COMPETENCY REQUIREMENTS
Design for Safety for Professionals Course





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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

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
		○ Define scope for DfS Review Meetings ○ Define roles and responsibilities of persons involved in the DfS 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 DfS Review Meetings ○ Determine the method of documentation of the DfS Review Meetings ○ Schedule DfS Review Meetings sessions ○ Make logistic arrangements for the review
PC1.4	UK1.6 DfS Review Meeting	Process of DfS Review Meetings, which include: ○ G – Group together a review team consisting of major stakeholders. ○ U – Understand the full design concept ○ I – Identify the risks that arise as a result of the design or construction method ○ D – Design around the risks identified to eliminate or to mitigate the risks. ○ 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: ○ GUIDE 1: Concept Design Review ○ GUIDE 2: Detailed Design, Maintenance and Repair Review ○ GUIDE 3: Pre-Construction Review
PC1.5	UK1.8 Coordinate DfS Review Meetings	Coordinate DfS Review Meetings, which may include and not limited to: ○ Guide Safety and Health Review Committee to keep discussion focused and on track ○ Encourage stakeholders involvement and cooperation in the review ○ Assist in identifying risks and highlighting the hazards concerned ○ Assist in identifying control measures for risk that cannot be eliminated ○ 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 o Simulated facilitation of DfS Review Meetings in class Products and Outcomes o Records of GUIDE processes o Updated DfS register Verbal and /or Written Reports o Relate the importance of design for safety and health of a construction project o Describe the key requirements of the legal requirements on risk management o List the duties and responsibilities of DfS Professionals o Describe the duties and responsibilities of Developers, designers and contractors of a construction project o Explain the necessary actions required in preparation of a DfS Review Meeting o 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

Course Content

Day 1

Time	Duration	Trainer's Key Presentation Points	Trainer's Key Activities
09:00 – 09:30	15 minutes	Introduction, overall objectives and content of the course PPT No.: 1-16 Learner Guide: Pg 4-6	Introduction. Give out attendance sheet and ensure names are legible. Introduce the followings: • Learning outcome • Assumed skills and knowledge of Learners • Pre-reading requirements • Assessment requirements.
09:30 – 10.00	30 minutes	Overview of WSH (DfS) Regulations, ACOP for DfS, DfS Professionals and their roles Importance of Design for Review Legal and Statutory Requirements PPT No.: 17-29 Learner Guide Pg: 7-15	Highlight the importance of DfS for construction, reference to CDM Introduction to legal and statutory requirements

Time	Duration	Trainer's Key Presentation Points	Trainer's Key Activities
10:00 – 10:15	15 minutes	Tea Break	
10:15 – 11:00	45 minutes	Legal and Statutory Requirements PPT No.: 30-41 Learner Guide Pg: 16-24	Introduction to: • WSH Act • WSH (DfS) Regulations • WSH (Risk Management) Regulations • Legal and Other Requirements
11:00 – 12:00	60 minutes	Basic concepts in WSH Risk Assessment PPT No.: 42-66 Learner Guide Pg: 25-35	Introduction to basic concepts in WSH Risk Assessment: • Risk Management Process • Hazard identification, risk evaluation and risk control • Hierarchy of Control
12:00 – 13:00	60 minutes	Lunch Break	
13:00 – 13:20	20 minutes	Duties and Responsibilities of Stakeholders PPT No.: 67-105 Learner Guide Pg: 36-54	• WSH (DfS) Regulations Explain the duties and responsibilities of: • Developer • Designer • Main Contractor / Sub-contractor • Subsequent Building Owner

Time	Duration	Trainer's Key Presentation Points	Trainer's Key Activities
			• DfS Professional Discussion questions on 5 case studies
13:40 – 14:40	60 minutes	DfS Review Meeting Process PPT No.: 106-150 Learner Guide Pg: 55-58, 63-68	Introduction to DfS Review Meeting Process: • GUIDE Process • Phases of DfS Review Meeting (GUIDE 1, 2 and 3) • DfSR
14:40 – 15:00	20 minutes	Safety and Health Risk Considerations for DfS Review Meeting PPT No.: 151-166 Learner Guide Pg: 59-61	Explain Safety and Health Risk Considerations for DfS Review Meeting: • Site planning and preparation • Civil and structural works • Architectural and Finishing Works • Mechanical & Electrical Works • Equipment & Services • General Considerations
15:00 – 15:15	15 minutes	Tea Break	
15:15 – 15:45	30 minutes	Hazard Identification Tools PPT No.: 167-169 Learner Guide Pg: - , 62-66	Introduction to hazard identification tools: • Checklist (Appendix 1, 2, 3)

Time	Duration	Trainer's Key Presentation Points	Trainer's Key Activities
15:45 – 16:15	30 minutes	Learning Activity 1 PPT No.: 170-171 Learner Guide Pg: 123-124	Conduct group discussion on Learning Activity 1 Objective of LA1: • RA methods
16:15 – 16:45	30 minutes		Facilitate presentation on Learning Activity 1: Comment and discuss on group presentation
16:45 – 17:00	15 minutes	Summary of Day 1	Summarize the key learning points of Day 1 Q & A Session

Day 2

Time	Duration	Trainer's Key Presentation Points	Trainer's Key Activities
09:00 – 09:15	15 minutes	Recap key learning points in day 1	Introduction, recap for day 1
09:15 – 09:45	30 minutes	Preparation for DfS Review Meeting PPT No.: 172-179 Learner Guide Pg: 63-65	Share important things to note during preparation of DfS Review Meetings: • Establish DfS Review Meeting Collate relevant information • Define scope for DfS Review Meetings
09:45 – 10:15	30 minutes	Conducting the DfS Review Meeting: ways to encourage participation PPT No.: 180-183 Learner Guide Pg: 66-67	Highlight points to take note when conducting DfS Review Meetings. Some pointers on facilitation skills
10:15 – 10:30	15 minutes	Tea Break	
10:30 – 11:00	30 minutes	DfS Register PPT No.: 184-193 Learner Guide Pg: 69-70	Explain items that should be in the DfS Register
11:00 11:30	30 minutes	Documentation, Monitor and Review of DfS Register PPT No.: 194-196 Learner Guide Pg: 71-72	Explain the elements of documentation system. Explain the monitoring and review process of safety and health issues.

Time	Duration	Trainer's Key Presentation Points	Trainer's Key Activities
11:30 – 12:00	30 minutes	Coordination and Communication of Safety and Health Information PPT No.: 197-202 Learner Guide Pg: 73-77	Introduction on the types of safety and health information required for communication, means of communication. Explain the factors to be taken into account when coordinating flow of safety and health information
12:00 – 13:00	60 minutes	Lunch Break	
13:00 - 15:15	135 minutes	Learning Activity 2 Key learning points from case study PPT No.: 203-204 Learner Guide Pg: 125-127	Facilitate presentation on Learning Activity 2 Comment and discuss on group presentation Raise points that were overlooked Highlight importance of GUIDE2
15:15– 15:30	15 minutes	Tea Break	
15:30 – 16:00	30 minutes	Guide 3 Summary of Day 2	Summarise key learning points from case study
16:00 – 16:15	15 minutes	Requirements and expectation of Assessments PPT No.: 205-206	Brief Learners on the requirements and expectations of Assessment 1 & 2
16:15 – 16:30	15 minutes	Course Evaluation	Facilitate evaluation of DfS for Professionals Course
16:30 - 17:00	30 minutes	Assessment 1	Conduct and invigilate Assessment 1

DfS for Professionals Course

Design for Safety for Professionals Course





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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)

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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.

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Course Overview

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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

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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 (DfS) guidelines published on 1 Aug 2016.

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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.

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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.

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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 (DfS) guidelines.
- Implement a system for documentation of safety and health records in accordance with organisational requirements.

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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

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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. different group of ppl different ways
- Establish means of communication to relevant stakeholders for safety and health information in accordance with organisation requirements.

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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.

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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

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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 (DfS) Guidelines
- Workplace Safety and Health Act and Subsidiary Legislations, such as:
  - WSH (Risk Management) Regulations
  - WSH (Construction) Regulations
  - WSH (Asbestos) Regulations

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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.

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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

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

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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.

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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)

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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

Identify flaws at design stage:

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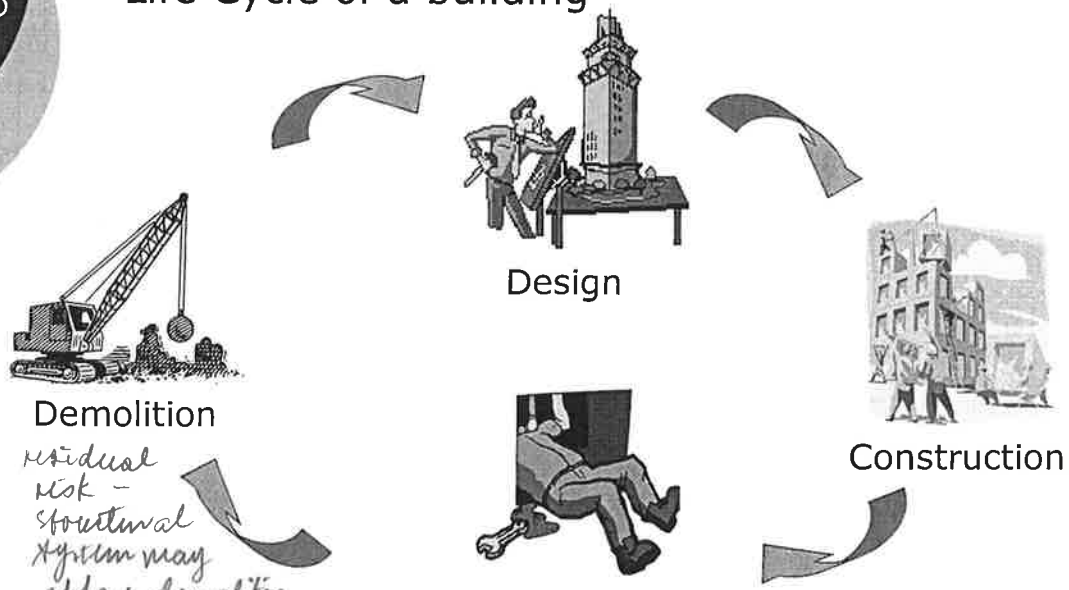
Importance of Design for Safety and Health for Construction Projects

Life Cycle of a building



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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 subject the worker to risk,
- ☑ Reduce overall costs of construction and maintenance of a building and structure due to injuries and illnesses

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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)

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Importance of Design for Safety and Health for Construction Projects

☑ Minimise losses:
- life,
- injury
- cost

and ensured safety for current and future users

☑ Minimise unnecessary delays

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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 (work at heights) Regulations
- ❑ WSH (WSH Officers) Regulations
- ❑ WSH (Risk Management) Regulations
- ❑ WSH (Construction) Regulations
- ❑ WSH (Asbestos) Regulations



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Workplace Safety and Health Legal Requirements

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
- ❑ ...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.

must have overall view of other disciplines to trigger questions or issues from them

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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).

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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.

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Workplace Safety and Health Legal Requirements

Resources on legal requirements may be found at:

- Singapore Statutes On-line
  http://agcvldb4.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

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Overview of Safety Legal Framework

Officially launched in 2008

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.

MOM & MOE started DfS in 2012

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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

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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.

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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.

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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.....

performance based

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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

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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**.

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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.

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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~~ (DfS) guidelines detail the process for stakeholders to discuss the design risks of the project so as to identify and mitigate the safety and health risks.

good to have an external party as a DfS - Designer + DfS having 2 hats,

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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.

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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
- Review the risk assessment at least once every 3 years, or upon occurrence of incident / accident or significant change in work practices

Bizsafe - 3yrs

Revisit and redo risk assessment.

