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Analysis of climatic factors influencing the architecture in the city of Darab

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Abstract

Weather condition is one of the much effective factors in the principle of architecture and urbanization. So in this research long-term trend of effective climate elements in architecture of Darab city including mean of minimum temperature, temperature mean, mean of maximum temperature, minimum relative humidity, maximum relative humidity, relative humidity mean, wind speed and sun hours in monthly and annual scale during period of 1373 to 1390 are surveyed. First of all, climatic element trend was analyzed and modeled. Next, this element effect on the range of climatic comfort is surveyed on the basis of Oleg bioclimatic chart. Pearson correlation method was used for analyzing trend of climatic element and polynomial models were used for modeling of trend behavior. This research shows that temperature elements have significant rising trend at most months of year and wind and humidity elements have significant decreasing trend. Survey of climate comfort condition of Shiraz city shows that they are in daily conditions in only April month and in nightly conditions in July month in the range of comfort condition by using Oleg bioclimatic chart and in the rest days of year, lack of climate comfort conditions are in Shiraz city.Finally,regarding climate elements on architecture, some points are suggested about climatic design principles.

Key words: climate and architecture, climatic design, comfort, Oleg, Darab

Introduction

Climate design includes building coordination with its surrounding natural environment and utilization of natural resources located in the way that they made suitable environment for users [1].Actually, climate design refers to methods that its aim is to reduce costs of building heat and cold by using natural flows for making comfort in buildings. In all kind of weather, buildings which are built according to principles of climate design, reduce necessity of cooling and heating of mechanical building as minimum as possible and instead they use natural energy located in surrounding of building [2].Traditional architecture is based on limited building facility before detecting and oil extraction. In cold regions, the aim of building design was using more energy and in warm regions its aim is to energy execration after discovering and oil extraction, gradually traditional and old architecture replace nondescript houses and new buildings due to cheap energy and large income accruing lots of sale which have less adaptability with climate. In Iran, buildings consume 40 percent of whole energy and big cities such as Tehran.30 percent of pollutions accrue building not only did make buildings have good function based on climate against unfavorable factors but also they provide healthy human life environment. One of the important issues in discussion of building and habitable environment architecture consistent with climate is issue of warming them in cold season and cooling them in warm periods of year for reaching the range of warm human comfort. So by presenting special arrangements related to shape, window dimensions, construction materials and climate condition, we can provide maximum thrift for heat and cold of habitable environments, we should notice that building design is incomplete based on heating in winter season and if shedding is not considered for summer, this kind of design is also harmful. For a long time, most engineers and researchers focus on correlation of building design methods. In this relationship, we should notice that each building and constructions are designed and implemented in the way that have minimum relation of energy wastes.Actually,urban elements and their functions were and are always influenced by weather elements and factors. This influence is approximately unilateral before genesis of metropolises and big cities and then cities are influenced in climatic circumstances of surrounding space and make micro climate changes.[4].It is obvious that if we notice at climate elements in architecture, planning and design of building and observe them carefully, suitable biological conditions are provided. The importance of climate effect on architecture makes comprehensive studies. In this regard, various studies are done in and out of country. Gioni presented bioclimatic chart of building in sixty decade and Elgi presented humidity and heating conditions in relation with human needs and climate design in 1953 in a scientific way. He decided to draw bioclimatic chart (5). Sam and Chung (1997) did significant surveys for using climate elements in architecture design and building energy (6).Kefa (2004) analyzed climate element period of 25 years for Nicosia in Cyprus for providing general and suitable information for useable utilization from inactive sun energy in urban planning and building design by using Mahani table and calculated design strategies and presented them (7). (Toy and colleagues 2007) studied and determined bioclimatic comfort conditions in Erzurum city in three areas; rural, urban and forest urban area. They conclude that forest urban area has more adaptability with useable heating comfort index.Johnsson 2006 studied the geometric shape effect of city on exterior heating comfort in warm and dry climate of Morocco and they concluded that urban design should be done compactly in warm and dry climate to provide heating comfort conditions in city (9).in Iran various studies were done in the field of climate role in architecture and building and urban design. In most studies they pay attention to architecture survey consistent with climate in various climates of country. For an example, Kasmaii has done a comprehensive research about architecture conditions in various areas of Iran. He has determined various Iran climates for utilization in Housing and architecture by using 33 Sypnotic station of country and by using bioclimatic tables of building and he has presented 950 weather stations of country by using climatic information, first climatic zoning of Iran in relation with residential environment and by using Mahani methods (11, 10).Saligheh 1383 modeled housing consistent with climate in Chabehar city. He studied climatic elements such as temperature, raining, radiation direction, relative humidity and etc. in this research (12) and pay attention to mortal resources such as sun and wind in improving heating conditions. Faraj zadeh and his colleagues 1387 researched survey of architecture conformity of Sanandaj city buildings with its bioclimate in the way of Mahani. Their result shows that old texture of city has most adaptability with local climate and new texture has least adaptability (13).Hossin Abadi and his colleagues 1391 studied climatic design principles of housing buildings of Shiraz city with emphasis on building orientation and shedding depth. They determined the best placement direction of building in cold and warm seasons and they also concluded that the best shedding depth is 0, 26 meter for having a window of one meter height for south barriers. Ataii and Fanaii (1392) surveyed the effect of climatic trend in architecture and habitations of Isfahan cities and the results was that during studied course, temperature elements have rising trend and windy and humid elements have decreasing trend. This study aims at surveying climatic elements of effective trend on Darab city architecture and their role and effects in sustainable architecture.

