



Safe excavations

EBRD briefing note

BN02

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Introduction

Work in the construction sector usually involves significant amounts of excavation work. This will vary in size, nature and scale and is always considered a high-risk activity. Excavations can be affected by an array of adverse conditions and factors, including weather, the presence of underground services, soil and ground conditions and vibrations and loading from passing traffic. Excavations can, in turn, affect the stability of nearby structures.

Many incidents involving excavations occur in what may appear to be good ground conditions, but which can deteriorate rapidly.

It is important to understand that depth and ground conditions are not the only factors that should be considered when assessing excavations. There is no minimum safe depth; incidents can occur in shallow excavations.

Risk assessment

A risk assessment should be carried out before any excavation work and should identify the present and potential hazards, who is at risk and how, and the control measures necessary to protect the health and safety of workers and local communities. The following hazards should be considered:

Collapse: Where the sides of an excavation fall in from the top or excessive ground pressure forces the sides of the excavation inwards, a collapse is likely to occur. Other factors that can contribute to a collapse include the ground material or type and its condition (dry or wet, for example).

Loading the excavation edges: Placing too much weight on the edges of an excavation can lead to collapse, causing the material or equipment responsible for the loading pressure to fall in.

Moving machinery: Construction work is often carried out in congested areas with limited space. Potential hazards include workers and members of the public in close proximity to moving excavators and other mobile work plant.

Access: Companies must ensure that they maintain a safe way in and out of an excavation.

People or material falling in: Densely populated areas with poor illumination increase the risk of members of the local community falling into an excavation.

Weather conditions: There may be flooding from rainwater, ground water or damaged services, such as high-pressure water pipes, which can cause instability and collapse. Warm weather can also dry soil and remove moisture, causing cracks to appear in the excavation walls, increasing the risk of collapse. Frost and freezing conditions can cause movement and collapse, especially when the ground begins to defrost.

Underground services: If an excavation is around services, such as electric cables or water and gas pipes, this can be hazardous and affect the shape, size and characteristics of an excavation.

Overhead services: Overhead cables can restrict movement and the ability of an excavator to operate safely.

Contaminated ground: The ground can be contaminated with oils, fuels or numerous other hazardous substances, including asbestos-containing materials that have been disposed of inadequately. Depending on the substance in question, the atmosphere inside the excavation may be flammable or toxic. If such substances are present, this may require the excavation to be categorised as high-risk environment and classed as a confined space. This would then require additional safety protocols, expertise and equipment.

Collapse

Excavation collapse can be caused by material falling in from the top of the excavation, or materials or heavy machinery placing too much pressure or load on the sides of an excavation. Sometimes the excavation can collapse as the ground conditions are not self-supporting and this can be compounded by the presence of water, be it groundwater, weather-related or from damaged water pipes.

Excavations can be sloped back to prevent collapse, but the angle of the slope will depend on the ground material and its condition. Sloping an excavation can present problems in itself, as finding a safe angle can take up a significant area around the excavation and require a substantial amount of ground material to be removed from the area. The typical slope angles for common types of ground materials are shown in Table 1. It is **important** to note that these vary for dry and wet conditions.

Table 1. Typical safe slope angles for different soils

Dry ground	Wet ground	Angle
Gravel		
30-40°	10-30°	<div>Dry ground 40° Wet ground 30° 10°</div>
Sand		
30-35°	10-35°	<div>Dry ground 35° Wet ground 30° 10°</div>
Silt		
20-40°	5-20°	<div>Dry ground 40° Wet ground 20° 5°</div>
Clay		
20-45°	10-35°	<div>Dry ground 45° Wet ground 35° 20° 10°</div>
Peat		
10-45°	5-35°	<div>Dry ground 45° Wet ground 35° 10° 5°</div>

Source: Construction Industry Training Board (2020).

Excavations can be sloped on an angle or stepped, as long as the steps do not exceed 1.2 metres in depth and follow the safe slope angles shown in Table 1.

At these angles, the ground material is self-supporting and less likely to collapse. Where space is limited, such as on a public highway or pedestrian footpath, excavations should be supported.

Supported excavations

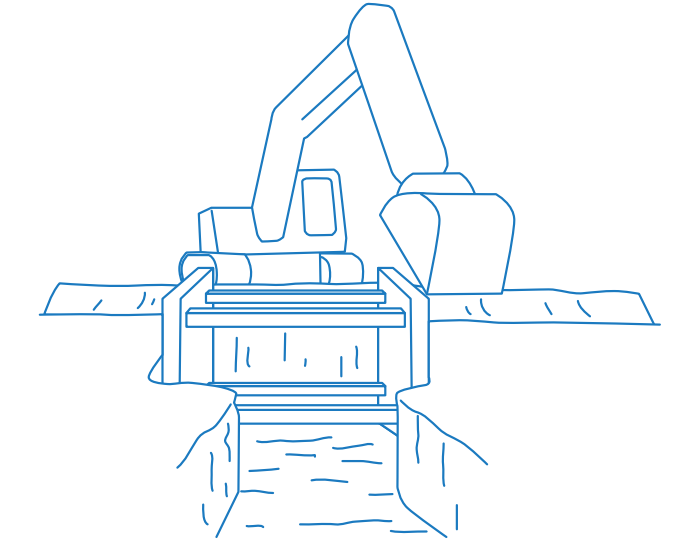
Supporting excavations will depend on the ground material and its condition, the type of work being carried out, the length of time the excavation will remain open, ground-water conditions and surcharging (the presence of loads that put pressure on the sides of an excavation).

