

## A Review of the Progress of China's Building Industry by Looking at its Development over the Last few decades



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### Introduction

The writer of this article, Ir Raymond Wong, began to follow up on China's construction development in the late 1990s, at a time when a number of major infrastructure projects commenced in Guangzhou. These projects included the Guangzhou Inner Ring Road, the Guangzhou Metro Line 1 and 2, a few sport facilities for the upcoming National Game in 2001, and the construction of the Guangzhou new airport in Huadu (花都).

Just a few years later, at the turn of the millennia, the writer started to pay attention to the construction development in Shanghai. His focus, at the beginning, was the beautiful western architecture spread all over the down-town area of the city. But soon, his footsteps wandered off to other areas of Shanghai, where a number of metro lines were being built, as well as a number of environmental upgrading projects, renovation works for historic buildings, redevelopment of old district zones, and finally, the regeneration of the entire city in preparation for hosting the 2010 World Expo.

There are a lot of similar stories to tell about his study experience in China. Since the early 2000s, he has visited and carried out a significant amount of study works with a focus on the overall urban development in almost every city inside China: Beijing, Tianjin, Hangzhou, Nanjing, Chongqing, Wuhan, Chengdu, Suzhou, Qingdao, Xi'an, Foshan ....., to name just a few.

This article tries to present to the readers in Hong Kong a highly condensed picture of what has been happening in China in terms of its construction development in the past 20 years, from the writer's point of view and through his lens.

### Development in Guangzhou since mid 1990s

A major sports event was in the pipeline in Guangzhou, to be held in 2001, exactly: the 9<sup>th</sup> National Games (全國第九屆運動會).

It is almost a common practice in China for cities hosting important national or international events to take it as an opportunity to put in significant amount of resources to enhance their infrastructure other than building the needed facilities to support the event. They will put in equal efforts to upgrade the overall local environment in all aspects in order to present a better image to domestic or international visitors participating in the event. Guangzhou, of course, would not be an exception.

Two major facilities were being constructed, which were directly related to hosting the National Games. One was a practicing gymnasium located in Baiyun (白雲區). The other was an Olympic-standard 40,000-seat stadium located in Huangcun (黃村). The construction of the two facilities started in 1998.

Other urban upgrade projects were mainly transportation infrastructure that started a bit earlier. These projects included the construction of the Metro Line 1 and 2 that linked the old city zones with the Guangzhou East Station. These were the first metro lines introduced to the city of Guangzhou. At the same time, a highway project known as the Inner Ring Road (內環路) was in progress as well. This 27-km roadway circled around the urban zone of Guangzhou and served all the major districts with interchange networks. The purpose of this project was to relieve traffic congestion that had bothered Guangzhou for years.



▲ Construction of the Inner Ring Road near Shamian, Liwan (1998) (沙面·荔灣區)

In order to build these infrastructure facilities, a substantial number of buildings in the built-up zones had to be torn down or relocated. This started a wave of redevelopment and urban regeneration.

Within less than 10 years, there was another major event held in Guangzhou. That was the hosting of the 16<sup>th</sup> Asian Games (第十六屆亞洲運動會) in 2010. The Asian Games was an international event and Guangzhou, as the host city representing China, took this opportunity for another wave of development and urban regeneration starting in 2006, over the entire territory of Guangzhou. By that time, Guangzhou was already well developed and more experienced than a decade before as it prepared for the 9<sup>th</sup> National Games, from the economic and administration point of views.

Works to be done for the 2010 event was of a much broader scale compared to those for the National Games. They encompassed four major areas. First was to construct a series of facilities, targeted for hosting the Asian Game meets, including the Athletic Village in Panyu (番禺亞運村), a series of practicing gymnasiums and sport complexes for various game meets, upgrading of the existing sport facilities, in particular the Tianhe Sport Center (天河體育中心), and the official venue for holding the opening ceremony of the event in Haixinsha, Tianhe District (海心沙·天河區).



▲ The Practicing gymnasium complex in the Athletic Village in Panyu.

The second major work was the infrastructure development. Construction work of three major metro lines (Line 3, 4 and 5) started in 2005, targeted to serve visitors attending the Games in 2010. Some other new highway routes, roadway improvement or extension projects, in particular those linking the major sport facilities, were part of these developments.



