

# EVALUATION OF PHYSICAL-SPATIAL CHARACTERISTICS AFFECTING THE QUALITY OF APARTMENT HOUSING

Pedram HESSARI <sup>1</sup>  , Farhad CHEGENI <sup>2</sup>

<sup>1</sup>*Ayatollah Boroujerdi University, Boroujerd, Iran*


<sup>2</sup>*Art University of Isfahan, Isfahan, Iran*

## Article History:

- received 09 November 2023
- accepted 08 October 2024

**Abstract.** Housing quality is one of the most important domains of quality of life. One of the most important qualitative aspects of housing is paying attention to the residents' satisfaction with their place of residence. The purpose of the upcoming research is to know the physical-spatial characteristics that affect the quality of apartment housing. The research method is combined and based on two quantitative and qualitative approaches. In this way, in the first part and the qualitative approach of the research, the text content analysis method was used. In this section, with the help of the content analysis method, the most important sources of the first category related to the quality of apartment housing are reviewed and the physical-spatial characteristics affecting the quality of the housing are identified. In the second stage of the research, with the help of a quantitative approach, the evaluation of people's characteristics has been done with the help of TOPSIS method. The statistical population university professors related to housing was used to evaluate the physical-spatial characteristics. The findings of the research show that the characteristics related to housing quality are not only physical.

**Keywords:** apartment, housing, quality, physical-spatial.

 Corresponding author. E-mail: [p.hessari@abru.ac.ir](mailto:p.hessari@abru.ac.ir)

## 1. Introduction

Thinkers often consider the quality of life to be derived from two subjective and objective aspects, which must be paid attention to in order to fully understand the quality of life (Zebardast, 2009). Housing is one of the sensitive and essential parts of the quality of life, along with food and clothing, it has long been considered as the most basic and essential needs of human groups (Ahmad Akhoundi et al., 2014). Housing is not only a roof over the head, and in addition to the physical location, it includes the entire residential environment and includes all the services and facilities necessary for the well-being of the family and the plans for employment, education and health of people (Pourmohammadi, 2001). Today, housing has gradually moved away from its one-dimensional concept and turned into a multi-dimensional problem (Masoudirad et al., 2017). Therefore, the importance of housing quality cannot be limited only to the housing unit; In fact, it includes the whole environment of human life and habitation (Pourmohammadi, 2001). While housing is defined by a set of characteristics (Rapoport, 2000). Despite all the many efforts that have been made in the field of improving the quality of housing, there is very little knowledge about what and the nature of the characteristics related to improving the quality of housing

(Zinas & Jusan, 2017). Therefore, in line with this research, the purpose of which is to identify and evaluate the physical-spatial characteristics affecting the quality of apartment housing; after introducing the research literature, in the first stage, with the help of the content analysis method, the most important influential characteristics and their components in relation to the quality of housing will be identified. In the next step and in the second step, the multi-indicator decision-making method (TOPSIS) is used to weight and specify the importance of physical-spatial characteristics related to the quality of apartment housing. In this regard, the research questions are:

- What are the physical-spatial characteristics affecting the quality of apartment housing?
- What are the most effective physical-spatial characteristics affecting housing quality in order of priority?

Discussing quality means looking for criteria that may be used to distinguish between good and bad (Garcia Mira et al., 2005). It is obvious that in the quality of housing, different criteria are important for different people, different social groups and different types of families, however, it is possible to explain the common criteria that are more or less common for all residents of the housing (Ahad-Nejad et al., 2015). The quality of residence is a subset of the quality of the environment. Therefore, it is necessary

to first define the quality of the environment. The concept of environment quality can be expressed as follows: if the environment means a set of natural and man-made spaces, then the quality of the environment is the quality of natural and man-made spaces. In other words, the quality of the environment is the quality of natural and objective spaces resulting from the physical environment (natural and man-made) and mental indicators (cognitive, sensory and mostly behavioral) of the users and residents of the environment. Higher quality means more satisfaction of the residents and users of that environment. Therefore, the quality of the living environment is a multidimensional, objective and subjective concept that has commonalities with concepts such as quality of life, quality of place, perception and satisfaction of citizens (Azizi & Rahmani, 2014). Housing quality has various social, cultural, economic and environmental dimensions. Although in the world, until the 1990s, the quality of housing included the examination of suitable housing standards, but later, different evaluation systems such as health, safety, and subjective indicators of housing were proposed. Even though the main issue in the field of housing quality has been reductionist analyzes in the economic perspective (Ghaznavian, 2016), there are discussions related to housing quality that focus on its cultural and social aspects. They judge the way people experience their surroundings, how they interact with the environment, and how they judge its appropriateness in relation to their daily affairs and their expectations for the future; are focused (Goodchild, 1997). Several criteria have been investigated in the researches for evaluating the quality of apartment housing such as site planning, structure, construction, construction services, safety, comfort and maintenance and sustainability (Brkanić, 2017). Evaluation of quality in apartment housing has various components, which can be mentioned in the variety in the arrangement of rooms, the location of the space, flexibility, comfort facilities, materials used (Zanuzdana et al., 2013). There are different approaches to the issue of housing quality, including satisfaction, attention to needs and characteristics, and preferences, which are specified below:

