HEALTH AND SAFETY AUTHORITY

# A Guide to Safety in Excavations

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# A GUIDE TO SAFETY IN EXCAVATIONS

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The Metropolitan Building, James Joyce Street, Dublin 1

## Introduction:

Work associated with excavations is one of the most hazardous construction operations.

Every year, people involved in this type of work are killed or seriously injured. These deaths and injuries are caused mainly by the collapse of the side walls of the excavation, the tipping of machinery over into the trench or people being struck by the bucket of the excavator.

To ensure the safety of those involved, excavation work has to be properly planned, managed, supervised and executed in order to prevent accidents. Persons involved at all stages should be aware of the hazards involved and the procedures in place to control the risks associated with this type of work.

In accordance with the Safety, Health and Welfare at Work Act 2005 employers must manage and conduct work activities to ensure safety and health. As excavation activities can involve significant hazards, a high degree of management commitment is required. The aim of this guideline is to assist persons in controlling the risks associated with excavations.

## 1.0 Hazard Identification and Risk Assessment

The Safety, Health and Welfare at Work (Construction) Regulations 2006 require that anyone in an excavation deeper than 1.25 meters be protected from dislodgement of the sides of the excavation. This protection could be in the form of shoring (support for the excavation), battering (sloping the excavation) or other suitable means. Notwithstanding this, all excavations (including those shallower than 1.25 metres) and the area in the vicinity of an excavation must, when people have access to them, be as far as is reasonably practicable safe and without risk to health.

It is a requirement of the Safety, Health and Welfare at Work Act 2005 that a risk assessment be carried out in relation to activities being undertaken by persons at a place of work and that a safe system of work be prepared and implemented to protect employees and persons engaged or affected by the activities taking place at a place of work.

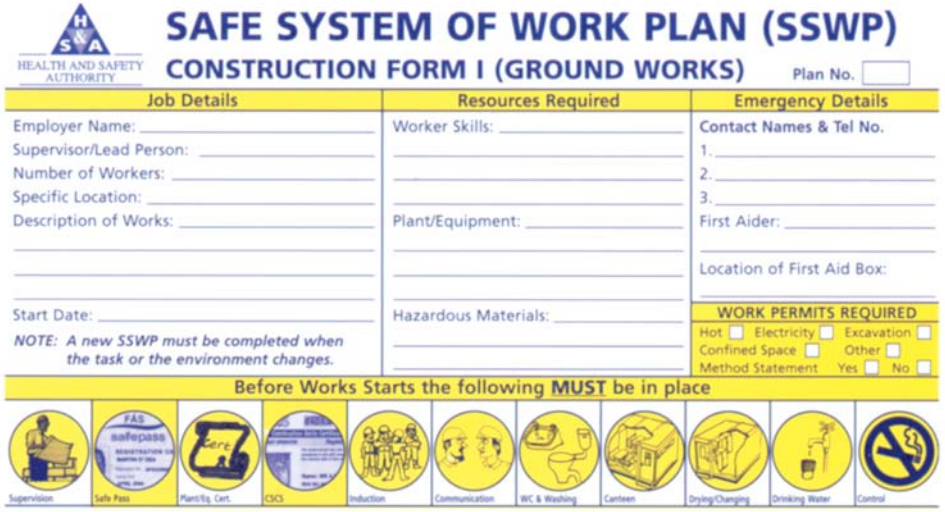
The common hazards associated with excavation works are:

- contact with underground services
- contact with overhead lines
- collapse of the excavation's sides
- materials falling onto people working in the excavation
- people and vehicles falling into the excavation
- people being struck by plant
- undermining of nearby structures
- ground water
- soil
- access to the excavation
- fumes
- accidents to members of the public.

## 1.1 Safe System of Work Plan

Once you have identified what the risks are, you must put in place a plan to effectively manage those risks. The Health and Safety Authority has in consultation with the construction industry, formulated a practical system to help employers and employees comply with their statutory requirements in this regard. This is called the Safe System of Work Plan (SSWP). The SSWP links the implementation of the safety statement directly to the work activity. One SSWP has been prepared specifically with ground works in mind. The SSWP is completed at the start of each activity, and can be reviewed at any time during the work. It increases awareness and

encourages the users to consider a range of options to deal with the risks. The SSWP uses pictograms in large part which will be of assistance in overcoming language barriers as currently being experienced on irish sites. It also is user friendly requiring a tick rather than long written paragraphs. Further information is available on our website at www.hsa.ie or phone 1890 289 389.



