Sustainable Architecture

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Inside this issue:

Walking into a Green 2009

Welcome to the very first issue of Sustainable Architecture for the year 2009!

This year, we expect more buildings to go green as more developers embark on the green journey in building more environmentally friendly buildings.

In this issue, we showcase the 43-storey Ocean Financial Centre developed by Keppel Land, which has been awarded BCA's highest accolade; the Green Mark Platinum Award. This eco-friendly office of the future adopts numerous green features that are incorporated with state-of-the-art technologies to maximise indoor environment quality, employee health and productivity, while minimising energy consumption. As a result, energy consumption is expected to be reduced by 35 percent while water consumption is expected to be reduced by 37 percent. We also interview Keppel Land's Chief Executive Officer for Singapore Commercial, Mr Tan Swee Yiow, who shares with us Keppel Land's green philosophy and shares his thoughts on going "green".

City Square Residences shows that design and going green can go hand-in-hand without compromise. The 910-unit development used mainly precast structures, as well as prefabricated items such as the Prefabricated Bathroom Units (PBU) and drywall internal partitions for the apartment units. The construction method for precasting elements eliminates the need to have conventional scaffoldings erected on the building perimeter. The PBU and drywall partitions offer a no-fuss, environmentally friendly construction process with less or no wastage and debris onsite. A Green Mark Gold Plus was conferred to the project for its green features that include energy saving air-conditioning systems, low-e glass and extensive usage of solar powered lightings for its external landscaping.

A building's sustainability starts with design, and by using the appropriate design software, will allow ideas to be experienced before they become real. Also in this issue, we introduce Building Information Modelling (BIM); an innovative method that allows architects and engineers to efficiently generate and exchange information, which in turn, creates digital representations of all stages of the building process and simulates real-world performance. Project Helios, a joint project between BCA, Autodesk and the National University of Singapore (NUS), uses BIM technology to calculate the amount of heat gained by a building through the façade.

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Sustainable Architecture is published twice a year by the Building and Construction Authority (BCA), Singapore Institute of Architects (SIA) and Trade Link Media Pte Ltd (TLM).

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City Square RESIDENCES

The spacious drop off allows for easy access into the development.

Built on a site area measuring 22379.70 m^2, City Square Residences hails as a city within a city. All the apartment units housed in six blocks are strategically designed to take full advantage of the sweeping views of the city, parks and the suburban skyline. The 910 North-South facing units of one, two, three and four-bedroom apartments vary from 28 to 30 levels. Quality exudes from the interior spaces to the outdoor facilities, from a pleasant façade to an interesting arrangement of beautifully landscaped decks, access and car parking.

The architectural language of clean, sleek, glassy façades echoes modern refrains that reflect the urban spirit. The sleek line created on the building complements the contemporary living concept of the apartments. Full height windows and glazing create a bold and dramatic statement; the glass reflecting the ever-changing skyline, lending an interesting addition to the low-rise neighbourhood. The modern glass exterior will establish the instantly recognisable architectural identity for the building, with a balance of variable storey height. Certainly, there is an air of vibrancy and ambience in the atmosphere, in the building form and in the external spaces.

From the very start of the project, very low building coverage with extensive use of greenery was envisaged. The most significant impact of the project is the achievement of said aspiration, particularly the realisation of the derived built environment in terms of a 'park setting' and the formulation and application of the planning, the architectural and landscape concepts to achieve a centre of quality and luxurious living identity. The integration and emphasis of landscape in the setting and design built forms and activity spaces ensured unified and cohesive character.

The development also uses solar heated water for the clubhouse changing room, showers & jacuzzi.

An off-white colour has been selected for the painting scheme of the residential towers' walls to reduce solar heat gain.

Extensive use of glazing has helped to diffuse the massing of the structure in chunky blocks. The precast elements and trellises are carefully integrated to blend with the glazing in order to create a new image of the building form that portrays contemporary architecture of the new millennium.

The linear towers, either placed in a row or staggered, provide an alternative façade to a massive and continuous wall of slab block.

Low E-glass is used to further minimize the impact of the western sun on these facades, thus reducing solar heat gains.

All units are provided with extensive openings, allowing natural daylight to penetrate the units.

