CREATIVITIES IN DESIGNING APPROPRIATE WITH THE SOUTHERN COAST CLIMATE, THE CASE STUDY OF CHABAHAR, IRAN

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ABSTRACT:
The significance of interaction between the climate and the architecture is not a secret and all of the buildings are affected by the climate elements. The necessity of saving energy requires reconsideration in the methods of construction, as a key element of the planning and designing, and this can be achieved via architecture compatible with the climate. Chabahar is one of the cities in a hot and humid climate where the main effective climatic elements are the radiation, temperature, humidity and wind, with very hot summers and mild winters. This paper tries to study and understand the states and conditions of Chabahar climate, and then presents some strategies for creating a comfortable situation, through designing buildings appropriate and consistent with regional climate. This paper employs a descriptive-analytical method, based on the climate design principles and collecting data from Library and Field studies to display creativities of climate designing appropriate with the southern coast in Chabahar.

KEYWORDS:
Architecture, Chabahar, The Climate, The Degree Of Comfort, Designing

INTRODUCTION

Thermal balance between the human body and the surrounding environment means keeping the temperature of internal body tissues within a certain range, despite the wide variation of the exogenous temperature. The interior designer's job is to create the best possible conditions that are comfortable and favorable for life, and provide the safety of the residents against adverse environments and weather conditions, and this is an essential principle of architecture in buildings [1].

Southern coastal towns have special weather conditions, such as: extreme humidity, high temperature, onshore to sea breezes and local winds that affect the formation of architecture and residential environment. The residential buildings are the most affected structures by the climate conditions, due to their simple functions and small scales [2].

Furthermore, they are used throughout the year, and at all hours of the day; while, most of styles which are used within the buildings today are not efficient enough. The climate is an important factor that affects all living things and natural environment phenomenon; Building professionals are increasingly aware of the issue and if they consider it carefully in the planning, they can decrease the energy consumption, even in very inclement climate, by designing proper structures and forms of the building and its outer perimeter. The relationship between the energy consumption and the local climate should be considered by the planner-especially, when s/he wants to minimize the cost for the consumers.

The geographical scope of this research is Chabahar; and firstly, some elements of the synoptic weather station, since its establishment (1957 to 2011) will be analyzed. Then, to determine the characteristics of the building in relation to the surrounding climate conditions, Olgi, Giveny and Mahani methods will be used After reviewing the climate performance of the structural elements and determining the thermal needs of buildings in Chabahar, the ways to meet these needs, moreover the proper orientation of the building plans will be proposed.

MATERIALS AND METHODS

The method of this research is quantitative, descriptive and analytical. Collecting the quantitative data is a library method, which uses the collected data from the charts and statistical yearbooks of the weather station in Chabahar. The descriptive data are collected through field studies and also summarizing and taking notes from written sources, including: books, articles, theses in libraries and universities of the city and archives of departments, organizations and sources.

The Scope of the Study

This city is located at 27 degrees and 10 minutes latitude and 56 degrees and 11 minutes longitude, near the Persian Gulf and the Strait of Hormoz entrance. The city's average height above the sea level is between 35 to 40 meters. An Aysyn Valley in the north of Chabahar is a farming area that is within the Chabahar limitations, and this city has the conditions and characters of a metropolis. The scope of the services in this city exceeded than a province and also it is well positioned internationally. Among

The factors that are important in shaping the climate of Chabahar are its latitude, nearing to the sea, low altitude, and the role of the sea in increasing the humidity, enjoying the Mediterranean and Monsoon winds, two types of rain regimes and etc. that influence on the architecture and shaping of residential environment. Therefore, considering the climate features in the design of residential areas in this city has special importance. [Fig1]

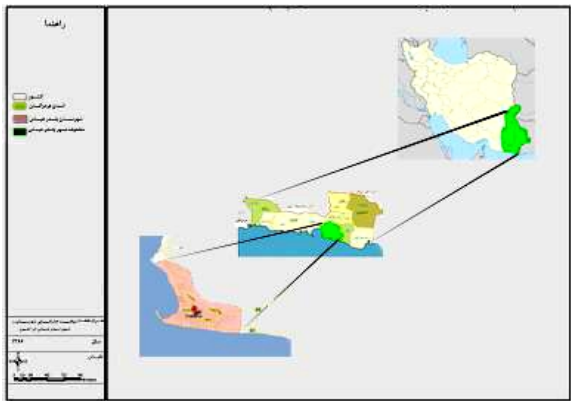

Fig 1. Location of the Sistan and Baluchestan province and the city of Chabahar [3]

Thermal comfort

In the design and technical issues of a construction, human thermal comfort refers to the situation in which the human feels thermal comfort, mentally and spiritually. Many researchers believe that (thermal neutrality) is a more accurate interpretation of thermal comfort, because in such conditions the human body does not feel the hotness nor coldness nor injuries due to local discomfort caused by asymmetric radiation, cold air, cold room floor, uneven wearing, etc [4].

