THE GAMMON PROMISE

EMBRACING INNOVATION

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“It is Gammon’s honour to be working, as we have done now for 60 years, on projects that embody ambition, excellence and service to the community and, which demonstrate to the world, the extraordinary achievements of which the Hong Kong construction industry is capable.”

Thomas Ho
Chief Executive

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FOREWORD

by Sir David Akers-Jones

Sir David is a former Chief Secretary of the Hong Kong Government. Now, after nearly 65 years of being closely involved in building Hong Kong he praises and encourages the builders of this great city of ours.

Gammon, after sixty years you can walk around the streets of Hong Kong and say to yourself with pride “we built that, and that, and that,” You began your work of building, I began my work at the same time in a building on the waterfront which, like so many buildings is no longer there. The waterfront, as well, has moved closer to Kowloon!

Can you believe while you were pouring your first loads of concrete it was my work as a public servant to look after 1,000 tons of firewood, 2,000 tons of soya bean and a stockpile of corned beef. It was 1957, these were emergency food supplies in case the gunfire between the mainland and Taiwan should become a real shooting war!

I next moved to Tsuen Wan where the first New Territory resettlement estate was being built. This was the real beginning of the thump of pile drivers and the boom of building this great metropolis of Hong Kong. We should remember, as we think of those days gone by, of the craftsmen, the carpenters, the straining muscles of the steel benders, the fearless scaffolders, the skills of men and women of many professions and the management and directors and shareholders of Gammon, all who have made their contribution to the work of building Hong Kong, and thank them on this memorial day.

It was sixty years ago. We are both sixty years from those days. I have had an exciting life since then. You as a giant construction company have had your years of excitement and achievement. What a different place we are in now than we were then. Did you ever dream then what Hong Kong would become? If I may borrow the words of his son we should say together as was said of Sir Christopher Wren:

Si monumentum requiris, circumspice

If you need a monument ‘to this great work’ just look around you.

Thank you Gammon.

Sir David Akers-Jones

VISION

by Thomas Ho

Anniversaries are a time to look both back and forward. In this 60th anniversary edition of *The Gammon Promise*, you will find an account of 60 years of innovation in the construction industry in Asia, and an outline of our vision for an even more innovative future.

Linking the two is an unwavering commitment to keeping the promise that gives this book its title – that in every project we undertake we will achieve excellence, founded on safety, sustainability and absolute integrity.

We are entering an exciting period in the development of our industry and in many areas Gammon is leading the way.

Excellence in construction now depends on digital transformation and this stage of our innovation journey requires radical rather than incremental change. Accordingly, we have set ambitious but achievable targets for Gammon under the banners of 25 per cent by 2025 and Zero Waste.

Waste, particularly in the form of overmanning, is a major issue for our industry. A typical construction project in Hong Kong now uses double the workforce required for its equivalent in the United Kingdom, Singapore or in mainland China.

We are addressing this problem through innovative solutions such as Building Information Modelling (BIM), Design for Manufacture and Assembly (DfMA) and Integrated Digital Project Delivery (IDPD), which allow much work previously carried out on-site to be done more safely and efficiently off-site in factory conditions.

On the sites we are introducing robotic technology, which takes some repetitive dangerous tasks out of the hands of the worker completely. We are investing in devices such as exoskeletons, zero-gravity arms and chairless chairs, making tasks that still require workers safer and less onerous, and modifying those devices to better suit our specialised requirements. All these developments are making workers on our sites more productive than ever before.

We have to go further, however. Our vision is to reduce manpower on our sites by 25 per cent by 2025; to simplify our work through DfMA and IDPD; to reduce non-value adding activities and to eliminate waste, thus maximising value to our clients.

With our Singapore Global Switch project, we achieved 70 per cent off-site precast construction and 60 per cent off-site Mechanical Electrical and Plumbing (MEP) DfMA. We intend to achieve the same level of enhanced safety and efficiency on all our sites. The more work we can move from the construction site to the factory, the safer, more productive and more environmentally sound the site will become.

To achieve this, we must change the mindset of the people who work for and with us, just as we did with the implementation of our now well-established Zero Harm strategy for safety. To make our vision of 25 per cent by 2025 a reality, we have identified five priorities – Innovation, Focus, Collaboration, Digitisation and Knowledge.

Innovative thinking will allow us to proactively apply methods and processes that are adaptable and easier to work with. We are asking each business unit to create specific areas of Focus to maximise opportunities and look for different opportunities for improvement. We are emphasising commitment to Collaboration along both the internal and external supply chains, starting at the tender stage. We are employing common Digital platforms to accelerate standardised workflows, and to expand automation exponentially. And we have developed an open data strategy to enable the efficient sharing of Knowledge and standard ways of working to align our common goals.

We have set specific targets for 2025, with each business unit required to identify performance measures in a strategic plan and to regularly report on their progress to group management.

We believe that by working closely from the inception of each project with all stakeholders, we can make our Zero Waste initiative as successful as our Zero Harm strategy. In Hong Kong, we hope it will be an example to the industry as a whole. We need to catch up with other cities where what we are now working towards has already been achieved.

“We face challenges in our marketplace. Major projects have been delayed by lengthy debate in the Legislative Council, which may not serve the SAR’s best interests. Politics aside, there is a pressing need for the construction of 460,000 housing units between now and 2026. It must be met.”

While we are determined to reduce overmanning, we remain strongly committed to the people we employ. Today, Gammon employs 8,000 staff members, including 5,000 professionals and, in line with our belief that construction is a people business, we have recently restructured the Gammon Academy through which our people develop their careers. We have also expanded our apprenticeship programme for the development of more skilled workers. We hope others will follow this example.

We have also made, and will continue to make, great strides in terms of sustainability and community engagement. Gammon is a leader not only in the construction of cutting-edge green buildings in Hong Kong, but of innovative sustainable practices on our sites, and in our offices and other facilities.

We have, among many other initiatives, introduced biofuels to the industry in Hong Kong. We are also known for the effectiveness of the measures we take to minimise the impact of our construction work on the wider community.

Hong Kong remains our principal focus of operations, but we also have a long history in Singapore. Our equity interest in leading Vietnamese contractor COFICO has established a successful strategic partnership, which we believe will lead to further expansion of Gammon’s presence and influence in Southeast Asia.

Wherever we are, we embrace and promote innovation and change for the better. This is our diamond anniversary, and diamonds are known for their durability and sharp edges.

We go into our seventh decade with the confidence that we will remain on the cutting edge of construction in Asia, that we have the staying power to handle whatever the years to come may require of us, and that the best is yet to come. It is our responsibility to build a better future to the best of our abilities. These are considerable, and we will continue to keep the Gammon Promise – to 2025 and beyond.

ONE

ENTERING THE INNOVATION ERA

成就創新世代

工業4.0成為全球的大勢所趨，同時推動香港發展高增值科技產業和生產工序。建造業亦積極轉型，由傳統的勞工密集產業革新至智能生產，邁進新時代。

金門建築(金門)與時並進，銳意與業界共同迎接工業4.0的挑戰。金門全面的業務範疇及創新的建築服務成為公司的獨特優勢，更被譽為客戶的首選承建商。我們的樓宇建築、土木、地基、機電工程及室內裝修工程，在內部的工程設計顧問琳寶、鋼結構、混凝土技術、機械部及創新團隊的全面配合下，為客戶提供一站式的高質建築服務。

我們的專業團隊一直秉持金門的核心價值 — 安全、誠信及卓越開拓創新技術。為提升施工效率和成本效益，公司正展開多項業務藍圖，包括「綜合數碼建造方案」(IDPD)，簡化製造及裝配過程的設計(DfMA)、建築信息模擬(BIM)、機械人、人工智能、感應器、三維立體打印、虛擬實境和無線射頻辨識標籤等。

其中，BIM是一項革命性的工程設計及管理建造技術，它令所有工程項目均能以全數碼形式運作。我們可以先在虛擬世界中模擬籌備、建造以及營運，以協助管理及執行工程項目，有助減少設計改動及損耗，並同時增加施工效益。現時，金門已擬訂BIM 10D 藍圖，將BIM逐步由三維空間推展至十維空間的建築模擬，其中包括設施管理、自動化與機械人，從而提升建築質量。另外，在建造過程中，BIM作為設計的現代技術，可以配合DfMA整合施工計劃，在工地外生產預製組件，簡化在工地的施工程序，藉此改善工地環境，加強整體的生產力和競爭力。

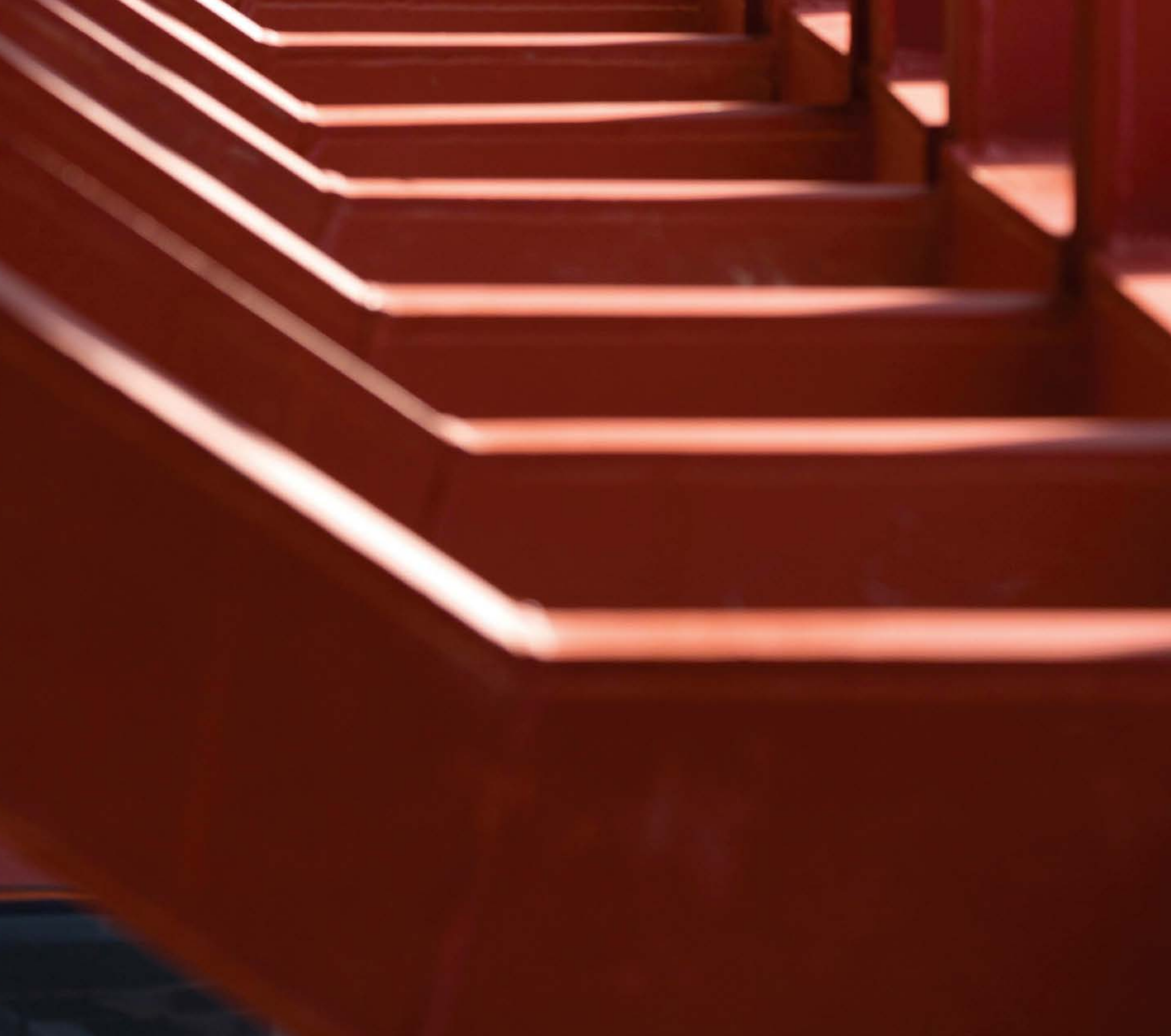
金門於工地應用感應器提升施工效率及加強安全。透過感應器收集工地及工程的資料，並傳送至BIM系統中加以整理，讓團隊及供應鏈可在整個工程期間活用這些資訊。除了引進機械人及連身機械裝置技術，金門亦成為全球第一間建築公司引入「無形襬」 — 雙腳外骨骼機械人，令工人更安全及有效地施工。

安全施工是我們業務的重中之重，金門一直竭力推動安全文化。傳統靠法規改善安全的做法並不能徹底剔除工地的風險，要締造零意外，管理人員以至前線工人必須各盡其職，改變根深蒂固「視之為安全」的思想，發揮「用心致志」的精神，防止意外的發生。因此，金門透過一系列的培訓教育及宣傳，加强安全文化，當中包括「I Lead 安全我撐起」培訓課程及「零傷害」計劃，並率先在香港建築界推行虛擬實境訓練課程，讓學員以第一身角度體驗不同工地情境，提升安全意識。

人才是金門最重要的資源。為了讓員工更易掌握自己的事業發展，我們推出電子學習平台，鼓勵員工突破自我，不斷上進。公司也致力推動不同年代的員工加強交流，藉着「逆向友導」計劃，讓資深員工能向擅長使用資訊科技的年青員工學習。

除此之外，金門非常關注建造業人才短缺的情況，我們一方面强調鞏固基本工程知識的重要性，同時積極推行多元化技術課程，讓工友裝備多種技能，以協助解決業界人力資源緊張的問題。另一方面，我們積極與建造業議會及業界的持份者緊密合作，加強人才培訓，當中包括建造業議會的「建造技工合作培訓計劃」及「進階工藝培訓計劃」，以增加半熟練技術工人及熟練技術工人的供應；我們亦與職業訓練局共同栽培新一代，為年青人提供具市場價值的技能訓練。

金門持守可持續建築，強調「善用、減耗、減排」。我們開創業界先河，率先使用生物柴油 ； 金門亦是首家建築公司採用可循環再造的高密度聚乙烯製造屏障、及採購超過95%森林管理委員會(FSC/PEFC)認證的可持續發展木材和夾板。我們在工地推行高效的「環保與關愛承諾」，嘉許在保護環境、創新意念、關懷工友福祉等方面有傑出表現的工程項目。此外，我們亦成為首家接受國際可持續採購標準 (ISO 20400) 評估的亞洲建築公司。



EMBRACING CHANGE

"You can't solve a problem on the same level as it was created. You have to rise above it to the next level."

Albert Einstein, 1879 to 1955.

Innovation is nothing new for Gammon Construction. Having reached its 60th anniversary, the firm, as Chief Executive Thomas Ho likes to point out, has been innovating continuously for six decades.

There is no doubt, however, that the construction industry as a whole has entered an era of radical and greatly accelerated change. Now, it is assimilating the implications of the Fourth Industrial Revolution and the Internet of Things. In the 21st century, says Ho, it is the innovators who will prosper. Indeed, it may be that it is only the innovators who will survive.

"Gammon has embarked on a programme of transformative change. That is perhaps most evident in our adoption of cutting-edge technology and new construction methodologies, but we are also reviewing and rejuvenating every aspect of our organisation, repositioning ourselves to take full advantage of the exciting growth opportunities ahead. We embrace change. Gammon always has," Ho explains.

Gammon's programme for change, as those who know the firm well would expect, is completely consonant with its founding principles. It is taking on the new challenges of the information age with a renewed commitment to the core values that have sustained it since its establishment – Safety, Integrity, and Excellence. Strict adherence to these is known as The Gammon Way.

Paul Morris, Gammon Head of Innovation. believes that the firm's success in innovation derives from a blend of engineering and construction excellence, a digital toolkit and inspired colleagues who are empowered to collaborate. "Relentless collaboration" is recognised as a keystone in every innovative company, Morris explains, and this is also true for Gammon.

"We understand that in order to deliver cutting-edge solutions for our clients, we need to harness the creativity and experience of individuals and teams across all Gammon business units. We also benefit from access to innovative global supply chain and can leverage solutions from other industries and adapt them to meet our needs. Whether its joint research and development with world class academia, supporting local start-ups or nurturing the next generation of Gammon digital engineers, we operate in a network of like-minded innovators who share our sustainability industry vision of the 'connected' smart city," Morris summarises.

Towards the end of 2017, it was determined that Gammon required a new strategy for Integrated Digital Project Delivery (IDPD). Its objective is to fully integrate processes from design to post-construction, using advanced communication and information technologies enriched by Building Information Modelling (BIM).

Gammon was already a pioneer in digital design and digital project delivery in Hong Kong. But the new ideas and new technology were being implemented on a project-by-project basis by individual business units, rather than according to a coherent strategy across the organisation.

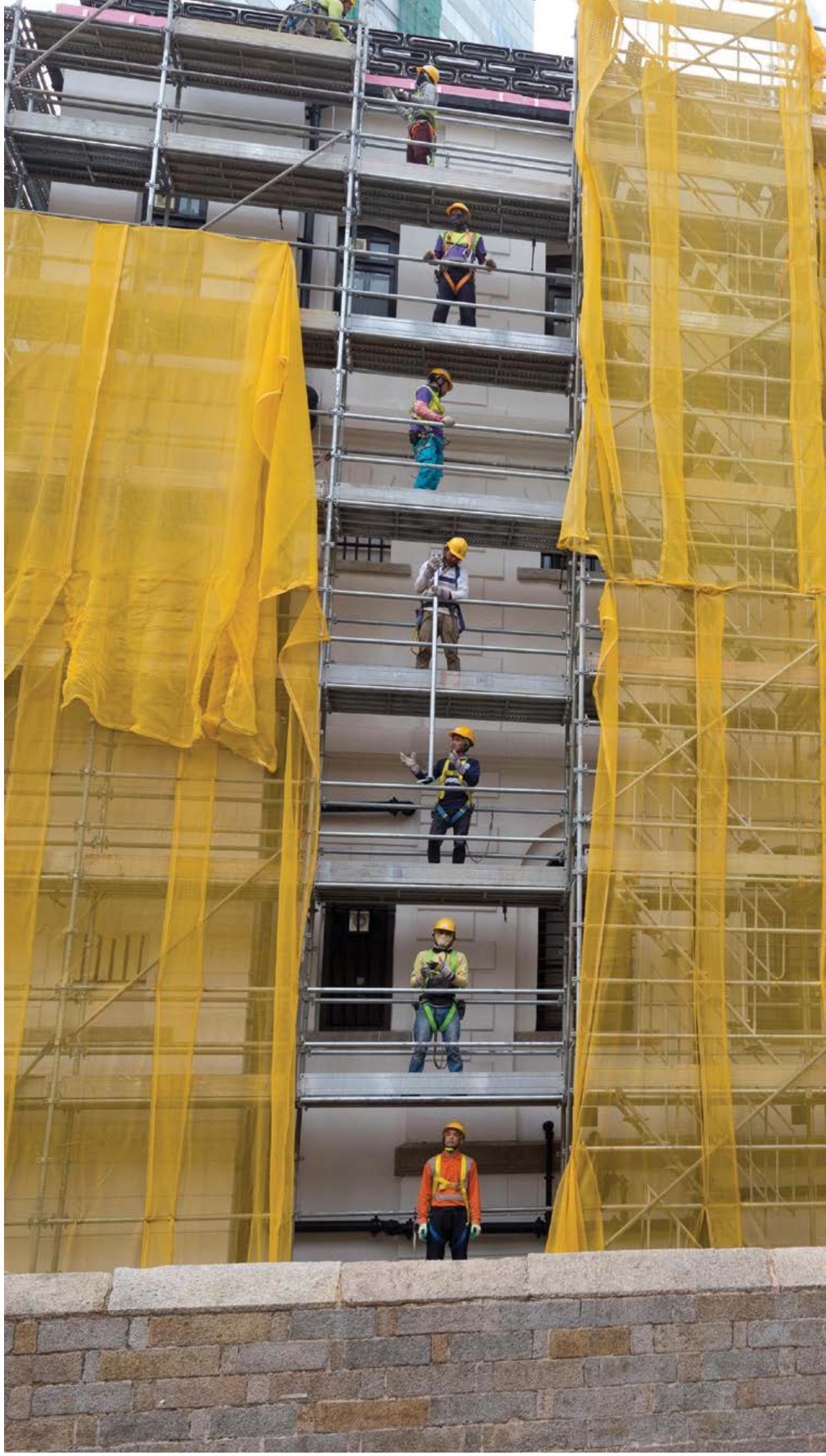
“The new strategy for IDPD is much clearer,” explains Senior Innovation Manager Andy Wong. “Each operational business unit has produced an individual IDPD roadmap based on four overall themes – namely BIM, Digital Transformation, Robotics and Design for Manufacturing and Assembly (DfMA). A Group Innovation Manager now oversees the operations of these central functions, as well as the co-ordination of ideas between different business units, and external communications with collaborating partners or overseas companies.”

This strategy ensures the new IDPD roadmap will be embedded into all projects from the tender stage up to completion, with BIM requirements agreed in advance and budgeted into the bid.

It is probably true to say that Gammon took its first significant step on the road to IDPD with the adoption of BIM – defined by the US National Building Information Model Standard Project Committee as “a digital representation of physical and functional characteristics of a facility… a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition”.

Gammon began to use the technology as soon as it became available, employing it first on the One Island East project completed in 2008. The firm has been a strong advocate for its use for Virtual Design Construction (VDC) throughout the industry. BIM is now used by the project team on every Gammon site, and is mandated in many tenders.

The technology’s initial impact was to replace the traditional two-dimensional technical drawings on which the construction industry had depended for generations with a three-dimensional virtual model. Visualisation helps to uncover any issues by eliminating clashes prior to construction, which greatly facilitates the reduction of wastage, abortive work and time-cost.



Physical models can also be made using BIM as the input for 3D printing. However, being able to model in the three spatial dimensions of width, height and depth only begins to unleash the power of emerging technologies.

BIM can also be integrated with 4D, providing the dimension of time, and 5D, adding the dimension of cost. Gammon has been exploring its 4D applications since Swire Properties' One Island East project. It has extended them further to 5D with the Ocean Park Water World project for material order predictions and concrete volume reconciliation.

Further dimensions are being gradually introduced. The Innovation Unit is now looking at BIM 6D, which incorporates sustainability credentials, and 7D for testing and commissioning of E&M equipment, including post-handover asset and Facilities Management (FM). The Common Data Environment (CDE) is considered the 8th BIM Dimension, providing a 'single source of truth' for all project internal and external stakeholders, to facilitate real-time collaboration.

Once a fully parametric detailed design model has been created, BIM design solutions and information can be optimised. BIM can also generate manufacturing instruction codes for robotics, for example Computer Numerical Control (CNC), enabling off-site fabrication and robotic welding in support of Design for Manufacturing and Assembly principles (DfMA BIM 9D).

Throughout this 10D BIM journey, Gammon will generate vast amounts of digital project data. Using Artificial Intelligence (AI) software platforms, it will harness the power of big data analytics to generate valuable insights and seek to optimise future delivery solutions.

Head of BIM Billy Wong joined Gammon in 2013. He had previously been involved in the earliest implementation of BIM in Hong Kong in 2005 on One Island East.

"We are the first company in Architecture, Engineering and Construction (AEC) in Hong Kong to use 3D printing from BIM, and we have used it to optimise designs and speed up assembly processes. A detailed co-ordinated model is better than hundreds of drawings and thousands of words to explain our challenges," Wong explains.

"Laser scanning is getting more and more useful for identifying clashes in 3D or even 4D. It has become essential for high-precision assembly and co-ordination projects. Photogrammetry is making a huge contribution to large-scale site formations. We can use a drone to take thousands of photographs, and from that we can generate a 3D model. It's not only more accurate, but it's much safer for the surveyors. BIM is not just a visualisation tool, it is a solution platform to integrate information from many peripheral technologies and to find the optimum solution in advance before construction on-site begins."

Terence Lui is the Innovation Unit's Head of Digital Transformation, responsible for the drive to eventually digitise all Gammon's data.

"We're establishing new standards for communication," says Lui. "Basically the idea is turning construction activities into digital information. We are streamlining processes and developing tools for people to use, but at the same time systematically capturing information about what they do so the computer can process it, analyse it, and produce reactions in a semi-autonomous way to revolutionise construction efficiency and productivity."

Gammon's digitisation strategy makes extensive use of sophisticated sensor and Radio Frequency Identification (RFID) technology to collect information. Bluetooth beacons are being used to track people on sites, while global positioning system technology tracks machinery.

Sensors can be used to evaluate the performance of machinery and identify maintenance issues before they adversely affect productivity.

"You can recognise problems when they arise and react accordingly. It saves a lot of wastage. Say a machine being used by Foundations isn't drilling as fast as it did previously. If the information is captured, you know about the problem earlier, and you can fix it faster. You can transfer digital information at almost no cost in real time. The better we understand what's happening on the

sites the better we can collaborate and make informed decisions," Lui explains.

Capturing data in a digital format from plant, labour and materials is the first major step towards total digitisation, and Andy Wong says, the team has made "remarkable progress" particularly on tracking both labour and plant on pilot sites.

"These, at the same time, serve as demonstration sites to educate colleagues in the company who may not all fully understand and appreciate the benefits of digital construction. And digital transformation itself is a long journey. The ultimate goal is to fully automate the data-capturing process during construction works to harness technologies such as AI to extract maximum insight. The end goal is what we call Digital Project Management." says Wong.

"The key to the success of achieving a full IDPD is a highly-detailed and data-rich BIM environment for all areas of the project, including the physical elements such as concrete walls and steel beams, plus windows and doors, as well as time factors such as the sequence of works. We ultimately hand over the project to the client with all the digital information they will need in the future."

A typical IDPD project cycle, he explains, starts with a highly-detailed BIM model to serve as a digital communication platform for co-ordination. Using the model, all stakeholders will be involved from the outset in the design, planning and quantification.

"Using walkthrough software such as Fuzor will help stakeholders to understand how the project will look by testing it in a 3D environment – perhaps with the aid of Augmented Reality/Virtual Reality (AR/VR), while the project programme and scheduling will be established with the aid of 4D BIM software such as 4D Synchro Pro," he says.

Once the digital design is agreed under IDPD, the digital information can be sent directly to CNC machines for the manufacturing of elements of the building including façades and ductwork, as more of Gammon's supply chain becomes geared towards smart-factory automation, now widely referred to as "Industry 4.0".

"For other elements, we can bring components of the building together into modules using DfMA, also known as Modular Integrated Construction (MIC) in Hong Kong

or Prefabrication Prefinished Volumetric Construction (PPVC) in Singapore, again with the aid of BIM. The logistics planning of bringing the elements together on-site is aided by the availability of all of the information in a digital format, and workflows can be automated to help plan deliveries and programmes through the 4D interface," says Wong.

Gammon's ACE Dashboard, a centralised cloud-based database uses Tableau software to pull together business information enabling smart decision-making in real time, while state-of-the-art technology deployed on IDPD sites includes sophisticated software such as the self-developed Gambot, designed to simplify and digitise on-site reporting as well as cutting-edge frontline robotic equipment, and exoskeletons.

"We will also be using sensors to help us understand the location of workers, behaviour of structures and location of key components, and using these to automatically update progress in the digital model," says Wong.

"At inspection and commissioning, we are recording compliance information via mobile devices on-site and uploading data directly into the digital design model. At the end of the project the digital design model can be used to manage building maintenance, subsequent amendments, or even live security checking. That takes BIM into 7D."

Already BIM 7D is being used on projects such as The Quayside, Hysan Place and Lee Garden Three.

Gammon has also established a new subsidiary, Digital G, to handle distribution of technology the firm has either developed or acquired, serving both its own business units and a broader international constituency.

"Digital G's mission is to bring digital and innovative solutions to the urban environment in which people live and work, which includes not only the projects in our business, but also projects outside Gammon as well as Hong Kong," says Wong.

"It acts as a sole distributor to Hong Kong and Southeast Asian countries for cutting-edge technologies brought from other parts of the world; as an investor or joint-venture partner with technology startups with future technologies; and as a window for capitalising on and commercialising Gammon's products, for example the inventory management apps developed by the digital transformation team."

NURTURING A CULTURE OF INNOVATION

Gammon is well-positioned to implement its new IDPD strategy at least partly because the firm has a tradition of embracing innovation. This dates back as far as founder John Gammon's pioneering work in reinforced concrete in the early 20th century.

As Paul Morris makes clear, the thinking of Gammon senior management today is very much aligned with the founder's.

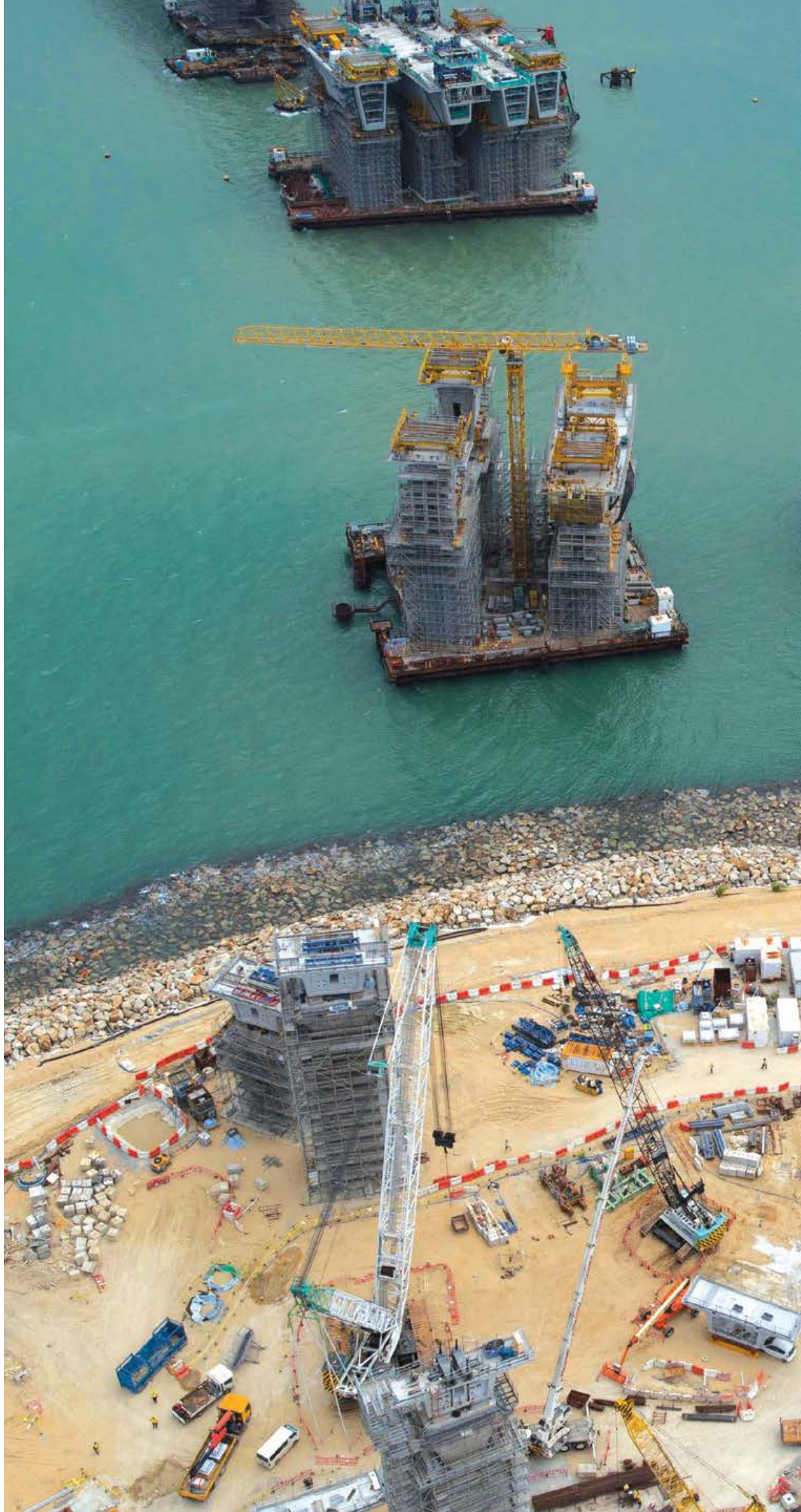
"Never stop innovating, always collaborate and remember, there's no such thing as a bad idea!" he says.

Gammon's culture of innovation has been carefully nurtured over the years through initiatives such as running the annual Innovation Competition, open to all Gammon staff and assessed by a jury panel of industry leaders and Gammon senior management.

The competition was introduced in 1999 to encourage original thinking at all levels of the organisation. From the outset, it challenged staff to question established ways of doing things and the originality of the entries was a revelation.

"It's always a tough job to choose the winner," says Professor Christopher Leung of the Hong Kong University of Science and Technology, who has judged the competition twice, in 2015 and 2016.

"There are a lot of good entries and we basically look at broad categories like productivity, sustainability, safety and so on. That means there are a great many entries in different categories, so it's difficult to compare, but with our panel of eight judges from different disciplines I think in the end we arrive at a fair assessment. It's a good way to encourage innovation. Apart from the Construction Industry Council's Innovation Award competition, in which some of the Gammon entries also contend, I'm not aware of any others."



The popularity of the formal annual Innovation Competition led to the establishment of the Innovator of the Month programme in 2011, which opened up the opportunity for staff to contribute ideas for incremental improvements to Gammon's processes through a more simplified submissions procedure. This, too, proved to be a wellspring of good practical ideas.

"People can submit by cellphone with just a photo and a simple explanation. The programme generates a lot of synergies," says Innovation Manager Vincent Yeung.

Gammon's ability to rapidly produce and adapt IT solutions to meet the strategic needs of the business has been a significant asset to the firm, Gammon Chief Information Officer and Director of Information Management Services Horace Chu points out.

"When I joined Gammon, IT was a back-office process and support," he says. "Over time, we created more value to the frontline of our operation and IT is now a strategic partner in business."

"It's not only the creation of software solutions that matters," Chu says. "More importantly, it's the ability to influence behavioural change in our business to make adequate use of the latest technologies to generate strategic value. Seamless collaboration and partnership is important for the success of the business, and we are driving cultural change in the use of information and digital technologies in the correct direction."

Among the many IT developments of recent years Chu highlights i720, a BIM collaboration platform that facilitates the use of BIM by end-users. The i720 platform provides a wide range of BIM related functions including mobile on-site defect and quality checking, model viewing and comparison, and site information tagging and sharing. He also stresses the importance of Gambot.

"Integrated with i720 and other frontline digital systems, Gambot is a software robot empowered with the latest AI technologies. In addition to the intelligent conversational Chatbot interface, it has Computer Vision for on-site safety, and productivity monitoring and reporting. It also possesses machine-learning capabilities for construction-planning automation. Gambot facilitates frontline operations and captures information from engineers and workers at the forefront of our operations for scientific data analysis." says Chu.

"We take a very agile approach on technical solution development. We partner with frontline operations to start small and grow quickly."

Gammon's commitment to nurturing innovation extends beyond the firm's own sites and business units, as Construction Industry Council Chairman Chan Ka Kui notes.

"In November 2017, the Construction Innovation & Technology Application Centre (CITAC) was launched and, in recognition of Gammon's contribution to innovation in the industry, Thomas Ho was appointed as chairman for a two-year term. He has served the construction industry for over 30 years. Aspiring to transform the industry through innovation, he has spearheaded efforts to introduce new methodologies and technologies," he says.

"Under his leadership, Gammon is a pioneer in Hong Kong to apply virtual reality gaming technology to safety training and to make use of robotics for construction. He has also promoted the adoption of BIM, DfMA, photogrammetry, and other new technologies in design and construction processes."

According to Dr Delman Lee, Chairman of the Hong Kong Management Association's Hong Kong Sustainability Award, Gammon's determination to influence government and industry in the adoption of biofuels was a major factor in the decision to give the firm the Grand Award in the Large Organisation Category of the Hong Kong Sustainability Award 2016/2017. This recognised Gammon's achievements through multiple initiatives across a variety of projects.

"I could see that Gammon is trying to lead the industry towards a certain standard," says Lee. "I think their work on biofuel shows society that it's actually possible. It's quite impressive that they manage to use 100 per cent B5 on

the Hong Kong operations and the source of the biofuel is Hong Kong. To get it going and keep it going in your own community is very good. I am a little bit of a techie, so one project that stuck in my mind was Gammon's use of VR to train people on health and safety aspects of using equipment – they also train their contractors."

Gammon Executive Director Gilbert Tsang agrees that the construction industry in Hong Kong looks to Gammon for leadership in the adoption of new technologies and it provides necessary impetus.

"Hong Kong's construction costs are the highest in Asia. The reason we are so expensive is a combination of a shortage of labour, the political environment and being conventional in the use of construction techniques. The industry has to invest in technology. Twenty years ago, we were using pagers, now we use smartphones. We're in the early stages of robotic construction. But Hong Kong is relatively slow by comparison with Singapore and other countries. In Hong Kong, we lead in the adoption of new technology and when opportunities arise we can mobilise ourselves much faster than a lot of our competitors."

Tsang is in charge of Gammon's Building, the E&M and China businesses, and of Entasis Ltd, a wholly owned subsidiary specialising in façade work. He singles out curtain walling as one important area in which Gammon is using technology to transformative effect on projects with complicated façade requirements such as Lee Garden Three, the Asian House redevelopment and the luxury residential building at 8 Deep Water Bay Drive.

"There is a lot of scope for human error in curtain walls. But with the software we now have and the potential to send the instructions straight to the CNC Machine, we don't need humans to input the data," says Tsang.

Gammon was also responsible for introducing Hong Kong's first curtain-walling installation robot, an innovation which has already significantly enhanced safety and accuracy, and has the potential to reduce the installation labour requirement by as much as 25 per cent, addressing an urgent issue for the local industry. In one of its many "firsts" for the Hong Kong construction industry, Gammon successfully trialled the technology on the Murray Building hotel conversion on which it was used to install both glass and metal panels.

“The average age of construction workers has risen and the workforce as a whole is shrinking,” says Thomas Ho. “We are subject to restrictions on imported labour. But we are not going to replace workers with robots. We are going to make their tasks easier and at the same time boost our productivity with robotic devices.”

“In recent years, we have been struggling to hire welders, so now we are adopting this robotic arm to do the welding,” adds Executive Director C.C. Wai. “We are also developing robotic arms to work on-site even under adverse weather conditions.”

Gammon’s innovative use of robots is not confined to Hong Kong. A tiling robot is currently under development for Gammon by a Swiss company, initially for use in Singapore, but will also be introduced in Hong Kong after it has been fine-tuned.

“We are still working on a prototype, which I hope can be rolled out this year,” says Executive Director for Singapore and Vietnam Hee Wee Tan. “We’re now on the second prototype. Laying floor tiles is a time-consuming task and this technology should make the process significantly more efficient. Initially, we are getting it to work on central floor areas, but eventually it should be able to tackle edges, which are more difficult. ”

Tan also points out that Gammon has been a strong advocate for BIM in Singapore, and is already using it in 8D for future building maintenance on its latest project for Global Switch.

Another area in which Gammon is pushing the envelope of what is possible is exoskeleton technology. The firm imported its first Exoskeleton Suits from Japan in 2017, and is already reviewing new-generation models from the United States. Battery-operated devices worn by workers and weighing about the same as a loaded backpack, Exoskeleton Suits provide automatic support each time the wearer begins to lift a heavy object. The repetitive strain that contributes to the back problems of so many construction workers is dramatically reduced.

Following successful trials in 2017, the use of exoskeletons is being widely adopted on Gammon sites, as is the purely mechanical ZeroG Arm, designed to make heavy tools such as impact drills, chipping hammers and grinders effectively weightless. Workers can now use them for extended periods without suffering from fatigue, particularly when working at a height.

Like the Exoskeleton Suit, the ZeroG Arm's adoption has both worker safety and well-being benefits, which will multiply as the technology is adapted and enhanced. Significant productivity gains were achieved from the ZeroG Arm's use on the Hong Kong Global Switch, and Express Rail Link 810A and 811B projects, and more of the units are being purchased.

Workers' welfare is also the motivation behind Gammon's introduction of the Chairless Chair – another exoskeleton-based device that attaches to the backs of workers' legs. While not impeding their ability to walk around the site, it provides instant support when they move into a crouch, squat or seated position, and is particularly appreciated by those engaged in activities requiring them to assume positions that can strain back and leg muscles – welding, plastering and painting among them.

Gammon scored highly in the CIC Innovation Award competition of 2018 with two examples of ground-breaking new construction technology, one of which was a refinement of the Exoskeleton Suit. Gammon partnered with Hong Kong Polytechnic University to create the Bio-Inspired Anti-Vibration Exoskeleton (BIAVE), which won First Prize in the Construction Safety category.

The BIAVE is designed to reduce the transmission of vibrations from hand-held tools such as jack hammers by as much as 90 per cent, minimising adverse effects on blood circulation and the risk of carpal tunnel syndrome. Facilitating more complex handling, the anti-vibration structure is designed to work with tools of different sizes and weights without sacrificing efficiency, and can be installed quickly and easily.

The Gammon-invented "K-Frame", developed for the Tuen Mun-Chek Lap Kok Link project, won Second Prize in the Construction Productivity category. Developed by a team led by Engineering Development Manager Ted Lawton of Lambeth, Gammon's in-house engineering design consultancy established in 1976, the original K-Frame concept has been extended into a versatile family of machines for use in the erection of segmental bridges. They offer project teams remarkable benefits in terms of cost efficiency, productivity and sustainability.

The signature "K" shape of the machines, with a lifting power to self-weight ratio of more than two to one, can be configured for different jobs using a common parts library of interchangeable modules, and Gammon intends to license the proprietary technology internationally.

It is one of many examples of innovative thinking from Lambeth to support the firm's operations in Hong Kong and its other markets internationally.

"If you invest in innovation, there needs to be a likelihood of a return. We have been successful in maintaining focus on strategic innovations that are proving transformational for Gammon," says Lambeth Director Ian Askew. "It's easy to fill a shop window with ideas. But when you walk into that shop you should see lots of real value stacked on the shelves. I see Lambeth as a conduit for collaboration, internally and externally. We do a lot of engagement with academic institutions in Hong Kong and overseas. That global exposure to new thinking is very important. It energises and instils fresh perspectives."

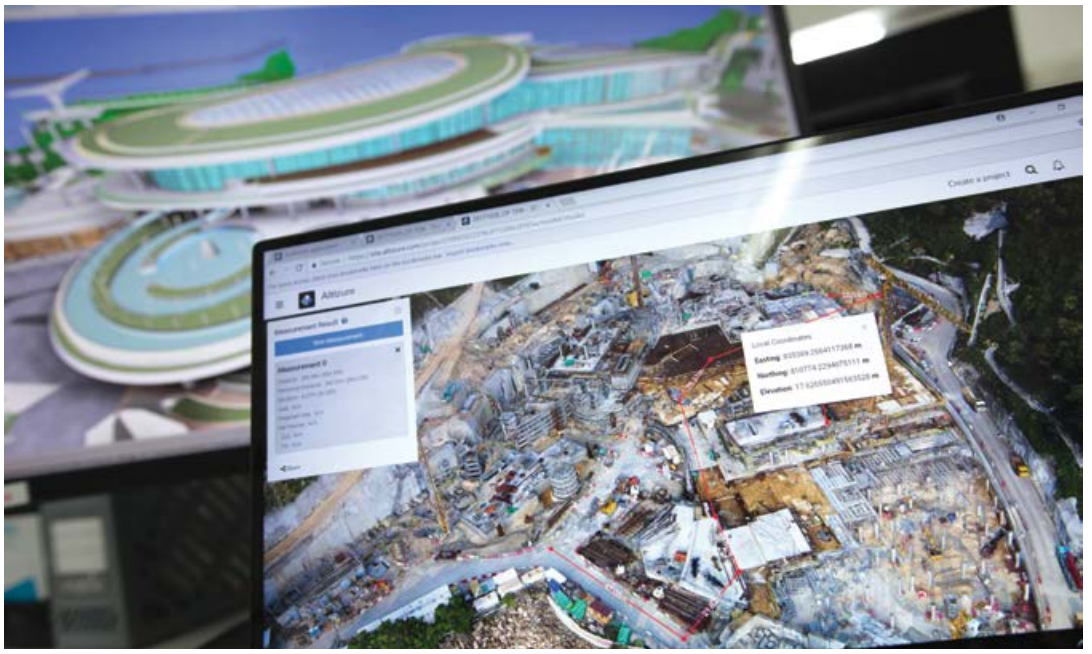
Areas in which Lambeth is responsible for important innovations, Askew explains, include the use of VR technology to vastly increase the safety of temporary works and a continuous flow of original ideas for value engineering on permanent works. Lambeth has also collaborated closely with Information Management Services on apps and other solutions, which have made the firm's digital transformation strategy possible.

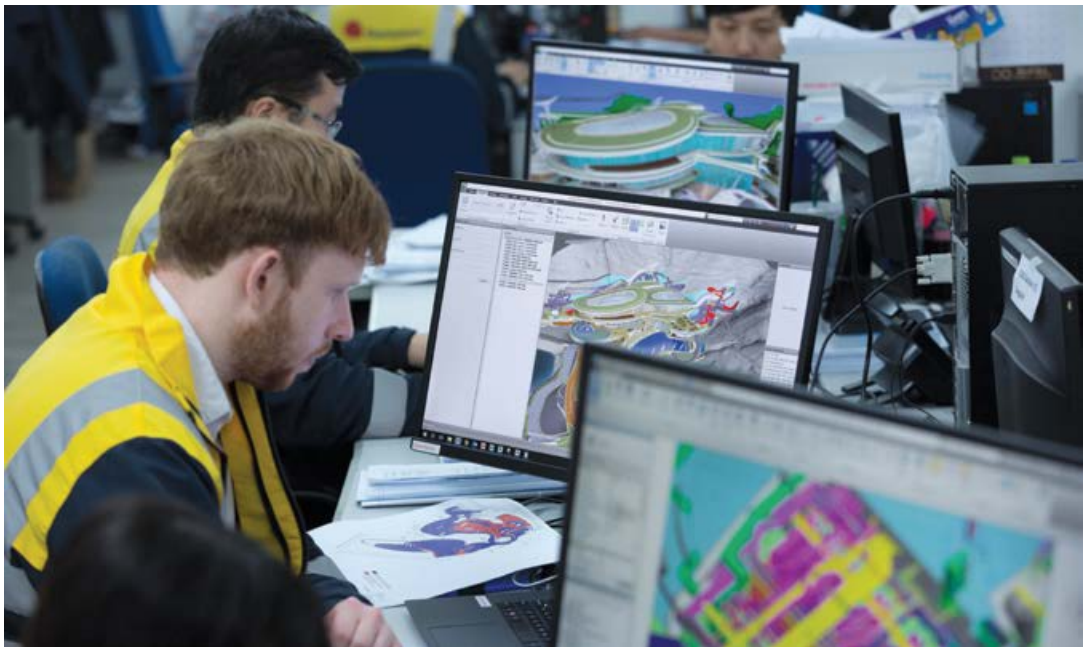
"Temporary works control and assurance is an important area, and we've developed various electronic systems and apps that improve control and make a big contribution to the safety performance of Gammon. Safety is our number one priority," says Askew.

"BIM is very important. We're very much promoting the idea that you build first in the virtual world, which enables the removal of a lot of risk in reality, and it is in Lambeth's DNA to engineer out the dangers. The initiatives we've got are really preparing Gammon for the future, and the future is digital. I think AI will strip away a lot of the more mundane activities and that will allow engineers to concentrate more on creative things. Advances in sensor technologies are hugely exciting. Coupling our digital design models to sensors on Gammon sites, so that they interact automatically and self-learn, which is what we are working towards," he says.

INNOVATIVE METHODOLOGIES

New technology on its sites is only one aspect of Gammon's strategy to meet the challenges facing the construction industry. Another major element is moving fabrication tasks historically performed on-site away to factories where they can be completed more safely and efficiently. Precast and prefabrication solutions are another





area of innovation Gammon has pioneered in Hong Kong. In 2016, the firm won the Hong Kong Awards for Industries Innovation & Creativity Grand Award for its work in build-to-order full modular MEP plant construction.

“We’re trying to modularise construction, so there are fewer people working on construction sites. We’re going to need to deliver projects with a lot fewer people, moving forward, so we need systemised production methods. In Gammon, one of the first questions we ask is what site operations can we move into a factory? We pride ourselves on working with our customers and supply chains to provide innovative delivery methods to improve quality, save time and reduce reliance on large numbers of site workers. Assembling kits-of-parts made in a factory rather than constructing on-site is the future,” says Ian Askew.

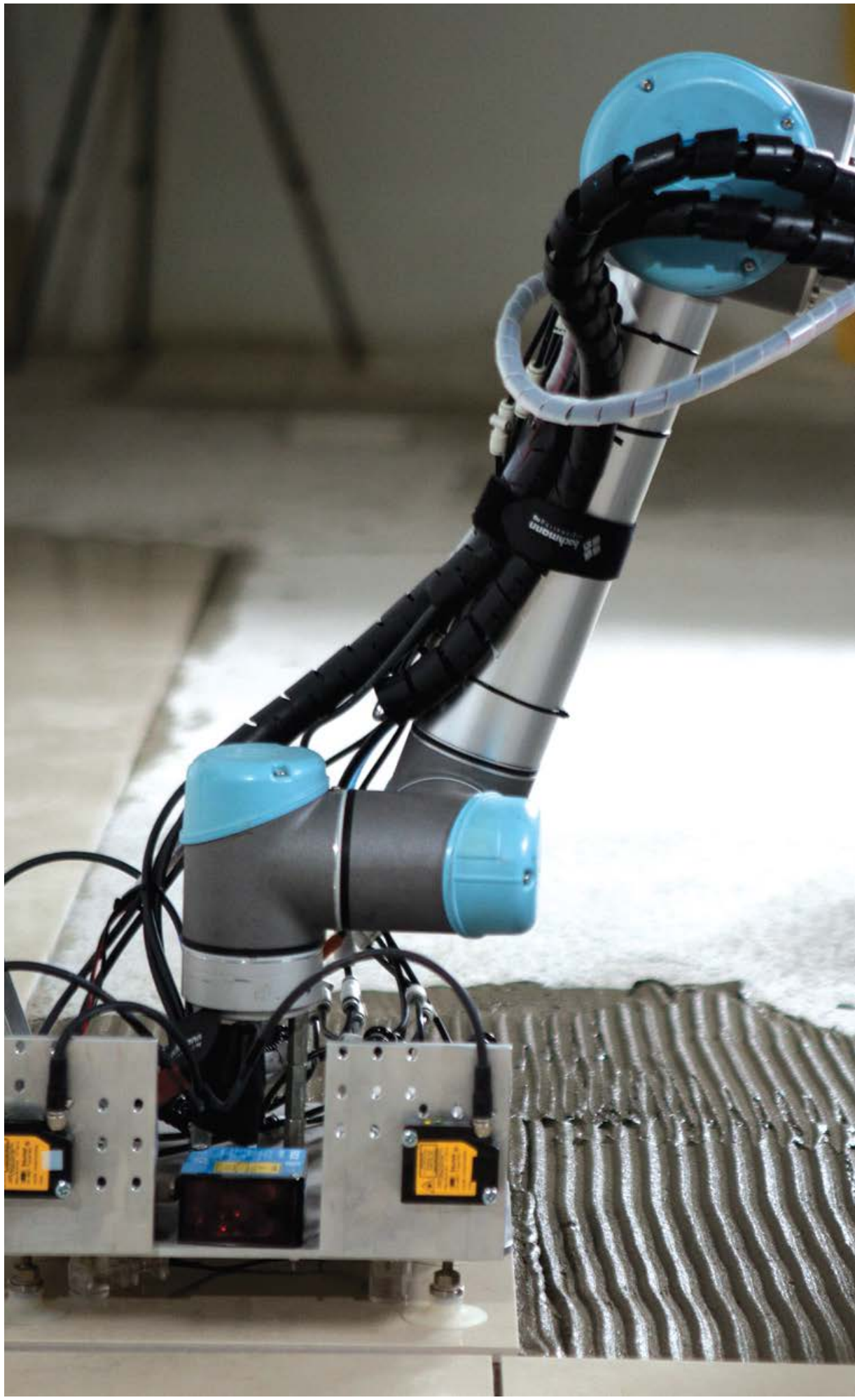
Lam Wo Hei, Principal Consultant at the architectural practice of Wong and Ouyang (Hong Kong) Ltd that has a decades old association with Gammon, first worked with the firm in the 1980s. He, too, believes that Modular Integrated Construction (MIC) is the best solution to many of the difficulties the construction industry in Hong Kong currently faces.

“We all face the problem of younger people not being prepared to suffer 40-degree heat and do steel bending on-site. Not surprisingly, they prefer things to be precast and easier to handle. It’s less demanding on the body and therefore safer. This is a direction that all of us should be aiming at, so that we can attract younger people to join this industry. Otherwise all our steel benders are over 50 years old, so how can they last much longer? There are so few of them and costs are going up. According to one recent survey, construction costs are higher in Hong Kong than Sydney, and 30 to 35 per cent higher than in Singapore. If we move more work off-site and engage more young people, we can keep the construction costs lower and make Hong Kong more competitive,” he says.

Chan Ka Kui says the Construction Industry Council would like to see Gammon’s initiatives in MIC more widely emulated throughout the industry.

“In the next 10 years, if MIC can be generally adopted in Hong Kong, it would be a revolutionary change. This not only answers the shortage of manpower, but also addresses issues of quality, safety, time and cost for construction. It may even mean we can export our industry skills to the major Belt and Road projects,” he says.

Playing a crucial role in enabling Gammon to make this radical change to construction methodologies is the Construction Services Division, including Gammon Steel



and the firm's expanding operation in the mainland, which includes Pristine in Dongguan, a 50,000-square-metre steel manufacturing operation.

"Only a few companies have their own factory for structural steel and that gives us a big advantage," says Senior Construction Manager C.F. Chan.

"We have around 100 staff members and 200 workers in mainland China, and around 70 staff and 120 workers in Hong Kong, so it's quite a big operation. We try to do the complex processes in the mainland and the simple processes in Hong Kong. Because of the co-operation with the Lambeth team in Shenzhen, we are able to bring a lot of innovative solutions to new tenders, and we also work closely with Foundations. We're working hard on optimisation and doing a lot of PPVC for projects," says Chan.

Gammon Steel's work now extends from tunnels to high-rises, and from mega structures to fine architectural features. It is, Chan says, a one-stop solution. He sees structural steel buildings as a growing area in the future for Gammon, and points to projects such as The Forum at Exchange Square and the two new buildings at Tai Kwun as examples of what can be achieved.

"The two new buildings at Tai Kwun demonstrate what we can do with complex steel structures – they were challenging on many levels, including delivery because of the location, and the whole structures being cantilevered to the wall. We're more proactive in persuading clients to consider steel buildings and I think there will be more of that kind of business over the next four or five years."

The era of digitisation and PPVC opens up exciting new possibilities for both Gammon's steel and concrete divisions, and as Dr Herbert Zheng, General Manager Concrete Services, points out, his department is entirely comfortable embracing change.

"Innovation is our routine agenda. It is integrated into our daily operations. We hold meetings every two weeks to review new ideas. We have developed a lot of techniques to improve our productivity. On the process side for quality control, we have installed temperature sensors on the concrete mixer trucks to get real-time temperature measurements. This also enables us to optimise our use of ice to cool the concrete, reducing waste. On the product side, we have developed ultra-high performance concrete and high-strength lightweight concrete, so construction stakeholders have more freedom to choose materials to realise their design concepts," says Zheng.

Robot technology for concrete testing is also under development. Zheng says that strong senior management support has encouraged the department to introduce new technology wherever possible to its operations.

"Because of the commitment of our top management to introduce new technology, we are proactively introducing concrete maturity sensors to transmit data wirelessly. We have been trying the Chairless Chair, which has made a significant contribution to staff welfare. Thomas Ho came to the batching plant and tried the Chairless Chair himself, and that was a great contribution to workers' morale," says Zheng.

Enabling Gammon's expansion is Gammon Shenzhen, established in 2002 and, in the words of Executive Director Edmond Lai, is a "China Centre of Excellence".

"It's now a strategic resource centre supporting our growth in Asia by providing quality Design, Drafting, Commercial, Finance, HR and Procurement services," he explains.

In recent years, Shenzhen has also emerged as an important resource centre for Virtual Design and Construction (VDC) and Electrical and Mechanical (E&M) works.

"Resourcing of 3D professionals is quite challenging in Hong Kong, but the situation is better in Shenzhen. In addition, we have built a new curtain wall team there – cross border leveraging of talent is very important," says Lai.

INTEGRATED INNOVATION

The combination of the increasingly versatile steel, concrete and plant and equipment departments of Gammon's Construction Services Division, and the innovative thinking of Lambeth, has created a platform for Gammon's Building, Civil, Foundations, and E&M business operating units to offer an ever more integrated range of construction services. This has placed the firm in a strong position to act not just as the main or lead contractor for ambitious and challenging projects, but in many cases as the sole contractor.

While Gammon continues to participate in joint ventures and to work with subcontractors, it is able to handle every aspect of many contracts from foundations to superstructure, façade and E&M, concrete, structural steel, plant and equipment – and to a much greater extent than most contractors its own full-time labour.

"One of the strengths of Gammon is that we are a one-stop shop," says Gammon Executive Director C.C. Wai.

“Most of our competitors just focus on a single speciality and have to rely on other subcontractors, which can compromise safety and quality. Our strategy is to work to widen the spectrum of capabilities all the time.”

Wong and Ouyang’s Lam Wo Hei sees advantages in the firm’s “one-stop shopping” capabilities in expediting project planning – particularly if the firm is called in at an early stage.

In recent years, Gammon has undertaken a number of consultancy contracts on projects prior to their going to tender, for Swire Properties among other clients. Lam, who has worked with Gammon on several projects for Swire, believes earlier involvement of the contractor in complex projects is a direction in which the industry should go.

“It is typical in Hong Kong that when the professionals finish the design and put it together with the Quantity Surveyor for the tender document, and after the tender is awarded, you start the next morning, so there’s little time for planning. If the contractor gets involved earlier, they can seriously look at the merchandise system, offer design suggestions and make the project more efficient and buildable. For most clients, especially the government, a lot of red tape prevents this early engagement. But I have been talking to many civil servants, saying that if we plan our schedule correctly, if one can have the tenders earlier, we could give the contractors a longer time to prepare, to do co-ordination and approval of drawings, but at the same time offer system construction possibilities earlier in the day. The technology is there. It’s just adoption within a time frame and within cost parameters that is challenging our industry,” says Lam.

Gammon Executive Director Gilbert Tsang sees the same problem.

“We are talking about modularisation, but that’s dependent on having the time for the planning. In Hong Kong, when you sign the contract the client wants work to start immediately,” he says.

The path to innovation is often an obstacle course, but Thomas Ho, for one, is confident that Gammon is on the right track.

“We must be bold and consistent enough to adopt innovations across the entire business,” he says. “Innovation will enable Gammon to compete in a totally different dimension of advantage, and make construction one of the most attractive industries to the next generation.”

PEOPLE – THE HEART OF OUR BUSINESS

"Train people well enough so they can leave. Treat them well enough so they don't have to."

Sir Richard Branson, 1950 -.

In 2008, 4,000 people worked for Gammon. Ten years later in its 60th anniversary year, the firm's headcount has risen to 8,000, mostly in Hong Kong but also in Macau, mainland China and Singapore.

The firm is known throughout the construction industry as a responsible employer, committed to nurturing its staff and bringing out their full potential. Many graduates who join straight from university are still working for Gammon when they reach retirement age.

"At the heart of Gammon is people," says Chief Executive Thomas Ho. "We want to have sustainable growth, and for that we need high-calibre people, who understand the complexity and the technical challenges of our business."

The firm's commitment to its staff, and to their development, starts with site workers. Imaginative initiatives to improve the safety and comfort levels of often gruelling working conditions are fundamental to the code of values known as The Gammon Way. So is "upskilling" workers from semi-skilled to skilled. Those who join Gammon as trainees have a clear path to follow to becoming foremen.

Even for a model employer in the construction industry, however, these are difficult times for the Human Resources (HR) function, which in Gammon is headed by Executive Director Edmond Lai.

"The construction industry in Hong Kong as a whole is suffering from a serious shortage of skilled labour – the estimated gap being 5,000 to 10,000 people. Gammon directly employs 3,500 workers. We are good at retaining them, and that workforce gives us a definite competitive edge. But we still need external labour, as a portion of our works is subcontracted," says Lai.

According to the Construction Industry Council (CIC), in April 2018, Hong Kong had 468,976 registered construction workers, but the supply of active skilled workers still lags behind industry demand.

"We must also remember that Hong Kong has an ageing workforce. More than 40 per cent are aged 50 or over, and 12 per cent over 60, while of the skilled workers 56 per cent are over 50. We urgently need new blood," says Lai.

Another HR challenge is attracting graduates to succeed and advance to management roles. At all levels, Lai says, the industry needs to work much harder to address an image problem.

"Construction used to be perceived as embodying the three Ds – Dirty, Dangerous and Demanding. We have to change that through innovation. To attract the younger generation, we need to create a smart, intelligent working environment," he stresses.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As Ho and Lai see it, it is up to Gammon to set an example to the wider industry. In staff development, from worker to senior management level, Gammon leads the way in the Hong Kong construction industry.

The firm is also working closely with industry bodies including the Development Bureau, the CIC, the Vocational Training Council (VTC) and the unions to effect improvements across the industry.

Gammon has been an especially active participant in the CIC's Contractor Co-operative Training Scheme (CCTS). The average dropout rate each year between 2011 and 2017 was 26 per cent, but of the more than 700 workers Gammon has trained through the scheme, over half are not only still working in the industry but working for the firm.

Gammon's resilient culture of talent development shone when its team received four Gold Awards from the CIC in 2018 covering the company's training footprint in a range of arenas.

"We are pushing to create a higher quality workforce for construction. There has been more funding recently, but Hong Kong should catch up with other leading countries in this area. Singapore's vocational training budget in GDP terms is much higher than ours," says Lai.

