SECTION 02145
CEMENT-STABILIZED SAND

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Cement-stabilized sand.

1.2 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 Unit Price Form requiring cement-stabilized sand.
  2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 REFERENCES
- A. ASTM – American Society for Testing and Materials.
  1. ASTM C33 – Standard Specification for Concrete Aggregates (Fine Aggregate).
  2. ASTM C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
  3. ASTM C42 – Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  4. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
  5. ASTM C123 – Standard Test Method for Lightweight Particles in Aggregate.
  6. ASTM C142 – Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
  7. ASTM C150 – Specification for Portland Cement.
  8. ASTM D558 – Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.
  9. ASTM D1632 – Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.
  10. ASTM D1633 – Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
  11. ASTM D2487 – Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
  12. ASTM D2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  13. ASTM D3665 – Standard Practice for Random Sampling of

Construction Materials.

14. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

B. CFTS – City of Friendswood Technical Specifications.

1.4 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 2.3, Materials Qualifications.

1.5 DESIGN REQUIREMENTS

A. Use sand-cement mixture producing minimum unconfined compressive strength of one hundred (100 psi) in forty-eight hours (48 Hrs).

1. Design will be based on strength specimens molded in accordance with ASTM D558 at moisture content within three percent (3%) above or below of optimum moisture content and within four hours (4 Hrs) of batching.
2. Determine minimum cement content from production data and statistical history. Provide no less than one and one tenth (1.1) sacks of cement per ton of dry sand.

PART II: PRODUCTS

2.1 MATERIALS

A. Cement: Type I Portland cement conforming to ASTM C150.

B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33 or requirements for bank run sand of Section 02140 – Utility Backfill Materials and the following requirements:

1. Classified as SW, SP, SW-SM, SP-SM or SM by Unified Soil Classification System of ASTM D2487.
2. Deleterious materials:
   a. Clay lumps, ASTM C142 – less than one-half percent (1/2%).
   b. Lightweight pieces, ASTM C123; less than five percent (5%).
   c. Organic impurities, ASTM C40, color no darker than standard color.
3. Plasticity index of four (4) or less when tested in accordance with ASTM D4318.

C. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C94.

2.2 MIXING MATERIALS

A. Add required amount of water and mix thoroughly in pugmill-type mixer.

B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within four hours (4 Hrs) after mixing.

2.3 MATERIAL QUALIFICATION

A. Determine target cement content of material as follows:
   1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three (3) points.
   2. Complete molding of samples within four hours (4 Hrs) after addition of water.
   3. Perform strength tests [average of two (2) specimens] at forty-eight hours (48 Hrs) and seven days (7 D).
   4. Perform cement content tests on each sample.
   5. Perform moisture content tests on each sample.
   6. Plot average forty-eight hour (48 Hr) strength vs. cement content.
   7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings and silo pressure (if applicable).

B. Test raw sand for following properties at point of entry into pug-mill:
   1. Gradation.
   2. Plasticity index.
   3. Organic impurities.
   4. Clay lumps and friable particles.
   5. Lightweight pieces.
   6. Moisture content.
   7. Classification.

C. Present data obtained in format similar to that provided in sample data form attached to this Section.

PART III: EXECUTION

3.1 PLACING

A. Place sand-cement mixture in maximum twelve inch (12 In) thick loose lifts and compact to ninety-five percent (95%) of maximum density as determined in accordance with ASTM D558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is plus or minus three percent (±3%) of optimum moisture content. Perform and complete compaction of sand-cement mixture within four hours (4 Hrs) after addition of water to mix at plant.

B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

A. Testing shall be performed under provisions of Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures.

B. One (1) sample of cement-stabilized sand shall be obtained for each one hundred fifty tons (150 Tn) of material placed per day with no less than one (1) 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 (3) individual samples of approximately twelve pounds (12 Lbs.) to fifteen pounds (15 Lbs.) each from the first (1st), middle and last third (3rd) of the truck and composite them into one sample for test purpose.

