

Vernacular Architecture of India: An Overview

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Abstract

Vernacular architecture is the outcome of survival habits within the available resources produced by people themselves without professional support across the world through generations. It skillfully responds to climate, technology, land terrain and the culture of places where they have emerged. India is no exception.

Vernacular architecture of India has a wide array of diversity. It is rich in culture and its traditions have produced spectacular architecture. However, they are undergoing change. The changes may be seen not as a threat but as a natural evolution and in response to modernism the globalization and homelessness. In this context, the role of architects and planners are to devise the means to protect the age-old traditions and explore the connectivity between culture, architecture, materials and construction techniques and find a way of taking them forward to the contemporary and neo-vernacular architecture in the future.

This paper examines the vernacular architecture of India. The paper intends to discuss the vernacular architecture of India and also worries about being able to withstand disasters. It adapts a component of classification of vernacular types as research methodology. It concludes that the factors influencing sustainable change of vernacular forms of architecture with modern building materials.

Keywords: Vernacular Architecture, Traditional Architecture, Contemporary Vernacular.

1.Introduction

'*Vernaculus*' is a Latin word meaning native (Oliver, 1997). Vernacular Architecture is defined as the architecture, which is indigenous to the location, sensitive to climate, usage of local materials, and arise from the culture of the place. It has evolved over generations and is peculiar to the geographical location, addressing the needs of the people. The terms like culture, indigenous local materials, and geography are important to define vernacular architecture. Hidden ideas like culture and tradition adorn the vernacular architecture.

Culture is defined as the ideas, beliefs, custom and social behavior of a particular person or a society. It is intangible. Tradition is one of the manifestations of culture. It is the custom or belief inherited from the ancestors and passed down to the future generations. Culture is not protected in a shell, but has the characteristic of exchange, i.e., give and take. When one culture mixes with another, there is a cultural exchange and it can be called either dilution of culture (very often in common parlance) or a way of a mixing of cultures, which somehow

change the traditional beliefs. Indigenous is like *vernaculus* as associated with the natives, which means specific to that geographic location. The term native is used either for the people or the material. For people the term aboriginal is frequently used nowadays in place of native.

Other definition involve 'Architecture without Architects' which came up in 1965 at the controversial exhibition at the Museum of Modern Art of New York (Rudofsky, 1970). Oliver in his book 'Dwellings: the vernacular house worldwide' defined vernacular architecture as "The architecture of the people, and by the people, but not for the people" (Oliver, 1987). Brown and Maudlin consider Vernacular Architecture as buildings only and not at all architecture (Brown & Maudlin, 2011).

Rapoport clearly distinguishes between folk, primitive, and vernacular architecture. He defines it and says that "the folk tradition is the direct and unselfconscious translation into physical form of a culture, its needs and values - as well as the desires, dreams, and passions of a people" (Rapoport, 1969). Primitive architecture is those built form which were designed by people who were primitive as per anthropologist's definition. Rapoport's definition of Vernacular architecture is listed below.

- (i) lack of theoretical pretensions.
- (ii) tuned with the site and micro-climate.
- (iii) respectful with other people and their dwelling and with the total environment.
- (iv) circumscribed within an idiom, with variations within a given order.
- (v) having an open-ended nature, accepting changes and additions defined by their occupants according to use and necessity.

The unselfconscious process of creating a built environment starts with tradition. Tradition is rigid and it resist the changes. Vernacular is widely open to change and through multiple iterations, it has achieved the best solution. The best solution within the limited resource is carried forward as Vernacular Architecture. We observe that the widely accepted definition of Vernacular Architecture is based on the works of Rapoport and Oliver. Rapoport uses the terms like, 'group solutions', 'catering to macro and micro-climate', 'distinct material and site conditions', 'potential of available material to interact with the environment', 'cultural skills', 'climatic conditions', and 'economic levels', acquired through a system of trial and error, achieved over a period of time (Rapoport, 1969). Oliver adds that 'this *prototype* is responsive to local needs', and it is 'carried ahead across generations' (Oliver, 2007).

