



Soft Soil Improvement Using CeTeau Drain

Method Statement

Scope of works: Vertical drain installation

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Introduction

All Prefabricated Vertical Drains (PVD) will be installed in the same manner, unless otherwise specified by CLIENT. This method statement describes all steps in the process of installing the Prefabricated Vertical Drains.



PVD Installation Rig

A specially designed hydraulic leader attachment for the installation of vertical drain causing a minimal disturbance to the existing soil will be used to execute the project. This leader attachment is supported on a large excavator base rig.

The main features of the installation rig are:

- A large excavator or foundation rig base with enhanced hydraulics.
- A custom built leader for the required depth of penetration at the specific site location.
- A long stroke piston or winch enclosed within the leader.
- A mandrel (approximate dimensions: 120x60x10 mm thickness, Fig. 1), which is pushed downwards into the weak subsoil, and afterwards pulled upwards.
- A vibrator and or pre drill auger might be used in case the soil resistance is too high.
- A drain roller assembly

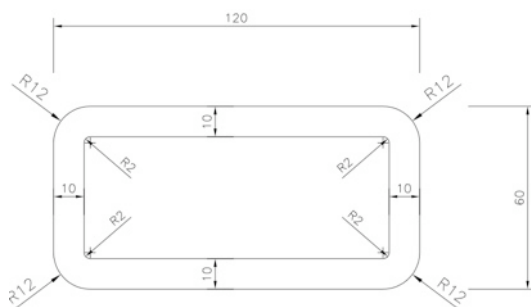
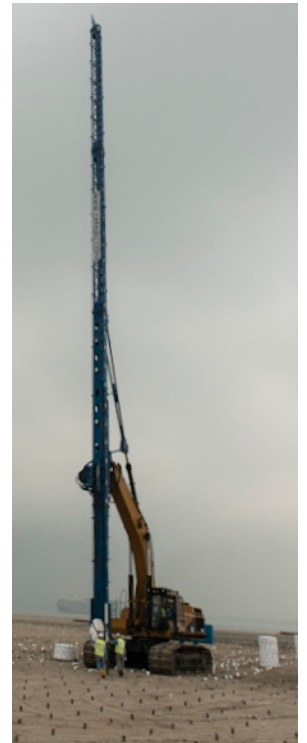


Fig. 1 Cross-section Mandrel

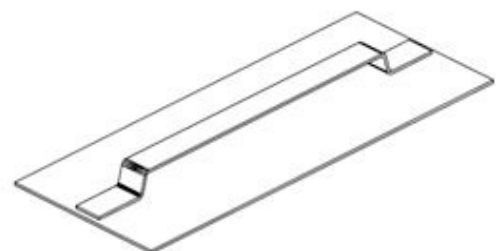


Fig. 2 Anchor Plate

Working platform

The level of the working platform should be provided according to the drawings made by the main contractor, the level has to be horizontal or in steps not smaller than 10.000 square meter. An working platform with sufficient bearing capacity for the equipment as stated in the equipment list has to be made, generally a sand fill platform of at least of approx. 1.5 m thickness or, if necessary, greater should be provided for the movement of the rigs. The working platform should be kept free of standing water at all instances. The main contractor should provide an access road with a minimum width of 6m. In addition the main contractor should also provide a site office, work shop and storage area for the lay down of materials and equipment.

The working platform will be prepared by the earthworks contractor to the lines and levels as shown in the specific construction drawing.



PVD Installation Procedure

A number of sections shall be defined and each section will be indicated by a letter/numerical code. For each section a predefined installation depth for the drains will be required. This depth shall be defined by the CLIENT/CONSULTANT or alternatively based refusal or on initial trial installation by means of installing test points around the boreholes to establish the base of the clay layer.

The surveyor sets out a section based on the information from the main contractor. The four corners of each section 50 by 50 meter will be marked with pegs by the MAIN CONTRACTOR. The grid, which defines the actual positions of the drains, has a triangular or square spacing as defined by the CLIENT/CONSULTANT.



The individual drain position will be marked by pulling a nylon string, marked with the required drain spacing along the alignment of the drain positions. The anchor plate will be used to mark the position of the drain.

The drain will be placed in position in the grid, with a tolerance of 150 mm.

The rig operator aligns the leader on top the drain location. The drain will be wrapped around the fixture on the anchor plate (dimensions: 140x80x1 mm, Fig. 2), dimensions might vary depending on soil conditions, and the folded end of the wrapped drain will be pulled back into the mandrel, until the plate rests against the base of the mandrel.

The hydraulic motors of the machine now push the mandrel to the design depth. The drains will be installed to the depth as defined above, with a tolerance of 150 mm.

The operator will see on the display of the drain logger, if the mandrel has been inserted till the required depth. This actual depth may vary due to irregularities in the layer profile; this has to be taken into account by both CLIENT and MAIN CONTRACTOR.

