2014 1st International Congress on Environmental, Biotechnology, and Chemistry Engineering
IPCBEE vol.64 (2014) © (2014) IACSIT Press, Singapore
DOI: 10.7763/IPCBEE. 2014. V64. 16

Environmental Aspects of Housing: Case of Pune

Narkhede Parag Govardhan[1], Babita Gadbail[2]

[1]Adjunct Professor in Planning: Govt. College of Engineering, Pune, Maharashtra

[2]Assistant Professor, P. R. Patil College Of Architecture, Amravati, Maharashtra

Abstract. In recent years, metropolitan cities and areas are growing fast. Scarcity of land in urban areas has influenced housing to be developed with a single intention of achieving maximum possible usage of available land. In this process the environmental concern is many times overlooked and in turn the urban housing is proved to be less energy efficient. To overcome this problem it is necessary that we should have a policy and guidelines for implementing environmental aspects as an integral part of site planning and building design for housing. The paper is an attempt to survey the selected housing developments in Pune and to analyze the same leading to a set of guidelines to achieve energy efficient housing. Site planning, appropriate orientation of the buildings is the simple measures to achieve the goal.

Keywords: Housing, Orientation, Site Planning, Metro Cities, Environmental issues, Sun Path, Wind Rose

1. Introduction

Environment cannot be looked at as a secluded subject any more. The built environment is a major contributor to the environmental loads generated by society. Increasingly, the housing industry is focusing on the concept of sustainable development in the design and construction of housing. The term, "green building" is often used to describe housing that is more in balance with the environment. Thus, a typical study of environmental issues in housing, in the context of today, might encompass the following content: A global perspective on environmental issues, Energy management, Waste management, Water quality and conservation, and Hazardous substances. The impact on the environment what is used, taken away, or altered is equal to the upgrading what is replaced, preserved, or enhanced.

2. Pune's Climatic Zone

Pune city falls under moderate climatic zone. Pune (Latitude: 18.53 °N, Longitude: 73.85 °E, Elevation: 559 MASL). The climatic conditions in Pune are mostly warm.

Fig.1 Site Plan of Blue Ridge, Pune

3. Case Study Area: Blue Ridge, Pune

Blue Ridge is located in Hinjewadi. The total site area is 138 acre. The apartments have range of 1, 2, 3, 4 and 5 BHK apartments and duplexes set in 25-storey high towers. There are total 31 buildings of apartments. The multiplex and mall is in one building and height of building is 24.0 m. The school is an international school with height of 18.0 m. It has the 9-hole golf course. The river side is developed as an entertainment zone. It contain garden, play area, restaurant, etc.

4. Survey and Analysis

4.1 Study Approach

Mostly approaches used for the design at site level are generally water conservation design, energy efficient lighting, solar water heaters, Solid waste management, etc. But while designing at site level we need to consider two basic approaches i.e. sun and wind. After studying these two criteria, apply the analysis for the designing of guidelines.

4.2 Analysis Techniques for Site

The goal of these Analysis Techniques is to determine what potential benefits or problems may arise from the sun and wind on the site. So technique will be of three types:

1st :SUN		2nd : WIND		3rd :Overlap Of Sun And Wind
Sun dial	Sun path diagram	Wind rose	Adjustment	Micro-climate analysis

1st: Sun: The goal in the preliminary solar study is to figure out where solar heat gain is most extreme and the best way to mitigate it.

Performing the detailed analysis : The Solar Shadow is generated with Ecotect Analysis (Software), with its "Shadow" system, utilizing the longitude and latitude of the area, along with the particular date and times needed; and then together rendered a frame a minute for the full daylight period. The shadow assessment considers those shadows occurring between 3.0 hours after sunrise and 1.5 hours before sunset.

2nd: Wind: The goal of study is to understand the prevailing wind patterns of project site can be useful when it comes to designing ways to take advantage of natural ventilation or to screen occupants from uncomfortable windy conditions.

Performing the detailed analysis :. The Wind survey is generated with Autodesk Vasari Beta 2 (Software), with its "Wind Tunnel Analysis" system, utilizing the longitude and latitude of the area, along with the particular month and time needed.

3rd: Sun and Wind:

Micro-climate analysis : The technique helps to determine micro-climate on a site, using the weightings for climatic elements by climate and season.

