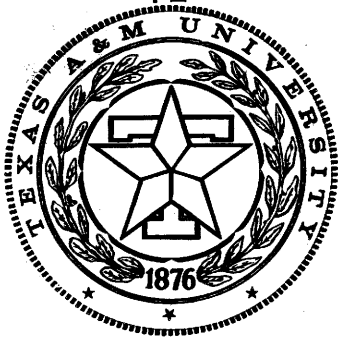




TEXAS
TRANSPORTATION
INSTITUTE

TEXAS
HIGHWAY
DEPARTMENT

COOPERATIVE
RESEARCH

**ROADWAY MAINTENANCE
EVALUATION USER'S
MANUAL**

in cooperation with the
Department of Transportation
Federal Highway Administration

**RESEARCH REPORT 151-2
STUDY 2-18-71-151
MAINTENANCE**

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ROADWAY MAINTENANCE EVALUATION

USER'S MANUAL

by

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and
H. L. Jones

Research Report 151-2
Maintenance Quality, Methods and Rating
Research Study No. 2-18-71-151

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TEXAS TRANSPORTATION INSTITUTE
Texas A&M University
College Station, Texas

ABSTRACT

The information contained in this manual defines a method for conducting a visual evaluation of the roadway. The purpose of this evaluation is to provide information that can be used together with certain other data for maintenance management purposes.

The manual has been developed as a reference to be used in conjunction with a training school and reference for personnel responsible for conducting the roadway visual survey. Items evaluated include the pavement, shoulder, roadside and drainage features, and traffic services.

KEY WORDS

Maintenance, roadway rating, pavement condition survey, pavement distress.

PREFACE

This is the second report issued under Research Study 2-18-71-151, "Maintenance Quality, Methods and Rating". This report provides the basic information required to conduct a visual evaluation of the roadway for maintenance purposes. The results of this visual examination in conjunction with other information will be utilized for scheduling maintenance activities as well as other uses.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification or regulation.

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The authors wish to express their appreciation to the Texas Highway Department's Maintenance Practices Committee whose guidance was instrumental in the development of the Maintenance Rating System. Trial implementation of the rating system was performed in Districts 21 and 7. S. G. Cox and J. R. Evans, the District Maintenance Engineers from the districts, were particularly instrumental in the application of the rating system for maintenance management purposes.

SUMMARY

The present condition of a roadway from right-of-way to right-of-way is of interest to maintenance forces as well as other groups within the highway department. Various types of instruments are available to aid the engineer in establishing the riding quality, structural adequacy and safety of pavements. However, these instruments by themselves do not in general supply the desired information on the pavement or the entire roadway. Thus it is necessary to visually survey the roadway and record in an orderly fashion the observations noted.

The information contained in this manual defines a method for conducting a visual evaluation of the roadway. The purpose of this evaluation is to provide information that can be used together with other data for the following purposes:

1. Define the present condition of the roadway;
2. Compare the present condition with the past condition to predict the future condition of the roadway;
3. Determine maintenance needs in terms of materials, equipment, manpower and dollars;
4. Establish maintenance priorities based upon available resources; and
5. Identify those maintenance activities which provide the greatest return for the maintenance investment.

The visual evaluation method described in this manual consists of the utilization of two forms; one for flexible pavement and one for rigid pavements. Items recorded include location of the roadway being evaluated, an indication of the type, amount and degree of pavement distress, and an evaluation of the conditions of the shoulder, roadside and drainage features and traffic service items. Road roughness is measured by use of a Mays Meter

whose output is converted to a serviceability index.

To provide for uniformity among those conducting the roadway maintenance evaluation, a training school format has been developed. Training programs will be conducted on a regional basis.

IMPLEMENTATION STATEMENT

Information presented in this manual will be used as a reference for conducting training schools. These training schools will be held on a regional basis to provide uniformity among those conducting the roadway maintenance evaluation. It is expected that the evaluation procedure described in this manual will be implemented in the majority of Texas Highway Department Districts during 1975.

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INTRODUCTION

The present condition of a roadway from right-of-way to right-of-way is of interest to maintenance forces as well as other groups within the highway department. Various types of instruments are available to aid the engineer in establishing the riding quality, structural adequacy and safety of pavements. However, these instruments by themselves do not in general supply the desired information on the pavement or the entire roadway. Thus it is necessary to visually survey the roadway and record in an orderly fashion the observations noted.

The information contained in this manual defines a method for conducting a visual evaluation of the roadway. The purpose of this evaluation is to provide information that can be used together with other data for the following purposes:

1. Define the present condition of the roadway;
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3. Determine maintenance needs in terms of materials, equipment, manpower and dollars;
4. Establish maintenance priorities based upon available resources; and
5. Identify those maintenance activities which provide the greatest return for the maintenance investment.

SELECTION OF ROADWAY SEGMENT

The length of roadway to be evaluated will vary depending upon a number of factors. Typical "breaks" in the roadway that will form limits of the segment to be surveyed are listed below:

1. County line;

2. Control and section limits;
3. Limits of past or present construction projects;
4. Limits of seal or overlay projects;
5. Changes in roadway geometrics
 - a. from two lanes to four lanes or vice versa
 - b. from four lane divided to four lane undivided or vice versa
 - c. from controlled access to non-controlled access or vice versa
 - d. from roadway with paved shoulder to pavement without paved shoulder or vice versa
 - e. from rural to urban area or vice versa
 - f. from roadway with curb and gutter to section without curb and gutter or vice versa
6. At maintenance section boundaries;
7. At certain roadway intersections where a single roadway is designated as more than one route; and
8. Significant changes in visual appearance of the pavement, shoulder, roadside or traffic services.

As indicated from the above information a certain amount of office work should be performed prior to field evaluation. The rating team should have access to construction records, overlay and seal coat program historical information, road logs and control and section maps for those highways to be examined. The final selection of the roadway segment limits must be performed by the rating team in the field as they must divide the roadway such that segment limits exist at points where the visual appearance of the pavement, shoulder, roadside or traffic services change.

VISUAL MAINTENANCE RATING FORM

The rating forms for flexible and rigid pavement are shown in Figure 1 and Figure 2, respectively. A flexible pavement is defined as any pavement surfaced with a bituminous material while a rigid pavement is

any pavement surfaced with portland cement concrete. Thus a portland cement concrete pavement overlaid with asphalt concrete is considered a flexible pavement. The difference between the rigid and flexible maintenance rating form is that part of the form that is concerned with the pavement. All other portions of rigid and flexible maintenance rating forms are identical.

General Information

General information defining the district, raters and the date of the rating is located in the upper left hand portion of the form. It should be noted that the input for the form is organized such that the data collected are convenient for computer analysis.

District Number - The district number should be placed in boxes indicated by numbers 1 and 2. If the district number is a single digit it should be placed in box number 2.

Names of Raters - The names of the raters should be placed in boxes 5 to 26 and 31 to 51. The name of the rater recording the data should appear in boxes 5 to 26 while the driver of the car should appear in boxes 31 to 51. The last name of the rater should be entered first, followed by a blank box, initial of first name, a blank box and the initial of middle name.

Date - The date is entered as a series of numbers indicating the month, day and year. The month of the year should be entered in boxes 60 and 61. If the month is represented by a single number it should be entered in box number 61. The day of the month should be entered in boxes 65 and 66. If the day is represented by a single number it should

be entered in box number 66. The year should be placed in boxes 70 to 73.

An example of a typical entry is shown on Figure 3.

Location

Information defining the location of the segment of roadway examined is located on the left side of the visual evaluation forms (Figures 1 and 2). Information defining the foreman number, highway class, county number, highway number, control and section designation and the limits of the segments must be provided as explained below.

Foreman Number - The maintenance foreman is that number assigned to the maintenance foreman responsible for a certain portion of a district. This number is widely used for cost accounting and budgetary items.

Highway Class - The highway class has been defined by the Planning and Research Division of the Texas Highway Department as shown in Table 2. The classification of a particular segment of roadway can be obtained from the district office. If the highway class is represented by a single digit number it should be located in the box at the extreme right side of that portion of the form designated highway class.

County Number - A county number system has been defined by the Planning and Research Division of the Texas Highway Department as shown in Table 3. The counties were arranged alphabetically and numbered in a continuous fashion beginning with number 1 and continuing to number 254. If the county number is represented by a single digit number it should be located in a box at the extreme right side of that portion of the form designated county number. If the county number is represented by a two

digit number, they should be located in the two boxes at the extreme right side of that portion of the form designated county number.

Highway Number - Each highway is signed with a route marker designating the roadway as one of the following types shown in Table 4. The two letter abbreviations shown in this table are to be placed in the two boxes at the extreme left side of that portion of the form designated highway number.

The route number is represented by any number of digits less than five; they should be placed in those boxes at the right side of the portion of the form designated as highway number, such that the last digit designating the highway number is placed in the box at the extreme right side.

Certain highways will have multiple route numbers. For example, US 62 and US 82 are common routes in West Texas. The rater should use a single route entry to designate these common highways. The rater should select a route designation according to the following guidelines:

1. Select the route type by reference to Table 4 with an IH highway selected for use over a US highway, a US highway selected over a SH highway, etc.

2. If two highways are of the same type, the highway with the lowest number should be selected.

For the example cited above the raters should select US 62 to designate as the roadway to be evaluated.

Control and Section - Control and Section numbers are utilized to identify certain segments of highways. Control and Section numbers for certain segments of highways are provided by the Planning and Research Division of the Texas Highway Department. If a control number is rep-

resented by any number of digits less than four, they should be placed in those boxes at the right side of that portion of the form designated as control, such that the last digits designating the control number are placed in the box at the extreme right side.

If the section number is represented by a single digit number, it should be located in the box at the extreme right side of that portion of the form designated section.

From and To - The limits of the segment of roadway to be evaluated are defined by the mile post numbering system. Mile posts at two-mile intervals often exist in the field as route markers on US, SH and FM highways. On interstate highways mile posts are located on green standards at one-mile intervals. The number of the mile post is located below the route marker on the support. It is important that the mile post exist in the field at the proper location prior to the initiation of the survey.

The number of the mile post system on US, SH and FM roadways increase for a north to south direction for roadways in a general north-south alignment and from west to east for roadways in a general east-west alignment. The interstate system has an increasing numbering system from west to east and south to north. Mile post numbering systems for US, SH and FM roadways continuing the entire length of a county, start at zero at the north county line and end at the proper number at the south end of the county. The interstate highway mile post numbering system starts and ends at the state line and is continuous across county lines. Roadways which do not continue in length for an entire county have number systems that initiate and end at roadway intersections or at the end of the road.

The number representing the limits of the roadway section being evaluated are reported to the nearest 0.1 mile and entered accordingly.

Lane - The designation of the lane being evaluated is as shown in Figure 4. The rating team should always orient themselves in the direction of increasing mile posts before consulting Figure 4 for the selection of the proper lane designation. Lane R or L is always at the extreme right or left side of main lanes of the highway. All frontage roads will utilize the letters ABC on the right side of the roadway and XYZ on the left side of the roadway.

For multilane highways all lanes should be evaluated separately if a significant difference exists in their condition. Frontage roads should always be evaluated separate and apart from main lanes where they exist.

Examples of typical entries are shown in Figure 5.

Pavement

As indicated above the only difference between the flexible and rigid evaluation form is pavement section. The flexible pavement evaluation section of the form will be discussed followed by the rigid section of the form.

Mays Meter

The portion of the form for the Mays Meter test results contains two boxes. The serviceability index reported to the nearest 0.1 is to be placed in these boxes. The serviceability index will be obtained by a two-man team driving an automobile equipped with a Mays Ride meter. The techniques used by this crew are discussed in a separate report.

Flexible Pavement

The types of distress to be recognized and recorded by the evaluation team are rutting, raveling, flushing, corrugations, alligator cracking, longitudinal cracking, transverse cracking, and patching (Figure 1). Other items contained in the form are degree of sealing of the cracks and number of failures. The extent and degree of each of these types of distress are to be noted in the appropriate location. For example, if 25 percent of the pavement contained moderate rutting as defined in Appendix A, the number 2 would be placed under the moderate column of the rutting portion of the form. If no rutting existed a zero would be placed in the slight column.

The extent of distress for rutting, raveling, flushing, corrugations, alligator cracking and patching is defined as a percent of the lane area displaying this type of distress. If a single wheel path illustrates a particular type of distress continuously, this is normally about 20 to 25 percent of the area. If two wheel paths illustrate a particular type of distress continuously, this is normally 45 to 50 percent of the area. If a single wheel path has discontinuous distress, it may often be less than 15 percent. The above percentages are based on the fact that a typical highway wheel path is about 3 feet in width.

Longitudinal and transverse cracking are recorded in terms of lineal feet of crack per station per lane and number per station, respectively. A single continuous crack along a highway would indicate that the longitudinal crack length is in excess of 100 feet. Similarly, two continuous cracks along a highway would indicate that the longitudinal crack length is in excess of 200 feet.

Under the heading cracks the evaluation team is asked to indicate whether the cracks (transverse and/or longitudinal) are sealed, partially sealed or not sealed. If no cracks exist a zero should be placed in the box below cracks. The number of failures per mile are indicated under failures.

Definitions of the severity for various types of distress are defined in Appendix A in terms of slight, moderate and severe, except for patching where good, fair and poor refer to the quality of the patch. Examples of typical entries for the flexible pavement portion of the form are shown on Figure 6.

Rutting, channeling or grooving are longitudinal channelized depressions that develop in the wheel paths of asphalt pavements. Rutting may result from consolidation or lateral movement under traffic in one or more of the underlying courses, or by displacement in the asphalt surface layer itself. It may develop under traffic in new asphalt pavements that had too little compaction during construction, or from plastic movement in a mix that does not have enough stability to support traffic.

Raveling is the progressive loss of surface material by weathering and/or traffic abrasion. Usually the fine aggregate wears away first, leaving little pockmarks in the pavement surface. As erosion continues, larger particles eventually break free and the pavement may become rough and jagged in appearance. Raveling is caused by poor construction methods, inferior aggregates, or poor mix design.

Flushing or bleeding is the presence of excess asphalt or a film of asphalt on the pavement surface. Pavement courses having rich asphalt mixes, improperly constructed seal coats, or too heavy a prime or tack

coat may form bleeding and flushing. Heavy traffic and/or high traffic volumes can force or flush the asphalt to the surface of the pavement in hot weather.

Corrugations or washboarding and shoving are a form of plastic movement typified by ripples across the asphalt pavement surface. Corrugations usually occur at points where traffic starts and stops, or on hills where vehicles brake on the downgrade and are normally associated with too much asphalt, too much fine aggregate, or round or smooth textured coarse aggregate.

Alligator cracking is interconnected cracks forming a series of small blocks resembling an alligator's skin or chicken wire. They are often associated with pavements that deflect excessively under traffic loads. The excessive deflection is due to improper design, weak base, subbase or subgrade pavement layers in relation to the traffic loads imposed on the facility.

Longitudinal cracking is a crack or break approximately parallel to the pavement centerline. Edge cracks, edge-joint cracks between the pavement and shoulder, lane-joint cracks, reflection cracks and cracks created by volume changes in the subgrade or pavement materials are common forms of this type of distress. Poor construction practice and volume changes occurring in the pavement materials and subgrade are common causes of this form of distress.

Transverse cracking is a crack or break approximately perpendicular to the pavement centerline. Reflection cracks and those cracks associated with shrinkage of the pavement materials are typical examples of this form of distress.

Sealing of cracks refers to the effectiveness of the longitudinal and transverse cracks to prevent the entry of water. If a crack is not properly sealed, water and debris will enter the pavement and reduce the pavement life.

Patching implies that a pavement repair has been made. The repair is evaluated in terms of the suitability of the patch to carry traffic and perform the function for which it was placed.

Failures per mile is a "catch all" type of category used when the normal evaluation procedure would not necessarily identify the true condition of the pavement. This type of distress allows the rater to identify a section of pavement containing limited observable severe distress as well as identify pavement that needs immediate maintenance action.

Rigid Pavement

The portion of the visual evaluation form allocated to portland cement concrete pavements is divided into three sections (Figure 2). The types of distress observed in both continuously reinforced concrete (CRCP) pavements and jointed pavements including pumping, surface deterioration, spalling, longitudinal cracking, patching and faulting are listed first. Types of distress observed mainly on CRCP are contained in the next section followed by those types of distress associated mainly with jointed pavements. The extent and severity of those types of distress are recorded on the form according to the guidelines given in Appendix B. Examples of typical entries for the rigid pavement portion of the form are shown on Figure 7.

