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Review article

Comparing climatic indices; mahoney, evans, biker, effective temperature (et) and givoni in rasht city

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ABSTRACT

The present research study and compare 5 well-known climatic indices in Rasht city. For studying these five indices a 15-year statistical climatic period (1995-2009) has been used. The aim of this paper is to assess that how much the results of each of these indices are close to each other that are the results provided by the indices are the same. The present paper tries to answer this question:"how much the results of the climatic indices are similar and close to each other and how much these results differ from each other?" For these three Mahoney, Evans and Givoni indices architectural guidelines and principles have been as well provided and we hope that they will be useful. The research method used in this paper is qualitative method with an applied approach. The analyses indicate that regarding the coldness of the January, February, March and December months all the indices share common aspects. Also, there is no different between the cold, warm or temperate weather of the days of the months in the Mahoney, Evans and effective temperature indices. However, in the rest of the days and nights of the indices some differences in the results are seen. Therefore, we can conclude that in Rasht city the results of the three Mahoney, Evans and effective temperature indices results are so much close to each other; however, there is a different in the results of Givoni and Biker results. On an average basis we can say that in this city three months of the year the weather is moderate and therefore, a comfortable condition

exists and for 3 months the weather is warm and for 6 months is cold. Based on architectural guidelines in these 6 months that the weather of this city is cold the buildings require Insulation and heating devices. In these months the air penetration through the seams of the windows and weak joints of the buildings should be prevents and the heat of the sun should be used. In the other 6 months of the year the buildings are required to make use of the air circulation, while in four of these months the air circulation is necessary.

1. Introduction

Identifying the climate in architectural subjects and applying the knowledge gained from it can significantly help us to reduce energy consumption in a building. Understanding and identifying the climate of every region requires accurate and scientific study and analysis that is not possible without studying every climatic phenomenon and statistics of that region one by one. Accurate and careful study of these phenomena and statistic is also possible with the help of the scientific tools and calculations that has been developed and conducted in the past years by different people. Considering the fact that the issue of energy and saving energy is the need of our today society; therefore, climatic studies can improve energy consumption in residential and commercial usages. Some recommendations have been provided for achieving this goal with the use of the climatic indices studies that in the following section will be discussed future.

The aim of the present research is to compare three comfort zone of Rasht with the use of a number of scientific climatic indices which are being used in Iran. Although, for achieving a more accurate results studying more indices is necessary; however, in the present paper we have sufficed to the comparison of 5 indices. Another aim of this paper is to provide some guidelines toward a better and more efficient architecture in Rasht city that all of them have been studies considering the climatic indices. These architectural guidelines have been presented with the use of three Mahoney, Evans and Givoni indices that have been suited on a monthly basis. No architectural guidelines have been provided on the basis of the other two indices. Therefore, the research method used in this paper is a qualitative one with an applied approach.

For studying the five climatic indices of Mahoney, Evans, Biker, effective temperature (ET) and Givoni the climatic data of the Head Office of Gilan Meteorology Agency and Meteorological Organization of Iran have been used. in this research a 15-year statistical period (1995 – 2009) has been used which includes Average Medium, minimum, maximum, Three-hourly temperature data (dry and wet), relative humidity and wind have been studied and considering the method of every indictors these statistics have been used. The present study seeks to answer the following questions:

- The results of which of the climatic indices are close (similar) to each other and which of then differ from each other?
- In how much of the year in Rasht city climatic comfort exists?
- Do different material for methods creates different results?
- What are the architectural recommendations for this climate?

So far a number of studies related to climate have been conducted in the climatic region of Rasht that the most relevant study is the master Dissertation with the title of “climate and architecture – case study of Rasht city” conducted by Hasan Hasani (September, 2003). In the paper the Olgay, Givoni, and effective temperature methods have been used in this city and some architectural recommendations in harmony with the climate of this city and proportional with each of these methods have been presented. The findings of this study indicate that the days of the May, June and September months are in comfort zone with an acceptable relative humidity. The architectural recommendation of this research is: “1- For protecting the buildings from the earth humidity and rain the building should have Korsi and should have a good humid insulation. 2- Due to low daily heat fluctuations and the usefulness of ventilation it is necessary to use light building material.” Due to the great number of architectural

recommendations in this study and the impossibility of mentioning all of them here we suffice to mentioning only two of them here.

