

Safety Code of Practice 47

2nd Edition, July 2011

EXCAVATIONS



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1 SUMMARY

This Safety Guide provides general guidance on the planning, specifying and management of all forms of excavations. It is aimed at those organisations such as Facilities Management Directorate (FMD) who carry out excavations for construction, and for those Schools/Departments that excavate as part of the student curriculum or research activities, such as Archaeology and Agriculture.

The main risks in excavations are:

- Hitting a buried utility service (e.g. electricity, gas, water, drainage, IT)
- Trench collapse
- Flooding with water or gas
- People or animals falling in
- Collapse of other structures nearby
- Spoil heaps which can change sight lines on a construction site, leaving 'blind' bends;
- Overhead cables being caught by excavation machines and tipper;
- Damage to surrounding trees and shrubs.

Even relatively small excavations can be complex and wherever possible expert advice must be sought. This also applies to any work which will involve piercing the ground, e.g. use of stakes for signposts or tent guy ropes.

Before starting any excavation, a preliminary investigation of existing records should be undertaken. This may identify:

- Past spills of chemicals or the dumping of waste materials
- Previous construction or excavations
- The existence of buried services
- Changes of soil type at set levels
- The depth of the water table
- The existence of natural features such as underground springs or rock formations

Gathering this information can reduce the risk and allow adequate pre-planning, it will also help to identify the best method of excavation. It is essential that all persons who work around and in excavations understand the risks, can recognise when conditions are unsafe, and are competent to select and use the most appropriate excavation techniques for the specific project. Schools/ Directorates should follow the recommendations of the appropriate professional or academic bodies with regard to excavation e.g. the Institute for Archaeologists.

Where the dig/excavation is on University premises, **approval must be obtained from Facilities Management Directorate (FMD) prior to any work starting** (this includes work associated with social events, such as erecting marquees, using tent pegs etc. Further details are given in FMD's Authorisation to Dig – Policy and Procedures Document:

http://www.fmd.reading.ac.uk/docs/maintenance/Permit_to_dig.pdf.

2 INTRODUCTION

This Safety Guide sets out what managers, staff, students and tenants have to do to ensure that risks are minimised when carrying out any operation that disturbs the ground. It should

be noted that this covers not only mechanical and hand digging but any operation that pierces the ground e.g. driving a stake into the ground for a guy rope on a marquee.

It provides management and general guidance that will be relevant to all Schools/Directorates. In addition, it provides detailed guidance on specific types of excavation and safety critical aspects of ground works. This includes, for example, trenches, large open pits, drainage channels, ground spiking operations and major excavations for roads and buildings.

3 SCOPE

Excavations include almost any operation involving the ground, including:

- archaeological digs
- digging new drainage ditches
- trenching operations for laying new services
- excavations for the foundation of new buildings
- investigation works
- contaminated land removal
- post holing for lighting and fences
- driving of pegs or spikes for support guys/ropes on masts and tents
- earth spikes for portable generating equipment.

The following are not classified as excavation work for the purpose of this guide:

- lifting of manhole covers
- surface skimming of roads for the relaying of a new wearing surface
- the lifting of existing paths and slabs for the purpose of relaying.

4 RESPONSIBILITIES

4.1 Duties of managers

Heads of Schools/Directorates and other unit managers must ensure that:

- you have gathered all the available information on the proposed excavation in order to fully assess the risk, including, where necessary, a survey of the location for underground services and ground conditions;
- where the dig/excavation is on University premises, **approval has been obtained from Facilities Management Directorate (FMD) prior to any work starting (this includes work associated with social events, such as erecting marquees, using tent pegs) see http://www.fmd.reading.ac.uk/docs/maintenance/Permit_to_dig.pdf;**
- if digging on non University property you should confirm that there is no other authorisation that you need to obtain;
- staff and students are suitably trained before taking part in any dig or excavation;
- where the work is to be undertaken by a contractor, that a competent contractor with experience in the type of work is selected;
- the selected contractor has sufficient information to carry out the required hazard appreciation and risk assessment;

