LONG TERM PAVEMENT PERFORMANCE PROGRAM DIRECTIVE

For The Technical Direction Of The LTPP Program

Program Area: Profile **Directive Number:** P-11

Date: April 22, 1996 **Supersedes:** n/a

Subject: Automated Dipstick Longitudinal Profile Measurement Procedure

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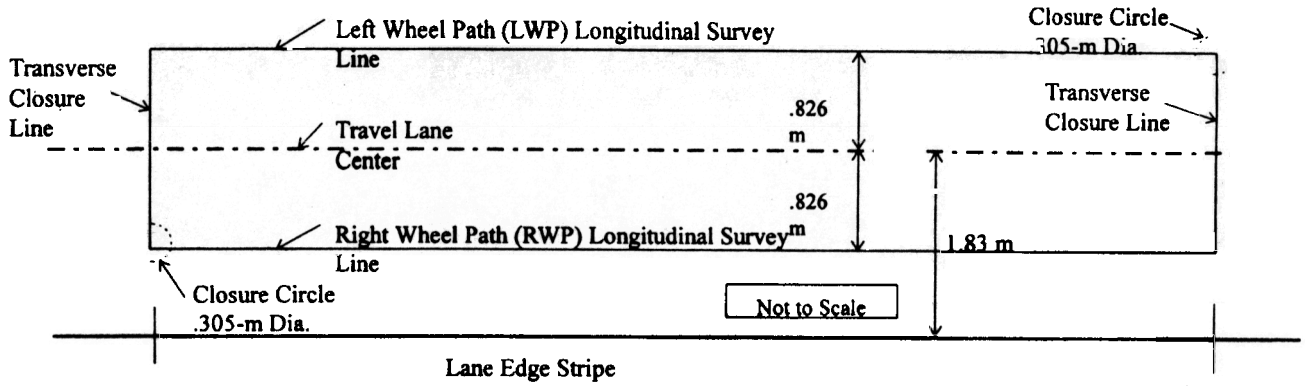
Introduction

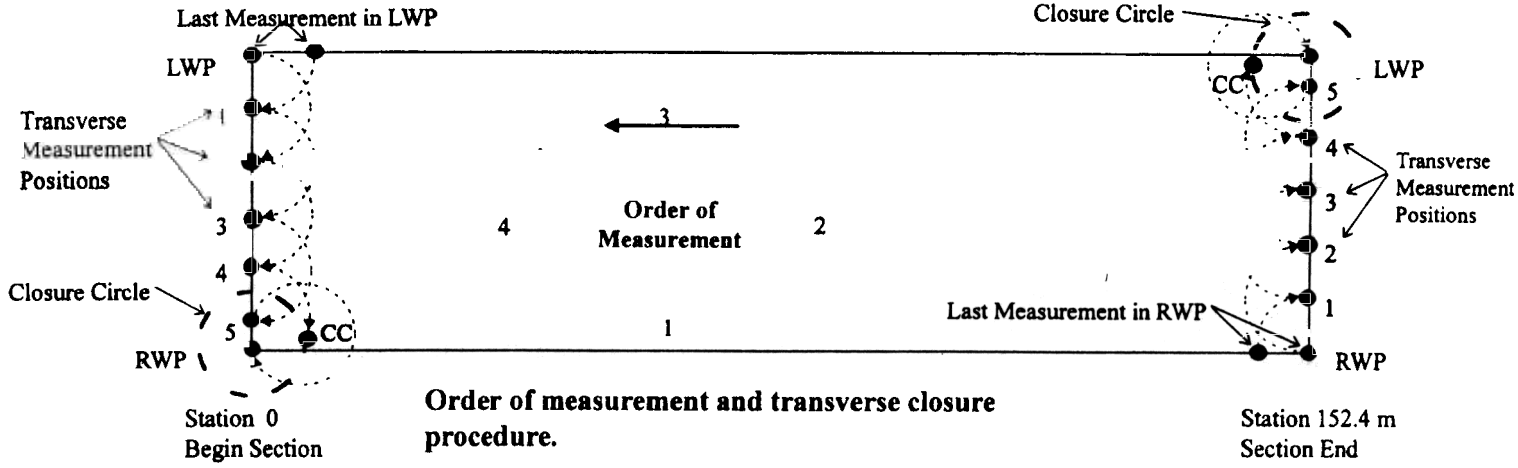
The following procedure for longitudinal profile measurements on LTPP test sections, using automated Dipsticks, should be used on all test sections requiring manual measurement of the longitudinal profile where the autoread devices are available. This is a replacement for the procedures contained in sections 3.3.2, 3.3.3.2, 3.3.3.3 and 3.3.3.4 of the SHRP Profile Measurement Manual, "Manual for Profile Measurements: Operational Field Guidelines," SHRP-P-378, Strategic Highway Research Program, National Research Council, 1994. Other portions of the SHRP Manual are still applicable.

