ELEMENT 11 EXCAVATIONS

Learning Objectives

- Explain the hazards and risk assessment of excavation work
- Explain the control measures for excavation work
- Explain the hazards and risks associated with confined space working
- Outline the control measures for confined space working.

Relevant Legislation

CDM Regulations 2015
Confined Spaces Regulations

Construction, Design and Management Regulations 2015

Regulation 22 Excavations

All practicable steps must be taken to prevent danger to any person, including, where necessary, the provision of supports or battering, to ensure that—

- *no excavation or part of an excavation collapses;*
- *no material forming the walls or roof of, or adjacent to, any excavation is dislodged or falls; and*
- *no person is buried or trapped in an excavation by material which is dislodged or falls.*

Suitable and sufficient steps must be taken to prevent any person, work equipment, or any accumulation of material from falling into any excavation.

Suitable and sufficient steps must be taken, where necessary, to prevent any part of an excavation or ground adjacent to it from being overloaded by work equipment or material.

Construction work must not be carried out in an excavation where any supports or battering have been provided in accordance with paragraph (1) unless—

(a) the excavation and any work equipment and materials which may affect its safety have been inspected by a competent person— (i) at the start of the shift in which the work is to be carried out;

(ii) after any event likely to have affected the strength or stability of the excavation; and

(iii) after any material unintentionally falls or is dislodged; and

(b) the person who carried out the inspection is satisfied that construction work can be safely carried out there.

Where the person carrying out an inspection has informs the person on whose behalf the inspection is carried out of any matter about which they are not satisfied, construction work must not be carried out in the excavation until the matter has been satisfactorily remedied.

Regulation 23 Cofferdams and caissons

A cofferdam or caisson must be—

(a) of suitable design and construction;

(b) appropriately equipped so that workers can gain shelter or escape if water or materials enter it; and

(c) properly maintained.

A cofferdam or caisson must not be used to carry out construction work unless—

(a) the cofferdam or caisson and any work equipment and materials which may affect its safety have been inspected by a competent person— (i) at the start of the shift in which the work is to be carried out; and

(ii) after any event likely to have affected the strength or stability of the cofferdam or caisson; and

(b) the person who carried out the inspection is satisfied that construction work can be safely carried out there.

Where the person carrying out an inspection informs the person on whose behalf the inspection is carried out of any matter about which they are not satisfied (under regulation 24(1)), construction work must not be carried out in the cofferdam or caisson until the matter has been satisfactorily remedied

British Standards

BS 1377 Methods of test for soils for civil engineering purposes

BS 5607 Code of Practice for safe use of explosives in the construction industry

BS 5930 Code of Practice for site investigations

BS 6031 Code of Practice for earthworks

BS EN 474 Earth Moving Machinery, Safety

11. EXCAVATIONS

Working in excavations is a particularly high risk activity, in a 4 year period 39 people lost their lives in excavations. It is wrong to assume that shallow trenches are safe, several people die every year in trenches under 2 metres in depth as just one square metre of earth weighs over one tonne.

Almost all construction work involves some form of excavation, for foundations, drains, sewers, etc. These can vary greatly in depth and may be only a few centimetres deep on the one hand or be very deep and very dangerous. Every year, on average, seven people are killed in excavations, some being actually buried alive, in collapsed tunnels and trenches. Many others are injured and there are hundreds of reportable accidents each year during excavation and tunnelling operation.

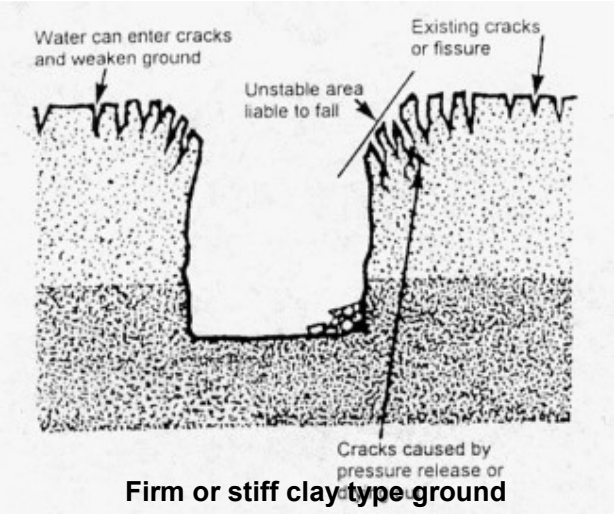
A relatively small collapse might involve about a cubic meter of soil, but a cubic meter of soil weighs over a tonne. A person at the bottom of a trench buried under this volume of material would be unable to breathe, due to the pressure on the chest, and would quickly suffocate and die.

Deep trenches look dangerous, so precautions are usually taken. But most deaths occur in trenches less than 2.5 metres deep. In fact most accidents occur in ground conditions with no visible defects; the trench side seem clean and self-supporting. Despite appearances, however, the removal of material causes pressure relief and introduces the conditions which lead to failure. Rainwater or hot, dry weather increases the chances of such failure.