He points out that labour without trade qualifications is predominant in the industry – a problem that has prompted Gammon to expand the base of its CCTS training to 17 trades.

One important part of the way forward for the industry, Lai believes, is Master Worker Apprenticeship programmes to produce the smart labour of the future on whom the industry will depend. As well as advancing that agenda within Gammon, as of 2018 he is serving as Chairman of the VTC Apprenticeship Training Board.

"Our HR strategy is to develop a high-quality workforce to reinforce our core capabilities through three to four years of intensive training – from scratch to a truly skilled level. The one- or two-year path many are pursuing at the moment is far from adequate. Some trades, like multiskilled plastering, may need five to seven years of hands-on training," he explains.

The Technician and Craft Apprenticeships are now coupled with comprehensive "Earn And Learn" training in the Civil, Building, Building Services, Electrical and Mechanical and Quantity Surveying areas. These entail a big commitment to workers who may or may not remain with Gammon after training. But while many do stay, Lai says, as long as they remain in the industry and continue to make contributions, this investment is worthwhile.

"We want the industry to have more capable people, whether or not they stay with Gammon. Our strategy is long term and for the benefit of the entire industry, and we think it is having an effect. The VTC has responded to our suggestions, and the CIC has built a construction academy and will seriously consider apprenticeships for that," says Lai.

CIC Chairman Chan Ka Kui says, "The established Institute of Construction aims to build up a well-developed career path for the benefit of construction workers, as well as being a symbol of quality construction training under the CIC to consolidate training resources. This means making frontline and management training more systematic to draw more of the younger generation to join the industry."

"Apart from workers, we are also constantly upskilling our professional staff," says Lai. "The Smart Prove Unit formed in the Building Division is an example. Team members are trained in scientific applications designed to assure the quality of our building products on completion to customers' satisfaction."

Since 2003, Gammon has had its own Academy for the development of graduate talent. But much has changed in the way HR operates since then, and the firm has recently undertaken a thorough review of its staff education and development programmes and policies, bringing them into line with the industry's changing needs and the different expectations of personnel.

The twin drivers of a radically new approach to the development of individuals and the mapping of their career paths within Gammon are, on the one hand, the empowerment of the individual to make choices, and on the other a renewed emphasis on practical fundamentals.

That started in 2015, with the restructuring of Human Resources so that each of Gammon's business units had its own partner in HR – someone with a deep understanding of the needs, nature and strategy of that particular unit.

The next step was to similarly restructure the Gammon Academy, of which Lai is President. It retains its original function of managing and integrating the firm's many diversified training programmes, mostly developed and delivered internally by Gammon staff. But, in what Lai calls a "journey of transformation", it has refocused its energies

and upgraded its technology.

“We devolved responsibility from the central Academy, splitting it into six colleges. Each corresponds to a business unit, each has its own Dean and its own roadmap. My function is to steer the business units, so the colleges are aligned with our business strategy,” he says.

In Hong Kong, Building, Civil, E&M, Foundations and Construction Services (CSD) each has its own college. All are supported by an Advisory Board, chaired by Lai. There are also four supplementary specialised Centres of Excellence: Commercial, Safety and Sustainability, Innovation and Technology, and Lambeth. Singapore has its own college of which Executive Director Hee Wee Tan is Dean. Each Dean is supported by course owners, who run the individual programmes, of which there are about 150 per year.

Staff members eligible for the courses are divided into new recruits, administrative personnel, middle managers, and senior management and above, and programmes are pitched at a suitable level for the experience of each group.

Much of this transformation has been made possible by technology. An integrated e-enabled Learning Platform called iLearn allows the Academy’s students to access course materials, and Lai says the emphasis of what was formerly classroom learning has shifted online and on-site.

“Theory is still very important, but the emphasis has been redirected to practicality,” says Lai. “Thomas Ho has stressed the importance of going ‘back to basics’. Before, people were taking courses without necessarily having an immediate application for what they were learning. Now we’re focusing on that.”

Percy Chan, Gammon’s Director for Building who joined the firm as a graduate trainee in 1987, also stresses the need for young recruits with an eye on a future in management to get to grips properly with site work.

“Our young engineers must master the basic skills. They must be able to lead a construction team. They need to get experience of how to lead a gang of workers, and how to work with subcontractors, so they have to be trained on the operation side and get their hands dirty,” he says.

Another new Gammon watchword for its operations is “streamlining”. Instead of filling out forms on paper, staff members now apply to enrol in courses online, and a line manager will review the application before deciding whether or not to approve it. If the application is accepted, it is added to an online enrolment list.

“It’s all automated. Once the programme is about to start,

the system will send an invitation to the participants. There is also an e-library in which you can look for useful materials. This is the kind of automated single platform we are promoting to support people learning," Lai explains.

Enrolment in one of the Academy's colleges is part of the continuous learning that Gammon fosters assiduously, and which starts in many cases even before a graduate joins the firm.

The Fellowship Programme, established in 2002, offers students in relevant disciplines in tertiary education in Hong Kong, mainland China and Singapore the opportunity to participate in a one-year programme – including a six- to eight-week internship – to get to know Gammon. This gives them the opportunity to find out whether a career with the firm might suit them.

"What sets Gammon apart from other internship opportunities is they think beyond the internship," says Professor Christopher Leung of the Department of Civil and Environmental Engineering at the Hong Kong University of Science and Technology. "There is a kind of continuous engagement. A senior mentor helps the student and brings them to sites and explains the projects to them. That's a very different approach."

One indication of how successfully Gammon is engaging with students is the result of a 2017 poll conducted by global employer branding company Universum, which surveyed more than 5,000 students from the city's top universities. Gammon was ranked as among the most attractive employers.

Gammon's relationships with the leading institutes of tertiary education from which graduates join the firm are not confined to Hong Kong, however.

In the mainland, Gammon has offered scholarship programmes to the South China University of Technology, Tongji University and Tsinghua University. Graduates can go on to work with the firm in the mainland, Hong Kong or Singapore.

"I have a sort of informal relationship with Tongji University and I have been recruiting their fresh graduates," says Hee Wee Tan, Executive Director for Singapore and Vietnam. "I had four of them join us three years ago and they are still with me. That's the kind of talent we want. I find the students from China are very good and technically sound. They are driven people."

Gammon also works with Singapore universities but the Lion City, like Hong Kong, is a challenging environment in which to retain talent, says Tan. The median age of Gammon's 850 workforce in Singapore is 40 years and six months, compared with 36 and seven months in Hong Kong and Macau, and 28 years and five months in the mainland.

"Every year, we go to universities to recruit," says Tan. "For the past five years, we have taken on at least six engineering graduates per year but, as in Hong Kong, the retention rate is not as good as we would like. Around half of them left after one or two years. We persevere though. As a multinational company, we have career development plans, a good work-life balance, and an active recreation club, so we have a lot to offer. I have always said, 'You can't go wrong with talent'."

Graduates with ability and a taste for hard work who do stay with Gammon have the prospect of a long and rewarding career ahead of them. For the next generation of leaders, Gammon's Talent Development Programme is geared to helping promising individuals in junior management develop the skills they will need.

The three Ds remain an issue, and persuading capable graduates to stay in the construction business continues to be a challenge, but given the structure and support Gammon offers, it's little wonder so many talented people who do stay choose to remain with Gammon throughout their entire careers.

SHALL WE TALK?

In construction, as in most industries, it is generally taken for granted that the young and inexperienced have much to learn from older wiser heads.

This is generally true, but Gammon's senior management also believes much can also be learned from younger minds in more junior positions, but with a fresh perspective.

"About two years ago, I launched a survey into cross-generational communication, and I deliberately used Eason Chan's popular song 'Shall We Talk?' to put a spotlight on that theme," says Edmond Lai.

This phrase from Chan's hit reflected on what may be lost if older and younger people fail to talk to each other, and it had become clear to Lai and Thomas Ho that traditional channels of communication with younger people in the firm were no longer working as well as they once had.

"Responses to the staff survey we ran from 2000 to 2015 were dropping. It had lost its momentum. Around 30 per cent of our workforce now is below 30. We had a rising generation of site engineers in their twenties – energetic, young with a lot of dreams. This was the new Gammon – so how did we communicate? How did we engage them? How should we respond to their needs?" reflected Lai.

Not, as it turned out, in the way the older generation had assumed.

"We asked our younger staff if they would like to communicate with senior management the way they communicate with each other, through social media, and they said 'No. We would rather communicate face to face'. For company issues, they wanted a forum. Social media is for social purposes. That was interesting to discover," says Lai.

To build more of a culture of engagement with new staff, HR instituted a policy of what Lai calls "High Performance Caring". This is embodied in a programme of mentorship designed to make the first six months of a new staff member's employment with Gammon a welcoming experience, and to help them contribute more effectively to the business at an earlier stage.

Both experienced and inexperienced new staff are assigned mentors to help them adapt to The Gammon Way and to understand how the firm works.

"To face the new environment, new staff members must be open-minded and take the courage to make changes. They should try to let go of old ways to adapt to the team and enhance themselves and perform," says E&M Director Bansom Lam.

Learning, however, can flow in the other direction, as Thomas Ho points out.

"We are now talking a lot about 'Reverse Mentoring' – I have a 29-year-old reverse mentor who has taught me a lot about digitisation," he says. "We are coming into a new era. For innovation, you have to break up the hierarchy and let people flourish."

Lai stresses that the firm is not issuing directives to experienced staff on what they can learn from youthful subordinates – but it is encouraging them to listen. They also receive some guidance in how to communicate with their younger colleagues through a training programme 'Leading With Care'.

"We've set up what we call Innovation Scouts – young people typically in their twenties. They are more exposed to what's online and going on in the digital world. We encourage all the managers in their interactions to listen to young people and encourage them to come forward with ideas. Make it a way of life in Gammon," he says.

"There must be two key elements in mentoring or reverse mentoring," adds Horace Chu, Gammon's Chief Information Officer and Director of Information Management Services and a member of the Gammon Academy's advisory board. "Respect and trust. You have to have both, or it won't work. Gammon works hard to be open to new thinking, and we are putting real effort into changing behaviour."

Retaining staff today, according to Lai, involves managing different expectations, happiness among them. Good salaries are no longer the only concern. Staff members are concerned about their well-being in a broader sense. In 2016, an annual staff happiness survey was introduced by HR and, in the first to be conducted, health, happiness and work-life balance emerged as the major priorities.

"I published a league table of who had the happiest workforce among the business units and who had the least. It motivated people to change and improve and 162 actions were taken," says Lai.

Much important communication with and between younger Gammon personnel takes place at a social level, notably through the Young Professionals Group, which organises a wide range of social activities.

"We have a lot of social engagement in Gammon – barbecues, boat trips and so on," says Lai. "Those are good times to listen. Thomas Ho organises some hiking days with the young engineers and during those walks he listens. I do the same and encourage others to try that."

Younger staff, Lai acknowledges, come from job-hopping generations in which staying with one employer for an entire career is the exception rather than the rule, and to retain them is a challenge.

"We are better at retaining talent than our competitors, but it is getting more difficult. HR has to work much harder than used to be the case," he says, with a smile. "But we are doing some interesting things."

SAFETY – THE HIGHEST PRIORITY

"The safety of the people shall be the highest law"

Marcus Tullius Cicero, 106 BC to 43 BC

"Safety has always been a core value, but the way we approach safety and sustainability evolves continuously," says Gammon Executive Director Edmond Lai.

"In the old days, it was mainly about compliance with the rules we created as our lines of defence. Now it's more about mindfulness – building the Zero Harm culture on our sites, so safety is a constant preoccupation as well as a clear priority. Training has a lot to do with achieving that. In Human Resources, we're working to create a real safety mindset that will have a genuinely lasting impact, and it is fundamental to our 'Leading for the Future' and 'I Lead' training programmes."

For Gammon, working towards ever higher standards of safety is a never-ending journey – one for which the firm introduced in 2009 a strategy called Zero Harm, which is about the removal of the risk of fatal and serious injuries. It had been adopted the previous year by Gammon's 50 per cent owner Balfour Beatty, and when Director Tony Small joined the firm – in 2010 from Balfour Beatty – he was charged with its implementation. Small now heads the functions of Health & Safety, Sustainability, and Systems & Audit.

"I report directly to Chief Executive Thomas Ho, which is a good indication of how important safety and sustainability are to Gammon," says Small. "We have quite a large safety team of about 130 people. That's grown considerably since I arrived in 2010, and that relates to the expansion of Gammon. We had around 10,000 people then, and that has risen since to about 20,000."

The original Zero Harm strategy set targets for 2012. These were achieved, but it was determined the platform had proven its worth and should be extended and updated for the indefinite future. It continues to be fundamental to every Gammon project, and retains the same aim for each: to remove the risk of fatal and serious accidents by achieving zero fatalities and zero injuries either to workers or to members of the public.

In 2017, Gammon achieved a marked improvement in its Accident Incident Rate – 3.8 per 1,000 workers, ahead of a target of 5.0. However, the firm also had to reflect on the loss of life of a worker who was killed following a fall-from-height accident in Hong Kong.

Construction is well known to be a dangerous business, but Gammon has never accepted fatalities as inevitable. As always, hard questions were asked about how this accident could have been avoided.

"In 2013, there was an average of seven incidents per 1,000. We're now down to less than four, and the fatality rate has also come down considerably. But one fatal accident is one too many," says Small.

"We can't predict exactly how fatal accidents will occur or when they will occur. But we can predict the mechanisms that lead up to an incident, and that does enable us to develop strategies to reduce the likelihood of those incidents occurring."

Gammon's Zero Harm strategy has been to adopt a model based on four distinct layers of protection.

"The first layer is design and engineering – can we engineer out the risk? The second is materials, plant and equipment selection, moving away from the cheapest and most convenient to what offers the greatest surety in terms of safety. The third layer is process – double-checking every engineering decision for safety, and the final layer is making safety personal; making the individual safety conscious and aware of the responsibility they have not just for their own safety but for that of everybody else," says Small.

Making safety a responsibility at all levels has been crucial to the success of the model – regular top management visibility on safety site walks, and listening to operatives' concerns, has helped to engage all stakeholders in the shared commitment.

Zero Harm also has the virtue of absolute clarity. If ever there is a conflict of project interests, safety always takes precedence. Consequently, Gammon has been able to achieve an accident rate far below the industry average.

Making safety a responsibility at all levels has not diluted the importance of strong leadership, however. In 2011, Gammon introduced its "Leading for the Future" training programme for managers that looks at leadership, the role of leadership in Zero Harm and the characteristics of Gammon's organisational safety culture that help protect it from a major incident or accident, namely: Mindful; Informed; Learning; Fairness; and Respect. The training also emphasises the importance of self-awareness and understanding of the influence and impact leaders have through the concept of the "leadership shadow", and identifies areas where leadership can be improved.

Gammon's willingness to adopt new technology has also created new avenues for safety enhancement. Take virtual reality for example.

"Every construction worker in Hong Kong or Singapore has to go through our mandatory basic training before they are allowed onto the site. There is a three-hour programme for which we now use virtual reality in place of traditional PowerPoint training," says Small.

Gammon developed its virtual reality training system in collaboration with the University of Hong Kong and the University of New South Wales. It employs high-powered computers, and a controller designed for video games with which many participants are already familiar. They can experience a simulation of dangerous situations, such as working at a height, while remaining in a safe, controlled environment.

"It gets the messages across much more effectively. The workers put on virtual reality headsets, for example, to simulate trying to walk along an I-beam without falling off, and we have large high-definition TV screens, so everyone else in the programme can also see what the person with the headset sees. It's quite good at getting dialogue going," Small explains.

Virtual reality technology has also been invaluable for training how to identify defects in temporary scaffolding works, also called falsework. These can lead to collapses, which have the potential to cause multiple fatalities.

"I think the falsework training we've done has had a major impact on the industry," says Small.

"What we've been able to do with one of our engineers, Iain Mowatt, is to summarise in just three key points what the critical issues are, and we've designed a whole training programme based on this. The issues are eccentric loading, where the loading is not balanced on the scaffolding; a lack of diagonal bracing to take the loading to the ground; and excessive cantilevers. We've been able to show people that if you have just one of these failure mechanisms, the scaffolding is unlikely to collapse. If you have two, a collapse is possible. If you have three, a collapse is certain. Being able to summarise a complicated engineering system in three key issues and provide the training behind that has had a real impact on the rest of the industry. And, because setting up falsework takes a lot of time, that was ideally suited to the virtual reality world. Virtual reality also allows us to change the defects and randomise them, so it's been a powerful tool," he observes.

Another helpful simplification in Gammon's code of safety practices was the 2016 introduction of four easy-to-remember Golden Rules, replacing a previous 12. The new rules, Small says, apply to all workers in all situations and are simply: "Be fit for work; Always receive a briefing before starting work; Report all unsafe events and conditions; and Stop work when anything changes". Helping to get the rules across were four videos prepared by project teams, using humour to make their point.

Rather than take a purely top-down approach to safety instruction, Gammon has been quick to take advantage of the insights into site safety from frontline workers – including those of accident victims, who are invited to share their experiences with their colleagues, in person or on video.

A landmark 2013 safety training initiative was led by Sub-Agent Leung Siu Hung, who conducted a highly effective programme over a nine-month period for riggers. No fewer than 1,055 workers have participated since 2013, from whom overwhelmingly positive feedback was received.

“We chose Leung because he has considerable operational experience and is held in high esteem by all of his colleagues,” says Tony Small. “We have a number of what we call ‘Safety Stars’ within Gammon, who we recognise every year. They’ve gone on their own journeys in safety and sustainability, which they share, and we’re very proud of them.”

It is also important, he stresses, that every worker on the site knows their safety is a priority of senior management, and ideas to improve it can be exchanged.

“On our projects, it’s the commitment of the senior leadership team that makes the difference. We’ve been leading a series of directors’ site walks on Saturdays and that has been a productive initiative. We’ve taken project managers round to other projects to perform something like a peer review. They look at quality and methods, and that has been a powerful process. We’ve taken younger engineers around as well, and really it shows them what good looks like, and not just in terms of a presentation. They are expected to offer feedback and there have been some useful recommendations – that’s been a change, broadening the base for consultation.”

Gammon’s programme of what the firm calls “Bold Commitments” is another example of uncompromising insistence on unbending safety practices.

“When we make a Bold Commitment it’s about doing something significantly differently,” Small stresses.

“Over the past five years, we’ve introduced about 20 of them, and although sometimes it’s hard to do, we stick to them. Take those relating to electricity, for example. With floating circuits in ceilings, we will not energise the distribution board until everything is complete. That can

cause massive disruption, but it has driven a behavioural change. Similarly, in the construction industry, it has been normal for one qualified electrician to have five non-qualified people assisting him, but we see that as a huge risk. We've simply said we have to have one qualified electrician with two assistants before we energise – and after energisation the ratio shifts to one-to-one. We can ensure that happens because all workers on the site have to use the hand-key system and behind that are all their competency records. We use that to check the electrical subcontractor is abiding by our standards," says Small.

Electrical safety has been further enhanced by the adoption, wherever possible, of cordless power tools – a policy that goes far beyond legal requirements and has established Gammon in a leading position in yet another area of best safe practice.

In introducing ever more demanding safety measures, Gammon is not setting itself apart from other contractors so much as challenging the industry as a whole to measure up to new, higher standards.

"We sit down with our subcontractors before the contract award and we tell them about our Bold Commitments, and that we expect them to abide by them. We're very clear upfront about that," says Small.

"I think we're probably unique in how serious we are about implementation. Our Bold Commitments are not objectives to be aimed for. They are absolute minimum requirements, and nobody can challenge that."

Gammon Chief Executive Thomas Ho is well known as a passionate safety advocate, committed to raising standards not just within Gammon but across the industry as a whole.

"We have been working together with our supply chain, clients, research establishments, business groups and the wider construction industry and are starting to see progress, albeit slowly in some areas," says Ho.

Construction Industry Council Chairman Chan Ka Kui points out that Ho has been conspicuously active in initiatives to promote safety through the adoption of new technology platforms.

"Thomas Ho has forged partnerships in the development of technology," says Chan. "For example, he has initiated the CEO Safety Forum to drive changes across safety systems with new thinking and technological applications.

Under his leadership, Gammon is the first construction company in Hong Kong to develop virtual reality gaming technology for safety training and to make use of robotics for construction."

Ho's CEO Round Table Safety Forums facilitate a dialogue at senior level between representatives of relevant government departments, institutions, worker's unions, Gammon clients, consultants, suppliers and academics, helping to make progress in the implementation of safety improvements and to create multidisciplinary stakeholder alliances, committed to better safety management.

"Gammon has taken an important lead in promoting safety in the construction industry," says Chow Luen Kiu, Chairman of the Hong Kong Construction Industry Employees General Union.

"We have been encouraging the Hong Kong government to follow Gammon's lead in strengthening safety training. Out of 350 cases of serious injury or death reviewed by the government, 70 per cent could have been avoided."

Since the introduction of Zero Harm in 2009, Gammon has won numerous awards for the health and safety aspects of its projects. Among those recently accepted are the Best Safety Performance Award from the West Kowloon Cultural District Authority for two consecutive six-month periods of work on the Lyric Theatre foundation works contract, and the highly respected Golden Helmet Award from construction charity the Lighthouse Club. But the real reward for Zero Harm is an accident-free site.

ENHANCING HEALTH AND SAFETY

Gammon extends its "Prevention is better than cure" approach to safety by taking a close interest in the health of all the workers on its sites – those of its subcontractors as well as direct Gammon employees.

Registered nurses Jo Ling and Elaine Kwan have been employed full-time by Gammon since 2011. They travel constantly to Gammon projects where they work alongside site nurses, providing health education and promoting health consciousness, an important aspect of which is conducting on-site health checks for workers.

On a busy day, they may handle as many as 80 or 90 health checks, giving workers advice on diet and lifestyle and providing information on both public and private healthcare access. By the end of 2017, 85,000 checkups had been conducted on-site.

Since 2013, Gammon has also standardised its medical check scheme at the clinics for machine operators and drivers, and extended it to staff and workers aged 60 or above. In 2016, over 1,000 staff and workers benefited from the scheme.

"There was one case when a worker was found on-site with extremely high blood pressure with a very high risk of stroke. We suggested he go to the emergency room of the hospital immediately. But with insufficient medical knowledge, at first he didn't understand his serious condition and refused to go. After repeated persuasion, he did go, and was admitted to the hospital for five days. He still thanks us when we meet him occasionally at a site. I felt contented that he eventually listened to our advice and changed his lifestyle," says Jo Ling.

"Our focus has shifted from secondary to primary care in the form of prevention, and now we are extending our scope to mental health. We have organised stress management workshops, explaining the links between stress and physical health problems," she adds.

Elaine Kwan finds her position as a Heathcare Leader refreshingly different from her former role, working in a hospital.

"The job takes me to different corners of Hong Kong including remote work sites. I need to pack my equipment, such as blood pressure, blood glucose and blood cholesterol machines and other necessary tools in my big backpack and carry it around," she says. "Sometimes, we even have to travel by boat to construction barges. I try my very best every time to manage my seasickness."

In addition to health checks, Ling and Kwan have delivered many health talks geared to the site workers' needs, on subjects ranging from dengue fever and the Zika virus to wound management and heart diseases. Medical specialists, doctors, traditional Chinese medicine practitioners, nurses, dietitians, physiotherapists and fitness trainers are often invited to give health talks to workers and staff.

"I joined Gammon because this is a meaningful job," says Jo Ling. "Not many companies in Hong Kong involve themselves so actively in health education and promotion and, most importantly, caring for staff and workers. It is essential and yet Gammon is a pioneer."

SAFEGUARDING THE FUTURE

"You cannot escape the responsibility of tomorrow by evading it today"

Abraham Lincoln, 1809 to 1865

In 2018, it is almost universally accepted that sustainability must be a priority for all construction industry contractors. It was not always so.

Gammon's first Sustainability Report, published in 2003, clearly stated the firm's sustainability objectives and what it was doing to achieve them. It was a pioneering document. Fifteen years later, Gammon remains the leader in the field in Hong Kong.

"We're very proud of having constructed more sustainable buildings in Hong Kong than any other contractor," says Gammon Director Tony Small who heads the functions of Health & Safety, Sustainability, and Systems & Audit. "We're proud to be leading a change in the industry."

Responsible for advancing the cause of sustainability within Gammon, and for promoting it to a growing number of stakeholders outside the firm, is a 30-strong team led by Group Sustainability Manager Emma Harvey.

Harvey joined Gammon in 2015 with a brief to reinforce and expand a holistic culture of sustainability within the firm, focused on all its processes, and anchored by the conviction that efficient construction has sustainability as its foundation.

"I get involved in value management workshops for major tenders, but I don't have a sustainability 'hat' on for those," she stresses. "I'm there to help drive efficiency."

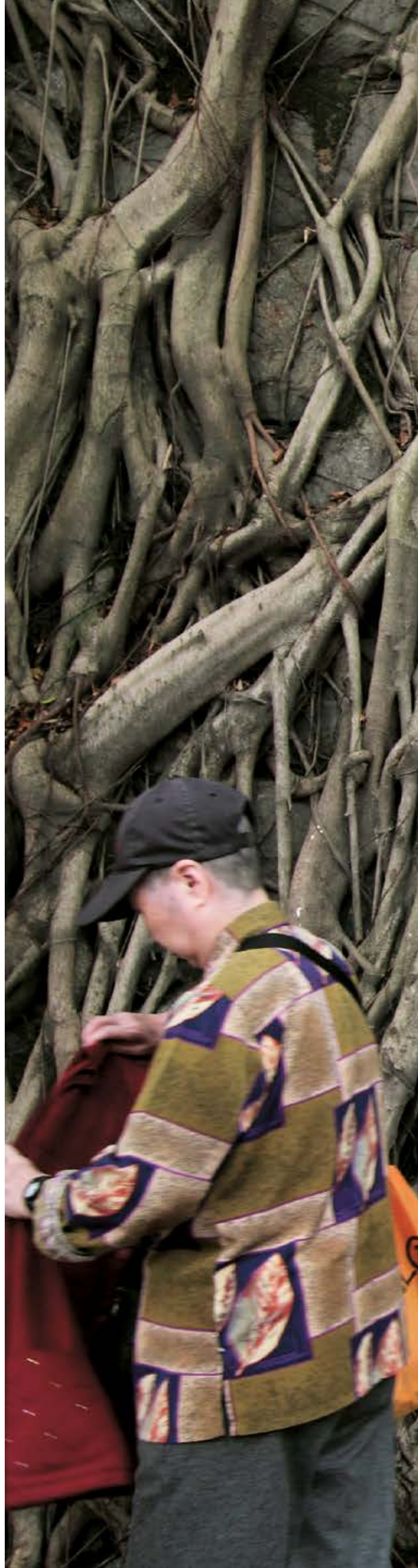
In 2012, Gammon introduced its Sustainability Roadmap 2020, articulating its goals for the next eight years. They were to promote the adoption of Gammon's Zero Harm safety ethos across the whole construction industry; to minimise the firm's impacts on the environment and reduce energy usage; to procure safe and responsible products, works and services; to optimise sustainable design, methods and materials, offering better alternatives wherever possible; to bolster construction's status as a viable long-term industry valued by society; and to adapt skills and grow expertise to meet developing stakeholder needs.

According to Harvey, so much progress has been made towards each of these objectives that the team is already looking at a roadmap for 2025 and beyond.

"We're looking at where construction should be in 2030, and what we need to do in order to get there ourselves. That involves seeing how we can integrate the United Nations Sustainable Development Goals into our business, mapping where we are, and considering what we can do more of. There's a tremendous amount of support from senior management and a lot driving it at other levels. People are aware and want to do better," says Harvey.

At the opening of Gammon's 2017 Safety Conference on the theme of "Smart Safety and Well-being", Thomas Ho said, "At the heart of this is Gammon's strategy to encourage innovation and creativity" and one initiative to stimulate creative thinking within the firm has been to establish a Next Generation Sustainability Panel.

"I think that's quite a characteristic Gammon initiative in terms of promoting engagement," says Harvey. "We're getting young people, from, for example, our engineering and quantity surveying teams involved. They're not sustainability professionals, but they have a special interest and that helps to drive us."

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The annual Sustainability Report, which documents Gammon's recent achievements with solid statistical information, and identifies new targets, continues to play an important role in keeping sustainability at the fore within the firm.

The department has also developed a "Sustainability Dashboard", collecting all environmental, social or safety data, including associated costs, and provides a monthly summary.

Other initiatives to keep sustainability at the forefront include the annual Safety Conference, which allows for a lively exchange of ideas between Gammon colleagues and stakeholders.

In 2017, the conference brought together no fewer than 900 participants, from within the firm and from among stakeholders, including clients and public bodies such as the Construction Industry Council (CIC), with CIC Chairman Chan Ka Kui delivering the keynote address.

"In recent years, Gammon has been perceived as a pioneer in construction techniques and practices," says Chan. "They bring in new methods and skills to push the construction industry to move forward."

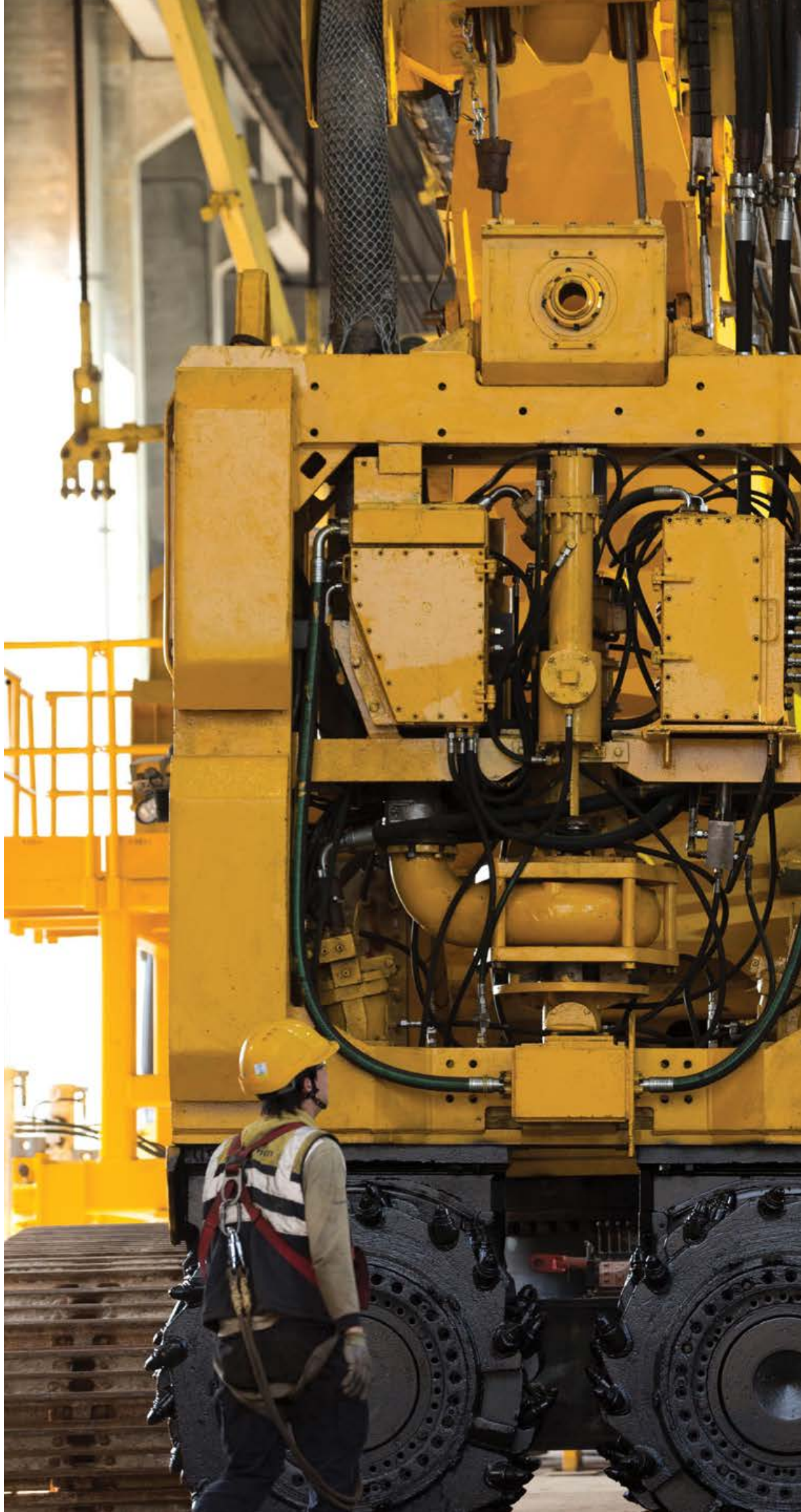
Effective communication, Harvey and Gammon Senior Environmental Manager Eddie Tse agree, is critical to advancing the sustainability agenda.

"Every time we publish our sustainability report, we do a roadshow to communicate with our project teams and get feedback on how they interpret and understand sustainability," says Tse.

"It's not only about the environment. It's about how you sustain your business, make a profit and look after your people. It's a holistic approach. That makes sustainability real to people. It's part of day-to-day operations. We tell them, 'You are already doing this. It's just a question of how you can do it in a better way'."

A particularly effective programme for improving the environmental performance of sites has been the Green and Caring Site Commitment Scheme.

"The Green and Caring Site Commitment Scheme is a self-assessment framework for project teams, which covers environmental and safety issues, but also considers worker welfare and recognises innovation," explains Tony Small.



Achievement is graded at Bronze, Silver or Green Flag level, with the “flagworthy” sites being considered exemplary.

“The teams are always making incremental improvements. If they think they are flagworthy, then an executive director, one of our sustainability team and I will do an inspection,” says Small.

“All the data is verified before we go, and for us to award them a flag they have to be absolutely consistent in every area. We’re very strict. If they are, we give them a sum of money for a project celebration, and people get very disappointed if they don’t achieve flagworthiness. It’s a voluntary scheme and it gets quite competitive.”

It is now common for clients to require that a project should achieve the Hong Kong Green Building Council’s Building Environmental Assessment Method (BEAM) Plus and the United States Green Building Council’s Leadership in Energy and Environmental Design (LEED) accreditation. In tendering for these projects, Harvey says, Gammon has a definite competitive edge.

“The amount of green building work that we do has gone up. That could be a product of the market rather than just us, but we were recognised as the contractor who completed the most BEAM Platinum Plus projects in 2016. And in the civil area, in 2016 for the Tuen Mun-Chek Lap Kok Link – Southern Connection Viaduct Section we won the Gold Hong Kong Award for Environmental Excellence. That project was very much about respect for nature. There was lots of interaction with the natural environment and we impressed the judges with the way we minimised the impacts from an ecological viewpoint,” she says.

As well as tendering for projects that clearly embody green values, Tse says Gammon goes out of its way to make each of its projects a little greener wherever possible.

“We try to influence and sometimes even educate a client by showing them how we can offer more sustainable solutions along the supply chain. When tendering for a project, we’re heavily involved in finding environmental initiatives that can be integrated into the design. Can we use low-carbon concrete for example? We then highlight what we can do. The sustainability agenda is built into tenders,” says Tse.

Harvey points out that Gammon has a dedicated environmental professional assigned to each project, who is responsible while work proceeds for identifying areas in which performance could improve.

“For the Murray Building, we introduced quite a lot of initiatives ourselves to give the building better performance, cut material use, or reduce waste. Then there are projects that set more demanding targets, which we are particularly well-positioned to achieve. The Quayside is interesting from a sustainability viewpoint because it is our first WELL® Building Standard project, which is all about healthy indoor environments and occupants’ well-being, and it is one of the first in Hong Kong. We also won the Gold Hong Kong Award for Environmental Excellence for Midfield,” says Harvey.

“We’ve been working closely with the Innovation team to try to drive better performance and better understanding of what we’re doing. In sustainability, however well you are performing you can always improve.”

GAMMON’S CARBON JOURNEY

“We have to address climate change now, so reducing carbon emissions is a Gammon priority,” says Eddie Tse.

“We started our carbon journey five years ago. Not many companies like to report carbon issues, but Gammon has made a point of it, and there are a lot of initiatives linked to carbon.”

In 2013, Gammon began reporting and accounting for its greenhouse gas emissions, in line with ISO 14064 standards. An emissions profile was built up from which the biggest area to emerge was diesel consumption.

“That prompted the initiative to use biodiesel, which has reduced our audited emissions by 5 per cent,” says Tse. “The second-highest contributor was electricity consumption, so we started looking at further improvements in energy consumption using smart electricity meters. The CIC Carbon Label for our ready-mixed concrete also demonstrates our commitment to low-carbon products.”

Tony Small adds that wherever possible Gammon will propose alternative methods and materials to reduce the embodied carbon in a project.

"For example, we have the carbon footprint values of 22 concretes certified by the CIC as "Outstanding" category low-carbon product, so if you buy one cubic metre of grade 45 mega-pascal concrete, which is the most popular in construction, you will have used nearly half a bag of cement less. Hong Kong uses about 7 million cubic metres of concrete every year, so that's a potential saving of at least 3 million bags of cement."

Dr Herbert Zheng, General Manager of the Concrete Services Department, points out that to date Gammon is the only construction company in Hong Kong accredited under the CIC Carbon Labeling Scheme for ready-mixed concrete.

"Objectively, reducing the carbon footprint of a concrete mix is quite straightforward," says Zheng. "Use as little cement as possible to produce the same quality of concrete, and that will create the minimum of embodied carbon. We are accredited as having the lowest level in Hong Kong."

In addition to the many measures Gammon routinely takes to reduce carbon emissions on its sites, Harvey and her team closely audit the carbon performance of the firm's own offices.

"We participate in the Carbon Care Label programme, which demonstrates that we're trying to reduce our carbon footprint, and we have installed smart electricity meters at our Tseung Kwan O office, which helps us to identify wastage. We intend to apply that to sites to increase our energy efficiency. We have indoor online air quality monitors, and we're piloting other sensors for environmental quality and plant operation using the Internet of Things," says Harvey.

"We have spent a lot of effort on understanding and managing our carbon and greenhouse gas emissions, and it is all linked to our business," says Eddie Tse. Our clients demand that, some industry standards demand it, our shareholders demand it and senior management demands it. And, not least, the planet demands it. There is no time to lose."

STRENGTHENING THE SUPPLY CHAIN

Sustainability for Gammon is closely linked to the supply chain, and Head of Procurement, Susan Siu, who oversees it, says that the firm's agenda is reflected in a department that is leaner and more agile than ever before.

"Our team is smaller than five years ago, which is good because it means it is more efficient. We are being more aggressive in our streamlining," she says.

Digitisation and improved information management systems have allowed Siu to reduce her team, split between the Gammon offices in Shenzhen and Hong Kong.

"Construction worldwide is a very traditional industry, but we have to innovate, and sustainable procurement is becoming more and more important," says Siu who believes the publication of ISO 20400:2017 provided a number of useful sustainable procurement benchmarks, and an opportunity to identify and establish best practices within the firm.

"The concept of sustainability isn't static – is constantly developing," says Siu. "We are now also focused on the social issues within our supply chain. Carbon emission reduction is one target, and one of our biggest achievements has been bringing biodiesel into the Hong Kong construction industry."

According to Siu, in 2012, Gammon realised that waste oil collected by recycling agencies from kitchens in Hong Kong could be formed into a biofuel and added to diesel, reducing carbon emissions during construction from using the fuel in plant and equipment.

"At that time, there were no established biofuel suppliers in Hong Kong. The mandatory requirement here is Ultra Low Sulphur Diesel (ULSD), so that is the product the oil companies supply. The government hadn't mandated biofuel but, because of our volume, we can actually influence the supply chain," she says.

One of Hong Kong's biggest fuel suppliers agreed to work with Gammon as a fuel partner, establishing a supply of ULSD blended with 5 per cent B100 biodiesel.

"We then conducted a lot of trials to make sure our maintenance and mechanical engineers and our site operators were happy with the performance. We had to go through some trials, but it appeared to be very successful," she explains.

Use of the fuel for site machinery began in 2013, and Gammon became the first and only construction company in Hong Kong to use B5 biodiesel in 100 per cent of its own plant and equipment on its solo project sites. It was a good start and, by 2015, the Procurement team was ready for the next step.

"Because it had worked, we were able to extend the biofuel use from plant and machinery to vehicles. Our biggest diesel fleet is our concrete mixing trucks, so we knew using the fuel for those would make a big difference," says Siu.


SKK (HK) CO LTD

Once again our fuel partner was amenable and established a biodiesel pump at a refuelling station close to Gammon's concrete mixing/batching plant.

"In 2015, we started using the fuel in 10 vehicles. Now we're up to 15 and there will be more," says Siu.

It has been calculated that between the introduction of the B5 fuel to Gammon sites and the end of 2017 a saving was achieved of 9,934 tons of carbon dioxide, which according to the UN International Civil Aviation Organisation Carbon Emissions Calculator is equivalent to one person taking about 10,000 return flights from Hong Kong to Amsterdam. But it has broader implications.

"We used to just look at what made the biggest impact. Now we look at impact plus – what has the most influence," says Siu.

"We chose fuel because we could also support the local waste-oil collection industry, but at the other end of the supply chain we have also been encouraging our clients to use it. We told China Light & Power (CLP) that we would use B5 for a foundation project for them and they were supportive. Then the Environmental Protection Department employed a consultant to investigate whether B5 could be used for government projects, and in 2016 they mandated all government projects to use it. One of our partners in concrete supply is also now buying B5 from the same gas station."

Sustainability in procurement, Siu says, now means looking at life-cycle benefits.

"We also have to look at cost efficiencies, which go beyond initial costs. We look at quality and durability, whether things can be reused, whether they can be recycled. We want our people to have that DNA in their sourcing mindset."

Replacing Gammon's PVC site barriers with a greener alternative also involved persuading supply chain partners to look at their businesses afresh.

"We talked to our suppliers and asked them to suggest another product with better recycling value, and after some discussion we came up with a High-Density Polyethylene (HDPE) solution. HDPE can be broken down into raw materials for other plastic products. Also, instead of one year the barriers are good for two to three years or

more. The initial cost is higher, but the cost over the life cycle works out over 30 per cent cheaper and the quality is better. The colours stay stable longer and the barriers are less breakable. Everybody likes them and, at the end of their life, they go to a recycling operation in the New Territories," Siu explains.

Initial supplier reluctance was overcome by generating the critical mass necessary for the manufacturer to produce the new material economically, with other customers like CLP also switching to the more recyclable HDPE barriers.

Gammon has also been an industry trailblazer in the responsible use of timber. Consumption has been reduced through the increasing use of steel and aluminium rather than wooden formwork, while Procurement has insisted on sustainable sourcing.

"We work with suppliers to bring sustainable timber to Hong Kong and initially we paid a premium – but with better quality for more reuse and sufficient demand created, you can now buy it as cheaply as non-sustainable timber. So we're influencing the industry," says Tony Small.

Gammon is also working to reduce the use of timber for loading pallets, which are used a limited number of times and then discarded, often as landfill.

"'We are trying to get to a point at which we see no timber pallet waste on our sites. The pallets will either be recycled or replaced with an environmentally sound substitute.

There are recycled paper pallets which are extremely strong, and recycled plastic pallets which can be reused many times," says Siu.

She points out that while 1,000 single-use timber pallets might cost $60,000, the same sum would buy 200 to 300 more durable pallets made from recycled materials, offering a far longer serviceable life.

It is, however, up to the suppliers of materials delivered on pallets to decide what they will use.

"We're talking to them. We also try to understand their difficulties," says Siu.

Paradoxically, she says, it is easier to establish a basis for co-operation with a large industrial concern than with many of the small to medium-sized enterprises (SMEs) in Gammon's supply chain.

"The focus is on trying to get the people in our supply chain ready for this journey – getting them to understand. The majority of operations in the chain are SMEs and with them the challenges are bigger because investment is involved. We want to establish a more responsible supply chain through factory assessments and we want strong capable partners who can work with us for the next five or 10 years, and be aligned with our strategy in sourcing and sustainability as well as in innovation and technology," she says.

"As a leader in the construction industry, it is part of our responsibility to bring in new ideas and try to influence the industry. That is also part of our procurement strategy – to procure materials in a way that is sustainable for the industry."

ENGAGING WITH THE COMMUNITY

According to Emma Harvey, Gammon is unusual within Hong Kong's construction industry in the level of proactivity at which it consistently operates in matters of worker welfare – whether or not the workers on a Gammon site are directly employed by the firm.

It is no coincidence that Gammon's staff are themselves enormously proactive in reaching out to the needy in the wider community.

In 2017, Gammon employees volunteered over 4,300 hours of their time, and participated in in over 140 community events. The firm in turn provided donations and sponsorships to a value of around $2.45 million.

Beneficiaries ranged from the Community Chest to charities concerned with mental health and intellectual disabilities as well as the Hong Kong Federation of Trade Unions Occupational Safety and Health Association – a cause directly in line with Gammon's strong commitment to safety and sustainability programmes.

As in construction, so in community engagement Gammon recognises the value under different circumstances of both top-down and bottom-up approaches. Some initiatives come from senior management. Others, from staff at all levels, receive a sympathetic hearing, and on the basis of merit and feasibility will receive the firm's support.

The Gammon Runners Club, established in 2009 to promote a healthy lifestyle and life-work balance is also highly active in charity runs, and since its foundation has raised around $115,000 for worthy causes.

TWO

輝煌六十載

金門建築(金門)的歷史可追溯至上世紀工程師JohnC.Gammon的故事。John是一位充滿創意及富有遠見的領袖，也是使用鋼筋混凝土的先驅。1919年，他在當時的英屬印度成立一間建築公司，遂由此創辦了子公司Gammon(Malaya)Ltd，並派遣一支項目團隊承建在香港的首個工程項目 — 香港舊啟德機場擴建跑道。工程於1958年完成，金門同年在香港正式成立。

1969年，怡和購入金門的部分股份，其後於1975年收購餘下股權，全資擁有金門。由80年代開始，除了怡和，金門另一半的股權曾分別由 Trafalgar House、Kvaerner及Skanska持有。2004年起至今，金門分別由怡和集團及保富集團各持有50%股份。

60年間，金門肩負重任，建設香港。經過多年來的不斷求進，我們已成為香港享負盛名的建築公司之一，業務亦擴展至亞洲其他國家，多元化的業務包括主要基建設施、地標性的商業項目及著名住宅建築等。

金門以專業服務建設香港的基建配套設施，推動經濟及加強香港的競爭力。我們成為赤鱲角新機場的主要承建商之一，建造中場客運廊以提升機場的設施和容量。此外，金門亦致力為擴建香港的鐵路網絡作出貢獻，除了興建最早期的鐵路站以至機場快線外，還有西港島綫 — 西營盤、香港大學及堅尼地城站，以及促進香港與中國內地跨境交通服務的廣深港高速鐵路 — 西九龍總站(北)。金門亦為香港建造了多條大橋及道路，加強區內外的連接，包括香港仔隧道、青馬大橋和深港西部通道。

香港的經濟發展蓬勃，社區的配套發展亦需配合時代的步伐。金門承建各類型的社區工程，提升市民的生活質素，當中包括水庫、游泳池、香港賽馬會馬場，以及各種大型環保項目，例如淨化海港計劃，目的是改善維港的水質。金門在淨化海港計劃工程中建造了香港最深的海底污水隧道，達海平面以下160米，這是公司多年來無數的標誌性工程之一。

金門亦憑藉其創新及優質建造服務，參與了香港許多地標性的建築項目，例如中環交易廣場、渣打銀行大樓、港島東中心、政府總部及立法會綜合大樓等。此外，金門承建多個著名酒店的工程，如為香港半島酒店進行擴建，與及運用其豐富的改建及加建工程經驗，將政府辦公室美利大廈改建為The Murray。

我們亦於建造高尚住宅方面享負盛名，其中包括山頂的Mount Nicholson，大嶼山WHITESANDS及位於司徒拔道的傲璇。

在可持續發展方面，金門不遺餘力推動環保建築。參與的大型環保建築項目包括零碳天地、科學園及希慎廣場。希慎廣場項目是香港首個獲美國綠建築協會（USGBC）頒發「領先能源與環境」（LEED）最高「白金」級認證建築主體與外殼類別的項目。

除了香港，金門也於澳門、中國大陸、新加坡及其他東南亞地區承接不少大型工程項目。


12 / 2019
Gammon

CONCRETE ACHIEVEMENT

John C. Gammon

On February 28, 1948, just over six months after the British Indian territories received their independence, the last of the colonial troops marched out through a majestic arch on the waterfront of what was then the city of Bombay. A major historic monument had been chosen for this historic ceremony.

The Gateway of India was built to commemorate the 1911 landing on the same site of Britain's King George V and Queen Mary. They were arriving for the Delhi Durbar, at which they were to be proclaimed Emperor and Empress of India. The 26m-high Indo-Saracenic style monument was completed in 1924. It was intended to express imperial power, but has outlasted it. Overlooking the Arabian Sea, it remains the most famous structure in what is now the city of Mumbai, and its most popular tourist attraction.

Mumbai's Taj Mahal, as it is sometimes called, stands on reinforced concrete piles extending deep into reclaimed land. The foundations, completed in 1920, were difficult to install, and the work was entrusted to the firm of J.C. Gammon (Bombay) Pty Ltd, established in 1919. The company later became famous throughout the land as Gammon India Limited, often referred to as "Builders to the Nation".

Over the decades, Gammon India staff have designed and constructed roads, bridges, tunnels, dams, ports, airports, power stations, chemical factories and fertiliser plants. But the firm foundations of the Gateway of India remain their most famous work.

Half a continent away in another former British colony, the ultra-modern city of Hong Kong – widely regarded as the Gateway to China – there are few surviving structures of comparable antiquity.

Here, too, a company bearing the Gammon name has made its mark. For six decades, Hong Kong's Gammon Construction Limited has been deeply involved in a sweeping range of major contracts in the city. These extend from airport works, highways, bridges and railways to towering high-rise commercial and residential developments. All bear the stamp of Gammon reliability. Just as the Gateway of India stands proudly after almost a century, so Gammon's works in Hong Kong stand as testimony to an unwavering commitment to lasting quality. That commitment is embodied in a professional modus operandi that has become known over the years as The Gammon Way. It is a direct outgrowth of the remarkable vision and drive of John C. Gammon, who founded the original company in India in 1919.

Born on June 2, 1887, John Gammon was aged only 21 when he received his first-class honours degree from London University. His first job, in the reinforced concrete department of Messers Leslie & Co in Kingston upon Thames, opened his eyes to what he correctly recognised as the future of construction.

Exploring the full scope of the potential of reinforced concrete became the principal focus of his life. Even before he was hired as an assistant engineer by the Indian Public Works Department in 1911, the youthful visionary had written a book. Entitled *Reinforced Concrete Design Simplified*, it was well received among the well-informed. Secretary of the Concrete Institute, H. Kempton Dyson who wrote an introduction to the book, said that its diagrams would "make the design of reinforced concrete almost a pleasure instead of a very great labour, for they will save 75 per cent or more in time and labour over direct calculation by formulae".

John Gammon pioneered the use of new reinforced concrete techniques in much of India, especially in Bombay and Sind province. In 1912, he was officially named a specialist in the field, and was attached to the consulting architecture office of the Bombay government. His energy was as monumental as some of the projects on which he worked.

Writing to his mother from Karachi in January 1913, the sentiments he expressed were an indication of the strength and independence of his character.

“The one thing I’m afraid of is that I shan’t get work, which will keep me going at top pressure. I want to feel that the work I’m doing is the most difficult that I could do. Otherwise I shall feel I’m wasting myself, that I’m not getting the best out of myself… I want to earn my money; or rather I would say if I’ve started with five talents I want to produce another five talents and not merely two and a half. Unless I’m doing the best work I can do, I shall not be satisfied. One thing I do know & that is I shall always be able to earn my living. I am tremendously thankful for it.”

His wish for high-pressure work was certainly granted. John Gammon designed the reinforced concrete work at the Bombay Victoria and Albert Museum, the Science College, and the majestic Customs House, the latter being the first major contract in India with concrete pile foundations. He also designed and supervised the reinforced concrete Cape Monte Lighthouse in Sind. He became renowned in India as the “Sculptor of Concrete”.

He also continued to earn his living – eventually a handsome one – as his son Andrew, who calls him JCG, can attest.

“JCG was, throughout his life, a workaholic. He filled his life with work. Even into his 70s, he woke up at 5:30am, drank his orange juice, and worked in bed in a yellow dressing gown until he got shaved and dressed at 7am. During this time, he went through all the previous day’s correspondence and drafted replies in a Parker fountain pen on the reverse of the letter, for his secretary to type up when she arrived at 9.00am. Late in life, to minimise his commute into work, he converted half our home at 80 Eaton Square into a large office for 10 engineers and support staff, even though non-residential use was prohibited by Grosvenor Estates, the landlord. His energy and drive are attested by the fact that his son David was born when he was 73½ years old.”

By 1913, still aged only 26, John Gammon had come to feel that his job in government was too restrictive of his talents and too safe. Writing once again to his mother, he voiced his frustrations at the idea of an uneventful career at the end of which he could expect to draw a pension.

“I’m not going to work because I’ve got to and because, if I don’t, I may have one day to apply for an old-age pension ... I want to work for the fun of the thing. I don’t care a hang if I don’t succeed on my own out here. If I don’t, I’ll have a dash in somewhere else. I don’t care if I never succeed; so long as I live. I don’t want & will not have a safe job. I want to take risks & to have a bit of fun.”

“This is the fullest explanation we have of what motivated JCG to leave government service and set up on his own as a civil engineer,” says Andrew Gammon. “His appetite for risk-taking remained with him throughout his life. He was proud of the fact that he never had an old-age pension.”

True to his instincts, in 1914 John Gammon left the Public Works Department and started his independent consultancy in reinforced concrete. The complexity and scale of his designs were demanding. In fact, they were so far ahead of their time that he was often invited to build the works he had designed. So he became both consultant and contractor. But his career as an independent operator was interrupted. The year he established his business, World War I broke out in Europe. He joined the Indian Army and was sent to the Western Front in France.

During that grim conflict, he served with a Sappers and Miners unit and the Indian Field Squadron, working on bridging, workshops and stores. Engineering skills were vital in that war of obdurate attrition, with life and death depending on strong trench works.

When the guns fell silent John Gammon returned to Bombay to establish his company as a civil engineer and contractor, specialising in concrete work. One of his first contracts was the Gateway of India, about which he had first been approached in 1913 before leaving government.

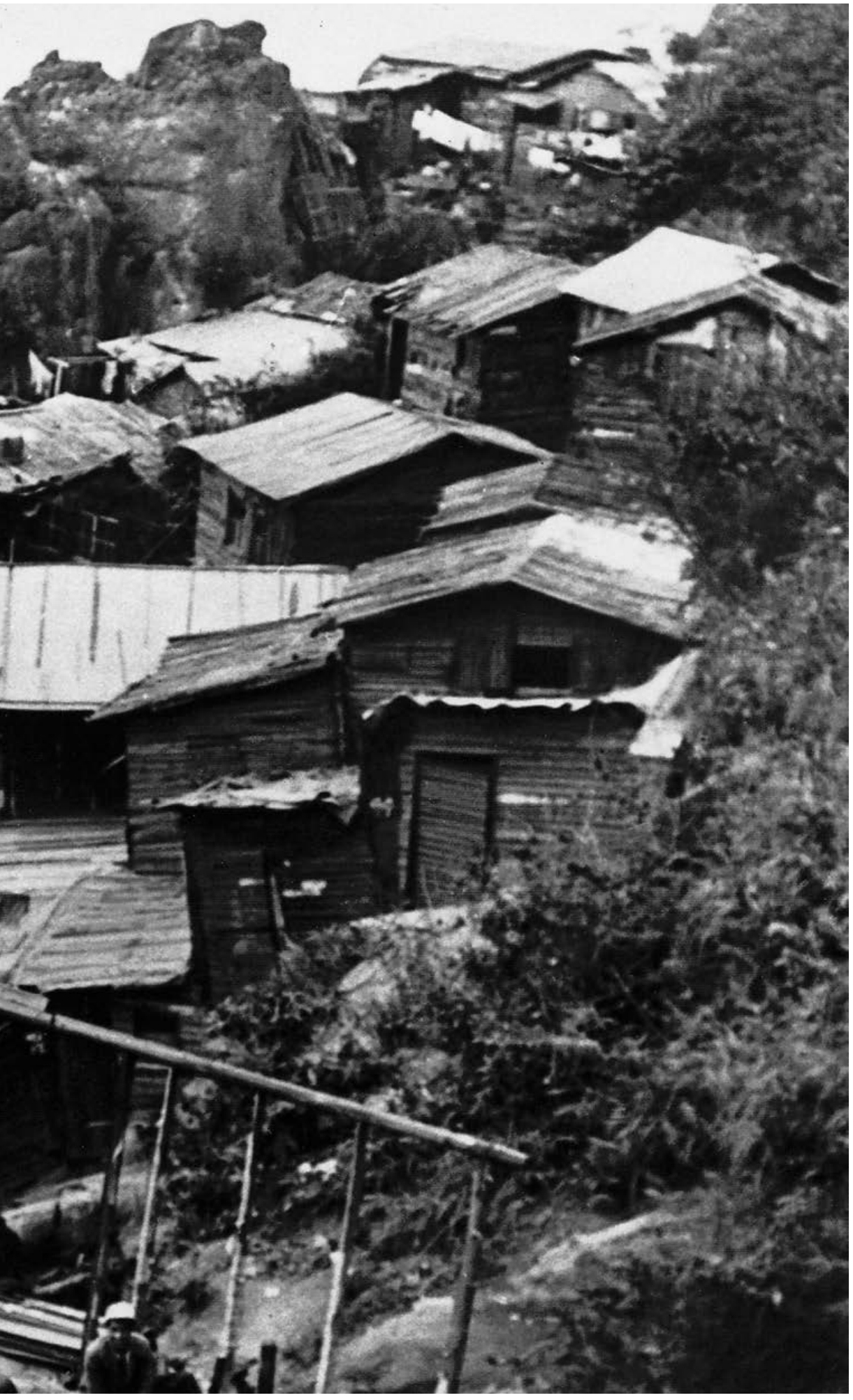
Other major works included the Bombay Cotton Depot and many public housing schemes. He expanded to Karachi and Calcutta, and set up branches in Rangoon, Singapore and Colombo. Over the coming years, branches were opened in Bengal, Ghana, Nigeria and the Gulf. The Singapore office developed into Gammon (Malaya) Limited, from which, eventually, sprang the subsidiary Gammon (Hong Kong) Limited.

His name was well known by 1939 when John Gammon went back to war. Britain was enduring relentless German bombing, and an important development in concrete processing had come at an opportune time. For years, Gammon had been working on a process known as Coloidal Concrete Grouting, or Colcrete. This came into practical use in 1939 and was promptly employed in defence. The British army had hundreds of colcrete mixers spinning busily at the military airports constructed down the east coast of Britain, where heavy bombers were based. Half the dams and reservoirs built in Britain for civil defence were designed by John Gammon, who had shifted his wartime base to London.

This work needed a corporate umbrella. Gammon Engineers Ltd was established in London with Gammon Overseas Ltd as a subsidiary. With John Gammon as the active Chief Executive, the group handled design, finance, recruitment of expatriate staff, and ordering of plant supplies and equipment. It maintained contacts with consultants and clients outside Britain, and formed consortiums for major contracts.

John Gammon explained to his executives and clients that although the companies remained mainly civil engineering operations, they also applied other scientific principles. Huge contracts involving construction, earthmoving and estate development were carried out with “economy and expedition”, he noted with pride. Principles that governed civil engineering and building construction had become fully integrated.

All his life John Gammon remained primarily an engineer who wanted to create structures of lasting quality. But he was also an astute entrepreneur and a shrewd businessman. He was fanatical about keeping down costs, once admonishing an executive in India for wasting



sixpence by posting two letters in one day when both missives could have gone in one envelope with a single stamp. As he wrote to his mother:

“I am & I expect always will be guided by my conscience as an engineer when working as an engineer. Deliberate waste – there is quite sufficient unconscious, ignorant waste to make one see red – is surely the one unforgivable offence for an engineer. It should revolt his soul.”

But he was known also for his generosity and loyalty to staff and colleagues. And when it came to standards of workmanship and materials he was adamant that quality of engineering and technology would never be compromised.

He was a man with the courage to put bold ideas into practice. During World War II, vast projects were initiated in India calling for pre-stressed concrete spans of up to 70m. Doubts were expressed about their feasibility. John Gammon said he would not ask for payment if the work was not successful. He was paid.

Those wartime developments pioneered by Gammon employed what later became universal building practices, but it was to be years before concrete work on a comparable scale was attempted in Britain or the United States of America.

John Gammon’s thinking on corporate structure was equally visionary. His insistence that every company in the Gammon group be operated as a totally independent entity led to each acquiring a strong local character. Ties binding the companies were loose, although there remained co-operation in access to resources such as plant, equipment and staff. The aim was to have strong companies operating as local concerns in the communities they served. This led to them being viewed as part of the local scene, able to compete freely with purely local operators.

True to this policy, Gammon (Malaya) Limited, based in Singapore, was autonomous. When that company was awarded a contract to expand the runway at Hong Kong’s old Kai Tak airport, it was determined that a local subsidiary should be established. It later became an independent corporate entity – with the personal encouragement of John Gammon himself.

John Gammon died in Britain on April 29, 1973, having lived a life rich in far-reaching achievement, and having stayed true into old age to the principles and ideals of his youth.

Today, throughout Asia there are structures, distinguished in design and construction, created by the companies founded by this visionary builder. Of no man could it be said more truly that he left a concrete legacy.

A NEW EASTERN ADVENTURE

In 1955, a branch of Gammon (Malaya) Ltd was established in Hong Kong to work on a major project at Kai Tak, the site of an aerodrome since 1925, and the city's official international airport from 1954 until its eventual closure in 1998.