It is recommended that a competent engineer be consulted or appointed to design a support system.

Trench boxes

Trench boxes are purpose-made devices which are sometimes called drag boxes and usually used for pipe-laying activities. These boxes can be narrow, but withstand large forces. They can be used in a specific area, then dragged (hence the name) along the trench to protect workers elsewhere in the excavation as work progresses.

Figure 1. Trench or drag boxes are typically installed with excavators

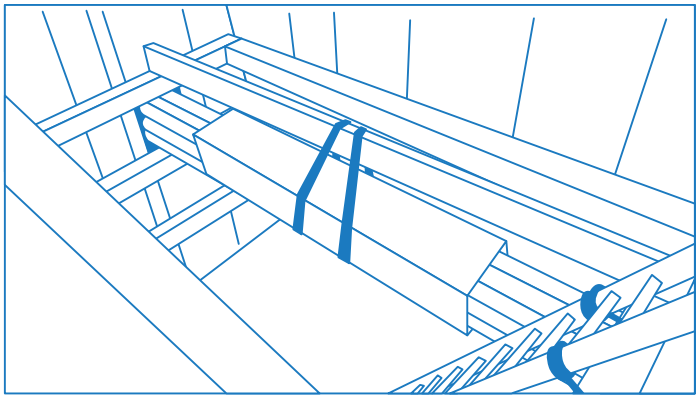


The boxes comprise of side plates with adjustable props, have few moving parts and can be set up quickly. They have limitations, however. They cannot be used where services such as cables and pipes cross excavations, for example.

Sheets and support

Metal or timber sheets can be used where other services cross trenches or where an excavation is unusually shaped. The sheets are generally braced with timber or steel props. The position and size of the timber or steel props should be confirmed by a competent engineer after considering the ground materials and conditions and the local environment, such as proximity to other structures and passing traffic.

Figure 2. Note how the services are supported and a ladder is provided for access



Access

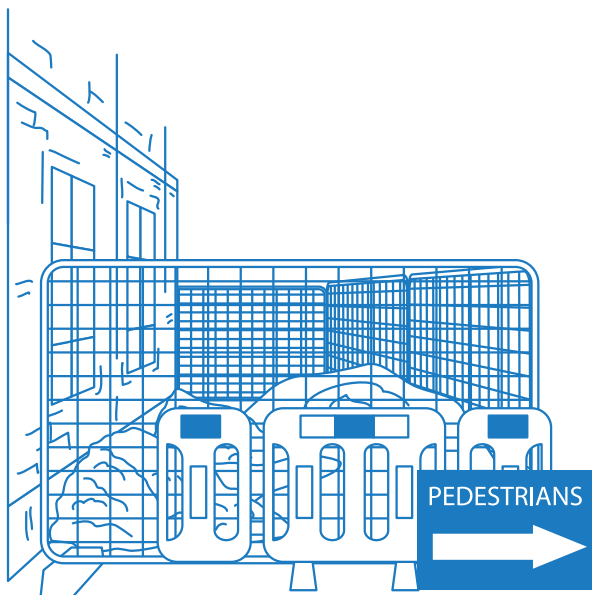
All excavations should have adequate, clear and unobstructed access to allow safe entry to and exit from the excavation. This may be a simple slope into the excavation at a safe angle, a ladder tied and fixed in place, or a staircase made of scaffolding.

When designing access routes, emergency evacuation should always be considered, so that workers needing to quickly evacuate the work area can do so unhindered. Workers should not use the support system or any underground services in the excavation for assistance when climbing in and out of an excavation. Excavators or other machinery **should not be used** to lower workers into excavations.

Guarding/fencing

Excavations should have some type of secure, robust guarding or fencing to prevent workers and the public from falling in. Longer excavation support systems, such as metal sheets, can achieve this by extending out of the ground to form a physical barrier at the edge of the excavation. Scaffolding tubes or, where available, portable temporary demarcation fencing, can be used to create a simple barrier. Excavations should also have signs clearly identifying the risks and prohibiting unauthorised access.

