

# THE ARUP JOURNAL

WINTER 1987/88



# THE ARUP JOURNAL

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Front cover: Exchange Square

Back cover: Shajiao 'B' Power Station (Photo: Neil Duncan)

## Foreword

The Hong Kong office has recently celebrated its 10th anniversary, and even though several projects have already been reported in the *Arup Journal* this is the first time that a full issue has been dedicated to our work.

The last decade has seen the most extraordinary level of activity in the construction industry in Hong Kong and the character of the office has been forged by the need to keep ahead with our technical skills, whilst fitting in to the demanding programmes asked of us by our clients.

We have developed from a small group of site engineers into a multi-disciplinary design office with a complement in excess of 300 staff and, together with the backup from Arups worldwide, we are now firmly established as one of the few major consulting engineering practices in the Far East. It has



been this breadth of experience and depth in resources that has enabled us to maintain a solid workload on home territory in spite of the volatility of the Hong Kong market. This has allowed us to pursue interests throughout the area and also to add new expertise to the mainstream of our activities.

We have completed several spectacular projects: the Hopewell Centre, the headquarters for the Hongkong Bank, and Exchange Square have all received international acclaim, whilst our work on the Mass Transit Railway represented a major step in the development of underground structural and geotechnical engineering, with a special bonus in the multi-storey developments above the railway sites. We have completed a number of Building Engineering projects involving all our design disciplines, including the Prince Philip Dental Teaching Hospital, the Carlsberg Brewery, the Members' Clubhouse at Shatin for the Royal Hong Kong Jockey Club, and the Cityplaza 2 development at Taikoo Shing. Massive civil engineering work at remarkable speed has enabled the Shajiao 'B' power station in China to open ahead of schedule, and many bridge, reclamation, and site formation projects are now successfully finished. Hong Kong's geology and topography are notorious and many of these projects have been constructed in extremely difficult ground. A lot of our commissions for work 'above ground' stem from our reputation for expertise in geotechnical engineering.

Commissions directly for contractors have formed a large part of our workload and it is gratifying that the people who actually build come to us for faster or more economical design solutions. The close relationships we have developed with many contractors have been of immense benefit as an in-depth appreciation of their particular design requirements makes us that much better in the conventional consultant's role. The industry is turning increasingly towards the turnkey contract and we are very happy to have numerous contractors as established clients.

Within the last three years our involvement outside Hong Kong has increased dramatically, particularly in China where five of our hotels are nearing completion. We have completed projects in Singapore, Malaysia, Brunei, Indonesia, and the Republic of Korea, and have assisted clients with their work in the Philippines, Thailand, Taiwan, Papua New Guinea and the USA. We have given advice to clients from all over the world on projects in Hong Kong and China.

Much has been written about the handover of Hong Kong to the People's Republic of China in 1997. We have already enjoyed the stabilizing influence which the joint British and Chinese declaration brought in 1984.

The Territory is still seen as the main entrepot for trade and investment with China and this healthy relationship is forecast to develop well into the next century. With political stability achieved, and a thriving economy, we have every reason to believe that Hong Kong will continue to be an exciting and rewarding place to work.

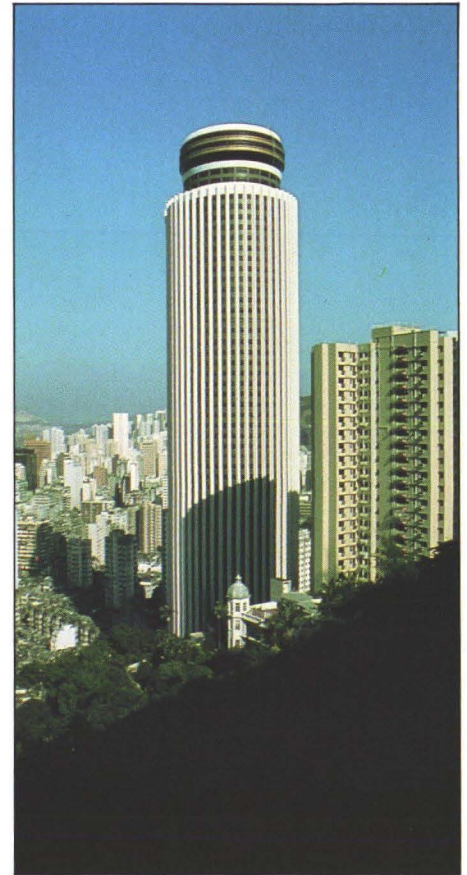
It has been a difficult task to condense 10 years of work into a single issue of the *Journal*. We have deliberately chosen to allow the finished product to speak for itself: if engineering is to be a means to an end then it is that end which we have illustrated here.

However, this can never do justice to the remarkable efforts on all the jobs that are not shown in this issue, including all the discarded alternatives, and those possible jobs and scheme designs which never left the drawing board.

There is a danger of complacency and it is worth remembering that many believe that we are only as good as our last job. Since the majority of new jobs stem from people we have worked with before, obviously whatever we produce must be of the highest quality.

However we must respond to the needs of the market and vary our range of services accordingly, and at the same time create more outlets for those things we do best.

Hong Kong is arguably the most international city in the world. Above all, our outlook must be increasingly international if we are to meet our clients' needs and to remain an integral part of the Practice worldwide.



1. The Hopewell Centre: Our first major project in Hong Kong; our offices occupy the 54th, 56th and 57th floors.

2. Hong Kong panorama (Photo: The Stock House/Robert Gale)



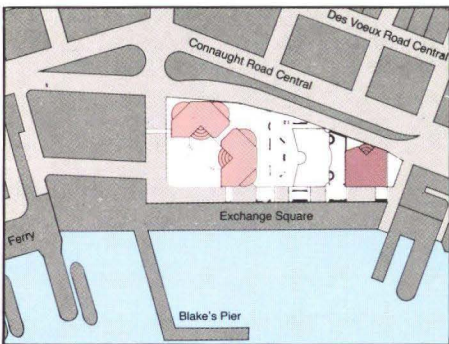
# Exchange Square

Visitors to this site are confronted with uninterrupted views, even at promenade level, over three points of the compass. The site lies in the cradle of Hong Kong harbour in the midst of the Central business district with every conceivable type of land and water-borne transport arriving at its door. It will come as no surprise that the Exchange Square site is one of the most valuable pieces of real estate in the world.

In February 1982 the Hongkong Land Property Company paid a record price for the development rights of the last remaining waterfront site in Central. On the day that the land was purchased the design team accelerated to meet a demanding programme, which culminated in the completion of the first 200 000m<sup>2</sup> of office and commercial development ready for occupation within a period of less than three years.

The principles of the client's brief and the architect's scheme were to produce the most prestigious office accommodation in Hong Kong, without compromise to standards of finishes, building servicing, and above all the fundamental need to maximize the development potential of this remarkable site. Estimates by the popular press put interest charges on the land cost alone at well in excess of £1 per second. It will be appreciated that in this case time really was 'of the essence'.

A structural solution was developed which could maximize the efficiency of the floor plan. To reduce the size of the vertical elements, outriggers were placed at the mechanical floor levels: these transferred bending moments from the central cores to the peripheral columns in 'push-pull' action, thus taking advantage of the allowable overstress under typhoon loading conditions. A wind tunnel test was carried out to supplement the local regulations for cladding design and total building forces.