Another study which is relevant to our study is the study conducted by Abbas Naser Sani and Salar Omidi Chenari with the title of "identification of the Ecotourism potentials of bioclimatic comfort of Chubar Shaft Rural District with the use of Biker and effective temperature indices" in 2010. It should be noted that Chubar Shaft Rural District is located in Shaft County in Gilan province and is close to the climatic area of this research. the result of this study indicate that at the Altitude range below 500 m, with the use of Biker index the days of 5 months of the year (April, May, September, December and March) and the nights of 6 months of the year (May, June, July, August, September and October) and with the use of effective temperature index the days of the two months of the year (May and October) and the nights of the 3 months of the year (July, August and September) are in the comfortable bioclimatic condition. This research have also studied these indices at the Altitude range over 500 m; however, doesn't provide the results and findings due to the fact that it is far above the altitude of Rasht city.

The article of Farajzadeh Asl, Ghorbani and Lashkari with the title of "studying the architectural conformity of Sanandaj city buildings with its bioclimatic conditions with the use of Mahoney method" (2007) and the study of Parvaneh, Shahrkhondi and Nazari with the title of "determining the climatic comfort condition on a decade scale based on bioclimatic indices (case study: Aligudarz County)" (2011) are also another examples of studies conducted with regards to architecture in harmony with climate.

On a average basis the results of the studies conducted in Gilan Province indicate that the best time of climatic comfort is in the months of May and October. However, in general and separately, the days of the months of May, June, September and October and the nights of the months of July, August, September and October are also in the comfortable condition.

Rasht city in Gilan province is located on the geographical coordinates of $37° 12'N$ and $49° 39'E$ on the Greenwich meridian. its altitude from the sea level is 36.7 meters. Alborz Mountain range is located at its south side and its average altitude is 3000 meters and its highest peak is Dorfak with an altitude of 3500 meters. The nearest county to Rasht is Sowme'eh Sara which located within 26 km from it. Rasht from north is limited to The Caspian Sea and Anzali Lagoon and from west to Pasikhan River, Sowme'eh Sara and Foman and from south to Sangar county and Roodbar and from east to Kuchesfahan city and Lahijan and its distance to Tehran is 325 km and to Anzali Port is 30 km. (website of Rasht Municipality at http://rasht.ir).

Due to its especial geographical location Rasht is one of the cities with highest level of perspiration in Iran. Statistics shoe high relative humidity in most of the time of the year as well.

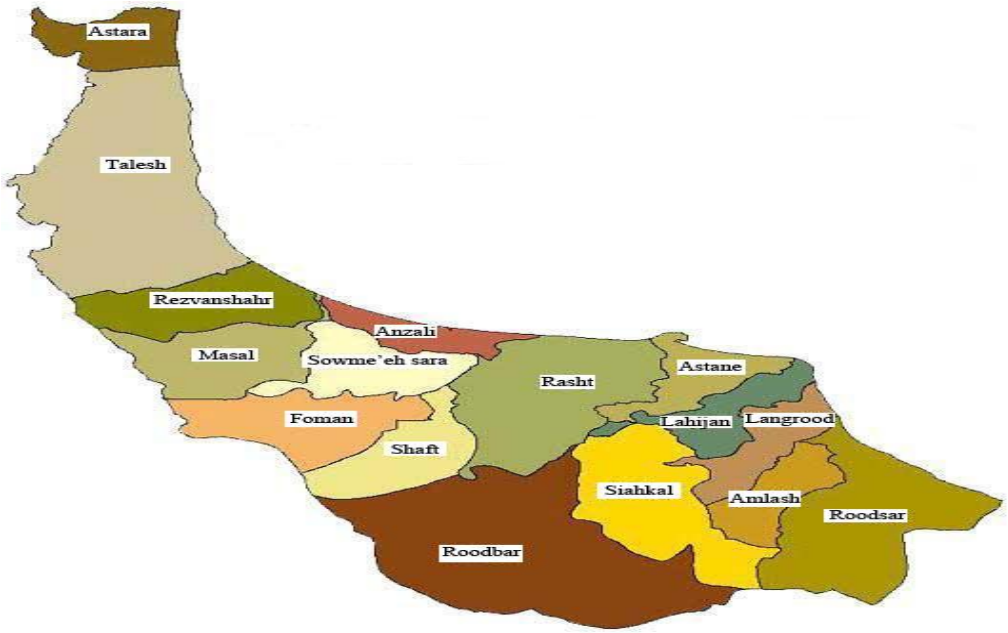


Fig. 1. Map of Gilan Province.
Source. online website at http://new.gilmet.ir/fa/menu55.aspx.

