# Memorandum

U.S. Department
Of Transportation

**Federal Highway Administration**

6300 Georgetown Pike
McLean, Virginia 22101

Subject: **ACTION**: LTPP Directive M-29
Long-Term Pavement Performance Program
Material Sampling and Testing on Overlaid Test Sections

Date: February 9, 2012

From: Jack Springer
Long Term Pavement Performance Team

Reply to
Attn of: HRDI-30

To: Dr. Frank Meyer, PM - LTPP North Atlantic Regional Contract
Dr. Frank Meyer, PM - LTPP North Central Regional Contract
Mr. Tim Martin, PM - LTPP Southern Regional Contract
Mr. Kevin Senn, PM - LTPP Western Regional Contract

Attached is the Long Term Pavement Performance (LTPP) Directive M-29, Long-Term Pavement Performance Program Material Sampling and Testing on Overlaid Test Sections, which supersedes M-20, and effective immediately is to be used for all LTPP materials sampling and testing of overlaid test sections. This directive should be transmitted to all appropriate personnel as soon as possible.

If you have any questions concerning this transmittal, please do not hesitate to call me at (202) 493-3144.

Attachment (1)

FHWA:HRDI-30:JSpringer:mdeeney:493-3144:2/09/12
File: c:/mdeeney/directive/materials/M-29dir.docx
cc:
Jonathan Groeger
Directive Binder
LTPP Team
Official file
Chron

# LONG TERM PAVEMENT PERFORMANCE PROGRAM DIRECTIVE

***For the Technical Direction of the LTPP Program***

| | | | |
|---|---|---|---|
| Program Area: | Materials | Directive Number: | M-29 |
| Date: | January 17, 2012 | Supersedes: | M-20 |
| Subject: | **Material Sampling and Testing on Overlaid Test Sections** | | |

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This directive provides material sampling and testing guidelines for newly placed materials on test sections with overlays where the thickness of the test section changes by more than 0.7 inches. The measurements in these guidelines should be performed if it is desired to continue monitoring the test section after construction. The standard sampling and materials characterization presented in these guidelines can be used to satisfy some of the considerations contained in LTPP Directive GO-49 on monitoring continuation after rehabilitation.

The LTPP Regional Support Contractors (RSC) should follow these guidelines to develop test plans for each existing LTPP test section or LTPP project site scheduled for overlay.

**Thickness Measurements**

It is desired to have the thickness of all changes to pavement layer structure confirmed and verified with cores for research purposes, regardless of the thickness change.

As a practical rule of thumb guideline, test sections that have a nominal change in thickness over the entire extent of the test section exceeding 0.7 inches, either by milling, addition of a new layer, or a combined total change exceeding 0.7 inches by adding the mill depth to the thickness of new layer placed after milling, should have the thickness of the resulting structure verified by on-site cores.

Laboratory determination of other material properties from new layers with a nominal thickness less than 2 inches is not required.

The standard three core pattern from each end of a test section for thickness determination is shown in Figure 1. Other details include:

- The distance from the ends of the test section for the thickness cores shall be located to avoid previous sampling locations.
- The core diameter is not specified since the objective is to measure thickness of the bound layers and not to perform material property tests.
- Preferred practice is to obtain three full depth cores of all bound layers from each end of the test section.
- The measurements described in LTPP protocol P01, test designation AC01, should be performed by LTPP RSC and all paper documentation completed for entry into the LTPP Pavement Performance Database (PPDB).
- All core locations (LOC_NO) and sample numbers (SAMPLE_NO) assigned to the cores shall be unique to the referenced test section from other entries currently contained in the PPDB across all FIELD_SET[1]. The LOC_NO naming convention suggested in Figure 1 does not have to be used provided a unique LOC_NO for the specific test section is assigned following the naming conventions contained in the SHRP LTPP Guide for Field Materials Sampling and Testing.
- SAMPLE_NO does not have to be based on the numerical part of the related LOC_NO naming convention. SAMPLE_NO only has to have a unique name relative to the test section and follow the general LTPP naming convention based on material type.

