

# BUILDING A DREAM

A Macau Landmark





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— A Macau Landmark —

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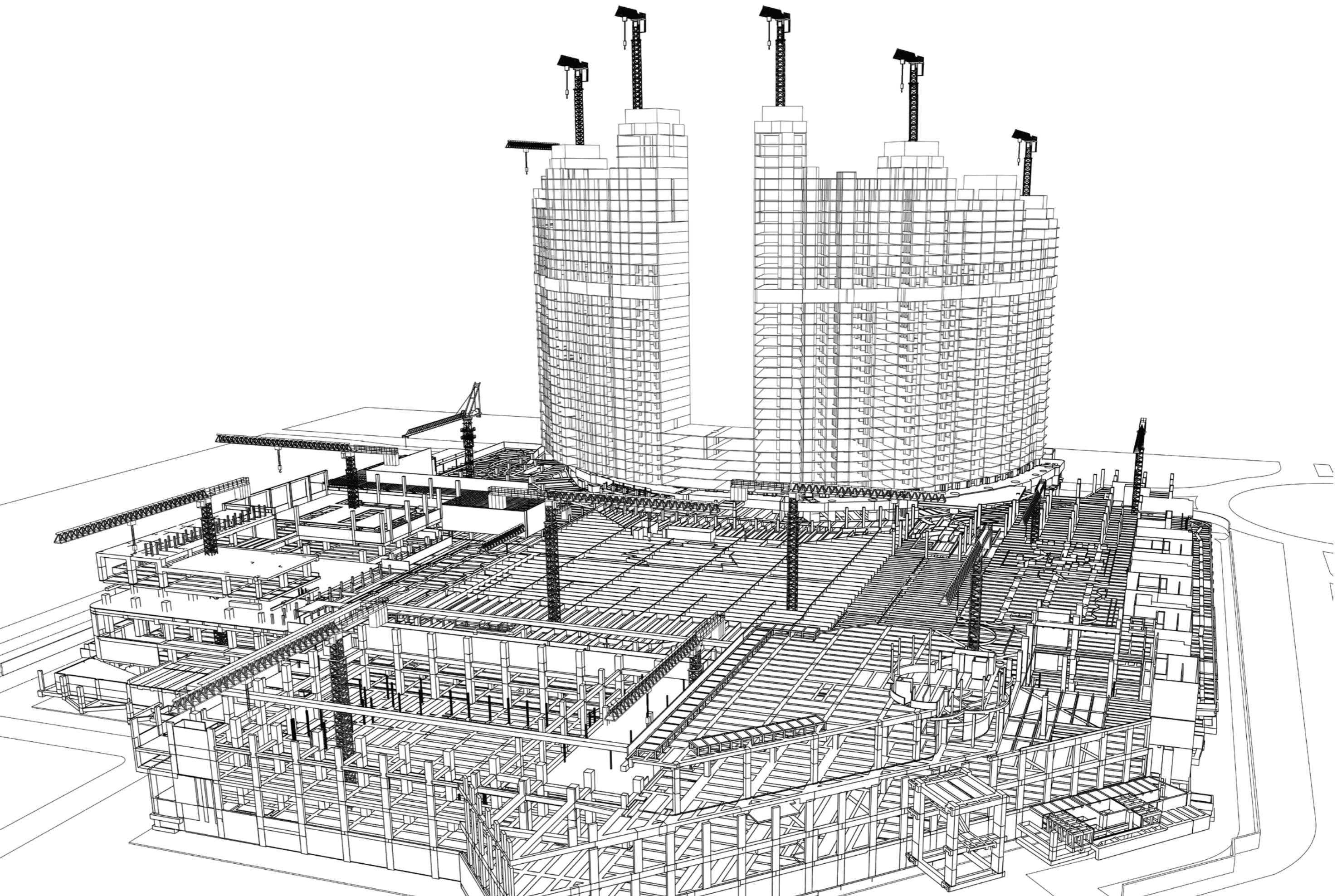
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*The Paul Y. Engineering Group Limited has always taken  
the view that expectations exist to be exceeded.*

保華建業向來秉持追求卓越、永不停步的信念，所以我們不滿足於只符合客戶的基本期望，更要超越他們的期望。

集團自1946年成立後，便一直在承建亞洲區的標誌性項目上，擔任著舉足輕重的角色，為不同城市注入魅力。

承蒙新濠博亞娛樂的信賴，保華建業能參與新濠影滙這富創意與挑戰的項目，展現出保華建業70年來的所有精粹和優勢，更象徵集團作為業界翹楚，在不斷努力和突破下，已經超越過去，邁向另一個高峰，向業界和客戶展示出我們保華建業能以創新及高效的方法承建大型、獨特而艱巨的項目。

為配合客戶要求如期竣工，我們充分掌握和妥善管理每一項工序，並堅持於專業操守和施工上抱持着最高標準，不妥協於業界的一般水平，讓這個極具規模的項目，最終創下零嚴重傷亡的紀錄。

新濠影滙的落成，證明了保華建業擁有超凡的實力和承擔，這不僅體現於我們為客戶帶來超越期望的豐碩成果，還包括我們為各持分者，以至整個社區所履行的企業社會責任。

專業和誠信這兩大重要核心價值，早已注入我們每一項工程項目中。我們很榮幸和驕傲能與客戶新濠博亞娛樂團隊一起「築夢」並攜手完成這極具挑戰性及開創性的世界級工程項目。我們有信心保華建業，在往後的日子將為大家帶來更多獨特和世界級的城市景觀。

**S**ince our company's establishment in 1946, the firm has contributed regularly as a key participant to landmark construction projects in and around Asia.

Thanks to the trust and support from Melco Crown Entertainment, our company is able to participate in this innovative yet challenging project. The completion of Studio City is, in many ways, a summation of a substantial body of work, created over seven decades. It is a symbol of our evolution over the years into a major group known throughout the industry, and among our clients, for our ability to manage large-scale projects of unusual complexity innovatively and effectively.

In response to our client's request of completing the project on schedule, we carefully managed every aspect of the construction process, maintaining the highest standards of professionalism and engineering excellence – without ever compromising on safety standards that we set at a much higher level than is generally thought to be achievable for projects of this scale. As a result, there were zero fatalities.

We are able to offer a comprehensive capability to develop and implement advanced construction solutions based on highly integrated teamwork, world-class expertise and in-depth local knowledge.

The success of the Studio City project is a testament to our competence and commitment to delivering impressive value to clients, while also more than fulfilling our responsibilities to all stakeholders and the wider community.

Professionalism and integrity are values with which all our work embodies. We are proud to have played a key role in this challenging and inspiring project, and building a "dream" together with the Melco Crown Entertainment team. There will be many more to come.

James Lee Hang Wing  
Executive Director & Chief Executive Officer  
Paul Y. Engineering Group Limited

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Asia's  
Entertainment  
Capital





## 亞洲娛樂總匯

澳門新濠影滙 — 亞洲最多元化的綜合娛樂度假村，為新濠博亞娛樂有限公司主席兼行政總裁何猷龍先生的構思。保華建業集團有限公司作為項目的牽頭承建商，與有榮焉能參與成就此非凡之夢。

新濠影滙為亞洲首個集影視製作、零售、博彩娛樂、酒店設施與時尚生活體驗於一身的綜合項目。其國際級多元設施包括澳門首間以電影為主題的酒店 - 巨星滙及明星滙、聳立於兩座酒店大樓之間的影滙之星、蝙蝠俠夜神飛馳、魔幻間、派馳、新濠影滙綜藝館、華納滿Fun童樂園，以及頂級的購物中心及餐飲區。

保華建業在承建此項目的聯營中佔有60%權益，項目合約總值超過100億港元。原定期為31個月，項目團隊在未扣除天氣影響下最終於28個月內完成。

此工程內容包括興建地下低層及4層平台層，兩座矗立兩側、樓高37至41層，合共提供約1,600間客房的酒店大樓，以及高懸130米，全球首個8字形摩天輪。整個工地面積超過130,789平方米，施工面積達450,000平方米。

項目的複雜程度、規模之大及工期的緊迫歷來少見。在工作時數高達3,200萬小時的情況下，項目團隊創下工地嚴重傷亡零紀錄，在如此龐大規模的項目中實屬難得。

事實上，過去70年，保華建業一直以建造獨特和創新的工程項目見稱。由40年代興建充滿西洋風格的上海股票交易市場，至50年代承載著新加坡重要歷史及精神的獨立橋，60、70年代於香港發展過程中肩負重要角色的啟德機場擴建和香港海底隧道，80、90年代令香港躍升為國際大都會的各類摩天大廈，21世紀的特色綠色和智能建築，以上豐富和寶貴的經驗都為今日建造新濠影滙奠下了雄厚和穩健的基礎。

今天，保華建業再一次展現其於承建獨特、高技術和龐大建築項目上的超凡實力，並進一步將其卓越的領導能力和項目管理能力昇華，以超乎客戶期望的表現，協助新濠博亞娛樂為澳門揭開了魅力非凡的新一頁。

**U**nique in concept and spectacular in scale, Studio City, for which the Paul Y. Engineering Group Limited was the lead contractor, was designed from the ground up to be the most diversified and exciting cinematically-themed integrated resort in Asia.

Dubbed Asia's Entertainment Capital, Studio City's expansive and imposing complex is a major new landmark for the City. "Today marks the start of a new era of leisure destination entertainment for Macau and Asia," said Lawrence Ho, Chairman and Chief Executive Officer of Melco Crown Entertainment Limited, at the grand opening ceremony on 27th October 2015. "It is the realization of our long-held vision to develop a leisure and entertainment destination that has no equal in Macau."

Studio City is the world's first Hollywood-inspired integrated resort. Its two hotels, Star Tower and Celebrity Tower, are the first in Macau based around cinematic themes. The centerpiece of its art-deco inspired façade is the iconic Golden Reel – the world's first figure-8 Ferris wheel, and, at 130 meters, the highest in Asia.

Batman Dark Flight – a thrilling 4D flight simulation – is the first ride in the world from the Batman franchise; The House of Magic, where the world's leading magicians and illusionists perform, is Macau's first permanent large-scale magic theater; and Pacha Macau is the city's first Ibiza-style nightclub.

Together with the Studio City Event Center, which can seat up to 5,000 people for major musical, theatrical and sporting events, and Warner Bros. Fun Zone, a 40,000 square foot family entertainment center, all those attractions significantly raise the bar for the delivery of entertainment in Macau and Asia.

Other noteworthy elements of the complex include a fully operational television and broadcast studio called Studio 8, and a 30,000 square meter immersive retail area modeled after some of the great shopping streets of New York, Hollywood and Beverly Hills.

#### Leading the project team

A major new landmark for Macau and Asia, Studio City's construction was also a watershed project for Paul Y. Engineering, which put together and managed the high-achieving team of consultants and contractors, who turned the vision into a reality.

Generally speaking, new integrated resorts open in stages – particularly in Macau where construction work contends with challenges that make full completion to schedule a rarity. Nevertheless, Melco Crown Entertainment had determined even before construction began that all Studio City's facilities would be fully operational from day one. The whole project would have to be completed in less than three years.

"It was an open tender," explains Paul Y. Engineering Executive Director and Chief Executive Officer James Lee. "We had collaborated with Melco Crown Entertainment on another project, Crown Macau, which is now renamed Altira Macau. Because of that previous relationship, we were invited to tender for Studio City. It was a very competitive tender and only contractors with adequate competency levels were invited."





Given the scale of this over HK\$10 billion project, Melco Crown Entertainment had decided that it should be conducted under a joint-venture arrangement. Paul Y. Engineering accordingly established the joint venture (JV) in which it took a 60% controlling stake. The JV was awarded the contract.

"This was one of the biggest building project ever for Paul Y. Engineering in its 70-year history," says James. "It was close to five million square feet – a huge site. A site inspection walk around just the podium would take easily three to four hours every morning." The firm had plenty of relevant experience, however, and a proven record of willingness to commit 100% to a challenge.

Established in 1946 in Shanghai by Paul Y. Tso as a firm positioned on the cutting edge of engineering technology, Paul Y. Engineering relocated to Hong Kong in 1949, and established an office in Singapore in 1953.

In its very early days, Paul Y. Engineering became known as a firm eager to take on unique groundbreaking projects – an organization stimulated by challenge. Many of these structures have had a transformative effect on the cities in which they were built.

In the 1940s, the firm built the western-style Shanghai Stock Exchange Square, swiftly making a name for itself locally for meticulous technique and sophisticated workmanship.

In the 1950s, Paul Y. Engineering played a major role in the construction of Singapore's 610-meter pre-stressed concrete Merdeka Bridge – a construction milestone and a symbol, when it opened in 1956, of the city's transition from colonial administration to self-government. It also transformed Singapore's infrastructure, linking the city centre to the east coast, and opening that area up for rapid development.

Since the construction of the Hong Kong Central Government Offices in 1955, Paul Y. Engineering has been continuously involved in major buildings and infrastructure projects in the city – including two on the same site. The firm participated in building Hong Kong Island's first five-star hotel, the Hilton Hong Kong in 1962, and the high-rise Cheung Kong Center 37 years later in 1999.

In 1972, the firm was prominent among the contractors involved in constructing Hong Kong's first single-shell immersed tube Cross-Harbour Tunnel, and thus the first road link between Hong Kong Island and the Kowloon Peninsula – still a major arterial route today and one for which Paul Y. Engineering introduced new engineering methods and concepts to the city.

The firm's tunnel engineering expertise also played a significant role in the development of Hong Kong's Mass Transit Railway system. Other infrastructure projects with its involvement include the Airfield Works and Super Terminal 1 of Hong Kong International Airport, and the Central-Mid-Levels Escalator and Walkway System.

In 1984, Paul Y. Engineering participated in the Dongjiang Water Supply Project from which the greater part of Hong Kong's fresh water flows – having already, in 1963, played a leading role in the construction of the Shek Pik Reservoir.

In 1998, the firm demonstrated that it was still on the cutting edge of bridge-building technology with the completion of another landmark – the Ting Kau Bridge, which is one of the longest cable-stayed bridges in the world.

In 1999, the expertise in high-rise construction, which Paul Y. Engineering built up from its earliest years, reached a summit – so far – in Hong Kong with the completion of construction of The Center. At 350 meters high with 80 storeys, it is currently the 40th tallest building in the world and a focal point of Hong Kong's spectacular skyline. Paul Y. Engineering was the lead contractor.

In the 21st century, the firm's expertise and experience have been called on for projects ranging from Hong Kong Polytechnic's hotel block, through the revitalization of Mong Kok Stadium, to the multiple award-winning Tuen Mun North West Swimming Pool.

It has concurrently played a significant role in a large number of unique projects in the Middle East, Mainland China – and Macau.

#### A high-powered project team

Today, in Macau, Paul Y. Engineering has been involved in the Concordia Development in Coloane; a public housing complex at Sac Pai Van; and THE 13 Hotel on the Cotai Strip. Studio City, however, was by far the most challenging building project it had yet taken on – not just in the Macau but worldwide.

It was clear from the outset that some senior management expertise would have to come from outside the JV. It was also clear that the prestige of the project would make Studio City a magnet for skilled and experienced professionals, and that the JV had the connections and credentials to assemble a high-powered project team.

"We set up a new team on site. Most had experience in Macau, and in casinos, hotels and







mixed developments. We were able to bring on board structural engineers, civil engineers, architects, interior designers, construction managers, quantity surveyors, and more, so we put together a full team of professionals covering all aspects of the development," says James.

Under the supervision of the project team, at various times there would be around 335 trade contractors, and during the peak period of construction as many as 10,000 workers, skilled and unskilled, on site.

