

CODE OF PRACTICE
Safe design of buildings
and structures



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Foreword

Basis for code of practice

This code of practice is issued by Resources Safety under the *Mines Safety and Inspection Act 1994*, with endorsement by the Mining Industry Advisory Committee (MIAC) and approval from the Minister for Mines and Petroleum.

Scope

The code provides guidance on meeting the requirements in the *Mines Safety and Inspection Act 1994* and Mines Safety and Inspection Regulations 1995 relating to the design of buildings and structures for use at mining operations.

Who should use this code of practice?

Anyone involved in the design or construction of buildings or structures, whether permanent or temporary, for use at mining operations, including process plants and exploration camps, should use this code. This includes employers, self-employed people, people with control of workplaces, designers, manufacturers, importers, suppliers, erectors and installers.

In particular, this code of practice aims to:

- explain the legal obligations applicable to a person who is in control of, or who may have influence over, the design of a building or structure; and
- provide guidance on how these obligations can be met by describing practical ways of maximising the safety of the design.

Acknowledgements

This code of practice is based, with permission, on the *Code of practice: Safe design of buildings and structures*, published by the Western Australian Commission for Occupational Safety and Health in 2008.

Relationship between this code and the Building Code of Australia

The Building Code of Australia (BCA) is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Federal, State and Territory governments. It contains technical provisions for the design and construction of buildings and other structures, and covers such matters as structure, fire resistance, access and egress, services and equipment, and certain aspects of health and amenity.

The BCA has been given the status of building regulations by all States and Territories and must be complied with, whereas this code of practice takes the form of practical guidance and does not have the same legal status as regulation. However, under the mines safety and inspection legislation, in addition to meeting the BCA requirements, consideration must be given to addressing specific hazards and risks that might arise in relation to the particular building or structure during its life cycle. For example, there may also be manual handling considerations to be addressed for workers who move equipment in the finished building.







INTRODUCTION

1 Introduction

1.1 Importance of safe design

Safe design is based on the principle that everyone has a right to be protected from unnecessary risk of injury or harm. It is concerned with eliminating occupational safety and health hazards at the design stage or controlling risks, as early as possible, in the planning and design of buildings, structures, products, processes or systems.

As well as the risk of loss of life, injury or income, poor design can result in a range of other economic costs, such as low productivity, higher maintenance, reduced asset life, and higher employment and workers' compensation expenses. It is more costly to retrofit or modify existing products to achieve safety than it is to "design out" hazards early in the process.

Designers have specific responsibilities under the safety and health legislation to, as far as practicable, eliminate or control hazards during the construction, use and occupation of a building or structure. Employers also have a "duty of care" obligation to ensure that, as far as practicable, their employees are not exposed to hazards and risks related to a building or structure to be used as a workplace. Appendix 1 defines some relevant terms and Appendix 2 lists the applicable legislation.

Safe design of a building or structure will always be part of a wider set of design objectives, including practicability, aesthetics, cost and functionality. These sometimes competing objectives need to be balanced in a manner that does not compromise the safety and health of those who construct, maintain or use a building or structure as a workplace. The benefits of safe design include risk control and a reduced need for retrofitting.

The opportunities to eliminate, as far as practicable, or reduce occupational safety and health hazards prior to construction commencing are considerable. Where hazards cannot be "designed out":

- risk control measures compatible with the original design concept, and with the structural and functional requirements of the project, can often be incorporated; or
- alternatively, where changes to the design are not practicable, the designer may be in a position to advise others of the risks involved and how these might be mitigated.

Put simply, designers have a responsibility to ensure that, in the construction and use of their designs, others are not subjected to unnecessary risk.

Safe design involves consideration of processes, including human factors, organisational issues and life cycle management, not just products.

Additionally, the designer must also take into account how the design of the building or structure will affect, or be affected by, the design of related products or systems, where these are part of the normal use or maintenance of the building or structure.

1.2 Principles of safe design

The former Australian Safety and Compensation Council (now Safe Work Australia) identified five principles (key elements) for safe design (Table 1), which can be applied to the construction and other industries.

While not all these principles are grounded in law, they collectively contribute to building the knowledge, awareness and understanding required for designers to adopt a safe design approach. Further information on the principles is available at www.safeworkaustralia.gov.au

1.3 Safe design approach

Life cycle of a building or structure

Safe design requires an understanding of the occupational safety and health issues associated with each stage in the life of a building or other structure, starting with the initial conception, through to demolition, as illustrated in Figure 1.

Risk management

The safe design approach begins in the design and planning phase with an emphasis on making appropriate choices about the design, methods of construction and materials used based on occupational safety and health considerations. This approach involves a range of stakeholders. The safety aspects of a design can be enhanced prior to construction if a participative risk management approach is adopted, with consultation and communication with all relevant stakeholders.

The focus is on how those responsible for the design phase of a building or structure might consider, in the context of a particular project, which hazards or risks are evident and whether these might be eliminated or controlled as part of the design process. Although primarily directed at design professionals and those who may have influence over the design, it is recognised that many groups or individuals can affect the design, and hazards and risks can vary widely, depending on the nature of a particular building or structure.

