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# Applying Fuzzy Logic and Analysis Hierarchy Process (AHP) in the Design of Residential Spaces; Case of Study: Arak City

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**Abstract**

Today, quality is measured in the form of sustainable architecture in the areas of meeting the physical needs of users. If architectural paradigms that include people's emotions and psyche have been neglected then this issue causes spiritual and even cultural and social losses. As a result, the quality value of the building has decreased. With this perspective, the present plan is trying to achieve a design with a phenomenological approach that is evaluated from the point of view of the end users of the buildings, so that it is finally considered to be of high quality. The methodology of this research is quantitative, and the data collection tool is a questionnaire. The data analysis tool is the use of Riashi's equations through Expert Choice software. Also MATLAB software version 2018 is used for fuzzy logic. After collecting the fuzzy weight differences of each building concerning each criterion, it still cannot be used as a ranking. Finally, after the analyses done by the researchers in this research through research tools, the proposed designs for the design of buildings that will be built in Arak City according to the indicators and evaluations of this research have been displayed.

**Keywords**: Housing, Housing Design, Fuzzy Logic, AHP, Arak.

## Introduction

Attention to quality is increasing today. Many architects looking for an ideal design; So the three characteristics of beauty, strength, and efficiency are the characteristics of the market in their products. If the strength of construction technology is the subject, then the benchmark of efficiency and beauty is in the hands of the users. It is not enough to meet the needs of users by using common and "habitual" products to obtain and maintain quality. Today, quality is measured in the areas of meeting the physical needs of users. It is necessary that architectural paradigms include people's feelings and psyche. In the meantime, neglecting this issue causes spiritual and even cultural and social losses. With this perspective, the current plan is trying to achieve a design with a phenomenological approach that is evaluated and considered high quality from the point of view of users (Dehghan, S., & Naghibi Iravani, 2022).

Users have different needs from the building. These needs and expectations become more complex every day with the users' experience of new ideas in the world around them. In this research, the "innovative product development process" is a response to these complexities, which re-

quires understanding the constantly changing demands and needs of the user. Therefore, the necessity of research and development seems to be in methods that help the designer and planners to gain a wide knowledge of the user's needs and satisfaction and then develop products with innovative features. This research is concerned that quality in construction becomes a secondary issue.

By examining the definitions of quality and by examining the performance optimization agenda, we notice the focus of measurement on the physical stages of buildings. So that the new generations of buildings emphasize the methods of reducing energy consumption, construction, and maintenance costs and reducing construction time. In the worst conditions, the design degrades towards the production of unattractive and boring buildings. And finally, the quality of the production design is lost in the effort to improve the process (Gheitarany et al., 2013).

If the principles of sustainable building production, especially regarding energy management, are well organized for energy and environmental issues, but it has not prevailed in any paradigm governing architecture. Here, the issue of how to define and measure quality is at the center of this discussion. Quality measurement raises major practical and conceptual issues. Some buildings have physical features such as modern cooling and heating equipment, etc. and some other emotional features such as sense of smell, sound, etc., but in this research, features are considered that by meeting the physical and psychological needs of building users, it is an environment worthy of "human" living. and receptive to his behavior patterns and as a result makes it full of quality. These features are called "user voice" here.

Therefore, with these conditions, the goal of this paper is to develop an approach to evaluate and measure quality based on the aspect of "perceptual load induced to the user". Undoubtedly, all human beings have an experience of the spaces around them, an experience that in its entirety is difficult to describe in words and does not lose its important parts (GHADARJANI, & GHEITARANI, 2013). In the same way, most of the time, the reason why we feel unfamiliar with a building or space is that that building or environment seems meaningless and without content to us, or that we can't establish a relationship with that environment.

Not establishing a conceptual connection with the building is also a kind of experience. Because understanding the meaning and not understanding the meaning are both part of the experience. The architecture of buildings is more than a shelter. Architects today are faced with the challenge of creating buildings that fulfill all the social requirements of conventional aesthetics and functionality as well as a sustainable environment. The efforts of many architects and researchers have been focused on the production of sustainable low-energy architecture.

In this case, sustainability will be a peripheral issue of architecture when it appears only as a part of architectural paradigms. Winters says that often the reason is that we feel unfamiliar and unfamiliar with a building or space. It is that that building or environment seems meaningless and without content for us, or that we can't establish a relationship with that environment. If the principles of producing sustainable buildings, especially regarding energy management, are well organized for energy and environmental issues, but it has not prevailed in any paradigm governing architecture.

**Theoretical**

*Residential environments, attachment to place, and the concept of home.* Throughout history, humans have made a shelter for themselves from everything in their surroundings. And still, the diversity of house building around the world continues strangely. People live in tents, boats, skyscrapers, mud huts, and shacks in the suburbs. Whatever their houses are made of, humans have a strong

sensory and emotional attachment to their living places. These attachments have a general nature, such as when people become attached to certain areas and environments such as cities, mountains, or deserts (Zakerhaghighi et al., 2015). A person with a general dependence on place can be satisfied in different situations with certain characteristics.