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# SAFE SYSTEM OF WORK PLAN (SSWP)

## CONSTRUCTION FORM I (GROUND WORKS)

Plan No.

| Job Details | Resources Required | Emergency Details |
|---|---|---|
| Employer Name: | Worker Skills: | Contact Names & Tel No. |
| Supervisor/Lead Person: | | 1. |
| Number of Workers: | | 2. |
| Specific Location: | | 3. |
| Description of Works: | Plant/Equipment: | First Aider: |
| | | Location of First Aid Box: |
| Start Date: | Hazardous Materials: | WORK PERMITS REQUIRED |
| *NOTE: A new SSWP must be completed when the task or the environment changes.* | | Hot ☐ Electricity ☐ Excavation ☐<br>Confined Space ☐ Other ☐<br>Method Statement Yes ☐ No ☐ |

**Before Works Starts the following MUST be in place**

Supervision | Safe Pass | Plant/Eq. Cert. | CSCS | Induction | Communication | WC & Washing | Canteen | Drying/Changing | Drinking Water | Control

*Figure 1: Safe System of Work Plan (Introductory Section)*

## 2.0 Underground Services and Overhead Power Line

If underground cables or overhead lines cannot be diverted, then the following steps should be taken to avoid contact.

- Contact the appropriate service providers (ESB, Bord Gáis etc) and ask their advice and obtain relevant drawings.
- Look around for obvious signs of underground services, e.g. valve covers or patching of the road surface.
- Use locators to trace any services and mark the ground accordingly. Make sure persons using these scanners are trained and understand their use.
- Make sure that the person supervising excavation work has service plans and knows how to use them. Everyone carrying out the work should know about safe digging practices and emergency procedures. (See the Authority's Code of Practice for Avoiding Danger from Underground Services).
- Survey the area for overhead obstructions such as electricity lines.
- Erect goal posts and bunting if required.
- Where work needs to be carried out in close proximity to overhead lines, contact the ESB for advice.

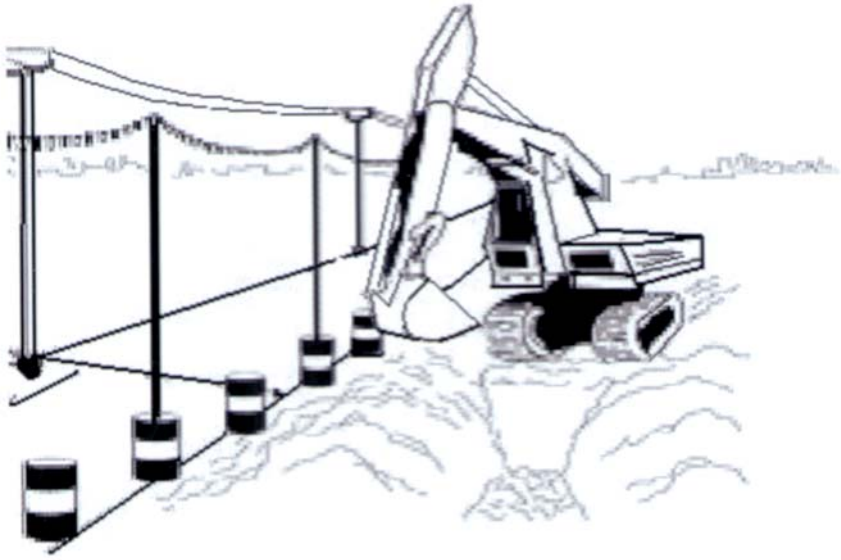


*Figure 2: Bunting to Protect Equipment from Coming into Contact with Overhead Electricity Lines*

