

Introduction about various types of Temporary Works/Falsework and its implication on work planning and cost (Part 1)

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Project manager cannot prepare an accurate and effective work plan and control the budget/expenses if they cannot understand the full coverage of work for a project that he is facing, in which the provision of the required temporary works is one of the key issues. Such works and provisions cannot be found in the contract drawings. Planners need to plan for it on their own accord satisfying the actual project/site conditions. This situation is more critical for building and civil jobs which is in very large-scale and complex in nature.

Construction is much more than the application of the right technology and method to construct. The main concerns is the actual scale, diversity, breakdown and sequence of works so arranged, as well as the physical condition of site. These attributes can make the work planning becomes extremely complex and non-guarantee. General rules often can hardly apply for this kind of project.

Take excavation and ground works for example. This is only a very general technical term, however, its scale of work makes a great difference. Please have a look of the following slides and you can see.



These two photos show two different sites under excavation process for some ground works. Any one can easily distinguish the differences in between. The main different is the scale of work.

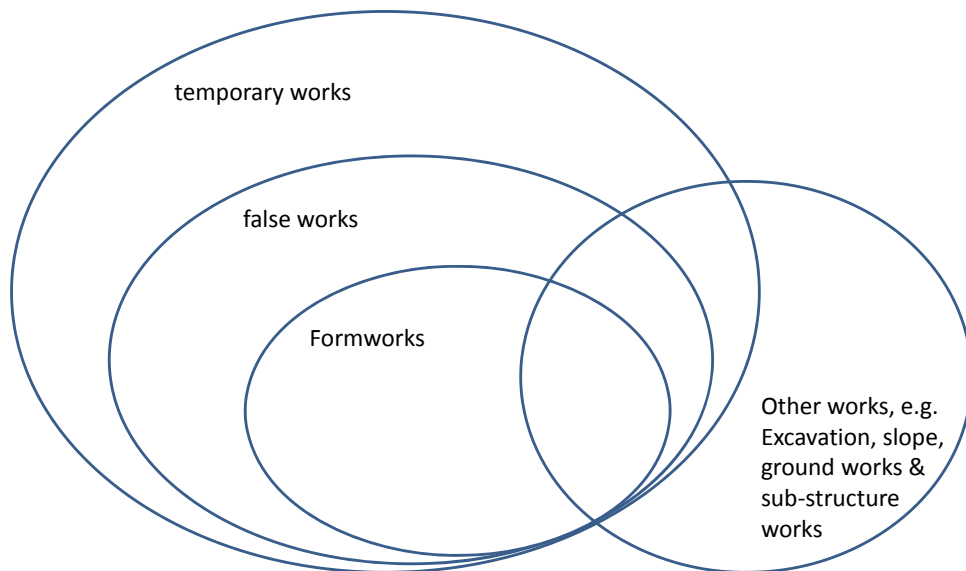




How about this site? It has an site area of about 40000m² and more than 100 activities working at the same time (Tai Koo Hui, Guangzhou)



The same site as seen 9 months later



Difference between temporary work, false work and Formwork using the “Set” idea

Types and examples of temporary works

- Falsework and Formwork
- Temporary access to works
- Temporary gangway, roadway and bridges
- Work platforms (elevated or else)
- Scaffold and work screen
- Support of excavation and other sub-structure works (ELS)
- Temporary support to adjacent properties
- Temporary office, stores, hoarding and temporary services
- Temporary diversion works (for traffic, storm water, drainage and other utilities)
- Works as safety provisions

1. Falsework for in-situ RC construction

Some in-situ RC works in particular for those high-headroom, long-span or heavy structures both in building or civil works, often needs to erect a temporary supporting structure to allow the onward erection of formwork. This temporary structure or falsework, can be in the form of props, tubular scaffold, temporary joist/truss, other forms of girder/gantry or their combination.



Falsework/propsing for traditional floor slab construction

Falsework/propsing for traditional floor slab construction



Falsework/propsing for traditional floor slab construction





Falsework for large-size in-situ works. In this example it shows the construction of the floor structure for the Express Rail Terminus in West Kowloon.



Also for the ERL terminus project, this photo shows the falsework at work. It will support the construction of an in-situ curved roof section after completion.



Falsework detail showing the spanned space supported by steel prop with u-beams.

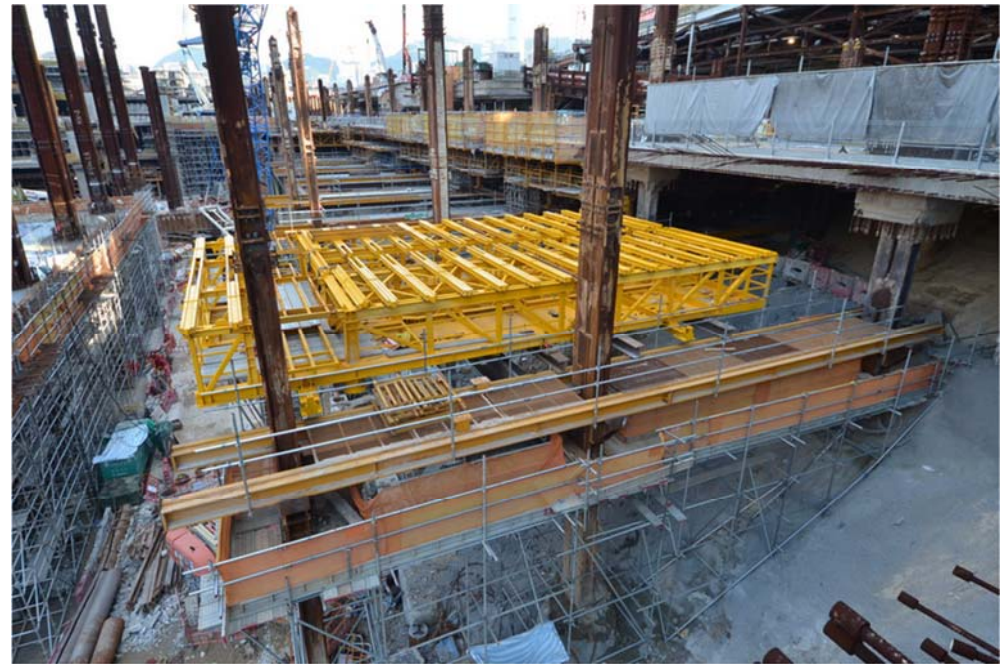


Other examples for in-situ RC construction under more challenging built-environment:
Gantry form to construct an elevated transfer slab, the "Arch 凱旋門" in Kowloon Station

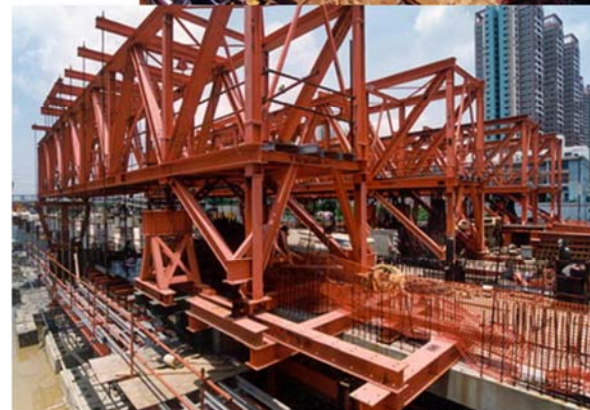




Example of more advanced falsework system to tackle work at elevated position and longer-span floor structure, the ERL terminus using Gantry form



This is a series of very gigantic formwork. Access, platform and other temporary supporting work set-up can be found everywhere around the gantry in order to facilitate work in a safe way.



Another example of gantry form used in the Siu Hong Station project, West Rail

Suspended platform

The gantries suspending the platform which will be used for the floor form erection



2. Formwork as a major form of falsework

There are various types of formwork which are so designed to fit different purposes and work environments. The followings are some of the examples:

- Traditional timber form mainly operated manually
- Gang-form/large-panel form often requiring lifting equipment for erection
- Mechanical formwork/climb form
- Travelling/gantry formwork
- Product Formwork

Using traditional timber formwork for building with smaller floor area. Observe the congested work layout.



Using traditional timber formwork for building in larger site. Observe the 3-D nature of work layout in this type of site.



Work situation commonly encountered in larger site – there are quite a number of work-fronts and activities working at the same time in relatively congested work space.