▲ Construction of a section of the Metro Line 5 near Zhujiang New Town. (珠江新城)

The third area was the formation or regeneration of a new city axis running from north to south from the Guangzhou East Station down to the bank of Pearl River, covering an area about 4 km in length. One of the objectives was to provide a new icon with a pleasant image to welcome all local and international visitors coming to Guangzhou. The most eye-catching development here was a central green park (the Flower City-Square 花城廣場), located at the southern end of the axis with an international Central Business District housing more than 10 top-grade commercial complexes on both sides of the square.



▲ Aerial view of the Flower City-Square as seen in 2013.

▲ Aerial view of the Guangzhou new city axis as seen in 2009.



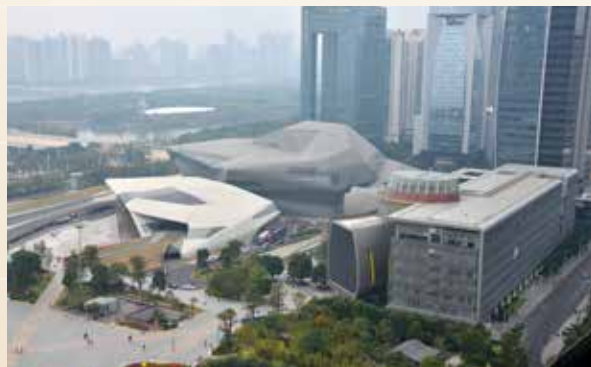
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The fourth target was the overall upgrading of the entire Guangzhou city in particular within the old city zones. The works included giving a face-lifting of all the building facades of the old buildings along major down-town roadways. They would also help to provide more decent public areas and landscape spaces, by regenerating old urban zones targeted to improve the urban quality and public image of Guangzhou.

All these gigantic projects carried out under the name of preparing the city for hosting the sports event can be considered as a comprehensive master city planning of Greater Guangzhou, aimed at meeting a planning target all the way to 2025 and beyond. This future mega city will cover an area more than 7,000 sq. kilometers and serve a population around 15 million.

After the completion of the Inner Ring Road and the Metro Lines 1 and 2 in early 2000s, new developments sprung up everywhere along the sides of these newly opened transportation facilities. Similarly, after the Asian Games in early 2010, developments continued, particularly after the completion of a number of new metro lines or their extension lines. These new facilities extended to the outskirts of Guangzhou, linking up new zones and districts originally far away from the traditional urban center. This created a great opportunity for development all over Greater Guangzhou.

These buildings or projects included Guangzhou International Convention & Exhibition Center and the nearby trading/sourcing centers, the East and West Towers along the Flower City Square (Chow Tai Fook Financial Center and Guangzhou IFC), Guangzhou Tower, Guangzhou Opera House, Guangdong Museum, Taikoo Hui, Universal Metro Plaza, Baiyun New Town, Guangzhou International Financial City, and countless other urban regeneration projects or commercial and residential developments scattered over the entire city center and the outskirts zones. These are the icons of Guangzhou's recent construction and development.



▲ Guangzhou Opera House



▲ Guangdong Museum



▲ Construction of the Chow Tai Fook Tower as seen in 2012.

## Development of Shanghai since mid 1990s

In the early 20<sup>th</sup> Century, Shanghai was much larger in terms of its city size, more advanced and better developed as an international city than Hong Kong and Guangzhou. Her development almost stood still just like all other cities in China after the change of power in 1949, until the end of 1970s when China embraced the economic reform (or Reform and Opening-Up).

The most significant triggering point for the development of Shanghai was the launching of the Pudong New Zone Planning Scheme (浦東新區規劃) by the end of 1980s. During the first 10 years, a few land-mark buildings, including the Oriental Pearl Tower, Jin Mao Tower and a few other commercial towers invested by local enterprises, sprang up gradually along the eastern bank of Huangpu River (黃浦江) in an area called Lujiazui (陸家咀) in Pudong, directly facing the Bund (外灘), which was and still is the heart of Old Shanghai.



▲ Lujiazui (陸家咀) on Pudong as see from the Bund in 1998.



▲ Lujiazui (陸家咀) on Pudong as see from the Bund in 2015.

On the other side of Pudong (浦東) across Huangpu River, traditionally called Puxi (浦西), various developments went on unnoticed after the Reform and Opening Up. Some of these developments at the early stage were typically initiated, to a certain extent, by capital coming from Hong Kong investors. Some representative developments during that period included Plaza 66 (Hang Lung Plaza 恆隆廣場), Central Plaza (中環廣場), Shui On Centre (Rui'an Square 瑞安廣場), and the New World of Shanghai (Xintiandi, 上海新天地). At the same time, quite a number of large-scale private residential developments were being built all over the downtown areas of Shanghai in order to accommodate the needs of the ever-expanding middle class.

