



Guidelines on Design for Safety in Buildings and Structures



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Objective

Design and planning is an essential component in every construction work. In line with the Workplace Safety and Health Act (WSH Act), reducing risk at source is one of the components to improving site safety. To address risk at source, there is a need to look at who creates the risk and address the issue from there. While the WSH Act imposes a duty on the occupiers, employers and principals, the risks inherent in the design also need to be addressed and means to mitigate the risks identified. In addition, accidents are often a result of either poor planning or lack of communication between the designer and occupier, resulting in loss of information. The process to ensure transfer of relevant information and documents are therefore recorded here as well.

This guideline serves to assist key stakeholders on the process of design safety and the transfer of vital safety and health information along the construction process chain. To facilitate this, duties of the various stakeholders are specified, as well as Design Reviews stipulated, creating a framework which allows every stakeholder to participate in making vital safety and health decisions.



Roles & Respon sibilities

Designers

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

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



Duties of the Designer

The duties of designers are as follows:

- Assess the design so as to review the safety and health risks that the design creates;
- Eliminate the hazards as far as reasonably practicable. Where hazards cannot be eliminated, designers should assess the resultant risks by looking at the severity and probability of occurrence. The resultant risks should be reduced by:
 - Proposing alternative solutions;
 - Providing the coordinator, contractors and end users with adequate information so as to prevent accidents from happening.

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

- Carry out construction work including demolition;
- Clean any window or transparent or translucent wall, ceiling or roof in or on a building or structure;

- Maintain the permanent fixtures and fittings of a building or structure;
- Use the structure designed as a place of work; and
- May be affected by such work, for example customers or the general public.

The designer should understand how the building or structure can be constructed, cleaned, maintained and decommissioned or demolished safely.



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

While these duties are not imposed on the designer, he should consider such requirements in his design.

A list of typical design hazards is included in **Appendix A**. The list serves as a reference for designers when doing design work, but does not limit possible hazards to only those listed there.

Competence of the Designer

Depending on the scope of works required, a professional engineer or an architect is required to be responsible for the design under the Building Construction Act regulated by the Building and Construction Authority.

A competent designer therefore should:

- Have relevant qualifications as required by the Professional Engineers Board or the Board of Architects; and
- Have safety and health experience.

A professional engineer or an architect is required to be responsible for the design under the Building Control Act regulated by the Building and Construction Authority.



Project Safety and Health Coordinator

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

To ensure continuity in information flow, the client should appoint a suitably qualified Project Safety and Health Coordinator. The Project Safety and Health Coordinator should follow through with the project from the design stage, to the construction stage until the handover to the client for maintenance.

As such, the Project Safety and Health Coordinator should be on-board the team as early as the concept design stage so as to facilitate the design review.



Duties of the Project Safety and Health Coordinator

The duty of the Project Safety and Health Coordinator is to:

- Facilitate the process to involve all stakeholders to review the design and mitigate the risks;
- Maintain records of safety and health issues arising from the Design Review Process and actions taken; and
- Ensure the relevant safety and health information is passed on to the contractor for his tendering and work purpose.

The Project Safety and Health Coordinator should not be in-charge of safety and health at the site, nor should he take over the safety and health responsibilities of the designer and the contractor.

However, he should ensure relevant information on safety and health is passed on to the designers, contractors and all other relevant stakeholders at the appropriate time.

Competence of the Project Safety and Health Coordinator

Before the engagement of any coordinator, the competence of the coordinator should be assessed. The coordinator should:

- Have relevant experience pertaining to the type of construction works stipulated: A total of 10 years of both design and construction experience in any combination;
- Have relevant construction related qualifications acceptable by recognised construction-related institutions; and
- Have safety and health experience.

The coordinator is a role that may be undertaken by an independent individual or a person within the project team that is assigned to carry out the task of a coordinator. In addition, he may take up more than one project at any one time.

In situations where coordinators are taking on more than one project, they should still fulfill their individual roles' duties as stipulated for each and every project.

The coordinator is a role that may be undertaken by an independent individual or a person within the project team that is assigned to carry out the task of a coordinator.



Client

The client plays a very important role in the process of the whole project. As a result of the client financing the project, he is able to influence many major decisions in the project such as the engaging of the designers, coordinators, contractors, etc., as well as type of design and materials used.

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



Duties of the Client

The client first fulfills his role by choosing a competent coordinator and designer to undertake his project. The client must demonstrate that he has checked the competence of the coordinator and designer and not merely appoint them based on the fees quoted.

In addition, while the client has the right to specify the type of construction and materials he requires for the project, he has to be advised by the coordinator and designer on the safety and health aspects of the design. This does not mean the client is limited to making choices that limit the creativity of the designer, but all risks and hazards arising from the design should be mitigated.

As such, it is vital that the client participates in the Design Review Process so as to be kept informed on the basis of the design and other important design or safety decisions.

Besides being advised by the coordinator and designer on the safety and technical aspects of the design, the client should also be advised on the time required for the completion of the project.

Accidents are more prone to happen if sufficient time is not allocated to address risks by implementing suitable control measures.

The time allocated for the project should be deemed sufficient by the designer and coordinator and agreed by the contractor when tendering for the project. This should be supplemented by some form of project planning by any stakeholder to show the practicality of the time frame.

The client should also provide relevant information that is needed by the project team to enable them to carry out their duties properly at different stages of the project. For the concept design stage, the information could include as-built drawings of existing buildings on site, topographical surveys, soil investigation reports and existing utility services. This information could be passed on to the project team in the form of a Site Risk Register.

Finally, when appointing a contractor for the project, the client must ensure he selects the contractor based on some form of assessment based on both the price and quality. BCA's Price Quality Method is one method that could be used.

The client must demonstrate that he has checked the competence of the coordinator and designer and not merely appoint them based on the fees quoted.



Main Contractor

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

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



Duties of the Main Contractor

The main contractor must be competent to carry out the work that he is engaged to do in a safe manner.

In addition, the main contractor should ensure that sub-contractors and designers engaged to carry out the works are competent and adequately resourced.

The main contractor should, in discussion with sub-contractors carrying out the works, take reasonable steps to ensure that risks identified are properly managed.

He should also ensure that all sub-contractors are provided with the required information to enable them to carry out the works safely.

Upon being awarded the contract, the main contractor should arrange with the Project Safety and Health Coordinator along with the designers for temporary works, specialist designers, etc. to carry out a design review prior to commencement of works.

The main contractor must be competent to carry out the work that he is engaged to do in a safe manner.



The Guide Process

To ensure the design is safe, a Design Review Process is introduced in the project flow. The safety and health (SH) review committee should consist of the main key stakeholders, such as the client, design engineer, architect, Project Safety and Health Coordinator and contractor if he is on board already. The SH review committee should be chaired and facilitated by the Project Safety and Health Coordinator. There should also be a systematic process whereby the risks of the design are highlighted, reviewed and recorded.

The outcome of the review process should be a safe design endorsed by all parties and a record of the resultant hazards or vital safety and health information. To assist the stakeholders in reviewing the design, a process called GUIDE is recommended.



Steps in Conducting GUIDE

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

The GUIDE Process should be chaired by the Project Safety and Health Coordinator who should be suitably qualified in both safety and technical aspects so as to guide the review team to identify and manage the hazards.

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



Communication between stakeholders is key to safe design.

There should also be a systematic process whereby the risks of the design are highlighted, reviewed and recorded.



imple mentation

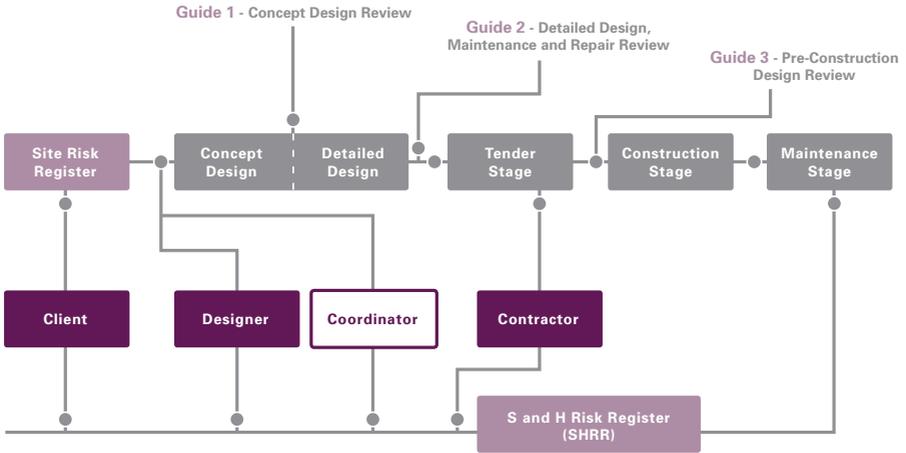
Implementation

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

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

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





Guide Process Flow Diagram

GUIDE-1: Concept design review should look at general location of the project, traffic and vehicular flow in the surroundings, type of building, and other general constraints.

GUIDE-2: Detailed design, maintenance and repair review should look at the detailed architectural and structural design. The review should also determine the risks involved in the construction methods, the access and egress, whether the design will create confined space or other hazards. The risks related to maintenance and repair of the building, such as the cleaning methods, should also be studied.

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

GUIDE-3: Pre-construction design review should examine temporary works design and design by specialist contractors not covered during the concept and detailed design phases.



Key Focus for GUIDE

The key aspects to be covered, when doing GUIDE, are suggested (but not limited) as follows:

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

A sample of topics that can be discussed for GUIDE-1, GUIDE-2 and GUIDE-3 are enclosed in *Appendix B*, *Appendix C* and *Appendix D*, respectively. The hazards highlighted then should be singled out and addressed in the Safety and Health Risk Assessment Form covered in *Appendix E*. The residual hazards should be highlighted to the contractor to ensure that they will be dealt with.

The project team should note that while the lists for GUIDE-1, GUIDE-2 and GUIDE-3 serve as a reference, there may be other topics not discussed in the lists that are specific to the project itself. The project team should therefore diligently consider other safety and health risks that could exist as a result of the design.



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



Designing a structure so that work does not need to be performed at height will prevent fall incidents e.g. lifting and erection of a hangar's roof truss.



Safety and Health Risk Register

The Safety and Health Risk Register should be a live document whereby risks identified from the design stage are recorded and kept for future reference. It should also record risks that cannot be removed through design changes and highlight them to the contractor during the tendering stage.

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



The items that should be in the Safety and Health Risk Register are as follows:

- Records of GUIDE-1, 2 and 3 and records of the resultant changes or risks to be mitigated.
- Relevant safety and health information that the contractor and the client should take note of.
- Construction method advisory notes by the designers as guidance notes to the contractor for building and demolition in the future.
- Maintenance method advisory notes by the designer and/or contractor as guidance notes to the owner.
- Safe Operating Procedures for use and maintenance of equipment / machinery of the completed building e.g. gondolas, scissor lifts, etc.

The Safety and Health Risk Register should be kept by the Project Safety and Health Coordinator before handing over to the client.

The Project Safety and Health Coordinator should be responsible to ensure relevant information is recorded and made available to the stakeholders for their work.

The Safety and Health Risk Register should be a live document whereby risks identified from the design stage are recorded and kept for future reference.



Term	DEFINITION
Designer	Anyone who creates or contributes to the complete design or the partial design of a road, a building, a bridge, a tunnel, a dam or any other civil engineering works.
Principal	A person who, in connection with any trade, business, profession or undertaking carried on by him, engages any other person otherwise than under a contract of service – <ul style="list-style-type: none"> - to supply labour for gain or reward; or - to do work for any gain or reward.
Risk	Likelihood that a hazard will cause a specific harm or injury to someone or something. More specifically, it is the likelihood of accidents or ill-health occurring at work and the consequences of such occurrences.
Design	Plans, calculations and drawings that dictate what the end product of the project should be.
Concept Design	The initial planned design of the project's layout, type of building or structure, etc.
Detailed Design	The final design of the project's outlook, the layout, the supporting structures and the materials.



Appendix A

To aid the designers in carrying out the guide process, this section identifies some areas over which the designer has direct influence. Designers should note that the list is not exhaustive, nor is every item relevant to every project.

Items that the designer should note are as follows:

1. The design of buildings or structures should consider risk from site hazards such as:

- Underground services;
- Vehicular traffic movements to and within the site;
- Pedestrian movements within and around the site; and
- Condition and proximity of adjacent buildings.

2. Health hazards should be designed out by:

- Specifying less hazardous materials, e.g. solvent-free or low solvent adhesives and water-based paints;
- Avoiding processes that create hazardous fumes, vapors, dust, noise or vibration, including

disturbance of existing asbestos, cutting chases in brickwork and concrete, breaking down cast-in-situ piles to level, scabbling concrete, manual digging of tunnels, flame cutting or sanding areas coated with lead paint or cadmium; and

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

3. Safety hazards should be designed out by:

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

Remove the need to work at height wherever possible, particularly where it requires work from ladders or where safe means of access cannot be provided.



- Eliminating materials that could create a significant fire risk during construction.
4. Consider prefabrication to minimise hazardous work on site, for example:
 - Designing elements like steel structures so that they can be prefabricated and assembled on ground and then lifted to position for installation;
 - Specifying cutting of steel members to be done off-site, under controlled conditions, to reduce the amount of dust created; and
 - Reducing site welding so as to reduce fire or burn risks and using prefabricated bolt and nuts as connections.
 5. Features that reduce or eliminate the risk of falling should be introduced where it is not possible to remove the need to work at height:
 - Early installation of permanent access, such as stairs, to reduce the use of ladder or scaffolds;
 - Edge protection or other features that increase the safety of access and construction; and
 - Anchor points for installation of life-line or safety harnesses when a work platform cannot be installed.
 6. Design to simplify safe construction by:
 - Providing lifting points on prefabricated elements and marking the weight and the centre of gravity of heavy or bulky items both on the drawings and on the items themselves;
 - Making provision for temporary works required during construction;
 - Designing joints in vertical steel structure members such that bolting can be easily done by someone standing on the floor using seating angles to provide support while bolting is being done;
 - Designing connections to minimise risk of incorrect assembly and providing clear directions on drawings; and
 - Designing for safe installation of external cladding i.e. installation of cladding from the inside of the building.
 7. Identify worst case scenarios and implement the preventive control measures, such as:
 - Designing adequate safety factors such that overloading (static, dynamic and impact)

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



and collapse of permanent or temporary structure are not possible;

- Putting in place monitoring instrumentation that provide early warning of possible collapse or ground movements; and
- Emergency route for mass evacuation in the event of emergency.

8. Design to simplify future maintenance and cleaning work by:

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

system for easy access and maintenance; design should be flexible to accommodate minor changes to building usage; and

- Considering safe movement of pedestrian and vehicular traffic flow during occupancy.

9. Identify unusual demolition hazards for future plans:

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

The designer is to note that their creativity should not be limited by the above, but safety and health requirements should still be evaluated. The designer need not design out every single hazard identified, but he should weigh the risk level of the hazards and as far as reasonably possible, design out the risks either by eliminating the hazards or incorporating control measures to reduce the risks to acceptable levels.

The designer need not design out every single hazard identified, but he should weigh the risk level of the hazards and as far as reasonably possible design out the risks.



Appendix B

Sample GUIDE-1: Concept Design Review

The purpose of GUIDE-1 is to review the conceptual design and identify the critical risks associated with the construction, maintenance, repair and demolition of the project. By identifying and understanding the risks very early in the life cycle of the project, risk controls can be established to ensure that these risks are managed either by eliminating or controlling them.

