**Title of Talk:**
An overview of various types of construction operations as an introduction to operatives involved in the construction related industries

**The talk aims** to allow audience to understand more about the following targets related:
- What kind of infrastructure projects are undergoing in HK during the recent years.
- What are the engineering or technical features of these kinds of projects.
- The complexity of these projects in terms of the procurement process, scale of work, construction planning, resources handling and other multi-disciplinary concerns.
- The use of technology in the construction process.
- The concerns of safety in the work process.

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### Engineering/Technical features of Construction Projects

1. Excavation/rock cutting works
2. Slope works
3. Foundation works
4. Falsework (including work platform, scaffolding and other temporary work erection)
5. Formwork
6. In-situ and precast construction
7. Structural steel works
8. super-highrise construction
9. Long-span construction
10. Heavy lifting and fixing/erection works
11. Landfilling and reclamation
12. Tunneling works
13. Construction of Bridged
14. Demolition and dismantling works
15. Building services/E & M installations

### Classification of Construction works in general

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Large scale cutting in the 1790s – Tuen Mun Highway at Ting Kau

Major slope cutting for the forming of the North Lautau Expressway as viewed in 1995
Land formation for the connection between Ting Kau Bridge and Tai Lam Tunnel (Route 3)

Some of the mechanical equipment used in the Route 3 project for slope cutting/land formation
Forming of the new town of Tseung Kwan O (Tiu Keng Leng)
Large scale slope cutting for the Castle Peak Road Improvement projects

The use of blasting and splitting method to cut the rock
Forming the tunnel portal for Nam Wan Tunnel at Tsing Yi (from Stonecutters Bridge)
Aerial view of the Express Rail Terminal at West Kowloon in 2011

The terminus site (south) as seen in mid 2012

Express Rail Terminal Site at West Kowloon (November 2011)

Overview of site as in August 2012
Forming the Ho Man Tin Station by rock cutting (August 2012)
November 2013

Slope work for highway projects, the Tuen Mun Highway Improvement Works

Foundation Works
Types of pile according to their operation

Basic pile type
- Displacement piles
  - Cast in-situ
    - Require permanent casing
    - Require temporary casing
  - Pre-formed
    - Precast concrete
- Replacement piles
  - Supported during operation
    - Require permanent casing
    - Require temporary support
  - No support
- Temporary casing
- Support by drilling liquid

Displacement piles
- Pre-formed

Replacement piles
- Supported during operation
- No support

Piles formed by percussion methods
- H-pile driven using gravity drop hammer
- Precast circular-section pile driven by diesel hammer

Steel H-pile as foundation

Forming of bore-pile as foundation
Piles formed by mechanical methods (e.g. bored piles of various kinds)

- Small dia. pile formed using boring rig and drill
- Medium dia. pile formed using bucket barrel
- Large dia. Pile formed by reverse circulation drill

Foundation using bored piles (Manual-dug method – Caisson)

- Hand-dug caisson working in sloped site

Foundation using bored piles (formed by chisel and grab and support with casing)

- Hose for supply of compress air for power tools
- Electric cable for lamp and water pump
- Tremie pipe for concreting
- Hose for pumping up of ground water

Working inside a caisson

Various forms of grab
Foundation using bored piles
(formed by chisel and grab and support with casing)

Various forms of chisel (for rock breaking)

The drilling process

Drilling rod and the auger head

Placing the drill rod into the bore hole with the RCD rig tilted to give way

The set-up – RCD rig, serving crane and spoil separating tank

Besides foundation, the sub-structure part of a building is also an important part of the building structure supporting a building.

Bored pile formed by Reverse Circulation Drilling (RCD) method

Operation details of a RCD plant

Besides foundation, the sub-structure part of a building is also an important part of the building structure supporting a building.

Other example for sub-structure works – City University new Administration Building
Other example for sub-structure works – City University new Administration Building

Ground beam details

Falsework and Temporary Works
External scaffold as work platform/safety screen for general building renovation work

Falsework to support the construction of a portal beam for the Route 8 Truck Road at Butterfly Valley

The falsework set-up as seen from the from the storm water discharge nulah
Temporary driveway-work platform for the Tuen Mun Highway Widening project

Work platform for sloped/confined sites

Falsework to support the large span roof truss of the Express Rail Terminus at West Kowloon

Temporary falsework to assist the erection of the roof truss
Temporary access way over water

Work platform in very congested site

Work platform in very congested site
Formwork

Large area of falsework forming part of the floor formwork

Typical set for a large-scale project using traditional timber formwork
Overview of the tower blocks seated on the transfer plate above the gigantic podium structure. Note the complicated spatial environment especially the working height in this job.

