Management of Shoring in Excavations
Part 1 - Management Process

CPA Good Practice Guide

Good Practice Guide for the Management of Shoring in Excavations

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Working in Partnership

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Contents

Management Process is the first of a series of documents to be published by the CPA on the subject of shoring in excavations. Part 2 - *Hazard Identification for Risk Assessment* has also been published. Future parts will include available shoring systems, shoring documentation and examples of current practice. Details of any future publication will be available on www.cpa.uk.net

Foreword

Construction is one of the largest and most hazardous industries in the UK. Despite an encouraging decrease in rates of injury over recent years, around 50 construction workers are still killed on construction sites every year with thousands more suffering major injuries and ill health. Many of the key hazards are well known and there are often simple precautions that can be taken to prevent harm to people.

We know that collapse of excavations causes deaths and major injuries. Typically, around two people die each year when excavations collapse and a great deal more will suffer serious, often life-changing, injuries. Ground conditions around excavations present an unpredictable hazard with the ever-present risk of unacceptable ground movement, collapse or cave-in. These risks have the ability to impact far beyond the footprint of the excavation to affect adjacent works, structures and the public.

Most injuries occur in and around excavations less than 2.4m deep when either little or no temporary shoring has been provided. Prior to proceeding with any excavation, it is imperative that the risks are fully assessed and that consideration is always given to the need for temporary shoring to support the ground, even in excavations as shallow as 1.0m.

Notwithstanding the legal requirement to control risks to workers in or near excavations, there are strong commercial arguments supporting the view that the careful planning and design of temporary works will lead to greater certainty of cost and programme. Even where no one is injured, the collapse of excavations inevitably causes substantial site delays and additional costs in managing and safely retrieving the situation.

This guidance has been prepared by a Working Group representing all parts of the industry, including the Health and Safety Executive. The guidance is straightforward, comprehensive and easy to adopt.

I thank those who have been involved in its preparation and commend the guidance to all those involved in the management of shoring and trenching operations. Please read the publication and turn the advice into action.

Philip White
HM Chief Inspector of Construction
Chair of the Health and Safety Executive's Construction Industry Advisory Committee (CONIAC).

1.0 Introduction

Construction workers tasked with excavating have to operate in close proximity to large, fast moving and powerful machinery within constrictive and potentially unstable earthworks. At the same time they have to contend with the ever present dangers of water entry, uncharted underground services, potentially hazardous atmospheres and falls from height. Each excavation can present a unique combination of hazards that require the work to be carefully sequenced, with appropriate control measures in place to safely manage the process. Most excavations are carried out in urban areas in close proximity to the public. This requires constant vigilance and planning in order to protect workers and the public.

This advice is written specifically for all the duty holders identified in the *Construction (Design and Management) Regulations 2015* (CDM 2015). It refers to and adopts the guidance given in BS 5975:2008+A1:2011 - *Code of Practice for Temporary Works Procedures etc* and BS 6031:2009 - *Code of Practice for Earthworks*.

Under CDM 2015 the main duty holders and their roles are;

- **Clients** – site owners and project funders who need to appoint competent persons to manage the works and provide information about the site;
- **Contractors** - Main or Principal Contractors and their subcontractors who manage or carry out the site works;
- **Designers** – Principal and other designers, including permanent and temporary works designers and shoring suppliers providing a design service who are responsible for specifying solutions that are safe to construct;

This advice is essential reading for anyone involved in the planning, management, design and supervision of excavation works during any stage of the construction process, including site investigations. Guidance is given in the form of a review of current practice, including a simple to follow management flowchart and advice on assessing the competency of the duty holders.

By adopting the guidance contained within this document it is considered that duty holders will generally be doing enough to manage the planning and execution of excavation works in order to meet their health and safety obligations. However, following this guidance is not a legal requirement and employers may discharge their duties in ways other than those described in this document.

It is assumed that the reader is already familiar with general health and safety management in construction, including the principles of hazard identification, elimination and risk management, and is seeking additional information relating specifically to shoring.

The advice in this suite of publications is intended to cover the vast majority of conventional and frequently encountered excavation schemes in the UK, together with the most commonly available shoring solutions for these schemes. Major, high risk or unusual shoring schemes will always require highly experienced shoring design specialists to be involved in their planning, design and management. It is recommended that for any **high risk** shoring a recognised specialist designer is engaged early in the planning process.

There is always an option not to provide any shoring and instead to remove soil over an extended area providing a graded slope, normally at 1 in1.2 for good ground conditions, at little risk of collapse. This is referred to as a battered or stepped excavation slope. However, most excavations created in urban areas do not afford enough room around the perimeter to safely do so and the positioning of plant and access/egress for personnel can present additional risks. This factor and the cost of increased areas of reinstatement would generally make this option uneconomical.

Figure 1 - Unacceptable Practice

Working in a deep, completely unsupported excavation the operative is highly vulnerable to any sudden ground collapse or materials/equipment falling into excavation.

2.0 Good Shoring Practice

2.1 *Assessing the need for shoring*

Work in an unsupported or inadequately supported excavation can be particularly hazardous as the short term stability of exposed faces is difficult to judge - even for experts. The consequences of sudden ground collapse or cave-in when a construction worker is not protected by an appropriate excavation support system are often serious or fatal. Collapse injuries are typically caused by impact, crushing or asphyxiation.

Collapses are commonly attributed on site to:-

- Inconsistency, and therefore unexpected instability, of the material being excavated, particularly in made or previously disturbed ground;
- Surcharging and/or vibration around the edge of the excavation such as the operation of heavy plant or the stockpiling of excavated materials in close proximity;
- Weather conditions and/or groundwater flows adversely affecting soil properties;
- Poor understanding on site of potential earthworks failure mechanisms;
- Poorly executed or inappropriate temporary support solutions.

The vast majority of excavations created in the UK are relatively shallow and in urban areas, where the ground has probably been re-worked several times. Made ground is particularly variable in terms of composition and behaviour, and exhibits large variations in strength and stability.

