Method of Test for

MOLDING AND CURING OF SPECIMENS FOR DETERMINATION OF SOIL CEMENT STABILIZATION OF SOILS AND SOIL–AGGREGATE MIXTURES

DOTD Designation: TR 434 - 81

METHOD A

Scope

1. This method of test is intended for molding and curing of specimens of soil cement and lime conditioned soil cement mixes of materials with less than 5 % by weight of aggregate retained on the No. 4 (4.75 mm) sieve, for subsequent testing in accordance with DOTD Designation: TR 432, Method B.

Apparatus

2. (a) *Mold* - A cylindrical metal mold having a capacity of 1/30 or 0.0333 ft^3 (1 dm^3) with an internal diameter of 4.000 in. (101.6 mm) and a height of 4.584 in. (116.43 mm), and with a detachable collar approximately 2 1/2 in. (64 mm) in height. The mold and collar assembly shall be so constructed that it can be fastened firmly to a detachable base plate. Molds shall be replaced if any diameter is more than 4.01 in. (101.9 mm) or the height is less than 4.55 in. (115.6 mm) on any side.

(b) *Compactive device* - A metal rammer having a 2.00 ± 0.01 in. (50.8 ± 0.3 mm) diameter circular face or a segment of a 2 in. radius circle with an equivalent area and weighing 5.50 ± 0.05 lb (2.5 ± 0.02 kg). The rammer shall be equipped with an arrangement to control the height of drop to 12.0 ± 0.1 in. (305 ± 3 mm).

(c) *Straightedge* - A rigid steel straightedge 12 in. (305 mm) in length and having one beveled edge.

(d) *Balance* - A balance or scale of 20 lb or more capacity sensitive to 0.01 lb or a 10 kg or more capacity balance sensitive to 1 g.

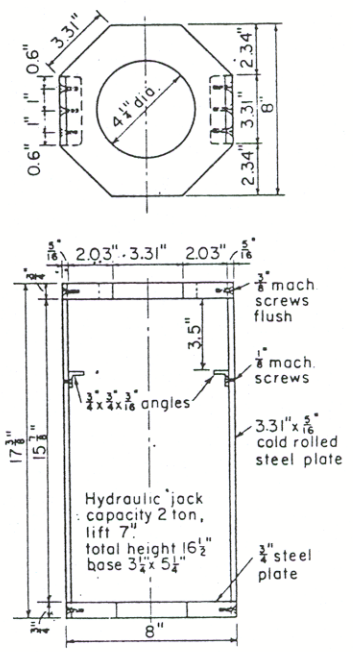
(e) *Mixing tools* - Miscellaneous tools such as a mixing pan, spoon, trowel, spatula or a suitable mechanical device for thoroughly mixing the soil with water.

(f) *Graduated cylinder (250 ml)* - For measuring water to be added to sample.

(g) *Container* - Airtight container to be used for slaking of material.

(h) *Curing environment* - A room or chamber thermostatically controlled to a temperature of 23 ± 1.7 C (73.4 ± 3 F) and a minimum of 90 % relative humidity to be used for curing specimens.

(i) *Extrusion apparatus* - An extrusion apparatus similar to the illustration below, used to remove specimen from mold.



(Courtesy of Portland Cement Association)

Figure 1

Sample

3. Secure approximately 150 lb (68 kg) of material for each type to be tested.

Sample Preparation

4. Prepare the soils in accordance with DOTD Designation: TR 411.

Procedure

5. (a) The material will be classified in accordance with DOTD Designation: TR 423.

(b) If required, the percentage of lime will be determined in accordance with DOTD Designation: TR 416.

(c) The moisture-density relationships will be determined in accordance with DOTD Designation: TR 418 at the estimated median cement content to be used, except that specimens shall be molded immediately after mixing the cement with raw or lime conditioned soil.

(d) Sufficient material to mold the desired number of specimens per cement content shall be weighed. For each cement content to be molded, weigh the material for each cylinder separately.

In the event of lime conditioning, the required amount of lime as determined in accordance with DOTD Designation: TR 416 shall be added to the dry soil prior to addition of water.

CAUTION: If quicklime is used, care must be exercised not to inhale its reaction fumes, or to let the quicklime contact skin.

(e) Add a quantity of water sufficient to bring each mixture to approximately 5 % below the optimum moisture content as determined in accordance with DOTD Designation: TR 418.