Pumping is a phenomenon reserved for pcc pavements. It was observed in early construction of pcc pavement, especially where untreated bases

and/or subgrades were utilized in areas of poor drainage. In more recent construction where typically the subgrade is stabilized and a treated base course is used under the pavement, pumping has essentially been eliminated in Texas. However, in areas where it does occur it is a serious type of distress and the negative values are stringent.

Failures per mile is a "catch all" type of category used when the normal rating procedure would not necessarily identify the true condition of the pavement. For example if the pavement were being visually rated at each mile post there may exist a severely distressed section in between mile posts that would not appear in the rating score, and the overall pavement score would be higher than it should be. By the same token, if the raters stopped and made a visual rating at only areas with observable distress, then the overall score would be lower than it should be. This column allows the rater to identify a section of pavement containing observable severe distress while proceeding with the normal routine of rating the overall pavement.

Surface deterioration includes pop-outs, raveling, scaling and disintegration. If the distressed areas are small (less than 15% of the surface area) and are not severe (less than 1/4" deep) then they will not significantly interfere with operation of the roadway. As the areas increase in size and severity, the effects on other properties such as skid resistance and riding quality will become apparent and further reduce the composite score of the pavement.

Spalling occurs at joints or cracks and is observable in some degree at almost every crack or joint. However, until its progress reaches the severe stage (greater than 3" wide) it will not significantly impair ser-

viceability. It will reduce the riding quality as it increases in severity and extent.

Longitudinal cracking, though unsightly, is not necessarily detrimental to the serviceability of the pavement. So long as the crack is not open or faulted to the extent that aggregate interlock is lost, load transfer across the crack will occur and the pavement will be serviceable. If the crack opens and permits the intrusion of water and/or debris, this will accelerate the deterioration of the pavement. Hence, if the crack is hairline or closed, no maintenance is required; but if the crack is open it will require maintenance to prolong serviceability.

Patching is a condition which may be present in either a flexible or rigid pavement. At the present time it is treated the same in both rating systems. That is, a good patch will prolong the serviceability of the pavement and as the percent of the pavement surface patch increases or the quality of the patch decreases the serviceability of the pavement decreases.

Faulting is the condition where two adjacent slabs or the slab and the shoulder have moved vertically with respect to each other creating a step. Faulting per se does not decrease the structural adequacy of the pavement though it may severely reduce the riding quality. Faulting may be the observable forecaster of severe pavement damage because it usually relates to a void under the pavement or to movement of the subgrade.

Crack spacing in CRCP is now recognized as a critical variable and recent research is attempting to develop techniques of design based on predictable crack spacing. The optimum crack spacing is between five and

ten feet. If the spacing is less the narrow slabs tend to rock under truck traffic and will accelerate deterioration of the pavement. For crack spacings above ten feet the thermal expansion and normal shrinkage may cause yielding of the steel reinforcement which allows the cracks to open excessively permitting the intrusion of water and even the loss of aggregate interlock; hence loss of load transfer between slabs. However, it should be emphasized that so long as the cracks are hairline or closed so as to prevent the intrusion of water and provide aggregate interlock, the cracks regardless of spacing are not detrimental to pavement serviceability.

The percent of cracks that intersect can be an indicator of other more detrimental types of distress such as loss of subgrade support or lower quality concrete. All CRCP pavements will have some intersecting cracks which are not necessarily bad. If the cracks continue to grow or if new cracks form, then eventually loose pieces will develop which will "rock" and perhaps even disintegrate or pop out creating a potentially dangerous hazard.

The joint spacing and joint type are more for design data feedback than for maintenance purposes and have no negative values assigned. The joint spacing is used in determining the negative values for transverse cracking. Obviously if the joints are 15 feet apart, it is more detrimental for the panel to contain 4 cracks than it is if the joints are 40 feet apart. Hence, the negative values are a function of the joint spacing as well as the number of cracks existing per panel.

For a jointed pavement to maintain its serviceability the joints must be sealed against the intrusion of water and debris. Hence, if the

joint is not sealed it will result in shortening the serviceable life of the pavement.

Shoulder, Roadside, Drainage, Traffic Services and Others

The rating scale for shoulder, roadside, drainage and traffic services is based on a scale of numbers ranging from 1 to 9. If the condition of the item being evaluated is very good the number 1 will be inserted in the proper box while the number 9 will be used if the condition is very poor. A zero will be utilized if the item is not present on the roadway section being evaluated. Thus, all boxes in this portion of the form must contain a number. The rating scale and the general description of the item being evaluated is shown in Table 5.

Shoulder - The shoulder area is to be considered either paved or unpaved. A paved shoulder will be surfaced with either a bituminous materials (asphalt concrete or surface treatment) or portland cement concrete. All other shoulders will be considered unpaved. For multi-lane highways the outside shoulder will be evaluated with the outside lane (lane R and L) while the inside shoulder will be evaluated with the inside lane. The descriptions of the categories to be evaluated are given in Appendix C.

Roadside and Drainage - Roadsides are defined as the areas between the outside edges of the shoulders and the right-of-way boundaries. On multilane highways the median and/or outer separations are included. Drainage refers to the facilities utilized for the removal of water from the highway right-of-way area and includes culverts, ditches, outfalls, channels and other drainage structures. Descriptions of these items are given in Appendix C.

Traffic Services - Devices, materials, methods and procedures used to maintain traffic flow at the desired level of service including guardrails, signs, delineators, striping and auxiliary markings are evaluated in that portion of the form. Descriptions of these items are given in Appendix C.

Other - This portion of the form is to be utilized by the evaluation team to denote unusual conditions that exist along the roadway. Examples of items to be noted by code numbers are encroachments, signals operating improperly, and dangerous geometric features including improper speed signing of curves and striping of no passing zones. A table of codes to be utilized is listed in Table 6. The two digit code should be placed at the extreme right side of that portion of the form designated as "other". The code should be placed in this portion of the form only if the condition exists.

EVALUATION TECHNIQUE

The rating team should prepare a district or individual county map illustrating the limits of roadway segments to be evaluated prior to the initiation of the field survey. The control and section maps appear to be the most useful for this purpose and should be prepared to show segment limits as indicated in the section of the manual titled "selection of roadway segments".

The evaluation team should ride the predetermined roadway section and note the location where further subdivision is necessary based on their observed difference in pavement, shoulder, geometric or roadside conditions. Once the roadway segment is located the rating team should drive the section at reduced speed and record the condition of the roadside, drainage, traffic services and other features. A second pass along the roadway section will provide information for the pavement and shoulder portion of the form. If the roadway segment is less than one mile in length the rating team should

stop and inspect the roadway at two locations for 100 feet in front of and in back of the vehicle. For roadway sections greater than one mile, the rating team should stop in proportion to the number of miles evaluated. For example if a ~~two~~-mile roadway segment is to be evaluated, three stops should be made. If a three-mile roadway is evaluated, four stops should be made, etc. Only one line of information need be provided for a single section regardless of the number of stops. This line of data should represent the observed average of all of the stops. If a great deal of variation exists between stops, the roadway segment should be further subdivided. Typical data are shown on Figure 9 for a flexible pavement and Figure 10 for a rigid pavement.

A review of information recorded on Figure 9 illustrates typical data obtained from field surveys. Data on lines one and two were obtained on FM 578. Lane R is the only lane evaluated, thus implying that lanes L and R of this two-lane road are identical. Lane R should always be designated if the data are to represent both lanes of the two-lane road.

Data on lines three through six were obtained on US 283 which is a four-lane undivided highway. As noted from each lane of this four-lane facility, lanes R and L contain the shoulder, roadside, drainage and traffic services rating. Note that lanes S and M do not contain ratings for other than the pavement. If lane R was the only lane evaluated, this would imply that all lanes are similar to lane R. If lanes R and L were the only lanes evaluated this would imply that lanes S and M are similar to lanes R and L, respectively.

Data on lines seven through twelve were obtained on IH35, a four-lane divided, controlled access highway with two-lane frontage roads on

each side of the main lanes. Data obtained on the main lanes (R, S and L, M) are recorded on lines seven through ten. Please note that shoulder, roadside, and drainage data are recorded for all lanes. The shoulder data recorded for lane S are for the inside shoulder; the roadside and drainage data are recorded for features from the shoulder to the center line of the entire roadway. Traffic services information is recorded for the outside or travel lanes (R and L) only. Frontage road information is shown on lines eleven and twelve. Lane A contains data for frontage lanes A and B while lane X contains data for frontage lanes X and Y. The shoulder data recorded for the frontage roads are for frontage road shoulders. Roadside and drainage features refer to conditions from the edge of the inside shoulder of the frontage roads to the right-of-way markers. Main lanes roadside and drainage features refer to conditions from the center line of the roadway to the edge of the shoulder of the frontage roads. Traffic service features recorded for the frontage roads are for the frontage roads only.

SCORING SYSTEM

The information obtained on the visual evaluation form is reduced by the computer to produce scores described as follows:

PRS - Pavement Rating Score

SRS - Shoulder Rating Score

RRS - Roadside Rating Score

DRS - Drainage Rating Score

TRS - Traffic Services Rating Score

Pavement Rating Score

The pavement rating score is obtained by subtracting "deduct values" associated with the various forms of distress from 100. A score of 100 indicates a pavement without observable distress. Deduct values for flexible pavements are shown in Table 7 and in Table 8 for rigid pavements. Using the first line of data in Figure 9, one can calculate a pavement rating score of 55 for this roadway section. This score is obtained by summation of the deduct values as follows:

<u>Type of Distress</u>	<u>Deduct Values</u>
Rutting	0
Raveling	8
Flushing	0
Corrugations	0
Alligator Cracking	5
Longitudinal Cracking	7
Transverse Cracking	10
Patching.	0
Failures.	0
Mays Ride Meter	<u>15</u>
TOTAL Deduct Points.....	45

$$\begin{aligned}\text{Pavement Rating Score} &= 100 - \Sigma \text{ deduct points} \\ &= 100 - 45 \\ &= 55\end{aligned}$$

(Other Rating Scores see Appendix D)

COMPUTER PROGRAMS

Computer programs are available for reducing the data obtained on the visual evaluation forms. The input necessary and the output obtained from this operation are contained in Appendix E.

SAFETY

The evaluation team should be aware of traffic hazards at all times

during the survey. Safety vests should be worn by members of the team. Flashing yellow lights should be mounted either in the car or on the roof to warn approaching traffic. Flags should be used when close pavement inspection is required.

Table 1: Training School Format

FIRST DAY

A.M.

I. Introduction

- A. Purpose of roadway maintenance evaluation
- B. Types of equipment available for evaluation

II. Visual Evaluation Form

- A. Selection of section to be evaluated
- B. Definition of section to be evaluated
- C. Pavement evaluation
 - 1. Types of distress
 - 2. Amount of distress
 - 3. Severity of distress
- D. Shoulder evaluation
- E. Roadside and drainage evaluation
- F. Traffic services evaluation

P.M.

I. Conduct first roadway evaluation

II. Scoring system

III. Score first evaluation

SECOND DAY

A.M.

I. Discuss results of first evaluation

II. Conduct second roadway evaluation

P.M.

I. Score second evaluation

II. Discuss results of second evaluation

III. Conduct third evaluation

IV. Score third evaluation

THIRD DAY

A.M.

I. Computer input

II. Computer output

III. Discuss training school

Table 2: Highway Class

Class	Location	Description
1	Rural	two lane primary or secondary
2	Rural	multilane primary or secondary
3	Rural	controlled access
11	Urban	two lane primary or secondary
12	Urban	multilane primary or secondary
13	Urban	controlled access

Table 3: County Numbering System

Co. No.	County Name	Dist. No.	Co. No.	County Name	Dist. No.	Co. No.	County Name	Dist. No.	Co. No.	County Name	Dist. No.
1	Anderson	10	65	Donley	25	129	Karnes	16	192	Reagan	7
2	Andrews	6	66	Kenedy	21	130	Kaufman	18	193	Real	22
3	Angelina	11	67	Duval	21	131	Kendall	15	194	Red River	1
4	Aransas	16	68	Eastland	23	66	Kenedy	21	195	Reeves	6
5	Archer	3	69	Ector	6	132	Kent	8	196	Refugio	16
6	Armstrong	4	70	Edwards	22	133	Kerr	15	197	Roberts	4
7	Atascosa	15	71	Ellis	18	134	Kimble	7	198	Robertson	17
8	Austin	12	72	El Paso	24	135	King	25	199	Rockwall	18
9	Bailey	5	73	Erath	2	136	Kinney	22	200	Runnels	7
10	Bandera	15	74	Falls	9	137	Kleberg	16	201	Rusk	10
11	Bastrop	14	75	Fannin	1	138	Knox	25	202	Sabine	11
12	Baylor	3	76	Fayette	13	139	Lamar	1	203	San Augustine	11
13	Bee	16	77	Fisher	8	140	Lamb	5	204	San Jacinto	11
14	Bell	9	78	Floyd	5	141	Lampasas	23	205	San Patricio	16
15	Bexar	15	79	Foard	25	142	LaSalle	15	206	San Saba	23
16	Blanco	14	80	Fort Bend	12	143	Lavaca	13	207	Schleicher	7
17	Borden	8	81	Franklin	1	144	Lee	14	208	Scurry	8
18	Bosque	9	82	Freestone	17	145	Leon	17	209	Shackelford	8
19	Bowie	19	83	Frio	15	146	Liberty	20	210	Shelby	11
20	Brazoria	12	84	Gaines	5	147	Limestone	9	211	Sherman	4
21	Brazos	17	85	Galveston	12	148	Lipscomb	4	212	Smith	10
22	Brewster	24	86	Garza	5	149	Live Oak	16	213	Somervell	2
23	Briscoe	25	87	Gillespie	14	150	Llano	14	214	Starr	21
24	Brooks	21	88	Glasscock	7	151	Loving	6	215	Stephens	23
25	Brown	23	89	Goliad	16	152	Lubbock	5	216	Sterling	7
26	Burleson	17	90	Gonzales	13	153	Lynn	5	217	Stonewall	8
27	Burnet	14	91	Gray	4	154	Madison	17	218	Sutton	7
28	Caldwell	14	92	Grayson	1	155	Marion	19	219	Swisher	5
29	Calhoun	13	93	Gregg	10	156	Martin	6	220	Tarrant	2
30	Callahan	8	94	Grimes	17	157	Mason	14	221	Taylor	8
31	Cameron	21	95	Guadalupe	15	158	Matagorda	12	222	Terrell	6
32	Camp	19	96	Hale	5	159	Maverick	22	223	Terry	5
33	Carson	4	97	Hall	25	160	McCulloch	23	224	Throckmorton	3
34	Cass	19	98	Hamilton	9	161	McLennan	9	225	Titus	19
35	Castro	5	99	Hansford	4	162	McMullen	15	226	Tom Green	7
36	Chambers	20	100	Hardeman	25	163	Medina	15	227	Travis	14
37	Cherokee	10	101	Hardin	20	164	Menard	7	228	Trinity	11
38	Childress	25	102	Harris	12	165	Midland	6	229	Tyler	20
39	Clay	3	103	Harrison	19	166	Milam	17	230	Upshur	19
40	Cochran	5	104	Hartley	4	167	Mills	23	231	Upton	6
41	Coke	7	105	Haskell	8	168	Mitchell	8	232	Uvalde	22
42	Coleman	23	106	Hays	14	169	Montague	3	233	Val Verde	22
43	Collin	18	107	Hemphill	4	170	Montgomery	12	234	Van Zandt	10
44	Collingsworth	25	108	Henderson	10	171	Moore	4	235	Victoria	13
45	Colorado	13	109	Hidalgo	21	172	Morris	19	236	Walker	17
46	Comal	15	110	Hill	9	173	Motley	25	237	Waller	12
47	Comanche	23	111	Hockley	5	174	Nacogdoches	11	238	Ward	6
48	Concho	7	112	Hood	2	175	Navarro	18	239	Washington	17
49	Cooke	3	113	Hopkins	1	176	Newton	20	240	Webb	21
50	Coryell	9	114	Houston	11	177	Nolan	8	241	Wharton	13
51	Cottle	25	115	Howard	8	178	Nueces	16	242	Wheeler	25
52	Crane	6	116	Hudspeth	24	179	Ochiltree	4	243	Wichita	3
53	Crockett	7	117	Hunt	1	180	Oldham	4	244	Wilbarger	3
54	Crosby	5	118	Hutchinson	4	181	Orange	20	245	Willacy	21
55	Culberson	24	119	Irion	7	182	Palo Pinto	2	246	Williamson	14
56	Dallam	4	120	Jack	2	183	Panola	19	247	Wilson	15
57	Dallas	18	121	Jackson	13	184	Parker	2	248	Winkler	6
58	Dawson	5	122	Jasper	20	185	Parmer	5	249	Wise	2
59	Deaf Smith	4	123	Jeff Davis	24	186	Pecos	6	250	Wood	10
60	Delta	1	124	Jefferson	20	187	Polk	11	251	Yoakum	5
61	Denton	18	125	Jim Hogg	21	188	Potter	4	252	Young	3
62	DeWitt	13	126	Jim Wells	16	189	Presidio	24	253	Zapata	21
63	Dickens	25	127	Johnson	2	190	Rains	1	254	Zavala	22
64	Dimmit	22	128	Jones	8	191	Randall	4			

