

CASE STUDY

The sustainable semantic foundations of the traditional neighborhoods in the desert cities

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ABSTRACT

BACKGROUND AND OBJECTIVES: In cities with a hot and harsh climate, defining space and territory in a sustainable and environmentally manner in urban management and human capital is critical. Cultural values and climatic adaptation played a prominent role in the neighborhood's basic elements. The main objective of the research is to identify and clarify the semantic foundations of neighborhood design in desert cities of Iran which will be used in future improvement and rehabilitation plans.

METHODS: Naeen City, which has a particularly integrated neighborhood design structure, was chosen as the case study to support this concept. The grounded theory has been used to conduct this qualitative research and neighborhood design as a text has been considered in five physical, social, environmental, functional and aesthetic categories and identified in detail 73 themes as first level open coding. These themes were interpreted under each of the three classes of social, scientific, and aesthetic. Then as the second level open coding, 29 topics are identified in 5 categories. Finally, 10 core themes have been recognized as the Sustainable Semantic foundations of the traditional neighborhoods in the desert cities of Iran after integrating and reflecting on the collected themes.

FINDINGS: The results showed that in the category of physical structure, a focal point and hierarchy in neighborhoods; in the category of social structure, social capital and human and religious values; in the category of functional structure, functional stability and climate adaption; in the category of aesthetic structure, physical and visual identity are most important factors in the neighborhood design in desert cities of Iran.

CONCLUSION: The findings revealed that the neighborhood in traditional Iranian cities was formed by the connectivity of physical and social elements and components, and it was the community of these neighborhoods that gave meaning to the Iranian city. Cities and neighborhoods are defined in perfect agreement with their surroundings. Neighborhoods, unlike residential units, do not require physical boundaries, and the services that people require are supplied with an emphasis on ease of access. Both as a municipal center and as an informal arena for public gatherings, the neighborhood center has been highlighted and exploited. The concentration is on common public areas that have given neighborhoods a sense of life.

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INTRODUCTION

The Iranian desert cities have struggled with a lack of meaning and environmental resilience. The contemporary development of urbanization in such hot and harsh climates has fundamentally altered their spatial and social foundations, causing cities' spatial patterns to lose their human and sustainable dimensions (Tajbakhsh, 2020). In cities with such a hot and harsh climate, defining space and territory in a sustainable and environmentally manner, as well as designating it within the borders that distinguish the public from the private, is critical (Lazzarini et al., 2015; Logan, 2006). Neighborhoods' physical texture, as a spatial crystallization of environmental and socioeconomic conditions, used to have a specific coherence and homogeneity, and it created an environment that reflected inhabitants' interactions in their daily relationships (Valibeigi and Shaneh, 2021). Traditional culture and climatic adaptation played a prominent role in the neighborhood's basic elements. Fundamental changes in urban space occurred as a result of the automotive industry expansion, the complexity of social labor division, and migration to cities. The destruction of the identity and structure of historic urban districts in Iran has resulted from changes in urban planning over the last few decades (Katouzian, 1981; Mehan, 2017; Souri et al., 2020; Vlibeigi et al., 2021). Leading to a shortage of knowledge of the notion of neighborhood and, as a result, the implementation of inefficient neighborhood systems, or simply spatial division on maps, neighborhood has frequently resulted in incorrect conclusions in contemporary urban planning of Iran. Obviously, paying attention to the neighborhood as a solution and necessity is effective when there is sufficient and correct knowledge of the concept of neighborhood in previous urban planning, as well as the optimal implementation of its principles and rules in accordance with contemporary conditions. The urban neighborhoods of Iran require a re-definition that preserves their cultural and environmental values while also meeting current requirements. As a consequence, it is vital to understand the semantic foundations of urban neighborhood organization and then design these concepts and symptoms in accordance with the new conditions. This is especially significant in desert cities of Iran, where the climate is hot and dry. One of the aspects of traditional urban planning in desert regions of Iran has been the separation of the

city into neighborhoods or local communities with distinct characteristics, which have been described using particular principles and rules and formed organically over time. A definite border and territory, a sense of solidarity and interrelationships among residents, collective identity, integration of space and activity, relative self-sufficiency, and a proportionate population have all been recurring themes in the definition of local community in several Iranian studies (Madanipour, 2003, 2006). Consequently, in the concept of local community, integrated spatial boundaries, the existence of physical boundaries based on mental perception or objective signs, a sense of spatial belonging and social solidarity, the possibility of face-to-face recognition, and the presence of local facilities and services are among the points that are crucial (Fazeli, 2006, 2008; Madanipour, 2011). According to the above points, a local community is a place with flexible and variable boundaries where people share their common and public interests in their lives and perform collective actions, and they have a sense of relative self-sufficiency, spatial belonging, place identity, and common history. In addition, it includes a network of organizations and institutions around local needs to meet the requirements of the community and provides a platform for collective action. Previous studies have discussed the notion of neighborhood and neighborhood design in Iranian cities, and have sometimes compared it to new models (Abbasi Harofofteh and Sadeghian, 2020; Gharavi Khansari, 2018; Hosseini and Soltani, 2018; Khabiri et al., 2021; Soleimani Meranjani et al., 2021). They have emphasized neighborhood analysis and planning in general, using an external method and from an expert-oriented perspective, while reading and interpreting the principles of traditional neighborhoods require to achieve a model for exploitation in the present era. The purpose is to interpret and explain the principles and regulations that can be implemented in the urban planning of central regions of Iran by using a posteriori approach and then a priori and dealing with the features and details of the neighborhoods. In this paper attempted to reach the concepts and regulations that constitute the sustainable foundation for desert neighborhood construction by: 1) To formulate the sustainable semantic implications and their representation in Naeen City neighborhoods; 2) To read desert neighborhood as a text in order to comprehend the hidden themes and categories as well

as, the links and interactions between them; 3) To find out main sustainable concepts of urban planning and neighborhood design principles in central regions of Iran. To achieve these objectives, the research survey was conducted in old town of Naeen City, Iran in 2020.