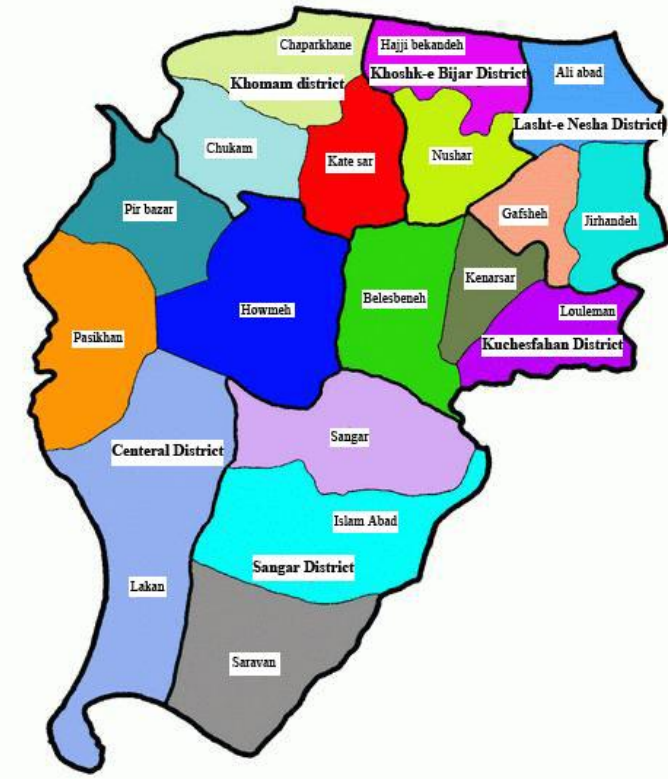


Fig. 2. Map of Rasht city.
Source. online Website at http://glk.wikipedia.org/wiki/:rasht.gif.

2. Mahoney index

This method was first introduced and developed by Carl Mahoney in 1971 and was later developed further. Mahoney table determines the day and night comfort zone of every month considering the annual average of temperature, minimum and maximum averages and the average relative humidity and the temperature of the same month (Raazjooyan, 2009: 54).

Mahoney index is one of the most important indices for studying the bioclimatic conditions. This index through developing especial table on the basis of climatic conditions of every region such as perspiration, temperature, relative humidity and wind provided architectural recommendations such as the positioning of the building, the dimensions of the windows and openings, the characteristics of walls and roofs and the necessity of protection against rain (Farajzadeh, Ghorbani and Lashkari, 2008: 166).

In table 1, the statistical data related to 1995 – 2009 have been presented. On the basis of this index the days and nights of the months of May, October and the nights of the month of September are moderate and the days and nights of the months of June, July and August and the days of the month of September of warm and the days and nights of the months of January, February, March, April, November and December of cold (table 2).

With studying the architectural recommendation we can see that it is better that the length of the building be in west and east direction and for using the wind open and broad complexes are recommended only if the cold and warm winds can be prevented. Single rooms for using air draft and draught, large and big window around 40 to 80% of the northern and southern walls, light walls with Low Latency, light ceilings with thermal insulation are among other architectural recommendations based on Mahoney index.

Regarding the details of the building also, it should be noted that the windows and openings should have an area of 40% to 80% of the area of the northern and southern walls and should be protected against the direct sun rays (should have canopy) and also be also facing the wind and at the level of humans body height. The walls and floorings should be light and with low thermal capacity and the ceilings should be light and with good insulation.

Table 1
Mahoney index.

Data during 1995 – 2009	January	February	March	April	May	June	July	August	September	October	November	December
Monthly average of maximum temperature	10.8	12.2	14.8	19	24	28	30.3	31	26.8	22.9	17.7	13.4
Monthly average of minimum temperature	3.3	3.8	6.2	10.3	15.2	19.4	21.4	21.9	18.8	14.7	9.3	5.5
Monthly temperature fluctuation	7.5	8.4	8.6	8.7	8.8	8.6	8.9	9.1	8	8.2	8.4	7.9
Monthly average of humidity	83.1	81.2	80.6	79.9	78.7	76.8	76.6	77.2	82.8	84.6	83.6	82.5
Comfortable zone of day	20-25	20-25	20-25	20-25	20-25	20-25	20-25	20-25	20-25	20-25	20-25	20-25
Comfortable zone of night	14-20	14-20	14-20	14-20	14-20	14-20	14-20	14-20	14-20	14-20	14-20	14-20

Annual average of temperature: 16.7

Source: statistical data of the Meteorological Head office of Gilan Province 2012 and with the use of the developed table by Raazjooyan, 2009: 60 .

Table 2
Heat condition of the months of the year based on Mahoney index.

Determining heat condition	January	February	March	April	May	June	July	August	September	October	November	December
Day	Cold	Cold	Cold	Cold	Moderate	hot	hot	hot	hot	Moderate	Cold	Cold
Night	Cold	Cold	Cold	Cold	Moderate	hot	hot	hot	Moderate	Moderate	Cold	Cold

Source: Author, based on the developed table by Raazjooyan, 2009: 61.

