Below Ground Tanks

GROUNDWORK

Excavations for below ground tanks

Ground conditions can vary significantly and not all locations are suitable for below ground LPG storage. As a result, Calor cannot accept any responsibility for any groundwork, including temporary or permanent earthwork support found necessary, or foundations that may be required. It is recommended that a suitably qualified and experienced engineer be employed to undertake a geological site survey and provide the appropriate advice on all the groundwork and foundations necessary.

Due to the dangers involved with carrying out excavation work, all persons who are involved in such work or working in them must be suitably trained and competent.

There is various legislation concerning persons working on, or in excavations. The emphasis is on an awareness of hazards and the methods adopted to eliminate or reduce to an acceptable level. All excavations must be assessed by a competent person to ensure they are safe to work with, both above and below ground level.

Groundwork has to be properly planned and carried out to prevent accidents. Before digging any excavations, decide what temporary support will be required and plan the precautions that are going to be taken against:

- Collapse of the sides.
- Materials falling in whilst persons are working in the excavation.
- People or vehicles falling into the excavations.
- Underground services or installations.
- Undermining of nearby structures.
- Flooding.
- Exhaust gases from vehicles etc.

Collapse of the sides

The need for adequate support will depend on the type of excavation, the nature of the ground and the ground water conditions.

The excavation should be prevented from collapsing by supporting with sheeting or proprietary support systems (see Figure 4.18.1). The support system should be installed without delay as the excavation progresses and work should not be completed ahead of the support system. The support system should not be removed until all work has been completed and the excavation can be safely backfilled.

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Figure 4.18.1 – Example of an excavation support system

Battering or stepping the sides back to a safe angle is an acceptable means of preventing instability. The angle will depend upon the type of material encountered (see Figure 4.18.2 below). Guidance is taken from the HSE book HSG 150: "Health and Safety in Construction".

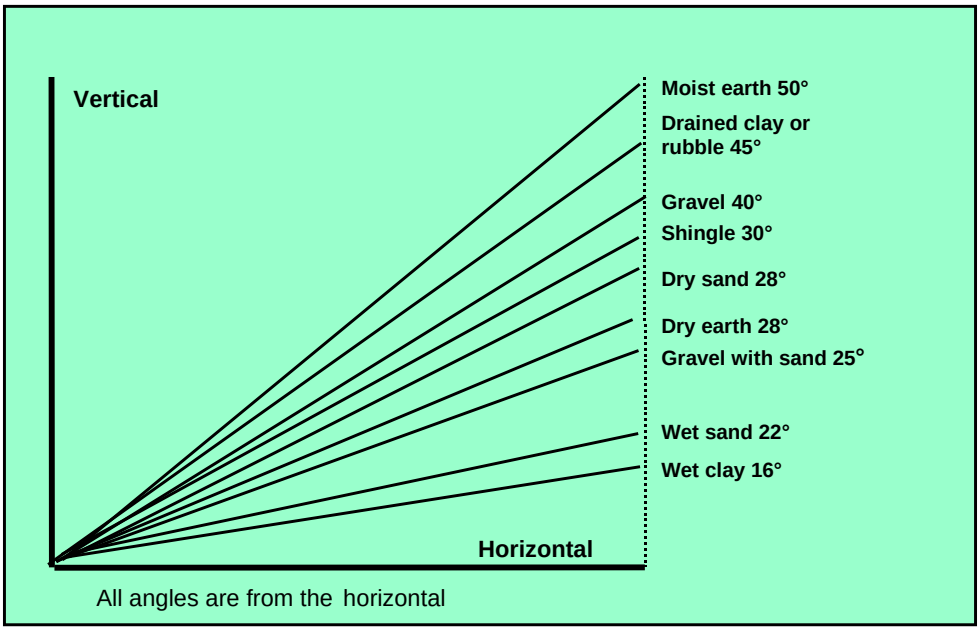

Figure 4.18.2 – **Recommended Battering Angles**

The battering should take place from the bottom of the excavation *(all measurements to be taken from the horizontal)*. Figures 4.18.3 shows an excavation with battered sides and the minimum safe vehicle standing points and the minimum safe distance for the excavated spoil.

