

# Exploring Vernacular Ventilation Techniques for Adaptation in Contemporary Buildings in Hyderabad, Sindh

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**Abstract:** The increase of technological development causes the vernacular design overlooked, especially in the urban areas of the world. The building sector is responsible for one-third of the global energy consumption and leads to a significant amount of greenhouse gas emissions. Hyderabad has hot and dry climate. The scorching heat of May to July season faces the extreme temperatures up to 50°C which becomes unbearable for the residents. The application of natural ventilation is one of the main techniques to moderate temperatures inside the buildings. The vernacular architecture of the Hyderabad provides an economical means for creating thermal comfort utilizing only natural forms of energy. But the number and variety of vernacular housing decreases significantly and almost become extinct in Hyderabad. The study aims to provide solutions of natural ventilation from vernacular design that can be applied in modern architecture. The feasibility of incorporating traditional cooling techniques is justified through the comparative analysis of vernacular and contemporary buildings. The exploration of traditional techniques will provide opportunities for future designers towards designing contemporary buildings to be more thermally comfortable and energy efficient. The paper concludes that vernacular techniques can be successfully implemented to the contemporary buildings without compromising on its own identity.

**Keywords:** Vernacular architecture, Ventilation, Thermal comfort, Contemporary Architecture.

## I. INTRODUCTION

Cities are growing at the cost of compromising the humanity and nature. The rising global populations, diminishing fossil-based energy resources, increase of harmful gases, have emerged as the main cause of energy efficiency in buildings. In addition, cost efficiency, thermal comfort and the need to reduce carbon emissions are also key factors for energy conservation. It is generally believed that vernacular buildings have withstood time and subtly crafted over generations in response to experience of conditions and use, including the local climate and human comfort needs using passive systems[1]. Hyderabad has hot and dry climate with extreme temperatures like 50°C are recorded in month from March to June. The vernacular architecture of Hyderabad in past exhibits many climate responsive elements and features like wind catchers, oriels, courtyards, verandahs, large doors and windows that helped in managing with hot climate[2]. The aim of this research is to analyze ventilation techniques used in the vernacular architecture for adaptation in the contemporary buildings in Hyderabad to reduce the reliability on mechanical means. The research is conducted through a comparative analysis of vernacular and contemporary detached houses in Hirabad Hyderabad. The primary objectives of the study are:

- i. To investigate the ventilation techniques used in the vernacular architecture of Hyderabad.
- ii. To suggest the energy efficient design techniques from vernacular architecture for adaptation in contemporary buildings in Hyderabad.

## II. ENERGY USAGE BY BUILDING SECTOR IN PAKISTAN

The building sector consumes 40% of the world's energy resources and contributes over 30% of the CO<sub>2</sub> emissions. Pakistan is one of the countries with the highest energy consumption for domestic use. The building's heating, ventilation and air conditioning (HVAC) and lighting systems consumes about half of the total energy consumptions.[3]. The energy efficient & sustainable architecture will make an impact towards decreasing the negative environmental effect. It contributes towards the decrease of development and running costs, increased thermal comfort, more healthy indoor surroundings quality, and enhanced durability. The use of locally available resources in previous time for building design was energy efficient & environmental friendly. Till now Pakistan has not perceived a vast contribution in the development industry towards energy efficient buildings. The techniques which were used in the past for cooling, heating and ventilation of the buildings were more balanced with the nature.

