

Identifying the most Significant Components of Affordability in Housing Design from the Viewpoint of Experts; Case Study: Minoo Island*

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ABSTRACT

Nowadays, population growth, increased construction costs, the lack of suitable land for housing construction, as well as the need to provide housing, especially for the lower-income class, who cannot afford to provide suitable housing in the current economic conditions, have caused minimum housing design to be seriously considered by the decision-makers in the housing sector. However, unfortunately, the designed housings only meet the lowest standards of living and are practically uninhabitable, due to inattention to cultural characteristics, lack of meeting occupants' personal and social needs, and the lack of user involvement in the design and construction stages. The present study aims to identify the most significant components of affordability in housing design from the viewpoint of experts in Minoo Island to attract the attention of state decision-makers and the locals to the construction of housing that, while being economical, has the necessary efficiency and sufficiency, meets living conditions, and is desirable in spatial quality. For this purpose, the required data are collected by library and field studies, and the experts were surveyed using a questionnaire and the Analytic Hierarchy Process (AHP). The experts are selected using the snowball sampling technique. The results indicate that, from the viewpoint of experts, among the components of affordability, allocating shared public areas, reducing the dimensions of spaces, and using the potential of local participation are the most significant components, and modular design, prefabrication, and the use of simple volumes are the least significant components in housing design in Minoo Island.

Keywords: Affordability, Housing Design, Minimum Housing, Minoo Island.

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1. INTRODUCTION

As a physical place, housing is a shelter where the social, psychological, and security needs of family members are met (Shokr Gozar 2006, 15). Lack of access to suitable housing is greatly related to the increased misdemeanor, increased divorce rate, and social disintegration and it is considered a factor hindering sociocultural and psychological growth and development. Lack of housing also causes the emergence of other social abnormalities such as rough sleeping, slums, and more acute problems such as beggary. To solve such problems, the issue of minimum housing has been raised for years. In fact, the solutions to this issue include providing adequate capital to create housing, using new construction methods, finding good quality building materials at proper prices, and applying new housing designs to more desirably use space. Mass construction results in reduced housing construction costs. Also, the small savings of people and their participation help to solve housing problems to some extent. This policy is abbreviated as "PAK" (Pasandaz, Anboohsazi, and Kouchaksazi, meaning savings, mass construction, and minimization, respectively, in English) policy in

the housing market in Iran (Dalal pour Mohammadi 2000, 135). Mass construction and minimum housing aim to provide maximum productivity for users with minimum built space (Ahari and Habibi 1988, 13). Minimum housing is economically affordable while satisfying spatial standards and residential living needs, and allowing residents' material and spiritual growth. Dwelling unit minimization is an answer to the problem of providing housing for the lower-income class, but it also has consequences. Inattention to the cultural characteristics and lifestyle and the lack of user involvement in the housing design and construction processes have caused the built houses to be small, uninhabitable, and qualitatively undesirable for living. The present study attempts to identify the most significant components of affordability in housing design on Minoo Island from the viewpoint of experts. Also, it seeks to answer the following question: Which of the components of affordability are most effective in the design of housing in Minoo Island from the viewpoint of experts?

Figure 1 shows the key relationships in housing from the perspective of affordability.

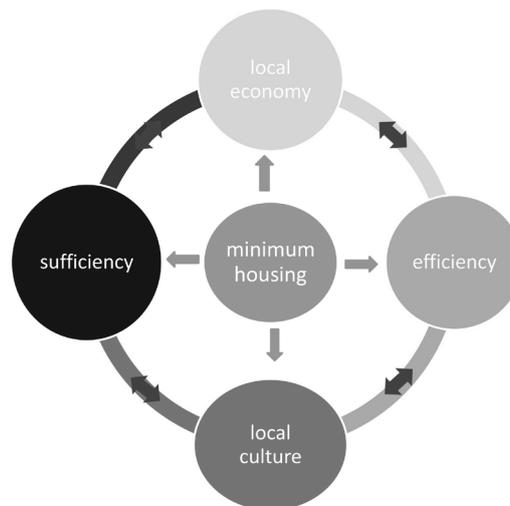


Fig. 1. Key Relationships in Housing from the Perspective of Affordability

2. THEORETICAL FRAMEWORK

According to the literature review and the opinions of experts, a part of the theoretical foundations was selected as the theoretical framework of the present research.

