SG Green I Issue 3.0

A publication by **SGBC**

# SG GREEN

SINGAPORE GREEN BUILDING COUNCIL

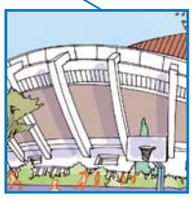
MCI permit number (MCI (P) 021/05/2016)

SGBC-BCA Sustainability Leadership AWARDS 2016

## Leading the way in Sustainability


PRODUCTS FOR LARGE PROJECTS, DAMS, CANALS AND VIADUCTS

ADMIXTURES FOR CONCRETE



PRODUCTS FOR UNDERGROUND CONSTRUCTIONS

PRODUCTS FOR THE REPAIR OF MASONRY

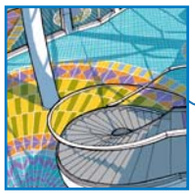
PRODUCTS FOR STRUCTURAL STRENGTHENING

PRODUCTS FOR BUILDING

WALL PROTECTIVE AND DECORATIVE COATINGS

PRODUCTS FOR WATERPROOFING

PRODUCTS FOR CERAMICS AND STONES



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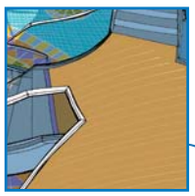
PRODUCTS FOR ACOUSTIC INSULATION

PRODUCTS FOR ROAD MAINTENANCE

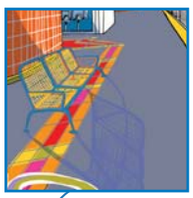
PRODUCTS FOR CEMENTITIOUS AND RESIN FLOORINGS


PRODUCTS FOR URBAN FITTINGS

PRODUCTS FOR WOODEN FLOORINGS



PRODUCTS FOR THERMAL INSULATION



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Illustrations by Carlo Stanga

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SG GREEN


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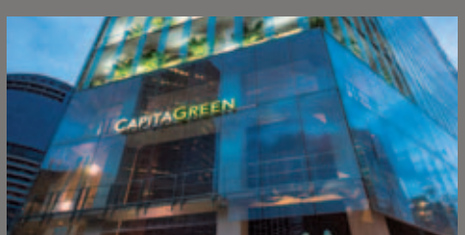







# MESSAGE FROM THE EDITORIAL TEAM

## THE SUSTAINABILITY MARATHON

With Singapore's Olympic ambition finally realised by Joseph Schooling in the Rio Olympics, the international spotlight is once again cast onto our tiny city state, with many marvelling at the immense feat accomplished by so small a country.

Indeed, this historic sporting milestone is testament to the tenacity of the Singapore spirit, relying on the core values of dedication, diligence and perseverance to make the impossible, possible. The building industry can take a page from our sporting achievement to advance the green building agenda towards a truly sustainable built environment.

Green building as a movement has advanced considerably over the years, with various technologies and techniques available for developers and building owners to tap on. However, the knowledge on green building among tenants and occupants of buildings is still wanting, with many of them unaware that they are actually inside a green building. Therefore, tenant and occupant engagement will remain a key green building topic for the foreseeable future.

## SGBC-BCA SUSTAINABILITY AWARDS 2016

This year, we celebrate eight sustainable organisations and building projects who have emerged as leaders in the inaugural SGBC-BCA Sustainability Leadership awards 2016. Spread across three different award categories, these companies and projects have embarked on and undertaken a myriad of programmes and initiatives that push the sustainability envelope.

Some of these companies and buildings will represent Singapore on the regional stage as they go head-to-head with similar companies and building projects from across the Asia Pacific region in the Asia Pacific Sustainable Leadership in Green Building Awards 2016 organised by the World Green Building Council.

In this issue of SG Green, read on about the Award Winners and their sustainability efforts. We have also added substantially more content to the magazine in order to give readers a more holistic perspective of the green building industry. You can read about Singapore's green future, a case for climatically responsive landscape design as well as some industry case studies based on certified technologies and solutions.

We hope you will enjoy this upsized issue of SG Green as we continue on our sustainability marathon towards a greener future.

Yours sincerely,
SG Green Editorial Team

THE POWER OF

# GREEN BUILDING EVERYONE WINS

**Makes great living sustainable**

- ✓ Promotes resource efficiency
- ✓ Lowers carbon footprint
- ✓ Reduces waste & pollution
- ✓ Promotes environmental stewardship

## AN INDUSTRY LED INITIATIVE

Our mission is to propel the Singapore building and construction industry towards environmental sustainability

# GOING GREEN is not a matter of '**If**', It's a matter of '**When**' – *for every **business.***

SINGAPORE GREEN BUILDING COUNCIL

Contact SGBC today and let us discuss how we can help to give your business an advantage with our corporate membership and green certification.

Don't ask what you can do for 'green'. Ask what going green can actually do for your business.

## **SGBC** MEMBERSHIP BENEFITS

- **Get to know the Green Business Professionals**
  Establish connections with green building leaders, advocates and practitioners in both local and international industries.
- **Stay Updated on the Latest Trends and Knowledge**
  Participate in numerous programs such as trade missions, seminars, conferences, and networking sessions.
- **Stay Updated on the Latest**
  Get access to the latest within green building and sustainability: new knowledge and technology, trends, engineering and more.
- **Make Your Voice Heard**
  Use your membership influence to set the direction for green building practices.
- **Gain Exposure in the Green Building Marketplace**
  On SGBC webpage, get your company listed together with a hyperlink in the member directory, as well as free monthly job listings.
- **Walk the Talk**
  Enjoy free use of the SGBC corporate logo for your business cards and corporate stationery.
- **Get Discounted Rates**
  Enjoy preferential rates to SGBC congress, events, seminars and for a range of certification services.

SGBC-BCA
Sustainability
Leadership
AWARDS 2016

# Leading the way in Sustainability

Uncovering the leaders of sustainability in the built environment, the inaugural SGBC-BCA Sustainability Leadership Awards are organised by the Singapore Green Building Council (SGBC) and the Building and Construction Authority (BCA).

The Awards are divided into three main Categories:

SGBC-BCA Sustainability Leadership AWARDS 2016
Business Leadership in Sustainability

## Business Leadership in Sustainability

Recognises companies which are truly integrating sustainability into their business models and contributing to the transition towards a sustainable built environment. These organisations understand that sustainability presents a long-term business opportunity, demonstrate sustainable practices within their internal and external operations, and show sustainability leadership within industry.

SGBC-BCA Sustainability Leadership AWARDS 2016
Design & Performance COMMERCIAL

SGBC-BCA Sustainability Leadership AWARDS 2016
Design & Performance INSTITUTIONAL

SGBC-BCA Sustainability Leadership AWARDS 2016
Design & Performance RESIDENTIAL

## Leadership in Sustainable Design and Performance

Recognises pioneering green building projects that deliver a range of benefits through a holistic approach to sustainability. These projects go beyond simply minimising their impact by considering factors that lead to positive outcomes for both the environment and for people. There are three sub categories under this award: Residential, Commercial and Institutional.

SGBC-BCA Sustainability Leadership AWARDS 2016
Green Building Product

## Leadership in Green Building Product

Recognises companies which place key emphasis on developing and offering industry-proven and environmentally-preferred green building products. These companies have developed a growing stable of green building products that are high performance in terms of contribution in a building (e.g. low volatile organic compound content) and yet produced in a manner with consideration to the environment.

After a challenging judging process performed by a panel of public and private sector representatives, the Winners for each category have been crowned. These organisations and green building projects will represent Singapore in the World Green Building Council Asia Pacific Leadership Awards in Green Building, alongside some of the most sustainable companies and projects in the Asia Pacific Region.

Read on to find out more about the Winners of the SGBC-BCA Sustainability Leadership Awards 2016.


# WHERE SUSTAINABILITY MEANS BUSINESS

SGBC-BCA Sustainability Leadership AWARDS 2016

**Business Leadership in Sustainability**

Beca is one of the largest employee-owned professional services companies in the Asia-Pacific. With over 3000 employees in 17 offices across the world, they have a substantial footprint which they are using to help create a more sustainable environment.

One of their core philosophies is to keep sustainability at the heart of what they do. This means maintaining consistently high social, economic and environmental standards and having a strong commitment to internal sustainability. They continuously seek ways to refine systems, policies and processes to have a sustainability focus, and deliver sustainable value to Singapore's built environment through projects like DUO, Marina One, and the Zero Energy Building.

Globally across the Asia Pacific region, Beca supports a myriad of clients with making pragmatic decisions during the design and development of projects. Offering a rich pool of consultancy services and experience, Beca is helping to deliver holistic, integrated solutions that are robust and sustainable in the long-term.

A leader in environmentally-sustainable design (ESD), the company in Singapore has received numerous awards and recognition for their work. From the Building & Construction Authority (BCA) Built Environment Leadership Award in 2010, to their most recent 2016 Business Leadership in Sustainability Award at SCBC-BCA's inaugural Sustainability Leadership Awards.

## PIONEERING GREEN BUILDING DESIGN

In Singapore, Beca has been a pioneer in adopting Green Building ESD. They have trained in-house ESD engineers, consisting of Green Mark Managers and Green Mark Professionals who are helping clients achieve BCA Green Mark status.

These designers offer professional advice to owners, developers and architects focused on integrating sustainability in their developments. Complemented by a strong background in building services consultancy, they synergise both passive and active design concepts with state-of-the-art technologies in computer simulation and modelling. Thus enhancing the life-cycle of the building elements, reducing operating costs and improving indoor environmental quality.

When it comes to Green Buildings, Irene Yong has a wealth of experience to share. The mechanical and electrical engineer at Beca is also a pioneer Green Mark Professional.

"Green Mark Professionals bring their holistic vision of a Green Building into a project" says Irene. "Buildings around the world today are being challenged to improve energy-efficiency, water-efficiency and reduce carbon footprint. As the environmental impact of buildings become more apparent, ESD is gaining momentum. Inefficiencies in design can create significant environmental impact and this can be reduced by incorporating sustainable features – in terms of design and also in the operation and maintenance of the building. Not only does this have a direct positive impact on cost savings, but developers also benefit from better yields on leasing and resale value, increased workplace productivity and a positive corporate image."

To date, Beca have helped their clients achieve more than 50 Green Mark Platinum Award projects (the highest tier in the BCA certification), and more than 80 projects that are certified Green Mark Gold Award or higher.

**Nanyang Technological University, Singapore**

Nanyang Technological University (NTU) has a vision to green all their academic and non-academic buildings within the campus. Beca was engaged as the mechanical and electrical, and ESD consultant to help NTU achieve their goal. In 2016, they received the inaugural Green Mark Platinum Star Champion from BCA – the first of its kind in Singapore – for achieving more than 50 Green Mark Platinum buildings on campus.

**DUO, Singapore**

This striking mixed-use development lies at the heart of a new growth area in Singapore's CBD. The project successfully attained three Green Mark Awards in 2012 and has anticipated energy savings of more than 25percent over baseline code compliance. A number of features were integrated to conserve energy and resources, including a chiller plant designed to operate at better than 0.65 kW/RT, energy-efficient LED lights in the carpark, heat pipes that recover cool toilet exhaust air for pre-cooling, the use of heat pumps for hot water generation, water-efficient fittings and rainwater harvesting.

**Zero Energy Building @ BCA Academy**

The Zero Energy Building at BCA Academy has captivated visitors and Green Building delegates from all over the world who are keen to understand and apply the concept of a zero energy building. The building successfully obtained a Green Mark Platinum Award in 2009 and incorporates many state-of-the-art green building technologies and test-bed technologies to achieve a net zero energy consumption. An innovative building design takes advantage of natural ventilation, lighting and solar energy to deliver 45percent greater energy-efficiency than comparable buildings.

**Beca Singapore Office, Westgate Tower, Singapore**

Beca's new office in Singapore offers a vibrant, collaborative and environmentally-friendly workspace for the team. The office received a Green Mark Office Interior Gold Award in 2016. The open-plan design minimises the construction of new partitioned rooms and maximises natural daylight. Features include energy-efficient T5 lights, lighting circuits to switch on or off in different zones, video conferencing facilities to reduce carbon footprint from travel between offices, and Energy Star-rated office equipment.

## LEADING THE INDUSTRY

Beca's Centre of Excellence (CenEx) in Singapore houses a team of mechanical and electrical engineers who specialise in ESD for buildings. The company has an in-house total of eight certified Green Mark Managers, two Green Mark Professionals, two LEED Accredited Professionals, and one Singapore Certified Energy Manager. Committed to keeping staff fully trained and up-to-date with best practice in sustainability, they have sent more than 20 staff to attend Green Mark Manager and Green Mark Professional courses over the year.

The team offers an integrated suite of services to help achieve greener solutions, including capabilities in energy modelling, computational fluid dynamics simulation and computer simulation. On ESD projects, they collaborate with several other professionals from different disciplines, including architects, structural, mechanical and electrical engineers, quantity surveyors and specialist consultants.

Leading the team in Singapore are Tan Kiat Leong and Irene Yong, who have been instrumental in advocating and adopting Green Building design at Beca. Kiat Leong – Singapore Business Director at Beca is also Singapore's inaugural 'Green Engineer of the Year' in 2011. Beca's Emeritus Chairman, Er. Lee Chuan Seng who was conferred the BCA Green Visionary Award in 2015, has also contributed significantly to the built environment as an active advocate in green building policies and regulations. He sits on various advisory boards and was instrumental in having Singapore Green Building Council (SGBC) accepted as a full member of the World Green Building Council (WGBC).

Beca's ESD team are also committed to research works pertaining to energy-efficiency and improvement. In 2013, they completed six tracks of research under the Singapore Economic Development Board "Innovation Development Scheme". In 2015, they collaborated with SinBerBEST – a joint collaboration between University of California Berkeley and three universities in Singapore – in research to benchmark energy consumption of office buildings in Singapore. And in 2016, they will embark on a two-year study as Co-PI with NTU and the University of California Berkeley in their research under the Green Building Innovation Cluster entitled "Scalable and Smart Building Energy Management System".

## SUSTAINABILITY AT THE CORE

"Engineers are passionate people – passionate about creatively transforming our world to be a better place to dwell in. Sustainability in its entirety is at the core of this passion" – Ben Henson, Buildings Operations Manager at Beca.

Beca's commitment to sustainability starts at a corporate level. A Group-wide environmental commitment document signed by the Group CEO commits the company to the principles of sustainable development and to the continual improvement of environmental sustainability. It seeks to incorporate environmental sustainability into projects, influence key suppliers in the adoption of sound environmental practices, reduce carbon footprint and waste generation, and raise awareness of environmental issues by being a leader in sustainability.

Complementing Beca's environmental commitment is a strong track record for community engagement. The company takes part in a number social initiatives and pro-bono projects with an aim to make positive and lasting change in their local communities. They support causes and projects that matter to their people and align with their values, skills and resources. They also employ whole life costing expertise to projects, which considers the total cost of an asset from design through to construction, operations and maintenance.