The project team's brief was to supervise the construction, mechanical electrical and plumbing (MEP) and fitting out works for a lower ground floor and four podium levels, surmounted by two hotels containing around 1,600 rooms, on a site area of 130,789 square meters with a construction floor area of 450,000 square meters.

#### Managing complexity

The project was unusual in its complexity as well as in its scale.

"All of the different functions had their specific designs, so the interfacing, making them connect, not only affected the design but also the engineering and the actual construction. How to sequence it all was the question. There were multiple programs and hundreds of method statements involved in building this," says James.

Not only would new methodologies and structures for communication have to be developed for the project, but focusing everybody's attention was the exactingly tight schedule leading up to the grand opening day. Each construction milestone was a significant hurdle that had to be cleared. Significant savings of time would have to be made at every stage of construction to bring the project in on time. Ultimately, however,

the project team did far better than make its deadlines. Despite complications ranging from an acute shortage of labor to the battering of typhoons, the 31 months allowed for construction was successfully reduced to 28. Furthermore, with more than 32 million man hours logged, and despite the hazardous nature of much of the work, the entire complex was completed with a bare minimum of accidents, and absolutely no fatalities – an almost unheard of achievement for a project of this scale.

To be found in the following pages are many of the technical and operational reasons why the project team was able to achieve all this, but in the end the most important element turned out to be teamwork. Perhaps Paul Y. Engineering's greatest achievement in leading the project was the successful fostering of a strong spirit of cooperation and commitment to a shared goal.

Studio City was built, safely, to the highest construction standards, and ahead of schedule, because the people working on the project were motivated to give everything they had. "Our strength is our staff. They will always go the extra mile, so we can be confident of delivering not only on time but faster," says James.

"We successfully assisted Melco Crown Entertainment in delivering a landmark project – a very unique project, not just by the standards set in Macau or Hong Kong, but for anywhere in the world."

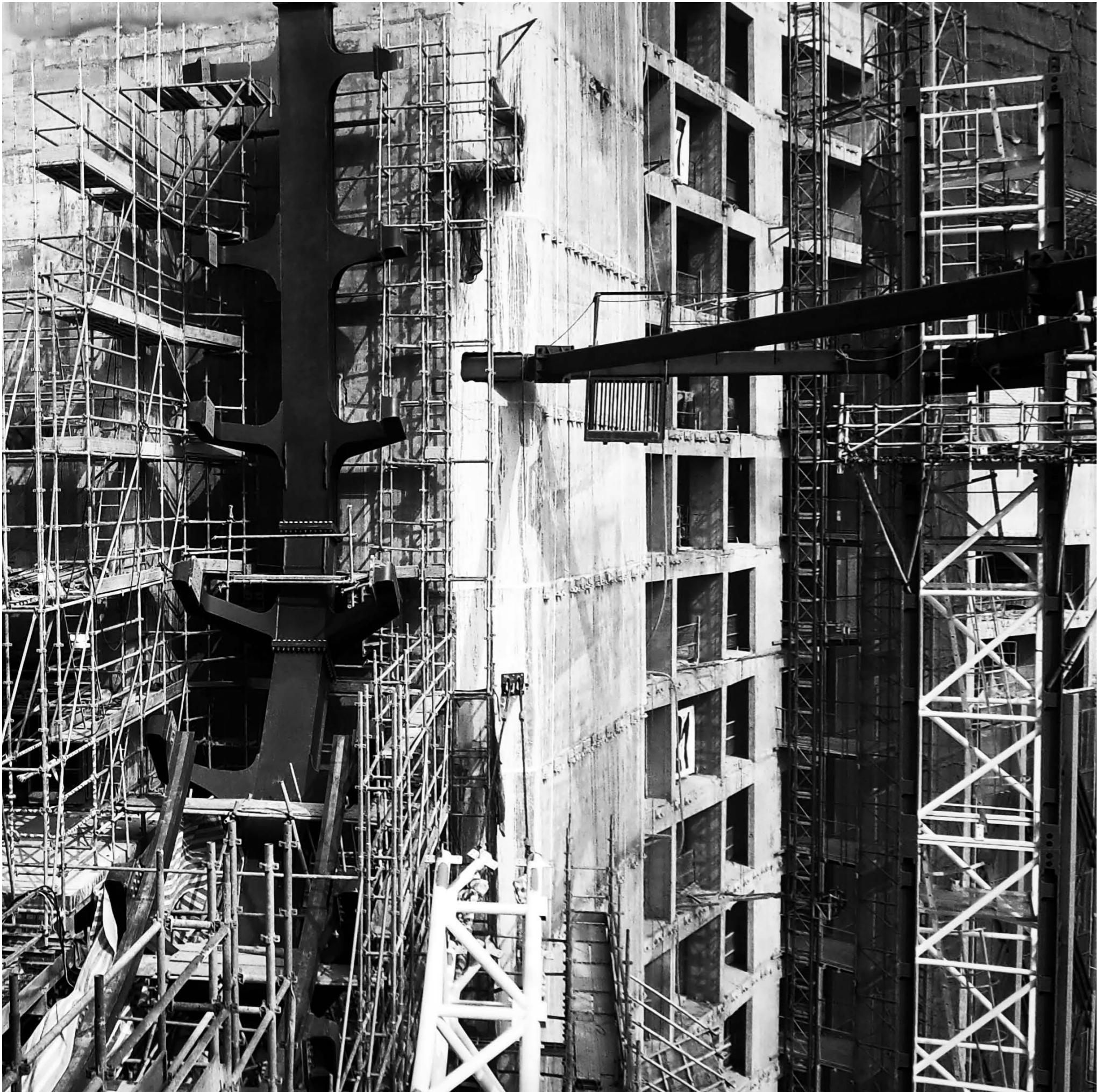




*"We successfully assisted Melco Crown Entertainment in delivering a landmark project – a very unique project, not just by the standards set in Macau or Hong Kong, but for anywhere in the world."*

## Rising to Challenges





## 無懼挑戰

工地面積超過130,789平方米，施工面積達450,000平方米，新濠影滙為保華建業至今在澳門最大及最具挑戰性的承建項目。主要挑戰在於其緊迫的工期、當地政府對聘用外地工人的限制、運送所需器械的困難，以及繁複的工地物流管理。

在新濠影滙2015年10月27日正式開幕前，項目團隊僅有31個月完成所有工程，他們需要在交付之日，確保所有設施能順利運作。面對嚴峻的工期之際，項目更於動工初期因地質問題，需要進行額外打樁，令工期一度延誤了6個月。

為了追趕進度，項目團隊審慎規劃並採取「一次做對」的原則。透過精簡管理和監督程序，以及妥善的拆細及劃分工序，避免因重做工序而耗費更多時間，務求爭分奪秒。最終，項目團隊成功加快施工進度，更創下一個月內每日平均灌注1,000立方米混凝土的紀錄。

除了逾500人的項目團隊外，參與是次項目的分判商多達335個，施工高峰期，每天駐場的工人數目更超過10,000人，足夠的專才和勞動力成為項目推進的關鍵。然而，澳門勞動法的規限，為聘請勞工事宜增添了不少的困難。為此，項目團隊特別成立人力資源小組專責處理相關難題。

在澳門，大部分的建造器械均從外地入口，為配合工程進度，除了要有效規劃，確保資源用得其所外，器械於工地上的配置和運作亦需費盡心思。此項目工程共運用了33部塔式起重機，及設置了超過650部升降台以進行高空作業。

新濠影滙工地面積廣闊，為物流帶來各項挑戰，其中包括水平及垂直運輸。以組裝在大樓之間的「8」字形摩天輪為例，為了能於水平運輸龐大的重型結構鋼材，團隊特別於2樓平台設計及搭建了路軌及電動車系統。

此外，為確保通道和物流暢通，項目團隊特別在塔式起重機未能覆蓋的工地邊緣位置額外設置流動起重機，及搭建內部運輸通道系統，運用卡車將材料運送至工作區中央，以減少重複吊運器械及材料。

綜觀整個新濠影滙的施工，項目團隊採取提早規劃的策略，以預早識別和預計潛在困難，提早妥善處理，並按工地進度持續檢討，力求完善。這種將困難變成機遇的能力，造就出超越預期的理想表現。

**W**ith a site area of 130,789 square meters and a construction floor area of 450,000 square meters, Studio City was one of the biggest construction projects ever undertaken in Macau. Not surprisingly it was also one of the most challenging.

Among the major issues the project team had to manage on an ongoing basis were an exactingly tight schedule; Macau's restrictions on the employment of imported labor; difficulties in getting access to the necessary plant and machinery; and management of complicated site logistics.

#### Working against the clock

Just 31 months were allowed for the completion of all work, with a commitment to hand over the site in a condition for all facilities to be fully operational before the grand opening day – 27th of October, 2015.

The road to this objective was marked out by a series of project milestones indicating the completion of construction stages. These also had to be completed to a tight schedule, in many cases, much earlier than is typical for a project on this scale. The pressure of time was already weighing on the project team when it took over the site – but then all the milestones had to be fast-tracked further. This was to make up for time lost to additional piling work required before construction could commence. The foundation design had been altered to overcome site geotechnical problems, and the piling work the alterations required set the project back by six months.

"We wanted to utilize as much as possible the existing piles, so the new design was a combination of new piles and old piles, and some existing pile caps," explains Project Director Andrew Keung.

To compensate for this delay, all work was rescheduled and resources consolidated to speedily achieve maximum progress. Wherever time could be saved without compromising the strict site safety rules observed at all stages of the project, those savings had to be made. "Planning and the elimination of preventable delays were essential and we stuck to the 'right first time' principle," stresses Andrew. "It was important to avoid abortive works. They always slow down progress, and they demoralize the workers. Good planning, good organization, and good communication between the trades minimize that."

One landmark achievement singled out by Senior Deputy Project Director Frankie Lui was the early handover to the client of the Data Center on the 10th of January, 2015, which, he says, was made possible by "bottom up accelerated sequencing". This facilitated early testing and commissioning of Studio City's operating systems – a major contribution to ensuring that the whole complex was ready for the grand opening.

"Project delivery goals were expedited by streamlining the management and supervision processes and breaking down work into packages and by zones," says Frankie. "Advance planning, and close and effective coordination with all the stakeholders further contributed to the smooth outcome."

Andrew adds that, where possible, work was planned in cycles to produce cumulative efficiency gains. "We did that particularly on the hotel towers, where a lot of repetition was involved, so that people would get more and more efficient at particular tasks," he explains. A considerable time gain on the building of the hotel towers was achieved by the adoption of aluminum formwork rather than traditional timber. "We taught the workers from Mainland China how to use aluminum formwork, and with some practice they were able to do it very quickly," explains Frankie. "The cycle was about four to five days for each floor. That's very quick. With wood, that would have taken seven days or longer."





Andrew credits the effective coordination and management of architectural builders works and finishes (ABWF), and building services installation works to the adoption of a dual matrix system of organization.

Ultimately, the project was successfully fast-tracked to a point at which over 370,000 cubic meters of concrete were successfully poured in just 19 months – 300,000 for the podium and 70,000 for the two hotel towers. Just as importantly, Andrew points out, the work was completed “with excellence”. At no time did the requirement for speed compromise the project team’s insistence on both safety and quality.

#### Building a team

Studio City’s requirements in terms of both professional expertise and skilled and unskilled labour were formidable.

The project team alone numbered more than 500 – according to Andrew – which was around double the number of professional staff he has worked with on any previous project. Trade contractors were engaged from more than 335 firms, and at the peak of construction activity 10,000 people were on site every day.

There was one problem the project team knew from previous experience that they would face throughout the project – balancing workforce requirements with Macau’s highly restrictive regulations on the employment of labor on construction sites. “Most contractors in Macau face labor problems. Some projects have been delayed for many months. The major problem is the quota,” explains Frankie. The Labor Affairs Bureau of Macau (DSAL) requires employers to engage one local construction worker for every one brought in from Mainland China, Hong Kong or overseas. However, there is an insufficient pool of local laborers to meet that requirement, and Frankie says that the project team had to contend with a constrained supply for at least 18 months of the construction period.

In the early months of 2015, the project’s planned labor requirement was for 8,267 workers. Actual labor on site in March of that year fell short of the target by more than 1,000 at 7,066. A strategy was formulated to manage this ongoing problem, and to reduce its impact. This involved reviewing actual labor requirements with each nominated subcontractor (NSC) and direct subcontractor (DSC).

A Human Resources (HR) section was established to handle all applications falling under the labor quota rules, liaising closely with the Macau government authorities. It was to be responsible for all necessary follow up action in line with progress on the site, and its role was to be diplomatic as well as organizational. Consultants with experience and expertise in the field were employed. Regular reviews kept the project team fully up to date on labor availability, and aware of the possibility of shortfalls, which would have to be managed.

“We got the right consultants to talk to the government,” says Frankie. “The problem was how to recruit workers on time. Most of the imported labor had some skills and experience. We needed different types of labor at different times, and that was a planning challenge for Human Resources.” HR moved quickly to establish lines of communication with the DSAL and Macau’s Human Resources Office (HRO). These have since merged, but operated during Studio City’s construction as separate entities.

A recruitment center was set up at the site project office, and a series of 24 special recruitment events were organized. These served the dual purpose of identifying potential workers from the Macau labor pool, and of demonstrating to the HRO and DSAL that recruitment within the strict “one for one” rule could not of itself satisfy the requirement for construction workers on the site. For skilled level positions, active recruitment programs were instigated at Macau’s institutes of further education, including the University of Macau, the Macau University of Science and Technology and Macao Polytechnic Institute.

“We tried to show the Macau government that we really wanted to find and employ Macau workers,” says Andrew. “As time went on, things got progressively easier.”

Careful management of overtime also helped ensure that a productive and alert workforce was on site at all times. “We had to make sure if people were working overtime that they were still working effectively. We didn’t want to extend hours too long, so we had to schedule work efficiently,” says Andrew. “The site was operational round the clock, but night time was basically for tidying up, cleaning the area. At night, we moved materials to the right place, so everything was in place for work in the morning.”

Harmonious labor relations were also a priority. Appreciation was expressed for work well done and targets met. “One important thing was avoiding labor disputes,” says Andrew. “We didn’t allow any flare-ups to occur. There was bound to be some occasional unrest with that number of people, but we had no walkouts, and no strikes.”

*"Obstacles became opportunities,  
and achievements regularly exceeded  
expectations."*





#### Equipment strategy

Construction in Macau has boomed since the administrative handover from Portugal to China in 1999.

The intervening period has seen the Special Administrative Region (SAR) gradually transform itself from a city known internationally primarily for its casinos into a diversified leisure destination. Studio City is one of the game-changing projects in that transformation.

The boom, however, has taken place in a city with limited resources not only of experienced construction labor, but of essential plant and equipment. For the Studio City project, most of the heavy machinery had to be specially shipped in, and shipped back again when it had served its purpose. The challenge for the project team was to accurately forecast the exact requirements at different stages of the project for plant and equipment to be hired, to ensure that it was delivered, and to plan to optimize its use during the time on site with a view to a timely return to the owner in order to limit costs.

At various stages of the project, a total of 33 tower cranes were required on the site, with more than 650 scissor platforms deployed for working at a height.

Through detailed planning and close coordination with the trade contractors, the project team was able to avoid delays in works progress due to a lack of equipment by working out a detailed plant procurement schedule, and liaising with plant hire agents both in and outside Macau to establish availability, and confirm the commitment to deliver. The plant schedule was reviewed regularly in line with site progress, and revised to ensure the necessary equipment would be on site on schedule and at all stages. In some instances, equipment needed to be specially purpose built, and in these cases the project team was able to call on manufacturing resources in Mainland China. The track-and-trolley system designed by the team for the horizontal transport of the heavy structural steel elements of Asia's tallest figure-8 Ferris wheel Golden Reel, for example, was manufactured to order in Mainland China, in component form, and assembled on site in Macau.