Table 4: Highway Description

Abbreviation	Description
IH	<u>I</u> nterstate <u>H</u> ighway
US	<u>U</u> nited <u>S</u> tates Highway
SH	<u>S</u> tate <u>H</u> ighway
FM	<u>F</u> arm to <u>M</u> arket (Ranch Road, Farm Road)
LP	<u>L</u> oop
SP	<u>S</u> pur
PR	<u>P</u> ark <u>R</u> oad
RR	<u>R</u> ecreational <u>R</u> oad

Table 5: Rating Scale for Shoulder, Roadside,
Drainage and Traffic Services

General Description of Condition	Numerical Scale
Very good	1-2
Good	2-4
Fair	4-6
Poor	6-8
Very Poor	8-9
Item not present on roadway section	0

Table 6: Code Numbers for Other Items
to be Evaluated

Code Number	Description
10	Encroachment
11	Automobile encroachment
12	Agricultural encroachment
13	Advertisement encroachment
20	Signal
21	Improper operating signal
22	Improper operating flashing signal
30	Geometrics
31	Improper speed signing of curve
32	Improper striping of no passing zone
40	Roadside hazard
41	Dangerous sign support
42	Dangerous tree
43	Dangerous slope
50	Bridge
51	Narrow bridge
52	Damaged bridge railing
53	Damaged bridge superstructure
60	Pest control

Table 7: Deduct Values for Flexible Pavement

Type of Distress	Degrees of Distress	Extent or Amount of Distress		
		(1)	(2)	(3)
Rutting	Slight	0	2	5
	Moderate	5	7	10
	Severe	10	12	15
Raveling	Slight	5	8	10
	Moderate	10	12	15
	Severe	15	18	20
Flushing	Slight	5	8	10
	Moderate	10	12	15
	Severe	15	18	20
Corrugations	Slight	5	8	10
	Moderate	10	12	15
	Severe	15	18	20
Alligator Cracking	Slight	5	10	15
	Moderate	10	15	20
	Severe	15	20	25
Patching	Good	0	2	5
	Fair	5	7	10
	Poor	7	15	20

Deduct Points for Cracking

Longitudinal Cracking

	Sealed			Partially Sealed			Not Sealed		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Slight	2	5	8	3	7	12	5	10	15
Moderate	5	8	10	7	12	15	10	15	20
Severe	8	10	15	12	15	20	15	20	25

Transverse Cracking

Slight	2	5	8	3	7	10	3	7	12
Moderate	5	8	10	7	10	15	7	12	15
Severe	8	10	15	10	15	20	12	15	20

Failures

Mays Meter

Deduct Points	20			30			40		
	50	40	30	20	10	5	0		
SI	2.4	2.7	2.9	3.1	3.3	3.5	4.7		

Table 8: Deduct Values for Rigid Pavement

Type of Distress	Degrees of Distress	Extent or Amount of Distress		
		(1)	(2)	(3)
Pumping		20	40	60
Failures/Mile		20	30	40
Surface Deterioration	Slight	5	10	20
	Moderate	10	20	30
	Severe	20	40	60
Spalling	Slight	5	10	15
	Moderate	10	15	20
	Severe	20	40	60
Longitudinal Cracking	Slight	5	10	15
	Moderate	10	15	20
	Severe	15	20	25
Patching	Good	0	2	5
	Fair	5	7	10
	Poor	7	15	20
Faulting	Moderate	5	15	
	Severe	15	40	
Crack Spacing	Closed	0	10	
	Open	15	40	
% Intersecting Cracks	Moderate	5	15	
	Severe	15	40	
Joint Spacing	Information Only			
Transverse Cracking				
If Joint Spacing is less than 20 feet.				
	Slight	5	10	20
	Moderate	10	20	30
	Severe	15	30	40
If Joint Spacing is greater than 20 feet.				
	Slight	0	5	10
	Moderate	5	10	20
	Severe	10	15	30
Joints		0	10	20

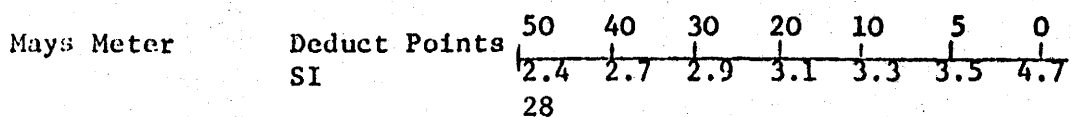


Figure 1. Maintenance Rating Form for Flexible Pavements

Figure 2. Maintenance Rating Form for Rigid Pavements

DISTRICT NO.		RATERS		DATE MONTH DAY YEAR	
LOCATION					
FOREMAN NO.		HIGHWAY CLASS		COUNTY NO.	
HIGHWAY NO.		CONTROL		SECTION	
FROM		TO		LANE	
MAYS METER					
① SLIGHT ② MODERATE ③ SEVERE PUMPING					
① 1-5 ② 6-10 ③ >10 FAILURES / MILE					
SLIGHT		MODERATE		SEVERE	
SURFACE DETERIORATION		AREA JOINTS PER STA		% AREA JOINTS PER STA	
SLIGHT		MODERATE		SEVERE	
SPALLING		LONGITUDINAL CRACKING		PATCHING	
SLIGHT		MODERATE		SEVERE	
FAULTING		CRACK SPACING		% INTERSECTING CRACKS	
SLIGHT		MODERATE		SEVERE	
JOINT SPACING		TRANSVERSE CRACKING		JOINTS (1) SEALED (2) PARTIALLY SEALED (3) NOT SEALED	
GOOD		FAIR		POOR	
MODERATE		SEVERE		CLOSED	
OPEN		MODERATE		SEVERE	
SAWED		CONSTR.		SLIGHT	
MODERATE		SEVERE		MODERATE	
SEVERE		SEVERE		SEVERE	
PAVED		UNPAVED		ROADSIDE AND DRAINAGE	
TRAFFIC SERVICE		OTHER		OTHER	

Figure 3. Typical General Information Contained on Maintenance Rating Form

DISTRICT NO. 03

RATERS 26
RAGLAND F L

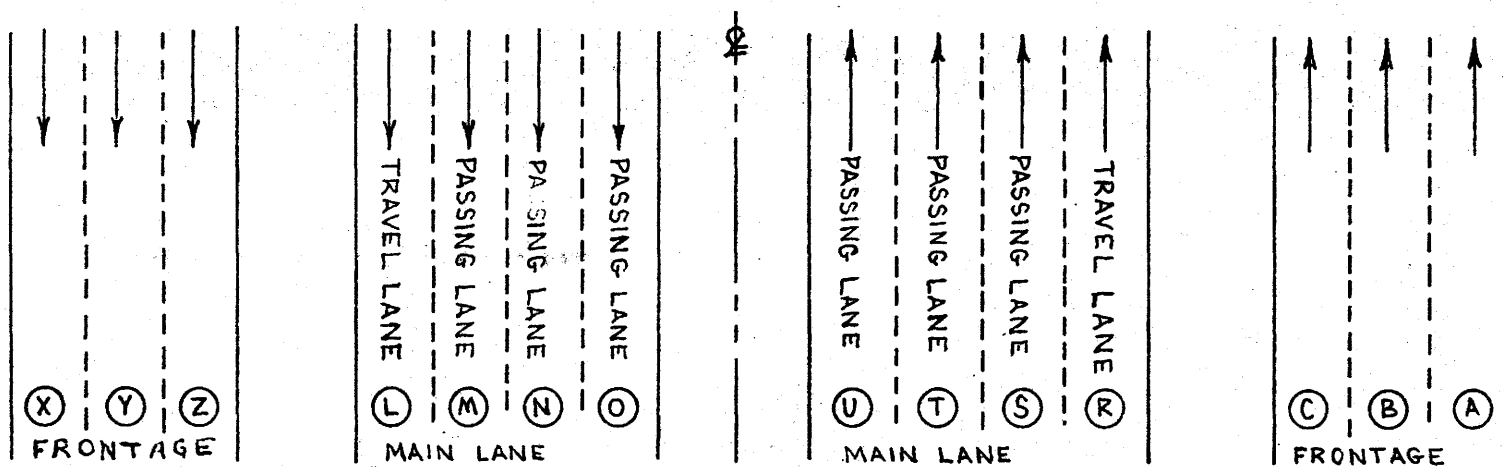
51
POPE W M

DATE MONTH 09 DAY 07 YEAR 1974

Figure 4. Lane Designation System

FACE IN DIRECTION OF INCREASING MILE POSTS

A. Interstate or Major Highway - 8 Lanes with frontage roads



B. Interstate or Major Highway - 6 Lanes with frontage roads.

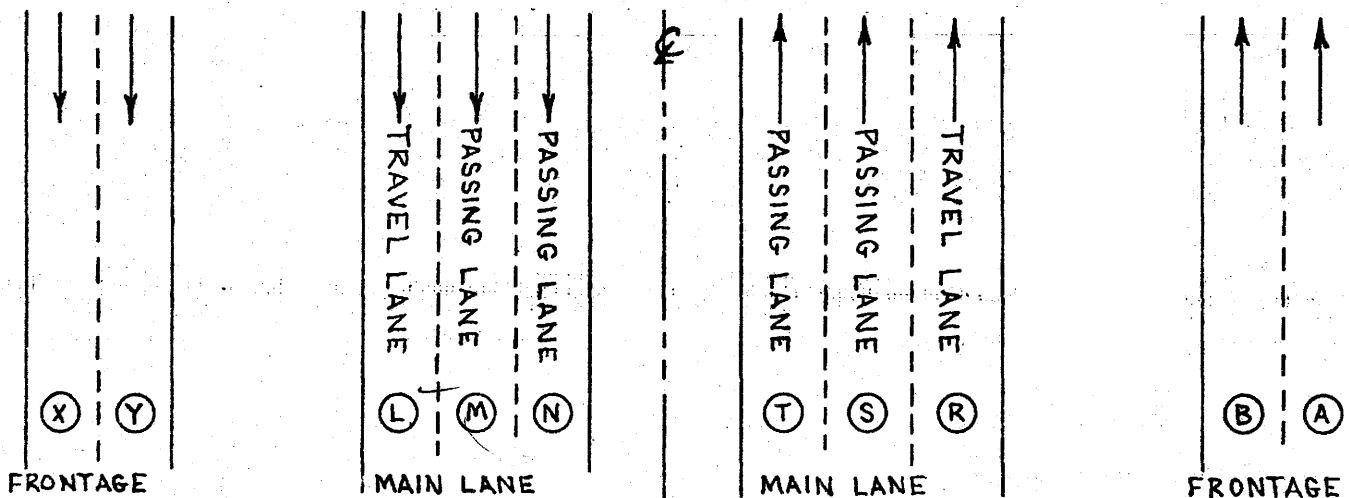
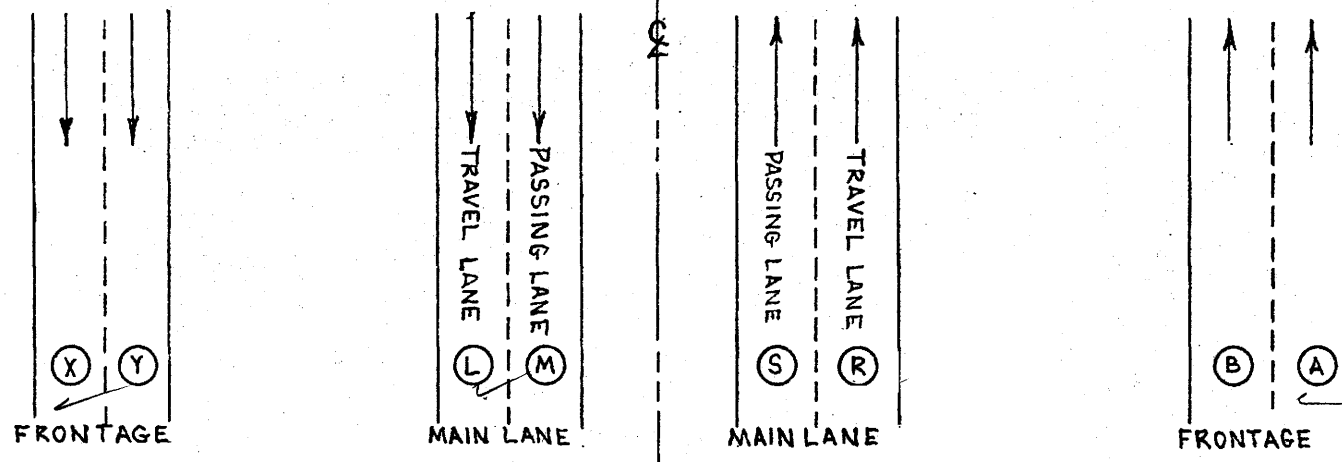
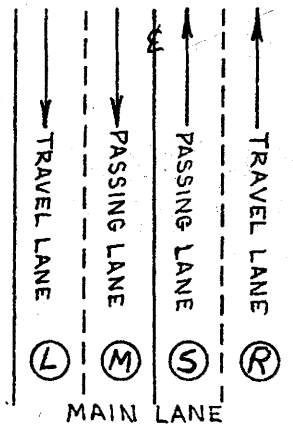


Figure 4. Lane Designation System (Continued)

C. Interstate or Major Highway - 4 Lanes with frontage roads.



D. Highway - 4 Lanes without frontage roads.



E. Highway - 2 Lanes without frontage roads.

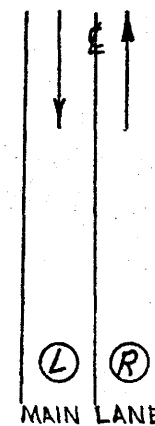


Figure 5. Typical Location Information Contained on Maintenance Rating Form

LOCATION													
FOREMAN NO.	HIGHWAY CLASS		COUNTY NO.	HIGHWAY NO.		CONTROL	SECTION	FROM		TO		LANE	
05	01	252	FM	578	1031	07		00		46		R	
05	01	252	FM	578	1031	06		46		82		R	
05	12	252	US	283	89	01		00		52		R	
05	12	252	US	283	89	01		00		52		S	
05	12	252	US	283	89	01		00		52		L	
05	12	252	US	283	89	01		00		52		M	
05	03	252	IH	35	22	01		52		90		R	
05	03	252	IH	35	22	01		52		90		S	
05	03	252	IH	35	22	01		52		90		L	
05	03	252	IH	35	22	01		52		90		M	
05	03	252	IH	35	22	01		52		90		A	
05	03	252	IH	35	22	01		52		90		X	

Figure 6. Typical Data for Flexible Pavement Rating Form

PAVEMENT													
MAYS METER	RUTTING	RAVELING	FLUSHING	CORRUGATIONS	ALLIGATOR CRACKING	LONGITUDINAL CRACKING	TRANSVERSE CRACKING	PATCHING			FAILURES / MILE		
	%AREA	%AREA	%AREA	%AREA	%AREA	LIN. FT. PER STA/LN	NO. PER STA	%AREA					
	① 1-15 ② 16-30 ③ > 30	① 1-15 ② 16-30 ③ > 30	① 1-15 ② 16-30 ③ > 30	① 1-15 ② 16-30 ③ > 30	① 1-5 ② 6-25 ③ > 25	① 0-99 ② 100-199 ③ > 200	① 1-4 ② 5-9 ③ > 10	① 1-5 ② 6-15 ③ > 16			① 1-5 ② 6-10 ③ > 10		
	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	SLIGHT MODERATE SEVERE	CRACKS (1) SEALED (2) PARTIALLY SEALED (3) NOT SEALED	GOOD FAIR POOR	
3.20		2	0	0	1	2		1	2	1			0
3.00		3	0	0	1	1		1	2	0			0
3.92		0	2	0	2	1	2	3	0				0
4.00		0	1	0	0	1	2	3	0				0
3.52		0	1	0	1	1	2	3	0				0
3.20		0	1	0	0	1	2	3	0				0
3.93		0	0	0	0	0	1	2	0				0
3.91		2	0	0	0	0	1	2	0				0
4.03		0	0	0	0	0	1	2	0				0
4.01		1	0	0	0	0	1	2	0				0
3.70		3	0	0	0	0	0	0	1				0
3.20		3	0	0	0	0	0	0	0				0
30													
35													
40													
45													
50													
55													