Typical view of a work front using traditional timber formwork



Typical view of a work front using traditional timber formwork

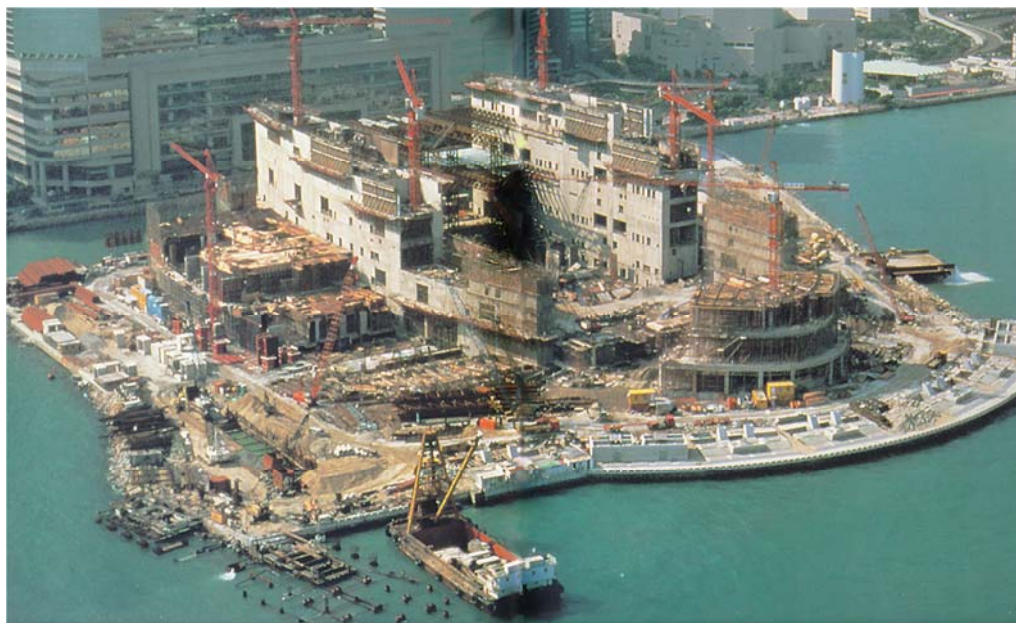




Gang form
(large panel form)



Operating concerns of this type of large panel form:
heavy in weight, require mechanical lifting, often need to work at high level



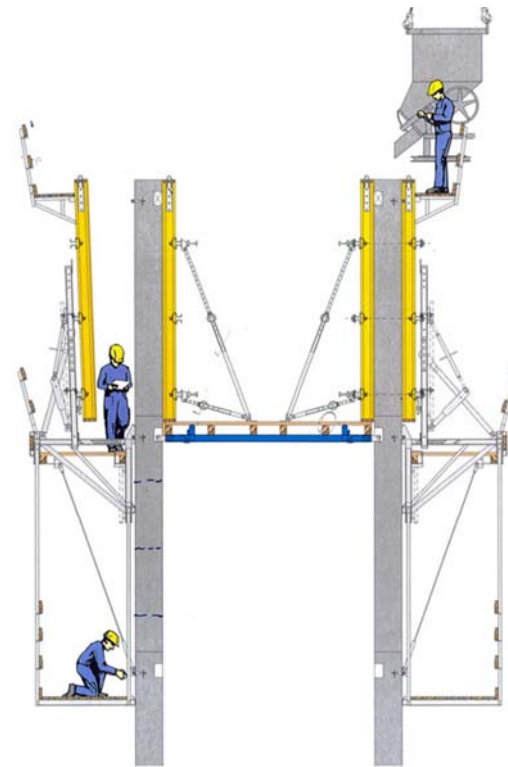
Representing case example –
constructing the core walls for the HKCEC project. Also observe: complicated
work fronts and spatial layout, multi-activities working at the same time.



This kind of large-panel formwork often involved
work at elevated position and heavy lifting



Fixing provision on wall for large panel gang form



Typical mounting and operation of large panel form. Observe the multi-level of working set-up



Column formwork using timber



Column formwork using timber





Column formwork using steel

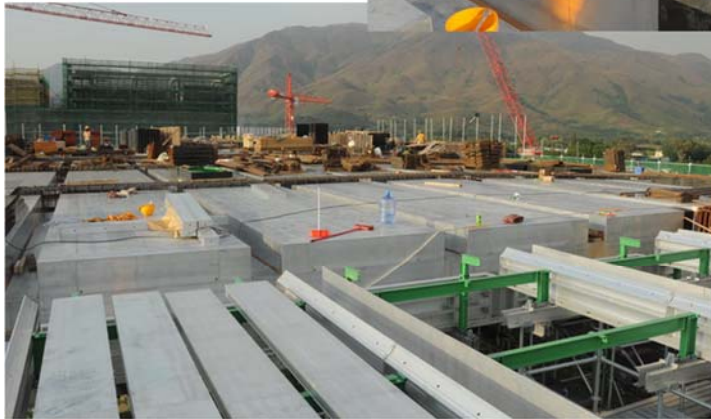


Aluminum Formwork for residential building



Aluminum formwork incorporated with precast elements

Aluminum formwork for larger structure



Example of gantry form for the casting of identical repeating structure.

Example of travelling form for the casting of parapet wall of elevated carriageway



Using climb form as a kind of mechanical formwork

Climb form, jump form or slip form are similar in the operating principle. They named differently due to trade-branding mainly.

This kind of formwork has a number of working features that may be unfavorable in terms of safety, such as:

- It is more fit for constructing shaft structure like a core wall such that it will create a vertical shaft before the adding in of the staircase etc.
- It works independently, i.e. it works a few floors in advance. This means accessing into it to work is difficult.
- It works at the upmost top front of a advancing structure.
- The size of the formwork is gigantic and heavy in weight. It has complicated spatial layout within.

The slides that follow show the working environment using this kind of formwork under typical/representing case examples.



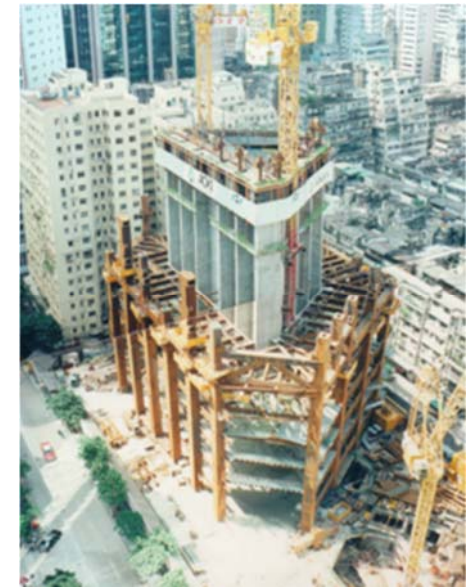
Construction of the core wall for residential building using mechanical form



Construction of the core wall using mechanical forms



Construction of the core wall for residential building using mechanical form



Construction of the core wall for office tower using mechanical forms

Manulife Tower, 2004 - 2007



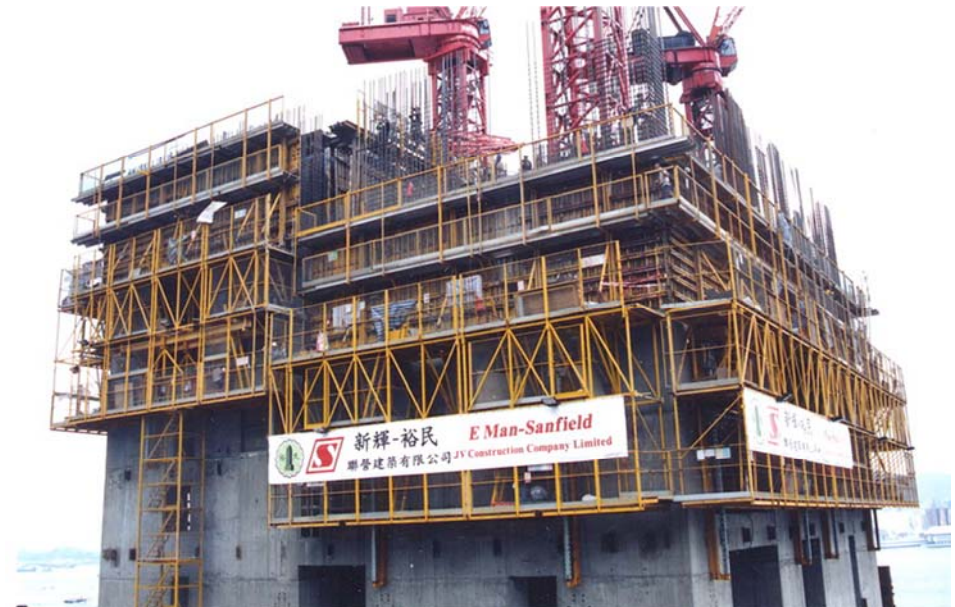
Office Tower of Langham Place
1999 - 2004