MATERIALS AND METHODS

Survey design and data collection

The research has been implemented in a qualitative manner and based on the grounded theory. A qualitative sampling including field observations, plans, documents analysis and ethnographic methods has been considered for detailed knowledge of semantic foundations of the sustainable neighborhoods in the desert cities. In qualitative field research, qualitative sampling also known as purposeful sampling or theoretical sampling (a sample approach) has been used. The sample size is determined by the “theoretical saturation” of the contents, the culture and the context of the case study. Saturation means that no new and important content is obtained and the themes are well developed in terms of features and dimensions (Hennink and Kaiser, 2020; Lambert, 2019; Low, 2019). An open interview with 20 local residents was conducted in addition to field observations of neighborhood structures.

One of the central desert cities of Iran should be selected for this research as intensive research based on an in-depth interpretation of the sustainable design principles of the desert neighborhood of Iran. Therefore, based on the opinions of seven experts in the fields of architecture, urban design, and planning, a list of five cities including Kerman, Yazd, Naeen, Tabas, Shahdad was prepared. According to experts, the historical texture of Naeen City is one of the best samples of historical textures in Iran in terms of space organization, which even today remains part of this pristine texture and where the spatial logic of urban local communities can be found. So, historical urban local communities in Naeen City were selected as the case study. Due to the numerous cultural and biological similarities in central regions of Iran, a distinct kind of local communities has emerged, with spatial characteristics from the other regions of the country. Naeen City is one of the mentioned cities which is located in the province of Isfahan in Iran. The most prominent feature of Naeen City is its location on the southern edge of the central desert of Iran, which has a hot and dry climate. The difficulty of supplying drinking water and agriculture is one of the city’s most pressing issues, and it is one of the key reasons for Naeen’s and its neighborhoods’

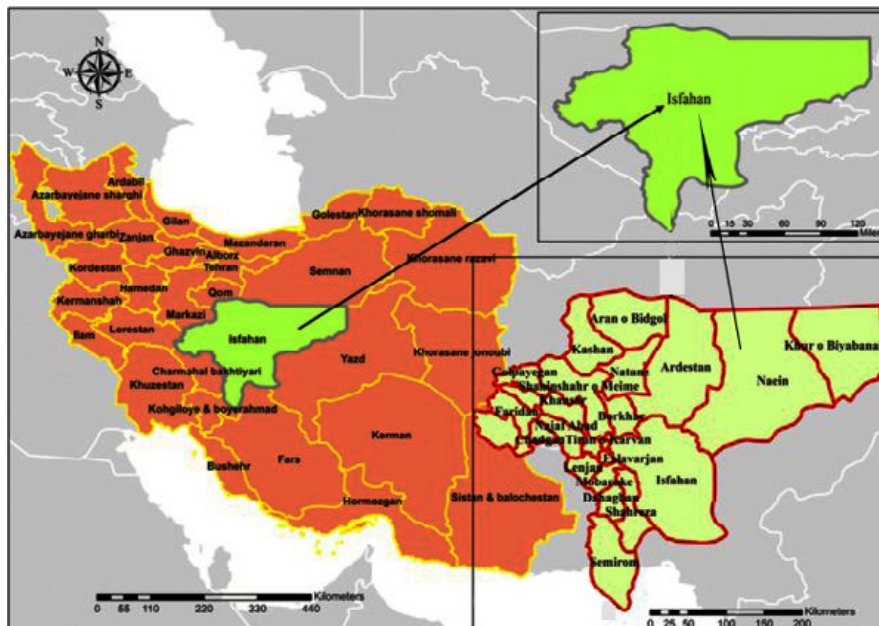


Fig. 1: Geographic location of the study area in Naeen City, Iran

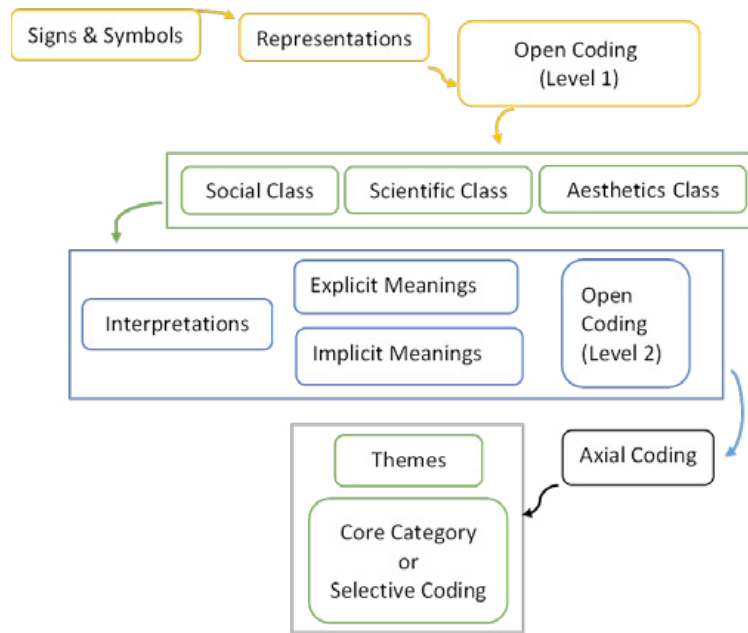


Fig. 2: Framework of the Study

lack of growth in terms of size and population. With these circumstances, the most important reason for the formation of this city can be considered its communication role in establishing communication between the central part of Iran and the northern and southern regions of the country, as well as the natural condition of the city, which has given it a continuous and cohesive texture. Kalvan, Bab Al-Masjed, Noabad, Saraye No, Panjaheh, Chehel Dokhtaran, Sang, or Godalo are among the city's seven historic districts. The location of Naeen City in Iran is represented in (Fig. 1).