The original runway had been rebuilt during World War II, largely by prisoners of war used as slave labour under the direction of the Japanese military occupation government. It needed to be resurfaced and extended. Gammon (Malaya) was engaged to work on building a broad landing path more than a kilometre out into Kowloon Bay.

The company was very much a newcomer in a city that badly needed skilled and experienced builders. Even a decade after the end of the war and the ordeal of the occupation, Hong Kong was far from recovery. The population had shot up from 600,000 in 1945 to 2.49 million in 1955, swollen by recent refugees. The hillsides were covered with squatter suburbs where hundreds of thousands of people lived in appalling conditions, in huts made of cardboard and tin.

To tackle the problem, the city was poised to embark on a construction programme transforming it from a colonial backwater into a modern metropolis. It became clear that Gammon would need to stay and therefore a Hong Kong company had to be formed.

In May 1958, as the Kai Tak contract neared completion, Gammon (Hong Kong) Limited was established as a subsidiary of Gammon (Malaya), which it was to remain until 1969.

A key member of Gammon's advance guard was John E. Ward, who retired as Managing Director in 1980, having spent a quarter of a century with the firm. He first arrived in Hong Kong in 1955 as a mechanical engineer to work on the Kai Tak runway project, and remained a consultant to Gammon in retirement.

A reflective man, after stepping down he also wrote a memoir of the company's growth and development, from which it was clear that the path forward was not always smooth. Gammon faced problems, Ward wrote, but overcame them "by dint of unstinting effort by a large number of competent and loyal people … Family spirit and teamwork have always been the essence of the company," he noted.

Ward recalled completing work on the airport job in 1958, going on home leave to Britain, and then returning to Singapore. In November 1959, he was sent back to Hong Kong to manage Gammon (Hong Kong) Limited under simple instructions – he was told to run the company down.

Gammon (Hong Kong) Limited had been established to absorb the large number of competent local staff employed on the airport construction, to handle the sizeable amount of equipment and to compete in the local construction market. But the new company had undertaken a heavy workload at very low prices. It had started with capital of only $10,000 and was losing money fast. The Singapore-based parent firm was paying for a substantial and unprofitable workload, so little help was available from the distant head office.

Ward's instructions were to take over management and complete or subcontract out the company's work "with a view to folding it up in the minimum of time and at the least possible cost".

However, he was a creative thinker, and perhaps something of a maverick. Faced with the harsh realities, he felt the best way out of the situation was to find profitable


CABLE AND WIRELESS

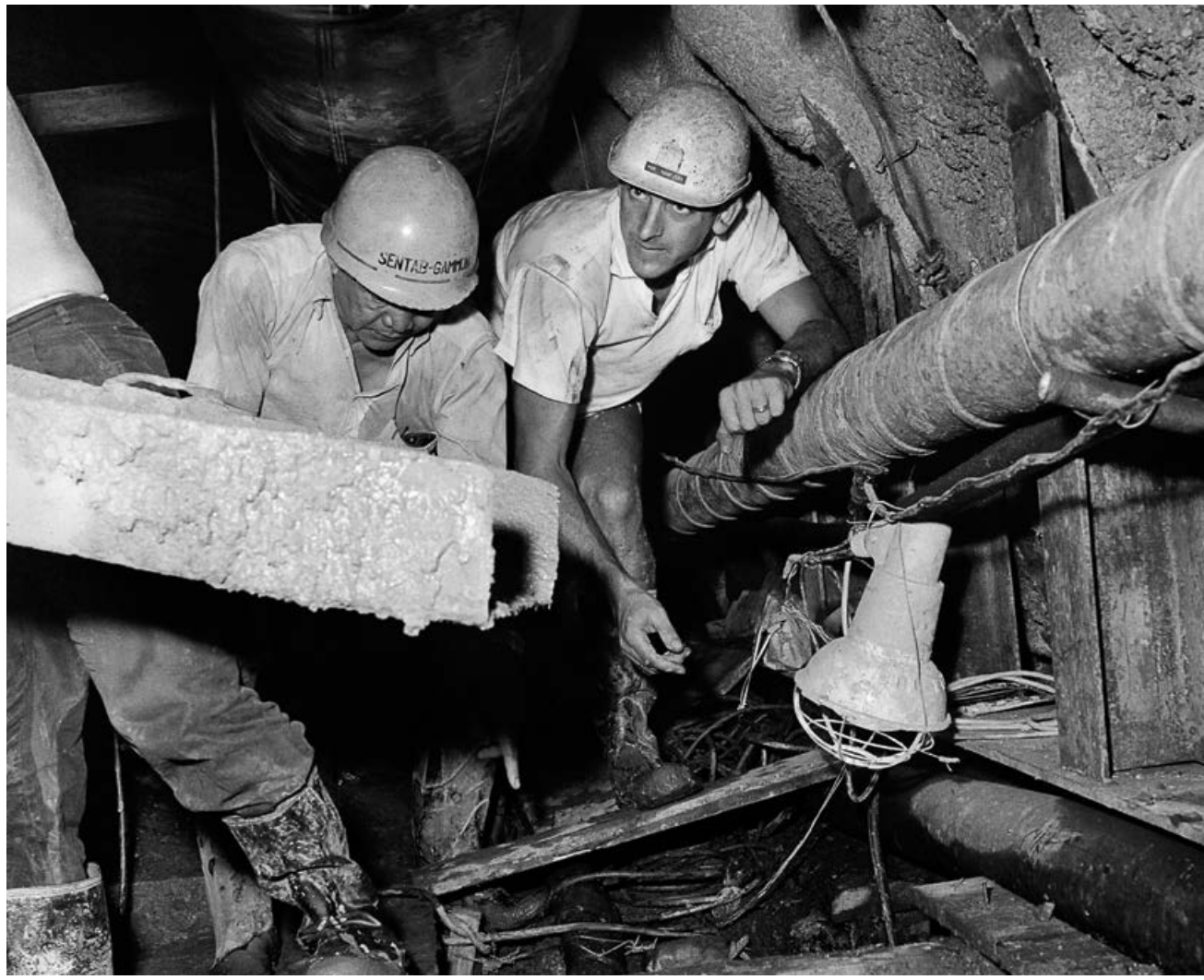
new work, which could be carried out without asking Singapore for more money, and to do it immediately.

At the time, the Hong Kong subsidiary was working on building Lung Cheung Road in Kowloon, draining the developing area of Kwun Tong, and constructing reservoirs on Hong Kong Island and in the New Territories. Instead of complying with his instructions and cutting back, Ward bravely tendered for site formation of the Lion Rock Reservoir.

“We submitted this tender with great trepidation,” he recalled, but the bid was successful. Effectively managed, the job was profitable from the start. The income, partially at least, offset losses on other projects.

Concrete piling work was in demand. The market for this specialised work seemed constant and had limited risk, so under Ward’s direction the infant Hong Kong company designed and built heavier and more powerful piling rigs than those that had been shipped from Singapore. At this critical juncture, John C. Gammon, the founder of the firm, arrived for an inspection visit. With the Hong Kong staff, the astute engineer calculated the cost of the rigs, and the likely flow of work and profit. He convinced the board of the Singapore company that the Hong Kong operation should proceed with the new rigs.

He also argued that the local operation should have more freedom to operate in its home market. The initiative by Ward, strongly backed by John Gammon himself, soon paid healthy dividends. It led to the company’s expansion into the lucrative and steady field of bored piling and sub-structural work.



Ward’s stewardship of Gammon (Hong Kong) saw the company quickly develop both in size and status. By 1969, the Central core of Hong Kong’s financial district was studded with buildings for which Gammon engineers had directed piling or foundation work. These included the Mandarin Oriental hotel, Prince’s Building, New Henry House, King’s Theatre and the Bank of Canton, where Gammon engineers also did the steel work.

The company had also strengthened its presence in civil engineering. It had handled the first stage of the phenomenal development of Kwai Chung. It had built one of the tunnels, which took water from Plover Cove reservoir to urban areas. It bored the piles and laid concrete decking on wharves, reclaimed land and created seawalls, and did site formation for a new power station on Tsing Yi.

John E. Ward ran the company with brisk efficiency and a growing amount of independence. His aim was to get contracts for work in all types of construction. Gammon (Malaya) in Singapore had “overlooked our disobedience to its instructions to phase the company out, and were so occupied with their own problems that they paid scant attention to our activities,” Ward noted.

As the Hong Kong company thrived, the Singapore operation ran into increasing difficulties. In 1967, the Malaysian government issued a Treasury circular banning Gammon (Malaya) from tendering for government contracts. This placed Ward, as Managing Director in Hong Kong, in an awkward situation. The Hong Kong company he ran was operating smoothly and profitably. He felt the ideal answer was to set it up as an independent local company.

“Conversion to a Hong Kong public company in a single stage seemed too adventurous,” he wrote. “We needed a gradual estrangement from our foreign owners and a build-up of local guidance and commercial management.”

Characteristically, Ward moved decisively. He discussed the situation with the firm’s bank. Then he approached Henry Keswick, the Chairman of Jardine, Matheson and Company, the legendary Noble House that had played a key role in the foundation of Hong Kong. It was then, and remains today, a major presence in the city. Would Jardines second one of their directors to the Gammon board? The answer was not long in coming – Jardine Matheson was not only interested in being involved with the construction company, but wanted to buy a minority interest in the firm.

At this stage, it was clearly necessary for Ward to tell the Singapore board about the negotiations. They accepted the situation with good grace, he recalled.

Jardines became a stakeholder in Gammon (Hong Kong) in November 1969. A year later, the company went public. “We were proud of our new independence and confident of our future, as we had by then built up a reputation for quality of work, ingenuity and adherence to contracts,” Ward wrote.

Former clients, satisfied with Gammon work, came back time and again, and a large proportion of new work was done on a negotiated basis rather than through having to submit tenders in a competitive process. Gammon, as a Hong Kong publicly listed company, was a success. John E. Ward’s faith in its future in Hong Kong had been triumphantly vindicated.


GAMMON HOUSE

A CONSTRUCTIVE PARTNERSHIP

"Gammon is not frightened of taking on new challenges and trying to find answers to them," says Ben Keswick, Managing Director of Jardine Matheson Limited. "Just look across Hong Kong. You can always see areas where Gammon is pushing the boundaries of what can be achieved."

Today, Gammon Construction Limited is 50 per cent owned by Jardine Matheson, and 50 per cent by the multinational construction, infrastructure and services group Balfour Beatty Plc. The joint ownership arrangement gives the firm access to Jardines' unsurpassed network of Asia-Pacific connections, as well as its formidable corporate resources in Hong Kong. Balfour Beatty complements that with its vast wealth of technical expertise and international experience in the construction industry.

The present ownership arrangement, which began in 2004, is regarded within Gammon, and by Jardines' senior management, as the best Gammon has ever had. But Jardines' interest in the firm dates back much further.

In December 1969, Jardines executives Henry Keswick and M.M. Smith were invited by Managing Director John E. Ward to join the board of Gammon (Hong Kong) Limited, then preparing for a public listing. One of the city's most distinguished accountants, future China Light & Power Chairman Sir Sidney Gordon, had taken up an earlier invitation.

At the same time, Gammon (Malaya) Limited announced that Jardine Engineering Corporation would buy a minority share in the Hong Kong firm. In 1970, Jardine Fleming helped Gammon (Hong Kong) to list, and its shares performed strongly.

The new Jardines connection opened up many opportunities for the firm, which was already working with Jardine Engineering on projects, including the new Bank of Canton Building and a hangar for the new generation of jumbo jets at Kai Tak airport.

The Jardines-Gammon alliance also made headlines when it engaged in a bidding war with rival conglomerate Hutchison over the purchase of a prime commercial site in Central. To the chagrin of the formidable Hutchison Taipan, Sir Douglas Clague, Jardines-Gammon won with an offer of $103 million. Gammon House, which was later sold for a substantial profit and is now known as Bank of America Tower, was built on the site. Clague settled for the adjacent plot for Hutchison House.

The firm continued to prosper through the boom years of the 1970s in Hong Kong, taking on a series of major projects. In 1975, Jardine Matheson bought up all the shares in Gammon (Hong Kong) Limited that it did not own, making it a wholly owned subsidiary, with no remaining ties to the original parent company in Kuala Lumpur.

By the 1980s, however, Jardines had come to believe that Gammon needed more than one alliance to achieve its full potential. In 1983, 50 per cent of its holding was sold to Trafalgar House, a UK-based company involved in construction, shipping and property, making Gammon the preferred construction firm throughout the Asia-Pacific region for both its owners.

There were more changes to come in an era rife with mergers and acquisitions. In 1996, the Norwegian-based engineering and construction group Kvaerner took over Trafalgar House, and thus acquired its 50 per cent of Gammon. In 2000, Sweden's Skanska, then the third-largest global construction company in the world, bought all Kvaerner's construction businesses, including its Gammon stake.

In recognition of this, the company was renamed Gammon Skanska Limited in 2002 – but just two years later Balfour Beatty bought the Skanska stakeholding, and the company has since been known as Gammon Construction Limited.

Through all these years of corporate upheaval Jardines maintained its holding and a steady commitment to the firm.

“Jardines has quite a lot of partnerships across its different businesses and we’ve always believed the partnerships should be to the benefit of all parties,” says Ben Keswick.

“What I think is great about this partnership is that both Jardines and Balfour Beatty bring something to the table, so the company is a stronger organisation. Balfour Beatty brings operational excellence, and Jardines brings its relationships and longevity. It’s one of those situations in which one plus one equals three, but you wouldn’t have that without the strong leadership and management we have in Gammon. We can give underlying support but, unless the core team is strong as well, you don’t get the benefits of the partnership.”

Philip Aiken, Chairman of Balfour Beatty and a frequent visitor to Hong Kong since 1973, agrees.

“It’s essential for you to have a partner whose business philosophy and work ethic are very similar to yours. We and Jardines are on the same page. The 14-year relationship has not only created a close bond between Jardines and Gammon, it has also established a strong position for Balfour Beatty in Southeast Asia. I always admire the ingenuity and spirit of the people of Hong Kong. However, since I have been involved with Gammon, I have come to realise the initiative and determination that drives Gammon, and that has created so many Hong Kong landmarks,” he says.

As well as being a stakeholder, of course, since the early 1970s, the Jardines group has been one of Gammon’s most important clients, mostly through subsidiary companies Hongkong Land and the Mandarin Oriental Hotel Group.

Major past projects include Jardine House – then called the Connaught Centre and at the time the tallest building in Asia, completed in 1973; Edinburgh Tower completed in 1983; Exchange Square opened in 1985; the major refurbishment of The Landmark in the mid-1990s; Chater House opened in 2002; and The Forum completed in 2013. In 2005, Gammon carried out the redevelopment work at The Landmark creating The Landmark Mandarin Oriental hotel and, in 2006, the radical refurbishment of the original Mandarin Oriental hotel on Connaught Road, Central.

"Gammon has been our trusted partner since the 1970s," says Robert Wong, Chief Executive of Hongkong Land, who also notes that beyond the corporate links within the Jardine Matheson Group, the two companies have similar philosophies and priorities. "The partnership is strong and organic. Gammon's ability to meet our high expectations for each and every project mirrors Hongkong Land's commitment to delivering excellence with all our properties. With Gammon, our projects are always in good hands – work is done safely, efficiently and at a high standard. Differences in geographic locations and project size do not compromise on quality. Gammon's work sets the benchmark in the industry. No matter if it's in Hong Kong, mainland China, or Singapore, their work is consistently top-notch."

James A. Robinson, former Executive Director of Hongkong Land, added that Gammon is always a preferred contractor for the company's major projects in Hong Kong. "From our experience with Gammon, we see outstanding results not only in new buildings, but also in older structures when the time comes to renovate, which is why they have been appointed to handle several major refurbishments in our Central portfolio. They have the right people and skills to work with minimal disturbance to our tenants, as we saw with the redevelopment of The Forum in 2013," says Robinson, who recently retired from Hongkong Land. Robinson first worked on projects with Gammon in the early 1980s, even before he joined Hongkong Land in 1988, and says that The Gammon Way provides a model for how Hongkong Land expects its other contractors and subcontractors to operate.

One of the strengths of the Jardines-Gammon bond has always been a shared ability to move with the times – something arguably never more evident than at present.

In 2017, when Ben Keswick introduced his Innovate Jardines initiative, with the objective of encouraging a culture of innovation and adoption of new technology throughout the group, he knew that Gammon was already pioneering that path.

"What was great about Gammon was that their mindset was already there. Thomas Ho and the top team already wanted to try out new things. Gammon won the Grand Prize in our 2016 Pride in Performance Awards, based on Technology Transformation. They won it because we wanted to highlight across the group that this is where Gammon already is, and this is where everybody should be going – it shows people embracing technology as part of day-to-day thinking," he says.

The award reflects a forward-looking attitude that, Jardines' Deputy Managing Director Y.K. Pang points out, cannot be taken for granted in the construction industry.

"That's a tremendous thing to achieve because construction is one of the oldest industries in the world and is not known for being innovative," he says. "Thinking outside the box, being innovative and doing new things are a great credit to Gammon."

Another shared characteristic is planning for the long term, backed up by a firm commitment and the ability to steer a steady course through occasionally troubled waters – one of the reasons Jardines has retained a stake in Gammon for nearly half a century.

"Gammon has had a long run of good times, but you never know what's round the corner," says Ben Keswick. "Thomas Ho and his team's great strength is thinking ahead when times are good. That's the key to a strong sustainable business."

A COLOURFUL HISTORY

A Gammon construction site can be identified easily from a number of visual clues. Its tidiness and efficient organisation are among them. So is the prominent display of its distinctive bright yellow corporate colour. Veterans of the building industry who remember the late 1970s, however, can recall a time of two different and separate colour schemes. This was the era of “Red Gammon” and “Blue Gammon”, a time of intense competition between two related but nevertheless rival companies.

Red Gammon, so named because of the colour of the company logo of that era, was the parent. But when the Swire Group decided to develop the massive Taikoo Shing private housing estate, which was to rise largely on land once occupied by the historic Taikoo docks and wharves and the Taikoo Shing sugar refinery, it sought a partnership to build it. That became Blue Gammon.

Taikoo Shing was an enormous project comparable in size to a large government housing estate. There were to be 61 residential towers with 12,698 apartments of between 65 square metres and 137 square metres on this 3.5 hectare site, close to the Quarry Bay waterfront. But they were designed to fulfil the much higher expectations of quality among the newly affluent middle classes, dreaming of owning their homes. Swire found the ideal partner in Gammon.

The complexities of the job called for the creation of an independent company, Gammon Building Construction. To differentiate it from the mother firm, it was nicknamed Blue Gammon and its equipment was painted blue to distinguish its activities from those of Red Gammon.

Over time, Blue Gammon developed as a totally independent business with its own ventures, its own board and a separate management team, headed by Gerry Long. There was a broad agreement while the two companies were active that Blue Gammon would concentrate on building work and Red Gammon would focus on civil works and foundations.

Y.K. Pang, who is involved today in Gammon’s business at the highest level in his capacity as Jardines’ Deputy Managing Director, gained his first experience of the firm when he applied to Blue Gammon for an internship during his university summer holidays.

“I studied civil engineering and I was accepted as a summer intern by Gammon, working on the Harbour City site in Tsim Sha Tsui. Gammon built Harbour City and I was on-site doing some of the run-of-the-mill undergraduate trainee tasks. I had a very enjoyable time and learned a lot that summer. That was with Blue Gammon,” he recalls.

The agreement between the two Gammons not to encroach on each other’s territory only worked up to a point. Each company displayed a naturally competitive spirit, and sometimes that meant the spirit of the accord was not punctiliously observed. Gammon veterans from that era remember how Blue executives would sometimes use other foundation contractors, saying Red prices were too high. Then Red staff would go directly to Blue clients offering them foundation work at low prices. Feelings sometimes ran high, notably in the early 1980s when Blue Gammon sought projects in Singapore, which was regarded as Red Gammon’s territory.

For a time there was also a “Black Gammon”, adding a third colour to the portfolio. This was the name given by staff, in jest, to Gammon Properties. That company, founded in 1976, was involved in the development of the 38-floor corporate headquarters, Gammon House, in Central. It was also a joint-venture partner with Swire Properties in the first phases of Taikoo Shing. But the Black company was less of a natural fit for Gammon than the Red and the Blue, and in 1984 Gammon Properties became part of Jardine Properties (Holdings) Limited.

As for the Red and the Blue Gammons, tensions between them disappeared after 1987 when Red took over Blue entirely, and absorbed most of the staff. The former rivals swiftly settled back into one big happy family.

THE VIEW FROM THE TOP

In 1959, when John Ward became CEO of Gammon (Hong Kong) it was merely a small subsidiary of a Singapore-based parent firm. Thanks to Ward it not only escaped being summarily shut down within two years of its establishment, but under his stewardship went on to become one of the most prominent and respected construction and civil engineering firms in Asia.

Since Ward's retirement in 1980, six men have occupied the Group Managing Director and Chief Executive hot seat. His immediate successor was David Morris, followed in 1984 by James Carlile, then in 1987 by John Chan whose background was in finance rather than engineering. His appointment turned out to be a short-lived experiment before another engineer took the helm.

An outspoken and capable Australian, Bill Kocass was fortunate indeed in the timing of his tenure. He took over as Hong Kong entered the construction boom of the 1980s, a period which saw the famous skyline of the city utterly transformed by one new landmark building after another. He retired in 1995, just as the boom was coming to an end.

Kocass presided over an exciting era. There was the enormous range of vast contracts linked to the development of Chek Lap Kok airport, and Gammon was entrusted with related rail and road projects as well as construction work at the site of the airport itself. It proudly built the towers of the immense Tsing Ma Bridge. In the years between 1990 and 1997, Gammon's turnover tripled from $3 billion to $9 billion a year.

When Martin Hadaway was appointed Group Managing Director in 1995, the outlook was still bright. But everything changed with shocking abruptness in July 1997, with the onset of the Asian financial crisis.

The sudden collapse in value of the Thai baht heralded a regionwide slump in the values of currencies and stock markets, and a sharp drop in morale throughout Asia. Panicked lenders withdrew credit and idle construction cranes loomed over deserted building sites.

"Bill Kocass enjoyed most of the boom," Hadaway later recalled, ruefully. "I had most of the slump."

Even before the economic bombshell hit, a difficult period had begun for the executive teams heading Hong Kong's construction companies. There was widespread concern about the future of Hong Kong after the city's 1997 reversion to Chinese rule.

When Hadaway took up his post in 1995, he had to prepare for a future fraught with uncertainty. Would Hong Kong continue to expand continuously as it had for so many years? Or were hard times ahead for the construction industry?

The owners, at that time Jardines and Kvaerner, instructed him to explore international diversification of Gammon's operations.

"I spent much of my time on aircraft flying from one Asian capital to another, setting up new Gammon subsidiaries in Malaysia, the Philippines and Thailand. The aim was to have new businesses in place should Hong Kong face a slowdown after 1997," Hadaway recalled.

The gloom about the outlook for Hong Kong turned out to be unfounded. Instead, the financial crunch of the second half of 1997 put all thoughts of expansion outside Hong Kong on indefinite hold.


mmon

Having completed a decade in his post, in 2005 Hadaway felt it was time to step down to look at a future outside Gammon, while remaining an active part-time adviser to the company.

As his successor the owners, Jardines and Balfour Beatty, appointed Thomas Ho On Sing to lead the company through what the Chinese call “interesting times”. The construction industry had not bounced back to the heady levels of the boom years. Major projects were few. Jobs were still slow to come up for tender and hard to win. Thomas Ho was determined Gammon would gain its fair share of Hong Kong projects and he, too, looked overseas for possible expansion.

Gammon’s new CEO had applied to study building technology and management at Hong Kong Polytechnic partly because he liked the name of the course. When he graduated three years later in 1978, the long-established firm of Hsin Chong Construction offered him a position and his career with them was to last for 18 years.

Determined to improve his qualifications, Ho decided to undertake further studies under a programme linked to the Hong Kong Institute of Engineers. Then, with the help and encouragement of Hsin Chong management, he spent a year at the University of Manchester’s Institute of Science and Technology, studying for a Master of Science degree. His research was into construction management and economics, and the theme of his dissertation was how to organise projects with differing scenarios.

“My time at Manchester was extremely valuable,” he reflects. “In Hong Kong, education is mostly by lecture and examination. In Britain, there was a need to figure out your own project, to be analytical.”

Ho recalls having a satisfying and happy career with Hsin Chong. He rose through the ranks and was involved in many major projects, the most challenging of which was building the University of Science and Technology, where laboratories for advanced research had to be as sophisticated as a hospital operating theatre.

However, when the opportunity to move to Gammon as contracts manager of the Building Division arose in 1996, it was too attractive to resist. “I left a well-managed company where turnover was $1 billion a year and came to another well-managed company that was five times larger,” he says.

After holding a number of increasingly important executive positions, he took over from Martin Hadaway as Chief Executive in 2005, at a slow time for the construction industry. Market conditions were difficult, but another boom was just around the corner with a surge of private and public mega projects coming on line – among them were various MTR Corporation projects, the Tuen Mun Highway and further developments at Chek Lap Kok.

“We have grown significantly since 2013,” says Ho. “Our turnover is now around $20 billion each year, compared to $6 billion 12 years ago and around $15 billion five years ago. Ten years ago, a contract of $1 billion was classified as a mega project. Now, there are maybe 10 projects in our portfolio worth about $3 billion or $4 billion. The scale and complexity have improved greatly.”

In the course of the past 60 years, Gammon has been through boom times and periods when projects were few and far between. Its skilled and experienced management have learned to handle both.

As Thomas Ho sees it, Gammon is now positioned as an industry leader, and the management’s role is to apply extensive experience to the challenges of the future by continuing to question norms and change mindsets.

“Innovation is going to change and reshape our industry,” says Ho. “We have to be open to new ideas. We have to continue to hone our competitive edge.”


B-LPG
HONGKONG AIRLINES
香港航空

TAKING FLIGHT

GAMMON AND HONG KONG'S AIRPORTS

On February 2, 1964, Gammon founder John C. Gammon, then aged 76, was visiting Hong Kong. He took a little time out of what was doubtless a busy schedule to send a postcard to his son, Andrew. On the picture side was a photograph of Kai Tak airport.

"You must keep this card, Andrew," he wrote, " because it was my company that built this remarkable airfield, which juts out into the ocean for a distance of 1½ miles. We landed there yesterday morning, but we approached it from the land end, and part of our work was to hew a way to it through the rock hills, so that this could be done."

Over the past 60 years, Gammon's construction work has contributed to most sectors of Hong Kong's economy, and its projects for the two airports that have served the city during that time provide some particularly notable examples of the firm operating at its best.

Looking back to 1958, Gammon had completed its first Hong Kong project, the Kai Tak runway to which John Gammon referred. Still serving the city today, it became the wharf of the Kai Tak Cruise Terminal in 2013.

Now in 2018, Gammon is hard at work on the latest of its projects at or connected to Hong Kong International Airport – this one is a vital part of the access infrastructure for Chek Lap Kok, which took over from Kai Tak in 1998.

The Southern Connection Viaduct Section of the Tuen Mun-Chek Lap Kok Link (TM-CLKL) is part of a strategic road system connecting the airport to the North West New Territories, North Lantau and facilities for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing. The $8 billion design-and-build project is Gammon Construction's largest solo contract to date.

In between those landmark projects, Gammon has made many significant contributions to keeping ever growing numbers of people and expanding volumes of cargo and airmail flying in and out of Hong Kong. These include other projects at Kai Tak – among them the major 1979 expansion of the Hong Kong Aircraft Engineering Company's hangar space – and many more at Chek Lap Kok.

At the "new" airport – already 20 years old though Kai Tak still looms large in the public memory – Gammon has played important roles in the construction of the Terminal One building, the Airport Express rail link, The DHL Central Asia Hub, the Cathay Pacific Cargo Terminal, the North Satellite Concourse, Sky Pier, the Midfield Concourse, and refurbishment work at Terminal One.

1958 KAI TAK RUNWAY

The ultra-modern airport facilities Hong Kong enjoys today would have been unimaginable in 1956. That was the year But Bing Him joined Gammon as a site clerk for the firm's first Hong Kong project, the Kai Tak runway extension. The basic airfield, which had been in service since 1925 and welcomed its first commercial passenger flight in 1936, was already woefully limited in capacity.

"First the engineers had to build a seawall which marked the new runway," But, who retired from the Accounts Department in 1993, later recalled. "That seemed to stretch forever out into the bay. Then sand dredged from the harbour bottom was dropped into the enclosed area. Finally, the rocks and earth from two hills in Kowloon City were added to create the compacted new land for the airport and runway."

For the era, it was an enormous, daunting task. The cost was $135 million – a staggering figure at the time, which caused Executive Councillors to blanch. The Legislative Council approved the financing nevertheless. It was clear that air connectivity was vital to Hong Kong's future.

For Gammon (Malaya) Limited and the large French firm Societe Francaise d'Enterprises des Dragages et de Travaux Public, the first challenge was finding the right staff and the proper equipment. Hong Kong was packed with refugees so labour was plentiful, but finding men with the necessary skills was more difficult.

The necessary specialised equipment was also hard to find, so the French partners imported two huge bucket dredgers and a floating crane. Local shipyards built suction dredgers, 10 barges to carry fill and nine tugs to pull them. Large pontoons to act as work stations were anchored in the waters, which were between 3m and 12m deep around the seawall.

As the seawall rose, the muddy silt on the bottom was dredged down to bedrock. Then the space within the seawall was filled with more than 1.83 million cubic metres of sand dredged from the clear waters off Hung Hom, and 670,560 cubic metres of decomposed granite from the flattened hills of Kowloon City.

"Dragages worked by sea, Gammon by land," explained But Bing Him. He worked at the Kai Tak Gammon site office and was in charge of recording everything that came in and went out. It was a constant flow.

"We virtually took over roads in the area for the lorries loaded with rock at the hill faces, then drove to the end of the emerging runway and dumped the granite. Load by load, the new land was formed and then compacted by bulldozers. After a year, it was already 500m out from the land."

The lorries were working on casual hire. Gammon opened its site offices at dawn to queues of privately owned lorries with owners or drivers offering themselves and their vehicles for a hard day's work. But paid them in cash at the end of each shift, on the basis of the number of cubic feet the lorries had carried from the hill quarries to dump in the bay. "That's why we had to be so careful and meticulous about counting the lorries coming into the site," he explained.

By 1954 the old Kai Tak Airport could not handle the increasing number of four-engine propeller aircraft of the international airlines that sought to use the tiny runways. Gammon won a significant part of the contract to extend the runway out into the harbour.

Working at a fast pace, Gammon and French construction partner Dragages dredged the shallow seabed, created a protective seawall and began to fill in the new promontory extending out into Kowloon Bay. They created 610,000 square metres of new land standing five metres above sea level, providing a platform 2.5 kilometres long. On the paved runway, the modern aircraft of the dawning jet age could land safely.

For the opening of the new runway in September 1958 Governor Sir Robert Black with his wife and daughter boarded a Hong Kong Auxiliary Air Force helicopter on the Island, then flew across the harbour where the helicopter cut the ribbon with its wheels. A 50,000 strong crowd of onlookers responded rapturously. In 1958, 122,082 passengers landed at Kai Tak. In 2017, 72.8 million passengers passed through Chek Lap Kok.

By 1972 it was obvious that the new generation of Jumbo Jets were going to need more landing and parking space. The government approved a $200 million project which would extend the runway to 3.3 kilometres and boost parking from 10 to 33 aircraft.

Gammon had 47 of their own vehicles and about 10 excavators to dig the rock from the mountains. “The work site had engineering shops and repair facilities. There were storerooms and facilities for staff.”

The first tender was called in mid-1955 and the contract was signed on behalf of Gammon (Malaya) Limited. The main contractual work began in 1956, and the *South China Morning Post* noted at the time that no civil engineering project on this scale had been attempted before in Southeast Asia.

The new airport reclamation totalled 610,000 square metres. The 2,194m-long runway rose five metres above the high water mark. So did the 1,160m of overrun, and the 180m-wide taxiway alongside the single runway.

In 1954, Kai Tak had handled 6,230 flights, a total of 17 a day. Two years after the contract was finished in 1960, air traffic controllers were guiding 33 flights daily to land on the expanded runway, 12,221 a year. Just before the airport finally closed in 1998, 440 flights every day were still taking off and landing on the runway Gammon worked on four decades earlier.

On September 12, 1958, the Governor of Hong Kong, Sir Robert Black, opened the new runway with dramatic flair. Halfway down the long promontory extending far into Kowloon Bay, there were two black-and-white striped poles. Suspended between them was a brilliant scarlet ribbon. A Royal Air Force helicopter bearing the governor came roaring down the runway, two metres above the tarmac. It burst through the ribbon, and a greatly improved Kai Tak airport was open for business – on time and on budget.

Gammon, which had played a key role in the project and was now registered as a Hong Kong company, was itself poised to take flight.

1980

HAECO

With more aircraft from many airlines passing through Hong Kong – 31 by 1975 – the Hong Kong Aircraft Engineering Company felt a need for greatly enlarged hangar space at Kai Tak airport in 1979. Gammon won three separate contracts to expand the existing hangars that the company had helped construct a decade earlier. Working within strict security, fire, safety and insurance guidelines, Gammon had to erect a 740-ton steel roof truss outside the main airport area. When completed, it took 12 days to slide the steelwork 380m into position. It was then jacked into place. The $15 million contract created an enormous hangar space, allowing aircraft maintenance staff to work safely on Boeing 747s – even under typhoon conditions.

1995 CHEK LAP KOK PASSENGER TERMINAL

In 1998, all Hong Kong's passenger and cargo traffic relocated to the new $50 billion Hong Kong International Airport at Chek Lap Kok. Building it was an enormous task and Gammon was involved in many facets of the work – at the airport itself and also in many of the associated bridge, road and other projects.

One of the most demanding and important was a joint venture with Nishimatsu Construction for the foundations and substructure of the sophisticated passenger terminal. The work began in 1995 and covered 420,000 square metres on the newly formed man-made island. Gammon's Foundations Division used much of its in-house plant and specialist equipment to bore foundations, set 2,600 tension anchors and drive down H-piles. Different areas under the sprawling terminal needed varying combinations of foundation works. In the middle of the work, Hong Kong had some of the greatest downpours ever recorded, but work went on. Despite the extreme weather difficulties and many other technical challenges, the job was completed successfully. At the time, Terminal One was the largest airport passenger building in the world.

1998 AIRPORT EXPRESS

With Kai Tak, Hong Kong had enjoyed an airport almost in the heart of town, but the new Chek Lap Kok Passenger Terminal was to be located 35.3km from the Central Business District. Without a fast rail connection, operation of the airport would not be feasible, so the $1.28 billion contract to build the track that would carry the Airport Express from Hong Kong to Chek Lap Kok was vital.

Starting in the spring of 1995, Gammon and joint venture partner Balfour Beatty – which nine years later would acquire a 50 per cent stake in Gammon – set about the challenge with determination. As well as laying 90km of welded track for the Airport and Tung Chung lines, there were another 20km at the maintenance depot at Siu Ho Wan. Staff also had to design and make the complex switches and crossings. Getting material to the artificial island was not easy; 185,000 tons of concrete were used, 30,000 tons of rails, and 85,000 tons of sleepers. When the airport opened on July 2, 1998, the railway had already been in operation for several months.

2013
CATHAY PACIFIC CARGO TERMINAL

Hong Kong International Airport (HKIA) is one of the world's busiest cargo gateways as well as a bustling passenger hub.

"For cargo handling, we have handled over 5 million tonnes of cargo and airmail in 2017 and by 2024 we are talking about 6 million," says Alex Kwan, Airport Authority Hong Kong's Executive Director Engineering & Technology. "By 2030, we expect it will reach 9 million tons per year. Our emphasis is on high-value cargo."

The construction of the Cathay Pacific Cargo Terminal, which opened on February 21, 2013, took Hong Kong's air cargo handling capabilities to another level. The terminal, which spans 246,000 square metres, is the largest and most sophisticated of its kind in the world. It offers the advantage of extended cut-off times, last-minute acceptance of cargo and reduced connection handling times for transshipments. The terminal can handle a throughput of 2.6 million tons per year and, when it opened, it increased HKIA's annual capacity by 50 per cent to 7.4 million tons.

The building includes an eight-storey cargo storage block and an office building. The Gammon-Hip Hing Joint Venture (JV) incorporated many sustainable and environmentally friendly features into the design. Working together with Lambeth Associates, Gammon's in-house engineering consultants, the project pioneered a new method of mechanised system construction, using elevated formwork platforms integrated with an alternative, precast floor design, to construct the concrete structure. This obviated the need for scaffolding frames and timber formwork. Compared with traditional methods, the new mechanised construction was evaluated as four times quicker, while requiring only half the labour.

For the terminal's offices, Cathay Pacific Services Limited worked closely with the JV to design and install a chilled-ceiling cooling system, able to cut power consumption by up to 30 per cent, and high-performance cladding. This also maximised the use of natural daylight throughout the building. BIM, electronic tagging of off-site components and advanced document management and collaboration software were used to maximise the management efficacy of the entire project.


CATHAY PACIFIC CARGO TERMINAL

2015

MIDFIELD

On December 28, 2015, right on schedule, Hong Kong International Airport's $10 billion Midfield Concourse welcomed its first passengers.

Construction of the concourse was a key project for Hong Kong's future as an aviation hub, and a difficult one. All work had to be conducted without compromising the safety or efficient running of the airport, which remained fully operational throughout.

When work began in March 2012, the $6.2 billion development contract was the biggest solo project undertaken by Gammon Construction up to that date, with works comprising 19 fully serviced aircraft stands and associated fixed-link bridges and aircraft loading bridges; extension of the Automated People Mover (APM) tunnel from Terminal One to the Concourse; a new taxiway with connections to existing taxiways; and extension of the South Runway Road.

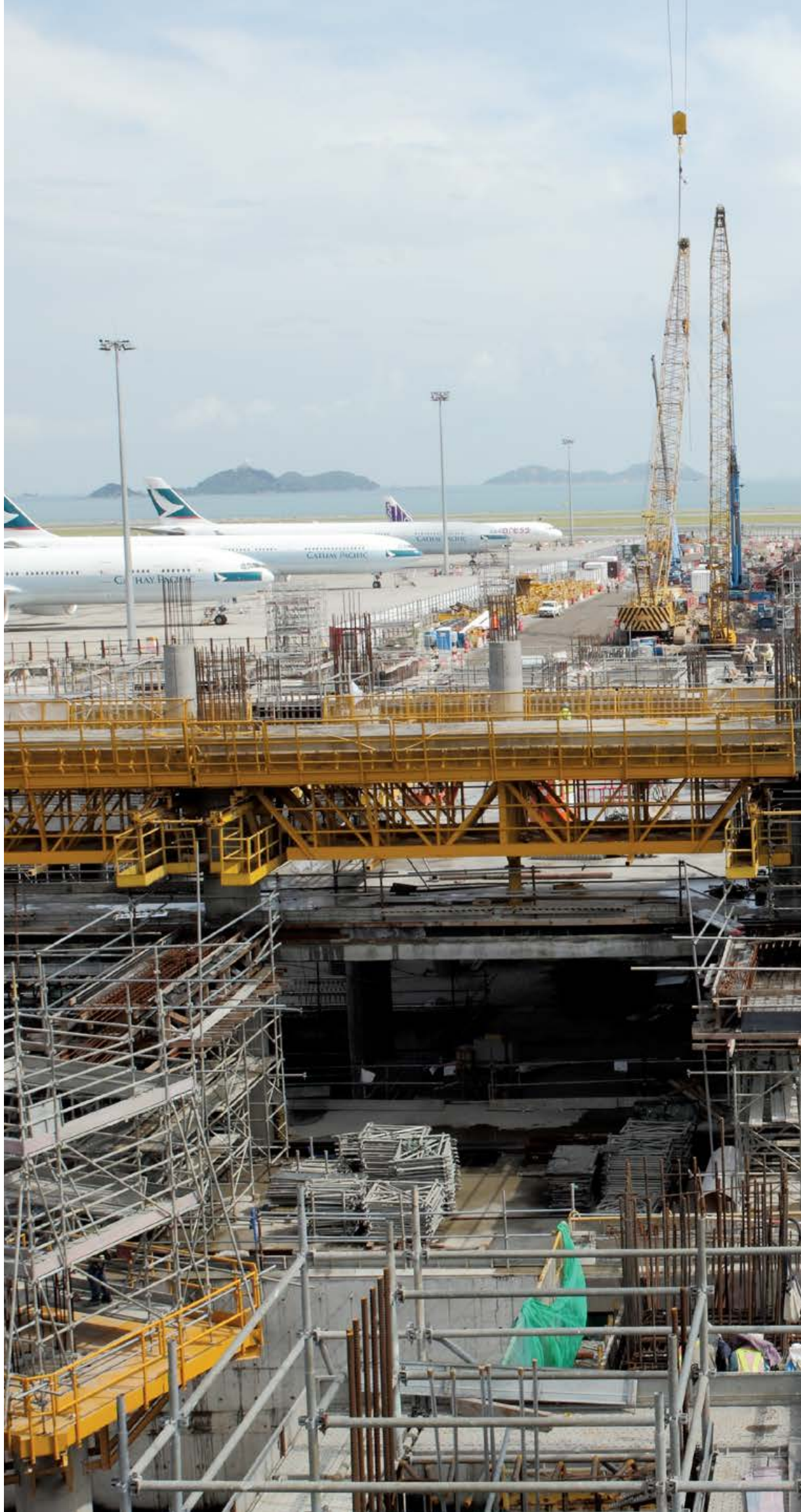
The five-level concourse spanning more than 700m is named "Midfield" because it is in the centre of the airfield, and does not have its own check-in facilities.

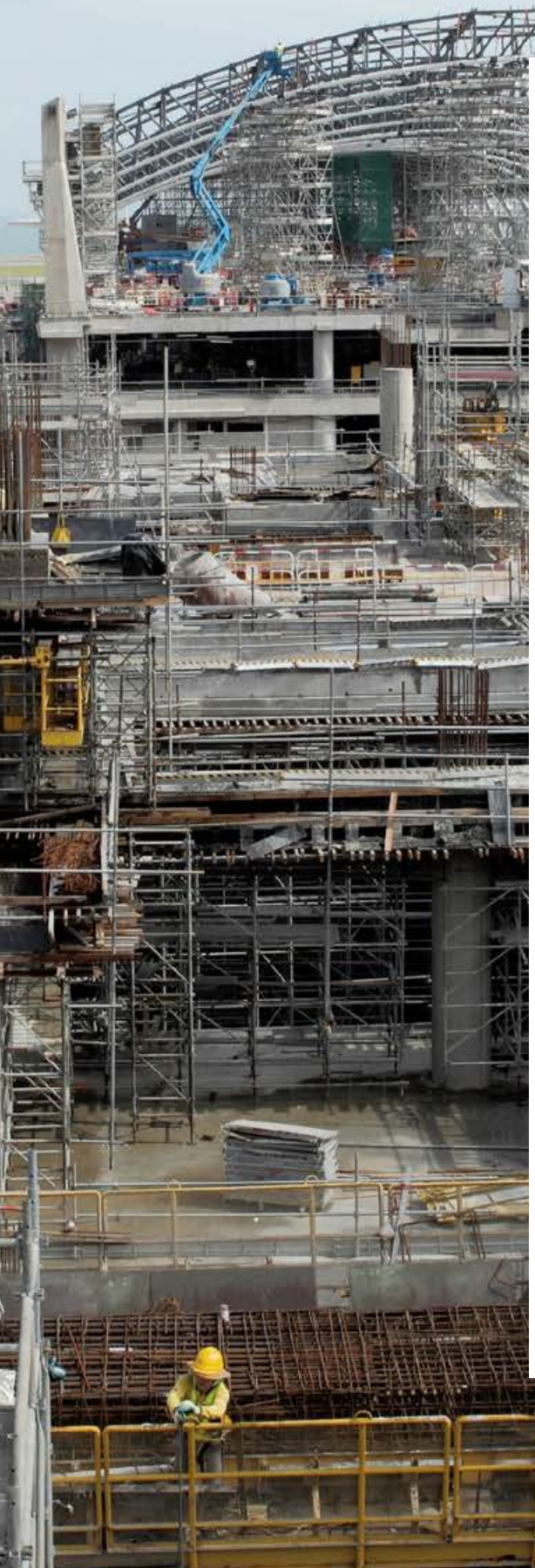
The contract was awarded with the proviso that construction work should be genuinely "green", as Kevin Poole, Airport Authority Hong Kong's Executive Director Third Runway, said at the time.

"During the tender submission period of Midfield Concourse, we wanted contractors to pay more than just lip service to green construction. What could they do to help us achieve Hong Kong BEAM Plus?

We want to take the extra step and do better. We recognise Gammon Construction brings a sense of enthusiasm to sustainable construction methods and fosters a culture of innovation," he observed.

The project exemplified Gammon's growing confidence – indeed ambition – in taking on major projects as a solo contractor, as Bid Manager, and later Contracts Manager On Site, Richard Ellis explained, after the contract was awarded.





"When Gammon first started talking about the project, our executives asked me: 'Do you want a joint venture partner?', as this was a significantly large project and having a joint venture would spread the risk. My answer was a firm 'no', as I felt confident that we could provide all the services in-house."

Because Gammon Construction had an established relationship with the Airport Authority (AA), and was familiar from past projects with the highly regulated working environment at the airport, Ellis believed this was an ideal opportunity to utilise internal business units to provide a one-stop shop for the project and go it alone.

Early on in the tender, team members were able to use their technical know-how and past experience of working at the airport to reduce the period of construction – a major feat demonstrating technical excellence in engineering and effective strategic use of the various business units.

"With this project, we have utilised the width and breadth of the Gammon business. The tender was led by the Civils team, but it's an internal joint venture with Building. We also are working with Foundations, E&M, Lambeth, CSD and Pristine," said Ellis at the time.

Unusually for Hong Kong, Gammon was able to set up an on-site batching plant and precast yard, while Pristine produced the steelwork for the roof trusses and A-frames in Dongguan. Pristine's contribution to the project was critical, demonstrating world-class competence as a steel specialist.

Also crucial to Midfield, as to previous airport projects, was Gammon's capacity to innovate.

"I have observed many examples of innovation ranging between the large, such as the beam shutter formwork, to the small examples such as on the DHL site," said Poole.

"This is when AA was concerned about the potential for lunch boxes being blown around the airport. Gammon's solution was simple and elegant. The project manager suggested creating a shaded worker's rest area, but I asked, how do you encourage workers to use the area? The answer: set up tables, fans, free water and a comfortable area for the workers to rest. Though it was a small site, it was a tangible example of the importance of worker welfare. Over our years of partnership, Gammon has fostered a climate where people feel they can do more through encouragement, reward and recognition."

The AA also entrusted Gammon with its mission, as Poole put it, "to make a statement as a sustainable airport", and many environmental initiatives were built into it.

"We started right at the beginning and designed in systems for both the structure and E&M to be champions for sustainability. The asymmetrical shape allows a balance of natural light into the building while minimizing heat gain. For this reason, the higher east façade allows light into the building, while the west façade is lower and also features louvres to restrict the heat gain."

During construction, the Gammon project team took advantage of BIM technology to provide a "virtual-before-built" image to enhance efficiency and reduce wastage. The project team also pushed traditional boundaries by transforming marine mud into a crucial green resource – for the first time in Hong Kong. The marine mud was successfully recycled for in-situ backfilling. The techniques that have been developed to achieve this will now be re-employed for upcoming foundation work for the Hong Kong Housing Authority, MTRC and on other government projects.

The AA and Gammon commitment to sustainability with the Midfield project was recognised at the 2013 Hong Kong Awards for Environmental Excellence organised by the Environmental Campaign Committee.

The Airport Authority Hong Kong Contract P533 Midfield Concourse Works won the Construction Industry Gold Award and Gammon's green treatment of marine mud for in-situ backfilling achieved a Green Innovation Award.


228-230
228-230

THE FUTURE

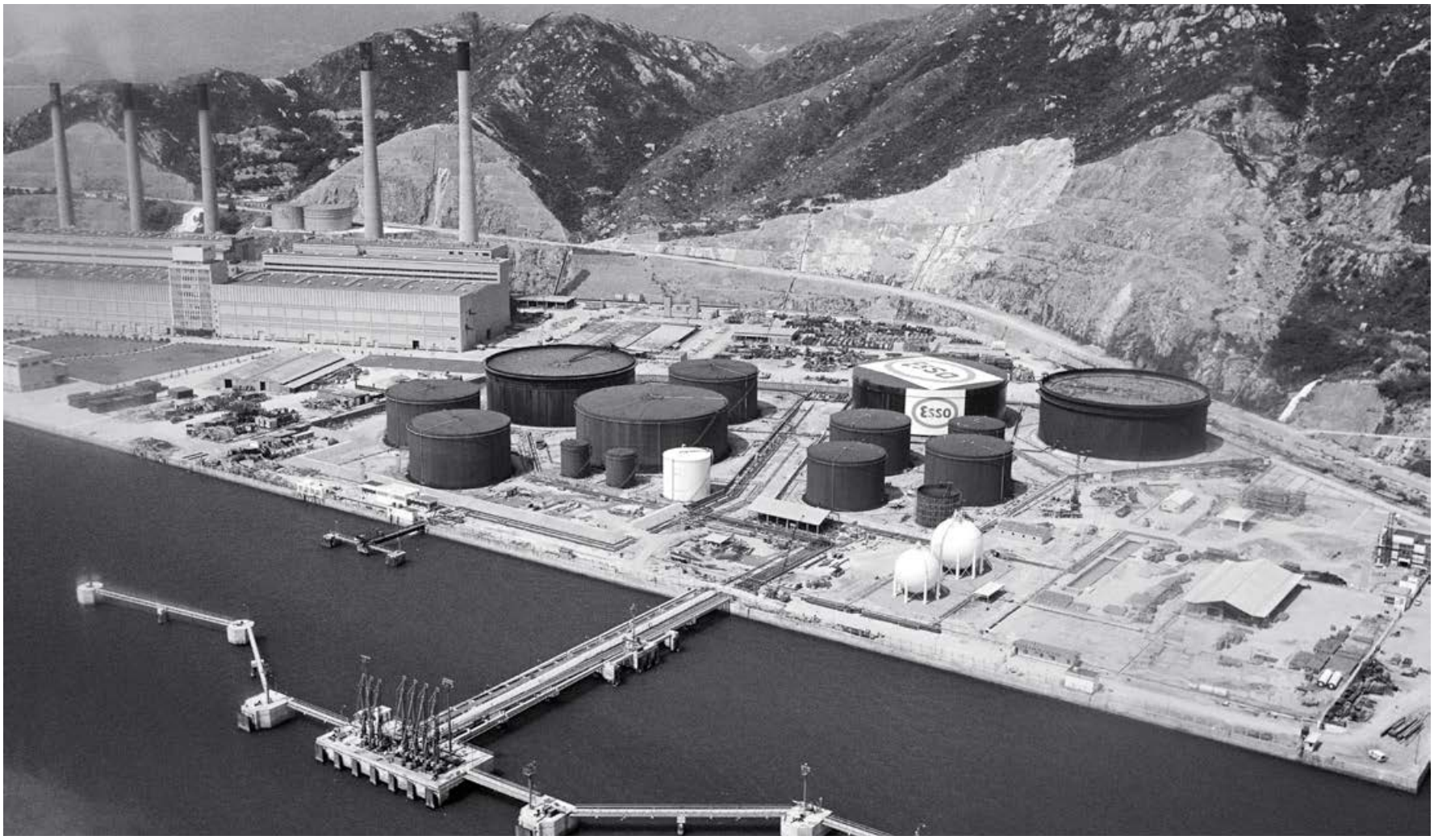
In 2017, the Hong Kong International Airport at Chek Lap Kok, widely acclaimed as one of the world's best airports for both passengers and cargo, handled 72.9 million passengers and over 5 million tons of cargo and airmail.

Chek Lap Kok continues to grow. Looking ahead, Gammon's expertise has already been called on for the projected Three-Runway System, and SkyCity – a 25 -hectare integrated development that is part of the AA's strategy to expand and transform Hong Kong International Airport into a city within a city, offering, according to the AA, "a new paradigm" for leading aviation hubs in the 21st century.

"For the Three-Runway System project our estimated expenditure is $141.5 billion and we've just started the reclamation, so there are a lot of projects to come," says Alex Kwan.

"In addition, over the next six to eight years we are already committed to spending over $30 billion. It is a significant capital investment in the passenger building, the new APM, enhancement of the existing terminal and facilities, and so on. We estimated that by 2024, passengers will increase from currently around 70 million to 90 million, and that by 2030 there will be over 100 million passengers per annum."

Hong Kong's civil aviation facilities have come a long way in the last 60 years, and have further yet to go. Gammon has played a role in their development throughout, and will doubtless continue to do so in the future.



1969 TSING YI POWER STATION

Until the 1950s, hilly Tsing Yi Island was home to fewer than 5,000 farmers and fishermen, living on boats and in houses built on stilts. It is now enlarged by land reclamation to 10.7 square kilometres and has a population numbering more than 200,000, mostly living in modern estates. In the 1960s, industrialisation transformed the island, and Gammon worked on the construction of Tsing Yi Power Station for China Light & Power. Electricity was needed urgently as people moved out of insanitary squatter huts into public housing, and as burgeoning factories made Hong Kong the workshop of the world. The 1,520MW oil-fired power station opened in 1969 and served the community until 1998.

The photo shows the completed power station, together with another Gammon project, a tanker pier for the Exxon Storage and Wharfage Co Ltd. Today much of Hong Kong's oil and petroleum supply flows from tanks on the island — it is a vital hub for the city's energy. Built over 16 months, when it opened in November 1976, the $187 million facility was 305m long and provided three berths for vessels weighing 110,000 tons, 2,500 tons and 500 tons.

1971 HIGH ISLAND RESERVOIR WORK

In 1967, a severe drought had Hong Kong panting for fresh water. Strict rationing meant most people got only four hours supply every fourth day. To prevent a recurrence of the problem, the government planned a second major reservoir in an area to be reclaimed from the sea. Work on Plover Cove reservoir had begun in 1960 and would be finished in 1968, but much planning was needed before work could start on the High Island project. Roads had to be constructed through the rugged Sai Kung mountains to get to the site. Gammon finally began work on the $320 million project in December 1971 and it took four years to complete. When sturdy dams had been built between High Island, other islands, and the shore of the Sai Kung peninsula, a vast reservoir with a capacity of 281 million cubic metres had been formed. Engineers used motorbikes to get through the 40km of tunnels that were part of the scheme. Gammon staff cut tunnels up to four metres in diameter to carry water from High Island the 23km to the Lower Shing Mun Reservoir. They also built 23km of access roads, and drilled and blasted 700,000 tons of rock from the tunnels.

1972 TAIKOO SHING

For seven decades, the Taikoo Dockyard on the Quarry Bay waterfront played a vital role in Hong Kong's economy. It opened in 1902, and several of the largest ships in the world were subsequently built there. Many vessels plying the China coast trade routes depended on its huge dry dock for maintenance and repairs. By the 1970s, however, the world economy was changing, and so were patterns of shipping. Clearly goods were going to travel mostly aboard the new generation of enormous container ships, and facilities on a much larger scale were required. In 1972, Hong Kong's first container terminal opened at Kwai Chung. The dockyard had been superseded.

Executives of the Swire Group, which owned the dockyards and surrounding property, were keenly aware of the home ownership aspirations of the emerging Hong Kong middle class. They believed a modern, well-designed, efficiently-managed private housing estate would be welcomed by this fast expanding and increasingly wealthy sector of society. They were proven right. Much of the construction work on what was to become the Taikoo Shing complex was carried out in close co-operation between Swire and Gammon.

1973

CONNAUGHT CENTRE

Still one of Central's most iconic buildings almost half a century after its completion, the 52-storey corporate headquarters of Jardine Matheson is famous for its distinctive round windows, a design element that allowed a reduction in the thickness of its structural frame. When the building was completed in 1973, it dominated the Central waterfront and the financial district. Gammon won a $77.4 million tender for the piling, substructure and superstructure. Work proceeded swiftly with one 1,394-square-metre reinforced concrete floor being added every week. When the 179m-tall building was ready for occupation, it was the tallest in Asia and remained so until the completion of the Shinjuku Mitsui Building in Tokyo in 1974. It was renamed Jardine House in 1989.

1975 GAMMON HOUSE

In the early 1970s, Hong Kong was gearing up for a building boom that was to transform the city. Towering new blocks seemed to rise every week and Gammon was involved in building many of them. Feeling it was time for the firm to have its own headquarters, the directors identified a suitable site in the heart of Central. After spirited competitive bidding they won the land and work on the $105 million project began in 1973. Naturally, Gammon designed and built the distinctive 38-storey structure. During construction, many pedestrians would stop and stare at an unfamiliar sight – in place of the familiar bamboo framework around a rising tower, this one was surrounded by lightweight steel scaffolding.

The speed with which the building was completed was equally arresting. From digging the 23m-deep foundation caissons to the triumphant opening ceremony, it took just 25 months to complete.

Gammon House did not remain Gammon's for long, however. Attendant on the building boom was a steep rise in property prices, and it was decided that the firm should cash in its investment. The building was sold to the now defunct local conglomerate Carrian Group for $998 million in 1978, and renamed Carrian House in 1980. Today, it is called Bank of America Tower.

1976

WATERLOO ROAD FLYOVER

Building the $33 million Waterloo Road flyover presented Gammon engineers with multiple challenges. The 660m-long divided elevated road was designed to ease severe traffic congestion in an area criss-crossed with busy arterial roads. In the three-year construction period, staff had to handle complicated logistical problems getting materials on site, and delicate situations caused by setting back property boundaries so the work could proceed. A feature of the contract was the 117 hand-dug caissons, up to 1.5m wide and 25m deep. The project demanded innovative thinking. The deck of the elevated road was made up of 239 precast box beams, weighing up to 47.5 tons. To handle these heavy loads, Gammon engineers designed a special crane, aptly named Goliath. It was so successful at meeting the demands of a particularly difficult project that it provided a prototype for similar equipment used on later contracts.

1976 HONG KONG POLYTECHNIC

In the 1970s, to cope with Hong Kong's ever-growing need for highly-qualified and well-educated professionals and technicians, the government embarked on a significant expansion of tertiary education. New campuses were needed for tens of thousands of young people, eager to seize the advantages of higher learning. Gammon tendered successfully for the $65 million contract to build the first phase of what would become Hong Kong Polytechnic University, formally established in 1972 and still one of the largest and most prestigious educational institutions in the city. The imaginative design melded modern technology with the concept of medieval cloisters, providing a peaceful, contemplative intellectual atmosphere for learning. Five circular cores, which held all the building services, rose from a massive podium. Between them were five blocks housing classrooms and laboratories. Included in the contract was one of the largest academic libraries in Hong Kong. Built in the remarkably short period of 17 months, Polytechnic University is still a major Kowloon landmark.

1977 OCEAN CENTRE

Integral to the sprawling Harbour City complex and looking out over the western tip of the Kowloon peninsula, Ocean Centre is linked to Ocean Terminal where many of the cruise liners visiting the city still dock. Gammon constructed the imposing 69,677 square metre complex of offices, retail outlets, restaurants and car parks, close to the Tsim Sha Tsui concourse of Hong Kong's iconic Star Ferry, under a $132 million contract for the Wharf Group. It took 16 months to build.

1978 SHA TIN RACECOURSE

In the 1960s, Sha Tin Valley was almost entirely agrarian. Its scattered Cantonese and Hakka villages had a population of about 30,000. Among gourmets it was considered a bucolic idyll, famed for honey-roasted pigeon, tofu made by local villagers, and what was said to be the best rice in China. The government had other priorities. The valley was selected as the site of the first and largest of the new town developments that started in the early 1970s. By 2007, there were 607,544 people living along the channelled banks of the Shing Mun River. On reclaimed land once occupied by a wide bay, rose public housing estates, smart shopping malls, luxury apartments, and a horse racing course widely acclaimed as the best in the world. The track opened in 1978 after six years of planning and construction. Gammon built the massive grandstands from which up to 85,000 people can enjoy an exhilarating afternoon or evening at the races.

1979 AP LEI CHAU BRIDGE

Ap Lei Chau is within a mooring cable's length of the southern shore of Hong Kong Island, but for most of its history was distinctly a place apart. Aberdeen Harbour, the twisting narrow channel that separated the islands, was a congested anchorage for thousands of sea-going junks and sampans. It was one of the largest settlements of junk-dwelling Tanka people on the coast of China. In the 1970s there were 7,449 registered inhabitants on Ap Lei Chau, mostly boatbuilders and fisherfolk. In 1977, the government decided to build a two-lane road and pedestrian bridge – the first link between Hong Kong and one of the outlying islands. Gammon won the $32 million contract to build the graceful 230m structure, carrying a large water main and the approach roads. As the two sides of the main 115m span edged together, the main navigational channel underneath was busy day and night. The Hong Kong fishing fleet headed out to sea, or came home with its catch, as it had always done. But the project opened Ap Lei Chau for the development of private housing estates and, by 2006, more than 90,000 people lived there.

1981

TAI PO RECLAMATION

The entrance to the old market town of Tai Po was a jumble of shacks on sticks above the estuary of the Lam Tsuen River and sampans floating in the noxious water. The area was a rural slum. Part of the government plan to develop Tai Po as a new town, with the old market area surrounded by modern high-rise estates, was to clean it up. Large areas had to be cleared, and land reclaimed from the sea to create space for housing, parks and industry. The river had to be channelled and made safe. It was a dirty job. In one of the contracts handled by Gammon, more than 1.5 million cubic metres of muck had to be shifted before rocks could be laid as the base for reclamation.

1981

CANAL ROAD FLYOVER

Following its curving path through the concentrated mass of apartment and office towers in bustling Causeway Bay, the 1,100m-long Canal Road flyover is a key road link. It takes traffic from the mouth of the Aberdeen Tunnel to the Cross Harbour Tunnel, and to roads heading for all parts of Hong Kong Island. When Gammon signed the $69 million contract for its construction in 1976, the five-year task was to build the four-lane flyover up the course of the Bowrington Nullah, along Wong Nei Chung Road, skirting the Happy Valley Racecourse, and on to the tunnel mouth. Along the way, it had to go through three historic cemeteries. The piers holding up the flyover were supported on broad 1.65m caissons or reinforced concrete piles. The work also included laying a kilometre of tram tracks and 25,000 square metres of ground level roads. The result is smooth traffic flow through one of the most congested areas on the planet, in an area where a dozen major roads converge.