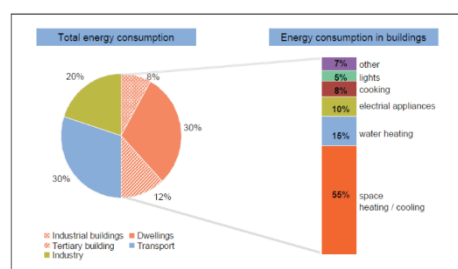


Fig 1: Energy Consumption by building sector in Pakistan

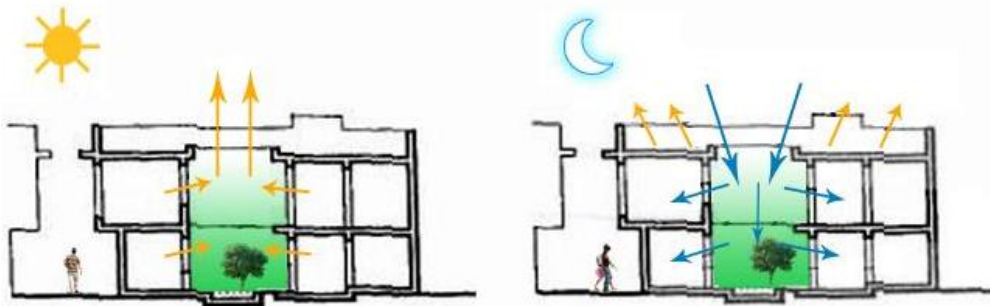
Source: A. Sohail, "ENERGY-EFFICIENT BUILDINGS IN PAKISTAN," vol. 16, no. January 2010, pp. 27–38, 2011.

### III VERNACULAR ARCHITECTURE OF HYDERABAD:

Hyderabad city in Sindh was an important center of urban life during the colonial era. Before 1947, there were many clusters of beautiful buildings that were scattered across the city, but most of these buildings are diminished now or are in a very critical state. These colonial building exhibits many vernacular techniques for natural ventilation. These techniques and elements provide the most energy efficient ways of natural ventilation and thermal comfort[4]. The mechanism of the vernacular elements for natural ventilation which has been used in old buildings of Hyderabad are:

#### A. Courtyard:

A courtyard is an open to sky area that is completely or partially enclosed by walls or buildings. The main reason for extensively using courtyard for more than 5000 years is its environmental effects[5]. Courtyard has social, cultural, religious, and environmental usage.[6] Correct orientation of courtyard can increase the thermal comfort, but orienting it without the concern of solar angles and wind direction can create thermal suffering[7].The factors which effects directly on the micro-climatic behavior of the courtyard includes location of the sun, direction of the wind, shading effect and radiant heat[8]. The courtyard is used in almost all building typologies and climatic zones as an architectural design element due to



its passive tendencies for low energy consumption in buildings.

Fig 2: Courtyard's effect on ventilation during days and night.

During winter seasons the courtyard may increases the direct solar heat gain in the rooms which have glazing on the courtyard side but in summer it can be a solar protection by planting deciduous trees in the courtyard. The air in the courtyard becomes warmer and rises during daytime. This draws out the interior heat air into the courtyard through the openings. During nights the process is opposite in which the ambient cool air sinks into the courtyard and enters into the internal spaces through the low-level openings. After the room air becomes warm it rises and leaves the rooms through the high-level openings.

#### B. Verandah:

A veranda or verandah is a term used in Indo-Islamic architecture which refers to the concept of a semi-covered roof area, open-air gallery or porch, attached to the outside of a building. In old buildings of Hyderabad courtyard attached with a verandah was the most essential part of the building .During day time verandah is the most active space of a house as it provides thermal comfort without using mechanical means during the household activities. Being the central place of the house it enable work comfortably. Verandah acts as a buffer space between the courtyard and the rooms. This helps in cooling the air temperature before it reaches the interiors of the rooms.



Fig 3: Existing verandah in vernacular building of Hirabad

### C. Jharoka

Jharokha is a decorated fenestration. Jharokha is an overhanging enclosed balcony supported by brackets or corbelling. The Jharokas were used typically in Mughal architecture and later used a lot in Indo-Islamic residential architecture. Jharoka also fulfills the aesthetic and privacy needs of the residents because of the integrate screen work done on it. The main reason behind using Jharokha is that it acts as climatic moderator by allowing natural ventilation and restricting the direct sunlight to enter the main space. This fenestration is used in hot and dry climate zone. The surface exposed to the sun minimized by repetitively using this element thus protecting the outer layer of the facade. However, organizing secondary areas adjacent to outer layer it acts as transitional space, keeping the comparative coolness inside the primary spaces.[9]