Analytical framework

A study based on grounded theory is used, in that, interpretations is derived directly from the data and contents collected and analyzed on a regular basis during the survey. The collected contents, analysis, and final theory are all tightly related in this process (Chamberlain-Salaun *et al.*, 2013; Salvini, 2019). In the first phase, the signs and representations are recognized by the open coding process in five categories of neighborhood design principles and then with three classes of social, scientific and aesthetic are interpreted, summarized and their subjects are identified. In the second phase, by linking the identified

theme and categorizing them, explicit and implicit meanings, as well as axial coding, are achieved. The third level coding (core category or selective coding) is achieved by performing classification between the obtained themes, and it is attempted to construct a theoretical system, a collection of selective coding and core categories that constitute a discourse based on grounded theory. The use of semiotic methods in converting concepts and contents to core categories and selective coding, based on five categories of neighborhood design principles, is the focal point of this section, with the purpose of achieving a deeper reading of the fundamental sustainable concepts and their representation in desert city neighborhood design. The research framework is depicted in (Fig. 2)

RESULTS AND DISCUSSION

Naeen structure as a model of cities in central region of Iran can be characterized in five general structures including, physical, social, functional, environmental and aesthetic structure.

Physical structure

Among the neighborhoods of Naeen, the central neighborhood includes the main constructions and functions of the city and the texture of the

neighborhoods around the center is very compact and includes buildings with residential use. The feature is now considered to a compact and stable city in which units and physical spaces are interconnected. As a result, each unit is connected to other units in two or three directions. There are also large units such as mosques, *Hosseiniyyeh* and caravanserais close to more modest units, such as residential spaces which leads to the creation of large and small units in an area. They are arranged close to one another, resulting in a smooth and consistent texture. The best performance against the climatic conditions of Naeen was achieved by a cohesive combination (Sultanzadeh, 1986, 2006). In order to smooth the movement in such a compact texture, space openings are created in selected areas of the city (most of the urban joints) generated by the collision of the main roads that modulate the observer's feeling in the best possible way. As a matter of fact, the center of Naeen is the center of the neighborhoods and the opening in front of the Grand Mosque. *Hosseiniyyeh* in the urban joints caused the new presence of these spaces to be constantly visible from various connection points across the city. The presence of these religious structures was so significant in many cities that the neighborhood's heart was named Tekiyeh (*Hosseiniyyeh*). Each of the *Hosseiniyyeh* exists not only as an urban joint and the center of the neighborhood, but also as a symbol of the existence of a neighborhood, because urban neighborhoods have certain edges that cannot be distinguished from each other and only when passing through One neighborhood center enters another neighborhood center, it feels like it has entered an area (Ghouchani and Taji, 2019; Nazarian and Baharlouei, 2013). One of the most important features of Naeen City's neighborhood design system is its physical and functional centrality (Fig. 3). The orientation of the all-side routes to the center of the neighborhood where the mosque and *Hosseiniyyeh* of the neighborhood are located. Moreover, the hierarchy of pathways in the old area of the Naeen City was carefully observed, such that three types of passages can be identified in each neighborhood, and each neighborhood has at least one main passageway adjacent to the *Hosseiniyyeh* (neighborhood center). These routes are frequently broader, more direct, and longer than other passages, and they operated as a linkage between different portions of the neighborhood

as well as a connection between the neighborhood and another neighborhood. A number of side routes exist in each neighborhood, and their purpose is to facilitate connectivity between different areas within the neighborhood. In addition, each neighborhood has a number of dead ends, which are designed to connect a restricted number of residential units with other places. The presence of a cohesive and compact texture (Fig. 4), dual residential units (Fig. 5), the formation of public spaces among enclosed buildings, the use of Sabats (Fig. 6), vertical blades for shading, and the use of clay mud and brick materials are some of the physical features of these neighborhoods. Furthermore, the presence of unique spaces and structures, as well as the use of materials that are suitable for hot and dry climates, have given this metropolis and the cities in central region of Iran a distinct identity.

Social structure

Due to social, economic, and cultural differences, the city of Naeen is divided into independent neighborhoods, which has resulted in a sense of solidarity and unity among neighbors, as well as an important role in supporting neighbors from each other through cooperation, collaboration, and partnership. There was a sense of belonging and loyalty to their community as a result of their participation in neighborhood affairs. With the formalization of the Shia Islam during the Safavid era, and the enthusiasm of the residents of Naeen in organizing religious rituals and ceremonies, as well as community competitions, each of the city's seven neighborhoods developed a *hosseiniyyeh* that was nearly identical (Ghouchani and Taji, 2019). It has been accompanied by the people's participation in the allocation of space in the form of endowments, its construction and maintenance, the preparation of space on days of grief, and the most spectacular performance of the ritual. This sense of belonging to the neighborhood and participation in holding ceremonies, which demonstrates people's sense of belonging to Imam Hussein, provides a connection between people, places, and rituals, as well as in the ceremonial return of residents from the city to the *Hosseiniyyeh*. The festivities, especially during Muharram, are based on the same local communities of the past, and the rituals are performed in the same manner. Another sociological element of these areas



