Analyses of Sustainable Rock Architecture in Kandowan Village, Iran

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Abstract: - Typology related examinations of rock houses shows that the most important characteristics of it is in crating space, and following the nature and the form of borders, Kandowan village (located in the north west of Iran) architecture is a function of nature not the nature function of space. Inside the conical and twofold natural hills of Kandowan with 60 meter height, which are created in slopes of Sahand Mountain due to its volcanic action and reaction, house of up to four floors are constructed. Number and form floors of inside spaces depend on the shape and dimension of extremity, and due to the compulsory resistance of spaces has a rather smaller dimension. For constructing bigger living spaces sometimes, in Kandowan, a number of extremities or parts are connected to each other and the space between there is filled with corpse stone, (and wooden and clay and straw roof) or a number of extremities are connected through narrow stone corridors or in some cases open wooden bridges are used to connect two extremities to each other. Due to its bigger size and low light first floor of extremities are used as sheepcote and second, third and fourth floors are usually used as residential place. The several ploughs in the village, on one to which the natural river is flowing, separate the extremities form each other and form natural shape of village valleys. If architecture is the mixture of culture, technology, territory, production, technical knowledge and sense of immunity of a nation in the form of building, in Kandowan architecture all of these factors are clearly crystallized.

Key-Words: - Rock Architecture, Space, Energy, Environment, Sustainability

1 Introduction
Kandowan village is one of the mountainous villages of Oskou town (located in the north west of Iran), which is located in 2400 meters from sea level. From geographical point the village is located in 45° 31' E longitude and 37° 48' N latitude, 62 kilometers far from Tabriz, center of East Azarbaijan province, in western of its special rock architecture and mineral water stream. This village is of plain concentrated type with organic growth which is constructed in a condensed form to use the land and creation of immunity. Buildings are usually constructed as one floor and arrangement and locations of different parts of one residential building including living rooms, guest room bream oven room and other parts which are separately built in the yard.

2 Climatic Conditions of the Village
With regard to the climatic conditions of Iran, Kandowan is located in a climatic zone with very cold winter and moderate summer. The rainiest month of the year is April with 67.8 mm rain and we have the least rain in August with 4.4 mm rain. The average seasonal rain of the year has been in spring with 140.46 mm being the rainiest season of the year. With 13.1 mm rain summer is indicated as the least rainy season.

Fig.1: Cold and dry climate in Kandowan (winter view).

Cold and dry climate, east-west winds, using sunlight, angle of sunshine and more profiting form it made the house to be built pacing Kiblah or geographical south. Most of the houses are south facing where the effects of solar radiation in warming the houses and melting snow are much tangible. At the same
time western winds which affect the village from west side in winter make the openings facing south. In summer, breeze from mountain to the river, have a cool effect on the fine of weather and acts as a cooler and natural air conditioner in the houses [1].

3 Living
Living is the most important factor in forming residential spaces and neighborhood areas in the village residential types of village are divided into two old and new types. The existence of residential units with animal has bandy and forming facilities is special for old times and the core of village. The constitution of straw and Lucerne storage, winter room, which is a guest house with stone for cooking bread and food, is one of the characteristics of ancient architecture of this village.

But the new building spaces include guest room, dinning room, hall, bathroom and we inside the building to follow city forms. These kinds of houses belong to people who have service and driving fobs. On the other hand formation of village houses has been more of functional and is made in each period based on the needs and facilities and limitations of the time [2].

4 Rare Rock Architecture in Kandowan
Rock architecture indicates scenes of human fighting and struggle with nature and taking natural rocks into service regarding rebuilding history rock architecture in more important than normal architecture.

In normal architecture the main body of architecture is made by building materials such as line, gypsum, brick and mud brick. In normal architecture space is the result of main body and building size. While the opposite is taking place in rock architecture it means, their architecture starts from space. Rock architecture of Kandowan relates with its natural borders and surrounding land space has created a world of beauties. This area being created in one of the mild weather area of E.A. reaction of Sahand Mountain looks like a dream.

5 Types of Rock Architecture in the World
Regarding its space and body rack architecture is divided into two types:

In first type, inside the rocks which are conical shape and are standing alone as hill mount is excavated and change into a residential place which maybe one floor or more floors; due to its conical shape first floor will be
bigger than the others on top. In such a case outward and enough light through can be considered in it; such as Indian temples, rock architecture of Gormeh area to Turkey and Kandowan rock architecture.

In second type same part of strong mount or rock is excavated and the external space of it is not clear; one door can only be considered for it and in same cases setting on air vent is possible but there is no place for window and light through, like rock architecture of Meimand village in Kerman.

