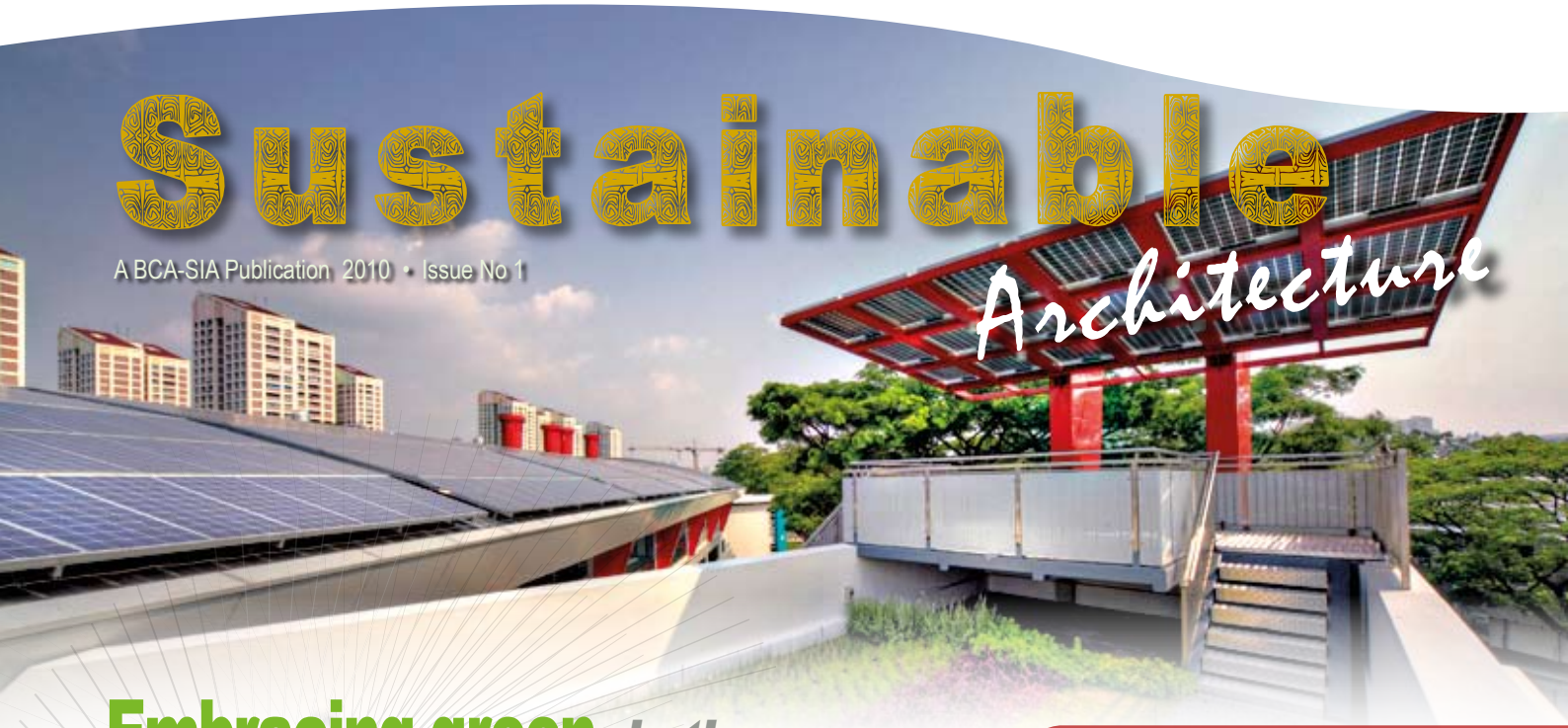

Sustainable Architecture

A BCA-SIA Publication 2010 • Issue No 1

Embracing green in the new year

Year 2009 has been a booming year for the construction industry. We have seen an increasing trend in the adoption of green building technologies, products and sustainable construction methods.

In this very first issue of Sustainable Architecture for the year 2010, we will showcase BCA's flagship R&D project - Zero Energy Building (ZEB). This three-storey institutional building at the BCA Academy is designed to be about 40 to 50 percent more efficient than an office building of a similar layout and is expected to generate as much electricity as it consumes over a typical year.

Another ground breaking project that is highlighted is the Samwoh Eco-Green Building, which is the first building structure in the region that uses concrete with up to 100 percent recycled concrete aggregate (RCA), which is derived from construction and demolition waste. It demonstrated a revolutionary achievement in modern construction and design and set a positive direction for sustainable design for the future.

Following the success of the BCA–NParks Green Mark for Existing Parks, the scheme will be extended to include new parks. The new BCA-NParks Green Mark for New Parks aims to inspire and promote sustainable park design, as well as to identify the best practices in park design, construction, management, and maintenance planning. Both the Dairy Farm Nature Park and the Greenwood Sanctuary @ Admiralty are featured in this issue.

We also look at two buildings that have obtained the Green Mark platinum award. Using a "Whole Building Design Approach", the Woh Hup building created a people-centric high performance commercial office building with highly integrated active and passive design features. The second project is called The Galen and it has one of the most energy efficient chiller plants in Singapore. The "super efficient" chiller plant attained total plant efficiency of 0.56kW/RT.

We also speak with Mr. Lee Chuan Seng, President of the Singapore Green Building Council (SGBC), who shares with us the aims, objectives and mission of the SGBC and the prospects for green building in Singapore.

Wang Lei
Senior Development Officer
Building & Construction Authority

Inside this issue:

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Printed on recycled paper

Another Green Initiative By...

Samwoh

Samwoh Eco-Green Park

Located at
51 Kranji Crescent
Singapore 728661

Founded in 1975, Samwoh Corporation is a leading integrated construction company. For years, the company has been investing heavily in Green business, which is in line with our nation's goal towards sustainable construction. The latest development is Samwoh Eco-Green Park, which consists of 3 premises and was officially opened by Ms Grace Fu, Senior Minister of State for National Development and Education on 22 March 2010.

1. Samwoh Eco-Green building is the first in this region to be constructed using concrete with up to 100% of recycled concrete aggregate after extensive research. Our green efforts for the building have been rewarded with the highest accolade in the BCA Green Mark Certification – The Platinum Award.
2. Asphalt recycling plant which employs state-of-the-art technology to recycle asphalt pavement waste.
3. Ready mixed concrete plant which is equipped with recycling capability to produce Eco-concrete.

The successful completion of Samwoh Eco-Green Park showcases a breakthrough in construction technology that will pave the way towards greater sustainability and environmental consciousness in construction projects.

SAMWOH

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The green roof and the PV roof at the ZEB.

