Guidelines on the Application of Preventive Maintenance and Rehabilitation Practices for Pavement Preservation

Volume 1

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Foreword

All pavements start to wear soon after construction ends. In order to ***preserve*** the integrity of the pavement above the minimum acceptable level, timely maintenance is the only alternative. Timely maintenance is a form of preventive maintenance. More and more agencies, including Louisiana, are becoming aware of this alternative by expanding their program of preventive maintenance before "demand" or 'emergency" maintenance becomes necessary. Preventive maintenance procedures are routine or major actions preventing pavement condition from deteriorating to a "higher" level of rehabilitation.

Louisiana uses a Pavement Management System (PMS) to assist in making decisions about pavement maintenance/rehabilitation treatments. Information from PMS also informs maintenance personnel about which segment are likely to have significant maintenance needs.

The purpose of this manual is to define established and proven maintenance/rehabilitation strategies for ***pavement preservation***. However, in order to implement these strategies, a necessary prerequisite is to be able to communicate fully terms that convey the same meaning to all involved in the management of pavements in general and preservation of same in particular. For example, a pavement distress (defect), such as ***Fatigue/Alligator/Chicken Wire*** cracking, should convey the same meaning, namely, **Interconnected cracks forming a series of small sharp-angled polygons that resemple an alligator's hide or chicken wire**, to engineers, administrators, inspectors, and others concerned with pavement distress and decision-making related to pavement preservation and/or rehabilitation. Use of this manual will lead to more uniform use of nomenclature relative to evaluation of pavement performance.

Sources used in developing this manual include established definitions of DOTD, AASHTO, publications from the Strategic Highway Research Program (SHRP), the Portland Cement Association, the Asphalt Institute and the Transportation Research Board (TRB).

The manual is divided into sections, sub-sections and appendices. Section 1 discusses the various established practices for preservation of pavements including the timing (when) of application of specific maintenance. Sections 2 is devoted to defining various distress types, including photographs for flexible/composite, jointed concrete and continuously reinforced concrete pavements, respectively.

Based on pavement condition data discussed in Section 2, Section 3 provides available strategies for extending the life of pavement, including cost-effectiveness of each strategy.

The general terms related to pavement components, defects and performance characteristics are discussed in Appendix A. Appendix B discusses a procedure for assessment of pavement condition at the project level. Appendix C lists the design guidelines for preservation projects.

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SECTION 1 - INTRODUCTION

1.1 PHILOSOPHY AND PURPOSE

As more and more highways age and show signs of deterioration, it is becoming increasingly important to find cost-effective maintenance alternatives that can preserve or extend pavement service life until major rehabilitation and/or reconstruction can be performed. What is taken out of the nation's highways as a result of the daily wear and tear must necessarily be put back into the system in a cost-effective manner. To accomplish this effectively, long-term system (pavements and bridges) preservation programs need to be established within the DOTD.

System Preservation is the sum of all activities undertaken to restore and maintain pavements and bridges to serviceable levels.

A sound preservation program should have the following characteristics (1/)*.

- Adequate road network preservation not only today and tomorrow, but in the long term.
- Optimization of the benefit/cost relationship of the road transport system, which is not the same as trying to spend as little as possible on roads.
- Intelligent and cost-effective use of funds.
- Minimization of damage to the environment by conserving scarce aggregate and fuel.

Figure 1.1 emphasizes how the various strategies used in the system preservation (discussed later) overlap one another. It also serves to emphasize the importance of timing of each activity in relation to the existing condition of the road. A sound preservation program must focus on "***doing the right thing at the right time***".

1.2 PAVEMENT PRESERVATION STRATEGIES & DEFINITIONS

Emergency Repair - describes work activities generally necessary to return a pavement back to a minimum level of service following a significant event. Examples of such activities include concrete pavement blow-ups, road washouts, etc.

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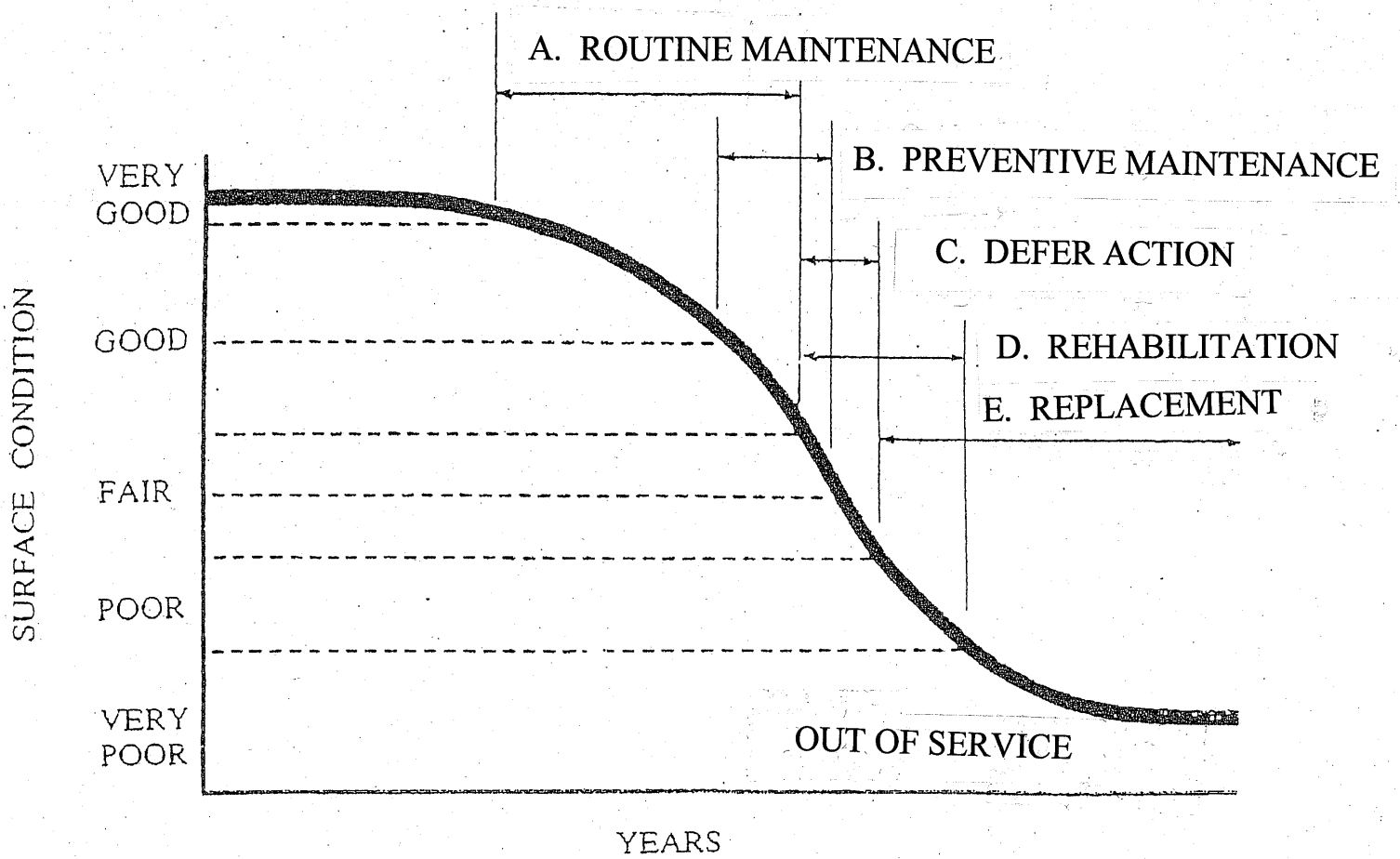
* - Underlined numbers in parenthesis refer to list of references at the end of this manual under References Cited



Source: Road Surface Management for Local Communities: Course Workbook (U.S. Department of Transportation & Federal Highway Administration, May 1985).

Figure 1.1: Maintenance Strategies and Timing

Corrective Maintenance - maintenance performed once a deficiency occurs in the pavement; e.g., pothole filling or spall repairs.

Pavement Preservation - A program employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life and improve pavement surface conditions. Pavement preservation includes ***routine maintenance, preventive maintenance, and light minor rehabilitation.***

1. **Routine Maintenance** - Defined as repair work typically performed by Department forces that is planned and carried out on scheduled basis to maintain the pavement in serviceable condition. Examples include Pothole Patching, Spot Leveling, Bump Grinding, Machine Leveling, etc.

2. **Preventive Maintenance** - This maintenance is a planned strategy of cost-effective, non-structural treatments to existing pavements that preserve the current condition and retard future deterioration. Micro-surfacing, Chip Seals, Joint Resealing, Crack Sealing, Thin Overlays (< 2"), etc., are some examples of preventive maintenance.

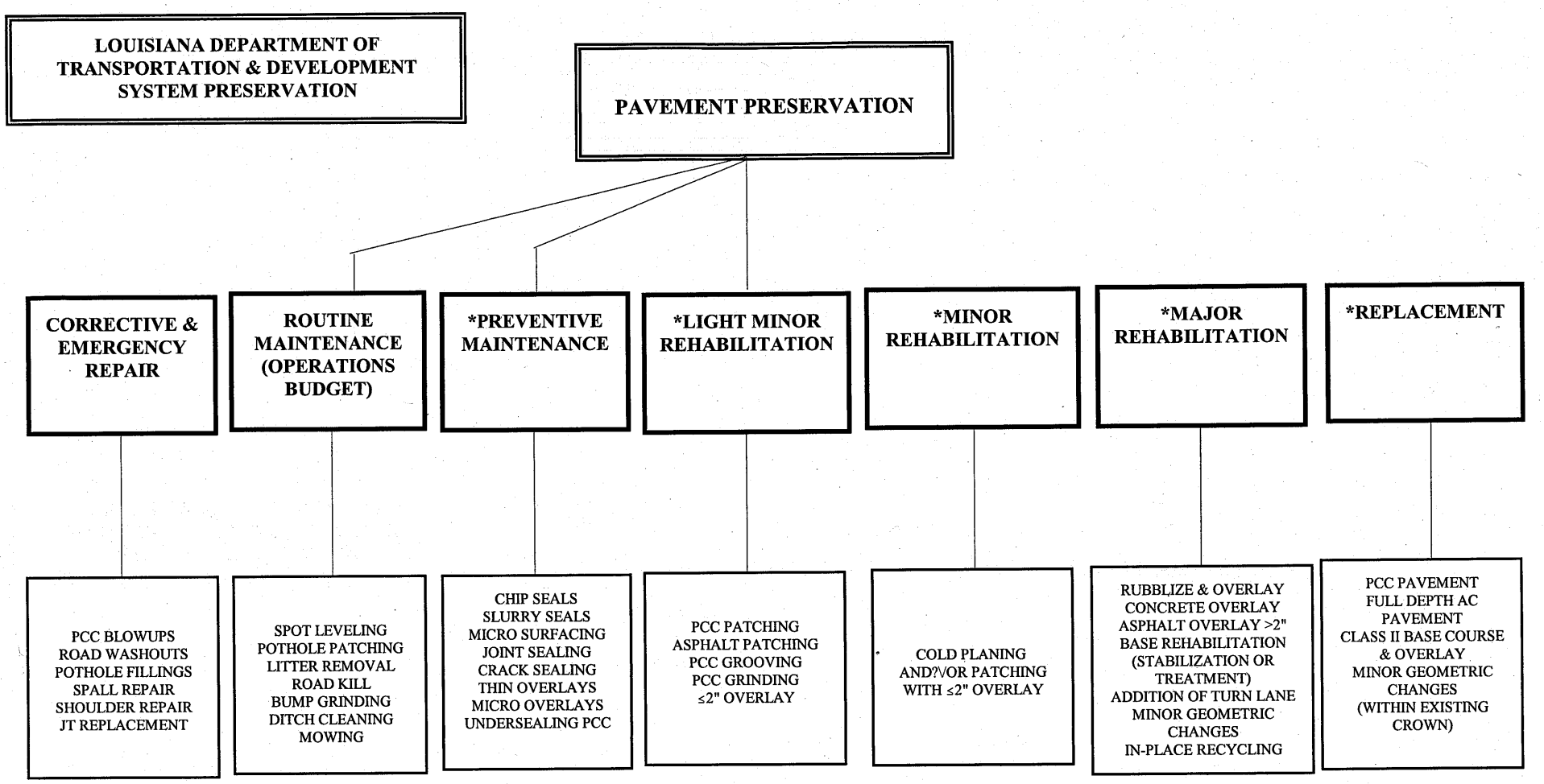
3. **Light Minor Rehabilitation** - This activity consists of non-structural improvements or repairs made to existing pavement sections to address pavement distresses. Examples are: Portland Cement Concrete Pavement Patching, Asphaltic Pavement Patching, Asphaltic Concrete Single-lift Overlay (≤2"), Pavement Grooving/Grinding, Load Transfer Restoration, etc.

Minor Rehabilitation - Consists of single lift overlay (≤2") of which existing pavement requires prior preparation such as cold planing or patching. Examples: Patching with Single Lift Overlay (≤2") (Patching limited to 10% of area within project limits) and Cold plane with Single Lift Overlay (≤2").

Major Rehabilitation - Consists of structural enhancements that extend the service life of an existing pavement system and/or improve its load-carrying capacity. These pavements would generally be designed for a minimum of 10-15 year design life within the existing crown. Examples: Rubblize & Overlay, Bonded Concrete Overlay, White-topping, Single or Multi-lift Asphaltic Concrete Overlay (>2"), In-place recycling, Base Rehabilitation (stabilized or treated) and Overlay, Geometric Changes to Alignment, Addition and/or Lengthening of Turn Lanes and Ramps, etc.

Replacement - is the replacement of the entire existing pavement structure by the placement of an equivalent or increased pavement structure generally within the existing crown. These pavements would be typically designed for a 20-year design life. Examples: Portland Cement Concrete Pavement, Full Depth Asphaltic Concrete Pavement, etc.

The various strategies discussed above are shown in Figure 1.2. Later, in Section 3, detailed discussion is provided on these strategies and the applicable treatments for each strategy.



* INCLUDED IN SECTION 41 SYSTEMS PRESERVATION PROGRAMS

Figure 1.2: Various Strategies for Pavement Preservation

SECTION 2 - PAVEMENT DISTRESSES

2.1 DATA COLLECTION PROCESS

System Preservation is a significant activity of the highway agency for preservation of pavements. This activity deserves attention in both the design and engineering processes. There are two basic elements to be considered in implementing a successful program. These elements are:

1. Assessment of existing pavement condition
2. Selection of appropriate treatment based on existing pavement condition

2.1.1. Assessment of Existing Pavement Condition

Pavement condition is normally measured using the following four factors:

1. Surface Distress

This factor involves identification of various surface distress in different types of pavements. The methods of evaluating such distress could be as simple as a visual manual (walking) or an auto windshield survey of randomly selected sections of the pavement scheduled for repair, or it could be a more sophisticated one using a high-speed van equipped with laser-video technology and automated processing of collected data. The latter is generally used in Louisiana for network survey. However, depending on the availability of resources, the walking/auto windshield visual inspection should be considered as part of the survey at **project level** evaluation to reinforce network listing of the condition of road segments.

Based on the identification of the existing distress, potential treatment(s) can be selected to correct the problem.

2. Structural Capacity

This factor can be measured using non-destructive deflection testing of the pavement. Such evaluation is necessary to evaluate the load carrying capacity of the pavement. Selection of the right treatment is dependent on knowing the structural condition of the project at the project level.

