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**MAINTENANCE TECHNICAL ADVISORY GUIDE**  
**Volume II - Rigid Pavement Preservation**  
**Second Edition**



State of California Department of Transportation  
Office of Pavement Preservation  
Division of Maintenance  
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# MTAG Overview

## (Rigid Pavements)

From... Maintenance Technical  
Advisory Guide (MTAG)



# What is MTAG?

- A Maintenance Technical Advisory Guide developed for Caltrans and other pavement professionals
- Developed by Caltrans Division of Maintenance
- MTAG Vol. 1 for Flexible Pavements
  - First edition – 2003 (8 chapters)
  - Second edition – 2007 (13 chapters)
- MTAG Vol. 2 for Rigid Pavements
  - First edition – July 2006 (7 chapters)
  - Second edition – July 2007 (8 chapters)
- Both volumes focus on pavement preservation strategies

# Chapters Covered in MTAG for Rigid Pavements

Chapter	Topic
1	Introduction
2	Surface Characteristics
3	Strategy Selection
4	Joint Resealing and Crack Sealing
5	Diamond grinding and Grooving
6	Dowel Bard Retrofit
7	Isolated Partial Depth Concrete Repair
8	Full Depth Concrete Repair

# Organization of Training Modules

- Modules on each treatment contain three sub-modules
  - Managers' overview
  - Design, materials, and specifications
