

Construction Hazard and Risk Control

Lecture Title: Excavation work and confined spaces- hazards and risk control

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Date: 21st January 2026



**Undergraduate Diploma in
Occupational Health and Safety**

This lecture covers the following learning objectives:

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



Excavations: work hazards and assessment

- premature collapse of the sides (possibly due to soil composition);
- materials falling on workers;
- excavation machinery and equipment (e.g. pneumatic drills);
- people and/or vehicles falling into the excavation;
- workers struck by plant;
- manual handling;
- noise and vibration

Excavations: work hazards and assessment

- hazardous substances, particularly near the site of current or former industrial processes;
- influx of ground or surface water and entrapment in silt or mud;
- proximity of stored materials, waste materials or plant – surcharging;
- proximity of adjacent buildings or structures and their stability;
- contact with underground services;
- contact with overhead power lines;
- access and egress to the excavation; and
- dust, fumes, lack of oxygen and other health hazards (such as Weil's disease)

<https://youtu.be/acW-gJkl2KE>



Site survey should include:

- previous use of site;
- location of existing buildings;
- location of new structures;
- results of soil investigations;
- ground contamination;
- level of water table and type of soil;
- storage and disposal of excavated material;
- amount of working space and storage required;
- the most suitable method of temporary support of the excavation walls;
and
- adequate emergency arrangements.

Risk assessments for excavations

Should consider the following factors:

- any alternatives to excavation?
- nature of the ground, soil structure and groundwater regime;
- location of the excavation (e.g. readily accessible public place, contaminated ground or heavily serviced urban area);
- depth of excavation;
- presence of hazardous atmospheres and contaminated soil;
- contact with existing underground or overhead services;
- nature of the work required to be undertaken within the excavation;
- required method of support of the excavation



Risk assessments for excavations

- removal from site of surplus excavated material;
- stockpiling of excavated material which is to be reused;
- fencing required to prevent plant and materials falling into excavations;
- provision of secure storage space for materials and working space for workers and plant;
- type of excavation and compaction equipment to be used;
- precautions necessary to prevent unauthorised access to the excavation;
- emergency arrangements, including first-aiders; and
- arrangements required for traffic management on adjacent public highways

<https://youtu.be/92ngMAFcEtU>



Control measures for excavation work

These include:

- supervision by a competent person;
- a competent person must inspect an excavation each time that a shift starts work;
- all excavation workers must be competent;
- safe access by ladders and crossing points for pedestrians and vehicles;
- hard hats, safety footwear and other relevant personal protective equipment must be worn;
- an excavation must be supported if there is a risk of the sides collapsing;
- erection of barriers around the top of the excavation

Control measures for excavation work

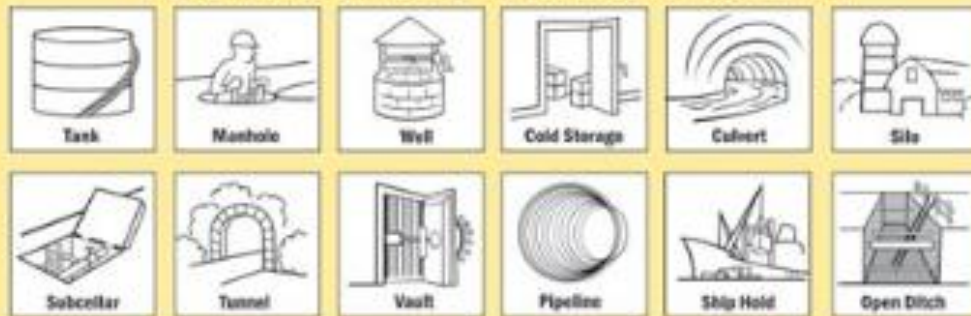
- not storing spoil material near the top of the excavation;
- vehicles kept away from the top of the excavation using warning signs and barriers;
- if a vehicle is tipping materials into the excavation, stop blocks should be placed behind its wheels;
- control of any influx of water;
- control of hazardous substances (e.g. exhaust fumes) or health hazards present;
- workings well lit at night;
- identify position of buried services; and
- care during the filling in

The location of underground services requirements:

- accurate service plans;
- excavation workers trained in safe digging practices and emergency procedures;
- locators used to trace any services, where possible, or hand dig a series of trial holes with insulated tools;
- assume that all pipes or cables are 'live' unless it is known otherwise;
- report any suspected damage to services to the service providers and health and safety enforcement agency; and
- update service plans when the new services have been laid

Confined Space HAZARDS

If you are required to construct or work in a :



You are working in a confined space.