Table 3
Heat indices based on Mahoney index.

Heat indices	January	February	March	April	May	June	July	August	September	October	November	December	Total
Necessity of air circulation H1						*	*	*	*				4
Desirability of air circulation H2					*					*			2
Necessity of fighting with rainfall H3													0
Necessity of heat accumulation in the buildings walls A1													0
Night sleep in open air A2													0
The problem of cold months A3	*	*	*	*							*	*	6

Source: Author, based on the table developed by Raazjooyan, 2009: 61.

3. Evans index

For studying the heat condition of a place with the use of Evans method we should: 1. For the average minimum relative humidity of each month, the range of comfort zone of the days of that month should be extracted from the table, 2. For the average maximum relative humidity of each other the range of the comfort zone of the nights of that month should be extracted from the same table, 3. The average of the maximum temperature of each month should be compared with the comfort zone of the day, 4. The average minimum temperature of each month should be compared with the comfort zone of the night. (Raazjooyan, 2009: 65).

Therefore, for studying this index we need to have the minimum and maximum average of the temperature and the relative humidity which have been presented in table 4. These studies show the following results:

The days of June, September and the days and the nights of July and August are hot, the days of May and October and the nights of June and September are moderate and the days and nights of January, February, March, April, November and December and the nights of May and October are cold (table 5).

Weather evaluations throughout the year indicate; humidity and high temperature during July and August are disturbing. The days of April, May, June, September and October have climatic comfort. The months of January, February, March and December have cool days and cold nights and November days have fresh air and nights have cold weather (table 6).

Architectural guidelines of the index are: necessity of air circulation and ventilation for the months with warm and high humid weather; protecting the building from strong wind and sunrays for the comfortable months;, no need of thick insulation and sufficiency of temporary heating device for months with cool days, necessity of good building insulation with medium thermal capacity or high for months with cold nights and the sufficiency of structure components with the capability of accumulating heat for the months with days with fresh air.

Table 4
Maximum and minimum humidity and temperature

1995 - 2009	January	February	March	April	May	June	July	August	September	October	November	December
Average of maximum temperature	10.8	12.2	14.8	19	24	28	30.3	31	26.8	22.9	17.7	13.4
Average of minimum temperature	3.3	3.8	6.2	10.3	15.2	19.4	21.4	21.9	18.8	14.7	9.3	5.5
Average of maximum humidity	96.7	96.3	96.5	96.1	96.4	94.5	94.9	94.8	97.1	99.1	97.5	96.1
Average of minimum humidity	69.4	66.1	64.6	63.8	60.9	59	58.1	59.5	68.6	70.1	69.8	69

Source: statistical data adopted from the Meteorological Head office of Gilan Province, 2012

Table 5
Heat conditions in Evans index.

Heat conditions	January	February	March	April	May	June	July	August	September	October	November	December
Day	Cold	Cold	Cold	Cold	Moderate	Warm	Hot	Hot	Hot	Moderate	cold	cold
Night	Cold	Cold	Cold	Cold	Cold	Moderate	Hot	Hot	Moderate	cold	cold	cold

Source: Author, based on the table developed by Raazjooyan, 2009: 67.

Table 6
Studying weather condition during the year.

Weather condition	January	February	March	April	May	June	July	August	September	October	November	December	Total
1. high temperature and high humidity							*	*					2
2. high temperature and high temperature fluctuation during 24 hours													0
3. Strong discomfort													0
4. comfortable day and night, but high fluctuation in temperature during 24 hours													0
5. comfort during the day				*	*	*			*	*			5
6. low temperature during the day — Fresh										*			1
6. low temperature during the day — Cool	*	*	*								*		4
6. low temperature during the day — Cold													0
7. high temperature and high humidity at night													0
8. high temperature and low humidity at night													0
9. low temperature at night	*	*	*								*	*	5

Source: Author, based in the table prepared by Raazjooyan, 2009: 69.

4. Biker index

One of the suitable methods for determining the comfort zone is with the use of index of environmental cooling power (CP) which is famous to Biker index the value of which is calculated from the following formula:

$$CP=(0.26+0.35v\ 0.632)(36.5-t) \quad (1)$$

Where, CP: micro-calories/cm2 per second, V: wind speed m/s and t: the average of monthly temperature°C. (Sani, Omidi Chenari, 2010: 30)

The reason of choosing this method is that all the climatic elements related to human bioclimatic are a combination of temperature and wind quantities and this method a suitable and comprehensive index. Biker have presented the degrees of environment CP and the Stimulation threshold of human bioclimatic (human comfort) as per the following table (table 7) (Mohammadi and Seyyedi, 2008: 78).

