

Investigating the Role and Place of Computer Software Programs in the Creative Design Process

Qader Bayzidi, Yousef Hamejani, Bayazid Golabi, Babak Motiei

Abstract

With the rapid advancements of the technology since the second half of the twentieth century and subsequently the appearance of the computers we have seen its applications in a verity of arenas. Since that era computers have been utilized in the construction and building industry, and their application in architecture has been considerably growing. Nowadays computers have become one of the major tools; being used by architects and engineers in design. Design, however, is one the key activities of humans and is a creative task, and the process of architectural design holds a very complex and vague structure. The emergence of new computers and software technologies in the process of architectural design has brought about challenges, advantages and a new story in producing architecture works. Yet the idea of full replacement of the computer software programs with the creative mind of the human in the whole design process is still a vague thought and has left many questions unanswered in this regard. Drawing on an analytical-descriptive approach and by exploring the potentials and capabilities of the technology in the case of the modern technology of software programs, attempts have been made in this study to identify the role and place of such software programs in the process of creative design. Last but not least, the study seeks to put forward effective solutions with regards to role and place of the application of such software programs in improving the quality of architectural design process.

Key words: computer software programs, creativity, architectural design, design process.

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Introduction

In the ongoing era the humans have observed the emergence of technology in all the levels of life. Digital technology, information and communication technology and computers are examples of such technologies. Information technology and computers have made many cultural, social and economic changes in human life. Architecture is also one the main affected fields. For one thing, due to the effects of the media power and cyberspace; on the other hand, the complex, philosophical concepts, which are often a sign of the advanced sciences, the new evolutions in the current era have increased the complexity of the process of analysis, imagination and production of the modern architect's mind. Utilizing computers as an affecting tool in the design process and producing architectural works has been increasingly growing, and the packages of computer software programs could easily perform all small and large-scale, complex projects (Kheirollahi, 2013: 72). Put it differently, nowadays, the architectural design, production processes, its tools, ideas, theories, methods and formats have all been dramatically affected and shaped by computers and communication technology. The ever more growing application of the computers in the context of architecture and engineering design has been one of the remarkable accomplishments by the humans. Such an accomplishment has been created to promote the design process and to maximize the efficiency in the different stages of construction. With the appearance of the computers in the early 1960s we have seen its applications in a verity of arenas. Since that era computers have been utilized in construction and building industry and their application in architecture has been considerably growing. Nowadays computers have become one of the major tools; being used by architects and engineers in design process. Many studies have been conducted on computer aided design (CAD) and computer aided architectural design (CAAD) in recent years, such studies demonstrate that the emergence of the computers into the design process takes place in three stages namely: the initial architectural design, drawing and presenting the sketch (Shekouhi Dehkordi, 2012). This research aims to find the real role and place computer design in the architectural design process.

Statement of the Problem

The ever more growing application of the technology has brought about big evolutions in various levels of human life. In this regard, the recent advancements in the fields related to computers and computer software programs have brought about a great deal of evolutions in the systems, approaches, computer design tools in a verity of areas; the architectural design also made use of these evolutions. But design is one of the significant activities by human; being a creative task. The architectural design process holds a very complicated and unclear structure. During the design task, the architects are occupied in three levels of activity namely: 1.skills 2.knowledge 3.Tools (Hashemnejad et al., 2014: 29). The design process, thus, is utilizing different tools with the range of knowledge which is controlled by the designer's skills. With the emergence of the computers (and the new technology of software programs) in the process of architectural design, new challenges, advantages and a new story in producing architectural works have raised (Golabchi, 2011); yet the idea of the full replacement of the computer software programs with the creative mind of the human is still vague and has left many questions unanswered in this regard.

Main Research Questions

What is the place and role of computers software programs in the process of architectural design?
Do using computer software programs in the process of architectural design promote its quality?

Do architects accept to employ the new computer technologies in the whole process of architectural design?
How will the usage of computers be affective in the process of creativity and solving the design issues?

Significance of the Study

In the last decades of the twentieth century and by entering the twenty-first century the rapid advancements of the technology in all arenas in particular in computer technologies have affected all the scientific and educational areas in the world and have made extensive changes in them as using such technologies as the main design tools has found its right place in teaching skills and techniques, and has become an inseparable part of design and training. The architectural design is also one of sorts of design process which has been affected by these new technologies. As a result, the presence and place of this phenomenon should not overlooked in this part of sciences and arts. It is, thus, appropriate to offer effective solutions in promoting the quality of the architectural design process through investigating the potentials and capabilities of the technology in the case of modern computer software programs and the way it is employed in the creative architectural design process.