*Figure 3: Operators on Site Locate Underground Services Prior to Excavating*

## 3.0 Excavation Collapse:

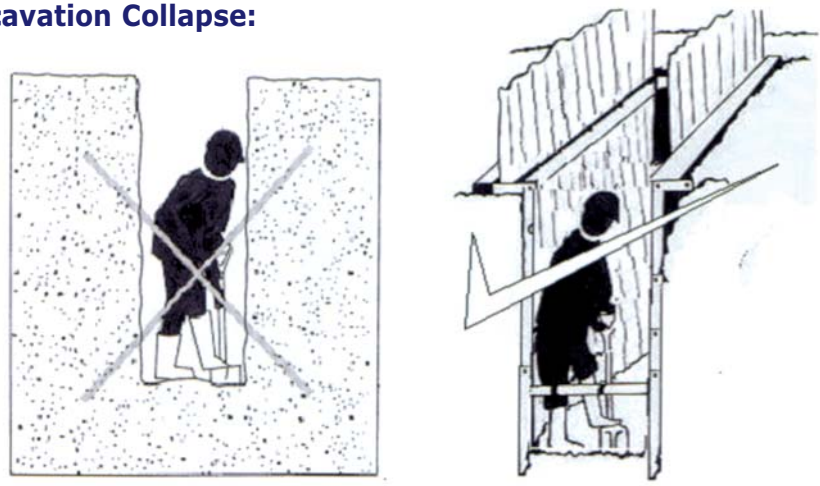


*Figure 4: Unsupported & Supported Excavation*

A range of proprietary trench boxes and hydraulic walls allow trench supports to be put in place without requiring people to enter the excavation.

The following is a summary of some of the steps than can be taken to prevent a person becoming engulfed or injured in an excavation.

- Prevent the sides and the ends from collapsing by battering them to a safe angle (see Figure 5).

*Figure 5: Battered Trench*

- Where it is not possible to batter, support the walls with timber, sheeting or proprietary support systems.
- Do not go into unsupported excavations that have not been battered to a suitable slope.

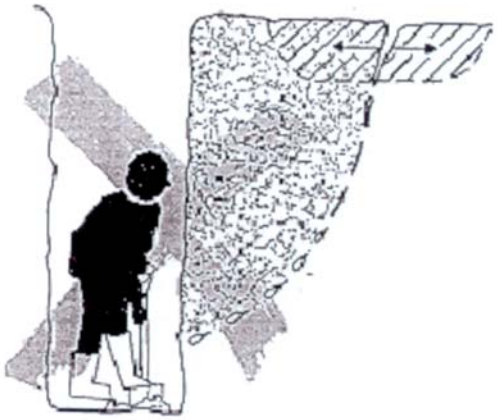


*Fig 6(a): This is a very dangerous situation, requiring ground support. It is a prohibited activity. As the excavation is greater than 1.25 metres deep, no worker should be in the trench unless support has been installed.*

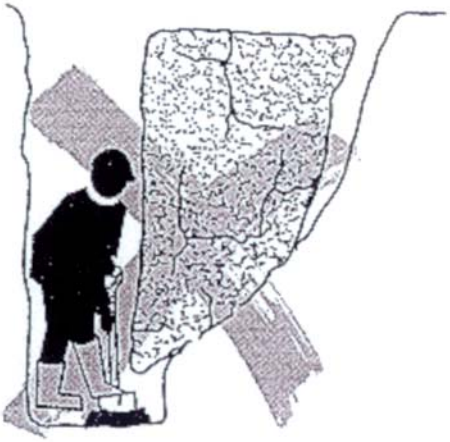


*Fig 6 (b): Shear plane failure along the seepage (slippage) plane*

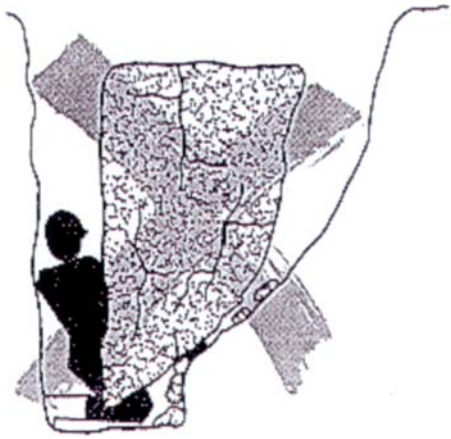


*Fig 6 (c): Worker trapped and crushed against the trench wall by the quick collapse*

