COMPETENCY REQUIREMENTS
Design for Safety for Professionals Course





Updated in October 2015 by the Workplace Safety and Health Council in collaboration with the Ministry of Manpower.

All rights reserved.

This document is provided for explicit use and guidance of MOM Approved Training Providers as information resource for Design for Safety Professional training purposes. Any other use of this document or parts thereof, including reproduction, publication, distribution, transmission, retransmission or public showing, or storage in a retrieval system in any form, electronic or otherwise, for purposes other than that expressly stated in this advice, without the expressed permission of Workplace Safety and Health Council and Ministry of Manpower is strictly prohibited.

Version	Effective Date	Changes	Author
1.0	March 2011	First issue	WSH Council Office
2.0	October 2015	Update	WSH Council Office

1. Overview

This Competency Requirements document specifies the performance criteria, underpinning knowledge and range and context for the design, training and assessment of the Design for Safety for Professionals Course. Learners of this course will gain the knowledge and skills for fulfilling the roles of the construction Design for Safety Professional (DfS Professional) in accordance with the WSH (DfS) Regulations.

Objectives

Upon completion of this unit, Learners will have the skills and knowledge to function as a DfS Professional which purposes to:

- Assist the Developer to identify and address means to eliminate or mitigate the risks inherent in the design of a construction project through conducting DfS review meetings and maintaining a DfS register so as to reduce the safety and health risks during the construction, maintenance / repair phase, and demolition of the building and structure; and

- Coordinate the flow of the construction project safety and health risks information among the stakeholders from the design stage, to construction stage until the handover to the Developer for occupation and maintenance.

Learning Outcomes

The skill and knowledge learnt during this course are likely to be applied in the following activities:

- Facilitate DfS Review Meeting that involves the relevant stakeholders to identify and address safety and health risks associated with construction project.

- Maintain records of safety and health issues arising from the DfS Review Meeting and actions taken.

- Coordinate the flow of relevant safety and health information among all stakeholders of a construction project at appropriate time.

Competency Elements

The competency requirements comprise three competency elements. These elements will be taught during the course curriculum and Learners must satisfy the requirements that assess their abilities to meet the performance criteria set under each competency elements.

1. Facilitate DfS Review Meeting
2. Maintain Safety And Health Records
3. Communicate Safety And Health Information To Stakeholders

Youtube Video: Design for Safety video, 2016 version.

Assumed Knowledge and Skill

As persons taking up the roles of DfS Professional are likely to be experienced professionals in the construction industry, they would have possessed certain qualifications, knowledge and experiences needed for the DfS Professional roles. To recognise the prior learning of the Learners in the course, and for more efficient delivery of the curriculum, it is expected that Learners possess the following assumed knowledge and skills, which will not be covered in this course:

- Building design and construction operations
- Building and construction processes
- Legal and statutory requirements associated with building and construction
- Basic safety and health issues associated with construction operations
- Written and oral communication, presentation, facilitation and problem solving skills

2. Competency Requirements

Competency Element 1: Facilitate DfS Review Meetings to identify and mitigate the safety and health risks

A competent individual must be able to successfully perform the following:

Performance Criteria	
PC1.1	Recognise the importance of design for safety and health of a construction project to eliminate or mitigate such risks throughout the different life cycle of a building and structure.
PC1.2	Recognise the duties and responsibilities of DfS Professional in accordance with WSH (DfS) Regulations.
PC1.3	Advise stakeholders in a construction project on their duties and responsibilities in accordance with WSH (DfS) Regulations
PC1.4	Prepare for DfS Review Meetings in accordance with WSH (DfS) Regulations.
PC1.5	Coordinate DfS Review Meetings for consideration of safety and health risks at different phases in the life cycle of a building and structure
PC1.6	Apply hazard identification tools and risk assessment for DfS Review Meetings in accordance with organisational procedures.

To meet the performance criteria above, the candidate needs to know and understand the following underpinning knowledge, with the range and context as illustrated in the following table:

Ref PC	Underpinning Knowledge	Range and Context
PC1.1	UK1.1 Importance of design for safety and health for construction projects	Importance of design for safety and health for construction projects may include and not limited to: o Improve planning and management of project at early stage of project. o Identify risk at design stage so that they can be effectively eliminated or mitigated o Reduce overall costs of construction, repair and maintenance of a building and structure o Prevent injury and ill health to persons o Minimise unnecessary delays o Improve quality of finished product o Complying with legal requirements, which include and not limited to

Ref PC	Underpinning Knowledge	Range and Context
		○ WSH Act ○ WSH (DfS) Regulations ○ WSH (Risk Management) Regulations ○ WSH (Construction) Regulations
PC1.1	UK1.2 Phases in the life cycle of a building and structure	Phases in the life cycle of a building and structure, which include: ○ Design ○ Construction ○ Maintenance / repair ○ Demolition
PC1.2	UK1.3 Duties and responsibilities of DfS Professional	Duties and responsibilities of DfS Professional, which include: ○ Facilitate DfS Review Meetings ○ Maintain safety and health records ○ Coordinate flow of safety and health information
PC1.3	UK1.4 Stakeholders' duties and responsibilities in a construction project	Stakeholders, which include: ○ Developers ○ Designers ○ Main Contractors ○ Subsequent Building Owners ○ DfS Professionals *Stakeholders' duties and responsibilities include those as defined in the WSH (DfS) Regulations.
PC1.4	UK1.5 Prepare for DfS Review Meetings	Prepare for DfS Review Meetings, which may include: ○ Establish Safety and Health Review Committee, which may include: ○ Developer ○ Design Engineer ○ Architect, ○ DfS Professional ○ Contractor ○ Collate relevant information, which may include: ○ Drawings ○ Specifications ○ Topographical surveys ○ Soil investigation reports ○ Site risk assessment records ○ Pre-construction survey of adjacent buildings and works

Ref PC	Underpinning Knowledge	Range and Context
		o Define scope for DfS Review Meetings o Define roles and responsibilities of persons involved in the DfS Review Meetings o Determine hazard identification tools and risk assessment methods to be used o Establish checklists and matrixes to be used for hazard identification and risk assessment o Arrange necessary training of persons involved in the DfS Review Meetings o Determine the method of documentation of the DfS Review Meetings o Schedule DfS Review Meetings sessions o Make logistic arrangements for the review
PC1.4	UK1.6 DfS Review Meeting	Process of DfS Review Meetings, which include: o G – Group together a review team consisting of major stakeholders. o U – Understand the full design concept o I – Identify the risks that arise as a result of the design or construction method o D – Design around the risks identified to eliminate or to mitigate the risks. o E – Enter all the vital information on safety and health risks and mitigating measures into the DfS Register
PC1.4	UK1.7 Phases of DfS Review Meetings	DfS Review Meetings at different phases before commencement of construction activities, which include: o GUIDE 1: Concept Design Review o GUIDE 2: Detailed Design, Maintenance and Repair Review o GUIDE 3: Pre-Construction Review
PC1.5	UK1.8 Coordinate DfS Review Meetings	Coordinate DfS Review Meetings, which may include and not limited to: o Guide Safety and Health Review Committee to keep discussion focused and on track o Encourage stakeholders involvement and cooperation in the review o Assist in identifying risks and highlighting the hazards concerned o Assist in identifying control measures for risk that cannot be eliminated o Promote the design suitability and compatibility

Ref PC	Underpinning Knowledge	Range and Context
PC1.5	UK1.9 Safety and health risks considerations during DfS Review Meetings	Considerations to be taken for safety and health risks at various phases of a life cycle of a building and structure may include: o Site planning and preparation, which may include: o Soil condition o Site topography o Under ground water o Underground services o Condition and proximity of adjacent buildings o Vehicular traffic movement o Pedestrians movement o Transport and storage of materials o Site clearance and demolition o Access and egress of persons o Excavation & Tunnelling o Trenches o Civil and structural works o Road works, pipe and cable installation, road reinstatement and maintenance o Soil investigation, stabilisation and earthwork services o Piling o Concreting o Concrete repair and surface works o Metal scaffolding o Metal formwork and supporting systems o Steel reinforcement o Structural steel works o Timber formwork and support systems o Precast erectors o Prefabrication o Architectural and Finishing Works o Wall and partition o Ceiling o Curtain wall / cladding o Drain Laying / pavement and kerb construction o Windows and doors o Joinery o Metal work o Painting and road marking o Plastering o Roofing o Flooring o Waterproofing

Ref PC	Underpinning Knowledge	Range and Context
		○ Horticulture and landscape ○ Additions, alterations, repair and interior decoration ○ Mechanical and Electrical Works ○ Air conditioning, refrigeration and ventilation works ○ Electrical engineering works ○ Fire protection works ○ Plumbing, sanitary, gas piping and sewerage works ○ Lift escalator installation ○ Building automation, industrial and process control system ○ Equipment and special services ○ Construction plant and equipment services ○ Corrosion protection services ○ Cleaning and housekeeping services ○ Desalting services ○ Waste removal and recycling services ○ Pest control services ○ General consideration ○ Heaving lifting ○ Temporary works and sequencing ○ Layout ○ Confined spaces ○ Emergency route ○ Weather ○ Impact to the public ○ WSH hazards during construction, maintenance, repair phases of building may include: ○ Falling from height ○ Struck by falling objects ○ Caught in between objects ○ Exposed / contact with electricity ○ Exposed / contact with Harmful Substances/Radiations ○ Step on object ○ Noise Induced deafness ○ Dermatitis ○ Solvent exposure ○ Manual handling ○ Muscular skeletal disorder ○ Hand/arm vibration syndrome

Ref PC	Underpinning Knowledge	Range and Context
PC1.6	UK1.10 Hazard identification tools	Hazard identification tools, which may include and not limited to: o Checklists, which include: o GUIDE1 Checklist o GUIDE2 Checklist o GUIDE3 Checklist GUIDE checklists may include: o Hazards considerations in design o Guide words / prompts o Detail / hazards identified o What-If analysis o Steps in conducting the analysis involves: o Develop What-If questions o Determine the answers o Evaluate the risk o Recommend control measures o Record the results of analysis
PC1.6	UK1.11 Risk Assessment	Process of risk assessment, which include: o Identify and analyse safety and health hazards o Evaluate the risks by considering factors, which include: o Existing risk control measures o Likelihood of occurrence o Severity o Risk level based on likelihood and severity o Control risks by mitigating measure, which may include and not limited to: o Design modification o Change in sequence of construction work o Change in construction material o Change in construction location o Change in positioning of equipment o Prefabricate of structures o Introduce safety features o Provide information about residual risks o Principle of Hierarchy of Control, which include: o Elimination o Substitution o Engineering control o Administrative control o Personal protective equipment

Evidence Sources

Listed below are a few examples of the kinds of evidence that would provide a guide as to whether an individual is meeting the standards required to become competent:

Activities

- Simulated facilitation of DfS Review Meetings in class

Products and Outcomes

- Records of GUIDE processes
- Updated DfS register

Verbal and /or Written Reports

- Relate the importance of design for safety and health of a construction project
- Describe the key requirements of the legal requirements on risk management
- List the duties and responsibilities of DfS Professionals
- Describe the duties and responsibilities of Developers, designers and contractors of a construction project
- Explain the necessary actions required in preparation of a DfS Review Meeting
- Discuss the tasks involved to effectively carry out a DfS Review Meeting

Competency Element 2: Maintain Records of Safety and Health Issues Arising From the DfS Review Meetings and Actions Taken

A competent individual must be able to successfully perform the following:

Performance Criteria
PC2.1 Establish the types of safety and health records to be kept in the DfS Register (DfSR) in accordance with WSH (DfS) Regulations.
PC2.2 Implement a system for documentation of safety and health records in accordance with organisational requirements.
PC2.3 Review safety and health records throughout the construction project in accordance with organisation requirements.
PC 2.4 Monitor safety and health issues throughout the construction project in accordance with organisation requirements.

To meet the performance criteria above, the candidate needs to know and understand the following underpinning knowledge, with the range and context as illustrated in the following table:

Ref PC	Underpinning Knowledge	Range and Context
PC2.1	UK2.1 DfS Register (DfSR)	Types of safety and health records in DfS Register (DfSR), which include: o Records of GUIDE 1, 2 and 3 o Checklist/matrixes used o Risk assessment o Safety and health information for contractor and Developer o Construction advisory notes o Maintenance method advisory notes o Safe operating procedures of equipment/machinery
PC2.2	UK2.2 Organisation's documentation system	Organisation's documentation system which may include and not limited to elements that provide for: o Clear direction towards identification and location of documents o Logical and organised filing for easy location of required document o Definition on responsibilities concerning creation,

Ref PC	Underpinning Knowledge	Range and Context
		amendment, custody, maintenance and up keeping of documents o Authorisation for access to classified documents o Revision control o Requirements on review of documents o Retention periods of documents o Back-up arrangement, which may include: o Hard copy o Electronic copy Organisational requirements may include: o Requirements of management systems o Requirements in consideration on: o Size of company o Requirements upon considering the scale and complexity of project o Resources available o Existing practices
PC2.3	UK2.3 Review of safety and health records	Review of safety and health records may include: o Establish the responsibility, frequency and scope of review of records o Check safety and health records for currency, completeness and accuracy o Identify safety and health issues o Address safety and health issues
PC2.3	UK2.4 Safety and health issues	Safety and health issues, which may include and not limited to: o Areas where design reviews were not yet started or incomplete o Part of design concept that was not fully understood o Hazards not identified previously o Design changes not finalised o DfS register entries incomplete o Opened action items for risk control
PC2.4	UK2.5 Monitor of safety and health issues	Monitor of safety and health issues may include: o Establish current conditions and status of issues o Compare current with desired conditions and status to identify gaps o Identify actions required to close gap *Review records and monitor safety and health issues

Ref PC	Underpinning Knowledge	Range and Context
		throughout the construction project include design stage, construction stage, until handing over to Developer for occupation and maintenance.

Evidence Sources
Listed below are a few examples of the kinds of evidence that would provide a guide as to where an individual is meeting the standards required to become competent Products and Outcomes o Safety and health records o Records of GUIDE processes o Updated DfS register o Documents prepared for GUIDE processes Verbal and /or Written Reports o List the types of safety and health records relevant to construction design reviews o Explain the elements of documentation system for safety and health records o Identify the requirements to consider for implementing documentation system for safety and health records o Describe the process for reviewing of safety and health records

Competency Element 3: Communicate Safety And Health Information To Stakeholders

A competent individual must be able to successfully perform the following:

Performance Criteria	
3.1	Establish the types of safety and health information to be communicated to stakeholders throughout the construction project.
3.2	Establish means of communication to relevant stakeholders for safety and health information in accordance with organisation requirements.
3.3	Coordinate the flow of relevant information to stakeholders throughout the construction project.

To meet the performance criteria above, the candidate needs to know and understand the following underpinning knowledge, with the range and context as illustrated in the following table:

Ref PC	Underpinning Knowledge	Range and Context
PC3.1	UK3.1 Types of safety and health information for communication	Types of safety and health information to communicate, which may include and not limited to: o Safety and health information provided by the designers and contractors o Handover of DfS Register (DfSR) to Developer o Sequence of construction works o Safety and health hazards affecting relevant stakeholders o Implications of hazards o Information arising from GUIDE processes o Control measures to mitigate risks o Safety and health responsibilities of relevant stakeholders o Actions required by relevant stakeholders for mitigation of risks o Means of communication available to stakeholders

Ref PC	Underpinning Knowledge	Range and Context
PC3.2	UK3.2 Means of communication to relevant stakeholders	Means of communication, which may include o Tendering documents o Provision of drawings, specifications, calculations and work statements o Provision of safety and health information and records o DfS Review MeetingsSharing of DfS register information o Meeting of stakeholders o Consultation / dialogue sessions o Training / awareness sessions o Verbal instruction o Telephone communication o Formal written correspondence o Email
PC3.3	UK3.3 Coordinate flow of information	Coordinate flow of information may include: o Determine the communication needs for relevant stakeholders o Determine the timing at which information should be made available to or gathered from the relevant stakeholders o Establish and use effective means for communication o Verify effectiveness of communication * Stakeholders as defined in UK 1.4

Evidence Sources

Listed below are a few examples of the kinds of evidence that would provide a guide as to whether an individual is meeting the standards required to become competent:

Products and Outcomes

- Communication records

Verbal and /or Written Reports

- List the types of safety and health information to be communicated at different stage of construction project.
- Describe the means of communication available in the organisation for disseminating and gathering information from relevant stakeholders
- Describe the important considerations in coordinating flow of safety and health information

DfS for Professionals Course

Design for Safety for Professionals Course

© 2015 All rights reserved

DfS for Professionals Course

Content

General Knowledge for Design for Safety (DfS) for Professionals:

- Course Overview
- Overview of WSH (DfS) Regulations
- Overview of safety legal framework
- Risk Assessment

Understanding the following:

- Duties and Responsibilities of Stakeholders
- DfS Review Meetings
- DfS Register (DfSR)

© 2015 All rights reserved

DfS for Professionals Course

Course Overview

This section covers the learning outcome of this course and what the trainee is expected to know. It also covers the assumed knowledge of the trainee as well as the pre-reading materials as well as the assessment requirements.

© 2015 All rights reserved

DfS for Professionals Course

Course Overview

© 2015 All rights reserved

DfS for Professionals Course

Learning Outcome

By the end of this course, you should be able to:

CE1: Facilitate the DfS Review Meetings to identify and mitigate safety and health risks;

CE2: Maintain records of safety and health issues arising from the DfS Review Meetings and actions taken; and

CE3: Communicate safety and health information to stakeholders

© 2015 All rights reserved

DfS for Professionals Course

Learning Outcome

You should be able to perform the following:
CE1: Facilitate the DfS Review Meetings to identify and mitigate safety and health risks

- Recognise the importance of design for safety and health of a construction project to eliminate or mitigate such risks throughout the life cycle of a building and structure.
- Recognise the duties and responsibilities of DfS Professional in accordance with WSH (DfS) Regulations and (Approved Code Of Practice (ACOP) for DfS.) [ACOP is expected to be published early 2016.]

WSH Guidelines - Design for Safety (1st Aug 2016)

© 2015 All rights reserved

DfS for Professionals Course

Learning Outcome

By the end of this course, you should be able to:

CE1: Facilitate the DfS Review Meetings to identify and mitigate safety and health risks

- Advise stakeholders in a construction project on their duties and responsibilities in accordance with WSH (DfS) Regulations.
- Prepare for DfS Review Meetings in accordance with WSH (DfS) Regulations and Approved Code Of Practice (ACOP) for DfS.

© 2015 All rights reserved

DfS for Professionals Course

Learning Outcome

By the end of this course, you should be able to:

CE1: Facilitate the DfS Review Meetings to identify and mitigate safety and health risks

- Coordinate DfS Review Meetings for consideration of safety and health risks at different phases in the life cycle of a building and structure
- Apply hazard identification tools and risk assessment for DfS Review Meetings in accordance with organisational procedures.

© 2015 All rights reserved

DfS for Professionals Course

Learning Outcome

By the end of this course, you should be able to:

CE2: Maintain records of safety and health issues arising from the DfS Review Meetings and actions taken

- Establish the types of safety and health records to be kept in the DfS Register (DfSR) in accordance with WSH (DfS) Regulations and (Approved Code Of Practice (ACOP) for DfS.) → WSH Guidelines – Design for Safety
- Implement a system for documentation of safety and health records in accordance with organisational requirements.

© 2015 All rights reserved

DfS for Professionals Course

Learning Outcome

By the end of this course, you should be able to:

CE2: Maintain records of safety and health issues arising from the DfS Review Meetings and actions taken

- Review safety and health records throughout the construction project in accordance with organisation requirements.
- Monitor safety and health issues throughout the construction project in accordance with organisation requirements

© 2015 All rights reserved

DfS for Professionals Course

Learning Outcome

By the end of this course, you should be able to:

CE3:Communicate safety and health information to stakeholders

- Establish the types of safety and health information to be communicated to stakeholders throughout the construction project.
- Establish means of communication to relevant stakeholders for safety and health information in accordance with organisation requirements.

© 2015 All rights reserved

DfS for Professionals Course

Learning Outcome

By the end of this course, you should be able to:

CE3:Communicate safety and health information to stakeholders

- Coordinate the flow of relevant information to stakeholders throughout the construction project.

© 2015 All rights reserved

DfS for Professionals Course

Assumed Skills and Knowledge

It is assumed that you already possess the following skills and knowledge:

- Building design and construction operations
- Building and construction processes
- Legal and statutory requirements associated with building and construction
- Basic safety and health issues associated with construction operations
- Written and oral communication, presentation, facilitation and problem solving skills

© 2015 All rights reserved

D Code of Practice on WSH Risk Management (2015)

DfS for Professionals Course

Pre-Reading

It is assumed that you have read the following materials prior to attending this course:

- Workplace Safety and Health Act
- WSH (DfS) Regulations
- Approved Code Of Practice (ACOP) for DfS (to be published early 2016) → WSH Guidelines - Design for Safety.
- Workplace Safety and Health Act and Subsidiary Legislations, such as:
  - WSH (Risk Management) Regulations
  - WSH (Construction) Regulations
  - WSH (Asbestos) Regulations

© 2015 All rights reserved

DfS for Professionals Course

References and Reading Materials

Useful references for further reading:

Code of Practice on WSH Risk Management - https://www.wshc.sg/files/wshc/upload/cms/file/CodeOfPractice_RiskManagement_SecondRevision.pdf
- accurate as at 3 Oct 2015.

© 2015 All rights reserved

DfS for Professionals Course

Assessment Requirements

The assessment comprises 2 components:
1. Written Questions (MCQs) – 30 mins
2. Individual Project – To be completed outside course within 12 wks upon course completion

* To submit report by 16/9-3-2018 (8 weeks)
Marking & Interview : 3 weeks ; Release of result : 1 week.

Pass Criteria:
Assessment 1 - At least 70% of Test Paper
Assessment 2 – At least 75% of the requirements of each question

Learners assessed to be competent will be awarded a Certificate of Completion

DfS for Professionals Course

Overview of WSH (DfS) Regulations and ACOP for DfS

This section covers a brief introduction of the WSH (DfS) Regulations and ACOP for DfS, including:

- Role of DfS Professional
- Importance of practising DfS

© 2015 All rights reserved

DfS for Professionals Course

Overview of DfS Professional

The role of a DfS Professional includes the competency to help control risks throughout the life cycle of building and structure at the early design stage

The content of the course is based on the WSH (DfS) Regulations and Approved Code Of Practice (ACOP) for DfS, co-developed by the Workplace Safety and Health Council and the Ministry of Manpower.

~ WSH Guidelines - Design for Safety

© 2015 All rights reserved

DfS for Professionals Course

Roles of DfS Professional

The key roles of DfS Professional are:

1) Facilitate the DfS Review Meetings to identify and mitigate safety and health risks;
2) Maintain records of safety and health issues arising from the DfS Review Meetings and actions taken; and
3) Communicate safety and health information to stakeholders (including Developers)

© 2015 All rights reserved

DfS for Professionals Course

Importance of Design for Safety and Health for Construction Projects

- ☑ Identify and correct flaws early in the life cycle of buildings and structures which includes:
  - ❑ Design
  - ❑ Construction
  - ❑ Maintenance/repair / Occupancy / Use /Addition & Alteration
  - ❑ Demolition

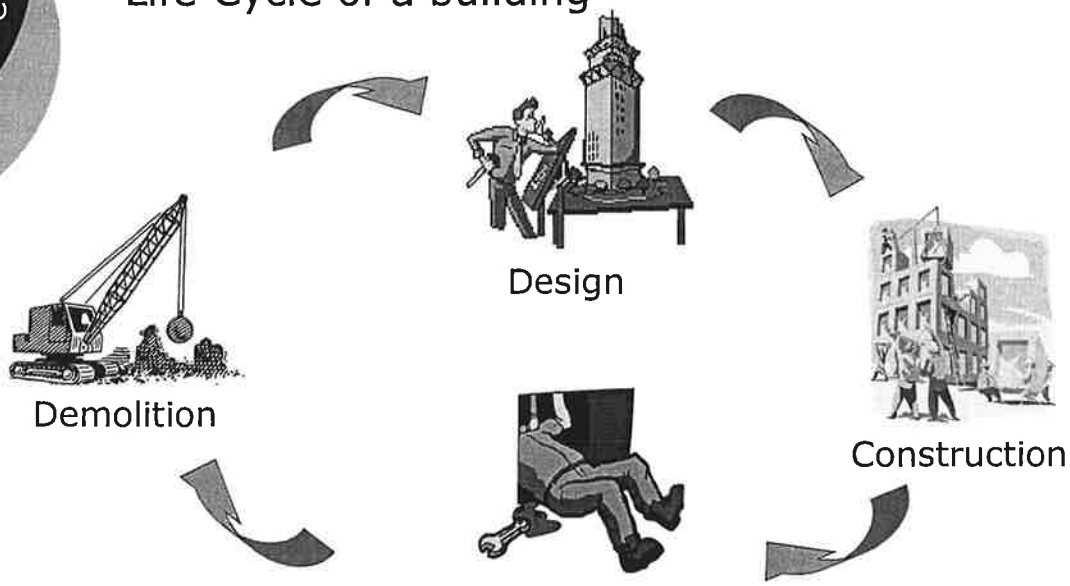
© 2015 All rights reserved

☒ Method:
① Elimination ; if impossible ②
② Mitigation

DfS for Professionals Course

Importance of Design for Safety and Health for Construction Projects

Life Cycle of a building



© 2015 All rights reserved

DfS for Professionals Course

Importance of Design for Safety and Health for Construction Projects

- ☑ Improve planning and management of project at early stage of project
- ☑ Identify and mitigate WSH risks at design stage
- ☑ Cheaper to eliminate WSH hazards at design or planning stage
- ☑ Reduce overall costs of construction and maintenance of a building and structure due to injuries and illnesses

© 2015 All rights reserved

DfS for Professionals Course

Importance of Design for Safety and Health for Construction Projects

Typical operating and owning costs of a building* are in the ratio:

- 1 for construction costs;
- 5 for maintenance and building operating costs;
- 200 for business operating costs.

*Report of the Royal Academy of Engineering on *The long term costs of owning and using buildings* (1998)

© 2015 All rights reserved

DfS for Professionals Course

Importance of Design for Safety and Health for Construction Projects

☑ Minimise losses:
- life,
- injury
- cost

} top priority

and ensured safety for current and future users

☑ ~~Minimise~~ Minimise damage to the property

☑ Minimise unnecessary delays

© 2015 All rights reserved

DfS for Professionals Course

Importance of Design for Safety and Health for Construction Projects

☑ Help stakeholders to better address the risks downstream to facilitate compliance with:

- ❑ Workplace Safety and Health Act
- ❑ WSH (DfS) Regulations
- ❑ WSH (WSH Officers) Regulations
- ❑ WSH (Risk Management) Regulations
- ❑ WSH (Construction) Regulations
- ❑ WSH (Asbestos) Regulations



© 2015 All rights reserved

Levels:
① Design for Safety
② Authority Compliance
③ Developer ~~requirements~~ ← time & resources available.

DfS for Professionals Course

Workplace Safety and Health Legal Requirements

Other 'Relevant legal requirements' relating to design of building and structures, such as:

- ❑ Building Control Act (Cap. 29, 1989)
- ❑ Fire Safety Act (Cap 109A, 1993)
- ❑ Sewerage and Drainage Act (Cap 294, 1999)
- ❑ Electricity Act (Cap 89A, 2001)
- ❑ ...etc

The legal requirements represent the minimum standards for which buildings and structures are to be designed and constructed and what must be considered and controlled.

It is important for DfS Professional to know about these requirements to play their role effectively.

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Legal Requirements

It should be noted:

- The WSH (DfS) regulations are effective from 1 Aug 2016 for projects where Designers are appointed after the effective date.

- The WSH (DfS) regulations is to be implemented for all projects:
  - Undertaken by a developer in the course of his business,
  - With contract sum $10million or more, and
  - Involves development under section 3(1) of the Planning Act (Cap. 232).

Ref: WSH Guidelines - DfS (Pg 3, Pg 40)

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Legal Requirements

It should be noted:

- It is optional for the Developer to appoint a suitably qualified DfS Professional under the WSH (DfS) Regulations.

- In the event that the Developer does not wish to appoint the DfS Professional, he has to take on his duties.

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Legal Requirements

Resources on legal requirements may be found at:

- Singapore Statutes On-line
  ~~http://agcvldb4.agc.gov.sg;~~
  sso.agc.gov.sg
- Government Printers & Retailers of Government Publications and Singapore Standards and Code of Practices at:
  - http://www.toppanleefung.com
  - http://www.singaporestandardseshop.sg
- MOM and WSHC Websites on legislations

© 2015 All rights reserved

DfS for Professionals Course

Overview of Safety Legal Framework

This section includes an overview of the safety legal framework in Singapore. Acts covered briefly include:

- Workplace Safety and Health Act (WSHA)
  - 3 guiding principles of the WSHA
- Risk Management Regulations
- Other relevant regulations

It should be noted that DfS is based on one of the guiding principle of the WSHA, which is to reduce risk at source.

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Act

- ☑ Main legislation in Singapore on workplace safety and health.
- ☑ Came into effect on 1 March 2006
- ☑ Aimed at creating a world-class WSH legal framework

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Act

The 3 guiding principles of the new framework:

- ☑ Reducing risk at source:
  - ❑ All stakeholders to eliminate or minimise the risks they create at the workplace;
- ☑ Instilling greater industry ownership of OSH standards.
  - ❑ Employers to be responsible for developing suitable safe work procedures
- ☑ Higher penalties for poor safety and health management. ($400k as of now)

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Act

WSH (DfS) Regulations is written with the objective to:

- ☑ Reducing risk at source:
  - ❑ All stakeholders to eliminate or minimise the risks they create at the workplace;

As such, a basic understanding of the WSHA is vital to enable DfS Professional to apply the same principle of reducing risks at source in the DfS Review Meetings.

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Act

Key requirements

In general, duty holders must,

... in so far as is reasonably practicable, take such measures to ensure safety and health of persons at work.....

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Act

The term **"practicable" in our context means that an action is capable of being done**. This therefore considers whether a measure can be done and is feasible.

The term **"reasonable"** takes into account of the following:

- **Severity** of any risk of injury or harm to health that may occur
- **Likelihood** of that risk of injury or harm occurring
- How much is **known** about that hazard and the ways of managing it
- **Availability, suitability and cost** of safeguards

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Act

There are two elements to what is 'reasonably practicable'. A duty-holder must first consider what can be done – that is, what is possible in the circumstances for ensuring safety and health. They must then consider whether it is reasonable, in the circumstances to do all that is possible.

This means that **what can be done should be done unless it is reasonable in the circumstances for the duty-holder to do something less**.

© 2015 All rights reserved'

DfS for Professionals Course

Workplace Safety and Health Act

- In line with the WSH Act, reducing risk at source is an important component in improving safety.
- To address risk at source, there is a need to look at who creates the risk and address the issue from there.
- While the WSH Act imposes a duty on the occupiers, employers and principles, the risk inherent in the design also need to be addressed and means to mitigate risk identified.

© 2015 All rights reserved

DfS for Professionals Course

Workplace Safety and Health Act

- Poor planning, lack of communication between designer and occupier / user, may lead to loss of information and result in accident
- As such, the WSH (DfS) Regulations and ACOP for DfS detail the process for stakeholders to discuss the design risks of the project so as to identify and mitigate the safety and health risks.

WSH Guidelines

© 2015 All rights reserved

DfS for Professionals Course

WSH (Risk Management) Regulations

- The cornerstone in the WSH legal framework.
- To instill risk assessment mindset to proactively identify hazard, evaluate risk and take control measures to prevent accident, rather than reacting to it.
- In line with the "reduce risk at source" principle of the WSH Act.
- The WSH (DfS) Regulations, adopt and apply the principles used in risk management.

© 2015 All rights reserved

DfS for Professionals Course

WSH (Risk Management) Regulations

Every employer, self-employed, principal shall:

- Conduct Risk Assessment
- Take reasonably practicable measures to elimination risks, if not, minimize risks
- Provide information to persons affected by the risks
- Maintain a record of risk assessment and measures or safe work procedure implemented
- Keep record of not less than 3 years (Not applicable for DfS Register)
- Review the risk assessment at least once every 3 years, or upon occurrence of incident / accident or significant change in work practices (Not applicable for DfS Register)

© 2015 All rights reserved

DfS for Professionals Course

Other Relevant Legal Requirements

- WSH (Asbestos) Regulations
- WSH (Scaffold) Regulations
- WSH (Operations of Cranes) Regulations
- SS 602:2014 Code of practice for noise control on construction and demolition sites
- SS 536:2008 Code of Practice for the Safe Use of Mobile Cranes (Under review)
- SS 559: 2010 Code of Practice for Safe Use of Tower Cranes (Under review)
- CP4: 2003 Code of Practice for Foundations
- SS 557:2010 Code of practice for demolition

Code of practices may be used by the Court to judge what is considered "reasonable practicable".

© 2015 All rights reserved

DfS for Professionals Course

Risk Assessment (RA)

This section covers Risk Assessment (RA) in detail as RA is needed to enable the trainee to perform the DfS Review Meetings.

The trainee will learn how to:

1. Identify and analyse hazards
2. Evaluate risks
3. Control risks

It should be noted that the same principles of RA will be used in the Design Risk Assessment.

© 2015 All rights reserved

DfS for Professionals Course

Risk Assessment (RA)

Risk assessment is the process of:

- Identifying and analysing safety and health hazards
- Evaluating the risks
- Controlling risks

Risk assessment includes:

- Routine operations
  - preparatory and troubleshooting work activities.
- Non-routine operations
  - Commissioning of plants/buildings
  - Repair and maintenance of plants/buildings

© 2015 All rights reserved

DfS for Professionals Course

Risk Assessment (RA) Guidelines

To help industry comply, especially those who do not have a risk management process, MOM has developed a "Code of Practice on WSH Risk Management" (available at WSHC website)

Companies can adopt risk assessment approach:

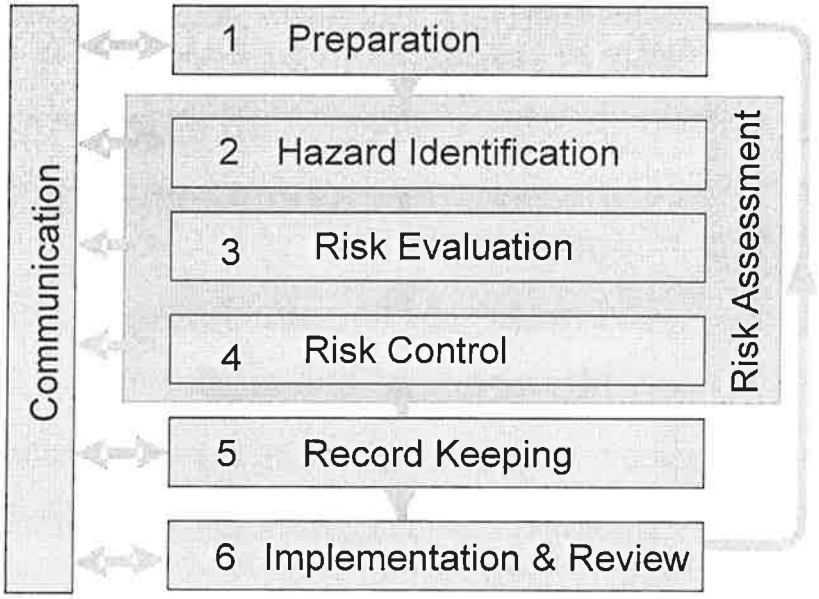
- Described in the Code of Practice, or
- Other established methods or hazard identification and risk analysis commonly used, while still applying the basic principles in the Code of Practice.

© 2015 All rights reserved

DfS for Professionals Course

Risk Assessment

Risk Management Process – MOM Guideline



© 2015 All rights reserved

Definitions:

- Hazards - anything w the potential to cause bodily injury, and includes any physical, chemical, biological, mechanical, electrical / ergonomic hazards.
- Risk - likelihood that a hazard will cause a specific bodily injury to any person.

Ref:
WSH (Risk management) Regulations (1 Oct 2007).

DfS for Professionals Course

Step 1 Identify and analyse hazards

- Hazard Identification is the most important step in RA
  - Hazards can only be controlled if they are identified
- Involves identifying hazards associated with the work activities of each process and type of potential accidents or incidents.
- Brainstorm
  - Possible types of accidents and ill health that can happen due to the hazard

© 2015 All rights reserved

DfS for Professionals Course

Step 1 Identify and analyse hazards

- Identify the persons that can be victims of the accident or ill health
  - Persons directly involved in the operation
  - Persons not directly involved in the operation
  - Visitors of the workplace
  - Members of the public

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

Risk evaluation is the process of estimating the risk levels of the hazards and their acceptability.

Risk evaluation consists of:

- Identifying the existing risk control measures
- Assessing the potential severity of the hazards
- Determining the likelihood of occurrence of accidents, incidents and/or ill health arising from identified hazards, and
- Assessing the risk level based on the severity and likelihood.

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

- Identifying the existing risk control measures
  - Identify existing control measures for each individual work activity for the process
    - Engineering controls
    - Safe work procedures
    - Personal protective equipment
  - Considering the effectiveness of existing controls and consequences of their failure
  - Assessing the risk of the activity

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

- Identifying the existing risk control measures

  Risk is made up of two parts:

  - Expected SEVERITY of the hazard; and
  - LIKELIHOOD of occurrence of an accident/incident or ill health taking into account the existing risk controls.

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

- Assessing the potential severity of the hazards

  Severity is

  - The degree or extent of injury or harm caused by accidents/incidents.
  - Classified into three categories
    - Negligible
    - Minor
    - Moderate
    - Major
    - Catastrophic

© 2015 All rights reserved

DfS for Professionals Course

Risk Assessment

Severity categories and description

Severity	Description
Minor	No injury, injury or ill-health requiring first aid treatment only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort)
Moderate	Injury requiring medical treatment or ill-health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, deafness, work-related upper limb disorders)
Major	Fatal, serious injury or life-threatening occupational disease (includes amputations, major fractures, multiple injuries, occupational cancer, acute poisoning and fatal diseases)

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

- Assessing the potential severity of the hazards

Severity of the hazard,

- Refers to the intrinsic or inherent nature of the adverse effect (e.g. cancer, amputation or fatal injury) that may result from the hazard,
- Does not depend on the controls in place.
- In assigning severity level, the existing controls should not be taken into account.

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

- Determining the likelihood of occurrence of accidents, incidents and/or ill health arising from identified hazards

Likelihood of occurrence is classified into three categories:

* Rare
- Remote
- Occasional
- Frequent
* Almost certain

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

Likelihood categories and description

Likelihood	Description
Remote	Not likely to occur
Occasional	Possible or known to occur
Frequent	Common or repeating occurrence

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

- Determining the likelihood of occurrence of accidents, incidents and/or ill health arising from identified hazards

  Consider the following sources of information:

  - Past incident and accident records
  - Industry practice and experience
  - Relevant published literature

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

- Assessing the risk level based on the severity and likelihood
  - Use the 3 X 3 matrix ← 5x5
  - Risk level may be classified as
    - Low
    - Medium
    - High

© 2015 All rights reserved

DfS for Professionals Course

Step 2 Evaluate Risks

Risk matrix to determine Risk Level

Severity \ Likelihood	Remote (1)	Occasional (2)	Frequent (3)
Major (3)	Medium Risk (3)	High Risk (6)	High Risk (9)
Moderate (2)	Low Risk (2)	Medium Risk (4)	High Risk (6)
Minor (1)	Low Risk (1)	Low Risk (2)	Medium Risk (3)

For example, if the Severity is Moderate (2) and the Likelihood is Occasional (2), the Risk Level is Medium Risk.

(RPN = 2x2 = 4)

© 2015 All rights reserved

DfS for Professionals Course

Step 3. Control risk

3. Control risk

- Based on the risk level determined
- Select risk controls to reduce risk level to an acceptable level
  - By reducing the Severity and/or Likelihood
  - E.g when the risk level is "High", effective and practicable risk controls must be implemented to bring down the "High Risk" level to at least "Medium Risk"

© 2015 All rights reserved

DfS for Professionals Course

Risk acceptability and recommended actions

Level	Acceptability	Recommended Actions
Low Risk	Acceptable	No additional risk control measures may be needed. However, frequent review may be needed to ensure that the risk level assigned is accurate and does not increase over time.
Medium Risk	Moderately acceptable	Careful evaluation of the hazards should be carried out to ensure that risk level is reduced to as low as is practicable within a defined time period. Interim risk control, eg admin controls, may be implemented. Management attention is required.
High Risk	Not acceptable	Risk level must be reduced to Medium Risk before work commences. There should not be any interim risk control measures and should not be overly dependent on PPE or appliances. If need be, hazard should be eliminated before work commences. Immediate management intervention is required before work commences.

© 2015 All rights reserved

DfS for Professionals Course

Step 3. Control risk

- Essential for risks to be eliminated or reduced "at source"
- If a risk cannot be controlled completely by engineering measures, protect the staff/trainees by administrative control or personal protection
  - e.g. use of notice board
- Use Hierarchy of Control Measures
  - Not usually mutually exclusive e.g. engineering controls can be implemented together with administrative controls like training and safe work procedures.

© 2015 All rights reserved

DfS for Professionals Course

Hierarchy of Control Measures

		Examples
Most Effective	**ELIMINATION**	Change design to eliminate risky maintenance works
	SUBSTITUTION	Use of less flammable construction materials
	ENGINEERING CONTROL	Design in safe access for building maintenance
	ADMINISTRATIVE CONTROL	Implement safe work procedure for maintenance
Least Effective	**Personal Protective Equipment**	Make provision for use of safety belt, harness etc.

© 2015 All rights reserved

DfS for Professionals Course

Step 3. Control risk

Elimination - Control hazards by eliminating them at the design stage



Example:

- Design modification
- Change in sequence of construction work
- Change in construction location
- Change in positioning of equipment
- Prefabrication of structures

© 2015 All rights reserved

DfS for Professionals Course

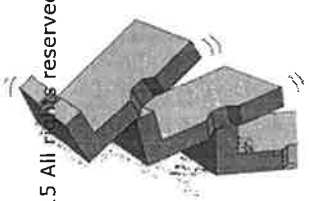
Step 3. Control risk

- **Substitution** – Replace the hazard with one that presents a lower risk

  Example: Pre-assembled equipment at ground level rather than height

- **Engineering Control** - Use engineering controls to isolate people from the hazards

  Example: Prevent falls from buildings during construction/maintenance by increasing wall/edge height.



© 2015 All rights reserved

DfS for Professionals Course

Step 3. Control risk

- **Administrative Control** - Use administrative controls to train and warn people of hazards.

  Example: Provide hazard warning lights, provide information about residual risks to contractors tendering the project



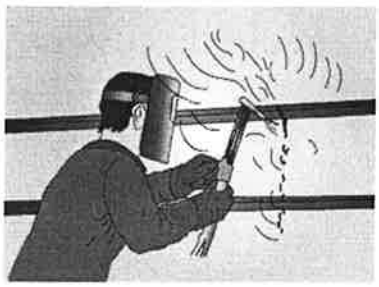
© 2015 All rights reserved

DfS for Professionals Course

Step 3. Control risk

- **Personal Protective Equipment (PPE)**

  - Use PPE to reduce exposure to hazards.
    - Used only as a last resort, or
    - As a short term contingency during maintenance/ repair or as an additional protective measure.



© 2015 All rights reserved

DfS for Professionals Course

WSH (DfS) Regulations

This section covers the WSH (DfS) Regulations in greater detail, including:

- Duties and Responsibilities of Stakeholders
- DfS Review Meetings
- DfS Register (DfSR)

There will also be an assessment where trainees will be divided into groups for the DfS Review Meetings.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities of Stakeholders

This section will cover the duties and responsibilities of the stakeholders including:

- Developers
- Designers
- Contractors
- Subsequent Building Owners
- DfS Professional

There will be some discussion questions where the responsibilities of the DfS Professional will be assessed for different circumstances.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Importance of Developer

- Able to influence many major decisions
  - engaging of the Designers, DfS Professionals, Contractors, etc.,
  - type of design and materials used
- Ensure safe design is implemented and adequate resources (time and finances) are provided.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Developer

1. General for handling risks

•Ensure all foreseeable design risks are eliminated or reduced to as low as reasonably practicable, where elimination is not reasonably practicable.

