DUBAI DELEGATION 2009

Engineering Miracles

Delegation Report

Young Members Committee and
Continuing Professional Development Committee
The Hong Kong Institution of Engineers

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Message from Delegation Advisor - The President of HKIE

Ir Peter Y WONG
Delegation Advisor
President, HKIE

"Three times more coastlines than Hong Kong".

Painted in bright colors across a signboard at least 20 times longer than what I had ever seen in Hong Kong, the advertised slogan promised the construction site behind the signboard yet to be developed would become a paradise matching the beauty and functionality of our metropolitan city.

The tallest building, the longest light rail system and the largest man-made island would elevate the city of Dubai to an impressive spot on the globe, a very impressive one indeed. For such pursuance, Hong Kong is marked as the target to surpass. At first, one would see that as a threat, in particular, noting the impetus of Dubai's Administration on their drive for such excellence with a determination that far exceeds what we have here. But I also see that as a compliment, again in particular, many members of our Institution are instrumental to help building the city of Dubai in the midst of a barren desert.

I had the fortune to witness these when I joined the Young Members Committee (YMC) visiting the city in March. We met some of the consultant and construction firms there and the Society of Engineers – UAE, an institution similar to HKIE in Dubai. I also met many of our members working there in a reception party.

I enjoyed my short stay with the YMC. I was much impressed with the eagerness of the delegation members in planning before the trip and their quest for knowledge during the visit. The YMC had again demonstrated a high degree of dedication and devotion in taking up their initiatives, vital constituent for grooming into true professionals. I have least worry that they all would flare best.

So, maybe Hong Kong does not have the tallest building, the longest light rail and the largest reclamation. But the beauty and functionality of a metropolis go far beyond a vast and swift induction of superstructures. And we do have plenty young and beautiful engineers.

I suppose there is no need for me to say more…

Message from Delegation Advisor – The Past President of HKIE

Ir Otto POON BBS OBE
Delegation Advisor
Past President, HKIE

The Young Members Committee (YMC) is one of the most active branches of the Hong Kong Institution of Engineers.

It's annual overseas and Mainland technical visits provide excellent opportunity for its members to plan and to organize activities to improve their soft skills and to broaden their vision as professional engineers to better serve the community.

I notice this year overseas trip was an adventure into a very dynamic part of the world with unique characteristics such as oil money, very ambitious infrastructure programs, co-existence of professionals and workers of many nationalities cultures, and strong religious background. The visit also coincided with rapid fall of oil revenue and world financial crisis of un-precedent scale. It is indeed a challenge for the Chairperson and its Organizing Committee to have executed this trip so smoothly and successfully.

My sincere congratulation goes to Ms Sally LEUNG and her team members.

Message from Delegation Advisor – The Vise President of HKIE

Ir Dr F C CHAN
Delegation Advisor
Vice President, HKIE

I wish to congratulate the successful trip to Dubai that the Young Members Committee (YMC), under the leadership of Ms Sally LEUNG, has organized. I trust that they all visit members have gained a lot after the visit.

Dubai is a wonderland of engineering achievement. YMC have made wisely chosen this place for their 2009 technical visit. Over the past decade, Dubai built up its city for a modern and advanced society, not only in terms of infrastructure development, but also on its sustainability implementation. The objectives of YMC for this learning trip are therefore focused on town planning, infrastructure and innovative projects.

To organize Dubai trip successfully, a lot of planning and preparation work are required. I am amazed by the effort that YMC have put in for planning the trip, collecting background information about projects in Dubai, selecting visiting members and the implementing process to ensure their learning objectives are met. Throughout their 7-day program, the visits were fully arranged in meeting the architect and engineers professionals as well as in seeing both the completed and under construction projects.

I would also like to appraise YMC to publish this report to share their learning experiences as well as giving presentation to allow other members who did not have the opportunity to join the Dubai trip. This learning culture must be further sustained.

Message from Delegation Advisor – Council Member of HKIE

Ir Gary C W KO
Delegation Advisor
Council Member, HKIE

One privilege, among others, to be the Advisor of the Young Members Committee (YMC) this year is to visit Dubai to experience the city of engineering miracles for the first time. Though no stranger in the organizing of overseas visit, I have witnessed a total different mode of preparation which is far more comprehensive! Determination of themes of study, selection of delegates, solicit of funding, liaison with unknown overseas organizations are among the challenges not normally faced by the organizers of other overseas delegations. The rapid shrinkage of construction activities after the financial tsunami in late 2008 has shattered the communication with several pain taking established contacts in the Middle East city. Many construction projects came to a sudden standstill along with the burst of the world economy. There was a time when cloud was shadowed over the visit. Young engineers, nonetheless, never give in to any difficult environment, they persist! The turn-up is an extremely, if not most, successful visit: exchanged with two professional/academic bodies, visited eight construction and mega projects, and interacted with three organizations responsible for town planning and infrastructure. The visit schedule was tight. Sand and sweat filled the hotel returning coach compartment every evening!

The three main themes of the Delegation, namely, town planning, innovative projects and infrastructure development, are the backbones of the Asia World City as well as Dubai. The counterparts in Dubai whom the Delegation met have shown immerse interests in and are deeply impressed with our achievements. All delegates have opened their eyes from the Dubai projects in which they saw, felt, visited and asked. Not only advancement of professional development has been achieved, the Delegation has also served as the ambassador of Hong Kong, a place we call home.

Peer learning, exposing to different environments and riding through challenges have been observed in the entire course of the Dubai Visit. I am confident that all delegates will develop and advance from this invaluable experience gained through the entire process of nine months. Through various sessions of sharing and publications, other members including non-YMC ones will equally benefit.

Lastly, I would congratulate the YMC, especially Ms Sally LEUNG and her team, for having organized successful Dubai visit!

Message from Delegation Advisor – CPDC Chairman

Ir Peter P F CHAN
Delegation Advisor
Chairman, Continuing Professional Development Committee (CPDC), HKIE

It is very much appreciated that the Young Members Committee (YMC) of HKIE had been very dedicated and made great efforts in providing professional development programs and training opportunities to young members. There has certainly been a very good built-up of Continuing Professional Development (CPD) culture through YMC. Over the years, overseas delegations have been organized by YMC with the objectives to appreciate engineering technologies abroad, to widen young engineers' horizon on overseas engineering practices for CPD purposes and to foster continual relationship with overseas institutions. This year, YMC's overseas delegation has been taken on the theme "Engineering Miracles" in March 2009 to Dubai with technical visits to explore the sophisticated construction technology of the world's famous engineering wonders in Dubai and to gain and share experience in advance engineering ideas and participation in complex, innovative and world class projects such as The Palm Island and Burj Dubai. This overseas delegation has served the useful purpose to enrich knowledge on overseas engineering practices and new technologies and has provided excellent opportunity for young engineers to acquire global exposure to innovation through these world class projects with inspiration to think creatively and to turn innovative ideas into action, and through the site visits to the large-scale construction sites in Dubai, experience sharing sessions with practicing engineers to understand the engineering issues as well as town planning aspects for the rapid growing city of Dubai. Not only the delegates themselves, but also other members would benefit from the valuable experience of the delegation through an experience-sharing seminar organized after the delegation. Congratulations to YMC, in particular Ms Sally LEUNG, and her team in organizing this very successful event.

Message from YMC Chairman

Ir Crystal W C HO
Delegation Chairman
Chairman, Young Members Committee (YMC), HKIE

Being a professional engineer, particularly for a young engineer, one should remain competent by modernizing our knowledge and expertise and by developing personal qualities required to fulfill the society's needs. In addition to update the professional knowledge by taking direct technical courses and attending technical meetings or seminars in the form of "one-way learning", will there be any other ways that a young engineer can gain professional knowledge outside the classroom? And, even outside Hong Kong?

Since 1991, YMC has been organizing delegations to different parts of the world including mainland China, England, Netherlands and Australia. In succession to the delegation experience in a roll, I am pleased to see that we have made another success to the Overseas Delegation 2009 – Delegation to Dubai. This Delegation provides a platform for young engineers not just to gain professional knowledge through visiting well-known mega projects but also to gain international exposure through sharing views and ideas with engineers from around the world in particular to the United Arab Emirates.

Through the Delegation, I am hoping that delegates can learn the needs and concerns in town planning, especially the difference in practices in Dubai and Hong Kong; the infrastructure development of a city; and the engineering technology that lead to an innovative and record breaking building projects. Most importantly, delegates can believe that Hong Kong can also be a city with "Engineering Miracles" by their engineering contributions and efforts.

I am pleased to see that the Delegation is supported by the President, Past President, Vice President and many senior members of the Institution. All these supports are greatly appreciated.

The Delegation is made possible by the generous financial assistance provided by the Continuing Professional Development Committee and sponsored companies, which are gratefully acknowledged.

I would also like to thank all hosting organizations for giving us an insight into the well-known mega projects. Particular thanks are given to our beloved friends for sharing with us their anecdotes about working in Dubai.

Lastly, I must thank the hard work of the Delegation Team, particularly the great effort made by the delegation manager Ms Sally LEUNG, and two deputy delegation managers Ir Mandy LEUNG and Ms Arlene LO.

Message from Delegation Manager

Ms Sally Y S LEUNG
Delegation Manager
Immediate Past Chairman,
Young Members Committee
(YMC), HKIE

It is indeed my great honor to have the opportunity to write the Delegation Manager's message in the Delegation Report.

At the start of this session, we have proposed to organize a delegation to Dubai. As Dubai is always the limelight of the world, with advanced technologies, sophisticated facilities and innovative buildings, we have set up a theme of "Engineering Miracles". Although it is foreseen that it would be a difficult mission with many obstacles ahead, we finally decided to take up this fruitful yet challenging task.

After pinkpage was posted, we have received overwhelming response. Special thanks should be given to Ir Peter P F CHAN and Ir Victor K Y LO, Chairman and Deputy Chairman of the Continuing Professional Development Committee (CPDC) for serving as our judging panels and delegation advisors. The delegation team was divided into 3 groups – Town Planning, Infra-structure Development and Innovative Projects. They needed to carry out research work, organize local seminars and visits, plan logistics and visits in the trip, arrange accommodations, flight, coach, catering and liaise with overseas parties. It is great that we have a marvelous team: energetic, considerate, tactful, hard working, lovely, brilliant and devoted. I enjoyed working with all of them.

The main objectives of the delegation are to provide our young members with a chance to expose more, to explore more and to exchange more and I have the pleasure to report that we have achieved these targets. In fact, delegates have opportunities to appreciate the tallest Burj Dubai, to visit the largest Arabian Canal, to step inside the longest Metro and to experience the most relaxing Palm Jumeriah. Moreover, the delegation team has organized two social receptions, one with Society of Engineers – UAE and the other one with American University in Dubai. Besides, informal gatherings with engineers working in Dubai were made.

On behalf of the Delegation team, I would like to take this chance to thank all our hosting organizations, belated friends and sponsored companies for their generosity and sincerity on us. Besides, we would like to send our greatest gratitude to a team of advisors. Firstly, we would like to thank two of our advisors, Ir Peter Y WONG (the HKIE President) and Ir Gary C W KO (the HKIE Council Member) who have traveled with us in Dubai and joined the core program of the delegation. Secondly, we would like to thank the support from Ir Otto POON (Past President of HKIE), Ir Dr F C CHAN (the HKIE Vice President) and three advisors nominated from CPDC, namely, Ir Peter P F CHAN (CPDC Chairman), Ir Victor LO (CPDC Deputy Chairman) and Ir W K LEUNG (CPDC Committee). They have contributed a lot since the commencement of the delegation program, recruiting delegates, conducting interview, attending meetings, advising on the delegation program, presentations, logistics and the delegation report.

I am proud to inform all of you that we have turned an impossible mission into reality. All these cannot be accomplished without the joint effort from the dedicated delegates, advisors and sponsored companies. I would like to thank once again to everyone's effort to make our delegation a memorable and successful one.

Last but not the least, although we have completed the delegation report, we will continue to sustain our friendship and apply engineering miracles in our daily jobs whenever possible.

INTRODUCTION

Since 1991, the Young Members Committee (YMC) of the Hong Kong Institution of Engineers (HKIE) has been organizing delegations to different parts of the world with the following objectives:

- To appreciate engineering technologies applicable to Hong Kong
- To enhance the relationship between HKIE and Mainland / Overseas Institutions
- To promote Hong Kong and its engineering practices
- To widen young engineers' knowledge horizon on overseas engineering practices for continuing professional development purpose. This can be achieved through the delegation visits and pre-/ post-trip local seminars and visits related to the delegation theme

The Theme - A Study on Engineering Miracles

Following the success and the meaningful delegation on sustainable development in 2008 to Australia, YMC has planned to organize another delegation in 2009 to acquire new experience and advanced technology in Dubai.

Innovation is the lifeblood to engineering, under the confront of global challenges, innovation to developing sustainable solutions is the only way to turn problems into opportunities. Extending this idea to our engineering practices, young engineers should be able to learn to develop solutions in an innovative way to deliver task objective while balancing social and environmental issues. One of the innovation practice ground is Dubai, a small country which is said to have 15-25% of all the world's cranes.

Dubai is an ever eye-catching country in the engineering industry. Its world famous engineering wonders, such as the Palm Islands, Burj Dubai and Arabian Canal, have gathered world top designers and engineers' ideas and participation in these complexes, innovative and sophisticated projects. The building boom also put Dubai to a challenge of town planning for the exponentially growing place.

With the theme "Engineering Miracles", this planned delegation is initiated to serve as an inspiration for young engineers to think creatively and to turn their ideas into action - whether that means practicing creativity in daily works, developing an innovation for the engineering industry or solving a problem that makes society better. Site visits to the large scale construction sites cross Dubai, communication sessions with engineering institutions and town planning officials to understand the engineering issues and town planning for the rapid growing city are the focus of the delegation trip to bring out the importance of innovation in their world famous engineering miracles.

Objectives

The Overseas Delegation 2009 to Dubai - "Engineering Miracles" has the following specific objectives:

- To acquire new experience and global exposure to innovation through Dubai projects, with particular focus on investigating the state policies towards town planning, infrastructure developments as well as new technologies and practices adopted in complex engineering projects.
- To appreciate large scale infrastructure and building projects in Dubai
- To inspire young engineers to think creatively and to turn their ideas into action, e.g. learning to practise creativity in daily works, developing innovation for the engineering industry and proactively providing solutions for engineering difficulties

Figure 2.1 Group photo in front of Burj Al Arab

Figure 2.2 Group photo at Atlantis

- To encourage young engineers to extend their network and increase the horizon
- To arouse the attention of HKIE members to the importance of innovation in engineering. This will be achieved through the delegation visits and pre-/post-trip local seminars and visits related to the delegation theme
- To promote the professional image of the HKIE and Hong Kong engineers

Composition of Delegates

The delegation commences from the recruitment of delegates. This year a total of 16 delegates were selected from over 40 applicants who are young engineers of the Institution. The selected delegates are specialized in wide engineering disciplines, including civil, structural, building services, electrical and mechanical. At present, they work in different sectors of the engineering profession, including government departments, public sectors, consulting companies, utility undertakers and contractors. This composition made the delegation a representative one from Hong Kong young engineers.

Figure 2.3 Delegates in Dubai Metro precast yard

Topics of Our Study

With the theme of "Engineering Miracles", the Dubai Delegation 2009 was further divided into three areas of study. They are:

- Town planning (Details can be found in Section 3.2 of the report)
- Infrastructure Development (Details can be found in Section 3.3 of the report)
- Innovative Projects (Details can be found in Section 3.4 of the report)

The Dubai Delegation 2009 comprised the following key elements:

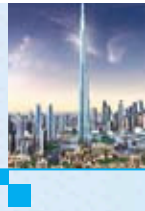
1. Organizing a 7-day delegation to Dubai from 20 – 26 Mar 2009. The overseas program included meetings with engineering professional bodies and consultant firms, visits to engineering infrastructures and innovative projects as well as attending exchange session with prominent engineers in Dubai.
2. Organizing a series of 11 local seminars/ visits related to the theme of delegation. The local events aimed to encourage members' innovative thinking, to promote innovative ideas in engineering industry and to enrich members' knowledge on innovative technologies adopted in construction projects in Dubai.
3. Publishing this report and organizing a presentation, with the findings of the delegation study and analogies with the Hong Kong practices included. This report has been distributed to the visiting organizations and companies in Dubai and major engineering organizations and companies in Hong Kong.

Contents of the Report

The report documents the findings and the events that were held locally and in Dubai.

It is divided into 7 sections. Section 1 records the messages from the delegation advisors, the YMC chairman and the delegation manager. The introduction in Section 2 provides an overview of the delegation study, its theme and activities organized. Section 3 illustrates the things each study group has learnt during the Delegation. The next section (i.e. Section 4) is an analogy made between Hong Kong and Dubai. After that, Section 5 records all the social gatherings and receptions in Dubai. The local seminars and visits conducted will be summarized in Section 6. Conclusion will be drawn in Section 7. Moreover, appendices containing the profile of advisors and delegates, messages from delegates, preparations before the trip, acknowledgement to the supporting organizations and sponsored companies, financial statement, photo gallery and advertisement from sponsored companies will be appended at the end of the report.

Figure 2.4 Ir Peter Wong and Ir Gary Ko presenting souvenirs to representatives from Society of Engineers – UAE



3.1 Background

Originally a small fishing and trading settlement, Dubai was taken over in about 1830 by a branch of the Bani Yas tribe from the Liwa oasis led by the Maktoum family who still rules the emirate today. In 1971, Dubai came together with Abu Dhabi, Sharjah, Ajman, Umm Al Quwain, Fujairah and Ras Al Khaimah to create the federation of the United Arab Emirates (UAE).

The discovery of oil in 1966 transformed the emirate and its way of life. Dubai's first oil exports in 1969 were followed by a period of rapid development that laid the foundation for today's modern society. However, the success of Dubai was not from oil. It was from the vision of its ruler who leveraged Dubai's oil revenue to maximum benefiting the emirate in a longer term and more sustainable manner. Today, Dubai is constantly building up its infrastructure of transport facilities, knowledge centers, tourism attractions, and other amenities of an advanced society.

Back in the 90's, Dubai had set strategic objectives to move from its oil industry to core economic sectors, making it an emirate with extraordinarily attractive investment environment. Its strategic focus on non-oil Gross Domestic Product (GDP) growth had paved way for its subsequent rapid development as a logistic hub, regional knowledge cluster as well as real estate development center of UAE. The quick move to the modern society has been complimented with numerous record-breaking developments.

To support its growth, Dubai has gone through a decade of blooming construction industry. It has been said to have 15-25% of all world's cranes, the 8th world wonder, etc. making Dubai an emirate of engineering miracles.

Figure 3.1.1 Dubai Sheikh Zayed Road [1]

Learnt from the successful story of Dubai, construction is progressively moving to other emirates of UAE. To understand more on the construction industry, it would be useful to look at its construction related economy in UAE, which was shared by Dr. Raymond Ho from Al Habtoor Leighton Group in our delegation visit [2].

	Age Group	Male	Female	Total	%
Nationals	0-19	217,424	204, 491	421,916	51%
	20-49	163,363	172,370	335,734	41%
	50+	37,269	30,002	67,272	8%

	Age Group	Male	Female	Total	%
Non-Nationals	0-19	300,806	268, 951	569,757	19%
	20-49	1,672,118	509,060	2,181,178	74%
	50+	156,061	37,162	193,223	7%

Table 3.1.1 Population in UAE [1]

Residents in UAE are dominated by expatriates, featured by its exceptionally high ratio of non-national and male in working age group. Its population growth also sustain at high growth rate of 4%, representing high import of human capital driven by the construction industry.

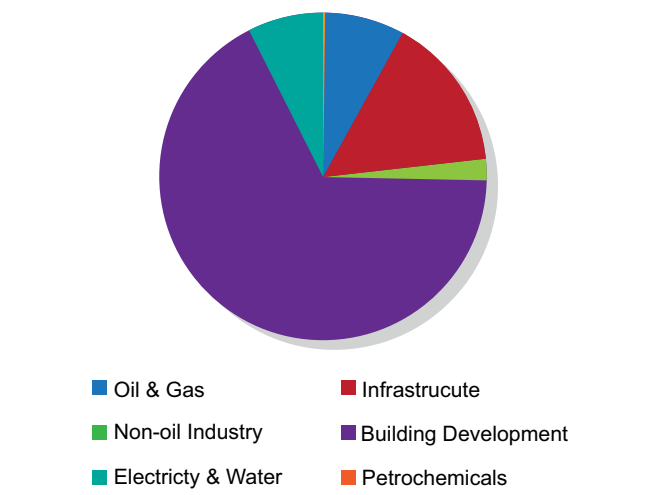


Figure 3.1.2 Construction economy by industry

Construction Related Economy

Preliminary data issued by the Central Statistics Department of the Economy Ministry UAE indicated that total GDP of UAE at fixed price amounted to Dh535.6 billion in 2008, representing a growth rate of 7.4%, against Dh498.7 billion, and a growth rate of 5.2% in 2007 [1]. The construction industry contributed about 8.5% of GDP. Of the 3.8 million population in UAE, about 3.2 million are working population. The share of the construction economy


Palm Jumeirah


Burj Dubai


Palm Jebel Ali


Dubai Metro


Arabian Canal


Burj Dubai

Figure 3.1.3 Remarkable projects in Dubai [4] [5] [6] [7]

is also indicated in Figure 3.1.2. Obviously, building development has been the major driver of the construction activities in UAE.

Another remarkable figure about construction industry in UAE is the multi-billion US dollars worth of projects in UAE, many of which have been taking place in Dubai. Among them, it is never difficult to name their well-known projects.

Our Visit to Dubai – Emirate of Engineering Miracles

Our 7-day Dubai Delegation was a mini-tour to Dubai's miraculous constructions. It was packed with sharing and exchange with professional bodies for grapping chance to understand the fundamental planning and regulatory concerns in planning stage; site visits to witness the pre-casting and construction method at construction sites shared by developers, as well as appreciation of finished pieces at the commissioning stage of selected projects.

Day 1 - 20 Mar	• AM:	City Tour with Engineers in Dubai
	• PM:	Exchange with P&T Architects & Engineers Ltd. (Dubai Branch)
Day 2 - 21 Mar	• AM:	Meeting with Society of Engineers-UAE
	• PM:	Site Visit to Dubai Mall Hotel
Day 3 - 22 Mar	• AM:	Site Visit to Pre-casting Yard for Dubai Metro & Palm Jebel Ali Water Homes Platform
	• PM:	Site Visit to RTA Launching Gantry
Day 4 - 23 Mar	• AM:	Visit to Arabian Canal
	• PM:	Presentation by Emaar Properties on Burj Dubai
Day 5 - 24 Mar	• AM:	Visit to Dubai Metro
	• PM:	Visit to Palm Jumeirah
Day 6 - 25 Mar	• AM:	Overview of UAE Construction & Planning Aspects of Dubai Projects by Al Habtoor Leighton Group
	• PM:	Exchange with American University in Dubai

Figure 3.1.4 Delegation itinerary

Our Learning Journey:

To meet our learning objectives in the 3 core areas: Town Planning, Infrastructure Development & Innovative Projects, the itinerary was designed to fit the purpose.

City Tour with Engineers in Dubai

To respect the praying day in Dubai which is the first half day of every Friday, of which all works and social activities are stopped, the first event of the delegation was city tour by coach guided by engineer in Dubai. It was target for giving delegates a first sight of Dubai with a scene of numerous construction projects with cranes all around. Delegates would be able to share among the team their pre-trip study on background of eye-catching projects in Dubai.

Figure 3.1.5 Ir Peter Wong (L) and Ir Gary Ko (R) presenting souvenir to Ir Johnny Wong, as a token of thanks for guiding the city tour.

Exchange with P&T Architects & Engineers Ltd. (Dubai Branch)

The P&T Architects & Engineers Ltd. (Dubai Branch) was established in 2004, under rapid expansion to support development in the Middle East. P&T was appointed for the master planning of an exciting cornerstone project, The City of Arabia, a 1.7 million m^2 multi-use development in the centre of new city, Dubailand, catering for 40,000 residents. Before attending the exchange session, engineers of P&T had been requested to give an overview of various projects in Dubai and share with delegates the building, infrastructure and town planning issues.

Figure 3.1.6 A warm welcoming note for HKIE-YMC at P&T Dubai Office

Meeting with Society of Engineers - UAE

The Society of Engineers (SOE) – UAE was founded as a result of high development existing in all engineering fields in the UAE, driving local engineers to realize their responsibility to form a professional assembly which includes the engineers and technicians of the UAE. In 1979, UAE Society of Engineers was formerly registered with the Ministry of Labor and Social Affairs, as a close link between the Governments and the engineering industry in UAE. This exchange meeting was target to provide delegates an opportunity to share with UAE engineers the accreditation system, training and development opportunities for engineers in Hong Kong and learn from UAE engineers the current practice in UAE.


Figure 3.1.7 An exchange between SOE-UAE and HKIE

Site Visit to Dubai Mall Hotel

Dubai Mall Hotel is constructed by CSHK Dubai Contracting (LLC), subsidiary to China State Construction Engineering (Hong Kong) Limited. With portfolio of high-rise building projects in Dubai including Amada Towers, Gold Towers III, Trident Grand Residence in Marina, XL Tower & Business Tower in Business Bay, Dubai Mall Hotel, being part of Burj Dubai Development, is another icon of CSHK. Close to project completion, the site visit was targeted to guide delegates to familiarize the construction practices in Dubai, in particular to the fast track process as compared to Hong Kong. Engineers from CSHK had been requested to introduce the statutory submission for construction projects in Dubai, with reference to the Dubai Mall Hotel project.


Figure 3.1.8 Presentation by CSHK Dubai Contracting (LLC) at Dubai Mall Hotel site office

Site Visit to Pre-casting Yard for Dubai Metro & Palm Jebel Ali Water Homes Platform

The contract for casting and erecting the elevated superstructure of the Red and Green Lines of Dubai Metro, the first railway system in Dubai, was awarded to a joint venture of VSL and Freyssinet and Rizzani de Eccher. The metro project involves approximately 1,700 spans made up of over 16,000 segments, precasting of which is now taken place at the precast yard at Jebel Ali, the far west end fetch of Dubai. Featured the biggest precast year in Middle East, the site visit was arranged to look at the production line with tower and gantry cranes, with 64 casting machines consuming 800m^3 concrete per day.

