Page 1 of 7

Section 24-3. Use to stabilize soil with cement.

Replace "Reserved" in section 24-3 with:

24-3 CEMENT STABILIZED SOIL

24-3.01 GENERAL

#### 24-3.01A Summary

1

Section 24-3 includes specifications for constructing cement stabilized soil (CSS) by mixing basement material, cement, and water, compacting, grading, and curing the mixture.

#### 24-3.01B Definitions

2

**stabilizing:** Treatment to improve strength and durability of basement material for inclusion in the pavement structure.

#### 24-3.01C Submittals

3

From 30 to 180 days before use, submit one 10-pound sample of each cement product proposed from each source.

4

Submit cement samples under California Test 125 except use airtight containers. Mark the sample date on the container. Include the MSDS and mill analysis with the submittal.

5

Submit a certificate of compliance with the cement samples. The certificate of compliance must comply with section 90-1.01C(3) and include a statement certifying the cement furnished is the same as on the Authorized Material Source List.

6

At least 15 days before starting cement treatment activities submit the name of the authorized laboratory you will use for QC tests.

7

Before performing QC sampling and testing, submit the time and location the sampling and testing will occur. Submit QC testing results within 24 hours of receiving the results.

#### 24-3.01D Quality Control and Assurance

##### 24-3.01D(1) General

8

If requested, perform QC testing in the presence of the Engineer.

9

Stop CSS activities and immediately notify the Engineer whenever:

1. Any quality control test result does not comply with the specifications

2. Visual inspection shows noncompliant CSS

10

If CSS activities are stopped, before resuming activities:

1. Notify the Engineer of the adjustments you will make

2. Reprocess, remedy, or replace the noncompliant CSS until it complies with specifications

3. Construct a 1,000-square yard test strip of CSS demonstrating ability to comply with the specifications

4. Obtain the Engineer's authorization

##### 24-3.01D(2) Preparing Basement Material

11

After preparing an area for CSS, verify the surface grades. For every 1,000 sq yd of basement material to be cement stabilized:

1. Test the relative compaction under California Test 231

2. Test the moisture content under California Test 226

##### 24-3.01D(3) Applying Cement

12

The Engineer determines the final application rate based on ASTM D 1633, Method A, except:

1. Test specimens must be compacted under ASTM D 1557, Method A or B.

2. Test specimens must be cured by sealing each specimen with 2 layers of plastic at least 4-mil thick. The plastic must be tight around the specimen. Seal all seams with duct tape to prevent moisture loss. Sealed specimens must be placed in an oven for 7 days at 100 ± 5 °F. At the end of the cure period, specimens must be removed from the oven and air-cooled. Duct tape and plastic wrap must be removed before capping. Specimens must not be soaked before testing.

13

The Engineer orders the application rate as pounds of cement per square yard of basement material to be stabilized.

14

The Engineer verifies the application rate using a calibrated tray or equal once per 4,500 sq yd of stabilized basement material, or twice per day, whichever is greater.

15

Before applying cement, measure and record the air temperature and in situ moisture content of the basement material to be stabilized.

##### 24-3.01D(4) Mixing

16

For each day of mixing, test the in-place moisture content under California Test 231, Part 1, Section E and verify moisture content under California Test 226. Sample immediately after mixing.

17

Except for clods larger than 1 inch, randomly test the adequacy of the mixing with a phenolphthalein pH indicator solution.

18

During mixing operations, measure and record the air temperature for the basement material to be stabilized.

##### 24-3.01D(5) Compaction

19

After compaction, determine in-place wet density under California Test 231 and moisture content under California Test 226, at the same locations. Perform one test per 1,000 sq yd of CSS. Test in 0.50-foot depth intervals from the bottom of the CSS layer regardless of the layer thickness. Convert wet density to dry density and calculate relative compaction under California Test 216 on a dry density basis.

20

Construct test pads for compaction tests by scraping away material to the depth ordered. If a compaction test fails, corrective action must include the layers of material already placed above the test pad elevation.

