# Foster a Healthy Community Through Active Design and Biophilic Design

WANG Hong[a], LIN Han[b], TONG Yun-on[c]

[a] *Executive Director, Sustainability, AECOM*
[b] *Associate Director, Sustainability, AECOM*
[c] *Left AECOM already*

## ABSTRACT

Humans are inherently interested in connecting with the natural environment. With the increasing urban constructions, they not only induced severely environmental impact, but also separated us from the nature. Despite the adoption of conventional green building technology can mitigate some of the adverse environmental impact, seldom can it help to re-establish the human-nature connection. To regain the missing link, Biophilic Design has become one of the strategic developments for AECOM Sustainability in the recent two years. Through a proper way to articulate the relationships between nature, science, and built environment so that we may experience the human benefits of biophilia in our design applications. Through a proper architectural design and the utilization of building physics, Biophilic Design can successfully integrate various natural elements within our working environment or habitat and positively influence our living style. Numerous research efforts have supported the benefits of adopting biophilic design in various development, which include helping hospital patients to recover within a shorter timeframe, increasing the students' learning motive and achievements, enhancing the working efficiency of employees and strengthen the communication within the community.

Currently, the lack of physical activity is being listed as one of the world's top ten major risk factors for death. The decline in the rate of physical activity is partly due to the limitation from our workplace and the sedentary living habit of modern society. To promote the concept of healthy living style through exercising amongst local community, the Community Active Design makes use of proper space planning and design to provoke the curiosity and interest of citizens to explore the nature of space around the neighbourhood, which can imperceptibility influence their living habits, enhancing their health and well-being and foster a healthy community.

***Keywords:*** *sustainable neighbourhood, biophilic design, active design*

## 1. INTRODUCTION

This paper is mainly divided into two sections. In the first section, the guiding principles of biophilic design will be discussed. In addition, special interests are drawn to examine the applicability and feasibility of integration biophilic design concept into modern architecture development. In the latter section, focuses will be switched to discuss how Community Active Design positively influences citizen's living habits through appropriate community planning and design.

## 2. BIOPHILIC DESIGN

Biophilic Design is a dedicated effort to affiliate human affinity with natural systems. Although the concept has existed for many years, it has not yet been a common consideration factor in modern architectural design. With the growing quantified supports from researches, the positive impacts of biophilic design begin to gain increasing attentions (Kellert, 2005).

To develop a common ground for discussion and to better organize the diverse concept, Terrapin (2014) has issued a paper to identify 14 patterns of biophilic design, which are organized into three main categories namely – (i) Nature in the Space; (ii) Natural Analogues and; (iii) Nature of the Space. Table 1 outlines the overview of 14 biophilic design patterns under these three categories and their possible forms of expression.



From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong – ISBN 978-988-77943-0-1 www.hkgbc.org.hk
From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong, Foster a Healthy Community Through Active Design and Biophilic Design, pp.1412-1418, with permission from Hong Kong Green Building Council

| **Nature in the space:** | **Natural analogues:** | **Nature of the space:** |
|---|---|---|
| Incorporation of plants, water, and animals into the built environment, especially with movement | One degree of separation away from true nature; patterns and materials that evoke nature | The way humans respond psychologically and physiologically to different spatial configurations |
| 1. Visual Connection with Nature – plants inside and out, green roofs, and living walls, water, nature artwork | 8. Biomorphic Forms and Patterns – organic building forms, structural systems (savannah effect) | 11. Prospect – views, balconies, 6m and above focal lengths, open floor plans |
| 2. Non-Visual Connection with Nature – sun patches, textured materials, bird sounds, weather, nature scents | 9. Material Connection with Nature – organic building forms, structural systems (savannah effect) | 12. Refuge – protected spaces, overhead canopies or lowered ceilings, places providing concealment |
| 3. Non-Rhythmic Sensory Stimuli – clouds, shadows, nature sounds, water reflections | 10. Complexity and Order – fractal patterns, sky lines, plant selection, and variety, material textures, and colors | 13. Mystery – winding paths, obscured features, flowing forms |
| 4. Access to Thermal and Airflow Variability – shade, radiant heat, seasonal vegetation | | 14. Risk/ Peril – floor to ceiling windows, water walks, high walkways |
| 5. Presence of Water – rivers, fountains, water walls, ponds, day lighted streams | | |
| 6. Dynamic and Diffuse Light – light from different angles, ambient diffuse, lighting, circadian lighting | | |
| 7. Connection with Natural Systems – seasonal patterning, wildlife habitats, diurnal patterns | | |

*Table 1: Patterns of biophilic design*

### 2.1 Nature in the space

Nature in the Spaces emphasizes on the direct, physical and ephemeral presence of nature in a space or place. Natural elements like the presence and diversity of plant lives, animal species and water features can be included within the built environment to strengthen the nature-human connection. There are mainly two strategies to bring nature into the interior space including integration or simulation.



