Function of Shanashir in Hot Humid Climate Case Study: Boushehr

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***Abstract*—Iranian vernacular architecture has been formed in accordance with climate features. Among the climate factors, the wind plays an important role in creating thermal comfort in residential buildings. One of the architectural elements that have been formed in concordance with the flow of local winds, in hot and humid climate of Iran, is "*Shanashir*". *Shanashir* is a semi-open space that is attached to the external wall of the building construction like a tape balcony. The objective of this research is to study the performance of *SHANASHIR* on conducting and the effectiveness of the flow of winds on mitigation of thermal state inside the residential buildings and consequently thermal comfort of their residents. In response to the above objective this paper using simulation program (Fluent software) is going to find the effectiveness of *Shanashir* in adjusting wind speed and consequently indoor thermal comfort condition. An analytical method has been employed, based on measurement of wind speed in the neighborhood and back side of SHANASHIR and rooms attached to this element to compare changes in wind speed in residential areas.**

***Index Terms*—shanashir, thermal performance**

I INTRODUCTION

Conditions of the wind in town, especially in the streets, have direct effects on human thermal comfort, energy (heating and cooling) consumption and also concentration of air pollution. In addition, conditions of the wind can decrease the pressures due to the heat at high temperatures and the creation of heat island will be postponed if the speed of town winds increases.

Shanashir is a half-open space that door was connected to the outer wall of the building as a strip trace that can be assumed as the effort of private spaces in order to reach the optimum usage of wind flow of public spaces of the texture. In the other words we can say Shanashir has provided continuous interconnectedness of private and public space to use wind and this climatic performance joins the public life to the private one. Fig. 1 shows a sample of Shanashir in residential buildings of Booshehr[1].

Latticed walls has made the flow of breeze possible without the inside space being seen from the outside. Also it has been a good barrier for direct sunlight. Some of the shutters are movable and opens through outside. Shanashir has been constructed in 2 types of roofed and unroofed that in roofed ones, the cover leans on the low-diameter 4-cutted columns. Woody cover is placed continuously on the whole of it or non-continuous just on openings of the room. Dimensions of Shanashir is ranged from 2~3 meters to about 20 meters. Shanashir is made with 1~2 outer façade and 1~4 inner façade. Using 4-cutted woods, beautiful woody and metal fence, active woody and metal shutters and GOLPAs beneath that, has given it a special beauty[2].

As hot and humid regions need suitable wind flow the most to reach thermal comfort, in the current paper we investigate the effect of Shanashir as a method of climatic design in Iran in order to utilize the wind flow in Booshehr[3].

Figure 1. Sample of use Shanashir in a Boushehr house

Shanashir utilization in traditional architecture is mentioned as follows[4]:

A. Breeze and pleasant winds utilization: Shanashir is a place for utilizing breeze and pleasant winds that leads to direct access to the public space from the private one.
B. Privacy: Shanashir creates the possibility of watching daily activity in public places of town without abolishing the privacy of the space; also it makes the contact between rooms through outside possible.

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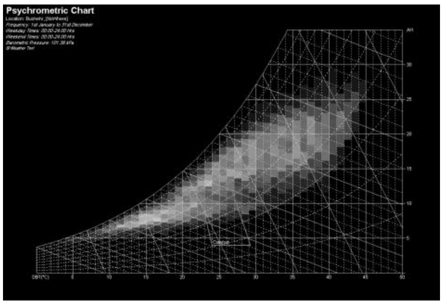
C. Utilizing shadow and blocking direct sunshine: Shanashir is assumed as an appropriate barrier of direct sunshine.
D. Visual diversity: using Shanashir causes texture diversity in façade.

Constraints of using Shanashir in Booshehr in the past were being spoilt and unstable as exposed to humidity and ants; however these days this problem has been solved by processing wood in the building.

II CLIMATIC CONDITIONS OF BOOSHEHR

Totally the border of Persian Gulf is really hot in summer and moderate in winter. In summer the sky is free of clouds but in winter the weather is cold and stormy. The blast of wind on sea surface is low or normal; but in some specific times especially in winter and spring the wind flows vehemently (9.9 m/s). Severe wind flows hardly ever in most months of the year; but in DEY the rate of occurrence increases that include a part of the month. Fog is hardly ever seen but dust is seen within the coastline in a way that sometimes scope of view decreases to less than 1 Km near to the beach due to the severe tornado and dust. In these regions the maximum of temperature is 35~40 °C and the maximum of humidity is %80. (Diagram 1)