##### 24-3.01D(6) Acceptance Criteria

21

CSS acceptance is based on:

1. Visual inspection

2. Compliance with CSS Acceptance Criteria Testing table

22

The Engineer accepts CSS in compliance with the following:

**CSS Acceptance Criteria Testing**

|  |  |  |
| --- | --- | --- |
| Quality Characteristics | Test Method | Requirement |
| Relative compaction (%) (min) | California Test 231 and 216 | 97% |
| Cement application rate | Calibrated tray or equal | Final rate ordered by the Engineer ± 5% |

23

If the Engineer orders you to stop CSS activities for non-compliance, before resuming activities:

1. Notify the Engineer of the adjustments you will make

2. Reprocess, remedy, or replace the noncompliant lot until it complies with specifications

3. Construct a 1,000-square yard test strip of CSS demonstrating ability to comply with the specifications

4. Obtain the Engineer's authorization

24-3.02 MATERIALS

#### 24-3.02A General

24

Reserved

#### 24-3.02B Cement

25

Cement sources must be on the Authorized Material Source List.

26

Cement must be Type II or Type V portland cement.

#### 24-3.02C Water

27

Notify the Engineer if a water source other than potable water is used and perform testing for chlorides and sulfates. If potable water is not used, water for CSS must be clean and contain no more than 650 parts per million of chlorides as Cl determined under California Test 422 and no more than 1,300 parts per million of sulfates as SO4 determined under California Test 417.

#### 24-3.02D Curing Seal

28

Curing seal must be asphaltic emulsion Grade SS1, SS1h, CSS1, or CSS1h.

24-3.03 CONSTRUCTION

#### 24-3.03A General

29

Do not mix different types of cement or cement from more than one source.

30

Deliver cement in full loads unless it is the last load needed for a work shift.

31

Apply cement at air temperatures above 40 degrees F and rising. Do not apply cement to frozen basement material.

32

After mixing, maintain the in-place moisture of the basement material to be stabilized within a range of 1 percent below to 2 percent above the optimum moisture determined under California Test 216. Determine in-place moisture content under California Test 231. During compaction and finish grading, add water to the surface to prevent drying until the next layer of mixed material is placed, or until you apply curing treatment.

33

Do not scarify surfaces of intermediate or final layers of CSS.

#### 24-3.03B Preparing Basement Material

34

Remove rocks or solids larger than 1/3 of the layer thickness. Regardless of the layer thickness, remove rocks and solids greater than 4 inches. Removing soil clods is not required. Notify the Engineer if you encounter rocks or solids greater than 1/3 of the layer thickness. Removing and disposing of rocks and solids is change order work.

35

Remove standing water.

36

Before applying cement, grade the basement material to be stabilized to within 0.08 foot of the lines and grades shown.

#### 24-3.03C Applying Cement

37\*. Edit to include the amount of cement to be added and the 7-day compressive strength, from 300 to 650 psi.

Apply cement to the material to be stabilized at a rate of \_\_ pounds per square yard. The Engineer may adjust the rate to achieve a minimum unconfined compressive strength in the cement stabilized soil of \_\_ pounds per square inch determined under ASTM D 1633, Method A, except:

1. Test specimens must be compacted under ASTM D 1557, Method A or B.

2. Test specimens must be cured by sealing each specimen with 2 layers of plastic at least 4-mil thick. The plastic must be tight around the specimen. Seal all seams with duct tape to prevent moisture loss. Sealed specimens must be placed in an oven for 7 days at 100 ± 5 °F. At the end of the cure period, specimens must be removed from the oven and air-cooled. Duct tape and plastic wrap must be removed before capping. Specimens must not be soaked before testing.

38

Do not vary from the Engineer's ordered application rate by more than 5 percent.

39

Apply cement uniformly over the area to be stabilized using a vane spreader.

40

Do not apply dry cement in windy conditions that will result in dust outside the treatment area.

#### 24-3.03D Mixing

41

Cement and basement material must be uniformly mixed at least twice to within 0.05 foot of the depth shown at any point. If you exceed the mixing depth shown by more than 10 percent, add cement in proportion to the exceeded depth.

42

You may mix cement and the basement material off the job site.

43

Remix until the mixture is uniform with no streaks or pockets of cement.

44

Complete initial mixing work within 30 minutes of the application of cement.