- all involved in the excavation have been briefed on the hazards and on the procedures/ techniques to be adopted (see Annex 1 for an example of a briefing sheet);
- where an agreed dig location has been marked, that no digging outside of that area takes place without a further survey;
- all excavations are classed as either 'entry safe' or 'no entry permitted';
- any excavation which the public may access, with or without permission, are assessed and suitable arrangements are in place;
- that any excavation is closed (filled in) in a safe manner i.e. mounding up so that settlement leaves a level surface and not a depression;

4.2 Duties of staff and students

All staff and students must ensure that:

- they use equipment suitable for the task and the location;
- they only operate work equipment which they have been trained and authorised to use;
- they only access excavations that are 'entry approved';
- all excavations are left in a safe condition or secured against access;
- any changes are communicated to the site manager;
- no new excavations or extensions of existing excavations take place without a check for buried utilities and ground conditions.

4.3 Duties of tenants

All tenants must ensure that:

- any proposed excavations are discussed with FMD and approved by them before work commences;
- the University is informed of any work that may take place near an existing or proposed excavation;
- any excavations carried out must be correctly annotated on a site drawing and passed to FMD to update their site records.

5 GENERAL REQUIREMENTS

Whilst the range of excavations carried out by the University grounds varies substantially, the overriding factors for a safe task are communication of information and good management. Management of the excavation begins with planning and ends when the drawings or details of utilities placed in the excavation and any reports on the task are handed over.

5.1 Health and safety information

Before any excavation is undertaken and ideally before a contractor is appointed, an investigation of the proposed area must be undertaken; this investigation will be both desk based and ground based. Sources of information are:

- previous excavation reports that may indicate the soil types and particular issues;

- maps, drawings and survey reports;
- utility and service drawings (note that there is a 'Dial Before Dig' service offered by utility companies);
- Land Quality Assessments (LQA);
- walking the ground (a physical walk of the area is very useful and should not be underestimated);
- cable scans and ground penetrating radar can be used to identify sub surface issues.

Once the data is gathered it should lead to an initial plan on how the task will be carried out. It should be noted that this information will influence the selection of the right contractor, and hence these initial steps should not be left to the contractor. Elements of the plan will cover:

- a site map showing where the excavation will take place;
- markings in the form of either pegs or spray paint to indicate the route or external dimensions;
- protection to prevent visitors, invited and uninvited, gaining access to the excavation. In particular consideration must be given to children gaining entry to the site;
- the need for site inspections. If you are working on the site or if you are handing the site over to a contractor, specify in the contract that inspections in accordance with HSE guidance HS(G) 150, Safety in Construction must be undertaken.

5.2 Contractor selection

Where the work is to be undertaken by a contractor, the selected contractor must be suitably qualified and experienced. They should:

- be able to demonstrate experience in ground works of the type being planned;
- have the right equipment to carry out the works, including equipment to support the trench sides if required;
- if they are to be in charge of the whole project, provide a management plan and method statement and suitable and sufficient risk assessments (referring back to the preliminary investigations).

On significant tasks it may fall into the scope of the Construction Design and Management (CDM) Regulations where the HSE must be informed of the proposed works, using an HSE Form 9. In these circumstances a CDM Co-ordinator must be appointed to advise on H&S issues. The regulations require that a CDMC is appointed at the planning stage before the contractor is appointed.

5.3 Competence and training

The required competence will be proportional to the task difficulty, size and duration. Simple excavations using hand tools, to a depth of 1m can be planned and executed using this guide. More difficult tasks using excavation plant or extensive (time and size) works may require more specialist knowledge or the appointment of a qualified project manager with excavation experience. The appointment of a technical project manager to aid in the planning and management of larger works should always be considered.

5.3.1 Academic project or research

Where the excavation is associated with an academic project or research e.g. archaeology, those in control of the work must follow the professional guidelines and good practice recommended by the relevant professional body. All staff and students must be trained to recognise safe and unsafe conditions, and in the safe system of work.

5.3.2 Legal requirements for specialist equipment

A list of designated named users of construction plant should be displayed by the equipment. No person under the age of 18 is allowed to operate restricted use equipment.