Assessing the short term stability of an excavated face on site by unqualified persons is therefore extremely dangerous and should not be permitted.

Providing general advice on when shoring is not required is dangerous!

Previously in the UK Construction Industry it had been standard practice to provide shoring for any excavation beyond 1.2m in depth when persons were required to enter the excavation.

NOTE: *That practice was based on the Construction (Working Places) Regulations 1966 which specified 1.2m as a depth beyond which shoring was required. These regulations were revoked in 1996 and later replaced by Regulation 31 in CDM 2007 and Regulation 22 in CDM 2015).*

Regulation 22 of CDM 2015 deals specifically with excavations; yet makes no reference to depth. Instead it requires those in control of the work to prevent danger to any person from the collapse of an excavation or dislodging of material. For some activities and materials/ground conditions, danger might arise from excavations less than 1.2m deep whilst in other exceptional circumstances excavations exceeding such a depth may not present potential danger.

The Management of Health and Safety at Work Regulations 1999 require an employer to carry out a risk assessment, identifying all significant hazards and setting out the control measures that will be in place before work begins. Assessing the risk and acting on the findings ensures that the selected control measures will enable the work to proceed with an acceptably low risk of failure. A breakdown in any stage of this process can lead to catastrophe.

A ground worker was working within a 1.0m trench only 0.6m wide and installing a drain at the bottom of this trench. To install the pipe he had to crouch down and physically prepare, inspect and connect a joint. At this point the trench collapsed and the worker was trapped. He was killed by just one cubic metre of displaced soil which weighed approximately 1500kg. The collapse was caused in part by heavy plant moving about 1m from the edge of the excavation and surcharging the soil that formed the face of the excavation.(Courtesy of HSE)

For these reasons it is not an acceptable practice to rely on the traditional 1.2m rule of thumb – the risks at each site must be assessed to ensure that appropriate control measures have been implemented.

Unless specific expert advice states the contrary, it should always be assumed on site that even in good ground conditions any unsupported excavation face at an angle to the horizontal greater than 40 degrees (slope of 1 in 1.2) may collapse at any time and without warning.

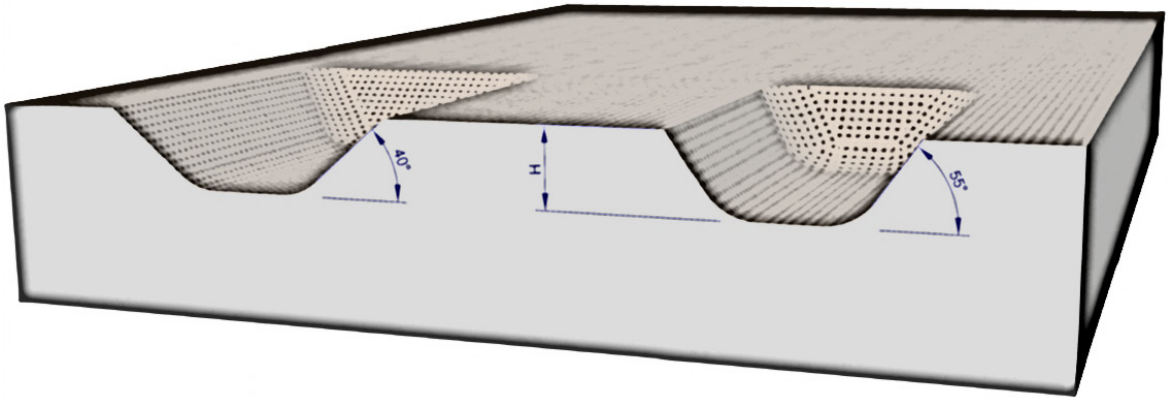

Figure 2 - Examples of acceptable and unacceptable sloped excavations in good ground conditions with no water

A 40° slope likely to be stable whereas a 55° slope likely to be unstable

Prior to carrying out any excavation (regardless of depth) it is therefore essential that a risk assessment has been carried out by a competent person. The assessment should firstly consider means of either eliminating or reducing the hazards. Consideration should always be given to avoiding deep excavations by either using a different method (such as directional drilling) or re-designing the permanent works (e.g. selecting piling and ground beam foundations instead of pad and strip footings).

The risk assessment should also aim to minimise the requirements for operatives to enter an excavation. Whenever this cannot be avoided consideration must be given to providing shoring taking into account the extent and nature of the works proposed. If in doubt - **BE SAFE - SHORE**.

NOTE: *The policy adopted by an organisation can simplify the process. For example, a standing procedure that requires shoring before worker entry at depths exceeding 1m reduces the level of ground assessment required and simplifies the risk assessment process to that of selecting the type of support equipment required, dealing with other hazards and devising a matching system of work.*

2.2 *Dealing with groundwater*

Besides the obvious risk of drowning, a high ground water level presents additional risks of instability and unpredictability within the vertical faces and bases of excavations. In granular soils for example, open soil faces may be twice as unstable and the loads exerted on shoring systems doubled, when significant water is encountered.

Within the UK it is common practice to attempt the control of water levels from within the excavation by providing sump pumps to collect and remove any water from the base of the excavation. The excavations are usually lined with interlocking steel trench sheets, toed to depth beneath the formation level, to minimise the inflow of water and maintain stability of the base. The design of the shoring must take account of the additional hydrostatic loads generated by the water levels building up on the outside of the excavation. Sump pumps cannot be relied upon to reduce hydrostatic loads on the outside of the excavation and in some cases can remove substantial volumes of fines from the surrounding soils causing unwanted ground movements.

Other methods of groundwater control such as well pointing and ground freezing are available to control water and can be used to reduce hydrostatic load on the outside of the excavation.

Whichever techniques are employed, the actual effectiveness of such systems, impact upon surrounding soils and consequences of system failure require careful consideration.

Whenever water is encountered in an excavation, additional caution is required and formal water control measures should be installed.