Figure 3.1.9 Dubai Metro Superstructure Project site


Figure 3.1.10 Pre-casted rail segments

Jebel Ali Water Homes are a series of elevated homes linked together by boardwalks to form a 12km chain at the Crescent of Palm Jebel Ali, the second palm island of Dubai which is now under construction. The 504 Water Homes are raised on platforms above water; these platforms being foundation for the Water Homes and elevated walkway, each sized over 350m^2 are pre-casted on a temporary reclamation site at Jebel Ali, also supporting world's largest gantry crane with maximum 340 tones under hook.

Figure 3.1.11 HKIE-YMC delegates at pre-casting yard for Jebel Ali Water Home platforms

Site Visit to Road & Transport Authority (RTA) Road Project Launching Gantry

By first half of 2009, RTA would be completing 11 major road and bridge projects in various part of Dubai. All these projects are undertaken as part of RTA Master Plan to keep pace with the urban development with an aim to comprehensively improve parallel roads of the emirate. To line up with rapid development, the construction has to be fast. This site visit was targeted to look at the huge size launching gantry for fast paced construction of at-grade bridges with post-tensioning techniques.


Figure 3.1.12 Launching gantry at RTA major road project construction site

Visit to Arabian Canal

Arabian Canal, when built, would be the world's longest sea level canal in length of 75km. The canal is developed by Limitless, the global development arm of Dubai World. Arabian Canal is designed to flow inland from Dubai Waterfront, passing to the east of the new Dubai International Airport before turning back towards Palm Jumeriah. Along the canal would be the development of another new city in dessert. The visit was targeted to enhance delegates' understanding on the overall town planning of a new district, the design difficulties as well as features of the canal and its function to the new city. In the visit, delegates would also visit the enormous 700m long, 200m wide and 45m deep trial excavation trench.


Figure 3.1.13 Project Director showing the construction plan of Arabian Canal to delegates

Presentation by Emaar Properties on Burj Dubai

Burj Dubai is currently the world's tallest building in all aspects. The breakthrough is the big step jump it brings to the world record. Historically, the Penronas Towers, Taipei 101 and Sears Tower had broken record with a few meters rise, but Burj Dubai is bringing a few hundred meters height to the world record. In the visit, delegates were expected to explore the innovative design of this skyscraper, in terms of structural system, construction technology, mitigation measure for strong wind load as well as stack effect, popular areas for study with skyscrapers.

Visit to Dubai Metro

The Dubai Metro is the first railway system in Dubai. In 2005, the design and build contract was awarded to Dubai Rapid Link consortium, made up of 4 Japanese companies and 1 Turkish company. The ultimate planning of Dubai Metro consists of 4 lines namely the Red, Green, Purple and Blue lines. The Red line, being the main trunk and also the world's longest driverless auto rail is due for opening on 9 Sep 2009. The site visit was arranged at a Metro Station of Red line, through which delegates would be able to appreciate the design theme and building services design of a metro station, as well as the park-and-ride facilities to be provided at station.

Figure 3.1.14 Project engineers explaining building services design at station platform

Visit to Palm Jumeirah

Palm Jumeirah is an artificial island created using reclamation. It was constructed by Nakheel, a Dubai government owned development company. Self-declared as the "8th World Wonder", Palm Jumeirah is the first of the three palm islands which although increase Dubai's coastal line by 520km when constructed. Palm Jumeirah alone increases the coastal line by 130km. The essence of the design is its palm shape, self-contained transport system with six lane highway and sub-sea tunnel, as well as utility supplies. Delegates were expected to learn its design as a mini-city, engineering challenges encountered in the construction of this first made island of scale, as well as its unique protection against high tide and wave to preserve its shape.

Figure 3.1.15 Harmonized power substation design (U) with luxury houses (D) on Palm Jumeirah

Overview of UAE Construction & Planning Aspects of Dubai Projects by Al Habtoor Leighton Group

Received by Al Habtoor Leighton Group, the largest multi-disciplined construction company in the region, the presentation was targeted to give delegates an overview on construction industry and understanding of the construction related economy in the boarder UAE. Major iconic projects in the emirates would be introduced by Dr. Raymond Ho (General Manager of Al Habtoor Leighton Group), and more importantly, the underlying value of these construction development to the economy and bilateral effect between financial and construction sectors.

Figure 3.1.16 Dr. Ho from Steel Fabrication Division sharing the overview of construction industry in UAE

Exchange with American University in Dubai (AUD)

The visit to AUD aimed to provide opportunity for exchange with academia as well as for cultural exchange with engineering students in Dubai. The exchange theme was General Overview of Town Planning and Development in Dubai, aiming to explore fundamental elements supporting the growth of Dubai and planning directives as seen from academic perspective. Inspired by the rapid growth of construction industry in Dubai, delegates are also looking for how engineering students could benefit from the learning through practicing, as well as their inspiration by innovative building design and practices of the construction industry.

Figure 3.1.17 Exchange with academia and engineering students from AUD

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[1] Photo from http://en.wikipedia.org/
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[3] UAE Economy: http://uaeinteract.com/
[4] Photos from http://www.thepalm.ae/
[5] Photo from http://dubaimetro.eu/
[6] Photo from http://www.arabiancanal.com/
[7] Photo from http://www.burjdubai.com/

3.2. Town Planning

Being one of the three study areas in Dubai Delegation 2009, delegates had appreciated the town planning history, policy and strategy in Dubai. Through pre-trip studies, delegates has gained background understanding about the four phases of urban development in Dubai – dated from 1900 to nowadays and Dubai's planning vision for future. Over the past decades, Dubai has dramatically rolled over from a modest economy, to rapid growing cosmopolitan city with staged but structured town planning. Through the delegation, delegates have got familiar with the Dubai Strategic Plan 2015, the guiding book for long term planning directives and strategies in 4 main sectors – urban planning, energy, electricity & water, roads & transportation and environment. The current town planning in Dubai is best illustrated by the mega-project Arabian Canal. Introduction of the three development horizons were also the highlight of this delegation, which bring delegates through the three focus development areas, covering trade, logistics and transport; technology, media, telecom and information technology; and the ultimate planning goal in education, research and development.

3.2.1 Urban Development and Zoning in Dubai

The urban development in Dubai could be divided in four major phases (Figure 3.2.1) [1]:

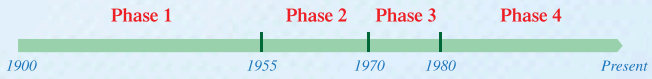


Figure 3.2.1 Urban development in Dubai

Phase 1: 1900-1955
Slow Growing Economy

The constrained economic growth together with marginal increase in population limited the expansion of Dubai. At the beginning of this period three major residential quarters with 10,000 populations were found in Dubai.

- **Deira**, the major area for inhabitants in Dubai consisted of 1,600 houses and 350 suq (Arabian market) shops, with Arabs, Persians and Baluchis.
- **Al Shindagha**, a former residence of the ruling family with only 250 houses and no suqs.
- **Dubai**, the smallest of the settlement areas dominated by Persian and Indian merchants with 200 houses and 50 suq shops.

Only 3.2 km^2 of the total area had been developed by 1955. Residential quarters were usually built in clusters for privacy and security purposes. To facilitate the transport of goods and drinking water from four public wells, the internal parts of each enclave were connected by narrow walkways. The first house constructed using concrete blocks was not built until 1956 [2].

Phase 2: 1956–1970
Embryonic Development with First Master Plan

During this period it was deemed necessary to have a formal institutional structure to guide the urban development. Under the supervision of a city council whose membership was drawn largely from the ranks of the leading merchants, the Dubai Municipality was established in 1957 to administer and co-ordinate all municipal services. At the same time a 1960 master plan was prepared by a British Architect in response to the future urban development of Dubai. This plan proposed the provision of a new road system, zoning of town into areas for different land uses, and creation of a new town centre. The modest goals of this plan were not only in keeping with the emirate's pre-oil resources but also maintain a strong central control over urban development.

The traditional land ownership in Arab-Islamic countries was based on two principles. Any area that had been occupied by a homestead over a long period would belong to the inhabitant. Elsewhere landed property was at the disposal of the ruler. Therefore, to accommodate such unique structure of the real estate market, regulation of the pattern of urban development in Dubai was established based on the datum of 1960. In areas where by 1960 solid houses had been built, the residents may have the right to dispose the plots. In those undeveloped areas within the city by 1960 the ruler may sell the land, lease it, put it to special uses, or allocate it to the municipality for public utilities. Moreover although the titles to plots that were already developed in 1960 may be traded freely among inhabitants, the municipality may reserve the right to reclaim such plots provided that the landowners must be compensated according to market value. The fact that the ruler may freely dispose of lands outside the settled areas of 1960

together with the right to reclaim the private plots by the municipality affords considerable central control over the pattern of urban development.

Phase 3: 1971–1980
Ambitious Growth with Structured Master Plan Taking Shape

A new and more ambitious master plan for Dubai was conceived as a result of urban expansion and the availability of development capital. A new ring roads system around the city and a radial street network to the suburbs were proposed together with other major transport developments including the Shindagha Tunnel beneath the creek to connect Bur Dubai and Deira, and construction of two bridges, (Maktoum and Garhoud) linking city districts on both sides of the creek.

The land use planning for this period could be summarized as following:

- On the area west of the creek, the international import and container harbour was built alongside the dry docks and the landmark World Trade Centre, as well as several major industrial areas.
- The other side of the creek, around Deira, developed as the major business banking and administrative centre of the city, handling coastal and re-export shipping activities.
- The development of Port Rashid, now named Jumeriah, towards Jebel Ali was designated for residential use.
- Special areas for health, education and leisure/ recreation developments were set to the south of the city.
- A new commercial and financial centre of Dubai would be set along Sheikh Zayed Road towards Jebel Ali named as 'New Dubai' [3].

Phase 4: 1980–Present
The Yielding Stage

The city came to a new era of explosive growth of the economy as well as city. Despite the master plan of 1960 outlined the general framework of the urban road network and the system of municipal services, the government could not have foreseen the rapid urban expansion, in terms of both the scale and diversity of development projects and physical spread of the city. Therefore since early 1990s, the city government implemented an Overall Development Planning (1985-2000) which identified the overall framework for the future economic and physical development of the city. Subsequent to this overall planning, the Municipality prepared a Dubai Urban Area Strategic Plan 1993–2012 (Figure 3.2.2) which outlined the explicit spatial framework for urban growth and the city's general land use structure [4].

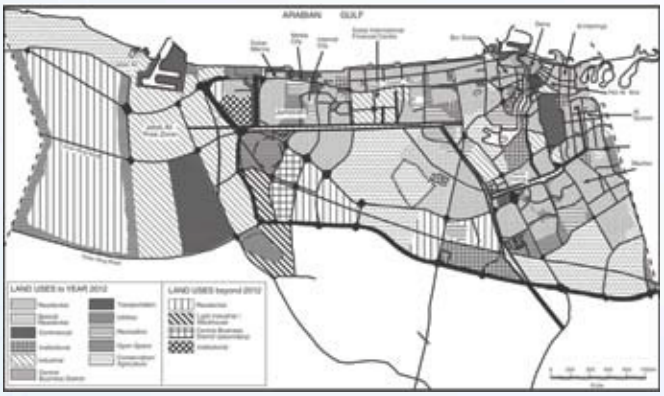
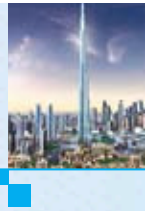


Figure 3.2.2 Dubai Urban Area Structure Plan 1993–2015

Figure 3.2.3 Dubai Urban Area Structure Plan 2003 [6]

Other planning and investigation including the Urban & Strategic Growth Planning for Dubai (2000-2050) and the subsequent First Five-Year Plan for Urban Dubai (2000-2005) (Figure 3.2.3) were also implemented since last decade. Together with a number of new legislations and laws on the use of the Emirate's lands, these plans aimed to maintain the steady development of the urban areas, including striking a balance between the population growth and the use of lands and enhancing environmental services.

The **Dubai Urban Area Strategic Plan 1993-2012** outlines three particular challenges relate to the adequate provision of housing, transportation infrastructure, and public services and facilities:



Housing

As a consequence of the particular system of land ownership in Dubai, allocation of land for housing can be divided between nationals and expatriate. The former refers to the need for new dwellings to accommodate the growing number of households, and to replace dilapidated housing units. The state policy dictates that all national males above 20 years of age receive a plot of land of 15,000 ft^2 (1,400m^2) and that nationals with a plot of less than 10,000 ft^2 (935m^2) may be granted another plot of 15,000 ft^2 in addition to the original plot. Emiri nationals are also entitled to interest free loans to assist with house purchase. Expatriate housing needs are catered for by the private sector, with the municipal responsibility confined to identification of development areas.

Transportation Infrastructure

In the view of expected population growth and consequent increase in the number of vehicles, starting from 1991, Dubai Municipality has prepared both medium and long-term transportation master plan detailing the future traffic flow in Dubai up to 2011. Main objectives of the plan included construction of new roads between Dubai and Sharjah, a ring-road system around Dubai and re-planning of traffic circulation, especially the flow of traffic crossing the Creek.

Upon the completion of the Dubai bypass road linking Sharjah with Dubai and Abu Dhabi in 1999, an additional two-lane expressway directly connecting Sharjah and Abu Dhabi had also been planned, which allows Abu-Dhabi-bound traffic and as a result, avoiding vehicles entering the traffic-clogged urban limits of Dubai. The new three-level interchange, which is right opposite to the Dubai Cargo Village and directly links with the approach roads to the airport, was also finished in August 2000.

Public services and facilities

Another major development issue refers to the provision of public services and facilities. Traditionally the services such as electrical power, water supply, sewerage, and waste disposal, as well as the capital and operating costs of facilities such as hospitals are all under the Ruler's subsidiary. As a result of the rapid increase of population and decline of oil revenues, these social infrastructure services are accounting for an increasing proportion of GNP. A fundamental challenge is how to maintain the standard of service without any further rising cost of social welfare subsidies. This could be solved by the implementation of higher cost recovery via increased user charges or improved demand management using price-related inducements to restrain consumption.

The **Dubai Urban Area Strategic Plan 1993-2012** also detailed a series of mega-projects which outline the principle of zoning in Dubai in future. These are:

- Internet City
- Media City
- Festival City
- Dubai Marina
- International City
- Dubai International Financial Centre
- Burj Dubai
- Dubai Mall

To promote Dubai as a prime business, tourist and shopping, the city government decided to employ a team of urban planning experts to deal with the rehabilitation of Dubai by implementing a series of overhauling projects. The area of Old Souq, which runs in parallel with the Dubai Creek from the direction of Deira and Bur Dubai, was the first selected area to be overhauled and converted as the Central Business District. The experts have also considered the rehabilitation of the mosques in the entire city. It's noteworthy that the number of mosques in Dubai has increased to more than 470, 278 of which are spacious enough to host worshippers during Friday prayer. Most of these mosques have been built in keeping with the latest architectural techniques while evoking, at the same time, the unique nature of Islamic architecture.

While in the past decade construction and real estate are the major contributors to Dubai's Gross Domestic Product (GDP), it is also among the prime resource-intensive sectors. In order to minimize negative environmental impacts and reduce natural resource depletion, the need for **Sustainable Development in Dubai** is taking important role as a rapid growing city. Taking up the responsibility of sustainable development, the Emirates Environmental Group (EEG), a leading non-government organization (NGO) based in Dubai, has established an ample scope which directly links between environmental

and developmental issues in Dubai's urban growth. EEG's vision is to facilitate a green and sustainable UAE. Through this, it aims to promote the three R's (reduce, reuse, recycle), sustainable lifestyles, cultural expression, sustainable transportation, public transit, water resources management, renewable energy, cleaner production, ecological urban design and construction, reduction of solid waste and sewage treatment, combating desertification by expanding urban green spaces public health, and social responsibility of residents [5].

A few years ago, EEG mounted an awareness campaign to popularize the concept of green buildings in an environment that was still unfamiliar with the imperative for sustainability. Together with the awareness raised among policymakers, communications media, professionals and community leaders, EEG has organized a green building council for the UAE, to establish minimum environmental quality standards and rating systems. To improve and expand the public use of transportation systems in Dubai, EEG has been contributing in the promotion of public education on the economic and environmental benefits of urban transit. Together with the active support by the corporate sector, in 2004, EEG has successfully launched the multi-stakeholder Corporate Social Responsibility Network in the UAE, bringing together the heads and hands of urban economic development in a single, structured, composite body.

3.2.2 Strategic Planning and Development Horizons in Dubai

Over the past years, Dubai has positioned itself as a regional business hub, an attractive tourism destination and a safe and great place to live. To achieve this, proper urban planning and development of mature infrastructure for supporting growth are key factors behind the success. Certainly, Dubai has demonstrated its full commitment to driving the fastest growth in UAE, supported by the planning of new development zones for commercial activities, building up of self-contained and sustainable community neighborhood and linking up all these cities within the city, the physical infrastructure development and transport system also play a role to accommodate the urban expansion, making the emirate grow socially and economically.

In this delegation, through the exchange with P&T Architects & Engineers Ltd. (Dubai Branch), as well as American University in Dubai, delegates were enlightened with more in-depth understanding to the existing zoning plan of Dubai and its longer term development focus and horizons.

The current developed lands are along the coastal line of Dubai, and even expand into the sea by the recent remarkable reclamations of the Palm projects. Yet, to accommodate the future urban expansion, additional lands are allocated in a phased planned process to meet current and future needs for residential, commercial and industrial uses.

To support the rapid growth development in city, the urban development in Dubai today is featured with a number of large scaled projects, which include the Dubai Metro Transport System, Dubai Creek Extension, Arabian Canal construction, upgrade of road interchanges, record-breaking land reclamations, power stations and the Al Maktoum International Airport [7]. All these projects are in support of the planning goal of self-contained and sustainable development of urban neighborhood and business districts in Dubai.

As shared by P&T's master planning experience in an Ajman Marina development project, from the landmark development frame view to public boulevards between mid-rise resident block, as well as the design of internal street environment perspective. Design of utility services corridor for incorporation of greening is also an integrated part of urban design in the emirates, putting uprising focus on pleasant livelihood and conservation of environment.

To ensure proper focus on sustainable development, long term strategic aims in respective key development areas are important in Dubai's territorial development. During delegates' visit to American University in Dubai (AUD), the Dubai Strategic Plan 2015 [8] was introduced. Playing an important role in guiding Dubai's planning and development directives, specific focuses are put in four main sub-sectors: Urban Planning, Energy, Electricity & Water, Roads & Transportation, and last but not least Environment (Figure 3.2.4).

Figure 3.2.4 The 4 main sub-sectors and aims for long term planning strategy

Detailed study on Dubai Strategic Plan 2015 revealed its analogy to Hong Kong's 2030 Study, in which aims and objectives for key development areas are laid down in plan. For Dubai, the aim for the infrastructure, land and environment sector would be achieved through the following strategic thrusts:

Optimize Land Use and Distribution while Preserving Natural Resource

Elements of urban planning process are to be integrated through proper coordination amongst stakeholders. Land use would be optimized through the integrated urban planning to ensure provision of community facilities, enhance existing national housing policies and program, and to ensure adequate supply of low and medium income housing by adopting Government-driven interventions, and to update existing labor housing policies and ensure enforcement.

Provide Efficient Energy, Electricity and Water Supplies to Meet Growing Needs

This is done by developing an integrated energy, electricity and water policy framework to invest energy, electricity and water demand management options and to secure long-term energy supplies. Power generation and desalination capacity have to be increased for securing electricity and water supplied required meeting Dubai's growing needs.

Provide Integrated Roads and Transportation System to Facilitate Mobility

To ensure mobility of transport network, the share of public transportation has to be increased for reducing private car travel demand. Road network and transportation system capacity has to be increased for optimizing transportation network use through deployment of modern technologies, demand management policies and accident management procedures. Traffic safety is also their uprising concern, which has to be improved by enforcing safety design standards and safety audits, as well as influencing driver behavior.

Maintain Dubai as a Safe, Clean, Attractive and Sustainable Environment

The objective is to be achieved by updating and aligning environment regulation with best practices and developing required enforcement mechanism. A sustainable development approach is to be adopted by integrating environment outcomes within development policies and by raising environment awareness.

Dr. Dima, Assistant Professor of Civil Engineering Department AUD, also shared with delegates the overview of development in Dubai. Best known as having the best tax-free system in the world, Dubai quickly evolutes from a moderate size of economy and population in early 1990's to a top modern emirate. In mid-1990's, Dubai had set the Dubai Vision 2010, putting development focus and setting objective in 3 areas:

- Government as the key driver
- Focus on core economy sectors
- Attractive investment environment

Using these three focuses as the elements of Dubai's early vision, the development in Dubai have been at much faster pace than forecast and by 2005, all objectives were achieved, in 5 years ahead.

Apart from the Strategy Plan 2015, the 3 development horizons of are also worth to note. Adopting the world's successful development model, Dubai also set Trade, Logistics and Transport being the 1st horizon of its development, moving on with the 2nd horizon to more high-tech development areas, being Technology, Media, Telecom and IT. Coming last would be the 3rd horizon in areas of Research & Development, as well as Education, for knowledge development in pursuit of sustainability.

Yet, the essence of planning is the flexibility of realigning planning goals to cope with changing economical environment. Under the economic downturn, all economic aspects of Dubai's Strategic Plan 2015 are currently under review, shifting basis from sustaining fast growth to helping the stabilization of the economy and security of jobs in the face of economic downturn. Expecting a real growth

of 2.5% in Dubai this year down from the 11% forecast under the Strategic Plan, the government is working with haste to assess all projects, capital and other economic aspects for necessary adjustment of development goals.

3.2.3 The Town Planning Showcase: Arabian Canal

The Arabian Canal, a Dubai Waterfront Development, is a perfect showcase to demonstrate the planning of a mini-city in Dubai.

Dubai Waterfront, which is expected to extend Dubai coastal line by as much as 820km, being claimed to be twice as length Hong Kong's coastline and will cover an area of over 81 million m^2, is currently under development. Emerging as part of the neighbouring Dubai Waterfront development and aiming at completion in 2013, the Arabian Canal currently under construction in Dubai, is the largest canal project in the Middle East since the Suez Canal was built in 1859. Developed by Limitless, the development arm of Dubai World, the canal will be 75km long, 150m wide and 6m deep, enough to accommodate vessels up to 40m long.

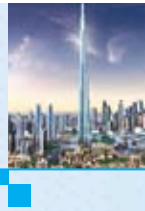
Starting from Dubai Waterfront at the coast of the Arabian Gulf west of Dubai city centre, the manmade waterway will flow inland, passing to the east of the new Dubai World Central International Airport before turning to run parallel with the shoreline and eventually coming back again towards Palm Jumeirah meeting the Gulf coast more than 25km later (Figure 3.2.5).

Figure 3.2.5 Master Plan of Arabian Canal [8]

Once complete, the Arabian Canal will include residential communities and marinas. The amount of earth excavated over three years will be five times as much as the Panama Canal. There will be 75km length of the waterway, 300 vehicles on site, 12,500 ha of desert set aside to become a new canal side city (2.5 times as big as Manhattan Island, New York City), 2.5 million residents in 1 million units (more than the population of Paris, Rome, Osaka or Riyadh), 1 billion m^3 of excavated materials will create a new topography, and 5 billion liter of water flowing through Arabian Canal each day (more than the total residential water use of Jeddah, Cape Town, and Frankfurt of Lisbon).

Social Sustainability - Master Planning

The Arabian Canal is, unlike most canals, of the main purpose neither for movement of water or freight. Instead it is used as a catalyst for waterfront real estate developments along its banks. Arabian Canal will include Urban Centres, Hillside Residential Communities, Commercial Districts, Marinas and Waterfront Activities, Beaches, Nature Parks and Green Spaces and Comprehensive Transit Networks. As said by Ian Raine, Project Director at Limitless, "the way the masterplan is being prepared is to provide a complete balanced community in each of the phases so it would be a mix of high density urban centres



moving through to more medium density commercial areas to lower density and residential areas."

Arabian Canal's master plan focuses on creating diversity through an array of distinct developments and landforms. Water will be a central element of the development, above and beyond the central thread of the canal. It is decided to build other canals that would be set into a streetscape theme. Smaller canals inform the design of streetscapes and shopping districts; lakes and streams meander through public parks and gardens; ornamental fountains take their place next to storm water basins and treatment wetlands. In short, water, in all its forms, permeates the project so that the whole idea of water moves away from the main body of the canal and gets expressed deeper into the community that surrounds it. A key feature of the inland development will be a number of smaller canals, referred as 'canal streets'. These 'canal streets' will be located within the medium density areas so away from the main canal. Besides, beaches, piers and marinas are expected to be some of the potential attractions.

In addition, a number of green areas, parks and open spaces will be created within each development area. Open space is another key element of the development. Since surroundings of canal will eventually become a city for up to 2 million people, it is important for the urban planner to make sure something on right scale and enough facilities for everyone. As much as possible open areas are always the main concern. A rich variety of parks and open spaces ranging from formal parks and plazas to desert reserves are envisaged. Arabian Canal brings engineering and design together in one. Many of its design elements are also important nodes of activity. The design of the open space will take its inspiration from urban models, with the application of mixed use model, so a park may, for example, feature a café, or have a civic use such as a library rather than simply serving as a green space. Working landscapes will form another part of the development including wetlands, agriculture, and habitat features.

Transportation is another consideration of the urban planning. To coherent with a vision of demonstrating the Canal as an important benchmark for sustainability and ecologically sound development both in Dubai and worldwide, streets are arranged and scaled to favour pedestrians and bicycles over automobiles to enable a mean of carbon free transportation. Mass transit would be applied. A comprehensive tram system puts most locations within a short 5-7 minute walk. A tightly woven network of roadways and transit systems not only provides safe, convenient and environmentally friendly access but also allow for efficient mass transport to urban centres, smaller villages and the rest of Dubai.

Environmental Sustainability - Inland Water Flow

Arabian Canal itself is already the fundamental element of environmental sustainability because the canal brings water into the desert and then water enables life along the Canal. However, this simple concept also takes a step further to help improving living environment making it comfortable. The Canal and its water features generate natural forces allowing for mist and evaporation, helping to cool temperatures in the surrounding city. This is a big contrast to most international cities which always suffer from heat concentration. Buildings are designed and grouped to provide shade to keep temperatures cool. Moreover, they are designed to exceed world environmental standards.

