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Design of Residential Complex with Semi Industrialization and Sustainable Architectural Approach

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Abstract— **Home as a safe place for daily human life considered as one of the most important architectural species that has a great role in boosting the morale and physical health. With this view, the house should be designed in a way that fits the needs and relieves the mentally and physically demands of individuals and provides human comfort. The objective of this thesis is designing the home for low-income people, which is based on reducing the total cost of housing so that not damage the health of housing and quality of living. Given that a group of people in society do not have the ability to buy high priced houses a modern design should be provided in a pattern of physical housing in which strategies such as materials and manufacturing technology with cheap housing, housing with low land value, minimizing the space required to create flexible spaces, construction series and gradual housing, or a combination of the above items be used in it to meet the needs of this group of people. to design this complex green spaces was highly regarded. Because green spaces in addition to providing environmental health of residential environment play a positive role in the mental health of residents and even citizens. In this plan in addition to providing greenness in communal spaces and the stories the security and safety, pluralism, vitality, mobility, spatial variation has also been considered. In this study, low-income population as the target group is separated from the other groups and a good architecture with an area needed for people, taking into account the basic needs of residential and relative prosperity conditions and according to the number of persons present in the family, from a couple to a family with numerous children including boys and girls, has been reviewed and designed.**

Keywords— design, housing, Isfahan, low-income, cheap

I. INTRODUCTION

Increasing housing demand due to population growth, migration to cities and finally the urban development on the one hand and the lack of supply of suitable housing due to the ineffectiveness of traditional methods of construction on the other hand, made inevitable the industrialization of the building in different societies and to become housing as one of the major problems in human societies so that:

"the basic program of any government to social reconstruction considers the issue of housing as the primary requirement and the basis of a society and attempts are done that with long-term installments and very low interest the possibility of having an appropriate hose for low-income people will be provided (1).

Today, the development of science and technology has been lead to the emergence of new technologies in the field of construction. According to the latest information obtained from the Building and Housing Research Center in 2009, at present more than 65 modern system and technologies of construction have been approved. So, the awareness and benefit from them according to climatic, geographic conditions and the housing needs of different regions of Iran considered as a technical and economic necessity of building and housing sectors.

Other advantages of industrialization can be as flexibility in mass production and sustainability aspects of Islamic architecture of Iran (design and viewing buildings, such as the curvature of the dome and motifs of Persia and arabesques, with prefabricated building) and safety in constructions (by creating networks of rebar at all levels of the walls and prevent a sudden collapse of the wall).

The industrial revolution, converted economy and handicraft to manufacturing and machine-made productions. Gradually all the frills and sub-tasks of houses were destroyed and the house was turned into a living machine (2). This revolution by creating machines, steam power and the the the the iron and steel construction began in the 18th century and with the invention of internal combustion and electric

power tools, fuel and chemical synthesis developed dramatically in the 19th century and now with electronics and computers sciences has reached its peak. Each of these stages of industry growth increased the productivity and improved efficiency and product quality. In other words, where there was a need to produce a product on a large scale, industrial production helped human to enhance the production's quality while making more production. In today's residential architecture the thermal comfort with a high cost established for threatening the life of future generations and this is despite the fact that due to the amount of consuming energy in the tissues of the building and reduce nonrenewable resources and population crisis, the use of renewable energy and clean and harmonious environment with climatic conditions can be effective in reducing energy consumption in the tissues of building. An important part of people's lives that has a directly critical role in the housing is the issue of housing shortage compared to the expectations and needs of the people. That is what all the officials and the people on are conscious and aware of it. On the other hand, the high rate of population growth during the first decade of the revolution and lack of appropriate programs to provide housing for low income leads to the inability to required demands. Looking at the industrialization of housing as a national necessity is the same change that should be provided in the planning goals. When building moves toward industrialization, not only have the ability to meet the current demands of the society but also it will have serious impacts on construction speed, quality, and cost of the building. Industrial buildings, considered as the most important factors in increasing production and establish a balance between supply and demand on the market. Industrial building by providing solutions such as industrial materials with a variety of insulating materials, significantly reduce energy losses.as well as the earthquake resistance (by reducing the weight of the building), reducing the total cost by decreasing the administrative staff.