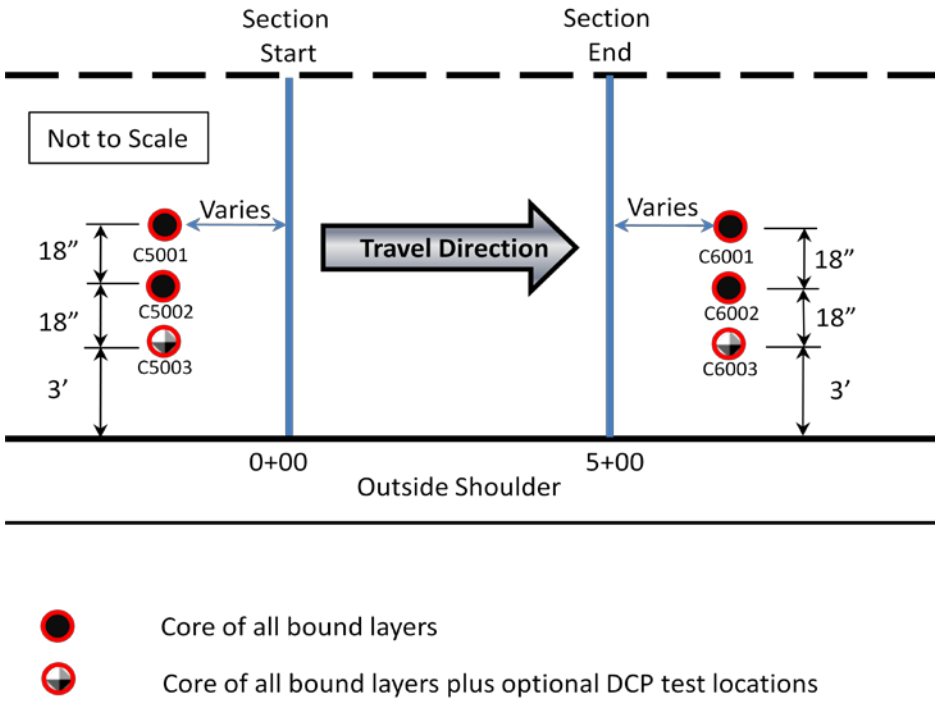


**Figure 1. Core locations to determine thickness of bound pavement layers after application of a new material layer.**

[1] Sequential number indicating the order of field sampling events. Assigned 1 for first sample event and incremented by 1 for subsequent events.

Thickness measurement requirements can also be satisfied by performing material sampling and testing plans to characterize material properties of the new material discussed in the next section.

Justification for continued monitoring of test sections meeting the requirements of this section, which cannot be cored to provide research grade measured layer thickness, shall be submitted to FHWA for approval. For example, if the new material layer was added without application of milling or grinding, and the new material's integrity is such that it will not permit a reasonable thickness measurement from a core sample, this might be a situation where the layer thickness measurement by coring can be waived. However, if a test section has had material removed from the surface by milling or grinding over the entire surface of the test section, then preferred practice is to measure the thickness of the remaining pavement structure with cores, unless field measurements during construction were used to provide reasonable research grade data.

While full depth cores of all bound layers are preferred for thickness measurements, practical considerations such as the length of available core barrels may require core samples from only the new material layers may be possible to obtain. In all instances, requests to waive the thickness measurement requirement shall be accompanied by a description of the basis the RSC will use to populate the PPDB with revised pavement structure layer thicknesses.

**Dynamic Cone Penetrometer Tests**

When possible, Dynamic Cone Penetrometer (DCP) tests following LTPP test protocol P72 should be performed. Preferred practice is to perform at least one DCP test at each end of the test section in a full depth core located in the approximate wheel path location.

**Standard Sampling and Material Characterization Schemes**

In general, material characterization tests should be performed when the thickness of a newly added material layer is nominally 2 inches or greater. The following sections present standard sampling and material characterization schemes for commonly used asphalt concrete[2] (AC) and portland cement concrete (PCC) materials. These schemes are based upon sampling and test requirements for the newly added material layer on a single 500 foot test section. Modifications to these standard schemes may need adjustment due to site conditions such as thickness of the new material layer, bulk samples collected during construction, type of material, available core barrel sizes, actual test section length, sampling space available at each end of the test section, construction plan, etc.

***AC Overlays***

Figures 2 and 3 illustrate the standard field materials sampling plan when AC overlay materials are placed on an existing LTPP test section. Unique labels have been assigned to the various core locations so that this sampling plan can be distinguished from the legacy LTPP materials

[2] Asphalt Concrete nomenclature is intended to include the vast variety of materials in which a bituminous material is used as the cement to bind aggregate mixtures.

sampling plans. As subsequently explained, this sampling plan is tied to satisfying a laboratory materials test plan.

