

# Feasibility of Sustainable Residential Design by Using New Technologies in Sari

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## ABSTRACT

Research and innovation and the use of different source of energy are the most important factor in the progress of human societies. One of the issues that have been raised is that if it is possible to build the construction by utilizing the new technology, and are these buildings accepted by a particular sect or not? The aim of this study was to investigate the possibility of using new technologies in the design of residential in city of Sari. This study used descriptive and applied research. The study was done on 200 residents, 60 staff and instructors who were expert in this fields. They were selected through direct simple random sample questioning. After collecting the data through questionnaires by using SPSS software and the correlation coefficient, the relation between variability of study was analyzed. Statistical test result shows that how the variables were defended, the significant result was shown between cultural patterns, Sari geographical elements, people awareness and people's information about benefits of optimizing by feasibility of designing by using new technology in Sari of city with 99% (percent) confidence. But there was not other significant relation with other variables. Such that 64%, 62.5%, 72.5%, 66% of respondents evaluated the impact of these factors far and too far on Sari citizen welcoming to new technologies in the design of complexes residential.

**KEY WORDS:** Building, New Technology, Sari, Sustainable Architecture.

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## 1. INTRODUCTION

Manuscript Sustainability and design in compliance with the environment is among the most important and vital issues discussed in architecture. Sustainability in the field of architecture must take steps in codification of criteria and standards having emphasized the consumption of the minimum energy, utilization of renewable materials, energy maintenance and renewal without creation of pollution [1]. Subject of sustainable development has been brought about in different sciences and professions including architecture and Urban Development for some decades [2]. Researches and inventions and utilization of different energies have been among the most important and fundamental steps having been taken by human beings during history for the development of their societies [3].

Identification and utilization of approaches for compatibility with the climate cause the building to have better comfort. All these approaches are on the basis of utilization of forces of the nature in order to make sustainable comfort condition in architectural space [4]. On one hand, sustainable architecture must be taught to all and "access to scientific knowledge regarding natural resources, ethical principles, values and skills in line with the objectives of sustainable development and popular participation in decisions making are the objective of this education [5]. Research and study about building design methods and offering appropriate suggestions for establishment and maintenance of the urban environment in good quality is effective in achievement of architectural objectives [6]. Coordination with sustainable development and energy efficiency and saving and utilization of new clean and renewable sources of energy are the points that architects and designers must consider in buildings' and places' design and architecture [7]. For this reason "specialists attempt to invent approaches to cope with inclement weather and utilize natural energies through utilization of special architectural methods in order to decrease the increasing consumption of fossil energy [8]. Energy section, whether as energy supplier necessary for the society or as one of the main elements in economic and social development plans, has been considered very important. On this basis, it is attempted in different countries to find some approaches for optimal use of energy and decrease of fossil fuel consumption and to utilize new energies [9]. On the other hand, "continuous increase of population has confronted the countries of the world with the problem of lack of energy even more than before and has threatened the human beings life. On the basis of the presented statistics, 15%-20% of the total consumed energy has been dedicated to buildings consumption especially residential space and this affair has imposed a lot of cost, destruction of natural resources and fossil fuels and environment destruction in large measure. Fossil fuel consumption in residential places for providing hot water to be consumed and supplying the heat necessary to make the home hot are one of the most important elements polluting the environment in our country, Iran, and the number of individuals consuming fossil fuels has been increased due to the growing influx of people movement from rural to urban areas. We can solve this problem through implementation of the principles of environmental sustainability [10]. Energy crisis in 1994 and 2000-2002 and much dependence on energy consumption in industrial countries have attracted the attention of these countries in order to pay attention to dependency. The consequences of high energy consumption and their understanding of these