On reaching the depth of the drains, the operation is reversed and the mandrel is withdrawn from the PVD. The anchor plate locks itself at the driven depth such that the drain is fixed as the mandrel rises. The drain roll is mounted on the side of leader allowing the drain to be fed into the mandrel through a series of rollers, which prevent damage and minimize friction.

When the CONTRACTOR encounters problems with anchoring the drain, due to too little resistance, the CONTRACTOR can alter the installation depth. In that case the CONTRACTOR will install the drains to a depth that is sufficient to anchor.

Once the mandrel clears the ground surface, the drain will be cut off approximately 250mm above ground level. The drain is now installed. The rig operator will now align the leader onto the next drain position and the above procedure will be repeated.

Within the defined grid as shown on the installation drawings the contractor will decide upon the order of installation. Working sequence is according to the standard method of working ahead including tracking with the drainage rig over previously installed drains. The experience is that tracking over the drains will cause no subsequent damage to the drains installed. Whenever there is the necessity to turn the drainage rig, the rig will drive to a clear area in a straight line and turn there, in order to prevent damage to the previously installed drains.

Connection of PVD to Steel Anchor Plate

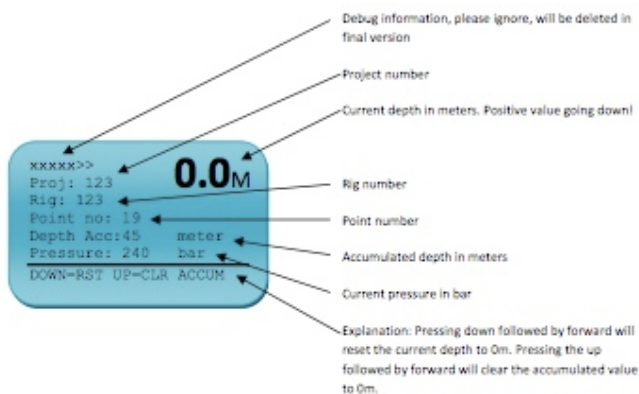
A length of approximately 150 mm of PVD is pulled out from the mandrel, wrapped around the fixture on the steel anchor plate and folded back tightly. Due to the stiffness of the PVD, the folded part then secures itself to the steel anchor plate. The drain is pulled back into the mandrel until the plate rests against the mandrel.



CeTeau Datalogger

Each rig is equipped with a data monitoring system that records online the following parameters:

- Date and Time
- Project number
- Installation panel
- Total length of drains installed
- Number of drains installed
- Installation depth per drain and maximum penetration force per drain
- Verticality of the leader



The monitoring system is positioned in the operator's cabin. The rig operator can use the data on the screen as a guideline for operations.

The next procedure is followed for data collection and processing:

- At the start of the day, before installing PVD, the ground level is set in the monitoring system.
- All installed points are recorded and saved in a data sheet.
- At the end of the day the data is copied from the system onto a memory stick or card reader.
- At the office the data will be processed and reports are made.

In case the monitoring system is out of order, recording will be done manually until the system is repaired.

PVD Joint and Lap Length

Joining the new to the old PVD shall be in accordance with the following procedure:

The last approx. 200 mm length of the old roll is guided into the beginning of the new roll.

The area of the overlap is then stapled together with sufficient staples to secure the strength of the joint and to avoid the two ends becoming separated while the mandrel drives the PVD into the ground.