2.1. Research Background

There is a lot of research on minimum housing in Iran. Domestic researchers have investigated minimum housing in terms of quantitative dimensions, quality, flexibility, and housing provision policies. In the present study, the research background indicates that most studies have investigated minimum housing with

a quantitative perspective. For example, Ahari and Habibi (1988) have presented the minimum housing plan and examined the quantitative and qualitative aspects of housing and the policies for its realization in Iran, Rasoli (1994) has studied minimum housing design solutions to achieve safety and comfort without considering quality improvement. Many other studies have assessed the existing quality of designed minimum housing such as Mehr housing, for example, Ansari (2015) has provided solutions to improve housing functionality indicators and Azizi and Rahmani (2014) have assessed the environmental quality of the Mehr residential complexes in Takestan City based on residents' satisfaction. Some other

studies have sought solutions to improve the quality of minimum housing, for example, Rahmani (2015) has analyzed how improving meaning influences the quality of the environment and Madani and Shafaie (2013) have proposed strategies to provide the middle arena considering problems related to minimum housing. In other research, minimum housing provision policies have been investigated with a macro view. For example, Maleki, Aman pour, and Zadvali Khajeh (2018) have discussed policies for providing minimum housing components and Danesh pour and Hoseini (2012) have investigated physical policies adopted for reducing housing prices and other researchers, such as Borhani Darian (2007), have investigated strategies for enhancing the flexibility of minimum housing. Reviewing international relevant studies indicate that they can be divided into 5 groups in terms of the main topic: the idea of using recycled materials and new construction technologies, low-cost housing policies for lower-income people, housing sustainability, flexibility in housing, and housing quality. However, most research has investigated the use of new materials and new construction methods. For example, Srivastava and Kumar (2018) have investigated the issue of recycling and the use of recycled materials, and Bayode Adegun and Daisiowa Adedeji (2017) have discussed the use of indigenous and natural materials. Other researchers have expanded on the issue of housing flexibility (for example, De Parisn and L. Lopes (2018)) and affordable housing policy (for example, Gooding (2016)). Another group has investigated low-cost housing (for example, Isnin et al. (2012)) and design quality and meaning in minimum housing (for example, Cousins (2009)).

2.2. Concepts

The following describes some of the abovementioned concepts, such as affordability and minimum housing.

2.2.1. Affordability

According to a national document on affordable housing published by the Australian government in 2005, affordable housing is defined as follows: "This term is used to describe housing suitable for meeting the lower-income class' needs. In other words, it is priced in such a way that it can also provide its owners' other basic needs" (Gurran 2008, 8). Also, in the book "Rethinking Federal Housing Policies", affordable housing is defined as follows: "A house is considered unaffordable when its costs rise above 30% of the household income" (Glaeser 2008, 16). Smaller housing refers to the use of fewer construction materials, less waste, and lower costs (Gonzalo and Habermann 2006, quoted by Friedman 2017, 65). By reducing the area from 279 to 186 m² (3000 to 2000 ft²), the owner can save a third of the cost and spend it on better materials and construction (Wilson 2006, quoted by Friedman

2017, 63). If the house is designed efficiently, it can be comfortable without increasing construction costs. In fact, by reducing the costs that occur during the lifetime of the house, the owner receives his reward (Fuad Luke 2004, quoted by Friedman 2017, 61). In his article entitled "Architecture Education in Civil Engineering", Golabchi (2009, 80) emphasizes the necessity of observing simplicity in construction and states that "a building in which the needs and comfort of the users are met difficultly, doesn't have simplicity. Simplicity does not mean being basic. A building, that is constructed according to the requirements of the design, implemented easily, and doesn't faces analytical and computational complexities, can be considered a building that meets the principle of simplicity". In addition to reducing waste, prefabricated structures provide faster and safer production with better quality control, enhanced health and safety, reduced noise and dust on site, time and cost savings, and reduced labor demands (Ferdous et al. 2019, 883-893). Housing flexibility can also be considered a solution to make housing affordable. A flexible space is a space that can adapt to the changing needs of users (Schneider and Till 2005, 287). Shared domestic spaces are defined as home-related that are located outside the boundaries of privately controlled domestic spaces and are shared with a limited number of neighbors, usually, members of a complex, in various ways (Tervo and Hirvonen 2017, 6). The participation of the local community in the design and construction stages also has a significant impact on the affordability of housing. Broome, one of the theorists of mass construction, states that when the residents have the right to make decisions about their own main issues and can intervene in the design, construction, or management of their housing, "the process and environment formed" will lead to the improvement of individual and social situations. But when people have no control over or responsibility for the main decisions made on the housing construction and design processes, residential environments operate as an obstacle to individual development and will be imposed on the economy (Broome, 2005, quoted by Raheb, 2014, 5). In his book "Welcome to the Urban Revolution", Jeb Brugmann also proposes the "participatory urban system" program (Johnson 2011, quoted by Danesh pour and Ghafari Azar 2020, 6). After the seventies, there were changes in the housing of the lower-income class. They implied that the poor must also participate in the provision of housing and shelter (Sarafi 2002, 8). Turner was one of the first who proposed the idea of self-help housing. This term means the government should use the efforts of poor people to provide housing instead of providing completed housing (Hall and Midgley 2009, 202). Sanoff believes that "participatory design is an attitude about a force for change and management of built environments for people" (Sanoff 2008, 57-69). Limited public facilities for affordable housing

strongly emphasize public and private participation (Florida and Pedigo 2019, 31).