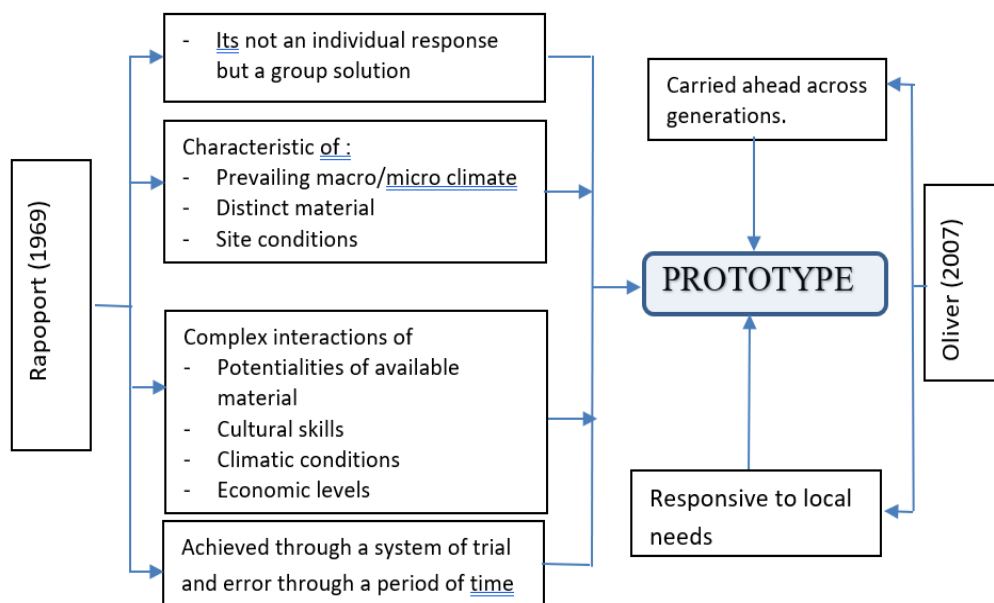


Fig. 1: Vernacular Architecture defined by Rapoport (1969) and Oliver (2007)

Source: Author

1.1 Vernacular Architecture: A Theoretical Introduction

There is a thin line of difference between traditional and vernacular architecture. Vastushastra is a written treatise on how to organize buildings in India. It represent traditional architecture. Similarly, Manusyalaya Chandrika a 17th Century scripture on buildings in Kerala region relates to traditional architecture. In comparison vernacular architectures are the buildings built by people themselves without professional involvement.

1.2 Architecture of the masses in India

Vernacular architecture is the architecture for the masses (Kawathekar, 2020). The common man of India never hires an architect or a structural engineer to make their houses. There is no formal training given to them to construct a house. Poor householders could be called self-architects of their houses. Those who can afford hire local masons in the construction of the houses based on a sketch drawn on a piece of paper by the house owner in consultation with the members of the family. A recent judgement of the Supreme Court of India also gave a ruling that anyone can practice architecture. Only the title of Architect is protected by legislation, not the profession of architecture (Supreme Court of India, 1819 of 2000, Civil Appeal No 1819 of 2020, Arising out of SLP (C) no 18752 of 2014, 2020).

Vernacular architecture can satisfy the needs of the people to build within their resources. However, they do not necessarily satisfy the aspirations of the people. As soon as new resources become available, their forms are transformed to the *pucca* prototype brick-concrete structures, giving a sense of ‘possession’ of an asset of significance to the owners of the house.

Different types of architecture exist among various groups of people identifiable on economic or social grounds. Vernacular architecture is strictly associated with the masses and the common people. Within them, group segregation is visible in their Architecture. While monumental scale of architecture is associated with the elite, the common people’s architecture is at a human scale. There is more of vernacular architecture among the common poor masses than among the elite.

1.3 The Vernacular Way of Life

Mud walls are cheaper to construct than brick walls. Mud is freely available and there is no need for skilled labour to construct a mud wall. Traditionally, a technology of mixing straw with mud has been used to provide reinforcement to the mud walls. Bamboo is available at a cheaper price, and grasses are available to make roofs. Kitchen is placed in a corner and the process of cooking and eating is done on the floor. Cats and dogs are an integral part of a family along with the cattle. A part of the food goes to the pets and all the leftover food goes to the cattle. There is no food waste. Mud walls are occasionally layered with cow dung and it is led to dry giving it a texture of cleanliness and hygiene.

It is not only the built form which exhibit the vernacular character, but the day-to-day household items are vernacular in nature too. Here, some of the items used in household use are listed. All these items become redundant once the economy of household improves. Nevertheless, few of them are still visible in contemporary vernacular houses.

Table 1: Vernacular items in Everyday life
Source: Author

Item	Description
<i>datun</i>	Neem, babool, bamboo twigs used for cleaning teeth.
<i>Khatia, khatoli, charpai</i>	A string woven bed, light in weight which can be shifted easily.

