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Application of Vernacular Energy Efficient Techniques in Contemporary Architecture (Northern Indian Plains)

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Abstract: Vernacular buildings are climatically responsive shelters. Thus, minimum energy is required or consumed for maintaining living conditions within the buildings and these result in less consumption of energy leading to energy efficiency. We should turn back to our past and understand how our ancestors lived a comfortable life in the age when there was no electricity and encourage the application of their energy efficient techniques in our contemporary architecture.

Northern Indian plains are the most populated planes, people have been living there for ages and its architecture has evolved over a period of time. This paper is explores the materials and techniques that the inhabitants of this particular region of the country used to construct efficient and successful buildings in the past.

This study is based on research done by different people on energy efficiency of vernacular architecture. Our present day buildings consume higher amount of energy. Hence, it is very important for us to reduce energy consumption and reserve it for our future generations. The case study mentioned in this paper demonstrates the attempts by its architects towards application of vernacular energy efficient techniques in contemporary buildings and how successfully these buildings perform their functions.

In order to progress in the field of sustainable architecture, we must first gain complete understanding of the vernacular techniques of the past to employ the strategies as a well-balanced and methodical approach to achieve optimum energy efficiency in contemporary buildings. .

Keywords: Vernacular architecture, energy efficient techniques, northern Indian plains

1. INTRODUCTION

As we are heading towards a more technological world, our energy needs are also increasing. Our sources are still mainly dependent on the conventional non-renewable resources. If we want to keep developing at the same pace, we'll have to work on both fronts, encourage the use of renewable resources and use energy more efficiently.

Our buildings consume a huge amount of energy for their proper maintenance and functioning. Architects have always been searching for techniques by which they can increase the energy efficiency of their buildings. But what about the time when we didn't depend on energy so much? We still had buildings, they were still able to provide us comfort and protect us from harshness of nature.

This paper is about vernacular energy efficient techniques, their functioning and case studies are taken to show their performance in contemporary buildings.

2. VERNACULAR ARCHITECTURE

Vernacular architecture is a category of architecture based on localized needs and construction materials, and reflecting local traditions. Vernacular architecture tends to evolve over time to reflect the environmental, cultural, technological, and historical context in which it exists.

3. VERNACULAR ARCHITECTURE AND ENERGY EFFICIENCY

Vernacular architectures, built by people whose design decisions are influenced by traditions in their culture, have been gleaned through a long period of trial and error and the ingenuity of local builders who possess specific knowledge about their place on the planet, and thus are valuable in promoting climate-specific passive building technologies to modern buildings. Sustainability is prerequisite for any successful vernacular development and is being followed through the ages. The size of vernacular settlement is small with minimal building footprint on the earth. The open area within the various houses is shared by the people of the community. In hilly regions, vernacular settlements are built on the relatively flatter grounds so that the site development work will be minimal.

Vernacular architecture is some of the most thought-out form of design. Everyone requires something different from their specific environment. One of the more important things to

remember when building a home is where you will want to spend your time. Some families consider meals to be one of the most important times of the day and so the preparation and eating of food becomes central in their lifestyle and results in the need for a larger kitchen or dining space. Others find that their kitchen is simply a pragmatic necessity, and does not require as much space. People understand their own needs better than anyone else. When a home is built to the homeowner's specific needs, space and energy are not wasted on unintended rooms or features. That is the basic principle behind vernacular architecture, an understanding of the place you call home and the needs of those that live there. In many ways this is also a principle of green design.

4. NORTHERN INDIAN PLAINS AND ITS ARCHITECTURE

The northern plains comprise the Ganges basin states of Delhi, Uttar Pradesh and Bihar with Punjab and Haryana to their west. A vast area of rich alluvial land, this represents the most fertile, hence most populous, part of India. The climate is continental, ranging from little more than freezing of a January or February dawn to well over 40 centigrade (104 Fahrenheit) in May and June. This relentless summer heat is broken by the southwest monsoon which, from early July, waters the fields for some two months. Sometimes it fails; sometimes it is over generous.

During the early days of man's presence, the Ganges Basin was richly forested, so timber played an important role in large-scale building, dictating its trabeate form of vertical posts and horizontal beams. A growing populace in search of agricultural land cleared the trees to till the soil. Alluvial clays were used to make sun-dried and kiln-baked brick, which has dominated the architecture of the region ever since.

5. ENERGY EFFICIENT TECHNIQUES

***Town Layout*:** The buildings were joined close to each other. The houses, on the other hand, shared walls and this minimized the surface exposed to the sun. The streets were like a trench. This helped the buildings to shade one another as well as to shade the streets. The only spaces that received a great amount of sunshine were the open spaces such as the courtyards.