Data and methods

In this research, monthly and annual data of effective climatic elements in architecture including temperature mean, maximum temperature, minimum temperature, relative humidity mean, maximum relative humidity, minimum relative humidity, raining, wind and sun hours of Darab city were used during statistic periods of 18 years i.e. time periods 1370 to 1390.firstly data were controlled in a quality way. Then Pearson correlation coefficient were applied for identifying and estimating trend amount and polynomial models were used for modeling trend behavior. Finally, by using Oleg bioclimatic chart, comfort conditions were determined in Darab city in daily and nightly circumstance. The most common index of trend disclosure is Pearson correlation coefficient of torque between one variable or its indices (F) and time (t) as following:

Relation1

$$r_{Ft} = \frac{\sum_{i=1}^{n}(t_i - \bar{t})(F_i - \overline{F})}{\sqrt{\sum_{i=1}^{n}(t_i - \bar{t})^2 \sum_{i=1}^{n}(F_i - \overline{F})^2}}$$

When time (t) and analog amounts (F is amounts of each climatic observations) change together, the highest possible coefficient (t number index) and absolute and positive correlation coefficient accrued between variables. Correlation coefficient (-1) represents absolute and negative relation. If correlation coefficient of time and index is zero, it is told that two variables are uncorrelated. For presenting image of Time-series behavior, climatic elements in monthly and annual scale are exposed at modeling in polynomial family till trend kind and line slope degree are determined. It is determined in modeling in polynomial family which one of linear or parabolic models or other models are the most elegant model for trend index. One polynomial model is defined as following:

Relation (2)

$$Yt = \beta_0 + \beta_1 + \beta_2 t^2 + \ldots + \beta_k t^k + e_t$$

Yt variable of β answer is passive parameters and e?? is remnant (t=1,2,…,n) are supposed in normal regression that e? is trail of dependent normal random variable with the hope of zero math and fixed variance ?. Linear and parabolic models are respectively corresponding to K=2, K=1.

Discussion

In order to survey climatic conditions of Darab city, climatic elements of temperature mean, maximum temperature, minimum temperature, relative humidity mean, maximum relative humidity, minimum relative humidity, raining, wind and sun hours of Darab city are analyzed during 18 year statistic period at annual and monthly time scale for sustainable architecture. Table 1 shows the results from trend calculations of effective climatic elements in Darab city architecture by means of Pearson correlation coefficient. As observed in Table, climatic element of minimum temperature mean (nightly temperature) has significant trend in all months of year and in monthly scale even in some warm months of year such as April, June, July, and August. This significance is stabilized at 95 percent of assuring level. An important point about minimum temperature mean is nightly temperature which has significant increasing trend in all months of year and annual scale. Third column of table 1 shows trend amount of maximum annual and monthly temperature mean (daily temperature).On this basis, winter has decreasing trend that sometimes doesn’t have significance but in warm months of year such as April ,May, June, July, August and September, trend of daily temperature of Darab is significant and increasing and fixed trend is observed in the rest of year months. Furthermore, maximum annual temperature mean has experienced significant increasing trend.

