University of South Australia

REF-FM-030

Safety in Design Principles

September 2013

Facilities Management Unit

INTRODUCTION

The University of South Australia (UniSA) understands its obligations for achieving the standards of health, safety, and welfare required under the WHS Act and the Work Health and Safety Regulations (the WHS Regulations).

> **Our aim is to provide safe, sustainable, and functional accommodation and facilities for our staff, students, and visitors, while ensuring appropriate safety in design.**

UniSA has adopted the relevant Codes of Practice and particularly those for Construction and Safe Design of Structures. We aim to provide our staff and contractors with the necessary guidance with regard to our specific requirements in addition to those of the WHS Act.

We acknowledge that Safety in Design extends beyond the Scope of the Building Code of Australia (BCA) and relevant State planning principles, Ministerial Specifications, and related regulations. We will provide our standards of design and construction which should be read in conjunction with the documents outlined above.

We recognise Safe Work Australia as the preeminent authority in prescribing safe work practices.

Safe Work Australia has identified the following five principles (key elements) for safe design:

- **Principle 1: People with control** Safe design is everyone's responsibility – ensuring safe design rests with all parties influencing the design of a building or structure.
- **Principle 2: The life cycle** Safe design employs life cycle concepts – applying to every phase in the life cycle of a building or structure, from conception through to redevelopment and demolition.
- **Principle 3: Risk management** Safe design implements risk management – through systematically identifying, assessing, and controlling hazards.
- **Principle 4: Knowledge and capability** Safe design requires knowledge and capability – which should be either demonstrated or accessed by any person influencing design.
- **Principle 5: Information transfer** Safe design relies on information – requiring effective documentation and communication between everyone involved in the life cycle of a building or structure.

1. RESPONSIBILITY FOR SAFE DESIGN

UniSA and its employees are considered to be a “person conducting a business or undertaking” (PCBU) and has the primary duty under the WHS Act 2012 to ensure, so far as is reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking.

As a PCBU who commissions construction work we acknowledge we must consult with the designer(s) to ensure that risks arising from the design during construction are eliminated or minimised as far as reasonably practicable. This includes evaluation plant and equipment for safe inclusion in the structures we commission.

Whilst we engage a range of contractors to provide services (sometimes specified); we acknowledge that we must ensure that qualified and competent people are engaged to undertake the desired services for the full lifecycle management of our facilities.

The WHS Act provides the following definitions: **A person conducting a business or undertaking that commissions construction work** (the client) has specific duties under the WHS Regulations to:

- consult with the designer, so far as is reasonably practicable, about how to ensure that health and safety risks arising from the design during construction are eliminated or minimised, and
- provide the designer with any information that the client has in relation to the hazards and risks at the site where the construction work is to be carried out.
- A person conducting a business or undertaking who commissions a design or construction work or a construction project is referred to in this Code as the ‘client’.

A person conducting a business or undertaking that designs a structure that will be used, or could reasonably be expected to be used, as a workplace must ensure, so far as is reasonably practicable, that the structure is without risks to health and safety. This duty includes carrying out testing and analysis and providing specific information about the structure.
A designer is a person conducting a business or undertaking whose profession, trade or business involves them in:

- preparing sketches, plans or drawings for a structure, including variations to a plan or changes to a structure
- making decisions for incorporation into a design that may affect the health or safety of persons who construct, use or carry out other activities in relation to the structure.

They include:

- architects, building designers, engineers, building surveyors, interior designers, landscape architects, town planners and all other design practitioners contributing to, or having overall responsibility for, any part of the design (for example, drainage engineers designing the drain for a new development)
- building service designers, engineering firms or others designing services that are part of the structure such as ventilation, electrical systems and permanent fire extinguisher installations
- contractors carrying out design work as part of their contribution to a project (for example, an engineering contractor providing design, procurement and construction management services)
- temporary works engineers, including those designing formwork, falsework, scaffolding and sheet piling
- persons who specify how structural alteration, demolition or dismantling work is to be carried out.

A person conducting a business or undertaking who alters or modifies a design without consulting the original or subsequent designer will assume the duties of a designer. Any changes to the design of a structure may affect the health and safety of those who work on or use the structure and must be considered by the person altering or modifying a design.

A principal contractor is required for a construction project where the value of the construction work is $450,000 or more. The principal contractor is a person conducting a business or undertaking that:

- commissions the construction project (the client), or
- is engaged by the client to be the principal contractor and is authorised to have management or control of the workplace.

