Journal of Research in Ecology

An International Scientific Research Journal

ISSN No: Print: 2319 –1546; Online: 2319– 1554

Original Research

Studying the relationship between climate, outdoor and indoor comfort for houses and apartment buildings (Case study: Bandar-e Anzali)

Authors:
Zahra Hassanzadeh and Atousa Beikdeli

Institution:
Department of Geography, Islamic Azad University of Rasht, Rasht, Iran.

Corresponding author:
Zahra Hassanzadeh

ABSTRACT:

In building construction, in particular pertaining to structures, it is critical not only to provide the security, but also to consider interior and exterior facility and convenience. In residential contexts, in past, more environmentally, climate compatible materials were often used; whereas, nowadays, growing population, increased land price, new materials as well as incompatible climate modeling led contexts congruence and climate conditions to be less interested. This research studied thermal comfort inside and outside of houses and apartment buildings in Bandar-e Anzali, Gilan through using a descriptive analytical, field study method. Eight sample stations were selected regarding Anzali land use and 60 days of wet and dry weather were screened in these stations. According to this capture and using Mahoney, bioclimatic constructional method and effective temperature, interior and exterior thermal comfort in houses and apartment buildings were determined in April, May, June, and July. Considering bioclimatic constructional method, maximum comfort condition is related to April and May inside and outside of houses in term of space. In some cases, inside of houses shares equal conditions with outside of apartment buildings. In operative temperature method, April and May are located in comfort condition (thermal comfort); and various positions in understudied stations showed thermal comfort in June and July at wind speed 0.5 to1.5 ms^{-1}.

Keywords:

Constructional bioclimatic, Comfort, Operative temperature, Dry and wet temperature, Bandar-e Anzali.

Article Citation:
Zahra Hassanzadeh and Atousa Beikdeli
Studying the relationship between climate, outdoor and indoor comfort for houses and apartment buildings (Case study: Bandar-e Anzali)
Journal of Research in Ecology (2019) 7(1): 2455-2462

Dates:
Received: 28 Mar 2017 **Accepted:** 25 April 2017 **Published:** 18 April 2019

Web Address:
http://ecologyresearch.info/documents/EC0342.pdf

INTRODUCTION

Weather mostly influences human life form comparing other factors such that many cities were built or expanded disregarding climate information. Climate variability is directly related to climate in term of construction and the type of heating and cooling. Applying meteorological data for designing and construction of new cities as well as developing old cities may minimize these side effects (Mollanejad, 2015).

Since human being live in the lower layer of air, the least air change may influence human. Daily life consists of stages such as activity, exhaustion and revitalization. Intellectual reinvigoration through recreation, rest and sleep to balance against mental and physical fatigue of everyday activities is a natural, critical issue. In this regard, adverse climatic conditions (heat, extreme cold, rainfall and excessive humidity, etc.) influencing human comfort may prevent proper implementation of these steps and impose pressures on human body and mentality. Therefore, the effect of climatic conditions on human being is a significant factor (Kasmaei, 2003).

There were conducted many academic efforts on this area around the world; the most historical studies include Olge model, in 1960s, individually determined the role of different factors through a bioclimatic graph. Based on the calculations and experiments carried out in four different climatic regions of the U.S.A, and concluded that the regions may demand unequal capacity and thermal resistance (Mohammadi and Saeidi, 2008).

Mahani *et al.* (1970) proposed a more precise method in which the building was interested. In the method, given temperature and relative humidity in each of the months of the year, daily fluctuation, annual fluctuation, average air temperature, as well as climatic condition are initially investigated in relation to human comfort; then, features of building elements are determined through some factors (Safaeipour and Taheri, 2010). Evans, like Mahani (1970) discusses, in detail, on effective climatic factors of discomforts and architectural guidelines in addition to setting comfort times (Razjouyan, 2009).

