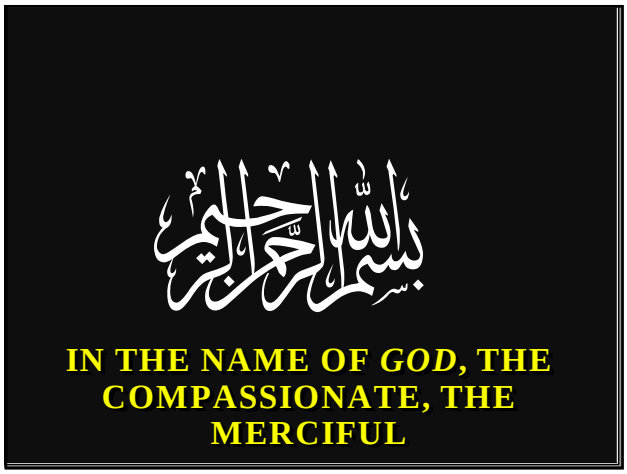
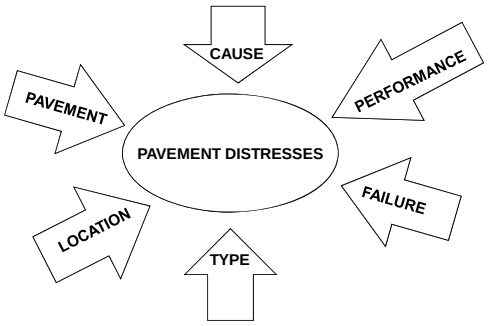



# UNDERSTANDING PAVEMENT DISTRESSES

## TOPICS

- Investment in Pavement.
- Types of Pavement Failure.
- Types of Pavement.
- Distress Grouping.
- Distress Rating.
- Role of Pavement Condition Surveys in PMS.
- Distress-Pavement Performance Relationships.
- Pavement Distress Prediction.




## Pavement Grouping

- Pavement Types-wise
- Distress Type-wise
- Failure-wise
- Cause-wise
- Location-wise
- Pavement Performance-wise

**INVESTMENT**

**PAVEMENT =**

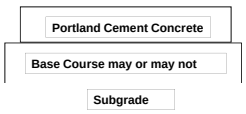

- INPUTS:
  - Money
  - Experience
  - Materials
  - Others

→

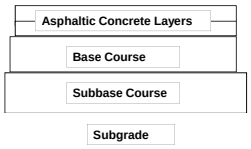
- OUTPUTS:
  - Transport
  - Safety
  - Comfort
  - Time Saving

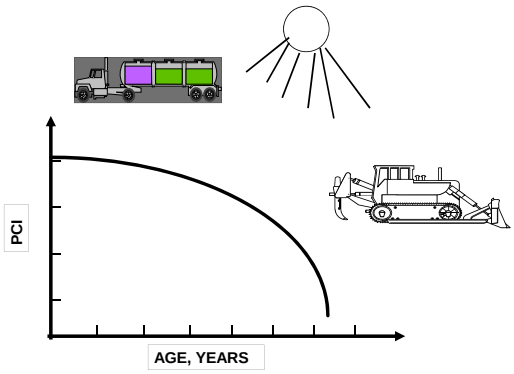
## Types of Pavements

**Rigid**




**Flexible**




## Flexible Pavement Distresses

**CRACKING**
- Alligator
- Block
- Edge
- Long. and Transverse
- Joint Reflection
- Mid-lane
- Slippage

**SURFACE DEFORMATION**
- Rutting
- Depression
- Corrugation
- Bumps & Sags
- Shoving
- Swelling
- Upheaval

**SURFACE DEFECT**
- Bleeding
- Polished Aggregate
- Weathering /Raveling
- Potholes
- Patching

**OTHERS**
- Lane Shoulder Drop-off
- Railroad Crossing

## Rigid Pavement Distresses

**CRACKING**
- Corner break
- Durability
- Linear
- Shrinkage
- Mapping
- Divided Slabs

**JOINT DEFICIENCY**
- Joint Seal Damage
- Corner Spalling
- Joint Spalling
- Faulting

**SURFACE DEFECT**
- Mapping Crazing
- Polished Aggregate
- Popouts
- Punchouts
- Patching
- Blow ups

**OTHERS**
- Lane Shoulder Drop-off

## Type of Pavement Failure

**Structural Failure: Collapse of the pavement structure due to breakdown of one or more of pavement components.**

**Functional Failure: Pavement can no longer carry out its intended function without causing discomfort to passengers or causing high stresses on vehicles operating over it.**

