TOPIC 10

Pavement Management and Rehabilitation

Introduction

- Roadway deterioration over the years is inevitable
- The gradual deterioration occurs due to many factors including variations in climate, drainage, soil conditions, and traffic
- Lack of funds limits timely highway repair and rehabilitation
- "Pavement Management" is a term that describes the various strategies that can be used to decide on a pavement restoration and rehabilitation policy

Pavement management systems are methods used to develop efficient policies to monitor, maintain and rehabilitate deteriorating pavements

Pavement Evaluation

- Pavement condition data are used in:
  - Establishing project priorities
  - Establishing rehabilitation priorities
  - Forecasting pavement performance
- Originally, pavements were evaluated by visual inspection
- In more recent years, visual ratings have been supplemented with standardized testing equipment to measure:
  - Road roughness (rideability)
  - Surface condition (pavement distress)
  - Pavement deflection (structural failure)
  - Skid resistance (safety)

Pavement Roughness

- Refers to the irregularities in the pavement surface that affect the smoothness of a ride
- Can be defined as: deviations of a pavement surface from a true planar surface that affect vehicle dynamics, ride quality, dynamic loads and drainage
- Primary measure of PSI
- Equipment for measuring roughness are:
  - Response-type:
    - **Measures the response of vehicles to road roughness**
    - **Can be car-mounted or towed in trailers**
    - **Need to be calibrated frequently**
  - Profilometers:
    - **Measures the true profile of the pavement**
    - **Eliminate the need for calibration**

Figure 21.5 Mays Ride Meter Trailer Unit

SOURCE: Epps, J.A. and C.L. Monismith, NCHRP Synthesis of Highway Practice 126: *Equipment for Obtaining Pavement Condition and Traffic Loading Data*, Transportation Research Board, National Research Council, Washington, D.C., 1986.

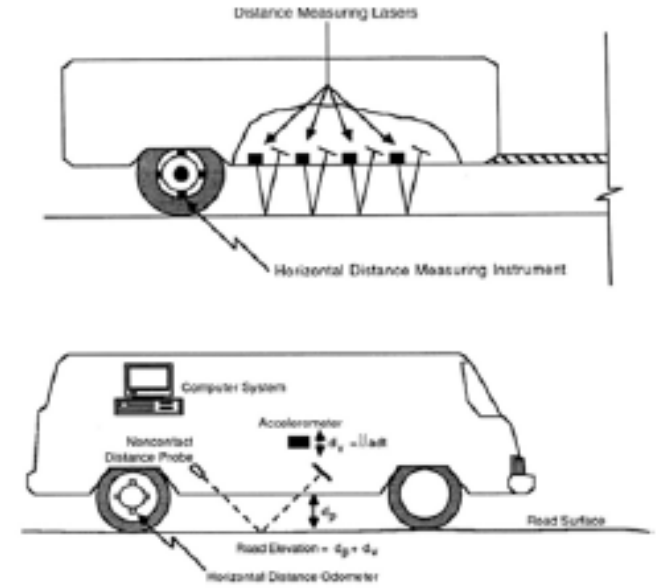
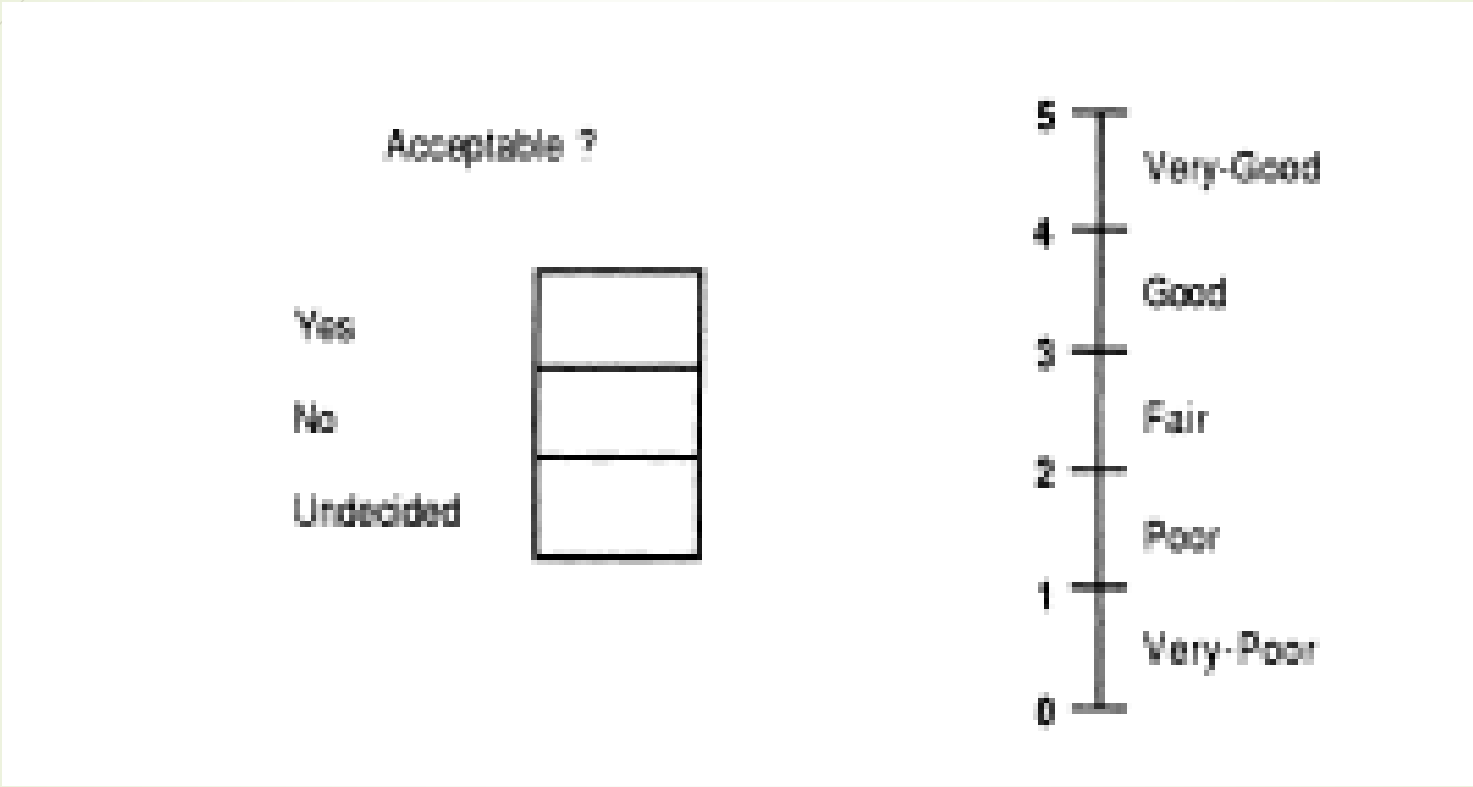