"To build a square meter's monument of residential buildings with traditional methods in Iran the 14-hour worker semi-skilled and 17-hour skilled workers are needed. If assume a work for a year, including holidays, annual vacations and the influence of climatic factors and the 274 days working 8 hours a day do useful work, in the ideal condition has done 2192 work hours that is equal to manpower employed in the construction of 72 square meters and this will be equal to 0.75 of a 100 meters' residential unit" (3).

On the other hand, Isfahan city because of problems such as population growth, immigration, housing shortages, its damaged building requires extensive construction. Despite the use of modern materials in the construction of some buildings, the construction of the metropolis, as well as other regions of Iran, is mostly traditional. However, due to the geographical situation and climate in Iran and being located on an earthquake belt, traditional methods of construction on the one hand because of the heavy construction materials, as well as a lot of debris and rubbles from 1.34 to 1.61 tons per square meter building is threatened by risks of human and environmental consequences. On the other hand, due to the long period of construction and losing energy from the perspective of manufacturing management faced with flaws and serious constraints (4). So according to industrialization to reduce costs and use a sustainable approach to keeping the environment are issues must be considered in the design of housing. Nowadays housing both in the national and international level faced to a very critical situation. With the advent of modernism in Iran, new materials were used instead of traditional materials without that their proper technique and technology of the materials be recognized. Also after the advent of modernism in Iran and the need to more production and becoming the hose as a profitable commodity, the construction of buildings was seized by housing dealers. In addition, the traditional production is a disorganized production and by starting early the winter the chaotic production rate in a year will be decreased and in many areas, there is no possibility of construction in that seasons. Therefore, due to presented materials, industry construction of the housing is a logic and reasonable solution for treating the sick today's housing (5). According to published statistics in 2007, the need for Iran's housing has been 1,285,000 and this is despite the fact that only in the first eight months of the year that 523 thousand units were constructed.

2. MATERIAL AND METHODS

The selected research method is fundamental-practical in order that the measurements of future developments of industrial systems in the residential field will be provided. In addition, this is a quality study, in order that by interpretation of both external and internal models, the used industrial systems in the field of residential and architecture would be defined. The data collection tools in this study include observation; whether with participation or without participation, table, computer networks, and databases, graph, sketch, drawings, image data, text data. In this research in addition to the usual methods for data collection, the architectural design was applied in order to achieve the goal. The field method is used to more recognize the design field or even access to considered information. In this study, according to the type of research that is based on foresight the analysis of interactions (which is a branch of foresight methods) are done and has eight steps as follows:

1. Define and determine the subject and the time period considered for the analysis
2. identify the characteristics of the key guide
4. identify and explain the impact events
5. The probability of the occurrence of events
6. diagnostics the analysis matrix interactions
7. implementing the prepared model (6).

Also in order to reach an architectural design that is the main issue and a key point of the research, the

researcher is required to use architectural design method to achieve the objectives of the research.

3. THE BASIC STUDIES

Climate introducing

Isfahan has the climate of four seasons. Jamshid Riazi based on nine climatic divisions put Isfahan in a climate with warm and dry summers and cold winters.Dr. Tahbaz in confirming this climate considered the name of Dashti climate. This city according to Koppen classification, on the basis of the accumulation of plant species in different regions located in a warm and semi-arid climate with the dry season in summer and average annual temperature less than 18 ° C.

Table 1. the weather conditions of plain climates (7).

the weather conditions of plain climates
The annual freeze 1 to 2.5 months Rainfall 70 to 350
Percent of the time sunny winter %55 Summer %80
The maximum relative humidity of winter %69 to %90 The maximum of summer %10 to %45
Absolute maximum winter temperatures -5 to -20 The maximum of summer 39 to 47
The minimum temperature of winter at night 0 to -3 The minimum at day 9 to 16
The minimum temperatures at night 12 to 23 The minimum in day 35 to 39
The annual temperature fluctuates annually 36 to 43 The average annual 16 to 19

The heating and cooling needs of Dashti Zone

In this climate there is a need for shadow for 7 to 8 months of the year, however, in 5 to 6 months of this time, the shadow is not enough and using appropriate materials and cooling water evaporation, provides comfort conditions. At the night these days about 2 to 3 months, the air is desirable, free air and can be easily used for sleep or other activities. In the other nights, using appropriate materials can be achieved under optimum conditions of indoors. In addition to using appropriate materials and solar heat stored in the sides of buildings, during cold nights in the 5 to 7 months of the year and days in some parts of this region, in the 1 to 2 months of the year, the use of heating devices is necessary.

