Pavement Evaluation Techniques

Pavement Evaluation

1. Surface condition / distress
2. Serviceability / roughness
3. Structural capacity
4. Surface friction

Pavement Evaluation

1. Surface condition / distress
2. Serviceability / roughness
3. Structural capacity
4. Surface friction

1. Condition (Distress) Survey

- Document existing condition
- Determine causes of deterioration
- Identify repair locations and quantities
- Identify feasible maintenance alternatives

Distress Characterization

- Type
- Severity
- Extent

Distress Types for Asphalt Pavements

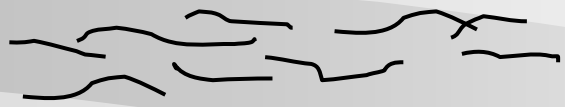
- Fatigue cracking
- Potholes
- Thermal cracking
- Rutting
- Bleeding
- Raveling
- Shoving
- Etc.

Severity

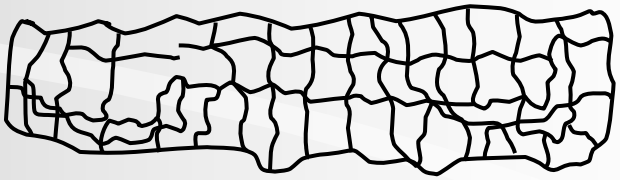
- Low
- Moderate
- High

Cracking Severity

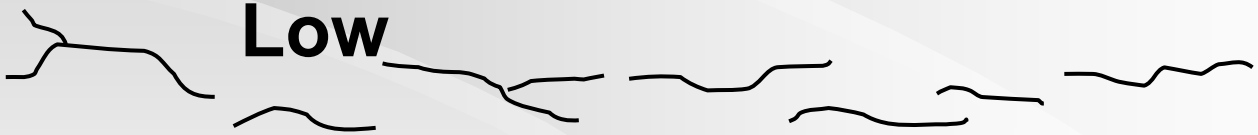
Moderate



High



Low

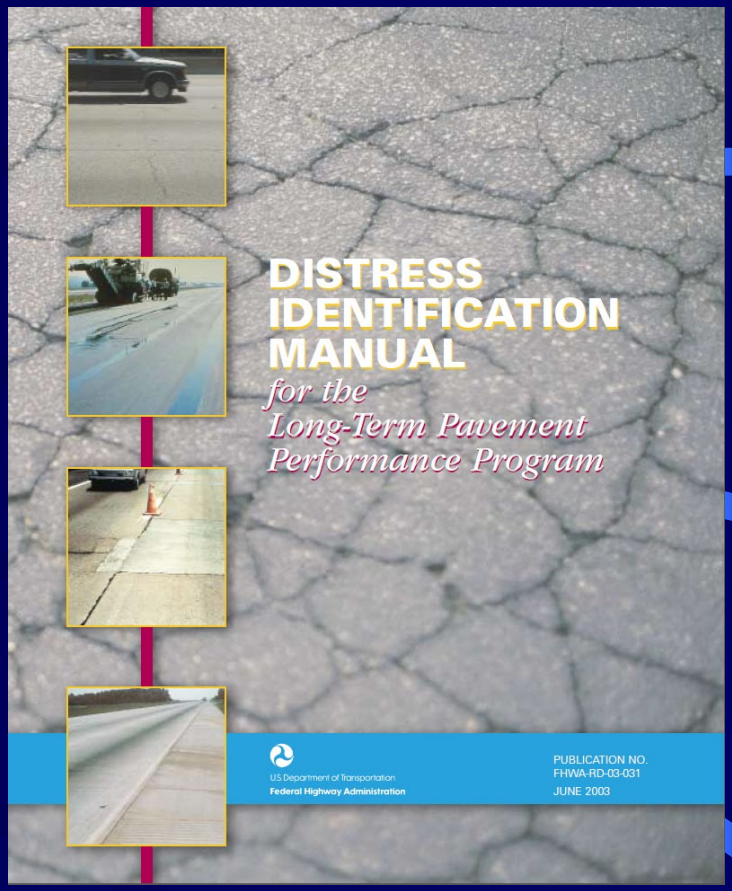


Extra High Severity Cracking

Extent

- Low
- Moderate
- High

Distress Identification Manual



Benefits

- Consistent definitions
- Standardized
- Calibration

Degree of sophistication

- LTPP (research oriented)
- Project Level (design oriented)

