Office of Industrial Relations
Workplace Health and Safety Queensland

Demolition work

Code of Practice 2013

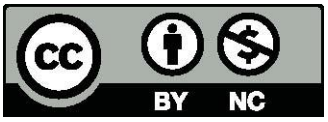
Queensland Government

This Queensland code of practice has been approved by the Attorney-General and Minister for Justice on and commences on 1 December 2013.

This code is based on a national model code of practice developed by Safe Work Australia and approved by the Select Council on Workplace Relations on 13 July 2012 as part of the harmonisation of work health and safety laws.

This code was varied by the Minister for Education and Industrial Relations on 1 July 2108.

PN11576



Creative Commons

This copyright work is licensed under a Creative Commons Attribution-Noncommercial 3.0 Australia licence. To view a copy of this licence, visit:

http://creativecommons.org/licenses/by-nc/3.0/au/

In essence, you are free to copy, communicate and adapt the work for non-commercial purposes, as long as you attribute the work to Safe Work Australia and abide by the other licence terms.

Contents

Foreword

This *Demolition work Code of Practice* an approved code of practice under section 274 of the *Work Health and Safety Act 2011* (the WHS Act).

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the *Work Health and Safety Regulation 2011* (the WHS Regulation).

From 1 July 2018, duty holders are required to comply either with an approved code of practice under the WHS Act or follow another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety to the standard required in the code.

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS Act and WHS Regulation. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.
An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice. This may include issuing an improvement notice for failure to comply with a code of practice where equivalent or higher standards of work health and safety have not been demonstrated.

This Code of Practice has been developed by Safe Work Australia as a model code of practice under the Council of Australian Governments' *Inter-Governmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety* for adoption by the Commonwealth, state and territory governments.

Scope and application

This code provides practical guidance to persons conducting a business or undertaking on how to manage the health and safety risks associated with the demolition work. This code applies to all types of demolition work.

The guidance in this code is relevant to demolition contractors as well as persons conducting a business or undertaking who have management or control of workplaces where demolition work is carried out, such as principal contractors.

How to use this code of practice

In providing guidance, the word 'should' is used in this code to indicate a recommended course of action, while 'may' is used to indicate an optional course of action.

This code also includes various references to provisions of the WHS Act and WHS Regulation which set out the legal requirements. These references are not exhaustive. The words 'must', 'requires' or 'mandatory' indicate that a legal requirement exists and must be complied with.

1 Introduction

1.1 What is demolition work?

Any work that is connected with the demolition of a structure is classified as 'construction work' under the *Work Health and Safety Regulation 2011* (WHS Regulation). When carrying out demolition work, the requirements relating to construction work must be complied with.

Demolition work means to demolish or dismantle a structure or part of a structure that is load-bearing or otherwise related to the physical integrity of the structure, but does not include:

- the dismantling of formwork, falsework, scaffolding or other structures designed or used to provide support, access or containment during construction work
- the removal of power, light or telecommunication poles.

A structure is anything that is constructed, whether fixed or moveable, temporary or permanent, and includes buildings, sheds, towers, chimney stacks, silos, storage tanks.

The demolition of an element of a structure that is load-bearing or otherwise related to the physical integrity of the structure is 'high risk construction work'. A safe work method statement (SWMS) must be prepared before the high risk construction work starts.

Demolition work that is notifiable under the WHS Regulation involves:

- demolition of a structure, or a part of a structure that is load-bearing or otherwise related to the physical integrity of the structure, that is at least 6 metres in height
- demolition work involving load shifting machinery on a suspended floor
- demolition work involving explosives.

Other key terms relating to demolition work are listed in Appendix A.

1.2 Who has health and safety duties in relation to demolition work?

A **person conducting a business or undertaking** has the primary duty 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.

The WHS Regulation includes specific obligations for a person conducting a business or undertaking to manage the risks associated with demolition work. These duties include:

- preparing a Safe Work Method Statement (SWMS) for the proposed work, or ensuring a SWMS has already been prepared by another person, before any high risk construction work commences
- obtaining a copy of the asbestos register for the workplace before demolition work is carried out
- if there is no asbestos register, you must:
  - not carry out the work until the structure or plant has been inspected to determine whether asbestos or asbestos containing materials (ACM) are fixed to or installed in the structure or plant
  - ensure that the determination is undertaken by a competent person
- if asbestos or ACM are determined or presumed to be present, inform the occupier and owner of the premises (if domestic premises) and the person conducting a business or undertaking with management or control of the workplace

- ensure that all asbestos that is likely to be disturbed by the demolition work is, so far as is reasonably practicable, removed before the demolition commences.

For the purposes of this Code, the person conducting a business or undertaking that has management or control of the demolition work is sometimes referred to as the 'demolition contractor'.

A **principal contractor** for a construction project (i.e where the cost of the construction work is $250 000 or more) has additional duties under the WHS Regulation (Refer to section 3.2 of this Code):

Designers of structures must ensure, so far as is reasonably practicable, that the structure is without risks to health and safety, when used for a purpose for which it was designed. Designers must give the person who commissioned the design a written safety report that specifies the hazards relating to the design of the structure (Refer to section 3.3 of this Code).

Officers, such as company directors, have a duty to exercise due diligence to ensure that the business or undertaking complies with the *Work Health and Safety Act 2011* (WHS Act) and WHS Regulation. This includes taking reasonable steps to ensure that the business or undertaking has and uses appropriate resources and processes to eliminate or minimise risks that arise from the demolition work.

Workers have a duty to take reasonable care for their own health and safety and that they do not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to health and safety at the workplace.

1.3 What is required to manage the risks associated with demolition work?

WHS Regulation section 297: A person conducting a business or undertaking must manage risks associated with the carrying out of construction work.

WHS Regulation sections 34-38: In order to manage risks under the WHS Regulation, a duty holder must:

- identify reasonably foreseeable hazards that could give rise to the risk
- eliminate the risk so far as is reasonably practicable
- if it is not reasonably practicable to eliminate the risk – minimise the risk so far as is reasonably practicable by implementing control measures in accordance with the hierarchy of risk control
- maintain the implemented control measure so that it remains effective
- review, and if necessary revise control measures so as to maintain, so far as is reasonably practicable, a work environment that is without risk to health and safety.

This Code provides guidance on managing the risks associated with demolition work by following a systematic process that involves:

- identifying hazards
- if necessary, assessing the risks associated with these hazards
- implementing control measures
- maintaining and reviewing the effectiveness of control measures.

Guidance on the general risk management process is in the *: How to manage work health and safety risks Code of Practice*.

Consulting your workers

WHS Act section 47: The person conducting a business or undertaking must consult, so far as is reasonably practicable, with workers who carry out work for you who are (or are likely to be) directly affected by a work health and safety matter.

WHS Act section 48: If the workers are represented by a health and safety representative, the consultation must involve that representative.

Consultation with workers and their health and safety representatives is required at every step of the risk management process. In many cases, decisions about construction work and projects are made prior to engaging workers, therefore, it may not be possible to consult with workers in these early stages. However, it is important to consult with them as the demolition work progresses.

Consultation may include discussions about:

- demolition methods
- type of risk control measures
- interaction with other trades
- safe work method statements
- provision of appropriate amenities
- procedures to deal with emergencies.

Consulting, co-operating and co-ordinating activities with other duty holders

WHS Act section 46: A person conducting a business or undertaking must consult, co-operate and co-ordinate activities with all other persons who have a work health or safety duty in relation to the same matter, so far as is reasonably practicable.

A construction workplace will often be shared by various persons conducting a business or undertaking, such as structural engineers, mobile plant operators and asbestos removalists. Persons with overlapping duties should exchange information about the risks associated with the demolition work and work together in a co-operative and co-ordinated way so that all risks are eliminated or minimised so far as is reasonably practicable.

Further guidance on consultation is available in the Work health and safety consultation, co-operation and co-ordination Code of Practice.

2 The risk management process

2.1 Identifying the hazards

The first step in the risk management process is to identify the hazards associated with demolition work. Examples of demolition hazards include:

- unplanned structure collapse
- falls from one level to another
- falling objects
- the location of above and underground essential services, including the supply of gas, water, sewerage, telecommunications, electricity, chemicals, fuel and refrigerant in pipes or lines
- exposure to hazardous chemicals – these may be present in demolished material or in the ground where demolition work is to be carried out (contaminated sites)
- hazardous noise from plant and explosives used in demolition work
- the proximity of the building or structure being demolished to other buildings or structures.

2.2 Assessing the risks

Under the WHS Regulation, a risk assessment is not mandatory for demolition work however it is required for specific situations (e.g. when working with asbestos or explosives). In many circumstances a risk assessment will assist in determining the control measures that should be implemented. It will help to:

- identify which workers are at risk of exposure
- determine what sources and processes are causing that risk
- identify if and what kind of control measures should be implemented
- check the effectiveness of existing control measures.