On the other hand, an attachment to a geographic location is a very strong attachment to a specific city or home. Place attachment has been defined as a positive emotional connection between people and their living environments. This relationship gives a sense of comfort and security. The emotional bond between people and places is called placeism. Schumacher and Taylor point to an evolutionary advantage in strong place attachment.

In early humans, this attachment made it easy to defend familiar environments, reduced unnecessary and dangerous exploration and wandering, and allowed individuals to enjoy the right of occupancy in their territories (Farrokhirad, & Gheitarani, 2024). The intensity of our attachment to our living environments is different. Robin Stein described the specific characteristics of four levels of attachment. At the lowest level; People just know a place and think about it without any strong feelings or personal memories.

At a relatively higher level of attachment, which is called personal attachment, a person has memories of a place that are inseparable from his personal experiences. The schools you attended or the fields and forests you played in represent your attachment. When places evoke strong emotional memories or engage us psychologically in some way, we experience a strong attachment called attraction. The most intense level of attachment is internalization, where the boundaries between the self and the environment disappear.

A house where a person has lived all his life or the grave of a spouse, child, or parent may evoke strong feelings of attachment. For such people, personal identity and sense of place are intertwined. Many factors affect people's attachment to places. Schumacher and Taylor found congruence between one's goals and needs, environmental resources, the individual's decision to stay and leave the environment, and attachment as important parts of the attachment process (Khanian et al, 2019). Children, the elderly, and those with limited mobility are especially susceptible to environmental dependence.

Strong place attachment leads to greater satisfaction with the home and high expectations of future-proofing. This attachment is also accompanied by a thorough knowledge of the history and geography of the place and the investment of more time and resources in that place. Although social networks are an important part of an attachment to a place, this feeling is superior to attachment to others and represents the purity of emotion hidden in a place (Ghadarjani et al., 2013). People who have moved to other parts of their country or the world often report that they miss the mountains, the ocean, or their neighbors.

People who are strongly attached to a place or house. If they are forced to leave it, they will suffer mental turmoil. People with strong attachments have strong roots and less motivation to move and be more satisfied in their place of residence. It seems that the passage of time is an important factor in the evolution of attachment; Therefore, it is not surprising that elderly people are more attached to their homes. Norris and Baker studied the attachment of elderly residents in a small, developing Kansas town.

A shrinking city is a problem for many seniors in small towns, especially in the Midwest, because as the city gets smaller, the elderly population increases. Many of the previously prosperous cities were destroyed by the migration of young people over 20 years old and looking for work. Most of them were seniors who had lived their entire lives in the city. Norris-Baker conducted in-

depth interviews with seniors living in Kansas City to explore their reactions to the slow erosion of behavioral situations that had characterized their lives (Iravani & Ahd, 2021- a).

The elderly had a stronger attachment to the buildings and places of the city compared to the younger ones. These strong attachments have functions. Strong attachments to place confirm membership They helped in the social organization of the city and created a psychological continuity between the past and the present against an unknown future (Maleki et al., 2024). It seemed that local memories are a means to preserve the pride and spirit of the society. The physical environments around us play an important role in giving meaning and organization to our lives. It is not surprising that the sense of the place we live in is so connected to our identity that it makes us strongly attached to that place and the mojo experiences in it (Gheitarani et al., 2013).

Homelessness is a social absence; Being homeless is a strong emotional and uncontrollable life event that leads to severe psychological trauma. According to Goodman, homeless people often show specific symptoms of post-traumatic stress disorder. Social isolation, depression, and poor nutrition from homelessness are exacerbated by mental disorders and substance or alcohol abuse. Therefore, the word "house" means more than a shelter. The concept of house expresses the emotional and meaningful relationship between people and their place of residence (Samami et al., 2024).

The house refers to a safe and predictable place where a person controls space and time. In short, the house is the main connection between a person and the rest of the world. The importance of returning to the father's house during the holidays h T to eat a group lunch shows the effect of houses in maintaining bonds between people. This ritual of returning home confirms and renews one's place in the family and is often considered the key factor in maintaining the social cohesion of the family.

For the people of Southwest America, home is a category with life and a place for raising children, communication with God, and the spirit of nature and life. For all people, home is the center of the world and the place to bring order to disorder. When children and teenagers were asked to draw "the place where they live", they made their houses the focus of the drawing (Naghibi Iravani et al., 2024- a). This is especially true for women; Compared to boys, girls provide more positive and emotional evaluations of their homes.

Since home is a subjective concept, in this research, one of the methods of environmental psychology called "environmental autobiography" was used. The environmental biography itself is a memoir of the events of a person's life with an emphasis on the role of the physical environment. People were asked to recall, talk about, write about, and draw about environments that were important to them. This method is a useful method for designing home environments and is especially useful in studying children's feelings towards their living place (Naghibi Iravani et al., 2024- b).

***Sustainability assessment systems***. Since two decades ago, many local or international groups have been formed to develop and promote techniques and policies to achieve sustainability in buildings. Often, the concern of these systems is in the field of energy saving. The processes of these systems aim to match building design and construction methods according to environmental sustainability criteria. Building assessment systems aim to establish standards for green buildings by evaluating performance against adopted criteria. A typical building assessment system consists of a checklist of elements, some of which may be optional.