Soop, tokri, daliya	Bamboo strip weaved for storage, and cleaning grain.
hookah	Wooden piped cigar.
hadiya	Process of making wine with rice.
lathi	Bamboo or wooden stick for walking and defense.
kothi	Mud storage unit for storing grain, term also used for elite building.
jata	Manual grain grinder using rotating stone system.
Silota, lodhi- pati	Stone slab and roller for making dry powder and wet <i>chatni</i> .
Okhli	Used for dehusking grain.
Hand fan (palm leaf)	Palm leaf hand fan for thermal comfort.
chatai	Weaved carpet of date leaf.
pidha	Wooden plank for sitting on floor.
Broom	Made from coconut leaf.
Heena, Mehendi	Decorative paste for natural tattoos.

1.4 Single Units of Vernacular Housing

In India there are many states which practice single units of Vernacular Housing of one or two storey high. Some of the states along-with their building typologies and building functions as remarks are present in the Table 2.

Table 2: Vernacular Housing Types in India

Source: Author

State	Building Typologies	Remarks
Kerala	Nalukettu (<i>Nalu</i> means four and <i>kettu</i> is for halls)	Based on Traditional Architecture (Manusyalaya Chandrika).
Chattisgarh/ Madhya Pradesh	<i>Ghotul</i> (youth dormitory)	Gond and Muria adult tribal life in regions of Chhattisgarh, Madhya Pradesh, Maharashtra and Andhra Pradesh in India.
Manipur	<i>Meitei Yemjao</i>	Straw reinforced mud thick wall.
Nagaland	Sema Naga <i>Morung</i> - Boys dormitory <i>Yo</i> - Girls dormitory	Seema Naga house is divided in four linear arrangements. i. The <i>Akiskekhoh</i> – or front room where the rice pounding tables were kept. ii. The <i>Abidelabo</i> – a narrow room between the <i>Akiskekhoh</i> and the <i>Amiphokiboh</i> (hearth room) where the unmarried girls of the household sleep. iii. The <i>Akuzu-Abo</i> – where the head of the family (father) and his wife sleeps. iv. The <i>Azhi-Bo</i> – the liquor room where rice beer is stored in bamboo jugs.
Mizoram	<i>Zawlbuk</i>	Youth boys' night stay dormitory.
Tripura	<i>Tonghar</i>	Thatch and bamboo house on stilt.
Assam	<i>Ikra, Chang house</i>	Stilt houses.
Sikkim	<i>Ikra</i>	Stilt houses.
Andhra Pradesh	<i>Chittuli</i> (Visakhapatnam)	Cyclone resistant houses.
Arunachal Pradesh	Adi House	Stilted house.
Meghalaya (separate for Garo and Khasi Tribe)	<i>Nokaichik</i> - (Garo) <i>Ingsad</i> - (Khasi)	Made of bamboo, wood and straw.
Bengal	Bangla (Bungalow) Huts with chala roof	Bungalow was developed by British military engineers.
Sikkim (Bhutia and Lepcha tribes)	<i>Khim</i> - (Bhutia House) <i>Doke moo Lee</i> (KAA DEN MO LEE)- (Lepcha House)	Khim house is made of stone and wood.

have separate typology)		
Jharkhand	<i>Dhumkuria</i> (Oraon Dormitory) Santhal huts- common masses	<i>Dhumkuria</i> - Youth dormitory of Oran community.
Gujarat (Ahmadabad)	<i>Pol</i> housing (cluster of a particular group, linked by caste, profession, or religion)	Traditional living within the walled city of Ahmedabad.
Gujarat (Vadodara)	Rathwa House	Wattle daub wall construction.
Gujarat (Kutch)	<i>Bhunga</i> house	Circular plan with a single undivided space with conical roof.
Himalyan Region of Jammu and Kashmir	<i>Dhajji Diwari wall construction</i>	Vertical, horizontal and diagonal frames of timber is used as structural member and it is filled with stone masonry.
Himachal Pradesh	<i>Kath Kuni</i>	Walls of timber and stone composite structure.
Uttrakhand	<i>Koti Banal</i>	Walls made of alternate layers of stone and timber.
Tamil Nadu, Ooty hills, Nilgiris	<i>Toda</i> huts	Conical structures, usually without any windows and in a semi barrel shape. Door such small that one has to crawl to enter.