Beca's commitment to sustainability is communicated to employees throughout the business. The aim is to cultivate positive habits and raise awareness around being environmentally and socially considerate both at work and at home. In many offices are Green Teams which consist of like-minded people, passionate about cultivating a culture of sustainability through coordinating and promoting sustainability initiatives.

## CREATING A SUSTAINABLE FUTURE

Lee Ang Seng, Singapore's Managing Director says, Beca is committed to creating a sustainable future, which means seeking continual improvements in all that they do. "The company continually measures and monitors their environmental performance and proactively seeks ways to reduce their environmental impact and prevent unnecessary pollution from activities."

In Singapore, Beca is in their third year, and New Zealand and Australia, their fourth year of collecting and monitoring internal environmental data. This includes carbon emissions, energy consumption, travel, waste generation and paper consumption. The information is analysed and shared with Beca's management team who agree and set future sustainability targets.

In Singapore, energy, water and waste management improvement plans provide a framework for Beca's environmental initiatives within the office. Electricity and water sub-meters are installed on each level and recycling bins are provided to encourage staff to reduce landfill. Electricity, water and paper usage are tracked on a monthly basis and the trending data is displayed in the office's 'Green Corner', to create awareness amongst employees.

The office aims to reduce energy consumption by 5percent in the next three years by installing energy-efficient office equipment, virtualisation of IT equipment, employing a capped water usage of 22m3 per month, and employee awareness campaigns.

Each year, Beca reviews their global sustainability practices and produces an internal Sustainability Report which aligns with Global Reporting Initiative (GR13) Sustainability Reporting Guidelines. The report presents financial, social and environmental performance for the year including internal and external sustainability initiatives and projects, and the progress made towards sustainability goals.

## WHERE TO NEXT?

Beca's long-term goal is to be a flagship organisation for the promotion of sustainable and innovative design for the built environment.

"I would like to think we are catalysts for transforming projects into green projects" says Irene. "One day, I really hope to see Singapore recognised as a leader in Green Building design, not only in Asia, but around the world."

In the short to mid-term, Beca's Singapore office seeks to establish themselves as the seeding ground to their other offices in Asia and across the globe. This will involve propagating their 'Green' knowledge through in-house training and technical sharing, mapping current and emerging technologies in pursuit of sustainable and innovative design, and identifying and communicating the vision to those who may influence the future direction of the company.

For Irene, helping buildings go Green has a deeper purpose beyond a career pursuit. "I think everyone has a key role to play in sustainable living" she says. "We want to pass on a green, sustainable, healthy environment for our children to live in."

"In order to achieve these goals, we believe that the power lies in nurturing the next generation. By fostering our younger leaders and teaching them the importance of integrating sustainability into all that they do, we hope to mainstream sustainability values and create young enthusiasts, passionate about 'going green' in both their work and personal lives."

All images courtesy of Beca Carter.

# put wellbeing at the heart of your building.

## Why "Better Places for People" ?

Research shows that a building's design impacts the health, wellbeing and productivity of its occupants.

The World Green Building Council's 2014 global report *Health, Wellbeing and Productivity in Offices* raised awareness of this issue by outlining the evidence linking office design with occupants' health and productivity. The same features commonly associated with green buildings have a measurable impact on human wellbeing. This strengthens the ongoing business case for energy-efficient, resource-efficient, healthier buildings.

Better Places for People builds upon the foundation provided by the report.

## What Are Our Aims and Activities?

Better Places for People aims to accelerate the demand and supply of buildings that support people in living healthier, happier lives by raising awareness of how buildings impact people, and by presenting the business case for action.

SGBC, BCA and our Programme Partners - owners, investors and real estate managers, will engage and collaborate with tenants through a range of activities to help drive action on the ground.

BETTER PLACES FOR PEOPLE

## Key Activites

- Outreach to tenants through owners, investors, real estate managers and more!
- Providing tenants with the knowledge and means of creating greener spaces and offices.
- Creating a database of information on tenant expectations and concerns, to better understand changing trends and needs.

## Get Involved in the Campaign!

**Singapore Green Building Council (SGBC)**

CONTACT:
outreach@sgbc.sg
TEL:
6732 5518

WORLD GREEN BUILDING COUNCIL

SINGAPORE GREEN BUILDING COUNCIL

BCA

Leadership in Sustainable Design and Performance - Commercial

# A TREE OF LIFE IN THE HEART OF THE BUSINESS DISTRICT

SGBC-BCA Sustainability Leadership AWARDS 2016

**Design & Performance COMMERCIAL**

Located in the heart of Singapore's Central Business District (CBD), CapitaGreen – one of the newest completed office buildings – stands out with its striking green façade. As a modern office tower comprising 40 storeys of premium Grade A space, CapitaGreen breaks away from conventional office building design, incorporating multiple sustainable features in its design and operation.

Designed by Pritzker Architecture Prize Laureate Toyo Ito, like a plant growing towards the sky, the 242-metre high CapitaGreen is crowned by a distinctive sky forest of tropical trees on its rooftop and a sculptural 'petal-like' funnel made of aluminium sheet with steel frames. These 'petals' draw in clean fresh air from the top of the tower into a cool void that penetrates 34 storeys of the building to deliver fresh air through its air-conditioning system, to cool the office floors. At the same time, the building's generous floor-to-ceiling height allows natural lighting to permeate the interior, creating a sense of space without the extensive use of energy-consuming artificial lighting.

The building's innovative façade design has a 55 percent green ratio, with over half the perimeter of its façade covered by living green plants. This energy-efficient double-skin façade consists of an outer layer of frameless glass and an inner envelope of double-glazed full-height glass. In between these two layers of glass are planter-boxes filled with shrubs and ground-covers. This façade helps to reduce solar heat gain by up to 26 percent. Premium, ultra-modern office space is further complemented by lush greenery in the sky terraces at selected floors and in the expansive roof-top sky garden, as well as unique sculptures by internationally renowned artists which are tastefully integrated with the building design.

With a net lettable area of approximately 704,000 square feet (sq ft), CapitaGreen has one of the largest and most efficient, truly column-free typical

floor plates ranging from 22,000 sq ft to 26,000 sq ft. CapitaGreen also has the highest raised floor-to-ceiling height of 3.2 metres of any CBD office building. All carpets, paint and ceiling boards used for office interiors are certified by the Singapore Green Building Council's (SGBC) Singapore Green Building Product labelling scheme.

For its environmentally-sustainable and inclusive design, CapitaGreen was awarded two pinnacle awards – the Green Mark Platinum Award in 2012 and Universal Design Mark Platinum in 2016 respectively by the Building and Construction Authority of Singapore (BCA).

## A SUSTAINABLE DESIGN

Conservation efforts were made at various stages of the life cycle of CapitaGreen, which occupies the site of the former Market Street Car Park. The project life cycle of CapitaGreen (from design conceptualisation, development, construction to operation) is strictly governed by CapitaLand's Sustainable Building Guidelines to maximise the economic and social value of the building and reduce its environmental impact.

Several innovative passive designs, such as the cool void and double skin façade, were incorporated to reduce energy consumption. New and efficient construction methods were adopted to improve productivity, reduce material wastage and cut unnecessary costs. Building Information Modeling (BIM) was used to study the construction sequence to minimise material wastage and enable sustainable demolition of the old building. CapitaGreen was recognised by BCA with a BIM Platinum Award in 2015. Reused and recycled materials were also widely used in the construction. A rainwater harvesting system and water efficient fittings rated "excellent" by PUB's Water Efficient Labelling Scheme in all common toilets, pantries and shower facilities help lower water consumption. Biodiversity was encouraged by consulting local authorities and specialists and native plant species were used for the greenery. Social factors were considered resulting in the creation of sky gardens, a rooftop forest, an open plaza at the northern end and dining amenities. Art pieces and sculptures by internationally renowned artists were also incorporated to inject a new vibrancy to the area. All vendors engaged at various phases of the development (construction, operation etc.) abided by CapitaLand's Environmental, Health and Safety (EHS) Guidelines.


The building's design factored in local physical and environmental conditions to optimise the intended results. The creation of sky gardens/forest and the extensive use of greenery serve to reduce the urban heat island effect, considering CapitaGreen is located in the heart of the CBD. The cool void takes advantage of the wind conditions at the maximum height of 242 metres and in an unobstructed part of the building to draw in cooler fresh air for circulation in the air-conditioning system. The Kakiotoshi wall, made from a special method of Japanese plastering, wraps around the core of the main lobby. The earth plastered wall is made by domestic soil and cement which are easily available in the local market. The full height glass windows draw in natural lighting into the office space to reduce reliance on artificial lighting as Singapore enjoys an abundance of sunlight due to its location along the equator.

## SUSTAINABLE FEATURES

The aesthetically pleasing and creative design of the cool void and sky forest on the rooftop allows for fresher and cooler air intake for distribution to the office floors below, after going through the air handling units (AHUs). This fresher and better quality air is expected to reduce the load on the air-conditioning system required to cool the fresh air intake. Together with the incorporation of an innovative double-skin (green and urban) façade which cuts down the solar heat gain, the energy consumption is estimated to be lower by over 1.4 million kWh per annum, which is equivalent to over 700 tons of carbon emission or planting around 235 trees.

CapitaGreen has a high window/wall ratio to maximise the visible light transmission (about 61 percent of the influx of natural light) through the inner glass skin and reduce the need for artificial lighting with the inclusion of photocells to control the office interior perimeter lights. The building is also designed with an Envelope Thermal Transfer Value (ETTV) of 37.13 W/m2, 26 percent lower than the benchmark of 50 W/m2.

The extensive use of vertical greenery comprising a wide variety of living plant species, largely in the east and west facades to diffuse the strong sunlight penetrating the building, provides tenants with a more comfortable indoor environment.

To boost water efficiency, condensate water from the AHUs is recycled and stored in the cooling tower water tank in Basement 2. In addition, an alternative source of water, NEWater (purified wastewater using dual-membrane and ultraviolet technologies), is available for cooling towers and irrigation purposes to reduce consumption of potable water.

A total area of 112,408 sq ft of greenery was brought into the urban landscape of CapitaGreen, which is equivalent to 190 percent of site replacement. About 311 trees of 17 different species can be found within and around the building. Some 65,000 shrubs and ground cover from 80 different species are planted within the site. Having extensive greenery in and around the building, as well as the rainwater harvesting features, significantly reduces the load on the local drainage system by slowing down rainwater runoffs and reducing peak flows.

The water-efficient automatic irrigation systems for most of the greenery includes drip emitters and a gravity feed delivery pipe network to save energy. Rainwater is harvested and reused for irrigation purpose. All the water efficient features translate to water savings of 34,536 cubic metres per year, which is about 60.5 percent of the total water consumption of the building. Sub-meters are installed to monitor the major sources of water consumption.

## A FOCUS ON WELL-BEING

The building design goes beyond the conventional office setting by including a wide variety of commercial, recreational and social space and amenities in the spatial planning. This ranges from the restaurants and cafes to social amenities on various levels of the office tower, providing convenience, comfort and breakout spaces to both office workers and the public.

CapitaGreen is well connected to existing public amenities, pedestrian walkways and transportation networks, offering ease of access for workers in the building and the general public. For example, there is a relocated taxi stand on the ground floor of the building along Cecil Street, and CapitaGreen is close to the Raffles Place and Telok Ayer MRT stations as well as multiple bus stops.

Covered walkways provide visitors with shade from the sun and shelter from the rain. The majority of the routes to the amenities of the building are step-less to facilitate movement of visitors on wheelchairs. The design and construction of an Underground Pedestrian Network with accessible lifts provides a seamless route to the nearby developments and beyond.

The building management team hosts frequent visits to CapitaGreen to market the building and educate people on the unique green features and sustainable designs adopted. CapitaLand organises tenant engagement programmes including an annual key event, called the CCT Eco Race, to promote awareness of the sustainability and green initiatives driven by the Group.

**Developer:** CapitaLand, CapitaLand Commercial Trust (CCT) and Mitsubishi Estate Asia
**Concept Designer:** Toyo Ito & Associates, Architects
**Project Architect:** RSP Architects Planners & Engineers (Pte) Ltd
**M&E Engineer:** Squire Mech Pte Ltd
**Main Contractor:** Takenaka Corporation

All images courtesy of CapitaLand.

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Leadership in Sustainable Design and Performance - Institutional

SGBC-BCA Sustainability Leadership AWARDS 2016

Design & Performance INSTITUTIONAL

# A CAMPUS IN THE CITY

Established in 2000, the Singapore Management University (SMU) sets its mission to generate leading-edge research with global impact and to produce broad-based, creative and entrepreneurial leaders for the knowledge-based economy. As part of its continuous drive to be a world-class academic institution, SMU aims to host a Green Campus as defined by the Building and Construction Authority's Green Mark (Platinum) certification.

Since 2007, SMU has actively taken steps to improve energy efficiency and to find ways to cut down energy wastage in the campus. SMU established the following management systems to manage the energy and water use in a systematic and structured way:

- ISO 50001: Energy Management System
- Singapore Standard 577: Water Efficiency Management System
- Singapore Standard 564: Green Data Centre-Environmental and Energy Management system

With consistent efforts and systematic approaches over the years, SMU has managed to reduce electricity consumption by more than 30 percent from 2006 to 2015, whilst its student population almost doubled in the same period.

## A GREEN CAMPUS DESIGN

SMU's architectural design of the modern City Campus blends seamlessly with the surrounding historical buildings, like the Singapore Art Museum, the Cathedral of the Good Shepherd, and the National Museum.

Considering Singapore's climate, passive environmental features are an essential part of the building design. For example, all west-facing facades of SMU buildings are shaded by a veil of plants growing from each storey of the buildings. This effectively reduces solar heat gain by the SMU buildings whilst providing a high level of natural day light. Sky lights and windows are widely used in the buildings to provide natural day lighting to the study areas, offices and lobby areas, reducing the dependence on artificial lights. The ground floors of buildings in the SMU City Campus are designed with natural ventilation in mind.


SMU is one of the pioneering buildings in Singapore's Central Business District area to use "NEWater" - reclaimed water produced by Singapore's national water agency PUB - in the buildings' central air-conditioning system.

## AN EMPHASIS ON ENERGY

A popular adage states that "You can't manage what you don't measure". This aptly applies to energy management in SMU. Energy is a critical component of SMU's operational cost. Hence SMU needs to boost the energy efficiency and improve energy performance in order to help SMU maximize the use of its energy-related assets to reduce energy consumption and costs.

ISO 50001 provides a framework for organizations to measure, review, analyse and monitor energy use and consumption in various areas, with a view to find ways to systematically improve organisational operations for effective use of energy.