Today, the need and significance of considering climate conditions is demonstrated for designing and construction, in particular for the constructions directly used by human and live beings. Considering climatic characteristics and the effects on construction formation is significant from two perspectives: on one side, climate compatible constructions or climatic constructions provide better quality of human thermal comfort. This provides better environmental conditions; further, daily and seasonal light variability, air flow and warmth bring different, friendly and pleasant contexts in such structures. On the other side, construction climate consistency may lead to fuel consumption saving for controlling structures' environmental conditions. In some climates, it is possible to naturally set interior conditions of climate consistent constructions at thermal comfort throughout the year without requiring mechanical sys-

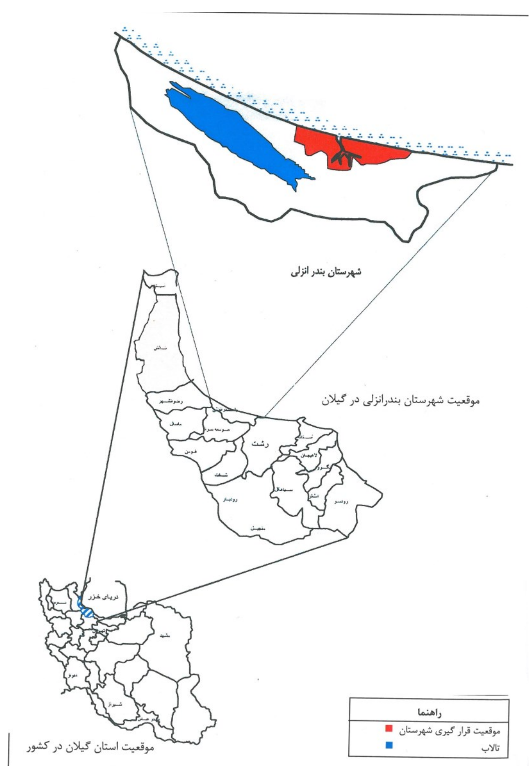

Figure 1. Location of Bandar-e Anzali (in farsi) (scale: 1.250000)

Figure 2. Marked stations through city (in farsi)

tems (Noorani, 2003).

Unfortunately, today, misunderstanding western architecture led to ignoring knowledge and experience of predecessors and imitating international architecture for planning our national fertile lands; where as the construction must be influenced under various climates in term of regional traditional architecture. Human thermal condition refers to the situation thermally proper and comfortable for at least 80% of people; in other word, neither cold nor heat. Some scholars argue that the term 'thermal neutrality' is more accurately interpreted as human may sense no cold, heat and local discomfort caused by climatic issues (Qobadiyan and Feyamahdavi, 1997).

Lowry (1980) shows that at temperatures above 28˚C, the body (face and legs) starts sweating; and at temperatures over 35˚C, transpiration of whole body occurs. Body evaporation level is associated to steam pressure gradient of body to air as well as air movement conditions in any climate. Thus, excess heat is easily removed from body at hot and dry climate; whereas, at warm and humid climates, body heat loss is more limited (Qobadiyan, 2003).

According to international standards, thermal comfort is referred to the conditions where 80% of human feel comfort and satisfaction within 22-25.5˚C, at water vapor pressure 5-14 mm Hg, and air flow rate 22 cm/s (Iran National Building Regulations, Section 19, 1994; 5). Clearly, main objectives of climate designing are achieved through various ways and regarding all aspects, the most appropriate method will be selected (Mohammadi, 2006; 143-144).

Decreased building heat dissipation

Utilizing solar energy and building heating

Reducing wind effect in building heat dissipation

Building sun protection in hot times

How human feels to surrounding may not be merely sensed through studying one of climate elements such as temperature, relative humidity or air flow, as these elements influence human and are associated to its physical comfort. For instance, if air speed is assumed constant and sunlight is ignored (i.e. in order to locate people indoors at shadow), most are physically satisfied at 21-26˚C and relative humidity 30-60%. Now, let the indoor weather conditions is changed i.e. increased humidity and decreased temperature, the individuals may feel dissatisfied (Kasmaei, 2003). Thus, research hypothesis is as follows:

Research hypothesis

Thermal comfort varies in house and apartment buildings in term of regional climate elements in Bandar -e Anzali.