Sometimes, risks identified in GUIDE-1 can only be addressed later in the project when more of the project details are known. However, the highlighting of the risk aids the designer in understanding the feasibility as well as the hazards associated with the project. The designer may be well-informed but not equipped with WSH knowledge. As such, GUIDE-1 should be done by a group of key stakeholders and not only by the designer in isolation. The contribution of the various people will therefore help to ensure that safety at every stage and level is examined and discussed. The primary concern of GUIDE-1 will be on the safety issues related to the **LOCATION** of the project. **LOCATION** determines several major considerations such as soil assessment, the public, the existing services and the placement of major machinery. GUIDE-1 therefore needs to examine the issues associated and highlight the risks and hazards arising.

To aid the GUIDE-1 Review Team, a series of questions are tabulated. While the questions may highlight important issues, they serve only as a reference for the team and may not be comprehensive. As such, the team should still have a “brainstorming” session which will be more effective in highlighting the hazards and concerns of the key stakeholders.

Considerations		Details / Hazards Identified
Solid	<p>Has the soil profile of the site of the proposed project been studied by the QP?</p> <p>Are there buildings or structures that may have shallow foundation in the vicinity of the proposed project?</p>	



	<p>Will there be possible lowering of ground water table as a result of the proposed construction?</p> <p>Will there be possible settlement due to the proposed project?</p> <p>Are there any possible preventive measures to ensure settlement is minimised?</p>	
Public	<p>Will the commencement of the project affect the public in any way?</p> <p>Will the commencement of the project affect the traffic in any way?</p>	
Services	<p>Are there underground services in the site that need to be removed for the project?</p> <p>Will the removal of these services, if any, be a hazard to the workers or the public?</p>	
Others	<p>Are there any special features that require special arrangements during construction?</p> <p>Can the method of construction/sequence be identified at present?</p> <p>Are there any hazards associated with the method of construction/ sequence that can be dealt with at present?</p> <p>Are there any foreseeable hazards that can be identified and eliminated?</p>	



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

The form allows for the hazards and control measures to be indicated and the Review Team should then agree on the party to be assigned to take the actions to further address the hazard. A follow-up review should be done to ensure that the hazards to be addressed are not merely shelved and filed away for information. Other considerations by the review team or actions done to mitigate the risks should be documented in the Safety and Health Risk Assessment form so as to ensure that all relevant information is captured.

At concept design stage, unless the exercising of GUIDE-1 proves that a redesign/relocation of the project is required, all issues can be addressed in the detailed design stage. As such typically GUIDE-1 needs only to be performed once.

Design issues highlighted in GUIDE-1 should be addressed by the designers when doing the detailed design. GUIDE-2 will hence be a session to identify the new hazards as well as ensure hazards raised in GUIDE-1 are followed through and mitigated.



Appendix C

Sample GUIDE-2: Detailed Design, Maintenance and Repair Review

GUIDE-2 serves to assist designers to review the detailed design where most of the design is in process but still subject to possible modifications. By the time GUIDE-2 is implemented the design intent should have been finalised, making the identification of hazards easier. In addition, the maintenance and repair methodology should also be reviewed at this stage, such that required maintenance or repair issues can be addressed.

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

GUIDE-2 should be done by the key stakeholders and not just the designer in isolation. It is important that proper documentation be done so as to ensure relevant information are passed on and kept in the Safety and Health Risk Register (SHRR).

A series of questions are tabulated below to aid the GUIDE-2 Review Team. While the questions may highlight important issues, they serve only as a reference for the team and may not be comprehensive. As such, the team should still have a “brainstorming” session which will be more effective in highlighting the hazards and concerns of the key stakeholders.

	Considerations	Details / Hazards Identified
Prefabrication	<p>Can elements such as steel structures be prefabricated, assembled on ground and then lifted to position for installation?</p> <p>Can the cutting of steel members be done off-site, under controlled conditions to reduce the dust created?</p> <p>Can site welding be reduced so as to reduce fire or burn risks and prefabricated nuts and bolts used as connections?</p>	



	<p>Can prefabricated elements be provided with designed lifting points, and the weight, the centre-of-gravity marked on the drawings and on the items?</p> <p>If the prefabricated structure is required to be temporarily suspended for a period of time before final installation, are there means to ensure the hazards arising are removed?</p> <p>Can joints in vertical steel structure members be designed such that bolting can be done while on the ground?</p> <p>Can connections be designed to minimise risk of incorrect assembly (e.g. unique bolt layout for each connection) and clear instructions provided on drawings?</p>	
Heavy Lifting	<p>Consider the work process and the equipment required for heavy lifting. Can the position for parking of these equipment be finalised and cordoned off?</p> <p>Does a foundation for these lifting equipment need to be designed so as to minimise settlement and failure of support?</p> <p>Consider the worst case scenario. Can this scenario be prevented or managed to minimise injuries?</p>	
Falling from Height	<p>Can the need to work at height be removed? E.g. removing the need to work from ladders, removing the need to work where a safe means of access cannot be provided.</p> <p>Can fragile roofing materials be removed or an alternative access route (including a work platform) to the roof be designed?</p>	



	<p>Can there be early installation of permanent access, such as stairs, to reduce the use of ladders or scaffolds?</p> <p>Can edge protection or other features that increase the safety of access and construction be designed and installed?</p> <p>Can anchor points for installation of life-line or safety harnesses be mounted where work platforms cannot be installed?</p> <p>Can floor openings, if any, be minimised?</p>	
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Temporary Works and Sequencing</p>	<p>Can a safer means of access or egress be used instead of the temporary means required?</p> <p>Can the permanent staircase and lifts be completed first and used during the construction stage?</p> <p>Will the design affect the work process and stages during construction?</p> <p>Can temporary works required during construction be planned for? E.g. specifying the type and position of the temporary works so as to ensure spatial considerations have been considered.</p> <p>Are there special construction considerations that need to be highlighted to the contractor for his construction?</p> <p>Does the sequence of construction create any temporary unstable working platform, which requires additional bracing?</p> <p>Can adequate safety factors be incorporated in the design such that overloading or collapse of the permanent or temporary structure is not possible?</p>	



Layout	<p>Can the layout be optimised to prevent any accidents from the flow of traffic, pedestrian, equipment, etc. within and around the site during the construction stage?</p> <p>Consider the flow of traffic, pedestrian, equipment within and around the site during the permanent stage. Can the layout be optimised to prevent any accidents?</p> <p>Is there a need to designate specific material, equipment, vehicular and human traffic flow diagram?</p>	
Confined Space	<p>Does the design create any confined space in the permanent or temporary stage?</p> <p>Can the confined space be removed from the design?</p> <p>Can the requirement to enter the confined space be minimised by removal of vital equipment or controls from the confined space?</p>	
Emergency Route	<p>Is the emergency route for both the temporary and permanent stages the shortest and most direct?</p> <p>In the emergency route, is there adequate lighting, directions, warning and backup power for mass evacuation of people?</p>	
Health Hazards	<p>Can less hazardous materials be specified? E.g. solvent-free or low solvent adhesives and water-based paints.</p>	



	<p>Can processes that create hazardous fumes, vapors, dust, noise or vibration be avoided? E.g. disturbing existing asbestos, cutting chases in brickwork and concrete, breaking down cast-in-situ piles to level, scabbling concrete, hand-digging tunnels, flame cutting or sanding areas coated with lead paint or cadmium.</p> <p>Can materials that are easier to handle be specified? E.g. lightweight building blocks, limiting the weight of formwork components to less than 25kg.</p>	
Weather	<p>Is there a possibility of floods in the site? If so, how can the hazard be minimised in the temporary and permanent stages?</p> <p>Is there a possibility of lightning strike in the site? If so, how can the hazard be minimised in the temporary and permanent stages?</p> <p>Are there any other adverse weather conditions that can affect the ability to safely construct the work?</p> <p>What are the effects of extreme temperature or humidity on instrumentation?</p>	
Others	<p>Can monitoring instrumentation that provides early warning of possible collapse or ground movements be installed?</p> <p>Are there any other major hazards that need to be dealt with? Can materials that can create significant fire risk be removed?</p> <p>Can sources of substantial stored energy, such as pre- or post-tension cables be specified in the drawings and highlighted for future demolition?</p>	



Can alterations that have changed the structure significantly be highlighted?

