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Dewatering system of a deep of excavation in urban area – Bucharest case study

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Abstract

Many excavations for basement construction will encounter groundwater. If not suitably managed and controlled, groundwater can cause problems for excavation and the buried structures themselves. These problems can range from nuisance seepages that reduce the efficiency of construction operations, through to major inflows that can result in instability, flooding and even collapse of the excavation.

Groundwater can be a significant problem when excavating for basement construction. However, with good planning and the use of suitable methods groundwater need not be a major obstacle.

If an excavation is made without suitable groundwater control various problems can result:

- the excavation may flood as a result of groundwater inflows from water-bearing layers of soil or rocks.
- high pore water pressures in batter slopes at the sides of the excavation may lead to instability or seepage erosion.
- groundwater uplift pressures beneath the floor of an excavation can give the risk of a base heave or piping failure in the base of the excavation.
- groundwater pressures can cause excessive hydrostatic loads on excavation retaining structures such as concrete pile walls.

Dewatering methods (also known as groundwater control methods) can be used to control groundwater and avoid these problems. This is an especial problem when excavating in water-bearing soil (such as sands and gravels) or fissured rock (such as chalk or sandstone). Without suitable control measures, inflows of groundwater can flood excavations or tunnels, and can also lead to instability when the soils or rock around the excavation weaken and collapse – either locally or on a large scale.

The current modern techniques allow the execution of the deep excavations in the urban zones in more difficult geotechnical and hydrogeological conditions.

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The main methods which provide the removal of the groundwater from the deep excavations are:

- Direct dewatering – the direct pumping of the water which penetrates through the walls and the background of the excavation;
- Indirect dewatering – the general descent of the groundwater level, through point wells needle filtres or dewatering wells, done before the excavation;
- Achieving of the watertight barrier that prevent the groundwater penetration in excavation.

For the execution dry environment works, in most of the situations it is needed the lowering of the groundwater level. Dewatering works provide the possibility of dry digging execution under the groundwater level.

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Keywords: dewatering system; deep excavation; groundwater; drawdown; wells.

1. Introduction

The construction of deep excavations in the urban environment is a technically challenging problem.

The design and execution of deep excavations in urban areas require knowledge of the expected environmental mpact which includes two types of the influence: changes of stress state in a subsoil and technological influence.

Groundwater poses a number of challenges to underground infrastructure projects being encountered in excavation underground infrastructure works such as multi story basements or tunnels. Working below groundwater level can be difficult, as the excavation is at risk of instability and flooding, however, modern geotechnical designs and technologies allow groundwater to be safely managed.

While in congested urban areas, space is at a premium, civil engineering often encounters a poorly treated issue, groundwater, a problem when excavating in water-bearing soil (such as sands and gravels) or fissured rock (such as chalk or sandstone). Without suitable control measures, inflows of groundwater can flood excavations or tunnels and can also lead to instability when the soils or rock around the excavation weaken and collapse – either locally or on a large scale.

Traditional methods which provide the removal of groundwater level for the protection of deep excavations encounter several problems specific to each particular project, for example: enclosed buildings, large volumes of water to be discharged, the aquifer homogeneity.

The rapid development of deep excavations in urban areas has generated the possibility of multiple dewatering works or drainages, thus influencing the natural groundwater flow through recharges and discharges of the groundwater system. Most of them can be temporary, during works, but they can be also final to prevent, for example, the appearance of the increase of pore pressure.

2. Case study - Bucharest

The city of Bucharest, Romania, is subjected to a continuous development regarding the infrastructure works, with high underground water tables consisting in confined aquifers, the impact of these new constructions on the environment being increasingly higher, as several hydrogeological studies, carried out over the past several years, have indicated.

As the influence of groundwater works is essential to the impact on the existing buildings and infrastructures, in the design phase of each new project, in the case of deep excavations in Bucharest's urban area, the influence of dewatering systems is subjected to critical awareness, having minim one aquifer encountered by the excavation works.

For a local project situated in Bucharest, with a surface of about 3300 m2, a deep excavation of approximately 19,00m is required.

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