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Development of the California Pavement Management System

Volume 2
Manual of Rating Instructions

Caltrans

FINAL REPORT
October 1978

FHWA-CA-HM-7139-78-04

NOTICE

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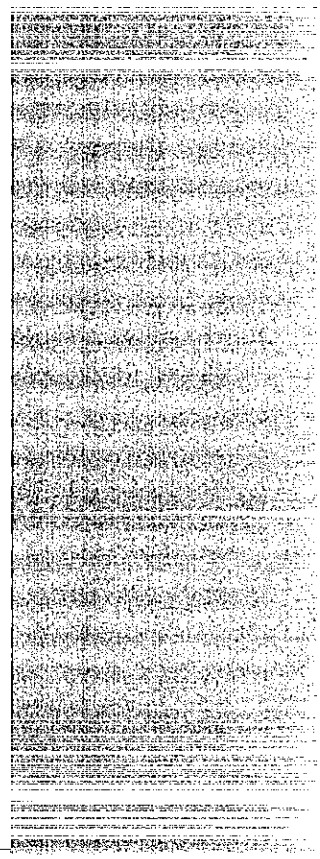

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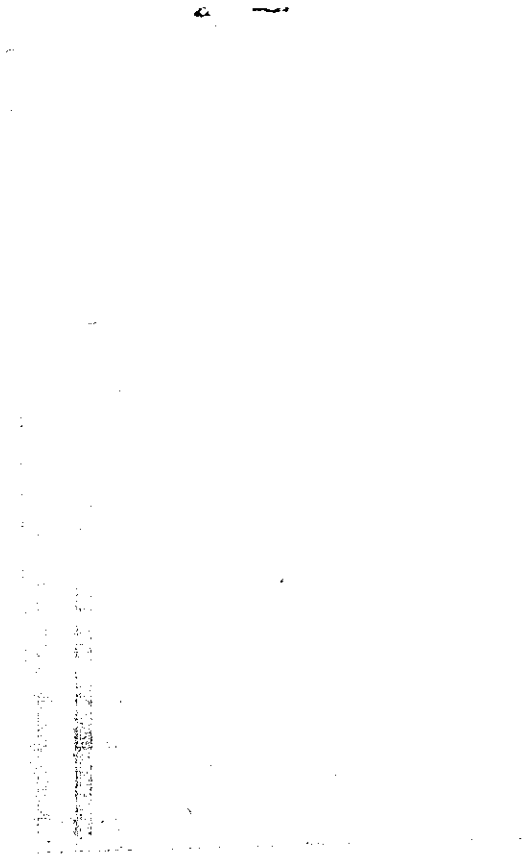

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The Pavement Management System uses data gathered every two years in a statewide pavement condition survey. This survey rates and measures physical condition and ride quality of all through lanes of the California State Highway System. A "Manual of Rating Instructions for Pavement Condition Surveys" was developed in order to establish consistent pavement condition inventory. The manual is used for training and as a reference in the field. Consistent and accurate application of these guidelines is essential to a successful Pavement Management System.

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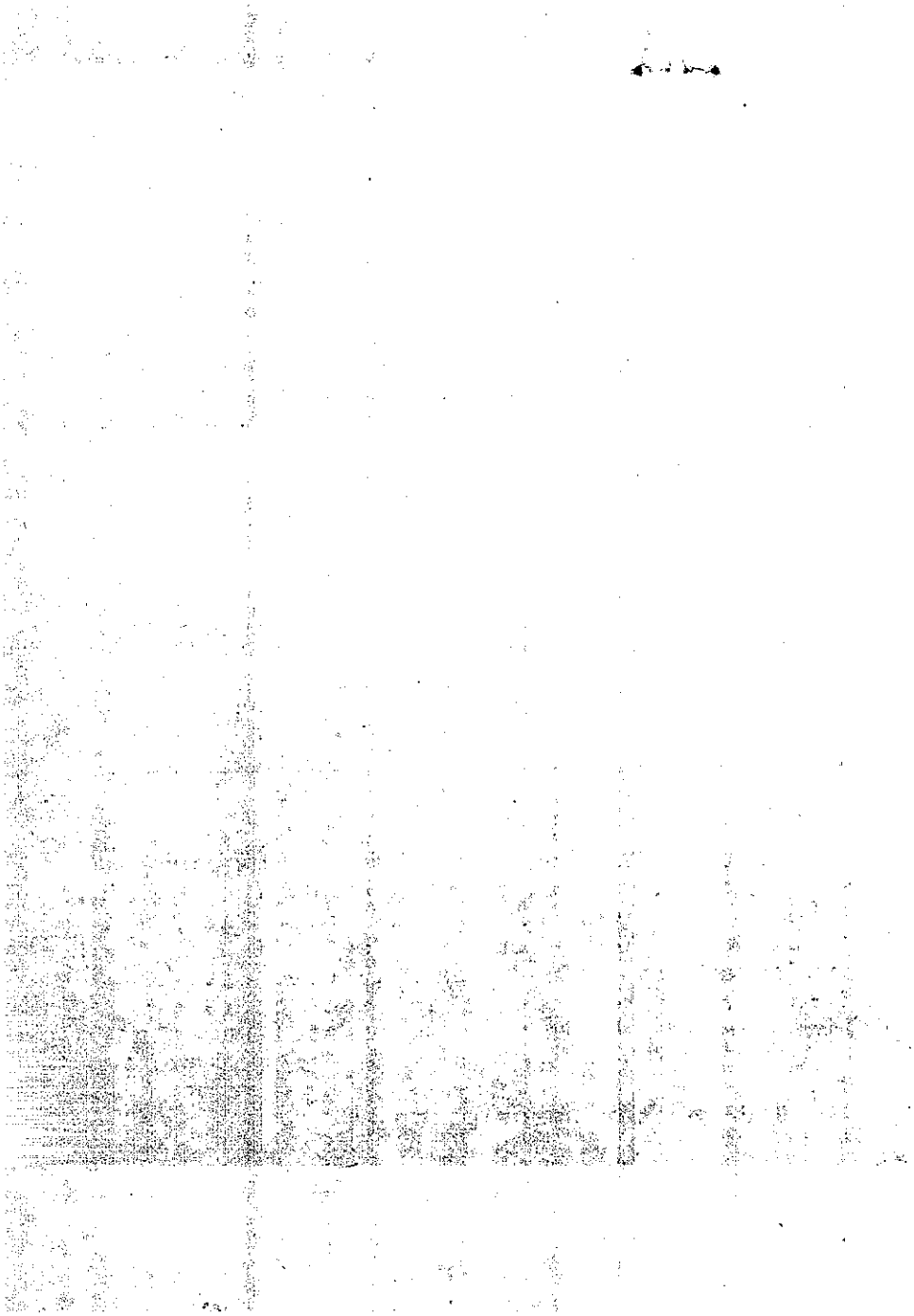

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PART I GENERAL DETAILS

A. General Survey Description

1. Pavement Condition Survey: A biennial statewide inventory on the present surface condition of the entire state highway system. The surface condition and ride quality of the through lanes are measured and rated lane by lane.

   Highways are classified according to surface type. All "black" pavements, regardless of the depth of asphalt wearing course or underlying pavement structure, receive flexible system ratings. PCC surfaces, "white" pavements, receive rigid system ratings.

2. Control Sections: A control section is a section of highway having basically the same roadway characteristics.

   Old construction contract limits are an example of a control section and should be observed whenever possible. A control section will generally be divided into subsections or segments.

   The term "subsection" as used in these instructions refers to control section divisions of the flexible system. "Segment" refers to control section divisions of the rigid system.

3. Subsections: Subsection breakdown is necessary when there is a definite change in roadway condition i.e.; an apparent difference in surface type, age of surfacing, or severity and extent of surface problems.

   The limits of a maintenance supervisor's territory, cost center, are also observed as subsection breaks.

   The minimum length of subsection is 0.10 mile. In actual practice subsections less than 0.20 mile in length are not generally rated separately. The maximum length of a control section rarely exceeds 10 miles. If contract limits or other reasons for dividing a control section are unknown, the maximum practical length is 15 miles.

4. Segments: The standard length of rigid pavement (PCC) segment is one mile. Segment break down is made at:

   - o Full postmiles
   - o Contract limits
   - o Cost centers
   - o Bridges
   - o Beginning and end of AC overlays

   Bridges, contract limits, etc. rarely occur at even postmile points. Fractional postmiles at beginning or end of segments result in non standard segment lengths. A resultant segment less than 0.50 mile is included with the adjacent standard segment creating a long segment. A resultant segment greater than 0.50 mile and less than 1.00 mile is rated separately.

   Segments less than 0.50 mile may occur between bridges, or between bridges and other segment break points. The minimum length of a segment of rigid pavement is 0.10 mile. The length of a long segment will generally be less than 1.50 miles. See Figure 1.

5. Bridges: Bridge decks are not rated in either system and are excluded from ride score measurements. (See lane coding in structions for identifying bridges on the flexible system, Part III-A-2)

6. Bridge Approaches: Bridge approach and leave slabs on the rigid system are identified and ride rated independently from the intervening pavement segments. Bridge approaches on the flexible system are not rated.