Development of Shanghai during the 2000s' can be divided into two somewhat parallel phases. The early phase was only an accelerated process of her ongoing development following the 1990s'. In 2004, Shanghai successfully won the nomination from the Bureau of International Expositions to be the host city for the World Expo in 2010. Therefore, in the second half of 2000s', Shanghai began another wave of development in preparation for hosting this great international event.



▲ Large-scale private residential developments were being built all over Shanghai.



▲ Construction of the China pavilion for the 2010 Shanghai World Expo.



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In order to prepare herself to welcome the upcoming global expo visitors expectedly in hundreds of millions, Shanghai kicked-off a great development plan starting from 2005, in addition to constructing the venue for the Expo and all other facilities there-in, which would promise to upgrade the entire city of Shanghai, in parallel with the Expo developments. This included the construction of a number of metro lines to provide convenience to visitors moving around the city, some regeneration projects to upgrade the urban environment as a whole, renovation works for some historic buildings to regain the glorious old-look of Shanghai, as well as the redevelopment of some old and deteriorating district zones. A great number of new building projects started as well, funded by investors who looked forward to the upcoming prosperous moment in 2010 and beyond.



▲ Construction of the Metro Line 12 at Hong Kou (虹口)



▲ Construction of the Metro Line 9 at Xujiahui (徐家匯)



▲ Renovation of historic building to regain the old-look of Shanghai. This photo took in 2009 showed the renovation work for the previous British embassy of Shanghai.

The immediate concern, of course, was finding the land for use as the Expo venue, which ended up locating along the river banks of Pudong and Puxi in Xuhui District (徐匯區). With fewer than 10 facilities retained for permanent use, all expo pavilions and facilities, more than 150 in number constructed for the Expo-show, were removed after the event. However, under the master plan of Shanghai, the Expo venue has already been earmarked for developing a new zone based on the land so formed with the needed infrastructure to accommodate future planning and development of this area.



▲ Part of the land (as shown in this photo) for development as the Expo venue belonged to the previous Jiangnan Shipyard at XuHui

The original land for the Expo venue was located within a heavily polluted rust-area (鐵銹區) previously belonging to a number of aged factories, workshops, shipyards, a power station and so forth. Taking advantage of the opportunity of hosting the Expo event, Shanghai started the regeneration of the entire Huangpu River bank areas stretching from Yangpu (楊浦區) to Xuhui and beyond. This regeneration process, as part of the overall Planning Strategy of Shanghai, triggered another wave of developments in the upcoming decade along these districts.



▲ The land belonged to previous Jiangnan Shipyard have a new look after the Expo. This photo was taken in 2016.

The area of Shanghai, or the "Greater Shanghai", is at least twice the size of Guangzhou or 4 to 5 times the size of Hong Kong. Her development potential under the current economic environment was numerous. Large-scale development/construction projects in various forms are now found in every corner of the city. Shanghai, for sure, exhibited her strength as a powerful driving force and a model for China's future development.



▲ From a corner at the junction of Huangpu and Jing'an District, one can see the scale of Greater Shanghai.

## An overview of China

Guangzhou and Shanghai are only part of the more representative stories of the writer. In fact, every part of China, in particular those so called Line 1 and 2 cities, underwent similar waves of rapid developments shortly after the beginning of this millennium.

In general, construction projects need to be summarized into several core categories for easier explanation. The following is a list of categories according to the scale and nature of works the writer would like to briefly discuss.

- 1 Major infrastructure projects – transportation related, mainly railway, metro lines, road works and highway projects.



▲ Construction of the Guangzhou Airport at Huadu as seen in 2002.

- 2 Major infrastructure projects – port works and airport facilities, mainly construction of ports and harbors, container terminals, airport, air-cargo handling and related logistic developments.
- 3 Major facilities – facilities related to large scale urban development, mainly new towns, new function zones, central business district, urban renewal and regeneration projects.
- 4 Major facilities – industrial facilities, including the development of industrial zones and decommissioning of aged industrial facilities.
- 5 Major building projects – large-scale or super high-rise commercial developments, iconic buildings representing special meanings or buildings serving specific functional purposes. Example of such building projects, other than commercial buildings, can include the city hall, convention and exhibition center, opera house, central library, museums or any other iconic representative facilities.
- 6 Major building projects – large scale residential developments. Such projects can be located downtown or on the outskirts of a city, of high-density or low-density in design. Some are even high-rise buildings.
- 7 Other projects – large scale heritage preservation and conversion projects, including the improvement, renovation, alteration, conversion and revitalization of historic buildings or heritage sites.
- 8 Other projects – large scale urban/environmental regeneration projects, including large scale drainage work, waste treatment, water supply and treatment, river regeneration, greening and landscaping projects.



