Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 09, September-2016

An Overview of Energy Efficiency in Vernacular Houses

Prof. Vijayalaxmi K. Biradar
Department of Architecture
PDA College of Engineering,
Kalaburagi – 585 102, Karnataka, India

Prof. Shashikala Mama
Prof. Shahikala Mama
PDA College of Engineering,
Kalaburagi – 585 102, Karnataka, India

***Abstract*— Vernacular architecture has successfully created a desirable indoor environment with nominal energy consumption due to the proper use of environmental design strategies and compatible with social and cultural contexts. Vernacular resources, technologies and built forms are generally seen to be well suited to local climatic conditions of a particular region. But today buildings consume more energy that becomes a part of concern. In this regard we feel that there should be some initiative to overcome this problem by analyzing and adopting essential features of Vernacular architecture so that they are energy efficient buildings.**

The main objective of this paper is to establish an architectural approach to resist the rapid growth of international styles and produce an environmentally, culturally and socially appropriate architecture at the same time to retain architectural identity of a particular area.

The undertaken review in this paper is vernacular Domestic Building of Kalaburagi, a hot dry climatic zone in North Karnataka, which seeks a better understanding and application of vernacular architectural features in present architecture.

The scope of this paper is designing & building in harmony with nature as it is one of the most efficient concept which works towards integrating the elements of balance between the built environment and nature. The factors such as climatically responsive design, selection of materials and building techniques must be evaluated together.

This paper concludes with consideration of energy efficient principles suitably adopted in Vernacular Architecture of hot dry climatic region & to integrate them in present situation in a more comfortable and efficient way.

Keywords*— *Vernacular Architecture, Courtyard, Building Envelop, Thermal mass, Energy conservation, Climate

I. INTRODUCTION

According to Oliver Vernacular Architecture is "the local or regional dialect, the common speech of the building. As such it comprises a range of building traditions as wide as that of the linguistic traditions" (Oliver, 1997).

Traditional architecture with hundreds of years of experience behind it has evolved appropriate building methods for each type of climate. In most cases such buildings create a very comfortable living environment without any mechanical cooling or heating. In contrast with these, modern buildings provide a much lower degree of thermal comfort and many of these are not usable without mechanical cooling and heating. So, the main purpose of the building is to provide a comfortable living environment protected from the extremes of climate in all the climatic regions (Gupta Vinod).

The most important design parameters affecting indoor thermal comfort and energy conservation in buildings are orientation of the building, building envelope, building materials and technology and Macro climate (Kamyar Tolou Behbood). All these parameters are related to each other according to the climatic characteristics of the region.

Kalaburagi (Gulbarga) means 'stony land' or 'heap of stones' in kannada language due to the availability of abundance of stone. Kalaburagi District is situated in the northern part of Karnataka State (*Bindoo D. D., 1942) (Fig.1).*

The district lies under hot & dry climatic region. The temperature ranges from 5°C to 45°C, winds are generally light to moderate & rainfall of about 776.5mm annually. Domestic Architecture of Kalaburagi depicts livability and comfort by taking advantage of the topography, climate & natural resources *(*Bindoo D. D., 1942).

Fig.1 Kalaburagi (Gulbarga) Map

II. ORIENTATION OF THE BUILDING

Vernacular buildings, square or rectangle in plan, are oriented strictly to the cardinal directions. This makes the spatial planning more perfect to control its environment with maximum comfort in all distinct seasons. Building orientation helps in minimizing heat penetration (through windows, walls, roofs) and maximizing cross ventilation (Fig. 2).

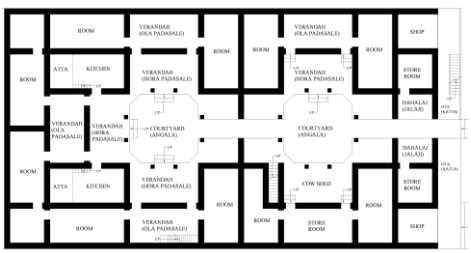

Fig.2 Residence Plan

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 09, September-2016

III. BUILDING ENVELOP

The main aim of Vernacular Architecture was to accommodate large families to live under one roof and enjoy the common facilities of the homestead (Fig. 3).

