Biophilic architecture

(Towards a new potential of healthy architecture)

Associate prof. Dr. Arch. Amjad Almusaed
Poul la Coursvej 3 -121
8660 Skanderborg
Denmark
(amjad_almusaed@yahoo.com)

Dr. Eng. Asaad Almssad ABETONG AB - Hallstahammar, Sweden
(assad_almssad@hotmail.com)

Prof. Dr. Adm. Zaki Khalil
ABSTRACT

Today, upon reflecting on the various settings and experiences of our lives, we should be able to find some fairly close matches between characteristics we like and characteristics that would have improved our chances of survival. In our course we perceive that the natural contiguous keeps us healthy and in turn, probably promotes physical performance as well. Occupants of built environments don’t want simply to work, play, eat, or sleep in a functional building. They want to be inspired, invigorated, comforted, and reassured by their surroundings. They want spaces that will make them more appropriate, comfortable. The concept of biophilia deserves a deeper explanation. The hypothesis is that this affiliation leads to positive responses in terms of human performance and health even emotional states. This path will discover a far deeper integration of nature with the built environment and the potential synergies in exchanging energy and nutrients across the human-nature interface. The new movement aims to create environmentally friendly, energy-efficient buildings and developments by effectively managing natural resources.

Keyword: Biophilic architecture, indoor energy, green buildings elements, thermal comfort, healthy architecture.
1. INTRODUCTION

One of human body reaction in environment consists in achievement of the adaptation poise through the building a protective cover. This behavior attitude, observe to man, has one of the explication in neoteny, foetal nature of species. The protective cover appear thus a retort of the bio-psychics internees, understood as orientation to the shelter state. The measurable environmental parameters and performance of plant species in the urban environment and the quantification of the associated benefits are of primary interest. Sustainable development’s emphasis on limiting infrastructure and materials use helps contribute to affordability during the construction of a project by eliminating some costs altogether. In the longer term, sustainable design’s principles of energy and healthy architectural spaces and material durability help make a home affordable. Renew ability is the key to our human range and our prime resource for architecture. Every site is definite as to its location, natural relief, local vegetation, and its macro-microclimate.

Architecture biophilic is a part of a new concept in architecture, that work intensive with human health, ecology and sustainability precepts, such a integrate part of architectural formation which must be in optimal proportion with other buildings material. The position of green covering and its area depend basically on the category of functions that occur under this area. However, the interpretation and final implementation of biophilic architecture must have a regional dimension with regard to environment and culture. It offers an exciting opportunity to achieve environmental, moral, social and economic benefits. Much remains to be understood about energy, environmental and life-cycle processes to engage young and enthusiastic researchers in the world-wide greenly architecture community and for those interested in biophilic architecture.
2. Energy effectiveness on biophilic architecture (analytical study)

Passive biophilic architecture produces buildings that use less energy to operate because they feature efficient designs, materials and systems. The majority biophilic architectures have highly competent heating, cooling, ventilation, lighting systems, and appliances. In addition, these biophilic restructures are built of energy-efficient materials carefully installed to prevent the loss of conditioned.

2.1 Food, energy, activity and thermal comfort

The body converts food into energy. The rate at which this is complete depends largely on the activity level. The energy, which is released in this conversion, is dissipated by the body as heat and used for a small part as external work. The sensation of comfort depends to a great degree on the effortlessness. With which the body is able to regulate the one balance, with on one side energy production and heat gain, and on the other side heat loss, in such a way that the internal body temperature is maintained constant at 37°C. The factors affecting this comfort may be divided into personal variables (activity and clothing) and environmental variables (air temperature, mean radiant temperature, air velocity and air humidity). The second group of variables is directly depending on technological place and building design. Sensitivity to indoor function varies considerably as a function of an occupant activity and, as well as other personal factors.

2.2. Interaction between architectural composition and human attitude

The role of architectural composition, through its complex activities, it is to create the framework material, of the organized space, with a view to satisfaction the material and spiritual needs of the person and society. Over the ages man has used his ingenuity to make his protective space safe, warm and weather protected. The house for example isn’t only roof, but also a home, the place where it is formed the moral climate and which lasts the family spirit. The settlement isn’t only the relation system which it permits existence and species
perpetuation, but also complex form to express deeper necessity man, as spiritual being- need to communicate and unfurl of his activities, into adequate climate morally, culturally, and energetically. Architecture, as much as any other design activity, is dependent on a satisfactory reconciliation of the intuitive with the rational. A building has to be both poem and machine.

