Design for Safety – Working at Height

Andy Lo

IOSH Council Member
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About IOSH

- Formed 1945; Royal Charter 2003
- Individual Charter 2005
- International NGO status (ILO) in 2006
- World’s largest health and safety professional body
- Over 47,000 members in more than 100 countries
- Independent, not-for-profit organisation
- Sets professional standards and provides OSH guidance
- Member of ENSHPO, INSHPO and APOSHO
Agenda

- Background
- Introduction of Design for Safety – Working at Height
- Development Bureau (DEVB) Experience
- Highways Department (HyD) Experience
- Airport Authority (AA) Experience
- Housing Authority (HA) Experience
- The Way Forward
- Q&A
Design for Safety – Working at Height
Background

**Design for Safety (DfS) – The Hong Kong Experience**

• In January 2001, the Construction Industry Review Committee (CIRC) appointed by Chief Executive of the Hong Kong SAR made a review on construction site safety and stressed that:
  • Site safety was a **shared responsibility**;
  • **Hazard identification** should start from the early design stage, and throughout the whole project life cycle; and
  • The **UK CDM** might provide a **base for improving** site safety in Hong Kong.
UK CDM Approach
UK - CDM

UK Construction (Design & Management) Regulations – CDM

• High fatality rate in UK construction industry (217 fatalities in the last 5 years in Great Britain) 40 in UK per year or 4 in HK per year

• Construction (Design & Management) Regulations were enacted in 1994 and came into force in 1995 by HSE. A review was conducted in 2007.

• Currently the 2015 version was enacted on 6th April 2015.
Key themes of CDM Regulations

• Identification of health & safety hazards and cost-effective mitigation measures early in & throughout the project.

• Timely involvement of relevant stakeholders and provision of necessary health & safety related information.

• Clear definition of roles & responsibilities for coordinating and communicating risk-related data at all stages of the project.
UK - CDM

Key themes of CDM Regulations -

Clients

- A commercial client is an organization involved in business and a **domestic client** is not involved in business but works in own property or in family.

- Ensures from start to finish in a way that adequately controls the risk to health and safety of those who may be affected.

- Client’s Health and Safety **brief to the designer**.
UK - CDM

Key themes of CDM Regulations - Designer

- Prepares or modifies a design for any part of a construction project, including temporary works.

- Understand and be aware of significant risks.

- Have right skills, knowledge, and experience, and be adequately resourced to address the health and safety issues likely to be involved in the design.
Key themes of CDM Regulations - Contractor

- To plan and manage construction work under their control so that it is carried out in a way that controls risk to health and safety.

- Responsibility to manage the work; co-operate with other duty holders; consult with employees; prepare the construction plan; ensure welfare facilities are provided.
Key themes of CDM Regulations – Workers

- Must be consulted about matters which affect their health, safety and welfare.
- Must cooperate with their employers, fellow workers, contractors and other duty holders.
BS 8560:2012

Code of Practice for the design of buildings incorporating safe work at height

BSI Standards Publication

Code of practice for the design of buildings incorporating safe work at height
BS 8560:2012 encourages designers to assess, as early as possible in the design process, how work at height can be minimized, and where required the provision of practical, efficient, cost-effective solutions for the safety of those who work at height.
Building and site characteristics

- Vertical plane walls
- Slope out
- Step back
- Sloping glass roof
BS 8560:2012

Code of Practice for the design of buildings incorporating safe work at height – Flat Roof

13a Temp edge protection with sockets
14 Temp perimeter scaffold during construction and maintenance
BS 8560:2012

Code of Practice for the design of buildings incorporating safe work at height – Low Rise pitched roof

1 Leaning ladder with anchor points and tension strap, life lines
5 Scaffold tower
BS 8560:2012

Code of Practice for the design of buildings incorporating safe work at height – Ground Equipment

3 Long pole
7 Mass climbing platform with Z for tie back
5 & 6 MEWP
BS 8560:2012

Code of Practice for the design of buildings incorporating safe work at height – Building-Mounted Equipment

1 Monorail
2 One man cradle
3 SWP
7 External gantry
BS 8560:2012

Code of Practice for the design of buildings incorporating safe work at height – Personal access equipment

3 Vertical access with fall protection
5, 11 Anchor line and work restrain system
Development Bureau Approach
DEVB Approach

The Essence of DfS

• The main objective of Design for Safety system is to achieve:

  • Identification of potential health and safety hazards at early stage of a project and continue throughout project delivery;

  • Early involvement of all stakeholders through timely provision of necessary information; and

  • Clear demarcation of the roles and responsibilities of different parties on risks at all stages of a project.
Who is responsible for implementing DfS?