•Design risks shall be reduced at its source and collective protective measures shall be used instead of individual protective measures.

2. Engage competent personnel

•Ensure that any Designer, Contractor or DfS Professional which the Developer appoints are competent to perform their duties under the Act.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Developer

3. Provide sufficient time and resources

•Plan and manage the project such that all Designers and Contractors appointed by the Developer have sufficient time and resources to perform their duties.

4. Provide relevant information

•Ensure relevant information is provided to all Designers and Contractors appointed by the Developer.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Developer

5. DfS Review Meeting

•Convene DfS review meeting to identify all foreseeable design risks and discuss how each of the foreseeable design risks can be eliminated.

•Ensure that the DfS review meeting is attended by the relevant Designers and Contractors.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Developer

6. Maintaining DfS Register

•Keep a DfS register containing information and records on DfS review meeting convened and every residual design risk for the project.

•Ensure that the DfS Register is up to date.

•Ensure that all Designers and Contractors appointed for the project have access to the DfS Register.

•Ensure the DfS Register is available for inspection by registered workplace inspectors.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Developer

7. Delegation of Developer's Duties to DfS Professional

•Developer may delegate the following duties to the DfS register:

- Convening DfS Review Meetings } Duty of DfS Professional
- Maintaining a DfS Register

•The Developer must provide the DfS Professional with the information necessary for him to perform his duties.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Developer

7. Delegation of Developer's Duties to DfS Professional – Cont'd

Note:

•Once the Developer assigns the duties to convene the DfS Review Meetings and to maintain the DfS Register to a DfS Professional, the Developer is no longer responsible for the performance of those duties.

•However, the Developer is still responsible for the other duties to ensure that a safe design is selected and implemented.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Developer

8. Passing on the DfS Register

- If Developer disposes of his interests in the structure, ensure that the DfS register is given to the person who acquires his interests in the project and inform him of the nature and purpose of the DfS register.

dispose buildings

•For subdivided buildings, ensure that the register is to be given to the subsidiary management corporation of the subdivided building and inform them of the nature and purpose of the DfS register.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Developer – engage competent personnel

- Developer has to ensure that the DfS Professional and other duty holders are competent in experience and training to fulfill their duties under the Act and Regulations.
- Developer to demonstrate that he has checked the competence of the DfS Professional and other duty holders and not merely appoint them based on the fees quoted.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Importance of the Designer

Specification of design

Designers are the ones who create the risks through their design. The Designer should therefore understand how the building or structure can be constructed, cleaned, maintained, and decommissioned or demolished safely.

He must therefore study the design and look at the risks to those carrying out the proposed works and others affected by it, such as the public or people using the building or structure in the future.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Designer

•Prepare a design plan that eliminates all foreseeable design risks.

•Where not reasonably practicable to eliminate the foreseeable design risk, to propose to the person who appointed him, a modification to the design plan that reduces the design risks to as low as reasonably practicable.

•When reducing the risks, the design risks shall be reduced at its source and collective protective measures shall be used instead of individual protective measures.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Designer

•Provide information relevant to the design, construction or maintenance of the structure to the person who appointed the Designer.

•Attend DfS Review Meeting where required by the Developer.

•Ensure any Designer appointed (called Delegated Designer) is competent to perform his duties under the regulations.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Designer

•Ensure Delegated Designers are provided with relevant information.

•Designer is still responsible for his duties even if a Delegated Designer is appointed.

Note:

•The same duties which apply to Designer would also apply to the Delegated Designer.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Designer

The consideration to remove the safety and health risks from the design is not to limit Designers in terms of their creativity but to ensure that the Designer in preparing a design avoids foreseeable design risks to the safety and health of those:

•carrying out or liable to be affected by construction work for the structure,
•for whom the structure is a workplace, including an individual who maintains or cleans the structure, or anything in or on the structure, or
•who carries out or is liable to be affected by the demolition of the structure.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Importance of the Main Contractor

- Main Contractors, being responsible for the planning, management and co-ordination of construction works, play a critical role in ensuring that hazards identified, both prior to and during the actual construction works, are properly addressed.

- Where identified hazards or risks are not eliminated/mitigated at the design phase, the residual risks must be addressed and managed by the Main Contractors and Sub-Contractors during the construction phase.

anything that cannot be eliminated

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Main Contractor/Sub-Contractors

- Inform the person who appointed the Contractor of any foreseeable design risk.
- Ensure that any Designer he appoints is competent.
- Ensure that any Designer he engages is provided with relevant information to assist him with his duties.
- Ensure that any Sub-Contractor he engages is competent.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Main Contractor/Sub-Contractors

- Ensure that any Sub-Contractor he engages is provided with relevant information to assist him with his duties.
- Attend and participate in the DfS review process where required by the developer.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Main Contractor/Sub-Contractors

Note:

- The same duties which apply to Main Contractors would also apply to Sub-Contractors.
- Main Contractors, as Occupiers under the WSH Act and subsidiary legislations, would have other duties imposed on him under these regulations. However these will not be covered in the scope of this course.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of the Subsequent Building Owners

After the completion of the building, the Developer must hand over the DfS Register to the Registered Proprietor or Subsidiary Management Corporations (for subdivided buildings).

This is to ensure that information on the residual risk captured and mitigation measures is informed to the subsequent people who may be handling the risks of the project.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Duties of Subsequent Building Owners

- Keep the DfS register.
- Ensure that DfS register is available for inspection upon inspectors request.
- Provide the DfS register to the person who next acquires the interest in the structure.
- Ensure the person who acquires the interest in the structure is aware of the nature and purpose of the DfS register.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Importance of the DfS Professional

The DfS Professional is not in charge of safety and health at the site, nor should he take over the safety and health responsibilities of the Designer and the Contractor.

However, he is responsible to facilitate the DfS Review Meetings to identify and mitigate the foreseeable design risks, ensure proper records are kept in the DfS Register and ensure relevant information on safety and health is passed on to the Designers, Contractors and all other relevant stakeholders at the appropriate time.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities

Importance of the DfS Professional

It is noted that the Developer remains overall responsible to ensure that all foreseeable design risks are eliminated, if not, reduced to as low as reasonably practicable.

- To enable the Developer to fulfil this duty, the DfS Professional is to update the Developer as soon as practicable with the relevant information on each foreseeable design risk identified and how each design risk can be eliminated.

This would ensure that the Developer maintains oversight on the design risks of the project.

© 2015 All rights reserved

Duties and Responsibilities

Duties of the DfS Professional

Coordination between the Developer, the Designer and Contractor is lacking, resulting in vital information not properly communicated that could affect safety and health risks in many construction projects.

To ensure continuity in information flow, the Developer should appoint a suitably qualified DfS Professional.

The DfS Professional should follow through with the project from the design stage, to the construction stage until the handover to the Developer for occupation and maintenance.

© 2015 All rights reserved

Duties and Responsibilities

Duties of the DfS Professional

As such, the DfS Professional should be on-board the team as early as the concept design stage so as to facilitate the DfS Review Meetings.

His duties include:

DfS Review Meeting

- Convene DfS review meeting to identify all foreseeable design risks and discuss how each of the foreseeable design risks can be eliminated.

- Ensure that the DfS review meeting is attended by the relevant designers and contractors.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities of DfS Professional

Maintaining a DfS Register

- Keep a DfS register containing information and records on DfS review meeting convened and every residual design risk for the project.
- Ensure that the DfS Register is up to date.
- Ensure that all Designers and Contractors appointed for the project have access to the DfS Register.
- Ensure the DfS Register is available for inspection by registered workplace inspectors.

© 2015 All rights reserved

DfS for Professionals Course

Duties and Responsibilities of DfS Professional

Updating the Developer

- Ensure that the Developer is provided as soon as practicable after the DfS review meeting, with the relevant information on each foreseeable design risk identified and how each design risk can be eliminated.
- Provide the Developer with updated DfS Register after the adding of any information or record.

© 2015 All rights reserved

DfS for Professionals Course

Discussion Questions:

Can the Designer or Project Manager be the DfS Professional?

- Yes, provided he/she exercised impartiality and is able to fulfill his roles independently.

Can the DfS Professional role be performed by a company?

- Yes, the Developer may appoint this role to a company, but the key personnel involve should still be certified DfS Professionals.

© 2015 All rights reserved

DfS for Professionals Course

Discussion: Case 1

A residential building has an irregularly-shaped façade which makes the cleaning impossible to do by normal gondola. **Can the DfS Professional ask for a design change?**

- The DfS Professional should raise up the difficulty in cleaning the façade and ask the other members attending the DfS Review Meeting to address the safety aspects of it. He/she should recommend that the design be changed if the DfS Review Meeting agrees that the hazard it poses is major with no means of addressing/ mitigating it with risk control measures.



Note: The DfS Professional should not take over the Safety and Health responsibilities of the Designer and the Contractor which may include design related decisions.

© 2015 All rights reserved

DfS for Professionals Course

Discussion: Case 2

The Designer had proposed that the flyover up-ramp be cast-in-situ. However, due to the difficulty of diverting existing traffic and creating space at the narrow site for erection of formwork, the Contractor requested that a section of the ramp be pre-cast. **Should the DfS Professional insist that the original design be followed?**

- No, the DfS Professional is a facilitator of the DfS process and should not decide construction methods for the Contractor. He/she should follow-up with a design review of the new design if Designer agrees with the design change.

© 2015 All rights reserved

DfS for Professionals Course

Discussion: Case 3

Spotlights are mounted on the external of the building at 10m above the ground. Several years after the completion of the building, a worker fell and died while changing the spotlight component.

Upon investigation, it was found that the worker had been asked to access the spotlight by rope access system but his PPE had given way.

© 2015 All rights reserved

DfS for Professionals Course

Discussion: Case 3 – cont'd

It was also found that during the DfS Review Meetings, the DfS Professional highlighted that the changing of the spotlight component posed a risk of falling from height but the project team did not address the issue.

It was noted that falling from height was deemed a remote risk and should be addressed by the Building Owner with means such as providing PPE and adequate training.

© 2015 All rights reserved

DfS for Professionals Course

Discussion: Case 3 – cont'd

Can the DfS Professional be charged with any legal duties in this case?

- The DfS Professional has a duty to convene the DfS Review Meetings to ensure that all design risks are eliminate, if not, mitigated.
- If the DfS Review Meeting team agree that the risk is remote and could be addressed by the Building Owner, the DfS Professional should ensure this info is present in the DfS Register and highlight to the Building Owner at handover stage so that the Building Owner could address the issue.

© 2015 All rights reserved

DfS for Professionals Course

Discussion: Case 3 – cont'd

Can the DfS Professional be charged with any legal duties in this case? – Cont'd

- Pursuant to the WSHA, the employer is responsible to ensure his worker is adequately trained and experienced to do the work and that the PPE is in good condition.

Disclaimer: Note that the WSH (DfS) Regulations is a new regulations yet to be tested and tried by the courts of law. While this courseware is developed by the MOM and WSHC with the best of the knowledge available, all regulations need to be tested with actual cases.

© 2015 All rights reserved

DfS for Professionals Course

Discussion: Case 4

During the Design Review, it was noted that the Air Handing Unit (AHU) was housed in a confined space which had no proper ventilation. This was missed by the DfS Professional and was not addressed by the building owner. **Is the DfS Professional liable for any confine space accidents resulting from this?**

responsible to identify & mitigate all foreseeable design risks

- The DfS Professional has a duty to ensure that all design risks identified are mitigated and that all residual risks should be captured in the DfS Register. He is therefore liable for not performing his duty under the WSH (DfS) Regulations.

↑ Architect should be responsible as a designer.

- The accident should still be investigated thoroughly to determine the cause and the responsibilities of the stakeholders as defined by the WSHA.

© 2015 All rights reserved

DfS for Professionals Course

Discussion: Case 5

During GUIDE 2, it was highlighted that the installation of a glass canopy required an additional work platform for the workers (eg. boom lift), instead of working on the canopy itself or hanging from the roof supports using safety harness.

The DfS Professional duly informed the Contractor the findings of GUIDE 2 and reminded him to take note.

Does the DfS Professional need to go to the site to ensure this is being done?

- No, the DfS Professional should not take over the Contractor's safety and health responsibility on site.

© 2015 All rights reserved

DfS for Professionals Course

DfS Review Meetings

This section introduces the DfS Review Meetings called GUIDE. Areas covered include:

- GUIDE Process
- GUIDE 1, 2, 3 and their scope
- Examples of GUIDE 1, 2, 3.
- Other Safety and Health Considerations
- Hazards Identification Tools used in GUIDE
  - Checklist Method and Brainstorming
- Learning Activity 1 – includes a scenario for discussion which will help to gain a better understanding of DfS Review Meetings.
- Pointers on Facilitation of DfS Review Meetings

© 2015 All rights reserved

DfS for Professionals Course

DfS Review Meetings - GUIDE

To ensure the design is safe, a DfS Review Meetings called GUIDE is introduced.

- Chaired and facilitated by the DfS Professional
- Consist of major stakeholders such as Developer, Design Engineer, Architect and Contractor (if onboard already)
- Guided by the DfS Professional to identify and manage the hazards

© 2015 All rights reserved

DfS for Professionals Course

DfS Review Meetings - GUIDE

1.	**G**	**Group** together a review team consisting of major stakeholders.
2.	**U**	**Understand** the full design concept
3.	**I**	**Identify** the risks that arise as a result of the design or construction method.
4.	**D**	**Design** around the risks identified to eliminate or to mitigate the risks.
5.	**E**	**Enter** all the information, including vital design change information affecting safety and health or remaining risks to be mitigated, into the DfS Register.

© 2015 All rights reserved

DfS for Professionals Course

DfS Review Meetings - GUIDE

Steps 3 and 4 (Identify and Design around the risk)

- ☑ Should be iterative, and
- ☑ Repeated until the review team is satisfied that the design can no longer be changed to totally eliminate all risks.

© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Review Meetings

To influence the design and identify the risks as early as possible, GUIDE Process is recommended to be done in three phases:

- ❑ GUIDE-1: Concept Design Review
- ❑ GUIDE-2: Detailed Design, Maintenance and Repair Review
- ❑ GUIDE-3: Pre-Construction Review

This is to ensure that the review team can concentrate on a smaller scope during each process, thereby reducing the possibility of missing out on any significant item.

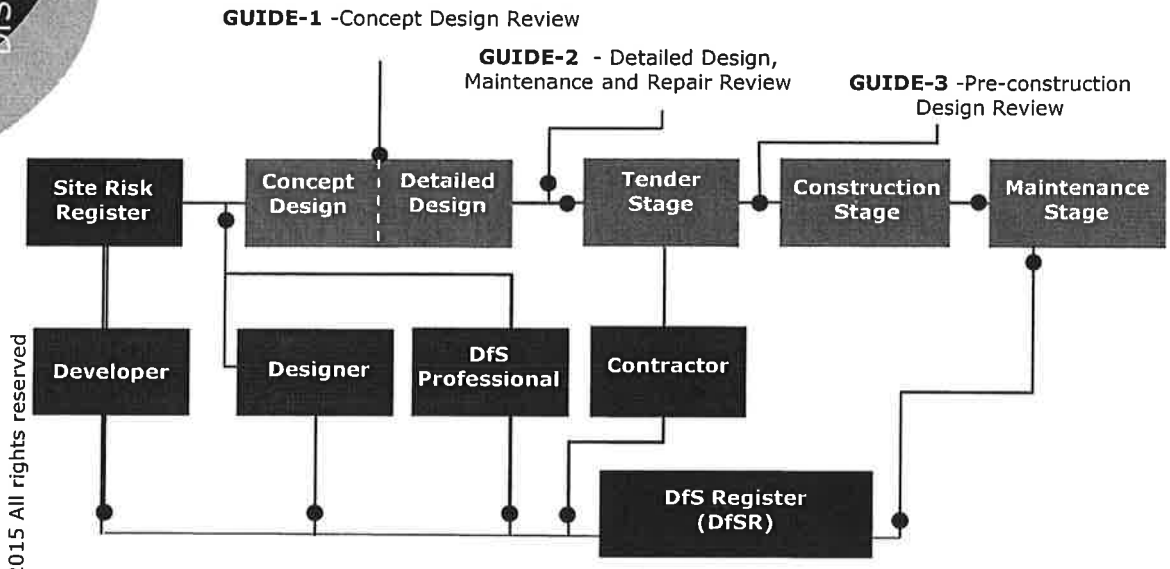
The GUIDE process may also be applied as and when new design revision occurs, throughout the life of building and structure.

© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Reviews

GUIDE Process Flow Diagram



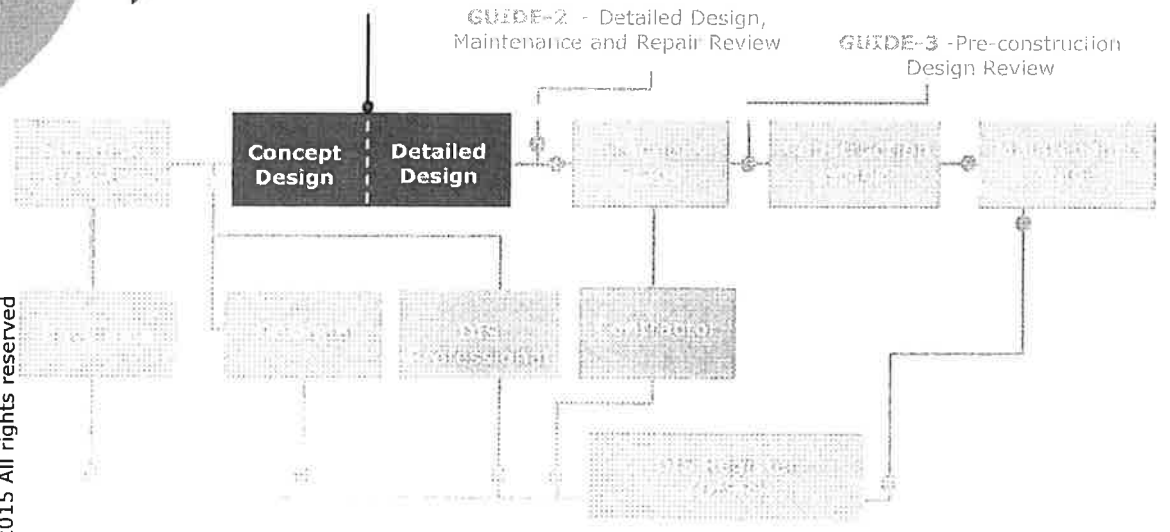
© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Reviews

GUIDE Process Flow Diagram

GUIDE-1 -Concept Design Review



© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Reviews

GUIDE-1: Concept Design Review

(Refer to Appendix 1 of Learner Guide)

Purpose:

- To review the conceptual design and identify the risk associated with the entire life cycle of the building.
- By identifying and understanding the risks in early stage of the building life cycle, the identified risks can be eliminated or control measured established.
- Sometime risk identified in GUIDE-1 can only be addressed later in the project when more details become available.

© 2015 All rights reserved

DfS for Professionals Course

GUIDE-1: Concept Design Review

GUIDE-1 Concept design review should look at

- ❑ General location of the project
- ❑ Traffic and vehicular flow in the surroundings
- ❑ Type of building, and
- ❑ Other general constraints

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 1

(Refer to Appendix 5 of Learner Guide for Examples)

Petronas Towers, Malaysia



Design for Safety consideration:

- General location of the project

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 1

Petronas Towers, Malaysia

Problems with original location due to soil condition

In September 1992, the site for the Petronas Towers was moved 200 ft. to the southwest.

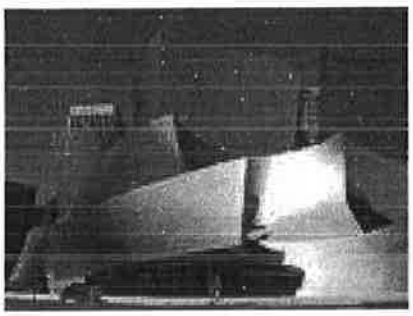
- Results of more thorough geotechnical studies revealed existence of a subterranean porous limestone cliff, which dropped in elevation from near the surface to a depth of more than 395 ft. over the span of the site

- This made the location of piles extremely difficult in the original location

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 1



Walt Disney Concert Hall in Los Angeles

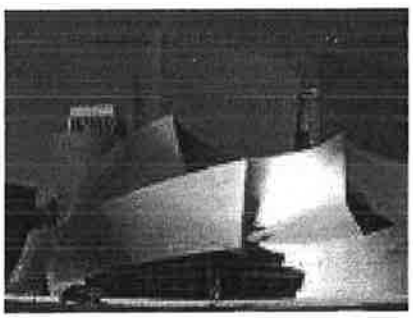
Design for Safety consideration:

- Type of building structure and building material
- Impact of the chosen building material on surroundings and public

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 1



Walt Disney Concert Hall in Los Angeles

- This innovative structure has a polished stainless steel skin.
- The sweeping curves of its roof were like a parabolic mirror, reflecting the sunlight on nearby buildings and walk ways.
- Temperatures exceeded 60°C in some places, and drivers and passer-by were temporarily blinded by the glare.
- The impact on safety and health to the public, as well as the workers could have been identified through GUIDE 1 process.

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 1

Design for Safety Considerations:

Impact on Public Access and Traffic with the commencement of project





The team should evaluate:

- Public Access during construction
- Impact to traffic during construction
- Vehicle, material, plant, movement to and within the site during construction

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 1

Design for Safety Considerations:

Access to building by occupants, visitors and public.





Hospital waste

The team should evaluate:

- Vehicular and pedestrian passageway – prevent crossing as much as possible.
- Effective waste disposal paths, away from public access

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 1

Design for Safety Considerations:

Location of underground services



The team should:

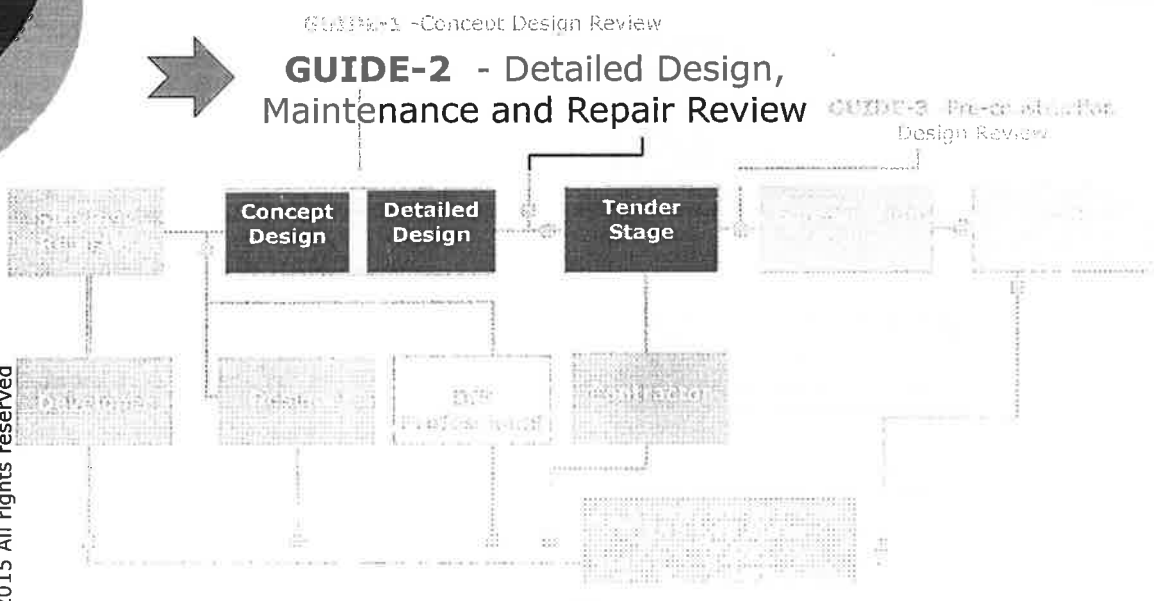
- Identify underground services, if any, that need to be removed for the project.
- Identify the hazards and impact to the workers and public, if any, due to the removal of these services.
- Provide contractor with existing services plan to plan for diversion, termination etc.

© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Reviews

GUIDE Process Flow Diagram



© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Reviews

GUIDE-2: Detailed Design, Maintenance & Repair Review
(Refer to Appendix 2 of Learner Guide)

Purpose:

- To assist designers to review the detailed design where most of the design is in process but still subject to possible modifications
- Review issues raised during GUIDE-1, and close them out if possible

© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Reviews

GUIDE-2: Detailed Design, Maintenance and Repair Review

- For Design and Build contracts where the contractor is in-charge of the design of the project, GUIDE-2 should be done with the contractor's input.
- Contractor can highlight constraints when constructing the building or structure.

© 2015 All rights reserved

DfS for Professionals Course

GUIDE-2: Detailed Design, Maintenance & Repair Review

(Refer to Appendix 2 of Learner Guide)

GUIDE-2 review should include considerations such as:

- Fabrication
- Heavy lifting
- Falling from height
- Temporary works and sequencing - e.g. construction staircase, Ac ledge w railing
- Layout
- Confined Space - e.g basement carpark
- Emergency Route
- Health hazards
- Weather
- Others (early warning of hazards, fire risk source of energy stored etc)

© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Reviews

GUIDE-2: Detailed Design, Maintenance & Repair Review

During GUIDE-2 review, should:

- Look at detailed architectural and structural design
- Determine the risks involved in:
  - Construction methods
  - Access and egress
  - Whether the design will create confined space or other hazards.
  - Risks related to maintenance and repair of the building, e.g. cleaning methods

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Construction Methods





Lift Shaft Installation

In evaluating the construction method, the team considered the use of prefabrication.

- lift shaft made of precast components hoisted up using heavy lifting cranes
- mobile working platform erected to facilitate jointing and painting works.
- Eliminated need for scaffold, minimized working at height

Another Risk : Heavy lifting

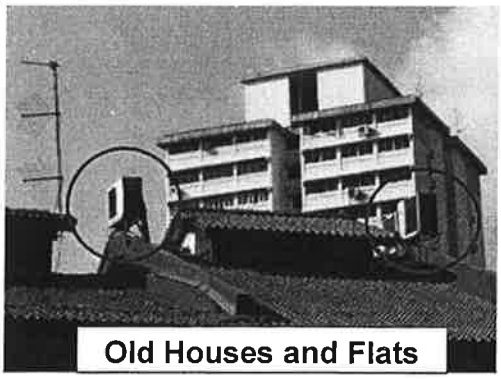
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Safe installation and maintenance access for air condition units



Old Houses and Flats

Lack of secured foothold for the persons who install and maintain air-con subjecting them to risk of falling from height.



New flats

Provisions for foothold are made in newer flats for the installation and maintenance of air con.

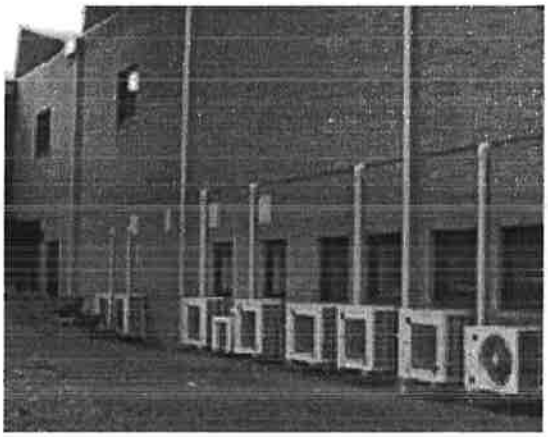
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Safe maintenance access



The team should consider to:

- Reduce working at height
- Avoid awkward conditions for manual handling
- Locate systems requiring maintenance at ground level for good access

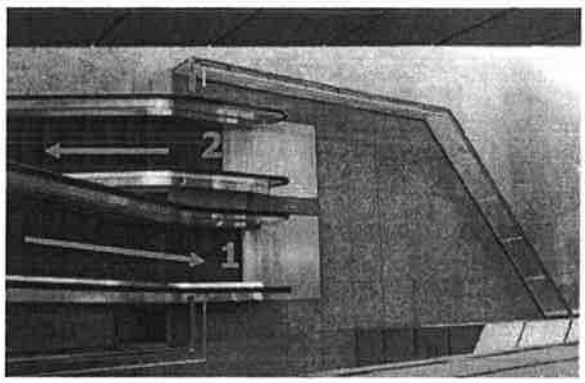
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Layout of the structure affecting flow of human traffic.



The team should review layout of structures, such as escalators:

·During high traffic flow, congestion might occur in the landing area between escalator 1 and 2.

· This might lead to people on escalator 1 having no place to land and result in accidents as the escalator is still moving.

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Detailed architectural design.



The team should evaluate the architectural design such as flooring finishes and:

- Choose finishes of sufficient hardness and strength for indented use in the finished buildings.

- Choose finishes that do not add to pedestrian slip and trip risks.

Note that the right flooring helps to reduce WSH risk (as well as costs) for modification / repair at later stage.

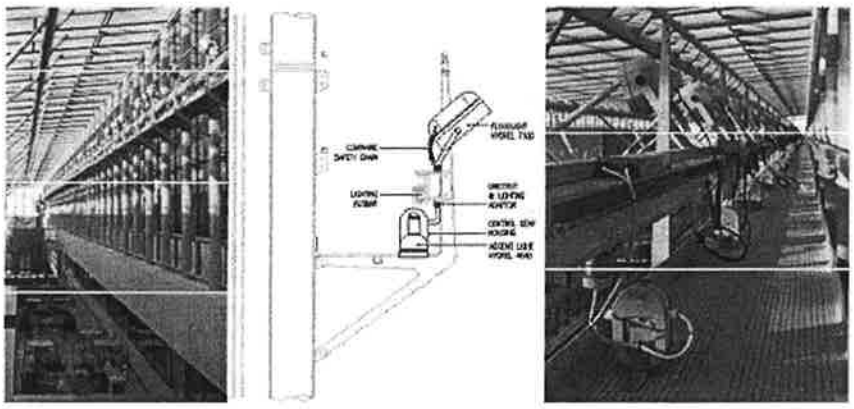
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Installation and maintenance of fixtures.



The team should consider the:

- Ease of installation of floodlighting, and feeder systems essential.
- Safe access for future maintenance.

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Accessibility for maintenance.



The team should evaluate the accessibility of the structure for maintenance:

- Foothold and anchorage point for maintenance should be provided, otherwise maintenance personnel need to deal with falling from height hazard.

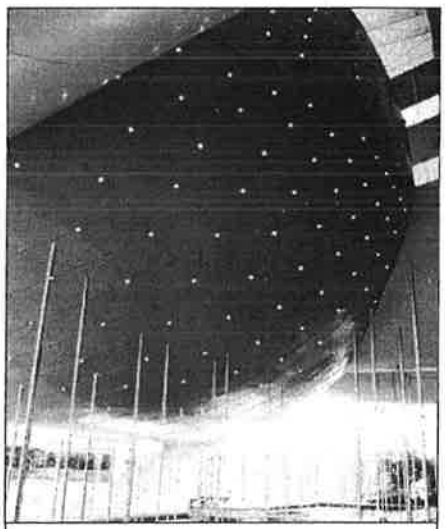
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Maintenance methods.



Hard-to-access circular structure

The team should evaluate the design and:

- avoid the use of abseiling methods or long ladders for building maintenance.

- position permanent anchorage and hoisting points into buildings

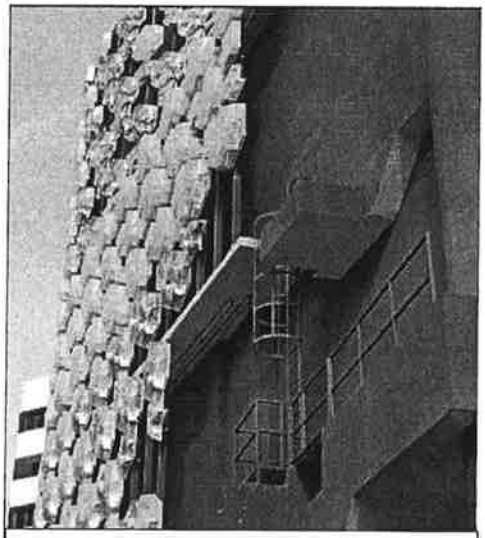
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Maintenance



Maintenance access provided for external facade

The design should consider:

- Providing safe external access to high areas of the building for maintenance personnel
- Preventing the risk of falls from height when carrying out maintenance or cleaning duties

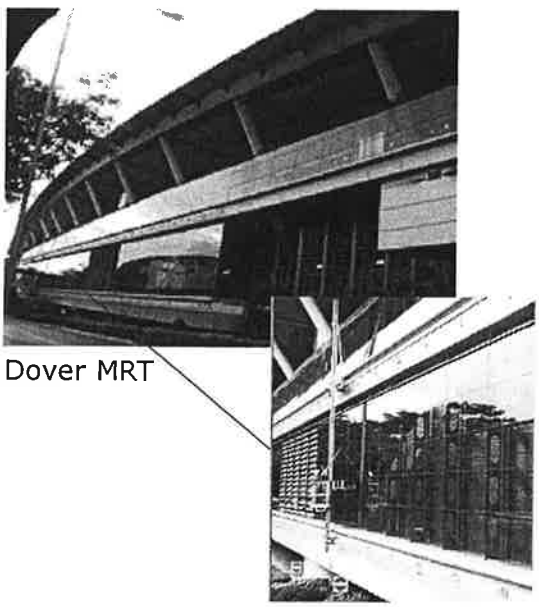
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-2

Design for Safety Considerations:

Maintenance



Dover MRT

In evaluating the maintenance issues:

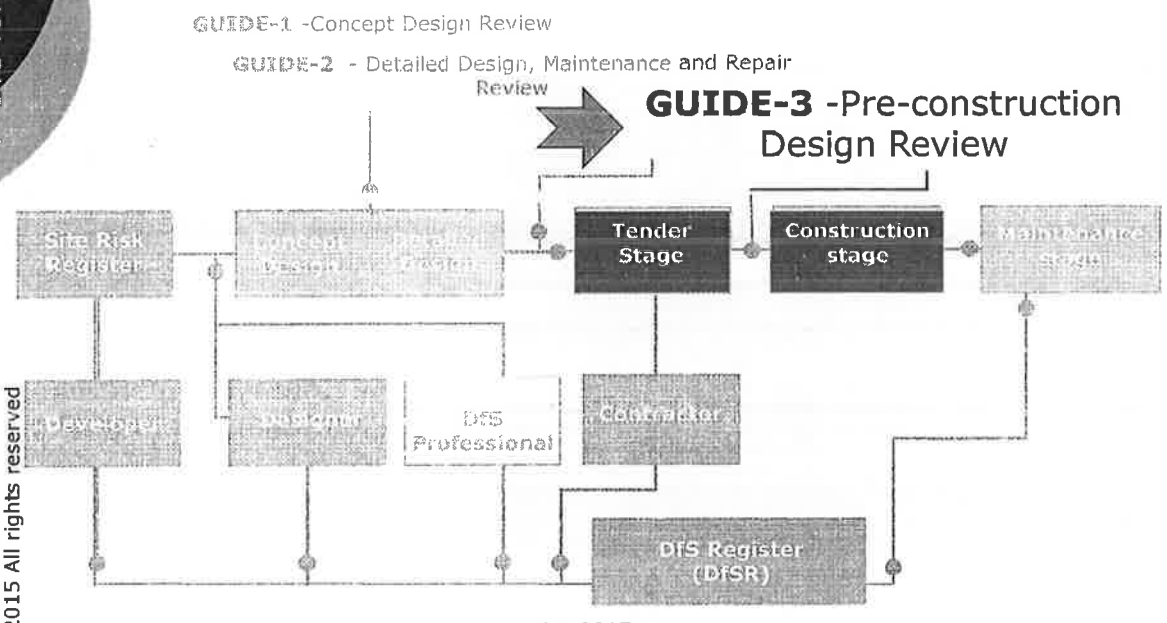
- Risk involved in maintenance of glass panels should be addressed.
- Work platforms (as far as possible) should be designed to address maintenance issue.

© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Review Meetings

GUIDE Process Flow Diagram



© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Review Meetings

GUIDE-3: Pre-Construction Review

Purpose:

- To identify and address the hazards and risks associated with the design and methods of construction, especially those which are not covered during the concept design and detailed design stages.
- To identify and address risk associated with temporary work design and design provided by specialist contractors.

D Can be before construction commencement, the ideal is before tender award.

© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Review Meetings

GUIDE-3: Pre-Construction Review

(Refer to Appendix 3 of Learner Guide)

Pre-construction design review should

- Examine design of temporary works and design by specialist contractors not covered during the concept and detailed design phases.

All hazards highlighted in the GUIDE Process should be singled out and addressed in the Design Risk Assessment Form. Refer to Appendix 4 of Learner Guide.

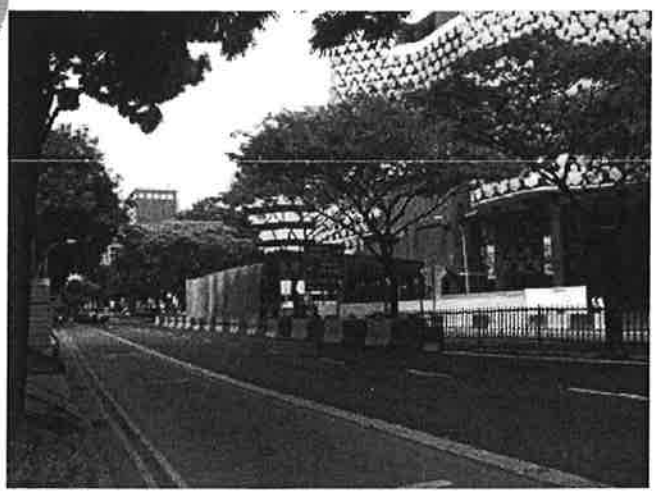
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-3

Design for Safety Considerations:

Temporary works



In evaluating the temporary works design, the team should ensure:

•Proper planning of work activities, diversion of road etc to reduce the impact on traffic condition, and more importantly safety of workers, public and road users.

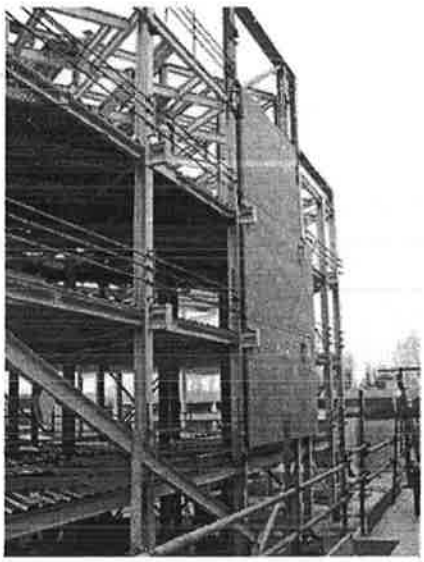
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-3

Design for Safety Considerations:

Works by Specialist Contractors



The specialist contractor had proposed a modular method of construction for the stone panel walls. The panels are lifted and bolted directly onto the steel structure. In doing so:

- manual handling risk is eliminated by utilising mechanical means to lift the panels.
- working at height is also eliminated.

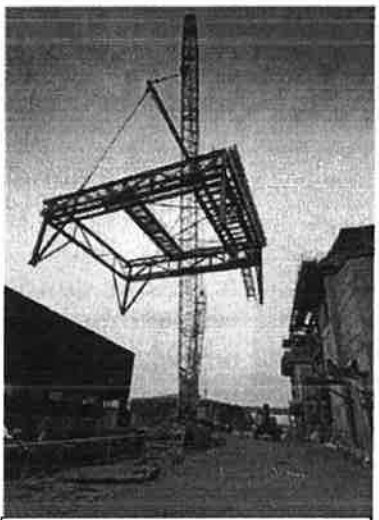
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-3

Design for Safety Considerations:

Works by Specialist Contractors



Gas Heater Structure

The Specialist Contractor proposed to change the design to modular units to facilitate tight schedule and ease of construction. Considerations include:

- Minimising work at height as each were fabricated on the ground and subsequently installed.
- Pre-fabrication also meant that time was saved in the process.

(contd...)

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-3

Design for Safety Considerations:

Works by Specialist Contractors



- Handrails and flooring were preinstalled before launching which meant workers had a completed work platform after installation.
- The location of the prefabrication yard and the final structure were evaluated and located such that transportation distance was minimized. This also ensure less hazards from transporting and lifting the structure.

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-3

Design for Safety Considerations:

Works by Specialist Contractors



A link bridge was designed to connect 2 buildings. The specialist contractor chose to prefabricate the steel bridge and then launch it in place. Considerations include:

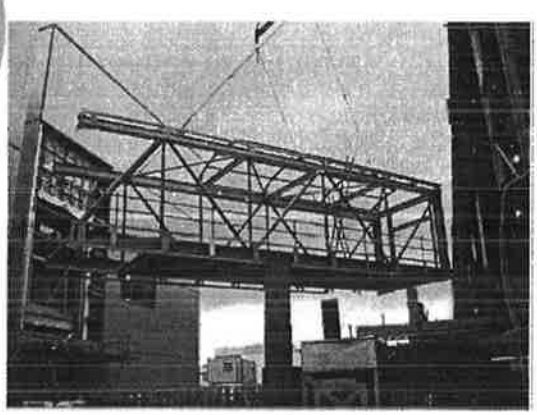
- Reduce work at height by prefabricating on the ground and minimizing connecting works at height

(contd.)

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-3



- The bridge was prefabricated off site in controlled conditions and brought to site as one unit.
- Foundations and a steelwork trestle were installed before the bridge was being delivered to site.
- The bridge was pre painted off site and scaffold edge protection installed at ground level prior to erection. This ensured workers had a ready-to-use work platform once the bridge was installed.

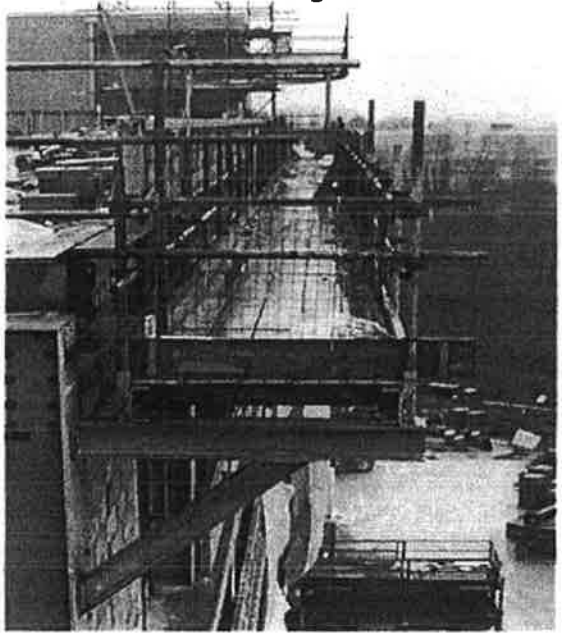
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-3

Design for Safety Considerations:

Construction stage hazards

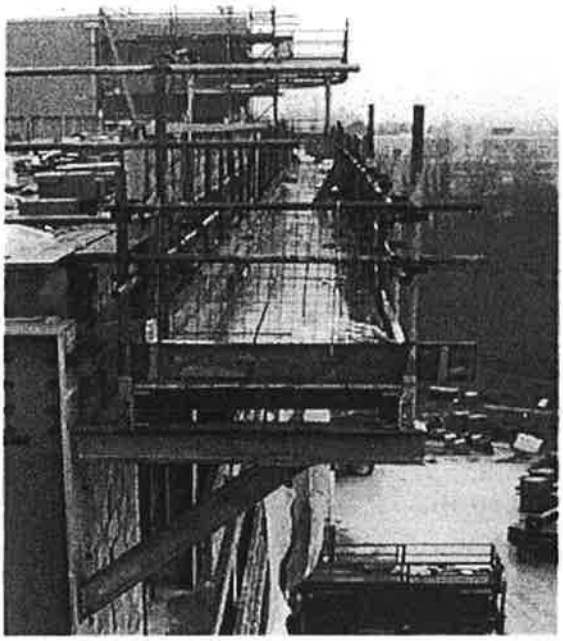


- This project was designed with a stone parapet around the perimeter of the roof
- This would require a full height scaffold from ground level (approximately 23m high)
- This meant that personnel were exposed to working at height for prolonged periods of time (in both erecting and striking the scaffold).
- (contd.)