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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
- SS 559: 2010 Code of Practice for Safe Use of Tower Cranes
- 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".

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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. also known as Design Risk record, or WSH risk assessment

More Design risk record & the assistant

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Risk Assessment (RA)

Risk assessment is the process of:

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

Even if the risk has been mitigated, we should record it.

Risk assessment includes:

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

eg if the piece of glass is broken

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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.

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Risk Assessment

Risk Management Process – MOM Guideline

2015 version include human factors



5 x 5 matrix

← DfS register

– GUIDE

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Step 1 Identify and analyse hazards

- Hazard Identification is the most important step in RA
  - Hazards can only be controlled if they are identified

for specific checklist for yes/no kind – type don't brainstorm. add on questions.

- Involves identifying hazards associated with the work activities of each process and type of potential accidents or incidents.

checklist – sometimes it will lead people to a certain way of thinking

- Brainstorm – how to do it? trigger – give an example of a hazard
  - Possible types of accidents and ill health that can happen due to the hazard

workshop – effective if you are a good facilitator

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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

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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 Med medical treatment
- Assessing the risk level based on the severity and likelihood.

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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

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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.

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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
    - Minor
    - Moderate
    - Major

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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)

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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.

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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:

- Remote
- Occasional
- Frequent

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Step 2 Evaluate Risks

6 X 5 matrix

Likelihood categories and description

Likelihood	Description
Remote	Once in 10 years Not likely to occur
Occasional	Possible or known to occur
Frequent	Common or repeating occurrence some 4 times a year 2 times a year

how to make all these easier to visualise
find a frequency to it.

once a month

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should it not be pegged to the standard of safety (Criteria)

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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

how likely it would happen. Probability of the accident happening.

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Step 2 Evaluate Risks

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

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Step 2 Evaluate Risks

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

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

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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"

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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.

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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
- 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.

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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.

have the correct mindset

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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

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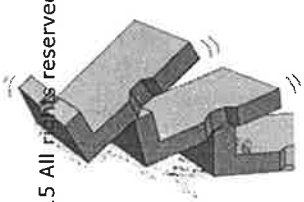
Step 3. Control risk

- **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.



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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



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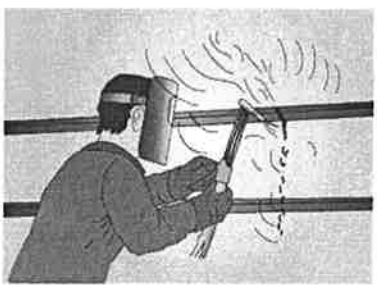
Step 3. Control risk

- **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.



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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.

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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

long term maintenance hand over the DfS register to the future owners.

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

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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.

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Duties and Responsibilities

Duties of the Developer

1. General for handling risks

(significant)

•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.

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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.

changes keep coming

4. Provide relevant information

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

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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.

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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.

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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
- Maintaining a DfS Register

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

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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.

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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.

•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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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guidelines on how to indicate the risk in the form of advisory note. / Facade in the DFS register.

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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.

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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 set of 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.

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Fine up to $20k, jail up to 12 mths.

Role is more of a facilitator than an auditor.

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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?**

- 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.

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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.

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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

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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

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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.

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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.

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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.

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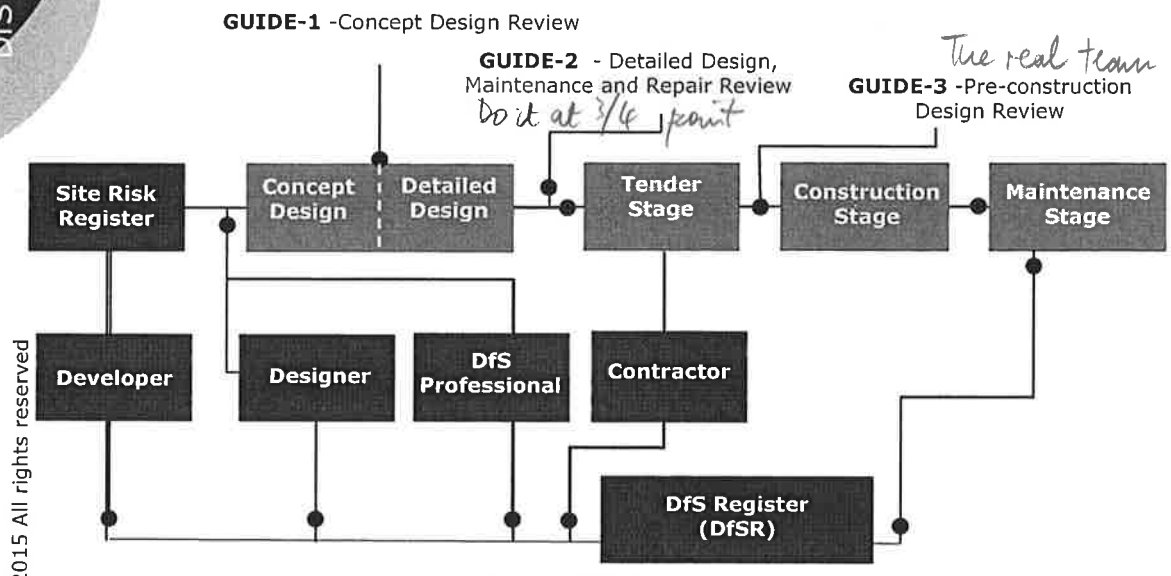
Phases of Design Reviews

GUIDE Process Flow Diagram



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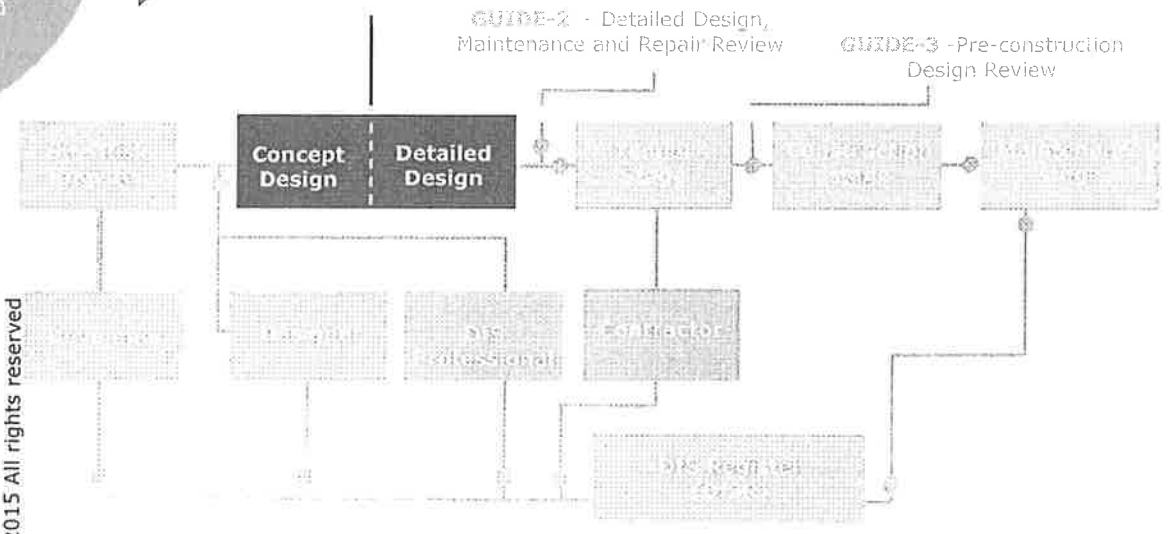
Phases of Design Reviews

GUIDE Process Flow Diagram

GUIDE-1 -Concept Design Review



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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 measures are established.
- Sometime risk identified in GUIDE-1 can only be addressed later in the project when more details become available.

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GUIDE-1: Concept Design Review

High level 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

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Example: GUIDE 1

(Refer to Appendix 5 of Learner Guide for Examples)

Petronas Towers, Malaysia



Design for Safety consideration:

- General location of the project

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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

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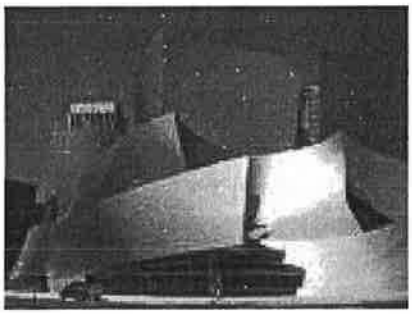
Example: GUIDE 1



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

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Roofs near changi should not be reflective.

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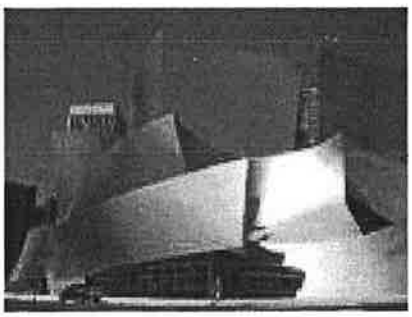
Example: GUIDE 1



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.

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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

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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

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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.

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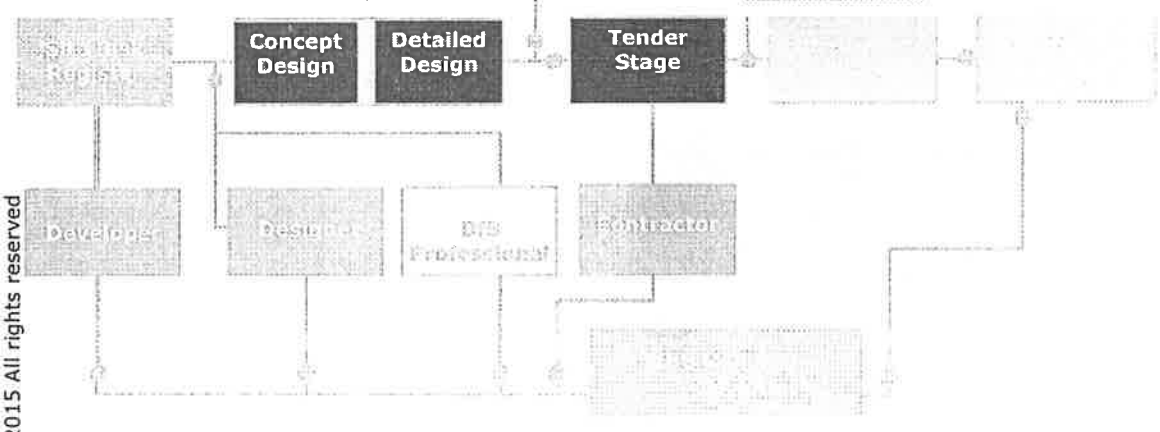
Phases of Design Reviews

GUIDE Process Flow Diagram

GUIDE-1 -Concept Design Review

GUIDE-2 - Detailed Design, Maintenance and Repair Review

GUIDE-3 Pre-construction Design Review



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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

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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.