Procedure:

1. Determine shadow patterns using sun-dial and site model to plot the shaded areas of the site for the time periods and critical months of the seasons, under consideration.
2. Determine wind flow patterns for the site with summer and winter directions.
3. Convert the site shadow and wind pattern drawing to grid-cell system. Give each climatic condition a different graphic representation.
4. Analysis

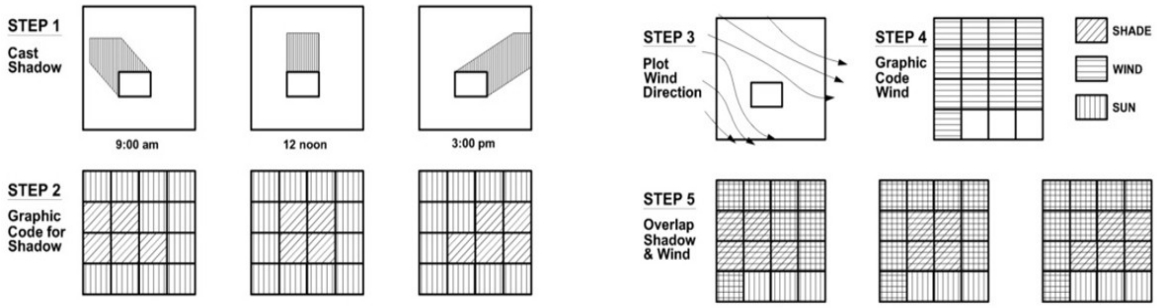

Fig 2: Analysis Procedure

4.3 Solar Survey

The solar analysis involves comparison of the survey finding and design principles, to understand the design implication on solar pattern. The solar survey analysis results are as following :-

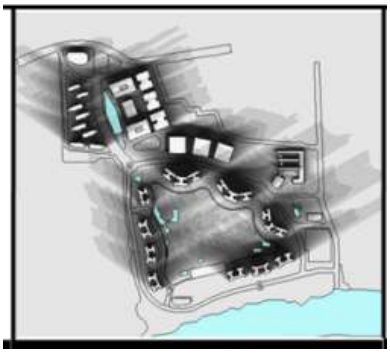

Fig 3: Solar Shading Plan

The result of survey conveys that the orientation of apartment T9 to T17 buildings is N-S and NE-SW (90 deg, 145 deg and 175 respectively to North), building height is 90.5 m. Therefore the road side i.e. NE side, which is a paved area, will be in shade throughout the year. While the other side i.e. SW side, will be exposed to heat of sun throughout the year. Due to this situation one side (SW side) of building will always get sunlight, but the other side (NE side) won't get direct sunlight.

The result of survey conveys that the orientation of studio apartment buildings is NW-SE (70 deg to North), building height is 90.7 m. and spacing between the buildings is 19.0 m. Therefore, the spaces between the studio apartment buildings are in shade in the month of January and November, while they are exposed to sun in May and August. This means that the studio apartment buildings will be in shade during winter season and exposed to heat of sun during summer season.

The result of survey conveys that the orientation of apartment T18 to T23 buildings is NW-NE (70 deg to North), building height is 90.5 m. and spacing between the buildings is 28.0 m. Therefore, the spaces between apartment T18 to T23 buildings are in shade in the month of May and August, while they are exposed to sun for little time in January and November. This means that the spaces between T18 to T23 buildings will be in shade during summer season and exposed to heat of sun during winter season. It is observed that, the present layout of these buildings complies with the design principles. Also, the spaces behind i.e. NW side, of apartment T18 to T23 buildings are in shade in the month of January and November while they are exposed to sun for little time in May and August.. This means that the spaces behind apartment buildings will be in shade during winter season, but partially exposed to heat of sun during summer season.

4.4 Wind Survey

The wind survey analysis involves comparison of the survey finding and design principles, to understand the design implication on wind rose. The wind survey analysis results are as following:

The result of survey conveys that the orientation of IT building, studio apartment buildings, apartment T3 to T6 buildings, apartment T18 to T23 buildings is 70 deg., 70 deg., 160 deg., 90 deg. to North; building height is 30.0 m., 90.7 m., 90.5 m., 90.5 m. respectively and spacing between the buildings is 14.5 m., 19.0 m., 40.0 m., 28.0 m. respectively. Therefore, the spaces over here are facing wind shadow throughout the year.

The result of survey conveys that the orientation of apartment T9 to T11 buildings is 90 deg to North, building height is 90.5 m. and spacing between buildings is 3.0 m. Therefore, the spaces from road side i.e. North side, are facing wind shadow in the month of January (morning), August (morning-evening), November (morning). This means that, the one side of buildings i.e. North side will be in shade during rainy season and winter season, while free wind movement is expected in summer season. While the other side of buildings i.e. South side will be in free wind movement during rainy season and winter season, while in wind shade during summer season.

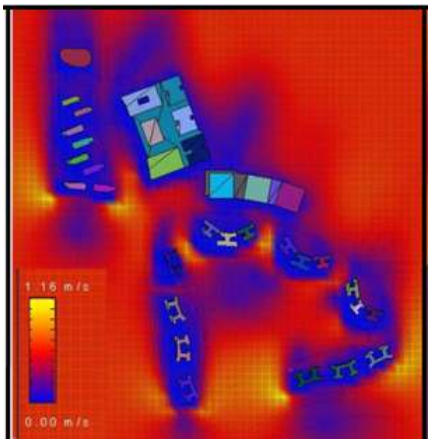

Fig 4: Wind Shading Plan

While few areas like river side and few area of golf course won't face high pressure or low pressure throughout the year.

