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SIMPLICITY OF SUSTAINABILITY: A TAIWANESE APPROACH

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ABSTRACT

Sustainability is defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Contemporary, the sustainable development has considered in many areas, such as waste and recycling, energy efficiency, water consumption, building design, emission, indoor environmental quality, alternative transport, landscaping, and management. Most of the modern sustainable buildings aimed to use complicated design and techniques to achieve sustainability, such as renewable energy, energy efficient products, computerized building information management systems (BIMs), automation and optimization controls, water recycling techniques, etc. However, in Taiwan, the Green Building Council uses a different sustainability measurement tools called EEWH (Ecology, Energy saving, Waste reduction and Health) to encourage simplicity of sustainability. This paper will first introduce the four fundamental principles of this approach and its nine measurement indicators. Hence, this paper presents two successful case studies in Taiwan on how they achieved sustainability using simplistic techniques. These case studies are Beitou library in Taipei and Yilan County Hall in Yilan city.

Key Words: Taiwan, sustainability, simplicity approach, Beitou library, Yilan County Hall

INTRODUCTION

LEED is a globally recognized symbol of excellence in green buildings. Since the first version of LEED released in 2000, The LEED system is gaining popularity in the international green building marketplace. Over the years, the rating systems became more stringent; with the recent fourth version released in November 2013. The new rating systems may be a challenge to achieve, however building owners and developers are motivated to design and build buildings which conform to the highest certification levels and are still able to compete in the real estate market. As a result of this, most of the modern sustainable buildings aimed to use complicated design and sophisticated techniques to achieve the highest score from the rating system.

Taiwan's Green building evaluation system, EEWH, is the fourth building sustainability assessment tool worldwide established in 1999, behind BREEAM, LEED and GBTool, and it is the first system developed specifically for tropical and sub-tropical climates in Asia. Taiwan uses this different sustainability measurement tools aimed at a holistic approach to sustainability from four fundamental principles, Ecology, Energy saving, Waste reduction and Health, and hence developed into nine indicators for green building evaluation. This paper will first explain the EEWH system and its nine indicators in relation to the sustainable environment. Hence, a brief comparison with the

LEED system to show the draw backs of the check-list rating system. Finally, two successful case studies in Taiwan are described to demonstrate how Taiwanese's simplicity approach to design sustainable buildings can be achieved. These two case studies are Beitou library in Taipei and Yilan County Hall in Yilan city.

TAIWAN'S GREEN BUILDING CERTIFICATION SYSTEM - EEWH

The green building of Taiwan is developed based on Taiwan's subtropical climate characteristics with high temperature and high humidity that can sufficiently meet the need in ecology, energy saving, waste reduction, and health. The EEWH green building labeling system was established in September 1999. The original system comprised of seven evaluation indicators: greenery (vegetation planting), water infiltration and retention, daily energy conservation, water conservation, CO2 emission reduction, construction waste reduction, and sewage and waste disposal facility improvement. In 2003, two indicators were added to the system, including biodiversity and indoor environment quality. The Architecture and Building Research Institute has amended the 1999 Evaluation Manual for Green Building and named it as the EEWH-BC (Basic Category) in 2011, using it as the most generic version of green building evaluation and the basis for other categories (Taiwan green buildings Q & A, 2014). The current nine-indicator green building evaluation was thus finalized, known as the EEWH system as shown in Table 1. Furthermore, Hwang & Hsu (2011) outlined the EEWH indicators in relation to the sustainable environment factors as shown in Table 2.

Table 1 EEWH Green Building Evaluation System of Taiwan
(Source: Intelligent Green Building, 2014)

Category	**Contents**	
	Indicator	**Evaluation Items**
Ecology	1.Biodiversity	Ecological network, biological habitat, plant diversity, soil ecosystem
	2.Greenery	CO_2 absorption (kg-CO_2/(m^2.40yr))
	3.Water content of the site	Water infiltration and retention, storm water runoff management
Energy Saving	4.Daily Energy Conservation(prerequisite)	Building envelope design ENVLOAD (20% higher than building regulation), and other techniques (including HVAC system, lighting, management system)
Waste Reduction	5.CO_2Emission Reduction	CO_2 emission of building materials (kg-CO_2/m^2)
	6.Construction Waste Reduction	Waste of soil, construction, destruction, utilization of recycled materials
Health	7.Indoor Environment	Acoustics, illumination, and ventilation, interior finishing building materials
	8.Water Conservation (prerequisite)	Water usage (L/person), hygienic instrument with water saving, grey water reuse
	9.Sewage and waste disposal facility improvement	Sewer plumbing, sanitary condition for garbage gathering, compost