The strategy is to reduce base energy and water demands, maximize efficiencies and minimize waste through a holistic approach: Landscape, street shading, energy production and distribution, waste treatment and water use. On top of all these, it is committed to fulfill targets stated in Table 1. As mentioned, the city is planned with a tightly-woven transportation system, including boats, trains, people movers, cycle paths and walkways. It is expected to reduce car dependency and cutting time spent in traffic: on average 5 years of a person's life.

	Typical Dubai Development	Arabian Canal
Water neutrality	0.61m^3/person-day	0.19m^3/person-day
Reliance on grid water	7 25-mgd (95x103m^3/day) desalinations plants required	2 25-mgd (95x103m^3/day) desalinations plants required
Electrical demand	6.4GW	2.5GW
Carbon emissions	12,560gCO_2/person-year	3,350gCO_2/person-year

Table 3.2.1 Environmental Targets

Innovation engineering is fully applied to ensure that the canal does not become a huge, stagnating pond all by natural power. Sluice gates and locks combined with tidal energy from the Arabian Gulf will create a natural flushing system to push water through the Canal. Innovative water features that regulate the Canal's flow and feature kinetic water sculptures is achieved by two tidal gates illustrated in Figure 3.2.6.

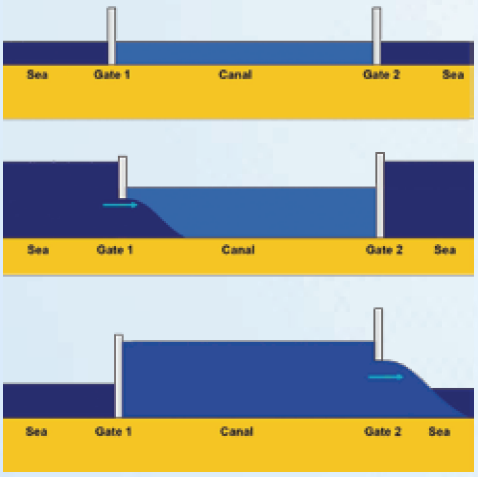


Figure 3.2.6 Working principle of tidal gates

The natural rise is about 2m. Tidal models were conducted which are all coming to the same conclusion that the canal will need 7 to 10 days' flushing time - the time needed to replace its water volume at the rate of flow through the canal. It was also claimed that strict quality controls would be executed on water discharge.

Regarding the effect to the ecosystem, an environmental impact assessment was said to be conducted to determine how the development would affect local wildlife. A carefully-planned rescue program safely relocated 6,500 animals, including 4,000 agamas, 2,000 jayakar's lizards, 301 Asian snake-eyed skinks, 101 spiny-tailed lizards, 78 Arabian gazelles, 43 Baluck Rock geckos, 13 cape hares and 8 field mice. In addition, the Canal will create a natural habitat where marine life can thrive.

Engineering - Challenges on Excavation

Excavation in Arabian Canal will be 5 times as much earth as the Panama Canal. The amount of excavation is more than 1 billion m^3 and the excavated material will be used to create a new topography surrounding the canal with man-made hills of up to 250m. To such a big scale, a fairly serious amount of earthmovers are to be needed to shift the volume of sand per day to keep on schedule. Excavation work on the canal continues at a rate of 100,000 m^3 per day, with more than 300 numbers of earthmoving, mining and other heavy equipment on site, and over 10,000 construction workers.

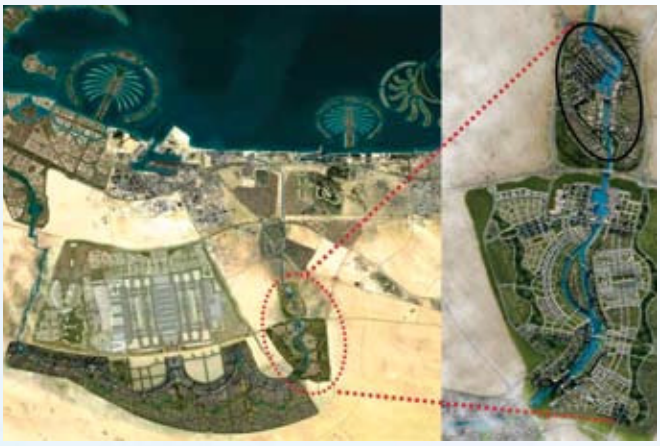


Figure 3.2.7 Canal Front [9]

In Figure 3.2.7, the area within the red dotted line is Canal Front, the first phase of the development, currently under construction. In this site visit, the delegation team visited Area 1 of Canal Front, shown in the figure in black circle.

A single phase of excavation has been awarded to local contractor Tristar. But before the contract was awarded, a trial excavation of 700m long, 200m wide and 45m deep was carried out by client Limitless to verify the excavation method because engineering precedence for the behavior of the weak rocks and groundwater regime in Dubai was in lack (Figure 3.2.8). The trial included complementary instrumented drilling to confirm rapid means to identify such layers. Information acquired from the trial enables contractors to understand more about the geotechnical conditions for determination of best excavation strategy.

Figure 3.2.8 Trial pit site

The first phase involves excavating more than 200 million m^3 of fill over a 9km length of canal. The depth of excavation will be 5m below sea level and the height of the canal bed is currently at +9.5mPD. It was decided to use conventional excavation methods for its section of the canal. Bulldozers fitted with rippers eat into the rock while other dozers with buckets attached lift the fill into trucks that hold between 20m^3 and 40m^3 of material (Figure 3.2.9).

Figure 3.2.9 Area 1 site of Canal Front

At another site, 30km along the canal from phase one, the contractor carried out a second trial that involved using heavy duty equipment usually used in quarrying. As of July 2008, 1.5 million m^3 of earth had been excavated, equivalent to a hole of 700m long, 200m wide and 45m deep in size, but yet, it is only 1/400 of required volume for shaping of the Canal.

The project still has a long way to go. Relocating the highway, tackling the effects of drainage and determining how the tidal gate system will operate are all hurdles to be cleared if the Arabian Canal is to work. The biggest challenge is always the fast-track for the construction of the Arabian Canal. Flexibility and adaptive engineering solution is the key.

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3.3 Infrastructure Development

With the fast growing real estate developments and population, Dubai's demand for infrastructure is on the rise, and the construction is in progress to meet the demand. In this regard, the infrastructure study focused on the transportation and water supply systems vital to support Dubai's development, through desktop studies, site visits and exchange sessions.

3.3.1 Transportation System

Dubai is a rapidly developing city and there are increasing construction and economic activities happening there, demanding for a strong and efficient transportation network to support its economic growth and the city as tourism, financial and logistics hub. In the delegation, delegates had an opportunity to understand Dubai's existing transportation network. Delegates also visited the Dubai Metro through the arrangements of Dubai Roads and Transport Authority (RTA), Parsons Brinckerhoff (PB) and VSL, which provided a chance to delegates to appreciate the future transportation network under planning and construction. Details will be discussed in the following sections.

Existing Transportation System

- **Mode of Transport**
  The current transportation network in Dubai mainly rely on road-based transport and public transport is not widely promoted and adopted. The commonly used mode of transport is private car which constitutes up to over 90% modal split. The car ownership rate is quite high. There are about 541 vehicles per 1,000 residents in Dubai which gives a ratio of approximately 1 vehicle to 2 people. Considering Hong Kong, there are about 600,000 vehicles which give a ratio of less than 1 vehicle to 10 people. The other 10% modal split in Dubai refers to buses, taxi and marine transport which is not that well developed currently [1].

- **Transportation Problems**
  Traffic congestion problem is serious in Dubai. Delegates experienced it on almost every weekday during the trip especially in the morning and evening. According to statistics, 350,000 vehicle trips are being made every hour and there is 15-min delay in every 25-min trip during rush hours. There are in total six rush hours in the morning and in the evening on each work day, causing an estimated loss of Dh4.6 billion annually for the economy [1]. From the observation, the high car ownership rate and inadequate road network constitute to the problem mainly.

  The extremely **high car ownership rate** as mentioned above causes serious traffic congestion in Dubai. RTA is working hard to encourage the use of public transport of which the Metro Dubai, which is under construction, is one of the highlights by the government. It aims at giving about 30% use by public transport in the future [2].

  Insufficient surface road in Dubai is another reason of the traffic congestion. The transportation network in Dubai mainly relies on surface roads and it depends almost entirely on the Sheikh Zayed Road, which is the trunk road linking east and west of the city as well as the gateway to other cities in the UAE. Sheikh Zayed Road is a dual 7-lane carriageway which is always congested during rush hours, leading to congestion at its main interchanges and other distributor roads (Figure 3.3.1).

Figure 3.3.1 Traffic congestion on Sheikh Zayed Road

Road network connecting different areas of the city has not been fully developed. In this regard, RTA is building roads and interchanges so as to expand the road network.

Road traffic safety deals exclusively with road traffic crashes. The statistics showed that in every 3-minute, there is a road accident in Dubai, which blocks the road network and results in traffic congestion [3]. In order to respond to social pressure, RTA is aiming at providing a safe and efficient transportation across the city, e.g. the Dubai Metro.

According to RTA, speeding is responsible for 80% of the traffic accidents in Dubai. RTA called on motorists and road users to comply with the prescribed speed limits and refrain from reckless driving which leads to horrific accidents and injuries, claiming lives and inflicting extensive losses to public properties.

This Call was made as part of the sweeping Haseb Safety Campaign, the first phase of which was recently launched by RTA. The Campaign aims to educate the public in general and road users in particular on the importance of complying with safety regulations, particularly traffic and safe driving rules. The overall objective of the Campaign is to minimize traffic accidents leading to fatalities and serious injuries on main roads by 40% by 2015 [1].

Future Transportation System

In view of the transportation problems in Dubai, RTA has been putting enormous effort in combating traffic congestion and developing a strategic plan to encourage public transport and expand road network. Other measures also include policies and rules to curb traffic flow such as road pricing. Each of these improvements, together with the findings and observations made during the delegation will be elaborated below:-

The vision of RTA is to provide a safe and smooth transport for all [1]. The focus is to encourage the use of public transport and ensure transportation safety by providing an integrated public transportation system to facilitate mobility and safety in the city. The highlight of this integrated public transportation system will be the construction of the Dubai Metro. Development of safe and efficient public transport provides an effective alternative to private cars.

Apart from the building the metro, RTA also puts effort to increase the bus and marine networks and developing tram networks. As such, RTA is targeting at using metro as the backbone of the public transport mode with bus, marine and tram networks to support its public transportation network.

In the following paragraphs, an overview on the components of the public transportation will be introduced. The Dubai Metro and expansion of road network, with which delegates visited during the trip, will be discussed in greater details subsequently.

Metro (Figure 3.3.2) - The construction of the Dubai Metro started in 2005. The project initially comprised 2 lines, namely Red Line of 52.1km (29 stations) and Green Line of 22.5km (20 stations), including elevated, underground and at-grade stations. Completion of the Red Line is projected for Sep 2009, and the Green Line is scheduled to be opened in Mar 2010. The project will be the longest fully automated rail system in the world when it opens in Sep 2009.

Figure 3.3.2 New Metro [4]

Bus - To expand its bus network, RTA is aiming to run 90 bus routes over 3,000km in year 2020 and increase the number of buses from 800 to 3,000. The passengers per day will be increased from 0.25million/day to 4.5million/day in year 2020. In addition, to improve passengers' comfort during waiting for buses, there is a program to build air-conditioned bus shelters for each bus stop (Figure 3.3.3) and an automatic fare collection system is under operation [2].

Figure 3.3.3 Bus and air-conditioned bus shelter [4]

Marine transportation - The public water transport system would complement the existing Abra creek crossing system (Figure 3.3.4), also named water taxi, which is currently having small boats carrying ferry passengers across the Dubai Creek, and would provide ferry services along the Dubai Creek and coast to the new offshore land developments.

Figure 3.3.4 Abra creek crossing system [4]

Tram - An advanced tram system for about 270-km network will be built to provide sustainable links for users to and from the developments with Dubai metro in a timely, comfortable and affordable way.

Expansion of road network - To expand the road network, 500km of road will be built with 96 bridges at a cost of Dh44 billion. The focus will be the expansion of the Sheikh Zayed Road, and the Parallel Roads, the Al Khail Road, Emirates Road and the Outer Bypass Road (Figure 3.3.5 and 3.3.6). There will be many upgrades of road interchanges in transforming them into bigger diameter interchanges with increased capacity for vehicles.

Figures 3.3.5 Construction of road interchanges [4]

Figures 3.3.6 Construction of road interchanges [4]

In addition to the integrated public transportation system, other measures such as exercising more policies by government are also imposed. For example, the government is imposing toll at major highways which can raise revenue for the government and meanwhile, promote the use of public transport and subsequently relieve traffic congestion.

Salik Toll System - During the delegation, delegates observed a "Salik" toll system, set up at numerous locations along the main Sheikh Zayed Road (Figure 3.3.7). Each time a vehicle passes through a Salik tolling point, a toll of Dh4 will be deducted from the prepaid toll account using advanced Radio Frequency Identification (RFID) technology. Each vehicle can be identified by the system through communication with the small, thin Salik sticker tag affixed to the windshield of each vehicle.

Figure 3.3.7 Salik toll gate

Salik is Dubai's new electronic toll collection system which was launched in July 2007. It emphasizes the system's congestion management objectives as well as the choice of technology for the toll system. There are some free exits and road users can adopt to use

these free exits and this serves as a means to relieve the traffic congestion at the main road [5].

Salik utilizes the latest technology to achieve free flow operation with no toll booths, no toll collectors, and no impact to traffic flow, allowing vehicles to move freely through the tolling points at highway speeds (Figure 3.3.8) [5].

Figure 3.3.8 How "Salik" works [5]

Dubai Metro

In studying the infrastructure development in Dubai, the delegates visited the Dubai Metro precasting yard and Dubai Metro station for deeper exploration into the railway project and the development of the transportation system in Dubai.

The need for a transit system in Dubai had been highlighted in a feasibility study R700 carried out during 1997 to 2000 in expectation of the growth in traffic demands that would put great pressure on the road transport. Subsequently, a follow-up planning study PS002 - Dubai Transit Options Study was carried out during 2000 to 2002, which established the concept for a main railway corridor, together with a Central Business District circular, that laid down the basic alignment of the Dubai Metro network. Between 2002 and 2004, a further planning study PS007 was undertaken to develop the preliminary design, technical specifications and tender documentations for Dubai Metro contract that was open for tender in October 2004. In July of 2005 and 2006, the design and build contracts for the Red Line and Green Line of Dubai Metro were awarded to the Dubai Rapid Link (DURL) Consortium [1].

Currently under construction are the Red and Green Lines. The Red Line corresponds to the main railway corridor stemming from the existing Airport and Central Business District on one end, along the main highway artery Sheikh Zayed Road to Jebel Ali on the other end, whereas the Green Line corresponds to the envisaged line serving as a circular in the Central Business District. The two lines will interchange at Union Square and BurJuman Stations on both sides of the Dubai Creek (Figure 3.3.9).

	Red Line (JAFZA / Limitless – Rashidiya)	Green Line (Jedaff 2 – Al Qusais 2)
Length (km) - Elevated - Underground - At grade	52.1 44.1 4.7 3.3	22.5 14.6 7.9 0
Stations - Elevated - Underground - At grade	29 24 4 1	20 12 8 0
No. of trains in 2010	44	25
Target opening	Sep 2009	Mar 2010

Table 3.3.1 Dubai Metro under construction – Red Line and Green Line [1][2]

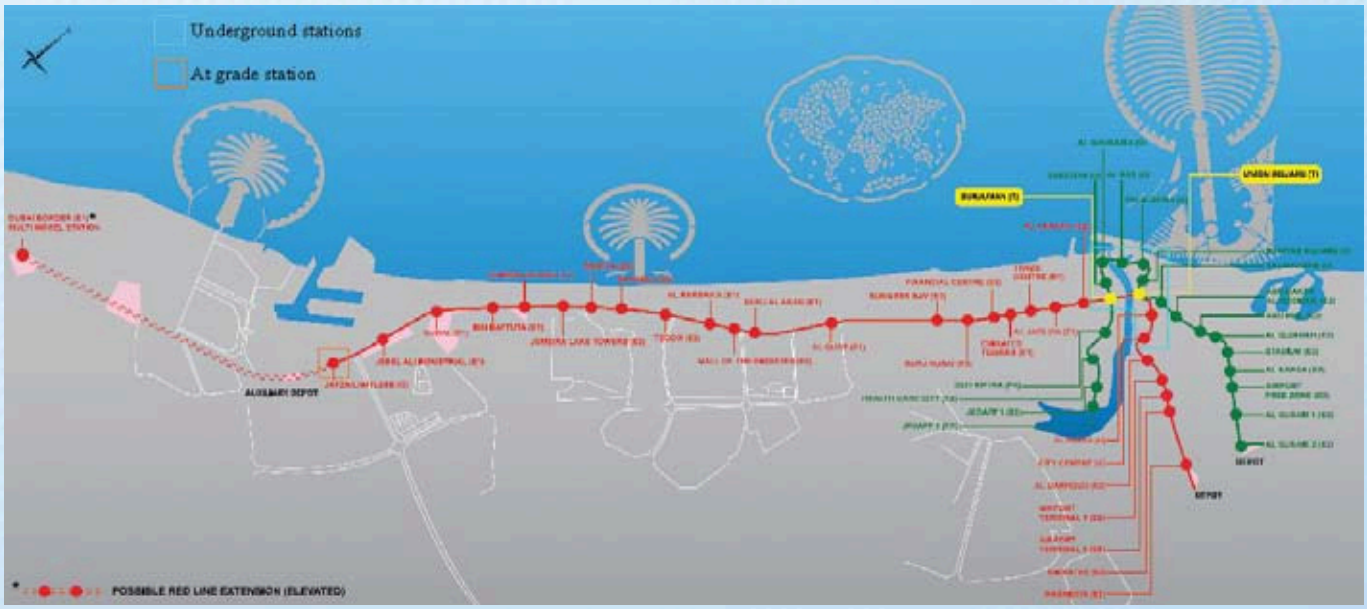


Figure 3.3.9 Dubai Metro system map – Red Line and Green Line (modified from [6])

- **Construction**
  With tender awarded in 2005, the 75km of Dubai Metro under construction is expected to be completed in 2010. The project is therefore on a fast-track program. For a metro project that comprises both elevated and underground sections, several features can also be identified in relation to the high speed of the project. Tunnel boring machines have been used for the construction of underground tunnel while installation of the precast viaduct segment has not been adopted for the elevated section. In the delegation, delegates had a chance to visit the precasting yard of the viaduct segment used and it would be detailed as follows.

  Elevated Section - As demonstrated in Table 3.3.1, the Dubai Metro is substantially on elevated section. The alignment of Dubai Metro has been designed to run mostly along highways. With the criss-crossing of highway structures, in particular to road interchanges, the alignment comes into crossing on plan with many highway structures both currently in place and being proposed. Instead of redesigning the horizontal alignment of the metro, the vertical alignment is being continuously adjusted to avoid such physical intersections (Figures 3.3.10 and 3.3.11). The medium rail has allowed up to 6% gradients at a maximum speed of 60km/h in catering for greater flexibility in vertical alignment.

Figures 3.3.10 and 3.3.11 Vertical alignment of Dubai Metro crossing highway structures

  Precasting has been adopted for speedy construction of the prestressed concrete viaducts. To allow for repetitive precasting, viaduct sections have been standardized for different spans and configurations in the design. Prestressed concrete using post-tensioning tendons has allowed simple spans of up to 36m. Longer spans are achieved by means of 2-span continuous units for up to 44m spans and 3-span continuous units for up to 72m spans. There are also station spans in which the viaduct decks integrate with the station platforms [7].

  The viaducts are constructed out of standard segments produced at the precasting yard for the Dubai Metro project. The delegation was received by VSL, a member of the superstructure sub-contractor VSL-Freyssinet-Rizzani de Eccher VFR JV, in visiting the Dubai Metro precasting yard (Figure 3.3.12). The precasting yard in Jebel Ali covers over 50ha and is one of the largest of its kind. The large precasting yard also includes dedicated concrete batching plant, as well as extensive storage area, to match its high production capacity. In constructing the viaduct units, precast segments are transported to sites using trailers. The precast segments are then erected segment by segment, connected to segments already in place using epoxy glue and temporary post-tensioning tendons, and eventually the permanent post-tensioning tendons running through the whole viaduct unit will be stressed [8]. As for the erection

Figure 3.3.12 Precast segments at Dubai Metro precasting yard

Deck Segments Erection Method	Applications	Speed of construction
1. Span-by-span using overhead launching gantries	Simple span or 2-span continuous unit	2 days per span
2. Span-by-span on ground supports	Simple span or 2-span continuous unit with limited overhead clearance	1 week per span
3. Balanced cantilever	3-span continuous unit	1 month per 3-span continuous unit

Table 3.3.2 Erection methods of viaduct deck segments

of deck segments, there are basically 3 methods as described in Table 3.3.2 [7][8].

Integral to the elevated section of the metro are the elevated stations. Without possibly disrupting the continuous construction of track viaducts, the elevated stations are constructed as envelopes around the viaducts (Figures 3.3.13 and 3.3.14 [7]). Moreover, the elevated stations are constructed of structural steel that permits easy and rapid fabrication around the completed viaducts.

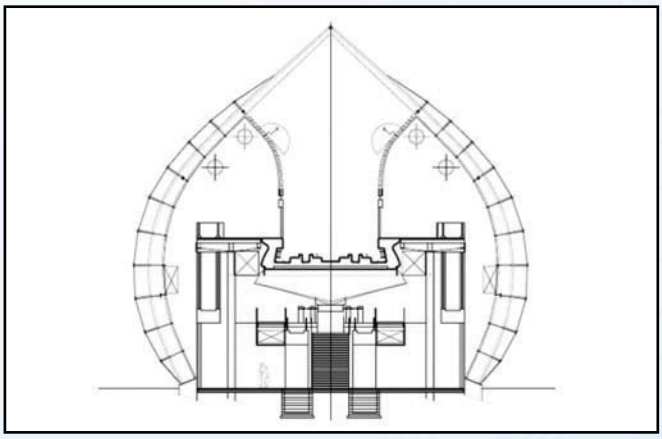


Figure 3.3.13 Type 1 elevated (E1) station: at-grade concourse

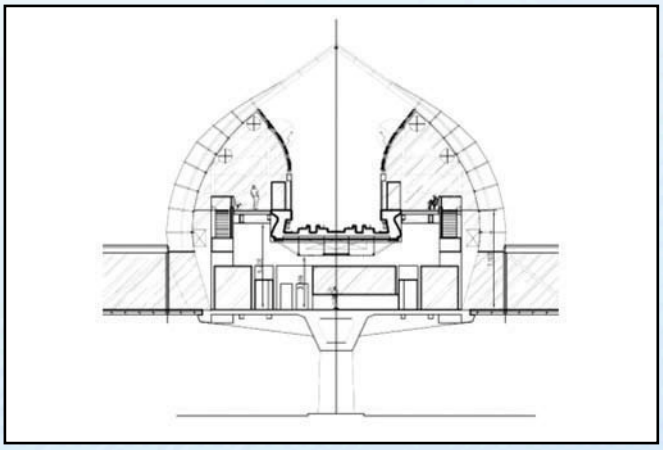


Figure 3.3.14 Type 2 elevated (E2) station: elevated concourse

- **System**
  Through the connection of PB Middle East regional office, the delegation was able to attend presentations and site visit to the Dubai Metro Jebel Ali Industrial station arranged by RTA officials, gaining deeper insights into the Dubai Metro system that is nearing revenue service.

Rolling stock (Figure 3.3.15) [2] for Dubai Metro will be manufactured by the Japanese firm Kinki Sharyo. The Dubai Metro train will feature 3-class accommodation: Gold Class, Women & Children Class and Silver Class, while the train will also have multi-use areas with space for accommodating wheelchairs.

Train	5 cars: 3 motor cars + 2 trailers
Total length (m)	85 (5-car)
Width (m)	2.78
Height (m)	3.86
Capacity (persons)	643 (5-car)

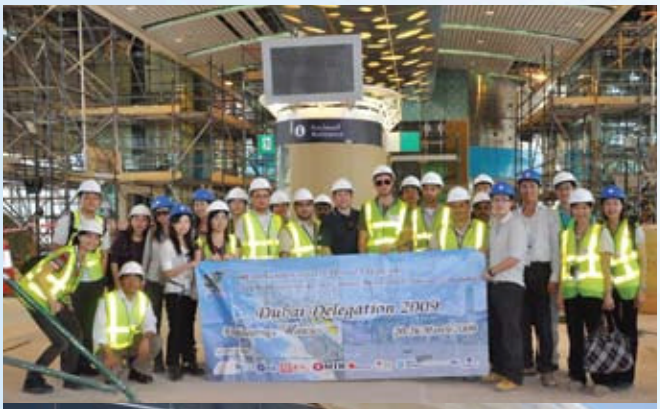
Table 3.3.3 Dubai Metro rolling stock

Figure 3.3.15 Dubai Metro rolling stock

Signalling [9] - Once in operation, the Dubai Metro will be the longest driverless, fully-automated railway system in the world. This is achieved by a moving-block communications-based train control system that allows higher frequency for shorter trains. The system can have an ultimate minimum headway of 90s [1].

Power Distribution [10] - Running on 750V DC traction power, the Dubai Metro will adopt third rail electrification system (Figure 3.3.16), instead of overhead line power supply. Electricity will be supplied from 3 main power supply systems (1 in Jebel Ali and 2 in Union Square) at 132kV, where it is also stepped down to 33kV. The rolling stock will also be equipped with braking power regeneration as energy saving measures.

Figure 3.3.16 Third rail in Dubai Metro



Figures 3.3.17 and 3.3.18 Group photos at Jebel Ali Industrial station: a Type 1 elevated station

- **Dubai Metro Stations**
  They are designed around 4 themes: Water, Air, Fire and Earth, each associated with a different color scheme. For elevated stations, the architecture will feature large roofs in the shape of arch-shaped shells, symbolizing the association of Dubai with diving and pearl fishing, which can already be seen along Sheikh Zayed Road where the Red Line runs. There are 3 types of elevated stations. Apart from Type 1 and Type 2 elevated stations for at-grade and elevated concourses respectively, there will also be a Type 3 elevated (E3) station with a stabling track, in additional to the 2 running tracks [2].