The satisfaction approach is mostly used as a measure to evaluate the success of constructions (Fung & Lee, 2014), which is usually done through a questionnaire; Therefore, it will be more useful to analyze the existing situation and not to repeat the defects than to provide a solution and strategy in the field of quality in housing (Dimuna & Olotuah, 2019). The most application of needs theories in housing quality has been based on Maslow's hierarchy of needs theory. The most important criticism that can be made in the field of housing quality based on this theory can be stated as seeing the needs in different societies as the same and ignoring the values and culture of the society. In this context, it is said that human needs differ from one person to another and are influenced by various factors such as individual preferences, historical and social contexts, and economic conditions (Gomes, 2011). Housing characteristics and preferences are important topics for designers and architects, planners and sociologists in the field of housing (Hooimeijer & Oskamp, 1996). The pur-

pose of research on residential preferences is to prioritize the quality concepts of the housing sector, which has been criticized due to the inadequacy of investigating the relationship between the desires of residents and residential houses in the field of design and planning (Maier & Fadel, 2009). Due to the complex and multi-dimensional concept of housing and the discovery of sector quality factors in the approach to housing, this sector quality approach (characteristics and preferences) to housing has been chosen.

Trait is the quality or characteristic of a person, place or thing. The characteristics usually reflect the point of view of consumers and their users, whose perceived characteristics can be determined through a numerical scale like the Likert scale, between two ranges of very high to very low. Also, Webster's new dictionary defines characteristics as follows; A desirable characteristic for the characteristic of a person or an object (Zinas & Jusan, 2012). Gluzak and Zieba (2017) define features as visible characteristics of a product. Valette-Florence and Rapacchi (1991) also consider features as characteristics or aspects of products or services. Gengler et al. (1999) introduce attributes as relatively real meanings that show the physical and understandable characteristics of a product. The characteristics of housing are characteristics of housing whose usefulness has come to human perception through the mechanisms that connect people and the environment. They can be called perceived characteristics (desirable or undesirable) of housing (Moghimi et al., 2016). These characteristics represent housing and the residential process that has wide capabilities to meet the needs of its residents at different levels (physiological, perceptual, cognitive, semantic, qualitative, evaluations and prioritizations and choices, activities, behaviors, etc.) and also represent the goals and values of their residents, which they choose among other housing characteristics (Coolen & Hoekstra, 2001). Features are preferred and non-preferred characteristics of housing (Akbari et al., 2020). Jansen et al. (2011) believe that preferences refer to the relative attractiveness of an object or phenomenon, while choice refers to actual behavior in the real world; Preferences as expressions of attraction and fascination may guide or ultimately lead to choice. The knowledge structures and preferences of the residents regarding the characteristics of housing, as well as their selective behaviors, are complex and heterogeneous dynamic processes that are related to many life factors. Preferences and choices are common and concrete phenomena of life. Actually, preference can be called a function of choice (Zinas & Jusan, 2012). In every preference and choice, there are important motivations that allow people to choose a particular option from among the available options. Housing preferences, housing preference and choice behavior is like any other choice behavior, a value-oriented and goal-oriented behavior or activity. Therefore, the selection of features that are important for a consumer and are placed in a higher priority are determined by their values. Therefore, housing can be divided into different categories based on the features that are important and the features that are ignored (Akbari

et al., 2020). The method of understanding the characteristics of residents in apartment housing in the current research is the content analysis method. Therefore, the current research also seeks to identify the (existing) categories considered in previous researches of physical-spatial characteristics and their components in order to improve the quality of apartment housing that researchers at the beginning of the research process. They were obtained from the respondents (residents) as preferences expressed in the form of housing characteristics (Table 2). Since the documentation of these categories is available in previous researches, by searching and checking among these researches, the preferred features of the residents in apartment housing are identified and they are organized and prioritized.

## 2. Research background

A review of the research literature shows that systematic studies on the quality of the residential environment is a relatively new category. The research on the quality of the living environment started from the satisfaction of the urban environment and gradually it is summarized in the neighborhood and apartment unit quality scale. However, it has been proven in all studies that the quality of the residential environment is a complex issue and depends on a wide range of issues including economic, social and biological. The background of the research specifically examines two categories of housing quality and components related to housing quality (Table 1).