Today, the importance of climate conditions in designing and constructing of all buildings, particularly the buildings that are used directly by humans or living creatures is obvious.

The climate features and characteristics, and their impacts on the formation of a building are important from two points: On one hand, buildings in harmony with the climate or climatic design of buildings have better quality in terms of human thermal comfort. These buildings have a healthier and better environment; Daily and seasonal variation and changes in light, temperature and air flow in buildings makes a pleasant atmosphere. On the other hand, the harmony of the building with the climate saves the fuel required for such buildings to control the environment [3].

Iran's southern coast, which is separated from the central plateau by the Zagros Mountains, constitutes the warm and humid climate of the country. The character of this climate is the hot and humid summers and mild winters. The maximum temperature in summers rises to 35 to 40 degrees of centigrade. The humidity is high in all seasons, so the temperature difference between the day and night is low. Chabahar, Bushehr, Abadan and Ahvaz are the cities which are located in this climate; but they have different temperatures and rain relating their location and distance to the sea [5].

One of the factors that are discussed about the human comfort in the climate is the vital climate, in which the human conditions of comfort, relating the temperature, radiation, wind and average humidity study. In this way, the bioclimatic conditions of the area are studied by using the bioclimatic charts and diagrams. Table 1 shows some average climate features during 54 years.

Tab 1: the average temperature and humidity of Chabahar weather station during 54 years [6]

THE CLIMATE FACTORS	DEC	NOV	OCT	SEP	AUG	JULY	JUNE	MAY	APR	MAR	FEB	JAN
The Average Temperature	24.4	28.6	31.7	33.5	34.6	33.5	31.8	28.9	25.1	22.6	21.0	21.6
The Maxim Average	26.5	30.7	34.0	35.9	36.9	35.7	34.1	31.2	27.4	24.8	23.1	23.7
The Minimum Average	21.4	25.1	28.0	30.0	31.3	30.5	28.5	25.7	22.3	19.9	18.4	18.5
The Humidity Average	68.6	70.4	78.1	82.3	82.2	83.0	83.6	81.2	79.8	77.2	71.7	68.5

MONTHLY COMFORT BASED ON THE GIVENY METHOD

In this method, the required features inside a building, to be under the influence of climatic conditions in the comfort zone are identified, depending on the weather conditions and changes in the surrounding environment. For practical purposes, Giveny draws some curves on the psychometric charts, to specify the usage of natural ventilation, the features of the construction materials, adding moisture to the air, as well as the necessity of using mechanical devices, relating to the different thermal conditions in the air around the building, and then he called this chart a building bioclimatic chart. This method is based on:

- To calculate the average minimum temperature and the maximum humidity of the coldest point, and mark it on the table with a triangle sign.
- To calculate the average maximum temperature and the minimum humidity of the warmest point, and mark it on the diagram with a circle sign.

Monthly comfort based on Olgy method

Amongst the elements of weather, temperature and humidity have a greater effect on the human comfort and health. Most models of human comfort measures in relation to climate conditions are based on these two elements. Temperature variation

depends on the amount of solar radiation, and the humidity changes depend on the amount of water vapor in the air. [Fig2]

Increase and decrease of water vapor in the air, in addition to the temperature changes, also depend on the wind speed, and the wind blowing controls the temperature. One of these models is Olgi's bioclimatic graph. The daily comfort is specified by the statistics of average maximum temperature and minimum relative humidity that are marked on the chart with a circle; and the average daily temperature and average relative humidity, marked with a triangle on the chart shows the night comfort.

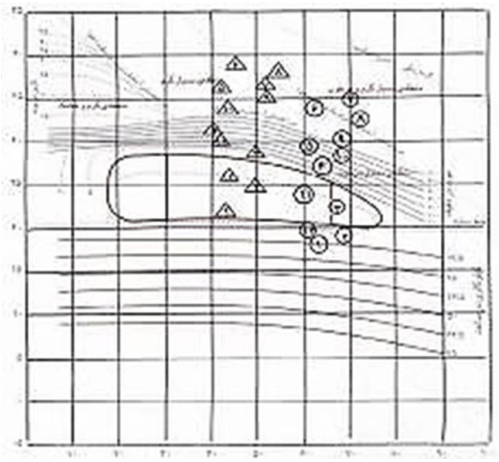

Fig 2. rate of monthly comfort in Chabahar based on Givny method [7]

