



Concrete Pumping Health and Safety Guidelines

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Cover photograph: Construction site with concrete mixer and cement pump. Photo by ewg3D/iStockphoto.

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INTRODUCTION

Concrete pumping is an efficient method of moving and placing concrete. This process is used in the manufacture of pre-cast and tilt-up panels, concrete formwork, slab construction, concrete paving and concrete spraying.

The construction and concrete pumping industries must be aware of the obligations to prevent harm to employees, contractors and others under the Health and Safety in Employment Act 1992 (the Act) and its regulations.

These guidelines provide practical advice about the safe operation and maintenance of concrete pumping equipment. The emphasis is to ensure a safe working environment whenever this equipment is used. They are not intended to be an all-encompassing design, maintenance and operation manual. This information is available in manufacturers' operating manuals.

This document is based on the current knowledge of construction methods within the industry, and is not intended to exclude other methods or processes that can be shown to meet the requirements of providing a safe workplace under the Act.

The guidelines were prepared by a committee of representatives from the Concrete Pumping Association of New Zealand (CPANZ) and underwent a public consultation process. This resulted in submissions from a range of affected parties, including the self-employed, employers and employees within the industry.

Consultation with the Ministry of Business, Innovation and Employment ensured overall compatibility with occupational health and safety legislation and technical alignment with standards.

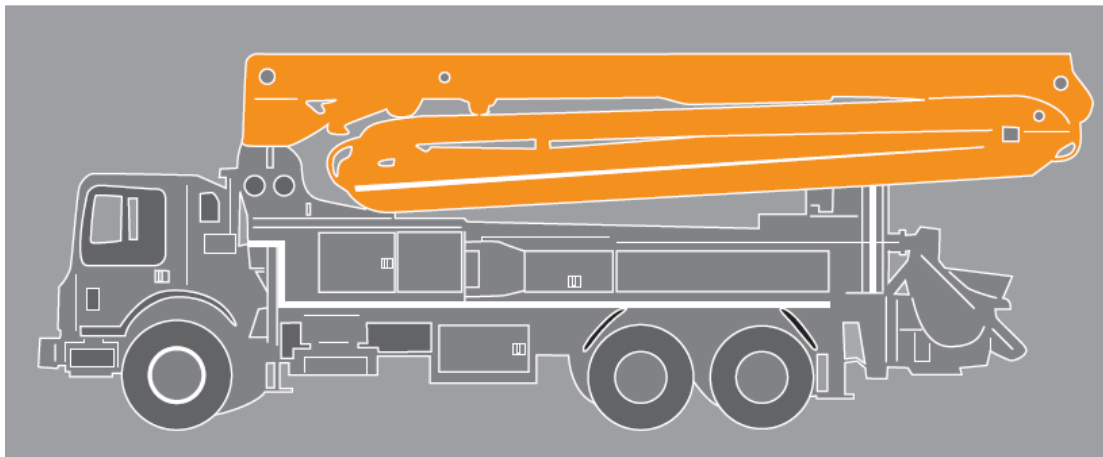


Figure 1: Truck-mounted placing boom

SECTION 1: GENERAL

1.1 Purpose

This guideline provides practical guidance about the health and safety issues of concrete pumping to ensure as far as practicable a safe working environment for people in the industry. It provides guidance for principals, employers, contractors and pump operators (employees or contractors) on how to meet their obligations to provide a safe working environment when using concrete pumping equipment.

1.2 Scope

The guideline applies to the supply, acquisition, disposal, inspection, maintenance, registration and safe operation of all types of concrete pumps and associated placing equipment used in pumping or spraying concrete in the construction industry throughout New Zealand.

1.3 Relationship to New Zealand Standards

This guideline complements the key New Zealand and Australian standards applying to concrete pumps (listed in Appendix B).

1.4 Reference documents

Documents referenced in this guideline are listed in Appendix B. This appendix also provides a list of suggested documents for further reading.

1.5 Definitions

A list of definitions is provided in Appendix C.

1.6 Legislation

A summary of applicable health and safety legislation is provided in Appendix A.

1.7 Hazard controls

All practicable steps must be taken to ensure that hazards are eliminated or isolated, or minimise the significance of the hazard by (for example) changing or modifying the proposed work method, construction method, or by using alternative equipment.

A significant hazard is something that has the potential to cause a person serious harm. "Serious harm" is defined in Appendix C.

If the hazard cannot be eliminated or isolated, control measures must be put in place to minimise risk to employees. In these circumstances, measures such as barricading areas of danger, providing specific safety training and work instructions, using protective equipment and posting of warning signs (as examples) should be implemented.

Such measures should be discussed with employees and other workers, and evaluated to ensure that they are effective and do not create additional hazards.

While it is not a legal requirement to record identified hazards and strategies for controls on a hazard register, this is recommended to ensure that everyone has received the appropriate information on how to keep safe when exposed to the hazards.

An example of a hazard register is located at Appendix F.

Task Analysis

A task analysis that lists the hazards and safe work procedures should be prepared for each concrete pumping operation. A generic task analysis may be acceptable in some cases, but it is likely to be modified to reflect specific site situations.

The minimum requirements for a task analysis include:

- identifying the hazards
- assessing the significance of the hazards and the control measures required to eliminate, isolate or minimise harm posed by the hazards
- identifying a person or people responsible for implementing and monitoring the control measures.

An example of a task analysis worksheet is located at Appendix G.

SECTION 2: MANAGING SITE HAZARDS

This section outlines some of the significant hazards that are likely to occur on concrete pumping sites.

2.1 Manual handling hazards

An employer has a duty to identify and control hazards, including hazardous manual handling tasks. These tasks must be assessed, and if the potential for serious injury is determined, control measures should be put in place to reduce the likelihood that harm will occur.

These and other manual handling tasks should be addressed as likely causes of injury:

Hazard	Controls
During set-up, pump workers manually handle items such as timber pads, reducers, pipes and hoses. When handling these items, the terrain or the access to the work area may increase the risk of injury.	Where practicable, establish walkways around the site and keep it clear of obstacles and debris. Provide non-slip ramps where workers are required to walk up inclines.
The use of hammers on clamps and the flapper box lever, if carried out in areas of restricted access, are tasks that may create an increased risk of injury due to working in cramped positions.	Ensure that impact tools are kept in good condition; wear appropriate protective equipment, such as eye protection. Where practicable, conduct work in environments where there is more space to move.
The incorrect positioning of the pump, ineffective boom placement, wind forces or oscillation due to pumping may cause the hose-hand to forcibly restrain the hose in the required position, risking strain injuries.	Plan the work before the pour commences to ensure that the hose-hand can work in the optimal area. Also refer to section 5.4 for further information.
The laying out of pipes is a task that requires carrying bulky objects. The risk of injury presented by this task can be increased by walking long distances and the need to manoeuvre pipes around obstacles.	Where practicable, use mechanical equipment to lift and move bulky objects. Position bulk stores of equipment as close as practicable to labouring sites to minimise carrying.
Bending one's back to move beneath objects, and stepping over obstructions whilst carrying pipes increases the risk of injury.	Where practicable, establish walkways that are kept clear of debris. Use mechanical equipment to lift pipes over objects or up to higher floors.

The location and design of the storage points on the truck for things like pipes, hoses, reducer and outrigger pads have a bearing on the operators' postures and the distance these items must be carried.

Position the truck as close as practicable to the concrete pour site. Do not use hoses longer than specified by the concrete pump manufacturer.

Clearing blockages in pipelines can be a highly hazardous task, as their removal may release built-up air pressure. This may also be the case during clean-up or when removing and inverting the hose reducer to empty out concrete.

- The end of the hose should not be enclosed by metal. Ensure that non-necessary personnel are kept clear of the pour area. The end-hose should not be longer than what the concrete pump manufacturer recommends.
- Operators should be trained in how to recognise the potential signs of when air blockages could occur in the hose, for example: when first starting, re-starting after moving, when the hopper is empty, if the concrete is too stiff and when the pump is reversed (although it should be recognised that sometimes it may not be possible to predict when an air blockage has occurred inside the hose).

2.2 Cement hazards

Overseas research shows that between five and ten percent of construction workers may be sensitised, or allergic, to cement. Exposing the skin to cement can cause both irritant and allergic dermatitis.

Irritant dermatitis occurs because the abrasive and drying nature of cement on the skin causes it to become dry, itchy, red and scaly.

Allergic dermatitis is caused by a person becoming allergic to a chemical component in the cement, usually chromium salts. This usually occurs upon skin exposure to wet cement. Further, repeated exposure to cement can lead to allergic contact dermatitis. The more often the person is exposed, the worse the dermatitis becomes. Affected people may have to leave the industry if the dermatitis becomes serious.



Figure 2: Wet cement caused the burns to this person's leg.

The symptoms of dermatitis usually show within 24-48 hours of cement exposure. Depending on the severity of exposure, symptoms include:

- a red rash or bumps on the exposed skin
- itching, sometimes severe
- dry, cracked, red patches resembling a burn
- blisters that drain fluid or become crusted
- pain, tenderness or heat on the exposed skin
- scaly, raw or thickened lesions.

Some components or additives in the cement are classified as hazardous substances. This means that the cement supplier has to provide the person in charge of the place of work with safety data sheets. Safety data sheets contain useful information on how to keep safe when handling the concrete, what to do if an emergency occurs or if significant health reactions occur.

Wet cement can cause burns if trapped against the skin (see figure 2). Personal protective clothing or equipment such as gloves or boots must not allow wet cement to be held against the skin.

However, if this occurs, it is important to immediately wash the area with soap and water to remove cement from the skin.

Hazard	Controls
Working in wet cement	• Wear appropriate protective clothing and equipment: gloves, safety goggles (if splashes to the face could occur), long clothing, waterproof footwear. • Remove footwear/clothing immediately and wash skin with a pH-neutral soap and water if direct contact with concrete occurs. • If the symptoms of dermatitis appear, see a doctor as soon as possible for treatment.

2.3 Noise hazards

Workers in the construction industry use a variety of tools and machinery in the course of their work. A significant hazard of using this equipment, or working near people who use this equipment, is excessive noise.

Prolonged exposure to excessive noise causes permanent hearing loss. It is not a general loss of hearing; the ability to hear some frequencies of sound is lost. It is a bit like listening to music with the treble control turned all the way down. Although a person with hearing loss may hear people talking, it becomes more difficult for that person to understand what they are saying.

Continuous exposure to noise above 85dB(A) (an average noise level of 85 decibels over an eight-hour work shift) will cause permanent hearing damage. As a rule, worksite noise exceeds 85dB(A) if conversation at a normal level between people is difficult when standing one metre apart.

Noise is measured on a logarithmic scale instead of a linear scale. This means that if machine A is 85dB and machine B is 88dB, machine B is, in fact, twice as loud as machine A.

On many construction sites, noise levels can be difficult to control. However, if a noise level assessment shows that workplace noise exposure exceeds 85dB(A) over an eight-hour timeframe, the employer must implement hazard controls such as:

- elimination (for example, substituting noisy equipment for less noisy equipment, or using less noisy work processes)
- isolation (for example, noise-reducing booths where noisy portable work can be conducted)
- minimisation (for example, reducing worker exposure to the noise by conducting noisy work at less busy times of the day or night, increasing employees' working distances from noise sources, and providing hearing protection and conducting health monitoring).

The Ministry of Business, Innovation and Employment has carried out noise tests on common construction tools to give an estimate of how loud they are. See figure 3: Noise levels of selected construction tools (overleaf).

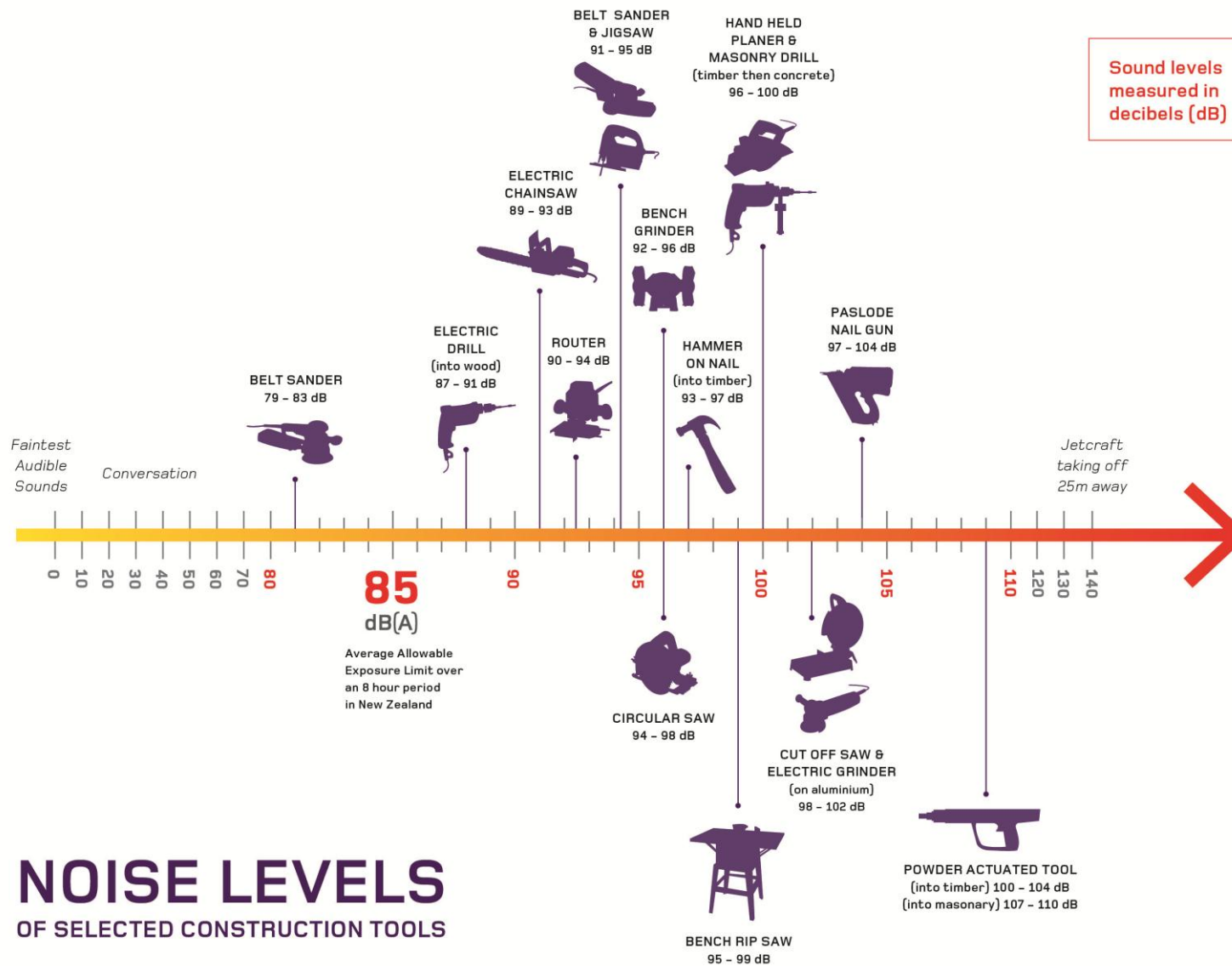




Figure 4: Beware of hazards when set up in enclosed areas

An increase to normal operating noise levels may occur due to sound being reflected back from other structures. Suitable control measures may need to be put in place to ensure that workers in the area are protected. These workers include:

- the workers in the affected area
- the concrete pump operators
- the delivery truck drivers
- the operators of other associated equipment.

When positioning the pump, efforts should be made to minimise the effect of the surroundings on the workers' overall noise exposure.

If workers in affected areas are provided with hearing protection to control exposure to noise, the hearing protection must be worn all of the times when noise levels exceed 85dB(A). Atmospheric testing is required when hearing protection is worn, as the noise hazards fluctuate depending upon the work activities.

For further information on noise level monitoring, refer to the *Approved Code of Practice for the Management of Noise in the Workplace*, available at www.osh.dol.govt.nz/order/catalogue/15.shtml.

Visit the New Zealand Occupational Hygiene Society at www.nzohs.org.nz to find a noise level testing provider, or contact the Ministry of Business, Innovation and Employment on 0800 20 90 20.

2.4 Carbon monoxide hazards

If concrete pumping equipment is set up in an enclosed or semi-enclosed area, special attention should be given to the hazards created by the build-up of hazardous exhaust vapours, particularly carbon monoxide.

Carbon monoxide (CO) is a deadly poison – it is colourless, odourless and non-irritating. Over 10% of people who have survived high carbon monoxide exposures are left with a permanent brain injury. Carbon monoxide is more likely to build up in enclosed or poorly ventilated areas where machines using petrol, diesel or gas are operated. All practicable steps must be taken to control this hazard.

This is what happens to the body when exposed to increasing levels of carbon monoxide:

Concentration of carbon monoxide in air	Symptoms
35ppm	Headaches and dizziness within six to eight hours of continual exposure
100ppm	Headache within two to three hours
200ppm	Headache within two to three hours; loss of judgement
400ppm	Headache within one to two hours
800ppm	Headache, dizziness, nausea and convulsions within 45 minutes; unconscious within two hours
1,600ppm	Headache, accelerated heart rate, dizziness and nausea within 20 minutes, death in less than two hours
3,200ppm	Headache, dizziness and nausea within five to ten minutes; death within 30 minutes
6,400ppm	Headache and dizziness in one to two minutes; convulsions, breathing stops, and death in less than 20 minutes
12,800ppm	Unconsciousness after two to three breaths; death in less than three minutes.

Table 1: Symptoms of carbon monoxide exposure at increasing levels

Hazard	Controls
Exposure to carbon monoxide from petrol, gas or diesel-powered machinery	Ensure that engine exhaust gases from the pump and delivery trucks are directed to the open air, and that a build-up of vapours such as carbon monoxide cannot occur in the work area. Confined areas may require extraction ventilation and/or air-supplied breathing apparatus.

2.5 Overhead power lines and other electrical equipment

If a concrete placing boom is set up in the vicinity of aerial power lines, the principal and concrete pumping contractors should take all practicable steps to ensure that workers are not harmed by the significant hazards faced by working near high-voltage electricity, such as electrocution from direct contact with the lines, or arc flash, where a flashover of electric current leaves its intended path and travels through the air from one conductor to another or the ground.

In line with the hierarchy of controls, where work is being planned in the vicinity of overhead power lines, principals and concrete pumping contractors should take all practicable steps to eliminate the hazard by de-energising the power lines through the line owner. Please note that the line owner will require a reasonable period of notice for this to be arranged.

If it is not practicable to de-energise the power line, principals and concrete pumping contractors must ensure, during all stages of the concrete pumping operation, that no part of the concrete placing boom comes within **FOUR METRES** of live power lines, unless the operator has received written consent from the line owner allowing a reduced distance.

Reasonable notice should be provided for written applications for consent to work within reduced minimum approach distances or to turn the power off to the area.

If approval to work closer to overhead power lines has been obtained in writing, the minimum approach distance between a power line and any mobile plant (in this case, the concrete placing vehicle) shall not be less than specified in Table 2¹.

Circuit voltage	Minimum approach distance (m)
Not exceeding 1 kV – insulated conductor	0.15
Not exceeding 1 kV – conductor not insulated	1.0
Exceeding 1 kV but not exceeding 66kV	1.0
Exceeding 66kV but not exceeding 110 kV a.c. or d.c.	1.5
Exceeding 110 kV but not exceeding 220 kV a.c. or d.c.	2.2
Exceeding 220 kV d.c. but not exceeding 270 kV d.c.	2.3
Exceeding 270 kV d.c. but not exceeding 350 kV d.c.	2.8
Exceeding 350 kV d.c. or 220 kV a.c.	4

Table 2: Required minimum approach distances (written consent has been obtained)¹

¹ Table 6 – Reduced Minimum Approach Distances (where written consent has been obtained) from NZECP 34:2001 *New Zealand Electrical Code of Practice for Electrical Safe Distances*, Energy Safety Service (Ministry of Economic Development)

Consent from the power line owner shall also include:

- the section of power line to which the consent applies
- any other reasonable conditions to be observed when working in proximity to or above the power line.

Competent employees

If the operator of any mobile plant is a competent person working in, or in the proximity of, an overhead power line, the approach distances may be reduced in accordance with the safety practices determined by the overhead power line owner.

It is recommended in these cases that the mobile plant operator is assisted by a spotter, who can determine the machine's proximity to the power lines.

If concrete placing booms or other mobile plant are likely to be used at any time in the proximity of overhead power lines, the owner or operator of the plant should affix an approved warning notice in a conspicuous place as near as practicable to the operator's position. The notice shall be maintained in a legible condition and shall state:

"WARNING: KEEP CLEAR OF POWER LINES".

When considering minimum approach distances, take into account the surge action of the concrete pump boom when it is pumping. This action has resulted in serious harm and fatal accidents through contact with electrical conductors.

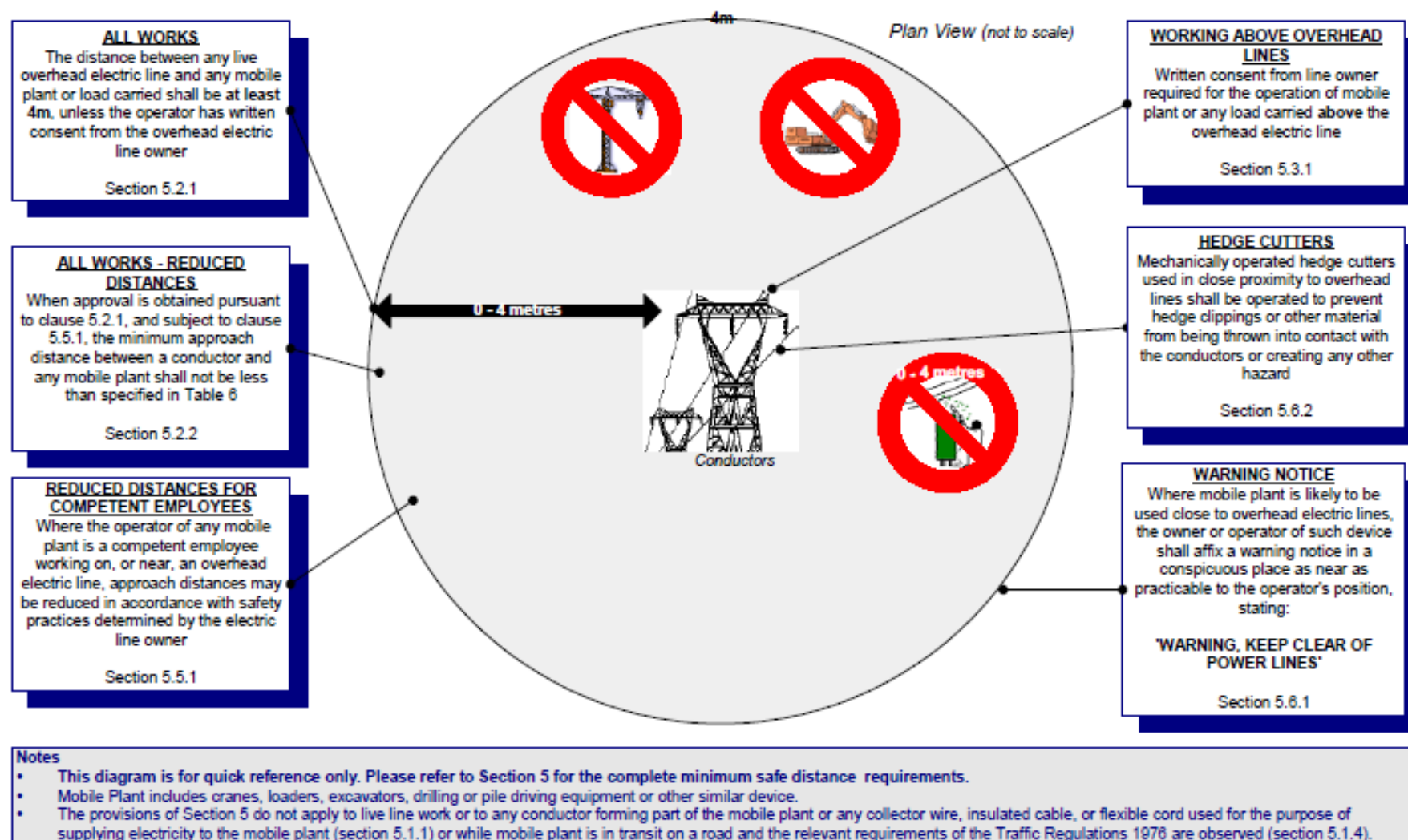
For further information on safe distances when working in the vicinity of overhead power lines, refer to the *New Zealand Electrical Code of Practice for Electrical Safe Distances* NZECP 34:2001, available from the Energy Safety Service of the Ministry of Business, Innovation and Employment (Economic Development).

Website: www.med.govt.nz.

It is recommended that concrete pumping companies engage proactively with the power line companies in order to ensure a viable and efficient working partnership.

Figure 5: Minimum safe distances for the operation of mobile plant near conductors² (overleaf)

² Source: NZECP 34:2001 *New Zealand Electrical Code of Practice for Electrical Safe Distances*, Energy Safety Service (Ministry of Economic Development)



SECTION 3: PLANNING AND PREPARATION

3.1 General

Planning and preparation is the first step in ensuring that concrete pumping is done safely, and must involve consultation with all those engaged in the work.

Planning should incorporate the project's total pumping operational requirements. This plan may need to be reviewed each time a concrete pumping operation is scheduled, to take into account any unforeseen circumstances.

Information regarding principals' legal duties

Section 18 of the Health and Safety in Employment Act 1992 (the Act) places a duty on a principal to a contract to take all practicable steps to ensure that contractors, subcontractors and their employees, are not harmed while undertaking any work under the contract.

A principal or contractor may also be an employer, a self-employed person, or a person who controls a place of work (with duties under section 16 of the Act).

A principal's duty under the Act is limited to matters which they can reasonably be expected to control. There are situations where control of a place of work may be shared by the principal and by contractors. For example, an electrical subcontractor working on scaffolding on a construction site may not be subject to the control of the main contractor (a "principal" in this case) regarding the electrical work he or she is doing, but the use of the scaffolding may be under the control of the principal.

Section 18 is intended to cover situations where either:

- the contractor does not have full control because of conditions in a contract or because hazards are under the control of the principal, or
- work is being carried out where there is no employer/employee relationship, and the principal retains control of the place of work.

For further information about health and safety in contract management, read "A Principal's Guide to Contracting to Meet the Health and Safety in Employment Act 1992" (refer to Appendix B).