There are some categories of equipment or work where there are legal requirements for the user to have a certificate of competence or specialist training. This includes:

- excavation plant; all drivers/operators must have training and certification in the form of a Plant Operators Licence.
- if any utilities need to be connected, installed or moved, personnel require specialist training and competent contractors.

5.4 Risk assessments and method statements

Any risk assessments or method statements should directly relate to issues found in the preliminary investigations. For example, if the preliminary investigation has identified that the excavation will be a cross slope cut, the risk assessment should identify the risk of spoil from the excavation falling back into the hole (one of the many hazards of cross slope cutting); therefore the method statement should address this by e.g. storing the spoil down slope. Any issue raised in the preliminary investigation must be dealt with in the risk assessment.

5.5 Control and management

It must be clear who is in control of the site. On construction excavations liaison with other construction activities is essential and should be controlled by the Principal Contractor.

Safe systems of work cover the following:

- **in excavations deeper than 1m** where workers have to enter the excavation, protection from collapse of the sides of the excavation must be in place;
- arrangements and responsibility for site inspections;
- any excavation under construction using an excavator, with people in the excavation, must have a banksman to aid the operator in maintaining safety (distance from the excavator is immaterial);
- any excavation on public land must follow <http://www.dft.gov.uk/pgr/roads/network/local/streetworks/cop/safetyatstreetworksandroadworks>
- any excavation where the public may enter must be assessed specifically for that risk; this is particularly significant in archaeological digs;
- any excavation with plant nearby i.e. power generation or pumps, must be sited so that Carbon Monoxide (CO) fumes do not enter the excavation;

- any fuels stored near the excavation must be sited so that the fuel vapours do not enter the excavation (most fuels are heavier than air and will 'flow' into the excavation);
- if it becomes necessary to pump out water from an excavation, an assessment of the need to apply for a permit to discharge consent will be required. A consent will normally be required if the discharge is to a water course (stream or river) or to surface or foul drainage systems.

5.5.1 Marking and fencing

All excavations must be marked and fenced. Where the excavation is accessible by the public, fencing capable of keeping children out (e.g. full height Heras fencing) must be in place around the whole excavation including any spoil heaps. Fencing should also be provided for any plant machinery, particularly any cranes where the swing arc of the counter weight at the rear needs to be isolated from people walking by.

5.5.2 Barriers for animal control

A frequent requirement of planning is the protection of wildlife; this is particularly difficult where animals are concerned. If the excavation is in a wild life protection zone or near a residential area (household pets) there may well be a need for specific protection measures e.g.:

- placement of a timber cover over the excavation;
- placement of a ramp to allow rabbits, foxes, badgers and hedgehogs to get out;
- installation of an amphibian barrier round the excavation.

5.5.3 Protection of landscape

Where digging is likely to cause damage to university grounds, landscaping or is in close proximity to trees or shrubs on campus, the prior approval of the Head of Grounds must be obtained. On other sites not owned by the university, permission of the relevant landowner and/or the planning authorities may be required.

6 TECHNICAL CONSIDERATIONS

6.1 Ground assessments

The soil type and task will be inextricably linked; if the soil type is sand or silt with no strength, it is likely that any trench below 300mm will be unable to retain an edge and will gradually widen as it deepens. Therefore, the amount of material to be removed will be large unless it is planned to use a support system for the trench walls.

Soft sands, silts and clays can present significant hazards to an excavation and should always be treated with care. The most significant issues are:

- the material can collapse back into the excavation, burying workers in the trench;
- in wet conditions material can flow away from the excavation and become a hazard outside the work area;
- trip or slip hazard for workers or visitors if they try to cross the area;
- it can be a hazard to other operations on the site.

6.1.1 Angle of repose

Any material has a limit to its ability to stack; loose materials like soils will form a mound with the slope of its sides forming an angle; this angle is called the Angle of Repose. The angle formed by a material as it is tipped or naturally forms has an angle in a direct relationship to its material qualities. Different materials will have different angles. The issues to consider are:

- the spoil material can dry out and change its angle of repose ratio;
- rain can cause it to slip;
- vibration from nearby plant and vehicle movements can affect the stability;
- large boulders or lumps of concrete etc. should be pushed down into the spoil heap to prevent them rolling back toward the excavation.

