CONSTRUCTION INDUSTRY COUNCIL
建造業議會

ARCADIS

Reference Materials

on the Design for Safety Management System for the Hong Kong Construction Industry

Version 1

November 2022

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ABBREVIATIONS & TERMS

Abbreviation	Definition
BIM	Building Information Modelling
CDE	Common Data Environment
CDM	Construction Design and Management (CDM) Guidance Regulations 2015 and HSE's L153 Guidance – United Kingdom (UK)
CIC	The Hong Kong Construction Industry Council
CPD	Continuing Professional Development
CPP	Construction Phase Plan
DfS	Design for Safety
DfSP	Design for Safety Professional (Singapore)
DfMA	Design for Manufacture and Assembly
HSE	Health and Safety Executive (UK)
H&S	Health & Safety
PASS	Performance Assessment Scoring System
PCI	Pre-construction Information
PV	Property Vehicle
RAG	Red, Amber & Green Lists
RMAA	Repair, Maintenance, Alteration and Addition
SIA	Singapore Institute of Architects
O&Ms	Operation and Maintenance Manuals

01

INTRODUCTION

1 INTRODUCTION

1.1 Background

Hong Kong's Journey to Safer Design Practices

The current Design for Safety (DfS) practices in Hong Kong are based on the United Kingdom's Safety in Design approach and Construction Design and Management (CDM) model. In 2006, Hong Kong's first CDM model was implemented based on the United Kingdom's CDM 1994 model, while Singapore also implemented a similar model.

The Development Bureau (DEVB) has published the Guidance Notes on Design for Safety and Worked Examples in 2016, which brought positive changes for the Hong Kong construction industry by specifying responsibilities on the duty holders and the Safety Design concepts engaged in the different stages of the construction projects.

In 2020, the Hong Kong Construction Industry Council (CIC) Task Force on Design for Safety (Task Force) was formed in May 2020 and a road map on the implementation of Design for Safety in the Hong Kong Construction Industry was agreed. One main element in this roadmap is to develop a Design for Safety Management System and training programmes applicable to various types of construction projects in the Hong Kong Construction Industry.

The Reference Materials have been referencing to DEVB's DfS framework with an intention of supplementing it with more details, drawing from experiences and practices of CDM in United Kingdom and Design for Safety in Singapore as well as comments received from the stakeholder engagement meetings.

1.2 What is 'Design for Safety'?

What is Design for Safety?

Design for Safety (DfS) is the process of identifying potential hazards and reducing health and safety risks through adequate design earlier at the conceptual and planning phases and throughout the project lifecycle.

Why is Design for Safety important?

The purpose of DfS is to improve the overall management of health, safety and welfare in the construction industry. By proactively applying the principles and guidelines set out in this report, members of the industry can apply best practices to deliver construction projects to prevent incidents (including injuries and illness to workers and members of the public), and to deliver timely and cost-efficient projects. Safe Design is the most effective risk control measure which is achieved by eliminating the hazards at source (Development Bureau, 2016). The strategic roadmap (Figure 1) on Design for Safety in Hong Kong is to ultimately introduce pilot schemes, facilitate use of digital tools, and set up a DfS Knowledge Hub to become a leader in safe design practices.

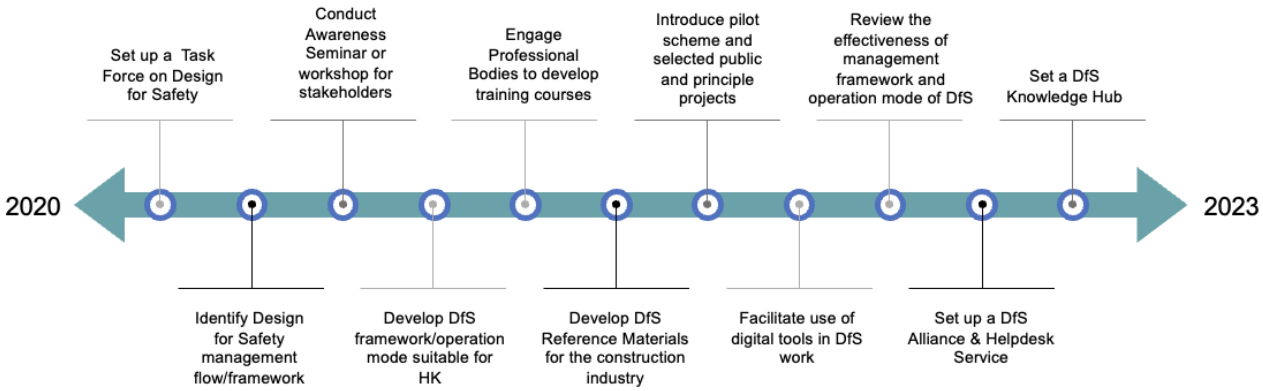

Figure 1 Roadmap on Design for Safety

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FRAMEWORK OF DESIGN FOR SAFETY

2 FRAMEWORK OF DESIGN FOR SAFETY

2.1 Supporting Legislation and Regulatory Requirements

Currently, there are three major laws governing industrial undertakings and occupational safety (OSH) in Hong Kong: Boilers and Pressure Vessels Ordinance (Cap. 56), Occupational Safety and Health Ordinance (Cap. 509), Factories and Industrial Undertakings Ordinance (Cap. 59) and its subsidiary legislation, as illustrated in Figure 2 below.

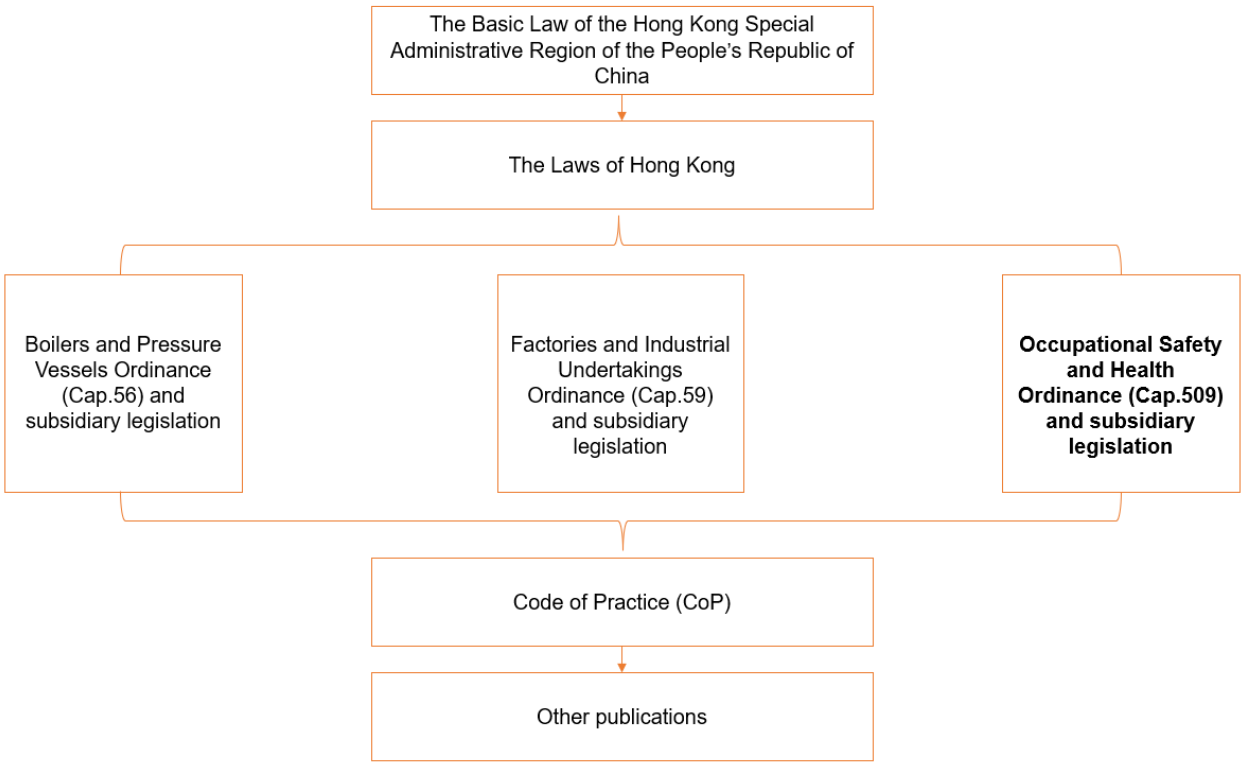

Figure 2 Framework chart of legal system of OSH in Hong Kong

In accordance with section 7A(1) of the Factories and Industrial Undertakings Ordinance (Cap. 59), the Occupational Safety and Health Branch of Labour Department issued a Code of Practice (CoP) on Safety Management in 2002 to provide practical guidance for proprietors and contractors to comply with the legal requirements. In addition to its special legal status, this CoP enables proprietors and contractors to have a better understanding of their roles and responsibilities and provides guidance on establishing and maintaining a safety management system, as well as safety audits and reviews.

The Building (Construction) Regulation (Cap. 123Q) which has come into operation since February 2021 requires the provision of adequate means of access for maintenance and repair of external building elements of a building (i.e. external walls, external claddings, curtain walls and roofs, as well as their projections).

In this connection, the Buildings Department issued a Code of Practice on Access for External Maintenance in February 2021, superseding the advisory Code of Practice on Design for Safety – External Maintenance 2019, to provide guidance on compliance with these requirements. This new regulation and CoP articulate the approach to integrate the maintainability concept in the building design so as to facilitate maintenance and repair of building.

2.2 CORE Guiding Principles

The key principle of “Design for Safety” is to identify potential health and safety hazards and their associated significant risks with the corresponding mitigation and treatment measures at the planning or design stage of a project. This principle is beneficial for the project by addressing time and cost concerns, risk mitigation, and prevention of having to make design changes in the later stages.

Based on the existing legislation related to occupational safety and health, this report provides a Design for Safety framework that aims to cultivate safety best practices to strengthen the safety culture in Hong Kong under four “CORE” guiding principles (Figure 3). First, enhanced communication and coordination between all duty holders across the project lifecycle from project setup to maintenance/operation phase. Second, encouragement for industries to adopt greater ownership of safety and health outcomes. Third, risk reduction at the source by requiring all duty holders to remove, minimise, and communicate the risk they create. Finally, conduct iterative project and training to ensure project resources are equipped with necessary requirements and review lessons learned throughout the project.

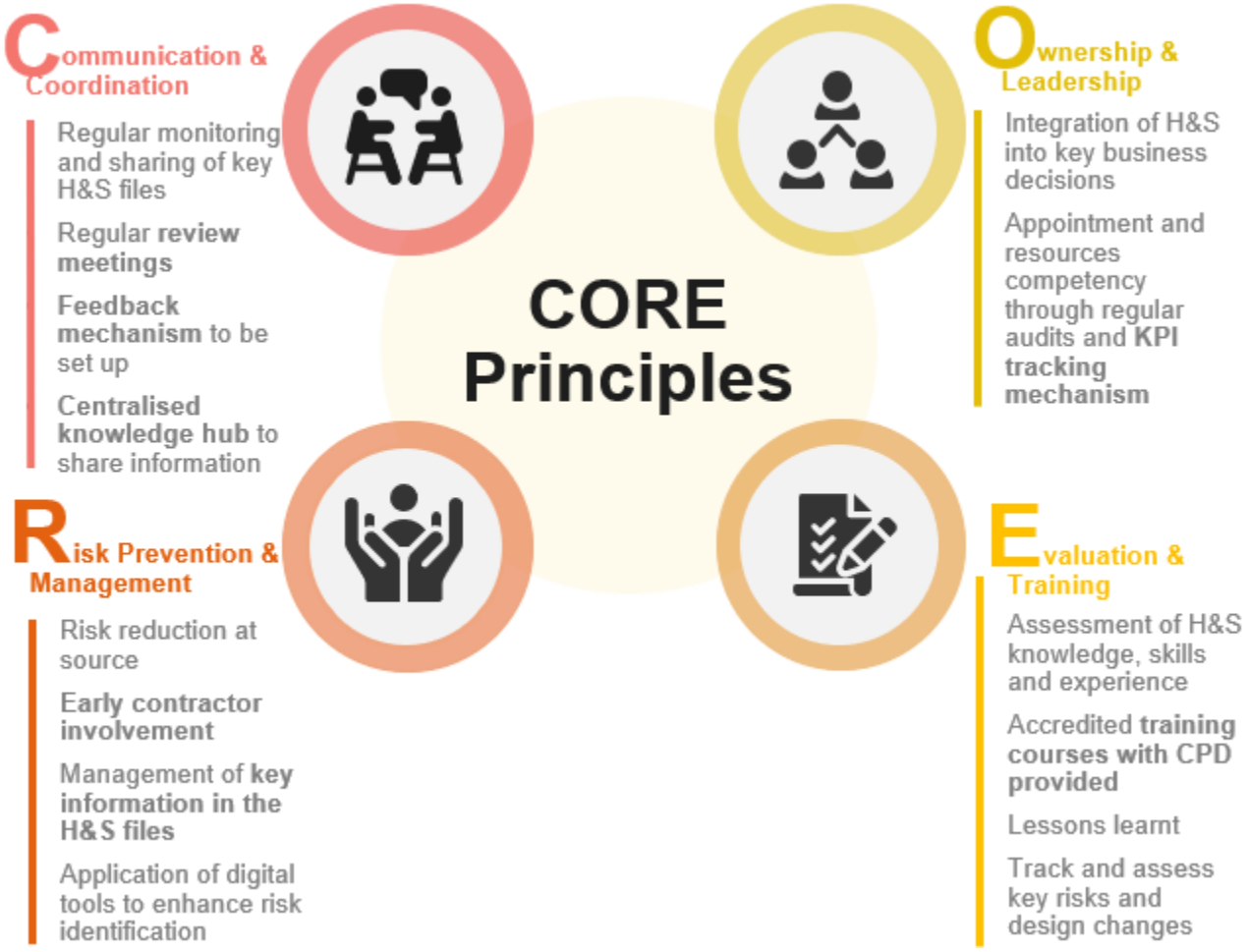

Figure 3 'CORE' Principles

1. Communication and Coordination
    - Maintain, monitor, and regularly update **relevant information into Pre-Construction Information (PCI)/ Health and Safety File** (Asset / Building Manual)
    - Conduct **regular review meetings** hosted by a competent duty-holder who understands design principles, when there is sufficient design concept / preliminary design, prior to

detailed design, to communicate lessons learnt, standards, and reduce risks prior to commencement of construction.

- Set up a **feedback mechanism** to notify Designers when there is design change or incidents occur during the construction stage, and operation and maintenance stage. Information collected should be reviewed regularly to identify core causes of safety problems encountered during the construction stage.
- Coordinate to share relevant information of identified risks to eliminate or mitigate risks related to the project, including within the design and enable duty holders, the construction industry and academia to collaborate, and share knowledge and information digitally through a **centralised knowledge hub** which will be provided by Client/project management team (please see in Reference Materials – Section 5 Templates & Tools)**.**

2. Ownership & Leadership

- Encourage organisations in all industries to **adopt greater ownership** at the beginning of the project and demonstrate leadership of safety and health outcomes
- Ensure **competency** during appointment of resources, and maintain performance through regular audits and include suitable KPI tracking mechanism (please see in the Reference Materials – Section 6 Templates & Tools)
- Group key stakeholders in a **review team**
- Integrate **Health & Safety considerations** into key business decisions

3. Risk prevention and Management

- **Reduce risk at the source** by requiring all duty holders to remove, minimise, and communicate the risk they create
- **Promote early involvement of construction experts** in the initial conversation to help mitigate risks and improve project performance. In order to achieve Safe Design, Client's team with construction management experience or Contractors engaged as advisor at an early stage of the project to offer input into the design phase (please see in the Reference Materials – Section 6 Templates & Tools).
- Include more DfS factors and outline significant risks in a **Tender Stage framework**.
- Design around the identified risks, and **manage key information in the PCI/H&S file**
- **Promote application using digital visualisation (i.e. BIM, Virtual Reality etc.) and tools** to enhance identification of risks that can be eliminated or reduced at earlier stages and prevention measures are implemented during construction and in use stage.
- **Implement an operating model** that duty holders can respond quickly to identified hazards or risks

4. Evaluation and Training

- Assess that the project team has **necessary and relevant skills**, knowledge and experience, and update training requirements accordingly
- Provide **evidence of accredited training courses and have records of CPD** via professional institution for respective roles
- Provide **evidence of all relevant skills, knowledge and experience** by including accredited training courses and have records of CPD via their professional institution for their role.
- **Evaluate risks and lessons learnt** during the project life cycle, not just at the end of the project

2.3 'Safety First' Mentality

Most industry practitioners currently focus on cost-saving measures and are concerned about the lack of resources and competent workers. This mindset must change to focus on maintaining health and safety performance as a part of the industry professionalism. Project leaders, industry practitioners, and businesses must shift to a safety-first mind-set and culture that leads to safer behaviour committed by all duty holders. This mentality shift can be achieved by applying the following:

Expand Physical and Mental Health Prevention Efforts throughout the DfS process

- Expand occupational disease prevention efforts
- Increase health hazard surveillance to more workplaces
- Consider practical solutions on site (e.g. mobile health kiosk, on-site regular health consultation kiosk)
- Consider on-site training that can cover the majority of frontline workers, especially non-skilled workers

Build Companies' Capabilities to Promote Workforce Health

- Develop guidelines on job adaptations that employers can take to support workers in managing their diseases
- Build companies' capabilities to promote workforce health by developing guidelines on job adaptations that employers can take to support workers in managing their chronic diseases and upskill professionals in workforce health
- Raise awareness of measures that promote workers' mental health

Promote application of incentive programmes

- Aim to motivate workers to work with safe behaviour and to increase safety awareness among the workers on construction sites
- Consider and supplement government-led incentive programs (such as the Pay for Safety scheme) to encourage safety awareness by removing restrictions to safety-related items from the consideration of competitive bidding.
- Focus on incentive implementation in the new works, sizeable RMAA works, etc. when starting the adoption of DfS across the construction industry.
- Offer an incentive scheme that may include guidelines for cost savings, promotions of increased Contractor participation by outlining shared gains and benefits for Contractors, publication of H&S / DfS practices in annual report
- Consider the implementation of an incentive scheme for workers (such as the "Worker Safety Point Deduction Scheme" published by the Hong Kong Registered Contractors Association) in the construction sites in Hong Kong. The scheme should aim at reducing accidents at work by enhancing workers' safety awareness, and providing opportunities to workers and management level to work hands in hands and to maintain a safety environment at work.
- Encourage safety awareness by removing restrictions to safety-related items from the consideration of competitive bidding. Typically, when selecting the duty holders (i.e. Designers and Contractors) in the tender evaluation, there should be incentive rating/scoring for those who are providing evidence of best practice and lessons learnt related to DfS.

