highways england

Fact sheet

Ground conditions, geotechnical

Surveying the ground conditions

Geotechnical investigations (ground investigations) are needed to find out about the geology and water table beneath the ground. These types of survey are the most invasive that we do, but they are vital because the information collected will inform engineering design decisions such as slope angles, construction depth and drainage. We will carry out a number of different tests, taking samples to work out the composition, properties and structure of the ground, and also to monitor the groundwater.

How it works

We use two types of investigation techniques; trial pits and boreholes.

Trial pits are deep holes in the ground which are excavated by a mechanical digger. Once excavated, an engineering geologist will inspect the material taken out of the pit to make an assessment of the ground conditions, as well as taking samples.

Boreholes are holes drilled into the ground, either as a vertical or angled narrow shaft. Boreholes can be drilled singly or in clusters, depending on the testing and sampling we need to do. Single boreholes can also be fitted with a piece of tubing called a 'standpipe piezometer', which allows measurements of the groundwater level.

What will happen on site?

Trial pits: We'll need an area of approximately 5m x 10m (allowing us to create a safe working zone and have sufficient space to place the excavated soils). It generally takes between 30 minutes to an hour to excavate a trial pit, and inspections will occur during excavation.

Trial pits with soakaway tests: At some trial pit locations, the pit will be dug to a depth of around 2m. The pits will then be filled with clean water bought to the site using a mobile water tank. The rate the water level decreases in the pit as the water discharges into the ground will be monitored. Each test will take no longer than a day to complete, but it will be necessary to repeat the test 3 times to obtain a reliable result.

Boreholes: We'll need an area of approximately 15m x 10m (allowing us to create a safe working zone and have sufficient space to store equipment and samples temporarily).
It takes about 3 days to drill each borehole. In the soft overlying soils a percussive drilling technique will be used. In solid bedrock we will use a rotary drilling method to recover core samples.
Both techniques of drilling can be undertaken by

one type of drill rig, along with associated support equipment and plant machinery. Once ready, each borehole will have a raised cap (100 to 300mm high) concreted at the surface and protected by a small 1 x 1m rail and post, wooden fence.

Boreholes fitted with piezometers: Standpipe piezometers will be installed inside nominated boreholes to monitor the groundwater level. The standpipe piezometers will be installed with a down-hole data logger, which will take readings every 15 minutes. Pedestrian access will be needed if we use this type of monitoring, so that we can collect regular data readings. We estimate that these readings will take place about every 2 weeks, taking about half an hour to complete. The piezometers will remain in place throughout the project to gather important groundwater data on an ongoing basis.

Once excavation/testing is completed, the trial pits/boreholes will be backfilled with excavated materials and the original top soil left until last. The ground surface will be left slightly mounded to allow for settlement.

The cone penetration or cone penetrometer test (CPT): This is an in situ method used to determine the engineering properties of the soil strata. The test method consists of pushing a series of steel rods vertically into the ground, utilising hydraulic rams mounted onto either tracked or wheeled trucks. The tip of a cone attached to the end of the steel rods is instrumented allowing a series of readings to be undertaken in real time. Data is collected to determine a variety of engineering properties such as shear strength, which will be utilised in geotechnical design.

The process creates no vibration, is quiet and creates minimal soil disturbance.

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