**Table 1.** Research background related to housing

	The result of the research	Research methodology	The title of the research	Writers
1	There is a significant relationship between the level of neighborhoods and the quality of the residential environment	Factor analysis method	Spatial measurement of housing quality in Sabzevar based on factor analysis method	Rezaei Rad and Rafiean (2012)
2	The biggest reason for dissatisfaction with the quality of the residential environment is due to the incompatibility of the living conditions with the way of life	Audience-oriented (survey)	Evaluation of the quality of the environment in residential complexes of low-income groups (Maskan Mehr Shahr Takestan)	Azizi and Rahmani (2014)
3	The low level of residential satisfaction in Mehr Shahr Karaj is due to the lack of a sense of place desirability, especially among new residents.	Causal correlation	Measuring residential satisfaction with location desirability in planned urban areas (Mehrshahr Karaj)	Rafiyan et al. (2016)
4	Ranges with simple order have more coherence and readability, and ranges with complex order have more mystery and complexity	Correlation	Investigating the relationship between the theory of environmental preferences and the order of urban blocks (Khane Isfahan and Mardavij in Isfahan city)	Massoud et al. (2017)
5	That the effective criteria of environmental sustainability are in line with residential quality and are: functional, experiential-perceptual, demographic-social-economic and environmental	Qualitative-survey	Evaluation of the quality of the residential environment in the city center with an emphasis on sustainability (Sar Shur and Chenou areas of Mashhad)	Mesgarani et al. (2018)
6	People's preferences in choosing their place of residence depend first on the neighborhood, then on the residential unit, and finally on the characteristics of the residential building	Survey-questionnaire	Prioritizing indicators related to people's residential preferences in three scales: residential unit, apartment and neighborhood (residents of Mashhad, Neishabur and Torbet Jam)	Heidari et al. (2019)
7	From the point of view of the citizens of Isfahan, housing quality depends on four managerial, economic, physical and neighborhood indicators	Survey-questionnaire	Measuring housing quality from the perspective of Isfahani citizens	Jalali et al. (2019)
8	That the components of structure diversity, constituent levels, complexity (visual richness) and the use of curved lines have the greatest impact on the quality of building facades	Analytical-descriptive	Evaluation of visual preferences in residential buildings, case study: twelve historical houses in Tabriz	Wahdattalab et al. (2020)
9	With the help of 33 indicators, the quality of housing in Bojnord city has been measured and it shows that the priorities are not the same throughout the city	Case study (using a questionnaire)	Assessing the quality of housing and identifying strategic issues based on the users' point of view	Yarmohammadi et al. (2020)
10	The results of the research show that the most important reason for dissatisfaction with the quality of the residential environment is the low level of security in these areas	Quantitative (correlation)	Spatial planning to improve the quality of the residential environment based on the results of the residents' satisfaction assessment (Maskan Mehr Pardis)	Rezaei Khaboushan and Nemat Mehr (2021)
11	The results of the research have shown that physical elements toward postmodern and late modern are effective on people's preferences	Analytical-descriptive	Visual preferences of architects and non-architects in evaluating physical elements Facades of mid-rise residential apartments in Tehran	Mortazavi Ravari et al. (2022)

In the upcoming research, the authors are trying to identify the most important physical-spatial features that are effective in relation to the quality of housing with the help of quantitative and qualitative methods, which cause satisfaction in the residents.

The current research method is a combination and derived from qualitative and quantitative approaches; in this way, in the first part and the qualitative approach of the research, the text content analysis method was used. Content analysis is a flexible method for data analysis that is used to classify concepts and meanings in the text. Content analysis is a method of analyzing qualitative studies by means of which data is summarized, described and interpreted (Momeni Rad et al., 2013). In this stage of the research, with the help of a purposeful method, the characteristics and residential preferences of people have been studied in texts and articles; and then the residential characteristics and preferences of people are specified in Table 2. In the second stage of the research, with the help of a quantitative approach, the evaluation of people's characteristics has been done with the help of TOPSIS method. The TOPSIS model is one of the best multi-criteria decision making methods and it is widely used. Also, this method was chosen because of its capabilities and strong mathematical support, and it has the least defects in the ranking of options (Makvandi et al., 2016). In the TOPSIS method,  $m$  options are used by  $n$  indicators to evaluate the options. According to this method, the first priority in the evaluation of options is assigned to the option that has the smallest distance from the positive ideal solution and the largest distance from the negative ideal solution (Dashti & Saeedi, 2016). Finally, in order to score the options using a questionnaire tool, from university professors were selected to evaluate and score the residential preferences of people related to residential characteristics. After performing the interpreted steps, the most important residential characteristics of people related to the quality of the residential environment are prioritized.

### 3. Methodology

In this part of the research, multi-indicator decision-making method or TOPSIS method is used to evaluate physical-spatial characteristics affecting the quality of apartment housing. This method is a multi-criteria decision-making method and has the least defects in the ranking of options. This method was first introduced by Huang and Yun. In the evaluation and ranking of options by this method, the first choice is assigned to the option that has the smallest distance from the positive ideal answer and the largest distance from the negative ideal answer (Dashti & Saeedi, 2016).

