
FEDERATION OF PILING SPECIALISTS

Federation of Piling Specialists

Best Practice Guidance Pumping Concrete to Form Piles

2020 Revision

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In this document reference is made to various National Regulations, European and British Standards and other appropriate reference documents. Some of the major aspects of these have been summarised. This is done only to assist users of these Best Practice Guidance Notes by drawing their attention to these regulations and standards. It is the responsibility of those who use these Best Practice Guidance Notes to make themselves thoroughly conversant with all the appropriate legislation and standards and not to rely on any reference or summary contained in this document which may be incomplete or not comprehensive. It is not intended that this document should replace any Acts, Codes of Practice, Regulations or other documents having legal or contractual standing.

Of necessity this document addresses the broad principles that should be adopted. Advice in respect of specific equipment or operations should be obtained from the appropriate body or technical reference source.

The recognition of the various and individual responsibilities of "DUTY OF CARE" are fundamental to the application of these Best Practice Guidance Notes and the principle of "Identify the Hazard, Assess the Risk and Take the Appropriate Corrective Action" should always be applied.

Best Practice Guidance

Pumping Concrete to Form Piles

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1. Introduction and Scope

This Federation of Piling Specialist best practice guidance has been prepared to supplement the Construction Plant-hire Association (CPA) Good Practice Guide 'Safe Use of Concrete Pumps' (September 2013) and provides sector specific guidance.

This document should be used in conjunction with the relevant legislation and guidance listed within Appendix A to ensure the safe pumping of concrete to form piles. This document provides guidance associated with pumping concrete from the concrete pump to the point of discharge into the pile. This document also provides guidance on the maintenance of; plant and equipment, the concrete pipeline, cleaning the pipeline, dealing with blockages within the pipeline and arrangements for wash out water.

2. Selection of Personnel

The safe operation of plant and equipment used in a concrete pumping system relies heavily on suitably competent personnel to carry out the required duties. Other site personnel involved in associated activities must also be suitably trained and competent to carry out their duties.

The Pump Operator shall hold an appropriate CPCS category for a relevant type of pump being used. This category will be supplemented by familiarisation training for the concrete pump and concrete agitator.

The Rig Operator shall hold an appropriate CPCS category for the type of rig being used.

Periodic assessments of all those involved with the process shall be undertaken, and recorded, by a competent person to verify the continuation of safe standards and to assess any additional training need.

Where required, additional familiarisation training should be carried out whenever an operator is transferred to a different make or model of plant or equipment.

3. Components of a Concrete Pumping System



It is important to evaluate the components of the concrete pumping system to ensure the maximum pressure developed by the pump does not exceed the working pressure of the concrete hose, its couplings and connections.

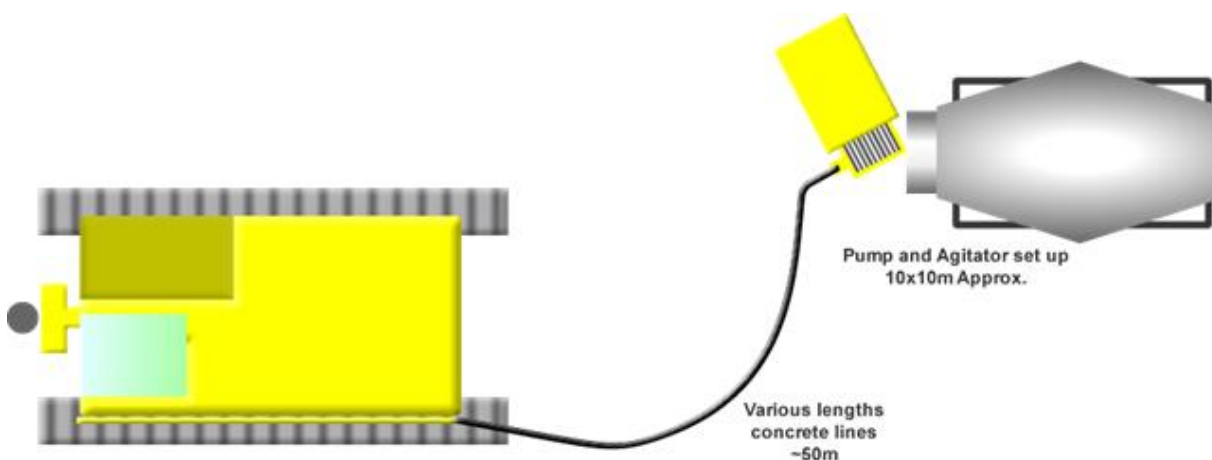


Figure 1

Figure 1 shows the typical components of a concrete pumping system which consists of:

Concrete Delivery System on the Rig

To allow the auger to move up and down the mast during pile formation, the rig is fitted with a number of components that form the concrete delivery system, these include:

- Steel/Reinforced rubber pipeline that runs along the side of the rig and up the mast.
- Reinforced rubber loop hose connecting the steel pipeline, elbow, swan neck and concrete swivel.
 - **Good practice:** All rubber hoses on the rig should be shrouded.
 - **Good practice:** These hoses should be changed after a period of no more than one year.
- 180° elbow which conveys the concrete from the steel pipeline running up the mast to the loop hose that connects to the swan neck and concrete swivel.
- Swan neck and concrete swivel allows movement of the auger during the pumping process.

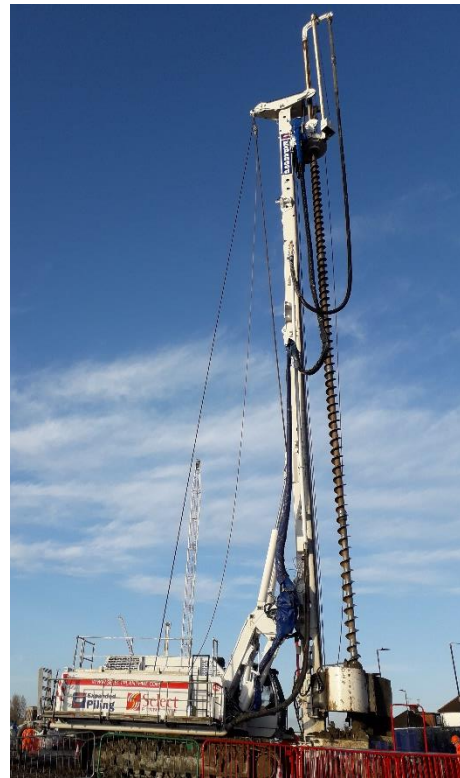


Figure 2

Concrete Pump

Has a typical maximum Pressure of 55 to 95 bar.

Concrete Agitator / Holding Drum

Generally used to ensure continuity of concrete supply.



Figure 3

Pipelines

Typically used on both the ground and at fixed locations on the rig. Pipelines can be constructed of:

- Steel, which is available in a variety of lengths that usually has a wall thickness of 4mm or 6mm.
- Reinforced rubber hose, which is available in a variety of lengths, with protective covering, different pressure settings 80 – 120 bar and usually 100mm or 125mm in diameter.

Pipeline Couplings

There are various types of couplings available but more common couplings are either bolted or snap - quick release couplings, which must be fitted with a securing spilt pin. Each coupling should be fitted with a rubber seal.



Figure 4

4. Planning and Management of the Concrete Pumping Process

Planning Arrangements

A competent person representing the piling contractor shall plan the piling works in liaison with the Principal Contractor. A working platform certificate, safe system of work and project specific risk assessment must be in place prior to work commencing.

Selection of plant, equipment, pipeline and pumping equipment for the work must be carried out by a competent person.

Arrangements for the safe delivery of plant and equipment must be agreed with the Principal Contractor prior to work commencing.

Designated areas and routes for the rig, pipeline, pumping equipment, materials, blowing out or cleaning and concrete deliveries including wash out must be agreed with the Principal Contractors and communicated to all contractors during their site induction.

Concrete hose crossing points should be clearly identifiable and evident to all site traffic (Typical examples are shown in Figures 5 and 6).



Figure 5



Figure 6

Consideration must be given to the location of the pumping equipment in relation to the works and the route of the ground pipeline in relation to the Plant and Vehicle Management Plan.

Note: *The location of the pumping equipment will require regular, possibly daily review, during the works.*

Pipeline Management

Where necessary and site conditions permit, the use of steel concrete pipelines may be an option if an undisturbed run of pipeline can be established and used for extended periods.

Designated crossing points must be agreed with the Principal Contractor such that site plant and vehicles can cross the pipelines without damaging them.

The crossing points must be suitable and of sufficient strength to provide adequate protection to the pipeline.

Movement of pipeline (both reinforced rubber hose used on the ground and reinforced rubber loop hose on the rig) must consider the bend radius to avoid kinks or sharp bends, which will cause internal damage.