Neither the shallowness of an excavation of the appearance of the ground should be automatically taken as indications of safety. The evidence suggests that far too often such assumptions are made.

11.1 Soil

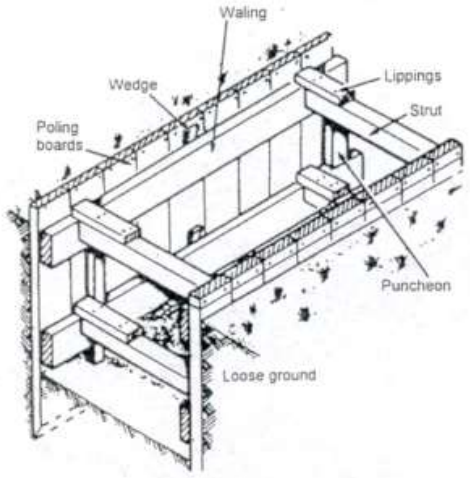
Excavation involved the removal of soil and rock in lesser or greater quantities. Water is almost always present, even if only as moisture in the soil. This presents an additional hazard, which must be considered.



Firm or stiff clay type ground

Soil varies in its nature. Some soil, like fine sand, flows easily. Other soils, like stiff clay, are more cohesive. No soil, whatever its structure, can be relied upon to support its own weight and, if a trench or excavation cannot be made safe by sloping or battering the sides, some form of support will be required. Loose and fractured rock will also need some support.

11.2 Supports



Close boarded excavation

Adequate support depends on:

- the type of excavation
- the nature of the ground
- ground water conditions

Generally speaking, timbering or shoring is not required for trenches or excavations where there is no danger of any material falling or collapsing.

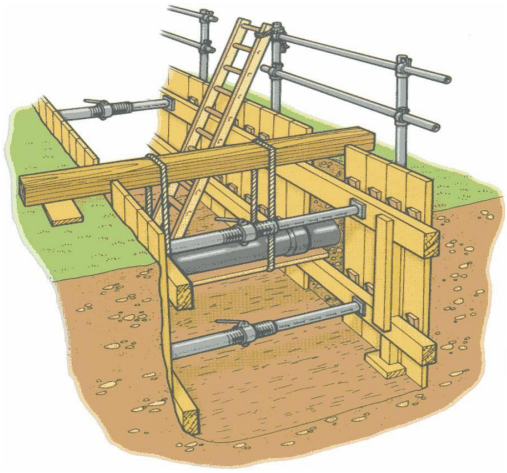


Diagram Supporting Services

For all other excavations or trenches, a survey of soil prior to excavation by a trained and experienced person will usually provide sufficient information for suitable methods of excavation and support to be determined.

Where large or extensive excavations are concerned, these are matters that a specialist engineer should decide.

Risk assessments, under The Management of Health and Safety at Work Regulations, or consideration of the excavation under The Construction (Design and Management) Regulations may also be appropriate.

Adequate supplies of support materials should be available before the excavation commences and must be sound, free from defects, of adequate strength, good construction and properly maintained. Supports must be fixed securely to prevent displacement.

All support should be erected, altered and dismantled under the supervision of a competent person.

11.3 Reasons for excavation failure

- sides not supported
- support failing or insignificant for task
- falling objects
- falls from ground level
- ingress of liquids can loosen the earth
- ingress or fall from plant and machinery

11.4 Problems with excavations

- Limited space
- Risk of flooding
- Collapse
- Falling people
- Collapse of adjacent building structure
- Material on side of excavation
- Lack of oxygen
- Underground cables
- Underground gas pipes
- Vermin/Contaminated land
- Flooding
- Falling objects (into the trench)
- Fumes
- Noise from plant and equipment
- Undermining other structures

11.5 CONTROLLING RISKS

All timbering and support work must be carried out under the direction of a competent person. Conventional timber shuttering or steel trench sheets and adjustable props should be used. The props may be mechanical (jacks or struts) or hydraulic.

Temporary framework on supports, or a protective box or cage, may be needed to protect workers while they put in permanent timbering. A box or cage can be moved forward as timbering progressing.

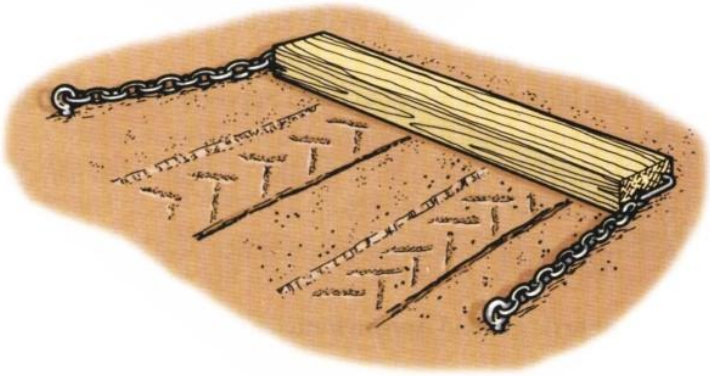
Care must be taken to see that excavation work does not jeopardize the stability of any adjacent structure. Precautions to protect workers and others must be taken before and during any excavation work.