The principal contractor has duties to ensure the construction work is planned and managed in a way that eliminates or minimises health and safety risks so far as is reasonably practicable.

Design, in relation to a structure, includes the design of all or part of the structure and the redesign or modification of a design. Design output includes any hard copy or electronic drawing, design detail, design instruction, scope of works document or specification relating to the structure.

Understanding the contractual arrangements is important, but understanding everyone's responsibility for safety in design is equally important as this responsibility is not transferrable.

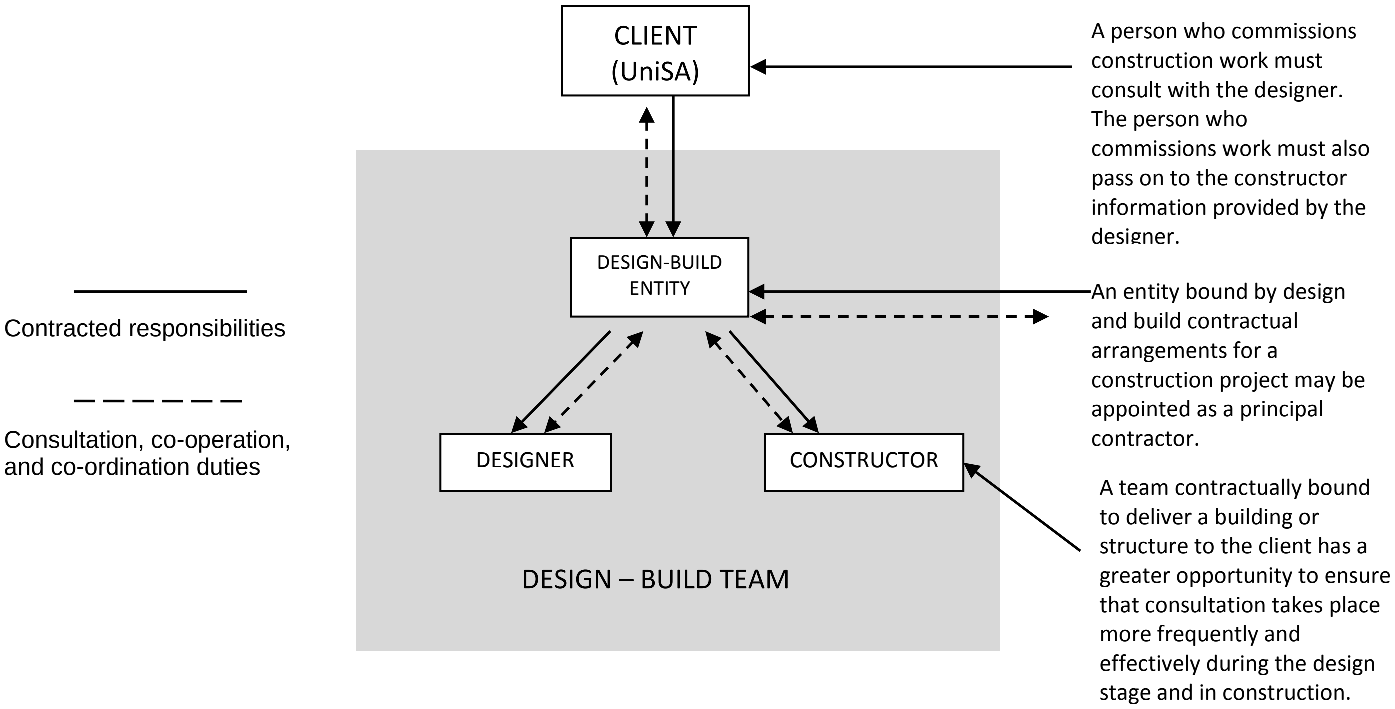


Figure 1 – This model represents design and build arrangements where all parties are contractually bound

2. HOW WE WILL ACHIVE SAFE DESIGN?

Safe design means the integration of control measures early in the design process to eliminate or, if this is not reasonably practicable, minimise risks to health and safety throughout the life of the structure being designed.

We will use a risk based approach, as a systemic way of investigating making a workplace as safe as possible. By using this process we will aim to:

- identify reasonably foreseeable hazards associated with the design of the structure
- if necessary, assess the risks arising from the hazards
- eliminate or minimise the risk by designing control measures, and
- review the control measures.