Fatigue - Medium Severity

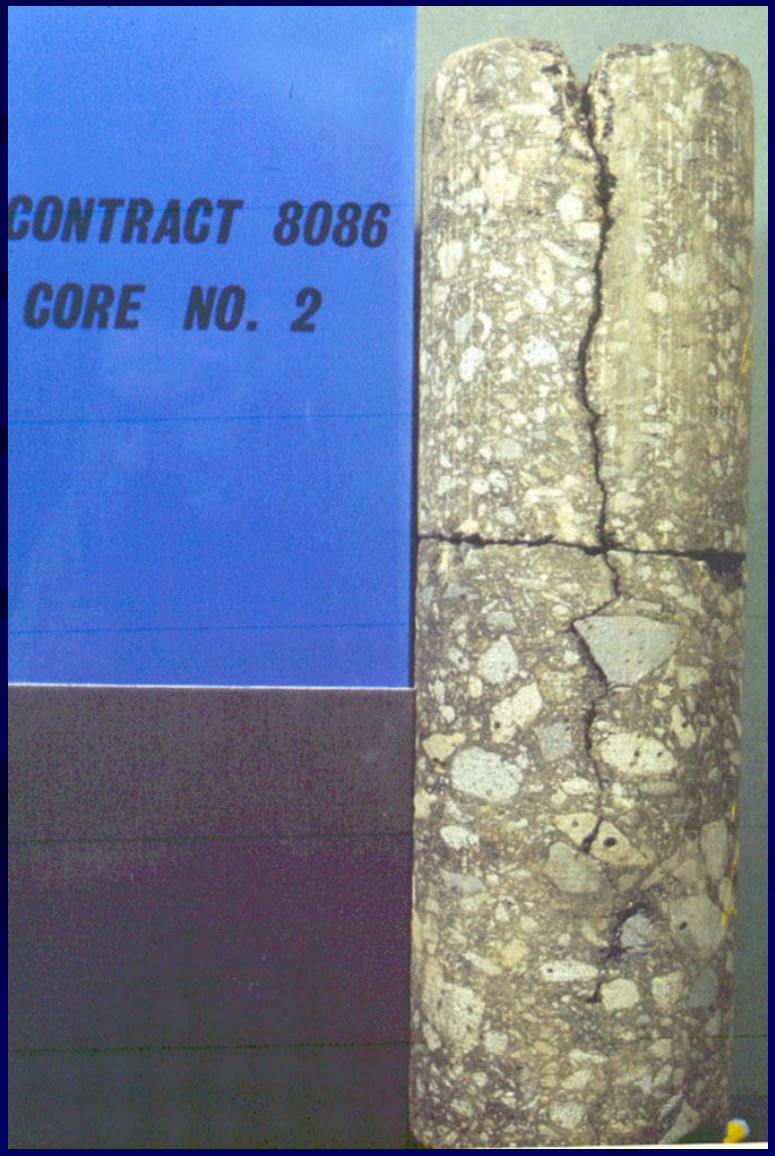
Fatigue - High Severity & Extent

Potholes - High Severity & Extent

Large Potholes-Signing ?

Transverse Crack – Med. Severity

Transverse Crack – Med. Severity



Transverse Crack - High Severity

Rutting - High Severity

Flushing / Bleeding - High Severity

Raveling – High Severity

Condition (Distress) Survey

- Types of condition survey
  - ✓Manual
  - ✓Mechanical (automated)
- Network level versus project level
- Sampling versus complete coverage
- Frequency of surveys

Manual Distress Survey

- More detailed than automated
- Slower than automated

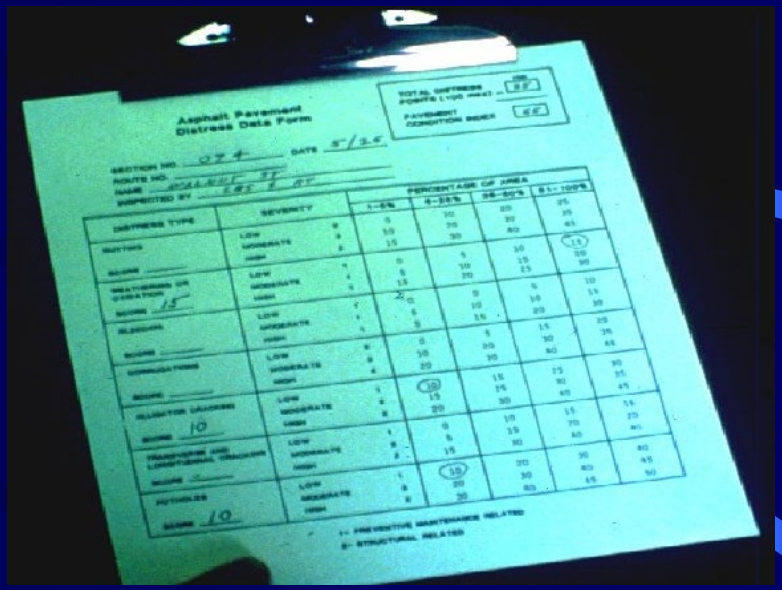
- Types
  - ✓Windshield survey
  - ✓Walking
  - ✓Combination

