MECHANISMS FOR NATURAL VENTILATION IN THE ALLAH BUKSH SETHI HAVELI,
Mohallah Sethian, Peshawar, Pakistan

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ABSTRACT

In the 21st century, there has been a rapid degradation of the environment due to emissions of large quantities of CO_2 and green house gases, produced by the burning of fossil fuels in order to provide thermal comfort to buildings. This has led to the concept of 'Sustainable Architecture', which works in harmony with nature and natural forces (sun-light, wind etc.) to create buildings that aim at minimizing consumption and preventing the depletion of natural resources. Sustainability requires that human activity exploits nature's resources only at a rate at which they can be replenished naturally. In the context of Pakistan, our current practices in architecture are based on western solutions to requirements of comfort provision, leading to a growing dependence on fossil fuels, and resulting in rapid environmental degradation. Rapoport (1969) states that modern solutions to climatic problems often do not work, and homes are made bearable by mechanical means whose cost sometimes exceeds that of the building shell!

Before western ideals were imported to create architecture within the local context, indigenous architecture made a conscious effort to balance the natural environment with human habitation and lifestyles. Indigenous buildings collaborated with nature to give comfort (Rapoport, 1969).

In this paper the climate responsiveness and appropriateness of the Sethi Haveli, Peshawar, are analyzed in order to understand indigenous responses to the issues of sustainable thermal comfort. The paper focuses on the natural ventilation methods employed in the Allah Buksh Sethi Haveli and in particular the basements of the haveli, in order to understand how natural, renewable sources of energy produce comfortable yet sustainable environments. The design of these basements and their inlet and outlet ducts in particular, together with other mechanisms, promotes natural ventilation, and provides thermal comfort during the hot summer season.

Keywords: *sustainable architecture, Sethi Haveli, indigenous architecture, natural ventilation, thermal comfort*

1. INTRODUCTION

There is a growing demand for space cooling in the hot climate of Pakistan, resulting in an ever-increasing demand for energy. At the same time there has been a steady decline in the production and supply of that much needed energy. The National Energy Conservation Centre (ENERCON) predicted this shortfall as early as 1990, but the rapid pace of urbanization and the resultant energy shortfall has surpassed all estimates. In the heat of Pakistan's long summers, most buildings are dependent on air-conditioning systems which are run on electricity produced by burning fossil fuels. The burning of fossil fuels results in the production of CO_2 and greenhouse gases.

The concept of sustainability took shape when the usage of fossil fuels began to adversely affect the environment. In literature, the seminal book 'Silent Spring' (Carson, 1962) was the first attempt to understand man's irreversible damage to the environment. The early ecological movements of the twentieth century had a great impact on formulating today's concept of sustainability (Keeler & Burke, 2009). The 1984 Brundtland conference in Geneva consolidated the concept of 'sustainable development'. The building industry followed this lead with the development of the American Institute of Architects (A.I.A.) Committee on the Environment (COTE), with the understanding that buildings are clearly responsible for an enormous burden placed on the environment. Sustainable architecture builds on the concepts of sustainability to create buildings that work in harmony with nature and natural forces (sunlight, wind, etc.) to minimize consumption of natural resources and their subsequent depletion (World Resources Institute; Dimensions of Sustainable Development, 1992).

Sustainable architecture involves a holistic approach to the design of buildings. All the resources that go into a building (materials, fuels, or the contribution of the users) need to be part of an overall whole. The design of buildings involves resolving many conflicting issues and requirements: issues of ecology, economy and human well-being. Each design decision has environmental implications, and sustainable architecture is the thoughtful integration of architecture with other building systems to minimise the negative impacts of design. A low energy and sustainable building must begin by designing for load reduction; a design that offers occupant comfort and uses less conventional energy. Environmentally sustainable design is one that minimises its impact on the environment over its life span, by incorporating techniques and technologies for conserving energy and water, and reducing emissions (BREEM, 2001).

Modern buildings in Pakistan are unable to adapt to a climate that is increasingly becoming warmer. In contrast, vernacular architecture is more adaptable to the environment, according to principles evolved over many generations. Rapoport (1969) states that vernacular solutions show a variety of designs related to the conditions that surround it, responding to the nature, culture, symbolic interpretations, and definition of comfort in that area. Traditional and vernacular homes form the basis of environmentally sustainable design (Meir & Roaf, 2006). Many vernacular technologies are energy efficient and sustainable; unfortunately, most of them have been abandoned due to changes in cultural traditions and economic situations. This paper aims to explore the design techniques that promote high thermal comfort via passive ventilation systems in the vernacular *havelis* of the *Sethian Mohalla*, Peshawar.