The TOPSIS method consists of three steps, which are:

First step: Knowing the required variables and criteria

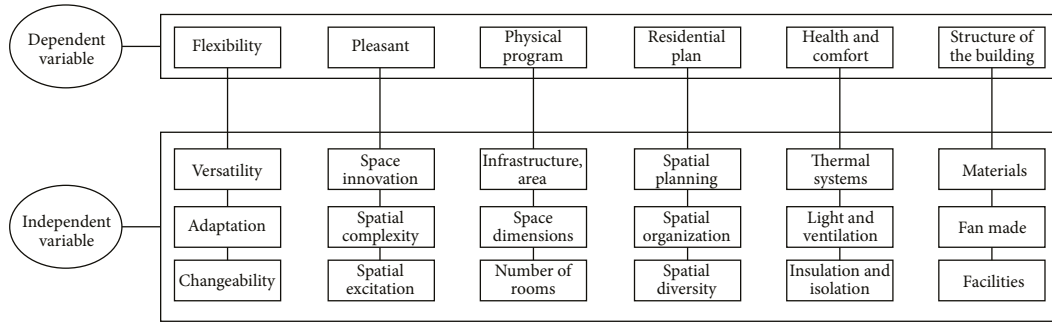
To know the required variables and criteria, research literature should be used. In this research, the dependent variables according to Table 2 are the six characteristics of spatial flexibility, spatial spatial pleasantness, physical plan, residential plan, environmental health and comfort, and building structure, which were selected according to the content analysis method, and the independent variables are actually. The components are physical-spatial. In Figure 1, independent and dependent variables are displayed.

Second step: Scoring physical-spatial features based on components

At this stage, university professors were used to rate the characteristics using a questionnaire tool. The criterion for selecting people in this research is professors related to housing and familiar with issues related to the quality of apartment housing. Since the criteria and sub-criteria are qualitative, it is necessary to use a suitable tool and convert qualitative data into quantitative data. In this research, a five-part Likert scale was used to score physical-spatial characteristics affecting the quality of apartment housing (research alternatives). In this way, according to

**Table 2.** Summary of characteristics affecting the quality of apartment housing

	Writers	Trait criteria	Trait
1	Hessari and Chegeni (2022); Habrakan (2008); Galfeti (2003); Kroneburg (2003); Till and Schneider (2005, 2007); Hosseini et al. (2015); Ostuzzi (2017); Chegeni et al. (2020); Zandieh et al. (2011)	Versatility Adaptation Changeability	Spatial flexibility
2	Gifford et al. (2002); Marans and Spreckelmeyer (1982); Gann et al. (2003); Hershberger (1970); Küller (1973); Van der Voord (2009); Rönn (2011)	Space innovation Spatial complexity Spatial excitation	Spatial pleasantness
3	Sima (2015); Femenias and Geromel (2019); Jiboye (2011)	Infrastructure, area Space dimensions Number of rooms	Physical program
4	Day (2000); Sima (2015); Pirinen (2014); Je et al. (2007); Stoiljkovic et al. (2020); Granja (2011); Femenias and Geromel (2019)	Spatial planning Spatial organization Spatial diversity	Residential plan
5	Sima (2015); Chohan et al. (2015); Brkanić (2017); Van Luu et al. (2009); Jiboye (2011)	Thermal systems Light and ventilation Insulation and isolation	Health and environmental comfort
6	Je et al. (2007); Chohan et al. (2015); Ilesanmi (2010); Al-Mimani (2003)	Materials Fan made Facilities	The structure of the building



**Figure 1.** Knowing the independent and dependent variables of the research to evaluate the most effective physical-spatial features

the importance of the numbers, they are from 1 to 5, and the number 5 indicates very well and the number 1 indicates very weak.

Third step: choosing the right option

TOPSIS method has been used to select the most suitable option and the most effective physical-spatial characteristics affecting the quality of apartment housing. This method is used due to having valid reasons, such as calculating the numerical value for the best and worst option, having a relatively simple calculation process, and the multifaceted function of the criteria (at least two aspects) (Moghimi-Kandolosi et al., 2018). Finally, by using this method, the calculation steps are carried out and the physical-spatial characteristics affecting the housing quality (alternatives) are weighted and the best option is selected.