International Commerce Centre 2003 - 2011



One Island East, 2007 -2010



Climb form for IFC2, a closer look of the system



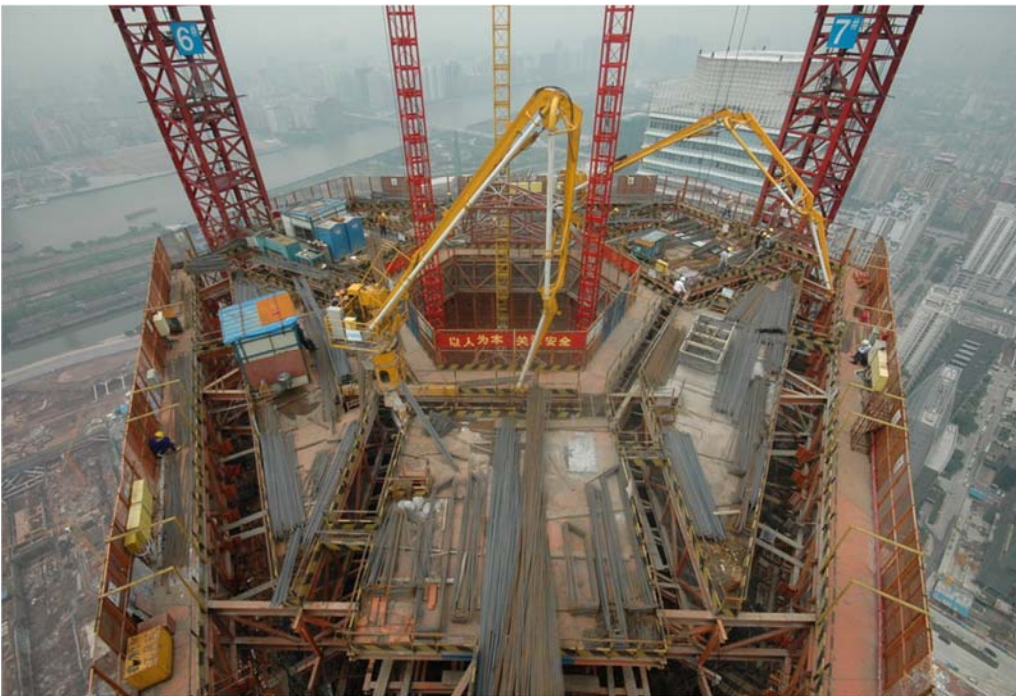
The climb form as seen on the working deck



Difficult spatial environment/complicated geometry on the working deck of a large-size core wall



Other case, the Guangzhou East Tower - core wall was constructed using a set of self lifting formwork



Layout detail on the working deck of the climb form



The working platform as seen on the deck of the formwork

Access provision inside the climb form system



3. Falsework to support floor soffit



Typical layout for floor working with traditional timber formwork



Elevated view of floor construction working with traditional timber formwork, the spatial environment getting difficult when the actual work is to be carried out.



Erect the prop before the layout of the soffit plank. Observe the work at elevated position.



Other example but in larger scale of work



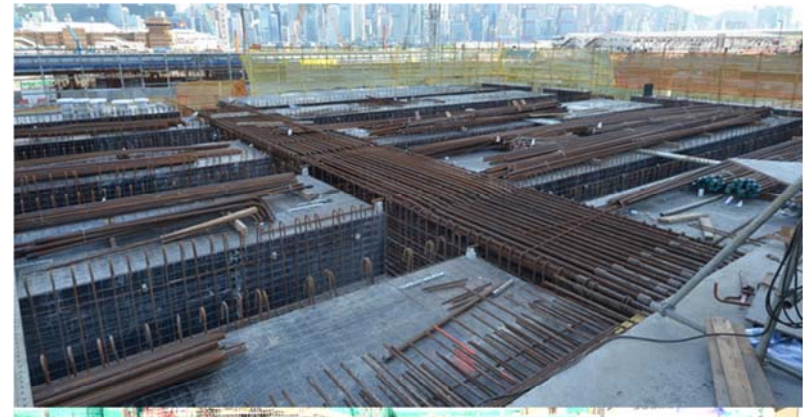
More example of falsework for the construction of floor structure (the ERL Depot)



More example of falsework for the construction of floor structure (the ERL Terminus)



Erect the prop before the laying of the soffit plank



Floor form being completed ready for the fixing of steel





Floor form system for building with large floor area, say up to $1000m^2$ or above



Floor formwork using proprietary products



Propping and re-propping



Traditional timber form for staircase (one of the most difficult parts to work with for its 3D geometrical shape)



Traditional timber form for staircase



4. Falsework for supporting heavy erection



Falsework to support the transfer plate



Fixing of steel bracket for erecting the supporting falsework



Detail of steel bracket and the supporting falsework



Falsework for transfer plate, other example, the Park Avenue project in Tai Kwok Tsui.

Construction of the columns on the podium level, on top of which will support the transfer plate and the tower-type superstructure

Erection of a temporary platform using universal steel sections with bracket support to the columns as work station for the transfer plate



Aerial view of the temporary platform erection for 4 tower blocks in stages



Two transfer plates gradually take shape at the base of two tower blocks



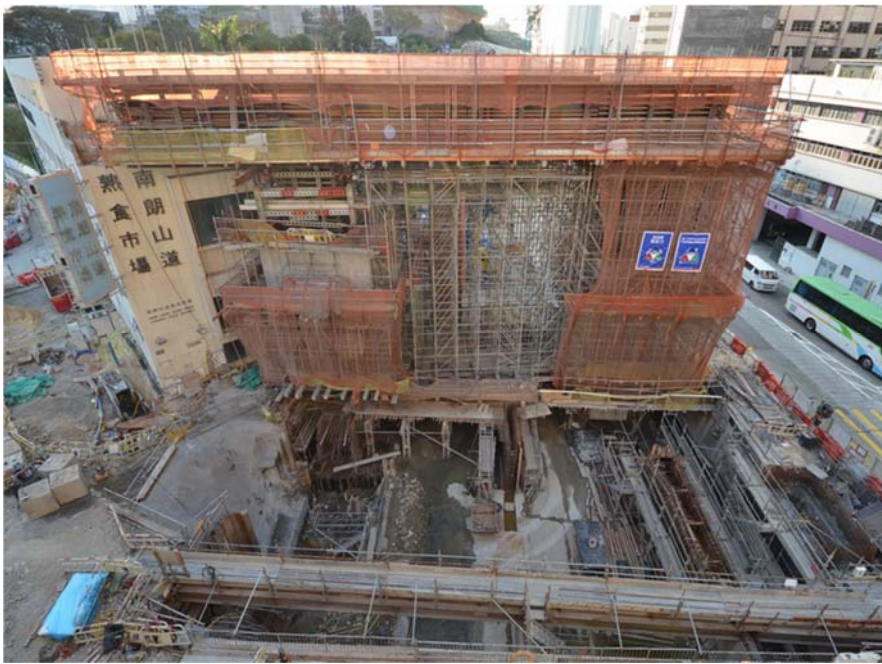
Sectional view of a tower block before the completion of the transfer plate.



Falsework to support heavy in-situ RC girder, the Deep Bay Link project in Tuen Mun



Set-up of the false with the vehicular pass, work access, work platform & final formwork erection etc.