2.3. Outdoor energy conception (microclimate)

The first step towards biophilic architecture is creating a competent and suitable local microclimate support by handling the power of negative climate variety. A local microclimate is the climate of a small geographic region considered with reference to the general climate. The biophilic plan is how in project development and design to conserve and keep going the organic life of the site with the smallest amount disruption. The microclimate of a site can have a deep effect on how people use its outdoor spaces, and on how readily and efficiently its buildings can provide comfortable and beautiful environments. A site’s microclimate can be altered by design to warm, cool, shelter, expose, and reduce unwanted pollution and sound. A well designing of surrounds landscape can be a good long term investment for reducing heating and cooling costs by protecting against winter wind and summer sunlight. Both the summer ventilation and cooling loads and the winter heating load can be reduced by well considered site use. Close surveillance is required to emphasize the preference areas on a site. Existing vegetation, geology and topography all engage in recreation a part in creating a unique microclimate for every site. There are analytical tackle available for simulating the wind flow patterns around buildings, trees and landforms and for on site investigations of microclimate. Effective landscaping can also help control noise and pollution and reduce the consumption of water, pesticides and fuel for garden maintenance. The limited variations may be due to earth relief, the vicinity of extensive water surfaces, and the structure of the soil, vegetation etc. which plays an important roll in determination the form, volume, orientation,
and relation outdoor-indoor of the bioclimatic house purpose. The following subjects will take these effects on local microclimate.

Fig1. Different natural surrounding in the world with special macro and micro-climate

At any time the weather is clear and calm down, the heating and cooling of hills may produce a valley wind. The effect of forests and trees on the microclimate is very complex. Cautiously positioned trees can save up to 50% of a building hold’s energy consumption for heating and cooling. The presence of trees generally reduces the day night variation, increases the air humidity and decreases the wind speed. Plants can be used as shading as well as wind breaks to control heat gain and loss correspondingly. Deciduous trees will provide shading in summer without, unlike an awning, blocking the sunlight’s in the winter. In summer, shading and evapotranspiration (the process by which a plant actively moves and releases water vapor) from trees can reduce surrounding air temperatures as much as 5 grad and air temperatures directly under trees by up to 14ºC. (1) In winter, trees, fences or geographical features can be used as windbreaks to shield against cold wind. The use of trees and landforms as shelter belts is one of the most influential aids available for influencing the microclimate. A wind tunnel is the understandable design tool for investigating the effects of shelter belts, but would be outside the resources of an architectural apply.

2.4. Indoor energy changes and movement

The changes of energy can take place also between insides interior spaces. Energy can changes also by opening of doors. The air change has been measured to about 5 m³ per opening of door, and with persons in the habitat architectural program there is calculated on ca 130 openings during the day. Other form of energy change is infiltration in which energy is
lost from building in two ways one is by infiltration and other by conduction. Air infiltration occurs where there are openings in the exterior envelope. Differences in air pressure at that moment allow too much air to simple enter or exit a building. A very well insulated building possibly will have infiltration losses of around 38% of the seasonal heat losses. As a result, by bio-substantially reducing the infiltration rate, 90% solar heating is without problems achievable. The problem is that infiltration is reduced to this level with great difficulty. The 1.5 air change per hour for standard building are reduced to about 0.5 air change per hour by income of good quality weather stripping around openings and by caulkking building cracks. (1)

2.4.1. Indoor energy design in biophilic architecture

Energy in the biophilic design must be allocate throughout regarding of thermal zones by utilized the energy in diverse architectural functional spaces such as cascade. The first step towards passive biophilic architecture is to reflect the energy distribution on the buildings form and volume, wherever the energy distribute be obliged to correspond the function and activity in those spaces. That is important to regarding the thermal level for different architectural spaces. This form of thermal hierarchy can transform in the architectural plan. It is better to assemblage the interior spaces that have the same temperature and intern contribution. It is better to emplacing essential functional spaces towards the center of the architectural plan, and the spaces which have more high temperature towards the periphery of the architectural plane.