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consequences have caused their attention to be paid to sustainable development problem in order to overcome the environmental restrictions through their utilization. Getting insured of the proper usage of energy for a specific objective is one the important aspects in increasing energy efficiency [11]. Considering the above cases, nowadays most developed countries of the world have paid attention to the approach of design on the basis of energy efficiency [12]. And we can “present appropriate approaches for design of the residential units in a way to respond to and meet people’s needs and make a development in architecture of city and our country Iran through utilization of new technologies” [1]. Housing architecture must be in a way that renewable energy such as airflow and sunlight to be used properly and efficiently [13]. Discussion of architectural design is one the approaches that can be pondered and in which it has been attempted to present principles having been obtained from an ingenious combination of traditional and modern methods of the contemporary design [14]. Considering the attainment of new methods in the technique of new materials manufacturing and production, significant advances have been achieved in the field of construction. However, among a wide range, some materials have some features and privileges in comparison with other components. These kinds of building materials have taken steps beyond saving the energy consumption, one of the important categories in the field of building construction, and they have attained the stage of energy production [1]. Iran has been one of the richest countries of the world in terms of various energy sources, since on one hand it has extensive resources of fossil and non-renewable fuels such as oil and gas and on the other hand, has great potential of renewable energies including the wind. Utilization of wind energy in buildings design must be considered with the development of environmental viewpoints and thrifty strategies in exploitation of resources of non-renewable energies [15]. In order to use the wind energy properly, window openings in facade of the building must be distributed properly. Amount of windows area in fronts of East, South and West 15% of the room infrastructure area and the window infrastructure can be increased to 30% of the room area in the case of utilization of double-glazed windows [16]. Solar energy is the indirect source of majority of energies, of course, with the exception of geothermal energy, fusion and nuclear fission. Even the fossil energies are indebted to sun for their origins because fossil resources were sometimes live plants and animals whose lives were dependent of the sun [17]. Heating the buildings through the utilization of solar energy was a new opinion having been brought about in 1930 and attained significant progresses in one decade. The first solar house was built in 1938 at Massachusetts Institute of Technology of America [18]. Solar cell technology can be observed in the majority of constructed buildings in small and big cities of the world. These cells have been placed adjacent to each other in big pages and transform sunlight into electrical energy. We can introduce combined floor heating system and solar water heaters as an optimal system among the applications for solar energy [19]. Smart window having been actually considered a chromic device has attracted a lot of attention as an appropriate material for window manufacturing in the recent years. We can easily select the amount of transmission or absorption of light by the glass to the level we desire [20]. In other words, “smart windows have been installed on the basis of the system and the control system controls windows’ opening and closing automatically considering the humidity change and wind speed” [21]. A large part of window is Glass. Window’s glass quality represents the whole window’s quality. Our windows can be made up of the best materials and we need windows with long-term performance and efficiency against the heat. Insulation is also one of the methods to make energy consumption optimized. Double glazed walls are another method for insulation and they have many advantages such as low weight, more stability, and the ability to run brickwork at the same view as the façade implementation. Besides, this kind of wall shall be the most effective wall in energy consumption optimization in the case that its empty space to be filled by insulating materials [16].

A very important point in foreign walls is that filled walls shall have high heat loss, because these walls’ area is larger than the area of the windows or other parts of the building [22]. The necessity for accurate and optimal designing shall be got more important even than before considering population density and the fossil fuels decrease and high fuel costs arisen from indiscriminate usage and its subsequent pollution. Statistics have shown that provinces located at North of Iran, after the Capital of Iran, are the densest parts in urban and rural districts due to their taking benefits from natural unique and exclusive features and capabilities and considering the fact that this district has been located at energy consumption zone by TAVANIR Co. in terms of energy consumption and being very cold at the last three months of the year and the high energy consumption, designing residential units through the utilization of new technologies shall be one of the basic necessities in next years. Therefore, this research attempts to find the possibility for utilization of these technologies in residential complexes design in Sari as Center of Province in order to prepare for the arrival of the new conditions in the country due to removal of energy carriers. The result is that our country is entering a new condition in which energy carriers are removed and the fuel costs have been increased, thus the design procedures of residential units shall certainly be changed in next years. In this research we want to investigate:

- 1- To what extent people are familiar with new technologies?
- 2- Is there the possibility for utilization of these technologies in the present situation from the viewpoint of people and experts?
- 3- What obstacles and challenges are there in this way?

