

**DESCRIPTION**

This work consists of installing stone columns using a bottom feed vibro-displacement (dry) method in accordance with these specifications and in reasonably close conformity with the lines and dimensions shown on the plan or established in writing by the Engineer.

This work shall be accomplished by a Contractor experienced and properly equipped in the installation of stone columns by the dry method. The Contractor shall submit evidence of having satisfactorily installed stone columns on at least three (3) projects to the Director of the Geotechnical Engineering Bureau who will evaluate this experience for approval or disapproval. This submission shall identify the client, size and dates of projects, list of equipment, method of installation and key personnel from those projects to be assigned to this project.

**MATERIALS**

Backfill used in the stone columns shall be crushed stone meeting the requirements of §703-02 Coarse Aggregate. The gradation shall conform to Size Designation 2, as shown in Table 703-4, or an approved equal. At least one (1) month prior to commencement of the stone column installation, the Contractor shall submit to the Department a minimum of three (3) 22 kg. bags of crushed stone proposed for this Backfill Stone for testing to determine specific gravity, loose and compacted density.

**CONSTRUCTION DETAILS****Equipment**

The Contractor's equipment shall be capable of producing and/or complying with the following:

1. Contain a motor to drive an eccentric mass at a frequency of 1600 to 3000 RPM which shall be capable of generating at least 75,000 W and 178kN of centrifugal force.
2. Produce a double amplitude (peak to peak measurement) of the probe tip, a minimum of 15 millimeters in the horizontal direction when the probe is in a freely suspended position.
3. The probe and follower tubes shall be of sufficient length to provide stone columns having a maximum length of 10.7 m and have visible external markings at 0.3 m increments to enable measurement of penetration and re-penetration depths.
4. Provide for supplying compressed air to minimize clogging within the stone delivery pipe and to assist in the placement of the backfill stone.
5. Be capable of compacting the backfill stone and forcing the stone radially into the surrounding in-situ soil by means of displacement in combination with vibration.
6. Be capable of constructing stone columns in a manner such that dissipation of vibratory energy to the surrounding soil occurs mainly from the lower portion of the probe.
7. Be capable of constructing stone columns in a manner such that the probe remains in the unbackfilled part of the hole at all times.

**Stone Column Construction**

The Drainage Blanket shown on the plans shall be placed before installing any stone columns.

The sequence of stone column installation shall be in accordance with the plans unless otherwise directed by the Engineer. The upper dense soil may be augered to a point where penetration of the remaining soil may be achieved by the probe tip to the required column depth. The depth of pre-augering, however, shall not exceed 2.0 m unless otherwise approved by the Engineer. Soil removed by augering shall be disposed of as approved by the Engineer. Stone backfill shall be placed from the bottom up to the working surface in increments not exceeding 0.6 m in depth. The use of water during installation will not be allowed.

Prior to the installation of production stone columns, the Contractor shall install five test columns within the stone column layout pattern shown on the plans. Each specific test column location shall be selected

by the Engineer. The purpose of these test columns is to establish optimum, site-specific, stone column installation and construction control procedures and power consumption to be used in the production work.

Stone columns shall be installed so that each completed column will be continuous throughout its length with an average effective diameter of 1.1 m for every 0.6 m increment of depth. If the average effective diameter of a 0.6 m increment of depth, either during the installation of a test column or a subsequent production column, is less than 1.1 m for three (3) or more measurements, and the workmanship, power consumption, and materials are otherwise acceptable, the Contractor shall be allowed to complete the column being installed. The Contractor shall then cease all further stone column installation operations in the immediate area of this stone column to allow the Engineer to determine if it is necessary, and to what extent, to adjust the column size and pattern spacing. The time period for the Engineer's assessment will not exceed one (1) full work day.

No stone column shall be accepted for payment that has an average effective diameter less than 0.9 m for any 0.6 m increment unless approved by the Engineer. The Engineer's decision will be based on a review of the Contractor's installation procedures including power consumption used for installing the stone column.

The average effective stone column diameter shall be calculated by the Contractor using the Department's assigned in-place density of the stone and the weight of stone used to fill a given length of the hole. For calculation of constructed column diameter, the assigned in-place density of stone columns shall be equal to the density corresponding to 95% of the laboratory relative density determined by the Department.

The Engineer may also required that stone column installation work cease if State installed instrumentation at this site indicates potential or actual slope movement. In this case, the Engineer will determine if, and to what extent, the sequence and rate of stone column installation is to be modified.

#### Subsurface Obstructions

In the event that subsurface obstructions are encountered during construction of a stone column, which cannot be penetrated with reasonable effort, the stone column shall be constructed following the specified procedures from the obstruction to the surface of the drainage blanket. The Engineer may direct the construction of a replacement stone column at another location.

#### Construction Records

The Contractor shall provide competent and qualified personnel to prepare and furnish to the Engineer, daily recorded logs of the following data:

1. Stone column reference number.
2. Elevation of top and bottom of each stone column.
3. Peak power dissipation from the probe, by instrument reading, for each 0.3 m of stone column, or each increment of stone charge added.
4. Volume measurement and calculated weight of the total amount of loose stone used for each column.
5. Time to penetrate and time to form each stone column.
6. The average effective diameter of every 0.6 m of increment in depth for columns. This information shall be provided to the Engineer as work progresses as well as at the end of the work day.
7. Details of obstructions, delays, notations of artesian flow from stone columns and any other unusual ground conditions.
8. Pre-augered depth, if any, for each stone column.

**ITEM 203.9987 17 – STONE COLUMNS- BOTTOM FEED VIBRO-DISPLACEMENT  
(DRY) METHOD**

All records shall be of form and content to the satisfaction of the Engineer.

**METHOD OF MEASUREMENT**

The quantity to be paid is the number of meters of stone columns, including test columns and obstructed stone columns, satisfactorily completed in-place in accordance with the contract documents and as directed by the Engineer. Measurement will be from the bottom of each column to the top of the working surface. Measurement will be to the nearest 0.15 m.

**BASIS OF PAYMENT**

Include in the unit price bid the cost of furnishing all labor, mobilization and utilization of all equipment and material for developing and backfilling stone column holes with backfill stone, providing records and logs as necessary to satisfactorily complete the work, and for removal and disposal of any excavated or augered material from stone column holes.