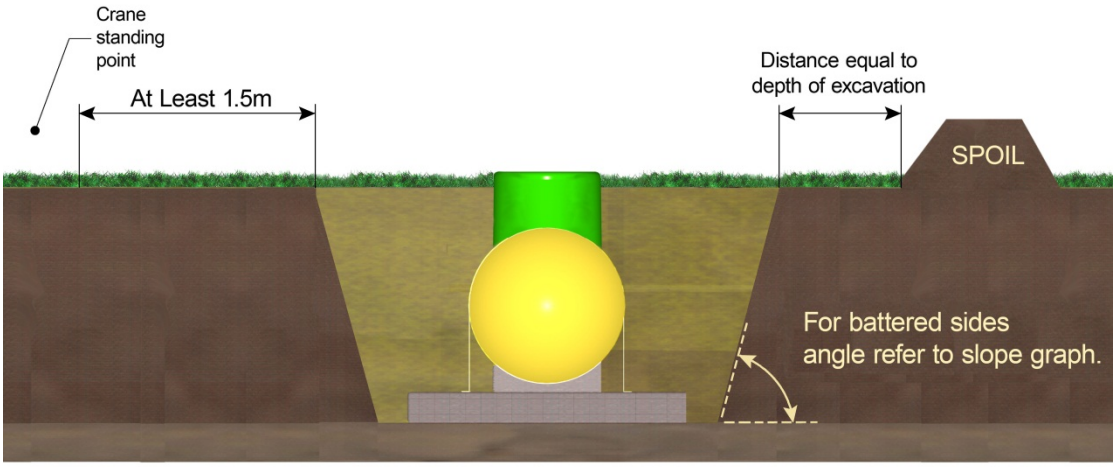

Figure 4.18.3 – Excavation using battered sides with minimum safety distances for vehicles and spoil

Stepping the excavation sides is an alternative to battering method, one or more steps are cut into the excavation side(s), see Figure 4.18.4. The depth and width of the step need to be determined using the typical slope angles, although the vertical distance shall not exceed 1.2 metres.

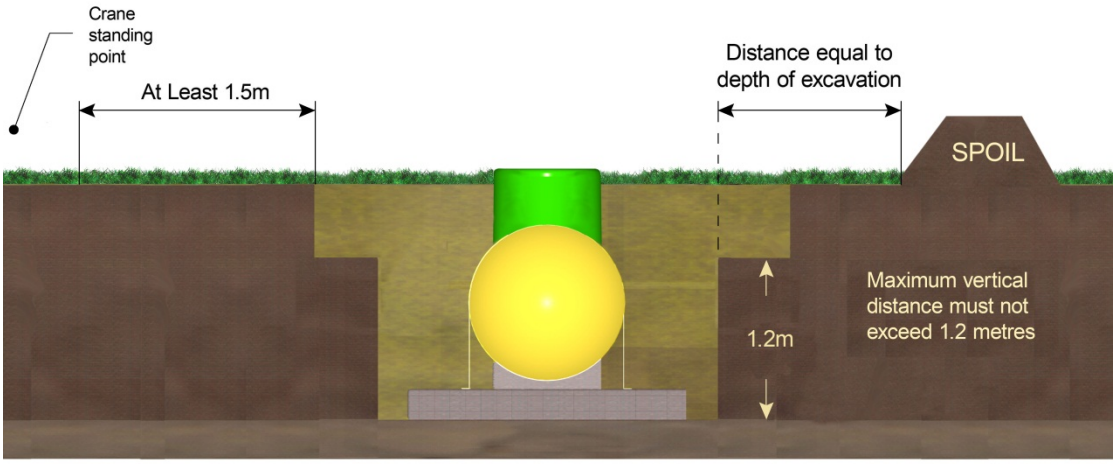

Figure 4.18.4 – Excavation using stepped sides

A competent person who understands the dangers and necessary precautions, should check the excavation before use or after any movement of material.

Materials falling into the excavation

Any spoil or materials used shall be placed a distance at least equal to the depth of the excavation from any opening to avoid excessive loading ”surcharging” of the sides.

Vehicles should be parked no closer than a distance equal to the depth of the excavation from the sides.

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People or vehicles falling into the excavation

There shall be suitable fencing or safety barrier provided if there is a likelihood of any person falling into the excavation, see Figure 4.18.5. A risk assessment may identify that fencing or barriers are not required i.e. where other measures are in place to ensure safety. Other factors that should also be considered include the time frame that the excavation is likely to be “open“.