2.3 *Dealing with underground services*

Damage to underground services during excavation work can result in both immediate and delayed safety incidents within or adjacent the works, together with interruptions to supplies. Each year workers are killed or seriously injured when they strike underground electricity supply cables, whilst accidental damage to gas pipes can lead to gas building up in voids or basements and eventually exploding.

In the UK prior to any excavation commencing available underground utility services drawings should be obtained for the work area.

Appropriate measures must be taken on site to accurately locate these and /or any other uncharted services that may be present. The use of a Cable Avoidance Tool (CAT) including a signal generator, and hand dug inspection pits are expected prior to using an excavator.

It is essential that all located services are clearly identified for the site team and appropriately marked/protected. (HSE publication *HSG47 Avoiding Underground Services* provides additional information. *Due to be updated 2013*)

2.4 *Dealing with confined spaces - Confined Spaces Regulations 1997*

All excavations have the potential to be classified as confined spaces which require special consideration of the potential presence of flammable vapour or liquid, toxic gas, oxygen deficiency and the ingress of materials or liquids.

Where the risk assessment finds that an excavation will need to be classified as a confined space, it is standard practice in the UK to provide gas detectors, emergency rescue systems and alternative escape routes.

Excavations within chalk or coal measures can release naturally occurring carbon dioxide, whilst work adjacent to foul sewers, peat or landfill sites can release methane or hydrogen sulphide.

Excavations within live highways or where plant is operating within the dig may require consideration of the potential for exhaust fumes to build up.

Excavations on or adjacent to water mains, sewers or gas mains will always require consideration of the potential for sudden water entry or the build up of toxic or flammable gas.

2.5 *Preventing falls from height - Work at Height Regulations 2005 (as amended)*

Falls from height are the largest single cause of construction fatal and major injuries. Most excavations will require operatives to work from ground level, close to the perimeter /edge and therefore at height. The legal requirement is to prevent falls that could cause injury and good practice is to install sturdy barrier protection to prevent anyone from falling into the excavation. Exclusion fencing is often specified around excavations to keep people away from the edge.

Figure 3 - Example of a safety ladder in a deep cofferdam

Perimeter edge protection is in place together with a means of access and egress available at all times

In addition, adequate means of access and egress must be provided and measures taken to prevent plant, vehicles or materials falling into the excavation. It should be noted that many accidents occur when operatives enter or leave an excavation via an unsupported face. It is therefore essential that any means of access is located within the protection of the excavation support system. The excavation size and sequence should

be planned so that suitable access and egress equipment (stairways or ladders) remain in place and immediately available all the time operatives are in the excavation.

2.6 *Plant selection*

Extracting soil from within an excavation is normally carried out by excavators which are available in a range of sizes and types. The excavators are also used for lifting and moving materials and installing/removing shoring systems. The correct selection and usage of an excavator for the works proposed and the specific site constraints is a key safety requirement. Groundworkers have been run over, crushed against fixed objects or other plant, and plant working too close to an excavation can overload the edge.

Any lifting operations must be carried out using an excavator which has been designed and equipped for object handling. All lifting operations must be properly planned and risk assessed by a competent person. Additional guidance on lifting operations with excavators is given in the CPA *Guidance on Lifting Operations in Construction When Using Excavators,* which can be downloaded from www.cpa.uk.net.

A competent person should always assess the suitability of the ground to safely support the anticipated loads from the chosen plant operating around the excavation. The assessment should take into account the risks of instability particularly during lifting operations.

2.7 *Shoring system selection*

A wide variety of proprietary shoring systems are readily available throughout the UK. Traditionally a small number of suppliers design and manufacture or specify these systems for the UK market. Suppliers are widely recognised as experts in the design and manufacture of excavation support systems and often provide comprehensive site specific designs, technical risk assessments and installation procedures to assist with use of their products. This guide concentrates on the most commonly used proprietary shoring systems as they usually offer distinct advantages in terms of safety and economy. Most of these are made of steel or aluminium; however local use of timber may be needed in conjunction with other support systems, especially where an excavation is crossed by multiple services.

Some contractors use timber boards in opposing pairs with an adjustable steel strut to force the boards against the sides of a narrow trench. Timber is lighter but less durable and more easily damaged than the equivalent steel sheet but may reduce inadvertent damage to exposed services. Timber poling boards (vertical boards) cannot be readily toed (driven) into the ground which limits their effectiveness and requires more rows of struts. Unless used in a shallow trench these systems require specialist design. They are extremely reliant upon the skill and experience of the installers who may also be tempted to leave increasingly large gaps between each pair of boards.

In addition there are specialist applications where fully timbered systems can be designed and be appropriate for excavation support. Examples include small tunnel headings and some types of structural underpinning. These use large quantities of timber and a progressive dig/support approach so that during both excavation and backfill workers stay in the protected area and the support is never more than a few hundred millimetres short of the working face.

2.8 *Safe Systems of Work (SSoW) for installing and removing shoring*

When selecting a shoring system it is vital to fully risk assess the assembly, installation and removal sequences. Understanding how the systems are safely assembled and at which stages of installation they are safe to load, enter or strike (remove) is therefore essential.

It is not considered acceptable to put operatives at risk while installing or removing shoring in order to make the excavation safe for others. All excavation support systems that need to be installed against exposed vertical faces by operatives working from

within the excavation are undesirable. Unless rigorous systems of work are used that allow installation from the surface or from a protected area, such equipment should be avoided where possible. A site specific SSoW should be produced on site for all excavations. Suppliers of shoring systems and their designers must provide sufficient information to the site team to facilitate this. The site team must allow sufficient time and resource to prepare the SSoW prior to work commencing.

Included within the SSoW should be easy to follow assembly, installation, maintenance and removal instructions, together with relevant plans of the works and residual risks to be managed on site. Simple diagrams or sketches are a useful way to help make the information clear. It is a legal requirement under CDM 2015 to inspect an excavation prior to each working shift to ensure it is safe to enter and also to maintain a report log of the inspections. Common practice on site is to further formalise this by the use of permits or inspection sheets built into the process.

SSoW's must be clearly communicated to the site team prior to excavations commencing, be readily accessible at all times and managed/updated as work proceeds.