A materials sampling plan for each test site or project site shall be created by the LTPP RSC taking into account the following factors:

- The distance from the ends of the test section for the core samples shall be located to avoid previous sampling locations.
- The designated full depth cores are intended to provide a measurement of the true resulting structure of the bound pavement layers after application of the construction treatment(s).Three full depths cores should be taken from each end of the test section for thickness verification.
- While some cores are designated as partial depth cores of the new material layer, it may be necessary to core full depth at all locations in order to provide material samples suitable for thickness measurements of the altered pavement structure, i.e. milled test sections, and samples for laboratory testing.
- Four of the 6 inch diameter cores from each end of the section can be replaced by a bulk sample of the AC materials. One bulk sample is required to be obtained from each end of the test section during construction. The size of these samples should be enough to satisfy AC04 requirements and related AG and AE tests.
- The specified distance between core locations may need to be altered for specific test section considerations depending on previous sampling locations, distance available for sampling at each end of the test section, etc.
- The standard sampling plan is based upon 6 inch diameter cores for tests on the extracted material constituents. This sample requirement can be reduced if larger diameter core barrels are used, or if the layer thickness exceeds 4 inches.
- It is desired that sampling of new AC pavement layers be conducted within 6 months of construction in order to capture the condition of the material at lay down.
- All core locations (LOC_NO) and sample numbers (SAMPLE_NO) assigned to the cores shall be unique to the referenced test section from other entries currently contained in the PPDB across all FIELD_SET. The LOC_NO naming convention in these figures does not have to be used provided a unique LOC_NO for the test section is used following the conventions contained in the SHRP LTPP Guide for Field Materials Sampling and Testing.

