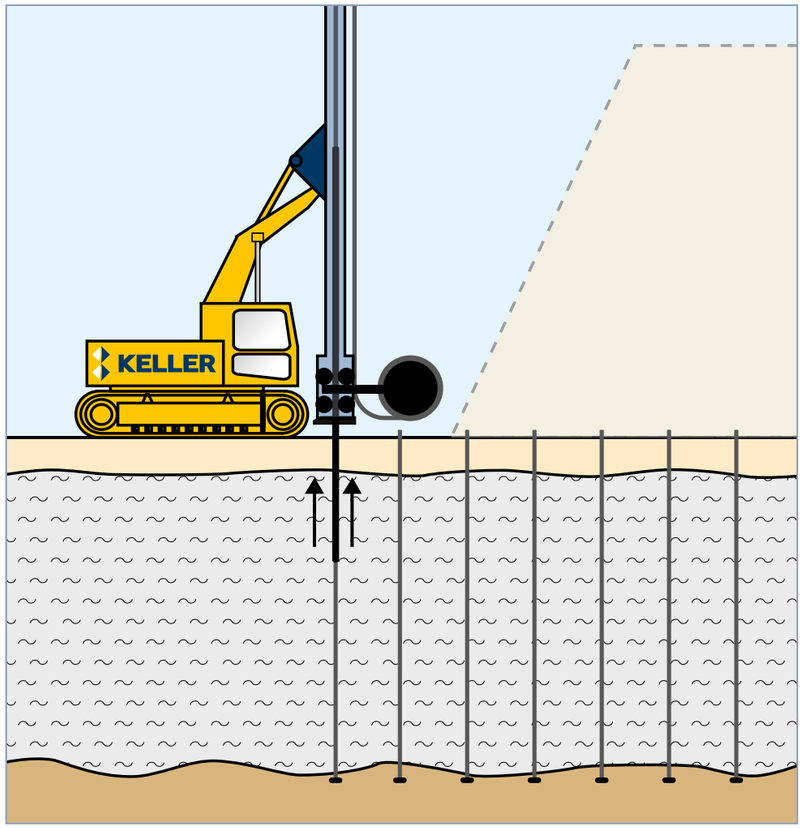
KELLER

Vertical drains

Ground consolidation on soft soils

Benefits

Vertical drains offer a cost-effective method of pre-consolidating soft, saturated and low permeability soils to allow construction of earth structures such as road or rail embankments. By incorporating a drainage layer and a superimposed surcharge load, such as earthworks fill, the consolidation of the soft soils is accelerated through the drainage paths introduced by the wick drains.



Applications

Vertical drains are often used in the consolidation of soft soils in conjunction with a preload fill (or applied negative pressure) or the accelerated construction schedule for staged loading or staged construction on soft soils.

Typical applications for vertical drains

- Acceleration of excess pore water dissipation.
- Reduction of soft soil consolidation period.
- Shear strength increase and stiffness.

Technical highlights

- Soft soil improvement
- Liquefaction mitigation
- Groundwater control

Vertical drains process

Before starting the installation process, the working platform is prepared with a sand or gravel layer that is well compacted to ensure a stable surface for the safe movement of the rigs. The sand and gravel used to construct the working platform also act as a drainage blanket allowing the dissipated pore water rising to the surface to be directed away from the treatment area.

The rig used for installation of vertical drains consists of a special mast fixed on a track mounted excavator or crane. The maximum drain length to be installed governs the required mast length and capacity of the base machine.

The vertical drain, with an anchor plate at its end, is passed through a mandrel which is mounted on the mast with a mechanism that can force the mandrel downwards into the soil. This takes the drain with it and leaves the drain anchored in the ground while pulling the mandrel upwards.

The mandrel protects the vertical drain from damage during the installation process. The mandrel is forced into the ground typically by a mechanism that is static or vibratory or a combination of both, depending on subsoil conditions. An anchor attached to the bottom of the drain keeps it in place during withdrawal of the mandrel. The drain is then cut leaving a “wick” above the ground. A new anchor is fastened to the drain end that is projecting from the bottom of the mandrel in preparation for the next installation point. After installation of the vertical drains, the area is pre-loaded to reach the desired consolidation of the soils.

Port Said Development Complex, Egypt

The East side of the Port Said development in Egypt has 50m deep deposits of very soft clays. Keller treated an area of 6.4km² by installing prefabricated vertical drains (PVD). Keller's optimized design required 25m deep PVDs in a triangular grid to accelerate the consolidation process under a 6.5m high preload. The design was verified by conducting a trial that was instrumented for intensive monitoring of settlements (staged build-up of preload embankment); the surrounding ground deformations and for variations in pore water pressures. The results indicated that approx. 90% consolidation was achieved in four months while soil parameters that were assessed by CPT were improved in eight months. On completion, 82 million linear meters of PVD were installed using 20 rigs with peak production rates exceeding 0.5 million linear meters in a double shift.

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