Bio-Climatic Architecture

A “new” Architectural Style with a deep roots

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Introduction

Nowadays, for the first time in history, half of the world's population (3.3 billion people) lives in urban areas. In developed nations, the total increase in urban population per month is 500,000, compared to 5 million in the developing world (UN Habitat 2008/2009).

Urban areas act as climate modifiers. Climate elements, such as solar radiation, air temperature, humidity, and wind, are affected by the urbanization.

Urban warming decrease thermal comfort in urban areas, especially in tropical climate like in Philippines.. That raises not only the energy costs through the increase in the use of air conditioning but also the air pollution that has a negative impact on people's well-being and health.

The urban area is generally uncomfortable because the knowledge about climate issues among planners and urban designers is often missing, and also because there is a lack of suitable design tools for urban planners and designers (Eliasson 2000, Givoni et al. 2003).

Increasing the awareness of climate considerations among architects and studying the example of vernacular architecture that has been adapted to the nature of its site, urban area can be designed better, with a favourable microclimate.. For instance, Philippine traditional architecture uses natural elements that also respond to the climate conditions of the site (De Luna 2000).

Therefore the climate adaptation has to start with references to vernacular architecture. We should try to follow a local building tradition that works well, and adapt itself to the present context, in order to improve the thermal comfort in urban area.

1 Urban Shelter Design Development

The Importance of Vernacular Architecture

The traditional Philippine houses are called Bahay Kubo or nipa huts, and are still seen in rural areas all over the country.

These buildings are composed of 4 main elements: the roof, the raised structure, the windows, and the internal distribution.

The roof, made of nipa shingles or cogon thatch, is high pitched and usually open gabled to allow ventilation, and to protect from the wind and rain in the typhoon season. The roof, with wide overhang eaves, also provides shade from the hot sun (De Luna 2000).

These houses are elevated three or four meters off the ground, supported by wood or bamboo and with a floor composed of bamboo slats, usually placed convex sides up, that are spaced apart to increase ventilation. The raised structure create air circulation, protection from the flooding if the houses are located next to coastal or riverside areas, and also keeps out small animals from the main structure. This space under the house, called the silong, can also serve as a workspace, a storage space, a pen for livestock (De Luna 2000).

The structure has usually four walls, with windows, made of bamboo and nipa, dried grass, wood, or siding made from splitted and pounded green bamboo halves. The windows, called tukod, have swinging shielding, which can be oriented during the day (De Luna 2000).

There is usually one simple multy-use space on the interior, that provide ventilation. This space could be used for cooking, eating, and sleeping. Sometimes the cooking is over an open fire in one corner or partitioned off in a space in front of the stairs. In some house, there is an open front porch, pantaw or batalan, that serve as anteroom, and where water can be kept to wash dishes. This extension can be easily added (De Luna 2000).

This architecture responds full to the climate, with use of natural materials to answer to the climatic conditions of the site.

But today the Philippine's architectural landscape is a mix of this small traditional huts built of light materials, the massive Spanish colonial buildings with their heavy decorative style, the American architectures with their modern 20^{th} century styles, and today's contemporary concrete and glass structures of the cities (De Luna 2000).

Although the modern era pushed the Philippine architecture to the adoption of the lines of the International Modern Style, there is still one problem not addressed by this model that is the lack of knowledge in climatical design. The designer have the tendency to follow the international architectural trend even thought it is not suitable for the country's climate. So the designer has to look

back at the traditional design concepts which respond to the climate and apply them today in the modern setting.

2 Factors Shaping Urban Shelter Design

The Importance of Climatic Factors

In developing countries, the rapid urbanization takes to uncontrolled growth of cities and a formation of informal settlements, where climate aspects are disregarded, and the built environment influence the urban climate.

This condition implies the lack of outdoor and indoor thermal comfort; and this will have a negative impact on performance and health of people.

So it's important to improve thermal comfort conditions, especially in tropical urban areas, considering the environmental variables like factors that shaping urban shelter design, and not the contrary.

The 4 environmental variables are air temperature, radiation, air humidity and air speed. Let's analyze one by one:

- The air temperature is one of the most important climatic factors influencing thermal comfort. Since cities are warmer than their rural surroundings, the air temperature is influenced by the built environment. This phenomenon is called urban heat island; and field studies shown that the nocturnal heat island increases with increasing H/W ratio of street canyons (Johansson 2006).
- The absorption of solar radiation and the exchange of long wave radiation strongly affect the state of thermal comfort. The absorbed solar radiation, in an urban area, depends on the reflectivities of the urban surfaces and on the canyon geometry, actually the irregular urban surface trap solar radiation (Johansson 2006).
- A change in the humidity of the atmosphere affects thermal sensation, especially under warm conditions; so people feels warmer, sweatier and less comfortable. Also humidity, like the air temperature, is influenced on the built environment, actually the cities are more humid by night and dryer by day, for the heat island effect (Johansson 2006).
- Air speed is a major factor affecting state of thermal comfort, and is an advantage in hot climates. But, also in this case, the forms of urban areas

affect this variable. Air movement in urban areas become extremely complex, for the variation in the size and shape of buildings and the distances between them (Johansson 2006).

"Built-up areas influence the absorption and reflection of solar radiation, the ability to store heat, the absorption and emittance of long wave radiation, winds and evapotranspiration" (Johansson 2006), so it's important try to control this influence, and project with the climate and not against.