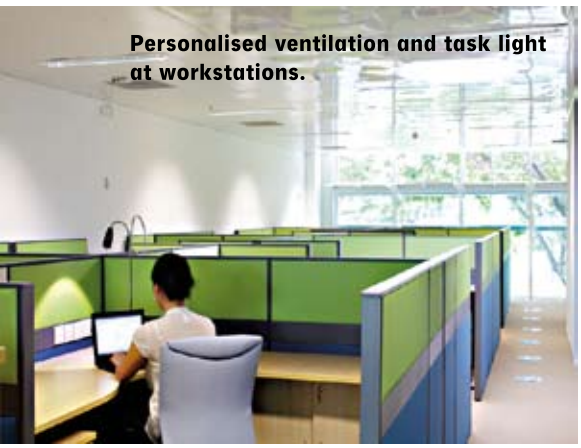
Singapore's first Zero Energy Building at the BCA Academy

The Building and Construction Authority (BCA) has successfully completed Singapore's first retrofitted Zero Energy Building (ZEB) located at the BCA Academy. ZEB was officially opened on 26 October 2009 by Minister for National Development, Mr Mah Bow Tan. It is BCA's flagship R&D project. The intent is to use ZEB as a test-bed for innovative building designs and energy efficient building solutions, especially for existing buildings.

ZEB is a three-storey addition and alteration (A&A) to an existing institutional building. The new premises house an exhibition space, multipurpose rooms, test-chambers and classrooms on the first storey, a library cum resource centre, more classrooms on the second storey, and offices and a school hall on the third storey. The building is partly funded by the MND Research Fund for the Built Environment and EDB Clean Energy Research and Test-bedding (CERT) Programme.

Solar-assisted ventilation in classrooms.

ZEB underwent a very energy efficient re-design of the façade, roof, M&E system and other building components to reduce its energy needs. At the same time, natural and renewable energy were harnessed from the environment. The Zero Energy Building is expected to be about 40 to 50 percent more efficient than an office building with a similar layout. Although the building is connected to the grid to cater for variability in the supply of solar energy, it is expected to generate as much electricity as it consumes over a typical year.



Personalised ventilation and task light at workstations.

ZEB was therefore conceived with the following objectives in mind:

• To serve as a test-bed for integration of Green Building Technologies (GBT) in existing buildings

• To be a hub for practitioners and students in the study of energy efficiency and green buildings

Sustainable building design practices

Zero Energy can be broadly defined as being energy self sufficient through being super energy efficient and generating 100 percent of all the energy that it needs internally using solar power. It is connected to the power grid, supplying energy when there is surplus and drawing energy when there is shortage.

Mirror duct installation for daylighting.

To be super energy efficient, ZEB adopts an integrated design approach that encompasses two general principles to reduce energy consumption:

a) Passive Design
b) Active Solutions (including active controls)

Being super energy efficient through the reduction of energy consumption is therefore the main focus of the Zero Energy Building. This integration of passive design and active technologies shall demonstrate how this building has achieved well-being for the user and at the same time is achieving adaptability to responsible use of resources. Its performance in use shall also be discussed based on post occupancy evaluation of the building in relation to its design predictions/prescriptions and its appropriateness.

Passive design strategies

Passive Design refers to the harnessing of nature's energy to provide for comfort and function without having to tap power supply from the grid. Therefore, passive design targets to reduce power consumption of the building and harness nature's energy, which is free and abundant. ZEB aims to develop a prototype for future green school in the tropics, where various passive design strategies and technologies will be incorporated in this prototype and detailed monitoring and analysis of the environmental parameters will be carried out to understand the performance of these strategies and technologies.

These include the proper choice of façade materials and design to ensure that the façade is sustainable with optimal thermal performance to minimise heat gain. Natural wind and daylighting will also be harnessed by the use of passive design technologies to reduce the dependence on cooling energy and artificial lighting without compromising the indoor environmental qualities of the classrooms.

Very extensive indoor environmental quality studies involving the long term monitoring of the indoor environment as well as the perception studies of the occupants will also be carried out with the objective of enhancing the indoor environment and thus the productivity of the students.

In the ZEB, passive designs are integrated into the overall architectural concept, blending in seamlessly as part of the façade or as a building feature.

To improve energy efficiency, three principles are used in the application of passive design:

a) Reducing heat transmittance

Less heat entering the building will result in less air conditioning power to keep cool, which is a major consumer of electricity.

b) Bringing in daylight

For most offices in Singapore, lights are turned on in the day even when sunlight is abundant. By guiding daylight deep into our space, we can actually reduce the amount of power spent in artificial lighting.

c) Natural ventilation

Over 40 percent of energy consumed in an office can be attributed to air conditioning. By leveraging on natural ventilation, we can reduce some of the electricity used to cool our environment.

Active design strategies

It is necessary to supplement the use of passive designs as it would not be possible to eliminate the use of electricity entirely. However, when electricity is needed, it is always consumed efficiently in the ZEB with as little wastage as possible.

Active solutions are energy efficient building systems and equipment that provide for comfort and function. These technologies implemented are recommended and concurrently investigated to achieve the targets for integrated energy sources and efficiency design towards a ZEB at BCA academy.

An example illustrating this is where energy wastage is minimised as intelligent building features such as sensors have been installed to control the amount of lighting needed based on whether a room is used and how many people are using it. Air conditioning is also adjusted according to the number of people using the space, the indoor temperature and the CO_2 levels. Another example is that lights are activated only when users enter a room and light intensity is adjusted according to daylight intensity. So if there is abundant daylight, the artificial lights will automatically be dimmed. To achieve energy self-sufficiency, the ZEB is powered by a broad spectrum of solar panels installed at many locations in the building. It is 100 percent clean renewable energy.

Sunshading PV louvres and green wall on west facade.


Light pipes and solar chimney

The generation of solar power can be broadly divided into two parts. Grid tied photovoltaic systems account for most of the solar panels and is connected to grid supply. Surplus power generated by these solar panels would first be distributed to the rest of BCA Academy before any excess is supplied back to the grid. If insufficient power is produced, then grid supply will provide for the ZEB, so that user comfort and function are never compromised. The other stand-alone photovoltaic systems are installed as test-bedding technologies that have the capability of charging mobile phone batteries.

Post occupancy evaluation and energy data logging report

Post occupancy evaluation is assessed based on quantifiable energy logging data and qualitative occupants' feedback.

Quantifiable Data

To ensure that the ZEB is quantifiably 'zero energy', it will be monitored in real time through the installation of different types of sensors throughout the building. Data collected in the centralised database will be used to produce audit reports as well as other knowledge that enhances the understanding of the building. It will also be used as feedback to the actively control the system.

Such data logging will be administered by the Building Management System which could also be used as applications to control the chiller plants, air-conditioning fresh air flow rate, lighting management and building energy monitoring.

Feedback

Although feedback from the users was mostly encouraging, there were some noticeable improvements that could be made to the light shelves' design to improve the control of glare caused by the evening sun. Also, the indoor air quality was compromised by the use of composite timber system furniture that contained less than ideal levels of formaldehyde.

While NUS professors are preparing a comprehensive report on the actual Energy Efficiency Index after a year of occupancy, the ZEB will continue to serve as a test-bedding platform for the integration of green building technologies, and be a hub for practitioners and students in the study of energy efficiency and green buildings.

This facility therefore exemplifies a project built for the community, designed for the well-being of the occupants and demonstrates the economics of adaptability to climate change and our sustainability.

The PV roofs.

Samwoh Eco-Green Park: A *future* where nothing goes to waste

By:
Dr. Ho Nyok Yong,
Dr. Kelvin Lee Yang Pin,
Mr. Lim Wee Fong

C&D waste recyling plant.