3. Roughness (ride quality)

This important factor is a measure of the surface distortion and provides an estimation of the ability of the pavement to provide a comfortable ride to the users. It is often expressed as PSI or IRI (see Appendix A for definitions).

4. Surface Friction

This is a safety-oriented factor and is generally considered a separate measure of the condition of the pavement surface. It is often used to determine a need for remedial maintenance by itself.

The above four pavement condition factors can be used to determine the overall pavement condition and to identify the most cost-effective and optimum maintenance and rehabilitation treatment. It should be noted that any treatment selected to correct the structural load-carrying capacity of the pavement can also take care of all other deficiencies that might be present, including roughness. Likewise, any treatment recommended for correcting pavement roughness will necessarily improve the surface friction and correct any surface distress as well.

Surface Condition Assessment

Network Level Condition Assessment - PMS (Pavement Management System) File

The DOTD's PMS file is the most comprehensive file containing data on the condition of the DOTD's network system. This distress file is created from the information collected using a high-speed pavement condition survey vehicle and consultant-developed software. This network survey is conducted once every two years through contract. The contract provides two types of data for each control section: measured data and interpreted data. Measured data includes roughness, rutting, faulting in concrete pavements and thickness of the pavement as measured by GPR (Ground Penetrating Radar). Interpreted data is generated from videos of each pavement segment in terms of cracking and patching. All data, measured and interpreted, is generated at specific intervals (0.004 miles for 2008 and 2009 survey year and at 0.01 mile interval for 2006-2007 survey year) for the entire control section. The data can be extracted for a specific project by defining the beginning and end log mile limits of the project. Table 2.1 is an example of the measured data for a project every tenth of a mile. Table 2.2 is for the interpreted data. It is also

possible to retrieve only the average distress conditions for the control section or project.

Table 2.1

Measured Data on Ruts, Roughness & Potholes - DOTD TIMED Project

PROJECT	Survey Year	Pavt Type	District	Parish	From Logmile	To Logmile	RUTS	IRI	No of Potholes
030-03-0023	2007	COM	62	52	0.6	0.7	0.47	90	0
030-03-0023	2007	COM	62	52	0.7	0.8	0.37	84	0
030-03-0023	2007	COM	62	52	0.8	0.9	0.46	84	0
030-03-0023	2007	COM	62	52	0.9	1.0	0.50	106	0
030-03-0023	2007	COM	62	52	1.0	1.1	0.35	100	0
030-03-0023	2007	COM	62	52	1.1	1.2	0.32	91	0
030-03-0023	2007	COM	62	52	1.2	1.3	0.39	159	0
030-03-0023	2007	COM	62	52	1.3	1.4	0.33	105	0
030-03-0023	2007	COM	62	52	1.4	1.5	0.30	116	0
030-03-0023	2007	COM	62	52	1.5	1.6	0.24	100	0

Table 2.2

Interpreted Data on Cracking Distress - DOTD TIMED Project

PROJECT	Pavt Type	From Logmile	To Logmile	Allig Crack Low	Allig Crack Med	Allig Crack Hi	Long Crack Low	Long Crack Med	Long Crack Hi	Trans Crack Low	Trans Crack Med	Trans Crack Hi
030-03-0023	COM	0.6	0.7	0	0	0	309	146	0	210	207	0
030-03-0023	COM	0.7	0.8	0	0	0	549	607	0	539	472	0
030-03-0023	COM	0.8	0.9	0	0	0	589	863	0	732	455	0
030-03-0023	COM	0.9	1.0	0	0	0	417	150	0	230	142	0
030-03-0023	COM	1.0	1.1	0	0	0	621	158	0	461	164	0
030-03-0023	COM	1.1	1.2	0	0	0	124	465	0	137	210	0
030-03-0023	COM	1.2	1.3	0	0	0	156	376	0	93	339	0
030-03-0023	COM	1.3	1.4	0	0	0	171	590	0	82	400	0
030-03-0023	COM	1.4	1.5	0	0	0	273	361	0	30	340	0
030-03-0023	COM	1.5	1.6	0	0	0	77	265	0	66	214	0

Project Level Condition Assessment -

If resources are available, the network assessment of roadways, which is performed every two years, can be supplemented by visual subjective assessment once every year or at some interval of time as deemed necessary by the districts. Such visual condition survey can add relevancy to the prioritized listing of projects developed from the network survey. Such relevancy would help the DOTD monitor pavement life cycles and provide equitable solutions to planning appropriate preventive maintenance strategies for pavement preservation.

Figures B-1 through B-3 in Appendix B are survey forms for flexible, rigid and composite pavements, respectively. The various pavement distress types proposed (in the forms) for the condition rating scheme have been selected based partly on the survey of the national state-of-the-art and reference (2/) and (3/).

The distress information defined in the forms can be converted into a condition index or information on each distress type, severity, and extent can be used individually. The condition index combines information from all distress types, severities, and extent (densities, quantities) into a single number. This is discussed below.

A procedure for conducting walking/windshield distress survey is discussed in Appendix B.

Pavement Condition Index (PCI)

A pavement condition index (PCI) acts as an indicator of the health of the pavement. It is basically a ranking and communication tool. It ranks the inspected pavement from poor to excellent (0 to 100) and allows the user to communicate the relative conditions within and between different sections over a given time period. A scale such as the one developed by CERL (4/), and illustrated in Figure 2.1, can be used to rate the pavement for maintenance and rehabilitation needs.

PCI		Rating	Strategy
86-100		Excellent	Routine Maintenance
71-85		V. Good	Preventive Maintenance
56-70		Good	Light Minor Rehabilitation
41-55		Fair	Minor Rehabilitation
26-40		Poor	Major Rehabilitation
11-25		V. Poor	Replacement
0-10		Failed	"

Figure 2.1: Pavement Condition Index, PCI (4/)

2.1.2 Selection of Appropriate Treatment Based on Existing Pavement Condition

As mentioned before, the condition index projects the overall health of the pavement and provides a basis for determining the type of action that should be taken to extend the life of the pavement. As was illustrated in Figure 1.1, the effectiveness of any action taken to enhance pavement life is dependent on the condition of the pavement at any specific time. Preventive maintenance is ineffective once the condition has reached a point between ***good*** and ***fair*** condition. Referring to the PCI scale of Figure 2.1, this would mean that once the PCI has reached below 55, preventive maintenance may not be the most cost-effective strategy to bring the pavement to serviceable condition. Some form of rehabilitation may be more appropriate to improve the functional condition of the pavement.

The ranges for PCI provide guidelines on which strategy, whether preventive maintenance, rehabilitation orreplacement, would provide the most cost-effective alternative. Likewise, information on each surface distress type, severity, and extent can also be used individually to select the best strategy. Which preventive maintenance treatments are the best candidates for observed surface distress is the subject of the next section.

2.2 DISTRESS IDENTIFICATION IN ASPHALT-SURFACED PAVEMENTS

In the previous section it was pointed out that before deciding on the type of treatment that should be applied to the segment of the pavement in need of repair, it is necessary to determine the condition of the pavement in terms of observed distresses which are flaws in pavement surfaces. In this section the various distress in asphalt-surfaced pavements, including overlays on concrete pavements, is identified through description, associated photographs, and the probable causes of the distress(2/, 5/).

Pavement Condition Evaluation

The evaluation and follow-up (feedback) of the condition of the pavements should be the corner stone of any rational plan of action for restoring and maintaining a road system. The methods of evaluating the condition (distress) of pavements could be as simple as a visual manual (walking) survey of randomly selected sections of the pavement scheduled for repair, or a more sophisticated one using a high-speed van equipped with laser-video technology and automated processing of collected data. The latter is generally used for network survey. The walking visual inspection remains an essential basis for knowledge of the state of roads and is generally the preferred approach at project level evaluation.

2.2.1 Identification of Distress

To conduct a manual visual survey of the pavement condition, the surveyor should be able to identify the various distress and the severity and extent of the distress in the pavement surface. The term ***severity*** applies to the degree of deterioration of the pavement due to various types of distress. Likewise, the term ***extent*** refers to the frequency of occurrence or the amount of road surface showing the particular distress. In order to facilitate recognition of deficiencies in flexible pavements, the most common signs of distress are listed below. This is followed by their description, the probable cause(s) and a photograph of each distress. However, it should be mentioned that data on some of the distresses listed are not collected (measured) by the DOTD's Pavement Management System. These are marked with asterisks.

- Cracking
  - Fatigue (Alligator or Chicken Wire) Cracking
  - Block Cracking (*)
  - Edge Cracking (*)
  - Longitudinal Cracking
  - Transverse Cracking
  - Reflection Cracking (*)

- Patching and Potholes
  - Patch/Patch deterioration
  - Potholes (measured as number and area)

- Surface Defects
  - Rutting
    - Densification of pavements
    - Unstable asphalt concrete
  - Bleeding (**)
  - Raveling (**)
  - De-bonding (overlay on concrete) (**)
  - Roughness
    - Corrugations
    - Bumps

2.2.2 Description and Illustration (Photograph) of Distress

The following pages describe each distress, the probable cause(s) of that distress and a photograph of each distress.

(*) - No longer measured by LaDOTD's PMS
(**)- Measured as just 'Yes' or 'No' by PMS

Cracking

Figure 2.2 shows the cross section of the pavement with some of the more common forms of cracking distresses on the pavement surfaces

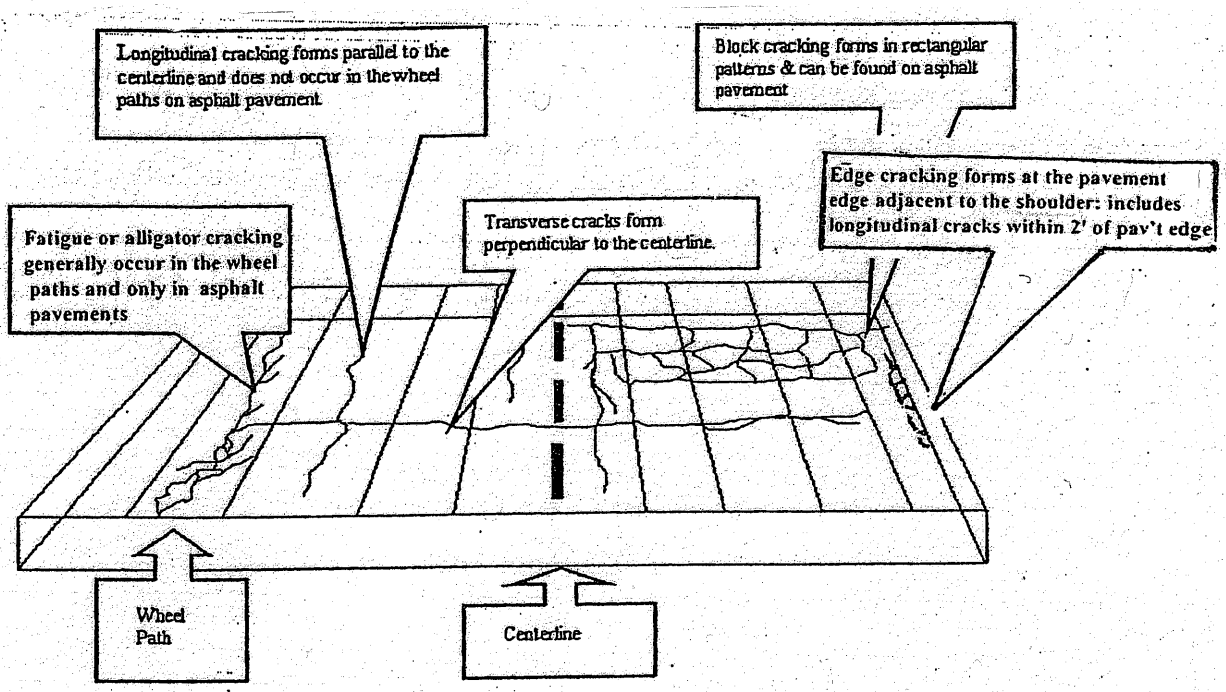
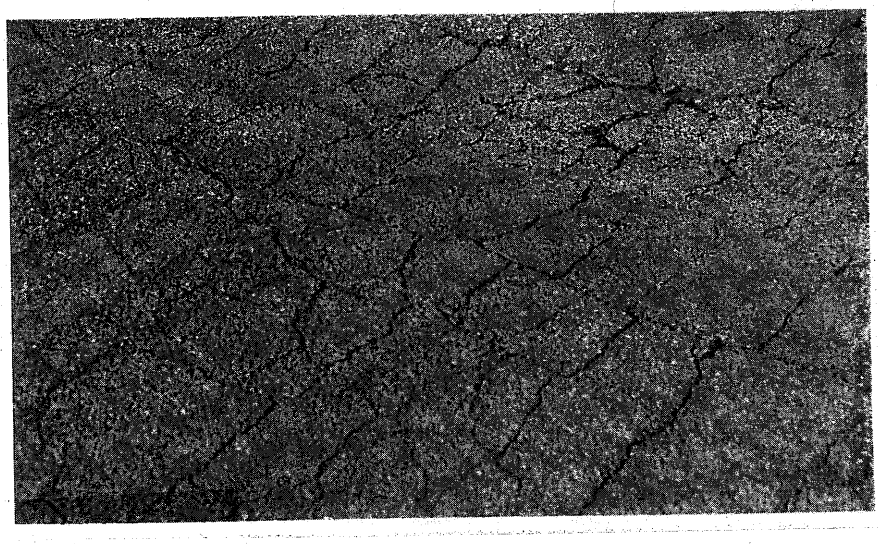


Figure 2.2: Pavement Cross Section with Some Common Forms of Cracking Distress (6/)

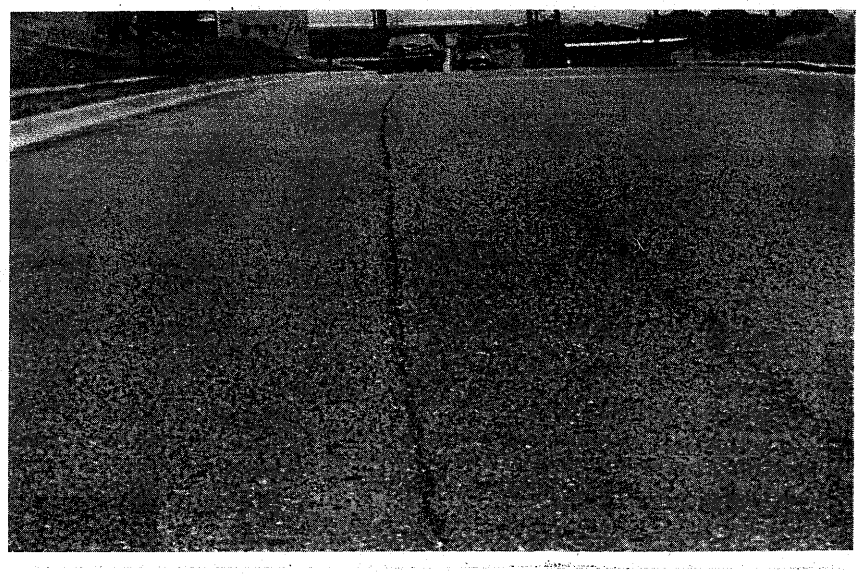
Distress	Description	Probable Cause
Fatigue/Alligator/Chicken Wire	Interconnected cracks forming a series of small sharp-angled polygons that resemble an alligator's hide or chicken wire	Generally unstable base or roadbed; weakening of pavement caused by embrittlement over a resilient foundation

