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An Evaluation of Human Comfort in Pars Abad Moqan City Using Evans Index

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ABSTRACT

Use of bioclimatic comfort indices in different geographical areas can help with tourist planning so that touristic attractions can be used more effectively for spending leisure time. The present research aims to identify areas with human bioclimatic comfort in Pars Abad Moqan City. We tried to evaluate presence or absence of human comfort based on Evans bioclimatic index using statistical information of Ardebil Province Synoptic meteorology station over 2000 and 2010. In this model and index, human comfort and discomfort of Pars Abad Moqan City was analyzed in different time periods of a year. This can help with civil planning. Results of this research indicate that the investigated area, in terms of comfort, is of very cold to very warm weather. Synoptic Meteorological statistics of Ardebil Province Meteorology Organization were used in a 10-year time period.
KEYWORDS: human comfort, bioclimatic, Evans index, climate and architecture, Pars Abad Moqan.

1. INTRODUCTION

There has been a relationship and dependence between human and climate since long days ago and researchers and scientists have based bioclimatology knowledge. "Humans have always searched for the best living conditions and this is possible if human body temperature is kept constant at 37 degrees of centigrade so that body is not exposed to cold or warm weather. Studies revealed that humans feel comfortable at 32.2 centigrade degrees when relaxing, of course if relative humidity of the weather is 35% and if it approaches 80%, human will feel uncomfortable." (Jafarpour,1979, p: 153). "If temperature or relative humidity is changed, human comfort conditions will be also changed. Therefore, environmental climatological elements change and human comfort conditions also change and all life aspects on the earth like food, clothing, housing and even culture are affected by climate". (Zolfaqari, 2004, pp: 43-55). " comfort means a creatures relaxation and comfort that fights against external intrusions" (Khaledi, 1995, 248). " “humanbioclimatic comfort depends on thermal balance of human body with surroundings. A temperature at which thermal radiation is done at a satisfactory level is called human comfort region. No climate can be considered as completely favorable or unfavorable. In fact, there is no standard human or standard climate. Therefore, comfort is something relative and is not constant. Climate is felt in different ways for different individuals in terms of age, health, physical activity, race and so on” (Mohammadi, 2007, p 186). Although there are different ideas about appropriate human body temperature, most studies propound temperatures between 58 to 80 degrees Fahrenheit. By human comfort conditions, we mean a set of conditions which is appropriate for at least 80% of a society’s people. “bioclimatic comfort balance state takes place when a balance forms between disposed and absorbed temperature and internal human body temperature is balanced at about 37 degrees of centigrade.” (Kasmayee, 1983, p 26).

There is a difference between human and environment temperature balance inside and outside of a building. Human comfort is important in both environments. Today, human bioclimatic studies are bases for regional civil programming. Determination of the degree of impact of climate on human physiology in normal conditions is the base of many studies which are concerned with determination of human bioclimatic and climate impact is the reflection of a feeling which is experienced by human in any particular place and climate and under conditions like formation of artificial micro-climate.

Statement of the problem

A comfortable and tension-free biological condition over life and everyday activities is an ambition for every human (Lashkari, 2004, p 35). Comfort and health are largely affected by weather conditions and climate. Four elements: temperature, humidity, sunlight and wind are the most effective natural elements (Nazem Sadat, 2008, p 71).

The importance of impact of climate on architecture and necessity for its investigation is studied in two sections. In the first section, regional meteorological information and statistics and climatological division is used. Therefore,

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climatological and meteorological data must be considered in building design in order to use energy. In the second section, building and structural form is used. Establishment of balance between human body and its surroundings is one of the primary needs for human comfort and health. Skin temperature remains constant or changes slightly under severe body surroundings temperature variations. Establishment of such a balance depends on the combination of different factors. Some of these factors are as follows: personal metabolism characteristics, physical activity and environmental weather (Kaviyani, 1988). Climate is one of the most important biological factors which plays an important role in human behaviors and states and interaction between human body and weather is very complex.

Recognition of human response to climatological factors is of great importance and depends on comfort. However, human comfort and biological response to climate mostly depends on temperature comfort of human and consideration of climatological factors in designing buildings is very common nowadays (Kasmayee, 1988).

Importance and necessity of research:

1. economic necessity: costs analysis considering proper selection of material and use of solar energy
2. performance necessity: balancing human body temperature in winter and summer using climatological criteria
3. educational necessity: education of citizens to safeguard energy

Research targets

1. analysis of climatological comfort of Pars Abad Moqan City citizens using Evans method
2. Creation of comfort and wellbeing conditions for designing buildings in Pars Abad City
3. identification of appropriate human bioclimatic comfort places in Pars Abad City

Research hypothesis

1. it seems that investigation of different methods can lead to comfort climate in Pars Abad City.
2. it seems that well-being and comfort conditions can be reached in Pars Abad City using climatological building design

Research background

Many studies have been conducted on bio-climate and explanation of all of them is out of the scope of the present research.