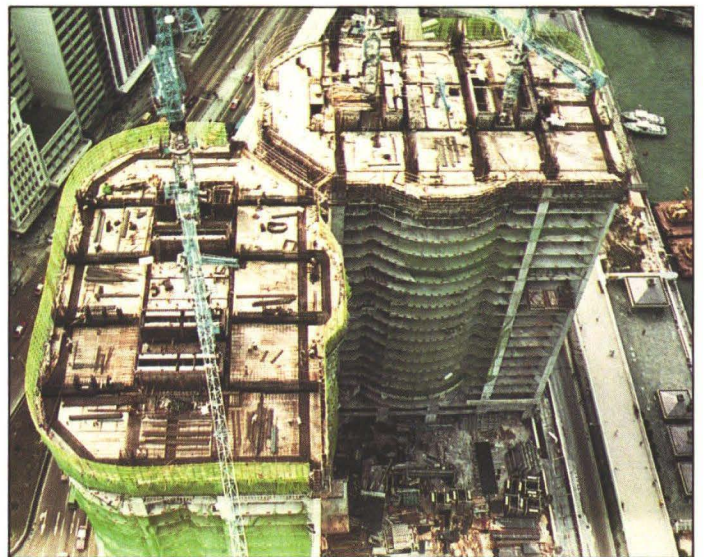
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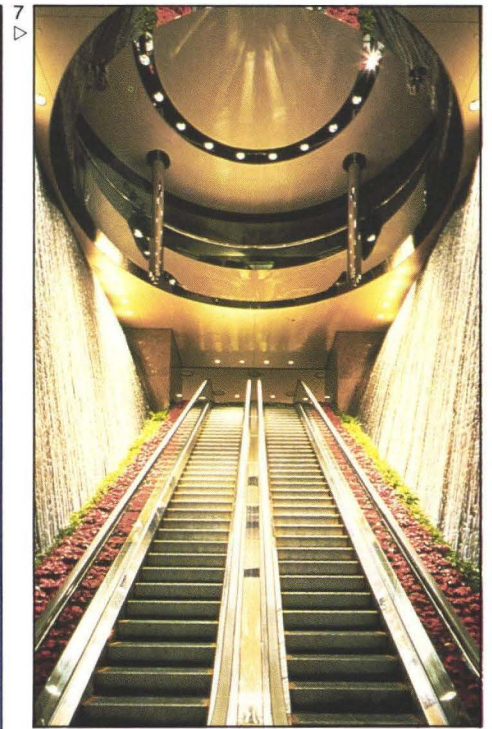
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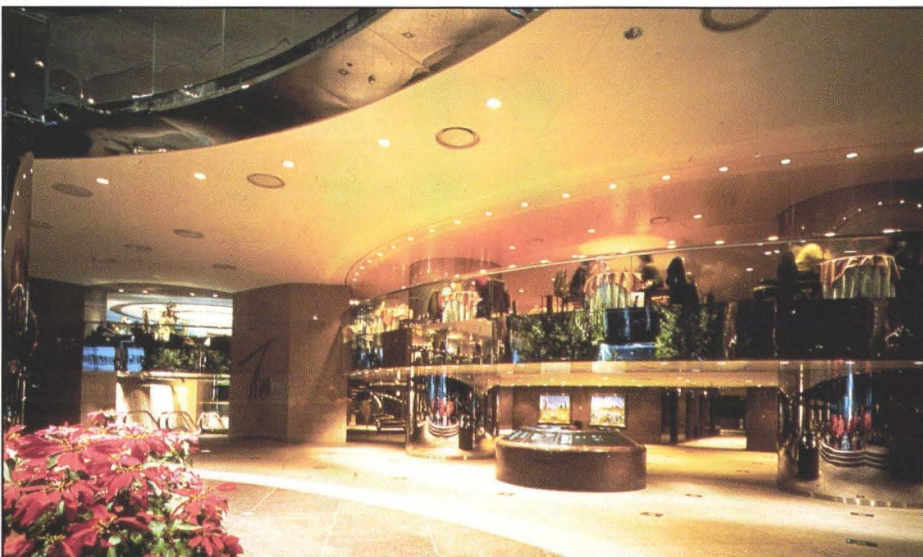


At the time, reinforced concrete was generally accepted to be the most cost-effective material for the construction of tall buildings in Hong Kong: opinions still vary as to the economies of structural steel and the difficulties with following trades. However, let it suffice to say that a brave decision was taken to proceed with the design in in situ reinforced concrete. This was vindicated by the construction cycle, which averaged six days per floor, with a sequence of four days per level being achieved on several occasions.

The total developed floor area of Exchange Square, including Phase II, is almost 300 000m<sup>2</sup>. Whilst the tall, deep, and spectacular parts of the project clearly form the focal points, the total development also included major design effort on the seawater intake system, the plaza concourse, the cladding design, and the Stock Exchange roof which spans a modest 52m and supports a four-storey glass rotunda.

At the time of construction of Phase I, Hong Kong's per capita expenditure on construction was more than 10 times that of the United Kingdom. It is a measure of the sophistication of the local industry that two 52-storey towers could be designed and constructed within a period of 28 months.

The architects, P&T Architects & Engineers HK, received the Hong Kong Institute of Architects Silver Medal Award in 1985 for Exchange Square.



1. Site layout
2. View from the harbour of the Phase I towers
3. Pile cap construction
4. Outriggers under construction
5. View from Western District
6. The main entrance
7. Access to the Rotunda (Exhibition and restaurant areas)

Photos:  
1,4: Gammon Building Construction  
2,5,6,7: P & T Architects & Engineers HK

# Mass Transit Railway

This is the largest and longest project undertaken by the Practice in Hong Kong. Since its inception in the mid '70s, we have been working continuously on railway projects and it seems likely that this will continue at least until the end of 1988.

Our first work on the Modified Initial System stations at Chater and Admiralty was completed in 1980. Both stations required innovations in excavation technology for the open cut at Admiralty and the top-down dig at Chater. Close geotechnical control was essential for the efficient design and construction of structures as much as 25m below ground. At Telford Gardens we designed transfer plates to allow the residential towers to be supported on discrete columns through the Kowloon Bay depot.

The Tsuen Wan Extension was completed in 1984. Our main contribution to this part of the system was the Tsuen Wan Depot and Station,

with the Luk Yeung Sun Chuen development above the depot podium. Seventeen 30-storey residential towers together with schools and commercial facilities have been built above. New computing techniques were developed in order to analyze the cruciform towers so that the most economical configuration of shear walls could be designed. This method, which enabled us to minimize concrete and reinforcement quantities, has been an invaluable tool for the design of subsequent residential developments.

We obtained several commissions on the Island Line: a new platform level underpinned beneath Central Station; new works at Admiralty with access shafts for the tunnel drives; a five level underground concourse for Wanchai station; and the station, depot, seawall and reclamation at Chai Wan. Again, geotechnical and underground structural engineering skills had to be developed for work in Central, Admiralty and Wanchai where closer control of ground movement was mandatory and faster construction periods were expected than for the first work on the Modified Initial System. Knowledge gained on the design of the depot at Tsuen

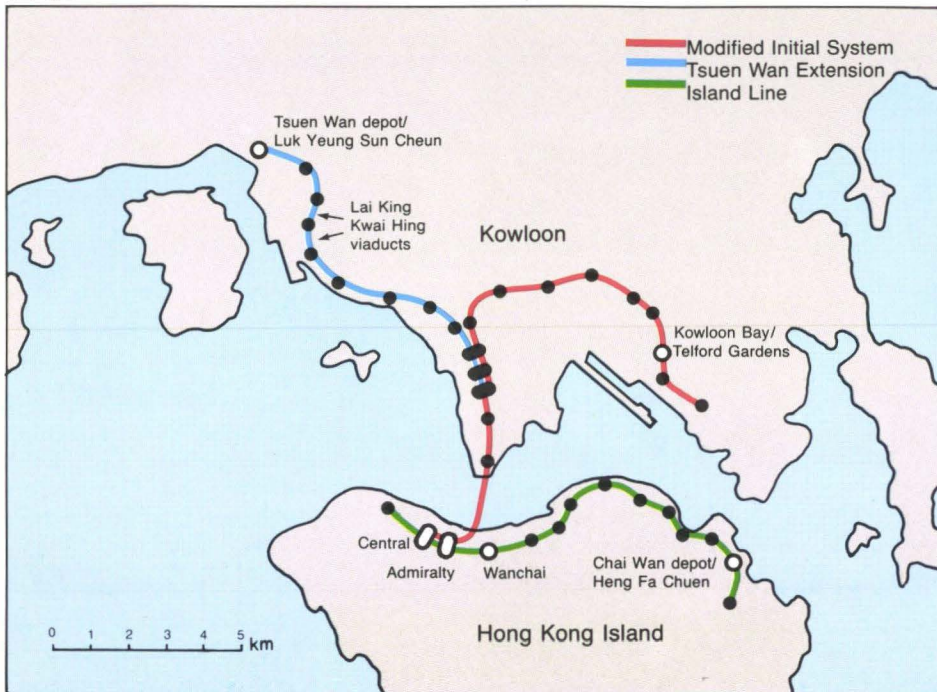
Wan was reapplied for the planning of the Chai Wan depot, this time allowing potential developers more freedom of choice in the form of their residential towers above the podium.

The Mass Transit Railway has been very successful: the construction of a sophisticated underground railway through some of the most densely populated areas in the world, on time, and within budget, is a remarkable achievement.

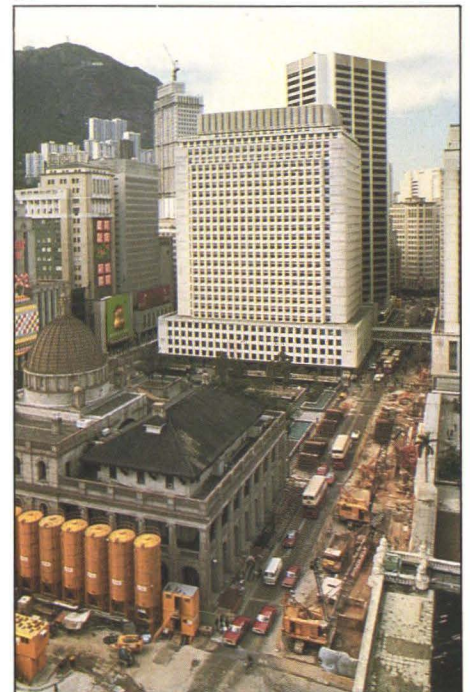
1. Chater Station (Now Central)
2. Route map
3. Top down construction under way in Chater Road (Photo: MTRC)
4. The Telford Gardens development above Kowloon Bay Depot
5. Tai Ho Road Flyover at Tseun Wan
6. Tsuen Wan Depot
7. Lai King-Kwai Hing Viaduct (Photo: Neil Farrin)
8. Luk Yeung Sun Chuen development above Tsuen Wan Depot



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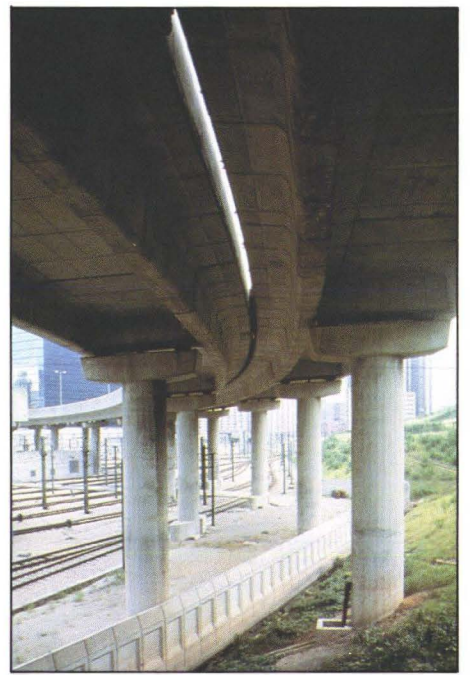


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# Chai Wan Depot and Heng Fa Chuen Development

Within the space of eight years a barren stretch of the coastline has been turned into a township of 30 000 people served by the Mass Transit Railway.