Figure 7. Typical Data for Rigid Pavement Rating Form

PORTLAND CEMENT CONCRETE PAVEMENTS														
ALL PAVEMENTS										CRACK ONLY		JOINT ONLY		
MAYS	METER	SURFACE PUMPING			SURFACE DETERIORATION	SPALLING	LONGITUDINAL CRACKING	PATCHING	FAULTING	CRACK SPACING	% INTERSECTING CRACKS	JOINT SPACING	TRANSVERSE CRACKING	JOINT & CRACK (1) SEALED (2) PARTIALLY (3) NO SEAL
		① LIGHT	② MODERATE	③ SEVERE										
		① 1-5	② 6-10	③ >10	% AREA	% JOINTS CRACKS	LIN. FT. PER STA.	% AREA	NO. PER STA.	① 5-10'	② OTHER	① 1-10'	② 10-20'	③ 20'-100'
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	1	0	0	1	1	0	0	0	0	2	1			
3	3	0	0	0	1	0	0	0	0	2	2			
2	1	0	0	0	1	0	0	0	2	2				
4	1	2	1	1	1	0	1	1	1			1	1	2
3	2	3	2	1	1	1	1	1	1			1	1	2
4	0	2	1	1	0	0	1	1	1			1	0	2
3	7	3	2	1	1	0	1	1	1			1	1	2
3	2	3	3	1	1	1	1	1	1			1	3	2
3	1	2	1	1	1	1	2	1	1			1	1	2
4	0	1	2	1	0	1	1	0	0			1	1	2
2	1	3	3	1	1	1	1	1	1			1	1	2

Figure 8. Typical Data for Shoulder, Roadside, Drainage and Traffic Services

SHOULDER													
PAVED							UNPAVED			ROADSIDE AND DRAINAGE			
RIDE	CONTRAST	PAVEMENT EDGE	SHOULDER EDGE	CRACKS	RAVELING	VEGETATION	PAVEMENT EDGE	RUTTING, CORRUGATIONS, LOOSE ROCK	LITTER	MOWING	VEGETATION	SLOPE EROSION	CULVERTS
00	00	00	00	00	00	00	33	33	22	11	22	11	22
00	00	00	00	00	00	00	42	11	22	11	22	11	22
35	26	22	11	00	00	00	44	11	22	22	14	54	66
00	00	00	00	00	00	00	00	00	00	00	00	00	00
32	23	22	11	00	00	00	44	11	22	22	14	54	66
00	00	00	00	00	00	00	00	00	00	00	00	00	00
21	11	11	31	00	00	00	22	22	31	21	32	12	00
21	11	31	21	00	00	00	21	11	11	11	00	00	00
31	11	11	31	00	00	00	21	11	31	21	21	12	00
21	11	31	31	00	00	00	11	11	11	11	00	00	00
13	43	22	30	00	00	00	22	22	21	11	02	21	22
24	22	12	20	00	00	00	22	11	11	11	02	21	22
60	65	70	75	80									

[illegible]

Figure 10. Typical Maintenance Rating Data for Rigid Pavement Form

[illegible]

APPENDIX A

Definitions Associated with Maintenance Rating Form for Flexible Pavement

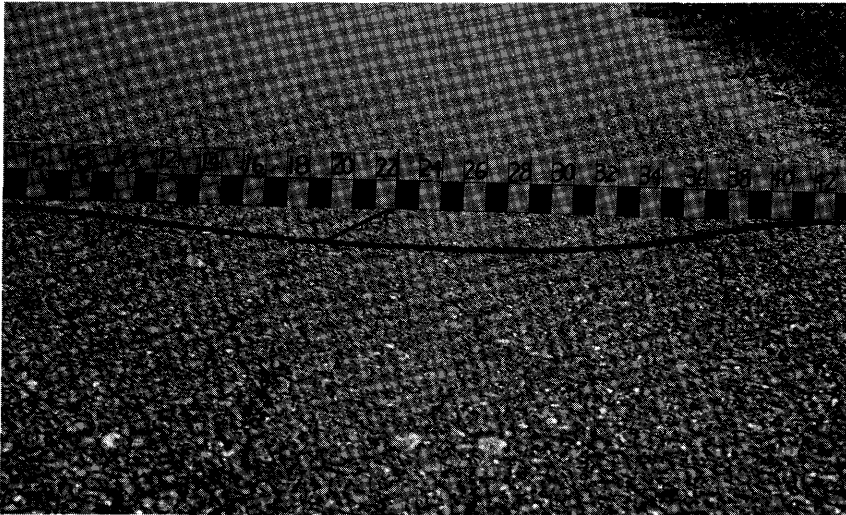
DEFINITION OF FLEXIBLE PAVEMENT DISTRESS

1. RUTTING

definition: Longitudinal depressions that form under traffic in the wheel paths and have a minimum length of approximately 20 feet

synonyms: grooving, channeling

<u>Severity of Distress</u>	<u>Rut Depth, Inches</u>
Slight	0 to 0.5
Moderate	0.5 to 1.0
Severe	greater than 1.0

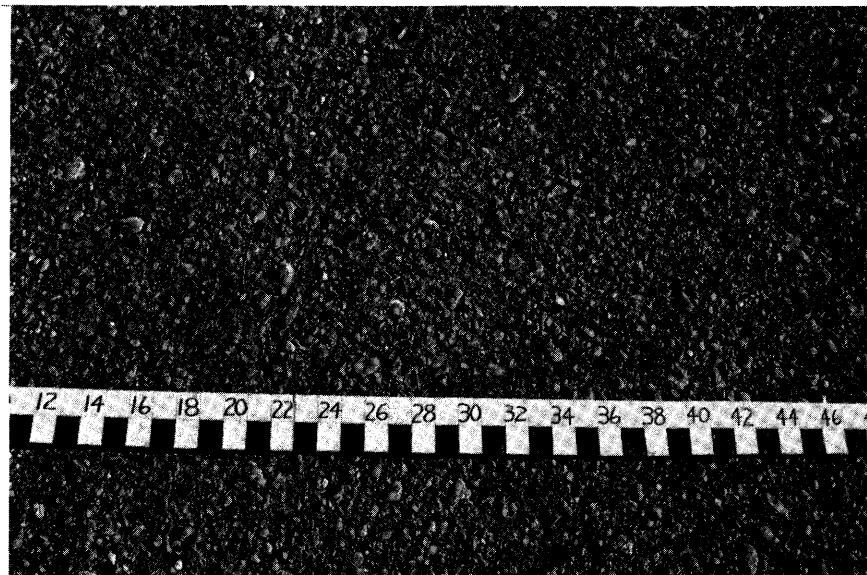


2. RAVELING

definition: The progressive disintegration from the surface downward
by the dislodgement of aggregate particles

synonym: surface disintegration

<u>Severity of Distress</u>	<u>Description</u>
Slight	less than 10% of surface aggregates dislodged
Moderate	10 to 50% of surface aggregate dislodged
Severe	greater than 50% of surface aggregates dislodged



3. FLUSHING

definition: Free bitumen on the surface of pavement

synonym: bleeding

Severity of Distress

Slight

Moderate

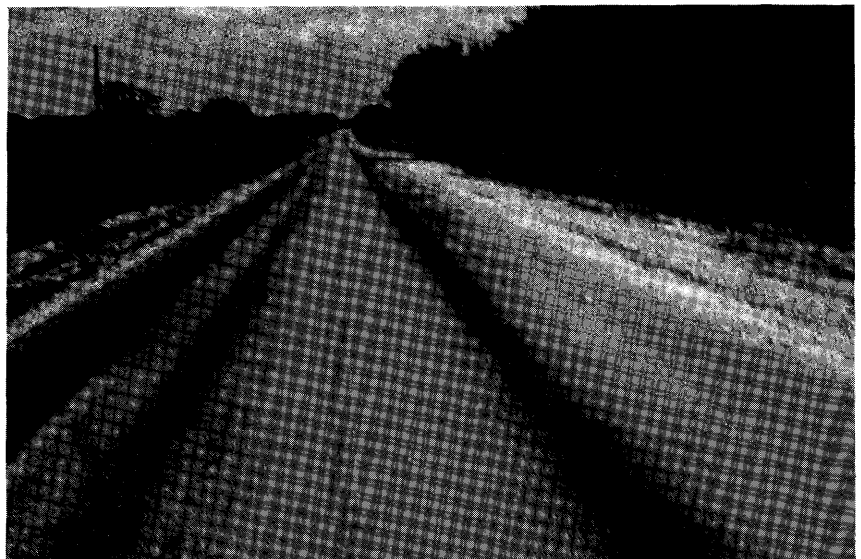
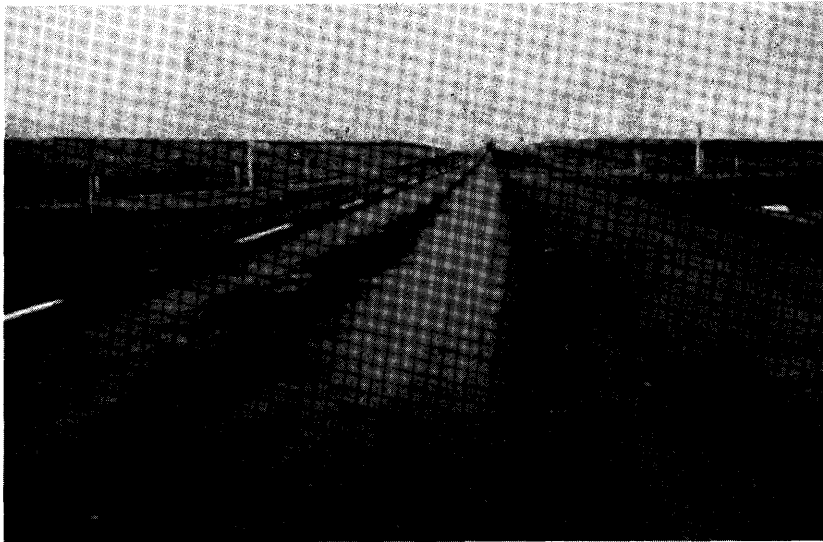
Severe

Description

initiation or start of bleeding, coarse aggregate above surface of asphalt

coarse aggregate and asphalt nearly at same plane; but coarse aggregate readily visible, looks slick in appearance

black appearing surface, few aggregate particles visible, slick in appearance

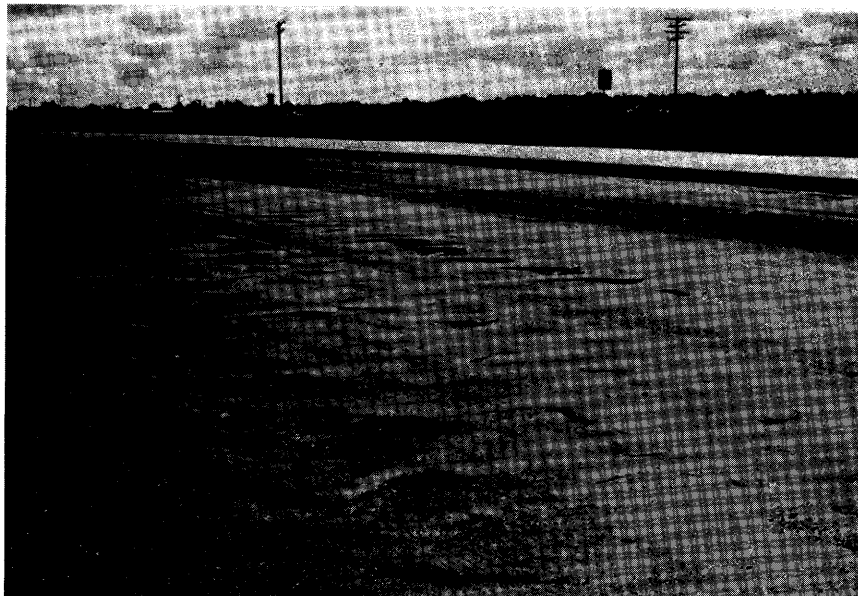


4. CORRUGATIONS

definition: Transverse undulations at regular intervals in the surface of the pavement consisting of alternate valleys and crests .

synonym: wash board

<u>Severity of Distress</u>	<u>Description, inches</u>
Slight	0 - 1/4 inch in depth
Moderate	1/4 to 3/4 inch in depth
Severe	greater than 3/4 inch in depth



6. ALLIGATOR CRACKING

definition: Interconnected or interlaced cracks forming a series of small polygons that resemble an alligator's hide

synonym: alligatoring, map cracking, chicken wire cracking

Severity of Distress

Slight

Moderate

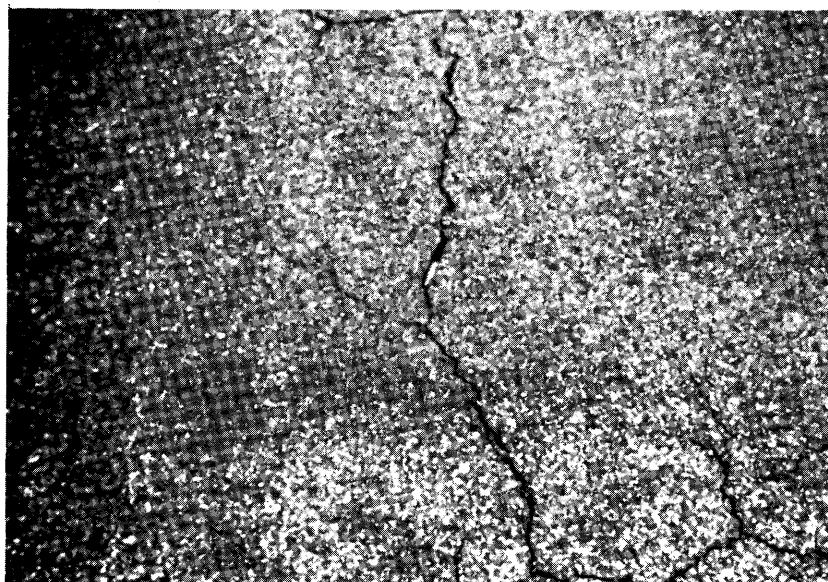
Severe

Description

hairline (less than 1/8 inch), no pumping

limited spalling and/or pumping

spalling and pumping or cracking 1/4 inch and greater

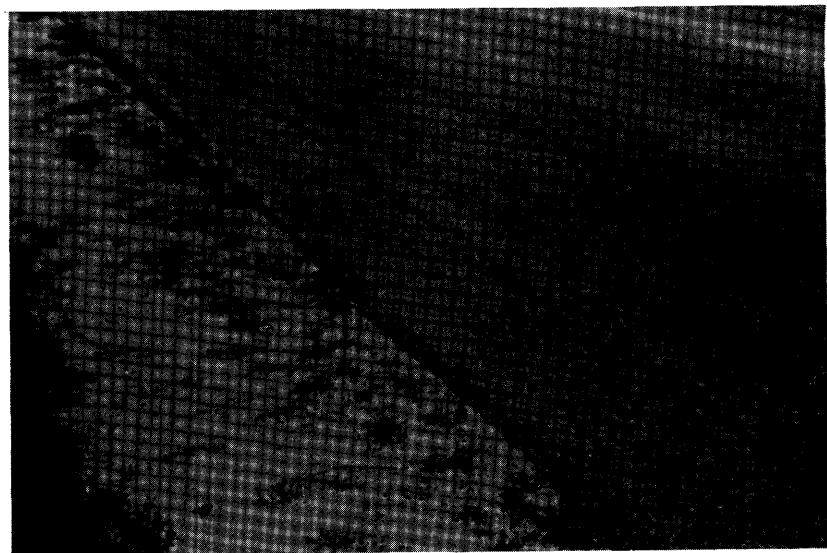
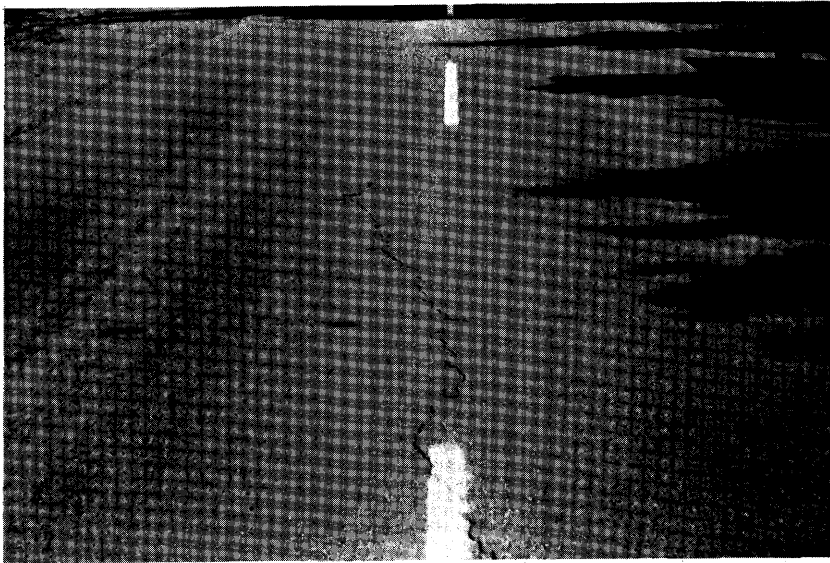


7. LONGITUDINAL CRACKING

definition: A crack or break approximately parallel to the pavement centerline

<u>Severity of Distress</u>	<u>Description</u>
Slight	hairline (less than 1/8 inch)
Moderate	some spalling, or pumping, or greater than 1/8 inch
Severe	spalling and/or pumping

Note: Any crack that has been poured shall be considered at least moderate.

