

Section 02321

CEMENT STABILIZED SAND

PART 1 GENERAL

1.01 SECTION INCLUDES

Cement stabilized sand material.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for Work performed under this Section. Include cost of such Work in Contract unit prices for items listed in bid form requiring cement stabilized sand.
2. Refer to Paragraph 3.06.A for material credit.
3. Refer to Section 01270 – “Measurement and Payment” for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. ASTM C33/C33M – Standard Specification for Concrete Aggregates.
- B. ASTM C40/C40M – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C42/C42M – Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. ASTM C94/C94M – Standard Specification for Ready-Mixed Concrete.
- E. ASTM C123/C123M – Standard Test Method for Lightweight Particles in Aggregate.
- F. ASTM C142/C142M – Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM C150/C150M – Specification for Portland Cement.
- H. ASTM DASTM D558 – Standard Test Method for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures.
- I. ASTM DASTM D1632 – Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.

- J. ASTM DASTM D1633 – Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
- K. ASTM DASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- L. ASTM DASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- M. ASTM DASTM D3665 – Standard Practice for Random Sampling of Construction Materials.
- N. ASTM DASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- O. Texas Administrative Code §290.44(e)(4)(B) - Public Drinking Water; Subchapter D: Rules and Regulations for Public Water Systems; Water Distribution

#### 1.04 SUBMITTALS

- A. Conform to requirements of Section 01330 – “Submittal Procedures”.
- B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.04.A, Materials Qualifications.

#### 1.05 RELATED REQUIREMENTS

- A. Section 01270 – “Measurement and Payment”
- B. Section 01330 – “Submittal Procedures”
- C. Section 01454 – “Testing Laboratory Services”
- D. Section 02320 – “Utility Backfill Materials”
- E. Design Requirements
  - 1. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours using no less than 1.1 sacks of cement per ton of dry sand.
    - a. Design shall be based on strength specimens molded in accordance with ASTM D558 at moisture content within 3 percent of optimum and within 4 hours of batching.
    - b. Determine minimum cement content from production data and statistical history.

1.06 – 1.13 NOT USED

PART 2 PRODUCTS

2.01 MANUFACTURER(S) (NOT USED)

2.02 MATERIALS AND/OR EQUIPMENT

- A. Cement: Type I Portland cement conforming to ASTM C150/C150M.
- B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33/C33M, or requirements for bank run sand of Section 02320 – “Utility Backfill Materials”, and the following requirements:
  - 1. Classified as SW, SP, SW-SM, SP-SM, or SM by United Soil Classification System of ASTM DASTM D2487.
  - 2. Deleterious materials:
    - a. Clay lumps, ASTM C142/C142M; less than 0.5 percent.
    - b. Lightweight pieces, ASTM C123/C123M; less than 5.0 percent.
    - c. Organic impurities, ASTM C40/C40M, color no darker than standard color.
  - 3. Plasticity index of 4 or less when tested in accordance with ASTM DASTM D4318.
- C. Water: Potable water, free of oils, acids, alkalis, organic matter or other deleterious substances, meeting requirements of ASTM C94/C94M.
- D. Mixing Materials
  - 1. Add required amount of water and mix thoroughly in pugmill-type mixer.
  - 2. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

2.03 FABRICATION (NOT USED)

2.04 SOURCE QUALITY CONTROL

- A. Material Qualification
  - 1. Determine target cement content of material as follows:
    - a. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.

- b. Complete molding of samples within 4 hours after addition of water.
  - c. Perform strength tests (average of two specimens) at 48 hours and 7 days.
  - d. Perform cement content tests on each sample.
  - e. Perform moisture content tests on each sample.
  - f. Plot average 48-hour strength vs. cement content.
  - g. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
2. Test raw sand for following properties at point of entry into pug-mill:
    - a. Gradation
    - b. Plasticity index
    - c. Organic impurities
    - d. Clay lumps and friable particles
    - e. Lightweight pieces
    - f. Moisture content
    - g. Classification
  3. Present data obtained in format similar to that provided in sample data form attached to this Section.
  4. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula:

$$f'_c + \frac{1}{2} \text{ standard deviation}$$

### PART 3 EXECUTION

#### 3.01 – 3.02 NOT USED

#### 3.03 ERECTION/INSTALLATION APPLICATION AND/OR CONSTRUCTION

##### A. PLACING

1. Place sand-cement mixture in maximum 8-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM DASTM D558, unless otherwise specified. Refer to related specifications for

thickness of lifts in other applications. Target moisture content during compaction is  $\pm 3$  percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.

2. Do not place or compact sand-cement mixture in standing or free water.
3. Where potable water lines cross wastewater lines, embed wastewater line with cement stabilized sand in accordance with Texas Administrative Code §290.44(e)(4)(B):
  - a. Provide minimum of 10% cement per cubic yard of cement stabilized sand mixture, based on loose dry weight volume. Use at least 2.5 bags of cement per cubic yard of mixture (2 sacks per ton of dry sand).
  - b. Unless otherwise shown on Plans, embed wastewater main or lateral minimum of six inches above and below.
  - c. Use brown coloring in cement stabilized sand for wastewater main or lateral bedding for identification of pressure rated wastewater mains during future construction.

3.04 REPAIR/RESTORATION (NOT USED)

3.05 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Section 01454 – “Testing Laboratory Services”.
- B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabilized sand shall be taken in the field at point of delivery in accordance with ASTM D3665. Obtain three individual samples of approximately 12 to 15 pounds each from the first, middle, and last third of the truck and composite them into one sample for test purposes.
- C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM DASTM D558, Method A, without adjusting moisture content. Samples shall be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.
- D. After molding, specimens shall be removed from molds and cured in accordance with ASTM D1632.
- E. Specimens shall be tested for compressive strength in accordance with ASTM D1633, Method A. Two specimens shall be tested at 48 hours plus or minus 2 hours and two specimens shall be tested at 7 days plus or minus 4 hours.

