The Global Seed Vault

This must be one of the most extraordinary activities at the service of mankind, and it was made possible also thanks to the contribution of Mapei. Inaugurated on 26th of February 2008 on the Svalbard Islands in Norway, the largest phyto-genetic bank in the world, the Global Seed Vault hosts examples of unique varieties of the world's most important flora. According to Jacques Diouf, Director-General of the FAO (Food and Agriculture Organisation of the United Nations) who inaugurated the complex, the gene bank offers "a guarantee, on a world-wide level, to face up to the challenges of the future".

Because of the task it must carry out, the inviolability it must guarantee and its universal value, it evokes legendary and memorable construction, such as Noah's Ark and the Pyramids. To those who are watching science-fiction films, it is similar to a docking station for space ships, or ice-bound headquarters of Spectra, the organisation against which the most famous secret agent of all times, James Bond, has been battling for more than 30 years.

The construction of the complex was financed by the Norwegian government. According to the FAO, the world gene vault "is essential to increase the productivity of the crops, to reduce the effect of climate change and the spread of diseases and parasites, and to guarantee a supply of genetic resources for the future. The Svalbard gene bank will receive about 200,000 types of seed, although its capacity is of around 4.5 million samples, for a total of around 2 billion seeds.

MAP: Laris Karklis, The Washington Post

The Contribution of Rescon Mapei

Mapei has also contributed to this important project which is destined to challenge the onset of time, through the Norwegian subsidiary Rescon Mapei AS. In fact, the bank was created mainly to face up to the future challenges of climatic changes. The job of building in the permafrost was quite a challenge, which Rescon Mapei approached by using innovative products designated by the group especially for extreme climatic conditions.

The structure is made up of three underground chambers, reinforced with special concrete. The temperature of the materials was one of the most difficult challenges which requires a series of high technology solutions and really special products. But let's look more into technical details to try and grasp the real importance of this work and who are the leading players.

Description of the works:

- The total area of the seed vault is approximately 1,000 m^2
- The entire complex has been built underground in the permafrost and has a constant temperature of approximately -3/-4 °C. Permafrost is a phenomenon which consists in the perennial freezing of the ground, and means exactly this: a territory where the ground is permanently frozen.
- The place is around 130 meters above sea level and considers all possible scenarios of a rise in the level of the oceans, caused by global climatic change.
- The complex has been built so deeply into the mountain that any kind of climatic variation on Svalbard, as far as current experiences and knowledge is concerned, will have no effect on the thermal sealing effect of the permafrost. In fact, the temperature will remain stable even if there are technical problems for short periods, such as black-outs.
- The external half of the entrance tunnel is made up of a steel tube with a diameter of approximately 5 meters. This tube goes through the layer of snow, ice and loose rock, right up to the heart of the mountain. The method of excavation which was used was Norwegian conventional method of drill and blast.
- The rock is supported by shotcrete and rock bolts. The rock bolts are 6 m long by 25 mm in diameter. The bolts are anchored with rock bolt mortar. The permafrost helps to maintain stability, however during the construction period, the local zones surrounding the tunnel is slowly being defrosted.

The Commitment of Mapei technicians

When shotcrete is used, it is important that the internal temperature of the materials is taken into consideration, while development of the mechanical strength depends on the chemical reaction among the cement, water and alkali-free setting and hardening accelerators. In those areas where the quality of the rock is quite good, it is not necessary to apply large thicknesses of concrete, and a 8-10 cm layer is usually sufficient. On Spitsbergen, there are no mixing plants, and all the concrete had to be mixed by a local contractor Leonhard Nilsen & SØnner AS.

Rescon Mapei was involved in this phase from the very start, to find the most suitable solutions and to supply a ready-to-use, dry mortar in order to make on-site spraying operations. A new product, RM SPRØYTEBETONG* was developed specially for these requirements. This dry mortar, which is supplied in 1,200 kg big bags, was formulated on the basis of a typical Norwegian shotcrete using 470 kg of cement per cubic meter.

The cement selected for this application was one which is widely known for its quick-setting characteristics. The mortar production plant in Rescon Mapei has different sand grain size, with maximum size of 4 mm. However, a normal Norwegian shotcrete has an aggregate size of up to 8 mm. Therefore, aggregates 4-8 mm was supplied in addition.

Apart from dry mix, Rescon Mapei also supplied admixtures and an alkali-free accelerator. The admixture used for the concrete was DYNAMON SX-N*, a superplasticizer of the latest generation. It is characterized by a high capacity to reduce the amount of mixing water required.

The concrete was mixed with hot water in combination with rapid cement to obtain a higher initial temperature and reactivity with accelerator. This is why a retardant was used: MAPETARD SD-2000*, liquid admixture for concrete. During spraying, a setting accelerator admixture is added. In this case, MAPEQUICK AF-2000* alkali-free set accelerator for shotcrete was used. When using this product, the retarding effect of MAPETARD SD-2000* is neutralized by the alkali-free accelerator.

Reinforcing the Permafrost

Rock bolting in permafrost is a hard task, because the temperature is constantly below freezing point. Rescon Mapei has designed a system for anchoring rock bolts at temperature as low as -25°C. For this particular job, a mix of products was developed, with the aim of optimizing the balance between mixing times and workability. In particular, a mix of NONSET 120FF* and ZINKBOLT* pre-blended mortar was proposed.

In the autumn of 2007, excavation of the tunnel was completed. The entire concrete surface was treated with a layer of MURTETT*, a special cementitious coating produced by Rescon Mapei, which is used for both protective and decorative purposes. It is available in two colors, white and gray, and the white version was chosen for this project.

MURTETT* is a cementitious product which does not contain any anti-freeze agents. The product may be applied by hand or by spraying and, for this operation, the latter method was chosen. In this case, spraying the materials on frozen concrete was a critical process. Because no accelerator could be used in the spraying process, due to risk of color change, there was a risk of getting problems with frost in the fresh product. In order to avoid it freezing before hardening, the tunnel system was divided into sections, and each one was heated to make sure that MURTETT* do not freeze during the first hours.

This work was the result of the commitment for research and development of a complete range of specific products, and the dedication of the team members which unite professionalism and experience. Which is why, once again, Mapei offered its services as a problem solver, to contribute in helping to make what man creates durable over time.

*Mapei Products: the products mentioned in this article belong to the "Admixtures for Concrete" and "Products for Underground Constructions". The technical data sheets are available on the "Mapei Global Infonet" DVD and at the website www.mapei.com

Source: Realtà Mapei International 25

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YTL Singapore, Successful Ready-mixed Concrete Supply to One Million Cubic of Concrete

Singapore's Integrated Resort Project at Sentosa Island

Construction of Integrated Resorts in Singapore

In April 2005, the government of Singapore announced the Cabinet's decision to develop two casinos and associated hotels and malls in Marina South and Sentosa, with the aim to boost the tourism industry in Singapore. Intensive public debates took place; however, the decision had been reached by the time the general elections were held in May 2006. The government of Singapore called for a request-for-concept (RFC) for the development of the casinos in December 2004. Through a bidding process, Las Vegas Sands was confirmed as the developer of the Marina IR Project in May 2006, and Genting International & Star Cruises consortium was confirmed for the Sentosa IR Project in December 2006.

Resorts World Sentosa is the first integrated resort to be built in Singapore with a vision of large- scale family resort with its host of world-class family leisure attractions. The key attractions include one of Singapore's two casinos, six hotels with more than 1,800 rooms, Southeast Asia's first Universal Studios theme park, the world's largest oceanarium as well as shopping and dining facilities. The S$6.59 billion- (US$4.93 billion) integrated resort is developed by Genting International. This mammoth resort occupies over 49 hectares (121 acres) of land, and when fully open, will directly employ more than 10,000 people.

The soft launch of the first four hotels took place on 20 January 2010, with the Festive Walk shopping mall following on 1 February 2010. The casino opened on 14 February 2010, the first auspicious day of the Chinese New Year. The opening of Universal Studios Singapore followed on 18 March 2010.

The West Zone of the Project, which includes two hotels, Marine Life Park, Maritime Experiential Museum, Equarius Water Park and ESPA, is still under construction. The whole facility is expected to be completed in 2011.

Construction of the Sentosa IR Project

Many contractors are involved in the mammoth project construction. However for the ready-mixed concrete supply, YTL Concrete (S) is the sole supplier of the project throughout the entire period of construction.

