

# Chapter 2

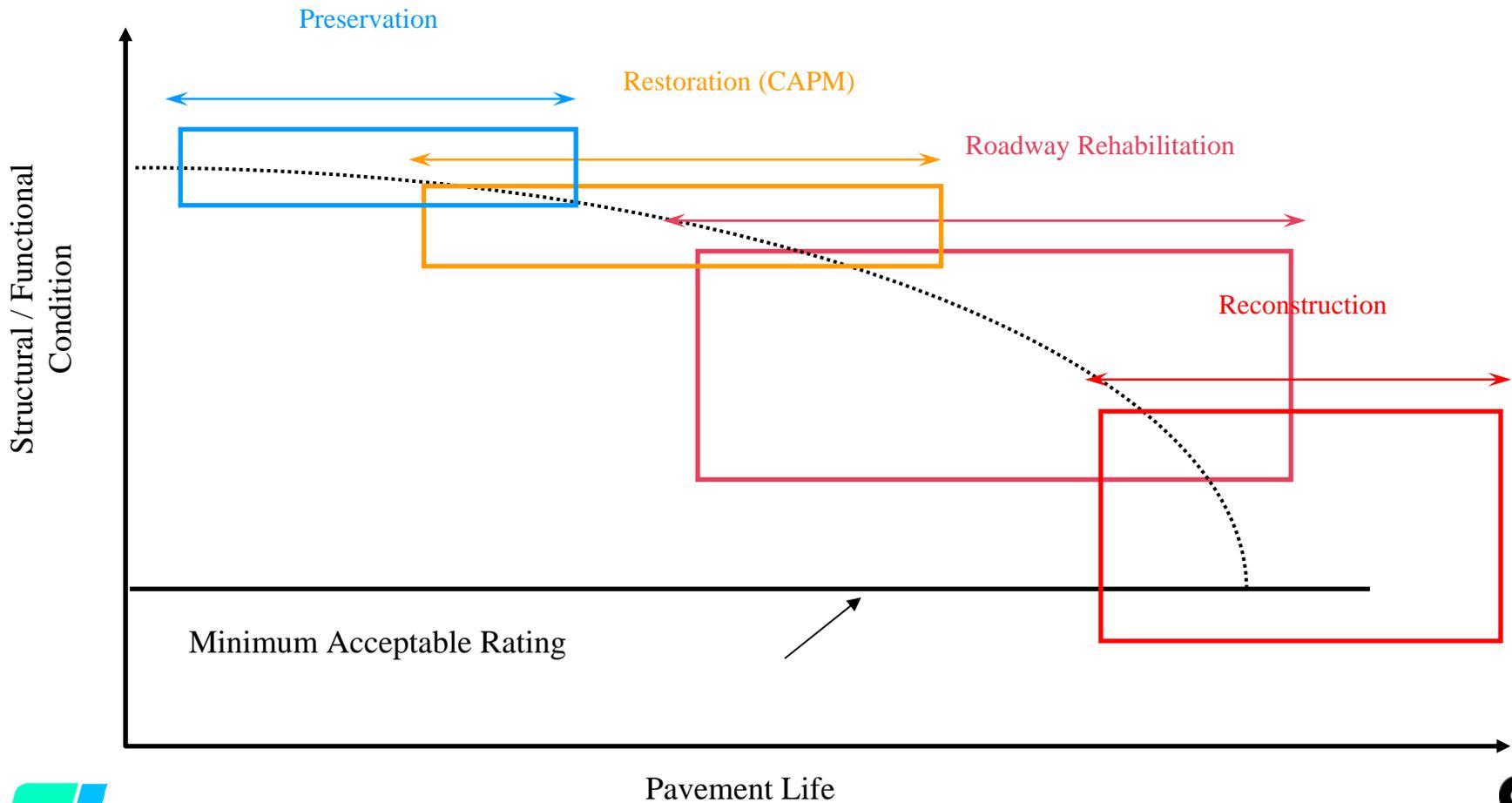
## Surface Characteristics

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



# Presentation Outline

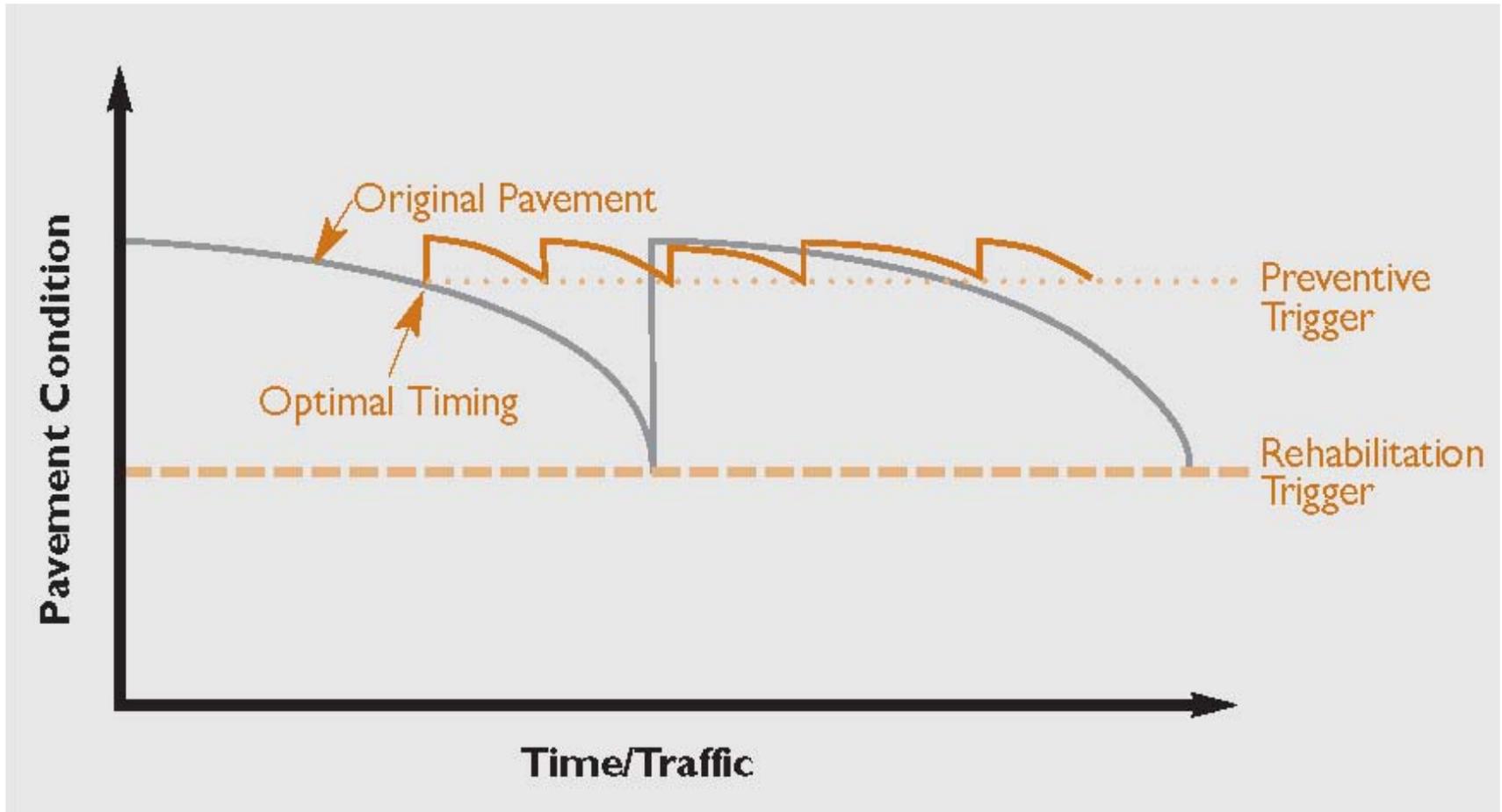
- Important Surface Characteristics
  - Ride quality
  - Surface Texture and friction
  - Noise
- Achieving Desired Surface Characteristics
- Summary