Fig. 3: Physical and functional centrality



Fig. 4: Physical texture cohesion



Fig. 5: Introversion of private and public buildings View from inside the Pirnyia house



Fig. 6: Use sabats and shades

is the availability of social security. The existence of social security in the neighborhoods is due to the hierarchy of accesses and places, as well as social cohesion and solidarity. One of the most prominent sociological characteristics of the people of these neighborhoods is their collective participation in cultural activities, particularly religious activities, which are normally carried out autonomously but in collaboration and communication with other neighborhoods. It has manifested itself in various ways, such as the Muharram decade festivities held in local squares (Karimi and Madani, 2020; Shoaie et al., 2013). The influence of ethnicity, kinship, profession,

type, and religious orientations in the social system and neighborhood designs of this city are also discussed in this section. On the other hand, it can be referred to the social and class mixing within a neighborhood, where one can see an interconnected mix of residences belonging to the rich and the poor. Agriculture was not very lucrative due to the severe climatic conditions, but people began weaving carpets, cloaks, dyeing, and other crafts within local workshops or outside the city walls and even in their homes, and Historic Naeen neighborhoods grew as a result of this practice (Alalhesabi et al., 2012; Asayesh, 2021). In addition, it can be discovered

from field observations that each of the communities served a specific purpose in the past; for example, the Kalvan area was mostly populated by carpet weavers. Part of the neighborhood residents' communication has been due to their use of shared neighborhood uses. Uses such as bathroom (sanitary space), water storage (service space), mosque (ritual space). Proper distribution of these services, which were usually located on the outskirts of local squares, led to the presence of people in these centers (Fig. 7), the continued presence in these cases has created a common spirit and story among the residents of each neighborhood. During the Safavid and Qajar eras, with the religious changes (conversion of the Shafi Sunni Islam to the Shia Islam), the *Hosseiniyyeh* were also formed next to the square and made this role more colorful. The city bazaar, as the strongest and largest axis of the city, connected the neighborhoods like the backbone of the city (Fig. 8) and the people of Naeen neighborhoods made their daily purchases from the city bazaar, thus the market space and the Grand Mosque They were a trans-neighborhood element, linking neighborhoods (Babaie, 2008; Johnson, 1994; Scherberger, 2011). This case has not been considered in newer contexts and is only a sign of the spatial boundary of the neighborhoods where residents use the city's mosques. Of course, it should be noted that the inhabitants of the new texture mostly belong to the surrounding villages and other areas, so the social cohesion of traditional neighborhoods is not seen in them. And identification

of the space of the *Hosseiniyyeh* and also standing in them has been used. In the neighborhoods of such indoor spaces, the gathering place of neighbors or the place of children's play has been a neighborhood area.

Environmental structure

The city of Naeen with an altitude of about 1600 meters above sea level is located on the southern edge of the central desert of Iran, which of course creates a hot and dry climate in this region. The absolute maximum temperature in 1996 was 41.2 degrees Celsius and the absolute minimum temperature was 19.2 degrees Celsius. Also, the average annual rainfall in Naeen is about 109 mm. Therefore, this area is considered as part of low rainfall areas (Fig. 9). The average annual relative humidity in Naeen, according to what is recorded at Naeen station, is 36.6%, the driest month of September with an average relative humidity of 20.5%. Naeen region is one of the poorest regions in terms of water networks, which due to dry weather and lack of rainfall, no significant permanent river can be seen in it. In this area, recognizing and studying the wind is of great importance the prevailing wind is the westerly wind. The highest wind speed is related to the south wind with 7.1 meters per second, followed by the southwest winds in Naeen in terms of seasonality in all seasons. In the four climatic divisions in Iran, Naeen is mentioned in the Central Plateau climate, in which the dry southwest winds have caused dry air. The formation of climate-friendly



Fig. 7: Presence of people in squares and public



Fig. 8: Naeen City market as the backbone of the city



Fig 9: Part of the land that was previously cultivated



Fig. 10: Formation of climate-compatible architecture for more compatibility with the hot and dry climate of the region

architecture and the creation of enclosed spaces for the use of shadows have been among the solutions for adapting to the hot and dry climate of the region (Fig. 10).

Functional structure

The dimensions of residential and urban spaces were not specifically articulated, but they were acceptable for the role and position of the founder or users. Residential units have widely varying dimensions as a result, depending on the social status of their residents. Thus, mosques established by generous people to pray beside side passages are frequently tiny, whereas mosques with an urban function or created and completed by rulers and affluent persons, such as the Jame Mosque, Baba Abdullah, and the Khajeh Mosque, are often large. They were huge in relation to their function or their founder's economic status (Babaie, 2008; Sultanzadeh, 2006). It's worth noting that the proportion between the size of the land and the amount of infrastructure has remained fairly constant. It was also observed in the neighborhoods that pedestrian access is limited and dependent uses outside the neighborhood are located on the neighborhood boundaries.