  - Construction and inspection

# Chapter 1

## Introduction

From... Maintenance Technical  
Advisory Guide (MTAG)

# Overview

- Purpose of pavement preservation (PP)
- Definition of PP
- Components of PP Program
- PP Concept
- Essentials of PP Program
- Benefits of PP
- Rigid Pavement Performance in California
- Common Rigid Pavement Distresses

# Purpose of Pavement Preservation

- To keep good pavements in good conditions by applying the right maintenance strategies at the right time to extend pavement life and preserve investments.

# FHWA Definition of 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, improve safety and meet motorist expectations”

# Components of Pavement Preservation Program

- Consists primarily of three components:
  - preventive maintenance
  - minor rehabilitation (restoration), and
  - some routine maintenance
- Does not include new pavements or pavements that require major rehabilitation or reconstruction.

# Pavement Preservation Concept

- A proactive approach to maintaining the existing highways
- Addresses pavements while they are still in good condition and before the onset of serious damage
- Applying a cost-effective treatment at the right time to the right pavement to extend pavement life

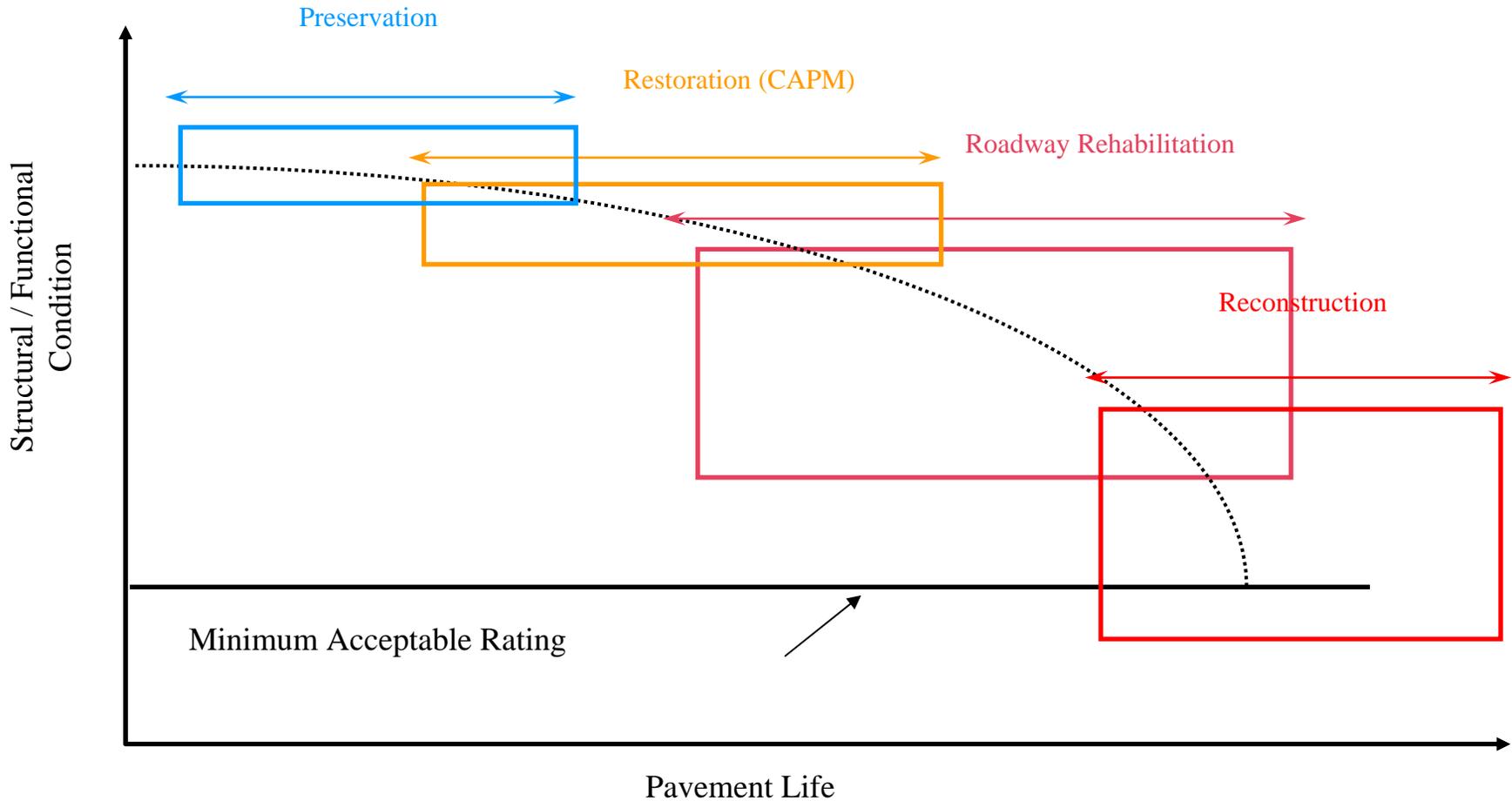
# Essentials of Pavement Preservation Program

