

Passive Cooling and Vernacularism: Design Strategy in Moorish Mosque, Kapoorthala, Punjab

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Abstract—Bioclimatic architecture has arisen as an effort in architectural design since last decades. It can be interpreted as an approach to architectural design that minimizes resource consumption, utilizes natural energy, assuages environmental damages, and improves human health. More decisively, it can also be considered as a tool to raising people's awareness of environmental protection or in other words a reaction to mother nature, which always cohabits and appreciates manhood. Presently the resources are not adequate enough to fulfill human needs in future. Sustainability is facing dual crisis due to global warming and depletion of fossil fuels. In today's world the major consumption of energy is in building sector. Passive cooling, ventilation and heating were few techniques used in the past and more harmonious, with the Mother Nature. Materials used for the historical buildings in the past were energy efficient. The paper deals with applicability of passive and low energy cooling technologies and analysis of Moorish Mosque in that perspective. Today's contemporary world requires such techniques and these can act as a source of inspiration for sustainable development in futuristic evolution. In this paper, the author has examined various passive cooling techniques and locally available resources used in Moorish Mosque in North Indian climate, buildings and systems analysis, to find out passive and low energy cooling technologies potential.

Keywords—*component; formatting; style; styling; insert (key words)*

I. INTRODUCTION

Human beings and mother nature had strong relationship in the past but with passage of time it merge into technology leading to the technical world with minimum respect towards nature .It has reduced the harmony, and which has resulted in building merely following context. Moorish Mosque is one of the astonishing examples using passive design as well as different technologies when mechanical ventilation was not found. The passive technology was merged together with newer methods that even after next seven centuries the building would cope with the extremities of climate in northern India. With the development of industrial revolution and the later phases of architecture, human being became more prone to mechanical devices rather than utilizing natural resources. Our great ancestors derived different means and developed comfortable spaces with inevitable expenditure on energy devices. Contrasting modern approach towards designing, the intention of designer's is to provide thermal comfort to the generation without knowing the cons of that which overweighs the pros of

designing thermal environment. Today's generation is consuming more energy, which results in less comfortable dwelling rather than the historical buildings. Modern architects does not place environment into value, designing is to utilize maximum resources through artificial control of environment. The consumption of building depends on three ideologies, first is to maintain internal environment to make spaces comfortable, secondly microclimate control and furthest manufacturing of materials [4]. The author has tried to understand the natural phenomenon involves in planning of Moorish Mosque to make natural cool environment to the building, which may guide architects to develop bioclimatic architecture in future.

II. PASSIVE DESIGN

A. Passive Design Technique

It is a key to sustainable building. It's a technique used in design so as to induce buildings that come back through their surroundings condition by natural process. It achieves this by using a free renewable offer of energy just like the sun and wind to provide house heating, cooling, ventilation and lighting. Using passive style will scale back temperature fluctuation, improve indoor air quality and create a home drier and plenty of enjoyment. Bioclimatology relates the study of the climate (climatology) to the kith and kin [1][6]. The bioclimatic style is an approach that takes advantage of the climate through the correct application of design elements and management promotes energy saving moreover as ensuring comfortable conditions into buildings. Throughout this case, the bioclimatic design is so specifically associated with the understanding of native environmental condition options and to the applying of passive ways that associated with this. Each of these parts works with completely different to realize comfortable temperature and sensible indoor quality. "Fig. 1". "Fig.2."