1982

CASTLE PEAK CEMENT PLANT

Hong Kong is held together with cement and needs a steady, reliable supply. When in 1980 China Cement Company (HK) finalised its plans to build, on a 770,000m reclaimed site at Castle Peak, a plant which would produce 1.4 million tons of cement per year, Gammon won a $318 million contract for the work. It was a major task efficiently carried out thanks to Gammon's comprehensive expertise in foundation work. The specialised kilns and silos needed for the plant were anchored by large-diameter bored piles, which went all the way down to solid bedrock.

1982 LAMMA POWER STATION

Seen from Kowloon, Hong Kong Island presents perhaps the most spectacular urban night-time views in the world. The backbone of the electricity supply that lights the millions of bulbs, brightens the neon signs and provides the energy for the nightly Symphony of Lights multi-media show along that famous skyline, comes from the Hongkong Electric plant on Lamma Island. Planning for the Lamma Island Power Station at Po Lo Tsui began in 1978. Because of rising concerns about environmental issues, it was designed to be run on either coal or oil. When it came into service in 1982, the construction time of 3.5 years established a world record. When the second phase of the submarine energy link to Hong Kong came on-line in 1986, it was the highest capacity cable in the world. The following year a second coal-fired generator was powered-up. Hong Kong needed the energy. By 1989, demand was more than 1,000 megawatts monthly. Gammon has been involved with many major projects for the power facility over the years. These include a $62 million contract for cooling systems in 1979; building the towering three-flue chimney completed in 1982; carrying out the $160 million civil works for stage two of the station; extensive boring and foundation work; and the $490 million contract to install cooling systems and handle substructure work for the main building in 1995.

1982

DISCOVERY BAY

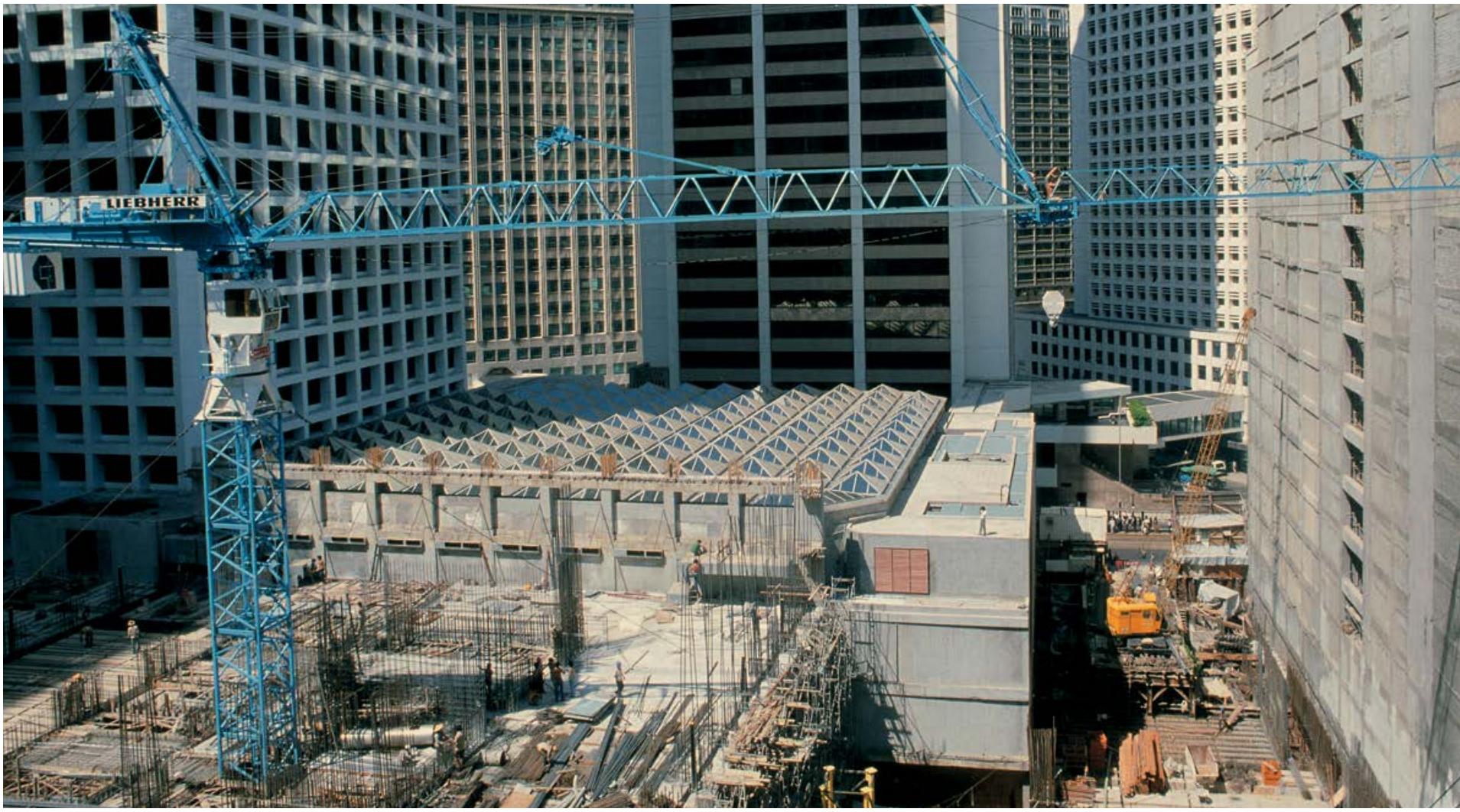
Until the late 1970s, Tai Pak Wan on the southeastern coast of Lantau was a remote cove, sparsely populated and surrounded by bush covered hills. That was to change radically. In 1979, the Hong Kong Resort Company began development of a private housing scheme given the name Discovery Bay. The intention was to offer an alternative lifestyle, a convenient ferry ride away from Central. By 2016, more than 20,000 people were living there. Right at the outset Gammon was a 50 per cent joint-venture partner with Leighton Contractors in an ambitious $400 million project to carry out marine works and site formation. It was a huge job, involving the excavation of 6.6 million cubic metres of earth, and the blasting of more than 1.3 million cubic metres of rock from the hills – much of it used as aggregate for concrete. Work included preparing a 700,000m 18-hole golf course, site formation for the first housing blocks, seawalls, ferry piers, reservoirs, roads, sewer mains and a dam. The first phase of the development was completed in 1982, with 504 residential units ready for occupation.

1982 ABERDEEN TUNNEL

Before construction of the Aberdeen Tunnel, for practical purposes the southern shore of Hong Kong island was all but inaccessible from its busy northern fringe. To get to town from Stanley, Aberdeen or Shouson Hill meant a long, torturous drive or bus trip along a narrow winding road. In 1977, the government contracted a Hong Kong, French, German and Swedish joint venture to drill a 2km-long twin tunnel through the mountainous spine of the island, connecting the two sides. Gammon was the $250 million local participant in this partnership. Most of the tunnels went through solid granite. The drilling and blasting involved much hard work, but had predictable outcomes. Towards the southern end, however, less stable quartz and volcanic rock presented more complex challenges. These were met, and when it opened for operation in 1982 the tunnel dramatically cut driving time between the south side of the island and the rest of Hong Kong, leading over time to the transformation of the area.

1982 SHA TIN BRIDGES

The Shing Mun River, which flows through Sha Tin, was not always the placid expanse of water it is today. In the wet season, before the development of Sha Tin New Town in the 1970s, the river regularly burst its banks. The planners for the massive urban development, where more than 600,000 people were expected to live, knew that annual floods could not be tolerated. Their solution to the problem was to channel the final few kilometres of the river, containing the flow between sturdy banks. Now, monsoon rains are carried safely out to sea. Gammon won two contracts of $39 million each to construct bridges spanning the 200m-wide channelled river. Work on the first began in 1978, and on the second in 1981. Each carried six lanes of vehicles, with pedestrian walkways and cycle tracks. Gas and water mains, and electricity cables were built into the structure. As part of the contract, Gammon also built approach roads and underpasses. In 1989, the firm was awarded a $232.5 million contract to build a kilometre-long four-lane elevated highway from Lion Rock Tunnel road to the Tate's Cairn Tunnel.



1983 EDINBURGH TOWER

The Landmark complex is located right in the heart of Hong Kong's vibrant Central Business District. The area is also the location for many of the city's most prestigious hotels, restaurants and retail outlets, many of them within or linked to The Landmark itself. The complex, surmounted by two office towers, transformed Central's core when it opened in the early 1980s, and construction of the 47-storey Edinburgh Tower and substructure work for the 48-storey Gloucester Tower, were entrusted by developer Hongkong Land to Gammon.

1983

ISLAND EASTERN CORRIDOR

For many years, access to the eastern areas of Hong Kong Island was primarily along the old Shau Kei Wan Road, a congested continuous thoroughfare with a tram track running down the middle. In the 1930s, stretches of it were renamed King's Road, Tung Lo Wan Road, and Electric Road. In the late 1970s, all three were constantly choked with traffic. A radical solution to the problem was eventually found with the Island Eastern Corridor. Work on the $196 million contract to build an elevated road, extending along the waterfront between North Point and Quarry Bay, began in December 1981. Two years later, the dual three-lane highway was completed. In 2000, the Highways Department wanted the Corridor broadened and more sliproads constructed. Once again, Gammon won the $688 million contract. Part of the task was to remove two concrete piers and 18 "dolphins" — large oval-shaped concrete buffers built to protect the roadway from possible ship collisions. An innovative approach to the challenge was adopted, cutting away the supports at seabed level and shipping the dolphins and piers to Sai Kung, where they were added to an artificial reef. This imaginative eco-friendly solution obviated an immense demolition job, and boosted an underwater haven for marine life. It won Gammon the Grand Award in Hong Kong's 2001 Eco-Business Awards.

1984

WHEELOCK HOUSE

When it was completed in 1984, the new 24-storey Wheelock House on the corner of Pedder Street and Des Voeux Road offered highly desirable prime office space in the middle of Central. Construction took place on a historic site where the first Jardine House was built in the early days of British Hong Kong. As the sturdy framework of steel beams climbed higher, onlookers in surrounding office towers enjoyed a privileged view of the hard work involved in erecting a modern building.

1984

HONG KONG CLUB

In 1897, the prestigious Hong Kong Club moved into new, gloriously ornate colonnaded premises. Its new home was built on reclaimed land, provided by the government on a 999 year lease. The building was an important Central landmark, forming the eastern side of the northern end of Statue Square. Seven decades later, however, the social establishment for the wealthy and powerful was losing money. Eventually members agreed the clubhouse should be demolished, and the club rehoused in a modern structure with additional storeys of office space. There was a vigorous campaign by preservationists, and some members, to preserve the old building, but they failed in the attempt. When construction was completed in 1984, the old clubhouse had been replaced by a modern 24-storey building, resting on secure foundations created by Gammon.

1985 CASTLE PEAK POWER STATION

The $567 million contract for construction of the circulating water system for China Light and Power's new power station at Castle Peak was a complicated assignment. Gammon engineers had to put in piles for a pumphouse, culverts and other structures – some of them underwater, and others driven through newly reclaimed land, which held many large boulders. Working against a tight deadline, these presented challenges. Over water, 24 large piles were driven into bedrock. On top of these a steel work platform was built, so a further 124 piles could be driven into the seabed. Laying the outfall for the two cooling water tubes meant working in swift-flowing, but also murky waters 30m deep. Despite the complexities of the job, the project was completed on schedule.

1985 - 2013

EXCHANGE SQUARE

Hong Kong's world famous Exchange Square complex takes its name from the Stock Exchange of Hong Kong, and one of the key objectives of the development was to provide a worthy home for the city's bourse. Phases One and Two of its construction were completed in 1985. They included a 51- and 52-storey tower, built over a podium resting on massive foundations on reclaimed land in a prime Central location, close to what was the Central waterfront and prior to yet more land reclamation.

As the project neared completion in 1984, the trading floor of the Stock Exchange was finished. It was a cubic space measuring 50 metres by 50 metres. To mark the milestone, Gammon project staff met with Hongkong Land executives and other partners. They planned to celebrate the achievement and have a little fun to relieve the many pressures that any major construction job necessarily entails.

"At that stage, it was a raw concrete box," Martin Hadaway, then a youthful Gammon Project Manager, recalled many years later. Drinks were poured and the party then divided into two sides for a game of cricket in the space. Executives from Hongkong Land had worked together closely with Gammon engineers on Exchange Square, which in the early 1980s was establishing new benchmarks for the construction industry. But, as with any large project, there were occasional disagreements about the best way to proceed. The friendly cricket match was a celebration, but was also aimed at building team spirit.

Mike Arnold, then with Hongkong Land and founding chairman of the BEAM Society, led the developer's team. The rules of the ancient game were bent slightly to fit the environment, but the will to win was alive and well. Many years later, Hadaway could still recall, with deep satisfaction, a particularly bold swing of Arnold's bat. Hadaway caught the ball, knocking the Hongkong Land chief out of the game. "Catching out Mike was the highlight," he admitted.

The game was a brief frivolous respite from concentrated serious endeavour. In June 1982, Gammon had been awarded the $144 million contract to carry out the foundations and substructure work on what would become Exchange Square. Then in November the firm was awarded the $1.37 billion superstructure contract. Work began as soon as the first contract was awarded. A steel retaining wall was inserted around the entire site, down to 20 metres below ground level. Within a month, a dozen piling rigs were boring the first of 392 piles. Up to two metres wide, they went as deep as 65m.

The building footprint occupied the entire site, so Gammon hired another nearby space to set up a concrete production unit where, over the ensuing months, a phenomenal 180,000 cubic metres of concrete were to be mixed. In five months, the piles were safely in place with 40,000 cubic metres of concrete poured. In one nine-hour working day, 3,500 cubic metres were poured, setting a construction industry record in Hong Kong.

Mixing on site was just the first challenge — powerful pumps were used to push 80 cubic metres of concrete every hour through tubes 127mm in diameter up as far as the 52nd floor of One Exchange Square. Running 24 hours per day, it was the largest concrete pumping exercise in Hong Kong history.

The towers each went up at a rate of one floor every five days and the timetable was rigid. The two towers had to be completed and ready for handover in 21 months, and the bus terminus beneath the podium had to be ready 12 months before completion of the project. The Stock Exchange was due for handover to the client four months before the towers were finished. There were 2,500 men on-site, and shifts worked 24 hours a day. The deadlines were met.

In 1988, the 33-storey Three Exchange Square tower, also built on Gammon foundations and sub-structure, was completed, and in 2012 Gammon was again back at Exchange Square, redeveloping The Forum podium level retail space into the ultra-modern office building, which Standard Chartered Bank has occupied since 2014.

Exchange Square, devised by Hongkong Land and constructed by Gammon, was so far ahead of its time in 1985 that more than three decades later it still commands some of the highest rentals in Central – equal to or greater than those of the most recent state-of-the-art buildings.

Working on it was also a career-defining experience for many of the engineers, Martin Hadaway being one example. Just 31 when he was named Project Manager and, within a decade of its completion, he had been appointed Group Managing Director of Gammon. He remained at the helm of the firm for a decade, retiring in 2005.

1989 ROUTE 5 TUNNELS

The dual tunnel link between Sha Tin and Tsuen Wan is a crucial component in the network of highways linking different areas of Hong Kong, and connects the city to mainland China. Planning for the project began in the mid-1980s and the $452 million contract was awarded in 1986. Three years and seven months was the time allocated for the complex of tunnels, bridges and roadworks to be completed. It was an exactingly tight time frame. The dual two-lane highways were to be just 3.5km long – but 2.6km of those would be through tunnels, with the roads emerging in about the middle into the open to cross the deep ravine of the Shing Mun River.

1990

REPULSE BAY BEACH

Named after a British warship, HMS Repulse which anchored there in the 19th century, Repulse Bay is Hong Kong's most famous beach. It derived some of its glamour from the historic Repulse Bay Hotel where real royalty and Hollywood royalty both liked to stay. That was demolished in 1982. By 1989, a replica of part of the old hotel had been erected on the same site, giving the area back its focus, but the beach itself was looking a little tatty. Port Works decided to upgrade it by preventing the sea from carrying away the golden sands. Gammon built sand retaining structures at both ends of the beach, which doubled as attractive places for beach lovers to stroll, and as landing sites for small craft. A new stormwater drain improved the quality of water and sand in the main swimming area. After the $54 million project was completed, Repulse Bay was once again the gem of Hong Kong beaches.

1990

STANDARD CHARTERED BANK

The distinctive pink granite exterior of the 42-storey Standard Chartered Bank Building makes it one of the most recognisable landmarks of Des Voeux Road, Hong Kong's "Bankers' Row". Gammon built the striking structure in a two-year and six-month-long joint venture project with Nishimatsu Construction. As the office tower rose above its large two-level podium, there were 600 workers on site, including 120 specialists in marble and granite. As part of Central's user-friendly system of walkways the bank was linked by pedestrian bridges to the adjacent Hong Kong and Shanghai Bank, to the Prince's Building office and retail block, and across Queen's Road to Battery Path. The joint venture also won a $112 million contract to fit-out the finished building.

1990

KWUN YAM TEMPLE

In 1990, Gammon tendered successfully to rebuild the ancient temple of Kwun Yam in the hills above Tai O on Lantau island. Now a project manager, Vincent Li was then a 27-year-old assistant engineer. He was delighted to be named project representative for the $32 million construction contract.

The old monastery and temple, originally built in 1910 and renovated in 1953, were demolished to make way for an imposing new structure. The site was on the steep mountainous flank of Lantau, between the Po Lin monastery on the Ngong Ping plateau and the fishing port of Tai O. The precipitous access road was too narrow for delivery vehicles, so Li not only had to work out a system for concrete to be made on site, he also had to order all the raw materials and work out how to have them manhandled up the steep slope.

Accommodation arrangements were also unusual. Li and other engineers lived in the almost deserted village of Keung Shan, which by then had a mere three indigenous inhabitants. Experts in heritage architecture from Beijing and teams of artists skilled in drawing temple murals also lived in the village during the months they spent on the project. Labour came from the stilt village of Tai O.

It was, Li later recalled, a most unusual contract. There was no question of getting heavy equipment on site, so the 16 piles, two metres wide and 15m deep, were dug in the time-honoured manner by a man in a shaft, with rock and earth lifted out by a rope and bucket system. As the shafts deepened they were protected from collapse by concrete rings set within a steel mould. It was more or less the last project for which hand-dug caissons were permitted in Hong Kong. When the shafts were dug, reinforcing steel was fixed in place, then the concrete poured. Atop these foundations rose a concrete structure designed by architect Daniel Heung Cheuk Kai, closely modelled on the famed wooden Tower of Buddhist Incense in Beijing's Summer Palace. Expressing the building's traditional lines in reinforced concrete was challenging for Li, but the three-level pagoda with its sweeping eaves gradually took shape.

When monks from the Po Lin monastery officially opened it in 1993, government officials, community leaders and religious dignitaries all praised the work. The octagonal three-level structure, 35m tall, dominates the hillside. All eight edges are an equal 15m long, giving a footprint of 1,000 square metres. A feature of the temple is a 4.9m-tall statue of the goddess Kwan Yin with 11 faces. More than a decade after the temple opened, Vincent Li, by then a construction manager, looked back on this extraordinary project as one of the highlights of his career.

1991 TAI PO GAS PRODUCTION PLANT

Considered the centre of the New Territories for generations, the government designated Tai Po as a new town in 1979, and within a few years the population soared to 320,000. The first housing estate was built in 1981, followed by Tolo Highway, which opened up the northern New Territories in 1985. Situated in the Tai Po Industrial Estate, just off picturesque Tolo Harbour and connected to the highway, the Tai Po Gas Production Plant was completed in two phases between 1985 and 1991.

Design and construction of a gas production plant is a complex and multidisciplinary undertaking, involving placing hundreds of pieces of equipment within a very constricted site. The first phase of the plant was completed in January 1987, costing $215 million for civil, building and marine works. The project was located on 117,000 square metres of reclaimed land and the particular challenge of the site lay in the foundation. Granite bedrock was difficult and expensive to core, so steel H-piles were used for a raft foundation.

The second phase cost $120 million, and Gammon used lessons learned from the first to fast-track it. In-house design team Lambeth, working with Babcock Engineering from the United Kingdom, played an important role. The level of co-ordination was intense. Co-operation and discipline in the design process called for early approvals for buildings, roads, drainage, utilities and a fire ring main. There were hundreds of pieces of equipment with identification markers and data sheets that outlined the holding-down requirements and weight. Once a foundation plinth was laid, it could not move. In addition, 800 steel H-piles had to be installed to provide foundations for the gas production plant and structures. Focusing throughout on quality control, Gammon got it right the first time.

1991

KWAI CHUNG CONTAINER PORTS TERMINAL 8

Hong Kong was an early participant in the late 20th century containerisation revolution that changed the face of world shipping. The decision that the city needed a dedicated container port was taken in 1967, and the first terminal at Kwai Chung opened in 1972. By 1991, when Gammon led a multinational joint venture on a $600 million, four-year contract to build Terminal Eight, Hong Kong had one of the three most important container ports on Earth. Two quays had to be built on land which the partners reclaimed and formed, along with a feeder road. The work was completed ahead of schedule. The massive reclamation linked the New Territories mainland to Stonecutters Island. Piling rigs mounted on barges drove 1,673 piles for the main 1.4km-long quay wall. It was handed over six months before deadline. Gammon has worked on many of the container terminals and other facilities that helped cement Hong Kong's role as the shipping hub of Asia.

1992

NORTHWEST KOWLOON EFFLUENT OUTFALL

In the 1980s, Hong Kong's famous Victoria Harbour was certainly "fragrant", but not in a good way. Cleaning it up had become an imperative. In 1991, the city produced about 2.7 million cubic metres of sewage per day. The $280 million contract for the Northwest Kowloon Effluent Outfall was an important initiative to improve the quality of the water in the inner harbour. From huge 900m-long culverts, ending on Stonecutters Island, Gammon had to construct twin 2.65m-strengthened tubes to carry waste 580m out from shore. Sections of pipe 30m long were carefully fitted and welded together, then towed into a prepared underwater trench 17m deep. A welcome improvement in water quality swiftly became apparent.

1993

CALTEX OIL TERMINAL

There are more than a quarter of a million licensed vehicles on Hong Kong's roads, virtually all of which run on imported fuel. So do aircraft, ferries and pleasure boats. When Caltex Oil decided in 1992 to expand its terminal at Tsing Yi Island, the $30 million contract was awarded to Gammon. First, 100,000 cubic metres of material had to be dredged from the seabed. Then, 36 tubular steel piles were driven 45 metres down and secured into bedrock. Special measures were taken to ensure tankers berthing in heavy weather could do no damage to the jetty. The expansion lifted the capacity of vessels that could discharge at the Tsing Yi facility from 40,000 to 60,000 tons – a major contribution to meeting a booming economy's steadily growing demand for fuel.


OOCL

1993

TSING MA BRIDGE

Gammon engineers went deep into solid rock on Tsing Yi and Ma Wan islands in 1993 to create the powerful anchorages needed to hold the supports for the Tsing Ma Bridge. Excavations were as deep as a nine-storey building. More than 1.1 million cubic metres of rock were dug out. The 1,377m span of the bridge, the longest in the world to carry both rail and road, needed enormously strong foundations. The massive structures sunk deep into bedrock used 300,000 tons of concrete.

1993/1994

DEVON HOUSE AND DORSET HOUSE

Within living memory, Tong Chong (Sugar) Street in Quarry Bay was an unprepossessing lane leading to an old sugar refinery, flanked by tiny factories, small workshops and crumbling tenements. Today, it is a hub for multinational businesses, known for state-of-the-art office space and stylish restaurants and wine bars. Its transformation was made possible by the opening of the MTR station at Quarry Bay, where the Island Line meets the Tseung Kwan O Line. Swire Properties had been swift to recognise the opportunities presented by MTR junctions at Pacific Place and Kowloon Tong, and the developer was equally quick off the mark close to Quarry Bay station. Taikoo Place currently offers almost 6.5 million square metres of prime state-of-the-art commercial space, much of it occupied by globally recognisable names. The 29-storey Devon House, opened in 1993, is one of the lynchpin properties in the area, and Gammon was awarded the $750 million contract to build it. Noteworthy aspects of the project included the use of post-tensioned slabs, designed by Gammon engineers to reduce steel reinforcing and the thickness of concrete slabs. A significant cost saving was achieved. In 1994, Gammon finished work on two other towers of what is now the Taikoo Place complex, the 39-storey Dorset House and 42-storey PCCW Tower.

1994 TATE'S CAIRN TUNNEL

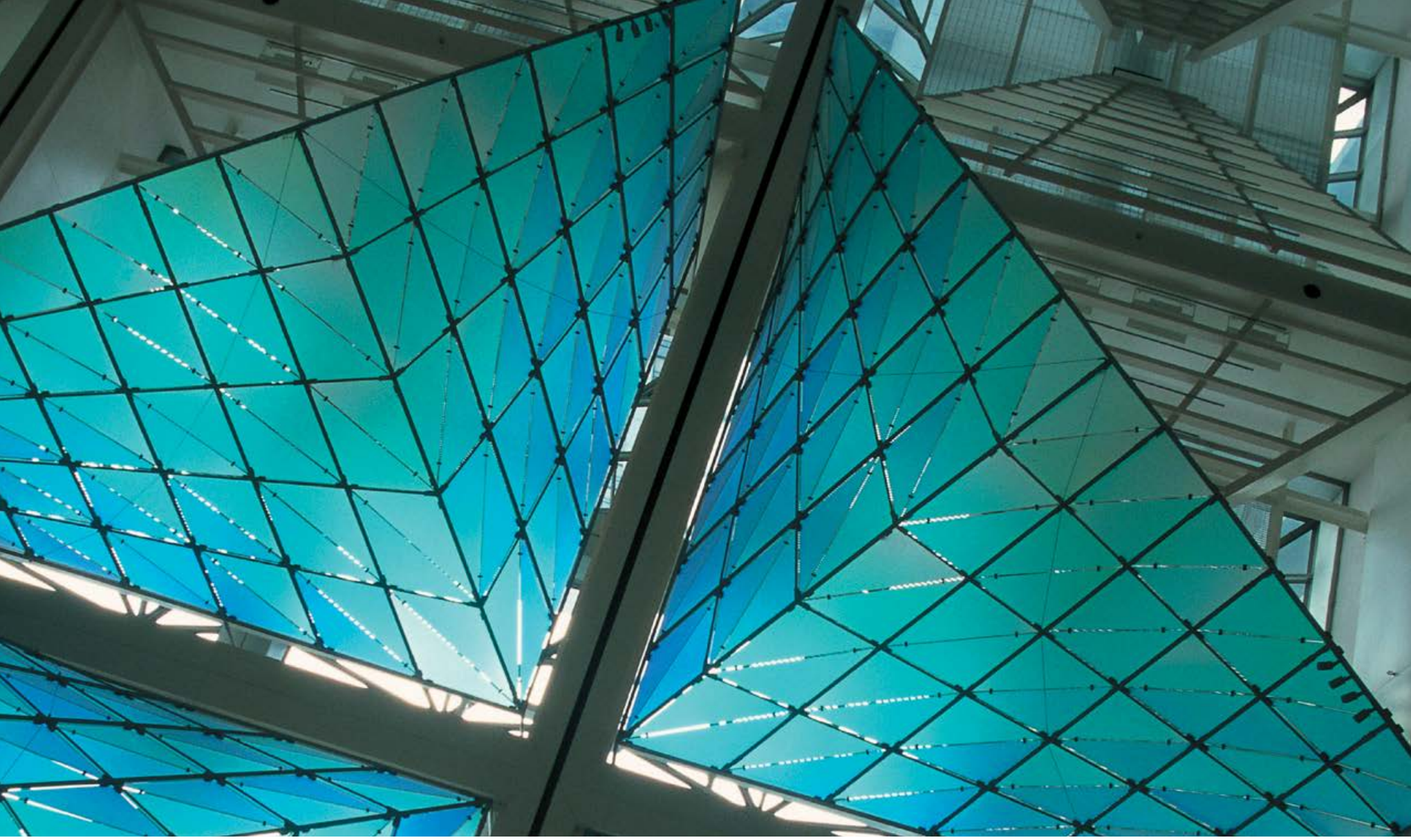
Between 1961 and 1981, the population of Hong Kong almost doubled, reaching 5,109,812. Demand for housing led to extensive development of the previously rural New Territories, which had been home to 409,943 people in 1961. By 1981, 1,303,005 were already settled there, with the greatest concentration in the new towns, including Sha Tin, Tsuen Wan and Tuen Mun. The 1980s saw extensive further construction in the New Territories, and greatly improved infrastructure connections were urgently required.

The 4km-long Tate's Cairn Tunnel, in a twin two-lane configuration, now connects Diamond Hill to Sha Tin. It was completed in August 1991, by which time 2.3 million people were living in what had previously been countryside. The $2.15 billion contract was awarded to the Gammon-Nishimatsu Joint Venture (JV), which was responsible for design and construction of the tunnels, the elevated road interchanges, ventilation, lighting, surveillance, emergency procedures and traffic management. More than 1,000 tonnes of explosives and the excavation of more than 800,000 cubic metres of rock were required. Elevated road interchanges at both ends, including a five-span bridge at Diamond Hill, called for crossheads and columns built on 245 bored piles, and 109 hand-dug caissons driven 50m into the earth. At just under 4km, they are still the longest road tunnels in Hong Kong. In January 2018, a typical month, they were used by an average of 61,638 vehicles daily.

1997

WESTERN HARBOUR APPROACHES

Connecting the 2km-long Western Harbour Crossing to the road network on Hong Kong Island was a complex project. The $1.5 billion contract was completed in 1997, five months ahead of schedule, allowing early opening of the third connection between the Island and Kowloon. Gammon was charged with building all the approach roads, including elevated roads with a total length of 3.2km.



1998 LANDMARK, CENTRAL

The Landmark is aptly named. The integrated office and high-end retail complex is an icon, situated at the heart of Hong Kong's Central Business District. Gammon finished building it for owner Hongkong Land in the 1980s. But ever since, the firm has been involved in projects to improve and enhance the Landmark, keeping it fashionably and functionally up to date. In 1998, Gammon completed a $120 million refurbishment. Great care was required to minimise disturbance to diners, shoppers and occupants of the grade-A offices during the demolition of an internal footbridge. The atrium ceiling was replaced with an imaginative combination of cantilevered grilles and laminated glass, enhancing the natural light flowing down on the fountain, which blesses the building with excellent feng shui. In 2003, Gammon began another two-year $590 million contract which included creating the spectacular 118-room Landmark Mandarin Oriental hotel.

1998 ROUTE 3

Comprising 12km of modern six-lane divided highway, extending from the Ting Kau Bridge over Rambler Channel to Au Tau, Route 3 cuts a swathe through the northwestern plains of the New Territories. The $2.7 billion project took three years and two months to build, with Gammon as the main subcontractor for all work except that on the Tai Tam Tunnel. More than four million cubic metres of rock were blasted from hillsides, and drainage systems were installed on the landscaped slopes to prevent future landslides. During the lengthy project, Gammon worked closely with experts on the environment to ensure the works had as little impact as possible on residents and the countryside.

1998/1999

LINCOLN HOUSE AND OXFORD HOUSE

When Swire Properties developed what was then Island East, creating an entirely new business precinct in Quarry Bay, it was decided to link many of the buildings by air-conditioned aerial walkways. In Hong Kong's steamy summers these were popular with tenants and visitors. Among the office towers built by Gammon in the area is Lincoln House, a 23-storey building which, when completed, was regarded as the city's first truly environmentally friendly building. The $487 million project won the top rating, "Excellent", from the Business Environment Council. Nearby Oxford House, finished a year later in 1999, is a 40-storey, $724 million office tower that also won recognition for quality. Today, Lincoln and Oxford House are both part of the sprawling complex known as Taikoo Place.

1999 TSEUNG KWAN O PORT

Original plans for dredging in the Tseung Kwan O Port development area called for the removal of 1.25 million cubic metres of seabed mud. Gammon suggested removing an additional 870,000 cubic metres. The idea saved the government a significant amount of money, allowing large volumes of construction waste to be dumped into the 570km reclamation earmarked to serve deep waterfront industries. Gammon and Ballast Nedam Dredging were joint venture partners on the $700 million contract, which lasted three years and nine months, until October 1999. The 330m-long seawall was fronted by water 10.5m in depth. To build the immensely strong eight-layer seawall, engineers used blocks weighing up to 58 tons. They were the largest ever employed in seawall design by the then Civil Engineering Department, which became the Civil Engineering and Development Department in 2004. To protect other areas of the reclamation 16,000 tetrapods were cast at Shekou in Shenzhen and barged to the site. When land based filling for the reclamation started in 1998, a special traffic system had to be devised to handle the more than 1,500 vehicles turning up daily to dump loads.

1999 TIU KENG LENG

The earth shuddered, thick clouds of dust rose, and hundreds of tons of heavy rock were blasted off the face of a cliff – just one of many such moments of high drama as more than a million cubic metres of earth were excavated for the construction of Tiu Keng Leng MTR station. The $139 million site clearance and formation contract was completed on time in 1999. Fleets of dump trucks carried away 6,000 cubic metres daily. Because it was so close to the sea, a concrete bundwall and dewatering system was used to control water inflow into the deep excavation. Controlled blasting played a critical role in the project.

2000

MAN YEE BUILDING

When the original Man Yee Building was erected in Des Voeux Road, Central, in 1957, it was a modern marvel equipped with the first escalator in Hong Kong. After it was demolished in 1999 and a glass curtain-walled 31-storey, grade-A office block constructed to replace it, a building of real stature once again occupied the site. The Man Yee Building has a floor area of 47,540 square metres comprising prime office space and a four-level shopping arcade. Office storeys have raised floors and suspended ceilings, features designed for maximum flexibility in installing the latest technology. Designed by Rocco Design Architects Ltd, it was built by Gammon.

2003

CHATER HOUSE

In 1998, Central's Swire House, built in 1962, was demolished to make way for a 30-storey office and retail building to be called Chater House. Gammon was appointed the main contractor, and it was agreed with owner and developer Hongkong Land that improved safety initiatives and alternative factory production based technologies would be employed in construction.

Among the innovative safety measures was a three-storey-high steel safety screen, installed to the perimeter of the building and supplemented by a protective safety fence installed to the edge of the floor slabs. This provided total safety, both for the workers undertaking the structural frame construction and the tradesmen subsequently carrying out the interior fitting-out and building services installations.

It was also agreed to implement a hydraulic jump formwork system for constructing the central core of the tower. The floor slabs were cast using a "mini" table form system, the table forms being moved and raised to the next floor of installation utilising hydraulic hoists. Steel pan stair forms were introduced to act as permanent formwork for the staircase construction, while internal walls comprised HardieWall dry-lined partitions with lightweight concrete infill, thus minimising wet works within the building.

To improve logistics and the loading out of materials, retractable loading-out platforms were utilised at various levels and elevations of the tower, while jump lifts to move workers were established in the permanent lift shafts. Waste from the project was minimised through systemised construction and prefabrication of certain building services. The waste that was generated was sorted, and, as applicable, recycled, thus reducing what was being taken to landfills.

Chater House was designed to meet the Grade A office and retail space expectations and the 53,790-square-metre building set new standards for a cleaner, safer and more environmentally sustainable manner of building in Hong Kong.

The programme for the works was rapid, requiring good working relationships and fast decision-making. A Guaranteed Maximum Price (GMP) contract helped to make this possible.

As part of the GMP contract, Hongkong Land, Gammon, the designers and the subcontractors, all signed a Partnering Charter, establishing key objectives for the project. Representatives from each company were chosen, and regular workshops were attended by all parties to discuss and resolve issues. The outcome was that out of the 39 parties and companies who signed the charter, only one felt their objectives had not been entirely fulfilled.

In this spirit of co-operation, when tenants JP Morgan took possession of their floors to carry out a partial fitting-out of their offices, a large workforce comprising JP Morgan's interior fit-out contractors and Gammon's building services and finishing works contractors were able to work side-by-side in an effective and co-ordinated way.

According to the Civic Exchange's report, Sustainable Construction, Innovations in Action: "Partnering increases the opportunity for innovation and ensures that stakeholders have each other's full support in implementing new policies and practices."

The construction of Chater House was a prime example of successful co-operation built on openness and trust. Thanks to Gammon's open book GMP contractual arrangement, the client was welcome to look at the contractor's numbers, including preliminaries. Innovative construction solutions were implemented, costs were a true reflection of how works were undertaken, and agreements were in place well in advance of works commencing to provide sufficient time for the procurement of the various systems adopted.

Multiple challenges were successfully met, including the temporary diversion of the seawater cooling system around the perimeter of a construction site, and ensuring that work did not disturb the fibre optic cable serving the nearby Stock Exchange of Hong Kong.

It was noted that something remarkable was being achieved even before completion of the project. In 2001, the Chater House team was awarded the BEC Environmental Performance Award and the Hong Kong Eco-Business Grand Award for Green Construction Contractor.

Today, Chater House is home to Armani and Bulgari as well as JP Morgan, and its construction is widely considered an example of industry best practice.

"We achieved something that others in the industry strive to achieve, but are unwilling to commit to," says Hongkong Land's then Executive Director, Projects, James A. Robinson, looking back. "And we showed them that by careful investment, possibly at a slight premium, innovation, safety, quality and sustainability can be brought together to produce a superb building for incorporation into the Hongkong Land portfolio of properties in Central while still maintaining profitable returns."

2006

HONG KONG-SHENZHEN WESTERN CORRIDOR

Winning the $2.2 billion contract for the construction of the Hong Kong-Shenzhen Western Corridor was a significant feather in the cap for the Gammon-Skanska-MBEC Joint Venture. A symbol of strengthening ties between the Special Administrative Region of Hong Kong and the government of Guangdong province, it also reaffirmed Gammon's status as a leader in civil engineering. The challenges involved in constructing the 3.5km Hong Kong section of the Hong Kong-Shenzhen Western Corridor project were formidable. The road and bridge project, carrying a six-lane highway, stretched across Deep Bay, which separates Lau Fau Shan in Hong Kong from the port of Shekou in Guangdong. Situated near the Mai Po Nature Reserve, this area is famous for its oyster beds. During construction, Gammon had to take into account the needs of the oyster farmers, as well as respecting other areas of environmental sensitivity. Another challenge was the tight deadline for the bridge project – two years and three months.

To protect the unique ecological environment, Gammon and its partners decided to use protective cofferdams around all excavations within the seabed. These were shrouded by silt curtains to prevent any disturbed mud from contaminating the bay. An inclined concrete tower was constructed, using specialised self-climbing system formwork to achieve a seven-day working cycle for the 30 pours required to reach the top. High-grade steel delivered from Japan was used to manufacture the steel-deck panel components, and stay-cables weighing 308 tons helped support the steel deck of the main 210m span, which weighs 9,500 tons in total. Gammon was able to call on the in-house expertise of Lambeth and Pristine, which designed and manufactured a heavy lifting system to lift deck units – each weighing as much as 2,000 tons – from barges that had been used to transport them from the assembly yard. Another major challenge successfully tackled was the construction of a temporary steel bridge, 1.8km in length, over the mudflats. This was specially designed in-house, using prefabricated pile/span modules allowing two complete 11m sections to be laid each day. This made construction of the whole structure in just three months possible. This massive temporary structure was a bold and innovative solution, without which the completion date for the permanent bridge could not have been met.

2008 ROUTE 8 – NAM WAN TUNNEL

The $1.7 billion contract for the Route 8 – Nam Wan Tunnel and West Tsing Yi Viaduct provided an excellent opportunity for Gammon to demonstrate its prowess not only in construction but in recycling waste and minimizing adverse environmental impacts. The Gammon Skanska International Joint Venture was tasked with building a 1.4km viaduct in West Tsing Yi and a 1.2km highway tunnel on Tsing Yi Island, with two parallel three-lane tunnel tubes. These are now part of Route 8, linking the eastern part of the New Territories with Hong Kong International Airport and the busy container ports. Tunnelling was carried out by drill-and-blast methods, using 2.5 tons of explosives. As blasting through granite and volcanic rock took place daily, a 7.5m-tall noise barrier was erected to minimize the impact on road users and the public nearby. For blasting conducted closer to public roads, a blast door was installed. The 1.2 milllion tons of tunnel spoil was used in the Penny's Bay Reclamation project, or was processed into aggregate at a local quarry. The majority of the cast units for the viaduct were precast, and transported to the site for installation, reducing both waste, such as the temporary timber formworks produced by on-site casting, and the need for surplus concrete materials.

2008

ONE ISLAND EAST

Swire Properties led the way in the metamorphosis of Quarry Bay from a rundown industrial area littered with low-rise tenements, into a hub of shiny shopping plazas and modern office towers. The majority of the construction work was overseen by Gammon. Commencing in 2006, the $2.3 billion contract for the construction of One Island East put Gammon in charge of one of the most significant award-winning projects built in Hong Kong up to that time. Located on a site convenient for the Tai Koo and Quarry Bay MTR stations, the project provided the firm with a golden opportunity to demonstrate its safe and environmentally responsible construction practices.

The project involved a lot of firsts. It was the first construction project to use Grade 100 concrete, and its development and application won the 2007 Technological Achievement Award from Hong Kong Awards for Industries. It was also the first to utilise BIM technology to “pre-construct” the office block. The system meant a proactive approach was implemented, which allowed architects, builders and subcontractors to avoid any clashes involving electricity, plumbing or lighting fixtures, resulting in a more efficient construction process and reduced waste. The use of a low-E-coated glass curtain wall lowered solar heat gain and maximised natural light. That improved energy efficiency, reducing the use of air conditioning and artificial lighting in the building.

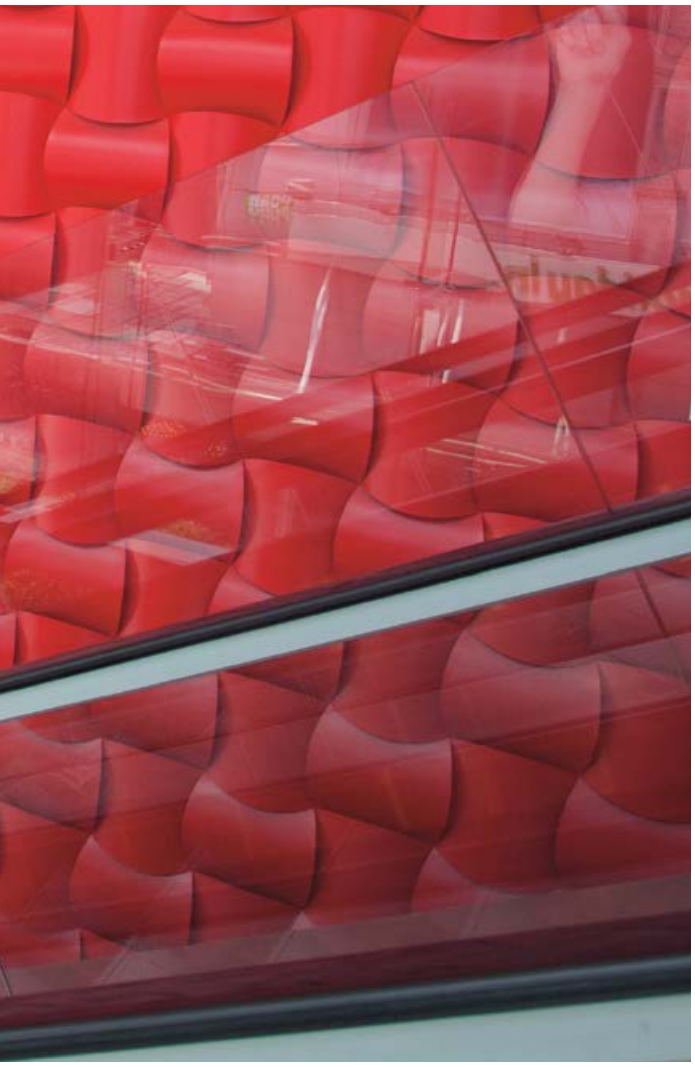
Construction of the project was not without its difficulties. Surrounding the premium site were high-rise residential and commercial blocks, and traffic congestion issues meant creative solutions had to be devised to manoeuvre within a restrictive environment. Nevertheless Gammon successfully erected a 68-storey, AAA-grade modern office building in just two years and two months, building the tower at a rate of one floor every four days.

2009 iSQUARE

Located on the site of the old Hyatt Regency Hotel, iSQUARE is a 31-storey shopping mall with 56,000 square metres of retail space spread out over 12 levels, a movie theatre housing five auditoria including an IMAX digital theatre, and an adjacent tower with 12 storeys of space dedicated to restaurants commanding magnificent views of Hong Kong. This makes it one of the tallest vertical shopping malls in the city. iSQUARE was also the first project to adopt the innovative glass-fins curtain wall system, which replaces the traditional aluminium transom and mullion with a heat-strengthened glass panel.

For Gammon, this was a challenging project on two levels. Working in a heavily congested area, ways had to be found to manage the movement on and off site of people, equipment and materials without interfering with traffic on Peking Road or Nathan Road, and creating the minimum possible disturbance level for people and businesses in the area.

A noise barrier was erected across Lock Road to reduce disturbance to nearby residents. The two connections from iSQUARE to the existing Tsim Sha Tsui MTR station



were constructed using a tunnelling method rather than open-cut excavation, to ensure pedestrian movement was not obstructed. However, during the tunnelling work, Gammon encountered a range of obstacles including underground utilities, sand fills and old basement structures that hindered the task.

The arcade area houses 43 escalators, with six servicing more than three floors. Two pairs of long escalators were required to rest on cantilevered structures at both ends, making them challenging to install. Nevertheless, Gammon successfully completed the entire project in just a year and a half – well within the contract period.

2011 TAMAR

CENTRAL GOVERNMENT COMPLEX AND LEGISLATIVE COUNCIL COMPLEX

When Britain handed Hong Kong back to China in 1997, it was widely assumed that place names with colonial associations would gradually be changed. Few have been. Hong Kong's Central Government Complex, completed as recently as 2011, is on a site still named after a 19th century British Royal Navy troop ship.

Launched in June 1863, HMS Tamar first visited Hong Kong in 1878, and from 1897 was anchored permanently in Victoria Harbour as a base ship for the navy. In 1902, a 160,000 square metre land reclamation to create a naval land base, named after the ship, was begun. When it was ready for use in 1908 the namesake vessel remained in the harbour. It was scuttled in 1941 to prevent it being of use to the Japanese invaders. Marine debris considered likely to be the ship's wreckage was found in 2014 during dredging work for the Central Wanchai Bypass – a project in which Gammon plays a role.

Shortly before the handover, and the departure of British forces from what had been the HMS Tamar shore station to make way for the People's Liberation Army, land in the Tamar Basin was reclaimed forming a 4.2 hectare site. The Central Government Complex was built there between 2008 and 2011 by the Gammon-Hip-Hing Joint Venture (JV).

When the design and build contract of the Tamar Development project went to tender in 2006, the contract covered the design and construction of a Central Government Complex to be occupied by the Chief Executive and the executive arm; the Legislative Council Complex to be occupied by the lawmakers; and an open space, with two elevated walkways.

In January 2008, the Gammon-Hip Hing Joint Venture was awarded the design and build contract for the Tamar project. The Central Government Complex is based on an "Open Door" concept expressing accessibility and transparency, while the Legislative Council Complex features a Council Chamber with a unique state-of-the-art light funnel. The two elevated walkways and a public "Green Carpet" area connect Admiralty, Wan Chai and the new Central waterfront. Elements of the project reflecting an emphasis on sustainability and environmental responsibility include green roofs, facilities for waste recycling, seawater-cooled chiller plants, and daylight sensors.

This project won the Sectoral Award (Gold) for the construction industry in the 2009 Hong Kong Awards for Environmental Excellence. The judges commended the JV's inclusion of carbon considerations in the innovative formwork strategy and earthworks. The project team was also praised for engaging with stakeholders to promote sustainable construction, while taking comprehensive steps to reduce waste and increase energy efficiency.

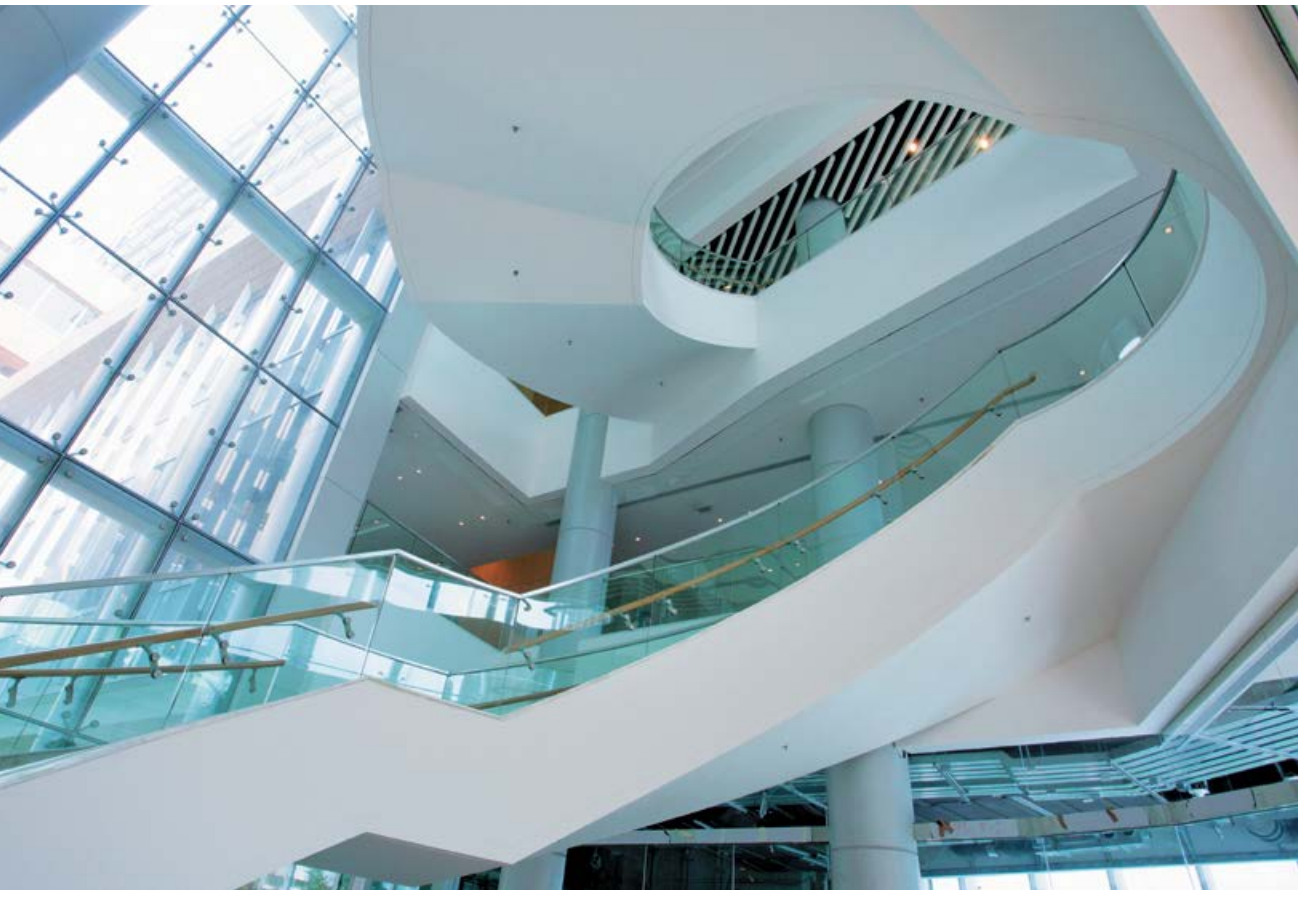
2012

OPUS HONG KONG

OPUS HONG KONG, located at 53 Stubbs Road on The Peak, was Pritzker prize-winning architect Frank Gehry's first residential project in Asia. He says of the landmark 12-storey building, "I wanted to make something incredibly beautiful that people will respect and love for generations."

Swire Properties awarded Gammon the construction contract for the complex design, noted for its distinctive external inclined structural steel columns. OPUS HONG KONG comprises 12 luxury homes, each occupying an entire floor and some 6,000 to 6,900 square feet of space, including two duplexes with private swimming pools. The building is anchored against the steep slope of The Peak by a stack of stone quarry blocks. These help to integrate it visually with the landscape from which Gehry took his inspiration. BIM played a crucial role in expediting the project, greatly enhancing design coordination. Significant savings were made in terms of both time and avoidance of abortive works. Project challenges included the unusual geometry of the building, the composite nature of the structure, uneven topographic conditions, difficult site logistics and numerous atypical interfaces. The steel columns, precast façade, shingle glass walls, stone cladding, glass balustrades and curved-glass sliding doors all involved complicated installation work. In November 2015, the 12th floor of the building became, for a time, Asia's most expensive apartment, when it sold for $510 million.

"I designed the building for Hong Kong, to respond to the unique conditions of the city," says Gehry. "You wouldn't build this anywhere else."



2012 THE UNIVERSITY OF HONG KONG CENTENNIAL CAMPUS

The University of Hong Kong, located in Pok Fu Lam on Hong Kong Island, is the oldest institute of tertiary education in the Special Administrative Region and boasts several of the few remaining examples of classic British colonial architecture. In 2007, Gammon was awarded the $520 million design and construct contract for re-provisioning the Water Supplies Department's utilities and infrastructure works for the Centennial Campus. A key innovative element in this prestigious project was deciding to house the saltwater service reservoirs inside tunnels excavated into the slope behind the new campus site. This environmentally friendly approach significantly reduced loss of tree cover, and the project was selected as one of the Hong Kong Institute of Engineers' Hong Kong People Engineering Wonders in the 21st Century.

In 2009, Gammon was also awarded the $1.97 billion building contract for the Centennial Campus. This project was implemented in two stages. The first involved site formation and slope works, piling and foundation works, and the demolition of the existing freshwater services reservoir. Three 82- to 95-year-old waterworks buildings, graded for having unique historic and heritage value, were protected – underlining Gammon's commitment to the preservation wherever possible of Hong Kong's architectural heritage. The second stage comprised the construction of three academic buildings, two of 10 storeys and one of nine, with three-level basements and three-level podiums, and the construction of the west gate lift tower and footbridge, connecting the new campus with the MTR station and to an open footbridge link to the Chow Yei Ching Building.

Among the ingenious features in the design was the use of intelligent building materials. Daylight sensors for auto-dimming reduces lighting energy use by approximately 25 per cent. There is a chilled-water storage system, and displacement air-conditioning systems reduce energy consumption by 20 per cent. A waste-food digester to decompose kitchen food waste produces biogas, mini-wind turbines provide power, and photovoltaic panels convert daylight into direct current electricity. Grey water recycling is used for landscape irrigation and reduced potable water consumption. A green roof, and natural ventilation are also sustainability enhancing features.

Completed in around two years and three months by a close-knit team, the project's focus on sustainability won platinum certificates from both Hong Kong BEAM and LEED.

2012

ZERO CARBON BUILDING

A joint initiative of the Construction Industry Council (CIC) and the Hong Kong Government, Hong Kong's first Zero Carbon Building was developed to showcase ground-breaking eco-building design concepts, and the latest green technology available to the construction industry. Its ongoing mission is to raise sustainability awareness in Hong Kong.

Not surprisingly, the CIC called on Gammon. The prime focus of the construction process was to create a building using only ecologically friendly material, from procurement to project completion. The onus was placed on the contractor to source low-carbon construction materials and to employ low-carbon construction methods. Gammon's record for doing just those things spoke for itself.

The firm was absolutely committed to the project from the outset. An innovative management contractor arrangement was decided on, under which Gammon's involvement began during the design process, leading to supervision of all 11 works contracts. The time frame for construction was to be tight, with the work observed by a committee of industry leaders. They oversaw four separate panels, each keeping an eye on various aspects of the project. Gammon's skill at building relationships with stakeholders was also extremely valuable.

Constructed in Kowloon Bay on a 14,300-square-metre site, the two-storey building, featuring indoor and outdoor exhibition areas, makes use of more than 80 technological advances and environmentally friendly design concepts. In addition to energy-saving natural ventilation and lighting and thermal insulation, a biofuel generator using biodiesel produced from waste cooking oil, in tandem with solar cells stretching across the roof. The site is also the location of Hong Kong's first native urban woodland, containing a diverse selection of shrubs and trees.

Throughout the project, green materials – such as responsibly sourced timber, recycled steel, eco-pavers, and a special concrete mix containing recycled aggregates and fuel ash – were used. BIM technology calculated the exact balance of cut and fill needed during excavation, cut-and-bend techniques reduced rebar waste, construction and demolition waste was used for the planter wall, and excavated soil was used in the native woodland. Transportation of materials was also taken into account when considering carbon emissions, as well as the energy use of construction equipment. When completed, the project was awarded a BEAM Plus Platinum rating, the highest recognition for excellent building and environmental performance.

Since opening, the ZCB has served as an exhibition/education centre for zero carbon eco-home and eco-office design technology, addressing industry professionals, both local and international. Seven zones open to the general public showcase new designs and technologies for green living, and the building has hosted functions ranging from corporate cocktail parties to zero carbon wedding receptions. It serves not only as an example of sustainable construction, and education and exhibition centre for low-carbon advances, but also as a tool to evaluate these advances in practice.

"The ZCB is a neat fit with Gammon's increasing commitment to green policies in the industry," says Gammon Chief Executive Thomas Ho, looking back. "It demonstrated our expertise in green construction technologies and practices, especially our capabilities in procuring green materials and managing embodied carbon during construction."

2012

HYSAN PLACE

In April 2009, work began on the site of the former Hennessy Centre in Causeway Bay for the construction of Hysan Place – recognised as a landmark project in terms of sustainable development even before its opening in August 2012.

Hysan Place is the first Hong Kong building to be certified at LEED Platinum level for core and shell. It also met the most stringent requirements of the Hong Kong BEAM Plus green building assessment scheme.

"Gammon helped us to create a really iconic green building in Hong Kong with Hysan Place – a BEAM Plus Platinum building," says Hysan Development Co Ltd Director, of Projects, Sunny Chan. "And we are really selective about contractors. We expect an 'A team' for all our projects."

The 40-storey mixed-use tower – with 15 floors of AAA-grade office space, 17 floors of retail outlets, a basement car park, two floors of retail basement with connection to the Causeway Bay MTR station and scenic views of the harbour and mountainside – was designed to embody Hysan's green vision for the future of Causeway Bay. Already vibrant, but currently also polluted and congested, the area is Hysan's home turf. The company is Causeway Bay's biggest commercial landlord, and its history there dates back to the 1920s.

It was determined at the outset that Hysan Place, Hong Kong's first green "vertical mall" should be outstandingly sustainable over its entire lifetime. It should also interact positively with its natural and man-made surroundings, and serve the community as a whole, as well as its tenants.

Sustainability meant flexibility. The first requirement was for a frame that would accommodate future changes of use, with minimal waste contingent on any necessary alterations. Steel is inherently more flexible than concrete, and Gammon's structural steel expertise was a significant advantage in tendering for the $1.3 billion contract. The firm's empathy with Hysan's vision and its record of insisting on sustainable construction practices in erecting state of the art commercial buildings, as well as its reputation for paying close attention to safety issues, also influenced Hysan's choice.

"Gammon really goes for safety first, and that is essential to us," says Chan. "Most of our projects are located within really dense urban areas, so that's safety not only within the site but safety for pedestrians and vehicles surrounding the site as well. Keeping noise and air pollution under control is also in the Gammon DNA."

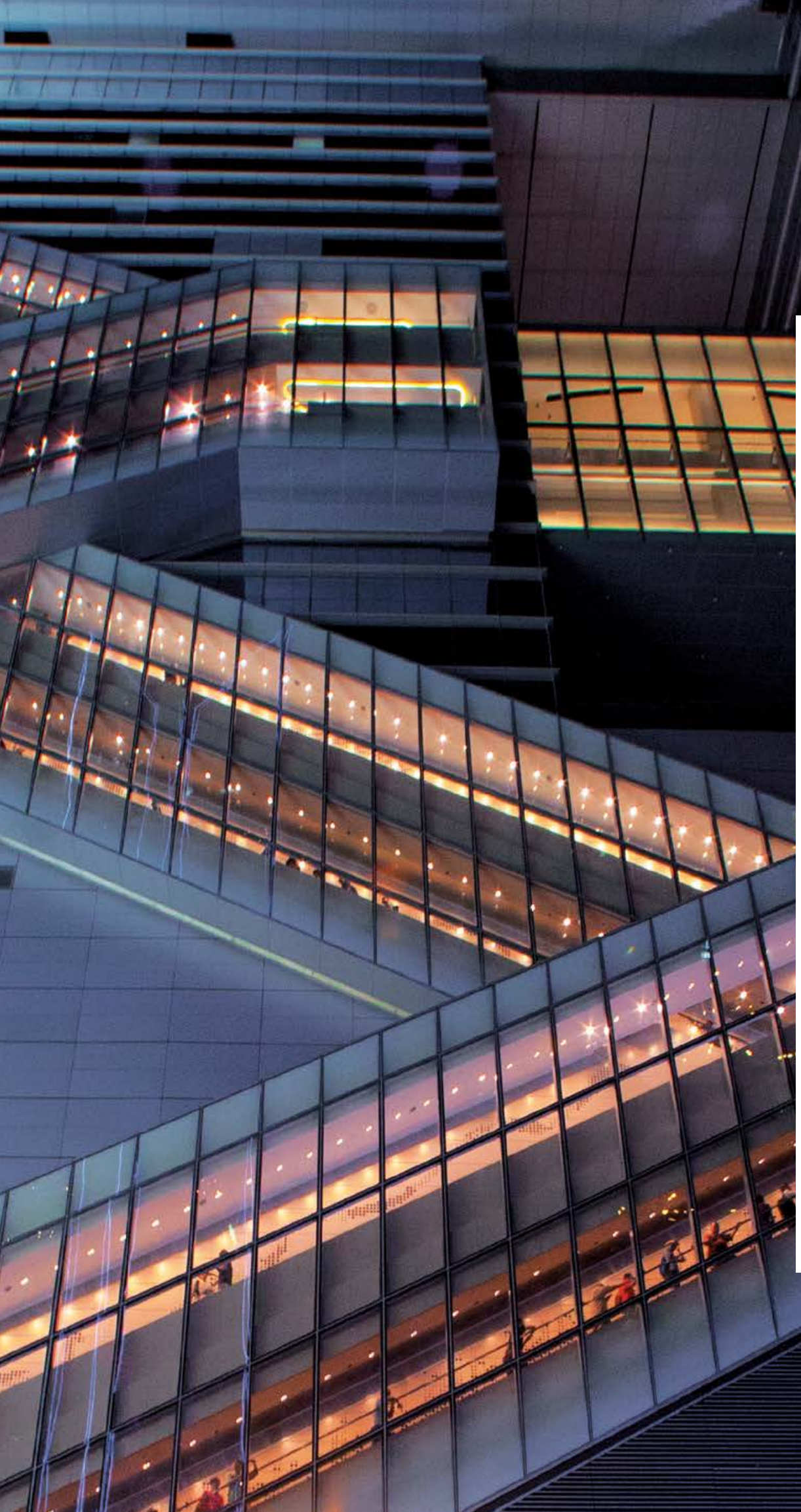
Measures Gammon took to protect the public included the use of noise dampened construction equipment, noise control mats, and the erection of "green hoardings" – the latter bedecked with flowers, and fitted with mist sprayers and overhead fans for the comfort of bus passengers queuing for transport alongside the site.

