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RESEARCH ARTICLE

# The effect of qibla direction on the hierarchy of movement in mosque: A case study of mosques in Yazd, Iran

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**KEYWORDS**
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Material Flow Pattern (MFP);
Activity Relationship Chart (ARC);
Mosques of Yazd city

**Abstract**
In the architecture of Iranian-Islamic mosques, besides the geographic directions affecting the climate, the direction of qibla also affects their architecture. In the present study, based on the descriptive-analytical method and using the material flow pattern and the activity relationship chart, the pattern of the path of human movement from the entrance to the altar, as well as the degree of proximity of each space relative to other spaces in this movement path were investigated. After describing and analyzing the qibla axis through the structural study on 12 samples of the traditional mosques of Yazd owing to the attention given by the people of this region to religious discussion and their efforts to focus on the axis qibla direction- the hierarchy of human movement was investigated with reference to the mosque being placed in the axis of the qibla direction considering the geometry, arrangement of forms, and interior functions. Studies in this area indicate that the architects and builders of mosques have considered the preservation of the divine orientation or the qibla, the path of human movement from his early arrival to his placement in the direction of the qibla axis, and the preservation of geometry as the valuable principles.
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## 1. Introduction

Mosques can be regarded as a symbol of the unity of Muslims and one of the most important and influential elements in the Iranian-Islamic architecture, which have played a key role in the life of humans since their formation. The

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architecture of mosques can be involved in the connection of the human soul with the highest levels of existence and facilitates both spiritual and mystical perceptions. The architecture of each building is formed around a functional, spatial, visual, and formal hierarchy system, and in the case of the particular theme of mosques, this system is based on the importance of the qiblah axis as a spiritual orientation (Fattahi and Omranipour, 2014).

Besides their core function which is for praying, mosques have always played a fundamental role in a variety of areas such as strengthening social cohesion, promoting public contributions, increasing social security, creating functional diversity, and enhancing a sense of belonging to a place. These places, on one hand, are the venue for worship and, on the other hand, a place where the social life of the inhabitants within the neighborhoods is organized and affairs of people are resolved (Aminzadeh, 2008).

In the architecture of the Iranian-Islamic mosques, besides the geographical directions affecting the climate, the architecture is also affected by the direction of the qibla (the spiritual direction), so that the building form is placed towards the direction of the qiblah and this adds up to the geometric richness of the texture. The direction is unified and calls all spatial cores in an orderly manner around its axis; the plan is organized and balanced around the axis of the qiblah, and the entrances, porches, and main and secondary spaces are valued around this axis. This is the beginning of the separation of the interior space from the outside and an introduction to attracting attention, fertility of thought, and entry to the cores of the interior spaces which are centralized and independent and are in the same direction with the qibla (Noghrehkar et al., 2008: 523).

Yazd enjoys a valuable history and culture belonging to the ages of the ancient world. These inspired works have been the result of the religious and social conditions of the early centuries of Islam in the land of Yazd. In the course of several thousand years of its culture and civilization, the land of Yazd has left many historical memorials and in this regard, it has provided a great service to the culture of Islamic art. Generally, Yazd Province is regarded as a religious province in Iran due to the attention given to the discussion of religion and the efforts to maintain it by the people of this city; evidence of this can be the holding of various Shi'ite religious ceremonies, especially the ceremonies which are held in the month of Muharram (e.g., the Nakhlbardari ceremony held on Ashura day). In addition, in a part of the Fred Richards' travelogue, it has been stated that "the religious feelings of the people of Yazd are much serious than most of Iran's cities." Recently, Yazd has been known as Iran's Hosseinieh due to its large Husseiniyahs and the special kind of mourning for the Third Imam of the Shiites. Therefore, the mosques of Yazd City were selected as a case study for this research in order to investigate the entrance framework of these mosques to the qiblah direction (Fig. 1).