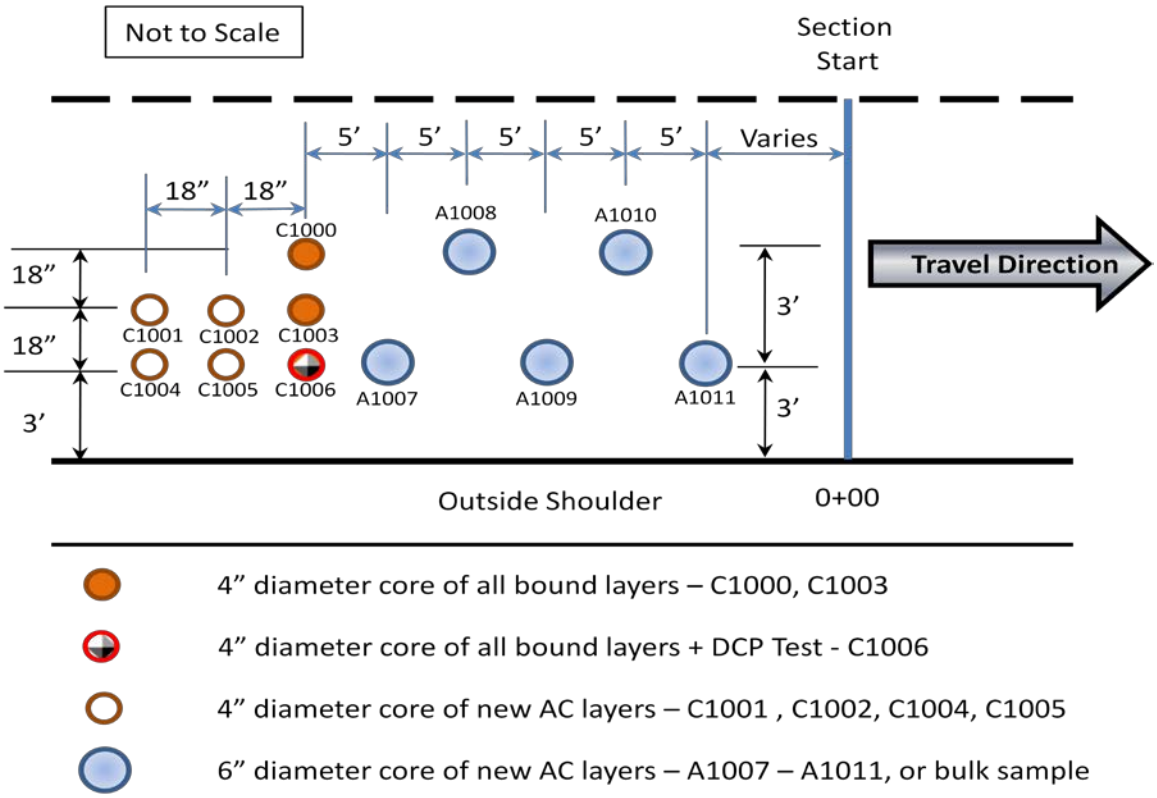


**Figure 2. Standard sampling plan locations at approach end of test section for new AC overlays.**

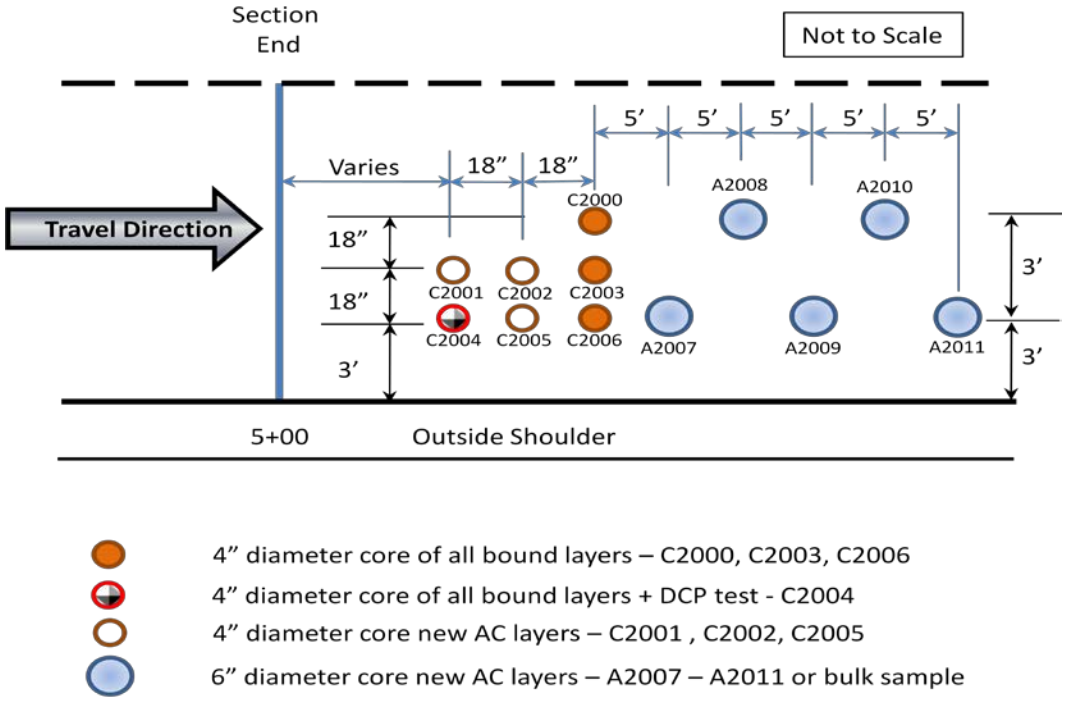


**Figure 3. Standard sampling plan locations at leave end of test sections for new AC overlays.**

The mapping of material tests on AC material samples from each core location in the standard plan are shown in Table 1. In Table 1, samples from the core locations enclosed in brackets {} are meant to indicate multiple or combined samples required for a separate test results.

**Table 1. Mapping of AC material tests from standard core locations.**

| Test Name | Test Designation | LTPP Test Protocol | Sample Locations | Notes |
|---|---|---|---|---|
| Core Examination & Thickness | AC01 | P01 | All cores | Perform this test on all cores prior to lab tests or storage shipment |
| Bulk Specific Gravity | AC02 | P02 | Perform on all cores used for the AC03, AC04, and AC07 tests | This test is to be performed on each new unique material layer contained in the core sample. |
| Maximum Specific Gravity | AC03 | P03 | A1007, A2007 | This test is to be performed on each new unique material layer contained in the core sample. |
| Extracted Asphalt Content | AC04 | P04 | {A1008, A1009, A1010, A1011} {B2008, B2009, B2010, B2011} | Combine samples from each end for one test per end |
| Resilient Modulus | AC07 | P07 | {C1004, C1005, C1006} {C2004, C2005, C2006} | Submit best three cores, plus one extra contingency core, to lab. |
| Specific Gravity of Extracted Asphalt Cement | AE03 | P23 | {A1008, A1009, A1010, A1011} {B2008, B2009, B2010, B2011} | Tests on extracted asphalt from AC04. |
| Kinematic and Absolute Viscosity of Extracted Asphalt Cement | AE05 | P25 | {A1008, A1009, A1010, A1011} {B2008, B2009, B2010, B2011} | Tests on extracted asphalt from AC04. |