3.2 The construction site principal

The construction site principal, in consultation with other involved contractors and the pumping contractor should:

- ensure that enough trained and competent workers are available to safely use the pumping equipment
- ensure that pumping equipment is well maintained and in a sound mechanical condition
- select the most suitable location for the pump set-up, including:
 - an accessible, reasonably level area with a firm base, able to support the fully loaded working pump and concrete delivery trucks
 - clearance from obstructions and excavations

- observing the restrictions of operating near overhead power lines
 - the pump's operational safety zone
- if the pump unit or delivery area is set up in the street:
 - observe all local by-laws
 - observe any requirements for traffic management
 - ensure that the general public is provided with safe and segregated access away from the pumping operation
- have an appropriate method for the collection of residue or waste concrete, before it enters storm water drains, which may result from:
 - concrete truck deliveries
 - spillage
 - the wash-out and cleaning of the pump or lines
- set a realistic time schedule for pumping concrete, allowing for:
 - weather conditions
 - capacity of the pump
 - volume of concrete
 - slab and site limitations
 - traffic requirements
 - local by-laws
 - the concrete contractor's work capacity.

3.3 Concrete pumping contractor

The concrete pumping contractor, after consulting with the principal and other involved contractors, should ensure that the most suitable location for the pump set-up is selected, including:

- an accessible, reasonably level area within the operating capacity of the equipment
- a firm base able to support the fully loaded working pump and delivery trucks
- clearance from obstructions and excavations
- observing electricity safety, including the restrictions of operating near overhead power lines
- the pump's operational safety zone.

The pumping contractor must ensure that any supplied pumping equipment is in a mechanically sound condition and has:

- legible identification on each piece of equipment
- comprehensive operator's instructions or the manufacturer's operation manual(s)
- all of the correctly positioned, legible warning and safety signs/stickers
- all required safety equipment
- an adequate supply of packing for the stabiliser base plates
- a completed assessment of the risks of injury from all associated tasks
- current equipment maintenance logbooks(s)
- any required transport authority permits and vehicle registration
- detailed maintenance and inspection records available upon request.

The pumping contractor must ensure that:

- enough workers are available to safely pump concrete

- safe systems of work are being followed
- personal protective equipment (PPE) is provided and used
- other required safety equipment is supplied and used
- all workers are adequately trained and/or supervised.

Other equipment

Each mobile concrete pump should be equipped with all necessary safety equipment, including a:

- stocked first aid kit
- charged and current fire extinguisher
- a sufficient number of reflective traffic cones (minimum 450mm high for identifying wet roads or pavements).

Additional safety equipment may need to be provided if the pump is set up on or near a roadway, and may include:

- pedestrian warning and diversion signs
- vehicle traffic warning signs
- traffic management equipment.

3.4 Equipment hirer

A supplier who hires or leases out concrete pumping equipment has duties under the Regulation 67 of the Health and Safety in Employment Regulations 1995, including ensuring that the pumping equipment is:

- well-maintained and in a sound mechanical condition
- equipped with all necessary safe use and operating information
- provided with the required maintenance and inspection records.

The vehicle component of the concrete pump shall have a suitable Certificate of Fitness and be registered to operate on the road.

SECTION 4: SET-UP

4.1 General

Concrete pumping equipment in operation should not create a hazard to the operators, other workers or the public.

4.2 Arrival on site

When arriving on site (where practicable), the concrete pump operator, or other experienced representative, should be shown the set-up area, and the site conditions reviewed with the other contractors involved in the pumping operation. Where any of the conditions under which the pumping equipment is to operate are not satisfactory, or if confirmation of the equipment's mechanical soundness is not available, rectification should occur before pumping commences.

4.3 Pump set-up

The concrete pumping area should be reasonably level, solid and free of obstructions, with careful attention paid to the positioning of the pumping equipment and any stabilising devices. In particular, the area should be:

- clear of excavations, trenches or holes in the ground
- clear of inadequately compacted or soft ground
- clear of cellars, basements, pits or back-filled ground, unless stability is approved in writing by a qualified engineer
- clear of overhead power lines and fixed electrical equipment
- of a size enough to allow for safe operation
- of a size enough to allow for the safe discharge from the concrete delivery trucks.

4.4 Boom set-up

The boom placement system should be set up level or at no greater angle than recommended by the manufacturer, as specified in the operator's instruction manual.

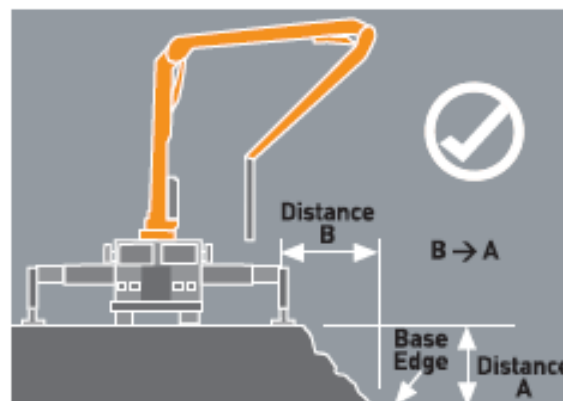


Figure 6: Position pumping equipment clear of excavations

4.5 Outriggers

Where outriggers are fitted, ensure that:

- adequate packing of sufficient strength and load bearing area is available for the outrigger stabilising pads. Packing may include engineered bog mats or suitable timbers. The use of loose softwood timbers is not recommended
- before the boom is erected, that the outriggers are extended, lowered and locked in position. Wherever possible, the outriggers should be fully extended.
 - If outriggers are not fully extended, the reduced safe operating radius must be known and recorded in the task analysis.
- the pads are clear of excavations; soft or filled ground or other obstacles are liable to interfere with the safe operation of the machine
- regular inspections of the outrigger pads are conducted to check for subsidence and loss of stability
- the boom is folded in the travel position before raising the outriggers when making any positioning adjustments.

4.6 Placing the boom

A concrete placing boom should not be:

- raised or left extended when winds exceed the maximum safe wind speed for operation (specified by the manufacturer)
- raised or left extended during an electrical storm or thunderstorm
- used as a crane
- used to pump concrete with the rams in tension, unless designed for this purpose
- raised, lowered or moved when there is insufficient light to do so safely.

In addition, any truck-mounted placing boom should:

- have the earth safety chain deployed before operation
- not be raised from the travel position if under a power line, unless complying with section 2.6.

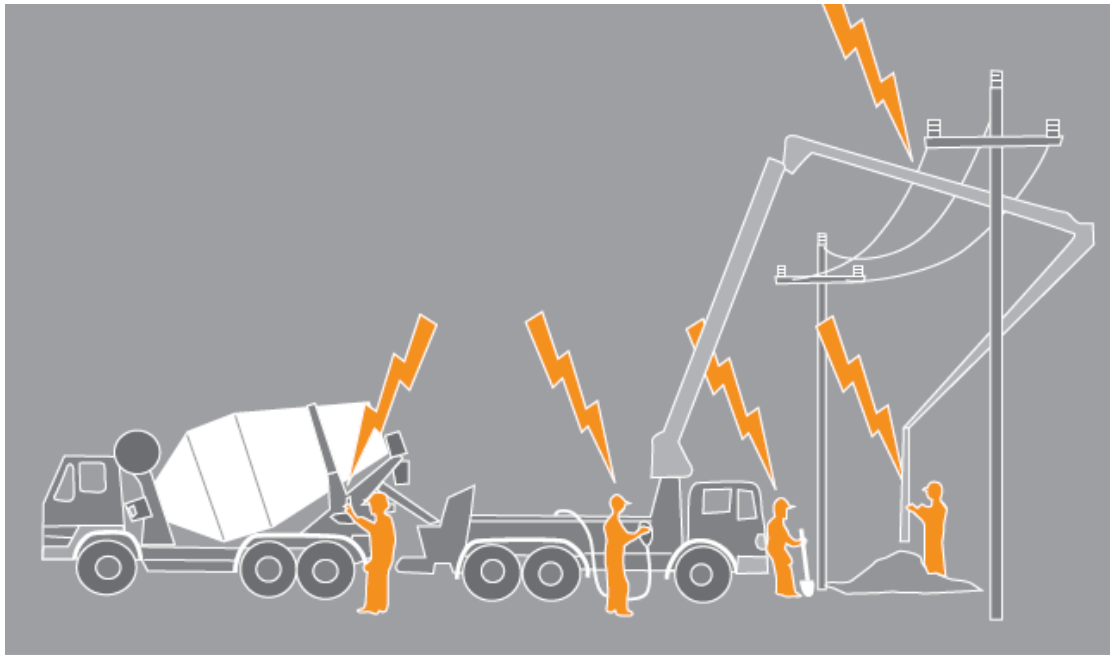


Figure 7: Look up and live - comply with area restrictions

Note: Tiger battens do not protect people from the risk of electrocution or electric shock - they only provide a visual warning for people working in the area of power lines.

4.7 Receiving hopper

General

The concrete pump should be positioned so the receiving hopper is at a height that allows a gravity flow of concrete from the pre-mix delivery trucks into the hopper.

Hopper guard

The concrete pump should not be operated unless the hopper opening is fitted with a grille-type safety guard:

- upon which no-one is allowed to stand
- which prevents access to dangerous moving parts
- is constructed of parallel or mesh bars complying with AS 1418.15: *Cranes (Including Hoists and Winches) – Concrete Placing Equipment*
- which requires a tool to be removed
- is connected to an interlocked cut-out switch designed to stop all moving parts if the guard is lifted.

A correctly fitted hopper guard reduces the risk of body entrapment within the moving parts of the hopper, but due to its design, it cannot protect against all possible contact with the moving parts. Equipment manufacturers use a range of additional measures to limit the likelihood of entrapment, including:

- separating the operator's controls away from the moving parts
- raising the height of the hopper lid from the ground.

When working in the vicinity of the hopper, the manufacturer's operating and safety instructions should be strictly observed.

4.8 Operational safety zone

General

Access to areas around the concrete pump and delivery pipeline should be restricted - the most appropriate method of isolating the area should be used.

The use of one or more of the following controls is recommended:

- covered walkways
- barricades
- posts and safety mesh
- posts and danger tape or flags.

Where the pumping or pipeline set-up is for a longer duration project, the isolation methods should be made more permanent.

Other people

No person, other than those workers directly involved in the concrete pumping operation, should be in the operational safety zone during concrete pumping.

Concrete delivery area

The concrete truck delivery area, including the area around the pump hopper, should be set up to ensure that:

- workers are safe from other vehicles
- adequate lighting is provided if pumping in non-daylight hours
- appropriate signage is posted
- there is clear access for delivery trucks.

If multiple concrete deliveries are expected and on-site traffic management is not provided, only one delivery truck should approach and discharge into the hopper at a time.

If a designated on-site traffic controller is provided, the following safety rules should be followed:

- all personnel connected with discharging from concrete trucks are to wear appropriate high-visibility safety vests
- all concrete delivery trucks must have operational reversing beepers
- the traffic controller and truck driver should be in positions which prevent them from being caught between the hopper and a reversing truck
- the traffic controller should warn the driver at the pump of the presence of another truck being reversed into position
- the traffic controller should be in a position visible to the reversing driver and where the hopper area can be observed
- delivery drivers should ensure that their vehicles remain clear of the discharge area until signalled to reverse into position by the traffic controller

- if the driver loses sight of the traffic controller when reversing into position, the driver should stop immediately.

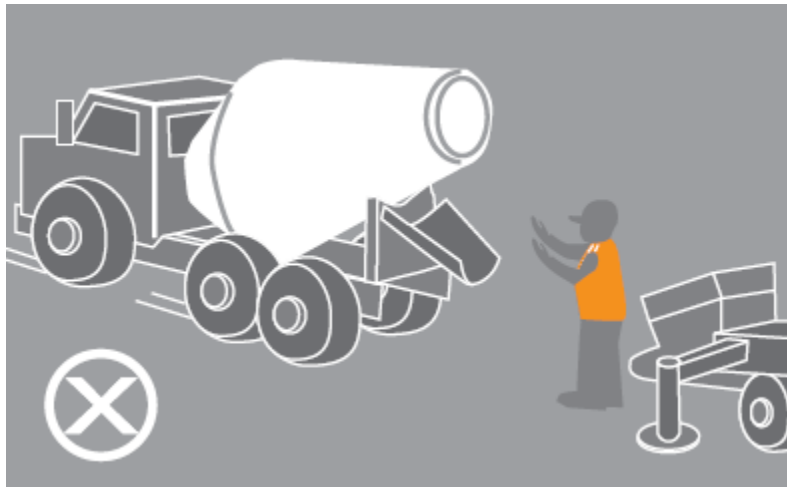


Figure 8: Keep clear when truck is reversing into position - don't stand between the truck and hopper

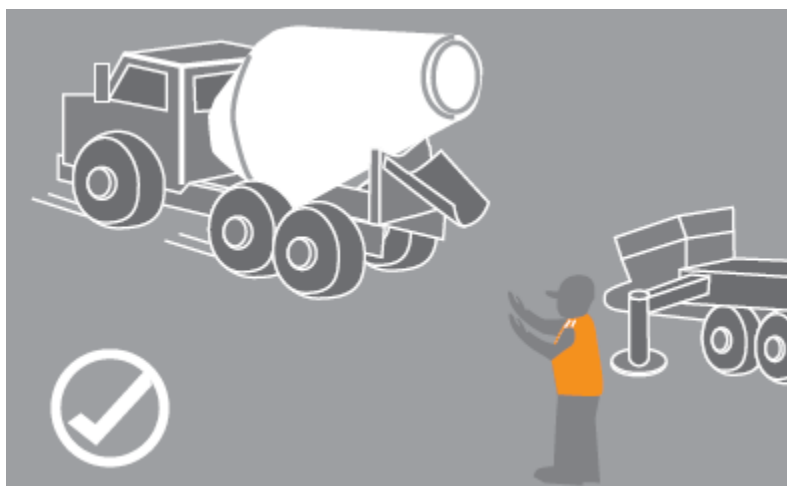


Figure 9: Keep clear when truck is reversing into position - ensure that you remain in the driver's view

Hand signals

Information about hand signals for concrete truck reversing is located at Appendix E.