### Site logistics

Because of its vast area, the Studio City site presented a considerable number of logistics challenges – horizontal and vertical, the latter particularly in the work on the two hotel towers, and in the installation of the giant figure-8 Ferris wheel between them.

"The most challenging issue was delivering material to the podium and lifting it to the top," says Frankie, "but we had good planning for the whole site." As with so many aspects of the project, planning was the key, particularly with regard to the positioning of the 33 tower cranes, which had a reach covering most of the podium area. Additional mobile cranes were also necessary along the haul roads at the boundaries of the site, where much of the site storage had to be located. A central storage area was established on the site designated for Phase II of the Studio City development, but it and the boundary areas were too far from the podium for the tower cranes to reach.

The solution was to devise a system of internal haul roads on which to transport materials to the active central areas of the site by truck. This minimized double handling of plant and materials to be transported. "We planned it so vehicles could be driven right into the heart of the site for the delivery of materials to each individual zone," says Frankie.

"The height of the podium roofs meant we could drive right into the building and deliver the materials to all areas. This was a very important part of the logistics plan."

Reinforced concrete construction work in the areas occupied by the haul roads was deferred for as long as they were required for access, and as work progressed from the centre of the site towards the boundaries they were progressively closed out. The roads were constructed in areas ultimately designated for late-cast concrete strips, employed to reduce concrete shrinkage.

The very large number of cranes on the site meant that their positioning had to be carefully planned. Sensors linked to an anti-crash system were installed in each to eliminate the risk of jib collisions.

Over the anticipated 31-month construction period, some adverse weather effects were to be expected. There were 83 days of inclement weather recorded, and in the early days before the drainage systems were complete, delays due to site flooding were an issue with which the project team periodically had to contend. One method of limiting the problem, and making the muddy site more navigable, was the deployment of one square meter of prefabricated concrete slabs as road pavers, as Andrew explains. "Precast concrete can be reused, so the method was sustainable and economical. We had some from previous projects, but of course we needed new-cast slabs as well," he says.

At every stage of the Studio City project, there were challenges to be tackled, and hurdles to be cleared. In each case, the project team's approach was to plan ahead, so difficulties could be anticipated and addressed well in advance; to review work constantly in line with site progress, searching for opportunities for improvements and enhancements; and to streamline work wherever practicable. Obstacles became opportunities, and achievements regularly exceeded expectations.





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## Engineering Excellence



## 非凡工程

新濠影滙的承建工程主要分為兩部分—4層高的平台層連酒店、購物和娛樂區，以及提供1,600間客房的酒店上蓋建築，並包括高懸於兩座酒店大樓之間的8字形摩天輪「影滙之星」。

此項目獨特非凡，每個環節各具挑戰，結合了建築、機電工程，以及建築設計及修飾工程等特殊專長。

由於打撈工程的延誤，加快建設平台層成當務之急，項目團隊以每天平均灌注1,000立方米的混凝土為目標，確保平台層可以於2014年5月23日平頂。最終，在大約19個月的時間共灌注了約37萬立方米的混凝土—當中約30萬立方米的混凝土是用於平台層部分，約7萬立方米的混凝土則用於酒店大樓。

兩座酒店呈弧型建築，劃分為8部分，共裝上17,000塊大小不一的幕牆面板，覆蓋超過86萬平方呎。

新濠影滙的機電工程系統的複雜程度，在澳門可謂數一數二。所有工程在28個月時間內完成，其效率之高全賴完善的項目規劃及採用建築信息模擬技術(BIM)協助。

此外，項目團隊需為新濠影滙的獨特娛樂體驗設施騰出物流空間，以讓專家顧問團進行製作及裝嵌。其中如「蝙蝠俠夜神飛馳」及「魔幻間」在工程上更涉及保密協議；夜店「派馳」的規劃，在較後期才正式落實，但項目團隊仍竭盡所能趕及在新濠影滙開幕前完成。

「影滙之星」可說是新濠影滙的焦點所在，它是全球首個和亞洲最高的8字形摩天輪，聳立於兩座酒店大樓10至41層之間，高懸130米。「影滙之星」設有17個以復古科幻為主題、每個最多可容納10人的觀景車廂。儘管面對技術勞工及焊接工人短缺的問題，項目團隊仍於7個月內完成了約950噸鋼材結構的組裝。

「影滙之星」垂直可分為3部分，包括車廂本身、放射區域(由6層水平鋼桁架組成以支撐幕牆燈光面板)及星際區域(結構鋼框以支撐「新濠影滙」牌匾、幕牆燈光面板及屋頂吊船)。其結構骨架總重量達157噸，最重部分為10.7噸。

最後，當「影滙之星」順利由臨時承托轉移至永久承托系統，亦代表著此項目能提前竣工。

「影滙之星」現已成為澳門的新地標，這個高聳於兩座大樓之間的摩天輪，除為遊客帶來獨特的新體驗，相信也必成為日後建築參考的對象。

**T**he main contract works with which the Studio City project team was tasked fell into two sections – the four-level podium with its hotel, gaming, retail and entertainment areas, and the 1,600-room hotel superstructure, including Golden Reel the figure-8 Ferris wheel suspended between the two hotel towers.

Each presented its own challenges, and collectively they called on special expertise in the areas of construction, MEP and ABWF involving the supervision and coordination of multiple contractors.

In each area of the project, a diverse range of solutions were developed and obstacles overcome to deliver the cinematically-themed integrated resort conceived by the visionary leader of Melco Crown Entertainment as Asia's Entertainment Capital. This was achieved significantly ahead of an exactingly tight schedule, and Studio City was able to open as planned on the 27th of October, 2015, with all elements of the complex fully operational, built to the highest standards, and ready to receive visitors and guests.

The project team's first task after taking over the site was to construct a four-storey podium, which would ultimately house, on different levels, the offices, plant rooms and car parking facilities, ballrooms, retail streets, many of the gaming and entertainment areas, the hotel main lobby, spa and gym facilities, and the Golden Reel waiting area. The entire 100,000 square meters of the podium deck area had to be landscaped as well.

Because of piling delays, fast-tracking podium construction was imperative, and to achieve this an average of 1,000 cubic meters of concrete per day were poured, enabling podium topping out on the 23rd of May, 2014.

#### Unique design

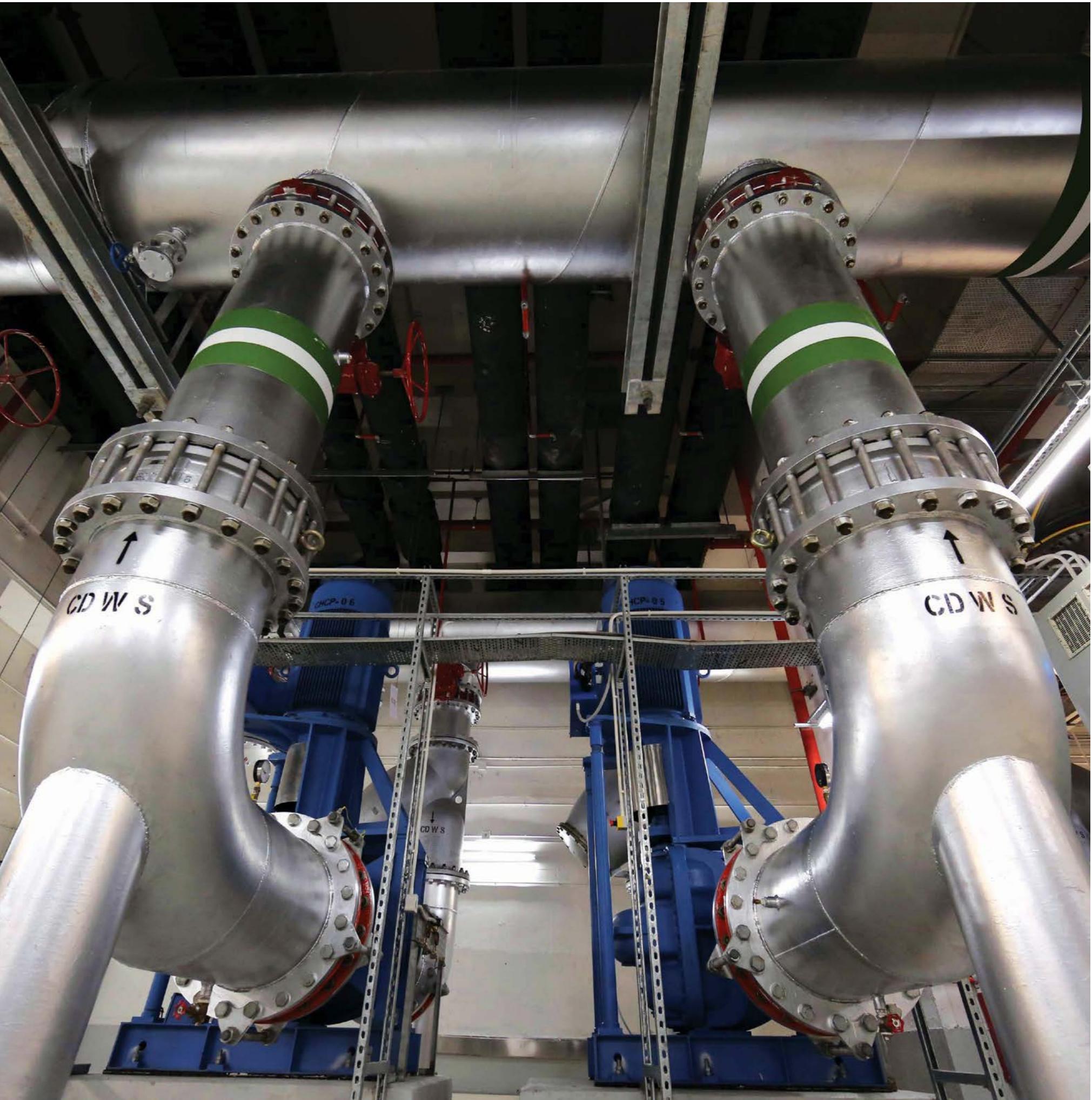
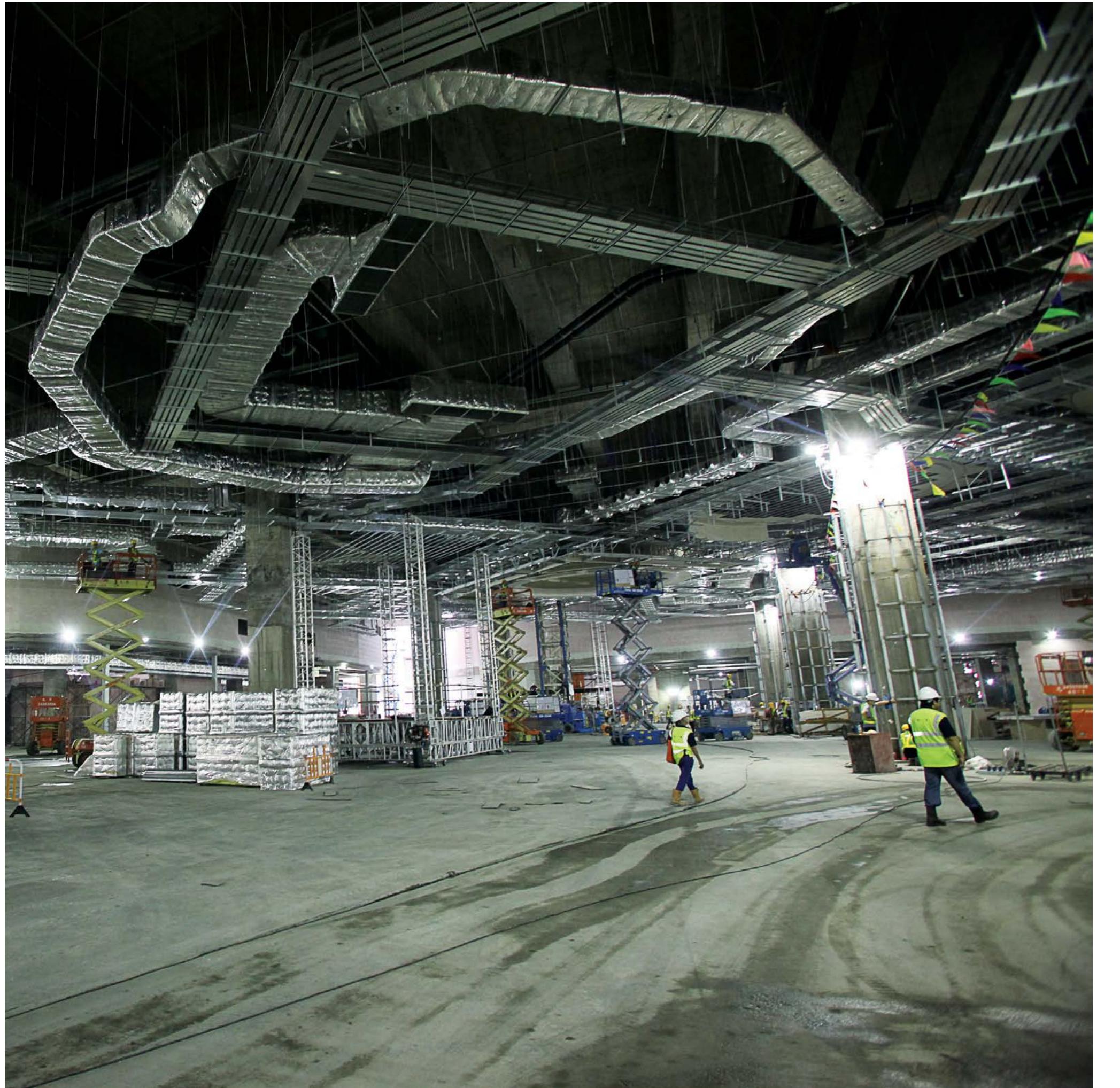
Rising above the podium in a semi-circular arrangement are eight conjoined art-deco inspired blocks, ranging from 37 to 41 storeys in height, each surmounted by a turret. Together these comprise Tower A and Tower B of the entertainment-themed Studio City Hotel, which offers a range of luxury accommodation to suit different guests.

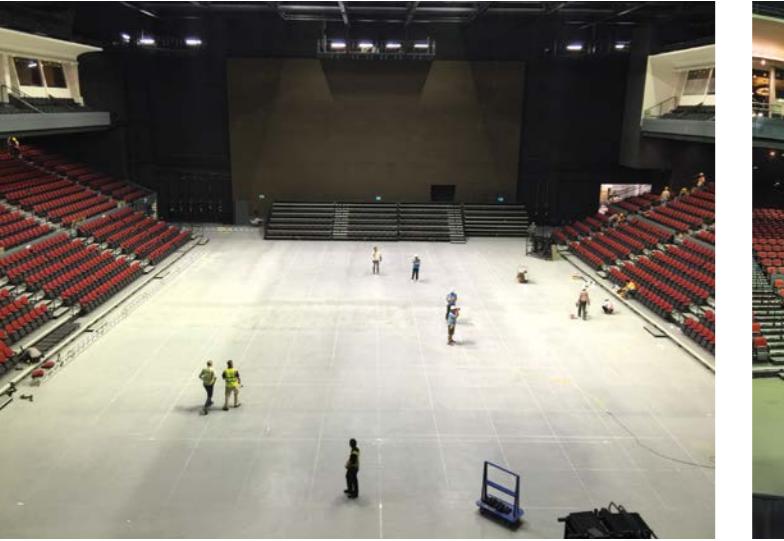
The Star Tower and Celebrity Tower offer five-star and four-star hotel service and facilities, respectively, with accommodation ranging from 185 square meter suites to 42 square meter rooms. "The design of the hotel is really unique," Chief Executive Officer James Lee points out. "In Macau, they are mostly blocks, and this is more of a semi-circle of different heights."

