REDAS

DfS & WSH GOOD PRACTICE GUIDE

Developer

Safer to Occupy

Risk Assessment

Leadership

Contractors

Communication

Asset Lifecycle

Hierarchy of Control

Teamwork

Commitment

Hazard Identification

Safer to Maintain

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Preface

Since the *Workplace Safety and Health (Design for Safety) Regulations 2015* became mandatory, many projects have benefited from it, with designs that are safer for site personnel to construct, for occupants to use, and for owners to operate. At the same time, however, it was also recognised that there were deficiencies in the implementation of Design for Safety (DfS) – e.g. unclear scope for DfS Professional, confusion over responsibilities, late or just plain non-compliant with the regulatory requirements.

In the past, Developers and Designers tend to leave the identification of workplace safety and health risks in construction and maintenance to the Contractors and building operators. They should do more upstream rather than only deal with the risks that materialise downstream. Studies have shown that design-related issues contributed to approximately 1/3 of workplace fatalities and similar ratio of serious non-fatal injuries.

Therefore, it was clear that a key priority was to address the causes of these deficiencies in DfS implementation. In August 2018, Real Estate Developers' Association of Singapore (REDAS) has spearheaded to address these by commissioning DfSP Consultants Pte Ltd to develop this *DfS &WSH Good Practice Guide* for Developers.

The purpose of this guide is to share knowledge across the industry as to best practice when approaching projects, with the aim to avoid the common deficiencies in DfS application so that it is a genuinely value-added process and not seen as just another red tape. This guide does not purport to be a ground-breaking report. It is a useful review and reminder of the key techniques that can be applied. The challenge is to apply these techniques in a consistent manner and to ensure that every project seeks to carry out these recommendations as a matter of routine. It will take determination and leadership to address them all. The themes highlighted in this guide apply to Developers at all stages of the design process from conception to specialist detailed designs.

We hope that you find this guide to be a useful tool to support the DfS application process. The philosophy should be such that we all learn from our mistakes by sharing those mistakes and the appropriate solutions across the industry. We are

sure that this guide can be improved with experience and use, so we are hoping that you will provide feedbacks with your comments and suggestions.

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1. Introduction

In 2008, Ministry of Manpower (MOM) and Workplace Safety and Health (WSH) Council published the *Guidelines on Design for Safety (DfS) of Buildings and Structures*. The Guidelines were adopted on a voluntary basis by industry and gained traction with major developers. To tap on the benefits of DfS to achieve significant and widespread WSH improvement in the building industry, the Singapore government decided to mandate it.

The *Workplace Safety and Health (Design for Safety) Regulations 2015* (herein referred as "WSH (DfS) Regulations") has come into operation on 01 August 2016. The Regulations require stakeholders such as Developers, Designers and Contractors to work together to address risks at source and plan for safe work in regard to a building or structure as a workplace. By working together, they can identify and eliminate or reduce, as far as reasonably practicable, all foreseeable design risk(s) to any person's safety or health.

This guide is intended to provide Developers the guiding principles and detailed knowledge of the DfS processes, and guidance on good practices. The guidance is based on some common issues experienced to date by the industry, to enhance the awareness of the Developers and apply it on their projects to deliver safer solutions for the project lifecycle:

- Safer to Build
- Safer to Operate / Occupy
- Safer to Maintain
- Safer to Demolish / Dispose of

Mandatory regulatory requirements are demarcated from what are recommended practices. The Developers and Designers must apply judgment regarding the extent to which recommended practices will be applied, based on the individual project circumstances, risk levels and the value add to be gained.

For the avoidance of doubt, this document is <u>not</u> intended for use by DfS Professional, as it does not provide complete information required for practising Design for Safety by DfS Professionals.

2. Success of Design for Safety

2.1 Guiding Principles

The guiding principles for Design for Safety (DfS) are as follows:

a) **Commitment** – Demonstrated commitment by the Developer to continuous improvements in health, safety and environment (HSE) to provide inherently safer design solutions over an asset's lifecycle.

b) **Alignment with Designers and Contractors** – Project HSE aspirations and safe design goals are made clear to the Designers and Contractors at the onset of the project. Requirements and responsibilities are defined and incorporated into planning.

c) **Early Opportunity, Hazard Identification and Risk Assessment** – Designers and Contractors are aware of the hazards and risks early. Safe design solutions are implemented early in the project. Promote hazard awareness and risk management within the Design Review Team. Reduce design risks at their source and adopt collective protective measures instead of individual ones.

d) **Promotion of Asset Lifecycle 'Thinking'** – Promote to the Designers the need to consider the entire asset lifecycle when preparing the design. Risks are considered across the whole of the asset's lifecycle, not just the design phase. Designers to have adequate consultation with people involved in the lifecycle of the asset, e.g. construction, operations and maintenance.

e) **Informed Decision Making** – Design decisions are transparent, soundly based and appropriate for the context. Decisions are made with suitable consideration of implications on safety initiatives. Decisions are documented to understand the basis for the decision.

f) **Timely Implementation** – Asset lifecycle risk reduction measures are implemented timely; and do not miss the opportunity to create a safer design.

g) **Design Knowledge, Capability and Communication** – Competent Designers work with effective cross discipline coordination. Safe design knowledge of DfS Professional and Designers.

2.2 Key Success Factors

The Key Success Factors (KSFs) are the things the Developers should do well to achieve the project DfS objectives:

1) Involve in the DfS Review

   It is highly recommended that the Developer attend the DfS Review Meetings, even if a DfS Professional has been appointed, to lead by example and demonstrate their WSH commitment.

2) Appoint DfS Professional early

   Fundamental to safe design is the identification of hazards and associated risks early on in the project where Designers have the greatest opportunity to influence and steer the design. Hence, the DfS Professional should be appointed at the inception of the project to plan the DfS activities.

3) Consider asset lifecycle

   Consultation with individuals or groups involved in the lifecycle is essential, e.g. from design to procurement, construction, operations and maintenance.

4) Active participation of the Designers

   While the DfS Professional is responsible for facilitating the hazard identification process, the active participation by the Designers is critical. This is because they have the intimate knowledge of the design details, notwithstanding the fact that they are responsible for deciding on the risk mitigation.

3. Design for Safety Implementation

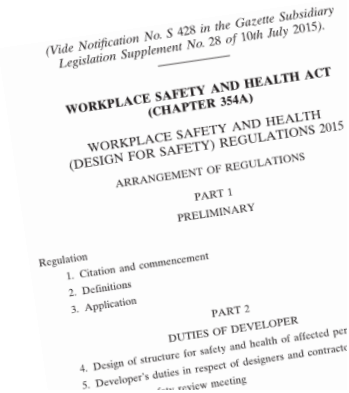
3.1 Overview

Design for Safety (DfS) is the set of activities that include the integration of hazard identification and risk assessment methods early on in the design development. This creates opportunities for Designers to eliminate or minimize asset lifecycle risks through their design efforts and ultimately deliver safer design solutions. Designers DfS activities need to consider and cater for the following:

- Use and foreseeable misuse of designed asset (building, structure, plant, etc.)
- Human error and ergonomic principles
- Prevention of major accident events and emergency response planning
- Minimal and justifiable residual risks across asset lifecycle

3.2 Legislative Obligations

The WSH (DfS) Regulations [Ref. 1] apply to any project undertaken by a Developer that has a contract sum of $10 million or more and involves "development" as defined in Section 3(1) in the Planning Act [Ref. 3]. The Regulations also apply to addition-&-alteration (A&A) projects.



