Office of Industrial Relations
Workplace Health and Safety Queensland

Concrete pumping

Code of Practice 2019

Queensland Government

This Queensland code of practice has been approved by the Minister for Education and Minister for Industrial Relations under section 274 of the *Work Health and Safety Act 2011*.

This code commenced on 2 December 2019.

It replaces the Concrete pumping Code of Practice 2005 (PN11172)

PN12522

Contents

Foreword

This *Concrete pumping Code of Practice 2019* is 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).

Duty holders must comply 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 this 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.

Scope and application

This code provides practical guidance to persons conducting a business or undertaking on how to comply with their health and safety duties when carrying out construction work involving concrete pumping.

The scope of this code includes safety issues relating to concrete pumping at a workplace. However, the safety of mobile concrete placing booms during road travel is not included within the scope of this code. For information on road travel, reference should be made to road safety legislation administered by the Department of Transport and Main Roads.

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 concrete pumping?

Concrete pumping includes using a:

- truck-mounted pump to pump concrete through flexible hoses that run along the ground (known as a “line pump”)
- truck-mounted pump to pump concrete through pipework that is supported by a multi-staged boom (known as a “mobile concrete placing boom”)
- fixed or trailer-mounted pump to pump concrete through pipework to a concrete placing boom fixed to the structure being built (known as a “satellite concrete placing boom”).

Concrete is normally delivered to the concrete pump using a concrete truck that discharges concrete into the hopper on the pump. The concrete is then pressurised and pushed along pipework to the location of the concrete pour. Concrete pumping is generally a more efficient means of delivering concrete in comparison to the use of a wheelbarrow or crane-lifted concrete kibble. However, due to the high concrete pressures involved and pulsating motion of the pump, there are a large range of safety issues that need to be addressed when pumping concrete.

Generally, concrete pumping work will be defined as construction work.

What is construction work?

WHS Regulation section 289: Construction work means any work carried out in connection with the construction, alteration, conversion, fitting-out, commissioning, renovation, repair, maintenance, refurbishment, demolition, decommissioning or dismantling of a structure.

Construction work includes:

- installation or testing carried out in connection with an activity referred to in the definition
- the removal from the workplace of any product or waste resulting from demolition
- the prefabrication or testing of elements at a place specifically established for the construction work, for use in construction work
- the assembly of prefabricated elements to form a structure, or the disassembly of prefabricated elements forming part of a structure
- the installation, testing or maintenance of an essential service for a structure
- work connected with an excavation
- work connected with any preparatory work or site preparation including landscaping as part of site preparation carried out in connection with an activity referred to in the definition above
- an activity referred to in the definition carried out on, under or near water including work on buoys and obstructions to navigation.

Concrete pumping may include construction work that is defined as high risk construction work in the WHS Regulation for which a safe work method statement (SWMS) must be prepared before the work starts (see Section 1.4).

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

A **person conducting a business or undertaking** (PCBU) has a primary duty under the WHS Act to ensure, as far as reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking. This includes eliminating or minimising health and safety risks so far as is reasonably practicable, and ensuring the:

- provision and maintenance of safe plant including concrete pumping plant
- safe use, handling, storage and transport of concrete pumping plant.

The WHS Regulation includes specific duties for PCBUs with management or control of a construction workplace, plant, powered mobile plant and plant that lifts or suspends loads.

If you own concrete pumping plant, you are the person with management or control of that plant and have duties to eliminate or minimise the risks associated with the plant.

Designers, manufacturers, suppliers and importers of plant must ensure, so far as is reasonably practicable, the plant they design, manufacture, import or supply is without risks to health and safety. This includes carrying out analysis, testing and examinations and providing information about the plant. Information must, so far as is reasonably practicable, be passed on from the designer through to the manufacturer and supplier to the end user.

Suppliers must provide a purchaser of a concrete placing boom, which requires plant design registration, with the design registration number.

People installing, constructing or commissioning plant must ensure, so far as is reasonably practicable, all workplace activity relating to the plant including its installation, use, decommissioning or dismantling, is without risks to health and safety.

Officers, such as company directors, have a duty to exercise due diligence to ensure that the business or undertaking complies with the 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 the risks from plant.

Workers and other people at the workplace must take reasonable care for their own health and safety, co-operate with reasonable policies, procedures and instructions and not adversely affect other people's health and safety.

1.3 What is involved in managing risks associated with concrete pumping?

WHS Regulation section 297: A PCBU must manage risks associated with carrying out construction work.

WHS Regulation section 34-38: To manage risk, a PCBU must:

- identify reasonably foreseeable hazards that could give rise to risks to health and safety
- eliminate risks to health and safety so far as is reasonably practicable
- if it is not reasonably practicable to eliminate risks to health and safety—minimise those risks so far as is reasonably practicable by implementing risk control measures according to the hierarchy of control in WHS regulation 36
- ensure the control measure is, and is maintained so that it remains, effective, and
- review and, as necessary, revise control measures implemented to maintain, so far as is reasonably practicable, a work environment that is without risks to health or safety.

The risks associated with concrete pumping are many and varied. It may be useful to list risks in terms of their originating hazard. Risk may originate from hazards such as:

- plant and equipment, including:
  - concrete placing booms
  - pump gauges
  - concrete pipelines
  - pipe clamps
  - anchor brackets
  - pipe movement
  - delivery hose
  - receiving hopper
- placement of plant and equipment, for example:
  - proximity to traffic, members of the public, powerlines and trenches
  - ground stability
- tasks, including:
  - concrete delivery
  - pump and boom operation
  - concrete pouring
  - line cleaning
  - pump cleaning
  - road travel

- by-products, for example:
  - fumes
  - noise.

This document discusses the risks listed above, including appropriate control measures.

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

Consulting workers

WHS Act section 47(1): The PCBU must, so far as is reasonably practicable, consult with workers who carry out work for the business or undertaking who are, or are likely to be, directly affected by a matter relating to work health or safety.

WHS Act section 48(2): If the workers are represented by a health and safety representative, the consultation must involve that representative.

Consultation involves sharing of information, giving workers a reasonable opportunity to express views and taking those views into account before making decisions on health and safety matters.

Consultation with workers and their health and safety representatives is required at each step of the risk management process. By drawing on the experience, knowledge and ideas of workers PCBUs are more likely to identify hazards and choose effective control measures.

PCBUs should encourage workers to report hazards and health and safety problems immediately so the risks can be managed before an incident occurs. PCBUs must consult your workers when proposing any changes to the work that may affect their health and safety.

Consulting, cooperating and coordinating activities with other duty holders

WHS Act section 46: If more than one person has a duty in relation to the same matter, each person with the duty must, so far as is reasonably practicable, consult, cooperate and coordinate activities with all other persons who have a duty in relation to the same matter.

Sometimes duty holders may share responsibility for a health and safety matter with other business operators who are involved in the same activities or who share the same workplace. In these situations, information should be exchanged to find out who is doing what and work together in a cooperative and coordinated way so that all risks are eliminated or minimised as far as reasonably practicable.

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

1.4 Safe work method statements

WHS Regulation section 299: When carrying out high risk construction work, a PCBU must ensure that a safe work method statement is prepared or has already been prepared by another person.

A safe work method statement (SWMS) must be prepared for high risk construction work before the work starts.

High risk construction includes work:

- involving a risk of a person falling more than two metres

- carried out on a telecommunication tower
- involving demolition of an element of a structure that is load-bearing or otherwise related to the physical integrity of the structure
- involving or likely to involve the disturbance of asbestos
- involving structural alterations or repairs that require temporary support to prevent collapse
- carried out in or near a confined space
- carried out in or near a shaft or trench with an excavated depth greater than 1.5m, or a tunnel
- involving the use of explosives
- carried out on or near pressurised gas distribution mains or piping
- carried out on or near chemical, fuel or refrigerant lines
- carried out on or near energised electrical installations or services
- carried out in an area that may have a contaminated or flammable atmosphere
- involving tilt-up or precast concrete
- carried out on, in or adjacent to a road, railway, shipping lane or other traffic corridor that is in use by traffic other than pedestrians
- carried out at a workplace in which there is movement of powered mobile plant
- carried out in an area in which there are artificial extremes of temperature
- carried out in or near water or other liquid that involves a risk of drowning
- involving diving work.

The SWMS must:

- identify the type of high risk construction work being done
- specify the health and safety hazards and risks arising from the work
- describe how the risks will be controlled
- describe how the control measures will be implemented, monitored and reviewed.

A SWMS must be developed in consultation with workers and their representatives who are carrying out the high risk work.

1.5 Information, training, instruction and supervision

WHS Act section 19(3)(f): A PCBU must ensure, so far as is reasonably practicable, the provision of any information, training, instruction or supervision that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the conduct of the business or undertaking.

WHS Regulation section 39(2) and (3): A PCBU 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 the information, training or instruction is provided
- the control measures implemented.

The person must ensure, so far as is reasonably practicable, that the information, training and instruction is provided in a way that is readily understandable by any person to whom it is provided.

WHS Regulation section 317(1): A PCBU must not direct or allow a worker to carry out construction work unless the worker has successfully completed general construction induction training and, if the worker completed the training more than two years previously, the worker has carried out construction work in the preceding two years.

All people exposed to work health and safety risks should be provided with information about:

- work health and safety legislation
- their organisation's work health and safety policy or program
- risk management processes
- control measures in place to minimise exposure to workplace hazards
- safe work procedures
- how to use and maintain equipment
- any special safety information needs.

Adequate and appropriate training is a way of managing the risks associated with hazards. Training should be appropriate to the type of work to be performed. In some cases, formal training will be required, in others, on-the-job training may be more appropriate. The special needs of workers should be considered when deciding the structure, content and delivery of training. This assessment should include literacy levels, work experience and specific skills required for a job.

At a minimum, information, training, and instruction should cover:

- the work methods to be used in the setting up and safe operation of concrete placing booms and pumps
- the method for inspection and maintenance of concrete pumping equipment
- the manufacturer's operation and service manuals
- the correct use, care and storage of personal protective equipment
- the correct use, care and storage of tools and equipment to be used, including electrical safety practices, and

- procedures to be adopted in the event of accident or injury.

Supervision must:

- ensure that only those workers who have received training and instruction are authorised to carry out that work, and
- include sufficient monitoring of the work to ensure that agreed safe work practices are being adhered to, including the use of all protection systems and personal protection equipment.

2 Design

Eliminating hazards at the design or planning stage is often easier and more cost effective to achieve than making changes later when hazards become real risks in the workplace. Safe design means the integration of control measures early in the design process to eliminate or, if this is not reasonably practicable, minimise risks to health and safety throughout the life of the plant or structure being designed.

WHS Act section 22: A person (the designer) who conducts a business or undertaking that designs plant or a structure that is to be used, or could reasonably be expected to be used, as, or at, a workplace must ensure, so far as is reasonably practicable, that the plant or structure is designed to be without risks to the health and safety of persons who:

- use the plant or structure at a workplace for a purpose for which it was designed
- store the plant
- construct the structure
- carry out any reasonably foreseeable activity at a workplace in relation to the manufacture, assembly or use of the plant or structure for a purpose for which it was designed, or the proper storage, decommissioning, dismantling or disposal of the plant or structure, or
- are at or in the vicinity of a workplace and who are exposed to the plant or structure at the workplace or whose health or safety may be affected by one of the above uses or activities.

The designer must:

- carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary to ensure, so far as is reasonably practicable, that the plant or structure is designed to be without risks to the health and safety of persons
- give adequate information to each person who is provided with the design for the purpose of giving effect to it, and
- on request, so far as is reasonably practicable, give current relevant information to a person using the plant or structure for a purpose for which it was designed or when carrying out a reasonably foreseeable activity using the plant.

The safe design of concrete pumping plant involves using the design process to eliminate or minimise risks to health and safety throughout the lifecycle of the concrete pumping plant.

Designers should identify potential hazards and design solutions as concrete pumping plant is manufactured, transported, installed, commissioned, used, maintained, repaired, de-commissioned, dismantled, disposed of or recycled.

2.1 Design of satellite concrete placing boom installations

Satellite concrete placing boom installations must be designed by an engineer in accordance with engineering principles or relevant technical standards.

Footings and foundations

Footings and foundations for a concrete placing boom must consider the following factors:

- placing boom type
- freestanding height
- wind speed in accordance with *AS/NZS 1170.2 Structural Design Actions – Part 2: Wind Actions* (AS/NZS 1170.2)
- ground bearing capacity
- anchors.

Staging

The satellite concrete placing boom staging details the placing boom installation as it climbs up through the building structure. The staging must consider the following factors:

- placing boom type and configuration
- freestanding height
- wind speed in accordance with AS/NZS 1170.2
- distance between floor frames
- levels of back propping
- imposed loads on supporting structure.

