Evaluating Climate and Climatic Factors (wind) at Residential Areas A case study: Rasht

Bashir Beigbabaei
Ajabshir Branch, Islamic Azad University, Ajabshir, Iran.

ARTICLE INFO

Article history:
Received 19 September 2013
Received in revised form 22 November 2013
Accepted 24 November 2013
Available online 6 January 2014

Key words:
Potentiometry, Wind power, Airflow, Natural ventilation, Gilan, Rasht

ABSTRACT

Background: Extensive need of human to energy resources and his endeavor to access unending energy resources were always regarded as one of the most essential problems of human life and his inveterate willing. Human consistently look for applying of energy in industries. He used wind power to move sailboats and windmills. At present, it seems necessary to deal with wind power considering the above-mentioned cases and its economical justifiability in comparison with other modern energies.

Objective: The purpose of this study was evaluating climate and climatic factors (wind) at residential areas (Rasht).

Results: Natural ventilation is one of the best and most inexpensive ventilation methods realized through creating indoor natural air. In traditional architecture, natural ventilation was regarded as one of the most important parts of buildings design. Nowadays, optimal use of wind power is extremely underestimated due to density of adjacent buildings. Rasht is located in a humid climate. Since its humidity is about 100% almost all over the year, creating draught between buildings and their inside is of special importance. Considering importance of the subject, the present study deals with wind flow status of some residential blocks located at Golsar district of Rasht in order to offer approaches to optimally use airflow through evaluating indoor and outdoor draught. External and internal properties and campus effect are of important factors in evaluating these residential buildings.

Conclusion: The research uses field and documentary studies and provides some results about better productivity of the energy.

INTRODUCTION

Always, convenience was one of the most significant needs of human life. Human was provided by or deprived from convenience in different ways. However, building convenience is the most important problem in this regard. Convenient space is one of the noticeable factors to access it through creating a thermally-appropriate environment. Creating airflow in life zone will play an important role in convenience [1].

Since Rasht is a relatively humid city and it rains almost all over the year, it is really difficult to prevent from rain into buildings and create airflow by wind power inside of the buildings. Although direction of draught around buildings is considered, creating of indoor airflow is also of special importance. Since Rasht has been surrounded by forests, there is not usually any disturbing wind. Sometimes, there are disturbing winds, however, serving as dominant ones [2].

Methodology: Wind power: A renewable energy:

Wind power is an energy resulting from moving air. It is created by unequal heat of earth resulting from sun function. Earth absorbs sun radiation unequally since it has been consisted of lands and seas. When sun shines during day, air of lands become warm before than that of seas. Warm air of lands is recorded and ascended and is replaced by cooler and heavier air found on seas. The process creates local winds. When sun radiation unequally reaches uneven surfaces of earth, changes temperature and pressure and, therefore, creates wind [3].

Nature-compatible architecture:

Most architects believe that human should be released from complete dependency on heating and cooling mechanical devices through merging buildings and nature because:
1. There are limited fossil resources which are regarded as the main force of heating and cooling machines.
2. There are some secondary problems resulting from fossil resources including air pollution.
3. Nature-compatible life and use of natural compatibility of human with climate and environment are of special importance [4].

*Importance of nature-compatible architecture and its effect on modern global designs:*

Following industrial revolution, technological and economical growth, human found that fossil energy resources are not renewable and these valuable resources will terminate in a near future. Therefore, different specialized organizations were established in order to develop renewable technologies and lessen dependency on fossil energy resources.

At present, most designers are intended to use more natural energies in buildings design, like Wind Tower project in Vienna. While surrounded by propulsion effects of wind, this light tower serves as a sea umbrella moving at water stiff flow and along with the most intensive oscillations of wind flow [5].

*Different climatic conditions and optimal use of wind power:*

Considering season and type of climate, different climatic conditions variously affect convenience conditions. At local scale, availability of an ideal energy resource is more important than limiting undesirable forces. For instance, taking benefit of sun energy is more important than limiting wind power in a cold climate. Although design strategies may be used to limit wind power in a building scale, no strategy is left to use sun thermal energy in building if sun is not available [6].

Therefore, use of renewable wind energy in a temperate and humid climate like that of Gilan will be more effective at local scale.

*Natural properties and geographical location of the understudy area:*

Factors including land morphology, natural vegetation, and adjacency with urban residential areas, rural and natural environment provide valuable information about climatic condition of the understudy area and its effective factors, e.g. local winds.

Rasht is located at -8m altitude and its humidity reaches about 100% most of the year. Since Rasht has been surrounded by forests, there is not usually any disturbing wind in this region. However, airflow is very useful to lessen humidity especially through creating draught around buildings [7].

*Results:*

**Climatic divisions of Gilan:**

<table>
<thead>
<tr>
<th>Climate Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperate and humid</td>
<td>It includes all plain and low coastal areas of Gilan and its southern limit</td>
</tr>
<tr>
<td>Bahr El-Roumi weather</td>
<td>can be regarded as Sefidroud Delta plain peak</td>
</tr>
<tr>
<td>Cold forest temperate</td>
<td>It is special to mountainous areas with decrease of heat due to altitude. In</td>
</tr>
<tr>
<td>Sefidroud weather</td>
<td>this climate, mean temperature of the warmest and coldest months is less</td>
</tr>
<tr>
<td></td>
<td>than 10° and 3°, respectively. In mountainous areas of Gilan, more than</td>
</tr>
<tr>
<td></td>
<td>1500m of tail of Alborz and Talesh mountains is seen at southeastern and west.</td>
</tr>
<tr>
<td>Semi-desert weather</td>
<td>In Gilan, the weather is limited to very small section of Roudbar, around</td>
</tr>
<tr>
<td></td>
<td>Sefidroud dam, its western and eastern valleys, and areas such as Loushan,</td>
</tr>
<tr>
<td></td>
<td>Manjil, and Gilvan</td>
</tr>
</tbody>
</table>

*Factors affecting morphology and speed of indoor airflow:*

**Establishment direction**

In wind-exposed front of building, the maximum air pressure is created when building façade is perpendicular to wind blow direction. Maximum indoor airflow is created in the same conditions.