(Vide Notification No. S 428 in the Gazette Subsidiary Legislation Supplement No. 28 of 10th July 2015).

WORKPLACE SAFETY AND HEALTH ACT (CHAPTER 354A)

WORKPLACE SAFETY AND HEALTH (DESIGN FOR SAFETY) REGULATIONS 2015

ARRANGEMENT OF REGULATIONS

PART 1

PRELIMINARY

Regulation

1. Citation and commencement
2. Definitions
3. Application

PART 2

DUTIES OF DEVELOPER

4. Design of structure for safety and health of affected per
5. Developer's duties in respect of designers and contracte

When the Regulations apply, the Developer is the key stakeholder and is responsible for the following:

General Duties:

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

4) Ensure that all Designers, Contractors and DfS Professional appointed are competent to perform their duties.
5) Plan and manage the project such that all appointed Designers and Contractors have sufficient time and resources to perform their duties.
6) Provide relevant information to all appointed Designers and Contractors.

DfS Review Meetings:

7) Convene DfS review meetings to identify all foreseeable design risks and discuss how each foreseeable design risk can be eliminated or reduced where it is not reasonable practicable to eliminate.
8) Ensure that the DfS review meetings are attended by all relevant Designers and Contractors.

Maintaining a DfS Register:

9) Keep a DfS Register containing information and records on all DfS review meetings and every residual design risk for the project.
10) Ensure that the DfS Register is up-to-date.
11) Ensure that all appointed Designers and Contractors for the project have access to the DfS Register.
12) Ensure that the DfS Register is available for inspection by gazetted WSH inspectors.

Passing on the DfS Register:

13) If Developer disposes his or her interests in the structure, ensure that the DfS Register is given to the person who acquires his or her interests in the project. The Developer is then responsible for informing him or her the nature and purpose of the DfS Register.
14) For subdivided buildings, ensure that the Register is given to the subsidiary management corporation of the subdivided building. The Developer must inform them the nature and purpose of the DfS Register.

Delegation of Developer's Duties to DfS Professional:

The Developer may appoint his or her employees, or engage a DfS Professional to undertake the duties of the Developer.

15) Developer may delegate the following duties to a DfS Professional:
    – convening DfS review meetings (i.e. Items 7 and 8 above); and
    – maintaining a DfS Register (i.e. Items 9 to 12 above).
16) The Developer must provide the DfS Professional with information necessary for him or her to perform his or her duties.

3.3 DfS Review Meetings

As seen in Section 3.2, the Developer has the option of appointing a DfS Professional and delegate those specific responsibilities to him/her. **This section is written on the basis that a DfS Professional is appointed by the Developer.**

DfS Reviews are divided broadly based on 3 project stages, namely Concept Design, Detailed Design and Pre-construction stages. In Ref. 2, these are called GUIDE-1, 2 and 3 DfS Review respectively. The purposes of DfS Review Meetings are to identify all foreseeable design risks to people who may be affected and discuss how each foreseeable design risks can be eliminated or reduced.

In order to have effective and productive DfS Review Meetings, the following practices are recommended:

1) The lead consultant, usually the architect, should brief the DfS Professional prior to the formal DfS Review Meeting, providing the necessary data to the DfS Professional to understand the project context, scope and potential issues.
2) The lead consultant, usually the architect, should also coordinate with the DfS Professional on the DfS Reviews as part of their design management scope as they have the intimate knowledge of the design development and progress.
3) The DfS Review Meetings are facilitated only by the designated DfS Professional(s) for the project, and this duty should not be delegated to other personnel without prior approval by the Developer.
4) The DfS Review Meetings are attended by the Developer, even when a DfS Professional has been appointed. This is not only to demonstrate the Developer's commitment to HSE improvements but also to facilitate the decision-making process for the design.
5) Briefing should be conducted by the DfS Professional at the beginning of each relevant stage of DfS Reviews, such as the purpose, basic process, and roles and responsibilities of the Design Review Team (DRT) which comprise the architect, engineers and contractor.

In particular, the Designers need to know they have a pivotal role in determining the appropriate control measures to mitigate the risks created by their design. Their active participation is critical to achieving a safe design. The DfS Professional's responsibilities are to guide them through the process, step in / re-direct ineffective discussions and build consensus amongst the team to efficiently come up with control measures.

6) The DfS Review Meetings are attended by all the relevant Designers and Contractor, and Subcontractor(s) if there is any specialist item. The Developer may also empower the DfS Professional to gather all the relevant stakeholders to attend the DfS Review Meetings.
7) The DfS Review Meetings should also be attended by the maintenance and operations personnel who typically have hands-on experience and are able to provide useful inputs.
8) During the DfS Review Meetings, encourage the whole DRT to actively participate in thinking about the hazards and relevant discussions. This is appropriate even for items which are not directly related to their own disciplines, for the fact that it is not uncommon that Designers cannot identify hazards arising from their own design.
9) When residual risks from GUIDE-1 or GUIDE-2 DfS Reviews are raised before the construction contract is awarded, those risk items should be segregated out and appended to construction Tender Document, to enable the Bidders to understand the design risks and help them determine if they are able undertake the project and price for it correctly.
10) The timing and frequency of the DfS Reviews can vary between projects, and need to be commensurate with the project phase, project size and complexity. However, it should be noted that DfS Reviews cannot be conducted too late or it would become downgraded to a design verification exercise rather than an opportunity to proactively influence the design early on.

    The DfS Review timing should be such that the design is sufficiently defined to allow a meaningful review, while there are still time and opportunities to make design changes to mitigate any risks identified. As a general guide, the timing and frequency of a typical residential project may be as follows:

Stage	DfS Review Meetings Timing & Frequency (Approximately)
GUIDE-1 Concept Design	• 30% completion; when massing / orientation is available for review • 60% completion • 90% completion; for final close out of relevant items
GUIDE-2 Detailed Design	• 50% completion • 90% completion; for final close out of relevant items
GUIDE-3 Pre-construction	• Upon main construction contract award • Every 1 to 4 months, depends on the stages, progress, complexity, etc.

Note:

a) Apart from the above, additional follow-up reviews are usually required to close out actions, to not miss the opportunities to create a safer design. These additional reviews can be embedded into the regular project meetings for efficiency reasons. The DfS Professional shall advise on the timing based on project requirements.

b) Additional DfS Review shall be conducted if there is any significant change to the design.

11) The DfS Review Meetings can be conducted with the aid of the BIM model, if available. It provides the visual effects that facilitate the identification of hazards.

3.4 Hazard Identification & Risk Assessment

3.4.1 Hazard identification

Hazard identification is arguably the most important part of DfS. If hazards are not identified, then they are not assessed and controlled, and will remain undiscovered for the remainder of the project and throughout the asset lifecycle until a safety incident occurs. It is a higher level study covering a broader scope and attempts to identify all hazards. It is normally conducted as early as possible. Further, it could be the precursor to other risk studies such as fire engineering studies, soil investigation, etc.