We will develop a scalable approach to advance safety on our projects using contemporary methods that will underpin safer designs and therefore safer facilities. We will innovate and seek the best of our consultants and contractors in aiming for these results.

We may conduct Hazard Identification Workshops (for example HAZOP or SWIFT) at various stages of the project life cycle as a method of considering hazards and how to eliminate them.

We may adopt the CHAIR® (Construction Hazard Assessment Implication Review) method as a tool to assist key stakeholders to come together to reduce construction, maintenance, repair and demolition safety risks associated with design.

By applying these methods from the pre-design phase we will aim to reduce hazards and aid in the selection of competent and capable consultants.

Periodically, independent design reviews and consultant reviews will be undertaken to assess the general nature and behaviour towards risk and safety on projects.

We will ensure that we provide our consultants and contractors with relevant site histories, information on known or suspected hazards, and a copy of the safety report to the principal contractor, as required under the WHS Act as a method of transferring important site information.

2.1 Stakeholder engagement

Through the stakeholder engagement phase of the project, the Project Manager is expected to identify, engage with and enlist any relevant stakeholders. This will extend to technical reference groups, stakeholder groups and business groups from within and beyond the University. (Refer Section 8)

3. UNDERSTANDING RISKS AND HAZARDS

Contemporary risk management practices and the integration of other tools and systems should be seen as the minimum standard to employing safe design on construction projects. It is not reasonable to expect that the Project Manager can be across and resolve every risk and hazard on a project without consulting with others. The knowledge of an integrated team can be gleaned through the lessons learned approach and the use of intelligent consultants and contractors can aid in growing our knowledge and awareness.

Safe design means the integration of control measures early in the design process to eliminate or, if this is not reasonably practicable, minimise risks to health and safety throughout the life of the structure.

If it is not reasonably practicable to eliminate a hazard the following control measures[1] should be considered:

The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest, known as the *hierarchy of control*.

- *Elimination* – The most effective control measure involves eliminating the hazard and associated risk. By designing-in or designing-out certain features, hazards may be eliminated. For example, designing components that facilitate pre-fabrication on the ground can avoid the need for working at height and therefore eliminate the risk of falls.
- *Substitution* – replace a hazardous process or material with one that is less hazardous to reduce the risk. For example:
    - Using pre-cast panels rather than constructing a masonry wall
    - Using pre-finished materials in preference to on-site finishing
- *Isolation* – separate the hazard or hazardous work practice from people, for example designing the layout of a building so that noisy machinery is isolated from workstations
- *Engineering controls* – use engineering control measures to minimise the risk, for example, including adequate ventilation and lighting in the design, designing and positioning permanent anchorage and hoisting points into buildings where maintenance needs to be undertaken at height
- *Administrative controls* – If engineering controls cannot reduce the risk sufficiently, then administrative controls should be used, for example using warning signs or exclusion zones where a hazardous activity is carried out.
- *Personal protective equipment – (for example hard hats, respiratory protection, gloves, ear muffs) should be used to protect the worker from any residual risk. It is the least effective control measure as it relies on the worker's behaviour and therefore requires thorough training and a high level of supervision to be effective.*

In many cases a combination of control measures will be required to minimise the risks to health and safety. For example traffic flow at a workplace may be controlled by incorporating traffic islands (engineering) and erecting warning signs (administrative).

Applying this hierarchy of controls should provide for a safe, cost effective, and practical facility.

[1] Safe Work Australia – Code of Practice – Safety in Design

Useful techniques may include a combination of the following actions:

- Conduct workshops and discussions with personnel using or working on similar structures within the University, including health and safety representatives.
- Conduct onsite assessment of an existing similar structure with feedback from the users of the existing structures and facilities.
- Research information or reports from similar structures on hazards and relevant sources of information and stakeholder groups, then complete analysis for own design needs.
- Conduct workshops with experienced personnel who will construct, use and maintain the new structure.
- Conduct workshops with specialist consultants and experts in the hazards. Review with OHS Personnel to eliminate or incorporate lessons learnt.

4. DESIGN REVIEW WORKSHOPS

4.1 Design Review Workshops

Design review workshops are a common practice by Project Managers specifically undertaken to review the design aspects, furniture, fittings, and equipment. Additional attributes of the design review workshop are verification against construction standards and guidelines; BCA and other standards.

