Climatic Design of Residential Building of Sabzevar with Emphasis on Building Orientation and Depth of Canopy

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Introduction
Considering the impact of climatic and environmental factors in creation of residential spaces is not a new debate. From the beginning, human has tried to create a favorable living place based on the temperature and climatic conditions of his living area. Also in terms of scientific and technical point of view, the climatic design or compatible architecture with the climate has been developed as a scientific debate for many years. The discussion of climatic design has two important aspects, creating better quality and thermal comfort in the buildings and saving fuel required for heating control of such building.

Therefore, it is required to determine design regulations based on the climatic conditions of that area. Considering the importance of the said subject, the goal of this article is to determine the proper direction and orientation of buildings and proper depth of the canopy for residential buildings of Sabzevar for achieving part of climatic design principles.

Research Methodology
The method used in this study is a combination of mathematical relations, models and bio-climatic indices. Firstly by using Givani building bio-climatic graph, the thermal requirements of the building, welfare borders, lack of requirement to sun and the priorities of climatic design for the under study city were determined. The data used for bio-climatic graph are the statistics related to climatic factors of medium, minimum and maximum temperature and medium, minimum and maximum relative humidity (monthly) of a 51 years period (1954 to up to 2005), gathered from climatologic station of Sabzevar.

After determining the thermal needs and the need for directing or preventing the sun light penetration, the amount of received energy in vertical walls of the buildings were calculated by using computation methods. Finally with respect to the angle and direction of the sun light in geographical latitude of the area, the most appropriate depth for canopy of the windows were also determined.
Discussion and Results

Each place has its own special climatic conditions and hence first it is necessary to identify thermal needs of the spaces for determining the design criteria including building orientation and depth of the canopy. Thus in this paper, by transferring the climatic data of Sabzevar city on the building bio-climatic graph, its most important thermal needs and priorities were determined. The most important priorities obtained from the city's Bio-climatic graph, include the followings:

1) To protect the building against the sun, during warm seasons
2) Using solar energy for heating the building during cold seasons.
3) Using daily temperature fluctuations
4) Decreasing the wind effects on building heat loss
5) Protect of building against outside warm air.
6) Provision of facilities for increasing humidity in the dry and hot seasons.

This study tries to realize the Priorities of 1, 2 and 4 (above) by determining the appropriate orientation of the building and depth of canopy.

The direction of the building is one of the most important factors in creating thermal comfort. In order to achieve climatic design goals, angle of the building place shall be determined with regard to the impacts of the two climatic factors of sunlight and wind direction.

In fact, if proper angle of the building be determined exactly, the three goals listed above may be achievable. Of course, in addition of choosing the proper direction, appropriate depth of canopies shall be determined for the windows.

Basically, building direction shall be so that it receives the highest energy in cold times and the lowest one in warm seasons.

The difference amount of energy in cold and warm times can be used for determining the best direction (energy of cold time minus warm times). If the result of this subtraction is a large number, it represents a more suitable building direction. Accordingly, 165 degrees (15 degrees east) are best direction for building.

In two sided buildings of the city, the best direction of the building settlement for receiving the solar energy is angle 15 degrees east.

In this case, one of faces is placed at angle +165 degrees and the other will be placed at 15 degree. Also the north - south direction has the second rank in terms of level of importance.

In the next step, for realization of another determined goal i.e. decreasing the effect of cold winter winds, the direction of winter winds was compared with the direction determined for sun light. The results of this study showed that the selected direction for sun radiation is appropriate also for wind.

Conclusions

In this study, determining the principles was considered for the design of residential buildings according to the environmental conditions. Therefore, firstly, the thermal and environment needs of buildings and the principles that should be considered in the design of buildings were determined. On this basis, items including directing solar energy during cold times, protecting buildings against the penetration of sunlight into the building in warm times and decreasing the effect of cold winds in loss of heat in buildings is one of the purposes and principles that should be considered in climatic design of buildings of Sabzevar. One of the solutions to achieve these goals is the proper orientation of building with respect to factors of wind, sun and determining proper depth of canopy. According to the recognized principles and priorities, main face or faces of building should be placed in the direction that receive less solar energy in warm times and more energy in cold times. Result of this
calculation was that direction 15 and 30 degrees east in one sided buildings and angle 15 degree east and north - south direction is the best placement angles in two sided building.

In the next step, for realization of another determined goal i.e. decreasing the effect of cold winter winds, the direction and angle of winter winds were compared with the direction determined for the sunshine. It concludes that the selected directions for sun are also suitable for wind. So that in case of choosing the said directions, winter winds will have less influence on the buildings.

Determination of proper depth of the canopy was another issue that was discussed in the paper. In this regard, the depth of canopy shall be determined so that decreases the arrival of sun in warm times and doesn’t prevent its penetrating into the building in cold times. Calculations illustrated that if there is a window with 1 meter elevation, depth of canopy should be 0.26 meter in south direction. Canopy depth increases with the increase of window elevation.

**Keywords**: residential building, direction of building, depth of canopy, climatic design, Sabzevar.

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