- Pavement preservation is an agency program
- An effective pavement preservation program include agency leadership and a dedicated annual budget
- It also includes support and input from staff in planning, finance, design, construction, materials, and maintenance

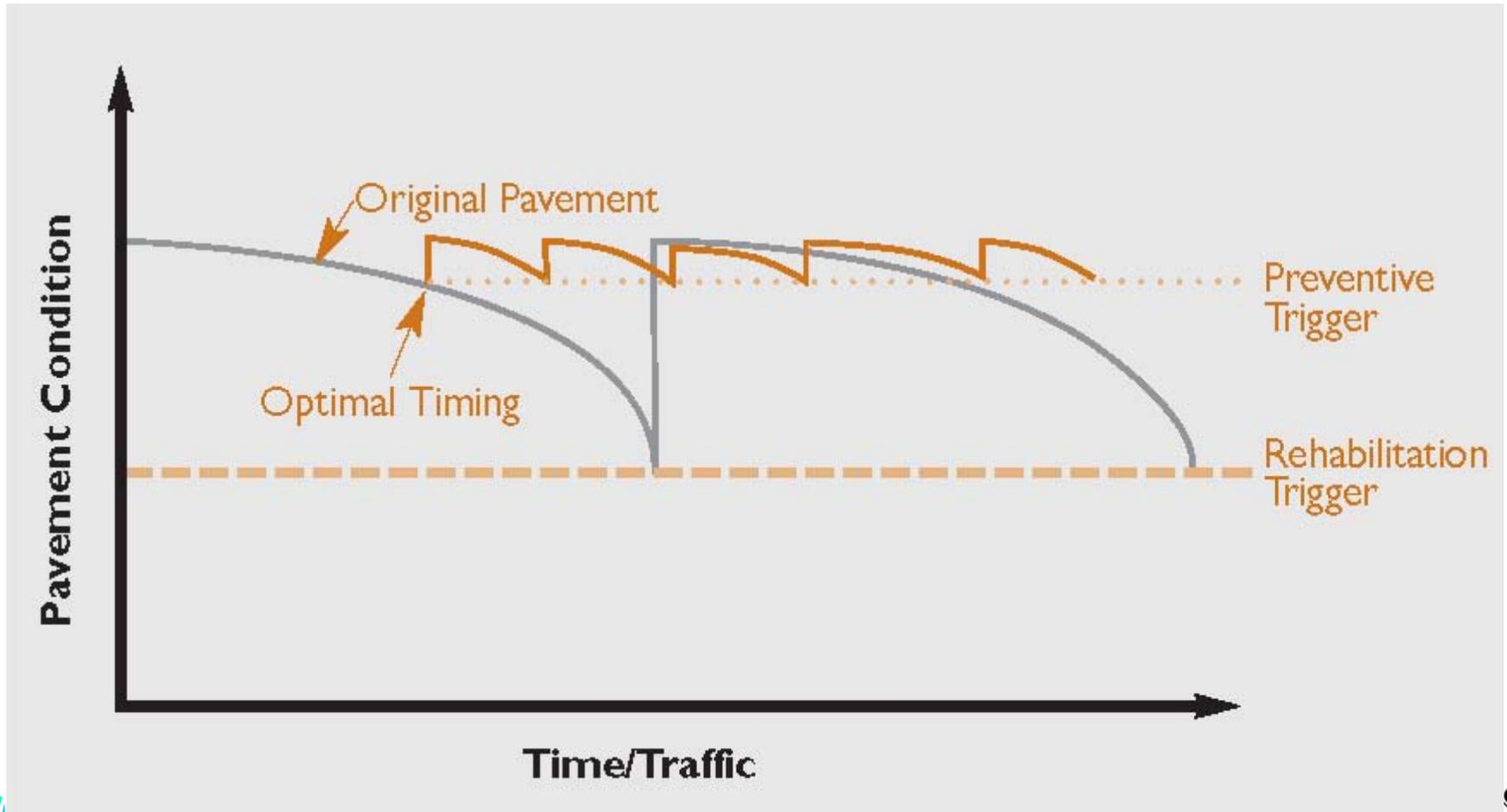
# Benefits of Pavement Preservation

- Benefits of pavement preservation program:
  - preserving the roadway network
  - enhancing pavement performance
  - ensuring cost-effectiveness by extending pavement life, and
  - reducing user delays by avoiding rehabilitation or reconstruction.
- Some of these benefits may be noticed immediately and some may be realized over time