6.1.2 Quick assessment guide

There are three quick 'Rules of Thumb' to be used in excavations:

- the edge of a spoil heap should be no closer to the excavation than half the base of the spoil heap e.g. if the spoil heap is 2m high and 3m across on the base, the edge of the spoil should be no closer to the edge of the trench than 1.5m;
- on any sloping ground always stack the spoil on the down slope side;
- for any excavation where workers have to crouch down to work in i.e. their head is below the top edge of the trench, the 1m depth rule should be discounted and the trench should either be widened, or protected from collapse e.g. by shoring.

6.2 Inspection

The HSE guidance document HS(G) 150, Safety in Construction has details of the inspection regime for construction sites and has a section on inspecting trench/excavations.

Records of inspection must be kept by the department and be available on site for inspection.

Where it is a field excavation i.e. archaeological excavation that may remain open for many months or years the expectation is that the area will be made safe i.e. designed with sloped sides drainage channels and fencing. If it is a temporary works or a dig, the records need only be kept till the work area has been filled back in.

Guidance: Competent persons for inspections

A competent person to complete the inspection requirements may be a department manager, supervisor or senior technician who is experienced in the requirements of HS(G)150 and knows what should be inspected. They should know how to detect increased hazards arising from deterioration due to weather or soil conditions. The actual inspection may be carried out by a member of staff who knows what to look at, what to look for (fault finding) and what to do to report a fault or keep records.

For more complex excavations, it may be necessary to bring in expertise, for example soils or civil engineering experts.

6.2.1 Adverse conditions

Weather can have a significant effect on an excavation, e.g. the ability for rain water to cause the collapse of a trench. On excavations where the ground slopes toward the hole a full drainage calculation should be undertaken to assess the risk and, if required, suitable interceptor gullies and channels must be constructed to prevent flooding and collapse.

Any pumping out of an excavation (dewatering) may be subject to Environment Agency waste management controls (see above 4.4).

6.3 Specialist and mobile equipment

Certain types of equipment require means to prevent it overturning and causing injury to operators working in excavations (e.g. piling rigs or cranes etc.). These will normally be identified by the presence of 'outriggers'. When using equipment needing outriggers, they must have sufficient distance from any excavation to permit the outrigger from resting too near to an excavation side wall; this distance also includes any add-on spreaders such as plywood or timber beams.

6.3.1 Non-mobile equipment

Work equipment which might fall over, collapse, or overturn if the excavation collapses, such as scaffolding, temporary work platforms, welding machines or pumps must be stabilised e.g. by bolting or other means of tying or fastening down. They may also need a separate level platform constructed off to the side of the main excavation.

6.3.2 Mobile work/plant equipment

Where mobile work equipment could roll over into the excavation, cause vibrations or soil spread that may affect the excavation, they must be kept away from the edge by the use of fences, timber kerbs or barriers. Site movement plans should indicate where mobile plant can drive or manoeuvre safely.

6.3.3 Other requirements for mobile equipment

Where mobile work equipment such as fork lifts, dump trucks and tippers need to enter the excavation they must have a ramp suitable for both wet and dry conditions. Any access points must be wide enough to cope with wet weather where the vehicle may slide too close to an edge. If the spoil is being removed by hand i.e. using a wheelbarrow any slopes must take into account the requirements of the Manual Handling Regulations 1992.

6.4 Shoring and excavation support systems

There are many different types of shoring systems that are designed to stop the collapse of any excavation wall. The default protective measure should always be to fill the trench back in as soon as possible; having the minimum amount of excavation exposed is always the safest option.

