Pavement-Condition Ratings and Rehabilitation Needs

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Pavement-condition surveys are used to determine the order of priority of rehabilitation needs, to identify problems and thus promote the use of more effective short-term remedial or longer-term rehabilitation alternatives, to allow maintenance staffs to match as closely as possible practical corrective and preventive treatments and ideal solutions, and to increase the effectiveness of maintenance and rehabilitation procedures through timely and cost-effective strategies determined from pavement-management optimization procedures. The practice of obtaining pavement-condition ratings through individual raters or panels allows the effects of human bias and judgment to affect these ratings and introduces inconsistencies in priority rehabilitation lists. Two states have adopted objective measurement procedures for determining pavement-condition ratings within the last decade. But despite the effects of human bias, there are advantages to retaining subjective assessments of distress, at least for maintenance and the design of rehabilitation projects. In Ontario, a system of uniform word descriptions of extent and severity of distress is used that should lead to retention of its subjective rating system for design and maintenance; the pavement-condition rating values calculated from these word descriptions should provide consistent ratings. To develop weighting values for the various types of distress and their extent and severity and the ride-rating scaling factors that apply to each of the five regions of the province of Ontario, the results of subjective pavement-condition ratings of about 6000 km (3720 miles) of highway were subjected to iterative best-fit analysis. Although there is still room for improvement, the resulting equation is remarkably similar to that used in the state of Washington.

Pavement performance has been defined as the serviceability history of the pavement surface. That is, it is the measure over time of how well the pavement has served its function, which is to provide safe and comfortable passage to persons and goods (1).

As a pavement ages, the effects of traffic and environment decrease its initial high level of serviceability. At some future time, then, the serviceability of the pavement falls from an acceptable level to an unacceptable level. This failure to continue to provide acceptable service may stem from structural inadequacies, heavy overloads, problem pavement materials, climatic and/or environmental effects on materials, or from combinations of these. At this stage, the engineer must decide whether to do nothing and accept the consequent lower level of serviceability, to prolong the life of the pavement by a higher level of maintenance activities, to rehabilitate it by resurfacing or some similar treatment, or to upgrade its structural (and traffic) capacity by reconstruction or thick overlays. To ensure that the best decision is made, it is essential to record the condition of the pavement at defined time intervals. Then, if one possesses sufficient knowledge of probable future behavior, timely action may be taken to proceed with an appropriate treatment within the funding available.

One of the aims of a pavement management system is the analysis of the most cost-effective rehabilitation treatment and when it should be applied to optimize the use of available funds (2). Pavement-condition ratings are an essential part of the process.

In the past, assessing the condition of a pavement has been a task assigned to experienced engineers and rating panels. In more recent years, systems have been developed that minimize the effects of human judgment and bias in condition ratings because these effects lead to inconsistencies in the priority lists that are used in fund allocation.

This paper describes the efforts in Ontario to reduce the effects of human bias through the use of uniform word descriptions for pavement distresses and the application of weighted values for different distresses in determining pavement-condition ratings. When there has been sufficient experience in using the method, it is expected that the consistency of the ratings will improve and that the use of additional resources to monitor pavement conditions by the actual measurement of ride quality and distresses can thus be avoided.

EXAMPLES OF CONDITION-RATING SYSTEMS THAT USE MEASUREMENTS

Objective pavement-condition-rating systems are exemplified by the slope-variance method developed at the American Association of State Highway Officials (AASHO) Road Test at Ottawa, Illinois. Here, the present serviceability index (PSI) is a function of slope variance, rutting, cracking, and patching (1).

Because the CHLOE profilometer (which was used in the AASHO Road Test) is slow and requires a relatively large crew, in Florida the Mays ride meter, which correlates well with the CHLOE, is used. The ride meter gives the Mays meter reading (MMR) from which the ride rating (RR) can be calculated by using equations that derive from correlations with the CHLOE PSIs (slope variance only). For example, at 48 km/h (30 mph), for a certain vehicle,

$$RR = 95.1459 - 0.1792MMR \quad (1)$$

The defect reading (DR) can be calculated by using Equation 2;

$$DR = 100 - \text{sum of deduct points} \quad (2)$$

where deduct points are amounts for rutting, cracking, and patching that are agreed on by engineers from construction, maintenance, design, and research and applied to measurements of short representative sections; the final pavement rating (PR) is then given by

$$PR = (RR \times DR)^{1/2} \quad (3)$$

[This method has been fully described by Smith (3).]

In the state of Washington, a modified Portland Cement Association road meter is used to measure pavement ride quality. This gives a reading in terms of counts per mile (CPM), which is used to calculate the ride score (Rs);

$$Rs = [(CPM)^{1/2}/c^{1/2}] - 1 \quad (4)$$

in which different values of c are used for three different types of pavement to try to equalize the inherent roughness characteristics of each type and Rs = 0 represents a glass-smooth ride and Rs = 9 represents a very rough ride. The structural rating (SR) is then calculated by using Equation 5;

Figure 1. Form for evaluation of flexible pavement condition.