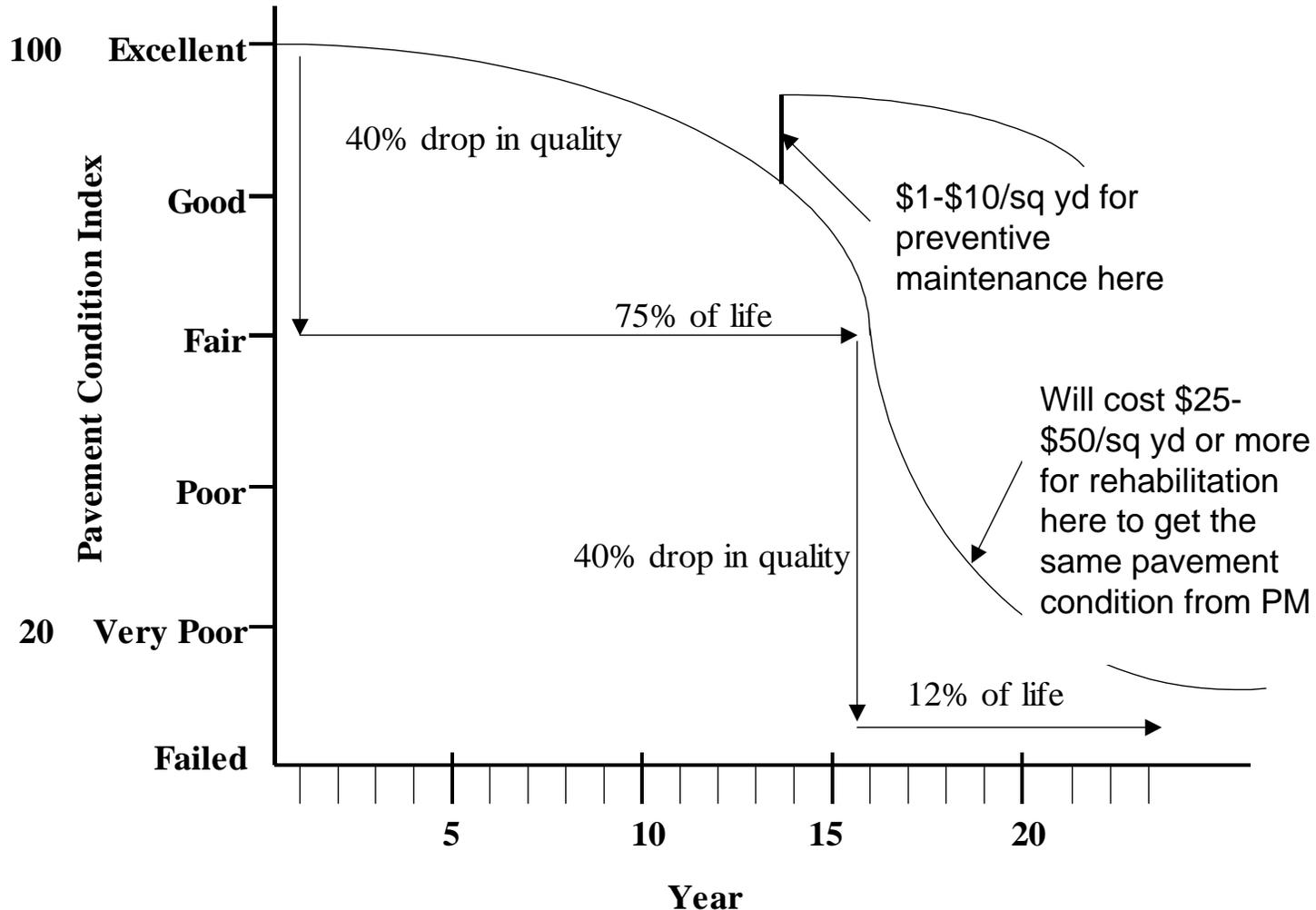
# Typical Pavement Performance Curve



# Importance of Timely Treatments



# Cost Effects of Treatments



# Rigid Pavement Performance in CA

- Design and Performance
  - Base support. Initially CTB; later LCB. CTPB and ATPB also used.
  - Slab thickness. In the 1950s, an 8-inch. Later 9-inch slab became common. Presently, 10-inch and even 12-inch thick slabs are used depending on projected traffic.
  - Dowels, tie bars, sealed joints were added in 2000.
- Common Distresses and Causes of Rigid Pavement Deterioration