Promote publication of H&S performance

- Promote publication of company's performance in terms of workplace fatality and major injury rates, normalised by workforce size and industry to facilitate meaningful comparison.
- Share work injury compensation claims data with insurance industry, so that premiums can be differentiated according to the performance of a firm.

- Labour Department issues suspension notices, improvement notice and Reference Manual for Inspection Reports on Workplaces to contractors in public and private sectors. Such actions reflect serious unsafe site conditions of construction firms.

03

ROLES & RESPONSIBILITIES

3 ROLES AND RESPONSIBILITIES OF DUTY HOLDERS

3.1 Overview

The 2016 Guidance Notes of Design for Safety in Hong Kong have specified roles and responsibilities for four key duty holders, which include **Client, Designer, Contractor and Maintenance Supervisor**. This section of the report aims to enhance the demarcation of roles and responsibilities.

3.1.1 Client

Definition

The Client is an individual, or a number of individuals, a company, or organisations, for whom a construction project is carried out for, who is 1) financing the project, 2) is able to influence many major decisions involved in the project. Clients only have duties when the project is associated with a business or other undertaking (whether for profit or not). This can include for example, developer, local authorities, school governors, insurance companies and project originators on Private Consortiums projects, as well as the owners of a residential unit.

Roles & Responsibilities

	• To provide management support (i.e. allocation of sufficient time and resource) • To establish and provide relevant information to the project team • To promote "safety first" mentality in the workplace; consider application of H&S incentives or benchmarks to the duty holders, and alleviation of cost concerns that may hinder project health and safety • To coordinate sharing of identified risks to eliminate or mitigate risks related to the project
	• To clarify the time required for the completion of the project • To ensure clear contractual relationships and allocation of safety responsibilities • To appoint and empower the Designer, Main Contractor, and Maintenance Supervisor to carry out their duties safely • To appoint project roles including: - A Designer to undertake the project and ensure other roles are competent by assessing qualifications, experience, and professional membership status - A Designer to comply with their duties in terms of DfS • To group duty holder leads in a project review team • To ensure management arrangements are in place, maintained and actioned through the project lifecycle • To ensure that sufficient welfare facilities are provided by the Main Contractor and checked by the Client or representative at the start and continued to be maintained throughout the project.

	• To be advised by the Designer on safety and health aspects of the design, such as finalising the type of design and materials used • To reduce significant risks at the source by requiring all duty holders to remove or minimise the significant risk they create • To ensure the Contractor's Construction Phase Plan has sufficient arrangements to manage the identified risks obtained the provide Pre-Construction Information before works commence and ensure construction work can be carried out according to the plan safely without risk to health of any person who may be affected • To check completion and handover arrangement prior to completion • To promote rehearsals to help enhance identifying significant risks that can be eliminated or at least reduced
	• To set and review KPIs, both Lead & Lagging Indicators, for the Designer, Contractor and Maintenance Supervisor. • To set and review lessons learnt with the Designer and his design team, Contractor and Maintenance Supervisor throughout the construction lifecycle

3.1.2 Designer

Definition

Designer is an organisation or individual who plan or alter a design or specify a particular method of work or material. This would include architects, architectural technologists, civil and structural engineers, mechanical and electrical engineers, quantity surveyors, interior designers, temporary work engineers, building surveyors, technicians or anyone who specifies or alters a design for permanent or temporary structures and works.

Roles & Responsibilities

	• To ensure full cooperation and coordination with other duty holders from inception throughout the construction lifecycle • To ensure all relevant information on design, construction and maintenance are available to duty holders
	• To make/check the Client is aware of their responsibilities • When preparing or modifying a design, the Designer must take into account the general principles of prevention • To assist the Client in preparing PCI

	• To provide relevant information for the PCI Note* To prepare, develop, collect information for PCI, this function should be carried by the Designer with support of the design team. • To conduct a risk assessment for their own design, ensuring that all foreseeable significant design risks are eliminated or reduced through the design plan and collective protective measures are taken to manage any residual design risks. • To establish construction method and a structure of risk assessment • To inform the Contractor about any significant health and safety risks/hazards associated with the design • To reduce risk at the source by requiring all duty holders to remove or minimise the risk they create Note* Significant risks are not necessarily those that involve the greatest risk, but those (including health risks) that are not likely to be obvious, are unusual, or likely to be difficult to manage effectively (i.e. not trivial and obvious risks).
	• To demonstrate information is provided in relevant and uniformed format following a recognized and auditable process and procedure and where applicable using standardised templates • To share such information other than via meetings in accessible and usable format agreed by the Client such as using a Common Data Environment (CDE) • To review lessons learnt with themselves and Designer

3.1.3 Contractor

Definition

A Contractor can be an individual or a company that carry out actual construction work. It is noted that a maintenance contractor can be classified under the Contractor role during the Maintenance Stage. It is noted that this role should be used purely during the asset / building lifecycle stage.

Roles & Responsibilities

	• If more than one contractors on the project, worker/contractors are to inform main contractor of any foreseeable risks • Information provided to the workforce must include a suitable site induction, where not already provided by the Main Contractor, including procedures to be followed in the event of serious and imminent danger to health and safety • Information provided to the workforce on risks and required control measures to health and safety risks identified by the risk assessments • To inform duty holders on H&S risks and control measures to as identified in construction stage • To cooperate with others and coordinating their work with others working on the project

	• If only the contractor for the project, prepare before any construction works start that the arrangements in the Construction Phase Plan (CPP) are adequate and regularly reviews and revises the plan to ensure it takes account of any changes that occur as construction progresses and continues to be fit for purpose. The Construction Phase Plan (CPP) depends upon the complexity of the project information obtained in the PCI at tender and prior to the commencement of works including Design Risk Register updates etc. Contractor has the flexibility to integrate elements suggested in CPP into Construction Health and Safety Plan when deemed suitable. • If only the contractor for the project, to plan, manage, and monitor the construction stage and coordinate health and safety • If only the contractor for the project, to ensure that suitable welfare facilities are provided at the start and maintained throughout the works • To prepare and update H&S File in construction stage and review regularly throughout the construction stage
	• To take reasonable steps to ensure that the H&S risks identified in PCI and during construction stage are properly managed • To ensure the right arrangements and controls are adopted to prevent accidents and incidents • To plan, manage and monitor their own work to make sure that each worker is under their control with appropriate supervision, instructions and information so that construction work can be carried out, so far as is reasonably practicable, without risks to health and safety • Must not begin work unless reasonable steps have been taken to prevent access by unauthorised persons (risk to third parties i.e. members of the public etc) to that site • In the construction stage, to keep full records of all safety and health issues, e.g. accidents or any prosecutions.
	• To ensure that all the workers have been provided with suitable health and safety induction, information and training • To provide and share appropriate and relevant information related to health and safety • To check, monitor and coordinate that their managers, supervisors and workers are fulfilling their duties on health and safety • To review lessons learnt and if there is more than one contractors on the project with Main Contractor

3.1.4 Maintenance Supervisor

Definition

The Maintenance Supervisor (e.g. Facilities Manager, Asset Building Supervisor) is in charge of overseeing operating and the upkeep of a building, including cleaning, maintenance, alterations, refurbishment and demolition during Maintenance Stage.

Roles & Responsibilities

	• To participate in meetings with Designer at the design stage where applicable (To best suit various construction projects in Hong Kong) • To work, coordinate, and cooperate with the Client • To suggest the contents, format for new projects and during any changes to the asset (i.e. replacing cladding, glazing, materials and changes to integrity of the structure during the asset lifecycle • To provide key relevant information into H&S File (Asset or Building Manual)
	• To study the H&S File that records all the details specific to the maintenance stage (i.e. maintenance access strategy and plant replacement or removal strategy etc) • To appoint the competent maintenance contractors • To plan, manage and monitor the maintenance work and coordinate health & safety • To update and hand over H&S File to future owners
	• To obtain all necessary information (e.g. the information from the H&S File and / or supporting operational and maintenance manuals, in order to carry out the works safely) • To keep full records of all safety and health issues, e.g. accidents or any prosecutions • To ensure the right arrangements and controls are adopted to prevent accidents and incidents
	• Project team provides training to relevant duty holder (e.g. facility management workers, building operator, etc.) on how to operate and maintain the building or asset provide the H&S File and any supporting Operation and Maintenance Manuals (O&Ms) for fully understanding the maintenance procedures and ensuring a safe working environment so as to reduce the risk of injury to the maintenance workers. • To review lessons learnt with Designer (lead/coordinating role), Designers, and the Contractors

3.1.5 Functional roles to coordinate DfS

The proposed addition of functional roles (i.e. *Designer (lead/coordinating role)*, *Main Contractor*) were introduced in the Draft Report and have been validated during the stakeholder engagement workshops. Across the workshops, stakeholders noted that the new terminology may cause confusion to local practitioners who are practising the current DfS requirements based on the 2016 DevB Guidance notes. Since many industry practitioners are still adapting to DfS practices, the introduction of new terms may take time to be adopted by the industry. As a result, this section outlines the functional roles and responsibilities that are required by specific tasks to achieve enhanced Design for Safety throughout the project life cycle following the CORE guiding principles.

<u>Functional roles and responsibilities of a Designer (lead/coordinating role) during the design stage</u>

Definition

There should be a functional role of Designer (lead/coordinating role) to coordinate the DfS during the design stage and construction stage appointed by Client to coordinate with

designers/contractors. This functional role can also be taken up by a Client Representative, Architect, Authorized Person or Project Manager. The Client can decide to appoint a coordinator or team with a functional role of DfS if there is a lack of DfS capability of Designer (lead/coordinating role) when the Client does not have the in-house capability and resource of a competent person to advise the Health & Safety.

Roles & Responsibilities

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To convene regular DfS review meetings
To maintain the DfS Register/PCI
To establish and provide key relevant information

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Plan, manage, and monitor the design work during design phase (which can during a Design & Build carry on during the construction phase) and coordinate Health & Safety
Assist the Client to identify and gather the pre-construction information
Developing and provide pre-construction information to Designer (lead/coordinating role) and Contractors (incl. Main Contractor)
Oversee and coordinate with the designers to identify latest building techniques and mitigate foreseeable significant risks

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Liaising with the Main Contractor to ensure the design is coordinated;
Providing information to the Main Contractor (the pre-construction information and the construction information)
Receiving information about any potential issues or proposed changes to the design

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This role is appointed by the Client, and may undertake the duties of the Client, only on their behalf, contractually
To get subsequent feedback from users to assist designers in improving their future designs may be provided through the below methods:

Post occupancy evaluations
Defect reports
Accident investigation reports
Information regarding modifications
User difficulties
Deviations from intended conditions of use

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To plan, manage and monitor the pre-construction information flow and design coordination related to the health or safety of the project
To provide all relevant information on each foreseeable significant risk identified and its mitigation to the Client
To identify and analyse risks at source
To reduce risk at the source by requiring all duty holders to remove or minimise the risk they create

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	• To lead application of digital visualisation (i.e. BIM etc) and rehearsals to help enhance the identification of significant risks that can be eliminated or at least reduced Note* A significant risk is not necessarily one that involves the greatest risk, but those (including health risks) that are not likely to be obvious, are unusual, or likely to be difficult to manage effectively (i.e. not trivial and obvious risks).
Evaluation & Training	• To demonstrate information is provided in a relevant and uniformed format following a recognised and auditable process and procedure and where applicable using standardised templates • To share such information other than via meetings in an accessible and usable format agreed by the Client such as using a Common Data Environment (CDE) • To demonstrate they have the necessary and relevant skills, knowledge and experience and provide evidence of such including accredited training courses and have records of CPD via their professional institution for their role. The accreditation can be covered in two ways - engaging with CIC to set up an accreditation scheme as used in UK under the Safety Scheme In Procurement (SSIP) where individuals and organisations require to provide evidence and are assessed annually and / or as undertaken in Singapore where the DfS Professional has to have attended an accredited course and passed an assessment in the last 5 years. • To check, monitor and coordinate that the designers are fulfilling their duties • To review lessons learnt with the Design team

The benefits of this role include:

1) To **help and advise the Client** in bringing together PCI.
2) To **work with any other Designers** on the project, as a team, to eliminate or at least reduce foreseeable health and safety significant risks.
3) To become a **single point of contact** that advises the Client and Main Contractor when there is more than one Contractor on the project.
4) To **assist the Client** to select the right Designers.

Proposed pre-qualification questionnaire for Designer (lead/coordinating role)

1	Are you able to demonstrate that you have a policy and system for Health and Safety (H&S) management? Please provide.
2	Are you able to demonstrate arrangements for ensuring that your H&S measures are effective in reducing and preventing incidents and occupational ill health? Please provide including any lessons learnt.
3	Do you have access to competent H&S advice and assistance – both general and construction sector related? Please provide.
4	Do you have a policy and process for providing your workforce with information and training appropriate to the type of work for which your organisation is likely to bid and deliver work? Please provide.

5	Does your workforce have H&S or other relevant qualifications and experience sufficient to implement your H&S policy and procedures for the type of work for which your organisation is likely to bid and deliver work? Please provide.
6	Do you have a process to check and review for any H&S risks arising due to design as post project lesson learnt?
7	Do you have procedures in place to involve your staff in the planning and implementation of H&S measures? Please provide.
8	Do you conduct accident/incident and near miss reporting and undertake follow-up investigations? Please provide evidence.
9	Do you have arrangements for ensuring that your designers and consultants apply H&S measures to a standard appropriate to the work for which they are being engaged? Also, regarding employing designers overseas. Please provide evidence.
10	Do you check that the Client is aware of their duties? Please provide.
11	How do you ensure significant risks are eliminated by design, taking account of the principles of prevention and show how construction and lifecycle risks are eliminated or controlled (with reference to buildability, maintainability and use)? Please provide.
12	How do you effectively manage any design changes, with regard to ensuring H&S during and post-completion for the life cycle of that building or asset? Please provide.
13	Do you review and monitor your design performance, notably in relation to H&S? Please provide.
14	Are you able to demonstrate how you encourage cooperation, coordination and communication between Designers (and anyone else)? How do you review and monitor your design performance and effectiveness in relation to H&S for each project? Please provide.
15	Are you able to provide evidence of your field of knowledge and experience in the design and construction process? e.g. skills, knowledge and experience of H&S within design and construction**.** Please provide.

Functional roles and responsibilities of a Main Contractor during the construction stage

Definition

The Client can decide to appoint a Main Contractor when the project engage more than one Contractor or a coordinator or team with functional role of DfS if there is lack of DfS capability of Main Contractor to monitor the DfS during the construction stage. The objectives include to manage, monitor and coordinate with other Contractors and/or subcontractors they employ. If there is only one Contractor where they directly employ every trade and profession directly as an employee, the Client can evaluate the necessity of appointing this role directly.

Roles & Responsibilities

	• To request from designers all information regarding the identified risks during design stage • To engage, coordinate, cooperate with all Contractors • To engage and communicate with workers, in order to 1) ensure clarity on requirements and issues, and 2) develop "safety-first" attitudes and behaviours
	• To prepare before any construction works start that the arrangements in the Construction Phase Plan (CPP) are adequate and regularly reviews and revises the plan to ensure it takes account of any changes that occur as construction progresses and continues to be fit for purpose. Main Contractor may choose to integrate the elements suggested in CPP into Construction Health & Safety Plan where deemed suitable • To plan, manage, and monitor the construction stage and coordinate Health & Safety • To ensure that sufficient welfare facilities are provided at start and continued to be maintained through the project • Preparing and developing during the Construction Stage the Health & Safety File, and passing the file to the Client at the end of the construction
	• To ensure all contractors are provided with the information they need to carry out their work safely and without risks to health • To take reasonable steps to ensure that the risks identified are properly managed • To prepare and enforce any necessary site safety rules • To reduce risk at the source by requiring all duty holders to remove or minimise the risk they create
	• To check, monitor and coordinate that the contractors are fulfilling their duties • To review lessons learnt with themselves and the Contractors

The benefits of this role include:

1) To **take account of all the health and safety risks** to the individual workers
2) To ensure arrangements are in place and allow **sufficient time and resources** on site, which later becomes the Client's responsibility
3) To be **a single point of contact** that liaises with the Client and Designer (lead/coordinating role) for the duration of the project
4) To prepare the Construction Phase Plan (CPP) or integrate into Construction Health and Safety plan before the construction phase begins with the necessary arrangements to manage the risks, and regularly review and revise it through the project

Proposed pre-qualification questionnaire for Main Contractors

1	Are you able to demonstrate that you have a policy and system for Health and Safety (H&S) management? Please provide.
2	Are you able to demonstrate arrangements for ensuring that your H&S measures are effective in reducing and preventing incidents and occupational ill health? Please provide including any lessons learnt.
3	Do you have access to competent H&S advice and assistance – both general and construction sector related? Please provide.
4	Do you have a policy and process for providing your workforce with information and training appropriate to the type of work for which your organisation is likely to bid and deliver work? Please provide.
5	Does your workforce have H&S or other relevant qualifications and experience sufficient to implement your H&S policy and procedures for the type of work for which your organisation is likely to bid and deliver work? Please provide.
6	Do you check, review and where necessary to improve your H&S performance? Please provide.
7	Do you have procedures in place to involve your workforce in the planning and implementation of H&S measures?
8	Do you conduct accident/incident and near miss reporting and undertake follow-up investigations? Please provide evidence.
9	Do you have arrangements for ensuring that your suppliers apply H&S measures to a standard appropriate to the work for which they are being engaged? Please provide.
10	Do you operate a process of risk assessment capable of supporting safe methods of work including permits and reliable project delivery where necessary? Please provide.
11	Do you have arrangements for cooperating and coordinating your work with others (including other suppliers, notably other contractors) including measuring their performance? Please provide.
12	Do you have arrangements for ensuring that on-site welfare provision meets legal requirements and the needs/expectations of your employees and workforce? Please provide.