2.2.2. Minimum Housing

Overcrowding in the house doesn't only affect children but all people living are differently influenced by the negative effects of out-of-control forces induced by overcrowding (Shokr Gozar 2006, 43). In the minimum housing design and planning, all economic, social, and physical aspects and the conditions required for supplying them are examined, especially for lower-income households. That is why, the minimum housing plan, while emphasizing this necessity, considers the quantitative and qualitative characteristics and aspects of housing, and attempts to examine the residential space required and suitable for Iranian households considering social and vital indicators of housing by observing the standards (Ahari and Habibi 1988, 132). Low-cost housing

is a purely political issue related to the minimum acceptable housing size, housing allowance, and social equity (Jokinen 2019, quoted by Pirnen and Tervo 2020, 5). The challenge of designing a small house is to maximize its efficiency (Chan, 2007, quoted by Friedman 2017, 50). The form is also considered one of the important components in housing design, as Chueca maintains that "a square is preferable to a circle and still maintains the minimum floor area-to-perimeter ratio." (Chueca 2009, quoted by Friedman 2017, 64). Experiences indicate that building houses with irregular dimensions and sizes, compared to modular construction, requires more cuts and connections, resulting in increased waste, more spent time, and costs for the labor force (Carpenter 2009, quoted by Friedman 2017, 69). Table 1 presents the theoretical framework and operational indicators of the present research.

Table 1. The Theoretical Framework and Operational Indicators of the Present Research

| No. | Expert | Theory | Criterion | Component |
|-----|--|--|-------------------------------------|---|
| 1 | (Carpenter 2009; Golabchi 2009; Ferdous et al. 2019) | Solving the problems related to time, useful lifespan, and cost through the use of new building systems and new building materials | Construction technology Material | Modular design; Prefabrication; Observation of technical requirements |
| 2 | (Schneider and Till 2005; Tervo and Hirvonen 2017) | Flexible housing | Space flexibility | Dedication of shared public areas; Use of multi-functional spaces |
| 3 | (Sanoff 2008; Florida and Pedigo 2019) | Improving the individual and social situations through the decision-making and intervention of the occupants | Participation-centeredness | Participation |
| 4 | (Chan 2007; Wilson 2006; Ahari 1988; Jokinen 2019) | Less but better The minimum housing provides residence quality while being extremely minimized. | Minimalism | Reduction of the dimensions of spaces; Removal of unnecessary spaces |
| 5 | (Bechler 2017) | Simple form | Simplism | Use of simple volumes; Removal of extra decorations |

According to the theoretical foundations and operational indicators listed in Table.1, the constituent layers of minimum housing, from the dimension of affordability, are placed in two general physical and functional groups. The physical group includes the building structure-related characteristics

and components and the functional group includes the components of spatial quality. The constituent layers of minimum housing, from the perspective of affordability, are extracted from the theoretical foundations, as shown in Figure.2.

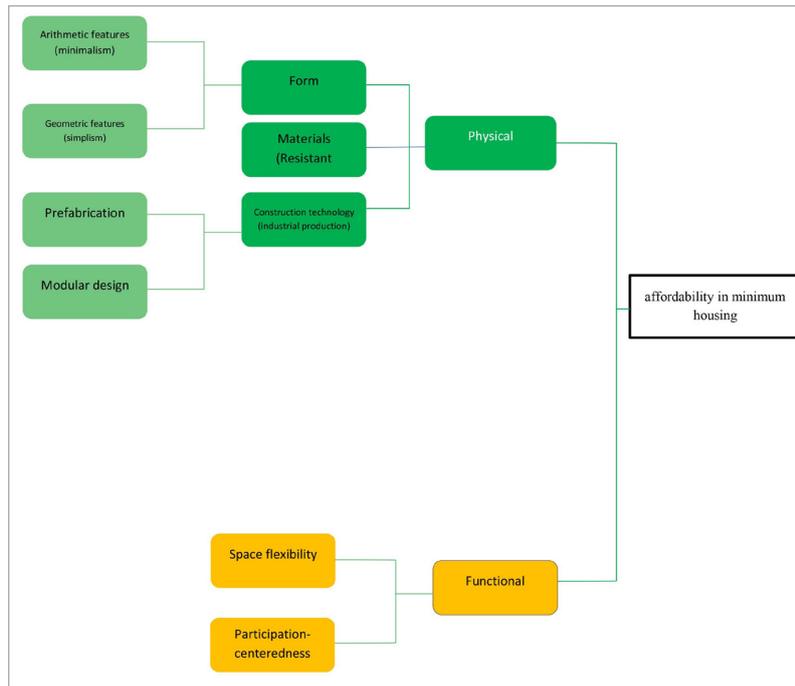


Fig. 2. The Constituent Layers of Minimum Housing, from the Perspective of Affordability