The different value assigned to each element is effectively considered on the degree of their different importance and their impact on sustainability issues. Judging those elements in a system and assigning values involves subjective views, although some elements can be objectively calcu-

lated, such as measuring energy consumption. One of the first of these systems is Briam's building research evaluation method affiliated with the British government, which started working in 1990. Some of these other systems and their specific evaluation criteria are shown in Table 1.

**Table 1. Building evaluation and research method systems**

| System | LEED | SBTool | EcoEffect | CASBEE | Green Globes | IBEAM | BEAM |
|---|---|---|---|---|---|---|---|
| **Country** | United States of America | 28 countries | Sweden | Japan | Canada | Ireland | Hong Kong |
| **Establishment** | 1998 | 1996 | 2000 | 2001 | 2004 | 1996 | 1996 |
| **Main domains** | Stable site saving water Energy Indoor environmental quality Materials and resources Smart places and communication Neighborhood pattern and design Green infrastructure and building Awareness and education Innovation in design Regional priorities | Selecting the project site Planning and development Energy and resources Loading environment Indoor environmental quality the quality of service Social and economic aspects Cultural and cognitive aspects | Energy use Use of materials Indoor environment Outdoor environment Life cycle cost | Indoor environment the quality of service Outdoor environment on the site Energy Resources and materials Reuse and reusability Off-site environment | Project Management Location Energy Water References Emissions, effluents, and others effects Indoor environment | Energy use Indoor environmental quality Loading environment Site and shipping Water and Wastewater Materials | aspect of the site Material aspects Energy use Use of water The quality of the indoor environment Innovations and additions |

***The result of the comparison between evaluation systems:***

- Shows that there is a significant overlap between these systems.

- All systems strive to promote sustainability principles.
- His attention is focused on the building and not its beneficiaries from the first stages of the design to the higher stages.
- Systems with simple and easy ratios between buildings are determined using global qualitative scales with quantitative methods.
- Although there are differences in the method of the evaluation process, all use explicit or implicit weighting processes.
- Weighting is often obtained using surveys of large groups of stakeholders.

Buildings consume large amounts of energy, for this reason, various groups in the world have arisen to fulfill the necessity of developing and promoting techniques to achieve sustainability in buildings. Investigations showed that less attention has been paid to the non-physical and content areas of the building (Karan et al., 2021, May). The content that Schultz defines as the "spirit of the place." In most of the quality assessment systems in the world, there are no clear functional criteria for assessing the building's stability, and on the other hand, the criteria are different based on local areas (Gheitarani et al., 2024; Ghadarjani et al., 2013).

Architects today are faced with the challenge of creating buildings that fulfill all the social requirements of conventional aesthetics and functionality as well as a sustainable environment. The efforts of many architects and researchers have been focused on the production of sustainable low-energy architecture. In this case, sustainability will be a peripheral issue of architecture when it appears only as a part of architectural paradigms (Iravani & Ahd, 2021- b).

With this description, this research has drawn its theoretical framework by placing the spirit of architectural phenomenology in the research. Architects design buildings based on the basic Figures and feelings of those who live in them, and phenomenology analyzes these basic feelings. Phenomenology deals with the common and fundamental feelings of humans and their imaginations. Considering the views of Husserl and others, it should be said that phenomenology aims to explain and show phenomena with a direct approach and attention to mere consciousness without presupposing theories or papers from natural sciences or psychology (Karan et al., 2021).

Thus, phenomenology means "pure attitude" to the phenomenon of "seeing its essence." Plasma considers the phenomenology of architecture as "looking at" architecture from within its conscious experience and through architectural feeling and contrasts it with the analysis of formal aspects and the appearance characteristics of the building and its stylistic characteristics. We are looking for the "internal language of the building." From Shultz's point of view, phenomenology is a method and not a type of philosophy, a way and method that aims to grasp the structures and meanings of the life world.

***Analytical model of research.*** In the current situation, knowing the value and values effective in human decision-making is expressed in the form of absolute numerical concepts, and it is not possible to use vague and vague words like "almost" in quantitative expression. On the other hand, these words are inefficient in classical and Boolean calculations in evaluating "users' voice" as their perceptual linguistic expression. And the ability to simplify information plays an important role in describing complex phenomena.