Falsework to support the construction of a portal beam for the South Island Line at Wong Chuk Hang Station



The falsework set-up as seen from the from the storm water discharge culah



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



Falsework to support the construction of a 45m elevated portal beam for the Route 8 Truck Road approaching the Stonecutters Bridge

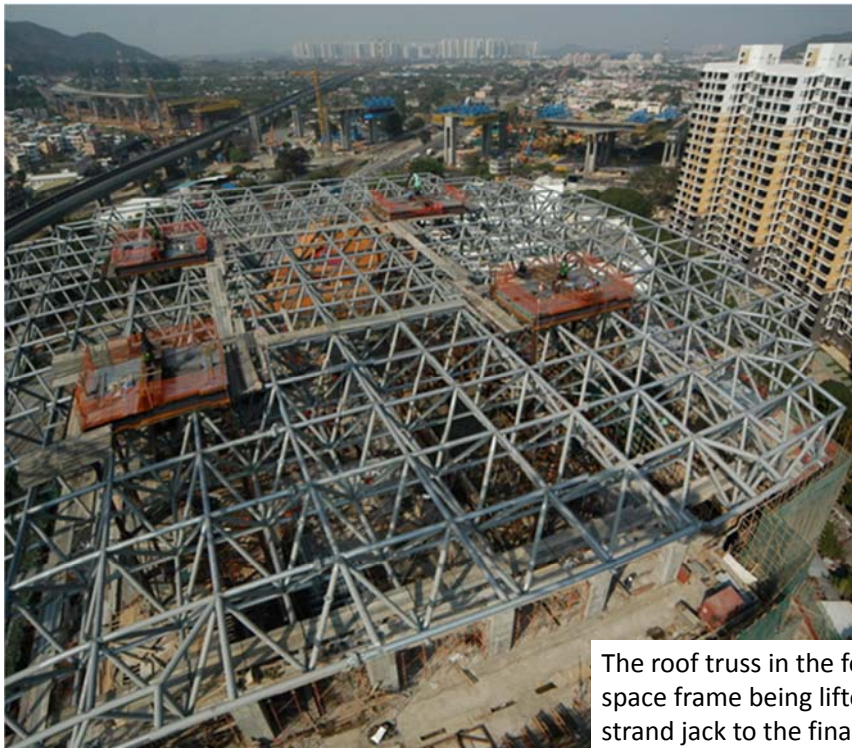




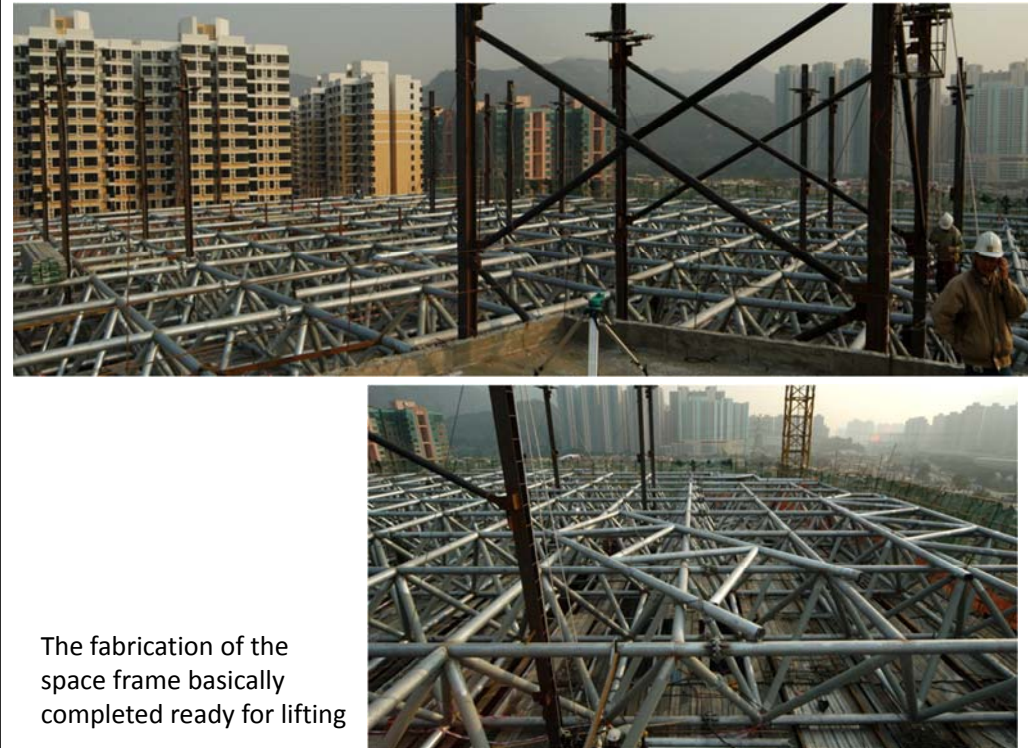
Detail seeing the detail of the scaffolding with stiffening members and access for work



Heavy installation and lifting – the Mui Fat Temple roof truss



The roof truss in the form of a space frame being lifted by strand jack to the final position



The fabrication of the space frame basically completed ready for lifting



Assembling the fabricated member on top of an elevated platform supported by tubular prop



Heavy lifting for the 80m suspended floor for the HKCEE Phase II Extension



The original roof truss of HKCEC lifted to position using strand jack



Fabricating the 300-ton hanging frame on a temporary platform with temporary marine pile as support

Jacking devices, the supporting trusses (temporary work all in blue) and the mounting columns.

The 300-ton hanging frame will be lifted to the roof level to form a roof truss on which three levels of floor will be suspended onto.



Falsework as support for precast unit in the construction of elevated carriageway

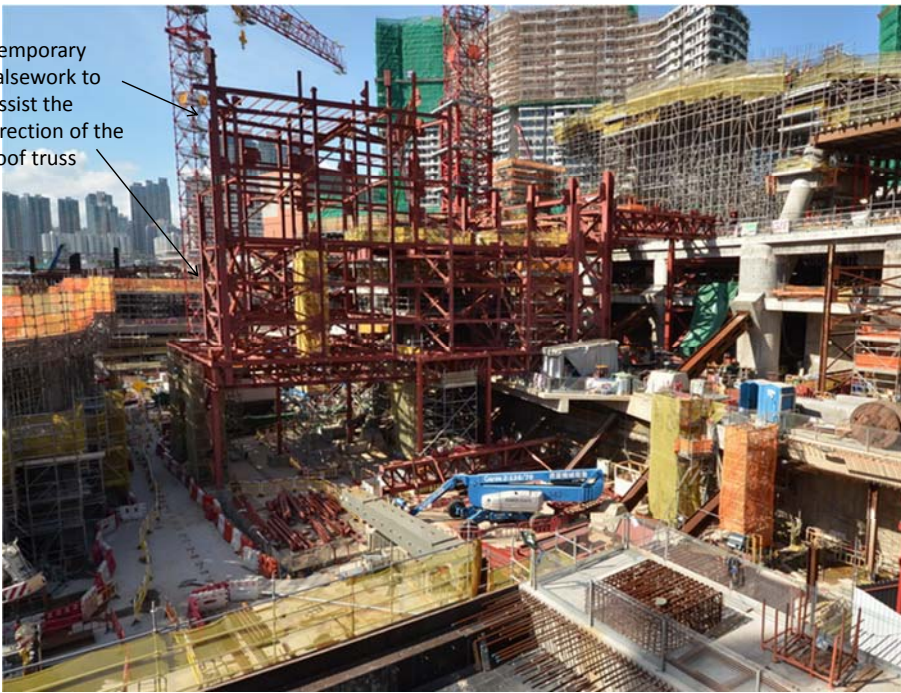


The roof structure in the form of a curved canopy requires a great number of temporary support during its construction



Terminus Building of the Express Rail with an eye-catching roof

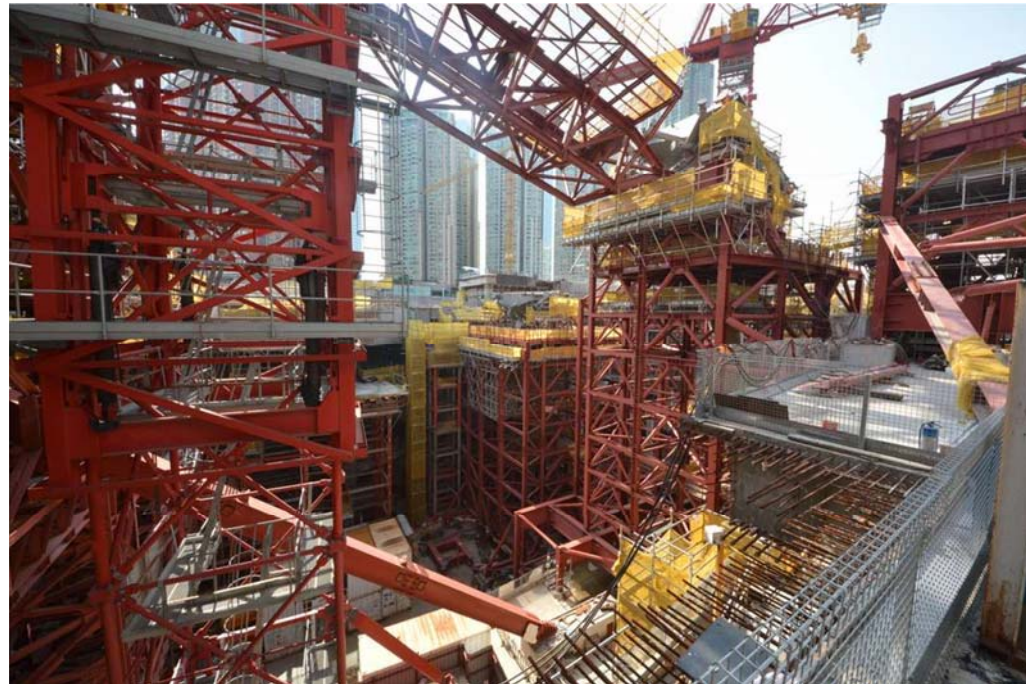
Temporary
falsework to
assist the
erection of the
roof truss



