NATURAL VENTILATION EVOLUTION AND INFLUENCE ON BUILT LANDSCAPE

EVOLUŢIA VENTILĂRII NATURALE A CLĂDIRILOR ŞI INFLUENŢA ASUPRA PEISAJULUI CONSTRUIT

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Abstract. *In the context of sustainable concerns of European Conventions in Landscape held in Florence in 2000, the paper points to a green alternative solutions for the rehabilitation of the build environment. It's about researching and promoting millennial solutions, used since ancient times for natural ventilation. These solutions of bioclimatic architecture is today an inspiration to create a sustainable, unpolluted built landscape.*

Key words: sustainable landscapes, naturalventilation, bioclimatic architecture

Rezumat. *În contextul preocupărilor sustenabile ale Conveţiei Peisajului European ţinută la Florenţa în anul 2000, lucrarea de faţă aduce în atenţie o alternativă la soluţiile verzi de reabilitare a mediului construit. Este vorba de cercetarea şi promovarea unor soluţii milenare, folosite încă din cele mai vechi timpuri pentru ventilarea naturală. Aceste soluţii de arhitectură bioclimatică constituie azi sursă de inspiraţie pentru a crea un peisaj construit sustenabil, nepoluat.*

Cuvinte cheie: peisaj sustenabil, ventilare naturală, arhitectură bioclimatică

INTRODUCTION

Degradation currently facing urban areas imposed daring solutions "green" rehabilitation of the polluted environment. Many of them are related to the sustainable improvement ventilation of constructed interior and exterior spaces. In light of these concerns, the paper points to a green alternative solutions for the rehabilitations of the build environment. It's about researching and promoting millennial solutions, used since ancient times for natural ventilation. These solutions are now a source of inspiration to create a sustainable build landscape, unpolluted. Creating this kind of landscape is in attentions of European Conventions in Landscape held in Florence in 2000. In the present paper will highlight aspects of comfort and natural ventilation of buildings in different climates and terrain, thus creating certain types of vernacular architecture that we find in different part of the world, depending on climatic conditions have brought them. In the past and today, one of the means to remove excessive heat from the building was ventilation. Ventilation of buildings is required to maintain an acceptable level of oxygen in the air needed for life, but also to prevent the

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increase the increase of CO_2 and other harmful gases and particles that can result from human activities, objects and materials used in buildings interiors (Gallo C.et al., 1998).

If, in the beginnings, natural ventilation was used only to achieve certain minimum conditions of comfort, in the eighteenth century and nineteenth-century she ventilate small dwellings and public buildings has become a social problem for public health. Therefore, professionals in constructions science and medicine have begun to assess and bring public attentions to need to ensure fresh air in buildings both quantitatively and qualitatively, using the most effective methods not proved always the most efficient.

MATERIAL AND METHOD

Since ancient times, the form and the function of buildings were subordinated to the climate type where these were built, and especially to the thermal comfort and adequate indoor ventilation. Consequently, the paper examines and highlights, in chronological order, some of the characteristics of different types of architecture, according to rules of natural ventilation, heating or cooling of buildings and their relationship with the environment.

RESULTS AND DISCUSSIONS

In what follows, we track how the populations subjected to extreme geographical conditions have succeeded to solve inventive problems of adaptation to high or low temperatures, depending on the type of climate or the nuance of geographical and cultural characteristics of the area. Will be stressed as the main settlement on bioclimatic considerations in different geographical areas.

In cold climates, the most important factor for human habitation is to maintain acceptable indoors heat conditions. Concern to minimize heat loss led to construction of the hemisphere, resulting in maximum volume in a form with minimum external surface. In these areas meet semi or fully buried underground constructions. In most examples of vernacular architecture in cold lands, it's giving up the possibility of solar heating or lighting for better insulations and protection for strong winds. Thus, the Eskimo igloo type houses, with no windows, receive light through the translucent wall of ice blokes, and when is needed better insulations or less light, the interior walls are covered with seal skins. Entering of the igloo is protected by a wind tunnel with a parapet witch could be covered at need with animal skins. The interior space is layered so that stead of sleeping is located on the highest stage, where the air is warmer (fig. 1).