3. METHOD

The present study was applied descriptive mixed-method research, in which the required data were collected using library studies, field studies (distributing questionnaires), and reviewing relevant projects. The priorities and weights of the research sub-criteria were determined using the Analytic Hierarchy Process (AHP) technique in EXPERT CHOICE software. The statistical population includes architecture and urbanism professionals who were involved with urban issues on Minoo Island. The samples were selected using the snowball sampling technique, and 10 professionals who had sufficient knowledge of the research topic were selected as samples to score the sub-criteria. In the pairwise comparison questionnaire, first, the main criteria are compared in pairs respecting the goal. Next, the sub-criteria of each main criterion are compared in pairs. In the AHP technique, the Consistency Ratio (CR) is calculated by the software. If it is >0.1 , it is necessary to re-evaluate all the input. The validity of the questionnaire is also confirmed since the questions were approved by the professionals. Also, to test the sub-hypotheses, analyze the status quo on Minoo Island, and compare it with the obtained priorities of the affordability components, a resident questionnaire (with items extracted from theoretical foundations) designed based on a 5-point Likert scale (from very low to very high) was used. The validity of this questionnaire was examined by the content validity ratio and the judgments of 5 university professors, and its reliability was examined by Cronbach's alpha,

which was acceptable since it was estimated as 0.93 (>0.7). according to Iran's Population and Housing Census-2016, Minoo Island has a population of 8223 people, so the sample size was estimated as 367 using Cochran's formula. A multi-stage cluster sampling method was used to collect information from 367 samples (including all the residents of Minoo Island) who were older than 21 years old. Using cluster sampling prevents waste of time and saves financial resources due to the proximity of the units of a cluster and easy access. Finally, the obtained data were analyzed using SPSS 24 software, the outputs of which are given below. the one-sample Wilcoxon test was used to evaluate the current status of the variables, and Pearson's correlation coefficient was used to show the relationships affecting the affordability components. The research sub-hypotheses are as follows:

Sub-hypotheses:

- There is a positive and significant relationship between residents' income and their ability to provide housing.
- There is a negative and significant relationship between rapid population growth and residents' ability to provide housing.
- There is a positive and significant relationship between the abundance of land suitable for residential construction and residents' ability to provide housing.

3.1. Case Study

Minoo Island is a verdurous island with a population of 8223 people. It is located in the southwest of Iran, between the cities of Abadan and Khorramshahr in Khuzestan province. It has an area of about 2000

hectares and it is surrounded by two rivers, Arvand Kochak, and Arvand Bozorg. Population growth, the lack of economic infrastructure within Minoo Island, the unemployment crisis, and its residents' low income, have caused the issue of housing provision, especially for the lower-income class, to face problems. In this regard, minimum housing design can be considered to achieve low-cost and accessible housing. For

this purpose, it is required to identify and prioritize the most significant components of affordability. Considering the current economic conditions in Iran, this issue can be generalized to other regions with similar geographical conditions and lifestyles. Figure 3 shows the three most frequent typical house plans in Minoo Island, as samples, and their locations.

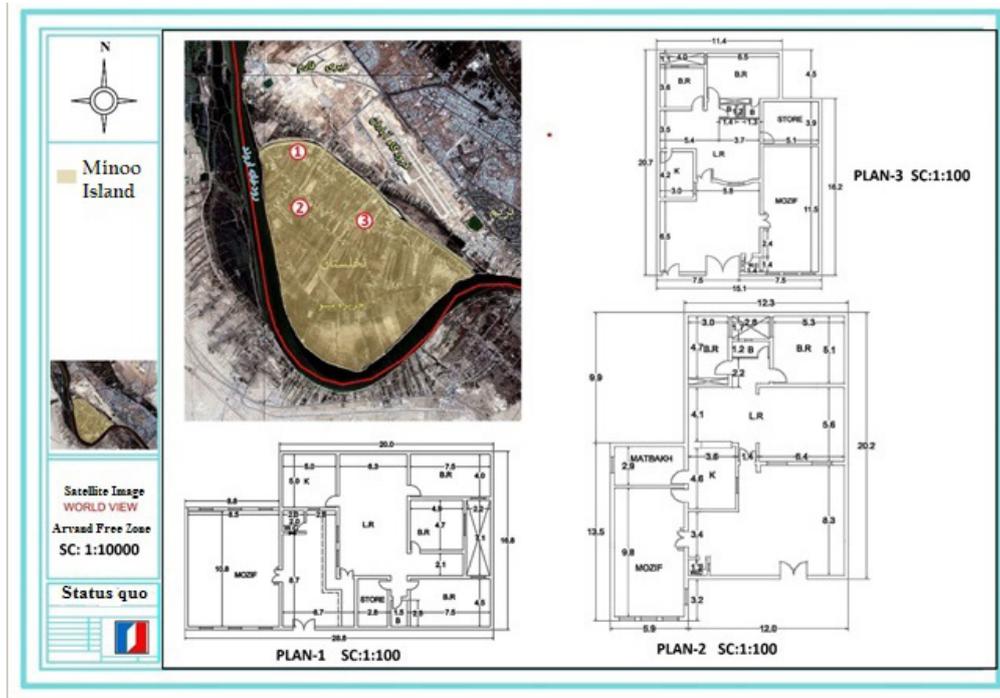


Fig. 3. The Three most Frequent Typical House Plans in Minoo Island and Their Locations

4. FINDINGS

To identify and prioritize the most significant components of affordability, first, the main criteria and then, the sub-criteria were compared.