Table 2: EEWH indicators related to the sustainable environment factors (Source: Hwang & Hsu, 2011)

EEWH		Sustainable Environment					
Category	**Indicator**	**Climate**	**Water**	**Soil**	**Biology**	**Energy**	**Resource**
Ecology	1. Biodiversity .	Y	Y	Y	Y		
	2. Greenery .	Y	Y	Y	Y		
	3. Water content of the site	Y	Y	Y	Y		
Energy Saving	4. Daily Energy Conservation	Y				Y	
Waste Reduction	5. CO_2 Emission Reduction			Y		Y	Y
	6. Constr. Waste Reduction			Y			Y
Health	7. Indoor Environment			Y		Y	Y
	8. Water Conservation	Y	Y				
	9. Sewage & waste disposal		Y		Y		Y

In 2007, a scoring and rating system was launched for enhancing green building design quality and motivating builders/owners to pursue better performance and innovative techniques. The rating system defines five classes of green building design, including Certified, Bronze, Silver, Gold, and Diamond.

The green building certification consists of two parts: “Green Building Label” for completed buildings, and “Green Building Candidate Certificate” for building projects according to their planning and design documentations. The candidate certificate is aimed at providing an opportunity to preview the possible inadequate design in advance so that the high-cost improvement after completion may be effectively eliminated. Such a certification system is a unique design in the world and has become an important policy instrument of green building promotion in Taiwan (Intelligent Green Buildings, 2014).

A green building is estimated in an average life span of 40 years to save 20% in electricity and 30% in water, to reduce resource consumption, as well as to provide a better living environment with health and amenity. According to Intelligent Green Buildings (2014), by the end of December 2013, a total of 4,300 buildings or projects were certified as green buildings in Taiwan. These certified buildings or projects are estimated to enormously reduce post-occupancy electricity and water consumption, which may also alleviate demand on building new power plants. The total accumulated electricity saving reached 1.213 billion KWH, which was equivalent to 691 million CO2-kg/year. The water saving reached 55.49 million tons per year.

COMPARISON: LEED AND EEWH

U.S Green Building Council, a nonprofit organization formed in 1993 created a voluntary program called “Leadership in Environment and Energy Design” (LEED) and released its first version in 2000. The program was aimed to support sustainability and help to develop buildings which will be efficient and cheaper to maintain. The first version of LEED rating system was created for new construction and it guided standards and benchmarks which were comparatively easy to achieve.

The LEED certification provides independent, third-party verification that a building was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health: Sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. In the current fourth version released in November 2013, the LEED rating systems have a number of prerequisites and a total of 110 points. Each credit is allocated points based on the environmental impacts and human benefits of the building-related impacts that it addresses as shown in Table 3.

Table 3: Categories for LEED version 4 BD+C – New Construction (Source: USGBC, 2013)

Categories	**Prerequisite**	**Max. Credit Points**
1. Integrative Process		1
2. Location and Transportation		16
3. Sustainable Site	1	10
4. Water Efficiency	3	11
5. Energy and Atmosphere	4	33
6. Material and Resources	2	13
7. Indoor Environment Quality	2	16
8. Innovation		6
9. Regional Priority		4
Total		110 points

Building projects satisfy prerequisites and earn points to achieve different levels of certification, from Sliver, Gold to Platinum level as follow:

- Certified: 40–49 points
- Silver: 50–59 points
- Gold: 60–79 points
- Platinum: 80+ points

The U.S. LEED and Taiwan's EEWH are both aimed at improving a site's sustainability, enhancing resource recycling and water conservation, raising energy efficiency and reducing impact on the environment. However, some criticisms on LEED rating system is that its "Rating System Checklist" to evaluate a building's water and energy efficiency, land use, choice of materials, and indoor environmental quality. Based on the checklist scoring results, it certifies buildings on a scale from simply "LEED certified" up through Silver, Gold and Platinum. Stein and Reiss (2004) pointed out that "*buildings that earn more LEED credits do not necessarily provide more environmental benefits than buildings that earn fewer credits*", and Frangos (2005) recognized that "point mongering" is a common phenomenon under the LEED rating checklist scoring system. In addition, Leu (2012) pointed out that further potential problem is the scoring point system creates negative incentives to design around the checklist rather than to build the greenest building.

EEWH evaluation systems are categorized according to ecology, energy saving, waste reduction, and health. Each category has weighted and accumulative indicators with different scoring ranges, totaling 100 maximum points, and graded on five rating levels: Diamond, Gold, Silver, Bronze and Qualified. Chang, Lin, & Ho (2012) claimed that by using progressive formulas in each indicator, the EEWH scoring system differ from the point system of LEED, thus avoiding drawbacks such as an over-emphasis on simplified quantifications and priority consideration over easy yet non-environmental related factors (Humbert et al., 2007).