Fig. 2: Morunga youth dormitory of Konyak Naga (Nagaland)

Source: Praween Kumar, 2020

1.5 Youth dormitories of Tribal India

Among some tribes of India such as the Dhumkeria of Oran tribe in Jharkhand, children stay away from their parents up to their age of marriage. Youth dormitories are community places for such living. These dormitories are away from the villages and trains the youth for dance, music, folk tales, vocational training and a way of life. Some of the dormitories are simple while some are ornate like the Morunga of Konyak Naga. These are the community's asset built in the vernacular style for a social living before the youth start their family life. It is architecturally very beautiful made of wood and has a wooden pitched roof with wooden decorative facade in the front. One of such can be seen in Figure 2.

Some of the youth dormitories in the tribal areas are listed below.

Table 3: Youth Dormitories of Tribes in India

Source: Author

Tribe	Nomenclature of Youth Dormitories
Khasi (Meghalaya)	<i>Chang</i>
Juang (Odisha)	<i>Darbar</i>
Bhotias (UP)	<i>Rang bang</i>
Apatani Tribes (Arunachal Pradesh)	<i>Patang</i>
Gonds (multi state)	<i>Ghotul</i>
Muriya's (Chhatisgarh)	<i>Ghotul- joint dormitories for boys and girls together.</i>
Oraon tribe (Jharkhand)	<i>Dhumkuriya</i>
Konyak Naga (Nagaland)	<i>Morunga- Boy's dormitory</i> <i>Yo – Girl's dormitory</i>
Mizoram	<i>Zawlbuk- Boys dormitory for night stay.</i>



Fig. 2: Morunga youth dormitory of Konyak Naga (Nagaland)
Source: Praween Kumar, 2020

2. Built form of Vernacular Houses

Vernacular houses are generally one storey high with sloping roofs. There is a single entrance door with no or minimal windows. They can be further distinguished into two categories, vernacular house arrangements and plan forms.

2.1 Vernacular House Arrangements

There are two types of vernacular houses in India: circular and rectangular. Rectangular is most common where one-dimension of an object fits with the dimension of a space: like a rectangular table fits a room corner. However, when mathematical efficiency of an area and the perimeter is concerned, it's the circular plan which gives the maximum internal area for a minimum perimeter.

2.1.1 Plan forms

For example, in the Kutch region of Gujarat, *Bhunga* huts have a circular plan with a conical roof. Internal diameter of a typical *Bhunga* hut is 18 feet in diameter. There is no internal partition and the whole area is used as a multi-activity space. A single door and a window are placed at the opposite ends of the house. A vertical post above the rafter which is placed along the diameter supports the conical roof. However, most of the vernacular houses have rectangular plans.

2.2 Concept of Courtyards

Rapoport regards a courtyard house as 'the inside-out city' in which the focal element is towards the courtyard. Houses with balconies, open terraces and large windows face towards outside, i.e., the street (Rapoport, 2007). Courtyard is a typical architectural feature in a tropical climate. It is widely seen in Southeast Asia and the Indian Sub-continent. Affluent people have personal courtyards. Most of the traditional houses are rectangular in form and they have either a personal courtyard or a shared semi open community courtyard.

Courtyard houses are of various types as per the geographical locations. In North Indian states of Rajasthan, for example, they are known as *Havelis*, while in Maharashtra they are called *Wada*. They are also referred to as *Rajbari* in West Bengal, *Cathurmukham* in Tamil Nadu and *Nalukettu* in Kerala. Many similarities exist between the Kerala Courtyard house and the houses of Indonesia which have the same tropical climate conditions of warm and humid and has the same proximity to the sea. Indonesian houses share the architectural features of *Nalukettu* with open living space, timber construction, hipped gable roof, granary concept and space utilization under protruding eaves (Widiastuti, 2018), while in India, there are courtyard houses with water element features and plants (tulsi) in the brahmasthana of house.

Functions of a courtyard:

- i. Serve as 'brahmasthan' for all the religious purposes starting from birth to death of the person consisting of 16 sanskars. Basil (*Ocimum tenuiflorum*) commonly known as Tulsi plant adorns the courtyard of a Hindu house. (Functional space).
- ii. Serve as the private space for the women and children (privacy).

- iii. Used for drying grains, drying clothes, sun bathing during winter, and open to sky sleeping during the night-time. Threat of tigers was common during the earlier days, but courtyard was the safest place at night (utility and safety).
- iv. Provided light and ventilation to interior spaces (Climatic considerations).