Access

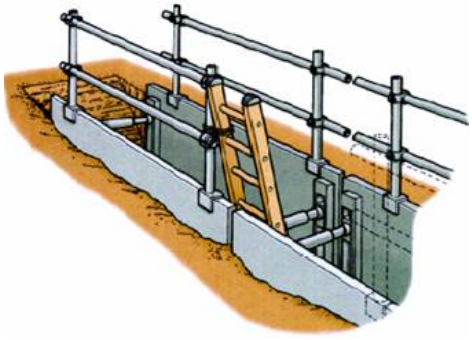
Safe means of getting into and climbing out of an excavation must be provided. If a risk assessment identifies that ladders are a reasonable means of access or egress from an excavation, they must be suitable and of sufficient strength for the purpose. They must be on a firm level base, sufficiently secured so as to prevent slipping and must, unless a suitable alternative handhold is provided, extend to a height above the landing place of at least 1 metre, so as to provide a safe handhold. Climbing into or out of an excavation using the walings and struts must be prohibited

Barriers should also serve to keep materials, plant and equipment away from the edges of an excavation. Barriers may be removed to permit access of personnel, plant and equipment, etc., but should be replaced as soon as possible.

A spoil heap can form an effective barrier

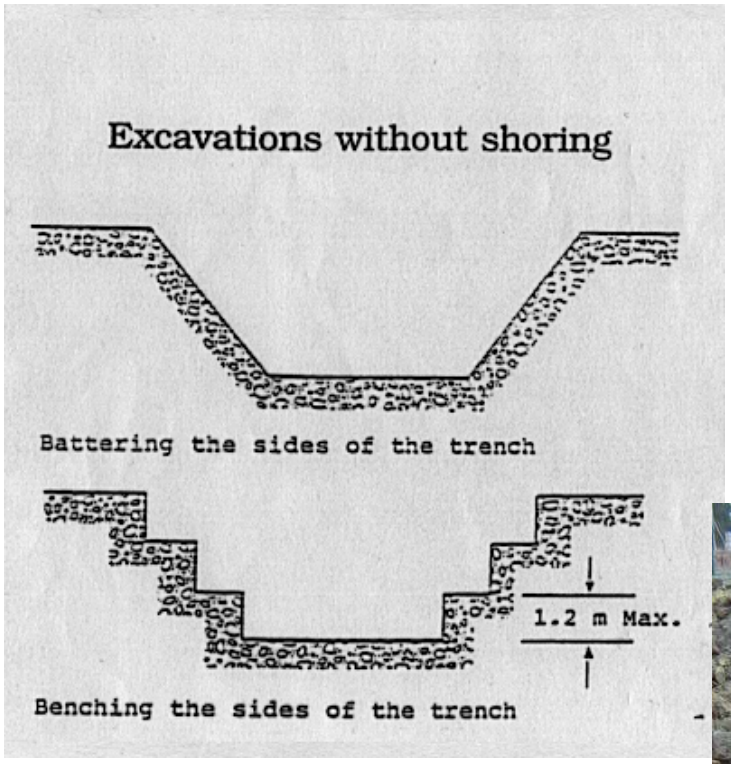


Large scale barriers are needed to keep vehicles away.



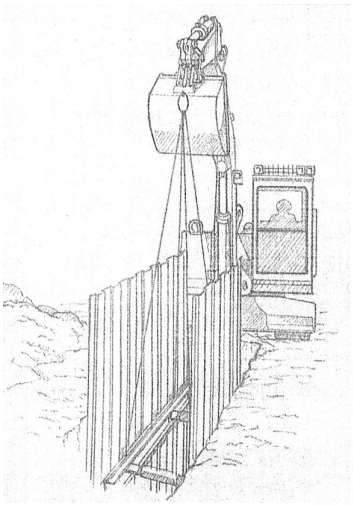
Edge protection and safe access

Battered Sides - This is where the edge is sloped, the exact angle will depend on the soil type. It is normally between 15 and 50 degrees.



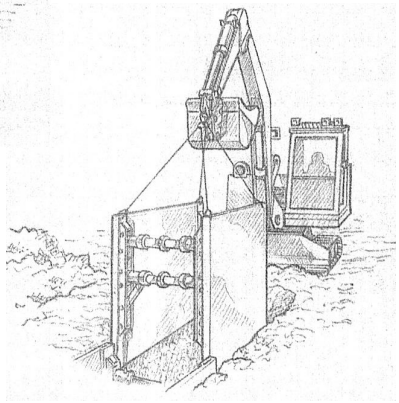
Stepped edges

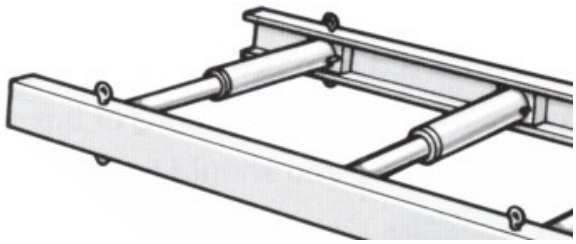
During darkness, the edges of an excavation should be marked with lights, especially where they are close to public thoroughfares. Oil or battery operated traffic lamps placed at suitable intervals are usually sufficient. Before excavation work begins steps must be taken to identify the location of buried services. When positions are uncertain then steps should be taken to identify precise locations by hand digging where necessary.