It is therefore essential for the DfS Professional to effectively facilitate the DfS Review Meeting, especially when it involves a large number of disciplines. Moreover, a range of techniques should be adopted to identify hazards and initiating events, e.g. checklists, brainstorming, lessons learnt review, guidewords, etc. Each technique has its own strengths and weaknesses.

It is common to use at least two techniques to prompt the DfS Review participants into thinking about the range of potential hazards, in order to have adequate coverage of potential hazards. Therefore, for example, just running through a checklist alone is not a good practice and should not be acceptable.

It is also important for the DRT to recognise that conformance with statutory codes of practice and standards typically only provides a minimum acceptable level of safety. Safe design should also incorporate human factors and consider human error and ergonomic principles, to ensure safe and comfortable human use.

For large projects, it is advisable to divide the DfS Review scope into manageable parts. Division can be based on location, process, activities, substances, etc. The intent is to make the parts small enough so all hazards are identified, but large enough so that the scope can be covered efficiently.

Following hazard identification, the DRT will determine the consequences or risks and then assess them. For each identified hazard, there is one or more potential consequences. But determination of the full range of consequences will slow the process down. Hence, a more practical approach is to identify the worst case credible consequence that the team considers can occur. The intention is that sufficient consequences are considered to correctly assess the risk and ensure that the correct controls are applied later.

3.4.2 Risk Assessment

Subsequently, the DRT will assess each hazard to determine if there are adequate controls in place. Control measures are determined to prevent the initiating event from occurring or mitigate the consequences. The performance of existing controls must also be considered. Where existing controls are assessed to be inadequate, additional controls should be recommended until the risk criteria are met.

The risk matrix and criteria must be selected early in the planning process. The commonly used risk matrix and criteria shown below can be found in the Code of

Practice on WSH Risk Management [Ref. 4]. However, it is important that they are aligned with the risk tolerance of the Developer, e.g. low, medium and high risk results (and corresponding criteria) must occur at consequences and frequencies that are in line with the Developer's expectations.

Level	Severity	Description
5	Catastrophic	Death, fatal diseases or multiple major injuries.
4	Major	Serious injuries or life-threatening occupational diseases (includes amputations, major fractures, multiple injuries, occupational cancers, acute poisoning, disabilities and deafness).
3	Moderate	Injury or ill-health requiring medical treatment (includes lacerations, burns, sprains, minor fractures, dermatitis and work-related upper limb disorders).
2	Minor	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, ill-health with temporary discomfort).
1	Negligible	Negligible injury.

Table 3.1 Determining Severity

Level	Likelihood	Description
1	Rare	Not expected to occur but still possible.
2	Remote	Not likely to occur under normal circumstances.
3	Occasional	Possible or known to occur.
4	Frequent	Common occurrence.
5	Almost Certain	Continual or repeating experience.

Table 3.2 Determining Likelihood

Likelihood / Severity	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost Certain (5)
Catastrophic (A)	Medium	Medium	High	High	High
Major (B)	Medium	Medium	Medium	High	High
Moderate (C)	Low	Medium	Medium	Medium	High
Minor (D)	Low	Medium	Medium	Medium	Medium
Negligible (E)	Low	Low	Low	Medium	Medium

Table 3.3 Risk Matrix

Typically, risks must be reduced to as low as reasonably practicable (ALARP). There is a continuum to the level of safety that can be engineered into projects, with each successive additional safety measure having an associated incremental cost. The concept of ALARP contains the ideas of practicality (*Can something be*

done?) as well as the costs and benefits of action or inaction (*Is it worth doing something in the circumstances?*). It allows the two aspects to be balanced carefully. As a rule of thumb:

- "High" risks are considered as intolerable. The expectation is that they need to be reduced unless the cost of reducing the risk is grossly disproportionate to the benefits gained.
- "Medium" band is where control measures are applied with costs and benefits taken into account, and opportunities balanced against potential adverse consequences, i.e. ALARP.
- "Low" band is where the risks are negligible, or so small that no risk treatment measures are needed.

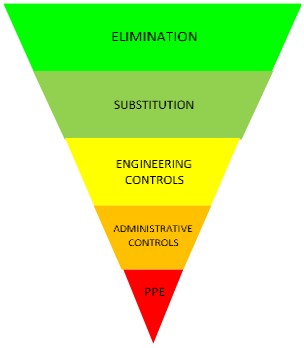
3.5 Control Measures

The DRT should be encouraged to implement the control measures in a timely fashion. As time passes, the project definition firms and changes become harder to accommodate. By delaying the implementation of control measures, they may become harder to implement and ultimately impractical. This results in a missed opportunity to reduce risk ALARP.

All residual design risks identified and recorded must be communicated to the Contractors engaged for the relevant scope of works so that they are aware of the risks involved and take steps to manage them.

3.5.1 Hierarchy of Control

The actual approach to managing the hazards and risks will vary from situation to situation. In general, attempts should be made to eliminate or minimize the source of hazard rather than place too high a reliance on control and mitigating measures, hence inherently safer.



When making recommendations, the team should apply the hierarchy of controls approach, recommending controls further up the hierarchy where practicable. The hierarchy of controls is as follows:

1. Elimination – Adoption of alternative methodologies to existing design which eliminates the associated risk.
2. Substitution – If hazard cannot be eliminated, then substitute it with process / material that has less potential for injury and harm.
3. Engineering Controls – Modify the design and/or introduce engineering controls which reduce the risks directly or indirectly, such as minimizing the requirement to carry out the hazardous activity, isolate the hazard, and minimize the inventories/hazard source associated with the activity.
4. Administrative Controls – Develop procedures, signage and/or training to create awareness.
5. Personal Protective Equipment – As a last resort, risks may be controlled through the use of personnel protective equipment (e.g. safety helmets, harness, gloves).

3.6 Design for Safety Register

As required by the DfS Regulations, a DfS Register must be set up and kept by the DfS Professional to contain and record the following:

- Design Risk Records for risks and mitigation measures that were generated during the DfS Review Meetings
- DfS Review Meeting attendance records
- Relevant drawings, where appropriate
- Supporting and reference documents, where appropriate

The DfS Register should be set up as soon as the DfS Review process commences. The DfS Professional is responsible for updating the information in the DfS Register from time to time to ensure its relevance, and decides if irrelevant or outdated information should be discarded to avoid unnecessary piling up of information. Updated DfS Register shall be disseminated to the Developer, Designers and Contractor when deemed appropriate, usually after each review meeting.

The DfS Register shall be kept available by the DfS Professional for inspection by gazetted WSH inspectors upon request. At the construction stage, the Contractor is also responsible for keeping an updated copy in the project worksite for ease of reference. Alternatively, electronic modes of information sharing and storage or filing can be used, e.g. internet cloud based storage with structured filing.

3.7 Project Completion

At project completion, the DfS Professional shall update the DfS Register and then hand it over to the Developer. Where there are residual risks related to operations and maintenance, it is recommended that the Developer communicate them to the Operations and Maintenance team who can then incorporate them into the Operations and Maintenance Manual for ease of reference.

3.7.1 Continuity of the Design for Safety Register

If the Developer disposes of the asset, he/she shall pass the DfS Register to the person who acquires the asset. This would include the asset's new owner and, in the case of subdivided buildings, the Management Corporation Strata Title (MCST). The Developer must also inform them of the nature and purpose of the DfS Register, and that it should be kept and updated for the entire life of the asset.

4. Appointing a Design for Safety Professional

4.1 General

A developer may choose to delegate any of the Developer's duties allowed by the Regulations to a competent DfS Professional to perform those duties for a project, as highlighted in Section 3.2(16) above.

It is important that the selection of DfS Professional should not be merely based on the fee. The Developer should check that the DfS Professional is competent in terms of experience, training to perform the tasks, and the proposed approach is sound, so that the DfS process genuinely adds value and contributes to a safer design, and not just to conform to the regulatory requirements.

It is also recommended that the Developer engage the DfS Professional directly rather than through another consultant or contractor. This way the DfS Professional can better represent the Developer who is at the top of the construction value chain, and hence has the greatest influence on the design. Also, there is conflict of interest if the DfS Professional is engaged by the Contractor.

Legally, the DfS Professional is to be appointed and delegated by the Developer. The delegation can be formalised by issuing a letter with reference to Clause 8 of *Workplace Safety and Health Act (Design for Safety) Regulations 2015*. This is especially important when the DfS Professional is not directly engaged by the Developer, not only because it is legally required but also it was often the case that the DfS Professionals were not empowered by the Developers to effectively carry out the DfS processes.

4.2 Scope of Services

When appointing a DfS Professional, it is recommended that the scope of work specifications to be in line with the regulatory requirements.

As the industry is still adapting to the relatively new DfS requirements, the scope of services put out in Tender Document often varies significantly between different tenders, with some even deviate from the *Workplace Safety and Health (Design for Safety) Regulations* [Ref. 1] or *Workplace Safety and Health Guidelines Design for Safety* [Ref. 2]. Hence, they cause confusion for the bidders who sometimes have to make their own judgement in interpreting the scope of work. The adverse impacts are that the DfS Professionals might not fulfil the regulatory

requirements, inefficiency in handling site safety matters due to mix-up of safety responsibilities, and inappropriate DfS consultancy fee quotations.

A proforma has been developed for *Scope of Consultancy Services for Engagement of Design for Safety Professional by Developers* (see Appendix A). This proforma has been developed based on Ref. 1 and 2. It provides detailed information on the roles and responsibilities of DfS Professional when engaged by Developers.

The proforma is aimed to preclude the common errors in scope of work specifications which could result in the aforementioned adverse impacts, and to make the Developer's procurement process more efficient.

The proforma can be used as it is. Should the Developer require the DfS Professional to perform additional duties on top of the regulatory requirements, although not recommended, such duties can be stipulated in an Annex section, if necessary.

5. Workplace Safety and Health Leadership

A successful project is not only measured by our ability to technically deliver the project, but also characterized and underpinned by strong WSH performance. This section has been developed to outline good practices for WSH leadership and procurement of services which compliment Design for Safety activities to achieve a higher level of safety.

5.1 Workplace Safety and Health Culture

Occupational health and safety of personnel and environment protection should be the common denominators in all the activities of the Developer organisation, irrespective of the project. Visible leadership, teamwork, accountability and the active involvement of all our people is essential to deliver HSE excellence. It is imperative that senior management give safety a high status in the business objectives, and safety should be prioritised in all situations, i.e. there is no task so important that it overrides the need to work safely.

There is also a need to create and maintain a culture of HSE leadership that genuinely values zero harm, and the culture should be such it encourages HSE leadership to be exhibited by everyone who works for the Developer organisation, not just their HSE personnel. All personnel should be aware of and demonstrate HSE leadership behaviours appropriate to their role and task.

Here are some of the good HSE culture and leadership practices:

1) HSE Policy - Stating the Developer organisation's commitment to achieve zero harm to people, assets and environment, outlining the core values and the control framework.
2) HSE Management System – HSE responsibilities for all levels of the organisation, goals, objectives, expected behaviours and performance measures should be defined. They should be communicated and regularly assessed, e.g. internal and external audits, at all levels of the organization.
3) Visible Management Commitment – Senior management to regularly (e.g. monthly) conduct safety site walks and reviews with the senior management team of the Designers and Contractors together with the project managers and WSH personnel. The objectives are to:

- Review construction safety standards.
- Meet workers to view working conditions – Cordial conversations to get workers thinking about how their work may affect the safety of themselves and others. Hand out rewards to those workers who demonstrate good behaviours or understanding of HSE requirements, e.g. supermarket shopping vouchers.
- Discuss key areas in safety / security.
- Ensure adequate safety standard is achieved at the construction sites.

4) Quarterly Senior Management Safety Meetings – Monitor and review safety performance and set improvements directions.
5) Senior Management Safety Charter – A single page A5-sized document for each senior manager to pledge their personal commitments to improve safety performance of themselves or for others. It should be prominently displayed in their workstation / office.
6) Incident Reporting and Investigation – Processes are in place for the timely reporting, classifying, root cause investigation, recording and closing out of incidents, near misses and 'at risk' behaviour. While safety incidents are undesirable, it is important to learn the lessons which should be captured and shared across the team to improve future performance.
7) Accountability – A process in place which recognizes and rewards positive behaviours and HSE performance, e.g. safety innovations. Equally, it holds people accountable for negative behaviour that compromises their HSE standards. For example, if senior management fail to challenge unsafe behaviours they unwittingly reinforce the notion that this behaviour is acceptable to the organisation.

5.2 Workplace Safety and Health Services Procurement

Developers takes on a variety of risks in construction projects, therefore safety and health management is critical for the following reasons:

1) Welfare of employees, workers and general public
2) Providing a safe work environment
3) Managing construction cost, time and quality, safety & health thereby project success

Developers should employ Designers (i.e. architects, engineers, surveyors, specialist engineers, etc.) with good safety knowledge and Contractors with a

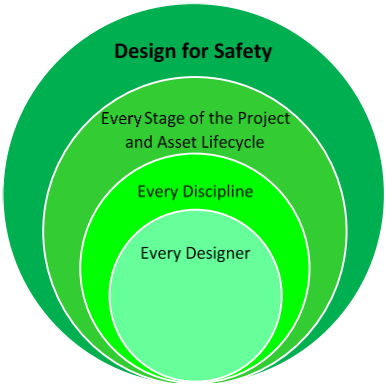
good safety record and framework. Poor safety performance increases the Developers' risks and will inflate the final development cost.

The following subsections provide examples of criteria which may be used for evaluating Designers and Contractors prior to appointing them. Evaluation can be conducted in the form of interviews and quizzes.

However, evaluation process should be fit-for-purpose depending on the project nature, and excessive pre-qualification and related paperwork should be avoided.

5.2.1 Performance of Designers

When appointing Designers, evaluation should consider their HSE skills, knowledge and experience to ensure they are reasonably capable of managing significant and foreseeable risks to create a safer design. They should be proportionate to the complexity of the project, and the range and nature of the risks involved.



DfS is a paradigm shift for Designers, and it requires new thinking and approach by them. They need to be participative in DfS Review Meetings to steer towards a safer design. As the importance of Designers' roles in DfS is often understated or overlooked, it may be appropriate to include a section dedicated to DfS in the Tender Document to outline the required competencies, for example, for the lead architect and lead discipline engineers:

1) Technical knowledge, expertise or experience relevant to the project
   - *No, basic, good or in-depth knowledge?*
2) Proactive approach to managing and designing out risks
   - *How do they intend to work with the DfS Professional to achieve a safer design? Their level of safety and risk management capabilities?*
3) Ability to understand, manage and coordinate the pre-construction phase
   - *Involved in DfS for other projects before from GUIDE1,2 to GUIDE-3?*
4) Equipped with relevant knowledge to design for safety
   - *Any records of DfS related training?*

5.2.2 Performance for Contractors

To ensure that the Contractor engaged has good safety standards and is capable of carrying out the work safely, the following may be considered as part of the bid evaluation process and contracting strategy.

1) **Contractor capability evaluation** – Selection and evaluation criteria should include an assessment of their health, safety and environment values, commitment and performance, as well as processes used for incident reporting, risk management, and assessment and improvement. These should be included in the Tender Document so that bidders can address these requirements in their tender submissions.

   The evaluation should focus on the practices utilised by the Contractor and seeks an overview of their strengths and weaknesses, HSE preparedness and their approach to HSE. This evaluation will also identify the opportunities for alignment and improvement where the Contractor can be set up for successful performance. The following criteria may be used for evaluation:

   i. Track Records – Relevant track records and experienced personnel engaged by the Contractor to adequately fulfil the competency requirements expected.
   ii. Safety Policy – And arrangements for putting it into effects
   iii. Safety Management Plan – HSE responsibilities are clearly defined for all project personnel.
   iv. Safety Records – Safety demerit points, stop-work orders, bizSAFE level.
   v. Accident Prevention – Objective evidence of trend analyses, lessons learnt or the likes to demonstrate continual improvement process.
   vi. Training – Training records to demonstrate commitment to HSE training to ensure their personnel's safety competency and awareness.
   vii. Planning – Pre-mobilisation activities and job hazard analysis (JHA) are part of their HSE management system.
   viii. Incident Management – Injury management, rehabilitation policy, emergency response, incident reporting & investigation procedures are clearly defined in their HSE management system.
   ix. Workplace Monitoring – Objective evidence of safety auditing, regular safety inspections and safety statistics.

x. Innovation – Proactive and innovative to come up with safer construction methods.
xi. Planned Supervision Ratios – Degree of supervision and training should be reflective of the project risks, contract conditions and experience of teams on site.
xii. Safety Awards – Any outstanding safety performance in the past.
xiii. DfS Focal Point – To have a focal point for DfS for the project who has attended DfS Appreciation Course, equivalent or higher level, to address residual design risks and participate in pre-construction DfS Review.

2) **Contracting strategy** – Contract to include penalty/bonus clauses based on lead performance measures, quality of deliverables and outcome of readiness review. Leading indicators are safety culture metrics that are associated with or precede an undesirable consequence such as near miss or safety incident. They can be implemented by the Contractor organisation to improve safety awareness, ownership and develop a positive safety culture. The following are examples of measurable leading indicators:
   i. Minimum number of safety observations
   ii. Minimum number of safety inspections
   iii. Number of Contractor's management site visits
   iv. Carrying out JHA as required
   v. Reporting near-misses and their lessons learnt sharing
   vi. Personal HSE Charter for key managers outlining their personal commitments
   vii. HSE training budget
   viii. HSE promotion and recognition

3) **Post-award** – Following award of contract, the strategy should be aimed at aligning and engaging the Contractor, managing risk and supporting them. HSE planning and implementation should be initiated sufficiently early such that the necessary arrangements are in place and effective before any site activities need to commence. The following practices may be considered:
   i. Allocating an experienced HSE personnel to support the Contractor on planning and other preparatory work.
   ii. Contractor executive management leadership activities, e.g. personal KPI, site visits, response to incidents and celebrating success.

iii. Submitting qualifications/certificates of competency
iv. HSE passports with trade specific requirements and training
v. Completing all pre-mobilization deliverables before commencement of work, for example:
    - DfS Review GUIDE-3, as well as reviewing residual risks from GUIDE-1 and 2 (mandatory)
    - HSE risk workshop/register, with project specific plans to address high risk activities, frequent incidents, emergency action and response, special training requirements, etc.
    - HSE Management Plan
    - HSE training strategy
    - Developing site orientation and induction programme that is visually engaging and easily understood by workers:
        - Present project HSE objectives
        - Induction of staff on site HSE matters
        - Set expectations, explain the rules and highlight hazards/risks
        - Outline reporting/notification procedures
    - Identifying / developing guideline to ensure the Contractor's equipment are well-maintained, their works are adequately trained to operate them and to adhere to the safe work procedures.
    - Risk based HSE audit schedule

6. References

1. *Workplace Safety & Health (Design for Safety) Regulations*, 2015.
2. Workplace Safety & Health Council, *DfS Workplace Safety and Health Guidelines – Design for Safety*, 2016.
3. *Planning Act*, Chapter 232, 1998.
4. Workplace Safety & Health Council, *Code of Practice on Workplace Safety and Health (WSH) Risk Management*, 2011.

Appendix A

Proforma for Scope of Services for Design for Safety Professional

Proforma for Scope of Consultancy Services for

Engagement of DfS Professional by Developers

Eligibility

The proposed Design for Safety (DfS) Professional shall be on the Workplace Safety and Health Council's list who have successfully completed the DfS for Professionals training course. He/she must be able to fulfil all their duties under the WSH (DfS) Regulations with due diligence.

General

The Design for Safety (DfS) Professional shall provide comprehensive service and perform the duties stipulated and implied in the following documents:

1. *Workplace Safety and Health (Design for Safety) Regulations,* 2015
2. WSH Council, *Workplace Safety and Health Guidelines Design for Safety*, 2016

Scope of Work

1. Providing briefing to the project team at the commencement of each GUIDE stage on DfS-related information, such as its principles, methodology, roles and responsibilities of project personnel, and timing of DfS Review Meetings and follow-up reviews.
2. Convening DfS Review Meetings at relevant stages of the design to identify and eliminate or reduce, as far as reasonably practicable, foreseeable design risks to the safety and health of any person affected by the project. The DfS Professional shall organise these meetings and involve the Developer, Designers and Contractor.
3. Facilitating the design review process during the DfS Review Meetings with the Developer, Designers (permanent, specialist and/or temporary works where necessary) and Contractor (and Subcontractors where necessary) to address risks at source and plan for safe work.
4. Conducting the DfS Review Meetings at concept design, detailed design and pre-construction stages using the recommended GUIDE process in Ref. 2 or other agreed review process. Identified hazards shall then be transferred to a Design Risk Record Form. The DfS Professional shall determine when additional DfS Review Meetings are required.
5. Facilitating and promoting the process for Developer, Designers and Contractor to systematically identify and eliminate foreseeable design risks

during the DfS Review Meetings. In the event that it is not reasonably practicable to eliminate a design risk, it shall be reduced to as low as reasonably practicable. When reducing a design risk, it shall be reduced at its source as far as reasonably practicable, and collective protective measures are preferred over individual protective measures.