BIM enabled Gammon to organise all the work effectively, and to achieve its own stringent environmental targets – including the recycling of 75 per cent of all construction waste.

Sustainability was fundamental at all stages of the supply chain. Timber was obtained from certified sustainable sources close to Hong Kong, and reused numerous time for multiple purposes. At the end of its usefulness, it was sent to a recycling plant for conversion into compost. Around 50 tons were recycled.

Water used during construction was also recycled, and used for general cleaning and dust suppression – thus reducing the consumption of potable water by about 10 per cent. Instead of going straight to landfill, around 36,000 cubic metres of broken rock became backfill for the Tuen Mun Aviation Fuel Facility, or went to Tiostone to be made into recycled aggregate. Gammon reduced the project's carbon footprint by the equivalent of the annual greenhouse gas emissions of 12,000 passenger vehicles.

Multiple green features were incorporated in the design. Among the most striking in the finished building are its "urban windows" – openings that enhance natural ventilation and promote air circulation, reducing the so-called "wall effect" created by neighbouring buildings, as well as being visually attractive.



Environmentally responsible features include green roofs, a rainwater harvesting scheme, and a high-performance curtain-wall system with sunshades and double-glazing to reduce solar heat gain. Hysan Place was the first building in Hong Kong to utilise this type of system and the construction of a curtain wall with operable vents was unusual. Air conditioning switches off automatically when the vents are open, while a master button closes them in severe weather conditions such as typhoons and rainstorms. The curtain-wall system also acts as a buffer to exterior noise, while photo sensors responsive to daylight curb excessive use of energy for lighting. Vertical gardens and energy recovery wheels reduce the cooling load further, while flat Sky Garden areas at different levels provide open spaces for the enjoyment of both tenants and the general public. An Urban Farm on the roof, where vegetables are cultivated, is managed by Hysan for the tenants, office staff, and other community stakeholders. On the 16th floor, the colourful plants in the Sky Wetland thrive on grey water from the office floors.

Major sculptures were crafted from rock quarried locally by Gammon, underlining the connection between Hysan Place and the natural heritage of Causeway Bay – of which it commands spectacular views.

In addition to LEED and BEAM Plus certification, the Hysan Place project won the Autodesk Building Information Modelling Award 2010; the construction sector Gold Prize at the Hong Kong Awards for Environmental Excellence 2010 for Gammon's work in reducing the environmental impact of construction; Gold for the best mixed-use development from the MIPIM Asia Awards 2012; and a merit prize for the New Building – Hong Kong (Building under Construction) sector of the Green Building Award 2012.

"Since Hysan Place, we have established a trust and also a partnering relationship with Gammon," says Sunny Chan. "That doesn't mean we don't go out for tendering, or that there are never disputes, but if the building contract is awarded to Gammon we know we are going to get a reliable, professional and total solution for building delivery."

2013

TUEN MUN ROAD EASTERN SECTION

The Tuen Mun Road (TMR) is an arterial high-speed throughfare connecting Tuen Mun with Tsuen Wan. Part of Route 9 around the New Territories, it was planned in the late 1960s and built in the 1970s. By the 21st century, it was carrying volumes of traffic far in excess of those envisaged by the original planners. Constructed with an extremely long, narrow carriageway, constant congestion and a high rate of traffic accidents had become serious issues.

In 2008, Gammon was awarded a $2.82 billion contract by the Highways Department for the reconstruction and realignment of the eastern section of TMR, a 6.8km carriageway from Tsuen Wan to Tsing Lung Tau. It was one of the firm's largest solo civil projects up to that time, and involved widening of the traffic lanes to a standard modern expressway width, provision of hard shoulders and verges, and improvement of sightlines and horizontal curvatures.

Sustainability was a key focus of the project. Barriers and semi-enclosures were installed to reduce the noise impact of the traffic, and associated environmental mitigation measures including drainage works, stabilisation of slopes, and landscaping were undertaken. Milled asphalt was recycled and used in road pavement, and felled trees were reused as mulch. New trees and shrubs were planted to stabilise slopes and beautify the roadside.

Many of the project's challenges stemmed from the fact that the road could not be taken out of service during the improvement works. Temporary traffic arrangements had to be put in place.

"Workers had to carry out their duties in the middle of the road, which were all fast lanes. Getting the material out and getting the material in was quite a challenge," recalls Contracts Manager K.F. Tam.

Challenges included a lack of space for storage of materials, working on steep slopes, and the safety issue of ensuring that nothing could fall from the site and cause damage or injury in the residential and beach areas below.

The project team was also working against the clock. Closure of lanes could only occur in off-peak hours, so construction was also carried out at night-time and on public holidays.

BIM technology was used to give the team a computerised construction site, assisting the planning process and improving site efficiency – particularly in the areas of hazard identification and waste reduction.

Tam and his team succeeded in keeping the work green. At the 2010 Hong Kong Awards for Environmental Excellence, the TMR project received a construction sector Certificate of Merit for its waste management programme, resulting in 52 per cent of waste being successfully reused. Traffic flow along TMR has also improved significantly, particularly during peak hours.

2013

THE FORUM

Taking its inspiration from cut gemstones, The Forum at Exchange Square is certainly one of the jewels of Hongkong Land's Central portfolio. Unconventional and visually arresting architecture made it extremely complex to build, and presented interesting challenges across a range of Gammon's areas of special expertise. Key contributions came from Lambeth and the Pristine steelworks in Dongguan.

The $338 million contract required the construction of a 4,500 square metre building with five floors of commercial space set in a landscaped plaza. The pure steel structure was designed with a diagrid-based inclined steel frame, supported by a steel core rather than a concrete core wall. Each curtain wall had to be manoeuvred to a precise 14.9 degree inclination to the northwest corner to create the sloping façades. Gammon was also tasked with handling all finishings, fitting-out works, external cladding, building services and external landscaping works.

There were many challenges to be addressed. In addition to logistical issues in accessing the small podium level site, works in Exchange Square's basement and public transport interchange areas had to be carried out at night to avoid disrupting services.

Ingenious solutions were found. All the structural steel, 1,096 cubic metres of concrete, and 3,000 square metres of curtain wall were lifted onto the site by a 35-metre luffing crane, with timely delivery requiring meticulous planning and co-ordination.

The steel structure, which was designed to exacting levels of tolerance and used nut and bolt connections rather than more conventional welds, was pre-fabricated by Pristine and erected first rather than following a conventional floor-by-floor construction model. BIM was employed to enhance design coordination, and to visualise and simulate the detail of connection points.

Another departure from traditional construction was that the steelwork for the centre core had to be loaded after the composite floor slabs were cast, achieving the designed strength to act as a diaphragm at the permanent works stage. Temporary support works were specially designed by Lambeth to stabilise the structure until completion.

Work on the project began in June 2012 and the plaza was completed in December 2013. The office space is now wholly occupied by Standard Chartered Bank, and the landscaped plaza, with its sculptures by Henry Moore, Ju Ming and Dame Elisabeth Frink, is open for the enjoyment of all.

Gammon won a Bronze Award in the Good Housekeeping Competition 2012 from the Occupational Safety & Health Council for the worker welfare measures implemented during the project, as well as achieving a BEAM Plus rating from the Hong Kong Green Building Council for its environmental protection measures. The project also won the Jardine Matheson 2014 Pride in Performance Award in the Innovative Idea category, and a Zero Harm Project award at the Gammon annual safety conference.

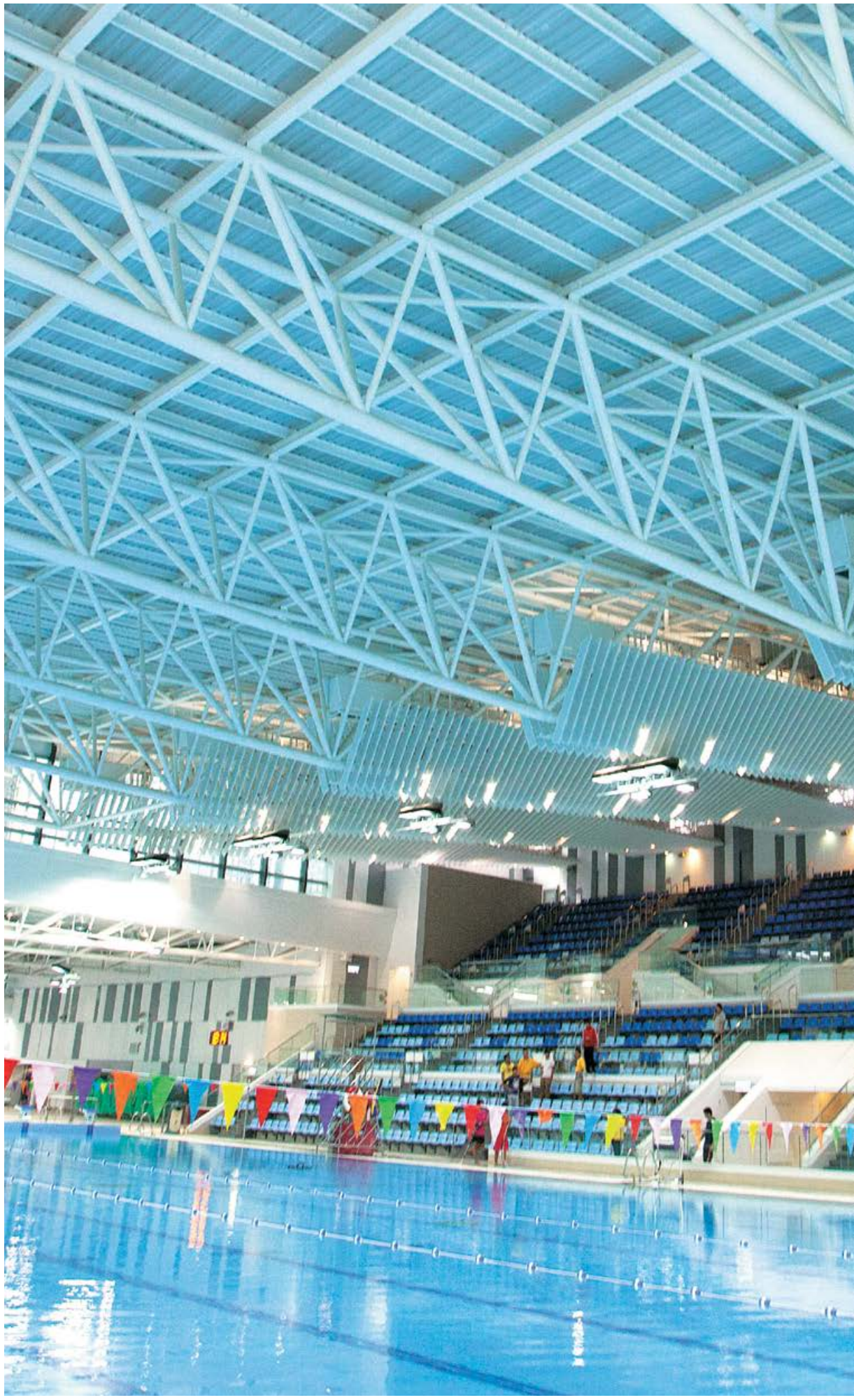
2014

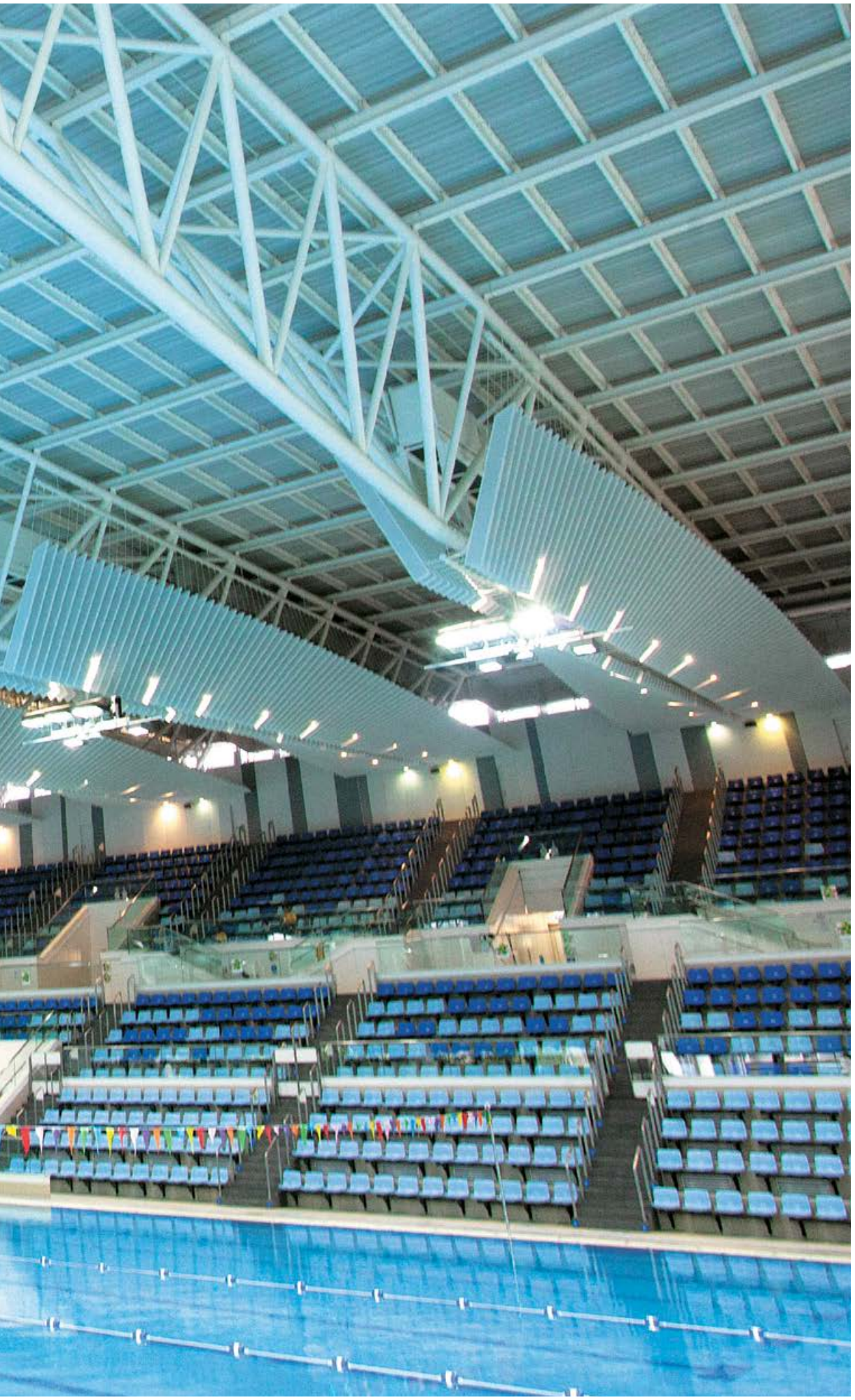
VICTORIA PARK SWIMMING POOL

The original Victoria Park Swimming Pool complex opened in 1957 and was the first of its kind in Hong Kong. It had happy memories for several generations of swimmers, but in 2009, after more than half a century of service, it was in urgent need of an upgrade. Able to accommodate only 1,100 swimmers and 1,700 spectators, it also fell short of the requirements of the Fédération Internationale de Natation (FINA), the world governing body for swimming as a sport.

In December 2009, the Architectural Services Department awarded Gammon a $930 million contract to redevelop the complex into a 24,000 square metre leisure centre – meeting FINA's stringent requirements and allowing Hong Kong to hold international aquatic events.

The project required the construction of a new 50m by 25m indoor heated main pool, and a 33m by 25m indoor heated multipurpose pool, with spectator seating for more than 2,500. Gammon was also asked to transform the previous pool areas to accommodate a handball court and two skating rinks, and to refurbish and resurface Victoria Park's four popular tennis courts a well as upgrading the lighting to international standards. The site occupied approximately 24,000 square metres, with a total construction floor area of 18,500 square metres.





One of the many challenges was to minimise the environmental impacts on a busy, densely populated area. Noise was drastically reduced by using a hydraulic crusher instead of a breaker, a vibration clamp for carrying out sheet piling, and an acoustic mat. Acoustic enclosures on piling plants provided a protective screen, and the hydraulic hammer was fitted with external and internal acoustic shields. A notable innovation was the first-time use of a double barrier to reduce percussive piling noise, achieving a reduction of 15 decibels.

Sustainability was a keynote of the project, with waste diligently reused, energy consumption reduced to the lowest possible levels, and recycled materials and Forest Stewardship Council timber preferred wherever the project allowed. Plastic sheeting shielded the park's mature trees from scaffolding.

In 2014, Gammon completed another landmark swimming pool project with the $980 million contract for remodelling of the three-storey Kwun Tong Swimming Pool complex, which also includes a FINA standard indoor pool.

The Victoria Park Pool project won the Gold Award in the 2012 Hong Kong Awards for Environmental Excellence in the Construction Industry.

2015

THE PARKSIDE

Recent years have seen rapid growth in Tseung Kwan O's popularity as a residential area for commuters. Swift and efficient MTR connections to Kowloon and Hong Kong Island, and the high quality of new-build residential accommodation becoming available, have both been significant contributory factors.

Luxury housing developments in the area have mushroomed, with several Gammon clients among the key developers. One of them is Wheelock Properties, which awarded Gammon the $1.4 billion main contract for the superstructure and external works of The Parkside, a mixed-use residential and commercial development at 18 Tong Chun Street, within a five-minute walk of Tseung Kwan O MTR Station.

Construction of the self-contained complex, designed by architect Ronald Lu and Partners, began in the first quarter of 2014, and was completed in early 2016. Under the lump-sum contract, Gammon was responsible for procurement and managing subcontractors, and also directly involved in the design – among other external works – of the precast concrete façade, the metal suspended ceiling, the stone cladding and a vertical green-wall system.

The project included the construction of a basement carpark, plant rooms, clubhouse facilities and access ramps servicing the car park. The podium supports a two-level commercial zone, and three residential towers, one is 25 storeys high, and the rest 27 storeys. A total of 591 residential units includes seven special duplex or garden units, 48 units with four bedrooms, and 536 units with one to three bedrooms. The Parkside has achieved BEAM Plus Final Gold rating for its sustainable design and construction.

"From the beginning, Gammon's focus was on quality, safety, and moving forward with innovation, technology and sustainability," says Ricky Wong, Managing Director, Wheelock Properties. "I think it's a good approach."

2015

SCIENCE PARK

When Gammon was awarded the construction contract for Phase 3c of the development of Hong Kong's Science Park, the company had already established a solid working relationship with Hong Kong Science and Technology Parks Corporation (HKSTP) through the construction of Phases 3a and 3b.

From 2012 to completion in 2014, Gammon had handled the $2.18 billion building contract for Phases 3a and 3b of the development, constructing three eight- to nine-storey Research and Development (R&D) office and laboratory buildings, along with a multifunction hall, car parks, service tunnels and link bridges over a gross floor area of 73,800 square metres. The project met the stringent criteria for Hong Kong BEAM Plus Platinum recognition and LEED Platinum certification.

The $1.09 billion Phase 3c contract was for the construction of two more R&D offices, each with a basement. The contract included the external and landscaping work, and two new link bridges to Phases 3a and 3b, and the existing Science Park complex, all once again to be built to BEAM Plus Platinum standard.

All phases were required to exemplify the latest developments in green construction technology and sustainable building design. For Phases 3a and 3b, Gammon was required to install natural ventilation, energy efficient systems and renewable energy sources such as photovoltaic cells.

The project won the Grand Award in the Green Building Awards 2014, organised by the the Hong Kong Green Building Council and the Professional Green Building Council for "Excellence in Sustainable Built Environment", with the judges commenting that Gammon's work had "a cohesive value system that permeates into every aspect of the entire process". Clearly, Gammon was the logical choice of contractor for Phase 3c.

Given the close proximity of the buildings to be constructed for this phase to already working offices and laboratories, it was particularly important to HKSTP that work should involve minimum disturbance, and no risk of damage or injury to people working in the park.

"Safety is a high priority for us and minimum disruption to work," stresses CEO of HKSTP, Albert Wong. "At Science Park, there is high-end research work going on, so, for example, the electricity and air-conditioning supply has to be consistent. We can't afford to risk any disruption. We need creative solutions to provide the best experience for our partner companies, and Gammon has that expertise."

One of the main challenges of the project was the complex Excavation and Lateral Support (ELS) works, which required detailed planning, statutory submissions and approvals. A successful re-engineering idea from Gammon was modification of the removal sequence of struts in the basement. This allowed basement construction to proceed smoothly and efficiently, with significant quality and safety gains.

The Gammon in-house façade team took on the challenge of sustainably designing and constructing the external façade system, including the curtain wall, cladding, glass-wall canopy and skylight. The majority of the management staff and frontline supervisors were transferred to Phase 3c from the previous Phases 3a and 3b. Their experience facilitated streamlining of processes, while maintaining the highest standards of work.

The project was a textbook example of considerate construction – from the perspectives of the client, the park's tenants, and the workers on-site. Lifting the two new structural steel link bridges, which had been assembled on site, into position was potentially one of the most disruptive construction processes. However, thanks to detailed temporary traffic management and site logistics plans prepared well in advance, it was possible to expedite the work and conduct it on Sundays and public holidays, when Science Park's offices and laboratories were not in operation.

Safety on-site was enhanced by the use of proper safe working platforms or scissor platforms for work undertaken at a height, and by a policy of encouraging subcontractors to use cordless electric-hand tools to minimise the risk of electric shocks. Those measures led to a nomination for the Hong Kong Development Bureau's 22nd Considerate Contractor Site Award Scheme (2015).

As well as achieving BEAM Plus Platinum certification for Gammon's work in reducing air and noise pollution, construction wastage, and other environmental impacts, the site was awarded a Green Flag under Gammon's Green and Caring Scheme for its commitment in promoting and adopting green and caring practices, including site traffic management, waste control, recycling, and the provision of welfare facilities.

"A lot of our buildings have received a number of awards. That's significant because we need that iconic recognition in Hong Kong – to demonstrate our capabilities to leverage the highest level of technology, and pioneering," says Wong.

Today, Science Park is home to a thriving community of more than 630 companies, working in fields ranging from robotics to renewable energy and pharmaceuticals. Comprising 21 state-of-the-art buildings, it houses some of the world's most advanced laboratory and R&D facilities, connected to a network of support spaces and ancillary facilities.

Over 260 park companies are in HKSTP's incubation programmes designed to help the originators of ideas proceeding from the conceptual phase to the product stage and build businesses – "to realise dreams", says Wong.

He points out that HKSTP has successfully helped park companies raise about $1.2 billion of capital through direct engagement in the last fiscal year. Over the next 10 years, Wong expects to see significant growth in the number of companies in the incubation programme, and the parks' R&D workforce will increase more than threefold. It will be, he says, a "tough vision to achieve".

Gammon is proud of the role it has played in constructing some of the most sustainable Science Park buildings.

"Our project teams are committed to bringing our vision in safety, health, quality and environmental performance into reality," said Gammon CEO Thomas Ho, in July 2014 when Gammon won the Phase 3c contract. "With our solid track record and support from our stakeholders, we will overcome any challenges and continue to excel."

2015

HATS STAGE 2A

Improving the quality of the water in Hong Kong's famous harbour is a perennial challenge for the government of the Special Administrative Region and the construction industry.

The first major improvement measure undertaken in the 21st century was the Harbour Area Treatment Scheme (HATS) Stage 1, commissioned in 2001. This prevented about 600 tons of sewage sludge entering the harbour each day. The second was HATS Stage 2A, in which Gammon played a major role. The firm won the contract to construct a sewage conveyance system from North Point to the Stonecutters Island Sewage Treatment Works, where chemically enhanced primary treatment takes place.

The system comprises three tunnels totalling 12km in length. The project also involved the construction of eight shafts. Work commenced in 2009, and the facilities were commissioned in 2015.

The most dramatic engineering breakthrough of HATS Stage 2A was the successful construction of Hong Kong's deepest tunnel at up to 160m below sea level. It is both the deepest and the longest sewage tunnel ever constructed in the city by the drill-and-blast method. Gammon worked together with Australia's RUC Cementation Mining Contractors Pty Ltd on the sinking work. But HATS Stage 2A presented a whole range of complex engineering challenges and innovative thinking was fundamental to its success.

One example of this was the decision to relocate the scum removal chamber from outside to inside of the drop shafts at Central and North Point. This maintained the structural stability and functionality of the original design, while saving construction time, improving safety, reducing carbon footprint, and saving around 700 cubic metres of spoil.

The effective application of a large-diameter bored pile technique for the construction of the drop shafts eliminated the need to construct a diaphragm wall through corestone-bearing saprolite; saved excavating a huge volume of soil and rock; reduced the risk of excessive groundwater inflows and base heave; and mitigated the risk of any significant ground movement in the surrounding areas. The total volume of excavated materials for the drop shafts in North Point, Wan Chai East and Central was reduced by approximately 8,500 cubic metres, and the level of construction noise and dust for nearby urban areas minimized. Measures taken to reduce disturbance and visual impact included the erection of noise enclosures above all production-shaft areas and the establishment of roof gardens. A comprehensive environmental monitoring and auditing system was established to ensure that environmental protection measures were working effectively.

BIM and 3D scanning were used extensively to enhance accuracy and maximise efficiency, and the in-house concrete team made a crucial contribution by developing grade-60 marine concrete for the project – far above the grade-45 specified in the tender and with higher strength and less thickness.

Other innovations included the adoption of a self-centering device with a single-layer rope drum for the gantry crane, to avoid collisions between objects being lifted and the walls of the shaft; and implementation of the GEOMON system, which collects data on surface settlement, groundwater changes and underground displacement. The information is made available to engineers in real-time and is accessible and updatable via the internet. A Wi-Fi network was set up in the tunnel, so tablet computers with anti-shake and dust-proof functions could be used for instant communication with staff on the ground.

As always, maintaining safety and optimum conditions for all workers was a high priority. A specialised RFID and CCTV tunnel personnel tracking system was developed to monitor workers, and an Automatic Shaft Mucking System, developed in Australia, was introduced to reduce manual procedures and workers' time in the tunnels. Both higher efficiency and improved safety resulted. Electrically powered equipment was selected for the tunnelling operations to reduce air pollution in the small tunnel spaces, and low-sulphur fuel was used for the locomotives. LED lighting saved energy and reduced carbon emissions, and a chiller system helped maintain a dry, comfortable working environment. Computerised drilling jumbos and computerised grouting injection systems were also deployed.

HATS Stage 2A is an excellent example of innovative thinking reducing costs, construction time and adverse environmental impacts, while enhancing safety. It also achieved significant improvement in the quality of the water in Hong Kong's harbour.

2017

MOUNT NICHOLSON

On November 20, 1997, the *South China Morning Post* announced that two apartments at Mount Nicholson, one of the most exclusive addresses on The Peak, had been sold for $1.16 billion to a single buyer.

“A buyer paid $600 million, or $131,000 per square foot, for a property measuring 4,579 square feet at Mount Nicholson, according to Wheelock Properties, which oversees sales of the joint project between Wheelock & Co and Nan Fung Development, without divulging the buyer’s identity,” the paper reported.

“The same buyer splurged another $560 million on the same day on a second flat measuring 4,242 square feet, or about $132,000 per square foot. In square footage terms, the second property is the most expensive residence in Asia.”

According to Wheelock Properties Managing Director Ricky Wong, one reason Gammon was chosen for the Mount Nicholson project, by Wheelock’s Market Prospect joint venture with Nan Fung, was the success of another luxury residential complex, also on The Peak, but built for another client.

“Gammon did another similar job few years ago, OPUS HONG KONG by the Swire Group, and we were definitely targeting those buyers and going for that perceived level of quality. We think the quality delivered by Gammon gives buyers more confidence. Their reputation is valuable to us. Location is the key, but buyers also look at quality and the setting of the development. What the sales have achieved has been higher than our expectations,” says Wong.

Mount Nicholson consists of 19 villas, two 12-storey apartment towers and a two-storey clubhouse over a basement car park, and another level for plant rooms.

With a lump-sum fixed-price contract worth $1.5 billion, Gammon’s contribution to building the complex included construction of the reinforced concrete superstructures; external finishing, including stone and aluminium cladding; aluminium windows; Electrical and Mechanical (E&M) installation; and landscaping works.

Project challenges included issues with access to different areas of the site, logistics, and traffic management. There were also complications in excavation work for the laying of electrical cables caused by the narrow winding nature of Mount Nicholson Road.

The high ceilings called for by the design also introduced work space restrictions, and other potential problems, which were addressed BIM. The technology identified potential works clashes, which were then resolved in advance. The same technology was used to review the interface details of the external stone-wall cladding with other works, such as installation of aluminium windows and glass balustrades. This preempted abortive work during the construction stage.

Potential access issues during different stages of construction were resolved by the installation of a specially designed temporary steel platform over the basement, allowing for work to continue beneath as well as above.

Safety, as always, was a Gammon priority, and successfully enhanced during installation of the external wall finishes by the use of a bespoke scaffolding wall tie, applied between the 6mm joints of the dry-fix stone cladding. This allowed cladding to take place without obstruction, obviating the need to remove wall ties to facilitate work. A safety net between the scaffolding and the external wall eliminated the risk of falling objects, and using powered scaffoldless rail-mounted working platforms significantly reduced the risks of working at a height.

The project was awarded provisional Beam Plus Gold certification, and three awards reflecting Gammon's responsible site management – a Merit for Building Construction (Private Contract) in the Labour Department-run Construction Industry Safety Award Scheme 2013/2014; the Caring Construction Site Award 2013, and a Merit for best working at a height improvement at Construction Safety Day 2015, both organised by the Occupational Safety & Health Council.

KEEPING HONG KONG ON TRACK

GAMMON AND THE MTR

Constructing the infrastructure that keeps the people of Hong Kong on the move has been one of Gammon's most important areas of focus since its earliest days in the city. Since the 1970s, when construction of Hong Kong's superb Mass Transit Railway (MTR) began, the firm has been deeply involved in the development of the city's rail system. It continues to play a significant role.

Modern Hong Kong could not operate without the MTR, which Gammon played a large part in helping to build. Carrying a weekday average of 5.8 million passengers, since its 2007 merger with the Kowloon Canton Railway Corporation, the MTR Corporation Ltd (MTRC) has operated a network that now includes 91 stations and 68 light-rail stops across 10 commuter lines – excluding the Airport Express. Fast, clean, safe and efficient, it completes 99 per cent of journeys on time. It is a byword for reliability.

1979

MTR MONG KOK, YAU MA TEI & PRINCE EDWARD

The first stretch of the MTR opened in September 1979 between Shek Kip Mei and Kwun Tong. It ran both deep beneath and high above the congested streets of Kowloon, and it immediately changed lives. Passengers quickly became accustomed to journeys that were swifter, smoother and safer than anything they had experienced before. Within a year, the line was extended to connect to Central – a job calling on Gammon's extensive expertise. The demanding project of designing and constructing three underground stations in the crowded and historic districts of Yau Ma Tei, Mong Kok and Prince Edward was contracted to a Gammon-Keir Lilley Joint Venture, and began in 1976. The task was complicated. The foundations of nearby buildings, rising 12 to 20 storeys above the ground, had to be protected. Contracts also stipulated that neither traffic nor pedestrians should be prevented from using the major artery of Nathan Road during the construction period. Engineers used the cut-and-cover method for the tunnels, which spanned 5.9m in diameter and 2.58km in length. The system also incorporated a crossover tunnel, which measured 240m in length, with a diameter of up to 11.6m to allow switching of rail traffic from upper to lower levels for both the northern and southern sides of the station platforms. The $672 million project excavated 83,000 cubic metres of earth, while utilising 9,900 tons of reinforced I-beams for the walls. It was the largest and most technically advanced undertaking of its kind in Hong Kong at the time. During its first year of operation, the line from Kwun Tong to Central carried 170 million passengers along its 15.6km of track. As work progressed on the many underground stations that Gammon built for Hong Kong's urban railway system, vast caverns unseen by the public were dug throughout the city.

1980 MTR ADMIRALTY

When under construction in the late 1970s, the open excavation above Admiralty station was the largest in any city on Earth. Working with international partners from France, Germany and Sweden, Gammon's 22 per cent share of the contracts to build Admiralty and Central stations and associated works was $565 million. The three-level, 360m-long station is buried deeply beneath high-rise commercial towers, which meant 350,000 cubic metres of earth had to be clawed from the site. More than 80,000 cubic metres of concrete were poured over 12,000 tons of reinforcing steel. The stretch of rail between Central and Tsim Sha Tsui opened on February 12, 1980 – at which time Admiralty and Central, then called Chater, were the only MTR stations on Hong Kong Island.

1985

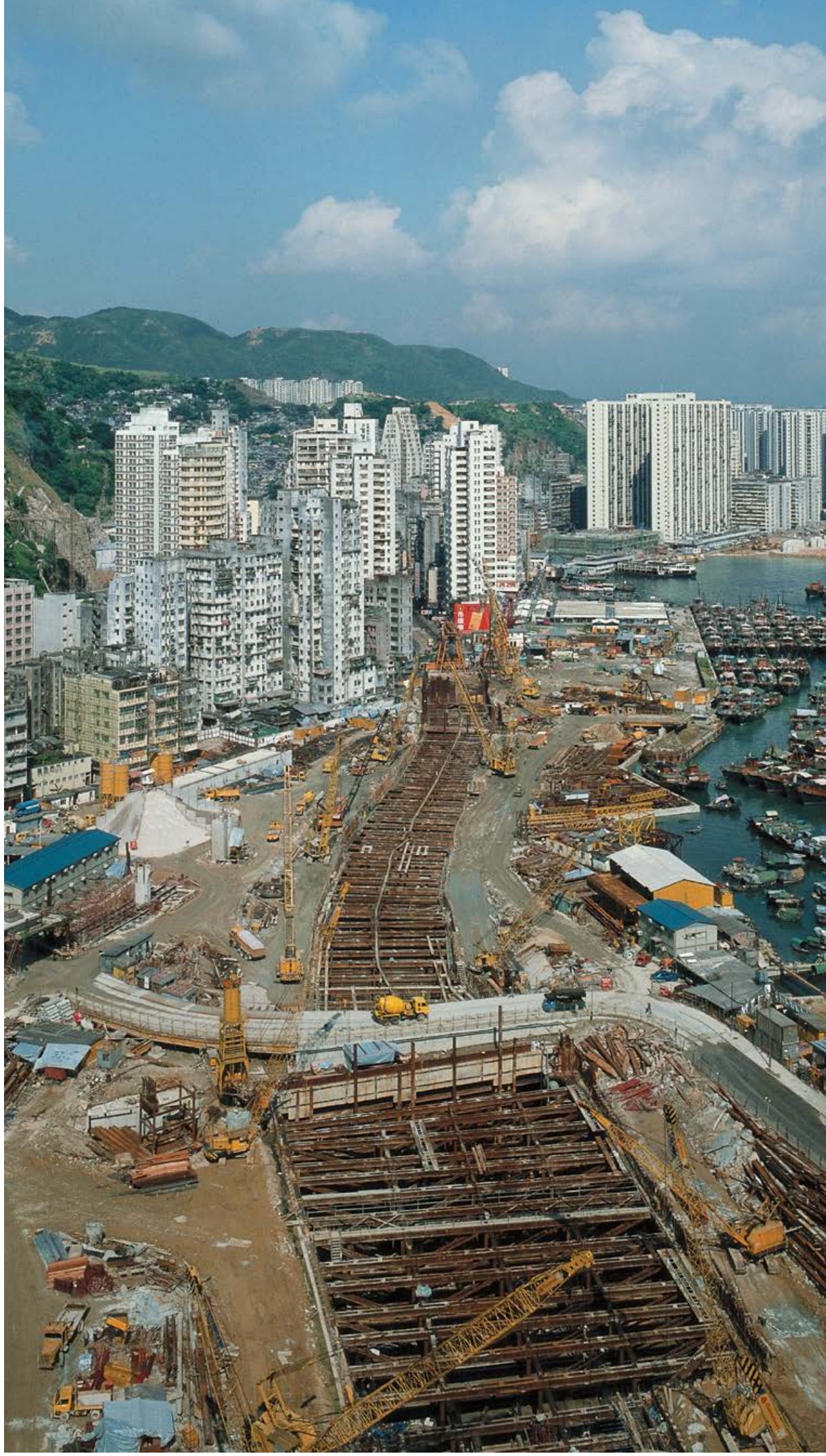
MTR SAI WAN HO

The $180 million contract for the MTR concourse at Sai Wan Ho station on the Island Line involved Gammon excavating 72,000 cubic metres of material, as it dug down 30m to create the space. More than 40,000 cubic metres of concrete were poured for the five-level basement. In the huge man-made caverns, workers and engineers created a modern underground railway station, which opened on May 31, 1985. The Island Line now calls at 17 stations along its 34-minute route between Kennedy Town and Chai Wan, serving Hong Kong Island's densely developed northern shore.

1985

MTR SHAU KEI WAN

When it awarded the $536 million contract to build Shau Kei Wan station to Gammon, the MTRC, which at that time was still a government-owned statutory corporation, issued it jointly with the Engineering Development Department's Highways Office, now the Highways Department. The firm also had to build viaducts, roads and footbridges in the area on the Island Eastern Corridor. Concrete in the projects totalled 120,000 cubic metres, all mixed at Gammon's own on-site batching plants.



2016

EXTENSION OF MTR ISLAND LINE TO WESTERN DISTRICT

The 3km rail link joining Sai Ying Pun, University of Hong Kong (HKU) and Kennedy Town to Central, known during construction as the "West Island Line" (WIL), was split into three main civil engineering contracts, two of which were awarded to Gammon.

The first, WIL 704, successfully tendered for by the Gammon-Nishimatsu WIL Joint Venture (JV), was a $4.76 billion contract for the construction of two intermediate stations in Sai Ying Pun and at HKU, joined by a running tunnel with a total length of 2.2km. The second, WIL 705, handled solely by the firm, was a $1.34 billion contract for construction of a cut-and-cover station with a 650m overrun tunnel in Kennedy Town.

For the first contract – which at the time of the tender was the largest single contract for the MTRC and the largest civil works project tendered for by Gammon – the JV constructed two rock-cavern stations, running tunnels, and pedestrian and construction adits by drill-and-blast techniques. A 100m-long soft tunnel was constructed using an advanced technique involving freezing the ground to below minus 10 degrees Celsius to form an ice ring, making tunnelling safer in treacherous geological conditions. This technique has been employed only twice previously on a Hong Kong rail project, and never on such a large scale.

The challenges of the project extended beyond pure engineering, however. The works took place in and under Western District, which has a large community of residents. The requirements of the construction process had to be balanced and harmonised with the welfare of the community and the environment.

"WIL 704 and WIL 705 is what we are good at – complex and large-scale projects in a very congested area," said Gammon Chief Executive Thomas Ho at the time. "It's all engineering balanced together with CSR and stakeholder engagement."

Recognising that many of the area's residents were retirees, Gammon appointed staff members as full time "Caring Ambassadors". They helped guide those in need across the site entrances establishing them as familiar faces with whom the local community could communicate. An initiative from Gammon for WIL, Caring Ambassadors are now a requirement for all MTR major projects.

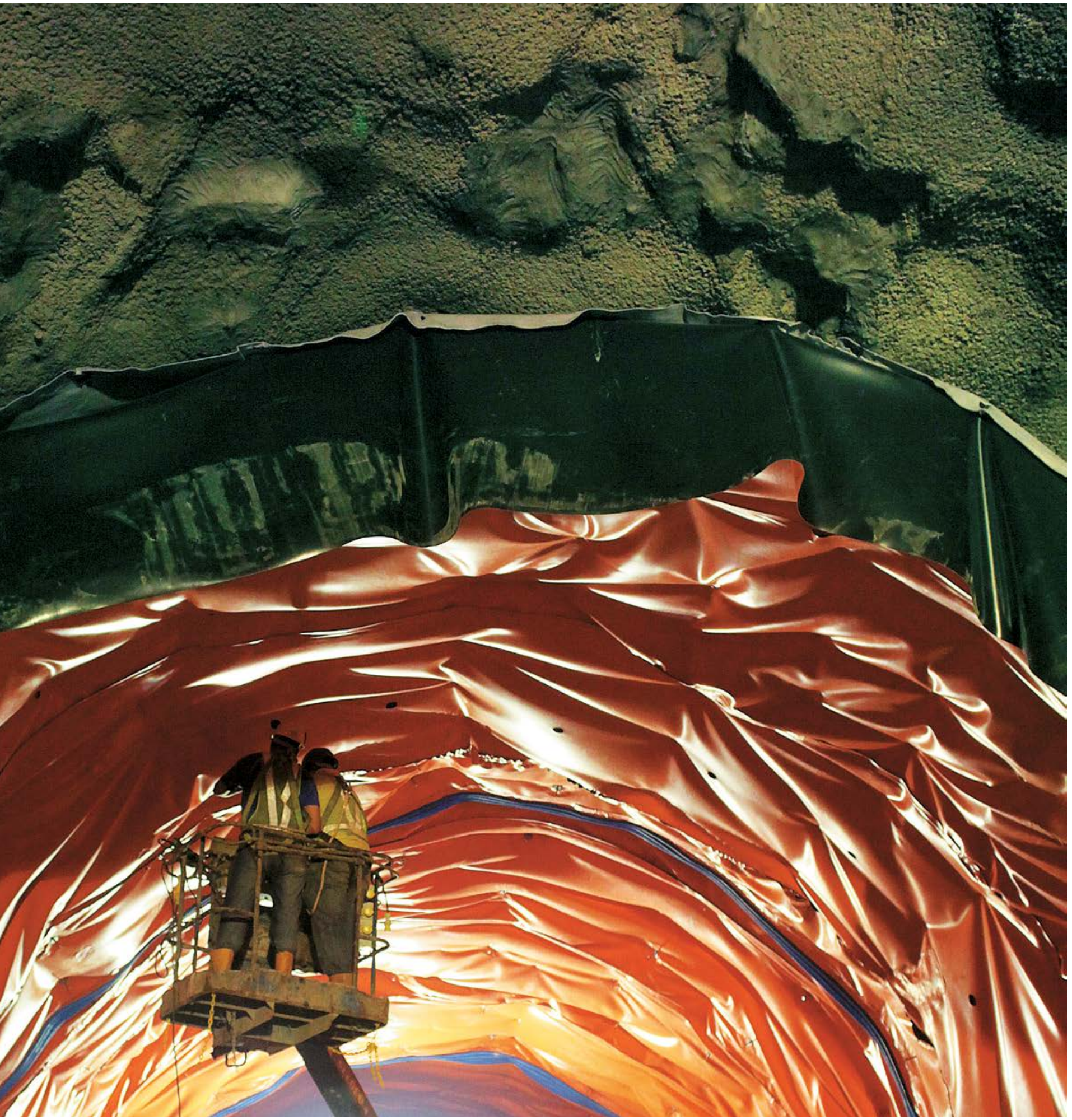
The schedule for dismantling the grand staircase of HKU's Haking Wong Building was compressed from three months to three days through co-operation with the university to effect a temporary road closure, giving the project team enough room to utilise a giant long-arm hydraulic demolition clamp mounted on an excavator. This expedited the process and greatly reduced the level of disturbance. That initiative won the team the MTRC Silver Stakeholder Engagement Award.

Noise control was an issue. Effective measures to contain both noise and dust included using the largest long-arm hydraulic crusher in Hong Kong for the demolition work, and the extensive deployment of acoustic cover, achieving levels of suppression never previously attained on a local construction project.

To protect the 100-year-old Forbes Street tree walls and the aged banyans, much loved by local residents, Gammon appointed an independent tree specialist to monitor protection work during construction. Temporary support structures to shield the trees and walls from adverse impacts from major works were also developed.

Several other green measures were adopted during construction, including removing more than 70 per cent of spoil generated by the underground tunneling work via a fully enclosed system of conveyor belts extending to a barging point at the waterfront. Much of the tunnel spoil was directed onwards for reuse in reclamation projects within Hong Kong. On-site, electrically operated equipment was preferred over diesel.

"There are ethics in business," notes Brian Gowran who was Project Director for WIL 705. "Most corporations are not interested in sustainability – maybe because they are not able to achieve success. At Gammon, we are not only known for quality and technical competence, but we also value initiative from all our workers and push for sustainable actions. What we achieve and how we achieve it speaks for itself."



THE FUTURE

Throughout its history, the question of where the MTR rail network should go next has been a topic of debate. Hard though it may be to believe now, back in the 1980s there were many voices in opposition to constructing the Island Line at all. Today, it is difficult to imagine getting around Hong Kong Island without it. What is certain is that Hong Kong's extraordinarily efficient rail network, which sets the standard for commuter trains for the world, will continue to evolve to meet the needs of the city – and Gammon will continue to play a significant role in its construction.

MORE ROOMS AT THE INNS

GAMMON AND HONG KONG'S HOTELS

One reason Hong Kong is such an internationally popular destination for business and leisure travellers is the excellence of its five-star hotels. Such legendary properties as the Mandarin Oriental and The Peninsula set the service standards for the world, and make vital contributions to many aspects of life in the city.

Hong Kong's leading hotels are the places local people, as well as visitors, meet. They are temples of fine gastronomy, and major contributors to the economy through the visitors they attract and the staff they employ.

The sector is intensely competitive. Existing Hong Kong hotels are renovated regularly – sometimes radically – and new properties continue to raise the bar with ever more modern and luxurious facilities.

Gammon's involvement with construction of Hong Kong's hotels began with the reinvention of a true icon of the city – The Peninsula hotel. Opened in 1928, and a symbol of gracious living ever since, the original seven-storey hotel is a recognised historic monument. To demolish it, or even to significantly alter the white-and-gold splendour of its famous lobby, was unthinkable.

Nevertheless "The Pen", as locals call it, urgently needed new suites and rooms, and space for the spa and swimming pool facilities a modern luxury hotel is expected to provide.

The owners, Hong Kong and Shanghai Hotels, decided to solve the problem by building a 33-storey tower behind and joined to the existing structure. They also decided, so far as possible, to maintain normal hotel operations during the construction period.

The extension – in the back half of the elegant H-shaped original structure, which was already occupied by a three-storey building – was to be 117m tall, and it had to harmonise with the architecture of the old hotel. All work was required to be of extremely high quality, in line with the Peninsula Group's exacting standards, and carried out with minimal disturbance to the hotel's affluent and demanding guests.

There were other challenges, including the constraints imposed by a confined site, working with three different architectural practices simultaneously, designing the world's largest double-glazed windows, and co-ordinating numerous specialist subcontractors to obtain the highest quality of finish.

Work began in the first quarter of 1992 and was completed in the fourth quarter of 1994. There is no doubt that the results were worthwhile. The Peninsula was repositioned as both a historic grand dame property and an ultra-modern luxury city hotel. It had gained 121 rooms and 18 suites – including a spectacular presidential suite – a swimming pool, 10 floors of top quality office space, a new cutting-edge restaurant with modern cuisine to complement the new modern facilities, and its own heliport on the roof. The tower blends so well with the lower storeys that in old photographs the original building now looks incomplete. Gammon's management of the project won the firm Hong Kong's 1996 Building Manager of the Year Gold Award.

Gammon had begun to make a name for itself in the hotel sector. In 2001, as project manager, it successfully completed a major renovation of the River Wing of the Oriental Bangkok, owned by the Mandarin Oriental Hotel Group (MOHG), and between 2002 and 2004 the firm

constructed the $300 million Le Méridien Cyberport, part of the Cyberport development at Telegraph Bay, Pok Fu Lam. Then a second renovation project for MOHG was up for tender.

Younger than The Peninsula, but an equally iconic Hong Kong hotel, the 25-storey Mandarin Oriental opened in 1963. By 2005, it too needed to upgrade its facilities, but the site constraints would not permit the kind of extension work that had been possible at The Pen. Nor was remaining open while the work was done an option. In December 2005, the hotel closed to be reborn nine months later after by far the most radical renovation of its history.

Gammon won the $1 billion contract against strong competition – even though MOHG is a sister company under the Jardine Matheson umbrella. However, the firm did have the advantage of completing a successful renovation at the Oriental Bangkok in 2001 and finishing Hongkong Land's radical renovation of The Landmark in 2005, which created a new space for The Landmark Mandarin Oriental.

On January 1, 2006, more than 500 workers began the arduous task of stripping the first MOHG hotel down to its core structure. Many of the dining and public areas were to be reconfigured, and the installation of a modern curtain wall would allow the enlargement of the guest rooms. At the height of the project, there were 2,100 workers on-site, including 70 Gammon specialists.

The project involved many challenges and complications, but it was completed on schedule for the hotel to reopen on September 28, 2006, ready to re-establish itself as one of the leading city hotels in Asia.

With experience both in successful new-build hotels and of renovation projects, Gammon was particularly well qualified to address the many complex issues presented by an exciting new opportunity. It came in the form of a $2.07 billion contract from The Wharf (Holdings) Limited to reshape the Murray Building in Central.

Built in 1969 for the use of the Hong Kong government, the Murray Building was originally a 27-storey office tower. The project was to convert it into a luxury hotel, with 336 guest rooms. The contract mainly comprised Alterations and Additions (A&A) works, including strengthening the existing structure; taking down two floors at the top and rebuilding three floors; reconfiguration of the podium floors; and major E&M, and Excavation and Lateral Support (ELS) work.

It was, Gammon persuaded Wharf, a project the firm could handle mostly in-house, forming an integrated team to handle 70 per cent of the contract work.

"It was very much a joint effort among internal departments and sister companies," says Contracts Manager Tony Wong. "About 40 per cent was Building, 20 per cent was Gammon E&M, and 10 per cent Gammon Construction Services Division, Entasis, and Gammon Foundations Division. Of the remaining Nominated Subcontractors (NSCs), some work was also done by sister companies such as Jardine Engineering Company Ltd, Jardine OneSolution, and Jardine Schindler who did the lifts for us. It made it an interesting project. One-stop shopping."

The Murray Building is one of eight projects under the Hong Kong government's "Conserving Central" initiative introduced in 2013. It is the only one to have been entrusted to a private developer. Conversion from office to hotel use was a requirement of the tender, and Wharf immediately saw its potential as a flagship for Wharf Hotels' new Niccolo luxury brand.

"We felt it was right, so we proactively tendered," says Leng Yen Thean, Executive Director, Wharf Real Estate Investment Company Limited. "The concrete structure featured beautiful ground-level arches and deeply recessed and angled windows as protection from direct sunlight and rain. These are timeless classic architectural features. It's a clever design because in the 1970s, air conditioning was not common, so windows were opened for ventilation, and it was vital rain should not come into the office. So for that time, it was an environmentally friendly building with a sustainable design."

The original vision for the building was that of Hong Kong government architect Ron Phillips, who returned to the city for the opening of what is now The Murray, Hong Kong, a Niccolo hotel. The then innovative idea of designing to conserve energy, he says, also determined the building's striking appearance.

"The prevention of direct sunlight into the building, formed by way of fins, resulted in the inevitable architectural concept that has proven to give the façade great visual strength," says Phillips, who was consulted extensively by architect Foster + Partners on the conversion design.

"Having resolved this, the next concern was access to the site by way of two steeply inclined roads. This was achieved by providing vehicular circulation within the curtilage of the building at the lower level. This generated a major structural need that was logically filled by arches, so completing the overall design concept and contributing to its iconic status. Needless to say, after 50 years I am delighted that Murray Building was preserved and is having another new life."

The Gammon project team had many challenges to address. Substantial temporary steelwork was required to preserve the elevated road link to Cotton Tree Drive, existing Old and Valuable Trees (OVT), and water mains. Temporary steelwork was also necessary to maintain the stability of the building during demolition work, after which new permanent steelwork including six new structural steel floors and strengthening steelwork for a 25-storey inside corewall were required. That adds up to about 2,200 tons of steel, all to be installed within a year.

The time frame was tight. Then it got tighter.

"At the beginning, we lost four months because of consent issues, but we caught up by almost two-and-a-half months by resequencing and design modifications," says Tony Wong.

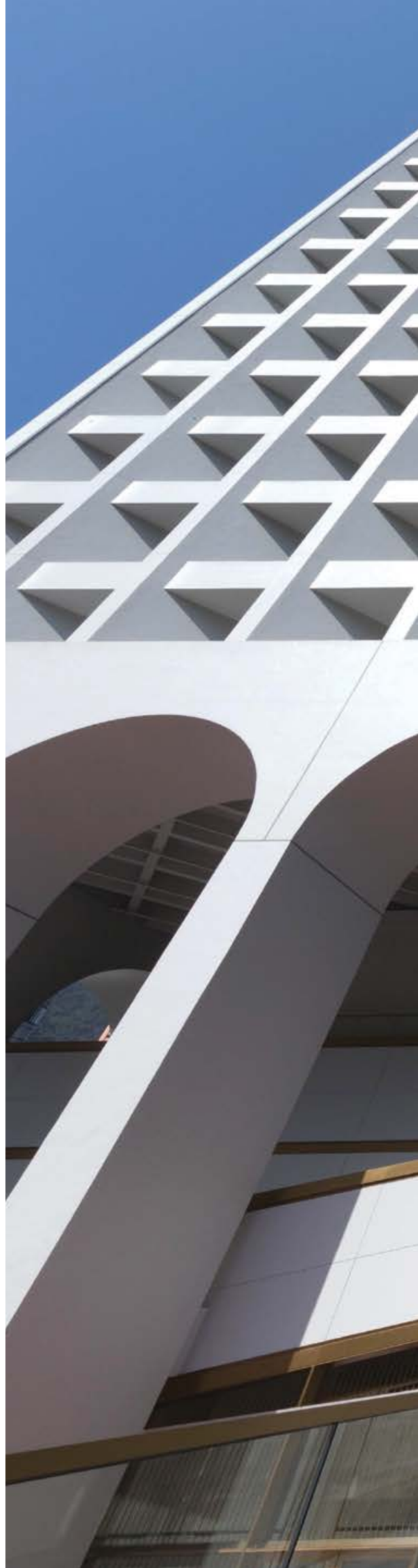
The original A&A works design covering the area from the basement to the first floor involved a significant amount of temporary steelwork, complex construction methods, and working at height. Gammon provided a value-engineering proposal calling for an amended temporary works design, simplified construction, and resequenced works. The result, says Wong, is that work was both faster and safer.

As so often on Gammon construction projects, safety was a driver for innovation. The Murray was a project on which the firm really started to explore the potential of robotics. Entasis is pioneering the use of robots in the installation of curtain-wall panels.

"Gammon focused on safety innovatively. Demolishing the floors at the top and adding the new ones was a dangerous process, so Gammon adopted the use of robotic construction for window installation. That made it safer for workers," says Leng.

Wong points out that there was an efficiency as well as a safety gain. One installation robot on-site replaced 25 per cent of the workers who would otherwise have been needed – a major advantage at a time when the shortage of construction workers in Hong Kong was acute.

"Another outstanding aspect of this project was the use of modular construction. Using our own factory in Mainland China, we had the riser modules produced there for installation on-site," says Wong.



“We discussed using modular systems like the pipe riser closely with Gammon,” says Leng. “Since it was a full revamp of E&M, this modular system speeded-up the installation process considerably. Welding on pipe work always takes a long time to do and is dangerous. It’s also difficult to control quality if it’s done on-site. Gammon used a lot of modular pipe risers, which expedited much of the installation work, and ensured quality and workers’ safety.”

BIM, 3D scanning and 3D printing also played their part in the Murray project, and the technology was applied to solving some otherwise intractable problems.

One of the obligations accepted under the tender was the preservation of a Rainbow Shower Tree on the government OVT register, which required temporary steelwork support during construction. Verifying the correct dimensions for the temporary works design was proving problematic until 3D scanning solved it. The tree was preserved.

Not all problem-solving depended on advanced technology, however. The project team managed to shorten the time necessary to pour 25 cubic metres of concrete for the corewall strengthening works by three hours, by the simple expedient of replacing traditional wheel barrows with a mini-concreting lorry to carry seven barrow loads.

Other challenges built into the project were less technical in nature, but still required teamwork and co-operation to tackle.

“A lot of government submissions were required throughout the process. Government departments treated The Murray as an iconic project, so they were anxious to ensure that there were no mistakes. Since they had no experience of giving a heritage project to a private developer, they were very careful and stringent. It was a difficult process getting government approvals,” says Leng.

Wong adds that Gammon worked closely with Wharf to reassure the various inspectors and government departments, and that a high level of mutual trust was built up between client and contractor. Wherever possible, they helped each other. It was also useful that Gammon was able to communicate effectively with Foster + Partners to resolve any difficulties relating to special characteristics of the almost 50-year-old building.

“It was a difficult project and we needed a main contractor who could communicate smoothly with the design team, particularly for a fast-track project. So we went for Gammon, given the firm’s good experience with top-end buildings and its international exposure. Expertise always comes first for us when considering contractors,” stresses Leng.

"Gammon also took care of E&M, so the interfaces were easy and that helped our programme. While the external structure of the building remained intact, we were glad to get government support to widen the windows a little to allow more daylight into the hotel rooms, and to broaden their views. We are proud of keeping the integrity of the building – for example retaining the vehicular ramp – but at the same time we could give the rooms a twist.

We also created a main front door facing Murray Lane, which is a new road we named, and a proper forecourt with the old tree, so both people and cars can access the main front door easily to enjoy the view."

Given the many complications necessarily involved in a major A&A conversion of a heritage building, Leng says she thinks the project was smoothly executed.

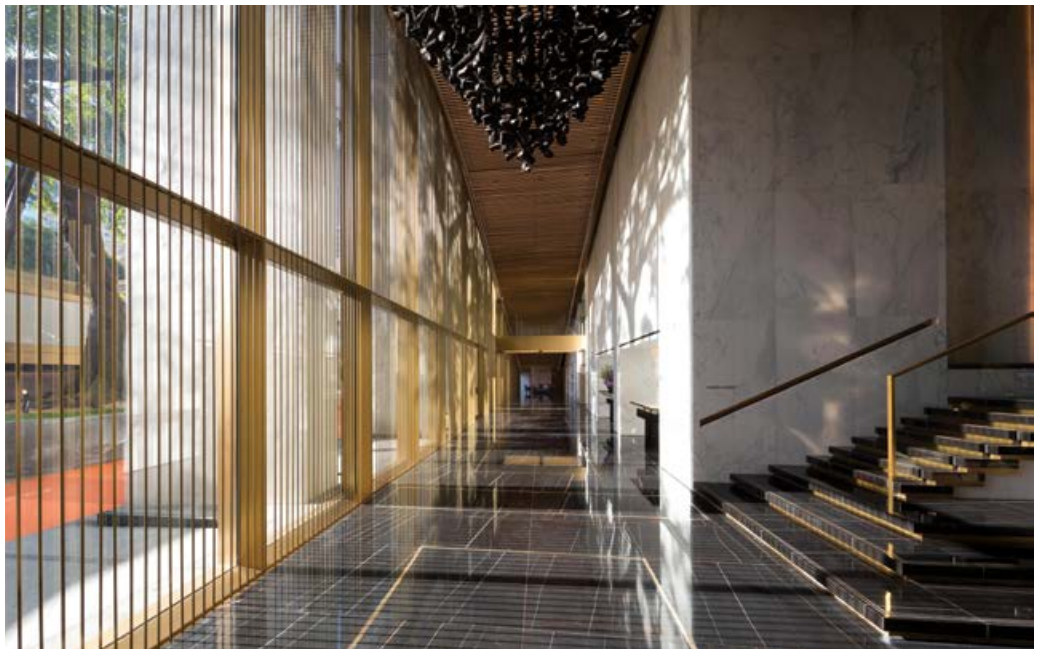
"It met our expectations and so far feedback is quite good. Frankly, the design was difficult. We and Gammon sat down to set the targets together from the start, and finally we achieved what we wanted. The spirit of partnership is vital under such a tight programme, and Gammon was willing to co-operate, sharing the same mentality and same level of thinking," she observes.