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE-3

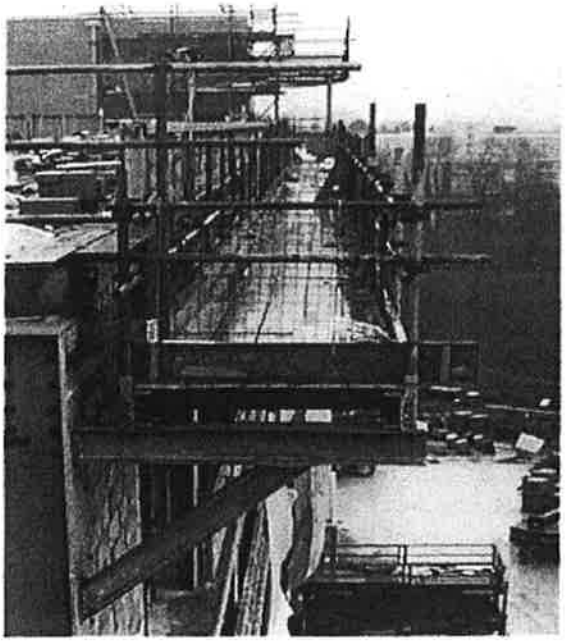


- Temporary cantilever steel brackets designed at roof level were capable of taking the loading for the stonework and the scaffolding.
- The fittings were attached to the handrail uprights at ground level, then taken up in a scissor lift and dropped into sockets allowing the handrail to be fastened immediately.
  - (contd.)

© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 3



Benefits:

- The guardrails could be installed far quicker allowing stonework to progress
- Reduces the amount of time needed to work at height
- Minimises down time associated with windy or wet weather conditions
- The support steelwork can be unbolted and re-used

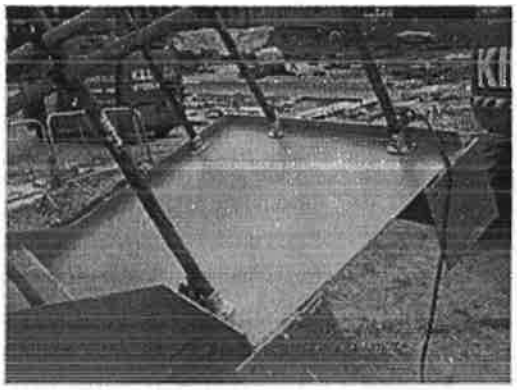
© 2015 All rights reserved

DfS for Professionals Course

Example: GUIDE 3

Design for Safety Considerations:

Construction stage hazards – fall from height



Temporary stair handrails installed at ground level (same holes were later used for the permanent handrail)

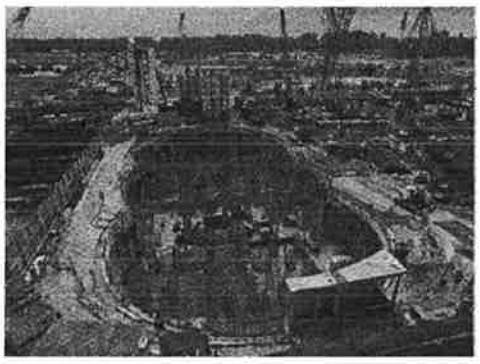


Staircase with Edge Protection being lifted into the Structural Steel Frame

© 2015 All rights reserved

DfS for Professionals Course

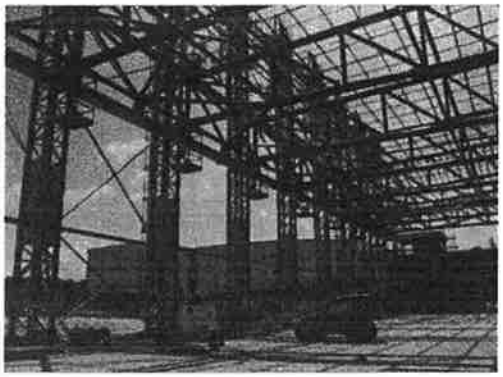
Phases of Design Review Meetings



Designing a structure so that work does not need to be performed at height will prevent fall incidents

e.g. lifting and erection of a hangar's roof truss. ➔

← Adequate provisions for temporary works during the design stage minimise risks during construction.



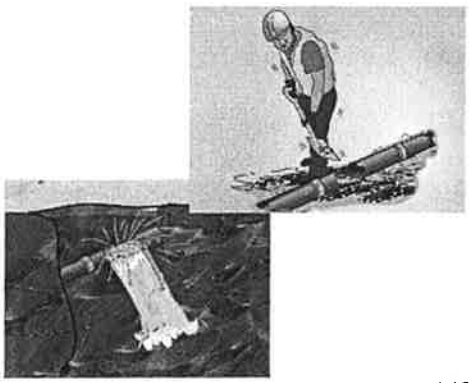
© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

Considerations to be taken for safety and health risks at various phases of a life cycle of a building and structure, during DfS Review Meetings:

- Site planning and preparation, which may include:
  - Soil condition
  - Site topography
  - Underground water
  - Underground services

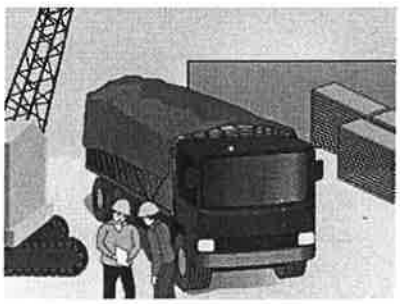


© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Site planning and preparation, which may include:
  - Condition and proximity of adjacent buildings
  - Vehicular traffic movement
  - Pedestrian movement



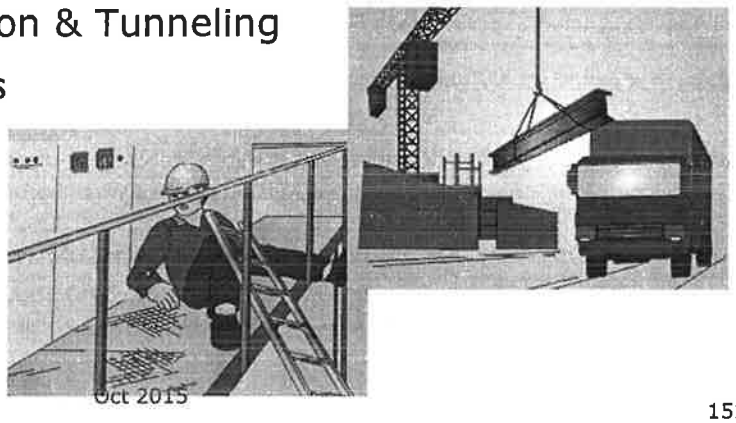


© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Site planning and preparation, which may include:
  - Transport and storage of materials
  - Site clearance and demolition
  - Access and egress of persons
  - Excavation & Tunneling
  - Trenches



© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Civil and structural works
  - Road works, pipe and cable installation, road reinstatement and maintenance
  - Soil investigation, stabilisation and earthwork services
  - Piling
  - Concreting
  - Concrete repair and surface works

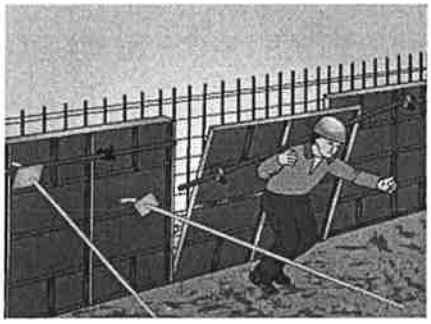


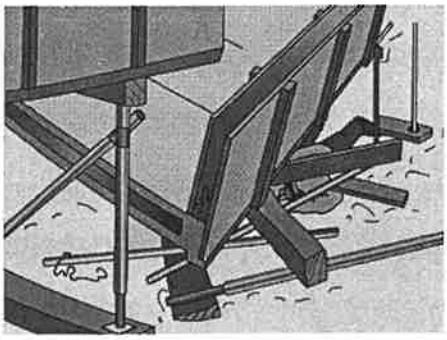
© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Civil and structural works
  - Metal scaffolding
  - Metal formwork and supporting systems



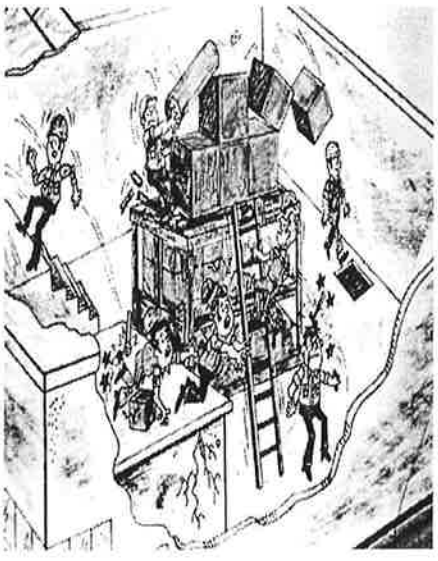


© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Civil and structural works
  - Steel reinforcement
  - Structural steel works
  - Timber formwork and support systems
  - Precast erectors
  - Prefabrication

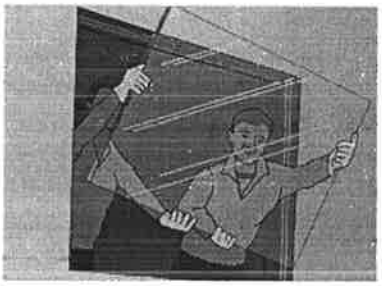


© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Architectural and Finishing Works
  - Wall and partition
  - Ceiling
  - Curtain wall / cladding
  - Drain Laying / pavement and kerb construction
  - Windows and doors
  - Joinery
  - Metal work
  - Painting and road marking

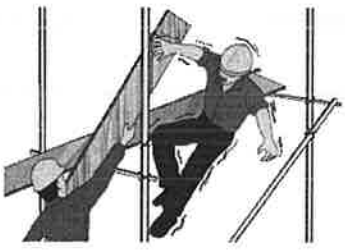


© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Architectural and Finishing Works
  - Plastering
  - Roofing
  - Flooring
  - Waterproofing
  - Horticulture and landscape
  - Additions, alterations, repair and interior decoration



© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Mechanical and Electrical Works
  - Air conditioning, refrigeration and ventilation works
  - Electrical engineering work
  - Fire protection works
  - Plumbing, sanitary, gas piping and sewerage work
  - Lift escalator installation
  - Building automation, industrial and process control system



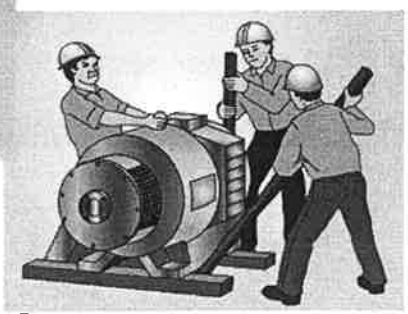
© 20

DfS for Professionals Course

Safety and Health Risks Considerations

- Equipment and special services
  - Construction plant and equipment services
  - Corrosion protection services



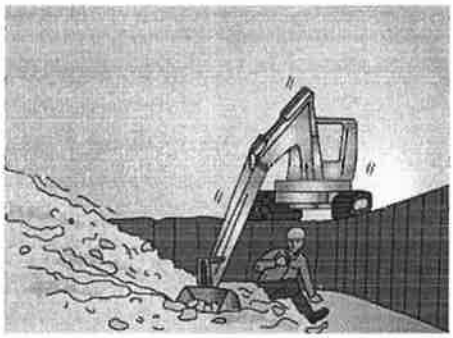


© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- Equipment and special services
  - Cleaning and housekeeping services
  - Desalting service
  - Waste removal and recycling service
  - Pest control services



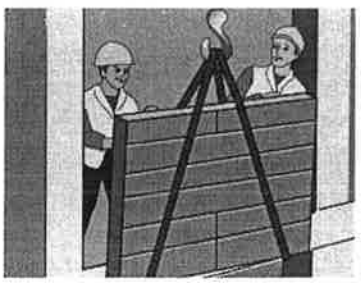
© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- General consideration
  - Heavy lifting
  - Temporary works and sequencing
  - Layout
  - Confined spaces
  - Emergency route
  - Weather
  - Impact to the public



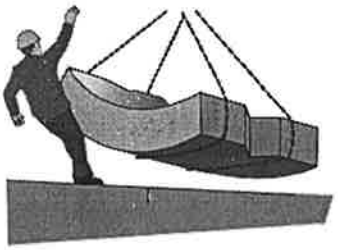


© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- WSH hazards during construction, maintenance, repair phases of building may include:
  - Falling from height
  - Struck by falling objects
  - COctht in between objects
  - Exposed/contact with electricity
  - Exposed/contact with harmful substances/ radiations
  - Step on object





© 2015 All rights reserved

DfS for Professionals Course

Safety and Health Risks Considerations

- WSH hazards during construction, maintenance, repair phases of building may include:
  - Noise Induced deafness
  - Dermatitis
  - Solvent exposure
  - Manual handling
  - Muscular skeletal disorder
  - Hand/arm vibration syndrome



© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Review Meetings

DfS Register (DfSR):

Hazards highlighted in the GUIDE Process should be:

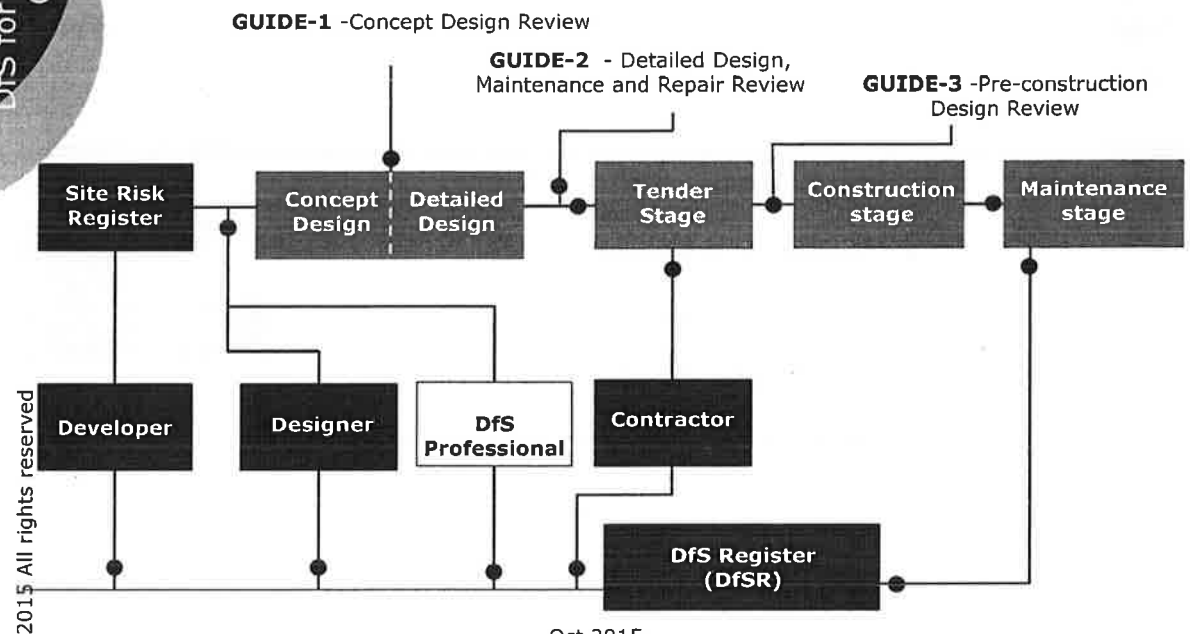
- Singled out
- Addressed
- Recorded

Record in DfS Register.
(Refer to Appendix 4 of Learner Guide)

© 2015 All rights reserved

DfS for Professionals Course

Phases of Design Review Meetings - Recap



© 2015 All rights reserved

DfS for Professionals Course

Hazard Identification Tools

Checklist for

- GUIDE-1 - Concept Design Review
- GUIDE-2 - Detailed Design, Maintenance & Repair Review
- GUIDE-3 - Pre-Construction Review

↑ Demolition of exfg building

Refer to Checklist in Appendix 1, 2 & 3 of Learner Guide

- Includes hazard considerations in design, and
- Detail/hazards identified



© 2015 All rights reserved

DfS for Professionals Course

Hazard Identification Tools

Checklists & Brainstorming

- The Checklists for GUIDE-1, 2 and 3 serve as a reference, there may be other topics not discussed in the lists that are specific to the project itself.
- While the Checklists highlight important issues, they only serve as a reference.
- The team should still have a "brainstorming" session which may be more effective in highlighting the hazards.

© 2015 All rights reserved

DfS for Professionals Course

Hazard Identification Tools

Design Risk Assessment Form

- Hazards highlighted through the Checklist and Brainstorming should be transferred to the Design Risk Assessment Form. (Appendix 4 of Learner Guide)
- The team should then assess the risk and provide mitigating measures according to the Hierarchy of Controls.
- All Checklists and Forms should be kept in the DfS Register. (Will be covered in greater detail later.)

© 2015 All rights reserved

DfS for Professionals Course

Learning Activity 1

Purpose:

1. To enable an overall understanding of Design Review
2. Establish the process for the Design Review
3. Establish a method for the identification of safety and health hazards and risks associated with construction project.

© 2015 All rights reserved

DfS for Professionals Course

Learning Activity 1

Instruction:

- Get into groups of about 6.
- Use the list of questions in the Learners' Guide – Appendix 8 (Learning Activity 1) to guide your discussion.
- Read the case information given to your group. The group should answer the questions with reference to the case information, and apply the concepts and materials discussed in class.
- The group work should take approximately 30 minutes.
- Record your group's answers and insights to the questions for sharing with the class, by giving a presentation of about 5 minutes.

© 2015 All rights reserved

DfS for Professionals Course

Prepare for Design Review Meetings

- Establish DfS Review Meeting consisting of:
  - Developer
  - Design Engineer
  - Architect
  - DfS Professional
  - Contractor

© 2015 All rights reserved

DfS for Professionals Course

Prepare for Design Review Meetings

- Provision of the relevant information by respective stakeholders, such as
  - **Developer**
    - As-built drawings of existing buildings on site
    - Topographical surveys
    - Soil investigation reports
    - Existing utility services
    - Site risk register
  - **Designers**
    - Designs
    - Specifications



© 2015 All rights reserved

DfS for Professionals Course

Prepare for Design Review Meetings

- Define scope for Design Review which may include:
  - Accessibility
  - Confined Space
  - Emergency
  - Lighting
  - Excavation
  - Fall Prevention
  - Working Platforms
  - Hoisting/Weight
  - Layout
  - Maintenance

© 2015 All rights reserved

DfS for Professionals Course

Prepare for Design Review Meetings

- Define scope for Design Review which may include:
  - Material Handling/ Storage
  - Means/Methods
  - Operation
  - Physical Hazards
  - Sequence
  - Standardisation
  - Weather

© 2015 All rights reserved

DfS for Professionals Course

Prepare for Design Review Meetings

- Define roles and responsibilities of persons involved in the Design Review, which may include:
  - Participate in Design Review to constructively challenge the design concept
  - Keep the Design Review on track and moving along
  - Meeting minutes-taker

© 2015 All rights reserved

DfS for Professionals Course

Prepare for Design Review Meetings

- Define roles and responsibilities of persons involved in the Design Review, which may include:
  - Follow up of minutes from previous meeting
  - Explore whether issues have been overlooked or sufficiently thought through
  - Document findings, attendees, methodology etc

© 2015 All rights reserved

DfS for Professionals Course

Prepare for Design Review Meetings

- Determine hazard identification tools and risk assessment methods to be used
- Establish checklists and matrixes to be used for hazard identification and risk assessment
- Arrange necessary training of persons involved in the Design Review, such as
  - Risk Assessment,
  - Hazard Identification and
  - Other relevant courses

© 2015 All rights reserved

DfS for Professionals Course

Prepare for Design Review Meetings

- Determine the method of documentation
- Schedule an appropriate date and time
- Make logistic arrangements, such as
  - Identifying and inviting participants to the review sessions
  - Arranging for a suitable meeting room etc

© 2015 All rights reserved

DfS for Professionals Course

Facilitate Design Review Meetings

The DfS Professional is required to coordinate and ensure continuity in information flow between stakeholders.

To effectively coordinate, the DfS Professional should:

- Guide DfS Review Meeting to keep discussion focused and on track.
- Encourage stakeholders' involvement and cooperation in the Design Review to identify the possible risk involved.

© 2015 All rights reserved

DfS for Professionals Course

Facilitate Design Review Meetings

- Assist in identifying risks and highlighting the hazards concerned as the Designers and Developers may not be equipped with WSH knowledge.
- Assist in identifying control measures for risk that cannot be eliminated.
- Promote the design suitability and compatibility.

© 2015 All rights reserved

DfS for Professionals Course

Facilitate Design Review Meetings

A team member's enthusiasm, involvement, and willingness to participate affect the quality of design review session.

Ways to encourage participation in design review session:

- Arrange seating to promote discussion.
  - Sit in a semicircle so that they can see one another
- Ensure each team member has an opportunity to talk in the review session
- Use nonverbal cues to encourage participation

  E.g. smile expectantly and nod as a team member speaks.

© 2015 All rights reserved

DfS for Professionals Course

Facilitate Design Review Meetings

- Maintain eye contact with team members.
  - Look relaxed and interested
- Draw team members into the discussion
  - Ask whether they agree with what has just been said
  - Ask whether someone can provide another example to support or contradict a point:

    "What is another solution for this issue?"

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

This section covers the details of the DfS Register (DfSR), including:

- Documents required to be inside
- Maintenance and follow-up of documents in the DfSR
- Practical tips on documentation for the DfSR
- Communication of risks with the stakeholders
- What to do with the DfSR when the project ends
- Learning Activity 2 – includes a scenario for conducting the Design Review Meetings and recording of hazards identified.

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

- A live document whereby risks identified from the design stage are,
  - Recorded
  - Kept for future reference
- Contain the information needed for future construction work such as,
  - Cleaning
  - Maintenance, alterations
  - Refurbishment
  - Demolition

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

- Documents residual risks
- Brings about transparency in the tender process. Contractor is
  - Pre-warned of the project hazards and the difficulties faced
  - Able to accurately price for the project
    - Reduce possibilities of any under-pricing
    - Reduce inability to complete the project



© 2015 All rights reserved

DfS for Professionals Course

DfS Register

The items that should be in the DfS Register are :

- Records of GUIDE1, 2 and 3 and records of the resultant changes or risks to be mitigated
- Checklist/matrixes used during Design Review
- Risk assessment
- Relevant safety and health information that the Contractor and the Developer should take note of
- Construction method advisory notes by the designers as guidance notes to the contractor for building and demolition in the future

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

The items that should be in the DfS Register are:

- Maintenance method advisory notes by the designer and/or contractor as guidance notes to the owner
- Safe Operating Procedures for
  - Use and maintenance of equipment/machinery of the completed building

    Example: gondolas, scissor lifts, etc.
- Incident/accidents related to design problem

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

Maintenance of records:

- Records to be kept up to date
- Retained for as long as it is relevant
- Normally the lifetime of the building or structure

Note: While RA records need to be kept for 3 years according to the RA Regulations, this does not apply here.

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

Case:

A worker sustained a cut due to wrong use of handtools.

Investigation showed that the worker was not trained in use of handtools. Corrective action was taken by sending the worker for training.

Question:

Should the incident report and training records be included in the DfSR file?

No.

DfS Register - more on design for Safety.

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

Practical tips on documentation

The safety and health records should be properly documented

- According to Organisation's documentation system or
  - Clear direction for identification and location of documents
  - Logical and organised filing for easy location of required document
  - Definition on responsibilities concerning creation, amendment, custody, maintenance and up keeping of documents
  - Authorisation for access to classified documents

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

Practical tips on documentation (contd.)

The safety and health records should be properly documented

- According to Organisation's documentation system or
  - Revision control
  - Requirements on review of documents
  - Retention periods of documents
  - Back-up arrangement
    - ❖ Hard copy
    - ❖ Electronic copy
- Organisation's documentation requirements

© 2015 All rights reserved

DfS for Professionals Course

DfS Register

Practical tips on documentation (contd.)

The safety and health records should be properly documented

- Organisation's documentation requirements
  - Requirements of management systems
  - Requirements to consider:
    - Size of company
    - Scale and complexity of project
    - Resources available
    - Existing practices



© 2015 All rights reserved

DfS for Professionals Course

Monitor and Review of Safety and Health Records

Vigilant monitoring on the following is essential to ensure safety and health issues are identified and closed:

- Areas where design reviews were not yet started or incomplete
- Part of design concept that was not fully understood
- Hazards not identified previously
- Design changes not finalised
- Incomplete risk register entries
- Opened action items for risk control

© 2015 All rights reserved

DfS for Professionals Course

Monitor and Review of Safety and Health Records

The monitoring process of safety and health issues may include:

- Establish current conditions and status of issues
- Compare current with desired conditions and status to identify gaps
- Identify actions required to close gap



© 2015 All rights reserved

DfS for Professionals Course

Monitor and Review of Safety and Health Records

On-going review ensures that data obtained through monitoring is available for feedback into the system.

Review process of safety and health records include:

- Establish the responsibility, frequency and scope of review of records
- Check safety and health records for up-to-dateness, completeness and accuracy
- Identify safety and health issues
- Address safety and health issues

*Review records and monitor safety and health issues for design stage, construction stage, until handing over to Developer for occupation and maintenance.

© 2015 All rights reserved

DfS for Professionals Course

Types of Safety and Health Information for Communication

A DfS Professional is required to communicate safety and health information to relevant stakeholders.

The types of safety and health information required for communication may include:

- Safety and health information provided by the designers and contractors,
  - E.g. information on soil movement
- Handover of DfS Register to Developer for occupation and maintenance

© 2015 All rights reserved

DfS for Professionals Course

Types of Safety and Health Information for Communication

- Sequence of construction works
- Safety and health hazards affecting relevant stakeholders
- Implications of hazards
- Information arising from GUIDE processes
- Control measures to mitigate risks
- Safety and health responsibilities of relevant stakeholders
- Actions required by relevant stakeholders for mitigation of risks
- Means of communication available to stakeholders

© 2015 All rights reserved

DfS for Professionals Course

Means of Communication to Relevant Stakeholders

Means of communication for disseminating and gathering safety and health information from relevant stakeholders:

- Tendering documents, e.g. residual risks
- Provision of drawings, specifications, calculations and work statements
- Provision of safety and health information and records
- Design reviews
- Sharing of risk register information

© 2015 All rights reserved

DfS for Professionals Course

Means of Communication to Relevant Stakeholders

- Meeting of stakeholders
- Consultation / dialogue sessions
- Training / awareness sessions
- Verbal instruction
- Telephone communication
- Formal written correspondence
- Email



© 2015 All rights reserved

DfS for Professionals Course

Coordinate Flow of Information

Coordinate to ensure the

right safety and health information is passed on to the right stakeholder at the right time.

Example residual risk should be passed on to the Contractor for his tendering and work purpose.

© 2015 All rights reserved

DfS for Professionals Course

Coordinate Flow of Information

Considerations when coordinating flow of safety and health information:

- Determine the communication needs for relevant stakeholders
- Determine the timing at which information should be made available to or gathered from the relevant stakeholders
- Establish and use effective means for communication
- Verify effectiveness of communication



© 2015 All rights reserved

DfS for Professionals Course

Learning Activity 2

Purpose:

1.Become familiarised with the roles and responsibilities of various stakeholders in a Design Review Meeting through **role play**.

2.Apply the hazard identification method in Design Review

3.Become familiarised with the recording of results of hazard identification and risk assessment

© 2015 All rights reserved

DfS for Professionals Course

Learning Activity 2

Instruction:

- Get into groups of about 5.
- Designate the roles among group members according to
  - Developer
  - Designer
  - DfS Professional
  - Main Contractor
  - Observer
- "Observer" roles are to
  - observe how well group member played their roles
  - record all observation;
  - Serve as time keeper
  - At the end of discussion, give feedback to members.
- The discussion should take no more than 1 hour.
- Additional case information will be provided.
- The "DfS Professional" will facilitate the session.

© 2015 All rights reserved

DfS for Professionals Course

Assessment 1

- In-class assessment
- Trainees may refer to their notes
- 10 Multiple Choice Questions
- Duration: 30 mins
- Make use of appropriate knowledge and skills from the course to answer the questions
- Passing mark is 70%

© 2015 All rights reserved

DfS for Professionals Course

Assessment 2

- Individual Written Report
  - Take on the role of a DfS Professional and implement the Guide Process
- To be completed outside training schedule
- Submit within 12 weeks
- All questions in the reports must be addressed. Report must be submitted in full
- Late submission will result in marking you as not yet competent

© 2015 All rights reserved

DfS for Professionals Course

GLOSSARY

© 2015 All rights reserved

DfS for Professionals Course

Glossary

Designer : Anyone who creates or contributes to the complete design or the partial design of a road, a building, a bridge, a tunnel, a dam or any other civil engineering works.

Principal : A person who, in connection with any trade, business, profession or undertaking carried on by him, engages any other person otherwise than under a contract of service:

- to supply labour for gain or reward; or
- to do work for any gain or reward.

Risk : Specifically, it is the likelihood of accidents or ill-health occurring at work, and, the consequences of such occurrences.

© 2015 All rights reserved

DfS for Professionals Course

Glossary

Design : Plans, calculations and drawings that dictate what the end product of the project should be.

Concept Design : The initial planned design of the project's layout, type of building or structure, etc.

Detailed Design : The final design of the project's outlook, the layout, the supporting structures and the materials.

© 2015 All rights reserved

DfS for Professionals Course

ANNEXES

© 2015 All rights reserved

DfS for Professionals Course

Annex A

To aid the designers in carrying out the GUIDE process, this section identifies some areas over which the designer has direct influence.

Designers should note that the list is not exhaustive, nor is every item relevant to every project. **Items** that the designer should note are:

1. The design of buildings or structures should consider risk from site hazards such as:
   - Underground services;
   - Vehicular traffic movements to and within site;
   - Pedestrian movements within and around the site; and
   - Condition and proximity of adjacent buildings.

© 2015 All rights reserved

DfS for Professionals Course

Annex A

2. Health hazards should be designed out by:
   - Specifying less hazardous materials,
     - e.g. solvent-free or low solvent adhesives and water-based paints;
   - Avoiding processes that create hazardous dust, fumes, vapors, noise or vibration, including
     - disturbance of existing asbestos,
     - cutting chases in brickwork and concrete,
     - breaking down cast-in-situ piles to level,
     - scabbling concrete,

© 2015 All rights reserved

Annex A

- manual digging of tunnels,
- flame cutting or
- sanding areas coated with lead paint or cadmium; and,

- Specifying materials that are easier to handle,
  - e.g. lightweight building blocks, limiting the weight of formwork for easier handling.

© 2015 All rights reserved

Annex A

3. Safety hazards should be designed out by:

- Removing the need to work at height wherever possible, particularly where it requires work from ladders or where safe means of access cannot be provided;
- Removing fragile roofing materials or designing access route to the roof including a working platform;
- Eliminating deep or long excavations in public areas or on highways; and,
- Eliminating materials that could create a significant fire risk during construction.

© 2015 All rights reserved

Appendix A

4. Consider prefabrication to minimise hazardous work on site, for example:

- Designing elements like steel structures so that they can be prefabricated and assembled on ground and then lifted to position for installation;
- Specifying cutting of steel members to be done off-site, under controlled conditions, to reduce the amount of dust created; and
- Reducing site welding so as to reduce fire or burn risks and using prefabricated bolt and nuts connections.

© 2015 All rights reserved

Annex A

5. Features that reduce or eliminate the risk of falling should be introduced where it is not possible to remove the need to work at height:

- Early installation of permanent access, such as stairs, to reduce the use of ladder or scaffolds;
- Edge protection or other features that increase the safety of access and construction; and
- Anchor points for life-line or safety harnesses when a work platform cannot be installed.

© 2015 All rights reserved

DfS for Professionals Course

Annex A

6. Design to simplify safe construction by:

- Providing lifting points on prefabricated elements and marking the weight and the centre of gravity of heavy or bulky items both on the drawings and on the items themselves;
- Making provision for temporary works required during construction;

© 2015 All rights reserved

DfS for Professionals Course

Annex A

6. Design to simplify safe construction by *(Contd.)*:

- Designing joints in vertical steel structure members such that bolting can be easily done by someone standing on floor using seating angles to provide support while bolting;
- Designing connections so as to minimise risk of incorrect assembly and providing clear directions on drawings; and
- Designing for safe installation of external cladding
  - E.g. installation of cladding from the inside of the building.

© 2015 All rights reserved

DfS for Professionals Course

Annex A

7. Identify worst case scenarios and implement preventive control measures, such as:

- Designing adequate safety factors such that overloading (static, dynamic and impact) and collapse of permanent or temporary structure are not possible;
- Putting in place monitoring instrumentation that provide early warning of possible collapse or ground movements; and
- Emergency route for mass evacuation in the event of emergency.

© 2015 All rights reserved

DfS for Professionals Course

Annex A

8. Design to simplify future maintenance and cleaning work by *(Contd.)*:

- Making provision for safe permanent access;
- Specifying windows that can be cleaned from the inside;
- Placing all controls and electrical boxes at accessible locations;
- Designing safe access to the roof;
- Making provision for safe temporary access to allow for painting and maintenance of facades, etc.;

© 2015 All rights reserved

DfS for Professionals Course

Annex A

8. Design to simplify future maintenance and cleaning work by *(Contd.)*:

- Using paints or materials that require less frequent maintenance or replacement;
- Designing ventilation system for easy access and maintenance; design should be flexible to accommodate minor changes to building usage;
- Considering safe movement of pedestrian and vehicular traffic flow during occupancy.

© 2015 All rights reserved

DfS for Professionals Course

Annex A

9. Identify unusual demolition hazards for future:

- Sources of substantial stored energy, such as pre- or post-tension cables;
- Unusual stability concepts;
- Alterations changing the structure significantly;
- Embedded materials, utilities, etc. whose exposure or removal may introduce new hazards.

© 2015 All rights reserved

DfS for Professionals Course

Annex A

The designer's creativity need not be limited by the above, but safety and health requirements should still be evaluated.

The designer need not design out every single hazard identified, but he should weigh the risk level of the hazards and as far as reasonably possible, design out the risks either by eliminating the hazards or incorporating control measures to reduce the risks to acceptable levels.

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1
Concept Design Review

The purpose of GUIDE-1 is to review the conceptual design and identify the critical risks associated with the construction, maintenance, repair and demolition of the project.

By doing this very early in project life cycle, risk controls can be established to ensure that the risks are managed by eliminating or controlling them.

Sometimes, risks identified in GUIDE-1 can only be addressed later in the project when more of the project details are known.

However, the highlighting of the risk aids the designer in understanding the feasibility as well as the hazards associated with the project.

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

The designer may be well-informed, but not equipped with WSH knowledge.

So, GUIDE-1 should be done by a group of key stakeholders and not only by the designer alone.

Contribution of various people will ensure safety

at every stage and level is examined and discussed.

Primary concern of GUIDE-1will be on the safety issues related to the LOCATION of the project.

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

LOCATION involves several major considerations such as soil assessment, the public, the existing services and the placement of major machinery.

GUIDE-l therefore needs to examine the issues associated and highlight risks and hazards arising.

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

To aid the GUIDE-1 Review Team, a series of questions are tabulated to identify hazards.

While the questions may highlight important issues, they serve only as a reference for the team and may not be comprehensive.

Hence the team should still have a "brainstorming" session which will be more effective in highlighting the hazards and concerns of the key stakeholders.

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

SOIL:

- Has the soil profile of the site of the proposed project been studied by the QP?
- Are there buildings or structures that may have shallow foundation in the vicinity of proposed project?
- Will there be possible lowering of ground water table as a result of the proposed construction?
- Will there be possible settlement due to the proposed project?
- Are there any possible preventive measures to ensure settlement is minimised?

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

PUBLIC:

- Will the commencement of the project affect the public in any way?
- Will the commencement of the project affect the traffic in any way?

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

SERVICES:

- Are there underground services in the site that need to be removed for the project?
- Will the removal of these services, if any, be a hazard to the workers or the public?

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

OTHERS:

- Are there any special features that require special arrangements during construction?
- Can the method of construction/sequence be identified at present?
- Are there any hazards associated with the method of construction / sequence that can be dealt with at present?
- Are there any foreseeable hazards that can be identified and eliminated?

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

The hazards identified should be transferred to a Design Risk Assessment Form (Annex E).

This form allows for the hazards and control measures to be indicated.

The Review Team should then agree on the party to be assigned to implement the control actions.

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

A follow-up review should be done to ensure that the controls are actually implemented and working and not merely filed away for information.

Other considerations by the review team or actions done to mitigate the risks should be documented in the SH Risk Assessment form so as to ensure that all relevant information is captured.

© 2015 All rights reserved

DfS for Professionals Course

Annex B : GUIDE-1

Unless the exercising of GUIDE-1 at concept design stage indicates that a redesign/relocation of the project is required, all issues can be addressed in the detailed design stage.

- As such, typically GUIDE-1 needs only to be performed once.

Design issues highlighted in GUIDE-1 should be addressed by the designers when doing the detailed design.

Identify the new hazards, and ensuring that hazards raised in GUIDE-1 are followed through and mitigated, will be done in GUIDE-2.

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2 Detailed Design, Maintenance and Repair Review

GUIDE-2 serves to assist designers to review the detailed design where most of the design is in process but still subject to possible modifications.

By the time GUIDE-2 is implemented the design intent should have been finalised, making the identification of hazards easier.

In addition, maintenance and repair methodology should be reviewed at this stage, so that required maintenance or repair issues can be addressed.

While GUIDE-2 serves to address these new hazards, the issues raised during GUIDE-I should also be reviewed and closed out if possible.

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

GUIDE-2 should also be done by the key stakeholders and not just the designer alone.

It is important that proper documentation be done so as to ensure relevant information are passed on and kept in the DfS Register (DfSR).

A series of questions are tabulated below to aid the GUIDE-2 Review Team.

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

The questions may highlight important issues, but they serve only as a reference for the team and may not be comprehensive.

So, the team should still have a "brainstorming" session which will be more effective in highlighting the hazards and concerns of the key stakeholders.

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

PREFABRICATION:

- Can elements such as steel structures be prefabricated, assembled on ground and then lifted to position for installation?
- Can the cutting of steel members be done off-site, under controlled conditions to reduce the dust created?
- Can site welding be reduced so as to reduce fire or burn risks and prefabricated nuts and bolts used as connections?
- Can prefabricated elements be provided with designed lifting points, and the weight, the centre of gravity marked on the drawings and on the items?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

PREFABRICATION *(Contd.)*:

- If the prefabricated structure is required to be temporarily suspended for a period of time before final installation, are there means to ensure the hazards arising are removed?
- Can joints in vertical steel structure members be designed such that bolting can be done while on the ground?
- Can connections be designed to minimise risk of incorrect assembly (e.g. unique bolt layout for each connection) and clear instructions provided on drawings?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

HEAVY LIFTING:

- Consider the work process and the equipment required for heavy lifting. Can the position for parking of these equipment be finalised and cordoned off?
- Does a foundation for these lifting equipment need to be designed so as to minimise settlement and failure of support?
- Consider the worst case scenario. Can this scenario be prevented or managed to minimise injuries?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

FALLING FROM HEIGHT:

- Can the need to work at height be removed? E.g. removing the need to work from ladders, removing the need to work where a safe means of access cannot be provided.
- Can fragile roofing materials be removed or an alternative access route (including a work platform) to the roof be designed?
- Can there be early installation of permanent access, such as stairs, to reduce the use of ladders or scaffolds?
- Can edge protection or other features that increase the safety of access and construction be designed and installed?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

FALLING FROM HEIGHT *(Contd.)*:

- Can anchor points for installation of life-line or safety harnesses be mounted where work platforms cannot be installed?
- Can floor openings, if any, be minimised?

TEMPORARY WORKS AND SEQUENCING:

- Can a safer means of access or egress be used instead of the temporary means required?
- Can the permanent staircase and lifts be completed first and used during the construction stage?
- Will the design affect the work process and stages during construction?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

TEMPORARY WORKS AND SEQUENCING
(Contd.):

- Can temporary works required during construction be planned for? E.g. specifying type and position of the temporary works so as to ensure spatial considerations have been considered.
- Are there special construction considerations that need to be highlighted to the contractor for his construction?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

TEMPORARY WORKS AND SEQUENCING
(Contd.):

- Does the sequence of construction create any temporary unstable working platform, which requires additional bracing?
- Can adequate safety factors be incorporated in design such that overloading or collapse of permanent or temporary structure is not possible?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

LAYOUT:

- Can the layout be optimised to prevent any accidents from the flow of traffic, pedestrian, equipment, etc. within and around the site during the construction stage?
- Consider the flow of traffic, pedestrian, equipment within and around the site during the permanent stage. Can the layout be optimised to prevent any accidents?
- Is there a need to designate specific material, equipment, vehicular and human traffic flow diagram?

© 20:5 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

CONFINED SPACE:

- Does the design create any confined space in the permanent or temporary stage?
- Can confined space be removed from design?
- Can the requirement to enter the confined space be minimised by removal of vital equipment or controls from the confined space?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

EMERGENCY ROUTE:

- Is emergency route for both the temporary and permanent stages the shortest and most direct?
- In the emergency route, is there adequate lighting, directions, warning and backup power for mass evacuation of people?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

HEALTH HAZARDS:

- Can less hazardous materials be specified? E.g. solvent-free or low solvent adhesives and water-based paints.
- Can processes that create hazardous fumes, vapors, dust, noise or vibration be avoided? E.g. disturbing existing asbestos, cutting chases in brickwork and concrete, breaking down cast·in-situ piles to level, scrabbling concrete, hand-digging tunnels, flame cutting or sanding areas coated with lead paint or cadmium.
- Can materials that are easier to handle be specified? E.g. lightweight building blocks, limiting the weight of formwork components to < 25kg.

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

WEATHER:

- Is there a possibility of floods in the site? If so, how can the hazard be minimised in the temporary and permanent stages?
- Is there a possibility of lightning strike in the site? If so, how can the hazard be minimised in the temporary and permanent stages?
- Are there any other adverse weather conditions that can affect the ability to safely construct the work?
- What are the effects of extreme temperature or humidity on instrumentation?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

OTHERS:

- Can monitoring instruments for early warning of collapse or ground movements be installed?
- Are there any other major hazards to deal with?
- Can materials of potential fire risk be removed?
- Can sources of substantial stored energy, such as pre- or post-tension cables be specified in drawings and highlighted for future demolition?
- Can alterations that have changed the structure significantly be highlighted?
- Can disruptions to existing utilities within occupied buildings be avoided?

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

Having answered the above list of questions and highlighting the hazards, the hazards identified should then be transferred to a Design Risk Assessment Form.

The form allows for the hazards and control measures to be indicated and the Review Team should then agree on the party to be assigned to take the actions to further address the hazard.

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

A follow up review should be done to ensure that the hazards to be addressed are not merely shelved and filed away for information.