Functional roles and responsibilities of a party (either can be a dedicated person or a team) to coordinate DfS

Definition

The Client can decide to appoint a party who is experienced in management of Health & Safety and can support design team to carry the DfS related works across different project phases. Client also has the flexibility to assign the role on DfS to the design team and Main Contractor.

Roles & Responsibilities

	• To coordinate the flow of construction project safety and health risks information among the duty holders
	• This role is appointed by the Client • To monitor and coordinate the Health & Safety from the design stage to the construction stage, and until the handover to the client for operation and maintenance Note* It is the responsibility of the Designer (lead/coordinating role) to plan, manage, monitor and coordinate H&S with the designer team in the Design Stage. While it is the responsibility of the Main Contractor to plan, manage, monitor and coordinate H&S with their Contractors in Construction Stage. The DfS functional role either by dedicated coordinator or Designer or Contractor cannot be expected unless they are empowered by Client to do this (plan and manage) with each of the designers, let alone the Contractors who should be managed by the Main Contractor.
	• To mitigate the significant risks inherent in the design of the project • To reduce the Health & Safety risks during the construction, maintenance or repair phase, and demolition of the building and structure
	• To check, monitor and coordinate that the duty holders are fulfilling their duties in terms of DfS • To review lessons learnt with Client, Designer (lead/Coordinating role) and Main Contractor

The benefits of this role include:

1) To **allocate the responsibilities of DfS** to an experienced entity to manage the safety issues and provide timely audit.
2) To monitor the competency from the beginning to the end of the construction project life cycle to effectively enhance site safety.
3) The appointment of the functional role of DfS can help the Client to develop their initial Strategy Brief, a good to have document for project team which will list the key management

arrangements related to the scope of works and scope of services that need to be covered by each duty holder who are part of the project team during and at each project lifecycle, establishing who is doing what and who in relation to Design for Safety. The Strategy brief may consist of and not exhaustive, as follows:

- Project name
- Project description
- Type – New construction/ refurbishment/asset management/decommissioning
- Details of work scope
- Location/environment
- Anticipated project cost

This is a good way of outlining the Client's key requirements and expectations for the project, including any limitations or restrictions, such as budget, planning constraints and timescales. This Client's Strategy brief is likely to be developed further as the project progresses and may include specifications and standards as well as health and safety expectations. For example, the brief could highlight DfS, on the use of risk registers and Red-Amber-Green (RAG) lists.

The obstacles of introducing this role include:

1) The introduction of a functional role of DfS may **require significant time to train talent** since duty holders in this role should ideally have **background on design** (e.g. carrying out the building design).
2) Reporting lines and management responsibilities of **the functional role of DfS** would be unclear (i.e. setting up a separate management position to manage DfS).
3) The introduction of such a role may cause the excessive reliance **on the DfS Consultant/Professional** and give less care to site safety monitoring and promotion.
4) The role of H&S advisor or functional role of DfS in tender evaluation stage may be a challenge to **procurement practices**, as the proposed role may be expected to conduct a safety assessment in the tendering stage. In the current industry scenarios, it may not be easy to seek an external advisor support in tender stage as the Client may not want a third party to be privy or manage sensitive tendering/procurement information.

Key practical solutions to address the above obstacles of introducing functional role of DfS can include:

1) Clarifying the Roles and Responsibilities of this role
2) Clarifying the Roles and Responsibilities of the Client, Designers, Contractors, Maintenance Supervisor
3) Clarifying the minimum competence (i.e. knowledge, experience and training - CPD) required to fulfill the functional role of DfS i.e. Designer (Architect / Engineer etc & experience relevant to the type of project working. The functional role will usually be individual or team for an organisation or, on smaller projects, they can be an individual with:
    - A technical knowledge of the construction industry, relevant to the project
    - The understanding and skills to manage and co-ordinate the pre-construction phase, including any design work carried out after construction begins.

    This functional role should have the organisational capability to carry out the role, as well as the necessary design skills, knowledge, and experience. Furthermore, this role will need to consider whether they have any gaps in their skills, knowledge, and experience for the project and, if so, seek further advice. The functional role of DfS needs the ability to develop good relationships with the Client and Main Contractor as well as the other designers working on the project.
4) All those taken the functional role of DfS should attend and participate on a CIC DfS 2-Day course with syndicate exercises and assessment to confirm obtaining minimum knowledge of who should be doing what, when and how.

04

APPLICATION ACROSS CONSTRUCTION LIFE CYCLE

4 APPLICATION ACROSS CONSTRUCTION LIFE CYCLE

To ensure that design is safe, and that the duty holders fully understand the key processes, outcomes, and tools of each stage, an overview of the key five stages of a construction project is detailed in this chapter across the Design for Safety Management System.

Figure 4 outlines the key project stages, from project set-up to the operation and maintenance stage, and sets out the details of the roles and responsibilities of the duty holders and project milestones at each stage. The Design for Safety Management System includes the following information:

- Objective of each stage
- Roles and responsibilities of duty holders
- Critical success factors or project dependent notes
- Key outcomes of stage
- Key supporting health and safety files, documentation, and tools

The Design for Safety Management System is developed based on the 'CORE' DfS guiding principles, best practice benchmarking, and survey findings analysis.

The application of the 'CORE' DfS guiding principles throughout the project lifecycle is illustrated in Figure 5. The continuous integration of these guiding principles helps to ensure that the health and safety objectives can be achieved throughout the entire project through

1) Promotion of **early and regular communication and coordination** between all duty holders
2) **Clear demarcation of roles and responsibilities** to promote greater ownership of safety and health outcomes
3) **Early detection of health and safety risk or hazards** and proactive elimination at the source, and
4) **Regular review sessions and training courses** to ensure that project resources are equipped with necessary requirements

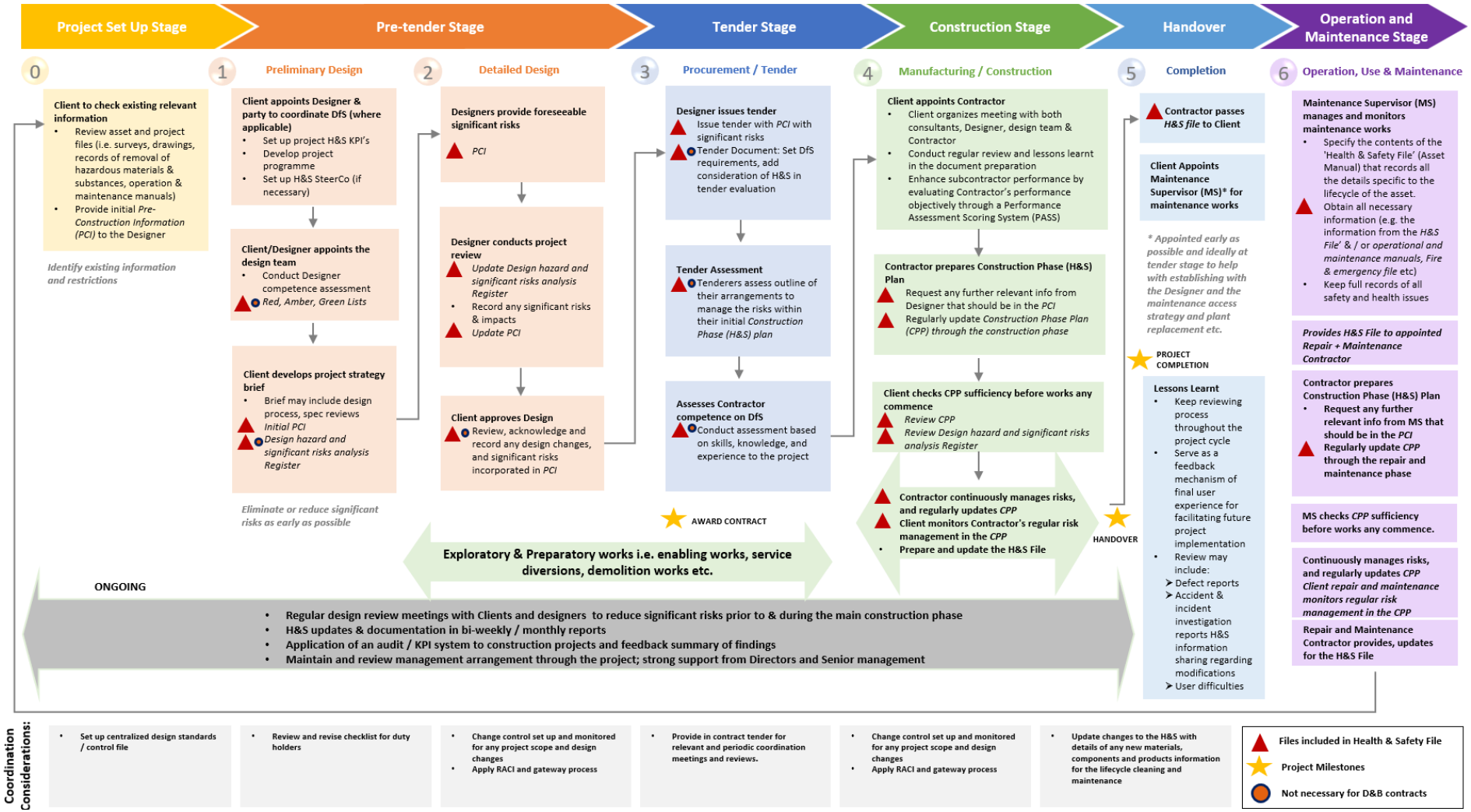


Figure 4 Design for Safety Management System

Note: The above process is for typical normal project lifecycle. As for Design and Built (D&B) Contracts, the appointed D&B Contractor will be taking up design as well as construction works. Therefore the flow sequence of Design for Safety Management System and recommended files/documentations to be included will be adjusted to suit, e.g. there may be no tendering stage and tender assessment once D&B contract is awarded. However, if specialist contractor required to be involved, perhaps the equivalent assessment and evaluation will be conducted internally by the D&B contractor. Some of the documents that may not be necessary required have been identified for D&B contracts.

Similarly for the integration of CORE principles below, the appointed D&B Contractor will take up the Designer and also Main Contractor functional role as outlined in the CORE principle below.

	Project Set Up Stage	Pre-tender Stage	Tender Stage	Construction Stage	Handover	Operation and Maintenance Stage
	DfS Strategic Project Brief	**Pre-construction Information (PCI)**			**Check H&S File**	**Maintain H&S File**
		Intrusive Surveys	Enabling / Demo Works	Construction Phase Plan (CPP)	Check Operation and Maintenance Manuals (O&Ms)	Construction Phase Plan (CPP)
		Provide relevant information and updates for the H&S File (Asset / Building Manual)			Check Certificates	Update H&S File
		Capture & updates relevant information as above via the CDE				
Communication & Coordination	• Client **sets up centralised design / standards** (may be in the form of a control file)	• Designer **shares relevant information of identified risks** to eliminate or mitigate risks related to the project, especially in earlier project stages	• **Designer changes control set up and monitored** for project scope and design changes	• Designer sets out regular meetings and **coordination measures in contract tender**	• Maintenance Supervisor **maintains, monitors, and regularly updates** relevant information into H&S file (Asset or Building Manual)	• Maintenance Supervisor **shares relevant information** in accessible and usable format agreed by the Client such as using a Common Data Environment (CDE)
Ownership & Leadership	• Client should **integrate Health & Safety considerations** into key business decisions	• Designer **ensures clear contractual relationships** and allocation of safety responsibilities	• In preparation and modification of design or change, Designer must take **into account the general principles of prevention**	• Contractor **ensures that sufficient welfare facilities** are provided at start and continued to be maintained through the project	• Maintenance Supervisor **plans the maintenance work** in earlier stages and communicate ownership of responsibilities	• Maintenance Supervisor **effectively hands over** the 'Health and Safety File' future owners
Risk Prevention & Management	• Client & Designer should **reduce risk at the source** by requiring all duty holders to remove, minimise, and communicate the risk at set-up	• Designer **designs around identified risks** and promote application of digital visualisation (i.e., BIM etc.) and tools	• Designer **provides all relevant information** on each foreseeable significant risk identified and its mitigation to the Client/Developer	• Contractor prepares and enforces any necessary site **safety rules** and implementation	• Maintenance Supervisor **maintains full records** of all safety and health risks	• Maintenance Supervisor **ensures the appropriate arrangements and controls** are adopted to prevent accidents and incidents
Evaluation & Training	• Client **conducts kick-off or training session** with addressing project-specific risks and management measures	• Designer **sets and reviews KPIs** (incl. Lead & Lagging Indicator)	• Designer **checks, monitors and coordinates** that the design team fulfilling their duties	• Contractor ensures contractors (and sub-contractors) have **sufficient health and safety induction, information and training**	• Designers and Contractors **set and review lessons learnt** with main duty holders	• Main Contractor **provides training to the Maintenance Supervisor** on how to operate and maintain the building

Figure 5 Integration of CORE Principles in the Design for Safety Management System

4.1 Pre-tender Stage (Project set up and Pre-tender stage)

Objective of stage

The objective of the pre-tender stage is to set out a high-level project master program, identify milestones and deliverables, and determine the scope of a project and the detailed design in collaboration with the designers. This is a key stage in identification of areas where optimising manpower, resources, and finances can be optimised to reduce costs and workplace injuries.

Key process

Project Brief: Prior to the commencement of this stage, the Client should have prepared a brief that outline information related to the project including relevant background information, project type, project objectives, stakeholders and criteria of to be achieved. It should include initial project delivery strategy including contract type and procurement strategy, Health and Safety goal, timeline, resources to be deployed, communication plan, etc. This brief will need to be updated as the project progress and it is good to share with project duty holders.

The purpose of the brief is to share with duty holders while keeping track of essential information related to the project establish whether the Client has identified who has been appointed in which role including specialists, Client commitment and involvement in Design for Safety, has there been sufficient preparation time for the design team and Main Contractor.

Project Set-up

In order set the project up for success at the beginning, the Client should check existing asset and project files of relevant information (i.e. surveys, drawings, records of removal of hazardous materials and substances, Health & Safety File, the supporting Operation and Maintenance Manuals (O&Ms)) and provide initial Pre-Construction Information (PCI).

Regular Monitoring and Management

Throughout the project life cycle, there are four critical elements that should be regularly reviewed and monitor to ensure health and safety in the project, and prevent risks in the early stages:

- *Regular Design for Safety review meetings with Client, Designer and his design team*: The objective is to reduce risks prior to the commencement of construction. In some specific projects, unsafe issues or problems can be found by the engineer and raised directly in the design coordination meeting and discussed with the designer for solution.
- Health and Safety documentation included in bi-weekly / monthly reports: The relevant files and reports will be monitored by Designer (lead/coordinating role) and Client through the project.
- Audit and KPI Tracking: Safety audits are carried out to assess health and safety processes and feedback summary of findings to all stakeholders
- Strong support from top management: this include allow sufficient time and resource for design for safety in project. Health and safety goals are expected to be set up at the forefront of the design phase with appropriate resources provided by the Client

Preliminary design

Client or Designer should appoint Designers (i.e. a design team) who are preparing or modifying designs at this stage as well as the completion of appointing coordinator or team with functional role of DfS if applicable. The role includes to plan, manage and monitor the design or preparatory work which is carried out for a project, which may continue during construction, to coordinate health and safety. It can be combined with other activities such as Designer and / or project management. This will assist with the integration of health and safety in the project. This also enables the provision and flow of information to ensure that DfS / health and safety is considered when making decisions.

Parallelly, Client develops the project strategy brief which describes the Client's requirements in sufficient detail of the Health & Safety goals, minimum standards and gets the relevant Health and Safety team involved with the Client's Project Manager, Designer and his design team in the project scope.

During the preliminary design phase, Designers should ensure the design can be constructed, maintained, used or demolished safely. Regular DfS review meetings will be convened with Client, Designer and his design team to understand the design requirements and identify the potential hazards and associated significant risks in their design. During the design process, the relevant Health and Safety team should also be involved to help ensure the appropriate safety & health measures are considered and adopted in the Design. Designers can use "Red, Amber and Green lists" to have suggestions on what hazards should be eliminated/avoided and if unable to do so reduce the associated significant risks in the design stage.

Once the preliminary design is completed, Designers need to provide the design information to the Designer and produce the list of foreseeable significant risks and all significant concerns / issues on health and safety. All the significant safety & health concerns/issues together with the corresponding responses should be recorded in the "Design Hazard and Significant Risks Analysis Register".

It is at this stage, where possible Client/Designer to engage construction expert (i.e. Client's team with construction management experience or Client to appoint an independent advisor or convene briefing sessions with contractors to provide feedback on projects during the design stage to be involved in DfS review meeting to provide input from contractor point of view) to review the design and support to identify any risk (e.g. if design solution is constructable, raise construction safety concerns, advise accessible issue during construction, operation and maintenance, raise any potential safety concerns due to design or solution) during construction stage that can be addressed through design.

After the completion of preliminary design, a feasibility study will be carried out to shape the final delivered design. Where the feasibility study has been completed, Designers must recommend an alternative design to meet client's need or the structure's requirement with the consideration of the identified safety & health concerns/issues. The "Design Hazard and Significant Risks Analysis Register" should also be updated and completed in this stage. This is a safety analysis tool for identifying hazards and their associated causal factor (i.e. significant risks) when detailed design information is not available.

Detailed Design

Following completion of the "Design Hazard and Significant Risks Analysis Register" at the earlier stage, the design team should proceed with the detailed design. The drawings of design works are expected to include visualisation and hazard symbols where relevant. At this stage, hazard identification and risk analysis and control will be carried out in order to help designers modify their design works. During the hazard identification and risk analysis process, Designers should produce a list of foreseeable significant risks which should be recorded in the same file of "Design Hazard and Significant Risks Analysis Register". It should be constantly updated for recording the risk management activity across the project stages. It records all details of the hazard, the significant risks, the assessed risk exposure and the relevant party who is undertaking the treatment and their current progress. Subsequently, it should be updated regularly and communicated to downstream duty holders.

Designer should update the relevant PCI and review Design Hazard and Significant Risks Analysis Register to record any significant risks and impacts when producing the design works. Where the detailed design stage is completed, Designer needs to record and document all the significant hazards and impacts identified in the Design Hazard and Significant Risks Analysis Register to facilitate the design risk management.