# 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 irregularities

# Timely Treatments Keep the Surface Characteristics in Good Condition



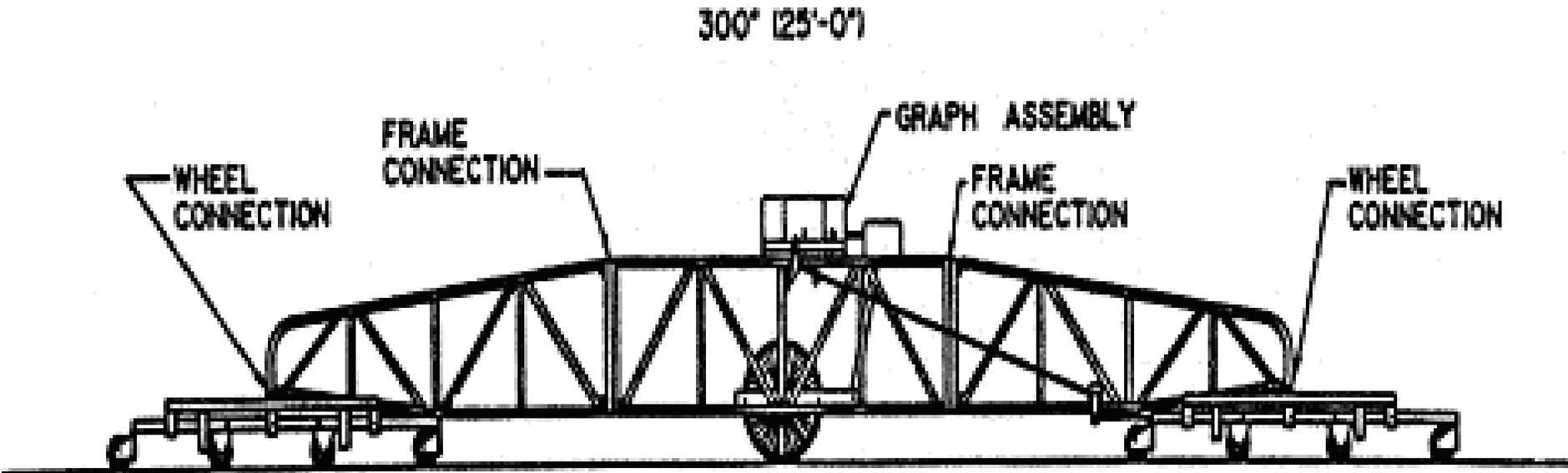
# Ride Quality

- 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

- 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
  - Road meters were used for many years to measure the relative smoothness of the pavement (e.g. Mays Meters). However, it is not a true measure of smoothness

