest floor area ratio (beyond 200%) belongs to Behjat-Abad complex, the closest to the city, and the lowest floor area ratio (30%) belongs to Kan complex (southern part), the farthest from the city (Table 2). These conditions almost equally apply to dwelling density and population density (Table 2). Also, housing complexes built close to city were 4-12 storeys, while housing complexes built on the outskirts and far from the city were up to 4 storeys high. The larger and relatively farther housing complexes (Narmak, Farah, and Southern Kan) have a covered area of approximately 40% to 44%, with independent houses up to 2 floors, which is in accordance with conventional residential neighbourhoods in Tehran (Table 3)¹. The covered area in the smaller and

relatively closer housing complexes of Behjat-Abad, Shahr-Ara, Chaharom-e-Aban, Nazi-Abad, is far less than (half or one quarter of) that of the above complexes (Table 2), with rather non-independent houses in higher floors, not similar to conventional residential neighbourhoods in Tehran. These all shows that planners, in order to encourage people to live in housing complexes far from the city, tried to develop plans similar to conventional houses of the city which was in accordance with the price. On the contrary for sites near the city, they developed rather modern plans (for those days) to cover the higher priced land. In terms of number of storeys, these complexes can be divided into three types: low-rise housing complexes (1-4 storeys) usually without elevator, mid-rise housing complexes (5-10) and high-rise housing complexes (higher than 10 storeys). They can also be categorized in 3 types in terms of access to street: 1-Independent: that dwelling units have direct access to street, 2-Non-independent: That dwelling units have controlled shared access (residents of all dwellings use shared staircases and corridors) to street, 3-Semi-independent: That dwelling units have access to street through public access within the complex (residents of all dwellings or even non-residents may use staircases and corridors) to street.

The area of residential units in the studied complexes represents the diversity of sizes in complexes close or near to city (Table 3). Except Behjat-Abad, which was designed for relatively affluent households with the aim of promoting apartment buildings (Ministry of ..., 1970), the average area of independent residential units is greater than the average area of non-independent housing complexes (Table 3). In low-rise and mid-rise apartment complexes with a shared staircase, the unit area is on average 60-70 square metres. In the apartment complexes with an independent staircase, the unit area is 150-220 square metres.

¹ Based on the comprehensive plan information of Tehran in 1970 (Ministry of Roads and Urban Development, 1970) the city was about 180 km² in size and had 7.2 million people in 1967. Considering the average area of the residential plots in the city centre at that time (about 100 square metres) and the area for the streets, the density of these neighbourhoods was about 80 units per hectare or about 300 people per hectare. According to the estimation of authors from a neighbourhood in Tehran based on the aerial photographs of that time showed that conventional residential neighbourhoods in Tehran's city centre consisted

of independent one or two-storey houses with courtyards with covered area of about 45% and floor area ratio of up to 70%.

Table 1. The area and the location of the land dedicated to the housing complexes studied.

Location	Near the city		Outskirts of the city				Far away from the city		Total
	Behjat-Abad	Chaharom-e-Aban	Chaharsad-Dastgah	Naziabad	Shahrara	Farah	Kan	Narmak	
Land area (ha.)	3	7	12	6/5	10	22	32	400	
Total land area (ha.)	10		50/5				432		492/5

Table 2. The area, floor, density and residential types of housing complexes studied.

Housing complexes	Narmak	Farah	South Kan	Chaharsad-Dastgah	Northern Kan	Naziabad	Shahrara	Chaharom-e Aban	Behjat-Abad
Population density (people per ha.)	88	145	90	160	180	230	320	400	500
Dwelling density (unit per ha.)	25	29	20	31	45	55	80	103	127
Covered area (%)	44	40	40	40	10	11	19	17/5	19
Floor area ratio (%)	65	60	30	35	40	43	60	80	215
Number of floors	1-2	1-2	1-2	1-2	4	4	3	4-5	12
Residential type	Independent row house	Independent row house	Independent semi-detached	Independent row house	Non-independent low-rise	Semi-independent low-rise	Non-independent low-rise	Non-independent low-rise	Non-independent high-rise

Table 3. The range of residential average area in housing complexes studied.