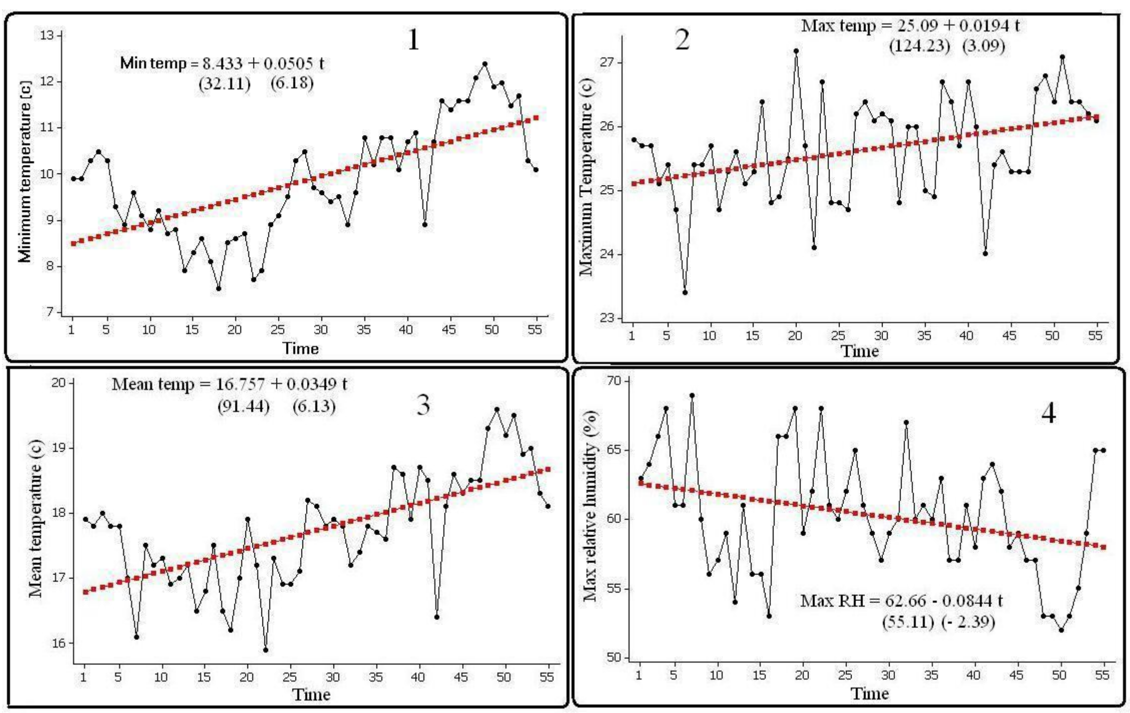
Table1 monthly and annual results of Pearson correlation coefficient for climatic elements of Darab

	Minimum temperature mean	Maximum temperature mean	Temperature mean	Number of sun hours	Maximum humidity	Humidity mean	Minimum humidity	Wind speed
January	*0.268	-0.025	0.135	-0.066	-0.186	*-0.305	*-0.322	-0.196
February	*0.327	-0.017	0.155	0.052	-0.263	*-0.344	*-0.390	-0.081
March	*0.455	-0.005	0.203	-0.042	0.165	*-0.270	*-0.363	-0.090
April	*0.655	*0.264	*0.486	*0.310	*-0.318	*-0.384	*-0.429	-0.015
May	*0.589	*0.290	*0.502	0.179	*-0.493	*-0.592	*-0.648	0.090
June	*0.633	*0.484	*0.682	0.023	*-0.345	*-0.494	*-0.547	-0.083
July	*0.607	*0.525	*0.629	-0.042	-0.169	-0.213	*-0.268	-0.101
August	*0.735	*0.503	*0.686	0.213	-0.166	-0.187	*-0.305	-0.156
September	*0.469	*0.394	*0.480	-0.283	0.022	-0.170	*-0.383	-0.251
October	*0.529	0.179	*0.523	-0.097	-0.072	-0.179	*-0.331	*-0.302
November	*0.515	0.103	*0.459	-0.052	-0.021	-0.080	-0.144	*-0.363
December	*0.406	0.203	*0.421	-0.124	-0.139	-0.213	*-0.309	*-0.306
Yearly	*0.630	*0.411	*0.647	0.028	*-0.312	*-0.453	*-0.590	*-0.445