The delivery of the ready-mixed concrete has started since August 2007 from YTL Concrete batching plants installed at the project site. Approximately 1 million m^3 of concrete have been supplied to the Sentosa Project to complete the major part of facilities. The total quantity of concrete is estimated to be approximately 1.2 million m^3, when the West Zone construction is completed by the end of 2011.

To ensure a substantial quantity of concrete supply, cement (OPC) has been sourced from Ube-Mitsubishi Cement, Japan, by shipment; ground granulated blast furnace slag (GGBS from Japan) from Slag Cement (Southern) Pasir Gudang Plant in Johor Malaysia by truck lorries; and coarse aggregate, and fine aggregate (M-Sand / Manufactured sand) from granite quarries of Batu Tiga Quarry in Malaysia, to be directly delivered to the project site by barge.

In January 2007, just before the project started, Singapore construction industry encountered quite a serious shortage of aggregate supply problem due to the sudden ban of natural sand supply from Indonesia. Most alternative sources of natural sand, where their quantity, as well as the quality, was inconsistent due to the different sand sources and the concomitant instability in the supply, however, YTL Concrete (S) was able to ensure a stable supply of fine aggregate (M-Sand / Manufactured

sand) and coarse aggregate with a stable quality throughout the entire construction period of the Project. YTL has, therefore, contributed to the smooth progress of the construction work.

The concrete batching plant installed at the project site was equipped with a wet-type twin shaft mixer with a mixing capacity of 3.0 m^3 per batch. Two batching plants were installed at the first and one additional plant was operated during the peak concrete supply period to cater for the huge demand – ranging from 3,000 to 4,000 m^3 of continuous concrete-pour in one cast. Approximately 40 truck-mixers with a capacity of 9.0 m^3 were arranged during the peak period.

Some Significant Issues

1. **Concreting of Thick Sections**

Substantial quantity: approximately 300,000 m^3 of mass-concreting for thick concrete was cast in the project for concrete sections exceeding 500 mm of thickness such as raft, base slab, roof slab, walls pile caps and footings. The thickness of the raft foundation slab was 1.2 metre to 3.5 metre.

Seventy percent of ground granulated blast furnace slag (ggbs) was used in the total cementitious material in the concrete mix. The main concrete grade was Grade 45 and some of the structures required waterproofing performance for pools, water-features, retaining walls, etc.

The major requirements and measures taken for the concreting of thick sections are listed as follows:

- Fresh concrete temperature at the placement was specified not to exceed 33 deg. C; and actual temperature at the concrete batching plant was controlled at 30 deg. C and below by using chilled water and flaked ice combination.
- The temperature differential between the warmer interior portion and the cooler surface of the thick element was specified not to exceed 27 deg. C, or allowable difference to prevent early thermal cracking due to the heat of hydration.
- The maximum temperature within any part of the structure was specified not to exceed 70 deg. C.
- The rise in temperature within a period of 30 minutes was specified not to exceed 10 deg. C, and the rate of subsequent cooling not to exceed the rate of heating.
- Contractors employed effective means such as insulation, the selection of appropriate pour cycle times and construction joints to prevent early thermal and shrinkage cracking.
- At all the mass-concreting, the initial placing temperature of concrete was measured by inserting a calibrated probe-type thermometer by an independent testing laboratory.

With close monitoring of the initial temperature and inspection at the hardening stage of all the mass-concreting structures, we have so far found neither early cracking, nor defects caused by the heat of hydration.

2. The use of 100 % M-Sand in the Fine Aggregate Content of Concrete

M-Sand /Manufactured sand is a processed crushed-sand produced at our granite quarries. Throughout the entire construction period of the Project, YTL Concrete (S) has used 100 % of M-Sand. YTL applies Vertical Shaft Impact Crusher (hereafter, VSI) for the production of M-Sand together with coarse aggregate in the granite quarries of Batu Tiga Quarry Sdn Bhd, Malaysia.

The features of aggregate quality produced by VSI are quite different from the aggregates produced by conventional type crushers: well controlled particle size distribution and improved particle shape by its re-shaping function.

The Sentosa IR Project is the first and mega project where VSI aggregates (fine & coarse aggregates) were used for the entire project period. This is a remarkable event in the history of construction industry in Singapore. The use of VSI aggregates (fine & coarse aggregate) will be of an advantage for special concrete castings such as high- performance concrete and difficult pumping concrete, where consistent quality of aggregates are required to achieve workable, stable setting and strength development of the concrete.

Before the introduction of aggregates

produced by VSI process, the shape of commonly used coarse aggregate & fine aggregate in Singapore is not rounded, and is quite irregular and contains a lot of flaky particles. The particle distribution of natural sand is quite inconsistent; some are very fine and the others are very coarse, and sometimes contain organic impurities depending on the source of the natural sand supply.

The common alternative fine aggregate replacement, is quarry dust, which is a by-product obtained during the crushed aggregate production process (production of coarse aggregate only), and therefore the quality of the quarry dust is quite inconsistent. The source of fine aggregates (after the natural sand ban from Indonesia), for both the natural sand source, and, quarry dust, are not stable enough to ensure sufficient supply to the construction industry.

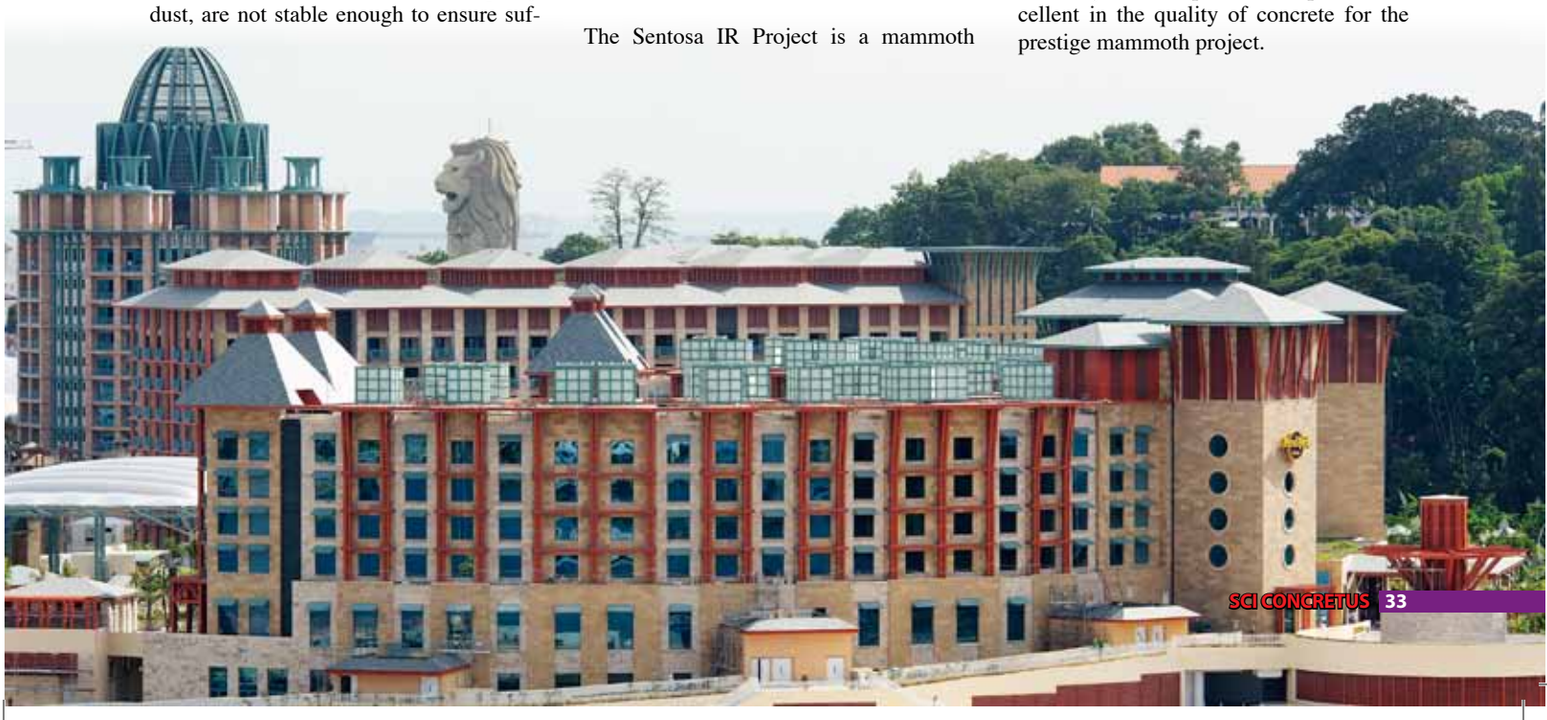
Recently, the Building and Construction Authority (BCA) encourages the use of crushed rock sand as a substitute for natural sand in concrete. BCA also currently shows strong interest in the use of 100 % M-Sand in concrete.

