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khoo teck puat hospital: healing gardens

Khoo Teck Puat Hospital (KTPH) is a 550-bed acute hospital designed with a focus on patients' needs and a careful consideration for environmental sustainability. Located in the north of Singapore, the integrated healthcare facility spans over 3.4 hectares and overlooks Yishun Pond. Its design incorporates natural ventilation and exterior envelope strategies as part of a Total Building Performance approach to minimise operating costs and enhance patient comfort, while bringing together elements of accessibility, comfort and convenience. From intuitive way finding to logical clustering of clinics and ancillary services, the focus is to provide a hassle free experience for patients and staff.

LANDSCAPE

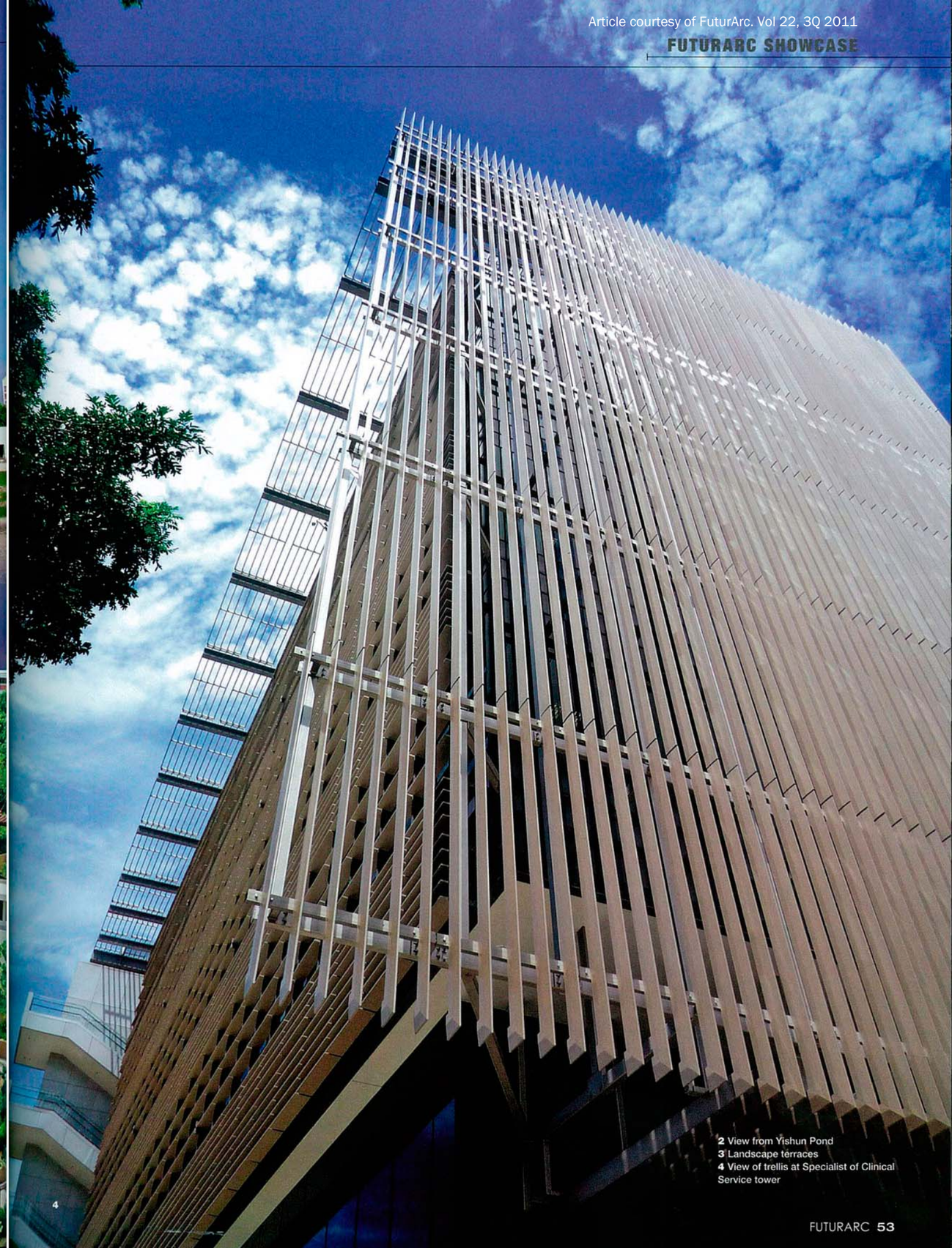
It is a long-standing tradition for Alexandra Health to create and maintain garden spaces that help in its patients' well-being and healing. Thus, KTPH is continuing this legacy by incorporating expansive gardens and landscaping in its grounds, creating a hospital in a garden, a therapeutic environment for healing.

