GUIDANCE NOTES OF

DESIGN FOR SAFETY

職業安全健康局
OCCUPATIONAL SAFETY & HEALTH COUNCIL

發展局
Development Bureau

CONTENTS

CHAPTER 1

INTRODUCTION

1.INTRODUCTION

The Development Bureau (DEVB) had taken the lead to implement the model under UK's (Design and Management) Regulations (CDM Regulations) in public works in 2006. The Guidance Notes on "Construction, Design and Management" and Worked Examples were prepared and brought a significant change for the Hong Kong construction industry by outlining Safe Design concepts for safety and health on construction projects and placing responsibilities on the duty holders who procure, design or manage the construction projects. To enhance the effectiveness of this initiative, the DEVB launched a review programme to the Guidance Notes and Worked Examples in 2013. The review was carried out through an external research project which consisted of a questionnaire survey, interview, focus group meeting and site visit.

The result of the survey indicates that many stakeholders in the industry struggled with the CDM Guidance Notes' systematic approach and concepts. The review of the Guidance Notes and Worked Examples, therefore, provides an opportunity to advance construction excellence, further promote team integration and improve its effectiveness.

A new paradigm of construction safety management, referred to as "Design for Safety", has been introduced the main objectives of which are to:

- Promote early involvement, effective cooperation and communication of all stakeholders through the timely provision of relevant and necessary information.
- Improve clarity on the demarcation of the roles and responsibilities of the parties responsible for coordinating and providing relevant project data on risks at all stages of a project.
- Identifying the outputs of the "Design for Safety" application process and the specific risk reduction measures. Hazard identification and mitigation should be initiated at the early design stages to eliminate or minimize the risks of injury and be continued through the subsequent stages of project development, implementation, maintenance and demolition for better safety management in the whole project life cycle.

CHAPTER 2

FRAMEWORK OF "DESIGN FOR SAFETY"

2. FRAMEWORK OF "DESIGN FOR SAFETY"

2.1 General Principles

The most cost-effective and practical approach is to avoid introducing a hazard to the workplace in the first place which can be done by eliminating it from Safe Design. This is often cheaper and more practical to achieve at the design or planning stage rather than making changes later when the hazards become real risks to clients, employees, users and business.

The principle of "Design for Safety" is to bring the consideration of the actual potential hazards and risks to each project to the forefront of a designer's work. Designers can then quantify the risk and develop a framework within which design, specification, and planning of project and operation activities can either be used to prevent such hazards materializing or be employed to mitigate their effects. Safe Design is the most effective risk control measure which is achieved by eliminating the hazards at source.

2.2 Interaction between "Design for Safety" and Systematic Risk Management (SRM) for public works

Systematic Risk Management (SRM) is one of the risk analysis techniques in public works projects following the promulgation of the Risk Management User Manual by the Environment, Transport and Works Bureau in June 2005. SRM is to be applied throughout the project period for public works programme projects with cost estimates exceeding $200 million throughout the project period except for those projects with detailed design already well in the advance stage, or which are of routine nature;primarily straightforward; and/or unlikely to attract interfacing problems or objections. The SRM process comprises a considered, systematic risk planning, identification, analysis, evaluation and treatment process, which is supported by appropriate monitoring, review and recording of the identified risks, together with effective communication and consultation with stakeholders and project participants.

Under this system, project team members are required to start preparing the Project Risk Management Plan at the early stage of a project once it is identified. The aim of this process is to identify potential risk and have risk treatment for the sake of proactive project cost control. The SRM process could also be regarded as the first step for executing "Design for Safety". Both aim to identify any risk at the early stage. Therefore, Designers are recommended to expand the SRM to include "Design for Safety" in order to achieve the best project outcomes more efficiently.

CHAPTER 3

ROLES & RESPONSIBILITIES OF DUTY HOLDERS

3. ROLES & RESPONSIBILITIES OF DUTY HOLDERS

Successful construction project management which deals with safety and is related to cooperation, coordination and communication, is fundamental to the delivery of effective health and safety management within the holistic concept of the integrated team. Clients, designers, contractors, maintenance supervisors and others involved in the project, have an important role to play in identifying the health and safety risks that could arise throughout the life cycle of the building or structure. It is important for all sectors in the industry to understand the implications of duty holders discharged within the conceptual embrace of competence and the comfort of proportionality. The construction industry should seek continuous performance improvement instead of just meeting the minimum requirements set by the clients and regulatory authorities. This chapter serves to demonstrate how the "Design for Safety" roles criteria could be fitted into the usual project team of current construction industry and how to apply the "Design for Safety" principle within their roles correspondingly. Checklists of considerations for duty holders are attached in Appendix A. These checklists can be used to verify the fulfillment of these duties.

3.1 Client

The client is the one who is financing the project and is able to influence many major decisions involved in the project, such as finalising the type of design and materials used. In this regard, the client plays a critical role in driving the project to improve through safety-oriented or contractual requirements. It is obvious that most of the clients need advice and assistance no matter how big or small the project. As clients have the right to specify the type of design and materials for the project, they have to be advised by the designer on safety and health aspects of the design. Other than the safety and technical aspects for the design, the client should also be advised on the time required for the completion of the project. The time allocated for the project should be sufficient and agreed by the designer and contractor when tendering for the project.

It is good for a client to manage their project risks in a proportionate and considerate manner. A good client should be clear about what the high-level risks are during construction and which key risks for operation and maintenance need to be managed after completion. A team that is formed by the client: may consist of designers, contractors, maintenance team and even safety professionals who work closely together to produce the best results and would greatly help to work out the best solution for the client's needs, taking account of the practicalities of buildability, usability and maintainability.

Roles and responsibilities of Client:

- To appoint a competent designer to undertake the project;
- To ensure designers, contractors and other members appointed are competent and adequately resourced to carry out their responsibilities;
- To ensure construction work can be carried out safely without risk to health;
- To provide the relevant information that is needed by the project team to enable them to carry out their duties properly at different stages of the project;
- To ensure the contractual relationships within the project are clear and their responsibility on safety are clearly allocated;
- To request details from the designers and contractors of the arrangements they propose to implement throughout the project.

3.2 Designers

Designers can be the architects/engineers/surveyors/interior designers and others who specify or alter a design or specify a particular method of work or material. Designers contribute to or have responsibility for the design and/or drawing up of the specifications of any part of the project works.

Designers' duties include considering construction hazards that can reasonably be identified and to provide information that contractors need to be made aware of. Designers are in a position to make major contributions to safety and health by hazard identification and elimination, and by risk reduction during all stages of design. The response of designers to any hazards identified will vary according to the stage of project. A high degree of flexibility would be offered if hazards are avoided at the start of the design process, when control measures may be more appropriate for dealing with any remaining hazards. Methods of dealing with hazards are not required to be outlined by designers but they should explain any particular construction assumptions that have been made as part of their design.

Designers should work with other duty holders to bring the design to fruition. Engineering drawings, design reports or models can be used to present their design ideas with other duty holders. Designers are also involved with the pre-construction coordination works to be delivered through a pre-existing part of a project team. Designers should act on behalf of the client on dealing with the relevant safety and health issues for the project. All the design issues that are to be considered in the design should be recorded in the 'Health and Safety File'.

3. ROLES & RESPONSIBILITIES OF DUTY HOLDERS

Roles and responsibilities of Designers:

- To ensure Designers are competent and adequately resourced to address the health and safety issues likely to be involved in the design;
- To make/check clients are aware of their responsibilities, e.g. make client aware of the need to provide sufficient information on time;
- To plan, manage and monitor the pre-construction stage;
- To assist the client in preparing pre-construction information;
- To assess the design and ensure that, where reasonably and practicable, foreseeable risks to those involved in the construction and future use of the structure are avoided;
- To ensure risks are eliminated or controlled and consider hazards which can reasonably be identified through design work;
- To provide adequate information about any significant risks/hazards associated with the design and pass information to contractors and other so that they can be made aware of the risks/hazards;
- To provide information and prepare the 'Health and Safety File' which must contain information relating to the project which is likely to be needed during any subsequent construction work, such as the significant residual risks, to ensure the health and safety of any person. The file should be reviewed from time to time;
- To explain any particular construction assumptions that have been made as part of their design;
- To ensure full cooperation and coordination with other duty holders in order to improve the way in which risks are managed and controlled.

3.3 Contractors

Contractors would normally be responsible for undertaking and carrying out the construction work. Contractors are the employers and they should have their general duties assigned under legislation to ensure their employees receive suitable and sufficient training, instructions and information. It is the contractors' duty to ensure that their employees are informed of relevant site safety matters, where identified hazards or risks are not eliminated at the design stage. Residual risks that have not been be eliminated by the designer must be addressed and managed by the contractors during the construction stage.

Main contractors play a critical role in ensuring that hazards identified both prior to and during the actual construction works are properly addressed. Main contractors are responsible for the planning, management and coordination of construction works. They should be able to effectively manage safety and health issues during the construction stage. Main contractors should ensure that they receive all the essential information pertaining to identified risks during the design stage. It is preferable for main contractors to receive all relevant information concerning the identified risks at the earliest time, after the completion of the design stage, as time is a resource and it would ensure that contractors can have optimal flexibility concerning ongoing arrangements.

It is important that contractors, both main contractors and sub-contractors, are involved as early as possible in planning how they will carry out their work safely and with due regard to health. Contractors should plan their activities properly and a work schedule should be fixed before starting work on site so that all parties are fully aware of what they should be doing and can ensure the smooth running of the project. Contractors should not only consider their own direct activities, but also how their activities may affect other trades working around them.

A good contractor will place health and safety as the first priority and will review the health and safety implications of all decisions. Contractors should involve all parties to ensure that the construction work is carried out efficiently and with full consideration for health and safety issues.