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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
- Layout
- Confined Space / Access for Maintenance
- Emergency Route
- Health hazards
- Weather
- Others (early warning of hazards, fire risk source of energy stored etc)

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BCA → checklist for maintenability – a very long checklist

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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

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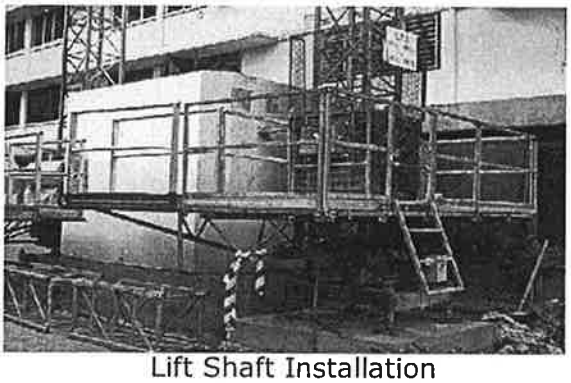
Example: GUIDE-2

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

Look at lifting issues

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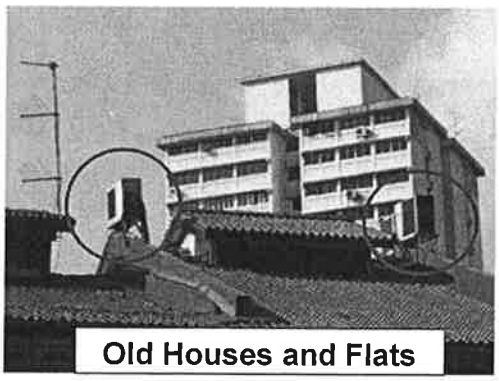
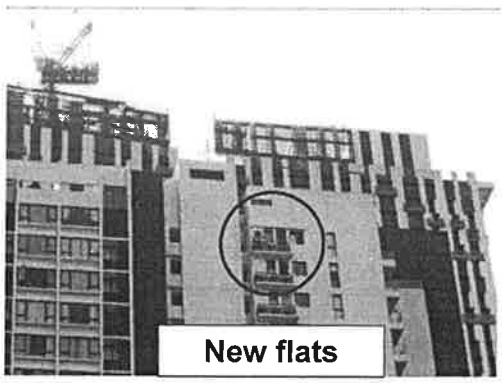
Example: GUIDE-2

Design for Safety Considerations:

Safe installation and maintenance access for air condition units



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



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

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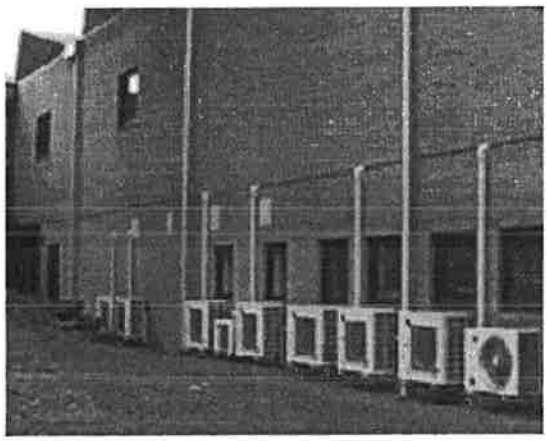
Example: GUIDE-2

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

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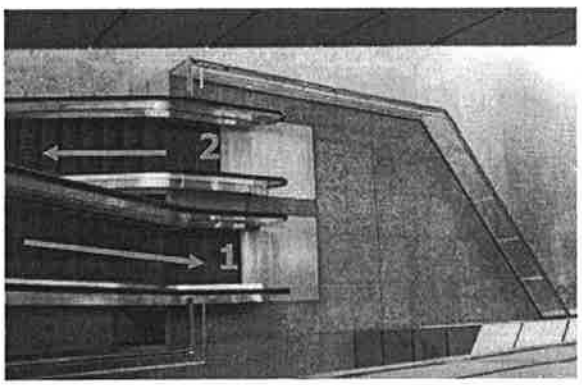
Example: GUIDE-2

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.

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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.

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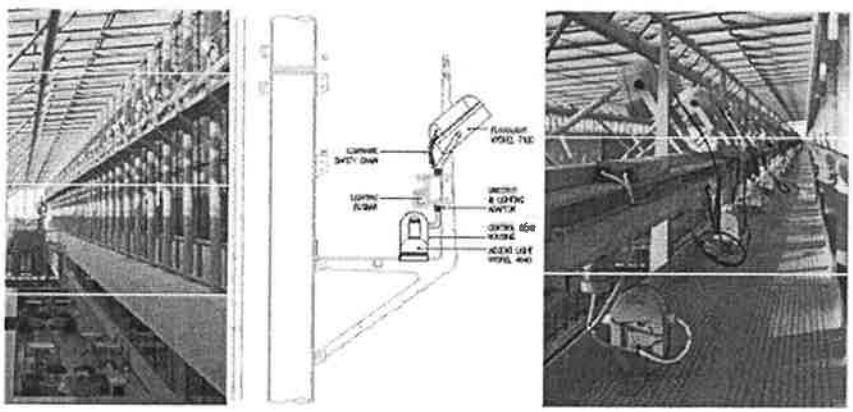
Example: GUIDE-2

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.

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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.

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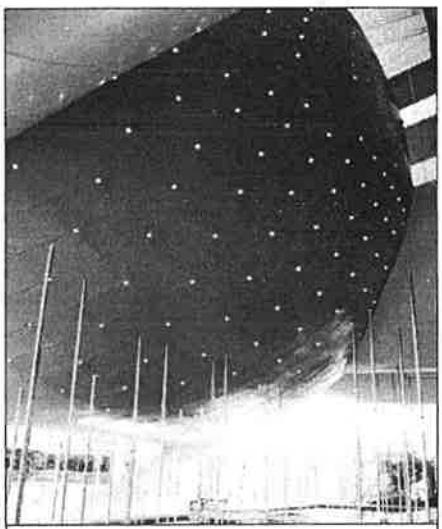
Example: GUIDE-2

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

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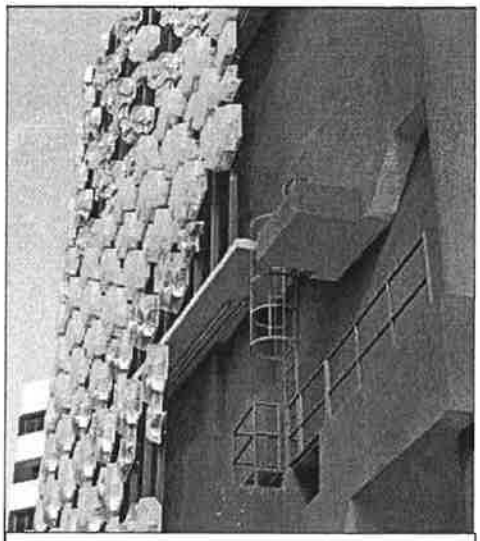
Example: GUIDE-2

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

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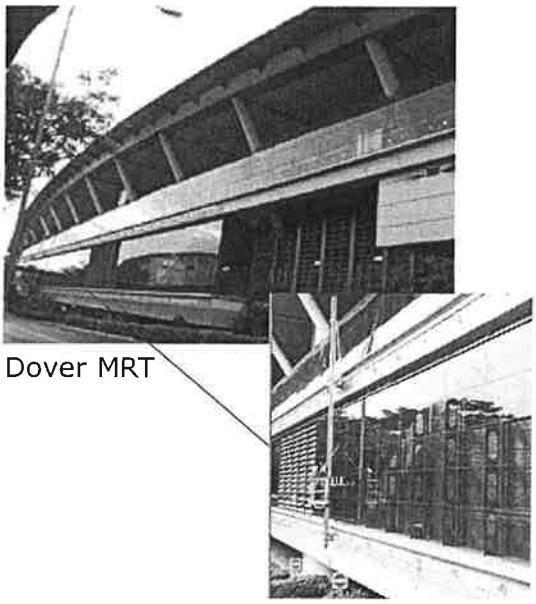
Example: GUIDE-2

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.

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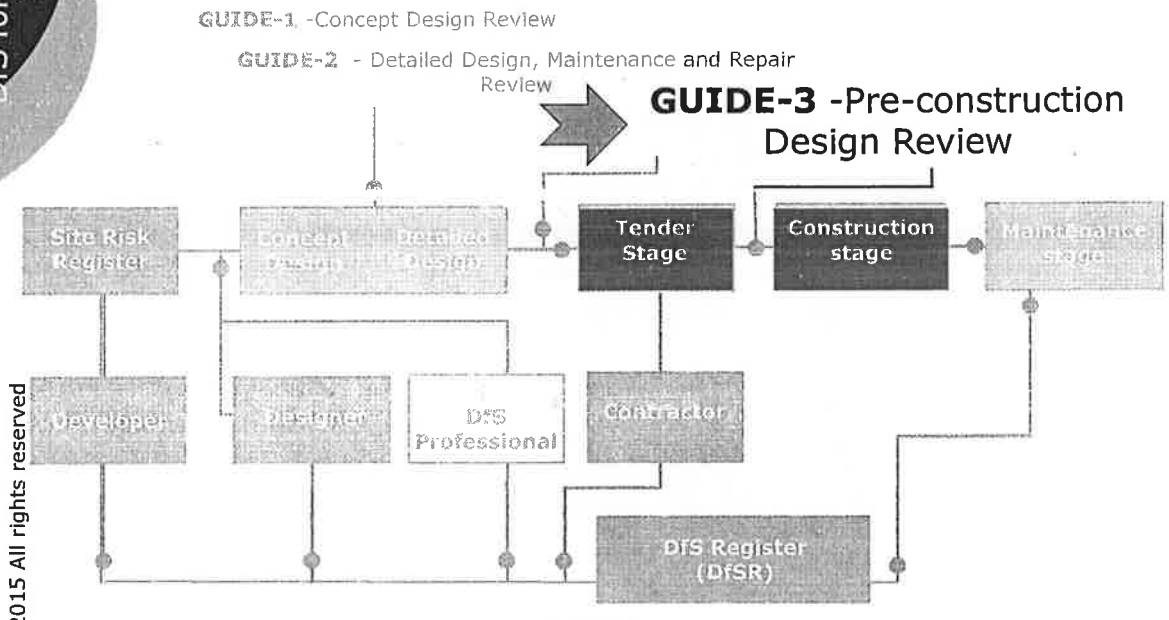
Phases of Design Review Meetings

GUIDE Process Flow Diagram



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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. Not specific element but overall

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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.

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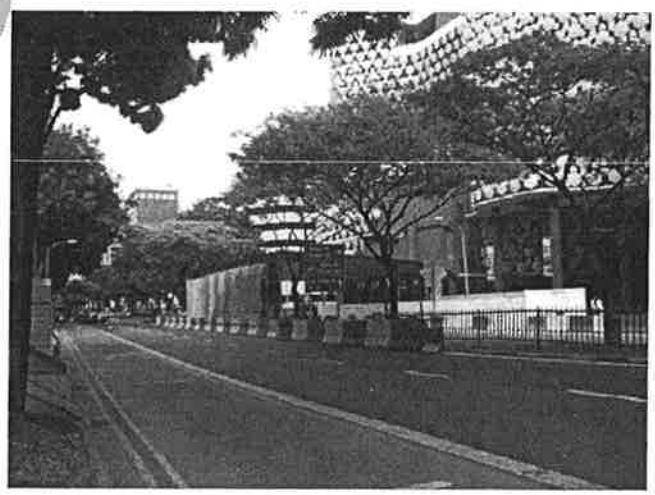
Example: GUIDE-3

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.

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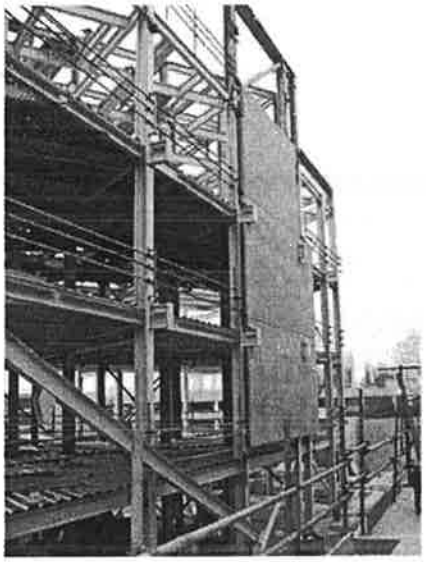
Example: GUIDE-3

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.

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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...)

