EXCAVATING FOUNDATION TRENCHES

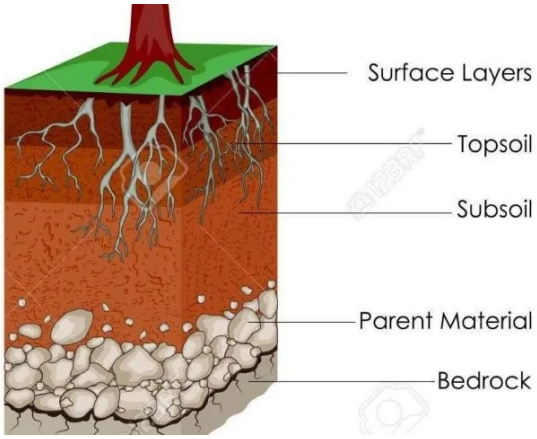
As a Party Wall Surveyor, I commonly come across issues relating to excavation works. If you are excavating for an extension and if this work is within 3 or 6 meters of your neighbour then you will need to serve a Party Wall Notice on your neighbour under Section 6 of the Party Wall etc Act 1996.

The purpose of this paper is to highlight issues relating to the excavation itself and not to delve into Section 6 of the Party Wall etc Act 1996. It attempts to explain the forces acting on the trench and why methods of excavation should be looked at to minimise the risk of excavating close to your neighbours property.

Your neighbour has a legal right to have his land supported by your land. This means that when you excavate for your foundations, you owe your neighbour a duty not to withdraw lateral support. It also means that where subsidence or other destabilisation occurs directly as a result of the excavation, you will be liable for a claim of damages, irrespective of negligence or intention.

SOIL STRUCTURE

Soil structure is based on the arrangement of soil particles into small clumps and these clumps are called aggregates or peds and to form peds soil particles like sand, silt, clay, and organic matter bind together.



The soil structure depends on the arrangement of particles, particle groups, composition, and pore spaces and these characteristics determine the type of soil that is present.

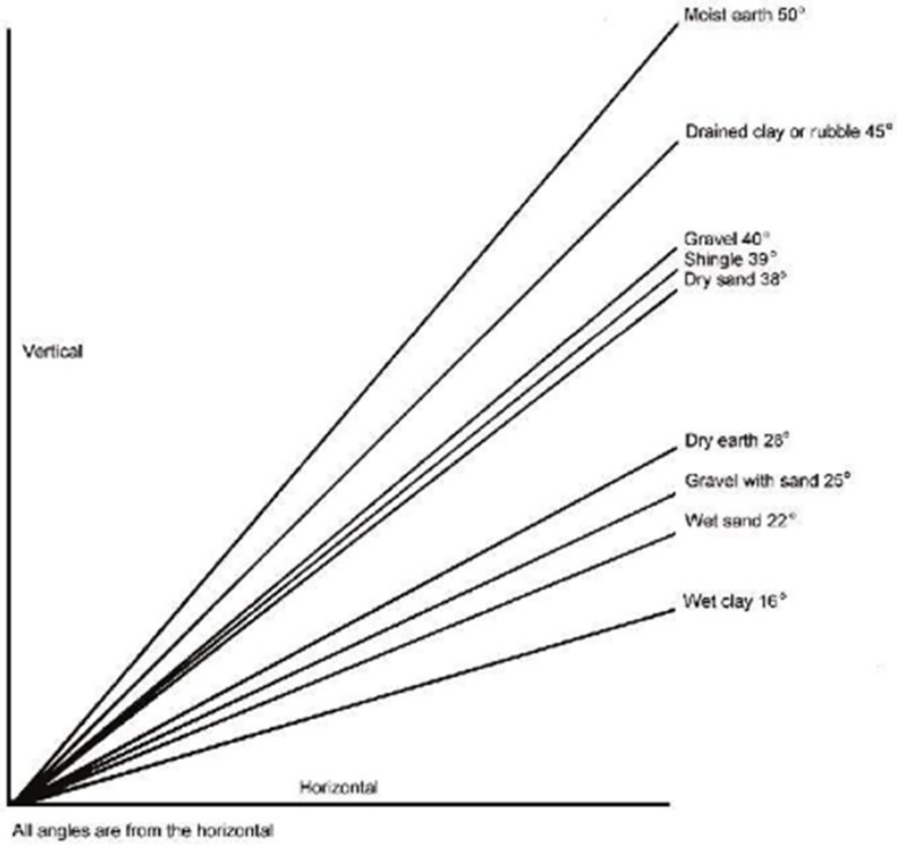
The basic thing to remember is that the soil is composed of air, water and aggregates. The extent or percentage to which each of these elements in the soil will also determine how that soil acts under bearing pressure.

ANGLE OF REPOSE

So, how can damage occur? One of the first questions you should ask regarding the soil at a trench site are “Is this sandy soil?” or “Is this clay soil?”.