A successful sustainable development is more than just counting the score points of the rating system. It is important to create integrated solutions across not only engineering but planning, architecture, interior and construction management aspects and also take the life time operation and maintenance aspects into account in the early stages of the project. This holistic approach has resulted in providing a clear direction for the projects to reach the highest sustainability targets. Some examples of modern building developments have been presented in the

Sustainable Building 2013 Hong Kong Regional Conference, for instance, the research & development campus in Shanghai (Laverick, 2013), Hysan Place in Causeway Bay Hong Kong (Chan, 2013), Holiday Inn Express SoHo hotel in Hong Kong (Ngan, Chan & Leung, 2013) and public rental housing developments at the old Kai Tak Airport site in Kowloon (Yim, 2013). In Taiwan, holistic approach using simplicity techniques have been implemented to sustainable design for more than 10 years. There are two outstanding examples of Taiwanese's simplicity approach to achieve sustainability in a holistic manner, they are the Beitou library in Taipei city and Yilan County Hall in Yilan city.

CASE STUDY 1: TAIPEI PUBLIC LIBRARY BEITOU BRANCH

The Beitou library building is located within Beitou Park in Beitou Hot Spring area, around 15 km north of Taipei City (Figure 1 & 2). It is Taiwan's first green library opened in November 2006. Beitou Library is fitted with eco-friendly features and settings making it one of the most energy-efficient and environmental-friendly architectures of East Asia. It has been awarded the Green Building Label Diamond in 2010.

Figure 1: Beitou Library

Figure 2: Location of Beitou District

Beitou Library plays an active role in bettering the environment by being energy and water efficient. The library is a timber structure building with a central atrium that save electricity in different ways. The use of timber material to build the library are timber from managed forests rather than primary or rainforests (Figure 3). Low level bookshelves arrangement throughout the library allows for natural lighting and natural ventilation across the internal areas of the library (Figure 4).

Figure 3: Timber structure

Figure 4: Interior with timber furniture and finishing

The thoughtful design of a central atrium with large windows is to save energy as the large amount of windows allow natural light to substitute interior lighting (Figure 5), and north-south direction openable windows provide cross-ventilation that reduces the need for fans and air-conditioning (Figure 6).

Figure 5: Atrium with large windows for natural lighting

Figure 6: North-south direction large openable windows for natural ventilation

Partial roof of the library is covered by photovoltaic cells to converts sunlight into electricity, and appointed with 20 centimeters of soil to provide thermal insulation (Figure 7). Beitou Library also conserves water by capturing rainfall and stored to use for the library's toilets (Figure 8).

Figure 7: Roof solar panels and roof soil layer

Figure 8: Rainwater storage

In summary, simplicity features of sustainable design of the Beitou library including:

- South-North Orientation
- Fit the building into the nature environment
- Timber used for building materials and furniture
- Central atrium with large windows for nature lighting
- North-south direction large openable windows for cross-ventilation
- Roof covered with soil & green, and solar panels
- Rainwater tank for toilet use

CASE STUDY 2: YILAN COUNTY HALL

Yilan County Hall is located around 66 km South-east of Taipei city (Figure 9). The county government is headquartered at the Yilan County Hall under the name County Government Centre-Urban Area with a total area of 238 hectares (Figure 10). The county hall was designed and constructed with the sense of community in mind with a new image to replace the unfriendly stereotype of the traditional public administration building with that of a welcoming centre open to the public (Figure11 & 12). The design of the space and facilities of the building reflects a traditional cultural past.

Figure 9: Location of Yilan County

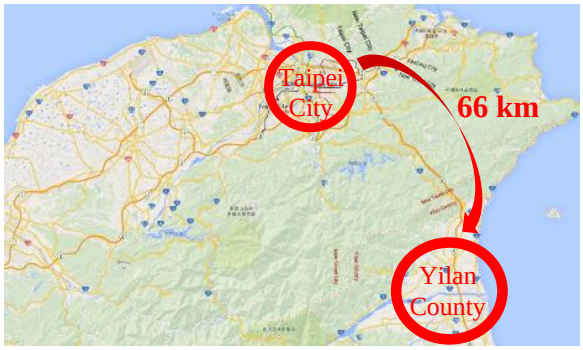


Figure 10: Yilan County Government Centre

Figure 11: Yilan County Hall

Figure 12:

The main building is located at the North-south orientation and the layout of the floor plan is widely spread rather than traditional building shape of square or rectangle (Figure 11). One of the most dominating features of the building is that there are many skylight openings throughout the roof area of the building (Figure 12). Each of these skylights open three levels down to the ground floor to form a small courtyard (Figure 13). It allows both natural light and natural ventilation reaching the ground floor area. More examples of skylight layout, such as skylights above corridors (Figure 14), and light-wells at mid-floor (Figure 15).