Figure 3.3.19 Platform screen doors

Lifts and escalators will be provided in the Dubai Metro stations. The stations will be air-conditioned with platform screen doors (Figure 3.3.19) for safety and facilitating platform air-conditioning. Space is also reserved for station commercial outlets.

To promote the usage of the metro, the 19 elevated stations along Sheikh Zayed Road will be built with air-conditioned pedestrian bridges linking the stations with the opposite side of the road using travelators, thereby facilitating pedestrian access to the metro stations. Furthermore, stations such as the Al Ghubaiba station will feature multi-modal transportation to integrate with other modes of public transport such as bus, marine and tram systems (Figure 3.3.20). The rail-based policy is completed with the park and ride facilities at 3 stations that provide a total parking capacity of 12,000 in extending the catchment to private transport. [2]

Figure 3.3.20 Public transport integration [11]

- **Future Development [2]**
  In attaining the goal of 30% of transportation by public transport, there needs to be further developed [2] in the Dubai Metro network to support the rail-based policy. RTA is currently working on its rail master plan. The expansion is expected to include new lines, as well as extensions to the committed lines. Some of the highlights are Red Line Extension (~15km) which is the extension of the elevated line to Abu Dhabi border and Green Line Extension (~10km) which crosses the Dubai Creek again for extension to International City etc.

Expansion of Road Network

In order to know more about the expansion of road network launched by RTA, delegates visited the RTA project R881-2C "Comprehensive Improvements of the Parallel Roads". Under the mentioned project, the total length of bridges is 4,863m, consisting of 4,395m segmental bridges and 468m cast in-situ bridges. The total distance between the precasting yard and the R881-2C site is around 40km. Logistics arrangement was taken into account. The precasting yard layout, including batching plant, moulds, cage assembly, rebar storage, quality control & segments repairing area, rebar storage and segments storage area, was carefully planned [12]. It also involves other utility works such as irrigation & sewage lines in addition to lighting, traffic and directional signs. It is noted that RTA is keen to carry out the required improvements of road network in a way compatible with the nature of development in the areas and all areas of Dubai. This merits upgrading road network and providing alternative corridors to serve residents and visitors of Dubai, and ease the traffic pressure from vital spots in the emirate.

Since the project is carried out at the existing busy road, road users and residents of the project neighborhood are encouraged to use alternative roads and diversions fitted with light signals and directional signs are required to ease traffic flow in the area.

Similar to the construction method used for the elevated section of Dubai Metro, precasting has been adopted for speedy construction of the prestressed concrete viaduct. Another advantage of using the precast unit is to allow the installation of the precast segment at night so as to minimize the impact to the public.

Figure 3.3.21 Temporary steel tower for segments

Figure 3.3.22 Launching girder

3.3.2 Water Supply System

It is always a big challenge to maintain sufficient and stable water supply to a rapidly developing city where there are great water demands for the development such as construction and rapid increase in population. The challenge for Dubai is even more acute as it is located in a desert. Though we could not visit the power and desalination plants in Dubai, we knew more about the water supply system in Dubai through exchange sessions in PB office and AUD.

Existing Water Supply System

In Dubai, the maximum annual rainfall is approximately 600mm [13] and such low annual rainfall could not be relied on as a **source of water supply**. Though the water table at Dubai is 2m below ground, the groundwater contains high concentration of salt which cannot be used as a source of water supply directly. Due to the geographical location of Dubai, seawater becomes the only source of water supply and thus desalination is a water treatment method widely applied.

Fresh water is produced by 6 desalination plants located at Jebel Ali and operated by the Dubai Electricity and Water Authority (DEWA). The installed capacity of the desalination plants is 1,250 million liters per day (MLD). DEWA supplies water to about 393,000 customers with annual water consumption of 365 million m^3 [14]. Multi-stage flash desalination (MSF) (Figure 3.3.24), a thermal process, is commonly adopted in DEWA's desalination plants. Power and desalination plant complexes (Figure 3.3.23) are also common configurations for reduction in energy consumption, by utilizing waste heat from power plant to heat seawater, while providing cooling for the power plant at the same time [15].

What is MSF?

MSF distills seawater by immediate conversion of water into steam (flashing) in multiple stages. Heated seawater is introduced to a chamber (referred as "stage") where the pressure is below the saturated vapor pressure of the seawater at that temperature. Flashing of a portion of the seawater takes place, and the steam condenses on tubes with feeding seawater passing through, allowing heat exchange. The remaining water is sent through a serious of additional stages, each possessing a lower ambient pressure than the previous stage. Fresh water is produced from condensation in each stage. [15][16]

Figure 3.3.23 DEWA's power and desalination plant

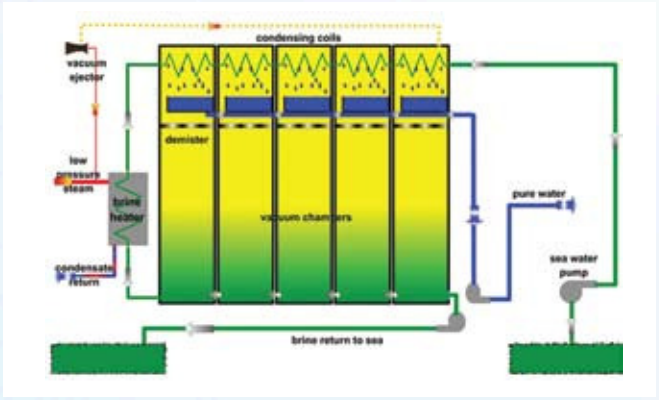


Figure 3.3.24 Multi-stage flash desalination process [17]

Future Development

To ensure enough power and water supplies to cope with the rapid growth of Dubai, DEWA has been constructing power and desalination plants to meet the demand forecasts. In 2008, DEWA has awarded a contract worth of US$1.1 billion for the construction of Jebel Ali Station Desalination Plant with treatment capacity of 530MLD. The target completion is mid 2010 [18].

DEWA plans to spend Dh70 billion over the next few years in water and electricity supplies projects. The centerpiece of the investment is the Dh20 billion Hassyan Power Generation and Water Desalination Plant in Jebel Ali. The contract is expected to be awarded in early 2010 [19].

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3.4 Innovative Projects

Dubai is a place that inspires dreams and attracts tourists from all over the world with a promise of stunning weather, great hotels, and legendary shopping malls. It is also a place for engineers to realize and experience the construction of several world number 1's buildings. Burj Dubai (the world's tallest building), Burj Al Arab (self-claimed as the world's most luxurious deluxe hotel in the world) and the Palm Jumeirah (the world's largest completed man-made island) are the examples of the engineering miracles.

"No matter how big the challenges, strong faith, determination and resolve will overcome them" by HH Sheikh Mohammad Bin Rashid Al Maktoum [1], inspires and encourages the engineering professionals to realize those miracles into reality. This section describes the three well-known mega projects, namely Burj Dubai, Palm Jumeirah and Palm Jebel Ali Water Homes, in different aspects, from its design concept to the application of technologies.

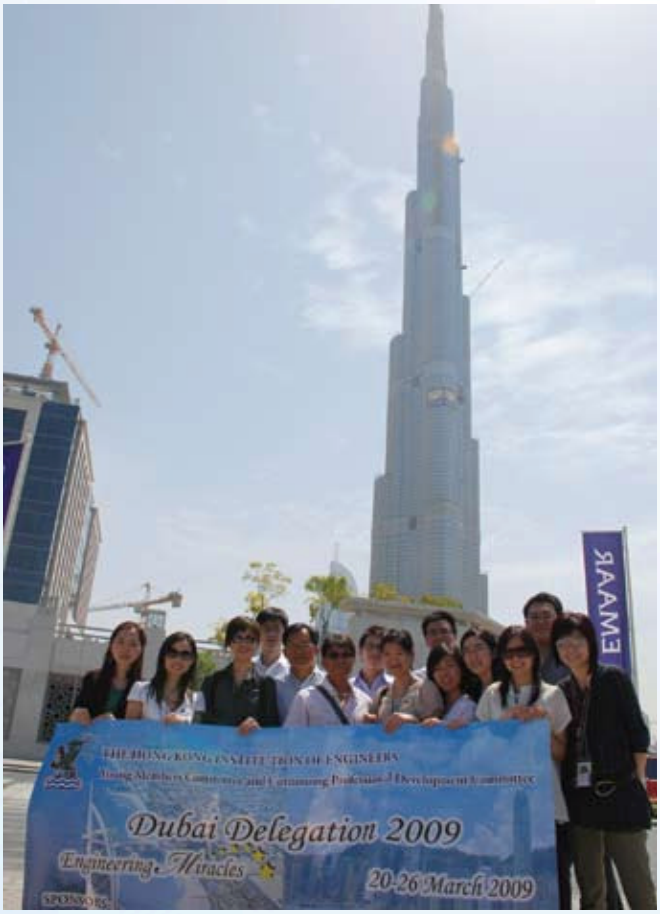

Figure 3.4.1 Group photo in front of Burj Dubai

3.4.1 Burj Dubai

If one asks the landmark in Dubai, the answer would be most likely the Burj Dubai (Figure 3.4.1). When it is complete, it will soar above the current tallest building – the 509m high Taipei 101 building in Taiwan (The height of Burj Dubai already exceeded 800m on the day of visit). Burj Dubai, which will comprise retail, residential, office and hotel when it opens, is having a layout of triple-lobed arranged around a central core. This triple-lobed is based on an abstracted version of the desert flower, Hymenocallis (Figure 3.4.2 and Figure 3.4.3).


Figure 3.4.2 Hymenocallis [12]

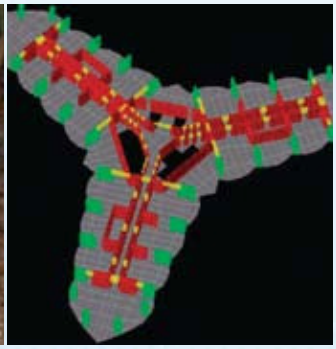
Figure 3.4.3 Floor model of Burj Dubai [3]

Through the presentation delivered by Mr. Greg Sang (Figure 3.4.4), Project Director of EMAAR (The developer of Burj Dubai), delegates learnt the innovative ideas as well as techniques adopted in this supertall skyscraper project.

Figure 3.4.4 Group photo with Mr. Greg Sang in the Burj Dubai Site Office

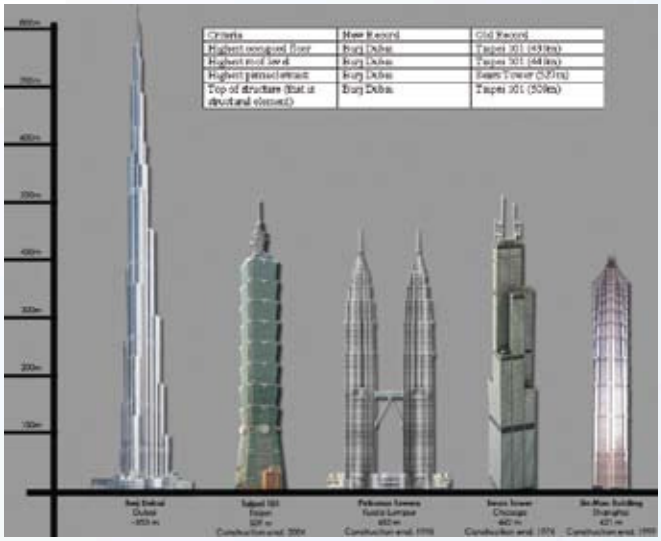

Figure 3.4.5 Comparison of the height of Burj Dubai with other recorded tallest buildings in the world [10]

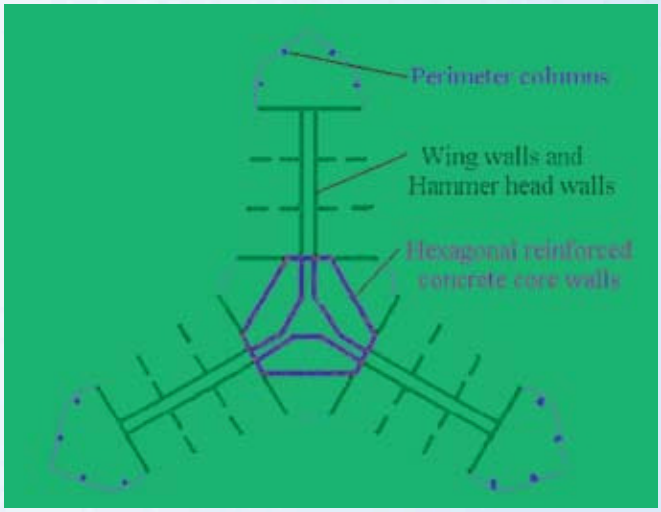

Figure 3.4.6 Structural system of Burj Dubai [5]

With four number-one in terms of highest occupied floor [1], highest roof level, highest pinnacle/mast and highest structure element, Burj Dubai exhibits its engineering miracles as well as its innovative techniques. Examples include lifeboat emergency operation with 10 high-speed shuttles aiming to reduce evacuation time and window washing system in mechanical floors separating the tower into five zones with three to seven weeks cycle time. The structural system, wind engineering and stack effect of Burj Dabai and its construction cycle and concrete pumping, in relation to innovative engineering, will be presented in the following paragraphs.

Innovative Engineering

- **Structural and Foundation Aspects**
  Burj Dubai was designed in a "Y" shaped in plan so as to reduce the wind effect on the tower as well as to keep the structure simple and foster constructability. The main structural system is the buttressed core with 3 wing core walls with top steel structure as shown in Figure 3.4.6. At the centre of the Burj floor-plate is a hexagonal core with high torsional stiffness. Three wings abut the core in a tripod like formation, resisting twist. The whole building acts as a beam. The high torsional stiffness of the core helps minimize the twisting of the building and three wings buttress the core. When wind blows, one wing will buttress the other two. The highest grade of concrete used in the main structure is C80.

  The Architect, Skidmore, Owings & Merrill LLP (SOM) apply a rigorous geometry to the tower that aligned all the common central core, wall, and column elements. Each tier of the building sets back in a spiral stepping pattern up the building. The setbacks are organized with the Tower's grid, such that the building stepping is accomplished by aligning columns above with walls below to provide a smooth load path. This allows the construction to proceed without the normal difficulties associated with column transfers. The setbacks are organized such that the tower's width changes at each setback. The wind vortices would not be organized because the wind encounters a different building shape at each new tier.

  The foundation consisted of a pile supported raft and was spreading out. By spreading the feet of a building out, the counter moment of the building's self weight could be maximized. This could lead to cost savings by minimizing rebar as the weight of the concrete was doing the work rather than the more expensive rebar. The solid reinforced concrete raft is 3.7 meters thick and was poured utilizing C50 self consolidating concrete. The raft was constructed in four separate pours separating by three wings and the center core. Each raft pour occurred over at least a 24-hour period. There are around 200 numbers of 1.5m diameter bored pile around 50m deep supporting the raft foundation above.

- **Set Back Approach**
  One of the critical design challenges in Burj Dubai

would be the wind force effect. To build a tower over 800m high, the design of its shape is highly related to the wind loading to diminish the wind effect. In order to obtain a more realistic wind loading on Burj Dubai, an extensive program of wind tunnel tests and other studies were undertaken. The wind tunnel program included rigid-model force balance tests, a full multi-degree of freedom aero elastic model studies, measurements of localized pressures, pedestrian wind environment studies and wind climatic studies. Pedestrian level wind study was also carried out as high building causes high wind speed on the ground level. Wind tunnel models account for the crosswind effects of wind induced vortex shedding on the building.

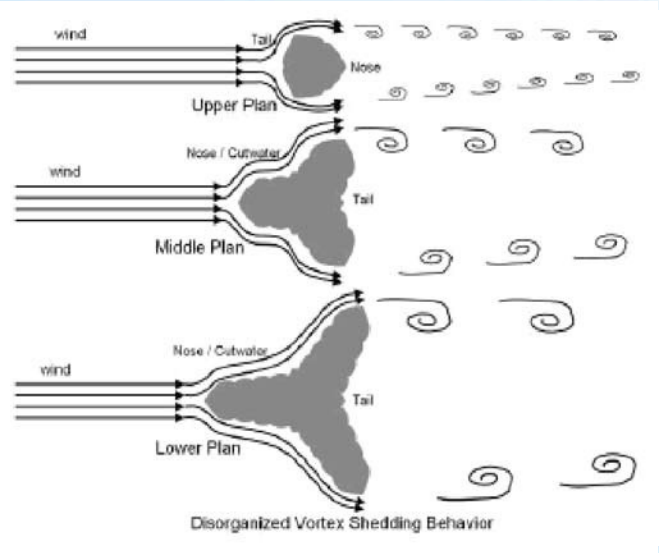

Figure 3.4.7 Wind behavior at different levels [3]

Several rounds of force balance tests were undertaken during the geometry of the tower evolved and refined. There are 27 nos. of set back in Burj Dubai to create turbulence of wind vortex. The three wings set back in a clockwise direction so as to diminish the wind effects. After each round of wind tunnel testing, the data was analyzed and the building was reshaped to minimize wind effects.

In general, the number and spacing of the set backs changes as the shape of the wings changes. As different shapes of floor plan would cause different wind vortex as shown in Figure 3.4.7, setting back process resulted in a substantial reduction in wind forces on the tower by "confusing" the wind by encouraging disorganized vortex shedding over the height of the tower. It is important to ensure the frequency of vortex shedding does not coincide with the natural frequency of the tower.

- **Stack Effect (Chimney Effect)**
  With a big temperature difference between the exterior and interior air, it brings about the stack effect concern to the design of Burj Dubai. Stack effect, also known as "chimney effect", occurs when air movement is induced. In cold climate, warm air inside rises through the building and cold air outside rushes at the base. The stack effect is reversed in Dubai due to its hot climate. The high outdoor temperature and cool indoor conditions create a difference in density that makes the indoor air travel downward, out to the bottom of the building. This phenomenon creates pressure difference along the building height (Figure 3.4.8). Some measures have been carried out in Burj Dubai so as to mitigate the negative impact of stack effect:

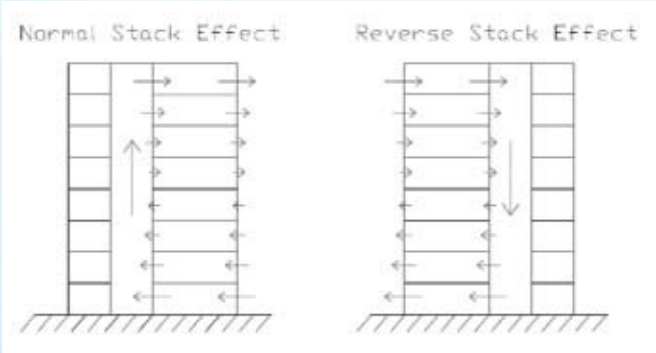

Figure 3.4.8 Stack effect

  - Mechanical system design specification to release excess air from appropriate locations and maintain a neutral to slightly positive air balance inside the tower
  - Isolation of the whole building into different segments by adding several refuges floors
  - Isolation by adding extra layers or barriers to the passage of air due to stack effect and it includes the provision of vestibules
  - Air locks and resolving doors between areas of different pressure and improving the air tightness and robustness of doors and partitions or the specification of improved performance to the exterior curtain wall

- **Concrete Pumping**
  The utilization of high strength concrete and concrete pumping technologies was critical in the construction of Burj Dubai. Moreover, due to the extreme temperature condition during day time and night time, pouring concrete in Dubai is very difficult.

Figure 3.4.9 High-rise pump - BSA 14000 SHP D [8]

Since summer 2005, several specially derived Putzmeister Super High Pressure trailer concrete pump 14,000 SHP D (Figure 3.4.9) has been delivered and operated for Burj Dubai projects. The frame and hopper of the pump had been reinforced to be able to withstand the enormous forces. The S-transfer tube and bearings had also been adjusted for the expected pressures. The pump has a particularly effective filter system to avoid contamination of the hydraulic fluid with water or dirt particles. The drive hydraulics has been modified so that the translation ratio between the hydraulic and the concrete pressure is less than one with piston side operation. To aid the cooling process, concrete is pumped and poured at night when temperatures are cooler. Ice is even added to mixture to help the process. After concrete delivery completion, it will reach a new world record height of 606m.

- **Fast Track Construction Program**
  The construction of Burj Dubai is under a very tight program which utilizes a 3-day construction cycle. As a result, the different key construction technologies were incorporated to achieve the 3-day cycle set for the concrete works, including Auto Climbing formwork system (ACS) as shown in Figure 3.4.10, rebar pre-fabrication, high performance concrete suitable for providing high strength, high durability requirement, high modulus and pumping, advanced concrete pumping technology, simple drop head formwork system that can be dismantled and assembled quickly with minimum labour requirements and special column/ wall proceeding method as part of the ACS formwork system.

Figure 3.4.10 Construction of Burj Dubai showing the climbing formwork [10]

3.4.2 The Palm Islands

The Idea of Palm

Creation of palm islands came from the Prime Minister and Vice President of the United Arab Emirates and Ruler of Dubai, HH Sheikh Mohammed Bin Rashid Al Maktoum, with a dream to build man-made islands offshore of Dubai [13] with beaches to become a tourism destination. In year 2006, the dream was turned into a reality, and it would be one of the iconic tourism locations promoted by the Dubai Government.

The shape of palm describes the heritage of Dubai and its physical geometry of the island. "Palm", also known as the "bride of the orchard" in Dubai, symbolizes Dubai's heritage. In addition, the palm leaves also provide a perfect geometry to create the longest stretch of beachfront, which in turn increases the value of development alongside the newly created coastline.

Construction of the Palm Islands

- **Surveying** - Unlike any other land reclamation in the world, this reclamation in the middle of the sea has no fixed point of land to survey from, and has no place to drive a stake. The elliptical shape of the Palm also makes accuracy difficult when placing the sand. To make the correct shape, Differential Global Positioning System (DGPS) is used to plot the palm, for which the accuracy of sand filling has achieved within 1cm [13].

- **Reclamation** - The Palm is constructed by pouring sand fill dredged from the sea floor onto the 10.5 meter-deep seabed using dredgers. All the 94 million m3 of sand for reclamation is dredged from the bottom of Persian Gulf instead of the desert as it will be more environmentally sustainable, more stable in terms of seismic and geotechnical terms and has the fertile, organic content that allow marine life to grow [13]. The sand is sprayed by the dredging ships onto the required area by a process called "rainbowing" in Figure 3.4.11, named by the shape which the sand fill is sprayed over the surface of the rising island in a high arc. Calcareous sand is used for the reclamation.

Figure 3.4.11 Rainbowing

- **Compaction** - The sand fill is compacted by vibro-compaction, which would increase the density of loose sand by saturating it with jets of water and vibrating it with probes. This method ensures any further settlement of sand and rock will be less than one inch over the next 50 years [16].

Palm Jumeirah

Palm Jumeirah (Figure 3.4.12) is the first Palm Island in Dubai. The island is 7km offshore by 5km across, with a total area larger than 800 football pitches. It consists of a trunk, a crown with 17 fronds and a surrounding 11km long crescent island that forms the breakwater. It increases Dubai's shoreline by 130km [14], which is twice the original length. Palm Jumeirah accommodates hotels, villas, shoreline apartment buildings, beaches, marinas, restaurants, cafes and a variety of retail complex.

Figure 3.4.12 Palm Jumeirah

Innovative Features

- **Island Shape Retention** - The 11km-long and 50m-deep breakwater is to protect the reclaimed land from the strong currents and winds of the Arabian Gulf. The lowest layer of the breakwater is made up by sand and covered by an erosion-preventing water-permeable geotextile. It is then covered by 7 million tons of large rocks. Each of the rock was placed individually by a crane, signed off by a diver and given a GPS coordinates [13]. Furthermore, the trunk of the Palm is protected by a diaphragm wall at the coast from the removal of reclaimed materials. At the beaches where no diaphragm wall is allowed, the sand removed by wave erosion will be closely monitored and repaired if necessary under the maintenance scheme [14].

- **Water Flow Regulation** - One of the concerns of creating the largest man-made island in the world is the effect on the water flow. Indeed, before the construction of the Palm Island, a 3D physical scale model of the crescent was created to perform exhaustive test in a laboratory tank,

using a 12m random wave generator [13]. Another numeric model was also created to simulate the tidal flow. These hydraulic modeling had come to the recommendation of including two 100m openings on either side along the crescent, so that the water inside the Palm will be refreshed every 13 days [16]. The water stagnation black spots in the Palm are at the channels between individual fronts. Since the water current in the Arabian Gulf flows from the west to the east, the beaches located at the eastern side of the trunk will be badly suffered from water stagnation. In order to resolve this problem, submerged water pumps were installed 1km from these corners to improve water circulation within the channels between fronts. These pumps are housed with reinforced concrete blocks, with gravel filter outside and a special filter at the outer layer to prevent algae growth in the pump and pipes.

- **Compatibility with Inland Transportation** - The transport network of the Palm Jumeirah was designed from surveys. That includes an extensive road network connected to the mainland by a gateway bridge, two dual five-lane bridges and a six-lane underwater tunnel connecting the spine to the crescent [13].

  Other than the road network, a 5.45km long driverless monorail (Figure 3.4.13 and 3.4.14) connecting the Palm to the mainland will also served as an efficient transportation system in the Palm. The monorail will run between the Gateway Station at the trunk of Palm Jumeirah and the Atlantis Hotel on the crescent, with two intermediate stations. The whole journey will take only about ten minutes.

  The monorail uses Hitachi Monorail straddle-type technology. The typical structure of the monorail includes 29m long guideway beams continuous over 5 spans. At locations where long spans were required, prestressed supporting beams with variable depth are installed.

  Tests of the trains are carried out before its opening. The system will initially carry 2,400 passengers per hour, with an ultimate capacity of 6,000 per hour in nine vehicles [13].

The Road and Transport Authority of Dubai also have the future plan to connect the Palm Monorail with the Dubai Metro, so that tourists will be able to go directly to Palm Jumeirah from the airport.