Distress	Description	Probable Cause
Block Cracking	Interconnected cracks forming a series of large polygons, (from 1 to 100 sq. ft) usually with sharp corners or angles	Hardening and shrinkage of the asphalt; roadbed becoming unstable. May become alligatored if not corrected



Distress	Description	Probable Cause
Edge Cracking	Crescent-shaped which intersect the pavement edge and are located within 2 ft of the edge adjacent to the shoulder. Includes longitudinal cracks outside of the wheel path within 2 ft of pavement	Inadequate thickness of the pavement to support traffic; vertical or lateral displacement of embankment or both if no traffic loads

Distress	Description	Probable Cause
Longitudinal Cracking	Cracks predominantly parallel to the pavement centerline	Improperly constructed pavement joints; settlement of roadbed under traffic; shrinkage of surface course or insufficient pavement thickness

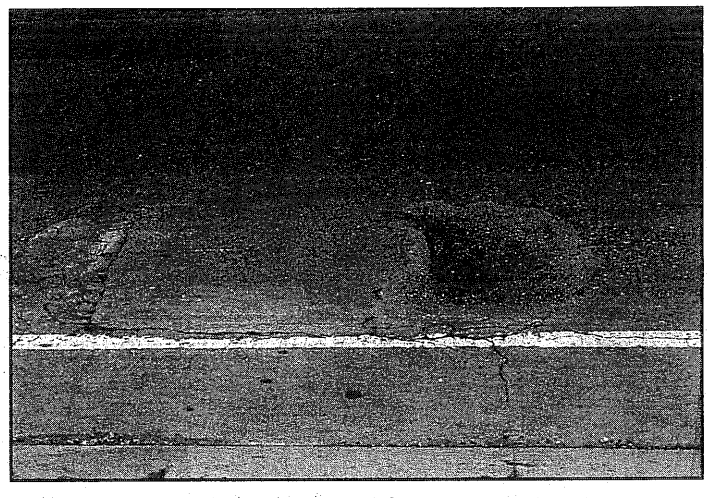


Distress	Description	Probable Cause
Transverse Cracking	Cracks approximately perpendicular to the pavement centerline and not located over PCC joints	Shrinking of the surface courses or pavement structure; insufficient pavement thickness

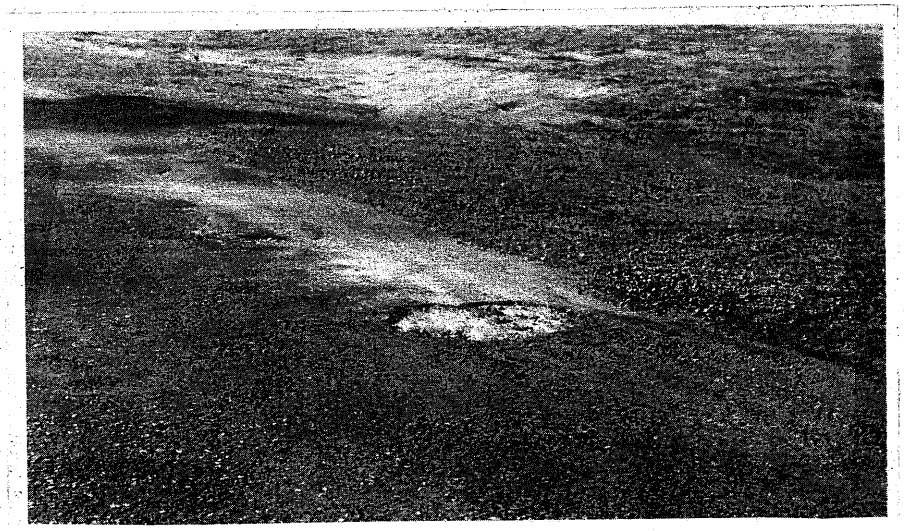
Distress	Description	Probable Cause
Reflection Cracking at joints	Cracking of a resurface or overlay above underlying cracks or joints in concrete slab or from a source supporting the surface layer	Movement of underlying pavement; lack of bridging over underlying cracks or joints; possibly shrinkage of underlying layer

Pothole Patching and Potholes

Distress	Description	Probable Cause
Pothole Patching	Portion of the pavement that has been removed and replaced or additional material applied after original construction	Improperly applied patch; lack of bond between patch material and pothole surface; improperly compacted patch

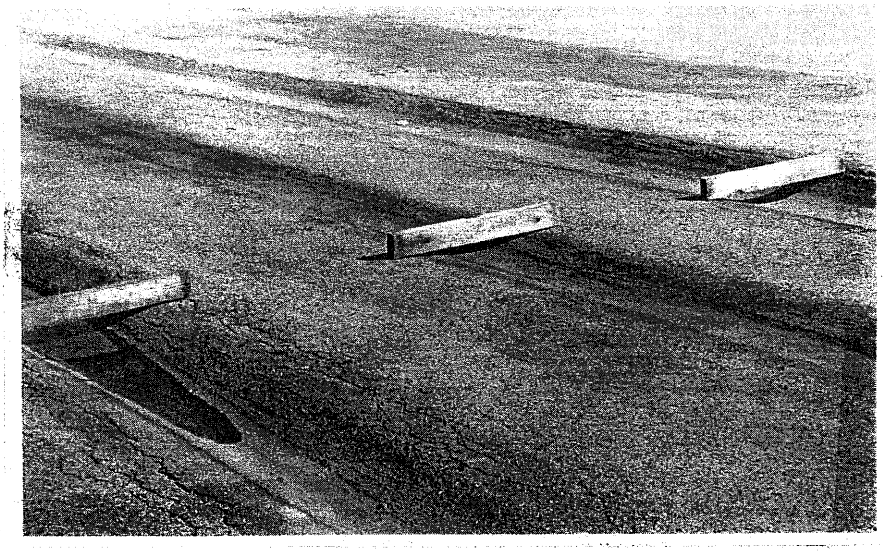


Distress	Description	Probable Cause
Pothole	Bowl-shaped holes of various sizes in the pavement surface	Small, localized disintegration or failure of the pavement from traffic over weakened spots in the surface; Progressive alligator cracking can also lead to this condition as a result of dislodgement of individual pieces



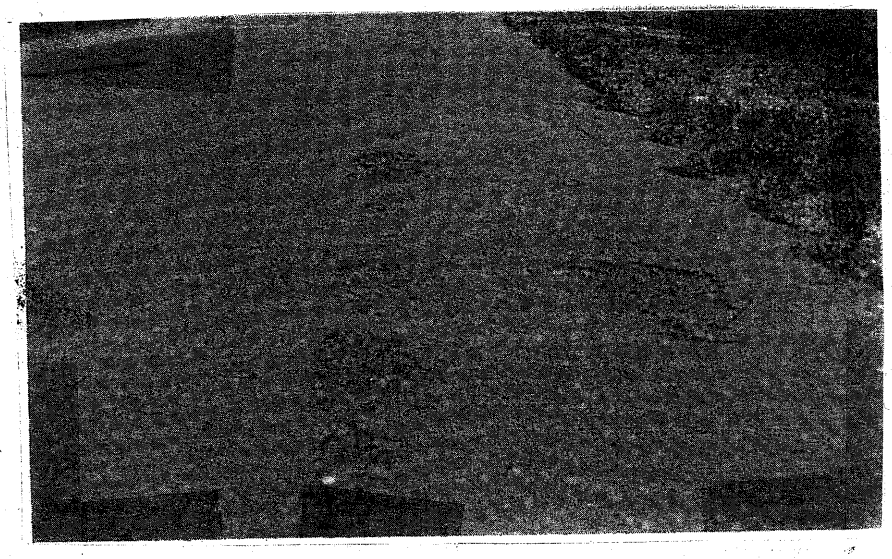
Surface Defects

Distress	Description	Probable Cause
Rutting	Longitudinal depression that form under traffic in the wheel path	Channeled wheel traffic over unstable pavement or foundation; additional compaction of the pavement in the wheel path due to traffic because of initial inadequate compaction of base or surface course

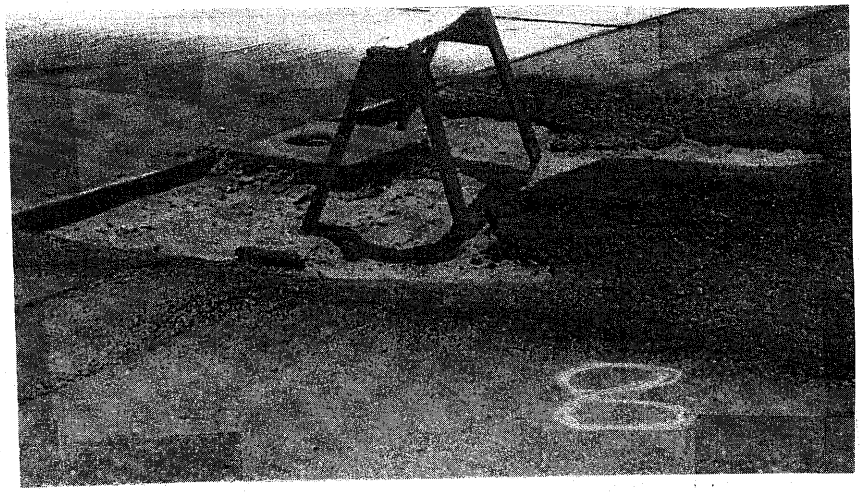


Distress	Description	Probable Cause
Bleeding	Free/excess bitumen on the surface of the pavement	Rich application of bitumen; excessive amounts of tack coat

Distress	Description	Probable Cause
Raveling	The progressive wearing away of pavement surface downward by the dislodgement of aggregate particles	Uneven distribution of the bitumen; insufficient bitumen or binding agent in the surface; loss of asphalt binder due to oxidation

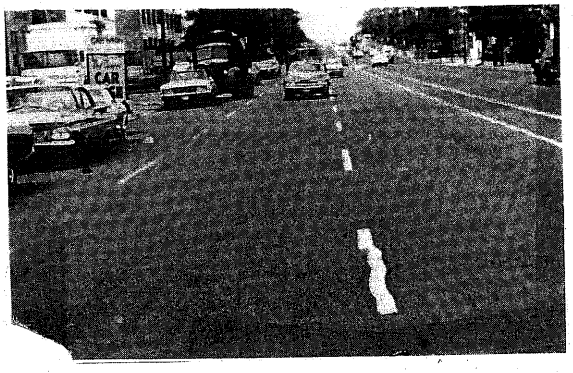


Distress	Description	Probable Cause
De-bonding (overlay on concrete)	Large chunks of surface course removed from the underlying concrete pavement	Unstable base; lack of proper bond between the asphalt surface layer and concrete



Distress	Description	Probable Cause
Roughness Corrugations Bumps	Corrugations are transverse undulations (crests and valleys) at regular intervals (less than 2' apart Bumps are localized upward displacements	Traffic action on an unstable pavement or roadbed; soft surface to resist shoving. Swelling of high clay content base, subbase or roadbed materials

Corrugations



Bumps

2.3 DISTRESS IDENTIFICATION IN JOINTED CONCRETE PAVEMENTS

This section covers jointed plain Portland Cement Concrete-surfaced pavements (JCP).

2.3.1 Identification of Distress

Distresses in these pavements can be grouped into the following categories. Presently, data on distresses marked with an asterisk is not collected by the PMS.

- Cracking
  - Corner Breaks (*)
  - Longitudinal Cracking
  - Transverse Cracking
- Joint Deficiencies
  - Joint Seal Damage
  - Spalling of Transverse/Longitudinal Joints (*)
- Surface Defects
  - Map Cracking (*)
  - Scaling (*)
- Other Distress
  - Blowups
  - Faulting of Transverse Joints and Cracks
  - Water Pumping (*)

Following the format used in Section 2.2, each distress is described below followed by a photograph of that distress.

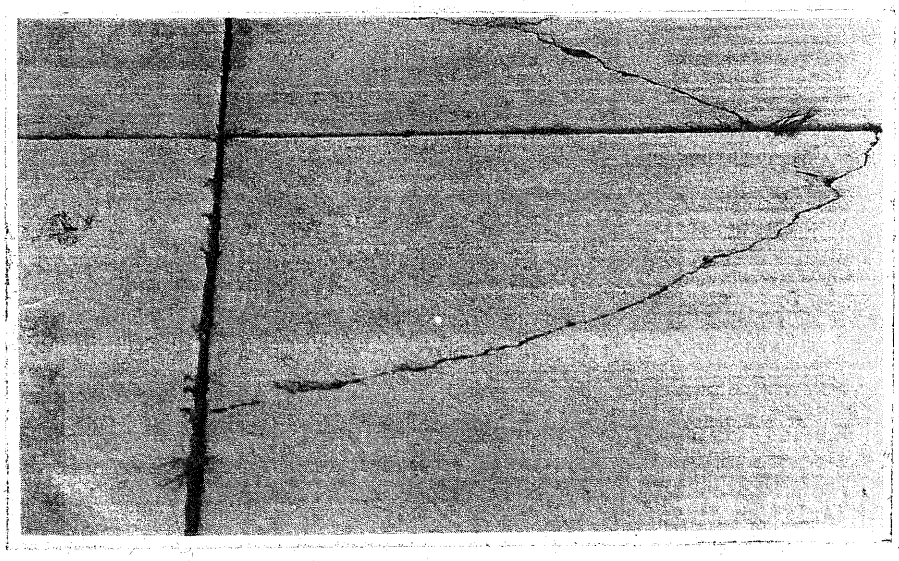
2.3.2 Description and Photograph of Distress

The following pages describe each distress in rigid pavements, the probable cause(s) of that distress and a photograph of the distress.