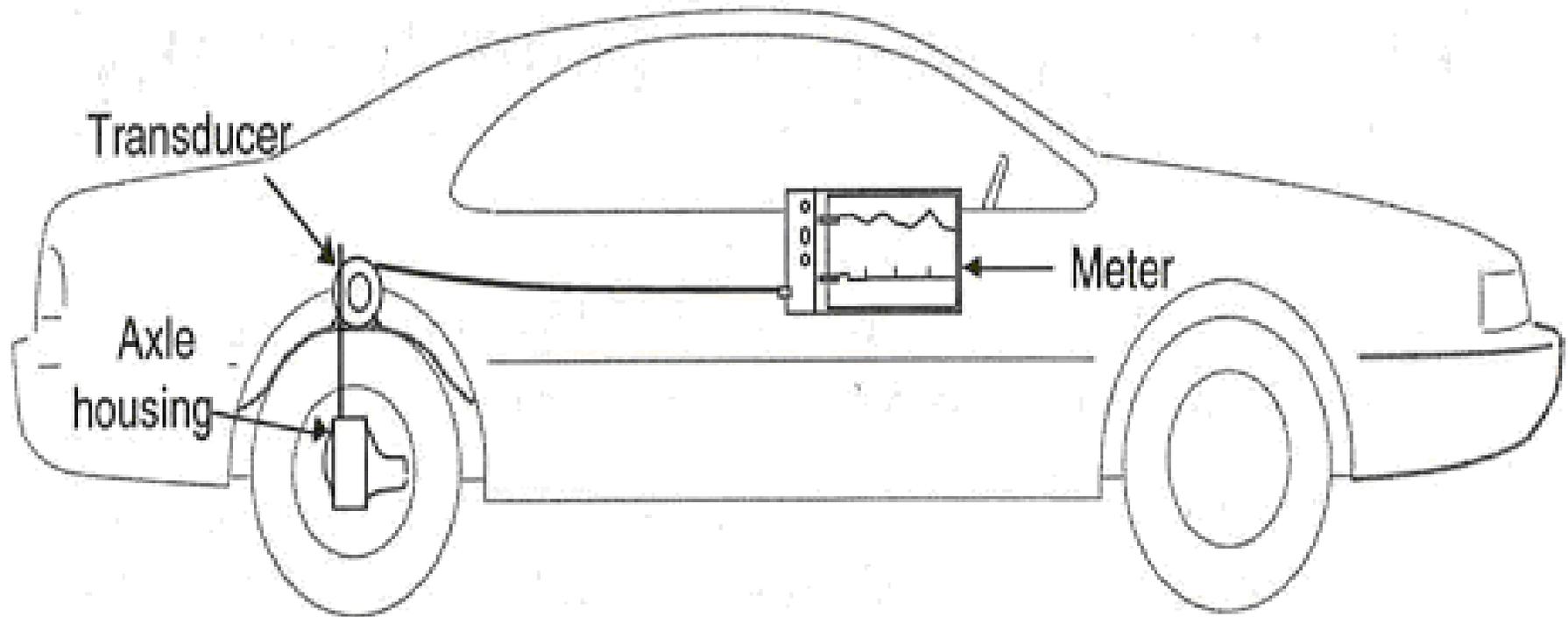
# California Profilograph



# Limitations of Profilographs

- Operates manually so the process is slow
- Cannot be used for high speed network data collection
- Used primarily for construction quality control

# Vehicle Instrumented with a Road Meter (e.g. Mays Meter)



# Limitations of Road Meters

- Operation dependent on the host vehicle; hence, equipment measurements were not transportable to other devices or other vehicles
- Not a true measure of smoothness-actually measures the relative motion of the host vehicle in response to the smoothness of the traveled roadway
- Smoothness measurements not stable over time

