



CPA Safety Guidance

Risk Assessment for Shoring & Piling Operations

1. Introduction

This safety guidance contains a generic list of possible hazards that may be present when planning and executing excavation and shoring related operations including piling. The list is not site specific however, nor does it attempt to be exhaustive.

The list has been provided to assist the user of shoring equipment to produce site-specific risk assessments for excavation and shoring operations to determine what measures should be taken to fulfil their statutory obligation. General duties are set out in the Health and Safety at Work Act 1974 and more specific duties are set out in the Management of Health and Safety at Work Regulations 1999.

2. Definitions

2.1 Competent Person - a person having sufficient knowledge, ability, training and experience of the work to recognize the hazards and the means to reduce or eliminate the risks.

2.2 External Organisation - An organisation that is independent to the original organisation undertaking the design

2.3 Global stability analysis - The process that is undertaken to check not only the local stability of the shoring system, but also the surrounding area, which may include an adjacent embankment, buildings etc.

2.4 Hazard – something with the potential to cause harm, (this can include substances or machines, methods of work and other aspects of work organisation).

2.5 Permit to Dig - these provide a formal safety control system aimed at the prevention of accidents, damage to property and damage to products, when foreseeable hazardous work is undertaken.

The permit to dig should consist of a document which:

- details the work to be done;
- details the precautions to be taken;
- states that all foreseeable hazards have been noted;
- states the control measures that are to be implemented.

Note: permits to dig do not, in themselves, make a job free from risk. They rely upon effective control and coordination in order that hazards are identified and risks are suitably and sufficiently assessed.

2.6 Risk – the likelihood that harm from a particular hazard will occur.

2.7 Short-term stability - the inherent ability of a soil to stand as a vertical cut without the aid of a further support for periods of short duration.

2.8 Slip circle checks - the process of checking the stability of sloped ground formed by excavation, natural embankments and earth dams.

2.9 Surcharge - a vertical load or weight caused by spoil, overburden, vehicles, equipment, or activities that may affect stability, incurring additional lateral loading on the shoring system.

2.10 Temporary Works Co-ordinator - a competent person appointed by the main contractor who co-ordinates all aspects of the temporary works from concept to finish of works.

2.11 Temporary Works Designer - a competent engineer, capable of designing a suitable temporary works system.

3. List of Hazards

The following tables list generic hazards and are divided into four different activities:

Activity 1 - Excavation Work (General);

Activity 2 - Excavation Support Systems;

Activity 3 - Temporary Works Design for Excavations;

Activity 4 - Piling Operations.

ACTIVITY 1 - EXCAVATION WORK (GENERAL)

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
1.1 Planning	<p>All excavation work must be planned before work commences to identify hazards and assess risk. Sufficient equipment and materials must be made available throughout the works.</p> <p>Appoint a temporary works co-ordinator (or responsible person), to supervise the whole of the works, ensuring that the final 'end-user' (if not the co-ordinator) is fully briefed and conversant with equipment, installation method & scheme layout.</p> <p>Appoint a temporary works designer when excavations are deemed to require a support system.</p>	<p>Plans, drawings, assumption, etc. must be conveyed to the excavation supervisor.</p> <p>A detailed design brief must be compiled for the designing organisation</p>
1.2 Lifting Operations	<p>The excavator or crane must be assessed to be adequate for lifting requirements associated with the works.</p> <p>Only use lifting gear as designated by the manufacturer. Ensure that all relevant personnel are aware of the loads.</p> <p>Ensure that all lifting equipment has the correct certification.</p> <p>Plan your safe system of work.</p>	<p>Ensure that loads and reaches are accurately assessed. Identify siting areas for crane – should be a minimum 5m away from the excavation unless specifically allowed for in the design.</p> <p>Note: hanging chains supplied by shoring suppliers must not be used for lifting. Refer to supplier's instructions.</p> <p>Note: equipment covered with spoil or concrete will weigh more than stated.</p> <p>Prepare a lifting plan for large lifts.</p>
1.3 Confined Spaces	Identify any confined spaces and deal with them in accordance with the Confined Spaces Regulations 1997.	Most excavation work should be treated as a confined space (if an "open topped chamber") unless assessed otherwise.
1.4 Hazardous Substances	Identify and assess any hazardous substances likely to be encountered or used.	Refer to COSHH Regulations
1.5 Spoil Storage	Spoil storage areas must be clearly identified on site.	These should be a minimum 5m away from the excavation unless specifically allowed for in the design.
1.6 Unauthorised access	Provide adequate barriers, signs and warning lights to prevent unauthorised persons entering the site.	
1.7 Existing services	<p>All known services must be located and marked prior to commencement of the excavation work.</p> <p>If services cause unexpected hazards or unknown services are discovered during excavation, the scheme should be reworked.</p>	Prior to the start of any excavation work, a "Permit to Dig" should be issued by the relevant authority.