Trench Sheets - Metal vertical sheets driven in slightly below the bottom of the excavation, they are held apart by timber or adjustable steel props.

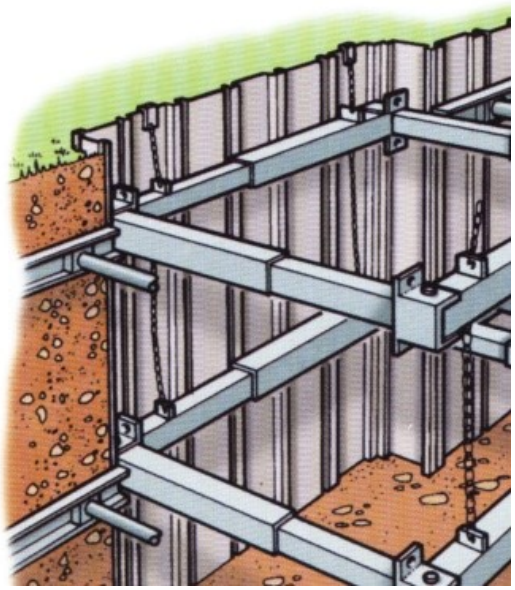
Trench/Sheilders Boxes - These protect the person working in the excavation as well as the side of the excavation.

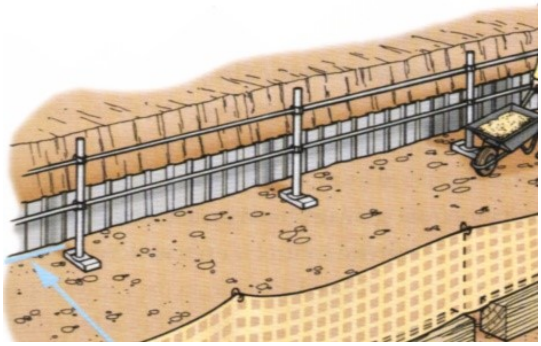




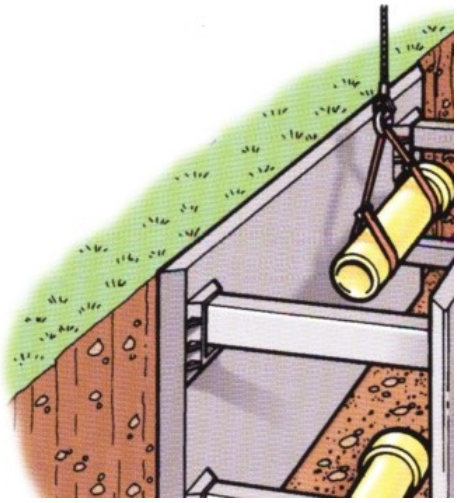
Above - Waler Frame

Manhole brace

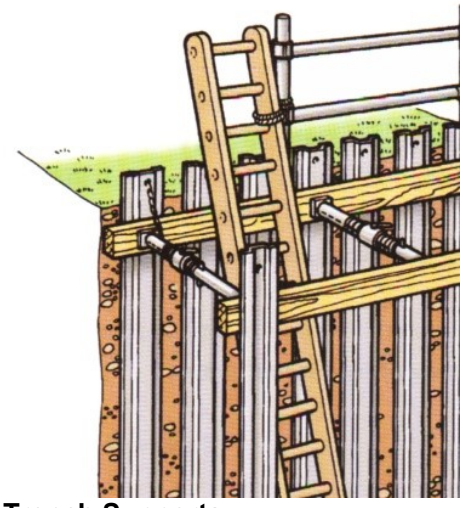




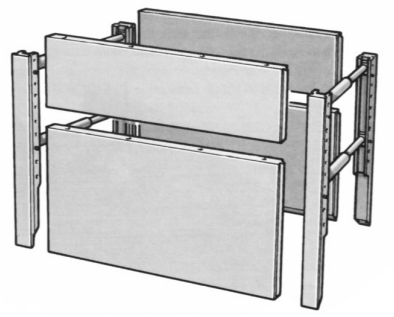
Plant Separation



Pipe Lowering



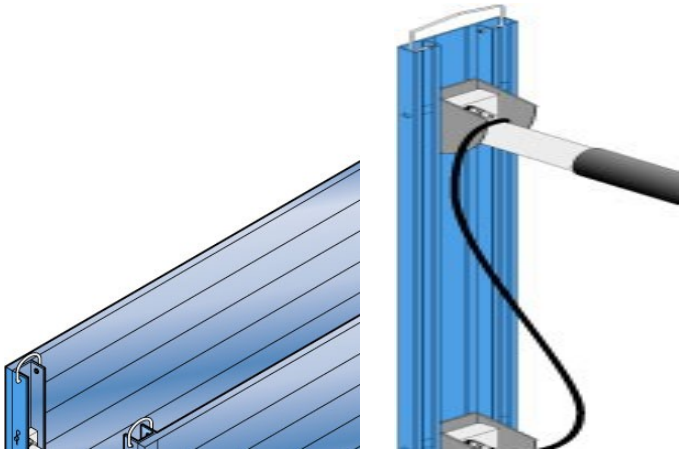
Trench Supports



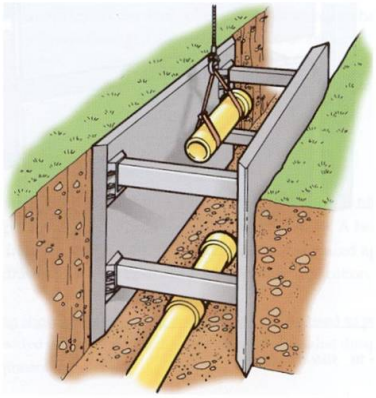
Slide Rail

Aluminium Trench Sheets

Light weight systems



Verti Shore system



Drag Box

Ventilation

Excavations must be kept clear of suffocating, toxic or explosive gases. These may be natural gases like hydrogen sulphide, methane and carbon dioxide, exhaust gases from nearby plant, or leaks from nearby pipes or installations.

These can seep through the soil and can accumulate at the bottom of an excavation, below ground level. Leakage of propane and butane from LPG cylinders is potentially very dangerous; the gases will sink to the lowest point and form an explosive concentration, which cannot disperse naturally.

For the purpose of dealing with these hazards, the bottom of a deep excavation should be regarded as a confined space.

Tests for gas must be carried out before work is started, and regularly as work progresses. It is also recommended that the work should be subject to the issued of a Permit to Dig certificate.

To ensure that every workplace or approach is safe and without risks to health, it must be provided with a sufficient supply of purified air. The most common method of ventilation is to blow clean air into the excavation in sufficient volume to dissipate any gas and provide adequate breathable air.

Any ventilation plant used must be fitted with an effective device to give a visible or audible warning of any failure of the plant.

Contaminated Soil

- Soil may be contaminated with a variety of different hazardous substances, chemical, biological and physical. Hazards such as Asbestos, Radio-active materials, -Explosives, Lead and biological agents such as anthrax may be present.
-
- Soil testing may be needed along with soil surveys. Steps must be taken to protect workers, this may include ongoing air monitoring as well as taking soil samples. If vehicles leave the site arrangements may be needed to stop vehicles taking contaminated soil off site. Depending on the contamination the soil can be classified for its end use-Type A to E.