The seven *Sethi havelis*, located near Gor Khuttree, were constructed without any mechanical means, in such a manner as to create micro-climates inside them to provide high thermal comfort levels. The sustainable architecture of the *havelis* includes multiple climatic modifying strategies like the courtyard, solar orientation, and thermal comfort through stack ventilation and evaporative cooling (Khan, 2010). The study of these *havelis* provides useful insights for designing energy efficient houses that provide thermally comfortable living conditions. The evolutionary passive climatic systems and design strategies of local building culture can be developed further and combined with modern technology for sustainable architecture in today's world (Sorensen, 2008). Hence the study of these buildings in relation to sustainability in today's context is significant.

2. SUSTAINABLE ARCHITECTURE AND THE HAVELI FORM

The *haveli* is a courtyard house, a form predominant in the Indian subcontinent since the Harappan cities of Mohenjo-Daro and Harappa. The courtyard form (*sehn*) developed as a response to climatic conditions of hot environments in regions as widespread as Egypt, Middle East, Iran, Afghanistan, Pakistan and India. The *sehn* is a square or rectangular open space, usually located in the heart of the house, which performs an important function as a modifier of climate.

In the context of the courtyard's environmental performance, studies were carried out at Cambridge University (Martin & Trace, 1972), which focused on comparing the two: the courtyard and the pavilion form of buildings. Results confirmed that courtyards performed better than pavilions in terms of efficiency in built potential as well as day-lighting. This research led to a number of important studies between the relationship of form and environmental responses of a building. Raydan et al (2003) re-evaluated this analysis of building form archetypes from the initial study using the latest computer based techniques. Raydon et al (2003) concluded that, "If best is interpreted in environmental terms, then the answer for hot arid climates is the courtyard form." Hasan Fathay (1986) has continually supported through his work that courtyards are environmentally responsive buildings in hot-dry climates. Bahadori (1978) states that the courtyard introverts space to fulfil several functions, including the creation of an outdoor yet sheltered space, the potential to use indigenous passive cooling techniques, protection against dust storms, and the mitigation of thermal heat from the sun. Sullivan (1996) observes that, "The courtyard integrates a wide variety of passive devices into its design, each creating its own thermal environment". Doell (1989) describes the courtyards as having the ability to modify and adapt to both cold and hot climates. Lobo (1995) carried out a study of housing typologies of the southern part of India; parametric modelling results showed that courtyard houses have a 50% less cooling load requirement compared to other generic building forms used in the same location. The courtyard as an architectural form exemplifies the concept of sustainable architecture: it is designed as a conscious response to the environmental context. Once constructed, these building forms represent an important strategy for creating environmentally friendly homes through minimal use of energy (Jadhav, 2007).

In the *Sethi havelis,* the *sehn* (courtyard) and the *tehkhanas* (basements) helped to harness the forces of nature to bring comfort to the inhabitants. The design of the *haveli* was energy efficient and sustainable through the use of natural and renewable forces of the sun and the wind for heating, cooling and ventilation. Rapoport (1980) writes that vernacular architecture is culture-specific and is adjusted to specific requirements of context and place. The *haveli* thus serves as an example of sustainable architecture, which was designed as a conscious response to the environmental, aesthetic and social contexts of culture.

3. CLIMATE OF PESHAWAR

An understanding of the attributes of climate in a region is important to the analysis of the performance of vernacular architectural types as different climates have their own reflection on culture and architectural traditions of the region (Nicol, 2001).

The Peshawar district lies between North Latitude 30º 40´ and 32º31´ and East Longitude 71º25´ and 72º47´ (Gazetteer, 1897-98). There are four seasons in the Peshawar valley:

- Spring in February, March and April.
- Summer in May, June and July.
- Autumn in August, September and October.
- Winter in November, December and January.

During the summers, the mean maximum temperature is over 40°C (104°F) and the mean minimum temperature is 25°C (77°F). In winters, the mean minimum temperature is 4°C (39°F) and maximum is 18.35°C (65.03°F).

Wind speeds vary during the year from 5 knots (5.8mph/9.3km/h) in December to 24 knots (28mph/44km/h) in June. The relative humidity varies from 46% in June to 76% in August. Summer winds are strong North and North-Westerly. Winter prevalent wind directions are Southerly and Westerly from October to March. The night breeze is from South and West direction.

4. METHODOLOGY OF THE STUDY

The primary goal of this paper is to identify the passive ventilation strategies used in the *havelis* of *Mohalla Sethian* that contribute to the thermal comfort of their occupants. A case study research method has been adopted for analyzing a representative sample of the *havelis* of *Sethi Mohalla*, Peshawar, in order to understand their ventilation designs and strategies. The research tools include: extensive on-site surveys of the courtyard houses observed; interviews with the residents of the havelis; on-site photography; and analytical sketches. These tools helped to address the research questions on accounts of thermal comfort and ventilation. The research design was divided into the following subparts:

- I. On-site data collection
- II. Data assimilation and analysis

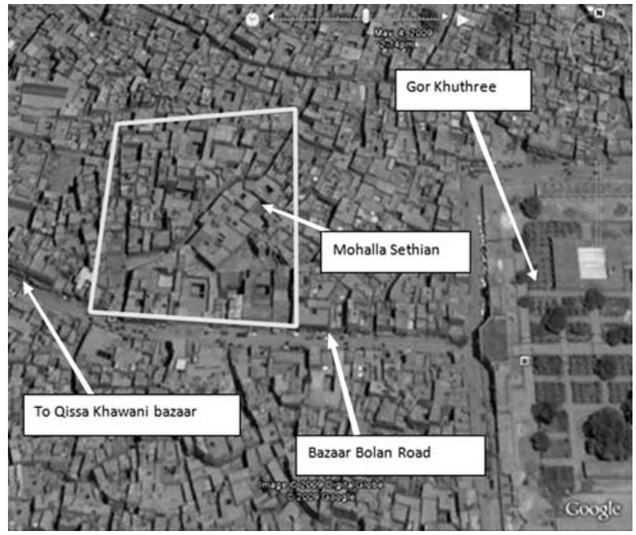

Figure-1: Aerial view of the walled city of Peshawar, showing Gor Khuthree and Sethi Mohalla. Source: Google earth, retrieved on May 4th 2009 from http://www.googlemaps.org

On-site data collection consisted of producing baseline drawings of the case study: the *Allah Buksh Haveli*. This included preparation of measured drawings, analytical drawings, sketches, and explanatory drawings to enable environmental analysis of key aspects.

The *Allah Buksh Sethi Haveli* was chosen as the final choice for the case study based on the following factors:

1. All the *Sethi havelis* are similar in the use of high thermal mass construction on the outside and use of lightweight construction on the inside facade.

2. The size of the *sehn* in relation to the total volume of the *havelis* and their aspect ratios were similar.

3. Ventilation strategies of the *tehkhanas* (basements) and *sehn* are similar.

4. The *haveli* was accessible for data collection and detailed study.

5. The *Allah Buksh Haveli* was part of the largest haveli (*Karim Buksh Sethi haveli*) of the *Mohalla* and as such exhibits the best of the bio-climatic features used in other *Sethi havelis*.

5. CASE STUDY: THE *ALLAH BUKSH SETHI HAVELI*

The *Allah Buksh Sethi Haveli* was part of the larger *Karim Buksh Sethi haveli* built in 1898. This was the largest *haveli*

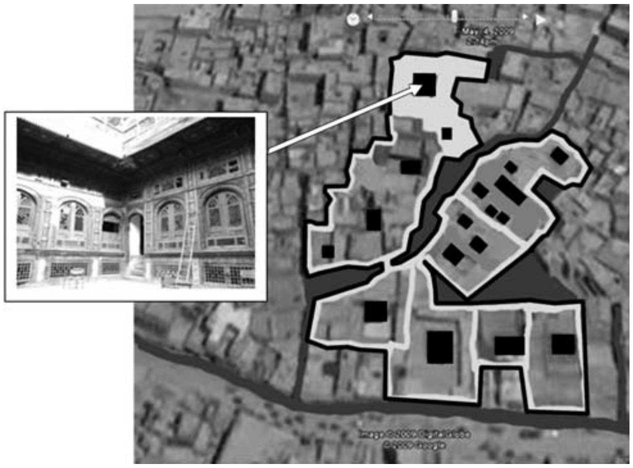

Figure-2: Location of Allah Buksh Sethi Havelis in the Sethi Mohalla. Area map retrieved on May 4th 2009 from; http://www.googlemaps.org

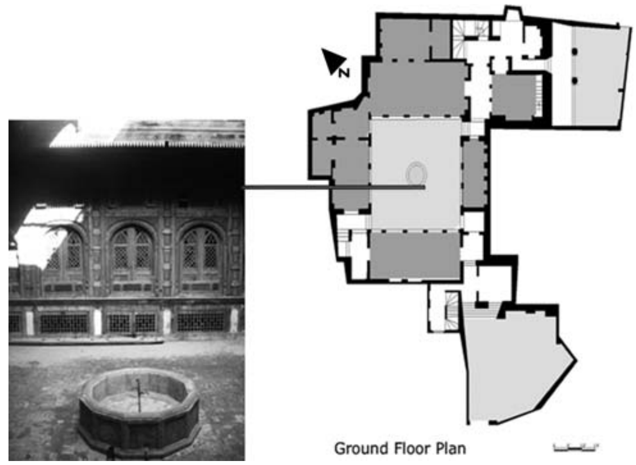

Figure-3: Plan of Allah Buksh Haveli

of the *Mohalla* (and possibly of the area). It consisted of separate *sehn* and spaces for the *mardana* and *zenana* areas (Personal communication with Nisar Sethi on Jan 22nd 2009). The *Mardana* (men) portion, consisted of offices of the business, and the *zenana* (women) area was intended for use of the *Sethi* families and their womenfolk. The *zenana* portion was converted into the current *Allah Buksh haveli* in the 1930s after the larger *haveli* was divided between the two sons of Karim Buksh Sethi (Qizilbash, 1990).