# Chapter 2

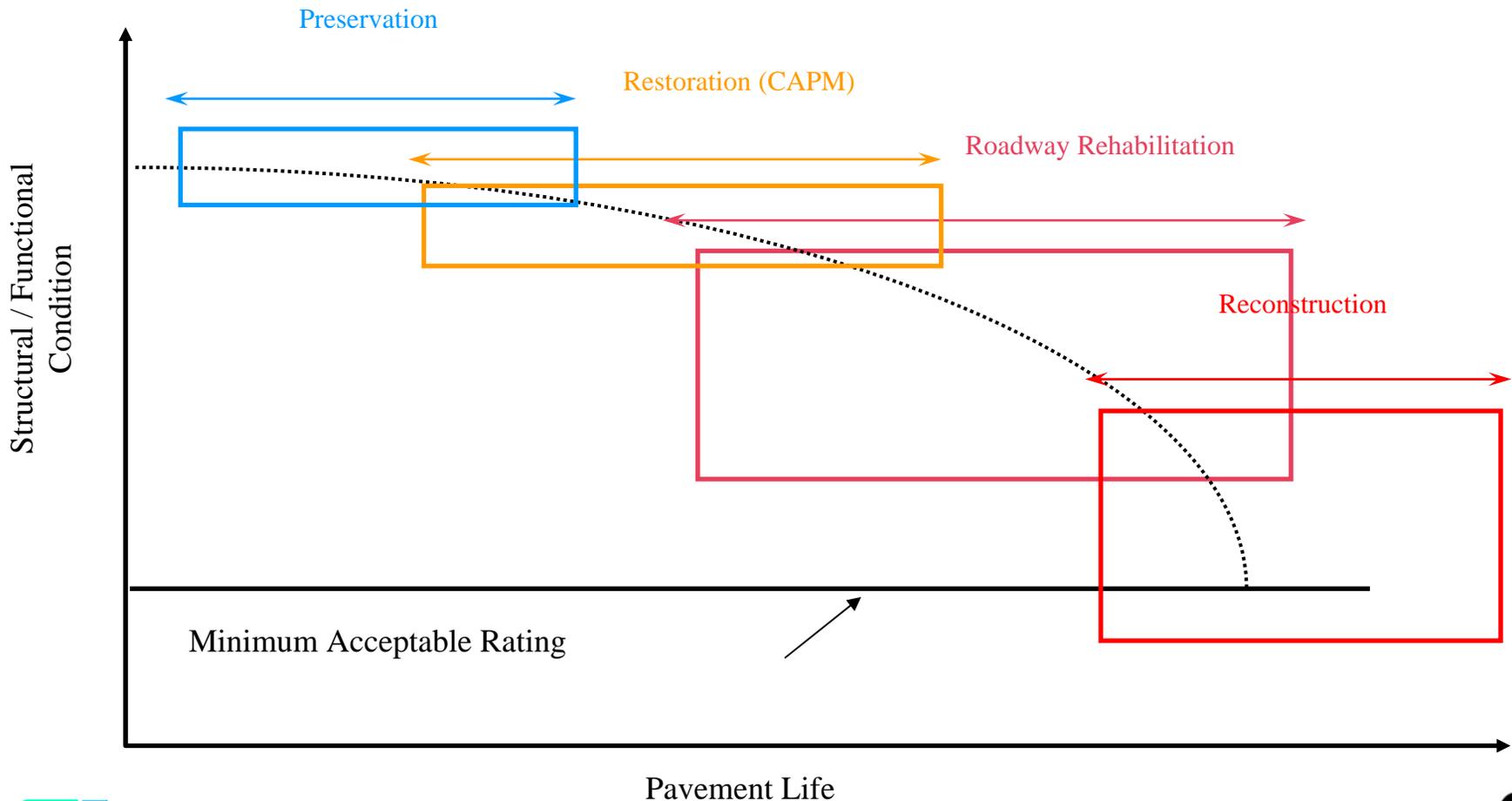
## Surface Characteristics

From... Maintenance Technical  
Advisory Guide (MTAG)

# Why are Surface Characteristics of a Pavement Important?

- They are what the public notices
- They also affect their driving and the associated costs of driving
- Customer satisfaction is at the heart and soul of a successful pavement preservation program

# Surface Characteristics Deteriorate as the Pavement Wears Out



# Important Surface Characteristics

- Ride quality-the public demands a smooth ride
- Safety-Safety for users in terms of texture and skid resistance
- Noise-Quieter pavements
- Durability-longer lasting treatments
- Aesthetics- eliminating patches and other surface deficiencies

# Ride Quality

- Definitions-deviations in the surface that affect vehicle dynamics, ride quality, and drainage. Smoothness can affect
  - driver safety
  - fuel efficiency, and
  - vehicle wear and tear
- Measuring smoothness
- Factors contributing to poor smoothness

# Ride Quality and Profiling

- Ride - measuring smoothness
  - Several techniques have been used over the years
  - Profilographs were one of the first and still is used in California for construction quality control
- Profiling - measuring the longitudinal profile
  - Common for network pavement data collection
  - Not designed for project level quality control

# Surface Texture

- Definitions
- Measurements of surface texture
- Importance of surface texture



# Techniques to Create Texture

- Drag textures
  - Burlap dragging
  - Broomed surfaces
  - Turf dragging
- Tined textures
  - Transverse
  - Longitudinal
- Diamond grinding

# Methods to Measure Texture

- Sand patch method- ASTM 365
- Circular texture meter (CT meter)
- Outflow time (using an outflow meter)



# Importance

- Good friction provides for safe roads in wet weather conditions
- Water on pavements also affects splash and spray which can result in a loss of visibility



# Measurement of Surface Friction

- Several methods have been used to obtain a number
- Some of the devices used in California include;
  - ASTM locked wheel trailer
  - British pendulum device
  - Dynamic friction tester
  - Caltrans test method

# Noise

- Noise is unwanted sound
- Pavement type and texture contribute to noise levels
- Caltrans has developed a pavement advisory guide for quiet pavements which can be found on the following website

[www.dot.ca.gov/hq/oppd/pavement/qpavement.htm](http://www.dot.ca.gov/hq/oppd/pavement/qpavement.htm)