Figure 3.4.13 Monorail

Figure 3.4.14 Monorail station

- **Self Sustainable Utilities Services** - The Palm Jumeirah is designed to be self-sustainable in terms of utilities services, except for the supply of electricity. It consists of its own vacuum sewage system, electrical substations, reverse osmosis plants, chiller water plants, underground sewage treatment plants, polishing plants, and LPG gas farm on the Island [14]. These utilities are laid at the utilities corridor along the trunk for distribution to each front.

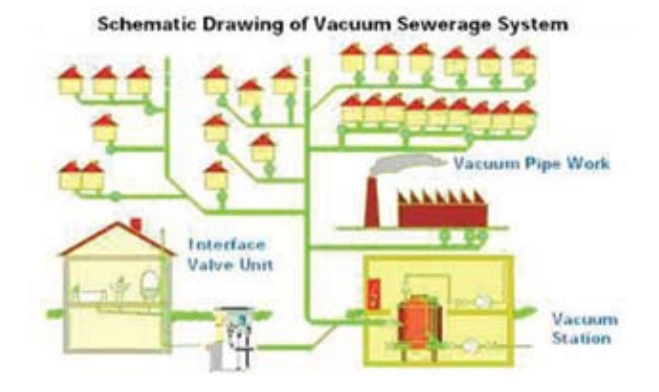

Figure 3.4.15 Vacuum Sewerage System [Source: Cordodex Electromechanic]

The vacuum sewerage system (Figure 3.4.15) for the Palm Jumeirah is the largest system of this kind in the world. It was completed in August 2008 and serves 2,000 villas [13]. The system consists of 900 collection chambers, 40km pipelines and the world's largest vacuum station. The system conveys the wastewater membrane bio-reactor (MBR) system sewage treatment plant (STP) located on the trunk of the Palm. It has a capacity of handling 16,000m^3 of wastewater everyday.

The vacuum system outclasses the traditional gravity system in the way that the waste from houses is instantly moved to the vacuum station at high velocity, keeping the pipelines devoid of stagnant waste. In addition, by using high-density polyethylene pipes, the exfiltration or infiltration of sewage or seawater can be avoided. The system will require less excavation during construction and resulted in less odor problem during operation [16].

The sewage system of the Palm is designed that no treated effluent will be discharged into the sea. Instead, the treated wastewater will be re-used to irrigate the landscaping on the Palm, which will reduce the demand of desalinated water [13].

Palm Jebel Ali

Palm Jebel Ali (Figure 3.4.16) is the second largest man-made island among the three Palm Islands in Dubai. It is approximately 50% larger than the size of Palm Jumeirah. It consists of two discrete and unconnected islands. The first consists of a "crown" leading up from the shore, a "spine" and sixteen "fronds" and the second is a crescent acting as breakwater, surrounding the palm shape formed of five segments in a semi-circle linked by bridges [17]. Two of the five crescents, namely Crescent A and E, mark the residential zoning in Palm Jebel Ali, which house 504 water homes.

Figure 3.4.16 Palm Jebel Ali [19]

Water Homes

Apart from the luxury villa residences on the Palm Jumeirah, a unique design of 504 nos. of water homes (Figure 3.4.17 and 3.4.18), raised on platforms with their own optional private leisure boat berths above the water of the Arabian Gulf was specially created for the Palm Jebel Ali. The developer, "Nakheel" will develop 252 nos. of timber water homes in 34 clusters (Figure 3.4.19) on both Crescent A and E of the Palm Jebel Ali, each around 2.7km long along the coastway. There will be 4 to 8 water homes in each cluster with an entrance bridge, which connects the causeway to walkways. There are taxi jetties at both ends of the crescents as another way to serve the transport needs [19].

Figure 3.4.17 Water Homes [19]

Figure 3.4.18 Palm Jebel Ali and Water Homes [19]

Figure 3.4.19 Water Homes clusters [19]

The 1st phase of the construction works of the water homes has been completed which consists of marine works, causeways reclamation works and protective breakwaters. The 2nd phase consists of infrastructure and utilities works, piles and pre-cast platform, the foundation for the Water Homes and elevated walkway, and causeway bridges connecting Water Homes causeway to Crescent were in progress. The first batch of the timber water homes is due for completion by the second half of 2011 and the remaining works on Crescent A is scheduled for completion during 2012 [17].

Fast Track Features

- **Precasting** - The water homes are timber structures built on top of individual platform above water. The original concept was to build steel platform supported by 9 piles underneath. Long cantilever is required in certain area of the platform, where large steel sections are required. Given the huge size (i.e. typical 26m x 14m) and weight of the platform, the scale of the project and the high cost of steel at that time, VSL Middle East LLC, the precast subcontractor, successfully raised the alternative construction scheme as a value engineering exercise. The precast and post-tensioning scheme for the water homes platform and entrance bridge was final adopted to save construction cost and time for the client. The self-weight of the precast platform was significantly reduced and the number of piles was reduced to 4 piles for each platform. Precasting of the water home platforms and entrance bridge beams (Figure 3.4.20) proved to be an economical choice and save on construction time.

Figure 3.4.20 Precasting yard for Water Home platforms and entrance bridge beams [19]

The precasting and post-tensioning sub-contract was awarded to VSL in May 2008. A precast yard approximately 100m by 600m long was built on a temporary reclaimed land adjacent to Crescent E to facilitate the production and erection flow. The yard will be dredged out and reinstate to the final form once the production is finished. The world's largest

gantry crane with a maximum 340 ton under hook capacity was used in this project to lift and transport the huge precast platforms. Another movable tower crane was used to cover the entire yard. It has a capacity of 18 ton at 23m jib length and 8 ton at 50m max jib length.

Rebar cages are fixed and then lifted into 5 sets of large steel formwork moulds for concrete casting. De-moulding will be carried out by jacking up the platform with 4 by 4 nos. of 30 ton hydraulic jacks. 50% of the design post-tensioning force will be applied and then lifted to the finishing bay for final stressing, grouting and finishing works. The finished platforms will be stacked in the storage bay before loading to barge for erection. The sequence for casting the entrance bridge beams is similar to the platforms.

- **Construction of the Precast Platforms and Entrance Bridge Beams** - The erection of platforms and entrance bridges follow a similar manner. The steel tubular piles were first driven by hydro hammer set on a crane barge. The pile plug will then be cast follow by the installation of capping beam for the walkway entrance bridge. An A-frame crane barge is required to lift and install the platform to its final position.

- **Innovative Application of Material** - Services and utilities pipes will run through the hollow slab to enter the water home from the entrance hut. For a hollow concrete slab with flanges as thin as 75mm, there is limited space for steel reinforcement. Therefore, glass reinforced fiber (GRF) was used as additive to improve the ductility of the concrete to allow such a thin slab to cantilever out by 1m. The quality control for concrete casting is also important to minimize cracks and deflection during lifting. [19]

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4.1 Design Practices

The weather and culture in Dubai is different from that in Hong Kong, which leads to different design practices adopted. During the delegation, through visiting various consultant firms and actual construction projects, we appreciated some design practices adopted there for sharing in this report.

The weather in Dubai is hot and dry. During summer, the maximum temperature is up to 54°C and there is sand everywhere. This extreme weather is quite different from Hong Kong and it affects the building design and the construction practices.

4.1.1 Building Design

In Dubai, façades (Figure 4.1.1) must have proper insulation to ensure comfort of the users and reduce energy usage. Also, the color of façades is usually similar to sand for easy maintenance and aesthetic purposes. In Hong Kong, there is no particular concern in the color of façades.

Figure 4.1.1 Façade at Dubai Mall Hotel [1]

There is also special glass requirement to reflect the extremely high heat from the surrounding. Chillers (Figure 4.1.2) are necessary for most of the buildings in Dubai. The concept of district cooling is widely adopted in Dubai for energy efficiency. In Hong Kong, chillers are mainly installed in commercial buildings and district cooling is still not very common.

Figure 4.1.2 Chillers in building [1]

4.1.2 Construction Practices

In Dubai, construction project is running 24 hours a day because concreting is mostly done at night due to the lower temperature required to ensure concrete quality. There is seldom concreting in daytime. Also, due to the extremely hot weather, workers may not be able to work during some hours of the day. This situation is different from Hong Kong which has milder weather conditions and concreting can be done on the day. Also, night work is rare in Hong Kong due to the stringent statutory environmental requirements under which construction noise permits are issued only under very rare circumstances.

Painting has to be done without direct sunshine in Dubai. Moreover, since there are a lot of bridges and metro construction across Dubai, transportation, delivery and erection of segments have to be done

at night to minimize inconvenience caused to the public. Working hours for most projects are almost 24 hours a day.

4.1.3 Construction Material

Concrete

Due to the extreme weather, monitoring of curing temperature of concrete is crucial especially there are so many tall buildings under construction in Dubai. For tall buildings, they use high strength concrete such as C60 and C80. Besides concreting at night, ice may be added during production of the concrete mix for cooling. Curing of concrete is also very crucial during concreting as it is windy there. Dehydrating after concreting will seriously affect concrete quality. Application of curing compound and steam curing will be adopted. In Hong Kong, water curing is usually adopted.

Protection for Underground Structure

Termite treatment is required for soil due to the desert environment in Dubai. The chloride and sulphate attack by the high concentration of salts in groundwater and seawater constitutes to the main problem. Therefore, waterproofing (Figure 4.1.3) is necessary for all structural members in contact with soil. There is no such problem in Hong Kong.

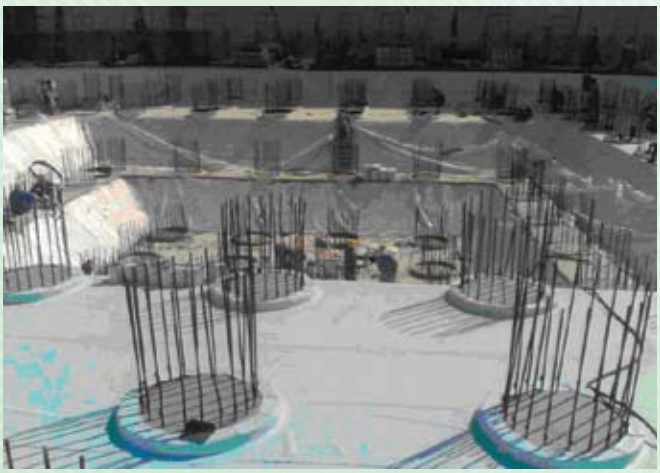


Figure 4.1.3 Waterproofing at the foundation of Dubai Mall Hotel [1]

4.1.4 Construction Method

Post-tensioning is commonly used in Dubai, not only for bridges and transfer structures but also for typical floor slabs and beams. According to engineers in Dubai, it can shorten construction period and save construction material.

4.1.5 Increasing Concern to Environment – Sustainability

During the visit to Arabian Canal, we appreciated that one of the purposes for bringing the water from the Arabian Gulf to inside Dubai is to introduce mist and evaporation to cool down the temperature for the comfort of its citizens. Sustainability starts to be a concern of the developers and engineers there with emphasis paid to ensure human comfort, social harmony and environmental protection. For example, with the construction of the Palm Islands which involves tremendous reclamation, marine life and seawater quality becomes a concern and engineers there paid special attention to this. In Hong Kong, we have paid attention to sustainability for some time. For example, in HK2030 study, the development of a low-carbon city was explored.

4.2 Statutory Submission Procedures in Dubai and Hong Kong

Over the past ten to twenty years, Dubai has been undergoing rapid development in order to achieve its target of being the international business hub and luxurious tourist city. Hundreds of remarkable building and infrastructure projects were launched. Considerable number of them has been completed or substantially completed. Examples are the world second largest hotel building Burj Al Arab, the world largest completed reclaimed island Palm Jumeriah, Dubai Metro, the world tallest building Burj Dubai, etc. In the coming years, even more remarkable projects such as Arabian Canal, Palm Jebel Ali, The World etc. will be completed.

To administer such rapid development, Dubai government has demonstrated its full commitment to ensure the quality and sustainability of the development by developing a streamlined yet comprehensive building control system. The objectives of implementing this building control system are:

- To ensure the safety, quality and sustainability of the buildings and associated works from planning, design to construction phase;
- To make provision for the safety, health and environment; and
- To ensure the development being compatible with the planning desire demonstrated in the zoning plan.

In this delegation, through the exchange with engineers from CSHK Dubai Contracting (LLC), delegates appreciated the roles of different building-development-related government departments and the building control system in Dubai.

Mr. Paul Lau, Director and General Manager of CSHK Dubai Contracting (LLC), has kindly introduced several government departments that are involved in the building control system in Dubai:

Dubai Electrical and Water Authority (DEWA) - DEWA is a government department administering the electrical and water supply in Dubai. Apart from providing reliable electrical and water supply to the city, DEWA is also responsible for supervising the design and construction of electrical and water system for every development in Dubai. In design stage, DEWA is responsible for reviewing the electrical and water supply design of each development and issuing the No Objection Certificate (NOC) which is one of the pre-requisites for the commencement of works. Upon substantial completion of work, DEWA would carry out inspection on site and issue completion certificate. The roles of DEWA are similar to that of Hongkong Electric Holding Ltd., CLP Group and Water Supplies Department in Hong Kong. However, unlike Hongkong Electric Holding Ltd. and CLP Group, DEWA is a government authority instead of a utility company.

Dubai Civil Defense - Dubai Civil Defense is also a government department administering the safety of each development from fire protection point of view. It has been committed to safeguard the safety of the end user by reviewing designers' drawings during design stage and inspection on site during construction stage. Upon Dubai Civil Defense's approval on the drawings, it would issue No Objection Certificate for the commencement of work. Similar to DEWA, Dubai Civil Defense would carry out site inspection to ensure the fire safety of the building is up to standard and issue completion certificate if the inspection is found satisfactory. The roles of Dubai Civil Defense are similar to that of Fire Services Department and Buildings Department in Hong Kong.

Dubai Municipality - Dubai Municipality is again a government department administering the safety and quality of each development from structural point of view. During design stage, Dubai Municipality is committed to review and approve designers' drawings and to issue No Objection Certificate. Upon substantial completion of works, Dubai Municipality is responsible for reviewing the concrete pour record and final survey certificate and carrying out site inspection to verify the buildings have been constructed as per the approved drawings. Final approval would be issued by Dubai Municipality

if the site inspection is satisfactory. The roles of Dubai Municipality are similar to that of Buildings Department (for planning control and construction), Drainage Services Department, Lands Department, Food and Environmental Hygiene Department, etc. in Hong Kong.

Through understanding the roles and responsibility of these three main government departments in Dubai, delegates appreciated that the commencement of building works is controlled by the issuance of No Objection Certificates, which is similar to the Approved Drawings and Letter of Consent in Hong Kong. On the other hand, the completion of works is controlled by the issuance of Completion Certificates and Final Approval in Dubai, which is similar to the issuance of Occupation Permit in Hong Kong.

Mr. Paul Lau had also introduced the approval procedures of building development in Dubai. In principle, the approval procedures for design and construction are very similar to those in Hong Kong. The comparison of design approval procedures is demonstrated in Figure 4.2.1 and Figure 4.2.2 respectively and that of construction approval procedures is demonstrated in Figure 4.2.3 and Figure 4.2.4 respectively.

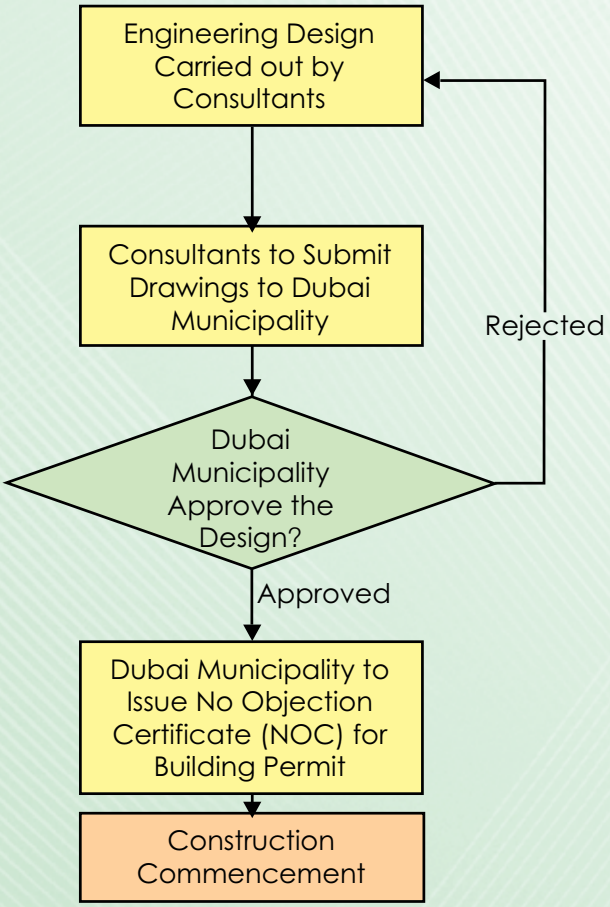


Figure 4.2.1 Statutory Design Submission Procedures in Dubai

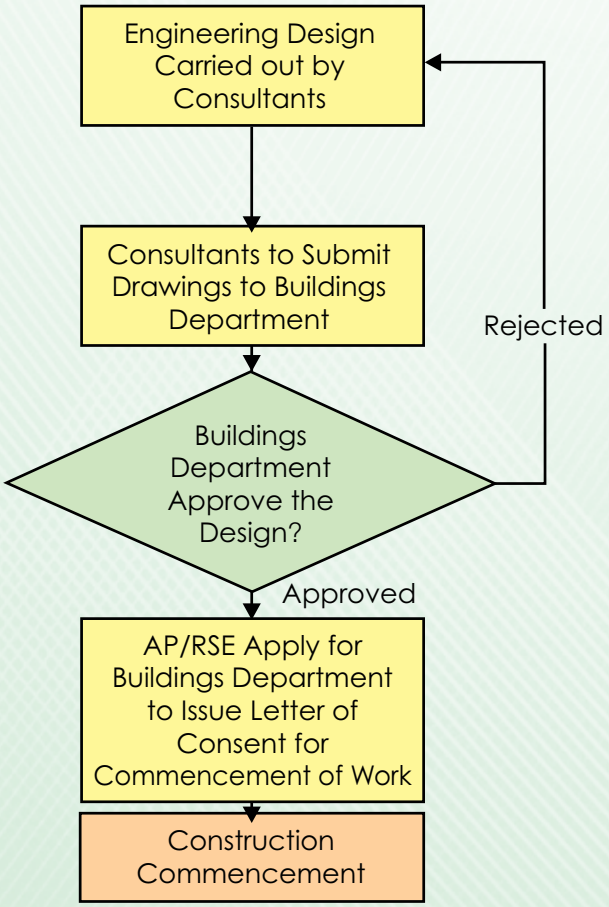


Figure 4.2.2 Statutory Design Submission Procedures in Hong Kong

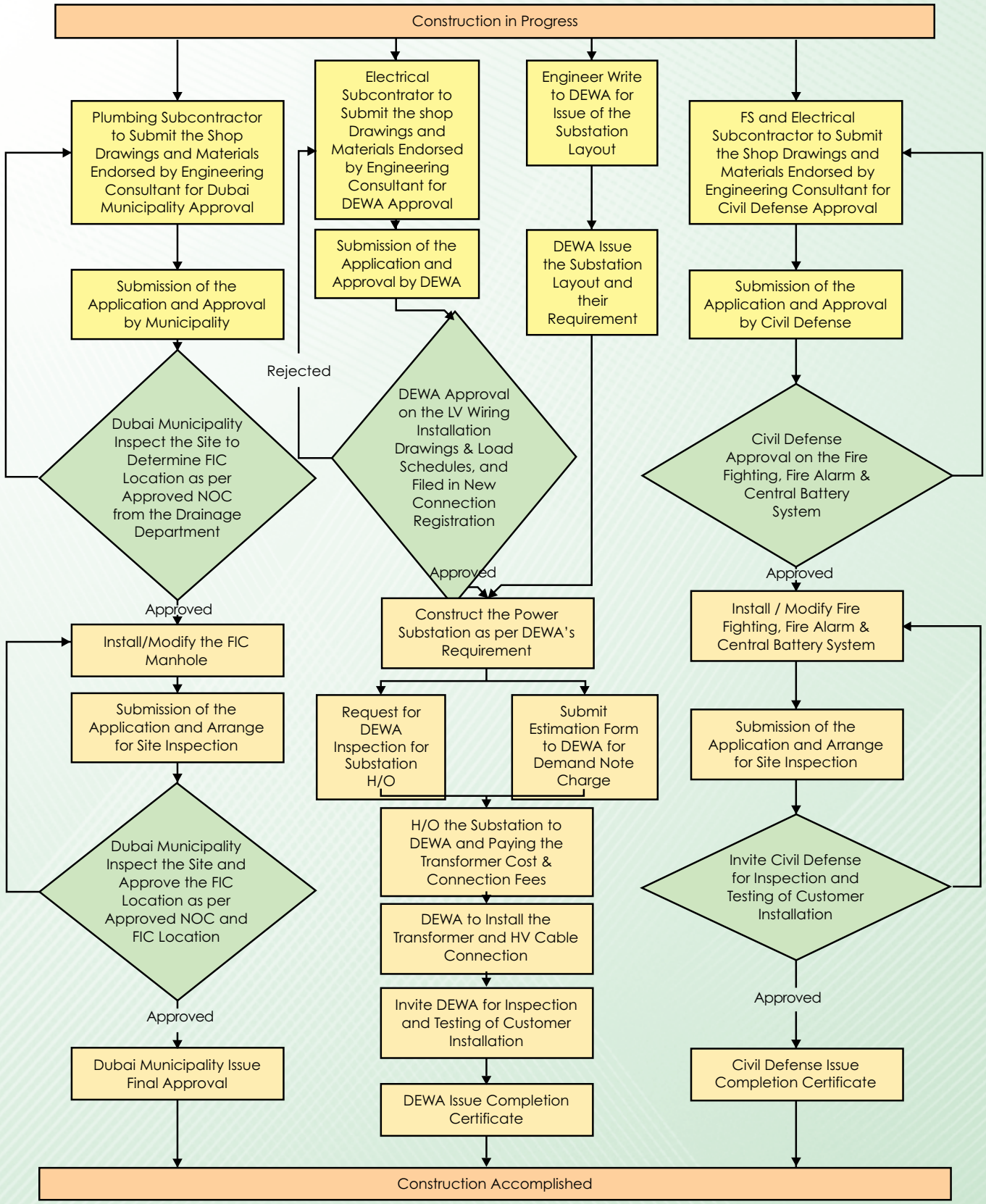


Figure 4.2.3 Building Control System (Construction Stage) in Dubai

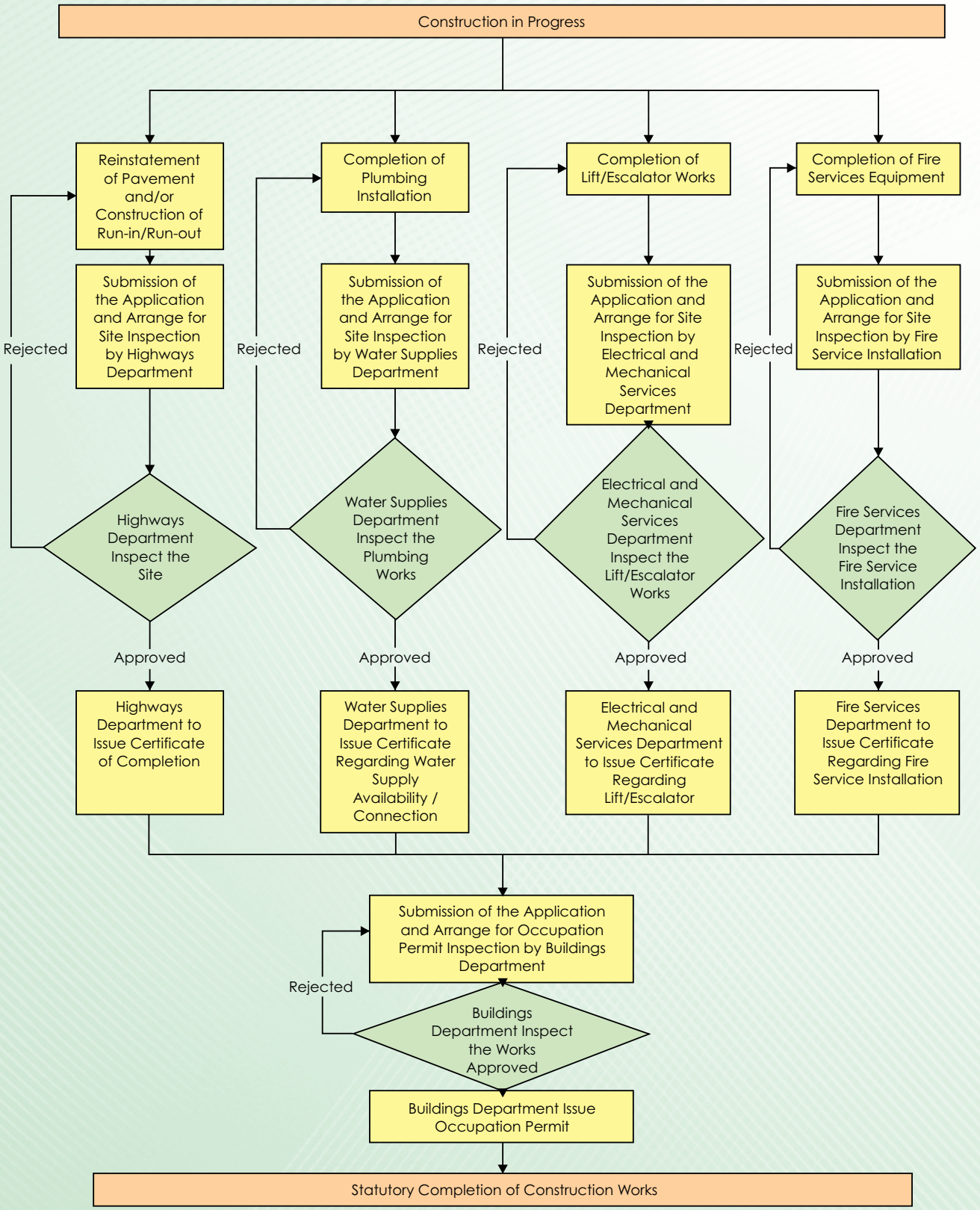


Figure 4.2.4 Building Control System (Construction Stage) in Hong Kong

4.3 Project and Construction Management

Project and construction management practices in UAE were introduced in the presentation by Dr. Raymond Ho, General Manager of Al Habtoor Leighton Group. We appreciated the differences between UAE and Hong Kong in the construction industry. Our findings are discussed in this section.