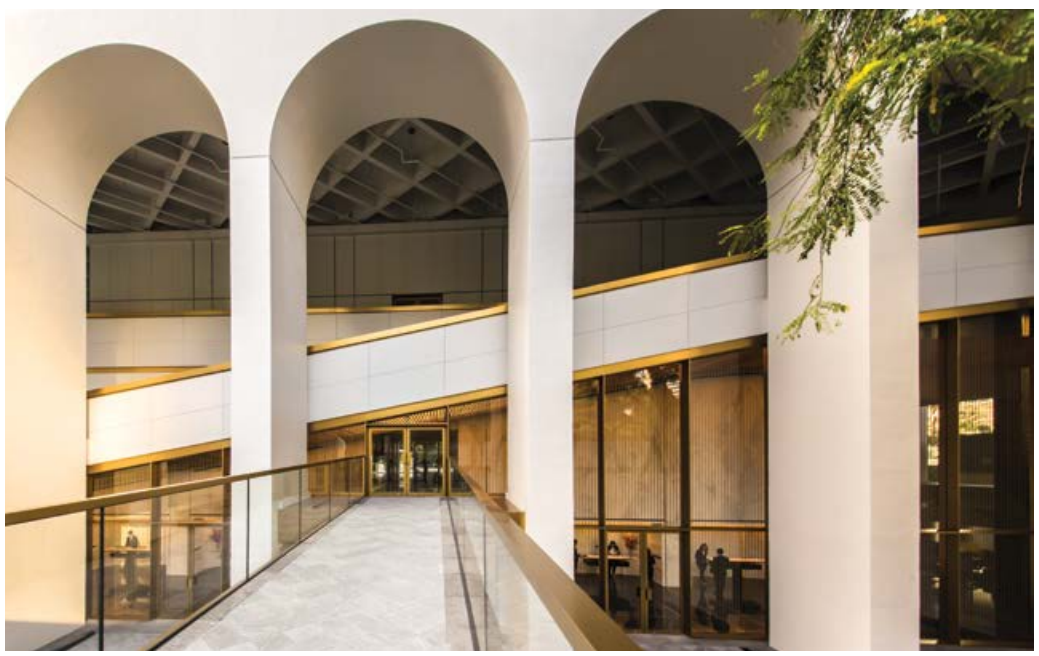
One former occupant of a Murray Building office was clearly happy with the transformation when she went back to officiate at a plaque unveiling ceremony to mark the project's completion.

"Having actually worked in this building twice in my public service career, I am thrilled to witness the impressive transformation of The Murray, once home to many government departments for half a century, to becoming a home away from home for guests from around the world," says Carrie Lam Cheng Yuet Ngor, Chief Executive of Hong Kong.

On the same occasion, Peter Woo, Chairman of Wheelock Holdings Pte Ltd observed that Wharf was grateful for being given the opportunity to take on a unique project. "We are inspired by the energy of this building, and the timelessness of the architecture; we are humbled because we have the responsibility to undertake this very important project to create a dialogue between the old and the new," he says.

The Murray opened for business as a hotel on January 15, 2018, when Tony Wong and his team were already planning Gammon's next hotel project. On November 20, 2017, it had been announced that Parkland (Hong Kong) Limited had awarded the firm a contract for the development of The Fullerton Ocean Park Hotel Hong Kong.





GAMMON OVERSEAS

For the past six decades, Hong Kong has been the main focus of Gammon's operations, but the firm's expertise is also regularly called on in locations outside the city. Gammon has undertaken projects in Beijing and other cities in mainland China, and elsewhere in Southeast Asia. In Malaysia, these include participation in the construction of Kuala Lumpur International Airport at Sepang; in Thailand building two stations for Bangkok's Mass Rapid Transit System; and in the Philippines management services for the Ayala Centre Redevelopment in Manila's Makati Commercial Business District. In Vietnam, Gammon has established a representative office and a strong strategic partnership with leading Vietnamese contractor COFICO.

SINGAPORE

2000

CITYLINK MALL AND ONE RAFFLES LINK

Gammon was originally established in Hong Kong as a subsidiary of Gammon (Malaya) Ltd, at that time an active Singapore-based construction firm. The Hong Kong company outlasted its parent, and in 1980 Gammon returned to the Lion City, with a another subsidiary, this time reporting to the Hong Kong head office. Gammon Pte Ltd (GPL) has built up a strong presence in the local construction industry based on its broad engineering expertise in railway, petrochemical and industrial infrastructure.

Completed in 2000, CityLink Mall is a 350-metre-long subterranean shopping complex through which tens of thousands of people pass daily, walking between the hotels and department stores of Raffles City, the Singapore International Convention and Exhibition Centre, Esplanade Theatres on the Bay, and the malls and luxury hotels overlooking Esplanade Park.

An underground connection was a key element in the development of One Raffles Link, a seven-storey commercial building erected above two floors of basement shopping malls flowing into the CityLink Mall. It provides 37,000 square metres of top-quality office space for global corporations. Between the City Hall MRT station and One Raffles Link stands the 1.4 hectare War Memorial Park and Nicoll Highway, a major road leading from the east coast into the Central Business District.

The first stage of the project was connecting the mall with the underground concourse of the City Hall MRT station. It was essential the railway operated as normal during construction, which imposed constraints on the use of jackhammers and other noisy equipment. Memorably, when Gammon engineers were about to cut through the final metre of rock separating the excavated tunnel from the station concourse, the engineers had to work virtually noiselessly.

Built for Hongkong Land under a guaranteed maximum price contract of US$71 million, the building was constructed to the highest-quality standards. An unusual top-down building programme was adopted, allowing the basement to be constructed at the same time as the upper storeys, reducing construction time by two months. The temporary occupation permit for Phase One was issued only 19 months after the superstructure started to rise.

Building the CityLink was a condition imposed on the developer by Singapore's Urban Redevelopment Authority. There were difficulties involved in building so close to the War Memorial Park, and under a canal. But having Gammon on board enabled Hongkong Land to proceed with complete confidence.

2003

A TALE OF TWO EMBASSIES

In 2000, Gammon in a joint venture with Shanghai Construction, was awarded the $210 million (S$34 million) contract to build a new embassy in Singapore for the People's Republic of China. The following year, as if fate had decreed it, the firm won the $78 million (S$12.7 million) contract to construct Singapore's embassy in Beijing, in partnership with Keppel Engineering.

The Chinese embassy in Singapore, a striking complex of seven buildings, was built in fashionable Tanglin Road. It is close to the British High Commission, the Embassy of the United States, and Singapore's Ministry of Foreign Affairs.

Given the elite environment, local authorities were naturally keen to monitor the impacts of the 22-month building programme closely. Gammon engineers took great care to control noise, insect pests and other issues, and to be good neighbours. Over a gross floor area of 15,049 square metres, workers poured 15,800 cubic metres of concrete and used 3,370 tons of reinforced steel bars.

As work proceeded in Singapore, a Gammon team was demolishing old buildings in the Chinese capital to make way for the Lion City's Beijing embassy. The contract called for construction of a chancery complex and staff housing.

There was also a civic hall, two residential blocks, guard houses, a visa office and an electricity substation. The total floor area of 7,100 square metres required 6,300 cubic metres of concrete and 2,240 square metres of external stone cladding.


ITE
College West
iBelieve

2010

INSTITUTE OF TECHNICAL EDUCATION (ITE) COLLEGE WEST CAMPUS

Combining cutting-edge architecture with environmental innovation, the Institute of Technical Education (ITE) College West campus in Singapore was Gammon Capital's first public-private partnership (PPP) project. The 27-year, $1.48 billion (S$243 million) contract offered an opportunity to create an award-winning design which would produce an optimised capital performance and operating life cycle, with contained maintenance costs – as well as incorporating a number of innovative features producing a reduction in energy consumption of more than 30 per cent.

The campus features extensive landscaping with 20,000 square metres of turf and almost 800 mature trees, high-efficiency chillers and lighting, 7,000 square metres of green roof, solar hot water, and rainwater harvesting. Designed to minimise the need for lifts and escalators, and building orientation also reduces heat gain. The unique design of the campus won multiple awards, including Project Finance International's Asia-Pacific PPP Deal of the Year 2008, and Platinum status in the Singapore Government's Green Mark environmental rating scheme. A significant architectural feature of the campus is the massive Teflon roof – one of the largest tensile fabric structures of its type in the world – that spans over 3,000 square metres above the Event Plaza to provide shade and protection from the weather.

Almost 7 million man-hours were expended during construction, with a total of 110,000 cubic metres of concrete, 12,000 tons of reinforcement bars, 750 tons of structural steel and 3.5 million bricks used. Despite a tight two-year construction time frame, the project was completed on time and welcomed its first students in July 2010.

2010 THE MOLE

The Mole was a sea wall, constructed in 1906 as a breakwater for Clifford Pier, comprising massive boulders dumped into the South China Sea. The breakwater extended 2km out in waters up to 20m deep. In the 1970s, land reclamation work at what is now known as Marina Bay formed the Marina Centre and Marina South areas, and in 2006 it became necessary to remove The Mole to make way for planned developments, including the Marina Bay Sands integrated resort. The challenge was to achieve this without leaving any underground obstruction behind.

Lambeth Associates was called in to devise a system for Phase One of the removal, involving a cofferdam using seawater to stabilise The Mole, together with up to eight mega trusses for cranes to dredge out the structure. The project was engineered to reuse 20,000 tons of steel, thereby saving significant material costs and time. Gammon's was not the lowest bid. The firm won the $559 million (S$92 million) contract on grounds that Lambeth's solution was innovative, safe and sustainable.

The scale of the project, completed in January 2009, was huge. It involved the excavation of more than 600,000 cubic metres of rock and sand – equivalent to the volume of 240 Olympic-sized swimming pools – the installation and removal on completion of steel pipe piles totalling 26km in length, and of structural steel strutting amounting to almost 7,000 tons.

The Mole Phase Two was an even larger project with a contract value of $1 billion (S$175.7 million), and again Gammon's was not the lowest bid. A similar design to Phase One was proposed in the second tender, and Gammon already had the mobilisation, equipment, plant – and the all-important experience. For the second phase, fewer people and less plant were required, and significant productivity gains brought the difficult project in on time in December 2010. The project brought Gammon international recognition and applause at the Ground Engineering Awards 2011 in London, as the winner of the prestigious "International Project of the Year" award, together with a commendation in the Technical Excellence category.

2012 WOODSVILLE INTERCHANGE

In October 2007, Gammon began upgrading the Woodsville Interchange, an at-grade road junction comprising Serangoon Road, Upper Serangoon Road, MacPherson Road and Bendemeer Road. The project required some ingenuity. A major Singapore road artery had to remain in operation while a new underpass, elevated flyover, pedestrian footbridge and slip roads were constructed.

The project team designed and implemented a gyratory traffic system, which improved the site logistics and reduced the need for traffic diversion and temporary traffic decking. On the site itself, 3,400 specialised instruments, including ground and building settlement markers, were installed and continuously monitored, greatly enhancing both safety and efficiency. Three 700m-long tunnels and a 350m-long, seven-span flyover were built. A former fire station was also partially reconstructed to retain the appearance of the original façade. The $694 million (S$130 million) project was completed and the tunnels opened to the public in January 2012.

2013 CHINATOWN STATION

Singapore's MRT carried its first passengers on November 7, 1987. In 2015, a daily average of around 3 million passengers travelled on 199.6km of track on three main lines between 119 stations.

An award-winning design, the Chinatown Station on the North-East Line was completed in 2002 by a Joint Venture between Gammon and Econ Piling Pte Ltd, while the Gammon-led Chinatown Interchange station on the Downtown Line opened on December 22, 2013. The $73.7 billion (S$12 billion) Downtown Line is separated into three sections linking 33 stations and connecting Marina Bay with the business and financial centre and with residential areas.

When the first Chinatown station was built, the Land Transport Authority already had plans for another to be constructed, and arrangements were in place for entrances, exits and escalators to connect the two. However, there were challenging complications. Precautions had to be taken to prevent tunnelling disturbing the foundations of the surrounding pre-war shophouses and commercial buildings.

Gammon was responsible for work including a diaphragm wall, foundation piling, extensive traffic diversions, temporary works, co-ordination with system-wide contractors, architectural finishes, and above-ground external work and structures.

The $982 million (S$160 million) interchange station project was constructed using top-down methodology to minimize disturbance to people in the surrounding residential and commercial areas, with construction noise kept to a minimum. The original street-scape was restored on completion of the project.

2015 SENTOSA CABLE CAR STATIONS

The Sentosa Cable Car Line, launched in July 2015 as part of the island of Sentosa's celebrations for Singapore's golden anniversary, was recognised in the Engineering Feats @ IES-SG50 Awards given by the Institution of Engineers, Singapore. It was among the engineering achievements to have made the most significant contributions to life in the country over the preceding half century.

Gammon played a role, constructing the Sentosa cableway stations at Siloso Beach, Imbiah Lookout and Merlion Plaza, including all foundation piling, architectural finishes, E&M services and cableway tower foundations. Under the Sentosa Development Corporation contract, sustainability was a high priority, with the project team committing to work in a way that did not disturb daily activities at this popular tourist destination, or damage the habitats of sensitive wildlife. Silent pilers were deployed, and noise and vibration levels closely monitored to minimise impacts on marine life in Underwater World Singapore – just 100m from one of the sites. Construction access was created using waste materials generated from the early works, and bricks from demolished substations. At the end of the project, the access route was transformed into an ecotrail, reusing waste materials generated by the project, including cut trees.

MACAU

2007

VENETIAN MACAO

Since its handover to China in 1999, the former Portuguese enclave of Macau, once considered a sleepy backwater on the South China coast, has undergone a radical transformation. Often called the “Las Vegas of Asia”, in many respects it has surpassed its Nevada inspiration. Along Macau’s Cotai strip is the world’s largest casino, combining the romance of Venice with the excitement of Vegas. At 980,000 square metres, the Venetian Macao is the largest single-structure hotel building in Asia. Playing a pivotal role in the $2.6 billion construction project was Gammon, through its Macau company, Gammon Building Construction (Macau) Ltd, and with its Macau Partner, Mei Cheong Construction Company Ltd.

This vast complex, inclusive of a 32-storey tower, contains 182,880 square metres of gaming floors, a 259,080 square metre shopping centre, 90,000 square metres of convention and exhibition space, a 15,000-seat stadium, a 3,000-seat auditorium, 3,000 hotel suites and several acres of swimming pools, as well as 15 fine-dining restaurants. Gammon’s role was to oversee work on the hotel and podium – including the signature indoor canal – handling the electrical and mechanical work and the interior fit-outs. Just two years were allowed for completion. Working around the clock and seven days a week, at its peak the project employed 2,500 workers. A revolutionary new feature, prefabricated bathrooms devised by Gammon’s interior design team, meant that each of the 3,000 en-suite bathrooms took only two workers just two days to complete, significantly reducing both installation time and manpower requirements, and substantially reducing construction waste. The fanfare surrounding the spectacular opening of this major landmark building in August 2007 cemented Gammon’s reputation as a leader in construction in Macau.

CHINA

2008

TAIKOO LI SANLITUN

Operating in mainland China for almost 40 years, Gammon has completed over 100 projects in 16 provinces across the country. In 2003, the firm became one of the first non-mainland companies to establish a wholly owned construction enterprise in the mainland, with headquarters established in Shanghai.

Before China hosted the Beijing Olympics in 2008, there was clearly an opportunity to develop an area of integrated mixed-use commercial and retail space to showcase what the city had to offer in terms of recreation – particularly shopping, dining, the arts and entertainment. Swire Properties developed Taikoo Li Sanlitun for this purpose, and appointed Gammon as Managing Contractor. The firm monitored design, cost control, and the programme and quality of works, also providing technical support and working closely with consultants for Climatic Design Analysis to reduce energy consumption and create an optimum environment for the entire retail area.

Located in fashionable Chaoyang district, Taikoo Sanlitun Beijing consists of 19 buildings, with over 240 shops and restaurants, a multifunction hall, and a 99-room boutique hotel. Today, the development is considered the centerpiece of the area, and a destination for young Chinese and foreigners alike.

2010

HONG KONG PAVILION

In 2010, Gammon constructed the Hong Kong Pavilion at the World Exposition 2010 Shanghai China (Shanghai World Expo 2010), one of more than 200 pavilions representing countries, districts and cities, each celebrating a unique cultural heritage.

The theme of the three-storey structure was “Hong Kong – Potential Unlimited” and the design expressed the city’s dynamism. Gammon was responsible for the detailed design and construction of the pavilion, the interior fit-out, exhibition works, and landscaping. A raft foundation in combination with 6m diameter soil-mixed piles extending 12m into the earth, was used to evenly distribute the load for the steel-framed superstructure. The firm also handled building maintenance during the exhibition, and dismantled it after the Shanghai Expo came to an end.

Across China, Gammon focuses on contracting, design and build, construction management and project management of works, including industrial facilities, hi-tech factory buildings, semiconductor facilities, pharmaceutical plants, commercial developments, hotels, hospitals and civil engineering works.

THREE

THE WAY FORWARD

Gammon goes into its seventh decade in Hong Kong with the confidence it has the capability to handle projects of the highest quality, on the most ambitious scale and, as ever, in The Gammon Way – with Safety, Integrity and Excellence. Projects recently completed or in progress range from vast road and rail infrastructure works to both public-housing projects and luxury apartment complexes for the private sector.

Gammon has been chosen as the main contractor for major projects for the people of Hong Kong, such as Tai Kwun at the former Central Police Station complex and the creation of a new Water World at Ocean Park. It is the contractor of choice on the one hand for the ultra-modern technologically sophisticated data centre at Tseung Kwan O, and on the other for the elegant repurposing as a luxury hotel of the 1960s architectural icon Murray Building. Known for the sustainability of its construction practices, Gammon continues to be called on for projects with a distinctly green identity such as Lee Garden Three and The Quayside. In the first few months of 2018, significant new civil contracts have included major works for the Lyric Theatre in the West Kowloon Cultural District, and a $6.2 billion project for the Highways Department constructing the Kai Tak West Section of the Central Kowloon Route.

With six decades of ever diversifying experience and expanding expertise, Gammon is ready and eager to meet the construction challenges of the future, both in Hong Kong and further afield.

築動未來

社會的發展日新月異，建造業亦正轉型，邁進數碼化的年代。我們滿有信心，繼續秉持公司的核心價值 — 安全、誠信及卓越，不斷革新，在施工過程中採用先進科技，領導業界。

金門建築 (金門) 在香港被譽為首選承建商，建造多項大型工程項目。最近我們克服挑戰，順利完成沙中線 — 紅磡站鐵路隧道建造工程，拓展香港的鐵路網絡；廣深港高速鐵路的西九龍總站(北)的工程項目也竣工，促進香港與中國內地的跨境交通聯繫。在新加坡，金門與新加坡陸路交通管理局建立了互信的合作關係，正負責建造合樂地鐵站，這是繼獲批美華地鐵站設計及建造合約後贏取的第二份湯申線工程合約；我們亦成功在合樂地鐵站工程中使用創新的矩形隧道鑽挖機。在新工程方面，我們於2018年獲得多項大型的建造合約，包括價值62億港元的中九龍幹線 — 啟德西段工程、26億港元的屯門至赤鱲角連接路 — 北面連接路隧道大樓及機電工程，以及15億港元的西九龍文化中心的演藝綜合劇場及擴建地庫項目。

與時俱進，金門的業務範疇亦愈趨多元化。在保育工程方面，團隊成功將大館 (舊中區警署建築群) 塑造為香港重要的文化地標，為市民提供優質的文化活動空間；我們亦獲Global Switch委以重任，於香港及新加坡建造大型數據中心，為市場提供高端的數據中心服務。隨著海洋公園逐步發展成為國際級度假勝地，金門正為園區承建水上樂園和香港富麗敦海洋公園酒店。

市場對優質私人住宅建築服務的需求正不斷增加，買家的期望亦越來越高。金門的卓越服務得到眾多著名發展商的支持，多次參與高尚住宅項目的發展。我們的專業建築服務亦成為客戶宣傳的重點之一，無論於結構安全或室內裝修的質素方面，均給予買家信心。

在商廈發展方面，金門以創新的施工方案為客戶創造價值，積極持守可持續發展的原則。我們建造的多個工程項目均達至美國綠建築協會之「領先能源與環境設計」(LEED) 的評級要求，及得到香港綠色建築議會的綠建環評 (BEAM Plus) 認證。目前，公司正進行的多個工程更以達至國際WELL建築研究院極為嚴格的WELL潔淨空氣標準為目標。

憑著60年的豐富經驗、不斷拓展的專業領域，金門熱切期待與業界攜手迎接新挑戰，再創新高峰。

HONG KONG'S NEW GATEWAY TO MAINLAND CHINA

EXPRESS RAIL LINK 810A AND 811B

There will doubtless be many reasons for the people of Hong Kong to remember 2018, but for many the completion of the Guangzhou–Shenzhen–Hong Kong Express Rail Link (XRL), connecting the city directly to China's high-speed rail network, will be high on the list. Gammon played a major role in building the station.

In 2010, Gammon formed a partnership with Leighton Asia to tender for four of the major contracts at the Hong Kong West Kowloon Station. The Leighton-Gammon Joint Venture (JV) was awarded 810A, the $8.9 billion contract for "West Kowloon Terminus Station North"; while the Gammon-Leighton JV was awarded 811B, the $2.88 billion contract for "West Kowloon Terminus Approach Tunnel South".

"The thinking behind a Gammon and Leighton JV was that you needed a big and financially stable company for such a huge project, one that you have confidence you can work with. Of course, we'd worked successfully with Leighton before. There are great synergies between the companies on safety, quality and in many other areas. We work very well together," says Brian Gowran, Gammon's Project Director for 811B.

"We didn't encourage people to say 'I'm Gammon' or 'I'm Leighton'. We said 'We're the JV'. It was a one-team approach to get the project done," adds Gammon Executive Director C.C. Hau, the firm's Principal Project Director for 810A and a Joint Venture Board Director for 811B.

The Hong Kong West Kowloon Station is an important new gateway to Mainland China – quite literally, with passengers completing the immigration formalities for both Hong Kong and the Mainland before boarding their trains. The co-location arrangement of Customs, Immigration and Quarantine (CIQ) will greatly expedite passengers' journeys, with enhanced convenience.

Thanks to the spectacular steel-and-glass roof structure rising majestically above its main entrance, the Hong Kong West Kowloon Station is already a major landmark in the city. And it is just as clear from within that Hong Kong now has one of the great railway station buildings of the world.

Facilities in the 400,000-square-metre structure include food and beverage operations and retail outlets, served by around 120 lifts and 70 escalators. The station also provides nine long-haul tracks and six short-haul tracks, as well as accommodation for CIQ facilities of both Hong Kong and the Mainland. According to Hau, the internal walls together add up to a total length of about 60km.

Connections to Hong Kong's famously efficient public transport system could hardly be smoother. Hong Kong West Kowloon Station is connected to the adjacent Austin Station of the West Rail Line and Kowloon Station of the Airport Express by a system of pedestrian bridges, subways and vehicular underpasses. The nearby bus terminus, which is part of the 811B contract, is also served by a steady stream of buses and coaches.

Under 811B, the JV has constructed the cut-and-cover approach tunnel to the station, 30m below ground, and 300m of a fan-shaped reinforced concrete structure, surmounted with a landscaped deck. The deck is both the place of ultimate refuge in the event of the station having to be evacuated, and a beautiful green plaza commanding superb views of Hong Kong Island. The contract also required construction of the footbridge networks and a multilevel vehicular underpass connecting Lin Cheung Road and Austin Road West.

The project, which involved extensive utility diversion and temporary traffic arrangements, also included construction of associated plant and support buildings.

The 810A contract gave the JV responsibility for by far the largest of the XRL civil projects, and for constructing the largest station in Hong Kong. “It’s an iconic project and it’s a great honour to be involved. It’s the greatest challenge in my career so far,” says Hau, who took over leadership of the project team in 2015.

At the peak of construction, 6,000 to 7,000 people were on the site every day and, Hau says, “It was like a small town in terms of logistics and welfare facilities. In terms of the number of people involved, it’s the biggest project Gammon has done.”

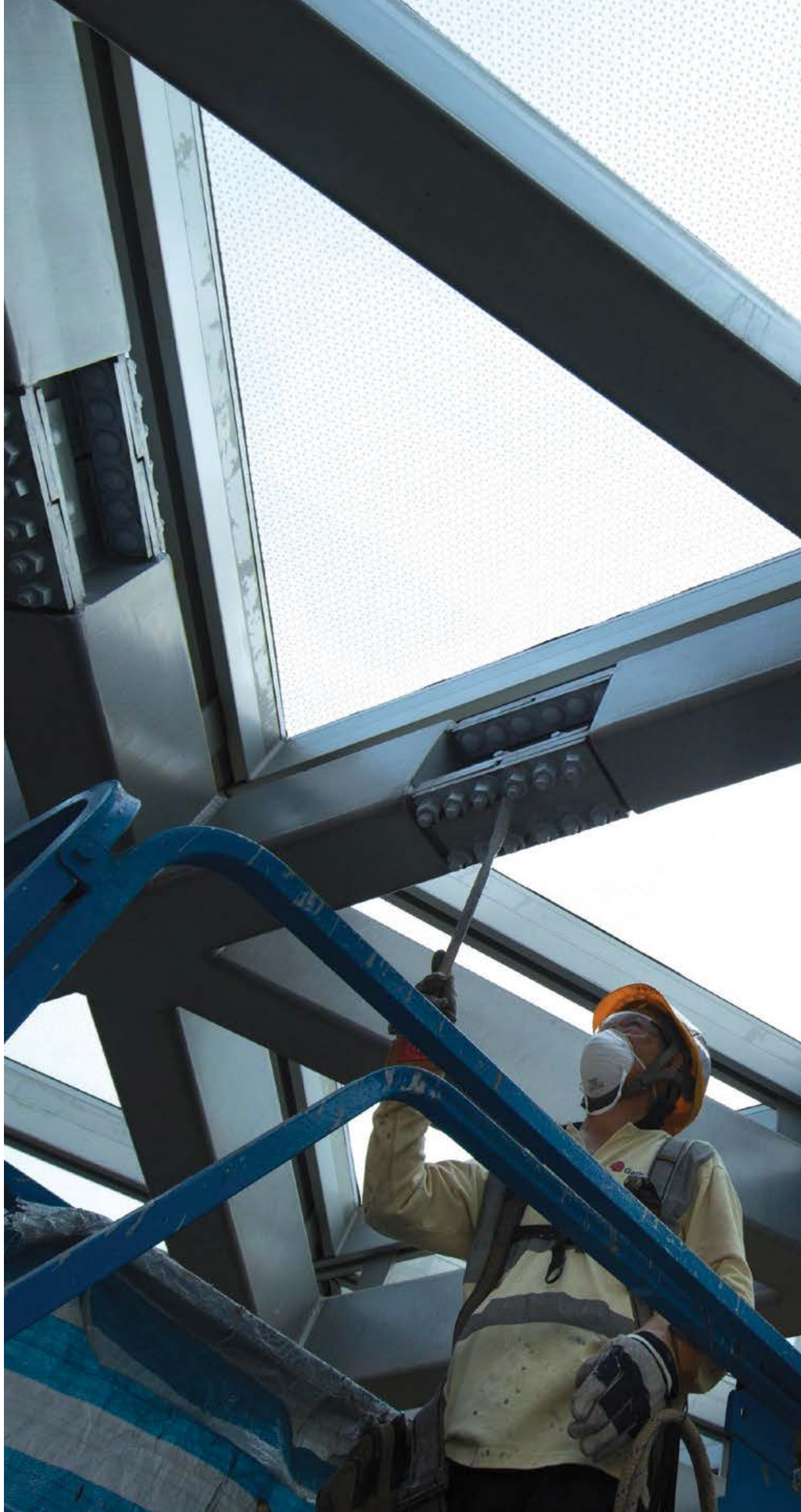
The engineering challenges were formidable. Utilising a combination of bottom-up and top-down construction methods, over 1.7 million cubic metres of earth were excavated, 700,000 cubic metres of concrete placed, and 150,000 tons of steel reinforcement used. The excavated pit measured 33m in depth and 11 hectares in size – the same area as would be occupied by about 11 football pitches.

The arching glass roof alone required 8,000 tons of steel trusses, each spanning up to 45m and made up of prefabricated components weighing as much as 40 tons each.

“It’s a very sophisticated roof structure – very complicated. There are a lot of interfaces and a lot of details in that roof,” says S.Y. Yu, Gammon’s Director in charge of civil work.

Technology helped with the installation, however, as C.C. Hau explains.

“The roof has over 200,000 joints and 25,000 component pieces to be attached to the frame, with no two having identical dimensions or shape, but we were able to use



BIM technology to prevent clashes and to assess how members should be installed," says Hau, adding that 3D scanning and drones also played important roles in the complex installation work.

The roof's permanent support takes the form of nine steel mega columns, on which the steel roof trusses rest. Both columns and trusses are visually arresting, geometrically complex elements of the architecture.

The roof was erected using temporary support towers, before being lowered onto the mega columns.

"When we finished the erection of the permanent steel, we needed to transfer the roof loading from the temporary supports to the permanent supports. We used about 30 hydraulic jacks, so we could transfer in a synchronised manner with the jacks releasing simultaneously at the 30 different locations, leaving the roof supported by the permanent columns. It was a successful load transfer, with no deformation of any steel member. We used a drone to survey the settlement of the roof, for which there was a tolerance of about 80mm, and the maximum was 40mm. So it was very accurate," says Hau.

The nine mega columns were originally to have been finished with reinforced gypsum, but more project time was saved by substituting aluminium, which is less susceptible to weather damage.

"That meant we were able to put on the cladding in parallel with the roof construction, whereas with gypsum we would have had to wait until the roof was finished," Hau explains.

The successful installation of the roof was one of the project's many milestones on the way to successful completion, and achieving it was all the sweeter because of the considerable difficulties the project teams for both contracts had to contend with along the way.

Take logistics and site access, for example. An 11-hectare site would normally have had 10 entrances, but this project was limited to 3.

"We also encountered unforeseen ground conditions and we had to work closely with the MTR and the consultants to address a lot of challenges," recalls Yu.

The geotechnical challenges, Hau and Gowran point out, were complex and varied.

"We faced unforeseen ground issues including an unexpected occurrence of a huge amount of rock, which caused a serious delay," says Hau. "We had to do some blasting to expedite construction, which is subject to stringent control in an urban area. But we did a lot of site studies and talked to the government, and finally got approval. The blasting technique used electronic detonators, which can reduce vibration to a safe level. We were blasting 400 to 500 cubic metres per day using new and sophisticated technology."

In the early days of the project, when not trying to shift solid rock, the JV was struggling to prevent its vehicles from sinking axle-deep in mud.

"Because of a lot of soft ground, we couldn't use wheeled trucks, so we brought in some tracked carrier crawlers from Japan, which aren't usually used in Hong Kong. They allowed us to move across the alluvium," explains Gowran.

Another project management challenge related to liaising with stakeholders over disturbance to the many pipes and cables running through the site, and the inevitable disruption of traffic.

"The amount of external approvals needed was phenomenal," says Gowran. "We moved and reinstated Jordan Road – a major arterial road – at various stages, and to do that we needed permissions from all the various stakeholders. But we had very good co-operation with the MTR with whom we worked as one team. It's all about building up trust."

Some of the time lost due to site difficulties was recovered by switching from the bottom-up construction originally planned, to a top-down construction method using 50 plunge columns for contract 811B.

"Normally we construct from the bottom and build up, but because we had this huge stretch of Jordan Road to keep operational we built the ground slab first. Then we could put Jordan Road on top of it, so the traffic could run, and after that we constructed the other slabs.

By working top-down you don't have to keep moving temporary works around, you don't have to disturb the public again. And its efficient because you are using the permanent works to build the temporary works."

Gammon's in-house expertise and strength of production capability in steel and concrete were particularly valuable to the project. In Dongguan, Pristine constructed 345 composite columns using 14,000 tons of steel and ranging in total weight from 27 tons to 72 tons for the mega columns. It also provided the traffic deck, the travelling steel formwork and the conveyor for the concrete batching plant established on the site by Gammon Concrete Services.

The purpose of the plant was to enable the pumping of high-performance concrete directly to where it was needed on the site, so there would be minimal recourse to vehicular transport. A reduction in the daily use of trucks for this purpose from 50 to four was achieved – a huge cost efficiency and environmental benefit.

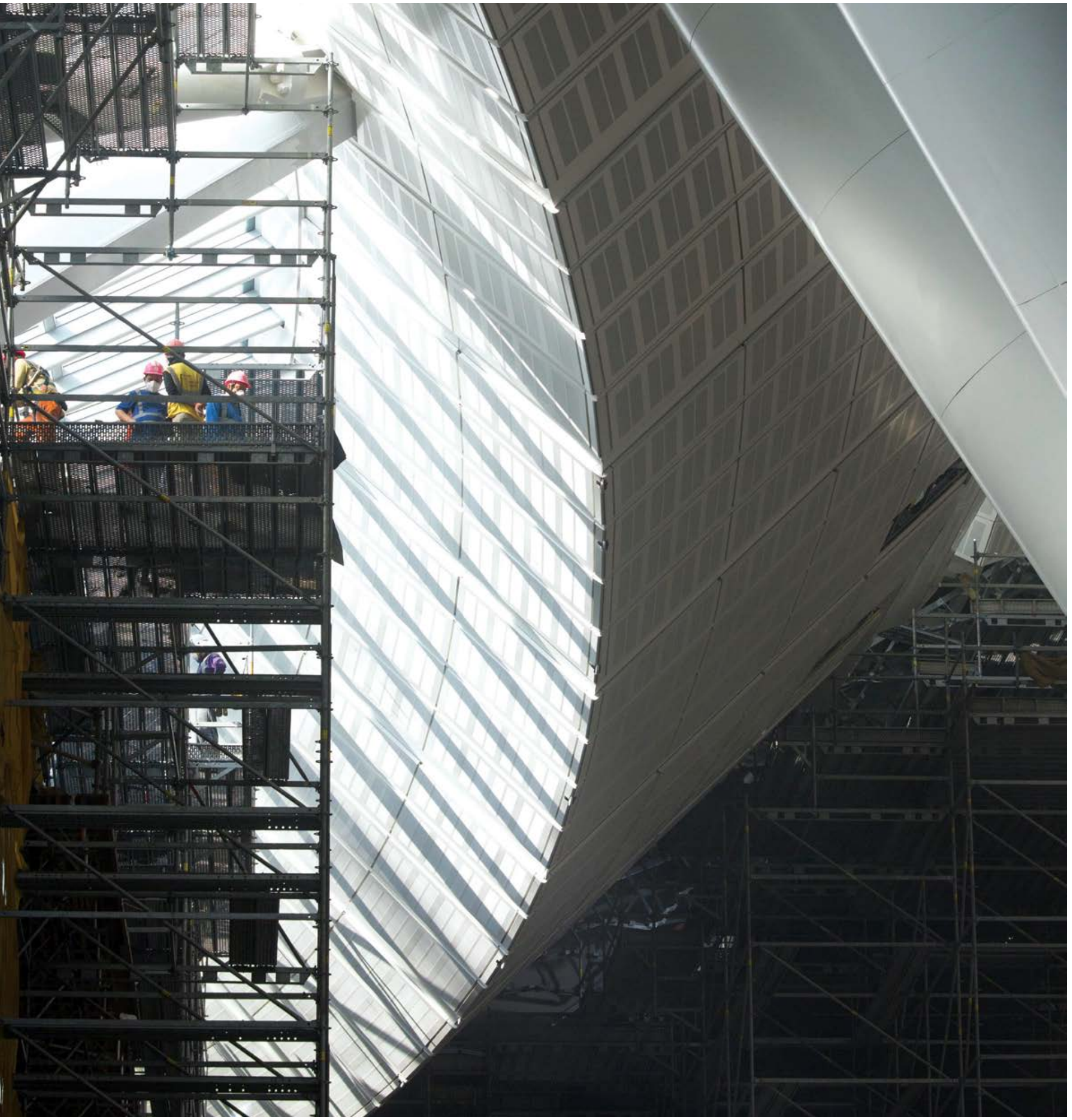
"The challenge was that we needed to make sure that after being discharged from our mixer, the concrete was still able to stay fresh and flowing even after it had been pumped a combined distance of about 600m," says General Manager of Concrete Services, Dr Herbert Zheng. "We needed to design a whole bunch of special concrete mixes that maintained their flowing properties after pumping."

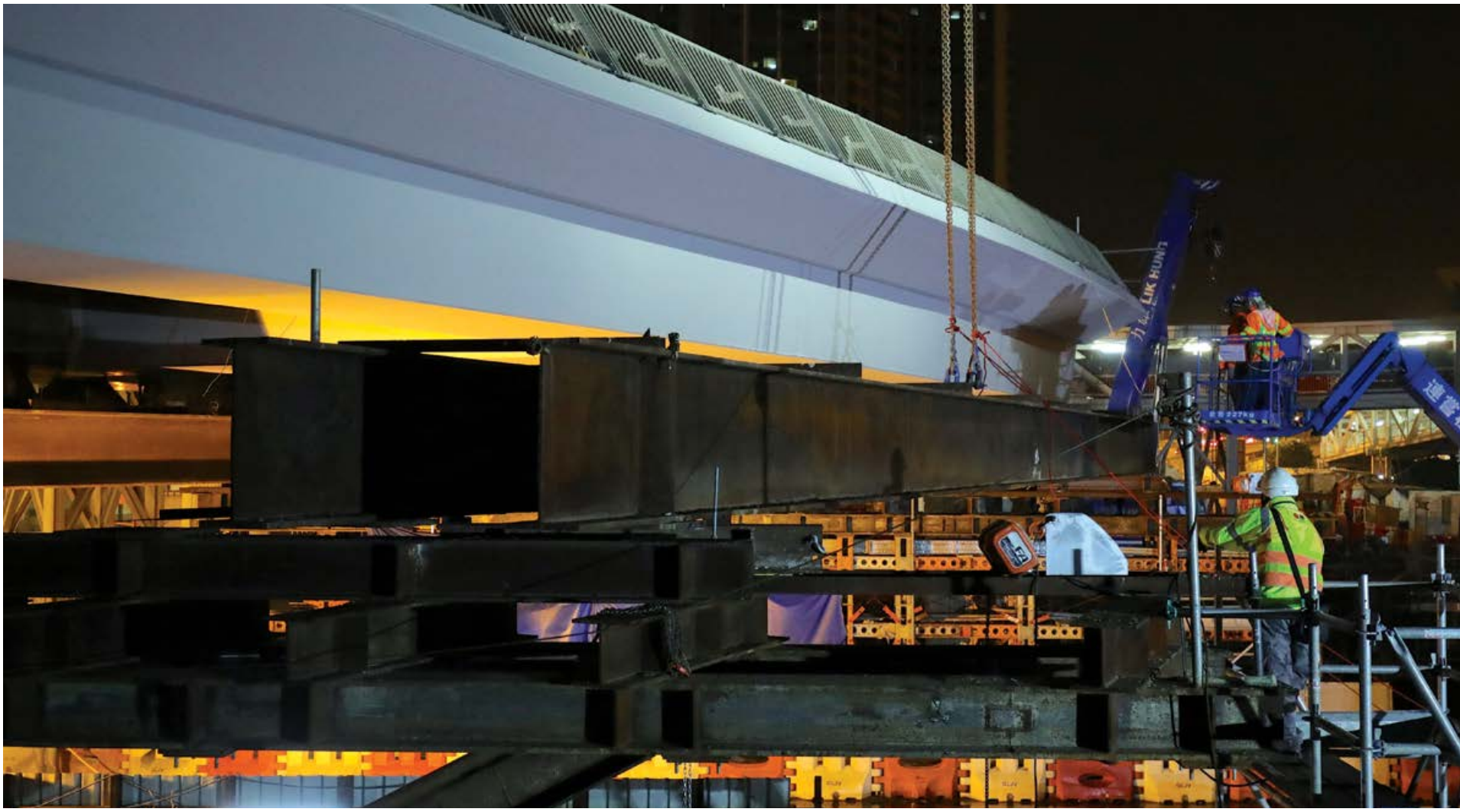
Another notable achievement was to successfully cast a P1 truss cantilever for the entrance arch, which according to Zheng, was "deemed not buildable, neither repairable", because of the size of the structural element, and its need for maximum steel reinforcement in excess of 470kg per cubic metre of concrete.

"Our Self-Compacting Concrete was used. The structural element size, in total volume, exceeded 600 cubic metres. So basically the whole structure had to be cast without any concrete compaction, and once and for all. We completed this 'unbuildable element' without any defects, so we demonstrated our capability in R&D and our combined capability in the frontiers of new construction. We showed what we could do," says Zheng.

The team also had to come up with a structural concrete formula to reduce the requirement for concrete shrinkage-control rebar. Approval was obtained, as an outcome of value engineering, for an alternative high-performance concrete mix for the thickest 1,750mm bottom slab, which contains around 20 per cent less metal reinforcement.

The JV had established Hong Kong's first on-site rebar yard and factory for the project. It produced, cut and bent 300 tons of metal for the site per day – an initiative credited with substantially reducing wastage and manual handling on site.





The project required more than 550,000 cubic metres of structural concrete, and the highly advanced batching plant was designed by another Gammon division, Lambeth Associates, which had a major role to play in both contracts. As Gowran notes, having Lambeth's in-house expertise makes it easier for Gammon to innovate.

"The beauty of Lambeth is that they really are experts in underground work, and if you have that kind of geotechnical expertise within a company you can get instant analysis done. We invest a lot of money in the information monitoring of our struts and our ground. That's wireless, and it goes to a central database and comes out on a screen, so you can always see what is happening for your whole project. It's important to know whether there is any redundancy in your struts, or if you are over-stressing them. We've put in wireless strain gauges, which allow you to know what load you are putting on the struts, and you can rationalise them. Not many companies can offer that, but we can because we do a lot of the work ourselves," he says.

It was also Lambeth that designed the travelling steel formwork, constructed by Pristine, which was used to fabricate the large slabs and beams. This Gammon innovation helped to reduce the risk of accidents for workers, particularly at a height, while also speeding up the construction process. The innovative approach of using steel-frame, light-weight precast concrete as an alternative to cast in-situ concrete for the low headroom plenum at track level generated a programme saving of several months in the most critical North Top-Down area, marking a significant milestone for the MTR for track laying and signals testing.

Technology helped to make up a significant amount of the time lost in the early stages of the two contracts.

"The E&M work under the deck over the bus terminus is quite extensive, and we had a robotic arm on the project to speed up drilling. There's a lot of ductwork and the robotic arm was able to drill the holes a lot faster for the fixings. We did a trial on-site with the arm and, on the basis of that, decided to purchase one. We've also been using it for surface preparation, which speeds up that process," says Gowran.

"We installed Wi-Fi underground, so we'd be able to use some of our technology better. The Gammon Engineering Management System (GEMS) is an online system that allows us to control temporary works. If you are underground with Wi-Fi, you can use that to approve an item of temporary works without having to come back

up to the office to allow it to happen. We've also installed chargers around the site for our workers, so they can charge their devices because that's how people choose to communicate now."

The successful completion of the two XRL contracts involved surmounting obstacles in every area from ground conditions to logistics, on the most challenging scale. For 810A, the temporary scaffolding required for the steel roof alone required 200 twenty-foot containers to transport. Good planning, says C.C. Hau, was of critical importance.

"Planning is very important. So is design. But the most important thing is the people. From the general workers, to the engineers, foremen, managers and directors, they are the people who turn the dream into reality," he says.

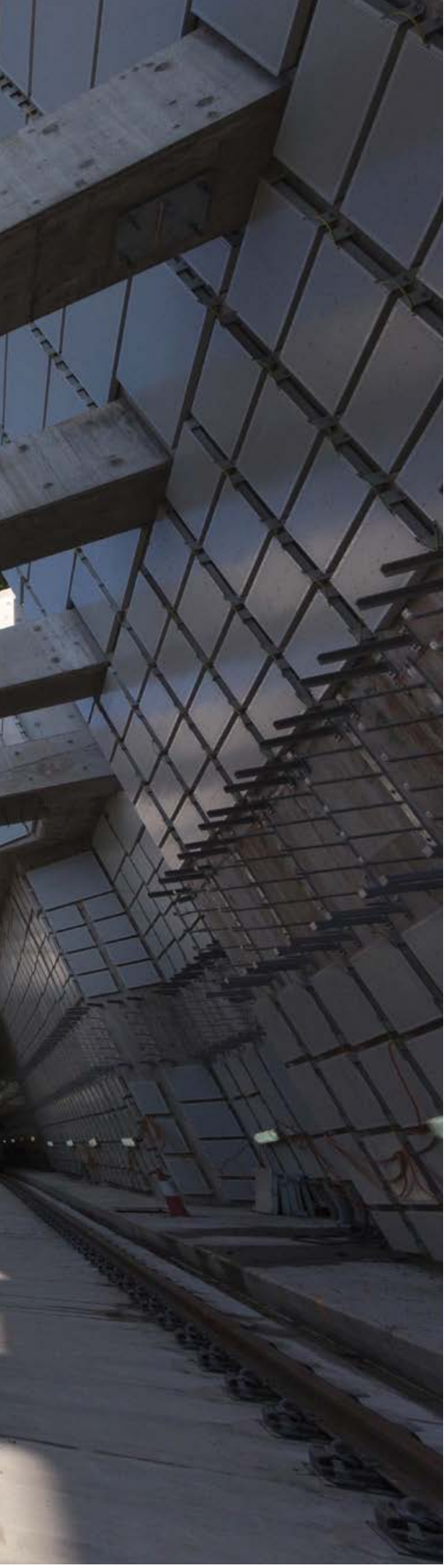
Much of the credit for the successful completion of the station can be attributed to the co-operative spirit in which the JV partners and the client worked together, as MTR Corporation Limited Projects Director Dr Philco Wong recalls.

"We worked together hand in hand, with a lot of effort from the contractors, our project management team, and other consultants. For a mega project like this, just in terms of staff, you are talking about 600 to 700 people from each side of the contract. That's only staff, not workers. Without a co-ordination mentality, and a partnering mentality, it'd be very difficult to finish the job."

Now, however, with all those challenges met and obstacles surmounted, Hong Kong has a station for the high-speed rail era that reflects, in a modern way, the grand aspirations for travel expressed by the great 19th century railway stations, built in celebration of rail's first golden age.

The project teams for both contracts can look back with satisfaction at a job well done.

"In terms of complexity and the urban environment, I don't think there are more difficult projects than these to build," says Brian Gowran. "It's not just the engineering. It's the logistics and getting agreement to do things with so many stakeholders. If you can deliver projects like these, you can deliver anything."



ADDING THE MISSING LINK

SHATIN TO CENTRAL LINK

Hong Kong moved one step closer to the opening of the long-awaited Shatin to Central Link (SCL) with the completion in April 2018 of the new strategic railway line's Hung Hom North Approach Tunnels. They were constructed by a Gammon Joint Venture (JV) with Kaden Construction.

According to Gammon's Contracts Manager, Alan Yan, the success of the project, which was completed on schedule, was attributable to co-operative teamwork right from the outset – between the JV partners, between the JV and client the MTR Corporation, and between the staff of different divisions of Gammon.

"Retired former Gammon staff contributed as well," recalls Yan. "When the project was awarded in December 2012, we had a few mega projects already in progress. We were at a peak with civil works and recruiting staff was not easy. My tendering team was made up of only five or six staff members and we had to mobilise a project team quickly. I decided to invite back colleagues who had already retired, but still have plenty of energy, to help us train new people. That helped enormously in forming the team."

Serving Hong Kong Island, Kowloon and the New Territories, the Shatin to Central Link will extend the existing Ma On Shan Line from Tai Wai to the West Rail Line via East Kowloon to form the East West Corridor; and the existing East Rail Line across the harbour to Wan Chai North and Admiralty to form a North South Corridor. The East West Corridor is expected to be completed in mid-2019 and the North South Corridor in 2021.

The $3.4 billion SCL 1111 contract required the Gammon and Kaden JV to construct one tunnel connecting the existing East Rail Line to Hung Hom Station, and another linking Hung Hom Station to Ho Man Tin Station. With a length of approximately one kilometre, the cut-and-cover tunnels were constructed with foundations formed on piles. Associated works included the reprovisioning of the railway's operational facilities, noise enclosures, slope works, traffic diversions and – in the original scheme – the underpinning of the Hung Hom Bypass bridge.

The collaborative nature of the project was embodied in the contract, which was drawn up on a "target cost" basis, meaning that the MTR would manage and control the project risks together with the JV. A longer than usual lead time between the contract being awarded and work commencing was allowed – around five months rather than the usual three – which gave the JV time to develop innovative value-engineering solutions to the project's challenges.

Among the most important priorities, as Projects Director of the MTR Corporation Dr Philco Wong points out, was ensuring there was no disruption to normal operations of the MTR network. As a former Gammon Chief Operating Officer with experience in working with the firm on projects for both the MTR Corporation and the KCRC, Wong had the advantage of being able to assess a project from the perspective of both the client and the contractor.

“SCL 1111 was quite a difficult project. It was not in green field and involved working with a live railway. The major issues weren’t to do with size or complexity. They were to do with being sure the railway service was not disrupted, which would have been very serious, and with ensuring that no lives were endangered,” says Wong.

Yan and his project team put their heads together and assessed the original plan for the works. BIM and 3D scanning played an important role in eliminating clashes in the construction sequence. Working with 3D models helped the project team to visualise the works, and to anticipate and resolve problems in the virtual world rather than encounter them on-site. There were, the team concluded, less obvious but better ways to address some problems than the solutions in the original plan. Two major changes were decided on.

“In the original scheme, we were asked to demolish two bridges over East Rail – risky and wasteful work that would have had to be done at night,” says Yan.

The scheme would also have involved the erection of temporary bridges for diverting traffic and the installation of new piles.

“We came up with a completely different design to retain the bridges by using temporary support. That hadn’t been considered originally because they were old and built to old standards, and the quickest solution was to get rid of them and build new ones. However, we found that the existing structure could be enhanced instead,” says Yan.

Protecting the track throughout this process was of paramount importance. A 6m-high protective hoarding was erected along the East Rail Line. Pre-grouting and closed-loop piling were employed to minimise track settlement, which was monitored round the clock.

“Gammon did the job with a lot of careful planning with our MTR project and operation colleagues to protect the track,” says Wong. “A tripwire system was installed along the protective fencing monitoring any movement of the hoarding, which would then trigger a signal to the train system. So any train would stop automatically. The signal went straight to the train, not to the driver.”

The redesign saved both the cost and risk involved in demolition, as well as a significant amount of time. In addition, an alternative underpinning method for the pedestrian subways was implemented that not only simplified construction work, but helped maintain normal pedestrian flow and shortened walking distance.

The second major value-engineering modification was a pile-retaining design, involving the realignment of the North South Corridor tunnel away from the existing Hung Hom Bypass Pier, obviating the need for underpinning works. Again, there were savings in time and costs, and also in environmental impact through dramatic reductions in construction waste and carbon emissions.

"If you can reduce risk and reduce cost there is usually an associated environmental benefit," says Yan. "Those were innovative solutions. Apart from using technology like BIM plus 3D laser scanning, our innovation focused on process. Sometimes innovation isn't just about using new technology to come up with a new product. It's about improving the efficiency of the process."

A third original idea the team came up with for the project is a perfect example of the way, Yan says, its members got into the habit of "thinking outside the box".

"With the first two ideas, we were fine-tuning designs to achieve improvements and savings. With the third, we were facing an on-site problem that required a solution. We had to come up with something new."

The problem that needed to be addressed was presented by the severely restricted working room available adjacent to the live East Rail Line near Ho Man Tin, where a noise enclosure wall was to be constructed. Working conditions needed to be made safer and more conducive to efficiency.

"We realised that a mechanical steel formwork system would be the solution, but we needed to work out the details, so we asked our Steel Department and designers from Lambeth to come up with this moveable system that would allow everything to be done within an enclosure," explains Yan.

The system they developed hydraulically lifted all the materials required within a safe enclosed environment, obviating the need to erect scaffolding.

The use of mechanised construction and pre-assembling the majority of the noise-enclosure components, helped to shorten construction time further and reduced the requirement for lifting works, also enhancing safety.

The efficiency of the system benefited local residents by reducing the need to work at night, and minimising the associated disturbance. It also reduced the use of timber by approximately 19 tons, or 110 trees.

The benefits of the target cost contract arrangement adopted for SCL 1111, Yan believes, are demonstrable in the cost, efficiency, safety and sustainability gains achieved through Gammon's value engineering work.

Construction time was reduced by 371 days and 180 nights; spoil was reduced by 9,510 tonnes; carbon generated was reduced by 3,721 tonnes; and the duration and extent of temporary traffic measures was significantly reduced. Gammon's Zero Harm programme kept the project accident incident rate down to 1.8 per 1,000 workers.

As well as being awarded the "Safety Week Best Effort Award" by the MTR Corporation, and a Green Flag under Gammon's Green and Caring Site Commitment Scheme, the project won the Gold Award in the Construction Industry Category of the 2014 Hong Kong Awards for Environmental Excellence (HKAEE) – Gammon's third consecutive year as a winner in that category, and its fifth HKAEE Gold since 2009.

Gammon, which was a 70 per cent partner in the JV, was well-positioned to execute the contract with the efficiency achieved because of the diversity of skilled professionals within the firm on whom it could call, stresses Alan Yan.

"We had the involvement of a lot of in-house departments working together as a team, including steel, concrete, foundations, E&M, the instrumentation team, civil, and Lambeth, so there has been very strong input from within Gammon. We required different types of skills and disciplines for this project, and we had access to them in-house."

UPGRADING INFRASTRUCTURE

SINGAPORE RAILWAY

"We are a bit different in Singapore," says Hee Wee Tan, Executive Director of Singapore and Vietnam. "We follow the Gammon model, so we also do building, civil, MEP, and foundations. But the rail track work is a bit different. Gammon in Hong Kong doesn't do track work."

The track work to which Tan refers is a legacy of co-operation on Singapore projects between Gammon Pte Limited (GPL) and the Hong Kong parent company's co-owner, Balfour Beatty, which had a Singapore office but is no longer active in Asia except through Gammon. But GPL was already a significant contributor to the construction of the Lion City's rail infrastructure in its own right. It has undertaken major contracts for Singapore's Land Transport Authority for both the acclaimed, and heavily used MRT system and the Bukit Panjang Light Rapid Transit System (BPLRT).

In the 1990s, Gammon was a partner with Adtranz and Keppel Engineering in a consortium that designed, built and commissioned the entire 7.8km BPLRT system. That opened in November 1999. More recently, GPL handled the contract to design and construct the People's Park MRT Station – now known as Chinatown – which opened in 2003 on the North-East Line; and subsequently to design, construct and commission the Chinatown Interchange Station, and associated tunnels for Downtown Line Phase 1, which opened in 2013. The first contract was through a Joint Venture with Econ Piling Pte Ltd. The second was Gammon-led.

The success of those projects won the firm two more station projects from the authority, both for the new MRT Thomson-East Coast Line, which will open in five stages starting from 2019. Initially, the new line is expected to serve around 500,000 commuters daily, eventually rising to around one million.

Those two contracts are for Mayflower Station and Havelock Station. The first, to design and build, is worth S$174 million ($1.09 billion); the second is a build contract worth S$210 million ($1.29 billion).

"We innovated by changing the layout and footprint of Mayflower station, facilitating additional retail space. That was a reason we won the job," says Tan.

There may have been more to the decision than the attraction of greater retail profits. Gammon's attention to community engagement was also evident in the design, which included enhanced architectural features helping the access and egress points to blend into the surrounding environment and to engage the residents of Mayflower, many of whom are elderly. The altered footprint is designed for what Tan calls "pedestrian friendly" flow in and out of the station.

Gammon achieved basic-structure completion on Mayflower Station in the last quarter of 2017, which was the first station on the line to hit that target and was around three months ahead of schedule.

Havelock Station, on which work started in the first quarter of 2014 and scheduled for completion in 2021, is located beneath Zion Road in close proximity to residential housing estates and commercial buildings. In construction terms, says Tan, it is the more challenging of the two projects.

"We just finished blasting 60,000 tons of rock using explosives in an open environment, so that was challenging. But an innovation we've introduced with this project is that we brought in a special tunnel-boring machine. We worked with China Rail Tunnel Group to bring it from China, and partner with us to do

During the opening ceremony for the start of construction of Havelock Station, Michael Lim, the Land Transport Authority Chairman of the Board, had this to say: "I would like to talk a little about the name of the RTBM, Themis. It suggests divine order, natural law and custom, and just as the name implies, I am confident that the team will be able to manage the challenges and complete this pioneering project successfully."


SAFETY IS AS SIMPLE AS ABC
Always Be Careful
SAFETY Starts with "S"
But Begins With "YOU"
Make Safety A Team GOAL!
DANGER-KEEP OUT!

an underpass tunnel into the station. Instead of being round, as you might expect, the machine is rectangular, and this is the first time anything like it has been used in Singapore," he explains.

The project team determined that using the traditional cut-and-cover method to excavate the 150m pedestrian underpass would have disrupted pedestrian and road traffic to an unacceptable extent over too long a time. The machine was considered the optimum solution.

The Rectangular Tunnel Boring Machine (RTBM), which was designed and built in China, is named Themis after an ancient Greek goddess, who symbolizes divine order. It measures 7.6m in width by 5.3m in height, and is equipped with six steel cutters fitted with tungsten carbide cutting tools. Themis weighs 300 tons and 14 people are required to operate it.

"We saved a lot of time and a lot of disturbance," says Tan, adding that the RTBM's benefits over cut-and-cover go further, and he expects the technology to be adopted for many future construction projects in Singapore. The machine, he says, makes construction simpler and safer, as well as generating far less noise and dust. For this project, it conferred a 30 per cent productivity gain.

It may not have disturbed traffic in the neighbourhood, but Themis certainly caused a stir among Singapore's media. "The Land Transport Authority has become the first to use a rectangular tunnel-boring machine here, paving the way for future rail and road projects, which could be speedier, cleaner and significantly less disruptive," announced *The Straits Times*, adding that "the underpass will be completed in 'six to eight months', instead of 'three to four years' with the cut-and-cover method". Certainly a quantifiable benefit.

Underground works are a well-established Gammon speciality, but rail track work is a relatively new area for the firm. Nevertheless Gammon has excelled as an innovator on two such projects for the Singapore Mass Rapid Transit (SMRT) Corporation, bringing the sleepers for the city's two oldest MRT lines up to the highest standards for modern railways.

The contract, issued by the SMRT for track system replacement on the North-South Line, began in 2013.

"Originally we worked with Balfour Beatty, and the technical expertise for the project came from their side, but later they decided to exit Asia, so the responsibility passed to Gammon. We worked together for a year before they decided to close in Singapore, and then we had five Balfour Beatty staff members transferred to us to help with the timber sleeper project. They've worked with us for the past three years," explains Tan.

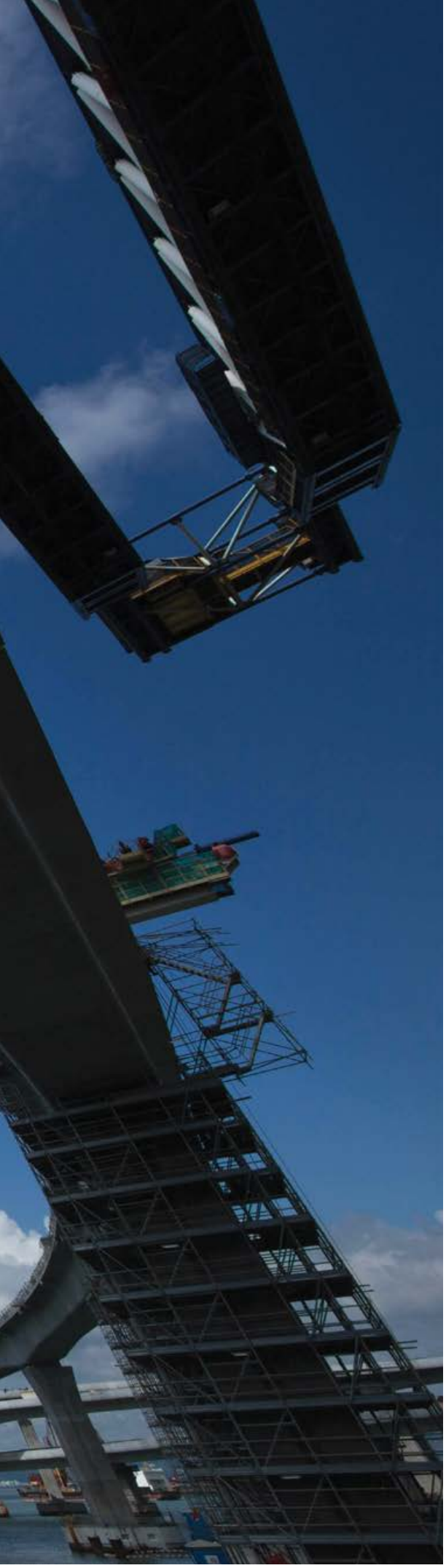
Initially the project to replace 30-year-old timber sleepers was a pilot, intended for the SMRT to see how the Balfour Beatty-Gammon team would handle it.

"Rather than give us the whole North-South Line, the government only selected two stations to test whether what we proposed would work. That is where Gammon innovation came into play. Instead of timber, we introduced concrete sleepers. Concrete has a longer life of around 50 to 100 years. The client liked that. Another innovation, as concrete is heavy, was to modify an excavator to move the sleepers and call it a Road Rail Vehicle. It can be hoisted on to the track by gantry crane. We did very well with this project. After that, the government gave us the whole line," notes Tan.

Having successfully completed the North-South Line project, GPL was offered the East-West Line sleeper replacement contract. Again, concrete sleepers were chosen to replace the original timber.

"We could only work during the period when trains weren't working, so all the replacement work had to be done between 1am and 4am – the same for the North-South and East-West Lines. That was a challenge and so was moving heavy concrete in very restricted spaces," says Tan.

Around 2.8 million people ride Singapore's MRT trains daily. The system's efficient operation is vital to life in the city. At the end of 2016, Gammon completed work on the East-West Line project, having replaced all 188,000 of the timber sleepers from the city's original two MRT lines with resilient new concrete. Hee Wee Tan can point proudly to a lasting Gammon contribution to safety and efficiency in a city which is, rightly, famous for both.