- First, the decision-making matrix should be normalized through Equation (1):

$$P_{ij} = \frac{r_{ij}}{\sum_{i=1}^m r_{ij}}, \tag{1}$$

(Options =  $i$ , entries =  $j$  and matrix entries =  $r$ )

- (preparation of criteria weights): this step of the TOPSIS method includes three steps. During these three steps, the values of  $E_j$  for each criterion are obtained from Equation (2), the degree of deviation from each criterion is obtained through Equation (3), and finally, the weight of each criterion is obtained using Equation (4).

$$E_j = -k \sum_{i=1}^m [P_{ij} \cdot \ln P_{ij}], \tag{2}$$

$$K = \frac{1}{\ln m};$$

$$d_j = 1 - E_j; \tag{3}$$

$$W_j = \frac{d_j}{\sum_{i=1}^n d_j}. \tag{4}$$

In the next step, six steps are used to calculate the decision matrix algorithm. First step: converting the decision matrix into a scaleless matrix through Equation (5):

$$n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^m r_{ij}^2}}. \tag{5}$$

The second step is to create a weighted scale-free matrix: Equation (6) is used for this purpose.

$$V = N_D \cdot W_{nn}. \tag{6}$$

Third step: In this step, positive and negative ideal options are specified using Equation (7).

$$A^+ = \{MAX(V_{ij} / \in J) (i = 1, 2, \dots, m), (j = 1, 2, \dots, n)\}, \tag{7}$$

$$A^- = \{MIN(V_{ij} / \in J) (i = 1, 2, \dots, m), (j = 1, 2, \dots, n)\}.$$

The fourth step: calculation of the separation steps, which is done using Equation (8).

$$d_{i^+} = \sqrt{\sum_{i=1}^n (V_{ij} - V_j^+)^2} \quad i = 1, 2, \dots, m; \tag{8}$$

$$d_{i^-} = \sqrt{\sum_{i=1}^n (V_{ij} - V_j^-)^2} \quad i = 1, 2, \dots, m.$$

Fifth step: In this step, we calculate the relative proximity using Equation (9).

$$cL_{i^+} = \frac{d_{i^-}}{d_{i^+} + d_{i^-}} \quad 0 \leq d_{i^+} \leq 1: i = 1, 2, \dots, m. \tag{9}$$

Sixth step: In the last step, the alternatives are done in terms of  $[(cL)]_{(i^+)}$ . At this stage, the greater the relative proximity to a criterion option, the better option it will be (Sheikhi et al., 2016). Finally, the studied options or physical-spatial characteristics affecting the quality of apartment housing are evaluated according to Table 5.

### 4. Result

After collecting the data from the questionnaire, which is the result of scoring the physical-spatial characteristics affecting the housing quality; the decision matrix table is formed. Table 3 consists of six rows (letter A: spatial flexibility, letter B: spatial spatial pleasantness, letter C: physical plan, letter D: residential plan, letter E: environmental health and comfort, and letter F: building structure) and 18 columns (criteria) (1: diversity, 2: adaptability, 3: changeability,

**Table 3.** Decision matrix derived from points to criteria

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	3.02	3.96	3.08	3.42	3.11	3.70	3.66	3.19	3.36	3.25	2.99	3.32	4.02	3.98	3.65	4.59	4.83	4.69
B	3.63	3.21	3.36	3.78	3.32	3.54	2.99	2.98	3.52	3.47	3.11	3.87	4.44	4.63	4.52	3.99	3.89	3.41
C	2.99	3.42	3.32	2.57	2.66	2.45	3.19	3.65	3.28	4.56	4.67	4.49	3.89	3.41	3.37	2.26	2.78	2.99
D	3.19	3.58	3.32	3.44	3.65	3.57	4.61	4.74	4.98	3.42	3.16	3.21	3.77	3.78	3.93	3.14	3.52	3.11
E	3.49	3.61	3.85	4.59	4.73	4.65	3.19	3.25	3.11	2.28	2.36	2.56	3.54	3.17	3.14	3.02	3.17	2.63
F	4.72	4.69	4.75	3.19	3.36	3.11	3.63	3.65	3.74	2.17	2.19	2.65	3.48	3.25	3.66	3.49	3.42	3.39

**Table 4.** Unscaled matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	0.432	0.461	0.496	0.532	0.511	0.574	0.452	0.489	0.421	0.532	0.511	0.469	0.611	0.521	0.563	0.769	0.705	0.732
B	0.502	0.516	0.498	0.564	0.547	0.512	0.603	0.599	0.601	0.496	0.563	0.598	0.796	0.799	0.831	0.611	0.650	0.658
C	0.511	0.528	0.532	0.435	0.468	0.498	0.618	0.592	0.611	0.731	0.745	0.758	0.469	0.487	0.461	0.503	0.492	0.536
D	0.537	0.541	0.536	0.473	0.503	0.469	0.799	0.811	0.836	0.565	0.516	0.583	0.436	0.411	0.468	0.409	0.468	0.425
E	0.602	0.619	0.632	0.790	0.811	0.798	0.536	0.519	0.517	0.508	0.458	0.469	0.578	0.561	0.539	0.596	0.587	0.603
F	0.799	0.794	0.801	0.526	0.509	0.511	0.497	0.495	0.517	0.411	0.458	0.421	0.496	0.511	0.499	0.561	0.521	0.562

**Table 5.** Prioritization of physical-spatial characteristics affecting the quality of apartment housing

Rank	Topsis score	Trait
3	0/542	Flexibility
6	0/361	Spatial pleasantness
1	0/686	Physical program
4	0/523	Residential plan
5	0/473	Health and environmental comfort
2	0/611	The structure of the building