Those workers involved in jumping a satellite boom (i.e. raising the tower height as the building height increases) are to be trained in the manufacturer's instructions and need to have received documented familiarisation training for climbing the make and model of satellite boom.

Jump form

The installation of a concrete placing boom on a jump form must consider the following factors:

- placing boom type and configuration
- structural adequacy of connections
- wind speed in accordance with AS/NZS 1170.2
- imposed loads on jump form and supporting structure.

2.2 Design registration of concrete placing booms

WHS Regulation section 243: The design of specified items of plant must be registered. Schedule 5, Part 1 lists the specific items of plant requiring design registration, which includes concrete placing booms.

WHS Regulation section 244: An altered design of an item of plant must be registered if the alteration may affect health or safety.

WHS Regulation section 245: A design of an item of plant is not required to be registered if the design is registered under a corresponding WHS law.

Concrete placing booms must be designed by an engineer in accordance with acceptable engineering principles and relevant technical standards, to ensure the concrete placing boom is without risk to health and safety. Design registration is required for concrete placing booms manufactured on or after 1 January 2014.

An application for a certificate of registrable plant design must be accompanied by:

- a design verification statement
- representational drawings of the concrete placing boom
- the appropriate fee.

A design verification statement must be written and signed by an eligible design verifier for the design and state that the design was produced in accordance with relevant technical standards or engineering principles. The following people are not eligible to be a design verifier:

- a person who is involved in the production of the design
- a person who was engaged by the PCBU that produced the design at the time the design was produced.

A certificate of registrable plant design stops having effect if the design is changed in a way that requires new measures to control risk.

3 Planning and preparation for concrete pumping operations

Planning and preparation is the first step in ensuring that work is done safely. Planning for concrete pumping operations should start as early as possible in the development of any work or project to help eliminate many of the associated health and safety risks. For planning to be successful, it must involve consultation with all people engaged in the work. Such people include the principal contractor, the concrete pumping PCBU, the electricity entity, designer and project manager.

Effective planning will help identify ways to protect people who are:

- directly involved in the concrete pumping work
- performing other work activities at the workplace.

Some issues to be considered when planning for concrete pumping operations include:

- liaising with electricity entities regarding the safe supply of electricity and control measures for working around existing power supply

- consideration of proximity to overhead powerlines, eliminating electrical risks if possible or using appropriate control measures to minimise risks such as exclusion zones (see section 4.2.3). The concrete placing boom manufacturer may specify instructions for operating near power lines which should be followed when planning concrete pumping operations
- determining concrete pumping requirements, including concrete pump selection, concrete delivery and site access, at the project design stage
- determining traffic control requirements (see section 4.2.4)
- ensuring that an emergency plan has been prepared for each workplace where concrete pumping work will be undertaken
- use of additional safety observers depending on the size and complexity of the work.

Adequate clearances to minimise the risk of contact between parts of cranes, crane loads and concrete placing booms are to be maintained. When cranes and concrete placing booms operate on adjacent sites and share the same air space, negotiations should be conducted between worksites to formulate systems of work to ensure sufficient clearances are maintained between concrete placing booms and cranes.

3.1 Roles and responsibilities associated with concrete pumping operations

3.1.1 Person conducting a business or undertaking

WHS Act section 19: A PCBU must ensure, so far as is reasonably practicable, the health and safety of workers, engaged, or caused to be engaged by the person, and workers whose activities in carrying out work are influenced or directed by the person.

The general role and responsibilities of a PCBU is outlined in section 1.2. The WHS Regulation also includes specific duties for PCBUs with management or control of plant, powered mobile plant and plant that lifts or suspends loads. As a principal contractor is a PCBU, these duties can also apply to principal contractors.

Persons who own, hire or lease concrete pumping equipment have duties to eliminate or minimise risks associated with the concrete pumping plant, so far as is reasonably practicable. This includes ensuring that maintenance, inspection and testing of the concrete pumping plant is carried out by a competent person.

3.1.2 Concrete pump owner

WHS Act section 21: A person with management or control of plant must ensure, so far as is reasonably practicable, that the plant is without risks to the health and safety of any person.

The owner of concrete pumping equipment must take all reasonable steps to ensure that all health and safety features and warning devices of the plant are used in accordance with the relevant instructions and training.

An owner of concrete pumping equipment who employs concrete pump operators should also ensure that operators have undergone appropriate training and that line hands are trained and competent. See Appendix 2 for a sample of questions that can be used as an indication of the knowledge and experience of concrete pump line hands.

Additionally, the owner of concrete pumping equipment must ensure that all information obtained from the manufacturer of the concrete pumping plant is supplied and readily available to those who need it (e.g. the concrete pumping plant manufacturer's operating manual should be kept on the concrete pump, and maintenance staff should have access to all current maintenance manuals). The owner of concrete pumping equipment should ensure the design, maintenance records and all inspection reports for the plant are available and signed off before deployment of the concrete pumping plant for use.

The owner of concrete pumping equipment should also ensure that the pads and/or timbers supplied with the concrete pumping equipment will adequately support the plant. The owner may need to seek the advice of a competent person when selecting appropriate materials to support the outrigger feet.

The owner of concrete pumping equipment must ensure that the maintenance, inspection and testing of the plant is carried out by a competent person. The maintenance, inspection and testing must be carried out in accordance with the manufacturer's recommendations, or if this is not reasonably practicable, the competent person's recommendations.

3.1.3 Concrete pumping equipment operator

A concrete pump operator must always exercise proper diligence and operate the concrete pumping equipment safely. Concrete pump operators are required to know:

- the model of plant to be operated, its characteristics, functions and limitations
- the information in the concrete pumping equipment's operating manual
- proper inspection and maintenance procedures to be followed in accordance with the guidelines of the manufacturer and owner
- any site conditions that may affect concrete pump operations, including the presence of overhead powerlines and nearby structures and plant, for example cranes.

Before and during concrete pumping operations, the concrete pump operator must:

- check unauthorised people are not present in the concrete pumping exclusion zone
- check each boom motion is safe and without risk
- complete the daily inspection checklist, including filling out the logbook
- for mobile concrete placing booms, outriggers should be set according to the manufacturer's operating instructions for the specific type of mobile concrete pump
- monitor the safe use of the concrete pump, concrete delivery lines and boom (if fitted)

  Note: In the case of satellite booms, the boom operator is responsible for the safe operation of the boom but will not be able to monitor the hopper – a separate pump operator located at the pump will perform this function. Likewise, the pump operator on a satellite boom installation is not able to monitor the safe operation of the concrete placing boom.
- in the case of mobile concrete placing booms, monitor the safe support of the carrier, including observing outrigger pads and the ground
- be in view of the line hand and monitor the safe delivery of concrete
- monitor the concrete hopper by being in view of it.

Operators of concrete placing booms must hold the high risk work licence *Licence to operate a concrete placing boom*.

The concrete pump operator is not to carry out the task of the line hand located at the end of the concrete delivery line.

3.2 Planning by the principal contractor or person in control of the workplace

When planning for the pumping of concrete the principal contractor or person in control of the workplace must consult with the concrete pumping PCBU regarding risks. The principal contractor or person with management or control of the workplace should ensure:

- the concrete pump is located in the most favourable position to pump concrete, including allowing adequate visual contact for the concrete pump operator with both the pump and the pour area. If this cannot be achieved, then alternative controls should be implemented (see section 4.3.2)
- a clear, level area of ground with a firm base that is capable of supporting the weight of the pump unit and the concrete delivery trucks, is available
- appropriate traffic control measures are in place for concrete delivery (e.g. single, multiple and continuous truck delivery - see section 4.2.4 for further information on traffic control for concrete pumping operations).
- clear access to the pump unit for concrete trucks
- safe and unobstructed access for the general public, to public areas in the vicinity of the pumping unit and the delivery trucks, if the pump unit is set up in the street
- a time schedule is set prior to a major pour commencing, based on a realistic assessment of the time to complete
- an allowance is included for weather, accessibility, volume of concrete, slab and site limitations, equipment back up, restricted work times (local council rules), equipment capacity, concrete pump operator availability, hose-hand's limitations and the concrete supplier's requirements
- that there is a clearly defined 'pump washout area' complying with environmental protection legislation and local authority requirements
- where compressed air and water lines are supplied on site, that they are positioned to avoid any damage and to comply with the appropriate Australian Standards
- there is a method to collect concrete residue and/or all necessary precautions necessary to prevent wash down residue from the clean-up of pumping operations finding its way into stormwater drains (including concrete delivery trucks), particularly where a permanent or semi-permanent set-up has been established on site or where a pump is set-up in a roadway or public place, and ensuring that this residue collection method complies with all Environment Protection Authority requirements.

3.3 Planning by the concrete pumping PCBU

The concrete pumping PCBU must consult with the principal contractor or person in control of the workplace about the overall planning for pumping concrete on site. Following this consultation, the concrete pumping PCBU should consider:

- whether enough workers are available to safely pump concrete and to operate the emergency shut down system, in case of line failure or other events that require the pump to be shutoff. The likelihood of hose whip from air being sucked into the concrete line is reduced where the

concrete pump is provided with an automatic system that effectively and reliably shuts down the pump when a low concrete level is detected in the hopper. However, the concrete pumping PCBU is still required to ensure there are an adequate number of workers to monitor the safe operation of the pump and, in the case of mobile concrete placing booms, this includes monitoring the outrigger feet and pads

- the concrete mix design and ensure, in consultation with the concrete mix supplier, that the mix is pumpable
- the most suitable method of pumping concrete to the pour area
- the capacity and type of pump to be used to complete the job satisfactorily within the required time span
- the location of the pump and access for concrete delivery trucks
- in ground and above ground services, including powerlines
- environmental factors, including wind conditions
- an assessment of any manual tasks that may cause any muscle or ligament strains, or other injures
- the provision of personal protective equipment and other safety equipment
- the provision of safe access and egress, including elimination of trip, slip and fall hazards
- electrical safety, including the location of nearby powerlines and systems of work which comply with electrical safety legislation and the recommendations of any local, relevant compliance requirements
- appropriate instruction manuals accompany the pump unit and/or boom, giving sufficient instructions for operation, maintenance and repairs
- the pump operator is trained and competent with the use of the appropriate manuals and the equipment
- maintenance and repair manuals are kept in a safe place at the registered premises, including a parts catalogue, and are kept up to date with any additional information from the manufacturer
- maintenance log books are to be kept on the pump, maintained and be up to date, and are to be made available on request at the workplace.

The concrete pumping PCBU must also consult with the concrete delivery company and truck driver prior to the commencement of pumping. Issues to be discussed:

- with the delivery company include:
  - control measures chosen and implemented for line blow-out procedures, based on a risk assessment
  - procedures for multiple trucks reversing to the concrete pump.
- with the truck driver include:
  - a safe location for the concrete delivery truck driver to stand, when concrete pumping is occurring
  - the need to follow any directions of any allocated traffic controllers/spotters
  - procedures for multiple trucks reversing to the concrete pump.

Note: Drivers of pre-mix concrete delivery trucks should not be considered workers for pumping operations, unless trained to carry out this function and authorised to act in this capacity by their PCBU.

3.3.1 Concrete pump selection

The three main types of concrete pumping equipment are:

- mobile line pumps without a concrete placing boom
- mobile pumps with a concrete placing boom
- satellite concrete placing booms on buildings or structures where the pump is at ground level.

When selecting the type of pump for an operation consideration should be given to:

- the amount of concrete required
- concrete mix design
- the delivery height and distance from pour area
- access to required location for concrete delivery
- clean out and waste disposal
- site access and condition
- construction methods and sequencing.

Consideration should also be given to the equipment location and citing hazards including:

- location of access and egress to the site
- location of underground and above ground services
- latent and inclement ground conditions
- environmental factors (e.g. storm water contamination, ground contamination, erosion and sediment control)
- management and reduction of hazardous manual tasks.

4 Risk controls for concrete pumping plant and equipment

4.1 Plant and equipment

Risk

The interruption of concrete flow and/or failure of pumping equipment can create potentially dangerous situations. Pressurised concrete escaping from the enclosed pumping system has the potential to strike workers and others, causing injury. Dislodged, unrestrained or burst pipelines and associated equipment also pose a risk to concrete pumping workers, delivery truck drivers and other workers working in and around the designated concrete pumping area. Risks associated with this plant should be identified in terms of pipe construction and pipe restraint.

The risk of mechanical or structural failure of equipment such as concrete placing booms should be identified. Concrete placing booms can have a greater risk of failure due to the cyclic loading of the

pulsating pump. The likelihood of fatigue failure of welds is increased in comparison to other plant that does not have this pulsating load. Restraining devices such as pins and circlips also have an increased chance of becoming dislodged. These risks apply to both truck mounted and satellite type booms (building mounted booms).