The risk management approach outlined here should be tailored to the unique demands of a particular building or structure.

Consultative processes

Many parties are involved in the design and construction of a building or structure, and their responsibilities often overlap. Consequently, there should be a focus on improving consultative processes, particularly between those with control, or the capacity to exercise control, over the design and the construction process to ensure there is no compounding effect in design decision-making that increases the risks of exposure to hazards.

Consultation between all relevant stakeholders during the risk management process is most likely to produce workable measures that draw on the knowledge and expertise of those either performing tasks or overseeing the construction process, as well as the end users of a building or structure.

Some of the groups or individuals involved in the design process are:

- those who influence design decisions, such as developers, builders, owners, project managers, purchasers, clients, end users and workers;
- design professionals, such as architects; civil, services, mechanical and structural engineers; landscape architects; building designers and drafters; and industrial designers;
- other groups who can influence design decisions, such as quantity surveyors, insurers, occupational safety and health professionals, and human factors and ergonomics practitioners; and
- suppliers, including manufacturers, importers and plant hire, constructors, installers, and trades and maintenance people.

Table 1 Principles of safe design

<p>PRINCIPLE 1 People with control</p>	<p>Safe design is everyone's responsibility – responsibility for safe design rests with parties or people having control or influence over the design of products, items or processes</p>
<p>PRINCIPLE 2 Product life cycle</p>	<p>Safe design employs life cycle concepts – safe design applies to every phase in the life cycle, from conception through to redevelopment and disposal, and involves eliminating hazards or minimising risks as early in the life cycle as possible</p>
<p>PRINCIPLE 3 Systematic risk management</p>	<p>Safe design implements risk management – risk management achieves safe design through the application of hazard identification, risk assessment and risk control processes</p>
<p>PRINCIPLE 4 Safe design knowledge and capability</p>	<p>Safe design requires knowledge and capability – these should be either demonstrated or accessible by any person with control or influence over design</p>
<p>PRINCIPLE 5 Information transfer</p>	<p>Safe design relies on communication – effective communication and documentation of design and risk control information between all people involved in phases of the life cycle are essential for the safe design approach</p>

Source: Australian Safety and Compensation Council (now Safe Work Australia), 2006, *Guidance on the principles of safe design*

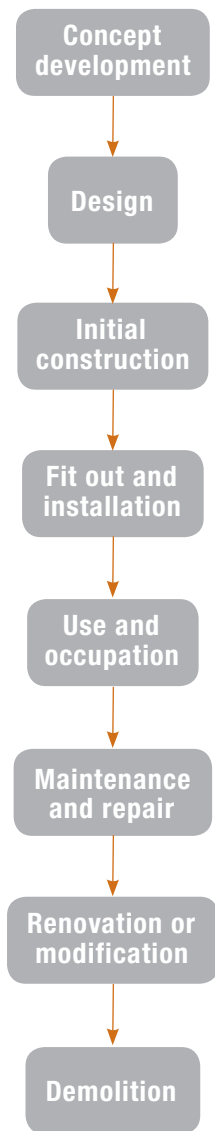


Figure 1 *Life cycle of a building or other structure*

2

DELINEATION OF RESPONSIBILITY

2 Delineation of responsibility

Principle 1: Safe design is everyone's responsibility

It will not always be possible to clearly delineate who has responsibility, under which circumstances, in relation to the elimination or reduction of hazards associated with a building or structure. However, there is an obligation not only on those who control the activity but also those who have the capacity to control or influence. Such decision making leads to a shared responsibility between the parties for the control of a design.

Stakeholders involved in a building project should be aware of the expertise required in order to carry out the project in a manner that does not expose themselves or others to hazards throughout the life cycle of the building or structure.

When determining what is or is not within their control, designers should consider that:

- something being outside of a designer's understanding is different to it being outside a designer's control;
- any changes to a design made without the designer's knowledge can remove the designer's control. The control of a design is limited to the elements of the design detailed or specified by the designer and not by others; and
- if a designer holds an accreditation to perform certain works, then that level of accreditation should be the level of control the designer has over the design.

Designers may not have management and control over the actual construction of a project but particular attention should be paid to:

- providing guidance on how it might be constructed safely;
- minimising hazards in the design;
- applying safe design principles to more traditional designs and processes, and considering whether new or innovative approaches to design will eliminate or reduce risk and result in an intrinsically safer building or structure;
- providing information about any identified hazards arising from an unconventional design to those who will construct or use the building; and
- carrying out the above in association with those who have expertise in construction safety.

Designers are well placed to manage risk and apply safe design principles, as an integral part of the design process, to ensure the products, systems and processes they generate are as safe as practicable for all who might interact with them, including end users and maintenance workers.

With tilt-up and precast construction, reference should be made to the Commission for Occupational Safety and Health's *Code of practice: Tilt-up and precast construction*, which sets out design considerations, as well as specific obligations for different parties.

