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### **Marina Bay Financial Centre and One Raffles Quay win awards for safety and sustainability**

**21 May 2008, Singapore** – Two of Singapore’s largest office developments, Marina Bay Financial Centre (MBFC) and One Raffles Quay (ORQ), have featured strongly in the latest Building and Construction Authority (BCA) Awards, proving that large scale developments can lead the way in safety and sustainability, said the joint venture consortium behind the two mega developments.

MBFC Phase 1 (Commercial), comprising of two towers with more than 1.6 million square feet (154,000 square metres) of prime Grade A office space, has been bestowed the BCA Green Mark Gold Award, following a similar award in May 2007 for Marina Bay Residences, also within the development.

ORQ, with its distinctive twin towers totaling 1.29 million square feet (120,000 square metres), garnered one of the BCA’s inaugural Design and Engineering Safety Excellence Awards recognising the numerous technical and safety challenges successfully addressed in this unique project which straddles the North-South MRT Line and incorporates a massive District Cooling System.

MBFC and ORQ were both developed by Cheung Kong (Holdings), Hongkong Land and Keppel Land (with Hutchison Whampoa sharing part of Cheung Kong’s interest in MBFC), although ORQ has since been sold to Hongkong Land and REITS associated with Keppel Land and Cheung Kong.

MBFC General Manager Wilson Kwong, said the awards affirm the feasibility for developers to offer safer and more sustainable developments even on a grand scale.

“These awards are further testaments to our efforts to deliver world-class and sustainable developments creating the best possible environment for live, work and play,” Mr Kwong said.

For MBFC Phase 1 (Commercial), the developers have employed construction techniques which will save 240,000 cubic metres of water (the equivalent of 117 Olympic-sized pools) as well as a host of energy conservation features including an energy efficient glass curtain cladding system, energy-saving air-conditioning, lighting and lift systems.

Mr Kwong added, “Apart from the green technology employed, more than 35% of the total land area will be landscaped, creating relaxing surroundings for tenants and cooling our urban environment.”

Future tenants of MBFC, such as Standard Chartered Bank (SCB) which will anchor Tower 1, have welcomed the benefits of an environmentally-friendly building.

“Relative to other sectors, SCB’s direct environmental impacts are small but the Bank is committed to minimising them. The Bank seeks to reduce carbon emissions and paper consumption, and monitors its operational impacts through our Global Environmental System, which is modeled broadly on ISO 14001. So environmental performance was definitely an important factor in choosing MBFC as the location for our global businesses,” said Mr Steve Riley, Project Director, Standard Chartered Bank Singapore Relocation Projects.

“We are committed to safety and sustainability in the built environment and will apply our experience as MBFC progresses towards completion of Phase 1 in 2010 and Phase 2 in 2012,” Mr Kwong concluded.

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For information, please contact:

Marina Bay Financial Centre  
Piet de Jong  
Baldwin Boyle Shand Limited  
DID: (65) 6230 5117 • HP: (65) 9830 7311  
Email: [piet.dejong@bbspr.com.sg](mailto:piet.dejong@bbspr.com.sg)

**About the BCA Green Mark Awards**

The Green Mark Award scheme operated by Singapore’s Building and Construction Authority is intended to promote sustainability in the built environment and raise environmental awareness among developers, designers and builders when they start project conceptualisation and design, as well as in construction and building management. Please see [http://www.bca.gov.sg/GreenMark/green\\_mark\\_buildings.html](http://www.bca.gov.sg/GreenMark/green_mark_buildings.html)

**About the BCA Design and Engineering Safety Excellence Awards**

The Award is aimed at recognising projects that have been successful in overcoming various challenges to ensure safety in design, construction and maintenance of a building/civil engineering project through the adoption of innovative design processes, measures and solutions. Please see [http://www.bca.gov.sg/others/Design\\_Engineering\\_Safety\\_Excellence\\_Award.pdf](http://www.bca.gov.sg/others/Design_Engineering_Safety_Excellence_Award.pdf)

**About Marina Bay Financial Centre**

Marina Bay Financial Centre is being developed by a joint venture by three of Asia’s most experienced and trusted property developers – Cheung Kong (Holdings)/Hutchison Whampoa, Hongkong Land and Keppel Land.

The Consortium will manage the development of the prime waterfront 35,500 square metre site in the heart of Singapore’s new downtown, including best-in-class office space, high-end residences and complementary retail and recreational facilities. The same joint venture partners developed the adjacent One Raffles Quay, now tenanted by leading global financial institutions. Please see <http://www.mbfc.com.sg>

### **About One Raffles Quay**

One Raffles Quay (ORQ) is developed by One Raffles Quay Pte Ltd, a joint venture of three of Asia's most experienced and trusted property developers – Cheung Kong (Holdings), Hongkong Land and Keppel Land. ORQ comprises of two office towers totaling 1.29 million square feet (120,000 square metres) of office space. The 29-storey South Tower has 18 office floors, with a typical floor area of 30,000 square feet (2,900 square metres), while the 50-storey North Tower has 42 office floors with a typical floor area of 18,000 square feet (1,700 square metres). ORQ was designed by Kohn Pedersen Fox Associates (KPF) and is now owned by Hongkong Land, and REITS associated with Keppel Land and Cheung Kong (Holdings).