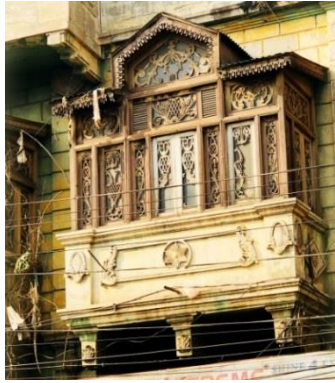


Fig 4(a): Exterior view of Jharoka



Fig 4(b): Interior view of Jharoka

Fig 4: Wooden Jharoka in an old building in Hyderabad

### D. Mashrabiya (Jaali work)

Mashrabiya also known as Moorish screens, is the Arabic term given to a type of projecting oriel window enclosed with carved wood latticework located on the second storey of a building or higher. The mashrabiya has different functions like, adjusting the air flow, controlling the passage of light, decreasing the temperature of the air current, increasing the humidity of the air and provides a great amount of privacy[10]. The air which passes through the wooden mashrabiya drops some of its humidity by means of the absorption property of the wooden balusters; if they are cold at night, and when the mashrabiya is heated by means of direct sunlight, this humidity is absorbed by the air which flows through the porous wooden mashrabiya. This technique is effective in making the dry air more moist in the heat of the day, humidifying and cooling it at a time when most needed[11].



Fig 5: Mashrabiya in an old building of Hyderabad to provide natural ventilation and privacy.

### E. Wind catcher

A wind catcher known as bagdir is a traditional Persian architectural device used for many centuries to ventilate the building naturally. The way a wind-catcher works is primarily based on taking the clean air into the building and sending the warm and polluted air out. Examples of wind catchers can be discovered in traditional Persian-influenced architecture throughout the Middle East, Pakistan and Afghanistan. Wind catchers come in various designs like uni-directional, bidirectional, and multi-directional[12]. Hyderabad was once known for its skyline dominated by many wind catchers. They were called manghus in traditional sindhi language. The wind comes from the southwest in the summer so the mangh face the wind direction. The warmer air gets cool before reaching to the rooms. In winters, the wind direction is opposite, thus wind catchers prevents the cold air from coming into the room and provides sunlight. Each "mangh" (wind catcher) serves one room, but in a multi storey house one wind catcher can serve two or three rooms. A close well is created from the rooftop to the ceiling of first floor.



Fig 6: Cluster of wind catchers in old Hyderabad.



Fig 7: Damaged and closed wind catcher in an old building of Hirabad.

#### IV. COMPARATIVE ANALYSIS OF VERNACULAR AND CONTEMPORARY HOUSES AT HIRABAD HYDERABAD

Table 1: information about the house location, orientation structure and construction style.

Vernacular Features	House No 1	House No 2	House No 3
Location	Opp: Sachal Sarmast College	Near HBL Bank Hirabad	Opp: Rangers Hotel Hirabad
Orientation	South facing	South facing	South facing
Structure	Load bearing	Load bearing	Frame Structure
Style	Vernacular	Vernacular	Contemporary
House #1	House #2	House#3	



Fig 8: Plans of various detached houses at Hirabad, Hyderabad.

Table 2: Vernacular Features in houses of Hirabad Hyderabad

Vernacular Features	House No 1	House No 2	House No 3
Courtyard	✓	Covered by the construction of two rooms.	×
Verandah	✓	✓	×
Wind Catchers	Removed	Removed	×
Jharoka	Demolished	×	×
Mashrabiya (Jalli work)	×	×	×

A detailed survey has been done on the detached houses of Hirabad Hyderabad. Three types of houses have been selected to study and observe to know how vernacular features were helpful in improving natural ventilation in old buildings. House # 1 has not changed or altered in planning. According to the residents there were wind catchers in every room but due to lack of maintenance and rainwater they have removed them. Jharoka were destroyed with time as the material used were wood which cannot remain intact for long period in outdoors without any treatment. The house has large doors, windows and ventilators which combine with courtyard and verandah does not only ventilate the house but also cool the warm air before entering into the rooms.