Figure 3. Excavations should be fenced to prevent access and clearly signed



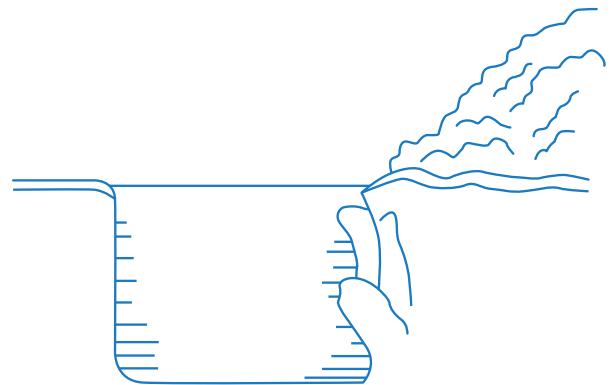
If an excavation is on a public highway, signs should be positioned so as to clearly direct traffic and pedestrians to alternative temporary access routes.

Signs should be positioned according to local traffic rules and regulations and inform pedestrians of a safe alternative route. Prior to commencing any work, it is important to engage with local businesses and communities that may be affected. Early stakeholder engagement can help to prevent the public from damaging and moving traffic management equipment and guarding or fencing. It is important to undertake regular inspections of fencing and signage to ensure ongoing protection of workers and the public. The excavation should also be adequately illuminated. These and other control measures should be identified prior to the commencement of work and included in the risk assessment. Additional consideration should be made for vulnerable road users, such as those with mobility or sight impairments, pedestrians, cyclists and young children.

Surcharging

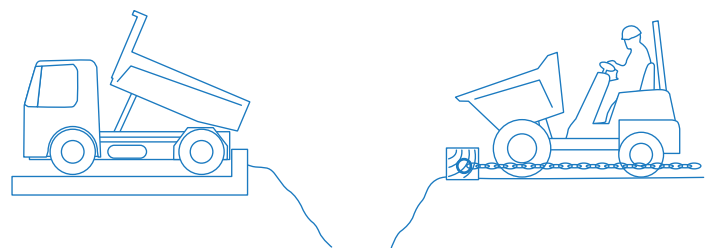
Surcharging occurs when waste or other excavated material is placed on the side of the excavation, putting additional weight and pressure on it. This dramatically increases the risk of collapse. Surcharging can also occur where mobile plant (machinery) and vehicles approach or pass by the edges of an excavation. It is, therefore, important to ensure that vehicles are kept at a safe distance. When removing excavated material, it is important to move it a safe distance away from the edge of the hole. As a rule, excavated materials should be moved the same distance away from the excavation edge as the intended depth of the excavation. In other words, if the excavation is 2 metres deep, the excavated material should not be placed within a 2 metre radius of the excavation edge.

Figure 4. If excavated materials are placed on the edge of an excavation, creating a surcharge, the hole can start to collapse



Stop blocks or berms (raised, compacted soil) should be created to keep vehicles and equipment away from the edge of an excavation. These control measures can prevent collapse by surcharging.

Figure 5. Stop blocks or upstands should be put in place to prevent plant driving into excavations



Inspection

Excavations should be inspected regularly to confirm their stability.

The inspection should be carried out by a competent engineer. Inspections should be carried out:

- ▶ at the start of each shift
- ▶ after an event that is likely to have affected the stability of the excavation or trench
- ▶ after any signs of a collapse (no matter how small) or dislodged material.

The competent engineer should be satisfied that work can be carried out safely. Creating a record of findings is a good way to confirm the condition of the excavation and when it was last

inspected. The inspection report can include information such as:

- ▶ the name and address of the person on whose behalf the inspection was carried out
- ▶ the location of the work being inspected
- ▶ a description of the place of work, or part thereof, to be inspected, including work equipment or materials
- ▶ the date and time of the inspection, including weather conditions
- ▶ details of any concern identified that could put at risk the health and safety of any worker or member of the public
- ▶ details of any action taken as a result of any health and safety concern identified
- ▶ details of any further actions deemed necessary
- ▶ the name and position of the person filing the report.

If the competent engineer is not satisfied that work can be carried out safely in the excavation area, they should inform the person who requested the inspection (or their representative) and the person in charge of the work area, such as the site supervisor or manager. Information should be passed on immediately (significant deviations, imminent risk) or, at the latest, by the end of the working shift or when the inspection has been completed.

Companies should check and follow local legal requirements for inspecting and reporting excavations.

Summary

Before carrying out any excavation work, a risk assessment must be completed and the following items considered:

- ▶ What are the ground conditions like?
- ▶ Will the excavation be sloped or require support?
- ▶ What sort of support is needed and will the support have to be designed?
- ▶ Who will design the support?
- ▶ Who will install the support and are they competent to undertake this work?
- ▶ How will workers access the excavation?
- ▶ Will the excavation need dewatering and how will this be done?
- ▶ Where will the excavated material be stored?
- ▶ Are there any underground services in the area to be excavated and have they been identified prior to the excavation work?
- ▶ How will the excavation be protected to prevent workers or the public, including vulnerable road users, from falling in, and will it need signs and lighting?
- ▶ Who will inspect the excavation and how often?

See also

- **BN01:** Underground and overhead services
- **BN04:** Safe working with mobile plant

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