5.1 Kandowan Rock Architecture
Old living spaces or Kandowan are first of type that the most important characteristic of it is the creation on space. By the force of nature and rock forms which belong to a residential unit or a public place for its capability. These building are external appearance and window and light through is considered for them. From the whole collection we can see some special case of second type architecture which are completely constructed in the heart of soil and are connected to outside with only an entrance door; for such cases we can name the house of Mr. Khadei and western sheepcote of village [3].

Local people call the spaces Gayeh (meaning rock) or Kara (extremity). The formation of extremities is that in very old times inside of the conical rocks is excavated depending of living needs and as much as possible and are made in the form of living space. For this reason the spaces are made only to answer to development limits, with suitable internal divisions and creating built – in shelves and platforms and even in some cases developing living space using materials such as corps stone and mud, an arrangement is made to provide long time living of families.

In creating spaces in addition to considering human measures, the immunity, techniques and form of extremities' parameters are considered. On the rout of creation, weak walls of extremities are ruined and destroyed under heavy rains and extreme winds and only hard part of tuff stones remain and are acting like insulator as a result. Some extremities have a cool air in summer and a worm one in winter for its strong and thick walls. On the other hand, transfer of heat between outside and inside is not felt much and as a result inside space of extremities have suitable weather during different seasons. For their special standing beside each other, the surface of conical break the wind and the resting of doors and windows inside the wall space prevents entering snow and rain to the inside of spaces.

For being strong, polishes and strength of conical stones, there is no need for roof covering and for their strong territorial conditions; these stones keep the extremities form any atmosphere damage especially during winter. From the general view, regarding the conical and twofold shapes of rocks, growth of space and its creation in Kandowan takes place in highland in contrast with other villages. Most of extremities have different floors which are available only through special ways of borders of extremities and has no connection form inside. The only internal connection is seen in Mr. Moramed extremity, in which an internal stair connects the basement to store house (under ground). Number of floors and internal shape and space of them depends on the shape and space of stones.

Fig.5: Space creation follows nature and rock forms.

Fig.6: Sustainable forms in Kandowan houses.

Extremities are almost of two floors, but in some cases there are three or four floor extremities. For considering immunity matters and standing support, dimensions are rather small and in the cases which more space were needed thick column are carved from the stone itself in the middle of extremities to share a part in
standing support of roofs. As the conical of Kandowan are formed naturally as a result of volcanic action and reaction of Sahand mountain, the passage of time and cooling the melted materials and outflow of volcanic gases, some holes (Kitches) are created in different parts of external walls of extremities which are taking part in creating light or ventilation of extremities depending on the case [4].

5.2 Internal Element of Extremities and the Relation between Spaces:
As it was mentioned extremities have two floors and in some cases there or four floor in general. Architectural elements of their internal parts are formed in two shapes of residential and public place usage; we will study architectural elements for residential use first and the second will be that of public spaces..

5.2.1 Architectural Elements with Residential Use
For their heaving not have light and bigger size first floors of extremities are mostly used as sheepcote and second and third floors are used for residential purpose. Only in some cases, the floors after (on top of) fourth one have been used as storage rooms.

In using the floors for residential purpose, inside spaces are divided based on the needs and floor's usage; the related elements are as follows:

a) Main Space: These parts are used as living, guest and bedrooms. In some extremities sleeping place is devised as a stone bench little bit higher than ground carpeted with short-napped coarse carpet, on which family members sleep. In most of the main rooms there has been a bread cooking stove which was used as heater in winter in addition to its being used for cooking purposes; in old times white washing (gypsum) was made by the white soil available in the region. In general stoves are like a circle shape holes, excavated on the ground of stone surface of extremities; and are almost ended for a natural funnel shape holes for ventilation of the smoke arising from cooking. The bread needed for the families are cooked in these stoves every two or three days [5].

b) Bed Cloths Place: A rather big and flat space on the walls which is used for putting bed cloths, matters and cloths; and some are separated from main space with a curtain.

c) Threshold: Entrance part of every extremity is called “Astana” (threshold) by local residents and is mainly seen as two types. In big extremities which do not have space limit are sometimes used as entrance filter and washing dishes, cloths and even family members would be in this place. But, in small extremities to avoid the flow of water to sitting place the threshold is separated from it with constructing a very low height wall for it; in such a case washing would be in some part of living room itself. Washing place is like a small basin made of cement which is connected to piping water of the village and has a hole to the outside for flowing out the excessive water.

d) "MATBAKH" (Kitchen): It's usually out of room and some nearby place, but in some cased cooking is done in the main extremity. Cooking in the kitchen is also by using stoves; which are mainly for cooking bread.

e) "GAZANE" (Store house): These are small store place inside the extremity in which weekly needs of family such as grains, wheat, barely and flour is kept. Generally, there are other kinds of store in Kandowan
apart from this as follows: Pea store & Open and roofed provender store houses [6].

f) Entrance Doors: Due to the difficulties and limits of excavating are constructed with 1.50 to 1.60m height and 1 to 1.30m width; to protect the extremities from entering snow and rain inside of it, the doors are constructed inside of them as mush as possible. Most of them are replaced with iron ones.

g) Windows: Regarding increase of diameter and thickness in lower parts of extremities, the light through are placed in upper floors of extremities and each space has the minimum level of light through. Windows are mainly made of wood and their shape is almost four square with small pieces. To prevent the snow and rain to come inside, windows are constructed inside the walls. Recently a very few number of them are changed to iron [7].