2.9 *Identifying unusual factors when planning excavations:-*

2.9.1 Site Hazards

- Any unusual or abnormal site specific risks including adjacent structures, services, surcharges, traffic and loads;
- Large height of soil to be retained (including any local ground level reduction or slopes/retaining structures) and extent of excavation particularly in relation to the competence of the site team;
- Any unusually difficult activities being carried out within the excavation or nearby;
- Any potentially severe consequences to the site should a collapse occur (risks to life, property or other site works/structures);
- Any unusual site constraints including access, settlement, vibrations and the potential for surface water to enter the excavation.

2.9.2 Geotechnical Hazards (Refer to BS 6031 for more detail)

- The presence of any high geotechnical risks including problematic soils or rocks, existing cuttings, embankments, soil failures, retaining structures, adjacent waterways and/or high ground water level issues;
- Extent and sensitivity of the geotechnical analysis - any potential inaccuracy or inadequacy of the site investigation information provided - e.g. sample points too far from the actual works, insufficient number of samples or tests, lack of interpretative reporting, potential for seasonal/tidal variations in ground water levels;
- Slopes with the potential for global slips /slides /falls or exposed excavation faces where the processes of scour, erosion or weathering could lead to global slope instability.

2.9.3 Shoring Solution Hazards

- Unusual complexity or sensitivity of the analysis/design solution proposed;
- Unusual levels of site control/monitoring required;
- Difficult to manage – e.g. High levels of skill and experience required by the site team to install, maintain or remove the proposed shoring.

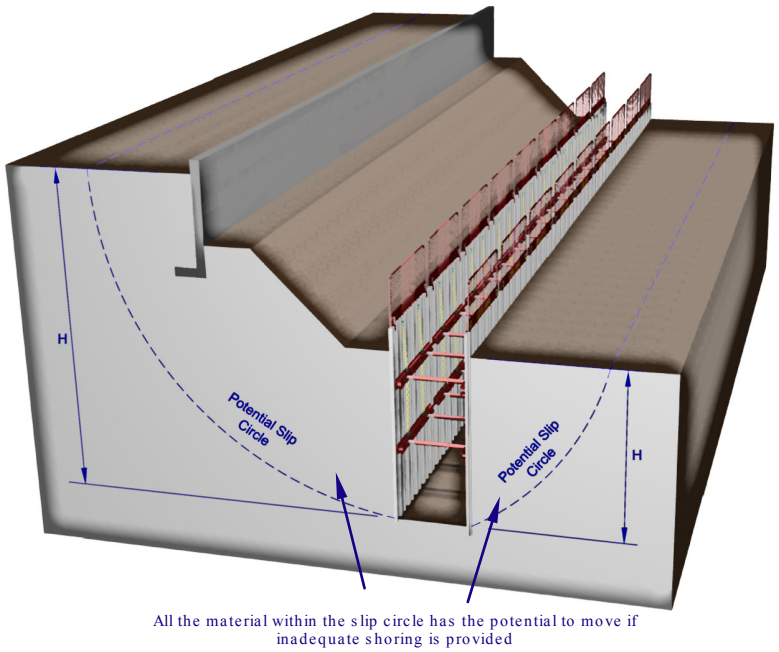

Figure 4 - Example of height of retained soil 'H' varying either side of a trench

2.10 *Assessing the level of excavation risk and design scrutiny*

Prior to obtaining a temporary works design for a shoring solution it is recommended that the level of excavation risk is assessed so that the commensurate, minimum level of design rigour can be specified. This guide adopts the concept of three levels of risk:-

2.10.1 Risk Level 1

Covers shallow excavations utilising simple shoring solutions in flat, open ground where there is little risk to property or life and previous site experience has indicated that ground conditions are not problematical. Typical solutions include shallow, low risk excavations employing simple, single-system, standard solutions. Design requires no interpretative soil or structural analysis. Normally restricted to excavations less than 2.0m deep utilising equipment such as trench boxes, walers, manhole brace and vertishore. Installed working to simple best practice guidelines. No major structural or ground risks identified in the risk assessment with reasonable ground conditions (no steep slopes or water present).

2.10.2 Risk Level 2

Covers the majority of excavations when an experienced site team is in place, they are using conventional shoring systems and only normal risks associated with excavations have been identified. A collapse would invariably have serious consequences in terms of risk to life and/or property. A site specific geotechnical investigation has confirmed that there are no abnormal ground risks. It is useful to sub-divide this level based on the type of solution specified and depth of excavation. Typical solutions include:-

2a Medium/normal excavations employing standard solutions, requiring some interpretative soil analysis and simple methods of structural design analysis. Normally trench boxes, waler and brace solutions up to 6.0m in depth. Not including complex cross strutting or raking prop solutions or schemes where unusual/high structural risks have been identified in the risk assessment. Can include cantilever walls retaining up to 2.0m in height.

2b More complex and/or deeper normal solutions requiring detailed interpretative analysis of site investigation reports, significant structural design analysis and sound

engineering judgement. This would normally include the full range of available support solutions for the vast majority of excavations encountered. To include cantilevers retaining up to 3.5m height, multi sided/propped systems to 10.0m deep including octagonal frames, raking props and slide rail/rolling strut systems.

2.10.3 Risk Level 3

Covers very large, complex or unusual shoring solutions which may or may not involve abnormally high risks or unusually difficult ground conditions or where unusually high levels of control or skill are required on site. The consequences of a collapse would inevitably be dire in terms of risk to life and/or property. Typical solutions include highly complex, innovative or unusually high risk solutions where considerable independent engineering judgement must be demonstrated. Normally including basements, demolition schemes, railways, bridges, coastal/river works, large embankments, dams, fragile existing structures or retaining walls and existing soil failures

Figure 5 - Risk Level 3 Excavation

Large, complex and high risk to life and property

Having classified the level of risk, a site team deemed competent to manage that level of risk should be selected. **Section 3.0** on assessing the competence of duty holders and **Table 1** on the desired minimum competences of duty holders in relation to level of risk, discusses this further.