3 The Role of Architects

The New References

In this process of reference renewal, the role of the architect has to change.

Tough architects, planners and, engineers have always been involved in the housing projects, they have always neglected the most important factor in the design and planning of the housing unit, i.e. the climate. The climate is a major design parameter, although it has still been left out of the designer's considerations (Johansson 2006).

Philippine traditional architecture responds to the climate, so start to overlook the traditional habitat and the basis of vernacular architecture, that in general has been adapted to the nature of its site, can help to understand the climate adaptation of the area, and the need of the people.

The architects have to transform these rural building traditions into dense urban structure, maybe using the main elements, like the roof or the rised structures, in a new way, and sometimes with new materials or new techniques.

But the reference to the vernacular architecture is just a starting point to understand the approach on the climate adaptation, but the climate is changing, and we have to able to provide answers of this change.

We should promote the cooperation between architects and climatologists during the entire planning process, because it's important to increase the knowledge of climate aspects among urban planners and designer (Johansson 2006).

4 Design of Sustainable Shelter and Neighbourhoods

Guidelines for Urban Design

Hot Humid climates are between latitudes approximately 20° north and south of the equator, and Manila is precisely in 14° north and 121° est.

In Manila the annual temperature variations are small, the mean daytime maximum temperatures vary between 25 and 30°C; the humidity is higher during the night than during the day. In the night it varies between 80% and 90% and during the day it varies between 70 and 80% in the rainy season while between 60 and 80% in the dry season. Precipitation is high, but varies between wetter and dryer seasons as a result of the monsoon winds. Due to high humidity and relatively high cloud cover, daytime solar radiation and nocturnal cooling are reduced. Not only in Manila the wind speed is normally low, but also in the entire tropical zone.

The urban design guidelines for the hot humid climates have been studied from Givoni (1992 and 1998).

He maintains that the optimum orientation of wide avenues is at angle of 30-60° to the prevailing wind direction to enable the wind to penetrate into the city and through the buildings. Furthermore he claims that streets with long rows of closely spaced buildings perpendicular to the wind directions should be avoided because they block the wind. Givoni also agrees that the best urban configuration in this climate is with slender buildings with different high, tower blocks or with the short end perpendicular to the wind direction.

He emphasizes also the need of shade in urban spaces, which can be achieved with trees, canvas screens, and pergolas.

But this guidelines are vague: the design aspects, like the space between buildings and building heights, are not define or quantify; that because these guidelines are general and are apt to larger region, so they should be adjust to local climate factors and to other local conditions, such as topography, existing urban form and building traditions (Johansson 2006).

There are also some field studies in hot humid climate that can help in the planning. Erik Johansson, for instance, made a parametric study in Colombo, a city located on Sri Lanka’s west coast.

The results of that parametric study are that the greatest influence on thermal comfort at street level are from the H/W ratio, street orientation and the provision of horizontal shading. The street should have high H/W ratios to improve thermal comfort conditions; the H/W ratios would have to be as high as 4 in the street canyons oriented east-west, and at leat 2 in the street canyon oriented north-south. Street in Colombo require also horizontal shading to improve thermal comfort (Johansson 2006).

In Colombo, it is also important to facilitate air flow, so interrupted street frontages are disadvantageous because they block the wind. Shade and air can be provided with the use of detached, rather high blocks. Buildings could also be varied in height ad raised on columns to increase air movement at pedestrian level (Johansson 2006).

Now, with the knowledge of the climate factors, the building traditions, the studies of Givoni and the field study of Johansson; it's possible to outline urban design guidelines more precise for Manila:

- *Improve ventilation*

  Facilitate ventilation is prioritary for a thermal comfort, it lowers the humidity and the air temperature. So it's important at the street level as well as inside the house.

  _outdoor

  The shape of buildings should be slender and with different high, like tower or long blocks with the short end perpendicular to the wind direction;

  The buildings should be raise on columns to increase air movement at pedestrian level;

  The main wind came from east, so the east-west street should be wide to allow the penetration of the wind, with a H/W ratios of 3;

  The H/W ratios of the street canyon oriented north-south should be 2.

  _indoor

  The houses should be elevated three or four meters off the ground, to allow air circulation beneath the houses;

  The project of one simple multy-use space in the houses, provides ventilation;

The roof should be ventilated.

- *Protect from solar radiation*

  Also the protection from solar radiation is important for the thermal comfort, because it can lower the air temperature inside and outside the houses.

  _outdoor

  The urban spaces should be shaded with trees, canvas screens, pergolas, colonnades;

  The shade with trees should be make with wide foliage, that provide protection from direct solar radiation at high solar elevations and it also permit air movement at pedestrian level;

  The shading should be horizontal to improve thermal comfort.

  _indoor

  The addition of the front porch to protect from direct solar radiation of the wall;

  The roof should be made with wide overhang eaves, to provide shade from the hot sun;

  The windows should be project with swinging shielding, which can be oriented during the day.

The recent studies can help us in the project of urban planning. With some user-friendly computer programmes, we can study urban microclimate, with reliable results and detailed output. We can check the effect of H/W ratio and orientation, the effect of shading at street level and the wind corridors.

What the programmes cannot make are the understanding of the needs of the people and their life-styles. Only with a look on the vernacular architecture, a result of real life experience, we can know the needs of the people; needs that were satisfied 2000 years ago with an architecture that was able to respond to the climate moreover without the help of the programmes.

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