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



Close up detail seeing
the actual set-up of
this gigantic
temporary structure





5. Working scaffold and platform

Work scaffold as access to facilitate the construction of large-size column



Typical detail of column formwork and its access provisions



Work platform for work at building exterior



Work scaffold as access for slope works

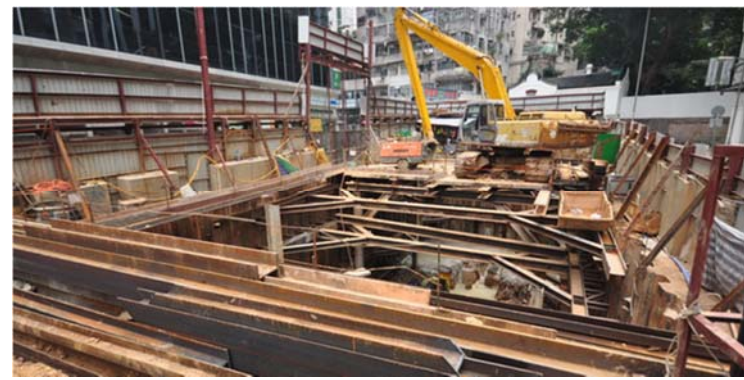


Work scaffold as access for slope works



Other form of falsework:
Self-climbing platform
for the construction of
portal beam for elevated
roadway (Route 8
Stonecutters viaduct)

Falsework to support the casting of the bridge deck (Side-span of the Stonecutters Bridge)



Work platform for confined sites



Work platform for sloped/confined sites

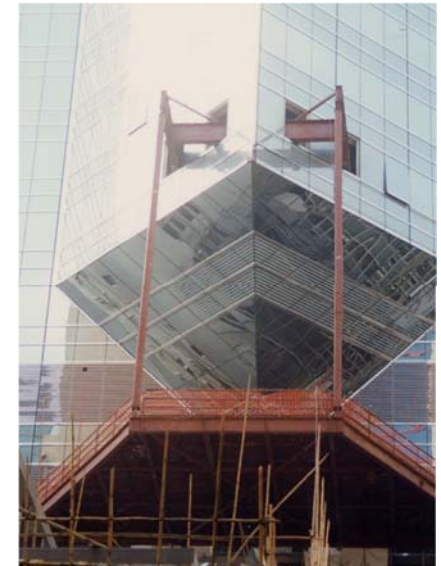
Work platform for sloped/confined sites (Stubbs Road, Hong Kong)



Work platform for confined sites (Stubbs Road, Hong Kong)



Work platform in more complicated/congested site



Working platform to install curtain wall with inverted surface

Working platform to install curtain wall with inverted surface



6. Safety Access and screen



External scaffold as work platform/safety screen for general building renovation work



Traditional bamboo scaffold for minor external works and repairs



Access stair to facilitate work at high levels



Scaffold as protecting screen to exterior face of building (HKU Centennial project)

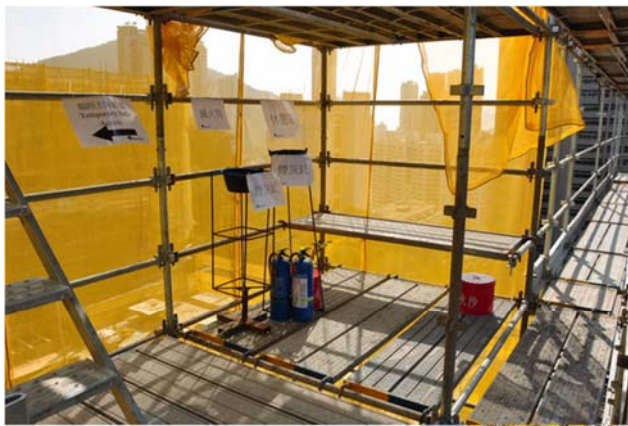
Close-up view of the scaffold

Observe: the need of securing the scaffold against wind action by the use of tying wire.

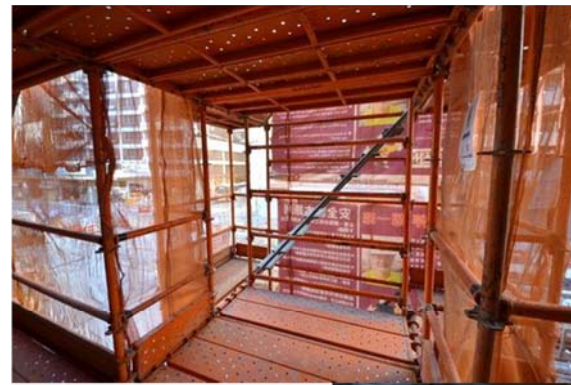


Other example of external metal scaffold

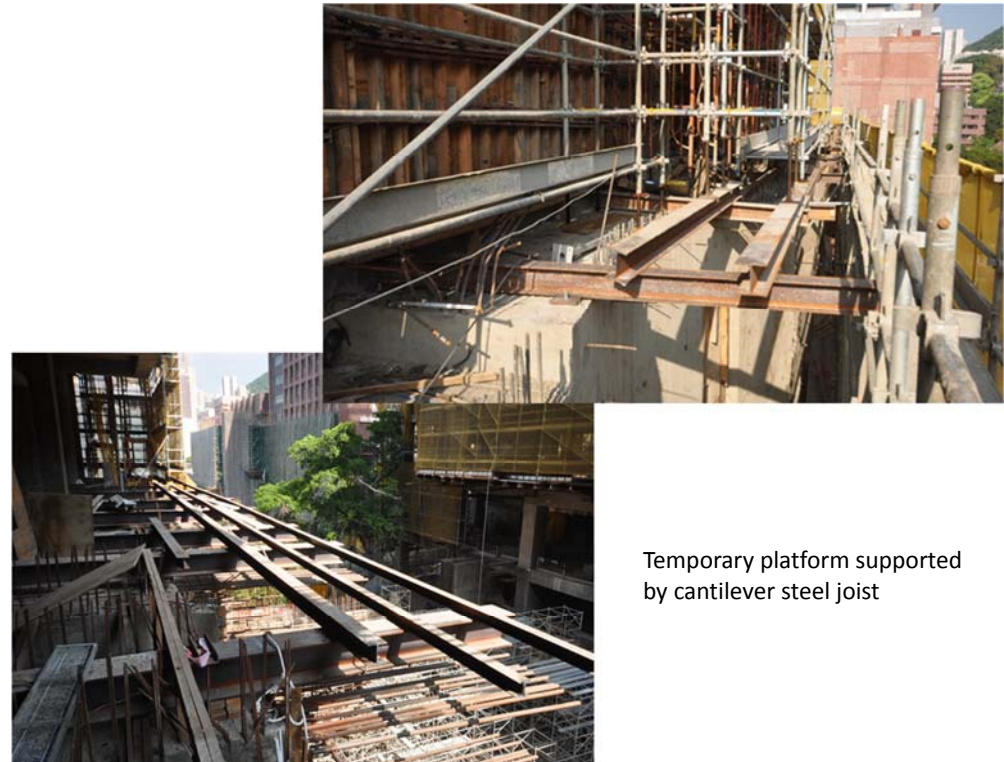
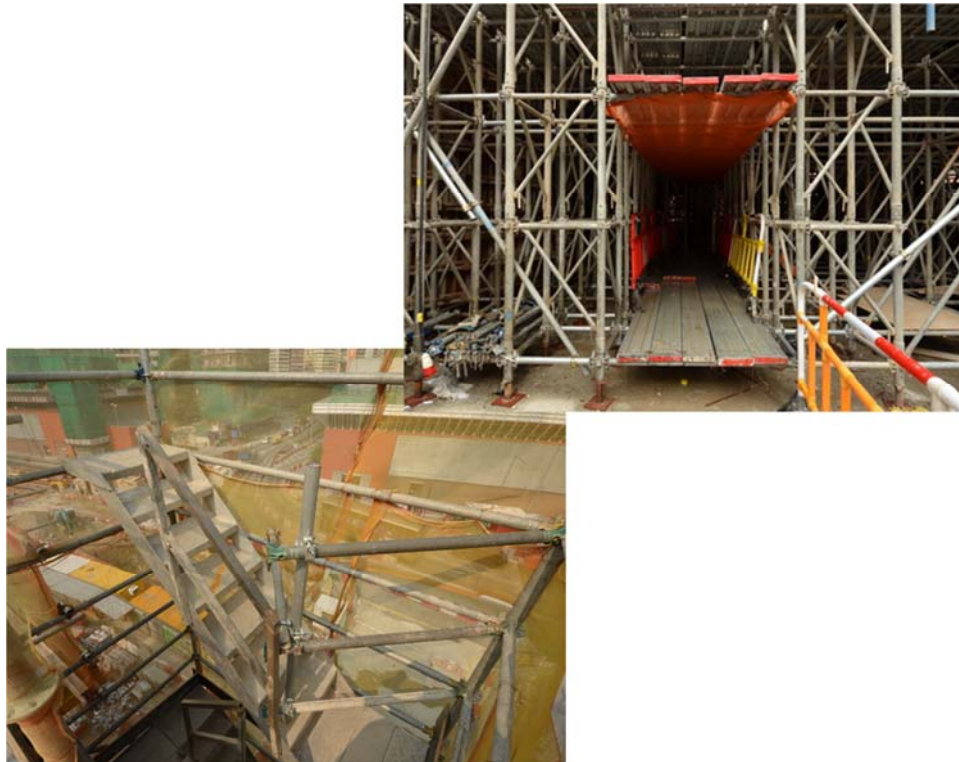