Some researchers like Adeli (1960) and Kaviyani (1992) used models presented by olgaj, 1973), Givoni (1997), beeker (1972), Terjung (1996) and oliver (1973) in different areas to sketch bioclimatic map of Iran. Tavassoli (1981), Kamali (1984), Razjouyan (1998) and Qobadiyan and Mahdavi (2005) used the models for achieving an arcitucture corresponding to climate. Kamali (1993) used them in Qaen city, Alijani (1994) and Jahanbakhsh (1998) used it in Tabriz, Kasmayee (1990) used in Khorramshahr, Zolfaghari and Moradi (2004) used it in Kurdestan, Lashkari and Davari (2004) used it in Western Azerbaijan and Nazam-al-Sadat and Haris (2008) used it in Shiraz, Bandar-e-Abbas, Birjand and Ardebil cities. Moreover, many different methods have been developed for recognition of impact degree of climatic factors on human body. In the present research, we considered advantages and disadvantages of the models and investigated models which are consistent with regional climate. Finally, a suitable model was resulted for determining comfort or discomfort degree of the region over different days, months, seasons and years.

Investigation of local climatic conditions in terms of human comfort

Accuracy and exactness of design capacity, design efficiency and calculations related to building energy depends on data quality and climatic information. Therefore, it is necessary to use meteorological information in order to reach higher energy efficiencies in buildings and prevent energy waste especially in developing countries like Iran. Furthermore, climatic information must be considered in architectural designs and building energy simulation in order to make much of climatic condition efficiency (Razjouyan, 2007). Temperature and humidity are more effective than other climatic elements in human comfort and welfare and these two elements are bases for models of human comfort measurement. Identification of regional comfort time is effective in optimal consumption of cooling and warming energy. In order to identify regional time, two-hour temperature variations diagram is prepared out of Ardebil Province calculated temperature and temperature curve is graphed and human comfort time is specified (Khaledi, 1995). Diversity of meteorological data needed for using in building architecture is closely related to methods of design analysis and development of building design science. In primary days, only climatic conditions of a region were analyzed for building design. Later, all meteorological data were used for simple calculations concerning building energy (Mohammadi, 2007).

Determination of comfort region using Evans method

Evans, in his book titled: "house-building, climate and comfort", investigates relationship between dry weather conditions with the following items in order to determine comfort region:

1. relative humidity-in four groups 0/70-0/100, 0/50-0/70, 0/30-0/50, 0-0/30
2. air flux-from intangible (0/1 meter per second) to tangible (1 meter per second)
3. activity-relaxation or light domestic works
4. clothing-light summer clothing and indoor winter clothing

He presented the results of his work in table 1.

The followings should be done in order to evaluate thermal status of a place using Evans method:

1. comfort region scope of the days of a month should be extracted out of the table with respect to average relative humidity of minimum of each month.
2. comfort region scope of the nights of a month should be extracted out of the table with respect to average relative humidity of maximum of each month.
3. maximum average temperature of each month should be measured with day comfort region.
4. minimum temperature average of each month should be compared with night comfort region.

Table 1. Evans Table for day and night comfort region

Scale	Thermal conditions	Relative humidity	Daylight temperature	Night temperature
A	Comfort region range with respect to an air flux with a speed equal to 1 meter per second	0- 30 30-50 50-70 70-100	32/5-29/5 30/5-28/5 29/5-27/5 29-26	29/5-27/5 29-26/5 28/5-26 28-25/5
B	Comfort region range with respect to light summer clothing or a light cover at night (intangible air flux with 0.1 meter per second speed)	0-30 30-50 50-70 70-100	30-22/5 28-22/5 27/5-22/5 27-22/5	27/5-20 26/5-20 26-20 25/5-20
C	Comfort region range with respect to an ordinary and warm piece of clothing and thick covering at night	0-30 30-50 50-70 70-100	22/5-18 22/5-18 22/5-18 22/5-18	16-20 16-20 16-20 16-20

Table 2. Pars Abad status in Evans's three scales

Longitude: 43.55 **Latitude: 39.39** **Altitude: 31.9 meter**							**Studied region: Pars Abad Moqan**						
	Temperature in centigrade	January	February	March	April	May	June	July	August	September	October	November	December
	Maximum average monthly temperature	3	4.5	9.3	16.7	19.7	23.2	25	24.7	22.6	17.5	11.4	5.7
	Minimum average monthly temperature	-7.9	-6.3	-2.4	2.8	6	9	11.6	11.6	8.7	4.8	.3	-4.6
	Maximum relative average humidity	88	90	92	92	88	88	91	91	88	89	87	87
a	Minimum relative average humidity	59	55	53	51	51	50	49	48	44	53	58	60