4.3.1 Major Developers in UAE

The major developers in UAE are Nakheel, EMAAR, Limitless, Aldar Properties, Dubai Properties, Damac, Sama Dubai, Sorouh Real Estate and TECOM. Most of them are government-owned. Nakheel, a government-owned developer, is the biggest project owners with projects valued at US$98 billion in 2007. It focuses on tourism-related projects, for example, Palm Deira, Palm Jumeirah, Palm Jebel Ali and the World. EMAAR is also a government-owned developer and one of the projects it works on is Downtown Burj Dubai, revolving around Burj Dubai [2]. In Hong Kong, the developers are privately-owned.

4.3.2 Project Organization

Construction project team includes developers, project managers, consultants (architects and engineers) and contractors. Major employers in Hong Kong, such as the government of the HKSAR and major real estate developers, generally have their in-house project management teams to deliver their projects. For Dubai with fast-growing real estate developments, it is common for major employers, i.e. government-owned developers, to deliver projects through employment of project managers in order to acquire sufficient manpower and expertise. The top 5 project managers taking up UAE projects with project values in descending order are Hill International (US$11 billion), CH2M Hill (US$9.5 billion), Parsons Brinkerhoff (US$6 billion), Kellogg, Brown & Root (US$4 billion) and Emirates Sunland (US$3 billion) [2].

4.3.3 Sub-contracting System

A construction management practice that we realized to be different from the common practice in Hong Kong was the sub-contracting system. According to Dr. Ho, sub-contracting system is not common in the Dubai construction industry. Most of the works were carried out by main contractor's in-house staff since they got their own expertise in most areas. However, specialist sub-contractors were sometimes adopted, for example, for curtain wall, facades, etc. Dr. Ho shared that one of the reasons for sub-contracting not being commonly adopted was the difficulty in managing the sub-contractors, which usually have workers with multi-nationalities and multi-cultural backgrounds.

4.4 Fast Track Program

In view of the importance of the program schedule to the success of construction projects, construction practitioners find ways, such as application of new technologies and innovative construction methods, to reach the limit of construction efficiency. However, construction constraints in good faith of environmental, economical, social and legal concerns need to be balanced with bustling construction activities.

Through this delegation, it is found that construction industry in Dubai adopts a practice of 3-day construction cycle while a 4-day program cycle in Hong Kong is found common. Below describes the 1-day difference in four major areas, namely, statutory requirement, contractual practice, social concern, and size of construction sites.

4.4.1 Statutory Requirement

The fast track program difference can fall into the realm of the different statutory requirements in Dubai and in Hong Kong. The two statutory requirements are set to satisfy the interests of different parties. The innovative approach without any compromise in safety issues would be encouraged in the building regulations in Dubai. Construction supervision is done according to the codes of practices followed by the employed consultancy. In Hong Kong, there are a set of defined codes of practices and Building Ordinances, which outline the statutory requirements and obligations for the building work supervision.

4.4.2 Contractual Practice

Mentioned in 4.3.3, the sub-contracting system is the main difference in construction management practice between Dubai and Hong Kong. A direct negotiation contracting is employed in construction projects in Dubai. In-house staff of the main contractors is invited to carry out the construction work. Such practice is found common in Dubai because:

- **Supply of Skillful Workers** - The main contractors have their own crew of expertise in the certain areas.

- **Cultural Diversity** - It is well known that the workforce in Dubai is formed by professionals from different countries. Such a diverse and inclusive environment leads to creativity and innovation. However, it brings challenges in managing sub-contractors in case of adoption sub-contracting system. It spends quite a lot of communication efforts in contractor coordination, especially in different cultures.

On the other hand, contractual practice in Hong Kong is found to be sub-contracting, in which large contractor coordination effort would be spent.

Direct negotiating contracting requires less coordination time than sub-contracting, making it possible to have a shorter construction cycle.

4.4.3 Social Concern

Social concern in the construction project implementation includes, but not limited to, safety and health of workers in construction site and nuisance to and impacts on the general public. It takes account of environmental issues such as noise and waste as well. Government, local community and many non-governmental organizations (NGOs) would play different capacities to voice out the above issues to the project owners.

The communication channel in Dubai for the local community on the construction projects is developing, with a current status that newspaper is the common means. In addition, it is found that there are not many NGOs in Dubai.

4.4.4 Size of Construction Sites

There are large construction sites in Dubai, in which the material, equipment and machine storage can be afforded. Construction owners can take this advantage to transport the construction materials

and machines to the site before construction work commences so to save the transportation time. In addition, large construction sites in Dubai make open-cut excavation method practical. In Hong Kong, the densely populated characteristic with the surrounding tall-building pattern limits the size of the construction sites, which makes the material and machine storage and open-cut excavation impractical. In coping with the size challenges, trenching with propping system and transportation of material and machine in time are employed in Hong Kong.

4.4.5 Project Procurement Method

Project procurement method is one of the critical factors to control the construction cycle. In Dubai, the procurement strategy is of build and design approach, which makes the construction process faster. In Hong Kong, a conventional approach, from the feasibility study, through inception, to detailed design, is widely applied.

5.1 Meeting with P&T Architects and Engineers Ltd. (Dubai Branch)

The delegation, arriving at Dubai on 20 Mar 2009, had an exchange session with P&T Architects and Engineers Ltd. (Dubai Branch) on the Friday rest day afternoon in Dubai.

Figure 5.1.1 Presentation at P&T Architects and Engineers Ltd. (Dubai Branch)

Receiving the delegation in its Dubai office, Mr. V. K. Liew, Associate Director of P&T Architects and Engineers Ltd. (Dubai Branch), shared on the opportunities of engineering projects in Dubai and the UAE in the aspects of buildings development, infrastructure and town planning that echoed the 3 core learning areas of the delegation. He started with a map of Dubai to give an overview on the major engineering projects in Dubai under its strategic development zoning. In buildings development, Dubai will see many iconic landmarks with unconventional designs. Mr. Liew gave a showcase of many of the buildings development projects in Dubai and highlighted their salient design features. Similar projects that were being pursued in the other emirates of the UAE were also introduced. For infrastructure, the Dubai government will be investing in large-scale infrastructure projects to parallel its development. These include the Dubai Metro, Dubai Creek Extension, new international airport, upgrading of road interchanges, construction of power stations, etc. Meanwhile, town planning has been playing an influential role from the early stages of engineering projects in the UAE, which usually find development projects on large plots of land. Entering the Middle East as the master planner of the City of Arabia project in Dubai, P&T is working on the master planning of the Ajman Freezone Marina Development project in the emirate of Ajman. The planning will feature the transformation of a run-down industrial district into a high-end water front development. The delegates gained insights from such new concepts as green boulevards between buildings and the provision of underground services reservation corridor in its master planning.

Mr. Rehan Shahid, Head of MEP, also enlightened the delegates on the sustainability elements in engineering in Dubai. For instance, district cooling has been implemented in many development zones in Dubai and guidelines on air-conditioning have been issued to alleviate the urban heat island effect. Another initiative has been grey water treatment system and he expected more sustainable elements to be incorporated into future projects.

Figure 5.1.2 Conversations between delegates and Mr. V. K. Liew

Figure 5.1.3 Conversations between delegation advisor, Ir Gary Ko, and Mr. Rehan Shahid

In exchange, the delegation gave a presentation on town planning, infrastructure systems and innovative projects in Hong Kong. After the formal presentations, there were lively chats of the delegates with Mr. Liew and Mr. Shahid, from such issues as the practices in engineering industry in Dubai and Hong Kong to the opportunities for the expansion of engineering firms in the Middle East.

5.2 Meeting with Society of Engineers – UAE

On 21 Mar 2009, an exchange session was held with Society of Engineers (SOE) – UAE in Dubai.

Figure 5.2.1 Sharing with SOE

Hosted by Mr. Eng. Maged F. Hanna, General Manager of SOE, a presentation was conducted to HKIE delegates and Ir Peter Wong, President of HKIE, introducing the foundation and development of the SOE in Dubai. With the objective of contributing to the progress of national industry, construction and agriculture, as well as the regulating the practices of engineering profession and improving professional performance in cooperation with competent authorities, SOE takes up the role of exerting efforts to foster relations as well as scientific and technical cooperation between engineers in UAE and other Arab and foreign countries.

Delegates were delighted to understand that SOE, in extension of its authority for accreditation system for qualifications, SOE of Dubai also contributes to the arbitration of engineering expressions and the elaboration of Arab engineering standards jointly with governmental institutions in the UAE as well as authorities and associations in other Arab, through the establishment of arbitration center responsible for all the engineering arbitration whether for the best or by the separation between the extreme ends or by offering consultation to solving disputes and artistic matters.

In exchange, Ir Peter Wong and Ms. Sally Leung, our delegation manager, also gave a presentation to introduce HKIE, our Young Members Committee and the objective of this delegation.

Figure 5.2.2 Meeting with SOE

Figure 5.2.3 Group photo in SOE

5.3 Meeting with American University in Dubai

An exchange session was conducted with American University in Dubai (AUD) on 26 Mar 2009, the last day of our delegation. Received by Civil Engineering Department of AUD, the focuses of this exchange were on overview of town planning and development in Dubai.

Dr. Dima Jawad, Assistant Professor of Civil Engineering Department, guided us through the development of Dubai from a modest size of economy in early 1990's to the glamour emirates nowadays. The key success factors have been the precious positioning of Dubai among the emirates and its focused development through its visions and strategic plans. Early in 1990's, Dubai had rolled out its Dubai Vision 2010, which clearly stated its 3 elements in Dubai's early vision: Government as the key driver of development; Focus on core economy sectors; and Cultivation of an attractive investment environment.

Through the positioning as a logistic hub, regional knowledge cluster as well as real estate development center, Dubai quickly achieved all the strategic objectives and targets set in Vision 2010 by 2005, 5 years ahead of its forecast. Its Strategic Plan 2015 continues to drive development in Dubai by setting guiding principles in 5 major sectors: Economic, Social, Security, Infrastructure, Land & Environment, and lastly Public Sector.

Figure 5.3.1 Presentation by Dr. Dima Jawad

In exchange, we gave a presentation on the town planning system in Hong Kong and shared with students our long term strategic plan The Hong Kong 2030 Study. Last but not least, we had a fruitful exchange with professors and engineering students from AUD after the presentations. To cope with the ever changing engineering industry in Dubai which has been moving really fast in the past decade, AUD had sent students for internship in various projects, like Burj Dubai. We also shared engineering codes and practices in Hong Kong and Dubai, and regulatory issues on building permits.

Figure 5.3.2 Souvenir presentation to Dr. Dima Jawad and Dr. Elias I. Saqan

Figure 5.3.3 Group photo in AUD

5.4 Meeting with Al Habtoor Leighton Group

Al Habtoor Leighton Group, a project management specialist, shared their insights in area of the project management through the presentation "Setting the Standards in Advanced and Effective Project Management" by Mr Jafar M. Khair, the Corporate Planning Director, at Al Habtoor Leighton Office, on 25 Mar 2009.

During the presentation, project management process, ranging from project initiation, project planning and execution to project closing with monitoring and conditioning, has been introduced. Of special attention was the project integration management system applied in the Al Habtoor Leighton Group, which integrated several systems for the ease of management:

Figure 5.4.1 Our Delegation Manager, Ms Sally Leung, and Delegation Chairman, Ir Crystal Ho presented souvenirs to the Corporate Planning Director, Mr Jafar M. Khair

The meeting ended with the constructive exchange of project management practices between Dubai and Hong Kong in the "Question and Answer" session.

Another highlight of the day fell into realm of presentation by Dr. Raymond Ho, General Manager of Al Habtoor Leighton Group, Steel Fabrication Division, on an overview and outlook of construction industry in United Arab Emirates (UAE). With the diverse workforce from different countries, effective communication would be one of the challenges, due to the language barrier and culture differences. A detailed analysis on the culture differences has been shared, in terms of four major areas:

- Collectivism
- Power distance
- High context
- Polychronism

With Dr. Ho's informative presentation, all the delegates had a more thorough understanding on the construction industry from the perspective of the economy, legal systems as well as the professional human resources. In addition, Dr Ho encouraged young engineers to widen their horizons to increase their competitiveness in the engineering industry in the face of globalization.

Figure 5.4.2 Group photo with Dr. Ho in Al Habtoor Leighton Group

5.5 Cultural Exchange Program with Engineers in Dubai

One of the highlights of the delegation would be the invaluable experience of the cultural exchange program, together with social gathering with engineers and other professionals. The program provided the delegates with professional and cultural exchange opportunities through discussion on the social and cultural environment of Dubai.

The cultural exchange program was composed of three activities:

- **City Tour** - An Overview of Dubai: On the first day of the delegation trip, Ir Johnny Wong of Atkins Middle East gave us an overview of Dubai through a city tour with appreciation of well-known structures in Dubai. Along Al Jumeriah Road, Ir Johnny Wong, supplemented by our delegates, introduced well-known landmarks such as Burj Al Arab and Burj Dubai. The orientation allowed us to understand the social, economic and cultural trends prevalent in the country with a historical perspective.

Figure 5.5.1 Lunch meeting with Ir Johnny Wong

- **Social Reception with Engineering Professionals in Dubai** - Delegates were delighted to be invited to join a welcoming dinner, hosted by engineering professionals in Dubai, on the first day of our trip. The welcoming dinner attracted many professionals who are now working in different capacities and in different industries in Dubai. Cultural exchange and sharing of ideas with different professionals were done with wonderful buffet dinner.

Figure 5.5.2 Delegates and the host

Figure 5.5.3 Greeting from young engineers from Hong Kong and overseas

- **Greeting from Young Engineers Stationing in Dubai** - Sharing with engineers from Hong Kong, in the aspects of their stories of working in Dubai - the hurdles and their overcoming, provided us with a precious opportunity to enrich the understanding of the cultural differences, which inspired the importance of tolerance of diversities and developing lasting cross-cultural friendships for the success of project completion in face of globalization.

6. Local Seminars and Visits

Nine local seminars and two visits were arranged to provide HKIE members and delegates an in-depth understanding on town planning issues, innovative projects and infrastructure development in Hong Kong and Dubai. We had the honor to have distinguished speakers to share with us their experience in these three areas. Highlights from the local events are presented below.

Topic	Date	Speakers
Town Planning		
Seminar on Town Planning in Hong Kong	27 Nov 2008	Ms Winnie LAU *Senior Town Planner, Planning Department, HKSARG*
Seminar on Transport Planning in Hong Kong	9 Mar 2009	Ir F F YING *Chief Engineer, Transport Department, HKSARG*
Seminar on Greening Master Plan and Urban Landscape in Hong Kong	10 Mar 2009	Ir Michael LAW *Senior Engineer,* Ms Kathy NG *Senior Landscape Architect. Civil Engineering and Development Department HKSARG*
Site Visit to Hong Kong Ocean Park Redevelopment	9 May 2009	Mr Vitalis WONG *Design Manager - Creative Content* *Ocean Park Corporation* Ir Simon MUI *Senior Resident Engineer, Maunsell Aecom*
Infrastructure Development		
Seminar on Metro Design in Dubai (E&M)	15 Nov 2008	Mr Tony CHIU *Technical Director, Parsons Brinckerhoff*
Seminar on Design and Construction on the Dubai Metro	24 Feb 2009	Mr Douglas SIMMONS *Associate Director, Atkins China Ltd.*
Seminar on Total Water Management and Pilot Desalination Plant Study in Hong Kong	13 Mar 2009	Ir C L WONG *Senior Engineer,* Ir Charles CHAN *Engineer, Water Supplies Department, HKSARG*
Seminar on MTR Corporation and Railway Development in Hong Kong	16 Mar 2009	Ir Peter LEUNG *Design Manager of MTR South Island Line (East), MTR Corporation*
Innovative Projects		
Seminar on Use of Building Information Modeling	30 Jan 2009	Mr Michael CHAN *Regional Technical Manager, Autodesk Far East Ltd.* Ir Francis Leung *Director, WSP HK Ltd.*
Site Visit to the HKCEC Atrium Link Expansion	7 Feb 2009	Ir Patrick TSO *Project Engineer, Hip Hing Construction Company Ltd.*
Seminar on International Commerce Center	10 Feb 2009	Ir Eddie HO *Associate,* Ir Ernest CHAN *Senior Engineer, Ove Arup & Partners Hong Kong Ltd.*

6.1 Town Planning

3 seminars and 1 visit were organized for our better understanding on town planning in Hong Kong.

Hong Kong is a home to seven million people. The aim of the Hong Kong Town Planning System is to promote the health, safety, convenience and general welfare of the community, and to bring about a better organized, efficient and desirable place to live and work.

A 2-tier planning system was adopted in Hong Kong: the outline zoning plan, development permission plan as well as prosecution and enforcement under the Town Planning Ordinance; and territorial and district planning under the Hong Kong Planning Standards and Guidelines. The statutory and district planning system in Hong Kong included the Town Planning Board as a statutory body established under the Town Planning Ordinance. Under the development control system, the development proposals are required to fulfill planning standards, lease requirements, building requirements and other requirements of the Planning Department and the Lands Department.

The purpose of the Hong Kong 2030 study is to develop a strategic, territory-wide planning framework to guide development of land and infrastructure, access the development needs in the long term and formulate strategies to respond and ultimately contribute to achieving Hong Kong's vision - Asia's world city. It recommends the promotion of sustainable growth, prudent approach in opening up of Greenfield land and focus on improving living quality. The concepts for the spatial pattern include:

- Doing more with less - explore opportunities in the Metro Area and existing new towns
- Rail-based pattern - optimize opportunities along three axes
- Balanced development - preserve as much countryside as possible
- Connection on all fronts - further develop regional transport networks

Another seminar on transport planning was then held. Transport planning plays a major role in town planning. Without comprehensive transport infrastructure, there will be road congestion and big economic loss to a city.

From the overview of traffic and transport planning, the key objectives of transport planning, being identification of bottlenecks, assessing effectiveness of improvement strategy, formulation of transportation policies, defining scope of infrastructure developments as well as resources planning for achieving balanced demand and supply were clearly delivered. The different planning focused between local transport network and cross-border transportation. With locality and demand being emphasised in the former, while the later would play a more strategic role in cross-border network supply, the application of transport model to meet specific analytical need could be different in terms of trip generation, trip distribution, modal split and trip assignment.

There were also some interesting points to note from transport planning, the underlying factors of demand driven by district development, population and economic atmosphere; political factors including custom inspection and immigration control policies; and factors of supply by infrastructure development policies, transport facilities all played important roles in formulation of an effective transport policy.

Figure 6.1 Ir FF Ying, Chief Engineer from Transport Department sharing transport planning issues in HK

Figure 6.2 Speaker, Ir FF Ying with the organizing committee

Many parts of Hong Kong are highly congested and urbanized, to make Hong Kong a better place to live in. The government implemented the Greening Master Plan (GMP). The GMP was initiated by the government in 2004, with an aim to define greening framework of urban areas, and serve as a guide for all parties involved in planning, design and implementation of greening works. In addition to identifying suitable locations for planting, establishing greening themes and proposing suitable planting species, district characteristics, public's opinion and expectation, history and experts' advice had to be considered. Public participation was one of the emphases in the development and implementation of GMP, so the authorities had organized many community forums and site visits to collect views from public. Extensive public participation activities, detailed local consultation, close liaisons with the relevant authorities and stringent specifications and site supervision were the successful factors of the GMP.

Figure 6.3 Mr. Michael Law, Senior Engineer from CEDD sharing GMP with participants

To provide better quality of life and ensure sustainability of society development, engineers not only had to confront the environmental challenges but also social challenges. In this regard, case studies of the Penny's Bay Development and projects under the GMP were discussed to demonstrate how engineers could team up with architects, landscape architects and other professionals to provide solutions strategically integrating environmental, social and economic aspects. To conclude, landscape or tree issues should be handled as an integral part of a project with a balanced, professional and holistic approach starting from early planning stage.

Figure 6.4 Ms. Kathy Ng, Senior Landscape Architect from CEDD introduced urban landscape in Hong Kong

A technical visit to Hong Kong Ocean Park Redevelopment provided a valuable chance for delegates to explore such a large scale civil works and innovative structures to be constructed in one of the largest themed and attractive parks in Hong Kong. The project involved both reconstruction and modification of existing facilities and expansion of the Park and it comprised large number of civil infrastructure works, geotechnical works, structural works, utility works and area redevelopment areas. The key project aims are to increase parkwide attractions to maintain competitiveness, to ensure continuous operation of existing facilities, to minimise disturbance to the guests, to minimise environmental impact and to enable smooth handover on completion.

The Master Redevelopment Project was first introduced. During planning stage of a theme park, needs of tourists must be taken into account, in particular, places for eating and shopping. It was also crucial to plan electricity and water supply in an early stage. We then visited Summit site formation and funicular tunnel. Funicular system, comprising funicular vehicles and associated systems, Waterfront Terminus, Summit Terminus and Funicular Tunnel, would become parkwide transportation between Waterfront Express Station and Summit Express Station upon completion. The system was designed for capacity of 5000 visitors per hour in both directions. Location of termini was strategically selected with an elevation of approximately 117m between termini and distance of 1300m between termini. Gradient of track required was 9%. The system would be a single track with passing loop and cable-propelled vehicle. The tunnel was around 1275m in length running from low land to formed area. Drill and blast was the main tunnelling method. After excavation and temporary support, tunnel lining was installed. A crusher and conveyor system

Figure 6.5 Group photo at Ocean Park Redevelopment

for surface transportation of excavated material from tunnel and Summit site formation was adopted. The disposal materials were transported to reclamation sites in Mainland as well as the Central Reclamation III project in Hong Kong.


Figure 6.6 Funicular tunnel with passing loop

6.2 Infrastructure Development

4 seminars have been organized to introduce the infrastructure developments in railway transportation and water supplies issues in Hong Kong and Dubai.

Facing with a rapidly expanding population, Dubai was constructing its Metro system, aiming at easing the traffic congestion problem and reducing passengers' journey time. Dubai Metro is a two-line fully-automatic light metro. It would be commissioned in two phases, the first in 2009 while the second about three years later. Construction had started in 2005. Upon commissioning, Dubai Metro will be the longest driverless and fully-automated railway system.

Dubai is situated near the deserts and has hot and humid weather. The features of E&M system design of the Dubai Metro included design considerations for adverse climatic conditions, fire and life safety features and special design tools such as computation fluid mechanics and evacuation model. Mechanical, electrical and plumbing systems designs of the Dubai Metro were introduced in the seminar.

Regarding the civil engineering design for the Dubai Metro, one of the challenges was fulfilling the fast-track program. It was particularly challenging with the coordination among the multi-disciplines of design including viaducts, tunnels, rail system, station structures, depots, etc. Construction of the viaducts with U-section precast segments was adopted. Various erection methods were adopted to cater for different site conditions, such as span-by-span using overhead launching gantries or span-by-span on ground support, and balanced cantilever method. Construction of tunnels and underground stations were also discussed in the seminar.

In Hong Kong, the railway was not developed solely to meet demand of transportation in the region but was to lure people moving into new development areas by allowing for efficient and convenient passenger flow as the integrated part of town planning strategies. The planning, design and construction of the new railway lines and interchange design requirements were shared in the seminar.

Figure 6.7 Speaker, Ir Peter Leung, Design Manager of MTR South Island Line (East) was giving the speech

Figure 6.8 Group photo of Ir Peter Leung with Organizing Committee

Besides seminars on railway transportation, a seminar about water supplies issues in Hong Kong was also held. The HKSAR Government has formulated the Total Water Management (TWM) Strategy for ensuring sustainable use of water resources. The Government's TWM strategy aims to manage water demand and supply in an integrated, multi-sectoral and sustainable manner. It puts emphasis on containing growth of water demand through conservation and strengthens water supply management. The key initiatives under the TWM strategy are as follows:

Water Demand Management
- To enhance public education on water conservation
- To promote use of water saving devices
- To enhance water leakage control through the program to replace and rehabilitate aged water mains, and application of new technology to improve pressure management and detection of leakage
- To extend use of seawater for flushing

Water Supply Management
- To strength protection of water resources
- To actively consider water reclamation (including grey water reuse and rainwater harvesting)
- To develop the option of seawater desalination

To evaluate the feasibility of adopting reverse osmosis (RO) desalination in Hong Kong as an alternative water source, a pilot desalination plant study was carried out in Tuen Mun and Ap Lei Chau. The findings of the study demonstrated that RO desalination was technically feasible under local conditions. Details of the study were shared in the seminar.

Figure 6.9 Group photo with speakers Ir C L WONG and Ir Charles CHAN from the Water Supplies Department

6.3 Innovative Projects

2 seminars and 1 visit were held to equip HKIE members and delegates with knowledge of innovative projects in Hong Kong, including Building Information Modeling (BIM), International Commerce Centre (ICC) and Hong Kong Convention and Exhibition Centre (HKCEC) Expansion.

BIM was one of the innovative technologies adopted to facilitate the increasingly complex design process. It was a data rich digital representation cataloging the physical and functional characteristics of design and construction. It could help producing sketches, rendering, material take-off, plans, sections, elevations and other schedules and also 4D construction planning analysis. Since some information would be lost inevitably when the project information was passed from one project party to another, BIM was developed to improve the reliability of information transfer and to enhance work efficiency.

Use of BIM in building design projects in Dubai included the Ocean Heights I, Ocean Heights II and Empire Tower. In Hong Kong, various organizations started using BIM, such as MTR Corporation, HKSTP, Housing Department, Henderson, Swire Properties, etc. It is anticipated that the use of BIM would become more popular in the near future.

Apart from BIM, we also attended a seminar on ICC. Upon completion in 2010, ICC would be the tallest building in Hong Kong. Technical challenges and innovative solutions in the design for the remarkable structure were shared.

With high-profile residential blocks and sensitive structures such as MTR tunnel and elevated roads, construction period of ICC was limited. The optimized structural system, consisting of central core wall coupled with eight mage-columns through three structural steel and prestressed concrete outriggers, were adopted to cope with the above constraints.