RIDING COMFORT RATING (AT 80 km/h)	EXCELLENT	GOOD	FAIR	POOR	VERY POOR

PAVEMENT DISTRESS MANIFESTATIONS			SEVERITY OF PAVEMENT DISTRESS: 1 VERY SLIGHT	2 SLIGHT	3 MODERATE	4 SEVERE	5 VERY SEVERE	DENSITY OF PAVEMENT DISTRESS (EXTENT OF OCCURRENCE): 6 FEW (< 10%)	7 INTERMITTENT (10 - 20 %)	8 FREQUENT (20 - 50 %)	9 EXTENSIVE (50 - 80 %)	10 THROUGHOUT (80 - 100 %)	CHARACTERISTICS OF PAVEMENT DISTRESSES: REFLECTION CRACKING	PAVEMENT EDGE CRACK: PROGRESSIVE 12" (from edge) 0.3 m	NON PROGRESSIVE 12" (from edge) 0.3 m	TRANSVERSE CRACK SPACING (m)	ALLIGATOR CRACKING: ALLIGATOR BLOCK SIZE (mm)	DISTORTION OF ALLIGATOR AREAS (mm)
SURFACE DEFECTS		1 COARSE AGGREGATE LOSS																
		2 RAVELLING																
		3 FLUSHING																
SURFACE DEFORMATION		4 RIPPLING																
		5 SHOVING																
		6 WHEEL TRACK RUTTING																
		7 DISTORTION																
CRACKING	LONGITUDINAL WHEEL TRACK	8 SINGLE																
		9 MULTIPLE																
		10 ALLIGATOR																
	MIDLANE	11 SINGLE																
		12 MULTIPLE																
	CENTER LINE	13 SINGLE																
		14 MULTIPLE																
		15 ALLIGATOR																
	MEANDER	16 SINGLE																
		17 MULTIPLE																
	PAVEMENT EDGE	18 SINGLE																
		19 MULTIPLE																
		20 ALLIGATOR																
	TRANSVERSE	21 PARTIAL																
		22 HALF																
		23 FULL																
		24 MULTIPLE																
		25 ALLIGATOR																
		26 RANDOM																
		27 SLIPPAGE																
		28																
		29																
MAINTENANCE PATCHING		SPRAY																
		SKIN																
		HOT MIX																
ADDITIONAL REMARKS																		

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$$SR = 100 - \text{sum of defect values} \quad (5)$$

where defect values are amounts assigned to various states of different distresses for both flexible and rigid pavements (4), and the final pavement condition rating (PCR) is given by

$$PCR = SR[1 - (Rs/10)]^{1/2} \quad (6)$$

SUBJECTIVE RATINGS

Rationale

There have been extensive attempts to determine how well ride quality can be assessed subjectively by single raters or rating panels when compared with mechanically measured roughnesses (5-7). Hutchinson (8) has pointed out rating-scale problems. However, the advantage of using mechanical roughness-measuring devices over using raters is at present only theoretical because of problems with equipment that include poor reliability, low speed of operation, the need for frequent calibration, speed and temperature variables, and the additional costs of acquisition and operation. In Ontario, it is still found attractive to continue the assessment of ride quality by raters, not only because the rater must visit the highway and examine it for pavement distresses and other deficiencies and assess what remedial measures are needed, but also because the visits can be scheduled at convenient times and the need for coordination with roughometer schedules does not arise.

The need for "standard nomenclature and definitions for pavement components and deficiencies" was partly answered by the Highway Research Board special report issued in 1970 (9). However, this report does not provide sufficient detail to enable an observer (or a recipient of a condition report) to accurately describe (or visualize from the description) all of the defects or deficiencies of the pavement. Thus, in Ontario, a formalized procedure that has uniformly worded descriptions of distress manifestations has been provided by the preparation of two manuals (10, 11) for use by raters. These manuals contain illustrative photographs of the various types of distresses and provide guidelines for the use of descriptors of the extent of occurrence and the severity of the distress. As shown in Figures 1 and 2, the evaluation work sheets for flexible and rigid pavements, the distresses are first listed under main headings and these are then subdivided; i.e., surface distress includes factors such as raveling and flushing, surface distortion or deformation includes such items as shoving and rutting, joint deficiencies are categorized, and cracking is di-

Figure 2. Form for evaluation of rigid pavement condition.

RIDING COMFORT RATING (AT 80 km/h)	EXCELLENT	GOOD	FAIR	POOR	VERY POOR

PAVEMENT DISTRESS MANIFESTATIONS		SEVERITY OF PAVEMENT DISTRESS: VERY SLIGHT	SLIGHT	MODERATE	SEVERE	VERY SEVERE	DENSITY OF PAVEMENT DISTRESS (% OF OCCURENCE): FEW 10%	INTERMITTENT 10-20 %	FREQUENT 20-50 %	EXTENSIVE 50-80 %	THROUGHOUT 80-100 %	CHARACTERISTICS OF PAVEMENT DISTRESS: REFLECTION CRACK	TRANSVERSE CRACK SPACING (m)	JOINT OR CRACK WITH PUMPING	JOINT OR CRACK WITH DEBRIS
SURFACE DEFECTS	POLISHING														
	LOSS OF COARSE AGGREGATES														
	POT HOLE														
	SCALING														
	RAVELLING														
SURFACE DEFORMATION	FAULTING (STEPPING)														
	SETTLEMENT (SAGGING)														
JOINT DEFICIENCIES	JOINT CREEPING														
	JOINT SEALANT LOSS														
	JOINT SPALLING														
	JOINT FAILURES (BLOW UP, ETC)														
CRACKING	LONGITUDINAL														
	MEANDERING														
	CORNER														
	D														
	TRANSVERSE — SINGLE														
	TRANSVERSE — MULTIPLE														
	DIAGONAL														
	EDGE CRESCENT														
	MISCELLANEOUS CRACKS														
MISCELLANEOUS DISTRESSES	LANE SEPARATION														
	SLAB WARPING														
	WHEEL TRACK WEAR														
	OTHERS														
MAINTENANCE	FULL WIDTH JOINT REPAIR														
	FULL DEPTH RELIEF JOINT														
	PRECAST SLAB														
	COLD MIX PATCHING														
	FULL WIDTH HL PATCH														

