Organizing the Residential Structures of Tehran City Proportional to Wind Flow

Taraneh Saniee[1], Mohammad Saligheh[2], Bohlol Alijani[3]

1. **Ph.D in Urban Climatology, Faculty of Geographical Sciences, Kharazmi University, Tehran, Iran. tsaniee@yahoo.com**
2. **Associate Professor of Climatology, Faculty of Geographical Sciences ,Kharazmi University, Tehran, Iran. saligheh@khu.ac.ir**
3. **Professor of Climatology, Faculty of Geographical Sciences, Kharazmi University Tehran Iran. bralijani@gmail.com**

Abstract

Although, over the past half century knowledge bases on the climatic issues are expanding, there is little evidence of practical application of the results of climate studies in urban design, Of course, this can be attributed to the fact that the results of many studies on the impact of spatial parameters on the climate change are difficult and difficult to apply in the urban design. Because, many of these results are scientific and theoretical and can not be applied in design operations. The city and climate are two man-made and natural systems that have a strong impact on each other. The climate as far as it relates to human comfort is the result of such factors as the sunlight, temperature and humidity winds and rainfall. The climate of each geographic location has special conditions which at the same time has some limitations in the urban design. The wind is a phenomenon that has been explored for many years in the meteorological arena. The meteorological information is important at all stages of wind energy conversion systems. Among the climatic factors, the wind flow has a very important role in shaping the city. The street orientation, height and density of buildings, the distribution of high buildings and ... are among the elements of urban design that affects the pattern of wind flow in urban spaces. In the approach of human reconciliation with nature, housing is an important issue that its interconnectedness with the environment can play a valuable role in modulating the energy crisis and environmental challenges. This paper by descriptive-analytic method based on the principles of climate design and based on the information gathering by the library and field method and applying RayMan Heat Index, Wind Chill and Ecotect software for studying the climate comfort followed by Urban design is proportional to wind-flow in Tehran.

Keywords: Climatic Design, Wind, Urban Spaces, Tehran.

Received 19/08/2018
Approved 02/09/2018

Introduction

Today, due to growing concerns about the climatic changes, the issue of urban adaptation to these changes and the local climate has become especially important. So that a conscious approach to this issue ends in human comfort and environmental sustainability (Dobbins 2009 84). For this reason, the part of various studies of science including the urban studies and in particular the urban design have been dedicated to climate topics. The climate and climatic factors play an important role in the occurrence of activities (Benetly 1985 &Gehl 1987) and providing human comfort in outer environments (Brown 2010). Hence a large part of the urban design activity is dedicated to providing comfort (Carmona et al. 2010 453). From the perspective of interaction between urban design and urban climate change ,the most potential is regarded to the wind blown in the city. The urban wind speed at street level with urban design elements such as street orientation, elevation and density of buildings, distribution of high-rise buildings and ... will make remarkable changes. The most important climate factor affecting the urban air condition is "regional wind". Moreover, the temperature differences between the densely populated cities and the open areas around the city cause the flow of air to the center of the city. The urban wind conditions particularly on the street level, on human thermal comfort , urban consumption rate can reduce the pressures caused by heat at high temperatures and if the speed of urban winds increases, it will be created and by creating a turmoil on the edges of buildings will creates problems. This phenomenon which is influenced by the city's design can affect the wind control at the different levels particularly at the pedestrian level. This issue is more important and remarkable in areas with a specific climate and wind speeds affecting the thermal comfort (Ranjbar et al. 2010:18). The starting point for observing the climate design rules, is the detailed and comprehensive urban planning guidelines. Unfortunately, the climatic studies in these projects have not been well-positioned and in most cases, it has been done to determine the location of the city in the climatic divisions of the country and to introduce a corresponding typology of architecture (albeit in general). Despite the many advances made in the field of climate studies and the feasibility of accurate measurements of many of the climate indicators, the relationship between the climate and the city has not been adequately addressed; While the proper perception of this relationship leads to the application of appropriate climatic facilities in urban design as well as it can be applied to reduce the inappropriate characteristics and unpleasant climatic conditions (Sheikh Biglou and Mohammadi, 2010: 62). Also, despite the significant influence of wind on the shape and quality of urban spaces and residential texture as well as the rich treasures of design consistent with the climate in the historical cities of Iran, there are no cognitive studies in this field and the creativity of the Iranian city in this area in a strictly scientific analysis It has not been revealed clearly .This has led the range of traditional knowledge usage is limited by wind flow to changes in urban planning and architecture in historical textures on the one hand and in designing new cities on the other hand , The climatic elements play an important and remarkable role in the quality of urban and residential

Received 19/08/2018
Approved 02/09/2018

spaces particularly the qualitative standard of comfort as well as we should seek more efficiency in the use of climate elements such as wind with the developing environmental sustainability movement. In this research, the status of the climate element of the wind in Tehran has been studied and analyzed with an emphasis on the urban design considerations and notes.