5.2.2 Architectural Elements with General Use

This includes public places of village including school, mosque, bath, sanitation house, post and telephone office guesthouse, shops, coffee house, public WC, etc. At present they are located beside the entrance road village (center of new locality), because there is no space inside the extremity texture to place these accommodations inside of it. In the old texture of village there is only big mosque. In the slopes of extremities there are a small underground mosque, one bath and two ruined old mills.

This part will first study on architectural elements constructing public places and later on the study will be on newly constructed public places.

a) Big Mosque Extremity: The mosque extremity is placed in the mouth of one of the big grooves and has four floors. First floor is sheeprcote, second is mosque, third is residential and fourth is store house [8].

Next to mosque extremity there is a residential extremity basement of which is used as sheepcote and the first floor is residential place. These two extremities are connected by a wooding bridge. The mosque entrance is connected to passing way through this bridge. The walls are stone and the surface of mosque is of soil and it has a wooding window to let the light in.

b) Small Mosque: Nearby connection way of village and beside the bath in underground this mosque is constructed for managing Morning Prayer.

c) Bath: The only bath house of the village is constructed in the center of present locality in the depth of 2 meter from land beside old mosque. The reason to construct it under the ground was the case of using river water which was flowing some meters down the bath. But at present the bath water is provided by watering water of the village. Bath has three spaces for taking bath, hot water storage and cold water spaces, excavated in the heart of extremity. The kind of material used for constructing it is of stone and cement. At present some parts of it can not be used for being ruined but it is being repaired by residents’ efforts.

d) Old Mills: In the eastern extension of the village beside Kandowan River, there are two old mills made of stone and mud material, which were working with river power and used by village residents.

e) Kandowan Village Sheep cot: Since the main living of village people is by keeping and fostering animals, constructing sheep cots is of special importance in this village. In general sheep cots are constructed in two below ways: 1) Private sheep cotes, which are constructed inside the residential houses of the village and due to the need for more space and less need for the light are excavated mostly in the first floors of extremities; in addition to keeping sheep and cow, it is used for keeping poultry as well. 2) Public sheep cotes,
which are constructed out of village texture and are located mainly in western side of village and are used for temporary keeping of the animals before they are taken to pasture. Some of these sheep cotes are constructed in the surrounding mountains before the village, which have only an entrance and some of them are excavated inside extremities. These sheep cotes are constructed of big and small spaces which includes a place for keeping animals, animal excrements, and fodder storage place; the height of them are rather short.

5.3 Review of Existing Materials and their Usage
Around the village there are no special building materials except stone, soil, sand and wood and the houses and buildings of the village were mostly of wood, stone and mud bricks. These are used for the recent development of the village [9].

6 Conclusion
In Kandowan village extremities are usually of two floors and in some case three and four floors are also constructed.

a) Human Measures: The measure of inside Kandowan or outside of extremities is human measures.

b) Small measures of spaces: For territorial reasons and for difficulties of excavating stone spaces, the excavated spaces have small dimensions in the minimum space with the most efficiency. For this reason we face multi-functional spaces and rooms inside Kandowan extremities. The rooms are used as living, guest and bedrooms as well; even in some cases by excavating a space in the main room, kitchen is also placed there; at the same time it helps increasing the heating of house. The small dimension of entrance doors are also due to territorial matters and seem the idea necessary for of respecting the family upon entering by bending the body.

c) Form: Form and shape of Kandowan architecture has three main methods: In the upper parts of the village: Extremities, in the middle; houses made of corpse stone with wooden roofs and plaster of clay and straw are constructed and in the lower (downward) part of the village we can see the modern houses which do not suit with the organic form and texture of the village. The sight unity of Kandowan is provided by stone; both in big volume (extremity) and small one (as corpse stone) forms the general view of the village.

d) Immunity: The immunity is provided for all military, strategic, and peace and immunity against territorial factors and cold in outside and inside of extremity.

e) Territory: Kandowan is constructed facing valley, river, sun and sunlight; and by using direction of wind blow from valley and sunlight from south, it benefits from suitable natural light and ventilation. This maybe the reason for less need of light through, canals and ventilation holes in Kandowan extremities are a few and due to the slight thickness of extremities in upper side, they are usually constructed in upper parts of extremities. Regarding the heat insulation the thick walls of the extremities are suitable heat insulators.

References: