OHD L-54
STANDARD METHOD OF TEST FOR MAKING, CURING, AND TESTING CEMENT-TREATED BASE FIELD SAMPLES

1 SCOPE

1.1 This method covers procedures for making, curing, and testing cylindrical specimens from representative samples of Cement-treated base (CTB). This method also covers the procedures for calculating the wet density, moisture content, and dry density for use with the nuclear gauge for field density determination using AASHTO T310, In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth), except as modified in this standard.

1.2 Laboratories shall be qualified by the ODOT Materials Division.

1.3 Technicians performing field sampling and testing of the Cement Treated Base by the methods outlined in this standard shall be qualified by the Oklahoma Highway Construction Materials Technician Certification Board. Technicians shall be certified in either Soils or Materials Sampler in order to perform field sampling and testing. Technicians breaking specimens for strength determination shall be certified in either Concrete or Materials Sampler.

1.4 Refer to the appropriate special provision or specification governing the quality control and acceptance testing of the Cement-treated base (CTB) to determine the party(s) responsible for the various aspects of testing outlined in this procedure.

2 APPARATUS

2.1 Balances and Scales. A balance or scale conforming to the requirements of M 231, Class G 20. Also, a balance conforming to the requirements of M 231, Class G 2.

2.2 Molds. Calibrated cylindrical molds, split sided, approximately 6.0 inches in diameter and 6.0 inches in height and having a volume of approximately 0.10 ft^3. The molds shall be equipped with a removable top collar and a removable base plate.

NOTE: A suitable sealant; such as heavy grease, molding clay, or microcrystalline wax shall be used where necessary to ensure that the molds are water tight when used for fabricating specimens. Molds shall be water tight when assembled as judged by their ability to hold water poured into them.

2.3 Rammer. A sleeveless rammer, per USACE EM 1110-2-1906, Appendix VI, shall be used for specimen consolidation (compaction), rather than rodding or vibration. A standard Proctor rammer (AASHTO T 99) may be used for specimen consolidation but use care to ensure the free fall of the rammer weight is not obstructed.

2.4 Straightedge. A hardened steel straightedge at least 10 inches in length. It shall have one beveled edge, and at least one longitudinal surface (used for final trimming) shall be plane within 0.01 in. per 10 in. (0.1 percent) of length within the portion used for trimming the mixture.

NOTE: The straightedge shall not be so flexible that trimming the sample with the cutting edge will cause a concave or convex sample surface.

2.5 Mixing Tools. Miscellaneous tools such as mixing pan, spoon, trowel, spatula, scoop, or a suitable mechanical device for thoroughly mixing the sample of aggregate with cement and/or fly ash and with increments of water.

2.6 Testing Machine. The compression testing machine should have sufficient capacity, readability, and capable of providing the prescribed rates of loading. Since the compressive strength of CTB cylinders will typically be 600 to 2000 psi, the testing machine must have a loading range such that valid values of compressive strength can be obtained.

3 MATERIALS

3.1 Aggregate mixture, mixing water, cement, and fly ash (if any) shall come from sources listed on the approved cement treated base (CTB) mix design.

4 SAMPLING

4.1 Obtain the sample from a representative location. Ensure that the sample is representative of the overall CTB and not segregated during sampling. Obtain at least 1

cubic foot of CTB material for fabricating the compressive strength specimens. From the pile being sampled, scrape away the surface of the material and collect three or more increments within the pile. The technician obtaining the sample shall use every precaution to obtain samples that are representative of the materials that the sample represents.

4.2 Begin compaction of the specimens for strength within 20 minutes of obtaining the overall sample. Complete the molding of the specimens quickly and protect the sample from evaporation and contamination. Remix the sample before and during molding to ensure uniformity and to prevent segregation.

5 PROCEDURE

5.1 Compaction of CTB Specimens. Compact a minimum of one specimen per sublot for wet density determination and compressive strength testing in the laboratory.

5.1.1 Mold specimens as close as practical to the place where they are to be stored during the first 24 hours. If it is not practical to mold the specimens where they will be stored, move them to the place of storage immediately after being struck off.

5.1.2 Place the mix in a lightly oiled mold using a scoop, blunted trowel, or shovel. Select each scoopful, trowelful, or shovelful of mix from the mixing pan to ensure that it is representative of the batch. It may be necessary to remix with a shovel or trowel to prevent segregation during the molding of specimens. Move the scoop or trowel around the top edge of the mold as the mix is discharged in order to ensure a symmetrical distribution of the mix and to minimize segregation of coarse aggregate within the mold. Further distribute the mix by use of a spatula prior to the start of compaction. In placing the final layer, the operator shall attempt to add an amount of mix that will exactly fill the mold after compaction. Do not add nonrepresentative samples of mix to an underfilled mold.

5.1.3 Form a specimen by compacting the prepared mixture in four approximately equal layers. Compact each layer with 56 blows from the rammer dropping free from a height of 12 inches. Distribute the 56 blows of the rammer uniformly over the surface area of each layer. During compaction, the mold shall rest firmly on a dense, uniform, rigid, and stable foundation or base. This base shall remain stationary during the compaction process.

NOTE: Each of the following has been found to be a satisfactory base on which to rest the mold during compaction of the mix: a block of concrete with a mass not less than 200 lb supported by a relatively stable foundation; a sound concrete floor; and for field application, such surfaces as found in concrete box culverts, bridges, and pavements.

5.1.4 Upon completion of compaction of the final layer, remove the extension collar and using the straightedge carefully strike off the specimen level with the top edge of the mold. Using the same straightedge at a slight incline, smooth off the material so that the surface is plane with no depressions or projections greater than 1/8" and the material is level with the top of the mold. Fill small depressions in the top surface with fines from the same sample immediately after striking off. If necessary, the top surface may be smoothed again.

5.2 Wet Density Determination. After each specimen is molded and struck off to the required smoothness, weigh each specimen on a scale or balance to the nearest 0.1% of the sample mass or better. The specimen shall be weighed before covering with plastic. Prior to compacting, the weight of each mold and base plate shall be determined.

5.3 Initial Curing. Once the specimen has been struck off to the required smoothness and weighed, cover the top of the mold with plastic, such as plastic cut from sample bags, and then place the compaction collar back on the mold and plastic. Tighten the collar so that the plastic will make an airtight seal around the rim of the mold and the surface of the specimen. This shall be done in order to prevent moisture loss from the specimen during the initial curing. Once all specimens have been molded and sealed with plastic, cover the specimens with wet burlap, cure blankets, place in ice chests or buckets with lids, or protect by any other means suitable to protect the specimens from temperature extremes and from direct sunlight. It is desirable to attempt to maintain a temperature range of 60° F to 80° F during initial curing in the field. Allow the specimens to cure initially in a location that is horizontally level, rigid, and free from vibration or other disturbances as near to the location of deposit of the rest of the truck sampled as possible.

5.4 Final Curing. Cure the specimens in the molds on the project site for a minimum of 16 hours before they are picked up to be transported to the laboratory. If the specimens are still too fragile to remove from the molds, place the specimens in the moisture room, protected from dripping, spraying, or pooled water, until the specimens can be removed from the molds without damage. Upon removal from the molds, the specimens shall be cured in the moisture room for the remainder of the 7-day moist curing period at a

temperature of 73 ± 3ºF, protected from dripping, spraying, or pooled water. Alternatively, the specimens may be wrapped in plastic, covered with wet cloths, and placed in an ice chest or five gallon bucket with a lid in a controlled temperature room (heated and air-conditioned) to maintain a temperature between 40 and 85° F.

5.5 Compressive strength determination. Determine the diameter using two diameter measurements to the nearest 0.01 inches taken at 90 degrees to one another near the mid height of the specimen. Prior to placing compressive strength specimens in the compression machine, verify that both ends of the specimen are plane to within 0.002 in. If an end of the specimen is outside of the 0.002 in. tolerance, that end of the specimen shall be capped in accordance with AASHTO T 231.

NOTE: Due to the irregular surface of the ends, it is highly recommended to cap both ends of all specimens.

5.5.1 Determine the 7 day unconfined compressive strength in accordance with AASHTO T 22 except as modified herein. The requirement for immersing cured specimens in water for 4 hours prior to testing shall be omitted. The specimen will be the 6.0-inch size.

5.5.2 Maintain free moisture on the outsides of specimens to prevent drying until testing is complete (except for the ends of the specimens when sulfur capping). When capping with sulfur, be certain that the ends of the specimen are dry enough to prevent small pockets of steam from forming within the capping compound.

5.5.3 Apply the load continuously and without shock. The rate of loading shall be within 10 ± 5 psi per second. Continue applying the load until the maximum possible load has been attained and the specimen shows a well defined fracture. Read and record the load to the nearest 10 lbf.

NOTE: For purposes of this method, strength determined for specimens at a height divided by diameter ratio (uncapped) of 1.0 is considered to be standard, and is not corrected by a length to diameter correction factor.

5.5.4 Calculate the compressive strength for the specimen. Calculate the average compressive strength for the four sublots. Use this average compressive strength for

determining compliance to the required strength. Use ASTM E178 for determination of outliers at an upper significance level of 10%. If one of the four sublot averages is determined to be an outlier, this sublot shall not be included in the average compressive strength. Any specimens that are damaged shall not be included when computing the average compressive strength for the four sublots.

6 COMPACTION TESTING USING THE NUCLEAR GAUGE

6.1 Field Wet Density. Determine the field wet density in accordance with the direct transmission method as described in AASHTO T310. Take and average four separate one-minute readings by rotating the gauge about the axis of the probe at 90° intervals for each test. If direct transmission is not possible, four two-minute nuclear gauge readings in backscatter shall be taken and averaged as depicted in OHD L-14 Appendix A.

6.2 Compare the field wet density to the average wet density of the field molded specimens for the previous four sublots. A moving average chart from previous sublots of molded samples may be used to visually depict the target compaction for wet density.

NOTE: The intent is to maintain the required compaction of the CTB with the moving average of the wet density determined by the field molded specimens to both ensure consistent compaction of the roadway and to ensure that compressive strength of the molded specimens is reflective of the strength in the actual roadway at the same age in the curing process. The percent compaction should be rounded to the nearest 1% for determination of compliance with specifications.

7 CALCULATIONS

7.1 The compressive strength shall be calculated as follows:

$C = L / A$

Where:

C = The compressive strength of an individual specimen in psi.
L = The maximum load attained by the specimen in lbf.
A = The average cross-sectional area prior to testing in in^2.

Round and report the compressive strength to the nearest 10-psi.

7.2 Calculate the wet density of the field molded specimen to be used in correlation with the determination of in-place density by AASHTO T310 as follows:

7.2.1 $Ww = SW / V$

Where:

Ww = Wet density of an individual specimen.
SW = Specimen weight in a wet condition after molding and striking off.
V = Volume of sample.

NOTE: The wet density calculated for the most recent sublot should be averaged with the previous three sublots to yield an average wet density for four consecutive sublots. This average should be used with the nuclear gauge for the required density for all material placed within the most recent sublot.

8 REPORT

8.1 The report shall include:

- the project or contract number.
- location of the rest of the sampled concrete's placement on the project.
- date sampled and the date tested.
- Site Manager ID number or sample identification number (as applicable).
- name of technician who fabricated specimens.
- name of technician who broke specimens for compressive strength determination.
- age of the specimen at the time of testing compressive strength (days).
- curing treatment (both initial curing method and final curing method).
- type of molds used in fabricating the specimens.
- average cross-sectional area, in^2.
- compressive strength to the nearest 10 psi
- wet density calculated to the nearest 0.1 lbs/ft^3 (for both molded specimens and nuclear gauge results.
- percent compaction reported to the nearest 1% (Wet Density).