2.11 *Identifying the Key duty holders in the temporary works design process*

BS 5975 recommends that all organisations involved in the temporary works design process ensure that a Designated Individual (DI) maintains a temporary works process for controlling the works and ensuring the competency of those involved. These

organisations include the contractors, subcontractors, shoring equipment suppliers and temporary works designers.

The key Duty Holders in this process (as identified in BS 5975) are the Temporary Works Co-ordinator (TWC), Temporary Works Supervisor (TWS), Temporary Works Designer (TWD) and Temporary Works Design Checker (TWDC). These individuals can come from any of the organisations involved (and may have alternative titles) but must, in relation to the works proposed, possess the appropriate competences. It is essential that these duty holders understand their legal obligations (under CDM 2015), the procedural recommendations of BS 5975, are capable of independent judgement and carry the authority to act on these judgements by halting unsafe practice and/or asking for advice.

2.12 *Temporary works design flowchart (Figure 6)*

The flowchart provided in this guidance (See **Figure 6**) assumes that the key duty holders described above are in place and that a package of temporary works involving excavation support has been identified and awarded to a Principal or Main Contractor and that a Principal Designer has been appointed by the Client. If the above processes are not in place it is a duty for those involved in the temporary works to inform the parties of their responsibilities and ensure that sufficient information is made available to safely plan, design and carry out the works.

Three simple stages are provided in the flowchart;

1. Planning & Investigation;
2. Design;
3. Construction.

During Stage 1 it is essential that a TWC role is allocated to a suitable person to collate the available information on the site of the proposed works. This would normally require an examination of existing (tender) information and a site visit. At this stage it may be appropriate to involve a TWS, if appointed at the time, to assist in this task. On completion of Stage 1, sufficient information should be available to categorise the scheme, produce a design brief and carry out an initial risk assessment. It is essential at this stage that the TWC notifies the Principal Designer.

If insufficient information is available then further work will be required which may typically include additional site investigation and searches for existing records.

During Stage 2 the TWC ensures that a design and Safe System of Work (SSoW) are produced. The design process requires that a design and design check is produced taking account of the site specific hazards/risks. This design can then be assessed against the brief for practicality to ensure a SSoW can be developed. The approval process must involve the Principal Designer.

At all times in this Stage it is imperative that the parties are clear on the need to identify hazards, eliminate them where possible, and use suitable control measures to reduce risks to an acceptable level. The conclusions of this assessment process must be communicated to all parties involved. It should be noted that as the design is developed the levels of risk may change and updates will need to be issued and discussed between the duty holders.

During Stage 3 it is common practice to adopt a system of permits to commence the works (Permit to Dig) and ensure that inspections of the excavation are carried out prior to each shift requiring man entry (Permit to Enter). This system should incorporate a robust method for identifying change and dealing with it safely (change control process). Adequate information requires communicating to the site team and as a minimum it is recommended that the design information is communicated to site via easy to read drawings and specifications showing the installation and removal sequences and clearly identifying any residual risks for the site team to control.