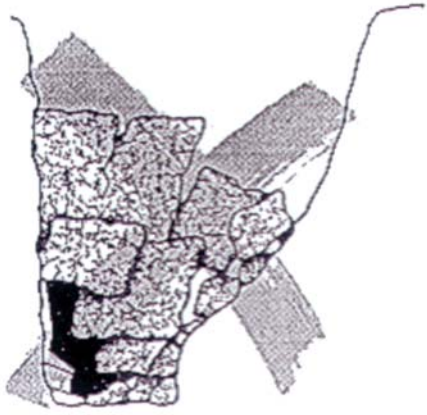


*Fig 6 (d): Worker badly injured and probably smothered after being crushed against the opposite wall by the collapsing ground. The weight of a wedge of sand over a one metre length of trench is about three tonnes; more than enough to crush a worker's chest.*

- No vehicle or item of plant is allowed near an edge of an excavation, which is likely to cause collapse (see Fig 7).

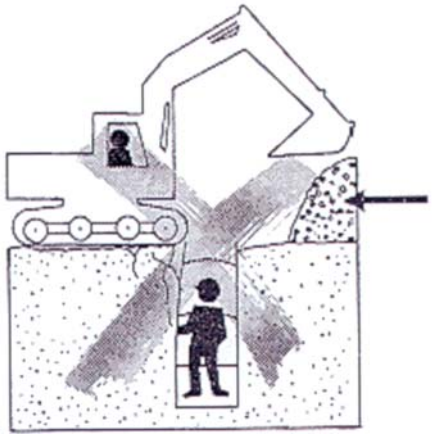



*Fig 7(a)*

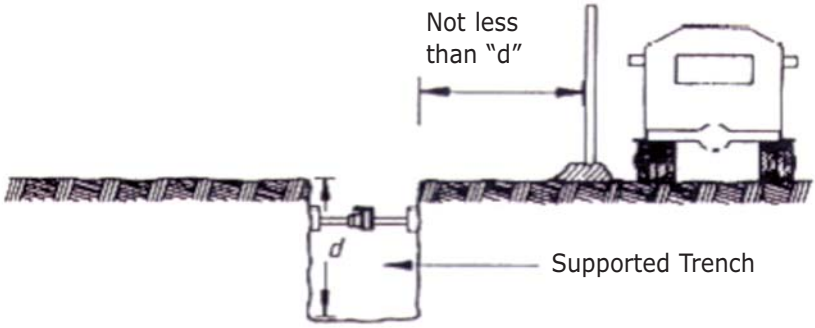



*Fig 7 (b)*

*Figure 7(a) & 7(b): Vehicle Separation from Trench*

- Never work ahead of the support.
- Remember that even work in shallow trenches can be dangerous. You may need to provide support if the work involves bending or kneeling in the trench.
- Even work in rock cut excavations may result in boulders falling in on persons at work.

*Figure 8: Trench Box Being Used to Prevent Collapse of Excavation*

## 4.0 Materials Falling into Excavations

- Do not store spoil or other materials close to the sides of excavations. The spoil may fall into the excavation and the extra loading will make the sides more prone to collapse.

- Make sure the edges of the excavation are protected against falling materials. Provide toe boards where necessary.

*Figure 9: Trench Box with Handrails and Toe-boards*

- Wear a hard hat when working in excavations.
- In rock cut excavations where the rock is friable netting should be used.

*Figure 10: Spoil being Piled Away from Edge of Excavation*

## 5.0 People and Vehicles Falling into Excavations

- Take steps to prevent people falling into excavations. Provide substantial barriers, for example guard rails and toe boards.

- Keep vehicles away from excavations wherever possible. Use brightly painted stop blocks or barriers where necessary.
- Where vehicles have to tip materials into excavations, use stop blocks to prevent them from over-running. Remember that the sides of the excavation may need extra support.
- Never have a person in an excavation while machinery is working over it. The extra surcharge from the weight of the machine may induce a collapse (see Fig. 7).

