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 field samples of Cement-treated base (CTB). This method also covers the procedure for determining the in-place wet density with the nuclear gauge 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 and Research 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, 6 inches in diameter and 6 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. The mold volume shall be

calibrated in accordance with AASHTO T19, at least once a year or whenever there is reason to question the accuracy of the calibration.

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 manually operated metal sleeveless rammer shall be used for specimen consolidation (compaction). The rammer shall have the same drop mass and free fall drop height as a standard AASHTO T99 rammer. 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.

NOTE: The sleeveless rammer is typically referred to as the “Army Corps of Engineers Hammer”. Two sources that are known to sell rammers of this type are; Gilson (model HM-555) and Humboldt (model H-4173)

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 Verify the materials incorporated in the CTB mixture (aggregates, mixing water, cement, and fly ash) are from sources listed on the approved cement treated base (CTB) mix design.

4 SAMPLING

4.1 Obtain a representative sample of the CTB mixture from a randomly determined location. Take care to prevent segregation during sampling. Obtain at least 1 cubic foot of CTB material for molding the compacted specimens. From the pile being sampled, scrape away the surface of the material and collect three or more increments within the pile.

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 CTB into the molds described in section 2.2 for wet density determination and compressive strength testing.

NOTE: The special provisions detail the number of specimens required. Additional specimens for compressive strength testing should be made if strength determination prior to seven days is anticipated.

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. Ensure the mixture placed into the mold 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 non-

representative 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. Calculate the wet density in accordance with section 7.2.

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 of the specimens 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.

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 in accordance with section 7.1. Determine the average compressive strength for the four sublots. Use this average compressive strength for determining compliance with the specified strength. Any specimens that are damaged shall not be included when computing the average compressive strength for the four sublots.

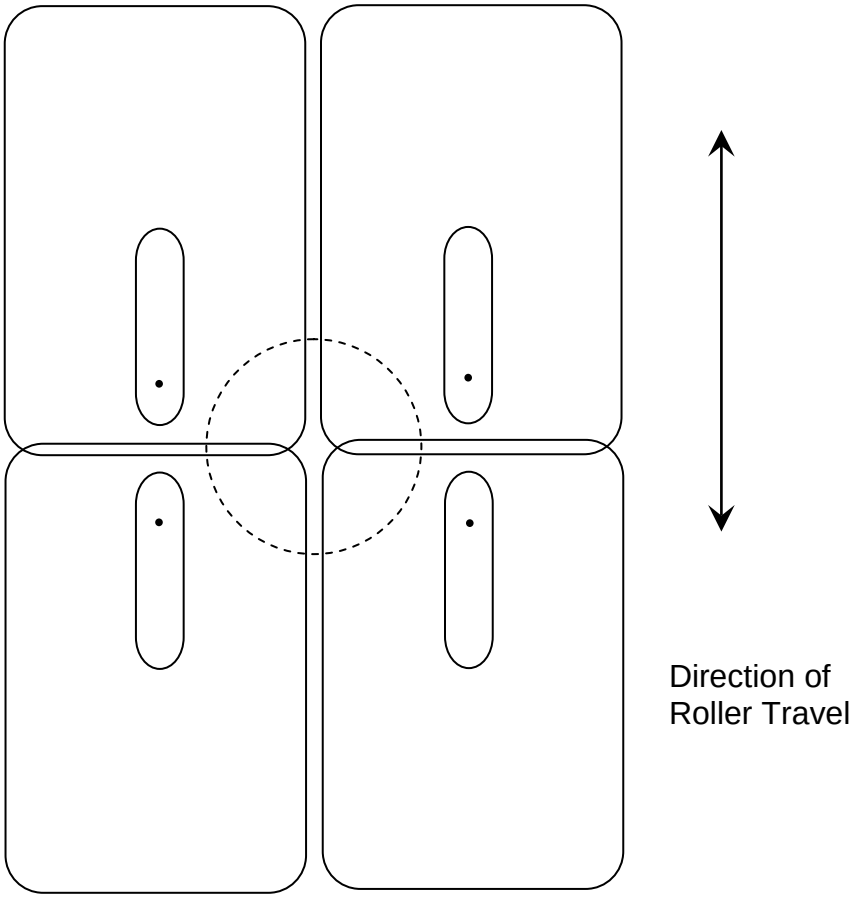
6 COMPACTION TESTING USING THE NUCLEAR GAUGE

6.1 In-place Wet Density. Measure the in-place wet density at a randomly determined location of the compacted CTB course using a nuclear density gauge in accordance with AASHTO T310 direct transmission method. For each location where density is being measured, take and average four separate one-minute readings by rotating the gauge about the axis of the probe at 90°. If direct transmission is not possible, four two-minute nuclear gauge readings measured in backscatter mode shall be taken as shown in Figure 1, and averaged.

NOTE: The in-place wet density measurements should be made on the same day as placement of the CTB to ensure the most accurate and representative determination of in-place density. Direct transmission is the preferred method.

6.2 Determine the percent density (compaction) in accordance with section 7.3.

Figure 1
Nuclear Gauge positioning for testing in backscatter mode



7 CALCULATION OF RESULTS

7.1 The compressive strength shall be calculated as follows:

$C = L / A$

Where:

C = The compressive strength of an individual specimen in lb/in^2;
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 wet density of the field molded specimen as follows:

$Ww = S / V$

Where:

Ww = Wet density of an individual specimen in lb/ft^3;
S = Specimen weight in lbs;
V = Calibrated mold volume in ft^3.

7.3 Calculate the percent density (compaction) as follows:

$P = (D / Ww_{ave}) \times 100$

Where:

P = Percent Density (%), rounded to the nearest whole number;
D = In-place wet density from nuclear gauge in lb/ft^3;
Ww_{ave} = Average wet density of the molded specimens from the four most recent sublots.

Note: For Ww_{ave} it is recommended to use the wet density from the current sublot being placed (if available), averaged with the three previous sublots. Otherwise, use the average of the four most recent sublots. At the beginning of a project (prior to four sublots placed) use the available wet density data at the time of testing.

8 REPORT

8.1 For each lot, the contractor shall furnish to the Residency a report documenting the sampling, molding, and testing of the CTB specimens. The Residency will input the information into SiteManager (template C95004) for project documentation. The report shall include:

- Contract ID and project number;
- Sample locations;
- Dates and time sampled and the dates tested;
- Lot and sublot numbers;
- Name(s) and Board Certification Stamps of technician(s) who sampled, molded, and tested the specimens;
- age of the specimens at the time of compressive strength test (days);
- curing treatment (both initial curing method and final curing method);
- Type/size of molds used in fabricating the specimens;
- average measured diameter of strength specimens, in inches;
- Maximum load, in pounds-force;
- compressive strength calculated to the nearest 10 psi
- molded wet density calculated to the nearest 0.1 lbs/ft^3

Revision Date	Revision Description
5/8/2014	Section 2.2: added language to determine mold volume used in wet density measurement. Section 5.1: removed frequency of test. Section 5.5.4: removed language pertaining to outliers. Section 6.1: removed reference to OHDL-14 and added a figure 1. Added language specifying when nuclear density testing should take place. Section 7.3: added new section to specify calculation method for percent density. Added a note to clarify use of the most recent wet density values. Editorial and minor revisions made to numerous sections.