-
- A Uncontaminated
- B Slight Contamination
- C Contaminated
- D Heavy Contaminated
- E Unusually Heavy Contaminated
-

The waste may also be classified as “hazardous waste”.

Inspection and Maintenance

All excavation work requires careful watching; especially when trenches are first opened and sides are unsupported. Even when support work has been installed, constant vigilance is essential.

Small movements of earth, resulting in movements in the supports or timbering of no more than 6-12mm, are usually the only sign of the progressive weakening in cohesive soils which can cause collapse. Such movements can easily pass unnoticed but they are signs that something is wrong.

Movements can be detected from slight distortion in the timbering, bowing of poling boards and walings, or signs of local crushing.

All timber must be regularly checked. Where timber remains in position for any length of time, it may dry out, shrink or rot. The only positive method of checking the state of timber is to drill small holes with an auger.

Ground, too, may dry out and shrink, which loosens the timbering. Alternatively, it may absorb additional moisture, swell and displace the timbering. Soil may even leak into the excavation from behind the timbering, loosening it.

Support-work members must always be kept tight against each other and against the soil face, wedges or telescopic struts holding them must always be kept tight. Raking, or angle, struts should all be regularly examined for signs of having been damaged or dislodged.

Warning signs to look out for:-

- small earth movements
- timber distortion
- timber shrinkage or rot
- dried out ground
- damage from skips or buckets
- slumping soil heaps due to bad weather

When loads are being moved into or out of the excavation by skip or bucket, care should be taken to avoid damage to struts or walings (see below). Vertical boards, commonly known as rubbing boards, are often provided for protection

During bad weather soil heaps tend to slump, and loose boulders or masonry may fall into the excavation.

Heavy vehicles should not be allowed near the edge of excavations unless the support work has been specially designed to permit it.

Safety helmets should be worn at all times, not only during the actual excavation of hard material like rock, but also whenever people are working in positions where earth and other material can slide down or fall on them.