3. ROLES & RESPONSIBILITIES OF DUTY HOLDERS

Roles and responsibilities of Contractors:

- To ensure Contractors are competent to address the health and safety issues likely to be involved in the construction stage and to do so in a safe manner;
- To request from designers all information regarding the identified risks;
- To ensure that the construction stage is properly planned, managed and monitored, with adequate resources, competent site management appropriate to the risk activity;
- To ensure all sub-contractors engaged to carry out the works are competent and adequately resourced;
- To ensure all sub-contractors are provided with the information about the project that they need to enable them 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 ensure safe working, coordination and cooperation between contractors;
- To ensure that a suitably developed 'Health and Safety Plan' for the construction stage is prepared before construction work begins and is developed in discussion with the contractors affected by it;
- To prepare and enforce any necessary site safety rules and provide relevant information to employees;
- To ensure that all the workers have been provided with suitable health and safety induction, information and training;
- To ensure that suitable welfare facilities are provided from the start of the construction stage, including sanitary conveniences, washing facilities, drinking water, changing rooms, secure storage and facilities for rest.

3.4 Maintenance Supervisor

The Maintenance Supervisor is in charge of overseeing the upkeep of a building, including cleaning, maintenance, alterations, refurbishment and demolition. It is the responsibility of the Maintenance Supervisor to ensure that all assigned tasks are handled in a safe manner as well as the usability and maintainability of the constructed structure.

The Maintenance Supervisor should participate in the design for safety meetings with designers at the design stage and raise their ideas for the design. As they will be involved in future maintenance work, they have their own concerns for ensuring that the finished structure can safely be used as a place of work. Maintenance Supervisors have particular knowledge and experience which can usefully be taken into account by the designers.

Furthermore, the Maintenance Supervisor needs to understand and give clear instructions related to information relevant to the maintenance team. The Maintenance Supervisor should study the 'Health and Safety File' thoroughly as it is a source of information that records all the details specifically for the maintenance stage. It not only aims to ensure that the work can be done properly, but also helps to eliminate and reduce risks to health and safety at the time of the maintenance work. The Maintenance Supervisor should communicate and cooperate with the maintenance team in order to optimise a safe working environment so as to reduce the risk of injury to the maintenance worker.

Roles and responsibilities of Maintenance Supervisor:

- To participate in meetings with designers at the design stage and raise their ideas to ensure that the finished structure can safely be used as a place of work;
- To study the 'Health and Safety File' that records all the details specific to the maintenance stage;
- To appoint and ensure that the maintenance contractors engaged to carry out the works is competent and adequately resourced;
- To ensure the maintenance work is properly planned, managed and monitored, with adequately resources site management appropriate to the risk activity;
- To ensure that maintenance contractors are provided with all necessary information, e.g. the information from the 'Health and Safety File' or operational and maintenance manuals, in order to carry out the works safely;
- To ensure safe working, coordination and cooperation with the maintenance contractors;
- To keep full records of all safety and health issues, e.g. accidents or any prosecutions.

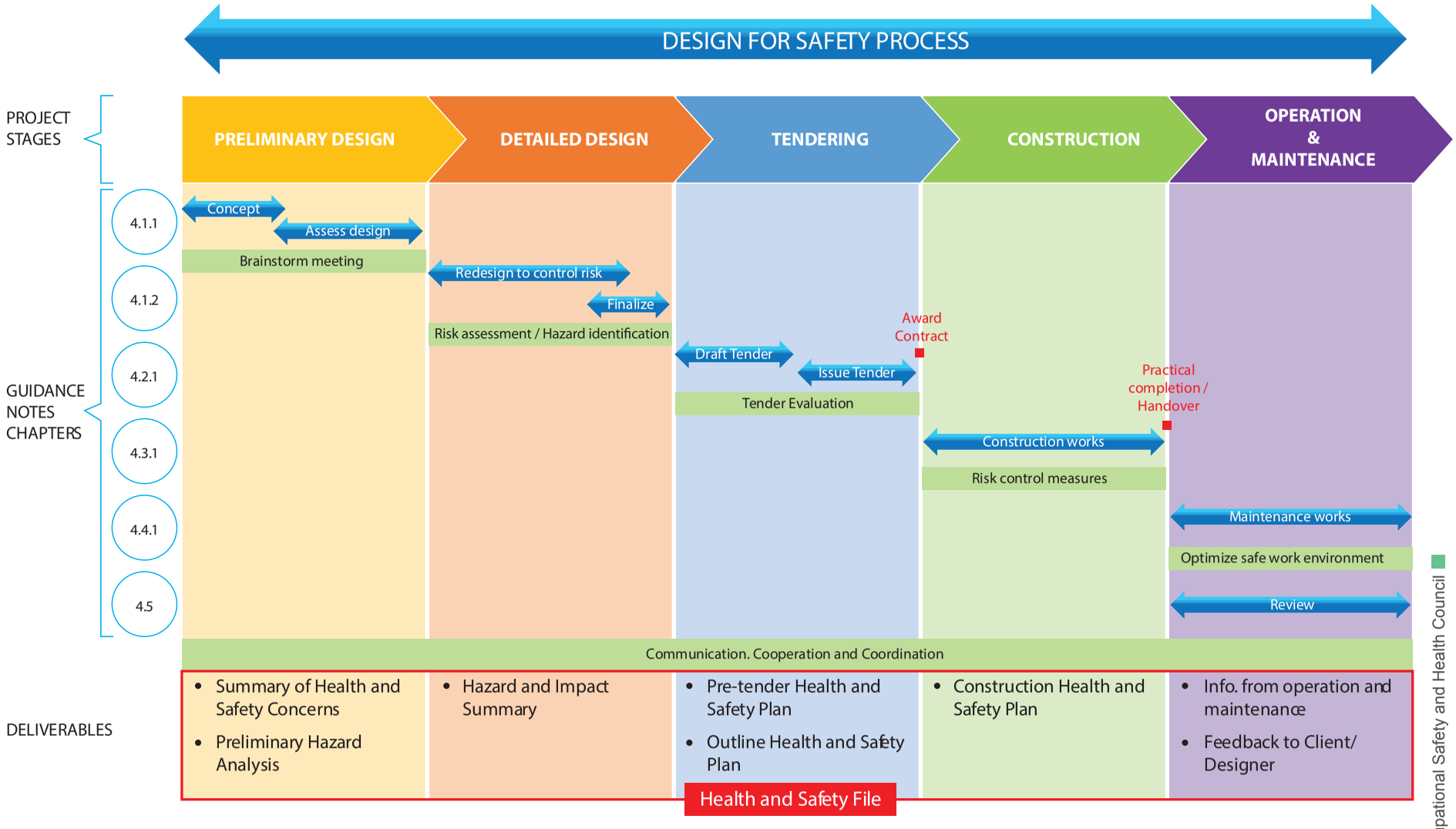

Figure 1. Design for Safety Process

CHAPTER 4

APPLICATION OF "DESIGN FOR SAFETY" UNDER DIFFERENT PROJECT STAGES

4. APPLICATION OF "DESIGN FOR SAFETY" UNDER DIFFERENT PROJECT STAGES

This chapter serves to assist the duty holders on the process of Safe Design and the transfer of vital safety information along the whole construction process chain. To facilitate this, Safe Design principles are incorporated and a framework is created that allows duty holders to making vital safety decision (see figure 1).

4.1 Pre-tender stage

A good Safe Design process must begin at the concept development stage. This is the best and the only opportunity to make fundamental changes because much of the design is still to be determined. Before starting to work on the design, the client should discuss with the designers which types of activities are to be carried out in the building or structure when it is completed. In collaboration with the designers, the scope of a project should be properly defined, and the project objectives developed. A site survey should then be conducted. This is a key stage before commencement of design work as it will provide a guide for considering a wide variety of factors in the development.

Typical information to be gathered through the site survey includes:

- Site location, description and context
- Overview of the existing environment and site constraints for construction
- Conclusions and recommendations justified for the design going forward

The preliminary information concerning the risks that are required to be considered during the design process can then be addressed.

4.1.1 Preliminary Design

For public works projects, government controls the scope and timing of new construction through the Public Works Programme. The various stages of a public works project, from its conception to its implementation, are assigned various categories in the Public Works Programme. Each category constitutes the authority to proceed with a specific stage or value of work. The list of projects is arranged according to a system of categories in the Public Works Programme, namely Category C, Category B, Category A and Category D. After a construction project item is upgraded to Category B status under the Public Works Programme authorization system, the project office is authorized to proceed with the design.

Designers have to weigh many factors for their designs. Health and safety considerations have to be weighed alongside other considerations, including cost, fitness for purpose, aesthetics, buildability, maintainability, usability and environmental impact. Thorough consideration must be given to all relevant factors at the planning and design stages to facilitate downstream activities.

At the preliminary design stage, the project office has greater freedom of choice and fewer constraints when dealing with potential health and safety hazards. Designers are not expected to consider or address risks which risk cannot be foreseen because zero risk design is simply impossible. Any foreseeable risks should be avoided with the consideration of other relevant design considerations; hazards should be eliminated from the design as far as is reasonably practicable. Designers should ensure the design will able to be constructed, maintained, used or demolished safely. They should consider the whole life cycle of the structure but not only consider how the design will be initially constructed; the consideration on how the structure can be safely kept in good order, maintained, repaired and finally demolished is necessary. To ensure sufficient consideration is given to health and safety design issues at this stage, discussion or brainstorming meetings should be conducted frequently. Brainstorming meetings at the start of the design stage will often identify the major issues that need more consideration. Discussion with the client or other responsible duty holders at this stage can inform the designers' understanding of the requirements, and enable them to be aware potential hazards in their design.

Once the preliminary design is completed, all the significant concerns raised by stakeholders together with the corresponding responses should be recorded in the 'Summary of Health and Safety Concerns' (the Summary). A sample proforma is attached at Appendix B and the coverage can be found at Appendix E. The purpose and extent of the project, including plant, ancillary equipment and tasks; major hazards and safety issues should be defined. Risks and hazards that may arise during the whole life of the structure should also be identified.

