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The Study of Architectural Principles Adaptable to the Humid and Temperate Climate (A Case Study of Ramsar)

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ABSTRACT

As we know life style and model in human communities and growing trend of population increase the use of just natural conditions of environment to provide thermal comfort is not for human beings. This has doubled the need for advanced and modern appliances which can use new energies to produce thermal energy. However, the ideal design happens when both i.e. climatic conditions of environment and advanced and modern appliances are used together to complete their performances. To do so data recorded by Synoptic Meteorological Station of Ramsar over 40 years (annual weather report of the year) and tables on average wind speed in knots have been collected and Mahoney Tables completed accordingly. Based on the index tables of thermal state of the months of year 6 indexes have been developed from Mahoney Tables. By wide- scale field research data on the climate of the region have been collected and analyzed. Based on the findings it can be said that the region has a very humid climate, Its summers are rather hot and wet and winters are mild.The absolute minimum temperature is nearly -10°C in January and frost occurs 11.2 days on average. The average temperature has reported to be 15.8°C. Thermal regime is in a way that there is the minimum required temperature for plants growth for the two third of year and the average temperature for the rest is 8°C.
KEYWORDS: Climatic design, Humid and Temperate Climate, Architecture adaptable to Climate, Ramsar)

1. INTRODUCTION

Settlement and shelter have been the basic need of human. Therefore s/he has attempted to use natural factors and the available materials to meet these basic needs. In Iran designing housing adaptable to the climate has been practiced from distant past and remained samples still attract the attention. Taking climate conditions and factors and available building materials into account architects practiced construction and with regard to the climatic conditions of each region and climate – appropriate design they tried to provide maximum comfort for the occupants.

However, with the advance of technology in electrical and mechanical sector climate-oriented architectures has been neglected. In the present study attempt is made to study the climate status of Ramsar based on the data recorded by Synoptic Meteorological Station of Ramsar [1] and investigate architectural principles adaptable to its climate.

2. MATERIALS AND METHOD

To study its climate data recorded by Synoptic Meteorological Station of Ramsar in a period of 40 years including temperature, precipitation, relative humidity and the like have been collected and presented in maximum, minimum and average parameters; moreover, cloud coverage, the number of sunny hours, wind speed and direction, the number of snowy day and frost and dusty day have been measured. The collected data and averaged parameters are plotted on the related diagrams and have been analyzed based on effective temperature, Olgay, Mahoney indices. Then the required recommendation is made to produce architectural design adaptable to climate [2].

2.1 Humid and Temperate Climate (Coasts of Caspian Sea)

Southern Coasts of Caspian Sea has a temperate climate. Precipitation is really high. Like a strip the region is surrounded by Alborz Maintain range and Caspian Sea and covered by coastal plains. The more one goes to the east the less would be the humidity. In fact Alborz Maintain range functions like a wall between two opposite climates and separates the coastal plains from the central plateau of Iran. The region is featured by high humidity and moderate temperature. In summer the temperature ranges between 25 and 30°c during daylight and varies between 20 and 30°c at nights and in winter usually above zero. Precipitation is really high and in summer rainfall is shower form [3].

3. Geographical Location of Ramsar

It is located at 50° 40′ of longitude and 36° 54′ of latitude and its altitude is -20. Its main bed is plain and in south it is border with Alborz Maintain, in north with Caspian Sea, in east to Katalom and Sadatshahr and in west with Alborz Maintain and Chaboksar [2].

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Figure 1: Geographical Location of Ramsar

Figure 2: Aerial picture of Ramsar

3.1 Climatic Features

Based on the data recorded by Synoptic Meteorological Station of Ramsar and averaged for a period of 40 years as observed in Mahoney table temperature, precipitation, relative humidity, cloud coverage, the number of sunny hours, wind speed and direction, the number of snowy day, frost and dusty day have been analyzed [3].

3.2 Temperature

By definition warm month refers the months their average daily temperature exceeds 20° c. the average daily temperature of the region is above 20° c during 4 months of a year. It suggests that the region is in humid range. Moreover, frost occurs when the temperature is zero or drops below it. According to the data recorded by Synoptic Meteorological Station of Ramsar the average number of frost occurrence is 11.2 days in October, November, December and January [4].