4.1. Prioritization of Affordability Criteria

To perform the AHP analysis, first, the main criteria were compared in pairs. Table 2 shows the integrated pairwise comparison matrix of the main criteria.

Table 2. The priorities of the Main Criteria of Affordability

| | Minimalism | Flexibility | Participation-Centeredness | Industrial Production | Simplism | Retrofitting | Geometric Mean | Eigenvector |
|----------------------------|------------|-------------|----------------------------|-----------------------|----------|--------------|----------------|-------------|
| Minimalism | 1.000 | 0.779 | 3.207 | 1.829 | 2.218 | 2.028 | 1.655 | 0.256 |
| Flexibility | 1.284 | 1.000 | 3.778 | 1.571 | 2.154 | 1.184 | 1.640 | 0.254 |
| Participation-Centeredness | 0.312 | 0.265 | 1.000 | 1.506 | 1.670 | 1.436 | 0.817 | 0.127 |
| Industrial Production | 0.547 | 0.637 | 0.664 | 1.000 | 1.205 | 1.770 | 0.889 | 0.138 |
| Simplism | 0.451 | 0.464 | 0.599 | 0.830 | 1.000 | 4.454 | 0.880 | 0.136 |
| Retrofitting | 0.493 | 0.845 | 0.696 | 0.565 | 0.225 | 1.000 | 0.577 | 0.089 |
| | | | | | | | 6.457 | 1.000 |

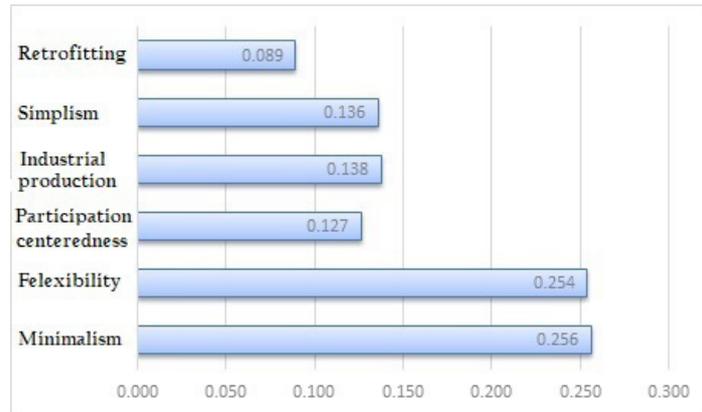


Fig. 4. Graphic Representation of Priorities of the Affordability Criteria

According to the results obtained, The minimalism criterion with an importance coefficient of 0.256 obtains the highest priority. The flexibility criterion with an importance coefficient of 0.254 obtains the second priority. The industrial production criterion with an importance coefficient of 0.138 obtains the third priority. The simplism criterion with an importance coefficient of 0.136 obtains the fourth priority. The participation-centeredness criterion with an importance coefficient of 0.127 obtains the fifth priority.

The retrofitting criterion with an importance coefficient of 0.089 obtains the sixth priority. The findings showed that the consistency ratio is 0.097, which is <0.1 , implying that the results can be trusted.

4.2. Prioritization of Minimalism Sub-Criteria

In Step 2, the AHP technique was used to compare the sub-criteria of each criterion in pairs. Table 3 presents the priorities of the minimalism sub-criteria.

Table 3. The Priorities of the Minimalism Sub-Criteria

| | Reducing the Dimensions of Spaces | Removing Unnecessary Spaces | Geometric Mean | Eigenvector |
|-----------------------------------|-----------------------------------|-----------------------------|----------------|-------------|
| Reducing the Dimensions of Spaces | 1.000 | 1.205 | 1.098 | 0.546 |
| Removing Unnecessary Spaces | 0.830 | 1.000 | 0.911 | 0.454 |
| | | | 2.009 | 1.000 |

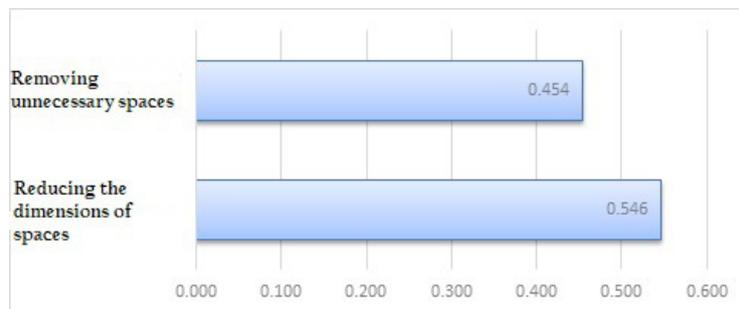


Fig. 5. Graphic Representation of Priorities of Minimalism Sub-Criteria

According to the results obtained: The sub-criterion of reducing the dimensions of spaces with an importance coefficient of 0.546 obtains the highest priority. The sub-criterion of removing unnecessary spaces with an importance coefficient of 0.454 obtains the second priority.