Aesthetic structure

In the context of Naeen neighborhoods, as mentioned, due to factors such as the development and organic formation of the city, the buildings lack land with a geometric and regular shape. In this case, the usual method and principle in the design were such that the ebb and flow distortion was solved

in the lower part of the building and the interior space, i.e., the yard, was designed in an orderly and geometric way. The open space of the local *Hosseiniyyeh* is more or less the same, that is, the central open space of the *Hosseiniyyeh* has a regular and designed shape. Of course, open spaces of passages have an organic form and this principle does not apply to them. The reflection of this principle in the composition of the body texture has made the physical boundaries of many architectural units not easily visible. The non-geometric form of residential plaques and the winding passages within the texture, for which many reasons such as evolution over time and maintaining security can be considered, increase the quality of the environment by considering new principles of urban design, such as diversity. Here and there, there is a sequential view or spatial sequence. In the wall space of *Hosseiniyyeh*, all sides and walls are designed to create an independent space. The introverted texture of Naeen has turned its back on the outer spaces. The only part of the outer space that is an exception to this principle is the entrance spaces and *Hosseiniyyeh*. The facade of all *Hosseiniyyeh* has been designed because its space as an enclosed space has an introverted aspect. In designing these walls, the principle of symmetry, balance, rhythm and emphasis on the central element has been used. In order to completely enclose the space of the square, in front of all the passages that enter the fields, an arch has been built in proportion to the other arches, and in cases where the opening of the dormitory was smaller than the opening of the pavilion or arch, the proportions were maintained. The opening of the

pavilion is preferred to other booths in terms of the size of the dormitory in determining the opening of the pavilion. In addition, in order to emphasize the enclosure and independence of the square, they have covered part of the passages at the junction with *Hosseiniyyeh* (Ibid: 80). In a way that in the walls where it was not possible to create symmetry (the most complete type of order) with the help of these principles, the viewer does not notice the asymmetry at first glance. In the view of the Shahneshin, all the *Hosseiniyyeh* are individual divisions, and in this way, the element of the *Hosseiniyyeh* (Shahneshin) is emphasized, which is located on the axis of symmetry of space in all the *Hosseiniyyeh* in the *Hosseiniyyeh* of Bab al-Masjid, Kalwan and Panjah, which are better examples than other *Hosseiniyyeh* in terms of design principles, respectively, all four facades are divided into sections. It is noteworthy that the entrance of the closed space of *Hosseiniyyeh* is less important than that of the royal settlements. The surfaces and open space of the *Hosseiniyyeh* are more or less the same in terms of the manner and type of decoration. The rafters and elastics located on both sides of the pavilion arches and bumps are covered with bricks, the surface inside the arches has been plastered, and tiles have been used for decoration in different places. Narin Qala, the Jame Mosque and the cover of the *Hosseiniyyeh*, due to their dimensions, volumetric and shape characteristics, were indicative of their function, and in fact, in this way, they revealed their place in the city and gave a special readability to the city from inside and outside. Also, the use of a special application pattern on the roof covering of the *Hosseiniyyeh*, makes it possible for the observer to distinguish between the domes that belong to the *Hosseiniyyeh* and other domes. Obviously, in this clarity and readability, the role of the whole height system should not be ignored the city as seen in the reports note that in the historical context of Naeen, 82% of the buildings are one-story (it should be noted that the *Hosseiniyyeh* and some prominent buildings such as the Grand Mosque and Baba Abdullah, Fatemi House, Pirnia Traditional House, etc. are considered two-story buildings). Have been seen as urban indicators in the city skyline). In the whole city of Naeen (a collection of valuable and new textures), 69.82% of the buildings are one-story and only less than 1% (0.65%) of the buildings are 3-story and taller. Another important factor in the appearance of

Naeen is the existence of unity and diversity, the unity resulting from the similarity of gender, texture, height and volume of the building and the diversity arising from the height and volumetric distinction of urban landmark elements. The thatched and brick material, which is combined with white brick and gypsum in certain places, in addition to the visual aspects that have caused unity and diversity, also offers the best possible option against the harsh thermal conditions of this region, because it prevents intense reflection of sunlight (Figs. 11, 12, 13).

Conceptualization of Neighborhood structures in Naeen

In order to identify more textually the dimensions of human and social life that have been used in the structure and body of the neighborhood units of Naeen City, five dimensions as the categories of the research have been collected including physical structure, social structure, functional structure, environmental structure, aesthetic structure (Carey, 2010; Fricano, 2011; Jabareen, 2006). Based on the contents analysis of the five categories of neighborhood design principles in the desert cities of Iran, it can be coded as follows (Table 1).

After the first open level coding, the themes are recoded according to the three types of selected interpretations (logical, social and aesthetic). The 73 themes from the first open level coding have been condensed into 31 themes (Table 2). If it is considered each of the elements used in the construction of historical desert cities of Iran as a kind of sign and the meaning, including special codes, and also if asked discovering the meanings and the signs, in any cultural network, the use of codes specific to that system is inevitable. Scientific (logical), social, and artistic are some of the classifications of sign-vehicles that can be matched by Peirce's Theory of Signs, which is used in the current research. Peirce thought signs indicate their objects not through all their features, but in virtue of some particular feature. By 1903, for reasons related to his work on phenomenology, Peirce thought the central features of sign-vehicles could be classified into three broad areas, and consequently, that signs could be classified accordingly. This classification depends on whether the sign- vehicles are represented on the basis of qualities, existential facts, or contracts and laws. Furthermore, signs with these sign-vehicles



Fig. 11: Regular and geometric interior design and independent wall space



Fig. 12: Organic design of open spaces of passages



Fig. 13: The principle of symmetry, balance, rhythm in the design of walls

are classified as qualisigns, sinsigns, and legisigns respectively (Albert, 2013; Marais, 2018; Zhang and Sheng, 2017; Zhao, 2019; Cuccio and Gallese, 2018).

Selective coding and core categories are carried out after the axial coding which has been presented in Fig. 2, which is the basis of the research theory. The 31 themes that were provided at the axial coding stage have now been altered to 10 selective themes in five categories. According to Table 3, the results showed that second-level codes reflect some of the underlying themes. The most important underlying themes in the

physical structure category are the existence of a focal point and hierarchy in neighborhoods. In the category of social structure, the emphasis on cultural and local values can form a continuous social interaction in neighborhoods. The origin of sustainable efficiency and performance in neighborhoods is environmental and functional stability enhancement. A definition of visual and physical identity in neighborhoods leads to sensational richness and readability. The basis of such a definition in desert areas can be a creative use of local materials and design.