Overview

This procedure consists of performing an elevation survey in each wheel path and using transverse measurements at the ends of the section to form a closed loop. As illustrated in Figure 1, the measurement procedure starts at Station 0 in the right wheel path and proceeds in the direction of traffic toward the end of the section. At the end of the section, transverse measurements are made to the end point of the survey line in the left wheel path. A 0.305-m diameter closure circle around this point is used to close the transverse measurements on this start location for measurements in the left wheel path. Longitudinal measurements are then performed in the left wheel path back to Station 0. Transverse measurements and the closure circle are used to close the survey on the starting point. This procedure is designed for a 152.4-m test section, although the concept can be applied to test sections of any length. Form DS-8 is used to record pre- and post operation checks of the equipment. Data are recorded, stored, and handled electronically. Data sheet DS-9 is used to record site identification information, survey date, time, operator, file names used, and any comments describing site anomalies which would possibly effect data collection.



Marking pattern for longitudinal profile measurements using the Dipstick.



Order of measurement and transverse closure procedure.

Procedure

1. Site Marking

The marking pattern is illustrated in Figure 1.

Clean both wheel paths of loose stones and other debris to prevent slippage of the footpads during measurements.

Locate the center of the travel lane.

+ Where the wheel paths are easily identified, the midway point between the two wheel paths should be used as the center of the lane.

+ If the wheel paths are not clearly identifiable, the center of the lane should be taken as the midpoint between the two lane edges.

+ Where the wheel paths are not apparent and only one lane edge can be clearly distinguished, the center of the lane should be established at 1.83 m from that edge.

Locate and mark longitudinal elevation survey lines in each wheel path. Locate the location of the two longitudinal elevation survey lines 0.825 m from the center of the lane. Mark these locations at intervals equal to the length of the chalk line used for marking. Use a chalk line to mark a straight line between the previously established points. The start location should be located so that back edge of the Dipstick footpad is located immediately adjacent to leave edge of the white stripe at the beginning of the monitoring portion of the test section. If this location is not marked with a stripe, the start location should be established at station 0+00. Using a tape measure (measuring wheels are not acceptable), carefully measure the length of each longitudinal elevation survey line to establish the end points at 152.4-m, or at the specified length for test sections not 152.4-m long, from the previously established start location. An accurate measurement of this length is required since it is used as a quality control check on the measurement process.

At Station 0 use a chalk line to mark a transverse line connecting the endpoints of the longitudinal elevation survey lines. In the Right Wheel Path (RWP), mark a 0.305-m radius circle centered on the first measurement point. This closure circle will be used for completion of the elevation survey loop.

At the end point marks placed at Station 152.4 m, or the end of the test section, use a chalk line to mark a transverse line connecting the endpoints of the longitudinal elevation survey lines. Mark a 0.305-m radius circle centered on the measurement point located in the Left Wheel Path (LWP) at this location. This closure circle will be used for completion of the elevation survey loop.

Note on data collection sheet DS-8, the method used and the location of the lane center and the two longitudinal elevation measurement survey lines, and any discrepancies between the painted and measured section end locations.

2. Pre-Operational Checks on the Dipstick

The pre-operational checks should be performed as specified in section 3.3.3.1 of the **Manual for Profile Measurements: Operational Field Guidelines**. Additional instructions specific to the automated Dipstick, model 2000, are as follows:

Zero Check. A zeroing shall be performed prior to any field data collection. The device should be fully assembled, turned on, and allowed to warm up for several minutes prior to performing the zero check. The check should be accomplished in a smooth clean stable location (the carrying case for the dipstick, or a flat board will suffice) where the instrument can be properly positioned. Circles shall be drawn around the two footpads and the CAL button depressed once. The instrument should then be rotated 180 degrees and the two footpads placed in the circles drawn earlier. The CAL button should again be depressed once. The display will indicate "CAL" three times after which the error is automatically stripped out of the readings. No physical adjustments should be made. Zero can only be performed once. If the check is not successful the Dipstick must be turned off and turned back on and the zeroing repeated. After data collection the zero will be verified by comparing the readings obtained by rotating the device 180 degrees but without depressing the CAL button. If this check fails the data shall be discarded and the survey repeated.