- Photos, Videos

Windshield Survey

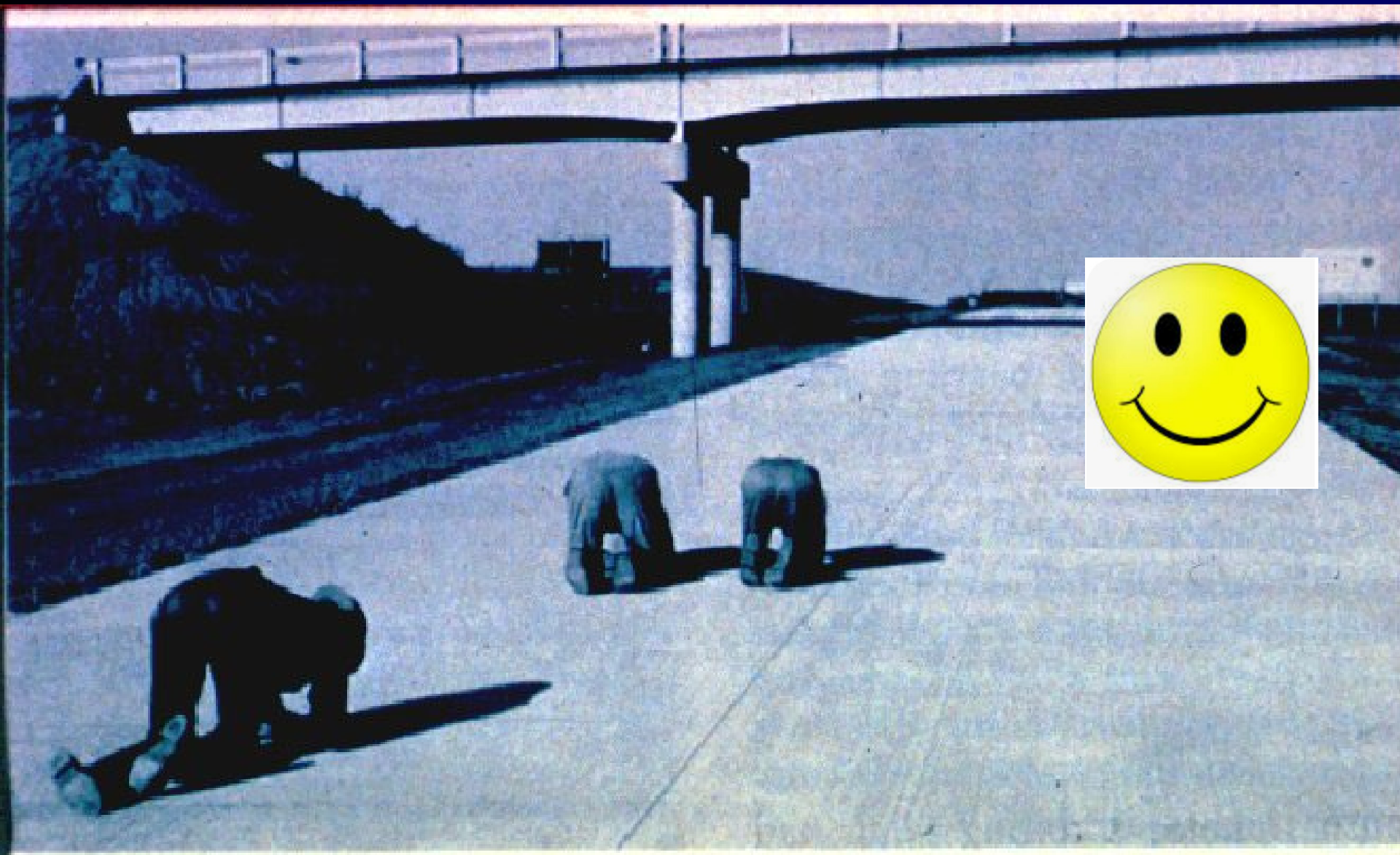
Walking Survey

Data Forms



Hand-Held Computer

Knees and Elbows Survey



Automated Distress Surveys

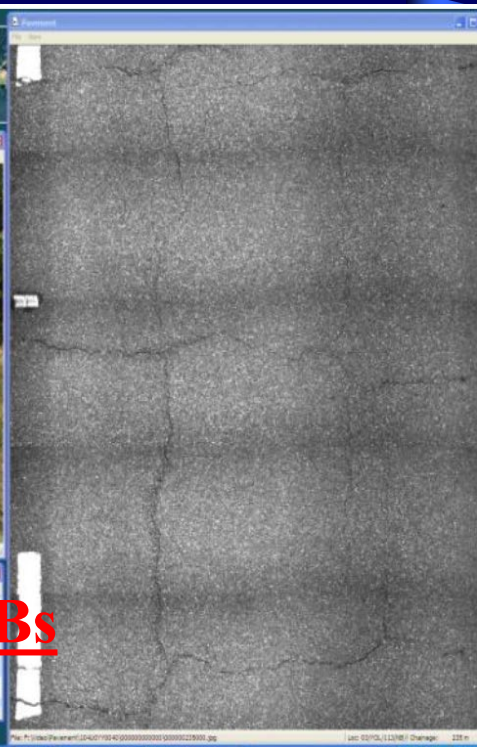
- More consistent
- Increased safety
- No traffic disturbance
- Predictable productivity
- Objective output
- Increased sample size
- Cost saving (Long term)

Profilometer for Measuring Rutting and Roughness

https://www.youtube.com/watch?v=rcDFVxcb__Q

Automatic Road Analyzer(ARAN)