Description and Photograph of Each Distress

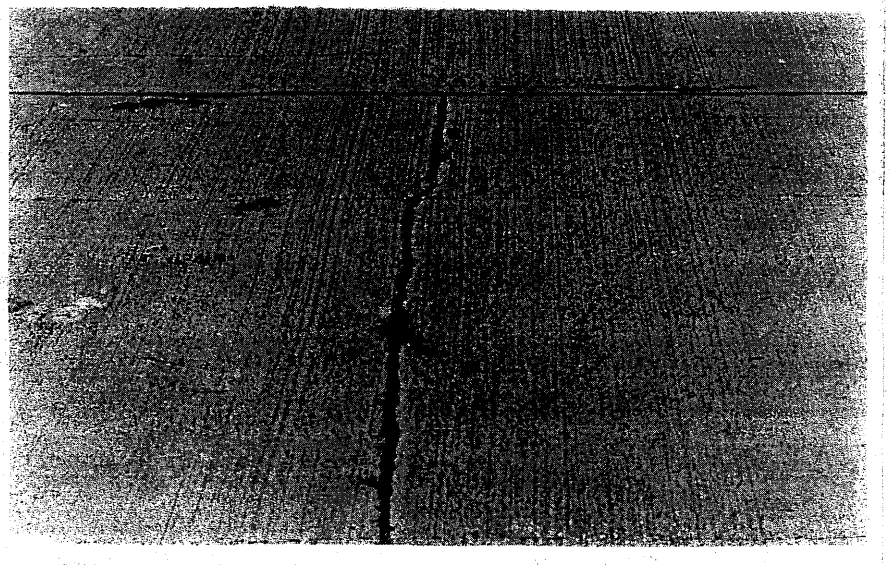
Cracking

Distress	Description	Probable Cause
Corner Break	A break in the pavement at the corner of the slab near the juncture of the transverse joint and longitudinal joint or slab edge	Overloading the slabs at or near the corners; an unstable foundation or voids because of loss of material under the slab



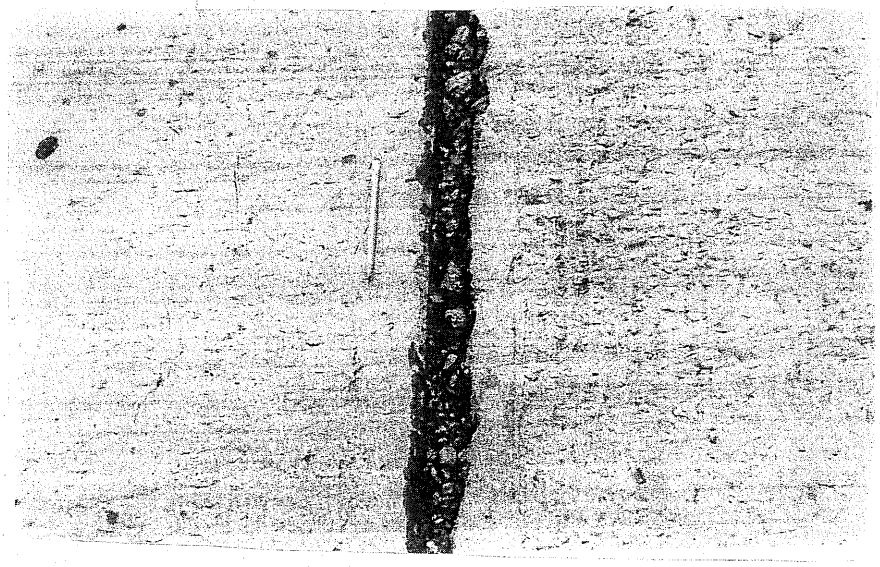
Distress	Description	Probable Cause
Longitudinal Cracking	A crack or break approximately parallel to pavement centerline	Lateral contraction; lateral movement and settlement of the roadbed

Distress	Description	Probable Cause
Transverse Cracking	A crack or break approximately perpendicular to pavement centerline	Insufficient contraction joints or weakened plane joints; overloading curled slabs with inadequate roadbed support



Joint Deficiencies

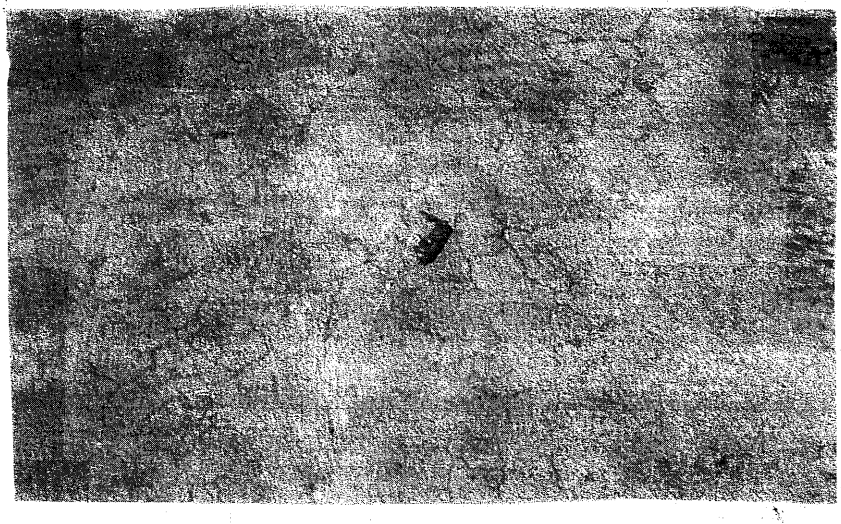
Distress	Description	Probable Cause
Transverse and Longitudinal Joint Seal Damage	A condition that enables incompressible materials or water to infiltrate the joint; Generally occurs as a result of broken or crushed slab edges	Joints fouled by incompressible materials tending to prohibit slab expansion



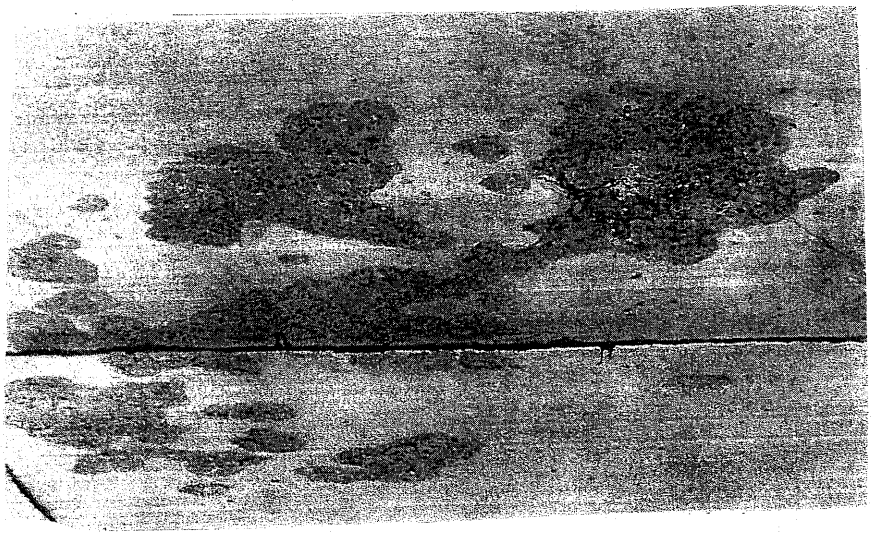
Distress	Description	Probable Cause
Spalling of Transverse and Longitudinal Joints	Breakdown or disintegration of slab edges at joints or cracks or directly over reinforcing steel, usually resulting in the removal of sound concrete	Breakdown of pavement joint edges from traffic action and progressive destruction of the surface adjacent to this damage

Surface Defects

Distress	Description	Probable Cause
Map Cracking Crazing	A series of hairline cracks extending only through the surface layer and tend to intersect at an angle to form a chicken-wire pattern	Weak surface of the slab caused by excessive finishing; possibly rich mortar in surfacing



Distress	Description	Probable Cause
Scaling	Progressive disintegration and loss of concrete wearing surface	Eroding of the surface by reaction from de-icing materials; repetitive freezing and thawing cycles or weakened surface caused by overfinishing



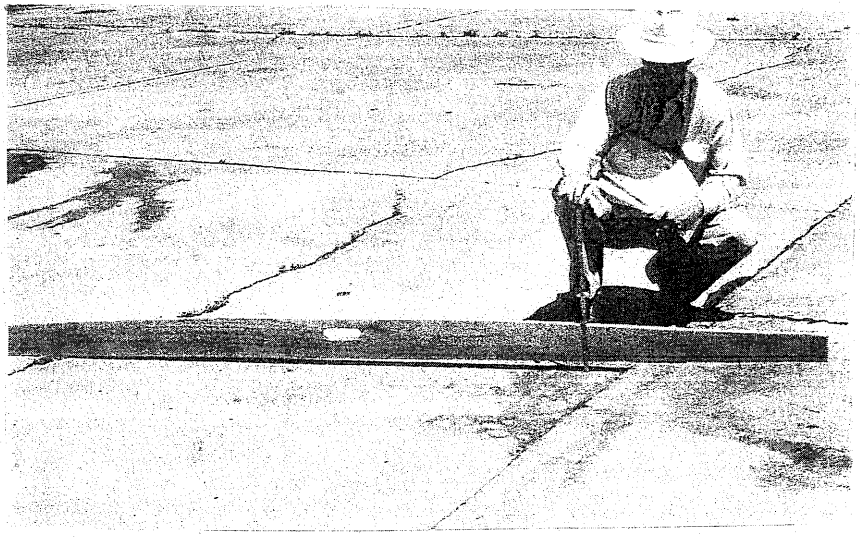
Other Distress

Distress	Description	Probable Cause
Blow-ups Buckling Shattering	Localized upward buckling or shattering of the slab occurring usually at a transverse crack or joint	Excessive expansion of the slab with insufficient joint width; joints fouled with incompressible materials preventing the joint from serving its intended purpose

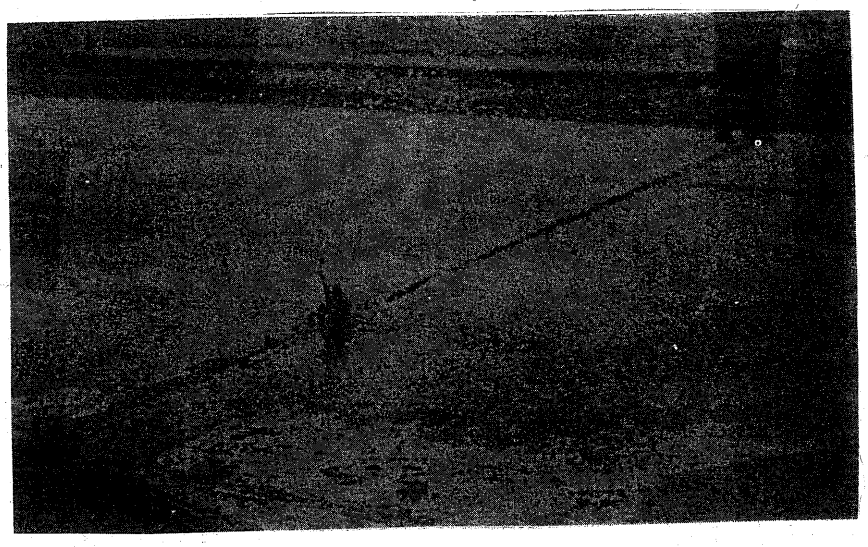
Buckling

Shattering

Distress	Description	Probable Cause
Faulting of Transverse joints and Cracks	Differential vertical displacement of abutting slab at joints or cracks creating "step" deformation in the pavement surface	Uneven roadbed support under the slab; reduced effectiveness of load transfer device



Distress	Description	Probable Cause
Pumping	The ejection of mixtures of water, clay or silt along or through transverse or longitudinal joints, cracks, or pavement edges	Insufficient support from water-saturated bases or roadbed. When the load is imposed by traffic, it is depressed onto the saturated material underneath, squeezing the mixture of water and fines out through the joints or cracks



2.4 DISTRESS IDENTIFICATION IN CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS

Distresses occurring in this type of pavements are similar to those identified in the previous section on jointed concrete pavements except that no corner breaks occur because of absence of transverse joints. Likewise, there are no joint related distresses to deal with, other than transverse construction joints and longitudinal joints.

2.4.1 Identification of Distress

Distresses in these pavements can be grouped into the following categories:

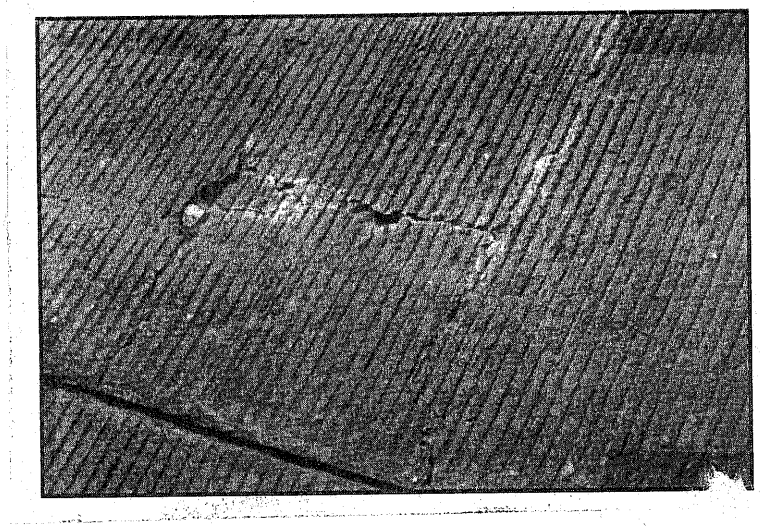
- Cracking
  - Longitudinal Cracking
  - Transverse Cracking
- Surface Defects
  - Map Cracking
  - Scaling
- Other Distresses
  - Blowups
  - Punchouts(*)
  - Transverse Construction Joint damage(*)
  - Spalling of Longitudinal Joints
  - Longitudinal Joint Seal Damage
  - Water Pumping

2.4.2 Description and Photograph of Distress

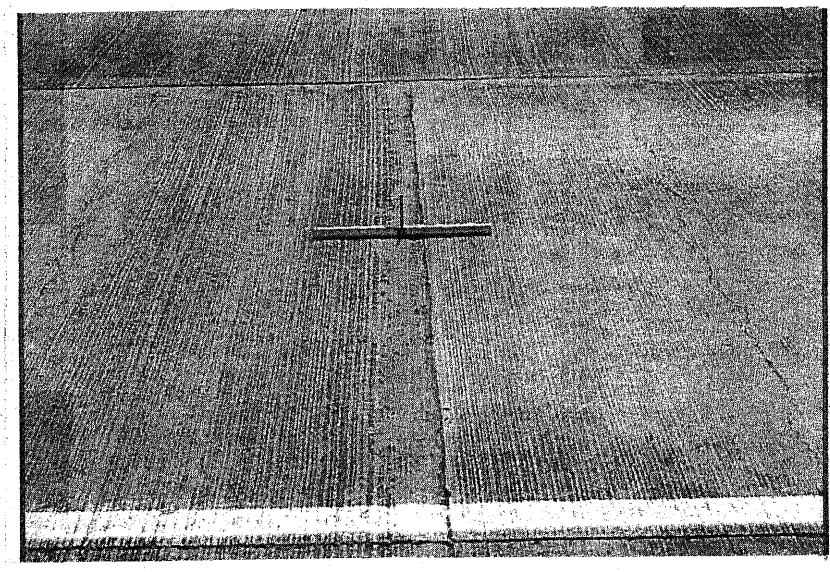
Since most of the distresses are similar to those discussed in Section 2.3 for JCP, only the description and photographs of those marked with an asterisk (*) are addressed here.

Other Distresses

Distress	Description	Probable Cause
Punchouts	The area enclosed by two closely spaced transverse cracks, a short longitudinal crack, and the edge of the pavement or a longitudinal joint	Loss of aggregate interlock which results in rupture of steel resulting in pieces to be punched down into the underlying layers



Distress	Description	Probable Cause
Transverse Construction Joint Deterioration	Series of closely spaced transverse cracks or a large number of interconnecting cracks occurring near the construction joint	Impact on the edge of the slab past the joint; loss of base or roadbed support; improper consolidation



SECTION 3 - TREATMENTS

3.1 TYPES OF TREATMENTS

The treatments used for preventive maintenance, minor rehabilitation and major rehabilitation can be grouped into the following categories:

A. Flexible/composite pavements

- Spray seals (fog seal)
- Cold thin seals (slurry seal, micro-surfacing)
- Chip seals (single, multiple, cape)
- Crack sealing/filling
- Thin hot-mix asphalt overlays
- Thick hot-mix asphalt overlays
- Hot in-place recycling
- Cold in-place milling and overlay
- Stabilize base and overlay
- Patching

B. Rigid pavements

- Partial depth repairs
- Joint/crack cleaning and resealing
- Undersealing
- Diamond grinding
- Slurry seal and micro-surfacing (limited application)
- Flexible overlay
- Rigid overlay
- Rubblizing/Break & Seating
- Load transfer restoration

Each of the above treatments are used for a specific purpose. Tables 3.1 through 3.4 provide an overview of the above treatments relative to what they are, where they are used and when they are used. It should be mentioned that some of the treatments listed can also be applied whenever emergency or corrective maintenance is required for safe travel.