The information supplied below deals with components of the concrete pumping system. Specific risk controls are recommended for each of these components. The assessment of risk for these hazards remains essentially the same in identifying components and assessing the likelihood of movement or failure.

4.1.1 Concrete placing booms

Risk

Structural or mechanical failure of the concrete placing boom.

Risk control

To prevent the structural or mechanical failure of concrete placing booms, regular maintenance in accordance with the manufacturer's instructions should be performed.

When inspecting concrete placing booms, consider:

- all functions and their controls for speed(s), smoothness of operation and limits of motion
- all emergency and safety devices
- lubrication of all moving parts, inspection of filter element(s), hydraulic oil, and coolant as specified by the manufacturer
- visual inspection of structural components and other critical components such as fasteners, pins, shafts, welds and locking devices.

The erection and dismantling of concrete placing booms should be conducted in accordance with the manufacturer's instructions unless otherwise specified by an engineer.

See section 5 for more information on the inspection and maintenance of concrete placing booms.

4.1.2 Pump gauges

Risk

Gauge damage or malfunction.

Risk control

Gauges fitted to the concrete pump should be accurate and of a size and style that are easy to read. All instruments should be visually checked and tested on a regular basis and replacements (as recommended by the equipment manufacturer), recorded in the pump's log book.

4.1.3 Concrete pipelines and restraint equipment

Pipelines – Risk

Concrete pipeline failure.

Risk control

When laying a pipeline, ensure that:

- unnecessary bends are avoided

- horizontal pipelines are adequately supported
- flexible hoses are not at risk of being run over by other plant and equipment being operated in the area
- each section of pipe in a vertical pipeline is supported to avoid extra load on the pipe clamp
- the 90° bend at the base altering the direction of the concrete line from horizontal to vertical is equipped with a leg sitting firmly on the ground sufficient to stop any movement in the vertical line which may snap off the first clamp
- vertical lines are positively secured to the building
- cranes or hoist towers, scaffolding or formwork are not to be used to secure the line, as this method may not be capable of taking the impact load when pumping concrete through the line
- all metal pipes and pipeline components are identified and checked to ensure they are not damaged and are within the specifications of the pipeline.

Pipe clamps - Risk

Concrete pipe clamp failure.

Risk control

When using quick release pipe clamps on fixed lines (horizontal or vertical), ensure that:

- the pipe clamps used are able to sustain the maximum concrete pressure applied to the pipeline by the pump
- the locking pins are used and are engaged
- all pipe clamps are regularly inspected by a competent person for signs of wear and fatigue
- pipe clamps which show any deformation or damage are immediately replaced
- quick release pipe clamps that are manufactured with no provision for locking pins are not used
- clamps are locked as per the manufacturer's instructions and are not locked by hammering the quick release clamp lever, or by other methods which may cause fatigue of the clamp's metal.

Figure 1. High pressure pipe clamp.

Figure 2. An example of acceptable marking on pipe clamps.

Anchor brackets - Risk

Concrete pipeline failure.

Risk control

When inserting anchor brackets on the concrete delivery pipe the PCBU should ensure that:

- anchor brackets and tie-downs are used to adequately secure the system, at intervals of no more than three metres apart, unless otherwise specified by a competent person
- the number of bolts used to secure an anchor bracket should be in accordance with the pump manufacturer's specifications or in accordance with advice from an engineer
- where friction type post-installed anchors are used, these are of the high-load slip, torque controlled type and have a factor of safety of 3 to 1 based on their failure load
- chemical anchors are pull out load tested to 125 per cent of their working load and have a factor of safety of 3 to 1 based on their failure load
- when securing pipes overhead (i.e. so that the bracket anchors are loaded in pure tension), 'through bolts' that extend through the concrete slab are preferable to post installed anchors. If post installed anchors are used in this application they should all be pull out load tested to 125 per cent of their working load.

> *Note:* It may not be practicable in all situations to install anchor brackets every three metres. If not practicable, a risk assessment should be conducted to ensure that risk of pipe movement is adequately controlled.

Figure 3. One method of anchoring pipe.

Pipe movement - Risk

Excessive pipeline movement.

Risk control

Where excessive pipe movement occurs in temporary laid lines due to the surging action of the pump, to:

- use extra anchorage methods to restrict the line movement, especially at bends and elbows, or
- install a short wire-braided high pressure rubber hose, that meets the pressure rating of the pump, between the concrete pump and pipelines in accordance the manufacturer's recommendations.

4.1.4 Hose whip

Risk

"Hose whip" is the term used to describe uncontrolled and rapid motion of the flexible rubber hose on the end of a concrete placing boom or other concrete delivery line. Persons can be injured by being struck directly by the whipping hose itself or being knocked over and hitting the ground or an object, or being hit by ejected material.

Hose whip can occur during the concrete pumping operation itself or when the line is being cleaned out. In either case, hose whip can be especially violent when air enters the line and becomes pressurised due to an obstruction further down the line, and the obstruction becomes dislodged.

Risk control

The likelihood of hose whip can be greatly reduced by the selection of suitable plant and safe systems of work. While the risk of hose whip can be reduced, additional precautions need to be taken to reduce the likelihood of injury.

To minimise the likelihood of injury from hose whip:

- only pump concrete that is a pumpable mix as specified by the concrete supplier. Other types of concrete can block the line and cause hose whip
- do not let the concrete solidify in the line as this will cause blockages. The concrete needs to remain in its plastic state
- use well trained, competent operators to pump concrete
- start the pump up slowly to reduce the likelihood of hose whip
- never use a rubber delivery hose with metal fittings attached to the free end
- people not involved in the concrete pour should be excluded from the delivery hose area
- never stretch the delivery hose if it doesn't reach the pouring location (see Figure 5)
- the delivery hose on a boom pump should hang close to vertical and only be guided by the line hand. If the boom is not long enough to reach the concrete pour area, a longer boom should be used, or the concrete pump should be moved closer to the job

Figure 4 – Line hand guiding hose and signalling to pump operator.

- workers should always wear appropriate personal protective equipment, including hard hats
- good housekeeping needs to be maintained around the work area to reduce the likelihood of tripping

Figure 5 – Workers stretching hose for additional reach. This is an unsafe work practice.

- do not let more hose hang from the boom than that allowed by the concrete placing boom manufacturer. Normally only a maximum of three or four metres of 125mm diameter hose can be suspended from the boom
- do not allow concrete to drop out of the hose when pumping is stopped, as this can allow air to enter the system. The hose can be folded over to prevent concrete dropping out
- always ensure the line hand has an adequate sized area to stand on (the width of the working surface should be 450mm or greater). The line hand should not stand on block walls or next to unprotected edges (see Figure 6).

- monitor the level of concrete in the hopper to avoid air getting sucked into the pump system. A reliable shut off device on the hopper will assist in reducing the risk of hose whip
- make sure safe work procedures are adopted for clearing blockages
- preferably clean out the concrete line with water instead of air

  when there is no other option but to clean the pump line out with air, secure the end of the steel line and have an exclusion zone. All reducers and rubber hose must be removed from the end of the delivery line. A ball catcher should be fitted to the end of the steel pipe which will contain the blow out plug (i.e. sponge) as it is ejected from the line.

Figure 6 – Pouring concrete into column form.

Good access provided

Risk

That the mix is not a pumpable mix or is poor quality.

Risk control

- the concrete pump operator must confirm that the mix is pumpable when it arrives at site i.e. by checking the order or delivery document
- the delivery driver is to notify the concrete pump operator if believes there is an issue with the mix

Risk

There is concrete left in the lines for a long duration or there is segregation of slurry.

Risk control

- kink the line, which will help to prevent segregation
- shunt concrete through the lines
- recycling by putting hose into hopper and circulating the mix.

Risk

Moving the boom pump with concrete in the lines.

Risk control

- blow out or suck in the mix in the lines before moving the boom.

Risk

Air in the lines.

Risk control

- the hopper may have “low level” sensors to indicate when the concrete levels are low and likely to pull in air with the mix.

Risk

There are foreign objects in the mix.

Risk control

- seek verification from the concrete delivery truck owner of when the bowl was last descaled/ dedagged
- person at the hopper must keep watch of the consistency of the mix and advise the operator of any issues
- if lumps or objects are identified then the pump operator must be advised to do an emergency stop.

Risk

Start-up of the pump.

Risk control

- maintain an exclusion zone around the line when starting up the pump
- once concrete is moving then the exclusion zone ceases.

4.2 Placement of plant and equipment

4.2.1 Setting-up on site

WHS Regulation section 40: A PCBU must ensure, so far as is reasonably practicable, the workplace is maintained to allow persons to enter, exit and move about without risk to health and safety under normal conditions and in an emergency.

WHS Regulation section 60: A PCBU must manage risks to health and safety relating to musculoskeletal disorder associated with a hazardous manual task. In deciding what control measures to implement the PCBU must consider all relevant matters that may contribute to a musculoskeletal disorder including postures, movements, forces, vibration, duration and frequency of the hazardous manual task, the design, layout and environmental conditions of the workplace and systems of work used.

Hazardous manual task means a task that requires a person to lift, lower, push, pull, carry or otherwise move, hold or restrain any plant that involves one or more of the following:

- repetitive or sustained force
- high or sudden force
- repetitive movement
- sustained or awkward posture
- exposure to vibration.

Risk

There are numerous risks associated with the setting-up of concrete pumping equipment, including mobile concrete pumping booms tipping over and the risk of workers being crushed or run over by the mobile pump or concrete truck. Consultation regarding the risks involved with the set-up of concrete pumping equipment must occur between the principal contractor or person in control of the workplace and the concrete pumping PCBU. Work activities must be co-ordinated so that all risks are eliminated or minimised so far as is reasonably practicable.

Risk control

When setting-up a concrete pump the area should be level, capable of supporting the load and free of obstructions, with careful attention paid to the following:

- particular care and precautions should be taken when a concrete pump is used in the vicinity of an excavation, as the weight of the concrete pump and the load can affect the stability of the excavation wall and cause the excavation wall to collapse, which may lead to the concrete pump overturning. The pump should not be positioned over or adjacent to:
  - previously disturbed ground that has been back-filled
  - excavations, trenches or holes in the ground
  - cellars, basements or pits
  - inadequately compacted or soft ground
- if the ground is bearing capacity is suspect or is near an excavation, the operator should immediately refer the matter to the principal contractor for re-location to a more stable location
- that the pump unit is set up level, and if this cannot be achieved ensure that the incline or angle of the machine does not exceed the manufacturers recommendations (refer to operating instruction manual)
- If outriggers are required:
  - supply adequate members (e.g. timbers) for packing the base plate
  - ensure the outriggers pads are clear of excavations, soft or filled ground, or other obstacles liable to interfere with the safe operation of the machine
  - ensure that the members (e.g. timbers) have sufficient bearing area to support the machine
  - ensure the outriggers do not subside, by making regular checks to ensure stability
- unauthorised persons should be kept away from the machine and associated equipment
- persons working in the concrete pumping exclusion zone should wear high visibility vests
- the exclusion zone should be marked with signage requiring persons to wear high visibility vests
- the area should be clearly marked and made safe from other traffic
- ensuring there is clear access for the safe movement of materials, equipment and persons. A second access way should be put in place when the concrete pumping activity is taking place on or near the access way
- set-up areas should be provided with clear access and adequate lighting at all times, during operation
- risks of hazardous manual tasks can be associated with the manual movement of concrete delivery hoses over a deck. When handling the concrete delivery hose there should be one line hand for every 10 metres of workable hose where the pipe diameter is 76.2 millimetres (three

inches) or more and every 20 metres of workable hose where the pipe diameter is less than 76.2 millimetres (three inches)

- where a concrete pumping hose has to be dragged over a deck being poured the path should be clear of obvious trip hazards. To help reduce musculoskeletal strain, post stressing bands and drops or rises on the deck exceeding 400mm height, should be covered with re-enforcement mesh or another suitable product for the concrete line hands to walk on. The mesh should be of a size where a worker's foot cannot become caught
- where operation of the plant is required at night or low light conditions, artificial lighting should be provided
- a sign is posted clearly stating that the area is for authorised persons either, for example 'Danger – Concrete Pumping Area – Authorised Persons only'.

Concrete placing booms should not be set-up or operated in the following situations:

- over designated worker access ways without a 10kPa gantry above the access way
- over site sheds (including worker amenities, lunchrooms, or any other site sheds where workers are located) *without* a 10 kPa gantry above the site sheds.

The live loading of 10kPa is the design benchmark specified for gantries, *other than for light duty work*, in section 315K of the WHS Regulation. The gantry is to safely withstand at least 10kPa loading, in addition to any materials that may be located on top of the gantry.

