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PREVIEW ISSUE

NOT FOR SALE

Green buildings

# Looking beyond cost



# Khoo Teck Puat Hospital heals the earth

**Singapore's first green hospital is 27% more energy-efficient**

**Building also designed to enhance patient care and staff efficiency**

By Ann Teoh

**Hospitals use two and a half times more** energy than office buildings.

In the United States, they are second only to fast-food restaurants as energy guzzlers in the buildings sector. Today, however, hospitals are using heat recovery, daylighting, and temperature and air control to reduce their carbon footprint.

In Asia, Singapore's newest and first green hospital, the Khoo Teck Puat Hospital (KTPH), showcases how sustainability can be built into hospital

design. Creativity in passive building design coupled with a few active measures resulted in it being 27% more energy efficient than conventional hospitals. KTPH is expected to have an Energy Efficiency Index (EEI) of 220kWh/m<sup>2</sup>/year.

Principal architect Jerry Ong Chin Po of **CPG Consultants**, who spoke at the Green Buildings Asia Conference in Singapore recently, says the 550-bed district general hospital was designed to be an energy-efficient, hassle-free hospital that enhances patient care and staff efficiency. It is also a hospital in a garden, and a garden in a hospital.

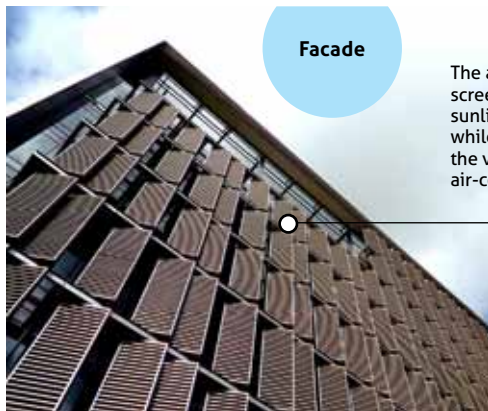
The Platinum Green Mark Award-winning complex sits beside a pond and comprises four blocks (specialist outpatient clinics, podium for treatment and diagnostics, private ward tower and subsidised ward tower) with a floor area of 105,000m<sup>2</sup>.



Jerry Ong

Adorned with a garden courtyard, terraced gardens, and even a community garden, and planter boxes at the wards, it is little wonder that KTPH clinched the top Skyrise Greenery Award 2010 by the Singapore National Parks Board.

"The garden courtyard is the heart of the hospital. One can see the whole hospital from the courtyard and



Facade

The angled fixed screens modulate direct sunlight and glare while still maximising the view from the air-conditioned wards

CPG CONSULTANTS



KTP Hospital was designed to be a garden in a hospital, and a hospital in a garden

## Project info

**Project owner:** Ministry of Health, Singapore  
**Hospital operator:** Alexandra Health  
**Project manager:** PM Link  
**Architect:** CPG Consultants in collaboration with RMJM  
**Building performance consultants:** Total Building Performance Team  
**M&E consultant, C&S consultant and quantity surveyor:** CPG Consultants  
**Landscape:** Peridian Asia Pte Ltd  
**Main contractor:** Hyundai Engineering & Construction

Being green pays off with multiple savings and a more comfortable stay for patients. The hospital saves 8.6 million kWh of energy or S\$1.54 million per year.

Light shelves cut glare and bring light deeper into the building

**Subsidised ward**

Operable jalousies allows in light and air, and can be controlled by the occupants, while the monsoon louvres below them are fixed, allowing ventilation even when all the jalousies are closed