(f) Slaking

(1) When raw soil is to be tested, it shall be slaked for a minimum time of 4 hours for A - 4 or better soils or 15 hours for all other soils in an airtight container, prior to the addition of cement.

(2) When hydrated lime is added to the raw soil, the mixture is slaked a minimum of 15 hours and a maximum of 24 hours prior to the addition of cement.

(3) When quicklime is added to the raw soil, the mixture is slaked a minimum of 24 hours for pulverized quicklime or a minimum of 48 hours for pelletized or coarse-sized quicklime, prior to the addition of cement.

(g) Prior to mix design and molding of specimens, a moisture sample of not less than 100 g shall be obtained after a slaking time of at least 4 hours from each batch of material, and tested in accordance with DOTD Designation: TR 403, Method C.

(h) Calculations for mix design shall be made in accordance with paragraph 6 (a).

(i) Weigh the calculated amounts of slaked soil or soil-lime and cement and mix thoroughly. Measure the net moisture volume in 250 ml cylinder and add to the soil cement mixture, mixing thoroughly.

(j) Obtain a moisture sample of not less than 100 g just prior to molding second layer and test in accordance with DOTD Designation: TR 403, Method C.

(k) The soil mixtures shall be compacted in the mold in three equal layers to give a total compacted depth of about 5 in. (127 mm), each layer being compacted by 25 blows of the rammer dropping free from a height of 12 in. (305 mm), or 12 in. above the approximate elevation of each finally compacted layer when a stationary mounted type rammer is used. The top surfaces of the first and second layers are scarified to remove smooth compaction planes. PARTICULAR ATTENTION MUST BE GIVEN TO THIS SCARIFYING OPERATION TO ENSURE ADEQUATE BOND BETWEEN LAYERS. A screwdriver or any similar object is used for scarification. During compaction, the mold shall rest on a uniform, rigid foundation weighing at least 200 lb (91 kg). The blows shall be uniformly distributed over the surface of the layer being compacted. After the specimen has been compacted, the collar shall be removed from the mold and the compacted soil carefully trimmed even with the top of the cylinder by means of the straightedge. The mold containing the compacted soil specimen shall be weighed in grams. This weight, minus the weight of the mold, shall be multiplied by 0.06608 and the result recorded as the wet density in lb/ft^3 of the compacted soil. The base shall be removed from the mold. The specimen shall be extruded from the mold by use of apparatus described in paragraph 2(i). The specimen shall then be inverted and a metal identification tag placed in the top.

(l) Immediately after molding, the specimens shall be placed on porous stones in a room or chamber meeting the requirements as described in paragraph 2(h). The specimens shall be protected from water spray. The curing time will be 7 days.

(m) Checking molded specimens

(1) The moisture content and dry density are calculated in accordance with paragraph 6(b).

(2) These values must meet the following

tolerances (variable from design data):

Dry density $\pm$ 3.0 lb/ft^3
Moisture content $\pm$ 1.0 %

The specimen or specimens not meeting the tolerances described above will be discarded and replaced with specimens meeting tolerances.

Calculations

6. (a) Mix design

(1) The soil cement work sheet (Figure 2) shall be used for mix design calculations and for molding of specimens.

(2) The moisture content as determined in paragraph 5 (g) shall be entered under hygroscopic M.C. for -4 material.

(3) Estimate the percentage of cement by weight which will be necessary to obtain the minimum psi requirements. A minimum of three specimens shall be molded at a minimum of four percentages of cement. The estimated percentage of cement shall generally be at the midpoint of the four percentages of cement.
NOTE: See chart 1 for conversion of % cement by volume to % by weight.

(4) Dry density of soil (lb/ft^3) =

$$\frac{\text{Max. Dry Density of compacted soil cement mixture}}{1+\left(\frac{\%\text{ Cement by Wt.}}{100}\right)} =$$

$$\frac{104.3}{1+\frac{8.87}{100}} = \frac{104.3}{1+.0887} = 95.8 \text{ lb/ft}^3$$

(5) Oven dry soil (lb) =

$$\frac{\text{Dry Density of Soil (lb/ft}^3)}{30} =$$

$$\frac{95.8}{30} = 3.193 \text{ (lb)}$$

NOTE: From this point, all values are converted to the metric system. If so desired, values used may be expressed to the nearest 0.01 lb.