▲ An overview of Yanshan Deep-water Port.



▲ Part of the land (as shown in this photo) for development as the Expo venue belonged to the previous Jiangnan Shipyard at XuHui



▲ The land belonged to previous Jiangnan Shipyard have a new look after the Expo. This photo was taken in 2016.



▲ From a corner at the junction of Huangpu and Jing'an District, one can see the scale of Greater Shanghai.

To have an overall review of China's construction development, at times slow moving and at others fast and dramatic, we need to highlight what was happening in society as a whole to provide a background for each development stage. Based on to my study in this area, I can sub-divide China into the following stages:



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### 1 Era between 1949 up to mid/late-70s.

After being stagnant for more than a hundred years after the Opium War, China started to redevelop herself almost from scratch after taking over the power in 1949. Unfortunately, she experienced another long period of political turmoil and instability due to various mistakes, man-made or natural, in finding the right ways to develop herself. Situation stabilized a bit only after the so called "Cultural Revolution" was brought to an end in 1976.

During the early stage of its Communist regime, China had close relationship with Russia (known at the time as the USSR). The then Chinese government had called in a great number of experts from Russia to help her develop in almost every aspect of her economy. The construction and engineering system was one of these being introduced and adopted to help building a modern China. This period roughly spans from 1949 to late 1960s.

During that period, the entire operation of the construction sectors, starting from project procurement, construction management, use of technology, industrial practices, training, the plant and equipment needed, architectural and engineering design, were almost completely duplicated or supplied by Russia, China's political partner.

During that period, heavy industry was the top priority in China's national policy in order to expedite her development. As a result, construction was mainly focused on the building of state factories, plants and workshops for various industries, power stations, and a few railway lines that would fulfill the basic needs to link up major cities. A few iconic buildings, like the Great Hall of the People in Beijing, the Exhibition Centre in Shanghai, and some state-owned hotels and guest houses, were also being constructed. However, the construction of other civil projects and residential buildings to fulfill the needs of the general public, were very limited.

Compared to the current work practice, the way the construction industry handled works by that time were relatively primitive, especially in term of site planning, work setting up and overall safety. For instance, hoarding or fence was seldom provided for any construction site. Safety provisions and other temporary works to facilitate construction were often reluctantly provided in order to save materials. Fortunately, quality control for those structural works could still be regarded as acceptable, thanks to the stringent engineering training system that had been introduced long before, under the influence of the European and Russian system.



▲ Quite a messy environment working in a road improvement project like this one as seen in Guangzhou in 1998.

Very old fashioned and traditional system with labor-intensive working approach, projects handled by state-owned construction units or engineering teams working under rather rigid system, were a conclusive summary for that period.

### 2 Early stage of the economic reform (early-80s to late-90s)

The old-fashioned, low efficacy, Russia-influenced system continued to prevail up to the mid-1980s. The stagnancy for a long period during the "Cultural Revolution" without the input of trained work force or the substantiation in the needed logistic back-up was for sure a major cause of the situation.

However, starting in early 1980s, a few investments mainly for hotel development projects funded by Hong Kong investors were called in as pioneer cooperative projects introduced to China. These hotels were located in Beijing, Shanghai, Guangzhou, Hangzhou and Shenzhen. As a result, new experience in business management, the running of high-class hotels, as well as new construction technology and practices were introduced to China and adopted later as a model for China's development in the coming years.



▲ The White Swan Hotel in Guangzhou, was one of the first investments coming from Hong Kong by Dr. Henry Fok, Fok Ying Tung. The hotel was opened in 1983.

By the end of 1990s, China had obtained sufficient momentum after introducing the reform for almost 20 years. China learnt quite a lot from the incoming partners as well as finding her own way to work through their own social and economic framework. Besides, the scale of internal demand was so huge that a great number of

construction projects were rolled out in every corner of China's cities. China's construction industry advanced, became more refined, self-regulated and well-developed in the continuous development process. Training at the vocational or professional level was adequately backed up by the industry through various training institutions including universities, as well as by formal training system provided by state-owned construction enterprises. A relatively more professional work team was gradually formed.