Table 1: contents analysis of neighborhood design principles in desert cities of Iran

| Category | Themes and Signs of the First level open coding | codes |
|--|---|-------|
| Physical structure | Existence of Mosque, <i>Hoseiniyyeh</i> , Saqakhaneh, Bazar, Mosques and baths in the center of neighborhood | A1 |
| | Existence of commercial, religious, educational, sanitary and service land uses in the center of the neighborhood | A2 |
| | Walling in neighborhood squares in order to emphasize the centrality in the neighborhood | A3 |
| | Access to all side passages to the <i>Hoseiniyyeh</i> or the main mosque in the center of the neighborhood | A4 |
| | The main mosque and <i>Hoseiniyyeh</i> in the center of the neighborhood and secondary mosques next to the side passages in the middle of the neighborhood | A5 |
| | Larger-scale open spaces in the center of the neighborhood (inside or around the mosque or <i>Hoseiniyyeh</i>) and smaller-scale open spaces within the texture | A6 |
| | Existence of three types of passages in each neighborhood | A7 |
| | The main passage is the most direct and main passage that the main uses of the neighborhood are located next to and this passage connects the neighborhood to another neighborhood. | A8 |
| | Existence of many secondary crossings inside the neighborhoods, all of which have access to the main pass way | A9 |
| | Existence of many passages and dead-end alleys inside the neighborhood that lead to secondary passages | A10 |
| | Securing the home through a porch, sash, and shed | A11 |
| | Introversion and closure of the home environment as the cells that make up the neighborhood and the lack of nobility of neighboring units | A12 |
| | Existence of <i>Hoseiniyyeh</i> , main mosque or shrine in each neighborhood | A13 |
| | Existence of covered and roofed paths (Sabat, porch) | A14 |
| | The roof of the covered part of all the <i>Hoseiniyyeh</i> is placed on an octagonal background, which is a symbol of Imam Hussein's tent. | A15 |
| | Use of local materials and special construction methods | A16 |
| | Observance of the appropriate height for residential units | A17 |
| | Distinguish and identify the entrances of each neighborhood | A18 |
| | Existence of domes, windbreaks, water reservoirs, glaciers, special landscape of city neighborhoods | A19 |
| | Large parcels such as mosques, <i>Hoseiniyyeh</i> and caravanserais are located next to smaller grains, i.e. residential spaces. | A20 |
| | Distinguish the texture of the neighborhood with the non-geometric form of residential plaques and winding passages | A21 |
| Social structure | Lives of people of different ethnicities, religions and classes in a neighborhood | B1 |
| | Mixing the poor and the rich in one neighborhood | B2 |
| | Existence of local trustees to solve the social and economic issues of the neighborhood | B3 |
| | Respect for the rights of neighbors and the existence of strong neighborhood ties and kinship | B |
| | The simplicity of the exterior wall of houses to prevent arrogance and induce an economic difference in the neighborhood | B5 |
| | The existence of <i>Hoseiniyyeh</i> , mosques and religious delegations caused the consistency of people's relations and interactions | B6 |
| | Holding cultural and religious ceremonies in urban spaces | B7 |
| | Preparing the space during the days of mourning and performing the most glorious religious and ritual ceremonies by the locals | B8 |
| | People's participation in allocating space in the form of an endowment, construction and maintenance | B9 |
| | Neighborhood support for each other, cooperation, cooperation and participation when each resident need | B10 |
| | Return of people who have left the neighborhood to this place on various occasions such as rituals, especially during Muharram and Shaaban | B11 |
| | Establishment of religious rites and ceremonies, along with neighborhood competitions to make the ceremonies of each neighborhood more glorious than the other neighborhood | B12 |
| | Independence and relative self-sufficiency of the neighborhood in social, economic, service and administrative dimensions | B13 |
| | Narrow passages to deal with bandits and thieves | B14 |
| | Existence of numerous gates and fences for the city and sometimes for the neighborhood that was closed at night | B15 |
| | Impossibility of easy access of strangers to the place due to the type of communication network design and the existence of side routes and deadlocks | B16 |
| | Existence of openings and windows for social monitoring (street eyes) | B17 |
| Existence of mental perception of the absence of crime in the neighborhood | B18 | |
| The roof of the covered part of all these <i>Hoseiniyyeh</i> is placed on an octagonal background. | B19 | |
| Reflecting the common attitudes and tendencies of society in physical-spatial symbols, these ideals have been able to be transmitted to future generations. | B20 | |
| Holding Muharram and Safar mourning ceremonies in public spaces such as <i>Hoseiniyyeh</i> and the main thoroughfares of the neighborhood with the presence of local residents | B21 | |