## 1.1. Literature review

Studies on mosques, their importance and application, and their dating in different periods of times have provided a platform for diverse topics of research (e.g., King, 1982; Ardalan, 1983; Daneshmir and Spiridonoff, 2012; Serageldinand Steele, 1996; Hillenbrand, 1988; Ghafar Ahmad, 1999; Alice Sabrina et al., 2010; Wiryomartono, 2009; Verkaaik, 2012; Jafar Mohammadi and Hamzehnejad, 2015; Saremi et al., 2016; Sadatjo et al., 2013; Hamzehnejad and Arabi, 2014; Falahat, 2005; Mohammadian Mansour, 2007; Taghvayi and Marofi, 2010; Motamedi Shafiq and Zolfagarzadeh, 2015). Some worthwhile researches have been conducted on the entrance of mosques

**Fig. 1** A view of the city of Yazd and the importance of mosques in this city.

and the form affected by the turning towards the qiblah, which are as follows:

Abdul Hamid Noghrekar et al. investigated the typology of the entrance of the mosques based on the semantic differences and epistemic concepts presented in mysticism; they pose the question that whether the differences in the entrances have certain meaningful bases and follow a particular pattern? (Noghrehkar et al, 2014:75) In the article titled "The analytical-comparative study of the entry of the mosques in the two periods of Samanids and Safavids", the authors state that the door and entrance of mosques are of a sacred status and a special place in Islamic thought, as the term "the divine mercy door" can be regarded as a metaphor for the holy status of the door of mosques which are located in the entrances; the entrance must be inevitably crossed to locate the mosques, a very important section in understanding the space of mosques; this study aimed to discover the entrance pattern and the type of entrance of mosques and also to find out the mystery of mosques related to these two historical periods and investigate their differences (Rashidi et al., 2015).

Mirahmadi and Mahdavipour in their article, while considering the central role of qiblah in the establishment of various mosques in Iran, identified the ways to strengthen the qiblah direction and explained its evolutionary process in the Iranian mosques; their study aimed to point out that orientation towards a specific direction in the mosques makes it possible to create a sense of unity in the physical elements of mosques and then in the people to be attracted by their lord at the entrance of the mosque (Mirrahmadi and Mahdavipour, 2015). In the study titled "Convergence of the three fundamental geometric types and the emergence of Iranian mosque geometry", through studying the geometry of mosques in the first Islamic millennium, the authors concluded the role of the altar to be geometrically decisive in the interior space of the dome and without it, recognizing the direction of the qibla would be difficult. Hence, the dome and the altar were joined together and the dome on the altar structure became one of the most commonly used architectural structures of the mosques (Hujjat and Maleki, 2012: 11).

In an article that compared the traditional and modern mosques with respect to the different needs and conditions of modern humans, Fahimeh Yari and Hassan Fereidoon zadeh analyzed the entrance space of mosques and concluded that the entrance space has always had a special place in the thoughtful design of Iranian architecture, since in addition to its original function as a visually and perceptually connective space, it is an interface between the building and the body of city, and it is often considered as a criterion for recognizing the value and the architectural and social identity of each building. This space is of great importance in the case of mosques, because when a person tries to relax after the fatigue associated with worldly rush, he seeks for a sign to guide him (Yari and Fereidoun zadeh, 2015). In another study, Fattahi and Omranipour investigated the role and position of the qiblah in the architecture of mosques in Ilam through recognizing the architects' system of thought and architectural infrastructure of Iranian-Islamic mosques; efforts were made to highlight the importance of qibla direction in designing Iranian-Islamic mosques through revealing the hidden angles of the subject in order to remind the contemporary architects in Ilam not to ignore this divine orientation (the qibla) while modifying and reviving the current approach (Fattahi and Omranipour, 2014). Investigating the hierarchy in Iranian mosques, Saheb Mohammadian Mansour categorized mosques in terms of the entry to the courtyard and compared this mode of entry with the entrance to the porch and dome. Finally, it was concluded that measures such as the hierarchy of confidentiality in Iranian mosques exacerbate the feeling of being in a different place for the audience, and these measures are effective in changing the individuals' behavior and their transferring to another mood (Mohammadian Mansour, 2007: 59).

