12 June 2017



Hong Kong – Temporary Works forum (HK-TWf) 香港 – 臨時工程論壇

Why do we need a TW forum?

- 60% of the deaths in the industry are TW related
- As an industry we are not improving
- We are not learning from accidents
- We repeat the same thing over and

over hoping for a different outcome



Temporary Works are the biggest single risk in construction







Temporary Works are the biggest single risk in construction

Codes of Practice Permanent works





Who oversees good practice in permanent works design





ice







Code of practice for TW design

TW ProceduresBS5975



- How to design platforms for plant access?
- How to brief the designer?
- How to use a safety by design approach?
- How to believe the supply chain?
- How to check falsework?
- How to train front line staff and subcontractors?



Causes of failure

What leads to failure?

- Inadequate design, construction and/or maintenance of TW
- Poor communication
- Inadequate checking
- Unauthorised changes to design
- Improper use of materials
- Inadequate site investigations
- Failure to control loading
- Inadequate foundations
- Absence of or inadequate application of TW Procedure



Consequences of failure

- The result?
- Collapse or failure of TW
- Collapse of permanent works
- Ingress or egress of materials, spoil and water
- Significant delay and increased costs
- Fatalities and serious injuries







SCL project 11 July 2016. Fatality!!





Working Groups

- Control & Management of TW
- Falsework & Formwork
- Rebar Cage Stability
- Temporary Platform



Control & Management Procedures





Control & Management Procedures







Control & Management Procedures







- 1. Inadequate design brief
- 2. Lack of design
- 3. Inadequate checking (Designer / ICE / Contractor)
- 4. Poorly constructed works
- 5. Inadequate on-site checking
- 6. Inadequate communication / lack of awareness of assumptions
- 7. Unauthorised changes to approved designs
- 8. Inappropriate use of materials
- 9. Inadequate temporary foundation systems

10.Failure to control loading in line with design assumptions



Review of Contract Requirements

Client	Contract Requirements		ICE Site	TWC
CEDD	Design for specified elements to be certified by ICE	Y	Y	Y
Highways	Design for specified elements to be certified by ICE	Y	Y	Y
WSD	Design for specified elements to be certified by ICE	Y	Y	-
ASD	Varies (Liantang – RPE) / (Columbarium – as above)	Varies	Varies	Varies
MTR	Design for 'non-minor' elements to be certified by ICE	Y	-	Y
Buildings Department	Code of Practice for Site Supervision 2009 (TCP's)	RSE	RSE	-
Airport Authority	Design to be certified by ICE	Y	-	-
WKCD	Design to be certified by ICE	Y	-	-
Science Park	Design for specified elements to be certified by ICE	Y	-	-
CLP / HKJC	No specific requirements (BD requirements)	-	-	-
Private Developer	No specific requirements (BD requirements)	-	-	-



Review of Contract Requirements

Buildings Department

Do the temporary works require BD approval ?

Y – AP / RSE to supervise the works

Do the temporary works cause any effect on the permanent works ?

Y – *RSE to give permission to proceed N* – *RC to carry out the works*





Current Challenges in HK

- 1 No commonly adopted code of practice or standard procedures for temporary works
- 2 No consistency in temporary works requirements across different Clients
- 3 A general focus on design rather than control procedures
- 4 Building Department SSP requirements focus on permanent works and don't adequately address or control temporary works
- 5 Permanent works design seldom address construction methodology / temporary works



Review of Current Industry Practice

Current Challenges in HK

- 6 General lack of experience in temporary works designers
- 7 Lack of involvement of Operations Team in temporary works process inc. Design Brief
- 8 Design briefs are often inadequate constraints, access, erection, dismantling
- 9 Change process for temporary works schemes is typically poorly managed on projects



Falsework & Formwork





- Lack of appreciation that falsework is the biggest of all the temporary works risks
- Lack of understanding of how falsework behaves
- The supply chain



Why does falsework collapse?

- The unbraced cantilever
- Lack of node to node diagonal bracing
- Eccentric loads.





