

CHAPTER 1 SCOPE & NATURE OF EARTHWORKS

Earthworks involve manipulating soil and rocks for different purposes. Although it is a significant aspect of preparing land for the construction of buildings, roads, and other infrastructure, it is also used for shaping land to alter its topography.

Nature of Earthworks

Earthworks deals with any kind of construction that requires the removal of earth, such as topsoil, subsoil, and rocks. These types of operations can include preparing land for buildings, roads, railway tracks, or canals. It can also involve building up the earth to build causeways over low-lying land or waterways.

Earthworks also deals with grading of land to alter its topography. This might be levelling land for construction of dwellings, or it could be shaping the land for other purposes. Examples of grading to shape the land include the construction of berms (levelled areas on slopes), dam walls, or embankments.

Earthworks can disturb natural environments and ecosystems by altering underground water systems, the soil biome, and plant and wildlife above ground. Therefore, it can require considerable planning and may require council permits depending on the type of works and scale of operation. Professional earthworks contractors must not only be able to undertake the earthworks in the most appropriate manner for the task at hand but must also be aware of environmental issues

and how to resolve these to maintain harmony in ecological systems.

Earthworks may include different processes depending on the purpose of the earthworks. Some of these processes are described below.



Surveying & Levelling

Land surveying may be required before any earthworks are undertaken. Surveys are done to reveal the topographical information about a site. To achieve this, surveyors use various surveying instruments (e.g., theodolite, dumpy level) where reference points are measured above a ground benchmark.

For example, land surveying can be used on building sites to set out boundaries and to locate the different sites for construction of buildings. Using this information, builders can set out new builds using metal stakes and ropes and do the same to mark perimeters. This ensures that earthworks and buildings are accurately located.

Various land surveying techniques can be used, including triangulation and levelling. Levelling can be regarded as a branch of surveying. It is used to determine the height of one level relative to another and on land sites it helps to establish the elevation of a point with regards to a datum. The datum is an arbitrary horizontal plane of reference from which all measurements are taken. Levelling is also used to establish a point at a specific elevation relative to the datum. Trigonometry can be used to work out the difference in elevation between two points.

Land Clearance

On building sites, as well as in many other cases, there is often a requirement to clear some, or all, parts of land before any earthworks can take place. Land clearance is usually regulated by government because depending on the nature of the land, and the extent

of clearance, it can affect the existing ecosystems, the drainage characteristics of the site, and can cause problems with erosion.

If mature trees are involved in land clearance, permission must be sought from local government or the council as they often require a permit to remove. Furthermore, they should only be felled by trained arborists. Tree stumps may need to be ground out using a stump grinder. This leaves wood chips in the ground where the stump was located. If the stumps are in the area to be excavated for foundations, they must be removed using a skid-steer loader or excavator and the hole backfilled and compacted to prevent subsidence later. If clearance involves the removal of buildings, then professional demolition contractors may be required.

Vegetation may be removed using a range of equipment such as skid-steer loaders, chainsaws, bowsaws, etc. The cleared vegetation can be shredded and retained for mulch or disposed of at waste depots that accept green waste.

Grading & Levelling Land

Grading is where earth is shaped to provide a level base (e.g., for a house foundation), or a sloped base (e.g., to divert groundwater away from the foundations of a house). Grading may be required for various purposes like preparing foundations, preparing railway and road bases, altering drainage patterns, or amending gardens or other landscapes.

Often the preliminary clearance work is done using machinery like bulldozers or excavators. Following this, the earth

is levelled using a machine called a grader which runs a large blade over the surface cutting it finely.

Levelling of land is where grading is done to make land level. On constructions like roads and railways the levelled section beneath the foundations is often referred to as the subgrade. To ensure the ground is level, a dumpy level or automatic level is used to measure the height of the ground surface at two horizontal points. A potential problem associated with levelling is that it can make nearby land steeper and thereby cause problems with erosion.



Excavation

Where excavation is involved in earthworks, it may be described by the type of material that is being excavated such as topsoil excavation, rock excavation, etc. It can also be classified according to the purpose of the excavation. For example, some different classifications of excavation include:

Foundation or footing excavation

– this is removing earth to prepare it for the foundations for houses, different buildings, and other structures. Excavation is required to prepare solid foundations unless the foundations are built on solid rock.

Dredge excavation – this refers to extracting material from beneath water. For example, dredging is used to excavate material to build canals, aqueducts, or other artificial waterways. It is also used during maintenance to reduce build-up of sediment.

Road excavation – the removal of earth to prepare for the construction of roadways and pavements that run alongside them.

Underground excavation – removing earth to create tunnels (e.g., for underground railways and roads, to transport water, etc.), to lay materials, repair foundations, etc.

Trench excavation – this involves excavating soil to create trenches. Trenches may be required for different purposes. For example, deep trenches are used for sewerage systems. Cables for services such as power, telephone, and gas are also often laid in shallow trenches.

Drainage excavation – this is used to remove earth ready for the installation of drainage systems. For example, it could be done on overly wet land that drains poorly, such as agricultural land or home gardens. It could also be required for laying stormwater drainage systems alongside roads and buildings.

Cut and fill excavation – this is where earth is removed (cut) and then placed in another location close by. For example, earth excavated for a canal could be mounded on either side to create banks. It could also be used to raise the level of ground or to flatten land by cutting mounds and filling depressions. As such, cut and fill is often used when houses are constructed in sloping land.

Small excavations may be undertaken using hand tools like mattocks, picks, spades, shovels, etc. Larger excavations are made using machinery such as skid-steer loaders, backhoes, excavators, and bulldozers. Larger machines require a licence to operate them. Some smaller machines may not require an operating licence depending on the laws of the country.

Excavation work not only involves the digging and removal of material from the earth, but it also involves knowledge of the correct procedures for storage of materials and understanding of shoring methods.

Shoring

Shoring refers to the use of supports to hold earth (or other materials like concrete) in place. It may be a temporary type of support like timber or metal props used to hold back earth during deep excavations or to support

concrete formwork until it has set. Temporary shoring can be used during repair work, when making alterations, or during construction. Shoring can also be permanent solutions like retaining walls.

Shoring may be used in excavation work to prevent the collapse of buildings or other structures. It also serves to protect workers whilst they work in trenches or temporary earthworks. Consequently, whilst shoring may take time to prepare and instal, it also saves time and costs associated with destruction of structures or earthworks projects or accidents involving people.

Various types of shoring may be used in earthworks to provide support, and can include:

Retaining walls – these are permanent walls that hold earth in position on the edge of an excavation or terrace so that the soil level is higher behind the wall. They may be used in gardens or other landscapes and are generally required on steeply sloping sites. For example, they may be used alongside the edges of hills where a road is cut through. There are different types of retaining wall designs such as anchored walls, gravity walls, and cantilever walls. Retaining walls need good drainage behind them to reduce pressure on the wall face.

A sea wall can be regarded as a special type of retaining wall where it supports land on one side and the sea is on the other.

Gabions – gabions are made from rocks, concrete or other materials enclosed in metal cages. If soil or sand are used as a fill, then the interior is lined with