C. Prepare and mold four (4) specimens (for each sample obtained) in accordance with ASTM D558, Method A, without adjusting moisture content. Samples shall be molded at approximately same time material is being used, but no later than four hours (4 Hrs) 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 (2) specimens shall be tested at forty-eight hours (48 Hrs) plus or minus two hours (±2 Hrs) and two (2) specimens shall be tested at seven days (7 D) plus or minus four hours (±4 Hrs).

F. A strength test shall be the average of strengths of two (2) specimens molded from the same sample of material and tested at the same age. The average daily strength shall be the average of strengths of all specimens molded during one day's (1 D) production and tested at same the 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, as specified in TABLE 4.1 – CEMENT-STABILIZED SAND REPORT in this section, 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 forty-eight hour (48 Hr) strength.
6. Average seven day (7 D) strength.
7. Technical 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.

3.3 ACCEPTANCE

A. Strength level of material shall be considered satisfactory if:
   1. The average forty-eight hour (48 Hr) strength is greater than one hundred pounds per square inch (100 psi) with no individual strength test below seventy pounds per square inch (70 psi).
   2. All seven day (7 D) individual strength tests [average of two (2) specimens] are greater than or equal to one hundred pounds per square inch (100 psi).

B. The material shall be considered unacceptable and subject to removal and replacement at the Contractor's expense when individual strength test [average of two (2) specimens) has seven day (7 D) strength] less than one hundred pounds per square inch (100 psi).

C. When the moving average of three (3) daily forty-eight hour (48 Hr) averages falls below one hundred pounds per square inch (100 psi), discontinue shipment to project until plant is capable of producing material, which exceeds one hundred pounds per square inch (100 psi) at forty hours (48 Hrs). Five (5) – forty eight hour (48 Hr) strength tests shall be made in this determination with no individual strength tests less than one hundred one hundred pounds per square inch (100 psi).

D. The Testing laboratory shall notify the Contractor, the Project Manager and the material supplier of tests by facsimile indicating results falling below specified strength requirements within twenty-four hours (24 Hrs).

E. If any strength test of laboratory cured specimens falls below the specified strength, the Contractor may, at his own expense, request testing of cores drilled from the area(s) 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 paragraph 3.3.A.

F. 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 one hundred pounds per square inch (100 psi). Additional testing of cores extracted from locations represented by erratic core strength results shall be permitted.

PART IV: TABLES

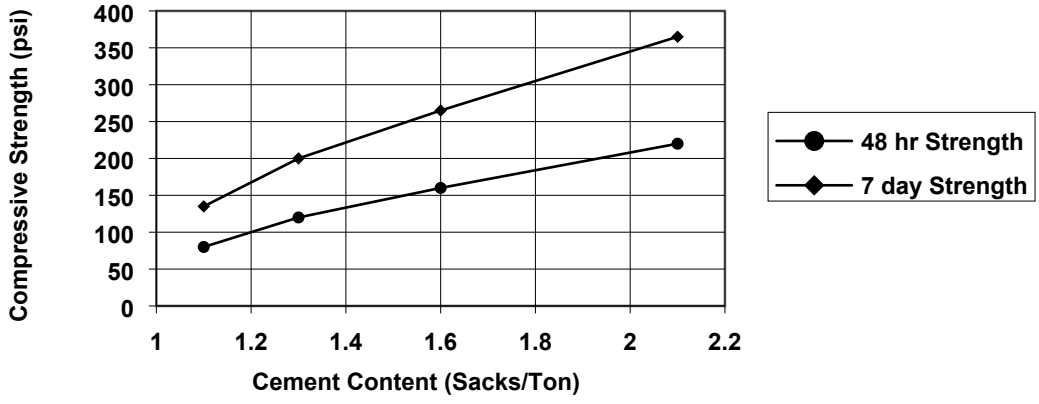
4.1 CEMENT-STABILIZED SAND REPORT

Supplier: Stabilized Sand Co.	**Plant No.:** 3 – Friendswood		**Date of Tests:** June 3, 2005		
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 as 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**	**COF Spec. Section 02140**
3/8 Inch	100%	100%
No. 200	30%	30%

Raw Sand Tests	**Result**	**City of Friendswood**
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



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