# Variability of Pavement Distress Data From Manual Surveys

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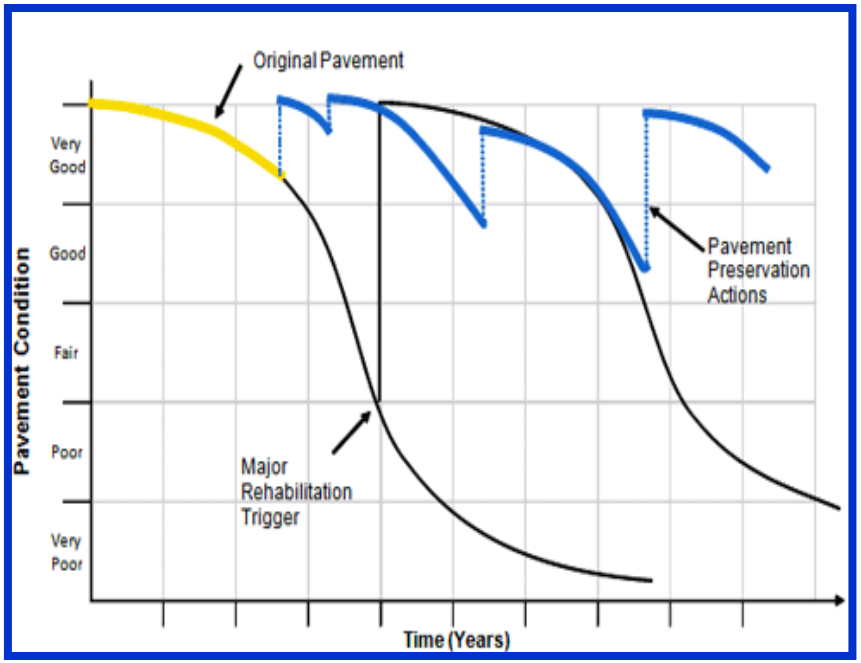
LTPP
LONG TERM Pavement PERFORMANCE

# Outline

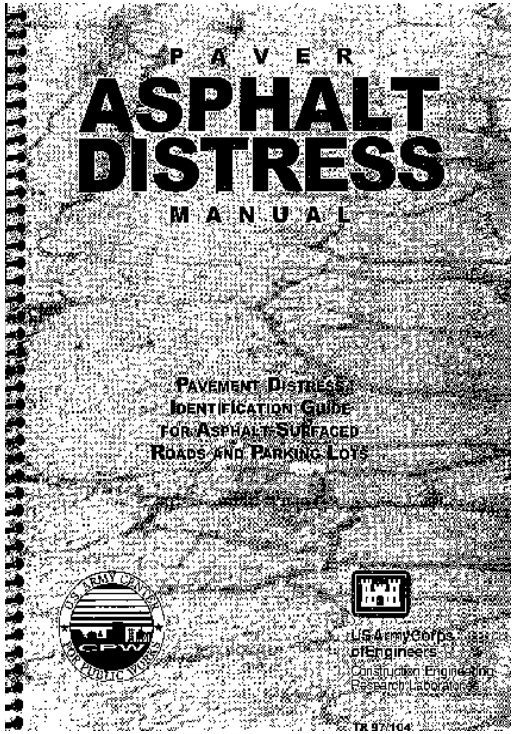
- Introduction
- Factors That Affect Variability
- Results of LTPP Study
- Observations

