Towards sustainable architecture in hot-dry climate, India

Introduction

Traditional housing patterns in India exemplify an appropriate response for the region. Thick clay bricks and mud walls are big enough to trap cool night air, which subsequently keeps the buildings cool during day. However, it could be most part of the day. Apart from providing structural stability, the thick mass of wall takes advantage of the climatic temperature difference to store heat flow from exterior to interior. The exterior air temperature drops back to comfortable levels. The courtyard facilitates heat loss from the building, by creating negative pressures as well as evaporation. Thus, reducing heat and reducing ventilation to release the heat accumulated during daytimes.

These measures are not only restricted to individual houses but also integrated in the urban structure. The narrow streets of Ahmedabad are one such example that takes into account the heat climate and passive responses lost to create a close link urban and social fabric. This research attempts at re-engineering this attitude of people to give a comfortable living and working environment integrated with nature.

Energy in India has been a major problem and a determinant in economic development. Depending on oil prices, power deficit is as much as 20%. People have to compromise with unreliable and low quality power supply. In urban areas like New Delhi, residents face regular power cuts during summer months, the time when it is the need to maintain comfortable spaces in such a situation. It becomes very important to come up with architectural solutions that are sensitive to the local environmental conditions.

This research investigates the issues of energy efficient architectural solutions in the hot-dry climate of India through a design of a house in the city of Ahmedabad.

Site Location

Ahmedabad

Latitude: 23° 11' 35"
Longitude: 72° 30' 25"

Altitude: 49 m above MSL

3 Solar control devices

- Creating shade in openings in the building envelope to avoid direct penetration of solar radiation.
- Guest rooms do not require high illumination levels during the day, indirect natural lighting is provided through private green courts and common circulation passages to provide fume light.

4 Built-in envelopes

- Thick brick masonry walls with insulation and check plaster on both sides, for low heat transmission coefficients and higher time lag to delay heat flow through the envelope.

5 Wind and natural ventilation

- Short wide alleys are provided in the building envelope for operable ventilation. Effectiveness of natural ventilation would depend upon the solar shading, orientation and the building orientation against solar radiation.
- Naturally ventilated lobby and inner spaces.
- Natural south lobby and north lobby.
- South building block shades the northern block.

6 Vertical landscaping and planting

- A microclimate is created by reinforcing courtyards of vernacular architecture into private green courts next to each guest room. Tree canopy shading caused due to transpiration from plants increases humidity levels and lowers the air temperature. Green walls give the much needed respite from the highly polluted air of Ahmedabad. These green walls would be irrigated by recycled grey water from showers and washing.

Conclusion

On analysis of the incorporated solution, it is clear that using proper orientation and building configuration, efficient shading devices, and low transmission coefficient glazing and insulated walls and roof, 40% savings in peak cooling load could be achieved. These passive measures are easy to incorporate at the conceptual level and may end up producing energy efficient solutions. The research will be pursued further into optimizing the solution by using mixed mode strategies as well as active systems, to make the building more energy efficient.

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