Public areas

If the concrete pumping equipment or pipeline is in an area accessible to the general public, the principal should provide adequate control measures to protect the public from any dangers associated with the pumping operation.

A. *Pedestrian Controls*

If the general public can come close to any part of the concrete pumping operation, the following options are recommended:

- directing the public to an alternative footpath, or providing an alternative pathway
- installing protective screens to prevent concrete splashing on members of the public
- erecting barricades and warning signs that are compliant with New Zealand Transport Agency (NZTA) requirements.

For longer concrete pumping operations, pedestrian controls should be of a more permanent nature.

B. *Traffic Controls*

The principal, in consultation with the pumping contractor, should provide adequate traffic control measures to comply with NZTA or local government requirements.

For further information, refer to the *Code of Practice for Temporary Traffic Management*, available from Transit New Zealand (refer to Appendix B: Reference Documents).

4.9 Delivery pipeline set-up

When installing a pipeline system, all individual components must be compatible and comply with the pump manufacturer's specifications for minimum pressure rating and maximum diameter. A pipeline should be installed in accordance with AS 2550.15: *Cranes – Safe use – Concrete placing equipment*, ensuring that:

- unnecessary bends are avoided
- each section of the pipeline is adequately supported and secured to the building to avoid extra load on the pipe clamps
- when changing the pipeline from the horizontal to the vertical, the pipeline is fixed to stop movement of the bend or the vertical and horizontal lines which may cause the 90° bend to snap off at the clamps
- cranes or hoist towers, scaffolding or formwork are not to be used to secure the pipeline unless designed for this purpose
- all metal pipes and pipeline components are identified and inspected before installation
- the designed pressure of the pipeline is compatible with the rated maximum concrete pressure of all pumps to be used on the pipeline during normal operations.

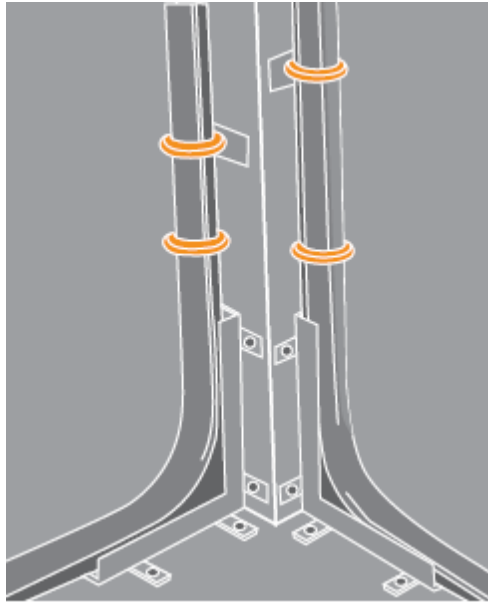


Figure 10: Securely fix the pipeline to avoid movement

Note: If a pump fails during operation, a replacement may be required to complete the pour and clean out the pipeline. If a pump of the same or lower (if suitable) pressure rating is not available, a higher pressure rated pump may be used to complete the pour, provided:

- the concrete pressure rating of the pipeline is known
- there is a method of monitoring concrete pressure
- an operator is continually monitoring the concrete pressure
- the concrete pressure does not exceed the pressure rating of the pipeline.

Note: if the manufacturer provides a conversion factor, the pump's hydraulic pressure gauge may be used as an indicator of concrete pressure.

Pipe clamps

Clamps connecting concrete piping need to be of the correct size, appropriate for the pressure rating of the pump, and maintained in good condition.

All pipe clamps used on any pipeline system must be:

- able to sustain the maximum concrete pressure applied to the pipeline by the pump
- regularly inspected by a competent person for signs of wear or fatigue
- immediately replaced if deformed or damaged.

Clamps should also be permanently marked with the manufacturer's name (or trademark), and the maximum permissible operating pressure. The clamps should be rated at a working pressure equal to or greater than the maximum working pressure of the concrete pump.

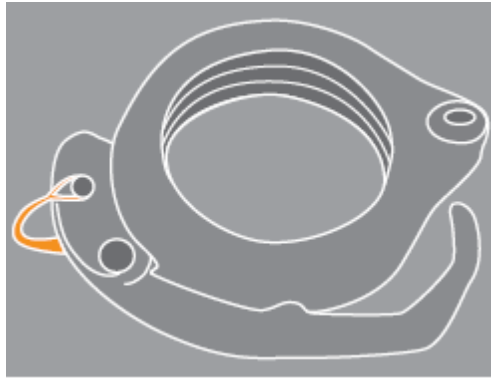


Figure 11: Quick-release clamp with locking pin

Quick-release pipe clamps may only be used if provided with locking pins, and should be visually checked prior to each pumping operation.

Locking pins, R-type or equivalent, are to be fitted and engaged when quick-release pipe clamps are used on fixed or vertical pipelines, or:

- where compressed air is used for cleaning pipelines
- the rated maximum concrete pressure exceeds 40 Bar.

All pipeline connections from the boom must be secured by safety chains or wire straps to prevent the pipeline falling to the ground if a clamp fails.

Pipeline movement

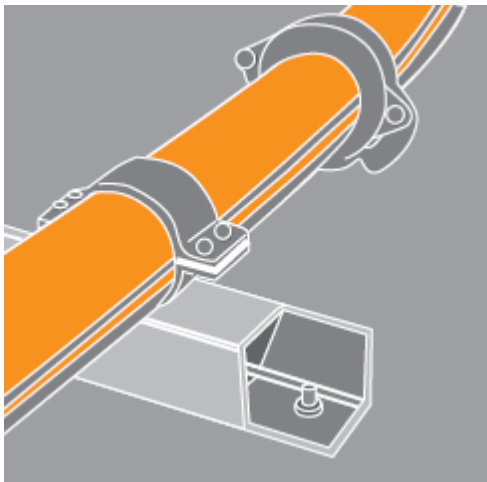


Figure 12: Use anchor brackets to restrict pipe movement

The pipeline should be adequately secured to the building or structure, with attention given to the reaction forces generated where high pump pressures are involved. The mounting system should be designed to ensure the pipeline remains in place.

Support brackets in a vertical pipeline should be spaced no more than three metres apart. Expansion anchors of the high-load slip control type or other fixing methods of at least the same structural strength should be used if fixed to masonry.

The surging action of the pump should not cause excessive pipe movement. If required, additional anchor brackets or other suitable methods to restrict pipe movement should be used.

End-hose

The rubber delivery end-hose should:

- be inspected for excessive wear or damage prior to being fitted

- where connected to a boom: be secured by a safety chain, sling or other restraining device
- not contain metallic parts
- not be longer than specified by the pump manufacturer.

If concrete pumping has stopped and the hose is manoeuvred over a work or public area, the operator must prevent concrete falling from the hose outlet.

End-hose and reducer combination

If the delivery end-hose is replaced by a hose and reducer combination, only those combinations assembled to the manufacturer's instructions should be used, and:

- locking pins are to be engaged on all quick-release pipe clamps in the assembly
- each piece must be capable of withstanding the rated maximum pressure of the pump
- each hanging piece is tethered by a safety cable, sling or chain
- the combined weight of all pieces **MUST NOT EXCEED** the weight of the manufacturer's recommended end-hose.

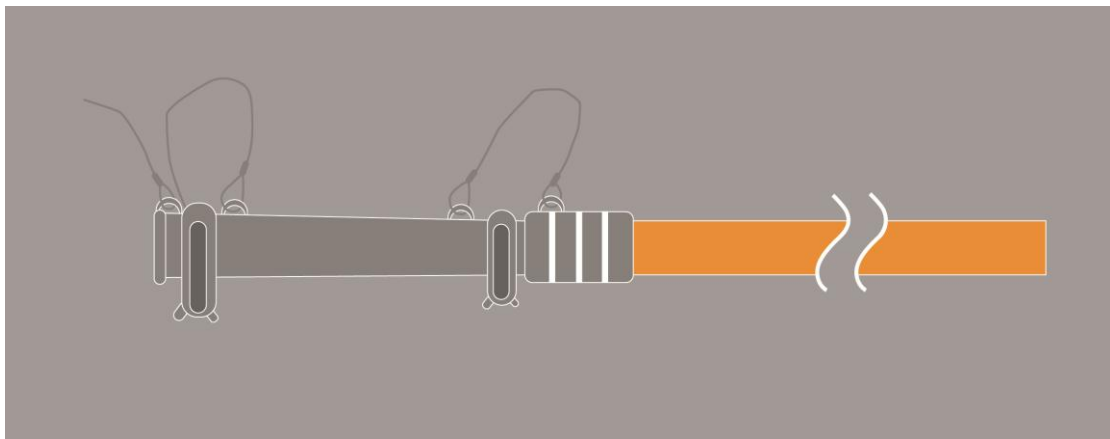


Figure 13: End-hose and reducer with safety slings

SECTION 5: OPERATION

5.1 General

To safely operate any type of concrete pumping equipment, it is necessary to have enough workers to control the pumping operation. These workers need not be directly employed by the concrete pumping contractor, but should be trained and experienced, and require their employer's authorisation before commencing the work.

5.2 Communications

The effective passing of directions from the hose-hand to the pump operator is essential for safe concrete pumping. The following examples may be used:

- non-verbal: a set of standard hand signals which cover all of the pump's operational functions (refer to Appendices D and E)
- verbal: standard operational phrases that may be delivered by a dedicated two-way radio system.

5.3 Pump and boom operators

The concrete pumping equipment operator should be trained in the operation of the type of plant being used, and:

- be familiar with the instruction manual(s)
- be able to carry out daily maintenance inspections
- before pumping commences, carry out a visual inspection of the pipeline
- not leave operating equipment unattended
- not adjust the hydraulic pressure of the pump and pipeline to which the pump is connected
- not pump concrete unless the hopper guard is in the closed position
- not stand or allow any other person to stand on the hopper guard or beneath the raised boom
- be located at the pump controls, or if using a remote control, have a clear view of either the hose-hand or the hopper
- follow the directions of the hose-hand
- if using hand signals and out of view of the hose-hand, be assisted by another worker to relay directions
- if out of view of the hopper, have a worker positioned at the hopper to operate emergency systems and control the discharge process
- report defects to the pumping supervisor without delays; if they are considered to be a significant hazard, stop pumping operations until they are repaired
- record daily inspections, defects and repairs in the logbook.

5.4 Pump operator/hose-hand

If a mobile concrete pump is fitted with remote control facilities, the operator may operate as a hose-hand and also control the concrete pump under the following conditions:

- a site-specific task analysis has been completed that addresses all issues relating to this dual function

- a worker is positioned at the hopper to operate the emergency systems and to control the discharge process.

If a mobile concrete placing boom is to be controlled, these additional conditions should be followed:

- the hazards of accessibility by the public or other workers have been addressed
- the boom is visible to the operator and the pump is in an audible range
- there are no obstructions which the moving boom may contact during the pumping operation.

5.5 Hose-hand

Fatal accidents have occurred where hose-hands have been killed by the end-hose whipping around under high pressure and hitting their head or body. This is a significantly hazardous operation, and all practicable steps to ensure the safety of the hose-hand and others in the vicinity of the hose must be taken.

Hose-whip

Hose-whip can occur either during the concrete pumping operation, or when the hose is being cleaned out. It is generally caused by air getting trapped in the hose line, usually behind a concrete blockage. If this happens, the air pressure behind the blockage builds up, and can eject the blockage with such force that the hose becomes unmanageable. Often the hose 'whips around' and strikes the operator with force. Fatal accidents have occurred when the hose has struck operators in the head or face.

Hazard	Controls
Fatal or serious accidents caused by hose-whip	• Do not attach metal fittings to the free end of the rubber delivery hose. • Inspect the delivery hose for wear or deterioration before use. • Use concrete that is of a pumpable consistency specified by the concrete supplier. Concrete that is too stiff is likely to cause blockages. • Do not let the concrete solidify in the line, as this also causes blockages. • The hose-hand should be able to communicate with the pump operator at a distance. • Experienced operators should be used to operate the hose. (Trainee workers may operate the hose under the direct supervision from a competent and experienced operator). • Start the concrete pump slowly to minimise air getting into the hose. • Do not stretch the hose if it cannot reach the pouring location. • The hose length should not exceed the manufacturer's recommendations. • Wear the appropriate personal protective equipment,

including a hard hat.

- Maintain good housekeeping around the pour site to minimise tripping hazards.
- If possible, avoid working directly beneath the raised boom by manoeuvring the hose from the side.
- The delivery hose on a boom pump should hang vertically and only be guided (instead of forced) by the hose-hand.
- Do not allow concrete to fall out of the hose when pumping is stopped (this lets air into the hose).
- The hose-hand should stand on a flat surface, and not on walls or unguarded structure edges.
- Ensure that someone is in position to view the hopper and shut the pump down if air gets into the system, for example, if concrete runs out.
- Other personnel (not related to concrete pumping) should be kept clear of the pour area.