# Chapter 3

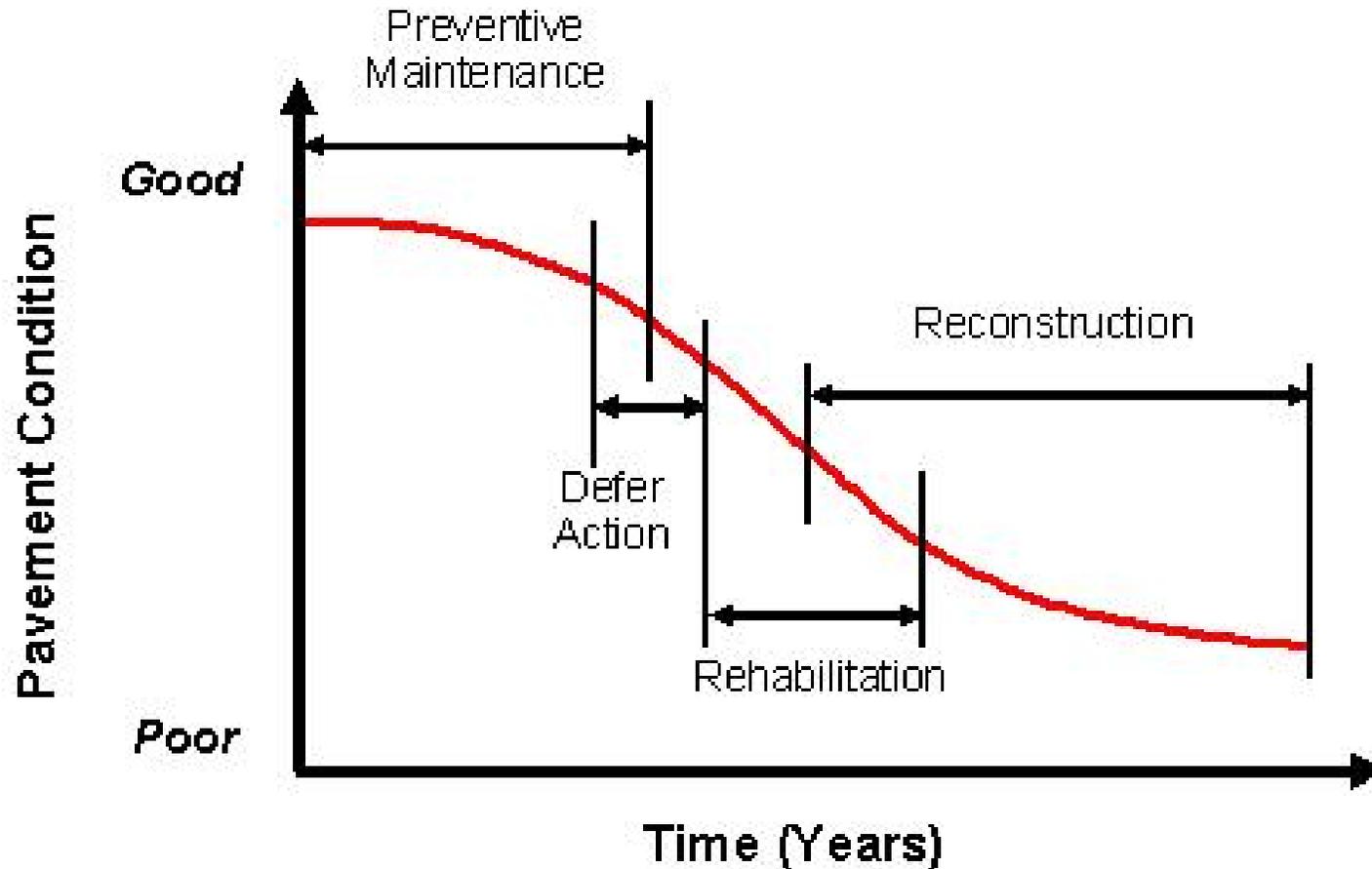
## Strategy Selection

From... Maintenance Technical  
Advisory Guide (MTAG)

# Factors to Consider

- Ride
- Skid
- Noise
- <http://www.dot.ca.gov/hq/oppd/pavement/qpavement.htm>
- Distress Types
- Durability/Longevity

# Treatment Selection Based on Pavement Condition



# Caltrans Approach to Selecting Maintenance Treatments

- Assess Existing Pavement Conditions
- Determine the Feasible Treatment Options
- Analyze and Compare the Feasible Options

# Feasible Treatments - Structural

<b>Distress Type</b>	<b>Preservation Techniques</b>
<b>Transverse Cracking</b>	<b>Joint and crack sealing</b>
<b>Longitudinal Cracking</b>	<b>Joint and crack sealing Slab stabilization</b>
<b>Corner Cracking</b>	<b>Joint and crack sealing Edge joint resealing Slab stabilization</b>
<b>2<sup>nd</sup>/3<sup>rd</sup> stage Cracking</b>	<b>Joint and crack sealing Slab stabilization; slab replacement</b>
<b>Spalling</b>	<b>Partial-depth repair Joint and crack resealing Full-depth repair</b>
<b>Pumping</b>	<b>Joint and crack resealing Slab stabilization; dowel bar retrofit</b>
<b>Blow ups</b>	<b>Full-depth repairs</b>
<b>D-cracking (not common in California)</b>	<b>Partial- or full-depth repair; Joint and crack resealing</b>