When assessing the risks associated with demolition work, consider the following:

- the structure to be demolished and its structural integrity
- the method of demolition including its sequencing
- the scheduling of the work
- the layout of the workplace, including whether there are fall hazards both for people and objects
- what plant and equipment will be used and the skill and experience required by the people who will use it safely
- what exposures might occur, such as to noise or ultraviolet (UV) rays
- the number of people involved
- local weather conditions.

2.3 Controlling the risks

The hierarchy of control measures

Some control measures are more effective than others. Control measures can be ranked from the highest level of protection and reliability to the lowest. This ranking is known as the *hierarchy of control*.

You must always aim to eliminate a hazard, which is the most effective control. If this is not reasonably practicable, you must minimise the risk by one or a combination of the following:

- *Substitution* (e.g., using a mechanical demolition method rather than a manual method, if it is safer)
- *Isolation* (e.g. use concrete barriers to separate pedestrians and powered mobile plant to reduce the risk of collision)
- *Engineering controls* (e.g. fitting an open cab excavator with a falling objects protective structure to minimise the risk of being struck by a falling object).

If risk remains, it must be minimised by implementing *administrative controls*, so far as is reasonably practicable, (e.g. install warning signs and establish an exclusion zone around the demolition work). Any remaining risk must be minimised with suitable *personal protective equipment* (PPE), such as providing workers with hard hats, steel cap boots and high visibility vests.

Administrative control measures and PPE rely on human behaviour and supervision, and used on their own, tend to be the least effective in minimising risks.

Factors that should be considered when choosing suitable control measures include:
- items of plant and equipment – large structures may require scaffolding or powered mobile plant to work on suspended floors
- stockpiling arrangements at the workplace (e.g. the location of demolished material to control dust)
- transporting the demolished material, including access to the workplace, the length and nature of the haul route, and the type of load shifting equipment to be used.

Chapters 4-6 of this code provide information on control measures for demolition work.

2.4 Reviewing control measures

The control measures that are put in place to protect health and safety should be regularly reviewed to make sure they are effective.

WHS Regulation 38: You must review your control measures and, if necessary, revise them:
- when the control measure is not effective in controlling the risk
- before a change at the workplace that is likely to give rise to a new or different health and safety risk that the control measure may not effectively control
- if a new hazard or risk is identified
- if the results of consultation indicate that a review is necessary, or
- if a health and safety representative requests a review.

Common review methods include workplace inspection, consultation, testing and analysing records and data. When reviewing control measures, the SWMS must also be reviewed and revised where necessary.

If problems are found, go back through the risk management steps, review your information and make further decisions about control measures.

3 Planning the demolition work

Demolition work should be carefully planned before work starts so it can be carried out safely. Planning involves identifying hazards, assessing risks and determining appropriate control measures in consultation with all relevant persons involved in the work, including the principal contractor, demolition contractor, structural engineers and mobile plant operators.

A demolition plan should be prepared for all demolitions where there are a number of other persons conducting a business or undertaking (e.g. subcontractors) involved. If the demolition contractor is also the principal contactor, the demolition plan should be incorporated as part of the WHS management plan.

Appendix B provides further information on what a demolition plan may include.

3.1 Notifiable demolition work

WHS Regulation section 142: A person conducting a business or undertaking who proposes to carry out the following demolition work must give written notice to the regulator at least 5 days before any of the following work commences:

- demolition of a structure, or a part of a structure that is load bearing or otherwise related to the physical integrity of the structure, that is at least 6 metres in height
- demolition work involving load shifting machinery on a suspended floor, or
- demolition work involving explosives.

The height of a structure is measured from the lowest level of the ground immediately adjacent to the base of the structure at the point at which the height is to be measured to its highest point.

The type of information which would normally be included in the notification would be:

- the name and contact details of the person conducting the business or undertaking
- if the high risk construction work is in connection with a construction project, the name and contact details of the principal contractor for the project or the principal contractor's representative
- the name and contact details of the person directly supervising the work
- the date of the notice
- the nature of the demolition
- whether explosives will be used in carrying out the work and, if so, the licence details of the person who is to use the explosives
- when the person conducting the business or undertaking reasonably believes the work is to commence and to be completed
- where the work is to be carried out.

In the circumstances where an emergency services organisation directs one or more of its workers to carry out notifiable demolition work for the purposes of rescuing and/or providing first aid to a person, the organisation must provide a written notice to the relevant regulator as soon as reasonably practicable before or during the demolition work, or if this is not reasonably practicable after the demolition work is carried out.

3.2 Principal contractor

Where the value of construction work is $250 000 or more, the construction work is considered a *'construction project'* for which additional duties apply to the principal contractor. There can only be one principal contractor for a construction project and this will be either the person

commissioning the construction work or a person that is appointed as the principal contractor by the person commissioning the construction work.

The principal contractor has a range of duties in relation to a construction project, including:

- preparing and reviewing a WHS management plan
- obtaining SWMS before any high risk construction work commences
- putting in place arrangements to manage the work environment, including falls, facilities, first aid, an emergency plan and traffic management
- installing signs showing the principal contactor's name, contact details and location of any site office
- securing the construction workplace.

It is possible that the demolition contractor may be appointed as the principal contractor. This may occur, for example, where there is significant demolition work required and there is a clear separation or delay between the demolition activity and any subsequent building work. In this case the person who commissions the construction work may appoint the demolition contractor as the principal contractor, who must then comply with all the duties of a principal contractor until the demolition work is complete.

3.3 Designers

WHS Act section 22: Designers must ensure, so far as is reasonably practicable, that the structure is designed to be without risks to the health and safety of persons in relation to the proper demolition or disposal of the structure.

WHS Regulation section 295: The designer of a structure or any part of a structure that is to be constructed must give the person conducting a business or undertaking who commissioned the design a written report that specifies the hazards associated with the design of the structure that, so far as the designer is reasonably aware:

- create a risk to the health and safety of persons who are to carry out construction work on the structure or part
- are associated with the particular design and not with other designs of the same type of structure.

This is particularly important with modern designs where 'limit state' design techniques are used by the structural designer. In this approach, the designer considers the structure in its completed form with all the structural components, including bracing, installed. The completed structure can withstand much higher loads (e.g. wind and other live loads) than when the structure is in the construction or demolition stage. With this in mind, it may be necessary for the designer to provide guidance to the demolisher on how the structure will remain standing as it is demolished or dismantled.

The principal contractor (or the demolition contractor if there is no principal contractor) should take all reasonable steps to obtain the designers safety report.

For demolition work, there may be a number of designer safety reports available, including:

- the report prepared for the original construction of the structure (if available)
- any reports prepared for subsequent additions or alterations to the structure (if available)
- where a designer is engaged for the demolition work, the report provided to the person commissioning the design of the demolition work.

Designers who develop demolition specifications or procedures for the demolition of a structure should consider the possible work methods available and associated health and safety risks.

Designers should then take into account the proposed demolition method and control measures available when producing any final design documents for the demolition of a structure.

If as-built design documentation is not available, or there is a concern that the structure has been damaged or weakened (e.g. by fire or deterioration), or plant is to be used on suspended floors, then a competent person (e.g. a qualified structural engineer) should conduct an engineering investigation and deliver an 'engineering investigation report'. Some issues that may be considered when undertaking an engineering investigation are listed in Appendix C.

The following design matters should be taken into account when considering demolition risks:

- the stability and structural integrity of the structure at all stages of demolition, including assembled portions, single components and completed sequentially erected braced bays
- the maximum permissible wind speed for partially demolished structures
- the effect of the proposed demolition sequence on stability
- the stability requirements for all components of the structure as it is sequentially demolished according to the structural engineer's requirements
- the proximity of adjacent or adjoining buildings
- the competent persons assessment of loadings at all stages of demolition
- the provision of clear instructions for temporary bracing
- the plant to be used for the work, including the size, type, position and coverage of proposed demolition crane(s) should be indicated on a site plan, locations such as unloading points and storage areas (if any) should be shown
- the need to ensure that the ground is compacted to any design specifications to enable plant to be moved and used safely at the workplace
- the proposed methods for handling heavy, bulky or awkward components
- the need for specific lifting arrangements to be detailed on structural member drawings to facilitate safe lifting
- the handling, lifting, storing, stacking and transportation of components, depending on their size, shape and weight
- the provision of safe access and safe working areas.

Further guidance on the safe design of structures is in the Safe design of buildings and structures Code of Practice.

Technical standards

Demolition specifications and procedures should be designed in accordance with acceptable engineering principles and published technical standards. Engineering principles would include, for example, mathematical or scientific procedures outlined in an engineering reference manual or standard.

3.4 Safe work method statements

If the demolition work is or involves high risk construction work, a person conducting a business or undertaking must prepare a SWMS before the work starts. The SWMS must:

- identify the type of high risk construction work being done
- specify the health and safety hazards and risks arising from that work
- describe how the risks will be controlled
- describe how the control measures will be implemented, monitored and reviewed, and
- be developed in consultation with workers and their representatives who are carrying out the high risk construction work.