(6) Oven dry soil (g) = oven dry soil (lb) x 453.6 (g) = 3.193 x 453.6 = 1448 (g)

(7) Oven dry sample =
Oven dry soil (g) + approx. 227 (g) * =
1448 + 227 = 1675 (g)

**NOTE: Approx. 227 grams (1/2 lb) added to ensure sufficient material for compaction.*

(8) Cement (g) = Oven dry sample (g)x cement % by weight = 1675 x .0887 = 149 (g)

(9) Oven Dry Soil + Cement =
Oven Dry Sample (g) + cement (g) =
1675 + 149 = 1824 (g)

(10) Theo. moisture volume (cc) =

$$\text{(Oven Dry Soil + Cement)} \times \frac{\text{Opt. m.c.}}{100} =$$

$$1824 \times \frac{18.4}{100} = 336 \text{ cc}$$

(11) Hygroscopic moisture (cc) =

$$\text{Oven Dry Sample} \times \frac{\text{Hygroscopic Moisture content}}{100} =$$

$$1675 \times \frac{13.6}{100} = 228 \text{ cc}$$

(12) Evaporation *(NOTE: Assume 1 % moisture evaporates during the mixing process).*
Evaporation = (Oven dry soil + cement) x .01= 1824 x .01 = 18 cc

(13) Net moisture volume (cc) =
Theo. moisture volume (cc) - Hygroscopic moisture content (cc) + evap. (cc) = 336 - 228 + 18 = 126 (cc)

(14) Soil or soil-lime (slaked) =Oven dry sample + hygroscopic m.c. (cc) = 1675 + 228 = 1903 (g)