House # 2 was also a house with vernacular features but now the residents has modified its planning. Courtyard has been replaced by two rooms which completely block the wind direction and left the houses suffocated. According to the residents they didn't need any air conditioning before the changes were made but now they had to rely on mechanical means for thermal comfort.

House #3 has shops and offices on ground floor and first floor has the residential unit. This has now been a very common feature in Hirabad because of the increasing land prices. The Terrace is provided on the south-west side to ventilate the house and duct is provide on the opposite side for cross ventilation. The living is directly connected with the terrace with no buffer space thus warming the interior of the house. Windows have no shades or extension from the outer layer of the wall which make the rooms warmer with the direct sunlight.

## V RESULTS

Table 3: Temperatures and humidity level in each house and outdoor.

Name	House # 1	House # 2	House # 3	Outdoor
Dry Bulb Temperature	32°C	33°C	34.7°C	40°C
Humidity	54%	57%	58%	72%

Table 4: Increase of temperature and humidity level from vernacular to contemporary housing.

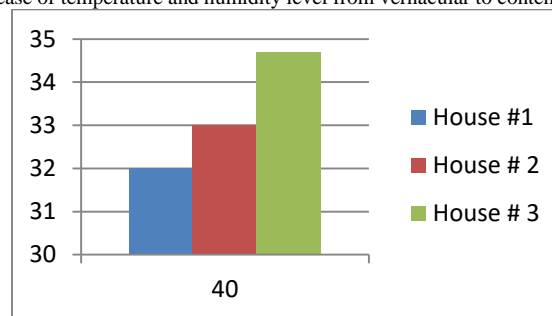


Fig. 9

The air temperatures and humidity levels have been recorded through a hygrometer thermometer of each house with the same outside temperature of 40°C and at the same time. The research shows that the old vernacular house had used many techniques used for natural ventilation which has been now eliminated from the contemporary houses which causes the houses to rely on mechanical means. The vernacular house recorded the least temperature and humidity level. The vernacular house with modern modification also recorded a temperature raise and the contemporary house recorded the highest temperature and humidity level. The use of large windows with no shading device and lack of cross ventilation increases the temperature in contemporary buildings rather than reducing it.

## VI CONCLUSIONS

The research has examined various natural ventilation techniques from the magnificent buildings of old Hirabad Hyderabad. Traditional buildings provide a strong link to the past and their vernacular techniques. The study of these vernacular buildings helps to better recognize their development and delivers examples of a sustainable building tradition. These dwellings respond to their climatic conditions effectively using low energy design principles to provide human comfort. Implementation of these vernacular ventilation techniques into contemporary buildings would certainly lessen our dependency on mechanical means for thermal comfort and minimize the environmental problems due to excessive consumption of energy and other natural resources.

It is observed that the vernacular features cannot be adopted as it is they are used in the past because of the various modern needs and materials. Adoption of these techniques should be done in a way that it should fulfill its functional purpose without compromising the aesthetics of the contemporary architecture.

## VII RECOMMENDATIONS

The economies and originality of the vernacular architecture of the Hyderabad region illustrates both culturally and climatically suitable solutions for creating comfortable environments employing only natural, renewable forms of energy. The application of traditional ventilation techniques in contemporary buildings presents a significant opportunity for energy savings. The old construction of Hirabad Hyderabad is slowly being damaged and destroyed because of lack of maintenance and negligence. The planning of these old buildings doesn't justify the needs of today's world, but the vernacular techniques which are used in these houses can be implemented in modern architecture along with maintaining the contemporary aesthetic value. The architect and designer should have re-adapted the vernacular elements of Hyderabad into the development of low energy buildings. The thermal comfort elements that have been re-adapted are the courtyard, verandah, Wind catcher, screen wall and jharoka. The use of these techniques into modern construction of Hyderabad doesn't only fulfill the purpose of natural ventilation and thermal comfort but also keeps the historical building essence of Hyderabad alive.

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