LONG TERM PAVEMENT PERFORMANCE PROGRAM DIRECTIVE

For the Technical Direction of the LTPP Program

Program Area:	General Operations	Directive Number:	GO-21
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Subject:	LTPP Pavement Performance Monitoring Adjustments		

Background

This directive presents pavement performance monitoring adjustments intended to achieve a balance in the data available for a test section relative to their use in development, verification, evaluation and validation of pavement performance prediction procedures while preserving the ability to support other types of pavement related investigations and analyses.

Monitoring Guideline Summary

Table 1 summarizes the revised pavement performance monitoring guidelines for Long-Term Pavement Performance (LTPP) projects by experiment type. The measurements covered by these guidelines include profile, distress, and deflection data collection. These guidelines relate to frequency and intensity of data collection, not data quality. High data quality standards must be maintained for measurements performed regardless of test section or monitoring category.

The "Monitoring Category" shown in Table 1 is the key to the monitoring adjustment sequence. The recommended monitoring category is based upon assessment of test section compliance with the minimum data completeness requirements contained in LTPP Directive GO-19: LTPP Data Completeness and Monitoring Adjustment Process. For test sections that do not meet the data collection requirements or that have critical unresolvable deficiencies, monitoring adjustments shall be made in the following sequence:

S1 L S2 L G L C

For example, if a test section in the S2 monitoring category has pavement performance

monitoring less than S2, but greater than the C monitoring requirements, the recommended monitoring category would be G.

Every effort must be made to maintain test sections at their highest potential category in order to reap the benefits of the investment in LTPP. The monitoring categories were tailored around the level of highway agency investment in the test site and relative utility of the data. The following is a description of the nature of the various monitoring categories.

S1 These are high value flexible and rigid pavement experiments (SPS-1 and -2) which began with a new construction or reconstruction event. It is on these test sections that we have the opportunity to best measure the effects of pavement features such as drainable bases, widened lane, base type, etc. starting from construction within the context of a nationally coordinated experiment. Some agencies have estimated that they have invested up to $500,000 to construct, test and monitor these test sections. In keeping with this level of investment, these test sections have been assigned the highest level and intensity of monitoring. These test sections will be the primary candidates for future special monitoring studies.

S2 This category includes the SPS-8 experiment on environmental effects and the SPS-5 and 6 rehabilitation experiments. The SPS-8 experiment is an adjunct to the SPS-1 and 2 studies; two test sections from the SPS 1 and 2 studies were constructed on lower volume roadways where environmental effects are most likely to cause deterioration. The SPS-5 and -6 are the high value flexible and rigid rehabilitation experiments that start with construction of a specified series of treatments on contiguous test sections. These test sections are valuable since they are also based on a nationally coordinated experiment with similar test sections constructed in other parts of the country.

G The G category of pavements is mostly comprised of test sections in the General Pavement Study. These test sections are of vital importance to the program since they provide the greatest extent of coverage of environmental factors, paving materials and paving practices. Some of the monitoring requirements are less intensive than the S categories with provisions for performing measurements in response to changes in the pavement condition or other events.

C The C or close-out category of monitoring is still ***an active monitoring status category***. Close-out monitoring means that one more round of pavement performance measurements will be performed on existing test sections, preferably at the end of their current life cycle when a rehabilitation treatment is applied. The objective is to preserve the previous investment in these test sections by obtaining a minimum level of performance information over the current pavement life cycle. Test sections are assigned to this category due to either an uncorrectable or minimum data requirement deficiency

which will not be corrected, or because they are part of an experiment with limited national impact, limited product potential or whose study time period has expired.

Table 1. Summary of data collection requirements and monitoring frequencies.