One SWMS can be prepared to cover all high risk construction work being carried out at the workplace by contractors and/or subcontractors. For example, demolition work might involve a number of types of high risk construction work, including work that:

- involves a risk of a person falling more than 2 metres
- involves, or is likely to involve, the disturbance of asbestos
- involves structural alterations or repairs that require temporary support to prevent collapse
- is carried out on or near a confined space
- involves the use of explosives
- is carried out on or near pressurised gas distribution mains or piping
- is carried out on or near chemical, fuel or refrigerant lines
- is carried out on or near energised electrical installations or services
- is carried out at a workplace in which there is any movement of powered mobile plant.

In this case, the contractors or subcontractors can consult and cooperate to prepare one SWMS. Alternatively, they can prepare separate SWMS. If they choose to do this they must consult with each other to ensure all SWMS are consistent and they are not creating unintended additional risks at the workplace.

3.5 Demolition licensing

A licence is required to undertake some demolition work.

Other licences

Depending on the type of work being done there may be a need for persons to hold the relevant licence (e.g. to carry out asbestos removal work, high risk work or use of explosives).

3.6 Asbestos registers and licensing

WHS Regulation sections 422(1), (2b) and, 425(1): A person with management or control of a workplace must ensure that all asbestos or asbestos-containing material (ACM) at the workplace (or assumed present) is identified by a competent person and an asbestos register is prepared for the workplace. The asbestos register must be kept up-to-date.

WHS Regulation section 458: A person conducting a business or undertaking that commissions the removal of asbestos must ensure that the asbestos removal work is carried out by a licensed asbestos removalist who is appropriately licensed to carry out the work, unless specified in the WHS Regulation that a licence is not required.

There are two types of licences: Class A and Class B. The class of licence required will depend on the type and quantity of asbestos, ACM or asbestos contaminated dust or debris (ACD) that is being removed at a workplace as set out in Table 1 below.

Table 1 – Asbestos removal licences

Type of licence	What asbestos can be removed?
Class A	Can remove any amount or quantity of asbestos or ACM, including: • any amount of friable asbestos or ACM • any amount of ACD • any amount of non-friable asbestos or ACM,
Class B	Can remove: • any amount of non-friable asbestos or ACM. Note: A Class B licence is required for removal of more than 10m^2 of non-friable asbestos or ACM but the licence holder can also remove up to 10m^2 of non-friable asbestos or ACM. • ACD associated with the removal of non-friable asbestos or ACM. Note: A Class B licence is required for removal of ACD associated with the removal of more than 10m^2 of non-friable asbestos or ACM but the licence holder can also remove ACD associated with removal of up to 10m^2 of non friable asbestos or ACM.
No licence required	Can remove: • up to 10m^2 of non-friable asbestos or ACM • ACD that: - is associated with the removal of less than 10m^2 of non-friable asbestos or ACM, **or** - is not associated with the removal of friable or non-friable asbestos and is only a minor contamination.

Further information on the duties associated when removing asbestos is in the How to Safely Remove Asbestos Code of Practice.

3.7 Adjacent or adjoining buildings

No part of the demolition process should adversely affect the structural integrity of any other building. Consideration may be given to the use of shoring and underpinning and to the effects of changes in soil conditions as a result of the demolition work.

Lateral support for adjoining structures should be equal to or greater than any provided by the structure to be demolished. Before the existing lateral support is disturbed, provision should be made for the erection of temporary supports, which will need to be checked for effectiveness as the demolition proceeds.

It is also important that other buildings in and around the demolition site are not adversely affected by vibration or concussion during the demolition process. Special precautions may need to be taken in the vicinity of hospitals and other buildings containing equipment sensitive to shock and vibration.

No part of the demolition process should cause flooding or water penetration to any adjoining building.

3.8 Essential services

One of the most important elements of pre-demolition planning is the location and disconnection of all essential services.

Essential services include the supply of gas, water, sewerage, telecommunications, electricity, chemicals, fuel and refrigerant in pipes or lines. The principal contractor must ensure, so far as is reasonably practicable, that essential services at the workplace are without risks to health and safety.

Construction work is defined by the WHS Regulation as 'high risk construction work' when carried out:

- on or near pressurised gas distribution mains or piping
- on or near chemical, fuel or refrigerant lines
- on or near energised electrical installations.

A SWMS must be prepared before this work commences.

All electric, gas, water, sewer, steam and other service lines not required in the demolition process should be shut off, capped, or otherwise controlled, at or outside the building line, before demolition work is started.

In each case, any utility agency involved should be notified in advance and its approval or services, if necessary, obtained. Any service retained for the demolition work should be adequately protected as required by the relevant authority (e.g. the protection of overhead electric lines).

Underground essential services

WHS Regulation section 304: Where there are underground essential services that may be disturbed by the work, the demolition contractor must take all reasonable steps to obtain current information on the services prior to commencing work and:

- have regard for the information
- keep the information readily available for inspection under the WHS Act
- make the information available to any principal contractor and subcontractors
- retain the information until the excavation is completed or, if there is a notifiable incident relating to the excavation, 2 years after the incident occurs.

The available information about existing underground essential services may not be accurate. Therefore it is important that demolition methods include an initial examination of the area to be demolished.

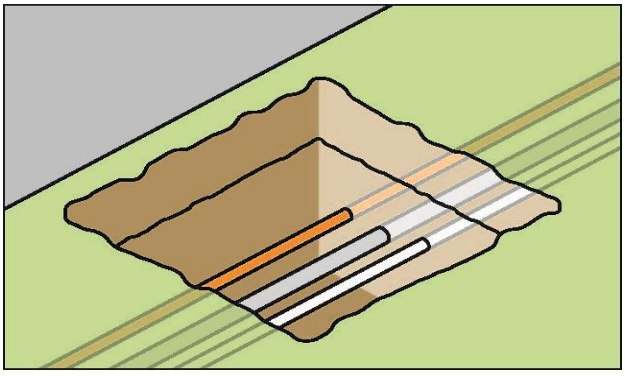


***Figure 1**: Underground essential services exposed by 'potholing'.*

4 Controlling risks in demolition work

4.1 The building or structure to be demolished

The person conducting a business or undertaking in control of the demolition work should consult with the designer and/or the principal contractor if appointed where reasonably practicable, to obtain a written report specifying the hazards associated with the design and the structure in the planning stage of the demolition work. Specific hazards may be outlined in a demolition plan.

The building or structure to be demolished and all its components should be maintained in a safe and structurally stable condition so as to prevent the unexpected collapse of part or all the structure. Temporary braces, propping, shoring or guys may need to be added to ensure that stability of the structure is maintained.

The position, depth and type of basements, wells and underground storage tanks should also be determined as should the contents of any storage tanks.

Adjoining properties and structures also need to be considered, as do the existence of easements, right of way, boundary walls and other encumbrances.

4.2 Hazardous chemicals and materials

WHS Regulation section 49: A person conducting a business or undertaking at a workplace must ensure that no person at the workplace is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture.

Demolition work may involve workplaces or structures that contain or have contained hazardous materials, including chemicals. Hazardous materials include lead, asbestos, polychlorinated biphenyls (PCBs), contaminated dust and combustible materials.

The risks arising from potential exposure to hazardous materials must be managed in accordance with the WHS Regulation.

For hazardous chemicals, exposure standards must not be exceeded. These are set out in the *Workplace Exposure Standards for Airborne Contaminants*, and should also be listed in the manufacturer's safety data sheet (SDS).

Before starting any demolition work, all areas of the workplace, including basements, cellars, vaults and waste dumps, should be examined to determine whether:

- there are any items which could be a fire and explosion risk
- any previous use of the site might cause a risk because of the nature of and/or decomposition of materials
- there are any toxic, radioactive or other hazardous chemicals present.

Any hazardous materials, including explosives, should be clearly identified. Information about a chemical's hazards and control measures can be obtained from the chemical's safety data sheet (SDS) or the label of the chemical's container. If available, the workplace's former hazardous chemicals register or manifest should be referred to for determining the nature and location of previous hazardous chemical storage areas.

The person conducting a business or undertaking and/or the principal contractor at a demolition workplace should inform all workers and other persons at the workplace of the presence of

hazardous chemicals, and the control measures for exposure and safe disposal. SDSs for hazardous chemicals must be readily available for reference.

Appropriate, clean facilities and amenities must be provided for workers to minimise risks where there are hazardous materials present.

Further specific guidance on hazardous chemicals can be found in the *Managing risks of hazardous chemicals in the workplace Code of Practice.*

Asbestos

Any construction work, including demolition work that involves or is likely to involve the disturbance of asbestos is defined by the WHS Regulation as high risk construction work and a SWMS must be prepared before this work commences.

The person conducting a business or undertaking with management or control of the demolition work has specific responsibilities in regard to identifying whether asbestos is present and informing others if it is.

WHS Regulation section 450: Where a structure is to be demolished, a person conducting a business or undertaking carrying out demolition work must obtain a copy of the asbestos register for the workplace from the person with management or control of that workplace.