We also use Design Review Workshops to ensure that the UniSA design and construction standards are being embraced and included by the design team. Safety in Design has always been a part of our design review process, notwithstanding its previous inclusion Safety in Design is now to be considered a dedicated function in the development and delivery of all our projects and is to be identified as such through formal inclusion as a standing agenda item across all project meeting forums.

4.2 CHAIR ® Construction Hazard Assessment and Implication Review

A CHAIR ® Construction Hazard Assessment and Implication Review is a detailed and systematic examination of the construction, maintenance, repair, and demolition safety issues associated with a design. CHAIR is a tool developed by the Work Cover Corporation (NSW) to assist designers, constructors, clients and other key stakeholders to come together to reduce construction, maintenance, repair and demolition safety risks associated with design.

"CHAIR is a tool that will enable better safety awareness and solutions for improving safety and construction through identifying potential hazards by a coordinated approach by all stakeholders.

It considers how design features have been incorporated to eliminate or mitigate potential construction hazards. The assessment assumes a certain level of safety management to exist at the construction site it is a supplement to, and not a replacement of, site specific construction safety reviews.

The RAIA also believes the value of CHAIR arises from its common sense approach and practicality in drawing key stakeholders together to co-operatively plan for safety.

A separate guide on the use, facilitation, and purpose of the Construction Hazard Assessment and Implication Review is available and should be used to cover the lifecycle aspects of your projects development.

An important aspect of conducting reviews is reflecting on past projects. Reviewing historic items like:

- Risk registers
- Design reports
- Safety in Design reports
- HazOp Reports
- Hazard and Incident reports; and
- Lessons learnt.

The Australian Council of Building Design Professions (BDP) and the Royal Australian Institute of Architects (RAIA) support the use of CHAIR. The BDP believes that along with the quality and amenity of the built environment, its safety is also determined at the design stage.

4.3 Indicative Stages of Safety in Design

- Design Consultant and Client, **2 party process**, establish the final design and identify any risks associated with through life operation and maintenance (through an established methodology and workshop, HazOp, SWIFT etc), these are then recorded and managed and may influence the final design outcome.
- The final design is tendered and a Construction Prime Contractor is appointed, the next stage of the Safety in Design process will now involve all **3 parties** to identify hazards which may be present during the construction phase. Record the hazards, manage and mitigate as far as reasonably practicable.
- Safety reviews to be undertaken at regular intervals to identify new hazards and review existing control measures for adequacy.
- At project completion all documentation relating to the Safety in Design process should be copied to all parties as evidence of compliance, by all parties, with the regulatory requirements.

The stages identified above provide an indication of how Safety in Design grows as a project matures and additional parties are introduced to become stakeholders in the process; Construction Contractor. One vital aspect of stakeholder engagement that must be remembered throughout the Safety in Design process is that the end users of a building are the ones that will have to manage residual risks for the longest and as such they should be fully involved and engaged throughout.

5. CONDUCTING RISK WORKSHOPS

UniSA has a Corporate Risk methodology and this process should form the basis of your risk practices whilst managing projects. There are specific risks unique to construction, operation, and maintenance that you will need to incorporate to satisfy the WHS Act and yourself that the project is progressing safely.

Assessing risk

A risk assessment involves considering what could happen if someone is exposed to a hazard and the likelihood of it happening. It is a way of deciding how much effort should be focussed on designing out a hazard – the more serious the risk of harm, the more time and effort should be dedicated to eliminating or minimising the risk.

Risk assessment is not an absolute science, it is an evaluation based on available information. Therefore, it is important those involved in a risk assessment have the necessary information, knowledge and experience of the work environment and work process.

If you require assistance applying the principles of these guidelines you may need to consult one of the following areas for further guidance; FMU staff, Divisional and HR Unit WHS staff.

You are not expected to know everything – you are expected to consult and engage with those that do.

Risk assessment methods for assessing design safety may include[2]:

- fact finding to determine existing controls, if any
- testing design assumptions to ensure that aspects of it are not based on incorrect beliefs or anticipations on the part of the designer, as to how workers or others involved will act or react
- testing of structures or components specified for use in the construction, end use and maintenance
- consulting with key people who have the specialised knowledge and/or capacity to control or influence the design, (for example the architect, client, construction manager, engineers, project managers and safety and health representatives), to identify and assess risks; consulting directly with other experts, (for example specialist engineers, manufacturers and product or systems designers) who have been involved with similar constructions, and
- when designing for the renovation or demolition of existing buildings, reviewing previous design documentation or information recorded about the design structure and any modifications undertaken to address safety concerns; and consulting professional industry or employee associations who may assist with risk assessments for the type of work and workplace.