3

KNOWLEDGE,
SKILLS AND
EXPERIENCE
REQUIRED

3 Knowledge, skills and experience required

Principle 4: Safe design requires knowledge and capability

In the context of the safe design of buildings and structures, “designers” includes architects and engineers, who need to:

- have a knowledge of workplace hazards and their harmful effects. For example, materials or techniques dictated by the design, those that might arise during the stages of the life cycle and especially those not self-evident, such as noise, heat, chemicals and radiation;
- understand common law and statutory occupational safety and health requirements, responsibilities and penalties;
- understand the risk management process, including risk assessment and typical industry practices used to control risk of injury or harm from hazards;
- understand the principles of designing to give consideration to normal human behaviour;
- be aware of how design can impact on reliability and safety, both on the environment and people; and
- be aware of sources of information relating to occupational safety and health.

4

RISK MANAGEMENT PROCESS

4 Risk management process

4.1 Three-step process

Principle 2: Safe design employs life cycle concepts

Principle 3: Safe design implements risk management

The risk management process for a design is a structured and systematic way of considering and addressing occupational safety and health issues that could arise during the life cycle of a building or structure.

The risk management process involves a three-step process to:

- identify hazards;
- assess risks of injury or harm arising from each identified hazard; and
- control risks through implementation of control measures to eliminate or reduce them.

The risk management process should be conducted and monitored on an ongoing basis to ensure control measures are working and no new hazards have been introduced when, for example, modifications are made to a design or changes are made to the materials used or sequencing of a construction project.

Generally, buildings or structures are unique in design, location and circumstances. Consequently, mechanisms are needed to anticipate, learn and modify designs where necessary based on experience. Designers should seek input from builders and consult with other stakeholders who are likely to know about the risks associated with each stage of the life cycle of a building or structure.

4.2 Getting started

To carry out the risk management process for a design, initial attention should be given to how it will be facilitated. Depending on the project, the following matters may need to be considered:

- who should be involved — consider holding discussions with those who may have responsibilities for safety (see Section 2) and key stakeholders either involved with or who may influence the design. This consultation may occur in two stages:

- firstly, during the conception stage, when there is the opportunity to consider all the stages of the building or structure's life cycle; and
- secondly, immediately prior to construction when the detailed design is known and construction, maintenance and demolition issues can be considered;
- what is needed to formally undertake the risk management process and discussions with stakeholders — consider those listed in Sections 4.3 and 4.4;
- who will be responsible for taking action, such as gathering further information and finding safer alternatives;
- what knowledge, skills and experience are required — see Section 3; and
- how will information be communicated to the relevant people — see Sections 5.1 and 5.2.

4.3 First step: hazard identification

The first step in the risk management process is identifying hazards — anything that may cause injury or harm to the health of a person — through the life cycle of a building or structure.

Table 2 lists some of the hazards that can be eliminated at the design stage or the risks controlled. Choosing an appropriate process or procedure for identifying potential hazards will depend on their nature and that of the building or structure as a workplace.

Table 2 Hazards that can be addressed by safe design

Category of hazards	Examples of hazards	Sources of control information to decide risk or control measures
Siting of structure	Events or incidents occurring between multiple structures, arising from poor siting or lack of separation	Specialist risk techniques may be required Controls will involve siting of structures Building Code of Australia (BCA) requirements
High consequence hazards	Storage and handling of dangerous goods Work with high energy hazards (e.g. temperature and pressure) Health hazards (e.g. toxic materials)	Specialist techniques are likely to be necessary to assess risks and controls Australian Standards and safety and health legislation, compliance codes and guidance will provide information and possible control measures Cumulative assessment of the overall risk may be necessary for these hazards BCA requirements
Systems of work involving the interaction of people with the structure	Inadequate pedestrian and vehicle separation Restricted access for building and plant maintenance Exposure to hazardous substances, manual tasks or working at height risks	Professionals, such as engineers, occupational physicians, ergonomists, occupational hygienists and materials chemists, can provide information on controls and suitable assessment techniques
Environment (conditions that are not part of specific system of work)	Inadequate ventilation or lighting Amenities that do not meet workplace needs	Requirements of BCA, Australian Standards, and building and related legislation will generally suffice if particular hazards or systems of work do not require a specific approach
Incident mitigation (possibility that the building or structure may increase consequences after an incident)	Inadequate egress, siting of assembly areas and emergency services access	Requirements of BCA, Australian Standards, and building and related legislation Emergency services Considerations when reviewing incident mitigation issues should include the situations involving all potential occupants and end users of the workplace. For example, will there be a safe interim area for people with disabilities in the event the workplace is evacuated?

Source: WorkSafe Victoria, 2005, *Designing safer buildings and structures (1st edition)*

Potential hazards associated with the design of buildings and structures include but are not limited to the examples listed in Table 3.

Depending on the complexity or uniqueness of the project, hazard identification processes or procedures may include:

- considering whether items from the checklist of hazards in Table 3 apply to the particular building or structure;
- developing a specific hazard checklist;
- using a risk assessment tool (see Appendix 3 for examples);
- examining records of past incidents for similar types of construction to facilitate a review of historical risks or failures for similar projects;
- examining data, where readily available, about the particular construction technique or use of a building or structure;
- conducting a constructability review with a special emphasis on occupational safety and health issues;
- consulting relevant standards, codes and guidance material;

- consulting with others with relevant expertise, including industry associations; and
- considering any particular issues associated with the known end-use of the project or foreseeable hazards that may occur during later phases of the life cycle, including modification and demolition.

