



Republic of the Philippines  
 DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS  
**OFFICE OF THE SECRETARY**  
 Bonifacio Drive, Port Area Manila



097-13 DPWH  
 12.05.2024

DEC 03 2024

**DEPARTMENT ORDER** )  
 )  
 NO. 224 )  
 )  
**Series of 2024** )  
 a 12/5/2024

**SUBJECT: DPWH Standard Specification for  
 Item 211 – Stone Column**

In order to ensure uniformity in the application/adoption of the Pay Item of Work to be used/adopted by those who are involved in the preparation of the Design Plans and Quantities, Program of Works (POW) and Approved Budget for the Contract (ABC) for infrastructures Project Nationwide, the attached **DPWH Standard Specification for Item 211 – Stone Column** is hereby prescribed for adoption in Government infrastructure projects that require the utilization of such on the Program of Works.

The Specification shall form part of the ongoing revision of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition and is now included in the Project and Contract Management Application (PCMA).

This Order shall take effect immediately.

  
**MANUEL M. BONOAN**  
 Secretary

Department of Public Works and Highways  
 Office of the Secretary  
  
 WIN4U02070

Encl: DPWH Standard Specification for Item 211 – Stone Column

14.1.2 MLL/GAM/JDV



**DPWH Standard Specification for  
Item 211 – Stone Column**

**211.1 Description**

This Item shall consist of furnishing and constructing stone columns for soil stabilization in accordance with this Specification and as shown on the Plans.

**211.2 Material Requirements**

**211.2.1 Stone Sources**

The Contractor shall notify the Engineer at least seven (7) calendar days before operations begin or if a new source of crushed stones is used to allow the Engineer to have time to observe the Contractor's stone sampling at the source. Crushed stones shall be brought to the site by the Contractor only after receiving written authorization from the Engineer. No changes in stone sources, stone characteristics, or stone gradations will be allowed without the approval of the Engineer.

**211.2.2 Aggregates**

Aggregates to be used for the construction of stone columns shall comply with the following:

**Table 211.2.1, Standard Sizes of Processed Aggregates (Size No. 57) (ASTM D 448)**

Sieve Size, mm	% Passing
37.50	100
25.00	95 - 100
12.50	25 - 60
4.75	0 - 10
2.36	0 - 5

**Table 211.2.2, Gradation for Vibro-Displacement (Dry) Method**

Sieve Size, mm	% Passing
63.00	100
50.00	65 - 100
37.50	-
25.00	20 - 100
19.00	10 - 55
12.50	0 - 5

**Table 211.2.3, Gradation for Vibro-Displacement (Wet) Method**

Sieve Size, mm	% Passing		
	Alternate 1	Alternate 2	Alternate 3
100.00	-	-	100
90.00	-	-	90-100
75.00	90-100	-	-
63.00	-	-	25-100
50.00	40-90	100	-
37.50	-	-	0-60
25.00	-	2	-
19.00	0-10	-	0-10
12.50	0-5	-	0-5

The Contractor shall provide adequate and suitable areas at the project site for the storage of aggregate and equipment.

The stone shall consist of hard, durable, washed, and crushed rock that is free from organic substances/matter or other hazardous material.

It shall also conform to the following test:

Test	Requirement	Test Method
1. Los Angeles Abrasion, Max.	40	AASHTO T 96
2. Soundness, 5 cycles, Max.	12%	ASTM C88
3. Specific Gravity, Min.	2.6	ASTM C127

*Note:*

*AASHTO T 96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse*

*ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate*

*ASTM C127, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.*

The unit weight of the stone shall be measured by ASTM C 29, Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate.

### **211.2.3 Water**

Water to be used in the construction of stone column can be fresh, brackish, sea water, or any combination and shall be free from deleterious substances.

### **211.3 Construction Requirements**

The Contractor shall be knowledgeable on the proper construction of stone columns.

Prior to the installation of production stone columns, four (4) test columns shall be installed as directed within the stone column layout pattern shown in the stone column plans. The purpose of these test columns is to establish site-specific installation and construction control procedures to be used in the production work at each site. Test columns shall be located within the area of the deepest stone columns at each site, as approved by the Engineer. A Modulus test shall be performed on one of the installed test columns to evaluate the stiffness and verify the design criteria requirements shown on the plans of the stone columns. Modulus test shall be performed in accordance with ASTM D 1143, Standard Test Methods for Deep Foundations under Static Axial Compressive Load to verify design criteria requirements.

In addition to installing four (4) test stone columns and performing modulus testing at each site, Standard Penetration Tests (SPTs) shall be performed in the presence of the Engineer through the center of two (2) of the test columns to verify the consistency of density of the stone column throughout the entire length. The maximum interval between SPTs is 75 cm. The Engineer shall approve the initial stone columns and results of the modulus testing and SPTs before proceeding with the installation of production stone columns.

SPT testing shall be performed on production stone columns for quality control and assurance at column locations and intervals as directed by the Engineer.

#### **211.3.1 Construction of Stone Columns**

Stone columns shall be constructed at a minimum center-to-center distance of 1.50 m.

Stone columns shall be constructed utilizing a vibroflot (poker vibrator) or any equivalent equipment capable of reaching the depth indicated in the plans and densifying the aggregate by forcing it radially into the surrounding soil. The vibrator shall be of sufficient size and capacity to construct stone columns to the diameters and lengths shown on the approved construction plans.