Fig.3 Main Entrance of the House

The courtyard types of houses have been one of the characteristic forms of Vernacular Architecture of hot-dry climatic region of Kalaburagi. The courtyard surrounded by the built mass creates an introverted response. Courtyard has been effectively used in designing residences with multiple courtyards, where varying privacy gradients are respected (Fig. 4).

Fig.4 Courtyard

The hierarchical positions of Central Courtyard, Verandah and inner spaces provide an organization of activities from one place to the other in relation to climate (Ali Asif, 2012) (Fig. 5).

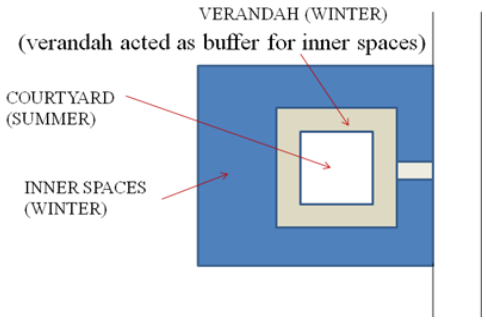

Fig.5 Hierarchical positions of Central Courtyard

The verandah acted as buffer for inner spaces to protect people from prickly heat which functioned as a place for organizing their daily activities (Ali Asif, 2012) (Fig. 6).

Fig.6 Verandah

Courtyard is always shaded throughout the day even if the building is oriented to any direction. The courtyard act as microclimate modifiers centrally located and are completely opened to the sky.

The courtyard provides comfort throughout the day. During night, cool night air descends into the courtyard and the surrounding rooms. Therefore, the courtyard is often used for sleeping during summer nights (Fig. 7).

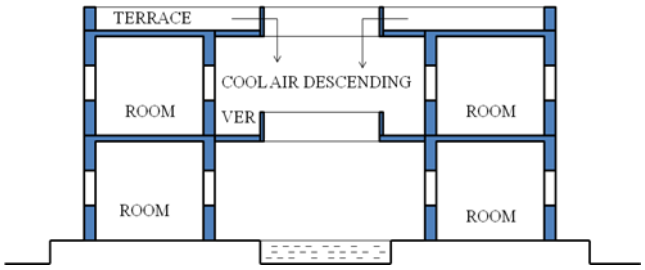

Fig.7 Condition during night

During noon, the sun strokes the courtyard floor directly. The warm air from the floor & the walls of the Verandah rises up and finally a fresh and cool air replaces the space evacuated by the hot air (Fig. 8).

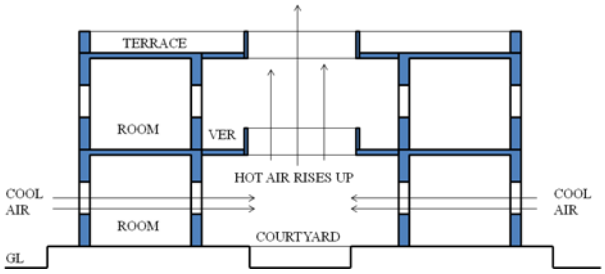

Fig.8 Condition during day

During evening, the courtyard floor and the interior rooms become warmer. After sunset the air temperature falls rapidly as the courtyard & walls radiate heat rapidly to the night sky. Cool night air begins to descend into the courtyard (Fig. 9).

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 09, September-2016

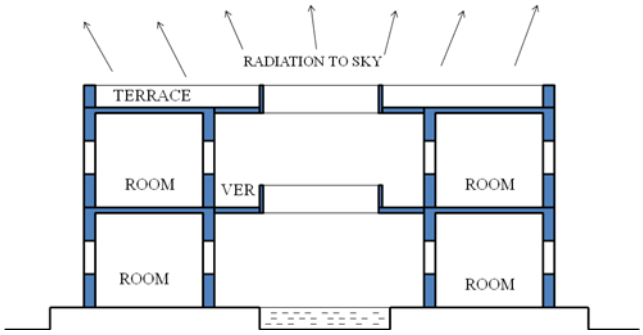

Fig.9 Condition during evening

IV. BUILDING MATERIALS & CONSTRUCTION TECHNOLOGY

Energy efficiency is a very important aspect and which is greatly affected by a building's envelops. The amount of surface area, choice of material and insulation strategies are key elements in buildings located in Kalaburagi.