Needs to moisture in the plain climate

In this climate, in the warm conditions, the moisture of the air is at a level which, using evaporative cooling resulting from the surface of the water and plant the air can be cool.

Solar radiation in Dashti Climate

This zone in terms of receiving solar energy is located in the area of very and very high radiation. Therefore, in the choice of materials to avoid fading and the use of radiation energy should be careful. Based on conducted studies Iran divided into four zones in terms of receiving radiation and Isfahan city located in a very high radiation zone with more than 430 calories per square centimeter per day is one of the strongest regions in terms of radiation.

Table 2. Climatic requirements to provide comfort of man in the Dashti climate (7).

Time Day Night
Freeze 1 to 2.5 months Avoid cold winds 4 to 5 months Heaters 1 to 2 ,5 to 7 months Capacitor materials 9 to 12 months Sun 5 months Shade or use of the open air at night 7to 8 ,2 to 3 months Evaporative cooling and air Curran 5 to 6 months Evaporative cooling and capacitor materials 5 to 6 months

Table 3. Moisture properties in the Isfahan climate (8).

Specifications of climatic conditions
The average freezing days 80 days The average annual rainfall 120 mm The maximum daily rainfall of 44 mm in March The rainy season from mid-autumn to mid-spring The maximum relative humidity of 75% In the December and January Minimum relative humidity of 19% in June to August The average daily maximum relative humidity of 62% in January and February The average daily minimum relative humidity of 30% In the July and August Comfort humidity lower than May to October

Table 4. The wind blowing in weather of Isfahan (8).

Specifications of climatic conditions
Prevailing wind in the spring West, Southwest Summer North, Northeast, East and West Fall North, Northeast, East and West Winter West, Southwest The annual prevailing winds of the North, West, and South-West West winds prevail from October to May, with maximum speed in March and April East prevailing winds from July to September, with a minimum speed In September The maximum wind speed in the winter and summer in the afternoon The wind direction changed over the years East and West

Table 5. Specifications of the temperature in the Isfahan climate (8).

Specifications of climatic conditions
The mean maximum temperature of 36 to 37 In the July and August The mean minimum temperature of 5/2 in January The mean annual temperature of 16 The maximum daily temperature swings in the late September and early October 18 In the late January and early February the daily fluctuations in temperature at least 12

4. INTRODUCING THE SITE OF DESIGN

In this part, the considered site in terms of geography, physical and socio-economic factors will be studied. The suggested site is a trapezoid-shaped piece of a land, that is located at the end of Khaje Amid street in municipalities range of the number 10 region of Isfahan that in the past brick furnace Maak (figure1) had been worked there and in the detailed plan of Isfahan in 2011, residential land-use has proposed for it and now don't have any land-use. The total area of the site "is equal to 99,625 square meters (about 10 hectares) and connected to Azar Bigdeli from the North and North West and finally connected to Sayyad Shirazi Highway. Also from the East and Southeast limited to Sayyad Shirazi Highway as the main road to reach the mentioned site. And from the West and South West limited to the residential neighborhood and Side Street.

Fig 1. Mahak Brick Furnace

In terms of features and forces available on the site we can refer to following items:

• Sayad Shirazi Highway that is raised as the third ring road and facilitates access to the site (figure2)

Fig 2. Sayad Shirazi Highway (Source: author)

•Kabotar historic tower close to the site (Figure 3).

Fig 3. Kabotar historic tower (source: author)

• Green surrounding Belt of the highway that has created a good view from the site of the surrounding

Fig 4. Greenbelt at the margin of highway (Source: author)

Among the most important reasons for choosing the site are its close to Highway connecting the factories of Zobahan and Foolade Mobareke, to produce and supply raw materials and saving transport costs and reduce project costs.

Fig 5. the extension of the Avenue Khwaja Amid in the development plan and its connection to the highway Sayyad Shirazi (Source: Google Earth)

Fig 6. The proposed site (Source: Municipality of District 10 of Isfahan)

Fig 7. An aerial photograph of the site (source: Google earth)

The analysis of site design

The main factors that commonly used to analyze the sites are the vegetation at the site, the topography of the site, the aesthetics of the site to the outside and vice versa, network access, away from the noise and the proximity of educational spaces, health, commercial and green spaces. The selected site in this project in terms of vegetation is poor and no part of it don't have priority to the other.in terms of the topography all of the site has a uniform approximately %2 slope from north to south and not see the difference between different parts. Therefore, it will be studied only in the perspectives of the access network, away from the noise and proximity to the dependent applications.