Condition & Roughness



https://www.youtube.com/watch?v=ws2hJSeSmBs

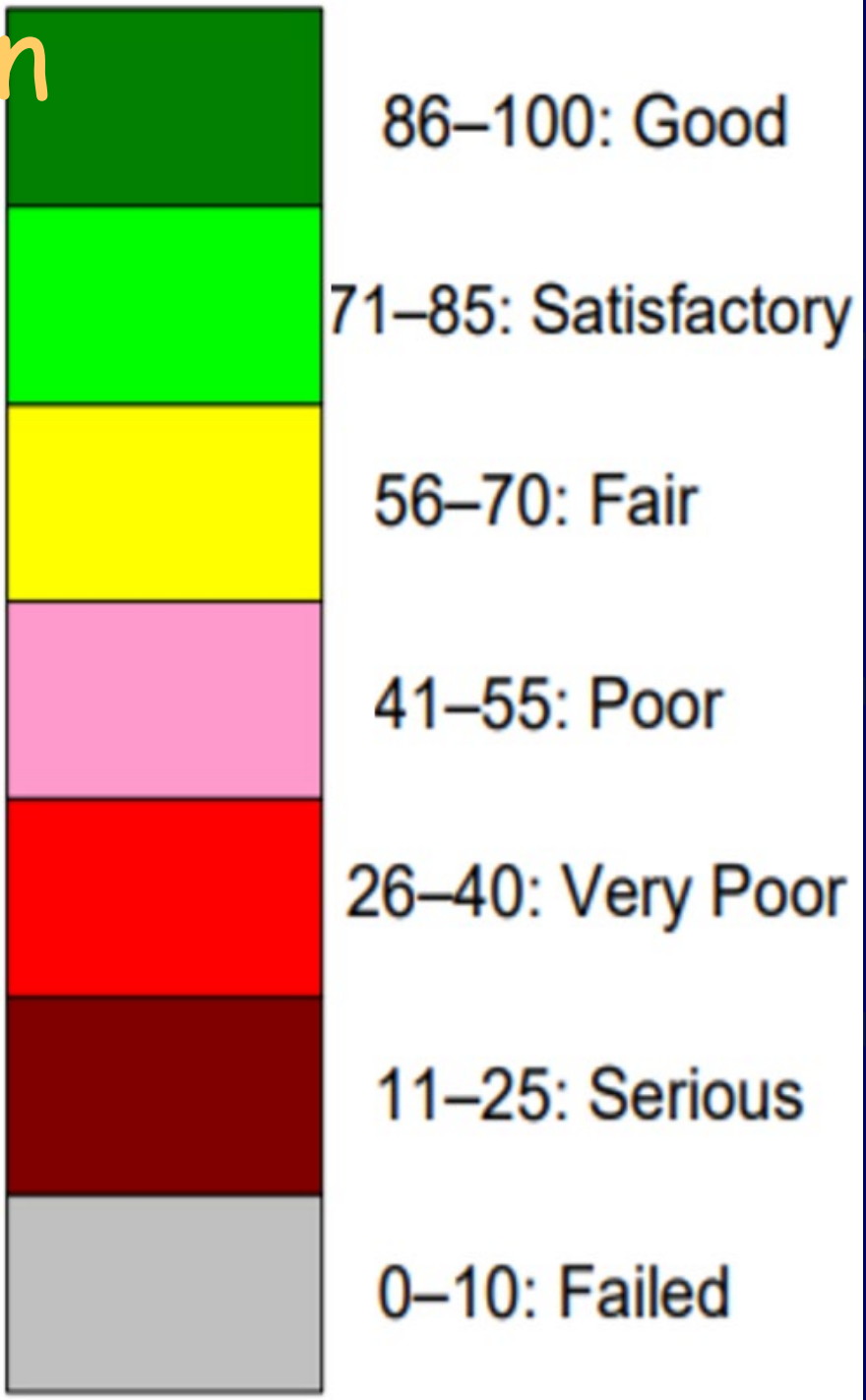
City of Phoenix ARAN

Use of Drones in Pavement Condition Survey

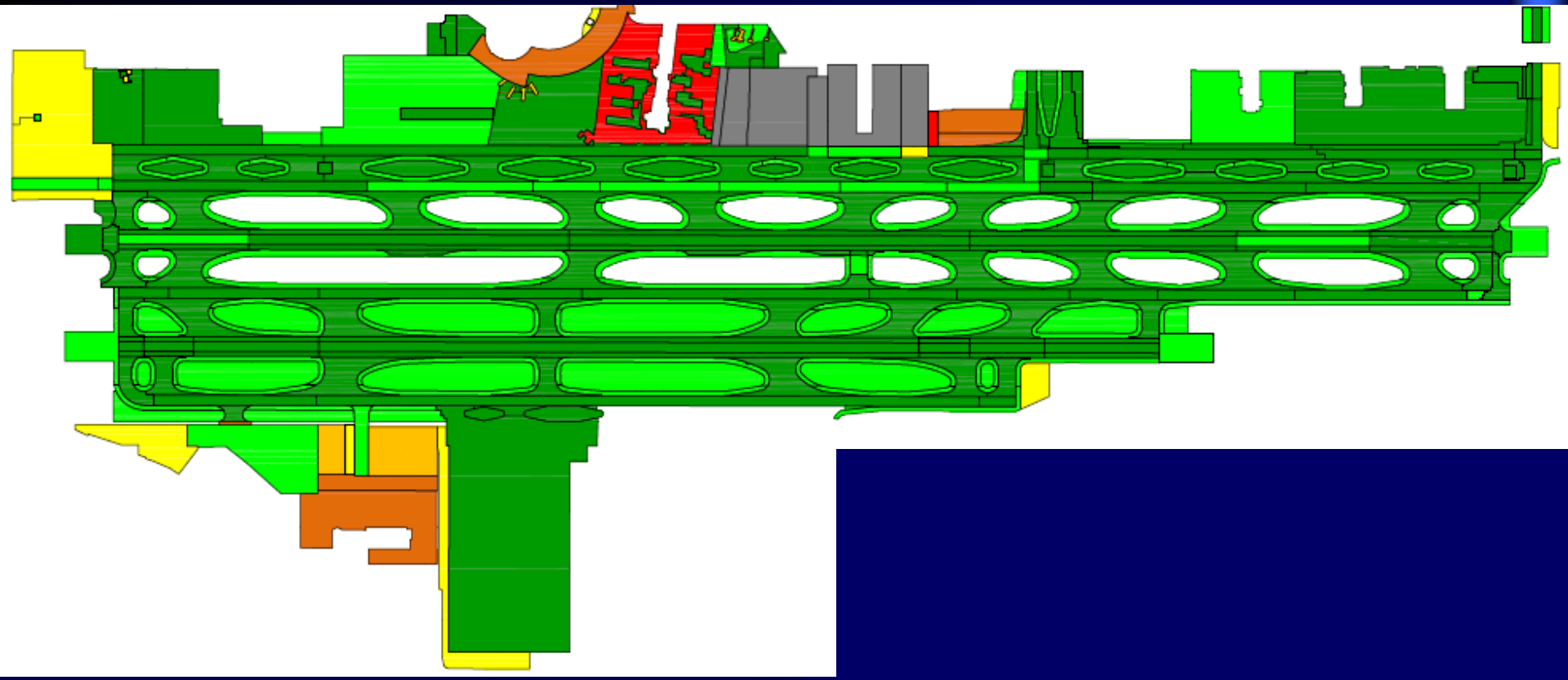
- Still developing

Pavement Condition Index (PCI) (ASTM D6433)

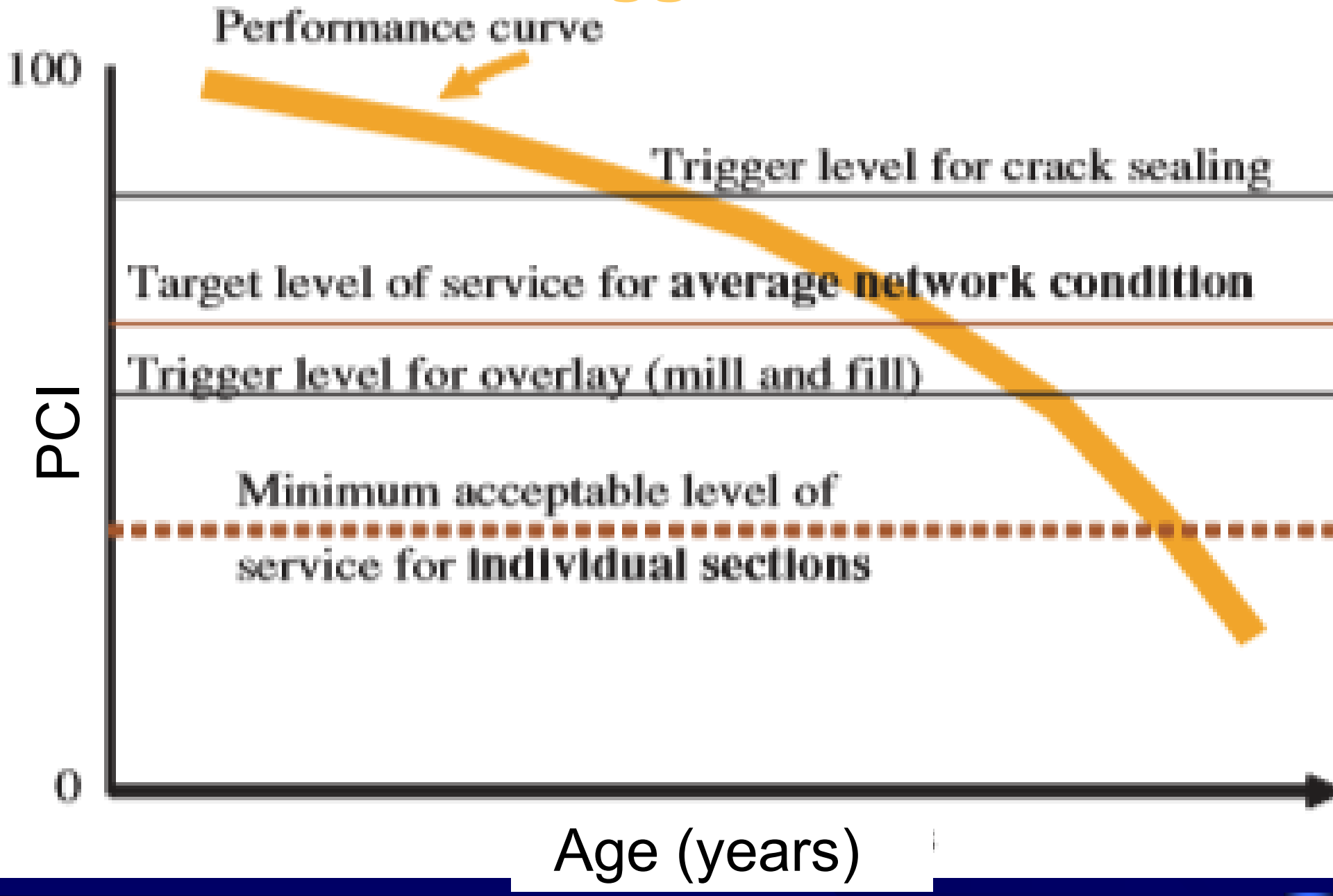
- Numerical rating of pavement condition ranging from 0 to 100
- Deduct values for each distress type and severity