2.3 Houses on Stilts

In Vernacular architecture, stilts are provided under two conditions. First is when the houses are built on a slope. In this situation, the stilts allow rain water to flow freely along the slope, without hampering the structure. Second, is during the recurrent flooding. Entire North-eastern part of India are hilly and have intense rainfall. Bamboo, wood and *Ikra* (a type of reed) is extensively used for vernacular houses in Assam. All these materials are light in weight and are widely available. Assam lies in a multi hazard zone (earthquake and flood). The *Chang* houses of Assam are stilted along the bank of the Brahmaputra River. Bamboo is used to stilt the house. Since the low-lying areas of Brahmaputra are prone to flood, a stilt house gives protection to the inhabitants from the flood waters.

The local belief is that the wild elephants do not attack stilted houses. Long grasses growing along the Brahmaputra River attract the elephants and through observation people have noticed that their houses are safe from elephants if they are stilt their houses. Generally, nine to ten steps, (1.5 to 2 m) are provided to reach the stilt houses. Prefabricated and treated bamboo products are structurally sound and are available at an affordable cost which can be used as replacement for timber and reeds. Research is going on for flood and earthquake resilient amphibious construction which will float in case of flooding, or else it will rest on the ground with no structural connection between foundation and the super structure but tied with a vertical guide pole (Das & Mukhopadhyay, 2018).

3. Materials Used for Construction

Vernacular houses always use naturally available building materials. There are many advantages of using naturally available building materials because they are readily available, local materials can be accessed easily and in larger quantities, local craftsmanship done by well-trained local people, helps in mitigating disasters, calamities of that region.

Table 4: Predominant Building materials for Vernacular Houses.

Source: Author

Region	Predominant material	Advantages
North- Eastern India	Wood, bamboo, thatch and <i>ikra</i> , stone slabs in hilly region.	Earthquake resistant design, Projecting eaves to mitigate high intensity rainfall.
Central India	Mud, straw, thatch, bamboo, wood.	High thermal resistivity wall.
North India (Hilly region)	Stone, Rammed earth blocks, wood.	Earthquake resistant design.
South India	Mud, wood, thatch.	Heat resisting wall and roof.

3.1 Walls

The choice of wall material and construction process is essentially a climate related issue. In the regions of cold climate of Leh, Ladakh and Kashmir, rammed earth blocks are used to make walls of one to two feet thickness (Habeeb, 2010). These walls have high thermal resistivity. Interior temperature is maintained for a longer duration of time. Although concrete walls have a higher thermal resistivity (2.299 mKW^{-1}) as compared to lateritic mud walls (1.912 mKW^{-1}) (Adekoya, 2013), there is no point of using concrete walls because of costs. Besides mud is readily available at a cheaper cost.

In the state of Himachal Pradesh and Uttarakhand, both stone and wood are used for wall constructions. Wooden beams are used at intermediate layers in case of *Kath Kuni* in Himachal Pradesh and *Koti Banal* in Uttarakhand.

Wattle-and-daub is a composite material consisting of a skeleton and a filler type material. Mud applied on both sides of the split bamboo framework produce the wattle-and-daub construction process known as *Ikra* walls in North-Eastern India. Where the climate is moderate, stripped bamboo are placed in a grid-iron pattern in two layers and mud is applied over it. Stripped bamboo reinforces the mud which makes the wall stronger and durable. Skeleton material could be bamboo, wood, reeds, straw and the filler material is generally mud mixed with straw, cow dung and clay. Thin walls are possible in this case.

Mud mortared stone walls are common in the Leh region of India which have the climate of dry deserts. Rainfall is scanty. Rammed earth blocks are also used in wall construction. The Leh palace has been constructed using rammed earth. Wall timber lacing is common in the Leh region (Nasir & Kamal, 2021).

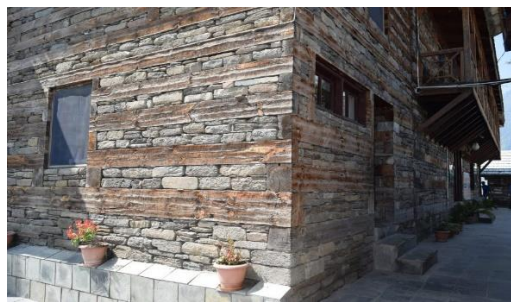


Fig. 1: *Kath Kuni* of Himachal Pradesh, Wood and stone as wall material.
Source: Soma Abhyankar, Architecture + Design.