Though still lagging behind international standards by quite a margin, the Chinese construction industry could stand up on its own and be able to handle all kinds of construction projects using the Chinese way, in particular in the application of appropriate construction technology.

### 3 Latter stage of economic reform (throughout the 2000s)

Throughout the decade starting from the millennium, countless benchmarking projects were introduced due to a number of triggering reasons. First of all, the current of the economic reform had almost come to its peak. Both internal and overseas investment sources were looking for other investment opportunities, such as high quality and mega-size property or similar developments. Super high-rise commercial buildings, business centres and malls, hotels and residential estates, were being constructed everywhere.

On the other hand, several world-events were being organized or hosted by China within a short span of time. The Olympic Game in Beijing in 2008, the World Expo in Shanghai in 2010 and the Asian Games in Guangzhou also in 2010, are what I will highlight below.

This may be again the "Chinese Style". To construct and provide the facilities to support the running of these world-events is only the immediate cause. Taking this opportunity to enhance the overall developments of the host city is understood as the inevitable outcome. This process usually spans 5 to 8 years, both before and after the events. As a result, huge amount of high-quality buildings, properties and infrastructure facilities were constructed. Needless to mention the multiplying effect it brought to the overall development of the host city as well as its neighboring cities.

Through such developments, China's construction industry advanced to a higher level. And of course, other large-scale infrastructure projects on a national-base, like the construction of the High-Speed Rail and nation-wide highway networks, were another aspect of the development that also contributed to the advancement process.

### 4 2010s onward.

2010s is the era of 5G, Artificial Intelligence (AI) and Internet of Thing (IOT). China is catching up with this unavoidable world trend. At the same time, China is also enjoys the harvest from her 40-year-long economic reform, not only lifting millions upon millions of her people out of poverty, but also growing prosperous in all social and economic dimensions. China is somewhat like a gigantic magnet attracting investments and funding from almost all parts of the world. The construction industry is for sure one of the business sectors that has benefited the most during the process.

Mega projects of both buildings and infrastructure developments mushroomed in every Line 1, 2, and 3 city, or even cities or towns with unfamiliar names to ordinary people.

World-famous super high-rise buildings like the CCTV Tower, the CICT Tower (中信大廈) and the Samsung Tower in Beijing; other eye-catching names like The World Finance Centre, Shanghai Tower, Sinar Mas Plaza (白玉蘭廣場) in Shanghai; Ping An Finance Center, Kingkey Finance Tower and China Resources Tower in Shenzhen; the Zifeng Tower (紫峰大廈) in Nanjing, ..... and many others, are just a few of the representative projects in



▲ The hottest Central Business Zone in Beijing which the CCTV Tower, CICT Tower and the Samsung Tower located.



▲ The newly opened Sinar Mas Plaza in Shanghai as seen in 2018



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recent years. These buildings, in addition to their impressive height which ranked them among the tallest in the world, cannot be built without the application of extremely advanced construction technology, management skill, and sophisticated logistic support.

And of course, also during these 10 years, more than 10 thousand kilometers high-speed railway were constructed, reaching and linking up all major cities within China.

## China's construction capability from a professional or industrial prospective

Allow me to discuss this starting from the frontline, that is, from my observations on the construction sites.

In the early years, when I first started my China study in mid-1990s, the working environment and daily on-site operation can be described as very non-professional. Basic work, like site layout planning, work supervision, quality control, and safety, etc., was of a very low quality. The only focus that concerned the management and other operatives was, fortunately, keeping the engineering and other related technical requirement up to standard. For example, when carrying out some roadworks involving site prefabrication and heavy lifting, there was no fencing-off between the work place and the public. Situation for building works was not much better.



▲ In the old day back to early 1990s, management and other safety concerns in the construction sectors can be considered as "poor".

The overall situation improved gradually as Chinese economy grew and advanced after the economic reform. The construction industry was able to find better resources to enhance the overall performance. One of the key factors was the supply of improved work force with better training by academic institutions, formal apprenticeship as well as on-the-job training. Sufficient budget and strategy to archive higher work quality was another influencing factor. This situation was much obvious for large-scale projects in which state-owned construction companies were the key players.