The flow matrix is a matrix containing estimated values of the flow between each pair of work centers. The flow can indicate the flow of materials (number, volume, weight, etc.) or the flow of individuals displaced between two work centers. The Material Flow Pattern (MFP) can be applied in many sciences including industries (Francis et al., 1998), mechanics (Jae-yongKim and Ghajar, 2006), management (Apple, 1972), geology (Ribats et al., 2008), medicine (Asakura and Karino, 1990), etc. A very close relationship exists between the process of material displacement and the layout mode. The layout design can be considered as a strategic issue that would have a significant impact on the performance of the production system (Yang and Hung, 2007). Obviously, if layout design is effectively carried out, the amount of material displacement would decrease, and consequently, the costs associated with the implementation of the material displacement system will be significantly reduced. A set of quantitative and qualitative criteria is influential in the layout design approach. However, the quantitative data is only accepted by some algorithms while others only use the qualitative data. Some valuable studies have been conducted in this regard including the study done by Houshyar (1991), with the two aims of minimizing the cost of material displacement and maximizing the proximity size to deal with the layout design problem using a multi-objective approach through the combination of the quantitative and qualitative aspects. In another study, a technique was presented to optimize the facility layout that takes into account the dynamic features and operational limitations of the system with the ability of solving the layout design problem based on the system performance, such as the efficiency and time cycle (Azadivar and Wng, 2000). In 2003, Yang and Kuo used a hierarchical analysis method and a data envelopment analysis approach to solve the problem of choosing the optimal layout design (Yang and Kuo, 2003). In 2012, Sadrzade presented a meta-innovative genetic algorithm to solve the layout design problem in a production system where the flow pattern is considered from multi-line layout with multiple products (Sadrzade, 2012).

## 2. Research method

This research is based on the qualitative and rational reasoning method and the data analysis method is of shape analysis. It is also a documentary and library study with regard to the analysis and description of the contents of the research. To conduct a comprehensive study, it was necessary to select the mosques in an efficient manner so that

they could be considered as a successful and credible case in examining the mosque's spaces in terms of the emphasis on the qibla axis. The criteria for selecting samples in this study included: a) the mosque which is among the great mosques with close attention given to its physical and conceptual structure; b) mosques which have been given special attention in all ages by the architects of religious and Islamic monuments in terms of the construction and certain physical characteristics. Therefore, 12 mosques were selected among the mosques of Yazd due to the attention given by the people of this city to the discussion of religion and their efforts to follow the religious issues; they included MullaEsmaeil, Amir Chakhmaq, Kabir central Mosque, Sarplak, Zein al-Din Agha, Pir-Hossein Damghani, Imam Hossein, Barkhordar, KouchakKhatib, Sarcham, Nomalmir, and Tal (Al-Rahman). With respect to considering the qibla axis, while investigating the geometry, arrangement of forms, and internal functions, the hierarchy of human movement was studied from the moment of arrival to placing at the direction of the qiblah axis in these mosques.

## 3. Entrance hierarchy with regard to placing emphasis on the qibla axis

The influence of the theoretical principles and values on the architecture of mosques causes some significant changes in the appearance of the building, the spatial layout, the geometric arrangement of the forms, consequently leading to these buildings representing a supreme concept while taking a harmonious form. Susceptibility of the appearance of mosques to the theoretical principle, including the direction of the qibla, influences the three general structures of the building, namely the movement hierarchy, the spatial axes, and the geometry. Adherence to these principles helps preserve the divine orientation, with emphasis placed on the centrality, strengthening the privacy, intelligent rotation of forms through a legible geometry, and directing human to the direction of the qibla. In expressing the principle of hierarchy and the concept of connecting curtains, one of the characteristics of Islamic architecture is the establishment of the spatial continuity. The spatial curtains set out special preparations and the peak is when the introspective states, due to their path and time, reach a complete sense of esteem and readiness for this space passage. This readiness is influenced by motion, time, light, and volume variation (Fattahi and Omranipour, 2014) (Fig. 2).