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
1.8 Inspection	The excavation should be inspected and results entered into an inspection register or similar.	As required by CHSW Regulations, Section 30.
1.9 Falls	Working off ladders should be limited to light work. 3 points of contact should be maintained.	Consideration must be made to the use of a safety harness.
1.10 Communication	Banksmen should be recognisable and be seen by the excavator or crane operator. Hand signals must be agreed, preferably recognised standard hand signals.	No excavator must be used without a competent banksman.
1.11 Access/Egress	<p>Access to an excavation must be by a suitably safe method, e.g. ladders. Personnel must not use the trench support system as a climbing frame.</p> <p>Provide suitable ladders - to be fixed at 75 degrees to the horizontal (1 in 4). Tie securely at the top and ensure a firm and level footing to prevent slip.</p> <p>Adequate provision must be made to prevent unauthorised access.</p>	<p>Ladders must be secured to prevent movement and must project about 1 metre above the ground at the top. Appropriate provisions for access in emergencies should be made when necessary.</p> <p>Carrying of ladders must be by two or more persons.</p> <p>Particular attention must be taken during out of hours.</p>
1.12 Damage to adjacent structures	<p>Assess the likelihood and degree by which adjacent structures or other features might be affected by the excavation - vibration, subsidence, noise and dust.</p> <p>Provision must be made for the prevention of falling of loose material by way of poling boards.</p> <p>An assessment must be made of the effects of groundwater, i.e. settlement of adjacent structures</p>	<p>e.g. buildings, services, foundations slopes, bridges, highways, railways, watercourses.</p> <p>Consult a specialist if necessary</p>
1.13 Contact Injury	<p>Personnel should not work or stand directly under materials or plant being placed within the excavation. High-visibility clothing and helmets and other appropriate PPE should be worn.</p> <p>Particular care must be taken by persons in the immediately vicinity of an excavator or crane to prevent crush injury when it slews or moves.</p>	Dependant on the excavation size, persons should be prohibited from entry during excavation work.
1.14 Visibility and Protection	<p>All persons must wear the appropriate personal protective equipment whilst on site.</p> <p>Public access must be clearly marked and kept free from debris and materials. Excavation on or near public access pathways must be guarded or cordoned off.</p>	2 metre high fence securely fixed with warning signs clearly displayed

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
1.15 Falling Objects	<p>Protect the edges of trenches with a suitable upstand on trench sheets or other appropriate barrier.</p> <p>Be aware of your surroundings especially in excavations or when working at height.</p>	<p>Use handrails when using trench boxes.</p> <p>Avoid the use of intermittent (hit and miss) sheeting, material can fall through the gaps between the sheets.</p>
1.16 Contaminated Ground - Health damage	<p>Identify, assess, and clearly mark areas of contaminated ground.</p> <p>No eating, drinking or smoking in designated areas. Wear protective clothing.</p> <p>Ensure no degradation of equipment (e.g. shoring) by contamination contact.</p>	<p>A site investigation may be necessary</p> <p>Provision of suitable protective clothing and changing and washing facilities.</p> <p>Consult equipment supplier - keep equipment clean.</p>
1.17 Pneumatic breakers -	<p>Persons at risk from eye injury must wear approved eye protection.</p> <p>Persons at risk from noise must wear approved ear protection.</p> <p>Where there is dust, the area must be ventilated and/or dust masks provided where necessary</p>	<p>Goggles to BS EN 166:1996, grade 2D</p> <p>Ear plugs or muffs.</p>