The curvature of the superstructure presented a number of challenges to the project team, as Architectural Director Frank Wong explains. "There are over 17,000 different curtain-wall panels in different sizes and around the whole building, and we had to cover over 860,000 square feet of façade. It's all very unique. It's quite different to other Macau projects in terms of curtain-wall design. Usually standard-sized curtain-wall panels are used because they are easier, faster and cheaper to build with. Here, because the project is semi-circular, all the panels are slightly different, and go up in a tapered form, which made fabricating and positioning them very difficult. If they're not properly labeled, you don't know where they go – and, if they are delivered in the wrong sequence, you can't put









them up either. We didn't let either of those things happen. It was also quite difficult to integrate the curtain wall with the Ferris wheel."

One of the important Studio City project milestones was early completion of the lower-level hotel rooms, according to MEP Director Jonathan Wong. "We needed to deliver about 90 rooms for early handover by the end of December 2014 from the low zone – about six to seven stories of rooms in a demarcated plan. It was a big challenge. We had to plan how to get these areas ready for inspection and handover and we had to push the contractors, but we managed the early completion."

The critical MEP and fitting out work was mostly conducted under intense pressure of time. Among the project milestones that had to be achieved on schedule or ahead of it were early completion of the Data Center, required by early January 2015; early activation of the air conditioning by early December 2014; and early handover of the back of house areas to the operations team by the end of December 2014. "We had eight large-scale MEP packages for both the hotel and the podium which were worth about HK\$3.5 billion, which is approximately one third of the total construction cost. That covered air conditioning, electrical, fire services, plumbing and drainage, and extra low-voltage installation works. We had seven MEP contractors, because two packages were awarded to the same company," says Jonathan.

#### Complexity

Studio City has, he believes, the most complex system of MEP works in Macau, and all work was completed in less than 28 months.

"The key milestone was early completion of the Data Center, which required a handover to the client's information technology (IT) operating team 12 months in advance of the opening, with the construction works, MEP works and fitting out complete. That's a very early completion date and it compressed our MEP program from 90 days to 57," he says.

Another was the early activation of the six-chiller-powered 18,000 air-conditioning ton AC system. "We had to get the physical work done in 4½ months and do the flushing in 1½ months. It was very challenging because it's such a complex pipework system and a huge length – more than 100,000 meters," says Jonathan.

High-speed installation was made possible, he explains, primarily by well-structured project execution planning, but also by the use of three-dimensional computerized animation techniques supplementing drawings to plan the complex MEP services. The deployment of customized hoisting equipment, which expedited installation of the prefabricated chiller-pipe work, was also important. The animated



and BIM models, he says were especially valuable in planning the particularly complex MEP works for the casino with its 13,100 square meter gaming floor and 9.5 meter ceiling height.

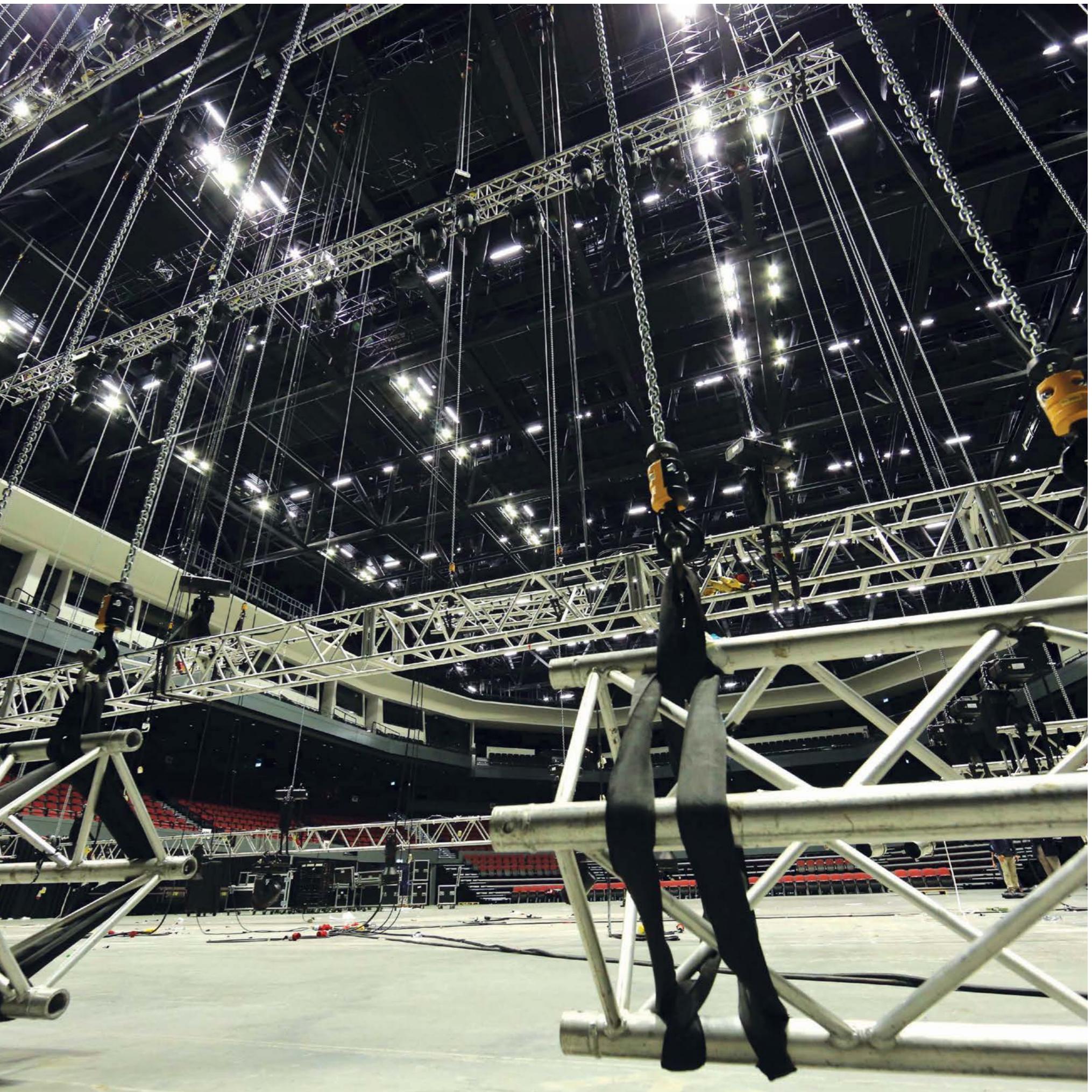
#### Challenges met

A variety of challenges were also presented by the attractions in the retail, food and beverage, and entertainment areas of the podium and the hotel towers. Frank singles out the 5,000-seat Studio City Event Center as an example of these being particularly effectively addressed. "As in most other areas, we needed to have several contractors from different trades working at the same time. The Event Center is a little more than 80,000 square feet across three levels and with clear headroom over the arena. That involved lots of activities at high level using heavy lifting equipment, so safety precautions and good planning were the main success factors. We actually divided the area into smaller zones, each with a set of timelines on three-dimensional aspects," he says.

Further installation time was saved through maximizing the use of prefabricated materials in fitting out the area. "For instance, the entire seating platform, stairs and seats were all completed with finishes overseas and only required minimal on-site installation work. Also the overhead working platforms were mostly constructed with prefabricated components to save time. We finished it in three months, including all the fitting out and MEP high-level services – duct work, lighting and so on," says Frank.

The Event Center also required some heavy lifting. The six V-shaped steel roof trusses, each with a 60-meter span and 5-meter depth, weighed approximately 56 tons per truss, with the heaviest section weighing 34 tons. The long-distance lifting was carried out by 300 ton and 350 ton mobile cranes with luffing jibs. "It is not the biggest stadium in Macau, but it is the most technologically advanced in terms of lighting, AV and acoustics. Madonna was the first international artist to appear there," says Frank.

Having created the spaces to be occupied by such major attractions as The House of Magic and Batman Dark Flight, the Studio City project team were also responsible for helping the specialist contractors who had developed them to complete the installation successfully. Batman Dark Flight was designed by Canadian flight-ride specialists Direct Structures, and assembled from components manufactured in Mainland China. "Our main role was to provide an enclosed weather-tight area which was dust free for them to work in," says Frank. "That sounds easy, but a dust-free environment in a heavy construction area is very hard to achieve. After constructing the weather-proof area, we





did it through access control with extra security guards, screening of what was brought into the area, and carrying out daily housekeeping. It's the first 4D simulation attraction I've worked on, and it's really quite amazing. They kept the details very secret, and we had to sign a confidentiality agreement."

Designed, curated and hosted by acclaimed illusionist, Franz Harary, The House of Magic was surrounded by even more secrecy – so much so in fact that the project team did not even have full access to the design drawings. "Only a few senior supervisors from their company had access to them, and they gave very full verbal instructions on site. Everything was very secret, right up to the last minute," says Frank.

Creating the landscaped gardens with their extensive water features, including an indoor and outdoor swimming pool, and the popular RiverScape ride, was also a more complicated undertaking than might at first appear, according to Frank. "It's a big outdoor garden with water features right above the casino. We had to create a span of 20,000 square meters of space above the casino, so water-proofing and structural stability were the main concerns. The podium design calls for two layers of construction with a second slab, which is the base for the swimming pool and the garden. It looks like one big simple area, but in fact there is a lot of complexity contained inside. In that cavity space is where all the drainage and MEP works are."

Having every facility ready for the grand opening was the project team's target, but until almost the last minute it looked as though Studio City might have to open without its Ibiza-themed nightclub, Pacha Macau. "The design and construction drawings for the nightclub only became available in March and April 2015. Initially, it wasn't expected to be ready for the grand opening," says Frank.

"But, in the end, we pulled it off. In just over six months, we turned an empty concrete shell into a fully functioning nightclub."

In the end, the project team successfully completed each stage of the Studio City work on or ahead of schedule, and it passed all the final statutory inspections between June and late October 2015. Amid much well-justified fanfare Studio City opened as scheduled on the 27th of October, 2015.

"We took just 28 months to complete the entire superstructure, MEP systems and fitting out works and had it ready for Melco Crown Entertainment to operate. That is approximately 5 million square feet of GFA, 1,600 hotel rooms, over 10 F & B outlets with a 5,000-seat Event Center, several gaming areas, a ballroom and major attractions, such as Batman Dark Flight and the Golden Reel, altogether involving 335 trade contractors from around the world," says Frank. "It certainly wasn't easy, but we proved it could be done."

# The Golden Reel

*Of all Studio City's notable firsts the most spectacular is The Golden Reel.*

**P**ositioned right at the center of the Studio City complex, the world's first figure-8 Ferris wheel is all the more visually arresting for being suspended 130 meters above ground and between the 10th and 41st floors of the complex's two hotel towers.

Designed by industry leaders Intamin Amusement Rides of Liechtenstein, the most exciting ride in Asia commands spectacular views out over Macau, China and the Pearl River Estuary. The 17 "Steampunk" themed cabins, each accommodating up to 10 people, take around 15 minutes to complete a circuit.

Built in China to Intamin's design, visually The Golden Reel simultaneously suggests a number 8 and a giant 35mm film reel. It is Studio City's defining icon, and its installation presented the project team with perhaps the most challenging engineering problems of the entire Studio City project – as well as involving some of its most dangerous procedures.

"An approximately 950-ton steel structure had to be assembled at height and completed in seven months. It was a very tight deadline, especially with the shortage in Macau of skilled labor, and particularly of qualified welders. Those were big challenges for us," explains Deputy Project Director Richie Lui.

The Golden Reel Zone is divided vertically into three sections. These comprise the ride structure itself, and the structural steel framework for two dramatic lighting displays.

The Sunburst Zone below the wheel extends from the 10th to the 20th floors; the Golden Reel Zone is from the 21st to the 39th; and the Starburst Zone above it from the 39th to the 41st.

The Sunburst Zone comprises six layers of horizontal steel trusses to support the façade lighting panels, and the Starburst Zone is a structural steel frame supporting the Studio City sign, façade lighting panels and a roof-top gondola.

In the Golden Reel Zone, Richie explains, the plant rooms are on the 21st floor, the observation deck and control booth on the 22nd, and between the 22nd and 39th floors are the Ferris wheel, two golden-coloured figure-8 steel trusses and lighting façade panels.

There were several significant issues the project team had to address in installing the three zones. One, of course, was the pressure of time. Another was safety. Not only were workers exposed to the usual risks of working at a height – a significant amount of welding work also had to be carried out with the additional attendant risks of fire. Here, as in all areas of Studio City, strict observance and enforcement of the project team's safety rules paid off. No serious accidents occurred while the Golden Reel was being erected.

Another issue was the coordination of multiple contractors. "In addition to the structural steel work and Golden Reel installation, there were a lot of other trades carrying out work in the Golden Reel Zone, such as installing the façade panels, façade lighting and MEP works. It needed close supervision and management, and demanded a lot of cooperation," says Richie.

There were also logistical issues to be addressed in getting all the components into position. "The Golden Reel is set back approximately 100 meters from the edge of the

second floor podium. Both the horizontal and vertical transportation of structural steel elements weighing between 7 tons and 19 tons from the ground to the zones presented a big challenge," says Richie. The solution was to install a track-and-trolley system on the podium deck, which would transport the heavy steel structural elements towards the Golden Reel Zone between the hotel towers and then be lifted to the final position for fixing by a tower crane. Tower cranes were employed for the Golden Reel, including an extra column-mounted luffing-jib tower crane. The first, at ground level, would lift the steel elements on to the trolley system, from which the others would pick them up and hoist them into position for fixing.

"The structure supporting the Golden Reel is called a 'backbone' and was delivered to the site in 14 elements for assembly to form a ring for fixing the chassis to, and to accommodate the cabins. Each backbone segment is bolted to a ride support and the support is connected to the towers by a cast-in embed," Richie explains. The "backbone" weighs 157 tons in total, and its heaviest section is 10.7 tons. Other steel elements transported by track to the cranes included four box trusses, each weighing approximately 50 tons and with the heaviest section weighing 19 tons, and two figure-8 trusses with a combined weight of 150 tons and the heaviest section weighing over 7 tons. "The track-and-trolley system proved to be very efficient in getting the elements into position. The track was only 700mm above the podium deck, which is a very low center of gravity, and therefore very safe. It had a capacity of 20 tons. We installed two systems as a contingency support in case one of them stopped functioning. It was a unique design, only for this project, but can be reused in the future for projects of a similar nature," says Richie.

Another challenge to the ingenuity of the project team was to design and erect an adaptable working platform between the two hotel towers for workers to carry out the structural steel work, the Golden Reel installation, and other necessary functions in the zone. "The design of the working platform had to be safe and flexible to change to suit different trades, fixing in different periods of time. In order to carry out façade panel and lighting work in the lower zone in parallel with the structural steel work, we adopted a proprietary steel scaffold platform and designed it to split the scaffold into three zones vertically. Each zone of scaffolding could be self-supported, so that the lower zone scaffold could be dismantled independently," explains Richie.

The tight schedule to which the whole project was subject meant that ways had to be found for the different trade contractors to work concurrently, which involved speeding up the installation of the wheel itself. Completion of the Golden Reel was one of the most critical milestones of the project, and bringing it forward required imaginative rethinking of the original installation plan, which called for only two tower cranes. Project Director Andrew Keung convinced the client to absorb the cost of installing the additional luffing-jib crane for the sole purpose of expediting work on the Golden Reel.

"This is the most important feature of the project." Andrew recalls.