Before the introduction of 100 % M-Sand use in concrete, YTL had conducted substantial laboratory trials to find out suitable admixtures for the purpose and had also established a set of optimized mix designs for the Sentosa IR Project. The mix designs were adjusted to actual operational conditions in Singapore.

Concluding Remarks

The Sentosa IR Project is a mammoth project in the construction history of Singapore, and YTL Concrete (S) has significantly contributed to the successful progress of its construction with support from business partners. These partners are the materials suppliers of cement, ggbs, aggregates and admixtures from the YTL Group companies, as well as from external suppliers and their distributors.
Credit should also go to the transportation companies and sub-contractors, and the YTL technical advisory team and laboratories.

The Sentosa IR Project is an exemplary case which points to the future direction whereby M-Sand will replace natural sand as the major source of fine aggregate. The use of M-Sand and coarse aggregate produced by the VSI-process has proven excellent in the quality of concrete for the prestige mammoth project.



WAK - A Better Alternative

WAK have been involved with the KLCC Lot 171 since late July 2009 and engaged directly by the Project Developer KLCC Sdn Bhd to provide QA / QC services encompassing the maintenance of consistent concrete performance. There was a major concern with the inconsistency in performance of concrete being delivered to site. Statistical Analyses on compressive strength test result indicate standard deviation prior July 2009 was at around 8 - 10 N/mm2. From August 2009 onwards, since the involvement of WAK Consultants the inconsistencies were brought under control with standard deviation at lower than 4 N/mm2 for Grade 75 concrete.

The project was managed by Mr Tony Yap, Technical Advisor for High Performance Concrete at WAK Consultants Pte Ltd who designed a program involving a complete batch plant audit, including on equipment, materials / mix designs and processes to identify problem areas.

Proposals to address the identified challenges were made in consultation with the concrete producer to ensure the proposals are achievable within the resources available to the producer. Where minimum requirements are identified and these are not available, the concrete producer was required to invest in the necessary infrastructure.

One major deficiency identified was in the processing and handling of the densified powdered silica fume used in the incumbent designed mix. It was found that the dosing of the material into each batch of concrete was inconsistent resulting in certain concrete batches produced without the proper and full dose of material. This of course then affected the plastic state properties of the concrete tremendously leading to inconsistent performance both in the plastic and hardened state of the concrete.

A reactive microsilica fume suspension, Centrilit Fume SX* was proposed as an alternative to the powdered silica fume. Centrilit Fume SX is made from undensified silica fume allowing the full surface of each particle to be available for reaction. This leads to a remarkable performance efficiency allowing major reductions in dosages as compared with densified silica fume for the same performance.

The material in a suspension form also allows for easy dispersion within the concrete mix and reduces energy requirements to achieve a uniform mix, saving time and energy consumption for the concrete producer. In the bigger picture, the reduction in energy consumption also contributes to worldwide efforts to reduce greenhouse gases effects on the environment.

Also because the material is in a suspension form, air pollution is greatly reduced as the dusty environment associated with handling powdered densified silica fume is eliminated.

With an automated dispenser system linked to the batch computer, a full record of dosages is possible thus ensuring a consistent concrete is produced.
All in all, the introduction of Centrilit Fume SX as an alternative to the powdered densified silica fume meant a win-win situation for all parties as

1. The Project Consultants and Contractors received a highly consistent concrete mix on site;
2. The Concrete Producer experiences lower energy consumption with a much higher mixing efficiency and productivity;
3. The Concrete Producer also experiences less wear and tear on the batch mixer; and
4. Because of the higher productivity at the batch plant, the Contractor was able to take delivery of the concrete in a timely manner.

WAK Consultants has since become an integral part of the team for the project where experienced personnel are deployed at the batch plant and site during casting of concrete to assist with monitoring and troubleshooting concrete issues that may from time to time arise.

A monthly concrete quality review meeting is also conducted to ensure all parties are kept up to speed on all issues related to concrete quality whether resolved on the ground level at the time it happens or perhaps issues that may require a systematic approach which WAK typically will propose solutions for.

** Centrilit Fume SX is a highly reactive microsilica fume suspension available from MC Bauchemie*

Ready Mixers help to waterproof Singapore's newest, largest mall in Serangoon Central

As recently as 2008, Singapore was named as one of the top 10 cement importers in the world and construction continues to grow. In 2008, Singapore saw a record high of S$35.7 billion worth of construction contracts awarded. Although the global financial crisis had an impact on the construction industry in 2009, especially on private sector demand, there was still a considerable S$21 billion worth of contracts awarded.

With activity like that, it's no wonder that ready mix concrete suppliers who can provide consistent quality concrete, on time and on budget are in great demand in Singapore. And, ready mixers who can offer additional time-saving or quality-improving features to the product they deliver are in even greater demand. Crystalline waterproofing is one of those value-added benefits.

Crystalline systems build the waterproofing directly into the concrete itself, transforming porous concrete into a permanent, waterproof barrier. When added to the concrete mix, crystalline chemicals react with the water to form millions of needle-like crystals. These crystals grow and fill the capillary pores and micro-cracks in the concrete. As time passes and stresses form new cracks, any incoming moisture causes the crystals to reactivate and grow until they block the incoming water – ensuring continuous waterproofing over many years.

Ready mixers who use crystalline waterproofing systems are able to offer contractors and developers a product that will save them time and money on their projects. Because the crystalline chemicals are integrated with the mix, there is no need to excavate a larger building footprint to accommodate external membrane application, no need to hire additional trades to apply the membrane and no need to build

those additional steps into the construction schedule. Ready mixers with knowledge and experience in crystalline waterproofing systems can increase their profit because the concrete they pour will have a higher value than regular concrete.

Kryton International Inc. created the world's first crystalline waterproofing admixture – Krystol Internal Membrane

(KIM). Kryton's CEO, Kari Yuers, says she's seen continued demand for the product from Singapore and the Asia-Pacific marketplace.

"Using KIM opens up an entirely new revenue stream by giving ready mixers access to waterproofing dollars that would normally go to waterproofing applicators," Yuers says. "As a result, we're seeing strong interest and support for the product from the ready mix industry all over the world and particularly in the Asia-Pacific region."

Yuers says reliable customer support has been particularly valuable for Singapore builders who continue to work fast and to deadline. She adds that ready mixers dealing with specific challenges in the field can rely on Kryton's on-site training, 24/7 online technical support and advanced concrete material laboratories around the world – making Kryton a valuable partner on their projects.

So, when the biggest mall in northeast Singapore was designed and ready to be built, Kryton's KIM was chosen to ensure the concrete would be waterproof. Kryton's distributor in the area, Lee Construction, provided the product.

When it opens in the fall of 2010, the new mall, named "nex," will be almost double the size of an average suburban Singaporean mall. In addition to its more than 600,000 square feet of net lettable area, nex will also feature a "24-hour zone" of shops open day and night, more than 400 local and internationally branded specialty shops and food outlets, a huge new public library, a 10-screen Cineplex and 70,000 square feet of grocery stores. Connected to the mall will be a 16-bay bus interchange and MRT interchange where the North East Line and the Circle Line converge, turning nex into an integrated transportation hub for the entire region.

The enormous size of the project was a factor in choosing a ready mix team that could provide consistency. Due to the quantity of concrete required, Serangoon's contractors needed an admixture that could be easily added to dozens of concrete ready mix trucks that would be delivering to the construction site daily. Using an external membrane waterproofing system would have been costly, time-consuming and without guarantee that the concrete was protected from the region's moist climate. Inadequate waterproofing would lead to leaking and possible structural damage, resulting in difficult and expensive repair over the years. With the mega mall expecting to generate traffic of two million people annually, the quality of the waterproofing system was imperative.

KIM was used to waterproof the nex mall as well as the Serangoon bus interchange. Alliance Concrete Singapore, one of two ready mix producers for the project, were pleased with the results. "It is imperative that any products incorporated into our ready mix concrete must not compromise our reputation in terms of our services and quality to our esteemed clients.… Lee Construction has performed beyond our expectations in their timely schedule and support as well as your product performance," Gary Leow, senior technical manager for Alliance Concrete Singapore wrote to Kryton following completion on the bus interchange work.