A GRAND DESIGN FOR SAFETY

TUEN MUN-CHEK LAP KOK LINK

"Engineers like challenges," notes Gammon Chief Executive Thomas Ho. "The Tuen Mun-Chek Lap Kok Link (TM-CLKL) has been so technically challenging, but so technically rewarding. Real excellence has been achieved".

As is often the case with a major civil-engineering project, building the Southern Connection Viaduct Section to the TM-CLKL looked challenging at the outset, but then turned out to be much more so and in ways nobody could have predicted.

The $8.66 billion design and build project for the Hong Kong Highways Department was the largest solo project undertaken by Gammon at the time the firm was awarded the contract in 2013.

On completion, the 2.4km mainly dual two-lane sea viaduct, between the Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities island and North Lantau, will form an important integral part of the 9km-long TM-CLKL road route to and from Hong Kong International Airport. The section will connect the southern landfall of TM-CLKL and the North Lantau Highway (NLH) near Tai Ho Wan.

The contract includes construction of nine link or slip roads, realignment of sections of the NLH and Cheung Tung Road at North Lantau, and associated civil, structural, geotechnical, marine, environmental protection, landscaping, drainage, highway and E&M works.

"It was a big challenge for Gammon to take on as a solo project, but we have previous experience in similar work," observes Project Director Max Ko. "With a joint venture, it would be more complicated from a management point of view."

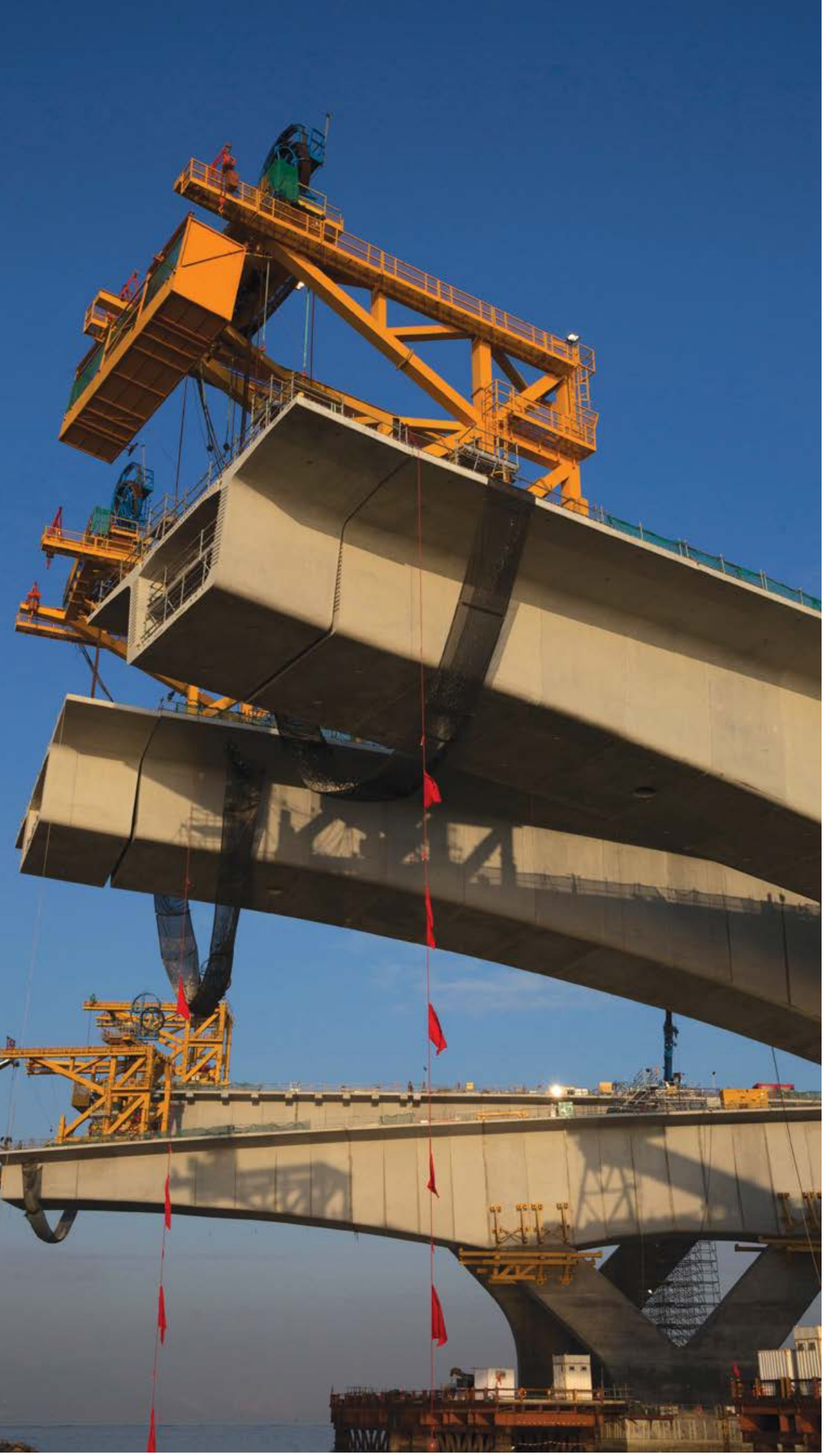
Although Ko says that on every major civil project complications are unavoidable, and the rule is to expect the unexpected, with TM-CLKL this has been more than usually the case.

"This is one of the most challenging segmented bridge constructions in Hong Kong history," he says. "We had no way of knowing at the outset how complicated ground conditions would be in the marine environment, and we didn't expect traffic diversion to be so complicated."

There have been other complicated issues to contend with on land. Balanced cantilever segmental bridges have had to be built at a height and with demandingly tight curves, over the MTR Airport Express and Tung Chung lines, and the NLH under tight space and time constraints.

To deal with TM-CLKL's many challenges, a talented project team was assembled, including specialist external consultants such as Arup Group Ltd, Tony Gee & Partners and YWL Engineering Pte Ltd on the bridge design.

From within Gammon, Lambeth consultants came up with innovative ways to minimise on-site safety risks, and



found solutions to the seemingly intractable problems involved in erecting the 2,653 segments of the main viaduct, some up to 11m tall, and fitting them seamlessly together.

“Lambeth was able to check the permanent works designs we got from the consultants and review the constructability, so they’ve played a major role in that area,” says Ko, “and it would have been very hard to complete the project without their innovations.”

Pressures on the team have included a tight time frame, and an acute shortage of skilled manpower in Hong Kong. Both of these were addressed in part – along with the imperative to make the site as safe as possible – by precasting the major elements of the viaduct system in Mainland China.

This approach made it possible to largely avoid in-situ formwork, and reduced time spent working at height, material wastage, and the risk of adverse environmental impacts through the spillage of concrete into the sea.

The site team also had the pile-cap shells, viaduct segments, parapets and retaining wall panels precast in Zhongshan, and shipped them to the site on barges.

To give some idea of the scale of the project, as well as the 2,653 viaduct segments, 9,026 precast concrete parapets and 25,800m concrete barriers, and 112 piers and 24 seagull piers had to be assembled and erected. All this was completed after sinking 464 socket H-piles and 112 bored piles on land, and 180 bored piles at sea.

On land, lifting precast viaduct sections into position has been a complicated crane operation involving lane closure of the exiting carriageway. However, the project’s Contracts Manager K.F. Tam points out that at sea cranes have to be barge mounted and are inherently unstable. For some sections, a launching gantry has had to be deployed instead.

“When you are doing marine work, and you get a Typhoon No 3 signal, you have to get all the vessels to a shelter fast, so all work stops until the typhoon has gone. That has a big impact,” says Tam.

Lambeth Engineering Development Manager Ted Lawton came up with two major innovations in response to the project’s marine issues – K-Frame bridge deck construction machines and match-cast precast pile cap shell modules.

“On this project, we were constructing four 200m spans and they all had different curvatures,” explains Lawton of the K-Frame’s genesis. “A length of 200m is as far as you go with segmented bridging, so we were pushing the limits of this technology. The launching gantry is designed for an 80m or 100m bridge span, so the equipment we had couldn’t really handle it, and we had to design our own erection machines. They needed to be strong enough to lift 240 tons, which some of these segments weigh, and light enough to not overload the deck as they came together. We invented what we call the K-Frame to do that.”

The K-Frame, so named because of its distinctive shape, is a compact multifunctional deck erection machine, capable of lifting 200-plus-ton segments with a self-weight of only 100 tons.

In addition to carrying exceptional loads where conventional lifting machinery could not be employed, K-Frame technology has been used on the project as a back-up to the two 200m launching gantries, facilitating work in areas where greater flexibility is required, such as sharp curves in the viaduct’s alignment.

Able to travel in different directions, and to rotate the pre-cast segments by 90 degrees, the K-Frame clearly has a future on other segmental bridge projects, and a “family” of modular machines has been developed to extend its applications.

Another major innovation was Lambeth’s match-cast precast shell modules, which solved at a stroke many of the problems associated with conventional marine piling arrangements. A direct result of the safety-through-design strategy that Gammon adopted in all areas of the project, Ko describes it as “a new method of safe construction for marine structures”. It offered simultaneously a way to greatly reduce both risks to workers and disturbance to a sensitive and ecologically valuable marine environment. The area is particularly well known for being inhabited by the Chinese white dolphin, an endangered species.

“The beauty of the system lies in its simplicity,” says Ko. “The vast number of man-hours that are consumed in the construction of a marine pile cap are undertaken first of all off-site in the safe environment of a precast yard and the pile cap itself is constructed in a safe dewatered environment.”

“Construction for marine pile caps typically involves the construction of cofferdams or marine falsework, which are potentially hazardous methods of construction in addition to being time-consuming and expensive,” Lawton explains.

“This new construction method involves match-casting large concrete shell modules up to 370 tons, which are placed on top of the permanent marine piles and then stressed together. This creates a watertight monolithic structural outer shell that has sufficient strength to support activities to construct the pile cap within, as well as provide a safe working platform without the need for hazardous diving activities.”

He adds that although the principle of a precast shell was already in use on the main Hong Kong-Zhuhai-Macao Bridge, it had only been deployed on small pile caps. Lambeth’s innovation was to apply to the precast shell modules the same match-casting technique as is used for the bridge segments: casting each segment directly against the face of the preceding one – using a debonding agent to permit separation without damage – ensuring an exact fit.

“We shortened the programme by four to six months with that new method,” says Lawton. Ko credits the innovation with achieving “significant time, cost, safety and environmental advantages.”

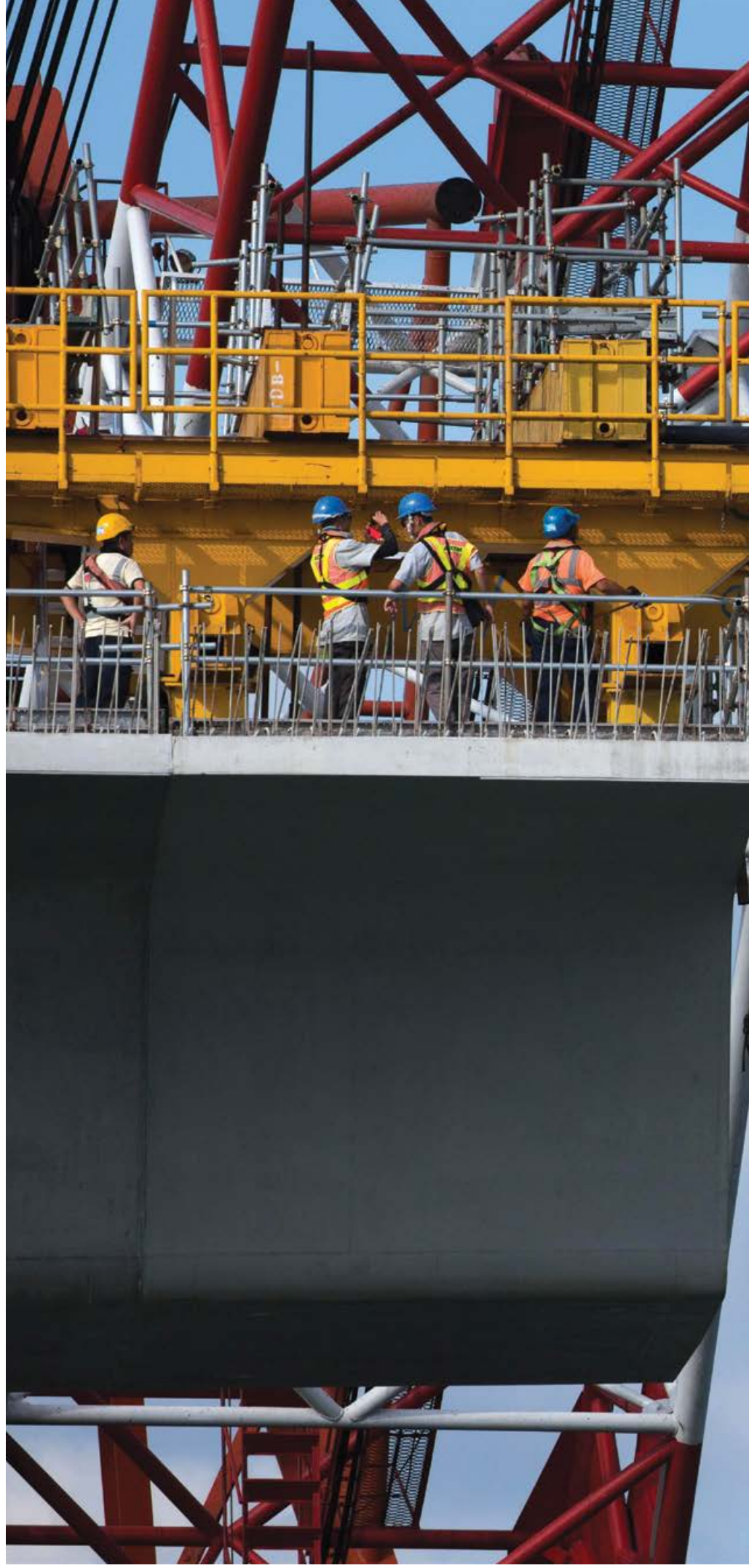
BIM technology played a critical role in visualising how all the viaduct segments, each of which had a slightly different curve, would fit together, while 3D scanning and photogrammetry helped to ensure the segments were accurately match-cast for a perfect fit.

Each segment of the bridge has had to be carefully lifted into place, making a balanced cantilever T-shape, then stitched together and stressed with tendons.

BIM also played an essential role in the construction of the piers, and helped Gammon introduce some functional and aesthetic improvements to the seagull piers, designed to evoke the motion of the gulls gracefully skimming the surface of the sea.

From the beginning of the project, stakeholder engagement and ensuring that the work exemplifies the values of Gammon’s Green and Caring Site Commitment Scheme have been among the project team’s most pressing concerns.

“On land, there are challenges because of working alongside the Airport Express Line and across the North Lantau Highway. We have had to work at night,” says S.Y. Yu, Gammon’s Director in charge of civil work.



Work near the MTR lines can only be done between 1:30am and 4:30am, when the railway is not operating. Minimum clearance between the MTR isolation zone and the bridges is just one metre, and 3D scanning has been essential to ensure that is not breached.

Temporary works have also been subject to height restrictions due to the project's proximity to the airport.

"Traffic management on the North Lantau Expressway has been an issue," says K.F. Tam. "That's the only route to the airport, so that's why the transport department and police are concerned. A lot of documents have been involved. They didn't want any accidents. Also there are blackout periods such as Christmas, Chinese New Year and the Easter holidays when they won't accept any major traffic management. But we managed to solve the problems."

Liaison groups, which meet regularly, have ensured that Gammon and relevant stakeholders are informed of each other's concerns and are able to address them face to face.

A Traffic Management Liaison Group comprising Gammon, the Supervising Officer and appropriate authorities has met every month to approve traffic management arrangements and safe systems of work, and to manage public interface issues. A Marine Management Liaison Group fulfils the same function relating to marine issues, and Gammon and the MTRC also have a working group.

Community engagement has also been a project priority. Gammon has taken steps to minimise or eliminate air and noise impact on the residents of nearby Pak Mong Village, and a public relations team continues to handle any enquiries from the community, and to keep the area's residents informed of construction progress and advance notice of traffic diversions.

Leaving aside the need to find space in a typhoon shelter for all the barges each time the Hong Kong Observatory hoists a Typhoon No 3 signal, the weather has been an occasional safety issue for other reasons.

"We have become weather experts," says K.F. Tam with a smile. "We have sensors to detect the proximity of lightning, so we can get people working at a height down before there is a risk of a strike."

Zero Harm, as always, is Gammon's aim and off-site precasting was a major step towards it. However, it was still necessary to work over water and at a height, and heavy lifting both in the marine environment and on land adjacent to the MTR and NLH presented risks that had to be managed and minimised.

Tsang Ting Fat, Director of Tin Wo Engineering Co Ltd that at one point had 100 workers on-site bending and fixing 10m-long pieces of rebar with different curvature, was impressed with the thoroughness of the safety measures.

“Our workers had to work at sea and at a height, and everybody was required to wear a life jacket,” he says. “There were daily safety briefings. My staff felt that Gammon’s safety standards were very high, and they were keen to match them.”

Safety messages have been communicated to the workforce in prework briefings, tool-box talks, lunch-box meetings, and through distribution of site safety standard leaflets and worker participation in on-site training programmes.

In the marine zone, life jackets have been mandatory for all from the beginning of the project, and a palm recognition key-card system records all workers entering and leaving to ensure all personnel can be accounted for in the event of an incident.

Each of the thousands of lifting operations required has been controlled by a site-specific Lifting Operation Approval Form.

Safety is one of many areas in which Gammon believes in continuous learning, so throughout the project a strong emphasis has been placed on “safety observation reporting”. This allows issues identified by the workforce as almost causing an incident to be addressed, helping to prevent one actually happening.

Sustainability and environmental protection measures were designed into the project in the same way as safety, Ko and Tam stress, starting with procurement. Grid electricity was preferred over on-site diesel generators to reduce Scope 1 carbon emissions, and B5 biodiesel and Forest Stewardship Council timber were used across the works. Modular steel temporary works such as pier moulds and piling platforms were designed for extensive reuse. Construction waste and excavated materials were directed to recycling facilities and other sites, so they could be reused.

The team was highly conscious of possible impacts on an environment of special ecological interest. Steps were taken to minimise the amount of dredging and foundation work required on the seabed.

“We employed observers to look out for dolphins, and whenever they spotted any dolphin activity we stopped work,” says K.F. Tam, although he notes that sightings in the the 250m dolphin exclusion zone were rare, as the dolphins probably preferred to move away from the immediate location of the works.

Seen or unseen, the dolphins’ welfare was a high priority. No underwater pile rock sockets were constructed during the peak calving season of May and June, and percussive piling in the seabed was restricted. To minimise noise and vibration throughout the project, boat speeds were limited to 10 knots.

As well as being a dolphin habitat, the site was also the location of 13 coral colonies. Gammon appointed a project coral specialist who supervised their translocation to an alternative site 5km away.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On land, wherever possible, road alignments were adjusted to minimise the necessary felling of trees and affected trees were transplanted. When that was not an option, new native trees and vegetation were planted in line with consultants' recommendations to improve overall biodiversity.

As is usual practice on any Gammon construction site, comprehensive environmental control measures were taken for noise and dust suppression and runoff management, and construction machinery approved by the Environmental Protection Department. Quality Powered Mechanical Equipment was used.

With TM-CLKL, the Gammon project team is close to the final stages of what S.Y. Yu calls "one of our most challenging and exciting projects".

Tsang Ting Fat is representative of many participants when he speaks of his pride at Tin Wo Engineering's involvement.

"This project has had the highest level of difficulty that I have experienced because of the demanding design. The aesthetic appeal of the structure is important and we had our bridge rebar detailing specialist using computer technology to calculate the exact angle of the bending. We feel very proud of this project and I think it is one only Gammon could have done."

More than 100 engineers and 800 workers, 200 directly employed by Gammon, have worked on the project, and at the peak of construction 1,000 workers were employed round the clock in two shifts. The multinational team included engineers and workers from Nepal, Japan, India, Thailand, the Philippines, Australia and South Africa, as well as Hong Kong and Mainland China.

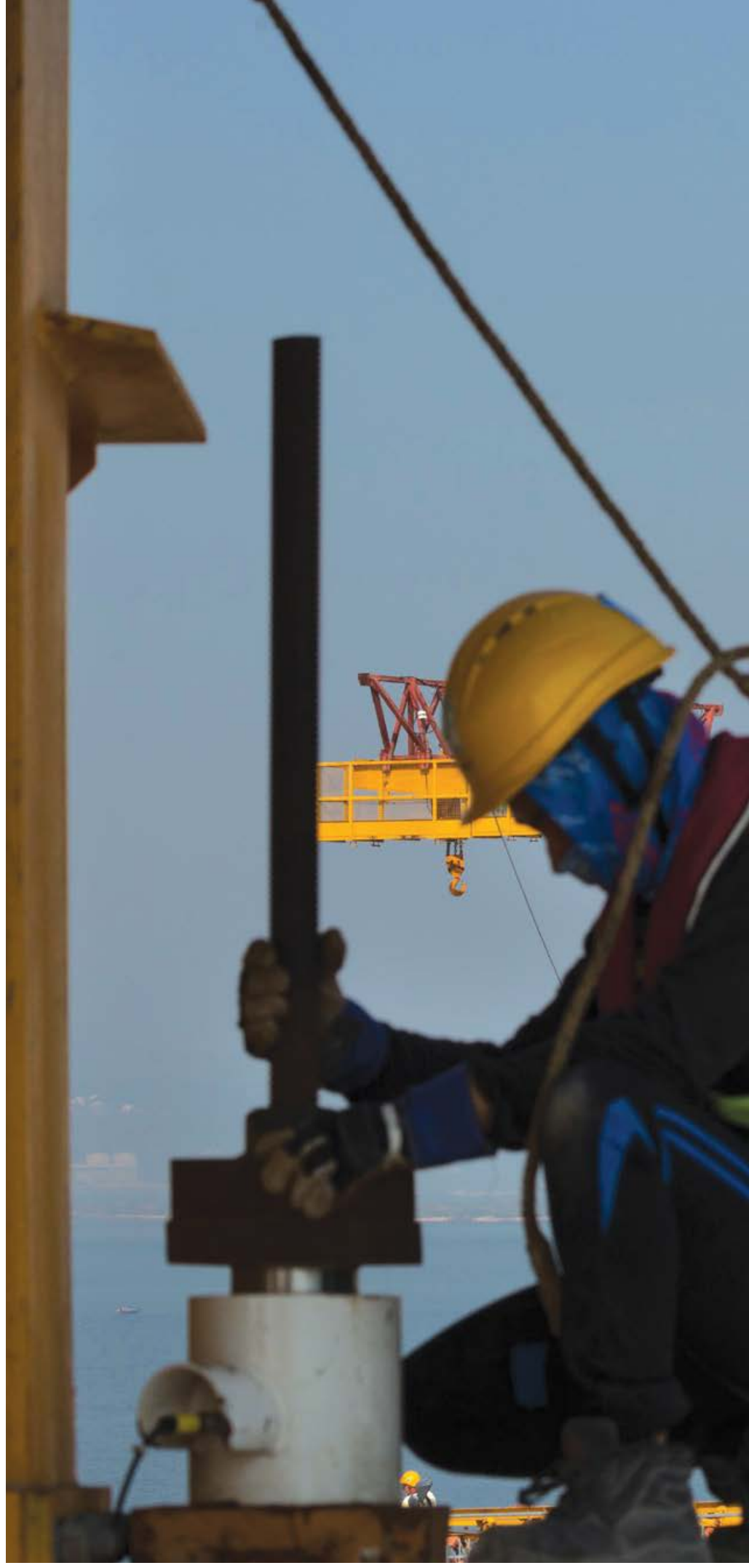
The project has been recognised by awards for both safety and innovative engineering.

The K-Frame secured Second Prize for Construction Productivity in the Construction Industry Council Innovation Awards. In the Construction Industry Safety Award Scheme 2013/2014 Safety Team Awards, Gammon took Bronze. The firm also picked up the Prevention of Pneumoconiosis Best Practice award 2014/2015, and the Development Bureau's Health and Welfare Innovative Safety Initiative Award 2015 Bronze Award.

TM-CLKL is a key component in a vast infrastructural project that will benefit the entire Pearl River Delta Greater Bay Area.

"We forged a team with a lot of different specialists and the project managers – a really strong team. This project has been a good experience, with problems we never expected, but which we solved," says K.F. Tam.

"It's a very big project and a big management achievement as well as a big engineering one," adds Max Ko.



WATER WORLD

"What is interesting about Water World is at least in as much as how we are building it as what we are building," says John Adams, Gammon's Project Director for the construction of Hong Kong's first year-round all-weather water park.

For Gammon, the project has provided an opportunity to push the limits of such technology as 3D scanning, 4D planning and BIM, and to test the efficiency of its integrated data management in areas ranging from concrete planning to labour allocation.

The new facility at Tai Shue Wan will be an integral part of Ocean Park's ongoing transformation into an international resort destination. Adams is leading a multidisciplinary construction team over 100 strong, racing against the clock to complete it. At the peak of construction, there will be 750 workers on-site.

The project involves construction and fitting-out of the main building; installation of the indoor and outdoor attractions; installation of E&M services; and building services work supporting such specialist systems as wave generators and water filtration plant.

When Gammon undertook the project, it was on the understanding the firm could offer a high degree of efficiency and value, using the latest lean technology to anticipate and resolve any issues early in the planning stage.

Ocean Park has long been one of Hong Kong's most popular visitor attractions, and an important part of the lives of the city's residents. It opened in 1977 and features in the childhood memories of most people born in Hong Kong over the past four decades.

The Park's fundamental appeal is enduring, and strategic investment in recent years has added exciting new elements. It reliably attracts around six million visitors per year.

Projects repositioning Ocean Park as a premier international resort destination include two new hotels: Hong Kong Ocean Park Marriott Hotel, which is scheduled to open in 2018, and The Fullerton Ocean Park Hotel Hong Kong – which Gammon is constructing – expected to be completed in 2021. Water World will be a major new attraction, designed to combine openness to the elements with protection from rainy and cold weather, allowing year-round daily operation.

Hong Kong has had a Water World before. An attraction at another location in the Park also bore that name and was operated between 1984 and 1999. The new facility, however, will offer a much more sophisticated experience.

Opening a new water park, according to Walter Kerr, Ocean Park's Executive Director of Project Development, was an idea that Allan Zeman, who was Ocean Park's Chairman between 2003 and 2014, was staunchly behind.

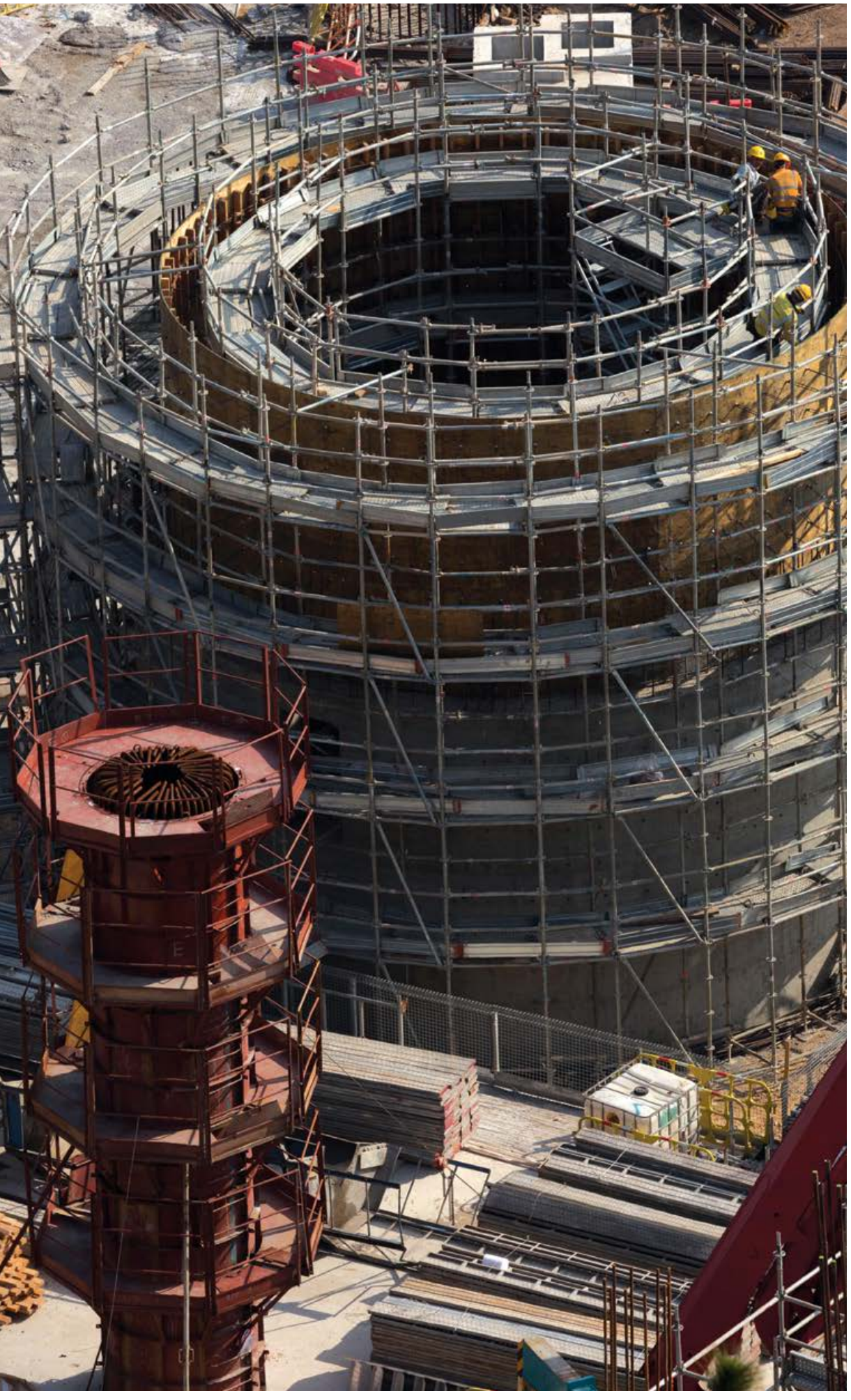
"It was agreed that we must bring a water park back as something that mixes a new project with some legacy. It has the same name as the previous one, which we did debate internally, but this is recognisable to people. And we're bringing back the Rainbow Slide."

Covering an area of over 64,000 square metres on the site of the former Middle Kingdom, Water World will be a spectacular addition to the Park's facilities and the first and only waterfront water park in Southeast Asia. The intention is that the new facility should integrate seamlessly with its spectacular hillside surroundings through a series of terraced platforms and wave pools, looking out over spectacular views of the South China Sea. A wide range of indoor and outdoor facilities will feature not only extensive attractions for water fun – many available in Hong Kong for the first time – but also a variety of dining and retail outlets.

"Parents with fond childhood memories of water fun at Ocean Park can look forward to bringing their children to the brand new Water World, which will span twice the size," promised Leo Kung, Zeman's successor as Ocean Park Chairman at the ground-breaking ceremony in November 2015. His predecessor, now an advisor to the Park, also attended.

"Water World will further enhance our contribution to local tourism by encouraging longer lengths of stay among visitors both in the Park and in Hong Kong."

On the same occasion, Kung observed that, "Given the hillside location of the project, the construction process will involve various challenges, starting with foundation and site formation work."



"The one-team approach is crucial to this project," says Adams. "We have our E&M division and modelling team working with us, our temporary works designer is in-house, our steelwork division is doing the steelwork for the roof, concrete is supplied by our concrete division, and the cranage and the plant is provided by our Plant Department. There is a high-grade filtration system going in for the water to ensure there is never any question as to the quality of the water in the Park, and the filtration system installation is a nominated subcontractor to us – so we effectively do everything. As much as possible, we've tried to always use an in-house resource and in-house expertise to bring about a successful conclusion to the project. We're trying to bring the different divisions closer together."

The project also involves many challenges not caused by cost issues.

"The site formation is very challenging. The total level difference from the top to the bottom of the site is over 50m. Normally in Hong Kong working areas are fairly flat, but Ocean Park is trying to get the rides to blend into the hillside rather than have big towers. The idea is to use the topography, so it's quite challenging in that respect. The formation and the logistics of installation are interesting," observes Adams.

To address the site-formation issues, extensive use has been made of photogrammetry, using thousands of photographs taken by drone and uploaded to a cloud-based application. That produced a 3D site model accurate to around 50mm.

"At a very early stage in the project, we were able to take the initial site photogrammetry and overlay the model of the project. Immediately, we could identify problem areas that we could raise with the client for the designers to fix before they became a major problem on-site. Most of the benefit has been in improved planning. It streamlines the whole process and gives you a higher level of confidence that you are not going to incur high costs through having to try to re-access areas you no longer have reasonable access to," says Adams.

Technology has also been helpful in solving problems related to the complex roof and curtain wall structures.

To take advantage of the dazzling views of the South China Sea and to maximise the amount of daylight reaching the interior, the building features extensive glass walling and shell-shaped roofing with an ethylene tetrafluoroethylene translucent skylight system. It also saves on use of energy for artificial lighting.

"The façade geometries are complex because it's all curved structures. All of the curtain walling is curved. No two panels are alike. One of our subcontractors has spent a lot of time getting the basic geometry correct. Initially, they were trying to do that in 2D and eventually we assisted them with our modelling team to come up with it in 3D, so they could finalise their designs. And the architects have created quite a complex geometry for the roof. They are pushing towards designs for which the calculations simply can't be done in two dimensions," says Adams.

E&M co-ordination is another area in which lean technology is proving its worth on the project. According to Adams, a combination of extensive use of BIM, and having the E&M team in-house and on-site, has improved efficiency considerably.

"For Gammon, it's about how we use new technology to deliver the project. We're trying to use as many of our new systems as possible. So we're using 3D modelling, the concrete management system – a system Gammon has developed for real-time understanding of concrete supply – and a labour allocation system, so we fully understand how much labour we have on the project and how it's performing – all of which will lead to productivity improvements over time."

While the technology is clearly expediting delivery of the project, its particular demands are also revealing the full scope of the technology's capabilities.

"One of the key things we're doing here, which is very new to Hong Kong, is 4D planning, which integrates the 3D model with the construction programme – so the fourth dimension is time. It's a great planning tool, and a great monitoring tool to know how the whole thing fits together. Once you've set it up, if the programme changes, everything automatically changes. You don't have to set it up again. This is the most advanced level at which we've used it so far," says Adams.

As always with Gammon projects, safety and sustainability have been priorities. Precautions have been taken to protect the hillside against excessive erosion during construction, and temporary drainage works proved so

effective the site suffered no major problems under the onslaught of two major 2017 typhoons, which did extensive damage to the surrounding area.

“We’re working mostly with subcontracted labour, so it’s important the subcontractors buy into our safety standards,” Adams stresses.

“We spent a lot of time developing the safety requirements for the project. We have a rotation of senior management walks, so senior management are visible. We spent a lot of time interviewing the subcontractors and the subcontractors’ supervisors to ensure they have the right mindset for the project. We think that’s very important.”

Also important for the project was building a relationship with the client and building an understanding of Ocean Park’s expectations.

“It’s important to understand what the client wants from the project. For something like this, the expectations are different from those for, say, a hospital or a railway station. It’s a matter of understanding their priorities,” he says.

Adams adds that good communication has been essential to deal with many necessary last-minute design changes occasioned by the challenges of the topography.

“Gammon is a genuine enthusiastic partner,” Walter Kerr says. “They are obviously competent and organised on-site, and that’s very important. A messy site is dangerous and inefficient. We see Gammon’s willingness to engage with us, as far as I can tell, honestly, directly and openly. That’s what we are looking for. We add our contractors to our team, so we do it together. That’s how we are working with Gammon.”

CONSERVING HERITAGE

TAI KWUN

The need to make the most effective possible use of Hong Kong's limited land supply has inspired the design and construction of some of the world's most remarkable high-rise buildings. It has also fostered a ruthlessly unsentimental attitude towards older low-rise structures. Or at least it had until quite recently.

For decades, the commercial value of a site almost automatically trumped the heritage value of any of the existing structures on it. It was accepted, often without question, that the old had to be demolished to make way for the new. Few buildings of architectural merit with any degree of antiquity remain – but now Hong Kong's people and government recognise an urgent need to preserve the best of those that do.

In 2011, Gammon was selected as the management contractor for one of the largest and most complex heritage architecture conservation projects ever undertaken in Hong Kong: the conservation and revitalisation of the former Central Police Station Compound, with the earliest surviving structure built in 1858. The compound was fully decommissioned in 2006, sparking a lively debate as to what was to be done with it.

Eventually it was determined it should become a new cultural hub, featuring art galleries and spaces for public performances, as well as cafés, restaurants and other visitor facilities. Now operating as Tai Kwun – the station's original name in Cantonese – it opened in its new role in May 2018.

The project was challenging on almost every level, and the fact that not everything went precisely according to plan was not a surprise to Michael Moir, Project Director for the Hong Kong Jockey Club. The project was funded by the Club's Charities Trust, and Moir and his team worked closely with Management Contractor Gammon throughout.

"On heritage renovation anywhere in the world, it's not unusual to spend double the number you first thought of," he says, philosophically.

"When we came to Central Police Station, which was a unique project with particular challenges, the scope of work couldn't even be defined at the beginning. We only went to three contractors, and Gammon had the right level of knowledge and understanding. With a management contract, it's really a partnership, so they've been our partner in managing 45 works package contractors. One of the reasons we picked Gammon was that some of the work can only be done by small contractors, not by large organisations with strong planning teams. Gammon's role has been to help them with things like planning, paperwork and compliance. Because the scope kept changing as we found problems to deal with, it was continuous commercial negotiation."

Moir knows Gammon well. He first encountered the firm in 1978 as a young engineer, working for Arup on an MTR project on which Gammon was the foundation contractor. Past projects for the Jockey Club with significant Gammon involvement include the Sha Tin Racecourse,

the Happy Valley Clubhouse and recent renovation work at the Happy Valley Racecourse.

Tai Kwun comprises the former Central Police Station, Central Magistracy and Victoria Prison. The former prison yard and the police parade ground have both been preserved, and there are additional areas of open space totalling over 4,000 square metres. Of the 19 buildings on the site at the time of the compound's decommissioning, 16 have been conserved.

Two new structures have been added – the JC Cube and the JC Contemporary, which together make up about one-fifth of the site's total gross floor area. Their arresting aluminium brick façades both complement and contrast with the restored surrounding structures.

"The Jockey Club board felt strongly that just restoring the buildings would not achieve revitalisation," says Moir. "We needed something more that would make it a cultural destination and centre. Of the two new buildings, one is a gallery of contemporary art, which is partly in an old building and partly in a new building, with around 1,500 square metres of gallery space. It's intended to be a meeting place for people with an interest in art. On the other side of the prison yard, we have a 200-seat auditorium that is suitable for a variety of cultural activities including lectures, music, performance and film. It's also suitable for private hire if companies want to have, for example, annual general meetings there. But the priority is the cultural programme that we run ourselves."

Among the many challenges involved in the project were those attendant on the Police Station, Magistracy and Prison all being declared monuments. All work affecting those structures required permits from the Antiquities and Monuments Office, which in turn required formidable amounts of paperwork and photography to process the approvals – particularly if they affected the long list of building attributes the heritage consultants had identified as Character Defining Elements (CDEs).

Special care was taken during the course of construction to protect such delicate fixtures and fittings as old doors, mouldings, tile floors and wooden window frames.

With little in the way of historic documents or drawings to consult, Gammon had to undertake an extensive programme of tests, assessing, for example, the resilience of concrete and the tensile strength of rebars. Authenticity of materials was also a high priority.

For example, Gammon took small samples from timber trusses and sent them to the UK to have species identification tests carried out so that when carrying out repairs of wood work, they would know what kind of timber to procure.

Authenticity, however, had to be balanced with sustainability. Some windows and doors needing repair or replacement were made of teak, which presented a problem under the Hong Kong Green Building Council's BEAM standards.

As this was a BEAM Gold project, the majority of the timber had to have a Forest Stewardship Council certificate and it is difficult to source teak with that paperwork. Gammon had to get it from Malaysia.

In addition to introducing new greenery throughout the compound, conservation of living trees was also part of the project. Six old trees were preserved, and cared for throughout by a trained arborist.

Authenticity also required the use of specially imported hydraulic lime for external rendering, and analysis of multiple layers of old paint to establish the correct colour for the buildings – originally beige and not the police station's familiar grey.

Façade repair, including both rendering and specialised brick laying painstakingly matched with the fabric of the existing buildings, involved bringing heritage reconstruction specialists to Hong Kong from the UK to supervise work, and at the same time to train workers in how to do the job without them – imparting valuable expertise for future restoration and reinvigoration projects. Other specialists oversaw the repair and replacement of Chinese roof tiles.

A recurrent issue was balancing the requirements of conserving the old buildings – without compromising their CDEs – with full compliance with current building use regulations.

The pump room for the sprinkler system and hydrant water tank also presented a challenge. Not enough space was available in the old buildings, and in any case the floors would not have been strong enough to bear the loads. The solution was to dig 18 metres down beneath the parade ground and create a concealed basement plant room.

For the new buildings, Swiss architects Herzog & de Meuron Basel Ltd of Switzerland – also the architects of Beijing's "Bird's Nest" stadium built for the 2008 Summer Olympic Games – incorporated several visually striking features, including the JC Contemporary's granite-like needle-gun finished concrete spiral staircase, and both buildings' aluminium brick façades.

The moulds for the bricks were created in Italy then shipped to Australia for casting, using metal recycled from car wheels. Each numbered brick is unique and the project team members were aware they could not afford to mix them up.

BIM was essential, both for ensuring all the bricks interlocked precisely, and for shaping the spiral staircase.

The drawings of the staircase provided by the designer were 2D, so Gammon needed a BIM model to coordinate the profile and curve. A 3D printer was used to create a model to determine the construction joints, so they could be sure of an accurate fit. After that, the subcontractor could proceed to on-site casting. The profile of the corner bricks of the façades was another tricky area where BIM supplied the solution. Gammon formed a BIM model of the corner pieces, put the information into Computer Numerical Control (CNC), and the pieces were cut to the correct profile in Australia using CNC to direct the machinery.

Poor vehicular site access meant heavy machinery for piling and construction of the new buildings had to be lifted on to the site by a 90-ton mobile crane – one of many logistical challenges presented by working on a heritage site in the heart of a congested urban area.

With a Central site surrounded by both residences and businesses, the project team had to be constantly mindful of ways to reduce construction impacts. Measures to reduce noise, air pollution and dust included extensive use of acoustic shielding, considerate scheduling of works, the selection of appropriate construction plant, and strict control over emissions. The Tai Kwun site was operated throughout at Green Flag level under Gammon's Green and Caring Site Commitment Scheme.

Sustainability and environmental responsibility are also engineered into the daily operation of Tai Kwun. Among other measures, the completed complex has energy-saving lighting and lifts.

Neither Gammon nor Moir pretend the project has been painless. There have been frustrations dealing with site and bureaucratic constraints. Teamwork, however, has cleared many obstacles.

“Gammon have always had a very strong and professional management team. They try to resolve issues in a non-confrontational way,” says Moir.

“It’s been about commitment to quality and not cutting corners restoring the buildings because we want them to have a long life. That’s what has been the driver for it.”

Tai Kwun will inevitably become a major visitor attraction, but Moir stresses it is first and foremost a facility for the people of Hong Kong.

“We want it to have a cultural impact on the citizens of Hong Kong in the broadest sense,” he says. “We want this to be a place that many people will go to for different reasons – to be entertained, to be educated, to learn about art, and most of the programmes we’re running will be free.”

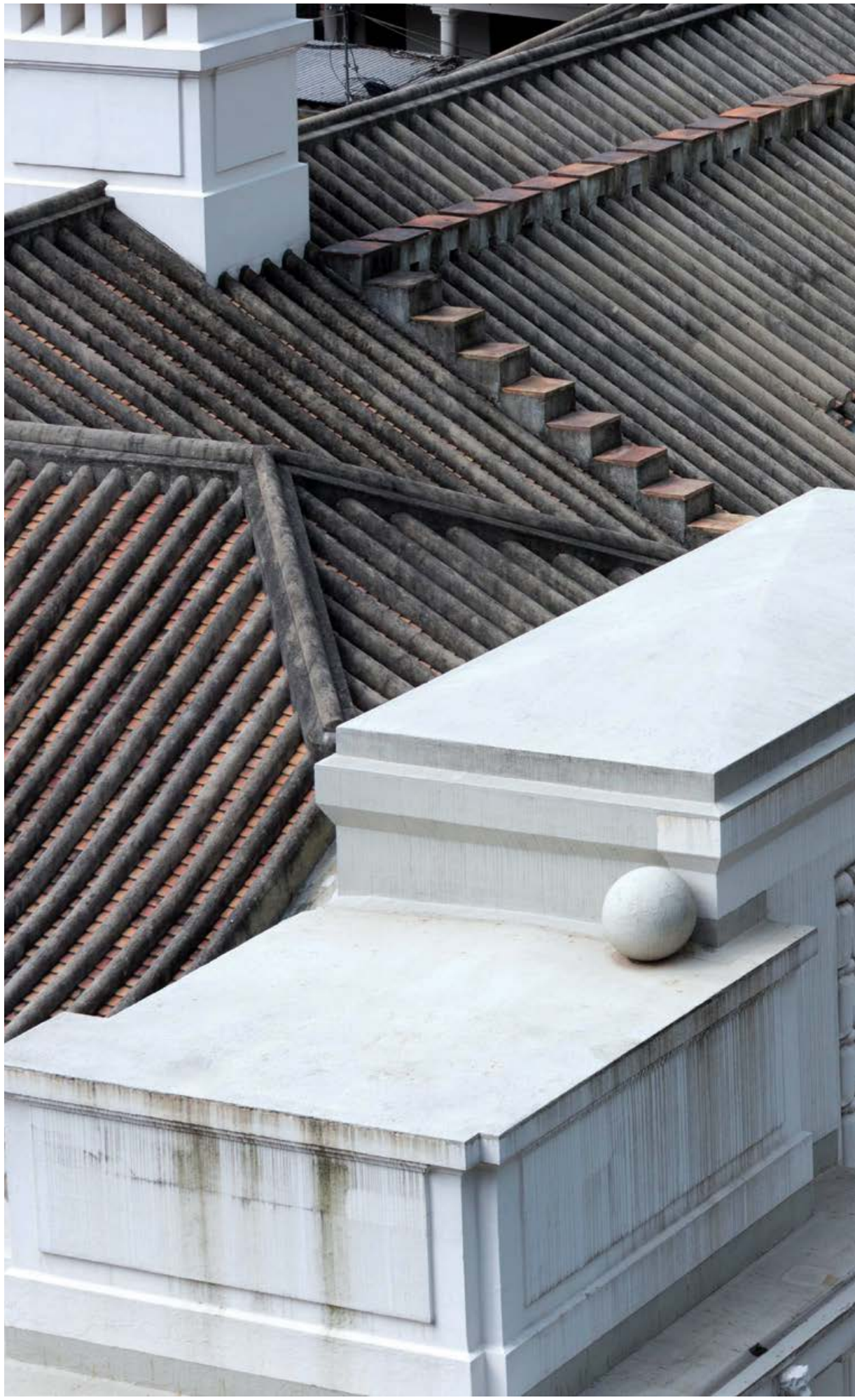
Although the compound offers a wide choice of food and beverage options, the mix is geared to general accessibility and affordability.

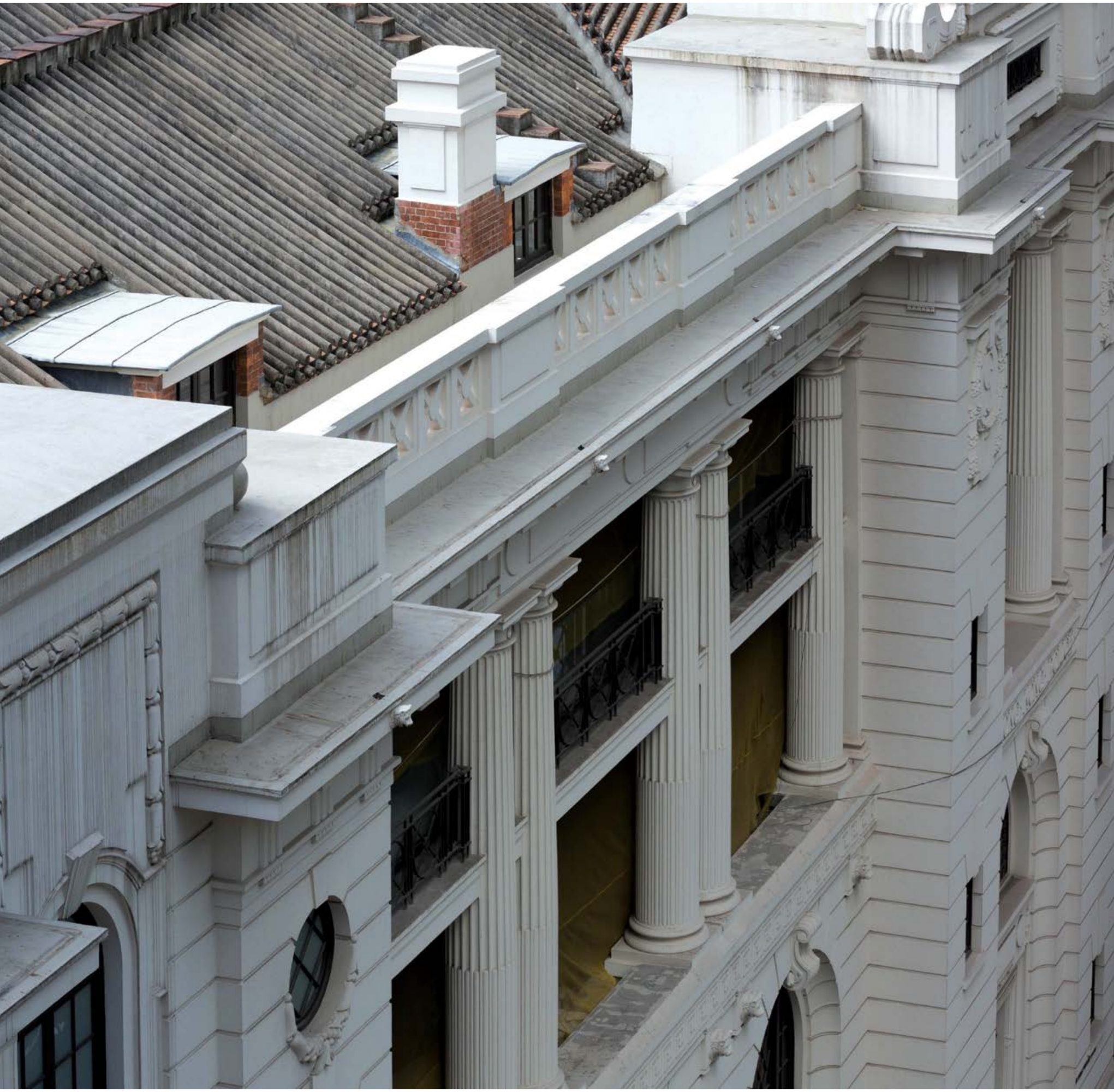
“It’s for Hong Kong people and we think they will go and hang out there. Our priority is what we’re doing for them,” says Moir.

Much has been learned from the project that will be of value in future work restoring and revitalising Hong Kong’s limited but precious legacy of heritage buildings – an area in which the members of the Gammon project team are keen to contribute further.

As to whether the Jockey Club would wish to fund another such project, Michael Moir’s view is “wait and see”.

“Nobody knew how difficult this was going to be when we started. Would we do another one? Right now I would probably say ‘no’, but in two or three years’ time, when everyone is really proud of Tai Kwun, I think perhaps we would. I have no doubt that it’s going to be a great success.”





LIVING GREEN

LEE GARDEN THREE

Hysan Place, which Gammon constructed for Hysan Development, opened up new vistas of possibility for the development of Grade A office buildings in Causeway Bay and for further partnership on projects between Hysan and Gammon.

“When it opened in 2012, Hysan Place created a northern gateway to the Lee Gardens, located at the north of the Lee Gardens precinct and drawing people from the Sogo crossing. With the success of the opening, we recognised that we had created a halo effect for our portfolio of about 4 million square feet of space,” says Hysan Development Co Ltd Director, Projects, Sunny Chan.

“But some of the buildings were quite old, so we carried out a study. At that time, on the site of Lee Garden Three was Sunning Plaza, with residential serviced apartments called Sunning Court. The study looked at whether it would be appropriate for us to develop those two sites, belonging to one lot, together.”

Preserving the frame of Sunning Plaza – the first I.M. Pei building in Hong Kong and something of a local icon – was considered, but the structure was ultimately deemed unsuitable for the quality of office space Hysan was determined to offer. Ceilings were too low. Redevelopment would allow a 25 per cent increase in the gross floor area, as well as significantly increasing headroom on the office levels. Chan says a new building was needed to add value to the neighbourhood, and attract the kind of international corporate tenant mix Hysan was eager to achieve – businesses such as major banks that are willing to consider areas beyond the core district of Central.

Fronting busy tree-lined Hysan Avenue, Lee Garden Three was designed by architect Wong and Ouyang (HK) Ltd as a premium mixed-use building, to include 21 floors of spacious offices, a four-level retail podium of shops, and food and beverage operations as well as a five-level basement providing parking for around 200 vehicles.

Gammon was appointed Main Contractor, construction began in February 2016 and the building was ready to welcome its first tenant in December 2017.

“We had a tight programme to complete Lee Garden Three, including fitting-out works and all MEP installation. It was extremely fast-tracked,” says Gammon’s Building Division Director Vincent Yuen.

“We had just 99 days to complete five levels of basement up to the ground floor, which was a big challenge for the project team.”

The green leafiness of the area around Hysan Avenue also presented challenges. Five of the trees in front of the building were protected under the Hong Kong Government’s Old and Valuable Trees designation programme. There were numerous other trees around the site Hysan was also keen to preserve, both as elements of the area’s natural heritage and for more personal reasons. Many had been planted by members of the Lee family, which founded and continues to oversee Hysan.

The impact of construction on the area in general, and on the tenants of Lee Garden One and Two in particular, were important considerations for Hysan in choosing, once again, to partner with Gammon. The company was appreciative of the precedents the firm had set with Hysan Place, but still insisted on inspecting the sites of other ongoing Gammon projects to see that standards were being maintained, and to find out whether there was anything new to be learned.

Gammon was not an automatic choice. The project went out for tender, but the firm’s commitments to safety, sustainability and community engagement all contributed to a definite competitive edge.

Once again Hysan expected the building to be awarded the Hong Kong BEAM Plus Platinum and the United States Green Building Council's Leadership in Energy and Environmental Design standard (LEED) Gold. Both were achieved.

Access to the latest technology made it possible for Gammon to commit to milestones and to sustainability standards, which would have been unachievable without it. BIM, 4D modelling and 3D scanning were all employed to enhance the project's environmental friendliness and construction efficiency.

Apart from protecting the trees from construction impacts, Yuen says, the great challenges of the project were complex vertical site logistics, traffic management and a shortage of skilled labour, which meant working closely with subcontractors to manage the shortfall.

"The shortage of skilled workers in every area was a major problem. Because we were working within a tight time frame, we had to work with the subcontractors to persuade them to work overtime. That meant they had issues over payment, claims and resources, and we had to work with them to help them manage those," says Yuen.

Technology helped. Conducting a full BIM operation was written into Gammon's contract for the $1.6 billion project.

"That meant at the start of the project we had already mobilised a six-person team of BIM modellers," Yuen explains. "The model was used for planning because the site logistics were quite complicated. We had a BIM model to allow the project team to look into the details of how we could enhance site logistics arrangements, such as the access road, vertical transportation and so on. It was a good visual aid for the team, especially the frontline engineers, to understand how our method of construction worked with the site logistics. It also helped us to apply earlier for excavation permits, and to submit temporary traffic management plans to the relevant government departments."

In performing its basic function of identifying clashes, BIM undoubtedly saved many potentially wasted hours of precious working time.

"At the beginning when we took over Excavation and Lateral Support (ELS), we carried out 3D scanning and fed the results into the BIM model, which identified where temporary structures would clash with future permanent structures. So at the start, we already had solutions for minor alterations to the existing ELS, to minimise clashes. By the time we got to a problem area, the problem had already been solved," says Yuen.

Another challenge was persuading subcontractors to comply with Gammon's insistence on strict adherence to site safety rules.

"The main challenge was to get subcontractors and workers to buy into our safety culture. We had to stop sometimes in a busy construction cycle and review whether our safety rules were being properly observed. One example is ensuring everybody uses the chin straps on hard hats because, if they are not properly secured, fatal accidents can occur. Some companies don't insist on that," he says.

In its emphasis on greenery and sustainability, Lee Garden Three clearly shares DNA with Hysan Place.

"I think I can say it's the new generation of Hysan Place. We designed this building to make it flexible enough to cater for the future in a sustainable way. We have provided flexible infrastructure for enabling nearly 40 per cent food and beverage use in the podium levels, which is far more than any building would have had 10 years ago. We have merged office and retail use a bit so people working in the building have convenient access to food and beverage outlets," says Chan.

Once again, the top floor of the building features a communal roof garden, and is also equipped with a private facility for the tenant of the top level, but there is also a Sky Garden on the 15th floor, open to all tenants, featuring a 100m jogging track. The whole building, says Chan, is geared to a "work-life balance". The garden also reduces heat-transfer into the building, as does the high-performance curtain wall, through which the building is flooded with natural light, reducing energy consumption. Among the naturally lit areas are the stairwells, which are finished to a high standard, encouraging multi-floor tenants to make use of them for circulation rather than automatically using the lifts. LED lighting and sensors also provide energy-efficiency gains.

Conserving the surrounding trees, of which around 90 per cent were saved, required special expertise and, for Gammon, much consultation on the subject with the government and the Hong Kong Green Building Council. The assistance of a landscape consultant and tree advisor Dr Jim Chi Yung from the University of Hong Kong were called on. At the end of construction when the hoardings were taken down, most of the trees were found to be still in good health.

Preserving the historically attractive aspects of the area's environment while introducing improvements for the benefit of not just tenants but of all the people who live and work in, or visit Lee Gardens, was very much the ethos of the project. It was one of the reasons Hysan wanted Gammon as a partner. The firm shared the client's commitment to serving a wider community, particularly during construction by minimising disturbance and disruption, but also in delivering a building all its users could appreciate.

"The podium of the building itself should not be considered just as a benefit to occupants, but to shoppers, people coming to the restaurants and all people coming to Lee Gardens. The green wall, trees and consistent green theme of Lee Gardens as a whole enhance the way of life of the neighbourhood. On the podium level terraces, we want to encourage al fresco dining and outdoor activities. We'd like to create a destination people will come back to again and again to create memories and enjoy life," says Chan.

The first tenant on the top floor – an international bank – began moving in right after the building obtained the occupation permit from the government. Already the new building is a landmark in an increasingly attractive and sophisticated area of Hong Kong. In the words of Siu Chuen Lau, Deputy Chairman and Chief Executive Officer of Hysan Development at the beginning of the project: "The entire new complex will be an integral part of our Lee Gardens community that attracts both locals and visitors alike. It will add even more value to our ownership cluster here at the Lee Gardens, which magnifies our ability to extract synergies among our incredible tenant mix. We are very glad to partner Gammon again to make Lee Garden Three a top office and retail destination."

Hysan has further plans for Causeway Bay, and beyond, in which Sunny Chan is confident Gammon will play a role.

"Gammon is our long-term partner for current and future infrastructure. This has been a really challenging job in terms of site logistics, dealing with government inspections and in enabling long-term planning infrastructure, such as the food and beverage provision. We have also learned lessons. With every project when we design and procure the construction, we learn how to improve our planning and design for the next one. We still go for tender, but Gammon is always on our top list of choices."

CLIMBING EVER HIGHER

ONE TAIKOO PLACE

Gammon and Swire Properties have a shared history that dates back to the 1970s. Gammon built many of the Swire developments that have transformed the formerly industrial eastern area of Hong Kong Island centred round Quarry Bay into one of the most attractive office areas in the city. Gammon also has its headquarters in Devon House, Taikoo Place, with many prominent local and international companies for neighbours.

When Swire Properties decided to redevelop three techno-centres – Somerset House, Cornwall House and Warwick House – into two new office towers offering around one million square feet of office space apiece, Gammon was awarded the contract to demolish the three existing structures, and the $4 billion main contract to construct the first tower and associated walkways.

Designed by another Taikoo Place tenant, architect Wong & Ouyang (HK) Ltd, One Taikoo Place is a AAA-grade 48-storey office tower on top of a five-storey podium and two-storey basement carpark, with a gross floor area of approximately 94,000 square metres.

The building is seen by Swire Properties as a core component of its $15 billion Taikoo Place redevelopment project, as Eliza Wong, General Manager, Projects (HK & SE Asia) for Swire Properties explains.