4.2.2 Maintaining stability of mobile concrete placing booms

Ground conditions can vary dramatically from one workplace to another, and even within the one workplace. Failure to address poor ground conditions to ensure stability of the mobile concrete placing boom may cause the plant to overturn and result in serious injury to the concrete pump operator and other people near the plant.

4.2.2.1Ground factors

Factors that will affect the ability of the ground to provide adequate support include the following:

- the presence of water, including when it is mixed with the soil as mud, and where it is present under the surface (e.g. underground springs and streams, tidal range)
- the type of ground (e.g. clay, sand, rock or a mixture of these)
- back-filled ground that was previously an excavation or trench
- cavities or penetrations in the ground that have been covered but still exist
- continued operation of the concrete pump in one location.

When a mobile unit is being set up, the operator can only decide based on the surface of the ground. Generally, rock provides the most stable supporting surface for mobile plant. However, although rock may be present on the surface, it may not extend far below the surface. One way to establish how far rock may extend below the surface is to examine nearby excavations or trenches at the workplace. Rock that extends far below the surface provides a good indication of the ground's integrity. However, this will only provide a reasonable indication of the ground's strength when the excavation is not too far from the concrete pump. Additional risks must be managed when outriggers are positioned too close to an excavation. See section 4.2.2.2 of this code for further information.

Care must also be taken with ground that has a 'crust' on its surface. The surface of this type of ground is usually firmer than the ground underneath. The firm surface may give the perception that

the ground is more stable than it is. If the ground is punctured by an outrigger, the softer ground will be exposed, which may cause the concrete pump to overturn.

Where a mobile concrete placing boom is continuously operated in one location, the ground underneath the outriggers will compact. Additional care must be taken to ensure that the concrete pump has not compacted the ground to the extent that the minimum overturning moment of the concrete pump is reduced (i.e. the concrete pump is more likely to overturn).

4.2.2.2 Plant proximity to excavations and trenches

When mobile plant is set up close to excavations or trenches, there may be an increased risk of the sides of the excavation or trench wall collapsing, causing the plant to overturn. This risk increases with softer ground, and the presence of groundwater. Additionally, the risk of collapse is greater for vertical cuts in the excavation wall in comparison to walls that have been battered back at an angle. The presence of 'slippery back', where there is a naturally occurring slip plain such as a fracture in the ground, can also increase the risk of excavation or trench collapse.

Generally, the following principles should be applied when setting up mobile plant near excavations:

- Where the ground is compact and non-friable (i.e. not crumbling), the distance of any part of the outrigger support timbers from the excavation should be at least equal to the depth of the excavation (1:1 rule).

  For example, for a three metre deep trench in compact ground, the closest edge of the outrigger timbers or pads should be a horizontal distance of at least three metres away from the closest edge of the trench wall.

- Where the ground is loose or backfilled (i.e. crumbling), the distance of any part of the outrigger support timbers from the excavation should be at least twice the depth of the excavation (2:1 rule).

  For example, for a three metre deep trench in backfilled ground, the closest edge of the outrigger timbers or pads should be a horizontal distance of at least six metres away from the c*losest face of the trench wall.*

4.2.2.3 Timbers, pads and bog mats

A variety of materials can be used to distribute the mass of the mobile plant to the ground. Lengths of timber (timbers) with rectangular cross sections are the most common form. However, timber and plastic pads are also provided for some mobile plant. For particularly poor ground steel plate is sometimes used.

Wherever possible, timbers, pads and steel plate should be of dimensions and materials as specified by the concrete pump manufacturer. If the manufacturer has not provided this information, a competent person such as an engineer should specify the minimum size of the material to be used.

Generally, the following principles should be applied to timbers, pads, steel plates and bog mats:

- Timbers should have a minimum width of 200mm and minimum thickness of 75mm.
- Timbers should be laid together so that the width of the timber pad is wider than the outrigger foot with no gaps between timbers.
- Pads should have a minimum thickness of 75mm.
- The risk of outrigger feet sliding off plastic pads or steel should be identified and controlled (i.e. when the plant is set up on a gradient).

4.2.2.4 Calculating ground pressure and outrigger pad area

The ground bearing capacity must be greater than the maximum pressure applied by the mobile plant to the ground to ensure the plant does not sink and/or overturn. If not, then appropriate control measures, such as increasing the area of the outrigger pads or carrying out earthworks to increase the ground's bearing capacity are to be implemented.

Some concrete placing boom manufacturers provide information on the maximum force applied by outriggers and the minimum area of outrigger pads to be used.

Different ground types will have different ground bearing capacities. Generally, harder ground (such as rock) is capable of withstanding higher ground pressures than softer ground (such as dry sand). Where the ground consists of a combination of ground types, the poorer ground type should be used for determining the maximum ground pressure that can be applied to the ground when the concrete pump is set up on outriggers.

The force applied by outrigger feet is often expressed as kilonewtons (kN) and pressure as kilonewtons per square metre (kN/m^2). However, for simplicity, the force applied by the outrigger feet can be expressed as tonnes (t) and the associated pressure applied to the ground as tonnes per square metre (t/m^2). The following three formulae can be used:

Pressure applied by outrigger, P_{out} = Force/Area

Force applied by outrigger, $F = P_{out} \times Area$

Minimum area of timbers, $Area = F/P_{out}$

Table 1 the maximum permissible ground pressure according to the ground type.

Ground type	**Maximum permissible ground pressure, P_{MAX} (Tonnes per m^2)**
Hard rock	200
Shale rock and sandstone	80
Compacted gravel (with up to 20% sand)	40
Asphalt	20
Compacted sand	20
Stiff clay (dry)	20
Soft clay (dry)	10
Loose sand	10
Wet clay	Less than 10

Example 1

The outrigger leg of a particular mobile concrete placing boom can apply a maximum downwards load of 25 tonnes. If the timbers under the outrigger foot have a length of 0.4m (400mm) and a width of 0.5mm (500mm), calculate the pressure applied by the outrigger leg. What type of ground can this set-up be used on?

To calculate the greatest force applied by any outrigger to the ground:

First of all, calculate the area of the timbers in contact with the ground,

Area, $A = 0.4 \times 0.5 = 0.2m^2$

Pressure applied by outrigger, P_{out} = Force/Area

$P_{out} = 25 / 0.2$

$P_{out} = 125$ tonne/m^2

After referring to Table 1, the unit is be set up on hard rock unless the area of the timbers under the outrigger feet is increased.

Example 2

The outrigger leg of a particular mobile concrete placing boom can apply a maximum downwards load of 25 tonnes. The unit is to be set up on compacted gravel. What are the minimum area and length by width dimensions of the timbers to be set up under the outrigger feet?

From Table 1, maximum permissible ground pressure, P_{MAX} is $40t/m^2$

Minimum area of timbers, $Area = F/P_{MAX}$

$Area = 25/40$

$Area = 0.625m^2$

To find the minimum length by width find the square root of the area.

Length and width = $\sqrt{0.625}$

= 0.79m

The length and width of the timbers are each to be at least 0.79m (790mm) long.

4.2.2.5 Short legging

Short legging refers to the use of mobile plant when one or more of the outrigger legs is only partially extended or deployed. Outriggers on mobile concrete placing booms either telescope or swing outwards from the vehicle. Although the way the outriggers are extended may vary, the potential hazard of not extending the outriggers correctly will be the same - the unit can fall over.

Short legging is a practice that should be avoided wherever practicable, due to the increased risk of overturning the mobile plant.

At the design and construction stages of the building, designers and builders should consider that adequate space is available so that mobile plant required as part of the building process, can be safely set up and packed up.

A person with management or control of a worksite including a principal contractor should ensure that adequate room is available to enable a mobile concrete placing boom to be set up and packed up safely. This includes, both operation of the mobile plant and ancillary activities, such as cleaning out concrete lines. It may also include obtaining road or footpath closures from the relevant

authority. The concrete pumping PCBU should provide the hirer with the actual area required to set up with the outriggers fully extended, expressed as a length by width dimension in metres.

If a mobile concrete placing boom is short legged, it is preferable that the unit is fitted with a slew limiting device that prevents the boom or counterweight from slewing into the zone where there is risk of the plant overturning. If the mobile boom is provided with this feature, the operator is to be trained in the use and limitations of the slew limiting device.

When short legging ensure:

- The manufacturer's operating manual for the mobile plant states that short legging is permitted. The manufacturer’s operating instructions for short legging are to be followed, including any restricted operating areas for the concrete placing boom.
- The outriggers are marked with an indicator that shows the extent of the short legging (i.e. marks on the outriggers) or the operator's manual shows how far the outriggers are to be extended (i.e. by diagrams).
- A documented safe work procedure has been prepared that shows the operating conditions under which short legging can be used. The documented safe work procedure is to include a diagram showing the permissible operating zone of the concrete placing boom (refer Figure 7 below). The safe work procedure should be provided to, and assessed by, the principal contractor or the person with management or control of the worksite
- The stability of any concrete placing boom is to be maintained during
  - set up
  - operation
  - pack up
  - pipeline cleaning.

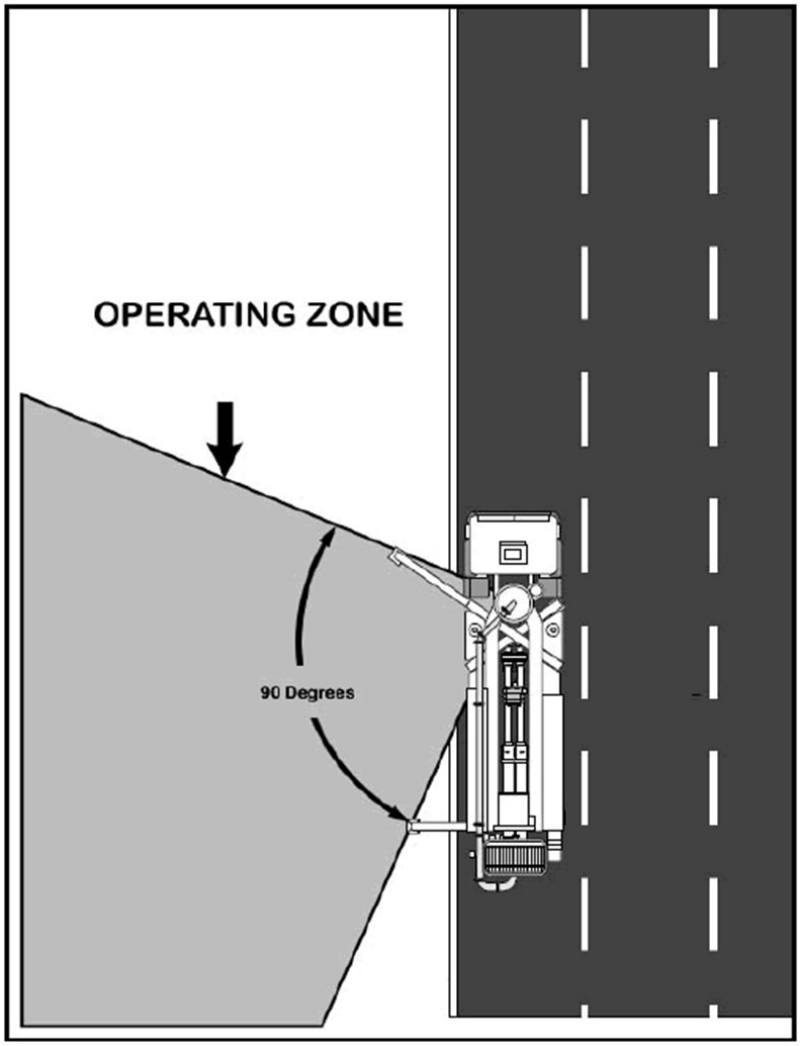

Figure 7 – Example diagram of permissible operating zone of the concrete placing boom

4.2.3 Working near overhead powerlines

4.2.3.1 Electrical safety laws

Information about requirements for working near overhead powerlines is provided in the following:

- Electrical Safety Act 2002 (ES Act) – outlines general electrical safety duties
- Electrical Safety Regulation 2013 (ES Regulation) – states exclusion zones for working near overhead powerlines (note that consultation regarding the risks of the work should occur with the relevant electricity entity and other relevant parties)
- Electrical safety code of practice –working near overhead and underground electric lines – provides practical advice on safe systems of work and exclusion zones.

ES Act section 30: A PCBU must ensure its business is conducted in a way that is electrically safe. If the work involves working near overhead powerlines the PCBU must ensure persons performing the work are electrically safe. This includes potential contact with overhead powerlines when operating a concrete placing boom.

4.2.3.2Planning for work near overhead powerlines

Contact with overhead powerlines can pose a risk of electric shock or electrocution when operating a concrete placing boom.