4. APPLICATION OF "DESIGN FOR SAFETY" UNDER DIFFERENT PROJECT STAGES

PRELIMINARY DESIGN

The Preliminary Design stage should involve:

- Determining client needs;
- Carrying out of the feasibility study;
- Consulting with relevant stakeholders by discussion and brainstorming meeting;
- Determining design information needs;
- Identifying hazards that may arise during the whole life of the structure;
- Taking account of the principles of Safe Design for the preliminary design;
- Preparing the 'Summary of Health and Safety Concerns' and 'Preliminary Hazard Analysis' for the detailed design.

According to the Technical Circular (Works) No. 19/2003, the responsible department should set up a Review Committee to review the preliminary design of the project in the form of a layout plan and method statement produced by the consultant/entrusted works agent (designers) of the Investigation Assignment before proceeding with the detailed design. The main objective of the review is to ensure that all relevant and important issues, including the appropriateness of design/construction method and the compliance of relevant statutory requirement are addressed. The Summary should then be reviewed by the project review committee in order to check the conformity of the health and safety issues of the design. Once the Summary is endorsed, it should be included in the 'Health and Safety File'.

The feasibility study is an important phase in shaping the final delivered design and it is used to evaluate and analyse the identified risks in the preliminary design stage of the project. The feasibility study aims to objectively uncover the constraints of handling the identified risks with the consideration of other factors, such as the environment, resources required to carry through, and ultimately the prospects for success. The feasibility study has the greatest influence on the design and it directs the project's design and even part of the construction strategy. By the completion of this stage, designers must recommend an alternative design to meet client's need or the structure's requirement with the consideration of the identified safety issues. This can be done by conducting extensive research and consulting with different stakeholders in order to work out the best decision.

The 'Preliminary Hazard Analysis' should be done in this stage. This is a safety analysis tool for identifying hazards and their associated causal factor when detailed design information is not available. A sample proforma with a 'Preliminary Hazard Analysis Checklist' is attached in Appendix B and an explanation regarding its coverage can be found in Appendix E. The 'Preliminary Hazard Analysis Checklist' may be useful as an aid, but it is not a substitute for experience and judgement. The intent of the 'Preliminary Hazard Analysis' is to ensure that the design meets considerations of safety as early as possible in the development project. It provides a methodology for identifying and collating risks/hazards in the design and establishing the safety requirements from the preliminary design based on basic design information. Major issues regarding safety should be recognized and carried forward as information for the detailed design. Before conducting the 'Preliminary Hazard Analysis', designers can use the 'Red, Amber and Green lists' as a reference. Sample lists are attached in Appendix F. The 'Red, Amber and Green lists' are practical aides to designers on what should be eliminated/avoided, and what to encourage to be completed during the design stage. The lists included in Appendix F provide examples. It is suggested that clients and designers prepare their own lists. In addition, some good design practices are attached in Appendix G for reference.

4.1.2 Detailed Design

Following completion of the 'Preliminary Hazard Analysis', the design team should proceed with the detailed design. At this stage, a comprehensive consideration of the possible hazards and impacts, together with a risk assessment should be carried out by the designers. Besides, a good and Safe Design should be achieved through effective communication between the stakeholders who are involved throughout the life cycle of the building or structure, especially the Maintenance Supervisor and the end-user. Their involvements in the design stage are important as designers can accommodate their points of view regarding the safety and health issues while using the building or structure. For example, designers can modify their design to ensure sufficient working space for future maintenance. These are the most crucial parts of the "Design for Safety" process.

Designers should ensure that the risks, hazards and impacts associated with the design are identified sufficiently. Risk assessment and hazard identification during the design stage is best to be carried out by the designers as they should possess sufficient knowledge and experience to identify the key hazards that need to be addressed in the design. Hazards identified at this stage should be sufficiently robust in order to ensure that the correct decisions are taken. However, the level of consideration should be focused on those hazards that are significant and/or unusual.

To ensure that project hazards and impacts are properly identified and addressed at the detailed design stage, designers should establish a structure of risk assessment, the Risk Assessment Method can be found in Appendix H. As a general rule, designers are required to conduct a risk assessment for their own design, ensuring that all foreseeable hazards and impacts during the construction and maintenance stages are covered. If the design involves inputs from more than one discipline, then each relevant designer should carry out the risk assessment for their own discipline. The risk assessment should be carried out at the beginning of the detailed design stage in order to identify the risks. Once the risks are identified and recorded, designers should consider these in their design and adopt appropriate control measures to eliminate them. Even though contractors can control the identified risks by the application of well-known precautions, designers should always consider how the risks can be avoided or reduced. For those identified risks that cannot be resolved easily, designers should make decisions concerning the most effective way of controlling the identified risks, through alteration of the design or even redesigning it. If it is not practical to eliminate the risks, designers should reduce the risk to the lowest practicable level by Safe Design and provide information on the residual risks in the 'Pre-tender Health and Safety Plan'. Designers should aim to reduce the total risks to be managed by contractors and to make the residual risks easier to manage wherever practicable.

Risk control measures should be established as far as possible. Stakeholders such as clients, end-users and even maintenance team should be communicated with and made fully aware of the safety and health issues affecting the design. This may make the residual risk that lies within a tolerable zone. When devising risk mitigation measures, the hierarchy of risk control, i.e. avoidance, minimization and control, should be followed.

The status of all identified risks should be recorded in the 'Risk Register'. Sample entries of the 'Risk Register' can be found at Appendix C. The 'Risk Register' is the prime document for recording risk management activity. It records all details of the risk, the assessed risk exposure, the treatment activities that have been identified, which party is undertaking the treatment and their current progress. Subsequently, it should be reviewed and updated regularly. Once the register has been completed, information about the residual risks should be communicated to the relevant downstream stakeholders.

At the end of the detailed design stage, all the significant hazards and impacts identified should be properly documented in the 'Hazard and Impact Summary'. A sample proforma is attached in Appendix D and the coverage can be found in Appendix E. The detailed design together with the 'Hazard and Impact Summary' should also be circulated to the relevant stakeholders, including the clients, end users, maintenance team and other relevant parties, for comments and agreement prior to finalization. Lastly, the 'Hazard and Impact Summary' should be endorsed and included in the 'Health and Safety File'.

The detailed design stage should involve:

- Discussion with stakeholders for enhancing the design;
- Conduct of risk assessment for the design;
- Development of a set of design options in accordance with the hierarchy of control;
- Test, trial or evaluation of the design solution;
- Selection of the optimum solution with the balance of different factors;
- Redesign to control any residual risks;
- Finalising of the design, prepare the 'Hazard and Impact Summary' and other risk control information needed for the project's life cycle.

4.2 Pre-construction stage

4.2.1 Tendering

Project-specific health and safety information that identifies hazards and risks associated with the design should be provided to those who may be bidding for the construction of the project. A 'Pre-tender Health and Safety Plan' should be completed at this stage before invitation for tenders. Information should be included where relevant to the work proposed. The pre-construction information provides information for planning work and for the development of the 'Outline Health and Safety Plan' for the construction stage afterwards. The information contained in the 'Pre-tender 'Health and Safety Plan' must be clear and concise. It should contain sufficient details of significant hazards and impacts for a tender to produce accurate pricing plans and assess the health and safety risks that need to be addressed during construction. The level of detail in the information should be proportionate to the risks involved in the project. Therefore, any unusual or unresolved hazards and impacts requiring the tenderer's particular attention should be highlighted in the 'Pre-tender Health and Safety Plan'.

The 'Pre-tender Health and Safety Plan' should be issued with the tender documents and included in the 'Health and Safety File' after the tender has been issued. Tenderers are expected to submit an 'Outline Health and Safety Plan' with their tender submissions. The coverage of the 'Pre-tender Health and Safety Plan' and 'Outline Health and Safety Plan' can be found in Appendix E.

To evaluate a tender, clients and designers should not only consider the competitiveness of the tender prices, 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 contract can only be awarded to the tenderer that conforms to the specifications and requirements. The tender submitted by the tenderer should cover solutions to risks arising specifically from the tenderer's proposed method of construction.

Tendering stage should involve:

- Issue the 'Pre-tender Health and Safety Plan' with the tender documents to the tenderer;
- Tenderer submitting the 'Outline Health and Safety Plan' together with the tender with the address of identified risks;
- Tender evaluation
- Agreeing the tenderer's 'Outline Health and Safety Plan'
- Award contract

4.3 Construction stage

4.3.1 Construction to Practical Completion

Following the contract award, the contractor should prepare a 'Construction Health and Safety Plan', detailing plans for managing the health and safety of the construction site. The 'Construction Health and Safety Plan' should be prepared based on available information including that contained in the 'Pre-tender Health and Safety Plan' and the 'Outline Health and Safety Plan', and other health and safety issues arising from the contractor's proposed construction methods. Contractor must ensure that all significant information relevant to the subsequent operation, maintenance and demolition of the project is collected in a systematic manner and included in the 'Health and Safety File'. Such information should include details of any hidden features (e.g. high-tension cables, pre-stressed elements, safety harnesses anchorage for cleaning or maintenance, toxic materials, especially those that would become toxic during removal, and fire prevention or emergency escape routes, etc.), together with the associated risk control measures that may influence the operation and maintenance of the completed project. In addition, the 'Construction Health and Safety Plan' should be regularly reviewed to keep up to date of any changes. The coverage of 'Construction Health and Safety Plan' can be found at Appendix E.

During the construction stage, effective management arrangement is essential irrespective of the scale and duration of the construction works. Effective communication, cooperation and coordination of construction work is necessary to achieve its safe completion. The contractor should work closely with other stakeholders with a view to ensuring that all work activities will be secure and safe. Contractors should advise their teams about what they can do to work together in dealing with the issues they face, both in their individual work and where they share working areas. Contractors should take full account of the directions that they have received and given in seeking cooperation between stakeholders. Effective communication can ensure the efficient exchange of information and bring about effective coordination and cooperation among stakeholders.