All excavations in public places should be suitably fenced.

Using baulks or barriers can restrict vehicles from getting too close to the sides. Stop-blocks may also be used where vehicles have to tip, or unload materials into the excavation.

Figure 4.18.5 – Excavation with safety barrier

Excavated materials

Any excavated materials that are intended to be reused as backfill material should be kept dry, it is recommended the backfill materials are totally wrapped on all sides by tarpaulins or similar protective sheeting, see Figure 4.18.6. During the excavation process if any saturated ground is encountered this material should be removed and replaced by suitable dry material such as Type 1 MOT stone or soil and only the dry material should be used for the backfill.

Figure 4.18.6 – Backfill covered with tarpaulin to be kept dry.

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Backfill

It is essential that during the backfill process all of the backfill material is totally compacted throughout the excavation, including underneath the tank where voids are more likely to occur, to avoid ground sinking, and to protect and prevent flooding of the turret. It is recommended that a suitably sized vibro tamper (trench rammer) is used to compact the backfill material. Under no circumstances should the excavator bucket be used to compact backfill materials within the excavation. The finished ground level must at all times be maintained so that the turret lid of the tank is not below the surrounding ground level.

Figure 4.18.7 – Compacting the backfill using a vibro tamper

Underground Services

Underground services can easily be damaged during excavation work. If proper precautions are not taken, then there is a risk of serious injury to persons carrying out the work and the inconvenience of interrupted services.

HSE Guidance Note HS (G) 47 “Avoiding danger from underground services” gives further information.

Underground services or installations are not permitted to pass through the tank excavation area.

Before any excavation takes place, a site survey should take place by a competent person to determine the presence of underground services or installations.

Where available, plans should be inspected for sewer, cesspit, drains, or any other underground installation locations.

Electricity, water services, telecommunications and other pipeline locations should be determined using a suitable means of pipe and cable location detection.

Guidance should be obtained in the first instance from the utility or service providers.

Look for obvious signs of services such as manhole and valve covers where services terminate above ground.

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Undermining of nearby structures

Ensure excavations do not undermine the footings of buildings, structures or walls. Walls have generally shallow foundations, which are easily undermined.

Where there is any doubt, then the advice of a structural engineer may be required.

Ground and Surface water

Where it is found that excavations are easily flooded, before proceeding with the installation of a below ground tank, National Engineering should be consulted.

Mounding of the tanks and/or suitable drainage will be required where excavations are prone to flooding. Any water entering the excavation needs to be channelled to where it can be pumped out. Caution needs to be exercised as pumping may weaken the excavation.

Excavations should be checked by a competent person where flooding has occurred to confirm the stability of the excavation.

The provision of a pump may be required when working in inclement conditions.

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General Safety

Ensure there is good ladder access or other ways of getting in and out of the excavation safely.

Consider the presence of hazardous fumes that can be around when petrol or diesel engines or generators are used nearby. Ensure adequate ventilation is available or arrangements made for fumes to be ducted away to a safe area.

EXCAVATION CHECKLIST

These details are listed to provide information and guidance to a customer or contractor to consider key safety areas before and during the excavation process. They are designed as a guide for safe working good practice. Calor recommend that any person carrying out any survey, or excavation work, is suitably qualified and competent.

Further guidance may be obtained from the Health and Safety publication HSG 185: "Health and Safety in Excavations".

Before digging takes place ensure that:-

- Cables or services are not within the tank excavation area.
- The person who is going to supervise the digging on site has the appropriate service plans and is competent to use them.
- All workers involved in the digging know about safe digging practice and any emergency procedures and are properly supervised.
- A locator is used to trace and mark as accurately as possible the actual line of any pipe or cable.
- The site has been checked with the Environment Agency to ensure there is no risk of flooding.
- The area around the excavation is clear of any foundations that may be at risk from undermining.
- Access is suitable for any excavation plant and crane vehicles.
- Trial holes are dug by hand using spades or shovels rather than picks and forks to confirm the position of any pipes or cables. This is particularly important with plastic pipes as they cannot be detected by normal locating equipment.