Appendix 4 lists other sources of information that may assist.

The designer should also consider any exceptional hazards or matters that a competent builder or user would not be expected to be aware of. For example, a builder would not necessarily be aware that a long steel span member was

unstable until fully fixed into position or that particular props or braces are integral to the safety of a tilt panel. In such situations, the designer should take responsibility for either including relevant information in the drawings or specifications, or transfer the information to the builder for appropriate design management.

The designer should take into account sources of risk and the likelihood of their occurrence, considering both technical and human factors. As outlined below for risk assessment, qualitative and quantitative techniques should be used to systematically analyse possible risks. The tools listed in Appendix 3 may be used to do this.

Table 3 Hazard checklist for designers and others involved with design

Electrical safety	
<input type="checkbox"/>	Electrical installations
<input type="checkbox"/>	Underground power cables
<input type="checkbox"/>	Proximity to exposed cables
<input type="checkbox"/>	Work near high voltage power lines
<input type="checkbox"/>	Number and location of power points
Fire and emergencies	
<input type="checkbox"/>	Fire risks
<input type="checkbox"/>	Fire detection and fire fighting
<input type="checkbox"/>	Emergency routes and exits
<input type="checkbox"/>	Access for and structural capacity to carry fire tenders
<input type="checkbox"/>	Other emergency facilities
Movement of people and materials	
<input type="checkbox"/>	Safe access and egress
<input type="checkbox"/>	Traffic route and control
<input type="checkbox"/>	Loading bays and ramps
<input type="checkbox"/>	Other emergency facilities
Radiation	
<input type="checkbox"/>	Exposure to ionising radiation (e.g. radiation gauges, x-ray equipment)
<input type="checkbox"/>	Exposure to non-ionising radiation (e.g. electromagnetic radiation, lasers, transmitters, radar)

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 (e.g. noise isolation, insulation, damping)
- Seating
- Slipperiness of floor surfaces for buildings
- Space for occupants

Plant

- Cyclone and storm lock-down systems and procedures for shiploaders, stackers, reclaimers and similar structures
- Tower crane locations for 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
- Guarding of plant and machinery
- Lift installations

Amenities and facilities

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

Earthworks

- Excavation (e.g. risks from earth collapsing or engulfment in swamp land)
- Exposure to underground utilities

Structural safety

- Erection of steelwork or concrete frameworks
- Temporary fragility or instability of structure
- Load-bearing requirements
- Stability and integrity of structure
- Structural capacity for mechanical upgrades of shiploaders, reclaimers and stackers

Manual tasks

- Methods of material handling
- Accessibility of materials handling
- Loading docks and storage facilities
- Access and egress paths and doorways to facilitate movement of mechanical aids
- Assembly and disassembly of prefabricated 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

Falls prevention

- Guard rails
- Footholds on or near guard railing
- 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 biological hazards
- Use of explosives
- Confined spaces
- Risk of drowning
- Over- and underwater work, including diving and work in caissons with compressed air supply

Noise exposure

- Exposure to noise from plant
- Exposure to noise from surrounding area
- Workplace layout

Note: This listing contains examples only and is by no means complete.

4.4 Second step: risk assessment

The second step is assessing the risks of injury or harm arising from the hazards identified for the particular building or structure. This involves looking at the chance or likelihood of a hazard occurring and, if it did occur, the potential extent of any harm or injury (i.e. consequences). It is a way of deciding which hazards need to be addressed first; that is, where is the highest risk of injury or harm?

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

Risk assessment methods should, where possible, be based on objective data. In assessing the risk, it is important to recognise that many hazards will be inter-related and they should not, therefore, be considered in isolation.

If similar tasks or processes apply for a number of projects, or the design is of a fairly routine nature, a generic risk assessment model might be appropriate. However, the designer is still responsible for ensuring that the generic assessment is valid for the project before deciding to adopt it.

Risk assessment methods for assessing design safety may include:

- fact finding to determine existing controls, if any;
- testing design assumptions to ensure that aspects are not based on an incorrect belief or anticipation, on the part of the designer, as to how workers or others involved will act or react (see hazard checklist in Table 3);
- testing of structures or components specified for use in the construction, end use and maintenance; including non-destructive testing of the main structural components;
- consulting with key people who have the specialised knowledge or capacity to control or influence the design (e.g. architect, client, construction manager, engineers, project managers, safety and health representatives) to identify and assess risks;
- consulting directly with other experts (e.g. specialist engineers; designers, manufacturers and product or systems designers who have been involved with similar constructions);
- 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 members of professional industry or employee associations who may assist with risk assessments for the type of work and workplace.

Appendix 3 lists a selection of tools that can be used to conduct risk assessments.

4.5 Third step: risk control

The third step is to implement control measures to eliminate or reduce the risk of a person being injured or harmed and ensure they are monitored and reviewed on an ongoing basis.