Concrete placing booms should not be operated over the top of energised powerlines for the following reasons:

- the shape and height of the boom does not allow for a large separation distance from the powerlines
- boom movement due to pumping motion, wind and 'bounce' as the boom is moved
- it can be extremely difficult for spotters observing from the ground to judge distances and determine clearance from the powerlines.

Before setting up a concrete placing boom near overhead powerlines, the concrete pumping PCBU should conduct an inspection to identify the presence of overhead powerlines that may pose a risk. Consultation regarding the risks of the work should occur with all relevant parties involved in the work. Once the risks associated with overhead powerlines have been identified and assessed, appropriate control measures must be put in place.

The most effective way to eliminate any risk of electric shock is by turning off the power. The PCBU and the PC should discuss options for de-energising or re-routing the electricity supply with the relevant electricity entity. These options are the most effective control measures and should be considered before anything else. The PCBU and PC should also consult with each other to ensure the electricity entity has been contacted.

De-energising or re-routing powerlines should be arranged with the electricity entity as quickly as possible as this can take some time to arrange. Where overhead powerlines have been de-energised, written confirmation should be sought from the person in control of the powerline before undertaking any work.

4.2.3.3 Exclusion zones for operating a concrete placing boom near overhead powerlines

ES Regulation 68: A PCBU must ensure, so far as is reasonably practicable, that no person, plant or thing at the workplace comes within an unsafe distance of an overhead or underground powerline.

If it is not reasonably practicable to ensure a safe distance, the person must ensure that a risk assessment is conducted for the proposed work and control measures implemented are consistent with:

- the risk assessment

- if an electrical entity is responsible for the electric line, any requirements of the electrical entity

ES Regulation 69: A person or operating plant comes within an unsafe distance of an overhead electric line if the person or plant is within the exclusion zone for the person or operating plant for the line.

If it is not reasonably practicable to turn off the power or re-route the powerline, the most effective control measure to reduce the risk is to establish “exclusion zones” that prevent people, plant, equipment and materials from coming close enough to energised overhead powerlines for direct contact or flash-over to occur.

A PCBU must ensure, so far as is reasonably practicable, that any person, part of the concrete placing boom and/or the drop hose does not enter the exclusion zone.

PCBUs should ensure that workers and the concrete placing boom (and/or the drop hose) stay at least three metres away from overhead powerlines, for voltages up to 132kV, with greater distances applying for voltages above that. These distances apply to any part of the concrete placing boom and/or the drop hose.

There are many ways this could be achieved, such as:

- setting up the concrete placing boom in a position that keeps it outside the exclusion zone
- erecting a physical barrier, made of non-conductive materials, to prevent any part of the concrete placing boom or person entering an unsafe distance. This may require isolating the electricity supply while the barrier is installed.

When implementing a system to maintain the exclusion zone consider factors including:

- identifying the minimum clearance distance from the closest part of the concrete placing boom to the powerline, the ‘exclusion zone’
- allowing for sway or sag of the powerlines (sway is usually caused by wind, while sag may vary as the temperature of the line varies)
- ensuring that persons, plant and vehicles always stay outside the ‘exclusion zone’
- using a safety observer (commonly known as a ‘spotter’) who observes the operation of the concrete placing boom if the plant could enter the exclusion zone.

The identified minimum clearance distance may need to be greater than the prescribed exclusion zone distance to ensure there is no breach of the exclusion zone.

It is important to note that the electricity entity may also specify a greater distance than the smaller exclusion zones provided in Schedule 2 of the ES Regulation, if they consider the risk warrants it.

There are devices available that assist in increasing protection from a hazard, including:

- warning signs to indicate the location of overhead powerlines
- tiger tails or line markers on overhead powerlines to act as a visual aid to highlight the location of the powerline. (Note: tiger tails do not insulate wires and therefore the exclusion zone must be maintained).

No matter what safety devices are being used, the ‘exclusion zone’ must not be entered.

Unloading and setting-up of concrete pumping pipes also poses a risk of contact with overhead powerlines. Pipes should be kept parallel to the ground when setting-up near overhead powerlines.

Role of a safety observer or ‘spotter’

A safety observer or ‘spotter’ is a person who is trained and competent to observe and advise the pump operator if the line or any part of the pump is likely to come within an exclusion zone of an overhead powerline. Typically, this is a person who has undergone specific training and is competent to perform the role in observing, warning and communicating effectively with the concrete pump operator. The spotter concept is designed:

- to encourage plant such as concrete pumps to be located away from the possibility of encroaching into the exclusion zone
- when that is not possible, adopt other suitable precautions to prevent encroachment.

A safety observer or spotter is also a person who is trained and competent to observe and advise the pump/vehicle operators if the vehicle or the pump is likely to contact a person structure or moving plant on site

The safety observer or spotter should:

- have knowledge about working safety around moving plant, including the understanding of escape routes and maintaining visibility
- understand the relevant traffic management guidelines for the site, including any site-specific traffic management plan or moving plant plan, the MUTCD (Manual of Uniform Traffic Control Devices) and the Traffic management for construction or maintenance work Code of Practice.
- understand exclusion zones and know about how the concrete pump operates and the limits of its movements and extensions.
- understand the potential of the equipment to encroach on exclusion zones or contact people, structures or plant.

Further information on requirements for operating plant near overhead powerlines may be obtained in the ES Regulation and the Electrical Safety Code of Practice – Working near overhead and underground electric lines or on the Electrical Safety Office website..

4.2.4 Traffic control

WHS Regulation section 315M: A principal contractor must, before construction work starts, ensure written approval is obtained from the relevant authority or person who controls the adjoining area, and if an authority controls the area, use any measures for the closure required by the authority (such as physical barriers, signs, traffic controllers etc.).

WHS Regulation section 214 and 215: A person with management and control of powered mobile plant must manage the risks of the plant overturning and/or colliding with any person or thing and must ensure so far as is reasonably practicable that the plant has a warning device to warn persons at risk from the movement of the plant.

Concrete pumping operations are often carried out in busy built-up areas and are often set up on the road or road related areas. Motorists, cyclists, pedestrians, delivery truck drivers and workers all interact with concrete pumping plant as it arrives and sets up in the designated concrete pumping area.

There are numerous ways to control the risks associated with working on roads or road-related areas. Examples of traffic control measures that may be considered include:

- road closures
- footpath closures
- detours
- signing
- traffic controllers.

Where concrete pumping involves multiple truck delivery there should be a person, separate from any traffic controllers in place, who is responsible for controlling the delivery of the concrete trucks. See information in previous section on the role of a spotter.

The SWMS prepared for the concrete pumping work should ensure that:

- People not involved in concrete pumping (workers and members of the public) are excluded from the work area.
- The spotter stays in view of the concrete truck driver while the truck is moving. When the spotter is out of the view of the truck driver the driver is to stop the vehicle.
- People in the concrete delivery area should always wear high visibility vests.
- Concrete trucks must have audible reversing alarms and flashing amber lights.
- Permits must be obtained from the relevant authority where concrete pumps are set up on, or adjacent to public roads.
- Lane closures on roads, signs, speed restriction signing and protective barriers for work on, or adjacent to public roads must comply with the MUTCD.
- Any necessary barriers and signage are in place, no matter how brief the occupation of the site for the:
  - protection of workers
  - provision of adequate warning of changes in surface condition, and the presence of personnel or plant engaged in work on the road
  - adequate instruction of road users and their safe guidance through, around or past the worksite, and
  - safe access and egress to and from the worksite.

Where concrete pumping involves the use of a satellite concrete placing boom the concrete pump will usually be located at ground level within the confines of the project. Where this is the case the concrete delivery area should be provided with demarcation barriers on all sides except the entry side for the concrete truck. Signs should be placed on each side of the barricades that state ‘Concrete Delivery Area – Stay Out’ or words to that effect.

Further information can be found in the *Traffic management for construction or maintenance work Code of Practice*.

4.3 Tasks

4.3.1 Concrete delivery

Risk

Concrete delivery involves the delivery of concrete from the delivery truck to the concrete pump hopper. In this operation one or more concrete trucks are reversed up to the concrete hopper to deliver concrete. This activity poses risks to the concrete delivery truck driver, the concrete pump operator, the allocated traffic spotter, other workers working in and around the concrete pumping exclusion zone and members of the public.

The risks from this phase of delivery include:

- being hit or run over by a delivery truck
- entrapment between the delivery truck and hopper or between delivery trucks

- being struck by concrete whilst delivering concrete to the hopper, due to equipment failure such as a burst line
- entanglement, crushing and amputation from the concrete hopper
- being struck by ejected pipes from the concrete pump due to clamp failures, whilst discharging concrete into the hopper.

Risk control

When delivering concrete, the following should be ensured:

- concrete delivery trucks should have clear and safe access to approach and leave the receiving hopper of the pump
- if more than one concrete delivery truck is required to approach the receiving hopper at any one time, the person in control of the relevant workplace area should ensure a spotter or traffic controller is on hand to safely direct the movement of the trucks, considering the safety of each worker in the area
- concrete delivery trucks should not reverse into the exclusion zone if they cannot see the nominated person for directing the truck (the spotter). The vehicle should be stopped immediately when the driver loses sight of the nominated person directing the truck
- if more than one concrete delivery truck is required to approach the receiving hopper at any one time the person in control of the relevant workplace area should ensure:
  - a spotter or traffic controller is on hand to safely direct the movement of the trucks
  - there is adequate room for the concrete delivery truck driver to operate the concrete delivery truck safely
- no person should stand between the reversing concrete delivery truck and the hopper
- the concrete chute on concrete trucks should only be moved when the truck is stationary. It is preferable for the truck driver to perform this task. If another worker carries out the task the permission of the driver should be obtained
- the concrete receiving hopper should be at a height that allows a gravity flow of concrete into the hopper
- additional ramping may be required for the concrete delivery truck where low slump concrete is to be used. Where ramps are used they should be specifically designed to:
  - ensure the truck cannot back off the ramps
  - ensure the truck remains stable
  - have a non-slip surface
- all concrete delivery trucks should be fitted with flashing hazard lights that are activated when the truck is in reverse
- all concrete delivery trucks should be fitted with audible reversing devices.

When delivering concrete to the pump hopper the following should be ensured:

- the receiving hopper of the concrete pump should be positioned so that it can receive a concrete flow readily from the discharge chute of a concrete delivery truck
- a grate is to be provided to prevent access to dangerous moving parts such as agitator mechanisms and valve gear (“S – tube” or “rock valve”). Hopper grates designed for opening are to be fitted with an interlock system that de-activates both the paddles and the valve gear.

This system is to ensure that there is no energy in the system that can cause movement of the agitator mechanism or valve gear after the interlock switch is activated (i.e. from remaining hydraulic pressure in the accumulator)

- the emergency stop button should be accessible to the concrete pump operator
- the grate should be constructed of parallel bars which are spaced so that it is not possible for a person's hand to become trapped (this spacing should not exceed 75mm)
- the distance from the top of the grate to any moving parts should be at least 100mm.

4.3.2 Pump and boom operation

Risk

Inexperienced or untrained operators pose a risk of unsafe operation.

Risk control

Concrete pump and boom operators should be competent to safely operate relevant equipment. Competency is achieved through training and supervision and should be assessed by testing both theoretical knowledge and physical operation of the machinery. Operators of concrete placing booms must hold the high risk work licence *Licence to operate a concrete pumping boom.*

Pump and boom operators should:

- be familiar with manufacturer's advice and information contained within manuals and other documents, including hydraulic pressure relief settings and maximum rated concrete pressure
- operate the plant in line with the advice and information of the manufacturer
- carry out the daily maintenance inspection, visual inspection of the pipeline and other pre-operational inspections in accordance with the plant operator's manual, before pumping commences
- always attend to equipment, or arrange for an alternative competent person to attend if required to work away from the equipment
- pump concrete only when the hopper grate is in the closed position
- ensure pump flow rates match discharge rates of concrete delivery trucks
- be able to maintain a volume of concrete in the concrete pump hopper at levels that will not allow air into the pump. Include specifics of how this will be achieved in the safe work method statement (e.g. automatic shut-off if level of concrete in hopper falls too low; or additional competent person stationed at hopper to stop the pump)
- follow the directions of the hose-hand
- ensure a system of communication is maintained with the hose-hand.

4.3.3 Wind loading

Mobile and satellite concrete placing booms are not to be operated in winds exceeding that specified by the manufacturer. The maximum permissible wind speed should be available on site where the concrete placing boom is being operated. The information should be either on the manufacturer's identification plate on the unit or in the operating manual for the unit.