ADDITIONAL REMARKS

vided into types such as pavement edge and traverse (cracks are further described by characteristics such as size of alligator block or the spacing of transverse cracks). The descriptors of severity and density are based on a scale of zero to five. For the density of the extent of occurrence, the standard words used are few, intermittent, frequent, extensive, and throughout. For the severity of the distresses, the standard words are very slight, slight, moderate, severe, and very severe. Thus, for example, a distress may be described by the phrase "moderate multiple centerline crack occurs frequently over the section." This description indicates that the cracks are about 1.3-1.9 cm (0.5-0.75 in) wide and that a multiple centerline crack occurs over 20-50 percent of the length of the section. Descriptions of condition are entered on the form shown in Figure 3.

Ontario Pavement-Condition-Rating Procedure

The ride quality of the pavement is rated subjectively on a riding comfort rating (RCR) scale of 0 to 10, where 10 represents a perfectly smooth surface and 0 represents a very rough (almost impassable) road.

The condition of the pavement surface is described by using uniform word sets after a visual inspection of the density of occurrence and the severity of the various distresses.

The pavement-condition rating (PCR) is determined on a scale of 0 to 100. For flexible pavements, eight stages in the life of typical pavement have been identified by word descriptions of ride quality, distortion, and distress, and the range of rating numbers appropriate to each stage has been assigned (see Table 1). The rater(s) compare their evaluations of the RCR, the distortion, and the distress with the standard descriptions of the eight stages and then decide which stage most closely fits the pavement being rated and whether the pavement is closer to the top or the bottom of the range for the stage. The rater next assigns a PCR value to the rated pavement. Because the rater also does the pavement design work, this rating is influenced by his or her perception of the

Figure 3. Pavement-condition report.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

REGIONAL MATERIALS & TESTING
PAVEMENT CONDITION REPORT

CONDITION RATING ______

DISTRICT No. ______ HWY. No. ______ W.P. No. ______ LENGTH ______

LOCATION: ______

Reference No. From ______ To ______ Last Contract No. ______

Offset Mileage ______ ______ R.C.R. ______

PAVEMENT: Type ______ Width ______ SHOULDER: Width ______

TRAFFIC: Year ______ A.A.D.T. ______ S.A.D.T. ______ % Trucks ______

SOILS DATA:

PAVEMENT STRUCTURE DATA:

MAINTENANCE HISTORY:

PERFORMANCE AND CONDITION:

REMARKS:

PROPOSED REMEDIAL MEASURES:

PROGRAM YEAR: Present ______ Suggested ______

DATE OF SURVEY: ______ PREPARED BY: ______

need for maintenance and rehabilitation. For rigid pavements, a similar system is used, except that this system has only six stages (see Table 2).

The PCR surveys are carried out in each of the five regions of the province of Ontario (see Figure 4) by two or three raters, generally in late spring and early summer. One region assesses all of its pavements on an annual basis. The other regions make rating surveys on a three-year cycle. The data are kept in a central computerized file and can be retrieved by the use of a remote terminal (12).

The procedure that is followed in examining the pavement is to first drive at a normal highway speed over the pavement and determine the ride quality and to then drive at a speed that does not exceed 48 km/h along the shoulder and observe the cracks and other distresses. The rater may stop occasionally to examine and measure particular distresses. The rater summarizes his or her impressions of any uniform section within a contract area by placing check marks in the appropriate boxes of the checklist of distresses (Figures 1 and 2). The rater then compares the condition of the pavement as just described against a number of descriptions of typical pavement conditions that represent various stages in the life of a pavement (i.e., column 1 of Tables 1 and 2). This comparison allows the rater to evaluate the particular pavement being examined and, from column 2 of the table, assign an appropriate condition rating number (whole numbers are sufficiently accurate). The rater also sees from column 3 of the table what rehabilitation may be needed and when it should be applied. The rater is thus alerted, where necessary, to the need for closer examination in order to make recommendations for remedial measures. (The rehabilitation alternatives listed are not all inclusive, thus leaving the way open for an examination of the whole range of possible rehabilitation strategies.)

ALTERNATIVE PROCEDURE FOR DETERMINING CONDITION RATING

The elements of a condition rating are ride quality and pavement distress. Ride quality can be measured and converted into a value on some convenient scale. For example, in Florida, a 0 to 100 ride-rating scale is used and, in the state of Washington, a 0 to 9 scale is used. In Ontario the 0 to 10 scale called the RCR is used. Pavement distresses are quantified in Florida by deducting points for rutting, cracking, and patching from a total of 100 and in Washington by a similar procedure that, however, includes a wider variety of defects and is also computerized. To determine the condition rating, in Florida, ride quality and pavement distress are combined by taking the square root of their product and, in Washington, the defect score is multiplied by the square root of a function of the ride rating. The development in Ontario of an alternative method that combines pavement distress and ride quality in a more systematic way is described below.