On 4 March 2013, SMU became the first public-funded, autonomous university in Singapore to achieve certification to the ISO 50001 Energy Management System (EnMS) standard.

With the structured and systematic approach, SMU aims to institutionalise its energy conservation processes. In addition to the ISO 50001 Energy Management System, SMU has also established the Singapore Standard SS 564 Green Data Centre - Environmental and Energy Management Systems and the SS 577 Water Efficiency Management System.

Hundreds of power meters had been installed in SMU campus to monitor the energy consumption in

each building and by important energy systems in SMU campus. SMU records and analyses the power consumption at the end of each calendar month. The data provides SMU with insights on where and how the energy is used.

Energy conservation efforts are applied throughout the campus, especially in areas with irregular use. Occupancy sensors are installed in 400 faculty rooms to ensure that energy is used only when required. The sensors automatically turn off air-conditioning supply to the offices when the rooms are empty. Shared facilities are not spared. These include 2 Auditoriums, the Sports Hall and 96 Seminar/Class rooms in campus. These teaching facilities were constantly served by the centrally controlled air-conditioning system. To reduce energy usage, local thermostats have been installed in the auditoriums, Sports Hall, seminar rooms and class rooms so that users can turn on the air-conditioning systems when they need to use the facilities and switch off the air-conditioning system at the end of their classes.

All air-cooled DX FCUs and Computer Room Air-conditioning (CRAC) units serving the data centre and 70 IT rooms have been replaced with highly efficient chilled water FCUs and chilled water Computer Room Air-Handling (CRAH) units to provide better cooling efficiency for IT rooms and Data Centres.

Before the chiller plant was retrofitted, the system efficiency of the older plant was measured at 0.81kW/RT. The chilled water plant was redesigned, including streamlining the chilled water pipes and condenser water pipes, right-sizing the plant capacity, selecting high efficiency multi-stage VSD chillers and split case water pumps, and installing VSDs for cooling fan motors. The plant retrofitting project was completed in November 2014. The system efficiency of the new plant was improved from 0.8 kW/RT to 0.5 kW/RT.

Through the energy conservation measures implemented, SMU has achieved significant reduction in energy consumption per annum since 2006. This is notwithstanding the rapid growth in student population over the years and the increases in occupancy and activity levels on campus. Although the total student population on campus has increased by 97.5 percent, the total energy consumption by the campus has been reduced by 31.4 percent. The average yearly energy used by each SMU student has been reduced from 4,226 kWh per student in 2006 to 1,481 kWh per student in 2015 -- a reduction of about 65 percent.

## A CAMPUS-WIDE APPROACH

SMU has an Environmental Policy, which requires all its stakeholders to progressively adopt the environmental perspective in the management and operations of the University's activities. A Green Procurement Policy is also in place to guide the staff to use green/non-toxic materials.

Recycling facilities are provided on the campus. Office occupants are provided with additional bins to dispose paper that can be recycled. Recycling campaigns are conducted to promote and encourage waste minimisation, while waste reduction programmes are disseminated across the campus through the intranet.

A number of green building products certified by the Singapore Green Building Product labelling scheme have been selected and widely used in SMU campus for building construction, upgrading and system retrofitting projects. The following table illustrates some notable examples:

| COMPANY | PRODUCT |
|---|---|
| EcoSpec Global Technology Pte Ltd | Water Treatment System |
| Grundfos (S) Pte Ltd | Water Pumps |
| Danfoss Industries Pte Ltd | Variable Speed Drives |
| Big Ass Fans Singapore | Ceiling Fans |
| Panduit Singapore Pte Ltd | Network Cables |
| ABB Pte Ltd | Transformer |
| Schneider Electric Singapore Pte Ltd | Switchboards |

For every new building construction/renovation and system upgrading projects in SMU, it is a "must" for the project teams to conduct comprehensive life-cycle analysis – this is to reduce the operational cost and minimize the environmental impact over the building/system's whole life cycle.


Modular design approaches are also adopted for managing major energy systems upgrading projects in SMU, to ensure that the energy systems are always designed to be right-sized for the needs of the building operation and can be easily scaled up when the demands from the building operations increase.

## LEARNING IN NATURE

The SMU campus has porous structures that engage the surroundings with open courtyards and free-flowing walkways, and allow for an easy and natural integration with activities of the city. The campus design and structure reflect and support the character of SMU's curriculum and its style of teaching.

SMU city campus was designed to be a campus in the park. During the development and construction stages, SMU did whatever was necessary to preserve the original landscape and greenery of the site. Heritage trees were relocated, and transplanted back on campus grounds. The façade of the buildings were cladded with double and low-E glazing glass.

SMU building façades are shaded by a veil of plants growing from each storey in response to the west orientation, which effectively reduces solar heat gain to the building while still providing a high level of daylight.

The SMU campus was built with 3 tiers of landscape in mind:

- Tier 1: Gardens on the building roofs reduce solar heat gain through the building roofs
- Tier 2: Campus Green on the ground floor, which works as the green "lung" for the SMU city campus
- Tier 3: Water features and courtyards built at basement levels, which provide light, natural ventilation and greenery for basement spaces.

The SMU Campus greenery is part of the 4km-long Butterfly Trail that starts at the gates of the Singapore Botanic Gardens, continues to Orchard Road, passes through the SMU grounds and ends at Fort Canning Park. "Hosts" and "Nectar" plants are found in this plot to provide food and shelter to caterpillars and butterflies.

SMU has many street-level linkages and has direct connections to MRT station and bus stops. There are also sheltered bicycle lots and green lots for hybrid cars in the campus to encourage faculty, staff and students to use green transport.

SMU will continue to advocate green building designs in future expansion to its campus, while also looking at adopting smart building innovations and technology to further enhance its sustainability efforts.

**Developer:** Singapore Management University
**Architect:** KNTA Architects
**Engineering Firm:** Kurihara Kogyo Co., Ltd
**ESCO consultant:** Johnson Controls Pte Ltd

All images courtesy of Singapore Management University.

# SMU LEADS THE WAY

## In sustainable institutional design and performance

The road to going green is marked with a relentless drive towards energy efficiency and waste reduction. We designed our campus to embrace the natural ecosystem as part of our architecture to realise sustainability. We also guide our stakeholders to adopt an environmental perspective in their operational and management decisions. Here at SMU, building a green campus goes hand-in-hand with nurturing the leaders of tomorrow.

Energy savings
over past 9 years:
>30% reduction
in energy use despite
doubling of student numbers

SMU
SINGAPORE MANAGEMENT UNIVERSITY

www.smu.edu.sg

Leadership in Sustainable Design and Performance - Residential

# TREE HOUSE

## AN ICONIC GREEN RESIDENCE, INSPIRED BY NATURE

SGBC-BCA Sustainability Leadership AWARDS 2016

## Design & Performance RESIDENTIAL

Nestled within the Upper Bukit Timah and Chestnut Avenue private residential enclave, Tree House condominium has caught the imagination of many with its eye-catching facade. Its stunning 24-storey 2,289 square metres (sqm) vertical garden is hard to miss – in April 2014, it entered the Guinness World Records for largest vertical garden, placing Singapore's built industry in the global spotlight.

Developed by leading eco-developer City Developments Limited (CDL), the 429-unit eco-residence was completed in 2013. Within its verdant grounds are four blocks of 24-storey apartments, along with an environmental landscape deck, common basement car parks, and a myriad of recreational facilities including a plunge pool, floating hammocks, tennis courts and a jogging track.

Reflecting CDL's ethos to "Conserve as it Constructs", Tree House showcased the hallmarks of CDL's eco residences – it was designed sensitively, built sustainably and managed sensibly. From the outset, around 2.7 percent of the development's total construction cost was invested in green design and innovation. Altogether, its sustainable design features are expected to result in energy savings of over 2,400,000 kWh per year and water savings of 30,000 cubic metres per year, or approximately a total of over S$500,000 per year.

### NATURE'S INSPIRATIONS

Surrounded by nature and greenery that is largely a green oasis encompassing a forested area, nature reserve, park connector and parks, Tree House drew its design inspiration from its natural surroundings – otherwise known as Biomimicry, or innovation inspired by nature.

By observing nature's models, the architects of Tree House took inspiration from these designs and processes to solve human problems. For instance, a solar cell inspired by a leaf, or a bio-shelter inspired by plant structure for the cooling of living environment; the conceptualisation of the Green Wall was inspired by the nearby Zhenghua Park.

### SUSTAINABLE GREEN WALL

Magnificent and majestic, the green wall is approximately 78 metres tall and 20 metres wide.

# GREEN FACTS AND FIGURES

1. Vertical garden measures 78 m high and 20 m wide
2. Total square area of 2,289 sqm
3. Giving structure to the vertical garden is a modular steel frame that took a year to fabricate and install
4. Planted with lush Thunbergia grandiflora vines, which took 14 months to plant and grow
5. Platforms and cat ladders were installed behind the vertical garden to facilitate maintenance. From these platforms, the planter boxes of the creepers can be easily accessed, enabling ease of maintainance
6. Approximately 2.7 percent of Tree House's total construction cost was invested into the development of its green innovations

More than just a unique architectural structure, the green wall, or vertical garden, was designed with environmental sustainability in mind. A natural insulation, it reduces the estate's carbon footprint by filtering pollutants and carbon dioxide out of the air.

In continuity of greenery from adjacent green surroundings, the green wall also functions as a Bio-shield against the westerly sun, reduces solar radiation and heat absorption, and lowers the energy needed to cool indoor spaces.

This is expected to achieve air-conditioning energy savings of between 15 percent and 30 percent, or a total of approximately between S$12,000 and S$24,000 annually for the 48 west-facing master bedrooms that are insulated by the vertical wall.

To complete the nature-inspired architecture, there are three layers of green sky gardens on the seventh, 13th and 19th floors of each block in Tree House, with green creepers clinched on the circular support. These act as vantage points and additional vertical green lungs for residents. The extensive cantilever of sky gardens maximises greenery and provides shade for internal spaces in Tree House.

## PLANNING AROUND BIODIVERSITY

The site planning embraces the native ecosystem by studying existing biodiversity and climatic conditions.

**Spanning across an expansive site area of 22,700.40 sqm and gross floor area of 52,437.92 sqm, the development offers a myriad of recreational facilities including a plunge pool, floating hammocks, tennis courts and a jogging track.**

A Biodiversity Impact Assessment was carried out to ensure continuity of the original ecosystem, and that vertical greenery and generous landscaping is expressed throughout the development.

Native plants and fruit trees were planted within development, along with the provision of the Eco-Pond and "bio-swales" in respect to the biodiversity study. Some 99 native animal and 32 plant species were identified, which was followed by a careful selection of tree and plant species for landscaping to attract native wildlife, among a long list of other recommendations to protect biodiversity.

Taking advantage of the natural sloped terrain of the site, the "bio-swales" aid in the collection of rainwater for landscape irrigation purposes, where the collected rainwater can then be treated and filtered, to be reused.

The "bio-swales" detain and treat rain water run-off from about 10 percent of the paved areas. Implementation of the swales is a sustainable green practice that not only provides an additional green aesthetic element, but also performs a vital role in reducing pollution to waterways. They filter pollutants, reducing the infiltration of pollution in groundwater. The swales are environmentally viable alternatives to conventional storm drains that are used to convey storm water run-off.

## SUSTAINABLE DESIGN & CONSTRUCTION

During block planning, the towers of Tree House were set in a north-south orientation to capitalise on passive environmental design. Concurrently, typical lobbies and basement car parks were designed to be naturally ventilated to eliminate the use of mechanical ventilation, smoke purging and sprinkler systems. Such deliberation has achieved significant impact to the natural lighting brought into the basement and has also cut down the need for mechanical ventilation, thereby allowing residents to enjoy the benefits of good natural lighting and ventilation.

As part of the careful consideration during design and construction, sustainable materials were used in the building process. These materials include laminate wood flooring, waterproofing, and composite timber flooring.

To employ building technology that is both efficient and sensitive to the environment, Tree House's construction was also largely driven by pre-fabricated construction methods.

Aside from extensive use of precast concrete for columns, walls, beams and slabs, Prefabricated Bathroom Units (PBUs) were installed in 75 percent of all toilets. By manufacturing and assembling the PBUs

**At the heart of Tree House are the majestic, eponymous Chestnut Tree Houses that will surely impress at first sight.**

**Within the sturdy boughs, children can spend hours play-acting their fairytale fantasies in their own perfect world.**

**Linking the tree houses is the Tree Top Walk, the ideal place for a romantic stroll in the evening. With ethereal lights illuminating the path, the tree houses come to life at night as the soft glow through the arches creates a mystical tapestry of silhouettes.**

off-site in factories and later delivering them to the construction site for installation, this increases social and environmental benefits, as a safe and healthier working environment is created through reduced site work.

In addition, service pipes were concealed in PBUs for greater reliability, performance and aesthetics. Produced locally, these high quality modules contributed to savings in manpower and time on-site and reduced heat transmission on-site during the construction stage.

A Cobiax flooring system was also used in the development. A void-forming technology which forms light-weight, biaxial floor slabs, it reduces the volume of concrete by displacing non-working deadload and reduces the cost of the foundations.

To maximise energy savings, other green features at Tree House include the use of heat-reducing laminated green tinted windows, lifts with Variable Voltage and Variable Frequency motor drive and sleep mode programming and motion sensors at staircases that will activate lights automatically.

## INSPIRING GREEN LIVING

Within the apartment units, green design also took centre stage. Residents enjoyed numerous eco-conscious design features within their living spaces.

Apartments are fitted with energy-efficient inverter air-conditioning and gas heaters, as well as water efficient sanitary fixtures and fittings. The use of water sub-meters helps to monitor water usage in key common areas, and reduce water usage.

For good indoor environmental quality and environmental protection, low formaldehyde adhesive was used for woodworks, while low VOC paints were used for internal walls and ceilings which improves air quality.

To encourage residents to recycle, a dual-chute pneumatic waste collection system allowed the segregation of domestic and recyclable waste.

**Architect:** ADDP Architects LLP
**Project Interior Design:** Axis ID Pte Ltd
**Landscape Consultant:** COEN Design International Pte Ltd
**M&E Engineer:** United Project Consultants Pte Ltd
**C&S Engineer:** DE Consultants (S) Pte Ltd
**Quantity Surveyor:** Davis Langdon & Seah Singapore Pte Ltd

All images courtesy of City Developments Limited.

# Does your building SENSE you?

Enlighted. Offering the ground-breaking sensory platform that is redefining what a smart building can be.