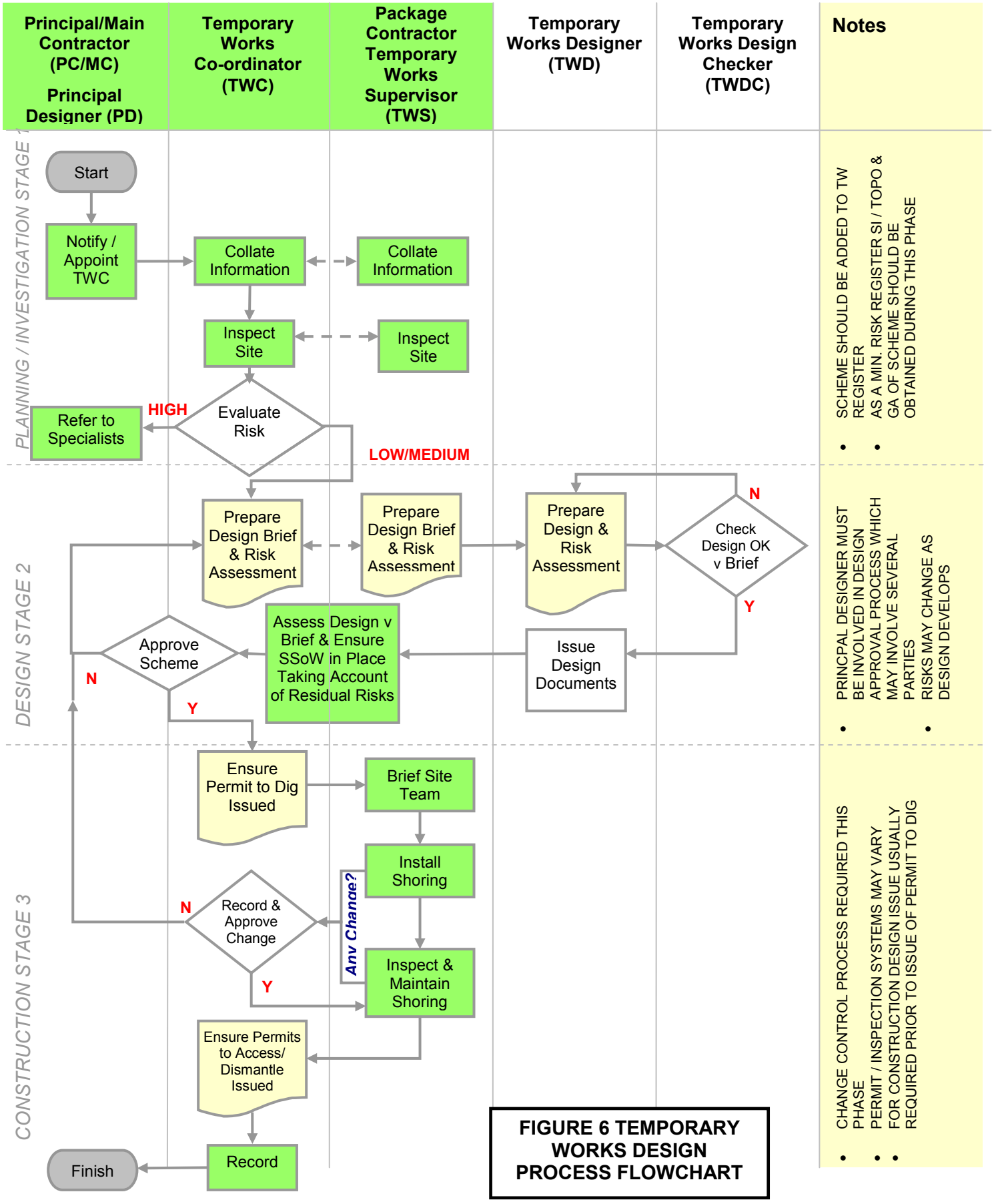

FIGURE 6 TEMPORARY WORKS DESIGN PROCESS FLOWCHART

3.0 Advice on Assessing the Competence of Duty Holders

3.1 *General Issues*

The UK construction industry has an improving safety record, however, it is recognised that there are issues particularly in terms of a methodology for assessing the corporate and individual competence of the duty holders (i.e. those organisations and individuals involved in managing and carrying out the works). Shoring was traditionally considered a specialist area of construction with competence measured solely in terms of time served experience working with recognised groundworks/shoring experts. However with the increasing use of proprietary shoring systems throughout the industry and the inevitable use of these systems by inexperienced teams there is a need to provide advice on the required competencies.

At present there is no widely recognised construction industry scheme/process for assessing the competency of the duty holders in relation to the difficulty or risks involved with excavation works. However CDM 2015 places duties on employers to ensure that their employees are competent and provided with appropriate training where necessary. BS 5975 supports this approach. Table 1 and Sections 3.2 and 3.3 provide some advice on this process in relation to the levels of excavation risk and design scrutiny identified in section 2.10.

Figure 7 - Unsafe Practice (Courtesy of HSE)

Wholly inappropriate and unstable shoring solution. Weak horizontal timber walings, struts too slender (liable to buckle) and poor shoring to end of trench. Management of the process has failed.

It is essential that employers engaged in any aspect of the provision of temporary works, ensure via the Designated Individual (DI) that their staff are competent to carry out the works proposed. This process must take into account the foreseeable complexity and risks of the works. If the DI judges an individual to be competent for certain processes, by virtue of their training, experience and capacity, then a record of the authorisation process should be made and kept as part of their development plan or training matrix.

3.2 *Corporate Competence*

One of the most important components in achieving a safe working environment is to ensure that all those involved in the programme of work are competent. Clients and Contractors, in particular, have a duty to take reasonable steps to only appoint appropriate organisations to carry out the works. Organisations are under a duty to avoid taking on work they lack the experience and competence to safely deliver.

It is vital when selecting the personnel for any task that the team is comprised of people with the correct mix of training, experience and supervisory and management skills to oversee all phases of the construction work. Where there are shortfalls within any area of the team, these may be addressed by either increasing the level of supervision in direct proportion to the inexperience of the individual (which is the model usually adopted as it also allows for development of employees) or by bringing in external contractors or other competent persons to make up for that shortfall.

3.3 *Individual Competence*

A competent person is one who has sufficient practical skills, theoretical knowledge and ability to carry out the function to which the term relates, taking account of the foreseeable complexity and risks of the task in hand. It should be borne in mind that different levels of competence are required for differing tasks and differing environments.

Employers should ensure that individuals are capable of safely carrying out the tasks they undertake. This includes the level of experience required for designers, managers and supervisory roles.

There are many routes through which an individual can gain sufficient skills. In order of priority competence can be measured in terms of relevant experience, formal training and education. Below are the general approaches to training and managing experience in order to be assessed by an employer as competent. All of these examples assume that the individual has already been assessed by the employer as someone who will have the required level of aptitude and maturity to be able to work in this discipline in a responsible manner.

Table 1 gives indicative levels of experience and training for individual competences of persons involved in the temporary works process. It is provided for simple guidance and relates the types of shoring solutions commonly encountered in the UK and their relative levels of risk to the desired competences of the main Duty Holders.

Risk Level 2 (Medium /Normal) covers the vast majority of excavation support schemes in the UK and have therefore been split into 2.10.2a & 2.10.2b to allow for a wider range of competences to be employed.

3.3.1 Temporary works skilled workers/plant operators

The most common routes for skilled workers includes a period of basic training, followed by an assessment of that training to ensure the skills have been successfully acquired. This would include basic health and safety training.

On completion of initial training there is a period of close supervision where the learning is consolidated on site. When the employer is satisfied that the operator can undertake the task with little or no risk to themselves or others, they are deemed to be competent to carry out this task. Supervision is normally gradually relaxed to monitoring safety performance plus the normal quality and productivity checks - unless concern occurs in which case the level of supervision should be reviewed.

This is an ongoing process and individuals become increasingly competent at a number of tasks as part of their development. This experience should be documented within a development plan or training plan so that they may be selected for work that is appropriate to their level of competence.

3.3.2 Temporary works supervisors (TWS)

A temporary works supervisor has built on their basic training and has become generally competent in the work involved and has been selected on the basis of their maturity and experience to oversee work on site. They have received formal up to date TWS training and are fully aware of their obligations and familiar with the implementation of the site temporary works procedures. TWS need to have sufficient experience and authority to take action whenever necessary to prevent unsafe procedures or practices. A TWS must also recognise the extent of their own knowledge and be comfortable asking for clarification or assistance where needed.

The more experience of supervision that is gained, the more complex work they are in a position to supervise. Experience should be documented within a development plan or training plan so that they may be selected for work that is appropriate to their level of competence.

For more difficult categories of excavation work, such as foundation and structural steelwork, the expectation would be that the temporary works supervisor would have also attended training sessions in temporary works principles and be able to interpret temporary works drawings and specifications.