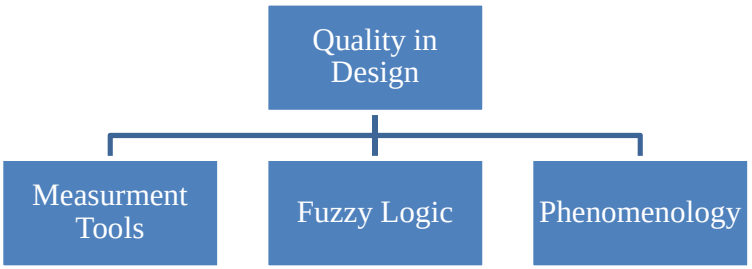


**Figure 1. Conceptual relationships of research**

The analytical model of the research, the main axis of this research, is done with the phenomenological framework with the scale of fuzzy logic. Fuzzy logic scale on the basis that local criteria in defining quality, criteria are defined and recognized based on local principles; In this regard, documentary and survey methods are used to collect criteria (Zaker Haghighi et al., 2014). A fuzzy logic scale during the research with a wider expansion of options and criteria with a non-Boolean perspective has an impact on the conclusions and increases its accuracy. In the following, the research will need to prove the adopted hypotheses, therefore, in the process, tools were used to achieve results close to reality in the "spectral" range (Kahvand et al, 2015).

**Methodology**

The type of research method of this research is based on its nature of "research and development". This is due to formulating an evaluation process of one or more [fuzzy] scientific products. In terms of the data collection method, this research is a "descriptive survey" and includes a set of methods whose purpose is to describe the conditions of the investigated phenomena and is only to better understand the existing conditions and help in the decision-making process. And also because the data collection is from a specific local perception and because a single aspect of local patterns and behavior as its specific culture can have different meanings and directly affect the results.

This research can be considered "ethnographic research with a qualitative-phenomenological nature" whose purpose is to record and describe events and processes in their natural and special conditions.

***Statistical Society***. To collect the required data of the statistical population under study, a group of people from the desired location, namely Arak city, were selected who had the experience of understanding the type of buildings similar to the buildings selected in the questionnaire. Also, these people should have been selected from general groups and not from opinionated and specialized units, especially in the construction industry, from various trades, so as not to be influenced by specialized opinions in the collection of information (Gheitarani et al., 2020).

For this reason, the final users of the buildings were selected and evaluated in the form of a cluster from all social strata. Arak It is one of the metropolises of Iran, one of the largest cities in the center of Iran and the center of the central province and the city of Arak. The population of Arak in the year 2016 was 520,944 people, which is the demographic center of Central Province and the 18th most populated city in Iran.

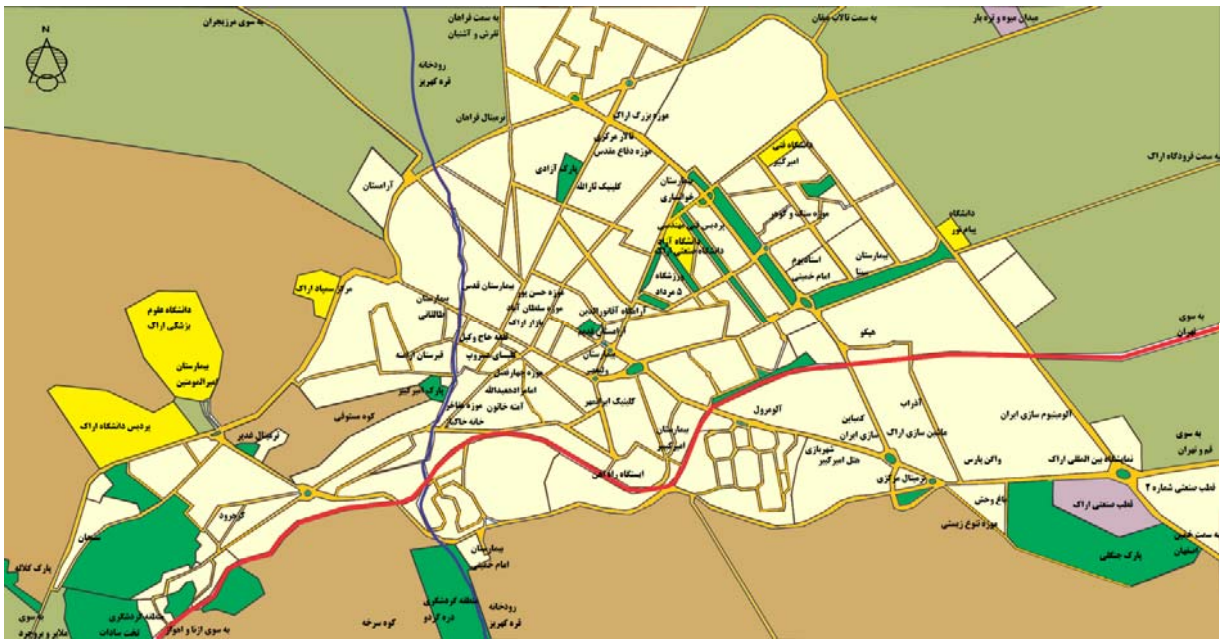

**Figure 2. The shape of the city of Arak (2024)**
**Source: www.wikipedia.org**

The city of Arak is located on the orbit of 34 degrees 5 minutes and 30 seconds in the northern hemisphere from the equator .Also, this city is located on the meridian of 49 degrees 41 minutes and 30 seconds east of the Greenwich meridian. The city of Arak has the climatic characteristics of the central plateau of Iran (cold and wet winters and hot and dry summers). The mountains around Arak, Miqan Lagoon, and Farahan Plain have influenced the climate of this region and have given it special characteristics.