The only Mass Transit Railway maintenance depot on Hong Kong Island is located near Chai Wan. The main building is covered by 6 ha of podium, with the passenger station alongside. Reclamation of the site began in 1978, which included dredging of the marine

deposits prior to backfill and construction of the seawall. The site is approximately 15 ha and is now known as Heng Fa Chuen. Construction of 50 residential tower blocks is underway, of which 17 are located above the railway depot and are already occupied. The development includes schools, kindergartens, shopping and leisure facilities.

Extensive computer analyses have allowed the most economical configuration of coupled shear walls to be designed with all peripheral and party walls contributing to the stiffness of the structure. The residents may modify the internal layout of their apartments as all internal partition walls are non-structural. By avoiding the intrusion of structure into habitable space, and by maximizing usable floor area, a most attractive apartment layout has been achieved.

1. Depot under construction with seawall & reclamation under way (Photo: Aoki Tobishima Joint Venture)
2. Reclamation nearing completion (Photo: Tim Watcyn-Jones/MTRC)
3. Heng Fa Chuen development: complete above the depot, construction of the towers on the reclaimed land under way





# Wanchai Station Concourse and Southorn Development

Construction of the Modified Initial System in the late '70s required major traffic diversions during cut-and-cover tunnelling. The concept for the Island Line avoided this: tunnels under the road were all bored with their access shafts and passenger concourses being located 'off-street'. This was a much cleaner and quieter operation and, most

importantly, eliminated the need for traffic diversions. These sites were ripe for development and the integration of the 'over-build' and the railway concourses was a key element of the Island Line strategy.

The Wanchai Station development is a very deep basement with two tall buildings on top. It is 25m deep and supports a 44-storey block of flats and a 32-storey office tower. The basement was built 'top-down' using diaphragm wall, grouting, and bored pile technology, with large-scale geotechnical tests to establish soil stiffness and permeability.

The superstructures sit on a thick transfer plate which spreads the office and residential loading pattern to the grid of columns through the concourse below.

The station opened in 1985.

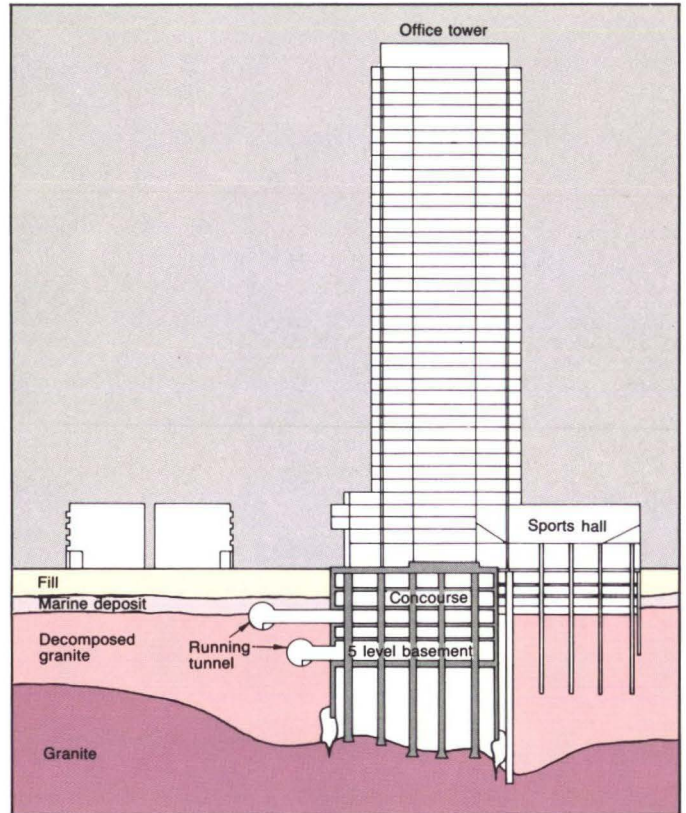


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1. Down to basement level 5, 25m below ground, top down construction under way
2. Topside development nearing completion
3. Cross-section
4. Temporary strutting for the diaphragm wall



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# Taikoo Shing Cityplaza 2

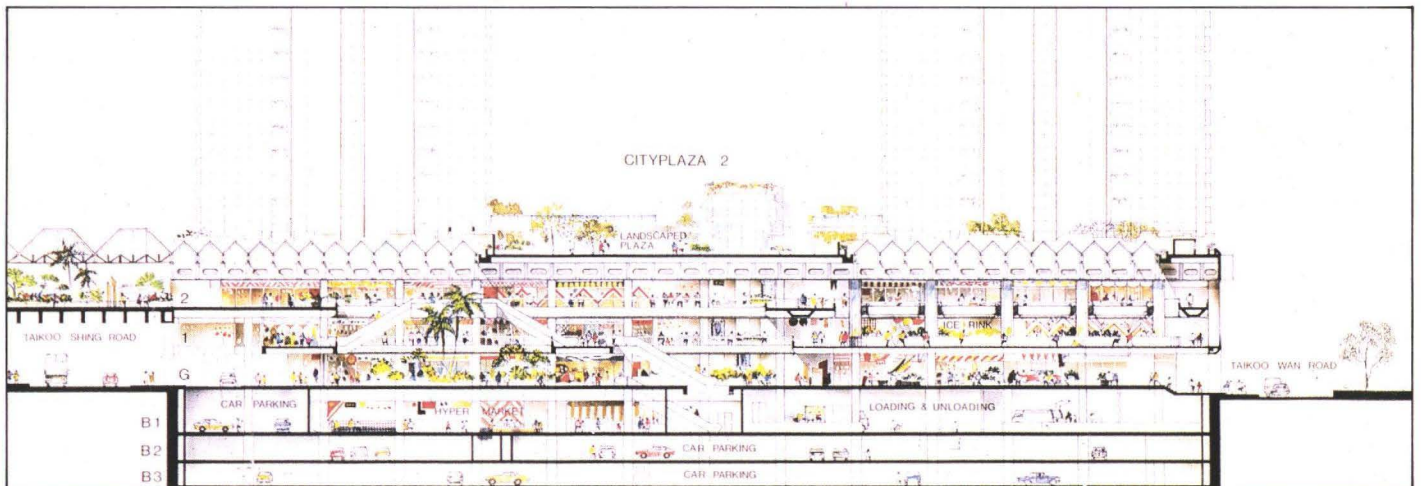
Cityplaza 2 is an attractive and successful shopping centre of 223 000m<sup>2</sup> gross area, with basement parking for some 1000 cars. It is located in one of Hong Kong's most popular residential areas overlooking the harbour and the airport.

There is much which makes this project especially 'Hong Kong'. The site is on reclaimed land within the former Taikoo Dockyard at Quarry Bay, easily accessible on the MTR Island Line and within a few minutes drive from Central along the Island Eastern Corridor. It is linked by air-conditioned bridges to the other retail and residential areas within Taikoo Shing, which is home to more than 60 000 people.

The basement was constructed top down in difficult ground and incorporates a permanent drainage underblanket.



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Nine residential blocks known as Horizon Gardens are supported on transfer plates above the shopping centre within a landscaped podium and were occupied in phases as the construction proceeded.

Elaborate fire services engineering has been incorporated and certain fire compartments are provided with an automatic fire detection system in addition to sprinklers. The basement areas include drencher and smoke extraction systems and the car park has an automatic control system linked to the fire alarms allowing visual instructions to be given to the public in the event of fire. The entire development was opened early in 1987.

1. View from the waterfront
2. Cross-section (Courtesy: Swire Properties Ltd.)
3. The link bridge over Taikoo Shing Road
4. Main entrance lobby
5. The atrium skylight
6. & 7. Views of the atrium
8. The ice rink



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# Tuen Mun Light Rail System

The population of Hong Kong has increased from 3.9 to 5.6 M within the last 15 years. A programme of new town development was initiated to absorb this increase and to provide modern housing for those living in temporary accommodation. Tuen Mun has a projected population of 1 M and is the most recent new town development in the New Territories.

It has been well planned with an efficient mix of transportation facilities that include the Light Rail Transit (LRT) System operating under priority conditions along a segregated reserve. The LRT will provide a comprehensive level of service in and around Tuen Mun with a link to the adjacent market town of Yuen Long.

The first phase of the system includes 23 km of double track, 40 stops, five termini, two transport interchanges, 11 rectifier stations, two primary substations, and a maintenance depot. We are providing civil, structural and building services design to the turnkey contractor and are also designing the residential towers over the depot podium, where 16 000 people will live in ten 43-storey blocks.

