Natural ventilation as a solution towards sustainability in architecture

M. Mahmoudi Zarandi
Islamic Azad University, Iran

ABSTRACT

Natural ventilation in ancient building proposes and introduces some strategies for the modern architecture while representing the natural ventilation as a sustainable cooling system in traditional Iranian architecture.

A sustainable development which widely discussed in scientific communities introduces environmental sustainability as one of its aims and environmental sustainability focuses on the use of clean recycling or renewable energy.

The sustainable architecture that advances to a point in order to be allowed to reach its aims and goals deems necessary the design off any building with the least adverse effect on environment as well as design consistent with nature. Thus by considering the traditional Iranian architecture, it is observed that Iranian architectural characteristics conform to the rules of sustainable architecture; and can obtain sustainability in modern architecture by being reveled by certain features of traditional Iranian one.

Natural ventilation, as used a natural energy such as wind and avoided using costly polluting energies, has mixed the framework and form of architecture with nature. In this context, the operation of a wind tower as one element of traditional Iranian architecture to being about cooling is defined. Then, the paper present some approaches to the use of natural ventilation in a building by taking models of its general concept. This model can be used in areas with hot-humid, hot- dry and even mild-humid climates.

Key words: natural ventilation- climatic design- sustainable architecture.

1. INTRODUCTION

Since human being always sought to adapt himself to his surrounding environment, the people in every region of the world endeavored to improve their living standards by employing the existing facilities and their levels of ingenuities. The unbridled increased energy consumption and uncontrollably employed technological instruments have left irreparable damages with destructed environment.

Iranian communities particularly the inhabitants of hot climates have also initiates and invented procedures to cope with the considerably intolerable and in supporting head of air. A regard to architecture as being used a science with its primary aim to create a heaven or a shelter to make people immune from the damages and harms of some natural factors is especially important.

2. NATURAL VENTILATION AND SUSTAINABLE DESIGNING

The principle of designing relies on the fact that a building or a structure is a tiny part of our surrounding nature and must act as a part of echo system and placed in to the life- cycle of organism. An access to qualities of higher standard, security and tranquility that really provide us with health and security constitute one of the most important goals of sustainable architecture.

Meanwhile, it is to be noted that taking advantage of the old learned people's experiences to improve the quality of architecture would pave the way to achieve a stably permanent design.

A sustainable designing concept invites our

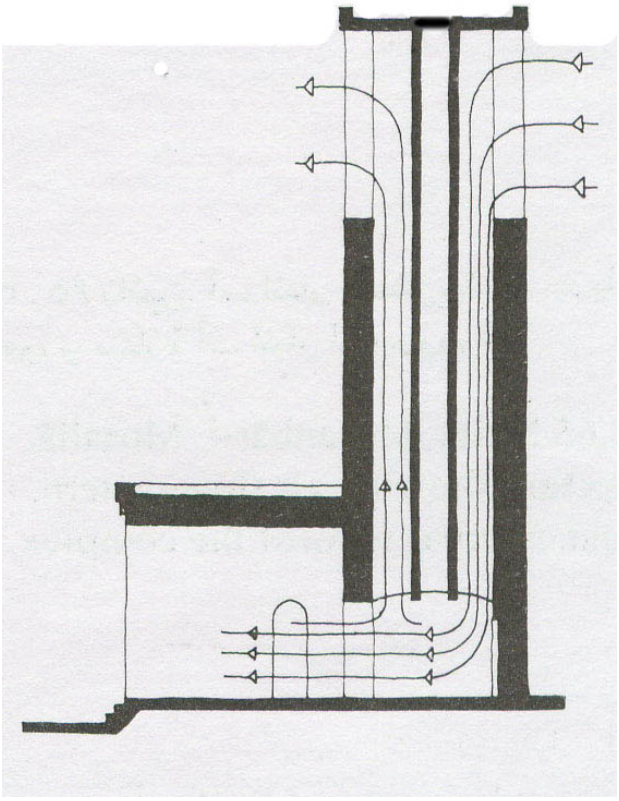

Figure 1: Natural ventilation in Iranian architecture (Tavasoli, 2002).

effort to create the maximum amount of comfort for people by scaling up the standard of living and produce the least volume of damages to the environment.