4.3.4 Concrete pumping

Risk

The concrete pour involves the pouring of concrete through the delivery hose connected to the concrete pump, to the concrete pour area. In this operation there may be a risk of concrete lines bursting, lines becoming unrestrained and pipe clamps being dislodged. Damage to delivery hose or the inappropriate selection of the delivery hose may also cause the discharge of concrete under pressure.

Risk control

- To be able to effectively move the drop hose on a concrete placing boom, the line hand needs to be located directly under the boom. In addition, concreters involved in the concrete pour will, at times, be located under the boom. All other workers are not to be directly under the concrete placing boom
- the rubber delivery hose should always be checked for damage prior to being fitted
- where the delivery hose is positioned over or above any working or public area, it should be fitted with a suitable stop at the outlet end
- care should be taken to avoid damage to the hose during use
- ensure the delivery hose fitting on a boom pump is secured in position by a safety chain, sling or other retaining device
- always use a delivery hose that has a pressure rating to accommodate the pumping concrete pressure. Steel re-enforced delivery hose should be used with high pressure pumps. As a guide, delivery hose that is not re-enforced (sometimes called ‘rag’ or ‘fabric’ hose) should not be used on piston type pumps, unless the pumping pressure is within the maximum allowable hose pressure rating specified by the manufacturer. Where there is any doubt about the ability of the hose to withstand concrete pressures, written verification from the hose manufacturer should be obtained
- additional hose added to the end of a concrete placing boom may cause structural failure of the boom, when the hose hangs from the end of the boom and concrete is pumped through it. Documentation should be available on site that shows the maximum size and length of hose that may be suspended, as stated by the boom manufacturer
- reducers should be used as per the manufacturer’s recommendations to avoid overload of the delivery hose or other parts of the unit
- the line hand should wear eye protection complying with AS/NZS 1336 Eye and Face Protection Guidelines.

4.3.5 Concrete line blockages

Risk - Concrete Line blockages

Causes of blockages in concrete delivery lines include:

- mix design deficiencies – a mix that is too stiff, poor mixing of the concrete, aggregate that is too large
- pipeline and joint deficiencies – including misaligned connections, excessive bends, too many reducers for the type of mix, leaking joint rubbers, or no rubbers at all
- excessive component wear in parts of the concrete pump – resulting in loss of water in the mix and a loss of its lubricating properties

- kinking of the discharge hose - blockages can occur in the flexible discharge hose when the hose is kinked, depending on the mix design and aggregate size
- worn discharged hose – where metal reinforcement chords become dislodged
- foreign matter in the concrete – examples include: old concrete that breaks away from mixer fin, unmixed clumps of cement, over-sized aggregate
- in twin wall pipes, fracture of part of the inner wall
- pumping the concrete too quickly – the velocity of the pump stroke can push the aggregate in front of the primer
- Delays between concrete delivery trucks – this can cause materials in the mix to separate.

Mix design deficiencies, pipeline and joint deficiencies and excessive component wear in parts of the concrete pump can cause segregation of the concrete mix. Segregation refers to the process where components of the mix do not bind together and start to separate. This can be a greater problem where the sand in the mix has been poorly graded.

Risk control

- Ensure the concrete mix is not too stiff or too wet. A mix that is too stiff can't be pumped because it will not fill the pumping cylinders and the pumping pressures will be excessive. A mix that is too wet can cause the mix components to segregate by allowing heavier materials to settle.
- Where recycled or remanufactured aggregate is used an additive may be required to assist with binding the mix together.
- The system must be sized or designed properly for the pump capacity to ensure the pumping pressure is sufficient to move the concrete over the full length of the pipeline. There is a maximum aggregate size in the concrete for the pipeline diameter. The line diameter should be three to four times greater than the maximum aggregate size.
- It is important to note that the friction and resulting resistance to pump concrete through a rubber hose will be significantly higher than through the same length of steel pipeline. In some cases the pumping effort required to pump concrete through only one metre of rubber hose will be the same as pumping concrete through at least three or more metres of steel pipeline. For this reason, blockages are much more likely to occur in rubber hose than steel lines of the same diameter.
- Ensure adequate priming and lubrication of the pipeline prior to commencing the concrete pumping operation.
- Minimise the number of bends and short bends in the pipe or hose as they will increase the concrete pumping pressure. Likewise, if the reducer, connecting the concrete pump to the pipeline system, is too abrupt the pumping pressure can increase to such an extent that a blockage results.
- Avoid sudden variations in pipeline diameter, either through short reducers or mismatched inside diameters of system components as they can cause blockages or rock (aggregate) jams because the concrete can't be pushed through the smaller line diameter.
- Pipelines and hoses should be cleaned properly to avoid blockages caused by the setting of old concrete.
- Replace damaged or defective couplings, gaskets, or weld collars as excessive component wear in parts of the concrete pump can cause segregation of the concrete mix and lead to blockages.

Clearing Blockages

If the pumping system has a blockage, the pump pressure gauge will likely show that line resistance is rising. The most common place for a blockage to occur is in the reducer connecting the concrete pump to the pipeline system.

Pressure-gauge readings can give a good indication of the blockage location. If the pressure builds up very quickly before the jam occurs, the blockage is likely to be near the pump. A slower build-up of pressure indicates the blockage is somewhere in the pipeline, possibly near the delivery end.

The concrete pump operator may be able to break an aggregate jam loose by alternately reversing the pump and resuming pumping a few times. Though a minor blockage can be cleared in this way, no amount of pressure will clear a major blockage. Do not continue the reversing process for more than a few attempts because it can make the blockage even tighter.

If reversing the pump does not work, an alternative method needs to be carried out to locate the blockage.

Leaking pipe joints in the system indicate grout loss and possibly the location of a blockage.

Standing on the rubber delivery hose can provide an indication of whether the blockage is in the rubber hose or in the steel line. If the worker's weight compresses the hose, then the blockage is likely to be in the delivery line.

On pipelines other than on high rise installations, movement between relative parts of the pipeline may provide an indication of where the blockage is. As the pump is stroking, some vibration or movement may be evident at each joint. When there is a blockage, its location can be determined by observing the joints while the operator alternately reverses the pump and resumes pumping. If no line movement is noted after a joint, the jam is likely to be between the pump and that joint.

When attempting to clear a blocked concrete delivery line:

- All people should be excluded from the pipeline area except for those workers involved in clearing the line.
- After locating a blockage or rock jam, always make sure the line is no longer under pressure before attempting to clear it. Reverse the pump to reduce the pressure
- Never straddle a horizontal line when opening a coupling; stand to one side. Lift the line so that all the free-flowing concrete runs out. Bend the hose or tap on the pipeline near the jam and shake out loose particles.
- If pressurisation of the line is used to clear the blockage, particular care needs to be taken to exclude all people from the vicinity of the line and, in particular, the delivery hose, in case of hose whip. Restrain the hose from movement and a attach a catchment device or properly designed receptacle to the discharge end of the pipeline to safely catch any projectiles, while still allowing concrete to flow. Workers must never try and restrain the hose.

4.3.6 Line cleaning (on site)

Risk

Line cleaning is usually performed with either high pressure water or air to ensure the dislodgement of residual concrete located in the pipeline. Dislodged concrete can act as a high-velocity projectile, potentially striking both workers doing cleaning and those nearby (including members of the public). To avoid hose whip, all reducers and rubber hose must be removed from the end of the delivery line.

This matter should be discussed by the principal contractor or person in control of the workplace and the concrete pumping PCBU.

Risk control

A risk assessment should be performed and documented so that adequate controls are implemented to control the risks associated with line cleaning.

When performing line cleaning the following safety precautions should be followed:

- Only experienced and trained pumping personnel should carryout line cleaning.
- Cleaning should be conducted in accordance with the manufacturer's instructions and PCBU's or other duty holder's procedures.
- Water should be used for cleaning in preference to air to minimise the risk of projectiles.
- There should always be a connection to atmosphere (air relief valve) as well as the air entry point to the pipeline, which will allow the system to be depressurised before removing any pipeline (never attempt to take a line apart to clean out a blockage or to dismantle it until after the pressure has been relieved).
- No pipeline connection or fitting should be disconnected unless it has been established that the pipeline is free of internal pressure.
- The pump operator is to remain at the pump controls while the pipeline is pressurised.
- Always remove the rubber delivery hose at the **end** of the pipeline, so that the hose cannot whip around dangerously should the line be blown out.
- Secure all parts of the pipeline to prevent movement during purging.
- Attach a positive catchment device or properly designed receptacle to the discharge end of the pipeline to safely catch the cleaning device, while still allowing concrete to flow.
- Restrain concrete lines from moving (if using a properly designed receptacle, such as a concrete truck bowl).. Restraint by attachment to the concrete truck's ladder is not an adequate control.
- Keep all workers away from the discharge end while the concrete is under pressure.
- Ensure all workers involved wear adequate personal protective equipment.

4.3.7 Pump cleaning (on site)

Risk

Entanglement, crushing and amputation hazards exist in a concrete hopper and pumping device and can injure workers who stand in or place parts of their body in hoppers. Workers should avoid placing any part of their body within the hopper.

This matter should be discussed by the principal contractor or person in control of the workplace and the concrete pumping PCBU.

Risk control

- A physical barrier to prevent a person contacting moving parts in a hopper should be fitted and maintained at all times during operation
- where cleaning or dislodgement of material requires a worker to enter the hopper, the equipment must be shut down and any accumulated hydraulic or air pressures exhausted that may allow the elements to move or rotate, even with the engine stopped
- cleaning should only be done when there is another person is in the immediate vicinity to provide assistance if required

- workers should receive adequate instruction, training and where required supervision, in cleaning a concrete hopper.

4.3.8 Preparation for road travel

Risk

Unsecured equipment poses a risk to concrete delivery truck drivers, pedestrians and fellow motorists. Over time unsecured equipment may be subject to increased wear which may lead to failure.

Risk control

The manufacturer's instruction must always be followed, particularly where the following items are appropriate:

- outriggers (whether hydraulic or manual), must be secured with a locking device specified by the manufacturer and stowed in a travelling position to ensure that there is no lateral movement
- loose components (such as pipes, couplings and tools etc), must be stowed in appropriate storage areas in accordance with manufacturer or other any relevant published guidelines for the safe carriage of loads on road vehicles (e.g. Load Restraint Guide (2018) National Transport Commission)
- disengage all drives to hydraulic pumps (for operating the concrete pump), boom and/or outriggers, and put the controls in the off position
- boom restraint should be in accordance with any instructions by the manufacturer and should ensure there is no unintended movement of the boom
- air operated devices for 'Engage' and 'Disengage' of 'power takeoff' (PTO) drives must be of an approved type and brand and must have a positive feel for the 'In' and 'Out' position with a warning light when engaged (if able to be operated independently).

4.4 By-products

4.4.1 Noise

WHS Regulation section 57: A PCBU must manage the risks to health and safety relating to hearing loss associated with noise and must ensure that the noise a worker is exposed to does not exceed the exposure standard.

Risk

Exposure to high noise levels can cause permanent hearing loss. Concrete pumps can generate various noise levels that may cause workers to be exposed to noise that exceeds the exposure standard.

The exposure standard for noise in relation to hearing loss, is defined in the WHS Regulation as an LAeq,8h of 85 dB(A) or an LC,peak of 140 dB(C). There are two parts to the exposure standard for noise because noise can either cause gradual hearing loss over time or be so loud that it causes immediate hearing loss.

The *Managing noise and preventing hearing loss at work Code of Practice* gives detailed information on the assessment of noise in the workplace. Use it for guidance on concrete pumping operations. Before pumping equipment is set-up consultation should be undertaken between the

principal contractor or person in control of the workplace and the concrete pumping PCBU, regarding the risk of excessive noise.

Risk control

Suitable hearing protection equipment, and training in its maintenance and use, should be provided to the operators of the concrete pump and other associated equipment if the noise is above the noise exposure limits.

4.4.2 Fumes

WHS Regulation section 51: A PCBU must manage the risks to health and safety associated with a hazardous atmosphere. An atmosphere is hazardous if it does not have safe oxygen level or if the concentration of flammable gas, vapour, mist or fumes exceeds 5% of the Lower Explosive Limit for that gas, vapour, mist or fumes.

Risk

All fumes should be identified and assessed for risk. Of most concern are exhaust gases from the concrete delivery truck and any internal combustion engines. Carbon monoxide is a hazardous chemical and in large concentrations can cause permanent illness and death. An assessment of the truck, concrete pump and associated plant location is necessary, to consider the likelihood of gas build-up.

This matter should be discussed by the principal contractor or person in control of the workplace and the concrete pumping PCBU.

The WHS Regulation states requirements when exposing persons to hazardous chemicals, such as exhaust gas fumes. The PCBU must follow these requirements.