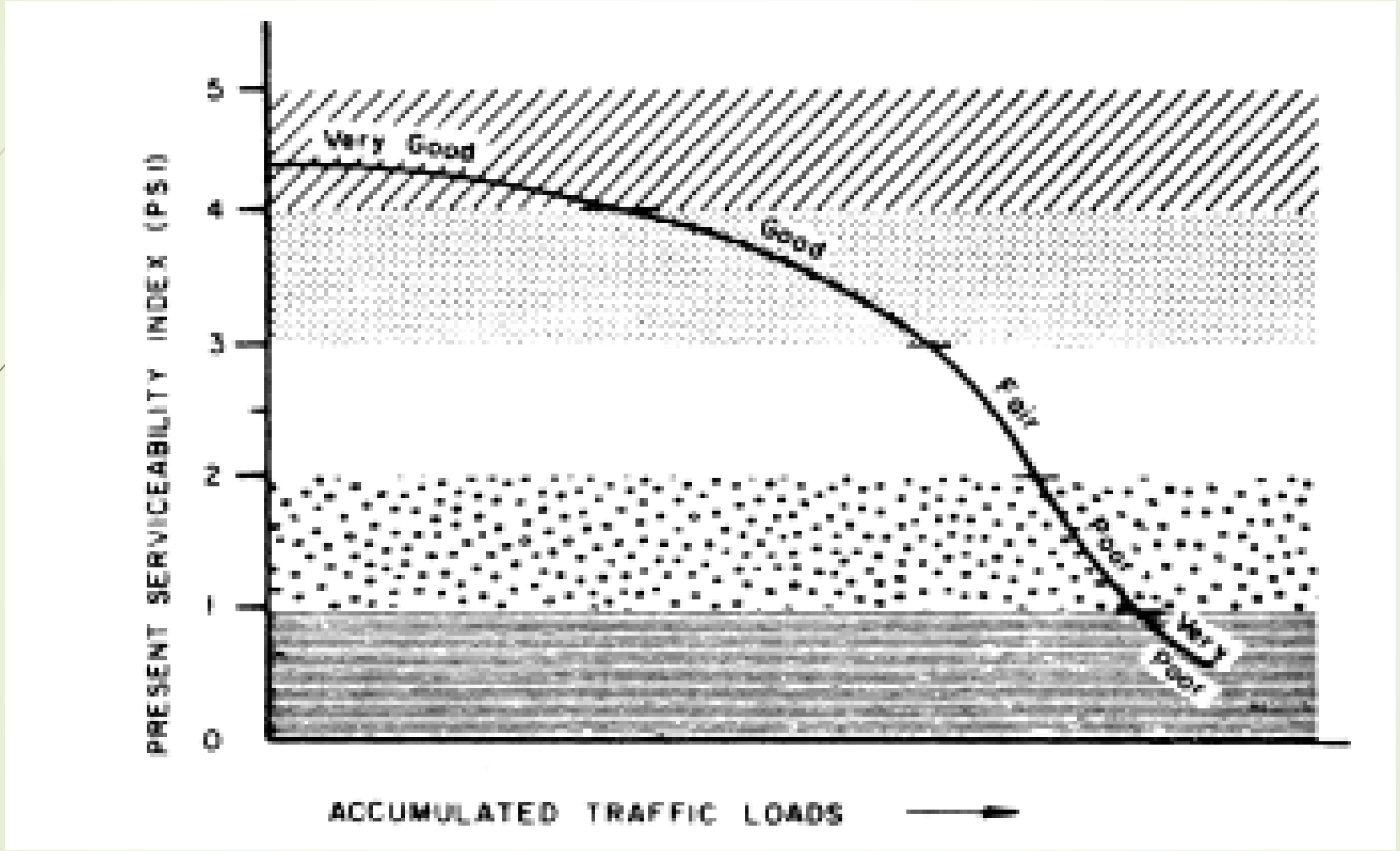
Figure 21.6 Example of Surface Dynamics Profilometer