Comfort can be provided in sustainable designing if the least level of pollution affects the living conditions in the environment and the natural possibilities are used satisfactorily.

Natural ventilation will, in many respects, influence the way in which sustainability targets can be achieved. It will, on one hand, provide a clean and recoverable energy and contribute to warding- off of head and facilitated temperature requirement and that of humidity with no use of recoverable energy which is, in it, another stride to reach the sustainability and on the other hand, it plays an effective role to maintain one s health in a building. It will provide the highest range of comfort by everything carbon dioxide and the pollutions of spaces.

The problem of quality as dealt with concerning the climate flowing within a structure plays a special part in establishing comfort conditions. The quality of climate in a building is related to the contaminating resources in a structure and the rate of fresh coming air.

If a structure has within it a contaminating substance that is thicker than the authorized level will inevitably provide discomfort and unpleasantness for the occupants of the building and hereinafter necessitates providing ventilation in order to remove this problem. In the interim, natural ventilation or air- conditioning has its special position.

3. NATURAL VENTILATION

The word "ventilation" has a Latin root of "venture" that means obviously "weather movement or displacement" (Watson, 2004) "ventilation" is a process during which the internal air flow of a building is replaced by the fresh air coming in from outside of it or on the other hand, it is said to be an interchange or exchange of inside and outside air flow on the condition that no air facilities are used in this case (state of affairs) and no irreplaceable energy is consumed either.

This method has been use since a long time as one original technical of refrigeration in the world. This acts based on a methodology by which heat transfer takes place by way of alluvial operation and air displacement wards off the heat.

4. VARIETIES OF NATURAL VENTILATION

4.1 Horizontal ventilation

A horizontal ventilation consist of creating a typical air flow in a structure by making a hole in the direction in which the wind blows and one more hole in another direction of it. Because the wind always blows in a horizontal direction it continues flowing in its horizontal direction. Across the structure although there are holes developed in it.

Then it flows out of the structure. This process in which the air flows is called horizontal ventilation or air conditioning. The pressure the wind applies to the surface. This pressure distribution depends largely on the dimension and size of a surface (Fig. 2).

4.2 stack ventilation (vertical ventilation)

When an air current develops due to varied internal and external air temperature, it continues its flowing course vertically with the last resis-

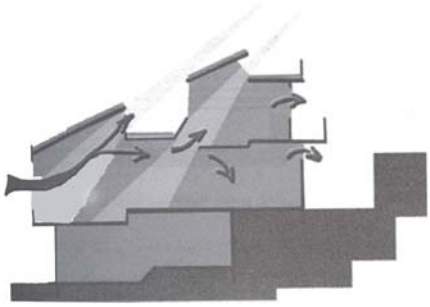

Figure 2: Horizontal ventilation (Saberi, 2002).

tance.

This varied temperature between internal and external of the room and its different perimeters results in a varied density and as a result, the varied pressure causes the wind to move. This effect is called that stack a known stack effect. It is in this state that the natural ventilation takes place as soon as the air begins to flow in a vertical direction. As far as vertical stack ventilation goes; the gravity force of earth influences it considerably (Fig. 3).

The following factors bring about stack ventilation:

- More temperature in the internal air but less that of external one.
- Warmer air moves up wards in the structure.
- Negative pressure develops in downstairs heights of building.
- Positive pressure in upstairs heights of building.
- Warmer air flows outside of the building out of the roof holes of building.
- Replaced colder air inside the building from the incoming pores and entrance of floor area.

A pressure difference created by using a stack depends on three factors such as acceleration, earth gravity, base point varied height and

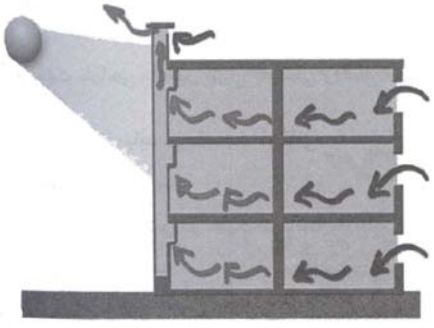

Figure 3: Stack ventilation (Saberi, 2002).

