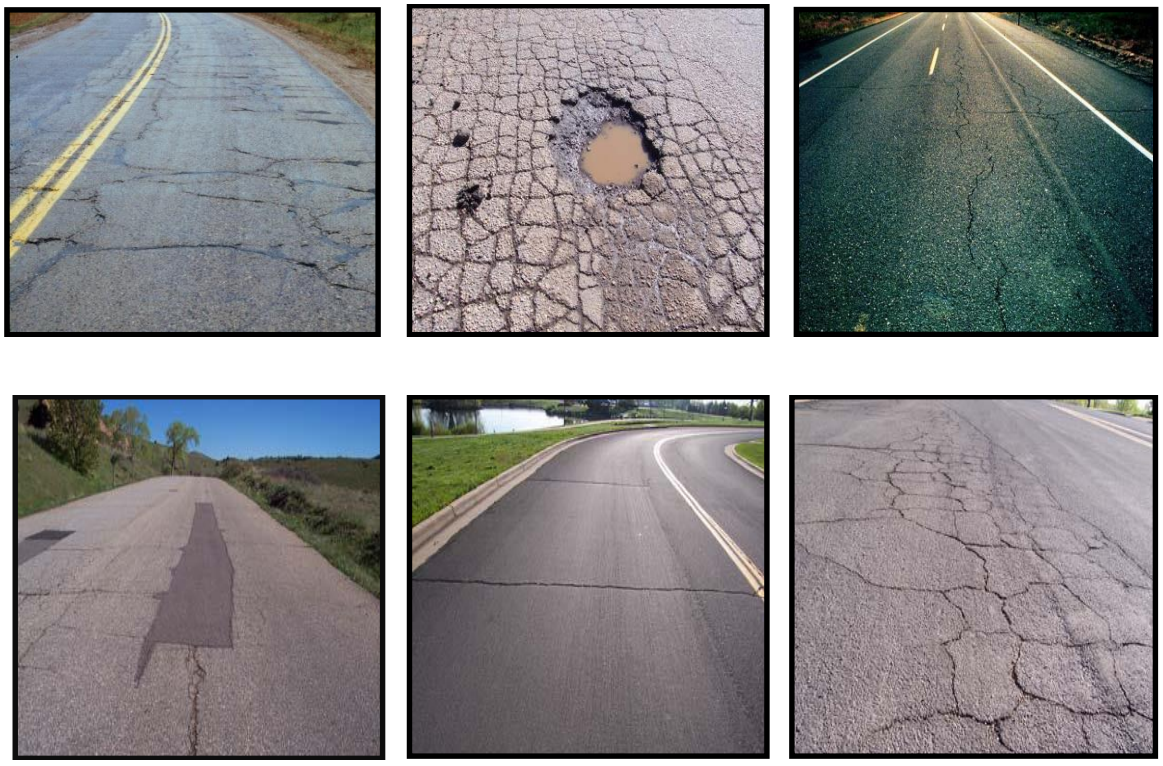
Countywide Pavement Management Plan Guidelines



January 2016

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Chapter 1 – Introduction

On November 6, 1990, the voters in Orange County approved a ½-cent sales tax for transportation improvements known as Measure M. This sales tax includes funding for streets and roads that is available to local agencies through both a formula distribution and a competitive process. On November 6, 2006, voters approved a renewal of Measure M to continue the ½-cent sales tax for thirty years, beginning in 2011.

1.1 Eligibility Requirements

One of the eligibility requirements included in the Measure M2 (M2) specifies that each local jurisdiction must adopt and update a Pavement Management Plan (PMP) every two years. All agencies must use a common format as part of the countywide pavement management effort conforming to American Society for Testing and Materials (ASTM) Standard D6433. In 2010, Orange County Transportation Authority (OCTA) adopted MicroPaver as the countywide standard PMP software and all agencies participating in Measure M were required to adopt this software for consistency in reporting pavement management conditions. In 2011, all local agencies submitted PMPs that were in conformance with the requirements in the PMP Guidelines. Local agencies may now also utilize Streets Saver, since it is in conformance with ASTM Standard D6433. The PMP must include:

- The current status of road pavement conditions;
- A seven-year plan for road maintenance and rehabilitation (including projects, funding, and unfunded backlog of pavement needs);
- The projected pavement condition resulting from the maintenance and rehabilitation plan; and
- Alternative strategies and costs necessary to improve road pavement conditions.

1.2 Local Match Reduction

In addition to the above requirements, a local agency match reduction of 10% of the eligible cost for projects submitted for consideration of funding through the M2 Comprehensive Transportation Funding Programs (CTFP) call for projects is available if the local jurisdiction either:

a. Shows measurable improvement of paved road conditions during the previous reporting period defined as an overall weighted (by area) average system improvement of one Pavement Condition Index (PCI) point with no reduction in the overall weighted (by area) average PCI in the Master Plan of Arterial Highways (MPAH) or local street categories;

or -

b. Have road pavement conditions during the previous reporting period within the highest 20% of the scale for road pavement conditions in conformance with OCTA Ordinance No. 3, defined as a PCI of 75 or higher, otherwise defined as in "good condition".

