International Journal of Research in Engineering, Science and Management
Volume-1, Issue-10, October-2018
www.ijresm.com | ISSN (Online): 2581-5782

Concepts of Passive Design in Composite Climate

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***Abstract*—This review is focused on Passive design concepts through literature study that can be incorporated in our design to make them comfort. Through world research on passive design strategies is carried out by many researches and various techniques are adopted to reduce the temperature and saving the energy. Maximum use of energy can harm our environment. As we know that the rapid growth of pollution and degradation of our environment can harm the human body. The use of more passive techniques will help to restore the energy and help for saving the environment. This paper presents critically analysis various methods of passive techniques that reduce the energy inside the building.**

***Index Terms*— passive techniques, comfort, composite climate.**

I. Introduction

Passive design is a design which uses natural sources of heating, cooling and ventilation to create environment comfort inside the building. Passive design reduces the energy from building through heating and cooling. Buildings are answerable for acquire 40% of the whole world's yearly energy utilization. The climate control systems, specifically ventilation, cooling and heating can account for as much as 70% of the total energy use. The use of passive design in a building makes human comfort. It consumes less energy; they do not always produce buildings that might be considered 'sustainable' as sustainability is dependent on a range of criteria, only one of which is energy uses. Passive design basically depends upon local climate. It designs on the basis of climate considerations. It do not involve mechanical and electrical energy. It involves maximum use of sun and wind to make the building cool and comfort.

It is achieved by approximately orienting your building on its site and carefully designing the building envelope (roofs, walls, windows, etc.). Well-designed buildings minimizes the unwanted heat gain and loss. Passive design may also cost effective to upgrade thermal comfort- even small upgrades can deliver significant improvements.

A number of different strategies contribute to good passive design. Passive design strategies vary with climate. It may help in environment to save energy.

It does not affect the environment. The use of passive design techniques may help the environment free from pollution. It involves less use of fossil fuels. , passive, naturally ventilated buildings have potential to provide more pleasant and healthier environments for the occupants compared to their mechanically ventilated counterparts. A well-designed naturally ventilated building can use just a third of the energy consumed by an air-conditioned building, while seemingly giving an equivalent level of comfort. For almost all type of climatic conditions there are few passive design concepts that help building design to develop buildings that are comfortable with very little or even without use of any artificial device. This paper review and discusses in detail various passive cooling techniques with a special focus solar shading techniques, as they are most economical and thus most suitable for buildings in developing countries.

II. Composite Climate

The composite climate zone covers the central part of India. A composite climate is one that has weather conditions outside of normal conditions for at least half a year Composite climate displays the characteristics of hot and dry, warm and humid as well as cold climates. The characteristics change from season to season. In summers day time temperature is 32-45 degree Celsius and during night time temperature is 27-32 degree Celsius. In winters day time temperature is 10-25 degree Celsius and in night time temperature is degree Celsius. Monsoon winds come from south-east and north-east.

Fig. 1. Composite climate zone in India

India being a tropical country, most of design decisions would pertain to cooling that is why we are discussing more for cooling in this paper.

III. Passive Cooling Techniques

A 'passive' solar design involves the use of natural sources for cooling to achieve thermal comfort in the building. The energy can flow in the form of radiation, conduction or convection without any use of electrical devices. Passive solar design relies on the integration of a building's architecture, materials selection and mechanical systems to reduce heating and cooling loads, taking into consideration local climatic conditions to create climate-responsive, energy conserving structures that can be powered with renewable energy resources. The most important process in passive cooling is to develop an energy efficient building to minimize heat gains and gain more and more cool breezes, for example: orienting more windows in north; incorporating adequate shading to prevent solar radiation; incorporating thermally massive building materials; suitable insulation; high performance glazing to reduce heat gain and admit natural light. Vegetation, green roofs, green walls, water ponds and fountains are also cooling techniques which are used in building to make energy efficient. Landscape and outdoor spaces are also important passive cooling strategies to make environment cool. Create proper ventilation, courtyards, and wind towers, shading devices, thermal mass, vegetation and insulation in our design to reduce energy loads for cooling.

About 30% of the unwanted heat comes from the building roof and more than 40% from the windows. To minimize the effect of radiant energy, a reflective waterproof coating and installation of a radiant barrier on the underside of the roof are essentially provided to reduce the energy. This can reduce about 25% of heat. Reflective window coatings can also reduce the heat gain by about 35%. Sun-coating films can reflect as much as 80% of the incoming sunlight. In composite climate conditions, such devices block the undesirable solar radiation very effectively during summer. Always choose light coloured reflective blinds than dark coloured, which absorb solar radiation and transmit it into the room in the form of long wave heat radiation.

Shading, insulation, plantation, and landscaping are good strategies to block the heat coming from the sun. In most cases, shading can reduce indoor temperatures by 10ºC. Effective shading can be provided by proper placing of trees and shading devices. Exterior shading is more effective than interior shading as it blocks sunlight before it enters through windows. Shading can be done by various types for example shading by overhangs, louvers, and awnings etc; shading by roofs; shading by trees and vegetation; shading by textured walls. Insulation also protects the building against the heat. The more insulation in a building exterior envelope, the less heat transferred into the building and out of the building due to temperature difference between the interior and exterior. Insulation also controls the interior mean radiation temperature by isolating the interior surface from the influence of the exterior conditions. The upper roof is the most important element to start insulation. Wall insulation is not as important as roof insulation because of differences in outdoor temperature between roof and wall. Natural ventilation helps to reduce heat and maintains indoor temperature. This strategy only works when the inside temperature is higher than outside temperature A solar chimney can be used to ensure ventilation by creating a warm zone with an exterior outlet. The use of solar chimneys is advisable for regions, where very low wind speeds exist. The wind-tower is another dramatic device for using the cooling potential of the available breezes. The hot air enters in the tower from the openings and is cooled, when it comes in contact with the cool air in the tower and thus becomes heavier and sinks down. The courtyard is a common architectural feature and is considered as a microclimate modifier, which improves thermal comfort conditions in the enclosed as well as the attached built environment. The courtyard provides thermal environmental conditions through its design concept, forms and heights. During the day, the shading arcades, trees, and vegetation protect the building from direct solar gain, and the cool mass in the courtyard floor absorbs a significant amount of solar radiation. A massive courtyard floor surrounded by a building provides cooling, primarily by radiation to the cool and clear night sky. The night time radiation cools the mass and the air trapped in the courtyard. When the courtyard is allowed to receive intensive solar radiation much heat is conducted and radiated into the rooms as against the induced draft of air, which may be problematic. The intense solar radiation in the courtyard also produce immense glare indoors. The best way is to keep the courtyard shaded and only partially open to sky.

IV. Conclusion

This study provides a review of basic ability to understand the passive design strategies for composite climate and also presents the various methods of passive cooling techniques. The key of design take an advantage of local climate (microclimate) for human comfort. The actual comfort conditions achieved will be contextual and depend on the building topology and building design specifications.

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