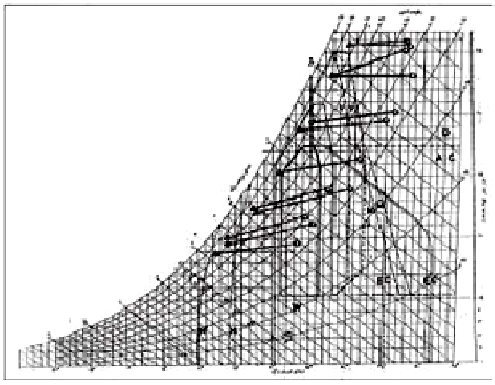

Fig 3. Chabahar bioclimatic diagram [5]

Figure 3 is the Chabahar bioclimatic diagram. In this diagram, the changes of temperatures (the average of maximum temperature and relative humidity at 12.30 o'clock and the average of minimum temperature and relative humidity at 6.30 o'clock) for all months of the year, over day and night's showed, in relation with the comfort zone.

As it is showed, during the months of June, July, August and September, Chabahar is out of the comfort zone, and placed too far from the maximum point of it, so that in the most of these months, the thermal conditions could not be adjusted by the air flow to achieve the human comfort, and ventilation systems are necessary. As it is shown in figure 2, six months of the year (including: May, June, July, August, September, October) have warm and uneasy days and nights. In one month of the year (November), the weather is comfortable overnight and warm over the day, and in two months of the year (December and April), the weather is comfortable over day and night, and in three months of the year (January, February, March), the weather is cold over day and night. Therefore, Chabahar has very warm and uncomfortable weather for the human during the warm months, but has relatively good weather at the other months, even in the coldest days of winter; the temperature is so that the human feels comfort under the sunlight.

Thermal requirements of the interior spaces

According to the studies, Chabahar has a suitable climate in the winter and very hot and humid climate in the summer. In this climate, even in the coldest months of the winter weather is ideal and we can say that it is lacking the winter climate. Even in the coldest month of the year, the thermal conditions are so comfortable that can be easily used in the outdoor spaces shade. The coldest time in this climate placed in the sun zone and the average mode of maximum temperature in the winter placed in comfort zone.

Thus, over the days of this season, outdoor spaces have no thermal discomfort. During the summer, it is very hot and humid, so that approximately every day and most of the nights in this season, have very awful thermal conditions in outdoor spaces and it is not possible to adjust it with natural methods for the human comfort and the outdoor spaces could be used only during the uncritical months of the year.

Dwelling for the hot and humid climate in Chabahar

In Chabahar, the air temperature is always close to the body temperature, hence the heat loss from the body to the air via convection and conduction is minor. To achieve the physical comfort, it is needed to excrete some heat from the body to the environment (at least, as much as the metabolism temperature).In very humid weather, a small amount of sweat evaporation creates a layer of saturated air around the body, which effectively prevents the last phase of evaporation and thus prevents the last stage of heat excretion from the body. [Tab 2]

This saturated layer around the body can be away from it by the air flow. So the airflow not only relieves the indoor conditions, but also around the residents' body. Indeed, this is the only way to improve the thermal conditions [5].

Table 2: rate of comfort over day and night Source: the author [8]

MONTHS OF YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Human Feeling Over Day	C	C	C	C	R E	U	U	U	U	P S	R E	C
Human Feeling Over Night	CO	CO	CO	C	R E	U	U	U	U	P S	C	C

COMFORT: C, RELATIVELY EASY: RE, UPSET: U, PRETTY SAD: P S, COLD: CO

Whereas in Chabahar, the weather does not cool significantly at night, the wall's surface and the roof's temperature are equal and as the air temperature. Moreover, the airflow from outdoor to indoor will accelerate the integration of temperature. Since the temperature of the surfaces is near the skin's temperature, the body's heat loss through the radiation would be negligible. But in any case, it is necessary to prevent gaining heat from the sun and sky. As the only way to improve the hot climatic conditions is the airflow, so it is vital to provide it for comfort in the interior spaces. Therefore, the buildings should be open to the breezes and establish so that they can use all of the existing winds. Failure to do so makes the interior spaces of the building, always warmer than the shady interior spaces, which are exposed to the air flow.

The openings' style

In this climate, big doors conduct more radiation into the buildings. The main feature of the buildings in the hot and humid climate is their openness and their location at shadows. Establishing all of the vertical surfaces- openings or integrated walls- in the shadow is useful. A broad Roof projection provides the needed shadow for the surface of the openings and walls. According to the regional climate features, the openings must be placed appropriately toward the prevailing breezes, in a way that the air circulation happens naturally, at the body height or the location height (up to 2 m. in height).