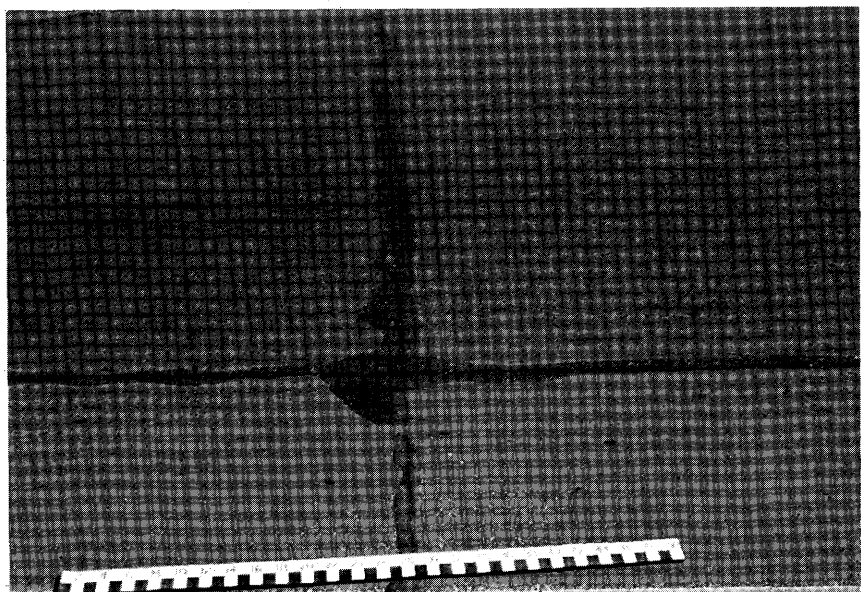
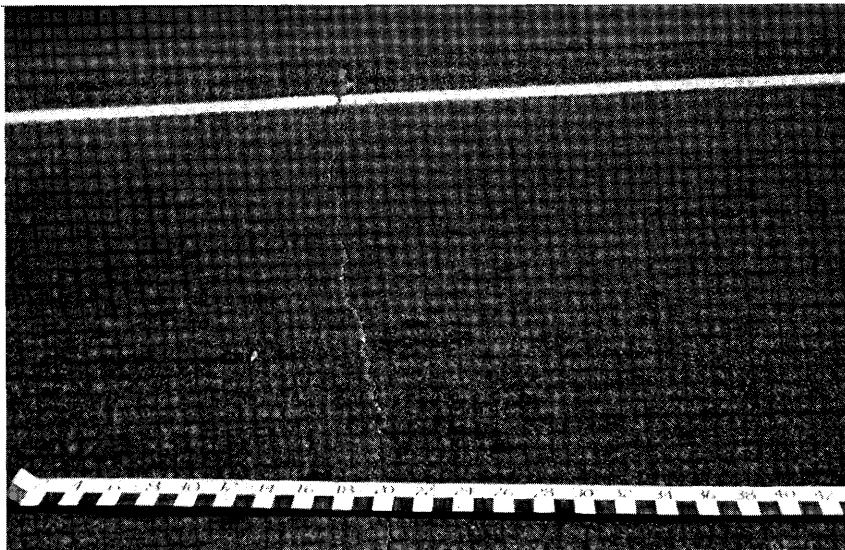


8. TRANSVERSE CRACKING

definition: A crack approximately at right angles to the pavement centerline

<u>Severity of Distress</u>	<u>Description</u>
Slight	hairline (less than 1/8 inch) no pumping
Moderate	some spalling or pumping, or greater than 1/8
Severe	spalling and pumping

Note: Any crack that has been poured shall be considered at least moderate.



Cracks

Sealed - crack contains a crack sealing compound that provides an effective seal.

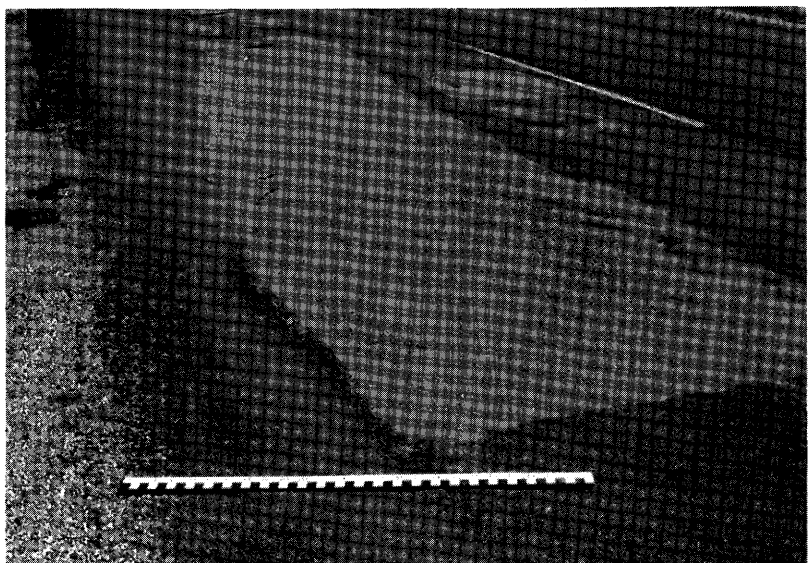
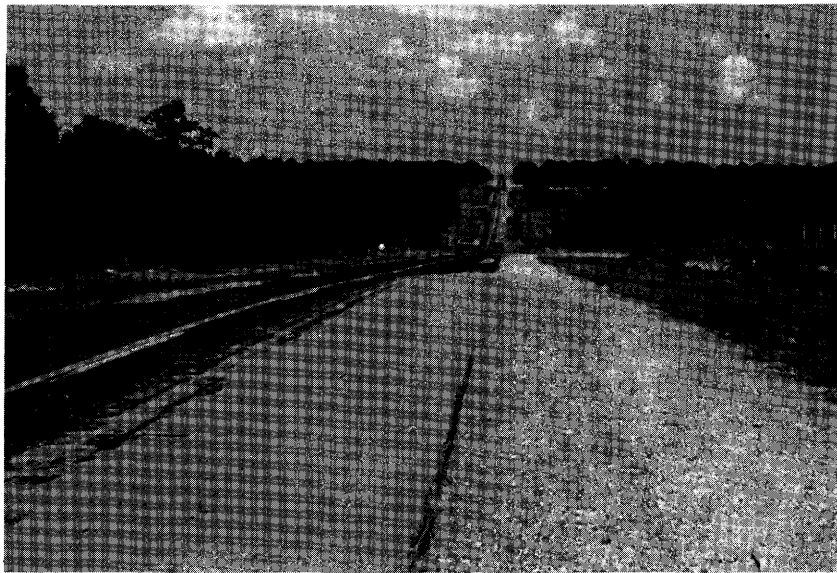
Partially sealed - crack contains a crack sealing compound that is acting as a partial seal.

Not sealed - the crack has not been sealed.

9. PATCHING

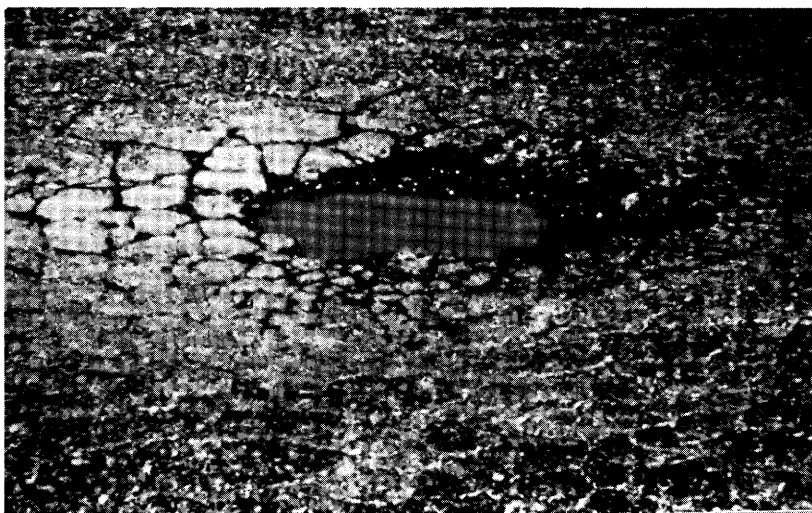
definition: corrections made to pavement defects by maintenance forces
including sporadic seal coating, crack sealing, etc.

<u>Condition of Patch</u>	<u>Description</u>
Good	adequate performance, patch is expected to serve function
Fair	marginal performance
Poor	patch should be replaced as soon as scheduling allows



Failures

definition: A section of pavement, usually confined to less than 20 feet, where the surface has been eroded or is badly cracked and depressed. The areas may contain loose pieces of material and creates a hazardous driving condition.



APPENDIX B

Definitions Associated with Maintenance Rating Form for Rigid Pavements

DESCRIPTION OF RIGID PAVEMENT DISTRESS

Note: Where applicable the following descriptions are taken from "Standard Nomenclature and Definitions for Pavement Components and Deficiencies," Highway Research Board Special Report 113.

1. Pumping

description: the ejection of mixtures of water, clay, or silt along or through transverse or longitudinal joints, cracks, or pavement edges.

synonym: blowing

Severity of Distress

Slight - visible deposits of material at the pavement surface.

Moderate - visible deposits of material at the pavement surface with slight subsidence or faulting of the pavement slab.

Severe - visible deposits of material at the pavement surface with obvious faulting of the pavement slab.



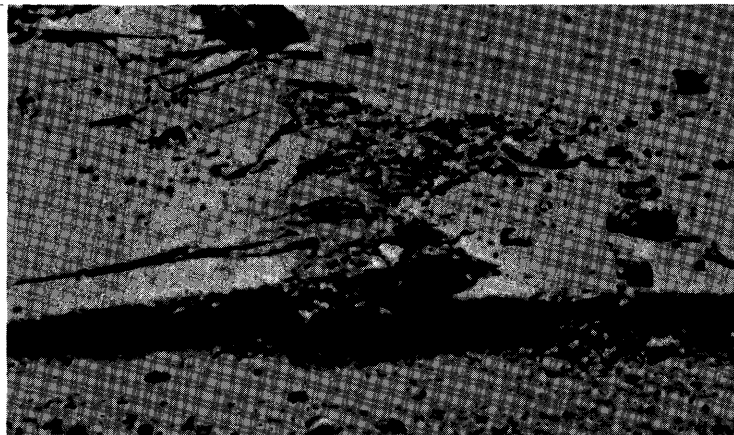
2. Failures

description: a section of pavement, usually confined to less than 20 feet, where the surface is badly cracked, may be faulted and/or contain loose pieces of the concrete slab. Hazardous to driving.

synonym: blow-up, buckling, D-cracking, shattering, random cracking, tenting, second and third stage cracking.

Severity of Distress

The number of failures per mile determine the severity.



3. Surface Deterioration

description: progressive disintegration and loss of the concrete wearing surface.

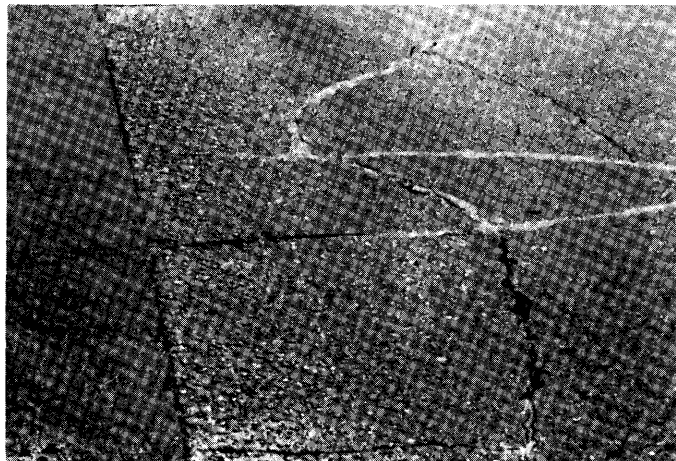
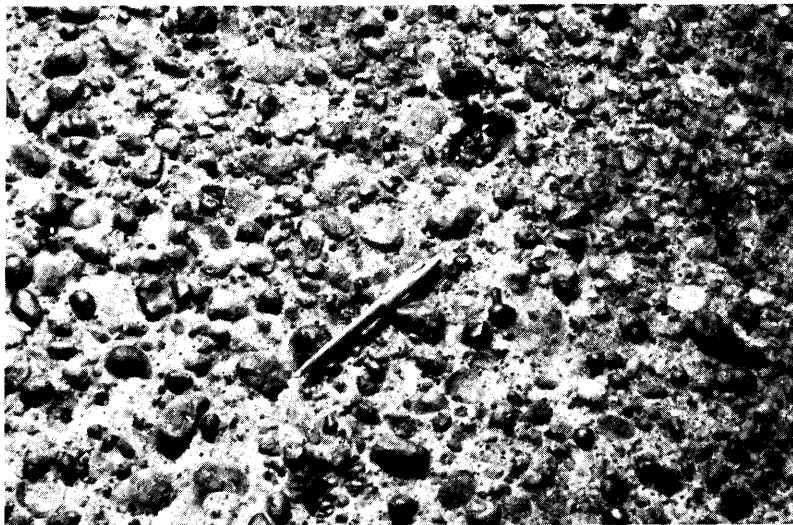
synonym: scaling, ravelling, disintegration, pop-outs.

Severity of Distress

Slight - visible disintegration.

Moderate - less than 1/2" deep, some coarse aggregate exposed.

Severe - greater than 1/2" deep, most of the coarse aggregate is exposed and evidence of coarse aggregate being removed is obvious.



5. Longitudinal Cracking

description: a crack or break approximately parallel to the pavement centerline.