Contractors should take account of any activities that they have subcontracted. They should include subcontractors in the arrangements that have been made. The most important is that contractors should ensure that their subcontractors are fully involved in, aware of and kept up to date with any changes in safety and health plans. Besides, contractors should ensure that all major design alterations ordered by the client or the designers during the construction period should take into account the resulting risk and impact on subsequent operation and maintenance of the project.

4. APPLICATION OF "DESIGN FOR SAFETY" UNDER DIFFERENT PROJECT STAGES

It is the responsibility of contractors to make sure that the 'Health and Safety File' is prepared, reviewed and or updated ready for handover at the end of the construction work. The 'Health and Safety File' must then be kept available for any future construction work. Upon completion of construction, the 'Health and Safety File' will be passed to the client.

The Construction stage should involve:

- Preparing the 'Construction Health and Safety Plan', review regularly throughout the construction stage;
- Planning, managing and monitoring of their own work to make sure that workers under their control are safe from the start of their work on site;
- Cooperating with others and coordinating their work with others working on the project;
- Consulting with other stakeholders on matters affecting their health and safety;
- Collecting the significant information relevant to the subsequent operation, maintaining and demolition of the project in a systematic manner in 'Health and Safety File';
- Managing the construction works for safety and health;
- Ongoing updating of the 'Health and Safety File'.

4.4 In Use

4.4.1 Operation & Maintenance

Upon completion of the construction stage, the 'Health and Safety File' is sent to the client who will review the sufficiency of its contents (particularly with regard to those areas that the contractor is required to address) before taking over the project for operation and maintenance. If the client is not the end user of the premises, the actual end user(s) should receive the 'Health and Safety File' from the client.

Upon receiving the 'Health and Safety File', a Maintenance Supervisor should be appointed to be responsible for supervising the maintenance works and continue updating the 'Health and Safety File'. If the maintenance works involve more than one discipline, the Maintenance Supervisor should coordinate the inputs from relevant parties of the various disciplines for updating the 'Health and Safety File'.

Usually, the safety and health aspects required in carrying out maintenance works in this stage are underestimated. The Maintenance Supervisor should study the information included in the 'Health and Safety File', such as the Operation and Maintenance manual in order to fully understand the maintenance procedures and then communicate and cooperate with the maintenance team in order to ensure a safe working environment so as to reduce the risk of injury to the maintenance workers.

To ensure that the information in the 'Health and Safety File' is kept up to date, the Maintenance Supervisor should request that the key players involved in operation and maintenance notify him or her of any problems that they have encountered. If necessary, the Maintenance Supervisor may request the maintenance contractors to carry out appropriate modifications or improvements to resolve the problem. It is important to document any major modifications or improvements carried out and relevant details should be included in the 'Health and Safety File'.

Operation & Maintenance stage should involve:

- Handover of 'Health and Safety File' to the Maintenance Supervisor
- Communication and cooperation with the maintenance team in order to optimise a safe working environment
- Ongoing updating of the 'Health and Safety File'

4.5 Review & Feedback

Design is an iterative process and it is important that designers contributing to a design think about the whole life cycle of a structure from initial concept to detailed design, tender, and construction stages as well as maintenance, future adaptation and eventual demolition. Accidents often occur as a result of either poor planning or lack of communication between designer and occupier, resulting in loss of information. In order to prevent this, a process to transfer all relevant information and documents should be followed. The purpose of the 'Review and Feedback' of the project is to tie together the project team's experience and learning that provides feedback for future projects.

On completion of construction, the effectiveness of safety in design should be evaluated. This will enable identification of the most effective design practices and any design innovations that could be used on other projects. The review may be carried out in a post-construction workshop attended by all relevant parties involved in the project.

Subsequent feedback from users to assist designers in improving their future designs may be provided through:

- post occupancy evaluations;
- defect reports;
- accident investigation reports;
- information regarding modifications;
- user difficulties;
- deviations from intended conditions of use.

The result of feedback can be provided to the designers and other stakeholders for improvement. Decisions made at the early stages will influence late design choices so it is important to signal the rationale for design decisions so they are not reversed later.

CHAPTER 5

APPENDICES

5. APPENDICES

Contents

Appendix A: Checklist for Duty holders

Checklist of considerations for Client

Pre-tender stage		Yes / No	Actions
1	Does the content of the proposed project come within any of the definitions for construction work?		
2	Does the project team identify who will be the client? (A group of clients can elect one of them to be treated as the client.)		
3	Do you need to appoint any designers?		
4	Do competent duty holders, i.e. designers, appoint for the proposed project?		
5	Do you give the information to the designers about the project in advance of the works?		
6	Do you involve as much as possible in the meeting with designers for the design work?		
7	Does the Preliminary Hazard Analysis conduct?		
8	Does the Hazard and Impact Summary prepare?		

Pre-construction stage		Yes / No	Actions
9	Is the client's management system capable of responding in case there is any amendment for the designs / construction works?		
10	Have you gathered the pre-construction information in your possession after making appropriate searches and enquiries including:		
	● any information about or affecting the site or the construction?		
	● any information concerning the proposed use of the structure?		
	● the time allocated for the pre-construction before commencement of construction work?		
	● an existing 'Health and Safety File' in respect of the structure?		
11	Do you take advice from the duty holders and allow sufficient time and resources for carrying the project?		
12	Have you identified the appointments for contractors?		
13	Have you assessed the competence of such contractors?		
14	Have you ensured that the contractors who have been, or may be appointed by you, are provided with pre-construction information?		
15	Have you made provision within the project documentation for the parties to cooperate with you and other persons?		
16	Have you provided within the project documentation the requirements and provisions for coordination with you and other parties?		
17	Have you ensured the contractor has appropriate welfare in place, e.g. toilets, water and restrooms before work starts?		

Construction stage		Yes / No	Actions
18	Have you ensured that the contractor has made provision for complying with the tender requirements?		
19	Are there any particular hazards or risks that should included in the construction stage plan?		
20	Have you taken all reasonable steps to ensure that the arrangements for managing the construction work are suitable to ensure there is no risk to the health and safety of any persons?		
21	Have you taken all reasonable steps to ensure that the requirements are complied with for all persons carrying out construction work?		
22	Have you ensured that the contractor has updated the existing 'Health and Safety File'?		

Post-construction stage		Yes / No	Actions
23	Have you assessed the competence of a Maintenance Supervisor?		
24	Have you provided the duty holders, e.g. Maintenance Supervisor, with all health and safety information that enable duty holders to manage the health and safety of the structure over its operation life?		
25	Have you ensured that the 'Health and Safety File' is compiled such that each site or structure can be easily identified?		
26	Have you ensured the 'Health and Safety File' available for inspection by any person who may need access to it?		
27	Have you ensured that the Maintenance Supervisor has revised the 'Health and Safety File' as often as may be appropriate to incorporate any relevant new information?		

Checklist of considerations for Designer

Pre-tender stage		Yes / No	Actions
1	Have you checked that the client is aware of his duties?		
2	Have you checked the competence of any sub-designers working for you?		
3	Have you received the 'Health and Safety File' and the information you need to complete the design?		
4	Have you ensured the design process fulfills the "Design for Safety" principle?		
5	Have you identified hazards and foreseeable risks to those involved in the construction and future use of the structure?		
6	Have you established how your design can be constructed without risk and without adverse effect on the health and safety of construction workers, cleaners and other occupants?		
7	Have you coordinated with others to complete your design for the construction work?		
8	For the design of a workplace, have you taken account of any relevant health and safety legislation?		
9	Is the pre-construction information issued promptly to all those designing the structure?		
10	Does the Preliminary Hazard Analysis conduct?		
11	Does the Hazard and Impact Summary prepare?		
12	Does Pre-tender Health and Safety Plan prepare?		

Pre-construction stage		Yes / No	Actions
13	Are competent duty holders, i.e. contractors, appointed for the project?		
14	Have you provided sufficient information about specific aspects of the design that will assist clients, other designers and contractors?		
15	Have you cooperated with others involved in a project and identified those who need to cooperate with you?		
16	Have you provided sufficient information about any significant risks connected with the design to other duty holders?		
17	Have you ensured that suitable arrangements are in place for cooperation, coordination and communication between the duty holders?		
18	Have you taken all reasonable steps to provide design information with respect to the 'Health and Safety File'?		

Construction stage		Yes / No	Actions
19	Have you ensured that design information is communicated well to duty holders for the purpose of health and safety?		
20	Have you coordinated the work with that of others in order to improve the way in which risks are managed and controlled?		

Post-construction stage		Yes / No	Actions
21	Have you attended the post-construction workshop for receiving any review/feedback from all the stakeholders?		
22	Have you recorded all the opinions from the post-construction workshop as a reference for the next project?		

Notes:

- Designers are not required to take into account or provide information about unforeseeable hazards and risk.
- The design carried out by the designers has only to take account of the foreseeable intended use of the structure in accordance with the design brief.
- The designers are not required to specify construction methods, except where the design relies upon a particular construction or erection sequence.
- The designers do not have any health or safety management responsibilities over contractors or others unless contractually bound to do so.
- Designers do not have to implement design measures to take account of trivial risks.

Checklist of considerations for Contractor

Pre-construction stage		Yes / No	Actions
1	Are you aware of your duties as contractor?		
2	Are you competent to undertake the duties of contractor in dealing with the health and safety issues involved in the management of the construction stage?		
3	Have you taken steps to ensure that the construction stage is properly planned, managed and monitored, with adequate resources and competent site management appropriate to the risk and activity?		
4	Have you ensured that all the foreseeable health and safety issues are addressed in the Outline Health and Safety Plan?		
5	Have you ensured that the construction plan is completed before construction work begins?		
6	Is the Health and Safety Plan prepared?		