SOURCE: R. Haas, W. R. Hudson, and J. Zaniewski, *Modern Pavement Management*, Krieger Publishing, Malabar, FL, 1994, p. 85. Used with permission.

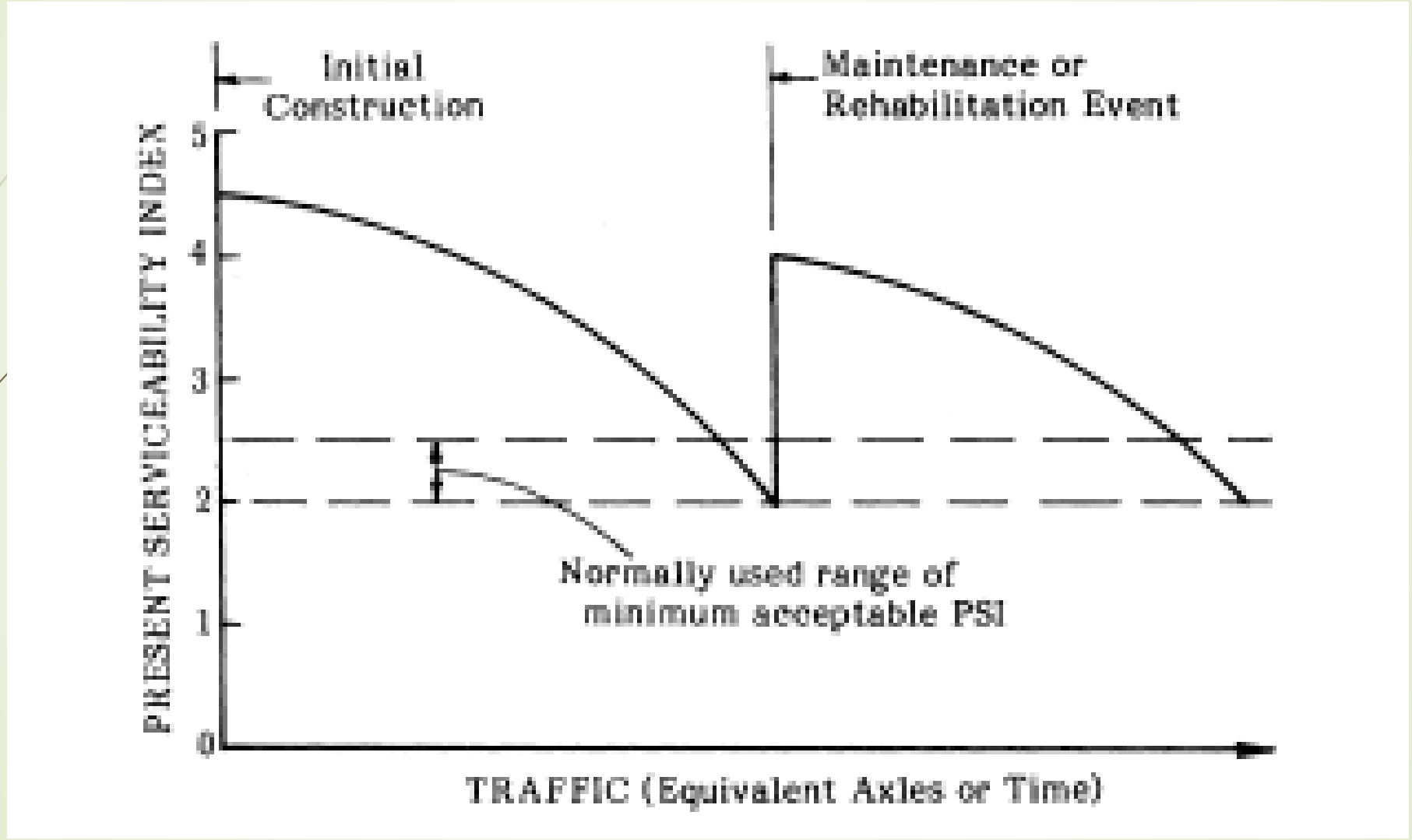
Pavement Roughness



Pavement Roughness



Pavement Roughness



Pavement Distress

- Refers to the condition of a pavement surface in terms of its general appearance
- A perfect pavement is level and has a continuous and unbroken surface
- A distressed pavement may be fractured, distorted, or disintegrated
- Most common measures for distress evaluation are:
  - Fracture: cracking
  - Distortion: rutting; shoving
  - Disintegration: ravelling
- Typically, distress data are obtained by trained observers
- Automated techniques can be used to record continuous images of pavement surface for later manual interpretation