## 4. The Material Flow Pattern (MFP)

The material flow is a path that materials, parts, people, information, and equipment moves along to perform the manufacturing process leading to the final product. The entire issue regarding the material flow is that the elements (materials, parts, individuals, etc.) move in the best possible paths (in terms of the economy, safety, displaced distance, etc.) from the commencement of the work (the entry part) to the completion (the delivery part) (Taji and Abbasi, 2017). The MFP is an outline in which the materials, parts, people, information, equipment, etc. are transferred; it may vary in shape (Table 1).

In the case of mosques, the material flow refers to the way human moves from the entrance to the altar. This movement can be defined based on the material flow pattern as follows: the elements (individuals) should move in the best possible paths (in terms of creating a spiritual sense in humans) from the commencement of the work (the entrance part) to its completion (the altar and the qiblah direction).

As earlier stated, in addition to the functional, spatial, visual, and form hierarchy that can be identified in most traditional and religious buildings of the world, mosques also have other levels of hierarchy in their ventricles which address deeper layers of human existence. One of these hierarchical aspects is the scheme that Iranian architects have used in the mosques in order to facilitate the confidentiality of presence in the divine mercy sanctuary.

From the examining the 12 samples of mosque plans in Yazd, six patterns of the eight patterns of the MFP can be regarded as a model of the movement from the entrance to the qibla in mosques, as described in the following Table 2:

From the analysis of the case examples in the table, the significance of qiblah in contemporary mosques can be examined in two general categories:

The first category: mosques along the axis of the qiblah;

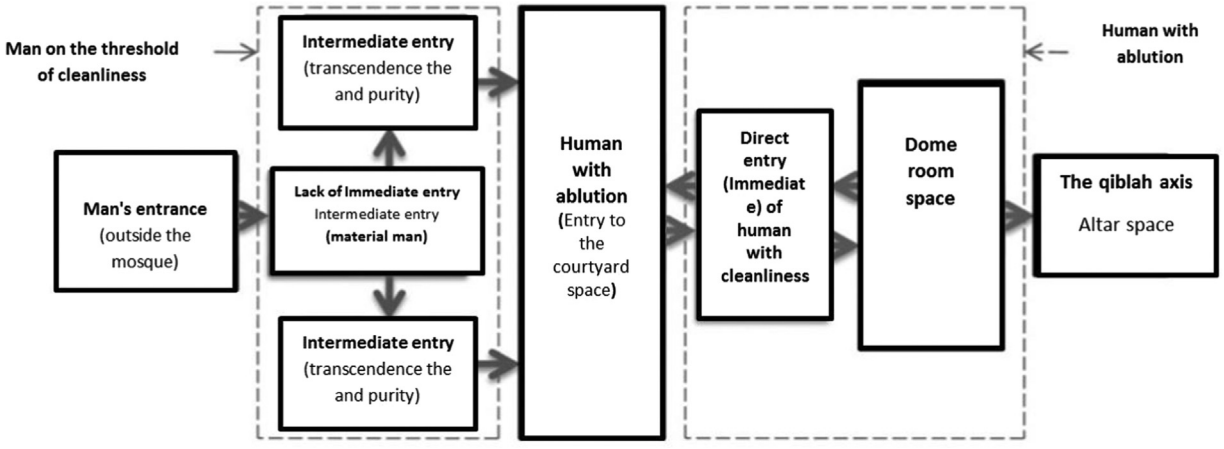
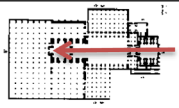
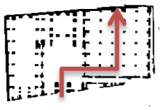
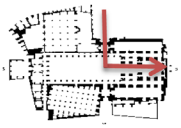
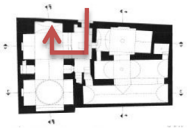



**Fig. 2** The course of mystical thoughts and the hierarchy of movement in traditional mosques Alice Sabrina et al. (2010).