As a result architects must avoid emplacing of spaces with a large different of temperature collectively. He must use in maximum form the natural convection in a building interior, for achievement transfer of energy to exterior, this difference of temperature is necessary for creation the natural ventilation by airflow. Architects can benefits of the thermal stratification of the air, through a placement of more warm spaces in the highness. Thermal zoning is a
vital consideration in recently designed environmental buildings. On the other hand, in an existing building the configuration of spaces was decided by the original architect. One has to adapt to the existing layout, deciding which spaces are used. A thermal zone represents an enclosed space in which the air is free to flow around and whose thermal conditions are relatively consistent. In most cases, any architectural space can be closed off with a door would be a separate zone. Sometimes temperatures in different parts of large spaces can vary. In these cases, the space can be divided into a number of smaller zones with adjoining elements defined as voids. This way heat is free to flow among the zones, but their thermal characteristics can be analyzed individually.

We alike to dissimilar temperature in different functional spaces in residential building for example, we like bathrooms to be very warm, living rooms to be a comfortable temperature, and bedroom to be modest cooler. Well-organized passive biophilic architecture recognizes these differences and creates thermal zones for the different building functional spaces. Thermal zoning tries to ensure the best match possible between the distribution of architectural spaces and the distribution of the available energy. The thermal zones are;

**2.4.1.1. Functional essential spaces**

This zone includes principal function in the building. The optimal temperature for these zones in residential spaces for example is between 18-21°C. The best place for functional essential spaces is in extremely centre of the building. Radiant heat from functional auxiliary spaces can penetrate into these spaces. (7) The next best option is with a south, east, southeast facing window in buildings from cold and temperate climate and north east, and northeast in buildings from hot climate.

**2.4.1.2. Functional auxiliary spaces**
This zone includes service spaces. The optimal temperature for this zone is between 20-23°C. This zone is modest warm and can located in the periphery of the house plane for create of natural ventilation and to be beside functional essential spaces for create of radiant heat and

2.4.1.3. Intermediary spaces

This zone includes storage rooms, buffer spaces, transit spaces, terraces, basements, etc. The optimal temperature for this zone is less than 16°C for buildings from cold and temperate climate in winter season, and 28°C for buildings from hot climate in summer season.

**Cold climate**

![Diagram of cold climate](image)

**Hot climate**

![Diagram of hot climate](image)

Fig2. The position of functional essential spaces

3. Green components in biophilic architecture

3.1 Green building elements

The term of green building elements, as vegetated or eco-system refers to an external elements covering that consists of a thin layer of living vegetation on top of an adapted conventional system. Contemporary dry green areas are not heavy, difficult to maintain collections of pots and planters high on top of the city. Instead, they are lightweight, durable systems that are not only beautiful but also provide insulation and help solve vital urban environmental problems. Vegetation protects the external elements from direct solar radiation and enhances its thermal performance. The optimized green buildings elements described in the following wording, with a green leaf area 5 to 10 times higher as the one of a green park,
are a much more effective and economic means to create better climatic living conditions in cities. The green component surrounded by the architectural composition usually appears in the form of a green roof and less often in that of a green façade outside layer. The latter may especially be found in vernacular architecture. The green components of architectural elements coating is typical of old vernacular architecture in rural areas, although it may also be found within city areas. Nowadays, plants are rarely used as a finishing façade stroke. The green roofs or façade coating does not indicate that we are dealing with a neglected house as it might seem at a first look. On the dissimilar, it produces many positive effects in terms of design, construction, health and ecology. Its function is not limited to the mere protection of the façade. The green roofs and façade coating indirectly affects the inhabitants feeling of comfort, and has a significant aesthetic function within the building’s vicinity. The biophilic architecture coating significantly contributes to the formation of balance between human and environment.