Typical provision inside the scaffold including access way, rest area and stairs etc.



Typical provision inside the scaffold including access way, rest area and stairs etc.



Temporary platform supported by cantilever steel joist

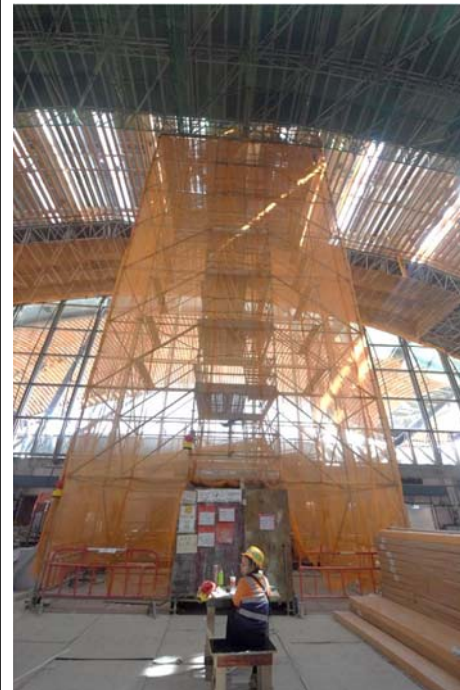
External scaffold with climbing
safe screen and material hoist



The material hoist and the climbing scaffold



7. Access for extremely high level work





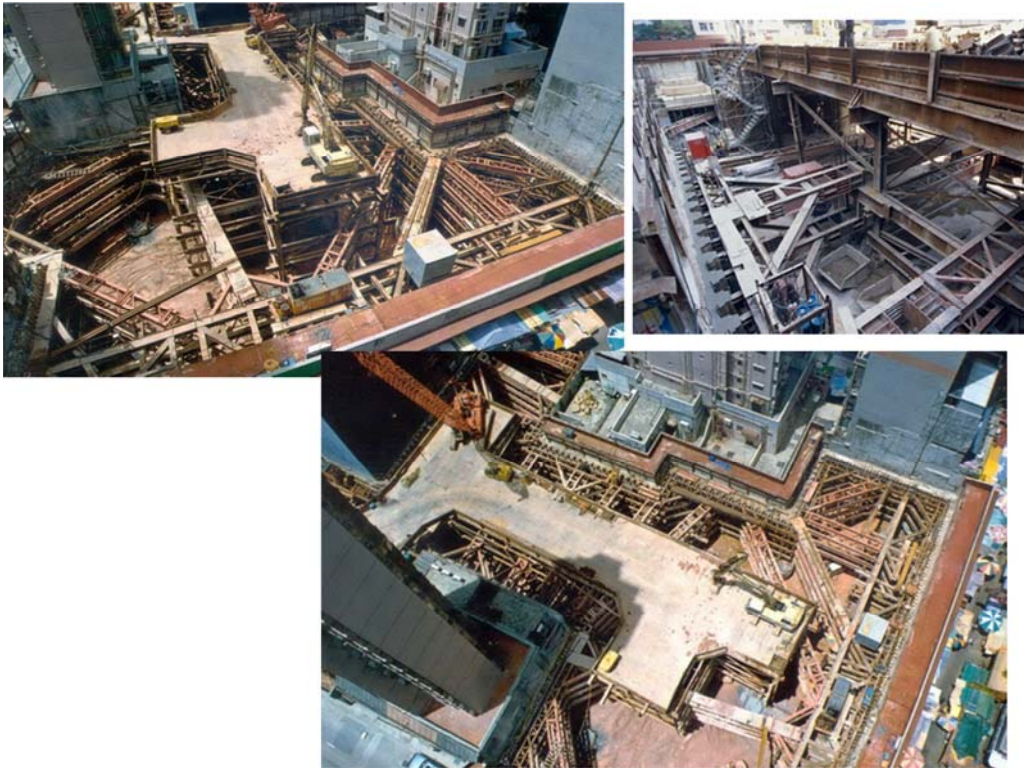
超大型的金屬支撐架



8. Temporary roadway



Access roadway and work platform for very confined site
(URA project at Wanchai Road)





Access roadway and work platform for very confined site
(Hang Hau Station, Tseung Kwan O Line)



Provision of temporary access-way for large-size building to enable the access for heavy equipment forming part of the construction planning
(ERL Terminus at West Kowloon)



Provision of temporary access-way for large-size building to enable the access for heavy equipment forming part of the construction planning



Making use of the permanent structure constructed in advance as access way.
(HKU Centennial project)





A temporary roadway for public passing across the site, the Express Rail Terminal at West Kowloon.



A temporary roadway formed on the downside of slope for the Tolo Highway Improvement project



A temporary roadway formed on the downside of slope for the Tuen Mun Highway Improvement project



A temporary roadway erected on slope for the Tuen Mun Highway Improvement project (2010)





A temporary roadway erected on slope for the Tuen Mun Highway Improvement project (2010)



Temporary accessway over water – the Western Corridor/Deep Bay Link Project



Temporary access way over water





General excavation where soil support is an important part of temporary work



Relatively simple excavation using open-cut



A simple pit for pile cap. How about if there are more than 10 of these working at the same time?



Excavation for the construction of an one-level basement in a small site

Basement construction – Traditional method

(soil support is an important part
of temporary work)



Construction of basement in a congested site in built-up area



Open-cut to construct the raft of an office tower
forming part of the basement (Langham Place

Viewing inside the excavation pit



Construction of the building base from the formation level of the basement pit.

Observe the very congested working space within the excavation supports during the in-situ RC works.