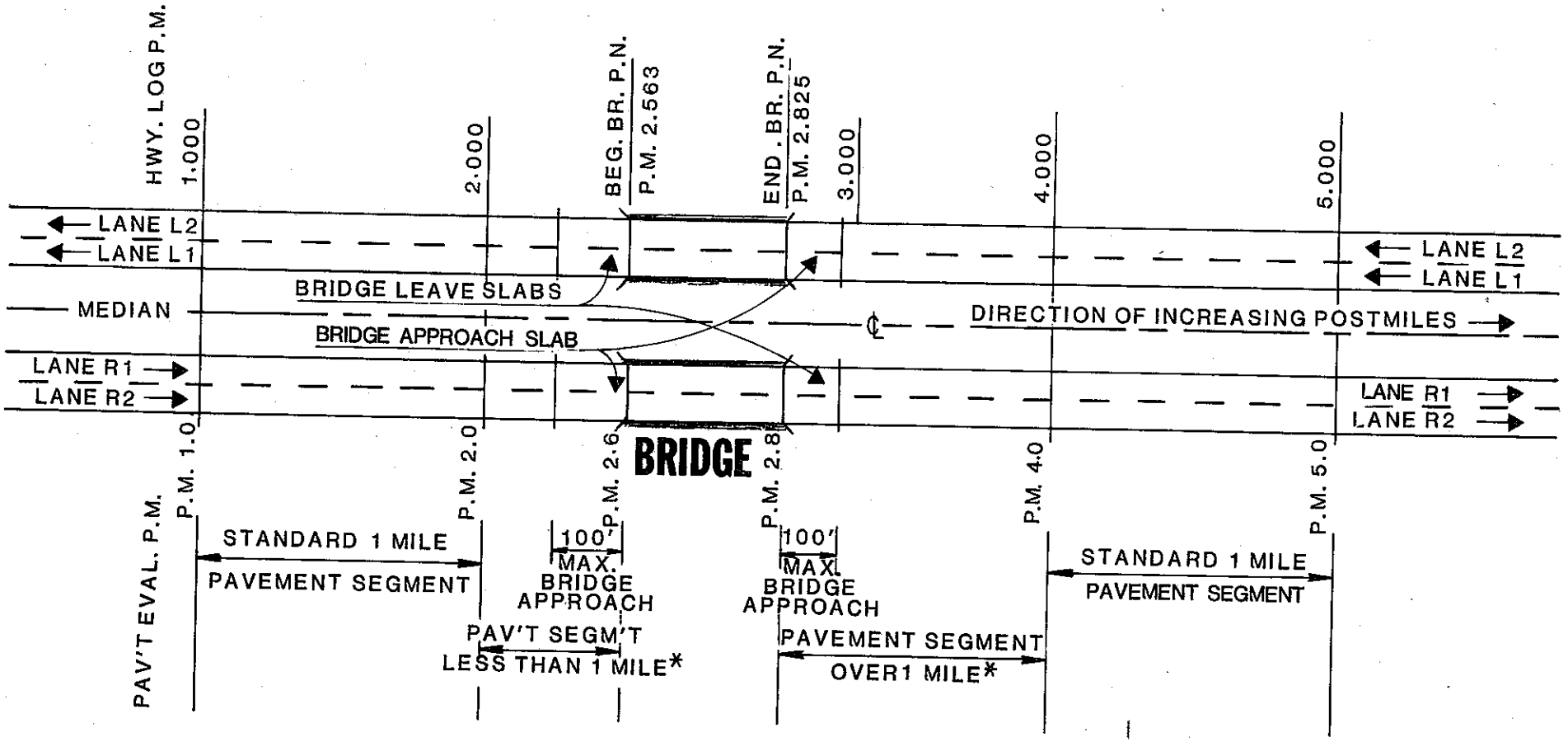
7. Interchange Ramps and Collector Roads: On and off ramps at interchanges are not presently rated. A ramp and collector road evaluation system is being studied.

FIGURE 1

PAVEMENT CONDITION SURVEY

RIGID SYSTEM

IDENTIFICATION OF PAVEMENT SEGMENTS AND BRIDGE APPROACHES



*FRACTIONAL POST MILES AT BEGINNING AND END OF PROJECTS AND BRIDGES RESULT IN NON-STANDARD LENGTH OF PAVEMENT SEGMENT. RESULTANT SEGMENTS OVER 0.5 MILE ARE CODED AS SEPARATE SHORT SEGMENTS. RESULTANT SEGMENTS LESS THAN 0.5 MILE ARE CODED WITH THE ADJACENT FULL SEGMENT CREATING A LONG SEGMENT.

B. Flexible System

The flexible system is designed to identify and account for every lane mile of State maintained highway. Every subsection of asphalt surfaced roadway and control section of rigid pavement are identified and listed in route sequence order, south to north and west to east in accordance with the overall route direction.

Lane by lane the surface condition and ride quality of asphalt surfaced roadways are rated.

Rigid, PCC, pavements are identified and listed on flexible system printouts for route continuity. Rigid pavement condition and ride ratings are made and listed separately.

C. Rigid System

The rigid system is a supplement to the flexible system. While rigid pavement control sections are identified and listed in the flexible system, only rigid, PCC, pavements are included in the rigid system. The two systems vary in other respects, such as in the division of control sections, but every attempt has been made to keep them as much alike as practical.

Lane by lane the slab condition and ride quality of all PCC pavements are rated. The ride quality of PCC bridge approach and leave slabs are rated. The right-hand lane/shoulder joint and the surface condition of the right shoulder are categorically rated.

PART II RIDE RATING

A. General Information

1. Equipment: Ride rating measurements are made with Soiltest Model ML-500B Road Meters installed in 1975 Plymouth Valiant sedans. The road meters have special folded scale transducer discs for recording plus and minus counts of equal magnitude on the same counter.

   The Valiants are fitted with cruise control units to aid in maintaining a constant speed. They are also specially fitted with 4-ply standard bias ply tires that have been trued and balanced.

2. Road Meters, General: The Soiltest Wisconsin Road Meter is a PCA response type road meter which measures the deflections between the vehicle body and the rear axle. It has two channels which allows consecutive tests to be run without stopping. One test may be run while the data of another test is being displayed.

   The road meter has two primary parts.

   - The coded wheel transducer, which is mounted in the trunk over the rear axle.
   - The control console, which is mounted beneath the dash.

   A cable connects the transducer geared belt drive to the differential housing. This cable should be disconnected when the road meter is not in use for any extended period of time. It must be disconnected from the belt drive if a bumper jack is used to change a rear tire.

   As the test vehicle travels over the road, the transducer disc rotates and a photoelectric pickup counts the number of 1/8-inch incremental deflections between the vehicle body and the rear axle. This information is fed through an electrical cable to the console where it is stored for the distance of the test.

   The meters have motor driven transducers, (auto null) which automatically find the zero point when there is a weight change or load shift in the vehicle. They are also equipped with two optional accessories mounted under the dash.

   - An odometer reading to one one-thousandth of a mile.

- o A printer capable of printing the count for each segment and odometer reading on paper tape. The address or count segment is printed in red and the number of deflections in blue.

Both of these optional features operate off 120V AC. The inverter which converts the car battery 12V DC to 120V AC is mounted under the front seat. The inverter has an "on" and "off" switch and is independently fused. Should the odometer and printer fail to work, check the inverter switch and fuse.

A copy of the manufacturer's instructions on installation and operation of the equipment is kept in each vehicle.

3. Vehicle Factors: Variable vehicle properties such as suspension, tires and weight distribution have an adverse effect on repeatability of road meter measurements. To minimize these effects the following precautions are to be observed:

   - o The roof-mounted sign must be in the up position when ride rating. The fold-down mount allows the sign to be carried in a horizontal position when traveling.
   - o Keep tires inflated to 28 psi. Check pressure aily when tires are cold.
   - o Work off the top one-half a tank of gasoline. If possible, do not allow the gas gauge to fall below one-half full.
   - o Do not carry excess weight in the trunk compartment. Luggage, etc. may be carried in the rear seat.
   - o Do not rate ride with more than two people, a driver and rater, in the vehicle.

Identically equipped vehicles will produce different ride measurements on the same section of pavement. To compensate for this all road meter equipped sedans are checked against a measured test section near Sacramento. Road meter readings of each vehicle are compared with a "standard" reading for the test section. An appropriate vehicle factor is thus determined for each vehicle used in the survey.

4. Equipment Checks: Every survey each vehicle is checked at least three times on the Sacramento test section. An initial check is made at the start of the survey, another about mid-survey and a final check at the conclusion of ride rating.

Raters are to perform independent checks periodically during the survey on convenient sections of road they select for this purpose. A standard reading for the check section is to be established by making a minimum of four passes. Once or twice a week thereafter road meter readings should be checked against the average of these initial measurements. A variation in the sum of counts of 10% is cause for having the vehicle or meter serviced.

A more thorough check is to be made if any repairs are made on the vehicle or road meter in the district, which may affect results.

- Select a second check section, one having a relatively higher ride score than the first.
- Before and after the repairs make a minimum of two runs on both sections. The variation in count between similar runs should be less than 10%. If this tolerance is not met, the car will have to be recalibrated at Sacramento.
- Compare the average of the after-repair counts on the check section with the standard count established earlier. If the difference is more than 10% the vehicle is to be returned to Sacramento for recalibration.

5. Speed: The basic speed at which ride measurements are taken is 50 mph. Speeds of 40 and 25 mph are acceptable. A maximum deviation of 5 mph is allowed.

Code 50 = 45 to 50 mph
Code 40 = 35 to 44 mph
Code 25 = 20 to 30 mph

If 20 mph cannot be attained enter the Code 25 and explain the condition in remarks. The ride measurements should be taken at 50 mph unless there are speed zone restrictions or it is unsafe.

A reduction in speed mandated by sharp curves, winding roads and steep grades is reason enough to divide a control section into subsections.

6. Ride Score: Ride score is a single value that represents the general significance of ride quality. It is computed from the sum of 1/8-inch deflections accumulated over a measured distance.

   Ride score is computer calculated using the following equation:

$$\text{Ride Score} = \frac{\Sigma \text{ PCA Road Meter Counts}}{50 \times \text{Odometer Length}} \times \text{Vehicle Factor}$$

   (Meter Counts = Counter Number times Number of Counts)

7. Ride Score Measurements: It is not essential that ride measurements be taken for the full length of a roadway section. It is, however, essential that as much pavement as is practical be included in the ride measurements. The larger the sample, the more reliable the resulting ride score value.

   Certain roadway features or conditions which, if included in the ride measurements, might overly influence the ride rating are deleted. Some features and conditions which should be eliminated from ride quality determination are:

   - o Bridge decks
   - o Bridge approach and leave slabs. On flexible pavement turn the meter off near the pavement notch. On rigid pavements the ride quality of the approach and leave slabs are rated separately. Exclude the pavement that is about 100 feet from the bridge/pavement joint on the rigid system.
   - o Railroad grade crossings.
   - o Sharp curves. If most of a section except for a few sharp curves can be comfortably driven at an acceptable speed turn the meter and odometer off while negotiating the curves.
   - o Reduced speed. Any reason for reducing speed more than 5 mph below the speed at which the section is being tested is cause for discontinuing ride measurements until full test speed is resumed.

- Passing slow traffic. Any reason for increasing speed or moving out of the lane being tested is cause for discontinuing ride measurements until lane position and test speed are resumed.

8. Bridge Approach Ride Measurements: Generally, the ride quality of rigid pavement immediately preceding or following a bridge deck exhibits ride characteristics different from those of the intervening pavement. These short sections, 100 feet in length, are ride rated independently. Only deflections equal to or greater than 5/8 inch are recorded and used in calculating the bridge approach ride rating. An odometer length is not required and a speed of 50 mph is assumed. See Part IV Attachment 2, Bridge Approach Ride for further procedural details.

B. Road Meter Operation

1. Push Buttons: The function of the various push button switches is as follows:

   - POWER - press to turn the control console on and off. A small red pilot lamp will light when the power is on.

   - L/T - press to test light emitting diodes (LED's). All seven segments of each LED should glow forming a row of figure 8's.

   - MODE - press to change from manual scan to automatic scanning of counter readouts. When the address, counter numbers, are changing at a steady rate the unit is in the automatic mode.

   - MAN - press to advance the counter segments one at a time when the unit is on manual scan.

     Depressing the MAN push button momentarily will advance the counter one segment. Holding the push button down will advance the counter at the automatic scan rate until it is released.

- RATE - pressing this button with the optional printer attachment connected has no effect on road meter operation. Without the printer attached two rates of automatic scanning are possible. This switch may be used to change the scan rate.

- COUNT - press to turn the transducer photo-electric pickup on and off. An indicator light will appear as a red dot moving back and forth when the transducer is on and the car is in motion.