Inspection and examination

Bad practice

Inadequate shoring of this excavation and others like it led to the collapse of an adjoining 3-storey property (see picture, right). Luckily, no one was injured.

The construction company and its director were fined £90 000 each, ordered to pay costs of £14 444, and compensation of £3000 to each of the three displaced residents of the flats.

The Construction Design and Management Regulations require excavations must be inspected:

- before any person carried out any work
- at the start of every shift by a competent person
- after any event likely to have affected the strength or stability of the excavation or any part of it
- after any accident fall of rock, earth or other material.

The competent person must be satisfied that the work can be carried out safely and without risk to workers.

A report must be prepared by the person carrying out the inspection giving the following information:

- the name and address of the person on whose behalf the inspection was carried out
- the location of the place of work inspected
- a description of the place of work part of that place of work inspected, including plant and equipment or materials, if any
- the date and time of inspection
- details of any matter identified that could give rise to the health or safety of any person
- details of any action taken as a result of any matter identified above
- details of any further action considered necessary
- the name and position of the person making the report

The person who prepare the written report must provide a copy of the report within 24 hours to the person on whose behalf the inspection was carried out. The report or a copy of it must be kept on the site for a period of three months from the date of completion of all

work on the project and be kept available for inspection by HSE Inspectors and safety representatives.

11.6 Excavation Safety checklist

Prior to commencing work

1. Is a risk assessment appropriate?

2. Are excavations included within the health and safety plan?

3. For purposes of excavation, no ground should be considered good or safe until it has been investigated?

4. Prevent all access to the excavation by un-authorised persons, especially children.

5. Check the soil types and decide on which type of support work is required in consultation with a competent engineer of supervisor.

6. Check whether the excavation will affect adjoining roads or buildings.

7. Determine the positions of all public services and ensure that they are adequately marked and disconnected as necessary.

8. Always seek advice before excavating below existing foundations of adjacent or adjoining buildings. It may be necessary to provide shoring, i.e. raking or flying or both.

9. Provide an adequate supply of material for support work, along with barriers and correct traffic notices.

10. Make provision for poling boards to stand proud of the existing ground levels. This prevents any loose material from falling into the excavation.

11. Check for the provision of adequate lighting.

12. Check the adequate and sufficient ladders have been provided for safe access to the excavation and that enough ropes for securing these items are to hand.

13. Determine the positions of bridges, temporary roads and spoil heaps.

14. Determine the methods of excavating before commencing work, and the method by which it is intended to install and remove any support work.

11.7 Excavations Safety checklist - Whilst work is in progress

1. Ensure that only sound material is being used.

2. Ensure that approved and safe methods are adopted for the installation of support work in excavations. A competent person should be in attendance at all times.

3. Ensure that all working surfaces are safe.

4. Install timbering as soon as the excavation sides are trimmed. This should be done from a work cage, from ground level, or from inside existing timbering.

5. Ensure that all support work is secure and that props and wedges are tight and properly maintained.

6. Check for signs of overstress in support work, any damage that may have been caused by plant and, when timber is used, make long-term checks for disease and defects, i.e. dry rot, shakes, etc.

7. Check for any water or soil, which may be seeping through support work.

8. Check for signs of the earth peeling or cracking at unsupported faces.

9. Check that there are adequate ladders, that they are maintained, secured and used correctly.

10. When pumping, ensure that there are adequate sumps and that soil is not being drawn from behind support work.

11. Check for unhealthy atmospheres.

12. Ensure that spoil heaps and materials etc. are kept back from the edges of the excavation.

13. Ensure that there are adequate barriers, notices and warning lights.

14. Check that the edges of excavations are provided with top-and mid-guard rails at all places where there is a danger or persons falling 2 meters of more, or falling and injuring themselves.

15. Bridges and gangways should be provided and handrails and toe-boards.

16. Ensure that stops for dumpers, tipping lorries etc., are well anchored.

17. Ensure that all passing traffic is kept well back from edge of excavation.

18. Ensure that the correct method of withdrawing support work is used; if for any reason it is considered unsafe to remove it, leave it in.

19. Ensure that persons are not working too close to machines or each other,

20. Ensure that the correct protective clothing and protective equipment is being used.

21. Ensure that persons are wearing suitable ear defenders when piling is taking place.

22. Ensure that machine operators have the best possible vision of the work which is in progress

23. Ensure that services are marked, protected and adequately supported when exposed in excavations.

24. Ensure that any backfilling is carried out correctly and in a planned sequence, and maintained.

25. Carry out inspections daily, prior to each shift, after use of explosives or after inclement weather, particularly frost and rain.

26. Ensure that a proper record of all inspections is made and signed by a competent person.
    The written report, or a copy, should be provided to the person on whose behalf the inspection was made within 24 hours.

11.8 Underground services

No excavation work should be carried out unless steps have been taken to identify and prevent any risk of injury arising from underground cables or other underground services.

There should also be precautions in place to prevent contact with overhead electric cables. Ideally the power should be disconnected, but using smaller plant or fitting restricting devices may suffice.