1.3 Background

The key is to ensure a reliable, consistent and uniform approach to data collection.

The primary goal of these guidelines is to ensure consistent field data collection and reporting procedures so that countywide funding allocations can be based on agency comparable pavement conditions.

Given that all agencies are using uniform data collection procedures, OCTA can answer typical questions such as:

- What is the average countywide condition of local streets and roads? For individual streets? For Arterial Highways?
- Which streets have a higher priority and need to be funded first?
- How much does it cost to bring them up to an acceptable condition?
- How much will it cost to maintain them in an acceptable condition over the next seven years or more?
- What are the impacts on pavement condition at the existing funding levels?

Training is provided, periodically, by OCTA to maintain consistency in data collection procedures and assist local agencies in the use of pavement management software.

Chapter 2 – Pavement Management Plan Guidelines

These guidelines and procedures are necessary for Orange County agencies to implement and update their PMPs with respect to conducting condition surveys. This is required to certify conformance with the criteria stated in OCTA's Ordinance No. 3. This ordinance requires that a PMP be in place and maintained to qualify for allocation of net revenues generated from Measure M2. A copy of Ordinance No. 3 is available from OCTA. A copy of the PMP certification is included in Appendix B. This is part of the submittals required for each agency (see Chapter 3).

The pavement management guidelines are discussed under the following categories:

1. Condition Survey Protocols
2. Inspection Frequency
3. Countywide Assessment Standards
4. Quality Assurance/Quality Control (QA/QC) Plan
5. Re-inspections
6. Prequalification/Calibration of Inspectors
7. Pavement Management Software Training
8. Pavement Management Data Files

2.1 Condition Survey Protocols

In 1998, OCTA adopted condition survey protocols that required the collection of certain surface distresses as a minimum for both asphalt concrete and Portland cement concrete pavements. These distresses were common to the variety of pavement management systems then in use by Orange County local agencies. Based on the usage of a common county-wide software, it is now possible to include all of the distresses in ASTM Standard D6433 "Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys" in these Guidelines. These surface distresses are as follows:

Asphalt Concrete (AC)

1. Alligator or Fatigue Cracking
2. Bleeding
3. Block Cracking
4. Bumps and Sags
5. Corrugation
6. Depression
7. Edge Cracking
8. Joint Reflection Cracking
9. Lane/ Shoulder Drop-off
10. Longitudinal Cracking
11. Patching and Utility Cut Patching
12. Polished Aggregate
13. Potholes
14. Railroad Crossing
15. Rutting
16. Shoving
17. Slippage Cracking
18. Swell
19. Raveling
20. Weathering (Surface Wear)

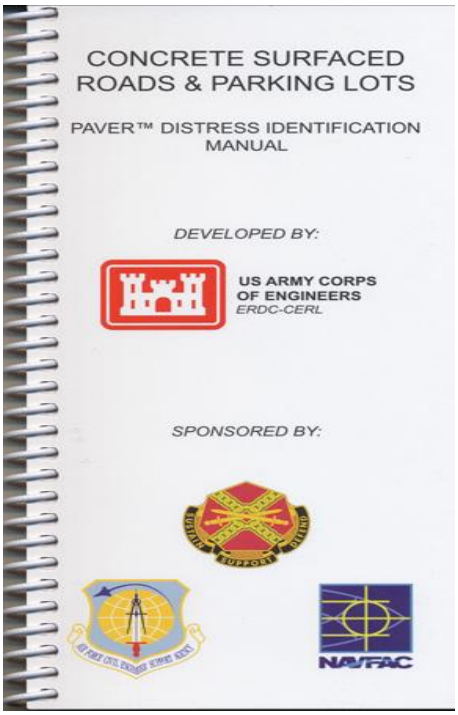
Portland Cement Concrete (PCC)

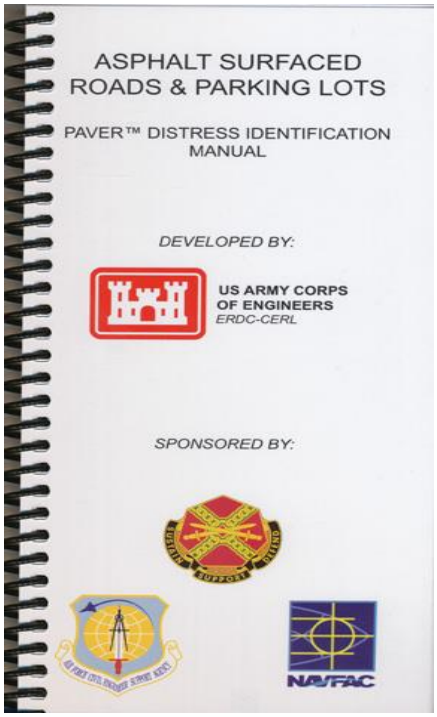
1. Blowup/ Buckling
2. Corner Break
3. Divided Slab
4. Durability ("D") Cracking
5. Faulting
6. Joint Seal Damage
7. Lane/ Shoulder Drop-Off
8. Linear Cracking
9. Patching, Large And Utility Cuts
10. Patching, Small
11. Polished Aggregate
12. Popouts
13. Pumping
14. Punchout
15. Railroad Crossing
16. Scaling
17. Shrinkage Cracks
18. Spalling, Corner
19. Spalling, Joint

The distress definitions, severity levels, and measurement methods are based on criteria described in Pavement Management for Airports, Roads and Parking Lots[1]. This reference has been formalized as ASTM Standard D6433[2] . ASTM's copyright does not allow for electronic distribution or copying of this standard. However, a link to purchase the standard is included in the footnote. OCTA's guidelines follow ASTM D6433, with a few minor exceptions.

