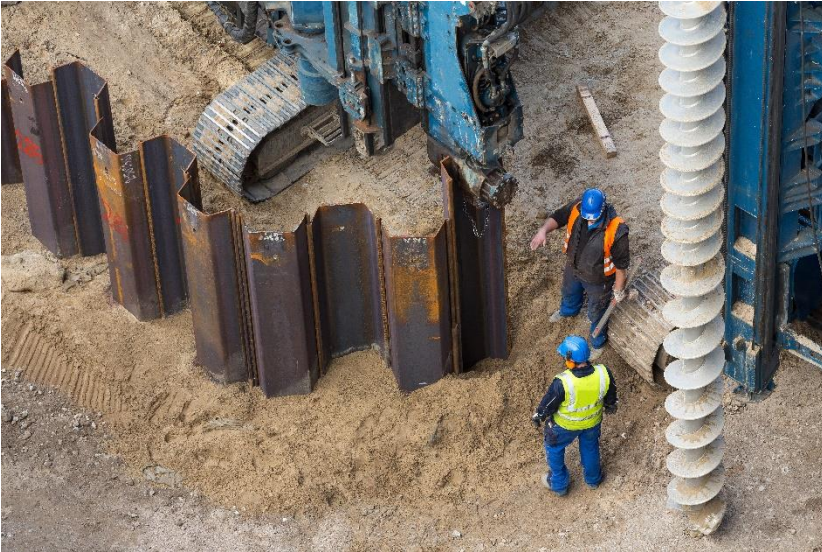


Application Note: Geotechnics



OVERVIEW

In geotechnical application, there is often a requirement to find the depth or detect underground structures which may not have been accurately recorded at the time of construction. This may include sheet piling, foundation, or in other cases older well casings.

One common feature which is likely to be present is a ferromagnetic component in the underground structure. Sheet piles are steel plates buried underground to stabilize slopes or river banks, whilst foundations may be reinforced with steel bars. Casing in wells will be a steel cylinder covering part or all of a well.

The ferromagnetic material will distort the local magnetic field, and the size of the features to be detected means that detection will be possible from a distance, though sensitive magnetometers will remain essential.

Equipment

- Three-axis Fluxgate Magnetometer with data acquisition



Applications

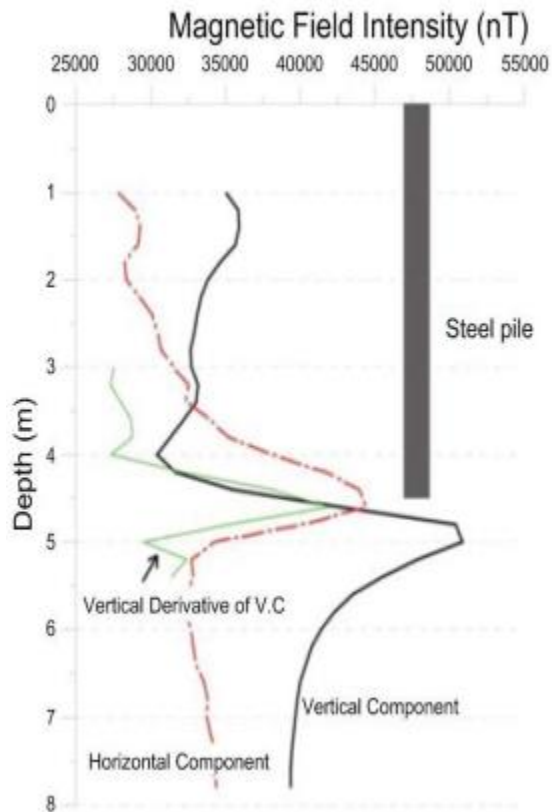
- Identify the depth of underground structures such as sheet piling or foundations

Detection of sheet piles and foundations

Sheet piles have long been used to stabilize slopes or waterways. Their depth, especially in older installation may not be well known. The same may be also true with the foundation of a building. In the event of further development in the immediate vicinity of the structure, it will be important to understand their depth in order to determine whether existing structures will be sufficient to allow for the development to go ahead.

Detection will be carried out using boreholes located a short distance from the sheet pile or foundation. Lowering a fluxgate sensor into the borehole will allow to monitor the magnetic field along the length of the borehole (recording the total magnetic field, as the rotation of the sensor would lead to amplitude changes as the sensor rotates). The use of a submersible sensor such as [Mag-13MSS](#) together with [Spectramag-6](#) is essential due to the likely presence of water into the borehole.

The end of the sheet pile or foundation will be typically characterized by a change of the field amplitude baseline seen within the borehole.



from

Jo, C.H.J., Cha, Y.H., and Choi, J.H. (2003). *A Borehole Magnetic Logging Tool for Estimating Unknown Foundation Depths*. Presented at the 3rd International Conference on Applied Geophysics, Orlando Fla., Dec. 8-12 2003.

Note that an alternative to the use of borehole, is to use instead a direct push tool – cone penetrating testing CPT in which a fluxgate magnetometer can be integrated. Here an unpackaged sensor may be more suited for this integration work, either a [Mag-03MCUP](#) or [Mag-13U](#).

Detection of well casing

Unlike the detection of the depth of sheet piles, casing localization is more important in the case of tunneling in area which were oil producing. Abandoned wells can be a hazard when tunneling and their detection ahead of the tunneling operation can help plan and mitigate their presence.

Here, depending on the implementation of the survey (carried out horizontally ahead of the tunneling, or multiple vertical boreholes), the instrumentation used may be either identical to the instruments used for sheet piles, or a gradiometer – [Grad-13S](#) (again submersible is preferred).

When performing the survey ahead of the tunneling, this can be done by drilling a horizontal borehole ahead of the tunnel boring machine (TBM), or can be done using horizontal directional drilling technique. Whilst the first case prevent any surface disruption, the boreholes do not extend far ahead of the TBM and therefore action to mitigate an obstacle is more limited.

When doing HDD, the whole route can be surveyed ahead of the tunneling even starting allowing for route planning to be adjusted.

In all cases, either a gradiometer or a magnetometer will be used along the pilot borehole to map the field along the path and detect whether there are any ferromagnetic obstacles ahead, along the planned route.