***Hypotheses:***

- Quality in architecture is not only limited to the physical and technical quality of the body, but the excellence of architectural quality occurs by accepting the technical aspects and paradigms of architecture.
- Quality in architectural buildings cannot be measured.
- The users and the main beneficiaries of the buildings can be meaningfully influential in the design process.
- Qualitative user data can be translated into specialized design data.

***Multi-criteria decision-making:*** One of the most important characteristics of a human being is his decision-making power. When this decision is of special importance and the selection options depend on other parameters, the responsibility and necessity in the way of decision and selection have a special approach. The selection process in discrete spaces and single-criteria decisions is easy; but in dependent and multi-criteria decisions, it is necessary to use a suitable method to explain and evaluate the selection parameters. Multi-criteria decision-making is a topic that deals with the decision-making process in the presence of different and sometimes contradictory criteria.

Multi-criteria decision-making techniques all try to determine how the best options can be chosen from the point of view of end users and consumers with the help of characteristic informa-

tion. There are various techniques in multi-criteria decision-making, such as the hierarchical method, network analysis method, entropy method, lane map, and the method of making multi-criteria models useful, etc.

***Hierarchical analysis process.*** The hierarchical analysis process is a multi-criteria decision-making method by which decisions can be made that depend on different criteria. By hierarchical analysis, the decision-making problem is first structured, different options are compared based on the criteria raised in decision-making, and finally, the priority of choosing each of them is determined. In general, this method is used in ranking, selection, evaluation, and forecasting issues that all require decision-making . The hierarchical analysis method is one of the most efficient methods and is considered by managers and decision-makers. This method was invented by Saati in 1980 (Iravani & Dehghan, 2022).

Hierarchical analysis uses a pairwise comparison of criteria to arrive at a ranking of priorities for different options. This method has been noticed in many researches, which can be used in the development of comparison criteria for intangible issues.

***Fuzzy Logic.*** One of the basic concepts in human cognition and decision-making is correct understanding and precision in recognizing connections and dependencies. In the current situation, knowing the value and values effective in human decision-making is expressed in the form of absolute numerical concepts, and it is not possible to use vague and vague words like "almost" in quantitative expression. On the other hand, these words are inefficient in classical and Boolean calculations in evaluating "users' voice" as their perceptual linguistic expression (Mahdaviparsa et al., 2014).

And the ability to simplify information plays an important role in describing complex phenomena. Especially in human studies, the ability to summarize information, and the necessity of using natural human language, creates an inevitable role. The concept of fuzzy and fuzzy sets was presented by Asgar Lotfizadeh in 1965, which is proposed to express imprecise concepts, thus it can be used to express many human qualities. The most important point of difference between fuzzy sets and classical sets is how a member is related to the set (Khanian et al., 2013).

In classical sets, an element is either a member of a set or not, while fuzzy sets allow us to use the degree of membership for the membership of an element. A fuzzy set introduces ambiguity by eliminating the sharp boundary dividing set members from non-members so that the transition from members to non-members is gradual rather than abrupt. An object in traditional logic is either 0 or 1 in value. In fuzzy logic, a statement can assume any real value between 0 and 1 and represents the degree to which an element belongs to a given set.

In the real world, people understand and use many concepts in a fuzzy way, meaning imprecise, vague, and ambiguous. For example, although words and concepts such as hot, cold, tall, short, old, young, and the like do not refer to a specific number, the human mind understands them all with surprising speed and flexibility, and in decisions and results takes into account this is while the machine only understands numbers and is meticulous. The goals of new methods in computer science are to first learn the mystery of such abilities from humans and then teach them to the machine as much as possible or to bring them closer to classical logic;

As a result, more accurate and scientific results can be obtained. Linguistic variables do not express the exact value. Quantification based on fuzzy logic will be widely used in systems and decision-making based on monitoring. Fuzzy logic can be used to model imprecise information, such as inaccurate measurements or verbal definitions. In the fuzzifier part or the fuzzy converter, va-

riables with real values are converted into a fuzzy set through the fuzzy interface machine and basic rules, the results are transferred to the non-fuzzier part, which converts a fuzzy set into a variable with a real value. In other words, input data are often complex values and these numbers are converted into fuzzy sets.

Models are interpreted based on fuzzy logic including "if, then" rules. The truth is that after the phrase "if" a preceding logic is expressed, and based on that we examine the other truth that comes after "then" and the result of the work is explained in it. Fuzzy logic puts human experience and knowledge in front of him in the form of a combination of numbers and enables him to make a decision based on mathematics and logic.

**Results**

***Determining the initial criteria.*** Selection of factors based on existing literature, including studies on architectural quality, design quality indicators, expansion of quality performance in architecture, and post-occupancy evaluation.

The initial criteria were determined by 18 university professors and master's students in the field of architecture and library studies. After reviewing and categorizing all the primary criteria based on meaningfulness, the less frequent and similar or aligned criteria were removed. For example, "contrast" "proportion" and "view" were categorized in the "aesthetics" unit, and "inside temperature" and "insulation against heat loss" were categorized in the "energy saving" unit. Criteria such as "potential health problems" "optimal land use" and "harmony with neighbors" were removed due to the low number of repetitions. Finally, after these steps, 8 primary criteria were selected.