Causes of Pavement Distresses

- Pavement distress is caused by various factors or a combination of factors including:

1. lack of structural capacity,
2. inadequate design,
3. inferior material quality,
4. poor construction techniques and/or
5. lack of preventive maintenance

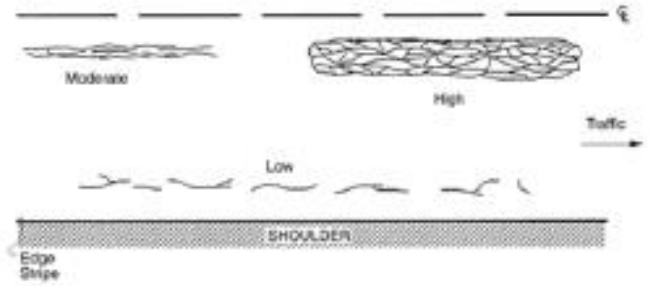
No.	Type	Description
1	Fatigue (alligator) cracking	Series of interconnected cracks caused by fatigue failure under repeate traffic loading
2	Longitudinal cracks	Individual cracks which form parallel to traffic direction or the roadway centerline
3	Transverse cracks	Observed on the pavement surface perpendicular to the direction of the traffic and roadway centerline
4	Block cracks	Interconnected series of longitudinal and transverse cracks, which divides the pavement into approximate square pieces
5	Edge Failure	Broken or irregular edge of a road wearing surface cause by poor drainage and lack of support at the pavement edg
6	Potholes	Small, bowl-shaped depressions in the pavement surface that penetrate c the way through the HMA layer down to the base course
7	Shoving	A form of plastic movement typified by ripples (corrugation) or an abrup wave (shoving) across the pavement surface
8	Raveling	The progressive disintegration of an HMA layer from the surface downwar as a result of the dislodgement of aggregate particles
9	Rutting	Surface depression in the wheel path
10	Depressions	Localized pavement surface areas with slightly lower elevations than th surrounding pavement
11	Patches	Sections of pavement that have been removed and replaced
12	Bleeding	A film of bituminous material on the pavement surface that become viscous when warm. It is caused by excessive amounts of bitumino materials in the asphalt mix

Code	Distress	Measure Unit	Defined Severity Levels?	Type of Distress	Cause
1	Alligator Cracking	M^2	Yes	Structural	Load
2	Bleeding	M^2	Yes	Functional	Other
3	Block Cracking	M^2	Yes	Structural	Climate
4	Bumps And Sags	M^2	Yes	Structural & Functional	Other
5	Corrugation	M^2	Yes	Functional	Other
6	Depression	M^2	Yes	Functional	Other
7	Edge Cracking	M^2	Yes	Functional	Load
8	Joint Reflection	M^2	Yes	Structural	Climate
9	Lane/Shoulder Drop-Off	M^2	Yes	Functional	Other
10	Longitudinal And Transverse Cracking	M^2	Yes	Structural	Climate
11	Patching And Utility Cut Patching	M^2	Yes	Structural & Functional	Other
12	Polished Aggregate	M^2	No	Functional	Other
13	Potholes	Number	Yes	Structural & Functional	Load
14	Railroad Crossings	M^2	Yes	Functional	Other
15	Rutting	M^2	Yes	Functional	Load
16	Shoving	M^2	Yes	Functional	Load
17	Slippage Cracking	M^2	Yes	Structural	Other
18	Swell	M^2	Yes	Structural & Functional	Other
19	Weathering And Raveling	M^2	Yes	Functional	Climate