## 2. MATERIALS AND METHODS

This research is descriptive- analytical and it is categorized in applied researchers, on the basis of the nature, subject and the objectives predicted for that. The data necessary for this research have been collected in documentary and field methods. This research’s statistical population includes all citizens residing in Sari Districts and the experts related to the subject of research (including Ministry of Housing and Urban Development, Housing Research Organization and Municipalities of Sari as well as specialized professors in this field) of which 200 individuals as sample from first group

(people) and 50 as sample from second group (experts and professors) have been inquired directly using Cochran Formula and Random Sampling Method through questionnaire. Research variables include the effect of “people’s economic situation, cultural patterns, information transferring, Geographical and climatic factors, the level of awareness of the people residing in Sari of these technologies and traditional architectural patterns”, on feasibility of building units design through the utilization of new technologies and actions were taken for analysis of the relationships between research variables through utilization of SPSS and Correlation Coefficient Statistical Test.

## RESEARCH FINDINGS

1) Considering the growing promotion of technology at the present century, utilization of building’s new technologies has got one of the new and interesting topics in construction industry causing saving in expense, time and energy. With this assumption that people desire to utilize and exploit the new technologies in building due to lack of energy, high cost of energy consumption and environmental pollution. The results obtained from this questionnaire in this research have shown that 95.5 % of people and 100% of experts agree on this plan implementation, as a consequence, people have got completely prepared to accept buildings with new technology.

2) A glance at construction industry in the province shows that this industry, unlike other industries, has not had a remarkable advancement in terms of utilization of new technologies and needs a special approach. On the basis of this research’s initial default, economical factor has a considerable impact on the acceptance of new technologies and causes an increase in final cost and decrease in people’s purchasing power. This matter was discussed with statistical population in a way that 64.5 % of first statistical population (people) with selection of options very much and much and 51.9 % of second statistical population (experts) with selection of the same options have emphasized the effect of economic factor on the utilization of new technologies, whereas just 1% of the respondents in first statistical population has selected the option little and none. The statistics obtained have indicated that people and experts consider the economic factor effective in utilization of effective new technologies. Therefore, the pertinent authorities must dedicate supporting packages in the form of long-term facilities with low interest for implementation of these plans in order to encourage people to utilize that in new buildings design.

3) Nowadays construction around the country is in the form of copying and is done regardless of the cultural pattern of the people living in that district, while people’s cultural pattern is one of the most important components in building design. The results obtained from questionnaires in the field of cultural patterns effect have indicated that 64% of the people with selection of the options very much and much and 46% of the experts with selection of the same options have emphasized the importance of this affair. People’s cultural patterns in the City of Sari consist in tendency to live in large areas, creation of comfort temperature in residential units, making their creations homogenized with the surrounded environment, and etc., therefore, this plan’s architects and executors shall be bound to pay as the same attention to the cultural and psychological aspects as to the economic aspect, since in the condition that one plan is justified economically but not accepted by people culturally, it shall fail certainly. We can hope these plans to get successful through culturalization and their education and promotion among designers.

4) Culturalization and information transferring are important elements in acceptance of new technologies and the objective is different segments of society’s awareness of the benefits of energy efficiency and optimization in the buildings designed by new technology. Information transferring in society is necessary for each new procedure progress and development, the statistical population were asked to specify and express their opinions regarding the effect of information transferring in acceptance of new technologies in building in the questionnaire. The results have indicated that 66% of people with selection of the option very much and 87% of experts with selection of the same option confirmed this affair. The pertinent authorities shall be authorized to extend their actions in this regard in order that the prerequisites of plan implementation to be provided for people’s acceptance, considering the low level of information transferring and the fact that the topic of utilization of new technologies in our country having been newly established.

5) We can save energy through keeping up with the world’s modern architecture and application of new energies as well as utilization of Iranian Traditional Architectural Valuable Patterns conforming to Sari Climate (porch of plan’s entrance door, sloping ceiling cover, long windows to create air Curran, utilization of maximum light and ...) and also we can decrease the environmental pollution. On the basis of the results obtained from conducting research in the field of agreement with imitation and imitation of traditional techniques in buildings design through the utilization of new technologies, 53% of people with selection of options much-too much and 64% of experts with selection of the same option have dedicated the highest percentage to themselves. This means that most of respondents have considered the utilization of traditional techniques in optimization of the building effective and utilization of traditional techniques in designing the building has been very important for them. It is so important that some foreign countries have taken steps to optimize the buildings through imitating and following Iranian Traditional Architecture.