Importance and Objectives

Urban land application planning and its impacts on the location and density, the design of residential houses and neighborhood units play a significant role in achieving the sustainable development (Bulkeley 2003; Betsill 2003 176). An essential feature of sustainable urban environments is their compatibility and coherence with the local climatic features (IPENZ 2007 3). Hence, recognizing, perception and controlling the climatic influences of urban areas is a prerequisite for planning and designing the urban spaces that needs the special attention for planners and designers prior to the operation of plans and projects (Biket , 2006: 262). The differences in human behavior patterns are broadly attributed to the effects of climatic conditions (Pressman 2005:5). The feeling of comfort in the human environment is undoubtedly effective in the quality of its behavior and activity; hence the consideration of the comfort of people in the design of various urban spaces has a significant impact on the health of their bodies and souls. The highest level of flexibility of the interior spaces of a building is when it can be naturally set in its environmental conditions in terms of ventilation and light (Bentley, 1382: 179). On the other hand, the range of activities and the range of its flexibility in an outer space depends to a certain extent on its climate especially on the state of sunlight and wind velocity (Bentley 2003: 220). Therefore, providing appropriate solutions for creating environmental comfort in human activities and following them in economic development and their optimal use will greatly save the consumption of abnormal energy and this will be a step towards sustainable urban development.

Research method

The present research is an analytical type, the main part of which is compiled via the library studies and the climatic information required for research is also from data from five meteorological stations including the Somal station (north), Chitgar, Dushan Tape, Mehrabad and Geophysics stations. Based on the data of these stations, the status of the climatic element of the wind was analyzed with an emphasis on the urban design.

Table. 1 - Specifications of the weather stations studied in Tehran

Station name	Station type	establishment year	Geographical coordinates		Height	Statistical period
			latitude	Longitude		

Received 19/08/2018
Approved 02/09/2018

Revista Publicando, 5 No 16. (2). 2018, 1-18. ISSN 1390-9304

Mehrabad	Synoptic	1321	and 41´ 35˚	and 19 ́ 51˚	1190.8	-2014 1951
Dushan tape	Synoptic	1351	and 42´ 35˚	and 20 ́ 51˚	1209.2	-2014 1972
Geophysics	Synoptic	1347	and 44´ 35˚	and 23 51˚	1418.6	-2014 1991
Shomal	Synoptic	1365	and 48´ 35˚	and 29 ́ 51˚	1549.1	-2014 1988
Chitgar	Synoptic	1375	and 44´ 35˚	and ´ 51˚10	1305	-2014 1996

The geographical location and typology of housing in Tehran

Tehran as the political and economic center of Iran with an area of 18596 square kilometers is located between 34 to 36.5 degrees north latitude and 50 to 53 degrees east longitude. Its relative position is determined in the north of the southern slopes of the Alborz and in the southern margin of the central desert of Iran. The city of Tehran is geographically located between 51.17 to 51.33 of east longitude and 35.36 to 35.44 of North latitude and its elevation is from 900 to 1800 meters above the sea level. The southern-northern stretch of the city on average is about 27 km and the east to west stretch extends over 50 km. This location has caused two factors of the mountain and the desert to be localized and the western winds and the tidal wave in the prevailing synoptic circulation scale affect the structure of the climate in Tehran. One of the most important factors that plays a significant role in the direction of this development, the natural factors are among the climatic factors that have been less attention in our country for various reasons such as economic benefits due to excessive construction. Recently, the urban designers have rarely considered the climate in urban planning. Approximately, the way the cities have been deployed, have been decided and dictated by a series of essentially political social economic or random processes. The physical development of cities has always been a major issue in planning in Iran, since in its everlasting history, there has been a continuous change in the spatial structure of large cities.

Tehran city as a metropolitan area that has undergone spatial growth and development over a period of less than two hundred years, faces many spatial and ecological problems in its geographic context (Rahnamaee, 1999). One of the most important issues in this metropolis is its excessive and irrational inflation regardless of the natural factors especially climatic factors.

Despite the fact that in the physical development of Tehran, the role of various factors particularly the natural factors was considered but the expansion of this city in all directions regardless of natural factors and solely on the basis of economic benefits. Such that today our urbanization is based on the classic model of development and blind pursuit of urban stereotypes that disregarded the indigenous conditions and not only creating

Received 19/08/2018
Approved 02/09/2018

instability in the city but also following the instability of the surrounding areas. (Bahraini, 2012 :469). This is despite the fact that today all has this general feeling that most of the urban areas are undesirable and inappropriate. It means uncomfortable ugly confusing and uninhabited neighborhoods (Lynch 1997). It can be said that the present city of Tehran is the result of developments in a 200-year history process that has undergone 4 periods of mutation or demographic and physical changes. Tehran's urban life began with its selection as the capital of Iran more than 200 years ago and the political decision of choosing this place as the capital makes it more attractive (Saifie Qomi ,Tafreshi, 1991).

Wind in Tehran

Wind is one of the most important factors in meteorology that is applied in construction projects due to the effect of wind speed rate, winds directions and wind forces in various buildings. Table .3 presents the wind data of the Mehrabad Synoptic Station ,Dushan Tape, North of Tehran (Tehran Shomal) , Geophysics and Chitgar.