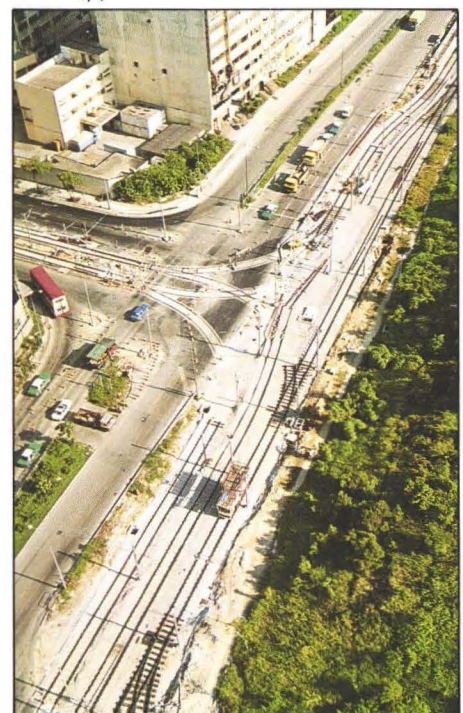
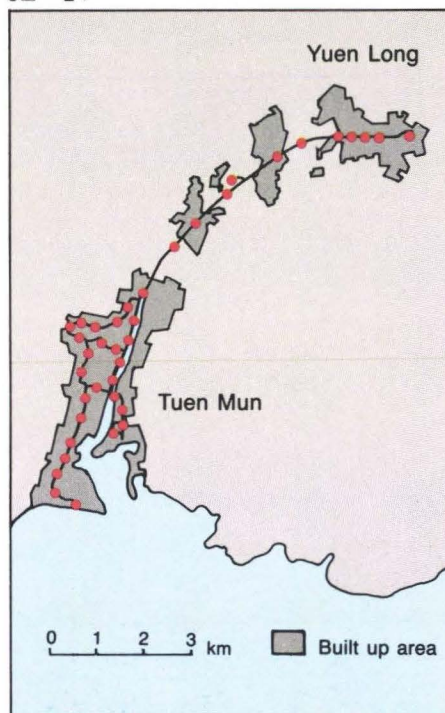
When the New Town is complete and the Light Rail vehicles are running at less than three minute headways, at speeds of up to 80 km/hour, the system will be operating close to its capacity. The system is planned to begin operation on 8.8.88, a most auspicious date on the Chinese calendar.



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1. Location map
2. Route map
3. Track laying through Melody Gardens Housing Estate
4. Road and rail junction at Tuen Mun (Photo: Leighton MTA)



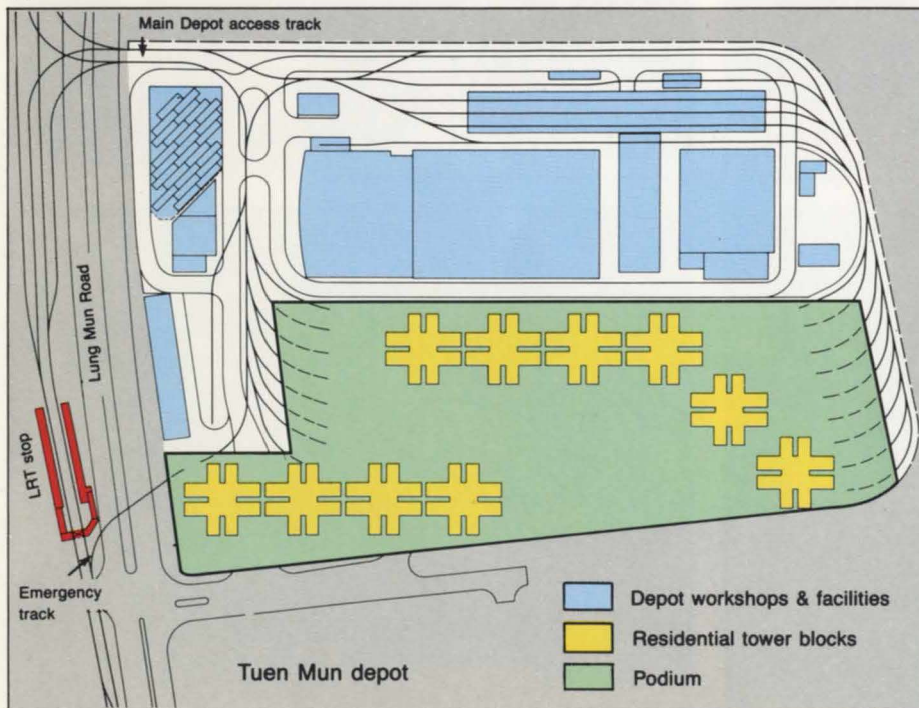


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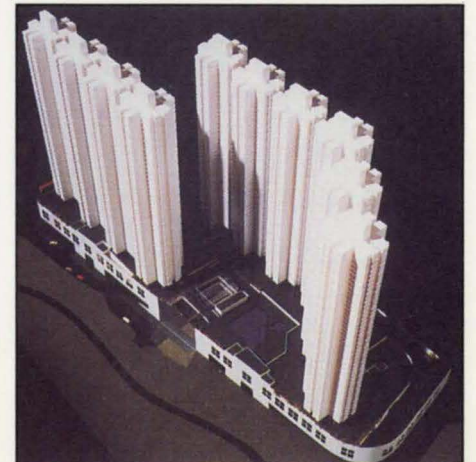


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5. The maintenance depot at Tuen Mun (Photo: Leighton MTA)
6. 'Stop' construction in progress
7. The first light rail vehicle leaves Australia (Photo: Leighton MTA)
8. Tuen Mun Depot & development layout
9. Model of the residential development above the depot (Photo: Ng Chun Man & Associates)

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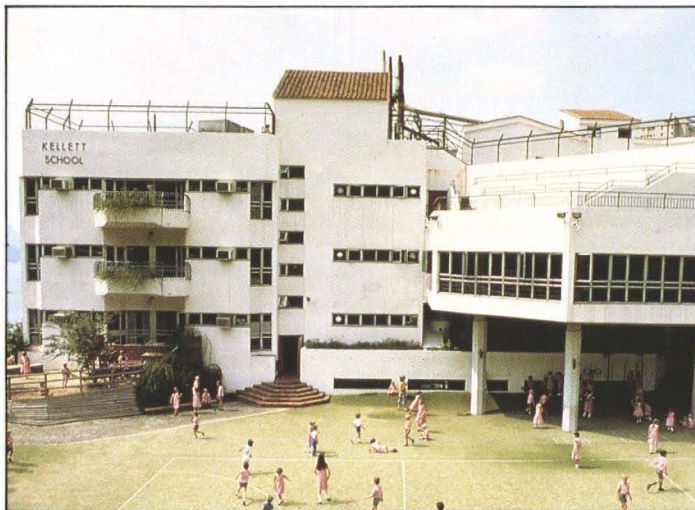


# A selection

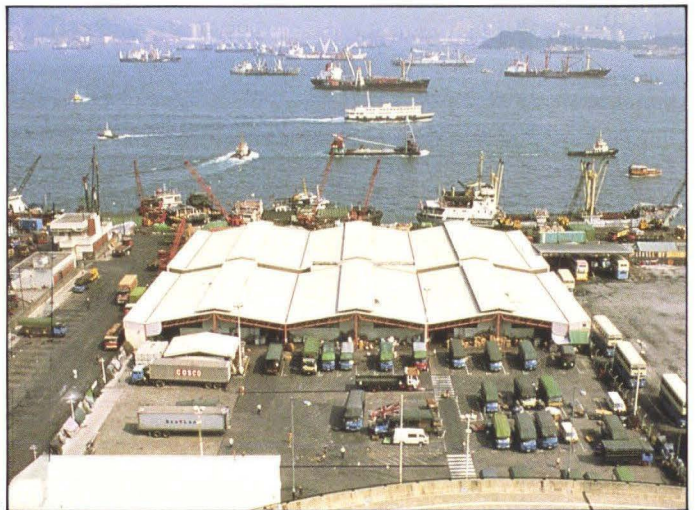
1. **Kohima Barracks** Site formation work on a 42 ha site in the New Territories. This will now be the site of the Hong Kong University of Science and Technology, a further Arup project. (Photo: Leighton Contractors Pty. Ltd.).
2. **Kellett School** A school for 400 pupils, designed and constructed within 12 months.
3. **Western Fruit Market** The re-siting of the fruit market in Western allowed the first tunnel access shaft to be sunk for the Island Line.
4. **Queen Mary Hospital** A 700-bed hospital in a 23-storey tower and six-storey podium.
5. **Treasury for the Hongkong & Shanghai Banking Corporation** This high security windowless building near Kai Tak International Airport provides the coin and bank note depository for the Hongkong Bank.
6. **Prince Philip Dental Teaching Hospital** 240 dental chair positions make this the largest dental teaching facility in Asia. The hospital is eight storeys high and has three basements.
7. **Flagstaff House** Conversion of the former residence of the Commander of British Forces into a museum.
8. **Swire Technologies Integrated Circuit Package Plant** The plant produces integrated circuit dies for the computer industry. The facilities incorporate 'Class 5000' clean rooms. (Photo: Neil Duncan).
9. **Tuen Mun Town Park** An 11 ha park providing recreational facilities for the New Town of Tuen Mun.
10. **Carlsberg Brewery** A brewery with an annual capacity of 400 000 hectolitres built on reclaimed land near Taipo in the New Territories. (Photo: Bong).
11. **Shatin Stables** Four additional two-storey stable blocks constructed at the Racecourse at Shatin in the New Territories.
12. **Hong Kong Country Club** Refurbishment and upgrading of the club's main service installations. (Photo: Hans Lindberg Design Ltd.).
13. **Hong Kong China Jetty** An alternative design for the Contractor of the new jetty in Tsim Sha Tsui, Kowloon (Photo: Franki Kier).