Such openings should be large enough and open completely. In this climate, there is no reason to install glass windows with constant frames. But as the winds and the sea breeze are blowing from the south and the south-West to the north, openings under the roof should prevent the solar energy and use these breezes simultaneously.

Using the breeze

The beach winds are different from the onshore winds. With the light warm breezes blowing in the months of summer, the coastal winds mostly blow in the opposite direction of the air masses [9].

Since Chabahar has mild winds at winters, building the houses on the top of the hills makes it possible for maximum use of the breezes. However, a topographic study of the region is needed to clarify the correct pattern of wind flow in the area and determine the best placement of the buildings [10]. Trees and shrubs can be used to redirect the airflow to the building and can even intensify the wind flow through a funnel. In this way, the canalization increases the wind speed. Studies show that when the path lengths are less than 40 meters, the height is not very noticeable, but when the lengths of the buildings or the streets are more than 40 meters, the ratio of V_m. (The average wind speed through the path) changes in proportional to the height.

Decrease of light absorption

In General, the amount of solar radiation on the Earth's surface during the warm months of the year is approximately twice the radiation on the eastern and western walls. Therefore, reflection of light from the ground to the walls and window scan greatly add to the cost of cooling requirements of the building. Selecting the external surfaces with low reflection can be a means to reduce the heat from the sun. Herbaceousplants and grasses absorb the light remarkably and also provide the evaporative cooling of the air. Development of the broad-leaved plants and their placement can reduce the thermal load on the southern wall.

Creating a shadow around the building reduces the amount of absorption of solar radiation. Tall trees on the south side of the building are suitable and can provide shadow for the walls and roofs. In the east and west of the house, using plenty of plants, shrubs and hedgerows prevents the sunlight before noon and afternoon. Adding shade scaffolds is useful in several directions:

- They can not only cast shadows on the walls, but also prevent the light reflection from the ground's surface to the walls and windows. Basic offers for climatic elements of architecture in Chabahar
- Chabahar for having a hot and humid climate have a very warm weather throughout the year, so the buildings should be oriented in the direction of east - west; as a result, the view which is facing the sun in the winters -the southern view- will be more than the east- west view which only faces the sun in the summers.

However, it should be noted that the proper forms are those which have less area on the eastern and western walls. It can be seen in the traditional architecture in this city. [Fig4]

To create strong winds in the interior spaces, the buildings should use the wide spatial plans. The exterior walls should use lightweight materials with a low thermal capacity so that it does not absorb and store the heat. It is better to use these kinds of materials for the southern walls which open to the cold breezes and enjoy the sunlight in the cold seasons. But for the eastern and western walls,

which should always be kept out of the sunlight and heat, the use of heavier materials with low thermal conductivity is better. Generally, in warm and humid areas, using materials with low thermal mass which do not store heat is better. Because in a hot climate, the main problem is overheating and saving the day temperature for night, which is not correct.

Fig 4. the north-south orientation of the modern buildings and the east-west orientation of the old buildings

Therefore, the wood is the best material in this region, because it transfers the heat slowly; the gained heat during the day remains on the wood's surface and with a relatively cool breeze at night, the wood loses its heat. The Roof of a building is the part that is influenced by the climatic factors, more than the other parts. In hot regions, the roof is the main cause of indoor air heat that is due to the type of roof design. In traditional designing of roofs, the most material is the brick and clay. These materials prevent the penetration of solar heat into the buildings in warm seasons; for this reason, it is recommended to cover the roofs in this climate with a double coverage. Interior and exterior Walls in Chabahar should be built of heavy materials. The use of heavy construction materials in exterior walls will reduce the transfer of the heat from the outdoors to indoor spaces. Heavy construction materials hold the absorbed heat for a long time, depending on their substance.

During this time, if the weather is cold outside, an amount of heat absorbed by the material will be transferred to the outside air.

In Chabahar, due to high temperature and slight daily temperature fluctuation, the delay of constructions could not generally control the interior conditions, in warmer months. But in any case, the use of such materials will improve the indoor air conditions. [Fig5]

Fig 5. reducing the thickness of the walls in the new buildings

Whereas the climate is hot and humid in the city of Chabahar, whatever the number of windows and their sizes are smaller, the amount of the heat transferred from them to the interior spaces, will be reduced.

Dimensions of the windows in Chabahar should be small and between 20 and 40 %.Windows are the weakest parts of the exterior walls, to prevent the external heat transfer.