Can disruptions to existing utilities within occupied buildings be avoided?

Having answered the above list of questions and highlighting the hazards, the hazards identified should then be transferred to a Safety and Health Risk Assessment Form (Appendix E). The form allows for the hazards and control measures to be indicated and the Review Team should then agree on the party to be assigned to take the actions to further address the hazard. A follow-up review should be done to ensure that the hazards to be addressed are not merely shelved and filed away for information. Other considerations by the review team or actions taken to mitigate the risks should be documented in the Safety and Health Risk Assessment form so as to ensure that all relevant information is captured.

As mentioned previously, design issues highlighted in GUIDE-1 should be addressed by the designers when doing the detailed design. GUIDE-2 will hence be a session to identify the new hazards as well as ensuring hazards raised in GUIDE-1 are followed through and mitigated.



Appendix D

Sample GUIDE-3: Pre-Construction Review

Temporary works design and design for elements provided by specialist contractors are often included as part of the scope of works in construction contracts. Where such design elements are not covered during the concept design and detailed design stages of the project, risks and hazards associated with the design and methods of construction should be identified and addressed prior to commencement of works.

GUIDE-3 aims to provide coordinators with a tool to identify and address risks associated with temporary works design and designs provided by specialist contractors.

Along with the key stakeholders involved in GUIDE-1 and GUIDE-2, the main contractor and his appointed designers and specialist contractors should be a part of the GUIDE-3 process Review Team. Similar to GUIDE-2, it is important that proper documentation be done so as to ensure that relevant information is passed on and documented in the Safety and Health Risk Register (SHRR).

To aid the GUIDE-3 Review Team, a series of questions are tabulated. While the questions may highlight important issues, they serve only as a reference for the team and may not be comprehensive. As such, the team should still have a "brainstorming" session which will be more effective in highlighting the hazards and concerns of the key stakeholders.

	Considerations	Details / Hazards Identified
Temporary Works and Sequencing	<p>Can a safer means of access or egress be used instead of the temporary means required?</p> <p>Can the permanent staircase and lifts be completed first and used during the construction stage?</p> <p>Will the design affect the work process and stages during construction?</p>	



Can temporary works required during construction be planned for? E.g. specifying the type, position of the temporary works so as to ensure spatial considerations have been considered.

Are there special construction considerations that need to be highlighted to the contractor for his construction?

Does the sequence of construction create any temporary unstable stage, which requires additional bracing?

Can adequate safety factors be incorporated in the design such that overloading or collapse of the permanent or temporary structure is not possible?

Will there be possible basal heave and piping during excavation?

Will there be possible settlement due to the proposed project?

Has a proper schedule for monitoring of instrumentation been provided?

Will there be any adverse effects on adjacent structures during the removal of temporary works?

Are there any alternatives or measures that could reduce or minimise such adverse effects?



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

Having answered the above list of questions and highlighted the hazards, the hazards identified should then be transferred to a Safety and Health Risk Assessment Form (Appendix E). The form allows for the hazards and control measures to be indicated and the Review Team should then agree on the party to be assigned to take the actions to further address the hazard. A follow-up review should be done to ensure that the hazards to be addressed are not merely shelved and filed away for information. Other considerations by the review team or actions done to mitigate the risks should be documented in the Safety and Health Risk Assessment form so as to ensure that all relevant information is captured.

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



Appendix E

Sample Safety and Health Risk Assessment Form

SAFETY AND HEALTH RISK ASSESSMENT FORM

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

Conducted by:

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

Attachment: **GUIDE 1, GUIDE 2, GUIDE 3**

Endorsed by:

Project Safety and Health Coordinator



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