Example of PCI of an Airport



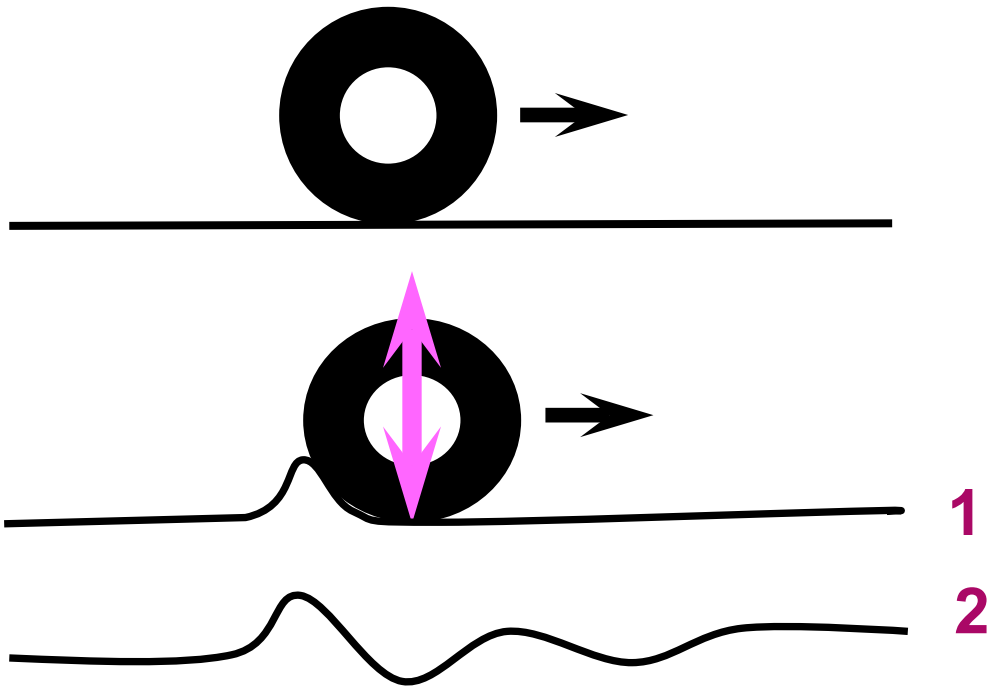
M&R Trigger Levels



Pavement Evaluation

1. Surface condition / distress
2. Serviceability / roughness
3. Structural capacity
4. Surface friction

Vehicle-Pavement Interaction



2. Serviceability / Roughness

Roughness

- Deviations in pavement surface that affect ride quality
- Caused by:
  - ✓Built-in surface irregularities
  - ✓Irregularities caused by traffic and environment
- Present Serviceability Index (PSI)
- International Roughness Index (IRI)

Serviceability

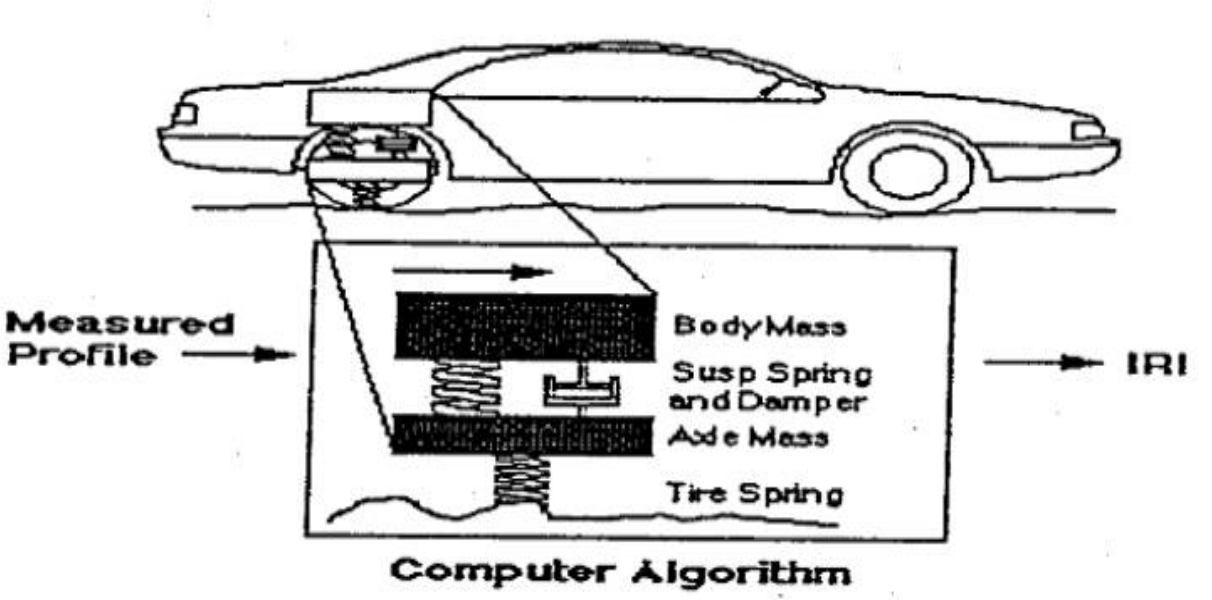
- Developed during the AASHO Road Test
- Measure of user's perception of pavement rideability
- PSI Scale
  - Zero (impassable) to Five (very good)
  - Working range: 2.5 to 4.6
- PSI is highly correlated with roughness

