The investigation of usage of native architecture methods at hot and dry regions of Iran according to sustainable architecture

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ABSTRACT: necessity of pay attention to human being, natural sources and their sustainability has been increasing their importance at recent years. The aim of experts’ efforts to reach the optimal usage of natural sources, ecological features, usage of cultural natural patterns and at the last suitable designing according to present needs. We tried at this article pay attention to the investigation of usage of native architecture methods at hot and dry regions of Iran according to sustainable architecture and at investigations of these methods; we can present solutions for today architecture of these regions. We used library method according to inductive and analytic methods to reach this goal. The results of research showed that at usage of sustainable development solutions at native architecture of these regions, we should consider the spiritual and physical needs of local people, cultural, climatic and social factors and pay attention to relation of human being, environment and human being scale that these patterns and ways can be used at near future designing. Architects should have new look to architecture elements at the past periods of this country to recognize its values and they try to use it at their next designing.

Key Words: sustainable development, hot and dry, native architecture, designing

INTRODUCTION

After the advancement and development at human being societies’ at recent years, necessity of pay attention to human being, nature, natural sources and their sustainability has been increasing. About this matter, the most important aims of experts’ efforts are related to the optimal usage of natural sources, ecological features, usage of cultural natural patterns and at the last suitable designing according to present needs. However, according to the some researchers’ opinions, pay attention to the qualitative points of architecture and designing has been considerable but it seems necessary the necessity of their continuity. This concentration is related to the continuity of some problems and some mentioned shortcomings at universal scale, especially in relation to natural environment and limitation of it resources’ and cooperation way with them by architects at specific geographical conditions (Rahbar, 2001). We can investigate at this direction, used methods at native traditional buildings as symbol of sustainable solutions then reconcile them by today’s technological advancement to the present new concepts and ideas. At the present age, because of following modern life parameters, it isn’t easy to create thermal facilities by non-fossil energy. Anyway, at the least possible space, we should make houses that satisfy the needs of human beings comfort at the all seasons. The best pattern of these houses can be found at our country traditional architecture. In fact, past lifestyle was so human being could reach a peaceable coexistence with his environment so that satisfy his needs and didn’t hurt to the nature (sustainable architecture). The houses at the depth of earth, air-trap, domical roofing, thick walls, central court…….. these were the survival secret of previous generations. At the hot and dry regions of Iran, we can see examples of this coexistence with nature and in fact sustainable architecture. At these regions, domical roofing has a unique property and it’s related to receive the least of sun radiation that this property can prevent high increase of temperature of building. Also, it creates an internal space that concentrates warm air at high part of house and under the dome. The being of HawzKHane (the part of house containing piscina) (underground) had half-open roofing that at the effect of wind and its hit with water and it created desirable weather. Sometimes Badgir (air-trap) were in place of half-open roofing. The exploitation of
thick wall that maybe their thickness reaches to one meter or more is one another property of this house. It makes the day hotness penetration to be more slowly and it can pass from the wall at the end of day and house people need to that hotness and hotness will be keep at the night. Before the night coldness can pass from the wall and reach the internal parts, night has finished and house people need its night coldness. The central court at these houses is a suitable factor at the Modification of desert weather. When court is at center and at all directions of court, walls have been made, persons can select their living place at the different seasons and during night and day time. At the center of court with using of a pool and small garden, they have helped to modify the air and creation of beautiful and green landscape at the desert weather.

Some studies have been done at this ground are including:

(Price Mora, 2007) for investigation of quality and sustainability of building materials and has searched about possibility of creation of strong buildings with weak materials. He has paid attention to the effect of urban growth and its infrastructure on the environment by consumption of raw materials and energy. He believes that urban metabolism is one of the most important reasons of environmental decay and present tendencies; it makes predictable the continuity of increase of urban and infrastructure development. (Gao et Al, 2006) have studied the qualitative improvement approaches from contractors view. They believe that attention of building-making team (owner, designer, and contractor) has been absorbed increasingly to communications improvement and cooperation at during designing process and plan development. They analyze the effects of improvement of building quality approaches. (Niroumand et. al) have evaluated with new look to the sustainable architecture dissection, soiled architecture and soiled building as example of sustainable architecture at different countries. They believe that we can use the traditional architecture and its view to sustainable architecture and its combination with new technologies for improvement of building quality. (Iraji and AkbariNamdar, 2011) they have certified this point in the article as “sustainable architecture at traditional architecture" and believe todays sustainable architecture is a method that architects and designers pay attention especially to regions properties and weather features. They express with investigation of traditional building-making systems at Iran; we can use new building systems for sustainable architecture. Sustainable development and Sustainable architecture have been done mostly at hot and dry regions. We see some problems and shortcomings about this matter and it needs pay attention to qualitative aspects of space creation at Iran’s cities with hot and dry climate. We tried at this article to pay attention to Sustainable architecture approach with investigation of using native architecture at hot and dry climate of Iran. Then, we can present solutions today’s architecture of these regions. We have exploited library method according to inductive and analytic method. We have investigated theoretical principles about Sustainable architecture and native architecture and have paid attention to native architecture of at hot and dry regions especially Yazd provenience. Finally, we have described the present solutions for Sustainable architecture of these regions.

**Sustainable development and general principles of its designing**

According to modern societies, it can be told that Sustainable development is a new field that at same time focuses on politics and culture, prosperity of economy, industry and business and it supports environment and coexistence with it also human rights. It pays attention to country and international affairs. We see the birth of new field that presents different solutions and capacities. Sustainable architecture is human-oriented case and according to its width and capabilities, it has been converted to the most important present discussion also one of the most important challenges of 21 century. Sustainable architecture is a solution for the problems of 21 century. Some principles of sustainable architecture are including following items.

Thriftiness in consumption resources: this principle is involving three main strategies which insist on especially the needed sources for building-making and exploitation, energy, water and material maintenance. According to this principle, we want reach to the minimums. Mies van der Rohe told at the modernism era, less is more and todays, Alexander Tombasis says at better interpretation that less is beautiful.

Designing according to life cycle: this sustainable designing principle is according to four stages, designing, building-making, exploitation and demolition. At this model the concept of life cycle has been considered at limited scope and it didn’t pay attention to environmental problems and residual management.

1 Price Mora
2 Goa et al
3 Niroumanet. al
4 Akbari and IrajiNamdar
5 Mies van der Rohe
6 Alexander Tombasis
Human designing: this principle is the most important principle of sustainable development. When thriftiness in consumption resources and designing according to life cycle are related to efficiency and maintenance and human designing pays attention to whole components of existence universal system.

**The hot and dry regions at Iran**

The general size of Iran is 165 million hectare; around 120 million hectare is related to the dry desert weather, 40million hectare moderate weather and 5 million hectare highlands (Rahbar, 2001). This case has created different climate at our country and it had its effect on the face of big and small cities and habitations. They seem as compressed and united structure and from visual aspect, they have special native climatic properties. The hot and dry regions are very valuable because of its widespread scope, importance of its habitations and parameters and patterns of native architecture, so, we describe in a short way interaction of human being and ecology and process ways environment at desert regions of Iran. Dry and hot regions generally are involving the central parts of eastern of Iran and its general properties are as following items:

The hot and dry summer and the hot and dry winter

Very low amount of raining
Very low amount of humidity
weak vegetation coverage
Very difference amount of day and night temperature (Jaafarpour, 1977, p34)

At the hot and dry regions because of winds with dust and humidity, we observe very difference amount of day and night temperature and life because of water shortage for agriculture and drinkable consumption, for habitants is difficult. Shelter-making is difficult because there isn’t tree there and wood shortage. But we observe their adaptation with such weather at different seasons at Iran’s traditional architecture. For reaching desirable comfort, we observe at Iran’s traditional architecture, parameters such as introversion, extroversion, orientation, using green space, using suitable materials, insulation and role of water (SmaiiZade and TorabiLangari, 2013, p, 4). At these regions, building plans are compressed, so, outer surfaces will be at the minimum to its volume. The plans compression will make the rate of thermal exchange to be the least at summer and winter and it will create the most shadow on the surface. The most of windows and opening surfaces are toward protected parts of central court that it is affected less by hard conditions of outer environment of building. The material types have high thermal capacity, light color and their orientation from south to south-eastern. We hint to some solutions that they been used at hot and dry regions:

