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Sustainable Architecture In Arid Regions Of Iran.

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Abstract:

This paper will investigate the special elements of architectural design which are mainly based on Islamic beliefs by consideration on Iranian architectural values and vernacular building methods. This research will focus on elements which created by inhabitants of arid regions that are very useful and common in those areas. These designs which physically suits this climate is necessary for staying sustainable so by obey these rules we will have sustainable architecture in future again .

Keywords: arid regions, Iranian architecture, vernacular buildings.

Introduction:

If we focus on the world of architecture we will find out that there is a difference between academic fields and professional practices in architecture all over the world. In Iran the academics recommend traditional architecture in traditional way, they believe we could use traditional elements from our past buildings which suit our culture and weather in an abstract way. Nowadays because of competition among architecture in the market, they are giving what the society aspires for “Modern architecture”. However in many cases this style of architecture does not suits our country completely, neither in culture nor in weather. Apart from just modern architecture we can focus on what we have, Islamic and

Iranian architecture. In the other hand using natural resources, reducing energy consumption and providing comfortable, healthier and sustainable living spaces are the aims of a climatically responsive sustainable building design. Sustainability, as a 21st century concept, has been in fact applied since Vitruvius wrote his books and was realized spontaneously in traditional architecture .Construction strategies and sustainable designs are of great importance nowadays. In any case, one may say that sustainability was already a driving force in the past, showing its legitimacy in those days in different forms and techniques. Therefore, problems and precautions in design and construction have never changed fundamentally, although a lot of development has been seen in materials and technology. When "sustainable design and construction strategies for Iran" are under scrutiny, then it is possible to observe how traditional buildings and settlements in this region design and construction could be integrated in today's design practices .It is to be noted that taking advantage of the old learned people's experiences to improve the quality of architecture would pave the way to achieve a stably permanent design. A sustainable designing concept invites our effort to create the maximum amount of comfort for people by scaling up the standard of living and produce the least volume of damages to the environment.

By paying attention on Iranian traditional architecture we could conform that its rules suit buildings in best way in sustainability and in correspondence to the local cultural, topographical and climatic conditions which have the least adverse effect on environment as well as design consistent with nature by obey its rules.

In this paper we introduce some of Iranian traditional and sustainable features in old buildings in hot and arid regions and try to suggest some new ways to have these elements in our modern buildings again. In this way we could transfer our sustainable features which are the best choice for our buildings.

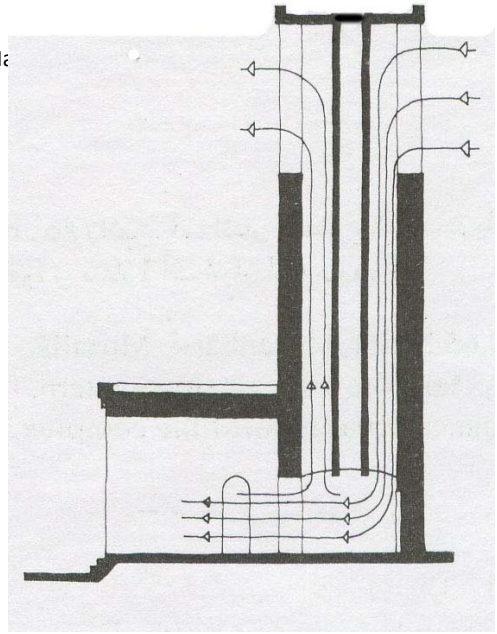
2. Data and material:

Data which used in this research is analysis of data gathered through library study from articles and conferences all over the world.

Some sustainable features of traditional architecture in hot and arid regions of Iran:

1. wind-catcher (badgir):

One of the traditional elements which is an architectural masterpiece among Iranian sustainable features in buildings and used in ancient times is wind catcher. Wind-Catchers are built in the direction of the most Strong and pleasurable winds. Traditional wind-catchers have various types they are in 1, 2, 4, 6, 8 sides or sometimes they are circles which direct the wind through its way (fig2). It is used to dislocated, move and cools spontaneously the internal air of buildings by employing wind blow and varied air temperature (fig1).A wind catcher is a vertical canal that is drawn up in plans in the forms of square, oblong, octagon or circle. It is made up of two parts: Internal section of canal that takes its start from the ceiling and leads down to basement and external part that consists of entry pores or holes for the wind to blow in and it is laid up on roof. The way a wind-catcher works is mainly based on taking the fresh air into the building and sending the hot and polluted air out, or the suction functions. In the system of a wind-catcher we



could see its intelligence in agreement with climate and of course it's a very good example of clean energy. In ancient times and in traditional buildings in arid and dry regions the air trap functioned like the present modern air conditioning system. Wind-catcher is like a chimney whose end is in the underground and the top is set over a specific height on the roof and were built at the entrance of the house over underground water reservoirs or ponds built inside the house. The working process of a Wind-Catcher is much alike to modern water coolers. When a breeze enters a Wind-Catcher it is channeled to above a pool. After being exposed to water and evaporation (a heat absorbing process) which Result in a cool breeze it's directed to the summer rooms.