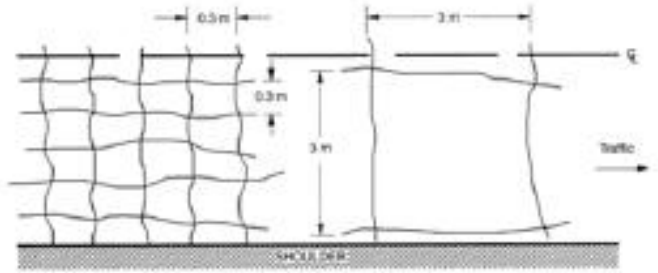
Pavement Distress

ACP Cracking

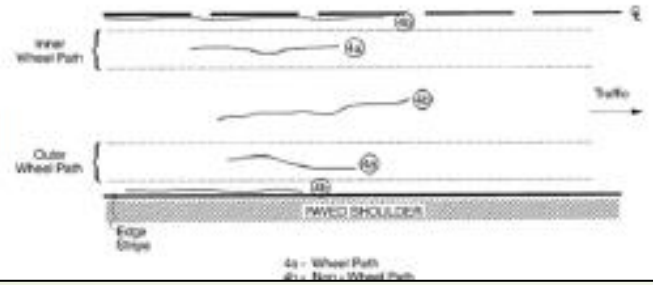
Fatigue



Block



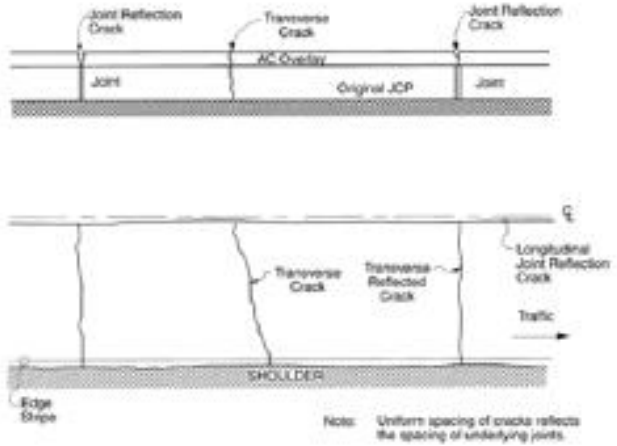
Longitudinal



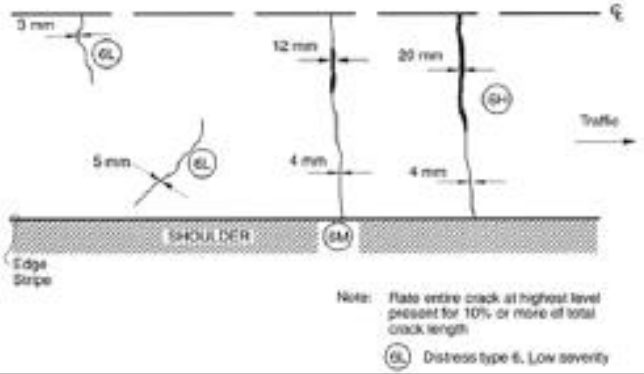
Pavement Distress

ACP Cracking (Cont'd)

Reflection



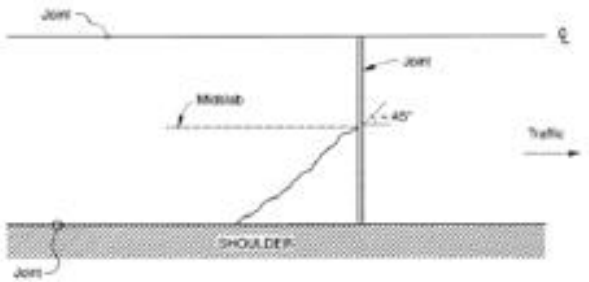
Transverse



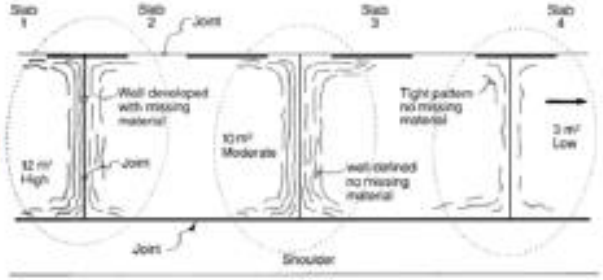
Pavement Distress

PCCP Cracking

Corner breaks



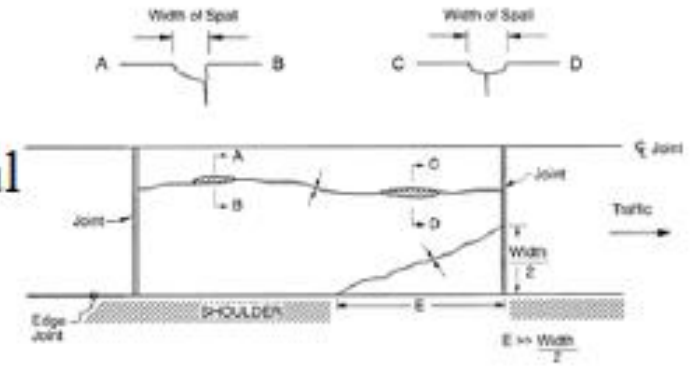
D-Cracking



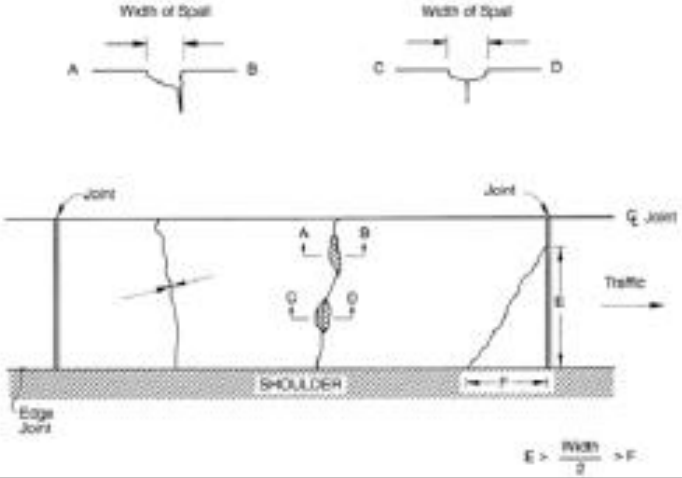
Pavement Distress

PCCP Cracking (Cont'd)