The *haveli* has a large central *sehn* measuring 40´x 40´, which is an important component of the bioclimatic design of the haveli. It plays a major role in reducing the harshness of the summer months by providing a micro climate for the haveli. There is a fountain in the middle of the courtyard, and wooden arcades on all four sides which open to the four main *balakhanas* (reception rooms) on the ground floor. The term *balakhana* is Persian and means an 'elevated room' (Qizilbash, 1990). The *balakhanas* are elevated five feet above the courtyard and three balakhanas have large *tehkhanas* (basements) underneath them. The *balakhanas* and *dalans* on the first floor receive air and ventilation through the courtyard. The courtyard is oriented NW – SE and draws in air from the outside through natural wind flow, as well as through the *tehkhanas* via the stack effect. The three *tehkhanas* are located along SE, SW, and NE directions. The largest *tehkhanas* (SW) is of double height at 22´. There are multiple ventilation shafts on its walls. The other two *tehkhanas* are smaller in size. One is located at the NE side and has ventilation shafts, and may have been used for sleeping purposes. The third *tehkhana* (SE), the smallest of the three, doesn't have any inlet shafts. There is a door which opens onto the street outside, and vents towards the courtyard.

5.1 Passive Ventilation Strategies used in Allah Buksh Sethi Haveli

The placement as well as the size and orientation of the courtyard are important aspects of the design. The Allah Buksh haveli has three courtyards: one at the SW entrance from the street, then the central main *sehn,* and the third on the E corner, leading to the side street. All the three courtyards provide for different functional needs, but they all facilitate the flow of the prevailing wind into the *haveli.* The two smaller courtyards on the periphery of the *haveli* channel the summer breeze into the *haveli*. The central *sehn* with its fountain adds moisture to this incoming air, thereby cooling it, and facilitates the passage of this air into the *balakhanas*. Another method to achieve the flow of air in the *sehn* is through the large fan (hanging from a steel wire across the courtyard), which is moved manually to increase the air flow within the *sehn* and into the *balakhanas*.

5.2 Natural Ventilation

Natural ventilation is the process of supplying and removing air from an indoor space by natural means. In the climatic context of Peshawar, where strategies must be employed to cope with the hot-dry climate, it is equally important to cater for ventilation for the hot-humid climate as well. Generally, cooling strategies used to combat climatic conditions of the hot-dry weather include evaporation, radiation and convection methods. Strategies used in hot-humid conditions like stack ventilation encourage wind flow and movement through the house. The *Sethi Haveli* uses the placement of openings in horizontal and vertical patterns to improve natural ventilation through the building. The natural ventilation strategies employed at *Sethi haveli* are the following:

1. Wind driven ventilation and
2. Stack ventilation.

These are described in the following sections.

5.2.1 Wind Driven Ventilation

Wind driven ventilation has several significant benefits, like being a natural source and thus readily available. It can be controlled by the size and angles of the aperture to flow as required. In Peshawar, the direction of summer winds is towards North and N-W. This works well with the orientation of the *haveli's* front entrance, and takes wind movement towards the central *sehn* and through the main *balakhanas*. The following factors help in the natural ventilation of the house:

i) Site and building situation to increase exposure to airflow effects:

The front entrance to the *haveli* is located on the SW side to allow the summer breeze to enter the *haveli* (Fig 4). On the first floor, the front has been left open. This allows the wind to flow into the *sehn* and the raised *dalans* on the first floor.

ii) Optimum orientation of the living rooms to the prevailing breeze and the linkage between leeward and windward sides to utilize pressure differences:

The orientation of the *sehn* allows air to flow into the main *balakhana* on the SW side, and the *balakhana* at SE side. The fountain in the middle of the courtyard adds moisture to the dry air and further cools it. The raising of the *balakhanas* 5' above the courtyard floor also facilitates the wind flow in the interiors (Fig.5).

iii) Maximum skin opacity through the number and sizes of openings:

All rooms have windows with multiple operable components. These can be opened horizontally or vertically (Fig. 6). The flow of air can be increased or controlled by choosing which component of the window to open (Fig.7).

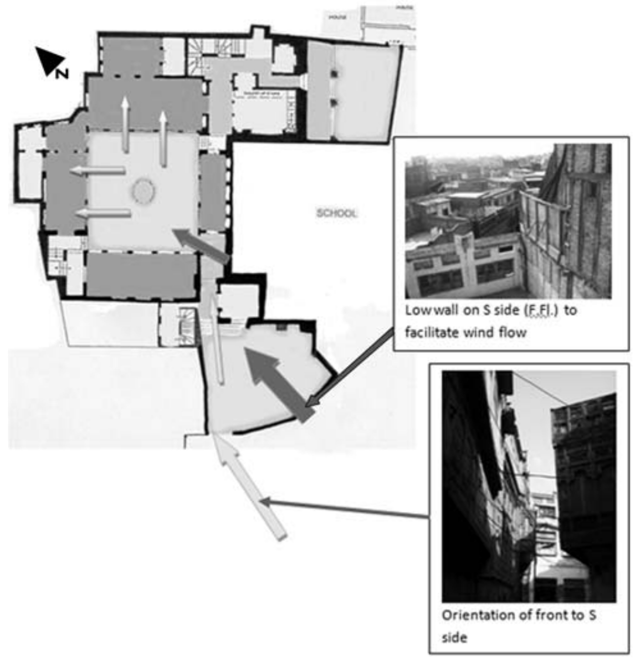

Figure-4: Orientation of Haveli towards the prevailing winds.