Construction stage		Yes / No	Actions
7	Have you provided the duty holders with the information necessary and relevant to the 'Health and Safety File'?		
8	Have you taken steps to prepare a construction plan which has been developed in discussion with, and communicated to contractors whose own construction work will be affected by it?		
9	Have you allocated sufficient time and other resources?		
10	Have you provided every sub-contractor who will work on the project with the information needed for the amount of time they will be allowed for planning and preparation before the start of construction work?		
11	Have you provided every sub-contractor who will work on the site with the information about the project that they will need for planning their own construction work without risk to health and safety?		
12	Have you coordinated your activities with other stakeholders to ensure the health and safety of those carrying out the construction work?		
13	Have you established a communication system to facilitate cooperation between the contractors and coordination of their respective construction works to ensure safe working?		
14	Have you ensured effective project management is being taken by coordination, cooperation and communication?		
15	Do you have a management system in place to ensure that the construction stage plan is implemented and reviewed and updated as the project progresses?		

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Construction stage		Yes / No	Actions
16	Have you taken reasonable steps to prevent unauthorized access to the site?		
17	Have you ensured that there will be suitable welfare facilities for all construction workers on the site at the start of the construction stage?		
18	Have you satisfied yourself that the sub-contractors and designers you engage are competent and adequately resourced?		
19	Have you published and circulated the necessary site rules together with the means of policing and enforcing such rules?		
20	Have you provided access to the relevant part of the construction plan to contractors in sufficient time for them to plan their work?		
21	Have you liaised with the duty holders on design carried out and/or completed during the construction stage and considered its implications on the construction plan?		
22	Have you satisfied yourself that all workers in a construction site have been provided with suitable health and safety induction, information and training?		
23	Have you taken steps to ensure that the workforce is consulted about health and safety matters and implement procedures to facilitate cooperation?		
24	Have you reported anything likely to endanger yourselves or others to those in control?		
25	Have you ensured that the existing 'Health and Safety File' will be kept updated?		

Post-construction stage		Yes / No	Actions
26	Have you passed the 'Health and Safety File' to the Maintenance Supervisor or other related stakeholders?		
27	Have you attended the post-construction workshop for receiving any review/feedback from all the stakeholders?		
28	Have you recorded all the opinions from the post-construction workshop as a reference for the next project?		

Checklist of considerations for Maintenance Supervisor

Pre-construction stage		Yes / No	Actions
1	Are you aware of your duties as Maintenance Supervisor?		
2	Are you involved in the meetings with client / designers for the design work?		
3	Are you familiar with the intention of the design?		

Post-construction stage		Yes / No	Actions
4	Are you competent to undertake the duties of contractor in dealing with health and safety issues involved in the management of the maintenance works?		
5	Have you taken steps to ensure that the maintenance work is properly planned, managed and monitored, with adequate resources and competent management appropriate to the risk and activity?		
6	Have you allocated sufficient time and other resources for the routine/ daily maintenance work?		
7	Have you provided to every contractor who will work on maintenance information about the amount of time they will be allowed for planning and preparation before the start of construction work?		
8	Have you provided to every contractor who will work for the maintenance work, information about the project that they will need for planning their own construction work without risk to health and safety?		
9	Have you established a communication system to facilitate cooperation between the contractors and coordination of their respective construction works to ensure safe working?		
10	Have you taken steps to prepare a maintenance plan which has been developed in discussion with, and communicated to, contractors whose own construction work will be affected by it?		
11	Have you ensured that the maintenance plan is completed before each maintenance work begins?		
12	Have you taken reasonable steps to prevent unauthorised access to the site?		
13	Have you ensured that the existing 'Health and Safety File' has kept updating?		

Appendix B: Proforma for "Summary of Health and Safety Concerns"

A. Project Profile

_____

_____

_____

B. Site Environment

_____

_____

_____

C. Site Constraints

_____

_____

_____

D. Record of Consultation/Brainstorming Sessions

Date of consultation/brainstorming session: _____

	Attendance	Post/Department	Contact Details	Role
1				e.g. Chairman/Facilitator
2				
3				
4				
5				
6				e.g. Note-taker

E. Preliminary Hazard Analysis Checklist

Significant Hazards and Designers' Action ↓ / Design Areas and Construction / Maintenance Activities ←	Significant Hazards Identified During Design *(Tick if applicable)*																							Designers' Actions
	Hazardous Substances	Contamination	Fall From Height	Falling Objects	Site Plant Vehicles	Collapsing Structure	Manual Handling	Lifting Operations	Buried / Overhead Services	Interface With Others	Cut / Drilling Concrete	Noise and Vibration	Deep Excavations	Asbestos	Fire Means of Escape	Highway Traffic	Restricted Access	Access for Maintenance	Component Replacement	Confined Spaces	Working Over or Near Water	Temporary Works Required	Others	Key C=Comments/Qualification; I=Information required to assist design G=Guidance, summary of Principles of Prevention that MUST be applied to a significant risk when designing A=Avoidance (Design to avoid identified hazards but beware of introducing others) CT=Control and Transfer (Design to provide acceptable safeguards or transfer the hazard with information)
Site Set Up Logistics																								
Access To Site																								
Site Offices and Compound																								
Site Surveys																								
Temp Services																								
Public / Highway Traffic Safety																								
Demolition and Dismantling																								
Design Areas and Associated Construction Activities																								
Ground Excavation Works																								
Piling																								
Concrete Substructure																								
Slabs																								
Interfaces																								
Drainage and Utility Services																								
Superstructure Frame																								
Superstructure Flooring																								

Notes: The activities and hazards are listed for reference, other related should be considered depends on actual condition.

Significant Hazards and Designers' Action	Significant Hazards Identified During Design (*Tick if applicable*)																						Designers' Actions
Design Areas and Construction / Maintenance Activities	Hazardous Substances	Contamination	Fall From Height	Falling Objects	Site Plant Vehicles	Collapsing Structure	Manual Handling	Lifting Operations	Buried / Overhead Services	Interface With Others	Cut / Drilling Concrete	Noise and Vibration	Deep Excavations	Asbestos	Fire Means of Escape	Highway Traffic	Restricted Access	Access for Maintenance	Component Replacement	Confined Spaces	Working Over or Near Water	Temporary Works Required	Others	Key C=Comments/Qualification; I=Information required to assist design G=Guidance, summary of Principles of Prevention that MUST be applied to a significant risk when designing A=Avoidance (Design to avoid identified hazards but beware of introducing others) CT=Control and Transfer (Design to provide acceptable safeguards or transfer the hazard with information)
Roofing System																								
Windows and Curtain Walling																								
Brick Blockwork																								
Cladding																								
Chimney / Flue																								
Mechanical - Lifts																								
Mechanical - AC Units																								
Electrical - Power																								
Lighting																								
Internal Walls Painting																								
Floor Screed																								
Tiling																								
Testing & Commissioning																								
Maintenance																								
Window Cleaning																								
Component Replacement																								

Notes: The activities and hazards are listed for reference, other related should be considered depends on actual condition

F. Record of Major Issues Raised (including written concerns) and Responses:

	Major Issues Raised by Stakeholders	Responses [see Note (1)]	Any Action Required [see Note (2)]	
			Yes / No	Action Parties
1				
2				
3				
4				
5				
6				

Record prepared by: _____ (Name of Officer)
Post :_____ Date : _____
Countersigned by: _____ (Name of Designer)
Post :_____ Date : _____

Notes

(1) The designer's response to any risks identified will vary according to the stage of design development. There is more flexibility to avoid or reduce risks at the start of the design process during preliminary stage, than during the detail stage when control measures may be more appropriate for dealing with any remaining risks.

(2) At the preliminary design stage, the designers of a project can do a great deal to avoid and reduce significant risks. One approach to achieve this is to alter the way the construction is planned including the sequence of construction that is assumed. This is a powerful tool, but it requires in-depth understanding of the construction process and the options that are feasible. For instance, designers can reduce the need to work at height by adopting modular sections, which can be pre-fabricated at ground level and sequentially lifted into place. This does not eliminate working at height entirely but should reduce it significantly.

Appendix C: Sample entries into the 'Risk Register'

Sample entries into the 'Risk Register' under ETWB Technical Circular No. 6/2005

Risk ID	001-1
Risk	Health and safety on construction site
Consequences	Should consider how health and safety hazards may affect the completion of the project (such as in terms of time and cost to the project)
Assessment - Likelihood	Depends on the nature of the construction – tunnelling would be different from erecting a one storey building
Assessment - Consequence	
Assessment - Risk Rating	
Assessment - Is it Understood	Depends on project team's assessment. Most safety and health risks are understood, and provided that means are in place to control them, they are acceptable
Assessment- Is it Acceptable	
Treatment strategy	By means of operating the "Design for Safety" process
Treatment options	May refer to "Design for Safety" documentations
Treatment - Associated Documents	
Treatment - Owner	Probably the Designers
Treatment - Residual Risk	Probably only those risks that are expected to be irresolvable even by the contractor in his construction health and safety plan need recorded here, and be assessed
Treatment - Likelihood	To be decided by the project team
Treatment - Consequence	
Treatment - Risk Rating	

Appendix D: Proforma for "Hazard and Impact Summary"

A. Project Profile

_____

_____

B. Site Environment

_____

_____

C. Site Constraints

_____

_____

D. Hazards and Impacts

	Task	Hazards and Impacts	Risk Assessment Rating	Control Measures	Residual Risk Yes/No	Necessity to Notify Contractor Yes/No	Other Relevant Parties to be Notified
1							
2							
3							
4							
5							

Note: Risk Assessment Method is given in Appendix H.

Record prepared by: _____(Name of Officer)

Post: _____ Date: _____

Countersigned by: _____(Name of Designer)

Post: _____ Date: _____

Appendix E: Deliverables for "Design for Safety"

The Health and Safety File

This contains information designed to aid persons carrying out construction, maintenance, repair or demolition work on the project at a time after completion of the works. The 'Health and Safety File' should consider the following where they are relevant to the health and safety of any future construction work and maintenance work. The level of detail should allow the likely risks to be identified and addressed by those carrying out the work:

- a brief description of the work carried out;
- any residual hazards which remain and how they have been dealt with (for example surveys or other information concerning asbestos; contaminated land; etc);
- key structural principles (for example, bracing, sources of substantial store energy, including pre- or post-tensioned members) and safe working loads for floors and roofs, particularly where these may preclude placing scaffolding or heavy machinery there;
- hazardous materials used (for example lead paint; pesticides; special coatings, etc);
- information regarding the removal or dismantling of installed plant and equipment (for example any special arrangements for lifting, order or other special instructions for dismantling etc);
- health and safety information about equipment provided for cleaning or maintaining the structure;
- the nature, location and markings of significant services, including underground cables; gas supply equipment; fire-fighting services etc;
- information and as-built drawings of the structure, its plant and equipment (for example, the means of safe access to and from service voids, fire doors, etc).