- RESET - press to clear all counter segments and set them to zero. There will be no change in the visual display unless the LOAD button is depressed.

- LOAD - press to transfer count from the first portion of the circuitry to the storage registers for readout.

  With the COUNT button off the tranducer is not operative, no "bump count" can be taken and all counters will be blank.

- ODOMETER - press the button below the pilot light to start and stop the odometer. With the odometer on press the second button, the one to the left, to print odometer miles.

- PRINTER - press the button below the pilot light to turn the printer on and off. With the odometer and printer on, road meter counts are printed by pressing the MAN or MODE buttons.

2. Transducer Hook-up: Prior to using the road meter the geared belt drive on the transducer must be connected. Open the car trunk and remove the dust cover from the transducer housing. Remove the "keeper cable" from the belt drive and attach the belt to the tension spring. Stretch the spring and place the geared belt over the two sprocket wheels.

   Check the position of the transducer disc assembly. It should be nearly centered on the auto null drive rod. If it is not, lift the belt and allow the auto null drive motor to center the disc assembly. Power must be on, the COUNT button on the console is the power switch to the transducer.

The small toggle switch on the transducer case operates the drive motor. The photoelectric pickup disc must be set slightly off the operating position to center the assembly. The operating position of the disc is with the small rectangular hole at the top of the disc and the photoelectric pickup holes at the bottom.

3. Verifying Check: Although the road meters are 100% solid state electronic and require no warm-up, the following steps should be taken enroute to the test site.

   Step 1. Turn on the console, press POWER button.

   Every time the car ignition or the power switch is turned on it causes a series of random numbers to appear on the console readout.

   Step 2. Press the RESET and LOAD buttons to clear the random numbers on the readout display.

   Step 3. Press the MODE and MAN buttons to check the automatic and manual scan. Observe that each segment is displayed and the cycle repeats after the number 12 segment is displayed. If the power to the transducer is off there will be no "count" numbers displayed.

   Step 4. Press the COUNT button to activate the transducer. The transducer is working properly if the red light appears as a moving dot with the vehicle in motion and the suspension reacting to the irregularities of the roadway surface. The auto null is working properly when the dot slowly moves to the left and momentarily disappears from view.

   With the vehicle stopped the dot should disappear from view and remain so until there is a change in vehicle loading or the rear springs are flexed.

4. Spot Survey Procedure: This procedure may be used when a single test is being made.

- Turn on the power and check out the equipment as previously described. Be sure that the auto null has adjusted to zero.

  If you wish to have the data recorded on paper tape turn on the printer.

- Turn off the odometer and set to zero.

- Approach the section of road at a steady speed. The cruise control should be used to maintain a constant 50, 40 or 25 mph.

- When you reach the beginning of the stretch of road to be tested, press the RESET and ODOMETER buttons simultaneously and release.

- At the end of the section press the LOAD and ODOMETER buttons simultaneously.

- The readout of deflections may be by automatic or manual scan mode and the distance traveled is the odometer reading.

- To record the data on paper tape the odometer must be on. If a tape printout of the odometer length is desired the odometer PRINT button may be substituted for turning the odometer off at the end of the section. Thus the odometer length is printed at the end of the run and count data may be printed while the odometer is allowed to continue to run. Press the MAN button to print in the manual mode or press the MODE button for the automatic scan rate. To stop the printer while on automatic scan press the MODE button.

When there is a need to exempt certain roadway features or conditions from the test, turn the transducer and odometer off at the beginning of the condition and back on again after leaving the affected area. Press the COUNT and ODOMETER buttons simultaneously to stop and start the test.

5. Continuous Survey Procedure: Use this procedure when successive tests are taken. This procedure may be repeated as long as there is enough time to record or print out the data from one test while the next test is being run.

- o Check out the equipment and proceed into the first test section as described for a spot survey.

- o At the end of the first section, (beginning of the second section), press the LOAD and odometer PRINT buttons simultaneously. Immediately press the RESET to clear the counters of the first section count and start new count accumulation for the second section.

- o Record or print out data from the first section which is now on the console readout while running the second section.

- o At the end of the second section, (beginning of third section), again press the LOAD and odometer PRINT push buttons simultaneously. Subtract the first odometer miles from the second odometer miles on the paper tape and record the difference as the odometer length of the second section.

6. Two Test Storage: Use this procedure when a succeeding test is not long enough to allow data from the preceding test to be recorded. With this procedure data from both tests may be retained but a third section cannot be started immediately.

   - o Complete one test section and start another as described for a continuous survey.

   - o Press the COUNT and odometer PRINT push buttons simultaneously at the end of the last section.

   - o Complete recording of data on console readout. Press the LOAD button to transfer data from the last section to the console readout.

PART III FLEXIBLE SYSTEM

A. Field Input Document: This computer generated form is completed in the field. Necessary corrections are made to update the data to correspond with current conditions.

1. Pre-printed Data

The following information is pre-printed on the form:

- o District, County, Route, Cost Center
- o Subsection sequence number
- o Subsection postmile identification
- o Subsection road type
- o Average annual inches of rain
- o Number and direction of traffic lanes

The above information is in the computer file from the prior survey. If it is not correct or does not correspond to the current California State Highway Log cross out the incorrect entry and enter the correct notations.

Both flexible and rigid road types are included in the flexible system. Although rigid pavement is rated independently, rigid pavement control sections are identified and included on the flexible input document.

Additional pre-printed information about each subsection may be given. Up to fifteen lines of remarks may be printed. This information is also updated and corrected to current status.

A maximum of forty characters (spaces), not including the line number, are available per line of message. If more characters are needed break the message at the end of a word and use another line to complete the entry. Abbreviations should be limited to those of common usage.

Line 01 is reserved for the geographical description of the section. Geographical descriptions should always be map oriented. Use names that appear on a good road map of the area. The geographical description format used in the Traffic Volumes booklet is preferred and should be used whenever applicable.

CALIFORNIA DEPARTMENT OF TRANSPORTATION.
DIVISION OF MAINTENANCE
OFFICE OF HIGHWAY MAINTENANCE OCTOBER 1977

PAVEMENT CONDITION - FIELD INPUT DOCUMENT
1977-78 SURVEY
FLEXIBLE PROGRAM

LEGEND
1=FULL FWY 3=TWO LANE F=FLEXIBLE
2=MULTILANE 4=CITY R=RIGID
9=CITY MAINTAINED

DIST: -- CO: --- RTE: ---- - COST CNTR: ---

RATER: _____

DATE: ___ ___ ___ (MO DAY YR) CHC NO: __ __ __ __

SEQUENCE NUMBER	LOCATION PRE FIX	LOCATION POST MILE	LOCATION PRE FIX	LOCATION POST MILE	ROAD TYPE	IRI	ROADMETER READINGS	PAVEMENT CONDITIONS
320130	9.0	9.5	3F	020				
01 CAFFNEY RD TO CLARKSBURG RD								
320140	9.5	11.7	3F	020				
01 CLARKSBURG RD TO BABEL SLOUGH RD								
320150	11.7	13.4	3F	020				
01 BABEL SLOUGH RD TO N OF BABEL								
02 SLOUGH RDL								

FIGURE 2

EXAMPLE INPUT DOCUMENT

Pre-printed explanations or descriptions of roadway condition may no longer be appropriate. A deletion is made by lining out the unwanted comment. It may be necessary to renumber the lines of remaining information. The computer will arrange the lines in numerical order. If remarks are unclear they should be rewritten.

When readily available or reasonably accessable construction and maintenance history of each subsection is to be chronologically listed. The area maintenance superintendent is a potential source of such information. List most recent work first and the year constructed last.

Occasionally it will be necessary to divide the control sections into subsections different from those identified. Some space, five lines, is provided between pre-printed subsections for additions. Changes requiring more space are made on blank pages provided for this purpose. Complete heading and identification information will have to be written in to input extensive revisions.

2. Identification Entries

District: The district maintaining the roadway. Use a zero prefix for districts 01 through 09.

County: The standard two or three letter abbreviation.

Route: Legislative route number, a three digit number. Use leading zeros for routes 001 through 099. Legislative route descriptions are given in the Traffic Volumes booklet. Entries are to correspond with current Statutes or State Highway Log.

An alpha suffix to the normal three digit number is used to set apart those roads where for some reason duplicate route numbers are appropriate. For example, an X suffix is used to identify a superseded highway maintained by the State.

Cost Center: A three digit Maintenance Management Systems code number assigned to each maintenance supervisor's territory.

Rater: Enter the name of the person who rated the condition of the roadway.

Date: Enter two digits each for month, day and year, i.e.; 01 (January), 05 (5th day) and 78 (1978).

CHC No.: Enter the four digit CHC number assigned to the vehicle equipped with a road meter and used to measure ride quality.

Sequence No.: A six digit number assigned to each subsection for computer sorting and listing in numerical order. This number allows for listing prior and current survey data together in chronological order according to control sections.

The pre-printed listing of subsections is in consecutive route and postmile order. Computer sorting by sequence number overrides postmile order. Pre-printed subsections that appear out of order on the field input document are to be assigned corrected sequence numbers. Correct assignment of sequence numbers to additions will assure that subsequent computer listings are in proper order.

From and To Postmiles: Postmile identification to the nearest 0.1 mile including prefix. Postmiles are to correspond to those in the current State Highway Log.

Road Type: The five codes for classifying highway types are listed in the legend appearing in the upper right corner of all pavement condition printouts. These are more fully defined as follows:

Code 1 = Full Freeway; All arterial highways with full or partial control of access including freeways, expressways, and parkways.

Code 2 = Multilane; Conventional rural or urban highways with more than one lane in a direction of travel.

Code 3 = Two lane; Conventional rural or urban two lane highways.

Code 4 = City Street; City streets or highways which are maintained by the State and meet any one or more of the following conditions.

- Curbs and gutters on either side.
- Sidewalks.
- Marked or unmarked parking spaces.
- Contiguous land use is business or residential with 16 or more buildings fronting upon the highway in one quarter of a mile.

Code 9 = City Maintained; Any of the above highway types that are maintained by a city or other local jurisdiction.

All of the above number codes are coupled with a surface type code.

F = Flexible; All "black" pavements, regardless of the depth of asphalt wearing course or underlying pavement structure.

R = Rigid; All "white" pavements, PCC surface.

B = Bridge

T = Tunnel

V = Viaduct

BA = Bridge Approach (Rigid system only)

Inches of Rain: The mean annual precipitation in inches for the area. One or two digits are used. Rainfall equal to or greater than 99 inches per year is shown as 99.

Direction: The traveled way, right or left of center line facing in the direction of increasing postmiles.

Leave direction blank for bridges, tunnels and viaducts only.

Lane: Lane numbering on multilane highways is from left to right when facing in the direction of traffic flow. A two-lane road has one lane for each direction of travel. Up to 9 lanes in one direction may be coded.

Leave lane number blank for bridges, tunnels and viaducts only.