## 6.0 People Being Struck by Plant or Heavy Items

- Keep workers away from moving plant such as excavators. Workers should work outside the reach of the excavator bucket. Where this is not possible, use safe systems of work to prevent people being struck.
- Plant operators should be competent and CSCS (Construction Skills Certification Scheme) trained or approved equivalent.
- Mobile work equipment such as articulated dump trucks that have reduced visibility in their direction of travel must be fitted with auxiliary visibility aids.
- Attachments for excavators fitted via quick hitch mechanisms must be effectively secured.
- Check lines should be used to guide items into position and the work carried out under the control of a slinger or signaller who is in possession of a CSCS card.
- A register of lifting equipment must be kept with appropriate records of statutory tests and examinations.

## 7.0 Undermining Nearby Structures

- Make sure excavations do not affect the footings of scaffolds or the foundations of nearby structures. Walls may have very shallow foundations that can be undermined by even small trenches.
- Decide if the structure needs temporary support before digging starts. Surveys of the foundations and the advice of a structural engineer may be needed.
- If shoring support is required, it should be installed in such a way that the stability of the structure is not compromised at any stage of the installation/excavation process.

## 8.0 Access

- Provide good ladder access or other safe ways of getting in and out of the excavation. Keep access routes clear from obstruction.
- A trench will generally be a confined space. Thus emergency and rescue procedures that comply with the Authority's Code of Practice for Working in Confined Spaces should be adhered to.

*Figure 11: Safe Access is Required*

## 9.0 Gases

- Exhaust fumes can be dangerous. Do not site petrol or diesel engine equipment such as generators or compressors in, or near the edge of, an excavation unless fumes can be ducted away or the area can be adequately ventilated.

Excavations can have poor natural ventilation so that the presence of, or potential for, a dangerous atmosphere can give rise to typical "confined space" conditions of immediate danger to life and health.

**Dangerous atmospheres** can occur in excavations due to lack of oxygen or the presence of toxic or flammable gases or of simple asphyxiants.

**Lack of oxygen.** Excavations can become oxygen depleted by any process which uses up oxygen faster than it is replenished by ventilation: e.g. by fire or other form of burning or combustion.

**Asphyxiant gas.** Simple asphyxiants are physiologically inert gases that dilute or displace atmospheric oxygen below the level required for normal respiration. Common examples of asphyxiant gases are carbon dioxide, ethane, helium, hydrogen, methane and nitrogen. Sometimes inert gases are deliberately supplied into excavations: Argon, helium, nitrogen or carbon dioxide, for example, may be

piped into an excavation for welding purposes. An excavation may also be located close to a buried underground gas main. A leak of any of these gases into the excavation can quickly lead to a dangerous atmosphere. Certain welding processes, which involve risk of inert gas accumulation, such as "purge gas damming" should be avoided in excavations or other confined spaces unless appropriate special controls are in place. Similarly, appropriate special controls should be in place if liquid nitrogen is supplied into an excavation for the purpose of isolating a section of live water main.

**Toxic atmosphere.** A huge variety of gases and vapours are considered to be acutely or chronically toxic. The leakage or seepage of a toxic gas into an excavation must be avoided. Toxic gas may also be generated within the excavation, for example carbon monoxide may be generated by the use of internal combustion engines. Chronically toxic gases may have immediate or long-term effects on health.

**Flammable or explosive atmosphere.** A gas or vapour that would burn will become explosive if it is confined in a tight space. So a gas or vapour can explode inside an excavation and produce a great deal of damage. These gases may come from sources such as renovation of fuel retail garages and in underground fuel tanks, or from leaking underground gas mains. Methane as stated earlier may also be produced in excavations adjacent to land fill sites or where other vegetation or biological waste is decomposing. In sufficient concentrations, it can cause fires or explosions when ignited.

Before beginning work in an excavation, the following questions have to be asked - and answered:

- Is a dangerous atmosphere present, or liable to be present?
- Is the space adequately ventilated to a) maintain an adequate oxygen content and, b) prevent the accumulation of harmful substances?

It is important to be aware of the use and history of the location of the work when considering the first vital question. Buried underground pipework or a leaking sewerage vault may present a hidden hazard. If a dangerous atmosphere is potentially present, the excavation must be treated as a confined space. A safe system of work must be developed and put in place, including the making of appropriate emergency arrangements. The safe system of work may involve the provision of adequate ventilation, the testing of the atmosphere, or other precautions, as devised by a competent person.