- Client;
- Designers (architect/engineer/maintenance surveyor);
- Contractors (including principal contractors and sub-contractors);
- **Maintenance Supervisor** (the client’s or end user’s representative supervising maintenance works).
DEVB Approach

The Key Words for Roles and Responsibilities of Duty-holders are:-

- Competency;
- Co-ordination;
- Co-operation;
- Communication; and
- Commitment.
The Application of Design for Safety Under Different Project Stages:-

• Preliminary Design:-

• Consider Health and Safety (H&S) together with cost, fitness for purpose, buildability, maintainability, usability and environment impact;

• Conduct brainstorming meetings and

• Record in the Summary of H&S Concerns.
DEVB Approach

Administration of the DfS Process

• Preliminary Design Stage
  Summary of H&S Concerns
  Preliminary Hazard Analysis
• Detailed Design Stage
  Risk assessment, design options, residual risk
  Hazard and Impact Summary
• Tender Preparation Stage
  Pre-tender Health and Safety Plan by Designer
  Outline Health and Safety Plan by Tenderer
• Construction Stage – Health and Safety Plan
DEVB Approach

**Hazard Identification and Risk Control**

- Identification of Hazards
- Risk Assessment
- Risk Control Measures
- Risk assessment structure *(ESCAPE)*
  - Elimination
  - Substitution
  - Control by engineering
  - Administration (permit to work)
  - PPE
  - Emergency preparedness
Highways Experience
HyD Experience

Construction of Passenger Clearance Building for HK Boundary Crossing Facilities (HKBCF)
HyD Experience

The Mega Passenger Clearance Building Roof Module under Transportation

Photo taken from HyD Web site.
HyD Experience

The Roof Module ready to be lifted
HyD Experience

The Roof Module supported by temporary works
HyD Experience

The Lifting Device
HyD Experience

The Slinging of the Roof Module through Rails
HyD Experience

The Temporary Sliding Rails
HyD Experience

Support to Roof Module and Temporary Rail
HyD Experience

Jointing of two Roof Modules
HyD Experience – HZM Bridge – Parapets Installation – Case Study

Pre-cast RC parapet delivered on site
HyD Experience

lifting by mobile crane
HyD Experience

The lifting C.G. with rebate in horizontal position
HyD Experience

The pre-cast parapet placed into final position with almost in a self standing situation
HyD Experience

The completed parapets with recess for utilities
The provision of handrail and safe access catwalk for glass panel cleaning
HyD Experience

Guard rail provided for gardener
HyD Experience

Proper working platform with access provided for lighting mast
Airport Authority Experience
Fall Prevention –
Use of Prefabrication

- Prefabrication done on the ground to reduce risk of working at height
- Units pre-fitted with temporary guardrails before installation
Fall Prevention – Use of Modularization

Prefabrication of Pipe Modules

Installation of Modules
Steel Beam Shutters – Guardrails & Toe-boards built with Shutters
Fall Prevention – Safe Platform
Ladders

Remark: A-ladders are prohibited in all projects
Roof Maintenance – Roof Walkways & Mansafe Systems

- Maintenance access system integral to roof design
- Access to roof from inside the building only
- Thorough fall arrest system to ensure ease and protection for future maintenance staff
Under-slung Platform
Roof Maintenance –
(Roof Top Walkway & Fall Arrest System)
Roof Maintenance – Stainless Steel Roof Ladder with Telescopic Safety Posts

Bilco Ladder
Internal Working Platform with Outreach Arm

Aerial Working Platform

Mobile Scissor
Some More Local Working at Height Experience
Sophisticated Columns and Segments Construction
Lifting Frame for Segments Erection
Segment erected with guard rail before lifting
Fall protection bar behind the doorway of utility falling pit
Ventilation Fan Module Assembled at Ground to Reduce Falling Hazards and Easy Maintenance
Built-in Mobile Working Platform at Tsing Yi Station for Cleaning and Repairing
Very Good Design and Artistic but Difficult in Maintenance and Cleaning
Housing Authority (HA) Approach
HA Approach

Background and purpose of the Pictorial Guide

- Jointly organized by the HA and the Occupational Safety and Health Council (OSHC).

- A safety workshop on “From Cradle to Cradle – Workshop on Planning and Design for Safety in Project Life Cycle for Public Housing Developments” was held on 31 March 2010.

- With a charter signed by all signatories pledging commitment to observe and drive planning and design for safety.