Upon the Client's approval on the design works with design changes and any significant risks incorporated, it will be granted to proceed to the tendering stage.

Critical success factors

- **Design for Safety Review Meetings**
  Regular DfS review meetings are convened by the Client or Designer and his design team for design related reviews and updates on the new construction, additions, demolitions and other major modifications. Clients or Designer can suggest how to prepare and run an effective DfS review meeting. Safety is enhanced when Designer performs design related safety review and constructability review in the design stage. Upon approval of the design works, Designer can update the Pre-Construction Information and proceed with tender and construction documents.

- **Pre-Construction Information (PCI)**
  The Designer (lead/coordinating role) has an important role in assisting the Client by taking control of the health and safety in the pre-tender phase. One of the key obligations of Designer (lead/coordinating role) is to prepare the Pre-Construction Information (PCI) which contains health and safety hazards and how they will be addressed. This starts during the pre-tender phase but is a continuing obligation. By updating and communicating this information with key duty holders in the project, the project team can share the health and safety information from one source.

- **Earlier involvement of Construction Experts in the initial conversation**
  Evidence from the Survey and Stakeholder engagement indicate that early involvement of construction experts in the initial conversation before detailed design can mitigate risks and improve project performance. In order to achieve Safe Design, construction experts should be engaged at an early stage of the project to offer input into the preliminary design phase. Involving contractors earlier can improve design quality, lessen variations during construction and prepare more accurate cost estimates. In addition, facility/property management or future owners (where applicable) should be engaged in the design stage to ensure suitable measures are provided to allow for maintenance and repair access or temporary safety measures are considered in the design.

Key outcomes

- Check on existing H&S Files of previous projects
- Development of Pre-Construction Information (PCI)
- Approval of design works by Client
- Hazards identification and mitigation during the design stage by preparing and updating the files including “Design Hazard and Significant Risk Analysis Register”, “Red, Amber and Green lists”
- Drawings of design works

Key supporting files

- Construction Project Notification (if applicable)
- Initial Pre-Construction Information in Preliminary Design
- Summary of Health and Safety Concerns
- Design Hazard and Significant Risks Analysis Register
- Red, Amber and Green (RAG) Lists
- Drawings
- Updated Pre-Construction Information (PCI) in Detailed Design by designers

Technology solutions

Once the preliminary design has started, Client needs to set up Organisational Information Requirements (OIR) related to the Project Information Requirements (PIRs) & Asset Information Requirements (AIR) via Exchange Information Requirement (EIR). During the design phase, Designer with design team are recommended to use visualisation and 3D by using Building Information Modelling (BIM) as a minimum for clash detection and logging Health and Safety significant risks.

BIM is a shared digital representation of a built asset and is initiated for the sake of managing construction projects effectively and efficiently. In the local context, Construction Industry Council (CIC) released BIM Standards - General (Version 2 - December 2020) in 2020, which contains major enhancements to align with ISO 19650's Information Management principles, workflows and requirements, also providing Hong Kong 'Local Annex' of ISO 19650-2:2018.

4.2 Pre-construction Stage (Tender stage)

Objective of stage

Following the Pre-tender stage, the tender stage will set out procedures for obtaining tenders for the agreed construction works afterwards. The purpose of the tender is to select a main contractor or Contractors to carry out the works on the basis of approved design and value for money. The Client is responsible for promoting the "safety first" mentality in the workplace and allocating the safety responsibilities and to ensure the main contractor has sufficient arrangements to manage the identified risks. Therefore, safety and health should be included as a parameter during the tendering phase.

Key process

The Pre-Construction Information (PCI) of significant risks is the fundamental document for the invitation for tenders. This document incorporates the design changes with the known hazards and will be shared with Client and Client's Project Manager.

At this stage, those with the functional role in DfS that equipped with strategic design & construction knowledge and experience is appointed by Client to conduct tender evaluation. The accreditation of those involved in functional role of DfS can be covered in two ways - engaging with CIC to set up an accreditation scheme as used in UK under the Safety Scheme In Procurement (SSIP) where individuals and organisations require to provide evidence and are assessed annually and / or as undertaken in Singapore where the DfS professional has to have attended an accredited course and passed an assessment in the last 5 years. It should not only include the considerations of tender price competitiveness, but also the safety and health performance of the tenderers and whether the tenders conform to the specifications, terms and conditions laid down in the tender documents. The detailed requirements on the tenderer's qualification (i.e. skills, knowledge, experience related to the project) are stipulated in the tender documents. An interested party may submit the Outline Construction Phase Plan (CPP) with the tender submissions based upon the received Pre-Construction Information (PCI) as well as Design Hazard and Significant Risks Analysis Register from the Client via the Designer. Tenderers are expected to detail their arrangements to manage risks in this document to ensure they comply with their duties in the Contract.

Upon receiving approval by the Client, the tenderer that conforms to the specifications and requirements will be awarded the construction contract.

Critical success factors

- **Tender analysis and evaluation**
  Each tender will be assessed to determine whether it meets all mandatory requirements of the tender document. The selection criteria may include the technical requirements, financial viability, management competence and relevant experience, quality assurance requirements. Tender analysis can include consideration factors such as knowledge of project and awareness for design for safety on this project. Tender can list out safety problems and let contractors address these problems during tender submission. In addition, the tenderer can prepare and submit an Outline Construction Phase Plan together with his tender to address the risks identified in the Pre-Construction Information (PCI) and Design Hazard and Significant Risks Analysis Register.

Key outcomes

- Development of Pre-construction Information (PCI)
- Submission of Outline Construction Phase Plan (CPP) together with tender documents. Tender valuation on both quality, health & safety, environmental, a realistic programme with innovative solutions and not solely based on the lowest bid or cost
- Tender awarded

Key supporting files

- Updated Pre-construction Information (PCI)
- Updated Design Hazard and Significant Risks Analysis Register
- Construction Phase Plan (CPP)

Technology solutions

Prior to the commencement of construction, Main Contractor may use BIM to visualise the clash detection and logging health and safety significant risks.

4.3 Construction Stage

Objective of stage

The construction stage is the execution phase of the planning and design. The designers, consultants, and engineers who are engaged for the construction services will review the technical submittals, perform quality control inspections, and ensure that the project is delivered as designed and on track. It is the Contractors' duty to ensure that the construction workers are aware of individual health and safety on the site. Significant residual risks that have not been eliminated or reduced, as so far as reasonably practicable in the pre-construction stage should be addressed and managed by Contractors at the start and during the construction. In cases of Design and Built (D&B) contract, where main contractor is appointed to carry out the design work in addition to delivering the construction work. In this case, the Contractor will have the flexibility to follow applicable stages and corresponding recommended documentation of the DfS management system. Details to refer to Note below Figure 8 – Design for Safety Management System.

Key process

Main contractor is appointed by the Client and have various duties relating to coordinating health and safety on site by eliminating hazards identified both prior to and during actual construction works. and particularly following any scope or design changes. Following the contract award, a pre-construction safety meeting will be conducted with the Client, Designer, the design team and Main Contractors to ensure that the contentious issues in health and safety are discussed and addressed.

It is the responsibility of main contractor to make sure that Construction Phase Plan (CPP) is prepared and developed based on available information from Designer in the Pre-Construction Information (PCI) and will be updated with the significant information relevant to any demolition and construction works carried out during the construction phase.

The main contractor has the flexibility to integrate elements of CPP into their Construction Health and Safety Plan if suitable for the projects.

Main contractor should provide a safe working environment to the workers and ensure the construction works can be carried out safely. Therefore, main contractor has the duty to enhance the site management and facilitate effective communication which are two important aspects to improve safety. In an attempt to improve the quality management and safe construction, performance assessment could be implemented similar to Performance Assessment Scoring System (PASS) is implemented as a mechanism for evaluating the effectiveness of a contractor's ability to deliver projects to specified standards for Housing Authority projects. The performance evaluation system can be considered as a supplementary tool for supervision of safe works.

Prior to the commencement of works, Client should review the Construction Phase Plan (CPP) or equivalent plan to make sure the plan is sufficient and there after updated regularly by main contractor. Designer should review the Design Hazard and Significant Risks Analysis Register in order to ensure the appropriate management of the identified design risks. On the other hand, main contractor should ensure the subcontractors are fully involved in and encourage the worker engagement and participation of raising health and safety concerns and offering suggestions of improvement. In the regular liaison meetings with the Client, all duty holders will share information of the construction progress and health and safety concerns raised by workers and provide responses. During this stage, main contractor may consider an action plan showing how to ensure all site personnel complying with statutory and contractual safety requirements. There is a list of topics could be considered if applicable:

(a) A description of the project such as key dates and details of key members of the project team;

(b) The management of the work including:

(i) The health and safety management of the project

(ii) The site rules including induction training, delivery routing, etc.

(iii) Arrangements to ensure cooperation between project team members and coordination of their work, e.g. regular site meetings

(iv) Arrangements for involving underground or overhead services diversion

(v) Site induction especially involving phasing

(vi) Traffic arrangement and diversion

(vii) Welfare facilities such as toilet, water, locker, changing area, etc.

(vii) Fire prevention and protection, dangerous goods storage and emergency procedures

I The control of any of the specific site risks (i.e. Works involving particular risks):

(i) For example work which puts workers at risk of burial under earthfalls, high headroom installation or maintenance leading to falling from a height, limited access for use of

equipment, temporary structural support, in where the risk is particularly aggravated by the nature of the work or processes used or by the environment at the place of work or site.

Main contractors need to inform Designer of any significant risks related to the design that occur and should be identified and controlled during the construction phase. During and prior to the completion of construction works, information related to the asset and / or building for its use, maintenance and cleaning etc, is provided to the Designer (lead/coordinating role) for finalising the Health & Safety File (Asset or Building Manual) that will be passed to the Client.

Critical success factors

- **Updating Construction Phase Plan (CPP) or equivalent such as Construction Health & Safety Plan**
  Main contractor prepares the "Construction Phase Plan" which records arrangements for managing significant health and safety risks associated with construction of the project. Contractor may incorporate CPP items into Construction Health & Safety Plan depending upon the complexity of the project including any temporary works, logistics and traffic management, heavy lifting operation and fire safety, security access and welfare facilities, etc. The objective is to achieve a desired outcome that safety and health is ensured, the injuries to workers and damage to property are prevented. Main contractor needs to track identified risks, identify new risks during construction and keep the document updated during the construction phase with assistance of regular inspections and audits. Apart from asking questions for Designer and main contractor, it is important to give all the design team and the contractor workers the opportunity to share their views and contribute to health and safety of the project.

- **Contractors should have basic DfS knowledge and awareness**
  Based on the feedback of stakeholders, there are some key factors to consider when engaging with the Contractor prior to and during the construction stage. In particular, the Client should exercise due diligence during procurement and tender stage to ensure the Contractor has basic knowledge and awareness on DfS, equip with sufficient skills and expertise to carry out the works safely. If concerns arise about the competence of the Contractor or their safety record including quality control, the Client should act promptly (i.e. provision of training on DfS) to reduce the onsite risks by having a thorough review meeting with immediate agreed actions.

- **Risk Assessments and Method Statements incl. Permits to Work**
  Main contractor and their subcontractors prior to carrying out their work not only require having attended site inductions before undertaking work. But be briefed on the risk assessments and method statement for their relevant tasks. But also, where applicable operate under a permit to work for any high-risk activities i.e. confined spaces, penetrating the ground, isolating live services, hot works etc.

Key outcomes

- Ensuring the main contractor and their subcontractors are competent
- Development of Construction Phase Plan (CPP) or integrated into Construction Health and Safety Plan
- Safety management of construction work on site
- Open communication with duty holders on matters affecting health and safety
- Contractors' performance evaluation

Key supporting files

- Construction Phase Plan (CPP) or equivalent e.g. Construction Health and Safety Plan
- Design Hazard and Significant Risks Analysis Register

Technology solutions

The development and integration of digital information and BIM models into a design can help main contractor and Contractor to detect significant risks on site. However, if BIM is created for a new project, some minor BIM changes may not catch up with the site progress. In this case, Main Contractor and Contractor can report the construction hazards/risks by mobile app or intranet reporting system.

4.4 In Use (Handover, Operations and Maintenance stage)

Objective of stage

The objectives of operation and maintenance stage include the inspection process to identify and resolve potential issues before the building is handed over to the client. At this stage, the building systems will need a period of continuous operation and during this period, regular reviews will be taken place to document the identified defects or errors that arise after the completion of construction.

Key process

When the construction work on site has been completed, there are some key steps to be followed prior to the handover stage. Main Contractor will carry out the inspection of the whole building or works to ensure the construction is completed as required and update the Health & Safety File (Asset or Building Manual). The file should include details of any hidden features (e.g. high-tension cables, pre-stressed elements for Building Maintenance Units (BMUs) such as suspended cradles, safety harnesses anchorage for cleaning or maintenance, toxic materials, especially those that would are hazardous during removal, and fire prevention or emergency escape routes, etc.) Once the inspection process is done with satisfying outcomes, the Health & Safety File (Asset or Building Manual) will be sent to the Client before taking over the project for operation, use and maintenance.

Maintenance Supervisor (e.g. Facilities Manager, Asset Building Supervisor) is appointed by Client for maintenance works. This role has the duties to participate in meetings with Designer at the design stages of new projects, specify the contents of the Health & Safety File (Asset or Building Manual) that records all the details specific to the lifecycle of the asset, obtain all necessary information (e.g. the information from the “Health & Safety File” and / or Operational and Maintenance Manuals, Fire and Emergency File, etc), manage and monitor the maintenance work, keep full records of all safety and health issues as well.

The project team may provide training to the Maintenance Supervisor and their maintenance team on how to operate and maintain the building and / or provide the Health & Safety File (Asset or Building Manual) and any supporting Operation and Maintenance Manuals (O&Ms) which usually include operation and maintenance instructions along with Manufacturers literature, As-Built Drawings and Signed Test and Commissioning sheet. It can help fully understand the maintenance procedures and ensure a safe working environment so as to reduce the risk of injury to the maintenance workers.

After the Client taking over the building or structure, it is advisable to perform a post-project review meeting which will involve the Client, Designer, designer team, main contractor or Contractor, and Maintenance Supervisor to uncover the identified problems associated with health and safety to avoid significant issues/risks and or occurrences in the future.

It is important to note that designer at the stage may not be able to foresee all situation of future maintenance and repair (M&R) requirements. M&R contractors will be expected to conduct proper

risk assessment and meeting statutory requirement, provision of adequate temporary safety precautionary measures is important to ensure conducting work safely.

Critical success factors

- **Health and Safety track record**
  The “Health & Safety File” (Asset or Building Manual) is a live and dynamic document that should be reviewed and updated by Main Contractor during the inspection process. The Client can appoint a competent person to be the Maintenance Supervisor that will continue updating the “Health & Safety File” after practical completion of the project and satisfactory via an inspection. The key element in this stage is to make the relevant document on track since the risks of safety and health could arise throughout the construction life cycle even during the dismantling and demolition of the building or structure.

- **A holistic feedback mechanism**
  At this stage, it is suggested introducing some management systems / apps to effectively trace the feedback and retrieve the safety information for the design team when accidents occur and / or design amendments/changes are required. It could better prevent the claimed reasons for accidents as “human error”.

- **Shared lessons learnt**
  The Client is recommended to provide lessons learnt (i.e. significant risks / hazards related to particular stages in the project), case studies and / or real examples to all relevant duty holders. Applying lessons learnt among the project team members can allow them to take advantage of good practices in the project and prevent the team from conducting or repeating the “human errors” on the safety in design and construction. It is suggested establishing a common platform to promote shared lessons learnt in the future.

Key outcomes

- Handover of “Health & Safety File” (Asset or Building Manual)
- Update “Health & Safety File” (Asset or Building Manual)

Key supporting files

- Health & Safety File (Asset or Building Manual)
- Fire and Emergency File
- Operation and Maintenance Manuals (O&Ms)

Technology solutions

After the completion of the project, end user or Maintenance Supervisor should ensure the BIM software procured is relevant to managing, monitoring and updating their AIRs.

4.5 Review & Feedback

Objective of stage

On completion of construction, the review session aims to evaluate the effectiveness of safety in design. This will enable identification of the most effective design practices and any design innovations that could be used on other projects.

Key process

At this stage, a project review session will be organised by Client with Designer and his team, main contractor, Contractor, subcontractors and Maintenance Supervisor in a post-construction meeting to gain valuable feedbacks from all relevant parties involved in the project. Maintenance Supervisor has the duty to review the defect reports, accident investigation reports and discuss with other duty holders regarding the modifications. The Client will share information on user difficulties and deviations from intended conditions of use. The ultimate goal of the "reviewing the project" is to achieve continuous improvement in the future projects. It is advisable to stipulate the “lessons learnt session” in the Contract during Tender stage.

Critical success factors

- **A knowledge portal/hub of DfS**
  It is suggested that a knowledge portal/ hub with BIM model (i.e. centralised system/ database) can be incorporated in the Review & Feedback stage in order to consolidate all incidents feedback/ lessons learnt/ similar designs etc., and capture any good practices for designers’ better referencing.

- **A structural assessment report / safety report**
  The report will be needed by Structural Engineer to their design which is already in the current system. It could cover either or both the temporary works and permanent works, where the structural design requires to checked / validated to ensure that the asset should have sufficient loadings and meet the design codes during construction and after completion of the project.

- **Post operation surveys for end-users**
  A post operation survey will be undertaken by the end-users and / or the maintenance staff to evaluate the effectiveness and efficiency of the project delivery process. It also consists of the safety plans and the supporting Operation and Maintenance Manuals for end-users’ reference.

- **Consistent review and feedback across the project lifecycle**
  The requirement of review and feedback starts from inception, concept, tender and during the construction phase following any significant scope and design changes. The Client should use the key milestones to make mandatory for all key duty holders to undertake and document this – as good risk management.

Key outcomes

- Review of defect reports and accident investigation reports
- Discussion on modifications, user difficulties and deviations from intended conditions of use

Key supporting files

- N/A

05

OVERSEAS CASE STUDIES & GOOD PRACTICES

5 OVERSEAS CASE STUDIES & GOOD PRACTICES

Case 1 Southampton Solent Pop in UK

Actions taken for the Design for Safety

The Client was advised by the Principal Designer (i.e. Designer (Lead/Coordinating role) to help eliminate the hazards and reduced the associated significant risks with installing a futuristic pod that was designed and manufactured/fabricated off site (known as for Design for Manufacturing & Assembly (DfMA)) and brought in sections to be assembled via heavy haulage lorries and crane etc. which is the centrepiece of Southampton Solent University's 'Spark' building which has a five-story atrium.