6. Facilitating and promoting the DfS Review process such that the Developer, Designers and Contractor consider the people affected by the project, including people:
   - who carry out or are liable to be affected by construction work,
   - for whom the structure is a workplace, including individuals who maintain or clean the structure, or anything in or on the structure, or
   - who carry out or are liable to be affected by the demolition of the structure.
7. Facilitating and promoting the DfS Review process such that the Developer, Designers and Contractor consider the hazards and risks of maintaining the systems and equipment related to the project.
8. Compiling the minutes or notes for the DfS Review Meetings, where appropriate.
9. Maintaining a DfS Register containing documents generated through the DfS review process. It shall contain information and records arising from every DfS Review Meeting such as minutes of meeting, and Design Risk Record with design residual risks clearly indicated.
10. Issuing the DfS Register to the Developer, Designers and Contractor for their effective communication of the DfS-related risk information to individuals facing the risks, so that the individuals are aware of any identified risks that they ought to address, and the control measures, if available, to implement.
11. Updating the Developer on matters arising from DfS Review Meetings, where appropriate.
12. Monitoring the status of the action items in the Design Risk Record. Follow-up meetings should be conducted to address the identified hazards.
13. Making the DfS Register available for inspection when requested by a Workplace Safety and Health Inspector appointed by the Commissioner for Workplace Safety and Health during the course of the project.
14. Handing over the up-to-date DfS Register to the Developer at project completion, i.e. upon granting of Temporary Occupation Permit (TOP) by the Building and Construction Authority.
15. Providing advice to the Developer, Designers and Contractors on matters relating to DfS.

16. For the avoidance of doubt, the DfS Professional shall not be responsible for, or directly involved in, the safety and health at the construction site, nor shall the DfS Professional take over responsibilities of the Designers or Contractors.

Annex

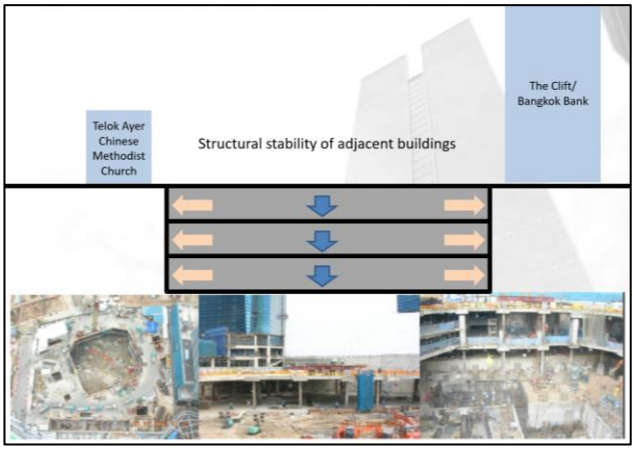
[*This Annex section is used, if required, for specifying any other work scope that is over and above the standard scope of services for the Design for Safety Professional outlined above. If not applicable, delete this section.*]

Appendix B

Examples of Design for Safety

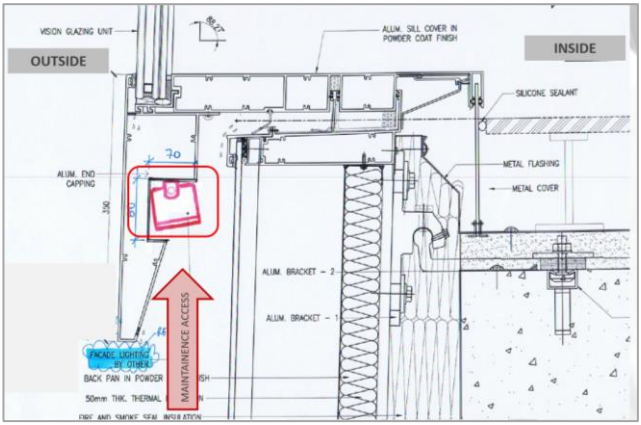
Example 1

- Hazard – Site is in close proximity to existing buildings in dense city centre area, including a 94-year-old national monument.
- Risk – Construction of foundation adversely affects structural integrity of adjacent buildings.
- DfS Control Measure – Adopt earth retaining wall structures and a "top-down" construction method to minimise any ground movement during construction.

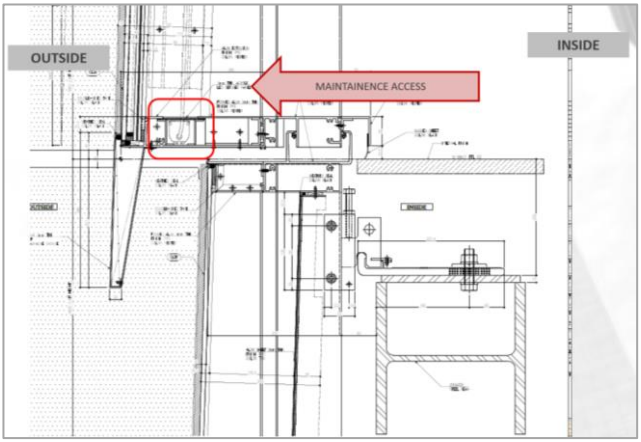


Example 2

- Hazard – Façade lighting is located on exterior surface of façade and hidden behind aluminium panel.
- Risk – Accessing the lights for maintenance requires working at height; resulting in workers falling from height.
- DfS Control Measure – Relocate façade lighting such that it can be accessed from interior of the building.



Before



After

Example 3

- Hazard – Site is in close proximity to an existing school across the road.
- Risk (residual) – Heavy construction vehicles using the road to access site; resulting in traffic accidents involving school children.
- Control Measure – Provide traffic control plan with particular focus on school children safety, e.g. no delivery during school start and dismissal times, provide banksmen, etc.

Site
Existing school

Stop-and-go traffic control method

Example 4

- Hazard – Façade is located in close proximity to pedestrian walkway (which was 2m wide) along Orchard Road.
- Risk (residual) – Falling façade panel or machinery toppling over onto pedestrian walkway during installation; resulting in personal injury or fatality.
- Control Measure – Keep pedestrian walkway outside of façade line, and re-route walkway inwards only after façade installation is completed to reinstate the footpath and planting strip along Orchard Road.

Re-routing of pedestrian walkway – Before and After

Example 5

- Hazard – Trailers delivering PPVC units having to reverse into site due to site arrangement constraints.
- Risk (residual) – Trailer operators unable to see school children crossing site entrance due to blind spot; resulting in traffic accident.
- Control Measures – (1) Provide traffic controllers to monitor and guide trailers reversing into site. (2) Brief traffic controllers about the risks involved and control measures.

Traffic controller guiding delivery trailer

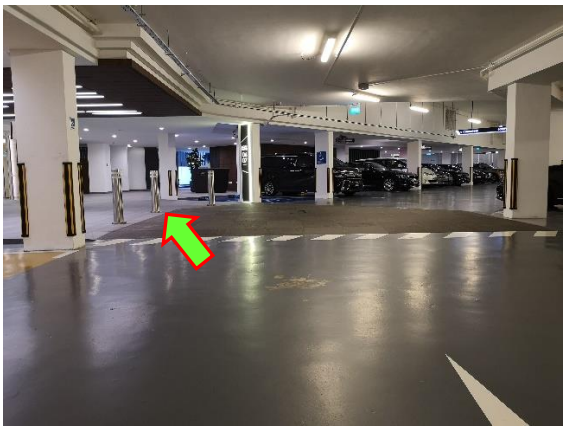
Example 6

- Hazard – Installation of PPVC units at the top level.
- Risk (residual) – Workers falling over the edge of PPVC units during installation.
- Control Measures – (1) Install temporary handrails along top edges of PPVC before being lifted into position. (2) Workers to use vertical ladder with railing and secured firmly to climb onto PPVC. (3) Workers to put on safety harness and anchor it to handrails while working on top of PPVC.