Figure 3: the three temperature parameters [1]

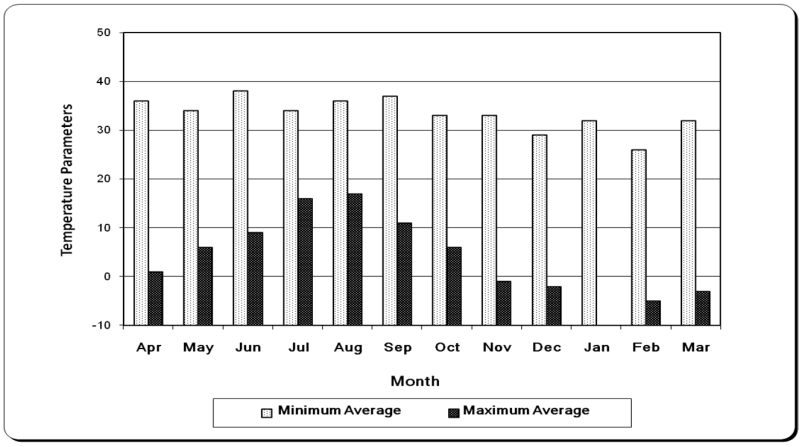
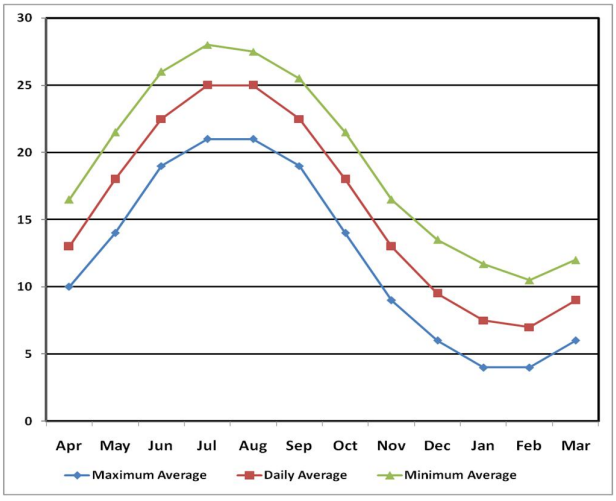


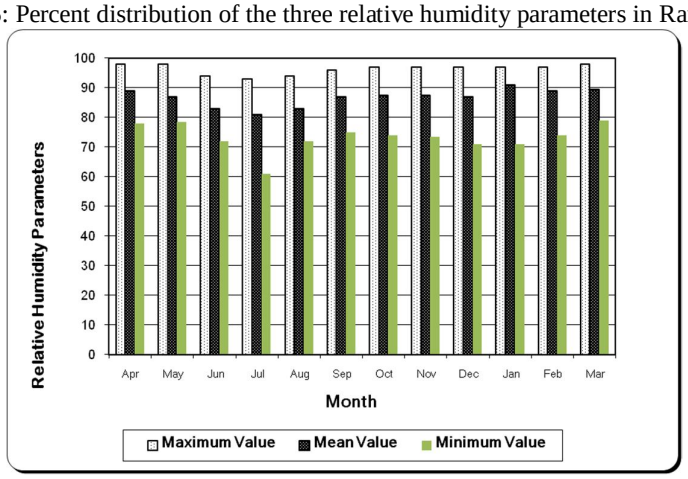
Figure 4: Absolute Minimum and maximum temperature distribution in Ramsar [1]



3.3 Relative Humidity

According to the data recorded by Synoptic Meteorological Station of Ramsar the average relative humidity has been calculated to be 84% and has had low fluctuation. Minimum humidity (95%) has occurred in December and April and maximum humidity (60%) in July [4].

Figure 5: Percent distribution of the three relative humidity parameters in Ramsar [18]



3.4 Coastal Winds

Coastal Winds are classified as local-regional wind. These winds blow from Sea toward coast from early morning to afternoon due to formation of high pressure centers in Sea and low pressure centers on coast. At night it blows from coast toward Sea. Off course this is the case when the region is not under the effects of climatic movements; otherwise, dominant currents prevent high and low pressure systems to cross the region. These winds move vapors from Sea surface towards the plains and mountains [5].

3.4.1 Western Winds

These Winds are under the influence of Mediterranean air mass. They are of rainy winds. It brings wintry raining. It is featured by continuous and mild precipitation and usually lasts several hours.