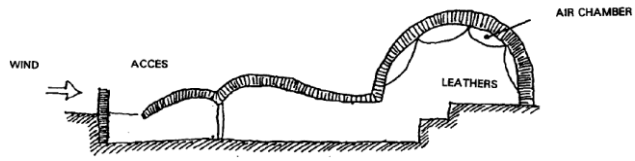

Fig. 1 - Construction adapted to cold climate. Igloo Eskimos (Gallo C.et al., 1998)

In summer and /or a warm climate, you can apply three levels of action in designing buildings to achieve thermal comfort in the most convenient way. So we talk about avoiding heat in first step, then passive cooling, which is achieved mainly through natural ventilation. If these methods are not sufficient to provide comfort, are complemented by the third method of giving action only applies to the modern era, namely the use of mechanical equipment just if they are necessary and efficient. Passive cooling is more dependent on climate that passive heating. Therefore, passive cooling strategies in hot and dry climate are different from those of the hot and humid climate (Lechner N., 2009).

Even during antiquity (Egypt, Mesopotamia, Greece and Italy) and until recent times, the principal of architectural composition in regions with **hot dry weather** concentration sought shade in a protected outdoor space. Introversion is used to a living space with outdoor patio or courtyard type, protected and shady portico, as they were and small ponds or fountains, creating a favorable microclimate. Building of this type today are specific to North Africa, Near and Middle East, Islamic civilization in general. This creates a landscape of white fortress-looking building with few and small window or door openings, separated by narrow streets which are protected from excessive heat by the shadow left by high walls. Building were upstairs balconies/ loggias covered with braided straw to shade Islamic streets but also to create a rest area facing the street, protected from heat and prying eyes (fig. 2).

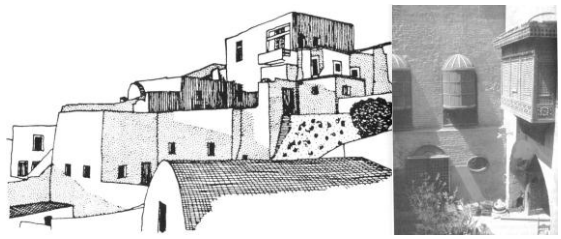

Fig. 2 - Buildings adapted to warm dry climate. Santorini, Greece (left); Mashrabia in Cairo, Egypt (right) (Lechner N., 2009)

Another important factor is how the massive walls and type of construction materials (usually stone or earth bricks) contribute to a comfortable indoor climate both day and night. Thus, massive wall with high thermal inertia, not only delay the passage of heat from outside to inside, but during the day store it inwards to release it at night, when the outdoor temperature drops quite a lot in these climates. The process takes place in the sense of cool night store and release it inside late, just when the heat of the day is more powerful. In urban sites or other places where there is wind of different intensities or different direction can be used to capture air currents with wind tower (fig. 3), which have their openings at the top in all directions or just prevailing wind direction, a way found even today. These towers would be based on porous ceramic pots or pools, and facilitator of cooling air that enters the room through evaporation. In the same

way that there could be penetrated by air ducts in the basement of building or even deeper in the earth where water supplies are kept at optimal temperatures.

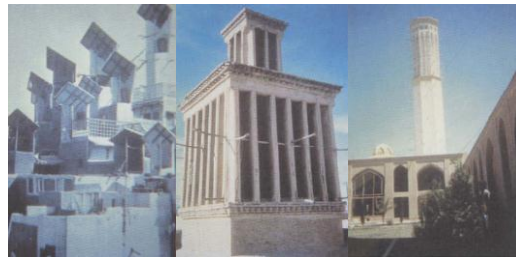

Fig. 3 - Wind towers (Gallo C.et al., 1998)

Massive dome structures encountered in unicellular homes in village in Iran, Afghanistan, or Kirokitia-Cyprus are also an appropriate strategy in the dry tropical climate zones. In addition to the thermal inertia afforded by their massiveness, their occupants will benefit from cooler air through the vertical stratification of air, hot air is exhausted through an opening to the top, but that, due to the shape warming is happening partial on the side exposed to the sun only, and radiant cooling at night is done all over the dome. In Cappadocia, Turkey (fig. 4 left) were carved thousands of homes in tuff cones, because they offer protection against heat and extreme cold. Community residents from Mesa Verde, Colorado (fig. 4 right), built the village in a very large fault rock that shade the entire settlement. In areas where no stone huts, were built with massive walls, roof and floor (Navajo population in southwestern North America) or mud from the floor (the village of Spain or Mexico)

Fig. 4 - Dwellings dug into volcanic tuff cones, Cappadocia-Turcia (left); Dwellings village built under a fault rock, Mesa Verde-Colorado (right); (Gallo C.et al., 1998)