### **About Cheung Kong (Holdings)/Hutchison Whampoa Limited**

Cheung Kong (Holdings) Limited is a property development and strategic investment company based in Hong Kong. It is one of the largest property developers in Hong Kong, having developed about one in twelve private residences in the territory. The company also owns a large portfolio of commercial, residential and industrial premises in Hong Kong, and is a major developer of the Central District.

In Singapore, Cheung Kong's residential property portfolio includes Cairnhill Crest, an oasis of tranquillity ensconced in prime district 9, and Costa del Sol, a prestigious east coast marine-themed development.

In terms of commercial property, the Company developed One Raffles Quay in its first joint venture with Keppel Land and Hongkong Land in Singapore.

Cheung Kong is a substantial unit holder in Fortune REIT – which holds eleven retail malls in Hong Kong and was listed on The Singapore Exchange in August 2003 – with a 26.92% stake.

### **About Hongkong Land**

Hongkong Land is one of Asia's leading property investment, management and development groups. Founded in Hong Kong in 1889, the Group has business interests across the region. Hongkong Land's business is built on partnership, integrity and excellence.

In Hong Kong, the Group owns and manages some five million sq. ft of prime commercial space that defines the heart of the Central Business District. In Singapore, it is helping to create the city-state's new Central Business District with the expansion of its joint venture portfolio of new developments. Hongkong Land's properties in these and other Asian centres are recognised as market leaders and house the world's foremost financial, business and luxury retail names.

Hongkong Land also develops premium residential properties in a number of cities in the region, not least in Singapore where its 77%-owned listed affiliate, MCL Land, is a significant developer.

Hongkong Land Holdings Limited is incorporated in Bermuda. Its primary listing is in London, and its shares are also listed in Bermuda and Singapore. The Group's assets and investments are managed from Hong Kong by Hongkong Land Limited. Hongkong Land is a member of the Jardine Matheson Group.

**About Keppel Land Limited**

Keppel Land Limited is the property arm of the Keppel Group, one of Singapore's largest multi-national groups. The Company is one of the largest property companies by total assets on the Singapore Exchange.

As an established developer of premier residential properties and investment-grade commercial properties, it is geographically diversified across 11 countries in Asia Pacific.

Keppel Land is a major office landlord with a quality portfolio of prime office towers located mostly in Singapore's Central Business District.



## **BCA Green Mark Gold Award for MBFC Phase 1 (Commercial) FACT SHEET**

- MBFC Phase 1 (Commercial) will be conferred the BCA Green Mark Gold Award on 22 May 2008.
- MBFC Phase 1 (Commercial) consists of:
  - Tower 1 (33 storeys, approx 57,763 square metres or 620,000 square feet of Net Floor Area)
  - Tower 2 (50 storeys, approx 95,947 square metres or 1,030,000 square feet of Net Floor Area)

### KEY ENVIRONMENT-SAVING FEATURES

- **Environmental Management System for the construction process**
  - Main contractor and consultants are ISO 14000 certified
  - Specific environment management programme for the Piling Contractor (Tiong Seng Contractors (Pte) Ltd)
  - Separation of sand and marine clay from boring operation
  - Recycling of steel waste
  - Use of Geo-polymer as a stabilizing fluid for bored piling operation
  - Segregation of wastes for incineration and recycling
- **Environment conserving features and systems**
  - Use of an energy efficient curtain-wall glass cladding system for an overall building Envelope Design that delivers low Energy Thermal Transfer Value (ETTV) and a high Energy Efficiency Index (EEI); both of which meet with BCA requirements.
  - Use of paints with low Volatile Organic Compounds (VOC) that are not hazardous to human and environmental health

- Environmental features incorporated into MBFC amount to a total savings of 22.5 percent of the total energy bill such as use of energy efficient lighting, air-conditioning, lifts and escalators and extensive use of private metering to monitor energy use.
- Use of the District Cooling System (DCS) to provide efficient air-conditioning maintained at 23.5 degrees Celsius, plus or minus one degree.
- **Extensive provision of green space**
  - 36% of the total land area of 20,505 square metres or 2,200,000 square feet has been allocated to “green spaces” to reduce urban heat and energy consumption through roof-top gardens, landscaped plaza and planting zones between Tower 1 and 2.
- **Water conservation**
  - Taps in the building are fitted with self closing systems and flow regulators to monitor leaks, while sea water is used for in early stages of the piling work, calculated to save 240,000 cubic metres or the equivalent of 117 Olympic-sized pools worth of potable water during construction.
- **Other innovative features included in the design are:**
  - Ductless car park mechanical ventilation system with Carbon Monoxide (CO) sensors
  - Provision for connection to the Central Pneumatic Waste Collection System via the Common Services Tunnel (CST)
  - Solar powered aircraft warning light on the roof
  - Use of car park guidance system to reduce parking time and save emissions etc.
- **Indicative savings**

Environmental features incorporated into MBFC have been calculated to reduce the annual energy bill by 22.5% compared to a standard office development of the same scale, that comply to building codes on Energy Conservation. Examples of individual savings include:

- Motion sensor lighting control installed in the toilets will bring an estimated savings of \$30,000 per year on power consumption
- Installation of heat recovery wheel savings worth \$46,000 per year on energy consumption
- Use of LED lights for EXIT signs and main lobby saving \$21,000 per year on power consumption
- Usage of sea water for ground improvement works bringing in a massive \$280,800 worth of savings on water consumption.
- **Energy Audit**
  - Energy Audit Specialist, Genergy Global Pte Ltd has been engaged to conduct an energy audit using energy simulation software.