The 'Health and Safety File' should contain the project purpose and description and the stakeholders safety requirements to locate the major hazards of the project. After gathering the project background information, the stakeholders need to carry out a brainstorming session for their project by using the preliminary hazard analysis as a tools to prepare a summary of health and safety concerns in order to manage the residual risk of the project.

Summary of Health and Safety Concerns

Summary of Health and Safety Concerns records major potential concerns or hazards identified by stakeholders, including clients, end-users, maintenance parties etc. at the preliminary design stage. The designer's initial responses and any strategic decisions taken or actions required, together with the appropriate action parties should be set out in the document. It provides an important basis for facilitating subsequent risk assessment and identification of cost-effective control measures.

Summary of Health and Safety Concerns include:

- Project Profile;
- Site Environment;
- Site Constraints;
- Record of Consultation Sessions;
- Preliminary Hazard Analysis;
- Record of Major Issues Raised and Responses.

Preliminary Hazard Analysis

Preliminary Hazard Analysis is a safety analysis tool for identifying hazards and their associated causal factor when detailed design information is not available. Hazard checklists should not be considered complete or all-inclusive but merely a list of items to help trigger the analyst's recognition of potential hazard sources.

Typical hazard checklists include the factors to be considered during construction:

- Hazardous functions;
- Hazardous operations;
- Hazardous components;
- Hazardous materials;
- Major risk factors;
- Major risk substances;
- Major risk operations;
- Failure state considerations.

Hazard and Impact Summary

The Hazard and Impact Summary contains a detailed summary of significant hazards and impacts expected to be encountered during construction and maintenance of the project. Hazard and Impact Summary should set out the corresponding risk control measures and key decisions that have been considered by the designers during the detailed design stage in addressing the hazards and impacts. Residual risks unable to be dealt with by the design should also be highlighted.

The Hazard and Impact Summary include:

- Project Profile
- Site Environment
- Site Constraints
- Record of Hazard and impact

Pre-tender Health and Safety Plan

The Pre-tender Health and Safety Plan contains information is based on the Hazard and Impact Summary and should be included in the tender documents for reference by the tenderers. The aim is to draw the tenderers' attention to the significant health and safety risks that are unlikely to be obvious to a competent contractor or other competent designers, or such risks are likely to be difficult to manage effectively. The information to be incorporated should be clear, precise and in a form suitable for the users. Therefore, designers do not need to mention every risk or assumption, as this can obscure the significant issues.

The Pre-tender Health and Safety Plan includes:

- Nature of Project;
- Client's name;
- Location;
- Nature / description of construction work to be carried out;
- Timescale / Programme for completion of the construction work;
- Drawings.

Existing Environment:

- Surrounding land use and related restrictions, e.g. existence of premises such as schools, court buildings, shops, etc. adjacent to the proposed construction site, planning restrictions which may affect safety and health. e.g. for noise, air quality, etc.;
- Existing services, e.g. underground and overhead lines;
- Existing traffic systems and restrictions, e.g. access for fire fighting equipment, times of delivery, ease of delivery, parking, loading and unloading operations;
- Existing structures, e.g. any special health and safety problems that may be caused by materials in existing structures being demolished, refurbished, altered or added to, any fragile materials which require special safety precautions, instability problems;
- Ground conditions, e.g. contamination, overall instability, possible subsidence, old mine workings, underground obstructions, disused tunnels, ground anchors, soil nails;
- Proximity to railway lines, tram lines, or live traffic with possible restrictions on the operation of cranes etc.

The Design:

- The risks identified by designers that have not been eliminated during the design stage. These residual risks will need to be addressed by the tenderers in their Outline Health and Safety Plan and considered further by the contractor in the Construction Health and Safety Plan after the contract award;
- The principles of the structure's design and any precautions or sequences of assembly that need to be followed during construction, e.g. temporary support requirements during periods when the structure may be unstable.

Construction Materials (if applicable):

- Health hazards arising from construction materials where particular precautions are required, either because of their nature or their intended use.

Site-wide Elements:

- Positioning of site access and egress points (e.g. for deliveries and emergencies);
- Location of temporary site accommodation;
- Location of unloading, layout and storage areas;
- Traffic / pedestrian routes, headroom restrictions;
- Existing welfare facilities if contractors are allowed use of them;

Project Concurrent with Client's or End-user's Undertakings

- Consideration of safety and health issues arising where the project is to be located in premises occupied or partly occupied by the client or end-user; provide details of operations which will continue as part of the client's or end-user's undertaking, e.g. office work on the floors below that which is being refurbished, factory processes, etc.;
- Restrictions on access, e.g. one particular site entrance may be the only access available for the contractor to use;
- Other restrictions e.g. on noise levels, use of percussive machines which cause excessive vibrations etc.

Site Rules

- Specific site rules which the client or designers may wish to specify relating to the construction and maintenance of the project.

Continual Liaison

- Procedures for considering the safety and health implications of design elements during the construction stage;
- Procedures for dealing with unforeseen events during construction that may result in substantial design change; and
- A specific procedure should be established on how and when the contractor, sub-contractors or other parties should provide information relevant to the operation and maintenance of the project to incorporate into the 'Health and Safety File'.

General Notes:

(1) Where some items are considered by the Designers as inappropriate for the project, they may be excluded from the Pre-tender Health and Safety Plan. The Designers should also determine the level of details to be provided.

(2) It is not necessary to mention every hazard or assumption in the 'Pre-tender Health and Safety Plan' as this can obscure the significant issues, but significant hazards do need to be pointed out, particularly those that are:

- unlikely to be obvious to a competent contractor or other (competent) designers;
- unusual; or
- likely to be difficult to manage effectively.

(3) Relevant information on hazards and impacts provided for construction or future work should be clear, precise and in the form suitable for the users, for example by:

- notes on drawings (the best solution in most cases where the information is not long or complicated);
- supporting documents if necessary, referenced from the notes on the drawings;
- a register or list of significant hazards with suggested control measures; and
- suggested construction sequences showing how the design could be erected safely, where this is not obvious.

Outline Health and Safety Plan

The Outline Health and Safety Plan addresses the risks identified in the Pre-tender Health and Safety Plan. It includes solutions to risks arising specifically from the tenderer's proposed method of construction.

Construction Health and Safety Plan

The Construction Health and Safety Plan covers the "14 elements" of a "safety management system for construction works", taking into account the content of the Outline Health and Safety Plan and the specific construction methods adopted and the relevant contractual requirements. All the details should be contained in the contractor's Safety Plan for the project.

Appendix F: Design for safety Red, Amber and Green lists

Red, Amber and Green lists are practical aides to designers on what should be eliminate/avoid, and what to encourage to complete during design stage.

* The lists are as examples and it is suggested that client and designers to prepare their own lists.

Red Lists: Hazardous procedures, products and processes that should be eliminated from the project where possible.
● Lack of adequate pre-construction information, e.g. asbestos surveys, geology, obstructions, services, 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;
● Processes giving rise to large quantities of dust (dry cutting, blasting etc.);
● On-site spraying of harmful substances;
● The specification of structural steelwork which is not purposely designed to accommodate safety nets;
● Designing roof mounted services requiring access (for maintenance, etc), without provision for safe access (eg. barriers).
● Glazing that cannot be accessed Safely. All glazing should be anticipated as requiring cleaning and replacement, so a safe system of access is essential.
● Entrances, floors, ramps, stairs and escalators etc not specifically designed to avoid slips and trips during use and maintenance, including effect of rain water and spillages.
● Design of environments involving adverse lighting, noise, vibration, temperature, wetness, humidity and draughts or chemical and/or biological conditions during use and maintenance operations.
● Designs of structures that do not allow for fire containment during construction
● 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)

Amber Lists: Products, processes and procedures to be eliminated or reduced as far as possible and only specified/allowed if unavoidable. Including amber items would always lead to the provision of information 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;
● The specification of heavy lintels (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;
● Specification of curtain wall or panel systems without provision for the tying (or raking) of scaffolds;
● Substituting dangerous with inherently less dangerous chemicals.
● 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
● Simplify the process control and reduce the sensitivity to deviation, thereby improving reliability of control systems when handling the hazardous chemicals.
● Using specific building components and construction methods that can eliminate the need for falsework or formwork for temporary works.
● 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.
● 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.
● Heavy construction components which cannot be handled using mechanical lifting devices (because of access restrictions / floor loadings etc.)
● On-site welding, in particular for new structures.
● Need to use large piling rigs and cranes near overhead electric power lines or where close to obstructions which prevent the guarding of rigs

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Green Lists: Products, processes and procedures to be positively encouraged.
● Adequate access for construction 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;
● Specify half board sizes for plasterboard sheets to make handling easier;
● Early installation of permanent means of access, and prefabricated staircases with hand rails;
● The provision of edge protection at permanent works where there is a foreseeable risk of falls after handover;
● Practical and safe methods of window cleaning (e.g. from the inside);
● Off site fabrication and prefabricated elements to minimize on site hazards;
● 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.

Appendix G: Good design practices

Design for Safe Maintenance

Risks relating to cleaning, servicing and maintaining a structure can be controlled by:

- 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, designing inward opening windows, integrating window cleaning bays or gangways into the structural frame.
- Designing features to avoid dirt traps.
- Designing and positioning permanent anchorage and hoisting points into structures where maintenance needs to be undertaken at height.
- Designing safe access, such as staircases, and sufficient space to undertake structure maintenance activities.
- Avoid locating high maintenance items above stairways and other recesses.
- Eliminating or minimising the need for entry into confined spaces.
- Using high durability and low maintenance materials that do not need to be re-coated or treated.
- Locating maintenance items of roof near the centre of the roof, away from hazards such as skylights and roof edges, and providing dedicated access walkways, including handrails and non-slip surface. Marking hazards and on-walk areas.