3.3.3 Temporary works coordinators (TWC)

In addition to construction site management experience acquired in previous roles a TWC has sufficient knowledge of temporary works design and procedures to fully understand the processes and issues involved in obtaining a safe temporary works solution. They have received formal up to date TWC training and are fully aware of their obligations and familiar with the implementation of the site temporary works procedures. In particular they understand the requirements for communication and interaction between designers and site and ideally have a good working knowledge of soil/structure interaction. In addition they should be able to evaluate the likely risk and complexity of the proposed works (taking into account the consequences of failure and impact/interaction on other site operations).

Above all, the TWC must have sufficient experience, maturity and authority to take action whenever necessary to prevent unsafe procedures or practices. The TWC fully recognises any limitations in respect of their own knowledge and is comfortable asking for assistance when appropriate. On complex works the TWC may need to be a chartered engineer or person with equivalent knowledge and expertise.

3.3.4 Temporary works designers/design checkers (TWD/TWDC)

A formal qualification in civil engineering would normally be required for both the designer and design checker. The employer should manage their development as they would any other category of worker by initially ensuring the designer undertakes simple designs under the supervision of an experienced designer and have an audit procedure where an increased number of their designs are quality assured until such a point where they are authorised to prepare designs for the appropriate levels of complexity and risk. The more complex the task the more experience is required.

Design checker is the title given to a designer who is not involved in the production of the design and, by virtue of this independence, is in a position to assess the suitability and accuracy of the design. This is a key function especially for more complex excavation work.

3.3.5 Additional TWS/TWC Qualifications for High Risk Works

Whilst relevant experience and training are the most important demonstrations of competency the Designated Individual will often deem it necessary to specify minimum academic qualifications for the TWS or TWC.

In particular for high risk or complex schemes it may be prudent to insist on a minimum formal qualification in Civil Engineering such as HND/Degree/Chartered Engineer. Alternatively support to the Duty Holders could be provided by appropriately qualified personnel (either available on site or remotely) formally appointed to assist with the management of the works.

RISK LEVEL	Excavation Support Solution Description	Temporary Works Co-ordinator (TWC)	Temporary Works Supervisor (TWS)	Temporary Works Designer (TWD)	Temporary Works Design Checker (TWDC)
1	Shallow excavations in flat, open ground employing simple, single system, standard solutions. Design requires no interpretative soil or structural analysis. Normally restricted to excavations less than 2.0m deep utilising equipment such as trench boxes, walers, manhole brace and vertishore. Installed working to simple best practice guidelines. No major structural or ground risks identified in the risk assessment with reasonable ground conditions (no steep slopes or water present).	Experienced site manager with appropriate TWC training and relevant experience of temporary works.	Experienced construction supervisor with appropriate TWS training and relevant experience of temporary works.	Either formal qualification in Civil Engineering (Graduate/HND) or experienced construction supervisor with relevant temporary works experience. Good working knowledge of TWD solutions and site processes combined with appropriate TWD training in the use of standard solutions.	Either formal qualification in Civil Engineering (Graduate/HND) or experienced construction supervisor.
2a	Medium/normal excavations employing standard solutions requiring some interpretative soil analysis and simple methods of structural design analysis. Normally trench boxes, waler and brace solutions up to 6.0m in depth. Not including complex cross strutting or raking prop solutions or schemes where unusual/high structural risks have been identified in the risk assessment. Can include cantilever walls retaining up to 2.0m in height.	Experienced senior site manager with appropriate TWC training and extensive relevant experience in temporary works. Must have specific experience of solutions proposed and understanding of basic soil/structure interaction.	Experienced construction supervisor with appropriate TWS training and extensive relevant experience in temporary works. Must have specific experience of solutions proposed. Able to interpret design drawings and specifications.	Formal qualification in Civil Engineering (Graduate/HND) with previous relevant TWD experience. Able to interpret basic soil properties and utilise simple methods of structural analysis to select appropriate shoring systems.	Formal qualification in Civil Engineering (Graduate/HND) with extensive relevant TWD experience. Able to interpret basic soil properties and utilise simple methods of structural analysis to select appropriate shoring systems. Competent and experienced in the design risk assessment process able to exercise sound engineering judgement.
2b	More complex and/or deeper normal solutions requiring more detailed interpretative analysis of site investigation reports, significant structural design analysis and sound engineering judgement. Would include the full range of available support solutions for the vast majority of excavations encountered. To include cantilevers retaining up to 3.5m height, multi sided/propped systems to 10.0m deep including octagonal frames, raking props and slide rail/rolling strut systems.	Experienced senior site manager with appropriate TWC training and extensive relevant experience in temporary works. Must have specific experience of solutions proposed and excellent understanding of soil/structure interaction.	Experienced construction supervisor with appropriate TWS training and extensive relevant experience in temporary works. Must have specific experience of solutions proposed. Able to interpret design drawings and specifications and understand soil/structure interaction.	Formal qualification in Civil Engineering (Graduate/HND) with extensive relevant TWD experience. Able to design the full range of shoring solutions. Thorough understanding of geotechnics, structural analysis, risk management, construction processes and permanent works design process.	Senior Engineer with formal qualification in Civil Engineering (min Graduate/HND) plus extensive relevant TWD experience. Able to design the full range of shoring solutions. Thorough understanding of geotechnics, structural analysis, risk management, construction processes and permanent works design process. Able to exercise sound engineering judgement.
3	Highly complex, innovative or unusually high risk solutions where considerable independent engineering judgement must be demonstrated. Normally including basements, demolition schemes, railways, bridges, coastal/river works, large embankments, dams, fragile existing structures or retaining walls and existing soil failures.	Highly experienced senior site manager (ideally with formal Civil Engineering qualification). TWC training, extensive relevant experience in temporary works and previous experience of being a TWC. Able to exercise sound engineering judgement.	Highly experienced construction supervisor with appropriate TWS training and extensive relevant experience in temporary works. Previous experience of being a TWS. Extensive practical experience of solutions proposed and able to exercise sound engineering judgement.	Senior Engineer with formal qualification in Civil Engineering (min Graduate/HND) plus extensive relevant TWD experience. Able to design the full range of shoring solutions. Thorough understanding of geotechnics, structural analysis, risk management, construction processes and permanent works design process. Able to exercise sound engineering judgement.	Highly experienced Senior Design Engineer (preferably Chartered Civil or Structural Engineer) with extensive relevant TWD experience. Able to design shoring solutions from geotechnical and structural first principles and to adopt a wide range of design philosophies. Checker should normally be demonstrably independent of the designer.