As a key segment of Singapore's economy, the construction industry plays an important role in providing infrastructure and buildings to support local economic development. Increasingly, the industry will have to play a greater role in shaping a sustainable environment for Singaporeans, both now and in the future.

Under the Sustainable Singapore blueprint, we recognise the need to improve the ways we use our resources, and to expand our renewable resources. This promotes resource-efficient building design and the use of recycled waste materials, which is an important component of our sustainable development journey.

A groundbreaking accomplishment

In response to the government's call, Samwoh Corporation, a leading integrated construction company and green products supplier, has embarked on an ambitious and forward-thinking demonstration project to build the first structure in the region using concrete with up to 100 percent recycled concrete aggregate (RCA), which is derived from construction and demolition (C&D) waste. The building is known as the Samwoh Eco-Green Building, which houses Samwoh's research and development (R&D) centre.

Samwoh Eco-Green Building.

BCA GREEN MARK PLATINUM AWARD 2010

The Samwoh Eco-Green building has marked a significant milestone in sustainable development in Singapore. It is part of the Samwoh Eco-Green Park that was officially opened on 22 March 2010 by Ms. Grace Fu, Senior Minister of State for National Development and Education.

C&D waste constitutes a significant portion of solid waste generated in Singapore. It is estimated that about two million tonnes in C&D waste is produced annually. The disposal of the waste poses a major environmental problem due to limited land space. In the past, when old buildings were demolished, the rubble was either discarded or used for low-value works such as land filling.

But today, through extensive R&D works that were undertaken jointly by Samwoh, Building and Construction Authority (BCA) and Nanyang Technological University (NTU), technologies have been developed to recycle the waste to produce RCA to replace natural aggregate for structural concrete. The project was awarded the MND research fund by the Ministry of National Development Singapore.

The project comprises two stages. The first stage involves extensive laboratory evaluation of the performance of concrete with RCA. The second stage is to construct a three-storey building using concrete that contains RCA, with advanced instrumentation installed in the building to monitor the performance of the structure. The data obtained from the project can be used to update existing building code requirements to allow the use of RCA in all buildings in the future.

Other green features

Together with this achievement, Samwoh has also built two other green premises that are beneficial to environmental sustainability, namely, an asphalt recycling plant and a ready-mixed green concrete plant.

Asphalt recycling plant

Every year, a large amount of asphalt pavement waste is generated during road maintenance and rehabilitation. The waste is largely used for temporary access roads or as backfill material for the road sub-base, which is very low in economic value. The rising cost of natural materials has triggered a need to use this waste more effectively.

The company has undertaken research studies together with the Land Transport Authority (LTA) and National Environment Agency (NEA) to study the effective use of the asphalt pavement waste for asphalt production in road construction. Both the laboratory and field studies have shown promising results.

Following the success of the study, Samwoh has set up a brand new asphalt recycling plant with processing facilities to recycle asphalt pavement waste into reclaimed asphalt pavement (RAP) which contains mainly aggregate and bitumen that can be reused for asphalt production.

The plant employs state-of-the-art technology to recycle asphalt pavement waste into asphalt mixtures for road construction. This offers an important opportunity to save the use of natural aggregate and bitumen, conserve energy, divert materials from landfills as well as save cost.

The recent announcement by LTA in March 2010 on the approval of the use of RAP in asphalt mixtures for road construction will accelerate the development of sustainable built environment for our future generation.

Asphalt pavement waste.

Asphalt recycling plant.

Green Concrete Plant

The Samwoh Green Concrete plant is capable of producing green concrete which contains recycled materials such as washed copper slag, RCA and green cements for the construction industry. It can also produce high performance concrete and other concrete mixtures.

In addition, the plant has the recycling facility to separate sand and stone from fresh waste concrete which can be reused for the manufacturing of green concrete. In fact, the concrete containing RCA used for construction of Samwoh Eco-Green Building was delivered by this plant.

Conclusion

The accomplishment of Samwoh Eco-Green Park has opened a new chapter in sustainable development in Singapore. The Eco-Green building showcases a breakthrough in construction technology by using concrete with up to 100 percent RCA, a feat that is beyond existing design code limits. The asphalt recycling plant is able to recycle asphalt pavement waste into asphalt mixtures, alleviating waste disposal problems and saving on natural materials needed for road construction. Last but not least, the green concrete plant not only produces green concrete for civil engineering and building construction, it can also reclaim sand and stone from waste concrete, reusing it for green concrete production.

These three facilities have demonstrated a revolutionary achievement in modern construction and design and set a positive direction for sustainable design for the future; a future where nothing goes to waste.

Samwoh's green concrete plant.

The authors would like to thank the following professionals who have contributed in the R&D works for the Samwoh Eco-Green Building: Er. Chew Keat Chuan, Er. Yvonne Soh, Mr. Low Giau Leong and Er. Punithan Shanmugam from Building and Construction Authority, Mr. Koh Hoon Lye from Samwoh Corporation and Assoc. Prof. Ting Seng Kiong from Nanyang Technological University.

BCA-NParks

Green Mark

Parks Scheme Extension

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Existing structures are conserved in park's design.

Following the success of the BCA–NParks Green Mark for Existing Parks, the scheme will be extended to include new parks. The new BCA-NParks Green Mark for New Parks is specifically developed for civic landscape areas, examining social and economic sustainability with strong emphasis on environmental sustainability.

It aims to inspire and promote sustainable park design, as well as to identify the best practices in park design, construction, management and maintenance planning. This environmental assessment framework also articulates in compatibility with the BCA–NParks Green Mark Park scheme for existing parks.

Under a comprehensive assessment system, parks are evaluated based on seven criteria:

- Material Resource
- Water Efficiency
- Energy Efficiency
- Greenery and Urban Ecology
- Design for Ease of Maintenance and Accessibility
- Parks Development and Construction Management
- Other Green Initiatives

Full pilot assessments were successfully conducted early this year on Dairy Farm Nature Park and Greenwood Sanctuary @ Admiralty.

Dairy Farm Nature Park

Certified (Green Mark New Parks)

Dairy Farm Nature Park is designed as a buffer to safeguard the core Bukit Timah Nature Reserve primary forest. It also aims to educate and raise awareness of our socio-cultural, historical and natural heritage of the site and to provide recreational opportunities that are economically, socially and ecologically sustainable.

Eco Park design educational messages are displayed throughout the park to educate visitors.

Dairy Farm Nature Park's strength lies in its effort in preserving, protecting and enhancing existing natural habitats during the Park's development. Dairy Farm has conducted an extensive Ecological Impact Assessment, Baseline Survey and Site Analysis. They have conserved the existing nursery, bungalow, cowshed, wells, the Singapore Quarry, and retained the open area within the Dairy Farm Quarry for the continued use of cycling and hiking routes and the rock-climbing site. The park's development also sees the transformation of the Singapore Quarry into a wetland habitat to attract the aquatic birds such as bitterns, sandpipers, waterhens, and native fish and dragonflies.

The park is also designed with the intent of 3Rs, water and energy conservation. The park uses recycled, salvaged and environmentally friendly material extensively in its development, such as benches, pavers/pathways, timber posts, tree logs, bricks wall (from salvage bricks) and energy efficient fitting.