Table 7
Degrees of environment CP and bioclimatic threshold based on Biker method.

group	CP value	Environmental condition	Human bioclimatic condition
A	0-4	Hot, warm, sultry, unpleasant	Bioclimatic pressure
B1	5-9	Warm but bearable	Bioclimatic comfort zone
B2	10-19	Mild and pleasant	Bioclimatic comfort zone
C	20-29	Cool	Mild stimulation
D1	30-39	Cold and a little bit pressuring	Average to severe stimulation
D2	40-49	A little bit cold	Averagely bothering
D3	50-59	Unpleasantly cold	Severely bothering

Source: Mohammadi and Seyedi, 2008: 78.

As per this index the months of January, February, March and December have moderate stimulation of bioclimatic condition and cool environmental conditions, the months of April, May, June, October and November have Mild and pleasant bioclimatic and environmental conditions and the months of July, August and September have the bioclimatic conditions of the comfort zone and the bearable warm environmental conditions (table 8).

Table 8
Biker index.

Months	Average of wind speed	Average of temperature	Group	Value of Biker index	Human bioclimatic condition	Environmental condition
January	2.12	7.1	C	21.26	Mild stimulation	Cool
February	2.47	8	C	22.54	Mild stimulation	Cool
March	2.42	10.5	C	20.28	Mild stimulation	Cool
April	2.42	14.7	B2	17.00	Bioclimatic comfort zone	Mild and pleasant
May	2.16	19.6	B2	12.24	Bioclimatic comfort zone	Mild and pleasant
June	2.16	23.7	B1	9.27	Bioclimatic comfort zone	Mild and pleasant
July	1.95	25.9	B1	7.20	Bioclimatic comfort zone	Warm but bearable
August	2.06	26.5	B1	7.03	Bioclimatic comfort zone	Warm but bearable
Septembe r	2.11	22.8	B1	9.77	Bioclimatic comfort zone	Warm but bearable
October	2.01	18.8	B2	12.25	Bioclimatic comfort zone	Mild and pleasant
November	2.01	13.5	B2	15.91	Bioclimatic comfort zone	Mild and pleasant
December	2.31	9.5	C	20.42	Mild stimulation	Cool

Source: Author, with the use of the data adopted from the Meteorological Head office of Gilan Province, 2012 .

5. Effective temperature index (ET)

Effective temperature index which is a combination of the two elements of temperature and relative humidity is one of the methods for identifying the bioclimatic comfort zone in different regions that is measured with the following formula:

$$ET = t - [0.6(t - 10)(1 - \frac{RH}{100}] \quad (2)$$

Where, ET= effective temperature value, t= temperature average in ℃ and RH = relative humidity in percent. This index has been extracted from table 9. (Sani, Omidi Chenari, 2010: 31)

Table 9
Studying the values of ET.

Heat coefficient	ET value
So much warm	More than 30
Sultry	27.5 – 30
So warm	25.6 – 27.5
Warm	22.2 – 25.6
Comfort	17.8 – 22.2
Cool	15.5 – 17. 8
So much cool	1.6 – 15.5
Cold	1.6 – (-10)
So cold	(-10) – (-20)
So much cold	Lower than (-20)

Source: Sani & Omidi Chenari, 2010: 31.

As per this index the days and nights of January, February, March, December and the nights of April, May, October, November are so much cold and the days of April and November are cool and the days of May and October and the nights of June, July, August and September have comfort and the days of June, July and September are warm and the days of August are very hot.

Table 10
Effective temperature index.

Months	Max. temperature	Min. temperature	Max. humidity	Min. humidity	Effective temperature of the day	Heat coefficient of the day	Effective temperature of the night	Heat coefficient of the night
January	10.8	3.3	96.7	69.4	10.65	Very cool	3.43	Very cool
February	12.2	3.8	96.3	66.1	11.75	Very cool	3.94	Very cool
March	14.8	6.2	96.5	64.6	13.78	Very cool	6.28	Very cool
April	19	10.3	96.1	63.8	17.05	cool	10.29	Very cool
May	24	15.2	96.4	60.9	20.72	Comfort	15.09	Very cool
June	28	19.4	94.5	59	23.57	warm	19.09	comfort
July	30.3	21.4	94.9	58.1	25.20	warm	21.05	comfort
August	31	21.9	94.8	59.5	25.90	Very warm	21.53	comfort
September	26.8	18.8	97.1	68.6	26.63	warm	18.65	comfort
October	22.9	14.7	99.1	70.1	20.59	Comfort	14.67	Very cool
November	17.7	9.3	97.5	9.8	16.3	cool	9.31	Very cool
December	13.4	5.5	96.1	69	12.77	Very cool	5.61	Very cool

Source: Author, with the use of the data adopted from the Meteorological Head office of Gilan Province, 2012 .