Table 1 - Desired minimum competences of duty holders in relation to level of risk

Notes

1. Table is a guide only. Experience and competence can be gained via different routes and with lesser qualifications (subject to formal assessment of individual skills) or exemptions made where close supervision/mentoring is provided by others.
2. It is the responsibility of the appropriate Designated Individuals to assess and authorise their individual Duty Holders above as competent to carry out the tasks. This process should be maintained and fully documented. Duty Holders should have specific product training in the excavation support systems proposed (often provided by suppliers).
3. On sites requiring multiple schemes and/or different temporary works disciplines, the TWC may not have experience across all the disciplines of temporary works and is therefore likely to require additional technical support on site.
4. Depths or heights quoted are overall dimensions including any reduced level digs or slopes/retained materials

Annex A – Definitions

Client

site owner and project funder who needs to appoint competent persons to manage the works and provide information about the site

competent person

person with sufficient knowledge of the specific tasks to be undertaken and the risks which the work will entail, and with sufficient experience and ability to enable them to carry out their duties in relation to the works, to recognize their limitations, and to take appropriate action in order to prevent harm to those carrying out construction work, or those affected by the work

NOTE: *Modified from HSE CDM2007.*

designated individual

a person in an organisation who is responsible for establishing and implementing a procedure for the control of temporary works for that organisation

notifiable project

a construction project where the construction phase is likely to involve more than 30 days or 500 person days of construction work

Principal Contractor

person appointed as the principal contractor under Regulations 12 to 14 of CDM 2015

Principal Designer

Person appointed as the principal designer under Regulations 11 and 12 of CDM 2015

safe system of work

SSoW

a formal procedure which should be followed to ensure that work is carried out safely and is necessary where risks cannot be adequately controlled by other means

temporary works

engineered structures that allow or enable construction of, protect, support or provide access to, the permanent works and which might or might not remain in place at the completion of the works

NOTE: *Examples of temporary works are structures, supports, back-propping, earthworks and accesses.*

temporary works co-ordinator

TWC

competent person with responsibility for the co-ordination of all activities related to the temporary works

temporary works supervisor

TWS

competent person who is responsible to and assists the temporary works co-ordinator

temporary works designer

TWD

competent person who carries out the design of temporary works

temporary works design checker

TWDC

competent person who carries out checking of the design of temporary works

Annex B - Further Information and Guidance

Legislation *(The following can be downloaded free via the HSE website)*

Health and Safety at Work etc. Act 1974. London: The Stationery Office.

The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER).

Provision and Use of Work Equipment Regulations 1998 (PUWER).

L22 Safe use of work equipment, HSE Books.

The Management of Health and Safety at Work Regulations 1999 as amended (MHSWR).

Work at Height Regulations 2005 (WAHR).

The Construction (Design and Management) Regulations 2015 (CDM 2015).

The Confined Spaces Regulations 1997 (CSR).

L101 Safe work in confined spaces, HSE Books.

Standards *(Priced documents available from BSI)*

BS 5975:2008 + A1:2011, *Code of practice for temporary works procedures and the permissible stress design of falsework*

BS 6031:2009, *Code of practice for earthworks*

Other Publications *(The following can be downloaded free from either the CPA or HSE websites)*

HSE Leaflet INDG218 – *Guide to Risk Assessment;*

HSE Leaflet INDG163 – *Five Steps to Risk Assessment.*

Selection of Proprietary Shoring Equipment, Construction Plant-hire Association

Risk Assessment for Shoring and Piling Operations, Construction Plant-hire Association

Guidance on Lifting Operations in Construction When Using Excavators, Construction Plant-hire Association

Safety in Shoring. The proprietary shoring and piling Equipment Manual, Construction Plant-hire Association

Management of Shoring in Excavations. Part 2 – Hazard Identification for Risk Assessment, Construction Plant-hire Association

Construction Plant-hire Association Shoring Technology Technical Information Notes:-

TIN 201 - *Definition of Engineering Terms Relating to Piling, Excavations and Temporary Works Design;*

TIN 202 - *Schedule of Cold Formed Steel Sheets;*

TIN 203 - *The Use of Restraining Chains to Support Shoring Equipment;*

TIN 204 - *The Correct Use of Lifting and Other Attachment Points for Shoring Equipment*

Useful Websites

Construction Plant-hire Association	www.cpa.uk.net
CITB	www.citb.co.uk
Health and Safety Executive	www.hse.gov.uk/construction/index.htm
Shoring Technology Interest Group	www.cpa.uk.net/p/Shoring-Technology-Interest-Group/
Strategic Forum for Construction	www.strategicforum.org.uk/report.shtml
Temporary Works Forum	http://twforum.org.uk/pubs.html
Build UK (formally UKCG)	www.builduk.org

Annex C- Working Group Membership

Chairman:

S Hesketh	MGF Ltd

Members:

D Coley	Aldridge Piling Equipment
G daLuz Vieira	Shore and Pour
A Gould	Groundforce
J Grubb	CSkills
J Hallows	CSkills
J Harris	Consultant
E Jones	Site Equipment Ltd
M O'Connor	HSE
R Paterson	Mabey Hire
H Steele	Construction Plant-hire Association
M Thompson	HSE
J Underwood	HSE

Temporary Works Forum Sub-Group

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S Marchand	Wentworth House Partnership
P Pallett	Pallett Temporary Works Ltd
R Filip	RKF Consult Ltd

Working in Partnership

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