The conserved building, also known as the interpretative centre, and toilets are designed for natural ventilation and daylighting. The Park also has installed solar panels to supply 20 percent of its demand in energy. Educational messages are displayed throughout the park to educate visitors on environmental protection and the importance of conservation.

Greenwood Sanctuary @ Admiralty

Certified (Green Mark New Parks)

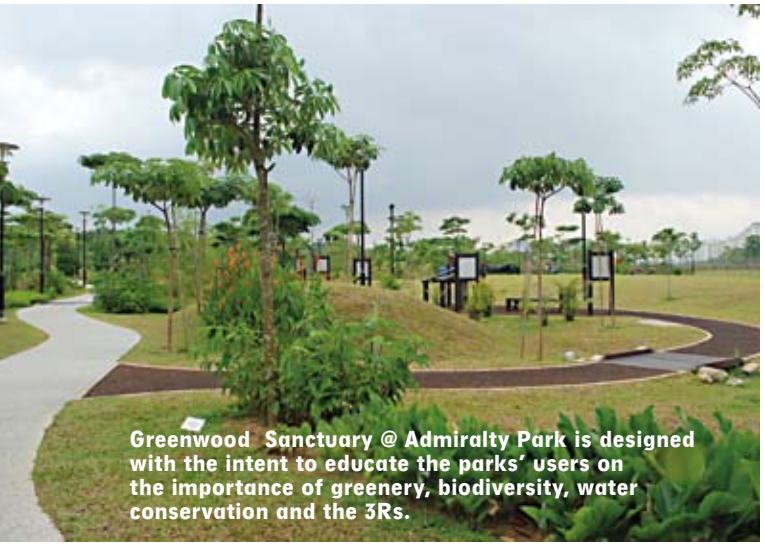
Greenwood Sanctuary @ Admiralty Park, a 1.5 ha park situated at Woodlands Drive 62 and 73 serves the residents of the Woodlands N6 neighbourhood. The park is designed to allow residents to meet, relax and play, with much of its design focused on children.

According to a survey done in 2009 by Pang Chin Eng, Geographic Distribution of the Singapore Resident Population, Woodlands has the largest population of children aged below 15 years, numbered at approximately 55,500. A wide range of play equipment catering to children is introduced in this park.

Greenwood Sanctuary @ Admiralty Park's design is intended to educate park users on the importance of greenery, biodiversity, water conservation and the 3Rs. This park uses recycled, salvaged and environmentally friendly material and products such as benches, play equipment, energy efficient fitting and many more. Educational messages on some of these features are displayed. Various planting themes were introduced (medicine, ornamental and forest planting) to allow users to learn and appreciate the diverse benefits of plants, their habitats and the biodiversity it encouraged.

The park is designed to allow residents to meet, relax and play, with much of its design focused on children.

Greenwood Sanctuary @ Admiralty Park is also strong in stormwater management design. Through careful design in creating earth mounts, the park is able to extensively employ bioswales and rainwater retention ponds to manage and treat its run-off as compared to building concrete drains. Also, the park's integration with an adjacent cluster of HDB shops, which include a school and a manufacturing plant, make the park an attractive proposition for the family crowd.



Greenwood Sanctuary @ Admiralty Park is designed with the intent to educate the parks' users on the importance of greenery, biodiversity, water conservation and the 3Rs.

Bioswales and rainwater retention ponds are used extensively to manage and treat its run-off.

All Together Now

How online collaboration streamlines project delivery

By Leigh Jasper

Leigh Jasper is Chief Executive Officer at Aconex, a global provider of project collaboration solutions to the construction and engineering industries.

On any construction project, it is essential that each party – developers, architects, consultants, project managers, subcontractors and others – can communicate efficiently. However, two industry trends are making this more difficult, causing hits in productivity and budgets.

Dispersed Projects

Projects now typically involve specialised organisations based across several locations, often far removed from the project site. This can make cross-company collaboration complex and expensive. Adding to the challenge is that each organisation is likely to have its own internal systems and processes for managing and sharing information.

The result of this is that files get lost or misplaced. Disputes arise over 'who did what and when' and parties lose track of the status of drawing reviews. Also, it can be unclear which information is correct and current and who is using the right information.

Drowning in data

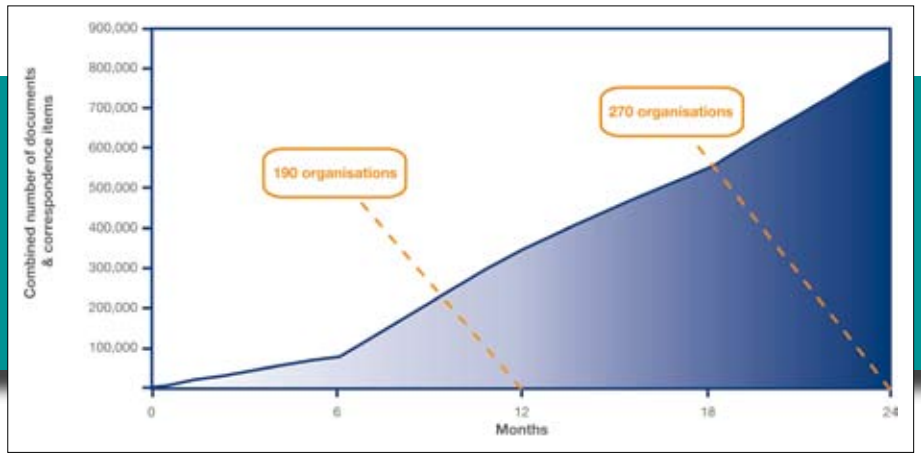
While technology has made it easier than ever to communicate and exchange information, the downside is that people, organisations and projects are often drowning in documents and email. To give an example, the chart below shows the typical number of project participants, organisations and data created during a US$200 million infrastructure project.

After 24 months, 270 organisations were engaged and they had generated 800,000 documents and correspondence items. As more firms joined the project, the number of drawing revisions, RFIs and the variations created increased exponentially.

Managing this volume of information in an unstructured way is extremely inefficient as there is no seamless way to find what you need, when you need it. This can add days to each document review and approval, and over the course of a project, cause significantly delays and contribute to cost overruns.

Traditional tools just don't cut it

The limitations of many commonly used tools make the task of managing project communication even harder. Hard copies, couriers, email and internal document management systems were designed for single enterprises, rather than the multi-



Source: Aconex Internal Data.

corporate, collaborative environment of a project. Using these tools turns each organisation into an information silo, where project members can neither find what they need, nor share what they have.

As well as slowing down the flow of information between participants, which is the lifeblood of any project, this can also lead to crucial data not being captured and miscommunication between organisations. Of more concern in these litigious times is that these tools often provide no audit trail of what's been committed to and agreed upon. All of this reduces project efficiency and increases exposure to an array of risks.

A solution built for construction projects

There is clearly a gap between what organisations need to manage project information and the traditional tools most often used today. Our industry is primarily project based, so it seems logical that our tools for communicating should also be.

This explains why the uptake of project collaboration systems has increased so rapidly over the past few years. These secure, web-based systems, which are independent of any one-project participant, allow all project members to access, distribute, track, and store their documents and correspondence using a single, common platform. At any time and from any location, project members can instantly access exactly what they need using a secure login.