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Design for Safe Construction

Control measures for risks relating to the construction of a structure include:

- Providing adequate clearance between the structure and overhead electric lines by burying, disconnecting or re-routing cables before construction begins, to avoid 'contact' when operating cranes and other tall equipment.
- Designing components that can be pre-fabricated off-site or on the ground to avoid assembling or erecting at heights and to reduce worker exposure to falls from heights or being struck by falling objects, for example fixing windows in place at ground level prior to erection of panels.
- Designing parapets to a height that complies with guardrail requirements, eliminating the need to construct guardrails during construction and future roof maintenance.
- 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.
- Designing and constructing permanent stairways to help prevent falls and other hazards associated with temporary stairs and scaffolding, and schedule these at the beginning of construction.
- Reducing the space between roof trusses and battens to reduce the risk of internal falls during roof construction.
- Choosing construction materials that are safe to handle.
- Limiting the size of pre-fabricated wall panels where site access is restricted.
- Selecting paints or other finishes that emit low volatile organic compound emissions.
- Indicating, where practicable, the position and height of all electric lines to assist with site safety procedures.

Design for Traffic Management

- Speed limits for adverse site conditions and for areas near work in progress.
- Traffic lights to control flow at busy junctions, in narrow locations and at entry and exit locations to the site.
- One-way systems to reduce the likelihood of collision, reduce congestion and improve traffic movement
- Traffic calming devices such as speed humps, rumble strips, width restrictors etc. can be incorporated into road design to encourage a reduction in speed. (such devices are not appropriate in areas where fork lift trucks routinely operate since they introduce additional hazards)
- Physical barriers to protect vulnerable and hazardous installations such as storage tanks, pipe-work systems, buildings or pedestrian access areas.
- Entrances and exits – provide separate entry and exit gateways for pedestrians
- Walkways – provide firm, level, well-drained pedestrian walkways that take a direct route where possible
- Crossings – where walkways cross roadways, provide a clearly signed and lit crossing point where drivers and pedestrians can see each other clearly.
- Provide parking for the workforce and visitors away from the work area if possible.
- Control entry to the work area.
- Plan storage areas so that delivery vehicles do not have to cross the site.
- The need for vehicles to reverse should be avoided, a one-way system can reduce the risk especially in storage areas.
- Separate heavy transport access from lighter vehicle access, and separate pedestrians from vehicle access.
- In areas that are likely to be vehicle traffic areas, additional consideration is needed for the safe access to the location of offices, meal rooms and toilets.

Design for Temporary Traffic Management

- Ensure that temporary traffic management layouts start in safe locations by avoiding hazardous positions, e.g. close to a bend, slip road, junction or the brow of a hill.
- Consider specifying the use of remotely-operated roadwork signs in high-risk situations.
- Consider the installation of permanent sign support brackets or remotely-operated signs in locations where there are frequent works.
- Before work begins, holding planning meetings with the traffic management contractor, main contractor, resident engineer, police and highway department to determine appropriate systems of work.

Design for Work in Confined Spaces

- Consider what measures can be taken to enable the work to be carried out without the need to enter the confined space.
- Modifying the confined space itself to avoid the need for entry, or to enable the work to be undertaken from outside the space.

Design for Manual Handling

- Avoidance of manual handling
- Mechanise or automate process
- Changes in the layout of the task to reduce the risk of injury
- Reducing the risk of injury from the load – make the load lighter

Design for Machinery

- Eliminating the cause of the danger (intrinsic safety – a process by which the designer eliminates dangers at the design stage with consideration for the elimination of dangerous parts, making parts inaccessible, reducing the need to handle work pieces in the danger areas, provision of automatic feed devices, and enclosure of the moving parts of the machine)
- Failure to safety – ensure that machines fail to safety and not to danger
- Safety by position - reducing or eliminating the need for people to approach the dangerous part(s) of the machine, making access to the dangerous parts difficult
- If possible, guards should be designed so as to allow minor maintenance on the machines without removing the safeguards
- If the guard must be removed or deactivated, then lock-off procedures or isolation procedures should be followed.

Design for Hazardous Material

Design to limit potential

- Keep inventories of hazardous materials as small as possible
- Eliminate risks by substituting the dangerous with the inherently less dangerous
- Minimise risk by small inventories of hazardous material that these are insufficient to cause significant harm even if released. Using personal protective clothing as a last resort

Design to limit likelihood

- Simplify the process control and reduce the sensitivity to deviation, thereby improving reliability of control systems
- Combat risks at source by engineering controls and giving collective protective measures priority e.g. enclosing the process

Design to limit people at risk

- On-site: Careful thought should be given to site layout to ensure that personnel who need not be close to the plant have buildings, workshops, etc. away from the plant
- Off-site: The installation site should be chosen with regard to the population nearby and there should be control of future development

Design for Human Factors

- The job is well-designed to match known strengths and limitations of person or team doing it.
- Select individuals matched to the needs of the job
- Management within the organization take responsibility for all aspects of work and work design.
- Human error assessment and reduction technique (HEART) is a technique used in the field of human reliability assessment (HRA), for the purposes of evaluating the probability of a human error occurring throughout the completion of a specific task.
- Such analyses measures can then be taken to reduce the likelihood of errors occurring within a system and therefore lead to an improvement in the overall levels of safety.
- There exist three primary reasons for conducting an HRA; error identification, error quantification and error reduction.
- There exist a number of techniques used for such purposes, they can be split into one of two classifications; first generation techniques and second generation techniques. First generation techniques work on the basis of the simple dichotomy of 'fits/doesn't fit' in the matching of the error situation in context with related error identification and quantification and second generation techniques are more theory based in their assessment and quantification of errors.

Design for Working at Height

- Eliminate the need to work at height at the design stage
  - Modify the design to reduce areas where dust and dirt can collect and thus eliminate the need for cleaning at height
  - Clean from ground level using jet washers
  - Design plant such that checking, sampling and maintenance can be done from ground level
  - Design plant to extract dust and fumes effectively rather than deposit them in areas that will need cleaning
  - Design to minimize manual handling at height
  - Design plant and structures so that the erection work can be done at ground level with the unit being craned into its final location

- Design in permanent measures to permit safe work at height
  - Where maintenance has to be done at height design in permanent access
  - Design in permanent anchor points for temporary access
  - Provide permanent lifelines for vehicle loading and unloading

- Provide temporary access to permit safe working at height
  - Scaffolding
  - Roof ladders
  - Working platforms and crawler boards
  - Secure means of getting on and off a roof
  - Mobile elevating working platforms
- Provide collective control measures always take priority over personal control measures. Collective measures protect more than one person at any one time, such as scaffolds. Personal control measures rely on personal protective equipment and only protect individual users.
  - Working platforms
  - Edge protection- guard-rails, barriers, toe-boards and fences
  - Coverings for openings
  - Gangways and runs
  - Safety netting

- Provide personal protective equipment to personnel working at height
  - Fall arrest system
  - Fall prevention/travel restriction systems
  - Harnesses
  - Lanyards

- Other measures
  - Demarcation of safe areas
  - Plan the construction and/or installation so that the permanent means of access are in place as early as possible
  - Issue permits to work to prevent unauthorized access

Design for Excavation

- Use of trenchless technology which eliminates the hazards associated with excavations
- Identify the exact location of existing underground utilities.
- 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).

Design for Ladders, Steps and Stairways

The gradient of stairs should be considered and adequate handrails, ramps and lighting should be provided.

- Ladders, if considered for working at height apart from access, should be less than 2 m in height and their applications should be limited for works of short duration and light-duty in nature, whereby the arrangement to provide a working platform for the work would be reasonably impractical. In connection with this, a risk assessment should be conducted to justify the use of ladders before they are used for work on the site.

Design for Workplace Housekeeping

- Demarcation of Areas:
  - Workplace
  - Materials storage area
  - Plants setup & location
  - Entrance & access

- Design:
  - Tailor-made machinery
  - Temporary storage
  - Waste Control (Solid & Water)

- Sufficient drainage is provided to manage the effects of rainwater and ponding.

Design for Utilities

- An electric hazard is considered to be removed when protective measures are put in place at the source (remove hazard or de-energize), or along the path (place electrical insulation/ barrier between the worker and the electrical hazard). Where PPE is relied upon for worker protection, an electrical hazard is considered to remain and it is still necessary to address safety requirements for other workers in the area.
- Design should consider the location of, access to and egress from, and work space in the switchroom.
- Adequate space for ducts and equipment to ensure that installers can work from safe position.
- The detailing of ducts, channels and openings should specify that they are either cast or built into the structure, to ensure that workers do not have to chase out their locations.

Design for Temporary Works

- Using specify building components and construction methods that can eliminate the need for falsework or formwork.
- Information about the restrictions, proper use and load bearing capacities of structural components, and on lateral forces to be supported by temporary works equipment should be provided.
- Anchor points should be provided at suitable spacing to limit the worker's movement to only the protected area.

Appendix H: Risk Assessment Method

The contribution of each of the elements for a risk assessment, viz. consequence and likelihood should be determined first, and then be rated according to a combination of these two elements.

(a) Consequence

Normally three ratings of severity should be adequate:

HIGH	(3)	Fatality, major injury or illness causing long-term disability, amputations, major fractures, etc.
MEDIUM	(2)	Injury or illness causing short-term disability, lacerations, burns, serious sprains, minor fractures, etc.
LOW	(1)	Superficial injuries, minor cuts or bruises or minor illness, etc.

(b) Likelihood

The probability of harm occurring is often strongly associated with the method of construction and how many workers would be involved, how often would they be exposed to the hazard, and for how long. The following ratings can be adopted:

HIGH	(3)	Certain or nearly certain to occur
MEDIUM	(2)	Reasonably likely to occur
LOW	(1)	Very rarely or never occur

(c) Risk Assessment Rating

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

The risk rating is given by multiplying the assessed risk severity and the probability of occurrence, as can be seen in the table above. 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.