The supply chain





The supply chain





HK-TWf proposed response

A. Basic Information

This guideline note is based on the MODERN - ARMS scaffolding system catalogue (attached in Appendix A - ARMS Catalogue) and also the current design code in HK - COP for the Structural Use of Steel 2011.

B. System Component

Main Component	0.D.	Thickness	Steel Grade	Photo
Vertical Post	48.3mm	3.25mm	Q345	
Diagonal Bracing	48.3mm	2.5mm	Q345	
Horizontal Ledger	48.3mm	2.5mm	Q345	ARMS



C. Recommend Working Load Capacity



The above recommended load is based on the system component size and steel grade as specified in the catalogue and design according to the COP for the Structural Use of Steel 2011. F.O.S. of 1.6 was applied to develop the safe working load. Please note that the above SWL is also based on the criteria as stipulated in Section E. (Note - limited to 45kN SWL)

D. Bracing & Ledger Arrangement

Below is the proposed ledger and bracing arrangement. All vertical post should be connect with ledger and bracing in 2-direction unless a detail design justification considered all adverse loading conditions including windload, member imperfection, out-of-plumbness and construction tolerance etc., submitted for review. Faisework towers should be connected together to fulfill the height-width ratio of 3 in 1.







Training and training materials





Formwork – In Reality



Formwork Observed on Construction Site









Formwork – Failure





Formwork – Failure





Formwork – Industrial Issues

IN-SITU WALL FORMWORK THROUGH TIES





Formwork – What Caused Failure?

Factors Likely to Affect the Formwork Performance & Stability

- 1. Basic, Retarded or Heavily retarded concrete
- 2. Concreting Temperature
- 3. Quality of Plywood, grades of timber joist
- 4. Spacing of primary / secondary bearer
- 5. Rate of concrete pour
- 6. Concrete pour methods
- 7. Design of through steel ties
- 8. Quality and workmanship of steel ties

- 9. Erection sequence of double sided wall forms
- 10. Omission of uplift forces in single sided wall form
- 11. Excessive wind load
- 12. Factor of Safety (FOS)
- 13. Design assumption of concrete fluidity
- 14. Formwork designer lack of experience
- 15. Irrelevant Code of Practice for formwork design and implementation
- 16. Site representative lack of understanding in Formwork

Common Industrial Issues......

- Neglect the importance of designed concrete rate of rise during concrete pour.
- Young Engineer / Frontline staff understating / not understanding rates of pour in conjunction with concrete delivery.
- Due to common procurement strategy practices among rebar fixer & formworker, welded ties is the only option.
- Non-Standardize of Formwork material properties by different designers.



Sep 2015, Hong Kong Steel fixing in progress...

After collapse...





- July 2011, Hong Kong
- Two killed





Dec 2014, China

COMPOSITION OF

10 killed















Temporary Works forum

Available Reference

July 2013

www.hkcic.org



Temporary Platforms



... related accidents ... (2007 – 2016)







Type of Accident Working platform collapsed



Trade Foundation Type of Accident Fall from height





Trade Civil Type of Accident Fall from height









Collapse of working platform uncontrolled loadings ... ?

Section











Fatal traps edge protections gave way ...









Dismantling of the platform went wrong ...





Openings were not captured in the planning and designs ...





Failure at connections corrosions ... fatigue ...





Unplanned logistics underneath risk to platform stability ...