LTPP Experiment	Minimum Pavement Monitoring Intervals			Monitoring Category[1]
	Profile	Distress	FWD	
SPS 1 & 2	1-year	1- year manual and 2 -year photographic	2-year and responsive testing	S1
SPS 5 & 6				S2
SPS 8				
SPS Supplemental	Same as core sections	3-year manual, 2-year photographic, and responsive	5-year and responsive testing	
SPS 9 & GPS 1, 2, 3, 4, 5, 6B/C/D/S, 7B/C/D/F/R/S, 9	2 year			G
GPS 6A & 7A, SPS 3, 4, & 7	One last measurement	One last measurement	One last measurement	C

[1] Although required pavement monitoring activities for SPS-1, -2, -5, -6 and -8 project test sections are the same, the level of traffic monitoring and climatic data collection at SPS-1 and -2 project sites is more intensive, and hence the reason for subcategories (S1 and S2) within the S monitoring catgory. Traffic data collection requirements for the monitoring categories shown in the above table are being finalized and will be issued under a separate directive.

Pavement Performance Monitoring

Pavement performance monitoring addressed in this directive includes profile, distress and deflection measurements performed by LTPP contractors.

Definitions

In order to describe when pavement performance monitoring should be performed, the following definitions are used.

Rehabilitation Construction Event	Performance of rehabilitation activities on a test section. Rehabilitation activities include overlays and associated pretreatments (patching, milling, joint repair, etc.), inlays (mill and fill), pressure relief joints in PCC pavements, subsealing and undersealing, retrofitted subdrainage, joint load transfer restoration, and shoulder restoration.
Maintenance Construction Event	Performance of maintenance activities on a test section. Maintenance activities include seal coats, crack sealing, patching, crack and joint sealing, grinding, milling less than 25-mm deep, and grooving.
Out-of-Study	Monitoring is discontinued because a test section is either unsuitable for continued monitoring due to reconstruction, non-qualifying rehabilitation construction event, major deficiency or the respective highway agency is no longer willing to support the required monitoring activities. (Previously collected data will be retained by the LTPP program.)
Routine Monitoring	Pavement performance measurements (profile, distress, and deflection) taken at regularly established intervals, where the interval length is defined by the measurement type and test section monitoring category (S1, S2 or G). Routine measurements are repeated until one of the three following conditions are reached: 1. Test section goes out-of-study. 2. Application of rehabilitation activity. 3. End of LTPP program

Routine monitoring after performance of rehabilitation activity will be continued if the test section does not go out-of-study. Such monitoring will be performed in accordance with the requirements for the post-rehabilitation LTPP experiment designation monitoring category.

Routine measurements do not apply to test sections classified in the C monitoring category.

Responsive Monitoring

Non-routine monitoring measurements performed on test sections that are triggered by changes in pavement condition, construction events, or status change.

Responsive monitoring based on change in pavement condition applies primarily to those test sections in the G monitoring category which have longer routine monitoring intervals than those in the S categories. The primary trigger for pavement related response monitoring are measurements and observations by the profiler operator who visits the site on a bi-annual basis. One or more of the following conditions may trigger the need for responsive monitoring:

- A change in average IRI over a two year period in excess 0.40 m/km.
- A significant change in pavement distress condition; e.g. appearance of fatigue cracking, increased rutting, or increase or decrease in severity or extent of other distress types.
- Report by highway agency personnel that rate of pavement deterioration appears to be accelerating.

Responsive measurements triggered by a construction event include:

- Maintenance construction event -- Profile and distress surveys shall be performed within six months prior to maintenance activities such as seal coats which cover the entire surface of the test section; no responsive post-treatment monitoring measurements are required. Routine monitoring measurements should continue in accordance with pre-maintenance routine monitoring schedule.

- Rehabilitation construction event -- Profile, distress and deflection measurements are required within six months prior to rehabilitation activity. If monitoring measurements are to be continued on a test section after rehabilitation, i.e. the test section does not go out-of-study, then a full suite of pavement performance measurements are also required within six months following completion of rehabilitation construction.

A full suite of pavement monitoring measurements shall be performed either:

- When it is determined that a test section will be taken out-of-study.
- At the end of the field monitoring portion of the LTPP program.