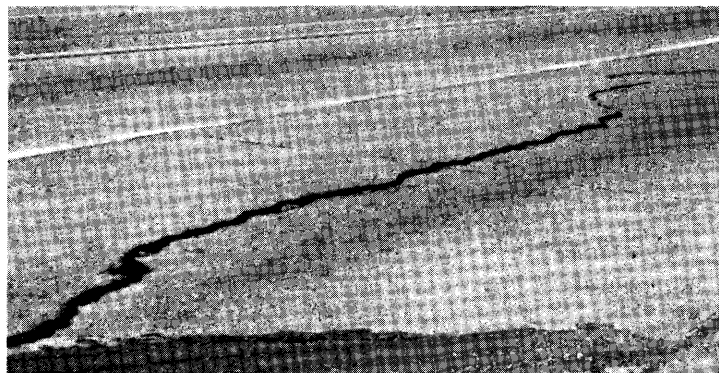
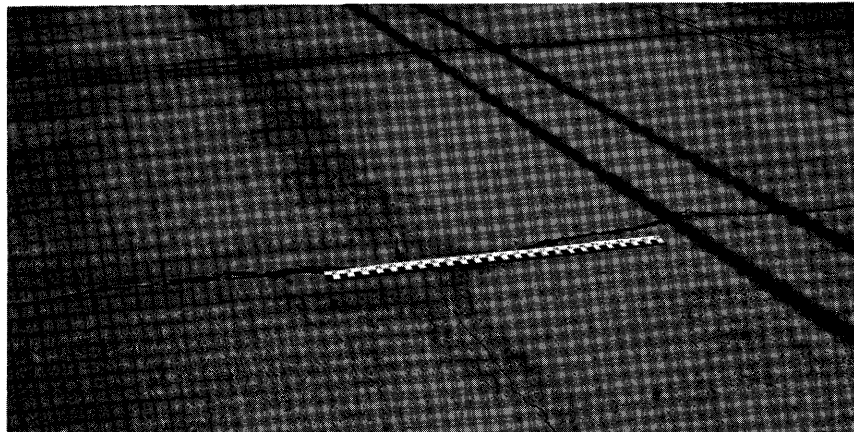
synonym: none

Severity of Distress

Slight - visible cracks less than 1/8" wide showing no evidence of faulting, loss of aggregate interlock or the intrusion of debris.

Moderate - cracks less than 1/4" wide that exhibit little or no faulting or evidence of intrusion of debris.

Severe - cracks that show loss of aggregate interlock, obvious intrusion of water and debris and may show faulting and/or spalling.



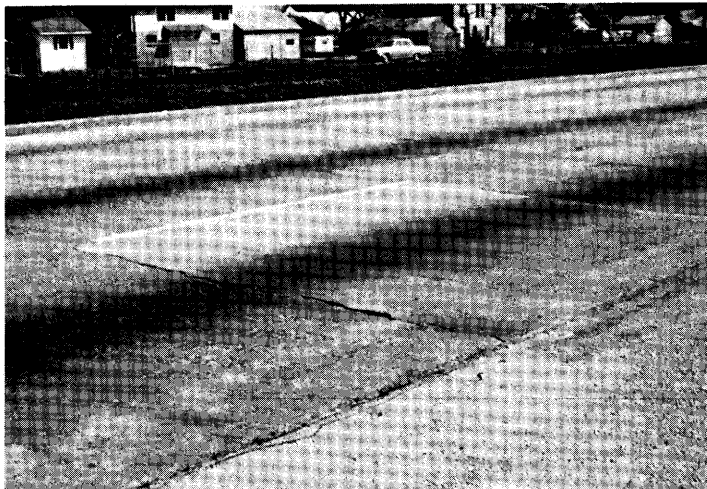
6. Patching

description: corrections made to pavement defects by maintenance forces.

synonym: repairs

Condition of Patch

- Good - adequate performance, patch is expected to serve function for over 1 year.
- Fair - marginal performance, patch to be replaced within 1 year.
- Poor - patch should be replaced as soon as scheduling allows.



7. Faulting

description: differential vertical displacement of abutting slabs at joints or cracks creating a "step" deformation in the pavement surface.

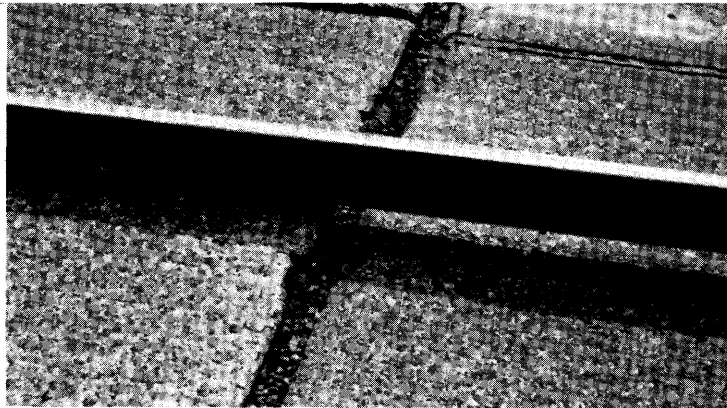
synonym: step-off, step.

note: curling and warping or slab bending is also evaluated under this heading since their visible evidence is similar to faulting.

Severity of Distress

Moderate - steps of less than 1/2" in height.

Severe - steps of greater than 1/2" that cause an obvious bump when driven over.



8. Crack Spacing

Note: CRCP should contain cracks (vertical cleavages) approximately perpendicular to the centerline of the pavement that extend both through and across the pavement section.

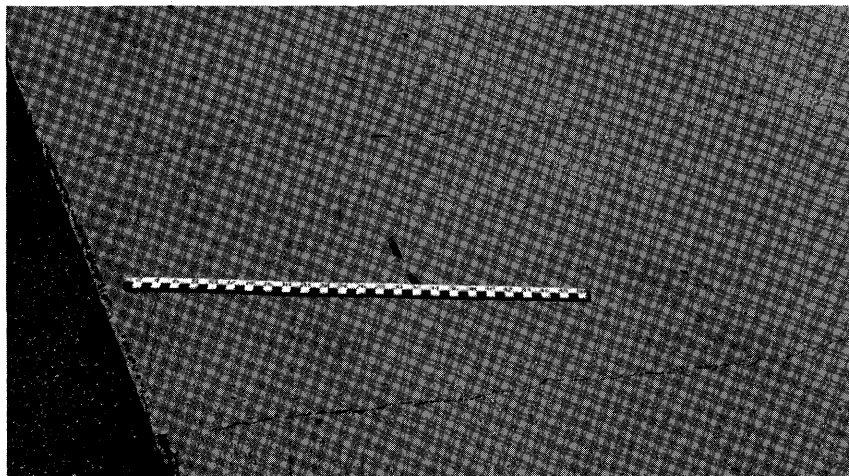
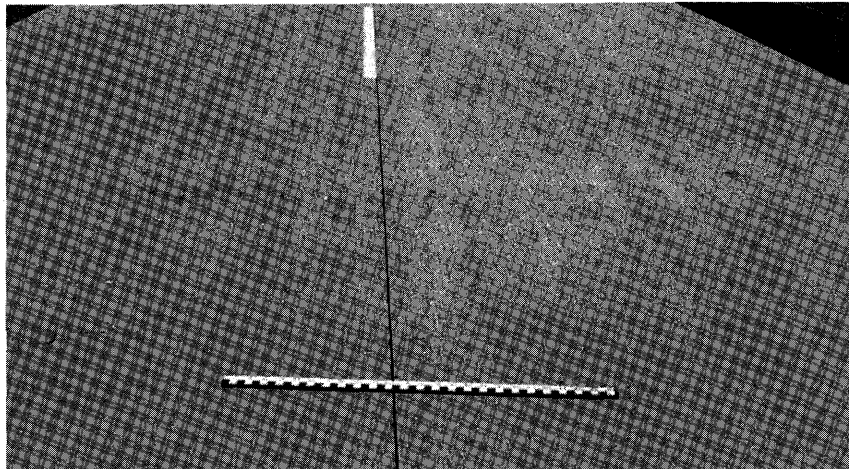
description: linear distance between transverse cracks.

synonym: none

Condition of Crack

Closed - cracks that are hairline or less than 1/16" wide that show no evidence of intrusion of water or debris.

Open - cracks that are greater than 1/16" wide that may show evidence of loss of aggregate interlock and/or intrusion of water or debris.



9. % Intersecting Cracks

description: cracks which intersect other cracks rather than
extending across the pavement slab.

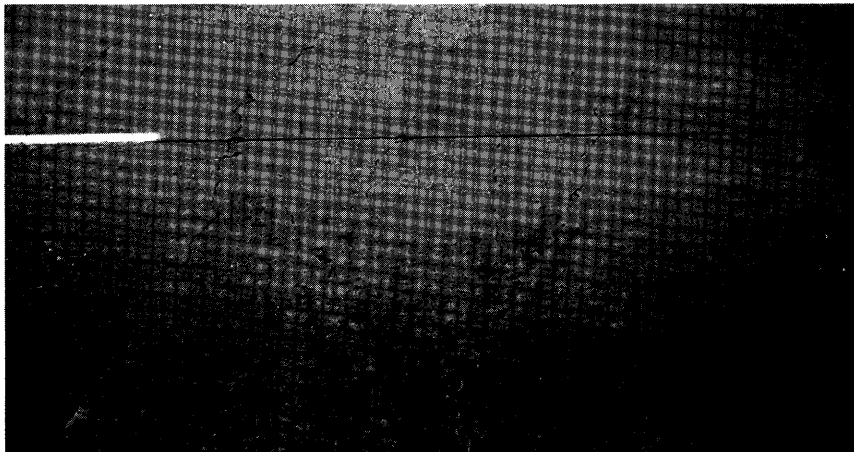
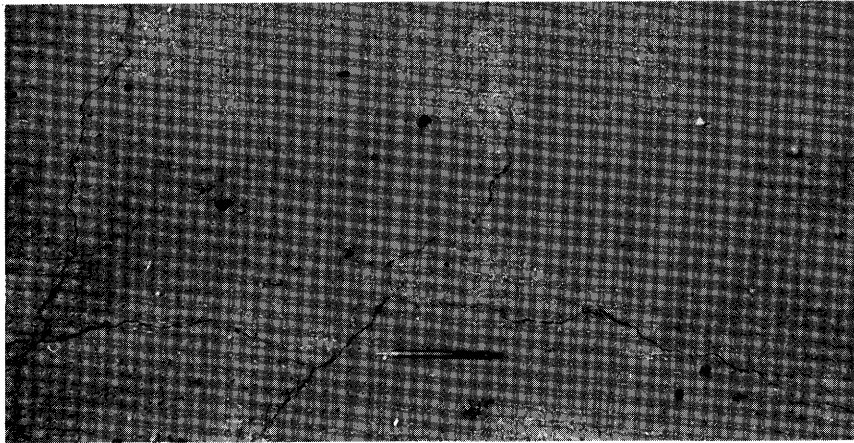
synonym: none

Severity of Distress

Moderate - Cracks intersect, but aggregate interlock is maintained
and no loose pieces of slab exist.

Severe - Loose pieces of the pavement slab are apparent.

These may be rectangular or triangular in shape and
may show evidence of rocking or other movement under
traffic.

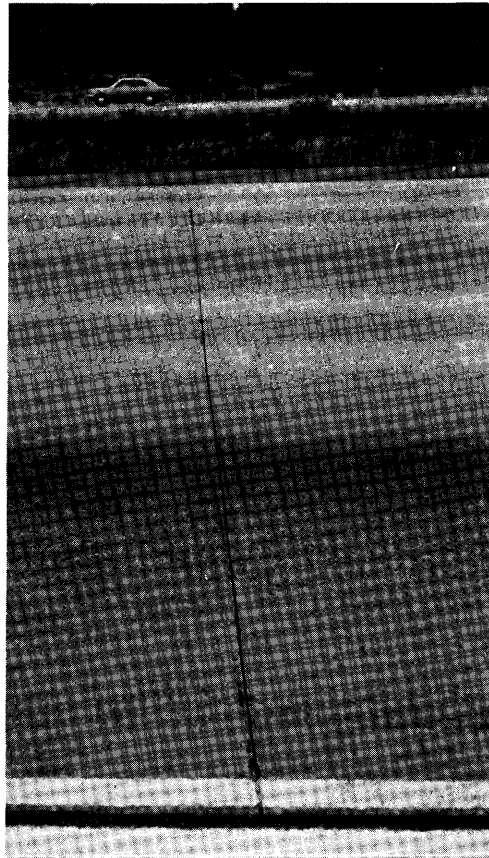


10. Joint Spacing

Note: Joints in pcc pavements may be either sawed or construction joints. Both are generally sealed with a filler material. Sawed joints are typically 1/4" wide with sharp square edges. Construction joints are usually 1/2" or greater wide and have rounded edges. For purposes of this rating form, expansion or contraction joints are considered to be construction joints.

description: lineal distance between joints.

synonym: none



11. Transverse Cracking

description: a crack or break approximately at right angles
to the pavement centerline.

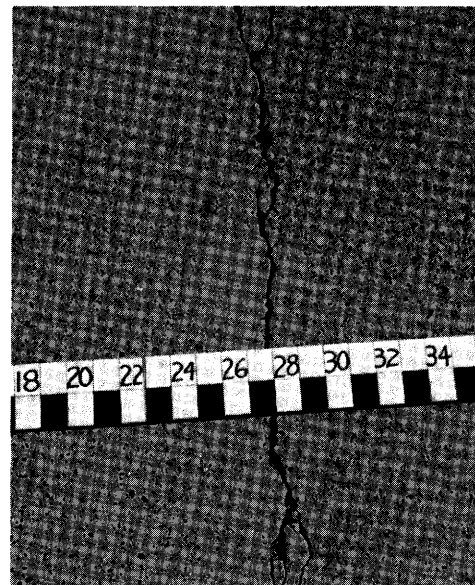
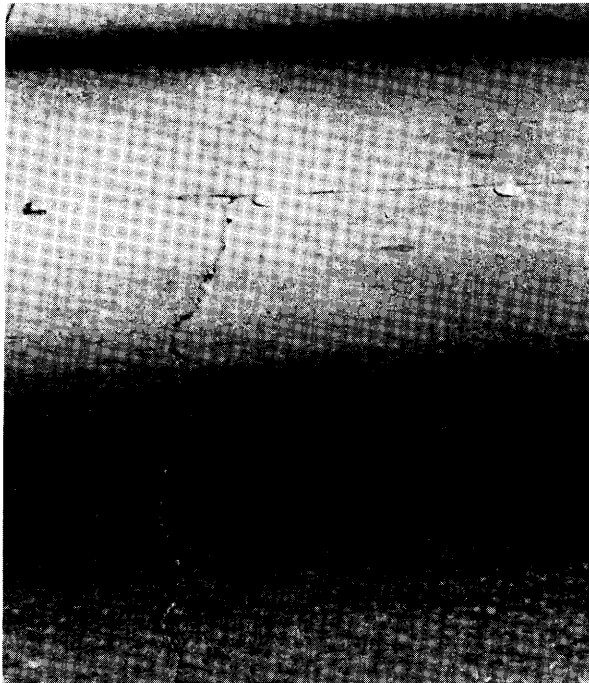
synonym: none

Severity of Distress

Slight - visible cracks less than 1/8" wide showing no evidence
of faulting, loss of aggregate interlock or the intrusion
of debris.

Moderate - cracks less than 1/4" wide that exhibit little or no
faulting or evidence of intrusion of debris.

Severe - cracks that show loss of aggregate interlock, ob-
vious intrusion of water and debris and may show
faulting and/or spalling.



12. Joints

description: vertical separation of the pavement slab either
sawed or formed to control cracking, expansion or
contraction.

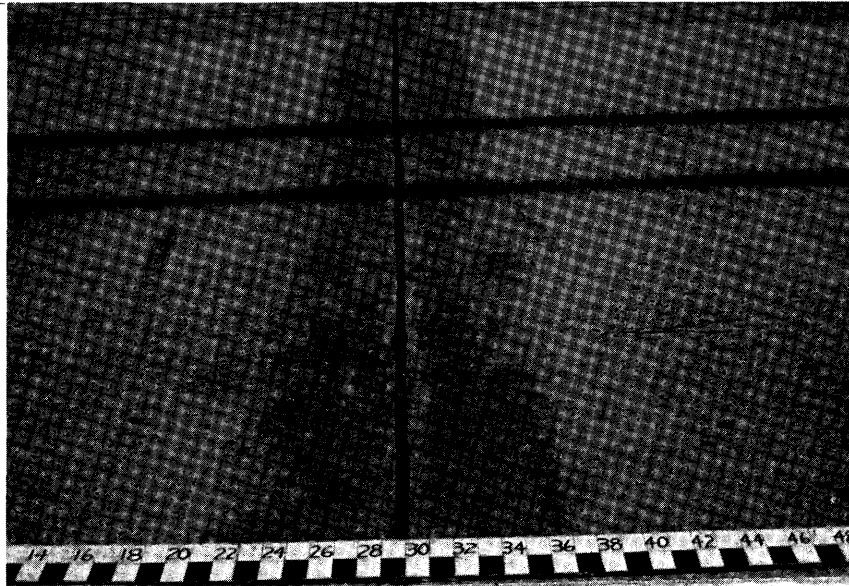
synonym: none

Condition of Joint

Sealed - joint contains a crack sealing compound that provides
an effective seal.