6) Pertinent authorities ought to propose some approaches for promoting the application of new technologies in construction of residential complexes by people. Several proposals and suggestions may be brought about in order to encourage people to use these methods in constructions, of which some have been discussed with experts statistical population and they have proposed approaches such as issuance of executive instructions to the Engineering Organization for residential units design through the utilization of new technologies, issuance of necessary licenses for production and manufacturing of new technologies inside the country, issuance of necessary licenses for importing of the new technologies to the country, promoting the application of these technologies through the society’s making informed, dedicating supporting subsidies to residential complexes constructors using new technologies and determining some rules

for urban dwellings (non-issuance of building completion certificate and granting the power, water, gas, etc. facilities) in order to make the utilization of these technologies in construction compulsory and binding, respectively 92.6 , 96.3, 64.8, 87, 79.6, 90.7 percent with selection of options much – too much, they have considered these factors important in order to promote people to utilize these technologies in construction and this issue needs to be planned carefully and purposefully by the government.

7) Value of one architectural space in each era and district shall be dependent of the building’s conformity to the special climate of that district. Climatic design is a method to decrease the building’s energy consumption, building design is the first defense line against building’s external climatic factors. In all weather conditions, the buildings having been made according to climatic design principles shall decrease the necessity of mechanical heating and cooling to the minimum and instead they shall use the natural energy existent around the building. The results obtained from the tables have shown that the majority of experts with selection of the options much- too much agree on the effect of Sari climatic and geographical factors on the new-technologies-based design for 78%. Therefore, natural energies and climatic conditions including solar and wind energies can be used in this regard.

8) Studies and researches done on several essays and books have indicated that the weakness in state technology is due to lack of special position in building technology in the world, the fact that the majority of new technologies in buildings having been imported indicates the governmental authorities’ little support and the insignificance of domestic investment, and all these elements interacting each other are effective in non-utilization of new technologies, this research by default knew these elements effective in not getting encouraged and interested in utilization of new technologies, the results obtained from the questionnaires have recognized effect of weakness on technology, not being supported by governmental authorities and negligence of the importance of optimization by citizens respectively for 79.6 , 99.1 and 81.5. Therefore, the above cases have been confirmed by most experts as the elements intervening in non-utilization of new technologies in construction of residential units and these shall be solved through the authorities’ responsibilities and planning.

9) First preliminaries must be provided for utilization of new technologies in buildings. Therefore, we ought to know how much technology in Iran shall respond to construction of buildings through the utilization of new technologies, then in the research conducted to investigate this issue most experts (70.4%) with selection of option intermediate believed that technology shall respond to this plan to some extent but that is not enough and some solutions must be found to promote and reinforce its level.

1-1-Second Section: Discussion (Hypotheses Test and Analysis of the Research Findings):

The primary assumptions on the basis of the presented theoretical discussions in this research have shown a significant relationship between cultural patterns, people’s awareness, climatic and geographical elements, transferring information in the society, citizens’ economic situation, traditional architectural patterns, with the feasibility of utilization of new technologies in residential complexes design in the City of Sari (as dependent variable). The analysis having been done via correlation coefficient test has indicted a significant relationship respectively with the correlation coefficient for the amount of 0.255, 0.237, 0.213 and the significant level of P=0.002, 0.001, 0.000 for the first three variables as well as correlation coefficient for the amount of 0.167 and the significant level of P=0.018, the existence of a significant relationship between the effect of information transferring and feasibility of utilization of new technologies in residential complexes design in the City of Sari, therefore, it can be said with 95 and 99 % certainty that there has been a significant relationship between the above variables, in a way that 64, 62.5, 72.5 and 66 percent of the respondents have pointed to the effect of people’s cultural patterns, people’s awareness of new technologies, climatic and geographical elements and transferring information about the benefits of optimization, to the level of much and too much, its effect on the encouragement and enthusiasm having been created among the people residing in Sari in order to use new technologies in designing residential complexes. Therefore, 5% of the error having been found in the results collected from the people’s views to be questioned can be generalized to all people residing in Sari. But, there has not been found any relationship between feasibility of utilization of new technologies with other variables whose analysis has been indicated in the following table. Therefore, considering the results obtained from the above tests, we can conclude that appropriate arrangements must be considered and provided in the form of supporting packages, investment in education section and enforcement of regulations for urban housing manufacturers and producers as requirement for utilization of these technologies in housing construction and etc. in order to promote and develop these kinds of technologies, and actions have been taken to analyze the relationships between research variables through the utilization of SPSS and correlation coefficient statistical test.