## The Most Advanced Digital Sensor in the World

- Light, motion (PIR), temperature
- Bluetooth 4.x radio
- Dual channel control for color tuned lighting
- Digital signal processing for richer information
- Built-in power meter

enlighted


Mapei Singapore Plants

SGBC-BCA Sustainability Leadership AWARDS 2016
Green Building Product

Founded in Milan in 1937, MAPEI is today the world leading producer of adhesives and complementary products for the fixing of all types of floor and wall coverings. In addition, the company is specialised in a wide range of chemical building products from waterproofers to special mortars, from admixtures for concrete to products for the restoration of ancient buildings.

More than 1,600 products are available making MAPEI "The Builders' Partner Worldwide".

Mapei has built their strategy following three main directions:

- Specialisation: Mapei offers a wide range of special, technologically-advanced building products and systems.
- Research & development: Annually, Mapei invests about 5% of total turnover and 12% of their employees in R&D. Most expenditures are devoted to eco-sustainable products. In November 2015, Mapei has signed up for a grant of 45 million euros from the European Investment Bank (BEI) to help fund Research & Development activities in Europe. The grant is for a period of 6 years and will be used by Mapei SpA to help fund all their main research projects in Europe over the next five years.
- Globalisation: since the 1960s, Mapei has advocated for globalisation to be closer to local requirements and to maximise logistics efficiency.

Mapei has developed a technical-commercial network in major parts of the world. The Group now counts 74 companies operating in 5 continents and 18 research laboratories. Mapei Group's annual turnover in 2015 is about 2.3 billion euros. The total number of Mapei Group employees is 9,000.

In the Asia Pacific, Mapei has made its presence felt since 1989 when Mapei Far East Pte Ltd was constituted in Singapore. Production facilities began from 1995, serving both the domestic and export markets. In Singapore, Mapei's renown as the "one-stop partner for construction needs from start to finish" has enabled us to contribute solutions to the most diverse kinds of projects: Marina Bay Sands, Gardens by the Bay, Victoria Theatre, Capitol Development, Singapore University of Technology and Design, South Beach, Sultan Mosque, Downtown Line, The Interlace, etc. Emphasising sustainability, Mapei has 52 product certifications with the Singapore Green Building Product (SGBP) labelling scheme.

Presently, Singapore is the regional base for the Management of MAPEI Group in the Asia-Pacific. There are Mapei companies in 11 countries with plants in Korea, China, India, Vietnam, Malaysia, Singapore, Australia, Indonesia and trading subsidiaries in Hong Kong, New Zealand and Philippines.



## MAPEI IS GREEN WORLDWIDE

Mapei is committed to developing eco-sustainable products and systems which contribute to safeguard the environment as well as the wellbeing of the workers and end-users. Mapei adheres to worldwide certification bodies and programmes: GEV, BLAUER ENGEL, DGNB, LEED, US GREEN BUILDING COUNCIL, RESPONSIBLE CARE, BREEAM.

52 products are certified by SGBC of which 21 cover adhesives for ceramic tiles and stones, 6 cover adhesives for resilient materials, 3 cover mortar additives, 7 consist of waterproofing materials, 8 products are for wall coatings and 7 products are for floorings.

## ADHESIVES

Mapei has a solution for all fixing needs, be they for stones and ceramic tiles, or resilient materials (e.g. wood, vinyl, rubber, textile). Mapei's adhesives for tiles and stones conform to the ISO 13007-1 & BS EN 12004 standards as well as other international standards and cover all three types: C (cementitious), D (ready-to-use dispersion paste adhesives) and R (reaction-resin in single or multi-component mixture). Most of Mapei's adhesives for resilient materials consist of those in water dispersion with low emissions of VOC (volatile organic compounds). Another kind is the "Reaction-resin" type that hardens through chemical reaction between the components.

## WATERPROOFING

Among the products certified by the Singapore Green Building Product labelling scheme, three of them are cementitious-based, two-component flexible systems **(Mapelastic, Mapelastic Smart, Mapelastic High Flex)**; two of them are polyurea-based **(Purtop 400 and Purtop 1000)** and one is synthetic-polymer based **(Mapelastic Aquadefense)**. With the above green products, Mapei is able to offer sustainable complete waterproofing and protection solutions to your building needs.

## WALL COATING

The SGBP-certified mineral wall coatings contain less than 5 percent organic content complying to the stringent DIN 18363 norms and have extremely low VOC emission. **Silexcolor Paint** and **Silancolor Paint** are highly breathable products perfectly compatible with all kinds of cementitious substrates. Hence, using such paints, there will be no more of paint peeling from the wall.

## FLOORING

Mapei's environmental-friendly flooring products cover a wide range of applications for residential, commercial and industrial projects. Mapei provides total solutions from the self-levelling mortar **(Ultratop)** to the finishings such as heavy duty epoxy mortar **(Mapefloor EP 19 SP)**, water-based epoxy coatings **(Mapecoat I 600 W, Mapecoat I620 W SP and Mapefloor I500 W SP)**.


From Mapei, a wide range of high-quality adhesives for the fixing of ceramic tiles, stone materials and mosaics, suitable for all conditions and locations.

## Leadership in Green Building Product

NIPPON PAINT

SGBC-BCA Sustainability Leadership AWARDS 2016
Green Building Product

An affiliate of Nippon Paint Japan and part of the Nipsea Group, Nippon Paint was established in Singapore in 1962. Today, it is one of the nation's leading paint manufacturers and enjoys an unsurpassed reputation for quality and innovation.

Nippon Paint Singapore combines in-depth local market knowledge with the global resources of the Nipsea Group. With 65 manufacturing facilities in 15 countries, the Group produces close to a billion litres of paints and coatings per annum.

In accordance with the Group's stringent quality control, Nippon Paint Singapore manufactures and markets a comprehensive range of paints that provide end-to-end solutions for virtually all painting needs, from residential interiors and exteriors to demanding industrial applications

The company enforces a strict Quality, Environmental, Health and Safety Management System (QEHSMS) committed to the prevention of pollution, injury, ill health an exposure to hazards. Its policies protect all those who work indirectly or indirectly for the organisation.

In July 2014, Nippon Paint Singapore was awarded the Singapore Green Building Product (SGBP) certification from the Singapore Green Building Council (SGBC). This certification differentiates Nippon Paint products as the green choice of paint products for the coating industry.It is testament to the company's relentless pursuit of environmentally friendly practices in innovating, manufacturing, quality control and process improvement.

Guided by core values of integrity, resourcefulness and the pursuit of excellence, Nippon Paint Singapore has blazed a trail for the painting industry with the launch of a series of first-in-Singapore functional painting products that not only beautify but protect the environment and the people in it.


NIPPON PAINT
Odour-less
Premium All-In-1
NIPPON PAINT
Odour-less EasyWash
Anti-Stain Formula 2X Easier To Clean
NIPPON PAINT
Easy Wash
Premium Washable Paint
NIPPON PAINT
3in1 Medifresh
Anti-Bacterial Protection
NIPPON PAINT
Vinilex 5000
NIPPON PAINT
Vinyl Silk


NIPPON PAINT
TimberCoat
Exceptionally Durable Wood Paint Finish
NIPPON PAINT
Weatherbond
Exceptionally Weatherable Paint
NIPPON PAINT
SolaReflect
Exceptional Heat Reduction Paint
NIPPON PAINT
Weatherbond AlgaeGuard
Exceptional Resistance Against Algae And Dirt Streaks

## Leadership in Green Building Product

SGBC-BCA Sustainability Leadership AWARDS 2016
Green Building Product

ParexGroup is one of the foremost producers of speciality dry-mix for the building industry, with 3,905 employees and 66 manufacturing plants in 21 countries. Having worked closely with internationally renowned pioneers in the building and construction industry, ParexGroup understands the customers it serves and the challenges that they face. By staying close to their customers, ParexGroup is focused on developing solutions that meet their needs and exceed their expectations.

ParexGroup commits to responsible and sustainable growth by adopting industry best practices and continually developing innovative and environmentally friendly products for their customers. Their manufacturing processes are certified to the ISO 9001: 2000 International Quality Management Systems, ISO14001:2004 Environmental Management Standards and OHSAS 18000 Safety Management Standards guidelines.

Through continuous investment in advanced manufacturing technology and research, ParexGroup offers a portfolio of sustainable building materials that are durable and resilient. Every product that leaves the plant stands for innovation and quality.

ParexGroup's eco-friendly product range includes:

- Technical Mortars
- Waterproofing
- Tile Adhesives
- Renders

Their products are certified by internationally recognised eco labelling authorities and marketed under two strong global brands: DAVCO and LANKO. Locally, ParexGroup has about 30 products certified under the Singapore Green Building Product (SGBP) labelling scheme.

DAVCO brand, originating from Australia, has been established in the Asia Pacific region for over 30 years. LANKO brand, well-known for technical mortars, originates from Western Europe.

ParexGroup is continually raising their customer service by hiring, training and keeping technically competent people who can empathise and offer solutions to its customers. By standing ahead of industry best practices, ParexGroup is poised to bring its close relationships with its customers to greater heights.

# WIDEST RANGE
## of Eco-Friendly Waterproofing

ECO FRIENDLY

GREEN MARK POINTS

WATER BASED

LOW VOC

LOW VOC

COLOURS

CRACK BRIDGING

1st in Singapore to be awarded 3 ticks

### Exposed Waterproofing System

| Products | Application | Rating |
|---|---|---|
| Davco K10 Green Sheet R | Roof & Facade | ✓✓✓ (Excellent) |
| Davco K10 SolarTAC | Roof & Facade | ✓✓✓ (Excellent) |
| Davco K10 Sovacryl | Roof & Facade | ✓✓✓ (Excellent) |
| Davco K10 PU Plus | Facade | ✓✓✓ (Excellent) |
| Davco K10 Duraflex | Facade | ✓✓✓ (Excellent) |

### Concealed Waterproofing System

| Products | Application | Rating |
|---|---|---|
| Davco K10 PU ECO | Roof | ✓✓✓ (Excellent) |
| Davco K10 Dampflex | Wet Area | ✓✓✓ (Excellent) |
| Davco K11 Flex | Wet Area | ✓✓✓ (Excellent) |
| Davco K11 Panel Pruf | Panel Wall Joint | ✓✓✓ (Excellent) |

### Integral Waterproofing System

| Products | Application | Rating |
|---|---|---|
| Davco K11 CWA | Basement | ✓✓✓ (Excellent) |
| Davco K11 Matryx | Basement | ✓✓✓ (Excellent) |

SINGAPORE GREEN BUILDING PRODUCT SGBC

TÜV SÜD PSB

LIC NO.: 00070G

✓ Excellent

# SKK (S) PTE LTD

SGBC-BCA Sustainability Leadership AWARDS 2016
Green Building Product

SKK (S) PTE LTD, a paint manufacturer, is a fully owned subsidiary of SK KAKEN CO. LTD in Osaka. SKK is well-known for wide range of functional paints, architectural stone coatings and floor coatings that are both environmental friendly and cost effective. SKK has been widely used in residential, commercial and industrial projects for new and old buildings in Singapore since 1981. With factory and R&D facilities in Singapore, it is well equipped to meet customer needs.

## CREATING A VARIETY OF UNIQUE AND NATURAL WALL-LIKE FINISH

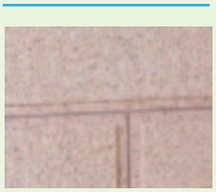
SKK's wide range of texture consisting of natural stone aggregate will decorate your internal and external wall with various finish. It creates luxurious and natural impression with dirt resistance and durability, thus adding value to your building.

## NATURAL STONE-LIKE TEXTURE

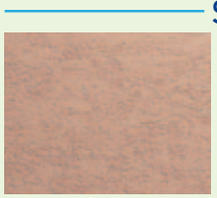
### ELEGANSTONE


Double coloured finish


Single deck finish


Double deck finish

### SAND ELEGANTE


Travertine finish

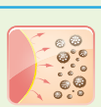

Sand bar-L finish


Hairline finish

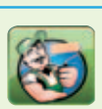
## FOR EXTERNAL WALL

### COMPO SILICON W55


Water Repellency

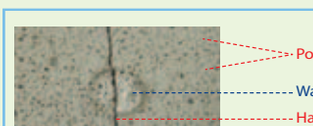

Anti-fungus


Anti-algae


Easy Application

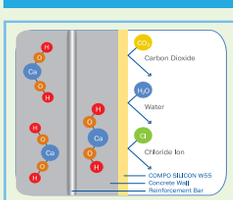

Water-based

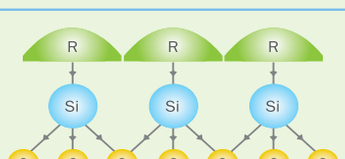
**WATER REPELLENT PROPERTY**




Hydrophobic Paint Film → Repels and prevent water from entering cracks

**Unique Cross Linking Technology**

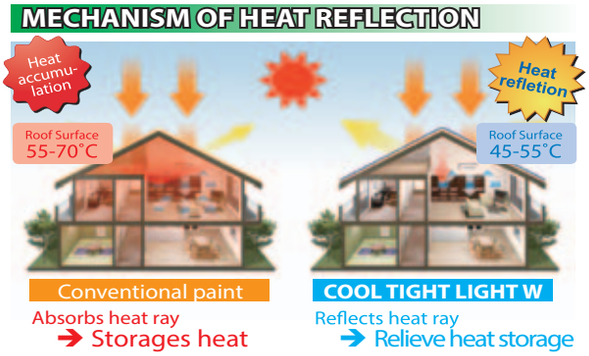



Superb Salt Resistance
Alkali and Chlorine Resistance
Carbon Dioxide Resistance

## COOL TIGHT LIGHT W


Solar radiation heat is reflected, thus the amount of heat which transmits from the painted surface to inside of the room is reduced.




### CERAMI FRESH IN

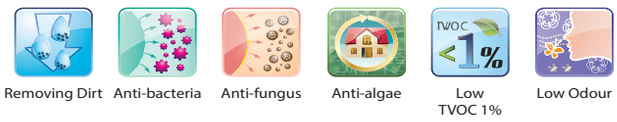
CERAMI FRESH IN provides excellent resistance to stain on the interior wall caused by liquid such as soy sauce and coffee. It is environmentally friendly that emits less than 1% of TVOC (Total Volatile Organic Compound).

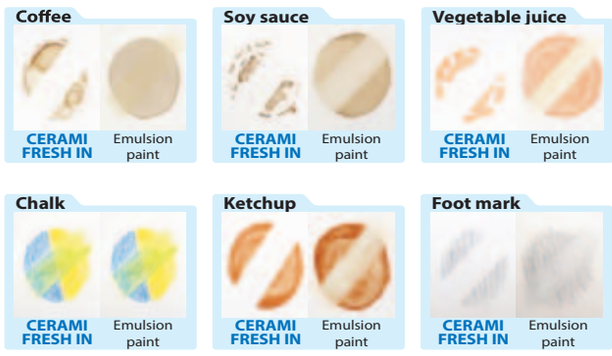
### SANIFRESH

SANIFRESH is a anti-bacterial acrylic satin emulsion paint. It is a water-based reactive curing type acrylic resin emulsion paint that contains silver as main element against to bring strong anti-bacterial action on MRSA (Methicillin-Resistant Staphylococcus Aureus), nucleolonema aeruginosa, escherichia coil, candida albican, etc. Its anti-viral properties against HFMD is also one of the key functions.