Fig. 4: *Chala* roof of Bengal in Vernacular Architecture.
Source: Naveen Nishant, 2023

3.2 Roof

All the vernacular structures have sloping roofs. The choice of material and the slope of the roof depends on the geographical locations and the climatic considerations. Places where the intensity and duration of rainfall is high (North-eastern India), a higher pitch is provided to the roof. Here, it is worth mentioning the unique roof of Bengal region. The *Chala* roof of Bengal has gained attention in research because of its exceptional form. The sagging property of thatch roof because of aging is well depicted by this form which later became the signature artwork in the Bengal region. The drooping nature of the *Chala* roof was successfully copied in tomb architecture of Fatah Khan in the Malda district of West Bengal (Nishant, 2023).



Fig. 2: *Chala* roof in rigid material at Fatah Khan Tomb, Gaur, Malda, West Bengal, India.
Source: Naveen Nishant, 2023

Thatch is the most common roofing material visible in all the vernacular houses. Large overhangs (eaves) are provided where the rainfall is high to protect the mud wall. A peculiar house is of Toda community in Nigiris where the Vernacular houses are in barrel shape with no windows and entrance gate such small that the habitants must bent and crawl on feet to enter the house(David Goran, 2016).

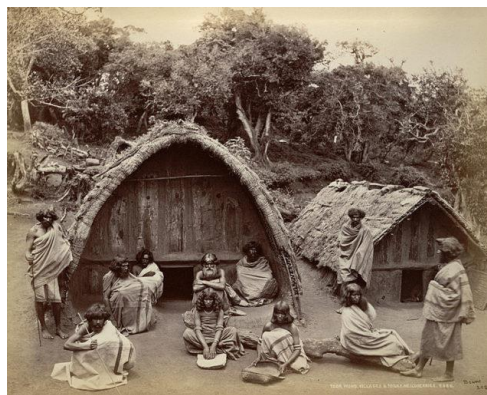


Fig. 6: Toda Community huts in Nigiris (Tamil Nadu).
Source: thevintagenews.com accessed on 09.03.2023.

Gable roofs are the most common with roofs sloping in both directions. Hipped roofs are provided in large houses. Terracotta tiles are very often seen as roofing materials in middle class families. These tiles are sometimes placed over the thatch roof which provide a better thermal performance. A visible change noticed is the replacement of roofing materials by GI sheets across the country.

4. An Audit of the Vernacular Houses in India

4.1 How Vulnerable are the Vernacular Houses to Disasters?

The greatest threat to any settlement is the natural disaster which may come without warning (Earthquake) or with prior known information in this technologically advanced weather warning system (flood and cyclone). Buildings must be resilient to this threat. Vernacular houses have performed better during the earthquakes as compared to the modern designed buildings. *Ikra* houses also known as Assam type house, are built in Sikkim and Assam. These houses are of hybrid type structures in which the walls are made partly of either brick or stone masonry and above that wall of bamboo, wood is used. From foundation and up to one meter from the plinth, either stone or brick masonry is constructed. Above that, wooden and bamboo woven walls are made up to roof. *Ikra* houses are only one storey in height. Recently, GI sheets are used as roofing materials supported on wooden or bamboo trusses. *Ikra* houses performed better during the Sikkim earthquake (14 Feb 2006) as compared to RCC and other buildings (Kaushik et al., 2006).

Uttarkashi earthquake (1991) and Chamoli earthquake (1999) did extensive damage to the vernacular houses made of stone in the Uttarakhand state in the Himalayan region. The *Koti Banal* form of Vernacular Architecture is a timber reinforced stone masonry of 7 to 12 meters height consisting of four to five storeys performed better during the earthquake. Simple symmetric plan, solid raised platform, wooden beams at regular intervals, shear walls of stone masonry and small openings because of climatic considerations make this vernacular building a truly earthquake resistant building (Saraswat, 2017).



Fig. 3: *Koti Banal* Construction process (Uttarakhand)
Source: Saraswat, 2017.

In the Himalayan region in Kashmir, *Dhajji Diwari* method is used for the construction of the walls. Vertical, horizontal and diagonal members of timber planks of varying dimensions are used as structural members and stone masonry are used to fill the voids. In the Kashmir Earthquake (2005), this type of construction survived the earthquake. 86,000 people lost their lives in this earthquake. *Dhajji Diwari* construction got recognition as an Earthquake resistant structure (The Himalayan Architect, 2022)



Fig. 4: *Dhajji Diwari* Construction in Himalayan Region of Kashmir
Source: UN habitat and SDC.