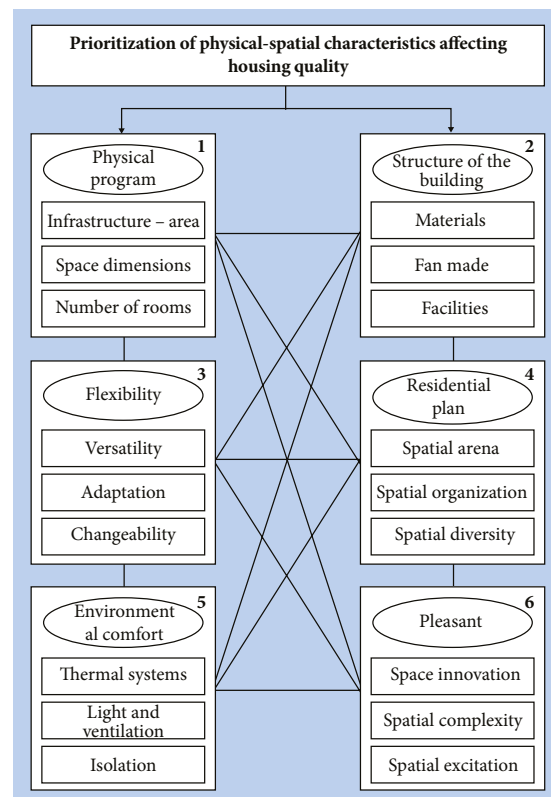
4: spatial innovation, 5: spatial complexity, 6: spatial excitement, 7: infrastructure-area, 8: space dimensions, 9: number of rooms, 10: spatial planning, 11: spatial organization, 12: spatial diversity, 13: heating systems, 14: light and ventilation, 15: insulation and isolation, 16: materials, 17: construction fan and 18: facilities) is formed. These numbers form a table that shows the average points to the influential physical-spatial features or alternatives, which is called a decision matrix in TOPSIS method.

The reason for using this formula is that different quantitative and qualitative indicators can be used together (Ahmadi Asl et al., 2019). In order to avoid prolonging the calculations, other tables and steps have been avoided and only the non-scale matrix (Table 4) is displayed. It is necessary to explain that the calculations using the TOPSIS method are very extensive and in this research, Excel software was used to perform the calculations.

## 5. Conclusions

Quality of life is a category that has been viewed from different perspectives. The quality of life represents the different characteristics of a society and can be divided

into different dimensions. On the one hand, it can express the urban physical and physical needs of the citizens, and on the other hand, it includes the emotional and psychological needs of the residents of a residential complex. The main essence of the quality of urban life is to provide and satisfy the quantitative and qualitative needs of human beings together. This is despite the fact

**Figure 2.** Prioritization of physical-spatial characteristics affecting housing quality

that the quality of life is one of the basic and main indicators of development in every society and country. The knowledge and understanding of quality of life indicators and their study and comparison over time in any society indicates that people's living conditions have improved or stagnated over time. The quality of life has various domains, one of the most important domains of which is the quality of housing. As a basic human need and provider of his sense of satisfaction, housing plays an essential role in improving the quality of human life. Recognizing and evaluating the quality of desirable housing depends on understanding the physical-spatial characteristics related to housing quality.

A systematic review in the field of characteristics related to housing quality shows that a structured study has not been done regarding the characteristics affecting housing quality. In spite of the lack of effective researches in knowing the characteristics related to the quality of housing, the present study tried to identify and introduce the physical-spatial characteristics that affect the quality of housing by introducing reliable researches by analyzing the content of the texts (Figure 2). The results of the research have led to the identification and prioritization of the characteristics that affect the quality of housing with the help of the TOPSIS method, which are the following in order of priority:

Physical plan (0.686), building structure (0.611), spatial flexibility (0.542), residential plan (0.523), environmental health and comfort (0.473) and spatial pleasantness (0.361) became. It should also be mentioned that the research findings showed that the characteristics related to housing quality are not only physical; rather, they can include levels of results (spatial-physical) with different values.