![Fig3. Green building elements over human building](image)

### 3.2. The positive effects of green building elements

Green elements are still often seen as an unadulterated esthetical element in architecture, as a spleen of some “greenies”. In fact green building elements by now contribute, some extent, to a better microclimate through evaporation, filtering of dust from the air and reduce in temperatures at the rooftop. Besides improving the microclimate and the indoor climate, the retention of rainwater is another important advantage. The most interesting are: the cooling
effect in summer, the warming effect in winter and the increase of lifespan for the green area.

The functions of green roofs on different seasons are as following:

3.2.1. In the summer

Cooling effect in the summer is resulting for the most part by the evaporation and shading effect of the vegetation, but also by its capacity to reflect sun radiation and the energy consumption through photosynthesis and heat storage by its embedded water. A surface of plant life reduces the strong thermal radiation that normally occurs on the black building surfaces usually used in cities. By extending the insulating properties of the waterproofs layer, green building elements can decrease energy consumption in hot urban environments considerably. Because the leaf surface of plants is evaporative, a major quantity of the sun’s radiation on a green building element is put to work evaporating the moisture in the plant. The larger the full amount of leaf area on a green building element, the greater this natural cooling effect. Although trees and shrubs provide greater cooling than ground covers, they also need greater soil depths, imposing higher loads on the roof deck. Structural load limitations will ultimately determine how much energy decrease is potential.

3.2.2. In the winter

Heating effect in the winter comes generally from the thermal insulation effect of the air pillow within the vegetation and the truth that the cold wind does not hit the earth surface. If the vegetation is forming a thick layer like a fur it increases the thermal insulation effect of the building elements effectively. (10) Some minor effects are the thermal mass of the earth layer, the reflection of infrared radiation from the house by the plants and the heat production if dew is formed in the morning (the condensation of 1 g water releases 530 calories of heat). The experiment made known that, if the air temperature reached -11 ºC, the earth temperature was only -2 ºC, and if the air temperature reached -14 ºC, the temperature underneath the 16
of earth was only 0 °C. At the same time the temperature over the earth that is to say underneath the grass was about -3 °C at the lowest. (5)

3.3. Vegetation and plant life on green building elements

Plant form, size, and selection depend on the depth of the roof overburden (growing medium) and local climate, but the plants are almost always drought understanding. (4) The positive effects of green building elements are stronger the denser and thicker the vegetation layer. This frequently corresponds with its leaf surface area. Low growing plants such as grasses, sedums, and other cactus like plants are used where the depth is only a small number of centimeters. (8) Where the average depth is several centimeters, shrubs and even small trees can be used. Although most easily used on flat areas, a low terrain roof can also be „greened”. In the following stage we will describe several of those plants and vegetation which is necessary to know.

3.3.1. Sedum: This is a group of hardy and tender succulent annuals and perennials, this plant grows 36 to 67 cm high, is very beautiful plant, with different form and flower colors.

3.3.2. Allium;

Caeruleum, dense flower heads in rich azure-blue from early summer.

Cernum, This spectacular species has nodding pink blooms during summer.

Globemaster, Huge 9 inch flower heads are composed of densely-packed.

Wild grasses like;

Poa;

Pratensis is a common lawn and pasture grass, it will grow on dry neutral soil.

Compressa, is an adaptable plants for all climates,

K. Angusttifolia, This species is with small reddish pink flowers borne in clusters.

Bromus tectorum, Come from Poaceae family, with annual duration.

3.3.3. Herbs;
Festuca vivpara, Plant typically 30cm tall is very common in grassland.

Festuca ovina, A vigorous mid-sized clumping blue fescue for dry sunny cites.

Festuca rubra, red festuca is a cool-season, plant typically 30-100 cm tall.

Thymus subphylum has purple flowers in the late spring, with 6-18 cm tall.

Thymus phlebitides Leaves small, with lemon fragrances, height to 5-6 cm

**Shrubs:** Shrubs are vital components of both rural and urban areas. They provide beauty, diversity, wind protection, privacy homes for wildlife and even a source of human food.