In an open environment, if buildings of a storey are arranged in a sequential network order, static air area of leeward of the first row will coincide with the second row. To supply appropriate airflow for the second row, a distance equal to 6 times of the building height is required.

If buildings are replaced in a checkered order, airflow range will be more equal and static air area is almost eliminated [8].

**Building location and site plan**

Arranging building in a linear order in site may create wind canals. However, potential of natural cooling will increase if buildings are arranged in a staircase order.

Buildings should be arranged with an irregular pattern in the site and long continuous paths and small open spaces between buildings at the direction of dominant wind should be prevented.

**External properties**

Arranging the buildings in site and replacement of buildings openings, it should be considered that building and its openings not arranged at the shadow of wind-exposed barriers. Disharmonious surfaces such as dispersed buildings, walls, and trees intensify wind speed.
External properties of buildings may automatically affect air pressure production. If airflow blows with a 45° angle to the building façade, a wing-like wall at the leeward end of the building or projection wing of a building may double wind pressure. The same effect may be created by wind-exposed projections of eaves. According to the it, most understudy houses have projections for the mentioned reasons and facilitate better direction of wind flow. In modern units where it has been underestimated, it has resulted in main problems.

Airflow and rain

More than natural ventilation, airflow focuses on lessening humidity. It seems that openings are opened less in most days. It can be attributed to rain and invasion of humidity inside the buildings.

It is not easy to simultaneously protect building against humidity and establish indoor airflow. When it rains and wind blows, opening windows leads to entrance of rain inside the building while closing them creates intolerable conditions.

1. Stiff wind and rain easily enters the building from upper part of louvers
2. Airflow is directed toward upper part of life zone [9]

Windows direction, sizes, and airflow patterns:

Indoor airflow depends on distribution of pressure around building, entrance direction, dimensions of openings, and inertia of outdoor peripheral air. Window direction is important considering equal distribution of air motion in space. When there is an axis between entrance and exit and when the entrance is perpendicular to the dominant wind direction, airflow is directly directed toward outdoors. It insignificantly affects other room spaces. When windows are located on opposite walls and dominant wind blows with a 45° angle of openings, higher speeds occur in the space.

Tests on square models indicated to wind shadows. Exact arrangement of openings and internal walls may modify the effect. In this case, the flow enters toward wind and continues its inward path such that pressure difference at the exit changes its direction [10].

Wind shadows

Division of internal space:

When an entering flow has to change its direction in a space, its inherent energy is significantly released. It occurs when width of a building is more than depth of its rooms. Every room should be ventilated in relation with other rooms.

1. Putting internal partitions at appropriate places, larger area of the space can be ventilated naturally or imposing some changes in airflow speed. It refers to wind flow in three types of houses found in the region considering division of internal space and openings [11].

Sometimes, oscillation of pressure (blow) is changed. It may be created due to putting an opening at leeward front without any air opening.

Plan and draught path:

Following behaviors are seen in most understudy plans. According to it, closing of the path by a barrier at the left side of the plan resulted in draught and wind flow circulation. Creating a small opening merely to make an indoor flow may lead to variations in indoor airflow pattern.

Wind behavior inside and around building

Control of openings:

Windows frame may direct airflow upward. Only hinged or rotatable axial frames may direct air downward. Projections may play a role through creating a pressure at upper part of windows. Therefore, pressure of lower part of the window directs airflow upward. Developing a gap and joint point of projection and building supplies pressure of the lower part and, therefore, directing of airflow toward life zone. In the understudy area, roof projection was always used to prevent from rain inside the buildings. It facilitates wind flow direction toward life zone.

Effect of roof projection and location of openings on directing of airflow toward life zone

Campus design and creating green space was always regarded as complementary part of residential design due to green nature of Gilan. In past, kinds of trees in different sizes were optimally used to direct airflow. Height, width, and density of campus elements may affect indoor airflow. According to the studies, leafage and brushes may serve as a barrier against airflow. Also, air speed under trees may significantly affect surrounding flows speed. Green space may affect airflow and plan design:

1. Direct effect of projection on plan
2. Creating of bevel in wind opposite angles to increase wind power productivity
3. Putting openings at draught location around building merely to direct wind inside
4. Using roof projection
5. Using appropriate partitioning and furniture
6. Arranging the building in a way that create airflow around the building
7. Putting entrance at posterior part of the plan

Discussion and Conclusion:

Similar to other renewable energy resources, wind power is geographically available as a widespread and dispersed energy. Wind power is naturally oscillating without any permanent blow. Prior to industrial revolution, the energy was widely used. At present, it has been replaced by fossil fuels. In a city like Rasht, buildings should have a path for wind circulation and airflow around the buildings. The factor of distance between building blocks is also considered to eliminate humidity [11]. According to the studies, factors affecting indoor airflow are not observed in modern buildings. For example, projections and recessions in some parts of buildings are not observed by residents. Practically, it resulted in less effective indoor wind flow. Objectives related to natural ventilation will be more realized considering distances to arrange buildings, appropriate location of openings, and possibility of airflow among blocks. The buildings should be arranged according to an irregular pattern in the site and long continuous paths and small open spaces between buildings and at the direction of dominant wind should be prevented. Southward buildings should be designed in a way that to be protected against wind without any changes in their solar energy receive. Buildings that are at the same height are more secure against wind [12].

REFERENCES