If the woody hatches or mobile networks of thermal insulators installed on the back of the windows, the amount of heat transferred from these windows (in any form: conduction, direct radiation, diffused and reflected rays) will be minimized. High windows can be used considering the solar radiation, if the building is toward the south. Moreover, large windows can be used in this part of the building, to enjoy the breeze. It is better to install them as high as the human height, to receive the least amount of solar radiation. But no windows on the west and east of the building are recommended.

In this climate, the excretion of radiation is more than the absorbed radiation. So the windows that bring light into the building must be located to the south. The solar radiation from the East and the West impacts mostly on the walls and windows; but influences on the roofs at noon, when the radiation's angle is vertical.

If you use windows on the eastern and western parts of the building, the canopy must be used.

Mobile networks of thermal insulators are also recommended on the back of the windows. Horizontal canopies on the south side of the building, which make optimum use of the sun's light indirectly, prevent it from the radiant heat into the house.

Balconies with Canopy, facing to the sea have also contributed a lot to benefit from the favorable weather. To predict the Performance of the canopies, architecture designers use the diagrams of the sun position and the shadow detection conveyor.

To calculate the sunlight angle, the position of the sun relative to the building at any given time should be specified. The position of the sun in the sky is characterized by two angles: the angle of radiation and radiation direction. These two angles can be set for any time of the year or any time of the day using diagrams gained from the position of the sun. Putting up the buildings from the ground level. In the hot and humid climates, the living spaces, generally, considered to be above the ground to prevent the moisture penetration. [Fig6]

In Chabahar, in order to adjust the indoor air, the wind ventilators are used in traditional architecture; they can be designed toward the sea to benefit the buildings with the cool breezes from the sea.

Fig 6. putting the buildings above the ground

Using the shadows of the uneven places, nearby buildings and plants can reduce the absorption of the solar radiation. Tall trees on the south side of the house that create shadows on the walls and ceilings are suitable. On The East and West, using plants, shrubs and hedges prevent the penetration of the sunlight, before noon and afternoon. Deciduous trees are the best sort of canopy, because they can protect the building in the summer, but in winter they lose their leaves and allow the building to take advantages of the solar radiation.

- An enclosed car park on the western side of the building can reduce the received solar energy. Separating the exothermic spaces, such as the kitchen and bathroom from the rest of the house is also good.
- To avoid increasing the humidity in these areas, the use of permeable materials in the building's floor, avoiding the water stay in the areas that receive the sunlight, and fully ventilation for the spaces, such as kitchen and bathroom should be proposed.

CONCLUSION

In general, the climate characteristic of Chabahar as follows: humidity is high, all year-round, but the annual rainfall is very low. The weather is very hot and humid in the summers and mild in the winters; and the temperature difference between day and night is negligible, because of the humidity. The vegetation of the area is very low due to lack of the rain; and solar radiation in the spring and summer is almost vertical. These climatic features can influence on the design of the buildings, in two ways: Coordination of the structures with the climatic conditions can result in fuel saving in environmental control of buildings; and also structures with climatic design have better quality in the human's thermal comfort.

- Based on the results, Chabahar has no problem with the cold season; and the comfort conditions can be achieved by using appropriate materials. However, in addition to the principles of architecture in the warmer seasons, the use of cooling facilities is needed to achieve the thermal comfort.
- Regarding the climatic factors and adapting the city's architecture with the hot and humid climate, the key design strategies for this city are provided here:

  * The building Protection against the hot air, out of the building
  * The Building protection against the sunlight
  * To create strong wind, in interior spaces
  * To prevent an increase in moisture
  * To correct the positioning and the use of appropriate vegetation
  * To create shadows on the surfaces and views by using the wide and covered front porches
  * To construct the residential spaces above the ground to prevent moisture Penetration
  * The use of thermal insulators in the roof's structure
  * The Use of materials that have a large heat capacity

THE PROPOSED PLAN

For this region, it is proposed to use an extended and opened plan, include rooms in a row to create strong winds in the interior spaces.

The elongation of the building can be perpendicular to the direction of the sea breezes the rooms can have covered porches or corridors that can also provide shade. Openings, doors and windows should be as huge as possible, to create a free path for the air to flow. The construction blocks should be well separated; and extended plans should be perpendicular to the prevailing winds and have low resistance to the air flow.

If the rows of the buildings establish consecutively, the air flow will be reduced through the buildings, which are backward in the wind, by the first row; so the buildings should be constructeddecussately and also the rows of trees should increase in the margins.

The Ground vegetation can decrease the wind speed, especially at 2 meters from the ground surface and prevent the air flow near the ground. Moreover, the most of the buildings should be constructed on the pilot so that the building stays above the ground in the still air to achieve greater air flow.

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