To establish the wind profile for 500m high ICC, wind tunnel test was performed. Site-specific studies of wind speeds and turbulence properties to establish wind profile were recommended. Moreover, large deflection of the skyscraper was one of the design

concerns in high-rise building design. In order to overcome the large deflection, high modulus concrete was applied.

A technical visit to the Hong Kong Convention and Exhibition Centre (HKCEC) Expansion was organized to appreciate the innovative ideas adopted in this project. The HKCEC Expansion project was to demolish the existing atrium link spanning across the water channel between Phase I and Phase II of the HKCEC and to construct a new atrium link, which would provide additional exhibition hall space of 19,400m^2. The new structure would have a 90m span across the waterway with no permanent intermediate columns.

The project was characterised by its complicated construction procedures due to the necessity of maintaining pedestrian flow between Phase I and Phase II of the HKCEC. A two-stage temporary footbridge was used. In the first stage, the contractor had come to a sustainable design of using part of the existing footbridge as a main structure of the temporary footbridge. After constructing most part of the structure, the second temporary footbridge was constructed to release the location at the first footbridge for constructing the permanent structure.

Figure 6.10 All participants were listening attentively to the presentation by Ir Tso

As the new atrium link would be spanning across the water channel, only very limited area for working space was available. To create more working space, the contractor had created an innovative idea of constructing a temporary working platform on temporary marine piles, for assemble of mega roof trusses and heavy lifting.

The major component of the structure, the mega roof trusses were fabricated in Mainland China, and then transported to the site by ship. After being assembled, the trusses were lifted to the final position by strand jacks and launching girders. During the heavy lifting and launching, methods such as bracing and tie-down were used to cope with the variation of loading.

Figure 6.11 Group photo at the roof of the atrium link of HKCEC

7. Conclusion

Dubai became a rich emirate because of the magnificent oil that lay under the ground. Since the discovery of oil in 1966, the emirate has undergone major transformations during these some 40 years, but the transformations had never been recognized by its oil related attributes, instead they were earmarked by the miracles it brought to the world.

The legendary Dubai had never been so true to our delegates, not after the 7-day delegation visit to Dubai. During this learning journey, we experienced in person the engineering culture there.

The demand for new developments has driven construction activities in Dubai to reach the fever pitch. From the exchange with engineers in Dubai, we were inspired to understand that besides the pull of aggressive investors to the region, the demand has also raised need for engineering innovations and technology advancement to unprecedented levels, in order to make the master pieces quickly and concretely on earth. The significance is in its aggressive planning, comprehensive infrastructure developments and the innovative individual projects that took place in the 4000km^2 of land.

On town planning, we were inspired by the Strategic Plans of Dubai that shared by the American University in Dubai. The strategic objectives have guided Dubai to the metropolitan today that built with core economic sectors, and balanced with social and environment developments. The comprehensive town planning were also appreciated through the visit to Arabian Canal, a perfect town planning showcase, as well through the sharing with P&T Architects and Engineers Ltd. (Dubai Branch) who demonstrated their iconic projects in master planning. The various design practices and statutory submission and procedures in Dubai was known through the reception in CSHK Dubai Contracting (LLC)

The infrastructure development in Dubai were also well appreciated through the visit to Dubai Roads & Transport Authority, Parsons Brinckerhoff and VSL for sharing on their long term vision on road and rail network development in Dubai, as well as witnessing the construction of Dubai Metro and major parallel road respectively. A significant attribute of these projects is the determination of the Authority to enhance the entire transportation system in Dubai, and the depth of change they target to achieve. The pre-casting construction and deployment of large scale launching machines were the highlight of visit that allowed our delegates to experience the speed and scope of infrastructure development in Dubai.

Innovative projects in Dubai were surely the focus of the delegation. The visit to Burj Dubai, Palm Jumeirah and water homes development at Palm Jebel Ali were remarkable experience that let our delegates realize the essence of innovation is not in the degree of advancement in engineering technique, but in the faith and determination of engineers that stretch everything to the limit for turning idea into reality.

The exchange with engineering societies in Dubai was another fulfillment in this delegation journey that brought our delegated closer to the engineering culture in Dubai. The visit to Society of Engineers – UAE, the culture exchange with academia and engineering students from American University in Dubai, the social gatherings with Hong Kong engineers working in Dubai were precious opportunities to understand the development opportunity, work culture, engineering practices and education for engineers out in the Middle East.

The series of local seminars, visits and pre-trip studies on aspects of town planning, infrastructure development and innovative projects in Hong Kong were preparation works that equipped the delegation team with knowledge and ground to grasp every learning opportunity throughout the delegation journey. Dubai is a great place for nurturing state-of-the-art engineering miracles, but our delegates were also triggered to appreciate the good work done by engineers in Hong Kong. The beauty of engineering in Hong Kong is its effort in meeting high degree of environmental standards, balance of public interest, and conservation of natural resources.

Profile of Advisors and Delegates

Ir Peter Y WONG
Delegation Advisor and President, HKIE

Ir WONG has worked in consultant, contracting and manufacturing firms before taking up his post as Director in Yook Tong Electric Co. Ltd. He has over 25-year experience in electrical equipment technology design, specification, sales and marketing in both Hong Kong and European Communities. Benefited by cross industry exposure, Ir WONG is in a good position to help shape the local construction practice: pioneering in upgrading standards of locally manufactured products; instrumental with the first RCD protected 13A ring circuit installation 5 years before adoption by IEEE Regulation; first to equip luminaries with energy saving lamps in projects 7 years before the Government adopted such as standard specification. He pens submission to the Administration for the electrical contractors proposing the first material fluctuation clause and tender format. Currently, Ir WONG is the Convener of several task forces responsible to formulate set of qualification framework for 10 different schemes of the electrical & mechanical industries for Education Bureau of the Government of the Hong Kong Special Administrative Region (HKSAR). Ir WONG was elected Vice President of the HKIE in 2005 and is the President of the HKIE of 2008/2009.

Ir Otto POON BBS OBE
Delegation Advisor and Past President, HKIE

Otto was educated in Hong Kong and England.

He is a Chartered Engineer with over 40 years' experience in E&M engineering. He established Analogue Group of Compaines in 1977 which has developed into diversified international engineering operations with over 1,500 staff in Hong Kong, Macau and China, specializng in building services, IT, security, environmental, process control, elevator, escalator, electrical and mechanical equipment and plant.

Otto was a Member of the Advisory Council on the Environment from 1996 to 2004, Chairman of Environmental Impact Assessment Subcommittee from 2003 to 2004, Member of Energy Advisory Committee from 2000 to 2006, Member of Solicitors Disciplinary Tribunal Panel from 1996 to 2007, Member of the Council for Sustainable Development from 2003 to 2009, Chairman of the Strategy Sub-committee from 2005 to 2009; and Member of Trustess Board, Institution of Mechancial Engineers, UK from 2005 to 2007. He was also the President of the Hong Kong Institution of Engineeris (1998/1999), Chairman of Institution of Mechanical Engineers, Hong Kong Branch (2002/2004); President of Hong Kong Association of Energy Engineers (2004/2008) and President of Association of Energy Engineers, Hong Kong Chapter (2006/2009).

He now serves as Council Member of Chinese Mechanical Engineering Society, China; President of the Hong Kong Federation of Electrical and Mechanical Contractors; Member of Advisory Committee of the Department of Electrical and Electronic Engineering, the University of Hong Kong; Member of Advisory Committee for the Department of Electrical Engineering, the Hong Kong Polytechnic University; and Adviser to Bauhinia Foundation Research Centre.

Otto was awarded OBE in 1996 and BBS in 2003. He was elected as an Outstanding Hong Kong Polytechnic University Alumni in 1999 and an Outstanding Branch Member of the Year (2003/2004) by the Institution of Mechancial Engineers, UK. He was also awarded as a University Fellow by the Hong Kong Polytechnic University in 2007.

Profile of Advisors and Delegates

Ir Dr F C CHAN
Delegation Advisor and Vice President, HKIE

Ir Dr F C CHAN received his education in both Hong Kong and United Kingdom. He was a graduate of the University of Hong Kong in Electrical Engineering in 1972. He carried out research in power systems protection and obtained his Doctor of Philosophy from Imperial College, University of London in 1979.

Ir Dr CHAN is currently the General Manager of CLP Engineering Limited with subsidiary companies CLP Engineering (Macao) Co. Ltd. and CLP Energy Services and Technology (Shenzhen) Co. Ltd.. He has extensive experiences in power systems specializing in power system protection, distribution automation, lighting applications and energy services. He has also involved in various management activities, including business process re-engineering, quality systems, contingency planning and procurement.

Ir Dr CHAN is active in various learned society activities in HKIE, IEEE and the IET. He was a past Chairman of the Electrical Division of HKIE and a past Chairman of Power Engineering Joint Chapter of IEEE HK Section. Ir Dr CHAN published over 40 papers and he won the HKIE Transactions Prizes 2 times, in 2003 and 2007. He received the IEEE Third Millennium Medal in 2000 for his outstanding achievements and contributions. He also received the IEEE Power Engineering Society Chapter Outstanding Engineer Award in 2008 for his years of dedicated service and volunteer spirit to the Power Engineering Society and the Engineering Profession as a whole.

Ir Gary C W KO
Delegation Advisor and Council Member, HKIE

Ir KO began his engineering career in CLP Power Hong Kong Limited as a Graduate Trainee after graduating with first class honours in electrical engineering from the University of Southampton, United Kingdom in 1980.

Ir KO moved to the contracting business by joining Kum Shing Group as a Contracts Manager in 1991. Initially responsible for electric cable trenching business, Gary advanced with the growth of the Group and is currently the Executive Director and Chief Operating Officer to oversee multi-disciplined contracts including :- (a) transmission and distribution cable trenching/installation/jointing works, (b) 11kV/ LV overhead line installation works, (c) 11kV to 400kVswitchgear and substation plant installation and maintenance undertakings, (d) power network relay and protection installation and testing, (e) energy meter installation and replacement programmes, (f) public lighting installation and replacement long term contracts, (g) power station generator and boiler installation and maintenance works.

One integral part of Gary's career is to serve the profession and the public. He has been the Honorary Treasurer of the Institution of Electrical Engineers Hong Kong Branch and Chairman of the Electrical Division of the HKIE. Currently he is the Vice Chairman of the CIE (Hong Kong), Council Member of the HKIE, Honorary Advisor of the Hong Kong & Kowloon Electrical Engineering & Appliances Trade Workers Union and Member of Engineers Registration Board. He is also a Member of the Barristers Disciplinary Tribunal Panel and Home Purchase Allowance Appeals Committee Panel.

Ir Peter P F CHAN
Delegation Advisor and CPDC Chairman

Ir CHAN has pursued the engineering career since his graduation from the University of Hong Kong. He started working in the consulting engineers and had subsequently joined the government engineering departments. He has over 30 years of civil engineering experience covering a wide spectrum of works including engineering projects, maintenance and administration/management works. He is now a senior engineer working in the Water Supplies Department of the Government of HKSAR.

Ir CHAN has been active in HKIE and Engineers Registration Board activities. He served as Council Member of HKIE for the sessions 1998/99 - 2001/02 & 2003/04 - 2006/07 in which he was also Council on Executive in 2001 & 2004. He also served as Member of Engineers Registration Board from 1998 to 2006 in which he was also Vice Chairman from 2004 to 2006. He was Chairman of Staff Resources Committee of HKIE from 2004 to 2006. He is currently the Chairman of CPD Committee of HKIE.

Ir Victor K Y LO
Delegation Advisor and CPDC Deputy Chairman, HKIE

Ir LO is the Deputy Chairman of CPD Committee of the HKIE and serving the Civil Division Committee, Training and Review Sub-Committee. He has organized hundreds of site visits, technical meetings, seminars and conference for the members in his ten years of service with the Institution. Victor has involved in the candidate selection interview and provided the contacts for the visiting sites through his connection in this delegation. He is now working in the Development Bureau of the HKSAR Government and responsible for the HKSAR's Post-512 quake Reconstruction support work in Sichuan.

Ir W K LEUNG
Delegation Advisor and CPDC Member, HKIE

Ir W K LEUNG is the Past Vice President of HKIE and Past Chairman of CIE Hong Kong. Ir LEUNG graduated from Hong Kong Technical College and received his M.Ed. (Higher Education) from the University of Hong Kong. He had worked in Swire Group and Hong Kong Polytechnic. He is now the Senior Lecturer in the Department of Engineering, Hong Kong Institute of Vocational Education (Tsing Yi). His current interest include mobile communications, electromagnetic compatibility and low power radio systems.

Profile of Advisors and Delegates

Ms Sally S Y LEUNG
(Building Services Engineering)
Delegation Manager and YMC Immediate Past Chairman, HKIE

Sally graduated with a Master and Bachelor Degree in Building Services Engineering from the Hong Kong Polytechnic University in 2000. Upon her graduation, she joined Meinhardt China and has been trained to become a professional Building Services Engineer. At present, she is responsible for the fire services system design. Since 2004, Sally stepped into the YMC. She became a committee member of YMC in 2005/2006. She was elected as the Honorary Treasurer in 2006/2007 and became the Chairman in 2007/2008. Currently, Sally is the Immediate Past Chairman. In the past years, Sally has opportunities to conduct / join many valuable events, such as the World Engineers' Convention 2008, Young Engineers of the ASEAN Federation of Engineering Organization Conference, Australia and China Delegations. During leisure times, Sally enjoys acting as volunteer eco-tour guides for the community.

Ir Cystal W C HO
(Civil Engineering)
Delegation Chairman and YMC Chairman, HKIE

Crystal is a Design Management Engineer I - Civil in the MTR Corporation Limited and has years of experience in railway, civil, building and geotechnical design and management works. Striving for professional development, upon obtaining her Master and Bachelor Degrees in Environmental Engineering from the Hong Kong Polytechnic University, she has been working in a contractor, a consultant and the public sector to understand different roles in the construction industry. Crystal first joined the YMC as a helper in the community services group and was elected as a committee member in 2005/2006 and followed by the Honorary Secretary and Deputy Chairman in 2006/2007 and 2007/2008 respectively. In leisure, she enjoys volunteering work in particular to those require execution of engineering profession. She plays an active role in the 512 Sichuan earthquake rebuilding of works.

Ms Arlene W L LO
(Civil Engineering)
Deputy Delegation Manager and YMC Committee Member, HKIE

Arlene obtained her Master and Bachelor Degrees in Civil and Environmental Engineering from the Hong Kong Polytechnic University and subsequently acquired professional chartership recognized by professional institutes of UK and Hong Kong. She is currently working as a civil engineer in Atkins China Limited. Her key experience includes utilities infrastructure assessment, design of drainage, sewerage and water main system, main laying and trenchless rehabilitation and replacement of water mains. She has joined YMC as helper since graduation and became a committee member in 2006/2007. She is the Honorary Treasurer in the current session and has been actively organizing and participating in different functions such as Annual General Meeting, Annual Seminar and Annual Dinner Manager, China Delegation Deputy Manager, etc.

Mr Kelvin Y K SHAM
(Project Management)
Secretary

Kelvin obtained his Bachelor Degree from the University of Auckland, New Zealand, major in Civil Engineering. He is a corporate member of the Association for Project Management. He is currently a project manager at Merrill Lynch overseeing the bank development and expansion projects in the Asia Pacific region. Prior to joining Merrill Lynch, he was a project manager at Ove Arup & Partners Hong Kong Limited engaged in managing various multi-disciplinary engineering projects in Hong Kong and the Mainland China. He loves music, water sports, skiing, traveling, motorbike, etc.

Ir Mandy M Y LEUNG
(Electrical Engineering)
Deputy Delegation Manager and YMC Committee Member, HKIE

Mandy graduated from the University of Hong Kong with a Master and Bachelor Degree in Electrical and Electronic Engineering, and is now a MBA candidate at the Chinese University of Hong Kong. She is currently working at CLP Power Hong Kong Limited in the capacity of Grid Planning Engineer, responsible for the planning of power grid network. Mandy first joined YMC as a helper to Public Relations group in 2003 and was elected committee member in 2005. During the sessions, she has led different function groups including seminars, non-technical programs and graduate promotion, actively organizing multi-disciplinary events for young engineers.

Mr John C H SUN
(Mechanical Engineering)
Treasurer

John was a mechanical engineering student from the University of Hong Kong. After graduation, John joined CLP Power Hong Kong Limited, a power utility company in Hong Kong, as a graduate trainee. John is now working as an assistant engineer specializing in day-to-day operation of Combined Cycle Gas Turbine generating units at Black Point Power Station in Hong Kong. Despite his profession in machines, he enjoys interacting with people. He loves to explore innovative ideas and areas new to him. This is the reason he joins this delegation to Dubai, which is one of the rapid growing emirates in United Arab Emirates. He is determined to learn from the engineering miracles in Dubai and exchange this valuable experience with his peers when he's back to his home land.

Profile of Advisors and Delegates

Ir Carman K M Lam
(Civil Engineering)
Local Liaison Officer

Carman obtained her Bachelor Degree in Civil and Environmental Engineering from the Hong Kong University of Science and Technology in 2003. She has experience in planning, design and contract administration of foundation, sewerage and landslip preventive measures projects. She acquired chartership recognized by professional institutions in Australia and Hong Kong. She is currently an Engineer of the Water Supplies Department of the HKSARG, and responsible for pressure management projects on fresh water distribution systems. She looks forward to diversifying her exposure in engineering and different cultures in the delegation visit.

Ms Iman W M LAI
(Civil Engineering)
Local Liaison Officer and YMC Committee Member, HKIE

Iman obtained her Bachelor Degree of Applied Science in Civil Engineering and LLB degree from the University of British Columbia, Canada and the University of London, UK respectively. She acquired chartership recognized by professional institutions in Australia. She has four years of experience in the planning, design and contract administration of highways, salt water supply system and drainage improvement works. She is currently an Engineer of Highway Department of the HKSARG, responsible for project implementation and administration for reconstruction of a footbridge and contract administration of a public transport interchange in Hong Kong. Since 2006, she has been fully actively contributing herself to YMC. She is now a committee member of YMC leading the Public Relations Group.

Mr Lincoln C H LEE
(Civil Engineering)
Logistics Officer

Lincoln obtained his Bachelor Degree in Civil Engineering from the University of Hong Kong in 2008. He subsequently joined MTR Corporation Limited as a Graduate Trainee and is involved in the current railway extension projects in Hong Kong. As a recipient of the HKIE Scholarship - 2004/2005 back in his undergraduate years, Lincoln is honoured to represent YMC as an overseas delegate for the first time.

Mr Eric Y L CHENG
(Civil Engineering)
Overseas Liaison Officer

Eric is a recent graduate of Civil Engineering from the University of Bath, UK. Having joined the Infrastructure Team in Scott Wilson (Hong Kong) Limited, he participated in multi-disciplinary projects in both Hong Kong and Mainland China. As a member of the Delegation team, he is sure that this will be a great opportunity for him to expose and explore his engineering knowledge by meeting with world top engineers as well as visiting large scale construction sites in Dubai.

Ms Jenny C L LAU
(Civil and Structural Engineering)
Publicity Officer

Jenny obtained her Bachelor Degree in Civil Engineering from the University of Hong Kong in 2007 and she is currently pursuing her Master degree in Structural Engineering. She joined the Ove Arup and Partners Hong Kong Limited in 2007. She has been involved in different projects for the design of buildings, canopies and stations. She is outgoing and likes stargazing and astronomy. She is keen to make friends with engineers from different backgrounds and hopes to explore engineering miracles in Dubai through this delegation experience.

Ir Carrie K Y LEUNG
(Civil Engineering)
Overseas Liaison Officer and YMC Committee Member, HKIE

Carrie obtained her Master and Bachelor Degrees in Civil Engineering from the University of Hong Kong and subsequently acquired professional chartership recognized by professional institutes of UK and Hong Kong. She is currently working as an engineer in Transport Department of the Government of the Hong Kong Special Administrative Region. She is responsible for managing daily district traffic engineering matters. She has joined YMC as helper since graduation and became a committee member in 2007/2008. She is the Graduates Promotion Group leader in the current session and has been actively organizing and participating in different functions.

Ms Suki S K KWOK
(Civil Engineering)
Public Relations Officer

Suki obtained her Bachelor Degree in Civil Engineering (Environmental Engineering) from the University of Hong Kong in 2007. She joined Metcalf & Eddy Limited as a Graduate Engineer after graduation. She has been involved in a number of sewerage projects, responsible for the design of sewerage systems, sewage pumping stations and hydraulic modeling. With interest in environmental issues, she hopes to extend her knowledge to environmental planning and management. She is currently pursuing her Master degree of Environmental Engineering in the University of Hong Kong.

Mr Kit N KCHAN
(Electrical Engineering)
Publication Officer

Kit received his Bachelor Degree from University of Alberta, Canada, and Master Degree from Cornell University, US. He started his career at CLP Power Hong Kong Limited as a graduate trainee in 2006, and now serves as an Assistant Engineer responsible for distribution network operations. Kit contributes himself to HKIE in different capacities, from being a helper in YMC to acting as Vice President Education in Toastmasters Club, with an aim to engineer a better world.

Mr Kelvin H C YU
(Civil Engineering)
Publication Officer

Kelvin obtained his Bachelor Degree from the University of Hong Kong in 2006. Upon graduation, he joined Chun Wo Development Holding Limited as a Management Trainee (Engineering) and has been working in the civil engineering discipline. He devoted himself to the field of construction project management and has involved in major project in the Hong Kong International Airport. Having interest in traveling and network building, Kelvin looks forward to establishing relationship with overseas professionals through this Dubai Delegation.

Ms Jackie K S CHAN
(Structural Engineering)
Public Relations Officer

Jackie graduated from the Hong Kong University of Science and Technology. She worked in Maunsel Aecom after graduation and she is now working in P&T Architects and Engineers as an assistant structural engineer. She is now studying a Master of Science in Construction Law and Dispute Resolution in the Hong Kong Polytechnic University.

Messages from Delegates

Ms Sally S Y LEUNG

Organizing the delegation is challenging but fruitful experience. Throughout the past months, we gained friendship, nurtured leadership skills, admired the sophisticated technologies in Dubai, enriched our communication and presentation technique, widened our horizon and promoted HKIE and YMC to counter parties. Special thanks to all of our honorable advisors and sponsored companies for their continuous support to YMC.

Ir Crystal W C HO

How a desert became a city? How great is the Island which shot off fireworks more than the Beijing Olympic Games Opening Ceremony at its opening? How far I should go to take a full picture of an over 800m tall building? I found all my answers after the delegation to Dubai. This delegation was more than gaining professional knowledge from well-known mega projects. It has extended my engineering experience to a new horizon as well as my social network to the United Arab Emirates. It was a great experience that I could never forget. YMC, where are we going next?

(L) Mr Kit N K CHAN; (M) Ir Crystal W C HO; (R) Mr John C H SUN

Ms Arlene W L LO

Dubai is the place that houses many engineering miracles, and it is also the place that makes my dream come true to learn, explore and grow with a different mix of young engineers. My great pleasure to be one of the organizing committee.

Overseas delegation to Dubai inspires the young engineers. Engineering miracle journey does not mark an end with the success of the trip, instead, it just starts, with our limitless creativity, to make the impossible into possible. Special thanks to CPDC and YMC for the continuous and precious support to make the trip happen.

Ir Mandy M Y LEUNG

I am so glad that I joined this Dubai Delegation. It had all the visits and technical exchanges that brought me to a real "Engineering Miracle" journey. Most importantly, the pre-trip studies and preparations were already memorable learning experience by themselves. It was a great experience to work with a great team.

Mr Kelvin Y K SHAM

It is my great honor to take part in the HKIE YMC overseas delegation to Dubai this year. I got to see a lot of amazing engineering projects in real life and the opportunity to talk to the professional team behind which greatly inspired me and broadened my horizon. I also learnt about the local culture and way of life working as an expatriate in Dubai. It is truly an invaluable experience and I would recommend every young engineer to reach out and see the other parts of the world.

Mr John C H SUN

"In Burj Dubai (the world's tallest building), we've just pushed technologies to the extreme," pointed out by the project manager. His comment concludes most of my appreciation in this trip – the 'can do' spirit, which is a key factor driving the success of all these fast-track engineering miracles. Moreover, I have learnt a lot from the organizing team of all diligent delegates with excellent leadership pushing this delegation to the best standard. Thank you YMC and advisors for granting me this opportunity.

Ir Carman K M LAM

It was a great pleasure to be one of the delegates, being able to see the engineering wonders, exchanging with overseas engineers, and working with a great delegation team. I would like to thank our advisors, the Dubai counterparts, and my fellow delegates for their kind assistance to make the delegation fruitful.

Ms Iman W M LAI

This delegation has not only broadened my horizon, but also expanded my social network. Engineering miracles in Dubai are impressive. I appreciate strong faith and determination that overcome the challenges and will continue to do my utmost to serve the community. Special thanks should be given to all hosting organizations.

Messages from Delegates

Mr Lincoln C H LEE

Joining the delegation in exploring many of the engineering miracles built in Dubai has inspired me the innovative solutions in overcoming engineering challenges. We also came across engineers of different nationalities in Dubai. Of course, without the support from our advisors and the joint endeavor of our fellow teammates in bringing the delegation into reality, I will not be able to have the fruitful experience to share in Hong Kong.

Ir Carrie K Y LEUNG

This has been the second time I have joined the YMC delegation trip. It was a very valuable and fruitful experience which has widened my horizon in the engineering aspects and also extended my network to engineers and friends in both Hong Kong and Dubai.

Mr Eric Y L CHENG

I am proud to become part of the Dubai delegation. I not only gained insight and appreciation in large scale infrastructure and building projects, but also expanded my social network through exchanging ideas and expertise with local engineers. It is a golden opportunity to explore the exciting industry of engineering, and is definitely an unforgettable part of my life.

Ms Jackie K S CHAN

It is fruitful experience for engineering exposure. Many thanks to our teammates' hard work which ends up a memorable learning journey and endless friendship in my life. I would definitely recommend you to join the delegation as a challenge and chance.

Ms Suki S K KWOK

It is my pleasure to participate in this delegation. I have learnt not only a lot of engineering knowledge, but also skills of organizing such a large event. I would like to thank all my teammates and advisors for their efforts and support to make this trip so successful and memorable.