WHS Regulation section 451: If there is no asbestos register, the person carrying out the demolition work must:

- not carry out the work until the structure or plant has been inspected to determine whether asbestos or ACM are fixed to or installed in the structure or plant
- ensure that the determination is undertaken by a competent person
- if asbestos of ACM are determined or presumed to be present, inform the occupier and owner of the premises (if domestic premises) and the person conducting a business or undertaking with management or control of the workplace.

All asbestos that is likely to be disturbed by the demolition must be identified and, so far as is reasonably practicable, be removed before the demolition is started.

If only a part of a building or structure is to be demolished, only the asbestos that is likely to be disturbed during the demolition of that part of the building or structure is required to be removed, so far as is reasonably practicable, before the demolition work commences.

When planning demolition or refurbishment, consider:

- the age of the building and the likelihood of asbestos or other hazardous materials being present
- the location of asbestos in relation to the proposed demolition or refurbishment
- if there are inaccessible areas that are likely to contain asbestos
- whether asbestos is likely to be damaged or disturbed as a result of the demolition or refurbishment work – if yes, can it be removed safely before work commences?
- type and condition of asbestos present
- amount of asbestos present
- method of demolition or refurbishment and how will it affect the asbestos
- the nature of the ACM (friable or non-friable).

Demolition of part of a building, structure, or plant can be carried out to access in-situ asbestos so it can be removed safely. For example, part of a wall may be demolished to access asbestos located in the wall cavity so it can be removed before further demolition.

Building and construction workers can expect that, in workplaces where asbestos is fixed or installed, all asbestos has been identified so far as is reasonably practicable. If there is any uncertainty about the presence of asbestos or if any part of the structure or plant is inaccessible and likely to be disturbed, it must be assumed that asbestos is present.

Further specific guidance on managing asbestos when demolition and refurbishment work is being carried out can be found in the:

- How to manage and control asbestos in the workplace Code of Practice
- How to safely remove asbestos Code of Practice

Lead

Lead is found in paint, old water pipes and other plumbing fittings, sheet lead, solders, lead flashing, lead light windows and glass. The age of a structure may be directly related to the amount of lead that can be present (see Table 2).

Table 2 – Lead sources

Approximate date of construction	Sources of lead hazards
1920 - 1978	Paint
1920 - 1978	Plumbing
1923 - 1986	Automobile exhaust (may accumulate as ceiling dust)

If it is suspected that the structure contains lead based paint, a test for the presence of lead should be conducted.

The precautions which should be taken when demolishing materials containing lead include:

- minimising the generation of lead dust and fumes
- cleaning work areas properly during and after work
- wearing the appropriate PPE
- maintaining good personal hygiene.

Further information is in *AS 4361.1 Guide to Hazardous Paint Management – Part 1: Lead and other Hazardous Metallic Pigments in Industrial Applications.* Testing can recognise dried paint film with more than 1 per cent (by weight) to be lead-containing paint.

Polychlorinated biphenyls (PCBs)

Workers can be exposed to PCBs when dismantling electrical capacitors and transformers or when cleaning up spills and leaks. Appropriate control measures should be implemented when handling damaged capacitors to ensure that any spillage does not contact workers and is appropriately cleaned up and disposed of.

Any equipment or parts containing PCBs should be placed in a polyethylene bag and then placed into a marked sealable metal container.

If PCBs cannot be transported immediately for disposal, all containers should be stored in a protected area which prevents any discharge of PCBs to the environment.

PPE including gloves made of materials that are resistant to PCBs (e.g. polyethylene, nitrile rubber or neoprene), should be provided to workers and worn when there is any likelihood of exposure to PCBs.

Synthetic Mineral Fibres

Synthetic mineral fibres are used extensively for insulation in building walls and ceilings as well as on items such as air-conditioning duct work. The specific material should be identified and control measures implemented relevant to the manufacturer's instructions.

PPE should be provided to workers and worn when insulation is being removed during the demolition process and dust should be suppressed by damping down.

4.3 Securing the work area

Exclusion zones

To protect workers undertaking demolition activities, exclusion zones should be considered to prevent unauthorised personnel entering work areas.

A system to prevent falling objects impacting on workers should be implemented to protect the safety of people who are working on or in the vicinity of the demolition work. In particular, any area where a falling object might reasonably be expected to land should be designated an exclusion zone. The enclosed and/or protected area should extend horizontally to a safe distance beyond the overhead work area.

Planning for exclusion zones should take into consideration:

- erecting secure impassable barricades with adequate signage and appropriate lock out procedures to prevent unauthorised pedestrian or vehicular access to the area
- providing information to workers and other persons at the workplace advising them of the status of the exclusion zones
- providing supervision so that no unauthorised person enters an exclusion zone.

Exclusion zones and safe distances may be required during:

- the stripping, removal and/or dropping of debris
- the operation of demolition plant or equipment
- pre-weakening activities for a deliberate collapse
- the deliberate collapse or pulling over of buildings or structures.

Public access and protection

Adequate public safety should be maintained in public places and areas adjoining the workplace as the work progresses (e.g. roads, walkways). Where demolition work is adjacent to a public place and there is a risk of falling debris or hazardous noise, a method of protection should be selected and:

- erected before the commencement of demolition work
- kept in position at all times during the progress of the work
- regularly inspected and maintained.

Control measures to isolate the work from the public may include installing hoarding such as security fencing, containment sheets and mesh, an overhead protective structure, road closures and specified exclusion zones.

Overhead protective structures should be provided for public walkways in conjunction with perimeter fencing. Overhead protection may be constructed from scaffolding, fabricated steel or timber and should be designed to withstand an appropriate load.

Unauthorised entry to a demolition workplace can expose persons to a number of hazards that, if not controlled, could result in fatalities or serious injuries. The person conducting a business or undertaking who controls the workplace, who may be a principal contractor or demolition contractor, must ensure, so far as is reasonably practicable, that the workplace is secured so as

to prevent unauthorised access. Monitoring of access and egress points for the workplace should be conducted during the work.

Further information on security fencing, falling materials, overhead protection and hoardings is in AS 2601: *The demolition of structures.*

4.4 Plant and equipment

A range of plant and equipment typically used for demolition work includes:

- powered mobile plant
- personnel and/or materials hoists
- air compressors
- electric generators
- jack hammers
- hydraulic jacks
- oxy-acetylene (gas cutting/welding)
- concrete saws and corers
- scaffolding
- ladders (limited use)
- many types of handheld plant, including: angle grinders, power saws, hammers, demolition saws, hydraulic jacks and pinch/lever bars.

You should ensure:

- plant is used and operated by a competent person
- that appropriate guards and operator protective devices are fitted
- that the safe working load is displayed and any load measurement devices are operating correctly
- plant is maintained in accordance with the manufacturer/supplier's instructions or relevant Australian Standards
- you refer to the manufacturers' recommendations for the safe use and storage of oxy-acetylene cutting equipment.

Further general guidance on plant is in the Managing the risks of plant in the workplace Code of Practice.

4.5 Powered mobile plant

The use of powered mobile plant such as cranes, excavators and bulldozers, requires the preparation of a SWMS before work commences.

A high risk work licence is required to operate some types of powered mobile plant, such as some cranes, elevating work platforms or forklifts.

Whenever powered mobile plant is to be used for demolition work, traffic management arrangements should be implemented to prevent collision with pedestrians or other mobile plant.

Cranes

Cranes may be used in demolition work for a number of purposes, including:

- lifting and lowering plant and/or materials
- lifting and lowering personnel work boxes
- holding suspended loads.

Cranes require a licensed operator. An operator may also need other competencies for specialist work.

If cranes are used to suspend loads that are to be cut and then lowered to the ground, it is important for the loads to be accurately calculated. It may be necessary to cut samples in order to determine the weight per unit length or area. Where this occurs, the safe working load of the crane should be reduced by 50 per cent to allow for miscalculations in the test weighing. A similar

approach should be followed where weights cannot be determined with reasonable consistency and accuracy.

4.6 Removal of debris

The person conducting a business or undertaking and/or the principal contractor in control of the workplace must manage the risks to health and safety arising from the storage, movement and disposal of construction materials and waste at the workplace.

Debris should be progressively removed to prevent any build up that could affect the integrity of a suspended floor of the building or structure, affect workplace access and egress, become a fire hazard, or cause a health and safety hazard.

Demolished materials should not be allowed to fall freely unless they are confined within a chute (or similar enclosure), shaft and/or exclusion zone.

A debris drop is a debris pile that is enclosed and where the risk of an object striking workers or the public has been eliminated. Debris drop zones should be clearly identified and any area where there is a risk that a worker or other persons at the workplace might be injured by falling or rebounding debris should be fenced or barricaded to prevent access.

If demolished materials are allowed to fall through internal floor openings in multi-storey buildings, such as lift shafts and/or debris drop zones, the following should apply:

- at the working level, each opening should be protected by an adequate vehicle buffer during the removal of debris by mobile plant, and guarded by suitable barriers at all other times. Vehicle buffers should be high enough to prevent the mobile plant from riding over them and solid enough to stop the fully loaded mobile plant
- at all levels below the working level, access to the area through or onto which material is falling should be prevented, either by sealing off the opening with guarding from floor to ceiling, or by erecting signs and barricades to prevent persons coming near the openings.