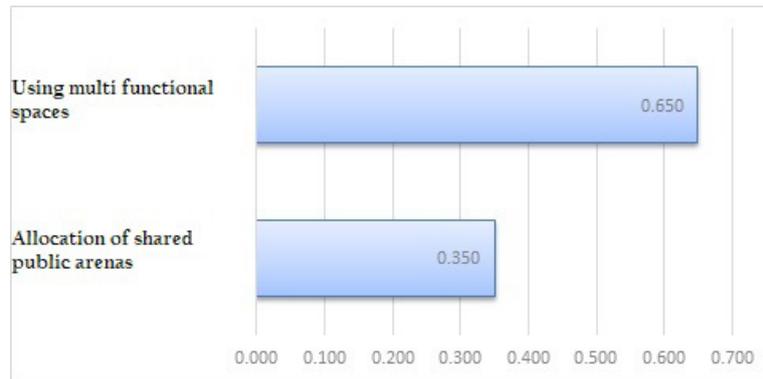
The consistency ratio is considered to be zero since only one pairwise comparison was performed.

4.3. Prioritization of Flexibility Sub-Criteria

Table 4 presents the priorities of the flexibility sub-criteria.

Table 4. The Priorities of Flexibility Sub-Criteria

| | Allocation of Shared Public Arenas | Using Multi-Functional Spaces | Geometric Mean | Eigenvector |
|------------------------------------|------------------------------------|-------------------------------|----------------|-------------|
| Allocation of Shared Public Arenas | 1.000 | 0.540 | 0.735 | 0.350 |
| Using Multi-Functional Spaces | 1.853 | 1.000 | 1.361 | 0.650 |
| | | | 2.096 | 1.000 |

**Fig. 6. Graphic Representation of Priorities of Flexibility Sub-Criteria**

According to the results obtained, The sub-criterion of using multi-functional spaces with an importance coefficient of 0.650 has the highest priority.

The sub-criterion of allocation of shared public arenas with an importance coefficient of 0.350 obtains the second priority.

The consistency ratio is considered to be zero since only one pairwise comparison was performed.

4.4. Prioritization of Participation-Centeredness Sub-Criteria

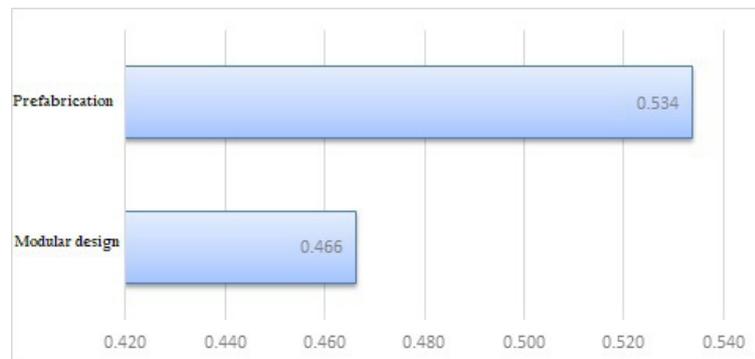
Since the publication-centeredness criterion has only one sub-criterion the weight of the sub-criterion "Using the potential of local participation" is considered to be one. Also, the consistency ratio is considered to be zero since there is one sub-criteria.

4.5. Prioritization of Industrial Production Sub-Criteria

Table 5 presents the priorities of the industrial production sub-criteria.

Table 5. The priorities of Industrial Production Sub-Criteria

| | Modular Design | Prefabrication | Geometric Mean | Eigenvector |
|----------------|----------------|----------------|----------------|-------------|
| Modular Design | 1.000 | 0.874 | 0.935 | 0.466 |
| Prefabrication | 1.145 | 1.000 | 1.070 | 0.534 |
| | | | 2.005 | 1.000 |

**Fig. 7. Graphic Representation of Priorities of Industrial Production Sub-Criteria**

According to the obtained eigenvector values, The sub-criterion of prefabrication with an importance coefficient of 0.534 obtains the highest priority. The sub-criterion of modular design with an importance coefficient of 0.466 obtains the second priority. The consistency ratio is considered to be zero since

only one pairwise comparison was performed.

4.6. Prioritization of Simplism Sub-Criteria

Table 6 presents the priorities of the simplism sub-criteria.

Table 6. The Priorities of Simplism Sub-Criteria

| | Using Simple Volumes | Removing Extra Decoration | Geometric Mean | Eigenvector |
|---------------------------|----------------------|---------------------------|----------------|-------------|
| Using Simple Volumes | 1.000 | 0.815 | 0.903 | 0.449 |
| Removing Extra Decoration | 1.228 | 1.000 | 1.108 | 0.551 |
| | | | 2.011 | 1.000 |

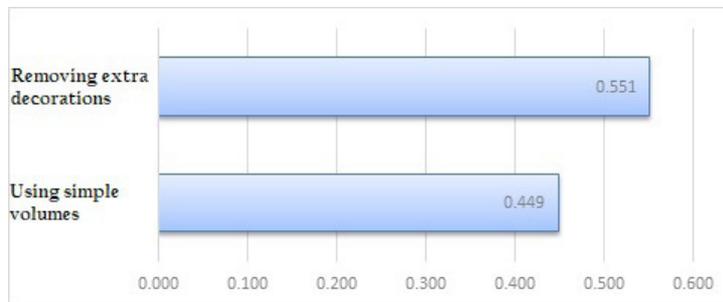


Fig. 8. Graphic Representation of Priorities of Simplism Sub-Criteria

According to the results, The sub-criterion of removing extra decorations with an importance coefficient of 0.551 has the highest priority. The sub-criterion of using simple volumes with an importance coefficient of 0.449 obtains the second priority. The consistency ratio is considered to be zero since only one pairwise comparison was performed.

consistency ratio is considered to be zero.