The result of survey analysis (solar survey and wind survey) conveys:-

The result of survey analysis (solar survey and wind survey) conveys that the orientation of studio apartment buildings is NW-SE (70 deg to North), building height is 90.7 m. and spacing between the buildings is 19.0 m. Therefore, the buildings are exposed to heat of sun and shadow of wind, throughout the year. While it creates high pressure zone of wind for some period of time. The present layout of buildings contradicts the design principles.

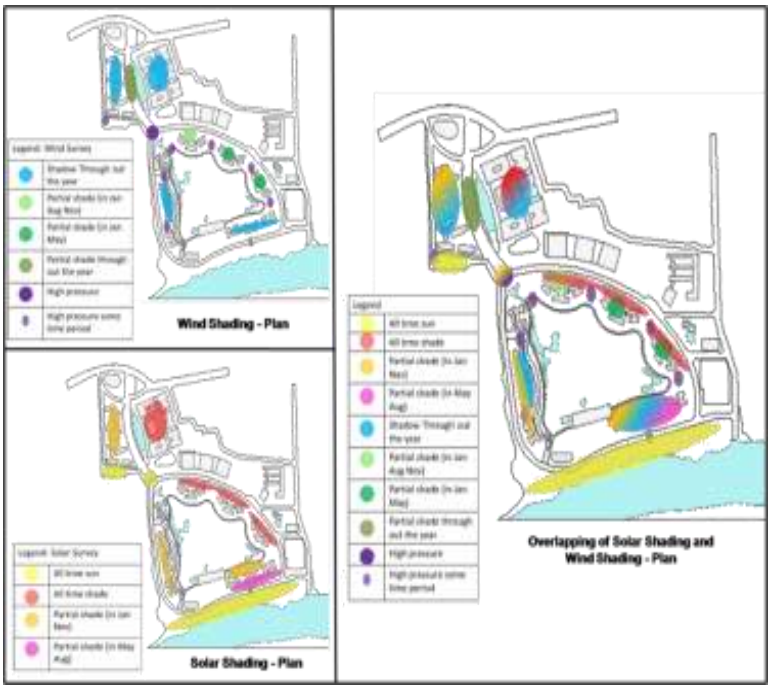

Fig 5: Overlap of Solar and Wind Shading Plan

The orientation of apartment T18 to T23 buildings is NW-NE (70 deg to North), building height is 90.5 m. and spacing between the buildings is 28.0 m. Therefore, the buildings are in partial solar shadow in summer season and wind shadow throughout the year. It is observed that, the present layout of buildings fulfills some design principles.

The orientation of apartment T9 to T17 buildings N-S and NE-SW (90 deg, 145 deg and 175 respectively to North), building height is 90.5 m. and spacing between the buildings is 3.0 m. and 60.0 m. Therefore, the buildings are in solar shadow throughout the year and partial wind shadow. The present layout of buildings contradicts the design principles.

The orientation of apartment T1 to T6 buildings 160 deg. to North, building height is 90.5 m. and spacing between the buildings is 40.0 m. Therefore, the buildings are exposed to heat of sun and wind shadow throughout the year. While it creates of high pressure zone of wind for some period of time. It is observed that, the present layout of buildings contradicts the design principles.

5. Conclusions

Site layout has a big impact on daylight, sunlight, and ventilation of buildings and the spaces around them. The main objective of this study is to understand environmental aspects for housing in urban planning to ensure good access to solar gain, daylight, and ventilation. Its aim is to enable to produce comfortable, energy-efficient building surrounded by pleasant outdoor spaces, within an urban context that minimizes energy consumption through orientation of building. The role that can be played by orientation of building, in the efforts to achieve development, without causing lasting environmental damage is the theme of this project. Street orientation and spacing between buildings were found to be important factors influencing temperature and urban microclimatic changes.

Conducting urban climate simulation studies in collaboration with urban planners and architects, to test effects of block layout alternatives, would improve climate sensitive block design.

6. Reference

[1] Arvind Krishan et al., 'Climate Responsive Architecture: A Design Handbook For Energy Efficient Buildings'

[2] Department : Stability & Environment Victoria Australia, 'Guidelines for Higher Density Residential Development'

[3] Frasers Broadway, 'Site Concept, Plan, Wind Environment- Study Utilising Computational Fluid Dynamics'

[4] G.Z. Brown et al., 'Sun, Wind and Light', 2nd edition

[5] http://blueridge.in/

[6] http://ecohousingindia.org

[7] http://en.wikipedia.org/wiki/Ecological_design

[8] http://en.wikipedia.org/wiki/Enevironmental_design

[9] www.iiec.org

[10] http://Map.google.co.in

[11] L. Morawskaet al., Environment, energy and health in housing design

[12] MPCB 2006, District Environmental Atlas of Pune District

[13] O. H. Koenigsberger et al., Manual of Tropical Housing and Building, climatic design

[14] Paul Carpenter,Wind in city streets

[15] Prof.S.L. Kolhatkar, Responding to Thermal Environment and companion reference book on climate