Partially sealed - joint contains a crack sealing compound that
is acting as a partial seal.

Not sealed - the joint has not been sealed.



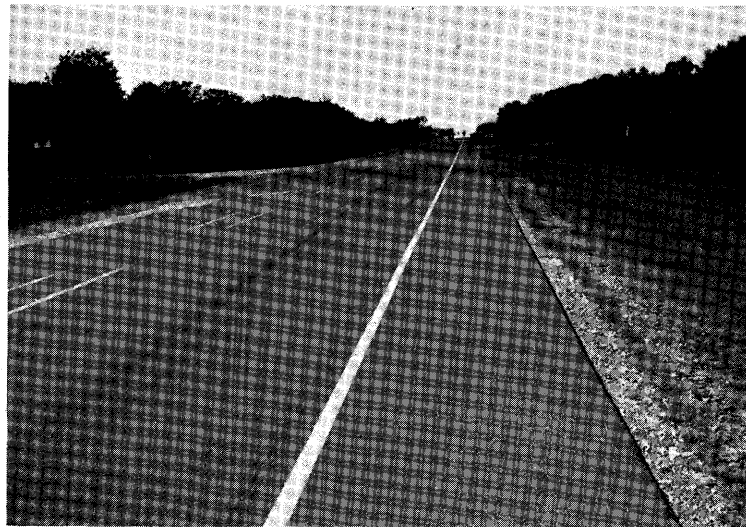
APPENDIX C

**Definitions Associated
with
Maintenance Rating Form
for
Shoulder, Roadside, Drainage
and Traffic Services**

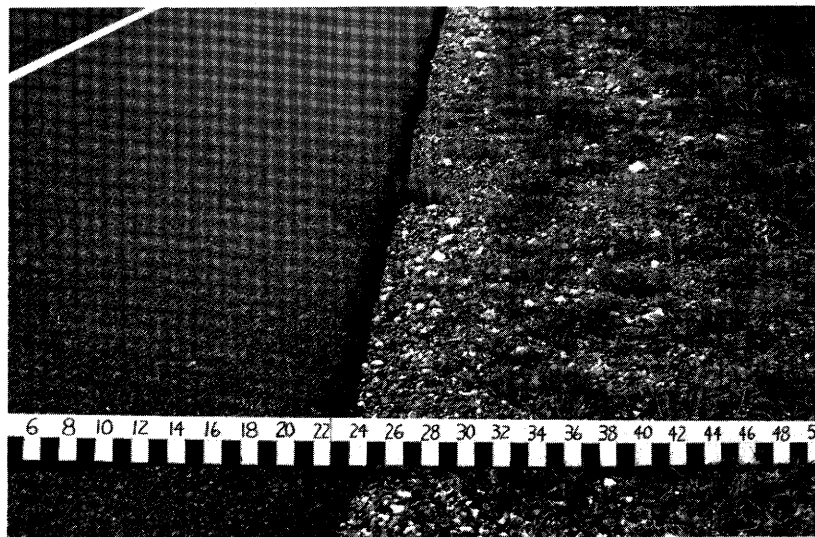
DEFINITIONS OF SHOULDER CONDITIONS

A. PAVED

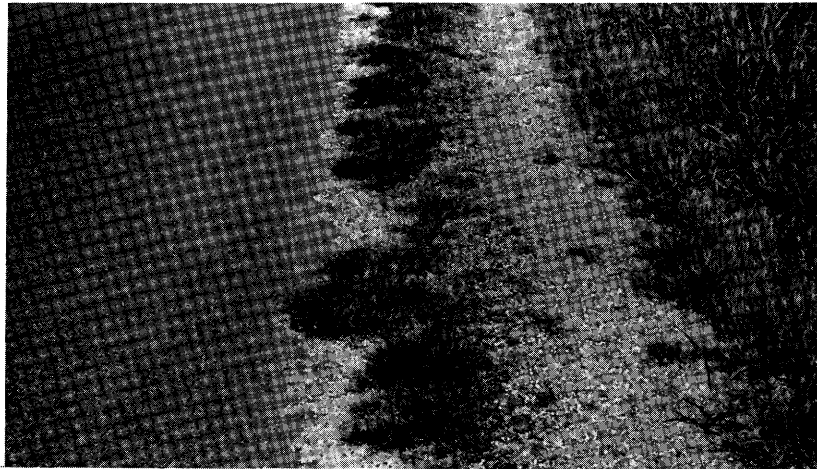
1. RIDE: Smoothness of the paved shoulder area. The shoulder should be smooth enough to provide for safe vehicle operation at legal speed limit over a limited length.
2. CONTRAST: Color and/or surface texture (tire noise) contrast should be provided between the paved main traffic lane and paved shoulder. Of the two components of contrast, color is the most important.



3. PAVEMENT EDGE: General condition of pavement edge. Elevation differential (pavement or shoulder build up) cracking, spalling, are common deficiencies noted at the paved pavement edge.
4. SHOULDER EDGE: General condition of shoulder edge away from paved main lanes. Elevation differential (shoulder drop off), cracking, spalling are common deficiencies noted at the paved shoulder edge.



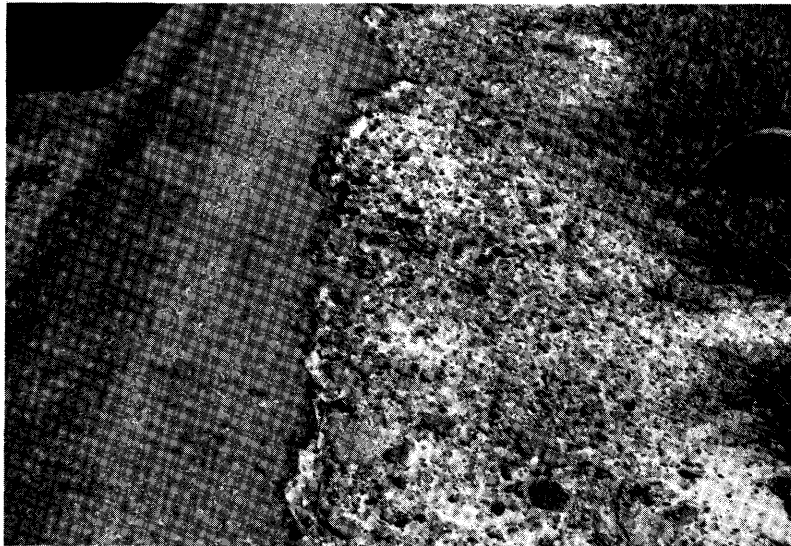
5. CRACKS: Presence of cracks in shoulder area. These cracks could be in the form of longitudinal, transverse or alligator cracking. Other forms may also be present.
6. RAVELING & FLUSHING: The progressive disintegration from the surface downward by the dislodgement of aggregate particles. Flushing can also be recorded in this column; however, it is felt that raveling is more likely to occur than flushing in the shoulder area.
7. VEGETATION: The presence of vegetation in the paved shoulder area. Common locations of vegetation are at the pavement-shoulder contact and at the shoulder edge. This item refers only to vegetation in the paved shoulder area exclusive of the outside 6 inches of paved shoulder and not roadside vegetation.



Shoulder Conditions

B. UNPAVED

1. PAVEMENT EDGE: General condition of pavement edge. Elevation differential (shoulder drop-off or build-up) spalling and vegetation encroachment are common deficiencies noted at pavement edge.
2. RUTTING, CORRUGATING, LOOSE ROCK: General conditions of the shoulder area to carry emergency traffic safely. Rutting, corrugations and loose rock either individually or in combination may contribute to loss of vehicle control in emergency situations.



DEFINITIONS OF ROADSIDE CONDITIONS

ROADSIDE: Roadsides are the areas between the outside edges of the shoulders and the right-of-way boundaries. On multi-lane highways the median and/or outer separations are included.

1. **LITTER:** General condition of highway section with respect to the presence of litter. Litter consists of paper, tires, bottles, tin cans, fallen branches, remains of animals and various other items which may give the right-of-way an unsightly appearance.
2. **MOWING:** General condition of highway section with respect to mowing. Mowing standards have been formalized and evaluation should be made with respect to these standards as described in general below.

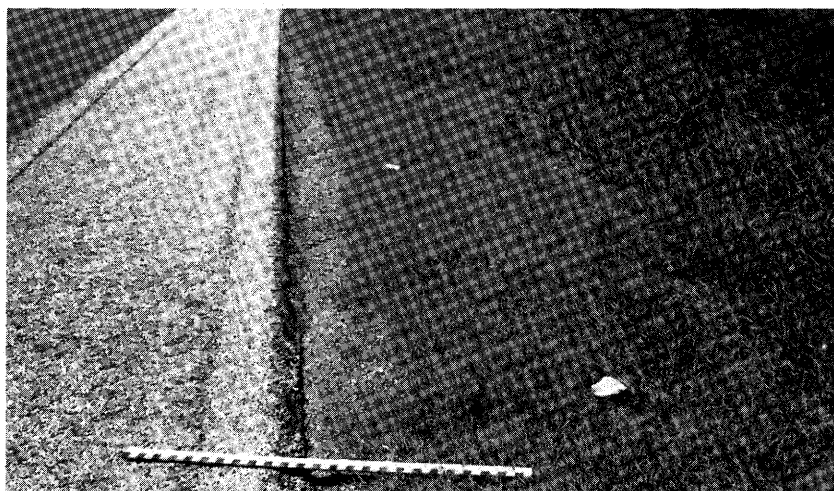
URBAN AREAS: The turf should be maintained in a neatly trimmed condition to present a pleasing appearance as expected by the public.

RURAL AREAS: The initial spring mowing in rural areas may have to be delayed some in order to permit the early spring native wild flowers to mature seed. In some instances when the vegetation becomes too high prior to the maturing of wild flower seed, it may become necessary to mow a strip adjacent to the pavement of sufficient width to expose culvert headwalls and guard posts.

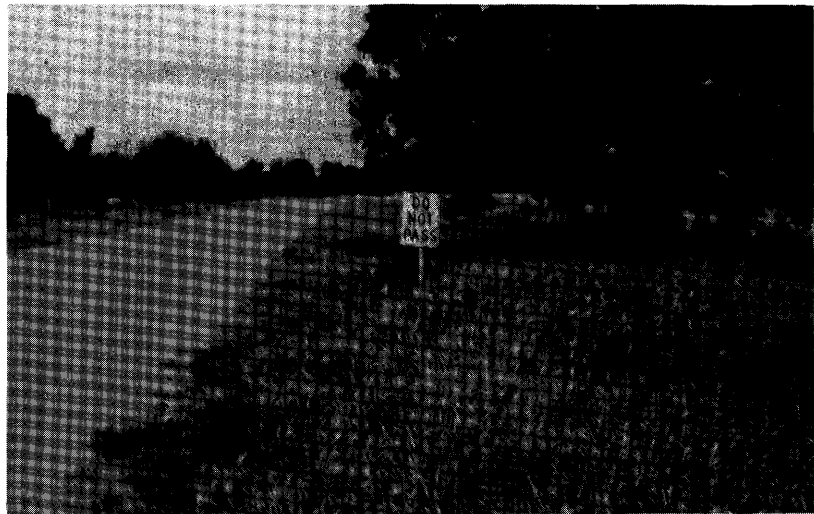
On low traffic volume highways it is desirable to mow full width of right-of-way only once a year if conditions will permit. However, considerations should be given to strip mowing as may be necessary for control of noxious weed, fires, and safety.

Main traveled highways should be maintained to a higher standard and it may be necessary to mow full width of right-of-way two or more

times to control the vegetation. The more frequent mowings on main traveled highways will reduce the amount of mulch and encourage the growth of a denser turf. The turf forming grasses, such as Bermuda, tend to form a heavier turf when closely mowed whereas the bunch type or western grasses will grow better when the cutting height is approaching 6 to 7 inches. Care should be exercised in the choice of equipment to be used for mowing of slopes in order that the damage to the grass cover be held to a minimum.



3. VEGETATION: General condition of highway section with respect to condition and amount of vegetation. Vegetation consists of all plants including grass, trees, shrubs, etc. The general condition and type of vegetation and the extent of ground coverage should be evaluated relative to the natural vegetation of fields adjacent to the right-of-way.



4. SLOPE EROSION: General condition of highway section with respect to erosion of cut and fill slopes. The removal and deposition of soil by the action of water and wind making routine roadside maintenance difficult or impossible and the probability of future erosion should be considered when evaluating this item.



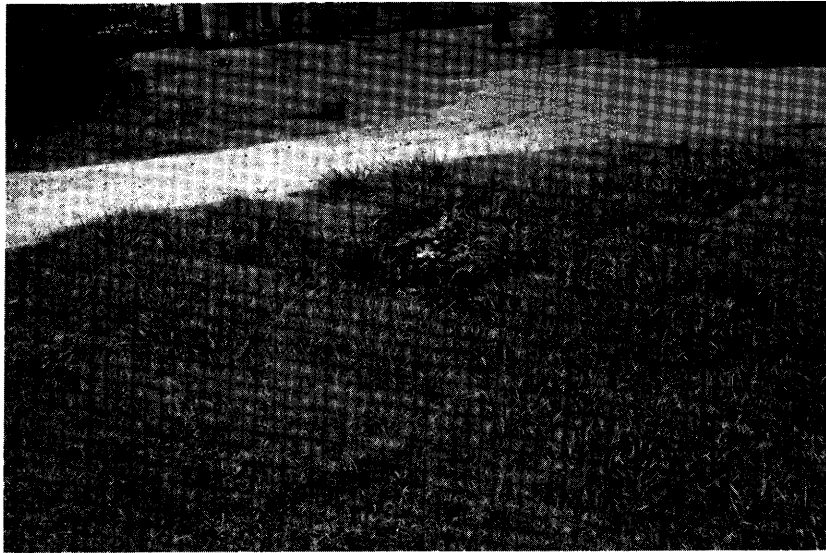
DEFINITIONS OF DRAINAGE CONDITIONS

DRAINAGE: Drainage concerns the removal of water from the highway right-of-way area and includes culverts, ditches, outfall, channels and other drainage structures.

1. **CULVERTS:** Culverts are all structures constructed for drainage less than 20 feet in span length. The general condition of culverts with respect to structural adequacy, silting, erosion at inlet and outlet and capacity to carry the necessary volume of water should be evaluated.



2. DITCHES, OUTFALLS, CHANNELS: General condition of all drainage facilities not including culverts, bridges and roadside drainage ditches. Erosion and vegetation in ditches and channels that intersect the highway should be evaluated in this item.
3. ROADSIDE DRAINAGE: General condition of drainage ditch which normally is parallel to the roadway. Erosion and vegetation should be evaluated in this item.



DEFINITIONS FOR TRAFFIC SERVICES

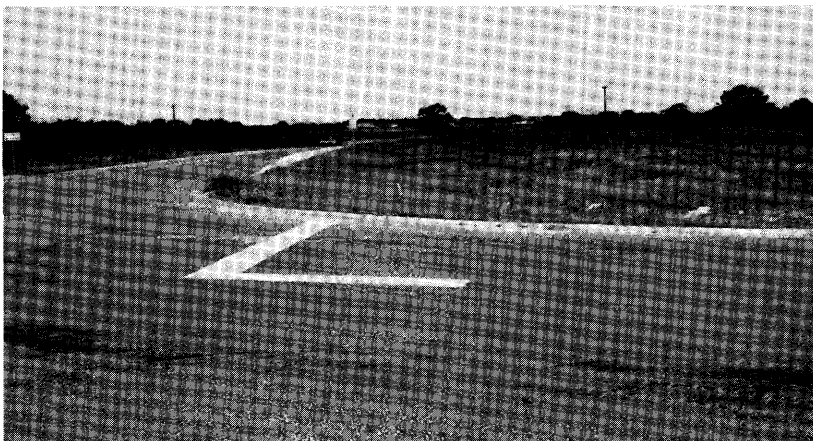
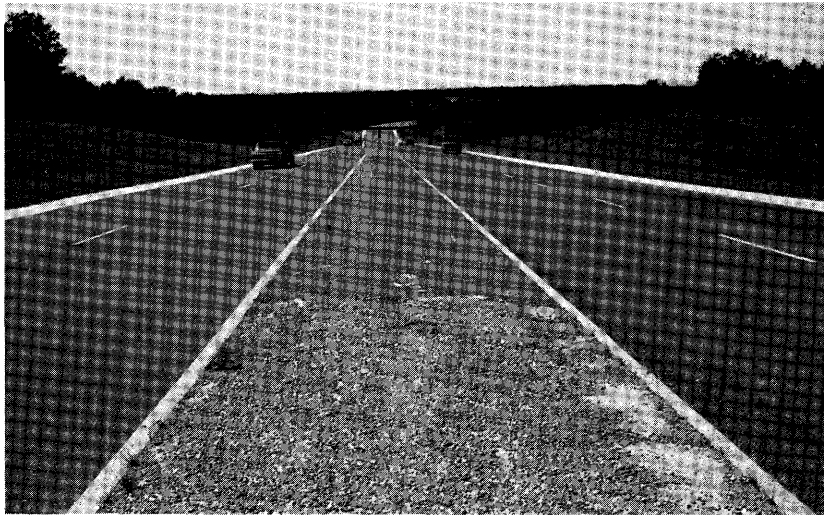
TRAFFIC SERVICES: Devices, materials, methods and procedures used to maintain traffic flow at the desired level of service.