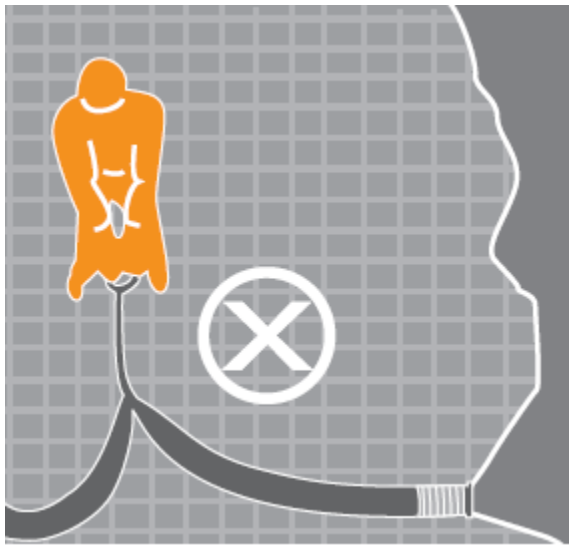


Figure 14: Do not allow hose to kink



Figure 15: Let the boom do the work

5.6 Workers

All workers engaged in concrete pumping should be instructed in the concrete pumping task analysis. Where it is applicable to the tasks undertaken, additional instruction may need to include:

- manual handling procedures relating to concrete pumping;
- communication methods for relaying directions;
- traffic management if directing multiple reversing pre-mix concrete delivery trucks.

Only those workers who are appropriately trained in traffic management and road safety procedures should act as road traffic controllers.

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

5.7 Trainee workers

Trainee workers must be under the direct supervision of a suitably trained or experienced worker who has been appointed as a supervisor by the employer or contractor, and can immediately take action to rectify a dangerous situation.

5.8 Concrete delivery drivers

When delivering to the site, it is essential that all concrete delivery drivers follow the directions of the worker(s) responsible for controlling traffic and the concrete discharge process. This is critical when multiple trucks are discharging or manoeuvring at the pump site.

A number of concrete mixer drivers have been injured by bursting pump lines and couplings. The following actions should be undertaken by drivers working near concrete pumping operations:

- stay well clear of pump lines and couplings where practicable;
- wear all required personal protective equipment (PPE); and
- immediately report any safety problems to the pump operator or foreman for action.

5.9 Cleaning of equipment

Cleaning out residual concrete from pumping equipment should only be carried out by trained workers in accordance with the manufacturer's procedures or the detailed written instructions developed by a competent person. When concrete pumping equipment is being cleaned out, ensure that another person is in the immediate vicinity to provide help in an emergency.

Pipeline

When cleaning out pipelines, the following safety precautions should be observed:

- the end-hose should be secured or removed before cleaning to prevent the hose whipping around
- the discharge end of the pipeline should be fitted with a cage to safely catch the cleaning device, but at the same time allow the concrete to flow
- all workers are to be kept clear of the discharge end while the concrete is under pressure
- never attempt to dismantle the pipeline while it is still under pressure.



Figure 16: The end-hose should be secured or removed



Figure 17: Keep clear of discharge end of pipe



Figure 18: Never dismantle pipeline while under pressure

If compressed air is used to clean the pipeline, the following safety precautions apply:

- the air entry point to the pipeline is to be fitted with:
 - a large diameter discharge air ball valve, to allow de-pressurisation (venting) of the line before removal
 - a smaller air entry ball valve
 - a pressure gauge, to show the air pressure in the pipeline.

Semi-permanent pipeline

If a semi-permanent pipeline is installed, (for example, a large construction project), the clean-out procedure(s) should be specifically designed for that installation, taking into account the general requirements in section 6.9 and specific site conditions.

Pump and hopper

When cleaning out the pump and/or hopper, the operator should ensure that the manufacturer's cleaning instructions are followed. To prevent the risk of entanglement, the following should be taken into account:

- mechanically locking the moving parts in position
- shutting down the equipment
- disengaging the hydraulic pumps
- exhausting accumulated hydraulic or air pressure and allowing time for the pressure to be fully released from all systems
- ensuring the pump is not under pressure before it is dismantled
- not allowing any part of the worker's body to be placed into the pump or hopper while cleaning.

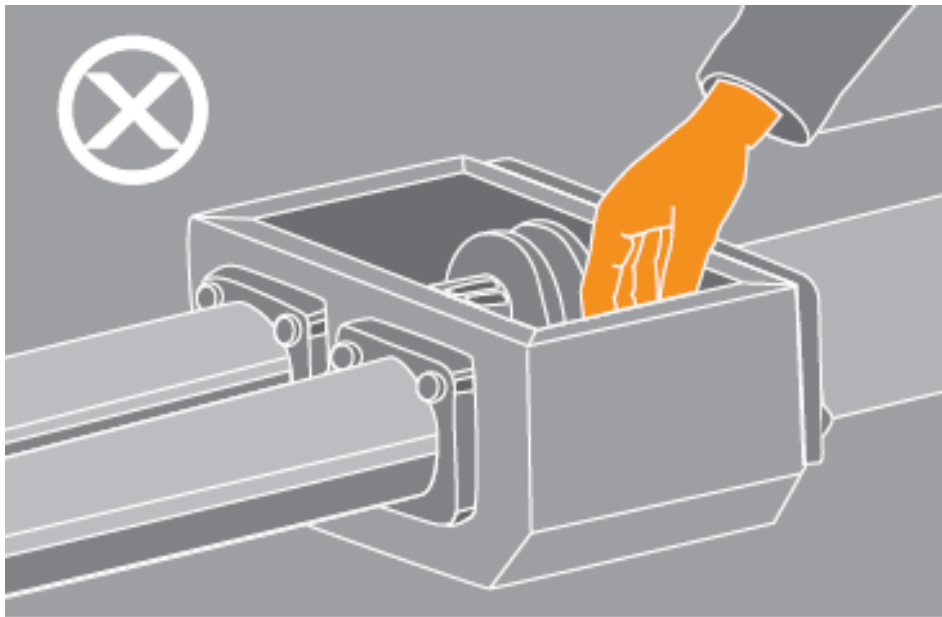


Figure 19: Dangerous cleaning practices



Figure 20: Dangerous cleaning practices

Note: Where fitted, the interlocked cut-out switch on the hopper guard should not be solely relied on to prevent movement of parts during cleaning.

5.10 Preparation for road travel

The manufacturer's instruction manual should always be followed; and may include:

- the boom being is folded and placed in the travel position before the outriggers are retracted, and securely stowed in the travel position with locking devices engaged
- any loose components (such as pipes, couplings, or tools) are to be correctly stowed or restrained on the vehicle as per the New Zealand Road Rules
- all power take-off (PTO) drives to hydraulic pumps for the concrete pump, boom and outriggers are disengaged and the controls put in the OFF position
- before moving, visually inspect the vehicle to confirm everything is secured.

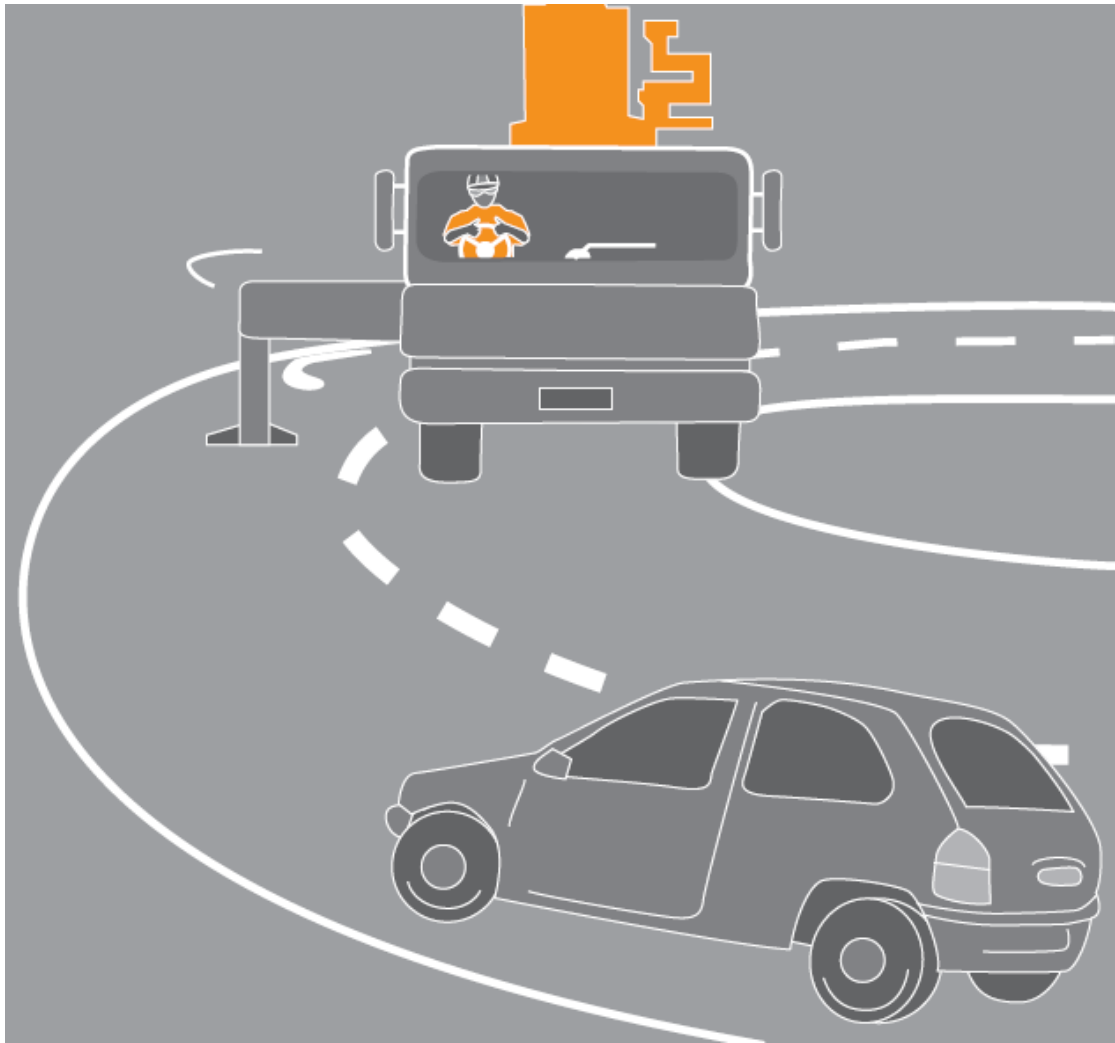


Figure 21: Confirm everything is secured before moving

SECTION 6: EQUIPMENT

6.1 General requirements

All concrete pumping equipment should fully comply with the 1418 series of Australian Standards, including *AS 1418.15 – Concrete Placing Equipment*, or equivalent standards.

6.2 Documentation

Any equipment – new, used, imported or locally manufactured – should be accompanied by all the appropriate documentation, including evidence of compliance to the appropriate standards, and should be retained for the life of the equipment. All documentation, including operation and safe use instructions, should be in English.

6.3 Identification

Data plates and vehicle permits

Concrete pumps and associated equipment prior to operation must have:

- all required vehicle permits and road registration
- if it is a truck-mounted placing boom, a Certificate of Fitness and registration
- legible and permanently marked data plate(s) in prominent position(s), containing:
 - the manufacturer's, distributor's or certifying competent person's name
 - the date of manufacture, or if unknown, the date the data plate was issued
 - the make and model numbers if known
 - the serial number.

The Manufacturers/Operators Manual should include the following information:

- rated length and height of the boom
- maximum allowable concrete pressure
- maximum length and nominal size of the end hose
- maximum nominal size of delivery pipe
- maximum loading, if fitted, of each outrigger leg
- maximum hydraulic pressure
- maximum concrete pressure
- pump capacity.

(The manufacturer's or operator's manual should always be carried in the cab of the vehicle).

A vehicle chassis on which any concrete pumping equipment is mounted must:

- be registered for travelling on public roads
- be in a roadworthy condition
- have an engineer's report for any structural alterations
- if required by transport regulations, have a vehicle logbook.

6.4 Pipeline components

The manufacturer or supplier must certify that all materials, pipes, hoses and accessories are safe to use in concrete pumping systems and are within the calculated design pressures. When components from different manufacturers are assembled, all components should be compatible, and the pipeline must have the design pressure of the lowest-rated component.

6.5 Hydraulic systems

The main hydraulic control panel should be fitted with an easy-to-read and accurate gauge that indicates the hydraulic fluid pressure supplied to the concrete pumping equipment. The entire concrete pumping system shall be protected against over-pressurisation.

Where variable pressure is available, the maximum must not exceed the manufacturer's recommended maximum safe operating pressure.

6.6 Controls

All concrete pumping equipment controls should comply with the relevant requirements of AS 1418.1, including:

- emergency stop button(s) that immediately stops all movement and pumps
- controls clearly marked with symbols or words in English to show their function
- where practicable, movement of controls should correspond with the direction of the motion being controlled
- all controls, when released, should return to the neutral position
- where multiple control positions are fitted, be operable from only one position at a time.

6.7 Pipeline and hose sections

Prior to being placed in service, each pipeline and hose component should be clearly and permanently identified with a unique mark or number to distinguish it from other components of the pipeline.

The following information should also be permanently recorded on the pipe or in the pipeline inspection logbook:

- the grade of pipe
- designated pipe diameter
- maximum concrete pressures and minimum wall thickness
- if a flexible hose, the manufacturer's recommended maximum operating pressure.