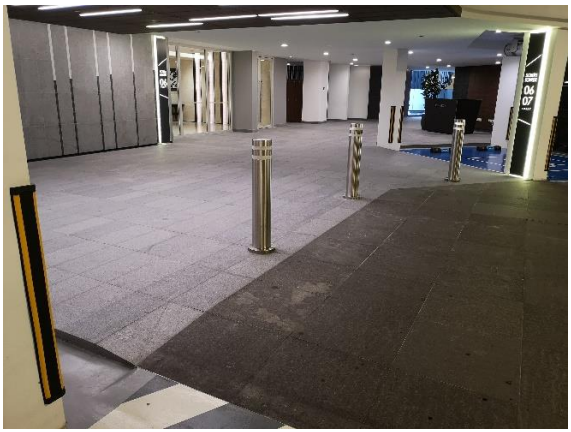
PPVC units with pre-installed temporary handrails

Example 7

- Hazard – Entrance to car park lift lobby at same level as driveway.
- Risk – Drivers accidentally drive towards lift lobby; resulting in traffic accident involving passers-by.
- DfS Control Measure – Provide bollards in front of lift lobby entrance, capable of resisting appropriate impact load.



Drivers may accidentally drive to the left towards lift lobby



Bollards installed at entrance to lift lobby

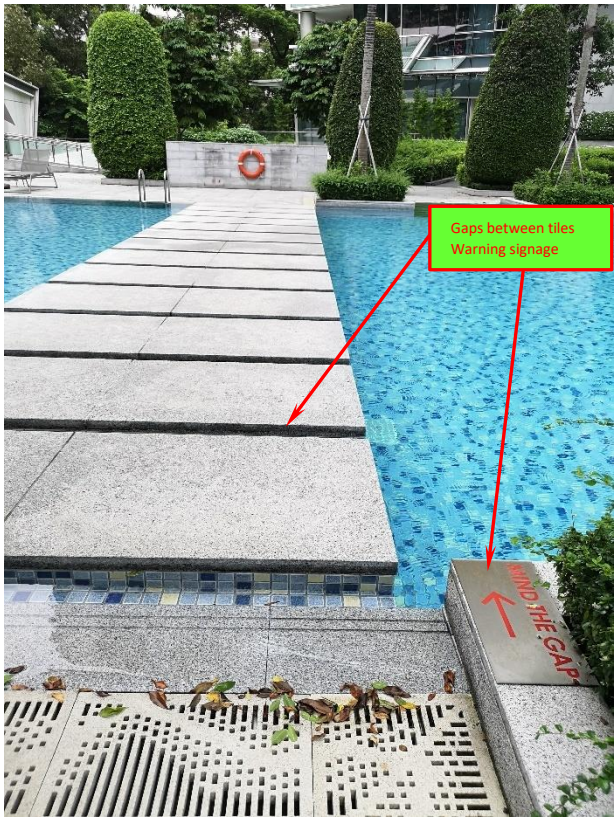
Example 8

- Hazard – Balustrade glass panels with sharp edges.
- Risk – Abrasion on hands, especially if children run their hands along top edge.
- DfS Control Measure – Provide metal capping along top edge.

Balustrade with glass panels

Example 9

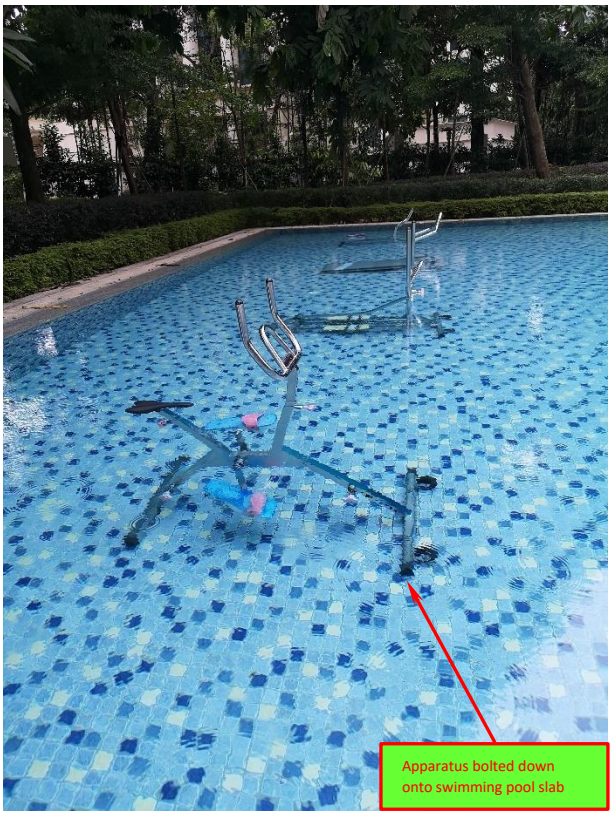
- Hazard – Gaps between tiles on swimming pool footpath.
- Risk – Trip and fall for users.
- DfS Control Measure – Provide warning signage for users to mind the gap.



Footpath crossing swimming pool

Example 10

- Hazard – Exercise apparatus in swimming pool.
- Risk – Apparatus toppling over with user exercising on it; resulting in injury or drowning.
- DfS Control Measure – Secure apparatus to swimming pool slab by bolting.



Exercise apparatus in swimming pool

Example 11

- Hazard – OG box located at bottom of wall, approximately 3m below with no proper accessway.
- Risk – Maintenance workers falling from height if using portable ladder.
- DfS Control Measure – Provide fixed ladder with foldable landing at top of wall to allow workers to climb over the wall safely.

Ladder with foldable landing

Foldable landing with safety pin for locking into position

Example 12

- Hazard – Canopy with no edge protection.
- Risk – Maintenance workers falling over the edge.
- DfS Control Measure – Provide anchor in middle of canopy for safety harness to prevent falling from height.

Canopy with anchor for safety harness

Example 13

- Hazard – Curved façade.
- Risk – Gondola colliding with façade as it moves downwards; resulting in façade maintenance workers falling from height.
- DfS Control Measure – Provide building maintenance unit (BMU) with telescopic boom.

Curved façade walls

BMU with telescopic boom

Example 14

- Hazard – Cat ladder located at edge of roof.
- Risk – Maintenance workers falling over the balustrade while climbing up/down cat ladder.
- DfS Control Measure – Replace balustrade with metal grill locally at the cat ladder to prevent workers from falling over the side of building.