The Chutillu round house of Andhra Pradesh made of mud using straw and water (cob web technique) can survive cyclones arising at the Bay of Bengal. Rafter and roofing materials are made of Palmyra palm trunks and leaf respectively available locally. The roof overhangs touch the ground protecting the mud wall from rain water and cyclones. These *Chutillu* mud houses have survived several tropical cyclones.



Fig. 9: *Chutillu* round house of Andhra Pradesh can withstand cyclone
Source: Serene Sarah Zachariah (thebetterindia.com).

4.2 Research in Cyclone Resistant Designs for Vernacular Architecture

It has been observed that Vernacular architecture was not prepared for wind velocity at 300 km/hr. (1999 Super Cyclone). It's a trial-and-error method in which the communities learn from the experiences. Apart from community learning, it is the expert intervention with knowledge-based system that will strengthen vernacular architecture and the newer terms like 'critical', 'contemporary' and 'modern' vernacular architecture will gain significance. Several continuing efforts are being made to prepare cyclone resilient designs that will strengthen the vernacular style of design for the states affected by it. 'Cyclone Resistant Building Architecture' is prepared by the Govt. of India and the UNDP under Disaster Risk Management Plan (Ankush Agarwal, 2007). Several strategies have been suggested to secure homes in cyclone prone areas.

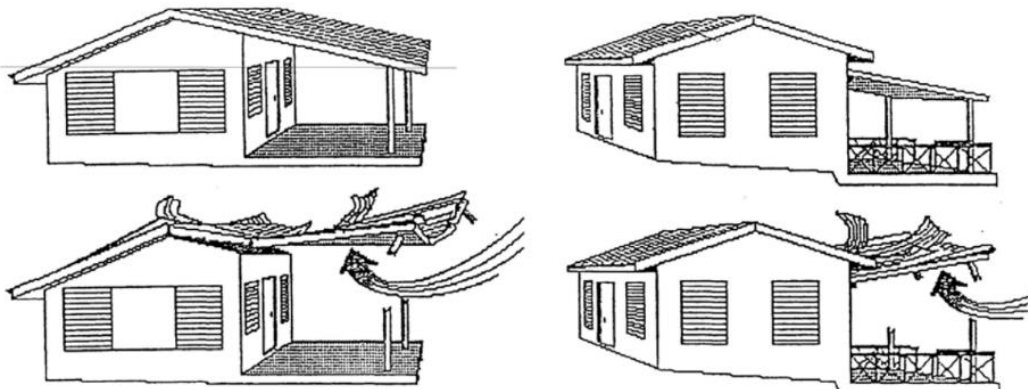


Fig. 5: Effect of cyclone on overhangs
Source: Ankush Agarwal, 2007

Traditional *Bhunga* huts of the Kutch district of Gujarat take the natural calamities of sandstorm frequently and survived the Bhuj Earthquake (26 Jan 2011). The other threat encountered by vernacular houses is fire. Closely built settlements are devastated by fire in no time. Since the materials are all combustible, the fires burn down everything. In North India, the months of April to May, in which the westerly dry and hot wind blow, vernacular settlements are vulnerable to fire.

4.3 Thermal Comfort in the Vernacular Houses in India

Thermal Comfort is the essence of any built environment. The success and failure depend upon the efficiency of the structure in providing thermal comfort to its occupants. Vernacular houses are naturally ventilated buildings. Availability of electricity has facilitated the usage of mechanical means to achieve a higher duration of thermal comfort in any building.

Here, it is imperative to discuss the work of Laurie Baker who has been influenced by Mahatma Gandhi and followed his philosophy not only in design but also in the life he lived. Laurie Baker was a British born Indian architect. After his studies in England, he was on a mission in India to convert a Leprosy Centre to a hospital in a cost-effective manner. He stayed in the Pithoragarh district (Uttarakhand) where he was in touch with Mahatma Gandhi.

In his association with Gandhi, he was advised to use the building material within a radius of 5 km for the houses to be built in India. Here, he stayed for the next sixteen years (1948-64). Later, he shifted to Trivandrum, Kerala and adopted innovative methods in brick for his architectural work. *Brick Jalis*, rat trap bond are his innovative features in his architecture. He did not practice traditional architecture, but responded to time for cost effective design for the masses, being sensitive to the local climate, tradition and landscape. Baker's work in India represents contemporary vernacular (Ali, 2015).