Table.3. Wind Climatic Data at Tehran Stations

Months	Mehrabad	Dushan tape	Shomal	Geophysic Station	Chitgar
	Speed m/s	Speed m/s	Speed m/s	Speed m/s	Speed m/s
January	1.9	1.0	0.5	1.6	1.1
February	2.7	1.6	0.8	2.4	1.9
March	3.1	2.0	1.0	2.7	2.2
April	3.4	2.4	1.3	3.2	2.4
May	3.6	2.5	1.3	3.4	2.6
June	3.3	2.1	1.1	2.9	1.7
July	2.9	1.6	0.9	2.6	1.6
August	2.4	1.6	0.9	2.6	1.4
September	2.3	1.5	0.9	2.5	1.6
October	2.2	1.5	0.9	2.4	1.7
November	1.9	1.2	0.6	1.9	1.3
December	1.6	1.0	0.4	1.5	1.0
Year	1.9	1.0	0.5	1.6	1.1

Wind blow

Received 19/08/2018
Approved 02/09/2018

Regarding the seasonal grunge of Mehrabad station of Tehran, Figure (1), the frequency and route of winds reached to this station in the cold and heat season are almost the same although there are slight differences. In winter, the dominant wind is the western region wind and generally winds are mostly from the west. As the southwest winds to the northwest it is the most frequent. Due to the extreme cold weather, this year the winds especially from the northwest can increase the lost amount of energy to the coldness of the air. After the mid-west winds, the flows from the south-east to the east are in the next stage regarding the abundance. Of course, the winds blow faster than the winds of the southwest. The wind rose of the summer season is largely in line with the winter season with the exception that the southeast winds are more abundant.

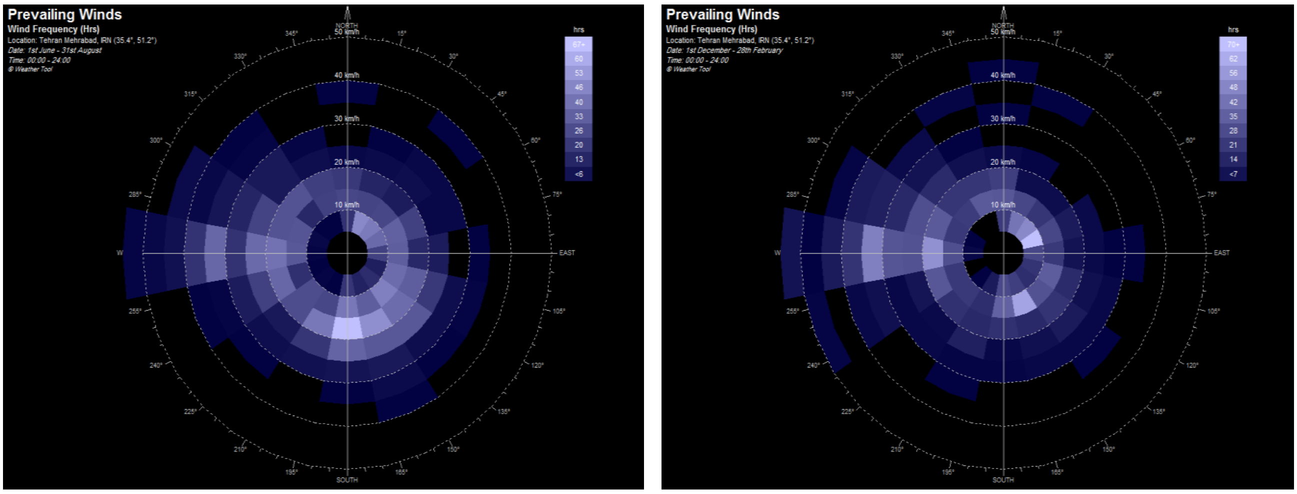


Figure.1 the wind rose (right hand) of the winter season and (left hand) the wind rose of summer season in Mehrabad station (ecotect software's output)

Conclusion from the Wind Patterns

As the main findings of the study of regional winds in the subject of the architecture – climate, the following are emphasized.

1- According to Tehran's wind roses is a western wind which during the cold seasons causes cold and unpleasant weather.

2- the directions of second degree wind in the cold months of the year are the west south ,west and southwest.

3. The windows in the south and southwest are completely sealed and double-glazed windows.

4. The direction of the south-east is in the appropriate direction of the effect of the wind blowing on the building. It's better to create a smaller angle to the building facades.

Received 19/08/2018
Approved 02/09/2018

Software indicators for leveling the climatic comfort of the study area

According to the nature of environmental cognitive sciences including the climatology, the software in this area has abundant capabilities and according to the increased accuracy ,reducing the spent time and the possibility of applying more climatic elements as complementary methods along with the experimental and manual methods of researches on "climate and architecture" has been institutionalized. In this research, the following software has been utilized with regard to the nature and objectives of the research.

1- Calculating PET index using RayMan software

The first version of RayMan software was designed in 2000 by Frank Roths, Andreas Matzarakis and Helmut Meyer at Meteorological Institute from the University of Freiburg.

In this study, Version 1.2 of this software has been utilized. The application of this software is in urban and district planning and is highly effective in issues such as housing and tourism (Matzarakis et al, 2006:323).

The main application of the outputs of this software is the modeling of the average radiant temperature to calculate the heat indicators in urban spaces. Therefore, the software has been instrumental in research on the climate and architecture. In the present study, RayMan software has been applied to obtain a factor affecting the sustainable architecture including the PET temperature index.The main advantage of the PET Indicator is the Delivery in terms of Celsius and the ability to evaluate it on a daily and even hourly basis (Ismaili et al. 104:2010).Among the climatic elements required to calculate the PET element Tmrt (C) or the average radiant temperature has special significance. The most of the major bio-meteorological elements affecting the human energy balance in hot and sunny weather are included in the mean radiant temperature Tmrt (Matzarakis et al. 2006 323). It should be mentioned that theoretically in the PET calculation the MEMI model is the basis (Matzarakis Amelung ,2008: 165). This model is based on the *energy balance equation* for the human body in accordance with the following equation.

$$M + W + R + C + E_D + E_{RC} + E_{SW} + S = 0$$

M as the amount of metabolism or energy produced by the body, W as the output of physical activity, R as the rare radiation of body energy , C as the transitional heat flow , E_D as the thermal flow of latent heat of vaporization via the skin (subtle sweating), E_{RC} as the total heat flow for heating and humidity, E_{SW} as the air flow energy from sweating and evaporation, S as the storing the heat flow to heat and cool the mass and body mass in the person being studied.