Superstructure
- irregularity in layout
- complicated architectural features in external envelops
- large amount of short-span slabs
- large amount of shear walls in the structure
- use of manually operated timber panel forms

Formwork in reality - in typical site environment

Examples of steel form in the form of large panel shutters
Using table form for slab

Table form for the flat slab structure
Floor formwork using manual system (propped small panels)

General detail of the aluminium form – stair

Detail of a typical aluminum formwork system for apartment-type building

Climb form operated by the use of a series of synchronized hydraulic jack systems
Formwork at its opened mold

Arrangement for the core wall and floor formwork

Traveling form for the forming of the passenger access linking the Airport Terminal Building and the Ground Transportation Center
The roof portion above column head that formed using normal soffit panel supported by props.

Gantry form/tunnel form system for the construction of station facilities.

Formwork Collapse Cases – The Festival Walk

Formwork Collapse Cases - Industrial Building in Kwai Fook Rord, Kwai Chung, 1995
Precast Construction

First generation of Harmony Block using after-fix façade

Later version of Harmony Block using in situ façade cast at the same time with structural walls
Mechanical formwork systems incorporating the standard precast elements in the construction of latest version of public houses in the late 1990 (the Concord design)

Formwork in the casting yard for the casting of the precast units
Precast elements required huge amount of space as handling and storage area. The construction of the Headquarter and Members Facilities Complex for the Hong Kong Jockey Club.

Other examples of using large amount of precast elements – Headquarters Building of the HK Jockey Club.
Other examples of using large amount of precast elements – Government staff quarters in West Kowloon near Nam Chong Station

Features in the construction – extensive use of precast façade and lintel beams, precast cast-in-situ internal partitions are also introduced.

Residential Development at Taikoo Valley (2003)
Residential development at Cyber Port (2003)

Detail of the precast balcony unit

Façade and general installation details

Incorporation of other sophisticated formwork in construction – steel gang form for walls and table form for floor
Another hotel project owned by Cheung Kong in Hung Hom Bay just next to the other one

Private residential development at Tuen Mun (2006)
Private residential development at Tuen Mun (2006)

Residential redevelopment in Kowloon City
Precast façade with finished tile work


Placing the secondary beams onto the main beam

Cruise Terminal at Kai Tak
Structural Steel Works
and
High-rise Construction

The Center

Redevelopment of the Lee Gardens Hotel – The Manulife Tower
Redevelopment of the Hilton Hotel – Cheung Kong Center

International Finance Center Tower 2

International Finance Center Tower 1 – RC core + RC perimeter columns configuration up to 23/F, 23/F to 38/F becomes a composite structure with columns & slabs in steel

IFC 2 – structural configuration of the tower with the first set of Transfer/Belt Truss on 6/F, mega-columns, edge beams, floor deck, and the RC core
The Jump form being used in the construction of the core wall for the Cheung Kong Center

Climb form system for the construction of the core wall for the Manulift Tower’s superstructure

External steel column being erected & tied back onto core wall by steel beams

The popular use of structural steel in construction other than in HK – the case in Las Vegas, USA, 2008
The popular use of structural steel in construction – the case in Guangzhou
International Finance Centre

Guangzhou Opera House, 2009

The popular use of structural steel in construction – the case in Guangzhou
Museum, (2009)

The popular use of structural steel in construction – the case in Guangzhou
Opera House, 2009
Long-span Construction, Heavy Lifting and Heavy Fixing/Erection Works
The Hong Kong coliseum

Cultural Center and Space Museum

The Hong Kong Stadium
Member Centre of the Hong Kong Jockey Club

Span about 25m

Actual Example –
Headquarter Building, Hong Kong $ Shanghai Bank
Actual Example –
The Skylight structure of Festival Walk

Other long-span spaces within Festival Walk constructed using in-situ method
Other long-span spaces within Festival Walk – the public bus terminus