Figure 11: Layout of the floor plan

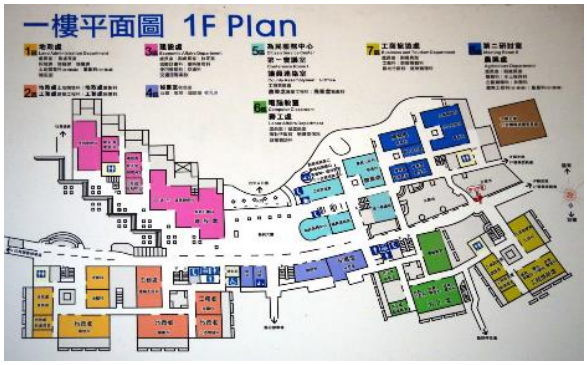


Figure 12:

Figure 13: A skylight at roof forms a small courtyard on the ground floor

Figure 14: Skylights above corridor

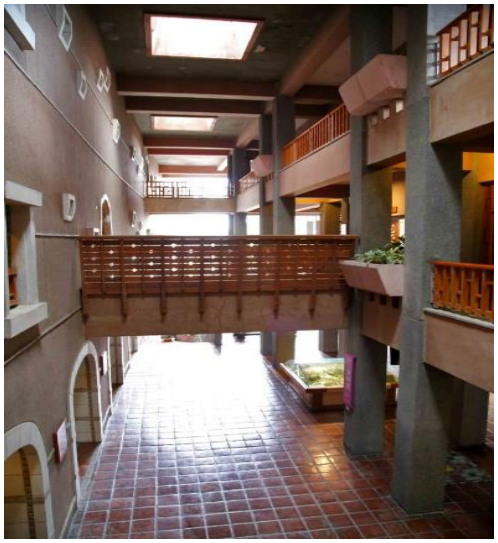
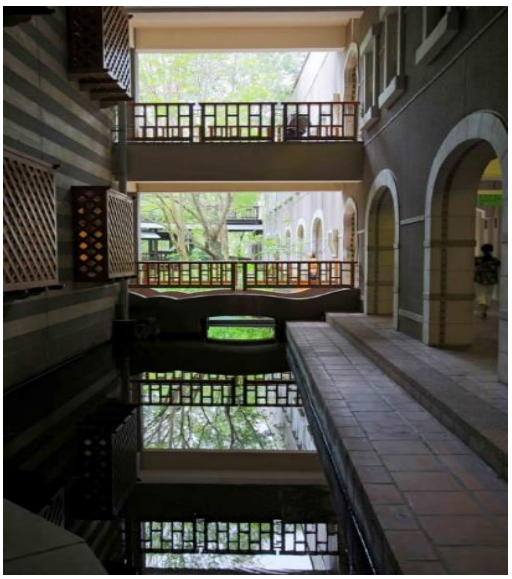


Figure 15: Light-well at mid-floor

In addition, there is a nature pool area located on the west side of the building that help to cool down the area during hot summer afternoon (Figure 16). In addition, part of the pool is extended inside the building that further improve the cooling effect (Figure 17).

Figure 16: Natural pool at the west side of the building

Figure 17: Part of the natural pool extended inside the building



In summary, simplistic sustainable design features of the Yilan County Hall are as follow:

- South-North Orientation
- Multi-levels open-plan layout for natural cross-ventilation
- Mini-courtyards penetrated multi-levels
- Roof skylights throughout whole building for natural lighting
- Roof covered with soil & green
- Natural pool on west side of building and also extended inside the building

CONCLUSIONS

The commonly used LEED green assessment rating tools for sustainability are based on scored points. In Taiwan, a holistic approach of EEWH rating tools encourages using simplicity techniques for sustainable design have been implemented more than 10 years. There are two outstanding examples of Taiwanese's simplicity approach that demonstrated achievements in sustainability in a holistic manner, they are the Beitou library in Taipei city and Yilan County Hall in Yilan city.

It is important to create integrated sustainable solutions across all aspects including natural environment, engineering, planning, architecture, interior, construction management and also take the life time operation and maintenance into account in the early stages of the project. This holistic approach has resulted in providing a clear direction for the projects to reach the highest sustainability targets that goes beyond the scoring points systems.

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