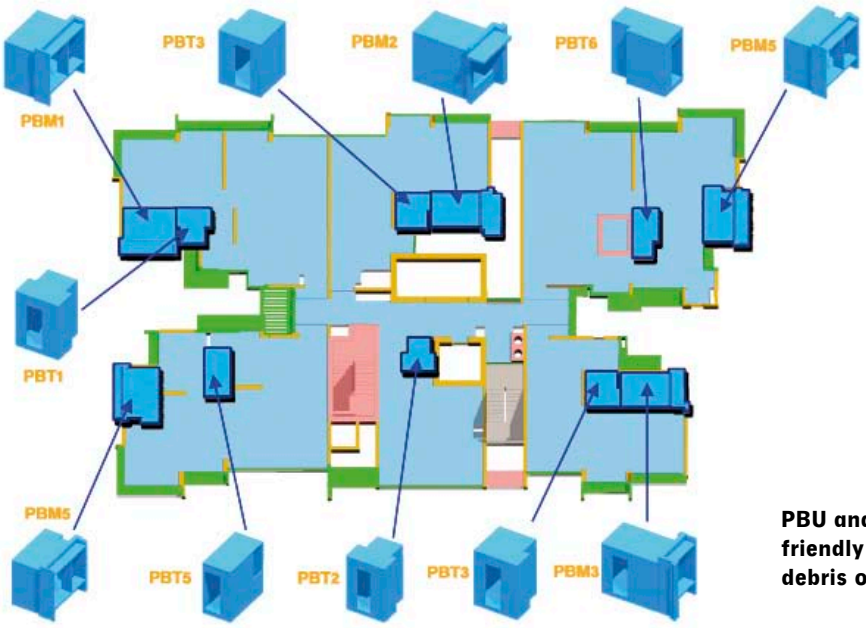
The structures were mainly precast for ease of assembling and the ability to be prefabricated offsite, in order to minimise damage on site and to ensure speedy construction. The construction method for precasting elements will eliminate the need to have conventional scaffoldings erected on the building perimeter.

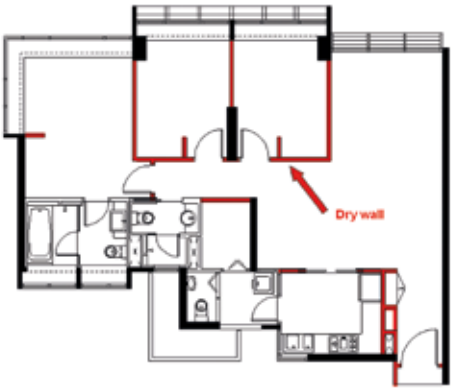
The other two key construction technologies utilised on this project are the use of Prefabricated Bathroom Units (PBU) and drywall internal partitions of the apartment units. Both methods provide a good process for control of workmanship and finishes, which, in return, minimises defects when completed. Unlike the conventional construction method, PBU and drywall also offers a fuss-free, environmentally friendly construction process with less wastage and debris on site.

The advances in glass technology can justify the fully glazed façade in this project, where low emissivity (low-E) and other energy efficient products help to engender the extensive use, even in a tropical environment, portraying the icon of modernity. Sub-meters are provided to assist in energy monitoring of the building services and the clubhouse. Individual electrical sub-meters were also provided in individual units in the electrical risers of every block to help the end users with energy monitoring.

Energy efficient lighting, such as PL lamps and compact fluorescent lamps, are provided for selected areas of the development. The KONE range of lifts within the building uses an advanced form of technology known as “Eco-Disc”, which reduces gear and electric losses, reducing energy consumption and running costs. Voids were created at the first-storey levels to eliminate the use of mechanical fresh air to Basement One, thus reducing energy consumed by the mechanical ventilation systems. The use of solar energy is practiced throughout the development, with the use of solar powered light-emitting tiles, solar powered pole lights and solar powered bollard lighting at the landscape areas.

The use of precast eliminate the need to have conventional scaffoldings erected on the building perimeter.





PBU and drywalls offer a fuss-free, environmentally friendly construction process with less wastage and debris on site

Installation of drywalls on site.