Rollouts of these systems are seamless on any project. They are delivered using the Software as a Service (SaaS) model, where the vendor hosts and operates the system for use over the Internet. This means that the provider is responsible for delivering product enhancements and meeting security, reliability and performance standards. No additional software is needed and it is accessed through a standard web browser.

With collaboration systems, all data is securely archived and cannot be deleted or accessed by unauthorised personnel. Throughout a project, these systems maintain an audit trail of every document and mail transaction to provide transparency and accountability.

In practice, this means that expensive print bills, waiting for drawings to reach the recipients, time wasted searching for files, and lost documents are all eliminated. The time and bottom-line savings can be significant. On the Abu Dhabi Financial Centre development, head contactor Oger Abu Dhabi saved US$550,000 in print costs by using a collaboration system and also cut drawing review times by 15 percent.

Also, one of Singapore's largest developments, the Marina Bay Sands, is using a collaboration system to efficiently manage and track its project information. To date, more than seven million documents have been created and over 13 million project mail items have been sent between nearly 4000 people from 300 organisations. It seems clear that collaboration systems are the only project-based solution able to support projects of this size and complexity.

Managing environmental accreditations

With a complete database of all project information, collating and submitting environmental accreditations is much simpler and faster. These certifications, such as Leadership in Energy and Environmental Design (LEED) and the Singapore Green Mark standard provide a third-party verification that a building meets the highest green building and performance measures when compared to conventional buildings.

At every stage of the application process, an organisation must submit a unique set of documentation that demonstrates sustainable and environmentally friendly practices. Using a collaboration system means that there is a clear, single version of information at all times. Documents needed for the submission can be tagged accordingly and made available by entering a few simple keywords.

The importance of adoption

Collaboration systems hold project information on a neutral, independent platform. Access rights are set for all companies and firms retain full ownership over the information they've created. This encourages organisations project-wide to use the system and creates a level playing field where no party has more control over the other.

Without everyone on board and using the system efficiently, the core value of project collaboration is lost. For this reason, it is important to select a vendor that makes adoption and uptake as simple as possible. They need to ensure that there are no limits on user licenses or data storage, as this can limit how much information is centrally managed on your collaboration system.

Also, every construction project varies in size and complexity, making it extremely difficult to know how much storage you'll need or many people will be involved on each stage. For this reason, you need to choose a system that is scalable and is able to grow with your project.

Most importantly, implementing a project-wide system needs round-the-clock support and training. There should be no additional fees for on-site training or support, and the vendor should have the capability and the expertise to offer support to everyone on the project, regardless of where they are located.

Lee Chuan Seng is President of the Singapore Green Building Council.

A quick word with Lee Chuan Seng

Congratulations on the formation of the Singapore Green Building Council (SGBC). Is the Council getting off to a good start?

Yes. Much has been achieved in a short span of time. Since its formal inception on 28 October 2009, we have participated in major events, such as BEX Asia 2009 in Singapore and Green Build 2009 in Phoenix, USA, in addition to the BCA-SGBC dinner on 27 October 2009 and SIA-SGBC Roundtable on 30 October 2009.

This year, we led a delegation of thirteen member companies to Beijing in March to attend the Sixth International Conference on Intelligent, Green and Energy-Efficient Building & New Technologies and Products Expo (IGEBC). We had a Singapore Pavilion at the Expo showcasing the BCA Zero Energy Building as well as products and services from the various companies

I would say that much interest, both locally and overseas, has been generated since the council was formed. At present, we have over 180 – and counting – companies and organisations in membership.

In addition, I am pleased that the Singapore Tourism Board, Singapore Institute of Architects and Singapore Manufacturers' Federation have all supported us in a big way in SGBC's successful bid to host the World Green Building Congress, which will be held from 13 to 15 September 2010.

Further to that honour, we have also attained Established Council status with the World Green Building Council (WorldGBC), which helps to accelerate the global green building movement. Therefore, at the international, regional and domestic levels, I think we have set ourselves on the right course for progressive partnerships and the sharing of knowledge, which in turn strengthens our collective voice in the area of green building.

Why was the SGBC created and how is it funded?

SGBC was formed as an industry-led initiative, supported by the Building and Construction Authority (BCA), primarily to mediate between and propel, growing private and public interest in green building. Following in the footsteps of other established GBCs, it is to be Singapore's unique representative in the field.

BCA has contributed seed funding of SG$100,000 and also secretariat support to the Council for two years. The main sources of SGBC funding are membership, sponsorship and our online product listing services, while also gaining revenue from co-funded members' events. We are certainly also open to other funding channels such as corporate sponsorship for green building-related events, such as the SGBC Green Building Conference.

What are the aims, objectives and mission of the SGBC?

The mission of the SGBC is to propel Singapore's building and construction industry towards environmental sustainability by:

1) Promoting green building design, practices and technologies, which will be achieved through:

- Demonstrating Green Leadership at home
- Provision of certified Green Products and Services

2) Integrating green building initiatives into mainstream design, construction and operation of buildings, which will be achieved through:

- Green Competence; enhancing professionalism and knowledge in sustainable development
- The acquisition and sharing of Green Information

3) Building capability and professionalism to support wider adoption of green building development and practices in Singapore, which will be achieved through:

- Public outreach via Green Campaigns
- Recognition of commitment, innovation and leadership via Green Awards

SGBC's work complements and supports governmental action to accelerate the greening of 80 percent of our existing buildings by 2030. At the same time we will be able to share our knowledge with other countries in our climatic zone.

How do these differ from the objectives of other green building councils in the Asia Pacific region?

Each of the countries in the region is at different stages of development. Therefore, their needs are different and their GBCs reflect these differences.

In Singapore's case, we had a situation where the construction industry had worked with BCA, the government agency charged with developing and regulating the industry for a number of years to support energy efficiency, and then the Green Mark scheme. We were able to set up the SGBC very quickly last year because all the participants had been working together for many years in the Green Mark effort.

The government has been very responsive and indeed has in many ways led the drive towards greenness. So what has been and is different for Singapore is that we are able to discuss new initiatives and work out the best ways to implement them and then go ahead very quickly with the government changing regulations and supporting the drive forward.

That is why the government's efforts to push Singapore as a living laboratory and test bed for the industry to develop and refine Urban Solutions is something that the GBC strongly supports. We can assist our members to come together to develop these integrated solutions so that we can all learn and then export these products and services into the region.

What are the Council's current activities?

We are currently building capacity towards certifying green building products. Comprising our Technical Coordination Committee (TCC) are ten taskforces, set up to study, develop and administer the certification process. We have had an open call to professionals and senior people with relevant experience in each functional area to help make this process possible.

In detail, the functional areas are Mechanical, Electrical, Façade Systems and Roofing, Concrete and Structural Systems, Finishes, Interior Systems, Recycled Materials, External Works, Renewable Energy and Green Services.

In conjunction, SGBC launched its online green building product listing on 19 March 2010. The listing will, as a first step towards certification, identify green building products in the market and provide supply-demand links between manufacturers and construction industry practitioners.

Is the SGBC certification standard in any relation to the Singapore Green Label Scheme?