Calibration Check. Calibration verification should be accomplished before and after each use of the instrument. After the zero check the calibration is checked as follows: Place the 3.175 mm (0.125 inch) shim under one of the dipstick footpads. The reading displayed minus 0.125 should equal the previous reading ± 0.003. If the answer is not within this tolerance an FHWA-LTPP major maintenance report should be filed and Face Construction Technologies, Inc. should be contacted through the RCO office. The calibration check shall be performed again, immediately after data collection and prior to shutting off the device.

Form DS-8, included in this document, should be used to record this information.

3. Longitudinal Profile Measurement

Automated data collection requires inputs to the palm-top computer as follows:

Under the bar menu item **Database**, select **New**; the "Database Name" should consist of the RCOC and year:

Example - "NCRCO96"

Under bar menu item **Settings**, select **Hardware**; "Dipstick" is Metric, "Foot Spacing" must be set at 305 mm, "Mode" must be Automatic (not Trigger),

"Survey Speed" should be 700 RPH, "Capture" should be Averaging, "Averaging" should be 2 readings, "Allowable Difference" should be set at 003.

Under bar menu item **Collect**, select **New**; "Run Name" should consist of the section ID (State Code + SHRP ID) and year:

Example - "42162796"

To start the profile measurement, the Dipstick should be placed with one foot on the marked elevation survey line in the RWP at Station 0 and the foot in the direction of the start arrow on the unit, positioned on the survey line. The start arrow on the Dipstick should point forward in the direction of traffic. The operator presses <Enter> when ready to collect data (following the instructions which are indicated on the computer screen)

After a reading stabilizes, it will be recorded automatically. The Dipstick should then be rotated to the next measuring point using a clockwise rotation. After the reading has stabilized it will be recorded automatically. This procedure should be repeated for the entire length of the test section. During the measurements, the following precautions and procedures should be used:

+ Always use a clockwise rotation.

  The handle of the Dipstick should be held in a vertical position.

  Lateral pressure should not be applied to the handle during a measurement.

+ The foot pads should be placed to avoid minor localized cracks, holes, open joints, the edge of open joints or wide cracks, and loose stones or debris.

+ If for any reason the measurements must be stopped, circles should be drawn around both foot pads with the start arrow in the direction of traffic at the last measurement position. The operator will note the reading number and end the Run by pressing <Enter>. When restarting the measurement process the Dipstick shall be returned to this position and adjusted so that the current measurement location agrees with last location prior to stoppage. On the computer the operator will then use the menu item **Collect**; **Append** and select the Run Name that was interrupted. The last reading number is entered and the collection process is continued from that point. A comment must be made on data sheet DS-9 indicating the interruption; note the reading number, cause for the interruption and any other relevant information.

+ If it is not possible to mark the leg positions prior to stoppage or to successfully reposition the Dipstick in the same position, then the data must be discarded and the measurement procedure restarted from the beginning.

After the last measurement in the right wheel path at Station 152.4-m (reading number 500 or 1,000 for some SPS-6 sections), the location of the front Dipstick foot should be compared to the pre-measured end point location. If the front foot is within 152-mm of the marked end point location, proceed with the transverse closure measurements as indicated below. If the front foot is not within this interval, perform the following:

Draw circles around each foot and note the direction of the start arrow.

+ Check the data for skipped or missing measurements by keeping track of the number of readings and the actual distance from the beginning point. Since the dipstick foot spacing is 305 mm (one foot) this should be a straightforward calculation for a 152.4 m (500 foot) test section.

+ If no apparent anomalies are present in the data, remeasure the length of the longitudinal survey line to verify the position of the end point. If the re-measured location of the end point is within 152-mm of the front foot of the Dipstick, remark the transverse line at this location and proceed. If the end-point is not within 152-mm of the Dipstick front foot, discard the data as suspect and restart the survey measurement from Station 0.

After the location of the last measurement in the right wheel path has been verified, the corner reading is identified in the data file by entering the keystroke <Ctrl-F10>. The transverse closure measurements should be then initiated by rotating the rear foot of the Dipstick toward the left wheel path and placing it on the premarked transverse line. When the Dipstick reaches the point in which the next measurement along the transverse survey line would pass the location of the Left Wheel Path, it should be rotated so that the foot pad rests at a point on the closure circle (CC). After this measurement is recorded, rotate the device so that the foot pad rests on top of the intersection between the longitudinal survey line in the LWP and the transverse line. Record the corner reading number by entering the keystroke <Ctrl-F10>. This procedure is illustrated in Figure 1.