ACTIVITY 2 - EXCAVATION SUPPORT SYSTEM

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
2.1 Excavation collapse	<p>Suitable shoring systems must be determined by an initial risk assessment and a design brief must be compiled. Engage a qualified temporary works designer.</p> <p>Spoil, plant or work materials must not be placed immediately adjacent to the excavation edge.</p> <p>Support systems must be installed into position without delay as work proceeds. A method statement should be prepared and adhered to.</p> <p>Supervision of the works must be by authorised persons who are adequately trained, competent and familiar with excavation activities.</p> <p>Suitable and sufficient steps shall be taken to prevent a fall or dislodgement of any material into or from within the excavation</p> <p>No material, vehicle or plant shall be placed near excavations where it could cause collapse unless allowed for in the design of the support system.</p>	<p>Consideration must be given to depth, soil strata, groundwater characteristics, location, surcharge loading, proximity of slopes or batters, duration of excavation, preferred method of installation etc. Referral to suitably qualified and competent personnel may be necessary.</p> <p>Provide appropriate barriers, treat as a surcharge</p> <p>The method of installation should be stated in the temporary works design.</p> <p>Use close sheeting or timber polling. Avoid the use of intermittent (hit and miss) sheeting, material can fall through the gaps between the sheets.</p> <p>Treat as a surcharge - consult the Temporary Works Designer</p>

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
2.2 Change in site conditions	Any deviations from the conditions used in the preparation of the temporary works design must be referred back to the designer for checking.	e.g. <ul style="list-style-type: none"> • different soil conditions • change in groundwater levels • change of size of excavation • change of depth of excavation • additional surcharge loading • change in method of installation
2.3 Shoring Installation	<p>All shoring systems must be assembled and installed in accordance with the manufacturer's instructions and site specific method statement.</p> <p>Ensure all support work is secure and that props and wedges are tight.</p> <p>Ensure that all hanging chains or other support means are in place as specified in the shoring design.</p> <p>All shoring systems must be checked regularly and maintained properly for the duration of the work. Check for visible over-stress, damage, leakage and non-alignment of all equipment.</p>	<p>Ensure installation instructions and method statement are passed on to the supervisor.</p> <p>These chains must not be used for lifting operations</p> <p>Inspections must be by a competent person in accordance with the CHSW regulations section 30.</p>
2.4 Groundwater control	<p>When necessary or specified, suitable and properly maintained pumping systems and equipment must be provided. Standby equipment shall be available in the event of breakdown.</p> <p>Type and extent of groundwater control must be assessed prior to excavation work.</p> <p>A suitable location for the discharge of pumped water must be agreed</p>	<p>Assessment may be necessary by a specialist supplier or organisation. Refer to the design of support system for any assumptions made regarding de-watering.</p> <p>Effect of groundwater removal on settlement of adjacent structures must be assessed.</p> <p>Refer to the local authority if in doubt.</p>

ACTIVITY 3 - TEMPORARY WORKS DESIGN FOR EXCAVATIONS

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
3.1 Inadequate design	Appoint a suitably qualified and experienced designer.	Essential to provide the designer with a comprehensive design brief including representative borehole or trial pit.
3.2 Lack of co-ordination and communication between all parties.	<p>Appoint a responsible person or a temporary works co-ordinator to:</p> <ul style="list-style-type: none"> • compile the design brief; • check submitted temporary works design; • assess risk and monitor; • ensure compliance with temporary works design; • ensure kit is assembled and installed according to manufacturer's instructions; • monitor changes in site conditions when compared to the design brief 	<p>Check, frames and struts are positioned as specified.</p> <p>Check required 'toe-in' of sheets/piles.</p> <p>Check that excavated ground and the groundwater regime is as assumed in the design.</p> <p>Monitor activities.</p>