4.7. Prioritization of Retrofitting Sub-Criteria

Since the retrofitting criterion has only one sub-criterion the weight of the sub-criterion "observing technical and regulatory requirements" is considered to be 1. Also, since there is one sub-criterion the

4.8. Determining the Final Priorities of Affordability Sub-Criteria Using the AHP Technique

In this step, the final priorities of affordability sub-criteria are calculated. To determine the final priorities of the indicators, the local weight of the sub-criteria is multiplied by the weight of their corresponding criteria to obtain the unnormalized final weight. Next, the unnormalized weight is divided by the sum of the weights to obtain the normalized final weight. Table 7 and Figure 9 present the results and weights of the indicators, respectively:

Table 7. The Final Priorities of Affordability Sub-Criteria

| No. | Sub-Criteria (Components) | Final Weights of Sub-Criteria |
|-----|--|-------------------------------|
| 1 | Allocation of Shared Public Arenas | 0.165 |
| 2 | Reducing the Dimensions of Spaces | 0.140 |
| 3 | Using the Potential of Local Participation | 0.127 |
| 4 | Removing Unnecessary Spaces | 0.116 |

| No. | Sub-Criteria (Components) | Final Weights of Sub-Criteria |
|-----|---|-------------------------------|
| 5 | Observing Technical and Regulatory Requirements | 0.089 |
| 6 | Using Multi-Functional Spaces | 0.089 |
| 7 | Removing Extra Decorations | 0.075 |
| 8 | Modular Design | 0.073 |
| 9 | Prefabrication | 0.064 |
| 10 | Using Simple Volumes | 0.061 |

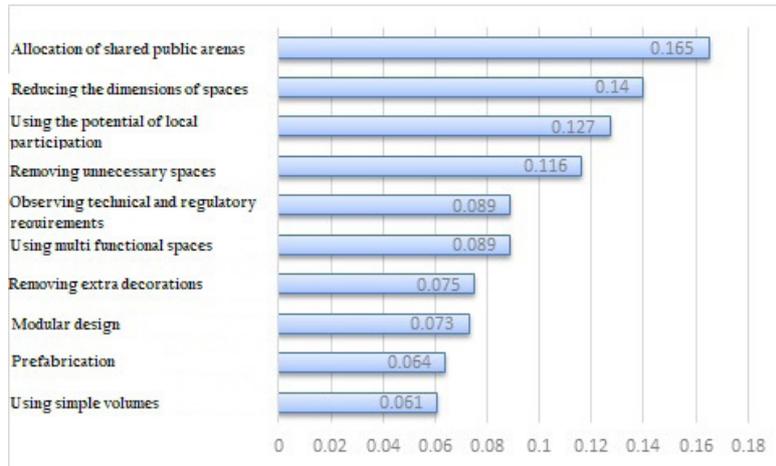


Fig. 9. Graphic Representation of the Final Priorities of Affordability Sub-Criteria

4.9. Investigation of the Status Quo

According to the result of assessing the normality of

the data, the one-sample Wilcoxon test was used to investigate the current status of the variables, and the results are listed in Table 8.

Table 8. The Results of the One-Sample Wilcoxon Test

| Variable | Average | Median | Standard Deviation | Wilcoxon Statistic | Sig. |
|--|---------|--------|--------------------|--------------------|-------|
| Income | 1.45 | 1.5 | 0.5 | 0 | 0.001 |
| Ability to Provide Housing | 1.54 | 1.5 | 0.59 | 0 | 0.001 |
| Rapid Population Growth | 3.76 | 3.5 | 0.71 | 24610 | 0.001 |
| The Abundance of Land Suitable for Residential Construction | 1.79 | 2 | 0.77 | 0 | 0.001 |
| The Number of Constructions Violating Rules | 4.46 | 4 | 0.68 | 53628 | 0.001 |
| Use of Shared Public Arenas | 1.97 | 2 | 0.78 | 0 | 0.001 |
| Use of Local Participation | 1.39 | 1 | 0.49 | 0 | 0.001 |
| The Dimensional Compatibility of Housing with Livelihood Needs | 2.16 | 2 | 0.76 | 0 | 0.001 |

The results of the one-sample Wilcoxon test in Table 8, show that according to the residents, the variables of rapid population growth (3.76) and the number of constructions violating rules (4.46) are above the average (3), but the variables of income (1.45), the

ability to provide housing (1.54), the abundance of land suitable for residential construction (1.79), using shared public arenas (1.97), using the potential of local participation (1.39), and the dimensional compatibility of housing with livelihood needs (2.16)

are below the average (3) (significance at the 0.001 error level).

sub-hypotheses in the resident questionnaire, and the results are listed in Table 9.