usually building is situated at minimal radiation direction of sun energy. As KockNilson writes in his book “compatible architecture with climate” about buildings orientation at hot and dry climate" larger surfaces of building at least should be situated at north-south direction to get the minimal hotness, and surfaces of building are situated to the western direction because of receiving high hotness amounts, they have worst conditions especially at afternoon time (KockNilson, 2009)." We should prevent from big surfaces of building at this direction. It is better that buildings are created in group form at near distances. The compressed context will lead to increase of cooling of internal spaces by combination of their shadows; we can use the common walls at building collections and created compressed context. At hot and dry regions, usually main spaces or open spaces will be opened to the shadow. These central courts will create suitable and efficient micro-climate for habitants. Also they use light colors at roofing surface and outer wall in front of summer’s sun to absorb less thermal amounts. For decrease of effect of weather fluctuations, these following solutions have been used at native architecture at hot and dry climate. Afshar writes at an article as its title “Iran’s traditional houses " about this case that " very difference amount at day and night temperature, it doesn't make desirable environment for living (Afshar, 2010)." For solving this problem at hot and dry regions, they used underground building (at summer or winter) or some parts of building constructed under the ground so as thermal insulation to modify the large part of daily fluctuation of air temperature. Also, they used the heavy and compressed building materials with high thermal capacity to decrease fluctuation of air temperature at day and night time, for example, thick brick-shaped walls as thermal capacitor, it saves the coldness at night period and gradually it releases it at mid part of day that air is hot. For decrease of thermal Wastage of building, they used the Tabestanneshin (the parts of building which have shadow at summer) and zemstanneshin (the parts of building which have shadow at winter) because southern parts were behind to sun and having maximal shadow at summer and northern parts are sunshiny at winter. For exploitation of sun energy at building thermal system because of strong sun radiation at hot and dry regions, usually some parts of building constructed in direction of sun energy maximal radiation and they used this property at necessary conditions for high temperature of building. At the native architecture of hot and dry regions whole buildings are introvert and closed,

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7KockNilson
for example, whole created spaces of house at hot and dry regions will be made around the court so to create various internal environments for receiving of heat and light of sun. According to exposure to sun's light, different parts of court (Tabestanneshin, zemstanneshin) can be used at different seasons. At these regions, whole partsunless bathroom, they have central court and mostly they have underground, patio and air-trap parts. Already, the using of court is prevalent at whole hot and dry regions habitations parts. The court orientation should be as more desirable geographical conditions at the behind of court and in its designing, the concentration of elements should be toward internal spaces. Whole opening-surfaces, it's better to be open toward court, general outer aspects should be simple at low numbers or haven't any window. The separated environment and cozy space of court will bring desirable and calm den for building habitants and also, being of court will help to create outer cool and favorable environment and effective to conduct cool air to internal spaces. HawzKHane or undergrounds are very favorable place for exploitation at hot and dry climate. When at summer, the temperature of air is 45 centigrade; temperature of underground will not be more than 25 centigrade. This difference is related to depth of court, fountain, trees and vegetables of garden and more important part of extraordinary mechanism of installed air-trap section. Air-trap section is square capsular tower that has been made above roofing to certain height in direction of seasonal winds. The main plan is based on considering harmony at two-wall inner parts of tower. So, there are two corridors for exhalation and inhalation of air and separation of hot air at building. The hot air from the desert and sun will move at wind direction, it passes from air-trap section openings and will be swallow into tower inner parts. Sucking corridor of hot air will reach to HawzKHane (underground) is pool full of water which is cool under the shadow. The hotness of new air will be passed on the surfaces of pool water with saving humidity; it will be rotated at multi-channels at underground spaces. The wind will be heavy with its volume increasing at the underground space and lead to more cool and light air at another tower corridor. We see extraordinary exactness at air-trap section designing which is effective at form, outer aspect and its landscape. The floor of court is lower than street's surface. This matter helps to the Habitants that use the soil as thermal insulation and makes easier the current of city water to building. The most of arches are cycloidal and domical; this is a solution for decrease of heat absorption by buildings especially at hot and dry regions. This form is suitable in adaptation with available materials and structure points in addition to thermo-physical reasons for decrease of thermal conduction because its special form is completely suitable form for emitting thermal radiation and makes it easier the cooling process during the night. Secondly at day time, the half shadow of a dome will cover the half of other, this will play important role at decrease of ceiling heat. Also, domical ceiling because of its protrude is exposure at the wind direction so the thermal radiation will effect at the low amount. The walls are some extent thick. The walls thickness at houses of Iran's warm regions is around one meter. Special high thermal capacity of brick-shaped helps remaining of heat at inner parts of wall, it means that low thermal changes aren't effective. At night time, walls lose their heat by conduction and radiation and their temperature at the day time will be kept at low amount and it creates enough comfort for habitants. So, soil will act as thermal insulation and because of high thermal capacity, it leads to independence of inner and outer parts from each other (KockNilson, 2009).