Table 1. Humidifier requirement at stations (Percentage)

Outdoor at houses	Indoor at houses	Outdoor at apartment building	Months
12.5%	12.5%	-	July
-	-	12.5%	August

Research methodology

This descriptive-analytical study used statistical, field data through library method. The collected data were analyzed by valid understudied approaches. Moreover, primary data were analyzed using monitoring and through findings and other proportions. The solutions were proposed by using information banks and computer networks, tables and plans.

According to research subject matter of comparative studying of indoor and outdoor thermal comfort at houses and apartment buildings and regarding the need for dry and wet temperature data of different days to observe aforementioned conditions, which were absent, the data were monitored and collected by the researcher. According to land use mapping of Bandar-e Anzali, the stations were randomly selected throughout the city in order to achieve better results. The stations were marked from 1-8 on maps selected by land use plan of Bandar e-Anazali (in term of residential areas).

To get the desired result, data were collected in no event conditions (clear weather with no wind and rain) over 60 consecutive days respecting climate conditions, which overall lasted four months. Monitoring initiated from May 5, every day beginning at 10.30 am and ending at 1.30 pm.

Data collection instrumentations

This descriptive-analytical study applied meteorological instruments (dry and wet thermometer) to record indoor and outdoor wet and dry temperature. In addition, base plans were provided by topography maps at 1.250000 scale, geology 1.250000, land use 1.100000 and water network map 1.250000; furthermore, online meteorological data were analyzed through excel software.

Research objectives are as follows:

- Evaluating proper construction in Bandar-e Anzali respecting regional climate
- Proper operation in Bandar-e Anzali
- Basic research for further studies as well as functional plans to improve building's thermal comfort in Bandar-e Anzali
- Research under studied area is Bandar-e Anzali.

Natural features of Bandar-e Anzali

Geographical location

Bandare-e Anzali is located at Gilan province plain close to Caspian Sea. It is bounded to Caspian Sea by north, Rasht city by east, to Soumeh Sara by south and Rezvanshahr by west. In term of geographical divisions, Bandar-e Anzali consists of a central part, two rural districts naming Chahar farizeh and Licharki Hassanrooud, and 28 residential villages. 24 of total villages exceed 20 households. Bandar-e Anzali is extended at 37˚ and 25' to 37˚ and 35' latitude and at 48˚ and 13' to 49˚ and 37' longitude. The area of city in 2006 was 380.9 km^2 and the relative density population was 388 individuals per km^2.

The transit road of Rasht-Bandar-e Anzali-Astara, which is an inter-regional road passes through this city and provides accessibility (Management and planning department, 2008).

RESULTS

Percentage of comfort condition (N)

According to the obtained percentages in Table 2 for four months, indoor thermal comfort at houses is higher than apartment buildings; further, indoor thermal comfort condition at houses is similar to outdoor ther-

Table 2. Percentage of four months (60 days)

Outdoor house	Indoor house	Outdoor apartment building	Indoor apartment building	Bioclimatic conditions
31.37	43.75	43.75	37.5	N %
15.62	6.25	12.5	18.75	VN%
43.37	37.5	34.37	37.5	V %
12.5	9.37	6.25	6.25	D %
3.12	3.12	3.12	0	V' %

mal comfort at apartment buildings; where as, outdoor thermal comfort at apartment buildings is larger than outdoor thermal comfort at houses.

Thermal comfort percentage if air circulation is used for normal buildings (VN)

This condition is mostly prevailed in apartment buildings as well as outdoor houses; in other word, such condition is more probable for outdoor conditions at houses rather than apartment buildings; while, for indoors, the percentage was higher for apartment buildings.

Percentage of benefiting air circulation in general buildings (V)

This is similar for both indoor and outdoor conditions at houses; further, apartment buildings also share equal percentage of indoor and outdoor conditions.

Humidifier requirement percentage (D)

This condition reveals higher indoor and outdoor percentage for apartment buildings comparing houses in July. Moreover, it shows higher outdoor percentage at houses than indoor in August (Table 1).