If we are considering this with a view towards working together, then my answer is 'yes'.

Our relation with the Singapore Environment Council (SEC), which administers the Singapore Green Label Scheme (SGLS) for consumer products, is collaborative. It can be a knee-jerk reaction to assert that either organisation is in competition with the other for the same market for green products, but I would like to think that our sense of shared interests goes further than that. For one, the standards for green building here can be raised by positive collaboration between both parties.

I think it is a misconception that we are trying to demarcate our areas of expertise, but that would be missing the point that the process of putting up a building and promoting its operational sustainability go hand-in-hand.

So, as we continue to support each other's work, I would say that talk of 'demarcating' specific domains between ourselves does not quite contain the idea of what we are trying to achieve, which is a synergistic relationship with SEC.

What is the WorldGBC International Congress, and how will it benefit Singapore?

The World Green Building International Congress is an annual forum for representatives from the different Green Building Councils around the world to meet and discuss objectives, policies and developmental strategies. It also brings together influential stakeholders from various related industries and international sustainable development experts.

Singapore's building industry will be able to leverage on this opportunity to raise its profile internationally and to develop its own capabilities in order to become an international test bed for green building technologies, products and practices.

Furthermore, as end users become more knowledgeable about green buildings and their positive impact on the improved quality of life, their increasing demand for green buildings will strengthen the business case for developers to incorporate green features in their projects.

What is the scope of using alternative materials such as recycled building products and solar energy in new construction projects here?

The current use of recycled building products and solar energy in new construction projects here has been improving steadily. For some years, there have been many projects that have used recycled building products such as drain linings and road kerbs, which are made of recycled aggregates.

There have also been more recycled timber products, substituting the use of real timber. We have also seen an increased uptake of photovoltaic technologies in residential, commercial, industrial and mixed development projects; in particular, solar energy constitutes a large part of energy used at the Zero Energy Building (ZEB) @ BCA Academy.

If green building is often seen to add more benefits than costs, why do you think some companies have been less receptive to the concept?

A very major cause of that is due to the lack of detailed knowledge by the public. The technical people in the industry are generally aware of the benefits but the non-technical people such as the end users and financial people who control the expenditure on buildings may not be as aware of these benefits.

This is where the media has a very big role to play in order to drive the message across to end users about the big benefits for small additional costs in green buildings so that they will demand for more green buildings to be constructed.

Continuous benefits can be gained along stages of a green building's life cycle when companies 'go green' from the start. We are not talking about iconic mega projects or the aesthetically avant-garde here: intelligent design and appropriate use of existing technologies can, for one, reduce the usage of energy and materials

So there is no excuse today not to be environmentally conscious. I would in fact say that with the strategic role that both legislated minimum standards and financial incentives are playing, it is easier for companies here to be pro-active.

How would you encourage developers in Singapore to make their buildings more eco-friendly?

I think first of all, the increased number of green buildings over the years reflects greater developer commitments to environmental sustainability. This essentially requires them to think harder about the net environmental and human impact of their projects, which is healthy in more ways than one.

Then, the learning curve for green building has also smoothened out with the amount of specialised knowledge resources put to good use.

What is your view on the government's approach in its support of the green building industry in Singapore?

The 1st and 2nd BCA Green Building Masterplans are very comprehensive and effective as useful route markers for Singapore's green building movement. I feel that as more homeowners are aware of, and indeed taking up the green cause, a public outreach strategy – one which ideally includes a role for non-profits - would be timely.

How do you feel about the prospects for green building in Singapore in the near term?

The future of green building in the near term – and we are looking at the next five-years – looks promising. A growing number of homeowners and commercial tenants are driving demand for green buildings, and this is evident in the progress and expansion of Green Mark criteria.

Also, the international presence of SGBC can now be said to be on firm foundations. At a domestic level, I think we can agree that it now is more attractive for companies to jump on the 'green' bandwagon so as to gain themselves valuable business partnerships.

Finally, as stakeholders, I think everyone has the capacity, independent of a timeframe, to contribute to Singapore's green movement, and I am hopeful that we can make a concerted effort towards green buildings.

Woh Hup brings *green* into its new building

The Woh Hup Building.

Since its inception in 1927, Woh Hup has become one of Singapore's leading builders with many landmark projects under its belt. Carrying on the proud tradition of industry, integrity and enterprise, Woh Hup remains at the forefront of the construction industry owing to its investment in innovative building solutions as well as the care and nurture of its human resources. Both these attributes have underpinned the design of the Woh Hup Building, which has recently been honoured by the BCA Green Mark Platinum Award.

At the outset, a green building Design Charette was undertaken with all project stakeholders to facilitate an integrated design approach and generate innovative design ideas. Woh Hup set out with the premise that if it is not required, it will not be used. This is evident in several key green strategies:

• Target Energy Efficiency Index of 120kWh/m^2/yr giving energy savings of 46 percent compared to a code compliant building

• 100 percent non-potable water replacement through grey water recycling for toilet flushing and rainwater harvesting for irrigation

• Sufficient natural daylighting to 55 percent of the building to minimise dependence on artificial lighting combined with excellent ETTV of 36.81 W/m^2 achieved via double glazed façade, low-E glass, low window-to-wall ratio and extensive external shading

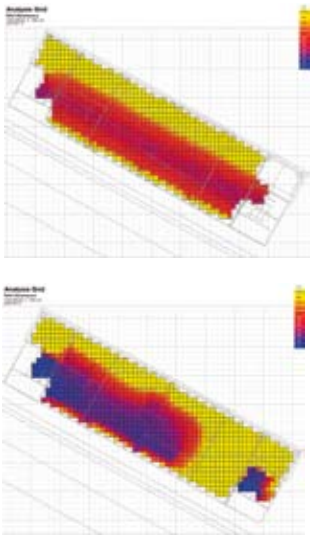
• Hybrid natural ventilation to achieve thermal comfort without air-conditioning for 75 percent of the year

• Development of a first-of-its-kind high percentage recycled structural concrete

• Installation of cylindrical solar modules as a trellis at the rooftop garden to create a solar garden

In addition, Woh Hup will implement advanced building controls and an environmental management system to maximise the operational efficiency of the active systems through monitoring and control. More importantly, the building's performance will be displayed live on monitors at the lift lobbies to increase awareness and foster positive behavioural change in the building's occupants.

People-Centric High Performance Building.



Simulations of Lux Levels

Woh Hup is in the unique position of being the developer, contractor and sole end user of this building. Therefore, they will conduct a pre- and post-occupancy evaluation (POE) on their employees to measure the impact of the new green building on their wellbeing, productivity and behaviour; another first-of-its-kind in Singapore.

The POE will involve a systematic evaluation of behavioural, functional and productivity metrics, as well as conduct research surveys on perceptions, attitudes and behaviours. It will assess how well the building matches users' needs and identify ways to improve building design.

In conjunction with the POE, Woh Hup will launch an internal green campaign, which involves a series of electronically delivered communications to raise awareness and engage their employees in the topic of green, and ultimately to encourage action.

Through this "Whole Building Design Approach", Woh Hup is creating a people-centric high performance commercial office building with highly integrated active and passive design features. The building, when completed in mid-2011, will boast some unique green features as elaborated further below.