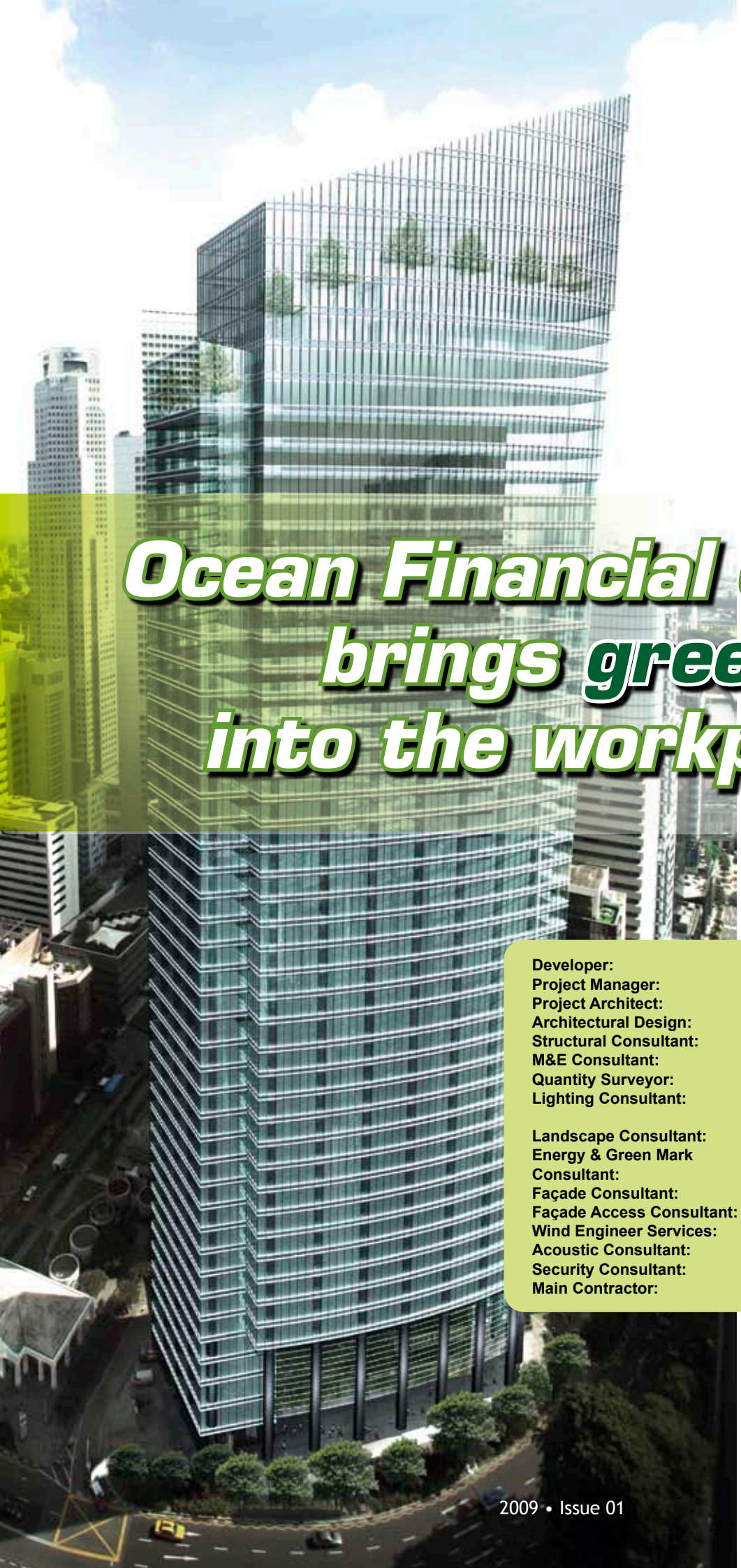
With the aim to create more green spaces, the Clubhouse Deck is converted into Rooftop Garden.

The use of canopies and ledges as sun shading devices at some of the facades reduces sun exposures in the common areas and units while still allowing sufficient natural lighting to enter the areas.

The creation of voids at the 1st storey level eliminates the use of mechanical fresh air to basement 1, thus reducing energy consumption for the mechanical ventilation system as a whole.

Motion detectors at common areas, linked to the lighting and mechanical ventilation systems, are installed with the aim to reduce energy consumption. Lighting and mechanical ventilation systems are also placed throughout the development, with individual switches and electrical circuits within units and dimmer controls and timer control lightings for common areas. Innovative designs and technologies are also adopted within the development. Water conservation practices are adopted to reduce the consumption of potable water for landscape irrigation. Recycling efforts are also encouraged with the setting up of a “Green Corner” within the building premises.