In addition, field manuals are available from the American Public Works Association (APWA)[3,4]. The field manuals include photographs of distress types and detailed descriptions and definitions, and are intended for the field inspector. All personnel involved with inspection or performing condition surveys must have read and understood these manuals.

[1] Shahin, M.Y. *Pavement Management for Airports, Roads and Parking Lots*, Chapman & Hall, 1994.
[2] *ASTM D6433 – Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys.* A copy may be purchased at http://www.astm.org/Standards/D6433.htm.
[3] *Paver Distress Identification Manual: Asphalt-Surfaced Roads and Parking Lots,* U.S. Army Corps of Engineers, Construction Engineering Research Laboratories, June 2009. To purchase, go to www.apwa.net.
[4] *Paver Concrete Distress Identification Manual: Concrete Surfaced Roads and Parking Lots,* U.S. Army Corps of Engineers, Construction Engineering Research Laboratories, June 2009. To purchase go to www.apwa.net.





Note that both ASTM D6433 and these field manuals contain 20 distresses and 19 distresses for AC and PCC pavements, respectively. These distresses are now required for data collection.

OCTA allows windshield, walking, and calibrated automated surveys. It is recommended that windshield surveys be supplemented with walking surveys.

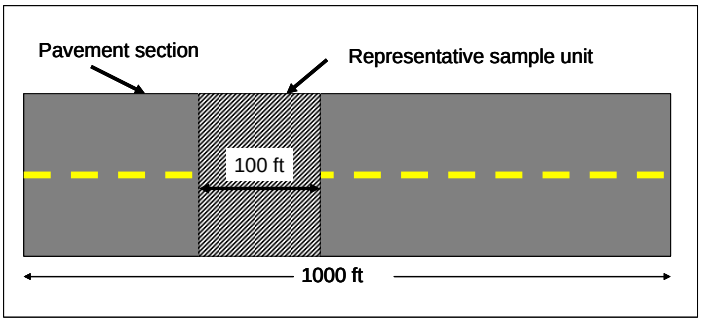
In a windshield survey, the inspector travels in a vehicle at slow speeds (5 to 10 mph) and observes the pavement condition from within the vehicle. The entire length of the pavement section is driven and observed. A driver is required for safety reasons, with the inspector/recorder in the passenger side of the vehicle. The inspector should have a list of street sections to be surveyed and a planned route.

The entire pavement section is surveyed and the distress data are estimated and recorded. In situations where the distresses need closer examination, or where there are difficulties in observation, the inspector should stop the vehicle and walk the pavement section to verify the distresses observed from the vehicle.

All field data collection procedures should conform to the local agency's safety practices and should be included in the QA/QC Plan (see Section 2.4).

When walking surveys are used, the following procedure should be followed:

1. Each pavement section must be inspected using sample units. Individual sample units should be representative of the pavement section conditions, and may be marked or identified to allow easy location for quality control purposes. Paint marks along the edge or sketches with locations connected to physical pavement features are acceptable. The figure below illustrates the definition of a pavement section and a representative sample unit.



2. The area of AC sample units should be 2500±1500 square feet, and for PCC sample units, this should be 20±8 slabs. The total inspected area or slabs for a pavement section must be at least 10% of the total pavement section area or slabs. This is an exception to the procedure described in ASTM D6433.

   For example, a pavement section 950 feet long and 32 feet wide must have at least one sample unit (typically 100 feet long x 32 feet wide = 3200 sf). Longer sections will require multiple sample units.

3. Additional sample units are to be inspected only when non-representative distresses are observed. Typically, these will be distresses that are localized in nature and not representative of the entire pavement section e.g. high severity alligator cracking found near bus pads, rutting in intersections, distresses due to landscape watering/ponding etc.

4. Conduct the distress inspection by walking on the pavement shoulder or sidewalk adjacent to the sample unit being surveyed, measuring the quantity of each severity level of every distress type present, and recording the data. Each distress must correspond in type and severity to that described in the Paver Distress Identification Manuals.

5. A copy of the recorded distress data should be provided on a weekly basis to the responsible agency personnel for quality assurance.

Finally, it should be noted that windshield surveys, while reasonably fast and inexpensive, do have shortcomings. Chief among these are that low severity distresses are difficult to identify in this procedure, and consequently, the PCI may be significantly higher than it ought to be. A pavement may therefore be selected for a slurry seal when a thin overlay is more appropriate or for a thin overlay when a thick overlay is more appropriate. This may result in treatments that are not cost-effective.