Other considerations by the review team or actions taken to mitigate the risks should be documented in the Design Risk Assessment Form so as to ensure that all relevant information is captured.

© 2015 All rights reserved

DfS for Professionals Course

Annex C : GUIDE-2

As mentioned previously, design issues highlighted in GUIDE-1 should be addressed by the designers when doing the detailed design.

GUIDE-2 will hence be a session to identify the new hazards as well as ensuring hazards raised in GUIDE-1 are followed through and mitigated.

© 2015 All rights reserved

DfS for Professionals Course

Annex D : GUIDE-3
Pre-Construction Review

Temporary works design and design for elements provided by specialist contractors are often included as part of the scope of works in construction contracts.

Where such design elements are not covered during concept design and detailed design stages of project, risks and hazards associated with design and construction should be identified and addressed prior to commencement of works.

GUIDE-3 aims to provide DfS Professionals with a tool to identify and address risks associated with:

- temporary works design, and
- designs provided by specialist contractors.

© 2015 All rights reserved

DfS for Professionals Course

Annex D : GUIDE-3

Along with key stakeholders involved in GUIDE-1 and GUIDE-2, the main contractor and his appointed designers and specialist contractors should be a part of GUIDE-3 process Review Team.

Like GUIDE-2, proper documentation must be done to ensure that relevant information is passed on and documented in the DfS Register.

© 2015 All rights reserved

DfS for Professionals Course

Annex D : GUIDE-3

To aid the GUIDE-3 Review Team, a series of questions are tabulated.

While the questions may highlight important issues, they serve only as a reference for the team and may not be comprehensive.

So, the team should still have a "brainstorming" session which will be more effective in highlighting the hazards and concerns of the key stakeholders.

© 2015 All rights reserved

DfS for Professionals Course

Annex D : GUIDE-3

TEMPORARY WORKS AND SEQUENCING:

- Can a safer means of access or egress be used instead of the temporary means required?
- Can permanent staircase and lifts be completed first and used during the construction stage?
- Will the design affect the work process and stages during construction?
- Can temporary works required during construction be planned for? E.g. specifying the type, position of the temporary works so as to ensure spatial considerations have been considered.
- Are there special construction considerations to be highlighted to contractor in his work?

© 2015 All rights reserved

DfS for Professionals Course

Annex D : GUIDE-3

TEMPORARY WORKS & SEQUENCING *(Contd.)*:

- Does the sequence of construction create any temporary unstable stage, which requires additional bracing?
- Can adequate safety factors be incorporated in design such that overloading or collapse of permanent or temporary structure is not possible?
- Will there be possible basal heave and piping during excavation?
- Will there be possible settlement due to the proposed project?
- Has a proper schedule for monitoring of instrumentation been provided?

© 2015 All rights reserved

DfS for Professionals Course

Annex D : GUIDE-3

TEMPORARY WORKS & SEQUENCING *(Contd.)*:

- Will there be any adverse effects on adjacent structures during removal of temporary works?
- Are there any alternatives or measures that could reduce or minimise such adverse effects?

SPECIALISED DESIGN:

- Are there safety concerns on specialist design elements to be considered by main contractor?
- Can alternative safe work practices be employed to mitigate such concerns?

© 2015 All rights reserved

DfS for Professionals Course

Annex D : GUIDE-3

OTHERS:

- Have the risks and hazards identified in GUIDE-1 and GUIDE-2 been addressed or mitigated?

© 2015 All rights reserved

DfS for Professionals Course

Annex E : Design Risk Assessment Form

Project Title: Company:
Review: Conducted by:
Review date: Next review date:
Process Location:

COLUMN HEADINGS:

(1) S/No.
(2) Design Consideration
(3) Risks
(4) Hazards Identified
(5) Risk Assessment:
  (5a) Severity,
  (5b) Likelihood,
  (5c) Risk Level

© 2015 All rights reserved

DfS for Professionals Course

Annex E : Design Risk Assessment Form

COLUMN HEADINGS:

(6) Can these hazards be designed out?
(7) Proposed Control Measures
(8) Residual Risk Level
  (8a) Severity,
  (8b) Likelihood,
  (8c) Risk Level
(9) Further review required?
(10) Action by:

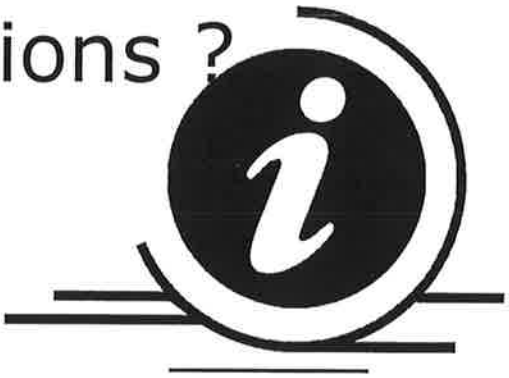
Attachment: GUIDE-1, GUIDE-2, GUIDE-3

Endorsed by: _____
(DfS Professional)

© 2015 All rights reserved

DfS for Professionals Course

Questions ?



© 2015 All rights reserved

DfS for Professionals Course

Published in Oct 2015 by the Workplace Safety and Health Council in collaboration with the Ministry of Manpower.

All rights reserved

This document is provided for explicit use and guidance of MOM Approved Training Providers as information resource for Design for Safety Professional training purposes. Any other use of this document or parts thereof, including reproduction, publication, distribution, transmission, retransmission or public showing, or storage in a retrieval system in any form, electronic or otherwise, for purposes other than that expressly stated in this advice, without the expressed permission of Workplace Safety and Health Council and Ministry of Manpower is strictly prohibited.

© 2015 All rights reserved

Design for Safety for Professionals Course

Learner's Guide





Updated in October 2015 by the Workplace Safety and Health Council in collaboration with the Ministry of Manpower.

All rights reserved.

This document is provided for explicit use and guidance of Training Providers as information resource for Design for Safety Course for Professionals training purposes. Any other use of this document or parts thereof, including reproduction, publication, distribution, transmission, retransmission or public showing, or storage in a retrieval system in any form, electronic or otherwise, for purposes other than that expressly stated in this advice, without the expressed permission of Workplace Safety and Health Council and Ministry of Manpower is strictly prohibited.

Contents

Course Overview 4

I. Learning Outcome 4

II. Assumed Skills and Knowledge 6

III. References and Reading Materials 6

Competency Element 1: 7

Facilitate DfS Review Meetings 7

1.1 Importance of Design for Safety and Health for Construction Projects ... 9

1.2 Risk Assessment 17

1.3 Stakeholders' Duties and Responsibilities in a Construction Project 28

1.4 Duties and Responsibilities of DfS Professional 34

1.5 DfS Review Meetings 38

1.6 Phases of DfS Review Meetings 39

1.7 Safety and Health Risks Considerations during DfS Review Meetings .. 42

1.8 Hazard Identification Tools 45

1.9 Prepare for DfS Review Meetings 46

1.10 Coordinate DfS Review Meetings 49

Competency Element 2: 51

Maintain Safety and Health Records 51

2.1 DfS Register 52

2.2 Organisation's Documentation System 54

2.3 Monitor and Review of Safety and Health Records 55

Competency Element 3: 56

Communicate Safety and Health Information to Stakeholders 56

Example: Maintenance 91
Example: Maintenance 92
Example: Maintenance 93
Example: Maintenance 94
Appendix 7 95
Examples on Guide 3 Design Review 95
Appendix 8 103
Learning Activities 103
Learning Activity 1 103
Learning Activity 2 105

- ☑ Coordinate DfS Review Meetings for consideration of safety and health risks at different phases in the life cycle of a building and structure
- ☑ Apply hazard identification tools and risk assessment for DfS Review Meetings in accordance with organisational procedures.

CE2: Maintain records of safety and health issues arising from the DfS Review Meetings and actions taken

☑ Establish the types of safety and health records to be kept in the DfS Register in accordance with WSH (DfS) Regulations and ACOP for DfS.

☑ Implement a system for documentation of safety and health records in accordance with organisational requirements.

☑ Review safety and health records throughout the construction project in accordance with organisational requirements.

☑ Monitor safety and health issues throughout the construction project in accordance with organisational requirements

CE3: Communicate Safety and Health Information to Stakeholders

☑ Establish the types of safety and health information to be communicated to stakeholders throughout the construction project.

☑ Establish means of communication to relevant stakeholders for safety and health information in accordance with organisation requirements.

☑ Coordinate the flow of relevant information to stakeholders throughout the construction project.

Competency Element 1:

Facilitate DfS Review Meetings to identify and mitigate the safety and health risks

Design for Safety for Professionals Course

Learner's Guide





Updated in October 2015 by the Workplace Safety and Health Council in collaboration with the Ministry of Manpower.

All rights reserved.

This document is provided for explicit use and guidance of Training Providers as information resource for Design for Safety Course for Professionals training purposes. Any other use of this document or parts thereof, including reproduction, publication, distribution, transmission, retransmission or public showing, or storage in a retrieval system in any form, electronic or otherwise, for purposes other than that expressly stated in this advice, without the expressed permission of Workplace Safety and Health Council and Ministry of Manpower is strictly prohibited.

Version	Effective Date	Changes	Author
1.0	March 2011	First issue	WSH Council Office
2.0	October 2015	Update	WSH Council Office

Contents

Course Overview 4

I. Learning Outcome 4

II. Assumed Skills and Knowledge 6

III. References and Reading Materials 6

Competency Element 1: 7

Facilitate DfS Review Meetings 7

1.1 Importance of Design for Safety and Health for Construction Projects ... 9

1.2 Risk Assessment 17

1.3 Stakeholders' Duties and Responsibilities in a Construction Project 28

1.4 Duties and Responsibilities of DfS Professional 34

1.5 DfS Review Meetings 38

1.6 Phases of DfS Review Meetings 39

1.7 Safety and Health Risks Considerations during DfS Review Meetings .. 42

1.8 Hazard Identification Tools 45

1.9 Prepare for DfS Review Meetings 46

1.10 Coordinate DfS Review Meetings 49

Competency Element 2: 51

Maintain Safety and Health Records 51

2.1 DfS Register 52

2.2 Organisation's Documentation System 54

2.3 Monitor and Review of Safety and Health Records 55

Competency Element 3: 56

Communicate Safety and Health Information to Stakeholders 56

3.1 Types of Safety and Health Information for Communication 57
3.2 Means of Communication to Relevant Stakeholders 58
3.3 Coordinate Flow of Information 59
Acknowledgement 60
References 61
Appendices 62
Appendix 1 62
Sample GUIDE-1: Concept Design Review 62
Appendix 2 65
Sample GUIDE-2: Detailed Design, Maintenance and Repair Review 65
Appendix 3 74
Sample GUIDE-3: Pre-Construction Review 74
Appendix 4 78
Sample Design Risk Assessment Form 78
Appendix 5 79
Examples on Guide 1 Design Review 79
Appendix 6 84
Examples on Guide 2 Design Review 84
Example: Lift Shaft Installation 84
Example: Utilities/ Air Condition Access 85
Example: Utilities/ Air Condition Access 86
Example: Human traffic flow 87
Example: Finishes and Fittings 88
Example: Illumination of Atrium 89

Example: Maintenance 91
Example: Maintenance 92
Example: Maintenance 93
Example: Maintenance 94
Appendix 7 95
Examples on Guide 3 Design Review 95
Appendix 8 103
Learning Activities 103
Learning Activity 1 103
Learning Activity 2 105

Course Overview

I. Learning Outcome

This module comprises of 3 Competency Elements (CE) as shown below. By the end of this course, learners should be able to:

CE1: Facilitate the DfS Review Meetings to identify and mitigate the safety and health risks;

CE2: Maintain records of safety and health issues arising from the DfS Review Meetings and actions taken; and

CE3: Communicate Safety and Health Information to Stakeholders

Learners are expected to be able to perform the following:

CE1: Facilitate the DfS Review Meetings to identify and mitigate the safety and health risks

- ☑ Recognise the importance of design for safety and health of a construction project to eliminate or mitigate such risks throughout the life cycle of a building and structure.
- ☑ Recognise the duties and responsibilities of DfS Professional in accordance with WSH (DfS) Regulations and Approved Code Of Practice (ACOP) for DfS.
- ☑ Advise stakeholders in a construction project on their duties and responsibilities in accordance with WSH (DfS) Regulations and ACOP for DfS.
- ☑ Prepare for DfS Review Meetings in accordance with WSH (DfS) Regulations and ACOP for DfS.

- ☑ Coordinate DfS Review Meetings for consideration of safety and health risks at different phases in the life cycle of a building and structure
- ☑ Apply hazard identification tools and risk assessment for DfS Review Meetings in accordance with organisational procedures.

CE2: Maintain records of safety and health issues arising from the DfS Review Meetings and actions taken

☑ Establish the types of safety and health records to be kept in the DfS Register in accordance with WSH (DfS) Regulations and ACOP for DfS.

☑ Implement a system for documentation of safety and health records in accordance with organisational requirements.

☑ Review safety and health records throughout the construction project in accordance with organisational requirements.

☑ Monitor safety and health issues throughout the construction project in accordance with organisational requirements

CE3: Communicate Safety and Health Information to Stakeholders

☑ Establish the types of safety and health information to be communicated to stakeholders throughout the construction project.

☑ Establish means of communication to relevant stakeholders for safety and health information in accordance with organisation requirements.

☑ Coordinate the flow of relevant information to stakeholders throughout the construction project.

II. Assumed Skills and Knowledge

Learners are assumed to possess the following skills and knowledge for this unit:

- ☑ Building design and construction operations
- ☑ Building and construction processes
- ☑ Legal and statutory requirements associated with building and construction
- ☑ Basic safety and health issues associated with construction operations
- ☑ Written and oral communication, presentation, facilitation and problem solving skills

It is assumed that learners are familiar with the following materials prior to attending this course:

- ☑ Workplace Safety and Health Act
- ☑ WSH (DfS) Regulations
- ☑ ACOP for DfS
- ☑ Workplace Safety and Health Act Subsidiary Legislations, including:
  - WSH (Risk Management) Regulations
  - WSH (Construction) Regulations

III. References and Reading Materials

The following are useful references and reading materials. These are relevant knowledge which will not be, or only briefly covered during the course. Learners who have prior knowledge and understanding of these materials will find it beneficial in following the course and meeting the assessment requirements.

Code of Practice on WSH Risk Management
https://www.wshc.sg/files/wshc/upload/cms/file/CodeOfPractice_RiskManagement_SecondRevision.pdf

Competency Element 1:

Facilitate DfS Review Meetings to identify and mitigate the safety and health risks

Overview

This course should enable learners to perform the role of a DfS Professional to understand his duties under the WSH (DfS) Regulations and help control risks throughout the life cycle of building and structure at the early design stage

The content of the course is largely based on the WSH (DfS) Regulations and ACOP for DfS, co-developed by the Taskforce for Design for Safety, Workplace Safety and Health Council and the Ministry of Manpower.

This course should enable learners to perform the role of a DfS Professional to help control risks throughout the life cycle of building and structure at the early design stage.

The key roles of DfS Professional are:

1) Facilitate the DfS Review Meetings to identify and mitigate the safety and health risks;

2) Maintain records of safety and health issues arising from the DfS Review Meeting and actions taken; and

3) Communicate safety and health information to stakeholders

These will be elaborated throughout the course.

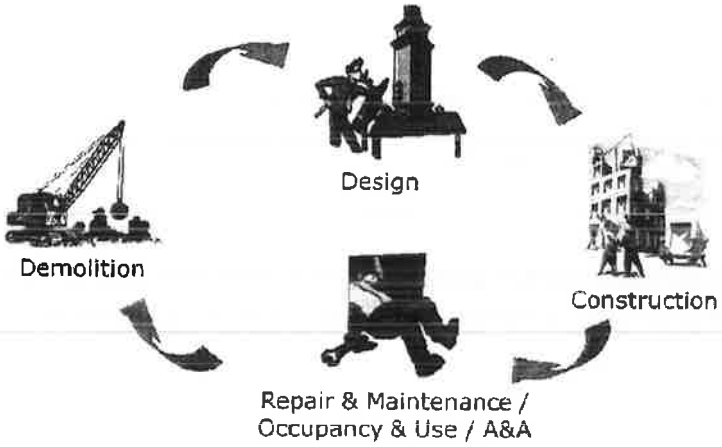
1.1 Importance of Design for Safety and Health for Construction Projects

Design is a fundamental engineering and architectural activity. Design for Safety and Health can help to identify and correct flaws early in the life cycle of buildings and structures which includes:

- ☑ Design
- ☑ Construction
- ☑ Maintenance/repair / Occupancy / Use / Addition & Alteration
- ☑ Demolition

Different safety and health issues can arise at different phase of the life cycle of buildings and structures. Many of such issues can be easily avoided or reduced if careful considerations have been taken during the design phase when corrective actions required is much less costly and more effective. A poorly designed building or structure without giving due considerations to safety can health issues will result in risk to, for example:

- Contractors building it;
- maintenance personnel maintaining and repairing it;
- users of the building while occupying it;
- workers demolishing it



Life Cycle of a Building and Structure

One important purpose of DfS Review Meetings is to identify safety and health issues throughout the phases of life cycles of the buildings arising from the design of the building, and address them during the design phases whenever possible. This is to reduce risk at source, which is in line with the basic principle of Workplace Safety and Health Act. Where the safety and health risk cannot be eliminated, the residual risk should be recorded during such DfS Review Meetings and communicated to the relevant stakeholders for control and monitoring during the later phases of the life cycle of the building and structure.

Importance of Design for Safety and Health for construction projects may include the following:

- ☑ Improved planning and management of project at early stage of project.
- ☑ Identification and mitigation of risks at design stage so that they can be effectively eliminated and properly managed.
- ☑ It is cheaper to eliminate occupational health and safety hazards at the design or planning stage, rather than making the changes when the hazards become real risks to the Developers, staff or business.

Safe design can reduce overall costs of construction, and maintenance of a building and structure. The typical operating and owning costs of a building* are in the ratio:

- 1 for construction costs;
- 5 for maintenance and building operating costs;
- 200 for business operating costs.

*Report of the Royal Academy of Engineering on *The long term costs of owning and using buildings* (1998)

☑ By identifying hazards as early in the life cycle of the building as possible, losses in terms of life, injury and cost can be minimised and safety can be ensured for current and future users.

☑ Minimisation of unnecessary delays

☑ Help stakeholders to better address the risks downstream to facilitate compliance of:

- Workplace Safety and Health Act
- WSH (DfS) Regulations
- WSH (Risk Management) Regulations
- WSH (Construction) Regulations
- WSH (Workplace Safety and Health Officers) Regulations
- WSH (Asbestos) Regulations

Other 'Relevant legal requirements' relating to design of building and structures, such as:

- Building Control Act
- Fire Safety Act
- Sewerage and Drainage Act
- Electricity Act

The legal requirements represent the minimum standards for which buildings and structures are to be designed and constructed and what must be considered and controlled.

It is important for DfS Professional to know about these requirements to play their role effectively. The DfS Professional should get familiar with these requirements although it is not covered in this course

It should be noted that:

- The WSH (DfS) regulations are effective from 1 Aug 2016 for projects where Designers are appointed after the effective date.
- The WSH (DfS) regulations is to be implemented for all projects:
    - Undertaken by a developer in the course of his business,
    - With contract sum $10million or more, and
    - Involves development under section 3(1) of the Planning Act (Cap. 232).
- It is optional for the Developer to appoint a suitably qualified DfS Professional under the WSH (DfS) Regulations. In the event that the Developer does not wish to appoint the DfS Professional, he has to take on his duties. (This will be covered later in the course.)

Workplace Safety and Health Legal Requirements

The 'relevant legal requirements' discussed in this course centres primarily on workplace safety and health. It does not cover requirements relating to design of building and structures such as the Building Control Act, Fire Safety Act, Sewerage and Drainage Act, Electricity Act etc. Learners may refer to the following resources such as the government statutes online at

http://agcvldb4.agc.gov.sg;

or Government Printers & Retailers of Government Publications, and Singapore Standards and Code of Practices at:

http://www.toppanleefung.com
http://www.singaporestandardseshop.sg

The Workplace Safety and Health Act

This is the main legislation in Singapore on workplace safety and health. It came into effect on 1st March 2006, aimed at creating a world-class WSH legal framework.

The 3 guiding principles of the WSH framework are:

- Reducing risk at source:
  - All stakeholders to eliminate or minimise the risks they create at the workplace;
- Instilling greater industry ownership of OSH standards.
  - Employers to be responsible for developing suitable safe work procedures
- Higher penalties for poor safety and health management

In general, one key requirement is that duty holders must:

... in so far as is

reasonably practicable,

take such measures to ensure safety and health of persons at work.....

In line with the WSH Act, reducing risk at source is an important component in improving safety.

The term **"practicable" in our context means that an action is capable of being done**. This therefore considers whether a measure can be done and is feasible.

The term "reasonable" takes into account of the following:

1. **Severity** of any risk of injury or harm to health that may occur
2. **Likelihood** of that risk of injury or harm occurring

3. How much is **known** about that hazard and the ways of managing it
4. **Availability, suitability and cost** of safeguards

There are two elements to what is 'reasonably practicable'. A duty-holder must first consider what can be done – that is, what is possible in the circumstances for ensuring safety and health. They must then consider whether it is reasonably, in the circumstances to do all that is possible.

This means that what can be done should be done unless it is reasonably in the circumstances for the duty-holder to do something less.

To address risk at source, there is a need to look at who creates the risk and address the issue from there.

While the WSH Act imposes a duty on the occupiers, employers and principles, the risk inherent in the design also need to be addressed and means to mitigate risk identified.
Poor planning, lack of communication between Designer and occupier / user, may lead to loss of information and result in accident.

Many accident or ill-health of worker or user of the building may have root causes traced back to the source of design. Unsafe / 'At-risk' designs will result in workers or users of the building not able to control the hazards effectively since the hazards are 'built in' by design. They will have to take risk to deal with these hazards.

From another point of view, where safety is not considered at the upstream during the design stage, it will become increasing difficult and costly for the stakeholders such as employer of construction workers, occupier of construction sites, installer, supplier and persons at work to deal with them. As there are legal requirements to control these hazards, compliance with the regulations become a challenge to these stakeholders.

The ACOP for DfS serves to assist stakeholders on the process on design safety and the transfer of vital safety and health information.

Other Relevant Legal and Other Requirements may include (not limited to):

- WSH (Asbestos) Regulations
- WSH (Scaffold) Regulations
- WSH (Operations of Cranes) Regulations
- SS 602 : 2014 Code of practice for noise control on construction and demolition sites
- SS 536:2008 Code of Practice for the Safe Use of Mobile Cranes
- SS 559: 2010 Code of Practice for Safe Use of Tower Cranes
- SS557: 2010 Code of practice for demolition

Note that Code of Practices may be "other requirements" used by the Court to judge 'reasonable practicable' although they might not be legal requirements.

The WSH (Risk Management) Regulations

- It is the cornerstone in the WSH legal framework.
- It aims to instil a risk assessment mindset to proactively identify hazard, evaluate risk and take control measures to prevent accident, rather than reacting to it.
- In line with the "reduce risk at source" principle of the WSH Act.

Under the WSH (Risk Management) Regulations, the employer, self-employed and principal shall:

- Conduct Risk Assessment
- Take reasonably practicable measures to elimination risks, if not, minimize risks
- Provide information to persons affected by the risks
- Maintain a record of risk assessment and measures or safe work procedure implemented
- Keep record of not less than 3 years
- Review the risk assessment at least once every 3 years, or upon occurrence of incident / accident or significant change in work practices

The WSH (DfS) Regulations adopt and apply the principles used in risk management. It is based on the principle of reducing risk at source.

To help industry comply, especially those who do not have a risk management process, WSHC has developed a " "Code of Practice on WSH Risk Management" (available at the WSHC's website)

Companies can adopt risk assessment approach:

- Described in the Code of Practice, or
- Other established methods or hazard identification and risk analysis commonly used, while still applying the basic principles in the Code of Practice.

1.2 Risk Assessment

Risk Assessment (RA) is covered in detail as RA is needed to enable the learner to perform the DfS Review Meetings.

Risk assessment is the process of:

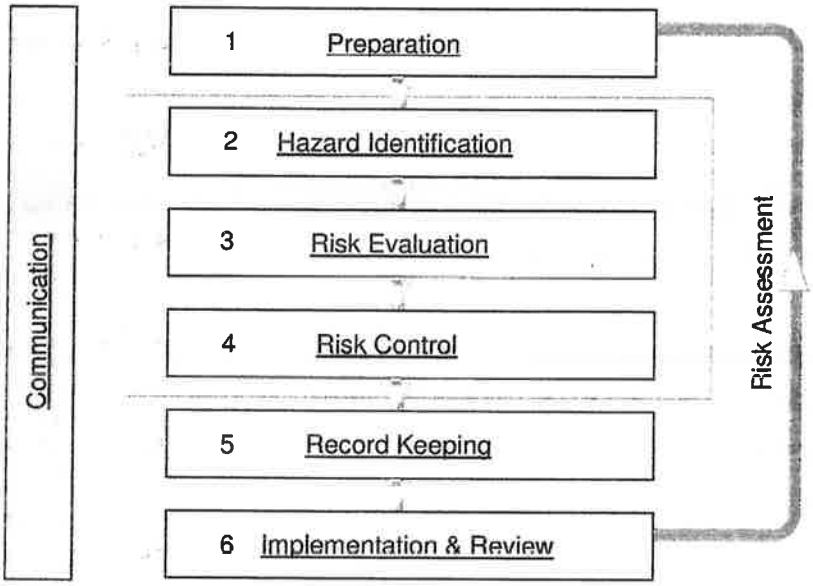
1. Identifying and analysing safety and health hazards
2. Evaluating the risks
3. Controlling risk

The corner stone in the new WSH legal framework and reform is the more proactive approach of risk management: the duty holders must take reasonably practicable measures to manage the safety and health risks arising from their undertakings.

It should be noted that the same principles of RA will be used in the Design Risk Assessment. The Design Risk Assessment and other information on the risks should be kept in the DfS Register throughout the whole life cycle of the building. This will be covered later in the course.

Risk Assessment is the most vital part of the risk management process, as illustrated in Figure 2.

Figure 2: Risk Management Process



Risk assessment includes both routine and non-routine operations. Routine operations include activities such as preparatory and troubleshooting work activities. Non-routine operations include commissioning, repair and maintenance of plants/buildings

Risk Assessment Steps:

1. Identify and analyse safety and health hazards

A hazard is anything or any source or situation with the potential to cause harm or injury. Examples of categories of hazards may be

- ☑ Physical (e.g. mechanical, electrical, thermal, radiation, fire etc)
- ☑ Chemical
- ☑ Biological
- ☑ Ergonomic

Hazard identification is perhaps the most important step in risk assessment because hazards can only be controlled if they are identified.

Hazard identification involves identifying the hazards associated with the work activities of each process and type of potential accidents or incidents. During this phase, the aim is to spot hazards, brainstorm on all the possible types of accidents and ill health that can happen due to the hazard, and identify the persons that can be victims of the accident or ill health.

Persons-at-risk include:

- ☑ Persons directly involved in the operation
- ☑ Persons not directly involved in the operation
- ☑ Visitors at the workplace
- ☑ Members of the public

2. Evaluate the risks

Risk evaluation consists of:

- ☑ Identifying the existing risk control measures;

- ☑ Assessing the potential severity of the hazards;
- ☑ Determining the likelihood of occurrence of accidents, incidents and/or ill health arising from identified hazards; and
- ☑ Assessing the risk level based on the severity and likelihood.

Risk evaluation is the process of estimating the risk levels of the hazards and their acceptability. This is used as a basis for prioritising actions to control these hazards and minimise safety and health risks.

Identifying existing risk control measures

The presence of existing control measures should first be identified for each individual work activity for each process. By considering the effectiveness of the existing controls and the consequences of their failure, the risk of the activity can be assessed.

Examples of risk control measures include engineering controls, safe work procedures and personal protective equipment.

Risk is made up of two parts:

- ☑ Expected SEVERITY of the hazard; and
- ☑ LIKELIHOOD of the occurrence of the accident/incident or ill health taking into account the existing risk controls.

Assessing the potential severity of the hazards

Severity is the degree or extent of injury or harm caused by accidents/incidents. Severity is classified into three categories: Minor, Moderate and Major. These are described in Table 2.

Table 2 - Severity categories and description

Severity	**Description**
Minor	No injury, injury or ill-health requiring first aid treatment only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort)
Moderate	Injury requiring medical treatment or ill-health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, deafness, work-related upper limb disorders)
Major	Fatal, serious injury or life-threatening occupational disease (includes amputations, major fractures, multiple injuries, occupational cancer, acute poisoning and fatal diseases)

As the severity of the hazard refers to the intrinsic or inherent nature of the adverse effect (e.g. cancer, amputation or fatal injury) that may result from the hazard, it does not depend on the controls in place. Therefore, in assigning the severity level, the existing controls should not be taken into account.

Determining the likelihood of occurrence of accidents, incidents and/or ill health arising from identified hazards

Likelihood of occurrence of an accident or incident or ill health is also classified into three categories as Remote, Occasional and Frequent. These are described in Table 3.

Table 3 - Likelihood categories and description

Likelihood	Description
Remote	Not likely to occur
Occasional	Possible or known to occur
Frequent	Common or repeating occurrence

To minimise the subjectivity of estimating likelihood, in addition to looking at existing controls, the following sources of information should be considered:

- ☑ Past incident and accident records
- ☑ Industry practice and experience
- ☑ Relevant published literature

Assessing the risk level based on the severity and likelihood

Once the severity and likelihood have been established, the risk level can be determined. One approach is to use the following 3 X 3 matrix. The risk level may be classified as low, medium or high and is at the intersection of the severity row and the likelihood column.

To determine the risk level, select the appropriate row for Severity and the
appropriate column for Likelihood; the cell where they intersect indicates the Risk Level.

For example, if the Severity is Moderate and the Likelihood is Occasional, the Risk Level is Medium Risk.

Table 4 - Risk matrix to determine Risk Level

Likelihood / Severity	Remote	Occasional	Frequent
Major	Medium Risk	High Risk	High Risk
Moderate	Low Risk	Medium Risk	High Risk
Minor	Low Risk	Low Risk	Medium Risk

3. Control risk

Based on the risk level determined, risk controls should be selected to reduce the risk level to an acceptable level. This can be done by reducing the Severity and/or Likelihood.

As indicated in the risk matrix in Table 5, when the risk level is "High", effective and practicable risk controls must be implemented to bring down the "High Risk" level to at least "Medium Risk".

Table 5 shows the acceptability of risk and recommended actions for different risk levels, which can be used to guide the selection of risk controls.

Table 5 - Acceptability of risk and recommended actions

Risk Level	Acceptability of Risk	Recommended Actions
Low Risk	Acceptable	No additional risk control measures may be needed. However, frequent reviews may be needed to ensure that the risk level assigned is accurate and does not increase over time.
Medium Risk	Moderately acceptable	A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as is practicable within a defined time period. Interim risk control measures, such as administrative controls, may be implemented. Management attention is required.

Risk Level	Acceptability of Risk	Recommended Actions
High Risk	Not acceptable	High Risk level must be reduced to at least Medium Risk before work commences. There should not be any interim risk control measures and risk control measures should not be overly dependent on personal protective equipment or appliances. If need be, the hazard should be eliminated before work commences. Immediate management intervention is required before work commences.

It is essential for risks to be eliminated or reduced "at source". If a risk cannot be controlled completely by engineering measures, it is necessary to protect the staff/trainees by administrative control or personal protection.

The control of hazards and reduction of risks can be accomplished by following the Hierarchy of Control Measures in Figure 3. These control measures are not usually mutually exclusive e.g. engineering controls can be implemented together with administrative controls like training and safe work procedures.

Figure 3: Hierarchy of Control Measures

ELIMINATION Eg: Change design to eliminate risky maintenance work
SUBSTITUTION Eg: Use of less flammable construction material

ENGINEERING CONTROL Eg: Design in safe access for building maintenance
ADMINISTRATIVE CONTROL Eg: Implement safe work procedure for maintenance
PPE Eg:Safety belt, safety harness

1. Elimination - Control hazards by eliminating them at the design stage.

Example:

- ☑ Design modification
- ☑ Change in sequence of construction work
- ☑ Change in construction location
- ☑ Change in positioning of equipment
- ☑ Prefabricate of structures

2. Substitution - Control hazards by substituting them with lesser hazards

Example: Pre-assembled equipment at ground level rather than height

3. Engineering Control - Use engineering controls to isolate people from the hazards. Example: Prevent falls from buildings during construction/maintenance by increasing wall/edge height.

4. Administrative Control - Use administrative controls to train and warn people of hazards. Example: Provide hazard warning lights, provide information about residual risks to Contractors tendering the project

5. Personal Protective Equipment - Use personal protective equipment to reduce exposure to hazards. This should be used only as a last resort, after all other control measures have been considered, or as a short

term contingency during maintenance/repair or as an additional protective measure.

1.3 Stakeholders' Duties and Responsibilities in a Construction Project

Duties of the Developer

The Developer plays a very important role in the process of the whole project. As a result of the Developer financing the project, he is able to influence many major decisions in the project such as the engaging of the Designers, DfS Professionals, Contractors, etc., as well as type of design and materials used.

As such, it is important to emphasize that the Developer's role is to ensure a safe design is implemented and that adequate resources (time and finances) are provided for the design and construction of a safe building or safe workplace.

The duties of the Developer as per the WSH (DfS) Regulations are as follows:

General duties of Developers for handling risks

- Ensure all foreseeable design risks are eliminated
- Where not reasonably practicable to eliminate the design risks, Developer shall ensure the design risks is reduced to as low as reasonably practicable.
- When reducing the risks, the design risks shall be reduced at its source and collective protective measures shall be used instead of individual protective measures.

Engage competent personnel

- Ensure that any Designer, Contractor or DfS Professional which the Developer appoints are competent to perform their duties.

Provide sufficient time and resources

- Plan and manage the project such that all Designers and Contractors appointed by the Developer have sufficient time and resources to perform their duties.

Provide relevant information

- Ensure relevant information is provided to all Designers and Contractors appointed by the Developer.

DfS Review Meeting

- Convene DfS review meeting to identify all foreseeable design risks and discuss how each of the foreseeable design risks can be eliminated.
- Ensure that the DfS review meeting is attended by the relevant Designers and Contractors.

Maintaining a DfS Register

- Keep a DfS register containing information and records on DfS review meeting convened and every residual design risk for the project.
- Ensure that the DfS Register is up to date.
- Ensure that all Designers and Contractors appointed for the project have access to the DfS Register
- Ensure the DfS Register is available for inspection by registered workplace inspectors

Delegation of Developer's Duties to DfS Professional

- Developer may delegate the following duties to the DfS register:
  - Convening DfS Review Meetings
  - Maintaining a DfS Register
- The Developer must provide the DfS Professional with the information necessary for him to perform his duties.

It is noted that once the Developer assigns the duties to convene the DfS Review Meetings and to maintain the DfS Register to a DfS Professional, the Developer is no longer responsible for the performance of those duties. However, the Developer is still responsible for the other duties to ensure that a safe design is selected and implemented.

Passing on the DfS Register

- If Developer disposes of his interests in the structure, ensure that the DfS register is given to the person who acquires his interests in the project and inform him of the nature and purpose of the DfS register.
- For subdivided buildings, ensure that the register is to be given to the subsidiary management corporation of the subdivided building and inform them of the nature and purpose of the DfS register.

The Developer shall **ensure that the DfS Professional is competent** in terms of **experience and training** to perform the tasks. The candidate should have **reasonable exposure in safety and health** for construction, and

- Be **registered Professional Engineer** with the Professional Engineers Board (PEB), or **registered Architect** with the Board of Architects (BOA) Singapore, with practising certificate; OR

- Have **10 years relevant experience** in the design (at least 5 years in design which includes contributions to designs, writing specifications) and the supervision of the construction of structures, and **degree accepted by PEB or BOA**, or **construction-related degree accepted by the Singapore Institute of Surveyors and Valuers (SISV) or Society of Project Managers (SPM).**

The competent person should **attend relevant DfS courses**, such as the "DfS Course for Design Professionals" conducted by Professional Bodies or Industry Associations.

Duties of the Designer

In line with the WSH Act, the person who creates the risk must be responsible to mitigate it. This is applicable to the Designers (architects and engineers), who should ensure that the risks created as a result of their design (called design risks), be reviewed through a systematic process and the resultant mitigated risk be passed to the Contractor.

In specifying the design of a building or structure, the Designer should understand how the building or structure can be constructed, cleaned, maintained, and decommissioned or demolished safely. He must therefore study the design and look at the risks to those carrying out the proposed works and others affected by it, such as the public or people using the building or structure in the future.

The duties of the Designer are as follows:

- Prepare a design plan that eliminates all foreseeable design risks.
- Where not reasonably practicable to eliminate the foreseeable design risk, to propose to the person who appointed him, a modification to the design plan that reduces the design risks to as low as reasonably practicable.
- When reducing the risks, the design risks shall be reduced at its source and collective protective measures shall be used instead of individual protective measures.
- Provide information relevant to the design, construction or maintenance of the structure to the person who appointed the Designer.
- Attend DfS Review Meeting where required by the Developer.
- Ensure any Designer appointed (called Delegated Designer) is competent to perform his duties under the regulations.
- Ensure Delegated Designers are provided with relevant information.

- Designer is still responsible for his duties even if a Delegated Designer is appointed.

The consideration to remove the safety and health risks from the design is not to limit Designers in terms of their creativity but to ensure that the Designer in preparing a design avoids foreseeable design risks to the safety and health of those:

☑ carrying out or liable to be affected by construction work for the structure,

☑ for whom the structure is a workplace, including an individual who maintains or cleans the structure, or anything in or on the structure, or

☑ who carries out or is liable to be affected by the demolition of the structure.

This would include those who may be affected by such work, for example customers or the general public.

With regards to the structure being used as a workplace, the Designer should note that the WSH Act imposes certain duties on the occupier of a workplace.

Duties of the Main Contractor

Where identified hazards or risks are not eliminated/mitigated at the design phase, the residual risks must be addressed and managed by the main Contractors and sub-Contractors during the construction phase.

Main Contractors, being responsible for the planning, management and co-ordination of construction works, play a critical role in ensuring that hazards identified, both prior to and during the actual construction works, are properly addressed. To enable the effective management of safety and health during the construction phase, it is essential that relevant information pertaining to risks identified during the design stage be provided to main Contractors. Where possible, main Contractors should be involved in identifying and through design mitigating the occupational safety and health risks at the concept or detailed design phase, e.g. a main Contractor may be involved in the detailed design phase of a 'design and build' project.

The duties of the Main Contractor are as follows:

- Inform the person who appointed the Contractor of any foreseeable design risk
- Ensure that any Designer he appoints is competent
- Ensure that any Designer he engages is provided with relevant information to assist him with his duties
- Ensure that any sub-Contractor he engages is competent
- Ensure that any sub-Contractor he engages is provided with relevant information to assist him with his duties
- Attend and participate in the DfS review process where required by the developer

The same duties above would also apply to Sub-Contractors.

It is noted that the Main Contractors, as Occupiers under the WSH Act and subsidiary legislations, would have other duties imposed on him under these regulations. However these will not be covered in the scope of this course.

Duties of the Subsequent Building Owners

After the completion of the building, the Developer must hand over the DfS Register to the Registered Proprietor or Subsidiary Management Corporations (for subdivided buildings). This is to ensure that information on the residual risk captured and mitigation measures is informed to the subsequent people who may be handling the risks of the project.

Their duties include:

- Keep the DfS register
- Ensure that DfS register is available for inspection upon inspectors request
- Provide the DfS register to the person who next acquires the interest in the structure
- Ensure the person who acquires the interest in the structure is aware of the nature and purpose of the DfS register

1.4 Duties and Responsibilities of DfS Professional

In many construction projects, coordination between the Developer, the Designer and Contractor is lacking, resulting in miscommunication of vital information that could affect safety and health risks in the project.

To ensure continuity in information flow, the Developer should appoint a suitably qualified DfS Professional. The DfS Professional should follow through with the project from the design stage, to the construction stage until the handover to the Developer for occupation and maintenance.

As such, the DfS Professional should be on-board the team as early as the concept design stage so as to facilitate the DfS Review Meetings.

The duty of the DfS Professional is to:

DfS Review Meeting

- Convene DfS review meeting to identify all foreseeable design risks and discuss how each of the foreseeable design risks can be eliminated.
- Ensure that the DfS review meeting is attended by the relevant designers and contractors.

Maintaining a DfS Register

- Keep a DfS register containing information and records on DfS review meeting convened and every residual design risk for the project.
- Ensure that the DfS Register is up to date.
- Ensure that all Designers and Contractors appointed for the project have access to the DfS Register
- Ensure the DfS Register is available for inspection by registered workplace inspectors

Updating the Developer

- Ensure that the Developer is provided as soon as practicable after the DfS review meeting, with the relevant information on each foreseeable design risk identified and how each design risk can be eliminated.
- Provide the Developer with updated DfS Register after the adding of any information or record.

The DfS Professional is not in charge of safety and health at the site, nor should he take over the safety and health responsibilities of the Designer and the Contractor.

However, he is responsible to facilitate the DfS Review Meetings to identify and mitigate the foreseeable design risks, ensure proper records are kept in the DfS Register and ensure relevant information on safety and health is passed on to the Designers, Contractors and all other relevant stakeholders at the appropriate time.

It is noted that the Developer remains overall responsible to ensure that all foreseeable design risks are eliminated, if not, reduced to as low as reasonably practicable. To enable the Developer to fulfil this duty, the DfS Professional is to update the Developer as soon as practicable with the relevant information on each foreseeable design risk identified and how each design risk can be eliminated. This would ensure that the Developer maintains oversight on the design risks of the project.

Discussion Questions:

Can the Designer or Project Manager be the DfS Professional?

- Yes, provided he/she exercised impartiality and is able to fulfill his roles independently.

Can the DfS Professional role be performed by a company?

- Yes, the Developer may appoint this role to a company, but the key personnel involve should still be a certified DfS Professional.

Case 1: A residential building has an irregularly-shaped façade which makes the cleaning impossible to do by normal gondola. Can the DfS Professional ask for a design change?

- The DfS Professional should raise up the difficulty in cleaning the façade and ask the other members attending the DfS Review Meeting to address the safety aspects of it. He/she should recommend that the design be changed if

the DfS Review Meeting agrees that the hazard it poses is major with no means of addressing/ mitigating it with risk control measures.

Note: The DfS Professional should not take over the safety and health responsibilities of the Designer and the Contractor which may include design related decisions.

Case 2: The Designer had proposed that the flyover up-ramp be cast-in-situ. However, due to the difficulty of diverting existing traffic and creating space at the narrow site for erection of formwork, the Contractor requested that a section of the ramp be pre-cast. Should the DfS Professional insist that the original design be followed?

- No, the DfS Professional is a facilitator of the DfS process and should not decide construction methods for the Contractor. He/she should follow-up with a design review of the new design if Designer agrees with the design change.

Case 3: Spotlights are mounted on the external of the building at 10m above the ground. Several years after the completion of the building, a worker fell and died while changing the spotlight component.
Upon investigation, it was found that the worker had been asked to access the spotlight by rope access system but his PPE had given way.
It was also found that during the DfS Review Meetings, the DfS Professional highlighted that the changing of the spotlight component posed a risk of falling from height but the project team did not address the issue.
It was noted that falling from height was deemed a remote risk and should be addressed by the Building Owner with means such as providing PPE and adequate training.
Can the DfS Professional be charged with any legal duties in this case?

- The DfS Professional has a duty to convene the DfS Review Meetings to ensure that all design risks are eliminate, if not, mitigated.
-
- If the DfS Review Meeting team agree that the risk is remote and could be

addressed by the Building Owner, the DfS Professional should ensure this info is present in the DfS Register and highlight to the Building Owner at handover stage so that the Building Owner could address the issue.