There is a general preferred order or hierarchy of control measures, ranging from the most effective to the least effective, to eliminate or reduce the risks of injury or harm. Examples are given in Table 4.

In applying the hierarchy of control measures, the following should be considered:

- engineering controls or “passive safety measures” rank higher in the hierarchy and above administrative controls, such as provision of training or information, as they do not depend on the actions of people. Therefore, passive safety measures should be designed into the construction or installation within the building or structure wherever they are needed;
- administrative controls include provision of information on any remaining or residual risks, and how to control them. However, control of risks using information should not be over used. The demand for information and the type to be provided needs to be carefully assessed; and
- when providing instructions, warnings and labels, their design needs to be considered carefully, as words can have unintended double meanings and will not alone protect those without knowledge of the language. For example, visual warnings or labels will not assist the vision impaired, while audible warnings may not assist the hearing impaired. Warning signs or labels should comply with Australian Standard AS 1319:1994 *Safety signs for the occupational environment*.

The applicability of control measures will depend on the particular situation and its hazards and risks. When considering which control measures to implement:

- look specifically at identifying any exceptional risks that a competent builder might not be aware of or have the appropriate level of expertise to deal with;
- where residual risks remain, ensure these are communicated to the builder and other people likely to exercise control in the next stages of the life cycle of

Table 4 Hierarchy of control measures to eliminate or reduce the risk of injury or harm

	Control measure	Example of design change to improve safety
Most effective	1. Elimination — removing the hazard from the building or structure design by “designing it out”	Air conditioning system moved to ground level for easier and safer maintenance access (no fall-from-height hazard and reduction in awkward positions for manual tasks)
	2. Substitution — substituting or replacing a hazard or hazardous design component with a less hazardous one through a process of redesign	Windows changed to “flip over” for easy inside cleaning Slippery flooring replaced with “rougher” finish to reduce slip hazard
	3. Isolation — isolating or separating the hazard from people involved in the work or people in the general work area	Construction of components off site to reduce dust levels on site and number of people exposed to hazard
	4. Engineering controls — if the hazard cannot be eliminated, substituted or isolated, an engineering control is the next preferred measure and should be specified in the design notes	Corridors widened for safer access for movement of goods and people Standard doors enlarged by 25 per cent to improve access for equipment
	5. Administrative controls — those include noting in the design, those work practices needed to reduce risks	Instruction to provide procedures and training
Least effective	6. Personal protective equipment only considered when other control measures are not practicable	
In some instances, a combination of control measures may be appropriate		

the building or structure (e.g. clients, maintenance contractors);

- take a holistic view on the interaction of hazards in the assessment of their risks and implementation of control measures:
 - interaction between a combination of hazards and the effect on the level of risk should be assessed
 - a potential hazard may not necessarily require a single matching control measure. A response could be to implement a control measure that addresses a number of potential hazards; and
- assess alternative control measures for their applicability.

Examples of control measures that may apply to safe design are given in Section 4.6.

4.6 Examples of control measures

Building elements

Excavation

- Avoiding additional or different excavation depths near site boundary (e.g. designing lift shafts away from boundaries).

Walls and tilt-up panels

- Limiting the size of tilt panels where site access is restricted.

- Considering the use of pour strips to assist in stability of wall panels.

Nature and pitch of roofing

- Considering any maintenance requirements and the need for access.

Plastering

- Using suspending systems, pre-formed corner and bulkhead sections to reduce dust during finishing.
- Changing the design to:
 - use smaller sheets;
 - use lifters to hoist sheets; and
 - preload floors to reduce manual task hazards.

Plumbing

- Using prefabricated risers to eliminate on site work and the need to work at heights.

Beams

- Designing concrete beams so they can be erected from above, to prevent the risk of workers being crushed should the beams become dislodged during installation.
- Designing beam-to-column connections to have support from column during the connection process by adding a beam seat, extra bolt hole or other redundant connection point that provides continual support for beams during erection.

Flooring

- Considering floor treatment specifications to take into account the end use (e.g. incorporating use of slip resistant surfaces in areas exposed to the weather, frequent spills or dedicated wet areas).

Lighting

- Ensuring adequate lighting for intended jobs and tasks in the building.

Building technique

Power lines

- Relocating power lines or placing them underground before construction.
- Ensuring power lines are the correct distance from the building to reduce exposure to radiation from the lines.

Radiation sources

- Considering the exposure of people to extremely low frequency radiation from internal power sources such as distribution boards, electrical wiring and lifts.

Loading

- Clearly indicating on documents what the design loads are for different parts of the structure.

Processes

- Considering different erection processes for steel structures.
- Designing components to facilitate prefabrication off site or on the ground so they are erected in place as complete assemblies, reducing worker exposure to falls from heights or being struck by falling objects.
- Considering different construction sequences.
- Considering the complexity of the design.

Construction process

Confined spaces

- Minimising or eliminating the need for confined or enclosed work spaces.

Work at height

- Considering work at heights at all stages of the life cycle.
- Minimising the need to work at height (e.g. positioning lift plant at ground level or designing to enable construction at ground level).
- Designing parapets to a height that complies with guardrail requirements, eliminating the need for guardrails during construction.
- Designing and scheduling a permanent stairway for the beginning of construction to help prevent falls and other hazards associated with temporary stairs and scaffolding.