Yazd native's architecture

Yazd provenience has been situated at central part of Iran's plateau between widths of 29grade and 52 minutes to 32grade and 27 minutes of northern widths and 52grade to 55 minutes to 56grade and 37 minutes of northern lengths, it has variety from topological view and also average yearly rainfall is between 50 to 100 millimeters. The fluctuation of temperature is very high at winter, summer and even at day and night. The average of daily temperature for whole seasons of year around 11.9 to 20.7 centigrade is variable. The maximum of temperature variability is 45centigrade. The territory of Yazd provenience is part of Iran's central plateau that deserts are mainly at this part and they have covered big part of Yazd provenience. At general, Yazd weather at summer is very hot and unbearable. At old contexts designing cities such as Yazd for citizens' comfort, internal city spaces are based completely environmental items and compressed context, narrow allies even color of building is according to environmental view. The ways of using spaces at traditional contexts as empty closed spaces such as internal city squares that creates main parts of traditional city, integrated combination of vegetables and water at city spaces (such as CHaharBagh), protection of building by earth, creating shadow in front of sun (such as high walls), installation of net windows and natural ventilation, they are some examples of pay attentions to environmental items (Tavasoli, 1989). As we told it is considerable the form of rural and urban context, adaptation of life conditions with natural factors and using of these factors at unfavorable weather conditions such as low rainfall, low air humidity, very low vegetation and very different amount of temperature between day and night and ....... According to mentioned items, we hint to items have been used at Yazd native architecture at sustainable architecture direction at traditional architecture of this region.
Coherence and integration of traditional buildings (compressed context of city with unordered and narrow allies with high walls around them)
The thickness of made walls
The usage and lack of undesirable effect of materials wastage
The closed spaces of houses which have central court
Correct usage of sun light
Done correct details at Kerman native architecture (such as high shelter)
Facility of materials transition and the lack of environmental pollution
Using of brick-shape and soil as insulation (materials which have high thermal capacity)
Using of high thickness for walls
Using of arches and domes
Construction of higher ceiling more than usual size
Building color and its walls
Two-crust ceilings
Ceiling of Sidewalks

At native architecture of Yazd, they have tried to prevent of thermal wastage and exit of heat to out of building at winter and solar heat to be absorbed more. At summer by more decrease of building thermal temperature, resistance against sun radiation heat and shadow creation was main attempts of this architecture type (Kasmaii, 1999). At the past centuries period at hot and dry regions, wood was found hardly and they used Golz (one of the most sustainable native materials) as building coverage (Minke, 2006, p12). At our traditional architecture, construction of CHaharFasl (which have favorable conditions at all seasons) they are obvious examples of the adaptations of these traditional context with climatic conditions and the rooms around court of these buildings are used according to seasons, it means that northern direction of court receive more sun light at winter than other parts of building are called Zemstanneshin and at summer, the rooms of court southern part which are under the shadow are called Tabestanneshin, of course it is called also Nesar or Sayehgir (the place which receive less heat). At traditional context of these regions, there isn’t any opening surface or window which be opened to out of house and only opening surface is entrance door that directly leads to outer parts of building especially by some extent high corridors to court. One of main features of houses at dry regions is house courts level lower than city streets and this was the result of different factors such as resistance against earthquake force, thermal exchange decrease between corridors and out of building, using the soil for brick-shaped production, building construction and also the most important principle water providing by rivers or wells were at level of urban rivers. The depth of habitation spaces also increased their security quotient against enemies and foreigners (Sadr, 1992). At general, architecture investigation of hot and dry regions cities of Iran such as Yazd, it shows the bodies properties of historical and traditional parts of these cities adapts considerably with ordered principles.