The mall's architect, SAA Architect, was also determined to integrate substantial amounts of landscaped space and sustainable features to ensure the new building would become a "green lung" for the Serangoon community. Suburban development over the decades since independence has eaten up much of the green space that existed. SAA Architects conceptualized a "green necklace" along the exterior of the six-storey building as well as a roof garden, complete with a dog run.

But green space and roof gardens need watering to thrive, and that posed chal-

lenges to architects and engineers to find a fail-safe waterproof solution for concrete construction. And in Singapore's climate, with its average rainfall of 2,370 millimetres per year, waterproofing for the wet season is critical to extend a building's life. Again, Kryton's product KIM was the answer.

For ready mixers and construction industry professionals such as Alliance Concrete and Lee Construction, KIM provided clear value. It comes in pails and can be added directly to ready mix trucks either on site or at the batching plant. The pails remove any guess work in the concrete mix, ensuring a quality product throughout the project.

It is estimated nex will cost the developer, Gold Ridge Pte, roughly S$1.3 billion. Still several months away from completion, the mega mall is already 90 per cent leased. With a long life-expectancy ensured by effective waterproofing, Serangoon Central's nex can expect many profitable years to come.

NSL
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Eastern Pretech Pte Ltd

Precast Prestressed
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SE CAD Software – The Total Solution To Efficient And Buildable Precast Design

By Er. Lau Joo Ming, Mr Heru Santoso Soedarsono, Ms Tey Hui San
Housing & Development Board

The Pinnacle @ Duxton
(This Project is Designed by SE CAD Software)

HOUSING & DEVELOPMENT BOARD

Its Beginning

Faced with the challenge of continually meeting the housing needs of the nation's rising population, HDB has embarked on the construction of taller buildings to deliver more homes in land scarce Singapore. With over three decades of experience in precast concrete technology, HDB has succeeded in developing and refining its own concoction of semi-precast system for optimal buildability in the development of these high-rise buildings. The HDB prefabrication and precast construction technology has won praises and admirations from industry players both locally and around the regions.

Over the years, HDB has been relentlessly looking into incorporating new technologies and striving for better quality and higher productivity in its structural engineering design and detailing. HDB had successfully developed an integrated computer-aided analysis, design and detailing software called SE CAD. This software facilitates seamless integration of design analysis and automates drawings production with prefabrication concept taking the centre stage. Since its inception in 1997, SE CAD has been used extensively in the structural design of numerous HDB projects, including the latest landmark development, Pinnacle @ Duxton – the first 50-storey public housing project in Singapore.

Presently, the SE CAD software has made significant headway by extending its reach to overseas customers in Malaysia.

Its Capabilities

SE CAD was developed with high-rise building analysis and design in mind. Key performance parameters required for high-rise reinforced concrete building are computed automatically by the software. Powered by a robust finite element engine with built-in precast components database and fronted with user-friendly interface, SE CAD provides a one-stop solution from 3D structural analysis and computational capabilities, design and detailing, to drawings production for in-situ or precast building systems.

(Refer to Figure 1 for a typical workflow using SE CAD)

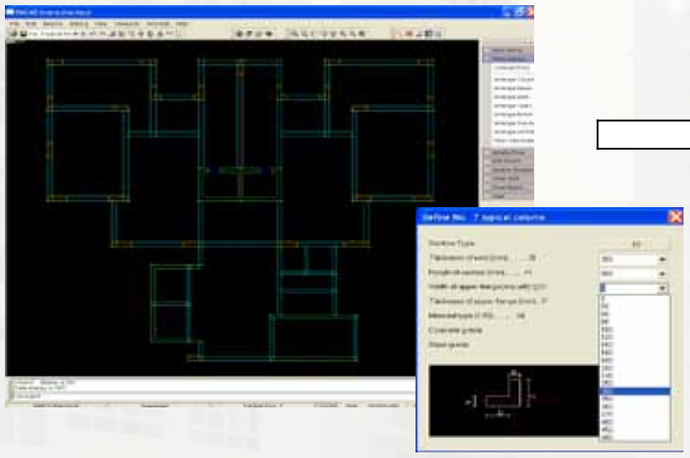
As the entire modeling and analysis process is fully integrated, feasibility study on

THE CORIS @ SENGKANG
(This Project is Designed by SE CAD Software)

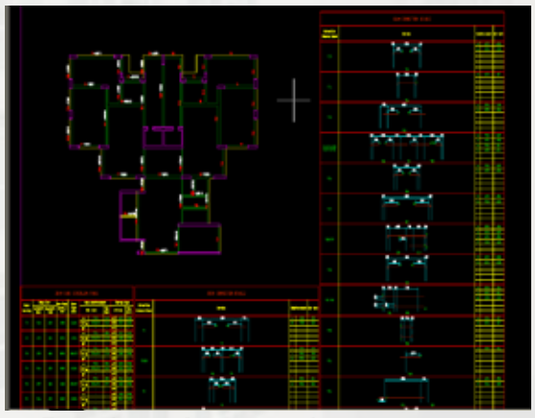
various possible structural configurations and identifying the most suitable design proposal will be a breeze. Once the shape and layout for the tall structures are established, their structural behaviors can be simulated effortlessly. Design and analysis results (e.g. bending moments and shear forces), structural drawings and material quantities can be obtained at an instant once the building's super structure is modeled. Additional capabilities include auto-generation of loading plan, 3D model rendering, shop drawings of precast components and prefabricated reinforcements, which can be produced within seconds!

A typical workflow using SE CAD

Input of design parameters

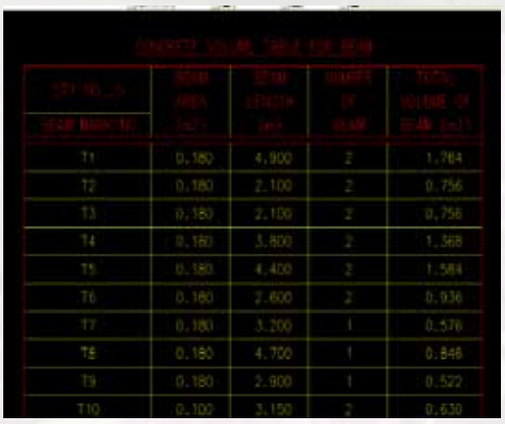


Instant 3D modeling



Detailing of structural components

Analysis of super structure



T1	0.180	4.900	2	1.764
T2	0.180	2.100	2	0.756
T3	0.180	2.100	2	0.756
T4	0.180	3.800	2	1.368
T5	0.180	4.400	2	1.584
T6	0.180	2.600	2	0.936
T7	0.180	3.200	1	0.576
T8	0.180	4.700	1	0.846
T9	0.180	2.900	1	0.522
T10	0.100	3.150	2	0.630

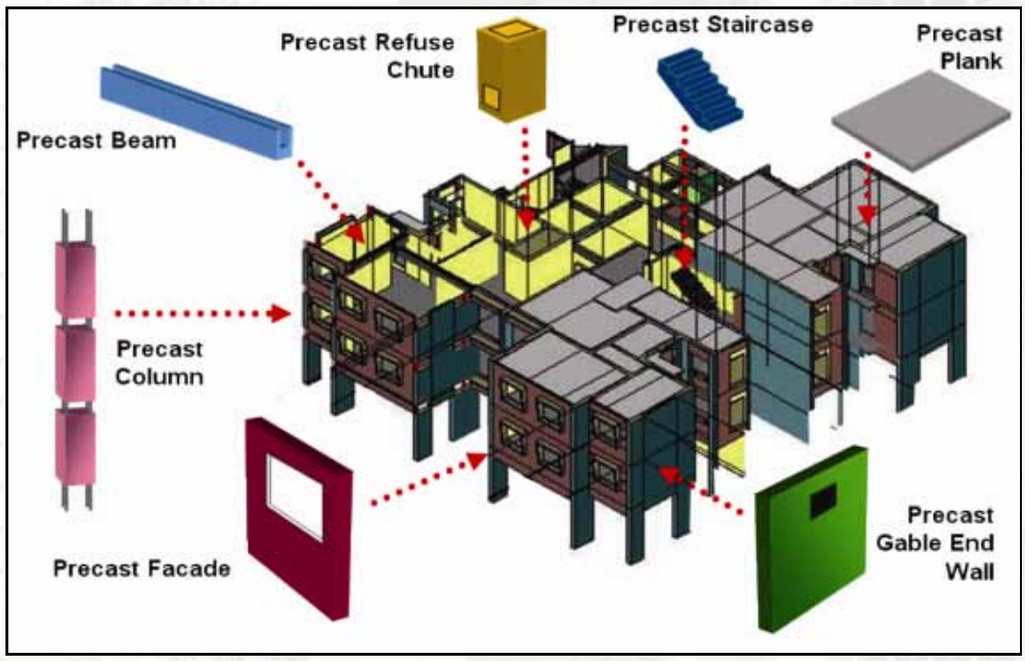
Quantity take-off

Its Uniqueness

The main unique feature of the SE CAD software lies in its extensive databases developed by HDB. These databases of accrued precast and prefabrication design, detailing and good practices, field tested over two decades of refinement and focused on enhancing the buildability of structural system, have no parallel in any of the other commercially available software packages. SE CAD has successfully integrated these fragmented databases into one single database to enable auto-generation of design and detailing drawings.