6. Building bioclimatic index (Givoni)

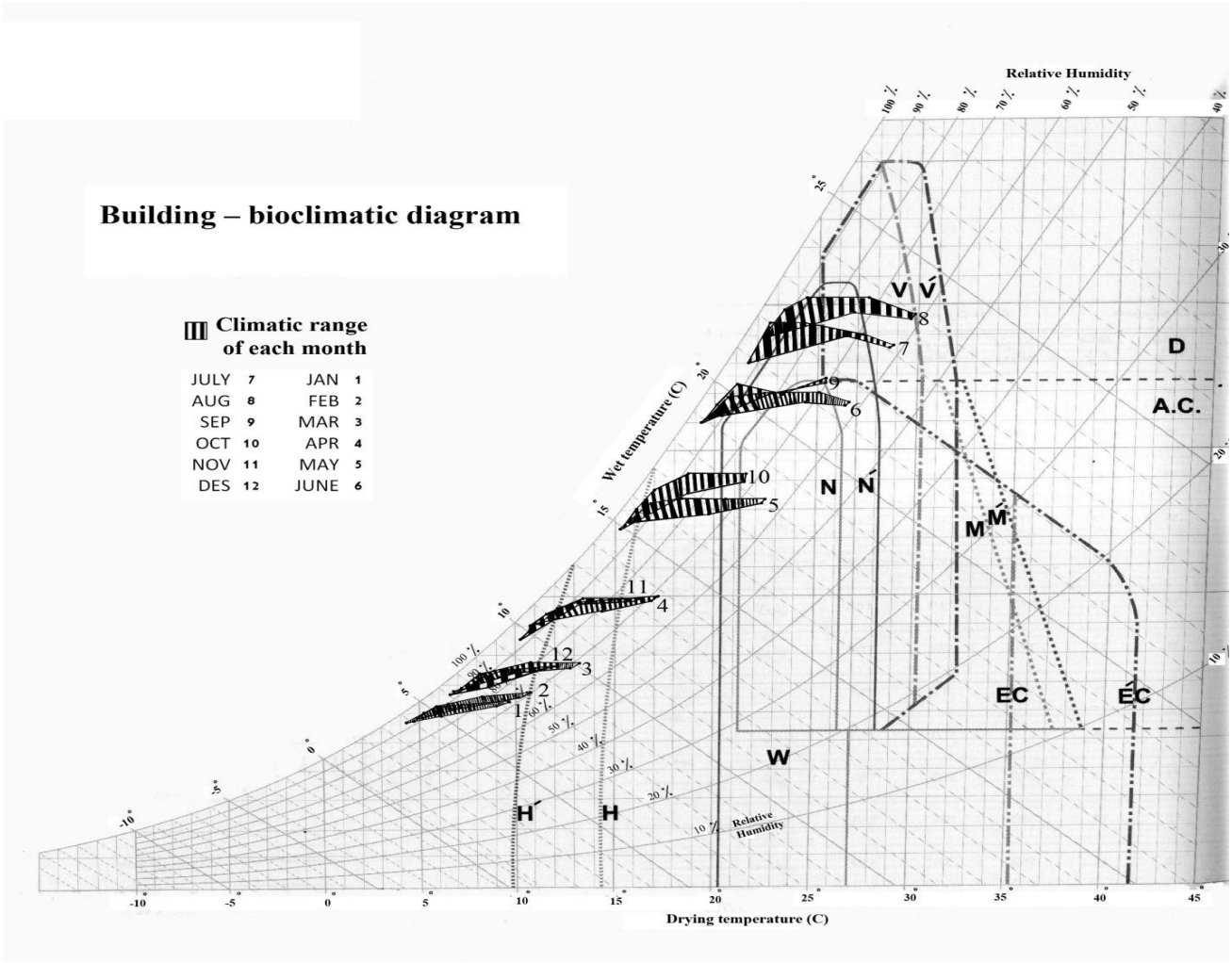
For using this index the existence of two weather phenomenon are required that can be dry temperature, wet temperature, relative humidity, water evaporation pressure or other phenomena which can be studied in psychrometric table (Raazjooyan, 2009: 53).

In the study for calculating this index the dry temperature and relative humidity on daily hours basis (0:30, 3:30, 6:30, 9:30, 12:30, 15:30, 18:30 and 21:30) have been used. with placing these phenomena in building bioclimatic (diagram 1) and connecting them together some ranges have been obtained that the summary of their results are as per the following:

January, February, March and December are in the range of the necessity to heating devices, April, May, August, September, October and November are among the months that don't need any heating resource and the months of June and July are summer comfort in shadow.