During the Concept Design stage, the CGI's, 3-D Model and drawings (see in Figure 6) are used to provide technical analysis and identify the hazards and significant risks.

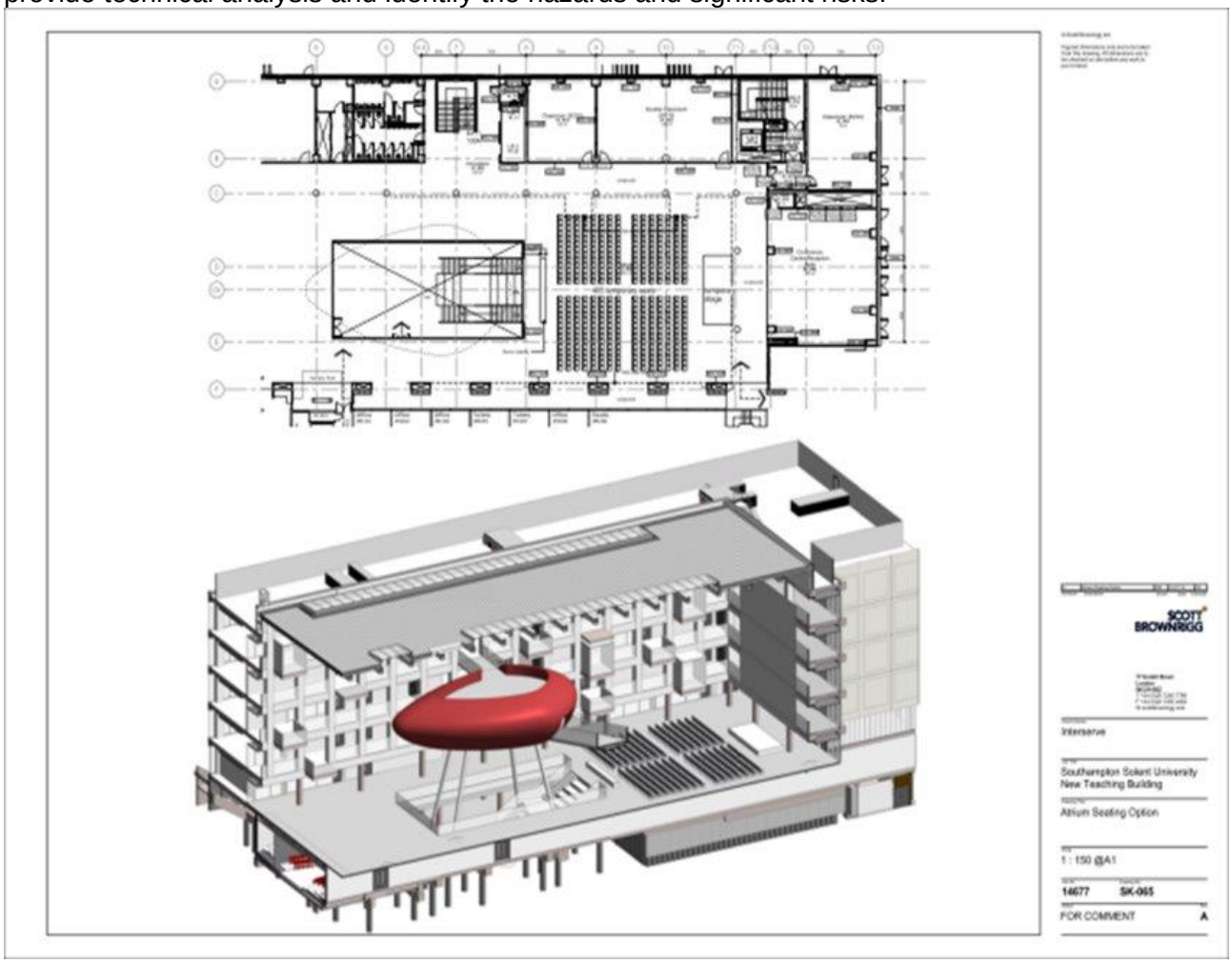


Figure 6 Concept Design using CGI's, 3-D Model and Drawings

The building around the pod contains teaching and learning facilities, including 35 classrooms and five lecture rooms, interactive study spaces, and a conferencing and exhibition space available for use by Southampton businesses and the wider community.

Results

By using DfS, the project has turned the site constraints into opportunities including

- Shorter programme
- Less waste on site

Case 2 Domestic building project in UK

Actions taken for the Design for Safety

During the construction stage, the potential hazards and significant risks have been visualised in the drawings that ensure the risk management has been completed prior to the commencement of construction. In the drawings in Figure 7, designers have noted the additional safety information as well as the actions to be taken in the following stages.

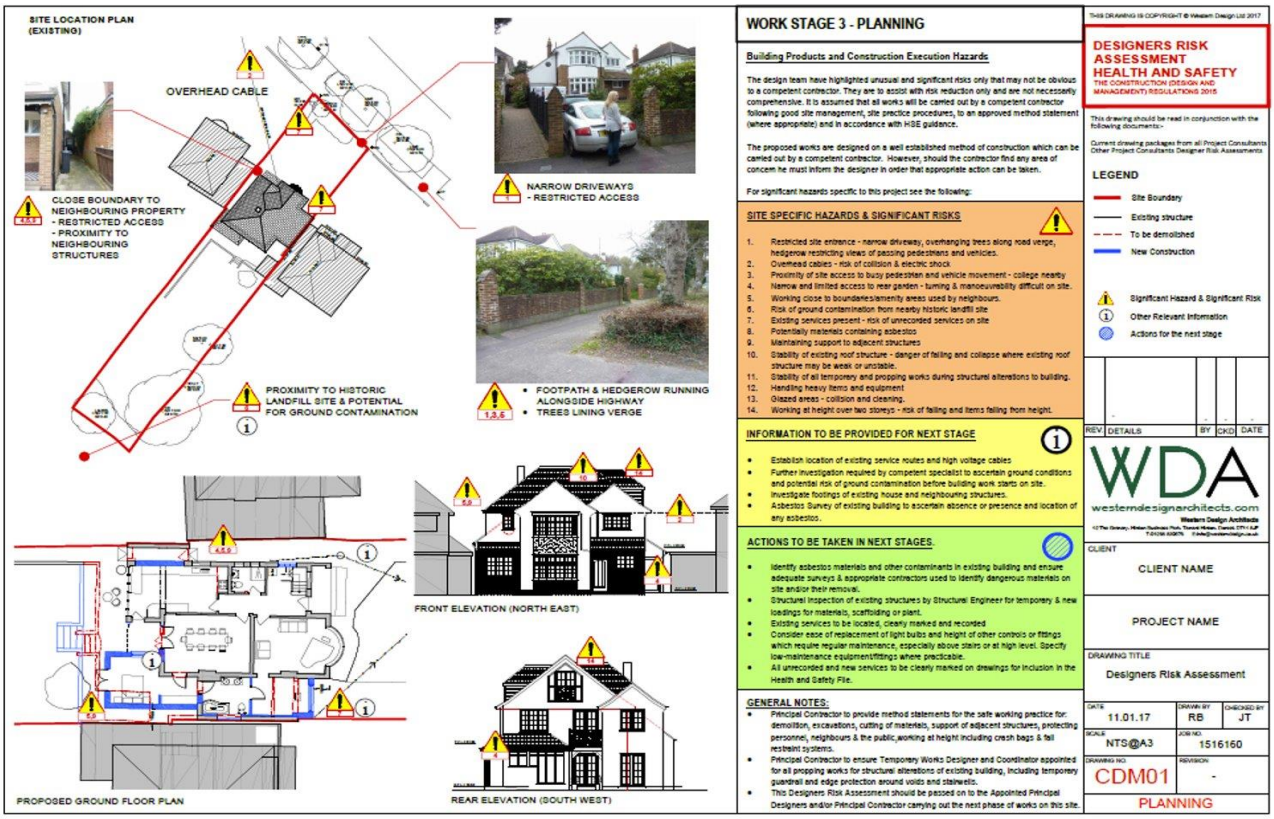


Figure 7 A Domestic DRM Drawing

Results

The hazards and significant risks are all included in one drawing that helps to foresee and eliminate the safety issues in advance and as effective means to communicate hazards and significant risks to all duty holders during construction.

Case 3 Public Realm / Highways works in UK

Actions taken for the Design for Safety

During the construction stage, the potential hazards and significant risks have been visualised in the drawings that ensure the risk management has been completed prior to the commencement of construction. By following the safety control tools, the designers and Principal Contractor (i.e. Main Contractor) are able to propose methods/options, demonstrate construction risk management preferences (see in Figure 8) and ultimately, to reduce or minimize the significant risks during the construction.

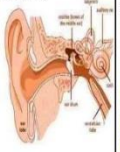
Work Stage :- Working Draft	Project:- **Reducing ill Health in Paving Roads and Highway Works**						Date:- August 2012	
Construction Matrix	Zero-HARM - Hazard Awareness & Risk Management						Breaking out & Demolition	
Description of Source	**HAZARD**	**SIGNIFICANT RISKS**	**PERSONS AT RISK**	**REDUCE/AVOID or MINIMIZE RISKS** (During all early/design stages)			**INFORMATION** To be provided with the design	**CONTROLS** Management Systems	**OTHER SPECIALIST GUIDANCE & COMMENTS**
Activity	Cause or Harm	Type of Risk	Individual or multiple	Design methods	Mechanisation	Containment, suppression, etc	Specialist Design & client input	Site Control	References
Hard surface breaking with hand held equipment 	Vibration 	White finger 	Individual Operator 	Use non hand held tools 	Use hydraulic drilling equipment Use hydraulic nibbling equipment 	Gloves Shock absorbent equipment New equipment 	Exposure time graphs 	Monitor task durations. Issue gloves. Site inductions. Proof of competency. Vibration monitoring on equipment 	Exposure points system and ready-reckoner  Advice for employers on the Control of Vibration at Work Regulations  http://www.hse.gov.uk/vibration/hav/vibrationcalc.htm
	Noise 	Damage to hearing 	Individual and general public 	Noise monitoring 	Noise screens 	Ear protection 	Acceptable levels	Noise meter 	Protect your hearing  Is your workplace noisy  Noise at work – advise for employees 

Figure 8 Construction Risk Management

Results

Using tools for safe designs can help to effectively review what controls and treatment requires to be considered, implemented and monitored in the project.

Digital technologies applied in construction projects

HoloSite

Construction often varies from the exact design, and traditional inspection methods are reactive, can be prone to errors and take time. Modern Methods of Construction requires less deviation from design tolerance, so more proactive approaches are needed.

In UK, Contractors are using HoloSite, which is an engineering-grade augmented reality headset to view BIM models onsite to millimetre accuracy in the form of holograms through the augmented reality headset (see in Figure 9).

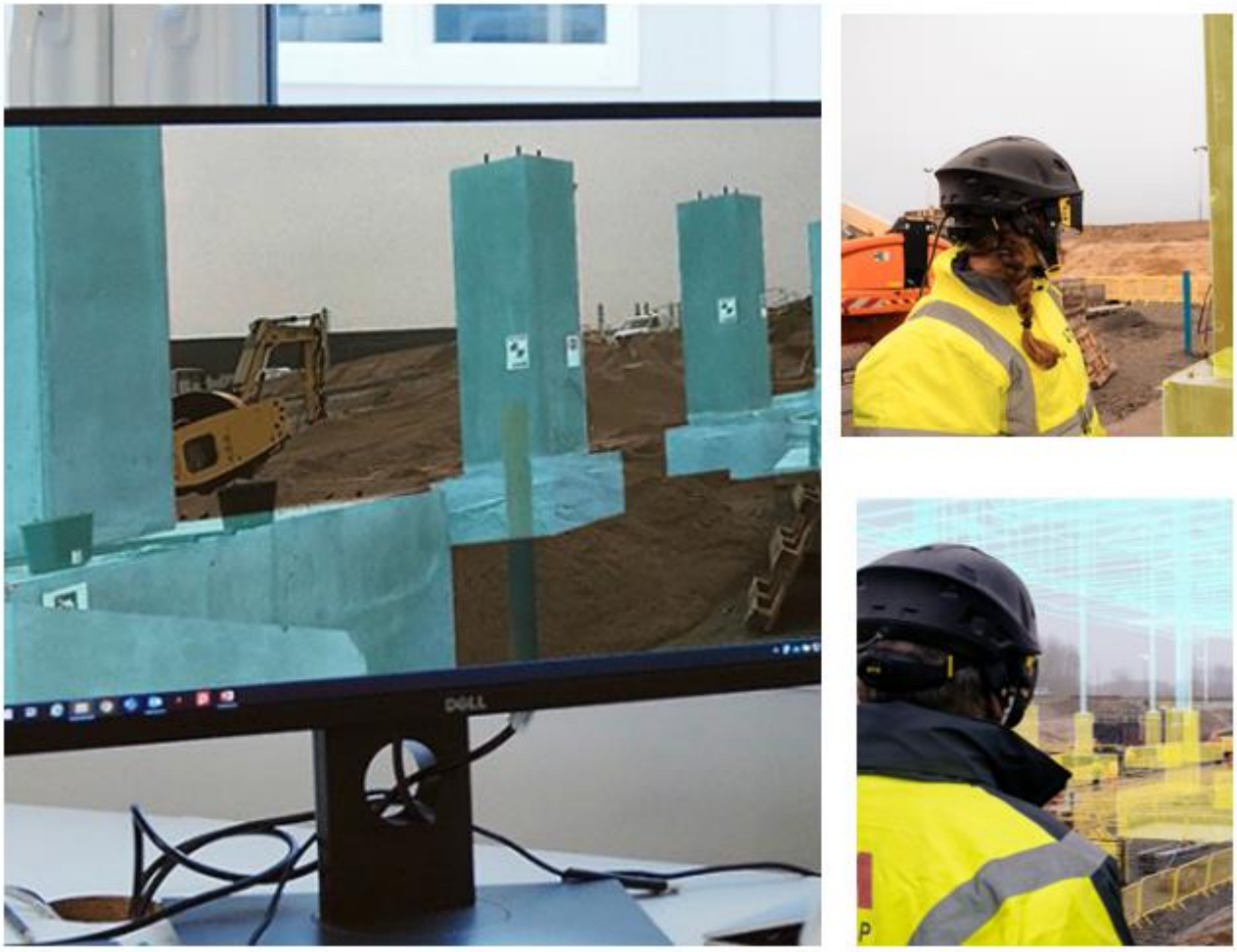


Figure 9 Holosite

Results

- Projects have used HoloSite proactively to eliminate errors before and during installation
- Construction teams have reduced inspection times by 97%
- The technology has enabled them to build to the BIM model and build it right, first time, whilst achieving significant return on investment on the technology

SafetiBase

SafetiBase is integrated with 3-D Repo and Bentley iTwin services to visualise hazards and significant risks in the 3-D model environment (see in Figure 10) to assist understanding, communication and crucially hazard mitigation or associated significant risk reduction or treatment.