Debris chutes should be designed and constructed to prevent the spillage of material and dust and to minimise noise while debris is passing through the chute. Vertical chutes should be fully enclosed with a cover or barrier at the top to prevent a person falling into the chute. Debris chutes should be adequately secured to the building or structure and to ensure that debris falls freely and does not become jammed in shafts or chutes. Securing of the chute should take into consideration the weight of the chute plus the accumulated load.

Overhead demolition should cease during removal of the debris bins. Signs which warn of the risk from falling or ejected material should be placed at the discharge end of every chute.

4.7 Falls

WHS Regulation section 78: A person conducting a business or undertaking must manage the risk of a fall from one level to another that is reasonably likely to cause injury to the person or another person.

In managing the risks of falls, the WHS Regulation requires the following control measures to be implemented where it is reasonably practicable to do so:

- eliminate the need to work at heights by performing work at ground level
- carry out the work on solid construction that includes a safe means of access and egress
- minimise the risk of fall by providing and maintaining a safe system of work including:
  - using fall prevention devices (e.g. temporary work platforms and guard railing)

- work positioning systems (e.g. industrial rope access systems), or
- fall arrest systems such as catch platforms.

- Any construction work, including demolition work that involves a risk of a person falling more than 2 metres is high risk construction work and a SWMS must be prepared before this work commences.

Fall prevention devices

A fall prevention device is any equipment that is designed to prevent a fall for temporary work at heights, and once in place does not require any further adjustment by workers using the device.

Fall prevention devices include perimeter guard rails, the protection of openings with solid covers and temporary work platforms.

Further information on the selection and use of fall prevention devices is in the Managing the risk of falls at workplaces Code of Practice.

4.8 Electricity

Any construction work that is carried out on or near energised electrical installations or services is high risk construction work and a SWMS must be prepared before this work commences.

Electrical power sources, whether overhead or underground, can be a major hazard. In addition to direct electric shock and possible electrocution, contact with overhead electric lines can lead to a variety of hazards including arcing, explosion or fire causing burns, unpredictable cable whiplash and the electrifying of other objects (e.g. signs, poles, trees or branches).

Specific control measures must be implemented when work is done in the vicinity of electric lines. The local electricity supply authority should be consulted and appropriate control measures implemented. Before demolition commences, all live electrical wiring and/or components (apart from any temporary electrical installations provided for the work) should be disconnected, isolated, or clearly marked and rendered safe by a competent person (e.g. licensed electrical worker) or, where necessary, the local electrical supply authority.

More detailed guidance on managing risks associated with electricity is in the Electrical Safety Code of Practice - Managing Electrical Risks in the Workplace.

4.9 Fire prevention

Where required, adequate fire prevention equipment should be provided and maintained at all times during the demolition of a structure. Access to the fire protection service, including any booster fitting, should also be maintained.

If a sprinkler system is installed in a structure to be demolished, it should be maintained in an operable condition at each storey, so far as is reasonably practicable. Portable fire-extinguishers should be kept in working areas at all times and maintained in an operable condition.

Fire hazards from welding and cutting

Welding and cutting operations present a severe fire hazard unless precautions are taken.

In areas where the floor, walls or ground cover are combustible, the area should be protected by spraying the area with water, spreading damp sand, laying fireproof blankets or other suitable means of protection.

In cases where a serious fire might quickly develop, a fire spotter should be assigned to the area. Fire extinguishing equipment should be readily available, and all workers trained in its use.

Where possible, flammable and combustible material should be removed from the work area and should not be allowed to accumulate to the extent that it can become a fire hazard.

Further guidance on welding is in the Welding processes Code of Practice and in AS 1674: *Safety in welding and allied processes - Fire precautions*.

4.10 Information, training, instruction and supervision

WHS Act section 19: A person conducting a business or undertaking must ensure, so far as is reasonably practicable, the provision of any information, instruction, training and supervision that is necessary to protect all persons from risks to their health and safety arising from work carried out.

WHS Regulation section 39: A person conducting a business or undertaking must ensure that information, training and instruction provided to a worker is suitable and adequate having regard to:

- the nature of the work carried out by the worker
- the nature of the risks associated with the work at the time of the information, training and instruction
- the control measures implemented.

The training provided must be readily understandable by any person to whom it is provided.

WHS Regulation section 317: A person conducting a business or undertaking must not direct or allow a worker to carry out construction work unless the worker has successfully completed general construction induction training.

Training specific to the demolition work and to the site should also be provided to workers by a competent person. A competent person is a person who has acquired through training, qualification or experience the knowledge and skills to carry out the task. A person conducting a business or undertaking must also ensure that workers operating plant at the workplace possess a valid licence to operate that plant, if a licence is required to operate that plant.

Workers in a supervisory role (e.g. a leading hand or foreman) should be experienced and trained in the type of demolition being carried out to ensure the work is carried out in accordance with the SWMS.

5 Demolition methods

The sequence in which a building or other structure is demolished can be critical for the health and safety of workers and the general public.

The demolition sequence will depend on things like the type of construction, location, and demolition method(s) selected. Buildings and structures should generally be demolished in reverse order to their construction, that is, by 'sequential demolition'. In particular:

- sequential demolition should be carried out in reasonably even stages, commencing from the roof or top of the building or structure being demolished
- multi-storey buildings or structures should be demolished storey by storey
- masonry and brickwork should be taken down in reasonably even courses.

There is a range of demolition methods that may be used, either separately or in combination. Control measures should be selected on the basis of the demolition method(s) used. However, no matter what method is used, the building or structure to be demolished and all its components should be maintained in a safe and stable condition so as to prevent the unexpected collapse of part or all the structure. Temporary braces, propping, shoring, or guys may need to be added for stability.

Further information on demolition methods can be found in AS 2601: *The demolition of structures.*

5.1 Manual demolition

Manual demolition includes any technique where hand tools such as jackhammers, sledge hammers and picks are used.

Manual demolition has many of the hazards that are present in other major demolition activities including unexpected collapse, falls, falling objects, manual handling and exposure to noise, dust and hazardous chemicals.

To manage the risk of unplanned collapses, the condition of roofs, walls and floors of the building should be assessed by a competent person before commencing demolition work.

Where concrete members are being demolished manually, the reinforcement shall not be cut while breaking of the concrete is in progress.

Where pre and post-tension demolition work is undertaken competent person advice should be sought as to demolition sequence. More information on the demolition of pre and post- tensioned concrete is at section 6.1 of this code.

Areas where debris will fall should be barricaded off and signs erected to prevent persons from entering before demolition starts.

Manual demolition of roofs

Where it is not reasonably practicable to demolish a roof using mechanical means or to remove the roofing from work platforms below the roof, then careful consideration should be given to the most suitable method of protection for workers engaged in the removal of the roofing. For example, roof trusses should be removed using safe temporary work platforms. It is important to ensure that the removal of trusses does not cause wall instability.

Controlling the risk of falls of persons or objects is an important consideration for roof work. Prior to commencing roof demolition or dismantling, you should consider:

- fall hazards

- structural stability
- condition and strength of the roofing material and the identification of fragile roofing
- identification of fragile panels or skylights in solid roofs
- crane access
- safe worker access and egress
- fall protection requirements including issues such as perimeter protection, the availability and strength of anchor points for static lines, inertia reels and lanyards and the suitability of roof structure for the use of safety nets
- means of rescuing persons from safety nets or safety harnesses
- the condition of any roof mesh or safety mesh
- methods of raising and lowering equipment and materials
- assessment of manual handling problems
- electrical safety including the location of nearby power lines
- worker competency and training needs.

Fragile roofs

Before working on the roof, the roof should be inspected to identify that it is structurally adequate to work on and whether there is any brittle material or if the roof has a fragile aspect to it (e.g. a skylight or worn section).

Brittle or fragile roofing material can include roofing made of asbestos cement, cellulose cement, glass panels, fibreglass, acrylic or other similar synthetic moulded or fabricated material used to sheath a roof or contained in a roof.

If asbestos cement roofing is involved, the work must be undertaken in accordance with the asbestos related requirements of the WHS Regulation. Further information is in the How to safely remove asbestos Code of Practice.

Where it is necessary for work to be carried out or adjacent to any part of a fragile roof, you should:

- inspect the underside of the roof to determine the extent of the fragile roof material, the existence of any safety mesh and its fixings, and the structural soundness of the roof material
- complete the work from a temporary work platform
- provide temporary walkways as a means of access to and egress from any work area on the roof where permanent walkways are not provided
- secure and fix cleats to walkways on high pitch roofs (e.g. where the slope of the roof exceeds 1:6)
- provide temporary roof ladders for steep roofs (e.g. in excess of 35 degrees)
- provide other fall protection as necessary (e.g. work positioning or fall arrest system).

Roof access

The person conducting a business or undertaking where persons are employed to work on roofs has a responsibility to ensure that the access from the ground to the actual work area is safe and without risk to health. Access arrangements may include personnel hoists, scaffolding, temporary work platforms and ladders.