Close-Out Monitoring: For test sections in the close-out monitoring category, only one more suite of pavement monitoring measurements (profile, distress and deflection) will be performed either:

- When it is determined that a test section will be taken out-of-study. This could be due to a construction event or at the option of the highway agency.
- At the end of the field monitoring portion of LTPP program.

Profile Measurements

Profile measurements on LTPP test sections shall be performed in accordance with established data collection guidelines, protocols and directives. The three general categories of profile measurement frequency specified in Table 1 include:

1. Annual profile measurements
2. Profile measurements every 2 years
3. Close-out profile measurements

The frequency of profile surveys on supplemental SPS test sections shall be performed in accordance with that for the associated core sections.

Annual Profile Measurements

Routine profile measurements on test sections within this monitoring category shall be performed once per year. It is highly desirable that these measurements be performed at approximately the same time each year (± 1 month). These measurements shall be repeated until one of the following conditions is reached: test section goes out-of-study, application of rehabilitation construction event, or end of field monitoring portion of LTPP program. Responsive profile measurements are required within six months prior to reaching any one of these conditions or within six months prior to application of maintenance construction event. Responsive profile measurements are also required within six months after application of a rehabilitation (not maintenance) construction event if that test section will continue to be monitored. Routine profile measurements after application of a rehabilitation construction event will be done in accordance with requirements for the post-rehabilitation LTPP experiment designation monitoring category.

Profile Measurements Every 2 Years

Test sections in this monitoring category shall be surveyed once every two years; i.e., every other year. It is highly desirable that these measurements be performed at approximately the same time each test year (± 1 month). These surveys shall be repeated until one of the following conditions is reached: test section goes out-of-study, application of rehabilitation construction event, or end of field monitoring portion of LTPP program. Responsive profile measurements are required within six months prior to reaching anyone of these conditions or within six months prior to application of maintenance construction event. Responsive profile measurements are also required within six months after application of a rehabilitation (not maintenance) construction event if that test section will continue to be monitored. Routine profile measurements after application of a rehabilitation construction event will be done in accordance with requirements for the post-rehabilitation LTPP experiment designation monitoring category.

Close-Out Measurements

For test sections within this monitoring category, one last round of profile measurements will be performed either when it is determined that the test section will be taken out-of-study (due to a construction event or at the option of the highway agency) or at the end of the field monitoring portion of the LTPP program, whichever comes first.

Distress Surveys

Two methods are used to document surface distresses on LTPP sections: photographic and manual surveys. Regardless of method, distress data shall be collected in accordance with current LTPP data collection guidelines, protocols and directives. Table 1 provides the survey frequency

that shall be followed for the collection of distress data according to LTPP experiment. Three general distress monitoring categories are provided in this table:

1. Photographic surveys every 2 years and annual manual distress surveys
2. Photographic surveys every 2 years and manual distress surveys every 3 years
3. Close-out manual distress surveys

A more detailed description of these monitoring categories is provided next.

Photographic Surveys Every 2 Years and Annual Manual Distress Surveys

LTPP test sections classified in this monitoring category shall be surveyed once every two years (i.e., every other year) using the photographic method and once per year (i.e., annually) using the manual method. It is highly desirable that these measurements be performed at approximately the same time each year (± 1 month). **When possible, photographic surveys shall be performed within one month of the manual survey for that year.** Both photographic and manual surveys shall be repeated until one of the following conditions is reached: test section goes out-of-study, application of rehabilitation construction event, or end of field monitoring portion of LTPP program. Responsive manual distress surveys are required within six months prior to reaching any one of these conditions or within six months prior to application of maintenance construction event which hides the existing pavement surface, such as a seal coat. Responsive manual distress surveys are also required within six months after application of a rehabilitation (not maintenance) construction event if that test section will continue to be monitored. Routine photographic and manual distress surveys after application of a rehabilitation construction event will be done in accordance with requirements for the post-rehabilitation LTPP experiment designation monitoring category.