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23 May 2008

## **One Raffles Quay BCA Design and Engineering Safety Excellence Awards 2008 Background**

One Raffles Quay (ORQ) was conferred a Design and Engineering Safety Excellence Award 2008 from Building and Construction Authority (BCA) on 22 May 2008.

The award recognises ORQ and its Mechanical & Electrical (M&E) engineers Meinhardt (Singapore) Pte Ltd. for implementing innovative features coupled with safety, construction methods and economy in the design of ORQ that was an engineering and technical achievement, given the site challenges.

### **1 Building overview**

- ORQ consists of two office towers with total gross floor area (GFA) of 214,000 square metres. North Tower ascends to 50 storeys high and South Tower to 29 storeys.
- Facilities include an underground retail and pedestrian link tunnel to Raffles Place subway station, two basements, above ground car-park floors, vehicular and pedestrian drop-off points, covered and open public plazas and various other public amenities.
- Singapore's first commercially applied District Cooling System (DCS) spaces, landscape
- The column free floor plates of each tower are tailor-made for the financial services industry and are equipped with state-of-the-art architectural, M&E, IT and intelligent building features.
- ORQ was developed by Cheung Kong Holdings, Hongkong Land and Keppel Land.

## **2 Construction challenges**

- The presence of existing twin Mass Rapid Transit (MRT) subway tunnels at an angle of approximately 30 degrees through the northern portion of the site, directly beneath the proposed North Tower.
- The extremely soft sub-soil conditions and deep layers of consolidating marine clay, with underlying variable strength bouldery clay.
- The medium-rise South Tower posed a challenge to accommodate the large column free floor plates tailor-made for the financial services industry.

### **3 Structural solutions**

#### **North Tower**

- The safety of construction and of the MRT tunnel operations were the prime considerations of Meinhardt, as well as to minimise building weight, devise transfer solutions for the central core walls and perimeter columns, and plan a foundation system to fit within the restricted space of the development boundaries.
- The unique transfer solution - the first in the world for a building of such height – was devised utilising the central core to act as a transfer structure. The transfer of the east and west perimeter columns of the tower was achieved through mega steel trusses and raking columns on each side of the MRT tunnels.
- For the floor system of the tower, composite steel-concrete floor system was selected due to the key considerations of safety, minimizing building weight, structural efficiency and cost-effectiveness.
- Wind loads were also an important consideration for the 50-storey North Tower. Excessive sway and acceleration levels were controlled through the adoption of a rigid lateral load resisting system comprising of concrete core, perimeter concrete filled steel tube columns, two levels of outrigger trusses and floors acting as diaphragms.

#### **South Tower**

- Concrete was adopted in the flooring of South Tower as opposed to steel-concrete system used for North Tower, its conventional strength and serviceability demands. It is also necessary to control floor vibrations - a critical consideration for long span floors serving busy offices and trading floors.

### **4 Foundation and basement system**

- The main sub-soil layers in the site geology consisted of 2 metres to 20 metres of reclaimed land, underlain by 5 metres to 30 metres of marine clay, followed by bouldery clay (a highly variable material with boulders in a stiff clay matrix). Large diameter piles were bored through the bouldery clay which was implemented through careful quality control and safe construction methods.
- The basement and foundation system was designed to ensure that the structural integrity of the tunnel is not compromised. The success of the adopted design and construction was reflected in the final measured cumulative movement of the MRT tunnels which was around 15mm limit (specified in the Code of Practice for Railway Protection)

## **5 Risk Analysis**

- Detailed risk analysis related to equipment planning and mobilisation, excavation methodologies and steelwork installation was carried out at various stages of the construction process.
- Comprehensive instrumentation and monitoring were implemented to detect problems early and fully executable contingency plans were put in place to mitigate the risks.

## **6 Safety and protection**

- To verify the feasibility of the design concepts, an extensive structural analysis and parametric studies were carried out using three dimensional computer models and software programmes.
- For the first time in Singapore, permanent shielding walls were constructed adjacent to the MRT tunnels to ensure safety and protection during construction.
- Also implemented for the very first time was a comprehensive instrumentation regime for close monitoring of the ground, MRT tunnels, retaining walls and tower movements to ensure full safety during construction.
- For construction of the underground pedestrian mall linking the development to Raffles Place MRT station, massive traffic diversion was required at one of Singapore's busiest streets, i.e., Raffles Quay / Collyer Quay. This was successfully completed through carefully controlled and progressive lane diversions without any negative public feedback.