Planter boxes bring the garden to the patients



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CPA PHOTO

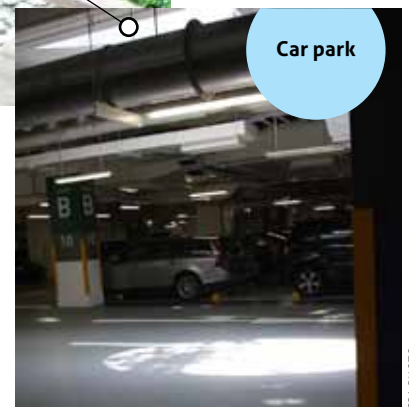
**Garden courtyard**



CPC CONSULTANTS

Note the glass encasement surrounded by plants that brings light into the basement car park below, reducing the need for lighting during the day

**Car park**



GPA PHOTO

enjoy the view of the Yishun Pond. This also brings light and greenery into the basement," says Ong, who believes the gardens both cool the hospital and aid in patients' recovery.

### Passive strategies

While private wards are air-conditioned, the subsidised wards are naturally ventilated. Extensive shading studies were carried out on how to keep out glare and heat.

Ong says specially-designed sunshades on the east and west facades, and glazing and thermal insulation for an opaque facade with low U-value have resulted in KPTH enjoying 23.6% less heat gain from its facades. Its Envelope Thermal Transfer Value (ETTV) is only 38.2W/m<sup>2</sup>K compared to current standards of 50W/m<sup>2</sup>K. The designs translate to an annual savings of S\$63,951 (US\$50,400).

To optimise natural ventilation in the subsidised wards – key to patient comfort – Ong looked at building orientation, wing walls, operable jalousies

(windows) and monsoon louveres.

By orientating the building to catch the north and south-east winds, KPTH enjoys a wind speed of at least 0.6m/s while a wing wall on the facade reduces the need for fans by 60%. Operable modular jalousie windows are angled for the best airflow and least rain splashing, tinted grey glass reduces glare and nearby planter boxes bring the gardens to the patients.

Ong says the private wards are also fitted with ceiling fans, an option for natural ventilation often preferred by elderly patients. When the windows open, the air conditioner automatically switches off.

These passive devices were tested using computational fluid dynamics simulation at the design stage and verification was done using wind tunnel study.

In the subsidised wards, light shelves reduce glare, and bring sun light deeper into the interior. Glazing allows light in minus the heat. This is further complemented with an optimal

window to wall ratio. Together the effect is a 30% cut in lighting needs.

### Active strategies

Placed strategically, T5 fluorescent lamps with electronic ballasts, PLC downlights and task lighting produce both energy savings and a calming and cheerful environment. Motion sensors are installed in transient use areas like toilets, staircase cores and infrequently-used corridors, achieving savings of 10%. Energy consumption is further optimised by energy-efficient lifts with sleep mode and VVVF motor drive (10% savings) and escalators with step sensors (30% savings).


Careful sizing and choice of air-conditioning plant room equipment have resulted in energy savings on the chiller (18%), chilled water pump (33%), total plant room (19%) and cooling tower (29%). Fan coil units (instead of diffusers) allow units to be switched off when rooms are vacant.

Low-VOC paints and adhesives are used indoors, UVC treatment eliminates airborne bacteria and viruses, and carbon dioxide and carbon monoxide sensors monitor air quality.

Waste is minimised at source and a pneumatic waste conveyance system is used to cut the risk of contamination. A composting machine processes food waste into fertilisers.

KPTH uses water fixtures and fittings with Water Efficiency Labelling System (WEL) ratings of "Very Good" and "Excellent". Estimated savings is 39.8% against non-rated fixtures.

The nearby Yishun Pond also serves as a catchment for rainwater that is subsequently used to irrigate the hospital gardens. For its cooling towers, the hospital uses AHU condensates and NEWater (treated wastewater).

Solar thermal systems supply the 21,000 litres of hot water used daily, bringing annual savings of S\$60,000 in electricity. Meanwhile, the 130kWp solar photovoltaic systems generate 150,000kWh of energy a year. 

Twilight view of KTP Hospital from Yishun Pond, which acts as a rainwater collection tank for the hospital. Pond water is used to irrigate the hospital's gardens and terraces