4.10. Testing Sub-Hypotheses

Pearson's correlation coefficient was used to test the

Table 9. The Results of Pearson's Correlation Test

| Sub-Hypothesis | Relationship | Pearson's Correlation Coefficient | Type of Relationship | Statistical Result | Final Result |
|----------------|--|-----------------------------------|----------------------|--------------------------|---------------------------------|
| First | Residents' Income; Residents' Ability to Provide Housing | 0.876** | Positive | Significant Relationship | The Sub-Hypothesis is Confirmed |
| Second | Rapid Population Growth; Residents' Ability to Provide Housing | -0.767** | Negative | Significant Relationship | The Sub-Hypothesis is Confirmed |
| Third | The Abundance of Land Suitable for Residential Construction; Residents' Ability to Provide | 0.503** | Positive | Significant Relationship | The Sub-Hypothesis is Confirmed |

** : significant at the 0.01 error level; * : significant at the 0.05 error level

According to the results listed in Table 9 from the perspective of residents, the correlation coefficient between residents' income and their ability to provide housing is equal to 0.876, which is positive and significant at the 0.01 error level ($P < 0.01$), implying a positive and significant relationship between residents' income and their ability to provide housing (the first sub-hypothesis is confirmed).

In the second sub-hypothesis, the correlation between rapid population growth and residents' ability to provide housing was investigated, and the results showed that the correlation coefficient is equal to -0.767, which is negative and significant at the 0.01 error level ($P < 0.01$), implying a negative and significant relationship between rapid population growth and residents' ability to provide housing (the second sub-hypothesis is confirmed).

In the third sub-hypothesis, the correlation between the abundance of land suitable for residential construction and residents' ability to provide housing was investigated, and the results showed that the correlation coefficient is equal to 0.503, which is positive and significant at the 0.01 error level ($P < 0.01$). P), implying a positive and significant relationship between the abundance of land suitable for residential construction and residents' ability to provide housing (the third sub-hypothesis is confirmed).

5. CONCLUSION

Population growth, the lack of suitable land for residential construction, and the economic problems of lower-income communities make the provision of suitable and low-cost housing face problems. The designed minimum housing currently includes small housing where only quantitative issues have been paid

attention to and cultural issues have been ignored. So, they have an unfavorable spatial quality. In general, the research on minimum housing has more focused on the evaluation or comparison of the design problems of existing minimum housing, especially Mehr housing, and they have not addressed the most significant effective components of affordability to remove obstacles and realize suitable minimum housing. Identifying and prioritizing the most significant components of affordability in the minimum housing design and planning seems to help to solve the problems of minimum housing design to some extent. The results of the present research indicate that in addition to the component of minimalism (reducing the dimensions of spaces), which is an essential part of minimum housing design, the allocation of shared public arenas through space compensation can solve the deficiency resulting from reducing the dimensions of spaces in minimum housing to a large extent. On the other hand, the participation of the local community and the use of users' opinions in the process of spatial planning and design is a missing loop that has been forgotten, according to which, the acceptance and realization of minimum housing for its residents become possible. From the viewpoint of professionals, the components of using multi-functional spaces, due to the multi-family residence and local lifestyle in Minoo Island, have a lower priority than the abovementioned components, and other components such as the component of simplism (removal of extra decorations), due to the lack of spread of elaborate decorations in designed residential buildings, and industrial production components (modular design and prefabrication), due to the local construction workers' unfamiliarity with these methods and the lack of suitable executive

infrastructure, have the lowest priorities according to the experts. In short and according to Table 7, from the viewpoint of experts, in minimum housing design in Minoo Island, among the components of affordability, the allocation of shared public areas, reducing the dimensions of spaces, and using the potential of local participation are the most significant component and modular design, prefabrication, and the use of simple volumes are the least significant ones. For the criterion of flexibility and the component of using multi-functional spaces, solutions such as the integration of residential spaces and the use of dividers, considering the multi-family residence in housing in this area, cannot be very helpful while regarding the component of the allocation of shared public arenas, the same solution, i.e. using courtyard and palm-grove, can be applied to provide the required

in-between and public spaces. Regarding the criterion of minimalism and the component of reducing the dimensions of the spaces, according to observations and field studies and considering the excess area of bedrooms and the living room in the current status of residential houses in Minoo Island (Figure 3), it is suggested to adopt solutions such as reducing the area of bedrooms and living room. Regarding the same criterion and the component of removing unnecessary spaces, considering the promotion of the construction of extra warehouses in the existing construction, it is suggested to remove these extra warehouses. Regarding the criterion of participation-centeredness and the component of the use of the potential of local participation in the housing design, it is suggested to form NGOs as an interactive solution.

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