3.1.1 Selection of Treatments

The selection of any of the specific treatment(s) discussed in Tables 3.1 through 3.4 should be based on three major factors (7/):

(1) Existing pavement condition,

(2) Traffic and,

(3) Environmental condition

Following is a brief discussion of each of these factors:

1. Existing Pavement Condition

This is the most important factor in determining what type of treatment should be applied to correct the deficiency in the pavement segment to be treated. This condition should be evaluated with respect to ***distress***, ***structural capacity, roughness*** and ***surface friction. Distresses*** in pavements are flaws in the surface condition of the pavement. (Refer to Section 2 for detailed description, cause(s) and photographs of each distress). ***Structural capacity*** refers to the ability of the pavement to carry the anticipated design loads. ***Roughness*** is the variation in the longitudinal profile of the pavement surface that affects the ride quality. ***Surface Friction*** is an interaction between the vehicle tire and the pavement surface and is an important safety factor in reducing wet weather accidents.

If the pavement distress is not load related, preventive maintenance treatments can be used to improve surface distress, roughness and skid resistance.

2. Traffic

Traditionally, preventive maintenance treatments have not been applied to high-volume roads in this country and are generally limited to traffic volumes less than 7000 ADT. If care is taken in their design and application, these treatments can be used on high-volume, high-speed, roads, as is done in Europe.

3. Environment Condition

To a large extent, preventive maintenance treatments are used to prevent the

damage that results from environmental conditions. In that respect, periodic renewal of the pavement surface provides a mechanism to prevent water intrusion into the pavement structure and provides a new surface controlling the effects of oxidation, cracking and raveling (2/).

Table 3.1
Summary of Preventive Maintenance Treatments for Flexible Pavements

Treatment	What is it	Used to
Fog Seal	Light application of diluted emulsion without the aggregate	Enrich/rejuvenate oxidized surface, prevent raveling, seal small cracks, provide shoulder delineation
Slurry Seal	Mixture of fine aggregate, emulsion, mineral filler and water	Retard surface raveling, seal minor cracks, improve surface friction
Micro-Surfacing	Mixture of aggregate, polymer-modified emulsion, water, mineral filler and additive	Provide texture, seal minor cracks, fill ruts
Chip Seal Cape Seal	Application of asphalt/emulsion followed immediately with cover of single or multiple layers of aggregate. A Cape seal is Chip Seal topped by a Slurry Seal or Micro-Surfacing	Waterproof surface by sealing *low-severity fatigue and block cracks*, restore surface friction. Prevent loose chips because of Slurry Seal or Micro-Surfacing cover
Thin Hot-Mix Overlays (<1.5") Dense mixes OGFC	Blends of aggregate, asphalt cement mineral filler and additive	Seal fatigue, block cracking and ruts, improve ride, improve surface friction
Crack Sealing/Filling	***Crack Sealing*** is the placement of specialized asphalt-based material into *working* cracks. ***Crack Filling*** is the placement of material into *non-working* cracks.	Prevent intrusion of water.

Table 3.2

Summary of Minor and Major Rehabilitation Treatments for Flexible Pavements

Treatment	What is it	Used to
Stabilization of base course followed by new surface	This work involves cold planing all or most of asphaltic surfacing, pulverization/mixing of remaining surfacing and base, treating with cement and placing new surface treatment	Base repair is often required to restore the structural integrity of pavement sections that are severely alligatored, potholed or distorted.
Thin Hot-Mix Overlays (≤2") Dense mixes Gap-graded mixes (Stone Matrix)	Blends of aggregate, asphalt cement mineral filler and additive	Seal, improve ride, improve surface friction, fill minor ruts
Thick Hot-Mix Overlays (>2")	Blends of aggregate, asphalt cement mineral filler and additive	Add structural strength to pavements, correct all types of cracking, excessive patching, raveling, weathering and rutting
Hot in-place Recycling	A process in which the existing surface of asphalt pavement is softened and reworked in place to a depth of 1-2" using heat , adding virgin asphalt and aggregate (if needed) followed by an overlay or a surface treatment	Correct rutting, bleeding, transverse slope, minor corrugations, improve surface friction
Cold in-place Recycling	A process in which a portion of an existing bituminous pavement is pulverized or milled to depth of 2"-5", and then the reclaimed material is mixed with new binder and, when needed, virgin aggregates. The binder used most often is emulsified asphalt with or without a softening agent. The resultant blend is placed as a base for a subsequent overlay or surface treatment.	Correct structural failures
Patching	Placement of a repair material to replace localized defect on segment of roadway	Mostly to correct surface defects
Milling and Overlay	This is a type of surface recycling which removes, with or without heat, 1" or more of asphalt concrete and followed by overlay	Correct same deficiencies as Hot-Mix Overlay and Hot in-place Recycling

Table 3.3

Summary of Preventive Maintenance Treatments for Rigid Pavements

Treatment	What is it	Used to
Thin Hot-Mix Overlays (<1.5") Dense mixes OGFC	Blends of aggregate, asphalt cement mineral filler and additive	Seal, improve ride, improve surface friction
Slurry Seal & Micro-Surfacing (limited application)	Mixture of fine aggregate, emulsion, mineral filler and water	Provide texture, Improve surface friction
Joint/Crack Cleaning and Resealing	This is a maintenance operation to seal joints and cracks with highly durable bitumen-based or one or two component thermosetting materials	Prevent intrusion of surface water and incompressible materials which can lead to blowups, spalling and pumping
Undersealing (Subsealing, slab stabilization))	Filling the voids under the concrete pavement with cement and fly ash grout or bituminous materials under pressure through holes drilled in the slab	Prevents pumping and faulting

Table 3.4

Summary of Minor and Major Rehabilitation Treatments for Rigid Pavements

Treatment	What is it	Used to
Partial-Depth Repair	Removal of shallow areas of deteriorated concrete and replacement of that material with a suitable repair material	Extend the life of PCC pavements by restoring ride quality to spalled or scaled pavements, joint/crack faulting, poor ride
Full-Depth Repair	Removal of a segment of pavement to the level of subgrade and replacement of that material with a suitable repair material	Restore: spalled joints, broken slabs, long/trans/refl cracking, blow-ups or shattered slabs
Diamond grinding	It is a process of removing the surface layer of hardened concrete using a series of closely spaced rotating diamond saw blades.	Remove: Joint and crack faults, Wheel path ruts, Roughness at joints, and Restore surface friction Reduce hydroplaning by restoring pavement drainage
Grooving	A process used to cut slots with widely spaced diamond blades	Remove water beneath tires to minimize hydroplaning potential, restore surface friction
Load transfer restoration	Installation of a device (dowel bars or shear devices) after initial pavement construction to transfer load and reduce the relative deflection across joints or cracks.	Retard deterioration due to joint spalling, pumping, faulting and cracking.
Flexible Overlay	This rehabilitation technique is used to increase the structural capacity of the pavement with an overlay of bituminous surface	Increase the structural capacity of the existing pavement, correct surface defects such as cracking and faulting and improve ride
Rigid Overlay	This is a technique used to increase a pavement's structural capacity with an overlay of either bonded or unbonded concrete overlay	Increase the structural capacity of the existing pavement, correct surface defects such as cracking and faulting and improve ride
Break and Seat	This technique uses special slab fracturing equipment to crack the slab into pieces 24 to 42 inches in size. A heavy roller firmly seats the fractured slabs before placement of hot-mix overlay	Corrects reflective cracking (subbase must be in good condition)
Rubblizing	It is a technique which uses a self-propelled resonant frequency breaker to break the existing pavement slab into pieces no more than 6 inches in size. The broken slab is compacted with vibratory and pneumatic roller before placement of the first course of surfacing	Provides the same benefit as Break and Seat treatment (subbase must be in good condition)

3.2 STRATEGIES FOR TREATMENTS

Development of Preventive Maintenance and Rehabilitation Treatments Strategies

Like initial construction, rehabilitation and reconstruction are costly activities. An analysis of existing pavement to determine the cause of deterioration, detailed in Section 2, should be made to select a cost-effective maintenance, rehabilitation, and reconstruction treatment that corrects the problem that created the need for repair rather than treating the symptom of the problem. To identify a feasible treatment solution at the project level, it is necessary to seek answers to the following questions:

- Is the pavement structurally adequate?
- Is the pavement functionally adequate?
- Is the rate of deterioration abnormal?
- Is the drainage adequate?
- Are the pavement materials durable?
- Has the previous maintenance been adequate?
- Does the condition vary substantially along the length of the project or between lanes?

The above questions essentially address the cause of deterioration. Once these questions are adequately addressed, the process of selecting the best strategy can be put in place. There is seldom a single alternative that is immediately obvious as the best choice. This is where the cost-effectiveness comes into play.

3.2.1 Selection of Treatment Strategies

There are several methods that can be used to assign treatments to the segments of pavements for a given type and extent of distress. Experience coupled with PMS data is commonly used in Louisiana. Regardless, there are a large number of maintenance, rehabilitation and reconstruction alternatives available for both flexible and rigid pavements and recycling has increased the number of options. Some of these were identified in Tables 3.1 through Table 3.4 . Surface seals such as aggregate seals and slurry seals combined with localized repairs are often used as preventive maintenance treatments for flexible pavements. These same treatments are also used for rehabilitation of low-volume roads when structural improvements are not needed.

Asphalt concrete overlays are the most common type of structural rehabilitation applied to flexible and rigid pavements. Such overlays have become more versatile by combining them with fabrics, milling and recycling. Table 3.5 provides a detailed guidance to selecting treatments for asphalt-surfaced pavements, based on severity and extent of some common distresses. Table 3.6 provide guidelines for concrete pavements.

Table 3.5: Guidelines for Effective Treatments for Asphalt-Surfaced Pavements(7/,9/)

Pavement Condition		Parameter	Thin(<2") Overlay (*)	Slurry Seal	Chip Seal	Cape Seal	Micro Surface	Crack Seal	Fog Seal	Minor/Major Rehab (Mill or Recycle)
Traffic	ADT/Ln	<2000	**	**	**	**	**	**	**	**
		2000-7000	**	**	**	**	**	**	**	**
		>7000	**	**	O	O	**	**	X	**
Ruts		<3/8"	**	O	O	**	**	X	X	**
		3/8" -1"	**	X	X	O	**	X	X	**
		>1"	O	X	X	X	O	X	X	**
Cracking	Alligator	Low	**	**	X	**	**	X	O	**
		Med	**	O	**	**	**	X	X	**
		High	O	X	X	X	X	X	O	**
	Long	Low	**	**	**	**	**	**	O	**
		Med	**	O	**	**	O	**	X	**
		High	O	X	O	O	X	O	X	**
	Trans	Low	**	**	**	**	**	**	O	**
		Med	**	O	O	**	O	**	X	**
		High	O	X	X	O	X	O	X	**
Asphalt Surface Condition		Dry	**	**	O	**	**	X	**	**
		Flushing	**	O	X	O	**	X	X	**
		Bleeding	**	X	X	X	**	X	X	**
Raveling		Low	**	**	**	**	**	X	**	**
		Med	**	**	**	**	**	X	O	**
		High	**	O	**	**	**	X	O	**
Roughness, in/mi	>110		**	X	X	X	X	X	X	**
Low FN	<35		**	**	**	**	**	X	X	**

Note: The table is for general guidance only and engineering judgment and experience should be used when selecting proper treatment.

(*) Dense mixes, OGFC, Gap greaded mixes

**** = Effective**
O = Marginally Effective
X = Not Effective

Table 3.6: Guidelines for Effective Treatments for Concrete Pavements

Pavement Condition		Parameter	Full-Depth Repair	Partial-Depth Repair	Joint Crack Seal	Underseal Subseal	Load Transfer Restoration	Diamond Grinding	Overlay		Rubblize/ Break & Seat slabs
									Flex	Rigid	
Spalled Joint		Low	✔	✔			✔	✔			
		Med	✔	✔			✔	✔			
		High	✔	✔			✔	✔	✔	✔	
Cracking	Map			✔							
	Trans	Low		✔	✔						✔
		Med	✔		✔						✔
		High	✔		✔						✔
	Long	Low	✔	✔	✔						✔
		Med	✔		✔						✔
		High	✔		✔						✔
	Scaling			✔							
Faulting				✔	✔	✔	✔	✔	✔	✔	
Blow-ups/ Shattering			✔								
Roughness, in/mi	>90			✔				✔	✔	✔	
Low FN	<35							✔	✔	✔	
Polished Surf								✔	✔	✔	
Texture								✔	✔	✔	
Pumping						✔	✔				

Note: The table is for general guidance only and engineering judgment and experience should be used in selecting proper treatment.

(1) - Justification for placing full-depth repair may also require consideration of traffic volume and composition. Thus, such full-depth repairs may not be justified on some lo-volume roads that exhibit these distresses.

(2) - These distress types may only require partial-depth repairs if the distress is limited to top portion of the slab.

(3)- Load transfer restoration should be considered when there is widespread evidence of loss of load transfer across transverse pavement joints

(4) - Diamond grinding should be used to restore the pavement profile and improve the ride quality

(5)- Overlays should be placed with appropriate joint and crack treatments (including fabrics, saw and seal) to retard the development of reflection cracking

3.2.2 Design Guidelines for Preservation Projects

The DOTD has developed guidelines relative to design standards for different roadway system. These guidelines appear in Appendix C.

3.2.3 Treatment Selection

The decision on which treatment or treatments to apply should be based on the pre-treatment condition of the pavement as determined from the PMS file or field survey discussed in Section 2 and Appendix B. In order to make the optimal decision in selecting a treatment for the candidate pavement, this pre-construction evaluation should consider the selection criteria defined in Table 3.7 for asphalt-surfaced pavements. The type of treatment that would best fit the long-term need should then be selected according to the recommendation of Table 3.8 .

Table 3.9 lists the selection criteria for concrete pavements. The recommended selection of appropriate treatment for the criteria is listed in Table 3.10.

Since multiple options are listed in Table 3.8 and 3.10 to correct the deficiency or deficiencies in the asphalt-surface and concrete pavements, respectively, the final selection for application must necessarily depend on the cost effectiveness of the treatment and previous experience with their application. The cost-effectiveness aspect is discussed in the next Section.