# Feasible Treatments - Functional

<b>Distress Type</b>	<b>Preservation Techniques</b>
<b>Surface Polishing</b>	<b>Diamond grinding Grooving</b>
<b>Noise</b>	<b>Diamond grinding See Caltrans website for the latest information</b>
<b>Scaling</b>	<b>Diamond grinding</b>
<b>Popouts</b>	<b>Diamond grinding</b>

# Chapter 4

## Joint Resealing and Crack Sealing

From... Maintenance Technical  
Advisory Guide (MTAG)

# Purpose

Placement of an approved sealant material in an existing joint or crack to reduce moisture infiltration and prevent intrusion of incompressibles

# PCC Joint Resealing

- Debate: to seal or not to seal
- Some believe the benefits do not offset the costs
- Most states seal transverse joints
- Recommendation: continue to reseal joints if they were originally sealed!

# Guidelines for Resealing Joints

- Sealant no longer functional
- Pavement not severely deteriorated
- Performed with other CPR activities
- Moderate installation temperatures
- Proper material selection and joint preparation is essential

# Guidelines for Sealing Cracks

- Seal working transverse cracks
- Can seal cracks  $\leq 13$  mm (0.5 in) wide
- Use special crack-sawing blades
- Same general *joint* resealing procedures apply to *crack* sealing

# Chapter 5

## Diamond Grinding and Grooving

From... Maintenance Technical  
Advisory Guide (MTAG)

# Diamond Grinding and Grooving - Benefits

- Restore smoothness
- Improve friction
- Improve cross slope
- Reduction in noise

# Diamond Grinding - Project Selection

- Consider effectiveness and limitations
- IGGA and ACPA recommendations
  - Present serviceability index (PSI) range of 3.8 to 4.0
  - Before critical faulting level
- Used with other CPR activities

# Diamond Grinding - Limitations

- Does not address structural or durability problems
- Hardness of aggregate affects costs
- Roughness will return if causes are not addressed

# Diamond Grooving - Project Selection

- Historical crash rate, friction number, or macrotexture depth data
- Potential locations for wet weather crashes
- Pavements should be structurally and functionally sound

# Diamond Grooving - Longitudinal

- Advantages

- Restore surface friction
- Decrease hydroplaning potential
- Improve curve tracking
- Easier to conduct under traffic

- Disadvantages

- Perception poor handling for motorcycles and light cars

# Diamond Grooving - Transverse

- Advantages
  - Most direct channel for water drainage
  - Introduces a surface that provides significant braking traction
- Disadvantages
  - Maintaining adjacent traffic
  - Excessive noise
  - Productivity

# Chapter 6

## Dowel Bar Retrofit

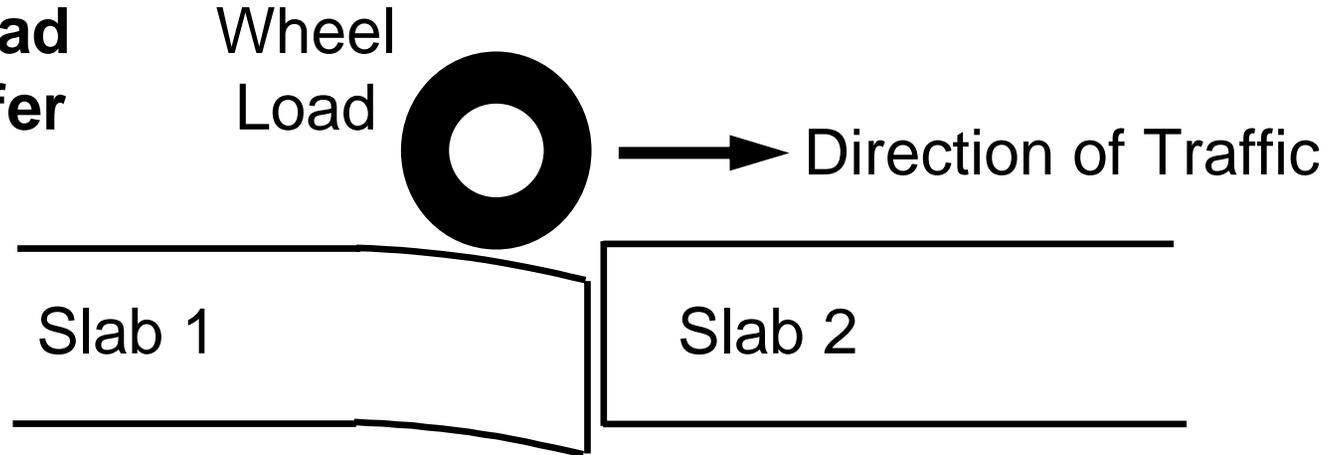
From... Maintenance Technical  
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# Dowel Bar Retrofit - Purpose