Code direction and lane number for subsections of roadway that are being excluded from rating. Explain reason for exception, i.e; construction, lane closure, etc. in remarks.

3. Ride Rating Entries

For specific instructions on how to rate ride quality see Part II - B, Ride Rating.

Speed: Enter the speed at which the ride measurements are taken. Do not leave blank.

Code 50 = 45 to 50 mph.
Code 40 = 35 to 44 mph.
Code 25 = 20 to 30 mph.

Odometer Length: Enter the road meter odometer reading to the nearest 0.01 mile.

Road Meter Readings: Enter the number of accumulated deflections (counts) for each of the transducer segments 1 through 8.

4. Pavement Rating Entries

For detailed descriptions and instructions on how to rate specific condition see Part III Attachment 2.

Condition categories and rating codes to be entered on the Field Input Document are:

Alligator Cracking:

Type A

(Initial stage)

% Wheel Paths

Code 01 = 1%
Code 02 = 2%
Code 03 = 3%

.
.
.

Code 99 = 99%

Type B

(Interconnected cracks)

% Wheel Paths

Code 01 = 1%
Code 02 = 2%
Code 03 = 3%

.
.
.

Code 99 = 99%

Type C
(Other pattern type)

Enter a ( ) check mark and explain condition, extent and severity in remarks.

Block Cracking:

% Length

Code 01 = 1%
Code 02 = 2%
Code 03 = 3%
.
.
.
Code 99 = 99%

Transverse Cracks:

Severity	Number per 100 ft. Station
Code 1 = <1/8 inch (hairline)	Code 1 = 1 crack/sta.
Code 2 = >1/8 inch	Code 2 = 2 cracks/sta.
Code 3 = 1/4 inch	Code 3 = 3 cracks/sta.
Code 4 = 1/4 inch	.
	.
	.
	Code 9 = 9 or more cracks/sta.

Longitudinal Cracks:

Severity	Lineal Feet per 100 ft. Station
Code 1 = <1/8 inch (hairline)	Code 1 = 1 to 100 L.F./Sta.
Code 2 = 1/8 inch	Code 2 = 101 to 200 L.F./Sta.
Code 3 = 1/4 inch	Code 3 = 201 to 300 L.F./Sta.
Code 4 = >1/4 inch	.
	.
	.
	Code 9 = 801 to 900 L.F./Sta.

Ravel and Weathering:

Severity	% Length	Drip Track Ravel Number of Locations
Code F = Fine	Code 01 = 1%	Code 1 = 1 location
Code C = Course	Code 02 = 2%	Code 2 = 2 locations
	Code 03 = 3%	Code 3 = 3 locations
	.	.
	.	.
	.	.
	Code 99 = 99%	Code 9 = 9 or more locations

Rutting:

% Length
Code 01 = 1%
Code 02 = 2%
Code 03 = 3%
.
.
.
Code 9 = 99%

Patching:

Surface Condition	% Area
Code G = Good	Code 01 = 1%
Code F = Fair	Code 02 = 2%
Code P = Poor	Code 03 = 3%
	.
	.
	.
	Code 99 = 99%

5. Shoulder Rating Entries

For detailed instructions on how to rate the condition of the right hand shoulder see Part III Attachment 2.

Right Shoulder Condition

Code G = Good
Code F = Fair
Code P = Poor

B. Glossary: "If individuals involved in pavement management processes are to communicate fully they must use terms that have the same meaning."[1] The attached summary of standard terms has been compiled from several sources to promote uniformity and as a guide and aid to the rater in recognizing and properly classifying most conditions which occur to asphalt surfaced pavements. Each rater must be familiar with these terms and the detailed instructions for rating specific conditions.

C. Condition Rating: Six flexible pavement conditions have been identified to receive categorical ratings. Attached are detailed descriptions and instructions on how to identify and rate each category including the surface condition of the right hand shoulder. Each rater must be thoroughly familiar with these instructions and glossary of terms.

[1]HRB Special Report 113 Standard Nomenclature and Definitions for Pavement Components and Deficiencies.

Pavement Condition Survey

FLEXIBLE PAVEMENT

GLOSSARY

of

STANDARD DEFINITIONS

AND

DESCRIPTIONS OF AC PAVEMENT CONDITION

California Department of Transportation
Division of Maintenance
Office of Highway Maintenance
Sacramento, California

- October 1978 -

Only three types of cracking are categorically rated; Alligator cracking, transverse cracking and longitudinal cracking. Most of the cracking described may be appropriately included in one or more of these categories, i.e., reflection cracking. When the more explicit classification of the condition or conditions are recognized they are to be noted in remarks.

1. Transverse cracking: A crack approximately at right angles to the pavement center line.

2. Longitudinal cracking: A crack or break approximately parallel to the pavement center line.

3. Reflection cracking: Cracking of a resurface or overlay above underlying cracks or joints.

4. Joint Reflection cracking: Transverse and longitudinal cracks appearing in an AC surface over PCC pavement above the weakened plane joints and cracks. Joint reflection cracks occur only in pavements that are PCC slabs overlayed with asphalt. This term is not intended to be used to describe cracking from any other type of base, i.e., cement treated, lime treated; such cracks are to be identified as transverse and longitudinal.

5. Contraction cracking: The horizontal separation of a pavement overlay. This type of crack is due to shrinkage of the surface course with possible loss of bond with the underlying layer.

6. Slippage cracking: Half-moon or crescent shaped cracks. The two ends often point away from the direction of traffic. Slippage cracks are produced by braking or starting wheel thrusts against a soft low strength surface mix or when there is poor bond between the surface course and underlying layer.

7. Edge cracking: Cracking near the edge of pavement usually due to inadequate thickness of surfacing or resurfacing and base.

8. Alligator cracking: Interconnected or interlaced fatigue cracks forming a series of small polygons that resemble an alligator's hide.

   Alligator cracks are always load associated, developing over an unstable base or roadbed. Under repeated wheel loads an embrittled asphalt surface over a resilient foundation will crack. Initially, the

cracks appear as a single longitudinal crack or a series of parallel cracks in the wheel paths. Upon further loading the cracks interconnect forming many-sided, sharp angled pieces which develop a pattern resembling chicken wire or the skin of an alligator.

Type A Alligator cracking: The development of initial single or parallel longitudinal fatigue cracks in the wheel paths.

Type B Alligator cracking: The development of interconnected fatigue cracks in the wheel paths.

Type C Alligator cracking: A catch-all for other pattern-type fatigue cracks due to a localized condition, minimal base or surface thickness.

Alligator cracking of this type generally occurs outside the wheel paths. The cause of the condition is usually apparent such as edge cracking due to widening of a pavement with minimal base or surface thickness. Other examples are; mud-balls in the base, pumping and deterioration at reflective cracks.

The extent and severity of the condition are to be noted in remarks.

Alligator cracking does not occur over an entire area unless the entire area was subjected to traffic loading. Pattern-type cracking which occurs over an entire area that was not subjected to loading is rated as block cracking.

9. Block cracking: Interconnected cracks forming a series of large polygons usually with sharp corners or angles.

Block cracking is not load associated. It is usually due to hardening and shrinkage of the asphalt. The blocks may range in size from approximately 1 x 1 ft. to 5 x 5 ft. Blocks larger than 5 x 5 ft. are rated simply as transverse and longitudinal cracks.

Since block cracking is not load-associated, pattern-type cracking over an entire area that was not subjected to wheel loading is rated as block cracking. Load-associated cracks in the wheel paths are rated as either Type A or Type B alligator cracking. Load-associated cracking outside the wheel paths is rated as Type C alligator cracking.

SURFACE WEAR AND WEATHERING

Wearing surfaces and seal coats exposed to various climatic and traffic conditions are subject to gradual and progressive surface disintegration. The only type of surface disintegration which is categorically rated is ravel. Several of the surface conditions described may appropriately be included in this rating category, i.e.; abrasion and weathering

Texture is a term relative to the appearance or character of the surface that depends on the size, arrangement and distribution of the aggregates and binder. A dense, smooth surface has a fine texture; an open surface has a course texture. The loss of some aggregate from a dense mix may effect texture without harming the integrity of the wearing course. A slight change in surface texture should not be categorically rated as ravel.

10. Raveling: The progressive disintegration of the surface downward by the dislodgement of aggregate particles and binder. Ravel is caused by the action of traffic on a weak surface. Raveling of a weak surface course is generally due to insufficient binder in the mix as opposed to weathering due to drying out of the mix caused by climatic conditions.

11. Weathering: Gradual disintegration of the pavement wearing surface, increasing the texture and exposing more and more of the aggregates. Weathering as opposed to raveling is due to the drying out or loss of bitumen caused by climatic conditions.

12. Abrasion: Scuffing of the wearing course. In snowfall areas where tire chains are extensively used it may be appropriate to rate this condition categorically as ravel. If so rated, it should be noted in remarks that the damaged surfacing is due to tire chain abrasion.

13. Drip Track Ravel: Progressive disintegration of the surface between wheel paths. Drip track ravel is caused by oil and gas dripping from under vehicles. Petroleum products soften and weaken the bitumen causing dislodgement of the aggregate and binder. Ravel due to gas and oil leaching out the asphalt binder is primarily a condition which occurs at intersections where vehicles must come to a stop before proceeding. Being a special condition drip track ravel is not included in the ravel and weathering category but is rated separately.

14. Streaking: Alternate lean and heavy lines of bitumen running parallel to the pavement center lines. Streaking is caused by clogged or improperly adjusted bitumen distributor spray bar nozzles during seal coating. Streaking should not be categorically rated but noted in remarks when significant.

15. Bleeding: Also known as flushing, bleeding is a film of free bitumen on the surface of the pavement. Bleeding creates a shiny, glass-like, reflective surface and is caused by excessive amounts of asphalt in the mix. It occurs during hot weather when the asphalt filling the voids expands out onto the surface. The process does not reverse during cold weather and the asphalt accumulates on the surface.

    Bleeding is not categorically rated but may be noted in remarks when extensive enough to cause a reduction in skid resistance.

DISTORTION AND ROUGHNESS

Any deviation in the pavement surface from its original shape is called distortion. Irregularities in the pavement surface such as potholes, grooves or wheel rim cuts that adversely affect ride quality are collectively referred to as roughness.

Of the following described conditions only one, rutting, is categorically rated. When significant all other types of distortion and roughness may be noted in remarks.

16. Rutting: Longitudinal depressions that form under traffic in the wheel paths and have a minimum length of approximately 20 feet. Rutting is a permanent deformation caused by localized and channeled wheel traffic over unstable pavement or foundation. It may be due to insufficient compaction or plastic movement of the mix.

17. Shoving: Localized displacement or bulging of pavement material in the direction of loading or pressure. Shoving is usually due to a surface course that is too soft to resist the horizontal pressure and that has a poor bond with the underlying pavement.

18. Corrugations: Also known as "wash board" or ripples, corrugations are transverse undulations at regular intervals in the surface of the pavement consisting of alternate valleys and crests less than 2 feet apart. Corrugations are caused by traffic action on unstable pavement or roadbed. Like shoving, corrugations may be due to a surface course too soft to resist horizontal pressure and usually occur where vehicles start and stop.