6.8 Manuals and logbooks

The pumping contractor or hirer must ensure that the pumping equipment has:

- a copy of the manufacturer's or operator's manual, or sufficiently detailed written instructions developed by a competent person, covering:

- transportation
- set-up and safe operation
- emergency procedures
- minor maintenance and repairs
- **note:** pumping equipment should only be operated under those conditions specifically covered in these manuals
- a maintenance logbook that contains the information listed on the data plates and has been maintained up-to-date, listing:
 - any defects found
 - all repairs carried out
 - details of all equipment inspections
 - details of monthly pipe inspections
 - **note:** logbooks are available to purchase from concrete boom manufacturers and suppliers
- maintenance records that are up-to-date with any additional information from the manufacturer.

The pumping contractor or the principal contractor must ensure that the pump operator is trained and competent in:

- understanding the operator's manual or instructions
- carrying out the daily operational inspections
- maintaining the logbook.

6.9 Warning and safety signs

The pumping contractor or hirer must ensure that all appropriate warning and safety signs/stickers are available, in good condition and correctly positioned on the equipment.

WARNING
OUTRIGGERS MUST BE FULLY
EXTENDED AND ON A FIRM
BASE BEFORE RAISING BOOM

CAUTION
THE CONCRETE
PLACING BOOM MUST
NEVER BE USED AS
A CRANE

Figure 22: Warning and safety signs must be legible

6.10 Disposal and acquisition of used equipment

When selling or disposing of used concrete pumping equipment, the supplier should identify any components of the plant that are unserviceable. The unserviceable components may constitute a hazard in the operation of the plant. Where plant is identified as not fully serviceable, the supplier shall inform the purchaser in writing that the plant should not be used until the plant is fully serviceable.

The supplier should provide any information in their possession relating to the safe use of equipment and any inspection, maintenance and repair records.

It is recommended that prior to purchasing any concrete pumping equipment, an experienced engineer, or the manufacturer's agent or representative or similar competent person, should inspect the equipment and determine if its condition is such that it can be expected to be safe for use of the repairs necessary to make it serviceable.

Section 18A of the Act also applies, placing duties on people who sell or supply plant for use in a place of work. The intention of section 18A is to ensure that any plant used or for use in a place of work is designed and made, and has been maintained, so that it is safe for its intended use.

6.11 Acquisition of unserviceable equipment

A person who acquires concrete pumping equipment in need of repair must ensure this equipment complies with the necessary standards before it can be returned to service. An experienced engineer, or the manufacturer's agent or representative or similar competent person, should certify in writing that the unit complies with the appropriate standard(s), and its condition is such that it can be expected to be safe for use until its next scheduled inspection.

If a record of the maintenance and inspection is not supplied with the equipment, it should be subjected to a major inspection and assessment in accordance with section 7.3 and AS 2550.15, to determine its suitability for use.

SECTION 7: MAINTENANCE AND INSPECTION

7.1 General

A preventative maintenance and inspection regime is essential for the safe and efficient operation of concrete pumping equipment.

Programme types

This maintenance and inspection programmes should follow either:

- A. a programme designed by a competent person to comply with the requirements of AS 2550.15 or
- B. a programme based on the manufacturer's recommendations in consultation with a competent person. This type of programme can only be established where there are verifiable records stating that:
 - (i) the concrete pumping equipment has been continually maintained in accordance with those recommendations since the pump was first put into service or
 - (ii) the manufacturer, at the time of purchase, had inspected the used concrete pumping equipment and issued a certificate deeming it satisfactory for continued service, and has been maintained in accordance with the manufacturer's recommendations since being put back into service.

Programme structure

The maintenance and inspection programme should include provisions for:

- pre-operational tests and checks
- routine inspection and maintenance at specified time intervals
- recording in the logbook and maintenance records all:
 - inspections and maintenance
 - defects found and repairs undertaken
 - structural alterations.

7.2 Annual inspections

General

All concrete pumping equipment should be inspected annually by a competent person such as a chartered professional engineer (CPEng) at intervals not exceeding 365 days.

Where there are no verifiable records of previous maintenance, inspection, repairs or modifications, a major inspection should be carried out by the competent person to determine the equipment's suitability for use.

Criteria

The annual inspection should be in accordance with the maintenance and inspection programme defined in AS 2550.15 or in the manufacturers' recommendations, and must include a report on specific critical wear and stress issues.

The inspection will also include an audit of the equipment's logbook to:

- determine that the required inspections and maintenance have occurred
- review the record of defects
- ensure the necessary repairs have been carried out.

7.3 Major inspection

The purpose of this inspection is to ensure that older equipment is suitable to continue in service.

Assessment for continued service

All concrete pumping equipment over 10 years old that does not meet the requirements of section 7.1 should be subject to an initial major inspection in accordance with AS 2550.15.

This inspection report, prepared by a competent person (such as a CPEng), should include:

- a confirmation of visual and selected strip-down of critical components as required or where necessary
- any defects discovered and all remedial actions undertaken to bring the equipment up to standard
- an assessment of the mechanical condition of the equipment
- a review of the existing inspection and maintenance regime to assess its continued suitability and modify as required
- a confirmation of the implementation of the inspection and maintenance regime
- a specified time period (not greater than five years) until the next assessment for continued service.

7.4 Repairs and modifications

Any repairs made to concrete pumping equipment should follow the detailed instructions of the manufacturer or the competent person as outlined in the maintenance and repair manuals.

All repairs and any replacement of components should be:

- carried out by trained and competent persons
- compatible with the equipment and parts supplied from the manufacturer
- recorded in the logbook
- detailed in the maintenance records.

Fitting of any concrete pumping equipment which involves modifications to a carrier vehicle should comply with AS 2550.15.

Welding

Welding of any type of concrete pumping equipment or pipeline component should be:

- carried out by a suitably qualified welder
- recorded in the logbook
- detailed in the maintenance records.

Outriggers and concrete placing booms or any other stressed load bearing components should be welded in accordance with AS/NZS 1554 by a qualified welder, competent in welding high-stressed components.

7.5 Testing pipeline components

All metal pipes and pipeline components should be checked for wall thickness at frequent intervals and the results recorded. Any used components in storage should be tested before being returned to service. Piping that has a wall thickness less than the recommended thickness for the pump's designed maximum concrete pressure should not be used.

An example pipeline inspection log sheet is located at Appendix F.

Criteria

Wall thickness testing should be conducted by ultrasonic test instruments or other suitable method. All testing must be carried out by competent persons. The test equipment should be calibrated regularly and maintained according to the manufacturer's requirements.

Pipes must not be used if the wall thickness is less than that recommended by the pipe manufacturer for the maximum concrete pressure of the pump. The suppliers of pipes for concrete pumps should provide data on the minimum wall thickness for differing pump pressures. The minimum wall thickness of single wall pipe is dependent on the grade of pipe, the maximum working concrete pressure of the pump and diameter of the pipe.

If the supplier's information is not available, minimum wall thickness can be calculated using the formula in AS 4041: *Pressure Piping* (refer to section 3.14.3(a)(1) of AS 4041 for greater detail).

The following table, calculated using the formula in AS 4041, provides default minimum pipe wall thicknesses for 108mm and 133mm outside diameter seamless steel pipes at different concrete pressures. These minimum thickness values cannot be used for pipe with diameters greater than those specified, nor can the table be extrapolated for other grades of pipe.

Maximum pressure		Outside diameter of pipe					
kPa	Bar	Grade 200		Grade 250		Grade 350/ST-52	
		108mm	133mm	108mm	133mm	108mm	133mm
4,500	45	2.2	2.7	1.7	2.1	1.3	1.6
6,000	60	2.9	3.5	2.3	2.8	1.7	2.1
8,000	80	3.8	N/A	3.0	3.7	2.3	2.8
10,000	100	N/A	N/A	3.8	N/A	2.9	3.5
12,000	120	N/A	N/A	N/A	N/A	3.4	N/A

Table 3: Minimum pipe wall thickness (mm)

- Grade 200 pipe thickness values are to be used if the grade of pipe is unknown.
- 120 Bar thickness values are to be used if the maximum concrete pressure of the pump is unknown.
- These requirements are for normal operating conditions; fixed pipeline systems for high-rise developments could use greater pressures and may need thicker pipes.
- Double wall pipe should use the manufacturer's nominal outer wall thickness as a minimum wall thickness.

Testing personnel

A person who carries out testing or inspection of any pipeline component should be competent and have received instruction in the method used, which may include the:

- use of supplied test instruments
- interpretation of test results against the testing criteria
- methods to be followed to achieve consistency of test results
- recognition of double thickness or faulty readings
- visual inspection of test and inspection results.

Ultrasonic testing

When using ultrasonic testers it is essential to have the test instrument calibrated for the material to be tested before carrying out any tests. This can be achieved by using a piece of pipe material of a known thickness to calibrate the instrument and by following the manufacturer's instructions. The test equipment should be maintained according to the manufacturer's requirements, which may include regular factory calibration and replacement of worn transducers.

Test surface

The areas to be tested on any pipe component should be:

- smooth with no imperfections
- free of weld spatter
- protected from rust
- free from thick paint
- free of concrete residue and dirt.

Single wall pipe

Single wall pipeline components in regular use should be tested at least monthly. Tests should measure the wall thicknesses at all known high wear areas on components. Generally these are close to the ends of straight sections of pipe and on the outer radius of the bends. Pump operators may also be aware of other areas of high wear, caused by the component's location within the pipeline.

Pipe sections should be tested at these known high wear areas and at locations within 500mm of each flange. Each location should contain four test points evenly spaced around the circumference of the pipe. For fixed horizontal pipes, one of these test points must be on the bottom of the pipe. Bends or elbows should be tested at three evenly spaced test points along the outside radius.

The lowest thickness measurement of each component should be recorded in the pipeline logbook against the component's unique identification number.

Double wall pipe

The manufacturer's recommendations for the testing of double wall pipe components should be followed. If the manufacturer recommends no testing prior to a component having pumped a portion of its design life, no monthly thickness testing is required, provided:

- the manufacturer's design life, in pumped cubic metres for the component, is known
- the manufacturer's recommendation for starting pipe testing (in pumped cubic metres) is known
- the component has not pumped either the manufacturer's recommended pre-testing volume, or 60% of the pipe's design life, whichever is the lesser
- an accurate log is kept of pumped cubic metres of the component
- a visual inspection of the internal lining, or thickness test of the outer wall is undertaken every 10,000 pumped cubic metres.

Once the volume of pumped concrete exceeds the manufacturer's recommendation, or 60% of the pipe component's design life, whichever is the lesser, a monthly visual inspection of the internal lining or a thickness test of the outer wall in accordance with the manufacturer's recommendations should commence.

Any double wall pipe component should be replaced if:

- wall thickness testing indicates wear to the outer layer
- the inner lining is breached
- a visual inspection detects excessive or abnormal wear to the inner lining.

A record of testing and inspection should be detailed in the pipeline logbook against the component's unique identification number.

Pipeline test recording

To assist operators to detect thickness error measurements, cross referencing to previous wall thickness measurements during the testing process is essential. A

suggested method of recording this information is to maintain a test sheet over the life of each component.

This record of pipe component testing may include:

- Single wall:
 - component identification number or mark
 - minimum allowable wall thickness
 - dates of tests
 - monthly measurement for each of the test points.
- Double wall:
 - component identification number or mark
 - minimum allowable wall thickness
 - estimated life of component in cubic metres
 - total volume of pumped concrete in cubic metres
 - visual inspections at 10,000 cubic metre intervals
 - volume in cubic metres when monthly testing is to commence
 - monthly test or inspection results.

Hoses

Any hose that is used to pump concrete should be visually inspected before every concrete pumping operation.

APPENDIX A: SUMMARY OF THE HEALTH AND SAFETY IN EMPLOYMENT ACT 1992

Note: This appendix provides a summary of duties under the Health and Safety in Employment Act 1992. A complete copy of the Act can be accessed at the New Zealand Government's Legislation website: www.legislation.govt.nz.

Introduction

The Health and Safety in Employment Act 1992 (the Act) requires the provision of a safe working environment and the protection of persons at work from health and safety hazards. To achieve this, it imposes duties on employers, employees and others to ensure that workplaces and work practices are safe. The Act also requires employers and employees to work together in good faith for the benefit of health and safety in the workplace. Duties are also imposed on the suppliers of plant to a workplace.

General responsibilities of employers

Employers have a duty to ensure the health and safety of employees while at work. In particular, they must take all practicable steps to:

- provide and maintain a safe working environment
- provide and maintain facilities for the safety and health of employees
- ensure that the hazards associated with the set-up and use of concrete pumping equipment are controlled so as to be safe for employees
- implement appropriate inspection and maintenance regimes for concrete pumping equipment
- provide procedures to deal with emergencies that may arise while employees are at work.

Employers:

- must inform employees of the results of any health and environmental monitoring
- are responsible for the health and safety of people who are not employees but are in or near the workplace
- must take all practicable steps to ensure that employees do not harm any other person while at work, including members of the public or visitors to the workplace.

General responsibilities of employees

Employees are required to take all practicable steps to ensure their own safety and of others in the workplace. This includes considering both the things they do and the things they omit to do (such as not using safety gear).

Employers should make clear to employees their responsibilities to use the provided safety equipment and to wear protective clothing. The expected level of an individual employee's responsibility will often increase with knowledge and seniority, but the employer's overall responsibility to ensure a safe workplace remains.

The practicable steps an employee should take also includes reporting to the employer any hazards or accidents, so that their employer can investigate and put safeguards in place to prevent any accidents.

An employee has a right to refuse to undertake work that they consider likely to cause them serious harm. However, employees have an obligation to work in good faith with the employer to try to resolve the matter prior to considering refusal.