In the aforementioned equation, if all the outcomes of factors and relations involved in the equation to each person's body are related to the acquisition and the energy increase, the combination of the above symbols (+) and if the energy decreases and falls it will be indicated by (-). Among the elements in the equation, M is always positive and against the W, E_D and E_{SW} as well as is negative. Also ,the unit of measurement is considered Watt for all energy streams (Hoppe 1999). It should be noted that the individual and

Received 19/08/2018
Approved 02/09/2018

personal energy flows in the upper equation are controlled by the above meteorological elements. 1. Air temperature, C and ERC, 2. Air humidity: E_D, ESW and ERC 3. The average radiant temperature :R. In addition to meteorological elements considering the physiological thermal elements such as 1- Thermal resistance of clothing of each person is known as the Clo unit. And 2- the physical activity of individuals measured in Watt is also necessary (Hoppe, 1999). In this regard, the necessary data is required to enter the software in the following topics.

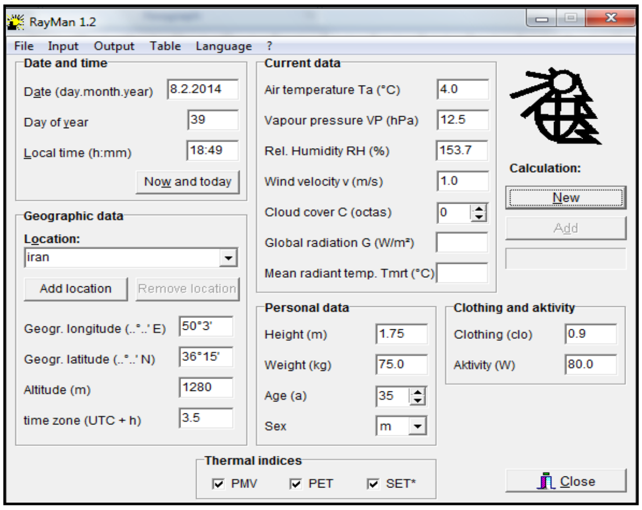
1. the climatic data: the temperature (Ta (C)), water vapor pressure (VP (hpa)), humidity (RH (%)), wind blowing (V (m/s)), cloudy (C(octas)), the global radiation G (w/ m^2) and average radiant temperature (Tmrt);
2. Time and place data including: date, time zone and geographic coordinates of the station under study;
3. Physiological data including: age, weight, sex, height, clothing type and physical activity of the person being studied.

The findings of the PET index as the main citation of the present research are considered in comfort conclusions and determination of structural measures and housing architecture in Qazvin.

It should be noted that the physiological equivalent temperature in the same climatic conditions is influenced by the individual characteristics including weight and type of clothing and is different. Therefore, it must be noted that in this study the PET index and the determination of the thermal sensitivity and physiological stress levels for a person with the characteristics of 1) physiological characteristics: male gender, age 48, weight 75 kg, height 170 cm; 2. Clothing and activities: The Clo is 0.5, the activity is 80 watts.