Figure-5: Orientation of the rooms to the prevailing breeze, and the exchange of hot and cool air.

Figure-6 & 7: (L) Ground floor SW balakhana. (R) First floor dalan.

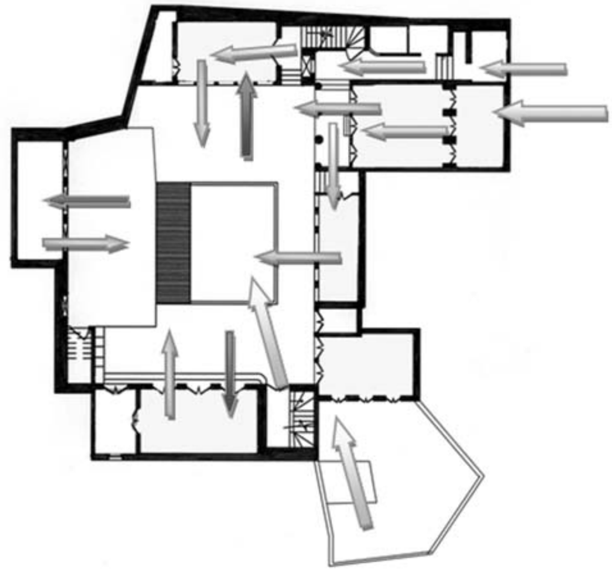

Figure-8: Plan of 1st floor showing the exchage of air in room.

Figure-9 & 10: (L) Rooms open up to one another. (R) Circulation of air through open rooms.

Figure-11: Plan of 1st floor showing the exchage of air in room.

iv) Reduction of internal obstructions, by opening rooms to one another:

All rooms on the ground and first floor open into one another, and there is efficient flow of air between them (Figs 9 & 10). The openings, whether in line or staggered, encourage circulation of air. Multiple openings between rooms and into the courtyard enhance the flow of the wind.

v) Reduced plan depth of rooms and increased openness of side sections to facilitate cross-flow and vertical flow of air throughout the haveli levels:

The rooms of the haveli are longer along the courtyard side and shallower in their depth (Fig.11). This allows better wind flow throughout the haveli. All rooms open into the side rooms and have multiple openings into the courtyard. The internal flow of wind is hence uninterrupted.

The *sehn* acts as a duct and re-entrant space for ventilation. The stairways act as vertical ducts for exhausting hot air from the *haveli* and promoting air movement. The design of the haveli shows that the rooms and spaces are conceived as large ducts that can moderate and direct flow (Hyde, 2000).

5.2.2 Stack Ventilation

Stack ventilation occurs due to differences in temperature. When there is a temperature difference between two adjoining volumes of air, the warmer air, having a lower density and being more buoyant, will start to rise above the cooler air, creating an upward air stream. In order for a building to be ventilated adequately via the stack effect, the following must be considered: the temperatures on the inside and outside of the building must be different; and the apertures that facilitate air movement must be planned at lower levels of a room for intake of colder, denser air from the exterior, and higher apertures must be provided to allow the warmer indoor air to rise and escape the building. Stack effect increases as the difference in temperature increases, as well as the height between the higher and lower apertures. Stack driven ventilation does not rely on the movement of air, so can take place on hot summer days with negligible air movement, when it is most needed. It offers a stable flow of air, giving greater control over choosing areas of air intake, and is a sustainable method.

This method of ventilation is employed in all the *Sethi havelis* by using double height *tehkhanas*. These *tehkhanas* are up to 30 feet below the courtyard floor (Fig. 12). In the Allah Buksh haveli, three *tehkhanas* open into the courtyard. The largest among them is the two level *tehkhana* on the SW side, where the lower level is used for accommodation (Fig. 13). This was quoted as housing the family, and being very cool, all through the summer months (per comm., Rabia Sethi, Nov. 15th 2008).

The Allah Buksh haveli has a series of inlet ducts designed in the two larger basements. These open on the outer walls in the open spaces of the haveli and outside it, where inlets are designed at a height of about 15 feet higher than ground floor level (Fig.14). The use of solar chimneys attached to these ducts is seen at the roof level.