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
3.3 Excavation is re-located after design has been submitted.	<p>Check if appropriate borehole log has been used. Check if surcharge details have changed. Check if depth has changed.</p> <p>Refer back to temporary works designer to re-work design.</p>	Check if access and lifting requirements have changed.
3.4 Contaminated ground.	<p>Check with planning supervisor if contaminated ground is to be expected in location of excavation.</p> <p>Continually monitor by sight, smell and use of gas detection equipment of excavated profile and excavated material for possible contamination.</p> <p>If excavation is known to be in contaminated land, check with shoring supplier that structural integrity of shoring equipment will not be compromised through contact.</p>	<p>Method of work to be specified to accommodate contamination.</p> <p>If suspected contaminated ground is encountered cease work immediately and inform safety co-ordinator.</p>
3.5 Soil profile encountered different to that used in temporary works design.	<p>Continually monitor soil profile.</p> <p>Temporary works co-ordinator to check 'actual' profile against 'design' profile.</p>	<p>If 'actual' varies from design immediately, inform temporary works designer to check design stability.</p> <p>If variance in profile is deemed to be significant stop work until, design has been re-checked.</p>
3.6 Groundwater characteristics and control.	<p>Regularly monitor and record groundwater characteristics, i.e. rate of flow, strike levels.</p> <p>Temporary works co-ordinator to check 'actual' groundwater regime is consistent with 'design' assumptions.</p> <p>Ensure the proposed method of groundwater control is as per that used in the 'basis of design', i.e. do not sump pump when well point de-watering has been specified.</p>	<p>If 'actual' varies from design immediately, inform temporary works designer to check design stability.</p> <p>If variance in characteristics is deemed to be significant, cease work until design has been re-checked.</p>
3.7 Change in depth of excavation.	If depth is to be varied, immediately inform temporary works designer to re-work design based on altered depth.	Do not exceed design depth without design being re-worked.
3.8 Change in plan dimensions of excavation.	If dimensions are to be varied, immediately inform temporary works designer to re-work design based on altered dimensions	Do not exceed stated dimensions without design being re-worked.
3.9 Change in surcharge.	<p>Ensure surcharge assumptions are correct, e.g.</p> <ul style="list-style-type: none"> i weight of excavator; ii position of spoil; iii position of adjacent roads and batters. 	Immediately inform Temporary Works Designer of change so design can be re-worked.

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
3.10 Introduction of new surcharge.	Monitor if new surcharges are introduced, e.g. i new haul road adjacent to dig; ii large plant positioned near dig; iii spoil dumped near excavation.	Immediately inform Temporary Works Designer of change so design can be re-worked.
3.11 Unknown structures/services encountered.	Note the position and nature of the structure and services and inform Temporary Works Designer to assess impact on design.	
3.12 Ground reduction details.	Ensure all ground reduction details (batters, etc) as specified in temporary works design are complied with. If not, inform temporary works designer to re-work design.	
3.13 Stability of shoring system during use.	Ensure that the system has been installed as per the temporary works design. Continually monitor equipment for signs of overloading e.g. deflection, deformation.	If in doubt refer to the equipment supplier. Do not use the shoring system as a work platform for storage of materials. Keep shoring equipment clear of spoil and debris.
3.14 Stability of adjacent structure and batters.	Continually monitor adjacent structures and batters for movement. If excavation is in or around embankments or slopes, carry out a global stability analysis, e.g. slip circle checks.	If in doubt refer back to the Temporary Works Designer.
3.15 Instability of excavation during extraction of shoring system.	Work to an approved method of work to ensure stability of excavation during extraction of equipment. Identify where 'short term stability' is being assumed when considering the stability of the excavation during extraction.	Do not remove any cross struts unless specifically allowed for in the temporary works design.
3.16 Temporary works design checked by external organisation.	Prior to commencing work ensure all relevant external organisations are issued with temporary works design for checking purposes.	
3.17 Change of Method Statement.	If method statements incorporating temporary works designs are amended, ensure the original design assumptions are not compromised.	

ACTIVITY 4 - PILING OPERATIONS

Notes:

- 1 The following hazard list applies specifically to the following types of hammer:
 - a) excavator mounted (EMV) type
 - b) suspended (remote power-pack) type
 - c) air hammers
- 2 The following standards apply specifically to piling operations:
 - a) BS EN 996:1996 - Piling equipment. Safety requirements
 - b) BS 5228:Part 1:1997 - Code of practice for basic information and procedures for noise and vibration control
 - c) BS 5228:Part 4:1992 - Code of practice for noise and vibration control applicable to piling operations
- 3 Many hazards associated with piling equipment can be avoided if a personnel exclusion zone of 15 m is maintained around the pile during piling operations.
- 4 Operators must be trained and competent in the operation of piling equipment. Both the operator and his supervisor should be made familiar with the operational controls and the supplier's instructions of the specific piling equipment in use.
- 5 Personal protective equipment e.g. gloves, hardhat, goggles, ear defenders, high visibility jacket etc should be used when necessary during piling operations.
- 6 Pile driving hammers are designed to transfer extremely high loads from the hammer into the pile and the surrounding soil. The forces are so high that without proper maintenance and skilful operation the piling equipment could damage itself.