Selecting plants is one of the most pleasant tasks. It should be based on your own personal tastes, as well as site location. The correct spacing between shrubs, whether in row or in clumps, is 60-90 cm. (3)

![Fig4. Different form of vegetations and plants specific for green buildings components](image)

### 3.4 Green advantage on biophilic architecture

#### 3.4.1 Energy saving concept

Heat management on different building components is the most effective assess for energy efficiency. The biggest and essential role of green building component is that to conserve, insulate and hold back a change of energy flux, between outside and inside. Passive biophilic architecture has need of a compact system of insulations, which guarantees for both low heat losses and a high level of thermal comfort. (6)Every building needs a building envelope with
a ground floor, exterior walls and roofs; the passive biophilic architecture focuses on extreme improvements to these building components high quality heat insulation is thus supplementary.

Green building elements provide important environmental and human health benefits which cover a large area of advantage and benefits that can be for example in ameliorate the urban island effect and relieving the damage on the ecology of the city, principally concerning microclimate, rainwater retention and filtering of airborne pollutant lowering energy expenditures, purifying the air, reducing storm-water runoff, longer durability of the roof skin, due to lower surface temperatures and better protection against UV-radiation, creation of recreation areas in parts of the city, aesthetical improvements in denaturalized urban centers and many others.(2)

3.4.2 Human comfort and healthy framework

Studies show that free time activities in natural surroundings such as garden and park are important for helping people handle with stress and meeting other non stress connected needs. This form of green elements increases the value of the property and the marketability of the building. Keep happy the aesthetic requirements of people looking down upon the green area from adjacent building. (5) Psychosomatic researches have shown that the restorative effect of natural view holds the viewers concentration, diverts their awareness away from themselves and from worrying thoughts thereby improving health. The patients were assigned essentially randomly to rooms that were identical except for window view: one member of each pair overlooked a small stand of deciduous trees; the other had a view of a brown brick wall. In 1990, Ulrich and Outi Lunde conducted research on the recovery of open-heart surgery patients in Sweden. Their findings suggest that patients with pictures of an open view with water had less postoperative anxiety than control groups or groups exposed to a picture with abstract geometric forms or an enclosed forest scene. While the evidence is still
circumstantial, these studies show the possibility that a greater connection between interior spaces and the natural environment could improve health. (9)

3.4.3 Ameliorate of local microclimates

A green building element will have a noticeable impact on the heat gain and loss of a building, as well as the humidity, air quality and reflected heat in the surrounding neighborhood. In conjunction with other green installations, green elements can play a role in altering the climate of the city as a whole. On a summer day, the temperature of a gravel green area can increase by as much as 25°C to between 50-60°C. Covered with grass, the temperature of the green area would not rise above 25°C, thus resulting in energy cost savings. 20 cm of substrate with a 20-40 cm layer of thick grass has the combined insulation value of 15 cm of mineral wool. Spaces under a green building elements are at least 3-4°C cooler than the air outside, when outdoor temperatures range between 25-30°C. (10) Green building elements comate the urban island effect due to the increased vegetation they bring to the urban landscape. Plants cool their surrounding environments through natural evapotranspiration cycles. By means of more green buildings elements in the city and less hard, nonporous blacktop, our cities can be cooled down. This procedure reduces the urban heat island effect in summer. This can play a role in reducing greenhouse gas emissions and adapting urban areas to a future climate with warmer.

4. Biophilic architecture in marketing strategies

The increase nationwide in local green building programs and media coverage of green building indicates that sustainable design is a growing market sector. Additionally; consistently brisk home sales in green developments provide evidence of the marketability of biophilic architecture. This endorsement of some of the principles of sustainable design by major housing lenders provides a strong indication of market support. The economical biophilic architecture provides us with the opportunity to reach extremely low levels of
energy consumption by employing high quality, cost-efficient measures to general building components such measures are in turn of advantage to the health, ecology and economy sector. A conflict often appears in architecture between the economical aspects, on one hand, and the quality of architectural products on the other hand. (11) Our mission is to realize a device that represents the balance that can be created by a functional-constructive issue generating the healthy and the economical forms of architectural produce. The concept of optimal biophilic architecture takes in evidence the optimal balance between the quality and all economical aspects. For marketing, the general trend to wellness and health, high living quality and modernity could be used.

5. CONCLUSION

The vital objective of biophilic architecture is to outline attributes and put them into a clear, sensible, organized format so developers, designers, planners, and architects can learn about the importance of a connection to the natural environment in all their building projects

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