With the aim to encourage greater use of rooftop gardens or sky terraces to reduce heat and energy consumption, extensive landscaping was designed on the roof of the clubhouse and bin centre. The elevated lush greenery deck that is used in this development will ultimately reduce reflected heat. The landscape strategies were carefully considered in the early design stage, integrating the built environment and nature to resolve issues of environmental control, statutory planning parameters and privacy. The style is crafted with building architecture kept in mind so as to create a synergy that ultimately yields to an ambience that is both uplifting yet comfortable, punchy but disciplined.



Ocean Financial Centre brings green into the workplace

Developer:	Ocean Properties Pte Ltd
Project Manager:	Keppel Land International Ltd
Project Architect:	Architects 61 Pte Ltd
Architectural Design:	Pelli Clarke Pelli Architects Inc.
Structural Consultant:	T. Y. Lin International Pte Ltd
M&E Consultant:	Parsons Brinckerhoff Pte Ltd
Quantity Surveyor:	KPK Quantity Surveyors
Lighting Consultant:	Lighting Planners Associates Pte Ltd Parsons Brinckerhoff Pte Ltd
Landscape Consultant:	Tierra Design (S) Pte Ltd
Energy & Green Mark Consultant:	G-Energy Global Pte Ltd
Façade Consultant:	ALT Cladding Inc.
Façade Access Consultant:	Lerch Bates Inc.
Wind Engineer Services:	WindTech Consultants Pte Ltd
Acoustic Consultant:	Acviron Acoustics Consultants Pte Ltd
Security Consultant:	Certis CISCO Security Pte Ltd
Main Contractor:	Obayashi - Woh Hup Joint Venture

Ocean Financial Centre will enhance Singapore's nightscape while benefitting the environment with its power-saving LED lights.

Designed by the world-renowned architecture firm, Pelli Clarke Pelli Architects, in association with Singapore's own Architects 61, Ocean Financial Centre (OFC) is set to take its place in the league of other iconic commercial office developments across the globe as a cutting edge, environmentally friendly and sustainable development. The building will incorporate numerous green features, such as state-of-the art technologies, which will help maximise indoor environment quality, employee health and productivity while minimising energy consumption.

Towering 43 storeys above Raffles Place, the expression of its façade is contemporary and exciting, with a soaring glass tower that broadens as it culminates in a spectacular roof crown that will be visible during both day and night. The dramatic roof crown of OFC will be topped off with a glass-canopied roof where special office floors and multi-terraced sky gardens will occupy it. Simple yet iconic, the architecture of the building is instantly recognisable.

The dramatic roof crown with its multi-terraced sky gardens add to OFC's iconic architecture.

Main Lobby Interior View.

Green Mark Platinum Award winner

In March 2008, OFC was assessed and awarded the highest accolade the BCA has to offer; the Green Mark Platinum Award. This award recognises the design of the financial centre as an eco-friendly office development of the future that will help reduce energy consumption by 35 percent and water consumption by 37 percent.

Contributing to the energy savings are energy-efficient air-conditioning, lighting and mechanical ventilation systems, including a hybrid chilled water system, an 'ECO Switch' control programme and a regenerative drive system for the fastest elevators in Singapore. Water is saved through the collection of condensate from the air-handling units (AHU), rainwater harvesting and the extensive use of water efficient fittings.

By incorporating green features and innovations, construction costs for OFC have increased by approximately three to five percent.

Tenants can benefit from OFC's numerous green features, such as better indoor environment quality, employee health and productivity, while minimising energy consumption.

The green wall will not only help to cool the environment but enhance the surroundings with its lush greenery.

Other Green features and use of sustainable technologies

Supporting Singapore's quest for green and sustainable living, this building will also feature extensive vertical green walls for a cooler and greener environment, with lush sky gardens for occupants to enjoy nature even at their workplace.

One of the highlights of OFC, which combines contemporary architectural form, sustainable technology and safety, is the use of triple-glazed façade glass, with state-of-the-art low emissive coating to maximise light transmittance and transparency while minimising heat gain. The high-performance and low-emission triple-glazed glass curtain-wall system is not only engineered to provide maximum protection for occupants, but the unitised curtain-wall design is also prefabricated locally to minimise carbon footprint.

Another exciting feature of OFC will be the use of power-saving LEDs on the building façade and the roof crown to create an unforgettable silhouette along Singapore's magnificent skyline. The icing on the sweet cake that is OFC however, is the assembly of the largest PV system for a commercial building in the CBD area that will harness 75kWp of solar energy. Being located on top of one of the tallest buildings in Singapore, at approximately 250 m AMSL in height, it will be the highest PV assembly in Singapore, and therefore the most visible eco-feature in the country.