Purlin trolleys

Purlin trolleys are plant designed to travel on top of purlins (horizontal beams running along the length of a roof) and can be used to support material and roof workers. They are sometimes used during the removal of roof coverings.

Purlin trolleys should be provided with a holding brake and a device to prevent their accidental dislodgment from the supporting purlins. Where it is intended that the roof workers be supported by the trolley, the trolley should be provided with suitable safety harness anchorage points.

Before a purlin trolley is placed on a roof structure:

- a competent person (e.g. a structural engineer) should have considered whether the roof structure is suitable for the particular purlin trolley and its operational loads
- the purlin trolley should be designed and constructed to withstand the loads placed on it and for the purpose of the safe movement of materials and/or persons across the roof surface.

Manual demolition of walls

Glass should be removed from the windows, doors or openings before the commencement of the demolition work.

Walls and gables should be demolished course by course. All work should be performed from safe working platforms. Workers should not work from the top of a wall or partition being demolished. A wall or partition should not be permitted to stand, unless it is effectively supported against collapse, including being supported against lateral loads from wind and other forces.

If the demolition work involves the demolishing course by course of any walls, columns, piers or other vertical structural members, the demolition contractor should check that:

- risks to persons and property from falling collapsing and rebounding material are eliminated or minimised
- the remaining portion of the building or structure, if any, can withstand any loads, impacts and vibration caused by felling or other environmental factors such as wind.

Manual demolition of floors and members

All floors and other surfaces used to support workers, plant, equipment or materials should be assessed as capable of supporting the load. Suspended floors and their supporting members should not be loaded by workers, plant, falling or accumulated debris/materials to the extent that there is excessive deflection, permanent deformation or danger of collapse. If water is used, the increased weight of the watered debris should be taken into account. For further information refer to AS 2601: *The demolition of structures*.

Openings in floors, through which a person may fall, should be properly guarded or boarded over and the boarding secured against accidental removal. Any covers or boarding of openings in floors should be of sufficient strength to withstand any expected loads that may be imposed on the floor (e.g. elevating work platforms, people and material). Drop zones should be isolated and/or guarded to protect workers and the public from falling objects. When jack hammering concrete floors, sufficient reinforcing steel should be left in position as protection against collapse or to prevent persons falling through the floor.

Manual demolition of frameworks

Before any framework is demolished or removed, all reasonably practicable precautions should be taken to prevent the rest of the building collapsing as a result.

A competent person (e.g. a structural engineer) should undertake an assessment to determine the necessary supports required when cutting members. Members should not be cut unless they are supported safely and effectively. Measures should be taken to prevent sudden spring, twist, collapse or other movement of the framework when it is cut, released or removed.

Any framework which is not demolished should be strong enough to remain safely in position, or should be guyed or otherwise supported to ensure that it will be stable in any adverse weather conditions.

Framework members should be lowered in a controlled manner. Tag lines should be used on loads where necessary to control the load.

5.2 Mechanical demolition

Mechanical demolition involves the use of powered mobile plant, such as excavators, cranes, loaders and bulldozers. There may be a mix of hand and mechanical demolition methods applied.

All powered mobile plant used for demolition work must be fitted with a suitable combination of operator protective devices.

Operator protective structures should be designed to the appropriate standard that eliminates or minimises the risk, so far as is reasonably practicable, of operator injury due to:

- roll over and consequent cabin impact damage
- objects falling on or over the cabin
- objects penetrating the cabin
- hazardous noise.

Demolition should be planned to be systematic and sequential. That is, a structure should generally be demolished in the reverse order to which it was constructed.

Working on suspended floors

Suspended floors and their supporting members should not be loaded by workers, plant, falling or accumulated debris/materials to the extent that there is excessive deflection, permanent deformation or danger of collapse. If water is used, the increased weight of the watered debris should be taken into account.

If powered mobile plant will be operated on a suspended floor, the demolition contractor should ensure that a competent person (e.g. a structural engineer) verifies and documents:

- the type, size, weight and usage of any specified plant
- that the floor is capable of sustaining the static and live loads of the plant (including attachments) and demolished materials, without excessive deformation or collapse, either:
  - without additional support from below
  - with specified propping to be applied from below so that the loads carried do not exceed their manufacturer's specified rating.

Any powered mobile plant used in demolition work should be moved between suspended floor slabs by hoist equipment or an appropriately fabricated ramp.

If load shifting equipment is to be used on suspended floors as part of the demolition work, a notification must be made to the regulator (see section 3.1 of this code).

When using powered mobile plant on suspended floors, the person conducting the business or undertaking should review the demolition SWMS to confirm that:

- where plant has been specified in the SWMS, another piece of plant of the same type and usage may be substituted for it provided that the substituted equipment is neither larger nor heavier than the specified equipment
- effective communication will be maintained between the equipment operator and the demolition supervisor while the equipment is operating
- debris is progressively removed from each floor
- buffers are used to prevent the plant from falling over the edge where plant is used to push/tip materials into a nominated areas
- guarding, hoarding and/or exclusion zones are used to protect persons against the risk of being struck by falling debris and materials.

Load shifting equipment should, so far as is reasonably practicable, be located on a beam. Skid steer loaders using a breaker may not be appropriate on suspended floors with their limited reach.

It is important to consider the load created when large or multiple pieces of plant are used for this purpose so as to ensure that any partially demolished structure can support the loads. For example, the use of an excavator with a hydraulic rock breaker or pulverising attachment to break up walls and floors while other load shifting equipment is used to shift the debris on a suspended floor will result in a higher load. Because of the weight of the plant, the vibration caused by its operation and the build-up of debris, careful design and planning is needed to prevent a premature collapse of the structure.

Demolition of walls

When mobile plant (e.g. an excavator with hydraulic rock breaker) is used to demolish walls, at least 900 mm of the wall being demolished should be left intact above the floor level to provide a protective barrier at the perimeter of the building and around all lift wells, stair wells, light wells and any other places where persons or objects could fall. The remaining wall can later be safely demolished from the floor below. All remaining sections of walls should be identified and highlighted as buffers for edge protection.

Guarding, hoarding and/or the exclusion zones should be used to protect workers and/or the public against the risk of being struck by falling debris and materials.

Walls should not be laterally loaded by accumulated rubble or debris, to the extent that they are in danger of collapse.

Using plant and attachments

All plant attachments should be pinned and secured as per manufacturer's requirements. The plant fittings used in demolition should be designed and fit for purpose. To avoid damaging the equipment itself and to prevent the risk of plant overturning, equipment should not be overloaded.

When plant is used to demolish vertical features such as columns or walls, the columns or walls should not be so high as to create a risk of debris falling onto the plant or operator.

Any member to be severed (with grapples, shears or pulverising attachments) should either be effectively supported or, if allowed to fall, will not endanger persons, plant or damage the remaining structure.

Exclusion zones should be established where necessary to protect the safety of people who are working on or in the vicinity of the demolition work. No person should be in any area near the mechanical demolition where there is a possibility of being struck by flying debris. Areas in which shears are operating should be kept clear of workers, because of the risk of smaller pieces of metal (e.g. bolts) flying off when sheared.

For further guidance on the safe use of plant refer to the Managing the risks of plant in the workplace Code of Practice.

5.3 Induced collapse

Induced collapse involves the systematic/sequential removal of key structural members and the application of a force to result in the controlled collapse of all or part of a building or structure. Expert advice should be sought from a competent person such as an appropriately experienced structural engineer, before this method is used.

Induced collapse methods should only be used on detached, isolated structures on reasonably level sites. There must be sufficient clear space into which the collapsing material will fall. The space should be large enough to contain the collapsed material and enable equipment and personnel to be removed to a safe distance prior to the collapse.

For further information on induced collapse methods refer to AS 2601: *The demolition of structures.*

Load reduction

Structures which are not carrying their design loads may be pre-weakened prior to deliberate collapse. This pre-weakening should be carefully planned so that despite the removal of framework members and/or the partial cutting of load-bearing members, the remaining structure has sufficient strength to withstand wind or impact loads until the actual collapse is initiated.

Dead load can be reduced systematically by removing surplus material, machinery, roofs, cladding, walls and parts of floors before demolishing the structural frame.

Sometimes heavy loads are left at height to induce the collapse of the structure after movement is initiated. If this system is adopted, it should be carefully analysed and documented by a competent person (e.g. a structural engineer) to avoid premature collapse.

Wire rope, slings and chain pulling

If using wire rope, slings and chain pulling to demolish a structure, the pulling medium should be a securely anchored winch or plant designed for towing and heavy enough to apply the required tension without sliding or lifting from the surface on which it is located.

The wire rope, sling or chain should be long enough to ensure that the horizontal distance from the demolition work to the pulling medium is at least twice the height of the highest part to be pulled. No person should be in any position where they could be struck by the wire rope, sling or chain in the event of a failure. The plant operator should be protected from rope breakage and flying debris. Exclusion zones should be established where necessary to protect the safety of people who are working on or in the vicinity of the demolition work.