This will determine the “angle of repose” (or angle of rest). The angle of repose is the steepest angle which a material can be piled without slumping or the surface material sliding. This is related to the density, surface area, liquid content, shapes of the particles, and the coefficient of friction of the material under consideration. The main quality which dictates the angle of repose, is the friction or cohesion between the individual pieces of material.

The diagram below shows the angle of repose for various soil types.



It can be seen from the above diagram that even shallow trenches can collapse depending on the soil type

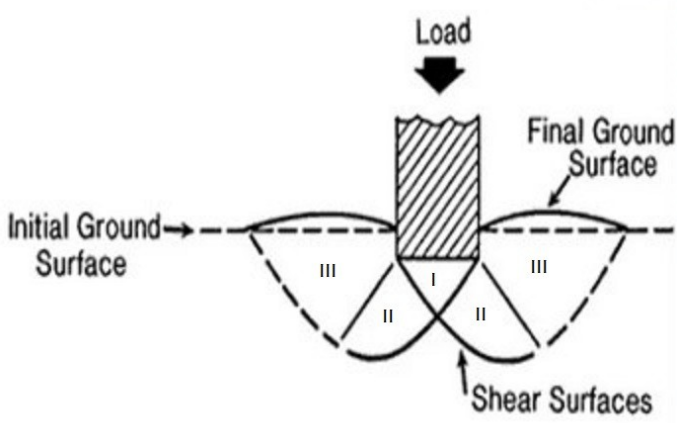
Naturally occurring soils exposed by excavation are not piles of loose material but they do possess a physical characteristic similar to a natural angle of repose. Internal friction and cohesion allow soils to support load and endure excavation when they are used as construction materials.

If an excavator is digging in a damp clay material, and there is a natural ability for the material to stand on its own. Initially, there could be a 90 degree angle of repose. However, if that material is subject to a heavy rain, the 90 degrees may end up being 0 degrees, due to a full slippage of the material.

EXCAVATING BESIDE OR NEAR AN EXISTING STRUCTURE

A common situation is where excavations are being undertaking beside, or close to, a neighbouring house or extension. These structures impose additional forces on the soil which need to be considered before evcavating works commense.

We can understand these forces by looking at an extract from the work of Professor Karl von Terzaghi.



The figure represents a foundation (hatched) sitting on horizontal ground equal in level on both sides. The foundation is loaded and the three zones marked I,II & III are what Terzaghi suggested to be the soil wedges 'mobilised' by the loading.

Zone I behave as an arrowhead pushing downwards into the soil displacing the two Zones II which rotate outwards about the corners of the foundation pushing Zones III upwards causing heave of the ground on either side of the foundation. At this stage the 'system' is stable and relies upon the weight of the soil 'wedges' and the friction between them.

Any soil above the level of the underside of the foundation will add resistance to the upward movement of Zones III and increase the load carrying capacity of the soil. Reducing the level of the soil will have the opposite effect.

When this is removed when excavating the trench, it destabilises the asymmetric forces which can cause the weightbearing side of the trench to 'slump' to its natural 'angle of repose' allowing the neighbouring foundation to rotate and subside.

It can also result in sudden failure associated with plastic flow and lateral expulsion of soil. This failure is usually accompanied by tilting of the adjoining foundations / wall as the soil adjacent to the foundation bulges.

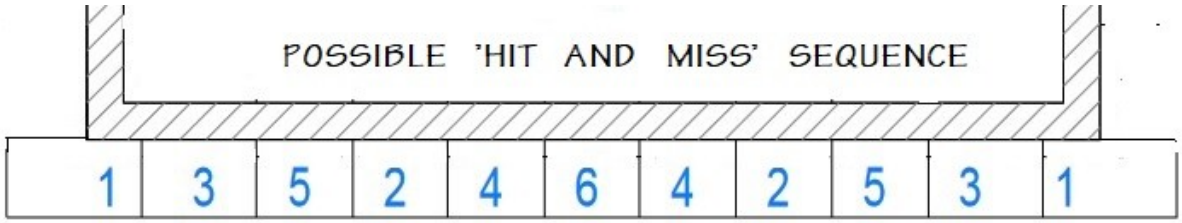
HIT AND MISS FOUNDATIONS

We can mitigate the risk of collapse by using sectional 'hit and miss' foundations when excavating close to a neighbouring structure (Section 6 (1) of the Party Wall Act). This is the process of digging a foundation trench in smaller parts, effectively digging part of the trench, filling that trench with concrete, letting the concrete set and then repeating the process onwards.

In undertaking the excavation trench in a sectional manner, the building owner will be ensuring that the risk associated with that work is as low as it can possibly be, and ultimately ensuring that the introduction of the foundation will be no different from the ground that was previously there, as ultimately the only open element of the construction works would be a very small section of trench, typically less than one metre at a time. The sequence of excavation should be undertaken such that no more than 20 per cent of any section of the wall will be undermined at any time.