Quite a good amount of research work exists for thermal comfort in Vernacular houses in India. A study conducted at Indira Gandhi Rasthriya Manav Sangrahalaya (IGRMS), Bhopal for the exhibit building of the museum which were made to the actual scale and by the tribal

show that the best thermal comfort was achieved by the Santhal hut of Jharkhand as compared to the Muriya Ghotul, Rathwa house, and the semi enclosed pottery hut of Bhopal (Mitra & Mitra, 2019). Another study conducted for North-east India for vernacular houses at Tejpur (Assam), Imphal (Manipur) and Cherrapunji (Meghalaya) show a better thermal comfort during winter and summer. At Tejpur during January (cold season), when the outside swing in Temperature was 17 degrees Celsius, inside swing was just 10 degrees Celsius. Similarly, during the summer (April) when the outside swing was 19 degrees, inside swing was just 9 degrees Celsius (Singh et al., 2008).

Field studies on Vernacular mud huts of Jharkhand have investigated the relationship between perimeter-area ratio and thermal comfort. Dwellings with a greater perimeter-area ratio (0.80- 0.65) show a better thermal comfort in response to those huts with perimeter -area ratio of 0.3. Moderately spread-out plan with good ventilation shows better thermal performance in rural areas of Jharkhand (Gupta & Chakraborty, 2016a). In another research (Gupta & Chakraborty, 2016b), it is suggested that the existing mud houses having wall of 450mm- 500 mm are to be replaced by 150-300 mm walls for better thermal performance.

5. Loss of Vernacular Architecture

Right from 20th century, modern international style of Architecture has influenced the built forms globally. Cement, steel, glass and concrete have dominated the entire building industry. Mass production, modular forms, cost effectiveness, durability and strength are advantages which a naturally occurring material cannot achieve.

We are living in the age of information revolution. This revolution has eased our life in almost all the dimensions. Digital data has penetrated almost every part of India. We are moving towards an era of global village where best practices will be imitated, and change will be visible in every aspect of life. Digital penetration has made the cross-cultural interchange highly viable. Mass production of building materials, improvement in transport, affordable costs, increase in income of people, awareness of newer materials and modular construction have made all the changes. The most prominent and the first visible change throughout India in vernacular architecture is the material of roof. Galvanized Iron (GI) sheet is used as roofing material over bamboo rafters or wooden trusses instead of other natural materials. Some of the advantages and disadvantages of GI sheets over the other natural material are listed below.

Table 1: GI (Galvanised Iron sheets) becoming a part of Vernacular Architecture.

Source: Author

Advantages of GI Sheets	Disadvantages of GI sheets
(i) High strength, better water proofing, modular dimensions, easy to install and easy availability are some of the reasons. (ii) Economic status of people has improved leading to smarter and durable materials. (iii) Fireproof material.	(i) Loss of architectural character. (ii) High thermal transmittance will hamper the thermal comfort of occupant. (iii) Noisy in rain and high winds.

These threats to vernacular architecture are due primarily to the attitudes of the people. Two perceived threats identified by Chandel et al. (2016) highlights that the modern house is the symbol of prosperity and a social status in the community. Secondly, there is neither recognition nor any institutional promotion of vernacular houses. The focus is on affordable houses but not the vernacular way. More research is required to connect the people with the vernacular architecture in the modern context. Scholars like Pillai discusses the historical linkages generated in the structures by materials and construction systems. After assessment of these linkages, it is re-established in post-traditional houses using modern building material. This is how the 20th century modernism has embraced the vernacular and traditional architecture of Kerala (Pillai, 2012).

6. Conclusion

Vernacular architecture is an iterative process which adapts itself from the changed circumstances. Introduction of newer materials, climate change, and global advances towards modernization will all contribute towards a neo-vernacular architecture. There will be two categories of vernacular architecture in the future. One will be those who are beyond the means of affordability and will use the age-old method of construction as per the initial definition of vernacular architecture due to the issues of affordability. The other will be the sensitized masses including architects, common people, and masons who will adopt the best practices to achieve the vernacular forms of architecture with modern building materials. Like other forms of architecture, which are evolving, vernacular architecture too must respond to the time if it wants to survive for a longer period.

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