## 10.0 Protecting the public

- Fence off all excavations in public places to prevent pedestrians and vehicles falling into them.
- Where children might get onto a site out of hours, take precautions (for example back-filling or securely covering excavations) to reduce the chance of them being injured.
- If possible, excavations in public roads or streets should be back-filled or covered over at night to minimize the risk of accidents to the public.
- Provide adequate guarding, signage and lighting on all footpaths, cycle tracks or roads.

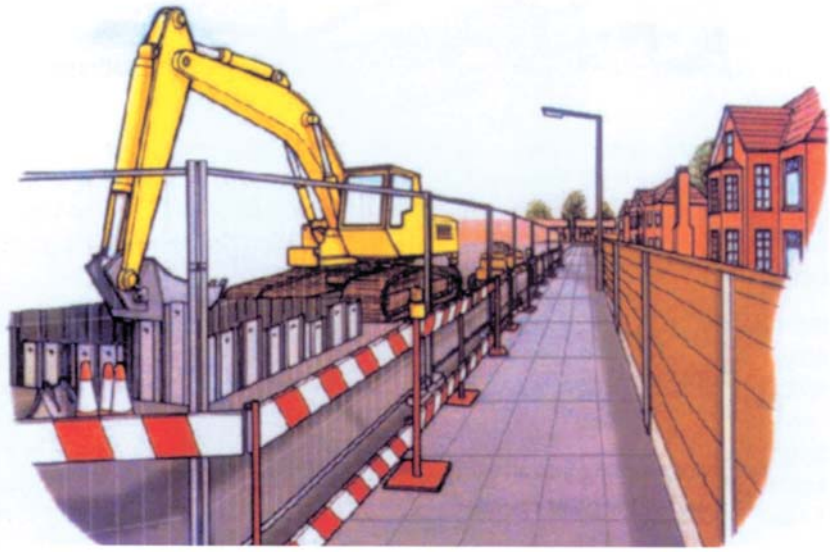


*Figure 12: Ensure that Excavations in Public Places are Fenced.*

- Do not leave materials lying beside an area of work. Materials should be stored in a secure compound and removed and used only as required. If material has been removed from the compound but subsequently is not required for imminent use, then that material should be returned to the compound until it can be incorporated into the work.

## 11.0 Supervision

- A competent person must supervise the installation, alteration or removal of excavation support.
- Excavation works on a road, footpath or cycletrack must be supervised by a competent person who has been issued wit h a valid construction skills registration card for the guarding and signing of roadworks.
- People working in excavations should be given clear instructions, through training, on how to work safely.

## 12.0 Inspection and Examination of Excavations

- All excavations must be inspected by a competent person at least once in every day during which persons are at work in the excavations.
- Every excavations more than 2 metres deep must be inspected by a competent person at the commencement of every shift.
- A thorough examination of the excavation must be carried out at least every 7 days.

*Figure 13: Installation of Excavation Supports Under Supervision*

A written report should be made after most inspections. Stop work if the inspection shows the excavation to be unsafe. The results of all inspections should be documented on the appropriate form in accordance with the construction regulations. A checklist should be compiled and gone through to aid the inspection process. Having completed the checklist, the inspection record should be filled in and retained. Other checks may be appropriate depending on conditions.

An Approved Form (AF3) should be used to record the thorough examination of excavations. This form is available on our website at www.hsa.ie.

## 13.0 Legal Requirements

The following is a list of the main legislation governing work in connection with excavations.

Safety, Health and Welfare at Work Act 2005
Safety, Health and Welfare at Work (General Application) Regulations
Safety, Health and Welfare at Work (Construction) Regulations.
Safety, Health and Welfare at Work (Confined Spaces) Regulations.
In all cases, the most up to date version of the legislation should be used. This may be monitored on our website at www.hsa.ie or by phoning 1890 289 389.

## Appendix 1. Check List to Aid with the Inspection of Shoring

Is the installation as per the design?

Is the soil and water as per design?

Is there ingress of water?

Are there proper sumps?

Is material being drawn from behind the sheets?

What are the deflections on frames and sheets?

What is soil composition, are there tension cracks?

Are the deflections excessive?

Is there damage to the system?