Objectives of the Study

This study does not aim to achieve a comprehensive perspective or to present an in-depth approach in architecture. Its purpose is to determine a direction for design so that the design process could be done more creatively. Thus, the way of interaction with computers based on this research's theory could improve and extend the mental imagery, and broaden the thoughts of (imagination) the designers, and promote the creative design.

The chief aim of this study is to investigate the effects of using computer programs in the process of creative architectural design, and other aims are as:

- finding the real place of software programs in the different stages of the architectural design process
- investigating the software program interaction and the concept of creativity in the initial stage of design

Research Hypotheses

- It seems that using computer software programs instead of manual tools in architectural design is inevitable.
- It seems that using computer software programs in architectural design could have positive effects on the final product.
- It seems that a special attention should be directed toward using computer programs in the initial stages of architectural design (the stage of idea and concept design) that is the key phase in expressing design creativity.

Methodology

Methodology speaking, this study is practical and is "deductive reasoning" since the current study intends to achieve the paradigms and items related to the creativity in architecture and its mental image. It also employs the strategies of "analytical-descriptive" which holds a qualitative approach. The data are acquired through library research and document analysis to fulfill the objectives of the research.

Design

Design is the first and key strategy for imaging the designer's thoughts and reflections which has been explored, evaluated and analyzed from various perspectives. Several definitions have been offered for it; in this section, some are mentioned:

Design has a heterogeneous process; as often as not its approach, strategy and methodology are influenced by personal experiences, designers' socio-cultural backgrounds along with the technical and economic conditions of the society. Design is reliant on both the designer's creativity and the methodological principles. These principles depict a verity of orientations and the choice of design process. ... though as a proven fact, the inspiring and internal motivating elements in design are vital (Yourmaka et al., 2015: 2). Design is process which transforms, renders, and interacts with the internal ideas and comments of the designer through sketches (Tang, 1991). Most designers believe that design is not a consistent process; in fact, it is an individual activity though it is also a collective task; it is sometimes clear but sometimes vague, sometimes quick, but sometimes too slow, it is both exciting and boring. In sum, it is a human activity rather than a mechanical task.

Architectural Design Process

Design is a device by which the architect could express and show his knowledge accompanied with creativity which is expected to be in the service of offering facilities and promoting the quality of life for a group of people in a given society (Khiabani, 2011: 45). The design process is composed of process and activities that the designers consciously or unconsciously perform so that they could present their mental findings in a definite frame (Ibid, 50). Therefore, the design process could be considered as changes in the process, and moving from uncertainty and lack of knowledge towards acquiring knowledge and information. Architectural design comprises different stages, and the final product and its quality depend on the content knowledge of the designer and the way the designer makes use of this knowledge in the form of creative thinking (Kheirollahi, 2013: 71). Architectural design is a creative, determined and repeatable process intending to determine identity information and to evaluate different solutions for providing the requirements of the project in question (Mahmoudi et al.: 8). The creative process of architectural design begins with the identification of the project in the human mind in that there is a dynamic interaction with the mind of the architect and the real world so that the subject at hand is full understood., and building on the results obtained from the analysis, the necessary and affective items are chosen (Khaibani, 2010: 14). The design process can be defined a process determined in many ways and with different contexts of generalizability. In architecture the designer's design process consists of many decisions and their stages of development, and finally an imaginary concept being formulated is originated from a fact which would be established in the future (Shiremberg, 2005: 7) Since the nature of architecture is art and is reliant on the creative and imaginary abilities of the designer (Falamaki, 2002: 69), the process of architectural design holds various

stages in that each has its own results and personality. Sometimes these stages are performed consciously and as often as not partly consciously (Kheirollahi, 2013: 72). In his book *How Designers Think* Bryan Lawson, after presenting and analyzing different diagrams from scholars of the field design, displays two diagrams (Figure 1 & 2) of design process. These diagrams are probably far too much of a simplification of what is clearly a highly complex mental process.