“In place of the three towers, we decided to build two high-rise office towers with a really big open space in the middle, which can be enjoyed by the tenants of Taikoo Place together with the general public. We hope it will be like a community hub where people can enjoy leisure time with a lot of greenery, water features and so on. It will be about 70,000 square feet of landscaped open space, which is similar in size and scale to Statue Square in Central,” she says.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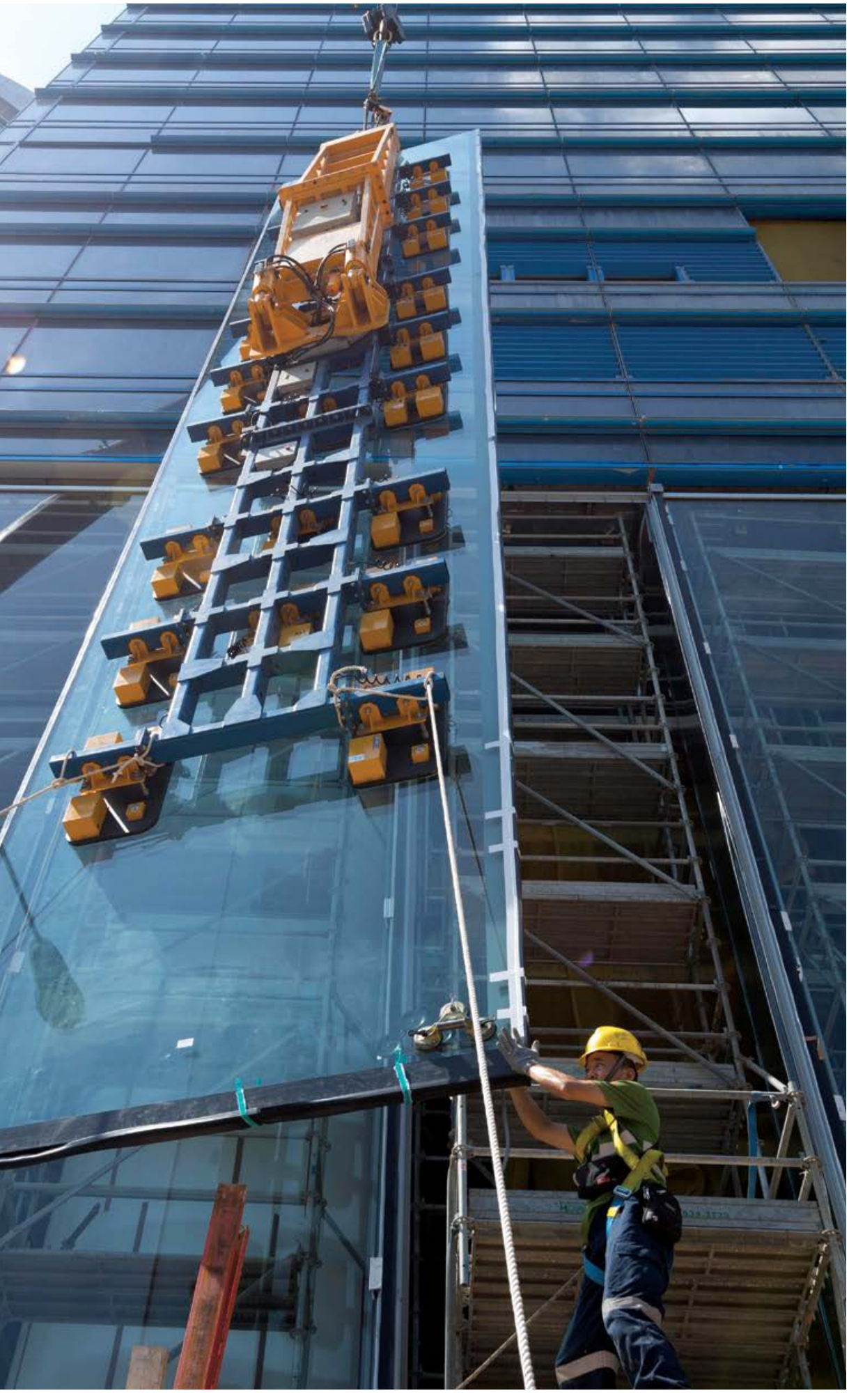


Although plans for this redevelopment were first discussed as early at the 1990s, it was 2014 before Gammon's Foundations team began the eco-friendly and quiet demolition of Somerset House. It was a lengthy process, managed to cause minimum disturbance, and with a strong emphasis on recycling as much of the waste as possible. Responsibly conducted, demolition work takes longer than it used to, but is a great deal kinder to the environment. Eventually the site was ready for the construction team to move in.

It helped that the client and contractor knew each other. Contracts Manager Sammy Lai first worked with Gammon for Swire on the One Island East project, which set some precedents for One Taikoo Place.

"Swire has a very long-term vision about developing this whole district," says Lai. "The culture of our firm is to understand the client's needs, and it helps to have a pre-existing relationship. You build up trust. They are willing to try new systems and new approaches. They are attuned to innovation."

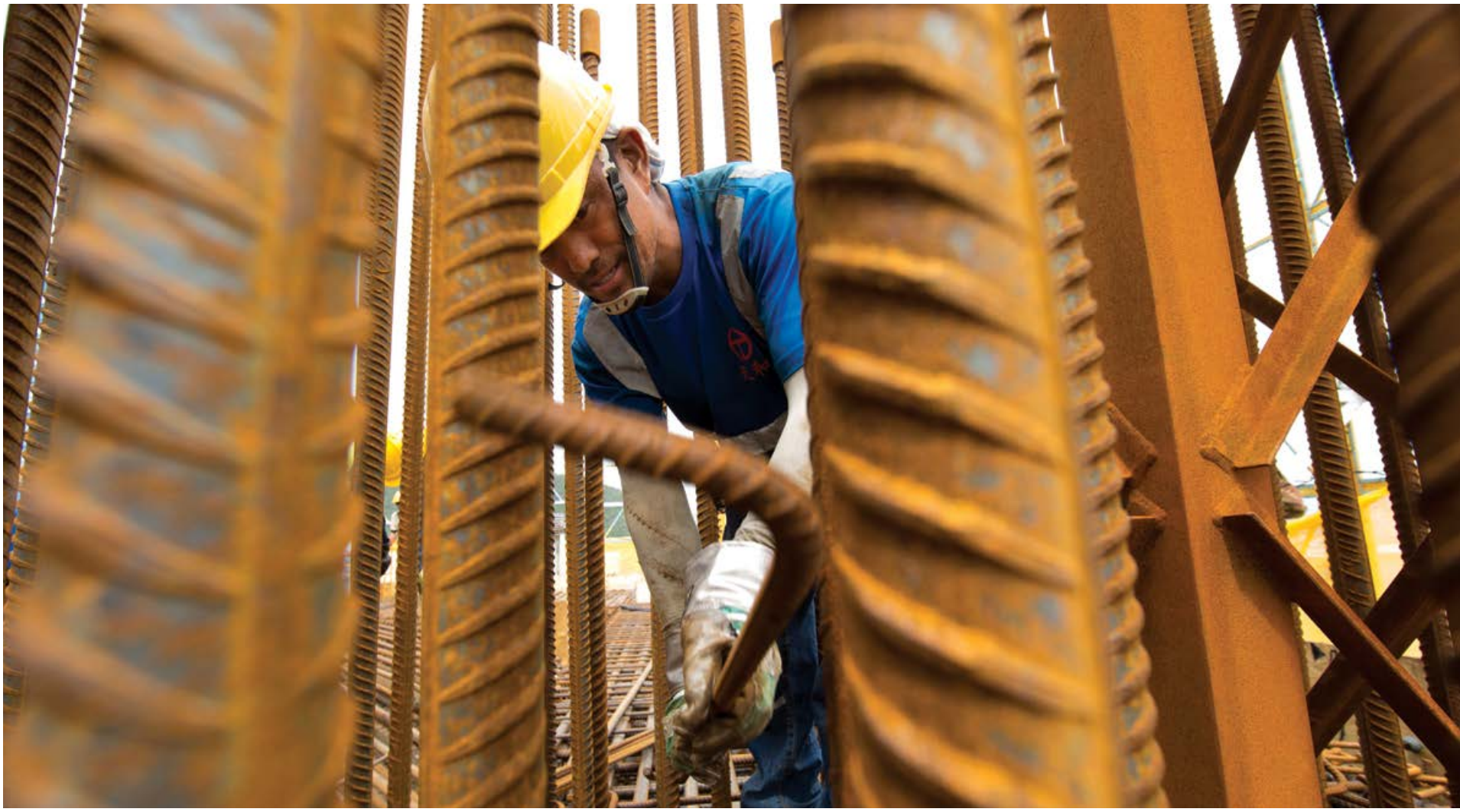
Concurrently with One Taikoo Place, Gammon was engaged as a building services contractor for two other Swire projects, in Kowloon Bay and Wong Chuk Hang, and acting as a buildability advisor for the next phase of the Taikoo Place redevelopment, which is currently at the design stage.

"It's an ongoing relationship," says Wong. "I think Gammon has a good management team and proposed a good team for this project. They've got a good system for enhancing site safety, which is our company's key concern. They've also got a good environmental methodology to ensure the project will comply with our requirements."

Pressure of time was not the only challenge the project presented. There were also site constraint issues to be managed, including access for deliveries in a built-up area and limited storage space. Noise and dust generated had to be minimal to avoid disturbing Swire's tenants, and other offices and businesses in the area.

As the buildability adviser, Lai had been on board with the project even before the tender stage, and had the opportunity to plan ahead and consult with colleagues in Gammon, who could help with various issues.

The foundation work had been completed by another contractor, and to avoid removing the Excavation and Lateral Support system in a congested site area at a later stage, a design amendment was submitted to remove it before construction of the basement slab and ground floor.



In addition to BIM and 3D scanning, it was determined the project should make extensive use of Wi-Fi connectivity throughout the site and of Gammon-developed apps for mobile communication devices. Live CCTV cameras continuously monitored the site for progress and safety, and Lai and his team could access them from tablet and smartphone screens.

“The Gambot, which has a lot of functions, was initiated for this project,” says Lai. “Originally, I just wanted photo management software, but Information Management Services (IMS) developed this. It maintains a site diary. It’s useful for record-keeping and checking progress. It’s open source and works rather like WhatsApp, but in a way that’s specific to the project. You can search by keyword or photo. It can also automatically generate reports, and helps site safety by generating safety observation reports.”

Drawing on lessons learned from One Island East, a total system formwork approach was adopted for the project, including the use of self-climbing formwork for the core and a mini-table for the outer core slab on typical floors.

“We ran a four-day cycle per floor using climbing form and table form, and some handset panels, together with safety screens and formwork hoists. Total system formwork is more sustainable because it uses less timber, and it’s safer and less labour intensive than traditional formwork,” says Lai.

“We did something similar with One Island East, but this time the form table was modified a lot in terms of weight. We used to use steel, but this time it was aluminium, which is lighter and requires fewer people to push the table – it used to be six to eight operatives, but now we only need two, and it’s much easier for the workers. For One Island East, the safety screens had to be delivered by tower crane, but this time we had a self-climbing system. The formwork hoist is larger and safer and we designed it ourselves with our Plant Department. Not many contractors in Hong Kong have adopted this kind of total system formwork approach, but Gammon has the resources to make it work.”

Extensive structural steelwork was fabricated by Pristine, under the supervision of the Construction Services team, using a 3D BIM model for enhanced accuracy and efficiency. All the steelwork for the two link bridges, the belt truss and outrigger system from the 24th to 26th floor, was shipped from the factory in Mainland China to the site.

The curtain wall and a fully transparent glass wall for the lower storeys also presented installation challenges.

“The 17m-high glass wall is the tallest in Hong Kong,” says Lai. “And it’s very expensive. We couldn’t afford to break a pane. The 3m-wide unitised curtain-wall system is double the usual width for a high-rise building, so that created more challenges for us in terms of manouvering the glass before installation.”

The project is targeted to achieve Platinum ratings in both the Hong Kong Green Building Council’s BEAM, Leadership in Energy & Environmental Design for Core & Shell version 2009 and WELL Building Standard version 1. But equally important was qualifying for the Green Flag under Gammon’s Green and Caring Site Commitment Scheme.

“There was a lot of stringent control in terms of waste management and recycling, but as well as safety, caring for the workers is important – we’ve paid a lot of attention to ensuring they have drinks readily to hand in hot weather, good resting, showering and toilet areas with air conditioning, and mobile charging points,” Lai recalls.

After some early delays, the four-day per floor cycle was established, and the project team made up for lost time, completing the works on schedule, and to the high standard of quality demanded by the client.

Tenants who have already taken space in the building include Baker McKenzie and Facebook.

At the topping-out ceremony in February 2018, Swire Properties Chief Executive Guy Bradley said, “With the redevelopment of Taikoo Place, we intend to redefine Hong Kong’s office landscape, not only by creating exceptional office space to suit the modern worker, but also by looking beyond bricks and mortar, and creating vibrant places where our expanding business community can thrive.”

“We wanted to have a very advanced, hi-tech, and AAA-grade office building” adds Eliza Wong. “I think this project will become one of the next few milestones for high-end office development in Hong Kong.”

GREENING KOWLOON EAST

THE QUAYSIDE

The Quayside, a landmark new building in Hong Kong's up-and-coming Kwun Tong business district, is a joint development by Link Real Estate Investment Trust and Nan Fung Development Limited. It is under construction by Gammon, working in close collaboration with both clients.

"The first contract awarded to Gammon was for the foundation bore piling and a surrounding sheet pile wall," explains Gammon Senior Construction Manager Franklin Sare.

"Our colleagues in Foundations did very well on the job, so we had an advantage in tendering for the second contract as the Main Contractor for excavation, basement construction and superstructure," he says. "The other advantage was the interfacing because the foundation contractor needs to hand over the site to the superstructure contractor and we could do that seamlessly because we're all in the same family."

In fact, the Foundations team stayed on to help the Building team with site set-up and Excavation and Lateral Support (ELS) works, saving a considerable amount of time. Lambeth was also called on to assist with temporary supports and composite columns. Gammon's Pristine contributed significantly to speeding up construction through off-site prefabrication work.

Time was of the essence and synergies within Gammon contributed considerably to the timely completion of a demanding building schedule. Link and Nan Fung were naturally keen to get major corporate tenants into the new building as early as possible.

"As a real estate investment trust, we are keen on cash flow, so we wanted to start leasing it out early," says George Hongchoy, Executive Director and CEO of Link Asset Management Limited, which has a 60 per cent interest in The Quayside.

"The 27-month construction schedule is pretty aggressive for this type of project, but with the experience Gammon has, it was able to deliver on time."

Nan Fung is the project manager and has a 40 per cent interest in the project. As Nan Fung has prior experience of working with Gammon, Donald Choi, who was Managing Director of Nan Fung Development at the time the project was awarded, says the firm was a natural fit.

"We knew Gammon's strengths were not limited to the foundation area. Before awarding the second contract, we looked particularly carefully at their safety record. We are very much in line with Gammon's commitment to site safety. Their standards are much higher than the industry's average. Also, The Quayside is a unique office development in Hong Kong, involving building on a large floor plate within a tight schedule. Naturally, we wanted to engage the best team available to help us deliver the project on time and on budget."

Built in a connected twin-tower configuration, in which each tower is served by its own lifts, The Quayside features 17 storeys of offices, a three-storey basement car park, and a three-storey commercial podium, the top level of which is largely given over to a sky garden of over 2,000 square metres.

The building adds approximately 82,000 square metres of office and retail space to what was the industrial district of Kwun Tong, but is now within the Kowloon Bay Action Area. The Hong Kong government has a strategy to transform Kowloon East into a new Central Business District (CBD 2), and The Quayside is the district's flagship office development project.

A maximum area of approximately 4,000 square metres is available per floor and blue-chip companies, including major international banks, are expected to occupy the office space on what Hongchoy calls the "financial corridor" of Hoi Bun Road. The Quayside also has easy access to the Kwun Tong Waterfront promenade with its 3.4 hectares of green space.

Over 25,000 square metres of office floor area, accounting for about a third of the total available in the building, has been pre-leased to J.P. Morgan.

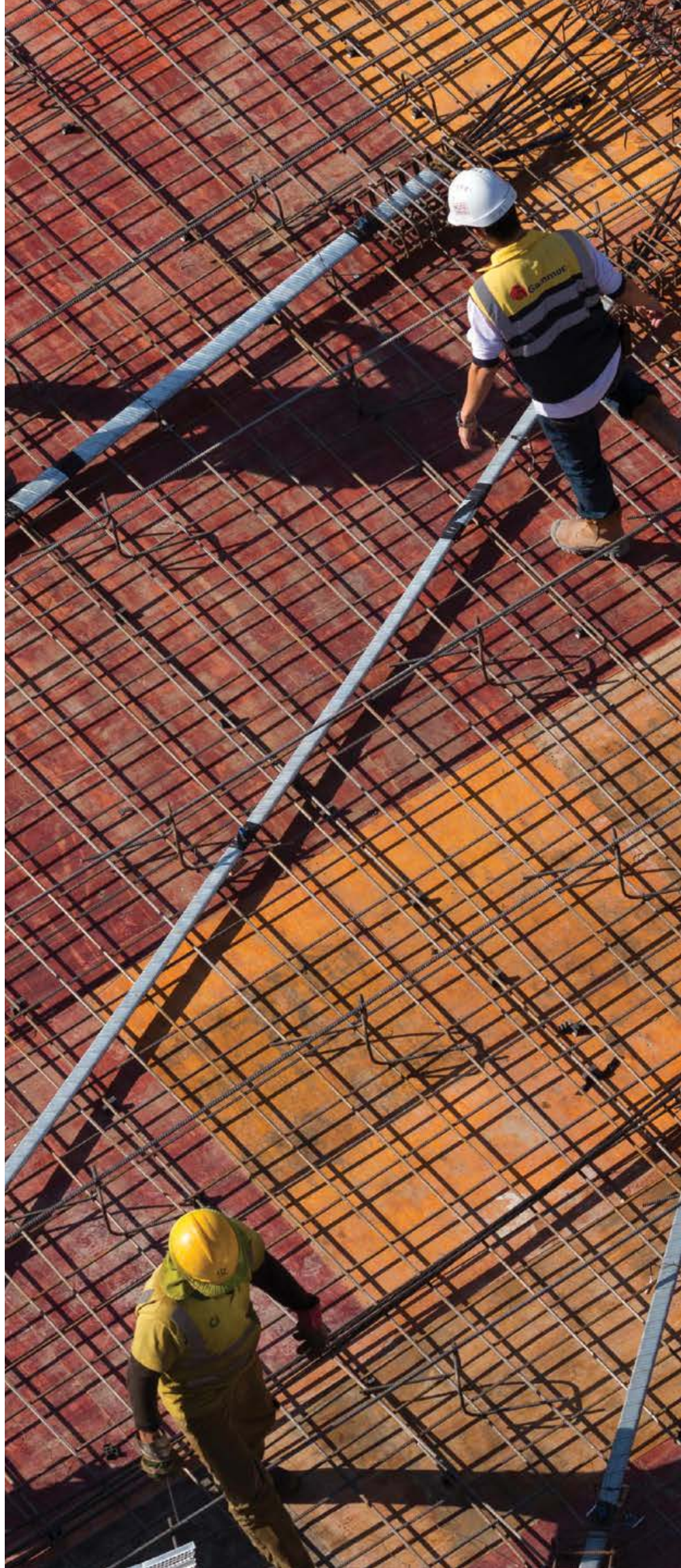
Hongchoy says The Quayside's space and technological sophistication, along with its distinctive architecture and spectacular harbour views, make it attractive to companies that would otherwise not consider moving away from the core district of Central. It is the first building in Kowloon East with a dual power supply, which multinational corporates require. They also expect trunking for their communications and information technology, and that has been built in ready for the first tenants.

"There will be multiparty dialogue to make sure the anchor tenant, the landlord and Gammon can take care of everything. We should be able to deliver and let the tenants take over in early 2019," says Hongchoy.

It was determined at the outset that The Quayside should be a prominent example of sustainable development, pointing towards a green future, and serving both tenants and the general public. Its retail and garden zones will become focal points and popular meeting places of the area. Nan Fung has a strong commitment to sustainable development contributing to the wider community in its projects, while maintaining their overall commercial viability.

As well as providing clean air and a refuge from intrusive noise to tenants through buffer zones around the building and an innovative system of air induction units, The Quayside was planned as a "green lung" for the surrounding environment with landscaping, green walls and green public spaces.

Garden spaces, interspersed throughout the building, occupy around 30 per cent of The Quayside's total area, with the roof and third-floor podium being mostly devoted to greenery. The podium garden with its jogging trails and exercise areas is expected to be a popular recreational



facility. The curtain wall system, fitted with horizontal fins that respond to sunlight, is designed to mitigate solar heat gain and contributes to the visual impact of architect Palmer & Turner's design.

Wherever possible, active green technology and passive green measures have been engineered into the building's operation to minimise energy consumption and carbon emissions. Displays in the lobby will allow both people working in the building and visitors to monitor its environmental performance in real time, and become engaged with the process.

The use of stairs as an alternative to lifts is encouraged, both to limit power consumption and as a healthy exercise. To encourage the use of non-polluting electric vehicles, each of the 415 parking spaces in the basement car parking levels has been fitted with an electric charging point.

The same sustainability values of The Quayside's operation had to be embodied in its construction. Gammon undertook at the outset that the site would be sustainably and safely managed, according to Sare.

"We limited our power and water consumption. We had enough time to apply to China Light & Power for a temporary transformer room on the site, so we did not need to use much electricity from diesel-powered generators. That was good for air quality. We have made a lot of use of reusable steel formwork, saving on the use of traditional timber and generating less construction waste. It's easier to erect and dismantle as well as being more environmentally friendly. Another issue was the high volume of contaminated soil from the excavation. We had to overcome a lot of problems, especially with disposal of it. We had to carefully monitor the volume and ensure every truck leaving the site had a tracking record for where the marine mud was disposed of in accordance with legal requirements."

Link and Nan Fung had determined that the project would not only achieve high levels of certification under the Hong Kong Green Council's BEAM and the United States Green Building Council's LEED ratings, but that it would also measure up to the exacting requirements of the International WELL Building Institute WELL standard. The project achieved pre-certification for LEED Platinum, a provisional BEAM Platinum rating and has been pre-certified Gold under WELL.

"We often construct to both BEAM and LEED standards, but it is still unusual in Hong Kong to also work to the requirements of WELL," says Sare. "We have a 10-page checklist of what we need to do to satisfy the three bodies. This has been an exceptionally green construction programme, and the result is an exceptionally green building."

Meeting ambitious sustainability targets, however, was not the most challenging aspect of the project for Gammon. In addition to working at speed, the team had to work to a complicated and highly time-sensitive logistics management programme.

"Planning has been extremely important because of the constraints of the site," says Sare. "We have had only two entrances to use, and the floor plate takes up 90 per cent of the site. We've worked closely with all the sub-contractors to avoid obstructions on the site, by ensuring that everything needed was delivered only just before it was to be used, and that any rubbish was cleared away quickly. Working with limited time and space took a lot of forethought and discipline."

Technology, Sare notes, has certainly played a major role in keeping the building programme on track.

"We've used Gammon-developed apps to make the logistics more efficient. Aerial photography by drone was helpful to us in logistics planning and reviewing hoisting requirements during substructure construction.

"We are also using BIM extensively on this project. We created a BIM model of the structure incorporating all the E&M services and the curtain wall. That helped us avoid clashes and to make improvements to the superstructure design. But the usefulness doesn't end there. We are also organising the BIM information, so the client can use it for facilities management in the future operation of the building," he says.

Off-site prefabrication by Gammon's steel division has also helped to enhance site safety and efficiency, and to make the space constraints more manageable by significantly reducing the amount of in-situ fabrication work.

"We've made use of a lot of prefabricated members from our own steel works, Pristine, which particularly helped with ELS basement construction, and that added value to the contract. We've also used a lot of prefabricated

elements, including pipe services and support, and plinth structures on the roof," says Sare.

From the beginning of the project, Link, Nan Fung and Gammon have been very much aware that The Quayside will set the standards for commercial and retail developments in the Kowloon East CBD2.

"This is a new commercial business zone and this is its first iconic building," says Sare. "This is a prestigious office building, and the clients have high expectations both of the quality and of the schedule."

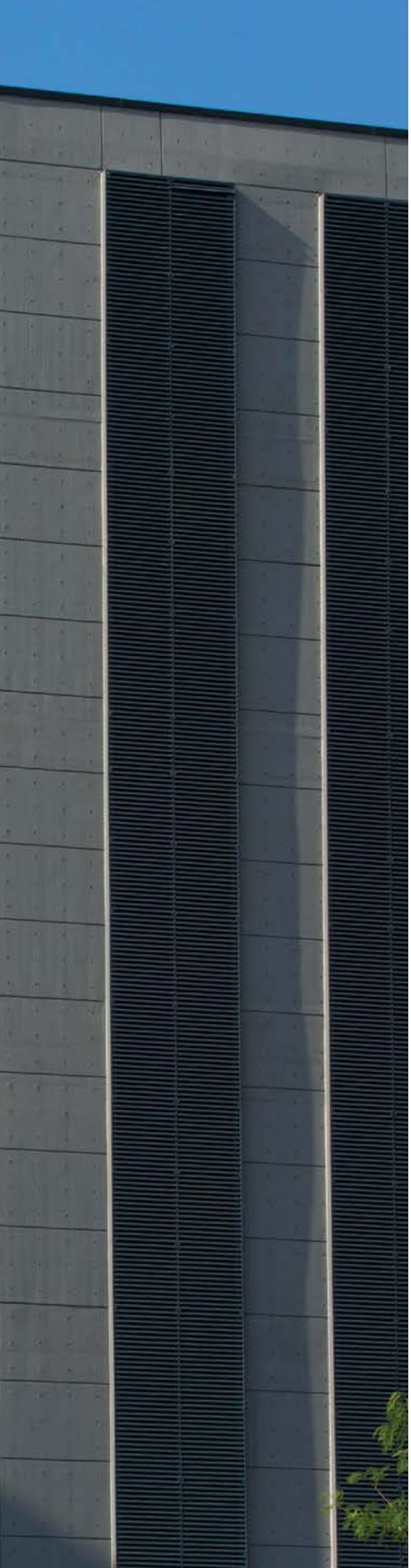
George Hongchoy points out that The Quayside is also important to Link as its first development project in Hong Kong.

"This is going to be a top-tier, super Grade-A office development. It means we take what someone would expect in Central and move those quality expectations to a project in Kowloon East where such quality has so far not been available. Office space is not only about workspace, but about life and experiences. A welcoming atmosphere, large floor plates, a podium garden with recreational facilities as well as an inviting promenade nearby are just some of the elements The Quayside will offer to bring its tenants a vibrant, exciting environment. This will be a place that engages its occupants 24/7, balancing their life, work and play," he says.

The high expectations have been met and, in addition to its BEAM, LEED and WELL certifications, The Quayside won the Merit Award in the New Buildings: Projects Under Construction and/or Design – Commercial Building category at the Hong Kong Green Building Council's Green Building Award 2016. In addition, Gammon also won the Hong Kong Awards for Environmental Excellence (HKAEE) 2017 Silver Award (Construction Industry) and Outstanding Green Leadership Award.

Teamwork has been essential to the project, as Franklin Sare points out.

"Both Nan Fung and Link have a pool of staff on the project, working to ensure that it will be a success. We have a lot of eyes watching us, but also lots of helping hands," says Sare with a smile.



CONSTRUCTING FOR THE DIGITAL ECONOMY

GLOBAL SWITCH

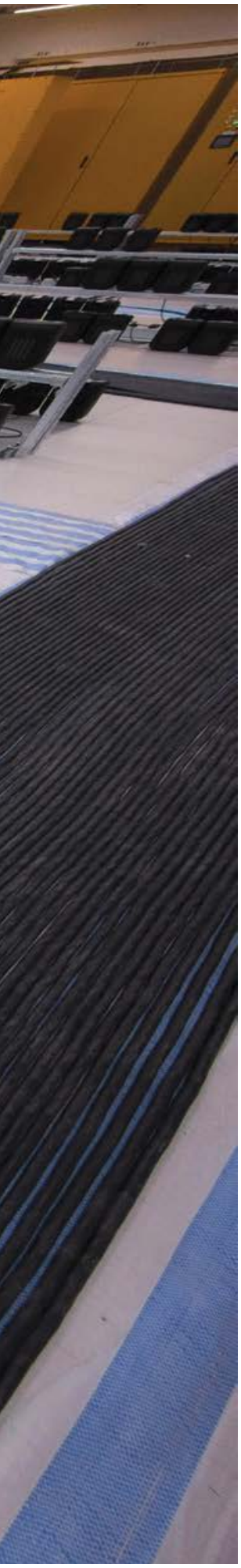
"We are entering an era of cutting-edge buildings designed to meet the huge demand from Information and Communications Technology (ICT) for special building and Electrical and Mechanical services to cope with state-of-the-art equipment. In Hong Kong we are leading the way in their construction," says Gammon Executive Director Gilbert Tsang. "Our work for Global Switch exemplifies that."

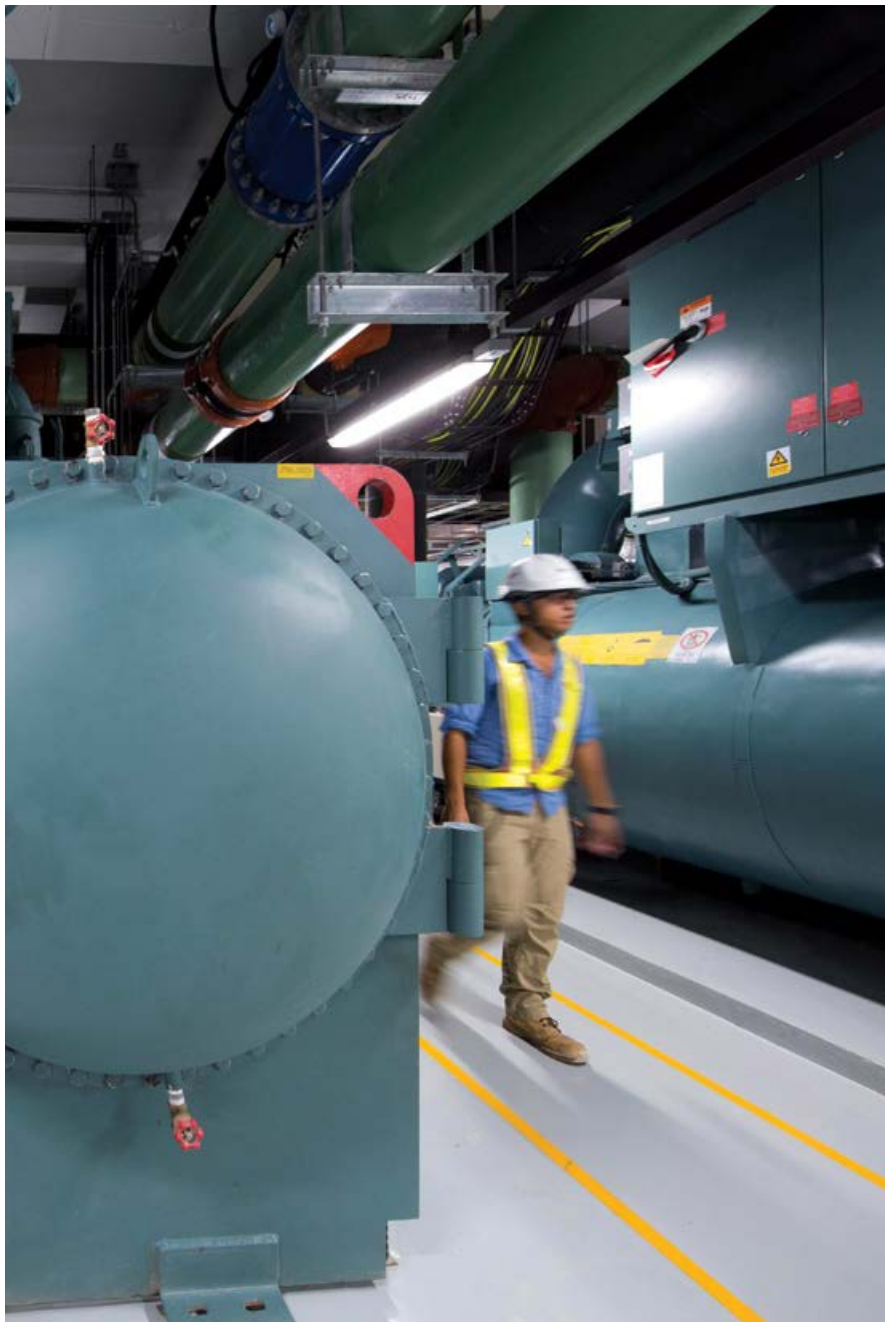
In Hong Kong, the Company has now contributed in various ways to data centres in Shatin and at Tseung Kwan O Industrial Estate for three clients – HSBC, China Mobile and Global Switch. The first of three phases for the biggest of these projects was completed in the fourth quarter of 2017 for Global Switch, one of the world's largest developers and operators of data centres.

"The relationship with Global Switch actually started in Singapore about 18 years ago," recalls Kevin O'Brien, now CEO of Gammon sister company Jardine Engineering Corporation (JEC) but until recently a Gammon Executive Director. "We worked with them successfully, once on Singapore's Tai Seng data centre and then on its extension project. Our partnership was later extended to Hong Kong. On the first phase of their new Tseung Kwan O data centre, we worked with them from the very early days when they put their bid in on the land. We gave advice on the geotechnics and followed that all the way through. The relationship has now returned to Singapore as we are building their second facility in Woodlands. We have established a long term relationship with Global Switch."

The Phase 1 contract for Global Switch's Hong Kong data centre development involved designing five buildings and constructing the first two. Towards the completion of Phase 1, which was delivered under a tight construction schedule to the client's satisfaction, Gammon was awarded the contract to design and construct the rest of the complex. On completion it will occupy 71,000 square metres and have an overall installed power capacity of 100 MVA. It will be Hong Kong's largest carrier and cloud-neutral multi-customer data centre.

One of the notable features of this market leading design and build project was the installation of a system of Diesel Rotary Uninterrupted Power Supply Units (DRUPS) for power back-up. This has an isolated parallel bus to achieve the highest levels of resiliency, redundancy and flexibility, providing optimum usage of space, reduced construction costs, and simplified design and installation. It also incorporates sufficient flexibility within the infrastructure for future adaptation. Furthermore, the energy-efficient chilled water cooling system Gammon designed reduces the data centre's overall carbon footprint.





"Power reliability and cooling availability are critical issues," O'Brien says. "If the grid power drops out, there needs to be a back-up power supply available to keep the servers functioning. This will be the biggest DRUPS installation in Hong Kong, yet it occupies less space and is more energy efficient and resilient than a traditional static Uninterrupted Power Supply system."

Given the advanced computer equipment the data centre is designed to house, the project team adopted the latest design methodologies and construction technologies. As Gammon Senior Construction Manager K.C. Lau explains, Building Information Modelling (BIM) was particularly important on the Global Switch Hong Kong project.

"I've used it on other projects, but this was the first where everything was developed through BIM from the conceptual design stage on. Every fixture and fitting went through it, even if the object's size was less than 50mm."

Extensive off-site fabrication of E&M services in factories in Mainland China was of critical importance in expediting this project. While the building structure was still in progress the E&M modules had already been factory built and were ready for delivery. BIM enhanced the accuracy of the manufacturing processes by supplying precise Design for Manufacture and Assembly (DfMA) input.

"In the Phase 1 work it saved a lot of time and avoided a lot of wastage," says Lau. "More than 80% of the cooling system pipework and ductwork was manufactured off-site by DfMA, which meant BIM data could be input directly into the machines with absolute precision. We used that process a lot for ductwork, and we'll use it for more items on Phase 2, including cable containment and other pipework."

In addition to producing air ducts automatically, BIM data was fed to Computer Numerical Control machines for DfMA, which enabled extensive off-site fabrication of other modules. All welding work was carried out in-factory to enable weldless plant room installation.

"There were no welded joints on-site, which greatly reduced the risk of fire or injury to workers. Through off-site prefabrication we also hugely reduced the amount of time spent working at height," Lau adds.


Gammo
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BIM was also used to programme a robotic arm for ceiling drilling, further expediting the E&M works.

“To anchor the E&M services, we had to drill more than 20,000 holes in the ceilings, for which the robot got precise coordinates from the BIM models. The first robotic drilling trial was done by the project team during the Phase 1 construction period. That was very successful, and now we plan to use the robotic method in the Phase 3 works,” Lau explains.

In addition to the innovative use of robotic technology, the team adopted another simple and flexible method for E&M fixing. Making use of cast-in channels instead of traditional post-drilling anchors helped shorten lead times by around 50% and reduced the number of holes to be drilled by 80%. Work at height and generation of dust were also reduced.

Another robotic tool that was deployed extensively was the mechanical ZeroG Arm. Clamped to a mobile platform, this device enables workers to manoeuvre heavy equipment easily.

While Gammon routinely hands over projects in an immaculate state of order and finish, for data centres the standards have to be raised to computer clean room level. For Phase 1, the project team developed the Gammon Indoor Air Quality (IAQ) disinfection robot, which extracted all construction dust and bacteria from the air ducts. This took over another task that would have involved working at height, and so also improved site safety.

The project aimed to achieve a Leadership in Energy and Environmental Design (LEED) gold rating, as well as the Hong Kong Green Building Council’s BEAM Plus gold rating.

Global Switch’s Singapore Woodlands data centre is the first project in Singaore to adopt prefabricated Mechanical, Electrical and Plumbing (MEP) modular techniques on a large scale. Gammon is assembling over 60% of the MEP works off-site, and over 70% of the structure was precast. This approach has multiple benefits, including increased productivity and enhanced quality and safety.

When a delegation from Singapore’s Building and Construction Authority (BCA) visited the development to view the advanced DfMA methods being used, its members were impressed.

“Global Switch Singapore Woodlands is contributing to our initiative to raise construction productivity,” commented Neo Choon Keong, Deputy Chief Executive Officer (Industry Development).

“Visiting the site was an eye opener, and we believe this project will boost the industry’s confidence in adopting prefabricated MEP systems for higher productivity and quality, in line with Singapore’s construction industry transformation efforts.”

Global Switch Singapore Woodlands will offer 25,000 square metres of world-class critical infrastructure, supported by 30MVA of utility power supply capacity. It will host multiple connectivity options, with the ability to directly access the dense networks currently operating from within Global Switch Singapore Tai Seng.

The new data centre will also have reconfigurable and highly efficient power and cooling distribution, with variable speed fans and energy-efficient computer room air handler units.

Planned as a prime example of an environmentally sustainable data centre, the project is targeting a Singapore Building and Construction Authority Platinum Green Mark as well as a LEED gold rating.

Gilbert Tsang foresees Gammon involvement in more such projects in the future.

“Following a co-operation framework agreement focused on data centre construction signed last year between China Telecom Global, Daily-Tech and Global Switch, it is possible that new opportunities for Gammon could open up elsewhere as a result of this agreement,” he says.

“In Hong Kong we have worked on three of the biggest data centres constructed to date and will continue to build on our achievements. Under the Hong Kong 2030+ development strategy a technology corridor will run from Tseung Kwan O through the Science Park and link to the Lok Ma Chau Loop, so we are likely to see more and more of those projects.

Because of the way people now communicate and store information, almost everybody is effectively a customer of the data centre world. We will continue to focus on this growth area.”

BUILDING A BETTER FUTURE

CURRENT AND RECENT BUILDING PROJECTS

As Gammon has extended the capabilities of its building division over the years, so its work has diversified with the firm gearing up to respond to new opportunities and market requirements.

Today, Gammon can offer a total design, construction and fit-out capability suited to buildings of any scale, with expertise and experience ranging from commercial, industrial, recreational and residential buildings to hotels and educational institutions.

Success, it has been said, breeds success, and proof of performance on one landmark project in a particular sector is often followed by a contract for another. Shortly after completion of the successful conversion of Central's Murray Building into a luxury hotel came the news that Gammon had been awarded the $1 billion contract to build another – The Fullerton Ocean Park Hotel Hong Kong.

To be built as two 10-storey blocks on a three-level podium in Tai Shue Wan, the project also includes site formation and piling works, with a workforce of 700 engaged at its peak.

The Fullerton contract was the second major Ocean Park development awarded to Gammon after the new Water World project. Work commenced in September 2017 and is expected to be completed in 2021.

Recently, Gammon has also been kept busy with a growing number of housing projects for both the public and private sectors.

The firm's long history of work for the Hong Kong government includes over 60 public housing estates and, in 2014, the firm was pleased to be awarded a $3 billion Housing Authority contract to construct around 4,600 public rental housing flats for a development in Tuen Mun.

The project comprised five 33- to 38-storey non-standard domestic blocks, a kindergarten, an estate management office, a day-care centre for the elderly, a commercial centre, and a refuse collection point with basement car parking.

As is increasingly Gammon practice, some precast elements were involved and the firm was also engaged for external works, including elevated pedestrian walkways, noise barriers, landscaping and associated drainage.

Gammon also continues to be extensively involved in private housing developments. The increasing quality consciousness of aspiring home owners has made its services particularly attractive to developers for both projects in the high-end luxury sector, and those priced at a more affordable level.

"People are spending a lot of money on their homes," says Gammon Director in charge of building, Percy Chan. "They expect them to be perfect, and there is a trend towards hiring professional inspectors to check for defects. For every residential project now, the expected standard of delivery is high."

Because Gammon is known within the industry and also to homebuyers for the integrity of its work, this trend towards heightened quality consciousness has given the firm a sharpened competitive edge, leading to the award of prestigious residential development contracts from some of Hong Kong's leading property developers – among them a new client, the Chinachem Group.

Gammon's first project for Chinachem, Parc City, is nearing completion. A $3.2 billion contract for the construction of seven residential towers from 12 to 40 storeys over a three-storey retail podium with recreational facilities and a one-storey basement, it has a total construction floor area of 112,400 square metres.

Work began in January 2015 and will be complete towards the end of 2018, and also involves the reprovision of a public transport interchange and the building of five footbridges. Upon completion, the development will provide about 953 residential flats.

Even before completion, Parc City has led to other work for the group, as Chinachem Sales Director Ng Shun Mo explains.

"We hope with Gammon's core values of safety, integrity and excellence we can bring exceptional and comfortable residential properties to the market," says Ng. "We work together with an aim to craft quality properties and co-build ideal homes. This explains why Gammon subsequently acted as main contractor for The Papillons development in Tseung Kwan O as well as a project at Bisney Road."

Percy Chan points out that Gammon's was not the lowest tender for the Parc City project.

"The client's concern was quality, which they expect Gammon to supply at each and every stage. And it is a fast-track project," he adds.

Parc City has presented a number of challenges, including at the outset the excavation of a large quantity of soil.

"We had a lot to ship out every day. The total quantity removed was 78,000 cubic metres. At its peak, it involved 205 trucks moving 1,700 cubic metres per day," he says.

Another issue was neighbourhood constraints. The site, next to West Rail Tsuen Wan West Station, is close to a large residential community and, because of privacy issues, technology that would have been useful – such as drone-mounted cameras – was unavailable to the project.

Not all the neighbours welcomed the project, and the

team had to respond sensitively to their concerns. Noise and dust suppression, always high priorities for Gammon, were acutely so in this case, and a full-time public relations team was tasked with handling community engagement.

Even with those issues to contend with, however, the project team was able to shorten the construction programme by four months, achieving four-day cycles to construct most of the floors.

“We were able to use BIM and 3D modelling for the underground services, the drainage and so on. BIM was useful in detecting and solving problems. Also useful was the application of software, helping us to locate and record defective areas and then rectify the problems. It provided a secure record,” says Chan.

At least one neighbour did derive some satisfaction from watching the construction process.

“Parc City is right next to our head office,” says Chinachem’s Ng. “I saw the demolition of the original structure followed by the birth of a new building, starting from scratch and taking shape floor by floor. It’s amazing to watch.”

The Papilllons, a $2.6 billion project in the southern part of Tseung Kwan O that Gammon began work on in April 2016 with completion expected at the end of 2018, involved the construction of six 12- to 18-storey residential towers, and five four-storey houses, adding 857 units to the housing supply.

Here, too, recalls Gammon Director Vincent Yuen, who was General Manager of building when the project began, Chinachem was clear about its requirements.

“The client was definitely looking for better quality. They already had a full-sized mock-up of a unit off-site, which meant we could visualise their expectations quite early in terms of the material quality and detailing. Then we created another real-sized mock-up on-site, which reinforced that understanding. It helped ensure the quality of the project. The client had a clear idea of what they wanted – so we had direction,” he says.

Simulations were also used to plan the project logistics, which Yuen recalls being crucial to keeping it on a fast-track.

“We used simulated deliveries of precast, rebar and other materials to see what worked efficiently with the tower cranes. Logistics were crucial to the success of the project with correct timing and sequence of delivery helping enormously to maintain clarity on the site,” says Yuen.

Ng Shun Mo says that Gammon and Chinachem worked together on the projects in a spirit of partnership.

“Safety and sustainability are our priorities, which is exactly the same as Gammon. In order to attain this high professional level, I believe that preparatory work is a must. Prevention is better than cure. Also Parc City demonstrated an exceptional sales record in mid-2017, and I believe Gammon’s brand promise is part of the reason,” he says. “In addition to Parc City, we hope to work more with Gammon in the future, helping us to build more milestones.”

The firm has similarly high expectations to meet with the $3 billion building contract for the Great Eagle Group’s Pak Shek Kok residential development project, on the waterfront in Tai Po overlooking Tolo Harbour.

Comprising eight medium-rise residential blocks and four houses over a two-level basement, the project is being built to BEAM Plus Gold standard and is scheduled for completion in 2019, adding 1,000 units to the housing supply.

While Chinachem and Great Eagle are relatively new clients for Gammon, it has a long record of successful projects for Wheelock and Company Ltd. In Gammon’s 60th anniversary year, the Building Division is working with the company on both a high-end villa complex at Plantation Road on The Peak, and on a residential tower development at Lohas Park in Tseung Kwan O.

Plantation Road, which will be part of Wheelock Properties' Peak Collection, follows on from the success of the firm's work on Wheelock and Nan Fung's Mount Nicholson development, which in 2017 set a record for the most expensive real estate by square foot in Asia. Gammon's work on the $800 million contract will be conducted to BEAM Gold standard, and will be completed in 2020.

The Lohas Park contract, Gammon's fourth for Wheelock in Tseung Kwan O, is for the construction of three 54- to 56-storey residential towers on a five-level podium, and has a value of around $4 billion. It will provide over one million square feet of large-scale residential development.

High standards of safety and sustainability are built in to the contract. Both will be enhanced by the strategic use of BIM, 3D scanning, and Design for Manufacturing and Assembly (DfMA) for off-site fabrication. The use of aluminum handset panels will replace traditional formwork in construction of the tower structure, and the project is aiming for BEAM Plus Certification.

Commencing in March 2018 and scheduled for completion in 2021, at the project's peak 1,500 people will be working on the site.

Gammon's extensive portfolio of recent building projects also includes a residential development at Pak Shek Kok in Tai Po for K. Wah International Holdings Limited, and Le Cap – a luxury homes project completed recently for Wing Tai Properties Limited and Manhattan Group.

According to Percy Chan, the requirements of developers are increasingly focused on the kind of results that Gammon has always promised to deliver. The firm is in tune with the times. More than ever in the future, quality will count.

"We have good clients who ask for quality and we like to deliver quality projects," Chan concludes.

BUILDING TRUST

THE FOUNDATIONS DIVISION

No structure can be stronger than its foundations, and Gammon's Foundations Division provides the rock on which the firm with all its multifarious capabilities and specialisations is established. No matter how much Gammon diversifies or expands its scope, sustained excellence in foundations work remains its corporate signature.

Gammon Foundations is the firm's largest division in terms of manpower, with about 400 staff members and 600 operatives working full-time. It has mastered the art of retaining good personnel and helping them achieve their full potential.

"I've been with Gammon for 20 years, but many of the staff in Foundations and Construction Services have been here for over 40 years," says C.C. Wai, who is Executive Director for both. "So in Gammon, I'm young."

In terms of its energy and eagerness to explore the new, so is the Foundations Division, which continually innovates, breaking new ground both literally and figuratively.

"We do a lot of research and development. The technology changes every day and we have to be on top of that," says Gammon Director Patrick Hou, who manages foundation operations in Hong Kong.

"Gammon is generally a client's first choice for foundations. Our core values of safety, integrity and excellence give them certain valuable assurances about budget and programme."

One of the strongest pressures on contractors in Hong Kong working on residential and commercial buildings is managing tight time frames. so that assets can be let and start earning. High land prices and construction costs make early returns on investment imperative.

The Foundations Division is famously adept at safely speeding up piling and Excavation and Lateral Support (ELS) Works, through means ranging from alternative designs to deployment of advanced equipment unavailable to competitors – much of it designed or modified by the Plant Department. Foundations has also been quick to make use of new information technology such as BIM.

"We started using BIM five or six years ago for site logistics planning. Whenever we tender, we will use BIM to model the site conditions, and also to illustrate any difficulties there may be, so the supervisor or foreman working on site will be able to visualise properly from a screen rather than just a drawing," says Hou.

When pressure of time is on, the Division can also make use of the good relationships it has built up over the years with Hong Kong's government departments with which contractors must liaise – as was the case with the foundations work for Global Switch's Tseung Kwan O data centre, of which Phase 1 opened in December 2017.

“For Global Switch, the programme was tight, but we persuaded the Environmental Protection Department to give us more pile-driving time. Usually it would be five hours, but for this they allowed 11 hours, and that meant we could speed up a lot, and finish the foundation works earlier for work on the superstructure to begin,” Hou explains.

Clients who are awarding superstructure contracts to Gammon can also save considerable time by engaging the firm for foundations as well, obviating the need for a formal handover between contractors when the piling work has been done.

Gammon’s one-team approach means not only can the transition from foundation works to basement and superstructure construction be seamless, Foundations team members can stay on to provide valuable assistance to the incoming project team, as happened in the Global Switch project.

“Also, on The Quayside, the first contract was for foundations, and the second for building the superstructure and the pile excavation. We were invited in to do the pile excavation under Building. We used prefabricated railings and struts, and completed it in a very tight programme – seven months,” Hou recalls.

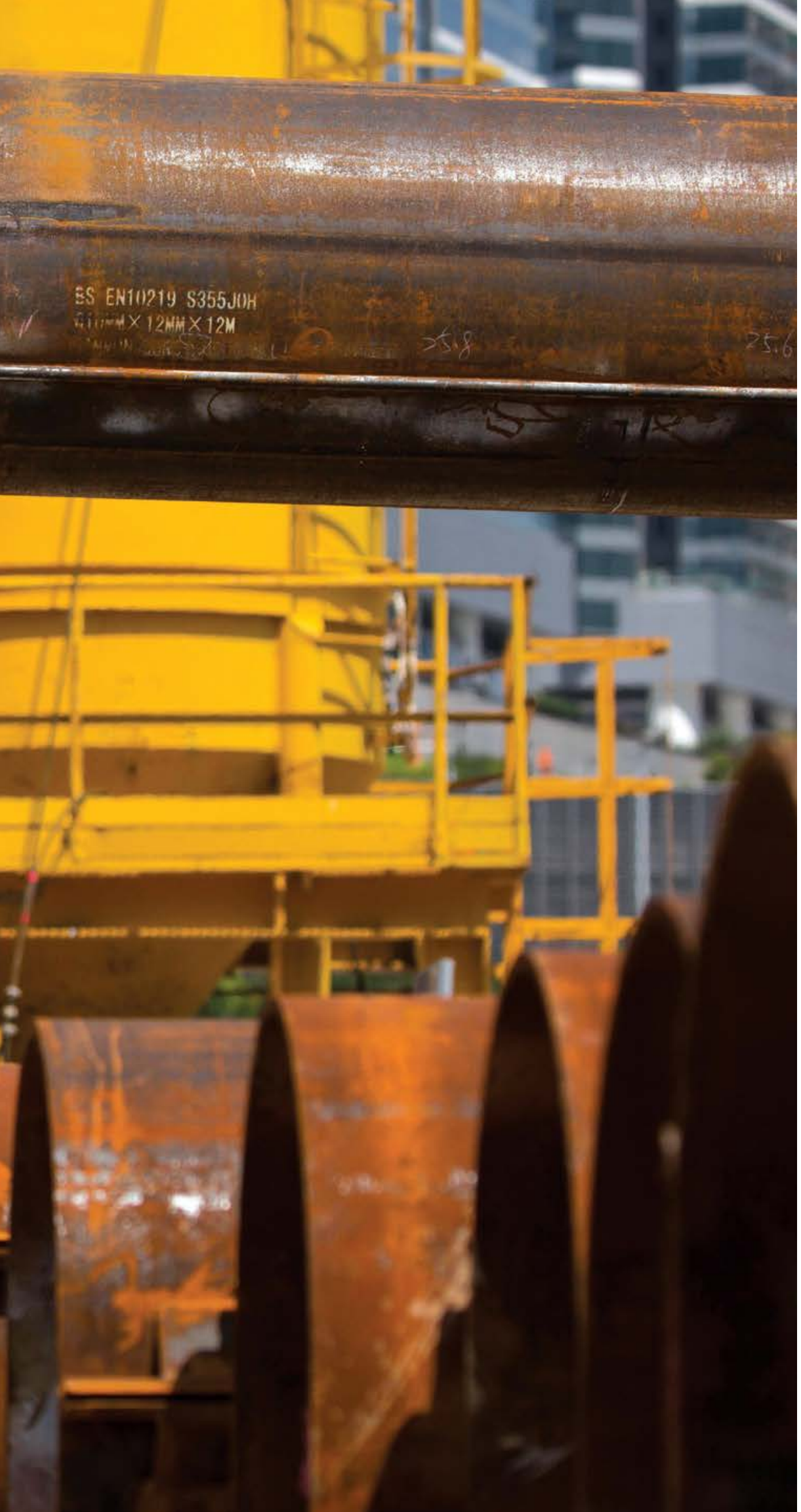
Pressure of time can also be a significant factor in foundation works for major civil projects, but again Gammon has the resources to expedite even the most complex large-scale works.

“For the Tuen Mun-Chek Lap Kok Link, the programme and the budget were very tight – that’s why we worked with the civil team, and also the Lambeth team, which designed reusable piling platforms for us, built by Pristine, to reduce the cost,” says Hou.

“During construction, we were using most of our foundation resources to complete the project as soon as possible. That was quite challenging.”

Gammon’s foundations expertise covers diaphragm walls, barrettes, bored piling, driven piling, deep basement construction, ground anchors, land and marine site investigation, grouting, vertical drains, and ground treatment by vibroflotation and dynamic consolidation. The division also has capabilities in demolition, site formation and horizontal directional drilling.

“It’s a much more comprehensive range of services than most of our competitors, who may have to engage subcontractors. Gammon can deliver everything with our own resources. We own all our own plants, so we don’t have to hire,” Hou explains.



Quite an arsenal of Foundations Division machinery is stored at the Gammon Technology Park plant yard in Tseung Kwan O.

“We have, for example, special rotators which allows us to drive the pile casing into the ground with 360 degrees of rotation. Most contractors use oscillators, but the rotator produces a straighter bore path. With an oscillator, the path may deviate if an obstruction such as a boulder is encountered,” Hou explains.

The pile casing rotator was originally Japanese technology, but Gammon has recently had rotators built in Korea, and also had them constructed to handle larger pile diameters. “We have put a lot of effort into foundation equipment,” says Wai. “The first rotator we had made in Korea was only 2.5m in diameter and now we have made a 3m rotator, which is 30 per cent more powerful than the Japanese machines and at a 30 per cent lower cost. We’ve also made one that is 3.3m in diameter – which is very big.”

Other equipment available to Foundations for piling works, includes reverse circulation drilling rigs with tungsten carbide roller cutters that cut through solid granite bedrock to site piles 100m beneath the surface, and marine drilling barges.

Sometimes for Foundations, as for other divisions, the Plant Department has to modify construction equipment for a particular project.

“For the SCL1111 Shatin to Central Link project, the distance between the pipe piles and the live railway is about 6m, therefore tailor-made plant and equipment were required to carry out the piling work. With the assistance of our in-house Plant Department, all the specially made machinery was completed as per schedule and the foundation work was also completed on time,” says Hou.

“We have also modified a Bauer BC Cutter, which was originally 24m high,” adds Wai. “We needed a low headroom cutter for a particular tender, and it was faster and more efficient to modify a 24m unit into a 6m unit, rather than order a new one from Bauer for which we would have had to wait at least nine months before delivery. We could have lost that tender if we had not had the cutter before that time. We see helping to make Foundations more versatile and more profitable as a big part of our job.”

C.C. Wai notes that Plant and Foundations have developed specialised rock-drilling equipment which has significantly improved productivity.

“What we call it is a heavy-drilling string. The idea is to

make the drill head much heavier to improve the drilling rate," he says.

"Another one is the rotating steel cage fabrication platform. It is both safe and efficient because the pile reinforcement is in a cage form, 3m high. If the cage can rotate, the steel fixers can fix the steel at a comfortable height," adds Wai.

Another major asset at Gammon Technology Park is one of the most comprehensively equipped soil-testing laboratories in Hong Kong, which has developed particular expertise in high-quality effective stress and consolidation testing.

The cool, calm, analytical atmosphere of the soil-testing laboratory seems a world away from the noise, dust and heat of a construction site. But what the scientists do here with their test tubes is absolutely essential to the success of what the Foundations Division will subsequently do with its pile drivers.

All the detailed analysis is necessary because Hong Kong's complicated ground conditions are among the most difficult on the planet on which to build. Where land has been reclaimed from the sea, for example, bedrock may lie far below the surface. Some pilings may descend as far as 120m before they are solidly embedded in stable rock.

Developers conduct their own site evaluations, of course, but not generally as searchingly as Gammon. The firm prefers to undertake its own intensive examinations of site soil samples, so the Foundations team understands clearly what it is up against, even before tendering.

Drills penetrate as much as 120m into the earth to collect core samples, which are taken to the Gammon laboratory for rigorous analysis. One site might yield as many as 800 samples, and the laboratory can process up to 100 site samples simultaneously. On the basis of the test results, an accurate geotechnical profile of the site can be established, providing all the information the Foundations team needs.

Among scientists and within the construction industry, the laboratory is widely regarded as one of the leading facilities of its kind in Asia – not surprisingly. Its approach to site analysis is informed by almost half a century of experience.

Gammon's own Soil, Rock and Chemical Testing Laboratory was established in 1972. In 1993, it became the first private-sector laboratory accredited by the Hong Kong government for soil testing. The Foundations Division set up its specialist geotechnical instrumentation

section in parallel with the Laboratory and, in 2004, the two were merged and relocated to the Technology Park. The result is a facility that ranks with the finest geotechnical laboratories anywhere in the world, and is widely regarded as the best of its kind in Asia.

Deep-core samples tested in the Laboratory can answer many questions essential to the planning and construction of stable, modern high-rise buildings, road and railworks or any other permanent structure – all of which are only ever as strong as the foundations on which they stand. Many contractors rely on the services of independent testing centres, but as in so many other areas, Gammon believes in having the necessary facilities and expertise in-house.

As Wai points out, Foundations is responsible for introducing techniques and technology proven overseas, but not yet tried in Hong Kong, as has been the case with clutch pipe piling.

“The clutch pipe pile is a major recent initiative. It is new to Hong Kong. We developed a technique for building retaining walls using clutch pipe piles, which can penetrate obstructions more easily. It also offers an alternative to a temporary soil-retaining wall, such as a diaphragm and sheet pile wall, which would not be effective in ground that is heavily obstructed by hard materials. We used that method on the Lyric Theatre in West Kowloon,” says Wai.

New techniques and technology are hugely important to foundations. “We are constantly trying to diversify our capabilities in areas like Horizontal Directional Drilling (HDD),” says Wai, but one thing about foundations that hasn’t changed in 60 years is the emphasis on trust. Foundations must be trustworthy, and so must foundations contractors.

“Transparency is very important,” says Hou. “We tell the client everything about the site geology and the site constraints, and we always let them know about any problems we anticipate – particularly if the work is going to take longer than they would like. We don’t compromise. We can’t rush this sort of work and maintain our standards of both safety and quality, and it’s best if that is understood from the outset. We don’t encourage unreasonable expectations, and people respect that.”

THE LAST WORD

Gammon's first project in Hong Kong was the Kai Tak Airport Runway extension, and it is appropriate in its 60th anniversary year that the firm should have been awarded the $6.2 billion contract to construct the Kai Tak West Section of the Central Kowloon Route by the Highways Department.

The section will form a vital part of the overall Central Kowloon Route, a 4.7km-long dual three-lane strategic trunk road. It includes the construction of a 370m-long underwater tunnel with an associated temporary reclamation of about three hectares in Kowloon Bay, and a 160m-long cut-and-cover tunnel in Ma Tau Kok, as well as a 125m-long depressed road and 170m-long underpass in the Kai Tak Development.

Gammon's proposal has reduced the temporary reclamation area and provided a number of environmental benefits. The firm is maximising the use of modularisation and using its patented piling technology to construct the temporary wall for excavation. Work is under way and is expected to be completed by 2025.

Another important contract valued at $2.6 billion from regular Gammon client, the Highways Department, is the Tuen Mun–Chek Lap Kok Link Northern Connection Tunnel Buildings, Electrical and Mechanical Works – Gammon's second major contribution to this important infrastructure mega project.

For this contract, Design for Manufacture and Assembly (DfMA) methods and an integrated digital project delivery approach are being adopted. At least 70 per cent of the E&M works are of modular construction, and drone photogrammetry for 3D mapping and surveying is being used to assist in delivering the works to the highest standards of accuracy. Other innovative solutions Gammon is implementing include a flying factory, tailor-made cable-laying trucks, and volumetric modularisation of toll booths. Commenced in May 2018, the project is expected to be completed in late 2020.

Also awarded to Gammon in this anniversary year, by the West Kowloon Cultural District Authority (WKCDA), is the contract for the $1.5 billion extended basement and public infrastructure works for the Lyric Theatre Complex. The contract is Gammon's third from the WKCDA, and the firm also carried out foundation works for the Theatre, for which it twice received the Authority's highest commendation for safety performance. Work is expected to be substantially completed by mid 2020.

"We are pleased to be working again with the WKCDA for the further development of the Lyric Theatre project, and once again with the Highways Department on the Central Kowloon Route," said Thomas Ho, Chief Executive of Gammon.

"On both contracts, we continue to demonstrate our ability to offer tailor-made solutions while working to the highest standards of safety. It is Gammon's honour to be working, as we have done now for 60 years, on projects that embody ambition, excellence and service to the community and, which demonstrate to the world, the extraordinary achievements of which the Hong Kong construction industry is capable."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