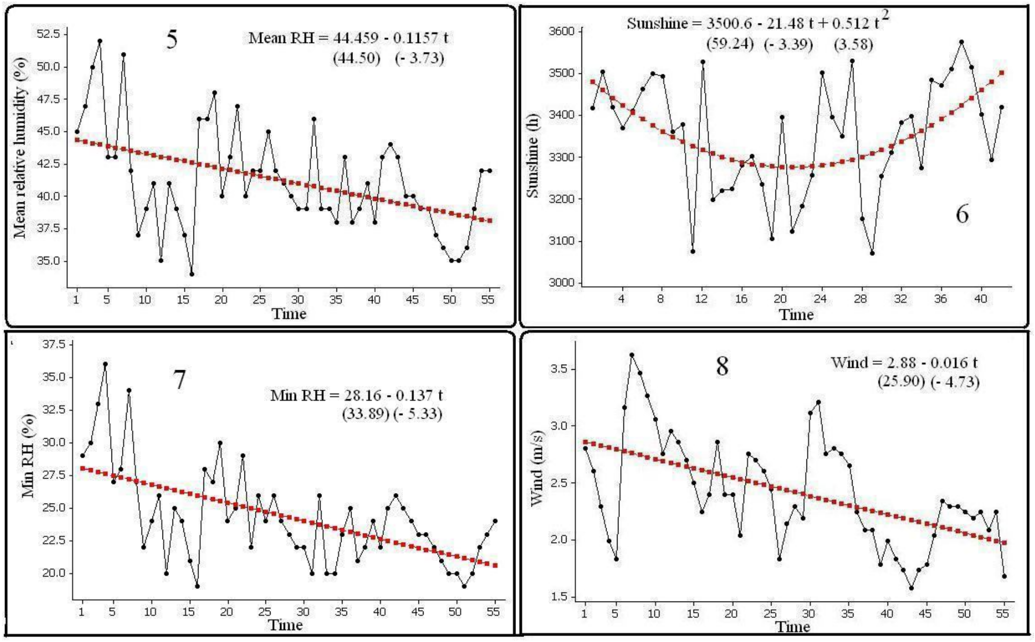
***Significance at 95 percent of assuring level**

Monthly and annual temperature mean which has lack of significant trend except cold season of year, shows significant increasing trend in the rest of months of year. Noticing that temperature is most effective elements in the field of climatic comfort and design, significant increase is much important in most months of year especially warm area such as Darab and it needs to be noticed that we point at them in continuation. Element of sun hours number has increasing rising trend only at April (Farvardin) and no significant trend is seen in the rest of months of year.

Humidity elements show decreasing trend approximately in all months of year especially in annual scale and minimum relative humidity mean in all months of year except November which has been significant. This suggests dryness increase in Darab weather that necessity of attention to this element in architecture designs is essential by noticing at the role of this element at climatic comfort and bioclimatic chart. Wind speed mean has decreasing trend in all months of year and yearly that this decreasing trend is significant in October, November and December months (autumn) and yearly. So during recent 18 year period, Darab city weather is warmer and dryer. Shape 1 and 2 show annual trend modeling of studied climatic elements for Darab city in polynomial way. It is determined in polynomial model which one of the linear, parabolic or sinusoidal (wave) models have better fitting on data. Fitting models are brought on each climatic element at shape 1 and 2 along with their Time-series chart. Criteria of significant parameters and finally significance of studied model is t-student statistics which amount of this statistics is brought below each parameter model and within parenthesis. If absolute valve of statistics t is more or equal to 1.96, we will judge at assuring level of 95 percent that the parameter has significant presence in model. For an example, in shape 1 chart 1, Time-series chart, minimum temperature mean, linear model has better fitting.On this variable. As observed in this chart, linear trend model of minimum Darab temperature (nightly temperature) is increasing. On the other hand, noticing that statistic amount t is more than 1.96 for this model.so linear model is significant. On this basis, noticing that line slope is about 0.05, we can say that minimum nightly temperature mean of Darab shows increase of 0.05 centigrade degrees for each year. Studied statistic period is more than 2 decades. We could conclude that nightly Darab temperature has increased during these two decades approximately 2.5 centigrade averagely. Shape 1 chart number3 shows linear trend of maximum Darab temperature mean (daily temperature).This variable has also significant increasing linear trend and daily temperature of Shiraz has increased 2220 centigrade for each year. Respectively Shape 0 chart 3 shows annual temperature mean that this temperature element has also increasing trend about 0.03 degree in a year. Chart number 4 retells linear trend of maximum relative humidity that absolute value amount t is more than 1.96.So this model parameters have significant presence and decrease maximum relative humidity about 0.08 percent each year. In shape 2, other charts are observed from climatic elements of Darab. In this shape chart 5 Time-series shows annual mean of Darab relative humidity. This important climatic variable has significant decreasing trend that this decrease is about 0.12 percent for each year. Minimum relative humidity mean has a significant decreasing trend that this decrease is about 0.14 percent for each ear averagely(shape 2 chart 1).Sun hours mean has significant non-linear and parabolic model that shows noticeable increase of recent decades (shape 2 chart 6).Finally chart 8 is annual mean of wind speed that this effective element at climatic comfort has significant decrease during studied statistics period in the way that wind speed has decreased about 0.02 meter per second for each year.