Internally the apertures open at a height of 5' inside the *tehkhana*. The outlet aperture is on the opposite side of the wall at the height of 22' and opens into the *sehn* (Fig.15). The thermal mass of the external walls (3-4 feet thick) and the level of the *tehkhana* at twenty feet below the ground level maintain a lower temperature inside it. The warm air in the *tehkhana* thus rises to the vent opening into the *sehn*. Here the air from the *tehkhana*, which is still cooler than the hot air inside the *sehn*, pushes the hot air out and replaces it. In case of natural wind flow into the courtyard from the Southern side, the cool air from the *tehkhana* is pushed into the *balakhanas* (Fig.16).

Figure-12: Double basement of Allah Buksh Haveli

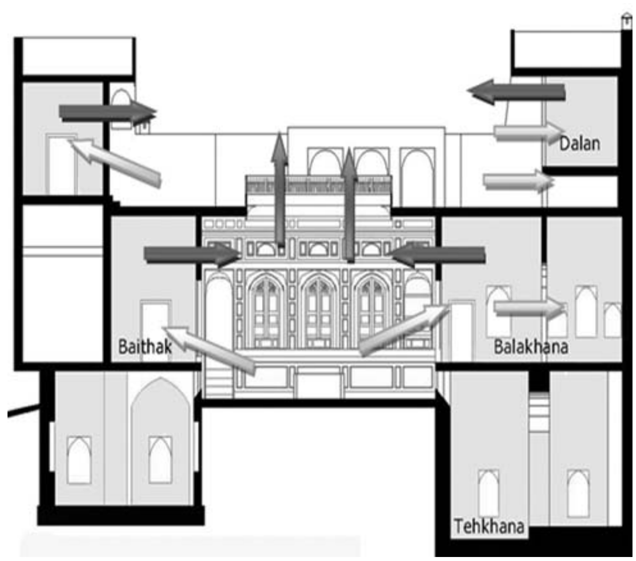

Figure-13: Stack ventilation on the Ground and First floor.

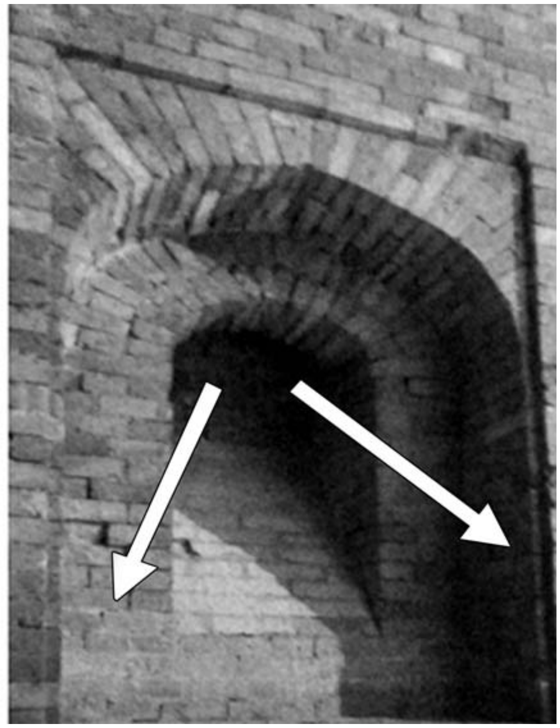

Figure-14 & 15: (L) Intel of basement duct. (R) Duct aperture inside the SW basement.