December	November	October	September	August	July	June	May	April	March	February	January	Thermal conditions	
cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	a	day
cold	cold	cold	comfortable	comfortable	comfortable	comfortable	cold	cold	cold	cold	cold	b	
cold	cold	cold	warm	warm	warm	warm	cold	cold	cold	cold	cold	c	
cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	a	night
cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	cold	b	
cold	cold	cold	comfortable	cold	cold	comfortable	cold	cold	cold	cold	cold	c	

December	November	October	September	August	July	June	May	April	March	February	January	Thermal conditions
cold	cold	cold	comfortable	comfortable	comfortable	comfortable	comfortable	cold	cold	cold	cold	**day**
cold	cold	cold	comfortable	cold	cold	comfortable	cold	cold	cold	cold	cold	**night**

Table 3. different weather conditions and corresponding agricultural guides

Architectural guides for adjusting internal building conditions	Temperature variations	Studies condition	Humidity average		Temperature average		Weather conditions
			minimum	maximum	minimum	maximum	
Necessity for air flux	-	Day with scale a comfortable and with scale b warm	More than 70%	-	-	More than 37 degrees	1. high temperature and high relative humidity in day
	1 degree or lesser		70% - 50	-	-	More than 27.5 degrees	
Building with thermal capacity and delay time	-	Warm days	30% - 0	-	-	More than 32.5 degrees	2.2. high temperature and high variations overnight
	-		50-30	-	-	More than 30.5 degrees	
	More than 10 degrees		70-50	-	-	More than 29.5 degrees	
Necessity for cooling and warming mechanical equipment	-	Warm days	30-0	-	-	More than 38 degrees	3. severe discomfort
	-		50-30	-	-	More than 37 degrees	
	More than 10 degrees		70-50	-	-	More than 35.5 degrees	
	10 degrees or lower		More than 70%	-	-	More than 32 degrees	
Appropriate thermal capacity	More than 10 degrees	Comfortable days	30-0	-	More than 10 degrees	Lower than 32.5 degrees	4. comfortable day and night but high temperature variations
	More than 10 degrees		50-30	-	More than 10 degrees	Lower than 30.5 degrees	
	More than 10 degrees		70-50	-	More than 10 degrees	Lower than 29.5 degrees	
	More than 10 degrees		More than 70%	-	More than 10 degrees	Lower than 29 degrees	
Wind and sunlight safeguard	All conditions not mentioned in states 1 2, 3, 4, and 6						5. presence of comfort
Building elements sufficiency with ability to store heat		fresh	-	-	-	18-15	6. low temperature during daylight
Absence of necessity for thick insulation and temporary thermal equipment		cool	-	-	-	15-10	
Necessity for appropriate insulation and permanent thermal equipment		cold	-	-	-	Lower than 10	
Need for air flux	-	Warm nights	-	More than 70%	More than 25.5	-	7. high temperature and humidity at night
	10 degrees or lower		-	70% - 50	More than 26	-	
Building equipment with high thermal capacity	-	Warm nights	-	30% - 0	More than 27.5	-	8. high temperature and low humidity at night
	-		-	50% - 30	More than 26.5	-	
	More than 10 degrees		-	70% - 50	More than 26	-	
Need for good insulation with average to high thermal capacity	-	Cold nights	-	-	Lower than 10 degrees	-	9. low temperature at night

Investigation and introduction of Pars Abad Moqan City:

1.1. Location and extent:

Moqan is located in the furthest north of Azerbaijan Province and its area is about 5226.9 square kilometer and it comprises 29.1% of Ardebil Province, 4.7% of total area of Azerbaijan and 1/315 of Iran's total area. This region is bounded by Azerbaijan Republic from northern and eastern side; it is bounded by MeshginShahr City from southern part ad it is bounded by Arasbaran region from western side.

Moqan region is divided into three sections: western Moqan (centered by Pars Abad City), eastern Moqan (centered by Bile Savar City) and Germi (centered by Germi City). In September 1991, western Moqan and eastern Moqan changed name into Pars Abad and Bile Savar cities and Moqan was divided formally (by Islamic Assembly of Iran) into three independent cities (Germi, Bile Savar, Pars Abad). Pars Abad Moqan is the furthest northern part of the region and the city its distance to the following cities are as follows: Ardebil (210 Km), Aslandouz (50 Km), Khedafarin (120 km), meshgin Shahr (200 km), Tabriz (400 km), Astara (310 Km), Tehran (815 km).

Pars Abad City is located on 47 degrees and 54 minutes (longitude) and 39 degrees and 39 minutes (latitude). It has been built on the alluvia settled by Aras River and its elevation difference with Aras River is about 20 meters. Its present area is about 1650 Hectares. Its area in fully developed map is about 1950 hectares.