Shape 1: Trend modeling of climatic elements of Darab



Shape 2: Trend modeling of climatic elements of Darab

Climatic design principles

Climatic design is the way for comprehensive decreasing of building energy and first defensive line against climatic factors out of building. In all types of weather, buildings which are designed according to climatic principles reduce necessity of mechanical heating and cooling as least as possible and instead they consume natural energy located in surrounding building. So noticing at climatic factors of every region and long-term behavior, some changes are essential. Darab city has specific environmental conditions due to warm and dry weather (Kasmaii, 1387) and comprehensive planning necessity makes such climate. Shape 3 bioclimatic chart which is known to oleg chart, shows Darab city. In this chart, oval curve into the shape is region range of Iran climatic comfort. On basis of this shape, range of comfort region is between 21.5 to 29 degree in summer and between 20 to 25.7 centigrade degree in winter. Relative humidity range of weather is supposed between 30 to 56 in two seasons (Mohammadi, 1389).In this chart, numbers into the circle shows Darab daily conditions that includes maximum temperature mean and minimum monthly relative humidity. For an example, number 1 January, number2 February and etc. Members into square are nightly conditions of Darab which includes minimum temperature and maximum monthly relative humidity. As observed in shape, climatic comfort region is in center of chart. This point is where temperature amount is not much and humidity amount is middle. So it is a comfort region. Temperature is more toward up side and naturally it becomes dire and unfavorable conditions. Relative humidity has increased toward right side and weather becomes humid and unfavorable. So in up parts of right side where temperature and relative humidity is high, there are unfavorable conditions and in this chart, this region is determined namely very warm and humid and hot and heat exhaustion. Temperature is less downwards and cooling becomes a negative factor in comfort, subsequently relative humidity is decreased toward left side and weather becomes dryer and in conclusion, satisfaction amount becomes less.so below regions of left side is cold and dry and have unfavorable conditions. Up left side corner is warm and dry regions and below right side corner is cold and humid regions. Remaining points form relative comfort regions. There are wind speed lines in up section of comfort region which shows comfort humidity against wind and humidity. On basis of this chart, it lies on comfort circumstance in daily conditions only in April (Farvardin: number4). January, February, March, November and December are out of comfort range because of lying on comfort region below. Cooling is a negative factor of comfort in these months and for its compensation it needs 12.5 kilo calories at sun energy hour approximately 2 degree temperature increase which should be compensated through radiation or heat. They are located in the rest of year months i.e. May, June, July, August, September, October in up and left side of chart. This section of chart has warm and dry conditions and for this reason it is out of comfort region range. Warm and dry weather is a negative comfort factor in these regions. So we can make up for increase of temperature and humidity deficiency by increasing humidity and expanding comfort region range. It lies on comfort conditions in nightly conditions only in July month and there were close to comfort region in June and August and they have favorable conditions. The rest of year months is below comfort range. From this point view of temperature, they need mechanical heat for compensation. This need is intensive for months of January, February and December. An important point about climatic comfort condition is the effective role of temperature and humidity at expanding comfort region toward wind in Darab. Both wind and humidity elements show decreasing trend which is significant in some months. So the range of comfort region is decreased by noticing at long-term trend of climatic elements and more months have unfavorable conditions.