Fig. 2. RayMan software input screen

Received 19/08/2018
Approved 02/09/2018



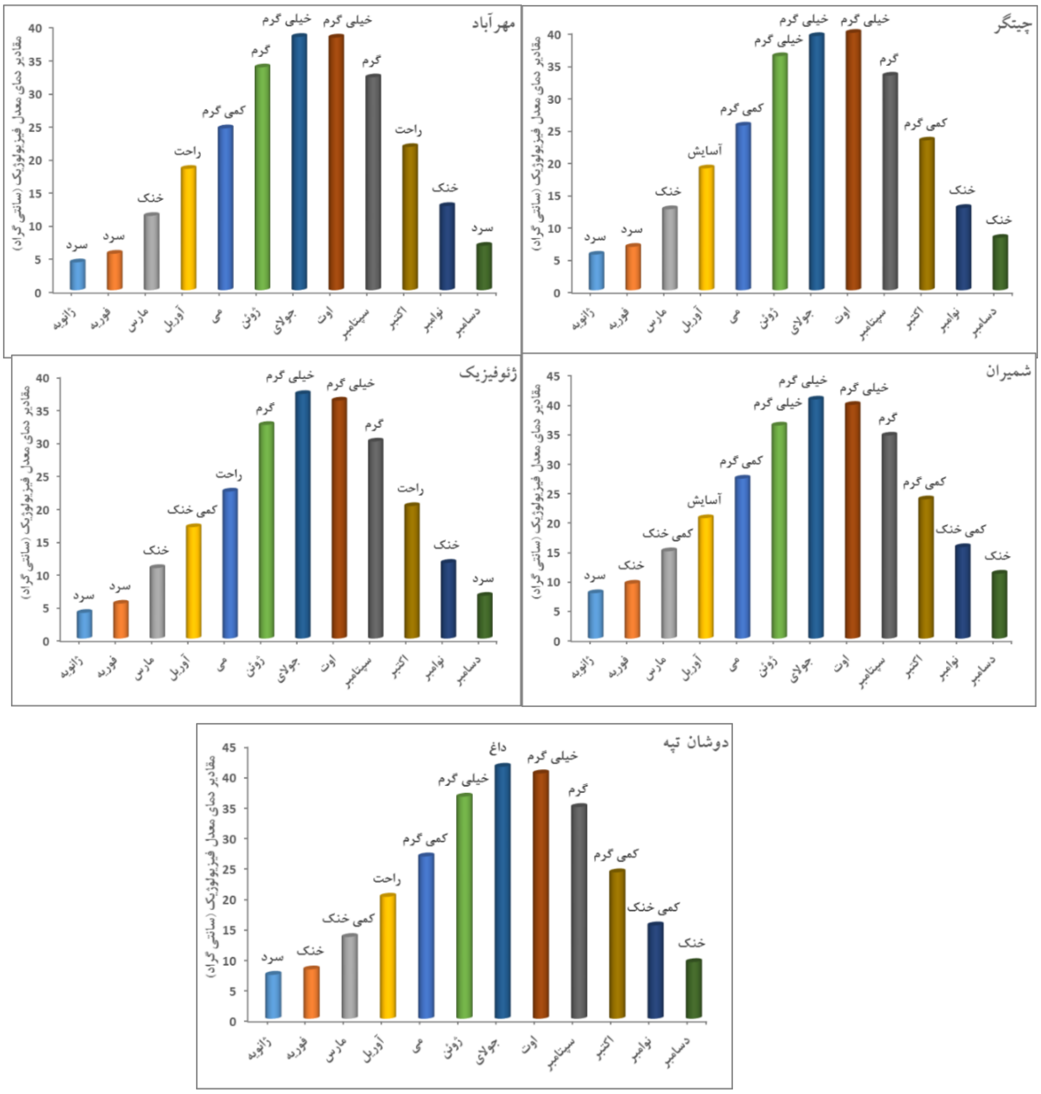
As the research findings of the above operations, the results of calculations with their climatic interpretation for each of the study stations were as follows. One of the main climatic elements in importing data of RayMan software is the temperature element (Ta). In this software, the temperature can be applied as Ta for thermal sensitivity and the physiological stress of each month. If the average daily temperature enters the software as Ta , the levels of thermal sensitivity will not be in line with the climatic realities. Hence , it is required to change the temperature of Ta for each month different from the rest of months and considering its placement in one of the temperate courses of mild, cold or hot and observing the above grouping.

1. For moderate months, average daily temperature is used; 2. In the cold months, the average moderate temperature is used; 3. For the warm months, the average temperature is taken into account. (Ta (C))

Fig. 3 - Monthly values of PET index for stations in Tehran

Received 19/08/2018
Approved 02/09/2018

Revista Publicando, 5 No 16. (2). 2018, 1-18. ISSN 1390-9304



(Fig. 3) shows the results of calculation of the physiological equivalent temperature (PET) index on a monthly basis for stations in Tehran. As shown on the diagrams of each station, there is no significant difference between the thermal and thermal stresses between different stations in Tehran so that all of Tehran's stations during the warm period of the year are accompanied by heat stress and during the cold period of the year with cold stress . However, in the early months of the transition season (spring and autumn) the comfort conditions at different stations of every month have minor differences. At the Mehrabad stations (April and October) and geophysics (May and October) they have warm conditions during the two months of the year. But in other stations only April has a relative convenience conditions based on the PET index. At the Mehrabad Station in May, at the Chitgar Station, Dushan Tappeh and Shemiran in October and May months and at geophysical station in April, they encountered relatively comfortable conditions. Also, PET station diagrams showed that the number of months related with cold stress during the year in addition to being high, has a great distance from the boundaries and thresholds of comfort and each station experiences five years of physiological cold stress

Received 19/08/2018
Approved 02/09/2018

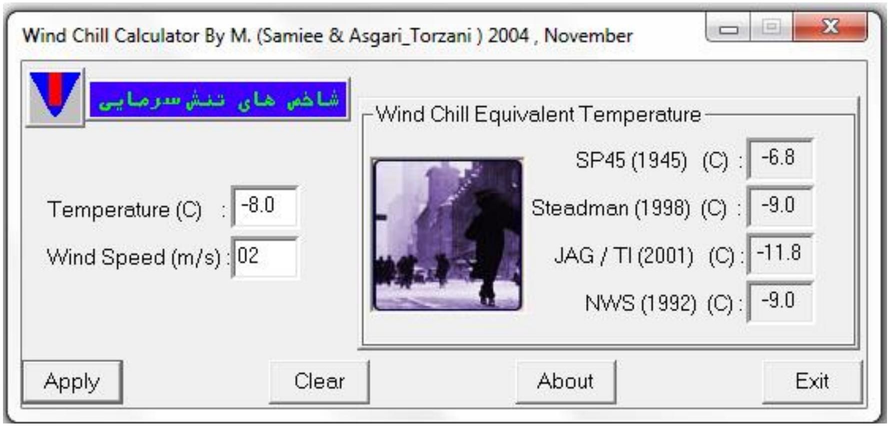
for five months. Therefore, there is no possibility of removing heating elements and architectural measures with having a long and intense cold period only allow the possibility of modulating the fuel consumption of the home-made thermal systems.