19. Waves: Longitudinal or transverse undulations in the surface of the pavement consisting of alternate valleys and crests more than 2 feet apart. Waves are generally due to subsidence of the roadbed or base.

20. Bump or Swell: Localized upward displacement of the pavement. A bump is caused by a variety of reasons; frost heave, bulging of a soft pavement from shoving, swelling of expansive material in the structural section or subgrade. A swell or bump may or may not be accompanied by surface cracking.

21. Depression: Also known as "bird baths" depressions are localized pavement surface areas having elevations slightly lower than those of the surrounding pavement. Depressions may be caused by subsidence of the roadbed, settlement, improperly compacted fill in trenches, or patched roadbeds. They may be "built in" during construction.

22. Indentation: Scarring of a pavement surface from such things as wheel rims of blown tires, tractor cleats or sharp objects dragged over the surface.

23. Pothole: Also known as "chuckholes", potholes are bowl-shaped holes of various size in the pavement. Potholes generally start to develop as small localized spots of alligator cracking or surface disintegration. If excess moisture infiltrates the area small pieces of asphalt and base are dislodged and pop out under traffic. Almost all potholes have excess moisture in the bottom.

PATCHED PAVEMENT

Patches are temporary or permanent corrections to damaged pavement areas. Patches, no matter how well they are performing, are categorically rated.

24. Spot Patch: Small localized patched areas such as potholes and small utility cut repairs. Spot patches are generally hand placed and wheel rolled.

25. Short Patch: Short AC overlays, digouts or sporadic seal coats used as a surface repair to small localized areas of damaged pavement. Short patches may be any length up to 100 feet. The maximum area covered by a short patch is generally that which can be covered to the desired depth by one truck load to material. Short AC patches are usually placed with a motor grader. The aggregates for short seal coat patches are usually placed with a mechanical spreader.

26. Long Patch: Extensive lane width AC overlays, digouts, or sporadic seal coats used as a surface repair on long stretches of damaged pavement. Long patches are over 100 feet in length. Generally the maximum length of continuous surface repair considered a patch is 1000 feet. Any isolated patched surface 0.2 mile or longer should be given special consideration as a separate section for rating.

LANE/SHOULDER DIFFERENTIAL

The Lane/Shoulder differential on asphalt surfaced pavements is not categorically rated. It should, however, be noted in remarks when there is a significant difference in elevation between the traffic lane and the paved shoulder.

27. Low Shoulder: The surfaced shoulder is lower in elevation than the lane. This is usually due to overlaying the traveled way and not the shoulder. When the difference in elevation exceeds 3/4-inch a notation in remarks is appropriate.

28. Shoulder Slope: The surfaced shoulder cross slope is much greater than the cross slope of the adjacent lane. This is usually due to feathering out of overlays over partial or full shoulder width. When the difference in cross slope exceeds 15% a notation in remarks is appropriate.

29. Shoulder Bulge: The surfaced shoulder is higher in elevation than the adjacent lane. Shoulder bulge is an upward bulge or curl of shoulder surfacing at the lane edge. This condition rarely occurs on flexible pavements but may occur on overlayed rigid pavements. When the difference in elevation exceeds 3/4-inch a notation in remarks is appropriate.

OTHER CHARACTERISTICS

In addition to those conditions previously described the following flexible pavement characteristics may be noted:

30. Grooved Pavement: Saw cut surface texture. Grooving is done to improve skid resistance. Grooves are 1/8 to 1/4 inch in depth and spaced 3/4 inch on center, concrete between kerfs remains intact.

31. Grinding: Bump cutting to improve pavement profile usually to meet construction profile index specifications. Saw cuts are closely spaced with surfacing between kerfs removed.

32. Polished Aggregate: Insufficient rough or angular aggregate particles in the asphalt wearing course to provide good skid resistance. Existence of this condition is indicated when the skid number is low or has dropped significantly.

33. Pumping: The ejection of mixtures of water, clay or silt through cracks. Generally pumping of flexible pavement is associated with alligator cracking. Pumping may also occur at reflection cracks and joint reflection cracks in AC overlayed rigid pavements. Pumping is most in evidence during or immediately after a rain storm. It may not be apparent in the summer or dry period. Pumping should be noted in remarks when crack edges are mud-strained or other positive evidence is observed.

34. Settlement: Noticeable or abrupt vertical distortion from the original pavement profile or cross slope. Settlement is caused by a shifting foundation and is generally most evident at locations of cut to fill, sidehill cuts, and over or adjacent to structures and drainage facilities. A characteristic wide crack following a defined meandering line with noticeable difference in elevation from one side of the crack to the other may accompany severe settlement. Settlement should be noted in remarks when it has a significant effect on the riding quality of the road.

Pavement Condition Survey

FLEXIBLE PAVEMENT

CONDITION CATEGORIES

AND

DETAILED RATING INSTRUCTIONS

California Department of Transportation
Division of Maintenance
Office of Highway Maintenance
Sacramento, California

- October 1978 -

FLEXIBLE PAVEMENT SELECTION AND RATING of SAMPLE AREAS

1. General: Ratings represent the average overall surface condition of a lane throughout the length of a subsection. To determine the overall average rating the rater selects one or more representative sample areas within a subsection and with close attention to detail rates the extent and severity of each condition.

   For short subsections, up to one mile in length, a single sample may be all that is required. At least three sample areas are generally needed to determine the overall composite rating for long sections.

2. Sample Area Selection: A safe area to park is the first requirement. A detailed inspection cannot be made from the seat of an automobile. Hard hats and approved orange vests or flagmen shirts are to be worn while rating pavement. Consider the typical overall appearance of the subsection and select a sample area that is representative of pavement surface conditions.

3. Size of Sample: The length of the sample area is about 200 feet. Determine the length by pacing, counting broken centerline stripes or reflective markers. The width of sample is one lane, generally 12 feet but may be less.

4. Procedure: Rate each lane separately. Inspect the pavement surface as closely as can safely be done. On some multi-lane high volume roads it may be necessary to prorate evaluations or estimate their extent and severity from a distance. A notation to this effect should be made in remarks.

   Worksheets may be used to rate several sample areas and to develop the composite overall ratings. The final rating should represent an overview of the road rather than that of a particular spot.

PAVEMENT CONDITION SURVEY

FLEXIBLE SYSTEM WORK SHEET

LOCATION		LANE		PAVEMENT CONDITIONS														SHLDR COND		
				ALLIG. TYPE			BLK	TRANS.		LONG.		RAV. & WEATH.			RUT.	PATCH.				
				A	B	C		SEV	EXT	SEV	EXT	SEV	EXT	D. T.	EXT	COND	EXT			
FROM POSTMILE	TO POSTMILE	L = LEFT ROADWAY R = RIGHT ROADWAY	LANE NO. = 1,2,3---9	WHEEL PATHS 1 THRU 99%	WHEEL PATHS 1 THRU 99%	(✓) EXPLAIN IN REMARKS	LENGTH 1 THRU 99%	$1 = < 1/8"$ $3 = \frac{1}{4}"$ $2 = 1/8"$ $4 = > \frac{1}{4}"$	1 = 1 STA, 2 = 2/STA 3 = 3/STA ---9 = 9/STA.	$1 = < 1/8"$ $3 = \frac{1}{4}"$ $2 = 1/8"$ $4 = > \frac{1}{4}"$	1=1-100', 2=101-200', 3= 201-300', 9=801-900',	F = Fine C = Coarse	1 THRU 99%	Drip Track Locations 1,2,3-9 LOC/Section	WHEEL PATHS 1 THRU 99%	G= Good P= Poor F= Fair	1 THRU 99%	G= Good P= Poor F= Fair	NO PROBLEMS	REMARKS

DH-M-104W (1/78)

FIGURE 3

Pavement Condition Survey

FLEXIBLE PAVEMENT

CONDITION CATEGORIES AND RATING INSTRUCTIONS

Name of Condition: Alligator Cracking

Description: Interconnected or interlaced fatigue cracks forming a series of small polygons. Alligator cracks are always load associated. Initially a single longitudinal crack or a series of parallel cracks appear in the wheel paths. Upon further loading the cracks interconnect forming the typical pattern resembling an alligator's skin.

Type A Alligator cracking: The initial appearance of fatigue cracks in the wheel paths.

Type B Alligator cracking: Interconnected fatigue cracks in the wheel paths.

Type C Alligator cracking: Other pattern-type fatigue cracks, generally outside the wheel paths.

Alligator cracking does not occur over an entire area unless subjected to traffic loading. Pattern-type cracking which occurs over an entire area that was not subjected to wheel loading is rated as block cracking.

How Rated: Severity of fatigue cracking is considered in identifying the type of alligator cracking that has developed.

The width of alligator cracks is believed to be somewhat inconsequential. It is very difficult to rate overall severity of alligatoring on the basis of crack width as different crack widths generally exist within a given area.

Sealed cracks are rated the same as open cracks.

Extent, except for Type C, is rated relative to the percentage of wheel paths that are alligatored. Use code number 01 through 99, 01 = 1%; 02 = 2%; 03 = 3%; --- 99 = 99% indicating the percent of wheel path length that is alligator cracked. A single wheel path for the full length of a subsection constitutes 50% of the wheel paths. Both Type A and Type B may exist in the same subsection and for that matter in the same wheel path.

Use a check mark (✓) to indicate Type C alligator cracking. Note the extent and severity of the condition in remarks.

Name of Condition: Block Cracking

Description: Interconnected cracks forming a series of large polygons usually with sharp corners or angles. Block cracking is not load-associated. Pattern-type cracking over an entire area that was not subjected to wheel loading is rated as block cracking.

Shrinkage cracks forming blocks larger than approximately 5 x 5 ft. are rated as transverse and longitudinal cracks and are not considered block cracking.

How Rated: Severity of block cracking, like alligator cracking, is not categorically rated. The difficulty of categorically rating the severity of block cracking is that many times two or three levels of severity, crack width and spalling, exist within a given area. Note in remarks if shrinkage cracks have been sealed and describe general crack condition.

Extent of block cracking is rated relative to the percentage of length that pattern-type shrinkage cracks over an entire area have developed. Used code numbers 01 through 99. 01 = 1%; 02 = 2%; 03 = 3%; --- 99 = 99% indicating the percent of the lane length that is block cracked.

Name of Condition: Transverse Cracking

Description: Cracks at approximately right angles to the centerline.

Transverse cracks are not usually load associated but are due primarily to shrinkage of the surface course or reflection cracking.

How Rated: Severity of transverse cracking is rated relative to the mean width of crack.

1 = <1/8 inch (hairline)

2 = 1/8 inch

3 = 1/4 inch

4 = >1/4 inch

Sealed cracks which are unopened are rated the same as hairline cracks. Cracks which have reopened after being sealed are rated according to the mean width of reopened crack.