When certain pavements are a high priority (usually those with high traffic volumes or other distinctive feature) for a local agency, walking surveys are preferred to ensure that all pertinent distresses are captured, although windshield surveys are the minimum standard. For residential or local streets, windshield surveys are acceptable.

2.2 Inspection Frequency

All streets identified on the MPAH must be surveyed at least once every two years. All local streets must be surveyed at least once every six years. This is a requirement of OCTA's PMP certification program.

2.3 Countywide Assessment Standards

In 1998, OCTA adopted the countywide pavement condition assessment standards for treatments as shown in Table 2.2.

Table 2.2 Pavement Condition Assessment Standards

Pavement Quality	PCI Thresholds	Funded Treatment
Very Good	86-100	None
Good	75-85	Surface seal*
Fair	60-74	Thin overlay
Poor	41-59	Thick overlay
Very Poor	0-40	Reconstruction

* Not eligible for M2 competitive funding program

Note that Table 2.2 does NOT preclude other treatments that a local agency may choose to select or use. Indeed, there have been many new pavement technologies and techniques introduced since 1998 that a local agency should consider for preventive maintenance, and which may be funded under the M2 Fair Share program. **The treatments in Table 2.2 are intended to identify the types of treatments that OCTA will fund under the competitive grant program only.**

2.4 Quality Assurance/Quality Control (QA/QC) Plan

A QA/QC plan must be prepared by all agencies. The purpose of the QA/QC plan is to ensure that all procedures used to collect distress data comply with OCTA's guidelines and result in the delivery of a quality data product. The QA/QC plan should also provide for corrective actions when deficiencies are encountered. As a minimum, the following components must be included:

a. Description of condition survey procedures (distress types, severities) or reference to the relevant documents in Section 3. All procedures, changes or modifications should be well documented in the QA/QC plan so that future updates will be consistent. In particular, unique situations are especially important and their documentation should be included.

b. How data will be collected (windshield, walking, automated or combination of methods).

c. Accuracy required for data collection.

d. Description of how data will be checked for accuracy by agency e.g. re-inspections.

e. Schedule for when data will be submitted to local agency staff.

f. Experience of inspectors including past training on condition surveys or calibration procedures.

g. Field data collection safety procedures.

Any findings that may compromise data integrity and consistency should be discussed and corrected. Examples of these include differences in survey methods from the last update (e.g. changing from windshield to walking surveys), collecting additional distress types and unique situations that may not lend themselves to existing condition survey procedures (e.g. gap-graded mixes, edge cracking with unpaved shoulders).

Prior to performing any work, local jurisdictions must review the QA/QC plan with inspection personnel.

A copy of the QA/QC plan must be submitted to OCTA together with the PMP certification.

2.5 Re-inspections

As part of any QA/QC process, it is essential to re-inspect portions of the network with different personnel than those performing the condition surveys. Re-inspections should be performed within one month of the original date of collection as pavement data will change with time, and during the winter, may change very rapidly.

The data to be re-inspected should include distress types, severities and quantities collected during the survey. At least 5% of the pavement sections should be re-inspected.

The selected sections for re-inspections should be representative of the local agency's network. This should include sections from:

- All functional classifications (i.e. MPAH and residential/local)
- All surface types (i.e. AC and PCC)
- Entire range of pavement conditions (i.e. good, fair, poor)
- All significant changes in PCI (i.e. sections with more than ±10 PCI points a year with no plausible explanations should be targeted for re-inspections)
- All inspectors
- Different geographical areas

Acceptability Criteria

In general, inspectors should identify distress types accurately 95% of the time. Linear measurements should be considered accurate when they are within ±10% if re-measured, and area measurements should be considered accurate when they are within ±20% if re-measured. For the data to be acceptable, 90% of the re-inspected sections must be within ±10 PCI points.

If the results of the re-inspections do not meet the above criteria, all inspections should be immediately halted and any differences should be identified and discussed. Corrective actions should be taken immediately. The local jurisdiction should then perform re-inspections of an additional 5% of the pavement sections.

2.6 Prequalification/Calibration of Inspectors

Prequalification or calibration of inspectors ensures that proper procedures are followed and that the results obtained are within acceptable variability ranges. This will be implemented by OCTA staff.

Briefly, the procedures to prequalify or calibrate inspectors are as follows:

a. OCTA will select approximately 20 pavement sections to be used as control or test sites. Collectively, the control sites should exhibit common distress types and levels of severity that will be encountered in the pavement network and should be across all functional classes, pavement age, surface type, pavement condition and distresses.

b. Inspect the sections manually (walking survey) using at least two different experienced inspectors and the established survey protocols (Appendix C and ASTM D6433), including any modifications. This will establish the baseline PCI for each control section.

c. The candidate inspectors should then survey the same pavement sections within one month of the control surveys established in Step (b). The data for the sections should be collected and submitted to OCTA as soon as they are completed.

d. OCTA will calculate the PCIs based on the survey data collected by inspectors.

e. Compare the control PCI data with survey results by candidate inspectors. Identify the differences and areas of consistency improvement.