The use of local materials, local technology for construction of buildings with the help of local artisans helps vernacular buildings energy efficient. The materials with greater thermal mass have been chosen in vernacular houses benefitted from the larger time lag of the temperatures in the building envelop. The most wide spread locally available building materials used in the building envelops are varieties of stones, lime, shale, timber, mud etc.

In Vernacular buildings the walls are massive with the thickness of 60cm with Basalt stone (Deccan Trap) and lime mortar as a binding material. The thick walls stores large amount of heat during day and creates larger time lag which helps inside cool during day time in summer when it is most inconvenient outside, while in winter heat stored in the walls is radiated during night (Fig. 10).

Fig.10 Massive Wall

The thickness of roof varies from 20 cm to 30 cm. In the first type Roofs are covered with 2 inch thick stone slabs supported by wooden beams closely spaced & joists cut into required size topped by lime mortar. The massive thickness of the roof provides larger time lag to heat enter inside. The second type of roof construction consists of jungle cut wooded logs on which stone slabs of 1inch to 2 inch thick are laid one above the other without any penetration of rain water (Fig.11).

Fig.11Massive Wall

The floors of Verandah & Rooms are generally in rough textured or polished lime stone slabs set regularly. The paving of entrance lobby & court is generally in the rough basalt stone set either regularly or random rubble fashion helps to reduce glare and prevent heat gain during day time (Fig. 12).

Fig.12 Floors of Verandah & Courtyard

Minimization of area, windows are at higher level to block floor radiation, Shading devices, textured external surface helps to reduce heat gain, lime wash or light colour paint applied to walls helps to reflect solar radiation, providing natural ventilation to reduce heat stock, these are some precautions taken against the solar radiation (Fig. 13).

Fig.13 Ventilator & Shading device

V ROLE OF MICRO CLIMATE

The houses have been very close together with narrow entrances & passages. The walls are very thick & strongly built. There are absolutely no windows on ground floor, only narrow slits or small holes are built in wall (Bindoo D. D, 1942). The reason behind this is mainly to protect them from theft, but it becomes a characteristic feature of this area. The buildings are close to each other to form a dense cluster which allows mutual shading by buildings reduces the area of exposed surfaces and provides shaded pedestrian walk area (Fig. 14).

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 09, September-2016

Fig.14 Narrow Street

Planting deciduous trees to shade east and west walls would prove beneficial in hot and dry zones. In summer, they provide shade from intense morning and evening sun, reduce glare, as well as cut off hot breezes. On the other hand, deciduous trees shed their leaves in winter and allow solar radiation to heat the building (Fig. 15).

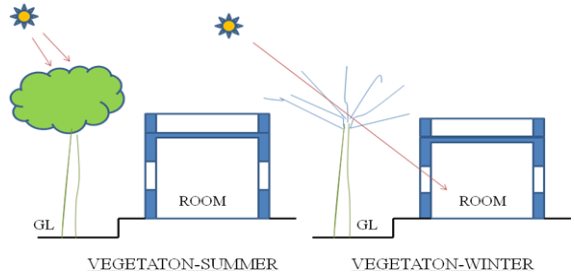

Fig.15 Vegetation

V CONCLUSION

Indoor thermal comfort & energy efficient parameters in hot and dry area of Kalaburagi were discussed in this paper through orientation of the building, building envelope, building materials and technology and macro climate.

Thermal comfort & energy efficient technologies of vernacular architecture can provide us with the inspiration for new and innovative approaches to the design of adaptive and resilient dwellings for hot and dry climates and give us an indication of our ability to survive in such regions without any mechanical systems.

Consideration and development of the above parameters allow architects and designers to build contemporary architecture in a more energy efficient, comfortable and self sufficient way.

REFERENCES

[1] Oliver Paul, 1997, Encyclopedia of Vernacular Architecture of the World, vol1 Cambridge university press, Cambridge

[2] Kamyar Tolou Behbood, Mohammad Taleghani and Shahin Heidari, Energy Efficient Architectural Design Strategies in Hot-Dry Area of Iran: Kashan,

[3] Gupta Vinod, Natural Cooling of Buildings-A Review (with examples from traditional architecture in India), Innovative Informations Incorporated – Research Report No: S 1

[4] Bindoo D. D., 1942, A critical study of the old domestic architectural buildings of Gulbarga, (A thesis report), School of Architecture Bombay.