Typical bottom-up method for basement construction with the cut-off wall, strut frame and work platform to support works (URA project at Wanchai Road)



Viewing inside the excavation pit

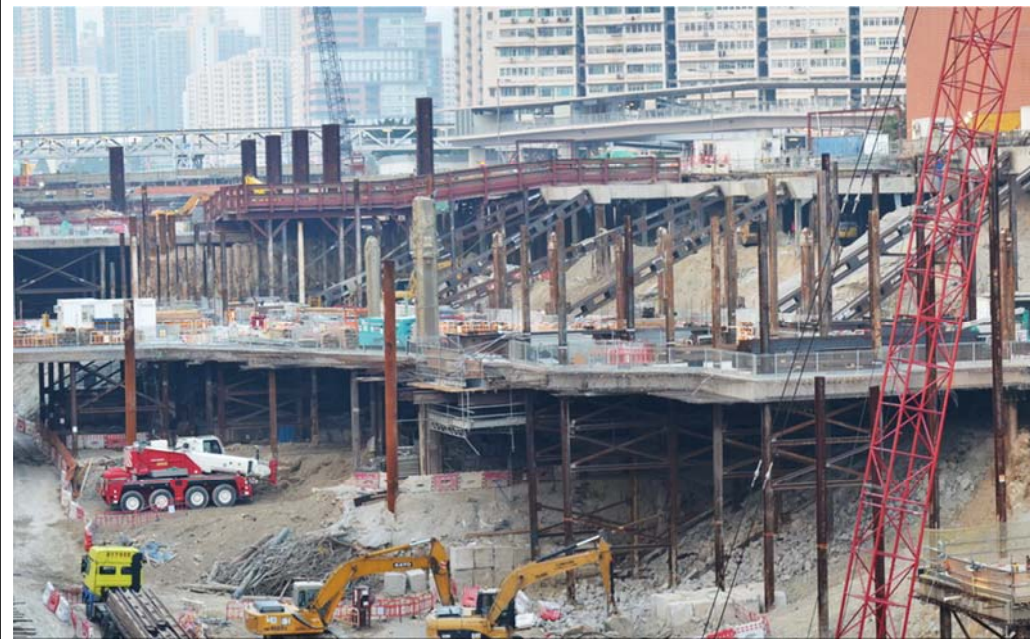




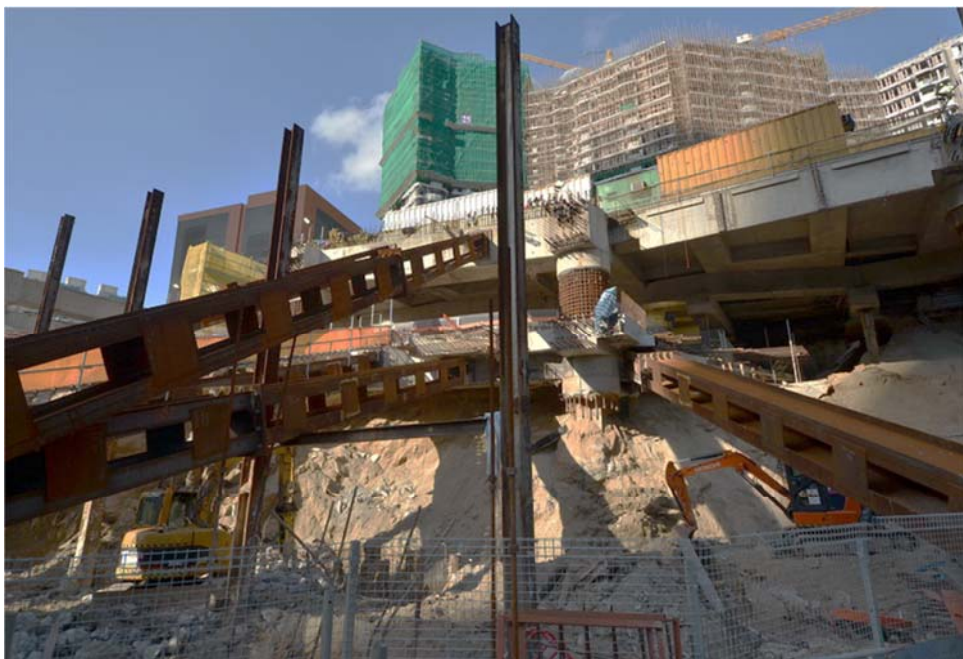
Construction of the basement structure inside the congested basement pit

Basement construction –
Top-down method





Working in a combined top-down arrangement for site of mega-size to fit the construction planning (The ERL Terminus in West Kowloon)



Close up look seeing the work arrangement in particular the temporary ground supporting system





Close up look seeing the work arrangement in particular the temporary ground supporting system





Underground obstructions
when doing the excavation



Servicing utilities exposed by the time of excavation in progress.
Protection and diversion of these services are needed



This is the actual happening inside the excavating pits for complicated projects.



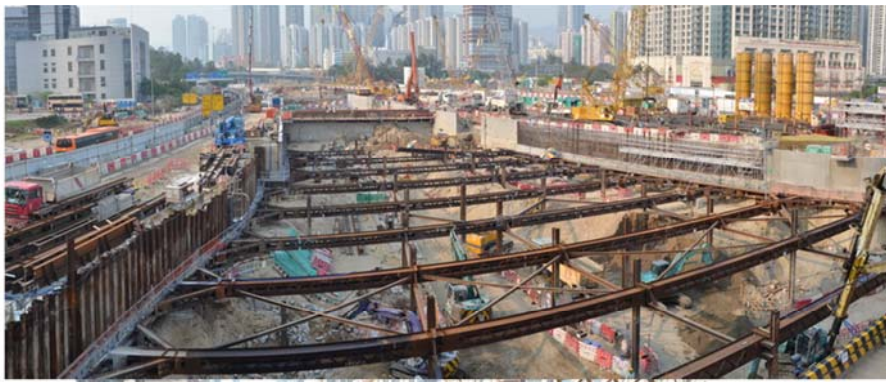
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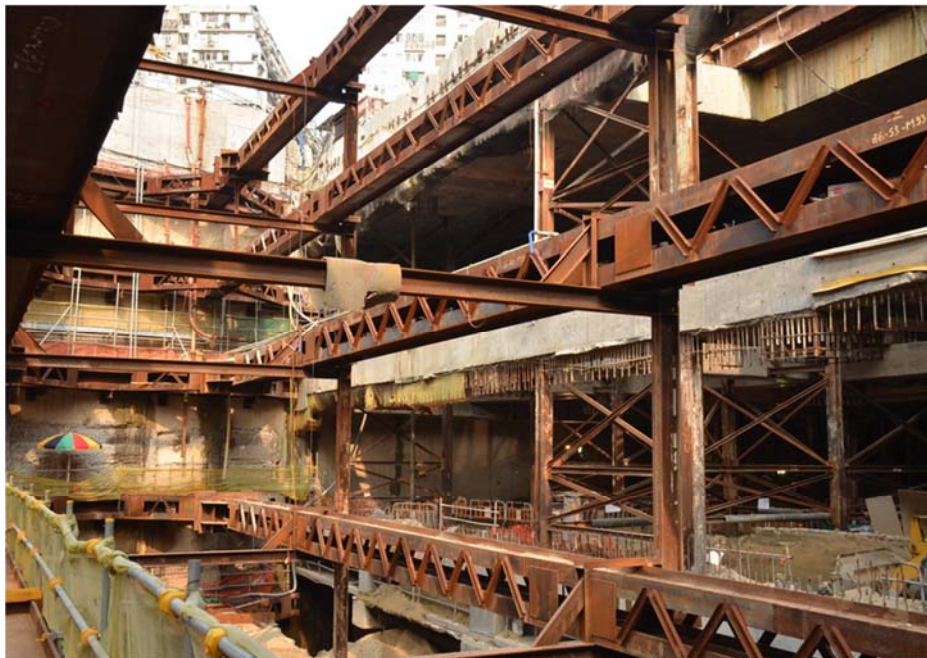
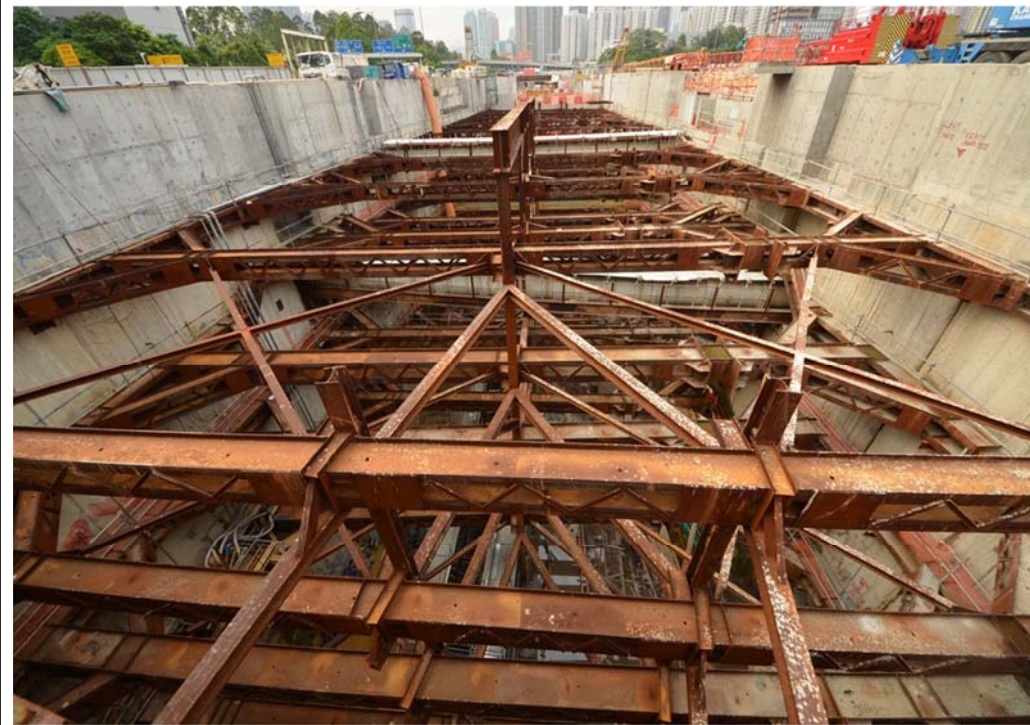
Open-cut tunnel and work trenches