This type of excavation is a slower process than undertaking foundations in a conventional strip fashion where there would be a high risk that the neighbouring structure would suffer some form of movement or slippage.

A Polystyrene block, say 150mm x 75mm, can be positioned at the end of the section before the concrete is poured. This can then be removed when digging out the adjoining section and so provide a 'key' to tie the sections together.



EXCAVATING TRENCHES AWAY FROM STRUCTURES

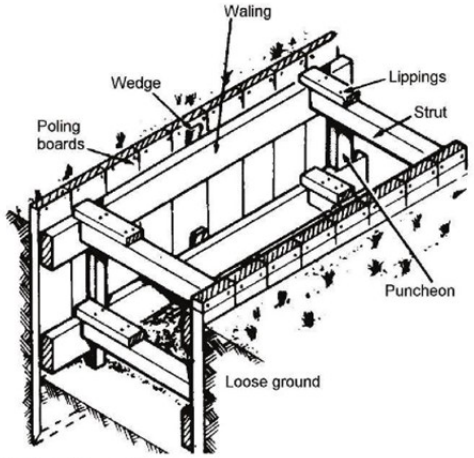
You may be excavating a foundation trench more than 3m away from but withing 6m from a neighbouring structure (Section 6(2) of the Party Wall etc Act 1996). There is still a risk of trench collapse but this can be mitigated against by adopting basic safety procedures and providing temporary support.

The type and extent of temporary support that is required will depend on the following factors:

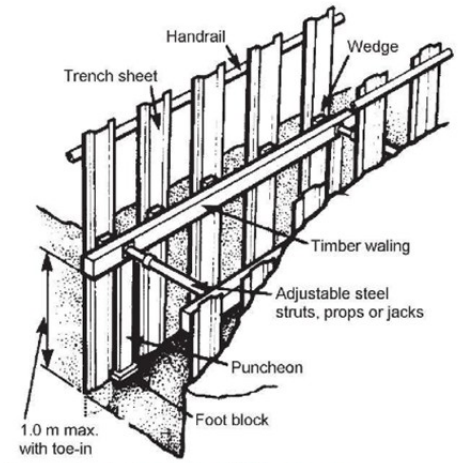
- The stability and angle of repose of the subsoil.
- The proximity of the excavation to vehicles, services and buildings.
- The level of the water table.
- The type/s of subsoil.
- The unit weight of the soil.
- The depth of the excavation.
- The length of time the excavation will be left open.
- The time of year and weather conditions.

The types of support that can be used include:

- Timber supports: Commonly used for low risk, narrow trenches.
- Trench boxes: Can be placed in pre-excavated trenches in low-risk situations.
- Trench sheets: Can be overlapping or interlocking, and are used to provide continuous support for deeper trenches.



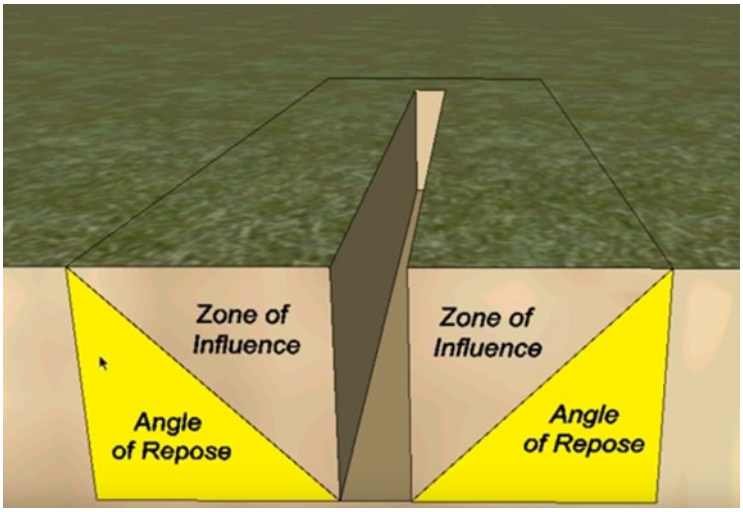
Close-boarded excavation



Open sheeting using steel sheets and jacks or acro props

Steps should be taken to prevent any part of an excavation or ground adjacent (the 'Zone of Influence') to it from being overloaded by work equipment or material.

A guideline is that the distance from the edge of the trench and the bottom of the spoil heap must not be less than the depth of the excavation. For example, the bottom of a spoil heap should be a minimum of 1m from the edge of a trench that is 1m deep.



In basic terms, a competent person should examine the soil being excavated to determine what type of soil it is and how long it will "stand-up" under its own weight. Soil conditions, including soil type and ground water levels, are two critical factors effecting the type of trench hazard(s) and choices of protective systems.

The inspection conducted by a competent person should not be done just once at the beginning of each day and/or shift, because disturbances during trench excavation procedures may change a soil's classification during the course of a work day/shift.

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