Acceptability Criteria

The criteria for acceptability are:

a. nRMSE ≤ 1.0 where:

$$\mathrm{nRMSE} = \sqrt{\frac{\sum_{i=1}^{n}\left(\frac{\mathrm{RPCI_i} - \mathrm{BPCI_i}}{\mathrm{SD_{PCI}}}\right)^2}{n}}$$

Where:
nRMSE = Normalized root mean square error or deviation
$RPCI_i$ = Reported PCI for control section i
$BPCI_i$ = Baseline PCI for control section i
n = Number of control sections
and

$$\mathrm{SD_{PCI}} = \frac{100 - \mathrm{BPCI}}{3.6}$$

b. Inspectors that obtain nRMSE values higher than 1.0 will be allowed to re-inspect and re-submit PCI values for three control sections. OCTA will indicate the three control sections where the inspectors showed the highest deviations from the baseline survey. Re-inspections are allowed only once. The normalized root mean square error (nRMSE) will be recalculated and the criteria described at point (a) applied.

c. All inspections must be performed independently by each inspector.

d. At least one inspector of a consultant firm or local agency staff must be prequalified.

2.7 Pavement Management Software Training

Local agencies may utilize either MicroPAVER or StreetSaver® software for their PMPs, as long as they conform to ASTM D6433 and these guidelines. At least one representative of the local jurisdiction must be familiar with the PMP software utilized, and have attended one training class. In the case of MicroPAVER, training classes are conducted regularly. The American Public Works Association (APWA) conducts "hands-on" MicroPAVER training classes for a fee, at least once a year (see www.apwa.net for more information). Web-based training programs on specific modules are also available for a fee and broadcast schedules are periodically posted on the APWA website.

The Metropolitan Transportation Commission (MTC) provides free training classes on their StreetSaver® software program as well as field condition surveys. Typically, two field training classes are conducted annually; one in Northern California and one in Southern California (see www.mtcpms.org for more information). There are enough similarities between StreetSaver's and MicroPAVER's condition surveys that this training class will benefit any inspector new to the process.

2.8 Pavement Management Data Files

The Pavement Management data files shall be submitted to OCTA in spreadsheet format. This must include the following information:

- Street name and limits for all public streets
- Street identifiers (Branch ID, Section ID)
- Direction (if applicable)
- Begin and end of section
- Length, widths and true areas
- Functional Classification (MPAH, local)
- Number of travel lanes
- PCI and date of inspection
- Type of recommended treatment
- Cost of recommended treatment

Public alleys formally accepted as part of the local agency's street system may be included at the local agency's option. Public parking lots and private streets shall not be included in this submittal.

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Chapter 3 – Agency Submittals

Local agencies must submit to OCTA the following as part of the biennial certification:

1. PMP Agency Submittal Checklist (See Appendix A)
2. PMP certification (see Appendix B)
3. QA/QC plan (see Appendix C Model QA/QC Plan)
4. Pavement management data files in a form useable by OCTA (see Section 2.8)
5. PMP "hard copies" which include the following:

    a. Average (weighted by area) PCI for:
        i. Entire pavement network
        ii. MPAH roadways
        iii. Local streets
    b. Projected PCI under existing funding levels over the next seven years for:
        i. Entire pavement network
        ii. MPAH roadways
        iii. Local streets
    c. Seven-year plan for road maintenance and rehabilitation based on current and projected budget, identifying street sections selected for treatment. Specific data to be submitted are:
        i. Street name
        ii. Limits of work
        iii. Lengths, widths
        iv. Pavement areas
            1. Each street
            2. Total area for local streets
            3. Total area for MPAH roadways
            4. Total area for entire public streets network
        v. Functional classification (i.e. MPAH or local street)
        vi. PCI and most recent date of inspection
        vii. Type of treatment
        viii. Cost of treatment
        ix. Year of treatment
    d. Alternative funding levels required to:
        i. Maintain existing average network PCI
        ii. To improve average network PCI
    e. Backlog by year of unfunded pavement rehabilitation, restoration, and reconstruction needs.
    f. Centerline mileage for MPAH, local streets, and total network.
    g. Percentage of total network in each of the five condition categories based on centerline miles.

6. In order to be eligible for the local match reduction of 10%, the local jurisdiction must either:

a. Show measurable improvement of paved road conditions during the previous reporting period defined as an overall weighted (by area) average system improvement of one PCI point with no reduction in the overall weighted (by area) average PCI in the MPAH or local street categories;

or -

b. Have road pavement conditions for the overall network during the previous reporting period within the highest 20% of the scale for road pavement conditions in conformance with OCTA Ordinance No. 3, defined as a PCI of 75 or higher.