The prospect and perspective from inside of the building to the outside

According to the location of the site and reviewing the surrounding only in some parts of the site there is an appropriate vision to the green space that this item must be considered in designing and be strengthen at the within of the site.

Fig 8. Total prospect of the site (source: the author)

Access network

In terms of network access, the northern street of the site with residential land-use considered as quiet streets of the city. Other streets of the site are most important streets of the city. In terms of the public transport network, the distance of two bus station close to the site is 290 and 370 m that in terms of resident the embedding closer stations would be necessary.

Be away from the noise pollution

The site in terms of noise pollution located in a quit area of the city and only having difficulty because of its proximity to the Sayad highway in the southwest corner that existing the green belt on the highway moderated somewhat this problem. In this regard, the use of double-glazed windows and double glass the increased the value of airborne.

Proximity to education, health, commercial and green spaces

Due to the fact that the radius of operation of preschool, primary, secondary and high schools, are respectively 200 m, 800 m, 1500 m and 2 to 3 thousand meters. The site will only need to pre-school but in general north and east areas in terms of access to public education, health and trade are in the better condition. In terms of access to green space south and then the east parts are in a better position.

CONCLUSION

To sum up about what the conditions mentioned in Isfahan, said that very radiation, very cold temperatures and dry air in this region are annoying for it must find a solution. The temperature in this region is not huge and a thing that makes difficult the summer conditions is an effective temperature that is comprehended by a human as a result of radiation in a day. Dry air due to high evaporation and radiation intensified adverse climatic conditions especially in the summer and finally, the cold winter is annoying. The obtained results of site analysis also show that the northern parts of the site were very suitable for the site for construction and guidance design to this part seems rational. Using the statistics of housing meters', the considered area estimated to between 100 and 150 meters. The information of family size, density and per capita are helping to create a balanced environment.

DISCUSSION AND CONCLUSION

Design solutions

According to stated issues and problems and also the title of the thesis that state the objective of industrialization and sustainability, the following ideas were considered in the design, including:

1. Creating a module designed to create a network to solve parking 5/2 meter, modulating the design, and ultimately reduce the Perth materials (It should be noted that the modulus after multiplying gives 5 meters and the 5/7 gap growth)

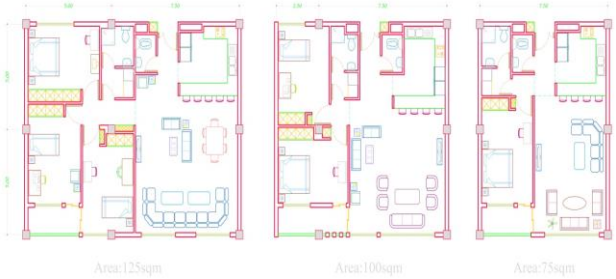

Fig 9. Unit types of one, two and three bedrooms (Source: author)

2. The proper orientation of apartment blocks for maximum efficiency of solar energy and improve the aesthetics of the site
3. Increase the amount of green space per capita in order to the stability in the system
4. Collect and redirect surface water on the site and saves them in the land bank
5. Predicting Public Transport Stations near the site

5. THE METHODS USED IN THE CONSTRUCTION

Super panel is a developed type of (evolved Insulating Concrete Forms ICF) systems. The old system ICF are walls that are constructed by arranging hollow polystyrene blocks picking and placement of vertical and horizontal bars on a limited basis in it and pouring concrete in the empty spaces inside the block. Blocks on both sides enclosed to double sides of the minimum of 5 cm thickness. Polystyrene plates connected to each other by plastic or metal interfaces and hollow blocks obtained from connecting hollow blocks that in its empty space the rebar placed and the concrete poured. Its resulting operation is similar to Chinese block that requires taking time and structural limits. The system consists of load-bearing and non-load bearing elements that are, the building's load-bearing walls, ceilings and wall load bearing partition. By using system can be done more than 60% of operations related to the implementation of a concrete structure at the factory and by transferring these parts to the site the executive operations quickly completed. The ease of execution in this system is removing formatting operations and connecting reinforcing bars of walls at the minimum %90 in the location of project implementation. The parts of the wall built at the height of the floor and parts of the ceiling are built with the size of the span and on the basis of architectural design and transported to the site and quickly put in place and concreting operations performed. Super panel system has been approved in the line with Wall Reinforced concrete buildings with permanent molds polystyrene by the Research Center for Housing and Construction and by helping it in accordance with the regulations of the Iranian earthquake to 15-story buildings designed and implemented.

