

# SUSTAINABLE ARCHITECTURE

ISSUE **ONE**

ZEB IS ONE • THE IDEA HOUSE • THINKING GREEN • IMPORTANCE OF DESIGN  
• A GREEN MOM • GREEN MARK FOR RTS • NEWS



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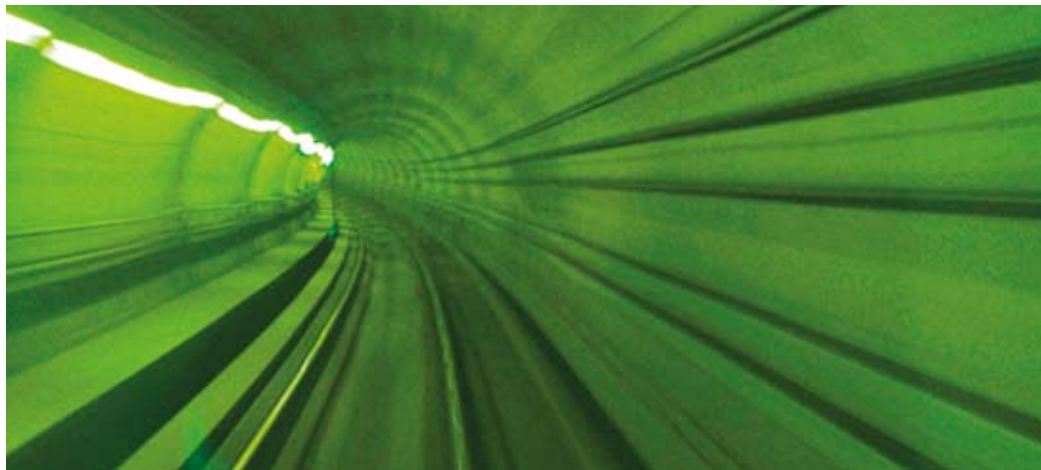
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# From the *Editor*

**Benjamin Towell**

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A brand new year and a brand new look to our very own green building magazine! This year continues to see the rise of the green agenda within the construction industry as we all push harder to do our bit as a responsible global city within Asia. Sustainable Architecture is proud to be a part of the paradigm shift within the construction industry continuing the journey towards creating an environmentally friendly, lively and liveable Singapore.

The new and improved Sustainable Architecture magazine will continue to highlight a wide range of projects and case studies within the built environment both locally and overseas. We will bring you the latest news and updates from the BCA and industry, whilst offering a multitude of educational and thought provoking articles.

With a new magazine, we believe it best to re-examine in this issue what is Sustainable Architecture? We take the holistic view that as a concept, Sustainable Architecture is more than energy efficiency and technology. Buildings can be described as primary objects within the physical environment, matters of location, design, visual impact and placemaking are central to the experience, connection and interpretation of the physical environment.

Designing for context is crucial in creating adaptable, flexible, usable and ultimately sustainable spaces. It is this blend of design, technology, and sensitivity to place that are present in Jason Pomeroy's 'Idea House'. This explores the translation of local vernacular to create a contemporary masterpiece of sustainable architecture.

In order for a building to be sustainable, it must be user-orientated and accessible, whilst being easy to operate and maintain. Stakeholder engagement in this respect is critical; occupants should play an active role in the layout and the operations design of the building to ensure its future successes. As such, we aim to share various projects experiences over the coming issues, highlighting how they developed a sustainable solution that guarantees user and operational friendliness by bringing the design team together with the facilities managers and end users at early stages.

The greening of existing buildings is vital to our future and has become a global concern. In Singapore, there are approximately 210 million sq m of existing building stock which gives great potential for environmental savings. We highlight two different projects with one thing in common, the government taking the lead. The articles and case studies highlighted are only the tip of the sustainable iceberg.

If you have a story or wish to highlight a project of your own, please get in touch with our team. With that I hope you enjoy this issue of SustainableArchitecture.





# The Idea House

by Jason Pomeroy, Broadway Malyan



# Sustainability in Southeast Asia

The global drive towards creating sustainable built products out of sustainable collaborative processes has given rise to a broad extent of literature that graces the bookshelves post-Brundtland report – a document that espoused the virtues of sustainable development that would meet the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987).

The maturity of the environmental agenda in particular parts of the World often owes as much to private sector advocacy as

movement is currently in Asia, where the population of firms largely dedicated to establishing a greener built environment is expected to nearly triple between 2008 and 2013 from 26 percent to 73 percent.

## The Idea House: Raison d'Etre

Whilst examples of environmentally responsive, sustainable built environments in Southeast Asia exist, the issue of measuring embodied and operating carbon quantity within building development, (i.e to objectively assess environmental impact), is an area that appears to have been explored to a lesser



The Idea House is an overseas provisional **GREEN MARK PLATINUM** project

well as through governmental legislation. Many green building projects have taken the idea further by quantifying the carbon emissions of their respective developments – thus applying objective measures and establishing its efficiency and therefore environmental impact. In the best case, a move towards carbon neutrality, or net zero carbon emissions has been the optimum goal to mitigate its negative effects.

It is predicted by 2050 that half of the world's carbon emissions will be from developing countries (in particular, India, China and Southeast Asian countries). Rapid modernisation and urbanisation may come at the expense of society and the environment, as the ill-gotten mistakes of an industrialised West pre-Brundtland fail to deter the developing nation's quest for economic prosperity.

A combination of governmental and private sector commitment to combating climate change has, however, found expression in green building legislation and the establishment of green assessment methods tailored to the tropical climate, and regional social economics. This is further testimony to a fundamental step change in the way buildings are being procured, designed and built in Southeast Asia.

The McGraw Hill 2008 smart market report 'Global Green Building Trends' showed that the fastest growing green building

extent. Whilst one can be seduced in thinking that the environment is the major component to the green agenda, the balancing of social and economic issues is also important. Sustainable developments provide a balance theory between the needs of Man and Nature through careful consideration and trade-offs between social, economic and environmental parameters, of which each should be given equal weighting. However, an often overlooked parameter is that of local culture.

There is a need for more culturally sensitive and quantifiable 'green' assertions in South East Asian building design that we have been fortunate enough to contribute. This has come in the form of the first carbon zero house in Southeast Asia; the Idea House. The Idea House is a prototypical dwelling that provides an insight into future tropical living, and is the brainchild of Sime Darby Property, Malaysia's largest land owner and leading property developer, and Broadway Malyan, an international interdisciplinary design practice. Conceived as a test bed for new ideas, the house showcases the latest in sustainable architecture in Southeast Asia.