Coupled with proven track record for its application in HDB projects since 1997, SE CAD provides industry players with valuable and practical insight of HDB's precast technology which can be easily adopted and replicated in other building projects.

HDB's precast and prefabrication system



Schematic diagram of standard precast components used in HDB's building projects

Standard precast components include precast walls and precast facades

Its Benefits

End users will benefit significantly from SE CAD's ability to speed up design processes and increase productivity in the drawing office. It also enables seamless transfer of information at various design stages and eliminates discrepancies between drawings through integration of applications. The use of SE CAD for HDB projects has enabled quantum leap in both design and drawing office productivity, with an estimated manpower savings of 35% for every design project!

With SE CAD, higher precast implementation can be achieved at construction sites. Industry players will also enjoy further benefits such as higher Buildability Score and better worksite safety record.

In its efforts to share knowledge with the industry for technology transfer, HDB's development of the SE CAD software serves as a definitive guide for engineers and practitioners to access and leverage on HDB's experience in precast and prefabrication systems. This will provide a launching pad for a greener construction practice with higher site productivity and quality finishes.

Therefore, SE CAD is not just a computer aided design engineering tool, but also a fully armed ally to learn and execute efficient and buildable precast design.

Its Reviews

"The database incorporated in SE CAD has given us insights on the wide range of precast components available that can be adopted in our design."

- Er.Teng Chee Wai,
LBW Consultants LLP

"The material quantity feature in SE CAD is particularly useful to us. It provides instant information to facilitate cost estimations."

- Mr Chaw Kean Yee,
OKA Concrete Industries Sdn. Bhd.

"We can immediately use the precast details that come with the SE CAD instead of re-designing everything from scratch. This saves us a lot of time!"

- Mr Zhang Chang Lin,
ECAS-EJ Consultants Pte. Ltd.

"SECAD, being an integrated software has helped us in reducing time spent on structural analysis and design work".

- Surbana International
Consultants Pte Ltd

Find out more…

It is our pleasure to share with you the wonders of SE CAD software. For more details or further enquiries, you may visit the website www.secad-software.com or contact:

1) Ms Tey Hui San, Senior Business Manager, at 64902607 from HDB Building Research Institute or

2) Mr Liew Yong Seong, Software Specialist, at 92760058 from Advance Contech (Singapore) Pte Ltd

Central Horizon @ Toa Payoh
(This Project is Designed by SE CAD Software)

Corrosion Protection of Post Tensioning Tendons

By Hans Rudolf Ganz, Chief Technical Officer
VSL International Ltd., Scheibenstrasse 70, 3014 Bern, Switzerland

Prestressing, introduced in the first half of the 20th century by visionary engineers and entrepreneurs, has permitted a progress in concrete construction which would have been simply impossible without it. Many outstanding structures are testimony for this. With so many post-tensioned structures built, the need to address durability of the system becomes of paramount importance.

Already in the conceptual design stage, questions such as aggressivity of the environment, exposure conditions of structures, and required level of protection of the post-tensioning tendons to achieve the desired design life have to be addressed. These questions have been discussed in a fib/IABSE workshop in Zurich in 2004. fib has published recommendations for the corrosion protection of post-tensioning tendons as a function of environment, exposure and protection provided by the structure itself [1].

Once suitable materials have been chosen for the tendon, the main concern for durability remains the protection of the tendon from aggressive media penetrating the tendon from the outside. In accordance with [1], the designer should choose a level of protection which ensures that: "Protection provided by the structure surrounding the tendon plus protection applied to the tendon itself is sufficient to resist the expected aggressivity of the environment with the actual exposure conditions". It is believed that the aggressivity and protection cannot be quantified accurately yet. Therefore, the fib recommendations propose three Protection Levels (PL1, PL2, PL3) for the tendons which seem well adapted to ensure durability for certain groups of environments. These are defined as follows:

- PL1: A duct with a filling material providing durable corrosion protection
- PL2: PL1 plus an envelope, enclosing the tensile element bundle over its full length, and providing a permanent leak tight barrier
- PL3: PL2 plus integrity of tendon or en capsulation to be monitorable or inspectable at any time.

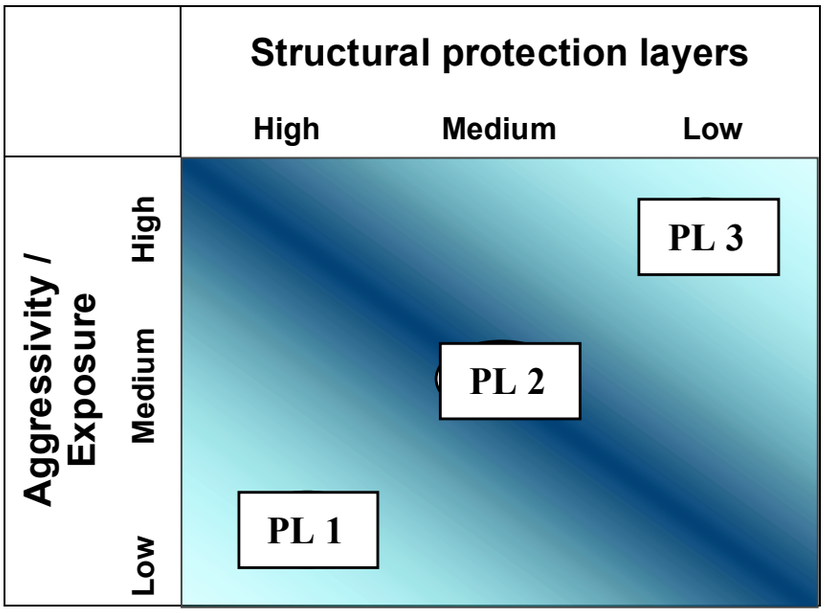


Figure 1. Protection Levels for post-tensioning tendons based on aggressivity / exposure versus structural protection layers [1]

A matrix of environment/ exposure versus protection by the structure itself assists the designer to choose the appropriate Protection Level for the tendon, see Fig. 1. Examples of generic performance specifications with test procedures and acceptance criteria are given in [1] for each Protection Level.

The corrosion protection in accordance with PL1 corresponds to the typical protection provided in the past to essentially all tendons, i.e. metallic duct filled with cementitious grout. This protection has performed well for low aggressivity and/ or high protection conditions. However, for aggressive environment in particular for exposure to chlorides encapsulation of the prestressing steel over the entire tendon length in a durable envelope is recommended, i.e. PL2. This envelope needs to include in particular the anchorage zones which are often the most severely exposed area. Fig. 2a illustrates a tendon fully encapsulated in a plastic envelope in accordance with the specification for PL2. The intent of the envelope obviously is to keep the aggressive media such as chlorides away from the prestressing steel. Full encapsulation of tendons was difficult in precast segmental construction across the segment joints. However, recently several special duct couplers for segmental construction have been placed on the market, and have been confirmed by testing, see Fig. 2b.

The highest level of protection, PL3, combines the details of PL2 with a system which permits to monitor the integrity of the protection and/or of the prestressing steel. One solution for PL3 is the electrical isolation and monitoring of tendons (EIT). In this solution, the prestressing steel is electrically isolated from the surrounding structure through the plastic envelope. The quality of the encapsulationcan be verified by a simple electrical resistance measurement between the prestressing

a) Encapsulation in anchorage

b) Encapsulation across precast segment joints

Figure 2. Fully encapsulated tendon in accordance with PL2 [1]

steel, inside, and the reinforcing steel cage of the structure, outside the envelope. A high electrical resistance confirms the leak tightness of the envelope. A low or negligible resistance indicates a leak in the envelope. Such leaks can be located by measurements of the magnetic field caused by an electrical current applied to the tendon. Once located, the defect can be either repaired, if considered necessary, or the particular area can be subjected to more intense inspection to detect any deterioration early enough.