Conventional and the modern versions of wind towers can be incorporated aesthetically into the designs of modern buildings in the hot-arid regions of the Iran, and other areas of the world with similar climate, to provide summer thermal comfort with little or no use of electricity. A careful attention to the fashion in which a wind catcher is applied indicates that the lay of spaces for the entry and exist of air when blowing in directions For or against those of wind is an important factor that allows for the operation of natural system. According to the suggestions if we want to

Fig 1. Natural ventilation in Iranian architecture (Tavasoli,2002).

Transfer a practical wind-catcher in today`s buildings we could do like this: In modern structure, this principle can be utilized as explained hereunder: The most dominant principle used in the development of vertical ventilation in a structure is air pressure difference in the lower and upper part of it and also heat convection to the upper part of it. If a structure has openers where wind is allowed to flow in to the construction, we can provide a duct or a vent in its opposite direction where the canal can inevitably catches the southern light. The air that flows inside it is heated by the sun light radiation and is moved upward and radiates out of it through upper openers. The suction that is created on top of it causes the air flowing in to the duct to be sucked in and facilitates air current.

Fig2. Various kinds of wind-catchers in Iran

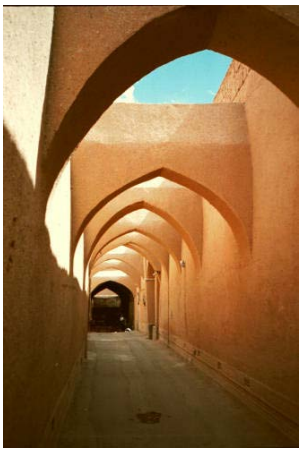
2. Courtyard:

The courtyard in a hot dry climate is usually the heart of the dwelling spatially, socially, and environmentally (fig3). Although, the size of the land, to some extent, is influential, the average sizes of the courtyards are generally determined according to the latitude. They are narrow enough to maintain a shaded area during the heat of the day in summer, but wide enough to receive solar radiation in winter. A courtyard can provide security, privacy, and a comfortable place within the house. The courtyard where it is usually planted with trees, flowers and shrubs, not only provides comfortable condition and beautiful setting, but also supplies some shade and increase the relative humidity of the courtyard space. In this climate, the most preferred plan type is the courtyard houses. In order to reduce the area affected by the solar radiation, compact forms are chosen. Shady areas can be obtained by arranging those forms of courtyards with the help of plants and water**.** for evaporative cooling, shady areas can be obtained, the floor temperature can be reduced by the high walls surrounding the courtyard, and the open areas can be used during the day. Water Channels poured out from the pool are important elements for cooling. Water is usually spread by channels to the floors of the courtyard and evaporative cooling from the surface of the courtyard floors which are made of porous stone is efficient. Courtyards are always in the ground floor and have distinct forms depending on the landscape of the house. Even without modern, mechanical heating or cooling systems, the courtyard house provides a comfortable living environment through seasonal usage of sections of the structure. The thermal performance of courtyards, have been studied by many researchers. (Roaf 1982, Bonine 1980, Givoni 1976, Dunhamm 1960). The common concept some authors provide is that the air in courtyard is cooler than air temperature above the courtyard mostly in the morning, but their interpretation of this phenomenon is different. “For instance, provides a general explanation of the performance and explains that as evening advances, the warm air of the courtyard rises and gradually replaced by the already cooled night air from the space above the courtyard. This cool air is stored in the courtyard in laminar layers and can flow into the surrounding rooms.

Fig3.iranian courtyard, Kashan

In the morning the air of the courtyard heats slowly and remains cool until the solar radiation falls directly into the courtyard. The warm wind passing above the house during the day does not enter the courtyard but merely creates eddies inside, unless baffles have been installed to deflect the airflow. In the other hand if we want to look at the courtyard in other point we could pay attention to its philosophical and spiritual role which have roots in Islamic and Iranian culture. Within the Islamic culture of Iran, the notion of the

'void' has an important philosophical meaning. The void is significant in pattern and decorative styles, in music - as the silence between sounds, and in calligraphy between black and white. The traditional Iranian courtyard is an example of the void in architecture. The "negative space" of the courtyard, surrounded by rooms as "positive", built forms, has roots in the "metaphysical principle of unity" of Islam. The void has spiritual significance and the courtyard as a void is a symbol of the presence of the divine in all things (Nasr, 1987, pp.185-186).