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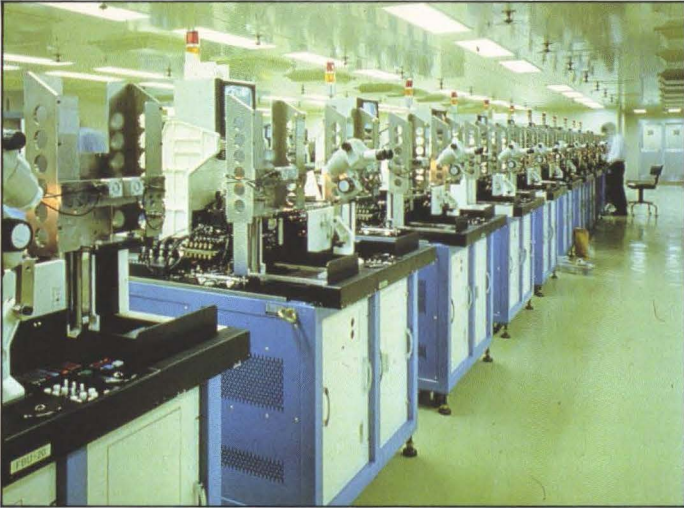
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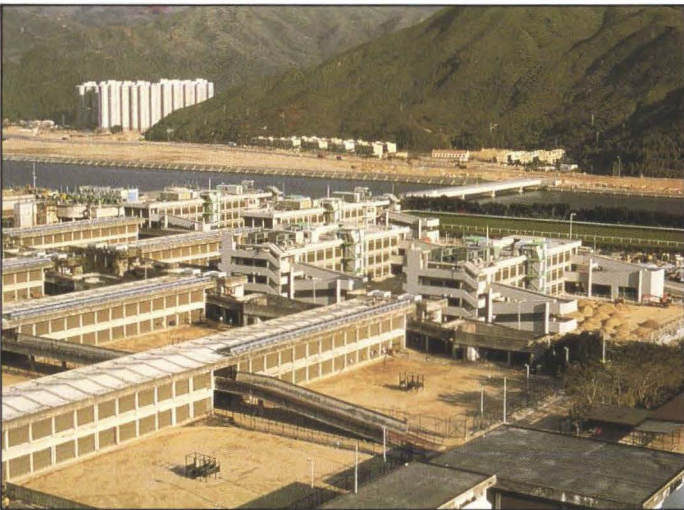
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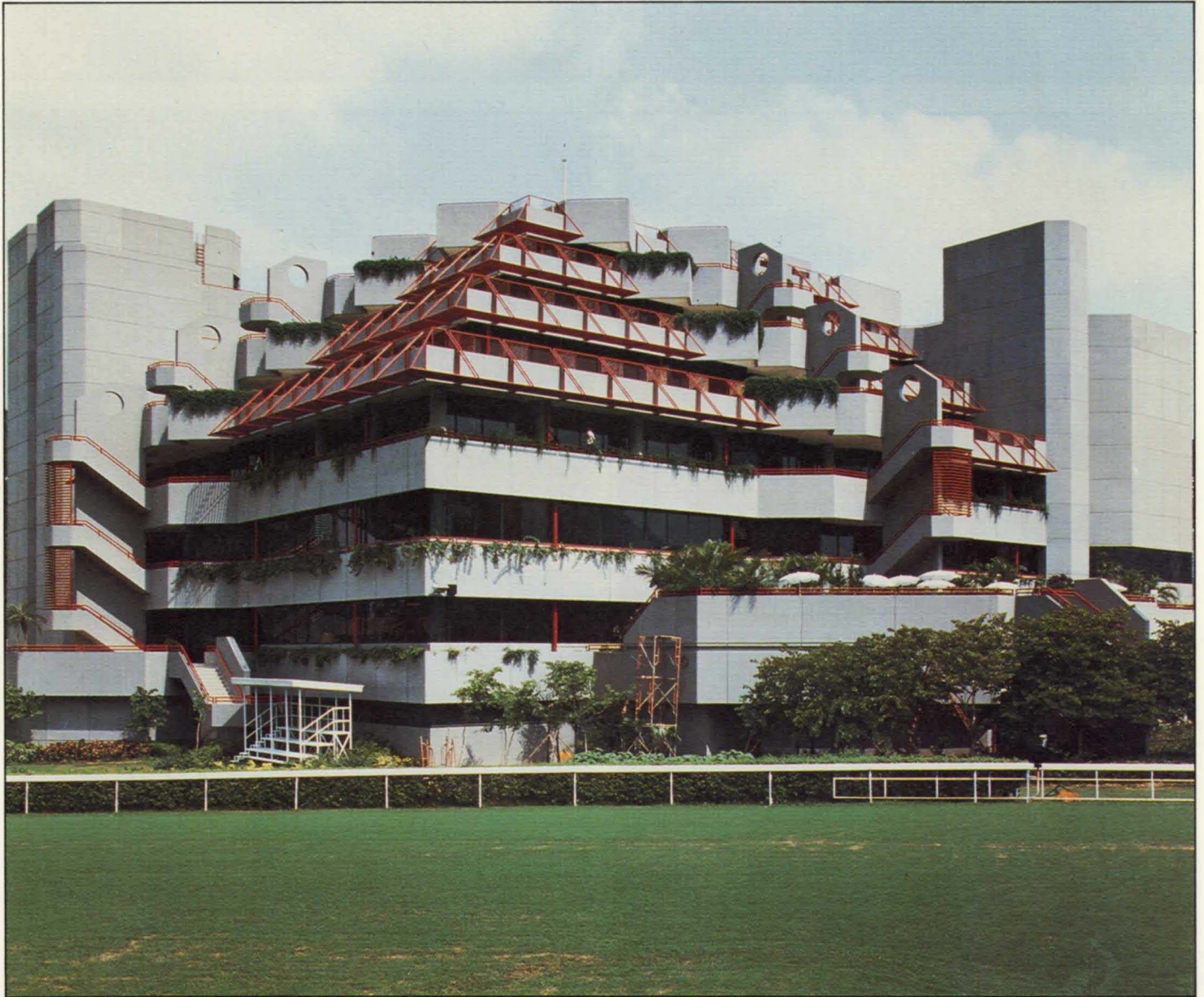
# The Members' Clubhouse, Royal Hong Kong Jockey Club, Shatin

The Jockey Club is one of the most influential institutions in Hong Kong. It organizes horse racing at two of the world's most sophisticated race tracks. From the outset, the Members' Clubhouse at the Shatin racecourse was intended to be a very special building.

The Club provides superb dining and sports facilities for its members, indoor and outdoor swimming pools, viewing galleries overlooking the race track, easy parking (a luxury for racing enthusiasts), and a tele-betting theatre which enables members to watch live transmission of racing anywhere in the world and place bets simultaneously.

We were required to design a building services installation capable of providing the highest quality environment, while keeping operating costs to a minimum, with an energy system linked into the grandstand and race track development.

Construction began in the summer of 1983 and the Clubhouse opened to its members in April 1985. This has resulted in the creation of a delightful and extremely comfortable building, for which the architects, Prescott & Partners, received the Hong Kong Institute of Architects Silver Medal Award in 1986.



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1. View of the Clubhouse across the race track
2. The entrance foyer
3. The tele-betting theatre
4. The European restaurant
5. The swimming pool
6. The kitchens
7. The main plantroom

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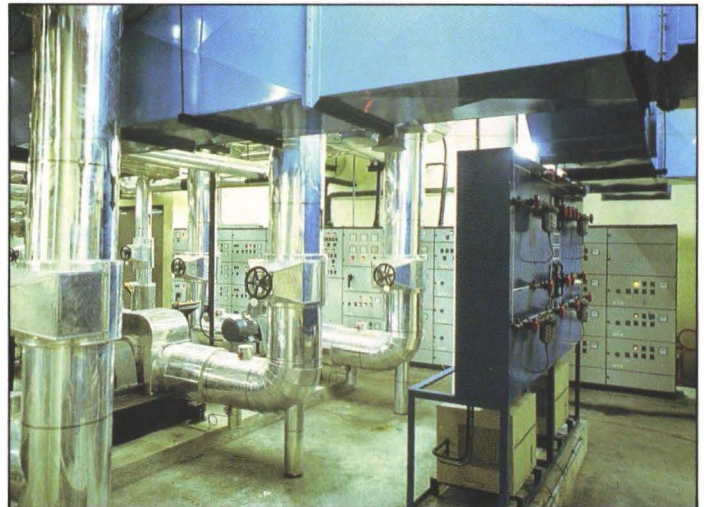
(Photos: Neil Duncan)



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# The Hong Kong Air Cargo Terminal

More than a quarter of the value of all Hong Kong's external trade now passes through this terminal, which handles more air cargo than any other single terminal in the world.