Diagram 1-comfort zone in Boushehr city



A. Effective Winds in Booshehr

Winds of Persian Gulf that mostly flows from west to north all over the year and is known as “north wind” among local people include 6 types[2]:

a) Southeastern wind: mostly hot and humid that sometimes occurs with cloudy weather.
b) Coastal wind: gradually affected by coastal factors. Basically the difference between earth and sea causes the flow of a coastal breezeduring the day and land breeze during the night.
c) North wind (northwest and west): usually flows from north and northwest by 270~360 degree and parallel to the north coast of Persian Gulf and Omman Sea to the south and southeast.
d) Northeastern wind: usually flows from northeast to southeast and the known effect is that high pressure of Asian anti-silicon is created. We can mention periodic flow in a short time as one of its sensible features.
e) Arc wind: this wind affects from the east to the southeast of northern coast of Persian Gulf and especially Omman Sea and is created caused by seasonal winds of Indian Ocean through the coasts of Iran.
f) Southern winds: they flow at special times of the year and have a high effect on the formation of tornados. They are mentioned as follows[5]:
    1) Chalim wind: flows from southwest to the coasts of Iran and causes tornados.
    2) Vakahi wind: flows from southeast in winter and makes the sea stormy.
    3) Heyroon wind: flows from southeast to east and its turbulence affect the coast less.

Finally because of the importance of both north western and south eastern winds that have highest flow among the others, both are assumed as dominant ones.

B. Wind Movement in Booshehr

Generally wind movement in the old texture of Booshehr is investigable in 3 levels[6]:

a) First level is the level of regional wind that hits the texture in collision with tall buildings. The first use of this wind is at roof.
b) The second level is the space of yard of buildings in higher floors than the ground.
c) The third level is open spaces at texture and crossings that affects human the most.

The body of public spaces forms in proportion with wind flow in a way that the old texture of Booshehr has the most openings to the outside. Openings form at different levels with different forms and affect the visual variety of urban spaces in addition to the climatic performance. In addition to the openings, special elements such as Shanashir and Tareme have been formed in the body of urban spaces in proportion with better use of shadow and wind.

C. Climatic Design Considerations Proportional with Wind Utilization in Booshehr[5]

The old texture of Booshehr is one of the interesting samples that have used the wind flow in order to provide thermal comfort in urban spaces and residential units as most as possible. This appropriate use of wind in the old texture of Booshehr can be seen from texture to structure.

The total space of the old texture of Booshehr forms as a mix of building lumps and open spaces between the buildings. These open spaces include crossings and local open spaces (that sometimes become the center of district). The space of the yard of houses creates a balanced mix of lump and space in combination with these open spaces in this texture. Crossings have the role of conducting wind flow to the inside of the house and open spaces have the role of distributing the flow at the crossings that are far from the sea. Residential blocks are formed as small single-house or multi-house blocks with transverse crossings in surrounding in order to provide the maximum flow around the lumps.

III SIMULATOR

“Fluent” is a software like the others that have been used in academic researches for investigating the manner of air flow inside the buildings. One of the important features of this software is that it can measure the wind flow speed at the desired points of the designer. So designer is able to measure the wind flow speed at any point and revise the comfort feeling based on the needed speed for ventilation.

Additionally Fluent is one of the strongest computational software for simulating fluid flow and heat transfer in complicated geometries.

So Fluent 6.3 has been used in this paper for calculating wind speed at two sides of Shanashir and also various distances of residential spaces from Shanashir.

A. Sample

Traditional residential architecture in Booshehr includes two northern and southern parts. The northern part possesses Shanashir at all spots.

Investigation of all the houses is out of scope of this paper. One of the houses that have the features of the other ones will be discussed as a sample.

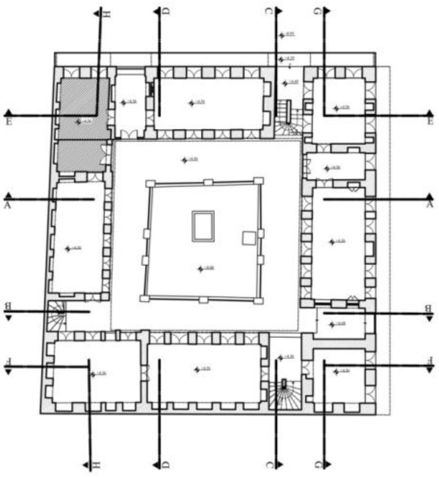


Figure 2. Simular house plan[7]

In order to analyze wind speed, it has been dedicated to the simulation of one of the rooms of a residential house in Booshehr. Fig. 2 shows the residential house plan. The hatched part is the simulated room in Fluent. View and the cut related to the simulated Shanashir are shown in Fig. 3.