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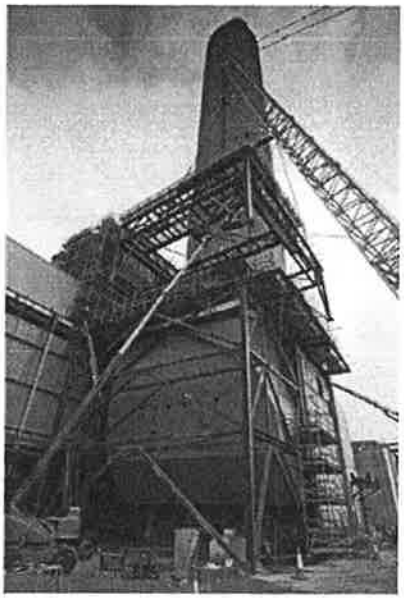
Example: GUIDE-3

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.

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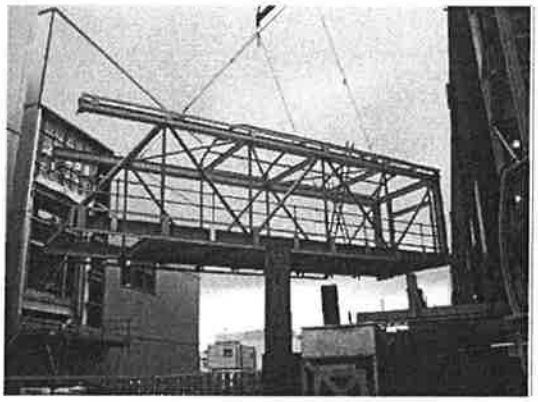
Example: GUIDE-3

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.)

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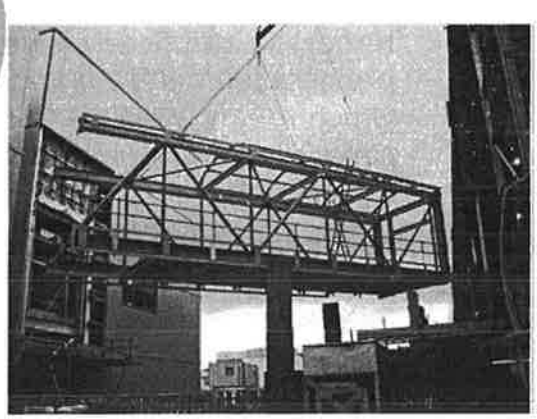
Example: GUIDE-3



- 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.

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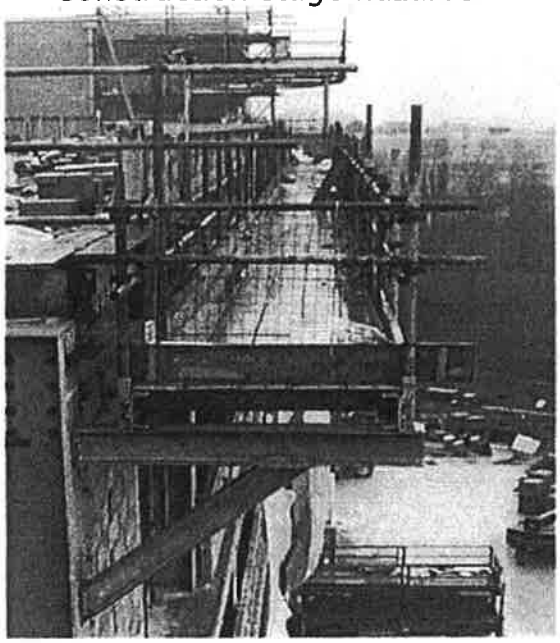
Example: GUIDE-3

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.)

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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.)

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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

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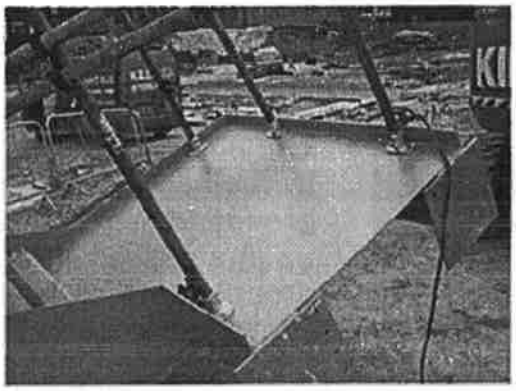
Example: GUIDE 3

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

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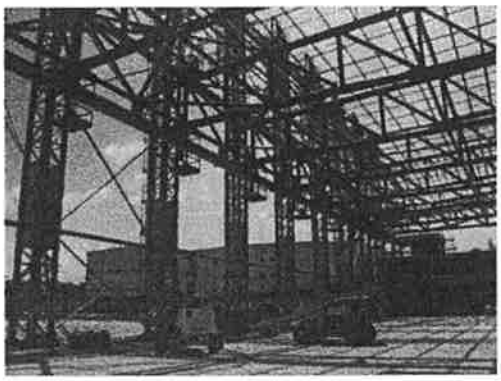
Phases of Design Review Meetings



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

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. →



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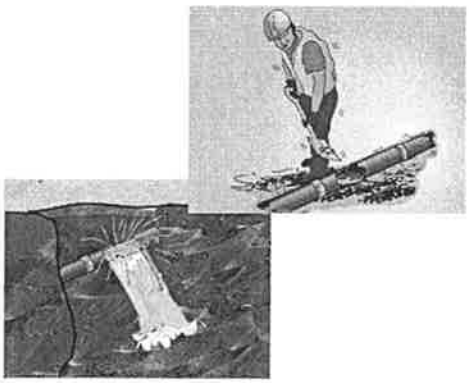
Safety and Health Risks Considerations

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



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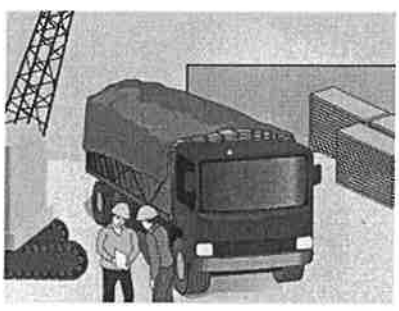
Safety and Health Risks Considerations

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





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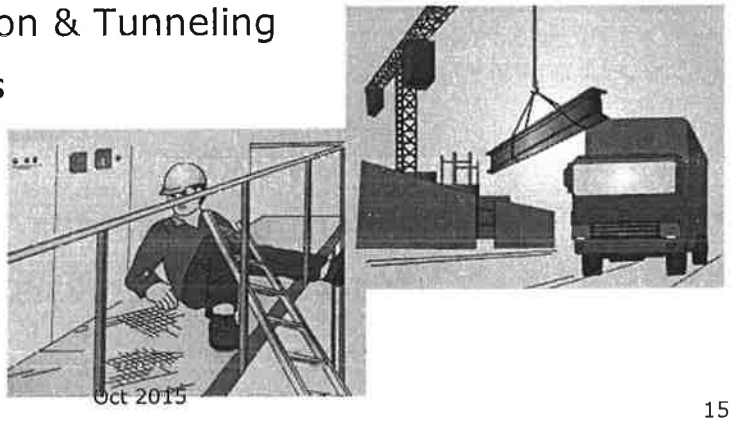
Safety and Health Risks Considerations

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



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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



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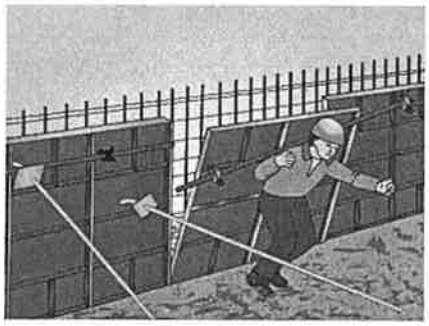
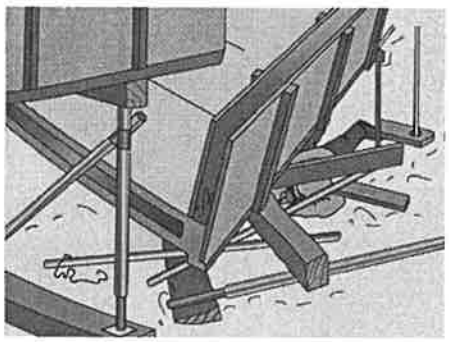
Safety and Health Risks Considerations

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





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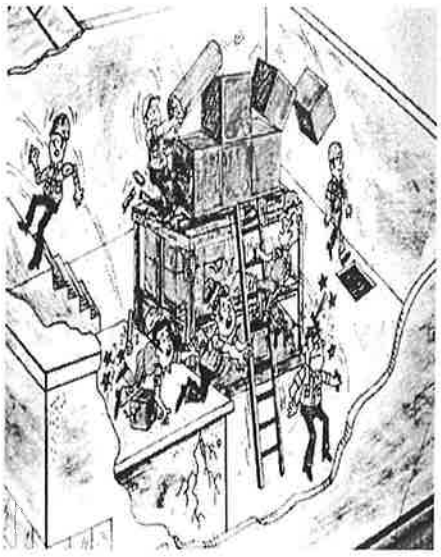
Safety and Health Risks Considerations

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



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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



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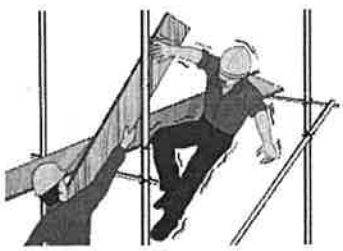
Safety and Health Risks Considerations

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



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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



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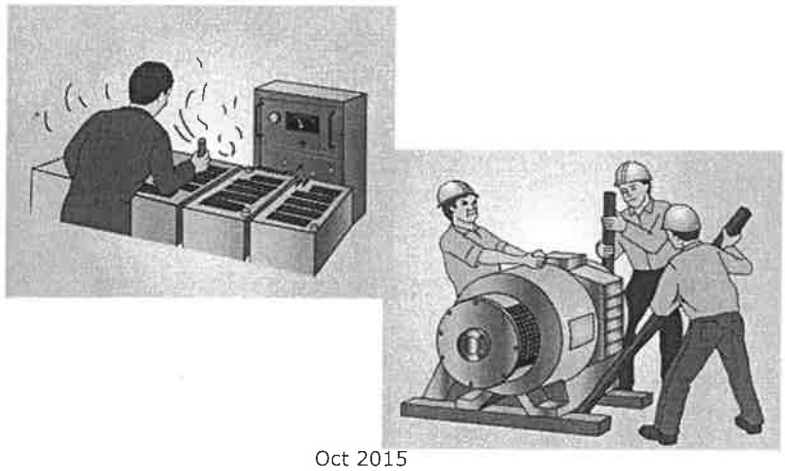
Safety and Health Risks Considerations

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



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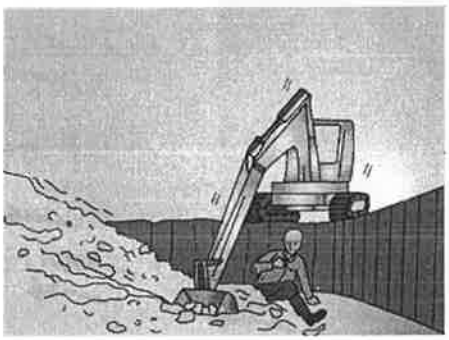
Safety and Health Risks Considerations

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



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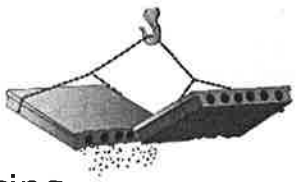
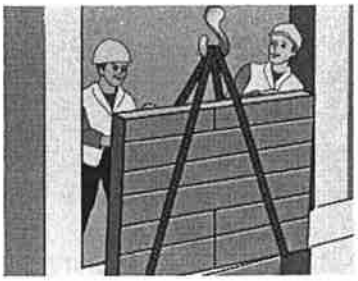
Safety and Health Risks Considerations