- Pursuant to the WSHA, the employer is responsible to ensure his worker is adequately trained and experienced to do the work and that the PPE is in good condition.

Disclaimer: Note that the WSH (DfS) Regulations is a new regulations yet to be tested and tried by the courts of law. While this courseware is developed by the MOM and WSHC with the best of the knowledge available, all regulations need to be tested with actual cases.

Case 4: During the DfS Review Meeting, it was noted that the Air Handing Unit (AHU) was housed in a confined space which had no proper ventilation. This was missed by the DfS Professional and was not addressed by the building owner. Is the DfS Professional liable for any confine space accidents resulting from this?

- The DfS Professional has a duty to ensure that all design risks identified are mitigated and that all residual risks should be captured in the DfS Register. He is therefore liable for not performing his duty under the WSH (DfS) Regulations.
- The accident should still be investigated thoroughly to determine the cause and the responsibilities of the stakeholders as defined by the WSHA.

Case 5: During GUIDE 2, it was highlighted that the installation of a glass canopy required an additional work platform for the workers (eg. boom lift), instead of working on the canopy itself or hanging from the roof supports using safety harness.

The DfS Professional duly informed the Contractor the findings of GUIDE 2 and reminded him to take note.

Does the DfS Professional need to go to the site to ensure this is being done?

- No, the DfS Professional should not take over the Contractor's safety and health responsibility on site.

1.5 DfS Review Meetings

Once preparation of the DfS Review Meetings is completed, the DfS Review Meetings called GUIDE should be chaired and facilitated by the DfS Professional so as to guide the review team to identify and manage the hazards.

GUIDE Process

1. G – **Group** together a review team consisting of major stakeholders.
2. U – **Understand** the full design concept by looking at the drawings and calculations, or have the Designers elaborate on the design.
3. I – **Identify** the risks that arise as a result of the design or construction method. The risks should be recorded and analysed to see if they can be eliminated by changing the design.
4. D – **Design** around the risks identified to eliminate or to mitigate the risks.
5. E – **Enter** all the information including vital design change information affecting safety and health or remaining risks to be mitigated into the DfS Register.

Steps 3 and 4 should be iterative and repeated until the review team is satisfied that the design can no longer be changed to totally eliminate all risks.

The GUIDE process can also be applied throughout the life of the building and structure, such as during construction, addition and alteration etc.

1.6 Phases of DfS Review Meetings

To influence the design and identify the risks as early as possible, it is proposed that the GUIDE Process be done in the various stages of the project. In addition, doing the GUIDE Process in different phases also ensures that the review team can concentrate on a smaller scope during each process, thereby reducing the possibility of missing out on any significant item.

It is recommended that the GUIDE Process be done in three phases:

GUIDE-1: Concept Design Review

Concept design review should look at general location of the project, traffic and vehicular flow in the surroundings, type of building, and other general constraints. Refer to *Appendix 1* for a sample of topics that can be discussed for GUIDE-1.

GUIDE-2: Detailed Design, Maintenance and Repair Review

Detailed design, maintenance and repair review should look at the detailed architectural and structural design. The review should also determine the risks involved in the construction methods, the access and egress, whether the design will create confined space or other hazards. The risks related to maintenance and repair of the building, such as the cleaning methods, should also be studied.

For Design and Build contracts where the Contractor is in-charge of the design of the project, GUIDE-2 should be done with the Contractor's input. He can then highlight constraints that he will face when constructing the building or structure. This would further help in the GUIDE process. Refer to *Appendix 2* for a sample of topics that can be discussed for GUIDE-2.

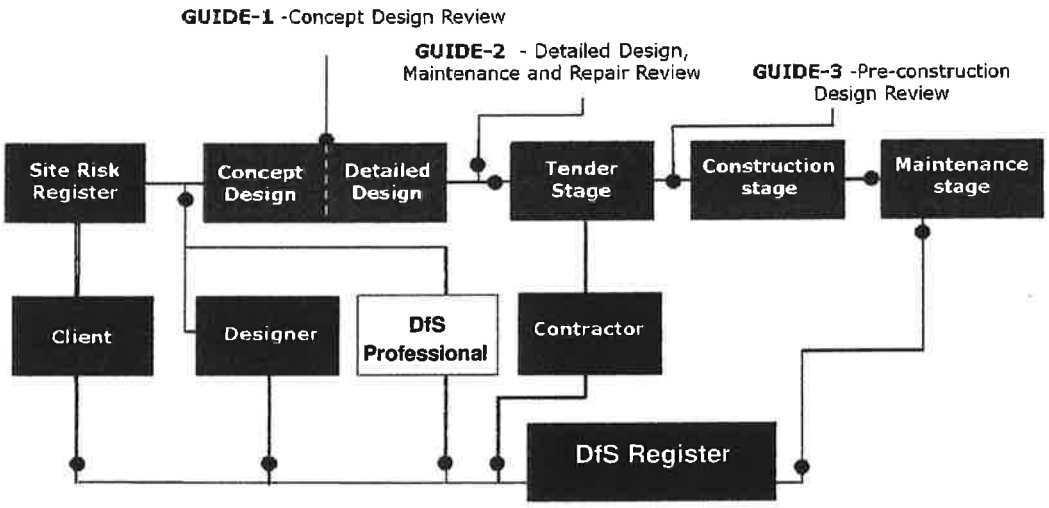
GUIDE-3: Pre-Construction Review

Pre-construction design review should examine temporary works design and design by specialist Contractors not covered during the concept and detailed design phases. Refer to *Appendix 3* for a sample of topics that can be discussed for GUIDE-3.

DfS Register (DfSR)

The hazards highlighted in the GUIDE Process should be singled out, addressed and recorded in the **DfS Register (DfSR)** shown in *Appendix 4.*

Figure 1: Guide Process Flow Diagram illustrates the phases of the construction project during which GUIDE 1, GUIDE 2 and GUIDE 3 should be conducted.



1.7 Safety and Health Risks Considerations during DfS Review Meetings

The following are considerations to be taken for safety and health risks at various phases of a life cycle of a building and structure, during DfS Review Meetings:

☑ Site planning and preparation, which may include:

- Soil condition
- Site topography
- Under ground water
- Underground services
- Condition and proximity of adjacent buildings
- Vehicular traffic movement
- Pedestrians movement
- Transport and storage of materials
- Site clearance and demolition
- Access and egress of persons
- Excavation & Tunnelling
- Trenches

☑ Civil and structural works

- Road works, pipe and cable installation, road reinstatement and maintenance
- Soil investigation, stabilisation and earthwork services
- Piling
- Concreting
- Concrete repair and surface works
- Metal scaffolding
- Metal formwork and supporting systems
- Steel reinforcement
- Structural steel works
- Timber formwork and support systems
- Precast erectors

- Prefabrication

☑ Architectural and Finishing Works

- Wall and partition
- Ceiling
- Curtain wall / cladding
- Drain Laying / pavement and kerb construction
- Windows and doors
- Joinery
- Metal work
- Painting and road marking
- Plastering
- Roofing
- Flooring
- Waterproofing
- Horticulture and landscape
- Additions, alterations, repair and interior decoration

☑ Mechanical and Electrical Works

- Air conditioning, refrigeration and ventilation works
- Electrical engineering works
- Fire protection works
- Plumbing, sanitary, gas piping and sewerage works
- Lift escalator installation
- Building automation, industrial and process control system

☑ Equipment and special services

- Construction plant and equipment services
- Corrosion protection services
- Cleaning and housekeeping services
- Desalting services
- Waste removal and recycling services
- Pest control services

☑ General consideration

- Heaving lifting
- Temporary works and sequencing
- Layout
- Confined spaces
- Emergency route
- Weather
- Impact to the public

☑ WSH hazards during construction, maintenance, repair phases of building may include:

- Falling from height
- Struck by falling objects
- Caught in between objects
- Exposed / contact with electricity
- Exposed / contact with Harmful Substances/Radiations
- Step on object
- Noise Induced deafness
- Dermatitis
- Solvent exposure
- Manual handling
- Muscular skeletal disorder
- Hand/arm vibration syndrome

1.8 Hazard Identification Tools

Hazard identification tools have been developed to help users systematically identify and assess risk. Some tools and techniques are relatively generic while others are specialized for particular industry.

The hazard identification tool recommended for use in the DfS Review Meeting is the checklist method.

Checklists

The review team can utilise the Checklist method in hazard identification during the GUIDE Process. The checklists for GUIDE1, GUIDE2 and GUIDE3 are enclosed in Appendix 1, 2 and 3, respectively.

- Checklists for GUIDE1, GUIDE2 and GUIDE3 consist of sample of topics that can be discussed in the review meeting. The review team should note that while the checklists serve as a reference, there may be other topics not discussed in the lists that are specific to the project itself. The team should still have a "brainstorming" session which may be more effective in highlighting the hazards.

Design Risk Assessment Form

- Hazards highlighted through the Checklist and Brainstorming should be transferred to the Design Risk Assessment Form. (Appendix 4 of Learner Guide)
- The team should then assess the risk and provide mitigating measures according to the Hierarchy of Controls.
- All Checklists and Forms should be kept in the DfS Register. (Will be covered in greater detail later.)

1.9 Prepare for DfS Review Meetings

One of the main duties of a DfS Professional is to facilitate the process to involve all stakeholders to review the design and mitigate the risks. The following needs to be prepared before a DfS Review Meeting can take place:

☑ Establish Safety and Health Review Committee, which should consist of the following main stakeholders:

- Developer
- Design Engineer
- Architect
- DfS Professional
- Contractor

☑ Provision of the following relevant information is required by the respective stakeholders in preparation for the DfS Review Meeting:

☑ The Developer should provide relevant information that he could reasonably be expected to obtain such as:

- As-built drawings of existing buildings on site
- Topographical surveys
- Soil investigation reports
- Existing utility services
- Site risk register
- Pre-construction survey of adjacent buildings and works

☑ The Designers should provide the following relevant information:

- Designs
- Specifications

☑ Define scope for DfS Review Meeting which may include:

- Accessibility
- Confined Space
- Emergency
- Lighting
- Excavation
- Fall Prevention
- Working Platforms
- Hoisting/Weight
- Layout
- Maintenance
- Material Handling/Storage
- Means/Methods
- Operation
- Physical Hazards
- Sequence
- Standardisation
- Weather

☑ Define roles and responsibilities of persons involved in the DfS Review Meeting, which may include:

- Participation in DfS Review Meeting to constructively challenge the design concept
- Keeping the DfS Review Meeting on track and moving along. Issues that are unable to resolve relatively quickly should be listed for action outside the review session.
- Meeting minutes-taker
- Following up of minutes from previous meeting
- Exploring whether issues have been overlooked or sufficiently thought through
- Documentation of findings, attendees, methodology etc

A typical structure of a committee consists of Chairman, Secretary, Members etc.

- ☑ Determine hazard identification tools and risk assessment methods to be used
- ☑ Establish checklists and matrixes to be used for hazard identification and risk assessment
- ☑ Arrange necessary training of persons involved in the DfS Review Meeting, such as Risk Assessment, Hazard Identification and other relevant courses.
- ☑ Determine the method of documentation of the DfS Review Meeting
- ☑ Schedule an appropriate date and time for DfS Review Meeting sessions based on the committee members' work schedule
- ☑ Make logistic arrangements for the review which may include identifying and inviting participants to the review sessions and arranging for a suitable meeting room etc

1.10 Coordinate DfS Review Meetings

Cooperation and coordination of work between stakeholders involved in a project is essential if risks are to be identified and mitigated early. The DfS Professional is required to coordinate and ensure continuity in information flow between stakeholders. To effectively coordinate DfS Review Meetings, the DfS Professional should:

- ☑ Guide Safety and Health Review Committee to keep discussion focused and on track.
- ☑ Encourage stakeholders' involvement and cooperation in the review to identify the possible risks involved.
- ☑ Assist in identifying risks and highlighting the hazards concerned as the Designers and Developers may not be equipped with WSH knowledge.
- ☑ Assist in identifying control measures for risks that cannot be eliminated.
- ☑ Promote the design suitability and compatibility.

Ways to encourage participation in DfS Review Meeting

A team member's enthusiasm, involvement, and willingness to participate affects the quality of DfS Review Meeting. The following suggestions are intended to help you in encouraging team members, participation:

- ☑ Arrange seating to promote discussion. If your room has movable chairs, ask team members to sit in a semicircle so that they can see one another.
- ☑ Ensure each team member has an opportunity to talk in the review session. The longer a team member goes without speaking in the review session, the more difficult it will be for him or her to contribute.
- ☑ Use nonverbal cues to encourage participation. For example, smile expectantly and nod as a team member speaks. Maintain eye contact with team members. Look relaxed and interested.
- ☑ Draw team members into the discussion. You can involve more team members by asking whether they agree with what has just been said or

whether someone can provide another example to support or contradict a point: "What is another solution for this issue?"

Competency Element 2:

Maintain Safety and Health Records

2.1 DfS Register

The DfS Register should be a live document whereby risks identified from the design stage are recorded and kept for future reference. It should contain the information needed to allow future construction work, including cleaning, maintenance, alterations, refurbishment and demolition to be carried out safety. It should also document risks that cannot be removed through design changes and highlight them to the Contractor during the tendering stage.

Such a document will bring about transparency in the tender process so that the Contractor is pre-warned of the project hazards and the difficulties faced. He will then be able to accurately price for the project, reducing possibilities of any under-pricing and therefore inability to complete the project.

The items that should be in the DfS Register are as follows:

- ☑ Records of GUIDE1, 2 and 3 and records of the resultant changes or risks to be mitigated
- ☑ Checklist/matrixes used during DfS Review Meetings
- ☑ Risk assessment
- ☑ Relevant safety and health information that the Contractor and the Developer should take note of
- ☑ Construction method advisory notes by the Designers as guidance notes to the Contractor for building and demolition in the future
- ☑ Maintenance method advisory notes by the Designer and/or Contractor as guidance notes to the owner.
- ☑ Safe Operating Procedures for use and maintenance of equipment/machinery of the completed building. Example: gondolas, scissor lifts, etc.
- ☑ Incident/accidents related to design problem.

To be useful the records needs to be kept up to date and retained for as long as it is relevant-normally the lifetime of the building or structure.

The DfS Register is also to be kept available for inspection by MOM inspectors where required. For practical reasons, at the pre-construction stage, the DfS Register should be kept in the premises of either the Developer or the DfS Professional tasked to assist the Developer. At the construction stage an updated copy of the DfS Register should be kept in the project worksite for ease of reference.

In addition, the DfS Register is to be readily accessed by the appointed Designers and Contractors of the project. This is to allow all the stakeholders to be informed on the design risks of the project and the mitigating measures such that they are able to adequately handle the risks.

2.2 Organisation's Documentation System

The safety and health records should be properly documented in accordance to Organisation's documentation system or requirements.

Organisation's documentation system may include and not be limited to elements that provide for:

- ☑ Clear direction towards identification and location of documents
- ☑ Logical and organised filing for easy location of required document
- ☑ Definition on responsibilities concerning creation, amendment, custody, maintenance and up keeping of documents
- ☑ Authorisation for access to classified documents
- ☑ Revision control
- ☑ Requirements on review of documents
- ☑ Retention periods of documents
- ☑ Back-up arrangement, which may include:
- ☑ Hard copy
- ☑ Electronic copy

Organisational requirements may include:

- ☑ Requirements of management systems
- ☑ Requirements to consider:
    - Size of company
    - Requirements upon considering the scale and complexity of project
    - Resources available
    - Existing practices

2.3 Monitor and Review of Safety and Health Records

Vigilant monitoring of the following is essential to ensure safety and health issues are identified and closed:

- ☑ Areas where DfS Review Meetings were not yet started or incomplete
- ☑ Part of design concept that was not fully understood
- ☑ Hazards not identified previously
- ☑ Design changes not finalised
- ☑ Risk register entries incomplete
- ☑ Opened action items for risk control

The monitoring process of safety and health issues may include:

- ☑ Establishment of current conditions and status of issues
- ☑ Comparison of current with desired conditions and status to identify gaps
- ☑ Identification of actions required to close gap

On-going review ensures that data obtained through monitoring is available for feedback into the system. The review process of safety and health records may include:

- ☑ Establishing the responsibility, frequency and scope of review of records
- ☑ Checking safety and health records for currency, completeness and accuracy
- ☑ Identifying safety and health issues
- ☑ Addressing safety and health issues

*Review records and monitor safety and health issues throughout the construction project include design stage, construction stage, until handing over to Developer for maintenance.

Competency Element 3:

Communicate Safety and Health Information to Stakeholders

3.1 Types of Safety and Health Information for Communication

A DfS Professional is required to communicate safety and health information to relevant stakeholders. The type of safety and health information required for communication may include:

- ☑ Safety and health information provided by the Designers and Contractors, e.g. information on soil movement
- ☑ Handover of DfS Register to Developer for occupation and maintenance
- ☑ Sequence of construction works
- ☑ Safety and health hazards affecting relevant stakeholders
- ☑ Implications of hazards
- ☑ Information arising from GUIDE processes
- ☑ Control measures to mitigate risks
- ☑ Safety and health responsibilities of relevant stakeholders
- ☑ Actions required by relevant stakeholders for mitigation of risks
- ☑ Means of communication available to stakeholders

3.2 Means of Communication to Relevant Stakeholders

A DfS Professional may utilise the following means of communication for disseminating and gathering safety and health information from relevant stakeholders:

- ☑ Tendering documents e.g. residual risks
- ☑ Provision of drawings, specifications, calculations and work statements
- ☑ Provision of safety and health information and records
- ☑ DfS Review Meetings
- ☑ Sharing of DfS register information
- ☑ Using an online document depository for sharing of information
- ☑ Meeting of stakeholders
- ☑ Consultation / dialogue sessions
- ☑ Training / awareness sessions
- ☑ Verbal instruction
- ☑ Telephone communication
- ☑ Formal written correspondence
- ☑ Email

3.3 Coordinate Flow of Information

A DfS Professional needs to coordinate to ensure the **right safety and health information is passed on to the right stakeholder at the right time**. Example residual risk should be passed on to the Contractors for his tendering and work purpose.

The following needs to be taken into account when coordinating flow of safety and health information:

- ☑ Determine the communication needs for relevant stakeholders
- ☑ Determine the timing at which information should be made available to or gathered from the relevant stakeholders
- ☑ Establish and use effective means for communication
- ☑ Verify effectiveness of communication

Acknowledgement

The following examples have been reproduced with permission from Design Best Practice:

Illumination of Atrium

The "Towel Rail" Initiative

Prefabrication of Steelwork

Handrails Designed into Staircase

Conversion to Modular Construction

Modular Construction of Stone Panels

Temporary Support Steelwork for High Level Work Platform

Day 1

Learning Activity 1

Objective:

1. To enable the participants to have an overall understanding of DfS Review Meeting Process. (PC1.1, PC1.6, PC2.1; UK 1.1, UK1.2; UK2.1)

2. Establish the process for the review of Design for Safety design. (PC1.4, UK1.6 and 1.7)

3. Establish a method for the identification of safety and health hazards and risks associated with construction project. (PC1.5, PC 1.6, UK 1.9 and 1.10)

Method:

- The course participants are divided into groups of about 6 persons.
- Each group will be given one set of case information.
- The group may, based on the case given, discuss and answer the questions and provide the input to the requirements mentioned in the "Instruction to Learners".
- The group should use about 30 minutes to discuss the case and thereafter summarise and present their works, each taking about 5 minutes for a 30 minutes discussion with the class.
- The Trainer will facilitate the group activities and discussion, and present and highlight the important learning points.

Instruction to Learners:

1. Get into groups of about 6.
2. Use the following list of questions to guide your discussion.
3. Read the case information given to your group. The group should answer the questions below with reference to the case information, and apply the concepts and materials discussed in class.
4. The group work should take approximately 30 minutes.
5. Record your group's answers and insights to the questions for sharing with the class, by giving a presentation of about 5 minutes.

Questions

You are tasked as a Design for Safety Professional to conduct DfS Review Meeting for the project given.

1. Brainstorm among the group and list down the purpose for conducting DfS Review Meeting.
2. What would the group suggest on the coverage of scope of hazard identification in such DfS Review Meeting? (Hint: consider the phases of life cycle of the building)
3. Suggest, with reference to the "GUIDE" process, when DfS Review Meetings should be conducted for your project. Give reason(s) to justify your suggestion as to the timing when such review should be conducted.
   (Hint: The DfS Review Meetings should be conducted at different phases of the construction project, suggest when)
4. Establish a checklist that your group would use for identifying the hazards associated with the design during the Concept Design phase.

Suggested Answers:

1. Brainstorm among the group and list down the purpose (importance) for conducting DfS Review Meeting.

   Purpose:

   ☑ To reduce risk at source for buildings and structures, by identifying the associated risks and hazards and eliminating or mitigating them during design phase.

   ☑ Where the safety and health risk cannot be eliminated, the residual risks and the associated control measures and information documented during such DfS Review Meetings can be communicated to the relevant stakeholders down the line of construction process chain and through the life cycle of the buildings and structures. This should help to minimise accident and ill health to persons throughout the phases of life cycle of the buildings and structures.

   Importance:

   ☑ Improve planning and management of project at early stage of project.
   ☑ Identify and mitigate risks at design stage so that they can be effectively eliminated and properly managed.
   ☑ It is cheaper to eliminate occupational health and safety hazards at the design or planning stage, rather than making the changes when the hazards become real risks to the Developers, staff or business.
   ☑ Safe design can reduce overall costs of construction, maintenance of a building and structure.

2. What would your group suggest on the coverage of scope of hazard identification in such DfS Review Meeting? (Hint: consider the phases of life cycle of the building)

   The scope of hazard identification should include those safety and health hazards that could be present throughout the phases of life cycle of the buildings and structures i.e.: from and throughout

   ☑ design

   ☑ construction,

- ☑ repair and maintenance,
- ☑ demolition phase of the building.

Hazards to be identified in each phase may include all reasonably foreseeable hazards associated with

- ☑ Site set up, layout, condition and environment,
- ☑ Activities, and the sequence and manner that they would be carried out
- ☑ Equipment and services used

Trainer should highlight to Learners that:

- ☑ A hazard is anything, or any source or situation with the potential to cause harm or injury. Hazards may be
  - Physical (e.g. mechanical, electrical, thermal, radiation, fire etc)
  - Chemical
  - Biological
  - Ergonomic

3. Suggest, with reference to the "GUIDE" process, when DfS Review Meetings should be conducted for your project. Give reason(s) to justify your suggestion as to the timing when such review should be conducted.

   (Hint: The DfS Review Meetings should be conducted at different phases of the construction project, suggest when)

   It is recommended that the GUIDE Process be done in three phases:

   GUIDE-1: Concept Design Review

   Concept design review should look at the general location of the project, traffic and vehicular flow in the surroundings, type of building, and other general constraints.

   GUIDE-2: Detailed Design, Maintenance and Repair Review

   Detailed design, maintenance and repair review should look at the detailed architectural and structural design. The review should also determine the risks involved in the construction methods, the access and egress, whether the design will create confined

space or other hazards. The risks related to maintenance and repair of the building, such as cleaning methods, should also be studied.

For Design and Build contracts where the contractor is in-charge of the design of the project, GUIDE-2 should be done with the contractor's input. He can then highlight constraints that he will face when constructing the building or structure. This would further help in the GUIDE process. Refer to *Appendix 2* for a sample of topics that can be discussed for GUIDE-1.

GUIDE-3: Pre-Construction Review

Pre-construction design review should examine temporary works design and design by specialist contractors not covered during the concept and detailed design phases.

Reasons:

- ☑ The GUIDE process is carried out in different stages of the project so as to ensure that the review team can focus on a smaller scope during each process so as to have more comprehensive review and increase the chance of identifying all foreseeable significant hazards.
- ☑ Most project designs are done in two stages: concept design and detailed (final) design. It is logical to align DfS Review Meetings (GUIDE 1 and 2) with these two stages. This allows any design changes that can reduce risks to be implemented as early as possible.
- ☑ GUIDE 3 would help to risks and hazards associated with the design and methods of construction and capture those design elements not covered during GUIDE 1 and 2. This allows the hazards to be addressed prior to the commencement of construction.

4. Establish a checklist that your group would use for the identification the hazards associated with the design during the Concept Design phase.

Notes for instructor:

☑ Guide the Learners to develop checklist with reference to Appendix C of the WSH (DfS) Regulations and Approved Code Of Practice (ACOP) for DfS.

- ☑ Guide the Learners to develop a logical and structured checklist.
- ☑ The checklist provided here is not exhaustive and only serves as a guide.

Case Information

Activity 1 - Group 1

Contract Information Sheet (New Building)

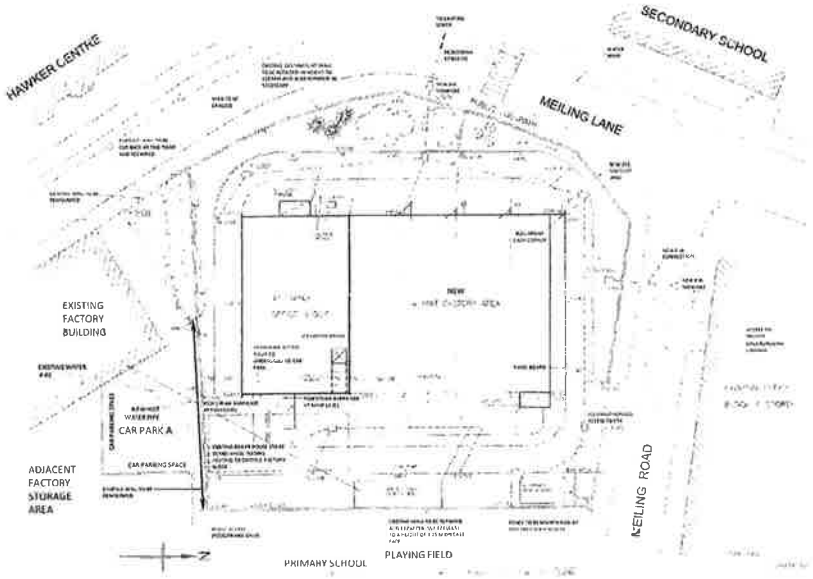
Element	Details
Developer	Patrick Seow - Light Industries Manufacturing Pte Ltd
Project Title	The Alterations and Additional (A&A) works for Light Industries Manufacturing Pte Ltd.
Contract works	A&A of an existing building consisting of a 3 storey office block to include a four units factory complex, a split two level car park, (underground and ground level), serving both parts of the development. The project also includes demolishing the existing boiler house at the south-eastern part of the site and installing a new gas-fired boiler at the east-central side. The new boiler is to supply hot water to the new factory and office block, as well as to an existing factory block at the south side.
Contract period	46 weeks beginning 24th February 2010
Property Address	Meiling Road
Site Description	The property is in a corner location bounded on the north side by Meiling Road and by Meiling Lane on the west. The site was previously used by a haulage contractor as a lorry park. Prior to that, the site was occupied by an electroplating factory from 1969 – 1983. The main factory building had been demolished and rebuilt to the office block but the boiler house at the south-eastern of the site was retained, and continues to supply hot water to the existing factory building at the south side. Between the existing factory building and the existing boiler house is a car park (Car Park A) with dead end bound by a wall separating it from the adjacent factory. This wall is to be demolished as shown on plan to provide access from both the existing factory building and the new office developments. A stretch of the wall as indicated on plan is to be cut back to ground level and recapped. Surrounding the site is a secondary school at the north-western side; a hawker centre at the south-western side; an adjacent factory storage area at the south-eastern side; a primary school at the adjacent east; and a 4-story office block to the north side, opposite Meiling Road. The wall surrounding the perimeter of the site is to be altered as shown in the drawing.

Documents provided

1) **Outline drawings**

2) **Asbestos survey report**

The boiler room building has asbestos cement sheet roofing, and inside the building there is asbestos insulation board and asbestos loose lagging, some of which is in poor condition.


HAWKER CENTRE
SECONDARY SCHOOL
MEILING LANE
EXISTING
FACTORY
BUILDING
CAR PARK A
ADJACENT
FACTORY
STORAGE
AREA
MEILING ROAD
PRIMARY SCHOOL
PLAYING FIELD

Suggested Questionnaire Answers ~ Group 1

Considerations		Details/Hazards Identified
Public	Will the commencement of the project affect the public in any way?	Noise, dust affecting a primary school, a secondary school and a hawker centre
	Will the commencement of the project affect the traffic in any way?	Traffic movements around the school must be restricted to avoid school opening and closing times
Services	Are there underground services in the site that need to be removed for the project?	- (more info to be made available)
	Will the removal of these services, if any, be a hazard to the workers or the public?	Removal of exiting boiler room will affect existing factory block. Pipe hit by vehicle
	Will the hot water pipe running across the Car Park post any danger to the public?	Pipe burst due to deterioration
Surrounding	Is there any hazard (noise, chemical, dust etc) from the industrial site affecting the site (Cluster A which is directly opposite)?	Noise, chemical (smell) from industrial building may affect site occupants.
	Is there any hazard from the existing perimeter walls (to be retained and altered) during construction and usage of the building?	Wall collapse during construction stage

Considerations		Details/Hazards Identified
Site Layout	Does site layout allow safe access / egress for plant equipment and workers during construction stage?	Details to be addressed during GUIDE 2 and 3
	Does site layout allow safe access / egress for occupants?	Access via Car Park A cross path with vehicle entering / leaving car park.
		Office block occupants need to pass by factory area
	Does site layout make provisions for easy access of fire engines?	More information required
	Are safe access / egress provided for repair and maintenance of existing boiler during construction stage?	To be reviewed at GUIDE 2 / 3
	Are safe access / egress provided for repair and maintenance of new boiler during occupancy stage?	Yes, to be reviewed at GUIDE 2 / 3

Considerations		Details/Hazards Identified
Others	Are there any hazards resulting from asbestos on existing boiler?	Yes, to be reviewed at GUIDE 2/ 3
	Are there any special features that require special arrangements during construction?	Access to the entrance must be maintained clear and clean at all times
	Can the method of construction/sequence be identified at present?	New boiler to be constructed before demolishing existing one
	Are there any hazards associated with the method of construction/ sequence that can be dealt with at present?	Existing boiler house would interfere with construction of new office block.
	Any other foreseeable hazards that can be identified and eliminated?	Office block occupants subjected to risks from factory area

Activity 1 - Group 2

Contract Information Sheet (House building)

Element	Details
Developer	Andrew Er - NewCity Developments Limited
Project Title	The Construction of a Cluster Housing development
Contract works	The development of a cluster of two storey and three storey houses including access roads, a roundabout, driveways and sewer lines at an estimated depth of 2 metres.
Contract period	80 weeks beginning 6th May 2009
Property Address	Edgefree Plain
Site Description	The development consist of low rise houses with similar design and divided into clusters A, B and C. Cluster D, an area at the south eastern corner is to be used as show area during the marketing stage. The northern boundary is marked by the Terking Water Canal across from which is a mix of existing residential housing and open fields. To the east of the site is a site marked by Edgefree Plain which includes additional pasture land. The southern boundary of the site is marked by Brick Road, across from which is a mix of existing residential housing and small industrial units. The western boundary of the site is marked by an old quarry. Site levels vary across the site although the land falls down from Brick Road to the Canal. A ditch crosses the site following the approximate line of a 150mm diameter sewer. Two underground power lines cross the site in both the south-western and the north-eastern corners. The locations are marked (with "X") on the attached drawing. Existing telephone lines are also found underground at the north eastern corner. Within the proposed site are areas occupied by a primary school, (with playing fields), a nursing home, and old disused industrial units. The access to the school and the home are through an old cracked concrete paved road leading from Brick Road. The development will include a children's play area, tree planting and fencing ~ the use of the existing features for the fencing and borders are encouraged where possible.

Documents provided

(1) Planning and landscape layout;

See next page

2) **Ground Investigation Report Extract**

The soil profile is largely clayey soil with intermediate silt deposits. The soil investigation report also found the presence of boulders scattered throughout the site.

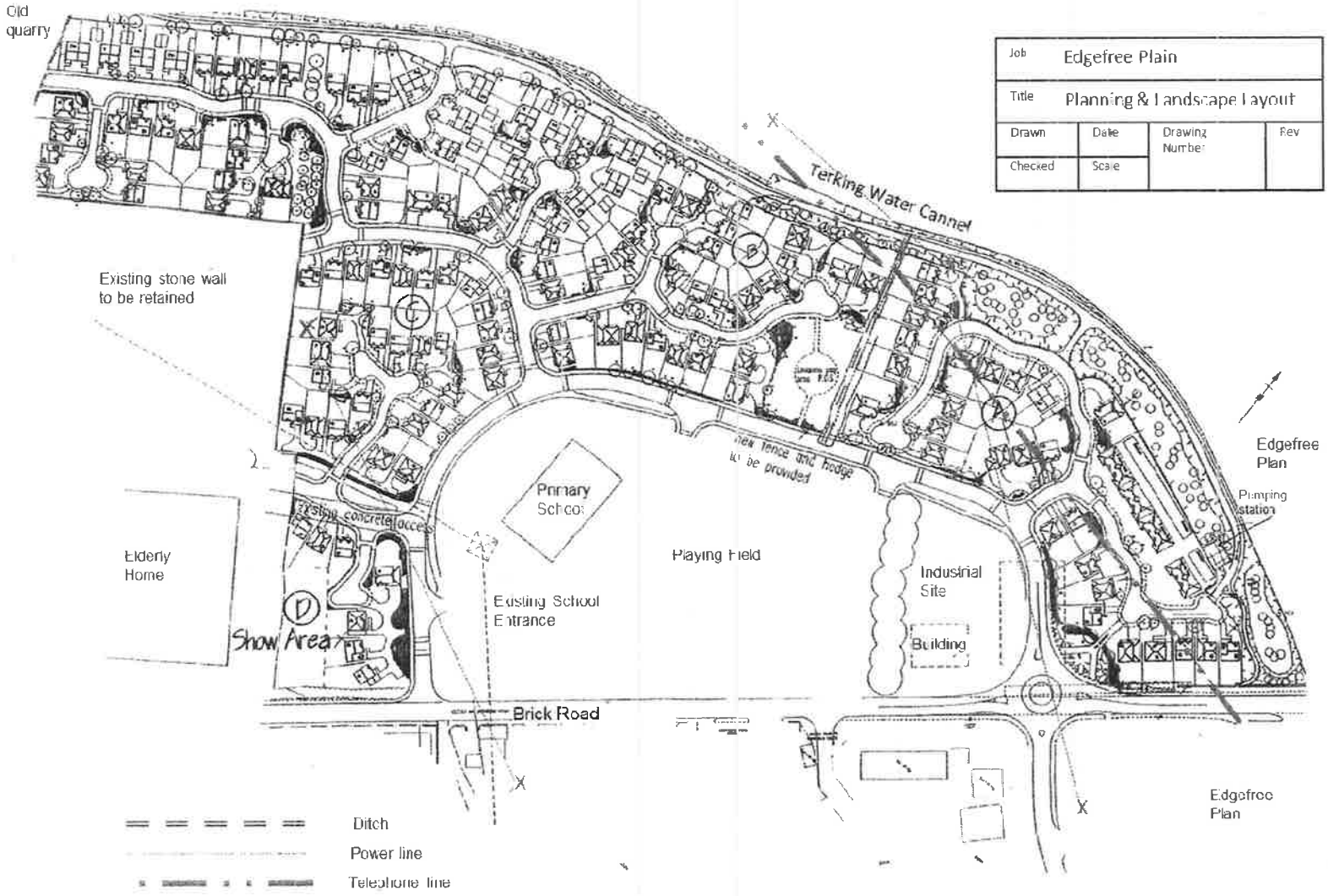
The canal bank did not appear to be supported and ponding (deep water puddles) was noted in areas close to the edges of the canal.

The site was previously used by a haulage contractor as a lorry park and the ground has contamination from oil/fuel spillages.

Contamination of the ground was also identified with high levels of lead, arsenic and cadmium showing in the sample analysis.

(3) **Asbestos Survey Report Extract**

The industrial unit and adjacent outbuildings are roofed with asbestos cement sheet roofing.
The heating equipment (boiler, pipes) located within the main industrial unit has extensive asbestos lagging ~ this is blue asbestos in poor condition.


Old quarry
Existing stone wall to be retained
Terking Water Cannel
New fence and hedge to be provided
Primary School
Existing concrete access
Elderly Home
Show Area
Existing School Entrance
Playing Field
Industrial Site
Building
Brick Road
Pumping Station
Edgefree Plan
Edgefree Plan
Ditch
Power line
Telephone line
Job Edgefree Plain
Title Planning & Landscape Layout
Drawn
Date
Drawing Number
Rev
Checked
Scale

Suggested Questionnaire Answers ~ Group 2

Considerations		Details/Hazards Identified
soil	Has the soil profile of the site of the proposed project been studied by the QP?	Sticky clay-based soil in the terrain
	Are there buildings or structures that may have shallow foundation in the vicinity of the proposed project?	Canal drain appeared to be not supported
	Will there be possible lowering of ground water table as a result of the proposed construction?	To review when information is available
	Will there be possible settlement due to the proposed project?	To get further soil investigation information
	Are there any possible preventive measures to ensure settlement is minimised?	To review when information is available
	Was there ground contamination that could affect safety and health of persons during construction, usage and demolition?	Toxic substance (lead, arsenic and cadmium) present in soil

Considerations		Details/Hazards Identified
Public	Will the commencement of the project affect the public in any way?	Noise, dust affecting Elderly home, School, residential and industrial areas.
	Will the commencement of the project affect the traffic in any way?	Clearance of existing concrete used by school and Elderly Person Rest Home
	Will the commencement of the project affect 24 hour access to the Old Folks Home in any way?	Children and old folks may have difficulty crossing at round-about
Services	Are there underground services in the site that need to be removed for the project?	Removal / shifting of underground cable and telephone lines
	Will the removal of these services, if any, be a hazard to the workers or the public?	High power cable at the south-western and north-eastern corner of the side

Considerations		Details/Hazards Identified
Surrounding	Is there any hazard (noise, chemical, dust etc) from the industrial site affecting the site (Cluster A which is directly opposite)?	Noise, chemical (smell) from industrial building may affect site occupants.
	Is there any hazard due to the nearby water canal to persons during construction and usage of the building?	Flooding of canal overflow to site Water seepage through canal affecting site soil condition Falling into canal
	Is there any hazard from the existing stone walls (to be retained) during construction and usage of the building?	Hindrance of construction plan and equipment Wall collapse during construction stage

Considerations		Details/Hazards Identified
Site Layout	Does site layout allow safe access / egress for plant equipment and workers during construction stage	Details to be addressed during GUIDE 2 and 3
	Does site layout allow safe vehicle and human traffic: ☑ to and from the site ☑ between each cluster ☑ within each cluster	- (Detailed design information required)
	Does site layout make provisions for easy access of fire engines	-
	Does the round-about post any traffic hazards to the vehicle and pedestrian?	-
	Are safe access / egress provided for repair and maintenance of utility facilities at locations which they are sited?	-
	Are emergency services such as medical centre provided for and easily accessible by residents of all cluster?	Delay in getting medical assistance during emergency.

Considerations		Details/Hazards Identified
Others	Are there any hazards resulting from asbestos cement sheet roofing of the industrial unit and adjacent outbuildings?	-
	Are there any special features that require special arrangements during construction?	-
	Can the method of construction/sequence be identified at present?	-
	Are there any hazards associated with the method of construction/ sequence that can be dealt with at present?	Show area to be completed first. Visitors during construction stage affected by on-going activities
	Any other foreseeable hazards that can be identified and eliminated?	

DfS for Professionals Workshop Exercise - Group 3

Contract Information Sheet (New Build)

Element	Details
Developer	NZ Luxury Housing Development Ltd
Project Title	Rooftop Garden
Contract works	Constructing rooftop garden on two towers of an existing residential apartment. Rooftop garden comprises of children playground, a fish pond and a miniature golf course.
Contract period	150 days beginning 03 January 2010
Property Address	Koh Tian Road
Site Description	The property is situated to the west of Tok Tak Boulevard, bounded by Koh Tian Street on the west and Moh Heng Street on the north.
Documents provided	3) Outline drawings 4) List of Suggested Plants for Rooftop Garden
Additional information	

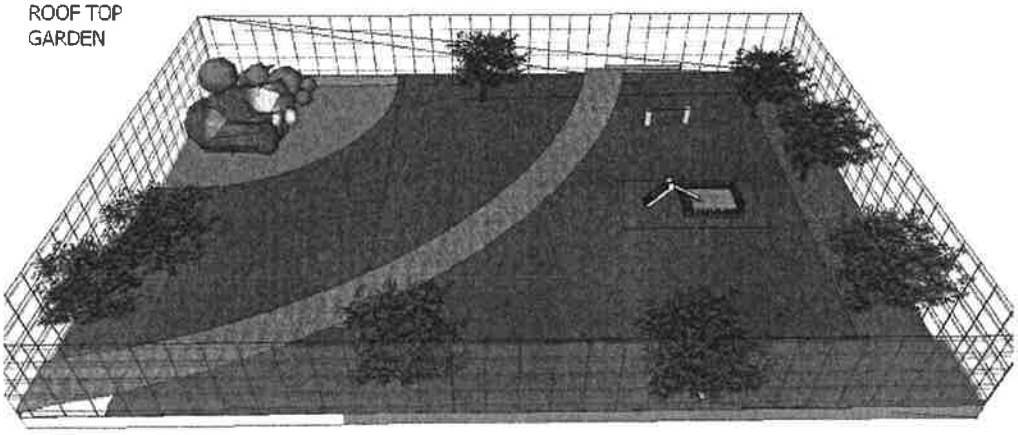
Solitaire Condominium can only be assessed from Koh Tian Road and Moh Heng Street. Koh Tian Street is always congested in the morning from 0730 to 0830 am and in the afternoon from 1400 to 1530 as a result of parents sending off and picking up their children. For safety purpose, the Transport Authority has issued an order that all construction vehicles are prohibited to use Koh Tian Road during these two periods during the day from 0700 to 0900 and from 1330 to 1600 hours.