Continued Table 1: contents analysis of neighborhood design principles in desert cities of Iran

| Category | Themes and Signs of the First level open coding | codes |
|-------------------------|---|-------|
| Functional structure | Gradual formation tailored to needs, spatial and climatic constraints | C1 |
| | Organic texture and adaptation to climate and community | C2 |
| | Functional centrality in the center of the neighborhood | C3 |
| | Type and quality of providing services and facilities suitable for the needs of different strata of the neighborhood | C4 |
| | Mixing and multiplicity of land uses | C5 |
| | Restriction of riding access to pedestrians | C6 |
| | Dimensions of local spaces appropriate to the social and functional status and status of the founder or user | C7 |
| | Proportion between the dimensions of the land and the amount of built-up area | C8 |
| Environmental structure | Avoid developing neighborhoods in agriculturally prone lands | D1 |
| | Aqueduct rehabilitation and watering of neighborhood trees and vegetation with aqueduct water | D2 |
| | Planting fruitful and non-fruitful trees compatible or resident in the area | D3 |
| | Creating natural barriers in the direction of the city's southwest winds | D4 |
| | Use of skylights and vertical windows located on the western front | D5 |
| | Use deciduous trees to provide shade in the summer and benefit from sunlight in the autumn and winter. | D6 |
| | Existence of narrow passages to create shade in summer | D7 |
| | Use of windshield for natural flow of air conditioning in buildings | D8 |
| Aesthetic structure | Wider main thoroughfares (less enclosure), more direct and with more diverse uses, forming the main structure of the neighborhood | E1 |
| | The general and main elements of each neighborhood have a distinct body from the residential units | E2 |
| | Physical and visual communication of the main route, squares and local landmark elements in a neighborhood and in the continuation of its relationship with other neighborhoods as a whole readable | E3 |
| | Narrow and organic paths that are sometimes covered in conjunction with larger squares create contrasting spaces. | E4 |
| | The main passages, small and large local squares connected the neighborhoods and created an interconnected complex. | E5 |
| | Creating a coherent whole with the presence of local and local components in the physical and functional composition together | E6 |
| | The domes and minarets of mosques and <i>Hoseniyyeh</i> illustrate the manifestation of religious values in the body | E7 |
| | Windbreaks, reservoirs, refrigerators, and other city facilities relevant to the region's specific climate | E8 |
| | Variety in the occurrence of privacy in space through porches, sash, etc. | E9 |
| | Use of special materials in building construction | E10 |
| | Distinguish and identify neighborhood entrances | E11 |

The results showed an example of a sustainability model. It can be stated, the principle of adapting the environment to human needs is one of the most basic lessons learned from Naeen neighborhoods. Attention to climatic constraints and especially water shortage, development commensurate with nature, recycling, the use of sustainable technical methods, and the use of natural flows such as water and wind to create pleasant urban spaces have been effective factors in the sustainability of the Naeen neighborhoods. Compact textures are the construction pattern of such neighborhoods and have moderator areas in population and construction densities, urban land uses and functions, and environmental conditions between urban centers and surrounding textures. Also, it seems a compact city design with density and appropriate functions has led to an optimal economic environment in Naeen City. Appropriate

density, suitable landscape, defined access patterns, and susceptibility to locating cultural and educational centers are combined in physical, functional, and aesthetic structures and make sociable places. It can be declared, there is an effort to maximize the optimal use of urban lands, especially vacant lands in old structures. Efforts have been made to avoid unreasonable developments that caused the scattering and disintegration of the structure of the city. Emphasis on the principles of access hierarchy and walkability has been an efficient way to reduce urban traffic problems. These methods can significantly reduce fuel consumption and thus reduce pollution. Savings have been made by diversifying urban land uses as well as activities at all levels from the city to neighborhoods and avoiding zoning activities. And this in itself has helped to create flexibility, freshness, and vitality in the city.

Table 2: The Second level open coding at three levels: scientific, social and aesthetic

| Category | codes | Classes | Themes |
|-------------------------|-------|------------------------|---|
| Physical structure | A1 | | Concentration of landmark buildings in the center of the neighborhood |
| | A2 | | Concentration of main functions in the center of the neighborhood |
| | A3 | | Orientation of all side roads to the center of the neighborhood |
| | A4 | • Scientific (logical) | Hierarchy of spaces and accesses |
| | A5 | • social | Introversion (securing residential homes) |
| | A6 | • Aesthetics | Existence of special buildings and spaces |
| | A7 | | Existence of distinct elements and materials |
| | A8 | | Cohesion and compactness of physical texture |
| | A9 | | The complexity of the texture |
| Social structure | B1 | | Diversity of social and economic strata of residents |
| | B2 | | social trust |
| | B3 | | Social correlation and vicinity ties |
| | B4 | • Scientific (logical) | Social participation |
| | B5 | • social | Sence of belonging to the neighborhood |
| | B6 | | Independent social identity |
| | B7 | | Objective and mental security |
| | B8 | | Manifestation of religious and cultural values in physical forms |
| | B9 | | Attention to religious and cultural activities collectively |
| Functional structure | C1 | • Scientific (logical) | Functional efficiency |
| | C2 | • social | Functional effectiveness |
| | C3 | | Functional centralism |
| | C4 | | Value-oriented and culture-oriented in practices |
| Environmental structure | D1 | • Scientific (logical) | Attention to water sources |
| | D2 | • social | Attention to soil sources |
| | D3 | • Aesthetics | Adaptation of the buildings and spaces architecture to climate |
| Aesthetic structure | E1 | • Scientific (logical) | Readability |
| | E2 | • social | Sensational richness |
| | E3 | • Aesthetics | The unity of the part and the whole |
| | E4 | | Physical identification |