Currently, a method is being developed for determining a numerical defect value. This is being done by using various suitable weighting values for various types, densities, and severities of distress in a trial-and-error

Table 1. Guide for estimation of pavement-condition rating and rehabilitation priority: flexible pavements.

Pavement Condition	PCR	Rehabilitation Indicated
Poor to very poor—extensive severe cracking, alligatoring, and dishing; poor ridability, very rough and uneven surface	0-20	Reconstruct within 2 years
Poor—moderate alligatoring and extensive severe cracking and dishing, poor ridability, very rough and uneven surface	20-30	Reconstruct in 2-3 years
Poor to fair—frequent moderate alligatoring and extensive moderate cracking and dishing, poor to fair ridability, moderately rough and uneven surface	30-40	Reconstruct in 3-4 years
Poor to fair—frequent moderate cracking and dishing and intermittent moderate alligatoring, poor to fair ridability, moderately rough and uneven surface	40-50	Reconstruct in 4-5 years or resurface within 2 years with extensive padding
Fair—intermittent moderate and frequent slight cracking and intermittent slight or moderate alligatoring and dishing, fair ridability, slightly rough and uneven surface	50-65	Resurface within 3 years
Fairly good—frequent slight cracking, slight or very slight dishing, and a few areas of slight alligatoring; fairly good ridability; intermittent rough and uneven sections	65-75	Resurface in 3-5 years
Good—frequent very slight or slight cracking, good ridability, a few slightly rough and uneven sections	75-90	Normal maintenance only
Excellent—only a few cracks, excellent ridability, a few areas of slight distortion	90-100	No maintenance required

Table 2. Guide for estimation of pavement-condition rating and rehabilitation priority: rigid pavements.

Pavement Condition	PCR	Rehabilitation Indicated
Very poor—severe cracking and stepping, frequent badly broken and tilted slabs, very poor ridability, extremely rough and uneven surface throughout	0-20	Reconstruct within 2 years
Poor—severe cracking and stepping, intermittent badly broken or tilted slabs, poor ridability, very rough and uneven surface throughout	20-40	Reconstruct in 2-3 years
Fair to poor—moderate to severe stepping at cracks and joints, fair to poor ridability, moderately rough and uneven surface throughout, occasional blow ups, surface moderately polished by traffic	40-50	Cut relief joints if necessary, resurface within 2 years
Fair—moderate stepping at cracks and joints, fair ridability, slightly to moderately rough and uneven surface throughout, occasional blow ups, surface moderately polished by traffic	50-75	Cut relief joints if necessary, resurface in 2-5 years
Fair to good—slight stepping at cracks and joints, fair to good ridability, intermittent slightly rough sections; surface slightly polished by traffic	75-90	Groove or resurface to restore skid resistance if necessary, otherwise normal maintenance only
Good—little cracking between joints, intermittent slight stepping at joints, good ridability, satisfactory skid resistance	90-100	Normal maintenance only, repair joint seals as necessary

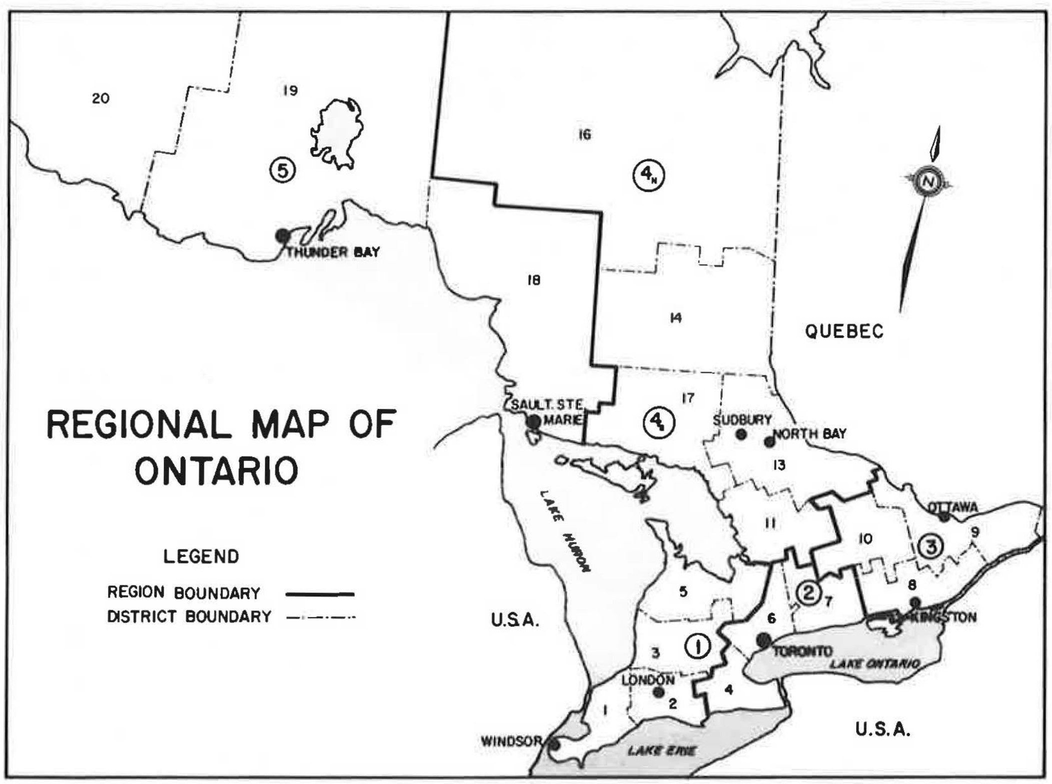


Figure 4. Regional areas for alternative pavement-condition-rating procedure.