Table 3.7: Selection Criteria Definition for Asphalt-Surfaced Pavements

Selection Number	Distress Definition
1	Moderate severity Fatigue Cracks
2	Low Severity (hairline) Cracks (< 1/8 in)
3	Moderate Severity Overall Cracks (*) (1/4 - 3/4 in) (cracks sealed)
4	Moderate Severity Overall Cracks (*) (1/4 - 3/4 in) (cracks unsealed)
5	Low to Moderate Raveling including oxidation
6	Low to Moderate Bleeding
7	Deep Ruts (> 3/8 in)
8	Low Friction Numbers including polished aggregate
9	Extensive Patching
10	Poor Ride
11	Corrugations
12	ADT <7000 (***)
13	ADT > 7000

(*) Longitudinal/Transverse/Block

Table 3.8: Selection Criteria Recommendations

Type of Treatment	Recommended if
Fog Seal	2, 5, 12
Crack Seal	2, 3, 4, 12, 13
Chip Seal	2, 3, 5, 8, 12
Micro-surfacing	2, 5, 6(*),7, 8, 10, 12, 13
Slurry Seal	2, 5, 8, 12
Thin Hot-Mix overlay	2, 3, 5, 7, 8(**), 10, 11, 12(***), 13
Base Course repair	1, 9, 12, 13
Surface Recycling	2, 5-8, 10, 11, 12, 13
Hot or Cold milling	2, 5-11, 12, 13

(*) Moderate bleeding will generally require two layers which will increase the cost

(**) OGFC, Nova Chip

(***) Chip Seals, fine mix and dense graded mixes are limited to 7000ADT

Table 3.9: Selection Criteria Definition for Concrete Pavements

Selection Number	Distress Definition
1	Spalled Joints
2	Joint and Crack Faulting
3	Scaling
4	Map Cracking
5	Broken Slabs
6	Transverse/Longitudinal Joint Deterioration
7	Transverse/Longitudinal/Reflection Cracking
8	Blow-ups/Shattering
9	Polished Surface/Low Friction Number
10	Poor Ride
11	Texture
12	Pumping

Table 3.10: Selection Criteria Recommendations

Type of Treatment	Recommended if
Full-Depth Repair (*)	1, 5, 7, 8
Partial-Depth Repair	1, 2, 3, 4, 6, 10
Joint Crack Cleaning/Resealing	1, 2, 6, 7
Undersealing/Subsealing	2, 5, 7, 12
Load Transfer Restoration	1, 2, 6, 7, 12
Diamond Grinding	2, 9
Flexible Overlay	2, 4, 5, 7, 9, 10, 11
Rigid Overlay	Same as Flexible Overlay
Rubblize	5, 7
Slurry Seal/Micro Surfacing	3, 4, 9, 11

(*) - Used when severity of all distresses are medium to high

3.3 COST-EFFECTIVENESS OF TREATMENTS

Generally, cost-effectiveness analysis is performed to determine least cost treatment for a given set of conditions (traffic, environment, funding available, etc.). For example, if a pavement section shows ruts that are less than ½ inch, cracking distress of low severity (hairline) and moderate raveling and/or low friction numbers, one has several choices available to take corrective action. These may include thin overlay, slurry seal, chip seal, or micro-surfacing. Since all these are considered very effective in correcting the stated distresses, their selection should be based on cost of each treatment since they can vary considerably.

3.3.1 Cost-Effectiveness Evaluation

The approaches to determining cost effectiveness can vary from a simple one requiring minimum information on input variable to a complex one necessitating input on several economic variables. For example, life costing requires input on inflation, interest rate, unit cost of treatment, analysis period, life of treatment, etc. A simple one is the Equivalent Annual Cost (EAC) and requires input on unit cost and expected life of treatment (10/, 11/). It is defined by the following equation:

$$\text{EAC} = \frac{\text{Unit Cost}}{\text{Expected Life of treatment}}$$

The unit cost can be the bid cost. However, before using this bid cost, it should be ascertained that the bid cost include items that are common to all projects across state. For example, if a number of items are grouped under one bid on one project, the same grouping should be on other projects. If maintenance costs are incurred on the project during the service life of the treatment, they should be part of the unit cost. The cost of this activity could be that associated with the routine maintenance function that is likely to prolong the life of the treatment.

The expected life can be obtained from available historical data on the treatments generally used by DOTD or from those reported by other states.

3.3.2 Extended Life and Cost-Effectiveness of Treatments

Table 3.11 lists the expected life of the treatments generally used by DOTD and the current available per lane cost of some of these treatments. The values are average for each treatment. The table also lists EAC of some treatments (11/). However, these values are based on 1997-98 cost of the treatments. These will have to be updated to reflect current cost, both bid and maintenance cost of the treatments. Also, since the EAC is directly related to the life of the treatment, the average EAC values would vary with environment and traffic.

Table 3.11

Extended Life and Cost Effectiveness of Treatments

Treatment	Pavement Type	Average Extended Life	Average Cost $/Lane Mi	EAC
Crack Fill (clean & seal)	Flexible	2		
	Composite	2		
Crack Seal (route & seal)	Flexible	4	$9,314.00	
	Composite	4	$9,314.00	
	Rigid	4	$9,314.00	
Single Chip seal	Flexible	5	$30,000.00(*)	0.20
	Composite	5	$30,000.00(*)	
Double Chip Seal	Flexible	7	$50,000.00(*)	
	Composite	7	$50,000.00(*)	
Triple Chip Seal	Flexible	8	$85,000.00(*)	
	Composite	8	$85,000.00(*)	
Micro-Surfacing (single course)	Flexible	6		0.48
	Composite	6		
Micro-Surfacing (multiple course)	Flexible	8		
	Composite	8		
Ultra thin Hot-Mix (0.75") Nova Chip or OGFC	Flexible	9		0.35
	Composite	9		
Hot-Mix (2" overlay)	Flexible	10	$190,000.00	
	Composite	10	$190,000.00	
Hot-Mix (2" mill &overlay)	Flexible	10	$210,000.00	
	Composite	10	$210,000.00	
Joint Resealing	Rigid	7		
Spall Repair	Rigid	5		
Full-depth Concrete Repair	Rigid	7	$95,050.00	
Diamond Grinding	Rigid	5		
Dowel-bar Retrofit	Rigid	3		
Conc Pav't Restoration	Rigid	10		

(*) Cost/mile

3.3.3 Highway Health Index

A necessary prerequisite to allocating resources adequately is to determine the present condition (health) of road network. It is also essential to know whether present and planned program actions (reconstruction, rehabilitation, and preservation) will produce a net improvement in the condition of the network. However, before the effects of any planned action to the highway network can be analyzed, the health of the network condition should be determined in terms of the **Remaining Service Life.**

Data on **Remaining Service Life** can be obtained from the DOTD's pavement management system (PMS). This, coupled with construction and rehabilitation cost and performance data, maintenance and preservation data can be estimated until such time that actual experience is gained with preservation treatments. After that, the maintenance and preservation costs can be integrated into the PMS.

4.1 Technology Transfer

Improvement in the surface rehabilitation techniques and treatments, relative to materials, testing and equipment, is an ongoing effort on national and local basis. The need to gather and disseminate such information cannot be overemphasized.

On a national scale, the Federal Highway Administration, FHWA, is the leader in disseminating information on emerging technology in surface rehabilitation . Likewise, the National Center for Pavement Preservation at Michigan State University, the **Research Record** publications of the Transportation Research Board (TRB), and the National Cooperative Highway Research Program (NCHRP) studies, are good sources for information on the state of the art/state of practice on pavement preservation treatments and techniques.

Locally, states are constantly evaluating new products/materials that would enhance the cost effectiveness of treatments. The trade associations such as the Asphalt Institute, Asphalt Pavement Association, Concrete Pavement Association, Slurry Seal Association, etc., and the equipment manufacturers also disseminate valuable information on the state of the art/state of practice on pavement preservation techniques.

4.2 Tracking of Plan Changes and Cost

This subsection will be developed later

4.3 Equipment used in Some Typical Treatment Applications

This subsection will be developed later. The following is planned for inclusion in this section.

- Micro-surfacing
- Chip Seal
- Slurry Seal (?)

SECTION 5 - RESEARCH

5.1 Research Problem Identification Process

Research problem statements are welcomed by LTRC at any time; however, they are formally solicited from LTRC, DOTD, universities, and transportation industry representatives biennially. The statements are ranked by Research Problem Identification Committees (RPIC) and the Research Advisory Committee (RAC) for funding. RFPs are issued for the contract research portion of the program. LTRC staff will also generate studies for the work program. The LTRC Policy Committee reviews the work program and provides recommendations to LTRC. The SP&R portion of the work program is reviewed and approved by FHWA, and each individual research proposal must be approved by the DOTD Secretary. The process for development and approval of the work program is depicted in figure 5.1.

5.1.1. Problem Statements

Research problem statements are solicited biennially from the transportation community at large. The problem statement is a concise description of a transportation-related problem for which solutions through research are deemed feasible. Problem statements received by LTRC in this process are assigned to Research Problem Identification Committees (RPIC) for rating according to need and implementation potential. The top problem statements from each RPIC are then submitted to the Research Advisory Committee, who also evaluates the problem statements according to need and implementation, resulting in a priority list used by LTRC to determine funding. This priority list is incorporated in the Work Program. In addition to the biennial solicitation, ***unsolicited problem statements may be submitted to the Director at any time.*** A Project Review Committee will be formed by the Director to make recommendations.

5.1.2 Format and Content of Problem Statements

The form, content and purpose of a problem statement (Figure 5.2) are described as follows:

1. **Problem title** – A concise, descriptive title of the problem.
2. **Problem statement** – A brief statement of problem, including some indication of its magnitude and impact on the highway program.

3. **Research proposed** – A brief description of those research, development, or evaluation activities proposed to resolve the problem.
4. **Problem implementation of results** – A brief description should state how it is anticipated that the results of the proposed research will be applied. This description should include a statement of the anticipated benefits from solving the problem.

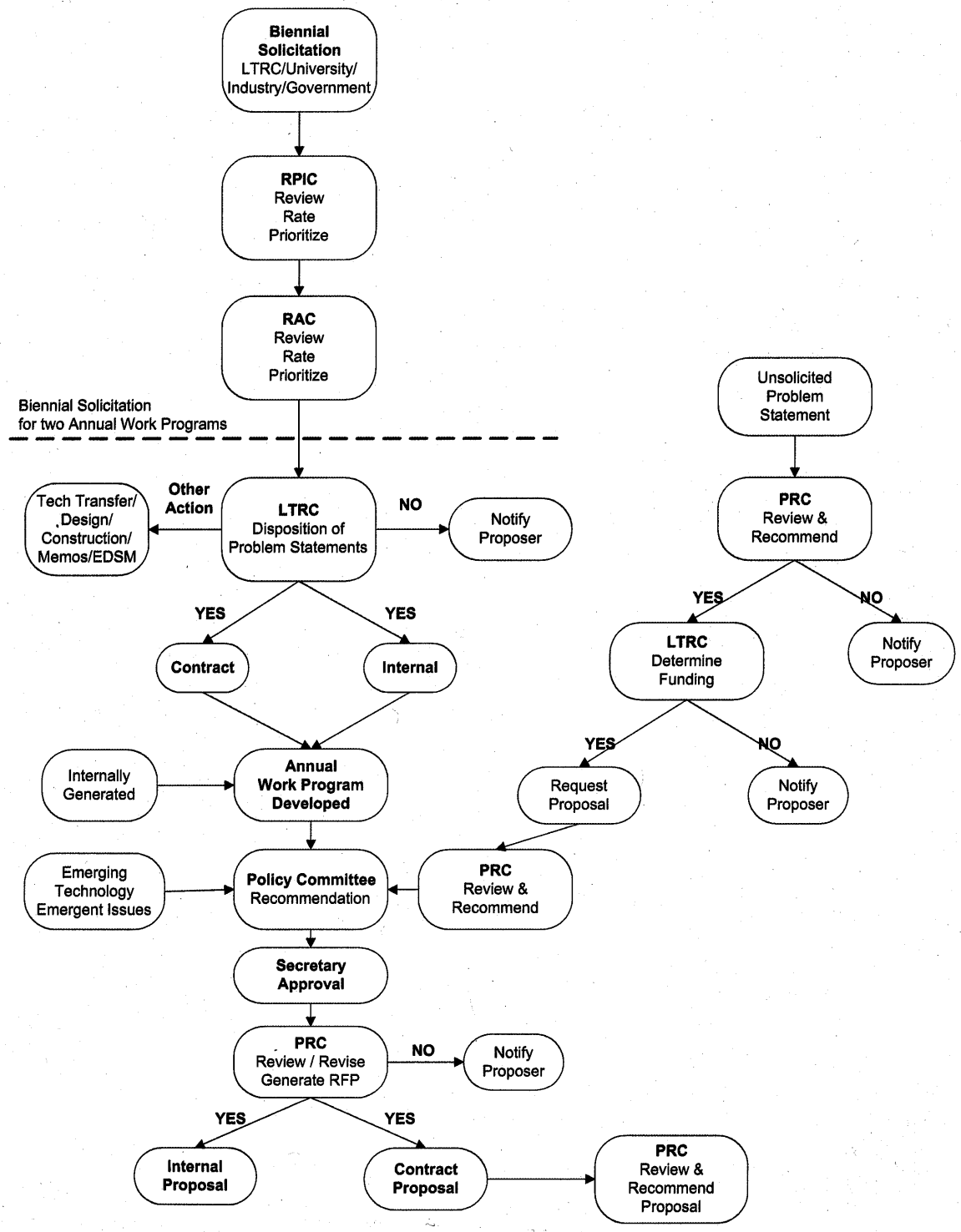


Figure 5.1: Research Problem Solicitation Process

LTRC USE ONLY
PROBLEM STATEMENT NO.
DATE OF RECEIPT

LTRC PROBLEM STATEMENT SOLICITATION

1. **PROBLEM TITLE:**

   (GIVE A BRIEF AND APPROPRIATE NAME TO THE PROBLEM YOU ARE PROPOSING)

2. **PROBLEM STATEMENT:**

   (BRIEFLY DESCRIBE THE PROBLEM YOU ARE PROPOSING)

3. **PROPOSED RESEARCH:**

   (DESCRIBE THE APPROACH YOU ENVISION TO SOLVE THE PROBLEM)

4. **POTENTIAL IMPLEMENTATION AND BENEFIT:**

   (DESCRIBE HOW YOU FORESEE THE RESULTS WILL BE IMPLEMENTED AND HOW THE TRANSPORTATION COMMUNITY WILL BENEFIT. HIGHER PRIORITIES WILL BE GIVEN TO STATEMENTS WITH SIGNIFICANT IMPLEMENTATION POTENTIAL)

5. **SUBMITTED BY:**

   NAME_____ AFFILIATION_____ TEL#

PLEASE SUBMIT TO: LTRC DIRECTOR, 4101 GOURRIER AVE. BATON ROUGE, LA 70808

Figure 5.2: Format and Content of Problem Statement

5.2 Product/Materials Evaluation

To have a product evaluated for approval and listed in one of the Qualified Products Lists(QPLs), a representative of the manufacturer must submit a completed "Qualified Product Evaluation Form." An official of the manufacturer (not the distributor) must sign the form indicating that they understand the requirements for approval that are listed in the Qualification Procedure for that QPL. A Qualified Products form is shown as Figure 5.3 .

For aggregate producers, please note that there is a different form to use: "Preliminary Information Form for Aggregate Source Approval." This form requires additional information pertinent to the aggregate source and the mining operations. There is a space for a local distributor to sign, but it must also be signed by an official of the company that operates the quarry. Figure 5.4 is the Aggregate Source Approval form.

While fax copies are acceptable for review and confirmation of the necessary information, the original signed form must be submitted to the QPL coordinator prior to the evaluation. Also, please include a copy of the form in each container or shipment of the samples submitted for evaluation.

For additional information, go to LTRC web site @ http://www.ltrc.lsu.edu/, On the web, click on ***DOTD Materials Lab*** link.