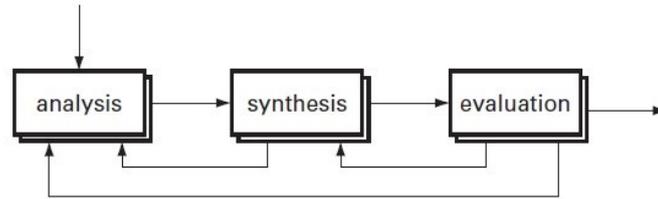


Figure 1: A Generalized Map of the Design Process. Source: (Lawson, 2013: 49)

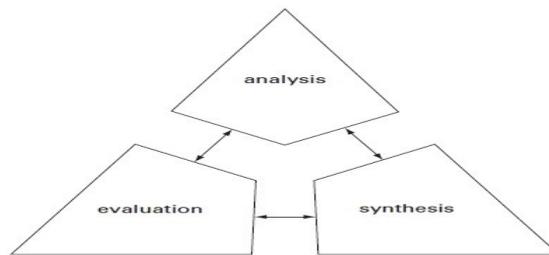


Figure 2: A More Honest Graphical Representation of the Design Process. Source: (Lawson, 2013: 50)

He regards this process as the interaction between problems and solutions through analysis, synthesis, and evolution (Lawson, 2013: 61).

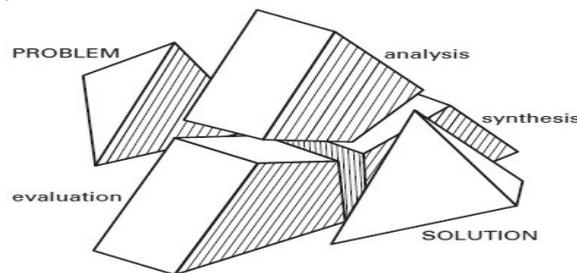


Figure 3: The Design Process Seen as a Negotiation between Problem and Solution through the Three Activities of Analysis, Synthesis and Evaluation (Lawson, 2013: 61)

On account of what was stated previously, it can be said that architectural design is a complex, creative and mental process which is dependent on practice and skills; trying to reach solutions from problems.

Creativity as the Base of Design

As it was seen in the previous sections, creativity is a fundamental word utilized widely in determining the process of architectural design and creative training. Thus, recognition and definition of it seem to be necessary in this research simply because it can create an accurate understating of the role and place of it in the architectural design process. Creativity was adopted from the verb *create* meaning to make something exist or produce (Dehkhoda, Vol. 21, 1968: 677). In defining creativity, Dehkhoda points out: creativity is one of the adjectives attributed to God Almighty, and the creativity ability is a power resulting in producing novel ideas (Dehkhoda, Vol. 21, 1968: 677). Most scholars who defined creativity regard it as an appropriate, proper and unique response to solving the issues and problems. The dictionary of psychology defines creativity as: creativity means the ability to find uncommon and perfect solutions for problems (Eysenck, 2000: 240). According to this definition, a creative person is who differently reacts to all direct information and data we all have got (Edward, 1998: 34). To express differently, creativity marks coming up with fundamentally new and infamous solutions which could overcome the problems and issues much better than the past could do so (Mahdavinezhad, 2005: 57). Creativity is a process making the power of imagination is formulated in the world. As a process, creativity has universal and ultimate characteristics formulating the performance and ultimate of the things and realities (Antonidas, 2011: 35). Frank Lloyd Wright defines creative imagination as "the humanistic light in the human kind" and considers the creative entities as they were related to Gods. "A creative person is the creator, and there are not many Gods" (Ibid: 39). When defining architecture Le Corbusier grants a special place for creativity; that architecture created in a moment of creativity is deniable. When the mind is engaged with guaranteeing the solidity of building and also meeting the requirements of comfort and convenience, it is motivated to achieve a goal bolder than fulfilling requirements being solely functional. The mind is prepared to expose the potential abilities provoking us and grant us joy and happiness (Khiabani, 2011: 20, as quoted in Clarke, 1990). Architectural design is a type of