# Introduction

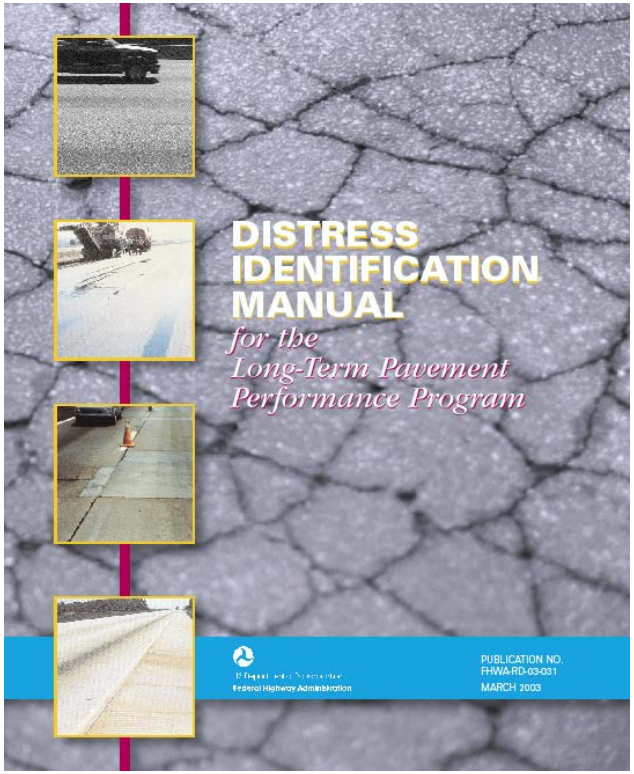
- Project Level M & R Selection
- Network Level Budgeting
- Performance Evaluations



