Ground Water Observations

Ground water exerts a special influence on the design of all structures in soil and rock. An exact knowledge of the type and quantity of water may be decisive for the execution of a project.

In rocks that are liable to soften, the strength of the rock is reduced by water in its pores. Shear strength at fissures with clay filling is decreased, and the water in open fissures can impair the stability of surface and underground structures through its hydrostatic action or seepage pressure.

In soils - especially cohesive soils - the ground water content has an effect on internal resistances, bearing capacity and compressibility etc. Seepage pressure and hydrostatic pressure impair the stability of structures in the same manner as in rocks.

Soil water is defined as the water found in liquid, solid and gaseous form in the soil. According to ZUNKER, we distinguish between:

1. **Ground water**, which fills the soil's cavities coherently.

2. **Capillary water**, which is lifted above ground water level to the ground surface by surface tension. The capillary rise of water lies between 0.3 and 1 m in coarse sand, between 1 and 3 m in medium silt, and between 3 and 10 m in fine silt.

3. **Adsorbed water** at the surface of certain mineral grains (also known as hygroscopic water).

4. **Retained water**, which is held by surface tensions, e. g. in the corners between grains (pore corner water).

5. **Seepage water**, which works its way into the soil from the ground surface.

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Water in rock is classified similar to ground water, except that the water which fills the rock's cavities coherently is called **rock water**. Unlike in soil, water in rock is not only found in cavities of the rock substance but also in fissures, where we speak of **fissure or crevice water**, in karst cavities where we speak of **karst water**, and finally in the fillings of fissures and karst cavities where we meet the same forms as in soil.

Ground water and rock water collects almost exclusively from seeping precipitation, i. e. water that is referred to as vadose water. Theoretically, a small amount of ground and rock water may also arise from magmatic differentiation. This so-called juvenile water is formed through condensation of gases from solidifying magma and rises from the magma body to the ground and rock water. However, the creation of new ground water by this process has hypothetical value only. Exact details have yet to be established.

Under the action of gravity, ground and rock water is able to circulate more or less freely depending on the size of the pores in the soil and rock, the width of a fissure's opening and its degree of separation. Various hydrological types of soil can be classified according to permeability:

- Nearly impermeable (water retainer)
- Hardly permeable
- Permeable
- Highly permeable (ground water conductor)

Water retainers are generally clayey soils and clay-stone, ground water conductors are sandy and gravel-like soils as well as heavily fissured rocks. The boundary between the two hydrological types cannot be defined in quantitative terms; a moderately permeable soil sandwiched in a highly permeable soil may act as a water retainer.

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In addition to the monitoring of seepage water and springs, ground water observations in boreholes are a standard procedure in soil and rock mechanics. The following tests are conducted:

- Piezometer measurements
- Temperature measurements
- Determination of ground water consistency
- Determination of permeability with pump tests
- Determination of flow rate with a tracer

In the natural environment, water never occurs in a chemically pure form. It dissolves substances, transports them and discards them again. Hence substances are redistributed in those levels where the water flows, resulting in mineral buildups in the ground water and soil. The chemical composition of water (its consistency) depends on its physical and physico-chemical properties. From a knowledge of these processes and a given consistency of water it is possible to draw conclusions about a ground water's origin and movement, about its usability in industry and the home, about environmental influences, and about the possibilities of eliminating negative impairments.

For all the above mentioned tests we can supply and install the right instruments. If required, we will also provide you with our expertise in conducting, evaluating and interpreting the tests.

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