Typically, the electrical resistance of a tendon increases gradually with time due to the hydration/drying of grout and concrete around the prestressing steel. If at any time a defect in the envelope occurs and humidity penetrates the envelope, the electrical resistance will drop significantly. Such a scenario is illustrated in Fig. 3 with a red arrow. Hence, simple electrical resistance monitoring permits reliable detection of the occurrence of a breach in the tendon protection throughout the design life of the structure. This applies even if the tendon had a sub-standard but still measurable electrical isolation initially. As mentioned above, the defect can be located and repaired as may be required.

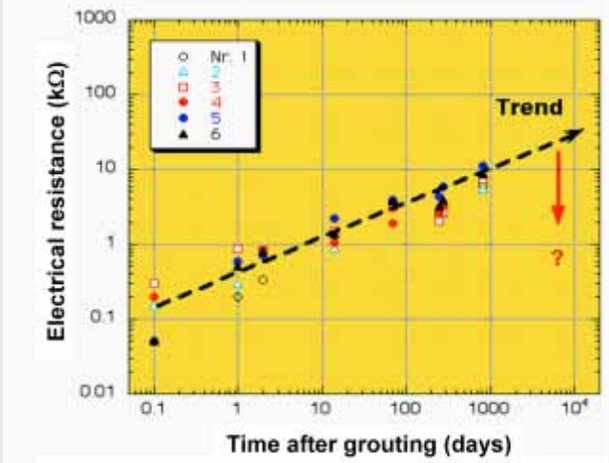
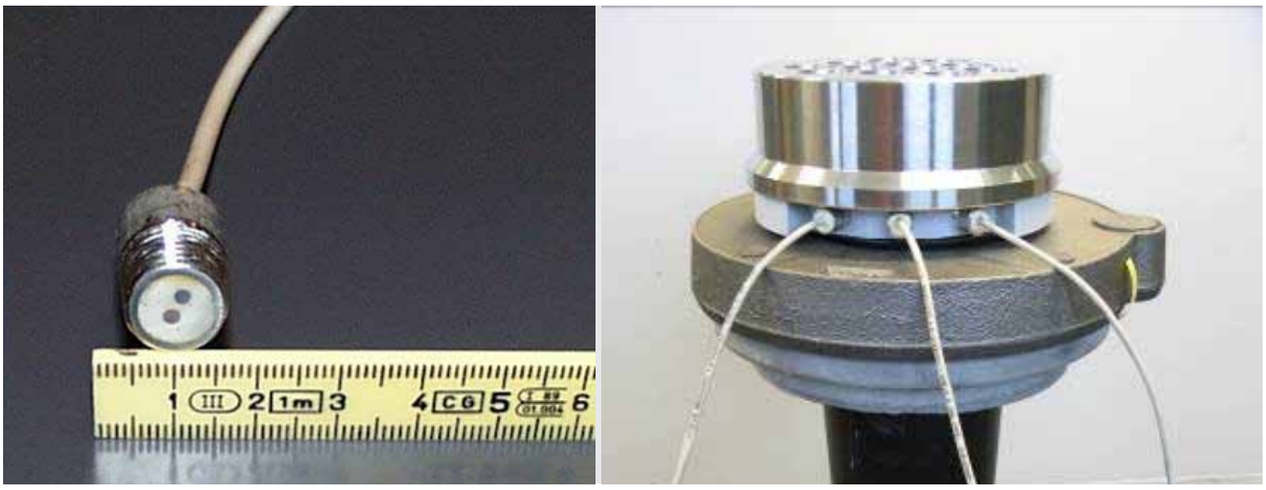


Figure 3. EIT monitoring permits to detect a defect in the tendon encapsulation.

It may be worthwhile noting that such electrical resistance measurements permit an efficient and comprehensive control of the quality of installation of the tendon and encapsulation. Such measurements may form part of the "birth certificate" of a structure which will serve as reference for any future inspection and investigation.

It has been argued that tendon encapsulation and EIT significantly increase the cost of post-tensioned structures. This is not true for most applications. In fact, the cost increase for the structure is below 0.5% in general, and may fall below 0.1% in many cases.



a) Sensor *b) Installation of sensor at anchorages*

Figure 4. Void and corrosion detection sensor

A specific sensor has been developed in Europe which permits detection of voids in tendons during grouting [2]. These sensors also permit confirmation of the passivation (no ongoing corrosion) of the prestressing steel inside the grout during the entire life of the structure. Fig. 4 shows the sensor and the positioning of the sensor to detect voids or corrosion just behind the anchor head. The sensor is installed in special vents for monitoring of critical locations along the tendon length.

References

1. fib Bulletin 33. Durability of post-tensioning tendons. Recommendations. International Federation for Structural Concrete (fib), Lausanne, Switzerland, 2005.

2. BUECHLER, M.; BREM, M.; GANZ, H.R. – Durability of tendons: Monitoring of grout quality during injection regarding alkalinity, chloride content, and bleeding water formation. Proceedings of 4th International Conference on Structural Health Monitoring on Intelligent Infrastructure (SHMII-4), Zurich, Switzerland, July 2009.

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Issued by Er John S Y Tan, conference Director
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Since 1991 SCI has been sponsoring the Gold Medal for the top graduating student in the Diploma in Civil and Structural Engineering course and a book prize for the second student in the same cohort from the **Singapore Polytechnic**.

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Diploma in Civil and Structural Engineering (DCSE)

SCI 2nd Vice president, SCI President and SP's Principal with this year's two awardees

In 1997, the Singapore Concrete Institute donated a capital sum of $15,000 for a gold medal award and a $100 book prize to **National University of Singapore**. The awards are governed by the following conditions:

Subject to rule 3 below, the gold medal and book prize are awarded to the best Civil Engineering graduate in Concrete Technology and Concrete Design related modules in the examination leading to the degree of Bachelor of Engineering.

- The award will be made by the Board of Undergraduate Studies on the recommendation of the relevant Board of Examiners.
- No award will be made unless there is a candidate of sufficient merit.
- The book prize, which will be paid from the balance of the proceeds available after the purchase of the gold medal, must be spent on books approved by the Head of the Department of Civil Engineering.
- If no award is made in any year, the funds available will be added to the capital sum.

Year 2009 winner from NUS is, **Mr Khoo Shin Dih**.

SCI awards a $200 book prize to the **Nangyang Technological University** since 1983. **Mr Boon Chia Wong** was awarded the book prize for the academic year 2008/2009.

Prof Pan Tso-Chien, Dean of the College of Engineering, presenting the award to the winner.

SCI Lifetime Achievement Awards 2009

is presented to:

Founder President Er Peter Lee Bay Tseng,

Despite facing a lot of initial challenges with his Protem Committee in 1978 in preparation for the founding of SCI, our Founder President Er Peter Lee went on to lead SCI until 1984. During this period, Er Peter Lee and his team of dedicated Directors successfully organized numerous activities and seminars for the members and published a set of "Good Concrete Practice" guide books widely used by the construction industry then. His vision and wisdom had indeed charted the course for SCI to move forward until where we are today, 32 years later.

Second President Dr Tam Chat Tim,

Our second President from 1984-1986, Dr Tam Chat Tim, is well known in Singapore and the region as the undisputed Concrete Guru. He is an authority in concrete and concrete constituent materials. Dr Tam, a distinguished educator in concrete and one who has contributed tirelessly for more than 40 years, has received many awards for his achievements and contributions to the concrete industry in Malaysia and Singapore. This award is yet another accolade added to Dr Tam's collection of awards.

Third President Dr Lau Yat Sun

Dr Lau Yat Sun, our third President from 1986-1988, a distinguished Professional Engineer and Accredited Checker well known in Malaysia and Singapore had contributed significantly to the concrete industry for more than 25 years. He made contributions to numerous technical committees on structural engineering and code of practice on the structural use of concrete. Dr Lau is a fellow of the Institution of Engineers Malaysia and Institution of Engineers Singapore. He is also a past President of the Institution of Structural Engineers UK, Association of Consulting Engineers, Malaysia.