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Appendices

A. PMP Agency Checklist

The PMP Agency Checklist can be found on the Eligibility Website:
http://www.octa.net/Projects-and-Programs/Plans-and-Studies/Funding-Programs/Eligibility/

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Pavement Management Plan
Agency Submittal Checklist

A Pavement Management Plan (PMP) is a plan to manage the preservation, rehabilitation, and maintenance of paved roads by analyzing pavement life cycles, assessing overall system performance costs, and determining alternative strategies and costs necessary to improve paved roads. Local agencies are required to update their PMP on a biennial basis. MicroPAVER or StreetSaver will be used for countrywide consistency. The software must be consistent with American Standard for Testing and Materials (ASTM) Standard D6433. Local agencies are required to submit a PMP unbound "hard copy" including: (See Chapter 3)

Local agencies must submit the following to OCTA:			Page(s) in PMP	Submitted
PMP Agency Submittal Checklist (See Appendix A)				☐
PMP certification (See Appendix B)				☐
QA/QC plan (See Appendix C and Section 2.4)				☐
Pavement management data files in a form useable by OCTA (see Section 2.8)				☐
Average (weighted by area) Pavement Condition Index for:				
i.	Entire pavement network			☐
ii.	Master Plan of Arterial Highways (MPAH) roadways			☐
iii.	Local streets			☐
Projected PCI under existing funding levels over the next seven years for:				
i.	Entire pavement network			☐
ii.	MPAH roadways			☐
iii.	Local streets			☐
Seven-year plan for road maintenance and rehabilitation based on current and projected budget, identifying street sections selected for treatment. Specific data to be submitted are:				
i.	Street name			☐
ii.	Limits of work			☐
iii.	Lengths, widths			☐
iv.	Pavement areas:			
	1.	Each street		☐
	2.	Total area for local streets		☐
	3.	Total area for MPAH roadways		☐
	4.	Total area for entire public streets network		☐
v.	Functional classification (i.e. MPAH or local street)			☐
vi.	PCI and most recent date of inspection (See Section 2.2)			☐
vii.	Type of treatment			☐
viii.	Cost of treatment			☐
ix.	Year of treatment			☐
Alternative funding levels required to:				
i.	Maintain existing average network PCI			☐
ii.	To improve average network PCI			☐
Backlog by year of unfunded pavement rehabilitation, restoration, reconstruction, and maintenance needs.				☐
Centerline mileage for MPAH, local streets, and total network.				☐
Percentage of total network in each of the five condition categories based on centerline miles.				☐

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B. PMP Certification

The PMP Certification can be found on the Eligibility Website:
http://www.octa.net/Projects-and-Programs/Plans-and-Studies/Funding-Programs/Eligibility/

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Pavement Management Plan Certification

The City/County of _____ certifies that it has a Pavement Management Plan in conformance with the criteria stated in the Orange County Transportation Authority Ordinance No.3. This ordinance requires that the Pavement Management Plan be in place and maintained to qualify for allocation of revenues generated from renewed Measure M (M2).

The plan was developed by _____* using _____ , a pavement management system, conforming to American Society for Testing and Materials (ASTM) Standard D6433,and contains, at a minimum, the following elements:

- Inventory of MPAH and local routes reviewed and updated biennially. The last update of the inventory was completed on _____ , _____ for Arterial (MPAH) streets and _____ , _____ for local streets.
- Assessment of pavement condition for all routes in the system, updated biennially. The last field review of pavement condition was completed _____ , _____.
- Percentage of all sections of pavement needing:

  Preventive Maintenance _____ , Rehabilitation _____ , Reconstruction _____
- Budget needs for preventative maintenance, rehabilitation and/or reconstruction of deficient sections of pavement for:

  Current biennial period $_____ , Following biennial period $_____
- Funds budgeted or available for Preventative Maintenance, Rehabilitation and/or Reconstruction.

  Current biennial period $_____ , Following biennial period $_____
- Backlog by year of unfunded pavement rehabilitation, restoration, and reconstruction needs.
- The Pavement Management Plan is consistent with countywide pavement condition assessment standards as described in the OCTA Countywide Pavement Management Plan Guidelines adopt by the OCTA Board of Directors.

* An electronic copy of the Pavement Management Plan with Micro Paver or StreetSaver compatible files has been or will be submitted with the certification statement.

A copy of this certification is being provided to the Orange County Transportation Authority.

Submitted by:

_____ _____
Name (Print) Jurisdiction

_____ _____
Signed Date

_____
Title

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C. Model QA/QC Plan

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Quality Assurance/ Quality Control Plan (QA/QC)
For City/County Of_____
[Enter Year] Pavement Management Update

Submitted to:
Orange County Transportation Authority
550 South Main Street
P.O. Box 14184
Orange, CA 92863-1584

[Enter Date Submitted]

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1. INTRODUCTION

When performing data collection in any field, the need for quality control is paramount as it is essential for accurate planning, analysis and design. This is particularly true for collecting pavement distress data for a pavement management system.

The Quality Assurance/Quality Control (QA/QC) Plan establishes minimum quality standards for performance and procedures for updates of the pavement management system.

[Include information on agency's QA/QC policies if applicable]

1.1. Objectives

This document constitutes a formal QA/QC Plan for the **[Enter City/County Name].** It was prepared on **[Enter date]** and last revised on **[Enter date]**.