The selection and use of shoring systems will be decided on a number of factors such as depth, ground conditions, work being undertaken in the trench and length of time the trench has to be open. Many of the current proprietary systems can be hired and most are relatively simple to use. Examples of the main types are:

- walling frames (hydraulic and screw)
- manhole shores (normally used for vertical excavations)
- trench and drag boxes (these are normally used round the working area only and are moved along or down as the work progresses)
- slide rails

Simple systems such as timber and sheet piles are more common in small works and can be quickly built from readily available materials. However, larger timber and pile systems need to be designed and installed by trained operators.

6.5 Underpinning works

Underpinning works are very difficult and require special skills to ensure that the already weakened structure does not collapse. Before any excavation takes place near a freestanding wall, a building or road the structure must be assessed by a structural engineer to confirm the need (or not) of external supports or the closest distance the excavation can come to a wall or structure.

6.6 Tunnelling

If the planned excavation involves an overhang or tunnel works, special consideration must be given to how it can be done safely; these operations are extremely hazardous and should not be undertaken without specific method statements and specialist contractors. Any works for the laying of services should, wherever possible, be done using a 'mole'.

7 ARCHAEOLOGY

7.1 Special Risks

Along with all of the issues above archaeology brings a number of special risks to excavations. Archaeological digs are a special case, not because they are any less of a hazard than civil engineering excavations, rather that they have all the hazards mentioned in the paragraphs above plus those that are special to this type of excavation. Issues such as diggers kneeling for long periods of time mean that Personal Protective Equipment (PPE) such as kneel pads may need to be provided.

7.2 Members of the Public

Archaeology will attract members of the public; this needs to be planned into the excavation site layout. If the option to have a viewing area is considered it should be as safe as possible and clearly delineated with adequate signage to dissuade the public from straying from the designated area. Always assume that at least one of the viewing public will feel that the rules do not apply to them e.g. land owner, officials or press, who may assume that they are free to roam; the best option is to have a designated guide whom they can call on whenever they visit.

A further but unfortunate aspect of any dig is the uninvited guest. Current UK case law has now swung away from the trespasser and providing you can show you have done all that is reasonable

to prevent access and to maintain a safe site, even for uninvited guests, the risk of litigation from a trespasser who has been injured is low. H&SS will advise on what is considered reasonable.

7.3 Modern Age Archaeology

Excavations on sites and in particular battlefields, from 1700 onwards have a particular hazard from weapons (guns and firearms). Investigators must exercise great caution and not make assumptions about the nature and condition of any weapons.

8 AGRICULTURE AND HORTICULTURAL EXCAVATIONS

8.1 Agriculture

Many agricultural field works are extensive and involve the movement of many tonnes of earth; there is a perception that this type of works is not subject to the same rules as construction. However the risks are the same. Farm excavations may be undertaken by less experienced workers, and may also be accessible to members of the public. Therefore always plan any excavations in detail; the guidance above is relevant for any excavation.

8.2 Horticulture

Most horticultural earth works are shallow and hand dug, however, some works involve digging below 600mm, in particular installing fence posts and support stakes. At these depths the chance of discovering buried services is increased. Any excavation below knee depth must be surveyed for services.

9 LEGISLATION

The following legislation is relevant to excavation works:

- Health and Safety at Work etc Act 1974
- Management of Health and Safety at Work Regulations 1999
- Provision and Use of Work Equipment Regulations 1998
- Construction (Health, Safety and Welfare) Regulations 1996
- The Construction Design and Management Regulations 2007
- The Water Resources Act 1991.

10 FURTHER INFORMATION

The following documents can provide further more detailed information:

- HSE guidance HS(G) 150, Safety in Construction.
- HSE Publication, Construction Information Sheet No 8 (Revision 1)

- HSE Publication, Construction Information Sheet No 47 (Revision1)
- Building Regulations Approved Document, Safety in Excavations Guidance booklet 185
- Civil Excavations and Tunnelling ISBN: 9780727733405

Appendix 1: Version control

| VERSION | KEEPER | REVIEWED | APPROVED BY | APPROVAL DATE |
|---------|--------|------------------|-------------|---------------|
| X.X | H&S | Every four years | XXXXX | XX/XX/XX |
| X.X | H&S | Annually | XXXXX | XX/XX/XX |