**Table 1.** Table of Correlation Coefficient Analysis between Research Variables

Feasibility of Residential Units Design through the Utilization of New Technologies in the City of Sari			Dependent Variable
Significance Level Between Variables	p	r	Independent Variables
0,01	0.000	**0.255	People’s Cultural Patterns
0,01	0.001	**0.237	People’s Awareness
0,01	0.002	**0.213	Geographical and Climatic Elements
0.05	0.018	*0.167	Transferring Information
N.S	0.532	0.044	Citizens’ Economic Status
N.S	0.633	0.034	Traditional Architectural Patterns of Sari

Correlation Coefficient Test indicates that there is a significant relationship between feasibility of residential complexes design through the utilization of new technologies and cultural pattern of the people residing in Sari (life in vast areas, creation of comfort temperature in residential units, open and non-dense residential texture for air conditioning and ventilation and disposal of moisture, homogenizing their creations with the surrounding environment and etc.). Paying attention to the life cultures and traditions and livelihood of different segments has a special importance, every district in Iran has its special custom and tradition. Therefore, it is very important to make a coordination and harmony between design and the special cultures, customs and traditions in each district, in addition to the religious beliefs and not paying attention to the above factors and the residents' not cooperating in design shall cause subsequent changes and finally waste of natural resources and energy.

Another assumption of this research is the relationship between feasibility of utilization of new technologies in designing residential complexes and people's awareness. There is no exaggeration if we claim that increasing people's awareness level and culturalization are the first and most important steps regarding energy consumption optimization in the country. Undoubtedly, successful and developed countries have considered raising the public awareness regarding optimized consumption of energy the most important factor in general impetus for energy consumption reduction and they have mentioned public media utilization as very efficient tool in this field. Nowadays it has been proven that we can contribute to preserving nonrenewable energy resources through creation of a culture of proper use and raising people's awareness and modifying consumption patterns in society. Improper use of energy consumer tools is the main reason for energy loss in our country. Therefore, teaching the proper use of energy tools in addition to other technical measures are the best method to prevent from waste of energy resources. As statistics say, students are the majority of the population of the country. Therefore, teaching these students and making them aware- as the generation bringing about the future of the society- of the proper usage of energy consuming equipment can be very effective in the attainment of the objective of energy consumption optimization.

This research's other assumptions are the relationship between the feasibility of utilization of new technologies in designing residential complexes with climatic and geographical elements of Sari. We can save energy through application of new energies in building and making the coordination between architecture and the climate, besides, we can prevent from the environmental pollution, in a way that human beings to have physiological and psychological comfort in architectural space. Concurrent use of new technologies as well as architectural principles in harmony with the climate can bring about satisfactory results in designing the residential complexes in the North of Iran.

This research's other assumptions are the relationship between the feasibility of designing residential complexes and transferring information in society. There are different methods for transferring information in the field of the benefits of optimization and building's modern technology for acceptance of new technologies in designing the buildings, and other leading and advanced countries' experience can be utilized in this field and imitating and following these countries' planning in preventing from energy waste including installation and establishment of energy consumption optimization principles educational workshops around the country, preparation of brochures and energy consumption and optimization manuals and its appropriate and widespread distribution in schools and educational centers, educational messages on billboards within the cities, the widespread use of radio, television and newsletters for transferring information and public awareness and strengthening culture of energy consumption and ...

This research's another assumption is the investigation on the relationship between people's economic status and feasibility of utilization of new technologies in designing residential complexes in the City of Sari. As table 1 shows, economic status has no relationship with the utilization of new technologies. Perhaps one of the reasons is that the majority of the city's residents are immigrants from neighboring towns or former villagers and lack of acquaintance with these technologies origins from their cultural factor and promotion of people's culture through transferring information has been among the effective approaches for people's utilization of these technologies.