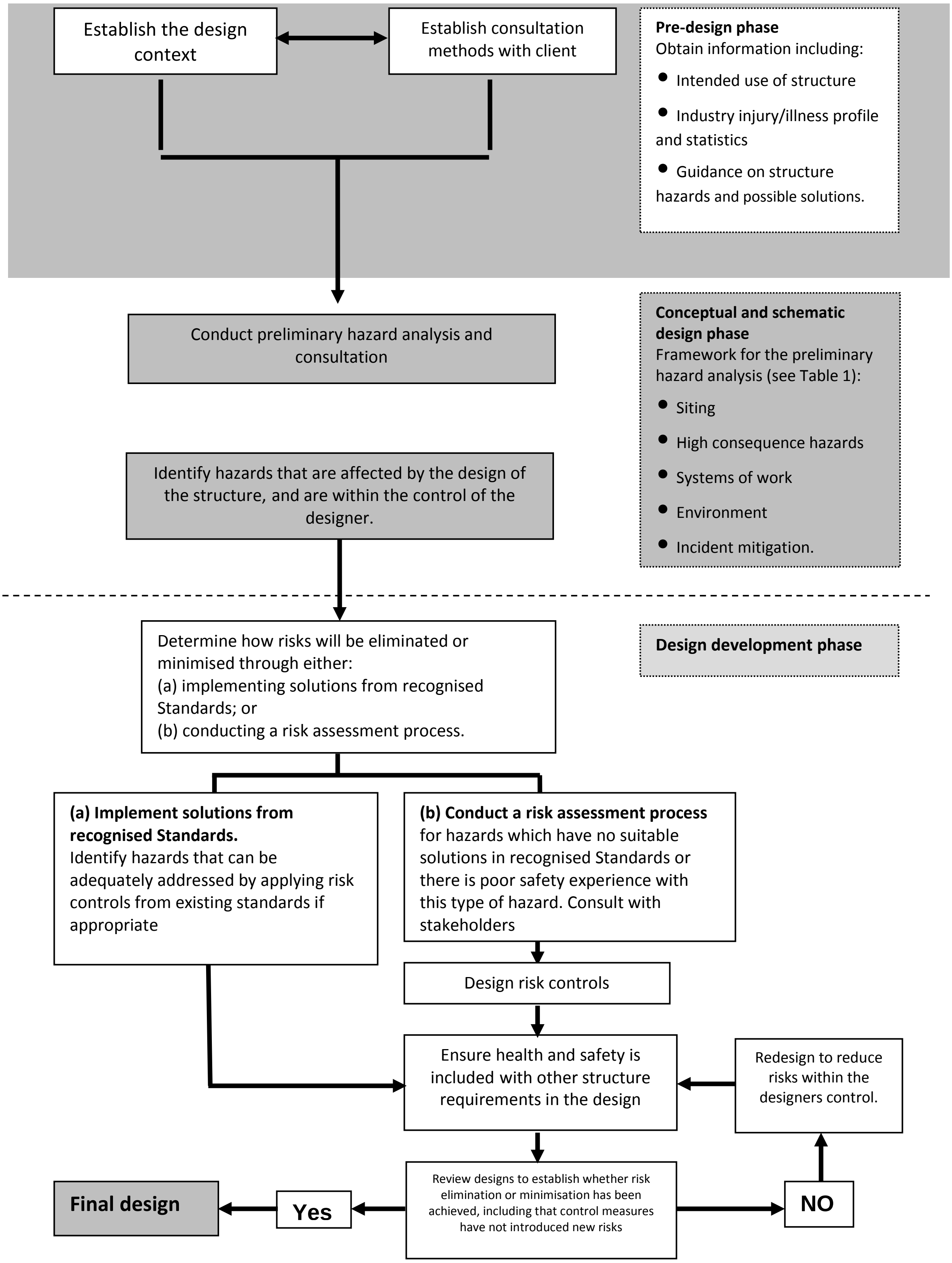
The risk register is a live document created to track, control, and communicate risks on your project. It should be reviewed as part of your regular project governance practices for the life of the project.