Begin measurements down the longitudinal survey line in the LWP

When the last measurement in the LWP is made at Station 0, verify that the position of front Dipstick foot is within 152-mm of the end point. If not, follow the procedures for end point verification previously discussed for the measurements in the right wheel path. This corner reading is identified in the data file by entering the keystroke <Ctrl-F10>. If a problem is found with a missing or skipped measurement or the final location of Dipstick in the left wheel path, the measurements in the left wheel path should be discarded as suspect and the survey restarted at the beginning point in the left wheel path.

After the location of the last measurement in the left wheel path has been verified, then closure measurements along the transverse line back toward the starting point in

the RWP should be performed. As illustrated in Figure 1, use the closure circle made around the starting point to close the elevation survey on the start point.

To end data collection the operator presses the <Enter> key, not the key combination used to identify corners.

4. Post Data Collection Check

After completing the survey, the operator must conduct the zero and calibration checks. The results of these checks should be entered on Form DS-8.

+ If the Dipstick fails the zero check, then the data should be discarded as suspect and another survey should be performed.

+ If the Dipstick passes the zero check, but fails the calibration check, the data should be discarded as suspect and the Face Technologies should be contacted for repair, as discussed under section 3.3.3.1 of the **SHRP Profile Measurement Manual**.

+ If the Dipstick passes both tests, the closure error computations should be performed.

5. Closure Error Computations

These closure error computations are performed in the field prior to leaving the site. Using the features in the COLLECT program the error is calculated and displayed for the operator. This reading should be recorded on Form DS-9.

If the closure error is greater than ± 76 mm (3 inches), then the data should be discarded as suspect and the test section resurveyed until the closure error is less than this amount.

6. Data Handling and Processing

Data may be processed on the palm-top computer with the COLLECT software and the resulting output files later transferred along with the database files to the RCOC designated PC compatible computer configured to accept such data. Alternatively, the database file may be transferred to the designated computer for processing using the RFDESK program. In either case the database file must have a backup copy at the RCOC office as soon as possible after data collection.

Processing the data will be accomplished using the **Process Data** selection under the **Database** menu. This selection activates a bar menu containing edit, report generation, and output features. Ouput destination is selected under **Output, Destination**, choosing "fle" for file. When prompted, enter the root name corresponding to the Run Name. The run to be processed must be edited to "Unbox"

the file, based on operator input of the reading numbers for the corners of the box. (Corner locations, where <Ctrl-F10> was keyed in during data collection, are stored as run notes and may be viewed by using **Reports, Run Notes**.) Once accomplished, the operator generates an output file using the menu item **Reports** and under that, item **LTPP-Long**. This produces a text file containing header information and the reading number and elevation for all points along the section, with the left wheelpath result already corrected to reverse the direction. This file is to be processed further by the RCOC using the latest version of PROQUAL to produce an IMS compatible set of data.

Any questions regarding this directive should be submitted to the FHWA Pavement Performance Division with a copy to the LTPP Technical Assistance Contractor (TAC).

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Approved by:

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LTPP Operations

LTPP Automated Dipstick Data Collection Longitudinal Profile Form DS-9 Measurement Information and Closure	State Code [__ __] LTPP Section [__ __ __ __] Date (dd/mmm/yy) __ __ / __ __ __ / __ __

Operator: _____ Database Name: _____

Employer: _____ Run Name: _____

Dipstick Serial Number:

Start Time (military): __ __ : __ __ Stop Time (military):

Weather: _____

Closure Error:

Comments:

LTPP Automated Dipstick Data Collection Longitudinal Profile Form DS-8 Zero and Calibration Checks	State Code [__ __] LTPP Section ID [__ __ __ __] Date (dd/mmm/yy) [__ __ / __ __ __ / __ __]

Operator: _____ Employer: _____

Dipstick Serial Number:

Pre Measurement Checks

Time (military):

Automatic Zero Performed:

Calibration

Calibration Check	
Measurement	Reading (inches)
First Reading	
Second Reading on Calibration Block	
Second Reading - 0.125 - First Reading	

Note: Reading 2 - Reading 1 must equal 0.125 with a tolerance of 0.003. If not, notify the RCOC office and contact Face Technologies for repair.

Post Measurement Checks

Time (military): __ __ : __

Zero Check Acceptable:

Calibration Check	
Measurement	Reading (inches)
First Reading	
Second Reading on Calibration Block	
Second Reading - 0.125 - First Reading	

Note: Reading 2 - Reading 1 must equal 0.125 with a tolerance of 0.003. If not, notify the RCOC office and contact Face Technologies for repair.

Comments