Extent is rated relative to the number of cracks in one lane per 100 foot station. Use code numbers 1 through 9. 1 = 1 crack/sta.; 2 = 2 cracks/sta.; 3 = 3 cracks/sta.; --- 9 = 9 or more cracks/sta.

Name of Condition: Longitudinal Cracks

Description: Cracks approximately parallel to the pavement centerline.

Longitudinal cracks are not usually load associated but are due primarily to poorly constructed paving joints, shrinkage of the surface course, reflection cracking and roadbed settlement.

Load associated longitudinal cracks are rated as Type A alligator cracking.

How Rated: Severity of longitudinal cracking is rated relative to the mean width of crack.

1 = <1/8 inch (hairline)

2 = 1/8 inch

3 = 1/4 inch

4 = >1/4 inch

Sealed cracks which are unopened are rated the same as hairline cracks. Cracks which have reopened after being sealed are rated according to the mean width of reopened crack.

Extent is rated relative to the average sum of lineal feet of cracks in one lane per 100 foot station. Use code numbers 1 through 9. 1 = 1 to 100 LF/sta.; 2 = 101 to 200 LF/sta.; 3 = 201 to 300 LF/sta.; --- 9 = 801 to 900 LF/sta.

Where multiple cracks occur the individual crack lengths are added to obtain the average length per 100 foot station.

Name of Condition: Ravel and Weathering

Description: The wearing away of the pavement surface causing a roughened surface texture due to dislodgement of aggregate and loss of bitumen.

Ravel is the progessive disintegration of the surface downward, usually as a result of traffic action on surfacing with insufficient bitumen. Weathering is the gradual disintegration of the surface, usually due to the drying out or loss of bitumen.

Ravel due to leaching out of the asphalt binder by oil and gas drippings and occurring primarily between wheel tracks at intersections is called drip track ravel and is rated separately.

Abraded surfaces such as occur in snowfall areas where tire chains are used is to be rated as ravel and weathering.

How Rated: The categorical rating of weathering and ravel primarily considers dense graded asphalt concrete surfaces. Open graded surfaces, chip seals, and other surface treatments having an inherently coarse texture do not readily lend themselves to a "coarse" or "fine" ravel rating. An apparent ravel problem with these types of surfacing would be more appropriately described in remarks.

F = Fine aggregate and/or asphalt binder has worn away and the surface texture is moderately rough and pitted.

C = Coarse aggregate and asphalt binder worn away and the surface texture is severely rough and pitted.

Extent is rated relative to the percentage of lane length raveled and weathered. Use code numbers 01 through 99. 01 = 1%; 02 = 2%; 03 = 3%; --- 99 = 99% indicating the percent of length that is raveled and weathered.

Name of Condition: Drip Track Ravel

Description: The loss of aggregate and bitumen occurring between wheel paths due to the leaching effect of oil and gas drippings on the asphalt binder. Drip track ravel does not usually occur over an entire area. It is usually confined to areas behind the limit lines at intersections where vehicles must come to a stop before proceeding.

How Rated: Severity of drip track raveling is not rated.

Extent is rated relative to the number of occurrences within the section of roadway being rated. Use code numbers 1 through 9. 1 = one location; 2 = two locations; 3 = three locations; --- 9 = nine or more locations per lane where ravel between wheel paths is evident.

Name of Condition: Rutting

Description: A rut is a longitudinal surface depression in the wheel paths at least 20 feet long. Rutting is usually caused by consolidation or lateral movement of roadbed material under heavy wheel loads.

How Rated: Severity is rated relative to the depth of rutting. Ruts less than 3/4 inch in depth are not rated.

Extent is rated relative to the percentage of wheel paths that are rutted. Use code numbers 01 through 99. 01 = 1%; 02 = 2%; 03 = 3%; --- 99 = 99% indicating the percent of wheel path length that is rutted. A single wheel path for the full length of a subsection constitutes 50% of the wheel paths.

Name of Condition: Patching

Description: Patches are temporary or permanent corrections to damaged pavement. A patch is considered a problem area no matter how well it is performing.

Materials used to patch flexible pavements may vary but are usually of asphaltic composition. Patches vary in size and method of placement from small hand placed spot patches to machine laid overlays. See the glossary of terms for definition of spot, short and long patches.

How Rated: Severity of patching is rated subjectively according to surface condition.

G = Good condition, performing satisfactorily.

F = Fair condition, somewhat deteriorated and affects ride quality to some extent.

P = Poor condition, ride quality is significantly affected.

An isolated full lane width patch 0.2 mile in length or longer should be rated separately. Repetitive patches, long or short and in any combination, within definable limits should be rated as a unit. It will therefore be necessary to rate the average composite condition of all the patches in a section of highway.

Extent is rated relative to the percentage of surface area patched. Use code numbers 01 through 99. 01 = 1%; 02 = 2%; 03 = 3%; --- 99 = 99% indicating the estimated surface area of the subsection lane that is patched.

Any problem such as alligator, transverse or longitudinal cracks showing through a patch should be individually rated.

Name of Condition: Shoulder Condition

Description: Shoulder condition is the overall appearance and condition of asphalt surfaced shoulders two feet wide or wider.

On divided highways only the outside shoulder is categorically rated. Obvious problems or objectionable condition of the inner shoulder are noted in remarks.

How Rated: Shoulders are rated subjectively according to surface condition.

G = Good condition, performing satisfactorily.

F = Fair condition, somewhat deteriorated with minor cracking and/or weathering.

P = Poor condition, significant cracking and/or weathering.

PART IV RIGID SYSTEM

A. Field Input Document: A different computer generated form than that used in the flexible system is used to record and update the rigid system.

1. Pre-printed Data

Pre-printed identification and information on the rigid field input document is essentially the same as that on the flexible input document. See Part III-A-1.

There are a couple of exceptions to the above; (1) Bridge approach and leave slab identification and (2) Remarks.

Bridge numbers and names are the only geographical identification appearing in the rigid system. These are to agree with the 1976 California State Highway Log and Bridge Log. The bridge number and name are repeated for the beginning and end of bridges. The postmile of the bridge paving notch, to the nearest one tenth mile, is used to identify the beginning and end of a bridge. A "FROM" postmile entry and a blank "TO" postmile identifies the beginning of a bridge. A blank "FROM" postmile and a "TO" post mile entry identifies the end of a bridge. See Figure 1 - Segment Identification, Part I-A-4.

A road type code of BA is further computer identification of bridge approach and leave slabs. The BA code is listed in the legend appearing in the upper right corner of all rigid pavement condition survey printouts. See Part III-A-2 of these instructions for definitions of other road type codes.

Conditions which were apparent to the rater and were noted in the prior survey are listed below the pavement segment identification data. These notes are to be corrected and updated when they do not correspond to existing conditions. Use standard terms to describe existing conditions. See Part IV, Attachment 1 - Glossary.

2. Pavement Rating Entries

For detailed descriptions and instruction on how to rate specific categories see Part IV, Attachment 2 - Condition categories.

Condition categories and rating codes to be entered on the field input document are:

Slab Breakup: The following codes are used to rate the extent of all three levels of severity; Light (L), Moderate (M), and Severe (S).

% Slabs
Code 01 = 1%
Code 02 = 2%
Code 03 = 3%
.
.
.
Code 99 = 99%

Severe Slab Breakup - Spalling:

Code N = <1/4 inch width (negligible)
Code M = 1/4 to 1 1/2 inch width (moderate)
Code S = >1 1/2 inch width (severe)

Patching:

% Area	Condition
Code 01 = 1%	G = Good
Code 02 = 2%	F = Fair
Code 03 = 3%	P = Poor
.	
.	
.	
Code 99 = 99%	

Faulting:

Code 1 = ≥25% of joints faulted.

Lane/Shoulder Joint Separation: (JOINT SEP)

Code 1 = ≥1/4 inch width.

MM3653-A

CALIFORNIA DEPARTMENT OF TRANSPORTATION
DIVISION OF MAINTENANCE
OFFICE OF HIGHWAY MAINTENANCE
RUN DATE: 02/16/78

PAVEMENT CONDITION - FIELD INPUT DOCUMENT

1977-78 SURVEY
RIGID PROGRAM

LEGEND

1=FULL FREEWAY 3=TWO LANE R=RIGID
2=MULTILANE 4=CITY ST
9=CITY MAINTAINED BA=BRIDGE APPROACH

DIST: ___ CO: ___ RTE: ___ COST CNTR: ___ RATER: _____

DEFECT DATE: ___ ___ ___ (MO DAY YR) CHC NO: _ _ _ _ RIDE DATE: ___ ___ ___ (MO DAY YR)

SEQUENCE NUMBER	LOCATION FROM PRE FIX	FROM POST MILE	TO PRE FIX	TO POST MILE	ROAD TYPE	I NR CA HI EN S	D IL RA EN CE T	S E P E D	L E ON DG OT MH	ROADMETER READINGS 1 (5)	2 (6)	3 (7)	4 (8)	5 (9)	6 (10)	7 (11)	8 (12)	PAVEMENT CONDITIONS: SLAB BREAKUP LIGHT (L) %	MOD (M) %	SEVERE (S) %	PATCH EP EA SIRR PICE AIEA LIN LIT	IF IA IO IU II IN IT I	IJ IO II IN IT IS IE IP	J O I N T D I S	RT SHLD SC UO RN FO AI CT EI OI NI
142100	R	36.0	R	36.5	1R	010																		
01 R3 LONG. CRACKING																								
142110	R	36.5			BA	010																		
01 BR. 57-688 SWEETWATER RIV.																								

FIGURE 4 EXAMPLE INPUT DOCUMENT

3. Right Shoulder Rating Entries

Lane/Shoulder Displacement: (JOINT DIS)

Segment Length affected ≥10%
Code D = ≥3/4 inch down
Code U = ≥3/4 inch up

Surface Condition

Code G = Good
Code F = Fair
Code P = Poor

B. Glossary: The attached summary of standard terms has been compiled from several sources to promote uniformity and as a guide and aid to the rater in recognizing and properly classifying most conditions common to portland cement concrete pavements. Each rater must be familiar with these terms and the detailed instructions for rating specific conditions.

C. Condition Rating: Four rigid pavement conditions have been identified to receive categorical ratings. Cracks developing in PCC pavements are included in and rated as slab breakup. Attached are detailed instructions on how to identify and rate slab breakup and other pavement conditions. Also identified are two categories for rating the right hand shoulder of rigid pavements. Each rater must be thoroughly familiar with these instructions and the glossary of terms.

Pavement Condition Survey

RIGID PAVEMENT

GLOSSARY

OF

STANDARD DEFINITIONS

AND
DESCRIPTIONS OF PCC PAVEMENT CONDITION

California Department of Transportation
Division of Maintenance
Office of Highway Maintenance
Sacramento, California

- October 1978 -

SLAB BREAKUP

The rating category of Slab Breakup is comprised of the following:

1. Transverse cracking: A crack or break approximately at right angles to the pavement centerline.

2. Diagonal cracking: A crack similar to a corner crack except that the fracture extends diagonally across the end of the slab. A diagonal crack, as opposed to a corner crack (see item 6), has a dimension greater than 6 feet measured from the corner in either direction.