Specifically, it is intended for the **[Enter year applicable]** Pavement Management Plan Update. The focus is on the collection of network-level pavement distress data (defined by National Cooperative Highway Research Program (NCHRP) Synthesis 401 Quality Management of Pavement Data Collection, as "Network-level data collection involves collection of large quantities of pavement condition data, which is often converted to individual condition indices or aggregated into composite condition indices.")

This document also addresses the QA/QC plan requirements of the Orange County Transportation Authority (OCTA)'s "Countywide Pavement Management Plan Guidelines" (section 2.4), adopted in May 2010.

1.2. Structure of QA/QC Plan

The following components are addressed in this QA/QC Plan:

- Condition survey procedures used
- Accuracy required for data collection
- Inspector qualifications and experience
- Safety

2. QA/QC PLAN

2.1. Condition Survey Procedures

The governing document in performing condition surveys for the **[Enter agency name]** is ASTM D6433 "Standard Practice for Roads and Parking Lots Pavement Condition Index (PCI) Surveys." Both asphalt concrete (AC) and Portland cement concrete (PCC) pavements are included in this protocol. The following distresses are collected for each pavement type.

Asphalt Concrete (AC) Pavements

1. Alligator (fatigue) cracking
2. Bleeding
3. Block cracking
4. Bumps and sags
5. Corrugation
6. Depression
7. Edge cracking
8. Joint reflection cracking
9. Lane/Shoulder drop off
10. Longitudinal & Transverse cracking
11. Patching and utility cut patching
12. Polished aggregate
13. Potholes
14. Railroad crossing
15. Rutting
16. Shoving
17. Slippage cracking
18. Swell
19. Weathering
20. Raveling

Portland Cement Concrete (Jointed)

1. Blowup/buckling
2. Corner breaks
3. Divided slab
4. Durability ("D") cracking
5. Faulting
6. Joint seal damage
7. Lane/shoulder drop off
8. Linear cracking
9. Patching (large) and utility cuts
10. Patching (small)
11. Polished aggregate
12. Popouts
13. Pumping
14. Punchout
15. Railroad crossing
16. Scaling, map cracking and crazing
17. Shrinkage cracks
18. Spalling (corner)
19. Spalling (joint)

Any exceptions to the above procedures are discussed before any surveys are performed. They are documents in the paragraphs below.

[Note to agency: these are usually related to distresses or situations that are not covered in the manuals. Examples include roller check marks or edge cracking on streets with no curbs and gutters. Others include the raveling of surface seals or the use of open-graded asphalt concrete mixes where the surface appears to have large voids present. Any modifications must be documented and included in this document. Photos are extremely helpful.]

All surveys are performed as **[Indicate type of surveys – walking, windshield, semi-automated etc.]** surveys, and a minimum 10% sampling rate is utilized. Field crews are typically composed of **[Agency should edit as applicable]** a one-person crew on residential streets and some collectors, and up to two-person crews for major arterials, depending on traffic volumes and speeds. The safety of field personnel is paramount in all instances.

The sample unit selected must be representative of the entire pavement section. This assumes that the section is homogenous; if it is not homogeneous, then the section must be split according to the criteria agreed upon by the agency. Typically, the criteria used are:

- Pavement condition
- Construction age, if known
- Maintenance history, if known
- Traffic volumes (or functional classification as a surrogate)
- Surface types (e.g. asphalt concrete or Portland cement concrete)
- Geometric elements (e.g. widths)

Any modifications to the section inventory data are documented in the pavement management report.

A sample unit must be between 2,500 ± 1,000 square feet in conformance with ASTM D6433 protocols. Typical sample unit dimensions are 100 feet long by the width of the street. Streets that are wider than 40 feet wide will have shorter lengths (generally 50 feet) or if they are divided by a raised median, separate sample units will be taken in each direction.

Any pavement areas that are not representative of the section will be noted and surveyed as an additional sample unit.

2.2 Accuracy Required for Data Collection

The accuracy required for data collection has two components, both of which are further described in the following paragraphs.

- Re-inspections
- PCI comparisons with past surveys

2.2.1 Random and Systematic Re-Inspections

A minimum of 5% of the total sample units will be re-inspected and this 5% will be selected based on both a random and systematic basis. All re-inspections are made by an engineer or inspector other than the original inspector.

Random Re-inspections

Random re-inspections will include a representative selection across the following categories:

- Functional classes (i.e. MPAH, locals);
- Surface types (e.g. asphalt concrete or Portland cement concrete);
- Pavement conditions (e.g. good, fair, poor);
- Inspectors;
- Geographical areas, if applicable.

Systematic Re-inspections

For systematic re-inspections, this could be due to noticed trends such as specific treatment types (e.g. open-graded mixes), a specific inspector or geographical area. In such cases, more than 5% will be re-inspected.

Acceptability Criteria

At the time of re-inspection, the actual distresses will be re-inspected and verified, and any corrections made, if necessary. Distress types and severities must be the same, and re-measured quantities within ±10% of the original measured quantity.

If corrections are required on more than 10% of the re-inspected sample unit, then an additional 5% will be re-inspected. This will continue until more than 95% of the re-inspected sections meet the acceptability criteria.