Is access to trench adequate?

Are there any surcharges?

Check for cracks in adjacent structures?

Is the surface clear of plant, spoil, etc?

Are spoil heaps properly controlled?

Is the area properly fenced?

Is the access to the trench adequate?

Is the edge protection/handrail to the trench adequate?

Are there exhaust gases in the trench?

Are buried services marked?

Are wedges tight?

Are the struts horizontal?

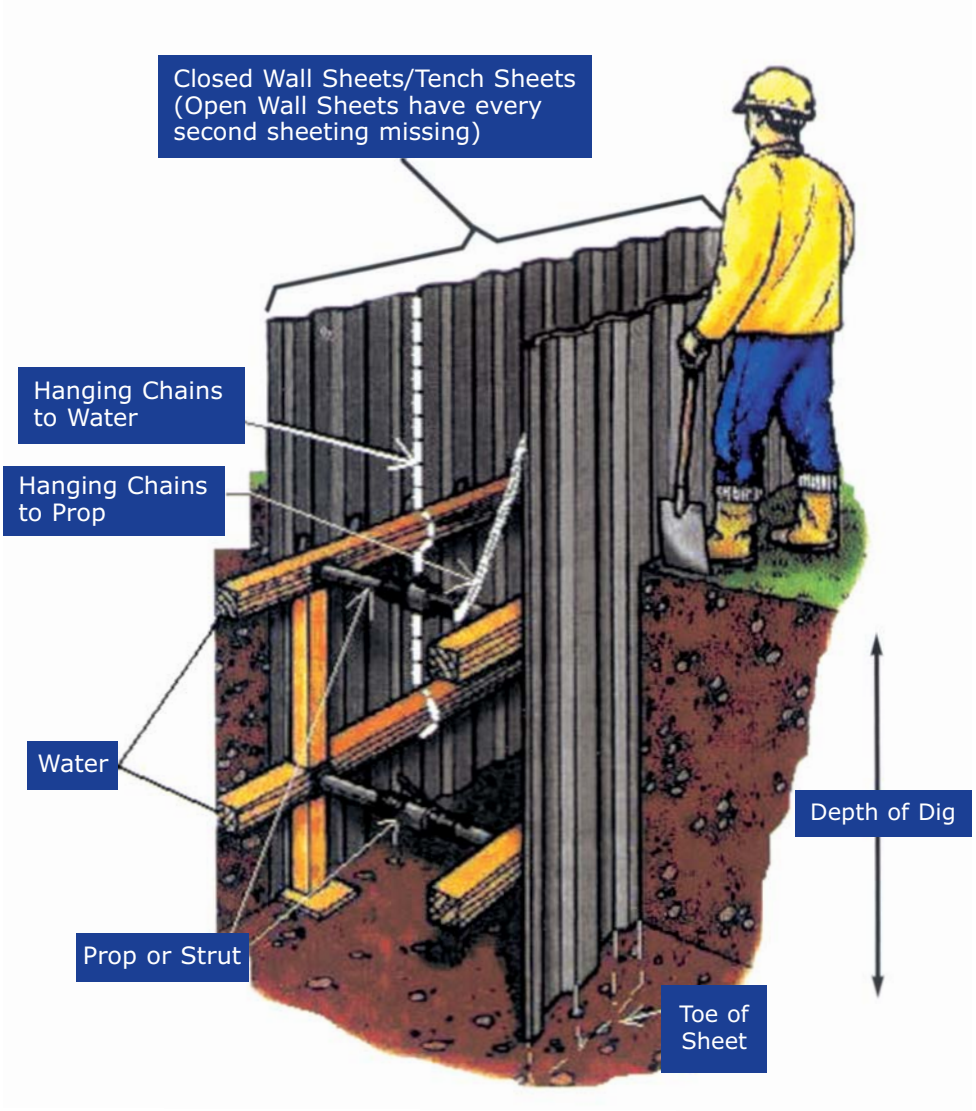
Have struts hanging chains?

Are the personnel competent?

Is the work as per method statement?

Is the safe system of work working?

## Appendix 2. Typical Excavation Equipment



# Notes

## Notes

# A Guide to Safety in Excavations

*Achieving a Healthy and Safe Working Life -Together*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