# Distress Protocols




- FHWA
- PAVER
- State DOT
- ASTM

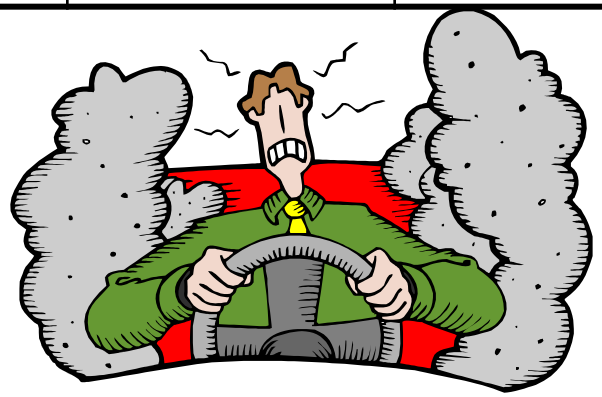


# Common AC Cracking Distresses

- Fatigue
- Block
- Longitudinal
- Transverse

# Evolution

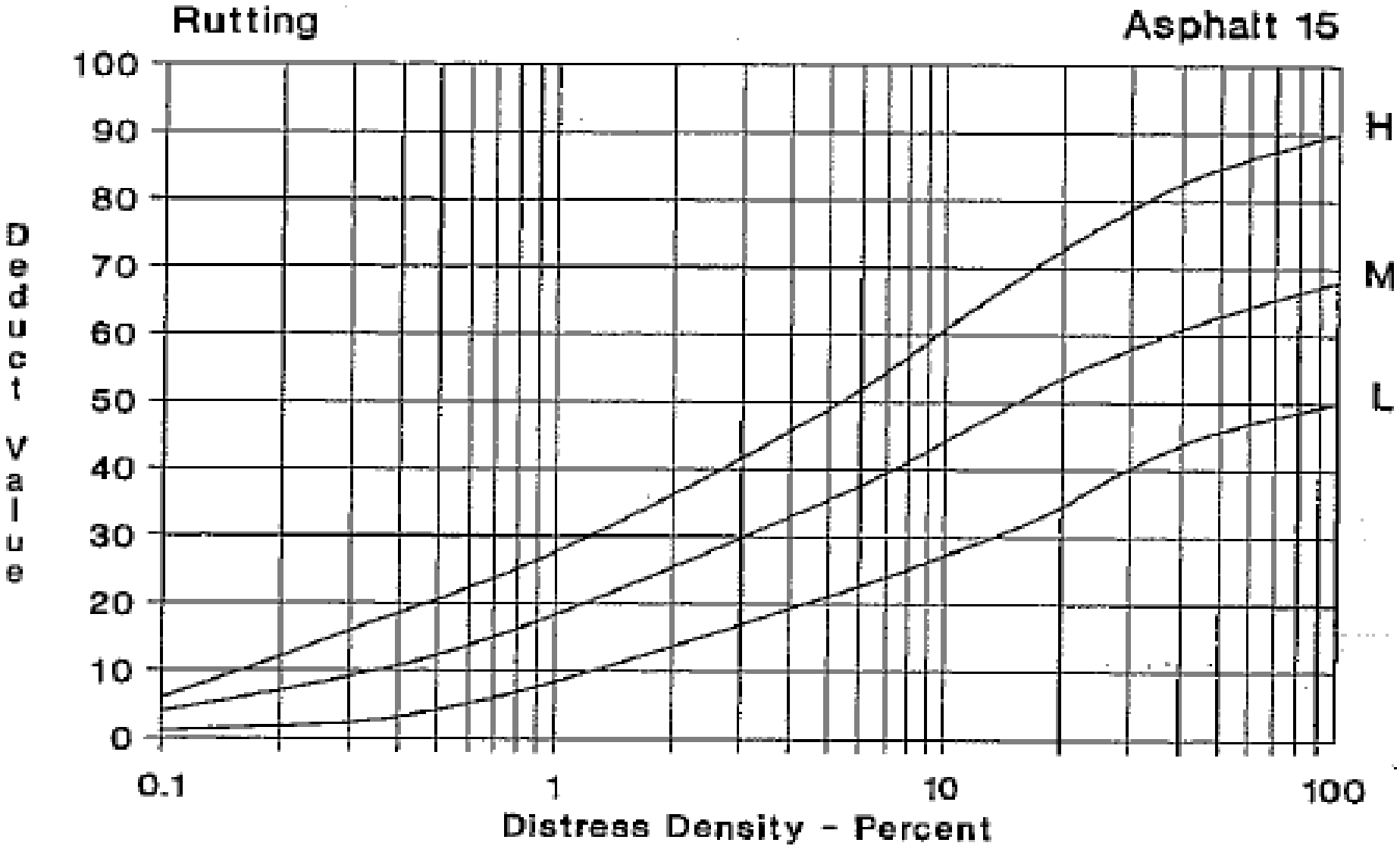
| Methodology | Fast | Safe | Repeatable |
|---|---|---|---|
| Walking | | | |
| Windshield | ✓ | | |
| Semi-Automated | ✓ | ✓ | |
| Automated | ✓ | ✓ | ✓ |



# Introduction

- “Precision and Bias”
- “Ground truth”

# Deduct Values



# Why is This So Important?

- What Distresses
- Ability to Quantify
  - Distresses
  - Severities
- Precision and Bias
- How they are combined