## Culturally Sensitive Passive Design

A key starting point for any sustainable design is a passive solution that is respectful of the site, the localised climatic conditions, and the local community. To this end, the house goes back to basics

by embracing traditional passive design principles that were historically rooted in the Malay Kampung tradition. This provided opportunities for the Kampung house's reinterpretation in light of societal, economic, technological and environmental change in the 21st century.

### Respecting cultural traditions

A study of the spatial configuration and architectonics of 20 traditional kampung houses and their modern day counterparts provided the basis for objective spatial planning to ensure that the dwelling would not only respond to local socio-cultural needs, but could be future-proofed for changes in social convention. Just as the traditional kampung was able to expand and contract according to the size of the family nucleus and be internally flexible to cater for a variety of different cultural practices, so too is the Idea House.

The house is designed to expand (and contract) internally by the incorporation of demountable floor and wall cassettes. This approach further permitted a flexibility of internal space for different functions to take place during the course of the day. Just as the kampung house's deep overhanging roofs permitted shade from the sun and protection from the rain, so too does the Idea House for similar environmental needs. Anjung and serambi verandah spaces were also reinterpreted and incorporated to allow for social interaction outdoors.

Such a reinterpretative approach to the vernacular allowed the Idea House to be a bold architectural statement that bore little physical resemblance to its historical cousin whilst being able to capture the socio-cultural essence of the traditional kampung house.

### Respecting the site

The house responds to the contours of the site's topography by emulating the natural contours in order to minimise the adverse effects of cutting and filling the landscape. This enabled the site to be preserved for future generations as much as possible. The landscape strategy then sought to enhance the level of greenery on the site for the purposes of reinterpreting the more foliated traditional setting of the Kampung house for its environmental and social benefits. Planting can act as a useful carbon filter that absorbs the noxious pollutants from the atmosphere. When integrated as part of a broader building development, they provide further social benefits in the promotion of health, well being, recreation and healing, or use for culinary purposes.

The Idea House sought to explore all of these ideas, by firstly measuring the quantum of greenery using the green plot ratio method\*. Existing levels of greenery were then enhanced by 100 percent by the incorporation of trees and shrubs in order to reduce temperatures, provide shade, and cool the prevailing winds for the cross ventilation of the house. Different species of planting were also used for

# The Management of Material and Resources



1 Waste Management

2 Timber Flooring

3 Aluminum External Wall / Roof Cladding

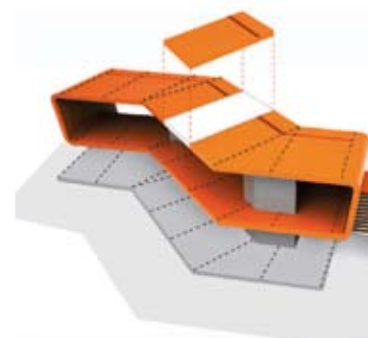
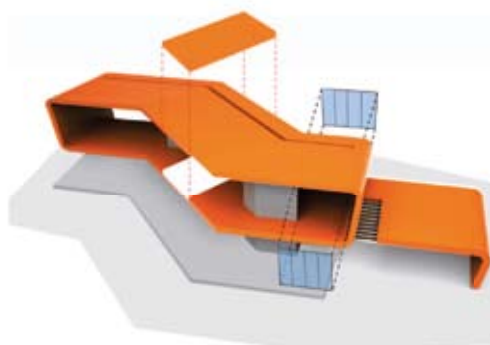
4 Ceilings

5 Drywall Internal Partitions

6 Ceramic Floor / Wall Tiles

7 Paint Finishes

8 Hardsurfacing / Turfed Driveway





their health and wellbeing attributes, most notably in the green wall by the kitchen that allowed for natural herbs to be used for cooking in addition to its ability to keep a hotter part of the house cool.

\* Green Plot Ratio - a means of understanding the level of planting on a site by assigning values based on leaf area to different types of planting and then calculating the area of greenery in relation to the site area.

### Respecting the localised climatic conditions

The appropriateness of the long and narrow form of the traditional kampung house demonstrated that the careful orientation of a long and slender floor plate permitted daylight penetration and also negated solar heat gain to the shorter eastern and western facades, thus facilitating lowering energy consumption. This was complimented by deep overhangs to provide shade and respite from the sun and tropical showers, all of which helped reduce the reliance on mechanical ventilation, cooling systems and its associated costs.

The open plan nature of the house, coupled with the ability for the external and internal walls to be slid back to remove any physical internal/external barrier, capitalised on its ability to be cross ventilated. Orientating the living spaces in a southwesterly/northeasterly orientation allowed for the harnessing of the prevailing winds, therefore reducing the need for artificial methods of ventilation. CFD analysis confirmed that the curvilinear profile reduced wind eddy with no obstructions. Daylight analysis of the narrow plan form demonstrated excellent daylight penetration to the habitable areas, reducing the need for artificial lighting during the day and into early evening.

### Active Systems and Green Tech

The Idea House also embraced the investigation into new technologies. In addition to testing the latest in renewable energy products as alternative sources and low energy fittings and appliances to reduce energy consumption, the house also explored smart systems that ultimately connected the occupant to the complete operation of the house via the simple touch of a smart phone.

### Harnessing solar energy

The Idea House includes the installation of photovoltaic cell technology on the roof to harness the sun's rays as a renewable energy source. The 125 sq m cumulative roof area designated for photovoltaic cells generates enough energy to sustain a family of five. It is intended to replace the photovoltaic cell technology after a period of time in order to gauge the relative merits between mono crystalline, polycrystalline, and membrane types of photovoltaic cell.

In the first instance, a polycrystalline silicon material has been used, rated at 15.3 kW peak, with an estimated renewable energy production of 17,068 kWh per year. With estimated conventional Malaysian family energy consumption being 15,000 kWh per year, this currently stands at approximately 20 percent surplus energy created. The excess power could be thus sold to the power companies when the feed-in tariff scheme is realised.

### Rain/Grey water management

Rainwater is targeted as the primary source to serve all domestic purposes except for the kitchen. Such a strategy helps to reduce the reliance on potable water as well as minimise storm water run-off and thus the loading onto storm water drainage. With an average of 2900mm of annual rainfall, the Idea House can harvest approximately 2565 l of rainwater per day – enough water to cater for 98 percent of the occupant's household needs. The rainwater is captured by the sloping roof and is channelled via down pipes into a microbiological filtration system that removes pathogens, harmful impurities, reduction in chlorine and turbidity. It is then stored in an underground tank and used for showers, basins, toilet flushing, landscape irrigation and the swimming pool.

A revolutionary rainwater switch system is designed to negate manual intervention by drawing the rainwater as the primary source. If the tank falls below a certain capacity, the municipal authority water will supplement and replenish for household need. This smart device separates the water from the two sources and saves energy. Grey water harvesting is the secondary source and involves the collection of wastewater from the bathroom showers and hand basins.