1/03

Ident. No. _____ Date: _____
Product Source Code _____ Date: _____
Lab No(s). _____

THIS BLOCK FOR DOTD USE ONLY

Louisiana Department of Transportation and Development

QUALIFIED PRODUCT EVALUATION FORM

QPL NO. _____

[Product Submittal Form for Qualified Products List Evaluation]

Date: _____

PRODUCT TRADE NAME: _____
(PRODUCT, SYSTEM OR MATERIAL) (Complete separate form for each product submitted)

MANUFACTURER (Company Name): _____
(Source)

Subsidiary of: _____ List Parent Company on QPL: Yes ☐ No ☐
(Parent company if different from manufacturer)

Manuf. Corporate Address: _____
Street/P. O. Box City State Zip Code

Manufacturing Location: _____
(Facility/Plant) Street/P. O. Box City State Zip Code

Address to be listed on QPL: Corporate ☐ Manufacturing Facility ☐ (**DOTD product verification and purchasing purposes**)

Manuf. Phone No.: (___) _____ Manuf. Fax No.: (___) _____

Manuf. E-Mail Address: _____

Manuf. Contact Person: _____ Contact's Phone: (___) _____

Contact Person's Title: _____ Contact's Location: _____

PRODUCT REPRESENTATIVE: Distributor ☐ Manufacturer's Employee ☐ Other _____

Representative's Company Name: _____
(If different from manufacturer)

Representative's Name and Title: _____
(Please print or type)

Representative's Address: _____
Street/P. O. Box City State Zip Code

Representative's Phone No.: (___) _____ Rep. Fax No.: (___) _____

Representative's E-Mail Address: _____

Will this product replace an existing approved product from your company listed on this QPL: Yes ☐ No ☐

If yes, existing product name(s): _____ Existing Product Source Code(s): _____

Why product is being replaced: Discontinued ☐ New Formulation ☐ Economic Reasons ☐ Other _____

If new product approved, remove existing product from list: Yes ☐ No ☐ When: Immediately ☐ 6 Months ☐ Other _____

Figure 5.3: Qualified Product Evaluation Form

Product patented: Yes ☐ No ☐ Patent applied for: Yes ☐ No ☐

Has this proposal been previously made: Yes ☐ No ☐ Under what name(s): _____

_____

Alternate or comparable to what existing materials or products: _____

_____

Primary use recommendation: _____

_____

Alternate or secondary use: _____

_____

Outstanding features or advantages/disadvantages: _____

_____

Material composition (generic description): _____

_____

Has this product been evaluated (or currently under evaluation) by the National Transportation Product Evaluation Program (NTPEP):

Yes ☐ No ☐ NTPEP Submittal Number _____ Comment _____

Meets requirements of following specifications: (List specification reference)

AASHTO _____ ASTM _____ Fed. Spec. _____ Other _____ _____ _____

Availability: Seasonal Yes ☐ No ☐ Delivery at site: Number of days after receipt of order _____

Further availability information: _____

Are quantities limited: Yes ☐ No ☐ Estimated cost of material per unit: $ _____

Product new on market: Yes ☐ No ☐ Date introduced: _____ Comment _____

Are educational courses/films available: Yes ☐ No ☐ Comment _____

Is special equipment required to install product: *Yes ☐ No ☐

*(If yes, manufacturer/supplier will furnish the special equipment and install the material.)

Further equipment information: _____

Background description of source offering this proposal: _____

_____

_____

_____

The following available and applicable information and materials shall be attached to this form in order to substantiate, verify, or clarify its contents. Attachments shall be numbered.

	Is Item Attached (Check here)	Attachment Number	Comment
Specifications			
Drawings, Sketches, Pictures			
Warranty			
Installation instructions			
Material Safety Data Sheet (MSDS)			
Product/material literature			
Test data sheets			
Certification			
Test results			

TEST SAMPLE SUBMITTED: DATE_____ **SUBMITTER**_____

Method of sample delivery: UPS/FedEx ☐ Bus ☐ US Mail ☐ Other_____

Complete the following information regarding field test site locations:

State	Contact Person	Telephone No.
		( )
		( )
		( )
		( )

Additional information: _____

General requirements:

1. Manufacturers/Suppliers are encouraged to install their materials at the test sites.
2. All test materials will be furnished by the Manufacturer/Supplier at no cost to the Louisiana DOTD.
3. A separate form will be required for each product/system submitted for testing.
4. Incomplete Qualified Product Evaluation Forms and/or erroneous information furnished as part of this form will result in the material being rejected for testing or inclusion.
5. The Department reserves the right to return all unused samples to the manufacturer at no cost to the Louisiana DOTD.
6. Form must be signed by an **official of the manufacturer.***

**The term "official of the manufacturer", as used herein and throughout this document, refers to an actual employee of the manufacturer - NOT a distributor.*

The manufacturer/supplier is hereby notified that the Louisiana Department of Transportation and Development reserves the right to release or distribute any of the information included in or attached to this form, as well as the results obtained as part of our laboratory testing and field evaluation. The Louisiana Department of Transportation and Development reserves the right to require additional information, samples, and testing per product/system as deemed necessary for proper evaluation.

The Louisiana Department of Transportation and Development will not consider any new product for QPL testing until the sample is received by the Materials and Testing Section, and this form, along with all required attachments, is completed, signed by an **authorized official of the manufacturer,** and mailed or faxed to the address below. Manufacturer/supplier must meet all requirements outlined in the applicable Qualification Procedure. The signer below agrees to comply with all QPL policy and requirements as though specifically outlined herein.

Louisiana Department of Transportation and Development
Materials & Testing Section
Attn: (Name of QPL Contact Person) (See list of Contact Persons)
5080 Florida Boulevard
Baton Rouge, LA 70806-4123
Fax: (225) 248-4187

Signed: _____
(Official of the Manufacturer)

Name: _____
(Please type or print signer's name)

Position in Company: _____

Address: _____

_____

_____

Date signed: _____

For further information, list of QPL Contact Persons, or to view a specific Qualified Products List, visit our web page at ***http://www.dotd.state.la.us/highways/construction/lab/default.html*** or contact us at (225) 248-4120.

For specific information regarding a particular Qualified Products List or Qualification Procedure, call or e-mail the listed QPL Contact Person. Telephone numbers, fax number, and e-mail addresses are provided on the Contact Person list.

Ident No._____ Rev. 12/05
(for DOTD use only)

STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
MATERIALS AND TESTING SECTION

PRELIMINARY INFORMATION FORM
FOR
AGGREGATE SOURCE APPROVAL

(Please print or type)

Name of Company _____

Address: _____ Phone No.: (_____) _____

City: _____ FAX No. : (_____) _____

State: _____ Zip Code: _____ WEBSITE: _____

Type of Aggregate_____ Date Submitted _____

Trade Name of Aggregate (if applicable): _____

Source: The following information applies to the point of origin of the aggregate such as quarry, pit, manufacturing plant, or site of reclamation.

Name: _____ Phone Number (___) _____

Address: _____ FAX (___) _____
P. O. Box or Street City State Zip

Site Location _____ Latitude _____

_____ Longitude _____

Details as to the extent and location of material within source (Quarry face, ledge elevations and thickness, etc.) and Overburden Material _____

_____

Distributor: The following information applies to the company that markets the aggregate.

Company Contact Person: _____ Title: _____

Company Name: _____ Phone No. (___) _____

Address: _____ FAX (___) _____
P. O. Box or Street City State Zip

Background Description of Company Offering this proposal: _____

_____

Intended Uses of Aggregate: Primary: _____
Alternate(s): _____

MATERIAL COMPOSITION

Description of Composition of Material _____

Is material naturally occurring? (Y/N) _____ Is material a manufactured aggregate? (Y/N) _____

Is material a by-product or waste product of a chemical or manufacturing process? (Y/N) _____

Description of process attached? (Y/N) ___ Copy of Quality Control Program Attached? (Y/N) _____

Alternate or comparable to what existing materials or product: _____

Meets requirements of following specifications: AASHTO___ ASTM___ FHWA ____ OTHER _____

Availability: Seasonal (Y/N)____ Delivery at Site _____

Are Quantities Limited: (Y/N) _____ Volume readily available (Estimate)_____

New on Market?: (Y/N) ____ Date Introduced _____ Estimated Cost Per Unit: _____

Will Special Handling be Required to use or Test Material: (Y/N): _____

Figure 5.4: Aggregate Source Approval Form

If Yes, please explain: _____

Has this material been previously evaluated by the LDOTD or LTRC? (Y/N): ____ When: _____
(If yes, please attach test report.) Previous Source Code (if applicable): _____

What other government agencies have used or tested this material?

Agency _____
Contact Person _____
Address _____
City, State, ZIP _____
Phone Number (____) _____

Agency _____
Contact Person _____
Address _____
City, State, ZIP _____
Phone Number (____) _____

General Notes:

1. All materials required for evaluation shall be furnished by the Source/Distributor at no cost to the Louisiana Department of Transportation and Development.
2. A separate form will be required for each aggregate source and type of aggregate submitted for evaluation.
3. Incomplete forms and/or erroneous information furnished as part of this form will result in the material being rejected for testing.
4. The Department reserves the right to return all unused samples to the source.

Data resulting from the evaluation of the submitted aggregate is public information and will not be considered privileged. The source is hereby notified that the Louisiana Department of Transportation and Development reserves the right to release or distribute any of the information included in or attached to this form and the test results obtained as part of our laboratory testing and field evaluation.

The Louisiana Department of Transportation and Development will not consider any new product for testing until this form is completed, signed (below) by an authorized official of the source and distributor, and returned to the Coordinator at the address shown below:

Louisiana Department of Transportation and Development
Materials and Testing Section
5080 Florida Boulevard
Baton Rouge, Louisiana 70806-4123

The undersigned hereby certifies that all information submitted with this application is accurate and correct to the best of their knowledge.

SOURCE

Name: _____
(Please print or type)

Title: _____

Signed: _____

Date: _____

DISTRIBUTOR

Name: _____
(Please print or type)

Title: _____

Signed: _____

Date: _____

5.3 Treatment Evaluation

In this section, some of the common problems encountered during and after construction will be identified. For example:

- Rippling effect, Drag marks, Texture uniformity in Micro-surfacing construction
- Bleeding, Raveling and Streaking in Chip Seal construction
- Too Fluid or too Stiff mix in Slurry Seal construction.

Appendix A

General Terms and Definitions of Pavement systems

This appendix lists and defines general terms and definitions relative to pavement system features, defects, components and performance characteristics (5/). The recommended standard term is shown under nomenclature. The definitions for pavement structure and roadbed components are derived from AASHTO. Figure A-1 is a cross section of a typical roadway on which this nomenclature appears.

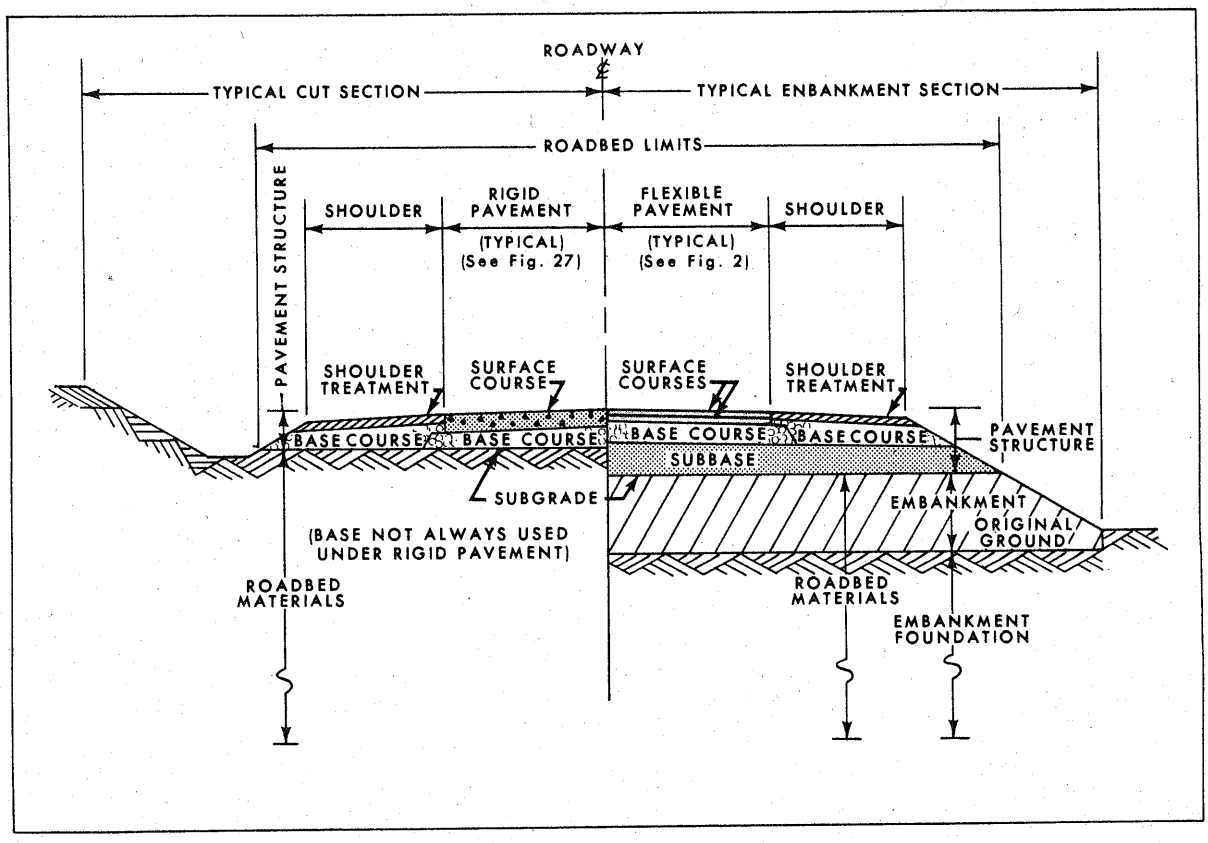


Figure A-1: Typical Roadway Cross Section

Pavement Defects

Nomenclature:

Distortion - Any deviation in the pavement surface from its original shape.

Distress - A general term used to indicate signs of impending failure observed through surface. There can be several forms of distress which were discussed in Section 2.

Failure - Unsatisfactory performance of a pavement or portion thereof such that it can no longer serve its intended purpose.

Pavement Structure and Roadbed components

Nomenclature:

Pavement, flexible - A pavement structure that maintains intimate contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction and cohesion for stability.

Pavement, rigid - A pavement structure that distributes loads to subgrade having as one course a Portland cement concrete slab of relatively high bending resistance.

Roadbed - The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulder.

Pavement structure - The combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Embankment - Sometime also identified as *fill*, is a structure of soil, soil-aggregate, or broken rock between the embankment foundation and the subgrade.

Subgrade - the top surface of a roadbed on which the pavement structure and shoulders including curbs are constructed.

Subbase - The layer or layers of specified or select material of designed thickness placed on a subgrade to support the base course.

Select material - Suitable native material obtained from roadway cuts or borrow areas or other similar material used for subbase, roadbed material, shoulder surfacing, slope cover, or other specific purposes.

Base course - The layer or layers of specified or selected material of designed thickness placed on a subbase or a subgrade to support a surface course.

Performance Characteristics

Nomenclature:

Performance - Measure of the accumulated service provided by a pavement, i.e., the adequacy with which a pavement fulfills its purpose.

Pavement Condition Index, PCI - It is basically a ranking and communication tool. It ranks the inspected pavement sections from poor to excellent on a scale of 0 (poor) to 100(excellent).

Present Serviceability Index, PSI - A subjective rating of the pavement condition made by a group of individuals riding over the pavement. May also be determined based on condition survey information.

Performance Index, PI - Summary of present serviceability indexes over a time period.