- All Affect
  - Cost Effectiveness
  - Reliability

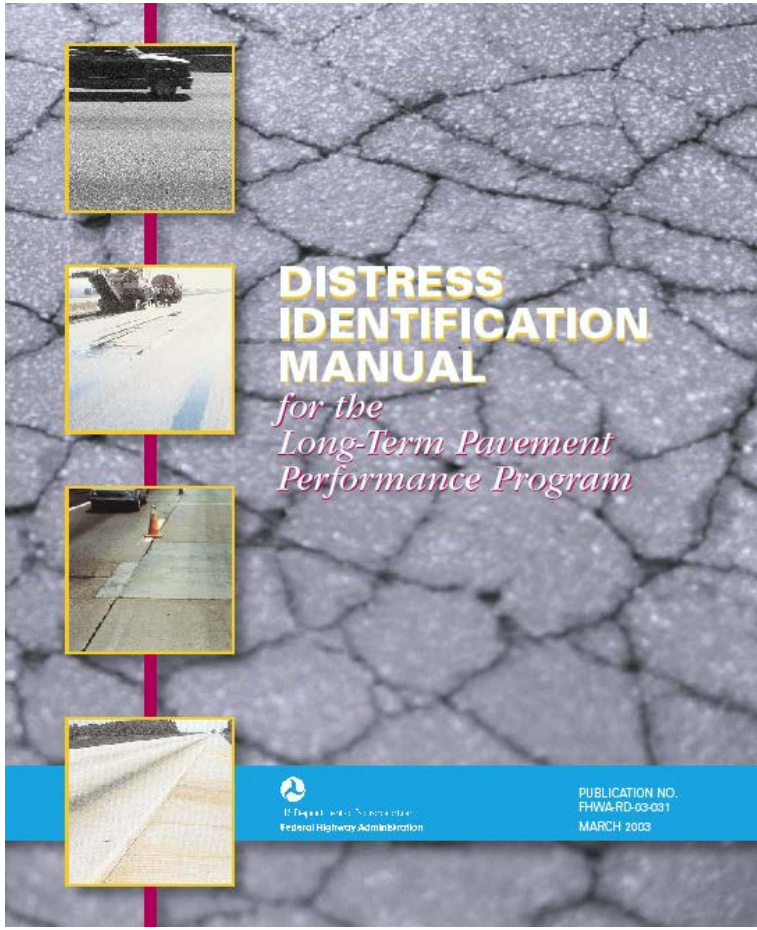
- Need Ability to Use Data With Confidence

# Factors That Affect Variability

- Clarity of Distress Protocols
- Quantity
- Severity
- Environment
  - Temperature
  - Moisture,
  - Sunlight and
  - Angle of sun
- Rater proficiency
- Rater visual acuity

# LTPP Study

- Conducting manual surveys over past 20 years
- Conduct Workshops Annually for all Raters



# LTPP Study

- Studied results of first 9 workshops
- 119 individual ratings
- All ratings
  - Same Day
  - Same Section
- Reference Surveys
  - "Ground Truth"
  - Consensus of Instructors
  - Immediately before individual ratings

# LTPP Study

| Distress Type | Unit | Reference | Mean | Std. Dev. | COV (%) | Bias |
|---|---|---|---|---|---|---|
| Fatigue | meters$^2$ | 14.2 | 16.5 | 6.2 | 38 | 2.3 |
| Longitudinal WP | meters | 18.4 | 18.3 | 6.0 | 33 | -0.2 |
| Longitudinal NWP | meters | 75 | 70.7 | 14.7 | 21 | -4.3 |
| Transverse | number | 26.4 | 24.7 | 3.2 | 13 | -1.7 |
| Transverse | meters | 44.3 | 44.6 | 4.2 | 9 | 0.3 |

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# Fatigue Cracking

- Normally occurs in Wheel Paths.
- Develops into a characteristically chicken wire or alligator pattern in later stages.
- Must have a quantifiable area.