## FAILURE-WISE Distress Grouping

**Structural Distresses**
- Cracking
  - Edge
  - Alligator
  - Reflection
  - Long. & Transverse
- Rutting
- Heaving
- Shoving/Corrugation

**Functional Distresses**
- Cracking
  - Crazing
  - Shrinkage
  - Slippage
- Bleeding
- Raveling
- Shoving/Corrugation
- Stripping
- Polished Aggregate

## Possible Causes for Flexible Pavement Distresses

- Heavy Traffic Loads
- Climatic Factors
- Asphalt Mixture Problems
- Subgrade Conditions
- Construction Practice Problems

## Heavy Traffic Loads

- Overloaded Traffic
- High Tire Pressure
- Stopping and Starting Action

## Climatic Factors

- High Temperature Levels
- Thermal Cycles (Day-Night Cycling)
- Frost Heave Conditions

## Asphalt Mixture Problems

- Use of Low or High Asphalt Binder Content
- Excess Fines in The Mixture
- Use of Rounded Aggregates
- Use of Low Penetration Binder
- Use of Poor Quality Aggregates

## Subgrade Conditions

- Lack of Subgrade Support
- Excess of Moisture of High Water Table
- Use of Swelling Materials in The Subgrade.

## Construction Practice Problems

- Poor Compaction
- Poor Jointing
- Use Excess Prime and/or Tack Coats
- Poor Shoulders Conditions (Compaction, Support, etc.)
- Poor Railroad Pavement Leveling.
- Poor Drainage Facilities

## LOCATION-WISE GROUPING

- Wide Spread Distresses
- Localized Distresses

## Localized Distresses

- Bleeding
- Bumps & Sags
- Depression
- Joint Reflection Cracking
- Patching and Utility Cuts
- Railroad Crossing
- Shoving
- Swelling
- Potholes

## Wide Spread Distresses

- Alligator Cracking
- Block Cracking
- Lane/Shoulder Drop-off
- Edge Cracking
- Long. and Transverse Cracking
- Polished Aggregate
- Rutting
- Raveling

## Performance- Distress Grouping

- Skid Related Distresses
- Riding Quality Related Distresses

## Performance- Distress Grouping

- Skid Resistance Related Distresses
  - Polished Aggregate
  - Bleeding
  - Rutting (with Wet-Surface Conditions)
  - Depression (with Wet-Surface Conditions)
  - Bumps and Sags (with Wet-Surface Conditions)

## Performance- Distress Grouping

- Riding Quality Related Distresses
  - Raveling
  - Rutting
  - Bumps and Sags, Shoving, Upheaval, Swelling, and Depressions
  - Patching and Utility Cuts
  - Railroad Crossing
  - Alligator Cracking
  - Potholes
  - Slippage Cracking

## PAVEMENT PERFORMANCE AND DISTRESSES

- Riding Quality Criteria
- Safety Criteria
- Structural Capacity Criteria

## PAVEMENT PERFORMANCE AND DISTRESSES

- Riding Quality Criteria
  - Alligator Cracking
  - Surface Deformation Distresses (Rutting, etc.)
  - Raveling
- Safety Criteria
  - Bleeding
  - Polished Aggregate
  - Pavement Surface Distortion Distresses at Wet Condition

## PAVEMENT PERFORMANCE AND DISTRESSES (Contd.)

- Structural Capacity Criteria
  - Any Load-Associated Distress with HIGH Severity Level
  - Any HIGH Severity Level Distress that cause pavement disintegration.

## DISTRESS EVALUATION IN PMS

- Condition Survey is one of the major Components of any PMS
- It includes a detailed identification of distress type, severity, extent, and location.
- It gives a general condition rating of pavement sections.
- It complements the performance evaluation to achieve the pavement evaluation process.

## DISTRESS EVALUATION IN PMS (Contd.)

- It is a part of maintenance prioritization subsystem.
- It is an assessment tool to maintenance strategy selection subsystem.
- It is a measure of pavement serviceability.