creating; and in fact creating means creativity that leads to creations of a new element; in plain English, in the process of architectural design formation, creating implies achieving creative thinking in an external environment. But for performing creating, the designer may require suitable tools: exposing himself to limitations through tangible and intangible elements. Tangible elements can be learned; hence, demand particular attention. Intangible elements, however, cannot be seen; thus, should be sought. The architect is supposed to find them in the mind of the employer. He should carefully take into account all human, spiritual, metaphysics factors, signs and words meaning, language, ideas and superstitions and phantasm of the employer (Antonidas, 2011:43). In other words, in architectural design process, the designer's creativity and his sound knowledge of the project at hand could generate an efficient architectural work; to put it differently, although having some knowledge of the required spaces, the number of costumers, the objectives and requirements of the employer, individual and social characteristics of the end-users, cultural, political and social features of the project's final place, natural and regional factors, materials and the available technologies, economic elements, fuel consumption specifications, building maintenance expenses, knowledge of the spiritual, social and identity values of the building position, and so forth, knowledge of the subject and project's bed is the first step in initiating the architectural design process, this is the designer's creative mind which is able to make use of part or whole of this information to yield a proper and novel response for the architectural form and space. It is noteworthy of mentioning, however, that creativity is not solely a gift from God or being a mysterious element so that it is not supposed to remain constant. In fact it is a talent which could be cultivated and developed though attempts and by acquiring skills and special techniques. Some creative persons work so hard to find special, brilliant ideas as the valuable ideas are not produced without hard working (Lawson, 2013: 183).

The Role of Computers in Design Process

As much as the designers need artistic creativity for generating rich works, they also need new methods and tools for design so that they could achieve the principal propose. As the computer tools and the behaviors related to them are increasingly growing even more than in the past, and are playing a pivotal role in all the levels of the life, design inevitably also makes use of these tools too for achieving its goals. Despite the fact in the past the architects utilized pencils and rollers as the main instruments of design, nowadays computers are playing the role of pencils and rollers for them. In addition to that, there has been a substantial growth of software programs with which the architects could analyze and evaluate their works. Some of these software programs and gadgets could enter the design process and by presenting update analysis could improve the general quality of architectural design. While in the past the design activities solely focused on space, its aesthetic features, at the moment the focus has been directed towards a verity of factors like building, energy, warmth and coolness and similar things. And natural powers are now regarded as affective factors in architecture (Khabazi, 2014: 220). The computers, too, had a leading role in emergence of a considerable amount of image equipment in design. It also helped to easily test various projects in the shortest possible time and to examine them from different angles. Computer software programs on design hold many complex capabilities, and each was offered for helping in designing to achieve a special goal, and are regularly being updated and generates more types.

Introducing Architectural Software Programs

By an initial examination among all design software programs, it is no denying that in terms of the number and verity of the applied software programs, architectural design is the foremost among the design fields. Due to the verity of the software programs, choosing is difficult. Attempts were made here to classify these software programs by taking into account their prime applications, and then the leading program in each group is introduced:

Table 1: A Classification of the Architectural Software Programs. Source: the Authors

Architectural Software Programs			
2D Drawing	Architectural Visualization	Building Information Modeling	Presentation
AutoCAD by Autodesk Company	3Ds Max Maya Cinema4D Rhinoceros Sketch Up Maxwell Indigo Arion V-ray Mental Ray Brazil	ArchiCAD Revit	Photoshop

2D Drawing

In the 2D Drawing there is no intense competition. AutoCAD, one of the main shareholders of Autodesk, was so powerfully introduced in the early 1980s that other software programs failed to overcome it. By launching a new version of the program, Autodesk presented its new abilities to the users and remedied its previous deficiencies. That is the reason why after three decades since the early version of the program, we are dealing with a program with the fewest shortcomings. In other words, it has been optimized to perform the tasks more carefully and quickly, and a considerable number of users are utilizing it in many fields. From the very beginning AutoCAD was put into practice for drawing architectural 2D maps, and now is the most basic program in architecture simply

because in comparison with other software programs this program is learnt more easily. The outcome of this program could act as a starting point for others like 3Ds MAX and Revit. However, on a superficial level many engineers and students of architecture assume that because this program is a basic one it might be very flexible and easy; consequently, they do not tend to learn it systematically. The outcome of this wrong way of thinking is that most maps have many fundamental problems though they hold a very neat and right appearance. For example, preparation of plot with the proper scale and with a special attention to the fact that such maps are used for 3D modeling is confronted with many difficulties. It seems vital for architects to master AutoCAD and to learn its capabilities.