In addition, OFC also incorporates numerous green innovations that include:

- An integrated paper recycling facility to recycle all the paper waste generated by the commercial office
- Motion sensors for all toilets and staircases
- Insulated paints for all external walls
- Auto-condenser tube cleaning system
- Heat recovery system for hot water production
- Anti-corrosion coating for pre-cooled AHUs
- Collection of condensate water for cooling tower make-up

The west-side view of Ocean Financial Centre's main lobby.

- Car parking guidance system
- Recycling of previous Ocean Building's materials, such as plywood and timber for use in the construction of the new building
- Conservation and transplanting of existing trees and use of horticulture recycled waste

By incorporating green features and innovations, construction costs for OFC have increased by approximately three to five percent. However, the long-term benefits translate to a payback period of seven to nine years, based on the energy and water savings achieved. Keppel Land is developing OFC with important considerations of the tenants in mind. The eco-features will bring about further savings in energy and water consumption in the long term for tenants. Other intangible benefits include better indoor air quality and environment, which contribute to improved employee productivity and wellness. Increasingly, global businesses are choosing to be housed in green developments to demonstrate corporate social responsibility and awareness of the environment through their business address.

Interview

with Mr Tan Swee Yiow,

CEO of Singapore Commercial, Keppel Land International

Mr Tan Swee Yiow, CEO of Singapore Commercial, Keppel Land International, receives the Green Mark Platinum Award for Ocean Financial Centre from Mr Mah Bow Tan, Minister for National Development.

1. What inspired the start of Keppel Land's strong commitment towards environmental sustainability?

Keppel Land has always been committed to developing properties that harmonise and improve the environment, as well as the quality of the life of the community. Going green is not new to us. As early as the 1970s, we had set our properties amidst lush greenery and incorporated green features such as roof gardens in the former Ocean Building, one of Singapore's first skyscrapers.

2. Following Ocean Financial Centre, which won the BCA Green Mark Platinum Award – Singapore's highest accolade for green building, will we see more "green" developments from Keppel Land? Can you tell us more about Keppel Land's upcoming "green" developments?

Beyond developing green buildings, Keppel Land is developing modern townships in Asia, which are environmentally sensitive while our parent company, Keppel Corporation, is leading the Singapore consortium in the development of the Sino-Singapore Tianjin Eco-City. Overseas, Keppel Land's residential development, The Estella, in Ho Chi Minh, Vietnam, has recently been awarded the BCA Green Mark Gold Award.

3. In your opinion, do you see "green" buildings fully going mainstream in the near future?

With rapid urbanisation, the global thrust into sustainable development and eco-friendly living is gaining momentum. In fact, government legislation in some countries is making green developments mandatory. Businesses that are going global appreciate state-of-the-art green features such as the ones found in our Ocean Financial Centre, which benefit occupiers in terms of long-term energy savings, corporate reputation, employee well-being and harmonising of operations with that of the environment.

4. At this point, do the economic and environmental benefits of "green" buildings present a strong business case for Keppel Land to go green?

The immediate economic benefits alone will not present a strong business case to go green. However, if we take into account the long term environmental benefits such as enhancing tenants' employees well-being and performance with optimal lighting and temperature and better indoor air quality; providing a more sustainable environment for our future generations, it is justifiable to go green.

Keppel Land believes in striking a balance between economic objectives and environmental viability. We are committed in creating a sustainable environment for our homeowners and tenants through incorporating green features in our developments and will continue to do so.

5. Tell us about how Keppel Land's sustainable design philosophy achieves low energy and energy efficient tropical developments while maintaining a low "green" cost premium.

When it comes to sustainable design and development, we believe in early and efficient planning and adopting a holistic view through a multi-disciplinary approach for each development. At Keppel Land, we aim to strike a balance between economic objectives and environmental viability.

6. How does Keppel Land encourage its consultants and contractors in adopting green measures or initiatives that complement Keppel Land's green efforts? What are the challenges faced when developing "green" buildings?

We share our vision with like-minded partners, consultants and contractors who appreciate the benefits of sustainable development practices. We develop close working partnerships towards common goals. Apart from stringent guidelines leading to green certification, developers would also have to bear higher costs in the development of green buildings. However, there are real benefits of energy-savings and there is also a positive impact on occupiers and the environment to be reaped in the long-term.