The New Hong Kong International Airport at Chek Lap Kok

The Hanger structure for HK Aircraft Engineering Company Ltd. (HAECO) at Chek Lap Kok Airport
Hanger structure for HK Aircraft Engineering Company Ltd. (HAECO) at Chek Lap Kok Airport

Linking structure between the International Finance Center Phase I and II
Hong Kong Convention and Exhibition Centre

The deck and roof structure of the HK Convention and Exhibition Centre

Hoisting of the 80m-span roof truss

Placing of the roof truss at the top of the core wall
Linking structure between Phase I and II of the HK Convention and Exhibition Centre

Extension to HK Convention and Exhibition Centre
Lifting and erecting of the link bridge between IFC 1 & 2

The link bridge as seen in 2014

The Sky Dome, Cyber Port
The Sky Dome, Cyber Port
Canopy for the New Stand/Race-practicing Court for the HK Jockey Club
The Grand Atrium in Langham Mall
The roof structure of Langham Place – Shopping Mall
New Lisbon Casino.
Macau

New Lisbon, the hotel tower
Sport ground in Tseung Kwan O

Lifting of the 45m precast beam for the Cruise Terminal project
Lifting and erection of the modulated roof deck for the Border Check-point for the HK-Zhuhai-Macao Bridge

Close up to see the setting up of the sliding arrangement for the modulated roof deck

Formation of the Shatin New Town in the late 1970s

Landfilling and Reclamation
Formation of Tuen Mun New Town in the early 1980s

Hung Hom Bay Reclamation in late 1980

Formation of the Airport Platform from the original Chek Lap Kok Island
Tai Ho Section and the Depot Facilities of the Tung Chung Line

West Kowloon at Yaumatei/Shamshuipo at the early stage of reclamation

Reclamation at Stonecutter Island to form land for Container Terminal No. 5 to 8

Construction of new ferry piers to replace the old that were still servicing central to Jordon Road and outlying islands
Reclamation carried out in a looped manner to allow servicing facilities to be replaced at the latest stage.

Tsuen Wan West reclamation in late 1990.

Reclamation for the Container Terminal No. 9.
Reclamation involved in the Central-Wanchai Bypass Project
Tunneling Works
Entrance arrangement to the tunnel portal for the 3.7km long Tai Lam Tunnel of Route 3 at Kam Tin as seen in early 1996. Tai Lam Tunnel consists of two main tunnels, each measuring 15.5m wide and 10.5m high, and a 950m long servicing duct for ventilation and other supply purposes in between the main tunnels.

A section of tunnel excavation using New Austrian Tunnel Method (NATM).

Blast hole layout pattern

Machine use for the drilling of the blast hole
The machine, known as Jumbo tunneling machine, is used to drill and form holes inside the tunnel for the placing of explosive to activate the blasting. This machine is computer controlled and can drill 3 holes at the same time with direction or angle precisely set.

Placing explosive into the blast hole

Excavating, Scaling and removing of the blasted section at tunnel end

The erection of the gantry-type formwork for the forming of tunnel lining at entrance of the tunnel portal on Ting Kau side.
After the tunnel formed by drill and blast process, the newly formed tunnel surface is to be lined with an in-situ concrete lining to stabilize the exposed soil or rock faces. The photo shows the gantry-type formwork used to form the in-situ concrete lining.

Fixing of the reinforcement before the forming the tunnel lining.

The tunnel boring machine for the forming of the 3.8m diameter tunnel tube on Butterfly Valley side.
The trial assembly of the tunnel boring machine in 1998 at the fabricating factory at Shanghai before shipping to Hong Kong for final operation.

Another set of tunnel boring machine at the fabricating factory at Guangzhou in 2005 preparing for the tunnel work for the KCR Kowloon Southern Link project.

The cutter head is being connected to the shield of the EPBM by the help of a track-mounted gantry crane positioned on the ground level. The rows of steel tubes on the background are lateral support used to stabilize the 25m deep tunnel shaft.
The tunnel interior with the in-situ concrete lining already been placed.

Section of the tunnel pit formed by soldier pile wall and laterally supported by anchors. The structure of the approach tunnel have basically been completed pending for backfilling at a later stage.