In **hot humid climates**, where humid exceeding 80%, is aimed the upper shading of constructions and removal of moist air around the building and the building itself. Traditional building type in these regions is that high ground by means of columns, walls of light materials being perforated with multiple holes and shaded using very wide eaves. Thus houses ware well ventilated and spaced apart to allow good ventilation wind out. Pile dwelling of up to 3 m, were built in wetlands or near water, in some countries in Asia, Africa, Central and South America, they reflect the concerns and lifestyle of people in these areas. Niger's population built their huts Zarma cylindrical timber of soil and plant material from the wall and conical roofs, no windows, only advance through a door, built

on wooden poles to the ground, and being apart from each other, all contributing to good ventilations (I.S.Lebedev, Jurov C., 1985). Traditional Japanese homes are perfect model of symbiosis between the needs of comfort and safety of human and natural environment with wet tropical climate and strong seismicity. Built on one level, the high ground of natural materials, Japanese homes had walls of the frames lighter board that was caught between waxed paper, slide the entire side of the building opening onto the garden or the other spaces. One to three verandas with high slope roof and wide eaves protect the house from excessive heat and humidity. Like the Japanese homes, the homes in US Gulf of Mexico (fig. 5, left), are built on the same principles of natural ventilation and humid removal: light wooden structures were lifted off the ground and had large openings in doors and windows so to allow cross ventilations, and air layering rooms facilitated high vertical evacuation, and also through holes in the ceiling and roof openings in the gable or dormer windows. In these case, deep verandas have a defining role in the shading of walls exposed to maximum sunshine during the day. Many of these concepts have been incorporated in to the neoclassical architecture, popular in South America and Europe in the nineteenth century. Classical portico was used to shade windows and high doors and stairs, and continued with a centrally located skylight or tower, creating a strong chimney effect, facilitating cross ventilation to all rooms (fig. 5, right) (Lechner N., 2009).

Fig. 5 - Building adapted to worm-humid climate. House in Louisiana, (left); Neoclassical house in Waverly (right), S.U.A. (Lechner N., 2009)

Temperate climate make the most difficult problems in terms of ensuring thermal comfort and ventilation, due to large temperature differences from summer to winter. The first houses protected against the cold, were attested by archaeological excavations since the period of the primitive. These houses have much wood in their structure material, so using the thermal inertia of the earth and the roof tilted slightly raised above the ground protect very well against strong winds from the plain. In various areas of the temperate climate found ingenious related solutions to housing construction. In general facades were entering and living rooms facing south, protected from sun and rain by a porch wide eaves of the roof. In the northern part of the house roof down closer to earth and it is shelter to various storage spaces of food or feed, or even kitchen. In France as in Transylvania homes were divided into two or even three levels so that all dependencies needed a wise households were embedded under the same roof (Lebedev I.S., Jurov C., 1985) (fig 6). More elaborate buildings of the nineteenth century built in temperate zones (fig. 7) are designed to respond optimally to both

types of climate. The compact design of house with medium size windows which prevent heat lost in winter, but allow ventilation in summer. The chimney of the fireplace have double role: both to create the effect of summer heat circulation, as evacuating hot or foul air of the building, and also to evacuate smoke from the fireplace and to store heat in winter. Each room has openings on all four sides, thus facilitating cross ventilation and roof turret may have different names depending on its destination: light, lantern, dome, pinnacle or just to dress and representativeness of the building.

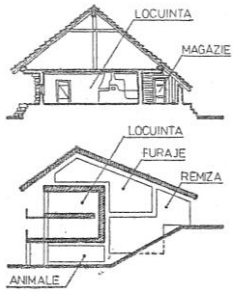

Fig. 6 - Traditional house in Moldova (top), house in Bricon – France (below). (Lebedev I.S., Jurov C., 1985)

Fig. 7 –Residence of the Governor Williamsburg, Virginia, S.U.A. (Lechner N., 2009)

CONCLUSIONS

When the depletion of conventional energy resources has created an acute crisis, has returned in very short time to the principles of sustainability. In this regard, given that natural ventilation principles have remained the same for thousands of years, the past twenty years, ventilation and energy conservation were the main topics of research in the design of buildings.

In the context of sustainable concerns of European Conventions in Landscape held in Florence in 2000, the paper points the bioclimatic architectural solutions as an alternative to green solutions build landscape rehabilitation.

REFERENCES

1. **Gallo C., Sala M., Sayigh A. M. M., 1998 –** *Architecture: Confort and Energy.* Elsevier Science Ltd., Oxford, p. 35, 67-87, 93-99,157
2. **Lebedev I. S., Jurov C., 1987** – *Arhitectura bionică şi bioclimatică*. Editura Tehnică, Bucuresti, p. 199-237.
3. **Lechner N., 2009 –** *Heating, Cooling, Lighting – Sustainable Design Methods for Arhitects.* John Wiley &Sons, Inc., Hoboken, New Jersey and Canada, p. 258-267.