

SUGGESTED SPECIFICATIONS FOR INSTALLATION OF EARTHQUAKE DRAINS

Description

The Contractor shall furnish all necessary labor, equipment, and materials and perform all operations necessary for the installation of Earthquake Drains in accordance with details shown on the plans and in accordance with these specifications. The prefabricated vertical liquefaction drains shall consist of a corrugated pipe with slot type perforations enclosed by a filter sock. Space within the pipes above the ground water table provides a reservoir for water expelled from the ground for liquefaction prevention. When required, additional reservoir space shall be constructed in accordance with details shown on the project drawings.

Materials

A. Pipe Requirements:

Pipe shall be 3-inch (75 mm), have an annular-corrugated interior and exterior, and shall meet the requirements of ASTM F-405. Pipe shall also meet the requirements of SCS 806. Pipe material shall be high-density polyethylene (HDPE) meeting the requirements of ASTM D3350 Cell Classification 324420C; or ASTM D1248 Type III, Class C, Category 4, Grade P33. Pipe splices shall be made in a workmanlike manner, so as to assure concentricity and continuity of the pipe conduit. In addition, the pipe shall have a minimum average wall thickness of 0.042 inches.

B. Filter Fabric Requirements:

The filter fabric sock shall be non-woven and made of thermally spunbonded polypropylene with minimum weight of 3.9 oz/ft² (128 g/m²), maximum apparent opening size (AOS) of 0.21 mm, minimum grab strength of 100 lbs (440 N), and shall be factory applied. The prefabricated vertical drain shall not be exposed to sunlight for more than 72 hours.

Installation

The Contractor shall submit for testing a sample of the vertical drain to the Engineer at least 21 days prior to installation. The sample of Earthquake Drain material shall be at least 10 ft (3 m) long. At the same time, the Contractor shall submit details of the sequence and method proposed for installation of the Earthquake Drain for the Engineer's review and approval. Approval by the Engineer shall not relieve the Contractor of the responsibility to install Earthquake Drains in conformance with the plans and these specifications.

Prior to the installation of Earthquake Drains within the designated area the Contractor shall demonstrate that his equipment, method and materials produce a satisfactory installation in accordance with these specifications. For this purpose, the Contractor will be required to install trial drains at locations designated by the Engineer. Payment will be at the bid price

per linear foot (meter) for the trial drains. Payment will not be made for unsatisfactory drains.

The prefabricated vertical drains shall be installed using a mandrel that will be advanced through the soil to the required depth. The installation rig shall utilize a vibrator with an eccentric moment of at least 500 in-lbs (55 Nm) to apply vertical vibration to the mandrel during installation. The mandrel shall be fitted with three symmetrically spaced fins for transmitting vibrations to the soil during installation. A suitable shoe or lost point shall be attached to the bottom of the drain to provide an anchor for the drain, and to cover the lower open end of the mandrel during penetration. The mandrel shall protect the drains and filter sock from tears, cuts, and abrasions during installation and shall be retracted after each drain is installed.

Depending on soil conditions, the equipment may be required to be capable of exerting at least 12 tons (10.9 tonnes) of vertical force (static crowd) to the mandrel to aid in forcing the mandrel into the ground.

A drain may be abandoned before reaching design penetration if the rate of mandrel movement is less than 3 inches (80 mm) per second with the full static force and maximum vibrator output. Falling weight impact hammers or jetting will not be allowed to install vertical drains. However, water may be introduced into the mandrel to facilitate anchoring of the drains. The Contractor shall be permitted to use augering or other methods to loosen stiff upper soils prior to installation of the Earthquake Drains, provided such augering does not extend more than 2 feet (60 cm) into the underlying liquefiable soils.

Where obstructions are encountered which cannot be penetrated using normal and accepted procedures, the Contractor shall complete the drain from the elevation of the obstruction to the working surface and notify the Engineer's representative. At the direction of the Engineer, the Contractor shall then install a new drain within 18 inches (50 cm) of the obstructed drain. A maximum of two attempts shall be made, as directed by the Engineer, for each drain. Payment for drains abandoned due to obstructions will be made at the contract price per foot (meter) for Earthquake Drain.

Equipment for installing vertical drains shall be plumbed prior to each drain and shall not deviated from the vertical by more than 1 inch per foot (8cm/m) during installation. Earthquake Drain locations shall be numbered and staked out by the Engineer. The Contractor shall take all reasonable precautions to preserve the stakes. The location of the drains shall not vary by more than 6 inches (15 cm) from locations indicated on the drawings or as directed by the Engineer. Drains that are out of their proper location or damaged will be rejected. Rejected drains may be abandoned in place or removed at the Engineer's option.

The Contractor shall provide a suitable means for the Engineer to determine the depth of the drain at any given time.

The Contractor shall observe precautions necessary for protection of instrumentation devices. After instrumentation devices have been installed, the Contractor shall replace at his cost any equipment that is damaged or becomes unreliable as a result of his negligence.

Reservoirs

Space within the Earthquake Drains above the water table normally functions as, and is often sufficient to provide a reservoir for water expelled to prevent liquefaction during a seismic event. In cases where this space is not adequate, additional reservoir space may be required. This additional space may take the form of a naturally occurring permeable soil layer if such layer is present. In other cases an artificial reservoir may be required. This artificial reservoir may take any of several forms, ranging from a layer of open graded stone applied over the area, to individually constructed reservoirs at each drain. One of the simplest methods to provide this reservoir is to leave an additional length of drain material, attached to the drain, folded and buried at each drain. Depending on individual circumstances, such reservoirs may or may not be paid as a separate item.

Method of Measurement

Earthquake Drains will be measured by the linear foot (meter) for the full length of the drain complete and in place.

Basis of Payment

Payment for Earthquake Drains shall be made at the contract unit price per linear foot (meter), which price shall be full compensation for the cost of furnishing the full length of drain material, installing the drain, altering equipment and methods of installation in order produce the required end result in accordance with the plans and specifications, and shall also include the cost of furnishing all tools, materials, labor, and all other costs necessary to complete the work. No direct payment will be made for unacceptable drains or for any delays or expenses incurred through changes necessitated by improper or unacceptable material or equipment, but the costs of such shall be included in the unit price bid for this work.

For additional information for installing Earthquake Drains (with or without reservoirs), or other Nilex Corporation services, or for assistance with your next ground improvement project, please contact us at one of the following locations:



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