Risk control

If possible place the truck in a position that will eliminate or reduce the build-up of exhaust gas. If it is necessary to place the truck in an enclosed area, ensure that:

- an adequate level of ventilation is maintained to prevent the build-up of hazardous exhaust gases; or
- exhaust gases are vented to open air.

The PCBU should disperse fumes if the concentration level is likely to exceed safe levels, particularly when working in enclosed spaces.

5 Inspection and maintenance

5.1 General

Appropriate ‘planned inspections’ and ‘preventative maintenance programs’ are essential for safety and efficiency in the operation of concrete pumps and booms. The inspections and routine maintenance are to be carried out at intervals specified by the manufacturer and should be carried out:

- daily before commencement of work
- weekly
- monthly
- yearly, and
- six yearly major inspection.

5.2 Compliance plates and certification

All equipment associated with concrete pumping must have the following verification:

- cab and chassis – by the state transport authority in which the unit is registered, with a fixed motor vehicle modification plate showing the appropriate modification codes
- concrete placing boom and outriggers:
  - by the manufacturer, with a fixed plate showing date of manufacture, serial number, maximum recommended working pressure, maximum recommended length of end (or drop hose), recommended maximum size of delivery pipe/hose
  - following each six year major inspection, an inspection certificate completed and signed by the engineer overseeing the inspection along with a comprehensive inspection report
- concrete pump – by the manufacturer, with a fixed plate showing date of manufacture and serial number
- maximum recommended working pressures for hydraulics and concrete etc
- Over Length and Overweight Permits must be obtained, kept current, and in the vehicle for the vehicle to be driven on a public road. Note: refer to Transport and Main Roads laws.

Any pump, boom, prime mover and/or associated equipment not having such a compliance plate or documentation, should be removed from service immediately, until such certification is in place.

5.3 Pre-operational inspections

Before the start of each work period, all concrete pumping/placing equipment should be given a visual inspection and function test – in accordance with the manufacturer’s instructions and recommendations.

Any repairs or replacements should be in accordance with the manufacturer's recommendations and only carried out by trained and competent personnel. Written records should be kept of maintenance and repair work performed on concrete pumping/placing equipment.

5.4 Routine maintenance inspections

The PCBU should establish an appropriate program of weekly, and monthly preventative maintenance inspections of all equipment in accordance with the manufacturer's recommendations which is based on the equipment's working environment and the severity of use of the equipment. Details of these inspections are to be kept in the appropriate log book, and a copy kept in the unit.

5.5 Annual inspections

All concrete placing booms, pumps and all other associated equipment, should be inspected at intervals not exceeding one year by a competent person, for the suitability of continued service, in accordance with the manufacturer's specifications.

The annual safety inspection is to be a comprehensive visual inspection of the boom, its support structure and outriggers (where fitted). The annual inspection should include, but not be limited to, the following:

- a function check for boom unfold/fold, slewing and outrigger deployment to ensure;
  - unit is operating in accordance with manufacturer's specifications and all limits are functioning (e.g. boom rest, stowage, slew, boom fold/unfold)
  - movement is unrestricted and that pivot points do not have excessive movement (play). Where significant play is evident, quantitative measurement should be carried out to determine tolerance is within manufacturer's specifications
- check to see that all joints have adequate lubrication
- check of slew ring and bolts – to determine that all bolts are installed and intact (where the manufacturer specifies a specific test on the bolts, this is to be performed)
- visual inspection:
  - of welds, boom sections (including wear plates), linkages, pins, outriggers and turret for cracks, corrosion and damage
  - of all pin retainers and locking devices (e.g. cheek plates)
  - for boom straightness in vertical and horizontal planes
  - of all hydraulic lines, both flexible and fixed, for damage and leaks
  - of hydraulic cylinders to include inspection of welds, leakage and hard chrome
  - of pipe bracket connections to boom sections.
- where cracking is observed, consideration of NDT examination of cracked areas and whether there is a need to dismantle parts of the plant for an enhanced inspection. The repair method statement should be sought from the boom manufacturer or, if unavailable from the manufacturer, from a suitably qualified engineer. Information in relation to any repairs should be retained with all future reports to assess further defects
- NDT thickness testing where there is evidence that corrosion has reduced a member's wall thickness – followed by an assessment of whether the member requires replacement or repair

- examination of concrete delivery pipeline that includes checking:
  - weight of the pipe and clamps fitted to the boom do not exceed the maximum allowable weight specified by the boom manufacturer
  - pipe clamps for wear, damage and security and to determine they are the correct type.
  - pipe clamps for identification Including manufacture, pressure rating and size.
  - bolts and wedges are appropriate, and R-clips are inserted on quick release clamps.
  - pipelines to determine they are the correct specification for the pump pressure, minimum wall thickness is acceptable, and they are free of damage
- where repairs have been made verification that the repairs have been made in accordance with the manufacturer's instructions or those of a suitably qualified professional engineer
- examination of hopper area including hopper guard
- hopper guard interlocks – safety switch is to isolate all energy sources, so that swing tube and hopper paddles will stop when grate is lifted (switch should dump accumulator pressure)
- checking boom sections and outrigger legs for ingress of water.

5.6 Major inspection for concrete placing booms

Concrete placing booms are subjected to cyclic loading and are generally constructed from high tensile steels. This combination can lead to cracks forming on the boom, boom connections and supporting structure. If undetected, the cracks will continue until catastrophic failure and collapse of the boom occurs. In addition, excessive wear of critical components can lead to failure.

While periodical inspection, including the annual inspection, can highlight faults on the equipment, some critical components can only be thoroughly inspected when the unit is dismantled, and the component is removed.

The first major inspection is to be completed no later than six years after the concrete placing boom was first commissioned, or if that date is not available, six years from the date of manufacture. Subsequent major inspections are to be completed at intervals not exceeding six years.

The major inspection is to be a comprehensive inspection that includes dismantling all high stress areas and components subject to wear, unless considered unnecessary by the certifying engineer, including those areas that normally cannot be readily accessed during periodical inspections.

Potential damage and wear to a concrete placing boom can be caused over time, by the following factors:

- normal operation of the concrete placing boom in accordance with the boom manufacturer's instructions

Note: The boom has a design life – when this is approached defects will start to appear even though the unit has been operated in accordance with the manufacturer's instructions.

- possible misuse of the unit that exposes the boom to additional and more severe loading than the designer intended (i.e. suspending excessive hose from the end of the boom, using the boom as a crane, etc)
- corrosion from water ingress or storage outdoors (particularly in coastal environments)
- in the case of truck mounted booms, and satellite (fixed) concrete placing booms that are transported over long distances, movement and vibration of the unit during road travel. This

effect will be more severe over uneven roads and when the unit is not restrained correctly for road travel.

For the reasons highlighted above, carrying out a major inspection after a set period is a more effective way of identifying and repairing faults on the unit rather than basing the inspection on hours of use as a pump alone.

Completion of the six year major inspection does not guarantee that a concrete placing boom will be safe to operate for another 6 years. It does, however, demonstrate that the concrete placing boom has achieved a minimum benchmark and the boom is safe for ongoing use provided continuing maintenance and inspection is carried out in accordance with the manufacturer's instructions. This maintenance and inspection program will include ongoing annual safety inspections. Should any periodical inspection highlight an unsafe item on the unit the fault is to be remedied immediately and not at the time of the next major inspection.

Major inspections should be carried out by a competent person. A competent person for major inspections means someone who complies with both of the following:

- has acquired through training, qualification or experience, the knowledge and skills to carry out a major inspection of the concrete placing boom
- is registered under a law that provides for the registration of professional engineers.

A certification should be issued stating that the concrete placing boom has undergone a major inspection and is safe to operate. A sample major inspection certificate is in Appendix 3.

Non-destructive testing (NDT): All NDT on the boom and associated parts is to be:

- carried out by a competent person who has been accredited by NATA (National Association of Testing Authorities, Australia)
- in accordance with a testing procedure specified in an Australian Standard wherever practical
- verifiable by means of a signed report that complies with NATA reporting requirements (this will include conditions of the test and a record of discontinuities found).

Removal of paint prior to NDT: It is generally advisable to remove paint from parts prior to NDT, particularly in high stress areas. If the certifying engineer makes the decision to carry out NDT through paint, the test method is to comply with the relevant test method through paint (one of the conditions of such testing will be that the paint does not exceed a maximum thickness).

Inspection criteria:

The major inspection criteria in this code are based on safety items to reduce the risk of boom collapse, boom overturn, falling objects, explosion, or operator injury from the hopper. The inspection criteria are based on the use of the concrete placing boom to pump concrete and not on roadworthiness issues for road travel. Additional inspection requirements for road travel, are contained within road safety legislation.

Prior to dismantling the boom, it is advisable to carry out a load test on the boom in its extended position to determine if the boom or outriggers creep so that any defective hydraulic cylinders can be identified.

Where the concrete placing boom manufacturer provides written instructions for the major inspection, these instructions are to be followed by the certifying engineer. Where instructions on the major inspection do not exist, the certifying engineer is to develop the inspection criteria based on sound and proven analytical practice, inspection methods and pass/fail criteria. The inspection criteria used by the engineer should include but not be limited to the following items:

- dismantling of boom sections, outrigger legs and king post (turret) or slew ring

- checking boom sections and outrigger legs for ingress of water and the associated internal corrosion
- measuring of boom sections for straightness in vertical and horizontal planes
- NDT examination of high stress areas on boom sections, linkages, outriggers and turret for signs of cracking

  Note: Where there are signs of cracks, corrosion or excessive wear, the certifying engineer is to decide on whether the part is replaced with a new part or repaired. Where the part is repaired, the engineer is to prepare a repair procedure that specifies welding details, material types, and dimensions of the repair.
- removal and inspection of all boom linkages
- NDT thickness testing where there is evidence that corrosion has reduced a member's wall thickness
- removal of boom rest plates (doubler plates) where these plates conceal part of the boom
- removal of all boom pivot pins – tolerance checking of pin diameters and examination for cracks
- examination of pipe support brackets
- examination of concrete delivery pipeline that includes checking:
  - pipe clamps for wear, damage and security and to determine they are the correct type. Checking that bolts and wedges are appropriate and R-clips are inserted on quick release clamps.
  - pipelines to determine they are the correct specification for the pump pressure, minimum wall thickness is acceptable and they are free of damage.
- examination of all hydraulic cylinders to include inspection of welds, leakage and hard chrome. NDT of rod and cylinder ends on hydraulic rams. Creep testing of hydraulic cylinders once the unit has been re-assembled. Replacement or repair of hydraulic cylinders where damage is observed or cylinders fail creep test

  Note: Where no visual faults are noted, hydraulic cylinders do not require strip down unless they fail a creep test
- removal and replacement of slew ring bolts with bolts of the type specified by the boom manufacturer
- examination of hopper area including hopper guard
- hopper guard interlocks – safety switch is to isolate all energy sources, so that swing tube and hopper paddles will stop when grate is lifted (switch should dump accumulator pressure).

Re-assembly: Pins are to be installed using retaining (locking devices) specified by the boom manufacturer. After installation of all pins, the name and signature of the competent person(s) who has installed the pins is to be provided in the major inspection report. Bolts, including slew ring bolts, are to be tightened in accordance with the tightening sequence and torque specified by the boom manufacturer. The torque is to be appropriate for the bolting conditions (i.e. whether grease is used or not, the grease type, etc). Once the bolts have been installed, the name and signature of the person who has installed the bolts should be provided in the major inspection report. Once the boom has been re-assembled, a function test of the boom is to be a carried out and the certifying engineer is to be satisfied with the operation of the boom.

When can the engineer decide not to dismantle a component?

Where there is documented evidence that the appropriate inspecting and testing has been carried out on a certain item within two years, this item does not have to be dismantled in the major inspection. However, the competent person must still inspect the safe operation of the item to certify that it is operating safely. The competent person is also to comment on future inspection requirements on the part that has not been dismantled. For example, the pins and bosses on one linkage have been replaced with new parts 18 months ago. The competent person carries out a function test, ascertains that the linkage is operating correctly and that tolerances are within manufacturer's specifications. The competent person notes that this part is to be periodically inspected and that it will require removal and checking within the next four and a half years.