# Profiling Equipment



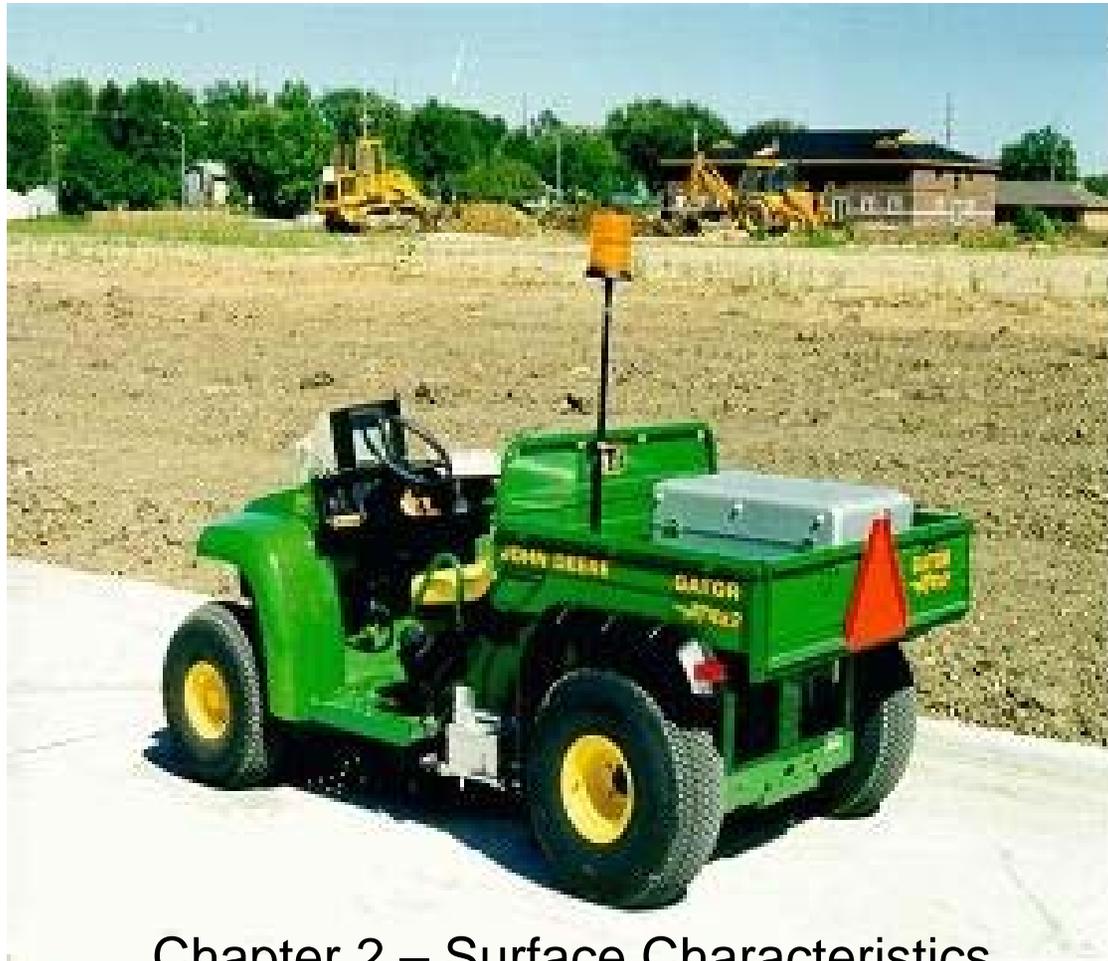
# Profiling Equipment

- Common for network pavement data collection
- Not designed for project level quality control
- Measures the longitudinal profile
- Inertial devices most commonly used (Dynatest Profilometer, South Dakota Profiling device)

# Profiling Equipment

- Operation typically requires a two person crew
- One person as the driver and one person to operate the system
- System calculates the roughness index in inches per mile