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





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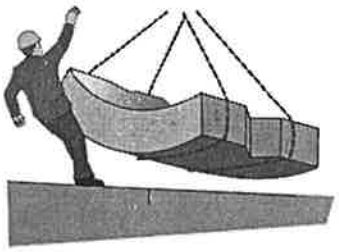
Safety and Health Risks Considerations

- 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





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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



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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)

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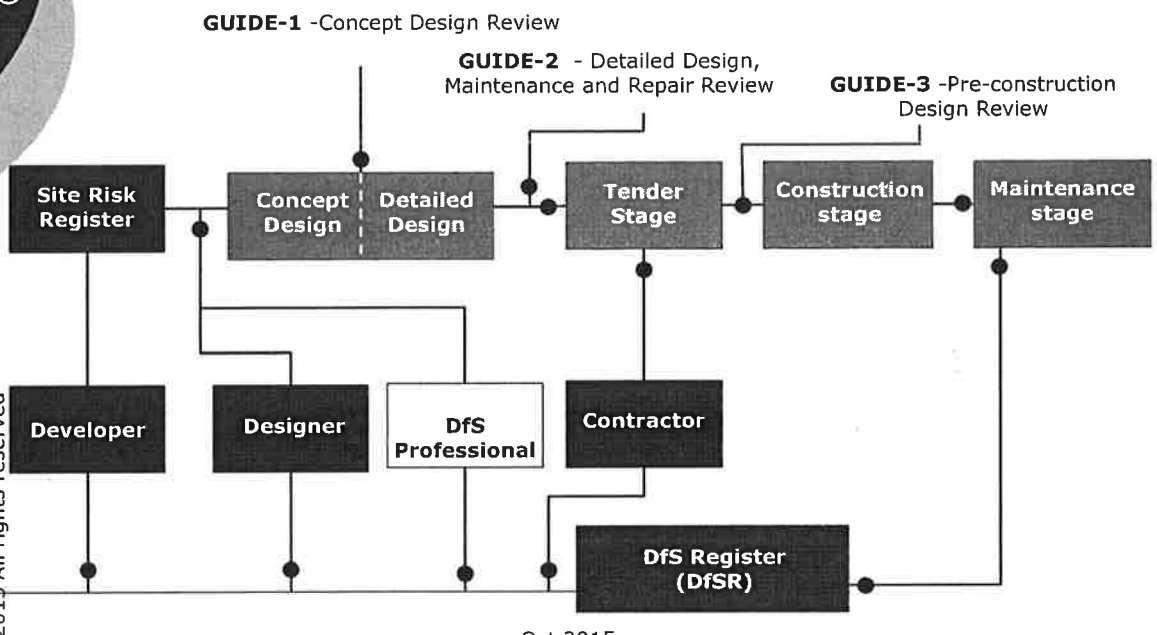
Phases of Design Review Meetings - Recap



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Hazard Identification Tools

Checklist for

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

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

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



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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.

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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.)

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Hierarchy should use:
1. Elimination
2. Substitution
3. Engineering Control pg 62

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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.

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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.

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Prepare for Design Review Meetings

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

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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



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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

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Prepare for Design Review Meetings

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

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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

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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

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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

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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

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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.

If the developer believes in Dfs. then the chances of active participation, Essential to have good rapport with clients PM or lead consultant.

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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. Highlight the risks.
- Assist in identifying control measures for risk that cannot be eliminated.
- Promote the design suitability and compatibility.

facilitator, not do for them. Let them identify the risks.

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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.

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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?"

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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.

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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

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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



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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

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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

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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.

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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, too minor; include in RA.

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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

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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

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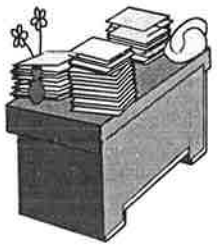
DfS Register

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



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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

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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



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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.

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Carry out yearly reviews.

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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

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Types of Safety and Health Information for Communication

- Sequence of construction works (part of tender docs)
- 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

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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 ground contaminated - tender information, soil removal not by general worker.
- Design reviews
- Sharing of risk register information

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Means of Communication to Relevant Stakeholders

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



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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.

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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



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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

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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.

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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%

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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

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GLOSSARY

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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.

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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.

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ANNEXES

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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.

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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,

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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.

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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.

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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.

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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.

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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;

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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.

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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.

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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.;

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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.

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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.

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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.

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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.

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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.

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

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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.

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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?

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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?

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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?

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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?

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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.

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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.

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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.

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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.

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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.

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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.

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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?

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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?

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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?

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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?

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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?

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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?

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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?

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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?

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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?

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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?

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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.

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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?

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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?

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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.

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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.

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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.

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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.

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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.

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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.

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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?

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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?

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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?

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Annex D : GUIDE-3

OTHERS:

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

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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

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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)

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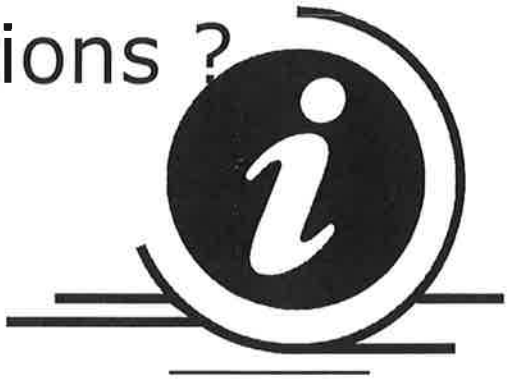
Questions ?



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Design for Safety for Professionals Course

Learner's Guide





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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.

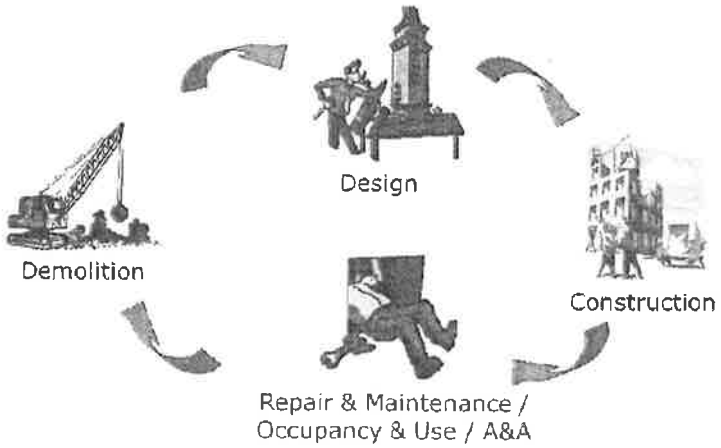
1.1 Importance of Design for Safety and Health for Construction Projects

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(i) 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:

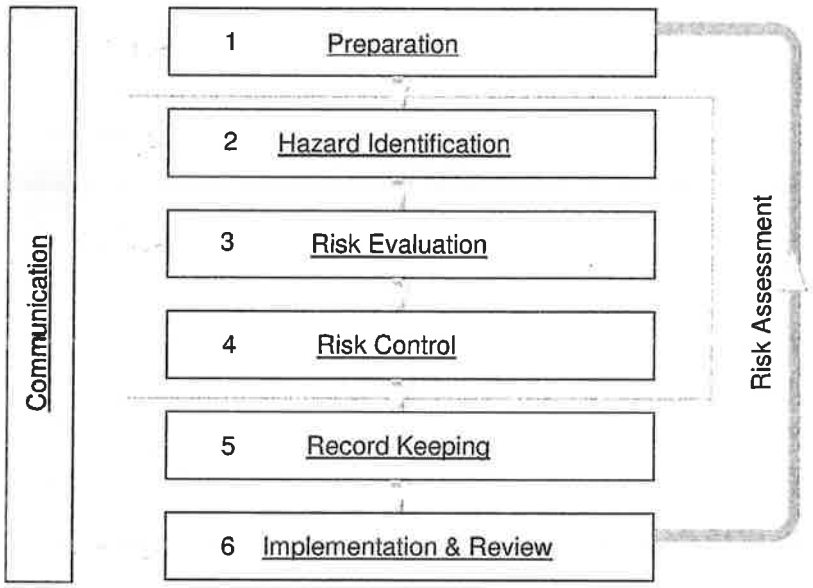
1. Identifying and analysing safety and health hazards
2. Evaluating the risks
3. Controlling risk

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.

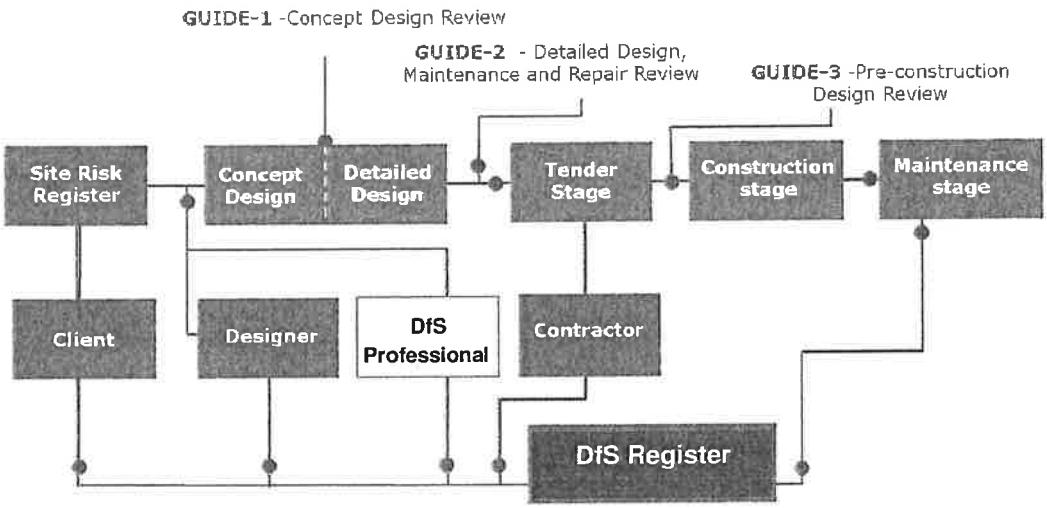
GUIDE-3: Pre-Construction Review

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

References

WSH (DfS) Regulations and ACOP for DfS, WSH Council

Workplace Safety and Health Act (WSH Act)

Workplace Safety and Health (Risk Management) Regulations 2006

Workplace Safety and Health (Construction) Regulations 2007

Workplace Safety and Health, Risk Management: Risk Assessment Guidelines

CIRIA C662, CDM 2007- Construction work sector guidance for Designers

Approved Code of Practice for Construction and Design Management Regulations 2007

Appendices

Appendix 1

Sample 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 identifying and understanding the risks very early in the life cycle of the project, risk controls can be established to ensure that these risks are managed either 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. The Designer may be well-informed but not equipped with WSH knowledge. As such, GUIDE-1 should be done by a group of key stakeholders and not only by the Designer in isolation. The contribution of the various people will therefore help to ensure that safety at every stage and level is examined and discussed. The primary concern of GUIDE-1 will be on the safety issues related to the LOCATION of the project. LOCATION determines several major considerations such as soil assessment, the public, the existing services and the placement of major machinery. GUIDE-1 therefore needs to examine the issues associated and highlight the risks and hazards arising.

To aid the GUIDE-1 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. As such, the team should still have a "brainstorming" session which will be more effective in highlighting the hazards and concerns of the key stakeholders.

Considerations		Details/Hazards Identified
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 the 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?	
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?	
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?	

Considerations		Details/Hazards Identified
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?	

Having answered the above list of questions and highlighting the hazards, the hazards identified should then be transferred to a Design Risk Assessment Form (Appendix 4).

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. 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 done to mitigate the risks should be documented in the Design Risk Assessment Form so as to ensure that all relevant information is captured.