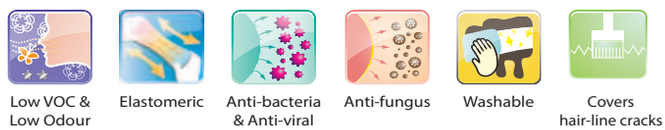
# FOR INTERNAL WALL

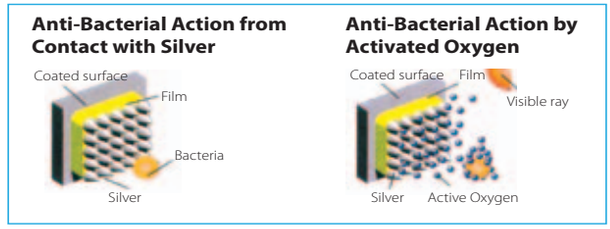
## CERAMI FRESH IN




## SANIFRESH




# FLOOR COATING SERIES

## SK EPO W EHG


### FLOOR COATING SERIES

SK EPO W EHG is a two-component, water-based environmentally friendly glass flake reinforced epoxy flooring system with chemical resistance designs especially for carpark flooring.

# SINGAPORE'S GREEN FUTURE

***Green Building Rating Systems and the Future of Sustainability***

More than ever, the building industry in Singapore is becoming increasingly focused on environmental sustainability and buildability. Would greater environmental consciousness lead to a misplaced focus on paperchase, and an administratively cumbersome checklist of rating systems? Does the over-management and accreditation of these systems alienate the process of design and a more immersive understanding of sustainability? Are these evaluation systems aligned with the whole point of sustainable design?

This essay tracks the decade-long history of the Green Mark evaluation and rating system for environmentally sustainable buildings in Singapore, and advocates improvement in broader considerations of efficiency, scale, context, culture, and new forms of environmental stewardship and lifestyle changes. It also argues that the dialogue among the stakeholders in the building industry must shift to a new focus on smart and sustainable living, and a correspondingly nimble evaluative process, so that Singapore can continue not only to survive, but to thrive.

## THE STORY SO FAR

In 2005, the Building and Construction Authority (BCA) of Singapore introduced its first Green Building Master Plan. This master plan saw the birth of the Green Mark scheme, which would be adopted by the industry in designing and creating environmentally sustainable buildings. At its inception, the scheme was modelled on other green rating standards like the Leadership in Energy & Environmental Design (LEED) programme in the United States, and the Building Research Establishment Environmental Assessment Methodology (BREEAM) programme in the United Kingdom. However, Singapore's Green Mark scheme ventured towards a more contextually and climatically local format in order to impose standards on environmental conservation and preservation, in the face of an increasingly high energy-consumption building industry. It was catered towards a more equatorial climate, with standards deemed more achievable and contextually appropriate for Singapore – with its misplaced penchant for glossy glazed buildings in the hot tropical sun.

By the 2000s, the building and construction industry in Singapore had rapidly matured. With this newfound maturity came the need for a more urgent and responsible look at environmental preservation and energy consumption. This interest in building sustainably leant towards the populist green movement from Europe, which soon gained traction internationally. The building industry in

**An illustration of the set-up of sensors in the test cell of the BCA SkyLab.**

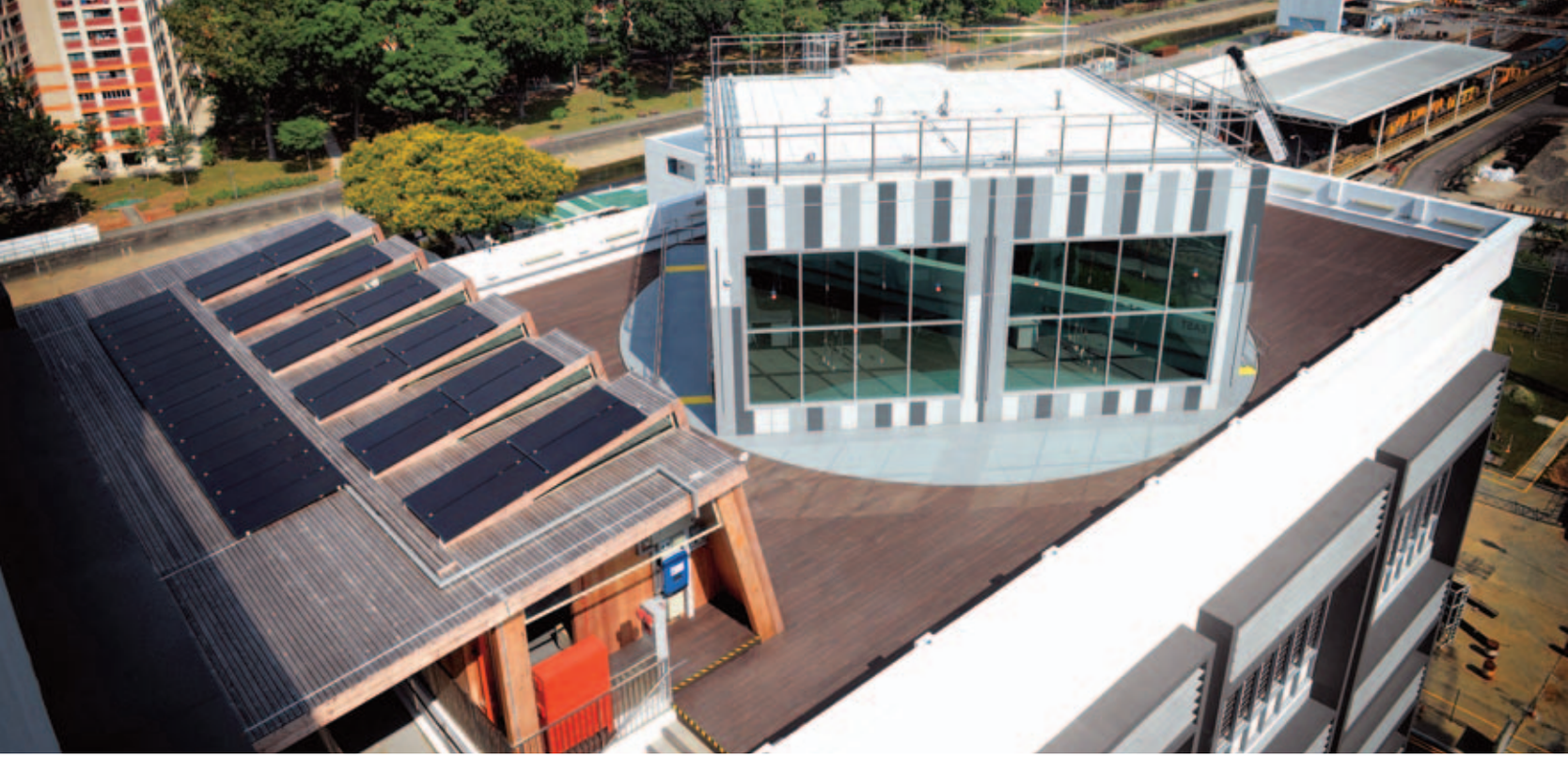
Singapore took this same cue, embracing terms such as "carbon footprint," "energy efficiency," and subsequently "renewable energy." These became the new collective vocabulary of architects, engineers and even developers. Where there was hesitation in adopting the Green Mark guidelines, lucrative financial incentives would be introduced. Projects gunning for Green Mark Platinum—the pinnacle of the nascent local green rating label—would be rewarded with additional gross floor area (GFA) beyond a predetermined cap, along with the possibility of capped government funding for green aspects of the project cost. Where there was further reticence in its adoption; legislation was imposed—since 2012, it has been mandatory for buildings beyond two thousand square metres in floor area to be Green Mark certified.

Across different geographies and jurisdictions, statistics from the International Energy Agency (IEA), the United States Environmental Protection Agency (EPA), and the United Nations Environment Programme (UNEP) consistently show that buildings consume between 30 percent to 40 percent of the world's energy consumption. Cognizant that buildings are the dominant culprit in the production of carbon dioxide, considered harmful to the natural environment, the Green Mark in Singapore undertook parallel strategies in reducing carbon emissions. This production of carbon dioxide takes place continuously during the conception of a building, its construction and its lifetime operation. As a result, local authorities reward high productivity in building and construction practices. Focusing on the inherent high energy consumption construction process of buildings and cities, BCA mandated a "Buildability Score" for all new building projects. The hope is to aim for a higher productivity in construction methods, because more efficient assembly processes would, in theory, reduce the overall embodied carbon footprint of buildings.

## UNPACKING THE GREEN MARK RATING SYSTEM

In Green Mark version 4.1, the point-based rating criteria leads to a development being rated within four Green Mark classifications: Certified, Gold, Gold Plus or Platinum. The constituent criteria are grouped into five categories, in the following order: Energy Efficiency, Water Efficiency, Environmental Protection, Indoor Environmental Quality and Other Green Features.

The first set of criteria on Energy Efficiency deals mainly with the reduction of heat load in a building, and how efficiently the building is being cooled. In the rating system for both residential and non-residential buildings, this accounts for more than 50 percent of the overall score. Energy Efficiency accounts for 87 out of a possible 155 points, or 56 percent in residential buildings; and 116 points out of a possible total of 190, or 61percent in non-residential buildings (BCA, 2013a; BCA, 2013b). The other sections include criteria such as the use of water-efficient fittings and judicious use of water for Water Efficiency, the use of sustainable products and provision of greenery under Environmental Protection, reduction of contaminants and health-related concerns under the Indoor Environmental Quality, and the use of additional green innovations, including renewable energy, as Other Green Features.



**The completed BCA SkyLab, designed by the Sustainable Urban Solutions Studio, Surbana Jurong.**

Compared to the Energy Efficiency category, these other four categories have a far lower weighting. Notably, the allocation of points on Environmental Protection is far outweighed by Energy Efficiency. For example, the rating system rewards up to fifteen points for designing an efficient building envelope system, but only one point for the restoration, conservation or relocation of existing trees on site (BCA, 2013a).

## EMPHASIS ON TECHNOLOGY

The criteria and weighting of the Green Mark rating system are motivated heavily by technological solutions, and made appropriate for industry practices today. However, there are risks of misinterpreting the good intentions of the Green Mark rating system if architects and engineers take it merely at face value. The heavy emphasis on Energy Efficiency in the ratings may mislead the architect and engineer to assume that most buildings should indeed be designed with full glass facades and air-conditioning. The primary goal of Environmental Protection in the design of the building thus appears only to maximise improvements in Energy Efficiency.

This incorrect impression risks causing fundamental aspects of environmental sustainability to be ignored. Passive design measures such as the preservation of natural sites, or appropriate orientation of the building away from the East-West solar path, tend to be glossed over. Design features such as large overhangs and voids for cross-ventilation long existing in vernacular methods of tropical building design are forgotten. The strategies and tenets of good architectural design such as appropriate site planning and interior layout, building orientation and building massing, appropriate architectural form and materials, and natural ventilation have given way to expensive engineering solutions.

The real-world challenges of compacted project schedules and aggressively commercial briefs are pushing building designers and engineers towards the path of least resistance. Technology becomes the default problem-solver, or worse, the stop-gap measure for larger and more deep-rooted problems. For example, fashionable full-height glass walls in the design of building facades require the highest-performance, and often costliest, glass specifications in order to mitigate heat transfer into the building. Building structural systems are routinely over-engineered to cater for extreme loads beyond normal usage, and air-conditioning systems are designed to cater for two to three times of typical cooling requirements.

In the rating system, a maximum of eight points can be garnered for using building materials and interior finishes rated for sustainability, compared to the sole point gained for conserving on-site trees. A myopic and languid architect would be encouraged to choose the convenience of specifying multiple "green" building products, and new building technologies to make the cut. Most would avoid point-deficient implementations such as a design for the reduction of car use, or the more long-term compost recycling strategies under the broader

**The accompanying Visitor's Lounge is one of Singapore's first structures constructed from Cross-Laminated Timber, a structural material sourced from renewable forests.**

protection of Environmental Protection that can contribute to a more systemic lifestyle change, or a deeper protection of the surrounding ecosystem.

While the phenomenon is hardly confined to the Green Mark rating system alone, the flipside of rating systems all over the world is the danger of treating them as checklists. These ratings become a convenient habit for architects to ignore the larger, fundamental challenges of designing a building and implementing long-term solutions. As long as the Green Mark rating system privileges quick and costly technological solutions, this trend will presumably continue.