Air circulation in constructions designed by natural ventilation (V')

This condition is equally met at all places including indoors and outdoors at houses and outdoor at apartment buildings excluding outdoor and indoor at apartment buildings. According to the abovementioned results, April is situated at 100% outdoor and indoor thermal comfort condition (N) at houses and apartment buildings. Indoor thermal comfort in June was 75% at houses, which is larger than indoor thermal comfort at apartment building (50%); further, indoor thermal comfort at apartment building was higher than outdoor thermal comfort at houses. Overall, thermal comfort conditions (N) is just observed in April and June. Bioclimatic condition (VN) was only seen in Jun and July such that indoor condition in June was higher in apartment building than houses and outdoor conditions were higher in houses than apartment buildings. VN was only equally seen for outdoor and indoor at apartment buildings in July.

Bioclimatic condition (V) was merely observed in July and August such that in August it was 50% for outdoor and indoor at apartment buildings and 75% for indoor and outdoor at houses. In general, V was higher at houses comparing apartment buildings. Indoor conditions at apartment building in August demonstrated 100% V; whereas, it was higher for outdoor V at apartment buildings than houses. This condition, in general, was higher for apartment buildings. Comparing indoor and outdoor conditions at houses represented higher indoor percentages. D condition was also only seen in July and August such that in July it was higher at apartment buildings than houses. D condition in August was only observed in houses such that outdoor percentage was larger than indoor percentage. And finally, (V') was only seen in July and August; however, it was only true for indoor at houses in July and outdoor at apartment buildings in August. According to the obtained results of understudied period, maximum thermal comfort was achieved for April and June for indoor and outdoor at houses. However, in some cases, indoor houses share equal conditions with outdoor apartment buildings.

According to Table 2, maximum normal thermal comfort (N), within understudied period, was 43.75% for outdoor houses and indoor apartment buildings. In air circulation conditions (VN) for normal constructions, maximum thermal comfort condition obtained 18.75% for indoor apartment building and outdoor houses placed second. In conditions where comfort requires the type of construction for natural circulation, indoor apartment buildings provided the highest thermal comfort by 37.5%. In D conditions where thermal comfort is provided by humidifier, maximum comfort conditions is associated to outdoor houses by 12.5%. It seems that natural humidity meets this condition. (V') condition represents thermal comfort for buildings along circulation excluding indoor apartment buildings (0%).

Operative temperature method

In term of operative temperature method, April and June are situated at thermal comfort range. In July and August, understudied stations showed comfort conditions with 0.5-1.5 ms^{-1} wind. According to investigations and according to operative temperature method, the largest comfort ranges in July and August was obtained for outdoor and indoor apartment buildings mostly provided in spite of 0.5-1.5 ms^{-1} wind. It seems that within this month, this condition is supplied by desired ventilations.

Hedayatian and Goudarzi (2014) designed a climatic need calendar for indoors and urban spaces to evaluate thermal comfort or discomfort in Borujerd (cold climate). Clearly, a proper and healthy environment requires supplying human thermal needs at both a for mentioned; therefore, they obtained building's thermal and environmental needs using constructional ecological climate and Olga as mean of the 23 year statistical period. Then, climatic need calendar identified several primary principles of climatic designing priorities, in Borujerd city such as solar energy guidance in cold weather, building protection against sunlight in war seasons, and reducing the effect of cold winter winds on building heat dissipation, etc., To create comfortable and desired life condition and to secure the residents from adverse environmental and climatic conditions are of integral part of architecture and building. Construction professionals are increasingly becoming a ware of the fact that if land planning is accurately applied, it would be possible to reduce energy consumption low, even in highly unfavorable climates, through structure and construction shape, and external peripheral environment (Bahreyni *et al.*, 2002).

Thermal comfort condition for apartment buildings and houses in Bandar-e Anzali varies in term of regional climate. According to the aforementioned and regarding research findings, comfort conditions vary for outdoor and indoor at apartments and houses. Research hypothesis was tested according to research subject matter through using constructional bioclimatic method and operative temperature. Giwoni (1969) specified comfort zone and climatic ecologic conditions in relation to temperature and relative humidity. Bioclimatic conditions and constructional needs were obtained by mean maximum temperature and minimum relative humidity (Parvaneh *et al*., 2011).

There are many studies conducted on climate and its effects on human and constructions. There are many studies conducted on climate and its effects on human and constructions; within summer and winter, it exceeds bio-climate thermal range; whereas, at early spring and fall, in cold to warm (March) and warm to cold (November) transition months, Shiraz climate approaches to thermal comfort conditions. Overall, spring season, with unique human thermal comfort is regarded as the best season for environmental activities and tourism in Shiraz.