Mr Kelvin H C YU

I am so delighted to participate in this delegation. Apart from witnessing the engineering miracle in Dubai, I also broadened my horizon through the exchange and sharing with professionals in Dubai. Being one of the organizers, I also gained valuable experience in organizing delegation. I would highly recommend all of you to join this kind of delegation.

Mr Kit N K CHAN

The investment in my growth here is remarkable. The feedback is frequent and insightful. If you like to explore, widen horizon and develop yourself in an all-round approach, there is really very little that you can't take advantage of. Also, the trip brings me another big family, which would be a long-lasting one. Thanks for CPDC and YMC for providing me with a very holistic experience.

Ms Jenny C L LAU

It is a memorable journey in my life. I had an opportunity to visit, not only the excavation of the longest man-made canal in the world - Arabian Canal, but also the tallest building in the world -Burj Dubai. It is an amazing city for engineers in which lots of innovative features and techniques are involved. I have broadened my horizon and have made friends with engineers from different walks of life.

Financial Statement

Income & Expenditure Statement

Income

	Budget (HKD)	Actual Sponsorship (HKD)
1. YMC Reserve	50,000.00	20,000.00
2. Delegates' Contribution	128,000.00	128,000.00
3. CPDC Contribution	48,000.00	48,000.00
4. Sponsors	40,000.00	70,000.00

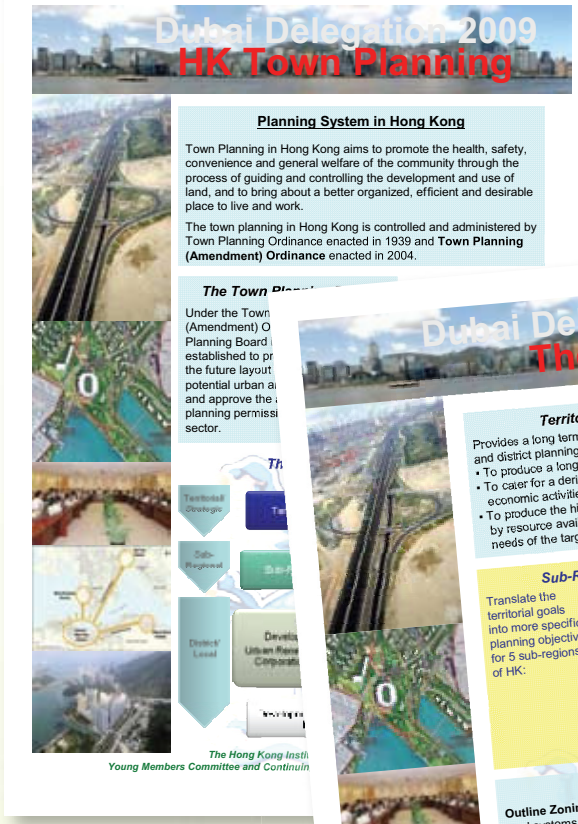
Expenditure

	Budget (HKD)	Financial Status (HKD)	
1. Meeting Expense	2,000.00	2,000.00	*
2. Overseas Events Expenditure			
a. Travel & Accommodation	170,000.00	161,147.50	
b. Catering	25,200.00	19,875.07	
c. Souvenirs	2,000.00	3,000.00	*
d. Photographs	1,000.00	1,800.00	*
e. Communication	1,000.00	530.40	
f. Postage	500.00	500.00	*
3. Local Events Expenditure			
a. Local Seminar & Visit	5,000.00	7,369.09	
b. Delegation Presentation	2,000.00	2,000.00	*
c. Catering	5,000.00	5,000.00	*
4. Publicity	500.00	2,500.00	*
5. Report Production			
a. Report	35,000.00	55,000.00	*
b. Postage & Stationery	1,000.00	3,000.00	*
6. Contingency	19,8000.00	3,000.00	*
Sub-total	270,000.00	266,722.06	

Sub-total	266,000.00	266,000.00
		Net (HK$): =

Remark:

* Estimate as of May 2009


Dubai Delegation 2009
HK Town Planning
Planning System in Hong Kong
Town Planning in Hong Kong aims to promote the health, safety, convenience and general welfare of the community through the process of guiding and controlling the development and use of land, and to bring about a better organized, efficient and desirable place to live and work.
The town planning in Hong Kong is controlled and administered by Town Planning Ordinance enacted in 1939 and Town Planning (Amendment) Ordinance enacted in 2004.
The Hong Kong Institution of Engineers
Young Members Committee and Continuing Professional Development Committee


Dubai Delegation 2009
The Plans
Territorial Development Strategy
Provides a long term planning framework upon which
and district planning is based on. It aims:
• To produce a long term land use/transportation strat
• To cater for a derived target population and associat
economic activities
• To produce the highest quality environment within
by resource availability and the time frame within
needs of the target population have to be met
Sub-Regional Development Stra
Translate the territorial goals into more specific planning objective for 5 sub-regions of HK:
District/ Local Pla
Outline Zoning Plans show the proposed
road systems of individual planning schem
by such plans are zoned for such uses as: Residential,
commercial, industrial, open space, Government,
institution or community uses,
green belt, conservation areas,
comprehensive development
areas, village type
development, open storage or
ses.
v.hk
stitution of Engineers
uing Professional Development Committee


Dubai Delegation 2009
Water Supplies in HK
Water Demand and Sources
Hong Kong's population of some 7 million consumes on average 2.605 million cubic metres of fresh water and 0.742 million cubic metres of seawater for flushing each day. About 70% to 80% of our fresh water is sourced from neighbouring Guangdong province, supplemented by Hong Kong's own water gathering catchments and held in a network of reservoirs across the city. Water supplies services are delivered by the Water Supplies Department (WSD) of the Government of the Hong Kong Special Administrative Region.
Water Treatment Process
There are now 21 water treatment works in Hong Kong with a total output capacity of 4.8 million cubic metres per day. During the water treatment process, raw water (untreated water) is dosed with chemicals for mixing and then passes to the clarifiers where coagulation and flocculation of the impurities in the water will take place. Settled water then flows into filters of sand or anthracite for removal of the more finely divided suspensions. The filtered water passes into contact tanks where dosed chlorine and lime are added to disinfect and control the alkalinity of the final treated water. Fluoride is also added to minimise the risk of dental decay. A small amount of residual chlorine is maintained in the water to keep it free from bacteria on the rest of its journey. The final water is pumped into a system of watermains, stored in service reservoirs and then supplied to the public.
Statistics
Installations
Length (km)
Fresh Water Mains
6,205
Salt Water Mains
1,599
Catchwater
120
Water Tunnel
199
The Hong Kong Institution of Engineers
Young Members Committee and Continuing Professional Development Committee


Dubai Delegation 2009
HK2030 Study
What is HK2030 Study?
The Hong Kong 2030: Planning Vision and Strategy, or "HK2030 Study" in short, is tasked to update the Territorial Development Strategy (TDS) for Hong Kong, which is defined as
"a long-term planning strategy to guide future development and provision of strategic infrastructure, and to help implement government policy targets in a spatial form".
It recommends, on the basis of a series of assumptions, how the spatial environment should respond to various social, economic and environmental needs in the next 20 to 30 years, taking Hong Kong towards a shared vision –
a vision that makes Hong Kong a better place in which to live and work, under the over-arching goal for sustainable development – a city that could rightfully assume the title of "Asia's world city"
How does Strategic Planning evolve?
• Strategic planning in Hong Kong has come a long way since the preparation of the Abercrombie Report in post-war 1948 (Fig 1.1).
• Despite the big step forward, there is still room for improvement. From the last review of the TDS, lessons can be learnt especially in revising the approach for the HK2030 Study:
"...allow a higher level of engagement with the community in the study process..."
Why and how "Public Engagement"?
• An extensive public engagement campaign has been conducted throughout the entire study process with a view to ensuring that the planning strategy formulated can best meet the needs of the people and cater for changes in the future.
• Major public engagement exercises had been undertaken at the end of each stage of the study. E.g. briefings, focus group meetings, public forums for the stakeholders and the public at large, ...
Colony Outline Plan 1970
Hong Kong Outline Plan 1979
Territorial Development Strategy (TDS) 1984
Revisions of Territorial Development Strategy 1986/1988
Territorial Development Strategy Review 1996
Fig 1.1
The Hong Kong Institution of Engineers
Young Members Committee and Continuing Professional Development Committee


Delegation 2009
verall Concept
Recommended Development Pattern
What are the key strategies?
The HK2030 Study has adopted sustainable development as its over-arching goal. The recommended strategy, focusing on the three broad directions of:
1) providing a quality living environment,
2) enhancing economic competitiveness
3) strengthening links with the Mainland
• The slower population growth allows room for a shift in emphasis from quantity to quality and a "do more with less" approach. On the top of currently built-up areas, it is intended to accommodate about 30% of the additional population in the new development areas (NDA) and the rural parts of the New Territories, offering opportunities to thin out the congested parts of the urban areas and promoting a more balanced development pattern.
• A "rail-based pattern", is proposed for future development confining major development to areas which are well served by the rail network. At present, about one-fifth of Hong Kong's land is urbanized. Under this prudent approach in opening up greenfield land for development, future urbanized areas will take up no more than a quarter of our total land area, enabling continuous preservation of countryside areas as much as possible.
• To effectively leverage on Hong Kong's ties with mainland China and for better integration with Greater Pearl River Delta city-region, HK2030 Study emphasizes on cross-boundary infrastructure and development at the Closed Area (including land-, water-, and air-based infrastructure) to ensure unimpeded flows of people, goods and vehicles.
Reference: http://www.pland.gov.hk/p_study/comp_s/hk2030/eng/home/index.htm
The Hong Kong Institution of Engineers
Young Members Committee and Continuing Professional Development Committee

Dubai Delegation 2009

Water Supplies in HK

Water Distribution Process

Fresh water and seawater are supplied through two entirely separate systems of pumping stations, service reservoirs and water mains. The water is pumped and, in some cases it flows by gravity, after leaving the treatment works or being extracted from the sea to the service reservoirs which are located at various places and elevations throughout the territory, each serving a particular area.

Water from the service reservoirs is distributed to customers by gravity via extensive networks of water mains. The pressure in the system is generally sufficient to provide a direct supply to six or seven stories above street level. Upper floors of tall buildings are supplied from their own roof tanks, filled by their own pumping systems. For higher level areas, such as mid-level developments on Hong Kong Island, it is necessary for the water to be pumped in stages to service reservoirs situated at different suitable levels. For remote village areas, the pressure in distribution network system is normally sufficient to provide a direct supply to three stories above ground level.

Statistics (as of 31.3.2008)

Installations	
Impounding Reservoir	
Water Treatment Works	
Fresh Water Pumping Station	
Salt Water Pumping Station	
Fresh Water and Salt Water Flushing	

Reference: http://www.wsd.gov.hk

Railway System in HK

Existing and Future Development

Introduction

In Hong Kong, railways play a vital role in serving the transport needs of Hong Kong. They account for about 35% of domestic public transport and some 68% of the land-based cross-boundary passenger trips. Being high speed off-road mass carriers, railways provide fast, reliable and comfortable services, reduce the pressure on the road network, and avoid many of the environmental problems associated with road traffic. They are therefore the backbone of our public transport network.

Existing Railway Network

The existing railway network in Hong Kong has a total rail length of over 200 kilometers. This extensive railway network is operated by MTR Corporation Limited at the moment. The newly expanded

Railway System in HK

Existing and Future Development

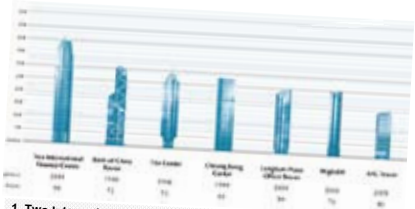
The MTR now also operates a 35.2km Airport Express and 36.2km Light Rail networks which can take you to Hong Kong Airport and 68 stops in the North West New Territories. It also provides speedy through train services to major cities across Mainland China. Helping average 3.4 million people reach their destination every weekday, the MTR is regarded as one of the world's leading railways for safety, reliability, customer service and cost efficiency.

Future Railway Development

The Railway Development Strategy 2000 announced in May 2000 aims to meet the increasing transport needs due to Hong Kong's population growth, continued developments and strengthened link s with the Mainland, in a sustainable manner. It maps out a blueprint for the further expansion of Hong Kong's railway network. We are proceeding with the implementation of five passenger railway lines: the West Island Line, the South Island Line, the Shatin to Central Link, the Kwun Tong Line Extension and the Hong Kong Section of Guangzhou – Shenzhen – Hong Kong Express Rail Link. In addition, the MTR is reviewing the Northern Link, the North Island Line and the Port Rail Line based on their needs and interfaces with other developments. The rail lines mentioned above involve a total investment of HKD 100 billion. Upon the completion of the various railway projects under the Railway Development Strategy, Hong Kong's railway network will expand to about 300 kilometers. The railway share in the public transport system will be boosted from about 35% now to about 45%.

Reference: www.mtr.com.hk/eng/homepage/corp_index.html

Hong Kong High-Rise Building Showcase



1. Two International Finance Centre

Rising 420 m high on its reclaimed site, Two International Finance Centre (Two ifc) is the latest phase of development to complete above Hong Kong Station, where the One ifc office tower and the first stage of ifc Mall completed in 1999. Two IFC will stand as the first part of a larger concept: a gateway to Hong Kong Harbour formed by it and the forthcoming commercial tower at Kowloon Station.

2. Bank of China Tower

Bank of China (BOC) Tower is located at No.1, Garden Road, a flourishing centre of activity in Hong Kong's business and financial core. The building was completed for occupancy in August 1989, the building was opened in May 1990, towering 70 floors above the ground floor level and offering parking in four basement levels. The tower structure of 315 metres and two masts of 50 odd metres give the building its aspiring height of 367.4 metres.

3. The Centre

An eight-pointed star rises vertically on the waterfront in the form of an ultra-tech office tower overlooking Central and Victoria Harbour. Silvery and reflective by day, the monolith transforms into a light show at twilight when its four angular projections morph into cool neon chevrons.

4. Cheung Kong Centre

"Respect and reputation" are two qualities that Cheung Kong Holdings possesses in abundance, derived in large part from Chairman Li Ka-shing's extensive property developments in the HKSAR. Cheung Kong Center – a 62-storey office tower – occupies a prime site, sandwiched between Norman Foster's Hongkong Bank Building and I.M. Pei's Bank of China Building.

Dubai Delegation 2009

Do you know?

Two International Finance Centre
Bank of China Tower
Cheung Kong Centre
The Centre
Langham Place Office Tower
Highcliff
AIG Tower

5. Langham Place Office Tower

The bustling Mongkok district has a new hive of activity on the west side of Nathan Road – the Langham Place commercial, retail and hotel development. More than 15 years in planning and construction, the urban renewal project enlivens its surrounding and draws on the locale's spirit in its planning and design.

6. Highcliff

The Highcliff development stands as the tallest purely residential building in the world, not least due to planning requirements. The orientation of the building was accordingly positioned to look over the Happy Valley and Jardines's Lookout areas. The smoothly curved profile was decided using the pure form of two ellipses overlapping and results in an all- enclosing curtain wall façade.

7. AIG Tower

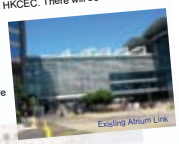
AIG Tower, located at the site of the former Furama Hotel in Central, is a 35-storey grade-A building, with a gross floor area of 39,000 square metres. Demolition of Furama Hotel commenced in December 2001, and the construction of the new tower was started in November 2002 and was completed in May 2005. The building has participated in the Hong Kong Building Environmental Assessment Method (HK-BEAM) and has achieved and Excellent rating in 2005.

References:
[1] Raymond Wong Wai Man, *15 Most Outstanding Projects in Hong Kong*, Published jointly by the editorial teams of Building Journal and Construction & Contract News, 1998
[2] Raymond Wong Wai Man, *Tall Buildings in Hong Kong*, China Trend Building Press Ltd Hong Kong, 2006

Hong Kong Convention and Exhibition Centre
Atrium Link Extension

Description

The Hong Kong Trade Development Council (TDC) is expanding the Hong Kong Convention and Exhibition Centre (HKCEC) to provide additional space for trade fairs. The existing atrium link will be replaced by the new Expansion spanning across the water channel between Phase I and Phase II of the HKCEC. There will be no permanent intermediate columns in the waterway.



Key Project Data

Employer: Trade Development Council, HKSAR
Project Manager: Maunsell Consultants Asia Ltd
Main Contractor: Hip Hing / Ngo Kee Joint Venture
Contract Sum: HKD 1.3 billion

Constraints & Difficulties

- No foundation is allowed at sea channel
- Limited site area is provided
- Disturbance to adjacent hotels should be minimized
- ...ption of HKCEC should be maintained

Engineering Innovative Features

Demolition of Existing Atrium Link

The existing atrium link was hanged down from 5-roof bow trusses which were supported as side trusses. In order to remove the roof trusses, temporary bracings were constructed to make the whole structure self-stand before cutting the hanger columns and dismantle the roof trusses. Saw-cutting method was mainly adopted in this project to minimize the disturbance to the neighboring structures under operation.

New Steel Structure

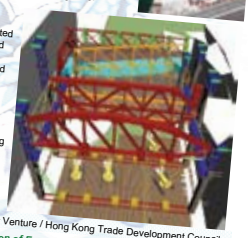
The main frame of the new structure is the mega roof trusses of 90m span supported on the mega columns on the two sides of the waterway, sitting on socket H-piles and bored piles. Hanger columns from the mega roof trusses in turn support the floor trusses where the floor slabs are constructed on. The whole building structure will be hanging.

Marine Platform

The use of temporary marine piles was limited by the Foreshore and Sea-bed (Reclamation) Ordinance to a maximum of 80 numbers and a maximum size of 800mm diameter. Hydraulic modeling was conducted to investigate the effects on water flow. Two marine platforms were constructed as the working platforms for loadings from 400t crawler cranes, 500t mobile cranes, and site assembly of 1,500t mega roof trusses.

Roof Truss Construction

The roof trusses were pre-fabricated in Mainland China and transported to site by delivery barges and trailers. They were then assembled on the marine platform. Lifting towers were erected at the top of mega columns and tie-down systems were installed at the bottom. After assembly, the mega trusses, together with a set of sliding girders were lifted up by hydraulic strand jacks. With the launching of sliding girders and each of the trusses step by step, all roof trusses were transferred to the final position.



Reference: Hip Hing – Ngo Kee Joint Venture / Hong Kong Trade Development Council

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...rs Committee and Continuing Professional Development Committee

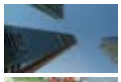
International Commerce Centre

Description

- Comprise of 118 storeys with a height of 485 m
- High-rise building designed by local professionals
- Project jointly owned and developed by MTR Corporation Limited and Sun Hung Kai Properties (SHKP)
- Tenants including 5-star hotel and Class A offices occupied by Morgan Stanley, Credit Suisse and Deutsche Bank

Key Project Data

- Architect: Wong & Ouyang (HK) Ltd.
- Structural Engineer: Ove Arup and Partners Hong Kong Ltd.
- Developer: Habour Vantage Management Ltd.



Engineering Innovative Features

Foundation

- The foundation was made up of more than 200 shaft grouted barettes scattered within a 75m diameter diaphragm wall
- The friction piles were used due to the great variation of the depth of the bedrock at 60m to 190m below ground
- The floor stability system comprised of a reinforced concrete (RC) central core and eight numbers of reinforced concrete mega columns with four outriggers (one post tension RC + three structural steel)
- Cost of structural steel was escalating due to rapid development for the Beijing Olympic 2008. Prestressed concrete is employed instead of structural steel for the bottommost outrigger

Wind Engineering

- The required wind profile in this project was up to 500m when the local wind code dealt with the building height up to 200m only
- Wind tunnel test was conducted and the design wind speed was 59.5m/s. Dynamic wind loads were evaluated and wind induced accelerations were investigated
- Wind profile of the site location was monitored to estimate the swaying of the structure
- International Commerce Centre (ICC) has adopted the central core and outrigger system to resist the large wind load
- Structural steel and prestressed concrete outriggers together with high modulus self compacting concrete were subsequently used in the structural system to reduce the wind induced accelerations and deflection

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International Commerce Centre

Power Distribution System

- Transformer room sat on above ground mechanical floors where the major Mechanical & Electrical plants are located is the best way to contain voltage drop
- Dual tenant risers serving each tenant floor to make changeover possible in case of power failure of one power cable
- Some lightly loaded transformer deliberately incorporated for the on-spot replacement to take up the loads in case of transformer fault on the heavily loaded transformers

Elevator System

- 40 double-deck elevators with crowd sensor control and sway control system
- Passengers on two consecutive floors to be able to use the elevator simultaneously, significantly increasing the passenger capacity of an elevator shaft

Chiller Plant Optimization

- Cooling load prediction for the whole building
- Condensing water supply temperature reset to determine the optimal condensing water supply temperature with ambient Wet Bulb temperature
- Chilled water supply temperature reset
- Chiller capacity control to assign operating capacity of each chiller, optimizing the power input to meet the cooling demand
- Optimal control of variable speed (VS) pump

Fire Engineering

- Smoke curtains, early warning system installed for better smoke control and early warning of fire occurrence
- Planned and managed evacuation to ensure fire egress and evacuation
- Sub-system of sprinkler and FS installation with direct booster pump connection for the super high-rise building, staircase pressure system, enhancement installations such as air-aspiration detection installation, public fire alarm system and fire phone communication provision

References:
[1] http://en.wikipedia.org/wiki/International_Commerce_Centre
[2] http://www.hkengineer.org.hk/program/home/index.php
[3] http://www.shkp.com.hk/data/publication/quarterly/30/30/30_448.pdf
[4] H.C. Chu, *Technical Talk on Challenges for Designing ICC's Central Chiller Plant*, 2008
[5] H.K. Yung, W.K. To, C.F. Lau, *Electrical Services and Vertical Transportation Design for International Commerce Centre*, HKIE Electrical Division Symposium, 2008

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Photo Gallery


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Acknowledgement

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- Emirates Airline
- ICE – UAE
- Jumeirah Group
- Jumeriah Lake Towers
- Limitless
- NSCC
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- VSL Middle East LLC
- WSP Group

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- WONG, Johnny
- WONG, Kelvin

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目標高瞻遠矚，摒棄「如常運作」模式

面對氣候變化的威脅，我們的未來，取決於今日的承諾。中電致力履行社會責任，訂立了進取且艱巨的目標：承諾在2050年底前把發電組合的碳排放強度降低75%。

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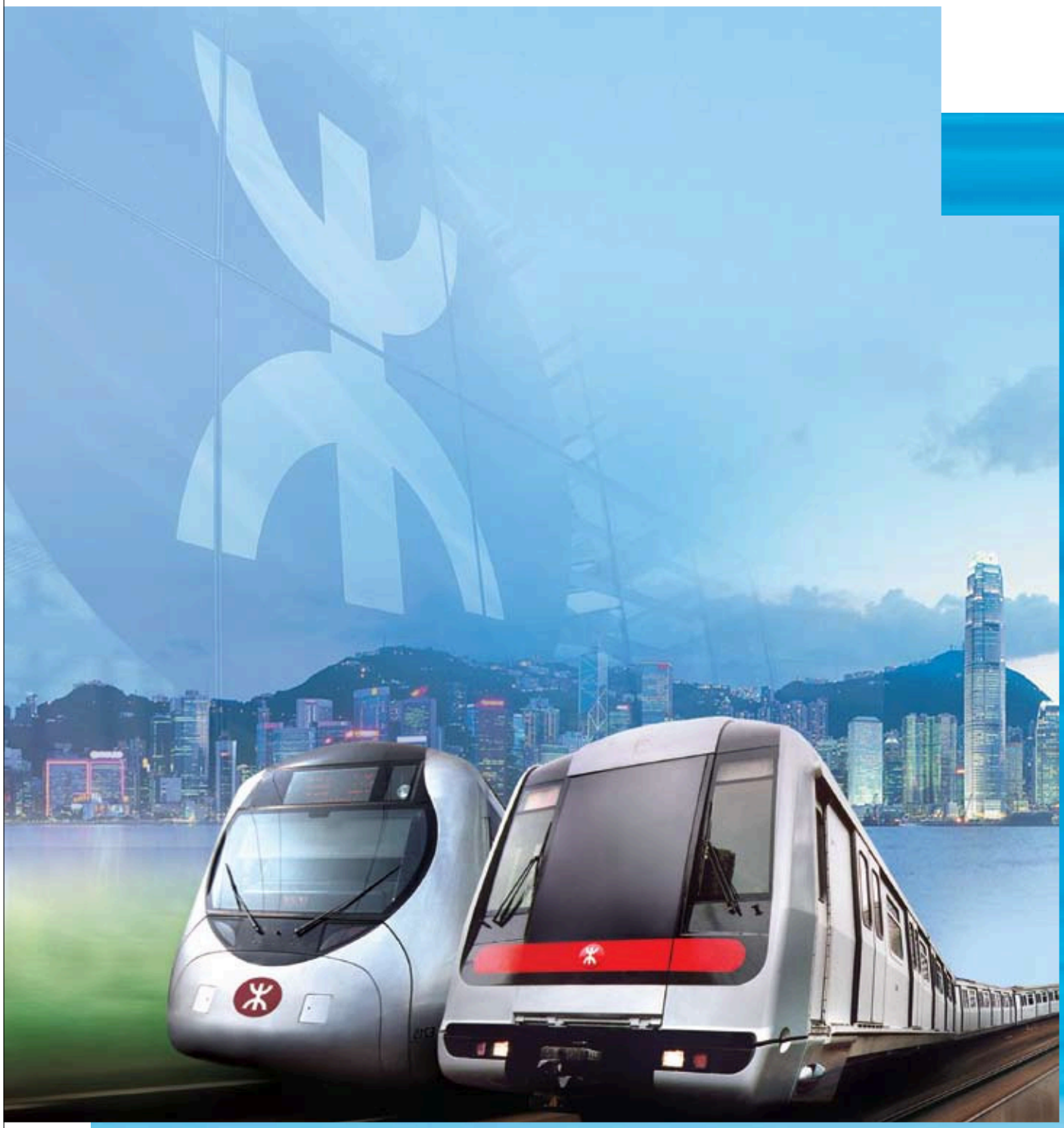

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