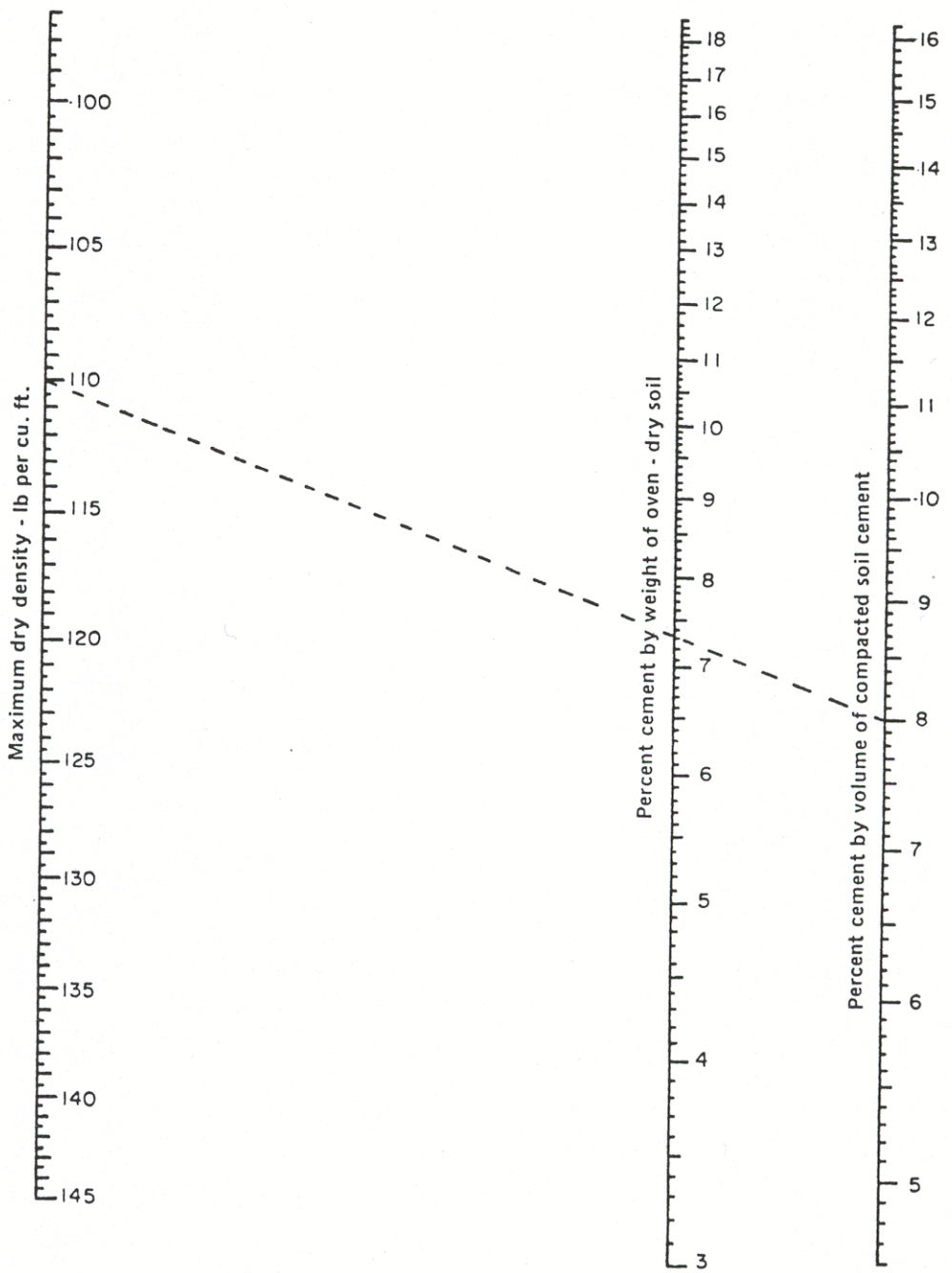
(b) Moisture content and dry density

$$\text{M.C.} = \frac{\text{(W.W.) (100)}}{\text{D.W.}}$$

$$\text{D.D.} = \frac{\text{(W.D.) (100)}}{\text{100 + M.C.}}$$

where:

M.C. = moisture content in percent
W.W. = weight of water
D.W. = weight of dry soil
D.D. = dry density
W.D. = wet density



Relation of cement content by weight of oven-dry soil to cement content by volume of compacted soil cement mixture.

CHART 1

FORM 22-2

SOILS LABORATORY

SOIL CEMENT WORK SHEET FOR MOLDING DURABILITY SPECIMENS

TAG. NO. (+ NO. 4) _____

7 DAYS CURING

COMP. STRENGTH TYPE CYLINDER

OPERATOR

DATE MOLDED

DATE TO BREAK

PROJECT _____ COMP. _____ _____ % PLUS #4 MATERIAL _____ % LIME COND.

DENSITY LBS. CU. FT. 123.5 WET 104.3 DRY

M.C. 18.4 %

CEMENT CONTENT DETERMINATION

% CEMENT VOL.	% CEMENT WEIGHT	DRY DENS. OF SOIL LBS./CU.FT.	OVEN DRY SOIL (LBS.)	OVEN DRY SOIL (GRAMS)	(GRAMS) OVEN DRY SOIL CONTINGENCY TOTAL	+ 4	- 4	CEMENT (GRAMS)
7	6.76	97.7	3.257	1477	1704		1704	115
9	8.87	95.8	3.193	1448	1675		1675	149
11	11.05	93.9	3.131	1420	1647		1647	182
13	13.40	92.0	3.066	1391	1618		1618	217

MOISTURE CONTENT DETERMINATION

OVEN DRY SOIL + CEMENT	THEO. C.C.	HYGRO. MOIST. (C.C.) + 4	HYGRO. MOIST. (C.C.) - 4	HYGRO. MOIST. (C.C.) TOTAL	EVAP. % (CC)	NET (CC)	HYGRO. M.C. + 4	HYGRO. M.C. - 4	AIR DRY SOIL (GRAMS) + 4	AIR DRY SOIL (GRAMS) - 4
1819	335		232	232	19	122				1936
1824	336		228	228	18	126		13.6		1903
1829	337		224	224	18	131				1871
1835	337		220	220	18	135				1838

