Special Specification 4064
Stone Columns

1. DESCRIPTION

Construct stone columns using a bottom feed vibro-displacement (dry) method or vibro-replacement (wet) method in accordance with these specifications and in accordance with the lines, design, and dimensions as shown on the plans or as established in writing by the Engineer. This work can be accomplished by one of the following specialty Contractors:

- Hayward Baker, Inc.
  509 North Sam Houston Parkway East | Suite 300
  Houston, TX 77060
  (281)-668-1870
- A.H. Beck Foundation Co. Inc.
  5123 Blanco Rd.
  San Antonio, Texas 78216 (210)-342-5261
- Nicholson Construction Company
  12 McClane Street
  Cuddy, Pennsylvania 15031
  (800) 388-2340
- Layne/GEO Construction
  2192 Dupont Drive, Suite 110
  Irvine, California 92612
  (949) 955-1122

The use of other specialty Contractors or Subcontractors than those listed in the special specification is allowed. However, before being selected for the work, ensure the alternate specialty Contractors or Subcontractors submit documentation to the Engineer for review and approval, demonstrating their experience with stone columns, dependability of the equipment and techniques to be used, and the proposed work plan.

Make arrangements with the specialty Contractor for the expertise and services necessary to perform the work under this item.

2. MATERIALS

For stone used in the stone columns, use crushed stone or gravel that is clean, hard, and free from organics, trash, or other deleterious materials. Use a gradation conforming to the limits shown in Tables 1 and 2 as determined by Test Method Tex-110-E.

Table 1
Gradation for Vibro- Displacement (Dry) Method

Sieve Size	Percent Passing for Alternate 4
2-1/2 in.	100
2 in.	65 - 100
1-1/2 in.	-
1 in.	20 - 100
3/4 in.	10 - 55
1/2 in.	0 - 5

Table 2
Gradation for Vibro- Displacement (Wet) Method

Sieve Size	Percent Passing		
	Alternate 1	Alternate 2	Alternate 3
4 in.	–	–	100
3-1/2 in.	–	–	90–100
3 in.	90 - 100	–	-
2-1/2 in.	–	–	25–100
2 in.	40 - 90	100	–
1-1/2 in.	–	-	0–60
1 in.	–	2	–
3/4 in.	0 - 10	-	0 - 10
1/2 in.	0 - 5	-	0 - 5

Variation of the above gradation may be acceptable with prior approval of the Engineer.

Use stone meeting the Tex-410-A, Abrasion, and Tex-411-A, Soundness requirements as stated in Item 421, "Hydraulic Cement Concrete."

Water used in the vibro-replacement method can be fresh, brackish, sea water, or any combination. Use water that is free of substances deleterious to the work.

3. EQUIPMENT

Provide equipment capable of producing and complying with the following:

- Capable of producing approximately circular holes during vibro-replacement.
- Contains a motor to drive an eccentric mass at 1600 to 3000 RPM, which is capable of generating not less than 20 Tons of centrifugal force.
- Produces a double amplitude (peak to peak) measurement of the probe tip of 0.50 in. when the probe is in a freely suspended position.
- Provides a probe and follower tubes of sufficient length to construct stone columns to a maximum length of 30 ft. and with visible external markings at 1 ft. increments to enable measurement of penetration and re-penetration depths.
- For vibro-displacement (dry) columns, provide equipment 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. Dissipation of vibratory energy to the surrounding soil should occur mainly from the lower portion of the probe.
- Capable of supplying to the tip of the probe a sufficient quantity of compressed air to advance the probe and to ensure proper placement of the stone backfill. Place stone backfill by bottom feeding through a placement tube, which is an integral part of the probe.
- For vibro-replacement (wet) columns, provide equipment capable of supplying to the tip a sufficient quantity of water to widen the probe hole to a diameter of at least 1 ft. greater than the probe to allow adequate space for stone backfill placement around the probe.
- Capable of constructing stone columns such that the probe remains continuously in the unbackfilled portion of the hole.

4. CONSTRUCTION

Before installing production stone columns, install 2 test columns for each embankment within the stone column layout pattern shown on the plans. The Engineer will select each specific test column location. The purpose of these test columns is to establish site-specific installation and construction control procedures to be used in the production work.

Install stone columns so that each completed column is continuous throughout its length. Place stone backfill from the bottom up to the working surface in increments not exceeding 1.5 ft. thick.

If the upper soils are stiff or existing pavement is present, these materials may be augered to a point where the probe tip penetrates the remaining soil to the required depth. However, do not auger deeper than 5 ft. unless approved by the Engineer.

Install stone columns with an average effective diameter as shown on the plans. If the average effective diameter for 3 consecutive columns is more than 3 in. smaller than the proposed effective diameter, cease further stone column installation operations in the immediate area of these stone columns to allow the Engineer to determine if it is necessary, and to what extent, to adjust construction procedures and column size and spacing. Do not include the augered depth (if any) in the calculation of average effective diameter.

For vibro-replacement columns, maintain a continuous flow of water from the bottom jet during backfilling to prevent caving or collapse of the hole and to form a clean stone column. Maintain an average flow of 350 to 530 cubic ft. per hour during construction. The flow rate will be greater as the hole is jetted in, and decrease as the stone column rises. After forming the hole, lift the vibrator up a minimum of 10.0 ft. and drop it at least twice to flush out the hole.

Stone columns with effective diameters less than the proposed effective diameter minus 6 in. will not be accepted for payment unless approved by the Engineer.

Calculate the average effective stone column diameter using the in-place density and the weight of stone used to fill a given length of hole. The in-place density will be taken as 95% of the maximum laboratory density as determined by the Engineer.

Provide competent and qualified personnel to continuously observe and furnish to the Engineer recorded logs of the following data to be obtained during column installation:

- Stone column reference number.
- Elevation of top and bottom of each stone column.
- Peak power dissipation from the probe, by instrument reading, for each 1.0 ft. of stone column, or each increment of stone charge added.
- Volume measurement and calculated weight of the total amount of loose stone used for each column. The average effective diameter for every 2 ft. increment in depth of the columns. Provide this information to the Engineer as work progresses, as well as at the end of each workday.
- Augered depth, if any, for each stone column.

In the event that subsurface obstructions are encountered during construction of a stone column that cannot be penetrated with reasonable effort, construct the stone column from the obstruction to the working surface. The Engineer may direct the construction of a replacement stone column at another location.

5. MEASUREMENT

The accepted quantity of stone columns will be measured by the foot of stone columns complete in place. Measurement will be from the bottom of each column to the top of the working surface. The working surface is defined as the same elevation as the top of the proposed retaining wall leveling pad. Stone columns installed above this elevation will not be measured for payment. Measurement will be to the nearest 2 ft.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided in "Measurement" will be paid for at the unit price bid for "Stone Columns" of the specified diameter. This unit price bid is full compensation for developing and backfilling stone column holes; for providing records and

logs; for removing and disposing of any excavated or augered materials from stone column holes, and for providing labor, backfill stone, tools, equipment, materials, and incidentals.