Note: *Reinforced rubber hose that has been subject to crushing by plant and vehicles will sustain internal damage, which will not be evident on visual site inspection, may lead to premature failure of the hose.*

Pipeline couplings

It is best practice that all hose connections between rubber and metal or rubber to rubber which are elevated above ground level on the piling rig or concrete pump should have a safety sling (Whip-check) incorporated:

- All couplings on the loop hoses on the rig.
- The hose connection from the rig to the ground pipeline.
- The connection from the ground pipeline to the concrete pump.
- All other connections where the pipeline is not laying on the ground, for example; pipeline between the concrete pump and the concrete agitator.

The safety sling (Whip-check) will act to restrain and secure the connection should the coupling fail.

The risk should be assessed whether to fit safety slings (Whip-check) to all ground pipeline couplings. Additional control measures may be required to prevent whip check devices introducing new hazards.

Equipment Deliveries to and from Site

Procedures must be in place to ensure the safe loading and unloading of; plant, equipment, pipeline and pumping equipment. Consideration should be made for the safe working practice when working at height on the back of vehicles. Appropriate control measures will need to be in place.

Communication during the Pile Formation Process

It is essential that effective communication (Visual, radio or other means) is maintained between the concrete pump operator, the rig attendant and the rig operator.

Good practice is to have the remote auto shut fitted to the concrete pump, this will let the rig operator shut down the pump from the cab if a problem occurs. This will reduce the communication time between rig operator and pump operator which will stop a potential hazard occurring.

Forming the Pile

All works forming the pile shall be carried out in accordance with procedures, a safe system(s) of work and risk assessment(s), which must have been communicated to all those involved in the process prior to the work commencing.

Dealing with Blockages within the Concrete Pumping System



Under NO circumstance should COMPRESSED AIR be used to clear a blockage.

A compressor will only produce 7 – 10 bar, a concrete pump will produce 55 - 95 bar, if a concrete pump won't move the concrete don't try compressed air, hydraulic pressure can be removed by back pumping the concrete pump, once you start using compressed air the system will remain under pressure until it is released, i.e explosive force.

Procedures must detail safe methods of clearing blockages, which must be communicated to the piling operatives prior to the commencement of work. Procedures must include the following:

- General safety precautions
 - Work at height.
 - Manual handling.
 - Working with pressurised systems.
 - Exclusion zones and restricted working areas.
 - Working with concrete.
 - Personal Protective Equipment (PPE) requirements.
- Assessment of the blockage and determining the action plan on how to deal with the blockage:
 1. Identify one operative or supervisor to control the action plan.
 2. Erect exclusion zone - remove all personnel not involved in the clearance action plan.
 3. Locate the blockage within the pipeline.
 4. Consider how long clearance work can progress before escalating the incident to senior management.
 5. Make sure all operatives are wearing full face EN166B visor when working on clearing a blockage.

Good Practice:

- Establish a hierarchy of control to refer to senior management when dealing with blockages
- Open all concrete clamps at ground level, where possible.
- If possible, attach concrete pump to loop hose and push blockage the opposite direction.

Cleaning the Concrete Pumping System

Procedures must detail safe methods of cleaning the concrete pumping system, which must be communicated to the piling operatives prior to the commencement of work. Procedures must include the following:

- General safety precautions
 - Work at Height
 - Use of compressed air
 - Working with pressurised system.
 - Exclusion zones and restricted working areas.
 - Manual handling
 - Working with concrete
 - Personal Protective Equipment (PPE) requirements
- Cleaning out the concrete pump and agitator.

- Cleaning out the pipelines:
 - Ball catching arrangements.
 - Means of containment of spent concrete (Typical examples are shown in Figures 7 and 8).
 - Use of the blow out adaptor. (Typical example is shown in Figure 9)
- Arrangements for dealing with wash out water.



Figure 7



Figure 8



Figure 9

Note: consideration is required for the size of chamber in conjunction with the length of hose to be cleaned

Good practice: Grout may be used as an alternative to to clear concrete from the pumping system and reduce the risk of introducing air into the concrete

5. Maintenance

Procedures must be in place to rectify any faulty or defective equipment as soon as practicable in a safe and controlled manner. If defective equipment is unsafe to use or if there is any doubt on its safety, then it must be immediately removed from service until it is made safe to use.

A robust maintenance scheme must be in place and carried out by competent personnel. Records of maintenance activities must be maintained and made readily available at site. The scheme should include the following for each component of the concrete pumping process:

All equipment requires daily inspection from competent operator with regular servicing and maintenance by a competent person. Any defects and records of inspection need reporting as company procedures.