Housing complexes	Chaharsad-Dastgah	Narmak	Farah	Behjat-Abad	Southern Kan	Shahrara	Naziabad	Chaharom-e Aban		
								north	south	North Kan
Average area of residential units (square meters)	80 to 150	200 to 350	200 to 350	150 to 190	100 to 150	60 to 80	45	60	75	70
Residential type	Independent row house	Independent row house	Independent row house	Non-independent high-rise	Independent semi-detached	Non-independent low-rise	Semi-independent low-rise	Non-independent low-rise	Non-independent low-rise	Non-independent low-rise
Average area in different types	220			170	125	70	60			

Except in two cases (Nazi-Abad and Behjat-Abad), the rest of the complexes were designed and constructed without an enclosure and gateway. The two complexes, which have shared (non and semi-independent) staircases, are medium to high-rise projects located on the outskirts and close to the city have fencing and a gateway. Northern Kan and the Northern and Southern Chaharom-e-Aban had no fence or gateway, nevertheless, their dwellings had functionally independent access to

street and the blocks' access were only used by their residents.

In terms of the overall pattern of access, these complexes can be divided into three types: simple grid network, grid network with multiple internal squares and tree network. Separation of pedestrian and vehicular paths gradually increases in these complexes so that this path ultimately became the main axis of the complex. There are four types of main public or semi-private

outdoor spaces in these housing complexes: linear for pedestrians (e.g., Southern Chaharom-e-Aban and Farah), square (e.g., Chaharsad-Dastgah, Northern Chaharom-e-Aban, and Narmak) distributed between residential blocks (e.g., Northern Kan, Behjat-Abad, and Nazi-Abad) and park type at the centre or along residential blocks (e.g., Southern Kan and Shahr-Ara). The distributed public spaces have gradually become unused or transformed to parking lots, such as Nazi-Abad and Northern Kan. All detached houses and some ground floor apartment units have private open space. In the studied complexes, private parking is not considered for detached residential units, and they have shared parking lots. Nevertheless, through widening of the access roads, apartment complexes with shared access are provided with parking lots located around the complex or between residential blocks.

The most important discussion about these housing complexes is about space organization (e.g., open vs. closed spaces). A notable factor in designing these complexes is the diversity of space organization. Detached houses (the so-called 'villa' in Iran) are combined with semi-detached or attached houses. Also, low-rise, mid-rise and high-rise apartment buildings, which constitute the majority of the units, are used individually or in combination (Table 3). Chaharsad-Dastgah, Narmak and Farah, were selected from the detached and attached category, each with a special type of combination. In Chaharsad-Dastgah, the covered area (building) of the units is located next to street with private courtyards behind them. In Narmak, the private courtyard is located between the building and the street. In this configuration, the building is in the northern part of the land and is oriented to maximize natural day lighting. In Farah, each street serves two rows of houses in its north and south, with the covered area being in the northern part of each plot. This design diversity is present in mid-rise apartment complexes, such as Nazi-Abad, Chaharom-e-Aban and the Northern Kan.

Another point about the residential units of the studied projects is the gradual change of plans towards modern patterns. In the first case (Chaharsad-Dastgah) the kitchen and bathroom are separated from living spaces and are located on the opposite side of the courtyard. In subsequent plans, there are contemporary space types, such as "dining room" or "bedroom", that were not present in well-known traditional housing patterns.

4. CONCLUSION

Focused on a small number of housing complexes developed in 20 years in Tehran, this study reveals this large metropolitan area's constant need for physical development, especially the design and construction of housing complexes. Implemented over the years on the city outskirts, close to or far from the city, the development of these complexes has been based on a careful selection of appropriate design patterns and has

valuable lessons for design and construction of new housing complexes in Tehran.