| Test Name | Test Designation | LTPP Test Protocol | Sample Locations | Notes |
|---|---|---|---|---|
| Specific Gravity of Fine Aggregate | AG01 | P11 | {A1008, A1009, A1010, A1011} {B2008, B2009, B2010, B2011} | Tests on extracted aggregate from AC04. |
| Specific Gravity of Coarse Aggregate | AG02 | P12 | {A1008, A1009, A1010, A1011} {B2008, B2009, B2010, B2011} | Tests on extracted aggregate from AC04. |
| Gradation of Aggregate | AG04 | P14 | {A1008, A1009, A1010, A1011} {A2008, A2009, A2010, A2011} | Tests on extracted aggregate from AC04. |
| Fine Aggregate Particle Shape | AG05 | P14A | {A1008, A1009, A1010, A1011} {B2008, B2009, B2010, B2011} | Tests on extracted aggregate from AC04. |

Table 2 present a summary of material sample requirements for the intended laboratory tests based upon current LTPP test protocols. Note that some LTPP material testing protocols allow testing of core samples less than the desired size since they are based upon realities of the constructed pavement structure for which pavement research require an estimate of the in-place properties of the materials. RSC may need to alter the standard sampling plan to provide enough material to meet test requirements depending on site conditions.

**Table 2. Summary of AC related sample size for specified lab tests.**

| Test Name | Test Designation | LTPP Test Protocol | Sample Size Requirements/Number of Samples per Test |
|---|---|---|---|
| Core Examination & Thickness | AC01 | P01 | None / 1 sample per test |
| Bulk Specific Gravity | AC02 | P02 | Length 4 times maximum aggregate size preferred / 1 sample per test. |
| Maximum Specific Gravity | AC03 | P03 | Sample size based on nominal maximum aggregate size:<br>No. 4 - 1.1 lbs<br>3/8” – 2.2 lbs<br>1/2” – 3.3 lbs<br>3/4” – 4.4 lbs<br>May need to combine samples from same sample area to get enough material. |

| Test Name | Test Designation | LTPP Test Protocol | Sample Size Requirements/Number of Samples per Test |
|---|---|---|---|
| Extracted Asphalt Content | AC04 | P04 | Sample size based on nominal maximum aggregate size:<br>No. 4 – 1.1 lbs<br>3/8" – 2.2 lbs<br>1/2" – 3.3 lbs<br>3/4" – 4.4 lbs<br>Will need to combine samples from same area to get enough material. |
| Resilient Modulus | AC07 | P07 | 4" diameter cores only.<br>Core sample must be ≥ 25 mm thick.<br>Three samples required per test.<br>Select "best" three samples from sampling area.<br>Ship one extra core sample from sample area to lab for contingency when possible. |
| Specific Gravity of Extracted Asphalt Cement | AE03 | P23 | Performed on sample obtained from AC04/P04 test. |
| Kinematic and Absolute Viscosity of Extracted Asphalt Cement | AE05 | P25 | Performed on sample obtained from AC04/P04 test. |
| Specific Gravity of Fine Aggregate | AG01 | P11 | Performed on sample obtained from AC04/P04 test. Note if sample size is less than desired. |
| Specific Gravity of Coarse Aggregate | AG02 | P12 | Performed on sample obtained from AC04/P04 test. Note if sample size is less than desired. |
| Gradation of Aggregate | AG04 | P14 | Performed on sample obtained from AC04/P04 test. |

***PCC Overlays***

Figures 4 and 5 present the standard materials sampling for new portland cement concrete (PCC) overlay layers placed on existing LTPP test sections. This standard materials characterization plan is based upon cores from the new overlay layer. When possible material samples obtained during construction for tests following the SPS-2 material test plan are encouraged. The indicated full depth cores are for material layer thicknesses, which should be considered when the thickness of the existing pavement structure is altered prior to placement of the new PCC surface layer.