Hazard management

The Act requires employers to identify hazards, assess their significance in the workplace, and to implement, monitor and review hazard control measures. The hazard control measures are usually defined as the “hierarchy of control” – to eliminate, isolate (if elimination is impracticable), and minimise (if elimination and isolation is impracticable) significant hazards in the workplace.

Hazard identification

Employers must have effective methods in place to identify hazards; and to determine if there are significant hazards that require further action.

“Hazard” is defined in Appendix C.

Information for employees

Before employees begin work, they must be informed by their employer about:

- hazards they may be exposed to while at work
- hazards they may create which could harm other people
- how to minimise the likelihood of these hazards becoming a source of harm to themselves and others
- the location and correct use of safety equipment (including personal protective equipment or clothing)
- emergency procedures.

Employers are also required to inform employees of the results of any health and safety monitoring undertaken. In doing so, the privacy of individual employees must be protected.

Training and supervision

An employer must ensure that every employee who:

- does work of any kind, or
- uses plant (machinery or equipment) of any kind, or
- deals with a substance of any kind

in a place of work has the knowledge and experience — or is supervised by someone who has — so that they are not likely to suffer harm, or lead to the harm of others.

Every employee must be adequately trained in the safe use of all plant, objects, substances, protective clothing and equipment that they are, or may be, required to use or handle.

To work safely, employees must be trained and instructed in safe work practices. Employers must ensure that an appropriately experienced person maintains a high level of supervision of employees who are not yet deemed competent to carry out their work safely.

Such training should be in addition to, and not replace:

- general construction industry occupational health and safety induction training
- site-specific induction
- induction on these guidelines
- induction on the site concrete pumping task analysis
- tool box talks
- supervised practical experience programmes, specific to the tasks being performed by the employee.

Where possible, any education or training programme should be complementary to, or part of a programme leading to nationally recognised qualifications.

It is recommended that specific training in concrete pumping operational and maintenance safety should reflect the detail in sections 4 to 7 of this Guide.

Specific training

Employers are required to provide the information, instruction, training and supervision to employees necessary to enable them to perform their work in a safe manner.

Information, training and instruction should include:

- safe work methods to be used in the set-up and operation of concrete pumping equipment
- emergency procedures
- identifying hazards associated with the use of plant and equipment
- procedures for inspection and maintenance of concrete pumping equipment
- the use of the manufacturer's operating and service manuals
- the correct use, care and storage of:
 - personal protective equipment
 - other safety equipment
 - equipment logbook and equipment documentation
 - pipeline and hose sections
 - tools and equipment
- electricity safety involving the dangers of:
 - overhead power lines
 - ground-mounted electrical equipment
- the procedures to be adopted in the event of an accident or injury.

Supervision

Supervision must include sufficient monitoring of the work and workers to ensure:

- that it is only carried out by competent, experienced workers

- that a truck-mounted concrete placing boom is driven by a person with a vehicle licence appropriate for the type and weight of the truck
- that all safe work practices are being followed
- the use, by workers, of all protection systems and personal protective equipment.

Trainee workers

The employer should ensure that a worker undergoing training is directly supervised by an authorised person who:

- understands what is required in providing supervision
- is competent and experienced in the use of the equipment
- can immediately take action to rectify a dangerous situation.

Personal protective equipment/clothing

Concrete pumping employers should ensure that their employees use appropriate personal protective equipment/clothing, which may include:

- eye and hearing protection
- leather and rubber work gloves
- safety boots or safety gumboots
- safety helmets or hard hats
- sunglasses (safety type)
- wide brim hats
- sunscreen
- appropriate high visibility or reflective safety vests
- appropriate clothing for the weather conditions.



Figure 23: Worker wearing personal protective clothing

Personal protective clothing requirements should be determined from an assessment of the hazards the workers are likely to be exposed to.

Accidents and serious harm recording and notification

The Act requires employers, the self-employed and principals to contractors to keep a register of work-related accidents and serious harm.

For employers, this includes every accident that harmed (or might have harmed):

- any employee at work, or
- any person in a place of work controlled by the employer.

Employers are also required to investigate all accidents, harm and “near misses” to determine whether they were caused by a significant hazard.

Any accidents where a serious harm injury has occurred must be notified to the Labour Group of the Ministry of Business, Innovation and Employment as soon as

possible after the occurrence becomes known to the employer.

Details of the accident must also be reported to the Ministry on the prescribed form within seven days. Forms are available from:

www.osh.dol.govt.nz/services/notification/accident.shtml.

If a person suffers serious harm, the scene of the accident must not be interfered with unless to:

- save the life of, prevent harm to or prevent suffering to, any person
- maintain public access for essential services, e.g. electricity, gas
- prevent serious damage or loss of property.

Duties of others

Persons in control of a place of work

The Act places duties on persons who control a place of work in relation to people in the vicinity of the workplace, and to visitors.

A person who controls a place of work is responsible for taking all practicable steps to ensure people in the vicinity are not exposed to harm - regardless of the purpose for which they are in the vicinity.

Where people are visiting for work-related reasons, pay to be there, or are present for the benefit of the controller, the person who controls the place of work is responsible for taking all practicable steps to ensure they are not exposed to harm. This includes people in the place of work:

- working as employees, contractors, subcontractors (or their employees) for the person who controls the place or
- with express or implied consent, and who have paid to be there, or who are customers or potential customers.

There is a duty to authorised visitors not included in the above categories - to warn all people who are to be in the place of work of known significant, out-of-the-ordinary hazards arising from the work that has been, or is being, carried on there. For this duty to apply, the visitors must have:

- the express authorisation of the occupier to be in the place of work, or
- have given the controller of the place oral advice that they will be working there under statutory authority.

People visiting a place of work under any other circumstances are owed no duty under section 16 by the controller. This includes people visiting for the purpose of recreation or leisure.

People who are working in the place of work - but not as employees or contractors of the occupier - are owed only the warning duty, and then only if they have express or statutory authority to be there.

People who control a place of work have no duty to trespassers.

A “person who controls a place of work” includes a person who owns, leases, subleases or occupies a place of work, or who owns, leases or subleases plant or equipment used in a place of work.

Duties of the self-employed

Every self-employed person must take all practicable steps to ensure that no action or inaction of theirs while at work harms the self-employed person or any other person.

Duties of principals

Principals to contractors are required to take all practicable steps to ensure that:

- no employee of a contractor or subcontractor, or
- if an individual, no contractor or subcontractor

is harmed while doing any work (other than residential work) that the contractor was engaged to do.

Hirers, sellers and suppliers of plant

The Act places duties on people to ensure that any plant or equipment that is used in a place of work is designed, manufactured and maintained so that it is safe for its intended use. The duties apply to people who:

- hire, lease or lend plant to another person that could be used in a place of work
- sell or supply plant (other than for hire, lease or loan)
- install or arrange plant in addition to either of the above.

For further information on legal requirements under the Act, go to www.osh.dol.govt.nz/order/catalogue/hseact-text/index.shtml.

APPENDIX B: REFERENCE DOCUMENTS

Note: the Ministry of Business, Innovation and Employment and the Concrete Pumping Association of New Zealand (CPANZ) have made every effort to ensure that the websites referenced in this Appendix are correct at the time of publishing. However, due to circumstances beyond our control, external website addresses may change without notice.

Acts

- Health and Safety in Employment Act 1992

Regulations

- Health and Safety in Employment Regulations 1995

Full copies of the Act and Regulations can be downloaded from the New Zealand Legislation website at www.legislation.govt.nz.

Approved Codes of Practice

- Department of Labour, Wellington (2001). **Approved Code of Practice for the Management of Noise in the Workplace (2nd Edition)**. www.osh.govt.nz/order/catalogue/15.shtml
- Department of Labour, Wellington (2010). **Approved Code of Practice for Cranes (3rd Edition)** www.osh.govt.nz/order/catalogue/10.shtml

Standards

- AS 2550.1 *Cranes, Hoists and Winches – Safe Use – Part 1: General Requirements*
- AS 2550.15 *Cranes – Safe Use – Part 15: Concrete Pumps*
- AS 1418.15 *Cranes (Including Hoists and Winches) – Concrete Placing Equipment*
- AS 4041 *Pressure Piping*
- AS 2452.3 *Non-Destructive Testing – Determination of Thickness – Use of Ultrasonic Testing*
- AS 3920.1 *Assurance and Product Quality – Pressure Equipment Manufacture*
- AS 4343 *Pressure Equipment – Hazard Levels*
- AS/NZS 1554 *Structural Steel Welding*

AS/NZS (joint Australian and New Zealand) Standards are available to purchase from www.standards.co.nz.

AS (Australian) Standards are available to purchase from www.standards.com.au.

Other publications

- Department of Labour, Wellington (2001). **Code of Practice for Manual Handling**. www.osh.govt.nz/order/catalogue/pdf/manualcode.pdf

- Department of Labour Wellington (2012). **Best Practice Guidelines for Working at Height in New Zealand.**
www.osh.govt.nz/publications/booklets/working-height/index.asp
- WorkSafe Victoria (2004): **Concrete Pumping Industry Standard.**
www.worksafe.vic.gov.au/wps/wcm/connect/wsinternet/worksafe/home/fo rms+and+publications/publications/import_concrete+pumping
- Transit New Zealand (2004): **Code of Practice for Temporary Traffic Management.** www.nzta.govt.nz/resources/code-temp-traffic-management/index.html
- New Zealand Ready Mixed Concrete Association Inc (2006): **Onsite Management of Concrete Washwater.**
www.nzrmca.org.nz/files/sitemanagementofconcretewashwater-generaledition.pdf
- New Zealand Ready Mixed Concrete Association Inc (2011): **Concrete Truck Driver Hand Signals.** www.nzrmca.org.nz/nzrmca.htm
- Scaffolding and Rigging New Zealand (SARNZ), 2009: **Best Practice Guidelines for Scaffolding in New Zealand.** Available for purchase from SARNZ:
PO Box 31 067
Lower Hutt 5040
Email: info@bsc.org.nz
Website: www.sarnz.org.nz
- Energy Safety Service, 2001. NZECP 34:2001 **New Zealand Electrical Code of Practice for Electrical Safe Distances.**
www.energysafety.govt.nz/upload/33443/nzecz34_2001.pdf.
- Workplace Health and Safety Queensland (2011): **Safety Alert: Hose Whip on Concrete Pumps.**
www.deir.qld.gov.au/workplace/publications/alerts/hosewhippumps/index.htm
- Department of Labour, Wellington (2010). **A Principal's Guide to Contracting to meet the Health and Safety in Employment Act 1992.** www.osh.govt.nz/order/catalogue/contracting-guide.shtml

Research documents

- Workplace Health and Safety, Queensland (2009): **Concrete Pumping Compliance Campaign.**
www.deir.qld.gov.au/workplace/subjects/concretepump/compliance/campaign/index.htm

- Workplace Health and Safety, Queensland (2005): **Concrete Pumping Code of Practice.** www.deir.qld.gov.au/workplace/resources/pdfs/concretepump_code2005.pdf
- Cement, Concrete & Aggregates Australia: **Concrete Pump Safety.** www.concrete.net.au/publications/pdf/ConcretePumpSafetyrev.pdf
- WorkSafe Victoria Construction & Utilities Report 06:004 (2006): **End-Hose of Concrete Pump Bursts.** www.worksafe.vic.gov.au/wps/wcm/connect/wsinternet/worksafe/home/forms+and+publications/educational+material/end-hose+of+concrete+pump+bursts
- Sydney Hospital Hand Unit (2002): Safety, Health and Environmental Procedure: **Fluid Injection Protocol.** www.dpi.nsw.gov.au/_data/assets/pdf_file/0004/84505/FIProtocol.pdf
- American Concrete Pumping Association (2010): **Safety Bulletin: Hose Whipping.** www.concretepumpers.com/pdfs/Hosewhip_Bulletin_FINAL.pdf
- British Concrete Pumping Group (2004): **Code of Practice for the Safe Use of Concrete Pumps.** www.cpa.uk.net/p/Concrete-Pumping-Interest-Group/
- National Ready Mixed Concrete Association, American Society of Concrete Contractors, and the American Concrete Pumping Association: **Checklist for Pumping Ready Mixed Concrete.** www.concretepumpers.com/cgi-bin/start.cgi/home.html
- Health and Safety Executive: **Information Sheet: Cement.** Construction Information Sheet 26, 2nd edition. www.hse.gov.uk/pubns/cis26.pdf

APPENDIX C: DEFINITIONS

a.c. or AC	Alternating current.
Anchor brackets	Metal components designed to support the weight and movement of pump pipelines when fixed to a structure.
All practicable steps	(Health and Safety in Employment Act 1992): "all practicable steps", in relation to achieving any result in any circumstances, means all steps to achieve the result that it is reasonable practicable to take in the circumstances, having regard to – (a) the nature and severity of the harm that may be suffered if the result is not achieved; and (b) the current state of knowledge about the likelihood that harm of that nature and severity will be suffered if the result is not achieved; and (c) the current state of knowledge about harm of that nature; and (d) the current state of knowledge about the means available to achieve the result, and about the likely efficacy of each of those means; and (e) the availability and cost of each of those means. To avoid doubt, a person required by this Act to take all practicable steps is required to take those steps only in respect of circumstances that the person knows or ought reasonably to know about.
Base plate	Outrigger foot – a swivelling metal plate at the base of an extendable outrigger stabilising leg that acts as a foot.
Boom pump	A truck-mounted combination concrete pump and boom system.
Boom	A delivery system that uses a hydraulically operated, folding multi-section boom and attached pipeline to deliver concrete.
Chartered Professional Engineer (CPEng)	A person who is registered and holds a current registration certificate under the Chartered Professional Engineers of New Zealand Act 2002. A list of CPEngs can be downloaded from IPENZ (Institute of Professional Engineers New Zealand) at www.ipenz.org.nz/ipenz/finding/cpeng/Search/search.cfm
Competent person	The person, who by their training or experience has the skills and knowledge to carry out the task they are to undertake.
Concrete pump	The equipment that applies pressure to the concrete and forces it through the delivery pipeline.