***Hierarchical broch analysis method***. For this purpose, a pairwise comparison matrix was used. All identified criteria and factors are expressed in a two-by-two comparison matrix that shows the relative priorities of the index. Therefore, the numerical values related to prioritization with the relative importance of one index over another should be assigned. With the research done by Saati, a range for comparing criteria was proposed, which includes numerical values from 1 to 9. So "1" indicates "equal importance" and the value "9" indicates "extremely important" of one indicator compared to another. Therefore, each of the respondents was asked to compare all 8 criteria two by two and use the numbers 1, 3, 5, 7, and 9 for comparison. These numbers will show the relative weight of the demands in the form of a matrix.

To avoid computational equations, the software was used in version 11. Finally, for the demands of the users, the degrees of importance were obtained in the form of Figure 3, and the result of the ranking of quality criteria was shown in Figure 4.

| | Details | Aesthetic | Durability | Comfortabile | Innovation | Performance | Energy Efficiency | cultural aspects |
|---|---|---|---|---|---|---|---|---|
| Details | | 1/01 | 1/85 | 3/94 | 1/6 | 6/22 | 12/87 | 1/61 |
| Aesthetic | | | 1/47 | 1/38 | 2/03 | 2/19 | 1/0101 | 1/3 |
| Durability | | | | 1/23 | 2/4 | 2/45 | 2/3 | 1/97 |
| Comfortabile | | | | | 5/82 | 1/33 | 1/89 | 2/66 |
| Innovation | | | | | | 2/09 | 4/99 | 3/5 |
| Performance | | | | | | | 1/45 | 1/25 |
| Energy Efficiency | | | | | | | | 3/28 |
| cultural aspects | Incon: 0/07 | | | | | | | |

**Figure 3. Average rating of pairs of criteria –software**

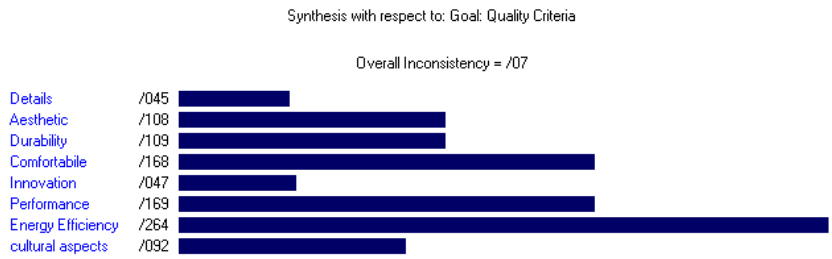


**Figure 4. The result of the ranking of quality criteria - software**

***Fuzzification.*** Fuzzification means converting valuable numbers into fuzzy numbers. Fuzzification can be done in different ways, and for this purpose, various formulas and functions have been provided. The types of common methods are mentioned below.

1- Direct calculation
2- Inference
3- Order of sizes
4- Angular fuzzy sets
5- Neural network
6- Genetic algorithms
7- Inferential reasoning
8- Flexible donor
9- Fuzzy statistics
10- Multi-base

Since the description of the features of the subject by humans is vague and qualitative, the fuzzy set theory contains fuzzy descriptors, and in the fuzzy state, the classification of the features of the object is achieved by fuzzy sets and qualitative judgments. Among the 120 questionnaires presented to the users, the total number of complete and reliable answers was 92, and this shows a participation rate of 76%. The questionnaire includes three modern buildings that won first place in national competitions in 2012 and 2011 and a traditional building owned by Iran's Cultural Heritage Administration, which represents the lifestyle before the introduction of technology into the construction industry.

At first, the respondents assigned a degree of importance on the mentioned verbal scale to each of the building quality factors found in the first phase. While all factors were rated preferentially by the audience, it is believed that the audience in search of architectural quality in a given building is familiar with its space or similar and has had the experience of being there. In fuzzification, value 1 was considered "very good" and value 5 for "very poor". In this way, the method of comparison has not been used; In such a way that two or more buildings can simultaneously have a rating such as "good" in a certain criterion.

***The results of fuzzification.*** The average results obtained from the questionnaires with the variable "raw weight" are shown in the table below.

***The ranking is based on quality score.*** After collecting the fuzzy weight differences of each building concerning each criterion, it still cannot be used as a ranking. Because each of the selected criteria has different weights we will need the following equation to get the final weight:

Final weight = [1 – Standard weight] * Raw weight

Where the raw weight is equal to the results of fuzzification for each building in each criterion. The weight of the criterion is equal to the weights obtained in the first phase of this research for each criterion in the Figure. It has been shown. The final weight is equal to the measurement criteria and is accepted as a quality score. After collecting the answers and fuzzifying them including the equations, the results were obtained according to Table 2.