# Lightweight Profiler

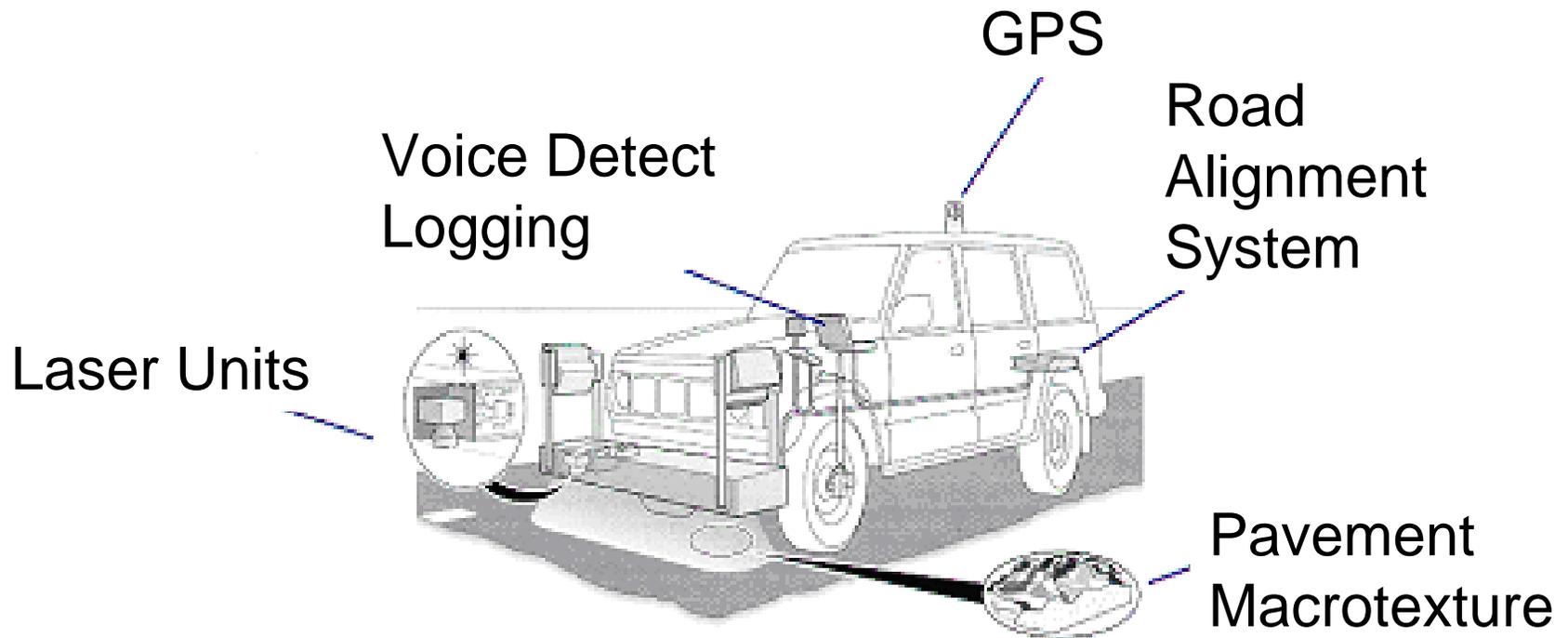


Chapter 2 – Surface Characteristics

# Lightweight Profiler

- New generation of profilers has emerged for quality control and quality acceptance purposes
- They are much smaller; however operating speeds are limited to 8-25 mph
- Equipment is available from Dynatest, Ames Engineering, International Cybernetics and Pathway services

# Multi-Laser Profiler



# Multi-Laser Profiler

- Useful in monitoring large road networks at speeds from 18-75 mph
- Simultaneously measures smoothness, rut depth, macro texture in both the longitudinal and transverse directions
- Portable devices are also available

# Summary

- Ride is an important surface characteristic
- It has been measured in a variety of ways
- Calibration of the ride equipment is important to get consistent results from year to year.