Factor of traditional architectural patterns is another assumption in this research, at first they assumed that there was a significant relationship between application of traditional architectural patterns of Mazandaran Province (existence of sloping ceiling cover, long windows for air Curran, maximum utilization of natural light and ...) and feasibility of utilization of new technologies, but the results obtained from Correlation Coefficient Test in table 1 indicate that there is no relationship between these two variables. It seems that people nowadays are not very interested in utilization of traditional architecture of Mazandaran Province in designing residential complexes through new technologies due to lifestyles changes, community renewal, population age composition change, and cultural context change. Nowadays we rarely observe vernacular and traditional architecture in the district, but, buildings with metal or concrete structures and facades entirely glass slavishly following foreign architecture and separation of interior spaces only to meet and respond to the needs of the family have replaced the buildings' former features and all these points have caused loss of vernacular architecture identity being in compliance with the environment, and one of the important messages having been transferred by modern architecture is increasing construction expenses and raising the utilization of non-renewable and or fossil energies for heating and cooling and the main reason is failure to use local or indigenous materials. The results obtained from Correlation Coefficient Test confirm this issue.

The following figures indicate the general effect of the factors to be discussed in two populations to be studied.

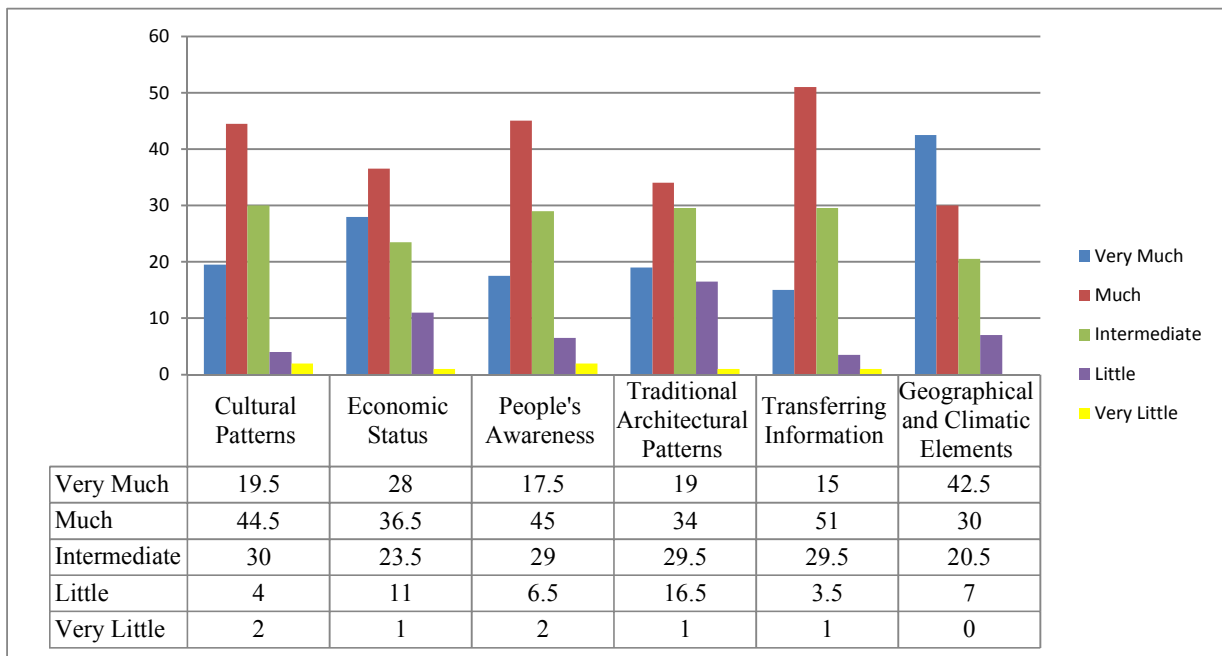


Fig. 1. Investigation of Different Elements in People’s Opinion

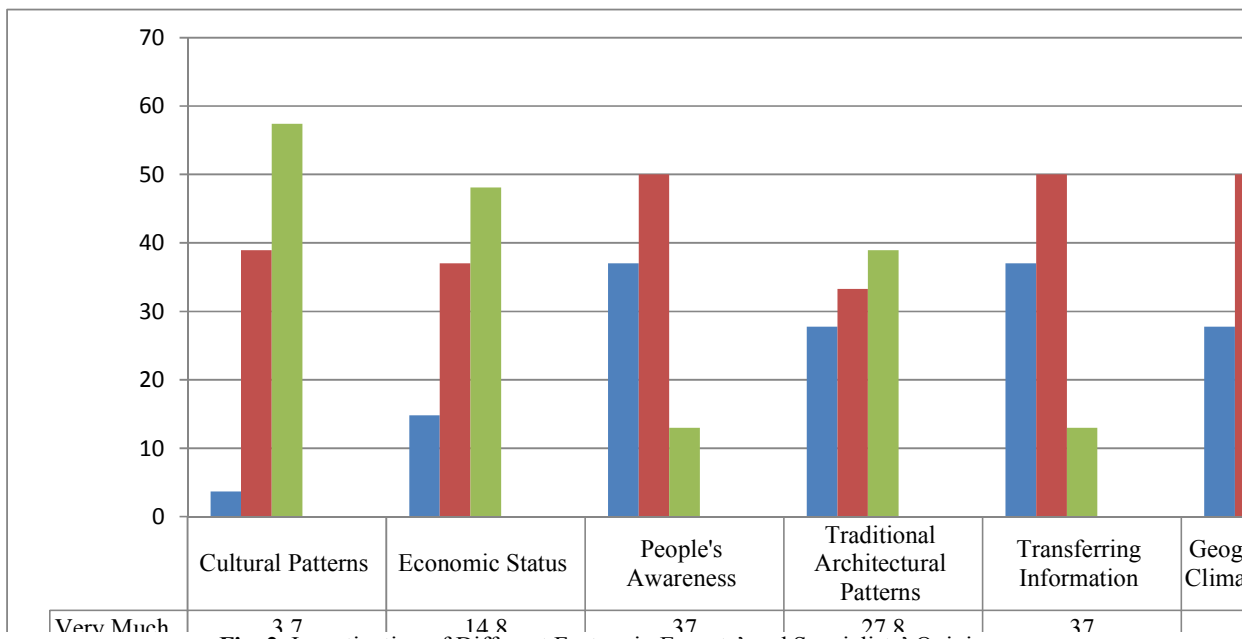


Fig. 2. Investigation of Different Factors in Experts’ and Specialists’ Opinion

### 3. CONCLUSION

Here, considering the studies and the researches done, it can be concluded that utilization of new technologies in the City of Sari may be possible through government’s support and transferring information and making people aware as well as utilization of Mazandaran’s traditional and vernacular patterns and etc. Besides, widespread and common patterns of construction can be developed through design and construction of buildings considering climatic factors to save energy, utilization of natural materials, providing