**Table 1** Types of flow patterns (people's path).

| Row | Template name | Shape flow pattern | Description |
|---|---|---|---|
| 1 | Direct | | The path is short and simple. |
| 2 | L | | The path is short and rotated 90 degrees. |
| 3 | U | | Enter the entrance and the qibla on one side. |
| 4 | S | | The route will be on both sides. |
| 5 | Zigzag | | The path to the existing space is long. |
| 6 | circular | | The path moves exactly to the starting point. |
| 7 | Angled | | The path is short and the rotation is less than or greater than 90 degrees. |
| 8 | mixed | | There is no particular geometric shape and may be due to space constraints. |

**Table 2** Study of the path pattern of the entrance to the Qiblah in the mosques of Yazd city.

| Path pattern | Input route to Qibla | Mosque name | Path pattern | Input route to Qibla | Mosque name |
|---|---|---|---|---|---|
| S | | Imam Hossein | Direct |  | Mulla Esmaeil |
| |  | Barkhordar | | | Amir Chakhmaq |
| Angled | | Kouchak Khatib | L | | Pir-Hossein Damghani |
| | | Sarcham | |  | Kabir central Mosque |
| mixed | | Nomalmir | U | | Sarplak |
| | | Tal (Al-Rahman) | |  | Zein al-Din Agha |

The second category: mosques needed for rotation to amortize the qiblah. From the analysis of this class of mosques, three types of entrances to the mosque are extracted: a) the entrance contrary to the direction of the qiblah; b) the entrance through the front sides; c) the entrance through the end-half sides. Mosques along the direction of the qiblah axis indicate that entering these buildings is done through the street and without mediation

and any specific geometry, and this is considered as a major disadvantage. There are two major drawbacks in mosques with the entrance opposite the direction of the qiblah. The first drawback is the lack of attention to the spatial axes such that not only is the entrance to the building not in the direction of the qibla axis, but it is also in the opposite direction of the divine direction, and people enter the courtyard or dome without any mediation, and after entering, they turn towards the qiblah direction with an unreasonable rotation. The second drawback is the lack of respect for the hierarchy of movements.

The architecture of mosques with the entrance in the front sides does not suffer a kind of rotation to deprecate the qibla axis, so that while dealing with the problem of not paying attention to the spatial axes, a hierarchy of movement is achieved so as to put the material human in a secure and religious atmosphere to enter a spiritual space. However, the architecture of this class of mosques does lacks a definite, regular, and meaningful geometry. Similar to the mosques in the second category, the architecture of mosques with the entrances in the lateral sides of the end-half lacks any kind of rotation to deprecate the qibla axis, so that while correcting the inappropriate spatial axes, the principle of the movement hierarchy is also observed to pass through a front space, reaching a mental readiness, leaving the material space, and placed in the direction of the

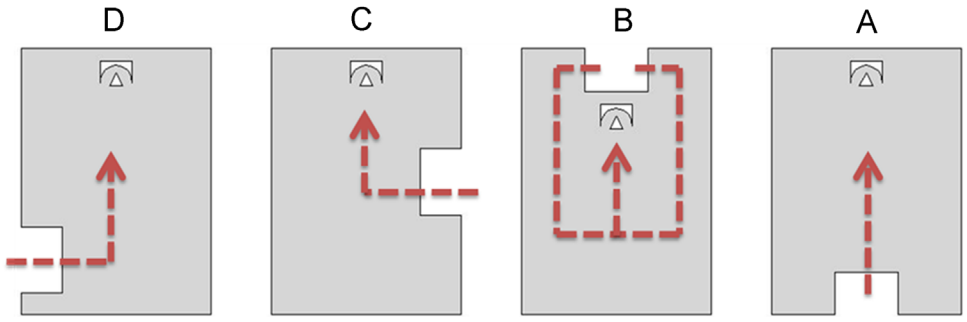



**Fig. 3** The route from the entrance to the Qibla (A: Entering the direction of the Qibla, B: Entering the opposite direction of the Qibla, C: Entering through the sides of the side of the front, D: Entering through the half-ends of the sides).