From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong – ISBN 978-988-77943-0-1 www.hkgbc.org.hk
From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong, Foster a Healthy Community Through Active Design and Biophilic Design, pp.1412-1418, with permission from Hong Kong Green Building Council

The most common approach for integration is to include tangible or integrate visible green features within the built environment. Should there be sufficient space, designers can consider features like indoor-terrace-gardens and courtyards. For area with limited space, features like potted tree and small water features can be adopted. Designers should also use windows strategically to maximize the visual connection with natural landscape. Additional benefits can be realized if natural ventilation or lighting is integrated to the building design to provide occupants with non-rhythmic sensory stimulation. While no specific criteria is laid down by the biophilic design guide in this area, references can be drawn to some of the internationally recognized standards like the ASHRAE 55 and ISO 7730 standard as design guide.

Besides integration, simulation is another useful technic to mimic the natural environmental for place where space or outdoor view are greatly limited. For examples, landscape representation (e.g. paintings) can be used as indoor decoration to enhance visual experience. Nevertheless, these simulated environments are steady with no variation across time. A more favourable alternative is to simulate the nature scenes through digital medium (e.g. video depicting nature scenes).

### 2.2 Natural analogues

Natural analogues focus more on evoking the indirection connection with the natural environment. The ultimate intention is to imitate the natural environment and articulate connections between aspects of the built and natural environments.

There are essentially two approaches to applying natural analogues concept, as either a cosmetic decorative component of a larger design, or as integral to the structural or functional design, characterizing mainly through four different forms: representational artwork, ornamentation, biomorphic forms, and the use of natural materials. For the former three forms, much emphasis is placed on using fractal patterns to create a visually nourishing environment that engenders a positive psychological or cognitive response (Salingaros, 2012). Extreme caution must be taken when using such strategy as over complex patterns are found to induce stress and visual perception problems (Hägerhäll et al.,2008). It is more preferable to apply this tactic to common area like corridors or pantries rather than normally-occupied space, which helps avoiding visual fatigue induced by prolonged exposure. For the use of natural materials, it is recommended to preserve the natural forms of the materials or undergo minimal processing. Terrapin (2014) pointed out that the type of material is important for perceived restorative quality and people usually preferred real materials over synthetic one. Hence, designers could consider adopting the natural materials such as natural stone and clay. Priorities should be given to those rapidly renewable materials which can replenish faster than traditional extraction demands, thereby reducing the adverse impact to the environment.

### 2.3 Nature of the space

Nature of the space pinpoints to the innate and learned desire of human to see beyond our immediate surroundings. The degree of perception of human in this aspect is greatly influenced by the spatial configurations of the space. Examples includes creating an unimpeded views over a distance or conversely, partially obscured views that inspire a sense of mystery.

The understanding in this category of biophilic design has long been demonstrated by a number of ancient and contemporary architectural examples. For illustration, the examples from JWT office in Atlanta and Hubspot's Headquarter in Cambridge will be used to demonstrate how this biophilic design category can be applied in modern office development to create a sense of prospect and refuge.



From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong – ISBN 978-988-77943-0-1 www.hkgbc.org.hk
From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong, Foster a Healthy Community Through Active Design and Biophilic Design, pp.1412-1418, with permission from Hong Kong Green Building Council

**JWT Office – Prospect**

The design is focused on creating a space which allows people to see from one space to another. This is based on the survival philosophy that it is the human instinct to be able to understand the environment and estimate any threats or opportunities. Hence, the JWT has applied a large number of windows both interiorly and exteriorly to provide users with a condition suitable for visually surveying. The exterior window façade also allows visual connection with nature which optimize the prospect experience with a quality view.

*Figure 1: JWT office in Atlanta*

**Hubsport's headquarter – Refuge**

The design objective is to provide users a small portion of protective environment within a large space. The area should limit visual access into the refuge place and offer overhead and back protection. In particular, it can be seen from the Hubspot's example that entirely enclosure of the refuge place is not necessary; instead a proper opening can provide users visual or aural contact with the surrounding environment for surveillance.

