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Study of Solar Passive Techniques suitable for Building in Mumbai Region

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Abstract – *Increase in indoor temperature and air humidity of a building, leads to discomfort and cause health problems. Nowadays, air conditioning systems are widely used to control the temperature and moisture content of the indoor air, which increases the energy consumption. Passive techniques are key remedies to improve comfort hours without any usage of mechanical methods. Passive cooling techniques can reduce the heat load over the building envelope reduce the size of air conditioning system and the period for which it is generally required. Climate of Mumbai is warm and humid the temperature ranges between 30° to 35° and 25° to 30° in summer and winter respectively and humidity is about 60%. This paper studies the passive techniques that can be adopted for the warm and humid climate of Mumbai.*

Key Words: Passive techniques, Warm and Humid, Climate, Comfort, Building envelope.

1. INTRODUCTION

The passive technique for different region is differs from climatic zones and their characteristics. There are six climatic zones in India. They are as follows;

1. Hot and dry
2. Warm and Humid
3. Moderate
4. Cold and Cloudy
5. Cold and Sunny
6. Composite

Among these, Warm and Humid climate covers the coastal part of country. Mumbai region is fall under this climatic condition.

Comfort is define as ''that condition of mind which expresses satisfaction with thermal environment.'' The characteristics of each climate differ and accordingly the comfort requirements vary from one climatic zone to another.

1.1 Passive Techniques

Adopting energy efficient practices in architectural design can appreciably reduce annual loads of building. The importance of evaluating the thermal performance of the building being design using the solar passive techniques, to understand the effectiveness of the design in achieving energy efficiency.

There are different types of solar passive techniques and they are as follows;

1. Direct gain
2. Trombe wall
3. Water wall
4. Solar chimney
5. Trans wall
6. Roof pond
7. Roof radiation trap
8. Solarium
9. Evaporative cooling
10. Noctumal radiation

And much more techniques are there.

1.2 Passive Techniques for Mumbai region

There are various types of solar passive techniques, but the selection of those are depends upon the climatic condition in that region. For Mumbai region, 3 techniques are advisable i.e.,

1. Induced ventilation
2. Desiccant cooling
3. Day lighting

2. Analysis of Passive Design

A passive solar design involves use of natural processes for heating and cooling to achieve balance interior condition. To prevent heat from entering in to building; this depends upon two conditions; one is availability of heat sink which is at lower temperature than indoor air, and second is promotion of heat transfer towards sink (heat sinks are outdoor air, water, ground, etc.).

2.1. Induced Ventilation

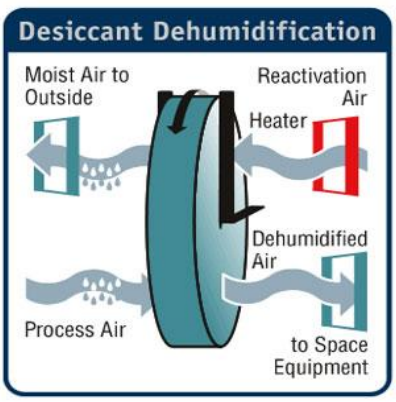
Passive cooling by Induced ventilation is more effective in Warm and Humid climate. This method involves heating of air into restricted area, this creating temperature variation and causing continuous air movements into the room. The draft causes hot air to rise and exit to the ambient and gets cool air inside, the cooler air having greater density so it I'll enter through the bottom. This cooler air is introduced into room through inlet provided at the bottom.

The air circulation is set into an open loop that is connected to the external space through a vent or pipes or mere openings at the top and bottom of rooms or space to be cooled the exit of hot air through the top vent and entry of external cool air from bottom facilitates the movement of air in that loop. The loop is induced by the movement of hot air in the upward direction.

2.2 Desiccant Cooling

Desiccant cooling is effective in warm and humid climatic condition. Presence of moisture increases the heat and causes perspiration through human body. The air conditioning systems, used in these regions and conditions are designed for controlling temperature and humidity, which in turn also uses large amount of energy

In desiccant cooling, desiccant salts or mechanical dehumidifiers are use to reduce humidity. They are solid like silica gel, alumina gel and activated alumina. Air from outside enters the unit area containing desiccants which absorbs the moisture and dries the air adiabatically. The desiccants are regenerated by solar energy.

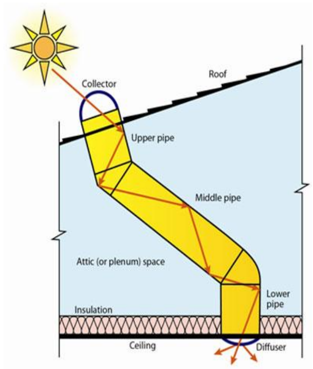


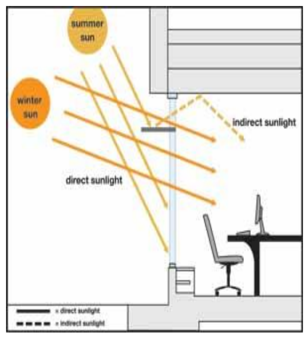
This system is composed of four principal components such as: a desiccant wheel as dehumidifier, heat recovery wheel, evaporative cooling as humidifier and solar evaporative tube collector as heat source. The process and regeneration air stream drive the operation, but it not open cycle.

In process air side, room air that including sensible load and latent load goes to desiccant wheel to removing latent load. Heat recovery wheel acts as per cooling in recovery side. The purpose of heat wheel is for sensible heat recovery only. In next step, air become cold by evaporative cooler and then air goes to room as supply air. Then in regeneration side, ambient air becomes cold by evaporative cooler. Then heat recovery wheel act as heater in regeneration air side and heat transfers to air. Then in last step, hot air take humidity of desiccant wheel and release ambient exhaust air.

2.3 Daylighting

In Daylighting, the internal shading devices are often used to protect the building from overheating by high solar radiation. The basic principal of Daylighting is that the sun is ultimate source of light. At time when sunlight reaches the earth surface, it has been subjected to atmospheric attenuation, scattering and reflection. Daylight receives on earth surface is composed of direct light and defused light. And the light reaching at particular point inside a building consist of direct sunlight, defuse light, externally reflected light from ground, building surface and internally reflected light from ceiling, walls, etc.





The availability of light within a building depends on its platform, orientation, the location and size of opening. Because of variation in outdoor lighting levels, it is difficult to calculate interior lighting. The ratio of indoor illumination (Ei) to the corresponding outdoor illumination (Eo) in percentage is called as Daylight Factor (D.F.).

D.F. = Ei/Eo X 100

RECOMMENDED DAYLIGHT FACTORS

Building	Area/Activity	Daylight factor (%)
Dwellings	Kitchen	2.5
	Living room	0.625
	Study room	1.9
Schools	Class room	1.9-3.8
	Laboratory	2.5-3.8
Offices	General	1.9
	Drawing	3.75
	Enquiry	0.625-1.9

3. CONCLUSION

Passive techniques can be used for designing the buildings to consume less artificial energy. The climate in Mumbai is warm and humid, so it becomes very crucial to design the passive system to control the humidity level. This can be done by adopting passive techniques for reducing the humidity level in the incoming air. Additional benefit of reducing the moisture level is that it can help in controlling the indoor air quality of the indoor space.

Passive techniques thus used can help in saving the energy which otherwise would have been used for conditioning of the air. The vital reason for incorporating such techniques in building is that it can give comfort to the occupants and also reduce the impact on environment.

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