procedure that combines the distress and ride fractions in accordance with the following equation for the distress index (DI):

$$DI = 100 \times [a \times (RCR/10)^{b}] \times [(320 - DM)/320]^{c} \qquad (7)$$

where DM = sum of defects (obtained by summing the products of the sum of the density and severity weights multiplied by the weight for the type of distress) and has a probable maximum value of 320. The DI calculated by using Equation 7 is then compared with the PCR assigned by the rater. The distress weighting values and the values of a, b, and c in Equation 7 are changed appropriately to minimize the differences between the DI and the PCR (3).

By using the PCRs assigned in the five regions of Ontario (see Figure 3) during 1977, for 450 construction contracts that included more than 6000 km (3750 miles) of highway, it has been found that b can be conveniently assigned a value of $\frac{1}{2}$. This value is identical with that used in the state of Washington.

The value of a, which is believed to represent a scaling factor, was found through best-fit iterations and deviates substantially from 1.0 in three regions as shown below.

Region	Districts	Value of a
1	1, 2, 3, and 5	1.2
2	4, 6, and 7	0.8
3	8, 9, and 10	0.95
4	11 and 13	1.0
	14, 16, and 17	0.95
5	18 and 19	0.85

This scaling factor represents a contraction or expansion of the ride scale by raters who are accustomed to riding on either generally smooth pavements or on a population of pavements that have a much wider range of roughness.

c can be assigned a value of 1.0 for all regions, but the weighting values for density and severity will change from region to region. This is not unexpected, because the climatic extremes in the southwestern part of the province are not as great as those in the northern and eastern parts, although there is more freeze-thaw cycling. Furthermore, the traffic in the less densely populated areas in the north is lighter than that in the central and southwestern areas where the majority of the population is located. It is logical to expect traffic and weather to affect the significance or weight that is placed on the severity and density of various distresses.

In summary, the trial-and-error procedure has led to the following results:

1. $DI = 100(a \times RCR/10)^{1/2} \times (320 - DM)/320$ (7a)
2. The best values of a for each region are those given in the table above.
3. The best weighting values for density and severity for each region are those given in Table 3.
4. The best weighting values for the types of distress are those given in Table 4.

The correlations between the DIs calculated by using the values of a given above and the weighting values given in Tables 2 and 3 and the subjectively assigned PCRs are shown in Figures 5-10 (14). In all regions, the majority of the correlations fall within five points of the 45° line of equality. However, a significant number are between 5 and 10 points away from the line, although very few are more than 10 away. But even these few serious disagreements are undesirable and, thus, further investigations are needed to refine the weighting values or add other parameters that would reduce the disagreements to values of less than 10 points.

PAVEMENT-CONDITION RATINGS IN REHABILITATION PROGRAMMING

The PCRs derived subjectively according to the scheme outlined above reflect not only the present condition of the pavement but also a forecast of the time when remedial action will become necessary. The DI calculated directly from a description of the pavement condition will represent only the present condition. The correct interpretation of the DI depends on having a DI history for the particular section of highway that shows the rate of deterioration of the pavement and thus enables accurate forecasting of future conditions. This forecasting ability should increase our ability to examine rehabilitation alternatives and their effectiveness at different times of application and result in use of more optimum strategies.

A low PCR is a signal that a pavement section should be included on a preliminary program listing for further consideration. The list is divided into projects that should be done in the next year, those for the next two years, and those for the next five years. At the time the lists are first compiled, cost estimates based on average cost figures from past experience are also prepared so as to outline and limit the size of the programs to within predicted funding levels. Then, as a project is moved in priority from the five-year program to the two-year program and then to the final program, the rehabilitation designs are reexamined and recosted. The choice of the design to be used is determined by the availability of funds and by factors such as regional equity, regional development policy, and general public acceptability. A certain amount of fitting is necessary to make the final program conform to all of the constraints and include as many of the more deficient projects as possible.

The pavement-condition survey provides a sound initial basis for the rehabilitation design. The structural deficiencies can be identified from the description of the distresses. For example, extensive wheel-track cracking is an indication of load-induced failures that may have been caused by fatigue or heavy axle loads. If the past records show that the defect has progressed rapidly, it may be necessary to upgrade the structural capacity. The presence of alligator failures of any magnitude also indicates the need to upgrade the structural capacity. Severe rutting not accompanied by cracking of the asphalt surface may have been caused by instability of the underlying layers (perhaps because of excess moisture) or by instability of the asphalt mix itself, although rutting is generally greater on weak pavements. Areas where such deficiencies are found should have overlay thicknesses designed after nondestructive testing with a Benkelman beam or a Dynaflect (9).