% CEMENT BY VOLUME	7	7	7	9	9	9	11	11	11	13	13	13
TAG NO.	61	62	63	64	65	66	67	68	69	70	71	72
WEIGHT CYLINDER & SOIL (GRAMS)	6070	6071	6065	6068	6064	6061	6070	6063	6070	6065	6065	6065
WEIGHT CYLINDER (GRAMS)	4217	4217	4217	4217	4217	4217	4217	4217	4217	4217	4217	4217
WEIGHT SOIL (GRAMS)	1853	1854	1848	1851	1847	1844	1853	1846	1853	1848	1818	1848
WEIGHT PAN & WET MIXTURE (GRAMS)	3100	3101	3098	3105	3104	3105	3110	3112	3109	3118	3120	3118
WEIGHT PAN (GRAMS)	931	931	931	931	931	931	931	931	931	931	931	931
WEIGHT WET MIXTURE (GRAMS)	2169	2170	2167	2174	2173	2174	2179	2181	2178	2187	2189	2187
WEIGHT OVEN DRY SOIL & CEMENT (GRAMS)	1819	1819	1819	1824	1824	1824	1829	1829	1829	1835	1835	1835
WEIGHT WATER (GRAMS)	350	351	348	350	349	350	350	352	349	352	354	352
THEORETICAL M. C. %	19.2	19.3	19.1	19.1	19.1	19.1	19.1	19.2	19.1	19.2	19.3	19.2
WET DENSITY LBS./CU. FT.	122.4	122.5	122.1	122.3	122.0	121.8	122.4	122.0	122.4	122.1	122.1	122.1
THEORETICAL DRY DENSITY LBS./CU. FT.	102.7	102.7	102.5	102.7	102.4	102.3	102.8	102.3	102.8	102.4	102.3	102.4
CUP NO.	701	702	703	704	705	706	707	708	709	710	711	712
WEIGHT CUP & WET SOIL (GRAMS)	148.02	159.36	153.47	133.53	128.68	134.40	133.85	132.03	135.65	132.53	130.74	142.38
WEIGHT CUP & DRY SOIL (GRAMS)	129.12	138.40	134.07	116.97	112.95	117.27	117.29	115.67	118.78	116.16	114.29	124.47
WEIGHT WATER (GRAMS)	18.90	20.96	19.40	16.56	15.73	17.13	16.56	16.36	16.87	16.37	16.45	17.91
WEIGHT CUP (GRAMS)	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50	27.50
WEIGHT DRY SOIL (GRAMS)	101.62	110.90	106.57	89.47	85.45	89.77	89.79	88.17	91.28	88.66	86.79	96.97
MOISTURE CONTENT %	18.6	18.9	18.2	18.5	18.4	19.1	18.4	18.6	18.5	18.5	19.0	18.5
DRY DENSITY LBS./CU. FT.	103.2	103.0	103.3	103.2	103.0	102.3	103.4	102.9	103.3	103.0	102.6	103.0

Figure 2

DOTD Designation: TR 434 - 81

METHOD B

Scope

1. This method of test is intended for molding and curing of specimens of soil cement and lime conditioned soil cement mixes of materials with 5% or more by weight of aggregate retained on the No. 4 (4.75 mm) sieve, for subsequent testing in accordance with DOTD Designation: TR 432, Method B.

Apparatus

2. The apparatus is the same as in Method A with the addition of a 3/4 in. (19 mm) sieve and a No. 4 (4.75 mm) sieve.

Sample

3. Secure approximately 150 lb (68 kg) of material for each type to be tested.

Sample Preparation

4. (a) Prepare the material in accordance with DOTD Designation: TR 411.

(b) Reconstitute the material for specimen preparation as follows:

(1) Determine the dry weight of the material to be used for molding the test specimens.

(2) Separate the aggregates in the material into plus 3/4 inch and minus 3/4 inch, plus No. 4 aggregate.

(3) Determine the weight of the plus 3/4 inch portion.

(4) Determine the weight of the minus 3/4 inch, plus No. 4 portion. Save this material.

(5) Discard the plus 3/4 inch aggregate and replace this material with an equal weight of minus 3/4 inch, plus No. 4 aggregate.

(6) Combine the minus 3/4 inch, plus No. 4 aggregate from (5) with the minus 3/4 inch, plus No. 4 aggregate from (4).

(c) Immerse the plus No. 4 aggregate from (b) (6) in water and soak for a minimum of 24 hours prior to molding test specimens.

Procedure

5. (a) The material will be classified in accordance with DOTD Designation: TR 423.

(b) If required, the percentage of lime will be determined in accordance with DOTD Designation: TR 416.

(c) The moisture-density relationships will be determined in accordance with DOTD Designation: TR 418 at the estimated median cement content to be used, except that specimens shall be molded immediately after mixing the cement with raw or lime conditioned soil.

(d) Sufficient minus No. 4 material to mold the desired number of specimens per cement content shall be weighed. For each cement content to be molded, weigh the material for each cylinder separately.