Photographic Surveys Every 2-Years and Manual Distress Surveys Every 3-Years

Photographic distress surveys on test sections within this category shall be performed once every two years (i.e., every other year), and manual distress surveys on these same test sections shall be performed on a nominal three (3) year interval. It is highly desirable that these measurements be performed at approximately the same time each year (± 1 month). These surveys shall be repeated until one of the following conditions is reached: test section goes out-of-study, application of rehabilitation construction event, or end of field monitoring portion of LTPP program. Responsive manual distress surveys are required within six months prior to reaching any one of these conditions or within six months prior to application of maintenance construction event. Responsive manual distress surveys are also required within six months after application of a rehabilitation (not maintenance) construction event if that test section will continue to be monitored. Routine photographic and manual distress surveys after application of a rehabilitation construction event will be done in accordance with requirements for the post-rehabilitation LTPP

experiment designation monitoring category.

Responsive manual distress surveys shall also be performed on test sections within this monitoring category based on changes in pavement condition as defined in the "Definitions" section of this directive.

Close-Out Manual Distress Surveys

For test sections within this monitoring category, one last manual distress survey will be performed either when it is determined that the test section will be taken out-of-study (due to a construction event or at the option of the highway agency) or at the end of the field monitoring portion of the LTPP program, whichever comes first.

Deflection Testing

Deflection testing on LTPP test sections shall be performed using Falling Weight Deflectometers (FWDs) in compliance with LTPP specifications following all applicable guidelines, protocols and directives. The revised deflection testing frequency guidelines are provided in Table 1 according to LTPP experiment. Three general FWD monitoring categories are provided in this table:

1. Deflection testing every 2 years
2. Deflection testing every 5 years
3. Close-out deflection testing

A more expanded description of each of these three monitoring categories is provided next.

Deflection Testing Every 2 Years

Deflection testing on test sections in this monitoring category shall be performed on a nominal two (2) year interval. This testing shall be repeated every 2 years until one of the following conditions is reached: test section goes out-of-study, application of rehabilitation construction event, or end of field monitoring portion of LTPP program. Responsive deflection testing is required within six months prior to reaching any one of these conditions. Responsive deflection testing is also required within six months after application of a rehabilitation (not maintenance) construction event if that test section will continue to be monitored. Routine deflection testing after application of a rehabilitation construction event will be done in accordance with requirements for the post-rehabilitation LTPP experiment designation monitoring category.

Responsive deflection testing shall also be performed on test sections within this monitoring category based on changes in pavement condition as defined in the "Definitions" section of this

directive.

Deflection Testing Every 5 Years

Deflection testing on test sections within this monitoring category shall be performed on a nominal five (5) year interval. These surveys shall be repeated every 5 years until one of the following conditions is reached: test section goes out-of-study, application of rehabilitation construction event, or end of field monitoring portion of LTPP program. Responsive deflection testing is required within six months prior to reaching any one of these conditions. Responsive deflection testing is also required within six months after application of a rehabilitation (not maintenance) construction event if that test section will continue to be monitored. Routine deflection testing after application of a rehabilitation construction event will be done in accordance with requirements for the post-rehabilitation LTPP experiment designation monitoring category.

Responsive deflection testing shall also be performed on test sections within this monitoring category based on changes in pavement condition as defined in the "Definitions" section of this directive.

Close-Out Deflection Testing

For test sections within this monitoring category, one last round of deflection testing will be performed either when it is determined that the test section will be taken out-of-study (due to a construction event or at the option of the highway agency) or at the end of the field monitoring portion of the LTPP program, whichever comes first.

Other Monitoring

Pavement performance monitoring by the RCOCs at times other than those specified in this directive (i.e., any standardized plan deviations) must first be approved by the appropriate FHWA COTR.

Questions concerning this directive should be addressed to the FHWA LTPP Team Leader.

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