## References

- AhadNejad, R. M., EbrahimZadeh, I., Gholami, Y., & Hosseini, A. (2015). Evaluation of housing quality in the urban areas of Zanjan. *Journal of Urban Social Geography*, 2(3), 1–22.
- Ahmad Akhoundi, A., Barakpur, N., Khalili, A., Sedaghatnia, S., & Safiyari, R. (2014). Measuring quality of urban life in Tehran Metropolitan. *Journal of Fine Arts: Architecture & Urban Planning*, 19(2), 5–22. <https://doi.org/10.22059/jfaup.2014.55385>
- Ahmadi Asl, F., Momeni, D., Atariyan, D., & Moghimi, N. (2019). Studies on Eco-Camp location using TOPSIS method (case study: Tourism areas in Lorestan province). *Geography and Territorial Spatial Arrangement*, 9(33), 41–56. <https://doi.org/10.22111/gajj.2019.5079>
- Akbari, S., Nourtaghani, A., & Pazhuhfar, M. (2020). The components of preferential attributes of residents in the meaning structure and means-end studies. *Armanshahr Architecture & Urban Development*, 13(32), 1–23. <https://doi.org/10.22034/aaud.2020.120048>
- Azizi, M. M., & Rahmani, M. (2014). Environmental quality assessment of low-income housing the case of Mehr housing complex in Takestan City. *Soffeh*, 24(1), 61–74.
- Brkanić, I. (2017). Housing quality assessment criteria. *Elektronički časopis Građevinskog fakulteta Osijek*, 8(14), 37–47. <https://doi.org/10.13167/2017.14.5>
- Coolen, H., & Hoekstra, J. (2001). Values as determinants of preferences for housing attributes. *Journal of Housing and the Built Environment*, 16, 285–306. <https://doi.org/10.1023/A:1012587323814>
- Dashti, S. S., & Saeedi, Y. (2017). Environmental risk assessment of drying the 4th and 5th reservoir of Hour-Al-Azim wetland aiming to develop Azadegan oil-field using TOPSIS method. *Irrigation Sciences and Engineering*, 40(1–1), 139–152. <https://doi.org/10.22055/jise.2017.12963>
- Dimuna, K. O., & Olotuah, A. O. (2019). A critical appraisal of residents' level of satisfaction with architectural designs in public housing estates in Benin City Nigeria. *Academic Journal of Interdisciplinary Studies*, 8(3), 318–329. <https://doi.org/10.36941/ajis-2019-0030>
- Fung, Y. W., & Lee, W. L. (2014). Development of price models for architectural and environmental quality for residential developments in Hong Kong. *Habitat International*, 44, 186–193. <https://doi.org/10.1016/j.habitatint.2014.06.004>
- Garcia Mira, R., Uzzell, D., Real, J. E., & Romay, J. (2005). *Housing, space and quality of life*. Ashgate.
- Gengler, C. E., Mulvey, M. S., & Oglethorpe, J. E. (1999). A means-end analysis of mother's infant feeding choices. *Journal of Public Policy and Marketing*, 18(2), 172–188. <https://doi.org/10.1177/074391569901800204>
- Ghaznavian, Z. (2016). *Our home world*. Research Institute of Culture, Art and Communication.
- Gluszek, M., & Ziba, M. (2016). Using the means-ends approach to understand the value of sustainability on the property market. *Smart City*, 360, 738–749. [https://doi.org/10.1007/978-3-319-33681-7\\_65](https://doi.org/10.1007/978-3-319-33681-7_65)
- Gomes, O. (2011). The hierarchy of human needs and their social valuation. *International Journal of Social Economics*, 38(3), 237–259. <https://doi.org/10.1108/03068291111105183>
- Goodchild, B. (1997). *Housing and the urban environment: A guide to housing design, renewal and urban planning*. Wiley-Blackwell.
- Heidari, A. A., Sadvandi, M., Damshenas, E., & Damshenas, E. (2019). Prioritization indices related to residential preferences of people in three scales of house, apartments and neighborhoods, case study: Views of residents in three cities of Mashhad, Neyshabour and Torbat-e Jam. *Armanshahr Architecture & Urban Development*, 11(25), 57–68.
- Hooimeijer, P., & Oskamp, A. (1996). A simulation model of residential mobility and housing choice. *Netherlands Journal of Housing and the Built Environment*, 11(3), 313–336. <https://doi.org/10.1007/BF02496594>
- Jalali, M., Naji Isfahani, Z., & Khademolfogharae, M. (2019). Quality of housing: Viewpoints of citizens of Isfahan. *Soffeh*, 29(3), 21–36. <https://doi.org/10.29252/soffeh.29.3.21>
- Jansen, S. J. T., Coolen, H. C. C. H., & Goetgeluk, R. W. (2011). *The measurement and analysis of housing preference and choice*. Springer. <https://doi.org/10.1007/978-90-481-8894-9>
- Maier, J. R. A., & Fadel, G. M. (2009). Affordance-based design methods for innovative design, redesign and reverse engineering. *Research in Engineering Design*, 20(4), 225–239. <https://doi.org/10.1007/s00163-009-0064-7>
- Makvandi, R., Astani, S., & Lorestani, B. (2016). Environmental risk assessment of wetlands using TOPSIS and EFMEA (case study: International Wetland Gavkhoni). *Environmental Researches*, 6(11), 35–58.
- Masoudirad, M., Ebrahimzadeh, I., & Rafieian, M. (2017). Assessment of Mehr housing policy according to sustainability indicators case study: Khorramabad City. *Geography and Environmental Planning*, 28(2), 1–20. <https://doi.org/10.22108/gep.2017.98119.0>