During digging:-

- Constantly check for evidence of pipes or cables, if necessary repeat checks with the locator. If unidentified services are found, stop work until further checks can be made to confirm it is safe to proceed.
- Treat all pipes and cables as “live” unless it is known otherwise.
- Ensure that no machine or power tool is used within 0.5 metre of a gas pipe or electricity cable.
- If any services are exposed during the excavation they should be adequately supported, to prevent them from being damaged.
- Any suspected damage to services shall be reported to the utility provider or appropriate person.
- Services shall be adequately back filled with fine material and compacted.
- Any spoil or materials which are removed are placed the appropriate distance from the edge of the excavation to avoid excessive loading on the sides.

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- The sides of the excavation shall be suitably battered or stepped back appropriate to the soil type and condition. The maximum vertical distance of each step shall not exceed 1.2 metres.
- Ensure that access is restricted to persons that are involved with the digging work.

Upon completion of digging ensure that:-

- Suitable barrier protection is provided around the excavation.
- Adequate lighting or marking is positioned if required.
- There is adequate drainage or removal of water, ensure the excavation is dry before and during the installation of the tanks. Until the excavation has been back filled there is a possibility that the tank will float, if the excavation is not kept dry.
- In wet or water retaining ground, it will be necessary to install permanent drainage for the excavation and for the turret. The latter should incorporate a suitable LPG interceptor.
- Suitable and safe access is provided for entry in and out of the excavation.
- Protection is provided to prevent vehicles from getting too close to the excavation.
- A competent person verifies the excavation as safe before any person enters.
- That any plans are modified to show the location of any unknown or inaccurate underground utilities or services.

Backfilling and reinstatement

- After placing the tank into the excavation, the top of the turret excluding the lid, should be flush with, or slightly above ground level. Under no circumstances should the top of the turret excluding the lid, be below the level of the ground.
- Once the tank(s) have been checked and sited into the excavation, then the Calor contractor will supervise the construction of the anode shelves appropriate to the relevant Calor specifications and install the anodes and ensure the tank restraining straps have been adequately secured.
- Back fill material should preferably be the excavated material graded to remove sharp rocks or stones or any other sharp objects.
- Where excavated material is unsuitable an alternative soil shall be used. Graded sharp sand, pea shingle or gravel shall not be used.
- Care should be taken at all times during backfill to ensure that no damage occurs or excessive strain is placed on the tank protective coating, anchoring straps, anode wires or service pipework.
- The back-fill must be carefully compacted underneath the tank(s) and at stages throughout the back-fill process to prevent voids and subsequent settlement. Each back-fill layer should be no more than 300-400mm deep between compactions. Under no circumstances should the backfill material be compacted using heavy machinery or vehicles over the tank(s).
- The yellow plastic warning mesh supplied by Calor must be laid out by the contractor at a depth of 200mm below the finished ground level in accordance with the Calor specification.
- Upon final backfill, Marker pegs are to be placed flush to the finished ground level in accordance with Calor specifications. These should not be removed.
- Due to the volume of the LPG tank and inert backfill material, there will inevitably be a large amount of spoil that will either require removal from site, or dispersal elsewhere on site. The customer shall be responsible for making suitable arrangements for disposal.
- It is recommended that an amount of spare backfill material be retained on completion of installation for making good any subsequent settlement.

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Covering the Tank Area

The cathodic protection relies upon moisture within the ground to function correctly and therefore any materials that restrict the ingress of water should not be used. The following guidance should be followed:-

- The area over the tank(s) may be turfed, shingled, or planted with shallow rooted, low growing flowers or shrubs. However, the need for clear access to the turret lid for filling must be taken into account.
- There shall be no decking over the tank. Any decking adjacent to the tank shall have 1m clearance for the turret lid to be opened. Paving using separate slabs is permitted, provided that gaps or holes are left to provide water ingress to ensure the cathodic protection system operates effectively.
- These holes are located at each corner of the excavation and the mid-point on each side.
- The area must not be covered with tarmac or concrete.
- Trees or deep rooted shrubs are not permitted within the specified separation distances due to the risk of root damage to the installation.

Calor should be consulted if the finishing material is different from the items listed to ensure it meets the requirements of the Codes of Practice and does not affect the integrity of the tank or installation.

Protection from Vehicles

Where necessary, barriers or bollards should be provided and placed outside the appropriate safety distance.

End of section 4.18 – Below Ground Tanks - Groundwork