In the event of lime conditioning, the required amount of lime as determined in accordance with DOTD Designation: TR 416 shall be added to the dry soil prior to addition of water.

CAUTION: If quicklime is used, care must be exercised not to inhale its reaction fumes, or to let the quicklime contact skin.

(e) Add a quantity of water sufficient to bring each mixture to approximately 5% below the optimum moisture content as determined in accordance with DOTD Designation: TR 418.

(f) Slaking

(1) When raw soil is to be tested, it shall be slaked for a minimum time of 4 hours for A-4 or better soils or 15 hours for all other soils in an airtight container, prior to the addition of cement.

(2) When hydrated lime is added to the raw soil, the mixture is slaked a minimum of 15 hours and a maximum of 24 hours prior to the addition of cement.

(3) When quicklime is added to the raw soil, the mixture is slaked a minimum of 24 hours for pulverized quicklime or a minimum of 48 hours for pelletized or coarse-sized quicklime, prior to the addition of cement.

(g) Prior to mix design and molding of specimens, moisture samples shall be obtained of each component:

(1) Minus No. 4 material - A sample of a minimum of 100 g of soil shall be obtained after a slaking time of 4 hours.

(2) Plus No. 4 material - A sample of a minimum of 400 g of aggregate as prepared and soaked in paragraph 4(b) shall be obtained and surface dried.

The moisture content of these samples shall then be determined in accordance with DOTD Designation: TR 403, Method C.

(h) Calculations for mix design shall be made in accordance with paragraph 6(a).

(i) Weigh the calculated amounts of the minus No. 4 portion of the slaked soil or soil-lime and the cement and mix thoroughly. Measure the net moisture volume in 250 ml cylinder and add to the soil cement mixture, mixing

thoroughly. Weigh the calculated amount of saturated surface dry plus No. 4 material, add to mixture and mix thoroughly.

(j) Obtain a moisture sample of not less than 400 g of aggregate and soil just prior to molding second layer and test in accordance with DOTD Designation: TR 403, Method C.

(k) The soil mixtures shall be compacted in the mold in three equal layers to give a total compacted depth of about 5 in. (127 mm), each layer being compacted by 25 blows of the rammer dropping free from a height of 12 in. (305 mm), or 12 in. above the approximate elevation of each finally compacted layer when a stationary mounted type rammer is used. The top surfaces of the first and second layers are scarified to remove smooth compaction planes. PARTICULAR ATTENTION MUST BE GIVEN TO THIS SCARIFYING OPERATION TO ENSURE ADE - QUATE BOND BETWEEN LAYERS. A screwdriver or any similar object is used for scarification. During compaction, the mold shall rest on a uniform, rigid foundation of at least 200 lb (91 kg). The blows shall be uniformly distributed over the surface of the layer being compacted, the collar shall be removed from the mold and the compacted soil carefully trimmed even with the top of the cylinder by means of the straightedge. If surface is not true after leveling, the following should be performed. The portion of the sample remaining in pan after compaction shall be passed through the No. 4 (4.75 mm) sieve. This material shall be used to fill voids which appear on the specimen. The mold containing the compacted soil specimen shall be weighed in grams.This weight, minus the weight of the mold, shall be multiplied by 0.06608 and the result recorded as the wet density in lb/ft ^{3} of the compacted soil. The base shall be removed from the mold. The specimen shall be extruded from the mold by use of apparatus described in paragraph 2 (i). The specimen should then be inverted and a metal identification tag placed in the top.

(l) Immediately after molding, the specimens shall be placed on porous stones in a room or chamber meeting the requirements as described in paragraph 2(h). The specimens shall be protected from water spray. The curing time will be 7 days.

(m) Checking molded specimens

(1) The moisture content and dry density are calculated in accordance with paragraph 6(b).

(2) These values must meet the following tolerances (variable from design data):

Dry density $\pm$ 3.0 lb/ft ^{3}

Moisture content $\pm$ 1.0%

The specimen or specimens not meeting the tolerances described above will be discarded and replaced with specimens meeting tolerances.

Calculations

6. (a) Mix design

(1) The soil cement work sheet (Figure 1) shall be used for mix design calculations and for molding of specimens.

(2) The moisture contents as determined in paragraph 5(g) shall be entered under hygroscopic moisture content.