Massive Walls: The walls of traditional buildings were massive with a thickness of about 60 cm. various materials were used to construct the walls as below.

a. **Mud:** This was the only material with sufficient cohesion to form walls. It was stable in dry conditions, and was mixed with straw to achieve maximum strength.

b. Lime and Clay: lime was used as plaster as well as to pigment the interior of a house with brilliant white. Clay was mainly used as plaster.

Courtyards: The traditional courtyard was surrounded by high narrow rooms having large unglazed windows facing the courtyard. They were completely opened to the clear sky or partially shaded with overhangs and arcades. They tend to differ in size and shape according to the geographical location and type of climate. Some courtyards contain fountains and trees to promote evaporative cooling and provide shade. Courtyards moderate the climatic extremes in many ways:

(i) The cool air of the summer night is kept undisturbed for many hours from hot and dusty wind provided that the surrounding walls are tall and the yard is wide,

(ii) The rooms draw daylight and cool air from the courtyard.

(iii) It enhances ventilation and filter dust.

(iv) The courtyard with its gentle microclimate provides a comfortable outdoor space to enjoy.

The Wind Tower (Badgir): The traditional wind tower consists mainly of two parts, the catching device and the tower. It is opened into either upstairs or downstairs rooms and stopped about two meters above floor level. The tower is subdivided by brick partitions to contain several shafts. The operation of the wind tower depends on wind conditions and the time of the day.

Shading Devices: The sunshades not only protect from sun's radiations through the windows but walls too. Traditional buildings have deep and inclined sun shades which are more effective as they cover the more surface area.

Evaporative Cooling: Evaporative cooling had not only been the element of external spaces in traditional buildings but the water channels and fountains were also part of the internal spaces, for example in Red Fort Delhi and Agra.

Natural Ventilation: Natural ventilation is the result of differential wind forces on various building surfaces and temperature difference between outside and inside air. There are several factors which affects the air flow within the buildings such as microclimate, size and proportion of windows, orientation with respect to wind direction etc.

***Lattice Screen (Jaali)*:** Another strong feature of traditional architecture which makes the internal spaces cool is lattice screen or *jaali. Jaali* is used frequently in traditional architecture and is a prominent element

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6. CASE STUDY: DILWARA BAGH COUNTRY HOUSE FOR REENA AND RAVI NATH, GURGAON

General Description: The Dilwara Bagh country house is located in Gurgaon (composite climate). It merges the traditional Indian courtyard house with the western 'prairie house' to meet the updated requirements of an international lifestyle.

The house is a ground-floor unit with a living room, a dining room, kitchen, and three bedrooms. There are ample verandas and gazebos. The dining area is a small courtyard with pool. There is an outhouse for guests and garages, four huts for servants and services.

Design Features

The lake: The lake acts as the central visual element of the landscape design as well as a microclimate modifier. It stores monsoon rainwater and is topped up in dry season using a tube well.

Courtyard: The rooms are arranged around a central patio where a small pool and plants are located. This enables cross-ventilation for all rooms and cooling by evaporation.

The in-fill walls are made from adobe blocks (handmade mud bricks). Insulating and Shading: A conical, light-coloured stone roof above the domical slab creates an air cavity and also reflects solar radiation, besides shading the roof below. Wherever the berms cover the external face, an air cavity is formed by an inclined stone slab resting against the wall. All external surfaces of the building have either an air cavity or summer shading by overhangs and louvers.

Earth Tunnel System: Additional cooling in the summer months is provided to each room by an earth tunnel system. The section consists of two masonry ducts at an average depth of 3 m.

Performance: The orientation works well in winter, and in combination with the tunnel system, eliminates all artificial heating requirements. The performance in the dry summer season is good. Monsoon comfort depends on closing or opening the windows.

The only problem reported is the absence of sufficient air circulation sometimes. This is because ceiling fans were not installed in order to appreciate the domical ceilings better. Floor-mounted fans are not very effective.

7. CONCLUSION

This paper demonstrates that vernacular energy efficient techniques provide us comfortable built spaces thus reducing our dependence on artificial cooling and lighting techniques and saving energy.

We can conclude from the above mentioned case study that techniques like courtyard, natural ventilation etc. are easily applicable and they help in meeting our lighting and ventilation requirement to great extent and also in maintaining a proper interior temperature. They keep our built spaces comfortable throughout the year and resultantly cut down the energy wastage.

The findings of this study suggest that along with our conventional energy efficient techniques we should integrate our vernacular techniques for better results.

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