Figure 2: Hubspot's headquarter in Cambridge

## 3. ACTIVE DESIGN

The Biophilic Design is usually applied at individual building level, which targeted at enhancing the psychological well-being and health of occupants through applying the 14 biophilic design patterns. Active design, on the other hand, is concerning the ways to form a healthy community through proper space planning and design. It focuses on inducing peoples' initiatives to explore and utilize their surrounding facilities; thus, promoting the physical health of the occupants.



From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong – ISBN 978-988-77943-0-1 www.hkgbc.org.hk
From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong, Foster a Healthy Community Through Active Design and Biophilic Design, pp.1412-1418, with permission from Hong Kong Green Building Council

By applying these two design philosophies at both building and community level, it could maximize the health benefits to occupants both psychologically and physically.

### 3.1 Oversea and Chinese researches comparison

In recent years, active design and active community concept have becoming a more popular topic in the green building industry. Numbers of researches have been published discussing ways to promote healthy lifestyle. Noticeably, the research direction for oversea researchers and Chinese researches are distinctively difference.

The researches effort in China is mainly focus on application level, especially the difficulties in implementing active design concept in China. Researchers conclude that there are two primary reasons that limit the prevalence of active design community. First, there are inadequate connections between active facilities and communities. Some active facilities are exists independently rather than an integral part of the community. For example, fitness trails are often only available around stadium which located distance away from the resident blocks. Such inconvenience discourages people to use these facilities. Second, designers sometimes have failed to recognize the cultural differences in planning the construction of community facilities. For instance, people in China are comparatively less enthusiastic about basketball than European countries. As a result, the utilization rate of these facilities are not too satisfactory.

Overseas researches show different areas of focus. They are more interested in establishing the positive relationship between active design and health. The hypothesized Active Community Environments (ACES) model proposed by Scott Doyle (2007) illustrated the process of how active community environments improve the overall health status of occupant (refer to Figure 3). Scott also found that sense of safety and the walkability of community are parts of the influential factors – people living in a walkable community with low crime rates tend to be healthier.

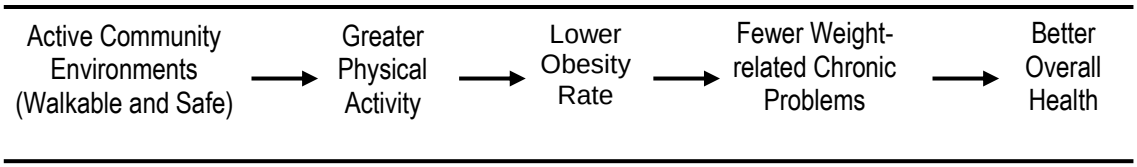
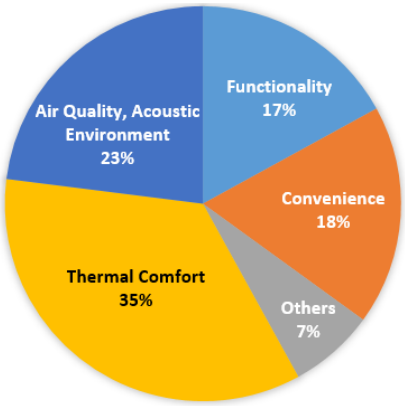



*Figure 3: Aces model proposed by Scott Doyle*

Although Chinese and oversea researchers have explored various factors influencing the active design, limited attention was paid to investigate the importance of human perception on comfortability. In a survey conducted by Lay (2014), his result proved the relative importance of comfort to active community design. When answering the question 'Why you choose this outdoor space?', over 58% of the respondents replied the primary reason was due to comfort-related concerns including thermal comfort, air quality and acoustic environment. Figure 4 presents the overview of the survey's result.






From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong – ISBN 978-988-77943-0-1 www.hkgbc.org.hk
From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong, Foster a Healthy Community Through Active Design and Biophilic Design, pp.1412-1418, with permission from Hong Kong Green Building Council

*Figure 4: Aces model proposed by Scott Doyle*

### 3.2 Consideration factors in active design

Despite the differences in researches focuses between Chinese and Oversea scholars, their ideologies are not contradictory but complementary to each other. To provide a more systematic approach and overall picture towards Active Design, the following matrix (Table 2) are proposed:

| | **Community Level** | |
|---|---|---|
| **Building Level** | **Safety:** From a design perspective, it is mainly affected by the environmental design including the lighting level, access control (e.g. locks, guards), surveillance and etc. | **Walkability:** A measure of how friendly an area is to walking. Factors influencing walkability include the presence or absence and quality of footpaths, sidewalks and etc. |
| 1. **Building Facilities** – promote physical activity and encourage healthy living style through provision of supporting facilities, e.g. indoor gardening area or bicycle parking facilities) | ✓ | ✓ |
| 2. **Open Space Design** – provision of recreational facilities appropriate to local culture, e.g. For China → provision of Taichi and dance area) | ✓ | ✓ |
| 3. **Circulation** – refers to appropriate design of indoor circulation path and provision of adequate signal to encourage physical activity within indoor environment, e.g. provision of office stair with appropriate length | ✓ | ✓ |
| 4. **Perception of Comfortability** – can be addressed through proper consideration of site characteristics such as site wind availability, noise emitting source from proximity area and etc. | NA | NA |