Our first appointment in 1983 was to double the annual capacity of the original terminal to 680 000 tonnes; this first expansion was completed within budget and on programme 18 months later.

Subsequent appointments for substantial alteration work to the original terminal involved major structural surgery to accommodate automated handling systems which further enhanced capacity.

It has now become apparent that saturation will soon be reached again, and outline proposals are well advanced for a second terminal on an adjoining site. This will increase overall capacity to 1 200 000 tonnes, and Terminal 2 is scheduled to be operational by October 1990.

1. and 2. Storage & handling facilities
  3. Access ramps
  4. The terminal fully operational, serving five 747s
- (Photos: HACTL)



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# Shajiao 'B' Power Station

Much of the work shown in this special issue of *The Arup Journal* is well-known simply because it is seen or used daily by the Hong Kong public.

It is unfortunate that some of our best engineering will only be appreciated by technical people operating the Shajiao 'B' power station. Fewer still will realise that the project was completed at such remarkable speed.

The People's Republic of China began to implement the 'Four Modernizations Programme' in 1978. Since then, Guangdong Province has experienced rapid industrial development which has created a severe shortage of electrical power. With a population of 62 M and a per capita generating capacity less than one tenth of the United Kingdom, this is now a priority in the provincial government's planning.

To help meet the increasing demand, a network of coal-fired power stations is being constructed at Shajiao on the east bank of the Pearl River estuary, 80km from Hong Kong. A joint venture between Hong Kong and PRC parties has undertaken the design,

construction and operation of the two 350 MW units for the Shajiao 'B' Power Station.

The statistics speak for themselves: 1.5 M m<sup>3</sup> of rock excavation; 23 ha of reclamation; 1500m of seawall; 3500 tonnes of structural steelwork; a 210m chimney slipformed in 45 days; a berthing jetty, 1100m offshore; 2km of cooling water culverts, including 700m to the offshore intake; and 22 ancillary buildings.

Site preparation began in 1985, followed by an astounding 22-month construction, testing and commissioning period.

To complete a project of this size would be a notable achievement on home territory, let alone at a remote site in the People's Republic of China.



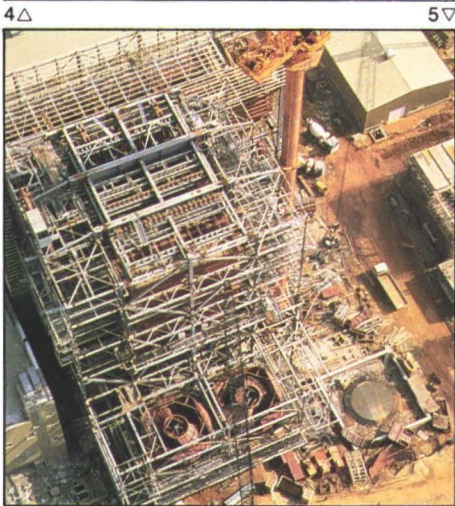
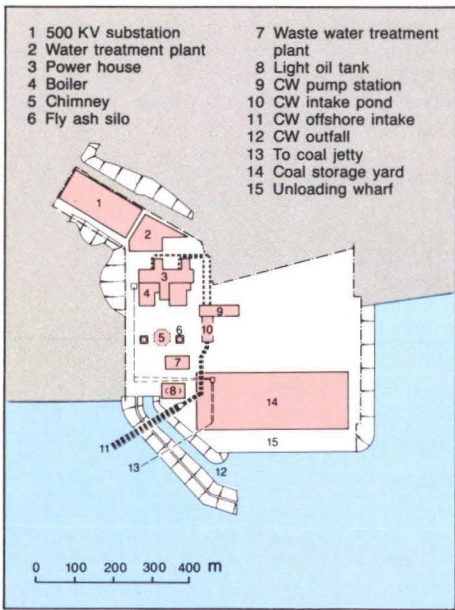
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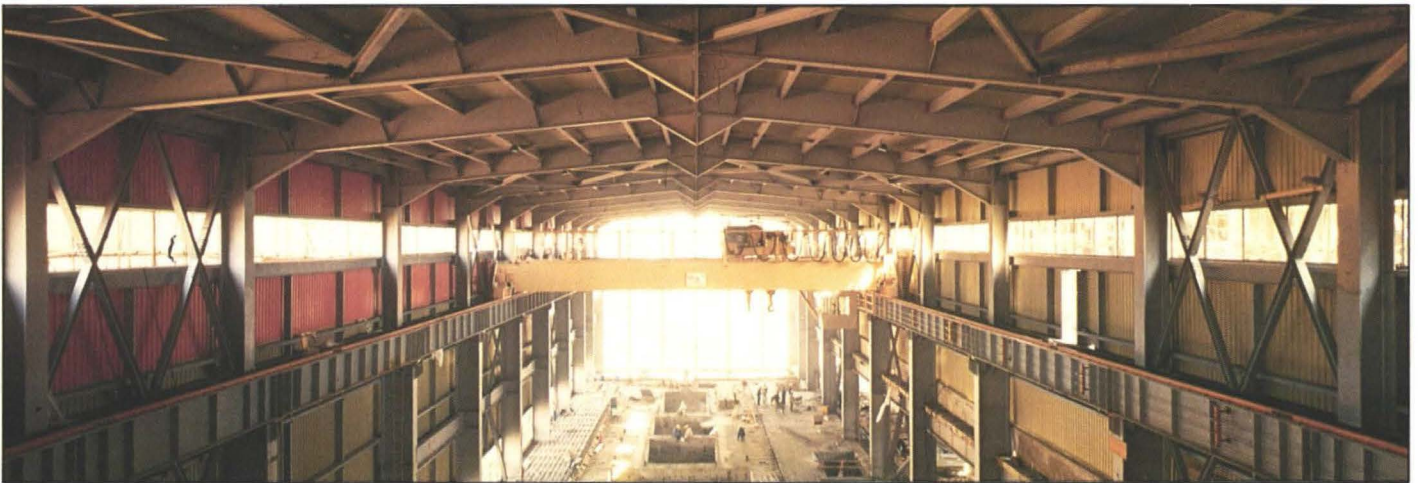




- 4. Site layout
- 5. Boiler house steelwork
- 6. Aerial view of the generation plant
- 7. View across the site
- 8. The jetty access arm
- 9. Inside the turbine hall

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(Photos: 5 to 7, 9: Neil Duncan)



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# Superhighway

Construction work has already started on China's first 'Superhighway' linking the Shenzhen Special Economic Zone with the provincial capital, Guangzhou, some 140km to the northwest. At present, passenger and freight movements between the two urban areas (with a combined population of around 10 M) are served by only one twin-track railway and a single carriageway road.

The project, which is estimated to cost US\$500 M, is the first phase of a network of 'superhighways' planned for the province. The work involves a 30-year co-operative

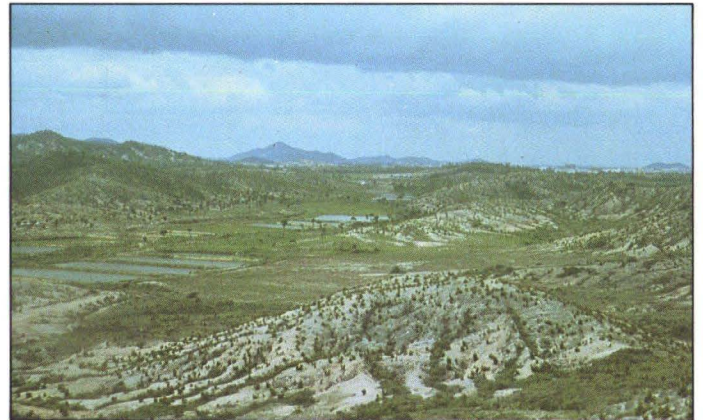
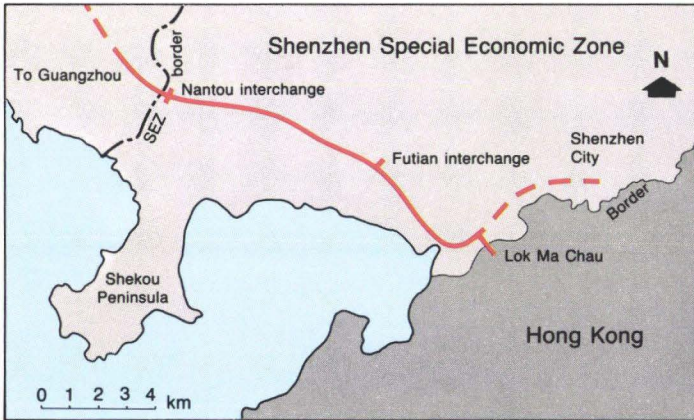
joint venture between Hopewell China Development (Superhighway) Ltd and the Guangdong Provincial Highway Construction Company. Revenue will be generated by collecting tolls on most highway sections.

Since an unusually high proportion of the total traffic flow on the existing road is buses and coaches, for the Superhighway to attract revenue it must cater for public transport. In particular, interchanges and intersections must be laid out to provide convenient transfer of passengers between the main and local bus services.