With an average of five persons staying in the house, the quantum of water that can be harvested can reach up to 1200 l of grey water a day. The design is able to recycle 50 percent of the grey water from wash hand basins and showers, which is then passed through a filtration system before being stored in an underground water tank. The water can then be reused to irrigate the landscape, thus reducing water consumption and therefore utility costs.

### SMART connections

Historically, different building systems (life safety, security, HVAC, lighting, kitchen appliances, telecommunication, etc.) were independent of each other and operated as individual islands of control. The built-in BAS (Building Automation System) simplifies

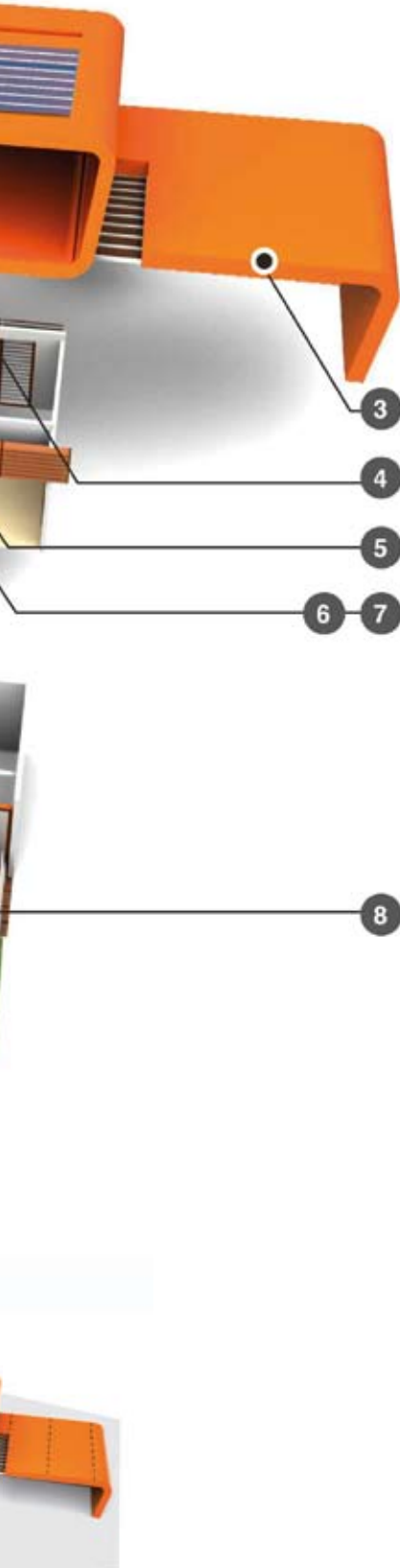




Photo Credit: Sime Darby



Photo Credit: Sime Darby

these systems by integrating them into a common platform. This enables the occupant and management team to conveniently identify and manage their running costs, energy consumption, comfort levels and safety of Idea House.

The BAS is able to store, record and monitor the occupant's usage of lighting, air conditioning, photovoltaic cells, grey and rainwater consumption and household security, and is accessible via an interactive touch screen display. The simplicity of use for the homeowner is further facilitated via the GSM Modem which is integrated to the homeowner's mobile device. The homeowner will be able to send commands to the BAS in order to control the lighting, ventilation, energy, water and security system at a touch of a button.

Furthermore, as the integrated solar photovoltaic panels provides a surplus amount of energy, the ability to identify how much energy is sold back to the power grid is possible via the touch screen visual display.

### Materiality and modularity

Specification of light thermal mass materials that had an 80 percent recyclable content and the ability to be dismantled in the future, given the houses' modularity, was essential in the interests of preserving the site for future generations. Reference was made to the Building Research Establishment's Green Guide to Specification, (UK-based green specification guide) which seeks to provide a comparative indication as to a particular building elements environmental impact. To this end, all materials selected were grade 'A-B', indicating a higher

environmental performance.

A modular approach to the construction was proposed for the structural elements and the architectural and building services components. This necessitated a close collaboration with the contractor, supply chain, and structural and building services engineers. The Idea House employs modern methods of prefabrication and modularisation in order to reduce the reliance on specialist labour and wet trades, and provides opportunities to employ individuals with a lower skills base.

Standardised units on modules of 300 mm, 600 mm, 900 mm and 1200 mm were employed throughout, thus minimising waste and allowing for cross construction discipline integration. A modular lightweight floor cassette system was developed from the combination of fibre-





Photo Credit: Sime Darby

cement boards with a light gauge steel framing. Small bolted fixings were incorporated into the floor cassettes for fastening on to the main steel frame to finally make up the final building structural body.

The modular construction also enables a speedier construction process, thus saving time and therefore financial/resource burden. As the entire frame and construction was modular, it allowed for the house to be demounted in the future in order to preserve the terrain for future generations or future development.

### Interdisciplinary collaboration

Both the client and architect recognised that the success of the project would be predicated not by the will of a single creator but the interdisciplinary collaboration of specialists with particular

sector knowledge, skills and judgement befitting the intricacies and complexities of the first carbon neutral house in SE Asia. It was therefore understood that specialist, as opposed to generalist, input from individuals would help clarify the key design issues in the project realisation.

Informed critical debate and problem solving by interdisciplinary specialists would challenge pre-conceived roles and responsibilities and embody more collaborative values. Transparency and frankness, the ability to address issues and not personalities, maintaining an open mind and constructive attitude, and striving to reach consensus helped facilitate interdisciplinary team working and allow the individuals expertise be tapped at the most critical junctures of the project. An interface between architects, engineers, landscape designers, urbanists, contractors and suppliers reduced the project programme by 50 percent when compared with the generic residential model.

In order to achieve this, the team's common understanding that the Ideas House would become a benchmark in sustainable residential design and act as a precedent for Malaysian lifestyle living, and also that such a position would only be attainable through pro-active knowledge sharing either via workshops or BIM models that would minimise design, production, and onward construction material waste. This resulted in a 50 percent saving in design time, and a 75 percent saving in construction time over conventional detached residential properties.

### Next steps

The house has been completed and documented in a book that profiles the collaborative journey between developer and design team in the creation of such a benchmark for sustainable design in Southeast Asia. Initial results have demonstrated its carbon zero credentials in terms of operational energy and the team are now undertaking a full life cycle analysis to substantiate the very same position in terms of embodied carbon/energy.

