



Client:

Architect:

Project Brief

This 32-storey commercial tower, located at Wan Chai district of Hong Kong, will become an iconic building in the commercial and business district when completed.

The complexity of the project, with its unique building form, an inverted pyramid, limited site access and working space, places an uncommonly strong emphasis on temporary work design and safety & health planning.

Contract Start Date: Contract Finish Date: Contraction Period: Contract Sum: Construction Floor Area: about 40,000m2 Number of storey: Carpark Floor: Podium Floor: MFP Floor: Office Floor:

劉榮廣伍振民建築師事務所(香港)有限公司

November 2016 February 2019 815 days approx.1000 million 32 1-storey at B/F 4-story between G/F and 3/F 6-storey between 5/F and 10/F 22-storey between 11/F and 30/F



Section of Building

Building Structural System

The inverted pyramid structure is located between 7/F and 10/F where 8 nos. of inclined mega size columns are connected to 7/F central core wall at one end and 10/F 3m deep tension beam at the other.

Traditional R.C. column-beam design is adopted between G/F and 7/F, non-traditional inverted pyramid shape R.C. columnbeam design is adopted between 7/F and 10/F, while traditional R.C. column-beam design is adopted above 10/F.

	Dennis Lau & Ng Chun Man Architects & Engineers (HK) Ltd.
Structure Engineer :	奧雅納工程顧問公司 Ove Arup & Partners Hong Kong Limited

Chinachem Group

華懋集團

- BS Engineer : 澧信機電工程顧問 J. Roger Preston Limited
- Main Contractor: 華營建築有限公司 **CR** Construction Company Limited







Specially designed timber formwork will be used for the construction of transfer structures including the inclined columns, 3000mm deep tension beams and the belt truss, which is supported by a combination of heavy duty scaffolding (i.e. Ring-lock) and traditional scaffolding. The falsework will be supported by a custom designed temporary steel deck at level +31.75mPD. Page 2

Four Corner







Project Challenges:

The main transfer structure consists of Hanger Post from 11/F, belt truss at 10/F & inclined structure between 7/F and 10/F.

The falsework supporting system cannot be dismantled until sufficient strength of the whole transfer structure is achieved & 28 days after the completion of hanger post. If traditional falsework is utilized to support inclined structure & transfer truss, all the space from 3/F podium down to basement floor (foundation floor) would be occupied in order to sustain all loading above. It would not only suspend the progress below the transfer structure, but also involve huge amount of falsework material on site and therefore induce logistic problem. There would be almost no space for rebar & formwork material storage.



Power Supply Route

The use of traditional falsework has advantages merely in terms of its constructability and economical benefit. However, after a thorough consideration of the complexity, the congested work space and the load path for the construction load, the traditional approach turns out to be nonviable.



Temporary Steel Deck

Solutions:

A fully covered temporary steel deck is proposed to release 3/F podium space for construction material storage and allow early completion of HKE cable trench at 3/F.





Challenges of Temporary Steel Deck during Construction:

- 1. Uncertain supply of welders;
- 2. Construction load to 3/F slab;
- 3. Safety risk for public and site during erection and dismantling;
- 4. Limited lifting capacity of tower crane;
- 5. Conflict between steel platform and scaffolding, permanent structures, etc.

Solutions:

- Off site prefabrication and anchor bolt connection design are orientated for steel members to save time and reduce the number of on site welders in terms of site safety & uncertainties to project programme.
- 2. All construction load (including all temporary construction load "6/F-10/F including transfer truss" and steel works) is transferred to core wall & vertical columns of 3/F.
- 3. Double net to protective scaffold, fall arrest system and mobile lifting-platform for steel fabrication running on 3/F.
- 4. The platform design considers about the 4 ton Tower Crane capacity, which also minimizes the safety risk in term of lifting.
- 5. To overcome such conflicts, the construction sequence has been planned out thoroughly during design stage of the temporary steel platform & work using BIM to preview all conflict in each stage before construction.

Other Considerations of Design:

Early preparation and submission of 3 months prior to commence of construction works for consultant's review. Full set of drawing & calculation with RSE's endorsement is provided to secure both time arrangement & material sourcing.



BIM Coordination (5)



Construction load transferred to vertical columns (2)



Off site prefabrication (1)



Mobile lifting-platform (3)



Conflicts between steel platform and permanent structures (5)



Anchor bolt connection design (1)



Protective cover for welding (3)



Minimized steel member (4)





Design Load Assumption for Temporary Steel Deck

1. Major Live Load (Construction Stages):

The construction has been differentiated into 4 stages for the design of temporary steel platform:

Stage 1 : Construction of inclined column from 7/F – 10/F

- Stage 2 : Construction of 10/F deck
- Stage 3 : Construction of 10/F to 11/F Hanger Structure and the belt truss
- Stage 4: Construction of inclined wall from 7/F to 9/F
- 2. Notional Horizontal Force

Notional Horizontal Force has been incorporated to the stability checking of the temporary steel platform.