Power tools

- Considering the use of power tools by limiting the extent of on site fabrication.

Accessibility

- Considering access and egress during construction for people and vehicles.

Specific hazards or risks

Falls

- Considering design features that can mitigate the risk of falls, during construction, occupation, maintenance and demolition (e.g. reducing the spacing of roof trusses and battens; installing mesh to decrease the risk of internal falls).

Electrocution

- Indicating, where practicable, the position and height of all power lines to assist with site safety procedures.
- Reorienting the building or structure to avoid overhead or underground services.
- Providing adequate clearance between the building or structure and overhead power lines.

- Specifying residual current devices (RCDs) are to be used in all temporary power circuits during construction.

Traffic

- Designing traffic areas to separate vehicles and pedestrians, and heavy and light vehicles.
- Moving the building back from the roadway to facilitate safety of delivery workers.

Inhalation of fumes or dust

- Designing prefabricated panels with channels for electrical cables and plumbing to reduce chasing.
- Selecting materials like paints or other finishes that have low volatile organic compound emissions.

Noise

- Encapsulating or isolating noisy plant and equipment.
- Applying “Buy quiet” policy for procuring plant and equipment with noise levels that complement safe noise level guidelines.

Toxic gases, vapours, chemicals

- Selecting non-hazardous products or chemicals where available.
- Changing coating types to be non-toxic, especially where they are to be applied in enclosed spaces, such as underground car parks, kitchens and toilets.
- Selecting paints or other finishes that emit low volatile organic compounds.

Demolition

- Considering whether the nature of the design facilitates safe demolition at the end of the life cycle of the building or structure or in the event of fire or natural disaster (e.g. designing tilt panel structures so panels fall inward).

End use

Maintenance and repair

- Allowing for access for maintenance by providing hatches, walkways or stairways.

- Designing so that maintenance operations (e.g. windows, light bulbs, smoke detectors) can be done from ground level or from the structure (e.g. gangways integrated into structural frame).

- Incorporating building maintenance units for multi-storey buildings to avoid the use of rope access methods or long ladders for cleaning windows.
- Designing and positioning permanent anchorage and hoisting points where maintenance needs to be done at height.
- Using durable materials that do not need to be coated or treated after occupation.
- Including safety rails and harness connection points.
- Designing adequate access and egress (e.g. alternative routes if an exit is blocked during an incident).

Occupation and use

- Designing adequate access (e.g. allowing wide enough corridors for the movement of equipment).
- Designing workshop layout (e.g. doubling distances to noisy activities, avoiding work areas in corners with reflective surfaces) and structures (e.g. incorporating damping material, sound barriers) to manage both sustained and sudden noise exposure.
- Designing spaces to accommodate or incorporate mechanical devices to reduce risks associated with hazardous manual tasks.
- Considering exposure to specific hazards such as hazardous manual tasks and dangerous goods storage in a warehouse.
- Considering injuries due to:
 - poorly designed seating;
 - inadequate or poorly placed lighting; and
 - lack of consideration given to human behaviour, including errors.

5

TRANSFER OF INFORMATION

5 Transfer of information

5.1 Importance of communication

Principle 5: Safe design relies on communication

Consultation with building or structure users and other stakeholders is an essential part of safe design to eliminate or reduce risks to workers and other people.

Effective communication at all stages, as far as practicable, along with documentation of key information concerning hazards identified and action taken to control risks throughout the life cycle of a building or structure, not only makes users aware of any residual risks, but helps in meeting the designer's legal obligations.

Designers should provide clear, precise information suitable for people in control and users of the various phases of the building or structure. This is particularly important where the tendering arrangements have precluded any initial contact and discussion between the building designer and the construction team.

Points for designers to consider when providing information include:

- making notes on drawings, as these will be immediately available to construction workers;
- developing a register or list of significant hazards, potential risks and control measures;
- providing information on significant hazards, including:
 - hazardous substances or flammable materials included in the design;
 - heavy or awkward prefabricated elements likely to create handling risks;
 - features that create access problems;
 - temporary work required to construct or renovate the building as designed (e.g. bracing of steel or concrete frame buildings);
 - features of the design essential to safe operation;
 - methods of access where normal methods of securing scaffold are not available;
 - residual risk where design change has minimised but not eliminated the risk; and
 - noise hazards from plant.

Communication of this information to all stakeholders will minimise the likelihood of safety features deliberately incorporated into the design being eliminated at later stages of the life cycle by those engaged in subsequent work on or around the building or structure.

Development and use of an occupational safety and health (OSH) file (see Section 5.2) could assist the designer to provide this information to others.

5.2 OSH file

An OSH file is one means by which information about safety issues in relation to the design can be communicated to everyone who needs it, including those involved in the construction of a building or structure.

The file can be established at the outset, maintained and passed to subsequent clients (building owners) and form a useful record for later reference during the life of the building or structure.