In this respect the project has satisfied three undertakings. In the first, it sought to objectively assess and document the development's carbon footprint in order to avoid the potential greenwashing that can take place by the superfluous addition of green technologies. In the second, it embraced the spirit of sustainable knowledge transference from one project to another, as lessons learnt from the past inform the present and future. In the third, and by virtue of the second, it demonstrated how the social, economic, environmental and cultural design and methodology of the Idea House can be applied to the terraced, semi-detached, and block typologies, and thus be true to its original intention of being a prototype house driven through research, development and innovation, for onward commercial application in the residential marketplace.



Photo Credit: Sime Darby

# Sustainable Products

Benjamin Huang, Singapore Green Building Council

## The Launch of Singapore's Green Product Certification

Environmental sustainability in the building and construction industry has recently received an additional boost with the introduction of the first dedicated Green Building Product Certification Scheme by the Singapore Green Building Council (SGBC). The scheme is set to complement the established Singapore Green Label Scheme (SGLS), which has already proved itself popular amongst consumers.

The new scheme aims to assess the level of environmental friendliness of building products in the areas of safety, health, performance efficiency and environmental protection. With the demand for eco-friendly resources and products poised to be the next market driving force, the Green Building Product Certification Scheme will provide consumers, building industry stakeholders, and government procurement departments with an excellent database of robustly assessed and certified green building products.

As a key initiative supporting the Building and Construction Authority (BCA) Green Mark Scheme, which measures a building's

environmental performance, the Green Building Product Certification Scheme also seeks to encourage manufacturers to strive for greener product innovations. A similar system has been in existence in the UK for many years. Here, the Building Research Establishment (BRE) have a 'Green Guide to Specification' where materials and components are assessed and graded A to E in terms of their environmental impacts, within comparable specifications, across their entire life cycles.

The BRE arranges the building materials and components on a building element basis including, external walls, internal walls and partitions, roofs, ground floors, upper floors, floor finishes, windows, insulation and landscaping.

In Singapore, the criteria for assessment for the Green Building Product Certification scheme has been developed by close to 100 professionals from the building industry, using a comprehensive set of standards to evaluate the quality of green building products. The standards set allow for a holistic calibration, ensuring measurements will be reliable, accurate and consistent, eliminating false claims on sustainability.

The Singapore Green Product Certification Scheme encompasses eight product categories:

1. Mechanical
2. Electrical
3. Façade and Envelope
4. Concrete and Structure
5. Interior Systems
6. Interior Finishes
7. Recycled and Sustainable Material
8. Renewable Energy

The number of product categories covered under the scheme will be expanded in the future to ensure the certification scheme is comprehensive and allows for the future extensive range of building products.

Products are assessed in areas such as energy efficiency, water efficiency, resource conservation, pollution avoidance, and carbon emission mitigation. With up to four different levels of ratings, the scheme will not only provide a good range of differentiation to incentivise suppliers to conduct research and development, but will also ensure continual development of products.





# Sustainable Construction

Giau Leong, BCA

## SG\$15 Million Incentive Scheme for building capabilities in sustainable construction

As part of BCA's initiatives to drive sustainable construction, the Sustainable Construction Capability Development Fund (SC Fund) has been set up to develop capabilities of the industry in delivering sustainable materials and adopting sustainable construction methods.

Industry players can now tap on the new fund to invest in extensive test bedding of sustainable construction technologies, materials and technical know-how, which they can integrate into their processes and business operations.

The SC Fund will focus on developing capabilities in recycling of waste arising from the demolition of buildings and in the use of recycled materials for construction. This is in line with the Inter-Ministerial Committee on Sustainable Development's (IMCSD) goals to mitigate impact to the environment by boosting our resource efficiency through waste minimisation and recycling. In doing so, the industry will be more self-sustaining in the demand and supply of sustainable construction materials.

The SC Fund emphasizes on the following key focus areas:

- **Sustainable Construction Practices or Technologies**

To achieve a higher level of efficiency in the use of natural materials or to use recycled materials such as recycled concrete aggregates through test bedding of sustainable construction technologies.

- **Waste Management or Waste Recovery**

To up-cycle the use of demolition waste by using recycled concrete aggregates processed from this waste to partially replace natural aggregates in the manufacturing of concrete for structural application.

- **Environmental-friendly materials or products**

To invest in technology and enhance the quality of recycled products.

## Design Incentive

Jonathan Cheng, BCA

### The BCA Green Mark Incentive Scheme (Prototype)

Best practices that result in most high performance, energy efficient buildings adopt a collaborative design process right from day one, allowing the entire project team to come together, understand one another's requirements early and optimise the design with in-depth simulation studies. To encourage such practices and push for even higher energy efficiency improvement, BCA has rolled out the SG\$5 million Green Mark Incentive Scheme – Design Prototype (GMIS – DP).

#### Eligibility

This scheme is targeted at developers or building owners if their buildings meet the following criteria:

- It is sited in Singapore
- Commitment to go beyond Green Mark Platinum and achieve at least 40 percent energy savings better than the current base building code.
- It is a new private/public development or an existing building that will undergo major retrofitting with gross floor area of 2000 sq m and above
- It is in its preliminary concept design stage at the time of application
- It must apply for the Green Mark assessment and achieve Green Mark Platinum and demonstrate 40 percent energy savings.
- Applications will be assessed based on

the competency and track record of the design team, proposed design approach and degree of replicability and novelty. It is recommended to begin preliminary discussion with BCA to assess the eligibility of the project before proceeding to lodge a formal application.

#### Funding

The GMIS-DP provides funding support for the engagement of Environmentally Sustainable Design (ESD) consultants with good track record to conduct design workshops and/or building simulation.

#### Grant Quantum

The amount of funding is up to 70 percent of the qualifying costs or SG\$600,000, whichever is lower.

#### Qualifying Costs

These include only fees for design workshops and/or design-phase simulation studies to go beyond Green Mark Platinum.

More information can be obtained at:  
<http://www.bca.gov.sg/GreenMark/gmisdp.html>

# Green Mark News

Grace Cheok-Chan, BCA

BCA launched the Green Mark scheme in January 2005 to encourage and promote the development of environmentally sustainable buildings. It is a green building rating system to evaluate a building for its environmental impact and performance. Over the last few years, the scheme has become well recognised and well received by the construction industry.

In line with Singapore's continued commitment to reduce the carbon footprint and energy intensity for its building sector, BCA announced on 5 August 2010 that a more stringent Green Mark standard will be implemented with effect from 1 December 2010. The move will raise the standards of 'green' buildings in Singapore and guide the industry towards more sustainable and energy efficient practices in building design, construction and maintenance.

The introduction of the revised BCA Green Mark Version 4.0 for new buildings is one of the steps towards fulfilling the Government's goal in "greening" 80 percent of its buildings by 2030. Details of this circular were communicated to the industry via a circular available at the BCA website and CORENET on 31 August 2010.