(3) Estimate the percentage of cement by weight which will be necessary to obtain the minimum psi requirements. A minimum of three specimens shall be molded at a minimum of four percentages of cement. The estimated percentage of cement shall generally be at the midpoint of the four percentages of cement.

NOTE: See Method A, Chart 1, for conversion of % cement by volume to % by weight.

(4) Dry density of soil, (lb/ft ^{3})=

$$\frac{\text{Max. Dry Density of Compacted Soil Cement Mixture}}{1+\frac{\%\text{ Cement by weight}}{100}} =$$

$$\frac{119.8}{1+\frac{5.81}{100}} = \frac{119.8}{1+.0581} = 113.2 \text{ lb/ft}^3$$

(5) Oven dry Soil (lb) =

$$\frac{\text{Dry Density of Soil (lb/ft}^3\text{)}}{30} =$$

$$\frac{113.2}{30} = 3.774 \text{ (lb)}$$

NOTE: From this point, all values are converted to the metric system. If so desired, values used may be expressed to the nearest 0.01 lb.

(6) Oven Dry Soil (g) =

Oven Dry Soil (lb) x 453.6 (g) =

3.774 x 453.6 = 1712 (g)

(7) Oven Dry Soil (Sample)

Total
Oven Dry Soil (g) + 454 (g)* =
1712 + 454 = 2166 (g)

**NOTE: An additional pound of soil has been added to*

ensure sufficient material to fill mold.

The required percentage of Plus No. 4 material shall be determined by the Soils Engineer.

+4 =Plus No. 4 pct x total soil sample= 50% x 2166 = .50 x 2166 = 1083 (g)
-4 = Minus No. 4 pct x total soil sample = 50% x 2166 = .50 x 2166 = 1083 (g)

(8) Cement (g) = Oven dry soil sample x cement % by weight = 2166 x .0581 = 126 (g)

(9) (Total) oven dry soil sample (g) + cement (g) = 2166 + 126 = 2292 (g)

(10) Theo. moisture volume (cc) = (oven dry soil + cement) x $\frac{\text{Opt. m.c.}}{100}$ =

$$2292 \times \frac{10.6}{100} = 243 \text{ cc}$$

(11) Hygroscopic moisture (cc)
The following calculations will be performed on the plus No. 4 and minus No. 4 components.

Oven dry soil sample x $\frac{\text{hygroscopic moisture content}}{100}$

+ 4

$$1083 \times \frac{3.9}{100} = 42 \text{ cc}$$

- 4

$$1083 \times \frac{6.6}{100} = 71 \text{ cc}$$

The hygroscopic moisture of both components will be summated.

(12) Evaporation
(NOTE: Assume 1% moisture evaporates during the mixing process).

Evaporation = (Oven Dry Soil + Cement) x .01 =
2292 x .01 = 23 cc

(13) Net moisture volume (cc) =
Theo. moisture volume (cc) - Hygroscopic m. c. (total) (cc) + evap. (cc) =
243 - 113 + 23 = 153 (cc)

(14) Soil or soil-lime (slaked)
The following calculations will be performed on the plus No. 4 and minus No. 4 components.

Oven Dry Soil sample + hygroscopic m. c. (cc)

+4
1083 + 42 = 1125 (g)

- 4
1083 + 71 = 1154 (g)

(b) Moisture content and dry density

$$\text{M. C.} = \frac{(\text{W.W.})\ (100)}{\text{D.W.}}$$

$$\text{D. D.} = \frac{(\text{W.D.})\ (100)}{100 + \text{M.C.}}$$

where:

M. C. = moisture content in percent
W. W. = weight of water
D. W. = weight of dry soil
D. D. = dry density
W. D. = wet density

Normal testing time is 2 weeks.

FORM 22-2

SOILS LABORATORY

SOIL CEMENT WORK SHEET FOR MOLDING DURABILITY SPECIMENS

TAG. NO. (+ NO. 4) 69

7 DAYS CURING

COMP. STRENGTH TYPE CYLINDER

OPERATOR

DATE MOLDED

DATE TO BREAK

PROJECT _____ COMP. _____ 50 % PLUS #4 MATERIAL _____ % LIME COND.