KTPH is designed to have three building blocks overlooking a central courtyard at Level B1 and Level 1, which is the "heart of the hospital". It brings light and greenery into the basement, and also acts as an orientating device. The three blocks consist of a seven-storey tower for Specialist of Clinical Service (SOC), an eight-storey Private Ward Tower (PWT) and a 10-storey Subsidised Ward Tower (SWT). All three are adjacent to eight roof gardens, five levels of corridor planters and 81 balcony planter boxes. To suit the local climate, tropical (i.e., Southeast Asian) plants are the main choice for a sustainable eco-system. Low-maintenance characteristics are a must. Water from the adjacent Yishun Pond is channelled to the hospital's irrigation system and treated for landscaping needs. To prevent water wastage, rain sensors are installed. This gives a near-50 percent savings in the projected consumption cost, a significant benefit to KTPH's operations.

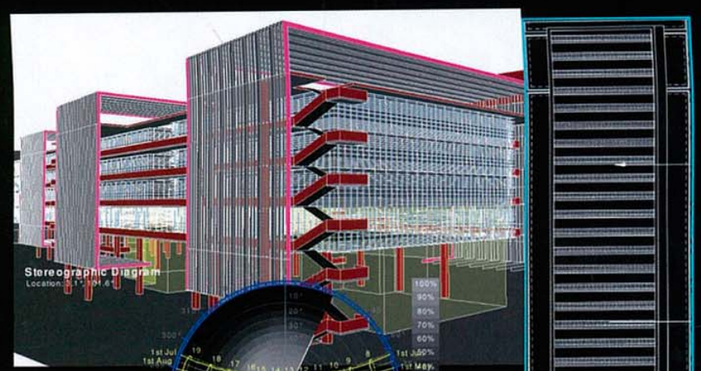
Applying the sustainable concept in the gardens of KTPH is derived from three principles: first, establishing the gardens in practical and self-sustaining ways; second, creating gardens with nature and people in mind; and third, implementing energy- and resource-efficient as well as environmentally-friendly landscape features. The hospital has 'landscape footprints' at every floor to ensure patients and employees are constantly treated to garden views from different angles, offering a calming surrounding that soothes and rejuvenates.

The hospital achieved the BCA Green Mark Platinum Award by adhering to a stringent Building Performance' benchmark. The other active and passive design strategies that contributed to the building's total performance are as follows.

1 Private ward screens



2 View from Yishun Pond
3 Landscape terraces
4 View of trellis at Specialist of Clinical Service tower



Effective Shading Coefficients

Latitude: 3.1°
Longitude: 101.6°
Timezone: 120.0°[+8.0hrs]
Orientation: 35.0°

Month	Avg.SC	Max.SC	Min.SC
January	45.7%	79.0%	6.0%
February	54.2%	94.0%	0.0%
March	67.6%	100.0%	0.0%
April	73.2%	100.0%	7.0%
May	75.1%	100.0%	5.0%
June	74.1%	100.0%	0.0%
July	73.8%	100.0%	0.0%
August	70.5%	100.0%	0.0%
September	67.3%	100.0%	7.0%
October	53.4%	88.0%	6.0%
November	43.0%	79.0%	5.0%
December	30.5%	66.0%	0.0%
Winter	43.5%	79.7%	2.0%

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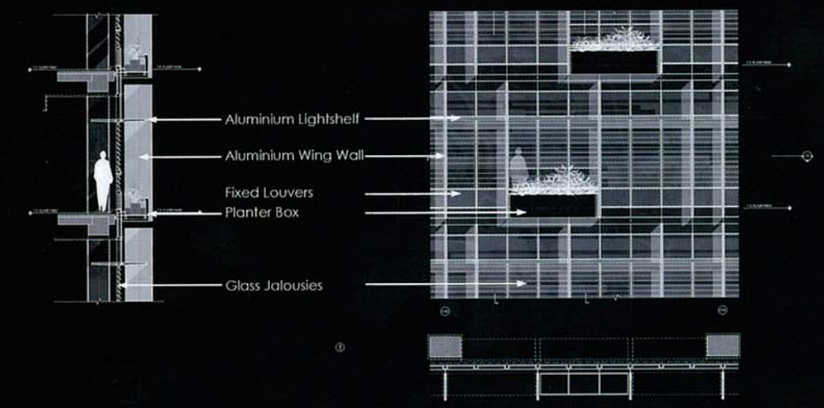

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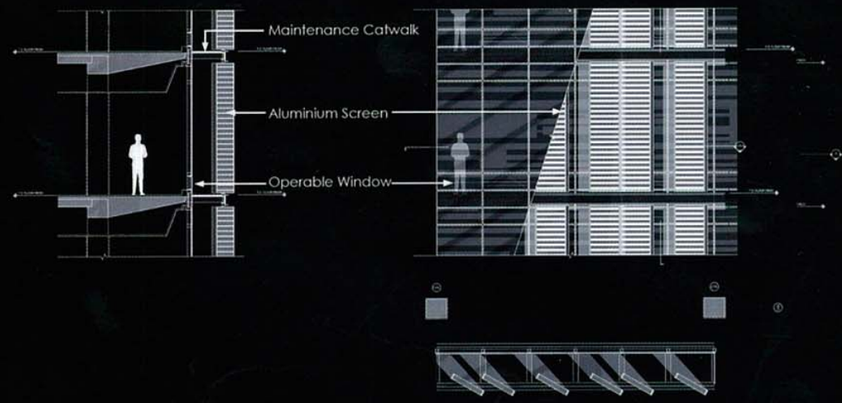