3. Wind Loads

Upward and downward wind loading acting on the decking has been included for steel platform design.

Desian Code and Reference

The structural steel design shall comply with the following: i. HK Code of Practice for Structural Use of Concrete 2004

- ii. HK Code of Practice for Structural Use of Steel 2011
- iii. HK Code of Practice on Wind Effect 2004
- iv. Code of Practice for Dead and Imposed Loads 2011
- v. HK Building (Construction) Regulations

Material Properties

Steel

Steel Grade

Steel Grade

Design Strength

Design Strength

i.

ii.

Concrete Concrete strength for Wall/Column Concrete Strenath for Beam/Slab Concrete density

60 MPa 40 MPa 24.5 kN/m³

- S275 JR 275 N/mm² (Thickness<16mm) S355 JR 355 N/mm² (Thickness<16mm) 345 N/mm² (Thickness<40mm)
- Design Strength Welding iii. Design Strength of Weld iv.

Grade 8.8 Bolt Design shear strength (P.) Design bearing strength of bolt (P_{bb}) $= 1000 \text{ N/mm}^2$ Design bearing strength of connected part (P_{bs}) Design tension strength (P_{+}) $= 560 \text{ N/mm}^2$

$= 375 \text{ N/mm}^2$

220N/mm²

- $= 550 \text{ N/mm}^2$

Tender Stage – Preliminary Design of Temporary Steel Deck

The preliminary design of the steel platforms consisted of three separated steel decks at 3 different levels. Each steel platform shall be erected once the corresponding permanent RC structures reached the soffit of the steel platform. However, the erection works for the steel platform would be highly depending on the progress of the permanent works under this approach. Moreover, it is not recommended due to safety reason, where both welding works and regular RC construction works would be conducted concurrently at the same location.

Final Stage – Design of Temporary Steel Deck

The final design combines all three layers of steel decks into only one layer with its footprint large enough to cover the floor plan for the upper level structures. This approach has significantly reduced the amount of steel that is used for the temporary works. it also allows the early commence of the construction works of the steel deck while remains the core wall construction uninterrupted. Furthermore, as the steel deck erection works no longer coexists at the same location for the RC construction works, the safety aspect of the construction site has been highly improved.







Final Design of Temporary Steel Deck

The construction of the 1110 sq. m. Temporary Steel Platform on 3F (+18.9 mPD). The level of the steel deck is at +31.750 mPD. The purpose of this method statement is to outline the safety measures, the detailed construction sequence and methodology for the construction of the Temporary Steel Platform.

General Methodology for the Construction Temporary Steel Platform

The key components of the temporary steel platform consist of:

- A. SP1 Vertical posts;
- B. SB1 Main girders;

Type 1: Supported by diagonal bracing (SB7 & SB11) fixed on core wall Type 2: Supported by spanning between core wall and SP1

- C. SB2, SB3, SB5, SB8, SB10 Secondary beams;
- D. D1 FSP III sheet piling decking;
- E. SB9 Diagonal bracing between core wall and SP1

After installation of SP1 and its temporary bracing, 8 groups of falsework (Ringlock system) tower are erected directly below all the SB1 to act as temporary support. The SB1 is situated in accordance to the final setting out and level. After confirmation of setting out and level for SB1, the end of Type 2 SB1 is fixed to SP1 according to approved drawings. Then the secondary beams (SB2, SB3, SB5, SB8 and SB10) are erected spanning between all the SB1 and SP1 following by the installation of sheet piling decking (D1).

In conjunction to the installation work of the secondary beams, the concreting works for the core wall is continued and cast in anchor bolt at 5/F, 6/F and 7/F is installed once the core wall reached the relevant floor level. After completion of concreting works, final checking of the setting out for cast in anchor bolt is performed following by the installation of baseplate according to approved drawings.

Upon the completion of concreting works at 7/F, SB1 is connected to the core wall through the designed baseplate according to Detail "R". Lastly, all the diagonal bracing (SB7, SB9 and SB11) is installed correspondingly.

The temporary falsework and the temporary bracing for SP1 are not removed until all the steel members has been fully installed and the relevant core wall has obtained its design strength (C60).



Falsework (Ring-lock system) Page 6









and UB1016x305x437 kg/m) which is spanning between the C60 core wall and steel post (UC356x406x340 kg/m) with moment resisting connections. The main girders then support the decking (FSP III) to provide a flat surface for the falsework erection. The steel post and the diagonal bracing supporting the main girder is supported by the permanent RC structures. Sufficient structural checking has been provided to ensure that there is no adverse effect on the structural integrity of the permanent works.