Unique Green Initiatives

Innovative High Substitute Concrete

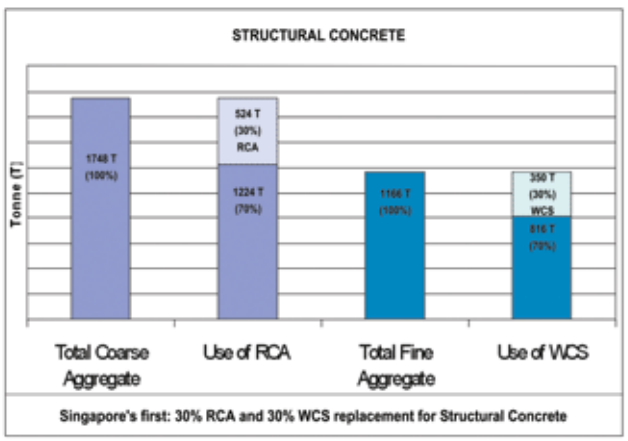
A high substitute structural concrete comprising 30 percent recycled concrete aggregate (RCA) and 30 percent washed copper slag (WCS) will be used for all superstructure elements of the building. This is the first-of-its-kind in Singapore to use more than 10 percent replacement of fine aggregates for structural construction. This translates into 524 tonnes of coarse aggregate and 350 tonnes of sand saved.

For non-structural areas such as drains and pavements, 50 percent RCA and 50 percent WCS will be used to replace the coarse and fine aggregates respectively. This translates into further savings of 74 tonnes of coarse aggregate and 50 tonnes of sand.

Advanced daylighting and glare analysis

The advanced daylighting exercise was an iterative one where multiple simulations were conducted in conjunction with ETTV re-calculations to ensure that the façade design would still deliver an excellent ETTV of 36.81 W/m^2 and 55 percent natural daylighting under overcast conditions. This implies that better lighting conditions can be expected for 80 percent of the year.

The team optimised natural daylighting with careful design of the façade and finishes schedule, position and length of sunshades and light shelves and glazing performance.



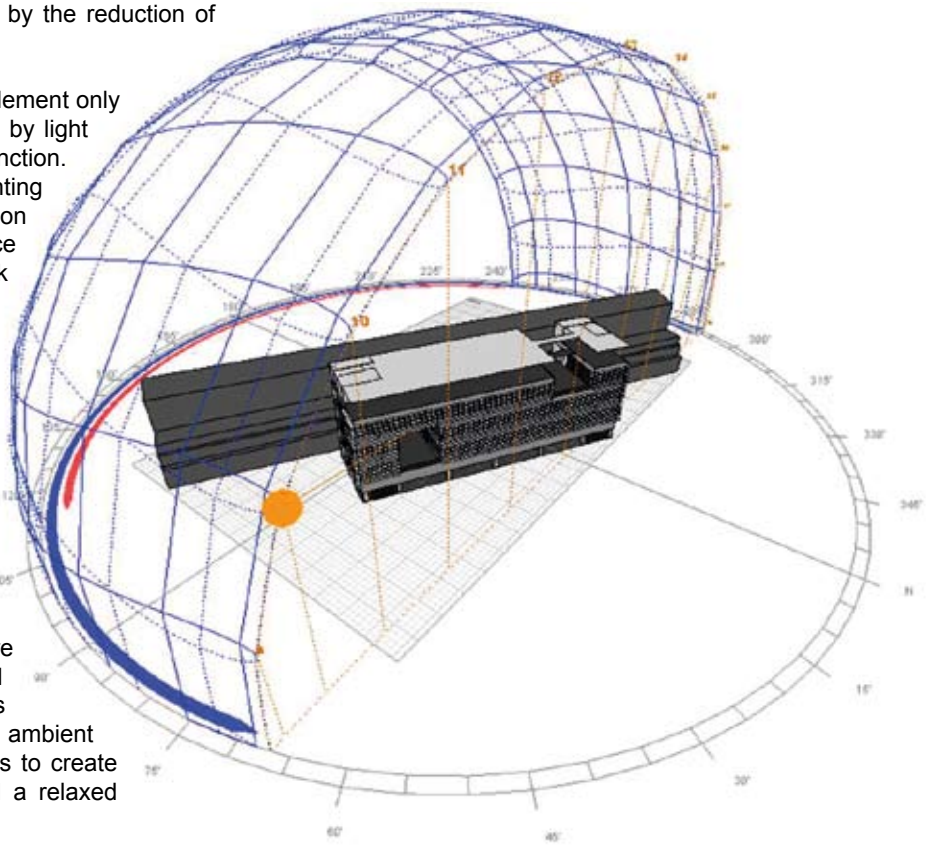
High Substitute Structural Concrete.

Extensive daylight and glare analyses were conducted to simulate indoor working conditions to ensure that occupants' visual comfort will not be compromised by the reduction of dependence on artificial lighting.

Dimmable lights will be installed to supplement only the shortfall in lux levels as determined by light sensors rather than a simple on-off function. Combined with the customised lighting circuitry that has been designed based on simulation results, this will further reduce the dependence on artificial lighting. Task lighting will complement the general overhead lighting.

Hybrid Natural Ventilation Strategy

The Woh Hup Building form and floor plate is designed to optimise cross ventilation. The building is oriented North East and South West, which will enable it to benefit from the prevailing wind directions in Singapore over the entire year. The sky gardens are strategically located to improve natural ventilation effectiveness, with ponds and water features that reduce the ambient temperature and enhance the aesthetics to create delightful and airy breakout zones and a relaxed built environment.



Sunpath Analysis.

The whole building has been designed for mixed mode hybrid natural ventilation. In particular, the general open plan office spaces, which span the width of the building, have been designed to facilitate cross ventilation as illustrated.

N and S prevailing winds.

In order to determine the extent of thermal comfort achievable and further optimise building design, Computational Fluid Dynamic (CFD) analysis has been conducted. The results of this CFD study show that average internal wind speeds of 0.4 m/s to 0.6 m/s are expected in the building. We can infer from the ASHRAE Standard (2004) that thermal comfort can be achieved for about 75 percent of a typical year in Singapore with natural ventilation.

Solar Garden

One of the objectives was to create a rooftop garden for the building's occupants to socialise and interact in, as well as providing a measure of thermal insulation, and improving the visual quality and attractiveness of the building. Another objective was to minimise the building's energy consumption by maximising the solar energy generated.

These two objectives seemed conflicting until a new type of solar modules was discovered; the innovative thin film cylindrical modules Solyndra. These modules are 50 percent open to the sky and allow light penetration and wind circulation. The Solyndra modules will be complemented by polycrystalline modules giving a total system size of 33.9 kWp and is expected to replace 12.5 percent of the buildings energy needs.