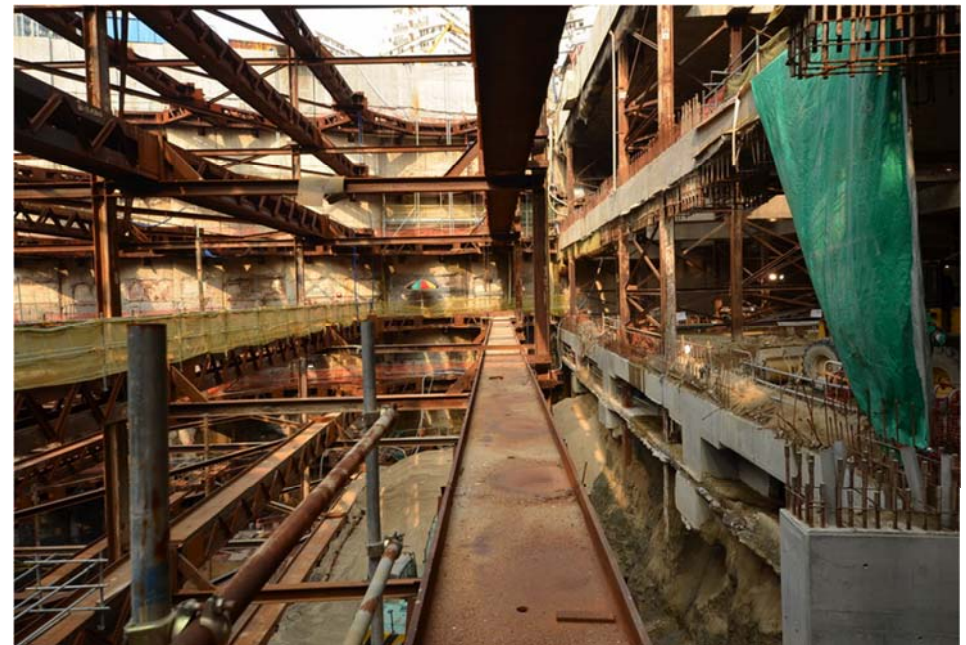
Access into an excavating trench



The cut-and-cover excavation arrangement for the ERL project



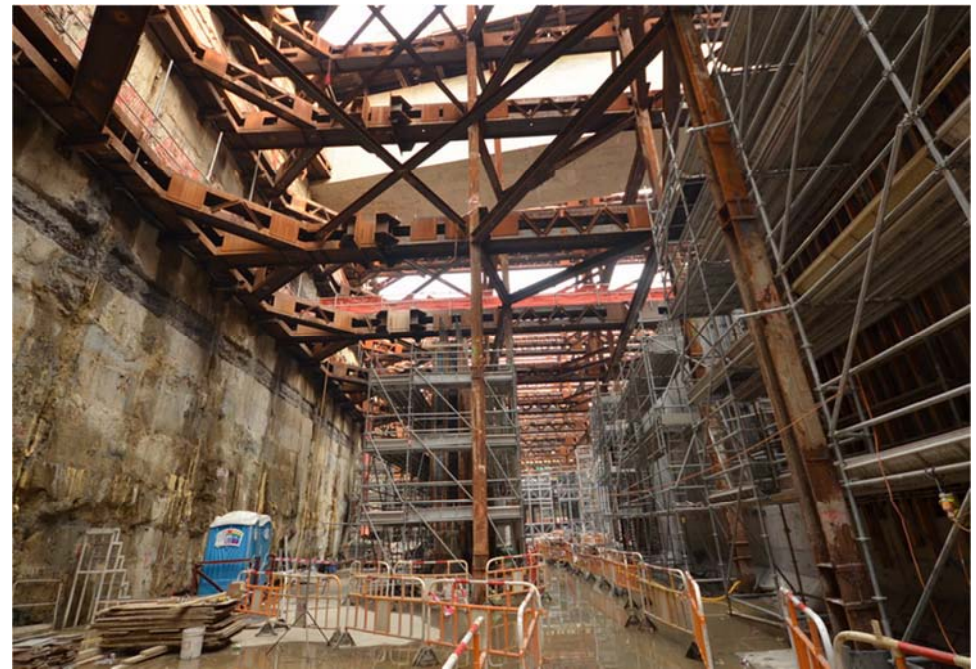
Viewing inside the cut-and-cover tunnel at the stage when the construction of the tunnel tube started



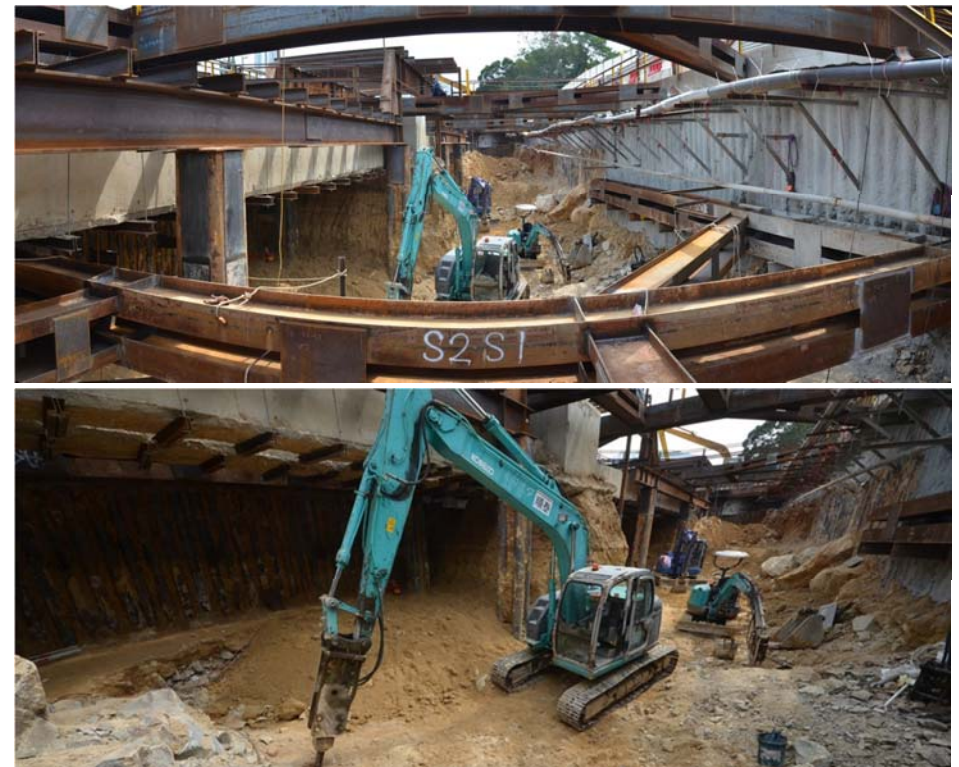
Viewing inside the cut-and-cover tunnel at the stage when the construction of the tunnel tube started



Viewing inside the cut-and-cover tunnel at the stage when the construction of the tunnel tube started



Viewing inside the cut-and-cover tunnel at the stage when the construction of the tunnel tube started





The end of Part 1 Presentation