7. Building owners in Singapore are beginning to "green" their existing building assets, as there is value in doing so. Does Keppel Land share similar plans as well?

We have already implemented energy efficiency and environmentally friendly features in some of our existing buildings and will be doing so progressively for other properties overseas. We have also implemented recycling programmes in our buildings. One successful example of "greening" existing buildings is that of Keppel Bay Tower. We have done energy audits and the results of the improvements have been positive in terms of energy savings and cost effectiveness.

8. Could you share a piece of valuable "green" advice for developers who are just starting to go "green"?

Firstly, instill a green culture from management to staff, from developer to consultants to contractors. Developers should also try to adopt a holistic or multi-disciplinary approach to going green and not as an afterthought. Developers must strike a balance between economic objectives and environmental viability and keep abreast of customer needs and the latest trends in green technology.

Achieving sustainable design with BIM

Sustainable design. Green buildings. BIM. Often, we hear these terms bandied about but what exactly do they mean?

Green buildings are one way of increasing efficiency in using energy, water and building materials, while reducing the building's effects on health and the environment. This is accomplished through a complete building lifecycle management that takes into consideration the location, design, operation, maintenance and relocation. It comes with practice and techniques to reduce and prevent side effects towards the environment and health.

An effective green building is supported by efforts to use environment-friendly technologies. It needs the careful and systematic conservation of the full building lifecycle and resource utilisation, as well as the isolation of pollution agents. How then does a building model after its environment? According to Denis Branthonne, Regional Director of Autodesk ASEAN, the global climate change creates a new phenomenon that impacts the building design industry, which will drive the adoption of green buildings.

Most modern, high-rise buildings around the world have begun using reusable resources such as collecting rainwater, recycling and reusing wastewater. Most architects and designers in Southeast Asia are now looking for solutions to ensure higher productivity, especially in designing environmentally friendly buildings. According to a report from the U.S., buildings consume 40 to 49 percent of overall energy, using a stunning 70 percent of electricity, 25 percent of fresh water, while releasing 38 percent of carbon dioxide. Employing smart and innovative design solutions can change statistics like these.

Most modern, high-rise buildings around the world have begun using reusable resources such as collecting rainwater, recycling and reusing wastewater.

Visualize, Simulate, Analyze – Introducing Revit

Autodesk believes that design innovation is a competitive advantage and using the right design software does allow for ideas to be experienced before they are real. Revit Architecture from Autodesk is purpose-built for building information modelling (BIM). Therefore, it mirrors the real world of buildings and helps to capture early design concepts. BIM is an innovative method that seamlessly bridges communication within the architecture, engineering and construction industries. With BIM, architects and engineers can efficiently generate and exchange information, which in turn creates digital representations of all stages of the building process and simulates real-world performance, streamlining workflow, increasing productivity and improving quality.

Green buildings are one way of increasing efficiency in using energy, water and building materials, while reducing the building's effects on health and the environment.

Bidirectional Associativity

A change anywhere is a change everywhere. In Revit, all model information is stored in one place. As a result, any information that gets changed is effectively changed throughout the model.

Parametric Components

These are known as *families* and are the basis for all building components designed in Revit. These can be elaborate assemblies such as cabinetry and equipment as well as simple building parts such as walls and columns. Most importantly, no programming language or coding is required.

Revit Architecture software has the following features:

Building Maker

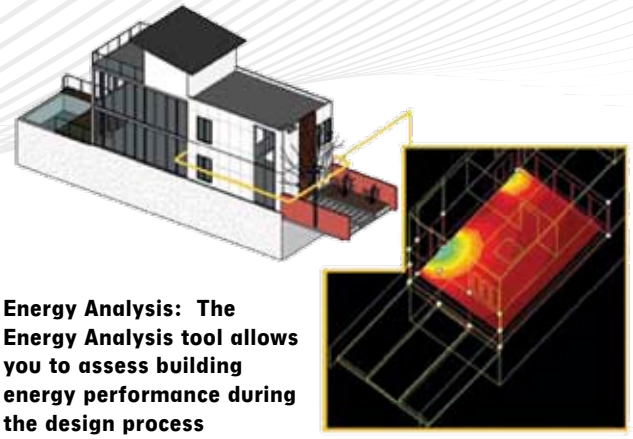
Users can access a better workflow for routine conceptual and schematic tasks. Expressive forms can be easily created to produce an overall massing study. It is also easier to import conceptual massing from applications such as form-Z, Rhino, Google™ Sketchup™ and AutoCAD® 2009 software or other ACIS® or NURBS-based applications and turn them into mass objects in Revit Architecture. Users can also select faces to design walls, roofs, floors and curtain systems. There are also tools to extract important information such as gross area per floor.