45

Before compaction, the CSS excluding rock must have the grading shown in the following table:

**Cement Stabilized Soil Grading**

|  |  |
| --- | --- |
| Sieve sizes | Percentage passing |
| 2" | 100 |
| 3/4" | 98‑100 |
| No. 4 | 55‑100 |

#### 24-3.03E Compaction

46

Complete initial compaction in a layer within 2 hours of initial mixing of cement.

47

Complete all compaction in a layer within 4 hours of mixing of cement.

48

Compact using a sheepsfoot or segmented wheel roller immediately followed by steel drum or pneumatic-tired rollers.

49

Wherever the thickness shown is 0.50 foot or less, compact in 1 layer. Wherever the thickness shown is more than 0.50 foot, compact in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any 1 layer must not exceed 0.50 foot unless you first construct a test strip to demonstrate your equipment and methods provide uniform distribution of cement and achieve the specified compaction. The test strip must contain at least 500 cu yd of material and no more material than 1 day's production. Construct test strips with materials, tools, equipment, and methods you will use in the work.

50

Use other compaction methods in areas inaccessible to rollers.

51

Compact the CSS to at least 97 percent relative compaction.

#### 24-3.03F Finish Grading

52

Maintain the moisture content of the CSS to within a range of 1 percent under and 2 percent above the optimum moisture content through the entire finish grading operation.

53

The finished surface of the CSS must not vary more than 0.05 foot above or below the grade established by the Engineer unless the CSS is to be covered by material paid for by the cubic yard, in which case the finished surface may not vary above the grade established by the Engineer.

54

Wherever the finished surface of CSS is above the allowable tolerance, trim, remove, and dispose of the excess material. Do not leave loose material on the finished surface. If finish rolling cannot be completed within 2 hours of trimming, defer trimming.

55

Fill areas of finished CSS that are lower than the grade established by the Engineer with material specified for the subsequent layer. Subsequent layer material used to fill low areas is not included in the quantities for payment.

56

Finish rolling of trimmed surfaces must be performed with at least 1 complete coverage with steel drum or pneumatic-tired rollers within 2 hours of compacting.

57

Do not proceed with construction activities for subsequent layers of material until the Engineer verifies the final grades of the CSS.

#### 24-3.03G Curing

##### 24-3.03G(1) General

58

Cure by any one of the following methods:

1. Water cure

2. Curing seal

3. Moist material blanket

4. Subsequent pavement layer

59

Apply the chosen cure method on the same day as completing compaction and any trimming and finish grading.

60

Do not trim CSS after curing.

##### 24-3.03G(2) Water Cure

61

Water may be used to cure the finished surface before you place a moist material blanket or apply curing seal. Keep the surface above the optimum moisture content of the CSS. Use this method for no more than 3 days, after which you must apply a curing seal or place a moist material blanket.

##### 24-3.03G(3) Curing Seal

62

Curing seal equipment must have a gauge indicating the volume of curing seal in the storage tank.

63

Apply curing seal to the finished surface of CSS under section 94 when the CSS is at optimum moisture content and:

1. When the ambient temperature is above 40 degrees F and rising

2. At a rate from 0.10 to 0.20 gallon per square yard. The exact rate is ordered

64

Repair damaged curing seal the same day the damage occurs.

##### 24-3.03G(4) Moist Material Blanket

65

Moist material blanket may be either a temporary or permanent layer of material of sufficient thickness to prevent drying of the CSS. You may use moist material blanket if the CSS can bear the weight of construction equipment. Maintain the moist material blanket above the optimum moisture content, as appropriate, until the next structural layer is placed.

##### 24-3.03G(5) Subsequent Pavement Layer

66

You may place subsequent pavement layers any time after finish grading if the CSS is sufficiently stable to support the required construction equipment without marring or permanently distorting the surface.

24-3.04 PAYMENT

67

The quantity of cement (stabilized soil) measured for payment is determined by the weight of cement used.

68

The Department does not pay for added cement when the mixing depth exceeds the depth shown by more than 10 percent.

69

Quantities of cement wasted or disposed of in a manner not specified, or remaining on hand after completion of the work, will not be paid for. If you use a partial load of cement, weigh the truck and the remaining cement on a scale and submit a weighmaster certificate.