Fourth President Dr Khoo Kay Chai

Our fourth President from 1988-1989, Dr Khoo Kay Chai, a distinguished educator in engineering, was the Principal of Singapore Polytechnic from 1976 until he retired in 1995. Dr Khoo has the distinction of being the first Singaporean Principal of the Singapore Polytechnic. Under his capable and dynamic leadership, the polytechnic became a model institution in the region. For his exemplary contributions, he has received numerous Honorary Doctorates from universities in the UK, Australia, the Philippines and Mongolia.

SCI 31st Anniverary Gala Dinner & launching of SCI Concretus

The Gala Dinner comprising of 36 tables and the Launching of our Inaugural Issue Magazine, SCI Concretus was held on 17th November 2009 at Marriott Hotel, Orchard Road. All Past Presidents including the Founding President were invited to our Gala Dinner.

SCI signed a joint agreement with ACI-SC for joint development of EN 206 course for RMC certification on that night.

SCI Social Networking Nights – Penny Black, Boat Quay

SCI holds several networking event through the year. The latest networking night was organized on 25th February 2010 and was generously sponsored by Qingjian Group Co Ltd Singapore Branch .

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Joint Event with BCA on Special Briefing Session to Specialist Builders

(pre-cast concrete work & in-situ post-tensioning work)

The talk was held on 26th February 2010 from 9.00am to 12.00pm at BCA Academy. Mr Steven Cheong (on behalf of Singapore Concrete Institute) delivered a lecture on the Precaster Accreditation Scheme. More than 100 copies of SCI concretus magazine was distributed in this event.

Cost-Effective Intelligent Green Building Masterclass

SCI endorsed the mentioned event organized by Salvo Global which was held on 1-2 March 2010 at Pan Pacific Orchard, Claymore Road and garnered architects, contractors and property owners in a programme of case study presentations, best strategic practices and group workshops.

The seminar was led by an expert who has more than 18 years of international experience exclusively to enhancing the value of projects. He is director to a leading design, research and advising firm focusing on next generation green building technologies.

A total of 40 copies SCI Concretus was distributed to the attendees for this event.

29th Technical Talk

Application of NDT in Building Diagnostics

Sharing of Building Inspection experience in Hong Kong

The event was organized by NON DESTRUCTIVE TESTING SOCIETY (SINGAPORE) on 12th March 2010 at Singapore Polytechnic Graduates Guild, 1010 Dover Road, Singapore. SCI was supporting organization for this event. The lecture was delivered by Ir. CK Cheung is a Senior Accreditation Officer of the Hong Kong Accreditation Service (HKAS).

SCI Accreditation Schemes

Waterproofing Accreditation Scheme

Singapore Concrete Institute's Accreditation Scheme for Waterproofing Specialist Contractors was launched in September 2004. The aim of this scheme is to ensure minimum competency and raise the capability of waterproofing specialist contractors serving the construction industry in the longer term. It also provides recognition to contractors who are committed to deliver quality works. This scheme is managed by the Singapore Concrete Institute (SCI) as part of the effort to promote greater self-regulation by the industry.

The accreditation criteria were developed jointly by the SCI and Building and Construction Authority (BCA) with inputs from Waterproofing specialists and the Waterproofing Trade Association. Real Estate Developers' Association of Singapore (REDAS) had given their support on the scheme and would encourage its members to specify the use of accredited contractors for their projects.

Accreditation Grading And Accreditation Process

There are three categories of grading under the accreditation; they are W1, W2 and W3. Waterproofing specialist contractors will be assessed using the accreditation criteria during the accreditation audit. Subsequently, the accredited contractors will be assessed annually for compliance in order to retain their grading.

Accreditation Criteria

The accreditation criteria are based on three main areas. They are:

- Financial & Track Records
- Human Resources
- In-house Quality Management System

Benefits of Accreditation

The benefits of the scheme include:

- To recognise contractors who are committed to deliver quality waterproofing works, the Building and Construction Authority (BCA) has agreed to award full points for the in-process check of internal wet area waterproofing for projects assessed under CONQUAS, if the waterproofing work is carried out by a SCI waterproofing accredited firm. On-site verification is not required.
- This will certainly add value to the SCI Accreditation Scheme as main contractors will be encouraged to engage accredited firms to carry out waterproofing works for their projects.
- Improved marketability and competitiveness
- Supported by REDAS
- Enhanced public image of firms

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Enquiry

To know more about the Accreditation Scheme for Waterproofing Specialist Contractors, application procedures and the updated list of Accredited Waterproofing Specialist Contractors, please contact Ms Edina Koh (Tel: 6325 5085).

Precaster Accreditation Scheme

Background

The Singapore Concrete Institute's Precaster Accreditation Scheme was launched on 1st January 2007. The scheme aims to improve the quality and productivity of precasters serving the construction industry. It also provides recognition to precasters who are committed to quality and safety of the production plant and products. The scheme is open to local and overseas precasters which have their fabrication yard located outside Singapore. This scheme is managed by the Singapore Concrete Institute (SCI) as part of the effort to promote greater self-regulation by the industry. The accreditation criteria were developed jointly by the SCI and the Building and Construction Authority (BCA) with inputs from the precasters.

Accreditation Categories & Criteria

There will be three Categories of Accreditation:

Category PC1
Precaster that has the financial, human resources, plant and design capabilities to fabricate Structural Building and Structural Civil Engineering Elements of more than or equal to $30 million in contract value for the past 3 years.

Category PC2
Precaster that has the financial, human resources, plant and design capabilities to fabricate Structural Building and Structural Civil Engineering Elements of more than or equal to $5 million but less than $30 million in contract value for the past 3 years.

Category PC3
Precaster that has the financial, human resources, plant and design capabilities to fabricate Non-Structural Building and Non-Structural Civil Engineering Elements.

Definition

1. Structural Building and Structural Civil Engineering Elements shall include but not limited to column, beam, double-T beam, hollow core slab, prestressed plank, household shelter, structural faade with built-in beams, staircase, balcony, parapet wall, gable end wall, faade (without beam), water tank, prefabricated bathroom, road viaduct components, MRT and LRT viaduct components, pedestrian overhead bridge components, deep sewerage tunnel components, MRT tunnel components, RC pile, spun pile, box culvert, sewerage tunnel, drainage tunnel.
2. Non-Structural Building and Non-Structural Civil Engineering Elements shall include but not limited to internal partition wall, cladding, sun breaker, refuse chute, roofing slab, interlocking block/ paver, manhole chamber ring, RC cover for sewer manhole, U-drain.

The accreditation criteria are based on two main areas. They are:

- Management and Facilities
- Track Record and Design Capability

Precaster Accreditation Process

Precasters will be assessed using the accreditation criteria during the accreditation audit. Subsequently, the precaster will be assessed annually for compliance in order to retain its grading.

The benefits of the scheme include the following:

- Accredited Precasters can pride themselves to be recognised as among the best in the industry, having achieved the required standards in its class of accreditation
- The Accreditation Register will be a good source for selection of reliable precasters.
- The scheme will encourage continual improvement and professionalism as Accredited Precasters aspire to upgrade to higher categories.

Precaster Accredited Firms

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Enquiry

To know more about the Precaster Accreditation Scheme, application procedures and list of Accredited Precasters, please contact Steven Cheong (Tel: 6325 5020, Email: Steven_Cheong©bca.gov.sg

SCI Memberships

GROUP MEMBERS shall be corporate bodies or organizations acceptable to the Board of Directors and engaged in or concerned with any business relating to concrete technology. Each Group Member shall be represented by one nominee.

Members Benefits

1 $250 worth of coupons will be given to Group Members upon joining. All the coupons can be used to redeem fees of courses and workshops conducted by SCI (up to 50% of registration fee) and up to a maximum of $150 can be used to pay for the next membership renewal. The coupons will be valid for 1 year from date of issue. Join NOW to take advantage of this special promotion - valid for a limited period only!