At concept design stage, unless the exercising of GUIDE-1 proves 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. GUIDE-2 will hence be a session to identify the new hazards as well as ensure hazards raised in GUIDE-1 are followed through and mitigated.

Appendix 2

Sample 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, the maintenance and repair methodology should also be reviewed at this stage, such that required maintenance or repair issues can be addressed.

While GUIDE-2 serves to address these new hazards, the issues raised during GUIDE-1 should also be reviewed and closed out if possible.

GUIDE-2 should be done by the key stakeholders and not just the Designer in isolation. 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. While the questions may highlight important issues, they serve only as a reference for the team and may not be comprehensive. As such, the team should still have a "brainstorming" session which will be more effective in highlighting the hazards and concerns of the key stakeholders.

Considerations		Details/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 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? 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?	

Considerations		Details/Hazards Identified
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?	

Considerations		Details/Hazards Identified
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? 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?	

Considerations		Details/Hazards Identified
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? Can temporary works required during construction be planned for? E.g. specifying the 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? Does the sequence of construction create any temporary unstable working platform, which requires additional bracing? Can adequate safety factors be incorporated in the design such that overloading or collapse of the permanent or temporary structure is not possible?	

Considerations		Details/Hazards Identified
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?	
Confined Space	Does the design create any confined space in the permanent or temporary stage? Can the confined space be removed from the design? Can the requirement to enter the confined space be minimised by removal of vital equipment or controls from the confined space?	
Emergency Route	Is the 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?	

Considerations		Details/Hazards Identified
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, vapours, 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 less than 25kg.	
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?	

Considerations		Details/Hazards Identified
	Can monitoring instrumentation that provides early warning of possible collapse or ground movements be installed? Are there any other major hazards that need to be dealt with? Can materials that can create significant fire risk be removed?	
Others	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 changed the structure significantly be highlighted? Can disruptions to existing utilities within occupied buildings be avoided?	

Having answered the above list of questions and highlighting the hazards, the hazards identified should then be transferred to a Design Risk Assessment Form (Appendix 4).

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. 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.

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.

Appendix 3

Sample 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 the concept design and detailed design stages of the project, risks and hazards associated with the design and methods of 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.

Along with the key stakeholders involved in GUIDE-1 and GUIDE-2, the main Contractor and his appointed Designers and specialist Contractors should be a part of the GUIDE-3 process Review Team. Similar to GUIDE-2, it is important that proper documentation be done so as to ensure that relevant information is passed on and documented in the DfS Register (DfSR).

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

Considerations		Details/Hazards Identified
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? 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 that need to be highlighted to the Contractor for his construction? Does the sequence of construction create any temporary unstable stage, which requires additional bracing? Can adequate safety factors be incorporated in the design such that overloading or collapse of the 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? Will there be any adverse effects on adjacent structures during the removal of temporary works? Are there any alternatives or measures that could reduce or minimise such adverse effects?	

Considerations		Details/Hazards Identified
Specialist Design	Are there any safety concerns on elements of specialist design to be considered by the main Contractor? Can alternative safe work practices be employed to mitigate such concerns?	
Others	Have the risks and hazards identified in GUIDE-1 and GUIDE-2 been addressed or mitigated?	

Having answered the above list of questions and highlighted the hazards, the hazards identified should then be transferred to a Design Risk Assessment Form (Appendix 4).

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. 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 done to mitigate the risks should be documented in the Design Risk Assessment Form so as to ensure that all relevant information is captured.

After going through the GUIDE-3 process, a session should be held to identify the new hazards as well as ensure hazards raised in GUIDE-1 and GUIDE-2 are followed through and mitigated.

Appendix 4

Sample Design Risk Assessment Form

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

S/No.	Design Consider-ation	Risks	Hazards Identified	Risk Assessment			Can these hazards be designed out?	Proposed Control Measures	Residual Risk Level			Further review required?	Action By
				Severity	Likeli-hood	Risk Level			Severity	Likeli-hood	Risk Level		

Attachment: GUIDE 1, GUIDE 2, GUIDE 3

Endorsed by;

Design for Safety Professional

Appendix 5

Examples on Guide 1 Design Review

Example: Petronas Towers, Malaysia

Design for Safety consideration:

- General location of the project

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

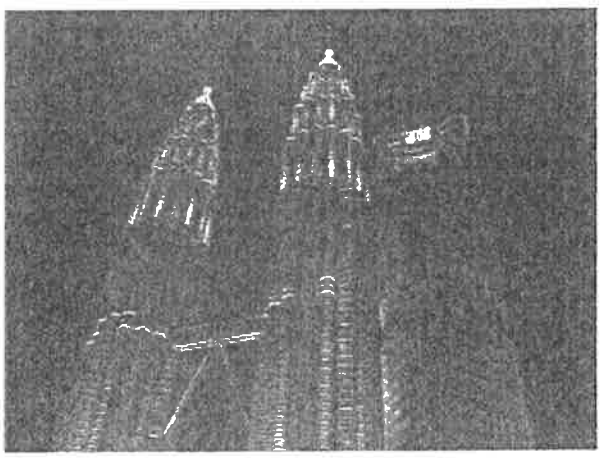


Photo 5.1: Petronas Towers

Example: 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

This innovative structure, with a polished stainless steel skin, was built in October 2003. 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 passers by were temporarily blinded by the glare.

The problem could have been identified during DfS Review Meeting and appropriate solution implemented.

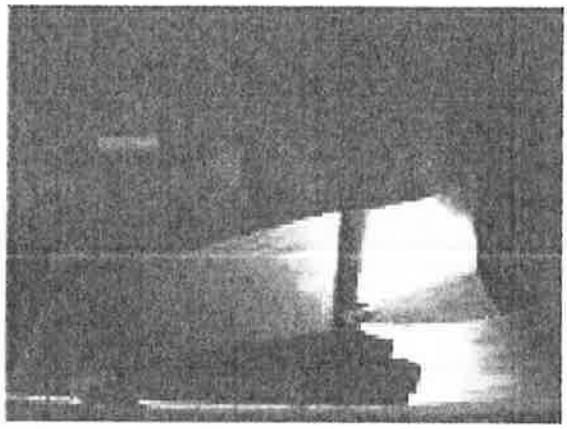


Photo 5.1: Walt Disney Concert Hall in Los Angeles

Example: Public and Vehicular Access

Design for Safety consideration:

- Impact on Public Access and Traffic with the commencement of project

The team should evaluate:

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

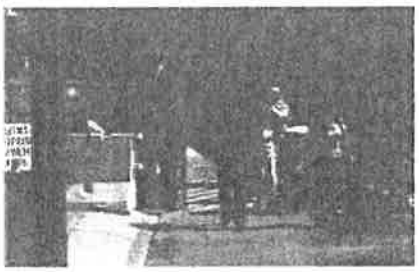


Photo 5.3: Public Access during construction



Photo 5.4: Vehicle, material, plant, movement during construction

Example: Public and Vehicular Access

Design for Safety Considerations:

- Access to building by occupants, visitors and public.

The team should evaluate:

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



Photo 5.5:
Designing traffic areas to separate vehicles and pedestrians



Photo 5.6: Delivery / Disposal of material and waste

Example: Underground Services

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.



Photo 5.7: Underground services

Appendix 6

Examples on Guide 2 Design Review

Example: Lift Shaft Installation

Design for Safety Considerations:

- Construction Methods

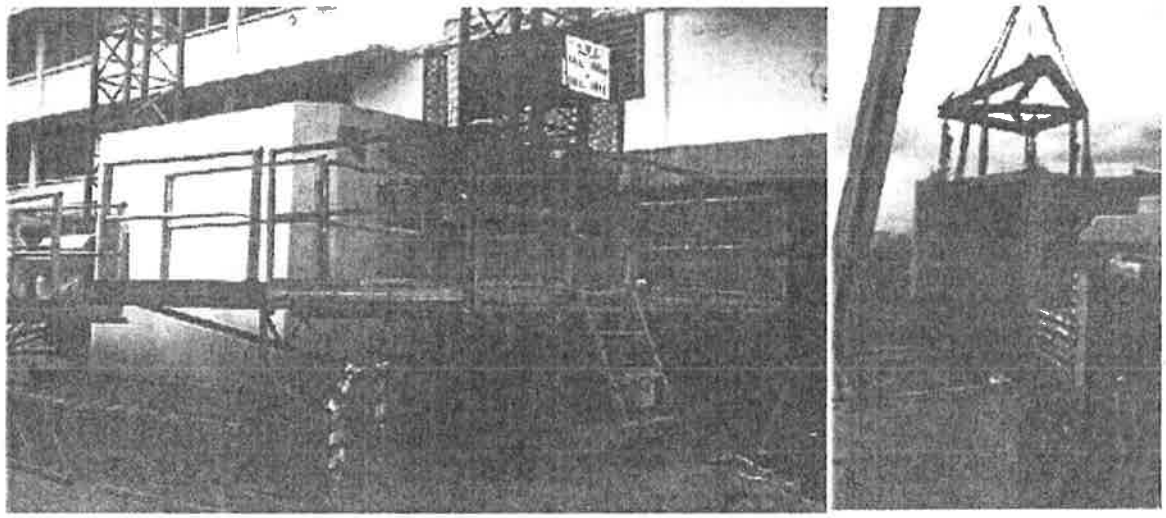


Photo 5.8: Lift shaft installation

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

Example: Utilities/ Air Condition Access

Design for Safety Considerations:

- Safe installation and maintenance access for air condition units

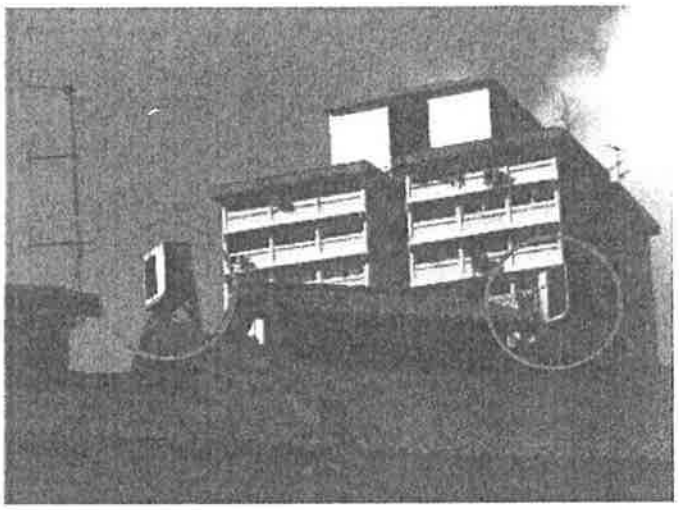


Photo 5.9: Old Houses and Flats

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

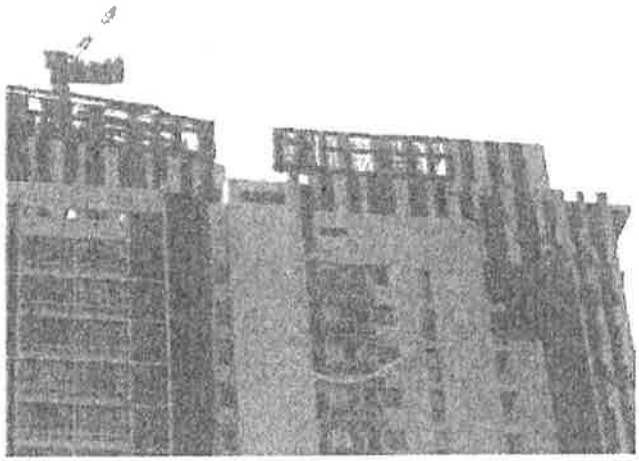


Photo 5.10: New Flats

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

Example: Utilities/ Air Condition Access

Design for Safety Considerations:

- Safe maintenance access

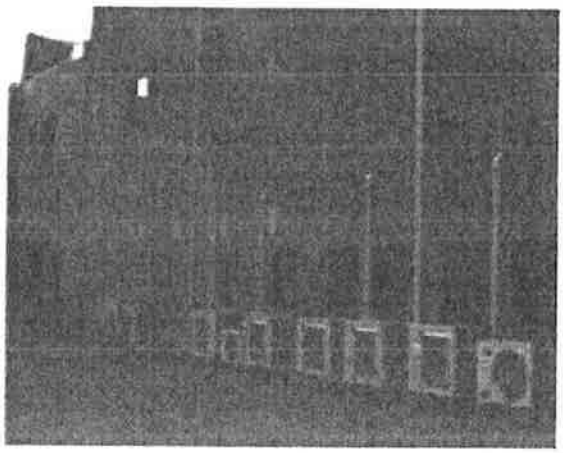


Photo 5.11: Air-conditioning systems located at ground level with good access.