**Table 3** The degree of proximity of activities.

| signs | The degree of importance | Description |
|---|---|---|
| A | Absolutely necessary | The closeness of two places is absolutely necessary. |
| E | Special importance | The close proximity of the two places is very important. |
| I | Important | The closeness of two places is important. |
| O | Normal | The closeness of two places is good. |
| U | not important | The closeness of two places is not important. |
| X | Undesirable | Being two places is better. |
| XX | Absolutely unfavorable | Two places are necessary to be distant. |

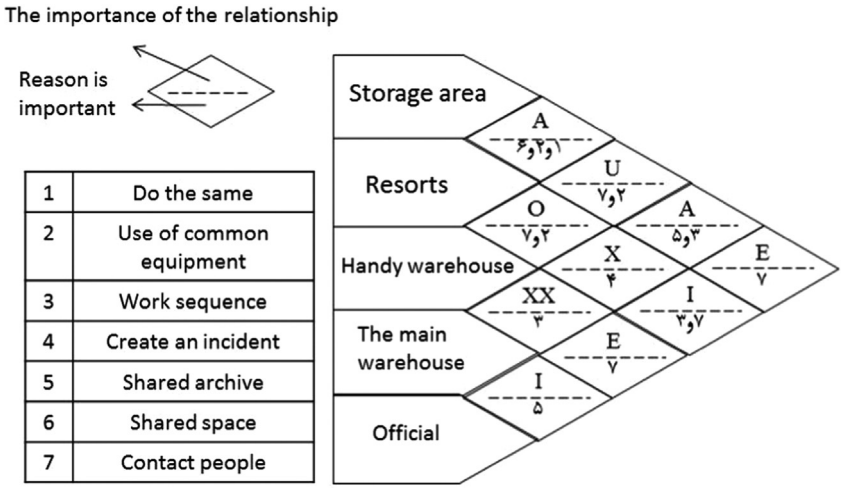



**Fig. 4** A sample of the relationship diagrams of a plant's activities Sadrzade (2012).

secure divine sanctum. In terms of considering the geometry, this category is similar to the second one (Fig. 3).

The Activity Relationship Chart (ARC) is almost the best technique for determining the relationship between the activities and different departments. This chart is used to analyze the relationship among all pairs of activities or departments and thus, the degree of necessity of their closeness is recorded; then the sectors to be close to each other and those to be separated are identified (Shayanfar and Taji, 2017). This chart can be applied in the following cases:

1) To determine the best initial arrangement of departments,
2) Showing the relationship between the different activities of a department and different departments,
3) An introduction to drawing up the activity relationship diagram (Tompkins et al., 1984).