A confined space is an enclosed or partially enclosed space that has an entrance or exit limited by size and location. It is not primarily designed for human occupancy and has unfavorable natural ventilation. All hazards found in a regular workspace can also be found in a confined space. However, they can be even more hazardous in a confined space than in a regular workspace.

Hazards in confined spaces can include :



Lack of Oxygen

Insufficient amount of oxygen for the worker to breathe. Any atmosphere with less than 19.5% oxygen should NOT be entered without a Self-Contained Breathing Apparatus (SCBA). The oxygen level can decrease because of work being done such as welding, cutting or brazing, or by certain chemical reactions (rusting) or through bacterial action (fermentation).



Fire & Explosion

An explosive/flammable atmosphere due to flammable liquid, gas and combustible dust which if ignited (by sparking or electrical tool) would lead to fire or explosion. Oxygen excess (above 21%) will cause flammable materials such as clothing and hair, to burn violently when ignited. Therefore NEVER use pure oxygen to ventilate a confined space. Ventilate with normal air.



Toxic Atmospheres

Most substances (liquids, vapors, gases, mists, dust and solid materials) should be considered hazardous in a confined space. Residues left in tanks, vessels etc. can give off poisonous gas, fumes or vapor. Toxic atmospheres are also generated by work in the area of confined space such as welding, cutting, brazing, painting, spraying, sanding, degreasing, etc.



Uncontrolled Energy

Dangers can arise because of ineffective isolation of a confined space from electrical sources, mechanical moving parts, liquid, etc. A wet surface will also increase the likelihood of electrical shock in areas where electrical circuits, equipment and tools are used, beside the potential hazards of slip and fall.



Temperature Extremes

Extremely hot or cold temperatures can present problems for workers. For example, if the space has been steamed, it should be allowed to cool before any entry is made.



Collapse of Solids or Liquids

Liquids and solids can suddenly fill the space when disturbed or because of barrier failure. Free-flowing solids such as grain can also partially solidify or 'bridge' in silos, creating blockages which can collapse unexpectedly.

Confined space working hazards and risks

Never Go In Without A Permit

**Confined Spaces Are
Dangerous Places**



**Never Go In Without
A Permit**

Don't Use Your Nose

**Confined Spaces Are
Dangerous Places**



**Don't Use Your Nose
To Test The Atmosphere**

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Confined space working hazards and risks

The Confined Spaces Regulations require that:

- No person at work shall enter a confined space for any purpose unless it is not reasonably practicable to achieve that purpose without such entry.
- Other than in an emergency, no person shall enter, carry out work or leave a confined space otherwise than in accordance with a safe system of work relevant to the specified risks



Definition of a confined space:

A confined space can be defined as any space of an enclosed nature which has limited means of access and egress, restricted natural ventilation and is not intended for continual occupancy by persons

<https://youtu.be/HA6yh0TB5ag>



Examples of a confined space:

Manholes, sewers, tunnels, excavations, storage tanks, holds of ships, pits, trenches, ducts, some unventilated areas or rooms within buildings, particularly below ground level, boilers, combustion chambers in furnaces, chambers, vats, silos, pipes, flues and wells.