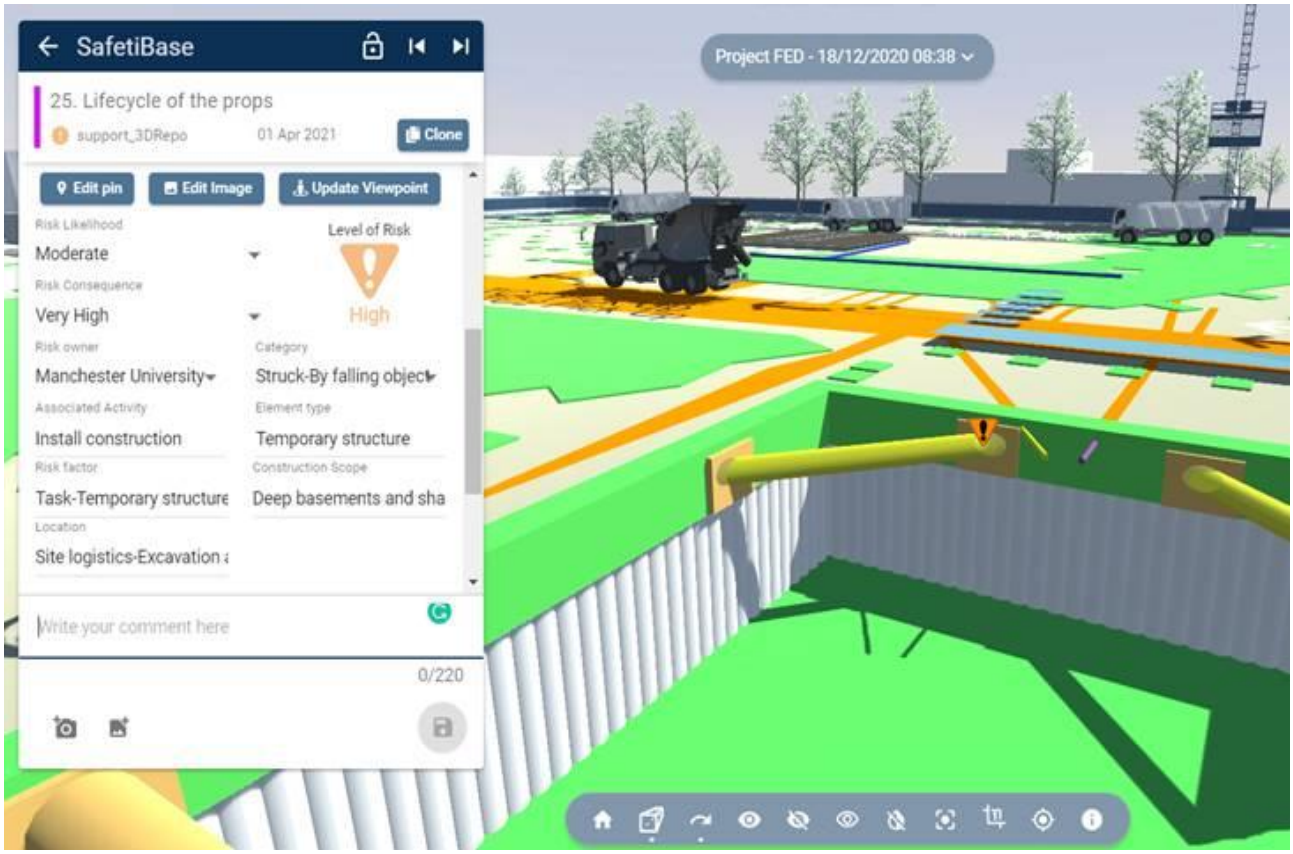


Figure 10 SafetiBase

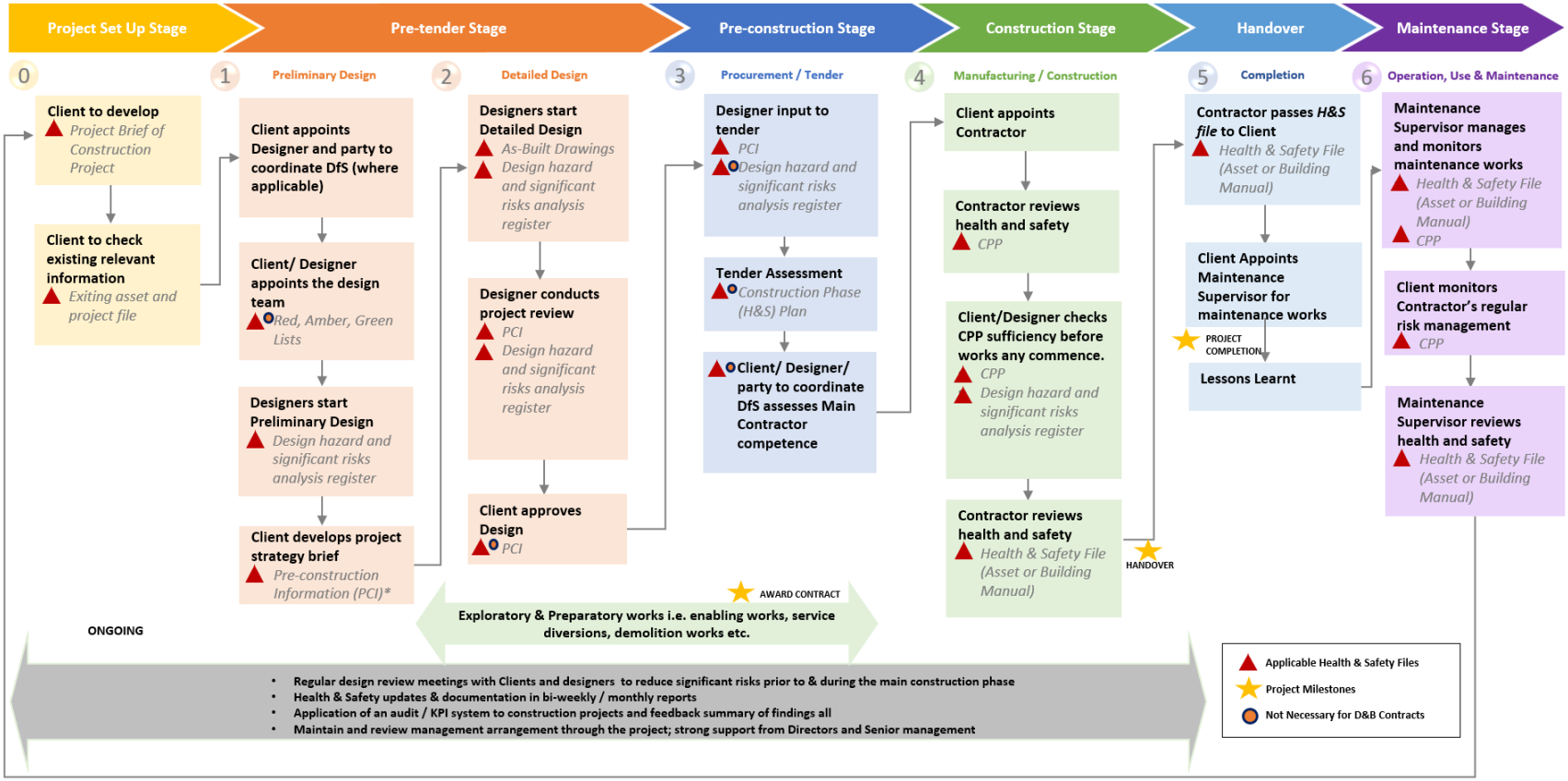
06

TEMPLATES & TOOLS

6 TEMPLATES & TOOLS

Design for Safety Management System (with relevant H&S Templates)

The process map below outlines a simplified version of the Design for Safety Management System with the relevant Health & Safety Files embedded throughout the project life cycle.



Note: The above process is for typical normal project lifecycle. As for Design and Built (D&B) Contracts, the appointed D&B Contractor will be taking up design as well as construction works. Therefore, the flow sequence of Design for Safety Management System and recommended files/documentations to be included will be adjusted to suit, e.g. there may be no tendering stage and tender assessment once D&B contract is awarded. However, if specialist contractor required to be involved, perhaps the equivalent assessment and evaluation will be conducted internally by the D&B contractor. Some of the documents that may not be necessary required have been identified for D&B contracts.

Checklist of Key Templates and Tools

The purpose of the following reference materials is to support different stakeholders during the construction and asset lifecycle.

"Design for Safety Management System" Information and Purpose				
No	**Health & Safety Document**	**Purpose**	**Duty Holder**	**Stage**
1	Project Brief of Construction Project	To provide details of a new Construction Project as soon as possible with sufficient time* before the construction phase begins	Client	Project Set-up stage
2	Pre-Construction Information (PCI)	To ensure that health and safety hazards are identified and associated foreseeable significant risks are addressed. To help enable the planning and management of the construction project. The PCI is continually developed and updated by designers.	Client #Designer (lead/coordinating role)	Pre-tender stage, Preliminary Design stage, Detailed Design stage
3	Red, Amber, Green (RAG) Lists	To aide designers on what hazards to eliminate/avoid and what associated foreseeable significant risks to encourage to reduce during the Design Stages.	Client Design team #Designer (lead/coordinating role)	Pre-tender stage, Preliminary Design stage, Detailed Design stage
4	Design Hazard and Significant Risks Analysis Register	To identify apparent hazards to eliminate/avoid and what associated foreseeable significant risks to encourage to reduce for both the project and asset lifecycle during the Design stages. This a register or schedule or tracker or even log of the identified significant risks being treated or raised.	Design Team #Designer (lead/coordinating role)	Preliminary Design stage, Detailed Design stage
5	As-Built Drawings	To provide a detailed blueprint of the building or asset and the land around it as actually constructed and built and / or installed. Ideally looking at utilising 3D/4D via BIM.	Design team #Designer (lead/coordinating role)	Preliminary Design stage, Detailed Design stage

"Design for Safety Management System" Information and Purpose				
No	**Health & Safety Document**	**Purpose**	**Duty Holder**	**Stage**
6	Construction Phase Plan (CPP)	To identify the significant health and safety risks associated with the project, and record the arrangements and monitoring for risk control, mitigation and treatment for the construction works	Main Contractor	Construction stage
7	Health & Safety File (Asset or Building Manual)	To provide sufficient details of the building's or asset's construction, history and information for the effective cleaning, operation, use as a workplace, maintenance, decommissioning and demolition of the building or asset	#Designer (lead / coordinating role), Design team Main Contractor	Handover stage
8	Fire and Emergency File	To assist Asset / Building Manager for owner or Building user to prepare for and enable occupants to respond quickly and safety to a safe location following a fire and / or emergency	#Designer (lead/coordinating role) Main Contractor	Handover stage
9	A Centralised Knowledge Hub for Design for Safety	To consolidate the feedbacks on incidents and lessons learnt	Client #Designer (lead/coordinating role) Main Contractor	All stages
10	Key Performance Indicators (KPIs) for Design for Safety	Client to appoint someone (i.e. Client's team, project manager/ party to coordinate DfS/) to assist in monitoring KPI's	Client #Designer (Lead/coordinating role) Main Contractor	All stages
11	Promotion of Early Involvement of Construction Experts	To appoint Contractor as independent advisor earlier during the design stage to be	Client	Pre-tender stage

"Design for Safety Management System" Information and Purpose				
No	**Health & Safety Document**	**Purpose**	**Duty Holder**	**Stage**
	in the Initial Conversation	involved in DfS review meeting to provide input from contractor point of view		
12	Tender Stage Framework	To outline significant risks at Construction stage	Client/ #Designer (lead/coordinating role)	All stages
13	Digital Visualisation (i.e. BIM, Virtual Reality, etc.) and Tools	To capture digital data using information management and requirements	#Designer (lead/coordinating role) Main Contractors	All stages

#*Note: the person/party appointed to take up a lead or coordinating role in DfS*

Guideline for Project Brief of Construction Project

Purpose of project brief of construction project

- Share with duty holders of the project
- Alignment on Client's project objectives and criteria to be achieved
- Understanding of Project delivery preference including contract type and strategy
- Allocation of Health and Safety goal
- Communication plan

Intended User of this brief

- Project Set-up Stage: Client prepares and share with project team to demonstrate that sufficient time and resources has been allowed
- This brief may require updating when changes are made and will keep the designer/contractor accountable for H&S throughout the project

The brief should include the following information:

- Site location
- Project profile
- Duty holders involved in the project
- Site constraint and limitation

Sample Template

Client information
Client Name/Organisation
Client's Email address
Client's telephone number
Client's Address
Description for your project
• Building services • Civil Engineering • Demolition and Dismantling • Groundworks • Mechanical and Electrical • New Build • Renovation • Railway • Refurbishment • Road and Bridge • Repair and Maintenance • Alteration and Additional • Site investigation • Utilities Work • Other
Project description

Brief description of the construction work and/or project:	
Project site location:	
Foreseeable site constraints and limitations? e.g. next to slope, reclaimed land, pedestrian/traffic, etc.	
H&S information for design team to be aware of	
Project Delivery Strategy and Planning	
Procurement strategy (conventional, design & build, management contracting)	
Health & Safety Goal	
Need of independent support such as H&S or DfS	
Project schedule	
Time allowed for DfS process in project programme	
How many weeks are allocated by the Client for the construction work (including all planning and preparation, and the construction phase)?	
When is the construction phase planned to start?	
How many weeks are allocated just for the construction phase?	
Is there a recommended maximum number of people at work on the Site at any one time?	
When is the Start Date?	
Details of those involved in the project	
Duty holder 1	
Name:	Role:
Email:	Tel. Number:
Address:	
Duty holder 2	
Name:	Role:
Email:	Tel. Number:
Address:	
Duty holder 3	
Name:	Role:
Email:	Tel. Number:
Address:	

Guideline for Pre-Construction Information (PCI)

Purpose of Pre-Construction Information (PCI)

- To provide a focus at which health and safety considerations of the project are gathered under control of the relevant duty holders including the Client and #Designer (lead/coordinating role)
- To ensure that health and safety hazards are identified and associated foreseeable significant risks are addressed. To help enable the planning and management of the construction project. The PCI is continually developed and updated, providing such to all designers and Contractors on the project.
- PCI plays a vital role in the tender documentation by offering sufficient information of the nature of the project that designers (incl. Designer (lead/coordinating role)) and contractors (incl. Main Contractor) will need to plan, mange, and monitor their work, including coordination.

Intended user of this form

- *Pre-tender stage*: Client initiates PCI
- *Preliminary Design stage*: #Designer (lead/coordinating role) and Design team update PCI
- *Detailed Design stage*: #Designer (lead/coordinating role) Design team continue update PCI
- *Tender stage*: PCI (including significant risks) is issued with the tender documents to contractors
- *Construction stage*: Main Contractor review PCI at initial 1 month then transfer the information to H&S file and update

Project stage	**File user**	**Action**
Pre-tender stage	Client	Client initiates PCI
Preliminary Design stage	Designers	Designer (lead/coordinating role) and Design team update PCI
Detailed Design stage	Designers	Designer (lead/coordinating role) and Design team continue update PCI
Tender stage	#Designers (lead/coordinating role) Main Contractor (tenderers)	Designer (lead/coordinating role) issues PCI (including significant risks) with the tender document
Construction stage	Main Contractor	Main Contractor review PCI and transfer to H&S file and update

The Pre-Construction Information should include the following:

1. Project Information	2. Safety Hazards
1. A description of the project 2. Key dates 3. Contact details for the project team 4. The extent and location of existing information 5. Project arrangements: • Planning and managing the construction work • Communication and liaison • Security • Site hoarding – preventing unauthorised access • Site transport – access routes • Permit-to-work systems • Fire precautions • Emergency procedures • Means of escape • Authorisation requirements • Ground works – excavations confined spaces • Smoking and parking restrictions	1. Boundaries and access including traffics 2. Restrictions on deliveries, waste collection or storage 3. Adjacent land uses and projects 4. Existing live and redundant services (i.e. overhead HV and underground utility services including gas, drainage, telecommunications, etc.) 5. Ground conditions (i.e. stability, contamination) 6. Existing stability of structures (i.e. permanent and temporary) 7. Issues relating to plant and equipment 8. Health and safety information in earlier design, construction or 'as-built' drawings
3. Health Hazards	**4. Information in Existing Health & Safety File**
1. Asbestos 2. Contaminated land 3. Client's activities 4. Storage of hazardous materials 5. Significant design and construction hazards: • Assumptions and working methods • Arrangements for co-ordination of ongoing design work • Significant risks identified during design • Materials requiring particular precautions	1. A description of the Health and Safety File and any conditions relating to its content. 2. Asset or Building Manual

PCI Sample Template

1.0 Project Details	1.1 Client 1.2 #Designer (lead/coordinating role) 1.3 Location of Site 1.4 Nature and Description of Construction Work to be Carried Out 1.5 Timescale for Completion
2.0 Existing Site and Environment	2.1 Site Location 2.2 Existing Site Access Points 2.3 Existing Underground and Overhead Services 2.4 Ground Conditions and Contamination
3.0 Site-Wide Hazards	3.1 Site Access Points 3.2 Location of Site Accommodation and welfare facilities 3.3 Materials Storage and Site Security 3.4 Logistics, Site Traffic/Pedestrian Movements and Restrictions etc.
4.0 Client's H&S Brief (Management Arrangements)	4.1 Client Health & Safety Goals 4.2 Client/ #Designer (lead/coordinating role)/ Main Contractor Liaison Arrangements
5.0 Health and Safety Procedures	5.1 Assessment of Contractor Designed Work Packages / Unforeseen Changes to Designs (Design Change Control) 5.2 Fire Precautions & Emergency Procedures 5.3 Pollution Prevention 5.4 Hours of Work 5.5 General Requirements for Main Contractors and Sub-Contractors Where applicable: Fire Safety Plan linking to the Fire Emergency Procedures Logistics and Traffic Management Plan, Lifting Plan, Permits for High-risk activities (i.e, Confined spaces, Hot Works, Breaking the ground, Access HV rooms etc.)

#Note: the person/party appointed to take up a lead or coordinating role in DfS

Guideline for Red, Amber, Green (RAG) Lists

Purpose of Red, Amber, Green (RAG) Lists

- To aide designers on what hazards to eliminate/avoid and what associated foreseeable significant risks to encourage to reduce during the Design Stages

Intended user of this form

Project stage	File user	Action
Pre-tender stage	Client/ #Designer (lead/coordinating role)	Client/ #Designer (lead/coordinating role) develops the Red, Amber, Green Lists
Detailed Design stage	Design team	Designers update the list in the Detailed Design stage
Detailed Design stage	#Designer (lead/coordinating role)	#Designer (lead/coordinating role) records the arrangements of design/maintenance to eliminate the hazards and address the associated foreseeable significant risks
Pre-Construction stage	#Designer (lead/coordinating role) with the design team	As above with the design team
Construction Phase	#Designer (lead/coordinating role) with the Main Contractor	Main Contractor to notify and discuss any design changes with the #Designer (lead/coordinating role) that may have additional hazards and / or increase significant risks related to the project and / or lifecycle of the asset

Checklist of Red, Amber, Green Lists

(Note that the following checklist should be referred to as a sample and is not meant to be exhaustive. The Designer (lead/coordinating role) should modify or add to this list based on their project and use this list to go through during DfS review meeting.)