- F. A strength test shall be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength shall be average of strengths of all specimens molded during one day's production and tested at same age.
- G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D1633 Section 9.
- H. Reporting: Test reports shall contain, as a minimum, the following information:
  - 1. Supplier and plant number
  - 2. Time material was batched
  - 3. Time material was sampled
  - 4. Test age (exact hours)
  - 5. Average 48-hour strength
  - 6. Average 7-day strength
  - 7. Specification section number
  - 8. Indication of compliance/non-compliance
  - 9. Mixture identification
  - 10. Truck and ticket numbers
  - 11. The time of molding
  - 12. Moisture content at time of molding
  - 13. Required strength
  - 14. Test method designations
  - 15. Compressive strength data as required by ASTM D1633
  - 16. Supplier Mixture identification
  - 17. Specimen diameter and height, in.
  - 18. Specimen cross-sectional area, sq. in.

I. Acceptance

1. Strength level of material will be considered satisfactory if:
  - a. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.
  - b. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.
2. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.06.A Adjustment for Deficient Strength.
3. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) have 7-day strength less than 70 psi.
4. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five, 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.
5. Testing laboratory shall notify Contractor, Program Manager, and material supplier by E-mail of tests indicating results falling below specified strength requirements within 24 hours.
6. If any strength test of laboratory cured specimen falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03A.
7. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less than 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.06 ADJUSTING

A. Adjustment for Deficient Strength

1. When mixture produces 7-day compressive strength greater than or equal 100 pounds per square inch, then material will be considered satisfactory and bid price will be paid in full.
2. When mixture produces 7-day compressive strength less than 100 pounds per square inch and greater than or equal to 70 pounds per square inch, material

shall be accepted contingent on credit in payment to the owner. Compute credit by the following formula:

$$\text{Credit per Cubic Yard} = \frac{\$30.00 \times 2 (100 \text{ psi} - \text{Actual psi})}{100}$$

3. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary Work at no cost to the Owner.



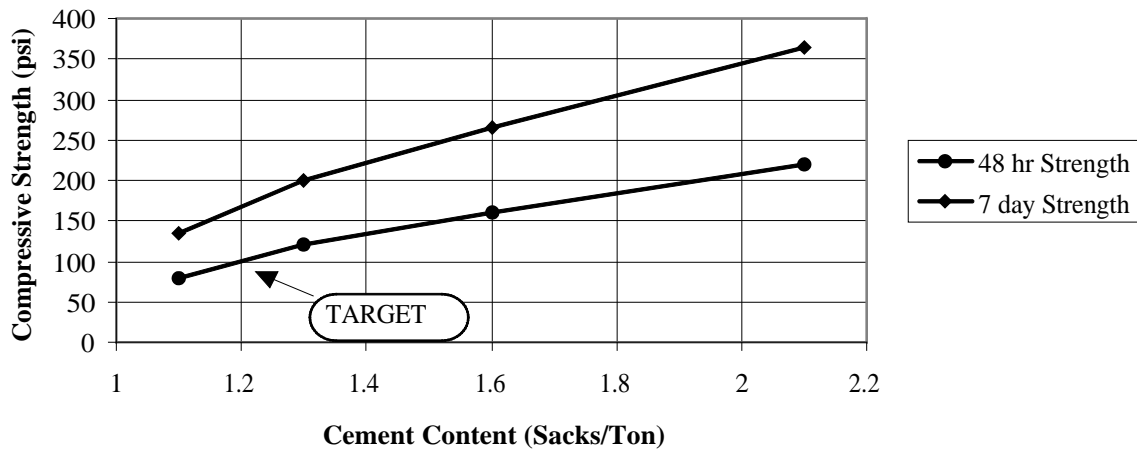
NORTH HARRIS COUNTY REGIONAL WATER AUTHORITY  
STANDARD SPECIFICATION

**CEMENT STABILIZED SAND**

<b>Supplier:</b> City Stabilized Sand	<b>Plant No:</b> 1 - Main Street	<b>Date of Tests:</b> January 1, 1997
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Item	Raw Sand	1.1 Sack	100 psi	1.5 Sack	2.0 Sack
Moisture Content	10.9	15.7	14.0	13.8	13.7
Cement Feed Dial Setting	-	2.25	2.5	2.75	3.75
Silo Pressure (psi)	-	4	4	4	4
Batch Time	10:00	10:10	10:15	10:20	10:25
Sample Time	-	10:10	10:15	10:20	10:25
Molding Time	-	12:30	12:45	1:00	1:15
Cement Content (sacks/ton)	-	1.1	1.3	1.6	2.1
Compressive Strength at 48 hrs. (avg of 2)	-	80	120	160	220
Compressive Strength at 7 days (avg of 2)	-	135	200	265	365
Sieve size	Percent Passing		Spec. Section 02320		
3/8 Inch	100		-		
No. 16	100		-		
No. 40	100		-		
No. 50	99		-		
No. 100	41		-		
No. 200	11		0 to 15		
Raw Sand Tests	Result		N.H.C.R.W.A.		
Plasticity Index	Non-Plastic		4 Maximum		
Organic Impurities	Passing		No Darker Than		
Clay Lumps & Friable Parts (%)	0.0		0.5 % Maximum		
Lightweight Pieces (%)	0.0		5.0 % Maximum		
Classification	SP-SM		SW, SP, SW-SM, SP-SM, SM		

**Compressive Strength vs Cement Content**



END OF SECTION