Architectural Visualization

This group also known as 3D have got diverse software programs from different 3D packages like 3Ds Max, Maya, Cinema4D, Sketch Up, Rhinoceros, and so on to physical based rendering engines as Maxwell, Indigo, Arion, etc and Raytracing based engines such as V-ray, Mental Ray and Brazil. Such diversity leads to confusion, and time and money wasting of the architects and students of architecture, and it would be difficult for them to choose the right way. As often as not it is heard that new software programs with unique capabilities have gone to the market and would replace the other programs. Such claims bring disappointments and discouragements to those who have chosen their own way and are under the process of learning. Certainly the first choice on Architectural Visualization in the 3D packages and almost all rendering engines is 3Ds Max by Autodesk company, and the famous and desirable rendering engine V-ray by Chaos Group. All the eminent scholars of this field like Peter Guthrie and Ronen Bekerman ... work with this combination, and in Iran more requests are put in for people specialized in Max and V-ray.

Sketch Up: The design process of concepts is a project requiring tools which could easily and quickly present a 3D sketch of the project to the employer. Sketch Up by the well-known Google company is an appropriate tool for quick and easy modeling. Certainly it cannot compete with 3Ds Max in terms of quality. So if your project was rejected by the employer, a great amount of time and energy were not wasted. But if approved, you can insert the outcome into Max, and follow the rest of design there or even you could finish up the design in Sketch Up. And thanks to V-ray plugin in Sketch Up, renders with good quality can be achieved. It should be bear in mind that learning this software has an easy and short process.

Rhinoceros: Known as Rhino, this industrial design program could make NURB Base modeling possible unlike the similar programs which are Poly Base. That is the reason why this software could carefully draw bends and curves. Because modeling some particular curves is difficult (not possible) in Max and requires a profound knowledge of Topography, but Rhino could perform these task very easily and quickly. The interesting point is that V-ray also has plugins for Rhino so one could make use of this powerful render engine in this program. In addition to that, certain plugins like Grasshopper were produced for Rhino and generate the parametric modeling ability on this program.

Building Information Modeling

In recent years a new and revolutionary concept named BIM was introduced, and soon become part of building industry. In simple English, BIM means simulating the whole building in a software program. All information regarding the building such as graphic perspectives like what we observed in Max, and processing data such as the type and amount of materials used, form, size, the number of doors and windows, position and measurement of the diverse spaces are available in this simulation. One can make two choices to have BIM: ArchiCAD by Graphysoft company and Revit by Autodesk company. Again our first option is products by Autodesk. Revit with a very sophisticated approach towards object-oriented and parametric modeling, and its congruence with other software programs by Autodesk like 3Ds Max has made the task much easier. It is worth mentioning that Revit is not the only 3D modeling program and its data processing plays an important role in design and management projects. It can be guessed that Revit would have a glorious future among other architectural programs.

Presentation

For using renders and maps acquired through other programs and for presenting projects we would need a presentation program. Here our first choice would be Photoshop the powerful and well-known software by Adobe company. In addition to creating sheets, Photoshop also has some other significant applications like correcting renders or Post Production. No renders is complete without post production. It does not matter if you have mastered Max and V-ray, the final outcome would not be a professional, photorealistic render. So for achieving the most fruitful result, some modifications should be made on render in Photoshop. Such modifications could bring the improvement of the colors, gamma, contrast, white balance, adding Vignette or Chromatic abbreviation or adding figures and personage to the render. Such capabilities have made Photoshop as one the fundamental software programs in architecture. It should be bear in mind that the render outcome of the 3D program could meet up to 50% of our expectations. The rest could be fulfilled in Photoshop. And our last recommendation is that in addition to the introduced fields and programs, there are other software programs like DIALux for lighting, Lumion for Real Time render and so forth that the students of architecture could learn. However, learning the previously introduced software programs is a must for all architects and students of architecture. Mentioning this classification and software capabilities clearly show this fact that improving and promoting the overall quality of creative process of design is an inevitable matter. On account of what was said and the significance of teaching architectural design software programs, designing manually or by computers is still a challenging point in higher education in Iran and the trainers hold different points of views about it. Although many trainers accept the use of computers in whole process of design, for some the focus is on manual design. The latter holds this belief that architecture as an art is an individual task, and the designer is expected to make a detailed use of his individual abilities. Different points of view in this case, and the lack of formulation of training programs due to these