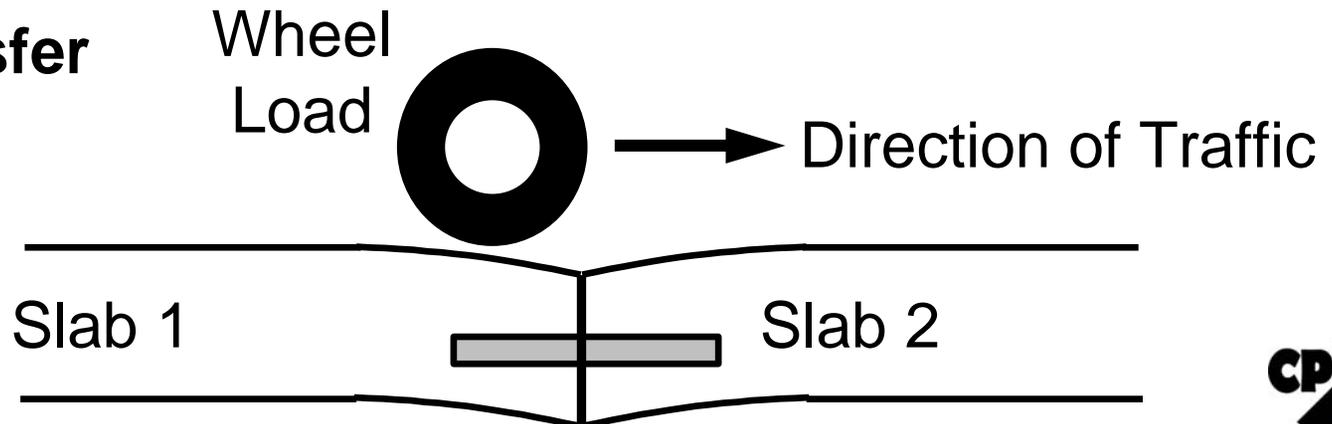
- Transferring wheel loads across a joint or crack
- Improving load transfer efficiency (LTE)

# Load Transfer (continued)

**0% Load Transfer**



**100% Load Transfer**



# Load Transfer Restoration - Benefits

- Reduced probability of pumping, faulting, and corner breaks
- Improved long-term rideability
- Increased service life

# Good Candidate Projects

- Relatively good condition but with:
  - Poor load transfer
  - Faulting between 0.125 and 0.5 in
  - <10% slabs with multiple cracks
- Pavements expecting overlays
- Medium to heavy truck traffic

# Chapter 7

## Isolated Partial Depth Concrete Repair

From... Maintenance Technical  
Advisory Guide (MTAG)

# Purpose

- Removal and replacement of small, shallow areas of deteriorated PCC at spalled or distressed joints.
- Distress limited to upper 1/3 of slab
- Existing load transfer devices are functional

# Benefits

- Restores structural integrity
- Improves ride quality
- Extends the service life
- Restores a well-defined uniform joint sealant reservoir

# Good Candidate Projects

- Spalling associated with joint inserts
- Spalling caused by intrusion of incompressibles
- Spalling associated with localized areas of scaling, weak concrete, clay balls, or high steel

# Poor Candidate Projects

- Joint spalling associated with dowel bar misalignment or lockup
- Spalled cracks
- Spalling associated with durability problems or reactive aggregate

# Chapter 8

## Full Depth Concrete Repair

From... Maintenance Technical  
Advisory Guide (MTAG)

# Purpose

- Cast-in-place concrete repairs that extend the full-depth of the existing slab
- Repair localized distress
- Preparation for an overlay

# Candidate Distresses

- Transverse cracking (M, H)
- Longitudinal cracking (M, H)
- Corner breaks (L, M, H)
- Spalling (M, H)
- Blowup (L, M, H)
- D-cracking (M, H)
- Deterioration of existing repairs (M, H)

# Benefits

- Restore rideability
- Restore structural integrity
- Prevent further deterioration

# Limitations

- Does not address structural inadequacy
- Not a long-term solution for material-related distresses
- Widespread deterioration
- Cost considerations

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# Thank You

## Questions?