# Surface Texture

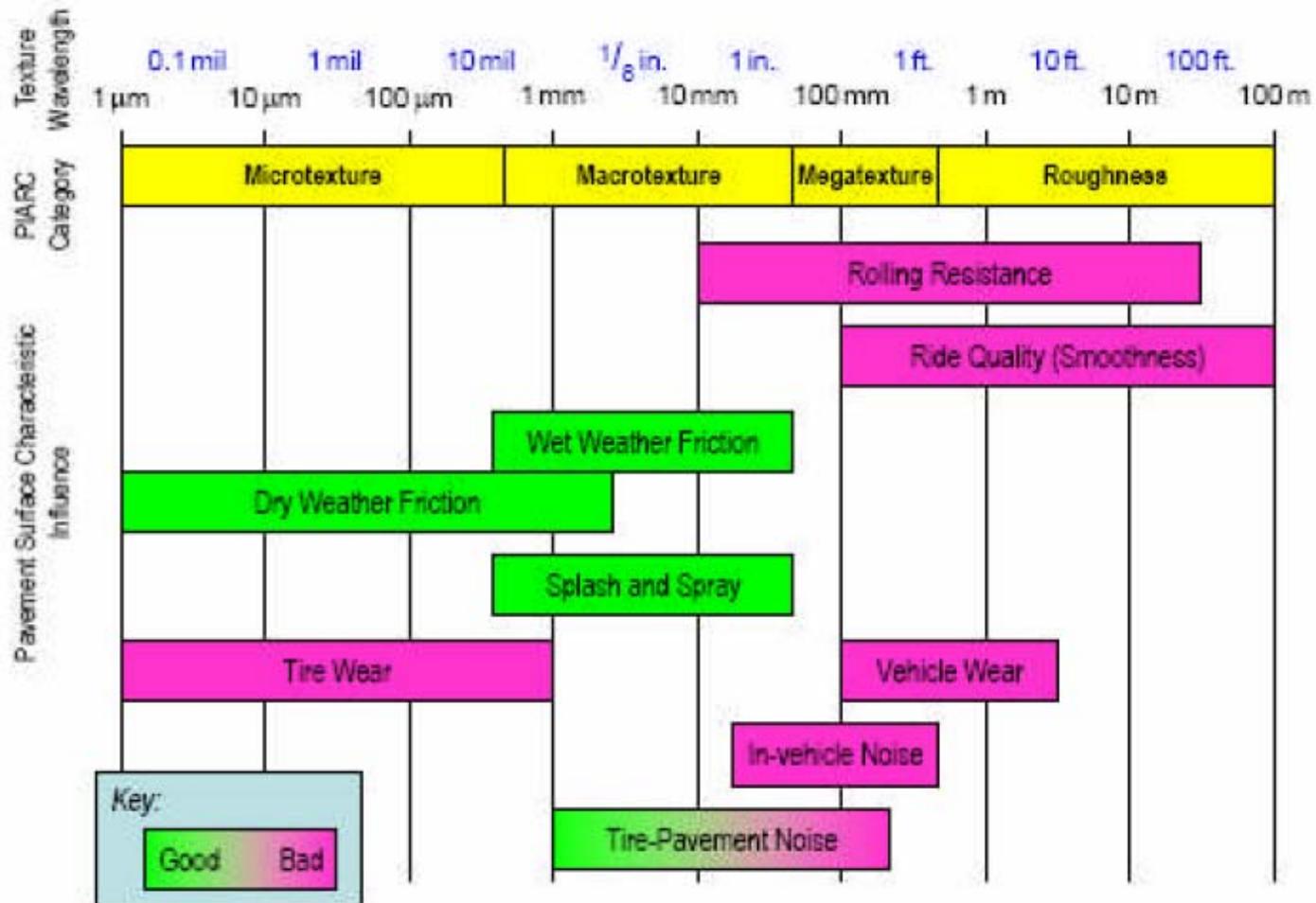
- Definitions
- Measurements of surface texture
- Summary



# Definitions

- Includes microtexture, macrotexture, and megatexture
- Texture affects friction, splash and spray, rolling resistance, and tire wear
- Roughness is not normally considered a traditional component of surface texture, but it does affect ride quality and noise.

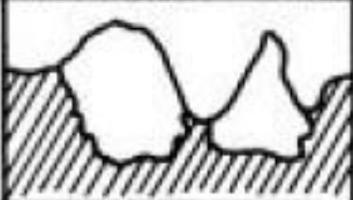
# Surface Characteristic Classifications



# Differences between Microtexture and Macrottexture

- Microtexture- fine texture and is all that is usually is needed to stop under normal dry conditions
- Macrottexture- intermediate texture and plays a key role in wet weather friction
- Megattexture- typically a result of poor construction practices and cause vibrations in tire walls, affects ride quality and produces noise

# Macrotexture vs. Microtexture

SURFACE	Scale of Texture	
	Macro (Large)	Micro (Fine)
A 	Rough	Harsh
B 	Rough	Polished
C 	Smooth	Harsh
D 	Smooth	Polished

# 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)



# Sand Patch Method



# Circular Texture Meter



# Outflow Meter



# Summary

- Surface texture influences several tire-pavement interactions
- Several methods have been used to measure texture; however the results cannot be compared directly
- It is believed by many that the CT meter is the best test for predicting wet weather friction

# Surface Friction

- Importance
- Factors affecting friction
- Measurement of surface friction
- Current practices
- Summary

# 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



# Factors Affecting Pavement Friction

- Tire design and condition
- Micro- and macro-texture
- Time and seasonal effects
  - Aggregate wear
  - Dust and oil accumulations
  - Cold climates
- Hydroplaning-cause by water ponding on the surface