3.4.2 North Western Winds

These Winds are under the influence of polar air mass of Northern Atlantic and enters into the country from western north. Fast showers in spring and fall are under the influence of these winds. Frequency and type of These Winds reduce from west to east.

3.4.3 Northern Winds

These Winds are under the influence of Siberian air mass which is observed from mid-fall to late in spring. They are usually cold and dry and their collusion with Mediterranean air mass results in snowfall and vast rainfall.

It can be inferred that:

- Dominant wind in Ramsar blows at 315° and in terms of direction is NW group. In Sprig wind blows at 9° E and in July and August at 360° N.
- Average Dominant wind speed is 0.8 knot which is classified under gentle breeze. Maximum wind speed in November and December is 8.5 know which is classified under light breeze.
- Dominant wind constitutes 9.8 % of the winds
- On average 52.8 % of the winds is calm wind which blows at less than one knot. The highest percent blows in October (59.8) and the lowest one in May (48.1%).
- On average wind speed at the Station is 2.9 knot which is grouped as light air. The lowest average speed (2.3 knot) has been in October and November and the highest average speed (3.4 knot) in December.
- Absolute average speed has been (40 knot) at 300° NW and occurred in 1971 [6].

Table 1: Climate Groups in Relation to Monthly Average Relative Humidity [13],[15]

Climate Group1	Relative Humidity less than 30%
Climate Group2	Relative Humidity between 30% and 50%
Climate Group3	Relative Humidity between 50% and 70%
Climate Group4	Relative Humidity between 70% and 100%

4. The climate of Mazandarn Province can be divided into Caspian temperate and mountainous humid (cold and temperate) based on precipitation and temperature [7].

4.1 Caspian Temperate climate

Western and central plains which bound to northern Alborz foothills have Caspian Temperate climate. This region due to its proximity to the Caspian Sea, Alborz mountain wall and short distance between the two has temperate temperature and high humidity. Its annual precipitation is 1300 mm, its seasonal distribution rain is appropriate and dry period is very short. Due to high relative humidity, continuous cloud coverage of sky and low altitude its temperature is temperate and its thermal range is limited. In summer it is hot and humid and in winter cold and wet. Frost rarely occurs. The climate of eastern parts resemble temperate Mediterranean climate.

4.2 Mountainous temperate climate

With the gradual increase of altitude from Caspian Sea toward Alborz Mountains and distancing from the sea the climate change remarkably. At the altitude of 1500 m to 3000m the climate is mountainous temperate. Its winters are long and freezing and summers are short and temperate. Reduction of annual precipitation and temperature are its main feature. The large proportion of its precipitation is snowfall and remains until the beginning of hot period.

4.3 Mountainous cold climate

On Northern slopes of High Maintains of Alborz range at altitude higher than 3000 m the temperature drops drastically and frosts last long. Accordingly its winters are cold and long and summers are short and cool. Its precipitation is usually snowfall which accumulates in cold seasons and begins melting in hot seasons. In mountains like Alamkoh, Takhtsoleiman and Damavand there are glaciers and constant snow accumulation. Even in warmest months of summer there are snow and ice reservoirs in these points [8].

5. Features of Native Architecture

Native Architecture of these regions including coastal strips and Northern slopes of Alborz ranges generally has the following features.

- In very high humid areas close to the Sea to protect the building against the wet buildings has been constructed on wooden supports and in mountainous areas in which humidity is low they have been constructed on stone or mud supports.
- To protect rooms against rains wide and covered small verandaare constructed round the rooms. The said spaces are used to keep crops, rest and to work.
- Most buildings have been constructed with minimum thermal capacity. In the case of heavy building materials the thickness has been kept at minimum as far as possible. (Since temperature fluctuation is low in these areas it is better to use light building materials. Thermal storage has no use; moreover, heavy building materials reduce ventilation.
- In all buildings natural ventilation is used. Generally speaking their plans are open and flat and their anatomical form is thin and long geometrical shape. To use wind blow maximally to create natural ventilation and draught buildings are built to face the Sea. In areas of high and long winds the parts towards the winds are completely closed.
- To take maximum use of air current and due to water abundance and easy accessibility buildings are organized in scattered and decentralized form
- Due to high precipitations the roofs are highly steep [9].