Large amount of cut-and-cover tunnels were constructed in the MTR Tseung Kwan O Line in the reclaimed land of TKO New Town.

Alignment of tunnel

Tunnel section along Jordon/Tai Kok Tsui (excavation up to about half of formation level)

Tunnel trench crossing main water pipes and flyovers
Construction of Bridges

Common Bridge Forms

Simple Supported – span effective from 10m to 60m
   Actual example – Route 3
   Interchange at Au Tau, Yuen Long

Continuous Span – from 10m to 100m
   Actual example – construction of a span of continual section of elevated highway bridge at Route 3, Kwai Chung
Balanced Cantilever – span from 25m to 200m

Actual example – balanced cantilever bridge series forming the approach to the Ting Kau Bridge

Balanced cantilever bridge for viaduct of West Rail at Au Tau Interchange

Steel Truss – 50m to 100m

Actual example – 5-span steel truss bridge in western part of Pearl River, Guangzhou
Steel Arch (framed or trussed) – from 150m to 500m

Close up view of the bridge trusses

In-situ Concrete arch bridge
Case study – construction of the Stonecutters Bridge

http://www.youtube.com/watch?v=GqpZamvJnU

Front leg

Master winch

Rear leg

Slave winch

Rear support

Hangers

Front support

Main Truss

116m long

(SWL = 105 T)

(For end span and 1st pair segment erection)

(SWL = 120T)

Master winch

Launch gantry used in the Hung Hom Bypass

Route 3 – Kwai Chung Section
Launching gantry used in Route 3 at Au Tau Interchange
Demolition and Dismantling Works

Difficult access for workers entering into a building under demolition

Further examples of difficult access in demolition jobs

Heavy machinery used in demolition may have risk of collapse due to insufficient support.
Accommodation of too much debris during demolition can impose intolerable loading to the disturbed structure.

Typical congesting neighbourhood condition for demolishing small buildings within urban environment.

Example for large scale building alteration project inside servicing facilities (the Windsor House A & A project).

Special safety and user provisions during demolition and other A & A works.
The actual condition during the demolition

Other demolition cases working in congested urban environment

Set-up and mounting of the saw dis on wall

Demolition using disc/saw cutting
Disc saw

Demolition using saw-cut and drill method for the diversion of a storm water discharge culvert

Using core and drill method to demolish a pedestrian subway

Partial demolition for historic building
– Shanghai Street Pre-war buildings revitalization project
Continual stages of the basement demolition with the incorporation of other substructure of the future building.

Appearance of the pre-war buildings before conversion

The redevelopment of the Lee Gardens Hotel (building with an existing basement)

The demolition of the basement structure working at the same time with the construction of the future building
The redevelopment of the Hilton Hotel

Demolition of the basement structure of the previous Hilton Hotel – the lower basement was backfilled to maintain stability of the disrupted basement structure before the commencement of the new basement.

The Millennium City in Kwun Tong

Demolition of the basement working at the same time with the building foundation.

Major demolition accident, the collapse of the Yau Tong Industrial Building in 2001.

The site as seen on 30.11.01.
Observation – all the fallen columns centered inward indicates that the collapse orientated somewhat from the building center

**Essential building services in building include:**

HVAC, Electrical, Fire Services, Plumbing & Drainage, Lift Services, Security, telecommunication, and Building Automation Systems, or other systems that provide human’s environment comfort (e.g. acoustic installation).
Service-runs inside floor slab

Service-runs within sub-structure of building

Electrical and cable installation as seen in a major switch room

Switch broad and control panel for electrical distribution systems
Installation of raised floor

Final finish to an office interior with raised floor and dry wall partition system

Ceiling services before the laying of false ceiling
Complicated ceiling services works within a club facility where curtain interior design elements are required.
Chiller plant/evaporator units located on roof of a commercial complex

The completed air-conditioning plant located on roof top

Plant Room before equipment fully installed
Inside a plumbing plant room

Installing Escalator into building structure

Window cleaning system as a form of mechanical building maintenance system in building

Installation of window cleansing equipment
Provision and installation of other environmental systems – Solar panel

End of presentation

Please note that this set of presentation is making use of a large amount of real-situation photo record to elaborate the topics. Explanation using written description is not the main design focus for this seminar.