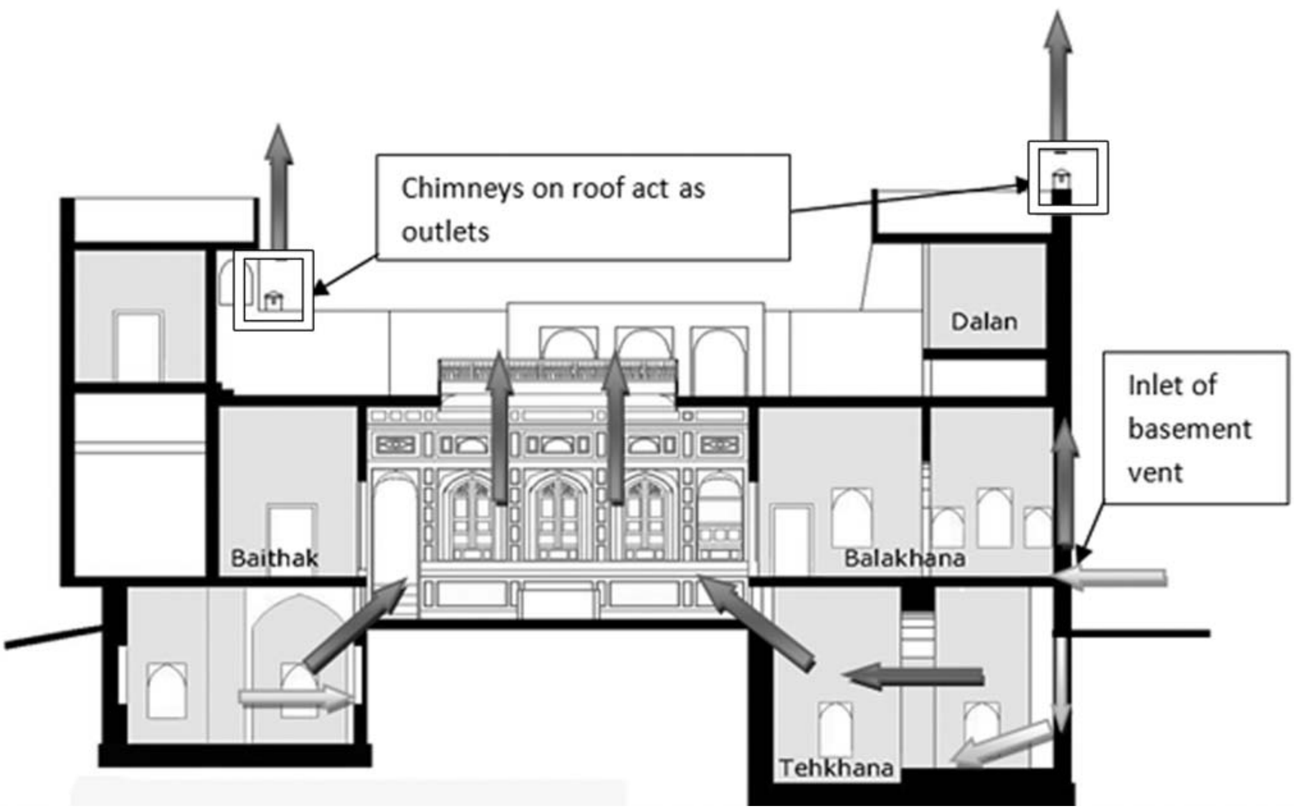

Figure-16: Stack ventilation through *tehkanas*.

Figure-17: The chimney of the ventilation duct on NE side.

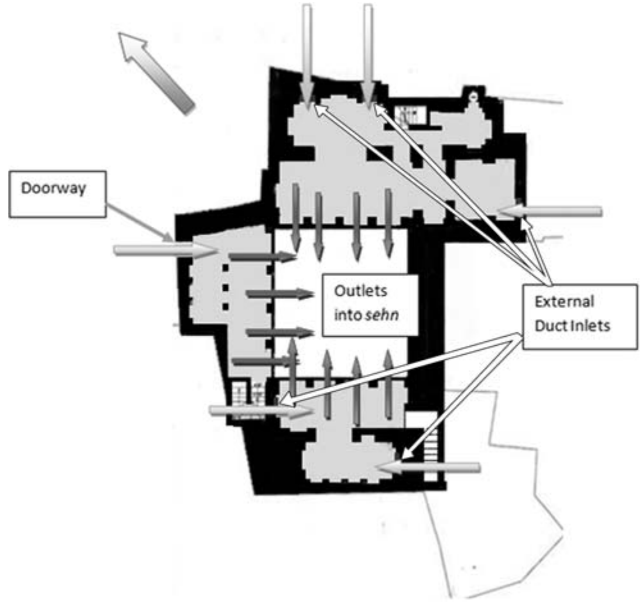

Figure-18: Stack ventilation via inlets and outlets of the *tehkhanas*.

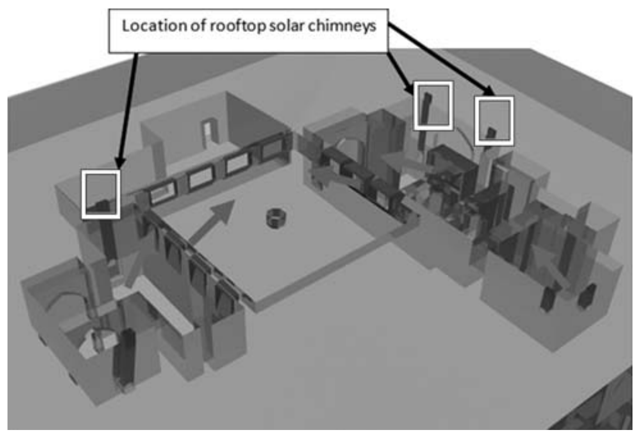

Figure-19: 3D of tehkhanas' stack ventilation; showing inlets (dark gray) and outlets (light gray).

The vents of the openings in the *sehn* are covered with *jallis* (wooden lattice screens) which are slanted at a 45° angle towards the basement. This helps to direct the flow of air between the inside and the outside.

The shafts in the SW and NE *tehkhanas* go up to the first and second floor roof levels, and terminate in chimneys. These chimney-like towers are outlet/inlets connected to the ducts from the *tehkhanas.* They have been blocked for many years, and are no longer functional.

This research pursued the objective of studying the traditional *Allah Buksh Sethi haveli* of *Sethi Mohalla* and its context, in order to understand the indigenous sustainable responses to the issues of ventilation and environmental comfort, and to apply these in the current scenario.