Table 2: Principles Applied in Native Architecture of Humid and Temperate climate [16]

Climate type	Humid and Temperate
Building material type	Low thermal capacity
Plan type	Flat
Roof Type	Steep
Direction	East to West
Building Connection method to ground	By wooden support and ground course
Window number and surface	Many
Amount of Natural Ventilation Use	Much
Settlement Texture	Scattered
Color	Free

5.1 Building Direction in Humid and Temperate climate

By plotting thermal conditions of Humid and Temperate climate on bioclimatic table we can find that the main problem is year-long high humidity. The most important comforting factor is to have constant ventilation and draught in inner spaces. Accordingly draught creation should be attended in building design in these regions. In this case paying attention to the following points is of particular importance.

Building height from ground surface is one of the determinant factors in producing wind pressure and having natural ventilation in building. Taller Buildings have better natural ventilation than shorter ones. High skyscrapers which are taller than the surrounding buildings not only have desirable ventilation but also play a main role in the improvement of their ventilation; however, in winters they are exposed to high winds and precipitation. For this reasons measures shod be adopted to prevent rain penetration into the walls.

Generally speaking in humid regions due to the importance of having draught buildings should be constructed in the direction of pleasant wind and in a way that to make maximum use of the winds to produce draught in inner spaces. Sunshine direction and the resultant energy are of particular importance. The bigger the windows, the more important would be the sunshine direction in building direction.

In humid climate building plan should provide the conditions to have draught in all rooms. Therefore apartments with one external surface and back to wind are not appropriate in these regions.

Too big windows are not that much effective. Even by a small window but in an appropriate place draught can be created in a building. However, if it is not possible to make draught, they can have particular importance in cooling notably in the afternoon. Awning construction on windows is of great importance, but it is difficult to construct it on eastern or western walls. To take maximum advantage of the natural ventilation and draught in building the main current should be directed to the dwelling points [12].

5.2 Desirable Form of Building in Humid and Temperate climate

Although the temperature in Humid and Temperate climate allows having flexible plans it seems necessary to develop plans in east-west axis. In relation to sunshine intensity and its effect on form of buildings there is more freedom in these regions. The reason is that the sunshine is less intense. Accordingly free and even cross forms can be used. However it should be extended in east-west axis [10].

6. Climatic Design

The main objectives of climatic design in terms of priority are :

- Reduction of thermal energy waste in building
- Protection of building against precipitation
- Reduction of wind effect on thermal energy waste
- Creations of draught in inner spaces
- To take maximum advantage of open air
- To take advantage of solar energy to building heating
- Protection of building against sunshine [11],[17].

7. Methods to achieve the main objectives of climatic design

- Avoid constructing building on negative slope and in hollows
- Predict to construct two -story building
- Predict to use the walls of unimportant spaces like storerooms as thermal insulators.
- Predict to construct appropriate anatomical form to reduce wind effect.
- Pay attention to winter wind direction in building direction
-. Try to construct building on high land to take maximum advantage of open air
- To maximize air current by distancing between buildings
- Try to construct building in direction of pleasant wind
- Try to design landscape elements in a way that the trees and nearby buildings direct the air current towards the building
- Try to design plan in a way that the air current move around the building
- Try to design the building in a way to have maximum ventilation under, above and in the building.
- Try to use extended plans with narrow base.
- Try to use tall roofs
-. Predict to construct open and uniform inner spaces.
- Try to use upper and lower windows to improve ventilation at night
- Try to predict two windows one facing the wind the other back to the wind
- Try to construct outer spaces with regard to the gentle breeze
- Try to construct steep roofs
- Try to predict wind direction in building construction
- Try to predict appropriate rain directing ducts
- Try to near the roofs to the surrounding surface [14].

8. Conclusion

Unlike other regions of Iran there is almost no dry season. Precipitation regime maximizes in fall (45.6 % of total annual rainfall) and in this season maximum precipitation occurs in October (275.7 mm). Spring is the driest season; however, precipitation in this season is still outstanding (12.6 % of total annual precipitation). In summer precipitation and shower distribution have specific form and are not accidental. In spite of raining a lot in summer the number of sunny days is remarkable and most wintry precipitation has a cyclonic origin and front.

In terms of precipitation regime two third of total annual precipitation occurs in the season of plants growth which suggests an appropriate distribution with regard to their needs to water. Lack of enough precipitation in July and August sets significant limitation to the crops which are in their critical growth stage. Complimentary irrigations can be a solution.

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