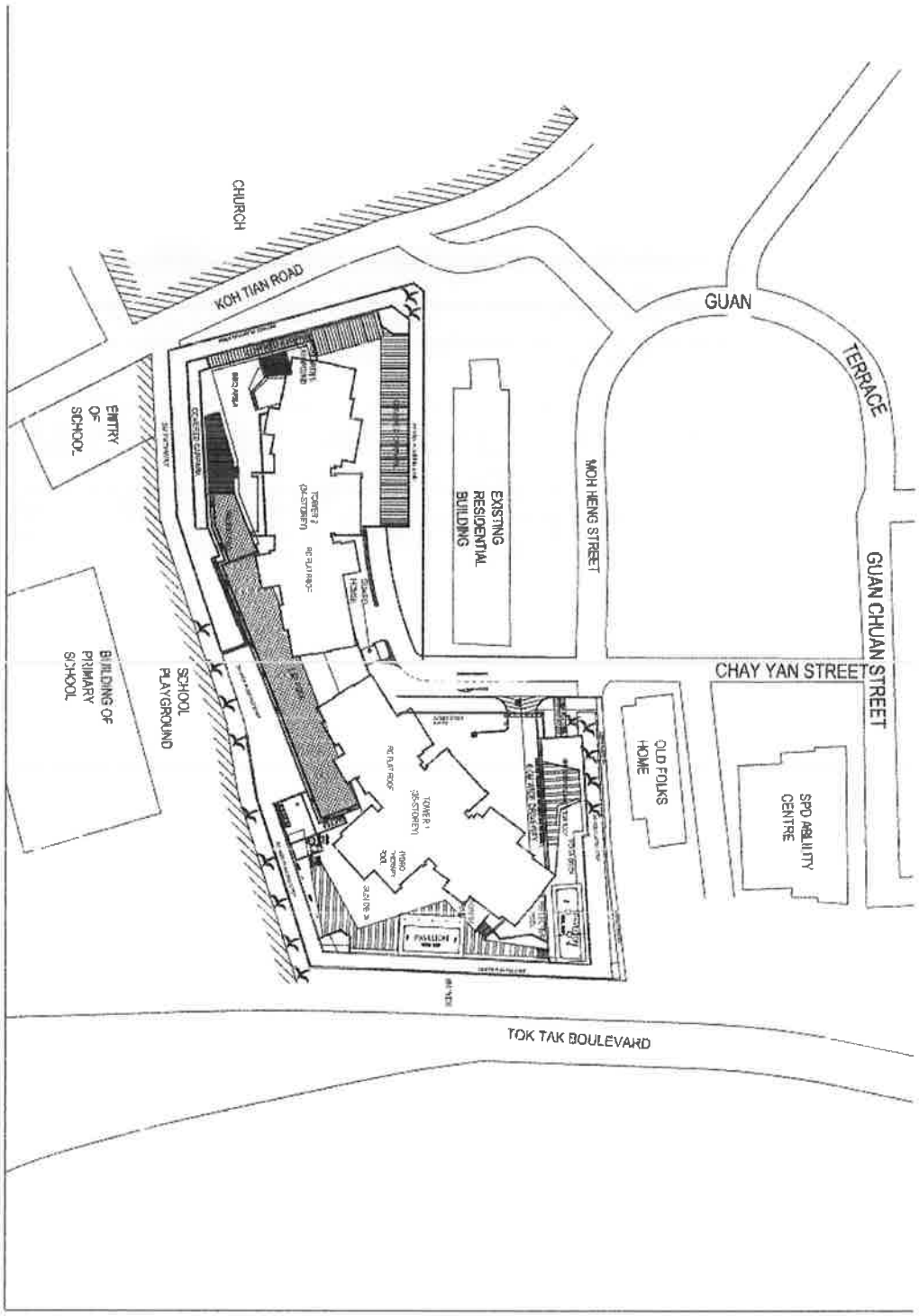
The proposed rooftop garden on both towers will be of the exact same design. The rooftop garden will not only provide a recreational space for the residents but form part of the energy saving program through reducing overall heat absorption of the buildings. It is thus agreed that the rooftop garden will be of intensive design i.e. a minimum of 2 ft of soil depth to accommodate trees, shrubs and other manicured landscapes. These trees and shrubs will be planted along the perimeter of the garden with the exception of a 2-m width entrance-exit. An elaborate irrigation and drainage systems will also be incorporated to maintain such rooftop garden. At the centre of the garden, there will be a children's playground, a fish pond and a miniature golf course. Directly below the rooftop is a residential unit.

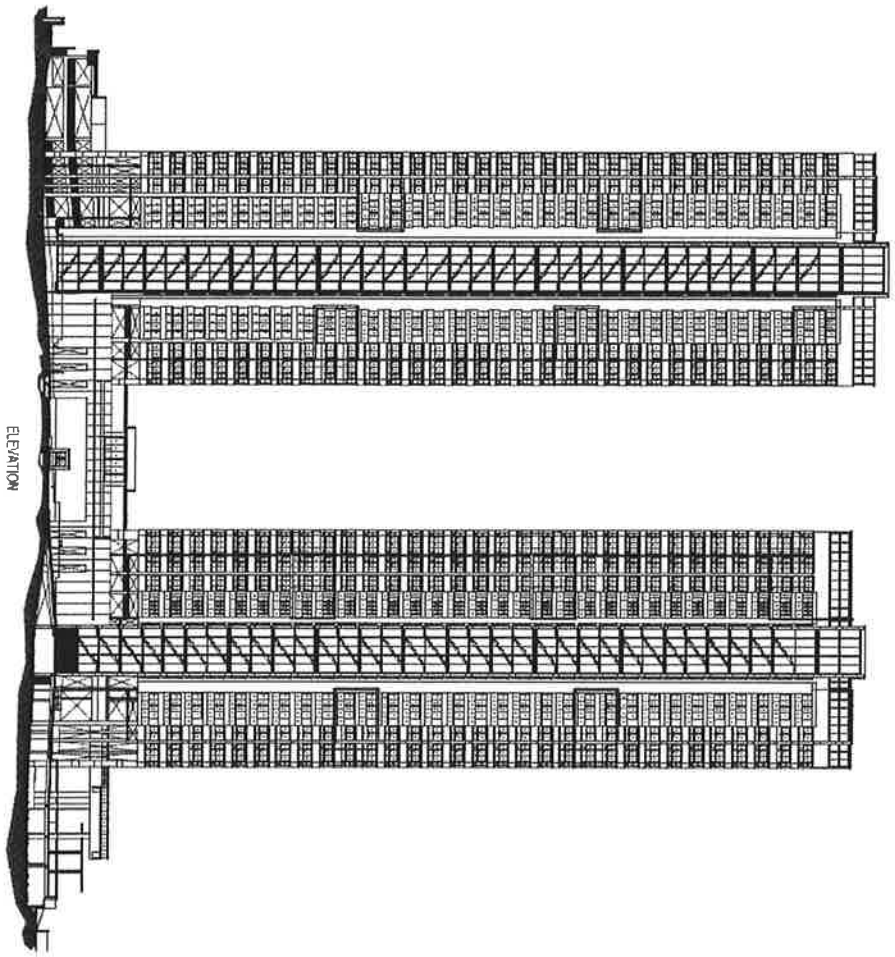
Things installed in the Roof-top garden are (see the attached sample 3D pictorial representation of the roof-top garden):

a) Parallel bars for children
b) Sea Saw for children
c) Slides
d) Benches
e) A fish pond

ROOF TOP
GARDEN




CHURCH
KOH TIAN ROAD
GUAN
TERRACE
ENTRY OF SCHOOL
EXISTING RESIDENTIAL BUILDING
MOH HENG STREET
GUAN CHUAN STREET
CHAY YAN STREET
BUILDING OF PRIMARY SCHOOL
SCHOOL PLAYGROUND
OLD FOLKS HOME
SPD ABILITY CENTRE
TOK TAK BOULEVARD


ELEVATION

Suggested Answers – Activity 1 - Group 3

Guide 1: Concept Design Review

Considerations		Details of hazards
Structural considerations	Is the existing structure able to withstand the loads of the rooftop garden?	Existing roof not able to withstand the loads exerted by the rooftop garden (soil medium, plants, irrigation systems, live load)
Public	Will the commencement of the project affect the public in any way?	Heavy vehicles may cause noise and dust nuisance to residents and public Struck by falling objects from construction works Residents, passer-bys, parked vehicles hit by falling objects Public – passer-by hit by construction vehicles.
	Will the commencement of the project affect the traffic in any way?	Traffic congestion at floor level due to parking of construction vehicle, forcing unsafe overtaking
	Will the project affect the public in any way during usage phase?	Struck by falling objects (loose parts) from the roof garden

Considerations		Details of hazards
Existing residents	Will the commencement of the project affect the existing residents in any way?	Struck by falling objects from construction works Residents encroaching into the lifting zone Residents, particularly children have access to rooftop whilst construction works in progress Resident hit by construction vehicles
	Will the project affect the existing residents in any way?	Water seepage to ceiling of unit directly below. Growth of plants (trees) causing cracks on building (ceiling of unit directly below)

Considerations		Details of hazards
Design features	Can the design protect fall of person from the roof garden?	Fencing not of sufficient height to prevent fall of maintenance personnel Fencing accessible to children (who can climb up the fence and fall) Fencing not of sufficient strength and durability Tree overgrowing the fencing allowing person to climb on it and fall from roof top.
	Can design prevent falling object from roof garden hitting person below?	Fencing, if not structurally stable, may become a falling object in future Trees branches falling due to adverse weather conditions e.g. strong wind Loosen garden features (eg umbrella shade) lifted by strong wind and fall below User throws down objects (bottles, cups, glasses etc) Loose articles brought up by user (table cloth with utensils) lifted by strong wind and fall below
	Design features safe for outdoor use?	Electrical appliance not of out-door water-proof type Fixtures not UV resistant, may deteriorate due to exposure to sun light

Considerations		Details of hazards
Design features	Design safe for worker during construction stage?	Features near edges of roof may cause worker to fall when installing them Worker electrocuted due to use of electrical hand tools in wet, outdoor condition. Worker struck by lightning working at roof top
	Does design post any hazards to person using the garden?	Trip and fall due to uneven grounds Slip and fall due to wet floor Fall due to poor illumination Fall into fish pond Children fall at playground Passer-by hit by golf ball Struck by lightning Use of unsafe electrical appliance (not out-door type) brought in by resident Set up of temporary structures for functions (eg tent, staging, declarative items, panels etc) which become falling objects due to strong wind Workers / residents manually carry heavy objects to the roof (for function etc) Touch and burnt by hot (metallic) furniture and fittings on a hot day. Accessibility (in particular, by children) to facility equipment and chemical used at roof top.

Considerations		Details of hazards
Design features	Does design post any hazards to person maintaining the garden?	Worker struck by lightning during maintenance Worker electrocuted due to use of electrical hand tools in wet, outdoor condition. Worker manually carry heavy objects (equipment, water, chemicals etc) for maintenance Worker having to over reach to maintain plants Worker falling from height during maintenance (eg, ladder on uneven ground, accessing to lighting feature at height)
	Is there a proper access and egress from the rooftop garden, especially during emergency situations?	Overcrowding when holding function at roof garden Emergency escape stair way blocked

Learning Activity 2

Objective

1. Get the participants to be more familiarised with the roles and responsibilities of various stakeholders in a project DfS Review Meetings through role play.
2. Apply the hazard identification method in DfS Review Meeting.
3. Get familiarised with the recording of results of hazard identification and risk assessment.

Instruction to Learners:

1. Get into groups of about 5.

2. Designate among the group members the role each person will play during the activities. These include:

    a. Developer
    b. Designer
    c. DfS Professional
    d. Main Contractor
    e. Observer

3. Group members may refer to the course material for roles of Developer, Designer, DfS Professional and Main Contractor. During the learning activities, group members should provide inputs from the perspective of their respective designated roles.

    The roles of the "Observer" are:

    - To observe how well each group member played their roles and record all observation. An "Observer Checklist" provided may be used. The observer should take notes during the observation process so as to provide feedback to the group member later.
    - The observer may also chip in from time to time to as "Assistant DfS Professional " to help the review process stay on course.
    - Serve as time keeper. The discussion should take no more than 1 hour.
    - Towards the end of discussion, feedback to the group member, especially the person playing the role of a DfS Professional , on how well they fare.

4. Additional case information is given in this learning activity, to supplement what was given in learning activity 1.

5. The DfS Professional will facilitate the session.

Part 1

6. Using the check list developed in Activity 1, the project DfS Review Meeting team will go identify hazards and discuss on appropriate control measures.

7. The product of discussion should be:

    a. A list of hazards identified
    b. A record of risk assessment and control measures using a "Design Risk Assessment Form"

Part 2

8. Brainstorm among the group on the following question in preparation for GUIDE 2.

- Do you require any other information as a DfS Professional ?
- Should the Main Contractor be asking for any more information?
- Site set up considerations
- Likely site activities
- Risks and controls
- Health and Safety responsibilities
- Emergency procedures

Additional Information – Group 1

1) Additional information

The entrance to the playing fields at the end of the Car Park A leads to a large primary school. Access to the entrance must be maintained clear and clean at all times, and traffic movements must be restricted to avoid school opening and closing times

The proposed boiler room will also serve the heating requirements of the factory block on the other side of Car Park A and the existing boiler house needs to be retained until the new boiler house has been completed, after which it will be decommissioned and removed. The switch over should be done over the weekend to avoid disruption to the existing factory block. Until then, the existing boiler will need to be maintained by maintenance personnel.

Noise and dust are to be kept to a minimum and contamination of the ground water must be avoided.

No working on Sunday is allowed without express permission of the local authority. During the week, working hours are restricted to 7am – 7 pm Mondays to Fridays and Saturday mornings only.

The site can only be accessed from Meilling Road.

Additional Information – Group 2

1) House and flat layouts
2) Additional information

The primary school playing fields are used by other schools in the area.

Access to the primary school is to be maintained throughout the construction phases for school traffic, pupils, pedestrians, visiting schools and service vehicles serving the school.

Access to the elderly person's home must be maintained 24 hours a day for emergency and service vehicles, visitors and supply vehicles.

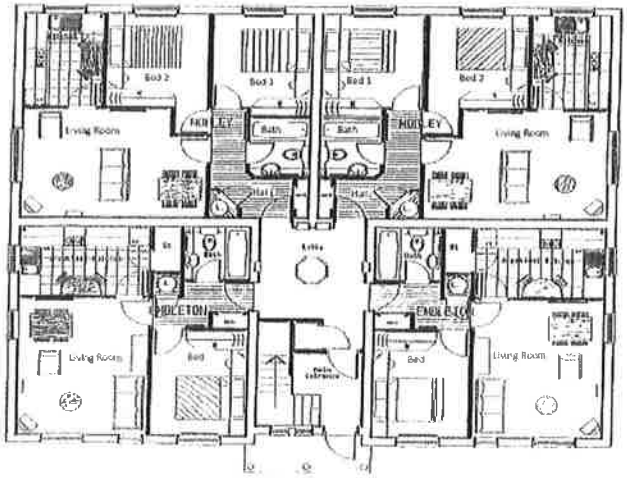
To the north-east of the plot the disused small industrial site is to be demolished so that the new feeder road and roundabout can be constructed.



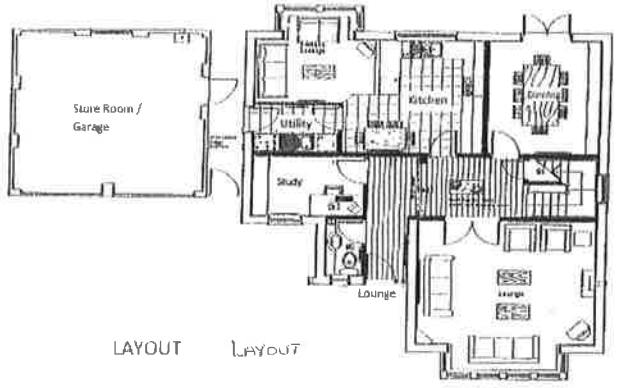
FRONT ELEVATION



FRONT ELEVATION



LAYOUT



LAYOUT LAYOUT

Job: Edgefree Plain			
Title: House Layout			
Drawn	Date	Drawing Number	Rev
Checked	Scale		

Additional Information – Group 3

Additional information

Lifting work is to be restricted to between 1100 and 1700 hours from Monday to Friday only. In addition, the committee of the Solitaire Condominium has made a request that there should be no construction vehicular movement in the morning and evening hours i.e. from 0730 to 0900 and 1700 to 1800 hours to avoid inconvenience to own as well as neighbouring residents.

Activity 1 - Group 1

Contract Information Sheet (New Building)

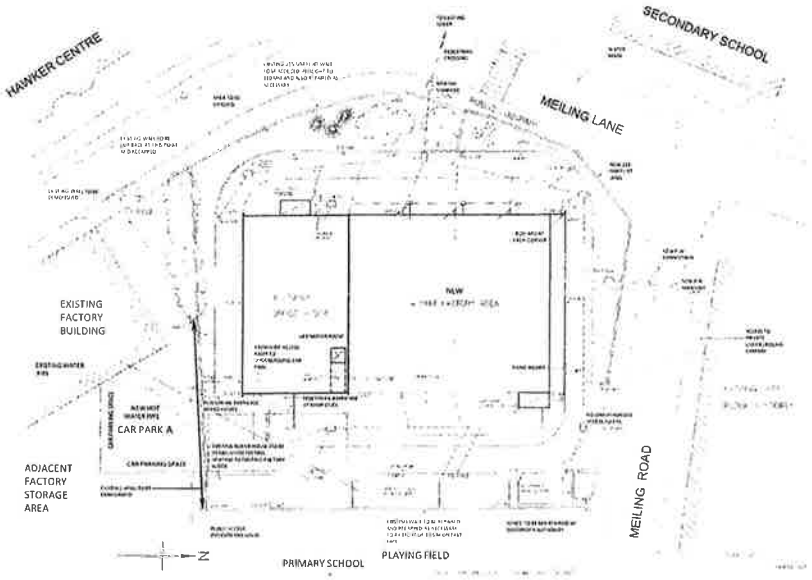
Element	Details
Developer	Patrick Seow - Light Industries Manufacturing Pte Ltd
Project Title	The Alterations and Additional (A&A) works for Light Industries Manufacturing Pte Ltd.
Contract works	A&A of an existing building consisting of a 3 storey office block to include a four units factory complex, a split two level car park, (underground and ground level), serving both parts of the development. The project also includes demolishing the existing boiler house at the south-eastern part of the site and installing a new gas-fired boiler at the east-central side. The new boiler is to supply hot water to the new factory and office block, as well as to an existing factory block at the south side.
Contract period	46 weeks beginning 24th February 2010
Property Address	Meiling Road
Site Description	The property is in a corner location bounded on the north side by Meiling Road and by Meiling Lane on the west. The site was previously used by a haulage contractor as a lorry park. Prior to that, the site was occupied by an electroplating factory from 1969 – 1983. The main factory building had been demolished and rebuilt to the office block but the boiler house at the south-eastern of the site was retained, and continues to supply hot water to the existing factory building at the south side. Between the existing factory building and the existing boiler house is a car park (Car Park A) with dead end bound by a wall separating it from the adjacent factory. This wall is to be demolished as shown on plan to provide access from both the existing factory building and the new office developments. A stretch of the wall as indicated on plan is to be cut back to ground level and recapped. Surrounding the site is a secondary school at the north-western side; a hawker centre at the south-western side; an adjacent factory storage area at the south-eastern side; a primary school at the adjacent east; and a 4-story office block to the north side, opposite Meiling Road. The wall surrounding the perimeter of the site is to be altered as shown in the drawing.

Documents provided

1) **Outline drawings**

2) **Asbestos survey report**

The boiler room building has asbestos cement sheet roofing, and inside the building there is asbestos insulation board and asbestos loose lagging, some of which is in poor condition.


HAWKER CENTRE
SECONDARY SCHOOL
MEILING LANE
EXISTING
FACTORY
BUILDING
CAR PARK A
ADJACENT
FACTORY
STORAGE
AREA
MEILING ROAD
N
PRIMARY SCHOOL
PLAYING FIELD

Learning Activity 2

Objective

1. Get the participants to be more familiarised with the roles and responsibilities of various stakeholders in a project DfS Review Meetings through role play.
2. Apply the hazard identification method in DfS Review Meeting.
3. Get familiarised with the recording of results of hazard identification and risk assessment.

Instruction to Learners:

1. Get into groups of about 5.

2. Designate among the group members the role each person will play during the activities. These include:

    a. Developer
    b. Designer
    c. DfS Professional
    d. Main Contractor
    e. Observer

3. Group members may refer to the course material for roles of Developer, Designer, DfS Professional and Main Contractor. During the learning activities, group members should provide inputs from the perspective of their respective designated roles.

    The roles of the "Observer" are:

    - To observe how well each group member played their roles and record all observation. An "Observer Checklist" provided may be used. The observer should take notes during the observation process so as to provide feedback to the group member later.
    - The observer may also chip in from time to time to as "Assistant DfS Professional " to help the review process stay on course.
    - Serve as time keeper. The discussion should take no more than 1 hour.
    - Towards the end of discussion, feedback to the group member, especially the person playing the role of a DfS Professional , on how well they fare.

4. Additional case information is given in this learning activity, to supplement what was given in learning activity 1.

5. The DfS Professional will facilitate the session.

Part 1

6. Using the check list developed in Activity 1, the project DfS Review Meeting team will go identify hazards and discuss on appropriate control measures.

7. The product of discussion should be:

    a. A list of hazards identified
    b. A record of risk assessment and control measures using a "Design Risk Assessment Form"

Part 2

8. Brainstorm among the group on the following question in preparation for GUIDE 2.

- Do you require any other information as a DfS Professional ?
- Should the Main Contractor be asking for any more information?
- Site set up considerations
- Likely site activities
- Risks and controls
- Health and Safety responsibilities
- Emergency procedures

Additional Information – Group 1

1) Additional information

The entrance to the playing fields at the end of the Car Park A leads to a large primary school. Access to the entrance must be maintained clear and clean at all times, and traffic movements must be restricted to avoid school opening and closing times

The proposed boiler room will also serve the heating requirements of the factory block on the other side of Car Park A and the existing boiler house needs to be retained until the new boiler house has been completed, after which it will be decommissioned and removed. The switch over should be done over the weekend to avoid disruption to the existing factory block. Until then, the existing boiler will need to be maintained by maintenance personnel.

Noise and dust are to be kept to a minimum and contamination of the ground water must be avoided.

No working on Sunday is allowed without express permission of the local authority. During the week, working hours are restricted to 7am – 7 pm Mondays to Fridays and Saturday mornings only.

The site can only be accessed from Meiling Road.

Jason OH
jason9021992@yahoo.com

Assessment 2

This assessment comprises submission of a written report and is done outside the training schedule. You are expected to apply the concepts learnt in the DfS for Professionals Course to a construction project at your workplace.

In the assessment, you are expected to demonstrate competency in the subject by submitting a report of how you take on the role of a DfS Professional in a project which you have chosen to work on.
This would include facilitating the GUIDE1 and GUIDE2, maintaining records and communicating safety and health information to stakeholders.

You must obtain the necessary concurrency and clearance from the relevant stakeholders such as the owner, Developers etc to allow you to use to project for your assessment. They must be mindful of the requirements in provision of relevant information in your report. Although the assessor and the course organisations, in their professional conduct, shall not divulge any information to any person without approval of the originator, candidates are advised not to select projects which may involve sensitive information. Candidates are not allowed to use sensitivity of information as reason to skip or not to address any requirement in the assessment.

Assessor will assess your report based on your relevant observations, clarity and understanding of the key issues and underpinning knowledge. You may be asked to re-work and re-submit your report for clarification, following which failure to address the requirements may result in the candidate being rated as "Not Yet Competent".

It is expected that your submission will be your own work. Assessor may seek clarifications from you or ask further questions about your submission. Any submission found not to be the original works of the candidate will be disallowed and the candidate will be rated as "Not Yet Competent". No course certificate will be awarded to the candidate in such case.

Please read the additional instructions given with Assessment 2, such as the questions to be address, the content of the report etc.

All submission of report must reach the training organisation by Date* your answers and project on time will result in you being marked "Not Yet Competent".

(* The date of submission is to be established between the trainer/assessor and the candidates. This should be within 12 weeks completion of class room training.)

All reports must be submitted in electronic copy and hard copy ** to:

Report to be addressed to: (Person's Name):	
Mail Address / Email:	

(** Delete where appropriate)

Assessment 2

Written Report

Instruction to Candidates

This written report is part of the assessment and is done outside the training schedule. You are expected to apply the concepts learnt in the DfS for Professionals Course to a construction project at your workplace.

In the assessment, you are expected to demonstrate competency in the subject by submitting a report of how you take on the role of a DfS Professional in a project which you have chosen to work on.
This would include facilitating the GUIDE1 and GUIDE2, maintaining records and communicating safety and health information to stakeholders.

You must obtain the necessary concurrency and clearance from the relevant stakeholders such as the owner, Developers etc to allow you to use to project for your assessment. They must be mindful of the requirements in provision of relevant information in your report. Although the assessor and the course organisations, in their professional conduct, shall not divulge any information to any person without approval of the originator, candidates are advised not to select projects which may involve sensitive information. Candidates are not allowed to use sensitivity of information as reason to skip or not to address any requirement in the assessment.

The report should include the following sections: an introduction, a discussion and a conclusion:

Section I Introduction

> $10 million

Include a brief description of the construction project which you have selected to work on. The description of project should indicate its nature, scale and other relevant background information that enable the assessor to have an overall understanding of the project and key project design features. You should include relevant drawings and illustrations where necessary. Typically this would include a site layout plan and drawings showing relevant areas being discussed in Section II below.

Section II Discussion

Provide your answers to the questions or subject matters listed below. You should also include, where relevant, your reflections of the learning points, comments and suggestions on the subject matters in the questions.

1. Responsibilities of a DfS Professional

i What were your duties and responsibilities as a DfS Professional in the project?

ii How well do you think you have fulfilled those responsibilities? You may discuss at least two (2) areas which you think you have done well and two (2) areas where you could have done better, and suggest ways to improve. (PC 1.2, UK 1.3)

2. The DfS review meeting

i. Explain how "GUIDE1" and GUIDE2" were carried out in your project. You may want to explain according to the following:

GUIDE process	To explain
G	a) How was the design review **Group** formed? You should describe the process of forming the group, such as how the group was appointed. who initiated the process etc b) Who were other members in the Review Team? What roles did they play, and how had they contributed to the success of the review? (You are not required to provide the names of the members.) (PC 1.3, UK 1.4)
U	c) How did the group get to **Understand** the full design concept?
I	d) How were the hazards **Identified** (using what method)? You should provide the checklists that were used for hazard identification e) Provide at least three 3 hazards <u>each</u> identified during the GUIDE1 and GUIDE 2 of Design Review. Present the hazards identified in the record format (such as a Risk Assessment Form) used during your project.
D	f) How had the group **Designed** around the risk identified to eliminate or mitigate the risk? Give at least three examples from GUIDE1 and GUIDE2. (You may use the same example as the hazards identified in the previous step, in question "e".) You should attach the relevant records (such as Risk Assessment Forms) on how these hazards were identified and the risk eliminated or mitigated.
E	g. How was vital information on safety and health risks mitigating measures **Entered** into the DfS Register (DFSR)? You should, in addition to the Risk Assessment Forms which were included as required in the previous questions, give a brief description on the content of your DFSR.

(PC 1.6, UK 1.7, UK 1.9, UK 1.10, UK 1.11):

ii. For the hazards and issues identified in GUIDE1 and GUIDE2 above, describe how they were monitored and addressed in the project (PC 2.4, UK 2.4, UK 2.5)

3. Communicating the Safety and Health Information

i. It is important that the right safety and health information is passed on to the right stakeholders at the right time throughout the stages of construction project. With reference to your project, illustrate how you, as a DfS Professional, had communicated at least three (3) types of safety and health information to relevant stakeholders. (PC 3.1, PC 3.2, UK 3.1, UK 3.2, PC 3.3, UK 3.3).

ii. Give a short reflection of how such effective communication had benefited you in the role as a DfS Professional.

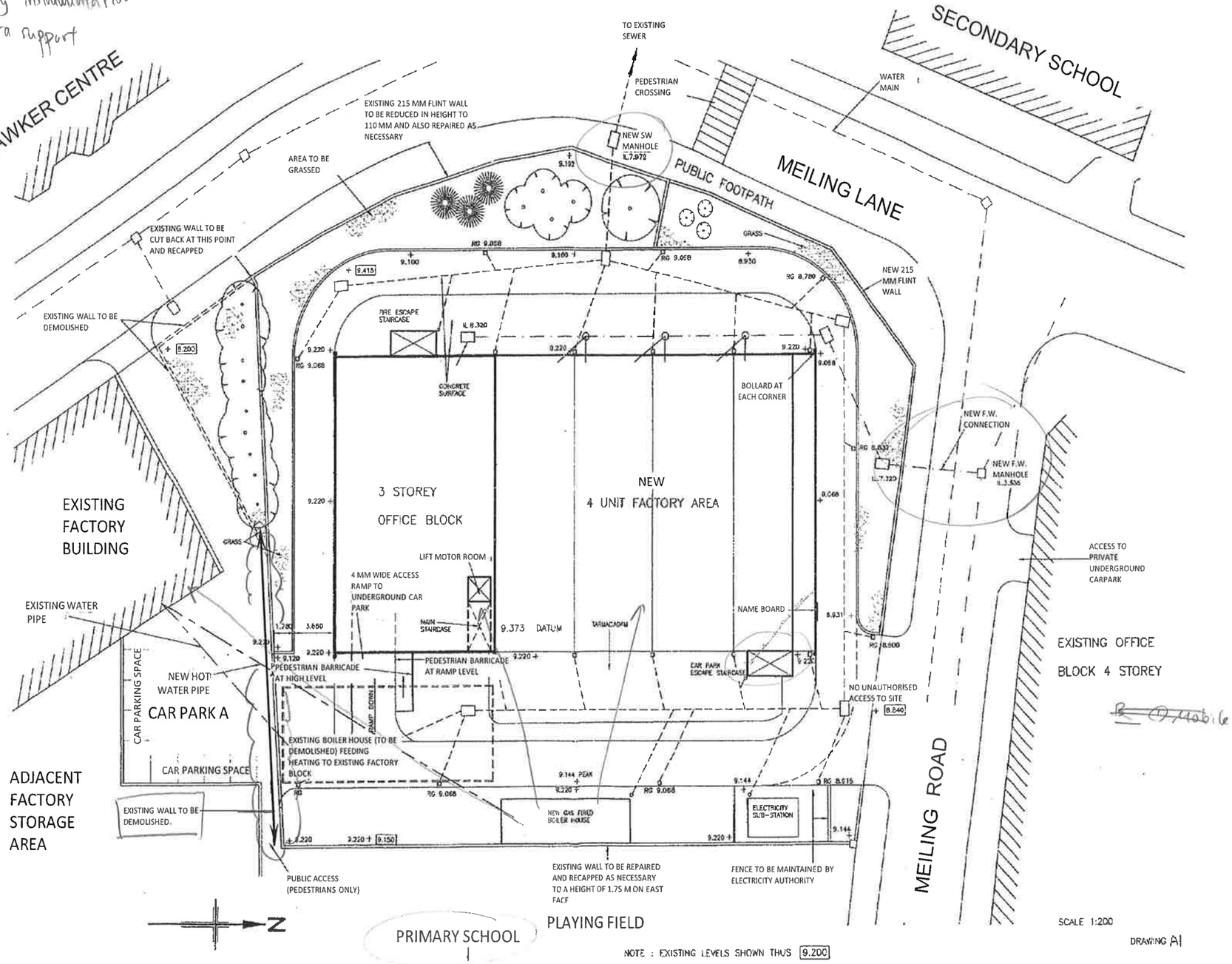
Section III Conclusion

Provide a short summary of the key learning points from the project. You should share any challenges faced during the GUIDE processes, and provide suggestions on area of improving the processes.

A2. Yes, soil settlement

A3. Yes - settlement surrounding building ← Recharge walls.

A4. Yes. - structure damage ← Monitoring instrumentation
← temp. extra support



Activity 1 - Group 2

Contract Information Sheet (House building)

Element	Details
Developer	Andrew Er - NewCity Developments Limited
Project Title	The Construction of a Cluster Housing development
Contract works	The development of a cluster of two storey and three storey houses including access roads, a roundabout, driveways and sewer lines at an estimated depth of 2 metres.
Contract period	80 weeks beginning 6th May 2009
Property Address	Edgefree Plain
Site Description	The development consist of low rise houses with similar design and divided into clusters A, B and C. Cluster D, an area at the south eastern corner is to be used as show area during the marketing stage. The northern boundary is marked by the Terking Water Canal across from which is a mix of existing residential housing and open fields. To the east of the site is a site marked by Edgefree Plain which includes additional pasture land. The southern boundary of the site is marked by Brick Road, across from which is a mix of existing residential housing and small industrial units. The western boundary of the site is marked by an old quarry. Site levels vary across the site although the land falls down from Brick Road to the Canal. A ditch crosses the site following the approximate line of a 150mm diameter sewer. Two underground power lines cross the site in both the south-western and the north-eastern corners. The locations are marked (with "X") on the attached drawing. Existing telephone lines are also found underground at the north eastern corner. Within the proposed site are areas occupied by a primary school, (with playing fields), a nursing home, and old disused industrial units. The access to the school and the home are through an old cracked concrete paved road leading from Brick Road. The development will include a children's play area, tree planting and fencing ~ the use of the existing features for the fencing and borders are encouraged where possible.

Documents provided

(1) Planning and landscape layout;

See next page

2) **Ground Investigation Report Extract**

The soil profile is largely clayey soil with intermediate silt deposits. The soil investigation report also found the presence of boulders scattered throughout the site.

The canal bank did not appear to be supported and ponding (deep water puddles) was noted in areas close to the edges of the canal.

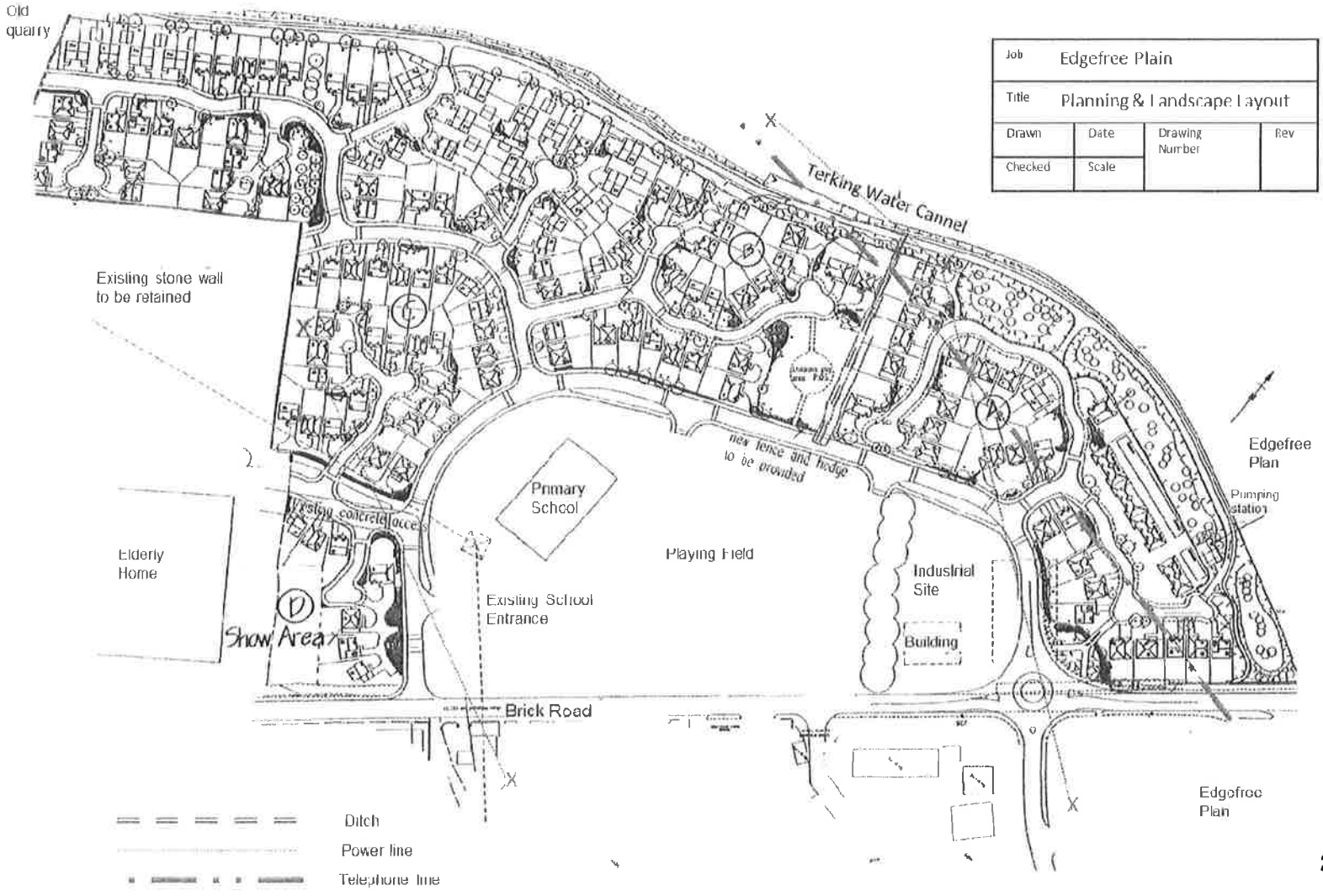
The site was previously used by a haulage contractor as a lorry park and the ground has contamination from oil/fuel spillages.

Contamination of the ground was also identified with high levels of lead, arsenic and cadmium showing in the sample analysis.

(3) **Asbestos Survey Report Extract**

The industrial unit and adjacent outbuildings are roofed with asbestos cement sheet roofing.
The heating equipment (boiler, pipes) located within the main industrial unit has extensive asbestos lagging ~ this is blue asbestos in poor condition.

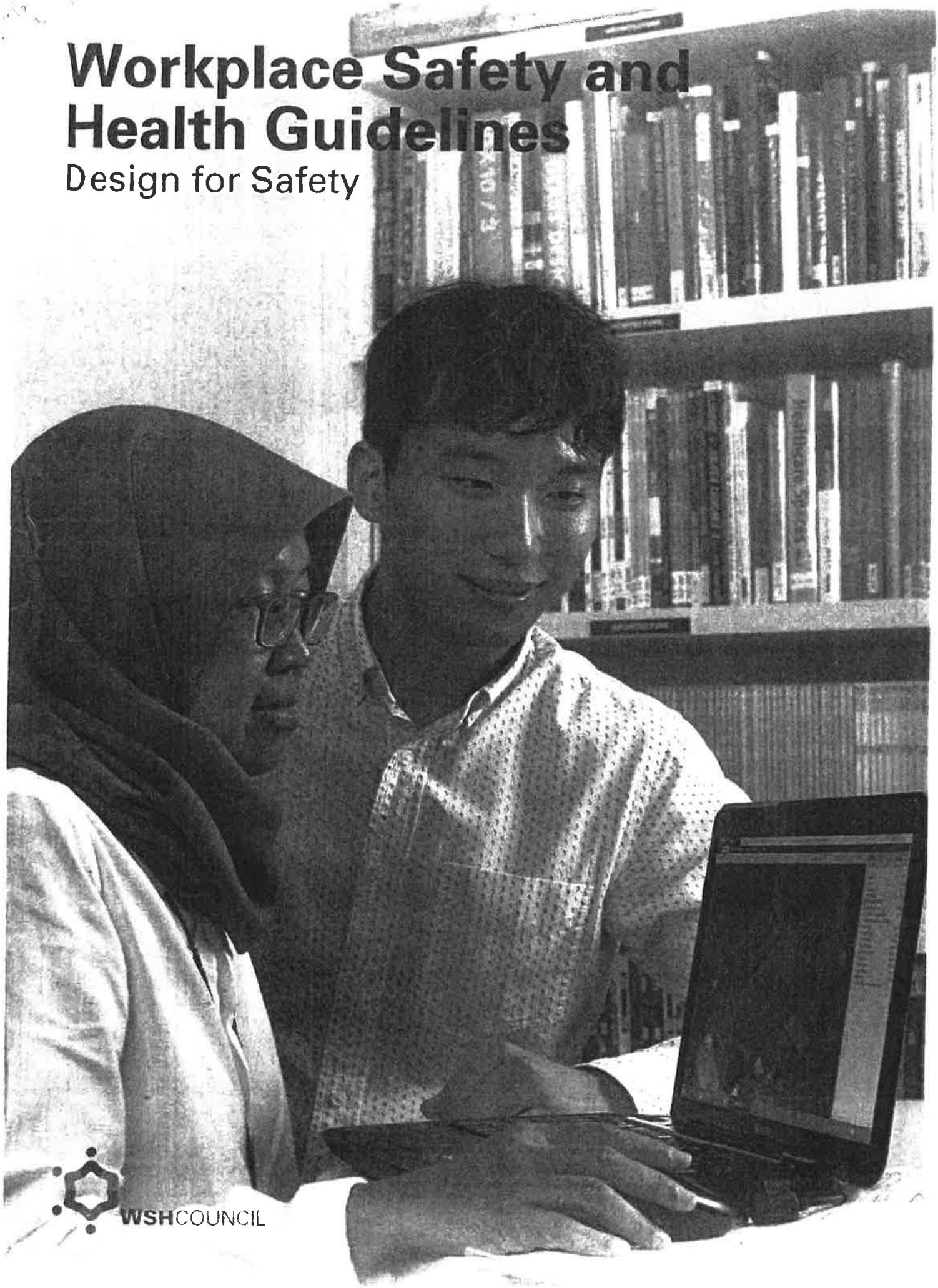
Environmental Health – public health.



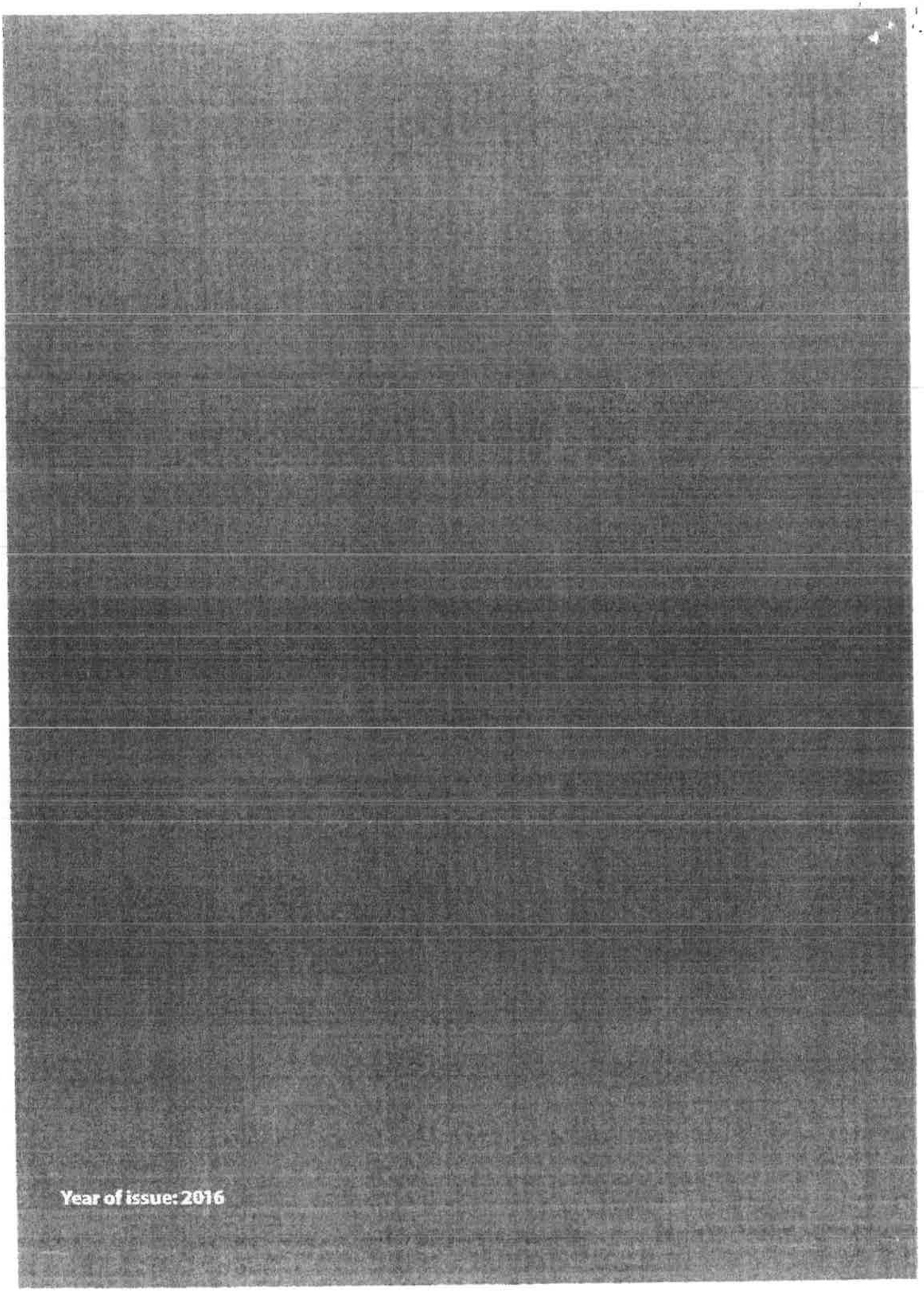
Job	Edgefree Plain		
Title	Planning & Landscape Layout		
Drawn	Date	Drawing Number	Rev
Checked	Scale		

Workplace Safety and Health Guidelines

Design for Safety



WSHCOUNCIL



Year of issue: 2016

Contents

1.	**Introduction**	**03**
1.1	Application of Regulations	03
1.2	Definition of "Structures"	05
1.2.1	What is "Reasonably Practicable"?	05
1.3	DfS Register	06
1.4	Penalties	07
2.	**Developers**	**08**
2.1	Who are Developers?	08
2.2	What must Developers Do to Comply with their Duties?	08
2.3	Delegation of Developer's Duties to DfS Professional	13
2.4	Design and Build Contracts	14
3.	**Designers**	**15**
3.1	Who are Designers?	15
3.2	What must Designers Do to Comply with their Duties?	15
4.	**Contractors**	**20**
4.1	Who are Contractors?	20
4.2	What must Contractors Do to Comply with their Duties?	20
5.	**Registered Proprietors and Subsidiary Management Corporations**	**22**
5.1	Who are Registered Proprietors and Subsidiary Management Corporations?	22
5.2	What must Registered Proprietors and Subsidiary Management Corporations Do to Comply with their Duties ?	22
6.	**The GUIDE Process**	**24**
6.1	Introduction	24
6.2	Implementation Stages for the GUIDE Process	25
6.3	Key Focus for GUIDE	27
6.4	Sample GUIDE-1: Concept Design Review	27
6.5	Sample GUIDE-2: Detailed Design Review	29
6.6	Sample GUIDE-3: Pre-construction Review	36
7.	**Annex**	**40**
	Annex 1: Definition of "Development" under Section 3(1) of Planning Act	40
	Annex 2: Summary of Duties under the WSH (DfS) Regulations	42
	Annex 3: List of WSH Legislation	46
	Annex 4: List of Design Works	47
	Annex 5: List of Typical Designers	49

Annex 6: Areas which Designer has Influence Over 50
Annex 7: Advisory Notes 53
Annex 8: Maintenance Strategy Report 55

8. **Acknowledgement** 58

1. Introduction

The Workplace Safety and Health (Design for Safety) Regulations 2015 (herein referred as "WSH (DfS) Regulations") will be effective from 1 August 2016. The Regulations require stakeholders such as Developers, Designers and Contractors to work together to address risks at source and plan for safe work in regard to a building or structure as a workplace. By working together, they can identify and eliminate or reduce, as far as reasonably practicable, all foreseeable design risk(s) to any person's safety or health. Person is defined as anyone:

- carrying out or liable to be affected by construction work (including additions, alterations and demolition) for the structure, or
- working in a completed building or structure as a workplace including an individual who maintains or cleans the structure, or anything in or on the structure.