Drain cuts

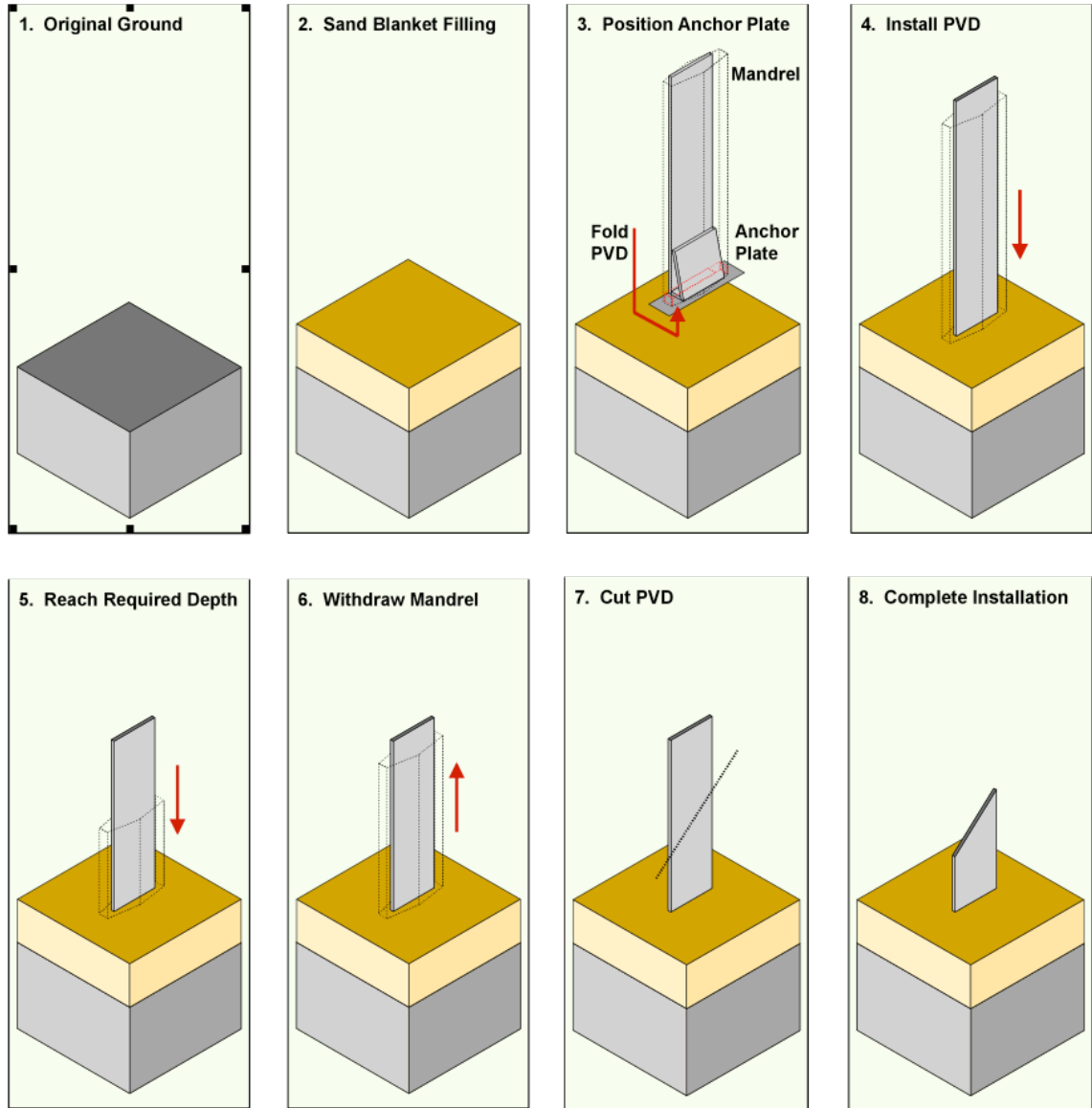
When the drain material snaps during installation, the mandrel will be retrieved and the drain material will be guided again through the mandrel. A new drain will be installed at the same position.

Obstructions

When the mandrel hits an obstruction which it cannot push through, the mandrel will be retrieved and a new drain will be installed within 500 mm from the original position. If the object proves to be large then the area will be clearly marked for further investigation.



Schematic Installation Procedure



Quality Assurance/Quality Control PVD

The drains shall be clearly marked with a, manufacturer name and product type.

A standard reference sample of each type of drain material will be kept on site, fully labeled to indicate its origin. Each consignment of PVD will be inspected on arrival on site. The manufacturer and drain type will be recorded, and it will be certified that the drains are of the approved type and undamaged as required by the Manufacturer. The delivery note and consignment inspection record shall be retained for inspection.

The product shall comply with all requirements and conformity assessment procedures that apply to it. The properties shall be within the limits announced in the accompanying document accredited by a Notifying Body. The certificate and declaration of conformity shall be presented in the english language.

Storage of the Vertical Drains on Site

The prefabricated vertical drains are delivered in containers to the storage area on site, from where the CONTRACTOR will transport them to the installation machines. Drains will be stored on site in a dry area and adequately covered to protect against deterioration, before being transported to the drain machine.

Risk analysis

The users of the drain mast are the operator of the excavator and the assistant, who has to be necessarily close to the mast to cut drains, install anchor plates and change rolls etc.

Risk: Contact between personnel and mast

Risk reducing measures:

- Operator and assistant have to take effective measures to protect them. This includes wearing a helmet, safety shoes, according to applicable regulations.
- Operator and assistant should make clear appointments about operation sequence.
- All movements must be checked and operative before commencing operation, and the controls on the operating panel may be operated only from the cabin. The operator will always follow instructions for traveling on slopes, near excavated areas or traveling to the work area.
- With all movements of the machine, the operator must keep his eye on the drain mast and the assistant.
- In case of repair, the mast should first be lowered to the transport position. Climbing in the mast is always prohibited.

Risk: Contact between mast and overhead power lines

Risk reducing measures:

- The machine must be kept at a safe distance from electrical aerial wires.
- If the machine should make contact with electrical aerial wires, it is not allowed to leave the cabin before the electrical tension is shut off. People finding themselves near to the machine must be warned not to approach the machine.

Risk: Collapsing of the crane

Risk reducing measures:

- The machine has to be positioned on a stable surface; therefore the thickness of the sand layer has to be minimum 1.5 meters.

The CONTRACTOR and operator have to take weather conditions into account.

Equipment

The CONTRACTOR will execute the works with the equipment as per submitted equipment list.

Vertical drain type

The CONTRACTOR will execute the works with the vertical drain, fulfilling the Client/consultant requirements as submitted.