Longitudinal



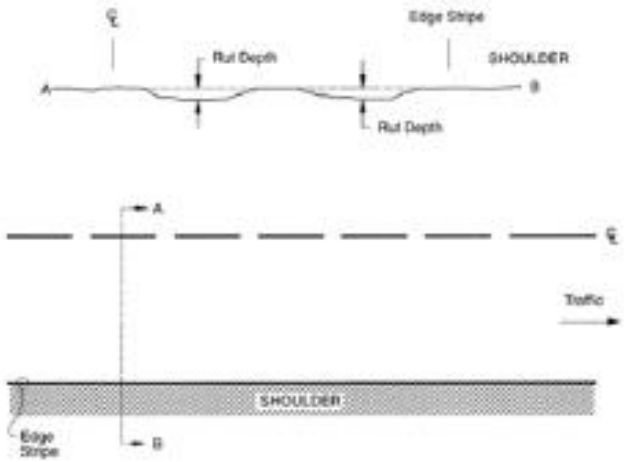
Transverse



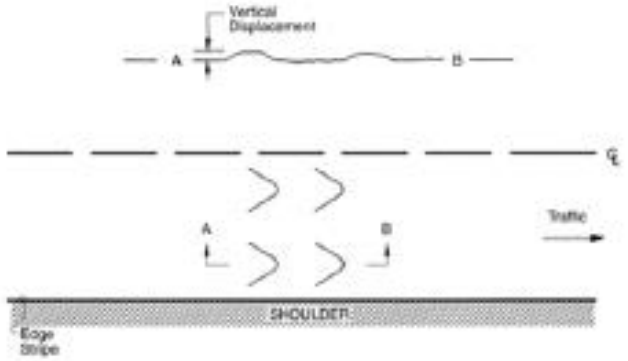
Pavement Distress

ACP Distortion (Deformation)