[2] From the Code of Practice - SiD

6. INTEGRATING DESIGN AND RISK MANAGEMENT

A systems approach that integrates the risk management process in the design phases and encourages collaboration between a client, designer, and constructor is recommended (see Figure 1).

Figure 1: A systematic approach to integrating design and risk management from the Code of Practice



Whilst not an exhaustive list the following guide, from the Code of Practice on preliminary hazard identification, can be undertaken by the project manager initially and then built upon with the collective input of others.

Table 1: Framework for the preliminary hazard identification

Siting of structure /equipment	Potential design issues that may affect safety include: • proximity to adjacent property or nearby roads/airports • surrounding land use • previous land use e.g. heavy metal soil contamination • clearances required for construction equipment and techniques • demolition of existing assets • proximity to underground or overhead services — especially electric lines • exposure of workers to adjacent traffic or other hazards • site conditions — including foundations, and construction over other assets or over water • safety of the public and adjacent workers • use of adjacent streets. • Emergency evacuation plan
High consequence hazards	The storage and handling of dangerous goods, or work with high energy hazards (for example, pressure) and health hazards such as biological materials. Use of plant such as forklift trucks, cranes etc
Systems of work (involving the interaction of persons with the structure)	The systems of work (including cleaning and maintenance activities) that pose risks, for example: • rapid construction techniques, i.e. prefabrication versus in situ construction • materials to be used in construction • staging and coordination with other works • sub contracting – ensuring communication via principle contractor or contractor • inadequate pedestrian or vehicle separation • restricted access for building and plant maintenance • hazardous manual tasks • working at height • exposure to occupational violence. Consider both technical and human factors, including humans' ability to change behaviour to compensate for design changes. Anticipate misuse throughout the lifecycle.
Environmental conditions	Impact of adverse natural events such as cyclones, floods and earthquakes, inadequate ventilation or lighting, high background noise levels and welfare facilities that do not meet workplace needs, shelter from extremes of heat and ultraviolet radiation.
Incident mitigation	The possibility of the structure to exacerbate the consequences after an incident due to inadequate egress, siting of assembly areas, inadequate emergency services access.

7. CONDUCTING HAZARD AND OPERABILITY STUDIES

7.1 HazOp Facilitation

A HazOp is a structured team-based method for the systematic review of the design of a facility or plant. A HazOp can be applied to both proposed and existing systems and provides for the participants to explore Hazards that may present through the occupation or operation of a facility or plant.

A HazOp can be applied at any time in the life of a project. To leverage the best opportunity for change a HazOp conducted in the pre-design phase can leverage past experience and guide the development of design – A HazOp conducted in the design phase can ensure earlier concepts have been applied and that the presented design is functional and does not introduce hazards, prior to committing to contracts or even more importantly construction. Every aspect of the design should be tested and questioned and the results of this process documented thoroughly.

The cost of change once construction is underway can impact not only budgets, but time and quality considerations.

By carefully selecting participants in the group you are seeking to embrace the knowledge skills and experiences of others to test your projects designs, concepts, or practices. The practice of engaging external personnel with fresh eyes should be encouraged to fully benefit from the HazOp process. An indicative list of 'Thought Triggers' which are designed to prompt open discussions and assist in identifying hazards are provided at Appendix A.

A HAZOP is a design verification process. It should not be used as a design development process – unless you are modifying the design to eliminate or reduce a hazard.

A design review undertaken with the HazOp should consider all the occupancy issues and associated plant and equipment. Analysis of workflow, traffic, P&ID's, plant and equipment layout, proximity between students, staff and operating infrastructure should all be considered in order to eliminate and reduce risks.

The HazOp process can be complementary to formulating safety and operating procedures and induction practices for facilities, plant and equipment.

A register of Hazards can be a product of the workshop process for sharing and communicating actions and responsibilities. The register can supplement the Risk Register and form part of the continuing project governance processes.

8. TECHNICAL REFERENCE GROUPS

8.1 Technical Reference Groups

A Technical Reference Group (TRG) is formed to engage relevant stakeholders and subject matter experts for the purpose of evaluating requirements and the suitability of proposals and designs. From the early phases of the project the TRG can provide their experience and expectations to guide and shape the development of the project.

It is the role to the Project Manager to impress on the members of the TRG that safety in design is a significant component of the group's responsibilities. Safety may override some project expectations if they cannot be achieved safely, comply with the various codes of practice or industry standards. Solutions will need to be driven on the basis of the hierarchy of controls and acceptance of lower level controls being considered and documented.

The use of the Technical Reference Group in the process of hazard identification ensures it is systematic and not limited to one or two people's experiences of situations.

8.2 Post-Occupancy Reviews

As an essential element of ensuring ongoing suitability of risk management measures and the continuing validity of identified risks it is vital that the Project Manager schedule a post occupancy review of the space affected by the project works, this assessment is to be conducted in consultation with space occupants and associated OHS&W representative.

Following the completion of construction it is recommended to review the effectiveness of safety in design. This process can be a good way to validate the success or otherwise of incorporated safety attributes and their effectiveness. It remains an important consideration that this process should be applied in the routine transition functionality in facilities. Should an office become something else, we should conduct a review to assess the safety and functionality of the space prior to re-occupation.

Providing advice to our consultant teams will assist them in improving their service offering and knowledge in the continual improvement of designs based on safety.

APPENDIX A – Indicative Safety in Design Workshop 'Thought Triggers'

The following list may be used as a starting reference point to evoke discussions and identify hazards and risks associated with the design of a structure throughout its lifecycle. It is not an exhaustive list and is a guide to considering what elements and hazards may exist in our projects.

Electrical safety

- Earthing of electrical installations
- Location of underground and overhead power cables
- Protection of leads/cables
- Number and location of power points

Fire and emergencies

- Fire risks
- Fire detection and fire fighting
- Emergency routes and exits
- Access for and structural capacity to carry fire tenders
- Other emergency facilities

Movement of people and materials

- Safe access and egress, including for people with disability
- Traffic management
- Loading bays and ramps
- Safe crossings
- Exclusion zones
- Site security

Working environment

- Ventilation for thermal comfort and general air quality and specific ventilation requirements for the work to be performed on the premises
- Temperature
- Lighting including that of plant rooms
- Acoustic properties and noise control, for example, noise isolation, insulation and absorption
- Seating
- Floor surfaces to prevent slips and trips
- Space for occupants

Plant

- Tower crane locations, loading and unloading
- Mobile crane loads on slabs
- Plant and machinery installed in a building or structure
- Materials handling plant and equipment
- Maintenance access to plant and equipment
- The guarding of plant and machinery
- Lift installations

Amenities and facilities

- Access to various amenities and facilities such as storage, first aid rooms/sick rooms, rest rooms, meal and accommodation areas and drinking water

Earthworks

- Excavations (for example, risks from earth collapsing or engulfment)
- Location of underground services

Structural safety

- Erection of steelwork or concrete frameworks
- Load bearing requirements
- Stability and integrity of the structure

Manual tasks

- Methods of material handling
- Accessibility of material handling
- Loading docks and storage facilities
- Workplace space and layout to prevent musculoskeletal disorders, including facilitating use of mechanical aids
- Assembly and disassembly of pre-fabricated fixtures and fittings

Substances

- Exposure to hazardous substances and materials including insulation and decorative materials
- Exposure to volatile organic compounds and off gassing through the use of composite wood products or paints
- Exposure to irritant dust and fumes
- Storage and use of hazardous chemicals, including cleaning products

Falls prevention

- Guard rails
- Window heights and cleaning
- Anchorage points for building maintenance and cleaning
- Access to working spaces for construction, cleaning, maintenance and repairs
- Scaffolding
- Temporary work platforms
- Roofing materials and surface characteristics such as fragility, slip resistance and pitch

Specific risks

- Exposure to radiation, for example, electromagnetic radiation
- Exposure to biological hazards
- Fatigue
- Working alone
- Use of explosives
- Confined spaces
- Over and under water work, including diving and work in caissons with compressed air supply

Noise exposure

- Exposure to noise from plant or from surrounding area

APPENDIX B – SAFE WORK AUSTRALIA GUIDANCE

Safe Work Australia leads the development of national policy to improve work health and safety and workers' compensation arrangements across Australia.