DENSITY LBS. CU. FT. 132.5 WET 119.8 DRY

M.C. 10.6 %

CEMENT CONTENT DETERMINATION

% CEMENT VOL.	% CEMENT WEIGHT	DRY DENS. OF SOIL LBS./CU.FT.	OVEN DRY SOIL (LBS.)	OVEN DRY SOIL (GRAMS)	(GRAMS) OVEN DRY SOIL CONTINGENCY TOTAL	+ 4	- 4	CEMENT (GRAMS)
7	5.81	113.2	3.774	1712	2166	1083	1083	126
9	7.62	111.3	3.711	1683	2137	1069	1069	163
11	9.42	109.5	3.650	1655	2109	1055	1055	199
13	11.42	107.5	3.583	1625	2079	1040	1040	237

MOISTURE CONTENT DETERMINATION

OVEN DRY SOIL + CEMENT	THEO. C.C.	HYGRO. MOIST. (C.C.) + 4	HYGRO. MOIST. (C.C.) - 4	HYGRO. MOIST. (C.C.) TOTAL	EVAP. ____ % (CC)	NET (C C)	HYGRO. M. C. + 4	HYGRO. M. C. - 4	AIR DRY SOIL (GRAMS) + 4	AIR DRY SOIL (GRAMS) - 4
2292	243	42	71	113	23	153			1125	1154
2300	244	42	71	113	23	154	3.9	6.6	1111	1140
2308	245	41	70	111	23	157			1096	1125
2316	245	41	69	110	23	158			1081	1109

% CEMENT BY VOLUME	7	7	7	9	9	9	11	11	11	13	13	13
TAG NO.	1	2	3	4	5	6	7	8	9	10	11	12
WEIGHT CYLINDER & SOIL (GRAMS)	6265	6236	6308	6316	6275	6219	6245	6253	6253	6250	6277	6292
WEIGHT CYLINDER (GRAMS)	4270	4215	4296	4310	4229	4194	4246	4256	4221	4213	4250	4262
WEIGHT SOIL (GRAMS)	1995	2021	2012	2006	2046	2025	1999	1997	2032	2037	2027	2030
WEIGHT PAN & WET MIXTURE (GRAMS)	3489	3489	3493	3500	3500	3497	3508	3510	3508	3516	3518	3515
WEIGHT PAN (GRAMS)	931	931	931	931	931	931	931	931	931	931	931	931
WEIGHT WET MIXTURE (GRAMS)	2558	2558	2562	2569	2569	2566	2577	2579	2577	2585	2587	2584
WEIGHT OVEN DRY SOIL & CEMENT (GRAMS)	2292	2292	2292	2300	2300	2300	2308	2308	2308	2316	2316	2316
WEIGHT WATER (GRAMS)	266	266	270	269	269	266	269	271	269	269	271	268
THEORETICAL M. C. %	11.6	11.6	11.8	11.7	11.7	11.6	11.7	11.7	11.7	11.6	11.7	11.6
WET DENSITY LBS./CU. FT.	131.8	133.5	132.9	132.5	135.2	133.8	132.1	131.9	134.3	134.6	133.9	134.1
THEORETICAL DRY DENSITY LBS./CU. FT.	118.1	119.6	118.8	118.6	121.0	119.9	118.3	118.1	120.2	120.6	119.9	120.2
CUP NO.	426	427	428	429	430	431	432	433	434	435	436	437
WEIGHT CUP & WET SOIL (GRAMS)	267.67	262.32	264.02	272.46	254.50	272.18	264.67	253.10	259.28	275.34	298.17	295.48
WEIGHT CUP & DRY SOIL (GRAMS)	244.13	242.62	244.13	250.97	234.60	251.12	243.25	231.50	239.10	252.49	272.50	269.62
WEIGHT WATER (GRAMS)	23.54	19.70	19.89	21.49	19.90	21.06	21.42	21.60	20.18	22.85	25.67	25.86
WEIGHT CUP (GRAMS)	40.05	41.59	41.12	42.99	43.05	42.89	41.15	40.89	41.73	40.96	41.21	42.74
WEIGHT DRY SOIL (GRAMS)	204.08	201.03	203.01	207.98	191.55	208.23	202.10	190.61	197.37	211.53	231.29	226.88
MOISTURE CONTENT %	11.5	9.8	9.8	10.3	10.4	10.1	10.6	11.3	10.2	10.8	11.1	11.4
DRY DENSITY LBS./CU. FT.	118.2	121.5	121.0	120.1	122.5	121.5	119.4	118.5	121.9	121.5	120.5	120.4

Figure 1