Roughness, IRI - A measure of a pavement's longitudinal surface profile as measured in the wheelpath by a vehicle traveling at typical operating speeds. It is calculated as the ratio of the accumulated suspension motion to the distance traveled obtained from a mathematical model of a standard quarter car traversing a measured profile at a speed of 80 km/h (50 mph). The IRI is expressed in units of meters per kilometer (inches per mile) and is a representation of pavement roughness.

Service Life - A period of time over which a pavement performs its design function.

Serviceability - Ability of the pavement to serve traffic with safety and comfort and with a minimum of detrimental effects to either vehicle or pavement.

Appendix B

Project Level Condition Assessment

Method of Determining PCI

The following steps are taken in developing the Pavement Condition Index (PCI), discussed in Section 2, for segment of the pavement:

Step 1 - Log the segment

Conduct a cursory windshield review of the segment of the control section (programmed for maintenance/rehabilitation) from beginning to end. This will provide an overview of the general condition of the pavement section.

Step 2 - Inspect the pavement

Return to the start of the segment. After zeroing the odometer, proceed to perform either a walking or windshield inspection of the segment every two miles. Each two miles will be a sub-segment.

Step 3 - Identify the distress for each sub-segment

Hundred feet on each side of the stopped location, identify the distress types subjectively as to the severity and extent levels as shown on rating form appropriate to the pavement type (Figures B-1, B-2 or B-3)..

Step 4 - Determine sub-segment deduct points

Annotate with a circle the distress type severity-extent weight factors on the rating form as appropriate. Multiplication of the weight factors for distress type severity and extent yields the deduct points for a given distress.

Step 5 - Determine the total deduct points

Add the individual deduct points for each distress type.

Step 6 - Determine final Pavement Condition Rating, PCI, for each sub-segment

Subtract the total deduct points in Step 5 from 100 to derive final rating of the sub-segment.

Step 7 - Determine overall PCI for the segment

Obtain final segment PCI by averaging individual sub-segment PCIs.

An example of the completed Pavement Condition Index rating form (Figure B-1) of a sub-segment is shown as Figure B-4

Some Helpful Hints During Inspection

- Include all patched areas within the inspection unit which is 100' on either side of the stopped location.

- If alligator cracking and rutting both occur in the same area, both should be recorded at their respective severity levels.

- If distress is found in the patched area, it is not recorded; however, the distress is considered in determining the severity level of the patch.

- Low severity alligator cracking looks similar to low severity longitudinal cracking; however, low severity alligator cracking always occur in the wheel path.

- When an area is completely destroyed, do not attempt to determine the exact areas of each distress type and severity level. The condition level (less than 40) should indicate a need for major rehabilitation. A quick estimate of the extent and severity (e.g. 100% high severity alligator cracking, etc.) should be recorded.

Pavement Condition Rating Form
for
Asphalt-Surfaced Pavements

Project/Control Sec No :_____ District :____ Name :_____

Project/Control Sec Begin :_____ From Log Mile :_____

Project/Control Sec End :_____ To Log Mile :_____

Route: _____ Surface Type :_____ Project Length :_____

Date Constructed :_____ Date Surveyed :_____ Surveyed By :_____

Test Section Begin :_____

Test Section End :_____ Insp Lane : NB SB EB WB

Distress Type	Weight Factor	Severity Level				Extent Level				Deduct Points
		None	Low	Med	High	None	Occ	Freq	Ext	
Longitudinal Cracking	10	None	<.25"W	.25-.75	>.75"	None	<10%L	10-30	>30%L	
		0.1	0.2	0.6	1.0	0.1	0.4	0.8	1.0	
Transverse/ Random Cracking	10	None	<.25"W	.25-.75	>.75"	None	<10%L	10-30	>30%L	
		0.1	0.2	0.6	1.0	0.1	0.4	0.8	1.0	
Alligator (Fatigue) Cracking	15	None	<.25"W	.25-.75	>.75"	None	<10%A	10-30	>30%A	
		0.1	0.2	0.6	1.0	0.1	0.4	0.8	1.0	
Block Cracking	10	None	<.25"W	.25-.75	>.75"	None	<10%A	10-30	>30%A	
		0.1	0.2	0.6	1.0	0.1	0.4	0.8	1.0	
Edge Cracking	5	None	<1'L	1-2'	>2'	None	<10%	10-30	>30%	
		0.1	0.2	0.6	1.0	0.1	0.4	0.8	1.0	
Patch/Pothole	10	None	Small	Med	Large	None	<5/1K'	5-10	>10	
		0.1	0.6	0.8	1.0	0.1	0.6	0.8	1.0	
Rutting	15	<1/4"	1/4-1/2	1/2-1"	>1"	None	<20%L	20-50%L	>50%L	
		0.1	0.3	0.7	1.0	0.1	0.5	0.8	1.0	
Raveling	5	None	Slight	Mod	Severe	None	<10%A	10-30	>30%A	
		0.1	0.3	0.6	1.0	0.1	0.5	0.8	1.0	
Bleeding	10	None	Slight	Mod	Severe	None	<10%A	10-30	>30%A	
		0.1	0.6	0.8	1.0	0.1	0.6	0.8	1.0	
Roughness	10		Good	Fair	Poor					
			0.2	0.6	1.0					

Deduct Points = (Distress Weight Factor) x (Severity Weight Factor x Extent Weight Factor)

Total Deduct Points(TDP) ---------- =

Pavement Condition Rating, PCI = (100 - TDP) ---------- =

Figure B-1: Pavement Condition Rating Form for Asphalt-Surfaced Pavements

Pavement Condition Rating Form
for
Portland Cement Concrete Pavements

Project/Control Sec No :_____ District :____ Name :_____

Project/Control Sec Begin :_____ From Log Mile :_____

Project/Control Sec End :_____ To Log Mile :_____

Route:_____ Surface Type :_____ Project Length :_____

Date Constructed :_____ Date Surveyed :_____ Surveyed By :_____

Test Section Begin :_____

Test Section End :_____ Insp Lane: NB SB EB WB

Distress Type	Weight Factor	Severity Level				Extent Level				Deduct Points
		None	Low	Med	High	None	Occ	Freq	Ext	
Longitudinal Cracking	10	None	<.25"W	.25-.75	>.75"	None	<5%L Slab	5-20%	>20L	
		0.1	0.5	0.7	1.0	0.1	0.4	0.8	1.0	
Transverse/ Diagonal Cracking	10	None	<.25"W	.25-.75	>.75"	None	<10%L	10-30%	>30%L	
		0.1	0.3	0.8	1.0	0.1	0.4	0.8	1.0	
Corner Breaks	15	None	<.25"W	.25-.75	>.75"	None	<1/mi	1-3	>3/mi	
		0.1	0.4	0.8	1.0	0.1	0.5	0.8	1.0	
Blow-up	10		Not Considered			None	<1/mi	1-3/mi	>3/mi	
		0.1	1.0	1.0	1.0	0.1	0.5	0.8	1.0	
Joint Seal Damage	10		Not Considered			None	<10%L	10-30%	>30%L	
			1.0	1.0	1.0	0.1	0.5	0.8	1.0	
Faulting	10	None	<.25"	.25-.5"	>.5"	None	<20%	20-50%	>50%	
		0.1	0.4	0.7	1.0	0.1	0.5	0.8	1.0	
Patch	10	None	Fault <.25"	fault .25-.5	Fault >.5"	None slab	<5%	5-20%	>20	
		0.1	0.3	0.6	1.0	0.1	0.5	0.8	1.0	
Spalling	10	None	<2"W	2"-4"	>4"	None	<20%	20-50%	>50%	
		0.1	0.4	0.7	1.0	0.1	0.5	0.8	1.0	
Scaling Map Cracking Crazing	5	None	<.125"D	.125-.5	>.5"D	None	<20%A	20-50%	>50%	
		0.1	0.4	0.7	1.0	0.1	0.6	0.8	1.0	
Pumping	10	None	Stain	Stain	Fault	None	<10%L	10-25	>25%L	
		0.1	0.7	0.7	1.0	0.1	0.3	0.7	1.0	

Deduct Points = (Distress Weight Factor) x (Severity Weight Factor x Extent Weight Factor)

Total Deduct Points(TDP) ---------- =

Pavement Condition Rating, PCI = (100 - TDP) ---------- =

Figure B-2: Pavement Condition Rating Form for Concrete Pavements

Pavement Condition Rating Form for Composite Pavements

Project/Control Sec No :_____ District :____ Name :_____

Project/Control Sec Begin :_____ rom Log Mile :_____

Project/Control Sec End :_____ To Log Mile :_____

Route: _____ Surface Type :_____ Project Length :_____

Date Constructed :_____ Date Surveyed :_____ Surveyed By :_____

Test Section Begin :_____

Test Section End :_____ Insp Lane : NB SB EB WB

Distress Type	Weight Factor	Severity Level					Extent Level			Deduct Points
		None	Low	Med	High	None	Occ	Freq	Ext	
Longitudinal Cracking	10	None	<.25"W	.25-.75	>.75"	None	<10%L	10-30	>30%L	
		0.1	0.2	0.6	1.0	0.1	0.4	0.8	1.0	
Transverse/ Reflection Cracking	15	None	<.25"W	.25-.75	>.75"	None	<10%L	10-30	>30%L	
		0.1	0.2	0.6	1.0	0.1	0.4	0.8	1.0	
Blow-up	10	None	<.5" Bump	.5-1" bump	>1" bump	None	1/mi	2-4/mi	>4/mi	
		0.1	0.4	0.6	1.0	0.1	0.4	0.8	1.0	
De-Bonding (Conc Overlay)	5	None	<1"D <1SY	<1"D >1SY	>1"D >1SY	None	<20%L	20-50%	>50%L	
		0.1	0.3	0.6	1.0 pieces	0.1	0.6	0.9	1.0	
Pumping	10	None	Stain	Stain	Fault	None	<10%L	10-25	>25%L	
		0.1	0.7	0.7	1.0	0.1	0.3	0.7	1.0	
Patch/Pothole	10	None	Small	Med	Large	None	<5/1K'	5-10	>10	
		0.1	0.6	0.8	1.0	0.1	0.6	0.8	1.0	
Rutting	15	<1/4"	1/4-1/2	1/2-1"	>1"	None	<20%L	20-50%L	>50%L	
		0.1	0.3	0.7	1.0	0.1	0.5	0.8	1.0	
Raveling	5	None	Slight	Mod	Severe	None	<10%A	10-30	>30%A	
		0.1	0.3	0.6	1.0	0.1	0.5	0.8	1.0	
Bleeding	10	None	Slight	Mod	Severe	None	<10%A	10-30	>30%A	
		0.1	0.6	0.8	1.0	0.1	0.6	0.8	1.0	
Roughness	10		Good	Fair	Poor					
			0.2	0.6	1.0					

Deduct Points = (Distress Weight Factor) x (Severity Weight Factor x Extent Weight Factor)

Total Deduct Points(TDP) ---------- =

Pavement Condition Rating, PCI = (100 - TDP) ---------- =

Figure B-3: Pavement Condition Rating Form for Composite Pavements

Pavement Condition Rating Form
for
Asphalt-Surfaced Pavements

Project/Control Sec No : 018-01-0026 District : 02 Name : JCT US 90 - S. End of Lk. Ponch

Project/Control Sec Begin : JCT US. 90 From Log Mile : 0.90

Project/Control Sec End : S. End of Lake Ponch Bridge To Log Mile : 5.90

Route: US 11 Surface Type : Micro-Surf Project Length : 5.90

Date Constructed : 3/01 Date Surveyed : 3.5.06 Surveyed By : SLS & BT

Test Section Begin : LM 2.40

Test Section End : LM 2.60 Insp Lane : NB SB EB WB

Distress Type	Weight Factor	Severity Level				Extent Level				Deduct Points
		None	Low	Med	High	None	Occ	Freq	Ext	
Longitudinal Cracking	10	None	<.25"W	.25-.75	>.75"	None	<10%L	10-30	>30%L	
		0.1	0.2	(0.6)	1.0	0.1	0.4	(0.8)	1.0	4.8
Transverse/ Random Cracking	10	None	<.25"W	.25-.75	>.75"	None	<10%L	10-30	>30%L	
		0.1	0.2	(0.6)	1.0	0.1	(0.4)	0.8	1.0	2.4
Alligator (Fatigue) Cracking	15	None	<.25"W	.25-.75	>.75"	None	<10%A	10-30	>30%A	
		0.1	(0.2)	0.6	1.0	0.1	(0.4)	0.8	1.0	1.
Block Cracking	10	None	<.25"W	.25-.75	>.75"	None	<10%A	10-30	>30%A	
		0.1	(0.2)	0.6	1.0	0.1	(0.4)	0.8	1.0	0.8
Edge Cracking	5	None	<1'L	1-2'	>2'	None	<10%	10-30	>30%	
		0.1	0.2	(0.6)	1.0	0.1	(0.4)	0.8	1.0	1.2
Patch/Pothole	10	None	Small	Med	Large	None	<5/1K'	5-10	>10	
		0.1	(0.6)	0.8	1.0	0.1	(0.6)	0.8	1.0	3.6
Rutting	15	<1/4"	1/4-1/2	1/2-1"	>1"	None	<20%L	20-50%L	>50%L	
		0.1	(0.3)	0.7	1.0	0.1	0.5	(0.8)	1.0	3.6
Raveling	5	None	Slight	Mod	Severe	None	<10%A	10-30	>30%A	
		(0.1)	0.3	0.6	1.0	(0.1)	0.5	0.8	1.0	0.1
Bleeding	10	None	Slight	Mod	Severe	None	<10%A	10-30	>30%A	
		0.1	(0.6)	0.8	1.0	0.1	(0.6)	0.8	1.0	3.6
Roughness	10		Good	Fair	Poor					
			0.2	(0.6)	1.0					6.0

Deduct Points = (Distress Weight Factor) x (Severity Weight Factor x Extent Weight Factor)

Total Deduct Points(TDP) ---------- = 27.3

Pavement Condition Rating, PCI = (100 - TDP) ---------- = 72.7

Figure B-4: Example of Completed PCI Rating Form for a Project

Appendix C

Design Guidelines for Preservation Projects

System	Classification	Type of Work	Design Standards	Design Reports	Safety Improvements	Design Exception
NHS	Interstate	Replacement & Major Rehabilitation	DOTD Design Standards, AASHTO Green Book, & Interstate Corridor Standards	Yes	Yes	FHWA/DOTD
		Minor Rehabilitation	DOTD Design Standards, AASHTO Green Book	Yes	Desirable/ If crash history warrants, consider low-cost safety improvements	FHWA* DOTD
		Preventive Maintenance	None	Desirable	If crash history warrants, consider low-cost safety improvements	Not applicable
	Non-Interstate	Replacement & Major Rehabilitation	DOTD Pavement Preservation Standards (required) 3R Standards (desirable)	Yes	Yes	FHWA* DOTD
		Minor Rehabilitation	None	Yes	Desirable/ If crash history warrants, consider low-cost safety improvements	Not applicable
		Preventive Maintenance	None	No	Not Required	Not applicable
Non-NHS	All Roads	Replacement & Major Rehabilitation	DOTD Pavement Preservation Standards	Yes	Yes	DOTD
		Minor Rehabilitation	None	Yes - Federally Funded No - State Funded	Desirable/ If crash history warrants, consider low-cost safety improvements	Not applicable
		Preventive Maintenance	None	No	Not Required	Not applicable

* - FHWA approval required for full oversight projects: Interstate > $1M and NHS > $10M

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