Concrete Pump and Agitator

Maintenance shall be carried out in accordance with the manufacturers' instructions.

Daily site checks of the outlet from the concrete pump shall be completed to identify potential points of failure in use.

Drilling and Piling Rig

Maintenance shall be carried out in accordance with the manufacturers' instructions.

- Concrete Swivel
 - Daily visual check for damage or leaks.
 - Daily greasing (To extend the life of the swivel and to prevent seizing best practice is that this is carried out twice daily; mid shift and during the installation of last pile of the shift).

Cleaning Out Accessories

- Periodic inspection & maintenance of Blow Out Adaptor.
- Inspection of Blow Out Containment Chamber.
- Inspection of containment vessel/chamber for accumulations of concrete reducing capacity.

Steel Pipeline, Elbow and Swan neck

- Pre-use visual checks for damage, coupling security and crossing points.
- Steel pipelines are checked for dents, cracked welds and damage.
- Ultrasonic testing every six months to measure pipeline wall thickness. Steel pipelines should be thickness tested a minimum of yearly taking account of the volume of concrete pumped through the system. Any pipelines that are have thickness measured below 3.5mm will require an increased testing frequency, pipelines measured less than 2.5mm should be changed or see company procedures. Close attention should be given to bends which wear more quickly.

All steel pipeline must be uniquely identified. A record of the inspection and test must be readily available at site.

Good practice: All hanging loop or rubber hoses which are located above ground level should be shrouded, these should be changed at a maximum of yearly intervals.

Good practice: Use a two-piece hanging hose when using an extension bar, the hose can then be split above or below the rotary table.

Reinforced rubber pipeline

The pipeline system should be visually checked daily and the inspection recorded:

- All couplings are secured with locking pins and safety slings [whipchecks] attached if above ground level.
- Pre-use visual checks for damage and coupling security – on the full circumference of the hose for cuts, abrasions, broken wires, crushed or damaged ferrules, deformed hoses and aren't kinked.
- Pressure testing to the working pressure as stated on the reinforced rubber hose which is held for a minimum of 2 minutes every six months (minimum).

Each rubber pipeline section must be uniquely identified. A record of the inspection and test must be readily available at site.



Figure 10

Figure 10 shows an anti-kink hose spring device which prevents the flexible concrete hose supplying the CFA rig from buckling at the point it enters the fixed steel pipe attached to the rig body.

The bend radius limit on reinforced rubber hose typically is:

- For 100mm hose the radius must not be less than 550mm.
- For 125mm hose the radius must not be less than 700mm.

Note: *This should be clarified with the supplier of each contractor's hose*

Consideration must be given to the transporting and handling of hoses (both on site and in equipment storage yards) to ensure that minimum bend radii are not compromised.

Note: *Failure of reinforced rubber hoses can be the result of hoses being forced into too tight a radius or bent double and site plant tracking over the hose and coupling.*

Appendix A Legislation and Standards

The following list, whilst not exhaustive, gives some of the more important legislation which may be applicable in Great Britain. In other countries, reference should be made to the appropriate national legislation.

Legislation

Machinery Directive 2006/42/EC Health and Safety at Work Act 1974

Management of Health and Safety at Work Regulations 1999

Provision and Use of Work Equipment Regulations 1998

Supply of Machinery (Safety) Regulations 2008

Construction (Design and Management) Regulations 2015

Manual Handling Operations Regulations 1992 as amended in 2002

Personal Protective Equipment at Work Regulations 1992

Work at Height Regulations 2005/SI735

The Control of Substances Hazardous to Health Regulations 2002

The Control of Noise at Work Regulations 2005

Standards

EN 16228 Parts 1 to 7; Drilling and foundation equipment, Safety Requirements

BS EN ISO 14121-1; Safety of Machinery, Risk Assessment Principles

BS EN ISO 12100, General Principles for Design, Risk Assessment and Risk Reduction

BS 8476, Code of Practice for the Safe Use of Concrete Pumps

BS EN 12001, Conveying, Spraying and Placing Machines for Concrete and Mortar – Safety requirements.

PD 5304:2005, Guidance on safe use of machinery.

Other Publications

Construction Plant-hire Association (CPA) Good Practice Guide 'Safe Use of Concrete Pumps'

HSE Leaflet INDG218 – Guide to Risk Assessment.

HSE Leaflet INDG163 – Five Steps to Risk Assessment.