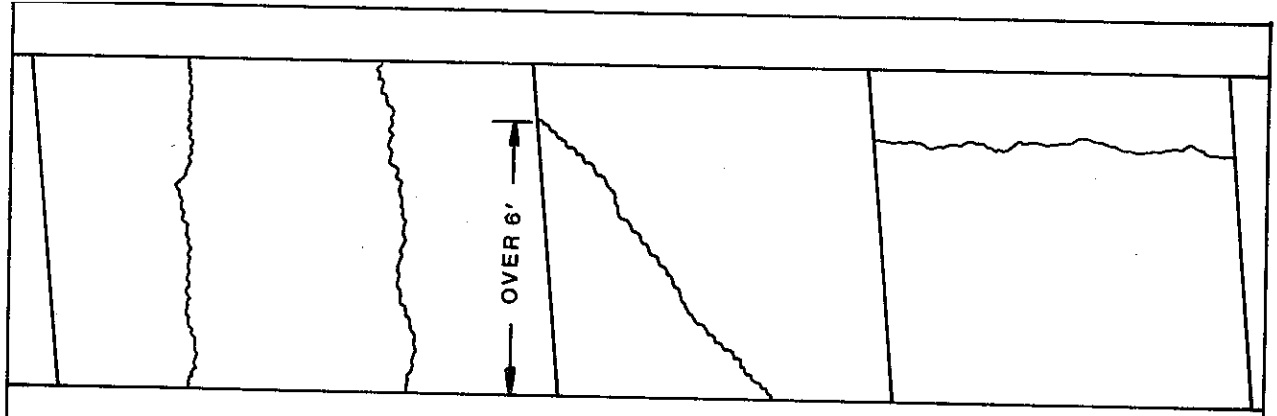
3. Longitudinal cracking: A crack or break approximately parallel to the pavement centerline.

4. First Stage cracking: Transverse, longitudinal or diagonal cracks in a slab which divide the slab into two or three large pieces. First stage cracking, as opposed to second stage cracking, is the development of minor cracks in a slab which are more than two feet apart or are more than two feet away from planned joints or cracks.

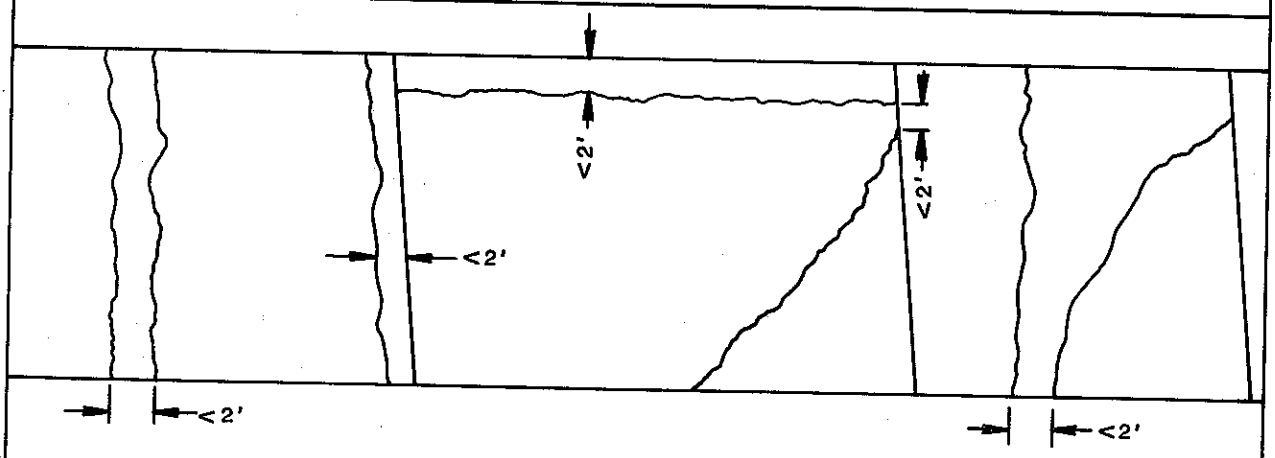
5. Second Stage cracking: Transverse, longitudinal or diagonal cracks which develop in a slab within two feet of planned or unplanned cracks or joints. Second stage cracking divides a slab into smaller pieces than first stage cracking. Second stage cracking, as opposed to third stage cracking, is when the cracks are basically parallel and do not intersect.

6. Corner cracking: A break at the corner of a slab near the juncture of the transverse joint and longitudinal joint or slab edge. A corner crack, as opposed to a diagonal crack, has a maximum dimension of 6 feet on either side measured from the corner of the slab.

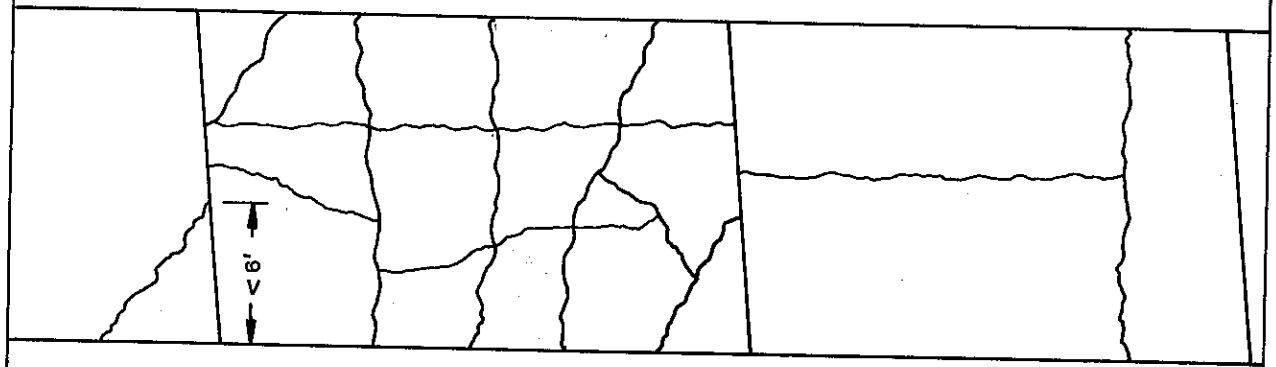
7. Random cracking: A vague and loosely applied term referring to unrestrained, or uncontrolled, irregular breaks or separation of the slab. The term is considered too general for pavement evaluation purposes.



FIRST STAGE - LIGHT (L)



SECOND STAGE - MODERATE (M)



THIRD STAGE - SEVERE (S)

FIGURE 5

RIGID SYSTEM

SLAB BREAKUP

8. Third Stage Cracking: Interconnecting cracks developing between cracks or joints. Third stage cracking, as opposed to first or second stage cracking, always divides the slab into at least three pieces and usually four or more.

9. Fragmented Slab: Interconnected irregular multiple cracks and breaks which divide a slab into several small pieces.

SPALLING

Spalling is the breakdown or disintegration of slab edges at joints or cracks, usually resulting in the removal of sound concrete. To complete the rating of slab breakup only the spalling of third stage cracking and corner cracking are categorically rated.

10. Joint Spalling: Breakdown or disintegration of slab edge at planned transverse and longitudinal cracks or joints.

11. Crack Spalling: Breakdown or disintegration of edges of cracks, resulting in the loss of concrete and progressive widening of the crack.

TRANSVERSE JOINT CONDITIONS

Problems may occur at transverse weakened plane joints and cracks intentionally designed into the pavement. In addition to joint spalling, the more common problems are described as follows. Of these, only faulted joints are categorically rated.

12. Joint Damage: Broken or crushed slab edges, generally caused by incompressible material fouling the joint and prohibiting slab expansion.

13. Faulting: Also known as "step-offs" is differential vertical displacement of abutting slabs creating a "step" deformation in the pavement surface.

14. Blow-up: Localized upward bulkling or shattering of the slab at a transverse joint or crack. Blow-ups occur only rarely in short jointed concrete pavement. In hot weather heat causes excessive expansion of the slab and a buildup of pressure at a joint with insufficient width or one which has been filled with imcompressible material. An isolated short lane-width patch may be the only visible evidence of this condition.

PATCHED PAVEMENT

Patches are temporary or permanent surface repairs to a damaged pavement. A patch is considered a problem, no matter how well it is performing.

15. Spot Patch: Localized small patches less than a lane-width, usually of asphaltic or epoxy composition that are applied to damaged PCC surfaces. Spot patches are commonly used to repair spalling, partially shattered slabs and to improve rideability.

16. Short Patch: A lane-width overlay, usually of asphaltic or epoxy composition. Short patches may be any length up to 100 feet. They are, however, generally AC overlays placed with a motor grader and cover one to six slabs, 20 to 100 feet in length.

17. Long Patch: A full-lane width AC overlay, generally machine laid, that is 100 to 1000 feet in length. An overlay more than 1000 feet in length is rated as a subsection of AC pavement.

18. Slab Replacement: Full depth removal of the original pavement slabs which have been replaced with new PCC slabs. Slab replacements are not categorically rated but an estimate of the number of slabs replaced in a segment should be noted in remarks.

LANE/SHOULDER JOINT CONDITIONS

The condition of the joint between the PCC lane and AC shoulder on the right is categorically rated as to the width of separation and the difference in elevation between the PCC lane and AC shoulder. The median lane/shoulder joint on the left is not included in the rating category.

19. Joint Separation: The widening of the joint between the PCC lane and AC shoulder, generally initiated by thermal expansion. With repeated cycles of expansion and contraction and the loss of resilience in the AC the bond between the dissimilar materials is eventually broken. Incompressible material that enters the resultant crack causes the joint to open.

20. Shoulder Depression: The AC shoulder is lower than the PCC lane.

21. Shoulder Bulge: The AC shoulder is higher than the PCC lane.

22. Joint Seal Damage: Any condition which enables soil or rocks to accumulate in the joint or allows significant infiltration of water. Typical types of joint seal damage are:

- o Extrusion - filler protruding above joint edges.
- o Absence of sealant - insufficient filler to prevent infiltration.
- o Loss of bond - filler pulling away from edge of slab.
- o Hardening - filler has oxidized and lost resilience.
- o Stripping - filler coming out of the joint.
- o Weed growth - grass growing in joint.

OTHER RIGID PAVEMENT CONDITIONS

In addition to those conditions previously described the following additional characteristics may be noted.

23. Shrinkage cracks: Hairline cracks usually only a few feet long and do not extend through the depth of the slab. Shrinkage cracks are formed during the setting and curing of the concrete.

24. Crazing: Also know as "map cracking." Crazing is fine, harline cracks which extend only through the surface mortar. The cracks tend to intersect at an angle of approximately 120 degrees and are caused by over finishing or cement rich mortar surfacing.