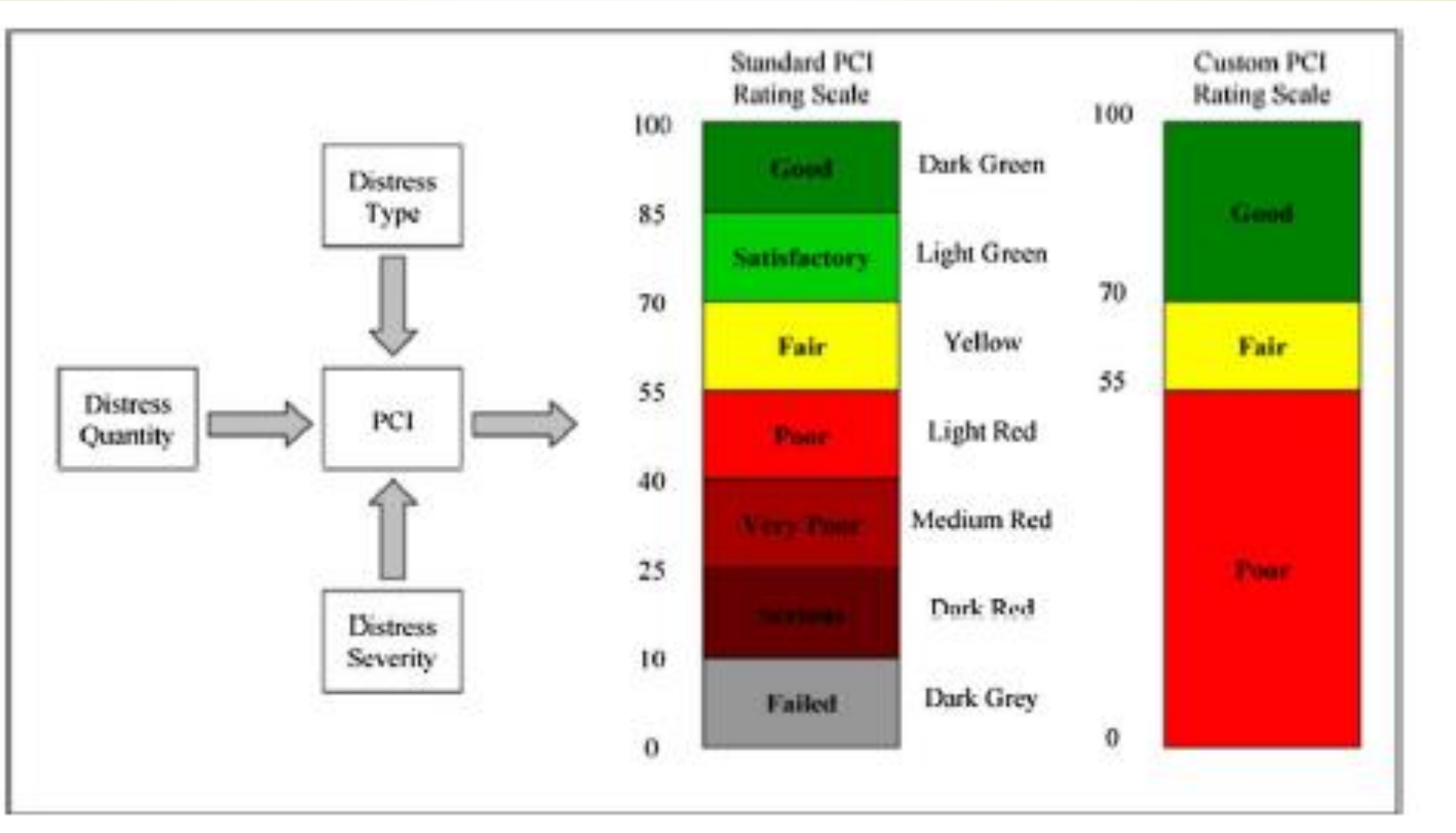
Rutting



Shoving



Pavement Distress

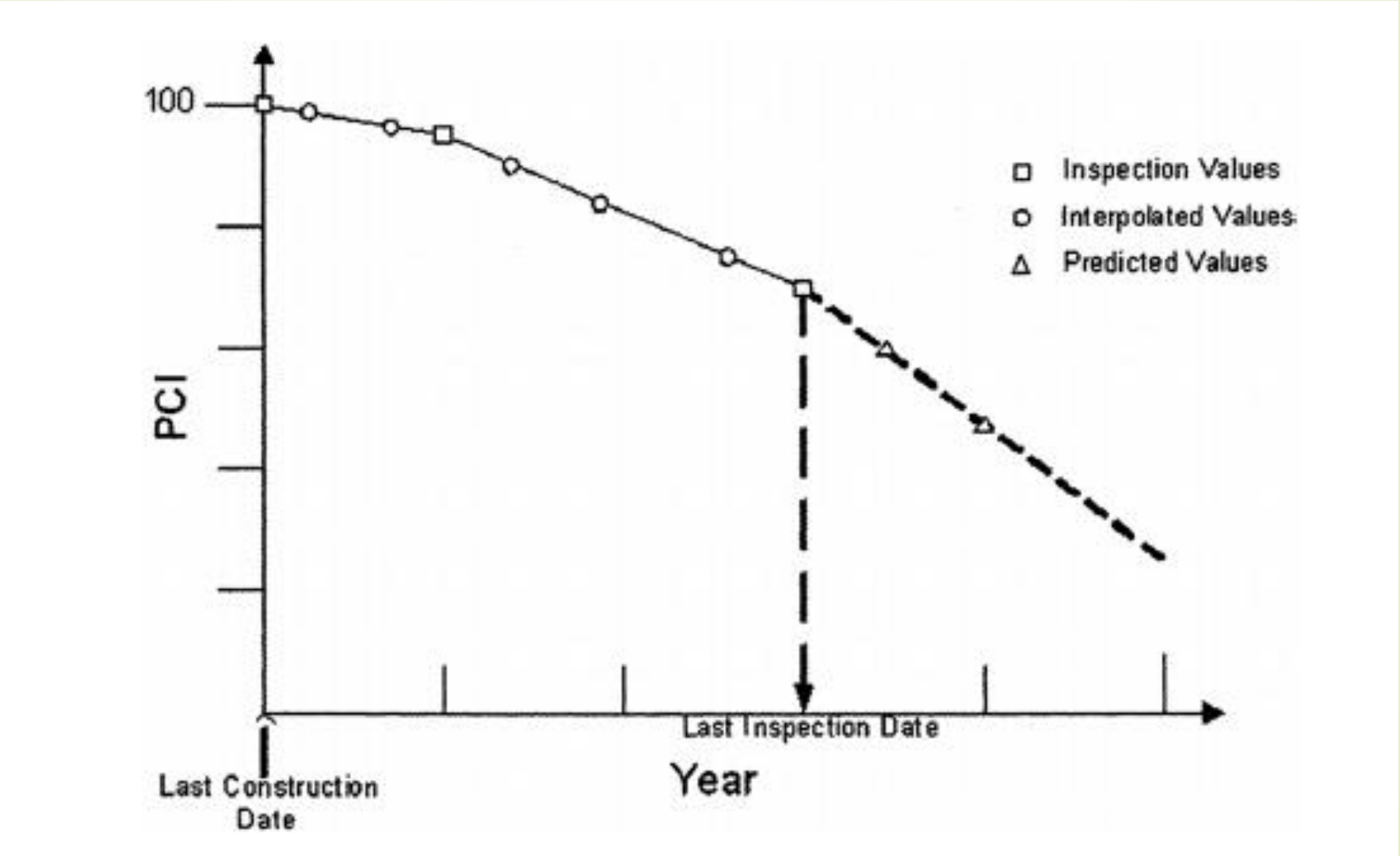


Pavement Distress

The PCI values estimation for sample section

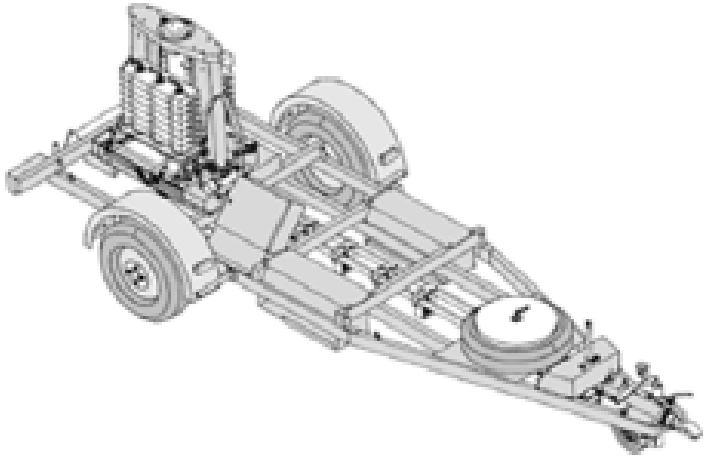
Unit	Distress severity	Quantity	density%	Deduct value	m_i	Q	TDV	CDV	PCI
2	Edge M	6	2.597	8	9.44	2	13.0	8.7	91
	Depression L	2	0.865	5					
4	Pothole L	4	1.731	32	3.98	2	47.4	34.3	66
	Edge M	30	13	15.4					
6	Edge H	25	10.822	25.5	7.77	1	25.5	25.5	75
8	Edge M	33	14.285	17.4	8.54	1	17.4	17.3	83
10	Edge H	32	13.852	29	7.41	1	29	28.5	72
12	—	—	—	—	—	–	—	—	100
14	Depression H	1.5	6.49	15.2	7.0	1	32.5	15.2	85
16	Depression H	1.5	6.49	15.2	7.0	1	32.5	15.2	85
18	—	—	—	—	—	–	–	–	100
20	—	—	—	—	—	–	–	–	100
Avg. PCI of section									85.7

Pavement Distress



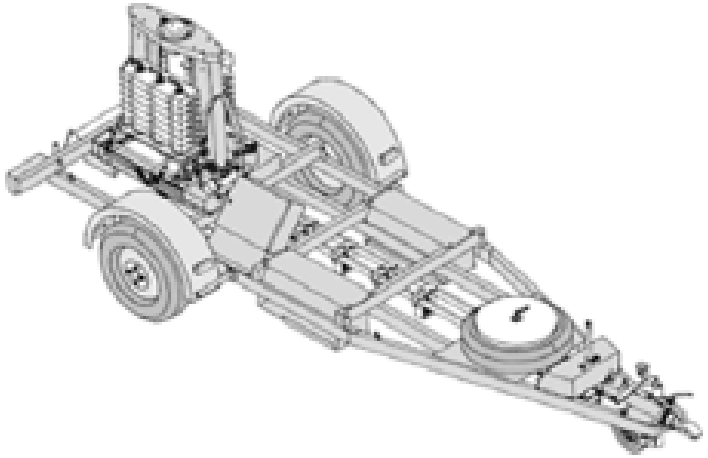
Pavement Structural Condition

- Structural adequacy can be measured by destructive or nondestructive tests
- Nondestructive tests are generally less accurate but faster and less expensive
- They are based on the premise that the pavement characteristics can be backcalculated using deflection measurements at the pavement surface
- Deflection measurements can be taken in response to a static, dynamic, or falling load
- Structural condition is rarely used for monitoring network pavement condition



Pavement Structural Condition

- Structural adequacy can be measured by destructive or nondestructive tests
- Nondestructive tests are generally less accurate but faster and less expensive
- They are based on the premise that the pavement characteristics can be backcalculated using deflection measurements at the pavement surface