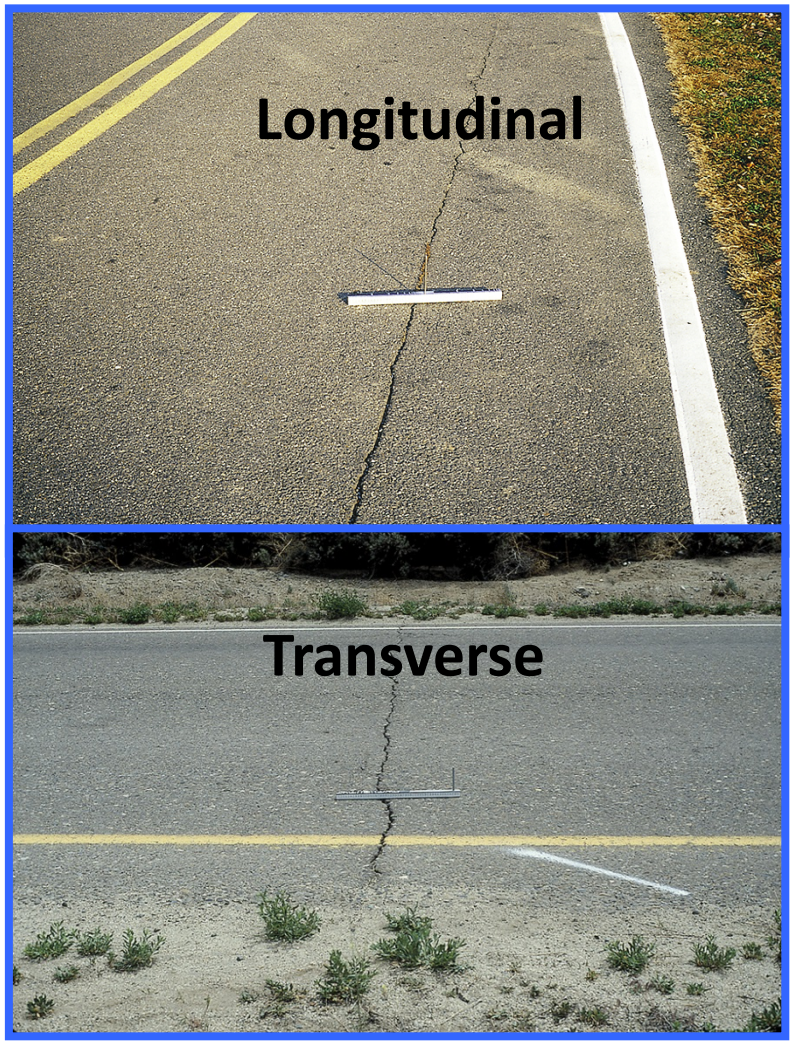
# Fatigue Cracking

- Low severity has no or only a few connecting cracks. No spalling, no sealant, no pumping.
- Moderate severity has complete pattern. Cracks may be spalled, may be sealed, no pumping.
- High severity has moderate or severe spalling. Pieces may move under traffic, may be sealed, may have pumping.

# Longitudinal & Transverse Cracking

- Longitudinal - Cracks predominantly parallel to the pavement centerline. Location is Significant (wp/nwp).
- Transverse - Cracks predominantly perpendicular to the pavement centerline

- Severities
  - Low: < 6mm wide or sealed cracks
  - Moderate: < 18mm or any crack with adjacent low severity random cracking.
  - High: > 18mm or any crack with adjacent moderate to high severity random cracking.



# LTPP Study Global Trends

- Individual rater variability
  - For any given distress type/severity combination
  - Is typically large
  - And increases as the distress quantity increases
- Total distress group means
  - Are generally close to the reference value
  - With less scatter than the individual severities
  - Showing significant differences in distinguishing severities
- For closely related distresses
  - Such as fatigue and longitudinal wheelpath cracking
  - Compensatory differences were observed
- Generating a composite score produced greater agreement

# LTPP Study Observations

- Standard Deviation seem to increase
  - As distress quantity increases
- Bias for most distress/severity combinations is small
  - Suggesting group means may be used to represent an unbiased estimate of the reference values
- Precision of manual distress data varies considerably
  - However, most of the large COVs are associated with small magnitudes of distress

# LTPP Study Outcomes

- Continual enhancements in Rater training
- Continual enhancements in Distress Protocols
- Minimum levels of data collection activity
- Stricter, more uniform data quality checks
- Target levels of variability of less than 10%

# Overall Variability Observations

- Evolution of automation has the potential to address many of the human factors
  - Rater Proficiency
  - Rater visual acuity

# Overall Variability Observations

Remember though,

Some variability

is beyond the Rater's control

- Environment
- Distress definitions

# Pooled Fund Study TPF-5(299)

**Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis**

1. Preparation
2. Verification
3. Precision and Bias Studies
4. Implementation

# Conclusions

- Establish Truly Quantifiable Ratings
- Only Collect the Data You Need
- Use Data Collection Protocols that Affect Decisions
- Be Consistent!

As Yogi Berra aptly put, “If you don’t know where you’re going, you might wind up someplace else”