COMMUNICATION Design Loading



STEEL MEMBER SUMMARY				
MEMBER		MEMBER SIZE		GRADE
MAIN BEAM (MB1) FOR PLATFORM LEVEL AT +6.40		TWIN 610×305×238 UC		S355
SECONDARY B (SB1) FOR PLATFORM LEV AT +6.40	eam El	TWIN 610x305x149 UC @2500 c/c MAX.		S355
MAIN BEAM (M FOR PLATFORM LEVEL AT +5.1	182) 1 34	TWIN 305X305X223 UC		S355
SECONDARY B (SB2) FOR PLATFORM LEV AT +5.84	eam El	TWIN 305X305X223 UC @2500 c/c MAX.		S355
KING POST (K	P1,KP18)	305×305×2 (EXCEPT OTHERWIS	23 UBP E STATED ON PLAN)	S450J0
HORIZONTAL T	IE	203x203x6	0 UC	S355
BRACING		102x51x10	.42 CHANNEL	S275
DECKING		FSP III SHE (EXCEPT OTHERWIS	ET PILE E STATED ON PLAN)	S275
GUSSET PLATE STIFFENER, BEARING PLAT	e.	VARIOUS SIZE & THICKNESS		S355
Working Radius (m)	Max. Lifting Load for BM1000 (75 ft boom) {Ton}		Max. Lifting Load for BM1000 (98 ft boom) (Ton)	
5		35@5.4	-	
6	32.5		30.5@6.4	
7	29		28.5	
8	26		25.5	
9		23.5	23.5	
10		21.5	21	
11	19		18.5	
12	16.5		16.5	
13	15		14.5	
14	13.5		13	
15	12		12	
16	11		11	
17	10.5		10	
18	9.5		9	
19	9		8.5	
20	8		8	





COMMUNICATION Design Loading





COMMUNICATION Construction sequence ...



COMMUNICATION Dismantling sequence ...



I) Dismantling Sequence of Sheet Piling 拆除鐵台閘板程序



Red Barrier 紅窗



DESIGNER'S NOTE - RESIDUAL RISK CLEARANCE DISTANCE BETWEEN 2 CRANES SHALL BE AT LEAST 10m



	HOLD POINT (3.1)
Checklist:	
3.1.1 Have	the lifting points been inspected by Site Responsible Person? 經地盤主管檢查吊運點
3.1.2 Is the	lifting chain vertical? 吊鏈是否垂直?
3.1.3 All pe	rsonnel to be kept clear from the exclusion zone? 所有工人是否已離開吊運區
3.1.4 Suffici	ient chains to be provided?吊鏈數量是否足夠?
3.1.5 Have checked the Independent lifeline secure the fixed point? 獨立救生繩是否已固定在穩固點	
3.1.6 Crane	lorry support fully extended? 檢查吊機支撐腳全部伸出?



STANDARDISATION Barrier and Handrail



DESIGN IMPACT LOAD: BS5975 4.4.3.3 – Vehicle Crash Barriers: 7.5kN/m applied in any direction.



Plant and Worker Separation



Plant and Worker Separation



Working Groups Composition

Control & Management of TW

Name	Company
Stephen Lumb	Leighton
David Sein	Leighton
Gary Chou	Chun Wo
Scott Smith	Aurecon
Tony Willis	Benaim
Wing Law	Jacobs

Rebar Stability

Name	Company
James Sze	Arup
Anthony Chiu	Arup
Henry Shiu	Arup
Kelvin Yeung	Winfield
Alvin Lei	Build King
Kelvin Ho	Hsin Chong
SS Chu	Tysan
Chris Cheng	Gammon

Temporary Platform

Name	Company
lan Askew	Gammon
Paxson Chan	Arcadis
Terence Lam	CEDD
William Robinette	Lambeth
David Sein	Leighton
Nick Southward	Tony Gee
Tommy Szeto	, Aurecon
Gavin Toh	Lambeth

Falsework & Formwork

Name	Company
Benson Tang	Leighton
lain Mowatt	Gammon
William Robinette	Lambeth



7. Goals / Objectives

Objectives

- 1 Best Practice Guide (for Designers, Contractors & Clients?....)
- 2 Training e.g. TW Awareness Course, TWC Training Course



- Ian Mowatt, Chairman and Champion of Falsework & Formwork ian.mowatt@gammonconstruction.com
- Steve Lumb, Champion TW Management <u>stephen.lumb@leightonasia.com</u>
- Henry Shiu, Champion Rebar stability <u>henry.shiu@arup.com</u>
- Gavin Toh, Champion TW platform gavin.toh@lambeth.com.hk

Thankyou