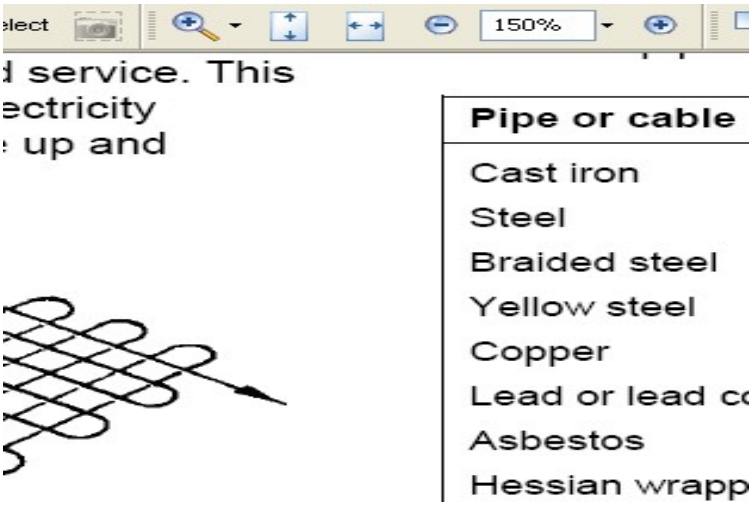
Buried services are to a great extent out of sight and out of mind until either uncovered or struck, the latter possibly having fatal results.
Services can be found underground at varying depths, in different sizes in any location and, can be in the form of cabling, pipe work and ducting.

- **Cabling** – carrying electricity (high and low voltage), telecommunications, and TV signals.

- **Pipe work** – carrying fluids such as (high or low pressure, hot, cold, storm or foul) water, petroleum products (oils, diesel, petrol), compressed gases such as compressed air, gas, oxygen, carbon dioxide, steam etc, and processed fluids.

- **Ducting** – constructed from brick, concrete, asbestos, earthenware, metal or plastic can be used to house cabling or pipework, either together or separately or may be empty having had previous services removed or be waiting to have services installed. Their sizes can range from as small as 20mm (conduit) to as large as 2m plus (sewers).

The chart below lists typical pipe and cable types and what they are likely to be carrying:



It should always be assumed, until proved otherwise, that there are services present in any ground, that is to be disturbed by excavations, trial pits, bore holes, piling etc, or have loadings placed upon it by heavy vehicular movement, out riggers or compacting equipment.

Any service found, should be considered live until proved otherwise.

Before any ground is broken into or has any significant loads placed upon it, all available information should be sourced to identify the location of any services that may be present. This information could be sourced from;-

The client, Local council and Local service providers, i.e. gas board, electricity board, telecommunications and cable companies.

Any charts or drawings received should not be assumed to be completely accurate as any services shown may have been diverted or rerouted since the installation date, and other unknown services could have been installed before or since the charts were made. To overcome this, the area should be scanned so as to confirm the position of known services and detect any unknown services.

There are various types of detection equipment available ranging from cable avoidance tools (cat) to ground scanning radar equipment. Which ever of these is used the equipment must meet the requirements listed in the PUWER regulations, and the person(s) using the equipment must be sufficiently trained and competent to use the selected equipment.

Any services detected are to be marked with paint, tape or markers, but not steel pins which could penetrate a pipe, cable or duct.

Before digging, piling or boring can commence the following documentation must be in place.

A Permit To Dig should be issued to record that all necessary precautions and required procedures are in place and ensure all those involved are aware of their responsibilities.

Once the location of a service has been established trail holes should be dug to confirm the depth and location. It should not be assumed that a service runs in a straight line between two trial holes. Mechanical excavators or power tools should not be used within 500mm of the indicated line of a service. Power tools can be used to break paved surfaces, but care must be taken not to over penetrate and damage the service(s). When hand digging near services, a spade should be used as opposed to a pick or fork as these can penetrate services more easily.

Any service exposed or which becomes part of a trench or excavation must be supported and protected from damage. Should a service become damaged the owner must be informed immediately.

If a gas pipe is fractured evacuate all persons from the area immediately and ensure there are no sources of ignition by banning smoking and naked lights.

If an electric cable is damaged avoid further contact with it. Do not attempt to disentangle a power cable from tools or machinery. Where a machine bucket has become entangled, the operator is to remain in the cab until the cable has been made safe.

Backfilling

When backfilling over services, suitable backfill materials should be used and any protective covers or identification tapes removed during exposure must be replaced. Rubble, surplus concrete, rock, flint and hardcore should never be used as these could damage the services. Where existing services are to pass through a new concrete footing or ring beam, a sufficient clearance must be left between the service and concrete to allow for future ground movement and for future access to the service should the owner require it.

PERMIT TO DIG

Permit No.	Contract No.	