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

Example: Human traffic flow

Design for Safety Considerations:

- Layout of the structure affecting flow of human traffic.

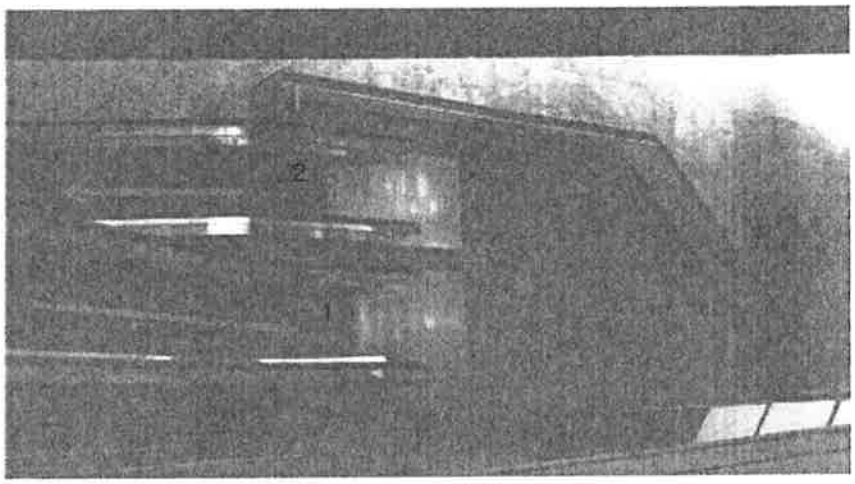


Photo 5.12: Escalator (top view)

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.

Example: Finishes and Fittings

Design for Safety Considerations:

- Detailed architectural design

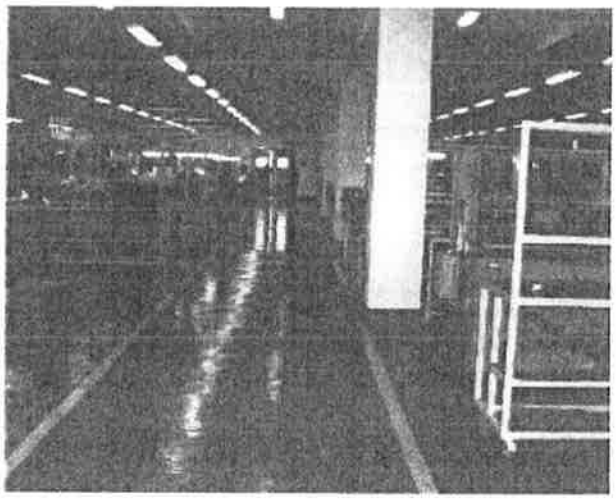


Photo 5.13: Flooring of a production area



Photo 5.14: Damaged production flooring

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.

Example: Illumination of Atrium

Design for Safety Considerations:

- Installation and maintenance of fixtures

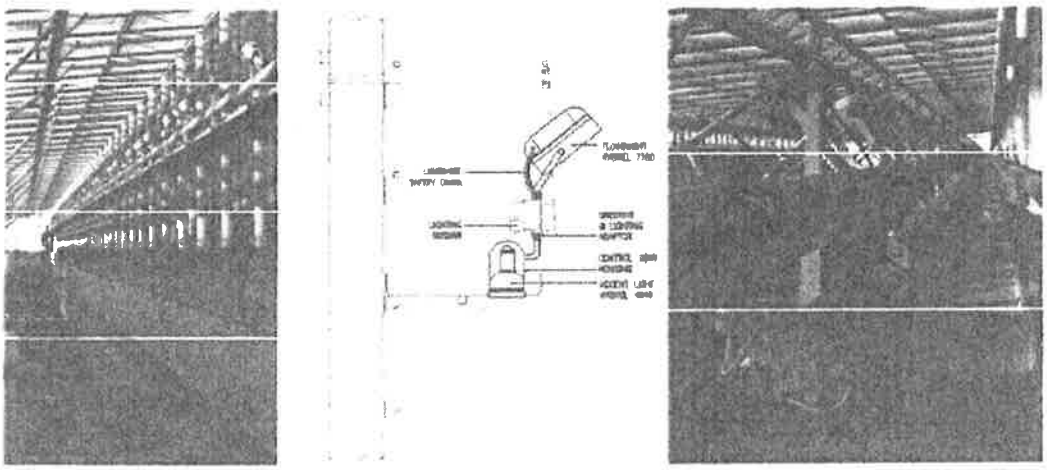


Photo 5.15: Maintenance gantry

The team should consider the:

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

Benefits:

☑ Bus-Bar systems used to avoid conventional labour intensive wiring at height.

☑ Gantry designed to accommodate floodlighting for walkways located directly below the gantry.

☑ Floodlights prepared at floor level with flying lead and plug in facility to enable quick installation into Bus-Bar at Gantry level.

☑ Colour of Gantry & Floodlights co-ordinated to blend into background.

☑ Floodlights pivot inboard of Gantry to provide safe access for relamping.

☑ Floodlights can slide along fixing rail for aiming during commissioning

- ☑ Gantry designed to accept quick fix installation of Bus-Bar.
- ☑ Gantry designed for quick installation of floodlights, prepared holes in floor and unistrut fixing rail.
- ☑ Improved safety and ease of installation using 3m lengths of Bus-Bar instead of trunking and conventional wiring.
- ☑ Clear unobstructed gantry walkway for future maintenance and relamping of the floodlights.
- ☑ No specialist working platforms or scaffolding required for future maintenance.

Example: Maintenance

Design for Safety Considerations:

- Accessibility for maintenance



Photo 5.16: The Esplanade Roof



Photo 5.17: Parkview Square

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.

Example: Maintenance

Design for Safety Considerations:

- Maintenance methods

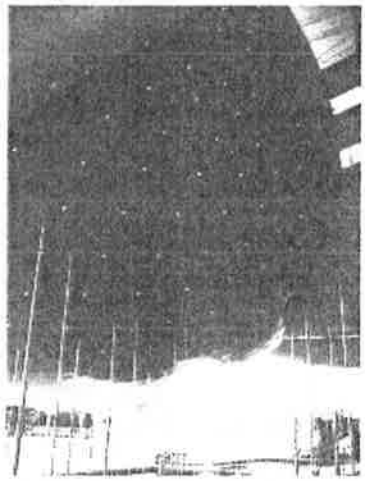


Photo 5.18: Auditorium at Fusionopolis

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

Example: Maintenance

Design for Safety Considerations:

- Maintenance methods

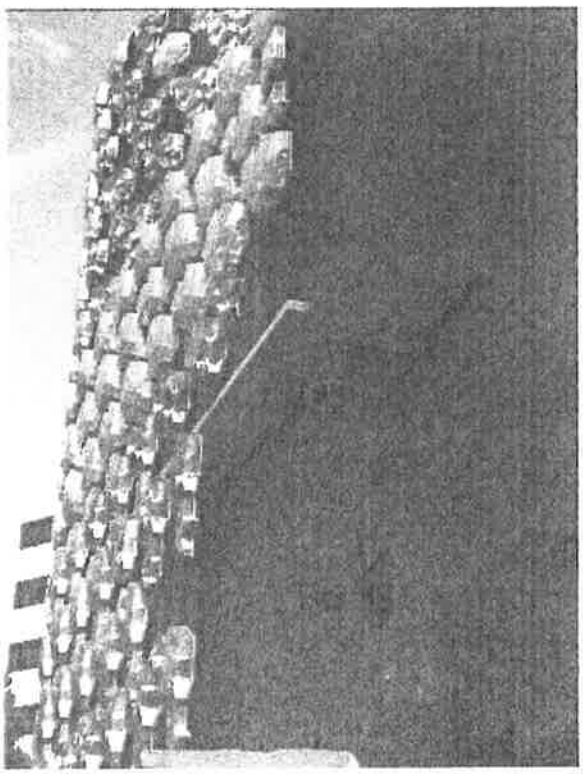


Photo 5.19: Maintenance access provided for external facade

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

Example: Maintenance

Design for Safety Considerations:

- Maintenance methods

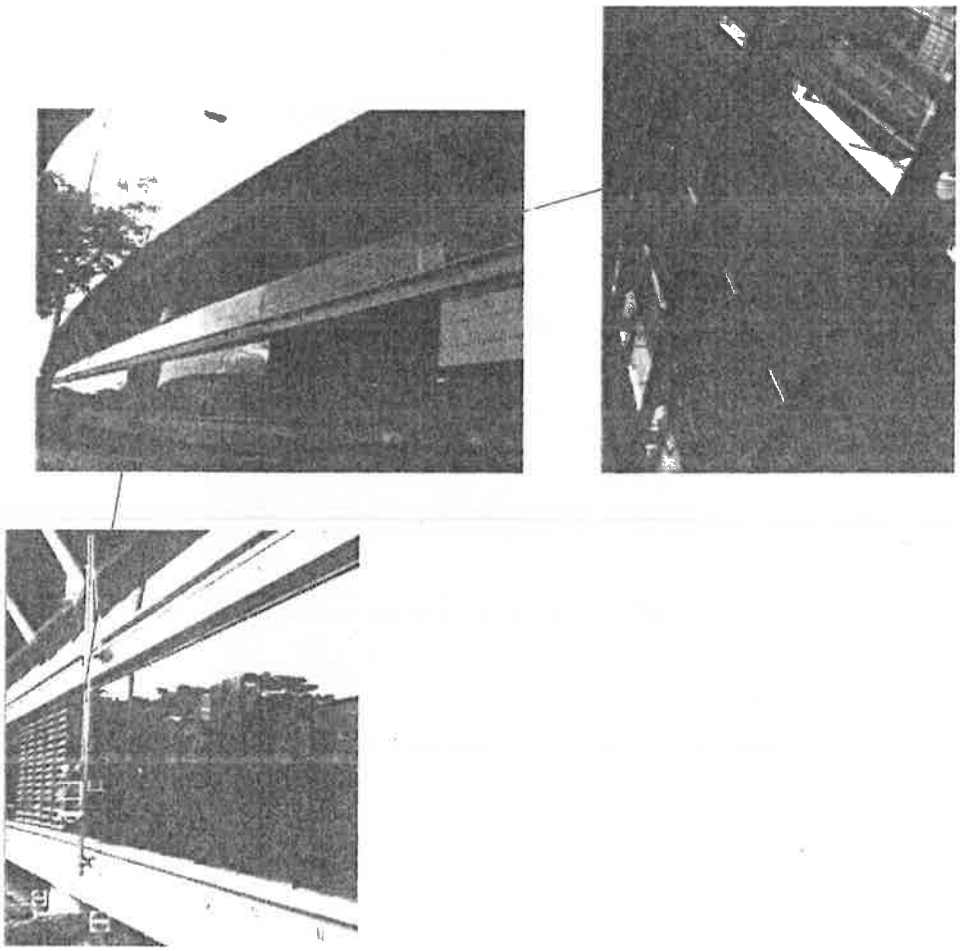


Photo 5.20: Dover MRT Station

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.