Before pulling of a wall commences, the wall should be cut into appropriate sections having regard to their height, width and construction. If it is not possible to isolate these sections, the chains or wire ropes should be attached to their respective sections prior to the first pull being made. The free ends of the chains or ropes should be left a safe distance from the structure. Vertical reinforcing bars should not be cut until after the wall has been pulled over.

All wire rope, slings and chains used in mechanical demolition should comply with the relevant Australian Standards.

5.4 Using explosives

Construction work that involves the use of explosives is defined by the WHS Regulation as ‘high risk construction work’ and a SWMS must be prepared before this work commences.

A competent person experienced in the controlled application of explosives for the purpose of carrying out the demolition should be consulted before deciding whether explosives may be used for demolition.

Explosives must not be used to induce the collapse of any structure unless approved by the regulatory authority.

All possession, storage, handling and use of explosives must be carried out in compliance with the relevant dangerous substances/goods or explosives legislation applicable in your state or territory.

The transport of explosives must be in accordance with the *Australian Code for the Transport of Explosives by Road and Rail.*

Explosives must only be used by a competent person who is licensed in the use of explosives and has experience in the work to be undertaken. If explosives are used in demolition work, a licensed competent person must develop the blast management plan and be responsible for all aspects of the use of explosives in the demolition.

If explosives are planned to be used in demolition work, a notification must be made to the regulator (see section 3.1 of this code).

For further information on the planning and use of explosives for demolition work, refer to AS 2601: *The demolition of structures* and AS 2187.2: *Explosives – storage and use*.

6 Demolition of special structures

Special structures are complex and/or unusual because of the nature of their construction or condition. They include:

- pre or post-tensioned construction
- pre-cast concrete panel and framed structures
- stressed skin structures (i.e. buildings that rely on the sheeting, cladding or decking to stiffen and restrain the structural framework)
- slung structures (e.g. floors or roofs) that are in some way suspended from a framework, supported by a structural core.

Special structures will require proper planning and care to be demolished safely. An appropriate demolition method and sequence should be selected and documented prior to the work commencing. A demolition plan and an assessment by a competent person of the proposed demolition method may assist with this process. A SWMS must be prepared where structural elements are to be demolished.

6.1 Pre and post-tensioned concrete

Pre-tensioned concrete contains tendons (wires, strands or bars) that have been tensioned before the concrete is placed.

Post-tensioned concrete contains tendons that have been tensioned after the concrete has hardened.

Tensioned tendons require controlled removal because the high level of potential energy stored in the tendons poses a risk to the health and safety and can cause damage to property. It is also important that structural stability is retained during and after tendon removal, prior to the final demolition of the concrete element.

The tendons can be subject to corrosion that weakens them and decreases the structural integrity of the building. Damage is not usually evident externally, even if strand breakage is extensive and conditions can vary widely even within an individual structure.

Before demolishing pre or post-tensioned concrete elements, review all available documentation on the building or structure including:

- building plans, designs and specifications to understand the type of tensioning used, the load carried, anchorage points and number of tendons
- any construction photographs to obtain information on anchorage details, the construction sequencing, and any other measures may affect moisture access.

The condition of the concrete and tendons should be considered before and during demolition, for example, by:

- conducting a visual inspection to confirm loads, obvious deviations from the original design and waterproofing details
- assessing conditions throughout the building, as well as utilising selective testing in representative areas to assess any weakening or breakage of tendons
- measuring humidity within tendon sheathing and analysing any sheathing contaminants
- removing, inspecting and testing a small number of tendons to assess their condition
- continuing to monitor tendon tension.

Suitable control measures should be implemented (e.g. using steel plates or other restraint measures, at locations adjacent to pedestrian areas or where concrete cover is reduced). This will

help to minimise the risk of personal injury or property damage arising from the unexpected release of stored energy in tendons.

6.2 Fire-damaged, ruinous and structurally unsound buildings or structures

An assessment should be undertaken to identify asbestos, hazardous materials and structural integrity issues relating to fire-damaged, ruinous or structurally unsound buildings or structures. The person conducting a business or undertaking should request a written report by a competent person specifying the hazards associated with the design and the current state of the structure. Control measures should be taken, as far as is reasonably practicable, during the assessment and demolition stages.

In specifying the hazards associated with the design and current state of the structure, the report by the competent person should also specify the control measures that should be applied to the demolition.

Where possible, fire damaged, ruinous or structurally unsound buildings or structures should be demolished by mechanical means.

6.3 Lift shafts

The combination of the lift shaft structure and the lift plant (including the lift cage or car, winders, counterweights, electrical supply and controls) can make these complex structures. Different methods can be applied to the demolition of lifts and these will depend on the circumstances of the particular site.

In general, demolition procedures should include the following:

- temporary support of the lift cage and the disconnection of electric power to all areas of the lift machinery
- lowering of any counterweights to an appropriate level for disconnection and the unwinding of cables in a controlled manner prior to the removal of drums
- provision of temporary decking in the lift shaft
- progressive demolition of the lift shaft walls onto existing floors and the removal of any debris.

6.4 Basements, cellars, vaults, domes and arched roofs

During the demolition of a basement, cellar, arch, vault or dome, frequent inspections should be made to identify whether there has been any unplanned movement. If unplanned movement is detected, appropriate action should be taken to avoid any uncontrolled collapse.

If a basement, cellar, vault or void adjoins another property, any adjoining walls should be inspected by a competent person to determine whether they are strong enough to withstand the resultant ground pressure. If they are not, the proposed methods of strengthening them should be subject to an assessment by a competent person (e.g. a structural engineer).

If a basement has been built in ground with a high water table, measures should be taken, as far as is reasonably practicable, to prevent any collapse as a result of hydraulic pressure, uncontrolled water inrush or flotation.

If work is to be undertaken in a basement, it will be necessary to determine if the basement is a confined space. There are specific requirements in the WHS Regulation for working in confined spaces. Further information is in the Confined spaces Code of Practice.

6.5 Masonry and brick arches

Masonry and brick arches should be demolished in a sequence that allows for the removal of as much of the dead load material as possible without interfering with the stability of the main arch rings. The spandrel infilling should only be removed down to the springing line as the load-carrying capacity of many old arches relies on the filling between the spandrels. In multi-span arches, lateral restraints should be provided at the springing level before individual spans are removed.

6.6 Independent chimneys and spires

A detailed inspection and survey should be completed prior to the demolition of a chimney or spire. In particular, the condition of the structural material, which can range from stone and brick to steel, timber and concrete, needs to be assessed to identify any faults, such as fractured or badly weathered stone or rotten timbers.

Measurements may need to be taken to determine whether there is any deviation from the perpendicular. The possibility of chimney instability resulting from inclement weather (e.g. high winds) needs to be considered during all stages of demolition work.

Due to their height, it is common for chimneys to be demolished by hand or through induced collapse. Temporary supports may be required to ensure that premature collapse does not occur.

Hand demolition should be carried out progressively from the top of the chimney and from safe working platforms.

Due to their height, control measures that need to be considered when demolishing chimneys or spires include:

- temporary work platforms
- falling object protection
- exclusion zones
- dust control.

Induced collapse will require sufficient clear space, approximately 1.5 times the total height of the chimney and of sufficient width depending on the type of structure.

6.7 Pylons and masts

If using hand demolition, a pylon or mast should be dismantled in the reverse order to that in which it was erected. If another method is used, such as demolition by wire rope pulling, planning including the provision of adequate clear space will be required.

6.8 Precast concrete panels

If a structure is composed of a series of reinforced precast concrete panels, an inspection of the fixings to the rest of the structural elements, jointing between elements, and the lifting points or fittings should be undertaken to establish their nature and condition before any demolition of the structure begins.

Where possible, the panels should be removed by a crane in the reverse sequence to that used for their erection. Wherever panels act as bracing (e.g. along a wall) sufficient temporary bracing should be provided to the structure, to maintain its stability during and after removal of the panels.

The original lifting points or fittings should not be reused to lift and/or support a panel during its removal if they have deteriorated and corroded.

Before removing any individual panel, it should be fully supported, both vertically and horizontally, above its centre of mass, so as to prevent any sudden rotational movement during its detachment from the supporting structure.

For further guidance on precast concrete elements, refer to the *Tilt-up and precast construction Code of Practice*.

6.9 Facade retention

The retention of facades should be planned and documented before demolition work commences. The demolition method(s) used should take into account the limits imposed by the planned facade retention.

Use guarding, hoarding and/or exclusion zones to protect persons against the risk of being struck by falling debris and materials.

The façade or footings may need to be repaired and temporary support for the façade may need to be installed before demolition work commences. Temporary support may also need to be installed in stages during the demolition work, depending on the support design and other external factors such as wind.

Supervision by a competent person (e.g. structural engineer) during various stages of the demolition work may be necessary in order to monitor any façade movement or cracking. The structure should be inspected after any unusual incidents such as heavy rain or wind, an earth tremor or accidental impact on the facade or its supports.

6.10 Storage tanks and pipelines

Before an above ground or underground storage tank and/or associated pipelines are removed or demolished, any previous use should be determined and appropriate action taken to identify and remove any hazardous chemicals. Delivery lines and vent pipes should be purged. The tank should be emptied and certified by a competent person as being free of gas, flammable vapours or other hazardous chemicals.