Conclusion

Weather is the most important environmental factors which has effective role in climatic design of building and urbanization. Building climatic design is in the way that its aim is to reduce building heat and cooling costs and to use environmental natural energies for making comfort in buildings. For achieving this goal, trend of effective climatic elements are surveyed in architecture including minimum temperature mean, temperature mean, maximum temperature mean, minimum relative humidity, maximum relative humidity, relative humidity mean, wind speed and sun hours in monthly and annual scale during 1373 to 1390.As a result, the role of each climatic factors are analyzed in climatic design and architecture. Results from trend analysis show that temperature factors of Darab have significant increasing trend in the way that minimum temperature mean has experienced significant increasing trend in all months and in the annual scale. Furthermore, maximum temperature mean and annual mean have increasing trend in warm months of year and annual scale. Survey of Darab bioclimatic chart shows that there is a lack of comfort conditions in the rest of year months except April in daily conditions and July in nightly conditions which have comfort conditions. Nightly comfort conditions are obtained from effect of nightly temperature (minimum mean) and on the other hand, by noticing at increasing trend of this element in all months of year, it is expected that nightly comfort conditions have improved in all months in future and it becomes close to the range of comfort region. Daily comfort conditions are out of comfort range in warm months in Darab and existence of significant increasing trend shows to worse daily climatic comfort circumstance of Darab in future and receding these months from comfort range. Trend survey of relative humidity suggests significant decrease of this element in most months of year in the way that minimum relative humidity mean has significant decrease in all months except November. As said minimum humidity mean is out of the effective elements in climatic comfort of daily conditions. Significant decrease of this element replaces with spatial distribution of transmittance year months from point view of daily conditions toward left side of comfort range and decrease occurrence intensity of a lack of climatic comfort. By noticing at up and left side of bioclimatic chart, humidity expands the range of comfort region, significant decrease of this element suggests daily comfort conditions has worsen from this circumstance in future and it leads to more distance from comfort range. Another element is wind in climatic comfort which decreasing trend has occurred in all months of year that is not significant in most months. Of course, Comfort region range in Darab is in the way that less wind can make comfort region expand. Generally, it can be said that temperature is one of the most important and effective climatic parameter in urban and climatic design and it is better that building establishment is in direction of minimum sun radiation in warm weather because of significant increasing trend in Darab. Main parts of building are opened to spaces located in shedding. It is tried that windows are built in small dimensions and in direction backward the sun radiation. Finally, exterior surfaces of building and constructions are predicted clearly.

References

1. Kasmaii.Morteza"climate and architecture of Khuzestan, publication of research Centre of building and housing", 1396.
2. Mohammadi. Hossein" applied weather", Tehran university publication, 1389.
4. Ataii.Hoshmand and Razieh Fanaii" climatic trend effect on architecture and urban habitants, case studies: Isfahan cities", second congress of national climate, building and utilization of energy consuming, 21 and 22 of Ordibehesht, Isfahan, 1392.
5. Kasmaii.Morteza, "climate and architecture", publication of Iran housing investing company,1387.
10. Kasmaii.Morteza,"guidance of climatic design and center of researches, building and housing", Department of housing and urbanization, Tehran, 1368.
11. Kasmaii.Morteza, Iran climatic zoning, housing and residential environment", Centre of researches of housing building, Department of housing and urbanization, 1372.
12. saligheh.Mohammad," housing modeling consistent with climate for Chabehar, geography and development magazine, P 147-170,1383.
13. Faraj zadeh asl. Manoochehr, Ghorbani, Ahmad, Lahkari, Hassan" adaptability survey of architecture of Sanandaj buildings with its bioclimatic conditions in Mahani way" Teacher journal of human sciences, number 2,P 161-180,1387.
14. Hossein Abadi, Saeeid, Lashkeri, Hassan, Salmani moghadam, Mohammad," climatic design of Sabzevar residential buildings with emphasis on building orientation and shedding depth", Geography and development, number 27,P 103-116,1391.
16.Asakereh, hossein, Kheradmand nia,Manoochehr,"modeling for middle monthly heating degree(case study: middle modeling of monthly heating degree of Jask", Nivar, number 46 and 47,P 41-54,1381.
[3].Hyde R, Bioclimatic Housing; Innovative Designs for Warm Climate, EARTHSCAN, London, 2008
[6].Sam. C.M, Chung, K.P: Climatic data for building energy design in Hong Kong and mainland China, in proc; of the CIBSE national Conference 1997, London, 1997.
[7].Kefa R; Development of energy - efficient passive solar building design in Nicosia Cyprus; Development of physics, Eastern Mediterranean University, Gazimagusa, North Cyorus, Via Mersinlo,Turkey,2004.
[8].Toy s ,Yilmaz S, Yilmaz h; Determination of bioclimatic comfort in three different land uses in the city of Erzurum, Turkey; Building and Environment,Vol.42,2007.
[9].Johansson E, Influence of urban Geometry on outdoor Thermal comfort in a Hot Dry Climate: A Study in Fez, Norocco, Building and Environment 41(2006) 1326-1338.
[15].Weisberg. (2005): Applied linear regression. Wiley Interscience. John Wiley and sons.Inc., Publication New Jersey.