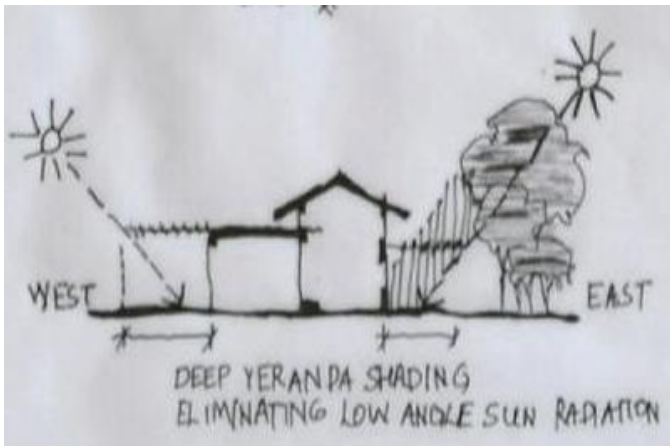


Fig .1. Passive Cooling Concep

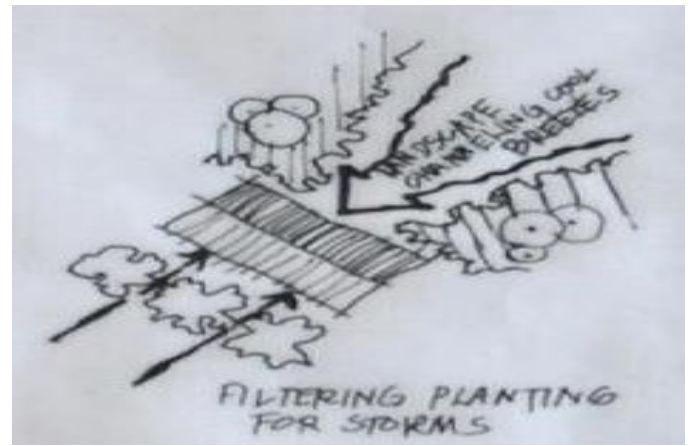


Fig.3. Filtering Plants

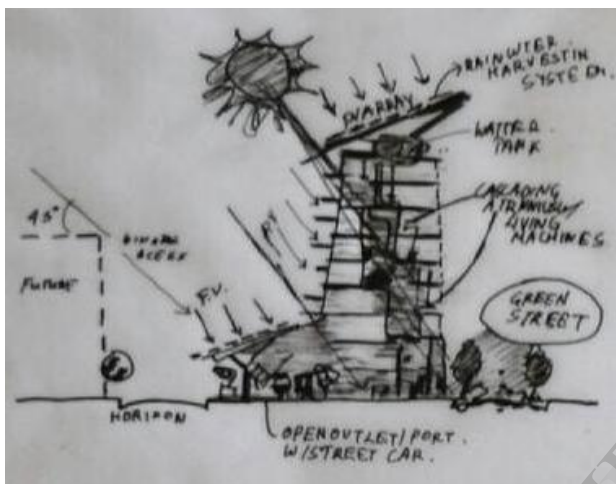


Fig .2. Passive Cooling Concept



Fig.4. Chahar Bagh Concept

III. CLIMATE CHARACTERISTICS

Before of the major part ongoing the strategies of Moorish Mosque it is desirable to understand the temperature prevailing in this area. Hot and dry winds prevail in North India leading to Composite climate, which is dominated by hot and dry conditions for at least two –third.

A. Microclimate Control

Persian garden have put an emphasis on Moorish architecture, which is used as a basic tool not only as a symbol but also to improve the quality of immediate surrounding environment of the building. The environment outside the building is important to control the inside temperature of the building. Surrounding environment is treated by the external breezes [3]. The environment outside the building is important to control the inside temperature of the building. Improving microclimate of the region, which consequently enhances the quality of, treats the external air inside the building. To enhance cooling by evapo-transpiration trees played a dominating role and addition of vegetation increased it's potential. Evapo-transpiration process adds water vapors to the air and brings down the air temperature [5]. The water bodies were added to improve the humidity in hot and dry regions. Fountains are the better way to improve the quality of air as it sprinkles the water drops into the air and make the process of evaporation faster. "Fig.3"

IV. INTEGRATED INDOOR OUTDOOR LIVING

Indoor relationship with the outdoor adds beauty and make design more utilitarian [1]. Verandah acts as a buffer for inner space to protect people from prickly heat while functioned as a place for organizing their daily activities during rainy season. The hierarchical positions of courtyard, verandah and inner spaces in Mosque provide an organization of activities from one place to the other in relation to climate. "Fig.4"

V. VERNACULARISM

A. Thermal Mass

Ancient structures have thick walls with highly permissible thermal insulation. The rate by which heat flows is responsible because of temperature difference between the exterior and the interior surfaces. Maximum heat gain by the surface is through outer surfaces but due to large thermal masses the inner surface remains cool [2]. By providing the shading devices on the exterior masses heat can also be controlled by transmitting to the interior zone. As it happened at daytime only, night is helpful at certain point as the atmospheric temperature is less at night so exterior get cools easily because of the high emissive property of walls. The same methodology is applied in Moorish Mosque. "Fig.5"



Fig.5. Indoor Outdoor Integration



Fig.6. Courtyard

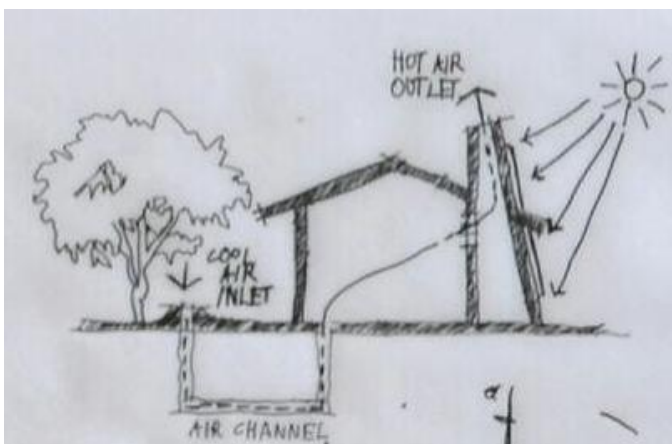


Fig.7. Air Channel

B. Courtyard

Courtyard is the another feature adopted in Mosque planning. Hot and dry climate consequences can be taken care by providing a comfortable place like courtyard, which enables environmentally as well socially requirements. Courtyard not

only prevents harsh solar radiations to enter but also protects from hot and dusty winds[4]. The temperature of the air present in the courtyard is raised due heated floors and walls which made rise of the air due to its light weight. The resultant is a fresh and cool air replaces the space evacuated by the hot air[7]. "Fig.6". "Fig.7"

C. Vernacularism

To fulfill the social and environmental significance; elements like verandah and courtyard were inbuilt in Moorish Mosque [3]. This had made building more harmonious with nature. Even the use of local materials by artisans has made this building more energy efficient. "Fig.8"



Fig. 8. Locally Available Material

VI. CONCLUSION

Author has tried to lay emphasis on passive cooling techniques and utilization of vernacularism in Moorish Mosque. The design elements by great ancestral builders evaluated on the criteria of climate and minimum resources. It can act as an inspiration for today's world to stress on natural resources and making building more energy efficient by less means of technical consumption. The environmental innovations in the Moorish Mosque may be used as a concept of upcoming architecture, which will develop harmony between man and nature.

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