Table 1.

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<tr>
<th>Main parameters of sustainable development</th>
<th>The principles of architecture of dry and hot regions</th>
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<tr>
<td>economical</td>
<td>_Minimum using of infrastructures with compression of urban context</td>
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<td></td>
<td>_The flexibility of designing</td>
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<td></td>
<td>_The decrease of building-making economic expenses because of native materials</td>
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<td>_Having social identity and cultural variety</td>
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<td>_Adaptation with local environment</td>
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<td>_Maintenance of healthiness and security at society</td>
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<td>_Pay attention to hometown interest sense and social participations</td>
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<tr>
<td>social</td>
<td>_Maximal usage of natural sources with exploitation of items of specific architecture</td>
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<td>_Using of special techniques for using of water, wind and solar energy resource</td>
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<td>_Using of renewable and recoverable sources</td>
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<td></td>
<td>_Prevention of Audio, visual and environmental pollution</td>
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<td>_Using of native materials</td>
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Also, details of native architecture investigation of hot and dry regions especially at Yazd, it shows that exactly they considered the principles of sustainable architecture at these regions. We show at the following lines some used methods at these regions:

Minke
The creation of sub-climate: for creation of sub-climate at these regions, they have used the following methods:
Designing according to the climate
Using of central court
Implant of vegetables around the court or around the building in order to increase humidity and shadow creation
Using of pool court for increase of air humidity
Construction two parts of Zemstanneshin and Tabestanneshin at buildings
Building orientation according to climatic factors
Hotness, coldness and light: for reaching desirable amounts of these items, the following solutions have been used:
The most important element for reaching this goal was air-trap (section) that has been used for natural coldness
Using of day light from central court, the light of north and south and light has spiritual aspect at creating of calm and living space.
Creating of Zemstanneshin at buildings for using of sun light and heat
Using of renewable energies: it is most important case at sustainable development approach, using of following solutions have done at hot and dry climate:
Using of air-trap coldness system and desirable natural ventilation
Correct using of prevailing wind and exploitation of it at air-trap (section)
Exploitation of thermal capacity of soil at winter and summer
Using of sun hotness energy at Zemstanneshin rooms
Maintenance and improvement of natural values with creation of artificial space with minimal interference and destruction at nature, harmonic designing with existing ground and facilities and decrease of building pollutions production because of native materials and using of other building residuals or same consumption .... Has been made.
Using of invention at building designing: at hot and dry regions, they used of compressed context for shadow creation, also using of light color because they receive less heat and used curve ceilings to reach this goal.
Materials, structure and building-making techniques: to reach this goal, they used regions native materials such as clay in the form of brick-shaped and mudfor decrease of transition expenses which it needs energy consumption.

CONCLUSION

The sustainable development and its principles have very strong background at native architecture of Iran's hot and dry regions. Native architecture of our hot and dry climates is compatible with nature and using of its sustainable energy such as light and wind and its main elements such as water, soil and vegetable. In using of sustainable development at native architecture of these regions, architects have paid attention to physical and spiritual needs of habitants and also whole climatic, cultural and social factors have been created according to relation of human being, environment and human being scale that it creates interest sense to natural environment, interest to living place, and environment maintenance by habitants. So, using of these applied patterns and methods can be used at future designing. Our countries architects should have new view to architectures elements at our past periods, recognize its value and try to use it at their next designing. Of course, mentioned items as elements, spaces or climatic tricks of traditional architecture of Iran's hot and dry climate are only small part of interesting used actions of ancient architects of this land. So, we suggest these following points to be considered at the next designing at hot and dry regions:
Pay attention to spaces arrangement and buildings orientation
Pay attention to building form and materials which are used at building-making
Pay attention to climate and sub-climate at site designing
Using special inventions at architecture for decrease of energy demand and or thriftiness at energy consumption such as green roofing, green windows, different types offbroad leafed trees to have shadow and wind and buildings arrangement for shadow creation on each other
Using of engineering principles for control of environmental conditions, management and effective programing according to reduction of construction expenses and building maintenance
Using of native materials, sustainable and recoverable at buildings.....

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