- Massoud, M., Qala-Noori, M., & Shakohi, M. (2017). Investigating the relationship between the theory of environmental preferences and the order of urban blocks (case examples: Isfahan and Mardavij Khaneh neighborhoods in Isfahan). *Architecture and Urban Development Journal Iran*, 14, 136–125.
- Mesgarani, N., Ajza Shokouhi, M., Khakpoor, B. A., & Noghsan Mohammadi, M. R. (2018). Quality assessment of residential area of city center with emphasis on stability, case study: Sarshor and Chahno Districts of Mashhad. *Armanshahr Architecture & Urban Development*, 11(23), 347–359.
- Moghimi Kandolosi, A., Mohibi Tafarshi, A., & Mohibi Tafarshi, Gh. (2018). Locating areas prone to sanitary landfilling of urban waste using TOPSIS method (case study: Langrod city). *Journal of Research in Environmental Health*, 2, 112–128.
- Moghimi, V., Jusan, M. B. M., & Izadpanahi, P. (2016). Iranian household values and perception with respect to housing attributes. *Habitat International*, 56, 74–83.  
<https://doi.org/10.1016/j.habitatint.2016.04.008>
- Momeni Rad, A. (2013). Qualitative content analysis in research tradition: Nature, stages and validity of the results. *Quarterly of Educational Measureme*, 4(14), 187–222.
- Mortazavi Ravari, M. S., Mehdizadeh Saradj, F., & Faizi, M. (2022). Visual preferences of architects and non-architects in evaluating the physical elements of mid-rise residential apartment facades in Tehran. *Journal of Fine Arts: Architecture & Urban Planning*, 27(1), 75–87.  
<https://doi.org/10.22059/jfaup.2022.325269.672641>
- Pourmohammadi, M. (2001). *Housing planning* (1st ed.). Smet Publications.
- Rafiyani, M., Nazari, M., & Dadashpour, H. (2016). Measuring residential satisfaction with location desirability in planned urban areas. *Hoyt Shahr Magazine*, 27, 40–31.
- Rapoport, A. (2000). Theory, culture and housing. *Housing, Theory and Society*, 17(4), 145–165.  
<https://doi.org/10.1080/140360900300108573>
- Rezaei Khaboushan, R., & Nemati Mehr, M. A. (2021). Spatial planning to improve the quality of the housing environment based on an assessment of residents' satisfaction; Case study Hesa Mehr housing, Pardis new town. *Soffeh*, 31(3), 79–96.  
<https://doi.org/10.52547/sofeh.31.3.79>
- Rezaei Rad, H., & Rafiean, M. (2012). Spatial assessment of housing quality in Sabzevar City, by using Factor Analysis Method (FAM). *Journal of Architecture and Urban Planning*, 4(8), 95–110.
- Sheikhi, H., Ghareibi, M., & Manavi, M. (2016). Residential evaluation location using TOPSIS method (case study: Behbahan city). *Geography and Regional Urban Planning*, 18, 69–84.
- Valette-Florence, P., & Rapacchi, B. (1991). Improvements in means-end chain analysis: Using graph theory and correspondence analysis. *Journal of Advertising Research*, 31, 30–45.
- Wahdattalab, M., Yaran, A., & Mohammadi Khoshbin, H. (2020). Evaluation of the visual preferences in the residential façades; Case study: Tabriz Twelve historical houses. *Armanshahr Architecture & Urban Development*, 13(32), 175–187.  
<https://doi.org/10.22034/aaud.2019.150473.1692>
- Yarmohammadi, B., Yadegarzade, B., & Vahidi Borji, G. (2020). Assess the quality of housing and identify strategic issues based on the views of the residents case study: Bojnourd. *Journal of Fine Arts: Architecture & Urban Planning*, 25(2), 57–68.  
<https://doi.org/10.22059/jfaup.2021.314699.672558>
- Zanuzdana, A., Khan, M., & Kraemer, A. (2013). Housing satisfaction related to health and importance of services in urban slums: Evidence from Dhaka, Bangladesh. *Social Indicators Research*, 112(1), 163–185.  
<https://doi.org/10.1007/s11205-012-0045-5>
- Zebardast, E. (2009). The housing domain of quality of life and life satisfaction in the spontaneous settlements on the Tehran metropolitan fringe. *Social Indicators Research*, 90, 307–324.  
<https://doi.org/10.1007/s11205-008-9260-5>
- Zinas, B. Z., & Jusan, M. B. M. (2012). Housing choice and preference: Theory and measurement. *Procedia – Social and Behavioral Sciences*, 49, 282–292.  
<https://doi.org/10.1016/j.sbspro.2012.07.026>
- Zinas, B. Z., & Jusan, M. M. (2017). *Choice behaviour of housing attributes: Theory and measurement*. E-International Publishing House. <https://doi.org/10.21834/aje-bs.v2i2.175>