"There was a lot of pressure on us to get it through. Technically, there were a lot of problems to solve in terms of structural engineering. There were issues such as when to release the support, the load sharing between the upper support and the lower support, and so on. We actually changed some of the design. Originally, it required us to do butt welding on site, but we proposed instead using temporary bolts and nuts, and then to do the welding afterwards." With the temporary bolt and nut connections, the steel sections could be self-supported, reducing tower crane hooking time, and the steelwork assembly could be continued before completion of welding the joints. The permanent welding work could then take place at night.

"It was like a 3D puzzle, so that's even more challenging," says Chief Executive Officer James Lee. "We had to allow for contingencies in both the vertical and horizontal paths. It was all very critical."

Some of the work to expedite the Golden Reel's installation took place off site. Richie says he and his colleagues would regularly visit the factories where the Golden Reel's structural steel elements were being made to check on progress and quality. "In order to achieve effective communication for problem solving, weekly meetings were arranged with the client and the subcontractors to review the fabrication and site erection progress, and to brainstorm mitigation measures if the progress was delayed. Ad hoc meetings would also be arranged when necessary," he recalls.

There were, Richie and Andrew agree, many tense moments during the installation of the Golden Reel, but perhaps the most tense was the backbone de-propping process. The backbone structure of the Golden Reel is supported by a bottom box truss at the 20th floor and some of the load is hanging-supported by the upper box truss at the 39th floor.

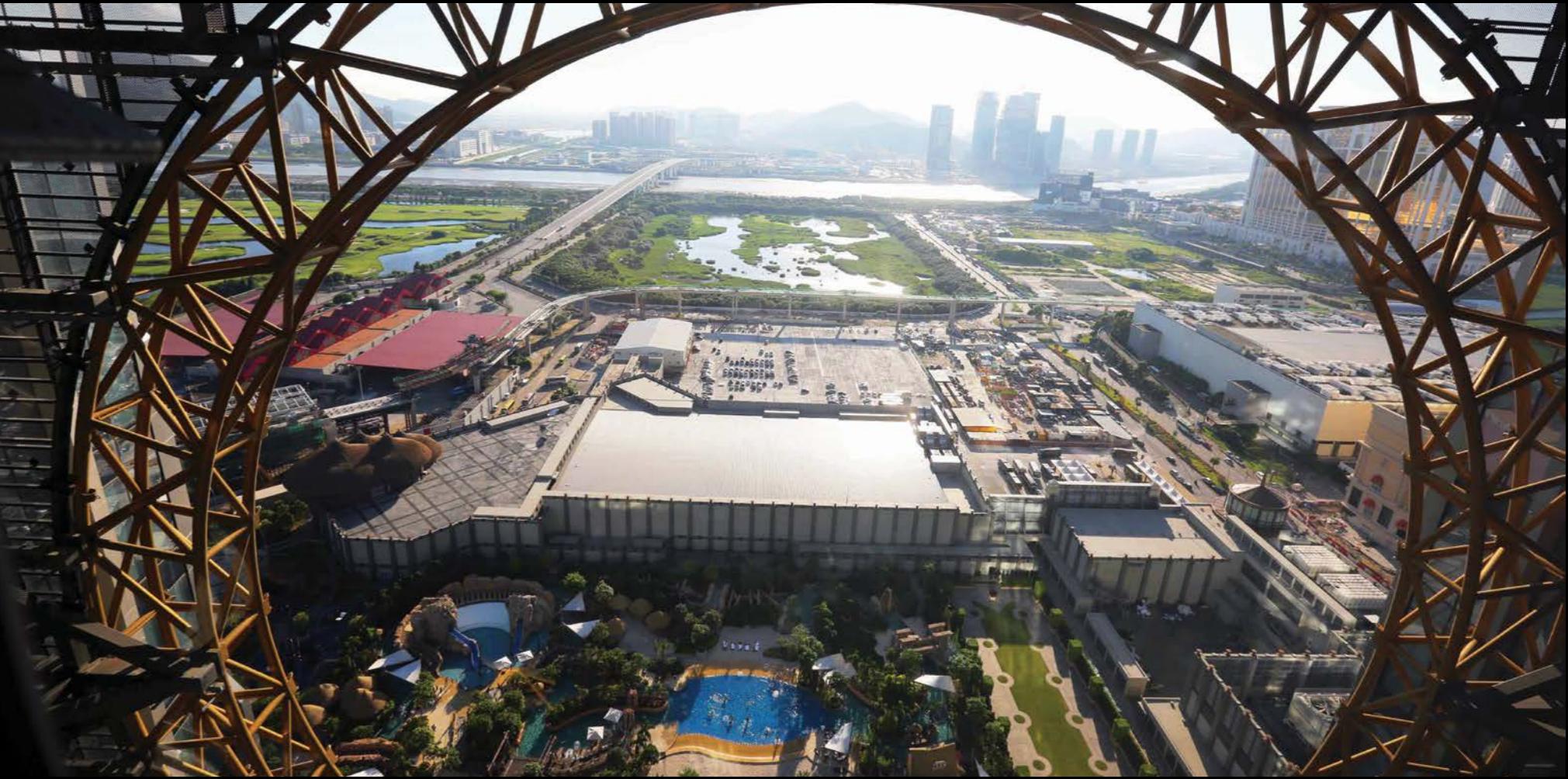
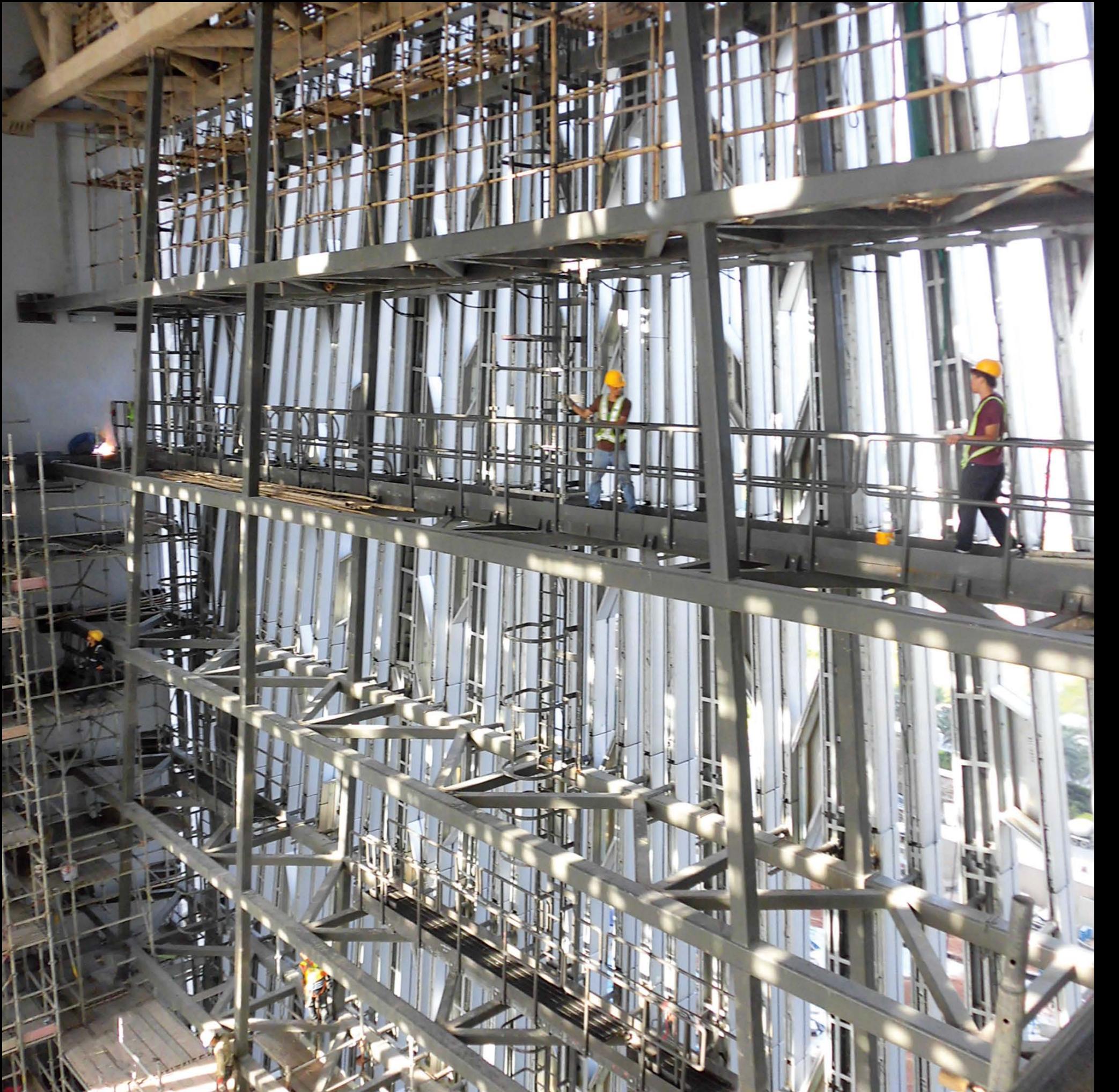
Before the connection of the backbone, the upper box truss was supported by temporary steel wires, which could only be released after the connection of the backbone and figure-8 to achieve the load transfer to the hotel tower structure. "The backbone needed to be jacked up by hydraulic jacks to connect to the upper box truss. The hydraulic jacks were then released in parallel with the temporary wire removal. The whole de-propping process had to be closely controlled and monitored by instruments and engineers. We had to monitor the jack pressure continuously during the jacking process and while releasing the temporary wire support," says Richie. The process however went without a hitch, and the installation was completed early.

"We shortened the whole duration of the Golden Reel construction by 122 days – four months," says Andrew. Ferris wheel mounted between buildings rather than standing as independent structures are a rarity, but the Studio City project has demonstrated that they can be so installed to sensational effect, and Richie thinks there will be imitators. "I think it will be like the competition to build the tallest building in the world," he says.

"The Golden Reel is not only an icon of the Studio City project, but also a landmark of Macau, which will attract tourists. I believe more rides in different shapes or with other unique designs and characteristics will be designed in future in other cities. When I rode on the Golden Reel for the first time, I felt a sense of accomplishment – and believed that everything is possible if you give your whole heart to do it."

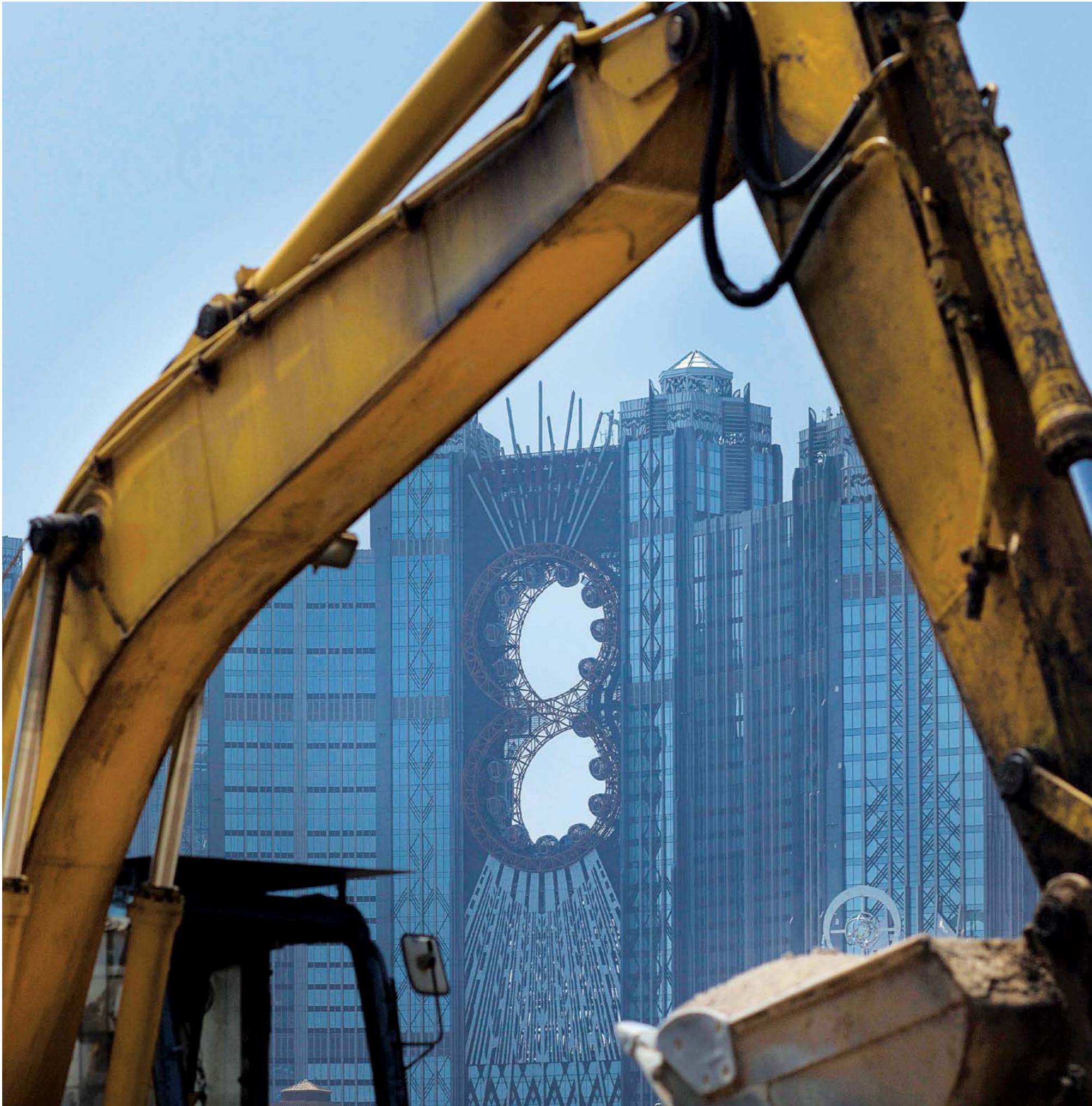






A black and white photograph showing three construction workers at a night-time construction site. One worker in the foreground is kneeling on a metal grating, wearing a hard hat and safety vest, and appears to be welding or working on a metal structure. Another worker stands behind him, also in safety gear. A third worker is visible further back, near a large cylindrical concrete structure. The scene is illuminated by artificial lights, creating strong highlights and shadows.

One Team  
One Dream



## 同築一夢

新濠影滙項目的成功，毫無疑問是建基於團隊之間的緊密合作及有效溝通。

28個月的施工期，多達500人的項目團隊，加上分別來自香港、中國內地、加拿大、列支敦斯登及南亞等世界各地335個分判商，要令所有人都抱持同一方向和目標，推動工程項目的發展，絕非容易的事情。幸而，在出色的領導才能、科技軟件的幫助和夥伴關係的文化下，項目團隊成功協調各方，令大家都樂意在自己的範圍以外多行一步，多想一層，將彼此的創意和生產力匯聚一起。

要統籌及協調這龐大的工程團隊，面對面和電郵溝通固然重要，而透過Aconex資訊系統，與客戶、項目團隊及分判商等共享資訊，更能事半功倍。由於所有資料均存放在同一平台，會議後，分判商可於48小時內取得相關圖則及資料，大大免卻了因傳遞信息造成的延誤或誤會。

此外，項目團隊採用BIM協調有關結構、建築及機電工程的事宜。團隊內各職級同事亦可透過智能電話內的聊天群組進行交流。針對各項特定範疇，團隊建立了約120個聊天群組，各同事可不分職級高低就工程的進度、困難或狀況自由交流，大收集思廣益之效。至於手機照片更可具體和明確地闡釋問題所在，讓相關單位能即時跟進。

在維持管理及職權同時，項目團隊視分判商及客戶為夥伴，當面對突發事情時，這種夥伴式關係更見成效。

另一方面，因著與客戶保持良好和互信關係，項目團隊亦可按需要提出新建議，如以石膏磚取代酒店內部分的砌磚，以及為「影滙之星」結構鋼工程額外添置塔式起重機。以上的建議雖牽涉增加成本，但因可以提高效率，客戶也欣然接受。

隨著項目不斷的推進，各持分者的互信協商精神更趨鞏固，各方都懷著同一個理念，在和諧的氛圍下，竭盡全力並一絲不苟地做好這工程項目。





**T**EAM, as Studio City Project Director Andrew Keung points out, is an acronym. It stands for "Together Everyone Achieves More", and it would be hard to think of a better example to illustrate the point than the success story of Studio City's construction.