With the introduction Green Mark Version 4.0, all Green Mark applications for new buildings that are submitted on or after this date will be assessed and certified based on this version. Projects that are submitted prior to 1 December 2010 but not assessed by 1 December 2011 will also be subjected to Green Mark Version 4.0 automatically.

To facilitate better understanding and highlight the salient changes to the requirement, three runs of industry briefing were conducted on 20 September 2010, 27 September 2010 and 1 October 2010. Response to the industry briefings was overwhelming with all sessions fully subscribed with a total of 514 attendees. Having previously consulted about 120 industry practitioners over the past year, the general feedback was that the requirements laid out in the revised Green Mark Version 4.0 were attainable and realistic. The industry briefings were moderated by the Director of the Technology Development Division, Mr Tan Tian Chong.

## Version 4 at a glance

The revisions to the criteria will raise the energy performance a further 10 percent from the previous standard. This represents a 28 percent energy improvement at certified level from the 2005 Building Code.

## Key Changes from Version 3

### Residential Criteria:

1. Additional pre-requisite requirements for Goldplus and Platinum projects:
  - Naturally ventilated staircases and common lobbies
  - 4-tick labelled Air-conditioners
  - Minimum scores under sustainable construction criteria
2. Removal of points capping of maximum scores.
3. Higher weight-age for good natural ventilation and passive design.
4. Additional criteria for daylighting strategies and alterations to artificial lighting weightage.
5. Revision of weightage for carpark and lift ventilation
6. Enhancement of scoring for Renewable energy.
7. Removal of point allocation for use of water efficient fittings rated as "Good" or '1 tick' as this is now mandatory.
8. Additional criteria for water efficient plants
9. Enhancements to Sustainable construction scoring and the ability to support the new multi tier green product rating system (See SGBC article for product rating details, page xx)
10. Enhancement of scoring for greenery provision, environmental management and practice and public transport accessibility.
11. Additional criteria for storm water management.

### Non-Residential Criteria

1. Removal of maximum points capping for both energy-related requirements and other green requirements.
2. New minimum prescribed air conditioning system efficiency for all tiers of award.
3. Permanent instrumentation for monitoring of water-cooled chilled water plant efficiency inserted as a pre-requisite.
4. Additional criteria for heat balancing substantiating test for water-cooled chilled water plant
5. Additional criteria for daylighting.
6. Additional pre-requisite for minimum points scoring under Sustainable construction for higher awards.
7. Enhancements to sustainable construction scoring and the ability to support the new multi-tier green product rating system.
8. Green Plot Ratio computed using prescribed leaf area index
9. Additional criteria for Indoor Air Quality management
10. Additional criteria for storm water management.

**More details on Green Mark Version 4.0 can be found at the following links:**

**Circular to Professional Institutes/ Associations**  
<http://210.23.8.172/info/Uploads/Circular/CBCA100902.pdf>

**For Green Mark Certification Non-Residential Building Criteria**  
[http://bca.gov.sg/GreenMark/others/gm\\_nonresi\\_v4.pdf](http://bca.gov.sg/GreenMark/others/gm_nonresi_v4.pdf)

**Residential Building Criteria**  
[http://bca.gov.sg/GreenMark/others/gm\\_resi\\_v4.pdf](http://bca.gov.sg/GreenMark/others/gm_resi_v4.pdf)

**BCA Green Mark Certification Standards for New Building, GM Version 4.0, Aug 2010 issue**  
[http://www.bca.gov.sg/EnvSusLegislation/others/GM\\_Certification\\_Std2010.pdf](http://www.bca.gov.sg/EnvSusLegislation/others/GM_Certification_Std2010.pdf)

**For Legislation on Environmental Sustainability Requirement Code for Environmental Sustainability for Buildings, 2nd Edition, Aug 2010 issue**  
[http://www.bca.gov.sg/EnvSusLegislation/others/Env\\_Sus\\_Code2010.pdf](http://www.bca.gov.sg/EnvSusLegislation/others/Env_Sus_Code2010.pdf)

**Slides for Industry Briefing for Green Mark Version 4.0**  
<http://www.bca.gov.sg/GreenMark/others/GMV4.pdf> or accessed via the following website <http://www.bca.gov.sg/sustain/sustain.html>



# Scoring with Sustainable Construction

Giau Leong, <sup>BCA</sup>

## Sustainable Construction and Green Mark Version 4: The Revised SC Score

In line with the Inter-ministerial Committee on Sustainable Development (IMCSD)'s drive towards achieving sustainable development, BCA revised their Sustainable Construction Masterplan (SCMP) to propel the adoption of Sustainable Construction (SC) practices for all new building projects. The two key thrusts are:

1. To design efficiently to optimise the use of natural materials
2. To minimise waste through reuse and recycling

### The following is a snapshot of the key changes:

- Under Sustainable Construction and Sustainable Materials categories of Environment Protection, the total points for the use of SC materials have been increased). This applies to both Residential and Non-Residential Projects.
- Additional pre-requisite for all GM GoldPLUS and Platinum projects to achieve a minimum of three points and five points respectively under Part 3-1 (Sustainable Construction).
- The main changes include awarding points for use of green cements for example: Granulated Blast Furnace Slag (GGBS) for superstructural applications, increased point

weighting for the use of aggregate substitutes such as recycled concrete aggregates (RCA) and washed copper slag (WCS) for structural applications and less stringent criteria for Concrete Usage Index (CUI). Developers have to provide documentary evidence of tender specs showing requirements of using green cements, RCA or WCS as well as evidence of site delivery of these materials.

- Two points will be awarded for using RCA or WCS if the total quantity (in tonnes) used for replacing coarse or fine aggregates in the project meets the minimum requirement according to the formula =  $0.03 \times \text{GFA (m}^2\text{)}$ ; four points will be awarded if the total quantity used is at least twice the minimum requirement.

Other Sustainable Construction practices recognised under GMV4 include the adoption of demolition protocol. This protocol is a set of procedures designed to help demolition contractors better plan their demolition procedures so as to maximise recovery of concrete waste for beneficial reuse or recycling.

One point for  $\geq 20$  percent crushed concrete sent to recyclers at Sarimbun Recycling Park and two points for  $\geq 35$  percent crushed concrete sent. Points will be awarded under Part 5-1 of Green Features and Innovation.



# The importance of good, people-orientated design

Benjamin Towell, BCA

This article examines the importance of 'good design' within the built environment as something that is often overshadowed in the green movement. Good design is not something that can easily be quantified and is deemed to be subjective. However, the element of design is crucial to provide spaces and create places that form a part of the urban fabric, facilitating human interactions, economic activities, and environmental stewardship.