Pars Abad City comprises about 390% of total Moqan area and comprises about 8.7% of total Ardebil Province area. Aras River in the border of Iran and Azerbaijan Republic goes through the north of the region and the city extension is in eastern-western form. Aras River is at the northern part of the city and farms are all over the eastern, western and southern part of the city.

2.1. Topographic features:

Moqan Plain is a smooth region. It has been formed as a result of Aras River alluvia and its branches. Except for Moqan's border with Meshgin Shahr and Azerbaijan Republic in the southern part and south-eastern part of Germi City which is mountainous, no topographic feature exists in other parts of the plain. This region is located in drainage basin of Caspian Sea.

3.1. climatic features:

3.1.a. weather:

Pars Abad has a mild to warm weather. Its summers are very warm and its winters are relatively cold and pleasant. Rainfall in Pars Abad is affected by Caspian Sea fluxes and Siberian air mass and cold northern air mass.

3.1.b. rainfall:

There is rainfall almost in all months of a year in Moqan Plain. The highest levels of rainfall take place in April, May and June.

3.1.c. temperature: average monthly temperature in Pars Abad Station shows that the warmest month of year is July and then August. Moreover, the coolest months are January and February. Average temperature of the warmest month is 27.1 degrees and the coolest month average temperature is about 3.2 degrees centigrade over a 20-year period of time.

1.3.d. wind and its variations:

Different seasonal winds blow in Moqan: KhazarYeli (Caspian wind), this name is because it blows from Caspian Sea. Some part of this wind covers Arasbaran and Western Talesh mountains. In Ardebil and Ahar, this wind is called Moqan Breeze. Moqan residents are afraid of this wind. It blows in winter and summer. In summer, it makes the weather very cold and it is disastrous in winter. It blows from east to west and is the main wind in the region.

Gachi Qiran (goat-killer) is another windin the region. It is a wind which blows in the opposite direction with respect to Caspian Wind, i.e. from west to east. Meh wind is another wind which blows in the region and it reduces weather warmth and dryness and makes weather pleasant. There are other local weathers which blow every now andthen and affect the region (central department of Ardebil Province Studies, 2009).

Wind measurements are usually done in most climatological stations of the region. In warm months of year, wind speed is about 2.5 meter per second and in cool months (November), wind speed is about 1.8 meter per second.

Conclusion

Main principles necessary for using climate in building design can be included using analyses. In order to achieve a logical and climate-oriented architectural design, it is necessary to consider regional climate and temperature and humidity variations in addition to the sun position and local winds and buildings bioclimatic table. The sun position which is a function of latitude is important in determining building features like windows dimensions and shades and building position with respect to sunlight. Physical direction is an important factor in determining positionof a building. Therefore, these two factors must be considered in order to reach a favorable design and buildings should be built in facing south and between 20 western and 20 eastern degrees.

Further, position of a building in northern-southern design with the long axis in east-west direction is also recommended and rooms should be designed so that they are in contact with fresh air from one side and temporary air flux should be also considered. Pop-ups should be between 20-40% in average and heavy external and internal walls and roofs are recommended to have more than 8 hours of delay time.

Therefore, building architectures and engineers should consider climate features and analyze meteorological data in order to make use of energy efficiently.

REFERENCES

[1]. Meteorological information and statistics, central department of Ardebil Province meteorology

[2]. Central department of economic studies and investigations in Ardebil Province, summary of weather conditions, climate, and water resources in Ardebil Province, 2009, page 6.

[3]. Bahreini, Seyyed Hosein, Karimi, Keivan (2002), environmental planning for land development, Tehran University Press.

[4]. Hasan Lashkari and Reza Davari (2004), an analysis of human bioclimatic features in wester Azerbaijan Province using Baker method, Geographical terrain quarterly, number 3, pp: 34-53.

[5]. Jahanbakhsh, Saeed (1998), human bioclimatic evaluation in Tabriz City and thermal needs of buildings, Geographical terrain quarterly, number 2, p 66.

[6]. Khaledi, Shahryar (1995), applied meteorology, first edition, Qoumes Publications, p 248.

[7]. Razjouyan, Mahmoud (1988), comfort through climate-oriented architecture, Shahid Beheshti University Press.

[8]. Zein-al-Abedin Jafarpour (1979), dependence of living creatures on weather, journal of faculty of literature and humanities, Tarbiyat Moallem University.

[9]. Kasmaee, Morteza, 1984, climate and architecture, Iranian house-building company, Tehran.

[10]. Kaviyani, Mohammad Reza, (2003), micro-climatology, SAMT publications, p 235.

[11]. Mohammadi, Hosein (2007), applied climatology, Tehran University press, p 186.

[12]. Watson, Donald and Ment, Lob, 1993, climatic design of theoretical and executive principles of application of energy in building, translated by Vahid Qobadiyan and Mohamamd Feiz Mahdavi, Tehran University Press.