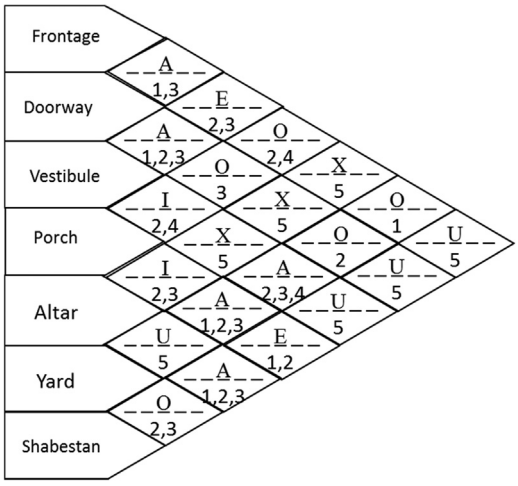



**Fig. 5** The relationship diagrams of the entry paths to the qibla in mosques.

**Table 4** Examining the degree of proximity of the entry paths to the Qibla.

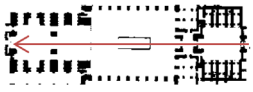
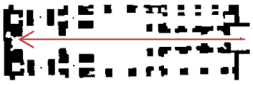
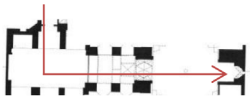
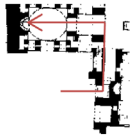
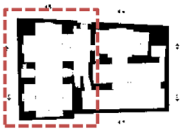
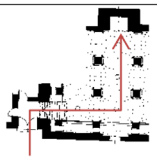
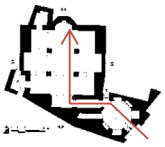
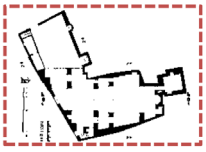
| Mosque name | Mosque plan | Zoom Input to Qibla | Arrange the placement of spaces on the path |
|---|---|---|---|
| Mulla Esmaeil | |  | Frontage, Doorway, Vestibule, Corridor, Yard, Porch, Shabestan, Altar |
| Amir Chakhmaq | |  | Frontage, Doorway, Vestibule, Corridor, Yard, Porch, Shabestan, Altar |
| Pir-Hossein Damghani | |  | Frontage, Doorway, Vestibule, Yard, Porch, Shabestan, Altar |
| Kabir central Mosque | | | Frontage, Doorway, Vestibule, Corridor, Yard, Porch, Shabestan, Altar |
| Sarplak | |  | Frontage, Doorway, Corridor, Yard, Porch, Shabestan, Altar |
| Zein al-Din Agha |  | | Frontage, Doorway, Shabestan, Altar |

**Table 4.** (*continued*)

| Mosque name | Mosque plan | Zoom Input to Qibla | Arrange the placement of spaces on the path |
|---|---|---|---|
| Imam Hossein | |  | Frontage, Doorway, Vestibule, Shabestan, Altar |
| Barkhordar | | | Frontage, Doorway, Yard, Porch, Shabestan, Altar |
| Kouchak Khatib | |  | Frontage, Doorway, Vestibule, Corridor, Shabestan, Altar |
| Sarcham |  | | Doorway, Yard, Shabestan, Altar |
| Nomalmir | | | Frontage, Doorway, Yard, Corridor, Shabestan, Altar |
| Tal (Al-Rahman) | | | Frontage, Doorway, Vestibule, Corridor, Yard, Porch, Shabestan, Altar |

Description: The red line of the Chinese line represents the input path to the Qibla on the plan, which is magnified in the next column.

In this chart, some qualitative symbols are used to specify the relationship of activities and codes are used to illustrate the reasons for these relationships. A classification of these qualitative symbols has been carried out by Richard Maitre in terms of the importance of the closeness of activities (Table 3).

Where A-related activities should be as close as possible; E-activities should be close and I-activities should be nearly close to each other. Two activities may have an X relationship due to the noise, the possibility of danger, etc. In addition, the codes that describe the reasons for the closeness of the activities are entered at the bottom of each cell. These numbers are inserted in a table below the chart with the degree of importance to make the reasons readable for the audience (Fig. 4).

By using the technique of ARC based on the 12 samples of mosque plans in Yazd, the relationship between the entrance spaces to the qiblah and the degree of necessity of the proximity of each department to each other was examined and an appropriate pattern was determined for putting these spaces together in the mosque plan, which is as follows:

At the entrance to the mosque, man must pass through a number of spaces until he reaches the sanctuary and the axis of the qibla. These spaces include the frontage, doorway, vestibule, courtyard, porch, corridor, pray hall, and altar. By using the ARC, the relationship between each of these spaces and the degree of closeness of each part to each other was examined (Fig. 5).

Reasons for the importance of spaces:

1. The sequence of working flow;
2. The relationship of individuals;
3. The normal route of movement;
4. The shared use of enclosure;
5. Noise, dust, cleanliness (purity).