We are responsible for the detailed design of the works within the Shenzhen Economic Zone in conjunction with the local Chinese

design institute. This section, which is about 20km long, consists of a dual three-lane motorway with grade-separated interchanges and more than 20 bridges. We are also advising the turnkey contractor on the remaining sections of the highway to Guangzhou.

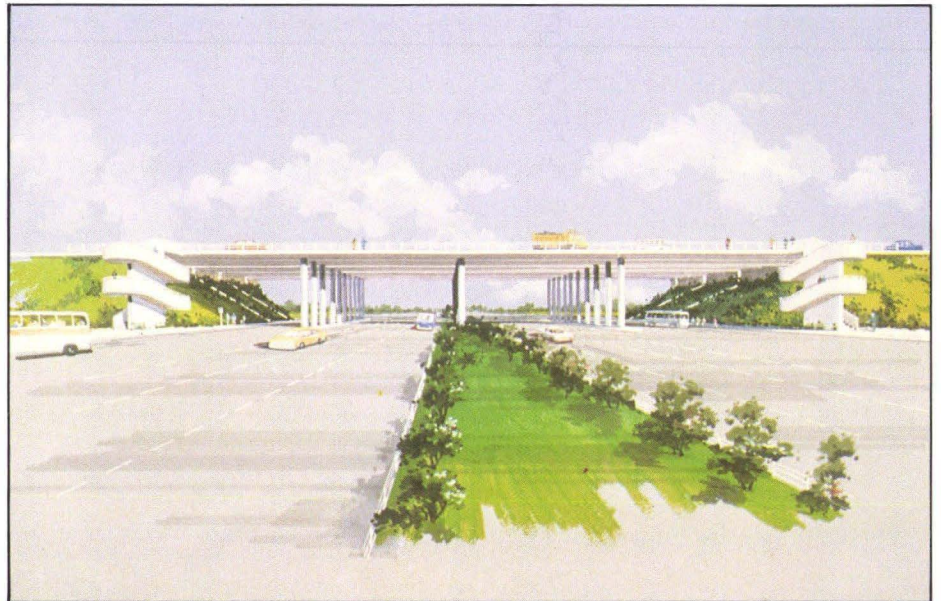
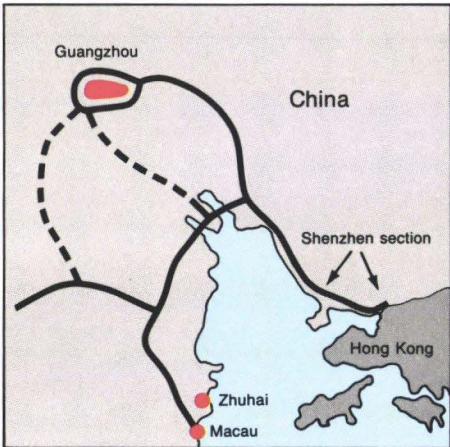
Scheme design began in early 1985 and progress has accelerated over recent months and several sub-contractors have now been appointed to carry out the earthmoving operations in the Shenzhen Section. The first phase of the Superhighway network, linking Hong Kong to Guangzhou, is due to be opened before the end of the decade.



1△ 2▽

4△

5▽



1. Route Map of the Shenzhen Section
2. The proposed Superhighway network
3. View of Shenzhen City across fishponds
4. Landscape close to Nantou
5. Typical underbridge

3▽



# The Shanghai Hilton International Hotel

Shanghai presents very difficult design criteria. The city lies in an active seismic zone; its latitude is sufficiently southerly for it to suffer from typhoons in summer, but it also has to endure the freezing northern



1△

airstream in winter. Deep alluvial clay deposits laid down by the Yangtse River provide difficult conditions for foundations and basements. The logistics of working in different cultural and political systems, with variable sources of material supply, to a variety of design standards and codes of practice were not to be underestimated, as this project represented our first job in the People's Republic of China.

The site lies close to the city's main east-west arteries in a pleasant part of the old French concession. The tower is 42 storeys high, and with a five-storey podium and basement over the entire site, provides facilities appropriate to this five star, 800 bedroom hotel.

The design philosophy for the main tower was to obtain the best compromise between opposing design criteria: of mass and stiffness for seismic loading; of local and off-shore materials, for project financing; and of cost and programme; all within the constraints of hotel management and architectural planning. An external structural steel frame with composite floors provided a fast lightweight solution. Together with curtain walling, power-floated floors, and dry wall partitions, major reductions in building weight were achieved with immediate advantages in seismic loading and foundation

costs. An in situ reinforced concrete core was constructed with a climbing shutter. Although heavier, this provided the necessary stiffness and was proven to be significantly more economical than an imported structural steel equivalent. Outriggers at the mechanical floor level helped to shed bending moments in the core to the peripheral columns. These reduced the core wall thicknesses, saving weight, reducing seismic loads, and foundation costs.

Foundations and excavation presented special difficulties. A piled raft with steel pipe piles driven into a sand layer 40m below ground gave the best compromise between foundation cost and settlement of the tower. A careful excavation and shoring system was designed to minimize ground movements and damage to adjacent buildings.

Design and construction began in 1984 and the hotel opened in December 1987. The project is widely regarded as one of the most successful hotel developments in China and is a major landmark on the Shanghai skyline.

1. Location map

2-3. The hotel under construction

4. View from gardens of Jing An Guest House



2△

3▽



4▽



# China Sun Lube Oil Plant

This is our first industrial engineering project for the oil industry in China. Sun Oil of USA and Sinopec, the Chinese State Petroleum Corporation, joined forces to construct this oil blending and packing plant at Shekou in Shenzhen.

Our work covered the design of all architectural, civil and structural elements; electrical, mechanical and fire services; tanks and process equipment including pipework distribution and pumps, steam and compressed air systems.

The plant has an annual capacity of 50 000 tonnes. The final products are pumped to filling lines which can handle a range of containers from 200 litre drums to 1 litre plastic bottles. Design and construction took less than one year and the plant has been fully operational since December 1985.



1. Location map
2. Oil storage tanks
3. The factory and office building
4. The oil blending tanks



3△

4▽





# Republic of Korea

Deep excavation techniques using diaphragm walls are now being implemented most successfully in the Republic of Korea. These photographs illustrate basement projects under construction to date.

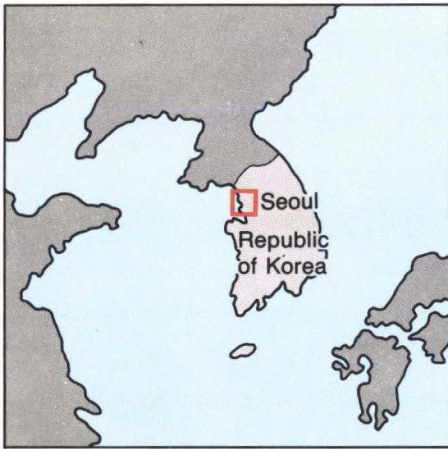
At Da Dong we collaborated with a Korean consulting practice to provide a basement design using diaphragm walls and drilled piles, and assisted the contractor in the construction of the first top-down basement in Korea.

At Yongdongpo Post Office and Lotte Jamsil we provided diaphragm wall designs with detailed construction systems for ground-water control and excavation.



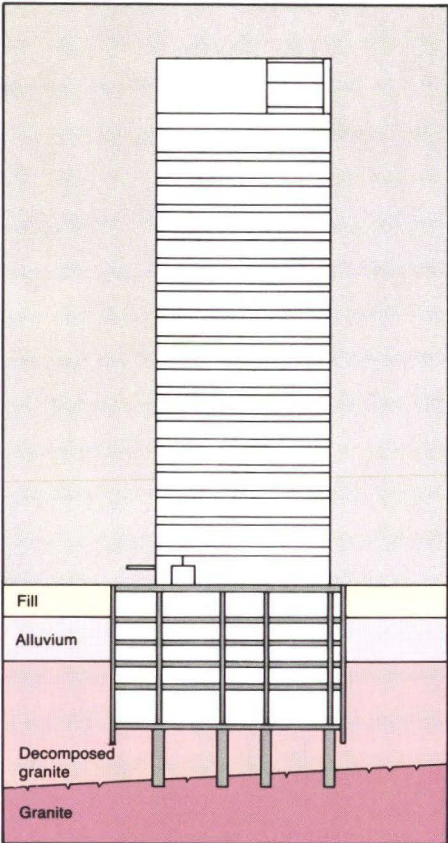
3△

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1△

1. Location map
2. Da Dong Development, Seoul
3. Lotte Jamsil Project, Seoul
4. Yongdongpo Post Office, Seoul



2△

# Indonesia

The Indonesian archipelago stretches from west of Malaysia to east of Darwin. It is the world's fifth most populous country.

We have assisted our Indonesian colleagues on many infrastructure and building projects and we are currently designing a large shopping development in the centre of Jakarta.