THIS PERMIT IS VALID FOR THE PERIOD SPECIFIED ONLY

PART A	
Location of excavation	
Purpose of excavation	
Proposed depth	
Method of excavation & Trench Support	
specify -	
Date and time of start of excavation	
Date Permit Expires ***NOTE: Persons must not excavate unless a daily safety check has been made.**	
Other document references: e.g., plans/sketches	
CONTAMINATED LAND	
Is the work to be carried out in areas known to contain contaminated soil?	Yes/No
If YES, have operatives received instruction for working in these areas?	Yes/No
OVERHEAD SERVICES	
Have precautions been taken to prevent contact if overhead services are in the vicinity of the operation, or near approach to the operation?	Yes/No
specify -	
UNDERGROUND SERVICES	
Have public utility drawings been referred to?	Yes/No
Has locating equipment been used to identify services?	Yes/No

Have identified services been exposed by hand and clearly marked?	Yes/No
Has instruction to plant operator/operatives been given with regard to the safe system of work:	Yes/No
specify -	
Name ..... Signed ..... Date	
PART B To be completed by Authorised Signatory	
The above excavation is approved/not approved* to be carried out by:-	
Subject to the following conditions:-	
Name ..... Signed ..... Date	
PART C To be completed by the Contractor	
Permit accepted and understood: Name (PRINT) ..... Company	
First Copy - Retain in Records Folder Second Copy - To Contractor	Signed ..... Date .....

11.9 PIPE AND GROUND FREEZING

The primary use of ground freezing for excavation support is in the sinking of deep shafts. The peripheral frozen cylinder performs the dual functions of groundwater control and earth support, allowing shaft excavation without the need for internal bracing and sheeting.

Water – and mud – flow downhill. This fact of nature can be an enormous problem in managing excavation and tunneling projects. One of the best ways to stop water is to freeze it. Freezing water in the ground is a growing application in construction emergencies, and is emerging as an engineering strategy in construction.

This method can be used in excavations of a variety of different depths and applications including those near water courses, road ways and the water table. They can allow the soil to be converted into a solid wall which may be cut into. Frozen ground is nearly twice as strong as concrete and is essentially impermeable.

Frozen soil shoring for an access shaft at Bryn Mawr utility improvement project in Renton.

Ground freezing may offer advantages over conventional methods such as shoring, including complete ground water cutoff, ability to go around buried utilities, virtually no ground vibrations and installation in all soil types (running sand, cobbles, peat, clay, bedrock).

The use of ground freezing may also be used in emergency situations.

Ground freezing may be used in any soil or rock formation, regardless of structure, grain size, or permeability. The mechanical properties of frozen ground are more dependent on time and temperature than on geology.

It is essential for groundwater to be present, supplied either by a high water table or artificially. The frozen water (ice) becomes the bonding agent, fusing together particles of soil or blocks of rock to increase their combined strength and make them impervious to water seepage.

A typical ground freezing system for a shaft or tunnel consists of a series of freeze pipes installed along the perimeter of the proposed excavation, extending into the subsurface strata. To freeze an area, freeze pipes are installed in a grid pattern and extend into the subsurface strata.

Typically, calcium chloride (brine) is used as the cooling medium and is chilled by one or more electrically-powered mobile refrigeration units. The cold brine (at -30 to -25°C) is pumped from the refrigeration unit

though a distribution manifold to each freeze pipe. The manifold has supply and return lines. Larger ground freeze systems often require a reverse return manifold line. Chilled brine flows down a pipe inserted within each freeze pipe and then flows back to the surface in the annulus created by the downpipe and the freeze pipe. As the warmer brine returns from the freeze pipes, it flows into the return manifold which permits flow back to the refrigeration plant. As the refrigerated brine is circulated through individual freeze pipes, frozen cylinders begin to form. After approximately six to eight weeks, the cylinders merge together, forming a massive frozen earth wall.

A typical ground freezing system using a circulating coolant can take 6 to 8 weeks for a smaller diameter shaft and 10 to 12 weeks for larger areas. This is only the time for the formation of the frozen earth structure. Time to mobilize and install the freeze pipes occurs before the freeze formation and is not included in the above time estimates.

A system using an expendable refrigerant, such as liquid nitrogen, can often form a frozen structure in a few days.

Freezing applications

Ground freezing has many applications in civil engineering.

It eliminates the need for structural shoring systems and dewatering. It also creates a very hard, durable surface for construction equipment, even in soft soils. Ground freezing provides a strong, stable support for existing or new foundations near excavations.

It freezes loose, wet sand to prevent liquefaction during an earthquake. In landslide mitigation, it creates strong points in the slope for stabilization but allows ground water to flow.

There are many environmental applications for soil freezing as well.

It can provide an in-situ barrier for containment of contaminated groundwater and a bottom barrier at landfills or other contaminated sites, and provides temporary shoring for construction of permeable barriers or excavation of contamination. It creates a dry, safe environment for construction and excavation. It also bonds soil and waste together to prevent dangerous mixing during removal.

Pipe Freezing

Frozen soil shoring wall around a 10-foot-deep basement excavation for a condominium in Madison Park.