2.2.2 PCI Comparison with Past Surveys

As another level of quality control, the new PCIs are compared with the previous PCIs. If they differ by more than ±10 PCI points, these sections are automatically flagged for further investigation.

If PCI Increases 10 points

The section is investigated to see if a maintenance and rehabilitation event has occurred since the last survey, but which has not been recorded. Typically, it may include activities such as:

- Crack sealing activities – changes medium or high severity cracking to low severity
- Patching activities – alligator cracking that has been removed and patched, so that the resultant PCI is increased.
- Surface seals
- Overlay
- Others

Therefore, an up to date maintenance and rehabilitation history file in the pavement management database is desirable, both for historical accuracy as well as to provide additional quality control.

If PCI decreases 10 points

The section is checked to see if the average deterioration rate (usually 3 to 4 points per year) is exceeded. If the drop in PCI is within range of what is acceptable, no further action is required. If the drop is more than the acceptable range, a re-inspection will be performed. The default performance curves in the pavement management software form the basis for what is acceptable.

2.3 Inspectors Qualifications and Experience

The **[Enter agency's name's]** inspectors have attended formal training on pavement condition distress surveys. This training was conducted prior to performing any work using the ASTM D6433 protocols, consistent with OCTA's requirements.

[Agency to fill in table]

Inspector Name	Date of ASTM D6433 Training	Training Conducted by

Resumes of technicians utilized are included in the Attachment.

3. SAFETY PROCEDURES

The **[Enter agency name]** administers a health and safety program in compliance with the Cal Occupational Safety and Health Administration (OSHA) Title VIII, Section 3203. The program is documented in **[Enter document name]**.

Generally, the safety procedures include **[Edit as applicable to agency]**:

- Inspectors to wear a Class 2 or 3 **[prescribed by agency]** safety vest at all times;
- Flashing beacon on all vehicles utilized for surveys; and
- Stopped vehicles to be parked at locations away from moving traffic (e.g. nearby parking, shoulders, etc.).

On streets where there is a high volume of traffic or high speeds, additional measures may be necessary, such as:

- Surveys to occur during off-peak periods or on weekends;
- Additional inspector to watch out for traffic; and
- Traffic flaggers in extreme cases.

Attachment

Resumes of Field Inspectors

D. Prequalified Pavement Inspection Consultants and Local Agencies

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Prequalified Pavement Inspection Consultants & Local Agencies

June 18, 2014 – Expires June 30, 2016

1. Bucknam Infrastructure Group **(4)**
2. Civil Source Inc. **(2)**
3. Nichols Consulting Engineers **(4)**
4. Infrastructure Management Services **(2)**
5. City of Cypress **(1)**
6. Adhara Systems **(1)**
7. Cartegraph **(1)**

May 29, 2015 – Expires June 30, 2017

1. Harris and Associates **(4)**
2. Civil Source, Inc. **(1)***
3. JG3 **(3)**
4. Bucknam Infrastructure Group **(1)***
5. GMU **(1)**
6. Onward Engineering **(1)**

_____
* Firms prequalified at least one representative in both cycles
(x) Number of inspectors prequalified

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E. Recommendations for Pavement Inspectors

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Recommendations for Pavement Inspectors

Since 2011, OCTA has completed prequalification studies which involved more than 30 inspectors and over 60 different pavement control sections. From one prequalification cycle to the next, OCTA made an effort to streamline and improve the process by learning from the observations made during each prequalification cycle. Following are recommendations for inspectors interested in participating in future prequalification studies:

General

- Inspectors should have in their possession the latest edition of the Paver pocket guides for easy reference to distress definitions and severity levels during field surveys.

- It is important to accurately measure crack width in order to correctly identify the severity of distress.

- It is strongly advised that inspectors have a second person watch for traffic while they are conducting the surveys. Visually approximating quantities of distress and severities will most certainly result in inaccurate estimates of the PCI.

PCC Pavements

- There are a limited number of concrete pavements in Orange County. The majority of these pavements are old and in some instances the slabs are more than 50 feet long. According to ASTM D6433, slabs longer than 9m (29.5 feet) must be divided into imaginary joints that are considered to be in perfect condition.

- Missing joint seal on concrete pavement is recorded as high severity joint seal damage for the entire length of joints affected. Most PCC pavements in the county completely lack joint sealant.

- When surveying a PCC section, it is very important to make sketch of the slabs being evaluated. Without the sketch, it will be very difficult to correctly count and report distress.

Asphalt Concrete Pavements

- Several types of distress may occur in the same area. With few exceptions, all types of distress have to be recorded: e.g. raveling and alligator cracking.

- Measurements of rutting require the use of a straight edge of minimum 6 feet length. Repeated measurements are required to correctly identify the areas of rutting and severity levels. This type of measurement requires the help of a second person to watch for traffic. Remember that OCTA does not provide traffic control.

Surface Treatments

- ASTM D6433 does not include distresses specific to surface treatment such as slurry seals or chip seals. Inspectors should use their best judgment to evaluate the condition of the original asphalt concrete surface underneath the surface treatment.

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