Circumstances under which dismantling of the plant may not be required

Under limited circumstances where the plant has had minimal use and has no adverse effects from its storage (e.g. has been stored indoors), the certifying engineer overseeing the major inspection may decide not to dismantle parts of the plant. When making this decision the certifying engineer is to base the decision on factors including the following:

- the design life of the plant, where this is available for the manufacturer
- a function test and load test to verify the unit is operating in accordance with manufacturer's specifications and all limits are functioning (e.g. boom rest, stowage, slew, boom fold/unfold)
- the certifying engineer has a comprehensive knowledge of the specific make and model of plant - such that the engineer is aware of where cracks and wear are likely to occur and uses this knowledge to decide which parts of the plant do not require dismantling. This should be backed up by documentary evidence (e.g. previous case studies including photographs)
- documentation on the working history of the plant that details the operating frequency and duration. This information should be derived from detailed log books and maintenance records kept for the life of the plant and not be based on statements from the boom owner that the boom has had minimal use (note: some of the more sophisticated units may be fitted with data loggers that can supply some of the use information)
- tolerance checking of critical connections (i.e. those where failure of the connection could result in collapse or overturning of the plant) to check these are within the manufacturer's specifications. Where the manufacturer specifies quantitative tolerances, the tolerances should be measured quantitatively and recorded within the inspection report.
- visual verification and/or testing, by the certifying engineer, that the plant is in good condition, after the plant has been cleaned, outriggers deployed, and the boom unfolded. This visual inspection should identify the absence of cracks, corrosion and damage to the plant. Where cracks exist and corrosion (other than surface corrosion) exist, it would be difficult for the certifying engineer to justify not dismantling the unit
- in the case of mobile concrete placing booms, the absence of damage or metal fatigue on the plant from road travel (i.e. even though a limited quantity of concrete has been pumped the unit may be showing signs of wear and damage from road travel – this may apply more to units operated in rural locations)
- any information from the boom manufacturer that may affect the decision on whether the unit is dismantled (e.g Has there been a safety recall on the unit that highlights failure and/or increased wear of critical components?)
- verifiable documentary evidence that a particular part of the plant has been dismantled and re-assembled to an acceptable standard recently (refer section "When can the engineer decide not to dismantle a component" above)

- full documented history of any minor or major repairs and modifications that have been carried on the concrete placing boom or support structure (photographic evidence and repair method statements should remain with plant for future reference).

Where the certifying engineer has determined that dismantling of the plant is unnecessary, inspection criteria should be developed by the engineer that includes any conditions associated with the ongoing safe use of the unit. For example, the engineer may specify more frequent inspection intervals or may state that the unit requires dismantling within a period of less than six years.

5.7 Inspection report

Prior to the concrete placing boom re-entering service, a comprehensive inspection report is to be completed that includes the following:

- a summary of the history of the boom prior to the major inspection being carried out, unless this is unavailable (if unavailable, the major inspection is likely to be more comprehensive)
- where provided, a copy of the major inspection criteria specified by the boom manufacturer
- extracts of the manufacturer's maintenance manual detailing wear tolerances, bolt torques, and other relevant instructions followed during the inspection process
- a list of work carried out on the boom
- photographs of the unit during the inspection process including photos of damage, wear or cracking
- if the decision has been made not to dismantle parts of the unit, reasons why this decision has been made based on sound engineering justification
- list of competent persons carrying out work on the unit as part of the major inspection
- signed statements from persons involved in the assembly process in relation to:
  - slew ring bolts being installed correctly (taking into consideration bolt type, lubricant if used, and bolting sequence)
  - pin and pin retainers installed correctly
  - hydraulics components installed correctly including a statement that replaced hydraulics components meet the manufacturer's specifications and that fittings have all been tightened to the correct torque
- hydraulic cylinders have been creep tested and are satisfactory
- a summary of parts replaced with copies of receipts for parts provided in the report appendices.

Where some of the work has been contracted to external parties a description of this work and copies of invoices provided in the appendices.

Where the certifying engineer has made the decision not to dismantle the plant, or parts of the plant, the engineer is to document a comprehensive rationale for his or her decision that includes a discussion of the factors included in, but not limited to, the section "Circumstances under which dismantling of the plant may not be required".

5.8 Welding and other repairs

Only a welder or service provider holding the appropriate qualifications, and where possible in possession of the manufacturer's current specifications may perform welding or repair work on the

concrete pump or any associated equipment (including the concrete placing boom, the outrigger system or any other stressed structural component that is related to the overall equipment stability or structural integrity).

5.9 Reporting defects

- A pump operator should report defects immediately
- if a defect is a hazard to safety, pumping operations should be stopped until the defect is repaired
- the details of reported defects and subsequent action taken should be entered into a log book.

5.10 Repair following an incident

Failure of a component on a concrete placing boom can occur during normal operation or when the boom contacts another structure or item of plant. In addition, when a mobile concrete placing boom overturns, damage to the boom and/or outriggers is likely to occur. In the event of an incident where structural failure has occurred or the unit has overturned, the unit is to be assessed by the boom manufacturer or an engineer. This assessment is to analyse the circumstances of the incident to determine the main contributing factors and possible reasons for the failure (i.e. soft ground, design abnormalities, normal wear, collision with other plant, etc). Where the unit is to re-enter service the following additional measures overseen by the manufacturer or engineer are to take place:

- an assessment to determine components that may have been damaged in the incident and that will need to be inspected
- dismantling to the extent necessary to enable adequate inspection of potentially damaged components
- preferably, replacement of damaged components with new components1 that meet the design specifications of the manufacturer
- function testing of the re-assembled boom that may include load testing if recommended by the manufacturer or engineer
- preparation of a detailed report on the repair of the boom that includes a statement by the manufacturer's representative or the engineer that the concrete placing boom is safe to operate.

Notes:

Loadings on concrete placing equipment can be severe and complex. For these reasons, it is usually a safer alternative to replace the damaged component with an original equipment part from the manufacturer. Where the decision is made to repair a component, the repair is not to adversely affect any other parts of the equipment and is to have a design life at least equivalent to the replaced component.

5.11 Log books and inspection record sheets

- Instruction manuals should accompany the pump unit and/or boom, which give sufficient instructions for operation, maintenance and repairs
- maintenance and repair manuals are to be kept in a safe place at the registered premises, and should include a parts catalogue

- the operator should be familiar with the contents of the instruction manual which should be available at the site of operation
- all manuals should be kept up-to-date with any additional information from the manufacturer.
- maintenance log books are to be kept up-to-date, on the pump, and be available on request at the workplace
- all log books and inspection record sheets are to show complete details of all inspections, tests, repairs, replacements and modifications carried out on the equipment
- evidence that the pump and associated equipment has been inspected and certified as 'suitable for continued service' (i.e. in a safe working condition), should accompany the unit, and be made available to the principal contractor or person in control of the workplace for inspection (on request), before the unit is allowed to operate on site
- similarly, up-to-date log books and inspection record sheets should accompany the unit and also be available for inspection by the principal contractor or person in control of the workplace.

5.12 Warning and safety signs

Ensure that all warning and safety signs/stickers are in good condition, legible and positioned on all equipment (after being inspected and found to be serviceable).

5.13 Pipe testing, identification and marking

- All pipeline segments should be clearly identified with a permanently fixed unique identification mark or number, prior to being placed in service.
- Pipe wall thickness should be monitored by inspection to ensure it exceeds the minimum thickness specified by the concrete pump manufacturer, for the specific type and grade of pipe used. Pipeline with a wall thickness less than that specified by the pump manufacturer should not be used.
- In the case of single wall pipe, actual thickness readings should be taken and recorded in a log book at intervals not exceeding one month (i.e. using a calibrated ultrasonic thickness tester). The pipe log book should record wall thickness and pressure details.
- Thickness of twin wall pipe cannot be easily checked unless pipe clamps are removed and an internal inspection is made. Wear rates on twin wall pipe may be less than single wall pipe, however a documented system to reduce the risk of pipeline failure should be implemented for any pipe. In the case of twin wall pipe, internal inspections should also be carried out to verify if the pipe is wearing at the predicted rate and a record of these inspections should be included in a log book.
- The discard procedure for any concrete pumping pipe should not be based solely on assuming that a specific volume of concrete can be pumped through the pipe before it is removed and discarded.

6 6. Safety equipment

6.1 Provision of personal protective equipment (PPE)

Personal protective equipment is the least effective method for controlling risk, however in many circumstances associated with the pumping of concrete this is the most practicable option. Before beginning any pumping operation, the concrete pumping PCBU and the principal contractor or person in control of the workplace, should assess the conditions likely to affect the health and safety of workers and arrange for the provision and use of appropriate personal protective equipment.

The following items of PPE are required when pumping concrete:

- safety helmets
- eye protection
- safety vest
- rubber safety boots.

The following items of PPE may also be required when pumping concrete:

- hearing protection
- gloves.

6.2 Additional equipment

Each pump unit should be equipped with the following items:

- first aid kit (must include eye wash)
- protective creams
- fire extinguishers
- sufficient reflective traffic cones (minimum 450mm high)
- signs (e.g. exclusion zone and use of high visibility vests).

Appendix 1: Dictionary

Australian Standard means a standard, rule, code or specification of the Standards Association of Australia.

Clean out adaptor means a short length of pipe with one end blanked off and connections for a water or air hose coupled to the pipeline for cleaning purposes. It should have a separate air relief valve vented to atmosphere and a pressure gauge when used with compressed air.

Competent person

For the purpose of conducting major inspections under Section 5.6:

- means a person who has the skills, qualifications, competence and experience to inspect the plant; and is registered under a law that provides for the registration of professional engineers.

For all other references in the code:

- means a person who has acquired through training, qualification or experience the knowledge and skills to carry out the task.

Concrete placing boom means plant incorporating a knuckle boom, capable of power operated slewing and luffing to place concrete by way of pumping through a pipeline attached to, or forming part of, the boom of the plant

Concrete pumping pressure means the pressure exerted by the pump on the concrete at the piston head.

Coupling system means the connecting sections of a delivery pipeline.

Delivery hose means a flexible hose used in or at the end of the pipeline.

Delivery pipeline means a portable rigid or flexible piping system supplied in sections with the provision for joining together with a coupling system.

Employee representative means an employee, member of a health and safety committee or a person elected by the employees at a place of work to represent them on health and safety matters.

Engineer means in relation to the performance of a task means a person who—

- is a registered professional engineer under the *Professional Engineers Act 2002*
- is competent to perform the task.

A person must not carry out professional engineering services in Queensland unless they are a registered professional engineer under the *Professional Engineers Act 2002*. For more

information refer to the Board of Professional Engineers of Queensland.

Hose whip means the uncontrolled and rapid motion of the flexible rubber hose on the end of a concrete placing boom or other concrete delivery line.

Outriggers means extendible structural members on the pump unit to increase the dimensions of the base to ensure the stability of the pump in set up, dismantling and use.

PCBU means person conducting a business or undertaking. See *Work Health and Safety Act 2011*.

Principal contractor. See *Work Health and Safety Regulation 2011*.

Pump unit means the concrete pump, concrete placing booms and associated equipment.

Reducer means a pipe that changes the internal diameter of the pipeline.

Relevant workplace area means:

- any place, or a part of a place, used as a workplace
- any area adjacent to the place or part associated with the use of the place or part as a workplace.

Examples of areas that could be adjacent to a place or part and associated with its use as a workplace—

- shopping centre car park
- common area in a shopping centre
- hotel beer garden
- outside play area for a child care centre.

Appendix 2: Sample questions for concrete pump line hands

What are six hazards that you would need to consider and plan for before commencing the task?	
What are the minimum safe distances which must be maintained when operating near low voltage powerlines?	
What precautions can be taken when working near overhead powerlines?	
Name three ways to clean out the concrete pump line	
What are two methods of communication used by a concrete pump operator and a line hand?	
What is the reason for priming a concrete delivery line?	
What would you look for when inspecting a drop hose prior to use?	
What should the line hand do in case of a blocked pipeline?	
Are you permitted to use a concrete placing boom for lifting purposes?	
Where can you find out what PPE is required prior to working on a concrete placing boom?	
Identify all hand signals for the operation of the concrete placing boom?	
Name three points to consider when setting up the outriggers.	
If the concrete placing boom is damaged during the day what should the line hand do?	
What are the procedures to stop the operation of the line in an emergency?	

Appendix 3: Example – Concrete placing boom safety certificate – Major inspection

Certificate no.: _____

Concrete placing boom type: _____

Boom manufacturer: _____

Boom serial no: _____ Plant no: _____

Recorded hours of use (if available): _____

WHSQ plant registration no.: _____ Manufacture date: _____

Owner's company name:

_____

Address: _____

Inspection date: _____

Name of engineer overseeing inspection:_____

RPEQ registration number: _____

Address of competent person: _____

Telephone number: _____

Engineer statement:

I certify that the concrete placing boom, including its outriggers (delete if NA) and ancillary equipment serial number: _____, has received its major safety inspection in accordance with the instructions of the *Concrete Pumping Code of Practice 2019* and is safe to use.
This inspection includes mechanical, structural and hydraulic items of the unit.
Where manufacturer's inspection criteria exist, these have been followed for the purposes of the major inspection.

Engineer signature: _____ Date: _____

Comments:

_____

_____