Where the defects described in the rating procedure do not indicate the type of structural inadequacy and borings along the edge of pavement or cores through the pavement show an adequate pavement depth, the descriptions can be used to indicate the type of rehabilitation treatment that should be used. For example, in the colder parts of the province, a possible rehabilitation treatment for a pavement that had severe transverse cracking throughout would be to pulverize the old asphalt and use the pulverized material as the base for a new asphalt surfacing. Another possibility would be hot-mix recycling of the total depth of pavement. Severe pavement-edge cracking would suggest to the designer that the overlay should be extended beyond the normal lane width to shift the area of softening of the base during late winter and early spring out of the range of the effects of wheel loads in the normal wheel path. Exten-

Table 3. Density and severity weighting factors.

		Severity					Density				
Region	Districts	Very Slight	Slight	Moderate	Severe	Very Severe	Few	Inter-mittent	Frequent	Exten-sive	Through-out
1	1, 2, 3, and 5	1.0	2.0	5.0	5.0	5.0	1.0	2.0	5.0	5.0	5.0
2	4, 6, and 7	0.0	0.0	0.5	2.0	5.0	0.0	0.0	0.5	2.0	5.0
3	8, 9, and 10	0.0	0.0	2.0	4.0	5.0	0.0	0.0	2.0	4.0	5.0
4	11 and 13	0.0	1.0	2.5	4.5	5.0	0.0	1.0	2.5	4.5	5.0
	14, 16, and 17	0.0	0.0	0.5	3.5	5.0	0.0	0.0	0.5	3.3	5.0
5	18 and 19	0.0	0.0	0.5	2.0	5.0	0.0	0.0	0.5	2.0	5.0

Table 4. Distress weighting factors.

Pavement Distress Manifestation	Weight	Pavement Distress Manifestation	Weight
Surface defects		Cracking (continued)	
Loss of coarse aggregate	0.5	Centerline	
Raveling	0.5	Single	0.5
Flushing	0.5	Multiple	1.0
Surface deformation		Alligator	2.0
Rippling	0.5	Meander	
Shoving	0.5	Single	0.5
Wheel-track rutting	3.0	Multiple	1.0
Distortion	3.0	Pavement edge	
Cracking		Single	0.5
Longitudinal wheel track		Multiple	1.0
Single	1.0	Alligator	1.5
Multiple	1.5	Transverse	
Alligator	3.0	Partial	0.5
Midlane		Half	0.5
Single	0.5	Full	1.5
Multiple	1.0	Multiple	2.0
		Alligator	3.0
		Random	0.5
		Slippage	0.5

Figure 6. Relationship between distress index and pavement-condition rating: region 2.

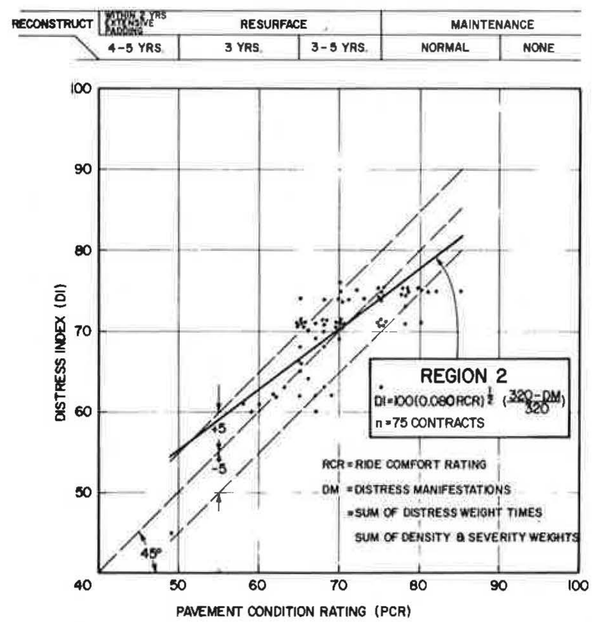


Figure 5. Relationship between distress index and pavement-condition rating: region 1.

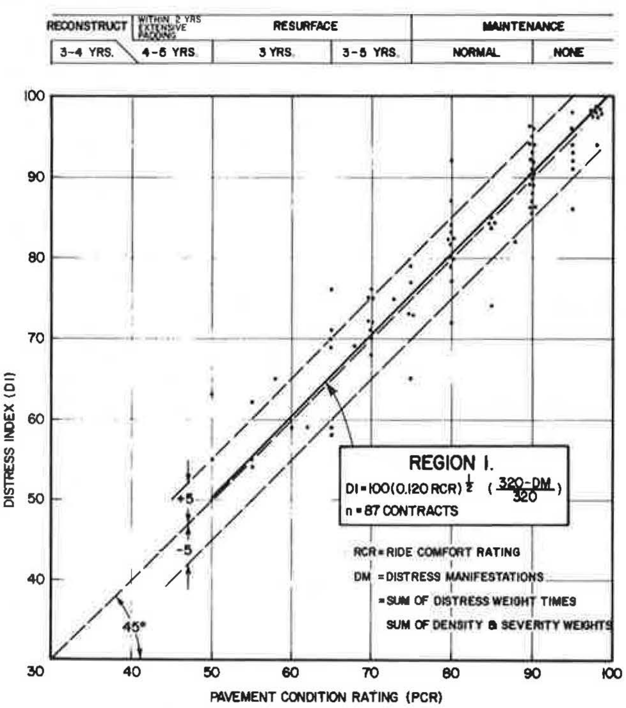


Figure 7. Relationship between distress index and pavement-condition rating: region 3.