1△

2▽



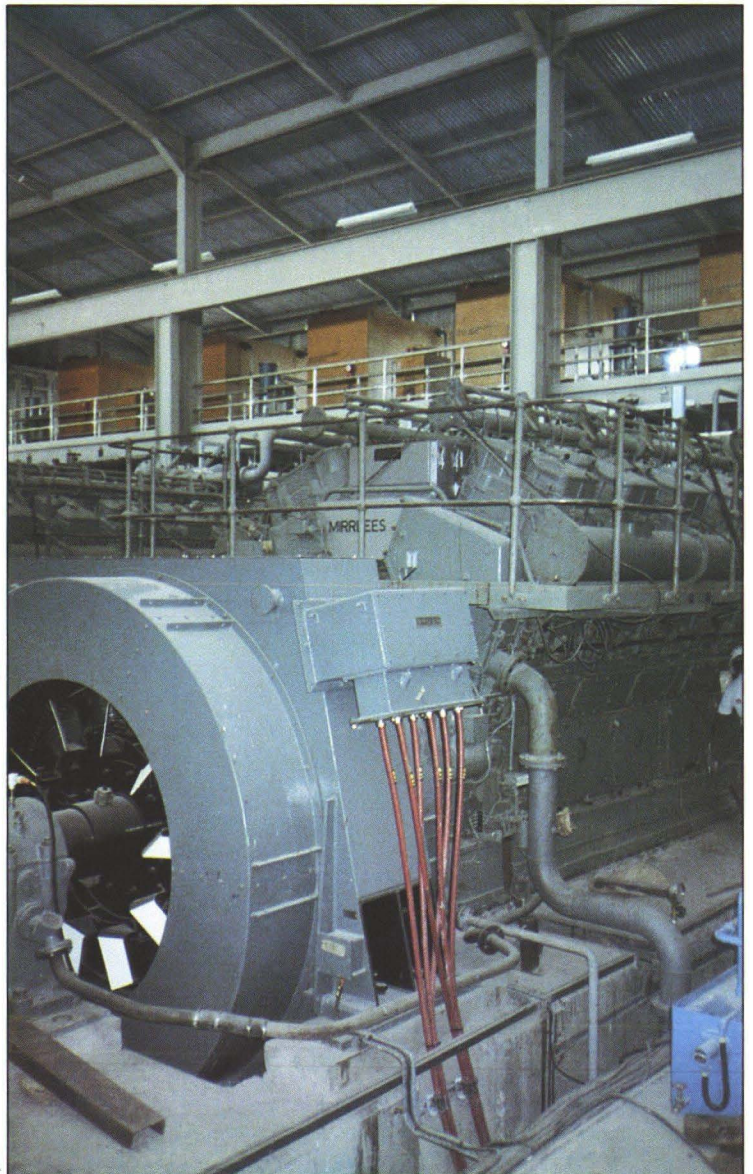
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1. Location map
2. Pulan Boelan earth fill dam
3. Site of Plaza Bandung Zudha
4. Cileungsi factories gas supply
- 5-6. PLN scattered diesel generating stations



4△



5△



6▽

# Hongkong Bank

The winter 1985 issue of *The Arup Journal* was devoted to this remarkable project, which is now complete. (Photo: Ian Lambot)



## Credits

- Exchange Square** Client Hongkong Land Property Co. Ltd. *Architect* P & T Architects & Engineers HK *Main contractor* Gammon Building Construction Ltd.
- Hopewell Centre** Client Hopewell Holdings *Architect* Gordon Wu & Associates *Main contractor* Hopewell Construction Ltd.
- Central & Admiralty Stations** Client & main contractor Metro Joint Venture.
- Tsuen Wan Depot & Station** Client Mass Transit Railway Corporation *Architect* Taoho Design *Main contractor* Dragages et Travaux Publics.
- Luk Yeung Sun Chuen Development** Client Luk Yeung Sun Chuen *Architect* Choa Ko & Partners in association with Lee & Zee Associates *Main contractor* John Lok & Partners.
- Telford Gardens** Client Telford Development Ltd. *Architect* Hsin Yieh Architects & Associates *Main contractor* Hopewell Construction Ltd.
- Tai Ho Road Flyover** Client & main contractor Dragages et Travaux Publics.
- Lai King to Kwai Hing Viaduct** Client & main contractor Dragages et Travaux Publics.
- Wanchai Station Concourse** Client Mass Transit Railway Corporation *Architect* YRM International Andrew Lee King Fun & Associates *Main contractor* Bachy Soletanche Dragages Joint Venture.
- Southern Development** Client Hang Lung (Real Estate Agencies) Ltd. *Architect* Wong & Ouyang (HK) Ltd. *Main contractor* Hip Hing Construction Co. Ltd.
- Chai Wan Depot** Client Mass Transit Railway Corp. *Architect* Mass Transit Railway Corporation *Main contractor* Marples Ridgway/Harbour Engineering Aoki Tobishima Joint Venture.
- Heng Fa Chuen Development** Client Heng Fa Chuen Development Ltd. *Architect* Simon Kwan & Associates *Main contractor* Carson Construction Ltd.
- Taikoo Shing Cityplaza 2** Client Swire Properties Ltd. *Architect* Wong Tung & Partners *Main contractor* Gammon Building Construction Ltd.
- Tuen Mun Light Rail Transit System** Client & main contractor Leighton MTA Consortium *Architect* DCM Yuncken Freeman Hong Kong Ltd. *Main contractor* Leighton MTA Consortium Henry Boot International (Permanent Way).
- LRT Development** Client Sun Hung Kai Properties Ltd. *Architect* Ng Chun Man & Associates.
- Kohima Barracks** Client & Architect Hong Kong Government *Main contractor* Leighton Contractors (Pty) Ltd.
- Kellett School** Client Kellett School Association *Architect* Concept Consultants *Main contractor* Yeung Fat Const. Co. Ltd.
- Western Fruit Market** Client Hong Kong Government *Architect* YRM International *Main contractor* Ahong Const. Co. (HK) Ltd.
- Queen Mary Hospital** Client Hong Kong Government *Architect* Llewelyn-Davies Weeks, Hong Kong *Main contractor* Shimizu Construction Co. Ltd.
- New Main Treasury for the Hongkong & Shanghai Banking Corporation** Client H S Property Management Ltd. *Architect* YRM International *Main contractor* Shui On Construction Co. Ltd.
- Prince Philip Dental Hospital** Client Hong Kong Government *Architect* YRM International *Main contractor* Paul Y Construction Co. Ltd.
- Flagstaff House Museum of Teaware** Client Hong Kong Government *Architect* EBC Hong Kong.
- Swire Technologies Integrated Circuit Package Plant** Client Swire Technologies Ltd. *Architect* Llewelyn-Davies Weeks, Hong Kong *Main contractor & project management* Swire-Haden Ltd.
- Tuen Mun Town Park** Client Hong Kong Government *Architect* EBC (Hong Kong) *Main contractor* China Construction Engineering Corporation Wing Mou Construction Co. Ltd. Shun Shing Construction & Engineering Co. Ltd.
- Carlsberg Brewery** Client Carlsberg Brewery Hong Kong Ltd. *Architect* Anders Helsterd (APS) Copenhagen YRM International *Main contractor* Paul Y Construction Co. Ltd.
- Shatin Stables** Client Royal Hong Kong Jockey Club *Architect* Leigh & Orange *Main contractor* Gammon Building Const. Ltd.
- Hong Kong Country Club** Client Hong Kong Country Club *Architect* Prescott & Partners/Design Group.
- China-Hong Kong Terminal** Client & main contractor Franki contractors Ltd. *Architect* Wong & Ouyang & Associates (HK) Ltd.
- The Members Clubhouse, Royal Hong Kong Jockey Club, Shatin** Client The Royal Hong Kong Jockey Club *Architect* Prescott & Partners/Design Group *Main contractor* Shui On Const. Co. Ltd.
- Air Cargo Terminal Extension, Kai Tak Airport** Client Hong Kong Air Cargo Terminals Ltd. *Architect* Breier, Neidle Patrone Associates *Main contractor* Gammon Building Construction Ltd.
- Shajiao 'B' Power Station** Client Hopewell Power (China) Ltd. *Architect* DCM Yuncken Freeman Hong Kong *Main contractor* Slipform Engineering Ltd.
- Superhighway** Client & main contractor G-S-Z Superhighway Project Turnkey Consortium.
- The Shanghai Hilton International Hotel** Client Cindic Consultants Ltd. *Architect* AP Architects *Main contractor* Shanghai Hong Kong Constructions & Engineering Co. Ltd.
- China Sun Oil Blending & Packaging Plant** Client China Sun Oil Co. Inc. *Main contractor* (Project Managers) GBC Management Services Ltd.
- Da Dong Development, Seoul** Client Lucky Goldstar Co. *Architect* Chahng-Jo *Main contractor* Lucky Development Co. Ltd.
- Yongdongpo Post Office, Seoul** Client Icos-Korea Inc.
- Lotte Jamsil Project, Seoul** Client Hotel Lotte Co. Ltd. *Main contractor* Lotte Construction Co. Ltd.
- Pulau Boelan Earthfill Dam** Client & main contractor PT Balfour Beatty Sakti, Indonesia.
- Cileungsi Factories Gas Supply, West Java** Client PT Arya Upaya Corporation *Main contractor* PT Gloria Electro Perdama.
- Plaza Bandung, Indah** Client PT Bandung, Indah Plaza, Permai *Architect* Nihon Architects.
- PLN Scattered Diesel Generating Stations** Client PT Balfour Beatty, Sakti, Indonesia.
- Hongkong Bank** Client The Hongkong & Shanghai Banking Corporation *Architect* Foster Associates *Management contractor* John Lok Wimpey Joint Venture.

