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Intelligent Slurry Wall System

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Cut-off walls in special foundation engineering are often carried out in order to avoid a flow around of dams, weirs or other hydraulic structures. In addition, cut-off walls are executed for retaining walls or for enclosing pollutant sources (landfill sites, fuel depots, refineries). Within the framework of the BAUER Research Foundation, the "*intelligent Slurry Wall*"- technique *(iSW)* has been developed.

1 Initial situation

Within the special foundation engineering, Bauer provides various methods for constructing cut-off walls. Soil mixing methods, such as Mixed-In-Place (MIP) or Cutter Soil Mixing (CSM), are often used in suitable soil conditions. The commonly used cut-off wall technique is still based on a replacement of soil by a cut-off wall construction material. A diaphragm walling grab or a trench cutter is used in order to excavate the soil. As a variant, the so-called single-phase cut-off wall technique can be mentioned. Thereby, the soil is replaced by a self-hardening, bentonite-cement suspension, which will stabilize the trench during in the construction phase. Another variant is the two-phase cut-off wall technique. In the 1^{st} phase the soil is initially replaced by a stabilizing (non-hardening) fluid (phase 1). In the 2^{nd} phase, the stabilizing fluid is exchanged by a hardening suspension, e.g. a bentonite-cement suspension. The hardening suspension is poured by the tremie pipe method (phase 2). The new iSW technique avoids disadvantages of the above-mentioned techniques and combines those advantages, especially for constructing cut-off walls with large and extreme vertical dimensions.

2 Basic principle of the iSW technique

The trench is secured by a stabilizing fluid for the duration of the cutting phase (firstly) and until the trench cutter is pulled out of the trench (secondly). However, the latter step is different in comparison to the usual pullout procedure. During the pullout of the trench cutter, a cementitious material continuously substitutes the stabilizing fluid. Alternatively, the trench cutter may mix a self-hardening material in the trench by adding cement to the stabilizing fluid. The existing stabilizing fluid in the trench with a lower density is displaced upward and pumped out at the top of the trench. In a simple case, this already pumped out stabilizing fluid could be mixed with cement and used as a cementitious material.

3 Method, Mechanisms und Advantages

3.1 Phase 1 – Conventional Cutting

For the cutting and excavation process, a stabilizing fluid is used, which is not self-hardening (Fig. 1). The trench cutter removes the soil material from the bottom of the trench, breaks it up and mixes it with stabilizing fluid in the trench. The stabilizing fluid with soil particles is pumped through the suction box and the return pipe to the de-sanding plant. Because of the non-hardening stabilizing fluid, there are no time restrictions for the cutting and excavation process. Therefore, large vertical dimensions could be reached. Furthermore, temporal interruptions (in phase 1) with long durations can be tolerated and the risk of loosing the trench cutter is not inevitably occurring. In contrast to this, the using of self-hardening materials in the cutting phase – even if a retarding admixture is used – this danger remains existent.

Phase 2 begins shortly after the cutter achieves the intended final depth of the trench.

3.2 Phase 2 – “Backfilling” with iSW technique

Phase 2 is characterised by a controlled backfilling of the excavated trench with a cementitious material (Fig. 1). Its composition varies, subject to the application. Generally, concrete (also plastic concrete), mortar or suspensions can be used.

The backfilling of the cementitious material is realized by a delivery hose with an outlet at the bottom side of the trench cutter. If the already used return pipe is intended for that purpose, the backfilling is carried out through the suction box of the trench cutter. This means a shift of the designated use of technical equipment is possible. The already mentioned components of the supply system must be connected with a feed pump. The cementitious material is supplied by a storage tank, which in turn, is charged by a stationary batching plant. Alternatively, truck mixers can deliver cementitious material to the site.

The backfilling of a trench starts at the bottom of the trench until the cementitious material is above the suction box, filling the trench. While the trench cutter is pulled, the trench is simultaneously filled (Fig. 1). The pulling speed of the cutter is adjusted to the filling rate, because the fresh cementitious material must be pumped into the already pumped material and still fresh cementitious material in the trench (almost tremie method). The trench cutter acts in the backfilling procedure as a protection against uncontrolled mixing of the cementitious material with the stabilizing fluid. The cementitious material, initially filled from the bottom (until over the suction box) functions thereby as a buffer.

4 Conclusion / Acknowledgement

The iSW technique supplements already existing techniques in special foundation engineering. For constructing deep cut-off walls, the conventional two-phase may be waived. After reaching the final depth, the filling process of a cementitious material with the aid of the cutter enable increased productivity. The economic efficiency, in comparison to other conventional techniques, is to be checked in each individual case for potential changed costs for the site set-up.

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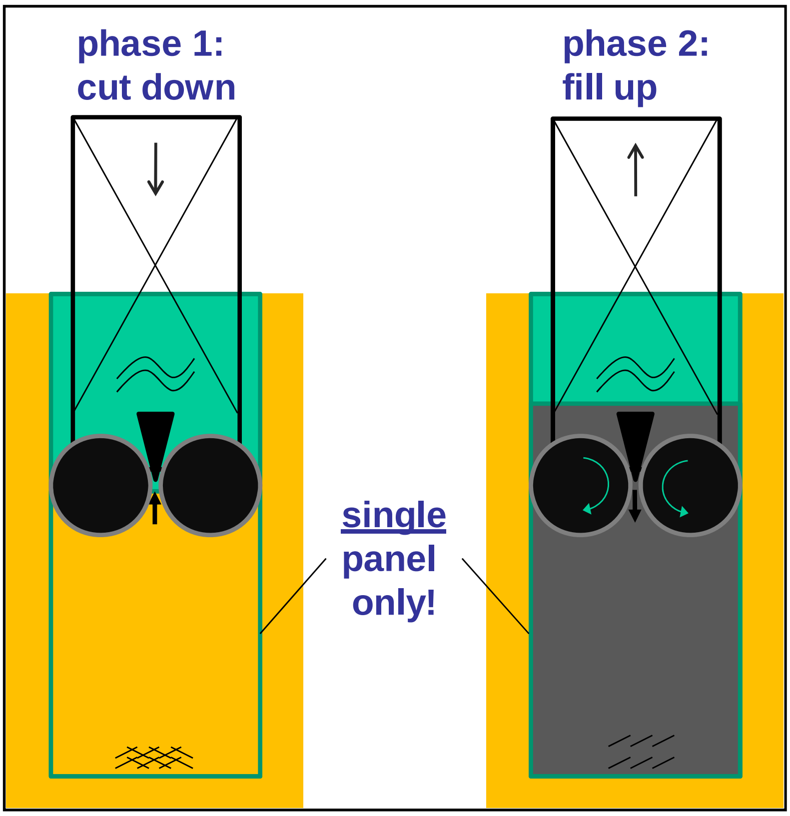

Fig. 1: Schematic diagram of the cutting and backfilling process within the iSW-technique