Bigdeli (2001), investigated different factors through comfort and examined thermal pressure and air pressure of various residents in several regions. Ramezani and Kianpour (2007), deduced that the best time for the tourists visiting understudied area is within war months (from April to the end of September and early Octobor). Further, up to a height of 1300 m around Masoule readily hosted ecotourism and sport activities.

Ramezani (2006), concluded that spring shows discomfort conditions; while, summer offers the highest comfort conditions at sea shore. In addition, maximum bioclimatic comfort in June, July and August exists by the seashores of Anzali and Langroud in Guilan.

CONCLUSION

As per bioclimatic constructional technique, greatest comfort condition is identified during April and May inside and outside of houses with regard to space. At times, inside of houses offers equivalent conditions with outside of apartments. In operative temperature technique, April and May are situated in comfort condition; and different positions in understudied stations indicated thermal comfort in June and July at wind speed 0.5 to1.5 ms^{-1}.

REFERENCES

Bahreyni H and Karimi K. 2002. Iran environmental planning for land development, A guideline to sustained local designing and planning. University of Tehran publication.

Bigdeli A. 2001. Climate function in regional planning focused on climate and comfort. Conference of research performance and achievements, Islamic Azad University of Rasht, Rasht, Iran.

Parvaneh B, Shahrokhvandi SM and Nazari SN. 1991. Climatic comfort condition in decades based on bioclimatic factors (Case study: Aligoudarz). *Environmental monitoring*, 4(140): 117-142.

Razjouyan M. 2009. Comfort by Architecture Compliant with Climate. *Shahid Beheshti University Press*, first edition, 285.

Ramezani B. 2006. Identifying bioclimatic condition areas of Gilan beaches. *Geographical Quarterly of Sarzamin*, 3(9): 1-14.

Ramezani B and Kianpour H. 2009. Human bioclimatic comfort in Masoule, Gilan. *Environmental Science and Technology*, 11(4): 45-58.

Management and Planning Organization of Iran (MPO) (webpage). Leveling Gilan towns. 2006 (as cited). http://www.mpogl.ir

BAndare Anzali Meteorological Organization (webpage). Statistics and announcements, 2009 (as cited in 2006). http://www.irimo.ir

Safaeipour M, Shabankari M and Taghavi S. 2013. Effective bioclimatic factors of human comfort evaluation (case study: Shiraz). *Geography and Environmental Planning*, 24(2): 119-125.

Safaeipour M and Taheri H. 2010. Studying the effect of climatic elements on urban architecture; case study: *Lali City*. 1(2): 103-116.

Tavili, A. 1991. Comprehensive History of Bandar Anzali. Moalef publication, 1st ed. 516 P.

Geographical dictionary of Bandar Anzali. 1998. Geographical organization publication, Ministry of Defense and Armed Forces Logistics.

Qobadiyan, V. 2003. Climate Designing. University of Tehran publication, 2nd ed. 637 P.

Qobadiyan V and Feyzmahdavi M. 1997. Climatic designing; theoretical basics and application of energy in building. University of Tehran publication, 2nd edition.

Kasmaei M. 2003. Architecture and cliamte. Khak publication.

Mohammadi, H. 2006. Applied meteorology. University of Tehran publication.

Mohammadi H, Saeidi A. 2008. Effective bioclimatic factors of human comfort evaluation; case study: Qom. 34(47): 73-86.

National Building Regulations. Office of national building regulations, Iran. 2006 (as cited in September 2006). From: http://www.bhrc.ac.ir/nbri

Molanezhad, M. 2015. Studying the relationship between climate and human comfort in urban area using nerve pressure index (case study: Tehran). Environmentalology, 4(1). 275-282.

Nourani M. 2004. Studying educational conditions along with climate. M.A. Thesis.

Hedayatian M and Goudarzi M. 2014. Climatic indoor and outdoor need calendar in cold climate (Case study: Broujerd). National Conference of Architecture and Sustained Urban Perspective.