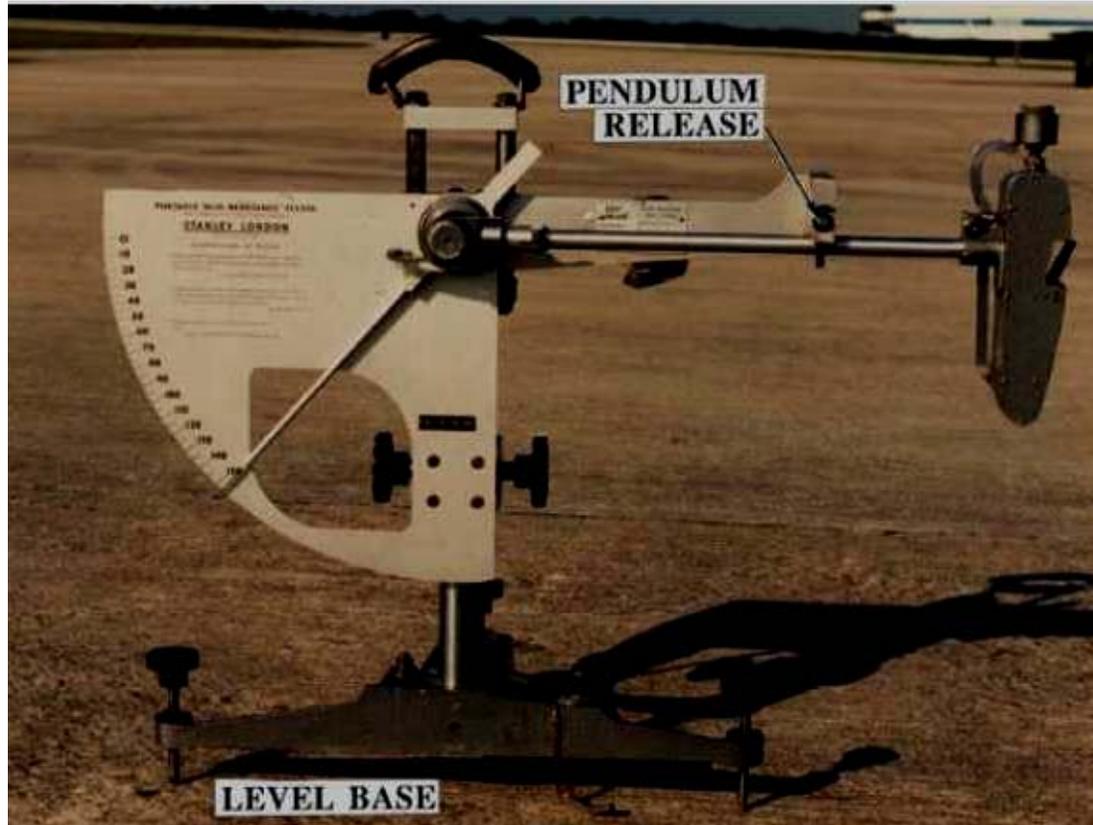
# Measurement of Surface Friction

- 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

# Locked Wheel Trailer (ASTM E-274)



# British Pendulum Tester



# Dynamic Friction Tester



# Caltrans Skid Tester (CTM 342)



# Current Practices

- FHWA-provides guidance to the states but recommends no minimum level of skid number
- AASHTO-Guides are currently being updated to provide more specific information
- SHA's-Many agencies require a minimum skid number of 30 to 40 for speeds greater than 40 mph

# Summary

- Highway safety is most important to the agency
- Pavement friction usually decrease over time
- Devices are available to measure surface friction
- Minimum acceptable skid numbers have been set by many agencies.

# 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)

# Achieving Desired Surface Characteristics for Rigid pavements

- Ride and smoothness- grinding is the most effective way to improve this property
- Texture and Friction- can be improved by grinding or with an overlay
- Noise- Grinding and overlays will improve this surface characteristic.

# Overall Summary

- Highway users are concerned with roadway surface characteristics
- Highway safety is most important to the agency , but ride and noise are important to the users
- Devices are available to measure all roadway surface characteristics
- We can control the surface characteristics through proper design and maintenance.

# Thank You

## Questions?