People are directly influenced and emotionally moved by the design of items surrounding them. Design is not merely an adornment of cultural life, but is present in all the interactions and transactions that constitute the social and economic fabric of a country. Design is the way we create all of the artefacts that serve us, striving to meet all our needs and desires, facilitating the exchange of information and ideas that is essential for civil and political life.

It has become commonplace in development to view the aesthetic dimension as secondary, an 'extra', or a luxury to be added when the rest of the building has been resolved, especially with the advancement of green technologies. There is a major conceptual problem relating to what is meant by 'better-designed' and, more generally, by 'good design' or 'design quality'. The green movement loves to be able to quantify elements in order to provide an evidence base.

Design cannot fit into these models, and as such, has recently started to take a back seat within discussions. Design should be understood as referring to placemaking. Thus, better quality design should promote better quality and more sustainable places. Well designed spaces often become a social attractor, as it orients the choices of a multiplicity of individuals, allowing for a range of people and activities to flourish.

Good design is not a frill or a luxury; it's a fundamental. Good design is design that

meets the genuine needs of real flesh-and-blood individuals; that will prevent feelings of estrangement from one's surroundings caused by places where the individual becomes a passenger, customer, or number.

The development process is subject to many influences that inhibit good design, and obstacles will vary for different stakeholders. In Singapore, land is scarce and development is very expensive, limiting the ability for building occupiers to develop their own buildings. Hence, design quality is hindered by this speculative nature of development where short term profit motives and clients and developers tend to fall back on 'safe' designs that are not challenging or innovative, but based upon the perceived market of what will sell or let to a majority of tenants.

The rise of the green agenda and BCA's Green Mark has aided in many ways with more attention needed during the crucial design phase, facilitating the inclusion of green features and basic passive design elements to secure its rating. However, the continued compartmentalisation of professional disciplines, lack of recognition of the legitimate role of high quality design, and the application of quantitative rather than qualitative judgments can all act as constraints to making quality places.

Good design is more than just the packaging; it creates an atmosphere that invokes an emotional attachment to a place. Aesthetical considerations are crucial to placemaking and identity, offering choice to consumers, a vibrancy and vitality that attracts people to live, work, and play in an area. Good design is key to delivering sustainable communities. A well designed building and area attracts people to stay and communities to form, helping to prevent social and environmental decay in neighbourhoods and promote longevity in the built environment.

“Good design is more than just the packaging; it creates an atmosphere that invokes an emotional attachment to a place”







# A Green MOM

**Noel Chin, Ministry of Manpower, Singapore**

Originally designed as a shopping complex in the 1980s, the building at 18 Havelock Road took a turn during the construction phase to become the new home to some 500 staff of the Ministry of Manpower (MOM) in 1988. The 7-storey block, with two levels of basement car park represented a paradigm shift for government offices at that time.

Over the next 20 years, with expansion of functions to cater to a growing demand for its services, MOM's staff numbers have tripled to 1600. MOM's Facilities Team recognised the need for a major reconfiguration of structural layout and an urgent replacement of obsolete fixtures to ensure that the aging building remains relevant and effective to meet the Ministry's growing needs.



## The Successes of the Facilities Team

The challenge for the Facilities Team was to carry out the changes and achieve the Building and Construction Authority's (BCA) Green Mark Platinum status. The challenge is made more daunting as the MOM Building is an old building and currently no other existing government building has attained the 'Platinum' status. In the process of its retrofit, MOM's water conservation efforts won the building recognition from the Public Utilities Board (PUB) as a water-efficient building in September 2008, and later, a Friend of Water in February 2009.

In March 2009, MOM was recognised for its excellent energy management by the National Environment Agency (NEA) with the Energy Smart Office Label. At the same time, MOM was also awarded the Green Office Label by the Singapore Environment Council (SEC) for their responsible environmental practices. The final piece of the jigsaw to fulfilling the Ministry's vision of creating a sustainable building was the achievement of the Green Mark Platinum certification in November 2010.

## Successful Strategies

### Environmental Policy

MOM's journey of excellence would not have been possible without a clear environmental policy, which helped shape key decisions in our green journey. The vision of creating an environmentally friendly organisation was guided by a strong commitment to adopting best practices and innovative green measures to reduce their carbon footprint and create an environmentally friendly workplace. As part of the vision of creating a great workplace, MOM is dedicated to conserving the environment, adopting new technologies and design concepts that will help achieve the mission.

### Passive Strategies

The building's orientation formed the foundation of MOM's passive strategies. The southwest orientation is aided by the use of egg-crate shading devices, which help to reduce glare and heat from incoming solar radiation, improved the overall Envelope Thermal Transfer Value (ETTV). Trees planted along Havelock Road provide shade to the lower levels of the building, while the newly constructed 7-storey hotel/office at Merchant Road further reduce the impact of direct solar radiation.

Careful thought was given to the building interiors when MOM decided to rejuvenate the workspace in 2007. They opted for an open office concept with lower partitions and relocated the office rooms to the central aisle to introduce more natural light into the main office spaces. Bright finishes for furniture and worktops and the use of full glass panels for office rooms help to maximise the penetration of natural light. This helps to reduce artificial lighting in the office area, while window films instead of curtains were installed to mitigate solar glare and heat emission.

### Air Conditioning System

MOM carried out a major retrofitting in 2008, replacing its chiller plant under the Guaranteed Energy Savings Performance (GESP) Contract. An investment grade energy audit was conducted by the appointed Energy Savings Company (ESCO). Several energy conservation measures recommended by the ESCO were adopted to improve our overall energy and water consumption, including the inefficient and under-capacity 3 by







250 tonnes R11 chillers made way for a 3 by 325 tonnes R134a high efficiency chillers and a 2 by 100-tonnes R134a chillers to cater to off-peak load. By introducing smaller capacity chillers for off-peak loads, it helped to improve the efficiency of the overall chiller system and reduced wastage in running the bigger chillers for smaller loads.

Pumps and cooling towers have been fitted with Variable Speed Drives (VSD) to support load variations and the introduction of pre-cool Air-Handling Units (AHU) helped to reduce humidity and temperature of fresh air intake, thereby relieving the load on the AHUs.

Chilled water was introduced to cool the data centre, resulting in greater savings; and an energy management system was put in place to monitor energy consumption. The efforts paid off. Chiller plant efficiency improved from 0.9kW/tonne to 0.65kW/tonne, surpassing the current Green Mark for Existing Buildings Platinum requirements.

### Smart Lighting

When it came to illuminating the general office area, the team used T8 tubes with electronic ballast. The office lights are controlled by the building management system, which is programmed to turn on during office hours and turn off at the end of the day. To cater for staff working beyond these hours, bypass switches were installed at every zone to allow for lighting at one-hour intervals.