Red Lists: Hazardous activities, methods, materials, materials, products and processes that should be eliminated or avoided from the project where possible	
	• Lack of adequate pre-construction information, e.g. insufficient relevant asbestos surveys, geology, location of obstructions and live services, extent of ground contamination etc.
	• Hand scabbling of concrete ('stop ends', etc) - Demolition by hand-held breakers of the top sections of concrete piles (pile cropping techniques are available)
	• The specification of fragile roof lights and roofing assemblies

	• Activities and tasks giving rise to large quantities of dust (dry cutting, blasting etc.)
	• On-site spraying and use of harmful substances;
	• The specification of structural steelwork which is not purposely designed to at least accommodate safety nets or be designed and installed with ease reducing time during lift with crane and use of mobile elevated working platforms and / or ideally have temporary guard rails installed to prevent falls.
	• Designing roof mounted services that could be at ground level, requiring access (for maintenance, etc), without provision for safe access (e.g. barriers)
	• Glazing that cannot be accessed safely. All glazing should be anticipated as requiring cleaning and replacement, so a safe system of access, removal and replacement is essential
	• Entrances, floors, ramps, stairs and escalators etc not specifically designed (no consideration) to avoid slips and trips during use and maintenance, including effect of rainwater and spillages
	• Design of environments incorporating adverse lighting, excessive noise, vibration, extremely low or high temperature, wetness, high humidity and cold draughts or chemical and/or biological conditions during use and maintenance operations
	• Designs of structures that do not allow for approved fire containment during construction and for future occupants for life cycle of a building.
	• During excavation, unable to allow sufficient space for the battering (sloping) or benching of excavations, to minimize the risk of collapse. Where possible, avoid locating excavations near static loads (such as buildings, walls and immobile plant) or dynamic loads (including traffic and excavation equipment)
	• Heavy construction components which cannot be handled using mechanical lifting devices (because of access restrictions / floor loadings etc.) – should be reduced in size and / or broken into smaller parts and installed in phases.
	• Designing in penetrations within the concrete slab for services without sufficient fall protection i.e. fixed or temporary guard rails or sufficient reinforcing mesh (to be cut out later) to take weight of person with equipment.
Amber Lists: Activities, methods, materials, products and processes considered to medium risk to be eliminated or reduced as far as possible and only specified/allowed if unavoidable. This information should be provided to the Duty holders.	
	• Internal manholes / inspection chambers in circulation areas
	• External manholes in heavy used vehicle access zones
	• The specification of "lip" details (i.e. trip hazards) at the tops of pre-cast concrete staircases
	• The specification of shallow steps (i.e. risers) in external paved areas
	• The specification of heavy building blocks
	• Large and heavy glass panels
	• The chasing out of concrete / brick / blockwork walls or floors for the installation of services – than designing in penetrations within the above for services.
	• The specification of heavy lintels (should design and install the use of slim metal or hollow concrete lintels being alternatives)

	• The specification of solvent-based paints and thinners, or isocyanates, particularly for use in confined areas – when alternative safer substances should be identified and procured.
	• Specification of curtain wall or panel systems without provision for the tying (or raking) of scaffolds
	• Substituting dangerous with inherently less dangerous and hazardous chemicals, materials and substances
	• Modify the design to reduce areas where dust and dirt can collect and thus eliminate the need for cleaning at height
	• Design plant to extract dust and fumes effectively rather than deposit them in areas that will need cleaning and removing.
	• Simplify the process control and reduce the sensitivity to deviation, thereby improving reliability of control systems when handling the hazardous chemicals
	• Designing and using specific building components in the permanent design to ensure structural stability during the construction works that can eliminate the need for falsework or formwork for temporary works and potential risk of collapse.
	• Anchor points should be provided at suitable spacings to limit the worker's movement to the protected area for temporary works
	• Information about restrictions, proper use and load bearing capacities of structural components, and on lateral forces to be supported by temporary works equipment should be provided for designing the temporary works if not incorporated in the permanent design and works.
	• Site traffic routes that do not allow for 'one way' systems and/or vehicular traffic segregated from site personnel
	• Site layout that does not allow for adequate room for delivery and/or storage of materials, including specific components
	• On-site welding, in particular for new structures – without consideration on use of pre-fabrication
	• Need to use large piling rigs and cranes near overhead electric power lines or are close to obstructions which prevent the guarding of rigs - Minimum distance is 15m from fully extended boom when working near electricity pylons. Also 9m from fully extended boom when working near cables on wooden poles.
Green Lists: Products, processes and procedures to be positively encouraged	
	• Adequate access for moving construction plant equipment and vehicles to minimise reversing requirements (one-way systems)
	• Provision of adequate access and headroom for maintenance in plant rooms, and adequate provision for replacing heavy components
	• Thoughtful location of mechanical / electrical equipment, light fittings, security devices etc. to facilitate access and keep away from crowded areas
	• The specification of concrete products with pre-cast fixings to avoid drilling in-situ.
	• Specify half board sizes for plasterboard sheets to make access and handling easier
	• Early installation of permanent means of access, and prefabricated staircases with handrails
	• The provision of edge protection in the permanent works where there is a foreseeable risk of falls during the lifecycle of the asset.

	• Design of glazing with practical and safe methods of window cleaning (e.g. from the inside)
	• Offsite fabrication and prefabricated elements to minimize on site hazards and associated significant risks.
	• Encourage the use of engineering controls to minimize the use of Personal Protective Equipment
	• Using high durability and low maintenance materials that do not need to be re-coated or treated
	• Designing the structure so that maintenance can be performed at ground level or safely from the structure, for example, positioning air-conditioning units and lift plant at ground level and designing inward opening windows etc.
	• Using continual support beams for beam-to-column double connections, be it adding a beam seat, extra bolt hole, or other redundant connection points during the connection process. This will provide continual support for beams during erection – to eliminate falls due to unexpected vibrations, misalignment and unexpected construction loads
	• Reducing the space between roof trusses and battens to reduce the risk of internal falls during roof construction
	• Separate heavy transport access from lighter vehicle access, and separate pedestrians from vehicle access

#Note: the person/party appointed to take up a lead or coordinating role in DfS

Guideline for Design Hazard & Significant Risks Analysis Register

Purpose of Design Hazard & Significant Risks Analysis Register

- To identify apparent hazards on site and during the preliminary design
- To assess the severity of potential accidents that could occur involving the hazards
- To identify arrangements for reducing the construction hazards
- To summarise all of the brainstormed or hypothesised significant risks associated with the design phase in the construction phase and asset or building lifecycle.

Intended user of this form

Project stage	File user	Action
Pre-tender stage	#Designer (lead/coordinating role)	#Designer (lead/coordinating role) updates Preliminary Hazard & Significant Risks Analysis
Detailed Design stage	Design team	Designers update the list in the Detailed Design stage
Detailed Design stage	#Designer (lead/coordinating role)	#Designer (lead/coordinating role) records the arrangements of design/maintenance to eliminate the hazards and address the associated foreseeable significant risks
Pre-Construction stage	#Designer (lead/coordinating role) with the design team	As above with the design team
Construction Phase	Main Contractor	Main Contractor to notify and discuss any design changes with the #Designer (lead/coordinating role) that may have additional hazards and / or increase significant risks related to the project and / or lifecycle of the asset.

Checklist of Design Hazard & Significant Risks Analysis Register

Significant Hazards Identified During Design (Tick if applicable)	
1.0 Environmental Restrictions	
• Boundaries and access including temporary access – for example narrow	
• Any restrictions on deliveries or waste collections	
• Adjacent land uses – for example schools, railway lines or busy roads	
• Location of existing services particularly those that are concealed – water, power cables, gas, underground cable,	

• Ground conditions, underground structures or water courses where this might affect the safe use of plant, for examples cranes or the safety of ground works	
• Others: please specify	
2.0 Safety Hazards and associated significant risks	
• Information about existing structures – stability, structural form, fragile or hazardous materials, anchorage points for fall arrest systems (particularly where demolition is involved)	
• Previous structural modifications, including weakening or strengthening of the structure (particularly where demolition is involved)	
• Fire damage, ground settlement, movement or poor maintenance which may have already have adversely affected the structure	
• Any difficulties relating to plant and equipment in the premises, such as overhead gantries whose height restricts access	
• Health and safety information contained in earlier designs, construction or "as-built" drawings, such as details of pre-stressed or post tension Structures	
• Others: please specify	
3.0 Health hazards and associated significant risks	
• Asbestos, including results of surveys (particularly where demolition is involved)	
• Existing storage of hazardous materials	
• Contaminated land, including results of surveys	
• Health risks arising from client's activities	
• Others: please specify	
4.0 Significant design and Construction Hazards and associated significant risks	
• Significant design assumptions and suggested work methods with solutions	
• Sequence or other control, mitigation, or treatment	
• Arrangements for co-ordination of ongoing design work and handling • Design changes	
• Information on significant risks identified during design	
• Material requiring particular precautions	
• Others: please specify	
5.0 Health & Safety File (Asset or Building Manual)	
• Description of its format and any conditions relating to its contents	
• Others: please specify	

Record of Arrangements of Design/Maintenance

Risk ref.	Description of Significant Risks	Arrangements/ Activities	Role/Department	Contact Details
1	Falls of persons, fall of glazing & / or fall of work equipment. Overreaching &/ or insufficient SWL resulting in crane collapsing.	Glazing removal & replacement		
2	Falls of persons & / or fall of work equipment and water containers	Glazing cleaning		
3	Fall of persons &/or fall of work equipment or tools, electrocution	Lighting unit removal & replacement		
4	Strain injury due to improper manual handling	Component, plant equipment Replacing		
5	Fall of work material/ concrete pieces or tools	Demolition and dismantling		
6				
7				

Rating of Risk Severity and the Probability of Occurrence

The level of risks or hazards should be assessed by following the rating matrix below. The risk rating is given by multiplying the assessed risk severity and the probability of occurrence. Risk ratings of 1 and 2 can be considered as tolerable. For risk ratings between 3 and 4, further consideration of ways to eliminate or reduce the risk is needed, and the resulting additional risk management measures selected must be stated. Where the risk rating is 6 or above, alternative design options or alterations to the design should be considered, otherwise detailed justification should be provided.

Severity (or Consequence) of the risks		
Red	High risk (3)	Fatality, major injury or illness causing long-term disability, amputations, major fractures, etc.
Amber	Medium Risk (2)	Injury or illness causing short-term disability, lacerations, burns, serious sprains, minor fractures, etc
Green	Low risk (1)	Superficial injuries, minor cuts or bruises or minor illness, etc.

Probability (or Likelihood) of harm		
Red	High risk (3)	Certain or nearly certain to occur
Amber	Medium Risk (2)	Reasonably likely to occur
Green	Low risk (1)	Very rarely or never occur

	Likely Severity (or consequence) of the Harm		
Probability (or Likelihood) that harm will occur	Low (1)	Medium (2)	High (3)
Low (1)	1	2	3
Medium (2)	2	4	6
High (3)	3	6	9

Sample (Simplified Risk Rating Matrix)

High	Medium	Low

Likelihood				
	High	Medium	High	Very High
	Medium	Low	Medium	High
	Low	Very Low	Low	Medium
		Low	Medium	High

Severity

Sample of risk identification and mitigation

Significant Risk / Issue No.	Significant Design for Safety Issues / Risks - *Description of Significant Risks Generic issues to be avoided	Mitigation, Control Measures, Treatment or further information 'So Far As in Reasonably Practicable' (SFARP)	Design Risk Action & Status • Not tolerable/ significant – requires high consideration and flagging up on drawings via symbols and notes and in BIM • Ongoing – medium – further consideration required • Tolerable – low to be monitored	

1.0	**Site Environment and Site Survey Analysis**	(incl. local features, transport corridors, pedestrian flow, welfare provisions, vehicular access, site storage, unloading, cranage etc.)		
1.1	**Existing site and local environment plan analysis**	Locations of residential properties, schools, and Care homes in close proximity clarified for site establishment purposes. Means of escape route for adjoining properties plotted. More details to be clarified by EA Survey		
1.2				
etc.				
2.0	**Site Enabling Strategy**	(incl. Demolitions, de-contamination, remediation, temp. Works etc.)		
2.1	Construction Logistics Strategic Plan	Principles agreed with client and planners to minimise disruption to local area	Main Contractor	
2.2	Construction logistic (affecting public/pedestrian safety) to be applied beyond the site	Planning, scheduling and organising the minimisation of large vehicle movements and manoeuvring in and around the site	Main Contractor	
etc.				
3.0	**Existing Building and Services Strategy**	(incl. above and below ground features, adjoining properties, party wall issues etc.)		
3.1				
3.2				

4.0	**Structural Works Strategy**	(incl. permanent, temporary, enabling & demolition requirements)		
4.1	Temporary works during enabling works, demolition (or construction)	Excavations for service diversions and replacement, prior to and during dismantling or demolition of a structure (i.e. Shoring, sheet piling and trench boxes etc.). Piling rigs for geotechnical surveys (i.e. mating etc) During the erection of permanent works for the existing &/or new structure (i.e. hoardings, mobile and tower crane bases, propping, gantries, column and wall forms, mast climbing platforms and hoists, scaffold systems, reinforcement cages, façade retention etc.		
4.2	Structural strategy of permanent works incl. where necessary also the overlap of the above and during the occupancy and use of the above.	Calculations with sufficient details of loadings etc. to facilitate & verify design solutions. Taking into consideration condition and combination of loadings are justified.		
5.0	**Heavy Component Movement and Lifting Strategy, Control and Treatment at source**	(incl. large, heavy and awkward components, method of vertical and horizontal movement for delivery storage & placement)		
5.1				
5.2				
6.0	**Off-site & On-site Manufacturing and Assembly Strategy**	(incl. prefabricated, modular components, materials and products lifted and / or assembled on site,		

		reducing waste and potential health risks etc)		
7.0	**Safe working at height strategies**	(e.g., significant roof access, high ceilings, etc.)		
7.1				
7.2				
8.0	**Health Strategy, Control, Mitigation and Treatment at source**	(e.g., excessive, dust, MSD, HAV, noise minimisation etc.)		
8.1				
8.2				
9.0	**Plant & Services design and installation strategy**	(e.g., location and construction issues)		
9.1				
9.2				
10.0	**Plant Replacement strategy**	(e.g., future access issues)		
10.1				
10.2				
11.0	**Plant, plantrooms services + riser access and Maintenance strategy**			
11.1				

11.2				
12.0	**I access, window cleaning and glass replacement strategy**			
12.1				
12.2				
13.0	**Phasing strategy**			
13.1				
13.2				
14.0	**Miscellaneous issues (e.g. landscaping, wellbeing, Workplace Regulations etc.)**			
14.1				
14.2				
15.0	**Fire Strategy – Construction Phase**			
15.1				
15.2				
16.0	**Fire Strategy – In use phase**			
16.1				
16.2				

Team Consultees	Client		Architect		Structural Engineer		Service Eng.		Main Contractor	
Others	Client PM		#Designer (lead/coordinating role)		Façade Engineer		Cost Consultant		Façade Access	
	Interior Designer		Fire Engineer		Acoustic		Lighting Design		Others	
	Mech Engineer		Electrical Engineer		Civil Engineer		Temp Works Engineer			

#Note: the person/party appointed to take up a lead or coordinating role in DfS

Guideline for As-Built Drawings

Purpose of As-Built Drawings

- The development of as-built drawings is a visualized method to compare and contrast between the designed versus final specifications
- To provide a detailed blueprint of the building and the land around it as actually constructed in the end

Intended user of this form

Project stage	File user	Action
Preliminary Design stage	Design team	Design team develops the initial drawings
Detailed Design stage	#Designer (lead/coordinating role) and Design team	#Designer (lead/coordinating role) and Design team review and revise the drawings
Detailed Design stage	#Designer (lead/coordinating role)	#Designer (lead/coordinating role) approves the drawings

Checklist of Requirements for As-Built Drawings for submission

(Note that the following checklist should be referred to as a sample and is not meant to be exhaustive.)

Requirement	Example
1.0 The drawings should show locations of all the mechanical, electrical and public health systems and components installed	Location of ducts, pipes, cables, busbars, plant items, pumps, fans, valves, dampers, control devices, strainers, terminals, electrical switchgear and components, security and fire sensors and control equipment
2.0 The drawings should be labelled with appropriate pipe, duct and cable sizes, pressures and flow rates	
3.0 The drawings should have marked on them positions of access points for operating and maintenance purposes	

Requirement	Example
4.0 The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location	

#Note: the person/party appointed to take up a lead or coordinating role in DfS

Guideline for the Construction Phase Plan

Purpose of the Construction Phase Plan (CPP)

- To identify the significant health and safety risks associated with the construction of the project and records the arrangements for risk mitigation
- The CPP is the basis for communicating the risk management to the relevant duty holders in the construction phase
- Contractor may incorporate relevant CPP items and integrate into Construction Health & Safety Plan depending upon the complexity of the project

Intended user of this form

Project stage	File user	Action
Construction stage	Main Contractor	Main Contractor develops the initial CPP prior to the commencement of Construction
Construction stage	Main Contractor and Contractors	Main Contractor and Contractors update CPP with details of safety concerns

Checklist of Requirements for Construction Phase Plan (CPP)

- Plan – key dates, information about the property
- Working together – site rules, Health and Safety Information, plan/materials change/delays, key decisions
- Organise – identify main dangers on site, make sure that there are toilet, washing and rest facilities, name the responsible person, explain how supervision will be provided

Sample Template (CPP) or items to be considered to integrate into Construction Health & Safety Plan

PLAN	Your name/company		
	Name and address of client Contact details of architect or principal designer		
	What is the job? Is there anything the client has made you aware of?		
	Key dates: Start Finish Other		
	Where are your toilet, washing and rest facilities?		
WORK TOGETHER	Who else is on site – and their contact details?		
	Who will be the Main Contractor?		
	How will you keep everyone on site updated during the job?		
ORGANISE	What are the main hazards and significant risks on site, e.g.:	Hazard is present	What controls do you have?

	Working at Height and Falls from height		
	Collapse of structures		
	Exposure to building dusts		
	Exposure to asbestos		
	Overhead live power lines and services		
	Underground live services		
	Activities or workers requiring supervision		
	Electricity and electrocution working on live services		
	Heavy lifting operation		
	Logistics and traffic management		
	Temporary Works		
	Fire Safety		
	Risks to members of the public, the client and others		
	Other dangers adjacent and / or on site		

Guideline for Health & Safety File (Asset or Building Manual)

Purpose of Health & Safety File (Asset or Building Manual)

- To provide sufficient details of the building's construction, history and maintenance, instructions for the effective operation, maintenance, decommissioning and demolition of the building
- To affect the level of health and safety of maintenance workers or building users
- To suggest the relevant people (e.g., the client, designers, engineers, contractors, facility managers) who have specialised knowledge and/or capacity to control or influence the health and safety matters to identify risks and appropriate solutions

Intended user of this form

Project stage	File user	Action
Pre-tender stage	Client	Client stipulates contents and format in line to their Asset Management and maintenance etc. Stipulated in procurement tender contracts.
Pre-Construction stage	#Designer (lead/coordinating role)	#Designer (lead/coordinating role) collects relevant information from the PCI and from initial designers for Health & Safety File (Asset or Building Manual).
Construction stage	#Designer (lead/coordinating role) and Main Contractor	Main Contractor cooperates with the #Designer (lead/coordinating role) in providing relevant information via their speciality contractors for the Health & Safety File (Asset or Building Manual) The file could help Main Contractor to liaise and coordinate safely with other contractors working on site.
Handover stage	Main Contractor	Main Contractor provides the Health & Safety File (Asset or Building Manual) to the Client. Client reviews with assistance of the Maintenance Supervisor.
Maintenance Stage	Maintenance Supervisor and Client	Client provides the Health & Safety File (Asset or Building Manual) on to the Maintenance

Project stage	File user	Action
		Supervisor for the operation, use and maintenance etc.