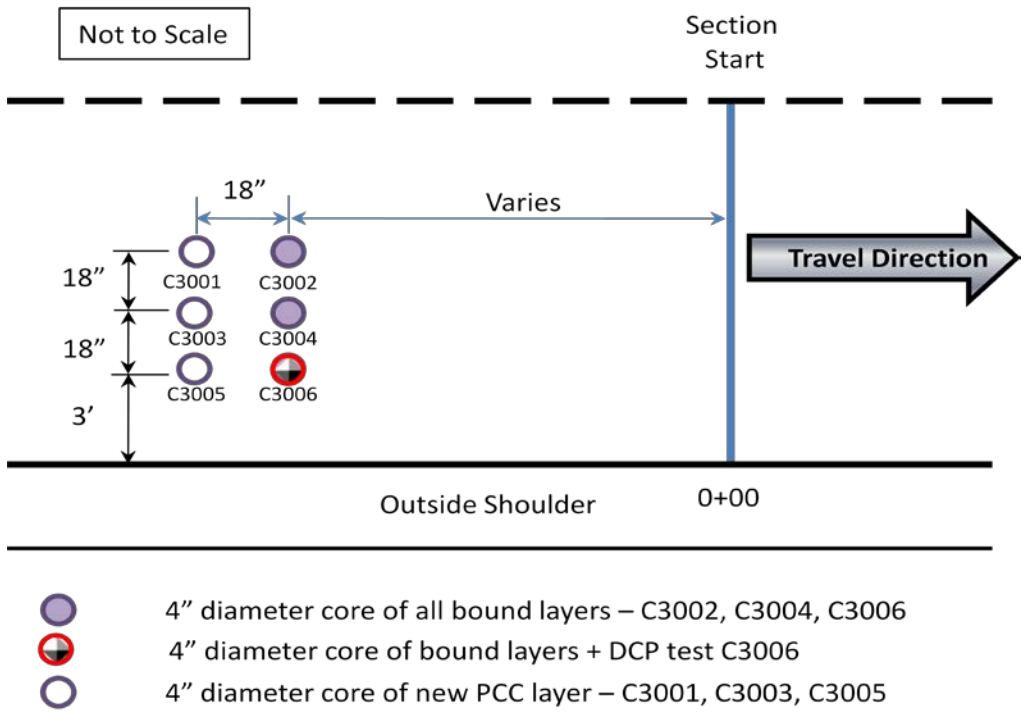


**Figure 4. Standard sampling plan locations at approach end LTPP tests sections with new PCC layers.**

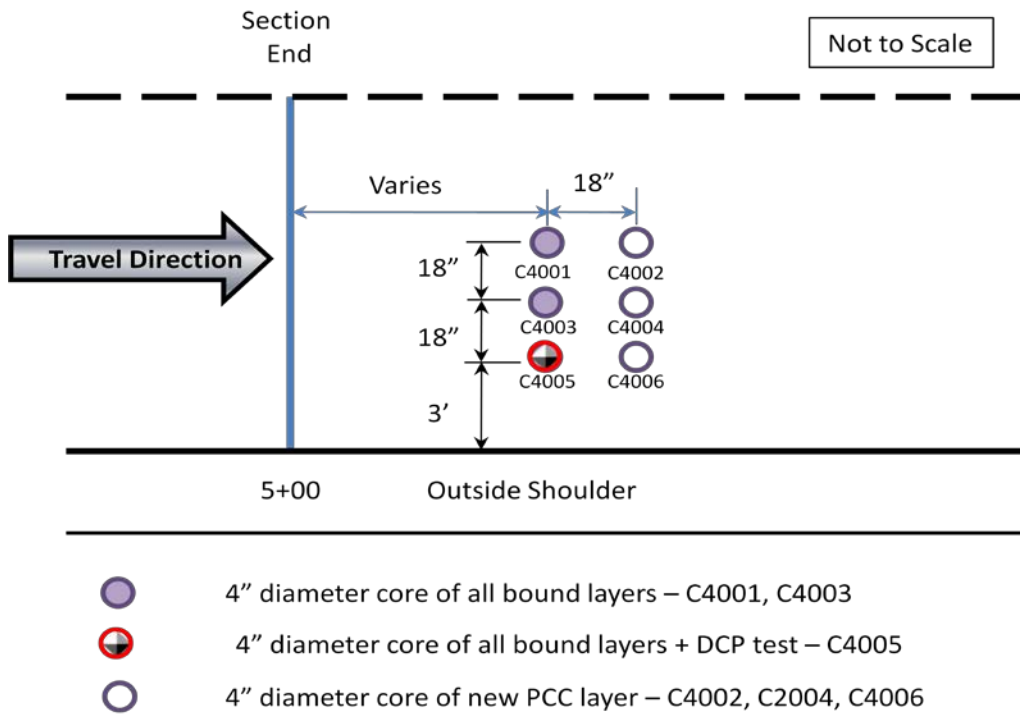


**Figure 5. Standard sampling plan locations at leave end LTPP tests sections with new PCC layers.**

Table 3 presents a mapping of the material tests from samples obtained from the standard materials sampling plan.