Concrete pumping	Any type of equipment used for pumping concrete.
Concrete residue	Matter left over from wet concrete operations, e.g. slurry or cement run-off.
Edge protection	<i>(Best Practice Guidelines for Working at Height in New Zealand):</i> Means a barrier or system to prevent persons and/or objects or materials from falling to a lower level from working or access surfaces. Edge protection may involve a proprietary system, materials to form a guardrail and/or barrier isolation, erected scaffolding supporting a temporary edge protection system, or a combination of solutions.
Employee	(Health and Safety in Employment Act 1992): Subject to sections 3C to 3F of the Act, means any person of any age employed by an employer to do any work (other than residential work) for hire or reward under a contract of service and, in relation to any employer, means an employee of the employer.
Employer	(Health and Safety in Employment Act 1992): (a) means a person who or that employs any other person to do any work for hire or reward; and, in relation to any employee, means an employer of the employee; and (b) includes, in relation to any person employed by the chief executive or other employee of a Crown organisation to do work for the Crown organisation for hire or reward, that Crown organisation.
Enclosed/confined area	Any space of an enclosed nature where there is a specified risk of serious injury from hazardous substances or conditions within or near the space. Toxic fumes and vapours can also be produced by work inside the enclosed/confined area, for example, exhaust fume from mobile plant, especially on construction sites.
End-hose	The rubber flexible pipe fitted to the discharge end of the pipeline system
Hazard	(Health and Safety in Employment Act 1992): (a) means an activity, arrangement, circumstance, event, occurrence, phenomenon, process, situation, or substance (whether arising or caused within or outside a place of work) that is an actual or potential cause or source of harm; and (b) includes – (i) a situation where a person's behaviour may be an actual or potential cause or source of harm to the

- person or another person; and
 - (ii) without limitation, a situation described in subparagraph (i) resulting from physical or mental fatigue, drugs, alcohol, traumatic shock, or another temporary condition that affects a person's behaviour.

HSE Act	The Health and Safety in Employment Act 1992.
Hopper	The loading reservoir of a concrete pump.
Hose-hand	The worker who controls the end-hose.
kV	Kilovolts (1,000 volts).
Line pump	A concrete pump connected to a pipeline system.
Logbook	A record setting out complete details of all inspections, tests, repairs, and modifications carried out on pump equipment.
Manual handling	Any activity requiring a person to interact with their environment and use any part of their muscles or skeletal system to lift, lower, push, pull, carry, throw, move, restrain or hold any animate, or inanimate, object.
Mobile pump	A concrete pump mounted on a truck chassis or trailer.
Outriggers or outriggering pads	The extendible structural members on a concrete pump used to increase the unit's stability.
Pipe clamp	A device used to firmly/securely hold pipeline joints together.
Pipeline system	A delivery system which uses rigid or flexible pipe sections coupled together to deliver concrete.
Pour area	The location/section where concrete pouring or concrete work activities are being undertaken.
Principal	(Health and Safety in Employment Act 1992): A person who or that engages any other person (otherwise than as employee) to do work for gain or reward.
Pumping contractor	The person engaged to provide the concrete pumping equipment with operator(s) and to pump concrete on-site.
Pump operator	The person who operates the controls of the pumping equipment.
Qualified engineer	A person, having appropriate qualifications, e.g. Chartered Professional Engineer, with experience in concrete pumping

equipment (refer to definition for Chartered Professional Engineer).

Reducer

A pipe that changes the internal diameter of the pipeline.

Serious harm

(Health and Safety in Employment Act 1992):

- (a) Death.
- (b) Any of the following conditions that amounts to or results in permanent loss of bodily function, or temporary severe loss of bodily function: respiratory disease, noise-induced hearing loss, neurological disease, cancer, dermatological disease, communicable disease, musculoskeletal disease, illness caused by exposure to infected material, decompression sickness, poisoning, vision impairment, chemical or hot-metal burn of eye, penetrating wound of eye, bone fracture, laceration, crushing.
- (c) Amputation of body part.
- (d) Burns requiring referral to a specialist registered medical practitioner or specialist outpatient clinic.
- (e) Loss of consciousness from lack of oxygen.
- (f) Loss of consciousness, or acute illness requiring treatment by a registered medical practitioner, from absorption, inhalation, or ingestion, of any substance.
- (g) Any harm that causes the person harmed to be hospitalised for a period of 48 hours or more commencing within 7 days of the harm's occurrence.

Significant hazard

(Health and Safety in Employment Act 1992):

A hazard that is an actual or potential cause or source of-

- (a) Serious harm; or
- (b) Harm (being harm that is more than trivial) the severity of whose effects on any person depend (entirely or among other things) on the extent or frequency of the person's exposure to the hazard; or
- (c) Harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard.

The Act

The Health and Safety in Employment Act 1992.

Traffic controller

A person who, using approved traffic control equipment and management methods, guide traffic and pedestrians around the worksite and hazards created by the work conducted on the worksite.

Tower boom

A tower-mounted boom system supplied with concrete through a fixed pipeline system.

Worker

In the context of this guideline, a worker can be one or any of the

following: an employee, a self-employed person, a contractor, or a subcontractor.

APPENDIX D: HAND SIGNALS FOR CONCRETE PUMPING³



BOOM UP

Hand in front of body, at face level, thumb pointing up.



BOOM DOWN

Hand in front of body, at face level, elbow raised, thumb pointing down.



BOOM LEFT

Forearm raised in front of body, thumb pointing in left direction.



BOOM RIGHT

Forearm raised in front of body, thumb pointing in right direction.

³ Concrete pumping hand signals are similar, but **not** identical, to Crane hand signals. For crane operations, please refer to the Approved Code of Practice for Cranes (3rd edition) available at www.dol.govt.nz.



OPEN OR EXTEND BOOM

Both forearms raised in front of body, thumbs pointing out in opposite directions



CLOSE OR RETRACT BOOM

Both forearms raised, thumbs pointing towards the centre.



STOP BOOM

Hand raised in front of body at face level, hand closed into fist.



START PUMP SPEED UP

Forearm raised, index finger pointing up.



SLOW PUMP DOWN

Elbow raised, hand in front of body, index finger pointing down and moving in a circle.



STOP PUMP

Index finger pointed, move finger from one side to the other at neck level.



LITTLE BIT

Elbow raised, hand at face level, thumb and index finger joined together to form a pinch.



ALL DONE CLEAN UP

Both thumbs raised, pointing up.

APPENDIX E: CONCRETE TRUCK DRIVER HAND SIGNALS



New Zealand Ready Mixed Concrete Association Inc.

Concrete Truck Driver Hand Signals

Back up



Arm bent at elbow, hand cupped. Move arm back and forth towards the body.

Shift truck over



Outstretched arms with open hands apart, clearly indicating where the truck is to be moved.

Stop truck, bowl



Arm bent at elbow, fist with knuckles facing outwards.

Move truck forward



Outstretched arm with hand outstretched and thumb pointing upward.

Mix



Left hand palm facing up. Right hand closed, fist rotating above left.

Discharge bowl



Arm bent at elbow, rotating clockwise.

Speed up bowl



Speed up, Lift outstretched arm, palm up.

Slow down bowl



Slow down. Lower outstretched arm, palm down.

Load finished, spin out bowl



Arm bent at elbow and quickly rotating in a clockwise (discharge) direction.

No response should be made to unclear signals

APPENDIX F: SIGNIFICANT HAZARD REGISTER (EXAMPLE – NOT FOR USE)

Location		Date of Assessment	
Hazards	Potential Harm	Eliminate, Isolate or Minimise	Controls
Insufficient lighting	- Walking into objects - Slips, trips, falls and other injuries	Eliminate	- provide sufficient lighting so that tasks can be safely conducted regardless of weather conditions, time of day or building enclosure - clearly define and light accessways
Poor access to work site Poor access around work site	- Slips, trips, falls and other injuries - Manual handling injuries	Minimise	- housekeeping regimes to help keep site clear - ensure sufficient space around work areas - ensure there is good access for concrete personnel and equipment - keep other people not directly involved with concrete pouring clear from area
Working at height	Falls from height	Isolate	Ensure scaffolding complies with SARNZ <i>Best Practice Guide for Scaffolding</i> and MBIE <i>Best Practice Guidelines for Working at Height in New Zealand</i>
Penetrations not covered	Falling onto sharp objects	Isolate	Ensure that penetrations are secured, identified and covered
Inadequate formwork	Falls due to formwork failure	Eliminate	- Formwork to be structurally installed as per engineer's requirements - Regularly inspect formwork for defects and repair immediately
Exposure to ultra-violet light, glare	- Skin cancer - Eye damage - sunburn	Minimise	Ensure that appropriate clothing and equipment is used/worn e.g. sunscreen, shirts, sunglasses
Skin/eye contact with concrete	- Skin rash or allergy/dermatitis - Concrete splashed in eye - Concrete burns	Minimise	- ensure water is available to flush eyes - ensure that eye protection is worn in situations where concrete splashes may occur - ensure that gloves and other protective clothing are worn

Hazards	Potential Harm	Eliminate, Isolate or Minimise	Controls
Contact with hazardous substances	Short or long term health effects: • overcome by vapours • rash/allergy • Disease	Minimise Eliminate Minimise	• Identify hazardous substances and provide Safety Data Sheets • Use less or non-hazardous alternatives where possible • Ensure that users are adequately trained in the substance's safe use and that appropriate protective clothing/equipment is used
Hot weather	• Dehydration • Dizziness	Minimise	• Ensure adequate drinking water is available • Suitable clothing to be worn e.g. light-coloured clothing • Ensure that there are shaded areas where appropriate • Provide temporary cover for work areas
Violent ejection of concrete from hose at first moment of delivery	Struck by concrete causing body injuries or falls	Minimise	• Give warning prior to starting or re-commencing the pour • Check hoses for air sources, such as: ○ blockage ○ change in supply ○ poor mix or delays in the pour • Ensure delivery hose is not damaged prior to pour • Be aware of potential for blow back in the line • Ensure appropriate edge protection
Delivery pipe/joint failure	Struck by concrete causing injuries or falls	Minimise	• Ensure connecting pipes are adequately secured • Ensure brackets are positioned close together to minimise excessive movement • Ensure that pipe's operating pressure is appropriate for diameter of pipe • Check pipe to ensure it is of correct thickness for operating pressure • Do not use damaged pipes • Provide support where a change in direction or reducer occurs
Walking on the concrete foundation during the pour	Slipping on wet ply or reinforcement	Minimise	• Do not walk backwards during delivery • Avoid getting feet caught in reinforcement

Hazards	Potential Harm	Eliminate, Isolate or Minimise	Controls
Sharp edges	Cuts from reinforcement bar ends or tie wire	Isolate	- Put caps on ends of exposed reinforcement bars - Turn tie wires into reinforcement cages
Noise from operating machinery	Hearing loss	Minimise	- Use quieter or muffled equipment where practicable - Provide adequate hearing protection suitable for the level of noise exposure
Fumes from fuel Fuel used in vibrator	- Explosion and/or fire, burns, rashes or allergies from skin contact - Illness, breathing difficulties from carbon monoxide	Minimise Minimise	- Use correct fuel storage containers and funnels - Do not smoke when refuelling - Do not refuel when machine is in operation - Ensure there is adequate ventilation when refuelling and using the vibrator
Electric powered vibrator	Electric shock	Minimise	- Ensure equipment is not faulty or damaged prior to use - Ensure equipment is earthed - Ensure extension leads are tested/tagged by an electrician and that faulty leads are not used/repared with tape - Ensure extension leads are not lying in water
Manual handling	Sprains and strains	Minimise	- Provide rest times - Avoid long periods of twisting, repetitive movements - Provide job rotation where there are enough trained employees - Ensure the concrete is not too dry when screeding and shovelling

Significant hazard register

Location

Date of Assessment

Hazards	Potential Harm	Eliminate, Isolate or Minimise	Controls

APPENDIX G: TASK ANALYSIS WORKSHEET

JOB DESCRIPTION		LOCATION/SITE		OPERATORS		DATE
SEQUENCE OF BASIC STEPS		POTENTIAL SIGNIFICANT HAZARDS		HAZARD CONTROL METHOD		
List the four-eight steps required to complete the job. (Follow the flow of the Product or the Process.)		List the potential SIGNIFICANT hazards beside each step. Focus on what can cause harm and what can go wrong. Use Seven Point Analysis.		List the control methods required to ELIMINATE, ISOLATE or MINIMISE each SIGNIFICANT hazard.		Person responsible to implement control(s):
STEP NO		STEP NO		E/I/M		

Seven Point Analysis

- Strain or sprain my back or other muscle
- Be caught in anything
- Slip, trip or fall on the same or different level
- Cause a fire, property damage or pollution
- Be struck by or against anything
- Come in contact with a hazardous substance
- Come in contact with an energy source

[illegible]

APPENDIX H: PIPELINE INSPECTION LOG SHEET

[illegible]