It is also the WSH (DfS) Regulations' intent to direct stakeholders to work together to perform their DfS duties and promote safe execution of construction and maintenance works so that buildings or structures can be safe workplaces.

Note:
This set of guidelines replaces the Guidelines on Design for Safety in Buildings and Structures (first issued in 2008, first revision in 2011).

1.1 Application of Regulations

The WSH (DfS) Regulations do not apply to a project where a Designer is appointed before 1 August 2016.

The WSH (DfS) Regulations is applicable to all projects:

- undertaken by a Developer in the course of his or her business;
- with contract sum of $10 million or more; and
- that involve development under section 3(1) of the Planning Act (Cap. 232).

Any modification carried out on a building or structure that has an existing DfS Register and falls under the definition of "Development" under the Planning Act will have to comply with the DfS Regulations. This is regardless of the contract sum value.

See Annex 1 for the definition of "Development" under the Planning Act (Cap. 232).

Contract sum in relation to any construction work, means the value specified in a contract of the works to be carried out by the Contractor undertaking the construction work; it includes goods and services tax payable in relation to the supply of the work. Contract sum here refers to the total contract sum in term contracts; variation orders are not considered in contract sums.

The stakeholders should also take into consideration that all systems and equipment are installed with safety and health provision in accordance to WSH requirements and best practices for future downstream maintenance. Some examples include safe access to cleaning, delivering or removing heavy parts, such as chiller plants, water tanks, or diesel where standby generators are mounted on roof level (with provision of minimum space to carry out maintenance safely and ergonomically). All such considerations should be addressed in a Maintenance Strategy Report. A Maintenance Strategy Report is a document where Designers record their proposals and requirements regarding access strategies for maintenance tasks (see Annex 8). Developer or Designer may use the recommended GUIDE process, in particular, GUIDE-2 outline in Section 6, when preparing a Maintenance Strategy Report.

"Alterations and Addition" (A&A) works that are considered developments under the Planning Act are required to comply with the WSH (DfS) Regulations if all the qualifying criteria are met (e.g., contract sum exceeding SGD$10 million).

In general, contracts that are not defined as developments under the Planning Act are not required to comply with the WSH (DfS) Regulations.

See Table 1 for examples of applications of the DfS Regulations.

Scenarios	Do the DfS Regulations apply? (Yes/ No)
1. I am building a good class bungalow with a contract sum of $12 million for my own occupation. Do the DfS Regulations apply to me?	No
2. Our company is developing a residential condominium project with a contract sum of $20 million. Do the DfS Regulations apply to our project?	Yes
3. We are developing a commercial building with a contract sum of $9 million. However, due to variation orders during the design phase, the contract sum is now $10.5 million. Are we required to comply with the DfS Regulations?	No
4. We appointed a Designer for our development project in 2015. Are we still required to comply with the DfS Regulations?	No

5. We are carrying out Addition and Alteration works with a contract sum of $6 million on a building which already has a DfS Register. Do we need to continue updating the DfS Register and comply with the Regulations?	Yes
6. We are carrying out Addition and Alteration works on an existing building built before 1 August 2016 and it does not have a DfS Register. The contract sum for this project amounts to more than $10 million and falls under the definition of the term "development" as specified in the Planning Act. Do we need to comply with the DfS Regulations?	Yes

Table 1: Examples of applications of DfS Regulations.

Note:
Despite the ambit of DfS application, WSH Council encourages Developers, Designers and Contractors to apply DfS to all building projects. The restricted applicability of the Regulations should not be construed as prohibiting or discouraging the practice of DfS to all building projects.

1.2 Definition of "Structures"

Under the Regulations, "structures" are defined as any permanent or temporary structures. A reference to a structure includes any part of the structure and any product, or mechanical or electrical system intended for the structure.

For permanent structures, this would include any building, timber, masonry, metal, composite or reinforced concrete structure, structure designed or used to provide support or means of access, railway line or siding, dock, harbour, inland navigation, tunnel, shaft, bridge, viaduct, waterworks, reservoir, pipe or pipe-line, cable, aqueduct, sewer, sewage works, gasholder, road, airfield, sea defence works, river works, drainage works, earthworks, lagoon, dam, wall, caisson, mast, tower, pylon, underground tank, earth retaining structure or structure designed to preserve or alter any natural feature, fixed plant and any structure similar to those listed.

For temporary structures, this would include any formwork, falsework, scaffold or other structure designed or used to provide support or means of access during construction work.

1.2.1 What is "Reasonably Practicable"?

The term "reasonably practicable" means that the degree of risk in a particular situation can be balanced against the time, trouble, cost and physical difficulty of taking measures to avoid the risk. An action is considered to be practicable when it is capable of being done. To decide if an action is reasonable, one has to consider:

- the severity of any injury or harm to health that may occur;
- the degree of risk (or likelihood) of that injury or harm occurring;
- how much is known about the hazard and ways of eliminating, reducing or controlling it;
- the availability, suitability and cost of the safeguards.

The risk and severity of injury needs to be weighed against the overall feasibility of the safeguards needed to remove the risk. The greater the risk, and/or severity, the more reasonable it is to go to considerable expense and effort to reduce it.

The cost of putting safeguards in place needs to be measured against the consequences of failing to do so. The judgement is an objective one. Whether an employer can afford to put the necessary safeguards in place is not a consideration, particularly when there is a risk of serious injury, or frequent but less severe injury.

Common practice and knowledge in the relevant industry are sometimes taken into account when one is deciding whether a safeguard is considered "reasonably practicable". Employers cannot claim that they do not know what to do about certain hazards if those hazards and their safeguards are widely known in the same industry.

For information on safety and health measures considered to be reasonably practicable, refer to WSH-related Singapore Standards published by SPRING Singapore; and WSH materials published by the WSH Council.

1.3 DfS Register

The DfS Register is a collection of documents generated through the DfS review process. The Register serves two key purposes.

First, the DfS Register serves as a record and evidence that the DfS review process has been properly undertaken. This includes:

- diligent and systematic identification of foreseeable design risks;
- elimination and/or mitigation of the identified risks as far as reasonably practicable; and
- effective communication of risk information to affected persons.

Second, the DfS Register contains vital information which needs to be communicated to individuals facing design risks, for example, during the construction, maintenance, repair or demolition of a structure, so that they are aware of any identified risks that they ought to address, and the control measures, if available, to implement.

For more information on DfS Register, see Section 2.2 (f) and Section 3.2 (c).

Note:
Documents kept in the DfS Register must be up-to-date and comply with the requirements of ISO 9001:2015.

1.4 Penalties

Under the WSH (DfS) Regulations, the failure to make available the DfS Register for inspection by a registered workplace inspector will result in a fine of not more than $10,000 upon conviction.

The penalties for failure to perform other duties under the WSH (DfS) Regulations will result in a fine of not more than $20,000 or imprisonment for a term not exceeding 12 months or to both. This is the maximum penalty for the contravention of each duty.

2. Developers

2.1 Who are Developers?

Developers are persons for whom or on whose behalf a construction project is carried out. In this context, Developers could be individuals or organisations. Developers are at the top of the construction value chain and have the greatest influence on the project. Developers also include the subsidiary management corporation of the subdivided building undertaking modification projects on existing building.

Homeowners who engage Contractors to build their homes or undertake project to build or rebuild houses for personal dwelling not intended for use as a business are not covered under the WSH (DfS) Regulations.

2.2 What must Developers Do to Comply with their Duties?

Under the WSH (DfS) Regulations, the Developer is the key stakeholder responsible for ensuring that foreseeable design risks in the project are eliminated. Where it is not reasonably practicable to eliminate the design risks, the Developer shall ensure that the design risks is reduced to as low as reasonably practicable.

The Developer is the one who engages professionals to design and construct a project at an allocated budget. As the key stakeholder in the construction project, he or she is the one who selects the scheme and makes key decisions in the design of the project. As such, it is the Developer's duty to ensure that the foreseeable design risks in the project are eliminated. In the event that it is not reasonably practicable to eliminate the design risks, the Developer has to work with other stakeholders (e.g., Designer, DfS Professional, Contractor) to ensure that the design risks are reduced to as low as reasonably practicable.

When reducing a design risk, it shall be reduced at its source and collective protective measures shall be used instead of individual protective measures. Individual protective measures refer to measures such as the usage of personal protective equipment (PPE). Instead of selecting PPE, collective protective measures which look at protecting workers as a whole team should be selected. An example would be opting for guardrails along an open edge instead of lifelines.

While it is understandable that the Developer may not have the domain knowledge to ensure that foreseeable design risk is eliminated, he or she should leverage on Designers' and Contractors' expertise to help him or her make the appropriate decisions.

- Engage competent Designer(s), Contractor(s) or DfS Professional(s) who is (are) able to perform the duties stipulated under the WSH Act and the subsidiary Regulations.

The competency of a person is defined as the experience and training that one has which helps one to carry out one's duties. To assess the competency of a person for the job, the Developer shall check that the person has the relevant training and experience in the scope required and is able to not just fulfil his or her contractual requirements, but also able to perform the duties prescribed under the WSH ACT and the subsidiary Regulations. To assess if a company is capable to do the job, the Developer shall check that the company has the relevant track records and experienced personnel to adequately fulfil the competency requirements expected of it.

Using the Quality-Fee Method (QFM) as reference, a vendor selection framework used by the Building and Construction Authority (BCA), here are examples of areas the Developer could check to assess an individual's or a company's competency:

- Company's or individual's track record including awards attained (e.g., bizSAFE level);
- Relevant expertise and experience of the proposed project team;
- How the proposed project team intends to manage with the project's design risks communicated to them by the Developer, and
- Safety and risk management capabilities of the construction project team (where applicable).

Example:

In a proposed residential development, a Developer required five high-rise buildings to be designed and connected at the mid and top floors via sky bridges. The Developer initially engaged a building designer for the design, but subsequently realised that the building designer did not have the competence, training and experience to design bridges. The Developer then engaged a bridge designer to design the sky bridges while the building designer designed the building.

- Plan and manage the project such that all Designers and Contractors appointed by the Developer have sufficient time and resources to complete the project.

This is to ensure that the project can proceed safely and smoothly from the pre-construction to the construction phase. This includes allocation of sufficient time and resource for:

- Designers including architects, engineers, and so on (see Annex 5 for a list of typical designers) to look into the safety and health of persons doing the construction work, cleaning or maintaining the completed structure and using the completed structure as a workplace.
- Contractors doing the construction work to look into the safety of persons doing the construction work, cleaning or maintaining the completed structure and using the completed structure as a workplace.

- When engaging Designers and Contractors, Developers have to consider the resources (e.g., staff, equipment and, particularly, time) needed to plan and do the work properly. At the tender stage, Developers should take into consideration the minimum time period Contractors need to plan and prepare before construction work begins on site. After they are appointed, Contractors should be given sufficient time to plan the work and mobilise the necessary staff and equipment (e.g., cranes, piling rigs) so that work can proceed without risk to workers' safety and health. This is particularly important when the project involves demolition work. Contractors must be given sufficient time for the planning and safe execution of any demolition activities.

- After awarding the contracts to Designers and Contractors at agreed prices, if there are major changes in the project that would lead to safety and health issues, the Developer should discuss with the Designers and Contractors if the time and resources agreed earlier are sufficient for the project. All parties should come to a mutual agreement on the resources and time allocated so that the project can proceed safely.

Example:

A Developer awarded a contract to a Contractor for the construction of a new development on a lot with an existing building. While it was unknown during the tender stage, it was later discovered that the building that was to be demolished contained materials with asbestos. With this new information, the main Contractor would need more time to engage and work with Contractors who are asbestos removal specialists to help demolish this building. Hence, the Developer should provide the main Contractor with additional time and resources to resolve this situation.

- Provide relevant information to all Designers and Contractors engaged by the Developer. This includes:
  - site plans and photographs of project location;
  - as-build plans;
  - utilities and services plans;
  - soil investigation reports;
  - existing DfS Register (if any); and
  - information on design risks associated with the project (if any).

The risks involved in the project shall be made clear by the Developers to Designers and Contractors before the tender starts. This would enable the Designers and Contractors to understand the design risks and help them determine if they are able undertake the project and comply with the WSH Act and its subsidiary Regulations.

Developers may assign a Designer, Contractor or DfS Professional to obtain the relevant information on their behalf from the authorities or other parties, but the responsibility to do so resides with the Developers.

- Convene DfS review meeting(s) with the relevant Designer and Contractor to identify all foreseeable design risks to people who may be affected and discuss how each foreseeable design risks can be eliminated or reduced.

  To fulfil this requirement, the Developer shall conduct DfS review meeting(s) with relevant stakeholders at various key stages of the project. Relevant stakeholders are personnel who may affect the design, construction and/or maintenance of the project. These could include Designers (permanent, specialist or temporary works), Contractors (permanent, specialist, temporary or maintenance works), surveyors and other stakeholders. Note that these stakeholders may not be on the project team during the key stages of the project but their inputs should be sought once they are appointed, so that DfS review meetings will be fruitful.

  When an identified foreseeable design risk cannot be eliminated, the Developer shall ensure that the design risk is reduced to as low as reasonably practicable and all residual design risks highlighted during the DfS review meeting(s) are recorded.

  Finally, all residual design risks highlighted and recorded must be communicated to Contractors engaged for the relevant scope of works so that they are aware of the risks involved and take steps to manage them.

  While it is recommended that DfS review meeting(s) be conducted using the recommended GUIDE process (see section 7), the Developer may choose other hazard identification tools to identify the risks for the project.

  While DfS review meetings are typically done during the pre-construction phase, the Developer may still conduct DfS review meetings during the construction stage of the project to:
  - Review any new or revised designs (e.g., variations, designs for temporary works, and designs by specialist contractors),
  - Provide necessary briefings and clarifications to the Contractor as part of passing-on information of residual design risks from the DfS review meetings.

  The DfS review meeting looks at risks associated with the design which begins on the drawing board, and considers how a building or structure can be constructed, maintained, cleaned and demolished safely, and if there are safety and health issues at every stage of the building's or structure's life cycle.

- Prepare a DfS Register containing information and records on every DfS review meeting and every residual design risks for the project.

  The information should be revised from time to time as and when new information concerning risks of the project is obtained. For example, the Register should be revised when there are reduced risks in a particular area of the project as a result of proposed design change or change in construction sequence.

Note that there could be more than one Designer and one Contractor in the course of the project. Under the WSH (DfS) Regulations, the Designer(s) or Contractor(s) is (are) required to provide information about risks of the project and this information has to be recorded in the DfS Register. To ensure that the risks identified are mitigated, the relevant risk information in the DfS Register or the DfS Register itself must be shared with the relevant Designers and Contractors so that they are informed of them. This would then allow them to look into and mitigate the risks accordingly.

The DfS Register shall be kept available for inspection by an inspector upon request. For practical reasons, at the pre-construction stage, the DfS Register should be kept in the premises of either the Developer or DfS Professional tasked to assist the Developer. At the construction stage, an updated copy of the DfS Register should be kept in the project worksite for ease of reference. Alternatively, subject to appropriate document control measures being in place, electronic modes of information sharing and storage or filing can be used.

Items that could be included in the DfS Register are listed, but not limited to:

- Design review records of risks and mitigation measures which could be generated by following the recommended GUIDE process described in Section 7;
- Services plan; and
- Plans of existing building or structures.

It is important to note that the information in the DfS Register has to be updated from time to time to ensure its relevance. Irrelevant or outdated information should be discarded to avoid unnecessary piling up of information.

- Ensure the continuity of the DfS Register by passing it to the person who acquires the Developer's interest in the building or structure.

This would include building owners and in the case of subdivided buildings, the Management Corporation Strata Title (MCST) who acquires Developer's interest in the projects.

The Developer shall ensure that the person who acquires the interest of the project is aware of the nature and purpose of the DfS Register. When the DfS Register is handed over during the pre-construction or construction phase, information on the risks concerning both the construction and maintenance of the project should be communicated to the person who acquires the Developer's interest. When the DfS Register is handed over after the construction phase, the Developer shall ensure that the person who acquires the Developer's interest is aware of the maintenance risks of the completed building or structure.

2.3 Delegation of Developer's Duties to DfS Professional

The Developer may appoint his or her employees or engage a person deemed competent or with expertise on safety and health risks of design of building or structure, termed as DfS Professional to undertake the duties of the Developer.

The Developer may delegate his or her duties only in relation to:

- convening DfS review meetings; and
- maintaining a DfS Register.

When these duties have been delegated, the Developer will not be responsible for their performance. This is provided that the Developer has ensured that the DfS Professional appointed is competent to perform the duties stipulated in the DfS Regulations.

The Developer shall ensure that the DfS Professional is competent in terms of experience and training to perform the tasks. The candidate shall have:

- Reasonable exposure and experience in safety and health matters in the construction industry; and
- Attended and passed the assessment on the Design for Safety for Professional Course (formally known as the DfS Coordinator Course) conducted by professional bodies, industry associations or statutory boards or attain equivalent qualifications.

The candidate must also either:

- Be a registered Professional Engineer (PE) or architect with a practicing certificate; OR
- Have 10 years of relevant experience in the design (at least 5 years in design which includes contributions to designs, writing specifications) and supervision of the construction of structures; and
- Have a degree accepted by PE Board (PEB) or Board of Architects (BOA) and a construction-related degree accepted by Singapore Institute of Surveyors and Valuers (SISV) and Society of Project Managers (SPM).

Example:

A Developer engaged an architect and an engineer to design a shopping mall with associated facilities. Under the DfS Regulations, the Developer is required to implement a DfS Review Process to eliminate foreseeable risks to people who may be affected by the construction or maintenance of the building. The Developer then appointed a DfS Professional to implement the DfS Review Process and gathered the architect, engineer and relevant stakeholders to join the review.

During the review, one of the items discussed was the installation of glossy ceramic floor tiles, which would get wet and slippery during washing or when water got spilled onto them, in the kitchen, cold rooms and toilet areas. Installation of the tiles in these areas would possibly lead to cleaners or kitchen staff slipping or falling. With this consideration, the team agreed that floor finishes at these areas should be of non-slip material to reduce the risk of slips and falls.

Developers may assign existing duty holders such as the Designer or Contractor as the DfS Professional under the WSH (DfS) Regulations. However, assigned DfS Professionals must be able to fulfil all their duties under the WSH (DfS) Regulations with due diligence.

Developers must also provide DfS Professionals with the information necessary for them to perform their duties.

Other than carrying out duties such as arranging for DfS review meetings and maintaining the DfS Register, the DfS Professional is also responsible for updating the Developer on all matters arising from DfS review meetings and all updates to the DfS Register.

The DfS Professional needs to ensure that relevant information on each foreseeable design risk identified and how each design risk can be eliminated is communicated to the Developer as soon as possible after each DfS review meeting.

The DfS Professional also needs to provide the Developer with an updated DfS Register after adding any new information or record. This is important to ensure that the Developer has an accurate oversight of the project's design risks and is able to make the right decisions on how the design risks are to be mitigated.

The duty of keeping a building's and/or structure's DfS Register updated and current shall be returned to the Developer unless stated otherwise in the contract of service by both parties.

2.4 Design and Build Contracts

In Design and Build (D&B) contracts, a Developer would need to assess a Contractor's competence by considering the experience and training of each member on the team. For example, the Developer has to assess if the team's Designer has the expertise to handle the risks of the project and fulfil his or her duties under the WSH Act and its subsidiary Regulations. In particular, this refers to the Contractor's competence to perform his or her duty under WSH (DfS) Regulation 10 and the Designer's competence to perform his or her duty under the WSH (DfS) Regulations 9.

3. Designers

3.1 Who are Designers?

Under the WSH (DfS) Regulations 2015, a "Designer" refers to a person or an organisation or a company who prepares a design plan relating to a structure. This would include PEs, engineers, architects, Qualified Persons (QPs) and even Contractors or Developers if they prepare a design plan for permanent or temporary structures.

A design plan includes drawings, building information modelling (BIM), design details, specifications, materials and bills of quantities (including specifications of articles or substances) relating to a structure, and calculations prepared for the purpose of a design.

See Annex 4 for a list of design and design inputs and Annex 5 for a list of persons deemed as Designers.

3.2 What must Designers do to comply with their Duties?

Decisions made by Designers have significant impact on the safety and health of workers, particularly to those who construct, maintain, repair, clean, refurbish and eventually demolish or remove the building or structure. It is, therefore, important that safety and health are considered at the start of the design process.

The Designer can help ensure workers' safety and health by considering these questions:

- Can prefabrication be used to limit risks arising from working at heights?
- Can permanent access arrangements be detailed to permit their early construction?
- Can slabs or hard-standings be detailed to suit mobile access equipment?
- Are there any potentially hazardous features of the site or permanent works that would need the Contractor's attention?
- Can permanent facilities be built in to allow easy access for workers doing maintenance work on the structure?

The Designer is a key stakeholder working for the Developer and/or Contractor(s) and is responsible under the WSH (DfS) Regulations to:

- Prepare a design plan for the structure that eliminates, so far as reasonably practicable, foreseeable design risks to the safety and health of any person affected by the project.

  While preparing a design plan, the Designer shall begin with the elimination of foreseeable design risks as the ideal solution. To be able to foresee design risks, the Designer must consider the people affected, namely persons:

- who carry out or are liable to be affected by construction work for the structure,
- for whom the structure is a workplace, including an individual who maintains or cleans the structure, or anything in or on the structure, or
- who carry out or are liable to be affected by the demolition of the structure.

The Designer must also:

- understand and be aware of significant design risks that construction and maintenance workers can be exposed to; and
- have the right skills, knowledge, and experience to address safety and health issues arising from the design.

To eliminate design risks, the Designer shall take into account all information provided by the Developer and/or the Contractor for the project. This would typically include:

- site plans and photographs of the project location;
- relevant drawings or plans (e.g., architectural plans, structural plans, as-built plans, etc);
- utilities and services plans;
- soil investigation reports;
- existing DfS Register (if any); and
- information on risks associated with the project (if any).

The Designer shall not produce designs that cannot be constructed, maintained, used or demolished in a reasonably safe manner.

Example:

A Designer designed a 10m tall external green wall facade, which required regular maintenance, for a building. To eliminate risks of falling from heights during maintenance, the Designer designed a green wall with rotatable green wall panels and access walkway inside the building so that the maintenance of the green wall could be done from the walkway.

See Annex 6 for a list of typical design hazards. The list serves as a reference for Designers and it does not limit possible hazards to only those listed.

- Propose to the person who appointed the Designer, a modification to the design plan that reduces the design risks to as low as reasonably practicable.

If the foreseeable risks to the safety and health of any person affected by the design decision cannot be eliminated due to the nature or functionality of the design, the next preferred measure is to control the risk arising from the design and reduce the risks associated with those hazards which remain. This can be achieved by:

- reducing the design risk at its source; and
- using collective protective measures rather than individual protective measures.

Designers can help to avoid, isolate or reduce risks that arise during the construction and subsequent maintenance work for the completed structure.

Design is not a one-step operation, but one that often requires modifications to address thoroughly what could go wrong during a structure's construction or maintenance phase. This would involve making modifications as a result of discussion with other stakeholders along the way and as more information becomes available.

When Designers are preparing the design, they are expected to do what is reasonable to prevent safety and health risks. They need to take into account current industry knowledge and acceptable practices, requirement for maintenance, cleaning and access to the finished project. Discussing these with those carrying out the work is important because they may have methods of working, specific needs or suggestions which Designers will need to consider in their design. Some examples include the use of Mass Elevated Work Platforms (MEWPs) for maintenance of internal structures, and use of suspended scaffolding or industry rope access system for maintenance of building facades.

Modifications to the design during construction are additional work and such efforts may not be cost effective. As such, Designers are advised to consider the people affected and eliminate the risks right from the start of the design, before key decisions are made, to prevent reworking of the design.

Example:

The distribution box of a multistorey carpark was located at the wall of a carpark next to the traffic lanes. This location put workers in the path of traffic during maintenance work. To reduce the risk of being hit by vehicles, the distribution box was relocated further down the carpark where the risk of being hit by a vehicle during maintenance of the distribution box was eliminated.

- Provide all information relevant to the design, construction or maintenance of the structure to the person appointed as the Designer.

  In addition to reducing risks through design modification, the Designer shall provide information about residual risks to assist main stakeholders such as the Developer, Contractor, and/or delegated Designer for further mitigation. This information is important and should be highlighted to the:

  - Developer so that he or she can allocate sufficient time and resources throughout the project to ensure that the project is able to proceed safely and smoothly from the pre-construction to the construction phase.
  - Developer and/or Contractor to allow him or her to make informed engineering decisions at an early stage in order to avoid foreseeable risks to those involved in the construction and future use of the building and/or structure. This could possibly include construction method which is unique to the design or maintenance notes.

Designers need to provide information about aspects of the design that could create significant risks during future construction work or maintenance. When in doubt about the level of information needed, besides asking those who will use or work in the building or structure, Designers can ask themselves:

- "If I were the operator maintaining this plant or roof, what would I need to access the plant or roof in a manner that will not affect my safety and health? Can the plant or roof be isolated for maintenance to be done safely?"
- "If I were the facilities manager, about to engage Contractors to undertake maintenance work, is it likely that I would be paying a premium due to poorly thought out access provision?"

A Designer is not expected to produce huge amount of unnecessary paperwork. However, he or she should maintain records on why key decisions were made with respect to the design or modifications to the design. The information must be presented in a clear and concise manner. It can be presented in these formats:

- Advisory notes on drawing

  These notes are immediately made available to those carrying out the work so they should be direct and concise. They must also be annotated and updated to be current (see Annex 7 for examples). Users can refer to other documents if more details are needed.

- Written notes provided together with the DfS Register

  These notes should be project specific, and should only contain information useful to those constructing or maintaining the structure (see Annex 8 for an example). The intent is for the maintenance strategy to be part of the DfS Register that will be eventually handed over to parties who acquire interest in the building.

- Attend and participate actively in DfS review meetings as required by the Developer, Contractor, and/or their appointed DfS Professional.

Under the WSH (DfS) Regulations, the Developer or his or her appointed DfS Professional is responsible for implementing the DfS review process. When a Developer appoints a Designer, he or she can request the Designer to participate in the project's DfS review process any time during the pre-construction or construction phase to review the design and how it affects the safety and health of people working on and maintaining the building.

In instances when the Designer for permanent or temporary works is appointed by the Contractor, the Designer may also be required to join the DfS review process as his or her inputs would be important.

The safe design of a building structure will always be part of a wider set of design objectives that include practicability, aesthetics, cost and functionality. These, sometimes competing, objectives need to be balanced so that they do not compromise the health and safety of those who work on or use the structure throughout its life cycle. The DfS review meeting is therefore the platform for duty and stakeholders to come together to discuss and resolve design risks and issues.

- Appointment of a Delegated Designer

The WSH (DfS) Regulations has made provision for the appointed Designer to appoint another Designer, called a delegated Designer, for the structure. This can only take place when the following conditions are fulfilled:

- the appointed Designer reasonably believes that the delegated Designer is competent to perform the duties of a Designer under the WSH (DfS) Regulations and any other subsidiaries regulations made under section 65 of the WSH Act.
- the delegated Designer is provided with all relevant information so that the delegated Designer is able to perform the duties of a Designer under the WSH (DfS) Regulations and any other subsidiaries regulations made under section 65 of the WSH Act.

The Designer should also consider whether he or she has any gaps in his or her knowledge or experience. If so, the Designer should seek out other professionals to help him or her to bridge those gaps. If a Designer delegate a portion of work to another Designer (e.g., a specialist), he or she should make enquiries about their skills, knowledge and experience to ensure that they are capable of carrying out the job in question.

However, it is important to note that in situations where the Designer appoints a delegated Designer to prepare a design plan for a structure, the Designer remains liable of the design plan in terms of its design risk in these two aspects:

- All foreseeable design risks are eliminated as far as it is reasonably practicable.
- If such risks cannot be eliminated, propose to the person who appointed the Designer, modifications to the design plan that reduce design risks to as low as reasonably practicable.

The delegated Designer must also be confident that him- or herself has the appropriate skills, knowledge, training and experience to do the work. This can be demonstrated by providing a portfolio of past work on similar projects and references from previous clients.

4. Contractors

4.1 Who are Contractors?

Contractors are persons or companies who have entered into a contract for the purpose of carrying out any construction work. In the WSH (DfS) Regulations, the term "Contractors" refers to both Main Contractors and Subcontractors. As such, the duties of Contractors would also apply to both Main and Subcontractors.

4.2 What must Contractors Do to Comply with their Duties?

Contractors of a structure are required under the WSH (DfS) Regulations to:

- Inform the person who appointed the Contractor of any foreseeable design risk that the structure poses or will pose to an affected person to ensure that the project is carried out without risks to safety or health of any person who may be affected by it.

  The person who appoints a Contractor may refer to a Developer, Main Contractor or any other stakeholder who appoints a Contractor. This would require the Developer or Subcontractors to provide their Main Contractors with information on any foreseeable design risks as soon as reasonably possible.

- When engaging a Designer or Subcontractor, a Contractor needs to ensure that the Designer or Subcontractor is competent and able to comply with his or her duties under the WSH (DfS) Regulations and any other regulations under the WSH Act.

  The competency of a person is defined as the experience and training that one has which helps one to carry out one's duties under the regulations. To assess the competency of a person for the job, the Contractor shall check that the person has the relevant training and experience in the scope required and is able to not just fulfil his or her contractual requirements, but also perform the duties prescribed under the WSH ACT and the subsidiary Regulations. To assess if a company is capable to do the job, the Contractor shall check that the company has the relevant track records and experienced personnel to adequately fulfil the competency requirements expected of it.

Example:

A Contractor needs to engage a PE, under the WSH (Construction) Regulations to design a formwork structure for a transfer slab that is 3 metres deep. The Designer requires the formwork to be cast in three stages to control thermal heat dissipation. Under the Regulations, the Contractor is required to engage a competent temporary works Designer. To ensure that a competent PE is engaged, the Contractor needs to check that the PE has the relevant training and experience in designing similar formwork structure for transfer slabs.

- Provide relevant information to Designers engaged by the Contractor. This includes providing them with:
  - site plans and photographs of the project location;
  - relevant drawings or plans (e.g., architectural plans, structural plans, as built plans, etc);
  - utilities and services plans;
  - soil investigation reports;
  - existing DfS Register (if any); and
  - any other information that the Designers would require to perform their jobs and comply with their duties under the WSH (DfS) Regulations.

- Participate in the DfS Review Process as required by the Developer or the DfS Professional.

  The Contractor may be called to participate in the DfS Review Process any time during the project. If the Contractor was appointed by the Developer in the pre-construction phase, the Developer may request for the Contractor to participate in the design review process even though the construction phase may have not started. This would allow for better planning of the project's work processes and construction methods in the pre-construction phase.

5. Registered Proprietors and Subsidiary Management Corporations

5.1 Who are Registered Proprietors and Subsidiary Management Corporations?

Registered Proprietors refer to building owners.

Subsidiary Management Corporations refer to Management Corporation Strata Title (MCST) engaged by building owners to manage the maintenance and upkeep in the common areas of a building. It is defined in the Building Maintenance and Strata Management Act as, in relation to any limited common property comprised in a strata title plan, the subsidiary management corporation constituted for that limited common property under the Land Titles (Strata) Act.

Managing Agents (MAs) are considered as occupiers of a workplace.

5.2 What must Registered Proprietors and Subsidiary Management Corporations Do to Comply with their Duties?

Upon completion of a structure, in the event the Developer disposes his or her interest in the structure in the project he or she had undertaken, the Developer is required to hand over the DfS Register to the next person who acquires the Developer's interest in the structure.

Registered Proprietors are required under the WSH (DfS) Regulations to:

- Keep the DfS Register for a structure that is not a subdivided building. They will be required to share information on residual risks in the DfS Register with affected persons such as those carrying out cleaning and maintenance works.
- Ensure that the DfS Register, for a structure that is not a subdivided building, is available for inspection when requested by an inspector.
- In the event that the Registered Proprietor disposes his or her interest in the structure, ensure that:
  - The DfS Register is given to the person who next acquires the interest in the structure when the Registered Proprietor disposes of his or her interest in the structure. The DfS Register is an up-to-date document that needs to stay with the structure for its entire life span, from design conceptual phase till its demolition. Hence, this document must be handed over from one Registered Proprietor to the next for their future reference and updating.
  - The person who next acquires the interest in the structure is informed of the nature and purpose of the DfS Register. The Registered Proprietor should ensure that the person who next acquires the interest is made aware of the maintenance and other residual risks associated with the structure.

For a subdivided building, the DfS Register must be kept by the subsidiary management corporation of the building. Under the WSH (DfS) Regulations, it is the duty of the subsidiary management corporation to ensure that the DfS Register is available for inspection by an inspector upon the inspector's request.

Registered Proprietors and subsidiary management corporations are required to keep the DfS Register so that information on residual risks is readily available for reference to those who will be using the structure as a workplace (cleaning or maintenance) or during demolition.

A subdivided building refers to any one or more buildings comprised in a strata subdivision plan approved by the relevant authority.

Example:

Upon completion of a condominium development project, the Developer will hand over the property to a new owner who has bought over the property. Under the Regulations, the Developer is required to hand over the DfS Register to the new owner. However, because the condominium is a subdivided building, the DfS Register is required to be kept by the MCST of the condominium.

In situations where Registered Proprietors or MCSTs have MAs to manage their properties, the Registered Proprietors or MCSTs have the duty to ensure that the MAs have access to the DfS Register and are informed of the residual risks. When MAs engage Contractors to carry out any work, MAs are required to inform Contractors of any residual risks involved in their scope of works.

Example:

A Registered Proprietor owns a shopping centre and engages a MA to manage the property. In this situation, the Registered Proprietor is required to keep the DfS Register and inform the MA of the residual risks. The MA then engages a Landscaping Contractor to carry out maintenance and pruning works on a green wall on the shopping centre's facade. The MA will be required to ensure that the Contractor has been informed of all residual risks involved in carrying out landscaping works on the shopping centre's facade.

6. The GUIDE Process

6.1 Introduction

To ensure that a design is safe, a DfS Review Process is introduced in the project flow. The DfS Review Process involves main stakeholders, such as the Developer, Designer (engineer and architect), and Contractor if he or she has been appointed.

The DfS Review Process shall be implemented by the Developer or his or her appointed DfS Professional who should chair and facilitate all discussions. There should also be a systematic process whereby risks of the design are highlighted, reviewed and recorded. The outcome of the DfS Review Process is to eliminate, as far as reasonably practicable, foreseeable risks to the safety and health of any person:

- carrying out or are liable to be affected by construction work;
- maintaining or cleaning a completed structure; or
- using a completed structure designed as a workplace.

After the DfS Review Process is done, there should be:

- endorsement of safest possible designs by all parties of the DfS Review Process; and
- a record of residual risks and vital safety and health information.

To assist stakeholders in reviewing the design, a process called GUIDE is recommended.

Note:
GUIDE is a recommended process but stakeholders are free to adopt, adapt or use other processes they deemed fit for their respective projects.

GUIDE ensures a systemic way of doing the DfS review (see Table 2).

Step 1	**G:**	Group together a review team consisting of main stakeholders.
Step 2	**U:**	Understand the full design concept by looking at the drawings and calculations, or have designers elaborate on the design.
Step 3	**I:**	Identify risks that arise as a result of the design or construction method. The risks should be recorded and analysed to see if they can be eliminated by changing the design.
Step 4	**D:**	Design around the risks identified to eliminate or to mitigate the risks.
Step 5	**E:**	Enter all the information including information on vital design change that would affect safety and health or remaining risks to be mitigated into the DfS Register.

Table 2: The GUIDE Process.

Steps 3 and 4 should be repeated until the review team is satisfied that the design can no longer be changed to totally eliminate all risks.

The process should be facilitated by the Developer or his or her appointed DfS Professional together with other stakeholders guided accordingly following a disciplined approach to identify foreseeable risks in the projects. After following the steps required for GUIDE, residual risks should be recorded and signed off by the project team.

6.2 Implementation Stages for the GUIDE Process

It is recommended that the GUIDE Process be done in three phases. See Figure 1 for GUIDE Process for typical contracts and Figure 2 for GUIDE Process for D&B contracts.

1) GUIDE-1: Concept Design Review

Concept design review should look at a project's general location, traffic, type of buildings in the surroundings, and other general constraints.

GUIDE-1 records risks and mitigation measures for risks and hazards arising from the design (e.g., materials used, structural concepts).

2) GUIDE-2: Detailed Design, Maintenance and Repair Review

Detailed design, maintenance and repair review should look at a building's detailed architectural and structural design. The review should determine risks involved in the construction methods, access and egress, and whether the design will create confined space or other hazards. Risks related to maintenance and repair of a building, such as cleaning methods, should also be studied.

GUIDE-2 records risks and measures such as:

- information provided by Contractor on mitigation of risks and hazards;
- residual hazards brought over to the maintenance phase; and
- maintenance methods of the building, structure or equipment.

For D&B contracts which the Contractor is in-charge of the project's design. GUIDE-2 should be done with the Contractor's input. The Contractor can then highlight constraints that he or she will face when constructing the building or structure. This would further help in the GUIDE process.

3) GUIDE-3: Pre-construction Review

Pre-construction design review should examine temporary works design and design by specialist contractors not covered during the concept and detailed design phases.

GUIDE-3 records risks and mitigation measures such as:

- shoring, trenches and deep excavation;
- confined spaces; and
- formwork and falsework.

GUIDE-1, 2 & 3 will be applied, where possible, at each stage of the design preparation process.

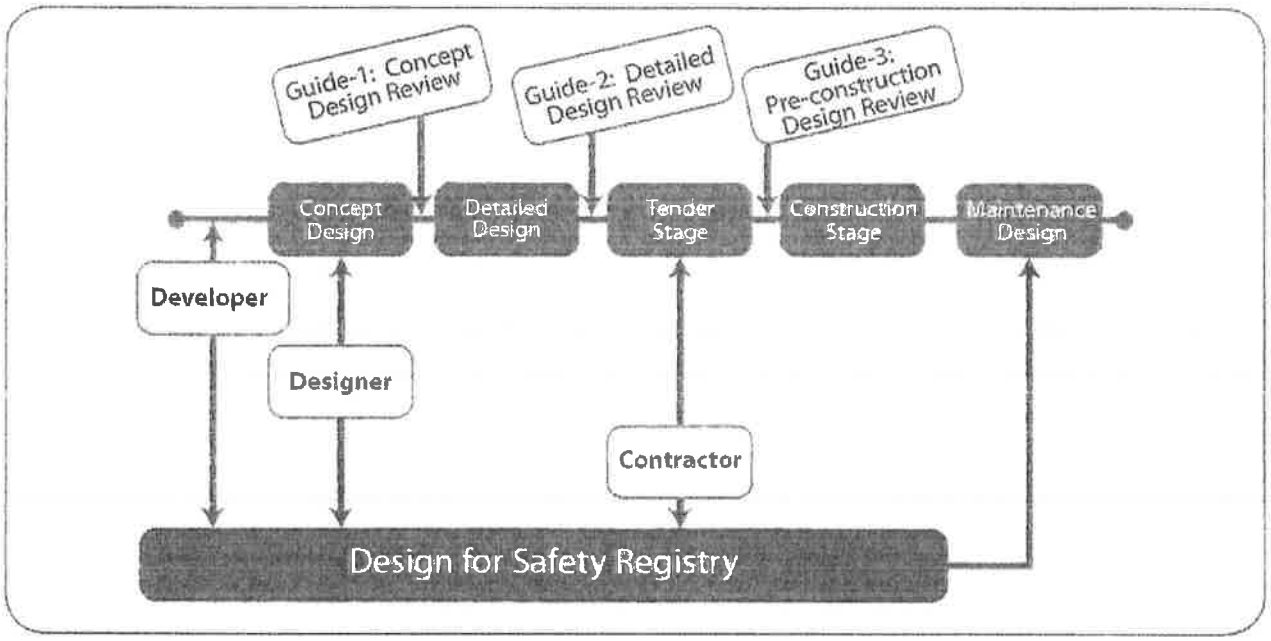


Figure 1: The GUIDE Process for typical contracts.