Assembling a project team was the JV's first task. Ultimately, a more than 500-strong group of professionals, managers and supervisors had the daunting challenge of managing no fewer than 335 trade contractors, including 35 nominated subcontractors (NSCs), 67 direct contractors (DCs) and 233 domestic subcontractors (DSCs) from different parts of the world, including Hong Kong, Mainland China, Canada, Lichtenstein and South Asia.

"We worked as one team and family," says Senior Deputy Project Director Frankie Lui. "That was very important because there were so many supervisory staff on site, so we had to. People from many different countries worked together on this project."

During the first quarter of 2015, when construction was at its peak, the team on site every day numbered more than 10,000.

#### Meetings, meetings, meetings – Interfacing at all levels

"Just getting to know all the contractors was difficult, never mind working with them all on a daily basis," says Chief Executive Officer James Lee. "But the interfacing protocol played a very important role in getting this built."

Before site preparation work was complete, James remembers having as many as 70 meetings a week with trade contractors, but he says the real team building began when those meetings could be held at the site itself. "Before the site actually had a frame so that you could walk it, it was just a piece of land. Once we had the skeleton in place, we started having morning site walks in different areas, with all the contractors working in each area participating. Those would take four to five hours in the morning starting at about 7.30am. We would discuss the drawings, discuss the problems, and resolve them on site, so the interfacing was very close. If we'd all been sitting around tables in a meeting room, I don't think we could have achieved what we have now," he says.

Andrew has no doubt what the key to the eventual success of the project was. "There were a vast number of people on a vast site. The most important thing was effective communication," he says, "and that was particularly important face to face."

From before moving on to the site to the final handover, the project group maintained a schedule of regular meetings with the client and contractors to ensure that everybody involved fully understood what was expected of them. An initial "kick-off" meeting between each subcontractor and the relevant project team managers would be followed by weekly progress meetings, attended by representatives of the client and subcontractors.

#### Coordination

Confirmation of what was decided in the meetings and other non face-to-face communication took place formally through a common data-sharing platform, the Aconex Information System. This system allowed information to be easily shared between the client, project team and the subcontractors.

Under this system, following decisions made in meetings, the subcontractors could expect to receive the relevant drawings and information within 48 hours. Because the information was all on the same platform it could be distributed very quickly. Building Information Modeling (BIM) was harnessed to coordinate structural, architectural and MEP works. "BIM helps – modern software technology gives you another perspective and it helps to plan work more efficiently," says Andrew. "You see things differently in 3D than from plan drawings. Virtual visualization technology helped us to make sure there was enough headroom, especially in kitchens, and comply with fire service regulations."

Working in tandem with the formal data sharing on Aconex was an informal smartphone chat group through which many of the contractors chose to communicate. Photographs taken with mobile phones were used to ask for action or assistance from colleagues. "People would post images of whatever needed attention and write the message, 'Can someone go fix this now?' And it would happen because so many people on the site were connected to it," says James. He believes that the chat-room discussions allowed for swifter action because of the immediacy of communication.





*"The coordination between different companies was one of the great achievements of the project."*

"It was extremely important to the project. It kept people aware of actual progress, and we knew who was facing problems and in which areas, and could then organize help. The best part of chat groups is you are not in a meeting room. Everyone can talk. There are no titles or seating plans – no hierarchy. So everyone can get right to the point. People working who perhaps weren't able to raise an issue during the morning site walk didn't have to wait for another opportunity. They were free to make any points they wanted to – directly to the top, so the response was immediate. It was a very effective system, and the process was continuous. Anybody working on the site could be involved."

#### Regular walk through

There were around 120 different chat groups within the bigger group, each devoted to a specific aspect of the project, such as safety planning or assembling the curtain wall. Although the online communications were helpful, James and Andrew both stressed the importance of face-to-face contact.

"Although we used Aconex for this project, we do believe that it is human communication that is the best way to get things coordinated," says Andrew. "We used lunches as meeting times with the construction and coordination team managers, so everybody could get together to discuss progress and solve problems quickly. Those worked very well."

Recognition by the project team of the importance of personal contact with colleagues and workers on the site was critical to building the team spirit that was ultimately so important in delivering the project.

MEP Director Jonathan Wong says he found that an additional benefit of the informal safety briefing sessions he personally conducted every Wednesday in the canteen was that he was able to establish a rapport with the people who worked under his supervision. "Every time 100 workers attended, and we discussed how to use equipment like the scissor platforms safely and in a proper way. I formed a very close relationship with the workers because about 60% of them I trained face to face," he says. "At peak time, we had about 2,000 workers in parallel with which I had to manage my own staff of about 50 and another 200 from the subcontractors," he recalls.

#### Project execution plans

As well as good interpersonal relationships and data communications, Jonathan attributes the speed and efficiency with which the MEP work was carried out to requiring all the contractors to submit detailed project execution plans (PEPs) before work commenced. "I gave them a standard format to follow, including, but not limited to, a project overview, organization chart for site operations, timeline for key milestones, subcontractor strategy, labor forecast, major equipment procurement, material and drawing submission status, site set up, site management, logistics planning, work sequence for major areas, testing and commissioning, works management, safety management, and training strategy," he explains. Once the PEPs were accepted, he says, work proceeded more smoothly and he and the contractors properly understood each other's concerns.

Keeping the lines of communication simple also contributed to site efficiency. Frankie stresses that the project team at all times retained "real and proper ownership of the whole construction process".

"Our strategy was to streamline production processes and mitigate construction risks by avoiding extensive subletting of work, and to secure the required high levels of resources by means of a breakdown of work in packages and work area, and in parallel. This approach allowed us to make use of NSC and DSC internal resources such as professional experts,

labor, plant, off-site fabrication, and storage," he explains. While retaining management control and authority, the project team's policy throughout the construction of Studio City was to treat contractors as partners, and the relationship between client and lead contractor followed a similar pattern.

#### Trust through teamwork

"Teamwork is not just a matter of people working together – you have to build trust, and not only among our own project team but also with the subcontractors and the employer," says Andrew.

"One of the successful factors of trust and teamwork was that we worked very well with the client. When problems arose it wasn't just a question of 'This is your problem' or 'my problem', it was 'our problem'.

Some problems that arose were due to circumstances beyond the control of anybody involved in the project, and required quick solutions. In addressing these, the cooperative relationships that had been developed were particularly valuable.

Melco Crown Entertainment has a very strong in-house design team and together with their consultants they had produced quite a comprehensive set of drawings for us to work with," says Frank Wong, the Architectural Director. "Despite that, there were a few cases where we had to suspend the site work and go back to the drawing board with the consultants, and redevelop the design and construction details due to changes of regulation or market needs."

"For example, a third of the casino area had to be redesigned during construction to provide smoking facilities," Frank explains. "We had to conduct urgent meetings to identify the impact and prioritize items that were affected. That was quite a change in construction planning with the contractors." A solution was found, and efficiently implemented. The area that was to have been a smoking area had been repurposed for VIP use and 10 enclosed smoking lounges had been installed at strategic points around the gaming floor for smokers to use.

"The coordination between different companies was one of the great achievements of the project. We had more than 10 consultants on MEP design, structural design, architectural, statutory approvals, and also the 335 trade contractors. Dealing with all that on a daily basis is a big task. We were able to form alliances to become one big integrated team, and that way we were able to manage all the contractors and all the changes that took place during the project," says Frank.

Because close contact was maintained and channels of communication kept open, Andrew says it was easier to propose ideas that could benefit the project but which were not part of the original plan.

Examples he cites include the substitution of gypsum blocks for some of the brickwork in the hotels, and the hiring of an extra crane for the installation of the structural steelwork on the Golden Reel – both decisions that produced a clear efficiency gain, but which also involved an increase in costs.

Melco Crown Entertainment's Chairman and CEO Lawrence Ho was a frequent visitor to the site, and other senior executives from the client also regularly joined site walks and talked to contractors, keeping themselves informed in detail about the works progress. "We had a partner's relationship with the client as well as with all our subcontractors," says James. "That is very unusual for a client. They were very helpful and proactive. Everybody had just one agenda. To get this built on time. It was a very happy project to work on. There were no politics around, no hidden agendas. Everyone was working hard just to get it done."





The veterans of many major construction projects who worked on Studio City were surprised at how smooth the interaction between the large number of stakeholders became. "A team is a group of people working together and you can only work together really efficiently if trust has been built up. Because there was so much open exchange of information, and because of the regular close monitoring of documents to ensure that everybody was up to date and on the same page, we were able to build up trust among the stakeholders," says Andrew.

James agrees that pulling a vast diverse team together and creating a culture of cooperation, which was conducive to efficiency and creative thinking, was one of the project team's greatest achievements. "With 335 trade contractors, at the end of the day we had not received one letter of complaint about coordination, money, or anything else. That was because everybody was working very proactively, solving daily problems. There were no hindrances, so everyone was happy to work hard to get the project done," says James. "Very close communications were important – and people willing to work beyond their scope. As long as everyone is willing to walk that extra step outside their own circle, everyone starts thinking about others. Then the whole relationship becomes harmonious. The contractors all want to help each other, and everything becomes very smooth."



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Safety as  
a Priority





## 安全規劃

安全和可持續發展是建造新濠影滙時的首要考慮。對工作時數高達3,200萬小時，高峰期超過10,000名工人的工地而言，能創下零死亡率的紀錄，絕對是難能可貴的事，這亦印證了安全和效率是可以和應該並行於施工中的。

風險評估和工作危害識別為全面安全管理規劃中重要的部分。項目團隊特別於與分判商的合約中加入安全守則和條款，規定所有工人需於入職初期參與安全課程，以及定期接受相關的課程。他們亦引入獎罰機制，分別獎賞遵守及警誠違反安全守則的分判商。至於從事特殊工種的工人，則需接受特別培訓，通過考試後，方能取得「獲准工作」認可。正式工作時，他們亦需向相關主管展示認可證明，以證明具備相關的技術和知識。

此外，完善工地管理亦是此工程項目所標榜的，一連串看似微不足道的安排，如利用吹風機減少空氣中的灰塵，以及使用減音設備，除了能為工人帶來安全的工作環境外，同時亦能保障他們的健康。

新濠影滙工地面積甚廣，每天有高達8,600名工人進出，每日接收880廂貨櫃材料，所以工地特別採用了掌紋識別系統，以迅速識別工人的身分及持有之准許證。如此嚴密的保安系統，詳盡的出入紀錄，成了確保工地安全的重要把關。

**S**afety was a high priority from the earliest planning stages of Studio City's construction. It was determined that while work was to be fast-tracked wherever possible, this was never to be at the cost of cutting corners on safety.

"With over 30 million man hours on site, there was not one fatal accident, and that is directly because of the methodology, the training provided to workers, and the housekeeping. All those things contributed," says Chief Executive Officer James Lee.

Safety was built in to all project processes from the planning stage, with the first steps to protect workers on site taken long before works commenced. Risk assessment and the analysis of job hazards were integral to the drawing up of all method statements, according to Project Director Andrew Keung. "Safety and efficiency go hand in hand. We knew the safer the workers were, the higher their morale would be, and the faster they would work," he says. "We also knew that in the safety area nothing could be left to chance. Systems had to be put in place, and strict rules had to be observed. Constant supervision would be necessary to make that happen."

#### The House Rules

A comprehensive safety management plan was drawn up. It comprised regulations that became known as "The House Rules" by which all on-site personnel had to abide. Observance of them was written into all subcontractor contracts.

Under The House Rules all workers were required to attend a safety induction workshop immediately on being hired. Further ongoing compulsory safety training was provided pertaining to specific tasks, which involved risks either to the worker, or to their colleagues, or to other third parties on the site.

For skilled tasks with significant associated risks – welding work, electrical work and driving forklift trucks for example – a system of "permits to work" was implemented, with the relevant workers required to undergo special training and to pass tests for diligence and competence. The permits had to be shown to managers and supervisors before any hazardous work could be undertaken.

Drawing up rules was one thing – ensuring that they were taken seriously and consistently observed was another.

Instilling a culture of safe work practices among the unskilled workers on the site was a challenge. Many came from Mainland China, and although some had considerable construction work experience, they had often gained it on projects with significantly less strict safety rules and regulations. "With workers from the Mainland China there were, of course cultural differences, and particularly to do with the safety culture. We put a lot of effort into working with them to make sure they were safe on the site," says Andrew. To maintain safety discipline, what Andrew calls "a carrot-and-stick approach", involving incentives and penalties, was adopted. Breaches of safety incurred fixed-rate fines, and the money raised went into a "Safety Fund", which paid for the incentives program. Over





the course of the project those fines added up to around HK\$1 million – all of which was returned in the form of awards to safety managers, individuals and works units who had successfully maintained the highest safety standards. The money was distributed not in cash, but in the form of prizes such as supermarket vouchers, or sponsorship of group dinners.

"Incentives really work," says Andrew, "but people also need to understand fully what the implications are if the rules are not followed. The consequences if safety harnesses or helmets are not worn, if shortcuts are taken on procedures, or if site vehicles are driven recklessly, for example, needed to be fully understood. Of course, there were some relatively minor accidents and injuries, and I asked the injured workers to share their first-hand experiences of what happened. I think that helped increase safety awareness. It made the risks seem more real."

Safety training, however, was only the beginning of an ongoing process, which involved constantly reminding the workers and their supervisors of the importance of abiding by The House Rules.

The project team worked in close cooperation with the Macau Labor Affairs Bureau to organize regular site-safety seminars for workers, and to encourage regular attendance. "Every now and again there would be batches of new workers, so we had to repeat the messages and be sure they got across," says Andrew. "And even for workers who had been on the site for some time, reminders never hurt. Over time people can become too relaxed and casual."

#### A clean sweep

Maintaining cleanliness and tidiness on the site also contributed significantly to making working conditions safe. Proper housekeeping reduced both accident and fire risks, and in James' opinion also made work more productive.

A project-specific housekeeping plan was designed for Studio City with which subcontractors were not only asked to comply, but to which they were invited to suggest improvements. The plan was regularly reviewed with a view to enhancing it and adapting it to project progress.

"Housekeeping sounds like a minor topic, but we look on it as very important," says James.

"We had a special team dealing with day-to-day garbage, because you have workers eating and drinking on site. That attracts rats, and they'll bite anything – including cables. Because of the housekeeping, in over two years stationed on site for the project I only saw one rat, and that was in an external area, not in the building itself. And I saw very few cockroaches."

The key to an unusually pristine site by construction industry standards was a systematic approach to waste collection and disposal. Special canteen areas were designated for workers. Cold drinking water was supplied, and garbage was regularly cleared away by collection carts, which removed the detritus before it could attract pests. Clean eating conditions also helped to maintain workers' morale – as did properly air-conditioned washroom facilities, conveniently located at strategic points throughout the site, and cleaned thoroughly three times per day.

With as many as 10,000 people on site every day at the peak of construction activity, proper maintenance of those facilities was absolutely essential, and additional wet toilets were installed as necessary during periods of anticipated increased demand.

The same methodical approach was applied to the regular collection and disposal of construction waste throughout the site. Workers were much less likely to trip up if there was nothing to trip over. "Mr Lawrence Ho, visited the site regularly and would walk it for at least three hours. He didn't need to wear specific boots because the site was maintained in a very clean way," recalls James.