- Latest version issued in January 2017
HA Approach

Use of precast concrete stairway provide an early access to floors, maintain good quality of work
HA Approach

Use of precast concrete floor panels to eliminate falling hazards when erecting timber formwork and placing joists
HA Approach

Pre-designed RC parapet wall with through holes for anchoring and mounting for suspension working platforms for maintenance works
HA Approach

Safety Considerations in the provision of stairways at roof top lift plant room – Safe Access

A retro-fix of stairway to replace the cat-ladder for safer access and material handling. Heavy cross beams added to support the stairway.
Safety Considerations in the use of precast toilets with epoxy coated reinforcement bar - reduce maintenance
HA Approach

Safety Considerations in the provision of special window hinges to allow cleaning from both sides – Safe for Cleaning
HA Approach

Safety Considerations in the provision of Air Conditioner Space and allow installation from inside the house – Safe for Maintenance
UK Experience
UK Experience

Provision of Safe Access at Roof
UK Experience

Provision of Safe Access Gantry for Maintenance Work
UK London Eye Experience

Over view of London Eye
UK London Eye Experience

Design for Maintenance – **Built-in hydraulic lifting crane and man-cage for maintenance work**
UK London Eye Experience

Safe Access Ladder for Maintenance and Rescue
UK London Eye Experience

U-shape Hand-holds at outside of Capsule for Evacuation
Safety Netting at a Church in London
Complicated metal scaffolds and working platform provided at pitched roof
Mast climbing working platform
Powered cradle for inspection and maintenance work
Advanced guardrail installation method

ADVANCED GUARDRAIL INSTALLATION METHOD

Telescopic rails allow danchons that are attached to the standbys to be moved up to the next platform level while the scaffoldie avails on the platform below. Platforms must be fully plumbed from below before scaffolders move up to that level to install the platform guardrails.

PROGRESSIVE GUARDRAIL INSTALLATION METHOD

A guardrail is installed from the level below before the work platform is installed (see Figure 12). The scaffolders can then enter the platform with the edge protection already in place.

Figure 11: Advanced guardrail system
Figure 12: Progressive guardrail installation
Shape of guard rail used in the advanced installation method
Advanced Guardrail - Different type of scaffold, different installation method...
Typical tubular metal scaffolds – Scaffold boards noted at the working level
Strong Anchorage to Wall by Eyebolt at Scaffolds
Metal Gate at Floor Access of Scaffolds
Scaffold Tag with Check List
Use of trestle ladder noted
Some More Overseas Experience
Aluminum Scaffolds at Church - Germany
– Can this be replaced by bamboo scaffolds
Access Ladders – Germany
How about the bamboo ladder at bamboo scaffolds
Access Tower to Roof - France
The dedicated timber guard rail is erected in-line with the floor level - NZ
Sub-standard Scaffolds - Mauritius
Scattered Planks at Scaffolds - Tunisia
Poor Planks Arrangement - Tunisia
Home Made Scaffolds - Tunisia
Suspended Working Platform Around Building - Korea
Access and Working Platform to underneath of Viaduct - Korea
Scaffolds with Standing Planks and Built in Vertical Access Ladder - Singapore
Working at height safety training - Singapore
Working at height reference - NZ
Conclusion
Benefits of Design for Safety

• Eliminate of hazards at source
• Reduced need for redesign and retrofitting
• Greater predictability in construction, maintenance and operation costs
• Reputation, socially and ethically responsible
Barriers of Design for Safety

- Lack of experience in DfS
- Lack of awareness by duty holders
- Designers fear of un-deserved liability for workers safety
- Increased costs for designers
- No specific legislation – (Transition with Guidance Notes or COP)
The Way Forward

• More resource, research, training, for stake holders, designers, safety practitioners, contractors and end-users on CDM subjects;
• Building up of a local data base on construction hazards, risk and its mitigation measures;
• More active roles from universities and institutions;
• Adopt new technology, BIM, new construction methods; and
• More sharing of experience among different countries and cities.
Reference

• Design for Safety Examples.pdf
• Design for Safety Guidance Notes.doc
• Pictural Guide to Planning and Design for Safety, HA
• www.workcover.nsw.gov.au/Pages/default.aspx
• CDM Guidance Notes : www.safetyindesign.org
• The Construction (Design and Management) Regulations 2015 – UK
• CDM 2015 Questions and Answers – A practical approach – Pat Perry
• CDM Regulations 2015 Explained – Raymond Joyce
• LD, OSHC, DevB and CIC relevant OSH publications

Andy Lo: andyhylo@gmail.com; Ph +852 9096 8937
Note:-

- Safety standards, COPs, laws and regulations various from countries to countries, some of the examples quoted in this presentation may not be complied with the local safety legislation requirements.