According to the ARC of the entrance to the qibla spaces in the mosques, the most complete hierarchy of entrance usually consists of seven components: the frontage is the first space that prepares humans to enter a space with different characteristics. After passing through the frontage, it is necessary for the audience to pass through the antechamber and the passageway. The antechamber is the station of disconnection from the world and is a little backward to its adjacent space (Dosti Motlagh, 2009: 100). After the antechamber, the doorway passes the seeker (wayfarer) from the previous stages to the next ones (Beheshti, 2010: 75). Following the passage of the doorway of mosque, it leads to the vestibule. This space is different from the previous spaces and stages. If the previous space calls the audience to pass through, this space calls for a pause in terms of its geometric form (Shirazian, 2002: 39). After the vestibule is the hallway; the hallway refers to the theme of patience, and it is similar to struggling with self-righteousness. The hallway is usually a narrower and darker space than the vestibule. The hallway leads to the courtyard; the courtyard, due to its magnitude, reflects the opening and expansion of the soul, its leisure and liberty. Then the porch is passed to reach the dome. The porch represents greatness and stretches upwards. The porch is also an introduction to the entrance to the dome. The greatness of the dome as the heart of the mosque calls for such an introduction, and the porch defines the authority of the importance of this space (Shirazian, 2002) (Table 4).

Using the ARC and the study of the 12 samples of the mosque plans in Yazd, it can be concluded that the geometry of the spaces and the hierarchy of movement from the moment man enters into the mosque is to facilitate the confidentiality of the presence in the divine shrine. A single pattern can be presented for the placement of spaces in relation to each other from the entrance to the qibla, which is as follows: the frontage, the doorway, the vestibule, the courtyard, the porch, the pray hall, and the altar.

## 5. Conclusion

In this study, based on the descriptive-analytical method and using the material flow pattern and the activity relationship chart, the pattern of the path of human movement from the entrance to the altar, as well as the degree of proximity of each space to the other space was examined in this movement path. Six patterns out of the eight patterns of the MFP were selected as the pattern of movement path from the entrance to the qiblah in the mosques, and the hierarchy of movement and the arrangement of spaces were defined from the entrance to the qiblah using the ARC.A single pattern was proposed for the arrangement of spaces from the time of human's arrival to placing in the qiblah direction, including the frontage, the doorway, the vestibule, the courtyard, the porch, the pray hall, and the altar. After analyzing the qibla axis using the structural study on 12 samples of the traditional mosques in Yazd, while investigating the geometry, arrangement of forms, and internal functions of the spaces, the hierarchy of human movement was studied from the time of the human's arrival to placing in the direction of the qibla axis and the following results were obtained:

The architects of traditional mosques have shown their thoughts in the forms and geometric arrangements of the spaces such that they tried to preserve the sense of confidentiality, sanctity, immortality, and spirituality of the mosque space, and also tried to transform the restless (anxious) man to a calm (perfected) man through guiding and observing the hierarchy of movement since his arrival to the mosques. In the opinion of the architects of the traditional mosques, man without ablution (wuzu) is similar to the material human, passing through the front spaces, porches and entrance fountains to reach the ablution space and this allows him to enter the courtyard with mediation.

The features necessary for the creation of spiritual space in mosques include: the introspection, tranquility, privacy, familiarity with God, and self-contemplation. These factors are achieved through considering the following two components: giving attention to the axis of the qiblah as a sign of unity and going through the preliminaries and the hierarchy of movement into the mosque spaces which are not observed in the architecture of the contemporary mosques. The geometry of building makes it possible for humans to be placed in the qibla direction inside a stationary form. Observing the principle of hierarchy in the geometry of a building makes it possible for humans to be consciously guided through the outer space into the inward space to worship in God's presence. Therefore, the architecture would be involved in the transmission of the audience from one place to another.

The architects and builders of the traditional mosques have considered preserving the divine orientation (qiblah) and the geometry of building as valuable principles; in designing contemporary mosques, not only has little been given to the qiblah axis, but also the sanctity, spirituality, and Islamic identity of these buildings have been lost. The obtained results can be regarded as a doctrine that can be used by contemporary mosque architects as a general model in designing the mosques with a consideration of the qiblah axis and the quality of the architecture of the traditional mosques, and enriching the mystical thought and the spirituality of contemporary architecture through analyzing and preserving these values.

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