#### Safe and secure

MEP Director Jonathan Wong says that the permit-to-work system was particularly helpful in protecting workers from electric shocks. During MEP works, without a competent person with a permit present, no worker was permitted to enter an energized area.

Jonathan also held regular training sessions to ensure that workers fully understood the safety aspects of the special hoisting and lifting equipment they were using in high-headroom areas such as the casino and the Event Center. Within the podium structures, storey heights ranged from 4.5 meters to 14 meters, and the project team was particularly conscious of the special risks associated with working at a height.





The decision, where possible, to use automatic raising platforms and scissor platforms for MEP and ABWF work at ceiling level – rather than less-stable traditional bamboo scaffolding – coupled with training and contractors' commitment to the specific project safety plan for the work they undertook, have been credited with preventing many potential injuries or fatalities from falls.

"We also organized regular site-safety walks," Jonathan explains. "Once a week, we would go round and identify areas in which safety could be improved, and ask contractors for immediate rectification where remedial work was necessary. It was something we monitored constantly."

With over 8,600 workers on site on a typical day and around 880 truckloads being delivered, safety was very much linked to site security systems.

#### Site security

Security was maintained using an access control recording system, through which workers were required to register when coming on to the site and when leaving. It maintained a comprehensive record of attendance on site, and successfully excluded illegal laborers and other intruders.

A permit system was also implemented for the entry and removal of materials and plant equipment. Security control points in key areas, a palm-geometric recognition system, which verified the identities of competent workers with relevant permits, and an emergency hotline for notification of breaches further secured the site.

Security personnel patrolled all areas regularly, and liaised with the project team and designated subcontractors' representatives to ensure that only authorized and registered personnel were present.

#### Caring for neighbors

The project team was meticulous in maintaining a healthy as well as a safe and tidy working environment throughout the site. Key contributory measures included regular sweeping of all areas, and the use of air blowers to minimize the level of dust in the atmosphere.

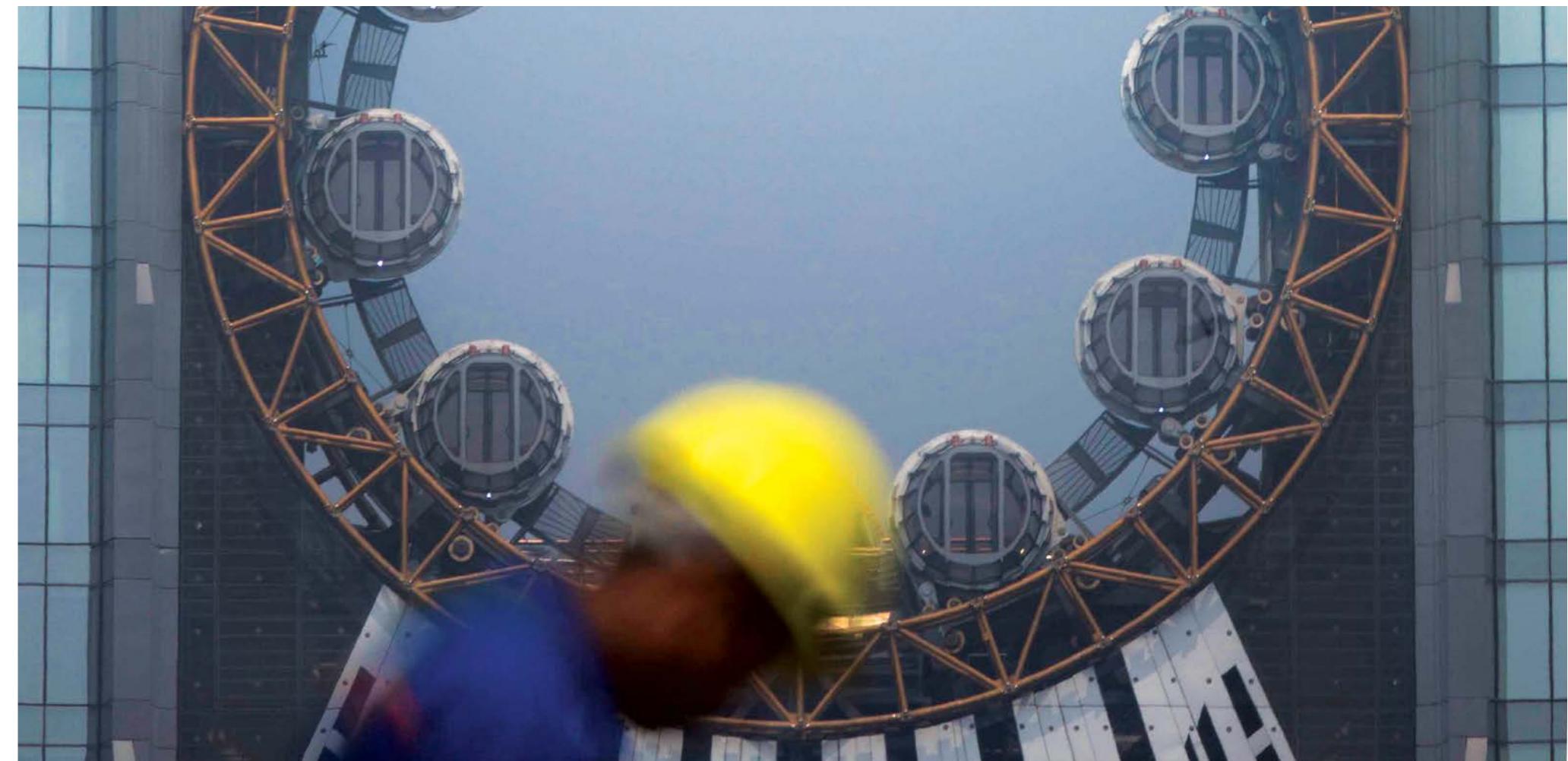
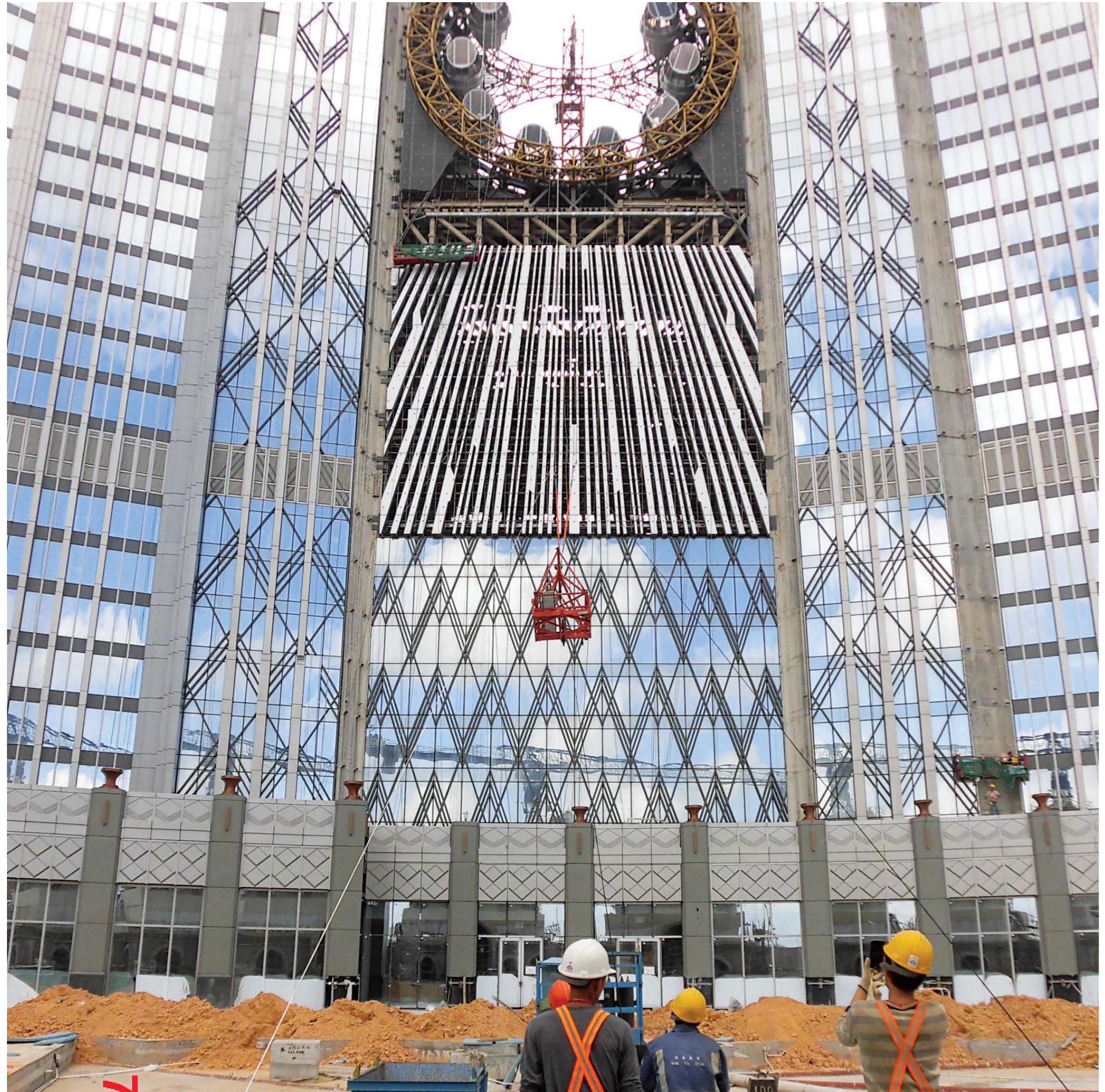
Noise suppression technology was employed wherever possible – for example on pneumatic drills – not only for the benefit of those working on the site, but also out of consideration for users of the nearby public areas. Sedimentation tanks were installed to remove foul content from waste water.

"On one day during the project a Typhoon Signal Number 8 was hoisted for a whole day – which meant nobody had to come to work. But most of our senior management were on the site at 8am making sure there was no flooding, that the scaffolding was secure, and that no mud was flowing off the site into public areas," says James. "People were willing to go the extra mile to make it happen. We care not only about the work environment for our people, but also the impact we have on neighbors and the public."

#### An achievement to be proud of

There are many impressive statistics associated with Studio City's successful completion, but the figure of which the project team is proudest is the zero for fatalities – an achievement recognized by several awards under the Macau Construction Industry Safety Award Scheme.

According to Macau Labor Affairs Bureau (DSAL) figures, during the three years of the Studio City project, there were 55 deaths of construction workers in Macau in the course of active projects. Studio City was completed with no deaths, and no reportable accidents, and was still delivered early – proof positive that in the construction industry safety and efficiency can – and should – go hand in hand.



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## Going Green Staying Green





## 綠色動力

新濠影滙的承建工程，見微知著，不乏環保元素。

為減低整個項目的冷氣負荷，建築設計採用了雙層平台設計以減低熱能；酒店幕牆使用高性能E-Glass面板，以及於員工後勤區安裝頂板冷氣系統，令新濠影滙每年大約可節省30%至40%能源。

以上的措施亦令新濠影滙最終只需開動6部3,000噸冷氣便足夠營運，較原本計劃開動7部為少。換言之，其耗用的冷氣亦由21,000噸減至18,000噸，大大減少了碳排放量。

除此之外，項目尚有其他環保措施，包括於主要照明面板使用LED燈，以及種植了超過10萬平方米的植物，為平台層泳池和戶外康樂設施添置園林景色。

建築材料的可持續性也是項目團隊關注的一環，他們以石膏磚及成型鋼架平台板取代環保效用較低的材料，而酒店大樓的鋼筋混凝土工序，更捨棄傳統不可再用的木製模板，採用可再用的鋁質模板系統。項目團隊亦盡量於鄰近的中國內地物色建築材料，以減低長途跋涉的運輸成本及對環境造成的影響。

# A

strong concern for all involved in or affected by the project influenced a number of decisions geared to reducing energy use and greenhouse gas emissions.

Melco Crown Entertainment had made it clear that Studio City should be as "green" as possible – not only for reasons of environmental responsibility but also because green solutions, while they might have a higher immediate cost, often offer huge savings in operating costs over the longer term.

At the design stage, it was determined that the upper podium should have a double deck. This would reduce heat gain in the gaming hall and retail areas located directly under the deck. It would also significantly reduce the air-conditioning load, as would the adoption of high-performance E-glass panels for the hotel curtain-wall system, and the installation of a chilled ceiling system in part of the Heart of House employee area.

"The short-term cost of the technologies is higher, but it can save millions from the electricity bill every year. With these systems we calculated a 30% to 40% energy saving. That really contributes to sustainability and greening," says MEP Director Jonathan Wong. "Because of the energy saving of this system, we were able to delete one chiller from the original plan. There were to be seven 3,000 refrigeration ton chillers generating 21,000 air-conditioning tons. In the end we only had to install six, generating 18,000 tons, which is sufficient. The missing chiller also means lower carbon emissions."

Power consumption was further reduced by the use of LEDs for the dramatic façade lighting effects around, above, and below the Golden Reel.

Another green measure at podium level included maximizing landscaping and planting to cover the whole external deck – an area of over 100,000 square meters, creating a garden environment of outdoor recreational facilities such as the swimming pools.

Wherever possible construction materials were chosen with sustainability in mind, as Chief Executive Officer James Lee notes. "We brought in new materials, which helped a lot. It was not a design-and-build contract. The original intention was that we would follow what the client had specified and drawn up, and build it. But, in the course of planning and construction, we were proposing to the client the use of alternative materials for the benefit of the project. Not necessarily in cost terms. Some actually cost more, but the benefits of the substitutions were enormous," he says.

For blockwork in the hotel and podium areas, dry-wall partitions and gypsum blocks were adopted instead of conventional brickwork – a substitution, which at once minimized construction waste and expedited completion of the work. "The blocks are imported from Germany, and they are not cheap, but they are much lighter, fire rated, soundproof, and waterproof, and you don't need to plaster them, because they're very smooth. That saved a lot of time, because when you are talking brickwork in a 5 million square foot building we are talking about 150,000 square meters of block works. Just putting that together into walls is already very time consuming – then you have to plaster it and paint it. With these blocks, there was less additional trade work." Ultimately, 162,000 square meters of gypsum blockwork were substituted instead of brick, leading to a huge reduction in construction waste and a substantial gain in construction time.

Further reducing construction waste, the use of traditional bamboo scaffolding was avoided wherever possible, in favour of reusable steel scaffolding and movable scissor platforms – more than 650 of which were used in the course of the project.

Another choice producing both environmental and efficiency benefits was that of Bondek profiled steel decking for permanent formwork in both the podium and Ferris wheel areas.

In the hotel towers, reusable aluminum panel formwork systems were adopted for the reinforced concrete work, in preference to traditional non-reusable timber formwork. Again, this choice produced a net reduction in construction waste and a net gain in construction speed.

Green considerations were given due weight at every stage of the construction process. A particular effort was made to source building materials nearby in Mainland China, thus reducing both the environmental impact and the costs of long-distance transport.

