

## Green Building Design

Environmental sustainability can be integrated into health facilities by incorporating green building principles in design and construction. The green building design maximizes natural lighting and ventilation, preserves open space, and includes features such as rainwater reclamation system. It also promotes a healthier indoor environment.

### Taiwan: National Taiwan University Hospital

National Taiwan University Hospital (NTUH), Children and Women Building is located near the NTUH original building and in the central area of Taipei. It is a 26-story, 100-meter building, with 22 floors above and 4 floors underground. It has base area of 9,570 m<sup>2</sup> and total floor area of 74,864 m<sup>2</sup>. The building adopted the windmill building form which inspires children's imagination and creativity. The design symbolizes the hope, youthful vigor and health of children.

The medical building houses the medical services of Genetic Medicine, Obstetrics and Gynecology, and Pediatrics, as well as teaching and research. There are

outpatient department, examination room, operation room, intensive care unit, general wards, bone marrow transplantation wards, laboratory and logistics support etc. The complexity of the facilities ensures full operational support in providing medical services.



National Taiwan University Hospital, Children and Women Building

The Children and Women Hospital is qualified in six green building design indicators of environmental protection: green environment, ground water-retention capacity, energy saving, reduction of carbon dioxide, water, sewage and waste.

#### ➤ Green environment

The ground and roof gardens measure

1,172m<sup>2</sup>, and the design takes reference of the capital's best landscaping.

➤ Water-retention capacity

The hospital adopted green land, gardening soil and permeable pavement to reserve water, with the total area of 3,331 m<sup>2</sup>.

➤ Energy saving

1. The Children and Women Hospital building adopted steel construction and the aperture ratio is 31.8%. The curtain wall uses external shading device and laminated glasses - green window, low-E clear glass with high insulation which can reduce solar radiation and Envelope Load (ENVLOAD).
2. The T5 lighting system used is energy-efficient with secondary control system by time- sharing.
3. The air-conditioning system adopted high efficient chiller, secondary chilling system and cooling tower and air box which all use the energy-saving inverter motors and heat exchanger to pre-cool the outer air. They used 8,000 RT-HR ice storage systems to shift the peak hours of electricity consumption and together with the heat recycle system (300RT) to maintain the temperature and humidity in the operation room and bone marrow transplant wards.

4. Established energy management system and auto control system to optimize operation and energy.

➤ Reduction of carbon dioxide

The main structure of the medical building and outer wall adopted light, incombustible, aseismic and metallic glass wall design. Moreover, it uses patent designs of flexural toughness scale frame and eccentrically braced frames, and light partition walls.

➤ Water

1. The toilets and faucet with water-saving labels are used. The faucet is aerator styled and the quantity of water consumed is 25-50% less than the traditional faucets.
2. Rain recycled by the rainwater recycling system can be used for watering.

➤ Sewage and waste

1. General sewage (including daily wastewater and kitchen wastewater), highly polluted wastewater, infectious wastewater, and radioactive water are discharged separately according to the emission standards into the Taipei City sewerage systems.
2. General Industrial/Commercial wastes are discharged in each floor and recycled according to waste type. Garbage in dumping stations in each

floor is delivered vertically by the tube to rotary waste compression store facility then sent to incinerator.

3. There is an infectious waste room and a cooling room for infectious waste. The combustible infectious waste can be incinerated, and the incombustible waste is sterilized by the sterilizers before smashed and buried.
4. The radioactive waste is sent to the radiation polluted waste storage room.

### **Taiwan: Buddhist Dalin Tzu Chi General Hospital**

When stepping into the hospital lobby, you will see natural lighting on the floor and people. It illuminates indoors through the transparent ceilings and corridors between buildings, and decreases electricity use during daytime expenses. It cuts down electricity use cost and creates healthy indoor environment.



Buddhist Dalin Tzu Chi General Hospital- Collecting skylight cover in lobby

### **Taiwan: Changhua Christian Hospital**

The new Changhua Christian Hospital's compound adopted eco-technology, green building and promoted ecological conservation. In order to create a comfortable and healthy green community, they planted trees and beautified the campus, using green building materials for buildings. In the hospital compound, they reused rain water by landscape-architectural loads and roofs to conserve the water. In addition, the greywater reclamation system reuses recycled domestic water. For the development, they used local materials to reduce harm to the environment. In the future, they will also try to adopt green building concepts for their new hospital campus in other areas.

### **Taiwan: Chang Gung Memorial Hospital**

In 2009, Chang Gung Memorial Hospital (CGMH) made great progress in greening and gardening. There were 36,801 arbor trees, 51,323 bushes, 21,321m<sup>2</sup> hedgerow and 340,935m<sup>2</sup> lawn planted. The total number of trees is 88,124, which could reduce 853 tons of carbon dioxide emission.

By mid 2010, the hospital continued to do green work in each compound; moreover, they also planted trees in Kaohsiung Yung- Ching Memorial Park and Chiayi CGMH and applied for 100 thousand trees to afforest.

The parking tower of Linkou CGMH and advanced medical center are expected to received the award of the LEED Green Building Labeling certification, and all the other branches will follow in the near future. They also plan to use wind power, solar photovoltaic system, LED lamps, electrodeless discharged lamp and ceiling light, frequency conversion and normal temperature air- condition facilities.

Furthermore, Chang Gung Memorial Hospital implemented green procurement policies to purchase green products and building materials, allowing them to win an award by Ministry of the Interior, Taiwan.

### **Taiwan: Taipei Medical University- Shuang Ho Hospital**

Shuang Ho Hospital has become the largest green building hospital in terms of total floor area by winning the Green Building Label of the Ministry of the Interior and the best Environmental Impact Assessment (EIA) project award of Taipei County.

Green Building Label makes a point in “build with the least resource, and produce the least amount of waste”. Shuang Ho Hospital was awarded the Green Label Building in March 18th of 2009 and was certified in four indicators: greenery, energy saving, water resource, and waste reduction.

In 2008, the Environmental Protection Bureau of Taipei County held the first EIA project performance competition, also first of its kind nationwide. The goal of this competition is to encourage eco- friendly behaviors in developing land project and constructing buildings. Shuang Ho Hospital won the best award and was honored in the ceremony of January of 2009.



Shuang Ho Hospital- Green Label Building

### **Singapore: Alexandra Health Cluster**

The hospital was awarded the Building and Construction Authority (BCA) Green Mark Platinum Award for its green and energy-efficient features, such

as the use of solar panels, enhanced daylight designs and natural ventilation.

Green Mark buildings contribute significantly to the environment. A Green Mark Platinum building, can achieve more than 30% of energy savings compared to a code-compliant building.



Alexandra Health Cluster- KTPH Pond view-landscape crop

## Alternative Energy Generation

While facing the crisis of energy shortage and environmental problem, government and non-governmental organizations have made more efforts in saving energy and reducing carbon footprints. Taiwanese Government popularized the photovoltaic systems nationwide in 2002, and offers 50% subsidy for private organization and households using photovoltaic systems. However, most people think that the photovoltaic system is too expensive, and the cost of generating electric power is high, making it difficult to be widely accepted. In fact, we import about 98% of energy source from other countries; therefore, we cannot afford to use too much energy. From the environment protection point of view, traditional ways of power generation include using coal, petroleum or firepower that would produce carbon dioxide, increase global warming, and pose a threat to human health.



Buddhist Taichung Tzu Chi General Hospital- Photovoltaic system