Along the office windows, perimeter lighting is controlled by the use of Photo-sensors, which were installed along the windows. These sensors detect the lux levels within the office area and will switch off perimeter lights once the desired lux levels are achieved. So, perimeter lights will be switched off on a bright sunny day, and the lights will remain illuminated on cloudy and stormy days. Lighting improvements were also made to the carparks and corridors with T-5 tubes with electronic ballast, while the main atrium located on the ground level is fitted with light-emitting diode (LED) downlights. Motion sensors for toilets were installed to help reduce energy usage in areas when there is a low demand for lights.

Going forward, the Ministry is exploring the feasibility of replacing the T-8 electronic ballast light fittings with LEDs. LED technology has advanced over the years with improvement in quality, design, as well as the durability of the product. This will further improve the overall energy savings since LEDs consume half the energy of fluorescent tubes, have a longer lifespan, and emit less heat, which in turn reduces the air-conditioning load.

### Water Management

The MOM building uses NEWater for more than 50 percent of our total water consumption. It is the first office building in Singapore to achieve this. The current consumption of NEWater to portable water ratio is 4:1. NEWater is supplied to the cooling tower, flushing, sprinkler system and used



for landscape irrigation. This was achieved by innovatively splitting our existing water tank to cater for NEWater as an alternative water source instead of building a separate water tank for this purpose.

To ensure higher efficiency in water utilisation, water sub-meters were installed and monitored daily to detect any abnormal fluctuations. All water fixtures and flushing systems installed were rated as "Excellent" using the Water Efficiency Labelling and Standard (WELS) ratings. This ensures a balance between flow and utilisation.

In addition, MOM also focused its attention on water recycling. The building recycles 155 cu m of condensate water every month that is collected from the pre-cool AHU and channelled to the cooling tower as makeup water. The water treatment system in the cooling tower is able to achieve more than seven cycles of concentration, improving the quality of condensate water and reducing the risk of legionnaire diseases.

### Regulated Ventilation

To regulate the need for mechanical ventilation (MV), MOM installed carbon monoxide sensors in the car park, while carbon dioxide sensors were installed in toilets. VSDs were also implemented to other MV systems to address load variations. These measures helped to reduce energy consumption by our MV systems.

### The Savings

MOM's efforts have resulted in improvements on their overall energy efficiency index and in significant energy savings of 537,984kWh/year (35% savings) compared to their historic baseline.

This is largely attributed to the improved performance of the chiller system. There were also savings in water consumption of 11,794 cu m compared to previous year from the use of water efficient fittings and recovery of condensate water. Furthermore, the use of NEWater accounted for 40 percent of the overall water savings due to the lower tariffs. In all, MOM gained a cost savings of SGD 946,000 a year from its energy and water conservation efforts.

### Cultivating a Green Mindset

At MOM, they recognise that people play a key role in any effort to create a sustainable environment. Their Corporate Social Responsibility efforts include constant engagement and cultivation of environmental awareness amongst staff. Outreach activities organised by MOM's voluntary group, the Community Environmental and Outreach Committee (CEOC), helps to promote environmental awareness among staff, vendors and service providers. MOM also regularly invites speakers from government agencies like SEC and PUB to share on their environment and water conservation initiatives.

To constantly remind staff to Reduce, Recycle and Reuse, MOM leverage on their internal communications platforms such as posters and the Intranet. Recycling bins are made available around the building at strategic locations to encourage recycling of plastics, cans, paper and ink cartridges. These recycled items are collected and separated on a daily basis by recycling companies.

### Conclusions

MOM's green journey has been challenging, but most rewarding. In the process of working with MOM on the implementation of green measures, their consultants and contractors have picked up useful ideas on efficient energy and water conservation practices, which they subsequently pass on by incorporating these measures in their other projects. MOM's challenge now is to maintain their standards and to continuously seek improvements by exploring new green technology and practices. This is an integral component of their corporate social responsibility commitment.

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# Green Mark for Rapid Transit Systems

Grace Cheek-Chan, BCA

The global trend towards environmental sustainability is increasingly evident in the railway development in recent years. While rail or rapid transit system networks are generally accepted as the more sustainable form of mass transport, there remain suites of sustainability objectives and strategies that can be set and delivered in its development process. For this, the Building and Construction Authority (BCA) in collaboration with the Land Transport Authority (LTA) has developed a green framework for rapid transit systems. This framework now known as the BCA-LTA Green Mark for Rapid Transit Systems (RTS) was formulated and officially launched in October 2010.

The BCA-LTA Green Mark for RTS sets out a practical and sustainable way forward in the development of rapid transit systems and networks. It comprises three key strategies namely:

## **Effective Use of Energy**

Promote efficient use of energy through better energy efficient design and provisions of electrical and mechanical systems and regenerative energy equipment to enhance the operational performance of RTS networks. One example will be the use of regenerative braking in RTS where energy can be harvested from the braking of the trains and channelled to a nearby train or station through an inverter system.

## **Environmental Protection and Sustainable Development**

Promote utilisation of environmentally friendly designs, materials and construction practices. For example, like the use of environmentally friendly materials such as eco-concrete in construction.

## **Water Conservation**

Promote the use of innovative water saving technologies and devices to reduce water consumption and to recycle waste water for non-potable use such as recycling the water in train wash plants.

In short, the framework has effectively integrated various sustainability strategies in planning, design, construction and operational aspects of the RTS, providing a holistic approach in evaluating and rating the environmental impact and performance of rapid transit systems of existing and future lines.

In October 2010, the Building and Construction Authority awarded the Circle Line the Green Mark Gold award for its environmentally friendly design and features using this framework. The certification reaffirmed LTA's commitment towards sustainable development, putting in place appropriate measures to mitigate potential environmental impact of RTS development. Using this framework, the environmental friendliness of the RTS for different lines can also be benchmarked and improved.

It is envisaged that the BCA-LTA Green Mark for RTS will soon pave the way for the adoption of more green technologies in the future and existing rapid transit systems, contributing to the achievement of sustainable development for Singapore.

# Aedas and Sustainability Design

AEDAS PTE LTD incorporated in Singapore since 1995 (as LPT Architects Pte Ltd) has contributed significant landmarks to the Singapore Landscape – most notably, Marina Bay Sands™ Integrated Resort and 313@somerset Shopping Centre.

Ongoing projects include commercial, residential, transport, mixed development, institutional and interior projects. This establishes us with a diverse portfolio of works as well as a good track record of delivering some of the best projects completed in Singapore, Southeast Asia and South Asia.

The philosophy of Aedas is to achieve architecture of distinction through a commitment of excellence in professional services to further the success in creating buildings of lasting value. It is Aedas' maxim that each project should not only compliment, but should also make a positive contribution to its surrounding precincts.