**Table 2. Final results**

| | **Building 1** | | **Building 2** | | **Building 3** | | **Building 4** | |
|---|---|---|---|---|---|---|---|---|
| | **Raw Weight** | **Final Weight** | **Raw Weight** | **Final Weight** | **Raw Weight** | **Final Weight** | **Raw Weight** | **Final Weight** |
| details | 2/23 | 2/13 | 4/59 | 4/38 | 2/89 | 2/76 | 2/33 | 2/22 |
| Beauty | 2/79 | 2/49 | 4/57 | 4/08 | 3/84 | 3/43 | 3/8 | 3/39 |
| Durability | 2/91 | 2/59 | 3/73 | 3/32 | 3/39 | 3/02 | 1/68 | 1/50 |
| Convevenience | 2/35 | 1/96 | 2/99 | 2/49 | 3/86 | 3/21 | 3/39 | 2/82 |
| invention | 2/79 | 2/66 | 3/28 | 3/13 | 2/83 | 2/70 | 1/4 | 1/33 |
| Function | 2/9 | 2/41 | 4/02 | 3/34 | 3/99 | 3/31 | 2/63 | 2/19 |
| Energy | 4/56 | 3/36 | 4/81 | 3/54 | 3/78 | 2/78 | 1/7 | 1/25 |
| Cultural aspects | 1/5 | 1/36 | 1/47 | 1/33 | 1/52 | 1/38 | 4/77 | 4/33 |
| Total | 22/03 | 18/95 | 29/46 | 25/61 | 26/1 | 22/59 | 21/7 | 19/03 |

**Discussion and Conclusion**

In the first phase, the results showed that energy saving is the most important criterion in terms of building quality by a significant margin. This issue is something that is confirmed in the reviews carried out in the global sustainability assessment systems and is at the center of the attention of experts and users. The next rank in this review is jointly achieved for "performance" and "comfort". This is while the criterion of "aesthetics" is in the next order. This will show that the users' view of housing has become technical and functional rather than an elegant and symbolic building. Therefore, designers as well as sustainability assessment systems and others should increase their attention to the amount of acceptance of the building about human performance by life patterns. In this research, a novel approach has been introduced to introduce architectural quality criteria and distinguish the quality of given buildings, and the possibility of ranking the buildings has been made possible.

In the second phase, without entering the weight of the criteria and the ranking of the buildings according to the raw weight, it is as follows:

Building 2, Building 3, Building 1, Building 4

But the ranking according to the final weights is as follows:

Building 2, Building 3, Building 4, Building 1

And also in checking the table we can see that building 4 ranks last in "energy saving" (as the weightiest criterion), but by applying the weights of the criteria, this building ranks third. This result was obtained when the minimum and maximum difference in the weight of criteria was equal to 22%. [0.264 - 0.045 = 0.22] According to that, this result has been faced with a small influence on the weight of the criteria. The highest amount of weight difference in buildings is related to the criterion of cultural funds, in which the traditional building ranks first.

In this way, it can be said that today's buildings have not been able to emerge from the local culture. It should be mentioned that according to the table, traditional buildings have a good level of "comfort" compared to buildings 1 and 2. Another significant result of this research is the participation of 76% of consumers in answering the questionnaires.

This paper shows the importance and attention of users to quality issues in building and also their trust in research and scientific methods. This amount of participation can be an important investment for housing decision-makers.

From what has been obtained so far, architectural design will be devoid of quality without considering the human content. In this chapter, using the discussed issues and the results of the questionnaire in line with the goal of architectural design, a bed in the ancient context of Arak City was selected and traditional patterns were used to complete the design process. Plan site. The chosen location is in the historical and cultural context of Arak, on Shahada Street. In this context, due to the existence of cultural and social potentials, the conditions for content research are necessary.

This site overlooks the historical site of the church under the possession of cultural heritage from the north and Shahada Street from the south. Its proximity to Tare Bar market, traditional covered markets, cultural centers such as mosques and shrines, sports such as Zorkhanehs, and educational centers such as libraries and schools have added to the locational value of this place.

Due to its dilapidated and inappropriate texture, this place is considered one of the necessary places for the reconstruction and revival of residential buildings. The topography in this place with a difference of 4.5 meters in the north-south axis has added to the mountainous features of this site. Figures 4 and 5 show the site plan and figure 6 shows an example of ideation. In the following, the plans and shapes of the designed building type are included.