## A NEW GREEN MARK

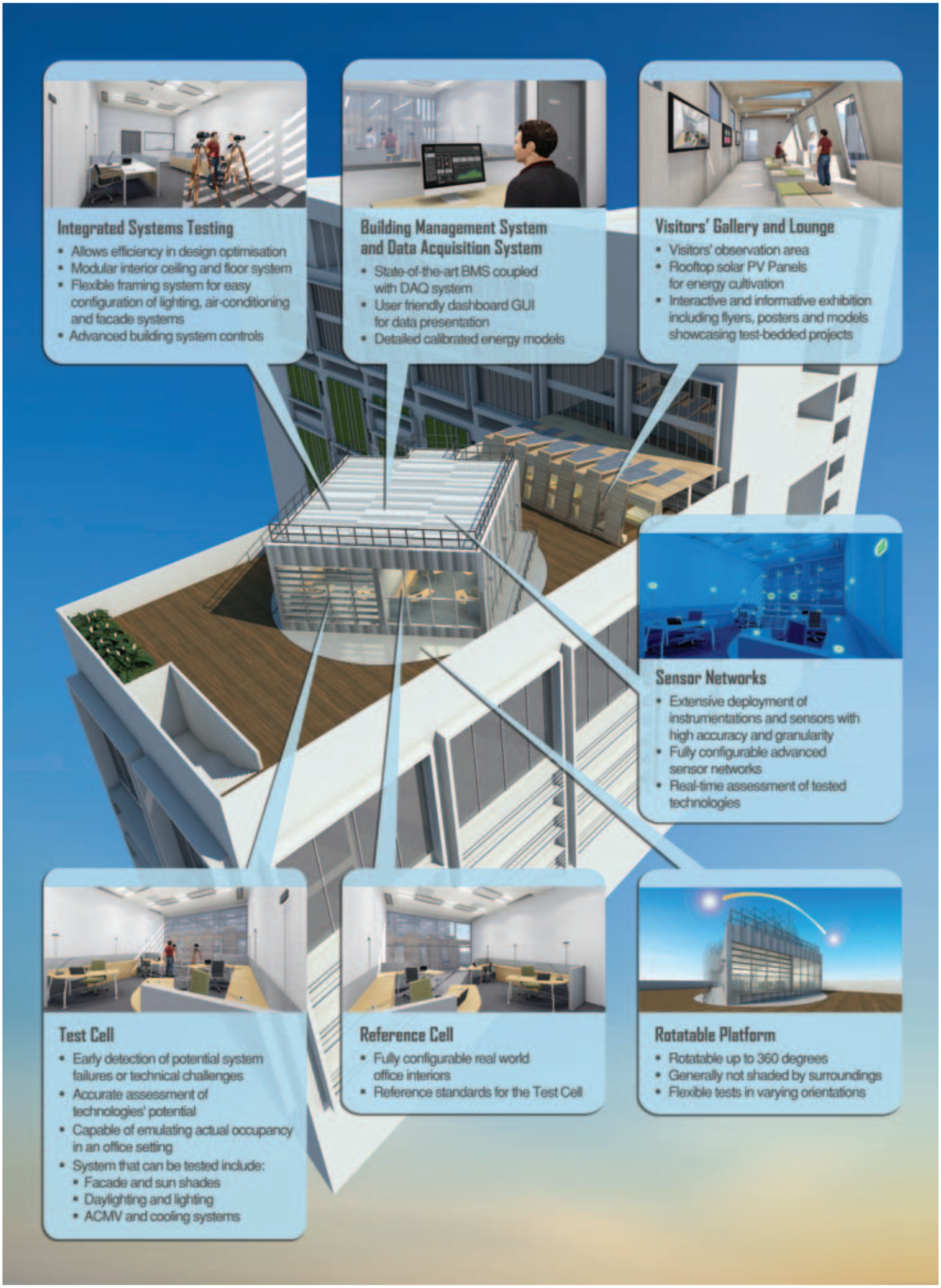
Yet, there is much encouragement in recent developments. In the past decade the BCA has implemented two revisions to its original Green Master Plan from 2005. Anchoring the third Green Building Master Plan is Green Mark Version 5, slated for a September 2016 release. This version has been previewed at the Singapore-held International Green Building Conference 2015 in September, and has been made available online by BCA as a "pilot" document. This new version has seriously reconsidered the issues discussed above, and has placed a far greater emphasis on environmental conservation and preservation, in an important section titled "urban harmony." In evolving this new version of Green Mark, BCA has made commendable efforts in constantly consulting more than a hundred architects, engineers and other building consultants. The result is the formulation of tropical climate's most comprehensive and balanced criteria for assessment as yet.

The authors of the new Green Mark have actively involved industry experts in their task forces, and gained a wide spectrum of views on how its rating system can be refined. Early signs are encouraging, with more attention being placed on appropriate, intelligent and well-considered passive design. Criteria involving the introduction of technologies and new building products have also been considered for appropriateness in specific building types, and specific environments.

The ten-year-old Green Mark scheme is barely emerging from its adolescence, but it has greatly matured in its reach and its depth in addressing the needs of the industry, and the urban and natural environment at large. Its progress is a testament to the success of continual and open dialogue between government agencies, design professionals, industry experts as well as end-users. The outcome reflects an acceptance towards further refinement and improvement of the guidelines.

## POSSIBLE GREEN FUTURES

Sustainable architecture, and by extension sustainable urbanism, cannot be achieved only through green rating systems. Efforts must be made in the design of appropriate buildings for their context, climate,




The features of the BCA SkyLab which allow for the testing of new building technologies in facade, cooling and lighting.

and culture. Architects are beginning to realise the follies of their urge towards gleaming glass towers and spectacular forms, and engineers are realising the imprudence of designing giant ice boxes. In his article "Thermodynamic Narratives," architect and writer William Braham writes: "Modern buildings are both wasteful machines that can be made more efficient, and instruments of the massive, metropolitan system driven by the power of high-quality fuels. A comprehensive method of environmental design must reconcile the techniques of efficient building design. Over the coming century, we will be challenged to return to the renewable resource base of the 18th century city with the knowledge, technologies and expectations of the 21st century metropolis." The new green rating system can go a long way in influencing the way architects approach environmentally responsible design.

Stephen Cairns and Jane M. Jacobs advocate technology that participates in the process of environmental mitigation in the context of urbanisation in the 21st century. Their provocatively-titled book, Buildings Must Die: A Perverse View of Architecture, examines the possible ways of embracing and harnessing the spalling, moulding, and general decay of a building. The case studies in the book analyse how the ravaging effects of urban pollution can be combated in a sequestering process.

The unbuilt B_mu museum in Bangkok by architects R&Sie(n) is an exemplary example of the process of sequestering. The museum's design is composed of "a stack of rectilinear gallery spaces wrapped in a drooping shroud coated with an electromagnetic material that would attract particles from the polluted city air, much (like) the way the screen of a computer monitor attracts dust." The skin of the building in effect becomes an extensive receptacle for elements of smog in the air, and acts as a sacrificial filter for its inhabitants. Despite not being realized yet, this case study demonstrates that technology can indeed be employed as a critical solution for sustaining the future of buildings and cities. It exceeds the boundaries of certified technology of any legislated green rating system.

Where new sustainable building technology is concerned, BCA has commissioned the design and construction of BCA SkyLab, a high-rise rotatable test laboratory where new building materials and technologies can be "plugged-and-played," and subsequently tested for their performance. As such, the facade of the laboratory, its air-conditioning system, and its lighting system can be tested with the latest, most energy-efficient products. Designed by this author and his teammates at the Sustainable Urban Solutions studio of the local multidisciplinary firm Surbana Jurong, the BCA SkyLab's ability to rotate allows for the testing of new building technologies along any given directional orientation. In all likelihood any future experimentation will have to take into account the building's orientation before any consideration of its new technologies. This seminal building underlines the BCA's new prioritization of passive design before active design, introduced in the new Green Mark guidelines, and mirrored in this live experimentation laboratory.

## SINGAPORE'S GREEN FUTURE

What can Singapore's green future be? Can it be a future with buildings designed more intelligently and appropriately for our climate? Can architectural design be carefully considered for optimal passive design, and expensive high-technology employed only as a secondary measure? It can be a future where recycle bins are more ubiquitous than rubbish bins; and buildings are able to convert energy from the sun, the wind, and even its occupants to fully satisfy its own energy requirements. (Rifkin, 2011) More than that, it can be a future where society has a stronger consciousness of its own consumption power and waste disposal habits. It can be a future where energy is sourced purely from renewable supply, as opposed to fossil fuels. Singaporeans can commit to changes in lifestyles, and take a genuine interest in extending the life span of consumer products and even buildings.

Over the last ten years, the discourse on buildings and the city in Singapore has shifted away from style and aesthetics to environmental sustainability. In the next ten years, discussions will continue to expand to include the integration of physical and information architecture. Singapore will have to embrace a rapidly evolving environmental and technological landscape, and the policies and evaluation systems created by the government and stakeholders must adequately aid this transformative process.

**Tan Szue Hann**
Surbana Jurong Consultants Pte Ltd

Prior versions of this essay were published as a feature essay in the book Singapore Dreaming: Managing Utopia, and the ECO issue of The Singapore Architect.

All images courtesy of Surbana Jurong Consultants Pte Ltd.

# FOR THE INDUSTRY, BY THE INDUSTRY

***Tapping on the collective wisdom of the industry, the Singapore Green Building Product labelling scheme relies on its Technical Committees to ensure that only truly sustainable products make the cut.***

As Singapore's only certification scheme dedicated to green building products, the Singapore Green Building Product (SGBP) labelling scheme bears great responsibility. Managed by the Singapore Green Building Council (SGBC), the SGBP holistically qualifies and assesses green building products for their environmental performance, helping building practitioners to select suitable building products for their projects.


The SGBP is also highly recognised by Singapore's national green building rating tool the Green Mark Scheme (administered by the Building and Construction Authority), with SGBP products able to score bonus points for the projects they are used in, contributing to a higher Green Mark rating. This ultimately results in greener and healthier buildings. To date, there are over 900 SGBP-certified products out in the market with varying degrees of application in buildings.

## BUT HOW DO THESE GREEN BUILDING PRODUCTS GET CERTIFIED?

To ensure that certified products truly function as intended as well as meet the needs and requirements of the industry they will be operating in, it is imperative to consult both members of the industry as well as public agencies involved with buildings. As different materials require diverse sets of criteria and parameters for a complete and holistic assessment, the SGBP counts on the expertise of its Technical Committees, the backbone of the SGBP labelling scheme.

Overseen by the SGBC Board Technical Coordinators, the SGBP Technical Committees are formed based on the needs and requirements of the multiple building disciplines. The Technical Committees are made up of industry professionals well-versed in their respective fields and meet regularly to develop assessment criteria for specific products, review existing criteria to reflect changes in the dynamic business environment as well as to provide crucial advice on complex certification cases.

This essentially allows for the SGBP criteria to be self-regulating: project demands and changing public expectations will influence the yardstick to define green building products, confirming its continued relevance in an ever-changing marketplace.

"This flexible and agile framework that governs SGBP certification has been the key driver to accelerate the uptake of certified products in the

industry," noted Mr Chia Ngiang Hong, President of the SGBC, "Product manufacturers and suppliers can rest assured knowing that the SGBP criteria will constantly be updated and refined to be in line with current industry concerns and practices."

Since the start of 2016, all SGBP product categories are being realigned to ensure their relevance to the built environment, especially in light of the new Green Mark 2015 which was launched as a pilot programme for non-residential new buildings last September. This realignment will be completed by the end of 2016, and product manufacturers and suppliers will find it to be more inclusive as well as encompass more specific product types than ever before. This translates to a broader range of certified green building products for the built environment's selection, ensuring that there is a certified product for every conceivable building need.

To encourage more industry players to obtain certification for their products, the SGBP has collaborated with SPRING Singapore to provide eligible building manufacturers and suppliers with Capability Development Grant (CDG) support for their standards adoption and accreditation projects. The CDG is a government scheme which supports SMEs' upgrading efforts in 10 business areas, including projects that enhance their quality and standards. Eligible SMEs may apply for the grant to defray up to 70 percent of qualifying certification-related costs for up to two green building products (capped at $30,000 per project).

This grant covers product testing, development and enhancement costs, allowing product companies to green their product line to the requirements of SGBP certification without being discouraged by the costs involved. The CDG also supports SMEs' ISO 14001:2015 certification projects, helping companies adopt international environmental management standards and improve their green credentials – essential aspects for companies that aim to gain prominence in the building and construction sector.

The SGBP will continue to widen its pool of green building products with the experience and expertise of its diligent Technical Committees, ensuring that there will always be a certified green building product for every building need.

Through a holistic assessment and evaluation framework, building products and materials certified under the SGBP labelling scheme are awarded a rating ranging from 1-4 ticks based on their environmental performance. Higher-rated products can earn bonus Green Mark points for the green building project they are used in.

## CAPABILITY DEVELOPMENT GRANT

**Who can Apply**

- Local Small and Medium Enterprises (SMEs) that meet SPRING's definition
- Building product companies with green products

**What is Covered**

At the end of this CDG project, you will obtain:

- SGBP certification for up to two green building products
- ISO 14001:2015 certification

**Funding Support**

The CDG can defray up to 70 percent* of the project's qualifying costs or up to $30,000, whichever is lower.

# WHEN BIGGER IS BETTER

The National University of Singapore (NUS) recently launched its lifetime learning center, the School for Continuing Education and Lifelong Education, to make learning flexible and accessible for adults at every age. With the goal of offering 10 degree and more than 30 certificate programmes, the NUS knew they needed a way to keep all their students comfortable in the heat and humidity. The school installed a high volume, low speed (HVLS) fan from Big Ass Fans in a covered outdoor study area. The large-diameter fan turns slowly to move large volumes of air, keeping students comfortable and refreshed as they work.

NUS is just one of the growing number of locations across Singapore that have discovered the value of using fans to bring energy-efficient comfort to spaces indoors and out.

## GREEN INSIGHTS INTO SCHOOLS

In Oakland, California, the La Escuelita Education Center in the Oakland Unified School District, was designed and constructed to meet the district's "green school" standards following the Collaborative for High Performance Schools criteria for healthy, high performance schools. CHPS is a national movement in the United States that had its start in California. Its goals are, quite simply, to improve student performance and the educational experience by building the best schools possible. Its criteria include ASHRAE Standards 55 and 62.1, which relate to thermal environmental conditions and air quality and ventilation. Big Ass Fans' design team considered building orientation, lighting and daylighting design, and employed an innovative thermal comfort strategy that capitalized on the mild climate in Oakland, which lies just across the bay from San Francisco and has temperatures similar to those found in the Mediterranean region.

The design team employed a comfort strategy that paired thermal mass, natural and mixed mode ventilation and large-diameter, low-speed ceiling fans rather than compressors. Engineers at Big Ass Fans created a mock classroom at the company's lab to tailor a fan that met the exacting criteria and could then be used at other schools. Building orientation and construction materials went hand in hand with environmental impact and occupant needs to satisfy CHPS requirements. The fans, including the Haiku, keep students and staff comfortable and help maintain the impressive green credentials of the school, which include net-zero status.

Up the Pacific coast from Oakland in the state of Oregon, Big Ass Haiku fans made a huge impact on air quality and the overall learning environment at a private school in the city of Corvallis. After tolerating the stifling conditions inside old portable classrooms for years, the Corvallis Waldorf School was ready to invest in new modular classrooms that would take advantage of the most advanced technology to improve the quality of the learning environment and minimise the school's carbon footprint.

The school reached out to a team from Portland State University School of Architecture in nearby Portland, Oregon. They used some of the most


cost-effective technologies available to create the Smart Academic Green Environment (SAGE) building. The spacious classrooms provide enhanced natural daylight, high quality non-toxic materials and dramatically improved indoor air quality to raise the bar for modular classrooms nationwide. Haiku fans, which operate silently and hold the top ENERGY STAR® rankings, were installed in each classroom, and they were an immediate hit.

"The fans are the single most used, most appreciated and most effective tool to create an environment that is comfortable to work and learn in," said Corvallis Waldorf School Facilities Manager Tim Love. "Noise is a critical factor that is almost always overlooked. It's a telling feature that noise is not an issue with the fans," he added. The improved air circulation keeps the students refreshed and alert during the school day. And the fans draw so little power that the school's energy monitors register at the lowest readable output.

## LARGE FANS FOR LARGE SPACES

Most businesses have the luxury of air con. However, in large facilities, that is simply not feasible, and certainly not environmentally friendly. More and more facilities are turning to overhead fans. The trick is to use the right fan: small fans simply cannot move enough air to make a difference in large spaces.