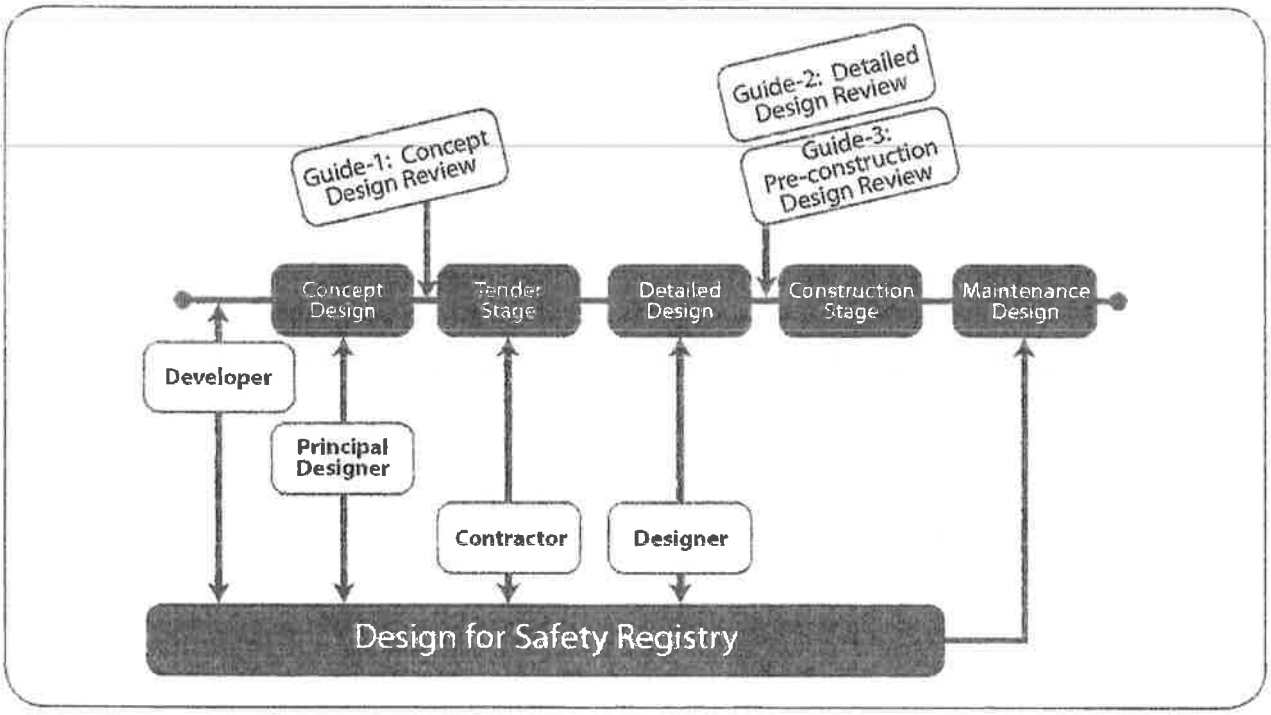


Figure 2: The GUIDE Process for D&B contracts.

6.3 Key Focus for GUIDE

The key aspects to be covered, when doing GUIDE, are suggested (but not limited) as follows:

- General design concept
- Accessibility
- Confined space
- Emergency
- Lighting
- Excavation
- Fall prevention
- Working platforms
- Hoisting or weight
- Layout
- Maintenance
- Material handling or storage
- Means or methods
- Operation
- Physical hazards
- Sequence of construction
- Standardisation of building elements
- Weather

Sample topics that can be discussed during GUIDE-1, GUIDE-2 and GUIDE-3 can be found below. Risks highlighted during the GUIDE process should be singled out and addressed in the DfS Register.

Residual risks should be highlighted to the Contractor so that they will be dealt with. The project team should note that the lists for GUIDE-1, GUIDE-2 and GUIDE-3 are references and there may be topics that are not in the lists but are specific to the project itself. The project team should therefore consider other safety and health risks that could exist as a result of the design.

6.4 Sample GUIDE-1: Concept Design Review

The purpose of GUIDE-1 is to review the conceptual design and identify critical risks associated with the use, construction, maintenance (including cleaning and repair), alterations, additions, decommissioning and demolition of a building or structure.

By identifying and understanding the risks very early at the start of the project, risk controls can be established to ensure that these risks are managed either by eliminating or controlling them.

GUIDE-1 typically addresses the following:

Site feasibility analysis

- Impact on site or development by existing surroundings
- Impact on site or development by environmental factors
- Impact of site or development on surroundings or passersby
- Existing site conditions
- Conceptual or schematic site planning—constraints and opportunities
- Feasibility of construction operations and site management
- Adjacent structures
- Ground or soil conditions

Sometimes, risks identified in GUIDE-1 can only be addressed later in the project when more details are known. However, highlighting risks at this stage will aid the Designer to understand the feasibility and the hazards associated with the project. The Designer may be well-informed but not equipped with WSH knowledge. As such, GUIDE-1 should be done by all the main stakeholders and not just by the Designer alone. The contribution of different stakeholders will help to ensure that safety at every stage and level is examined and discussed.

The primary concerns of GUIDE-1 will be on safety issues related to:

- the generic type (or nature) of the proposed development; and
- the location of the project (i.e., analysis of potential sites to determine the selection of an appropriate site). Analysis of location will include several major considerations such as soil assessment, the public, traffic, existing services and placement of major machines. GUIDE-1 will examine issues associated and highlight risks and hazards arising from the location of the project.

To aid the GUIDE-1 Design Review Team, the following questions can be used. While the questions highlight important issues, they are not comprehensive and serve only as references for the team. As such, the team should have a brainstorming session to raise and highlight hazards and concerns of the main stakeholders.

Considerations		Details or Hazards Identified
Soil	Has the soil profile of the proposed project's site been studied by Qualified Persons (QPs)? Are there buildings or structures that may have shallow foundation in the vicinity of the proposed project? Will the groundwater table be lowered as a result of the proposed construction? Will there be possible settlement due to the proposed project? Are there preventive measures to ensure that settlement is minimal?	
Public	Will the commencement of the project affect the public? Will the commencement of the project affect traffic?	
Services	Are there underground services in the site that need to be removed or relocated for the project? Will the removal or relocation of these services, if any, be a hazard to workers or the public?	

Others	Are there special features that require special arrangements during construction? Can the method of construction or sequence be identified at present? Are there hazards associated with the method of construction or sequence that can be dealt with at present? Are there special features such as facade, roof and skyrise greenery features that require special arrangements during maintenance? Are there any foreseeable hazards that can be identified and eliminated?

After hazards are identified from answering these questions, significant hazards should then be transferred to a Design Risk Record Form. The Design Review Team should then agree on the stakeholder to address the hazards. A follow-up review should be done to ensure that the hazards are addressed and not merely filed away. Other considerations by the review team or actions taken to mitigate the risks should be documented in the Design Risk Record Form to ensure that all relevant information is recorded.

Unless results from applying GUIDE-1 at conceptual design stage indicate that a redesign or relocation of the project is required, risks identified under GUIDE-1 can usually be addressed during GUIDE-2 design stage. As such, GUIDE-1 is usually performed once.

Design issues highlighted in GUIDE-1 should be addressed by the Designer when he or she is doing the detailed design. GUIDE-2 will hence be an exercise to identify risks and ensure that risks raised in GUIDE-1 are eliminated or mitigated.

6.5 Sample GUIDE-2: Detailed Design Review

GUIDE-2 serves to assist the Designer to review a building's or structure's design progressively as it develops. Although building or structure design is often done by Consultant Designers on behalf of the Client, designs can also be done on a D&B basis by a Contractor. Parts of the building or structure can also be designed by the Contractor's Specialist Contractors or other Designers.

GUIDE-2 typically addresses the following:

Schematic or Development Control (DC)* planning design

- Impact on site or development by existing surroundings
- Impact on site or development by environmental factors
- Impact of site or development on surroundings or passersby
- Existing site conditions

- Conceptual or schematic site planning—constraints and opportunities
- Feasibility of construction operations and site management
- Design of permanent works—layouts, configurations, relationships and spatial use or function

Developed or Building Plan (BP) design

- Adjacent structures
- Ground or soil conditions
- Design of permanent works:
  - Site formation:
    i. earthworks
  - Underground services
  - Sub-structure:
    i. foundation and footings
    ii. excavation
    iii. basement
  - Building super-structure and external structures
  - Building envelope
  - Internal and external assemblies, systems and plant (mechanical and electrical [M&E] and architectural):
    i. M&E plant or major equipment
    ii. architectural systems or assemblies
    iii. M&E systems
- General design function

Developed, BP design and/or construction or contract

- Design of permanent works:
  - Materials, fixtures and detailing:
    i. architectural fixtures
    ii. M&E fixtures
    iii. materials
    iv. furniture, fittings and equipment

Note:

Development Control (DC) is a type of planning application submitted to regulatory authorities such as URA, LTA, NParks, and CBPU (NEA & PUB). DC plans usually use schematic design to format drawings for submission.

Building Plan (BP) is a type of technical application submitted to regulatory authorities such as BCA, FSSD, LTA, NParks, and CBPU (NEA & PUB). BP plans usually use developed design to format drawings for submission.

While GUIDE-2 identifies and addresses hazards as they emerge from the deve
design, the issues raised during GUIDE-1 should also be reviewed and resolved a

GUIDE-2 should be done by all the main stakeholders and not just the Designer in isolation. It
important that proper documentation is done so that relevant information are passed on and recorded in the DfS Risk Register.

To aid the GUIDE-2 Design Review Team, the following questions can be used. While the questions highlight important issues, they are not comprehensive and serve only as references for the team. As such, the team should have brainstorming sessions to identify hazards and concerns of the main stakeholders.

	Considerations	Details or Hazards Identified
Prefabrication	• Can elements such as steel structures be prefabricated, assembled on ground and then lifted to position for installation? • Can the cutting of steel members be done off-site, under controlled conditions to reduce the dust created? • Can site welding be minimised to reduce fire or burn risks? • Can prefabricated nuts and bolts used as connections? • Can prefabricated elements be provided with designed lifting points, and the weight and centre-of-gravity marked on the drawings and prefabricated items? • If the prefabricated structure is required to be temporarily suspended for a period of time before final installation, are there means to ensure the hazards arising this are removed? • Can joints in vertical steel structure members be designed such that bolting can be done on the ground? • Can connections be designed to minimise risk of incorrect assembly (e.g., unique bolt layout for each connection)? • Can clear instructions provided on drawings? • Can the Designer verify if site conditions allow for lifting cranes to be positioned safely before deciding on prefabrication as the method of construction?	

Heavy Lifting	• Consider the work process and equipment required for heavy lifting. Can the position for parking these equipment be finalised and cordoned off? • Does the lifting equipment need a customised foundation to minimise settlement and failure of support? • Consider the worst case scenario. Can this scenario be prevented or managed to minimise injuries?	
Falling from Heights	• Can the need to work at heights be removed? For example, removing the need to work at heights when a safe means of access cannot be provided. • Can fragile roofing materials be removed or can an alternative access route to the roof (e.g., a work platform) be designed? • Can an early installation of permanent access (e.g., stairs) reduce the use of ladders or scaffolds? • Can edge protection or other features which allow safe access and construction be designed and installed? • Can anchor points for installation of life-line or safety harnesses be mounted where work platforms cannot be installed? • Can floor openings, if any, be minimised?	
Temporary Works and Sequencing	• Can a safer means of access or egress, instead of temporary means, be used? • Can the permanent staircase and lifts be completed first so that they can be used during the construction stage? • Will the design affect the work process during construction? • Can temporary works required during construction be planned for earlier? For example, specifying the type and position of temporary works required to ensure that spatial considerations are taken into the account during the design stage. • Are there special construction considerations that need to be highlighted to the Contractor?	

	• Does the sequence of construction create any temporary unstable working platform that requires additional bracing? • Can adequate safety factors be incorporated in the design so that overloading or collapse of the permanent or temporary structure is prevented?	
Layout	• Can the layout be optimised to prevent any accidents arising from the flow of traffic, pedestrian, equipment, and so on within and around the site during the construction stage? • Consider the flow of traffic, pedestrian, equipment within and around the site during the permanent stage. • Can the layout be optimised to prevent accidents? • Is there a need to designate specific material, equipment, vehicle and human traffic flow diagram?	
Confined Space	• Does the design create confined space in the permanent or temporary stage? • Can the confined space be removed from the design? • Can the need to enter the confined space be minimised by removing vital equipment or controls out of the confined space?	
Access for Maintenance (see Annex 8: Maintenance Strategy Report)	• Does the provision of access take into account the safe and efficient movement of maintenance workers and the tools and equipment needed to carry out maintenance work? • Can temporary means of access (e.g., scaffolding, makeshift ladder, etc.) be eliminated by providing workers with permanent safe access to areas requiring regular maintenance? • Does the design incorporate permanent safety lines, anchorage and hoisting points into structures for maintenance work that need to be carried out at height?	

	• Can durable materials that require lower frequency of maintenance be used (e.g., powder-coated aluminium materials versus mild steel materials that require regular repainting)? • Can the maintenance work be carried out at ground level in a safe and productive manner? For example, locating air-conditioning units at ground level, locating luminaires within reachable height. • Does the design create low headroom that reduce the safety and efficiency of workers carrying out the maintenance work? • Does the design minimise the need for maintenance workers to enter ducts and crawlspaces? • Does the design minimise the need for the deconstruction of bulkheads, claddings, casings, and so on, during routine inspection and maintenance? • Does the design allow sufficient space for vehicles (e.g., cranes, cherry-pickers) to operate safely and efficiently during maintenance and operation of the building? • Does the design allow for sufficient working space in M&E rooms and around M&E equipment for inspection, maintenance, repair and replacement of equipment? • Does the design provide maintenance access at every level if there are vertical greenery systems that span a few storeys?	
Emergency Route	• Is the emergency route for the temporary and permanent stages the shortest and most direct? • Are there adequate lighting, directions, warning and backup power for mass evacuation of people along the emergency routes?	

Heaith Hazards	• Can less hazardous materials be used (e.g., solvent-free or low solvent adhesives and water-based paints? • Can materials that can create significant fire risk be removed? • Can processes that create hazardous fumes, vapours, dust, noise or vibration be avoided? Examples of such process include disturbing existing asbestos, cutting chases in brickwork and concrete, breaking down cast-in-situ piles to level, scrabbling concrete, hand-digging tunnels, flame-cutting or sanding areas coated with lead paint or cadmium.	
Weather	• Is there a possibility of floods happening in the site? If so, how can the hazards be minimised in the temporary and permanent stages? • Is there a possibility of lightning strike happening in the site? If so, how can the hazards be minimised in the temporary and permanent stages? • Are there other adverse weather conditions that can affect workers' safety and health on site? • What are the effects of extreme temperature or humidity on instrumentation?	
Others	• Are there other major hazards that need to be dealt with? • Can sources of substantial stored energy, such as pre- or post-tension cables, be specified in the drawings and highlighted for future demolition? • Can alterations that have significantly changed the building or structure be highlighted? • Can disruptions to existing utilities within occupied buildings be avoided?	

After hazards are identified from answering these questions, identified hazards should then be transferred to a Design Risk Record Form. The Design Review Team should then agree on the party to address the hazards. A follow-up review should be done to ensure that the hazards are addressed and not merely filed away. Other considerations by the review team or actions taken to mitigate the risks should be documented in the Design Risk Record Form to ensure that all relevant information is recorded.

Design issues highlighted in GUIDE-1 should be addressed by the Designer when he or she is doing the detailed design. GUIDE-2 will hence be a session to identify new hazards and making sure that hazards raised in GUIDE-1 are eliminated or mitigated.

6.6 Sample GUIDE-3: Pre-construction Review

Temporary works designs are part of the scope of works in construction contracts, but sometimes temporary works are designed by Consultants on behalf of their clients.

GUIDE-3 aims to provide the Design Review Team with a tool to identify and address risks associated with temporary works design.

GUIDE-3 typically addresses the following:

Employer or consultant design

- Prescription or specification of site arrangements, facilities and scheduling requirements
- Prescription or specification of interim works for construction of permanent works

Contractor design

- Interim works for site arrangements and facilities
- Interim works for construction of permanent works

Along with the main stakeholders involved in GUIDE-1 and GUIDE-2, the Contractor and his or her appointed Designers should be part of GUIDE-3 Process Design Review Team. Similar to GUIDE-2, it is important that proper documentation is done so that relevant information is passed on and recorded in the DfS Risk Register.

To aid the GUIDE-3 Design Review Team, the following questions can be used. While the questions highlight important issues, they are not comprehensive and serve only as references for the team. As such, the team should have brainstorming sessions to identify hazards and concerns of the main stakeholders.

	Considerations	Details or Hazards Identified
Temporary Works and Sequencing	• Can a safer means of access or egress, instead of the temporary means, be used? • Can monitoring instrumentation that provides early warning of possible collapse or ground movements be installed?	

	• Can the permanent staircase and lifts be completed first so that they can be used during the construction stage? • Will the design affect the work process during construction? • Can temporary works required during construction be planned for earlier? For example, specifying the type and position of temporary works required to ensure that spatial considerations are taken into the account during the design stage. • Are there special construction considerations that need to be highlighted to the Contractor? • Does the sequence of construction create temporary unstable stage that requires additional bracing? • Can adequate safety factors be incorporated in the design so that overloading or collapse of the permanent or temporary structure is prevented? • Will there be possible basal heave and piping during excavation? • Will there be settlement due to the proposed project? • Has a proper schedule for monitoring of instrumentation been provided? • Will there be adverse effects on adjacent structures during the removal of temporary works? • Are there alternatives or measures that could reduce or minimise such adverse effects?	
Specialist Design	• Are there safety concerns on elements of specialist design to be considered by the Contractor? • Can alternative safe work practices be used to mitigate such concerns?	
Weather	• Is there a possibility of floods happening in the site? If so, how can the hazards be minimised in the temporary and permanent stages? • Is there a possibility of lightning strike happening in the site? If so, how can the hazards be minimised in the temporary and permanent stages?	

	• Are there other adverse weather conditions that can affect workers' safety and health on site? • What are the effects of extreme temperature or humidity on instruments?	
Others	• Have the risks and hazards identified in GUIDE-1 and GUIDE-2 been addressed or mitigated?	

After hazards are identified from answering these questions, identified hazards should then be transferred to a Design Risk Record Form. The Review Team should then agree on the party to address the hazards. A follow-up review should be done to ensure that the hazards are addressed and not merely filed away. Other considerations by the review team or actions taken to mitigate the risks should be documented in the Design Risk Record form so that all relevant information is recorded.

Note:

DfS Regulations only require documentation and/or highlighting of residual risks that would be encountered by someone downstream during the building's or structure's lifecycle. The stakeholders can decide if they want to keep design risk records on hazards that had been eliminated or mitigated.

Aside from going through the GUIDE-3 Process, further Design Review sessions should be held to ensure that risks identified in GUIDE-1 and GUIDE-2 are eliminated or mitigated.

Example of Safety and Health Risk Assessment Form

Project title

Company:

Review: Conducted by:

Review data:

Next review data:

Process / Location:

related

S/No.	Design consideration	Risks / Risk	Hazards identified / Impact	Risk assessment			Can these hazards be designed out?	Proposed control measures	Residual risk level			Further review required	Action by
				Severity	Likelihood	Risk level			Severity	Likelihood	Risk level		

Note: This design risk record form is a sample. Other formats may be used if deem suitable.

7. Annex

Annex 1: Definition of "Development" under Section 3(1) of Planning Act

Planning Act (Chapter 232)
Meaning of "Development"

(1) Subject to subsections (2) and (3), in this Act, except where the context otherwise requires, "development" means the carrying out of any building, engineering, mining, earthworks or other operations in, on, over or under land, or the making of any material change in the use of any building or land, and "develop" and "developing" shall be construed accordingly.

(2) The following operations or uses of land shall not be deemed for the purposes of this Act to involve development of land:

- the carrying out of works for the maintenance, improvement or other alteration of a building which do not materially affect the external appearance or the floor area of the building;
- the carrying out of such minor or preliminary works and such temporary use of land as may be declared by the competent authority for the purpose of this subsection;
- the carrying out by any statutory authority of any works on land within the boundaries of a street, being works which are necessary for the maintenance or improvement of the street;
- the carrying out by any statutory authority of any works for the purpose of laying, inspecting, repairing or renewing any sewers, mains, pipes, cables or other apparatus, including the breaking open of any street or other land for that purpose;
- the carrying out of any act authorised or required by the Control of Vectors and Pesticides Act 1998 (Act 24 of 1998);
- the use of any existing building or land within the curtilage of a dwelling-house for any purpose incidental to the enjoyment of the dwelling-house as such;
- the use of any land for the purposes of agriculture or forestry (including afforestation) and the use for any of those purposes of any building occupied together with land so used; and
- in the case of buildings or land which are used for a purpose of any class specified in any rules made under section 61, the use of the building or land or any part thereof for any other purpose within the same class.

(3) For the avoidance of doubt, it is hereby declared that for the purposes of this section—

- the use as 2 or more separate houses of any building previously used as a single house involves a material change in the use of the building and of each part thereof which is so used;

- the use as a dwelling-house of any building not originally constructed for human habitation involves a material change in the use of the building;
- the use for other purposes of a building or part of a building originally constructed as a dwelling-house involves a material change in the use of the building;
- the demolition or reconstruction of or addition to a building constitutes development;
- the use for the display of advertisements of any external part of a building which is not normally used for that purpose involves a material change in the use of the building;
- the deposit of refuse or waste materials on land involves a material change in the use thereof notwithstanding that the land is comprised in a site already used for that purpose, if
  - the superficial area of the deposit is extended; or
  - the height of the deposit is extended and exceeds the level of the land adjoining the site;
- subject to subsection (2)(h), the use of any building or part thereof for any purpose other than that for which the building was originally constructed involves a material change in the use of the building;
- any decorative, painting, renovation or building works, whether external or internal, to or on a monument in respect of which there is in force a preservation order under the Preservation of Monuments Act 2009 shall constitute building operations; and
- the use and operation as 2 or more separate entities of any building or buildings or part of a building which is or are approved or authorised to be used and operated as one single entity for any of the uses specified in the Second Schedule involves a material change in the use of the building or buildings or part of the building.

Annex 2: Summary of Duties under the WSH (DfS) Regulations

The table below shows duties of various stakeholders under the WSH (DfS) Regulations.

Stakeholders	Duties
Developers	**General duties** • Ensure that all foreseeable design risks are eliminated if reasonably practicable. • Where not reasonably practicable to eliminate foreseeable design risks, Developer shall ensure that the design risks are reduced to as low as reasonably practicable. • When reducing risks, design risks shall be reduced at its source and collective protective measures shall be used instead of individual protective ones. • Ensure that all Designers, Contractors and DfS Professionals appointed are competent to perform their duties. • Plan and manage the project such that all appointed Designers and Contractors have sufficient time and resources to perform their duties. • Provide relevant information to all appointed Designers and Contractors. **DfS Review Meeting** • Convene DfS review meetings to identify all foreseeable design risks and discuss how each foreseeable design risk can be eliminated or reduced where it is not reasonable practicable to eliminate. • Ensure that the DfS review meetings are attended by all relevant Designers and Contractors. **Maintaining a DfS Register** • Keep a DfS Register containing information and records on all DfS review meetings and every residual design risk for the project. • Ensure that the DfS Register is up-to-date. • Ensure that all appointed Designers and Contractors for the project have access to the DfS Register. • Ensure that the DfS Register is available for inspection by registered workplace inspectors.

	Delegation of Developer's Duties to DfS Professional • Developer may delegate the following duties to a DfS Professional: – convening DfS review meetings; and – maintaining a DfS Register. • The Developer must provide a DfS Professional with information necessary for him or her to perform his or her duties. **Passing on the DfS Register** • If Developer disposes his or her interests in the structure, ensure that the DfS Register is given to the person who acquires his or her interests in the project. The Developer is then responsible for informing him or her the nature and purpose of the DfS Register. • For subdivided buildings, ensure that the Register is given to the subsidiary management corporation of the subdivided building. The Developer must inform them the nature and purpose of the DfS Register.
DfS Professional	**DfS Review Meetings** • Convene DfS review meetings to identify foreseeable design risks and discuss how each foreseeable design risks can be eliminated or reduced. • Ensure that DfS review meetings are attended by relevant Designers and Contractors. **Maintaining a DfS Register** • Keep a DfS Register containing information and records on all DfS review meetings and every residual design risk for the project. • Ensure that the DfS Register is up-to-date. • Ensure that all appointed Designers and Contractors for the project have access to the DfS Register. • Ensure that the DfS Register is available for inspection by registered workplace inspectors. **Updating the Developer** • Ensure that the Developer is provided, as soon as practicable after DfS review meetings, with relevant information on all foreseeable design risks identified and how they can be eliminated or reduced. • Provide the Developer with the updated DfS Register after new information or record is added.

Designers and Delegated Designers	• Prepare a design plan that eliminates, as far as reasonably practicable, all foreseeable design risks. • Where not reasonably practicable to eliminate foreseeable design risks, propose to the person who appointed him or her, a modification to the design plan that would reduce design risks to as low as reasonably practicable. • When reducing risks, design risks shall be reduced at its source and collective protective measures shall be used instead of individual protective ones. • Provide information relevant to the design, construction or maintenance of the structure to the person who appointed the Designer. • Attend and participate in DfS Review Meetings when required by the Developer. • Ensure that any appointed Designer (called Delegated Designer) is competent to perform his or her duties under the Regulations. • Ensure that Delegated Designers are provided with relevant information. • A Designer is still responsible for his or her duties even if a Delegated Designer is appointed.
Contractors (Main Contractors and Subcontractors)	• Inform the person who appointed the Contractor of any foreseeable design risk. • Ensure that any Designer he or she appoints is competent. • Ensure that any Designer he or she engages is provided with relevant information to assist him or her with his or her duties. • Ensure that any subcontractor he or she engages is competent. • Ensure that any subcontractor he or she engages is provided with relevant information to assist him or her with his or her duties. • Attend and participate in DfS Review Meetings when required by the Developer.
Registered Proprietors	• For a structure that is not a subdivided building, keep the DfS Register. • For a structure that is not a subdivided building, ensure that the DfS Register is available for inspection upon inspectors' request.

	• Provide the DfS Register to the person who next acquires the interest in the structure. • Ensure that the person who acquires the interest in the structure is aware of the nature and purpose of the DfS Register.
Subsidiary Management Corporations (For a subdivided building)	• Keep the DfS Register. • Ensure that DfS Register is available for inspection upon inspectors' request.

Aside from complying with the duties stated in the WSH (DfS) Regulations, the duty holders are required to comply with the WSH Act and its other subsidiary legislation. See Annex 3 for a list of the subsidiary legislation.

Annex 3: List of WSH Legislation

Workplace Safety and Health (WSH) Act

WSH (Workplace Safety and Health Officers) Regulations

WSH (General Provisions) Regulations

WSH (Construction) Regulations 2007

WSH (First Aid) Regulations

WSH (Incident Reporting) Regulations

WSH (Risk Management) Regulations

WSH (Registration of Factories) Regulations 2008

WSH (Workplace Safety and Health Committees) Regulations 2008

WSH (Abrasive Blasting) Regulations 2008

WSH (Explosive Powered Tools) Regulations 2009

WSH (Confined Spaces) Regulations 2009

WSH (Safety and Health Management System and Auditing) Regulations 2009

WSH (Noise) Regulation 2011

WSH (Medical Examinations) Regulations 2011

WSH (Operation of Cranes) Regulations 2011

WSH (Scaffold) Regulations 2011

WSH (Work at Heights) Regulations 2013

WSH (Asbestos) Regulations 2014

Annex 4: List of Design Works

Civil and Geotechnical Works

Design inputs include drawings, design details, analysis, calculations, specifications and bills of quantities, terminology, definitions, classification and use of materials, products, their performance requirements, methods of tests, and good practices in the area of civil and geotechnical works such as in the area of reclamation and earthworks, foundation, roadwork, drainage and sewerage system, bridges and land surveying.

Building Structure and Substructure

Design inputs include drawings, design details, analysis, calculations, specifications and bills of quantities, terminology, definitions, classification and use of materials, their performance requirements, methods of tests and good practices in building structure and substructure, including reinforced concrete, steel and composite steel, pre-cast and pre-stressed, and tall building structures.

Building (Mechanical and Electrical) Services

Design inputs include drawings, design details, analysis, calculations, specifications and bills of quantities, terminology, definitions, classification and use of materials, products, their performance requirements, methods of tests, and good practices pertaining to the design, installation, maintenance, testing and commissioning of mechanical and electrical, plumbing and sanitary services in a building.

Architectural Works

Design inputs include drawings, design details, analysis, calculations, specifications and bills of quantities, terminology, definitions, classification and use of materials, products, their performance requirements, methods of tests, and good practices in the area of architecture works encompassing building components such as roof work, facade, door, wall and floor finishes, paints and vanish and landscaping including skyrise greenery.

Construction Management and Demolition Works

Design inputs include drawings, design details, analysis, calculations, specifications and bills of quantities, terminology, definitions, classification and use of materials, products, their performance requirements, methods of tests, and good practices including effective management techniques pertaining to the construction of a project from inception to completion.

Facilities Management and Addition and Alternation Works

Design inputs include drawings, design details, analysis, calculations, specifications and bills of quantities, terminology, definitions, classification and use of materials, products, their performance requirements, methods of tests, and good practices pertaining to maintenance and repair, energy conservation, indoor air quality and upgrading of building.

Fire Protection Provision and Maintenance

Design inputs include drawings, design details, analysis, calculations, specifications and bills of quantities, terminology, definitions, classification and use of materials, products, their

performance requirements, methods of tests, and good practices pertaining to the design, installation, maintenance, testing and commissioning of both active and passive fire protection provision and maintenance. Active Fire Protection (AFP) includes fire suppression system, sprinkler systems, fire detection and alarms system, and smoke and heat extraction and ventilation system. Passive Fire Protection (PFP) includes compartmentalisation of the overall building through the use of fire-resistance rated walls and floors, compartmentalisation, fire dampers and fire door closers, as well as intumescent fire protection coatings, and so on.

Annex 5: List of Typical Designers

With the whole scheme of works mentioned in Annex 4, Designers include:

1. Architects, civil, geotechnical and structural engineers, building designers, engineers, fire safety engineers, interior designers, landscape architects, town planners and all other design practitioners contributing to, or having overall responsibility for, any part of the design (e.g., drainage engineers designing the drain for a new development) building service designers, engineering firms or others designing services that are part of the structure such as ventilation, electrical systems and permanent fire extinguisher installations;

2. Anyone who specifies or alters a design, or who specifies the use of a particular method of work or material, such as a design manager, quantity surveyor who insists on specific material or a client who stipulates a particular layout for a new building;

3. Building service designers, engineering practices or others designing plant which forms part of the permanent structure (including lifts, heating, ventilation and electrical systems), for example, a specialist provider of permanent fire extinguishing installations;

4. Those purchasing materials where the choice has been left open, for example, those purchasing building blocks and so deciding the weights that bricklayers must handle;

5. Contractors carrying out design work as part of their contribution to a project (e.g., an engineering contractor providing design, procurement and construction management services);

6. Temporary works engineers, including those designing formwork, falsework, scaffolding and sheet piling, curtain wall and facade retention schemes, scaffolding, and sheet piling; and

7. Interior designers, including shop fitters who also develop the design.

Annex 6: Areas which Designer has Influence Over

To aid Designers to carry out the GUIDE process, this section identifies some areas the Designer has direct influence. Designers should note that the list is not exhaustive, nor is every item relevant to every project. Items that the Designer should note are:

1. The design of buildings or structures should consider risks from site hazards such as:
   - underground services;
   - vehicle traffic movement to and within the site;
   - pedestrian movement within and around the site; and
   - condition and proximity of adjacent buildings.

2. Health hazards should be designed out by:
   - Specifying less hazardous materials (e.g., solvent-free or low solvent adhesives and water-based paints);
   - Avoiding processes that create hazardous fumes, vapours, dust, noise or vibration, including disturbance of existing asbestos, cutting chases in brickwork and concrete, breaking down cast-in-situ piles to level, scabbling concrete, manual digging of tunnels, flame cutting or sanding areas coated with lead paint or cadmium; and
   - Specifying materials that are easier to handle, (e.g., lightweight building blocks, limiting the weight of formwork for easier handling).

3. Safety hazards should be designed out by:
   - Removing the need to work at heights wherever possible, particularly where it requires work from ladders or where safe means of access cannot be provided;
   - Removing fragile roofing materials or designing access route to the roof (e.g., a working platform);
   - Eliminating deep or long excavations in public areas or on highways; and
   - Eliminating materials that could create a significant fire risk during construction.

4. Consider prefabrication to minimise hazardous work on site, for example:
   - Incorporating design elements like steel structures that be prefabricated and assembled on ground and then safely lifted for installation;
   - Specifying cutting of steel members to be done off-site, under controlled conditions, to reduce the amount of dust created; and
   - Minimise site welding to reduce fire or burn risks and using prefabricated bolts and nuts as connections.

5. Features that reduce or eliminate the risk of falling should be introduced where it is not possible to remove the need to work at heights:
   - Early installation of permanent access (e.g., stairs) to reduce the use of ladders or scaffolds;
   - Edge protection or other features that increase safe access and construction; and

- Anchor points for installation of life-lines or safety harnesses when work platforms cannot be installed.

6. Design to simplify safe construction by:
   - Providing lifting points on prefabricated elements and marking the weight and centre of gravity of heavy or bulky items on drawings and on prefabricated items;
   - Making provision for temporary works required during construction;
   - Designing joints in vertical steel structure members such that bolting can be easily done by someone standing on the floor using seating angles to provide support while bolting is being done;
   - Designing connections to minimise risk of incorrect assembly and clear directions on drawings on how to do so; and
   - Designing for safe installation of external cladding (e.g., installation of cladding from the inside of the building).

7. Identify worst case scenarios and implement preventive control measures, such as:
   - Designing adequate safety factors so that overloading (static, dynamic and impact) and collapse of permanent or temporary structure are not possible;
   - Putting in place monitoring instruments to provide early warning of possible collapse or ground movements; and
   - Emergency route for mass evacuation in the event of emergency.

8. Design to ease future inspections, maintenance and cleaning work by:
   - Making provision for safe permanent access, including to roofs and M&E spaces;
   - Making provision for safe temporary access to allow for painting and maintenance of facades, reapplication of fire protection material on steel structures, and so on;
   - Provision of adequate working space in M&E areas;
   - Using paints or materials that require less frequent maintenance or replacement;
   - Designing features on facades that facilitate cleaning from inside, for example, windows, vertical greenery, and so on;
   - Placing all controls and electrical boxes at accessible locations;
   - Considering safe movement of pedestrian and vehicle traffic flow during occupancy.

9. Identify unusual demolition hazards for future plans:
   - Sources of substantial stored energy, such as pre- or post-tension cables;
   - Unusual stability concepts;
   - Alterations that have changed the structure significantly; and
   - Embedded materials, utilities, or artefacts whose exposure or removal may introduce new hazards.

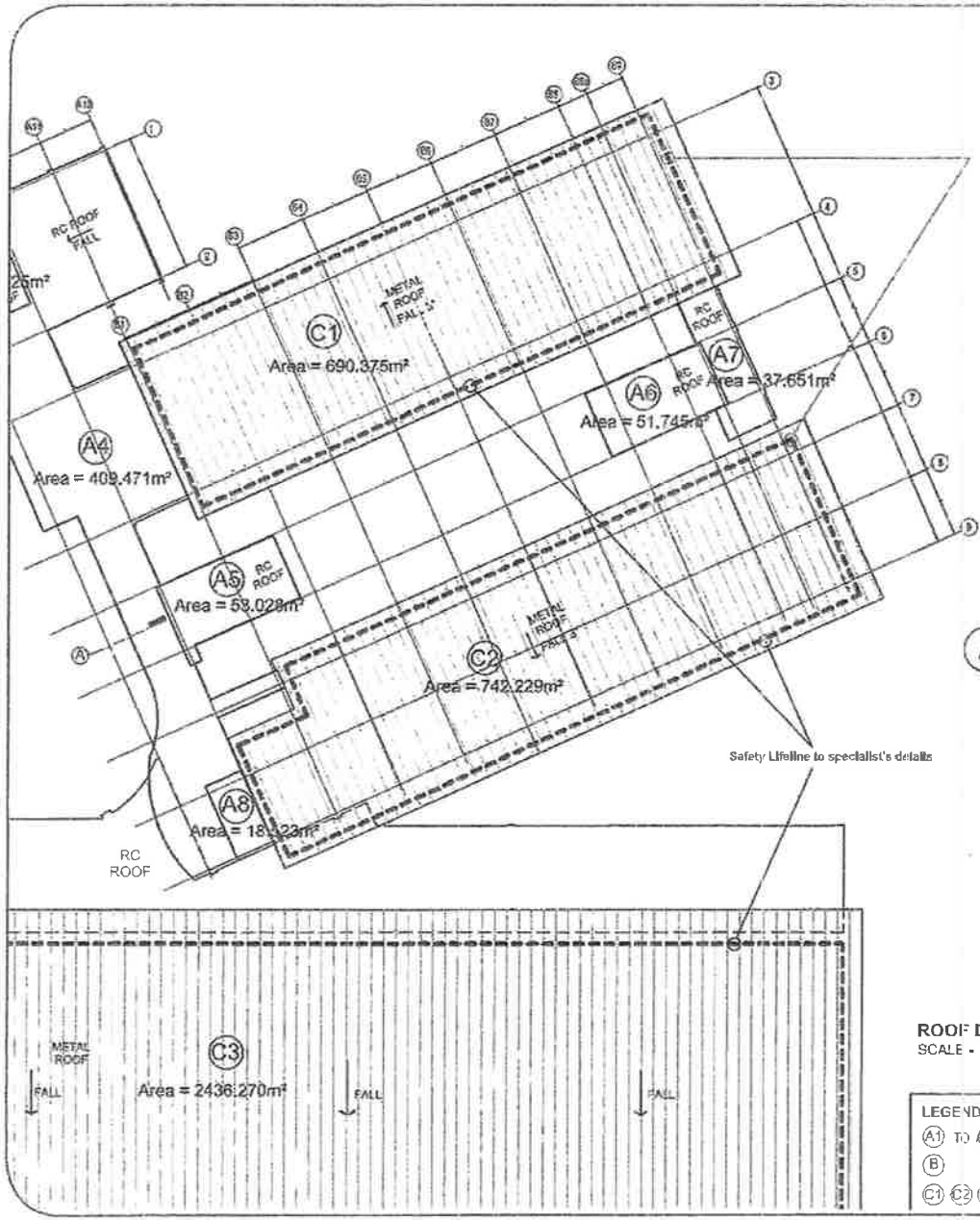
Designers have to note that their creativity should not be limited by the above. Designers need not design out every hazard identified, but they should weigh the risk level of the hazards and as far as reasonably possible, design out the risks either by eliminating the hazards or incorporating control measures to reduce the risks to acceptable levels.

Annex 7: Advisory Notes

It is recommended that effective communication of residual risks is best achieved through "advisory notes". Such advisory notes should appear in the documents the affected person would refer to in the natural course of their work, for example:

- In construction: Advisory notes should be provided in the contract documents (including working drawings and details, specifications, preliminaries, etc). The Contractor should transfer such advisory notes onto shop drawings, method statements, construction planning documents, and so on that would be disseminated to workers on the ground.
- In maintenance: Advisory notes should be provided in the Operations and Maintenance Manual (including as-built drawings) typically provided to building owner upon handover of the building.
- In occupancy (of a building used as a workplace), the advisory notes should be provided in the Standard Operating Procedures that may be provided, if applicable, to building owner upon handover of the building.

An example of an advisory notes on drawings is shown on the next page.



DFS ADVISORY NOTE

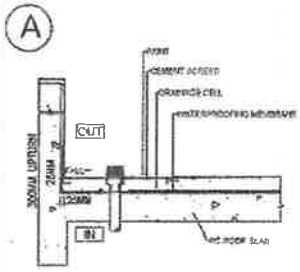
AFFECTED PERSON:
Construction Worker

ACTIVITY:
Working from height

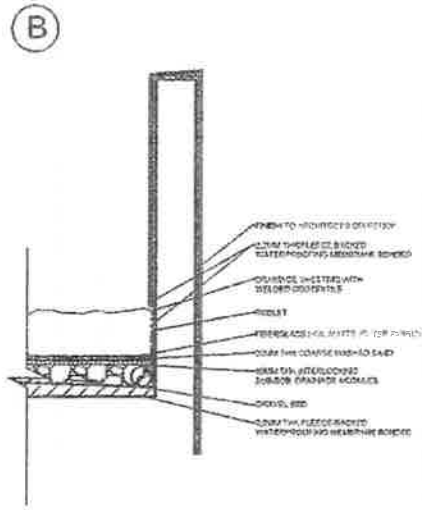
HAZARD:
Unprotected edge at height

DfS Provision:

1. Contractor / Worker to conduct own risk assessment which shall include provision of own safety equipment and procedures.
2. Permanent installation of lifelines should be completed as soon as possible and used during construction.



RC ROOF DETAIL
SCALE - 1:20



ROOF GARDEN DETAIL
SCALE - 1:20

ROOF DETAIL PLAN
SCALE - 1:200

LEGEND

A1 TO A10	RC FLAT ROOF (N/V)
B	ROOF GARDEN (A/C)
C1 C2 C3	METAL SLOPE ROOF (N/V)

Annex 8: Maintenance Strategy Report

During early design processes, Designers should document their proposals and requirements regarding access strategies for maintenance tasks via a Maintenance Strategy Report, which should then be collated into the DfS Register. Designers should identify key features relating to maintenance activities that:

- are carried out in a particular manner;
- affect the health and safety of maintenance workers or building users;
- entail a disciplined approach, for example, in scheduling, coordination and execution.

In developing access strategies and maintenance work methods, Designers should consult relevant people who have specialised knowledge and/or capacity to control or influence the design (e.g., the client, engineers, contractors, facility managers, DfS Professional and products specialists or manufacturers) to identify risks and appropriate solutions.

A typical report should contain sufficient details to inform those undertaking the maintenance tasks. The content of the report should include but not limited to:

- key building features relating to maintenance tasks;
- anticipated maintenance tasks and their frequencies;
- proposed work equipment and methods employed for achieving accessibility and productivity in maintenance; and
- specific safety measures.

An example of Maintenance Strategy Report is shown on the next page.

A. EXTERNAL AREAS

	Building Area/ Element	Routine Maintenance	Major Maintenance	Solution		Comments
1	Tower block: Facade curtain wall • Full height from ground level to roof • All elevations including recesses and protrusions	• Facade cleaning and inspection	• Glass replacement • Curtain wall repairs • Facade lighting repairs	• Routine maintenance • Major maintenance		• Permanent suspended platform with monorail system to access all facade surfaces • Integrated restraints in facade system
2	Tower block: External planters	• Routine inspection and cleaning • Planting, pruning and fertilising	• Plant or soil replacement • Drainage or irrigation repairs	• Routine maintenance • Major maintenance		• Permanent suspended platform with monorail system to access all planters • Integrated restraints in facade system • Protection rail for hanging planters
4	Tower block: Entrance glass canopy • Top and underside including structural element	• Cleaning • Luminaire replacement	• Glass replacement • Building services repair (drainage, electrical, etc)	• Routine maintenance • Major maintenance		• Access using self-propelled access platform • Accessible via paved fire engine access • Fall arrest system provided on surface of canopy
5	Covered walkways	• Cleaning	• Cladding repairs • Building services repair (drainage, electrical, etc)	• Routine maintenance • Major maintenance	C	• Accessible via ground level walkway • Fall arrest system provided on surface of canopies

B. INTERNAL AREAS

	Building Area/ Element	Routine Maintenance	Major Maintenance	Solution		Comments
6	Atrium	• Glass cleaning • Cleaning shading devices • Luminaire replacement	• Glass repair or replacement • Ceiling or shading devices repair • Building services repair	• Routine maintenance • Major maintenance	D	• Personnel lifting hoists for suspended platforms

Legend

Solution A – Suspended platform with monorail system

Solution B – Self-propelled access platform

Solution C – Rope access

Solution D – Personnel lifting hoists or other suitable means

More details on Maintenance Strategy Report can be found in the Design for Maintainability Checklist by the Building and Construction Authority (BCA).

8. Acknowledgement

The Workplace Safety and Health Council and Ministry of Manpower would like to thank the DfS Capability Building Sub-committee for their valuable assistance and involvement for this publication. The Committee include representatives from the following organisations and professional associations in the building and construction industry:

Association of Consulting Engineers Singapore (ACES)

Building and Construction Authority (BCA)

Centre for Public Project Management (CP2M)

Institution of Engineers Singapore (IES)

Ministry of Manpower (MOM)

Real Estate Developers Association of Singapore (REDAS)

Specialists Trade Alliance of Singapore (STAS)

Singapore Institute of Architects (SIA)

Singapore Contractor Association Limited (SCAL)

Workplace Safety and Health (WSH) Council

The Workplace Safety and Health Council would like to thank architects61 Pte. Ltd. for contributing the cover image.