The probe and follower tubes shall be of sufficient length to reach the elevations shown on the Plans. The probe, used in combination with the available pressure at the tip jet, shall be capable of penetrating to the required tip elevation. Pre-boring shall be permitted if it is specified in the Plans or approved by the Engineer.

The probe and follower tubes shall have visible markings at regular increments to enable measurement of penetration and re-penetration depths.

Appropriate materials shall be adopted to supply to the tip of the probe a sufficient quality of air or water to widen the probe hole to allow adequate space for stone backfill placement around the probe.

The probe shall penetrate the foundation soil layer to the pits required in the Plans. Any variations in the depth of stone columns due to conditions unforeseen in the design shall be immediately reported to the Engineer.

Lift thickness shall not exceed 1.20 m. The vibrator shall be slowly retrieved in 300 to 450 mm increments to allow backfill placement, after penetration to the treatment depth.

The backfill shall be compacted in each lift by re-penetrating it at least twice with the vibrating probe to densify and force the stone into the surrounding soil.

Stone columns shall be constructed in such a manner that all the necessary required activities shall be done continuously until the completion of each column.

Stone columns with effective diameters less than the proposed effective diameter minus 15 cm shall not be accepted for payment unless approved by the Engineer.

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

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

- a. Stone column reference number and date constructed;
- b. Estimate of ground heave;
- c. Elevation of the top and bottom of each stone column;
- d. Peak power dissipation from the probe, by instrument reading, for each 30 cm of stone column, or each increment of stone charge added;
- e. Volume measurement and calculated weight of the total amount of loose stone used for each column and average effective diameter for every 60 cm increment in the depth of the columns;

- f. Augered depth, if any, for each stone column;
- g. Auger diameter, temporary casing length, and diameter of each stone column constructed;
- h. Details of obstructions, delays, and any unusual ground conditions;
- i. Amount of water used (if any) per column; and,
- j. Results of SPT testing.

If subsurface obstructions are encountered during the construction of a stone column that cannot be penetrated with reasonable effort, the stone column shall be constructed from the obstruction to the bottom of the granular drainage blanket. The Engineer may direct the construction of a replacement stone column at another location.

### **211.3.2 Tolerances**

The following tolerances shall be maintained:

- a. Horizontal: The center of the completed column shall be within 20 cm of the plan location.
- b. Vertical: The completed column shall not deviate more than 5 cm in 3 m from the vertical as indicated by the tilt of the vibrator.
- c. Diameter: Completed stone column diameter shall not be less than 10% below the plan column diameter unless excessive ground heave occurs due to the presence of unexpected stiff strata of soil. Such heave will be cause to allow a reduction in the column diameter requirements as approved by the Engineer.

### **211.3.3 Acceptance of Stone Column**

Stone columns constructed beyond the allowable tolerances shall be rejected and abandoned by constructing another stone column as near as possible to the abandoned column subject to the approval of the Engineer. All materials and labor required to replace the rejected stone column shall be provided at the expense of the Contractor.

### **211.3.4 Stone Column Modulus Test**

Stone column Modulus/Uplift Load Test shall be performed to verify or modify stone column designs. Modulus test procedures shall utilize appropriate provisions of ASTM D 1143, Standard Test Methods for Deep Foundations under Static Axial Compressive Load.

### **211.4 Method of Measurement**

The measurement of the stone column shall be based on the linear meter of the completed stone column and accepted by the Engineer.

The quantity of the Modulus/Uplift Load Tests to be paid for shall be the number of tests completed and accepted except that Modulus/Uplift Load Tests made to calibrate different types of hammers, if not included in the Bill of Quantities, shall not be measured for payment.

**211.5 Basis of Payment**

The quantity to be paid for shall be in linear meters of the completed stone column and accepted by the Engineer. Payment shall cover the provisions of all equipment, materials, labor, and construction of the stone column. All works performed and accepted quantity measured as prescribed in Subsection 211.4, Method of Measurement, shall be paid for at the Contract Unit Price for each of the particular items listed in the Bill of Quantities, which price and payment shall constitute the full compensation for the supply and construction of the stone column and other incidentals necessary to complete the work prescribed in this Item.

Payment shall be made under:

<b>Pay Item Number</b>	<b>Description</b>	<b>Unit of Measurement</b>
211 (1)a1	Stone Column, 600 mm dia.	Linear Meter
211 (1)a2	Stone Column, 700 mm dia.	Linear Meter
211 (1)a3	Stone Column, 800 mm dia.	Linear Meter
211 (1)a4	Stone Column, 900 mm dia.	Linear Meter
211 (1)a5	Stone Column, 1000 mm dia.	Linear Meter
211 (1)a6	Stone Column, 1100 mm dia.	Linear Meter
211 (1)a7	Stone Column, 1200 mm dia.	Linear Meter
211 (2)	Modulus or Uplift Load Tests	Each

*References:*

1. *Memo 097.7\_062618\_Standard Specification Item 211 Stone Column*
2. *U.S. Department of Transportation, Federal Highway Administration, "Design and Construction of Stone Columns, Vol.1", 1983*
3. *Texas Department of Transportation, "Special Specification 4082 Stone Columns, 2017*