5. APPENDICES

Appendix I: The Risk Management Process

Risk management is a dynamic process used to monitor and review the key activities which are sometimes overlooked. Risk exposure for projects can arise at any time and will wax and wane with the project cycle. Consequently, the importance of the identified risks will change, and new risks will emerge, as the project proceeds. Therefore, although the Risk Register that we will produce represents an understanding by the Project Team of the significant risks associated with a particular project at a particular point in time, it should never be viewed as a 'one-off' exercise. It is essential, to ensure success, that the risk management process is kept relevant and alive throughout the duration of the project. Risks and the effectiveness of control measures need to be monitored, as they will change with time. Additionally, as the project proceeds through planning, design, procurement and construction stages, new risks will emerge. As such, ongoing review of the process and monitoring are essential to ensure that risks and the management plan remain relevant and effective.

Establish Context and Risk Planning

The safety risk management context for the project should be listed. To establish the context, both the external and internal parameters must be considered for managing risk. They include the environmental parameters and factors, as well as key drivers and trends that influence its objectives that may influence safety risk management. Criteria which lead to any safety risk should be evaluated, including stakeholder values, perceptions and relationships, as well as its social, cultural, political, legal, regulatory, financial, technological, economic, natural, and competitive environment. A Safety Risk Management Plan should then be established, the context, intent and structure of which is to ensure that the safety risk management process will be specified.

The Safety Risk Management Plan may contain:

- Outline of the project objectives
- Details of the scope and objectives of the safety risk management activities on the project, analysis and evaluation criteria
- Description of the arrangements for safety management and supervision of the safety risk management process
- Responsibilities of duty holders for implementing the safety risk management process
- Proposed timing of key safety risk management activities

Safety Risk Identification

Safety Risk identification is the process of determining the individual safety risks of the project. Only the safety risk should be concerned when considering with the aspect of "Design for Safety". The aim is to identify how the events could prevent, degrade or delay. Safety Risk identification is undertaken throughout the project implementation process. It is a record of events that may affect the achievement of project. Safety risks for all stages should be identified; not only for the construction stage, any predictable safety risks exist for the whole life cycle, including operation and maintenance stage should also be addressed. It is necessary for all duty holders that participate in the project to identify the safety risks first before any commencement of work.

Safety Risk Analysis

Safety Risk analysis is the process of measuring the level of risk exposure that the identified safety risks pose to the project. The level of safety risk exposure can be considered as a product of the probability of the safety risk event occurring and the consequence to the project if it does occur. It can be measured by qualitative means or by quantitative means.

Safety Risk Evaluation

Comparison of estimated levels of safety risk against pre-established criteria will allow the prioritisation of safety risks for treatment and the identification of safety risks that require active management and those that are considered as acceptable and do not require active treatment.

Safety Risk Treatment

Safety Risk treatment firstly considers the options for treatment. This involves the identification of effective strategies and actions plans for the management of identified safety risks. The benefit of those options and the level of safety risk that will be present once that treatment has been undertaken are then considered. With this information, specific treatment options can be selected for implementation, monitored and reviewed for effectiveness.

Communicate and Consult

The project safety risk management process does not take place in isolation from other project and organizational activities. Communication of safety risk information and consultation with project participants and stakeholders should be continued throughout the whole project.

Record, Monitor and Review

The status of all identified safety risks is recorded in the Safety Risk Register. The Safety Risk Register is the prime document for recording safety risk management activity. It records all details of the safety risk, the assessed safety risk exposure, the treatment activities that have been identified and the current progress of treatment undertaking.

Three main steps of risk management process:

- identification of all the hazards
- evaluation of the risks
- risk elimination or control

Designers should eliminate any foreseeable hazards that may arise from the design of a structure. If it is not reasonably practicable to eliminate the risk completely, the designers should control the risk. The Risk management process should be taken and it is a process including the identification of hazard, then assess the risk taking measures to reduce the risk and finally management controls that contain any residual risks.

Hazard Identification

It is necessary to be clear between the difference between a hazard and a risk. A Hazard is an exposure to an actual or potential cause of loss. Risk can be defined as "The possibility of loss, injury, disadvantage of destruction".

Before one can start to evaluate risks it is necessary to define the system boundaries. The first way of identifying the potential for loss is to consider what you could lose. Identification of risk exposure or the potential for loss is a matter of experience and can be assisted by using check lists. The check lists can be based on considering activities which could result in injury or illness. It is important to think systematically about potential hazards. In order to develop a comprehensive list of potential hazards, designers should consider the work procedures involved in each life cycle phase of the structure. This hazard identification may need to involve relevant stakeholders to provide expertise in the potential hazards throughout the life cycle. It may be useful to identify the significant causes of injury in the industry likely.

Risk Assessment

Risk assessment is a tool to assist architects/engineers/designers to assess and manage hazards according to the perceived risk level. Before deciding on the appropriate measures for an identified risk, it is necessary to consider the consequence of a risk, and the likelihood of its occurrence. A risk assessment may be defined as an identification of the hazards present in an undertaking and an estimate of the extent of the risks involved, taking into account whatever precautions are already being taken. Designers should assess how likely it is that someone could be harmed by each hazard and how serious the injury could be. This process enables priorities to be set and helps determine what control measures might be appropriate.

Risk Elimination or Control

The hierarchy of risk control begins with the need to eliminate the risk, however, if the risk cannot be eliminated, then it must be controlled. The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest, known as the hierarchy of control. Measures at the top of the hierarchy of controls are preferable because they are the most effective if risk can be eliminated.

The hierarchy of control:

- Elimination
- Substitution
- Isolation
- Engineering controls.
- Administrative controls
- Personal protective equipment

Elimination

The most effective control measure involves eliminating the hazard and associated risk. By designing-in or designing-out certain features, hazards may be eliminated. For example, designing components that facilitate pre-fabrication on the ground can avoid the need for working at height and therefore eliminate the risk of falls.

If it is not reasonably practicable to eliminate a hazard the following control measures should be considered:

Substitution

Replace a hazardous process or material with one that is less hazardous to reduce the risk.
For example:

Using pre-cast panels rather than constructing a masonry wall
Using pre-finished materials in preference to on-site finishing

Isolation

Separate the hazard or hazardous work practice from people, for example designing the layout of a building so that noisy machinery is isolated from workstations

Engineering controls

Use engineering control measures to minimise the risk, for example, including adequate ventilation and lighting in the design, designing and positioning permanent anchorage and hoisting points into buildings where maintenance needs to be undertaken at height

Administrative controls

If engineering controls cannot reduce the risk sufficiently, then administrative controls should be used, for example using warning signs or exclusion zones where a hazardous activity is carried out.

Besides, emergency preparedness should also be included under Administrative Control. Even when the very best control measure is in place, some emergency situations can arise. The emergency preparedness programme includes development, communication and execution of plans prescribing the effective management of emergency situations.

Personal protective equipment

Personal protective equipment (for example hard hats, respiratory protection, gloves, ear muffs) should be used to protect the worker from any residual risk. It is the least effective control measure as it relies on the worker's behaviour and therefore requires thoroughly training and a high level of supervision to be effective.

A list of typical hazards and their solutions can be created that might be a useful prompt when thinking about the summary of concerns. This could include hazard identification checklists and other environmental concerns could be established as a reference for the duty holders to adopt.

Appendix J: Terminology

This section gives explanations of the common terms used in these guidance notes.

Client	*the person who commissions the project and has the final say in design decisions*
Contractor	*the person who carries out the construction work and coordinates health and safety during the pre-construction and construction stages of the project*
Design	*drawings, design details, specifications and bill of quantities relating to a structure, and calculations prepared for the purpose of a design*
Designer	*the person who is –* *(a) appointed for designing or modifying a design for a structure; or a product, a mechanical or electrical system intended for a particular structure;* *(b) by reason of substantial training and practical experience, competent to perform the duty.*
Hazard	*a source or a situation with a potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these*
Maintenance Supervisor	*the client's or end user's representative supervising maintenance works*
Pre-construction Stage	*any period of time during which design or preparatory work is carried out for a project;*
Preliminary hazard analysis	*a safety analysis tool for identifying hazards and their associated causal factor when detailed design information is not available.*
Probability (Likelihood)	*extent to which an event is likely to occur*
Residual Risk	*any remaining risk that has not been eliminated or adequately controlled through Safe Design.*
Risk	*the combination of the likelihood and consequence of a specified hazardous event occurring*
Risk Analysis	*the process of measuring the level of risk exposure that the identified risks pose to the project*
Risk Assessment	*the overall process of estimating the magnitude of risk and deciding whether or not the risk is tolerable. It also includes the process of recognizing that a hazard exists and defining its characteristics*

Risk Control	*the overall process of developing, implementing and maintaining the safety procedures and risk control measures. It also includes the review of the safety procedures and risk control measures*
Risk Identification	*the process of determining the individual risks of the project*
Risk Management Plan	*a view of the risk management process as applied to a specific project, and how it is embedded in project activities*
Risk Register	*the latest details on identified risks and their current status*
Safe Design	*the integration of control measures early in the design process to eliminate or, if this is not reasonable or practicable, minimise risk to health and safety throughout the life of the structure being designed*
Safety management	*means the management functions connected with the carrying on of an industrial undertaking that relates to the safety of personnel in the undertaking, including* *(a) the planning, developing, organizing and implementing of a safety policy; and* *(b) the measuring, auditing or reviewing of the performance of those functions*
Safety management system	*means a system which provides safety management in an industrial undertaking*
Safety plan	*means a plan for carrying out a safety policy*
Site safety rules	*rules which are drawn up for a particular construction site and are necessary for health and safety purposes*
Stakeholders	*those people and organisations who may affect, be affected by, or perceive themselves to be affected by a decision, activity or risk*

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