The early housing complexes studied in this paper were mostly designed for low- and middle-income groups and adapted diverse patterns considering project distance to the city. Complexes that were closer to the city centre included higher population density, dwelling density, floor area ratio and number of floors. Design strategies applied in early residential complexes to improve sustainability and environmental qualities included semi-independent residential units with public corridors on floors to provide more independence, careful attention to walkways and the separation of pedestrian from vehicular paths, suitable green spaces on one or both sides of streets or in the middle of housing clusters with private, public and semi-public open spaces. In almost all of the studied housing complexes, we saw the simultaneous presence of public amenities, educational, and sport facilities, and residential units. Despite the fact that some complexes were built far or in outskirts of the city in early days, but due to the adopted design solutions such as coordination of residential plot size and orientation, floor area ratio and mainly street layout and direction, they could integrate with the city expansion in years after. Other positive design aspects in most of the studied complexes included suitable orientation of residential blocks and adequate distance between them. The organization of closed and open spaces and spatial design of residential blocks inside each housing complex provided diverse viewpoints for the whole project.

Problems associated with some recent major housing complexes in Tehran, highlight the importance of design solutions and points mentioned in early housing complexes. Interestingly, in recent housing complexes (mentioned before), near or on the outskirts of the cities, there is not any difference in design since most of them are mid- to high-rise high density complexes. The lack of public facilities and educational and cultural uses has transformed these complexes into single-function areas. One of the most important issues we face in recent complexes is the lack of identity, urban character, and proper planning leading to the construction of a number of dead, soulless dormitory-like complexes around large cities.

Overall, the current study showed that the designers of early housing complexes had achieved the ability to design and create a variety of sustainable complexes based on long-term user needs. Unfortunately, this long-term view was forgotten in recent projects. This study tried to reveal some advantages and disadvantages of the design of early residential projects in order to achieve a clear view about housing complex design and to provide guidance for future housing complexes.

APPENDIX A

Housing complexes architectural characteristics:

Residential complex	Location		Year of construction	Floor area (sq. m.) Land area (ha.)	Population	Number of residential units	Covered area (%) Number of floors	Floor to area ratio (%)	Dwelling density (per ha.)	Population density (per ha.)	Residential types	Contact with the city	Investor
	Longitude	Latitude											
Chaharsad-Dastgah	51-27-25	35-41-20	1946-1950	12 ~ 40000	1900	374	1-2 40	35	31	160	Independent row houses	No fence or gate	Public sector
Narmak	51-29-35	35-43-47	1953	400 ~ 2.65 million	35000	10000	1-2 44	65	25	88	Independent row houses	No fence or gate	Public sector
Nazi-Abad	51-24-5	35-38-16	1958	6.5 ~ 28,000	1500	360	4 11	43	55	230	Semi-independent low-rise	Fence or gate	Public sector
Shahr-Ara	51-22-24	35-43-32	1958-1959	10 ~ 60,000	3200	800	3 19	60	80	320	Non-independent low-rise	No fence or gate	Private sector
Kan (South)	51-17-59	35-44-26	1958-1959	10 ~ 30000	900	200	1-2 40	30	20	90	Independent semi-detached	No fence or gate	Semi-public sector
Kan (North)	51-17-28	35-44-50	1960-1964	22 ~ 80,000.	4000	1000	4 10	40	45	180	Non-independent low-rise	No fence or gate	Semi-public sector
Behjat-Abad	51-24-36	35-43-0	1964-1970	3 ~ 65000	1500	380	12 19	215	127	500	Non-independent high-rise	Fence or gate	Semi-public sector
Farah (Parastar)	51-29-3	35-41-23	1963-1966	22 ~ 132000	3200	632	1-2 40	60	29	145	Independent row houses	No fence or gate	Semi-public sector
Chaharom-e-Aban (North)	51-24-31	35-38-37	1969-1970	2.2 ~ 15000	900	232	4 17	70	105	400	Non-independent low-rise	No fence or gate	Public sector
Chaharom-e-Aban (South)	51-24-30	35-38-31	1970-1971	4.8 ~ 43000	1900	480	5 18	90	100	400	Non-independent mid-rise	No fence or gate	Public sector

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