Detail "R" Page 7 i jukoo

14

SECTION "R1-R1"

. Dit enige

DETAIL R/DETAIL R'

SCALE: 1:10





Dismantling of Temporary Steel Deck

The sequence for the dismantling of the temporary consist of 5 stages. In general, the general dismantling sequence will start with FSPIII sheet pile decking -> Secondary beam -> Diagonal steel member -> Main beam -> Vertical Post -> steel plate and anchor bolts.

- Stage 1: 8 nos. of T25 stainless steel omega lifting hook to be preinstalled on the inclined column (anchored on the permanent structures);
- Stage 2: After the steel member has been fastened and secured on the lifting hook, utilization of winch and chain block to help safely descent the detached steel member to flat roof at 3F;
- Stage 3: Once the steel member reached at 3F, it would be hauled to the lifting area by another winch system setup at 3F;
- Stage 4: The detached steel member will be lifted to delivery trucks for transport to steel fabrication yard.



Typical details for T25 Stainless steel omega lifting hook



Graphical demonstration for diagonal steel member dismantling



Safety Management:

The safety management function for the temporary steel deck are fully complied with the safety management functions of the RC stated in Technical Memorandum for Supervision Plans 2009.

Risk assessment is prepared before works & design brief to worker is carried out to remind the critical issue. Particular protection to vertical steel post is provided during steel beam erection to avoid crash by lifting platform. Besides, fully "Fall Assets System" is provided for workers who is working at height. Designated person to monitor the welding works with covering sleet.

Daily basic briefing / training for all related workers are conducted before works commencement.

Quality Supervision:

The working procedures for the temporary steel deck is prepared strictly in accordance with the guidelines stated in Code of Practice for Site Supervision 2009. The temporary steel deck is defined as case 2 temporary works.

Designated site foreman monitors the whole process. Daily brief of all works is carried out before commencement. Checklist is signed by subcontractor, T1, T4 & representative of RSE after works. Setting out of cast-in bolt is checked before casting. An HKOLAS lab is employed to test all welding works following the requirement of Code of Practice.

Environmental Issue:

This scaffolding mostly uses reusable metal to replace traditional single-used bamboo. Moreover, rising of the scaffold level reduces the use of bamboo substantially for about 6-storey-quantity of material. Therefore, this methodology is eco-friendly which could reduce numerous waste of resource.



Protective Handrail along steel deck



Provided Proper Safety access between 3/F floor level and steel deck



Briefing / Training for worker before steel deck construction



Storage area under steel deck



Pull out testing by certified laboratory



Construction falsework on steel deck



<u>Mobile lifting – platform</u> <u>for working at height</u>

 華營建築有限公司 CR Construction Co. Ltd

 Project:
 查測層任新圧的坦1號(HNS)地值

每日放工前鐵台工作檢查表

工字鐵編號 檢查事項		XB 10	
		1/4/2017	備註
1	已停止所有热工序	12	
2	已服底视察工作地點, 说明並無留下火種或存 在火營產險	/	
3	機械及手提電動工具已把電源簡上及收好	~	
4	已將風標傳關好及所存在合通位重及已檢查服 爆榫沒有泄漏	/	
5	教文設備情況良好		
6	安景之工字鐵接駁位置焊上至少 5mm 全焊	/	
7	工字螺反支撑已依據施工圖安聚	/	
8	支撑依據施工圈焊上 5mm 全焊	-	
9	支撑依撑地工圈安装足的螺丝丝锁紧	/	
10	其论		
	检查者(高輝-呉繼有): 苦著:	35	
	確認高輝收工檢查工作(華營-黃君偉): 簽署:	N	
	確認所有檢查工作(導管 T4-揭景迪): 簽署:	nt	
4	認所有檢查工作(華誉 RSE 代表-Ray Lam): 簽署:	Ph	

5 如須改善之事項目,請於備註一欄註明位置,時間及改善事項, 6 所有須改善之事項必須立即跟進並報告予有關人士







Contribution to safe and successful completion of the project

- 1. The Steel Deck provides the working space for material storage underneath.
- 2. Minimizing the number of scaffold (3/F to 7/F) means the max. height of scaffold is reduced from (18.9mPD to 52.9mPD) to (33.125mPD to 52.9mPD), the chance of "working at height" is therefore reduced.
- 3. The impact on site logistic is reduced due to limited space of site entrance and unloading area.
- 4. The required member of workers is reduced, which reduces the site safety risk.



View from Junction of Lockhart Road & Hennessy Road



Falsework erecting on steel desk



View from Junction of Arsenal Street & Hennessy Road



Under steel desk



Top View





View from HKT Lockhart Road Exchange Building