*Table 2: Active design consideration matrix*

The above table outlines the general design principles to be applied at both building and community level. It should be noted that these principles have to be considered as a whole in order to achieve a satisfactory active community design.

### 3.3 Active design in application – Foshan MEGAHALL MOMA project

To instil a sense of safety, the carriageway of this project was designed all along the exterior area of the community while all pedestrian areas were centralized in the middle of the project site. This effectively separated the pedestrian and vehicle movements and improved the residents' safety index. Moreover, the community reserved a large, concentrated and open spaces for recreational and leisure purposes of the all-age of occupants. Advanced sunlight analysis and wind environmental analysis were also conducted within the subject site to assist in the strategic planning



From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong – ISBN 978-988-77943-0-1 www.hkgbc.org.hk
From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong, Foster a Healthy Community Through Active Design and Biophilic Design, pp.1412-1418, with permission from Hong Kong Green Building Council

of community. For instance, the activity spaces for children and seniors were deliberately placed at areas where abundant of sunshine was availability to ensure the maintenance of a comfortable environment.

Regarding the community facilities, a 600 meters long jogging lane was provided within the community site. Calories signs were marked on the lane every 150 meters to promote a healthy lifestyle. Apart from the provision of traditional lighting facilities, fluorescent coating was also painted along the lane. This special feature provided extra incentives or attraction for people to explore the lane and to exercise more frequently.

## 4. CONCLUSION

This paper presents the design principles in implementing the concept of biophilia and active community. It points out the associated psychological and physical health benefits to the occupants such as the enhancement of employees' working efficiency and the reduction of risk of having chronic-related health problems. In particular, based on literature reviews and precedent project experiences, the paper briefly discussed the difficulties in applying biophlic design and active design in real-project situation. To address/ eliminate these potential difficulties, the paper also proposes some practical approaches, through project examples, to provide design insight for optimizing the building and community design which can facilitate the development of a healthy and comfortable community environment.

## REFERENCES

[1] ASHRAE (2004) Thermal Environmental Conditions for Human Occupancy, Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers.
[1] Browning, W.D, Ryan, C., Clancy, J. (2014) 14 Patterns of Biophilic Design, Improving Health & Well-Being in the Built Environment, New York: Terrapin Bright Green.
[2] Doyle S. (2007) Active Community Environments and Health: The Relationship of Walkable and Safe Communities to Individual Health
[3] Hägerhäll, C. M., T. Laike, R.P. Taylor, M. Küller, R. Küller, & T. P. Martin (2008) Investigation of Human EEG Response to Viewing Fractal Patterns, Perception, 37, 1488-1494
[4] Kellert, S. (2005) Building for Life: Designing and Understanding the Human-Nature Connection, Washington, DC: Island Press.
[5] Lay, D. X. (2014) Outdoor Space Quality: A Field Study in an Urban Residential Community, Energy and Buildings, 68, Part B, 713-720
[6] Ryan, C. O., Browning, W. O., Clancy, J. O., et al. (2014) Biophilic design patterns: Emerging nature-based parameters for health and wellbeing in the built environment, ArchNet Int J Architect Res 8: 62-76.
[7] Salingarios (2012) Fractal Art and Architectural Reduce Physiological Stress, Journal of Biourbanism 2(2).
[8] Salingaros (2005) Biophilia & Healing Environments: Healthy Principles for Designing the Built World, New York: Terrapin Bright Green.
[9] UNI EN SIO 7730 (2006) Ergonomics of the Thermal Environmental - Analytical Determination and Interpretation of Thermal Comfort Using Calculation of the PMV and PPD Indices and Local Thermal Comfort Criteria.



From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong – ISBN 978-988-77943-0-1 www.hkgbc.org.hk
From the Conference Proceedings of World Sustainable Built Environment Conference 2017 Hong Kong, Foster a Healthy Community Through Active Design and Biophilic Design, pp.1412-1418, with permission from Hong Kong Green Building Council