If such a file is generated and maintained, it is important to specify clearly who is responsible for preparing and contributing to it. Initially:

- it could be established by the principal or the principal's agent at the concept development phase; then
- transferred to the designer during the design phase; then
- updated by the main contractor during construction and fit out; and
- at the conclusion of the above phases, the principal or owner or the agent of the owner should retain the file. It should be made available to those responsible for maintaining the building and to any future designers and principal contractors involved in renovation or demolition.

The file could contain:

- design criteria;
- details of the client, designer(s), principal contractor(s) and any other people involved (e.g. developers);
- construction methods and materials used;
- details of services;
- plant and equipment as built and installed; and
- all drawings and operations and maintenance manuals that can provide information for future construction and subsequent maintenance work, such as cleaning, maintenance and demolition.

The following information needed by end users for maintenance, modifications and demolition is also relevant:

- general work instructions;
- existence of hazardous substances and materials;
- stressors;
- work likely to be dangerous;
- confined spaces;
- design reviews;
- hazards and limitations related to use of machinery and equipment;
- hazards created by, and within, surrounding environment including traffic; and
- any other matter judged by one of the key people, particularly the designer, to be relevant.

APPENDICES

Appendix 1

Definitions

Building or structure: Any erection, edifice, wall, chimney, fence, bridge, dam, reservoir, wharf, jetty, shiploader, reclaimer, stacker or ship, dredge or other floating structure, and includes any part of any of those things.

Practicable: Some of the general duty provisions in the *Mines Safety and Inspection Act 1994* are qualified by the words “so far as is practicable”. This applies to general duties for employers, self-employed people, people with control of workplaces, designers, manufacturers, importers, suppliers, erectors and installers. These people are expected to take measures that are practicable.

“Practicable” has a particular meaning in the Act – see section 4(1) – and is explained in more detail below.

If something is practicable, it is “reasonably practicable”, taking into account:

- the severity of any injury or harm to health that may occur;
- the degree of risk (or likelihood) of that injury or harm occurring;
- how much is known about the risk of injury or harm, and the ways of reducing, eliminating or controlling the risk; and
- the availability, suitability and cost of the safeguards.

In other words, to be practicable, something must not only be capable of being done, it must also be reasonable in light of the factors mentioned above. The risk and severity of injury must be weighed up against the overall cost and feasibility of the safeguards needed to remove the risk. Only those factors listed above are relevant, and a factor cannot be ignored unless, after considering what a reasonable person at the time would have known, the factor is clearly irrelevant. Each factor is considered in light of what a reasonable person, in the position of the person who owes the duty, would have known.

Appendix 2

Legislative provisions

Sections of the *Mines Safety and Inspection Act 1994* and *Mines Safety and Inspection Regulations 1995* relevant to this code of practice are listed below.

Note: The only authorised versions of the Act and regulations are those available from the State Law Publisher (www.slp.wa.gov.au), the official publisher of Western Australian legislation and statutory information.

Mines Safety and Inspection Act 1994

- s. 9 Duties of employers
- s. 9A Breaches of section 9(1)
- s. 10 Duties of employees
- s. 10A Breaches of section 10(1) or (3)
- s. 12 Duties of employers and self-employed persons
- s. 12A Breaches of section 12
- s. 13 Duties of principal employers and managers
- s. 13A Breaches of section 13
- s. 14 Duties of manufacturers etc.
- s. 15 Breaches of section 14
- s. 15D Duties of employer in respect of certain residential accommodation
- s. 15E Breaches of section 15D

Mines Safety and Inspection Regulations 1995

Part 3 Management of mines, Division 1 Exploration activities

rr. 3.3 to 3.9

Part 4 General safety requirements, Division 1 General

rr. 4.1 to 4.17

Part 4 General safety requirements, Division 2

Construction work

rr. 4.18 to 4.22

Part 6 Safety in using certain types of plant in mine, Division 2 General duties relating to items of plant

rr. 6.2 to 6.31

Appendix 3

Risk assessment tools

CHAIR (construction hazard assessment and implication review) has been specifically developed for the construction industry by WorkCover New South Wales. The primary aim of CHAIR is to identify hazards and eliminate or minimise risks as early as possible in the life of a project. While it is focused on safety, the process also takes into account operational requirements, aesthetics and financial considerations, with a view to producing the safest possible design in all the circumstances.

The **designer misconception** tool helps designers systematically test products and processes for misconceptions about how people will act or fail to act in particular situations. It complements other tools for technical analysis and is based on the premise that many design faults are due to the designer:

- having an incorrect belief about how a person will act or a situation will develop; or
- failing to anticipate these.

Event tree analysis (ETA) is used to identify initiating events and then considers how often they might occur and possible outcomes. The initiating event may be a failure within a system or an external event. ETA starts with the initiating event and then searches forward. Event trees are well suited to analysing failsafe mechanisms in safety critical systems, such as a centralised gas heating hot water system in a building.