- Deflection measurements can be taken in response to a static, dynamic, or falling load
- Structural condition is rarely used for monitoring network pavement condition



Skid Resistance

- Skid resistance data are collected to monitor and evaluate the effectiveness of a pavement in preventing or reducing skid-related accidents
- Coefficient of friction between a tire and pavement depends on weather conditions, pavement texture, tire condition, and speed
- Skid resistance is represented by a skid number (SN) that can be determined using a locked-wheel or yaw-mode trailer
- SN = 100 L/N

Maintenance and Rehabilitation Techniques

- Rehabilitation techniques are classified as:
  - Corrective:
    - **Permanent or temporary repair of deficiencies on an as-needed basis**
  - Preventive:
    - **Improvements intended to keep the quality of pavement above a predetermined level**
- Pavement rehabilitation strategies can be categorized in terms of:
  - The problem being solved
    - **e.g., skid resistance, cracking, roughness, …**
  - The type of treatment used
    - **e.g., overlay, surface treatment, …**
  - The type of surface resulting from the process
    - **e.g., AC overlay, rock seal coat, …**
- Maintenance and rehabilitation alternatives are evaluated by considering several factors including cost, experience, and traffic
- Expert systems can be used in the selection process of the maintenance and rehabilitation strategies
- Expert systems are useful in transferring experience to inexperienced users

Thank You!!!