Table 3: Selective Coding in the neighborhood design principles of desert areas

| Category | codes | Second level codes | Selective Coding and Themes |
|-------------------------|-------|---|---|
| Physical structure | A1 | Concentration of landmark buildings in the center of the neighborhood | |
| | A2 | Concentration of main functions in the center of the neighborhood | |
| | A3 | Orientation of all side roads to the center of the neighborhood | • Neighborhood center as a focal point in urban neighborhoods |
| | A4 | Hierarchy of spaces and accesses | • Hierarchy in city neighborhoods |
| | A5 | Introversion (securing residential homes) | • Confidentiality |
| | A6 | Existence of special buildings and spaces | • Physical identity |
| | A7 | Existence of distinct elements and materials | |
| | A8 | Cohesion and compactness of physical texture | |
| | A9 | The complexity of the texture | |
| Social structure | B1 | Diversity of social and economic strata of residents | |
| | B2 | social trust | |
| | B3 | Social correlation and vicinity ties | |
| | B4 | Social participation | • Social capital |
| | B5 | Sense of belonging to the neighborhood | • Social Security |
| | B6 | Independent social identity | • Emphasis on cultural and religious values |
| | B7 | Objective and mental security | |
| | B8 | Manifestation of religious and cultural values in physical forms | |
| | B9 | Attention to religious and cultural activities collectively | |
| Functional structure | C1 | Functional efficiency | |
| | C2 | Functional effectiveness | |
| | C3 | Functional centralism | • Functional stability |
| | C4 | Value-oriented and culture-oriented in practices | |
| Environmental structure | D1 | Attention to water sources | |
| | D2 | Attention to soil sources | |
| | D3 | Adaptation of the buildings and spaces architecture to climate | • Environmental sustainability |
| Aesthetic structure | E1 | Readability | |
| | E2 | Sensational richness | |
| | E3 | The unity of the part and the whole | • Physical and visual identity |
| | E4 | Physical identification | |

CONCLUSION

The neighborhood in traditional Iranian cities was formed by the connectivity of physical and social elements and components, and it was the community of these neighborhoods that gave meaning to the Iranian city. A study based on grounded theory was used to identify sustainable design principles in Desert neighborhoods. Based on the opinions of seven experts in the fields of architecture, urban design, and planning, Naeen City because of its very coherent neighborhood design was selected as a case study. Contents collected from various texts and sources, field studies, and interviews in five categories including physical, social, environmental, functional, and aesthetic categories were examined. And then the initial codes were interpreted based on the social, scientific, and aesthetic classes. Finally, the main themes in the sustainable design of desert neighborhoods were identified. The results showed that neighborhoods are defined in perfect agreement with their surroundings. The principles of sustainable architecture gleaned from Naeen local communities showed that old cities can be manifestations of a culture of sustainability, passing on the general guidelines of urban stewardship from generation to generation in a friendship relation with nature. Both as a municipal center and as an informal arena for public gatherings, the neighborhood center has been highlighted and exploited. The concentration is on common public areas that have given neighborhoods a sense of life. Residents have contributed in the construction, management, and maintenance of facilities and locations needed in the community, and social life and local nexus have been extremely essential. In the neighborhoods that can be referred to as affordable housing, a pattern of a combination of types of housing for all classes can be seen. With the support of residents and benefactors, the preservation and reinforcement of traditional structures and historical buildings has long been a priority. The notion of hierarchy in the spatial organization of neighborhood, and the system of access and distribution of urban services has been completely observed, and climate-appropriate design has received substantial attention both in the construction of houses and in the design of neighborhoods. The size of the passages has a human scale in terms of length, width, and height, as do most buildings. The presence of numerous urban landmarks with local traits adds to the neighborhood's sense of

orientation. In the urban texture, the way the texture is designed, taking into account climatic issues and local materials, all contribute to a sense of recognition and orientation. The utilization of local materials has resulted in the unity and coordination of the building's external surfaces. Most roads and pathways are indirect and winding, and neighborhood forms are organic. Each type of road had a nearly fixed position, allowing for the monitoring and control of present actions and behaviors, and neighborhoods had side streets and main major roads which connected to the squares. In the neighborhoods, it was observed simple and harmonious views of buildings, and the structures do not differ in appearance whether they belong to a wealthy person or a person from the lower economic class. The internal architectural style of these structures distinguishes them from one another. This introversion is a result of the residents of this context's historical experiences across many periods, and the neighborhood's external parts have at least a physical and visible link with the outside world. The presence of minimum openings in alleys, the identification of units by entrances, and the design of rest areas as platforms at the entrances of houses all contribute to the neighborhood's recognition and comfort. Although high permeability is now considered one of the attributes of urban design in desert cities, the quantity of permeability should be regulated according to the climatic conditions and culture of such areas. Moreover, in such a climate, alleys with human scale and often shady, as well as the shortage of aristocracy of buildings, have provided residential privacy. In other words, in such neighborhoods, should be paid special attention to climate adoptions, compact neighborhood design, and social participation in resource supplies, using local building materials, organic structures, access hierarchy, cultural values, human scale, and easy sense of orientation. The design principles of Naeen neighborhoods show that they are significantly in line with the sustainability development. This environmental coordination is the product of a long process of repeated trials and errors that have occurred throughout history and during the design and construction of buildings and urban textures. These features can be used to plan, design and popularize today's living environment. Desert cities have been severely exposed to scattered and irregular growth based on modern principles of urban design over the past few decades. Modern interventions

such as urban complex plans, road widening projects, etc. have had adverse consequences on the spatial scale and physical organization of desert cities. Some of the adverse consequences include the prevalence of buildings that are inconsistent with the hot and dry climate of these cities, water and energy waste, damage to environmental resources such as the destruction of potential agricultural lands due to a wasteful and uncontrolled expansion of cities in the form of dense development. Knowing the sustainable design principles of desert cities and applying them in accordance with current conditions is a big step towards the sustainable development of such cities.

AUTHOR CONTRIBUTIONS

S. Maroofi and M. Valibeigi performed the literature review, research design, analyzed and interpreted the data, prepared the manuscript text, and manuscript edition. A. Shaneh performed the manuscript preparation and helped in the literature review.

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CONFLICT OF INTEREST

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