25. Durability "D" cracking: A series of fine, hairline crescent-shaped cracks usually paralleling a joint and curving across the slab: "D" cracking is believed to be caused by freeze-thaw cycles in concrete with high moisture content. Certain aggregates which are highly absorptive and relatively weak may become saturated and after many freeze-thaw cycles cause the concrete to break down forming the characteristic crack pattern.

26. Curling: The bending or warping of slabs due to uneven expansion or contraction of the top and bottom slab surfaces caused by difference in temperature or moisture conditions above and below the slab.

27. Scaling: Progressive disintegration and loss of the concrete wearing surface from over finishing, freeze thaw cycles or reaction to de-icing materials.

28. Abrasion: Erosion or scuffing damage to the concrete surface from the wearing action of tire chains or equipment cleats, studs and lugs.

29. Settlement: Localized cracking or displacement of isolated slabs due to slippage or consolidation of the underlying foundation. Settlement may be characterized by a wide crack following a defined meandering line with noticeable difference in elevation from one side of the crack to the other. A spot or short AC patch is often in place to restore the lower section to grade.

    Culverts and cut to fill grade lines are typical locations where settlement is found.

30. Mudjacking: High pressure pumping of concrete slurry through drilled holes to replace sunken base materials or to raise a slab. Mudjacking is usally associated with correcting bridge approach slabs but is occasionally used to correct settlement.

31. Subsealing: High pressure pumping of hot asphalt through drilled holes to fill voids beneath a slab as opposed to raising slabs to grade. The asphalt seal helps prevent water intrusion and offers a measure of protection against pumping action.

32. Grooved Pavement: Saw cut surface texture. Gooving is done to improve skid resistance. Grooves are 1/8 to 1/4 inch in depth and spaced 3/4 inch on centers. Concrete between kerfs remains intact.

33. Grinding: Bump or joint cutting to improve rideability or pavement profile. Saw cuts are closely spaced with concrete between kerfs removed.

34. Pumping: The ejection of mixtures of water, clay, or silt along or through transverse or longitudinal joints, cracks, or pavement edges.

Pavement Condition Survey

RIGID PAVEMENT

CONDITION CATEGORIES

and

DETAILED RATING INSTRUCTIONS

California Department of Transportation
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- October 1978 -

Pavement Condition Survey

RIGID PAVEMENT

RATING PROCEDURE

1. General: Unlike flexible pavement ratings, rigid pavement ratings for the most part can be made from the seat of a car. It is, however, a two man operation requiring a driver with the rater in the back seat. With a four bank counter the rater can keep a count on the number of slabs in each of the three categories of slab breakup and that have been patched while the vehicle is driven slowly down the right shoulder. One stop per segment to determine the severity of third stage crack spalling, if any, is generally all that is required.

   It may be necessary to make more than one pass over multi-lane highways in order to rate each lane separately. On some high volume roads it may be unsafe to actually count slab breakup in all lanes. An estimate of extent and severity based on proration or other observations is then acceptable. A notation to this effect should be made in remarks.

   For the purpose of rating the condition of rigid, PCC, pavements the highway roadbed is divided into three basic elements; Bridge Approach, Pavement and Shoulder.

Bridge Approach: The pavement in the direction of travel, immediately preceding or following the bridge "paving notch." Bridge approach and leave pavements are considered to be 100 feet in length.

Pavement: The intervening concrete pavement between structures, projects limits or asphalt surfacing divided into standard segments. Normally, a segment is one mile in length beginning and ending at full postmile points. Short and long segments are caused by structures, project limits and other restraints which occur at incremental postmile points. A short segment will usually be 0.5 mile or more in length and a long segment 1.5 miles or less in length.

Shoulder: The paved area, usually asphalt surfaced, contiguous to the traveled way.

Pavement Condition Survey

RIGID PAVEMENT

CONDITION CATEGORIES AND RATING INSTRUCTIONS

BRIDGE APPROACH CONDITIONS

Name of Condition: Ride

Description: The quality of ride experienced when traversing bridge approach and leave slabs at normal highway speeds.

The poor riding quality of bridge approaches is usually due to: (1) differential settlement at the "paving notch" causing a step up or step down condition, (2) settlement of support foundation under one or more slabs causing a sag in the profile grade, (3) shattered or distorted bridge approach slabs, (4) patched or mudjacked bridge approach slabs.

How Rated: The severity of bridge approach ride discomfort is relative to the maximum movement, from extreme positive deflection to extreme negative deflection between the vehicle body and the rear axle. The number 5 through number 12 counts on the Model ML 500B Road Meter are used to measure this deflection. Road meter counts are entered on the field input document by making dual use of the space provided.

Approaches - Turn the road meter "on" approximately 100 feet in advance of the bridge paving notch. Turn the road meter "off" after the rear wheels have passed over the bridge/pavement joint and 25 to 35 feet (1/3 to 1/2 second at 50 mph) onto the bridge deck.

Departure - Turn the meter "on" when the front wheels pass over the bridge paving notch. Turn the meter "off" approximately 100 feet from the bridge/pavement joint.

Record the 5 through 12 meter readings. If there is no count on the number 5 meter place a check mark (✓) in that space. Many bridge approaches will measure less than a 5 count. Considerable time may be saved by entering the check mark in the (5) space when it can be judged that the approach is not rough enough to measure.

Odometer length need not be recorded for bridge approach ride. Speed entries are only necessary when road meter readings are taken at less than 50 mph.

PAVEMENT CONDITION

Name of Condition: Slab Breakup

Description: The development of cracks in a slab which divide it into two or more pieces. Slab breakup is usually caused by a combination of heavy load repetitions on pavement with unsatisfactory roadbed support, thermal curling, shrinkage or moisture stresses.

How Rated: Severity of slab breakup is rated relative to the stage of cracking that has developed in a slab. Light (L) slab breakup is the development of first stage cracking. Moderate (M) slab breakup is the development of second stage cracking and Severe (S) slab breakup is when one or more of the following have developed: (1) third stage cracking, (2) corner cracking, or (3) fragmented slab.

Extent is rated relative to the percentage of slabs in a lane segment that exhibits the state of cracking described. Use Code 01 through 99. 01 = 1%; 02 = 2%; 03 = 3%; --- 99 = 99% indicating the percent of slabs at each level of cracking. For estimating purposes assume 350 slabs per lane mile.

Name of Condition: Crack Spalling (Severe slab breakup only)

Description: Breakdown or disintegration of the edges of cracks, resulting in the loss of concrete and progressive widening of the cracks. Crack spalling is usually caused by the individual slab segments moving against one another under heavy load repetitions.

How Rated: Severity of crack spalling is rated relative to the mean width of the crack including the frayed area on either side of the crack.

For purposes of this survey joint spalling, first stage crack spalling and second stage crack spalling are not rated but should be noted in remarks when significant. Rate spalling of severe slab breakup cracks by estimating the average width of crack and spall for the lane segment. Select 5 slabs in the segment with typical severity to determine applicable overall average width for the lane segment.

N = Negligible spalling, overall average width $\leq$1/4 inch.

M = Moderate spalling, filled or non-filled cracks having an overall average spalled width $\geq$1/4 to 1 1/2 inches. Crack edges are generally frayed with some small pieces loose or absent.

S = Severe spalling, filled or non-filled cracks having an overall average spalled width $\geq$1 1/2 inches. Crack edges are generally fragmented with loose or absent pieces.

Name of Condition: Patching

Description: Patches are temporary or permanent surface repairs to damaged pavement. A patch is considered a problem area, no matter how well it is performing.

Surface repairs to PCC pavements are usually of asphaltic or epoxy composition. Slab replacement, where full depth removal of the original pavement has been replaced with new concrete, is not considered patching.

How Rated: Patches are rated as to extent and subjectively according to surface condition.

Extent is rated relative to the percentage of surface area that is patched. Use code numbers 01 through 99. 01 = 1%; 02 = 2%; 03 = 3%; --- 99 = 99% indicating the estimated surface area of the segment that is patched.

Any problem -- slab breakup, transverse or longitudinal cracks -- showing through a patch should be individually rated.

The subjective patch condition ratings are:

G = Good condition, performing satisfactorily.

F = Fair condition, somewhat deteriorated and affects ride quality to some extent.

P = Poor condition, ride quality significantly affected.

Name of Condition: Faulted Transverse Joints (Step-offs)

Description: Faulting, also known as joint "step-offs," is a difference of elevation across transverse joints. It is most apparent when looking in the direction of approaching traffic. Faulting is generally attributed to a buildup of loose material under the approach slab near the joint rather than a depression of the leave slab. The buildup of eroded or infiltrated materials is caused by pumping, the action of free moisture under pressure. Free moisture is subjected to high pressure when a heavy

load is applied near the joint. Faulting is, therefore, a more common condition to the outside lanes where trucks are required to travel.

The natural curling upward of the slab near the joint due to differences in temperature and moisture above and below the slab contribute to the pumping condition.

How Rated: Severity of faulting is not measured directly but is reflected in the ride score rating.

Extent of faulting is not finitely rated. If joint faulting is visually and audibily apparent in at least 25% of the slabs it is rated. Joint faulting in less than 25% of the slabs which significantly affects pavement rideability should be noted in the remarks.

When faulted joints are apparent in 25% or more of the slabs a Code 1 is used. 1 = $\geq$25% of slabs faulted.

Name of Condition: Lane/Shoulder Joint Separation

Description: Joint separation is the widening of the joint between the PCC lane and the AC shoulder on the right. Widening is caused by movement of the asphalt shoulder away from the traveled way due to loss of lateral support.

How Rated: Severity and extent of joint separation are not finitely rated.

Once the joint has opened to 1/4 inch wide or wider it has generally been filled with asphalt or petrolastic. Tightly sealed joints are not categorically rated. If 10% or more of the segment has lane/shoulder joint separation 1/4 inch wide or wider that is unsealed or it is not tightly sealed a code 1 is used.

1 = $\geq$1/4 inch width, unsealed or not tightly sealed.

SHOULDER CONDITION

Name of Condition: Lane/Shoulder Displacement

Description: Displacement (up and down) of the asphalt shoulder at the right edge of pavement causing a 3/4 inch or more difference in elevation between the lane and shoulder surfaces.

Shoulder downward displacement is due to settlement, consolidation or pumping of the underlying material. Shoulder upward displacement is usually due to thermal expansion or expansive soil heave resulting in the asphalt shoulder being deformed in an upward bulge or curl.

How Rated: Severity and extent of shoulder displacement are not finitely rated.

If there is a 3/4 inch or more difference in elevation between the lane and shoulder for 10% or more of the segment length the following ratings are applied.

D = $\geq$3/4 inch shoulder displacement-down

U = $\geq$3/4 inch shoulder displacement-up

Name of Condition: Shoulder Condition

Description: Shoulder condition is the overall appearance and condition of the right AC shoulder.

How Rated: Shoulder condition is rated subjectively according to surface condition.

G = Good condition, performing satisfactorily

F = Fair condition, somewhat deteriorated with minor distress cracking and/or weathering.

P = Poor condition, badly deteriorated with major distress cracking and/or weathering.