Design Visualization

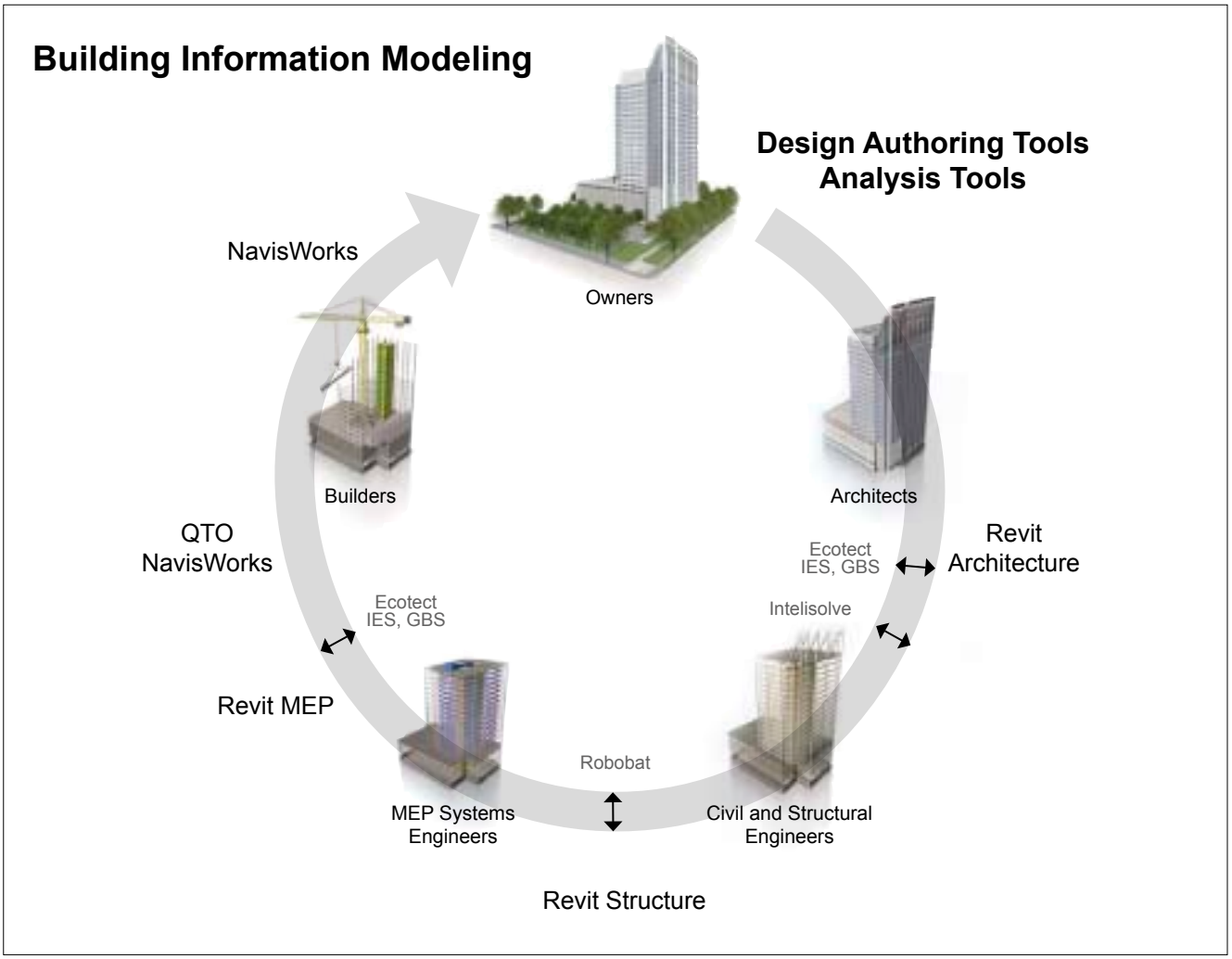
This new feature has its roots in the entertainment world; the mental ray® rendering engine. This feature enables accurate visualizations through the Autodesk ®FBX® file format and easy interoperability with Autodesk ®3ds Max® Design 2009 software.