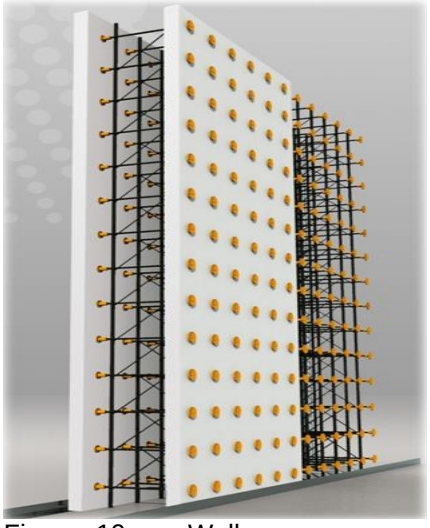

Fig 10. Wall super panels (source: http://psco3.blogsky.com/)

The basis of this system, as previously mentioned, is the use of reinforced concrete structures bearing in the load-bearing roof and walls of buildings, and partitions of lightweight polystyrene concrete, In the non-load-bearing blades. The walls are concreted in the mold of polystyrene reinforced concrete panels and roofs are made as well as polystyrene formwork for reinforced concrete roofs.

In other words, the building is wrapped in the two layers of expanded polystyrene that has the highest efficiency in terms of insulation. All parts of polystyrene wall and ceiling and partitions armed and ready to be installed at the factory is carried to the place of execution.

System elements include the following:

Ceiling panels, load-bearing wall, partition walls.

The major benefits of the Super panels system include:

- The speed of installation
- Energy saving
- increase durability and protect building structures against the environment
- Strength and power broker
- Ability to pass a facility tubes
- reduce the consumption of materials Joinery
- Ability to install Gypsum Plasterboard
- Building Weight Loss
- Reduced Building Perth
- No restrictions on architectural design
- Soundproof
- Save shipping costs
- Faster return of capital construction

Fig 11. Super panel (source: http://psco3.blogsky.com/)

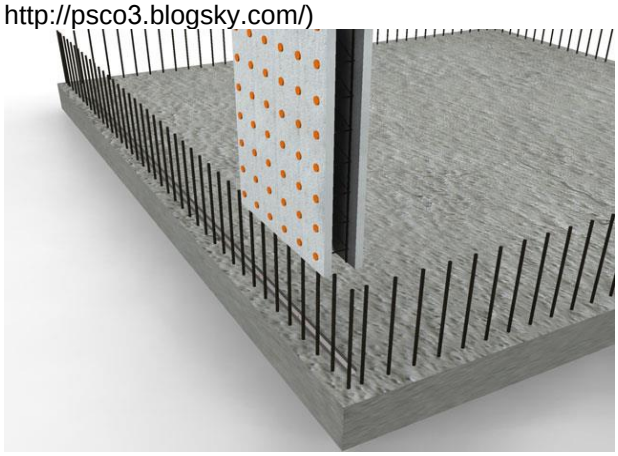

Fig 12. Super panel (source: http://www.superpanelco.com/supper-panel/what-is-super-panel.html)

Fig 13. Super panel (source: http://www.superpanelco.com/supper-panel/what-is-super-panel.html)

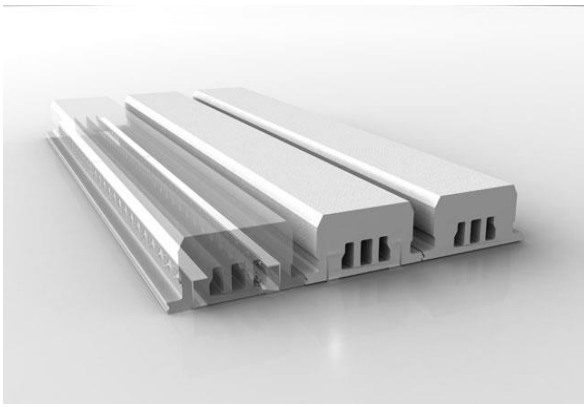

Fig 14. super panel (source: http://www.superpanelco.com/supper-panel/what-is-super-panel.html)

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