Fault tree analysis (FTA) is a technique used to identify and pictorially depict conditions and factors that can lead to undesirable events. Possible causes of fault modes in functional systems are identified by assessing what could go wrong. It is a technique that could be used to further analyse undesirable events identified during the CHAIR process. FTA can assist the designer or engineer to focus on causes and faults likely to have the most severe consequences and assess how frequently these might occur. FTA could be used in a construction setting to analyse and assess the importance of the consequences of a failure of computer-driven systems within a building.

Fault mode effects analysis (FMEA) is used to identify potential failures in a structural or mechanical design. The process breaks down the design into appropriate levels for examination to identify the potential modes and consequences of failures and the effect these may have on the component and the systems as a whole. This technique asks the question – if this part fails, in this manner, what will be the result? Further questions are then asked about:

- how each component might fail;
- the possible causes of these failures;
- the effects of these failures;
- the seriousness of these failures; and
- how of each failure mode will be detected.

FMEA typically considers and ranks severity from 1 to 10 (minor to major) and consequences in categories I to IV (minor to catastrophic).

Preliminary hazard analysis (PHA) is used to identify hazards, hazardous situations and events that can cause harm in particular situations. It is often used early in the development of a project but can be used in other

phases of the life cycle, such as prior to renovation or demolition.

Human reliability assessment (HRA) deals with the impact of people on system performance and the influence of human errors in reliability.

Constructability (“buildability”) review is a review of the plans and design to check for buildability. It is an approach that links the design and construction processes. This type of review can be useful for identifying potential hazards and risks in the design of a building or structure, allowing these to be addressed at less cost than when construction commences.

Appendix 4

Other sources of information

Legislation

- *Radiation Safety Act 1975*
- Radiation Safety (General) Regulations 1985

Available from the State Law Publisher (www.slp.wa.gov.au), the official publisher of Western Australian legislation and statutory information.

Codes of practice, guidance material and other documents

Resources Safety, Department of Mines and Petroleum [www.dmp.wa.gov.au]

- Consultation at work – code of practice
- Manual tasks in mining – fact sheet series
- Mine safety matters – brochures
- Noise control in mines – guideline
- Safeguarding of machinery and plant – code of practice

Australian Building Codes Board [www.abcb.gov.au]

- Building Code of Australia

Safe Work Australia [www.safeworkaustralia.gov.au]

- National standard for construction work [NOHSC: 1016 (2005)]
- National OHS strategy 2002-2012
- Guidance on the principles of safe design for work
- Safe design for engineering students
- Design issues in work related serious injuries

Commission for Occupational Safety and Health
[www.worksafe.wa.gov.au]

- Code of practice: Concrete and masonry cutting and drilling
- Code of practice: Tilt-up and precast concrete construction
- Code of practice: The prevention of falls at workplaces
- Guidelines for the development of industry codes of practice

Australian Radiation Protection and Nuclear Safety Agency [www.arpansa.gov.au]

- Radiation Protection Series No. 6 - National Directory for Radiation Protection (NDRP) (December 2009)
- Radiation Protection Series No. 9 - Code of practice and safety guide for radiation protection and radioactive waste management in mining and mineral processing (2005)
- Radiation Protection Series No. 11 - Code of practice for the security of radioactive sources (2007)
- Radiation Protection Series No. 13 - Code of practice and safety guide for safe use of fixed radiation gauges (2007)
- Radiation Protection Series No. 15 - Safety guide for the management of naturally occurring radioactive material (NORM) (2008)
- Radiation Protection Series No. 16 - Safety guide for the predisposal management of radioactive waste (2008)

Standards Australia [www.saiglobal.com]

- Australian Standard AS 3610:1995 Formwork for concrete
- Australian Standard AS 1319:1994 Safety signs for the occupational environment
- Australia/New Zealand Standard AS/NZS 1680.1:2006 Interior and workplace lighting – General principles and recommendations
- Australia/New Zealand Standard AS/NZS 1680.2.4:1997 Interior lighting – Industrial tasks and processes
- Australian Standard AS 4024 series Safety of machinery
- Australia/New Zealand Standard AS/NZS 4360:2004 Risk management
- Australia/New Zealand Standard AS/NZS 4576:1995 Guidelines for scaffolding

- Australia/New Zealand Standard AS/NZS 4801:2004 Occupational health and safety management systems – Specification with guidance for use
- Australian Standard AS 4324.1:1995 Mobile equipment for continuous handling of bulk materials
- Australian Standard AS 2550.1:1993 Cranes – Safe use

Government agencies and organisations that may be contacted for further information

Department of Mines and Petroleum

Resources Safety

Level 1, 303 Sevenoaks Street
Cannington WA 6017

Telephone: 08 9358 8079

Facsimile: 08 9358 8000

Email: minessafety@dmp.wa.gov.au

Website: www.dmp.wa.gov.au/ResourcesSafety

Department of Commerce
WorkSafe

Level 5, 1260 Hay Street
West Perth WA 6005

Telephone: 1300 307 877

Facsimile: 08 9321 8973

Email: safety@commerce.wa.gov.au

Website: www.worksafe.wa.gov.au

The Chamber of Minerals and Energy
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Level 7, 12 St George's Terrace
Perth WA 6000

Telephone: 08 9325 2955

Facsimile: 08 9221 3701

Website: www.cmewa.com

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