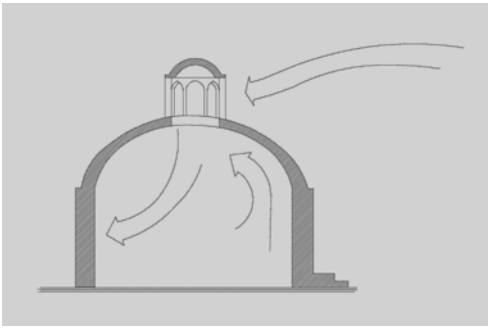

Figure 4: Kolah farangi in Iranian architecture.

targeted point as well as on the density difference of inside and outside air and is especially made by the following equation (http://www.Arch.hku.hk, 2006):

$$\Delta P_S = (\rho_{o-} \rho_i) \times g \times (h - h_{neutral}) \quad (1)$$

ΔP_S: difference pressure created by a stack (N/m^2 or Pascal),
ρ: air density (Kg/m^2),
g: earth gravity,
h: desired height (m),
$h_{neutral}$: base height (m).

5. KOLAH FARANGI

A *Kolah farangi* is said to be a hole on a vault-shape roof that acts as both an air vent and a light catcher (clerestory) for the space under the vault (Fig. 4).

When air passes over a spherical body, it has a higher speed there than everywhere and the pressure on this point falls in accordance with Bernoulli rule. Speed acceleration and pressure fall are equally based on a scientific principle.

Based on it if a room is equipped with a spherical or vaulted ceiling and a hole is made above its hemispherical section, there will appear a sanction on this point and the air inside the room is sucked out of it and as a result the fresh air enters the room from under the pores drilled for this purpose.

When a cap- shape cover is laid on the drilled aperture on top of vaulted roof a more pressure difference develops and better and more effective ventilation is provided than the case where a *Kolah farangi* has not been provided on the said aperture.

6. WIND CATCHER

A wind catcher is a traditional structure in Ira-

Figure5: Wind catcher in Iranian architecture.

nian architecture. It is used to dislocated, move and cools spontaneously the internal air of buildings by employing wind blow and varied air temperature. A wind catcher is a vertical canal that is drawn up in plans in the forms of square, oblong, octagon or circle. It is made up of two parts:

Internal section of canal that takes its start from the ceiling and leads down to basement and external part that consists of entry pores or holes for the wind to blow in and it is laid up on roof. Most Iranian- made wind catchers have the necessary capability to receive wind in every respect (Fig. 5).

A careful attention to the fashion in which a wind catcher is applied indicates that the lay of spaces for the entry and exist of air when blowing in directions for or against those of wind is an important factor that allows for the operation of natural system. In modern structure, this principle can be utilized as explained hereunder:

The most dominant principle used in the development of vertical ventilation in a structure is air pressure difference in the lower and upper part of it and also heat convection to the upper part of it. If a structure has openers where wind is allowed to flow in to the construction, we can provide a duct or a vent in its opposite direction where the canal can inevitably catches the southern light.

The air that flows inside it is heated by the sun light radiation and is moved upward and radiates out of it through upper openers. The suction that is created on top of it causes the air flowing in to the duct to be sucked in and facilitates air current.

7. CONCLUSION

The peculiarities and rules dominating the development of natural ventilation during earlier Iranian architectural periods are good practices to take patterns and using them for modern architecture. This will lead up the art of architecture to sustainability while increasing the profitability of clean energies.

REFERENCES

Battle McCarthy consulting Engineering, 2002. Wind towers, Ahmadinezhad (translator), khak press.

Saberi, O., 2002. Low energy architecture, Negahe sabz press, Tehran, p134- 6.

Ghiabaklou, Z., 1996. Passive cooling system, Ph.D. thesis, New South Wales University.

Tavassoli, M., 2002. Urban structure and architecture in the hot arid zone of Iran, Payam Press, Tehran, p100.

Watson, D. and K. Labs, 2004. Climatic Design, Ghobadian (translator), Tehran University Press, p64.

http://www.Arch.hku.hk/teaching/lectures/airvet: 2006/02/01 18:30 pm