Items included are guardrails and barriers, signs, delineators, striping, auxiliary markings and signals.

1. **GUARDRAILS:** General condition of highway section with respect to guardrail and barrier fence. Items to be noted include appearance in terms of corrosion, painting, straightness; post spacing; minimum length of section; anchoring system and turned down ends.
2. **SIGNS:** General condition of highway section with respect to signs. Items to be noted in the evaluation include alignment, placement, cleanness, and legibility during day and night operating conditions.
3. **DELINEATORS:** General condition of highway section with respect to delineators. Items to be noted in the evaluation include appearance in terms of corrosion, painting, straightness and reflectors and reflective coating.



4. STRIPING: General condition of highway section with respect to striping. Striping includes center line striping, lane line striping and edge striping. Items to be noted include visibility in both day and night operating conditions; paint build-up and crazing.
5. AUXILIARY MARKINGS: General condition of highway section with respect to auxiliary markings. Auxiliary markings include turn markings, stop lanes, crosswalk lanes, route direction markings, pavement width transition, curb markings, channelization markings and various types of raised lane markings. Items to be noted include visibility in both day and night operating condition, paint build-up, crazing, fractured raised markings.



APPENDIX D

**Determination
of
Rating Scores**

APPENDIX D

DETERMINATION OF RATING SCORES

The equation utilized for the computation of the rating scores obtained as a part of the roadway evaluation are described below.

Pavement Rating Score (PRS)

The pavement rating score is obtained by subtracting "deduct values" associated with the various forms of pavement distress from 100. A score of 100 indicates a pavement without observable distress. Deduct values for flexible pavements are shown in Table D-1 and for rigid pavements in Table D-2.

$$PRS = 100 - \Sigma D$$

where:

PRS = pavement rating score

ΣD = summation of deduct scores

Other Rating Scores

Other rating scores are obtained by one of the equations listed in Table D-3. The words utilized in the equation refer to the categories noted in the evaluation for the particular scores in question.

TABLE D-1 Deduct Values for Flexible Pavement

Type of Distress	Degrees of Distress	Extent or Amount of Distress		
		(1)	(2)	(3)
Rutting	Slight	0	2	5
	Moderate	5	7	10
	Severe	10	12	15
Raveling	Slight	5	8	10
	Moderate	10	12	15
	Severe	15	18	20
Flushing	Slight	5	8	10
	Moderate	10	12	15
	Severe	15	18	20
Corrugations	Slight	5	8	10
	Moderate	10	12	15
	Severe	15	18	20
Alligator Cracking	Slight	5	10	15
	Moderate	10	15	20
	Severe	15	20	25
Patching	Good	0	2	5
	Fair	5	7	10
	Poor	7	15	20

Deduct Points for Cracking

Longitudinal Cracking

	Sealed			Partially Sealed			Not Sealed		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Slight	2	5	8	3	7	12	5	10	15
Moderate	5	8	10	7	12	15	10	15	20
Severe	8	10	15	12	15	20	15	20	25

Transverse Cracking

Slight	2	5	8	3	7	10	3	7	12
Moderate	5	8	10	7	10	15	7	12	15
Severe	8	10	15	10	15	20	12	15	20

Failures

Mays Meter

Deduct Points
SI

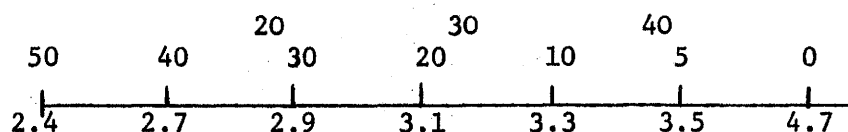


TABLE D-2 Deduct Values for Rigid Pavement

Type of Distress	Degrees of Distress	Extent or Amount of Distress (1)	(2)	(3)
Pumping		20	40	60
Failures/Mile		20	30	40
Surface Deterioration	Slight	5	10	20
	Moderate	10	20	30
	Severe	20	40	60
Spalling	Slight	5	10	15
	Moderate	10	15	20
	Severe	20	40	60
Longitudinal Cracking	Slight	5	10	15
	Moderate	10	15	20
	Severe	15	20	25
Patching	Good	0	2	5
	Fair	5	7	10
	Poor	7	15	20
Faulting	Moderate	5	15	
	Severe	15	40	
Crack Spacing	Closed	0	10	
	Open	15	40	
% Intersecting Cracks	Moderate	5	15	
	Severe	15	40	
Joint Spacing	Information Only			
Transverse Cracking				
If Joint Spacing is less than 20 feet.				
	Slight	5	10	20
	Moderate	10	20	30
	Severe	15	30	40
If Joint Spacing is greater than 20 feet.				
	Slight	0	5	10
	Moderate	5	10	20
	Severe	10	15	30
Joints	(Sealed)	0	10	20

Mays Meter	Deduct Points	50	40	30	20	10	5	0
		SI	2.4	2.7	2.9	3.1	3.3	3.5

TABLE D-3 Equations for Determining Rating Scores

Shoulder Rating Score - Paved

$$\text{SRS} = 100 - [1.428 (\text{Ride} + \text{Contrast} + \text{Pavement edge} + \text{Shoulder edge} + \text{Cracks} + \text{Raveling} + \text{Vegetation})]$$

Shoulder Rating Score - Unpaved

$$\text{SRS} = 100 - [5.00 (\text{Pavement edge} + \text{Rutting, corrugations, loose rock})]$$

Roadside Rating Score

$$\text{RRS} = 100 - [2.5 (\text{Litter} + \text{Mowing} + \text{Vegetation} + \text{Slope erosion})]$$

Drainage Rating Score

$$\text{DRS} = 100 - [3.333 (\text{Culverts} + \text{Ditches, outfall, channels} + \text{Roadside drainage})]$$

Traffic Services Rating Score

$$\text{TRS} = 100 - [2.0 (\text{Guardrails} + \text{Signs} + \text{Delineators} + \text{Striping} + \text{Auxiliary markings})]$$

APPENDIX E

Computer Programs for the Reduction of Rating Data

APPENDIX E

COMPUTER PROGRAMS FOR THE REDUCTION OF RATING DATA

INTRODUCTION

Two computer programs are available for processing maintenance data; MRSFP (Maintenance Rating System - Flexible Pavements) for roadways with flexible pavements and MRSRP (Maintenance Rating System - Rigid Pavements) for roadways having concrete pavements. These programs operate on data taken from the maintenance rating forms (Figures 1 and 2) and transferred to computer punch cards. For each line of data appearing on a maintenance rating form, the programs compute the rating scores for pavement, shoulder, roadside, drainage and traffic services. The program will, at the user's option, group the results from an entire block of input data in various ways on printout. The information which follows describes how data cards should be prepared for input to the program and how program output occurs.

PROGRAM INPUT

Input to either MRSFP or MRSRP is identical except for differences in certain information appearing on roadway segment data cards. A data deck for these programs contains three different types of cards:

- (1) a sort options card
- (2) district-rater-date header cards
- (3) data cards for segments of roadway

The first data card indicates how information is to be sorted and printed on output. The second type of data card contains the information appearing in the upper left hand corner of the maintenance rating form. Data cards containing roadway information, the third type of data card, are prepared from the rating form.

Data Card 1 (Sort Options Card)

Each roadway segment data card read by the program is processed to compute the rating scores for that segment of roadway. The composite results for all roadway segments may be displayed on output in any or all of the following ways:

<u>Option No.</u>	<u>Mode of Data Display</u>
1	Group all roadway segments within the same county together. Segments are arranged by highway type (IH, US, SH, FM, LP, SP, PR) and ordered by mile post.
2	Group all roadway segments under the same foreman together. Segments are arranged by highway type and ordered by mile post.
3	Group all roadway segments together, arranged in increasing order of pavement rating score (PRS).
4	Group all roadway segments within the same county together, arranged in increasing order of PRS.
5	Group all roadway segments under the same foreman together, arranged in increasing order of PRS.
6	Group all roadway segments having the same highway class designation together, arranged in increasing order of PRS.

- 7 Group all roadway segments of the same highway type together, arranged in increasing order of PRS.
- 8 Group all roadway segments under the same foreman together, with all segments of the same highway type grouped together and arranged in increasing order of PRS.
- 9 Same as Option 7, except highway types US & SH combined as single highway type.
- 10 Same as Option 8, except highway types US & SH combined as single highway type.

To specify any of these sorting options, enter a 1 in the column given below on the Sort Options Card.

<u>For Sort Option No.</u>	<u>Enter 1 In Column</u>
1	5
2	10
3	15
4	20
5	25
6	30
7	35
8	40
9	45
10	50

Data Card 2 (District-Rater-Date Header Card)

All data input to the program must be from the same district. Roadway ratings may be made by different rating teams or at significantly different times. This information is reflected on the maintenance rating form through completion by the rating team of the

information block at the upper left corner of the form. This information is acquired by the programs through the District-Rater-Date Header Card, which precedes all roadway segment data cards compiled by the raters and on the date specified by the header card. A team may rate more segments of roadway than can be entered on a single maintenance rating form. When this occurs, all rating forms completed by the team on the same date should be grouped together, and the keypunch operator preparing roadway segment data cards from the forms should be instructed to punch only one header card for that group. The information appearing on the header card and the columns into which it is punched are given on the maintenance rating form.

Data Set 3 (Roadway Segment Data Cards)

A single data card is produced for each line completed on the maintenance rating form. There are 80 columns on the rating forms and on a card. Information on the form is punched onto a card, column by column, to produce a Roadway Segment Data Card.

A sample input data set is shown in Figure E-1. Thirteen segments or roadway were evaluated by two different rating teams. All roadways have asphalt pavements, so program MRSFP is used. The program user wishes to have the data sorted by county, arranged by highway type and ordered by mile post (sort option 1) and all segments within the district grouped together, ordered by pavement rating score (sort option 3).

PROGRAM OUTPUT

The output produced by program MRSFP for this data deck is shown in Figure E-2. The first page of output contains a listing of the roadway segment data cards, printed out in the order in which they appear in

the data deck. The program inspects each roadway segment data card upon input to determine if errors (either by the rating team or by the keypunch operator) have been made which would make it impossible to process the card. If a card is found to contain an error, it is set off in the listing of data cards input by a double row of asterisks. A coded error message is listed in the rightmost column of the printout entitled "OTHER". Tables E-1 and E-2 contain a listing of error message code numbers and a description of the type error which has been found. During inspection of the data card, the program lists only the first error encountered. In Figure E-2, a keypunch error was made in the highway number (VS was punched instead of US) and this card is ignored in subsequent operations. The second page of output contains a listing of the information on each District-Rater-Date Header Card appearing in the data deck. Also shown is a letter code symbol corresponding to each Header. For output sort options 1 and 2, each segment of roadway data is identified by this letter code, which appears in the rightmost column of the printout entitled "OTHER". This is shown on the third page of output, Figure E-2. If other information is entered in the last columns of the maintenance rating form, it overrides the code symbol and is printed out by the program. The third and fourth pages of output shown in Figure E-2 show the roadway information displayed as requested on the Sort Options card.

09 SMITH H L PRINCE R H 09 07 1974

0512252US	283	8901	00	52N380	0	1	0	0	1	2	30	0000000000000000000000
0512252US	283	8901	00	52L352	0	1	0	1	1	2	30	0322321100441122214546
0512252US	283	8901	00	52S400	0	1	0	0	1	2	30	0000000000000000000000
0512252VS	283	8901	00	52R392	0	2	0	2	1	2	30	0352621100441122214546
0512252US	283	8901	00	52R392	0	2	0	2	1	2	30	0352621100441122214546
0501252FM	579103106	46	82R300	3	0	0	1	1			120	0000000042112111202330
0501252FM	579103107	00	46R320	2	0	0	1	2			121	0000000033221121202330

03 RAGLAND F L POPE W M 09 07 1974

(Sort Option Card)

[illegible]

Figure E-1. Input Data Cards

*ROADSIDE*****
** AND *TRAC*

Figure E-2. Output from Program MRSFP

HEADER CARD INFORMATION AND CODE SYMBOL

IF COLUMNS 78 THRU 80 ON INPUT FORM ARE LEFT BLANK
THE CODE SYMBOLS LISTED BELOW IDENTIFY
RATERS AND DATE FOR THE DATA.

CODE	RATERS	MON	DAY	YEAR
A	RAGLAND F L	9	7	1974
B	SMITH H L	9	7	1974
	POPE W M			
	PRINCE R H			

DISTRICT NO. 3 --SORT BY COUNTY

[illegible]

Figure E-2. Continued

Figure E-2. Continued

ERROR MESSAGE
CODE NUMBER

ERROR TYPE DESCRIPTION

F 1	Sort options 2, 5, 8 or 10 specified, but no foreman number given. Sort option 6 specified, but no highway class given. Sort options 1 or 4 specified, but no county number given.
F 2	Improper highway designation given (columns 8 and 9).
F 3	Columns 1 thru 7 or 10 thru 27 contain a symbol which is not a digit.
F 4	More than one entry has been made in the columns under a single type of pavement distress. Check for multiple entries in columns 31-33, 34-36, 37-39, 40-42, 43-45, 46-48, 49-51, 53-55.
F 5	An out of range digit has been encountered in a column pertaining to pavement distress. Check for a number greater than 3 in columns 31 thru 56.
F 6	A symbol other than a digit was encountered in columns 57 thru 77.
F 7	Entries under both PAVED and UNPAVED shoulders are not permitted. If columns 57 thru 63 contain entries, columns 64 and 65 must be blank (or contain zeros) and vice versa.
F 8	If an entry is made under LONGITUDINAL CRACKING (columns 46 thru 48) or TRANSVERSE CRACKING (columns 49 thru 51), an entry must be made under CRACK SEALING (column 52).

TABLE E-1. ERROR MESSAGES FOR PROGRAM MRSFP

ERROR MESSAGE
CODE NUMBER

ERROR TYPE DESCRIPTION

R 1	Sort options 2, 5, 8 or 10 specified, but no foreman number given. Sort option 6 specified, but no highway class given. Sort options 1 or 4 specified, but no county number given.
R 2	Improper highway designation given (columns 8 and 9).
R 3	Columns 1 thru 7 or 10 thru 27 contain a symbol which is not a digit.
R 4	More than one entry has been made in the columns under a single type of pavement distress. Check for multiple entries in columns 33-35, 36-38, 39-41, 42-44, 45-46, 47-48, 49-50, 51-52, 53-55.
R 5	An out of range number has been encountered in a column pertaining to pavement distress. Check for a digit greater than 3 in columns 33 thru 44 or 53 thru 56. Check for a digit greater than 2 in columns 45 thru 50.
R 6	A symbol other than a digit was encountered in columns 57 thru 77.
R 7	Entries under both CRCP and JOINTED pavements are not permitted. If columns 47 thru 50 contain entries, columns 51 thru 56 must be blank (or contain zeros) and vice versa.
R 8	Entries under both PAVED and UNPAVED shoulders are not permitted. If columns 57 thru 63 contain entries, columns 64 and 65 must be blank (or contain zeros) and vice versa.
R 9	Dual entry under JOINT SPACING. Joints are either of the SAWED type (entry in column 51) or CONSTRUCTION (entry in column 52).
R10	If an entry is made under TRANSVERSE CRACKING (columns 53 thru 55), an entry must be made under JOINT SEALING (column 56).

TABLE E-2. ERROR MESSAGES FOR PROGRAM MRSRP