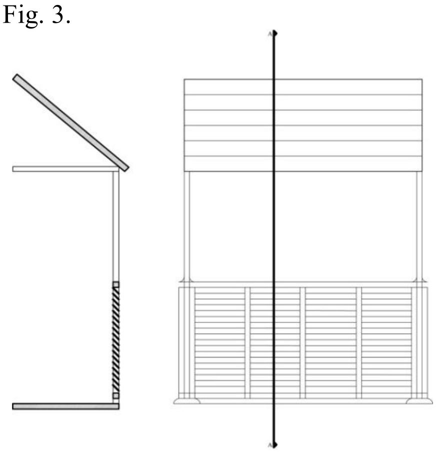


Figure 3. Shanashir elevation & section

In Table I the input data of air flow simulation in Fluent are given including climatic data of Booshehr, geometry of the room and geometry and dimensions of Shanashir.

TABLE I. CHART 1-DATAS

CLIMATE DATA OF BOUSHEHR	
m/s 9.9	Wind speed of area
ROOM SIZE	
660 cm	length
345 cm	width
370 cm	hight
100 cm	Balcony width
210*115 cm	Window size
SHANASHIR SIZE	
10 cm	Fence tickness
45	Blind slope
115 cm	Blind hight

B. Analysis Of Simulator

3-4 Analytical compare of variations of wind flow in coordinate axis between a space having Shanashir and a one without Shanashir.

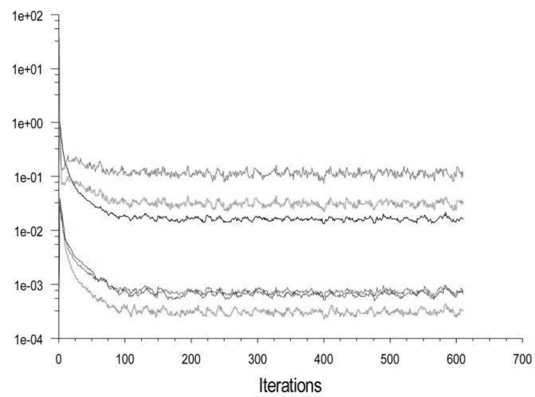


Figure 4. Room with Shanashir

Fig. 4 & Fig. 5 show variations of air flow in x, y, z coordinate axis in a space using Shanashir compared with a one without Shanashir. The range of wind speed in order to provide comfort feeling is 2m/s based on the standards.

C. Comparing Variations of Air Flow In X Axis

Wind flow is equal in the space using Shanashir with the one without it up to the 200th point through the width of the room (x axis). But after that, wind flow speed is lower about 0.005m/s in the space using Shanashir that this difference is negligible.

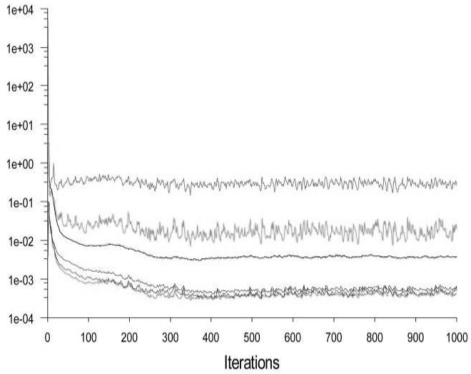


Figure 5. Room without Shanashir

D. Comparing Variations of Air Flow in Z Axis

As it can be seen in the Fig, using Shanashir causes the increase of wind speed in z axis (height of the room) up to 300th point and after that we observe a wind flow with constant speed. As an example, speed of the wind in 100th point in the space possessing Shanashir is two times bigger than the other space.

E. Comparing Variations of Air Flow in Y Axis

Usage of Shanashir has caused the speed of the wind in y axis in the space possessing Shanashir to be bigger than the other one up to the 250th point in a way that at the 100th point, the wind flow in the space mentioned is 2 times bigger than the other one. After that we observe a uniform air flow. (0.94 m/s in the space using Shanashir and 0.47 m/s in the other one at 100th point)

By investigating climatic conditions of Booshehr, it was determined that in this region, utilizing the maximum air flow has been assumed as one of the most important priorities of a design proportional with the climate in the past. Results of the wind speed simulation in this region in spaces having Shanashir and the ones without that, shows that the variation of wind speed in x, y, z coordinates is notable and most of the difference occurs at the points nearer to the Shanashir; in a way that air flow speed at 100th point of the simulated room possessing Shanashir is two times bigger than the other space in y and z directions; but no sensible variation is observed in x axis.

IV CONCLUSION

Based on the investigations, it is clear now that we can use Shanashir in modern architecture as the best element for correcting and changing the wind speed in order to decrease humidity and reach the comfort feeling in people in different spaces by considering climatic conditions of the region and humidity level; while today not enough attention is drawn to that.

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