2. The calculation of cold stress index (wind chill) using Wind Chill Index software

In this software, by entering the dry temperature (in Celsius or Fahrenheit) and wind speed (m / s) are obtained by four valid methods (Fig. 4).

The increasing role of wind speed in tangible chill has caused the designers of this software in addition to temperature recording, to classify the size of the cold stress by entering the wind speed.

Figure. 4 – The Input page of the software of cold stress index (Wind chill)



As is shown in Fig. 4, the temperature of -8 ° C with a wind speed of n m/s, recorded a cold stress of - 9° C in the Steadman Index and indicates a severe cold stress. The effect of stress on wind speed is higher than the air cooling effect. As shown in the example an increase of 5 units at the wind speed along with temperature constant in - 8° C greatly increases the amount of cold stress and with its 7 unit intensification, the temperature of cold stress reaches -15 ° C.

However, with constant wind speed of 2 m/s and decreasing the dry temperature from – 8 ° C to – 15 ° C ,the cold stress is increased by only 1 unit and reaches from the – 15 C to – 16 C temperature. Tehran stations: The passage of temperature from the resilient boundary causes the physiological and psychological disturbances to humans as well as causes the physical and mental impairment.The increase of environmental factors such as humidity can exceed the emotional temperature of hot weather relative to the recorded temperature.

Also , it is proved that the relative humidity effect can be felt like heat ,for example in humans in two temperatures with a relative humidity of 75% and 20%, it feels that the first 1st ambient temperature is about 1.5 ° C above the second environment (Razjouian ,2010: 17). Hence, the designers of comfort software invented thermal stress software by combining the recorded temperature and humidity in the air. Table.7 shows the results

Received 19/08/2018
Approved 02/09/2018

of applying the Heat Index software at the stations of Mehrabad , Shemiran, Dashan Tape, Geophysics, Chitgar. The output of the thermal stress software indicates that in these five stations in December, January, February and July, the status is 2 (high alert). Wind blowing is another factor affecting the temperature of the human body. The above-mentioned climatic element in many ways particularly increases the ability to evaporate and conceal heat during evaporation that leads to lower temperatures. Hence, the effect of the wind blowing on temperature variations is considered in its reverse form to relative humidity and is considered as a lowering factor in temperature. The design of the Wind Chill software has been made based on the scientific guidelines. The output of the cold stress software presented in Table.7 shows the effect of the wind blow on the downturn of minimum temperature of the study stations. Accordingly , the lower wind effect is more pronounced at lower temperatures as well as has resulted in a higher temperature drop.

Table. 4 – The calculation of thermal stress and cold stress indicators at the study stations

Stations	Months	January	February	March	April	May	June	July	August	Septemb er	October	Novemb	Decembe
Mehrabad	Average maximum temperature	9.7	10.4	15.4	22.1	27.9	33.9	36.6	35.6	31.6	24.4	16.2	10
	Average humidity (%)	64	56	48	41	33	25	26	26	27	36	49	62
	Thermal stress level	-	-	-	-	1	2	2	2	1	-	-	-
	Average temperature range	-4	1.2	5.4	11.2	16.1	20.9	23.9	23.3	19.3	13.3	6.7	1.7
	wind speed (m/s)	1.9	2.7	3.1	3.4	3.6	3.3	2.9	2.4	2.3	2.2	1.9	1.6
	Wind chill	-4.9	-0.7	3.6	9.6	13.9	19.7	22.8	22.8	18.8	12.7	5.9	0.5 -
Shemiran	Average maximum temperature	6/3	8/5	13/7	20/2	25/6	31/7	34/4	33/7	29/5	22/8	14/4	8/7
	Average humidity (%)	65/9	59/0	50/2	43/8	38/3	29/4	30/5	30/9	32/9	43/7	57/4	65/7

Received 19/08/2018
Approved 02/09/2018

	Thermal stress level	-	-	-	-	-	1	2	2	1	-	-	-
	Average temperature drop	-1/5	0/2	4/5	9/9	14/3	19/7	22/7	21/6	17/3	11/6	5/3	9/0
	wind speed (m/s)	0/5	0/8	1	1/3	1/3	1/1	0/9	0/9	0/9	0/9	0/6	0/4
	Wind chill	0	0	0	9/2	13/7	19/2	0	0	0	0	0	0
Duchan tape	Average maximum temperature	8/8	11/1	16/1	22/9	28/2	34/2	36/8	36	32	24/9	16/9	10/7
	Average humidity (%)	59/3	52/3	44/5	38/0	33/1	26/6	28/8	29/1	30/4	38/7	50/1	59/0
	Thermal stress level	-	-	-	-	1	2	2	2	1	-	-	-
	Average temperature drop	0/8	2/4	6/4	12/4	17/3	22/7	25/4	24/7	20/6	14/5	8/1	7/8
	Wind speed (m/s)	1	1/6	2	2/4	2/5	2/1	1/6	1/6	1/5	1/5	1/2	1
	Wind chill	0	1/6	5/6	11/7	16/7	22/2	25	24/3	20/1	13/9	7/4	0
Geophysics	Average maximum temperature	6/9	9/4	14/2	20/6	26	32/1	34/8	34/2	29/8	23/2	14/7	9
	Average humidity (%)	59/3	52/3	44/5	38/0	33/1	26/6	28/8	29/1	30/4	38/7	50/1	59/0
	Thermal stress level	-	-	-	-	-	1	2	2	1	-	-	-