Aedas acknowledges sustainability and the protection of the environment as a moral obligation. The practice is proud to embrace the new challenges that the environment urgently needs addressing. We view each Architectural solution as a beacon for change and hope to lead by example.

Recently in Singapore, Aedas has completed 313@somerset which achieved Green Mark Platinum in 2009. Aedas has also expanded its sustainable design capability to Indonesia by achieving the first Green Mark District certification in Indonesia for the BSD City Office Park Masterplan and Head Office Building in Jakarta. Moreover, Aedas has completed numerous buildings that have successfully received certificates from recognized building environmental assessment organizations recognizing our projects are environmentally friendly buildings. The firm sees strong potential in the Asian region where governments continue to support green and environmentally friendly projects. In addition, Aedas believes by leveraging on sustainable design it can maintain its growth and take part in the global movement for green building.

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39 in four continents.







# Thinking Green

Benjamin Towell, BCA

Green is at its peak in popularity and awareness. However there is a danger that the message will easily get lost and confused with so many companies promising 'green' products and services. The same is true with green buildings. How can we tell what is truly green and what is simply a green wash?

**We at Sustainable Architecture are big believers in getting the fundamentals right. Buildings should be designed with reference to limiting their impact on the environment using passive design before attempting to incorporate active and high technology solutions. Many buildings worldwide will rather entertain a visible green technology than have an effective passive design that reduces the overall consumption of the building over its lifetime.**

Buildings must be fit for purpose and located in close proximity to social and physical infrastructure. A green building is not green if it is demolished rapidly after construction due to not being adaptable or fit for purpose. It is not green if it constantly needs upgrades and maintenance, and it is not green if the occupants have to travel great distances to reach it by private transport.

Recently, emphasis has been placed on searching for renewable energy sources and technologies; these technologies can consume large quantities of power and raw materials in their production. As such, a triple bottom line and life cycle analysis approach should be used to assess whether the reduced energy consumption at the point of use balances the initial energy and impact of production.

The use of renewable building materials, improved passive solar design, high thermal performance, and the recycling of used materials are all approaches that aid to tackle consumption both in terms of initial resources and lifetime operations.

The Zero Energy Building at the BCA Academy (page 22) is a prime example of getting the basics right before implementing the technological active features. The design team worked in reducing the building's consumption by 50 percent when compared to a base building of the same layout. Natural light and natural ventilation strategies have been used to reduce the need for the active systems that have been incorporated, offsetting the energy consumed in the buildings daily operations.

We must not overlook the simple solutions in the search for hi-tech infrastructure and greener buildings. It is imperative we get the basics of context specific design right and make the right material and technological choices for the job.

We at  
Sustainable  
Architecture  
are big  
believers in  
getting the  
fundamentals  
right.







# ZEB is ONE

The Zero Energy Building (ZEB), which is located at the BCA Academy in Braddell, made history in October 2009 when retrofitting works at the former classroom building was completed. It claimed the title of being the first existing building in Southeast Asia to be fully retrofitted with green building design features and technologies.

The main target of the project was to demonstrate that the concept of a zero-energy building is possible even in the tropics, where high air-conditioning loads make up more than 50 percent of the electricity consumption of buildings.

## Active and passive solutions

To be super energy efficient, ZEB project team adopted an integrated design approach that encompasses passive design and active solutions to the building's energy consumption. The ZEB passive designs are integrated into the

overall architectural concept, blending in seamlessly as part of the façade or as a building feature. Passive solutions adopted in ZEB included vertical and rooftop greenery, shading devices, low-E glass and solar film coating.

For active solutions, intelligent building features and sensors were installed to control the amount of air conditioning and lighting needed based on utilisation to minimise energy wastage. These included single coil twin fans, variable speed drive fans and pumps, and personalised ventilation systems.

## Pioneering use of materials

Mirror ducts made of highly reflective material were used to bring in natural light through external collectors into the space resulting in considerable energy consumption saving. There are no mechanical parts involved and no power is required.



"ZEB has placed Singapore favourably on the world's green building map. Through achieving innovation and engineering excellence, we have also enhanced sustainability in the built environment through advanced green building technologies."

- CEO of BCA,  
Dr John Keung

A solar-assisted, stack ventilation system uses heated air to induce ventilation. When sunlight heats the duct, the heat builds up in the ducts below the metal surface and, due to the buoyancy effect of heated air, air rises and flows out through the chimney. This creates a negative pressure, inducing cooler air from outside to enter the spaces.

#### Innovations in planning, design and construction

A Single Coil Twin Fan (SCTF) coupled with a personalised ventilation (PV) system help to conserve fresh air and re-circulate cool air, optimising air supply to the individual user's localised demand for ventilation or cooling. This differs from conventional systems where the fresh air and re-circulated air are controlled together. The use of the SCTF and PV can possibly lead to improved air quality, thermal comfort and humidity control.

#### Unusual aspects and aesthetic values

The west and south facades of the ZEB are installed with vertical greenery systems. They don't just help to reduce the heat island effect; they also reduce heat transmittance and enhance the building's appearance. The PV Story Façade, a staircase façade featuring three types of prevailing PV technologies not only serves to educate visitors about the prevailing PV technologies, it also gives the ZEB's façade a state-of-the-art look.



#### One year on, did the ZEB make the mark and deliver as promised?

Yes it did. In the last year, the ZEB managed to achieve net zero energy consumption. The power surplus that the ZEB has generated translates to savings of about SG\$3900 per month, which is enough to power 52, 5-room HDB units for a month! The surplus electricity is fed back into the premise grid to offset electricity consumption by other buildings in the Academy.

Commenting on the ZEB's achievements on its first anniversary celebrations, Dr John Keung, CEO of BCA said, "ZEB has placed Singapore favourably on the world's

green building map. Through achieving innovation and engineering excellence, we have also enhanced sustainability in the built environment through advanced green building technologies."

The ZEB employed Passive Design and Active Solutions, a two-step, integrated design approach to ensure that it would be 40 to 50 percent more efficient than







a typical office building. Through Passive Design, the project team managed to minimise heat transfer through the building envelope. This was achieved via design features such as the greenery systems, light shelves and sun-shading devices. This was followed by a well-conceived installation of Active Solutions, such as an energy-efficient air-conditioning system, and high-efficiency lighting that includes motion sensors and carbon dioxide sensors.

Going forward, the ZEB will serve as a test bed for the integration of green building technologies in existing buildings, a living laboratory for putting appropriate green building technologies to test. It will function as a hub for students and practitioners in the study of energy efficiency and green buildings to learn and network. It will aspire to inspire the industry, leading it toward a greener future.





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