Appendix 7

Examples on Guide 3 Design Review

Design for Safety Considerations:

- Temporary works

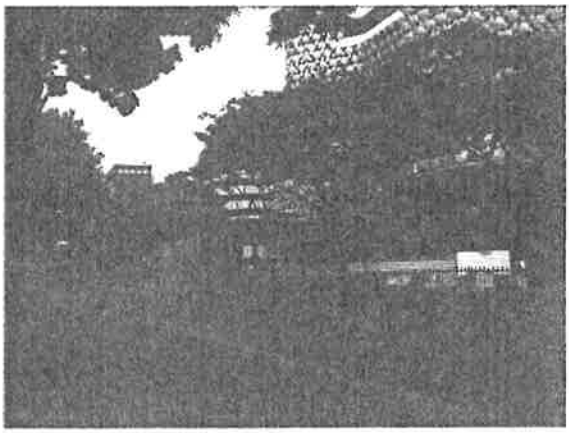


Photo 5.21: Pre-construction of overhead bridge

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.

Design for Safety Considerations:

- Works by Specialist Contractors

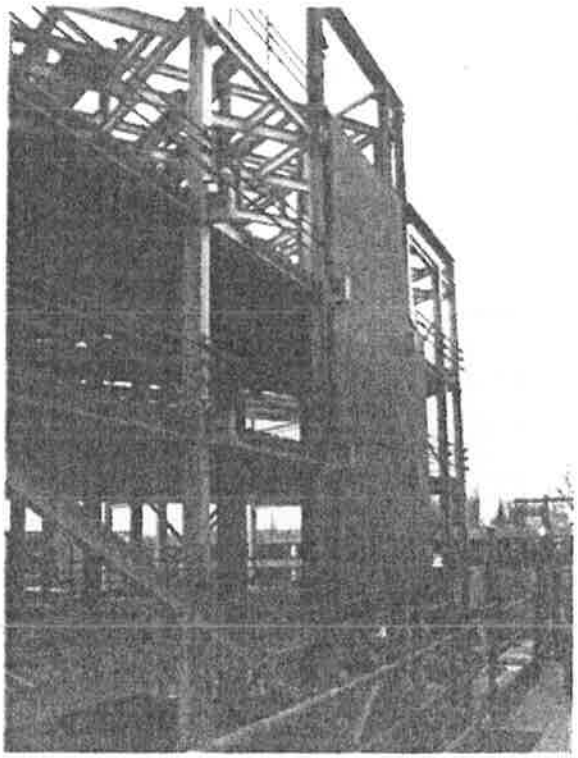


Photo 5.22: Modular Stone Panels

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.

Example – Conversion to Modular Construction

Design for Safety Considerations:

- Works by Specialist Contractors

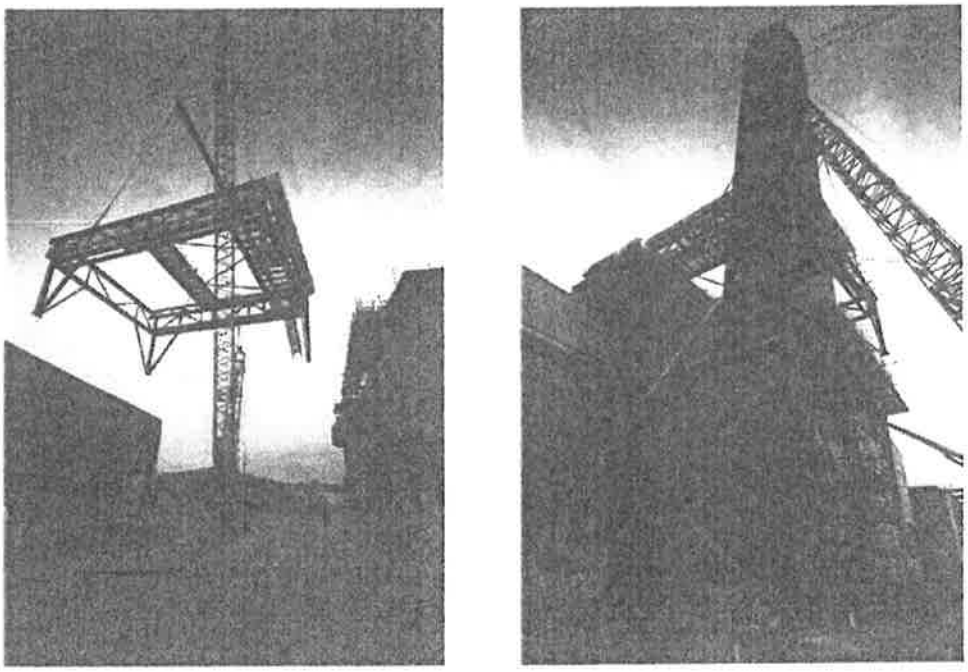


Photo 5.23: Gas heater structure

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.
- 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.

Example – Prefabrication of Steelwork

Design for Safety Considerations:

- Works by Specialist Contractors

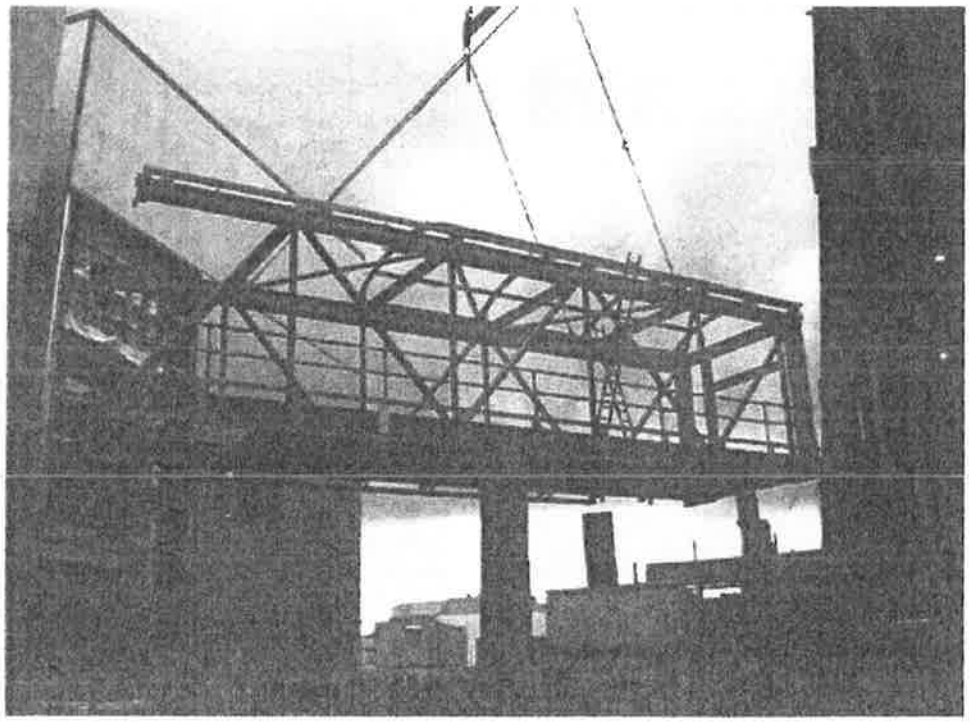


Photo 5.24: Lifting of link bridge

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
- 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.

Example: Temporary Support Steelwork for High Level Work Platform

Design for Safety Considerations:

- Construction stage hazards

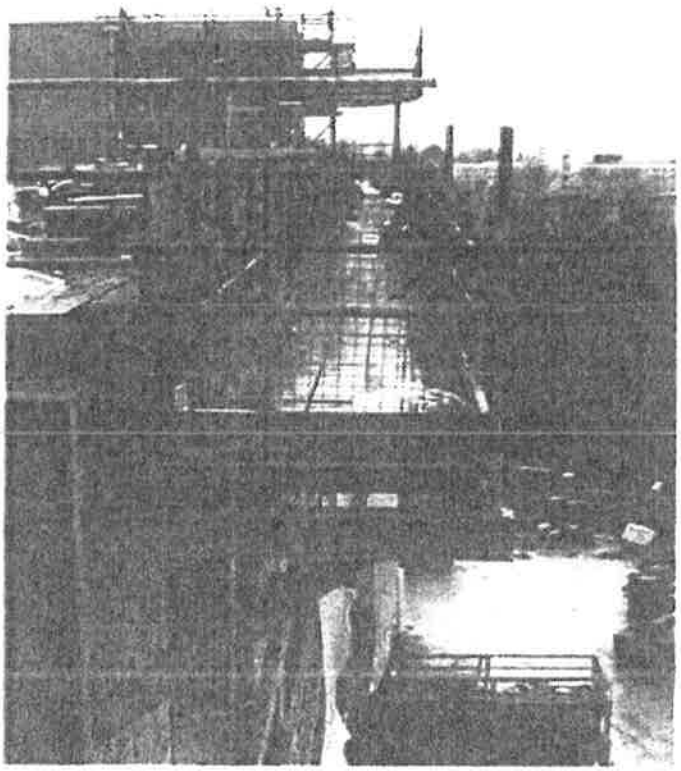


Photo 5.25: Temporary cantilever steel brackets

- 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).

- 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.

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

Example: Handrails Designed and Installed onto Staircase

Design for Safety Considerations:

- Construction stage hazards – fall from heights

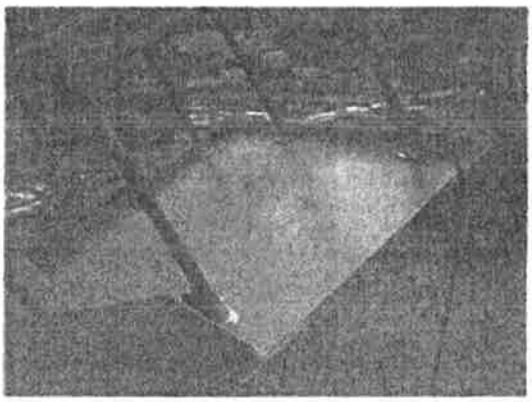


Photo 5.26: Temp. stair handrails installed at ground level

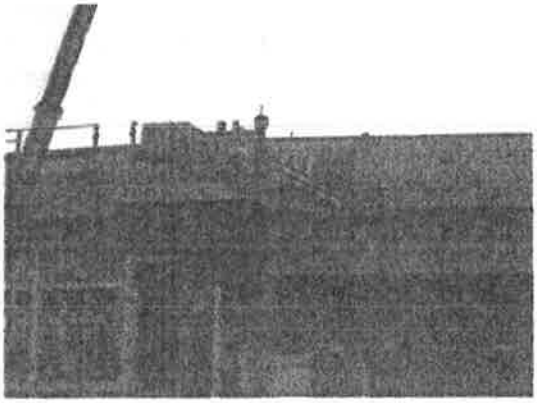


Photo 5.27: Staircase with Edge Protection being lifted into the Structural Steel

Benefits

- Minimises work at height (including scaffolders).
- Quicker to install protection at ground level rather than moving all materials to the staircase and also reduces manual handling risks.
- Handrail was installed by scaffolders away from the main erection process thus no conflict of trades working in the same area.
- Purpose made fixings for the scaffold uprights make this a much sturdier form of edge protection than is typically found on staircases.
- Fixing for the permanent handrail were already in place which was a time and quality saving (no damage to intumescent paint).

Drawbacks

- Need to have design from the permanent handrail Designer/installer at the structural steelwork stage of project design.

Appendix 8

Learning Activities

Learning Activity 1

Objective:

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

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 purposes 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.

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 Meeting 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 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