2 Put your company logo in the Group Member page and useful link.

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Name	*Occupation*
Wong Chung Wan	Technical Director
Wee Boon Liang	Principal
Tong Kam Fei	M.D.
Kuppalagan Rajendran Chezhian	Project Engr
U Zaw Myo Tun	Snr Civil/Str Engr (Lead)
Zhang Kuo	Engineer
Er Lim Teck Choy	Principal Engineer

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MEMBERSHIP APPLICATION FORM

Type of Membership applying (please tick) :

☐ Corporate ☐ Ordinary ☐ Associate

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Nominee 2	Prof/Dr/Mr/Mrs/Miss	Designation	
Email Address	Company		
	Nominee 1	Nominee 2	

For Ordinary/Associate Members

Name in full	Prof/Dr/Mr/Mrs/Miss				
Residential Address					
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Date of Birth		NRIC/PP No.		Nationality	
Home Tel. No.			Mobile No.		
Email Address	Personal		Company		

Employment Records

Employer's Name				Designation	
Address					
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Tel. No.		DID/Ext. no.		Mobile No.	
Working Experience	Please state number of years in construction industry				

Qualifications: Academic (please attach photocopy of certificates):

Year of Graduation	University/College Attended	Highest Qualifications Obtained

Professional Bodies / Learned Societies (please attach photocopy of membership certificates):

Date Joined	Name of Professional Organization	Membership No. & Type

Special Achievements / Publications

Year	Type of Award / Publications	Awarding Bodies / Publisher

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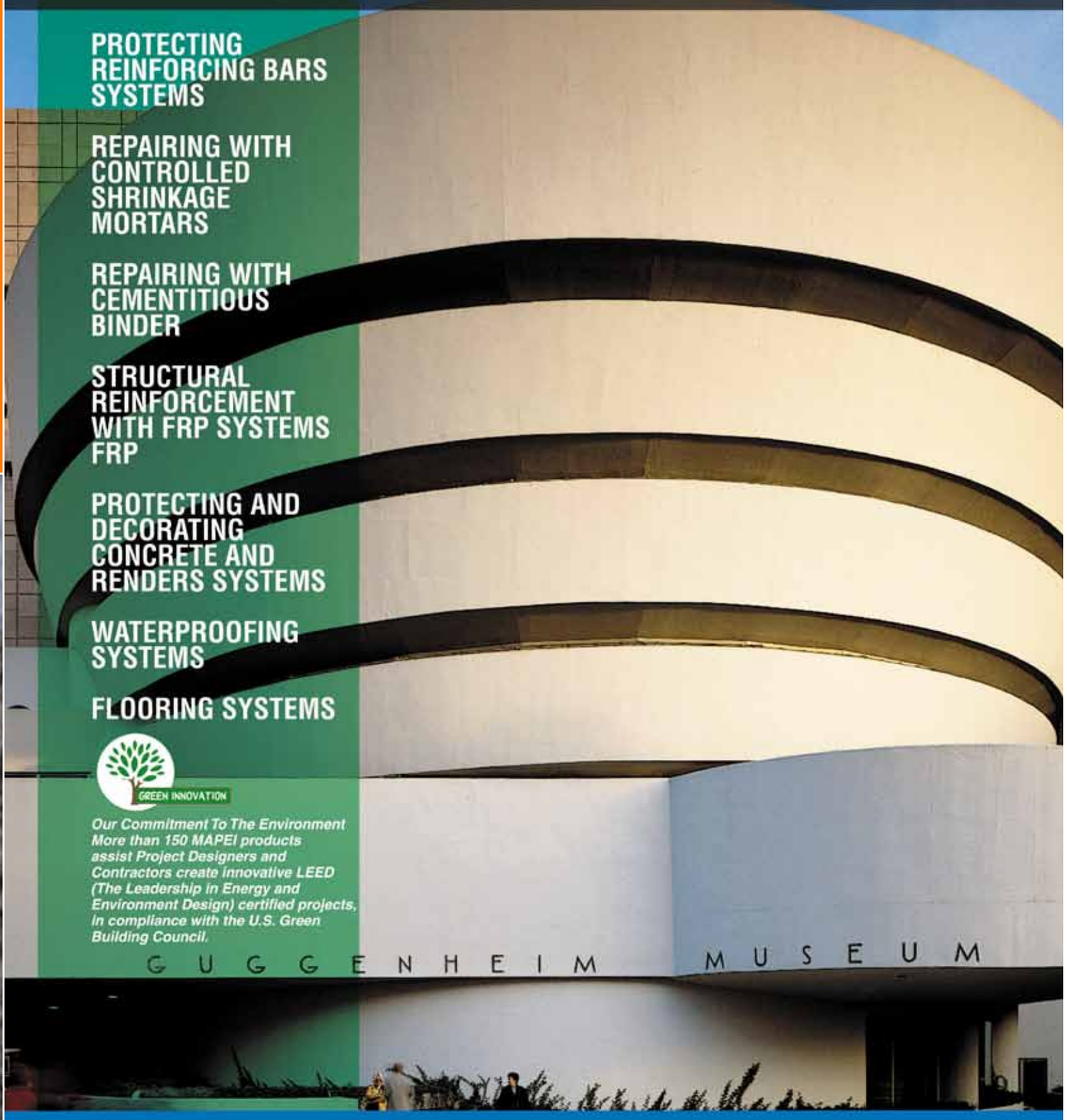

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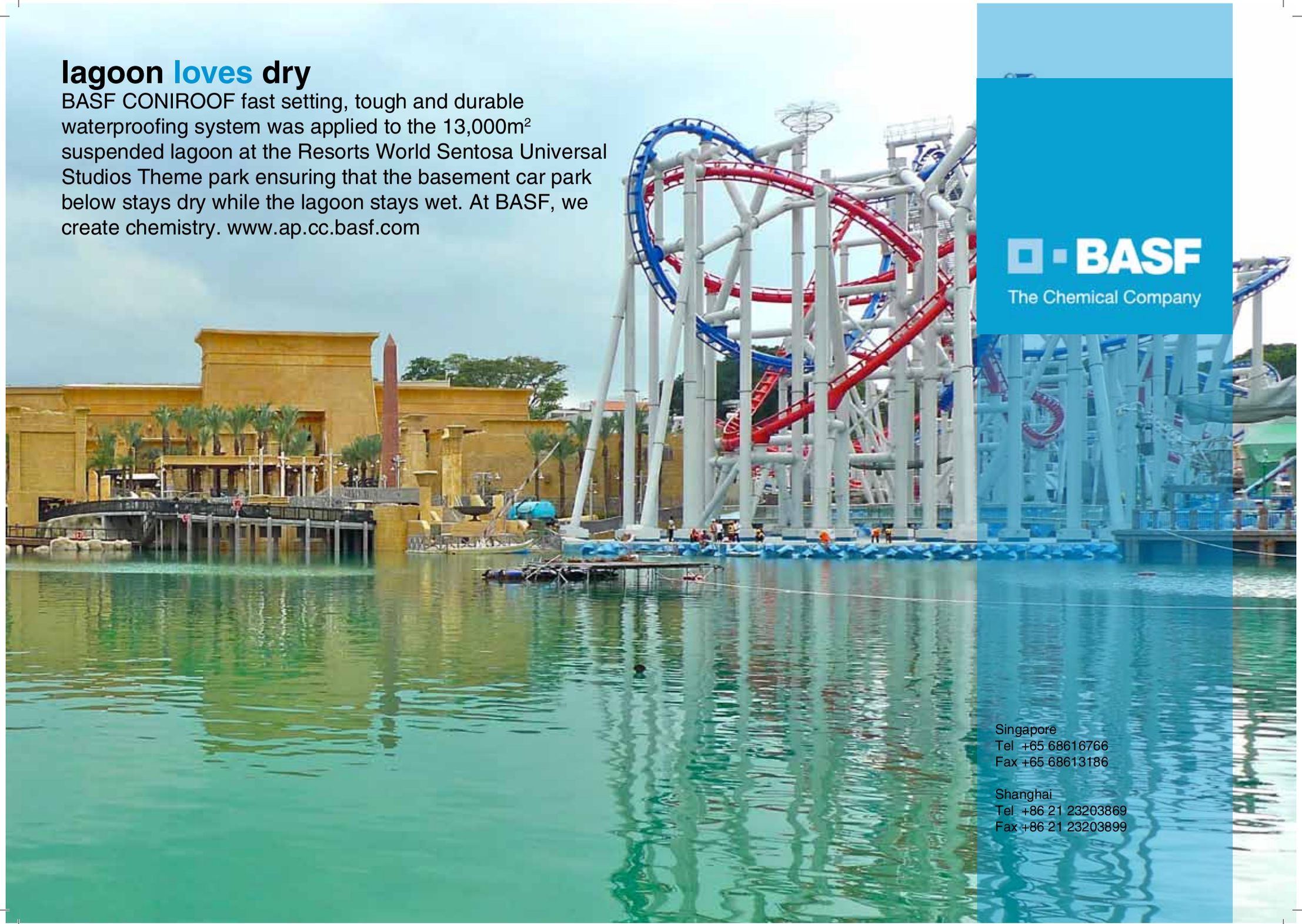

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