Received 19/08/2018
Approved 02/09/2018

	Average temperature drop	0/6	2/3	6/2	11/8	16/4	22/1	25/2	24/5	20/4	14/5	7/4	2/7
	wind speed (m/s)	1/6	2/4	2/7	3/2	3/4	2/9	2/6	2/6	2/5	2/4	1/9	1/5
	Wind chill	-0/3	1/5	4/5	9/4	15	20/9	24/1	23/4	19/9	13/9	6/7	1/9
Chitgar	Average maximum temperature	7/5	10/3	15/5	21/5	27/5	33/4	35/7	35/2	30/9	24/6	15/2	9/9
	Average humidity (%)	57/4	49/3	37/6	35/8	27/7	22/9	24/3	24/0	25/0	31/1	47/2	57/9
	Thermal stress level	-	-	-	-	-	1	2	2	1	-	-	-
	Average temperature drop	0/2	1/8	6/1	11/7	16/7	21/5	23/5	23/7	19/8	14/7	6/7	2/2
	wind speed (m/s)	1/1	1/9	2/2	2/6	1/7	1/6	1/4	1/4	1/6	1/7	1/3	1
	Wind chill	0	-0/4	5/3	10/2	16/1	21	23	23/2	19/3	14/1	5/9	0

Table.5 illustrates the reduction of climate in the study area by tabulating and comparing the comfort findings.

Table.5 Months having the climatic comfort at study stations using software methods

Station name	PET
Mehrabad	April (comfortable) October (comfortable) May (Relative Comfort)
Shemiran	April (comfortable) October (Relative Comfort) May (Relative Comfort)
Dushan tape	April (comfortable) October (comfortable)

Received 19/08/2018
Approved 02/09/2018

	May (Relative Comfort)
Geophysics	May (comfortable) October (comfortable) April (Relative Comfort)
Chitgar	April (comfortable) October (comfortable) May (Relative Comfort)

According to Table.5 the comfortable climate in the studied area is for the months of May April and October. In order to avoid the continuation of the current non-environmental approach and to establish a relationship with the sustainable architecture by implementing the climatic design guidelines of the building, the natural potential of the study area can be utilized to provide thermal comfort. By implementing such an approach, cooling equipment can be removed and the use of heating equipment will be reduced. Concerning the presentation of climate design, it can be said that the maintenance of thermal comfort results from the balance of temperature between the body and the surrounding environment (Watson & Lobes 2011: 29). This heat exchange is carried out according to four physical principles of conduction displacement, radiation and evaporation (Watson & Lipes 2011:4). In connection with the selection of architectural measures for residential areas in the area under consideration, with regard to the comfort findings, the attention is required to the following points are required. The results obtained from the mentioned indicators for different stations in Tehran show that the output of biomass indicators is very close to each other and there is no significant difference in their output. Also, the climatic conditions of different parts of Tehran are very close to each other in terms of thermal comfort and there is not much difference between the cooling and heating needs of the north, west , south and east of Tehran.

According to the various indicators, the environmental conditions of Tehran's different areas in October and May, are in the best thermal conditions and climatic comfort can be felt in most hours of the day. The air temperature is greatly reduced and there is no need for energy during the day In April. During 5 to 6 months of the year from November to April, the cold stresses at all stations are confirmed by the most thermal indicators. Of course, in regions of Tehran where the wind speed is less than 1 m per second such as Shemiran in November and especially in April, cold tensions are limited. At all stations from December to February extreme cold stress is extremely intense so that the maximum solar absorption is not enough to provide enough energy for the environment. The air temperature usually affects Tehran's regions from June to September which is only very severe in July and August. Generally, the climatic conditions of Tehran can be called cold and semi-arid because the thermal stress caused by the cold-weather more than heat stresses cause residents' dissatisfaction. Therefore, the architecture design should be more in line with the use of sunlight and less fuel consumption.

Received 19/08/2018
Approved 02/09/2018

Conclusions and suggestions

An optimal climate design involves the maximum application of the site resources while minimizing environmental expectations. This comes from a long-term vision of potential environmental impacts and the following points are required for this - How to use the solar energy; as well as use the full rain water and drainage networks;

- We restrict wind power; - Use ground potential for heating or cooling; - reduce energy demand.

We conclude based on the observations and analyzes carried out on the spaces in Tehran, that the current status of architecture with a climate design and the provision of natural heating and cooling show a profound alienation, Also in the design of many urban spaces, the principles of climate design have not been respected and consequently certain problems have been observed in relation to each of the climatic elements. Accordingly , it is recommended to observe the following criteria in order to design a city that is appropriate to the climatic characteristics of the study area and to provide thermal comfort in urban spaces:

- The orientation angle - the orientation of the planes from the azimuth is 140 to 210 degrees (the maximum radiation in the winter and minimum in the summer).

Buildings on the eastern-western axis;
- Compact design with square to rectangular plans (to reduce the external surface of the building and lessen the exchange with outside air);
- application of medium openings;
- The depth of the southern openings canopy for each meter of the height of the window is 0.22 meters
- The depth of the canopy of the northern openings per meter of the height of the window is 1 meter;
- The depth of the canopy of eastern openings is 1.5 meters per meter high;
- The depth of the canopy of the western openings per meter of the height of the window is 1.1 meters;
- Use of thick walls (in order to increase the resistance and thermal capacity of the walls);
- Using double-glazed windows;
- Lack of design in the wind direction of the prevailing winter;
- Application of a ceiling-fan for summer air conditioning and hot air transfer to the floor during the winter.