Ventilation plays an important role in making buildings healthier by displacing heat from the building. It is required to remove air pollutants, odors and water vapor from a building. The natural air flow, coupled with stack ventilation techniques, continues to replace air throughout the rooms of the *haveli*. Evaporative ventilation helps bring down the temperature of the *sehn* and surrounding *balakhanas* during the evening and the night. The high ceilings of the *balakhanas* and the *dalans* help in temperature stratification. As hot air from the living zone rises upwards, it escapes out of the rooms through the high ventilators and is displaced by relatively cooler air from the *sehn*. The *tehkhana* of the *haveli* continually brings in cool air from the exterior and pushes out this cooler air into the *sehn*, from where it circulates through the surrounding rooms.

The evidence from Oct 22nd 2008 - June 25th 2009 (interviews conducted in field study) suggests that there is more to vernacular passive cooling methods than meets the eye. Of critical importance is the active participation of the occupant of the house: by spatial migration; in adjusting (shutting or opening) of windows and doors to reduce temperatures by increasing air flow; and wetting the courtyard floor to induce evaporative cooling in the hot dry season. Nicol et al (Nicol, Rijal & Humphreys, 2007) state that the use of windows is a key adaptive opportunity in naturally ventilated buildings, especially in the summers. The opening of windows to increase ventilation or the closing of windows to reduce heat gain in summers are important factors that contribute to maintaining comfort for the occupants. In context of the *Allah Buksh* and other *Sethi Havelis*, there is also a strong tradition of retiring to the *tehkhanas* during summer afternoons (Per. Com. Saleem Sethi, Jan 29th 2009).

The occupants of the various *Sethi havelis* narrated feelings of ‘relative thermal comfort’ experienced in the *tehkhanas*, and some older members described them as ‘ice-cold’ and ‘*hawa-dar’* (breeze running through) in the summers. Reynolds (2002) attributes the feeling of “relative comfort” of occupants to having active control over their environment. The comfort levels regulated by adaptive behaviour include active measures like seasonal spatial migration through the house, and inducing evaporative cooling (through the use of wells in the *tehkhanas* and pots of water on the first floor) to maintain thermal comfort levels. The resultant temperature range will be deemed comfortable, based on culture and the phenomenon of acclimatization.

6. CONCLUSION

Integrated design, where each component is considered part of a greater whole, is critical to successful sustainable architecture. In the context of the *Sethi havelis*, there is a need to look at them not just as remnants of the past but rather as lessons for our future. We observe that these have the ability to provide comfortable living conditions during large parts of the day in the summers, and consequently a major part of the year, thereby reducing annual cooling costs. The combination of the *tehkhanas* with the *sehn* has the ability to create more thermally comfortable conditions inside the house through natural evaporative ventilation. This study shows that in reducing the harsh effects of summer heat, one does not necessarily have to resort to energy-intensive methods, and by reducing the use of mechanical energy for cooling and ventilation, one can save precious energy that could be used elsewhere.

Today buildings are made more comfortable by enclosing them with glass and employing mechanized cooling systems within. The question is whether our modern approach of closing in buildings is a sustainable response to our environmental context. This research investigated just that, and concludes that vernacular houses have the ability to create comfortable conditions for their residents without the use of any mechanical means. Thermal temperatures above the accepted standards of comfort in the context of Pakistan (Nicol et al, 1994) can be mitigated by opening or closing windows of a space and by using ceiling fans. We need to design mix-mode buildings that incorporate thermal mass, night ventilation and operable windows to provide comfort and occupant control during the spring and fall seasons, with air conditioning used only during the hottest months. Such designs not only use less energy, but also offer occupants greater control, thereby reducing the need for mechanised cooling and ventilation through the major part of the year. Producing energy from renewable sources is a widely recognised necessity for a sustainable building, which helps one avoid many negative environmental impacts like the release of green house gases and other pollutants, and the depletion of fossil fuels.

Reinvesting in the mix-mode courtyard house which utilizes traditional ventilation strategies along with modern features and amenities to provide for contemporary needs is the answer to our quest for sustainable architecture. The passive ventilation systems can be used for providing thermal comfort in the months of March, April, May, and June, where air movement would help generate comfort levels. The active systems may be used to transform the energy from the sun or the wind into electricity, to cool the house during July and August, or heat it in December, January and February, when internal climatic conditions become uncomfortable. Future studies are needed to help increase our understanding of the characteristic behaviour of a traditional *haveli* and its passive architectural design features, and how these may be employed to make our current architecture sustainable.

Glossary

Balakhanas	Elevated Room
Dalan	Reception Room
Haveli	Courtyard House
Hawa-Dar	Airy, Well Ventilated
Jalis	Terracotta Trellis
Mardana	Men’s Quarters
Mohalla	Neighborhood
Sehn	Courtyard
Tehkhana	Basement
Zenana	Women’s Quarters

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