**Figure 5. Design site**

**Figure 6. design site**

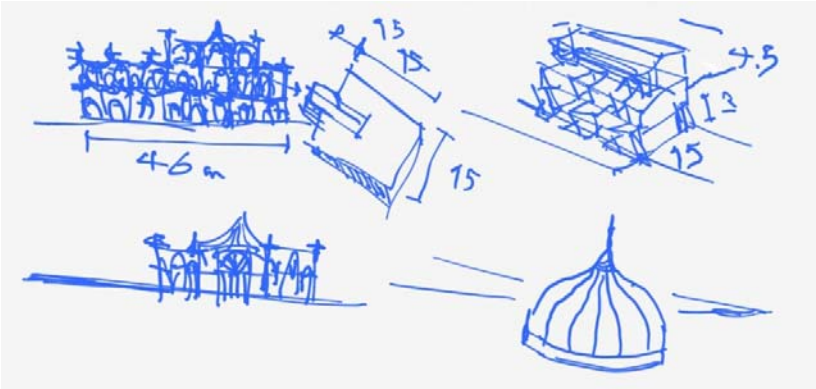


**Figure 7. Ideation**

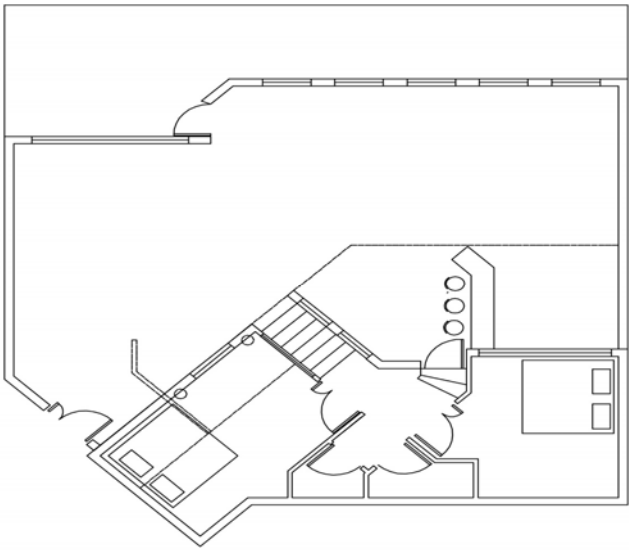

**Figure 8. 1st-floor brigade plan – scale 1/100**

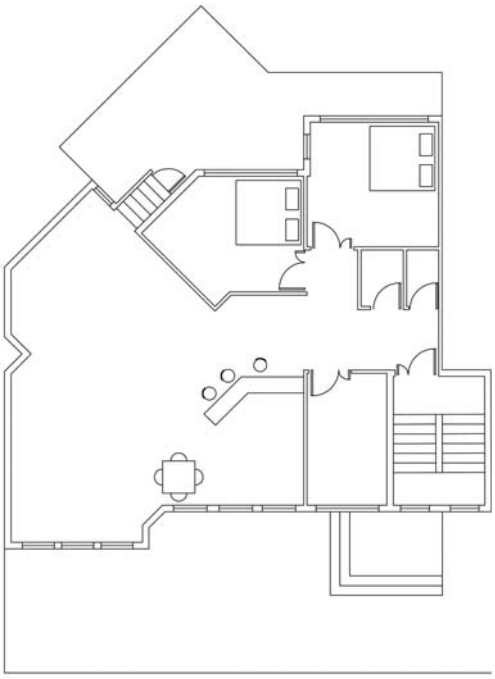

**Figure 9. Floor plan of the brigade - scale 1/100**

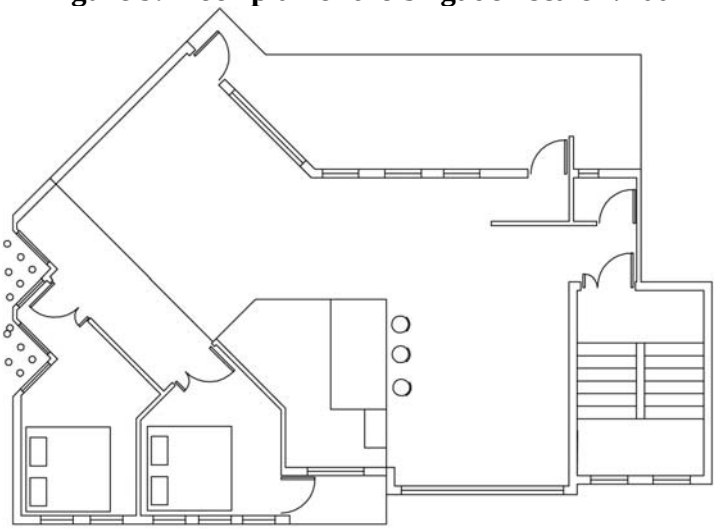

**Figure 10. First-floor brigade plan - scale 1/100**

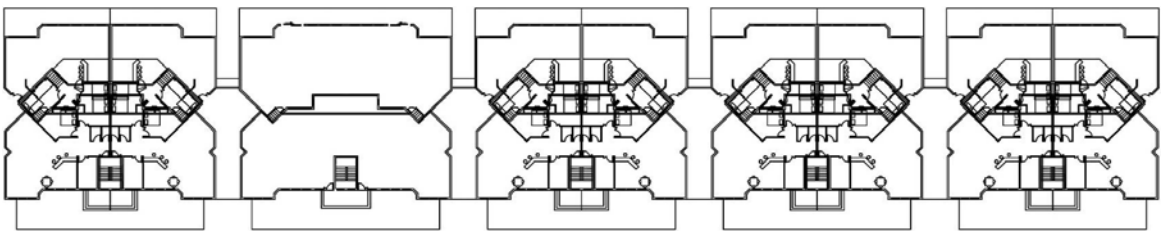

**Figure 11. site plan - scale 1/1000**

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