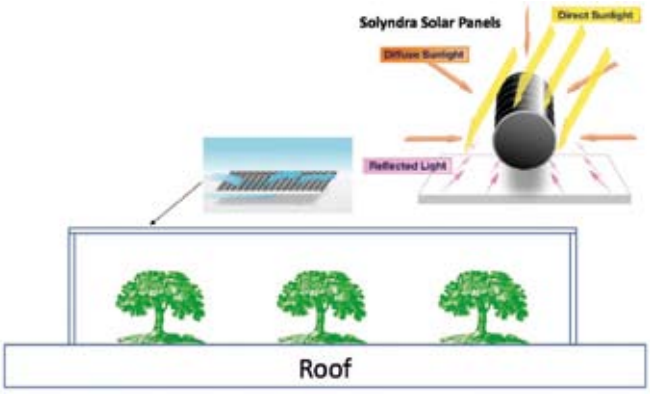
Other Green Features

In terms of energy efficiency, the low target EEI of 120kWh/m^2/yr is achieved largely due to the excellent ETTV, which helps to reduce cooling loads by 10 percent. Applying natural ventilation at all feasible areas further reduces cooling loads by another six percent, efficiency improvements to the air-conditioning system with COP of 4.67 further reduces energy requirements by 40 percent, and artificial lighting systems comprising dimmable T5 fluorescent lighting reduces energy consumption by 36.5 percent against code-compliant buildings.

In terms of water efficiency, it is targeted that rainwater and condensate harvesting and grey water recycling shall fulfil 100 percent of the non-potable water requirements for irrigation and toilet flushing respectively. All water fittings will have PUB WELS "Excellent" rating and only waterless urinals will be installed. Water sub-meters will be installed at each floor to identify possible leaks, helping to provide timely maintenance to any faulty fittings.

In terms of environmental protection strategies, Woh Hup will promote sustainable construction through the extensive use of SGLS products including carpet tiles, ceiling boards and drywall partitions as well as recycled materials.

Woh Hup's Solar Garden.



Furthermore, a high greenery provision is achieved through extensive planting at the ground level, level two and level four sky gardens and the roof garden. Woh Hup will facilitate use of public transport by providing a free shuttle service to the nearest MRT stations as well as promoting the use of the adjacent bus stop. In addition, the building will have two electrical power points for electric car charging.

Ascendas determines benchmark with The Galen

The Galen is located at 61, Science Park Road, Singapore Science Park II. The building is a six-storey office complex with a basement car park. Comprising a gross floor area of 30,729.84 sq m, the building is over 90 percent occupied and is the base for more than 20 local and multinational companies in the biotech R&D arena.

The Galen attained the Green Mark Certified Award in 2005 from Singapore's Building and Construction Authority (BCA) for its internationally recognised best practices in environmental design and performance.

The BCA Green Mark Certification is a green building rating system to evaluate a building for its environmental impact and performance. It provides a comprehensive framework for assessing the overall environmental performance of new and existing buildings to promote sustainable design, construction and operations practices in buildings.

In 2008, The Galen received the PUB Water Efficient Building certification for its water conservation system. Ascendas' office at The Galen attained Eco Office Certification by the Singapore Environment Council in 2009 for initiative and effort in implementing effective environmentally friendly practices in the office by increasing awareness amongst staff.

In 2010, The Galen achieved the Platinum Award in BCA Green Mark certification, a first in Singapore for existing buildings in the industrial category. It is also the first building in Singapore to be successfully upgraded from a certified rating to Platinum award. To qualify for this certification, the building had to meet strict criteria relating to energy efficiency, water efficiency, environmental protection, indoor environmental quality as well as incorporate other green features in its infrastructure, and demonstrates that it has achieved at least 35 percent in energy savings.

Energy Efficiency

The Galen incorporates key green features that have resulted in generating significant energy efficiency. Initiatives undertaken include investment in the upgrading of an existing chiller plant in July 2009. The new system consists of a "super efficient" chiller plant and a state-of-the-art Energy Management System with high accuracy instrumentations for monitoring and controlling of system operations.

The new chiller plant attained a total plant efficiency of 0.56kW/RT. The Galen has one of the most efficiency chiller plants in Singapore. The improved system efficiency has resulted in energy saving of 5500 MWh per year, which translate into reduction in CO_2 emissions of 2700 tonnes per year. 2700 tonnes of CO_2 are equivalent to the emissions produced by 550 cars. 70,000 trees need to be planted in order to offset this amount of CO_2.

Other features at The Galen include energy efficient lifts with VVVF controls and efficient lighting system, which also contribute to the reduction in energy consumption in the building.

Water Efficiency

The Galen has a rainwater harvesting system for irrigation, which replaced 11 percent of the monthly portable water. The building optimises water conservation through an advanced monitoring and detection system with dedicated water meters to monitor the water consumption of building users, the chiller plant and the irrigation system. Periodic analysis is conducted to identify water consumption trends and explore areas for improvement.

There is also provision for connection of NEWater supply to The Galen for its cooling towers and sanitary usage in future.

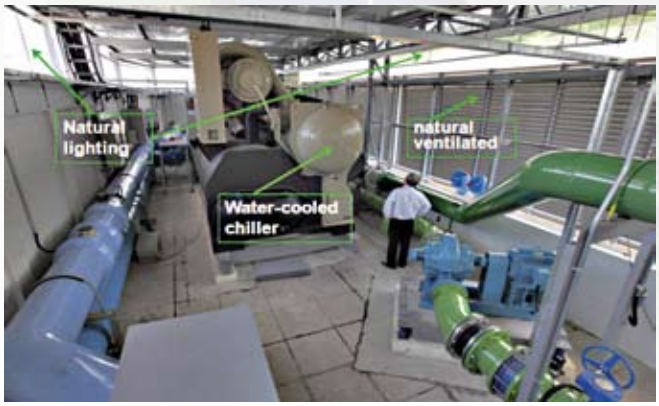
Sustainable building management

Ascendas recognises that its business has a long-term impact

on the natural environment. Its key focus is to ensure that its developments are energy-efficient and environmentally friendly, from design through to building maintenance and operations. Ascendas' Environmental, Health and Safety Handbook, M&E Design Guide, standard operating procedures were developed as reference materials to ensure good design and practices are adopted for sustainable development and operations.

The use of sustainable construction materials is a big feature at The Galen. These include workstations, which were made using between 27 percent to 66 percent of recycled materials, and the use of environmentally friendly carpets.

Tenants located in Ascendas' properties are also urged to be environmentally conscious in their business activities. Ascendas also distributes reference materials such as a renovation guide and a list of eco-friendly features to the tenants.



Ascendas employees and tenants are encouraged to embrace green practices in their daily lives to lower their carbon footprint and minimise waste. These include taking public transport, opting to use the stairs, utilising recycled paper and/or printing on both sides of a clean sheet of paper, where appropriate.

Conclusion

Extensive efforts have been taken to make The Galen the most environmentally friendly building and as the benchmark building for industrial property developers in Singapore. The Ascendas way is a holistic approach to going green, as even more environmentally friendly initiatives are rolled out to all its developments across Asia in the years to come.

Extensive efforts have been taken to make The Galen a most environmentally friendly building.

Got Sun?

We will cool your building with it.

(We can also do it with waste heat)

Our CYNERGY Solar-Thermal Air-Conditioning system pays for itself and cuts CO2 emissions*

* as long as the sun exists

Guess where's the fan coil unit?

Our Cleantech range:

Vacuum boilers
Designer fan coil units
Combined heat and power
Solar PV/wind/biomass system integration
Power saving and CO2 reduction solutions

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