controversial ideas have made students of architecture confused, and utilizing the modern technologies is also confronted with problems. Also nowadays there is not a clear pattern of training at universities and students with considerable talents and creativity capabilities are not effectively trained, and they resort to computers for filling their mind gaps on design. What is unquestionable here is that based on the increasing growth of the computer technologies in all levels of science and art, learning these software programs appeared vital and inevitable for the architects. As alluded to earlier, their applications would have leading roles in improving and promoting the quality of design process. But the fundamental issue remained here is the place of this technology in the architectural creative design process, and addressing these questions: Can the whole process be done by the computer? Is the computer a good replacement for the human in the whole design process? For answering the raised questions and identifying the place of this technology in the architectural creative design process, reminding the comprehensive definition of the architectural creative design process seems necessary here: "architectural design is a process which is mental, creative and complex and for achieving a solution for the problem it is reliant on practice and skills". Based on the aforementioned definition and according to Table 2 concerning the features of the initial stage of design process it is concluded that accelerating the initial creation process by the computer has some disadvantages.

Table 2: Features of the Initial and Final Stages of Design

The Main Stage	The Initial Stage of Design	The Final Stage of Design
Presenting the problem	Vague	Clear
Actions	Exploratory: -Sketching -Schematic design - scale model design	Comparative: -Exact design -Design with details -3D modeling
Activities	Exploring the problem (to diverge) -Alternative production and explorations - Transforming ideas (not necessary for generating ideas) -General information is considered -Raw simulation (Interpretation and explanation in time is possible)	Comparative description of the problem (to converge) -Testing a particular solution -Complexities of the idea with more details -Special information is considered -An exact definition

Because if the right time and place are not provided for formulating and imagining the ideas in the initial stage of exploration, and to be dependent solely on the speed and power of the computers, no satisfactory result is obtained. We should learn that we must depend on our own mind and creativity. Creation is a phenomenon which cannot be acquired just through academic training or experiences at work; creation is an event which occurs inside the human and makes him visualize his results from the real world; in this stage one can utilize computers to materialize the architectural ideas. Training one's creativity capability is a fundamental pillar of teaching art and architecture, and accidental results of the computers for architectural design should not be regarded as creative tasks.

Conclusion

Architectural design is a process of creation and ingenuity, but creativity is a talent which could be developed by knowledge and skills; one of these skills is having knowledge of architectural software programs on design. The widespread use of computer tools and technological techniques in today's world, and their applications in other sciences and arts have been seen as an urgent need. This application enables the architects to have careful deliberations through digital devices before initiating the project. Software capabilities have enabled carrying out projects which were used to be impossible. Via this approach rhetorical aesthetic enters architecture. The effect of technology and its effects on architecture are inevitable, and with some knowledge and great command of it one could increase the power of design. Notwithstanding this, not only most architects are not familiar with advancements of technology and computer sciences, but also they are not able to communicate with them. But as mentioned before, technology is approaching us; thus, it should be warmly welcomed as our world, beyond any doubt, is evolving. In fact, the computers in architectural design- irrespective of their role as a designer- have always been propounded as a catalyst which are a great help for the architects in selecting the effective solution and in accelerating achieving the final purpose. That if it is possible to fully replace the designer with the computer in the design process is still questionable; as a matter of fact, in spite of computers' principal role, it cannot perform the design process without the designer's help and interference. For the reason that the decision making process, presenting different alternatives in response to different issues in design, and the initial phase of creativity are done in the mind of the designer, but the role of computers is accelerating the process and prioritizing those alternatives. To put it differently, in spite of the emergence of media like computers and also their applications in architecture, and that most activities in the process are done by them, they have not been able to exclude the designer and its creativity which is the product of the designer's mind from the process. It could, however, have positive effects on its development and productivity. Based on what was stated in the section discussing the role and place of technology of computer programs in architectural training, it is recommended to the trainers not to engage the students with the design by the computers from the very beginning of their education. But they should learn that learning computers is an urgent need so that in the next stages they would become more familiar with software programs and computer sciences. Moreover, by having a perfect command of each program capabilities, they could develop and promote their ideas and level of creativity.

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Qader Bayzidi, Assistant Professor, Department of Architecture, Sanandaj Branch, Islamic Azad University, Sanandaj, Iran

Yousef Hamejani, Bayazid Golabi, Department of Architecture, Mahabad Branch, Islamic Azad University, Mahabad, Iran

Corresponding Author: Q_Bayzidi@yahoo.com

Babak Motiei^{PhD}, Researcher, Department of Architecture, Sanandaj Branch, Islamic Azad University, Sanandaj, Iran