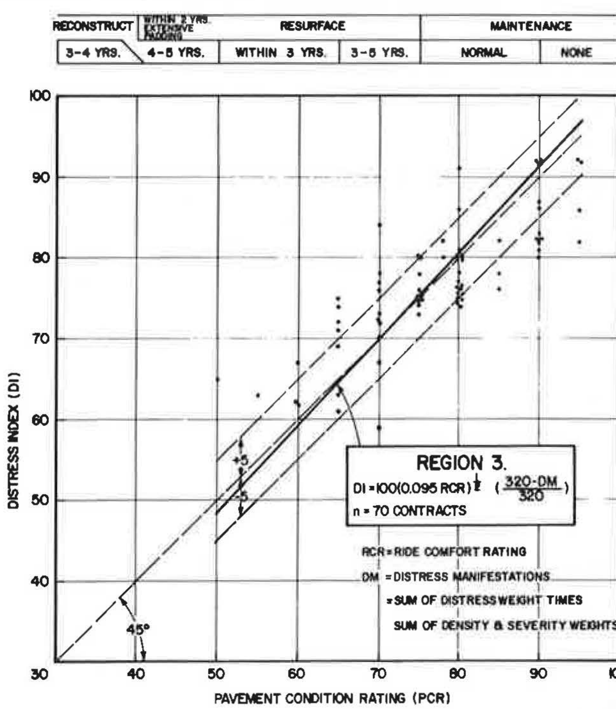


Figure 8. Relationship between distress index and pavement-condition rating: region 4 (districts 11 and 13).

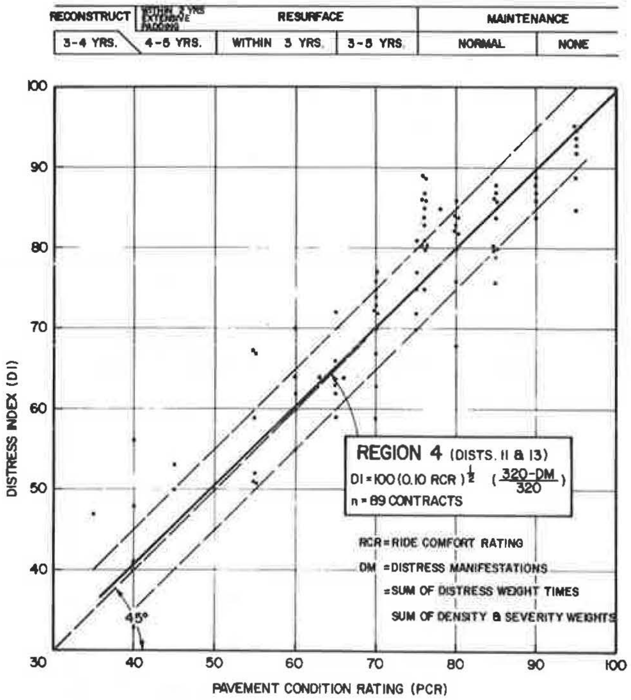
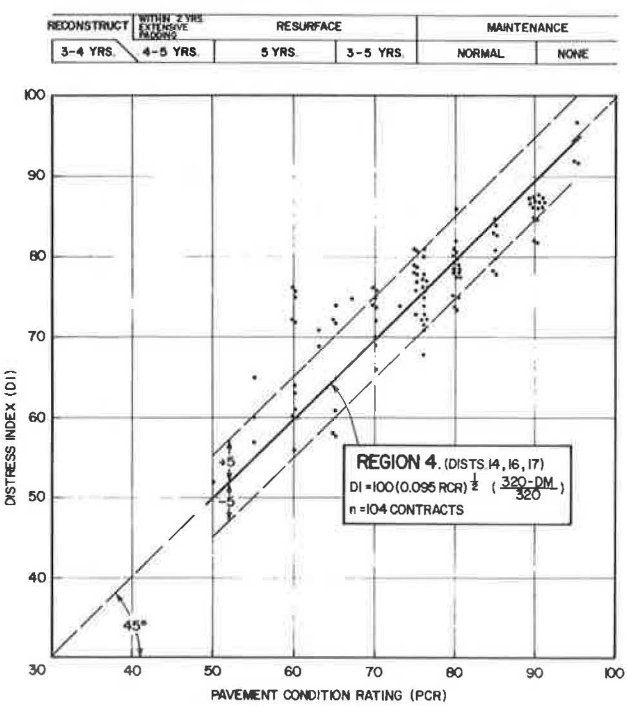