necessary energy for building through appropriate design of openings and building extraversion, orientation in accordance with the building’s climate and creation of a desirable environment through natural energies and minimizing the consumption of fossil fuels, consistent with these patterns updating and utilization of new technologies in the topics related to buildings and construction.

Overall, we have attained some approaches considering the discussions and the results of the descriptive findings and the hypotheses test in order to design complexes through the utilization of new technologies that shall be indicated later:

- Usage of rich and simple experience in traditional and vernacular architecture of Mazandaran Province, the inventions made in vernacular architecture in their simplest forms shall play role in energy saving, residents’ needs and necessities

meeting, and generally creation of the best comfort through the least utilization of energy and the least environmental pollution.

- Accurate and proper usage of indigenous and local materials and their integration with the new conditions of construction and enjoying and taking advantage of the experience of the efficient specialists in energy affair
- Paying attention to culture and livelihood in design, considering Mazandaran's vernacular architecture shall consider other values such as culture, identity, traditions and customs and social values, in addition to coordination with natural environment, important and this affair also contributes to the creation of social and cultural sustainability.
- Necessity for teaching people and making them aware of the importance of energy and its consumption optimization.
- Utilization of modern technologies of the world in order to optimize equipment energy consumption.
- The need to create research groups in the field of energy consumption reduction feasibility in residential complexes design.
- Maximum usage of renewable energies such as solar and wind energy for building's cooling, heating and ventilation and fulfilling this requires the cooperation between architects and energy experts.
- Creation of desirable culture regarding tendency to natural energies
- Guidance of the investment in order to optimize energy consumption
- Investigation of National Building Regulations and explanation of Engineering Organization performance.
- Designers teaching and specialists raining in the field of building's new technologies

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