Hazards include:

- difficult access and egress;
- accumulation of vapours, gases or fumes;
- lack of ventilation;
- asphyxiation due to oxygen depletion;
- poisoning by toxic substance or fumes;
- explosions due to gases, vapours and dust;
- fire due to flammable liquids, vapours and oxygen enrichment;
- fall of materials leading to possible head injuries;



Hazards include:

- free-flowing solid, such as grain in a silo;
- electrocution from unsuitable equipment;
- difficulties of rescuing injured personnel;
- drowning due to flooding;
- excessive heat leading to heat stress;
- claustrophobic effects due to restricted space; and
- diseases from animal wastes, infected materials or micro-organisms

Risk assessment should include:

- the physical dimensions and layout of the confined space;
- any oxygen deficiency or enrichment;
- the use of cleaning chemicals and any interaction with other substances;
- any residues that have been left in the confined space (e.g. sludge) and details of gases or vapours which may be generated if these substances are disturbed

Risk assessment should include:

- any contamination which may arise from adjacent plant, processes, services, pipes or surrounding land, soil or strata;
- any sources of ignition for flammable dusts, gases or vapours;
- the need to isolate the confined space from outside services or from substances held inside the space; and
- emergency rescue arrangements, including trained people and equipment.

Control measures for confined space working

The main elements of a safe system of work (possibly a 'permit to work') are:

- extent of the supervision of the work;
- competence, training and instruction of the workforce;
- stipulation of a minimum gang size for large confined spaces;
- details of any information required by the workforce;
- methods of communication between people inside, from inside to outside and to summon help in an emergency;
- testing and monitoring of the atmosphere inside the confined space for hazardous gas, fume, vapour, dust and the concentration of oxygen



Control measures for confined space working

- gas-purging of toxic or flammable substances with air or inert gas;
- provision of good ventilation, possibly by mechanical means;
- if appropriate, the cleaning of the space before the work commences;
- removal of residues using appropriate equipment;
- effective and complete isolation of electrical and mechanical equipment by the use of a lock-off and a tag system with key security;
- provision of personal and respiratory protective equipment if it is not possible to enter the confined space otherwise;
- access and egress to the confined space in an emergency;
- details of fire prevention equipment and procedures;
- lighting arrangements, including emergency lighting;

Control measures for confined space working

- emergency and rescue arrangements and procedures (including first-aid);
- maximum length of any one working period;
- details of any required health surveillance of the workforce; and
- monitoring and audit arrangements.

Monitoring arrangements

- before any work commences, the supervisor must arrange for any necessary environmental surveys and sampling needed to protect the health of the workforce;
- competent specialists required to test and monitor the atmosphere and interpret the results accurately;
- continuous gas monitoring should be used over the complete work period;
- regular checks on all breathing and reviving apparatus, rescue equipment and emergency alarms



Monitoring arrangements

- regular checks on all first-aid provision and the accreditation of first-aiders; and
- periodic health checks given to the workforce by an occupational health specialist, and consideration should be given to the exclusion from confined spaces of individuals who have any of the following problems:
 - heart disorders, including high blood pressure
 - fainting, blackouts, fits or loss of balance
 - weak eyesight or hearing
 - asthma or chronic bronchitis
 - physical size, poor mobility or back pain; and/or
 - claustrophobia or psychological stress



Emergency arrangements should incorporate the following:

- details of rescue teams and their individual responsibilities;
- contact names and telephone numbers of the local emergency services;
- details of the communication arrangements from inside the confined space;
- provision and maintenance of the rescue and resuscitation equipment;
- raising of the alarm, alerting the rescue team and maintaining close supervision of the workforce inside the confined space;
- notification of and consultation with the emergency services



Emergency arrangements should incorporate the following:

- the protection and safeguarding of the rescue team;
- fire safety precautions and procedures;
- provision and maintenance of fire-fighting equipment;
- control and possibly the protection of adjacent buildings, plant and equipment;
- the arrangements for dealing with emergencies outside the normal working day;
- first-aid arrangements, including any special training required of first-aiders;
- training of rescuers and simulations of emergencies, such as fire drills; and
- size of access openings to permit rescue with the normal respiratory protection and rescue equipment for confined spaces.

General points

- Work in a confined space requires a risk assessment, a method statement and a permit to work.
- The first consideration when planning a confined spaces permit to work is whether there is an alternative method of working.
- Before any work starts in a confined space, a rescue plan and team must be in place.
- The top person at a confined space begins the rescue if it is needed.
- A confined space must be vacated if the permit to work expires.



Um el Farud- 1995 accident in Malta

- <https://youtu.be/pCUcCKiXh1E>





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