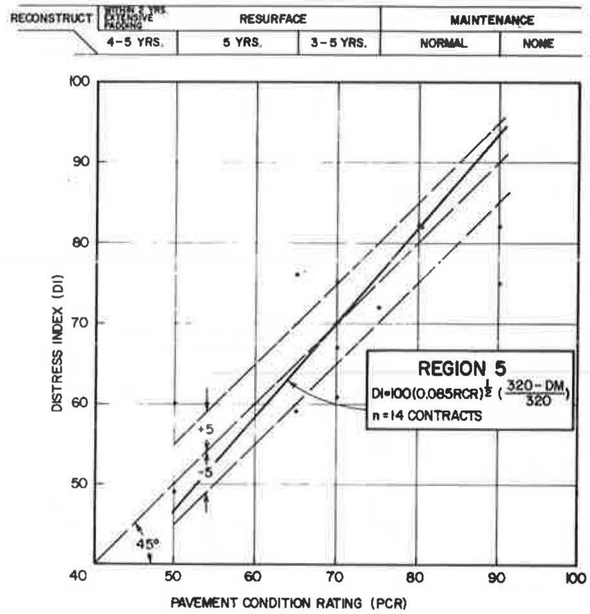
Figure 9. Relationship between distress index and pavement-condition rating: region 4 (districts 14, 16, and 17).



sive joint spalling and blowups in concrete pavements would alert the designer to the need to create pressure relief joints and to the probable need to install subdrains before overlaying to minimize future blowups from moisture expansion.

The severity and density of deformations other than rutting might point out the need for frost-heave treatments or drainage improvements and indicate the amount

Figure 10. Relationship between distress index and pavement-condition rating: region 5.



of preparatory padding or leveling that might be required before overlaying.

When the condition surveys from previous years are available, an examination of the development and rate of progression of various types of distress is useful in assessing the effects of postponing rehabilitation treatment.

CONDITION SURVEYS IN MAINTENANCE

The use of condition surveys in maintenance activities is primarily to ensure safe passage of vehicles over the highway; the preservation of the pavement and shoulders must play a secondary role. The preservation and prolongation of pavement life will, however, probably increase in importance in future years as a result of the effects of inflation on costs and of static or reduced construction budgets. Condition surveys for maintenance purposes are thus needed more to direct immediate and short-term corrective measures than to handle preventive or medium- and longer-term maintenance. In this context, Bartell (15) has indicated that the alphanumeric defect-rating system used in California, which reflects the extent and severity of a distress, is more relevant to the near-term type of maintenance action than was the previously used simple defect number.

The alternatives that may be considered in maintenance work range from filling cracks and potholes to full-width hot-mix patching, from work that can be done by regular maintenance patrol crews to work that requires specialized equipment and trained personnel and even to full-scale contract work.

It is obvious that, despite the many maintenance alternatives available, the selection that is suitable for use in correcting any particular distress condition is more limited. It is also clearly impractical to try to match the ideal corrective action and the specific distress condition in all cases. Nevertheless, the effectiveness of maintenance should be improved if better matching is accomplished. A uniform approach to descriptions of pavement distress is a first step toward systematically improving the overall effectiveness of maintenance (16).

The manuals of pavement-distress manifestations (10, 11) that contain complete descriptions of the total range of distress conditions appear to be too detailed for maintenance purposes. The maintenance rater is not attempting to trace the performance history, he or she is trying to determine immediate and short-term maintenance needs, i.e., only those distress conditions that he or she must do something about. Therefore, a simplified manual of distress manifestations is currently in preparation, designed specifically for condition surveys for maintenance needs.

In the maintenance manual, the descriptions of any type of distress are restricted to the words for severity conditions, i.e., slight, moderate, and severe. The guidelines for use of these terms in maintenance-need surveys are similar to the guidelines for condition rating for rehabilitation purposes. It is not intended that the maintenance guidelines be used in general periodic inspections—these guidelines will be used only as required to plan immediate and short-term maintenance activities. However, the main purpose of these guidelines is to ensure as far as is practicable that effective maintenance treatments are used as a rule rather than by chance or good judgment.

Condition-rating surveys for maintenance purposes may use the same elements as condition-rating surveys for rehabilitation purposes. However, because of the different purposes to which they are put, it is essential to clarify, through the use of adequate manuals, the system applicable in each case. In condition rating for rehabilitation purposes, it appears sufficient to assess defects in terms of weighted numbers when the purpose is to determine priorities, but details of distress are needed when the purpose is the design of a rehabilitation treatment. In condition surveys for maintenance purposes, it is important that details of the extent and severity of any specific distress be separated to facilitate the choice of the most effective maintenance treatment.

The advantages of using word descriptions rather than arbitrary defect values in rating surveys are that

1. Word descriptions are on value scales associated with the language itself, a language that has been learned early in life and is used daily by raters;
2. The rater assesses conditions in familiar terms; and
3. Word descriptions can be translated into weightings for condition ratings and may also serve for choosing appropriate maintenance treatments.

The system used in Washington for condition rating has undergone several stages. The alternative system used in Ontario, started a few years ago, has benefited from previous reports from Washington. The Ontario system resembles the Washington system when the equations that combine ride quality and distress manifestations to derive a condition rating are compared. The similarities in the two systems then become obvious.

Condition rating systems are a fundamental part of evaluating pavement performance. They will probably remain subjective until distresses can be measured by mechanized systems, a task that has not yet been successfully or effectively addressed. Meanwhile, subjective condition ratings remain a convenient and relatively satisfactory procedure for use in assessing rehabilitation needs.

It is hoped that the use of a dual condition-rating system in Ontario will serve both as a method of determining the order of priority of rehabilitation needs and as an aid in the selection of suitable treatments.

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