Interface to Energy Analysis

Export building information, including materials and room volumes, to green building extensible markup language (gbXML). Users can also perform energy



Energy Analysis: The Energy Analysis tool allows you to assess building energy performance during the design process



The function of Project Helios is the calculation of the amount of ETTV and RETV that is gained by a building through the facade.

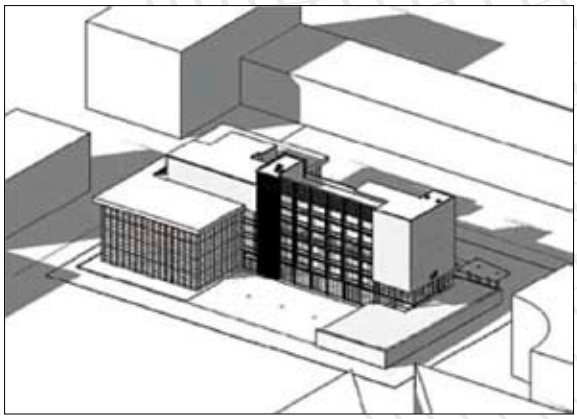
analysis and study building performance by using services from Green Building Studio, Inc and IES Ltd.

Material Takeoff

Detailed material quantities can be calculated with this tool. It is appropriate for applications such as sustainable design and for checking material quantities in cost estimates. It also simplifies the tracking of material quantities. As the project evolves, the Revit Architecture parametric change engine helps to ensure that material takeoffs are always up to date.

Sun Studies

Revit Architecture sun studies allow for users to quickly analyze sun positions and solar effects while informing and influencing design strategy. Simply choose a specific time frame to generate a still or animated sun study.

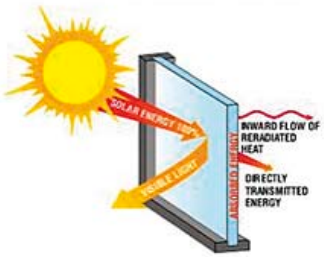


Sun Studies: You can influence design strategy by performing sun studies to quickly analyze sun positions and solar effects

Embarking on Project Helios

Project Helios is the joint Proof-of-Concept project between the BCA, Autodesk and the National University of Singapore (NUS). Project Helios is the creation of an application plug-in (module) that utilizes the building information captured within the digital building model created by commercial BIM design software; in this case, the use of Autodesk Revit Architecture software. Dr Uma Maheshwaran of NUS developed the module and Autodesk provided the BIM technology.

The function of Project Helios is the calculation of the amount of Envelope Thermal Transfer Value (ETTV) and Residential Envelope Transmittance Value (RETV) that is gained by a building through the façade. The current manual way of calculation is time - consuming, expensive and inaccurate. It is ideal that ETTV and RETV calculations be done at the onset of the design stage so that adjustments can be made and that the final outcome will be something that is impressive rather than lived with.



Scope of Project Helios

Project Helios enables architects to calculate ETTV very early in the design stage. The properties that affect ETTV are:

- Wall Orientation
  (facing north/south)
- Window/Wall Ratio
  (area of window/area of wall)
- Shading Device
  (overhang, fin, egg-crate)
- Glass Properties
  (thermal transmittance, shading coefficient)
- Wall Properties
  (thermal transmittance)

The ETTV value depends on wall orientation. The architect defines these properties; therefore making the MEP engineers' job merely a post-mortem. It is for this reason that the ETTV plug-in for Revit Architecture was conceived. This enables the architect to control the first three factors that affect the ETTV value.

The plug-in works like this:

a) The architect models the external walls of a building as he normally would by either drawing the walls or by creating the walls by Face from a mass element.

b) The walls have preset values/shared parameters that are required for ETTV calculations.

c) The user then clicks on a command from External Tools, which completes the ETTV calculations.

d) This helps the user to try various options to arrive at an optimal ETTV value, such as the orientation of the building, window/wall ration and shading devices.

The benefit of using Project Helios is that architects can accurately calculate ETTV and RETV values at a very early stage of the design. It enables quick calculation to arrive at these values, allowing architects to change and improve their design in rapid iteration, which allows them to produce better designs without incurring large amounts of overheads and time. Project Helios also allows architects to design and receive immediate feedback on the scoring based on Green Mark standards, ensuring that the best design meets the standards.

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