Before closing, I would like to introduce briefly the "construction companies" in China. Except for some local contractors for handling minor jobs, all construction companies in China are state-owned enterprises. Their scale is usually large and they can employ tens of thousands of workers. With such scale, they can provide systematic training for all levels of staff, ranging from site operatives, engineers, planners, controller and managers. Base on this strong set-up, they can organize works in a focused manner and achieve challenging targets. When needed, they can form expert teams who can work anywhere within or even outside China.

Another positive factor that can be observed is the work culture. Thanks to the well-structured training system again, the majority of the working staff and operatives nowadays have a good working attitude with good role-playing mentality. They are serious about performing the duties assigned to them, and willing to observe and obey rules. Diligence to work is also quite common for most workers. Division of expertise and labor is precise which effectively improves control and work performance.

Besides, in most cases staff and workers seldom come from local sources. They are being assigned and sent to the site away from their hometowns or motherland when working overseas. This arrangement often makes workers more concentrated in their work and duty because of lack of interference and distractions. Nevertheless, this is almost the norm for the construction sector and people are quite used to it.



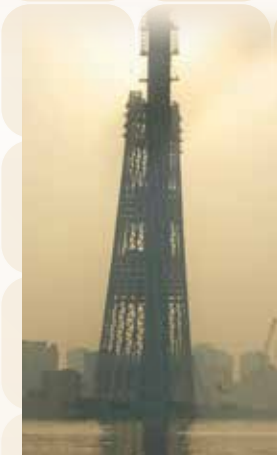
▲ Construction site is maintained relatively quite in order and tidy nowadays.

In the early years, safety was usually the neglected matter for most worksite operations. Thanks to the development of the work culture and systems mentioned above, safety situation has improved in most construction sites, which are maintained neatly and orderly in most cases.

I will concentrate more on buildings than civil works when discussing the application of technology in construction. Building works can be classified into super high-rises, buildings of more traditional design, as well as special structures for the sake of easy explanation.

Buildings with a height of more than 250m can often be classified as super high-rise structures. The majority of these buildings are in single tower format and constructed in composite design, that is, using a central core in either reinforced concrete or structure steel, and the embracing frame is constructed using structural steel.

Buildings of more traditional design usually range from office towers, commercial buildings as well as residential blocks. Campus buildings for schools and universities are also under this category. Reinforced concrete structure in frame-layout design, incorporated with limited or large-amount of shear walls, sometimes even with certain amount of tensioning works for large-span elements, are common. The use of simple or system formwork, standard steel fixing and concreting arrangement, equipped with the help of tower crane, is almost a standard way to construct in most cases. The use of curtain walls and certain precast elements in construction is also becoming popular.



▲ The construction of a super high-rise building/structure, the Guangzhou Tower by the time it was under construction in 2008.



▲ Use of precast elements in building construction is becoming popular

Special structures usually refer to buildings with innovative design or need to fulfill specific functions. Buildings with exaggerated-shape or appearance, with challenging structural demand, complicated spatial layout, extremely long-span or high headroom, are some examples usually encountered in this type of structures. Using structural steel to construct is almost the only solution in most cases.



▲ A very challenge example of a special structure, the skeleton frame for the Guangzhou Opera House.

In order to construct these special structures, the support behind is much more demanding. The operation of work in this case usually involves high quality project planning, an experienced work team, special plant and equipment provision, supply of special materials or components, off-site production, logistic and transportation support, and finally precise front-line operation and site management input. These are the keys to ensure that the work is done and meets the required performance targets.

As a supplement, new concepts like the application of intelligent technology involving the use of BIM (Building Information Modelling), digitalization in site production and control, or the incorporation of AI (Artificial Intelligence) means to construct, sometimes even with R & D (Research and Development) input to achieve specific functions, are not rare in construction projects in recent years.

As a conclusive remark, I would like to add that, frankly speaking, the entire construction sector in China at present is as professional as any others in the world and can be regarded as up to and, in some cases, even above most international standards. China's counterparts are quite prepared for another take-off to meet the needs of the future world, judging from availability of education and training, the structure and organization of the construction industries, work execution ability, associated logistic support, and the input of large amount of research and development. They provide a solid backing for the entire construction profession in China.

▶ The construction of a super high-rise building, the Pearl River Tower in Guangzhou, is a type model of intelligent building including input of significant amount of environmental friendly and energy saving design.



▲ A modern workshop in the Pearl River Delta using high level of digitized and automated system in production. This workshop is part of the Shenzhen-Zhongshan Link Road projects.