The architectural guidelines related to these months are as per the following:

In the months of January, February, March, April, November and December the air penetration through the seams of windows and weak building joints should be prevented, also, the heat exchanged through building walls should be minimized and getting use of the sun heat is recommended for these months. For the months of May, June, July, August, September and October the entrance of the sun effective heat should be prevented and for the months of July and August the use of air draught for rooms are as well recommended.



Diagrams 1. building bioclimatic diagram (Givoni).

Source: Author, with the use of the statistical data adopted from Meteorological Organization of Iran 2012 and based on the prepared diagram by Kasmae, 2008: 209 .

7. Conclusion

For comparing these indices there was need to make some changes in the way of the way the results beings presented that these changes have been presented in table 11. In this table 12 months have been placed in the first column and the five indices have been presented in the next column. Due to ease of comparison and studying the results of the indices the results of every month have been presented in three category of hot, moderate and cold. The last column is related to the conclusion of these five indices. In this column the results have been calculated in a quantitative way to specify that considering every index each month has what kind of weather condition (hot, moderate or cold). For example, the month of April from the point of view of three indices have a cold weather but from the point of view of the other two indices have a moderate weather. And since this month has determined to be a cold month by more indices then it is determined that it is a cold month. Only regarding the month of September the number of determinations for being warm and moderates are equal which makes concluding difficult. comparing these five indices indicate that in all these five indices the days and nights of the months of January, February, March and December are cold and the days of the months of May and October are moderate and the days of July are hot. It should be noted that this comparison show the similarity between the days of the months of the Mahoney, Evans and Effective Temperature indices that in turn indicate to the closeness of these methods to each other. in the rest of the days and the months of the year a difference of comfort is observed between the indices which is due to the methods and the material of each of them. For example, in calculation of Biker index the phenomena of wind and temperature are so much important, while in other methods relative humidity and temperature are more important. Even in indices the in which temperature and humidity are the measurement criteria also some small and big difference are observed.

In general and considering the results of table 11, we can conclude that 6 months of the year that is, the months of January, February, March, April, November and December are cold and three months of June, July and August are warm and the months of May and October are moderate. The results for the month of September indicate this month is both warm and moderate and none of them have a quantity higher than the other one.

Table 11
Comparison of the 5 indices.

months	Mahoney		Evans		Biker	Effective temperature		Givoni	conclusion
	Day	Night	Day	Night		Day	Night		
January	Cold	Cold	Cold	Cold	Cold	Cold	Cold	Cold	Cold
February	Cold	Cold	Cold	Cold	Cold	Cold	Cold	Cold	Cold
March	Cold	Cold	Cold	Cold	Cold	Cold	Cold	Cold	Cold
April	Cold	Cold	Cold	Cold	moderate	Cold	Cold	moderate	Cold
May	moderate	moderate	moderate	Cold	moderate	moderate	Cold	moderate	moderate
June	Warm	Warm	Warm	Moderate	Moderate	warm	Moderate	Warm	Warm
July	Warm	Warm	Warm	Warm	Warm	Warm	Moderate	Warm	Warm
August	Warm	Warm	Warm	Warm	Warm	Warm	Moderate	Moderate	Warm
September	Warm	Moderate	Warm	Moderate	Warm	Warm	Moderate	Moderate	Warm and moderate
October	Moderate	Moderate	Moderate	Cold	Moderate	Moderate	cold	Moderate	Moderate
November	Cold	Cold	Cold	Cold	Moderate	Cold	Cold	Moderate	Cold
December	Cold	Cold	Cold	Cold	Cold	Cold	Cold	Cold	Cold

Source: Author.

8. Architecture guidelines and rules

Mahoney, Evans and Givoni indices have some recommendations for a better architecture in different climates that have been presented in table 12. With studying these guidelines the following results have been obtained:

As per this table, 6 months of the years that is the months of January, February, March, April, November and December have cold weather and therefore require insulation and heating system. In these months the air penetration from the windows seams and buildings weak joints should be prevented and the sun heat should be used. In the months of May, June, July, August, September and October the need to air circulation is tangible which turns into a necessity in the months of June, July, August and September . in general, due to the existence of conform zone in the months of April, May, June, September and October in the condition of preventing the sunlight and protecting the building from strong winds, there is no need of heating or cooling system or device; however, air circulation seems to be good.