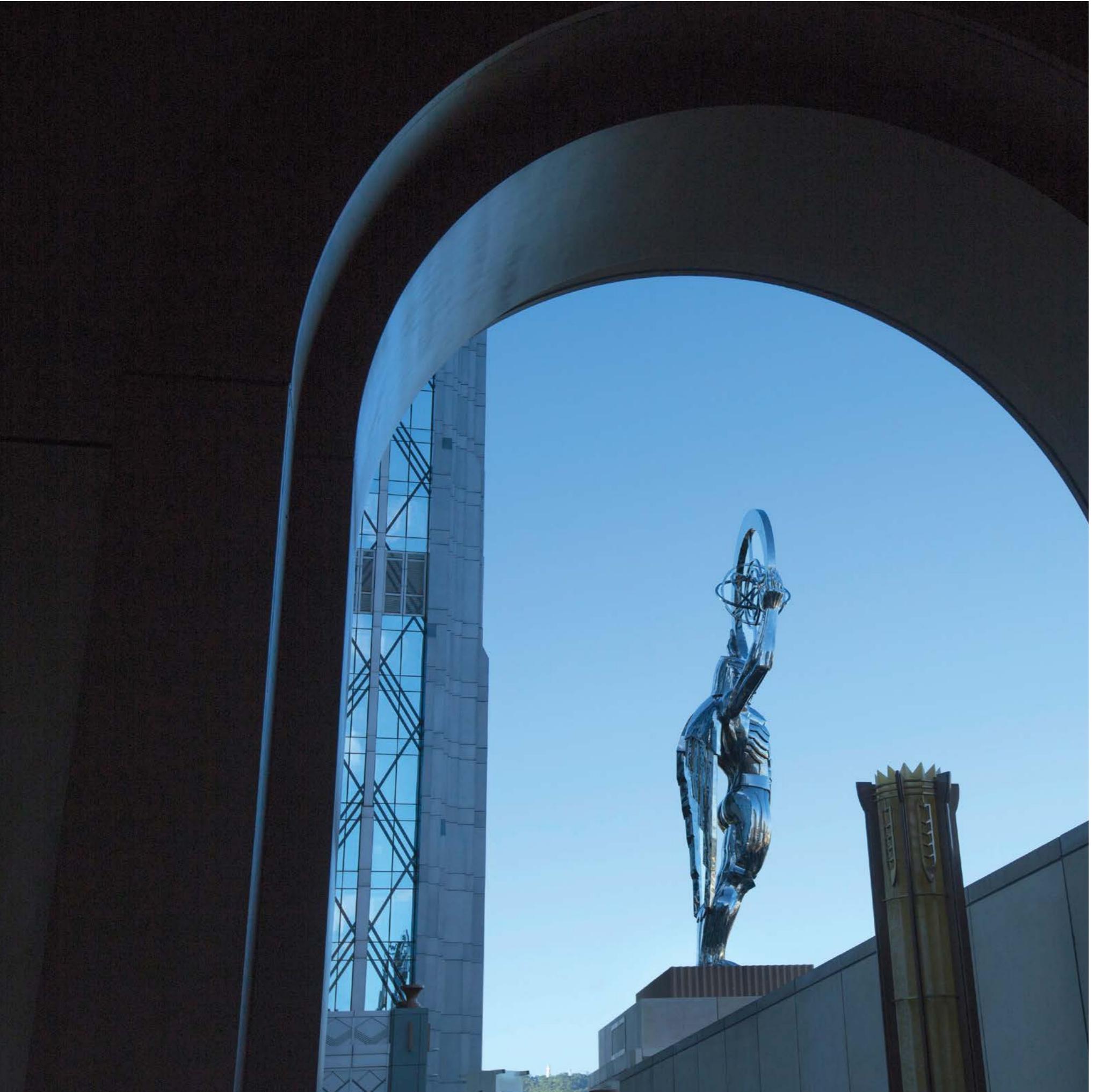




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## Looking Ahead





## 世界級城市景觀

新濠博亞娛樂旗下的新濠影滙成為了澳門的全新地標，為澳門揭開璀璨迷人的新一頁。同時，也成了保華建業悠久歷史中另一傑出和重要的工程項目，其喻表著保華建業正式邁向另一個高峰，向世界展示其承接國際級工程項目的超凡實力和極致水準。

追求卓越，從不停步。一直是保華建業的DNA，從其過去70年參與承建的不同類型，大大小小項目中，已可以真切反映到其高質、嚴謹、承擔和高效的表現。今天，保華建業更將其累積的豐富經驗和一流的技術，以及那份勇於創新的精神帶到澳門，並把原已出色的領導才能和項目管理能力進一步推進和昇華，令新濠影滙這個施工面積達450,000平方米的工程項目，在28個月內，以超越客戶的期望下，提早了3個月圓滿竣工。

新濠影滙之所以被形容為獨特非凡的工程項目，除了因著其廣闊面積，以及各種工程挑戰外，其一連串的數字也叫人印象難忘。當中包括使用162,000平方米石膏磚；安裝超過5,000個防火和非防火門；鋪上超過17,000塊幕牆面板；分別使用765公里和21公里的低壓電纜和高壓電纜；鋪設282,000米水管道和排水系統；安裝85,000個消防灑水器和高達323,000平方米的主要冷氣管理系統等。

保華建業成功統領和匯聚335個來自世界各地的分判商，以及數以萬計的工人，讓大家抱持同一個理念，嚴謹和一絲不苟地把以上的數字締造成一個如此龐大和優質的項目，還創下沒有任何嚴重傷亡的紀錄，為業界開創了一個新指標。

「新濠影滙的工程項目，證明了保華建業不但是亞洲領先的工程承建商，也展現出我們擁有超凡實力和經驗承建世界級獨特創新的綜合工程項目。因為我們的目標不是準時交付而是提早交付；我們不單是接受挑戰，而是無懼挑戰。我們不單是符合標準而是引領標準。」保華建業行政總裁李恒穎表示。

建築，是不斷演進的過程。保華建業為今天的成就感到自豪，但並不表示我們便停留於此。今日，其於建造新濠影滙得來的寶貴經驗，加上過去70年建立的雄厚實力，將成為保華建業邁步向前，再創高峰的原動力。

「我們的目標是要為香港、澳門、中國內地，以至其他亞洲地方，帶來更多獨特和世界級的城市景觀。」李恒穎表示。

**M**acau has a new landmark and for Paul Y. Engineering another milestone in a long history of engineering excellence has been reached. "For 70 years now, Paul Y. Engineering has been continuously pushing the envelope of engineering thinking, techniques and technology," says Chief Executive Officer James Lee.

All that accumulated expertise and experience came together for the construction of Studio City – and it also demonstrated the exceptionally high levels of leadership and project management skills we have at our command. We put together an extraordinary team, held it together harmoniously throughout the whole construction period, and brought a hugely ambitious project to a successful conclusion much more quickly than anyone had anticipated."

Every stage of work that could be expedited was – and yet in 32 million man hours of work there were zero fatalities. It is an extraordinary success story.

With the completion of Studio City and its successful grand opening behind them, the members of the project team have had time to reflect on the achievement, and what it means for the future.

"Studio City was in all respects inspiring to work on – and very much in Paul Y. Engineering's tradition of taking on unique, landmark construction projects and exceeding expectations in delivering them," says James.

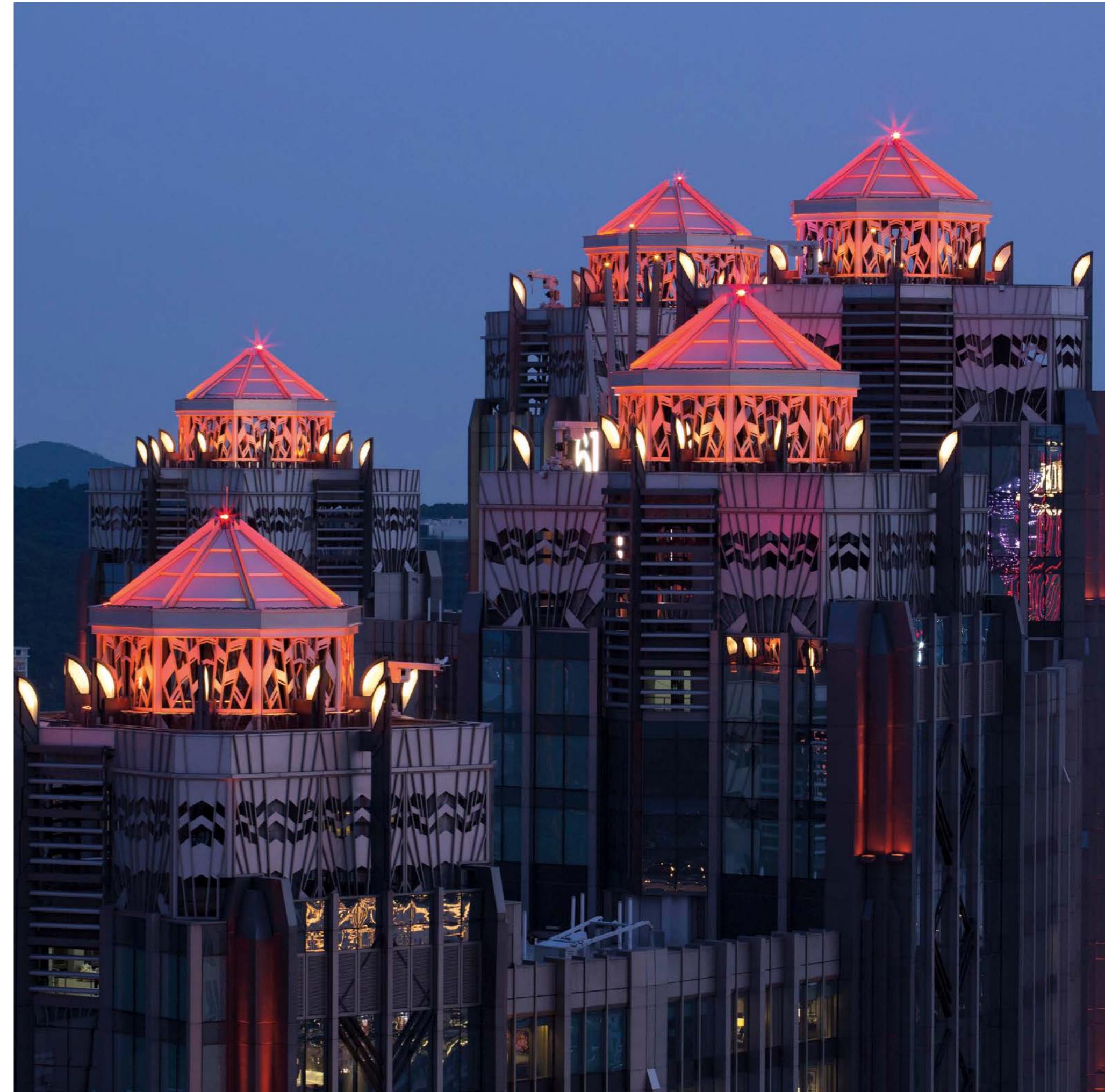
"Now we are looking for fresh, world-class challenges. We will continue to identify and implement new and innovative ways of streamlining construction processes, and moving to ever higher levels of engineering excellence and efficiency."

James sees Paul Y. Engineering's future in Asia and further afield as continuing to take on leadership roles in managing large unique projects comparable to Studio City. "I think the sheer scale of Studio City gave us a great opportunity to demonstrate that not only are we one of the leading engineering contractors in Asia, but that we also have exceptional capabilities in managing people and other organizations. The level of harmony and cooperation we were able to achieve working with an army of subcontractors was exceptional for any construction project. And we know we can keep doing that," he says.

"The commitment and support from the very top management of both the employer and the contractor was very important, too," adds Project Director Andrew Keung. "We proved that a strong partnership could be established between us and the client, and that by working cooperatively in that way we could achieve remarkable efficiency and impressive results."







The connections forged with the 35 named subcontractors, 67 direct contractors and 233 domestic subcontractors from different parts of the world will be maintained, and reinvigorated through future collaboration.

"It's all about orchestrating teamwork," says James. "Our expertise is not confined to engineering. We understand people. By helping them to achieve their full potential, we achieve our goals. We succeeded in building real team spirit at site level with a large culturally diverse workforce. When you have that large a number of people, all looking to achieve personal bests while working towards a common objective, results that might seem unattainable become within your grasp."

Continuous improvement and striving for excellence, he stresses, are in Paul Y. Engineering's DNA, and insistence on quality at all levels permeates every aspect of the firm's operations. "We have a commitment to, and a long track record in, efficient, responsible, sustainable construction work, marked by excellence from the largest concepts to the smallest details. That has provided the basis for 70 successful years as a progressive, innovative international contractor," James says.

The Paul Y. Engineering philosophy is based on certain core values.

"A forward thinking and team-oriented organization.

"A combination of our experience with the latest technology and sensitivity to market dynamics.

"A culture that is committed to sharing knowledge and developing skills."

Those values were all essential to the success of the Studio City project, and, says James, will continue to guide a firm known for regularly scaling new heights of achievement for many years to come.

"We have the capability and the attitude to take on very big complex mixed-development projects, and to bring them in not just on time but early," says James. "We'll continue to grow progressively with each successive challenge, and we expect to continue to set new standards. Our culture is to deliver excellence."









Some projects test the mettle of a team to a far greater extent than others, and Studio City was unquestionably one of them.

The numbers alone speak volumes. In the course of construction, a team comprising more than 335 trade contractors, and with 10,000 workers per day on site during peak work periods, poured 370,000 cubic meters of concrete and assembled more than 4,100 tons of structural steel.

The structure required the erection of 162,000 square meters of gypsum blocks and the installation of 5,000 fire-rated and non-fire-rated doors; 17,000 curtain-wall panels around the superstructure and 80,000 square meters of façade systems around the podium; 765 kilometers of low voltage cables and 21 kilometers of high-tension cables; 282,000 meters of plumbing and drainage systems; 85,000 sprinkler heads and 323,000 square meters of major HVAC ductworks – the equivalent of 30 full-sized football pitches.

All that work was completed in the 28 months between April 2013 and August 2015 – as can be seen in the timeline and time lapse photos on the following pages. And, despite the handicap of 83 days of inclement weather and 21 statutory holidays when work was either limited or impossible to undertake, the project was completed three months ahead of schedule.

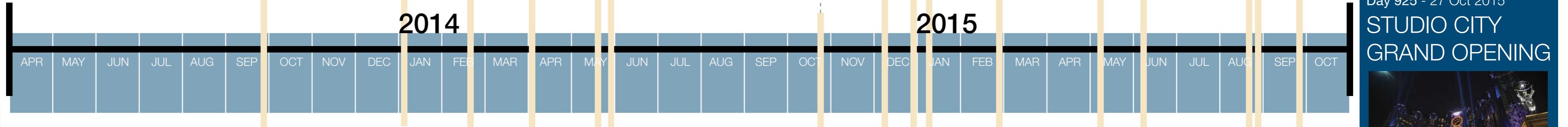
The combination of speed, efficiency, innovative thinking, and discipline that made it possible to achieve all this without one major accident or fatality is a reflection of outstanding leadership and teamwork.

An exceptional project was seen through to successful completion by an exceptional project team – with the unstinting support of the client whose vision it realized. It is an outstanding and enduring achievement, and an inspiration for the future.

## PROJECT MILESTONES



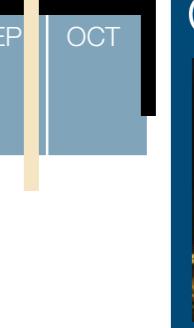
**Day 1** - 16 Apr 2013  
Commencement of Superstructure



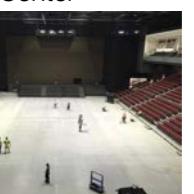
**Day 864**  
(27 Aug 2015)  
Completion of Casino



**Day 787**  
(12 Jun 2015)  
Fire Services Department Inspection



**Day 925 - 27 Oct 2015**  
**STUDIO CITY GRAND OPENING**



Practical Completion





SEP 2013



NOV 2013



DEC 2013



JAN 2014



FEB 2014



MAR 2014



APR 2014



JUN 2014



JUL 2014



AUG 2014



SEP 2014



OCT 2014



NOV 2014



DEC 2014



JAN 2015



FEB 2015



MAR 2015



MAY 2015



JUN 2015



OCT 2015