Large industrial fans, like those made by Big Ass Fans, move air on a much larger scale, and are engineered and optimised specifically for places with high ceilings and wide-open floor plans. The fans create columns of air that move from the ceiling to the floor then spread out across the facility.

**Other benefits include:**

- **Fewer distracting floor fans:** Numerous high-speed, portable fans generate lots of distracting noise and create tripping hazards.


- **Improved ventilation:** Mixing the air inside the space improves indoor air quality. Rather than just replacing air at vent-level, big fans provide complete air turnover.
- **Productivity:** Comfortable employees work harder. Studies suggest people are at their most productive when their environment feels between 21°C and 26°C.
- **Safety:** Airflow can quickly dry spills and condensation. In the right circumstances, big fans can mitigate condensation before it forms.
- **Peace of mind:** Big fans manufactured by Big Ass Fans are available with warranties up to 15 years that cover any potential issues that arise.

"We build Big Ass Fans to produce airflow superior to everything else on the market. For example, we don't use blades, we use aerofoils specially modeled after airplane wings and patented winglets to direct more air to the workers who need it," said Matt Mullins of Big Ass Fans. "Airflow from our fans can make workers feel up to 6°C cooler."

With large fans, greater thermal comfort can be achieved without sky-high utility bills.

All images courtesy of BAFCO.

Big Ass Fans' airflow products have become the industry leaders in energy efficiency, reliability and sleek design. The fans can be found in virtually every variety of industrial, commercial and residential space, but have established a particularly strong presence in buildings where sustainability and green practices are a priority. Big Ass Fans has garnered dozens of awards for energy conservation and product design and has more than 160 patents to its name, with nearly as many patents pending. More than two years ago the company opened its Singapore office, and its fans have quickly begun making a difference in projects throughout the country. Recently, Big Ass Fans' Haiku fans were certified under the Singapore Green Building Product labelling scheme, and the company has certification in its sights for its other industrial and commercial fans.

# COMFORT WITHOUT SACRIFICE

When you just can't beat the heat stay cool in school with Big Ass Fans. We'll significantly improve HVAC efficiency, lower energy costs by up to 20 percent, and keep staff and students alert, comfortable and eager to learn. Sweating through class? Stay up to 6°C cooler with Haiku®.

Got a gym or an auditorium with even bigger needs? Improve indoor air quality with our 2.4 – to 4.2-m Essence® fan. Let us know how we can contribute to your next project.  We'll help you become more sustainable and achieve Green Mark certification.

**+65 6709 8500 | BIGASSFANS.SG**

BIG ASS FANS
*No Equal*

SINGAPORE GREEN BUILDING PRODUCT SGBC VERY GOOD

# THE FUTURE OF CABLE SUPPORT SYSTEMS HAS BEGUN

What is more than a simple piece of steel plate to carry cables going around from infrastructure like tunnels and bridges to buildings like hospitals and industrial plants? With the ever increasing demand for more services and complex network of pipes, cable supports and HVAC (heating, ventilation & air conditioning) systems, the task has never been easy for consultants, mechanical and electrical engineers.

Buildings and mission critical industrial plants all demand better and more reliable cable support systems with a tad more innovation and intelligence. Increasing labour cost calls for more productive methods of installation which in turn facilitates shorter project timeline. With the increasing onus on green buildings, such cabling systems must be sustainably produced and contribute to the sustainable operation of the building.

Challenges as such have been presented at every single building and infrastructure project. However, the focus is always on the bigger and more critical systems like the power generation system, air-conditioning systems, lighting systems, etc. This is due to the drive for better energy efficiency and lower operating costs. Thus, advancements in the basic routing of electrical services, water services, gas services and the like have always taken a back seat.

Common problems associated with existing materials and methods of installation of electrical cable support systems included:

- Weak and flimsy material used
- Excessive and unsightly mounting supports used
- Excessive DIY works on routing corners and bends resulting in weak installations
- Labour intensive and time consuming installation methods
- Overloading of cables
- Corrosion prone finishing

## A CABLE TRAY SYSTEM THAT'S "MAGIC"

Clearly, there is a need for better cabling systems that can at once accomplish its intended purpose while also helping the building to achieve greater efficiency. OBO Bettermann has spent years researching and developing a cable tray system that can revolutionise the industry and help it become more productive.

Available in different grades of material and finishing, suitable for every industrial, commercial and infrastructure application. The Magic cable tray system was designed to improve the way of installation, increase the loading capability, maximise support structures and most importantly to better hold and protect the cables which they are supporting.

## SIMPLIFIED MOUNTING

Current cable tray systems require specialised tools or equipment to install, necessitating the usage of more manpower to mount the entire system. A lighter cable tray structure produces a considerable benefit for overhead mounting and at great heights. The Magic cable tray system is the world's first completely screw-less tray system. All the system components and tray types are equipped with the innovative Magic connection from the tray through to the fitting. The combination of both advantages makes mounting simpler and quicker. To illustrate this, a 400 meter length of cable tray connection requires only 24 minutes compared to 4 hours and 16 minutes with the conventional cable tray using bolt and nut connection. This will greatly improve productivity and free up manpower for other tasks.

## INCREASED LOAD CAPACITY

Compared to conventional systems, Magic cable trays offer greater stability. Current standard guidelines calls for cable tray to be with thickness of at least 1.5mm (up to 300mm width) and 2.0mm thickness (for 300mm width and above). New cable tray products in the market can offer lesser thickness (up to 50 percent less) with the same loading capacity by means of better structural design as well as tested to IEC standard 61537.

Standard guidelines also calls for cable tray to be finished with pregalvanised steel and additional powder coating. Such finishing does not last in outdoor installations and is quickly prone to corrosion, thus presenting a safety hazard. New

cable tray products in the market can offer different thickness of hot dip galvanised finishing on cable tray to suit different application environment.

The complex 3D structure and the different material structure around the laser seam produce previously unachieved load values. As an example, a minimum support distance at 1.5 meters apart is achieved with less than 20mm deflection for all ranges of cable tray width.

## LOCKABLE FITTINGS

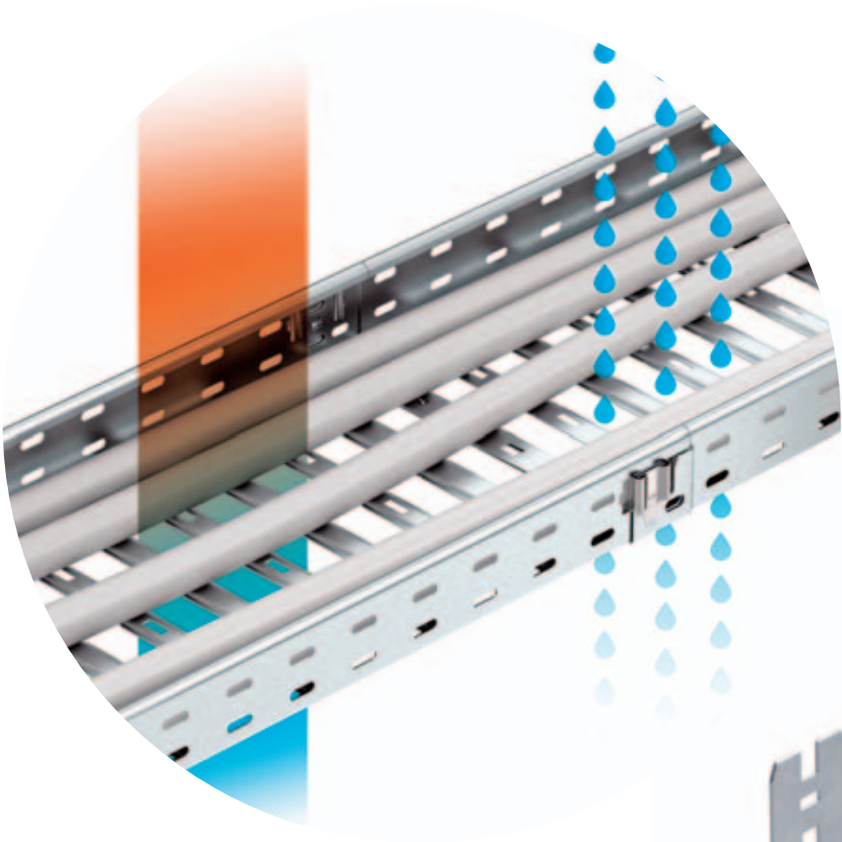
All the classic fittings, such as bends, T pieces, mounting/branch pieces and intersections are equipped with the trusted, lockable Magic connector. The cable tray is run into the fitting connection from above with the spring element. Just connect the pieces, lock them in place – and the installation is done. Gone are the days where a big and costly Tee piece is required when the Magic add-on Tee does the same function with increased flexibility and yet at a lower cost.

## IMPROVED ECO-BALANCE

The use of the new, highly innovative and patented manufacturing method DUO-Plus leads to a considerably optimised CO2 balance for the entire product family. This technological leap saves 2,600 tonnes of CO2 emissions per years. This cable tray system fulfils the Green requirement of being a sustainable product.

## IMPROVED CABLE VENTILATION

The completely new base structure allows perfect cable ventilation. According to VDE 0298-4, a tray made up of more than 30 percent holes is considered a perforated tray. This means that lower reduction factors can be taken into account during cable dimensioning, possibly allowing the use of cables with smaller cross-sections thus achieving cost savings.



## WATER RUN-OFF GUARANTEED

Perforated cable tray systems are suitable for safe installations under sprinkler systems - in accordance with the requirements of the VDS. The new base structure allows perfect water run-off.

## SURFACE TESTING/SALT SPRAY MIST TEST

Whether indoors or outdoors, in aggressive atmospheres or under special hygienic conditions: cable trays must be able to withstand significant punishment. The Magic cable tray system can offer the perfect surface and materials for any need, no matter what the requirements may be. Machined from high-quality sheet steel or steel wire and are available with various surfaces, the cable trays are also treated with different hardening and coating methods to ensure tailor-made corrosion protection, specially tailored to the appropriate application. All the system components must show sufficient resistance against corrosion in agreement with the standard, DIN EN 61537.

## CONCLUSION

With the move towards smart buildings, more cables to support the various systems in a building a required. Usage of new cable support systems can help buildings to at once organise the kilometres of cable while also keeping the carbon footprint of the buildings down, allowing the building to function more efficiently and sustainably. With these cabling systems, the installation and organisation of cables will be so easy that it is like Magic.

OBO offers cable support systems made by professionals for professionals. It focuses on technical properties from the area of application, through test conditions, up to corrosion resistance and temperature classifications. BIM modelling is also available on the range of Magic cable tray to help designers and planner achieve a better and more efficiency design in the early stage of the project. Overall installation time can be greatly reduced with the usage of smart and innovative snap on solutions. Strong, better looking and longer lasting cable support systems pave the way for the next generation of building technologies.

# A CASE FOR CLIMATE-RESPONSIVE LANDSCAPE DESIGN

## FROM SCIENTIFIC KNOWLEDGE TO INDUSTRY PRACTICE

City dwellers of today are no strangers to rising temperature in the urban environment, brought about by the combined effects of climate change and the urban heat ssland (UHI) effect. While some turn to mechanical cooling (e.g. air conditioning) as a convenient mitigation strategy, many others look into environmentally-friendlier solutions such as passive design strategies involving natural ventilation and reducing temperature with greenery.

Greenery, in particular, has become an integral component of contemprary urban design. Few can deny the aesthetic qualities of urban greenery and its effectiveness in softening the harsh urban landscape. Yet, there are even lesser people who truly appreciate their potential to improve thermal comfort in the urban environment.

Introducing greenery to the built environment is not a new concept. Those *Green Fingers* and *Green Lungs* artfully envisaged by the Housing and Development Board (HDB) for the latest Built-To-Order (BTO) public housing precincts have their origins rooted in Ebenezer Howard's *Garden City of To-Morrow*, a vision conceived more than a century ago. How interesting is it to note then, that in a hundred years, we have not progressed beyond the

rudimentary allocation of 'green' spaces in built up areas? With ample literature validating the benefits of urban greenery and identification of specific plant traits that can provide such benefits, it is only rightful for this body of knowledge to be incorporated into the practice of landscape design.

As we work towards building cities of the future, it is also important to also ponder on landscapes of the future and how they can function both as an integral aspect of urban design as well as a force for improving the cityscape climate. Herein lies the question: *How can the process of landscape design be optimised to improve livability in the urban environment?*

To answer this question, we have to look into how landscaping and landscape design are currently being evaluated. The local government has adopted a "the more the merrier" approach to landscaping. This is evident in policies such as the Landscaping for Urban Spaces and High-Rises (LUSH) Programme, where developers have to replace 100 percent of the greenery lost from the site due to development with greenery in areas within the development. In the BCA Green Mark scheme, the addition of greenery is also strongly encouraged: up to six points are allocated for achieving a green plot ratio of four and above. Both initiatives justify the allocation of greenery as a means to lessen the UHI effect in cities.

These initiatives are implemented with the assumption that:

1. All plants are equally competent at reducing temperature.
2. Plants can be placed anywhere for cooling effect.
3. Having more plants will equate to a greater cooling effect.

While the industry is currently operating under such assumptions, research into actual plant cooling potential has progressed tenfold in the last decade. Although there is merit in having more plants around, it is understandably more effective if they are strategically chosen and placed in areas where cooling can be maximised. Currently, there exists a significant gap between actual findings in the scientific realm and what is being translated into industry practice.

Part of the reason for the gulf between academics and practitioners is due to the fact that both parties speak very different languages and operate under a very different set of rules. On one hand, scientists tend to focus solely on very specific aspects of plant study and findings, while scientifically robust, may not necessarily make logistical or economical sense in actual practice. Take studies on rooftop greenery, for instance. There is ample literature validating the benefits of rooftop gardens and sky terraces. However, practictioners are not able to discern the impact of adding rooftop gardens into their design in terms of how much temperature it can reduce, simply because there is no convenient way for them to evaluate their design in view of greenery and its effect on temperature. Scientific studies also tend to be too technical to be fully understood by industry practitioners in a short amount of time. The result is a piecemeal approach to greenery implementation that

seldom goes beyond basic requirements of aesthetics and maintainability.

In recognising the disparity between science and practice, scientisits are now working towards the formulation of a framework that incorporates meteorological as well as site conditions as prerequisites for landscape planning. The Department of Building in the National University of Singapore, in particular, has conducted extensive research on climate-responsive landscape planning.

## DESIGNING WITH SCIENCE

Recent advancements in scientific research on the cooling effect of plants have shown that plants react differently when exposed to varying ambient conditions. In particular, the cooling effect of plants will vary according to their physical traits, as well as physiological attributes such as plant evapotranspiration rate and reflectivity. Using this data, as well as information from related research, a simple framework is established.