It is recommended to study other indices such as Olgyay index, innovative effective temperature (ET*), Terjung index, Physiologic equivalent temperature (PET), stress index, Thermo-Hygrometric index and … for achieving more accurate and better comparative results and to determined which of the indices provide similar results and which are them provide different results. Also, it is recommended that the climative indices of the existing articles will be studies and compared in a meta-analytical article in different climates to determine which of them are close to the actual condition in different climates of the country.

Also, for a better measurement of these climates and provision of guidelines of them it is recommended to use an index which evaluates Precipitation, because most of the comfort indices and their guidelines consider temperature, humidity, sunlight and wind, while for architecture in area with high amount of Precipitation the necessity of steep roof is undeniable. As it was mentioned in the beginning of the article, the reputation of Rasht city is as one of the cities with the highest amount of Precipitation in Iran and for protecting the buildings against rainfall using Humid insulation is necessary.

Table 12
Architectural guidelines and rules.

Months	Indices		Architectural guidelines and recommendations
January	Mahoney		The problem of cold months
	Evans	Day	Cool, no need of thick insulation and sufficiency of temporary heating device
		night	Cold, necessity of good insulation with a building with average to high heat capacity
	Givoni		The air penetration through the seam of windows and weak building joints should be prevented, heat exchange thought building walls should be minimized; the sun heat should be used.
February	Mahoney		The problem of cold months
	Evans	Day	Cool, no need of thick insulation and sufficiency of temporary heating device
		night	Cold, necessity of good insulation with a building with average to high heat capacity
	Givoni		The air penetration through the seam of windows and weak building joints should be prevented, heat exchange thought building walls should be minimized; the sun heat should be used.
March	Mahoney		The problem of cold months
	Evans	Day	Cool, no need of thick insulation and sufficiency of temporary heating device
		night	Cold, necessity of good insulation with a building with average to high heat capacity
	Givoni		The air penetration through the seam of windows and weak building joints should be prevented, heat exchange thought building walls should be minimized; the sun heat should be used.
April	Mahoney		The problem of cold months

	Evans	Day	Comfort, protecting the building from strong sunlight and wind
		night	Cold, necessity of good insulation with a building with average to high heat capacity
	Givoni		The air penetration through the seam of windows and weak building joints should be prevented, heat exchange thought building walls should be minimized; the sun heat should be used.
	Mahoney		Desirability of air circulation
May	Evans	Day	Comfort, protecting the building from strong sunlight and wind
		night	The entrance of the sun heat effective on building and the sun to the inside the building should be prevented
	Givoni		Necessity of air circulation, large windows around 40 to 80% of the northern and southern walls, light ceilings with thermal insulation
	Mahoney		Comfort, protecting the building from strong sunlight and wind
June	Evans	Day	The entrance of the sun heat effective on building and the sun to the inside the building should be prevented
		night	Necessity of air circulation, large windows around 40 to 80% of the northern and southern walls, light ceilings with thermal insulation
	Givoni		Warm with high humidity, the necessity of air circulation
	Mahoney		Necessity of air circulation, large windows around 40 to 80% of the northern and southern walls, light ceilings with thermal insulation
July	Evans	Day	Warm with high humidity, Necessity of air circulation
		night	Warm with high humidity, the necessity of air circulation
	Givoni		The entrance of the sun heat effective on building and the sun to the inside the building should be prevented; using the air draught for the rooms
	Mahoney		Necessity of air circulation, large windows around 40 to 80% of the northern and southern walls, light ceilings with thermal insulation
August	Evans	Day night	Warm with high humidity, necessity of air circulation
	Givoni		The entrance of the sun heat effective on building and the sun to the inside the building should be prevented
	Mahoney		The necessity of air circulation, large windows around 40 to 80% of the northern and southern walls, light ceilings with thermal insulation
September	Evans	Day night	Comfort, protecting the building from strong sunlight and wind
	Givoni		The entrance of the sun heat effective on building and the sun to the inside the building should be prevented
	Mahoney		Desirability of air circulation
October	Evans	Day night	Comfort, protecting the building from strong sunlight and wind
	Givoni		The entrance of the sun heat effective on building and the sun to the inside the building should be prevented
	Mahoney		Problem of cold months
November	Evans	Day	Cool, no need to thick insulation and efficiency of temporary heating device
		night	Cold, necessity of good insulation with a building with average to high heat capacity
	Givoni		The air penetration through the seam of windows and weak building joints should be prevented, heat exchange thought building walls should be minimized; the sun heat should be used.
	Mahoney		Problem of cold months
December	Evans	Day	Cool, no need to thick insulation and efficiency of temporary heating device
		night	Cold, necessity of good insulation with a building with average to high heat capacity
	Givoni		The air penetration through the seam of windows and weak building joints

should be prevented, heat exchange thought building walls should be minimized; the sun heat should be used.

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