Checklist of Health & Safety File (Asset or Building Manual)

- Description of the Buildings Construction, or Installation
- As Built Drawings and Specifications
- Key building features relating to maintenance tasks – Maintenance access strategy
- Anticipated maintenance tasks and their frequencies – i.e. cleaning of roof gutters and glazing panels
- Proposed work equipment and methods employed for achieving accessibility and productivity in maintenance – plant replacement and removal strategy, glazing removal and replacement.
- Specific safety measures
- Product Data Sheets
- Reference to the Cleaning & Maintenance Instructions (including manufacturers health and safety information)
- Testing and Commissioning Certification
- Guarantees and Warranties
- Requirements for Demolition, Decommissioning and Disposal

Sample Outline of Health & Safety File (Asset or Building Manual)

Section	Description	Details
–	**Front Page**	Title of the project, the particular element of the project covered by the manual, the relevant manual reference, and the date of issue of the manual.
–	**Contents Page**	A fully detailed index of the Operation and Maintenance Manual. Title/Page number etc.
1.0	**Introduction**	Description of the manual content and structure. How to use it and why it is being issued. [could be standardized across all your projects]

Section	Description	Details
2.0	**Project Information**	Include detailed information on the project. [can take information from the Owner's Project Requirements (OPR), Basis of Design (BOD), Specifications, Commissioning Plan/Cx Plan]
3.0	**Project Specifications**	Include a register of Specifications that were utilized on the project.
3.1	Building Management System (BMS) Specification	Include BMS Systems Specification.
3.2	Extra Low Voltage (ELV) Systems Specification	Include ELV Systems Specification.
3.3	Electrical Systems Specification	Include Electrical Systems Specification.
3.4	Fire Systems Specification	Include Fire Systems Specification.
3.5	Mechanical/ Heating, ventilation, and air conditioning (HVAC) Systems Specification	Include Mechanical/ Heating, ventilation, and air conditioning (HVAC) Systems Specification.
3.6	Plumbing and Drainage Systems Specification	Include Plumbing & Drainage Systems Specification.
4.0	**As-Built Drawings**	

Section	Description	Details
4.1	**BMS System As-Built Drawings**	Include a register of BMS Systems As-Built drawings.
4.1.1	Schematics/Single Line	Include a set of as-built schematics/single line diagrams for the BMS Systems.
4.1.2	Layouts	Include a set of as-built layouts for the BMS Systems.
4.2	**Controls System As-Built Drawings**	Include a register of Control Logics As-Built drawings.
4.2.1	Control Logics	Include a set of as-built Control Logics.
4.3	**ELV System As-Built Drawings**	Include a register of ELV Systems As-Built drawings.
4.3.1	Schematics/Single Line	Include a set of as-built schematics/single line diagrams for the ELV Systems.
4.3.2	Layouts	Include a set of as-built layouts for the ELV Systems.
4.4	**Electrical System As-Built Drawings**	Include a register of Electrical Systems As-Built drawings.
4.4.1	Schematics/Single Line	Include a set of as-built schematics/single line diagrams for the Electrical Systems.
4.4.2	Layouts	Include a set of as-built layouts for the Electrical Systems.

Section	Description	Details
4.5	**Fire System As-Built Drawings**	Include a register of Fire Systems As-Built drawings.
4.5.1	Schematics/Single Line	Include a set of as-built schematics/single line diagrams for the Fire Systems.
4.5.2	Layouts	Include a set of as-built layouts for the Fire Systems.
4.6	**Mechanical/HVAC System As-Built Drawings**	Include a register of Mechanical/HVAC Systems As-Built drawings.
4.6.1	Schematics/Single Line	Include a set of as-built schematics/single line diagrams for the Mechanical/HVAC Systems.
4.6.2	Layouts	Include a set of as-built layouts for the Mechanical/HVAC Systems.
4.7	**Plumbing and Drainage Systems As-Built Drawings**	Include a register of Plumbing Systems As-Built drawings.
4.7.1	Schematics/Single Line	Include a set of as-built schematics/single line diagrams for the Plumbing and Drainage Systems.
4.7.2	Layouts	Include a set of as-built layouts for the Plumbing & Drainage Systems.
5.0	**Electrical Discrimination Study**	Include the approved discrimination study report for the electrical systems.

Section	Description	Details
6.0	**BMS Graphic Document**	Include the approved BMS Graphic document.
7.0	**BMS Access/Messaging As-Built Information**	Include the approved information relating to access to the BMS/Control Systems and messaging.
8.0	**Summary of Systems Installed**	Provide a summary of each system's components, location, and how they are designed to operate. [can take from specifications, drawings, control logics]
9.0	**Asset Register**	Include a detailed list of equipment for each type of system that has been installed. 1. Equipment ID 2. Type 3. Manufacturer 4. Model 5. Size/Rating 6. Building/Floor/Room [usually taken from the progress trackers that were created through the project]
10.0	**System Operation**	Expand on the way in which each of the systems operates: 1. Start-Up, interfaces/interlocks 2. Setpoints 3. Running 4. Shut down, interfaces/interlocks 5. Fault finding/problem solving [Use specifications, drawings, control logics, manufacturers data, and information].

Section	Description	Details
11.0	**Manufacturers Literature/Information**	Include all the manufacturer's information relating to the equipment, ancillaries, and systems. [Use the asset register for reference of what would be needed]
11.1	[Add each type]…	
11.2	[Add each type]…	
11.3	[Add each type]…	
12.0	**Health and Safety**	
12.1	Safety Procedures	Include all safety processes and procedures related to the operation, access, and maintenance of the equipment and systems. Don't forget a register/index to show what is included. [Use the project health and safety file for examples and reference]
12.2	Control of Chemical/ Substances Hazardous to Health	Include all Chemical/substances hazardous to health data sheets for items related to the maintenance, cleaning, and disposal of chemicals [paint, adhesives, gases, and chemicals]. Don't forget a register/index to show what is included. [Use the project health and safety file for examples and reference]
12.3	Risk Assessments	Include all risk assessments related to the operation, access, and maintenance of the equipment and systems. Don't forget a register/index to show what is included.

Section	Description	Details
		[Use the project health and safety file for examples and reference]
12.4	Arc Flash Study	Include the approved Arc Flash Study for the electrical systems.
13.0	**Disposal of Equipment/Products**	Provide information on how equipment and products should be disposed of.
14.0	**Maintenance**	
14.1	Planned Maintenance Instructions and Schedules	Provide instructions and schedules on how to maintain each piece of equipment, systems, and ancillaries of the installation. Cover: monthly, half-yearly, yearly program on items such as lubrication, adjustment, replacement, routine maintenance, cleaning, filter changing, access, safety, etc. [most should be provided by the manufacturers]
15.0	**Equipment/System Spares**	
15.1	Handover Spares List	Provide the list of spares that have been provided under the contract.
15.2	Recommended Spares & Purchase Information	Provide a list of spares that are recommended to be held by the operator/facilities department and also provide any purchasing information needed

Section	Description	Details
16.0	**Service Level Agreements**	Include information from the suppliers, vendors, and contractors relating to any Service Agreements/Warranties that are to be included for the operation of the building and systems after handover
17.0	**Final Testing and Commissioning Report**	Include the Final Commissioning Report that is usually to be written and issued by the Commissioning Agent/Authority

- Building Maintenance Units (BMUs) with monorail system and cradles
- Anchor points for rope access etc

Sample Template (Operation and Maintenance)

A typical Maintenance Strategy report should contain sufficient details to inform those undertaking the maintenance tasks. The content of the report should include but not limited to:

- Key building features relating to maintenance tasks
- Anticipated maintenance tasks and their frequencies
- Proposed work equipment and methods employed for achieving accessibility and
- Productivity in maintenance, and
- Specific safety measures

An example of Maintenance Strategy Report is shown on the next page.

- Solution A– Suspended platform
- Solution B– Self-propelled access platform
- Solution C–Rope access, anchor points
- Solution D– Personnel lifting hoists or other suitable means

External Areas						
	Building Areas/Element	**Routine Maintenance**	**Major Maintenance**	**Solution**		**Comments**
1	Tower block: Façade curtain wall • Full height from ground level to roof All elevations including recesses and protrusions	• Façade cleaning and inspection	• Glass replacement • Curtain wall repairs • Façade lighting repairs	• Routine maintenance • Major maintenance	A	• Permanent suspended platform with monorail system to access all façade surfaces • Integrated restraints in façade system
2	Tower block: External planters	• Routine inspection and cleaning • Planting, pruning and fertilizing	• Plant or soil replacement • Drainage or irrigation repairs	• Routine maintenance • Major maintenance	**A**	• Permanent suspended platform with monorail system to access all planters • Integrated restraints in façade system • Protection rail for hanging planters
4	Tower block: Entrance glass canopy • Top and underside including structural element	• Cleaning • Luminaire replacement	• Glass replacement • Building services repair (drainage, electrical, etc.)	• Routine maintenance • Major maintenance	**B**	• Access using self-propelled access platform • Accessible via paved fire engine access • Fall arrest system

						provided on surface of canopy
5	Covered walkways	• Cleaning	• Cladding repairs • Building services repair (drainage, electrical, etc.)	• Routine maintenance • Major maintenance	**C**	• Accessible via ground level walkway • Fall arrest system provided on surface of canopies
Internal Areas						
6	Atrium	• Glass cleaning • Cleaning shading devices • Luminaire replacement	• Glass repair or replacement • Ceiling or shading devices repair • Building services repair	• Routine maintenance • Major maintenance	**D**	• Personal lifting hoists for suspended platforms

#Note: the person/party appointed to take up a lead or coordinating role in DfS

Guideline for Fire and Emergency File

Purpose of Fire and Emergency File for buildings over 18 Metres (7 storeys)* or more with two dwellings or more.

- To assist Maintenance Supervisor or Building user to prepare for and respond quickly and safely to fire emergency
- To control or limit any effect that a fire emergency may have on site
- To ensure communication of all vital information as soon as possible

Intended user of this form

Project stage	**File user**	**Action**
Pre-tender stage	Client	Client stipulates contents and format in line to their Asset Management and maintenance etc. Stipulated in procurement tender contracts.
Pre-Construction stage	#Designer (lead/coordinating role)	#Designer (lead/coordinating role) collects relevant information from the PCI and from initial designers for Fire & Emergency File
Construction stage	#Designer (lead/coordinating role) and Main Contractor	#Designer (lead/coordinating role) and Main Contractor cooperates with the #Designer (lead/coordinating role) in providing relevant information including via their specialty contractors for the Fire & Emergency File
Handover stage	Main Contractor	Main Contractor provides the Fire & Emergency File to the Client. Client reviews with assistance of the Maintenance Supervisor.
Maintenance Stage	Maintenance Supervisor and Client	Client provides the Fire & Emergency File on to the Maintenance Supervisor for the operation, use and maintenance etc.

Checklist of Fire and Emergency File

- Building information
- Site layout plan
- The principles, concepts and approach relating to fire safety that have been applied to the development
- Emergency road vehicle access and water supplies for firefighting purposes

*Note: In England, since 24th April 2022 (Wales and Scotland are looking at similar) it has been made a statutory legal requirement under the Building Safety Act 2022 that initially all new and modified buildings over 18m (7 storeys) or more than two dwellings or more (to known as High Risk Buildings (HRBs). A new Fire and Emergency File (FEF) has also been introduced. Building on the existing

requirements of Regulation 38 of the Building Regulations 2010 (amended), where it enhances and formalises the management and delivery of critical documentation at handover for HRBs.
The FEF will ensure the delivery of complete, accurate and compliant fire and emergency information at handover to the'owner's Accountable Person (AP) and responsible person for fire Safety, which can then be used for correct property maintenance and management during occupancy. It will demonstrate the ability to manage risk and prepare for future regulations and audits. This is going to be enforced by t'e HSE's Building Safety Regulator (BSR) from April 2024 and it is considered as best practice and should be adopted for all buildings.
This is in addition in the UK to all structures under the Construction Design & Management Regulations 2015 (CDM15) requiring a Health & Safety File, which does not go into far enough detail to manage fire and emergency risks etc.

#Note: the person/party appointed to take up a lead or coordinating role in DfS

Purpose of implementing a centralised knowledge hub

- To share relevant information of identified risks to eliminate or mitigate risks related to the project, including within the design and enable duty holders, the construction industry and academia to collaborate, and share knowledge and information digitally

Intended user of the centralised knowledge hub

Project stage	File user	Action
All stages	Client, #Designer (lead/coordinating role), Main Contractor	To consolidate the feedbacks on incidents and lessons learnt

Requirement of a centralised knowledge hub

- This hub should consolidate all feedback on incidents and lessons learnt in a centralised system and become an accessible catalogue of industry best-practices to help push industry-wide action for a shift to a “safety-first” mentality”.

Demonstrate H&S information is 1) provided in relevant and uniform format following a recognized and auditable process and procedure and where applicable using standardised template, and 2) share such information via meetings in accessible and usable format agreed by the Client such as using a Common Data Environment (CDE) capturing any accidents, incidents and dangerous occurrences, incl. near misses/hits/close calls with lessons learnt.

#Note: the person or party appointed to take up a lead or coordinating role in DfS

Purpose of using KPIs in the implementation of Design for Safety

- To implement a simple and effective performance measurement system which will both incentivise the Property Vehicle (PV) to continually improve their performance as well as to improve and encourage / motivate Safety.
- To be used for all construction projects and to be suitably adjusted to reflect varying project values and programmes

Intended user of the KPIs

Project stage	File user	Action
All stages	Client with #Designer (Lead/coordinating role) and Main Contractor	Client should appoint someone (i.e. Client's team, project manager) to assist in monitoring KPI's

Checklist of KPIs

KPI's can include but are not limited to the following:

1) KPI 1 – Number of Design for Safety Meetings conducted, and number of significant risks identified in the design divided by number eliminated or reduced or treated to Low/Green.
2) KPI 2 – Number of Audits. Taking record of the number of positives (good practice) identified and recorded vs actions from non-conformances/compliances required to be closed out
3) KPI 3 – Number of non-conformances/compliances closed immediately vs number still outstanding after 3 days)
4) KPI 4 - To deliver projects in a safe and controlled manner by reducing accident frequency. It is recommended to use Accident Frequency Rate (AFR) which is fabricated even more by number of hours of everyone including construction office staff not just the site workers hours.

Supplementary Notes:

The objectives of setting up KPIs is to assess and monitor that sufficient resources are allocated to enable the project led in time i.e. sufficient time to mobilise and deliver the project. The principles include, as illustrated in the below flow diagram –

(1) Decide what to measure
(2) Collect the data
(3) Analyse the data
(4) Report the results

(5) Take action

In the construction projects, KPIs should be balanced with the same number of **lead KPIs** (i.e. provision of the Health & Safety file before or at practical completion; Reporting a Near Miss/Hit/Close Call within 6 hours with an investigation report with lessons learnt and actions in 3 days; More than 3 key hazards eliminated or significant risks reduced in the design or More than 5 positive actions agreed and carried by the design team following a Design Team Meeting or workshop; Communication of Safety Alerts/ Information from other projects on a monthly basis; Safety share notices from workers to the management with actions carried out on a monthly basis – "turning concerns into positive actions) and **lagging KPIs** (delaying provision of the Health & Safety File, Not reporting Near Misses / Hits / Close Calls; Not reporting within a set time period and providing an accident / incident report with 10 days of the root causes and actions to be taken to prevent a reoccurrence.

#Note: the person/party appointed to take up a lead or coordinating role in DfS

Guideline for Promotion of Early Involvement of Construction Experts in the Initial Conversation

Purpose of Promotion of Early Involvement of Construction Experts in the Initial Conversation

- To help mitigate risks and improve project performance. In order to achieve Safe Design, Client's team with construction management experience or Contractors engaged as advisor at an early stage of the project to offer input into the design phase; or Client can convene briefing sessions with contractors so as to allow opportunity for contractors to provide feedback on projects when appointed parties are excluded from joining the tender for avoiding conflict of interest.

Intended user

Project stage	File user	Action
Pre-tender stage	Client	Option 1: Client to appoint Contractor as independent advisor earlier during the design stage to be involved in DfS review meeting to provide input from contractor point of view Option 2: Client to convene briefing sessions with contractors so as to allow opportunity for contractors to provide feedback on projects

Supplementary Notes:

- Involve Client's team with construction management experience or Client to appoint Contractor as independent advisor during the design stage to be involved in DfS review meeting to provide input from contractor point of view (e.g. if design solution is constructable, raise construction safety concerns, advise accessible issue during construction, operation and maintenance, raise any potential safety concerns due to design or solution that could be address through design.)
- Early market engagement and sufficient time for pricing and evaluation of bids based upon the existing information and design is essential. Procurement is often seen as a separate activity from planning, managing the design, construction and asset safety risk but procurement has a direct impact on project and asset lifecycle in terms of the finished asset and how it protects people from harm and in terms of the health and safety of people working on the design, construction, maintenance, use and demolition of the asset across its lifecycle.
- Tendering Contractors should undertake a due diligence process to establish there is sufficient information to establish any significant issues / risks to appropriately plan resources, time, and cost allocation to deliver the project.

Guideline for Tender Stage Framework

Purpose of Tender Stage Framework

- To include tenderers' understanding of DfS factors considered during design stage such as project knowledge and safety awareness during construction as one of the assessment criteria

Intended user of the framework

Project stage	File user	Action
All stages	Client, #Designer (lead/coordinating role)	Client/ #Designer (lead/coordinating role) outlines significant risks at Construction stage

Requirement of Tender Stage Framework

- Pre-Construction Information to be included at tender stage to provide existing information concurrently with tender to share early risk identification.
- Tenders (e.g. top three tenderers) can outline their understanding of PCI, list out preliminary significant risks foreseeable at Construction stage and provide an opportunity for Contractors to address these issues during tender submission, which will also promote earlier involvement of Contractors and raise awareness of DfS issues before construction work commencement.

#Note: the person/party appointed to take up a lead or coordinating role in DfS

Guideline for Using Digital Visualisation (i.e. BIM, Virtual Reality etc.) and Tools

Purpose of using digital visualisation (i.e. BIM, Virtual Reality etc.) and tools

- To enhance identification of risks that can be eliminated or reduced at earlier stages and prevention measures are implemented during construction and in use stage

Intended user

Project stage	File user	Action
All stages	#Designer (lead/coordinating role), Main Contractor	#Designer (lead/coordinating role) and Contractors to capture digital data

Supplementary Notes:

- Promote client guidance on ISO 19650 Information Management and requirements for the designers and contractors to capture digital data early on same platform e,g, BIM from inception through the project land then the asset lifecycle.
- This provide also effective communication on H&S concerns and map onto system and make sure concerns are being addressed and mitigation measures are being implemented during construction stage.

#Note: the person/party appointed to take up a lead or coordinating role in DfS

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REFERENCE

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