## DISTRESS RATING

**DISTRESS SEVERITY**

- LOW: Problem has just started or in early stages.
- MEDIUM: Intermediate state of the problem or pavement deterioration is in progress.
- HIGH: Distress is highly pronounced and acceptable levels are exceeded.

## PAVER Method : Flexible Pavement
## DISTRESS SEVERITY

| | Distress Type | Low | Medium | High |
|---|---|---|---|---|
| 1 | Alligator Cracking | Fine, not spalled | pattern, lightly spalled | Well defined pieces |
| 2 | Bleeding | Few days in a year | Sticks to shoes | Sticks and lasts weeks |
| 3 | Block Cracking | < 10 mm nonfilled,or filled (any width) | 11-75 mm crack nonfilled, or filled/nonfilled with random cracks | > 75 mm nonfilled, or any crack surrounded by M or H random cracks |
| 4 | Bumps & sags * | Low sev. ride quality | Med. sev. ride quality | High sev. ride quality |
| 5 | Corrugation | Low sev. ride quality | Med. sev. ride quality | High sev. ride quality |
| 6 | Depression | 13-25 mm deep | 26-50 mm deep | > 50 mm deep |
| 7 | Edge Cracking * | L or M crack with no raveling | Med. crack with some breakup and raveling | Considerable breakup and raveling along the edge |
| 8 | Joint Reflection cracking over PCC slab | < 10 mm nonfilled,or filled (any width) | 11-75 mm crack nonfilled, or filled/nonfilled with random cracks | > 75 mm nonfilled, or any crack surrounded by M or H random cracks |
| 9 | Lane/Shoulder Dropp Off * | 25-50 mm difference in elevation | 51-100 mm difference in elevation | > 100 mm difference in elevation |
| 10 | Long. and Transverse Cracking* | < 10 mm nonfilled,or filled (any width) | 11-75 mm crack nonfilled, or filled/nonfilled with random cracks | > 75 mm nonfilled, or any crack surrounded by M or H random cracks |

## PAVER Method : Flexible Pavement
## DISTRESS SEVERITY

| Distress Type | Low | Medium | High |
|---|---|---|---|
| 11. Patching and Utility Cut Patching for small areas | Good patch Low sev. riding quality | Moderately deteriorated and/or Med. sev. ride quality | Badly deteriorated and/or High sev. ride quality, |
| 12. Polished Aggregate | No degree of severity | | |
| 13. Potholes ** | Depth (mm) / Diameter (mm): 13-25: 100-200 M, 201-460 M, > 460 H; > 25-51: 100-200 M, 201-460 M, > 460 H; > 51: 100-200 M, 201-460 M, > 460 H | | |
| 14. Railroad Crossing | Low sev. ride quality | Med. sev. ride quality | High sev. ride quality |
| 15. Rutting | 6-13 mm deep | 14-25 mm deep | > 25 mm deep |
| 16. Shoving | Low sev. ride quality | Med. sev. ride quality | High sev. ride quality |
| 17. Slippage Cracking | < 10 mm crack width | 11-40 mm crack width | > 40 mm crack width |
| 18. Swell | Low sev. ride quality | Med. sev. ride quality | High sev. ride quality |
| 19. Weathering and Raveling | Agg. or binder has started to wear aways | Agg. and/or binder has worn away | Agg. and/or binder has considerably worn away |

# DISTRESS RATING
## DISTRESS EXTENT

- **DENSITY : Percentage of affected portion of the surveyed area**
  - **Distresses Measured By Linear Length**
    - **Long. &Transv., Joint, and Edge Cracking**
    - **Bumps and Sags**
    - **Lane Shoulder Drop-off**
  - **Distress Measured By Number**
    - **Potholes**
  - **Distress Measured By Area**
    - **All Others.**

## DISTRESS PREDICTION

- Cracking (Load Associated)
  - Fatigue Analysis & Modeling
- Rutting (Permanent Deformation)
  - Rut Depth Modeling
- Low Temperature Cracking (Thermal)
  - Thermal Cracking Modeling

## Fatigue Analysis
## Rut Depth Analysis
## Low Temp. Cracking

- Input Parameters
  - Traffic Loads
  - Material Properties
  - Environmental information
  - Construction Requirements
- Output Parameters
  - No. of Load Applications to Failure.
  - Stresses and Strains Critical for Permanent Deformation
- Decisions
  - Comparison between Available and Allowable Limits
- Models

# *Thanks*