If work is to be undertaken on storage tanks then it is necessary to determine whether they are a confined space for the purpose of the work. There are specific requirements in the WHS Regulation for working in confined spaces and further guidance is in the Confined spaces Code of Practice.

General precautions

During the demolition of tanks and pipelines, the following precautions should be taken:

- make sure that no flammable or toxic substances or combustible liquid is allowed to enter any drainage system or watercourse
- if excavating underground tanks and/or pipelines, check the soil surrounding the tank/pipe to establish that it is not contaminated, either by leakage from the tank/pipe or by spillage
- hot work (e.g. welding; oxy-acetylene cutting) should not be undertaken where there is a chance that flammable material may be present as a result of leakage/spillage or after cleaning out the tank/pipe.

Hazardous facilities

Special precautions should be taken during the demolition of major hazard facilities (MHF), chemical works, gas works and similar establishments. These types of facilities should be examined in conjunction with a competent person (e.g. a chemical engineer), in order to determine the nature of any of the plant, chemical deposits and their influence on the method of demolition or dismantling.

The removal of flammable materials and their new locations should be ascertained before any demolition work starts.

Containers that have held flammable or combustible material

Welding and cutting work on containers that have held flammable or combustible liquids, solids, gases or dusts can result in fire or explosion if the containers are not entirely free of these materials.

It is therefore important to conduct a rigorous cleaning process and that any instructions for cleaning are followed. Containers which have held any of the following materials are considered unsafe and hot work should not be started before they are properly cleaned:

- petrol, kerosene, solvents, or light oils
- acids and alkalines, which can react with metal to produce explosive or toxic gases
- heavy oils, tars or solids which can release combustible gases when exposed to heat
- flammable solids, whose finely divided particles may form an explosive dust cloud.

Any container which has held flammable or combustible substances should be considered unsafe until confirmed otherwise by a competent person.

Further guidance on safety precautions that can be taken when welding is in the Welding processes Code of Practice.

Appendix A – Definitions

Asbestos	The asbestiform varieties of mineral silicates belonging to the serpentine or amphibole groups of rock forming minerals including actinolite asbestos, grunerite (or amosite) asbestos (brown), anthophyllite asbestos, chrysotile asbestos (white), crocidolite asbestos (blue), and tremolite asbestos, and a mixture that contains one or more of the above.
Asbestos containing material (ACM)	Any material or thing that, as part of its design, contains asbestos.
Bearer	The primary horizontal support members for a formwork deck that are placed on top of formwork frames. Bearers are usually constructed from timber but are sometimes constructed from metal, such as in the case of some modular formwork systems.
Brace	A member, usually a diagonal, which resists lateral loads and/or movements of a structure.
Chute	An inclined or vertical trough or tube through which articles are passed from a higher to a lower level.
Competent person	A person who has acquired through training, qualification or experience the knowledge and skills to carry out the task
Dead load	A permanent inert load on a building or other structure due to the weight of its structural members and the fixed loads they carry, which impose definite stresses and strains upon the structure.
Debris	Material created by demolition work that is larger than rubble.
Demolition drop zone	Zone for the disposal of demolition rubble and debris, which is clear of obstruction and isolated from workers and other persons at the workplace, to allow objects to fall freely.
Earthmoving machinery	Operator controlled plant used to excavate, load, transport, compact or spread earth, overburden, rubble, spoil, aggregate or similar material, but does not include a tractor or industrial lift truck.
Essential services	Services that supply: (a) gas, water, sewerage, telecommunications, electricity and similar services (b) chemicals, fuel and refrigerant in pipes or lines.
Exclusion zone	An area from which all persons are excluded during demolition work.
Footing	The construction that transfers the weight of the structure to the foundation.
Foundation	The ground upon which the footings of a building are constructed.

Framework	A structure constructed of metal, concrete, timber, brick or other rigid materials.
Lagging	Insulated covering for services (e.g. hot water pipes).
Live load	A moving load or a load of variable force acting upon a structure, in addition to its own weight.
Load bearing wall	A wall which provides structural support, including for the floor and/or roof in a building, its own weight, live loads, dead loads and lateral forces of arches, vaults and wind.
Main	Street reticulation service provided by the supply authority (e.g. gas, water and sewerage).
Masonry	Brick, concrete, stone, artificial stone or terracotta laid in mortar.
Partition wall	An interior non-load bearing wall that divides a building into rooms.
Pier	A column or post supporting a superstructure such as floor bearers, verandas or beams.
Purlins	• In simple roof construction, longitudinal roof timbers giving intermediate support for rafters, supported at intervals longitudinally by struts • In some roofs of trussed construction, the purlins provide direct support for the roof covering, they bear on the principal rafters of each truss and span between trusses • In roofs of trussed construction employing common rafters, purlins span between trusses supporting the lighter common rafters at requisite intervals.
Rafter (common)	In roof construction, a timber framing member providing the principal support for the roofing material.
Reinforcing steel	Steel bars of various sizes and shapes used in concrete construction for giving added strength.
Roof truss	A truss providing structural support for a roof.
Rubble	Rough broken stones or brick used for filling.
Shoring	Temporary supports used to maintain stability and prevent movement typically to: • prevent the collapse of an excavation • support an existing structure, especially where they may be weakened by the removal of adjoining buildings.
Stability	A determination of the ability of a structure to withstand overturning, sliding, buckling, or collapsing.
Underground essential services	Essential services that use pipes, cables other associated plant located underground.

Underground essential services information	In relation to proposed demolition work, means the following information relating to underground essential services that may be affected by the excavation: • the essential services that may be affected • the location, including the depth, of any pipes, cables or other plant associated with the affected essential services • any conditions on the proposed excavation work.
Underpinning	The construction of new footings and walling under the footings of an existing structure which have failed or may fail.
Vault	An arched structure of masonry usually forming a ceiling or roof.
Ventilation	The process of changing or circulating the air in a space by either natural or artificial means.

Appendix B – Demolition plan

Given the specialist nature of demolition work, a demolition plan might be prepared to collate the key information relevant to the work into a single document, including some information relevant to work health and safety. A demolition plan should not duplicate a WHS management plan or SWMS but may reference them.

A demolition plan may include:

- the location of the site on which the structure to be demolished stands
- the overall height of the structure above ground level and the least distance from the structure to each site boundary
- the type of building (occupancy class), its structural support system and the principal materials of its construction
- the proposed methods of demolition including the number and types of major items of plant
- the proposed methods for handling and disposing of demolished materials and, in particular, of hazardous materials
- the proposed methods of controlling and maintaining access and egress to workplace
- the proposed sequence of carrying out the demolition works and an estimate of the time (in days) it is likely to take to complete all of each of the stages of the work
- the proposed hoardings, scaffolding and fencing and of any overhead sidewalk protection
- any other plans, illustrations, written documents, or specialist reports as may be necessary to support the proposed methods of work or protective structures
- traffic management arrangements, which includes managing vehicles and mobile plant hazards in relation to operation at the workplace and interaction with the public
- the location and condition of the following:
  - underground essential services including:
    - electricity
    - drainage and sewerage
    - gas
    - water
    - communications cables (e.g. telephone, radio and television relay lines)
    - hydraulic pressure mains
    - liquid fuel lines
    - lubrication systems
    - process lines (chemical, acid)
  - above ground essential services
  - hazardous materials, including asbestos
  - underground structures such as a basement, cellars, or storage tanks
  - any confined spaces where work will be undertaken
- the general condition of structures on adjoining properties, particularly where these are close to or on the boundaries of the demolition workplace
- the effect demolition may have on people working in adjoining properties or seeking access to and egress from those properties
- the emergency arrangements, which should include equipment for the rescue of injured persons.

Appendix C – Engineering investigation considerations

Some of the issues to be considered when undertaking an engineering investigation include:

- obtaining the as-built details of the component members (if available)
- identifying the type of structural system involved
- conducting a search for engineering details specifying size, type and configuration of reinforcement and the strength of materials (if available) and the located documents referenced
- assessing the current load-carrying capacity of the structure, taking into account:
  - the strength requirements of the relevant structural technical standards current at the time of construction and the strength and loading requirements of those now current
  - degradation of the original properties of the materials used due to time, weathering, wear, or other deleterious causes, and
  - the capacity of the structure as a whole and individual members to sustain superimposed loads without:
    - premature collapse of any member
    - deforming to an extent which will lead to static instability of the member itself or to connected members.
- verifying the composition or quality of structural components, if necessary, using methods such as:
  - core drilling
  - electronic reinforcement location
  - exposure of reinforcement
- assessing any loss of structural strength resulting from any destructive investigation methods used
- identification and location of floor penetrations to facilitate construction or structural irregularities
- assessing whether the proposed methods and sequence of demolition can be executed without causing unpremeditated collapse of the whole or part of the structure
- identifying any other details of the structure regarding strength, construction or contents which will influence the selection of demolition methods/procedures.