3. Sabat

In the design of traditional houses in the hot and arid area in Iran, there are several precautions taking against the hot climate. Houses are isolated from the street and surrounded by high walls. During the day, external walls of houses provide generally shady areas in narrow streets and especially in courtyards .By means of heavy and thick walls, warm environment in winter and cool environment in summer could be provided easily. One noticeable and conspicuous of urban planning in old location in cities with hot- dried climates is the roofed lane and porches passage. It is called sabat (fig4). A sabat is designed in order keep safe human living in desert from direct radiation of sunlight in shade for some moments. In fact, Iranian architects, in the same instances, built houses up to somewhere lying on the lane and began to build one or more protruded rooms with same eaves above the passage all commuting was made under these rooms called sabats. A sabat can modulate a transient temperature. It is such a way that any pedestrian on his way to his destination is positioned in shade in a suitable succession. In many sabats, there are several integrated entrances of houses that are of highest importance in view of improved sense of neighbored and local correlation. A sabat can be also used as a mean of countering monsoons. The roofs of sabats, are usually by neighboring unites same of which are in the forms of roof commanding the lane underneath. Debate is more usually laid up from blind alleys. A string gate is also more usually fixed at its entrance. Such space is commonly called "darband" that is in sum, wholly suitable to provide added security for the occupants across the lane.

Fig4.sabat in yazd

4. Structure of the buildings:

There had been numerous creative climatic planning in order to use energy efficiently. Studying of these and combining them with new climatic systems can be a proper way to make the building more sustainable. Regarding the four climate regions Iran, there are different adopted architectural approaches on the basis of the best ways of efficiency and sustainability by using the best combination of vernacular materials. The important point in using such materials is their environment friendliness.

In the hot and arid climatic area in Iran where the continental climate is effective, in traditional architecture examples, to profit from the time lag of the building envelope, materials with greater thermal mass have been chosen. These sort of thermal massed envelope details are very convenient for continental climates, where the summers are very

severe with high swings in daily temperature variations. This big thermal mass will decelerate the heat transfer by means of the envelope and thus higher day-time temperatures will be reached indoors while outdoor air temperature is much lower and consequently more stable indoor thermal conditions will be provided. On the other hand this thermal mass, that has higher surface temperature on outer side will rapidly lose heating energy to the atmosphere through radiation at night to start the next day from a cooler rank. When observing traditional examples, it can be seen that the opaque parts of building envelope were constructed by the materials with a high heat capacity as thick as possible and the transparency ratio of the building envelope is chosen as low as possible. (Fig5)The high heat capacity of the opaque part provides a high time lag for the transmission of the outside temperature to the internal area while the low transparency ratio reduces the direct solar radiation gained through the windows. In hot and arid climate, through the high heat capacity of the building envelope, the effect of the outside temperature is reduced and a cool internal area can be achieved during the day. Therefore, mud, calcareous rock, stone and the combinations of those materials are always preferred in this climate .Particularly calcareous rock, which is a sort of porous limestone, is a good insulator against cold and warm air and regulates the humidity of the living place. In arid and hot climate some other precautions against the solar radiation are:

•Minimization of the number and the area of windows
• Construction of a window at a high level to obstruct the floor radiation;
• Reduction of the absorptivity of the facades by light colors;
• Providing natural ventilation particularly at night;
• Constructing a part of the building into ground which is to be always cooler than the outer ambient temperature in summer.

Fig5. Massive wall of an old building

Conclusion:

Sustainable architecture has a main role in the world of architecture nowadays. In any parts of the world architects try to suggest methods to use energy efficiently. Human is worried about energy for next generation, in the other hand culture and civilization of every society are of valuable things that every nation have. Nations like to keep and improve positive points of their culture in any part. Iranian traditional architecture has valuable features which could reflect Iranian culture in best way, in the other had they have some methods to save energy, we could name them as sustainable features. On the whole the researches have shown that these elements of Iranian architecture could meet with needs and demands of their own age and adopt themselves with the identity, culture and climate of their regions. by suggesting new ways to transfer sustainable elements in

our modern buildings we could have the best choice for our generation both in energy and in culture. A designing method which suits our culture and a culture which everyone knows Iranian with it.

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