Vibratory Hammers		
Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
4.1 Crushing Hazard	Keep hands clear of the clamping mechanism	
4.2 Pile falling from clamp	<p>Ensure operator is trained and competent and familiar with the operational controls of the specific equipment in use.</p> <p>Ensure that the hydraulic hoses are in good condition.</p> <p>Ensure that the correct safety chain is fitted and is within certification and of sufficient capacity for the pile being lifted.</p> <p>Ensure that the retainer works correctly and is used at all times.</p> <p>Operatives should as far as is reasonably practicable stand clear from the slung pile whilst it is being traversed into position.</p>	<p>Ensure that the supplier's instructions have been supplied with the equipment.</p> <p>The safety chain is prone to accidental crushing by the clamping device; care should be taken to avoid this.</p>
4.3 Noise	<p>Follow guidance in BS 5228 (see Note 2 above)</p> <p>Maintain 15m-exclusion zone (see Note 3 above)</p> <p>Operatives must wear ear defenders at all times.</p> <p>If power-packs are insulated for sound, keep access doors shut.</p>	

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
4.4 Vibration	Follow guidance in BS 5228 (see Note 2 above) Maintain a 15m-exclusion zone as noted above. Use high frequency or resonant free type vibrators.	Resonant free vibrators can significantly reduce effects of vibrations to personnel and structures during the critical start up period of the vibrator.
4.5 Settlement	Seek professional advice in sensitive locations.	
4.6 High pressure fluid injection	Ensure all hydraulic hoses and fittings are in good condition. Fit burst protection guards to hoses. PPE should be worn at all times.	Equipment should be inspected at the start of each shift or if the operator suspects that the hoses have become snagged during piling operations.
4.7 Failure of swivel components	Regular inspections of the swivel connection including all pins and retaining clips should be carried out.	Equipment should be inspected at the start of each shift.

Air Hammers

Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
4.8 Noise	Follow guidance in BS 5228 (see Note 2 above) Maintain a 15m-exclusion zone as noted above. Operatives must wear ear defenders at all times. Keep access doors on the compressor shut.	
4.9 Fracture and/or failure of components	Inspect the hammer regularly, look particularly for cracking to the anvil and anvil retaining stops. Ensure operator is trained and competent and is familiar with the suppliers operating controls and instructions.	The hammer should never be run off the pile. The operator should ensure that the supporting chain remains slack whilst the pile is being driven down.
4.10 Oil Mist	Correct airline oil lubrication should be maintained. Maintain the personnel exclusion zone when the hammer is operating. Do not stand directly in line with the exhaust ports.	Correct fitting of the oil lubricator is essential – refer to suppliers operating instructions.
4.11 Compressed Air	Ensure all hoses couplings and clamps are regularly inspected and in good order. Switch off compressor and decompress prior to removing hoses.	According to instructions in the operator's manual for the compressor Use hose retainers to avoid whiplash if hose ruptures during use.
4.12 Falling components	Maintain 15m exclusion zone when hammer is operating.	

4. References:

Legislation

The Health and Safety at Work Act 1974
The Construction (Health, Safety and Welfare) Regulations 1996
The Construction (Design & Management) Regulations 1994
The Management of Health and Safety at Work Regulations 1999
The Control of Substances Hazardous to Health (COSHH) Regulations 1994
The Lifting Operations and Lifting Equipment Regulations (LOLER) 1998

HSE Guidance

Health and Safety in Construction (HSG150 - rev)
A guide to managing health and safety in construction (ISBN 0 7176 0755 0)
Health and safety in excavations – Be safe and shore (HSG185)
Safe work in confined spaces - Regulations, Approved Code of Practice & Guidance (L101)
Five Steps to Risk Assessment (INDG 163)

Other Guidance

CPA Guidance - Selection of Proprietary Shoring Equipment (STIG 0201)
CPA Guidance - The Use of Chains to Support Shoring Equipment (STIG 0202)
CPA Safety Guidance - Risk Assessment (SG 003)
CIRIA report R166 – CDM Regulations – Work sector guidance for designers.

British and European Standards

BS EN 996:1996 - Piling equipment. Safety requirements
BS 5228:Part 1:1997 - Code of practice for basic information and procedures for noise and vibration control
BS 5228:Part 4:1992 - Code of practice for noise and vibration control applicable to piling operations
BS EN 166:1996 - Personal eye protection. Specifications.

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