Accordingly , based on the results achieved in this study and comparing it with the results of the similar studies, it can be said that in the urban area of Tehran due to its cold and semi-arid climate, it is necessary to use the cooling systems and particularly the heating systems to prepare the thermal comfort. However, using the heavy construction materials, observing the principles of architecture ,proper orientation, effective ventilation can

Received 19/08/2018
Approved 02/09/2018

greatly control the thermal conditions of internal spaces and reduce the need for using the high energy mechanical systems in Tehran's urban area.

References

1- Bentley Yin et al. (2003) "Responsive Environments" Translated by Mostafa Behzadfar ,Tehran, Iran University of Science and Technology, 1st Edition.

2- Database of Meteorological Office of Qazvin province (2011).

3. Davis Lullin et al. (2005) "Urban Design Guide" translation by Reza Rezaei. Tehran. Civil Corporation of new cities. First Edition.

4- Razjouian Ma(2007). "Comfort in the shelter of wind". Tehran Shahid Beheshti University .Second Edition.

5- Ranjbar, Ehsan and Parojafar, Mohammad Reza and Khaliji, Keyvan (2010) "the creativities of climatic design adapted to the wind flow in the old context of Bushehr" .Journal of Bagh Nazar, No. 13, seventh year, spring, pp. 17-34.

6. Sheikh Biglou, Rana and Mohammadi ,Jamal (2010) "Analysis of Wind Climatic Elements and Rainfall with Emphasis on Urban Designing of Case Study of Isfahan City", Geography and Environmental Planning, Vol. 21, No. 3 ,Autumn, pp. 61-82.

7- Alijani Bohlul (2002, "Synoptic Climatology", Samt Publication ,1st Edition, Tehran.

8- Alijani, Bahlol and Kaviani, Mohammad Reza (1993) "The Basics of Weather", Samt Publication ,First Edition Tehran.

9. Famili,Dariush et al, (2011) "Geography of Qazvin province" Textbooks printing and publishing company of Iran., Second edition Tehran.

10. Qobadian,V. (2012) "Climate Study of Traditional Buildings of Iran" Tehran University Press. Seventh edition, Tehran.

11. Coch Nielsen, Helger (1398) " Architecture in harmony with the climate" translation by F. Soflaee , First Edition , the center for Urban and Architectural Studies and Research, Tehran.

12- Mohammadi, H(2011). " Weather in arid regions ". Tehran University Press. First Edition Tehran.

13. Watson, Donald and Lobes, Kent(2011)."the climatic design", translation by Vahid Ghobadian and Mohammad Fatemeh Mahdavi, thirteenth edition, Tehran University .Tehran.

14. Ministry of Housing and Urban Development (2009). "The 19th Chapter of the National Building Regulations of Iran". Office of National Building Regulations .Tehran.

15. Hashemi. F (1349), "Surveying the Winds of Ghazvin Plain". Meteorological Organization.

16- Arif, Kamal. M, (2012), "AnOverview of Passive Cooling Techniques in Buildinds", Desing Concepts and Architectural Interventions, Civil Engineering & Architecture Vol.55,No.1,pp,84-97.

17- Benetly I. et Al., (1985), "Responsive environment: A Manual for Designers", London: The Architectural Press.

Received 19/08/2018
Approved 02/09/2018

Revista Publicando, 5 No 16. (2). 2018, 1-18. ISSN 1390-9304

18- Biket, Asli P nar, (2006), "Architectural Design Based on Climatic Data", 1st International CIB Endorsed METU Postgraduate Conference, Built Environment & Information Technologies, Ankara, pp. 261-267.
19- Brown, Robert D, (2010), "Design With Microclimate The Secret to Comfortable Outdoor Space", Island Press.
20- Bulkeley Harriet and Betsill Michele M., (2003), "Cities and Climate Change", Routledge, London.
21- Carmona et Al., (2010), "Public Places, Urban spaces (second edition)", Routledge.
22- Davenport, A.G.,(1960), "Wind Load on Structures", Technical Paper. No, 88. National Research Council. Ottawa, Canada.
23- Dobbelsteen A. van den et. Al., (2009), "Smart Building in a Changing Climate", Techne Press.
24- Emmanuel, M. Rohinton ,(2005), "An Urban Approach to Climate Sensitive Design: Strategies for the Tropics", Taylor & Francis. London.
25- Fathy, Hassan, (2000), "Architecture for the Foor: An Experiment in Rural Egypt", Published by University of Chicago Press.
26- Givoni, Baruch, (1998), "Climate Considerations in Building and Urban design", Van Nostrand Reinhold. New York.
27- IPENZ (Institution of Professional Engineers New Zealand Incorporated), (2007), "Urban Design, Institution of Professional Engineers", New Zealand Incorporated, New Zealand.
28- Pressman, Norman, (2000), "Climatic Factors in Urban Design", Arch. & Comport. /Arch. & Schav., Vol. 10, no 1, p. 5 – 7.
29- Mtzarakis A. and et al ,(2006), "Modelling Radiation Fluxes in Simple and Complex Environments- Apllication of the RayMan Model", Biometeorol. Pp,323-334.
30- Mtzarakis A. & Amelung B, (2008), "Physiological Equivalent Temperature as Indictor for Impacts of Climate Change on Thermal Comfort of Humans", Springer Science + Business Media B.V.PP, 161-172.

Received 19/08/2018
Approved 02/09/2018