The underlying strategy is to produce a map that displays resultant thermal conditions arising from the landscape proposal (Figure 1). In this manner, landscape planners will be able to visualise the impact of their design and make amendments without infringing on their design autonomy. To illustrate how a climate-responsive landspace planning method will work, consider the following scenario:

> Four design iterations have been conducted for an area slated to be park space. Simulation is conducted with software that is readily available in the market. In Iteration 1, trees with small canopies (5 m diameter) are placed at locations

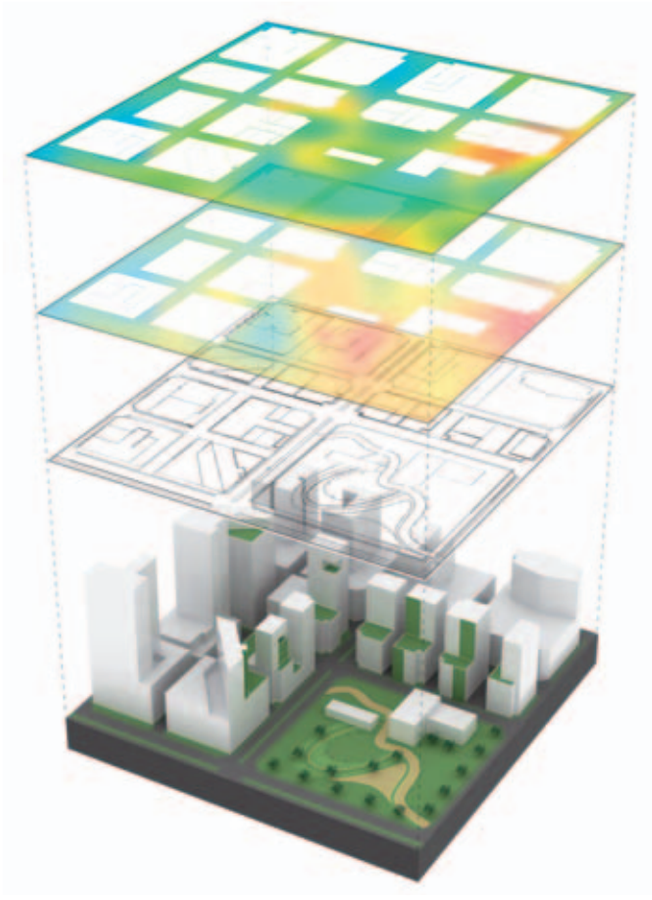


**Figure 1.** Landscape planning with temperature maps

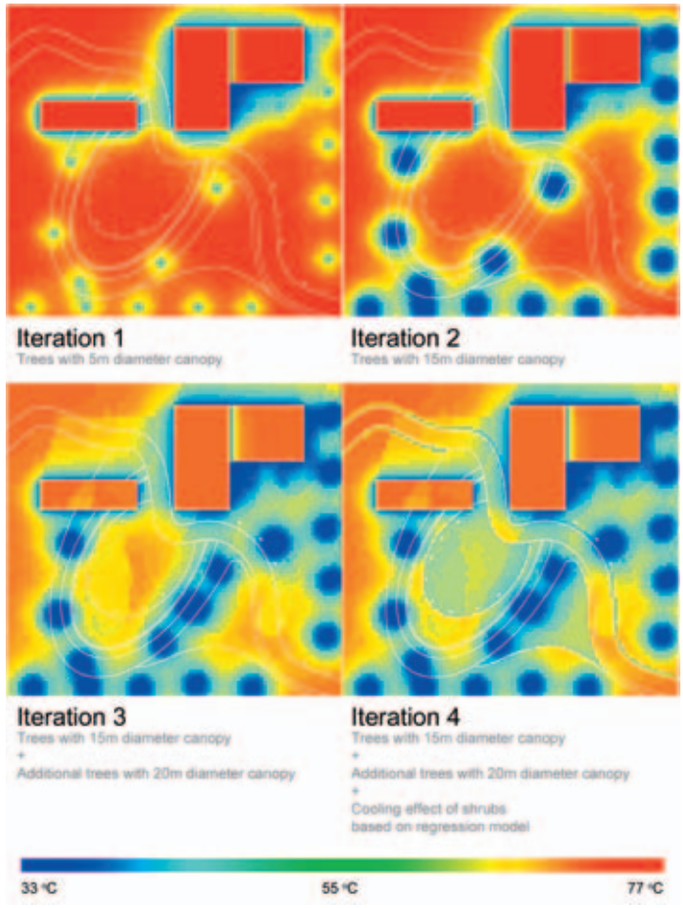



**Figure 2.** Improving thermal conditions through iterative design

designated by the landscape planner. In Iteration 2, trees with larger canopies are assumed (15 m diameter) at the same spots. Radiant exposure reduces drastically near the trees. In Iteration 3, more trees (20 m diameter canopy) are added to areas that are anticipating larger pedestrian flow. As a result, thermal conditions of these areas are shown to have improved significantly. In Iteration 4, thermal effects of shrubbery are factored into the radiation map.

A visual comparison of all four iterations reveals the immense positive impact of tree and shrub allocation using the proposed landscape planning framework (Figure 2). The proposed landscape design framework allows designers to understand the impact of their choice of plant selection and allocation before eventually committing to a final decision. This can help to minimise undesirable outcomes such as lack of shading provision at prominent locations or inadequate light provision for plants due to excessive overshadowing from adjacent buildings.

## CONCLUSION

Objective plant selection and placement are important factors in landscape planning. In the proposed framwork, scientific objectives are proposed to lend sophistication to the landscape design process. It is easy to appreciate the importance of context and locality with the temperature map. Adjacent buildings can affect solar exposure significantly, thereby influencing the plant placement process, dispelling the common myth that plants can improve the environment by cooling temperature indiscriminately.

The proposed iterative framework for landscape planning seeks to more effectively realise the cooling potential of greenery as an urban heat mitigation technique and to optimise urban greenery as an ecosystem resource. Through the use of this climate-responsive landscape design framework, landscape planners and designers can do their part to improve thermal conditions in the urban environment.

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Images courtesy of Urban Gree Lab Singapore and Chop Ching Hin Pte Ltd.

# BEYOND THE SURFACE: RENOVATION WHILE IN USE


Façade renovation while the building is still in use: a combined office and commercial property built around 120 years ago offers an example of the aesthetic benefits and technical advantages for installation of a modernisation façade. Careful conversion to meet sustainable energy standards was enabled by a creative façade design, precise project planning as well as fabrication and installation by an experienced metal fabrication company.

The office and commercial building in Lower Saxony has a varied past: since its construction in the late 19th century, and it has been almost completely destroyed (1944) and seen numerous renovations, installations and further floors added. In its condition before the recent renovation of the façade, the seven-storey corner property was used as an office building with commercial premises on the ground and first floors. It was intended that this concept would also be retained in future.

## HETEROGENEOUS BUILDING MATERIALS

As its history would suggest, the building is made from different building materials. The large cellar constructed from brick masonry can be traced back to the late 19th century, the ground floor and the first and second floors were made from reinforced concrete as a support beam structure in the architectural and construction style of the fifties. The three upper storeys of steel construction were built in 1989. The stepped storey (6th floor) is a lightweight, timber-frame construction.

The property had to be renovated to adapt it to current standards of energy efficiency/ thermal insulation and design. Before conversion, there was a clothing shop on the ground floor, as well as two office units, a dental practice and a flat on the six floors above. Two storeys did not have tenants. Service areas, archives and storage spaces were located in the cellar.

## MODERNISATION WHILE IN USE

The *hertrampf+brokate planungsgesellschaft* architectural practice faced the difficult task of planning the façade renovation to keep disruption of activity in the building to an absolute minimum. It was a requirement that conversion and renovation work would not bring about any changes in relation to places of work or their use. Renovation work therefore centred in particular on the façade with the aim of replacing the light openings and considerably improving the thermal insulation properties.

It was the architects' intention to concentrate the renovation work regarding energy-efficiency and design on the entire street-side façade including the adjoining stairwell and the entrance area. An improvement in energy efficiency but not design was planned for the façade on the courtyard side.

## ONLY POSSIBLE WITH A SYSTEM FAÇADE

The complex requirements for converting this façade while the building was still in use could only be satisfied with a special system construction that takes such structural and organisational conditions into account in their conception. Just under two years ago, an initial "modernisation façade" by Schüco made it possible to renovate a façade in stages, whilst only interfering with the activity in a building to a tolerable extent. This system offers a number of benefits (see box) that were demonstrated in practice in Hanover.

## METAL FABRICATOR INVOLVED EARLY

In addition to the system technology, the metal fabricator responsible for planning, prefabrication and installation is a major factor in renovating the façade "quietly". The façade specialists from Metallbau Burckhardt were therefore incorporated into the plans by the architects and clients as soon as the order was placed. By prefabricating the components – substructure and window units – in the workshop, the metal fabricator was able to ensure that the units could be replaced swiftly storey by storey, allowing the building to be sealed again very quickly.

## STEP-BY-STEP MODERNISATION

Firstly, the substructure for the modernisation façade, the stone façade and the vertical pilasters were fabricated and installed, followed by the new window units which were fabricated and installed storey by storey. Only following their installation were the

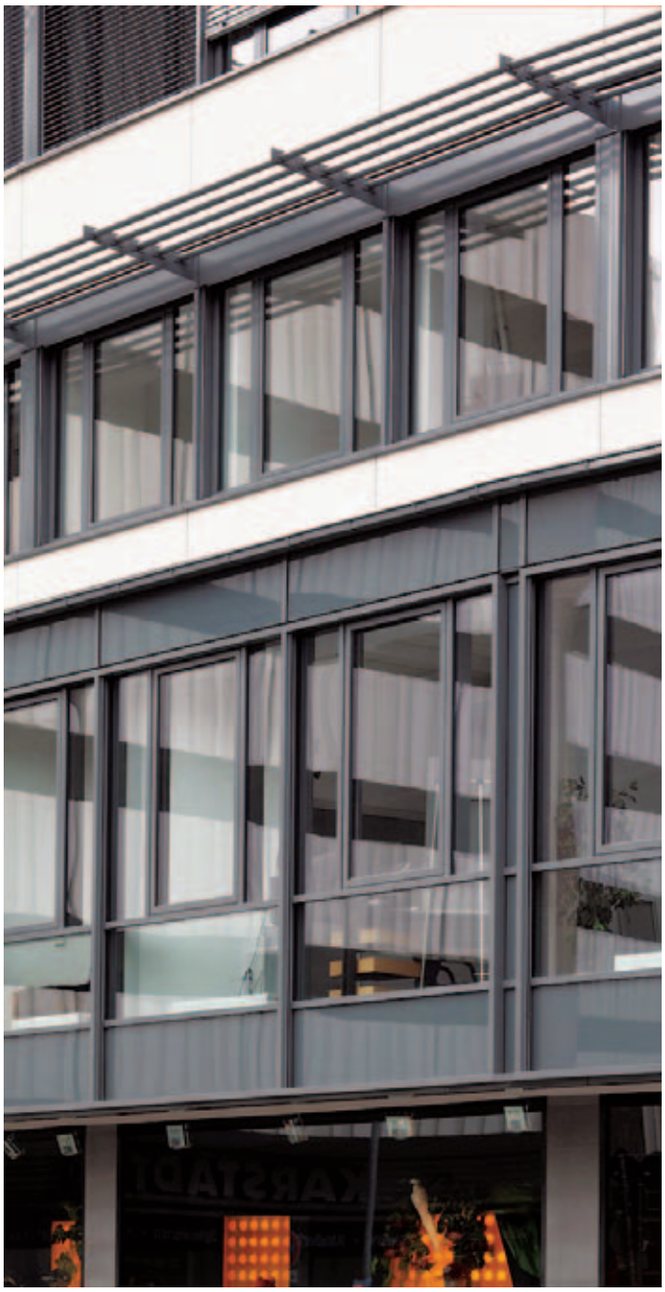

old window units removed. The last step entailed the installation of the stone façade and placement of the new wider window sills. All aforementioned steps were taken whilst work in the offices continued. However, drilling and anchoring work was carried out outside business hours or during strictly defined break periods for reasons of noise protection. The total amount of dirt and dust that accumulated during the renovation work was so small that dust barriers hardly had to be used.

## IMPROVED ENERGY EFFICIENCY

No changes were made to load-bearing components. For this reason structural calculations did not have to be made either. The floor plans were also retained, i.e. no work was carried out on the underlying structure of the building. The favourable result of this was that, due to unaltered fire compartments and an identical escape route situation in the building, a special fire protection concept was not required as is normally the case for building renovation. The new façade matches up well against new buildings which have been designed to be energy-efficient, without altering the dimensions of the outer envelope of the building. Therefore, re-calculations of the floor area factor and the utilisation factor were not required as part of the building application.

## HARMONIOUS INTEGRATION

The modern, technical appearance of the multi-functional façade of the property on Schillerstraße is not only a harmonious shell for various activities and building materials, it also uses the façade technology in different ways. Whilst the existing façade of the clothes shop – which consists of large shop windows and an entrance area – on the ground floor remained



largely untouched, the commercial area on the first floor acquired a "special solution". Unlike the renovation façade directly above it, it was fitted with window units with solar shading from floor to ceiling. The second to fifth floors were fitted with the modernisation façade, and belts of new window units alternate with light spandrel areas. On these levels the façade is also equipped with cantilevered fixed solar shading units at each storey. The adjoining side stairwell, on the other hand, acquired a slimline profiled glass façade on all floors.

It is testament to the creative skill of the architects that the building appears harmonious in terms of function and across systems. Through uniform grids, profile face widths and colours as well as the dominant horizontal arrangement, they have created a building with a homogenous technically modern appearance, which could be combined within the Schüco system range with modern energetic values and comfort functions in a cost-effective way.

## ECONOMIC, ENVIRONMENTAL AND DESIGN BENEFITS

- Installation of the new second façade skin with minimal disruption whilst the building is in use (reduction in rent losses)
- Installation and electrical wiring carried out entirely from the outside
- Highest level of sustainable energy savings and reduction in CO2 emissions
- Increase in comfort for the user / prevention of vacant space
- Modern appearance and a variable façade design through the selection of cladding materials including photovoltaic units
- Minimal noise during the construction phase and accelerated renovation process through the universal use of modular system technology

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Images courtesy of hertrampf+brocade and Schüco International KG.

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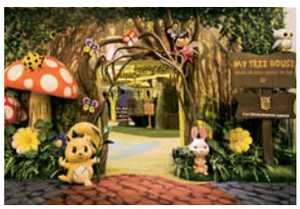

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*Skyline image, left to right: 7 & 9 Tampines Grande, Grand Copthorne Waterfront Hotel Singapore, Cube 8, South Beach, The Sail @ Marina Bay, Republic Plaza, City House, Tree House, 368 Thomson, W Singapore – Sentosa Cove, City Square Mall*

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