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ENERGY-EFFICIENT RESOURCES

Advanced shading studies are done to optimise external environments during different times of the day. A tropically responsive façade was critically designed for optimum occupant comfort and minimal heat penetration into the interior to minimise cooling requirements (details below). Condensate water from the AHUs is used for the cooling towers. Solar vacuum tubes are used to generate hot water to cater for the hot water usage requirements of the hospital—the solar thermal system and solar heat pumps produce all the hot water needs of KTPH (21,000 litres daily). By not having to install boilers, it saves 780 kWh/day of electricity, which translates to $60,000 annual savings in electricity bills. An efficient drip irrigation system is used for landscaping, using non-potable water from Yishun pond. The pond also serves as a rainwater collection 'tank', saving space for the actual water tanks. Rain sensors are utilised to reduce irrigation requirements during rainy seasons.

FAÇADE SYSTEM

The façade design and internal layouts are designed to enhance daylight, maximise natural ventilation and reduce glare for all wards. In the five- and 10-bed wards, which are naturally ventilated, the design of the hospital incorporates a cleverly designed façade that promotes air circulation to enhance comfort for patients.

At the subsidised wards, optimising natural ventilation is the key to patient comfort. Common areas and subsidised wards are critically designed for optimal natural ventilation. An optimal wind speed of at least 0.6 m/s is achieved, which would provide adequate thermal comfort for the patients. This would in turn reduce the requirement for turning on aiding mechanical ventilation by up to 60 percent, saving energy consumption.

Light shelves help bring daylight deeper into the interior. They also help to reduce glare. It is shown that there are comfortable daylight levels in the building perimeter zone of the subsidised wards brought deeper by the light shelves. As a result, it reduces lighting energy requirements by up to 30 percent in the effective zones.

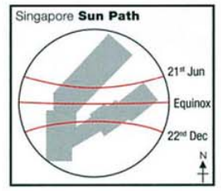
Glazing with high visible light transmittance value and a high cooling index has also been selected. There is also an optimal window-to-wall ratio. Operable, modular jalousies facilitate controlled enhanced airflow, contingent on external climatic factors. Grey-tinted glass reduces glare. Jalousies are angled at 15 degrees for the best airflow and least rain penetration. The wing wall design on the façade helps to increase wind pressure build up, which aids in natural ventilation. Monsoon louvres help to get at least a minimum air exchange even during heavy rains without the letting the rain in. Planter boxes are integrated with the façade for patients in every subsidised ward, effectively bringing a garden right outside the window. They can be maintained from within the wards at the common corridor hence the patients would not be disturbed.

At the private wards, fixed screens modulate direct sunlight and glare; they are angled to maximise views while providing maximum shading. Operable windows give patients the option of natural ventilation. There is also a dual switch system where the air-conditioning of the room is automatically cut off when windows are opened. All private wards are also installed with ceiling fans.

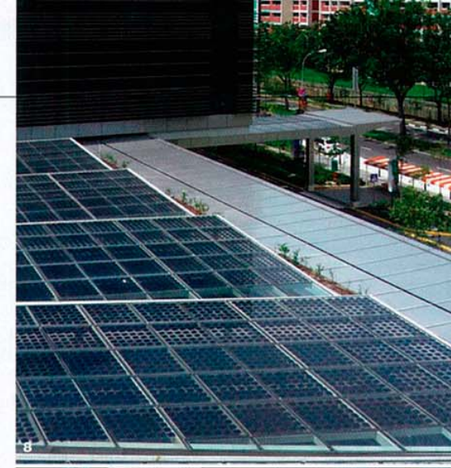
PROJECT DATA

Project Name
Khoo Teck Puat Hospital
Location
Yishun Central, Singapore
Completion Date
June 2010
Site Area
3.4 hectares
Gross Floor Area
108,600 m²
Number of Rooms
NA
Building Height
48 metres or 56 metres amsl
Client/Owner
Ministry of Health/ Alexandra Health Pte Ltd
Architecture Firm
CPG Consultants Pte Ltd
Design Consultant
RMJM Hillier
Architecture Team
CPG Consultant Pte Ltd team comprising:
Lee Soo Khoong
Lim Lip Chuan
Tan Pauline
Kanda Narasimhan
Jerry Ong
Tang Kai Vern
Cherilyn Chan
Mahesh M G

Main Contractor
Hyundai Engineering & Construction Co. Ltd
Mechanical & Electrical Engineer
CPG Consultants Pte Ltd
Civil & Structural Engineer
CPG Consultants Pte Ltd
Project Manager
PM Link Pte Ltd
Green Consultant
Total Building Performance Team
Landscape Consultant
Peridian Asia Pte Ltd
ID Consultant
Bent Severin & Associates Pte Ltd
Images/Photos
CPG Consultants Pte Ltd



5 Shading devices **6** Living walls and light shelves for subsidised wards to optimise natural ventilation and maximise daylighting **7** Fixed screens for private wards angled to maximise views while modulating direct sunlight and glare **8** View of PV cells **9** View of fins at Specialist of Clinical Service tower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