Further guidance can be found in the various codes of practice at the Safe Work Australia Website:

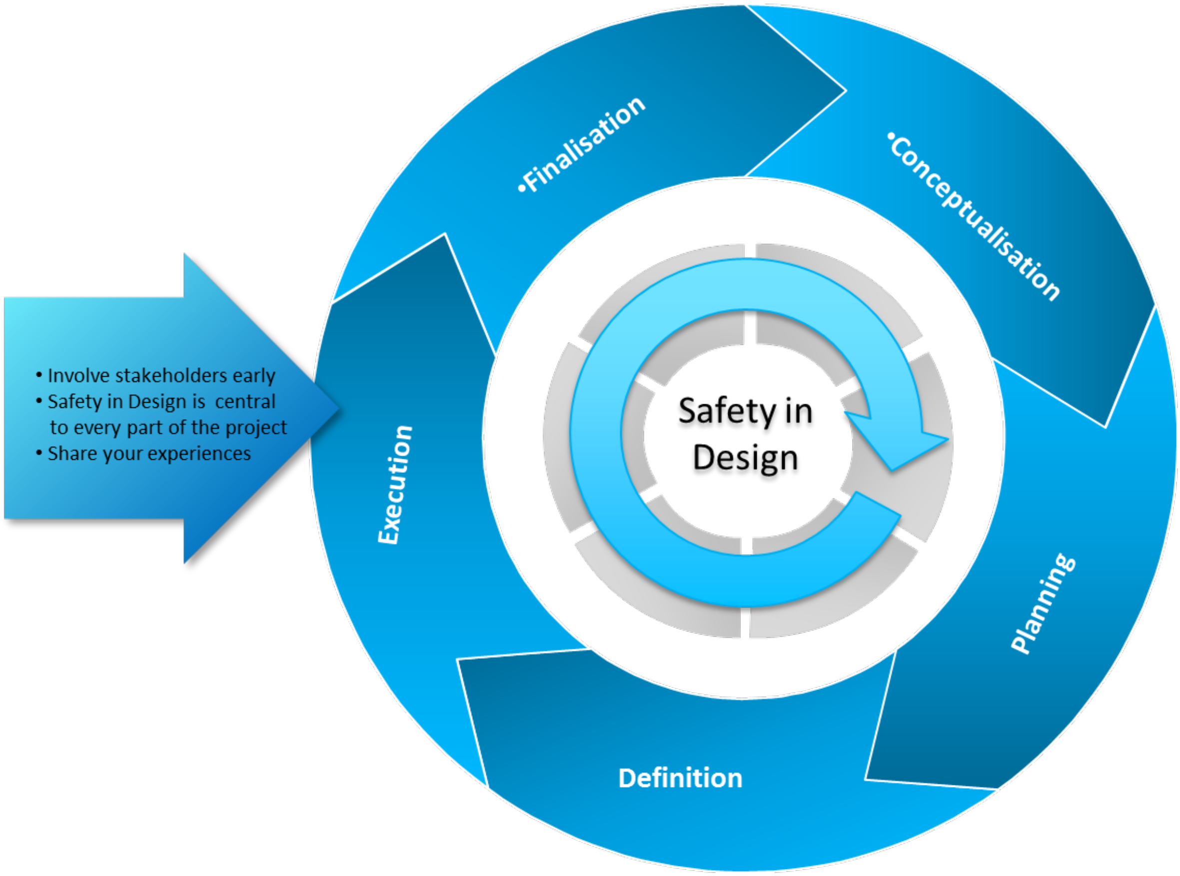
http://www.safeworkaustralia.gov.au/sites/SWA

Code of Practice: Demolition Work.
Code of Practice: Confined Spaces.
Code of Practice: Construction Work.
Code of Practice: Safely Remove Asbestos.
Code of Practice: How to Manage and Control Asbestos in the Workplace.
Code of Practice: Work Health and Safety Consultation Co-operation and Co-ordination.
Code of Practice: Managing Electrical Risks at the Workplace.
Code of Practice: Excavation Work.
Code of Practice: Managing the risk of Falls at Workplaces.
Code of Practice: Managing the Work Environment and Facilities.
Code of Practice: First Aid in the Workplace.
Code of Practice: How to Manage Work Health and Safety Risks.
Code of Practice: Safe Design of Structures.

This list is being continually updated and benefits from the public consultation phase of draft codes of practice.

APPENDIX C – SiD GRAPHIC

Safety in Design (SiD) is another continuous project function. It requires the Project Manager to be thinking and responding to issues that can be attributed to SiD. Effective and accurate documentation of communication is a core attribute of recording your effort toward Safety in Design.



Refer to the Project Management Framework for additional guidance and project templates.