Table 3. Mapping of material samples from standard PCC core locations to laboratory tests.

| Test Name | Test Designation | LTPP Test Protocol | Sample Locations | Notes |
|---|---|---|---|---|
| Compressive Strength | PC01 | P61 | C3001, C3006, C4001, C4006 | |
| Split Tensile Strength | PC02 | P62 | C3005, C4005, | |
| Coefficient of Thermal Expansion | PC03 | P63 | C3004, C4004 | FHWA test method |
| Static Modulus of Elasticity | PC04 | P64 | C3003, C4003 | |
| Core Examination & Thickness | PC06 | P65 | All cores | |
| Air Content of Hardened Concrete | PC08 | P68 | C3002, C4002 | |

**Considerations for SPS Project Sites**

The standard test plans presented in this document can be altered when the same rehabilitation treatment is applied to more than one existing pavement test sections at a SPS project site.

Preferred practice is to treat each rehabilitated test section on a SPS project site as an individual test section following one of the previous standard plans since it will be classified into a GPS rehabilitation experiment for future monitoring.

When the same treatment is applied on more than one test section at a SPS project site in the same construction event, the following guidelines can be used to reduce field sampling resource requirements:

1. All test sections must have a minimum of three cores extracted from the start and end of the section for thickness determination. A single three core set can be used to characterize the thickness for two adjacent test sections, provided the same pavement structure thicknesses existed prior to the construction event. Where possible, these thickness cores should be used to satisfy material characterization tests.

2. The material sampling and testing plan can be reduced from that required for individual test sections based upon the following concepts:
    a. A material sample unit is defined as a common layer of material, with the same mixture specification, and placed on the same day from a common plant source(s).
    b. Three test results, which may require multiple samples from each sampling area, are required to provide characterization of each material sample unit.
    c. Project sampling based upon this sample unit concept shall be spread out over the construction project to capture temporal changes due to the planned construction events.
    d. Project based sampling and testing plans should be altered based upon the actual sequence of construction events.
3. Preferred practice is to sample and test each test section as an individual material sample unit.

**Roles and Responsibilities**

The expected roles and responsibilities for conduct of field sampling and material testing are:

- RSC shall create individual field material sampling and laboratory testing plans for each test section and submit to FHWA.
- RSC personnel shall be present in the field when the material sampling is performed.
- RSC personnel are responsible for completing the required field sampling data forms, sample labeling, packaging samples for shipment, and sample shipping.
- RSC shall perform core thickness exams following appropriate LTPP measurement protocols.
- RSC shall coordinate with laboratories performing materials characterization tests to verify proper assignment of tests to samples and reconciliation of data transfers.
- RSC are responsible for loading and processing field sampling and laboratory test data into the PPDB, and updating entries into the Ancillary Information Management System.
- Participating highway agencies are requested to provide traffic control, drill rigs, core barrels, and pavement repair materials for the coring activities.
- RSC are responsible to coordinate field activities with participating highway agencies.
- FHWA will provide resources and further instructions on laboratory materials tests and sample storage.
- FHWA will review material sampling and test plans, plans to conduct field activities, and will maintain approval authority to authorize work under its contract authority.
- TSSC will provide technical support to RSC, FHWA, and material test laboratories in the execution of this work as requested.

**Test Plans**

The following considerations should be used by the RSC for submission of the test plans required by this directive to FHWA:

- The test plan approval request can be made by e-mail or phone conversation to the FHWA COTR of the RSC contract.
- The test plan submission should be as brief and concise as possible.
- The test plans should provide justification on deviations from the standard sampling and test plans, thickness measurement requirement, expected role and responsibilities concerning requested participating highway agency activities, and how these deviations will be addressed to provide research grade data in the PPDB.
- When possible, the directions developed by RSC for their field crews to follow can also be submitted to FHWA.

Prepared by: TSSC

Approved by:

Aramis López, Jr.
LTPP Team Leader