Cat ladder located at edge of roof

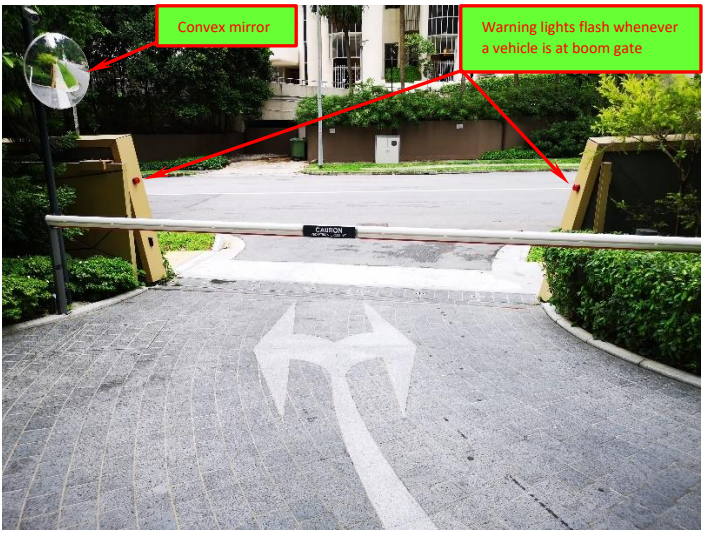
Example 15

- Hazard – Glass balustrade is in proximity of curved driveway.
- Risk – Vehicle crashing through balustrade and falling onto level below.
- DfS Control Measure – Provide bollards capable of resisting appropriate impact load.

Bollards provided along edge of driveway

Example 16

- Hazard – Solid boundary walls on both sides of carpark exit.
- Risk – Drivers unable to see pedestrian approaching; resulting in traffic accident involving pedestrian.
- DfS Control Measure – (1) Provide convex mirror to improve visibility for drivers; (2) Provide warning lights for pedestrian.



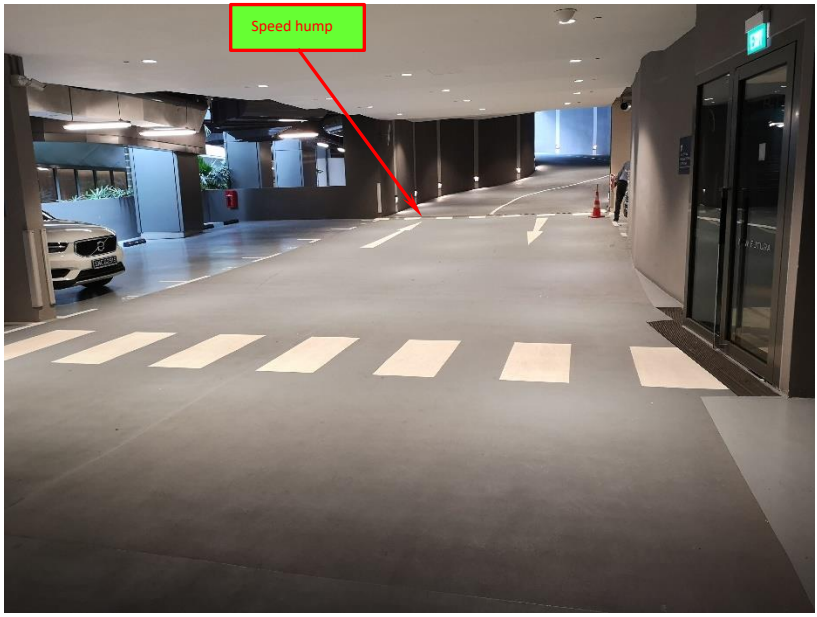
Carpark exit

Example 17

- Hazard – Horizontal fins in between façade panels.
- Risk (residual) – Gondola too far from façade surface; workers unable to clean or maintain façade safely.
- DfS Control Measure – Provide gondola with counterweight which allows gondola to be positioned close to façade surface.

Example 18

- Hazard – Lift lobby located next to driveway.
- Risk – Drivers unaware of personnel coming out of lift lobby; resulting in traffic accident.
- DfS Control Measure – (1) Provide floor marking for pedestrian crossing to alert drivers; (2) Provide speed hump to slow down vehicles coming down the ramp.



Pedestrian crossing outside lift lobby

Example 19

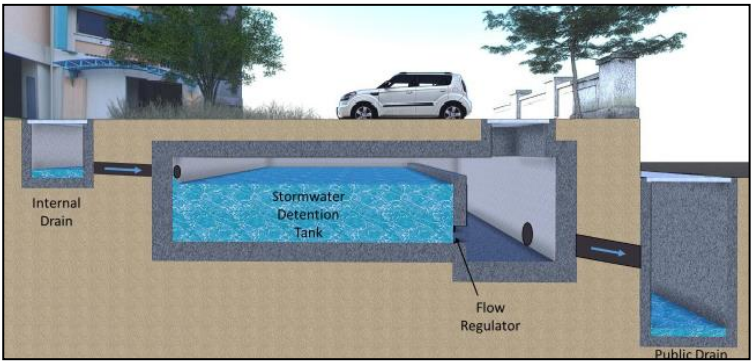
- Hazard – Sky garden with high ceiling.
- Risk – Workers falling from height while replacing lighting or maintaining ceiling panels.
- DfS Control Measure – (1) Locate lighting at low level which can be accessed using short ladder; (2) Use of aerial work platform for maintenance of ceiling.

Sky garden with high ceiling

Aerial work platform with outriggers for maintenance

Example 20

- Hazard – Workers having to enter into detention tank for maintenance.
- Risk – Insufficient fresh air supply for maintenance workers; resulting in asphyxiation.
- DfS Control Measure – (1) Provide multiple access hatches; (2) Open all hatches and provide forced ventilation during maintenance.



Detention tank with multiple access hatches

Example 21

- Hazard – Installation of external façade at height.
- Risk – Precast components or workers falling from height during installation.
- DfS Control Measure – (1) Design connection points to be fixed from interior to minimize risk of falling from height; (2) Design connection details that minimize the number of components to be fixed and limit the height of each component to 3.1m.

Façade panel which is fixed into position from building interior

Example 22

- Hazard – Installation of air-conditioner ledge railing at height.
- Risk (residual) – Railing or workers falling from height during installation.
- Control Measure – Install railing at ground level before entire precast unit is lifted into position.

Railing installed before entire precast unit is lifted up

Acknowledgment

We would like to thank Workplace Safety and Health (WSH) Council and REDAS WSH Working Committee members who have helped to review this guide; with one common objective which is to do their bit to improve the implementation of DfS in the industry. They have all taken time out from their normal jobs because they realise just how important this task is.

Mr Paul Lau from Keppel Land Ltd and Ms Quek Chay Hoon (formerly from Wing Tai Land Pte Ltd) co-chair the REDAS WSH Working Committee which comprises the following members:

- Mr Lim Song King, City Developments Ltd
- Mr Kelvin Pek, Far East Organization
- Mr Lee Choon Li, Frasers Property Ltd
- Mr Chris Wu, Frasers Property Ltd
- Mr Ashith Alva, Jewel Changi Airport Development Pte Ltd

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- UOL Group Ltd

The PDF version is currently available at REDAS website:
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The Real Estate Developers' Association of Singapore (REDAS), established in 1959, is Singapore's premier business association in the real estate and development industry.

Representing some 300 members comprising developers, builders, consultancies and professionals, bankers, REITs and fund managers, REDAS plays a relevant role in the real estate industry.

REDAS actively engages regulators, policy makers and stakeholders to promote best practices and to support the growth of a vibrant and progressive real estate industry in Singapore. The Association also organises seminars and courses to strengthen capabilities and competencies of members as well as events and study and business trips to facilitate connection and explore opportunities.

The Association is led by a committed team of Management Committee Members who are business leaders of reputable and established property organisations. REDAS members are committed to enhance Singapore's position amongst the top ranks of one of the world's most attractive and liveable city which is environmentally and economically sustainable for present and future generations.