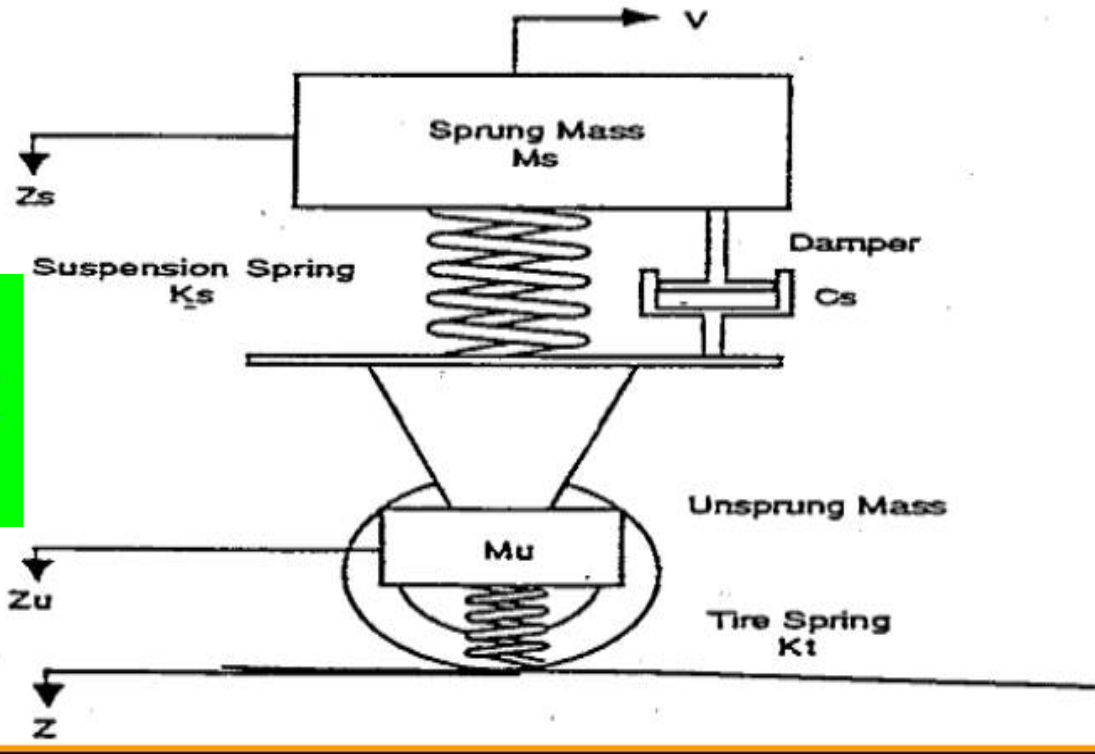
IRI

- A roughness scale based on the response of a generic motor vehicle (Quarter car model)
- IRI is the cumulative vertical deviations over a section of road per unit length (inches/mile)
- A wide range of roughness measuring devices can be used
- Typical values: 25 in./mile (smooth), 250 in./mile (rough)

Quarter Car Model

$$IRI = \frac{1}{L}\int_0^{L/V} \left| \dot{Z}_s - \dot{Z}_u \right| dt$$





ARAN

Profilometer

Maysmeter

Pavement Evaluation

1. Surface condition / distress
2. Serviceability / roughness
3. Structural capacity
4. Surface friction

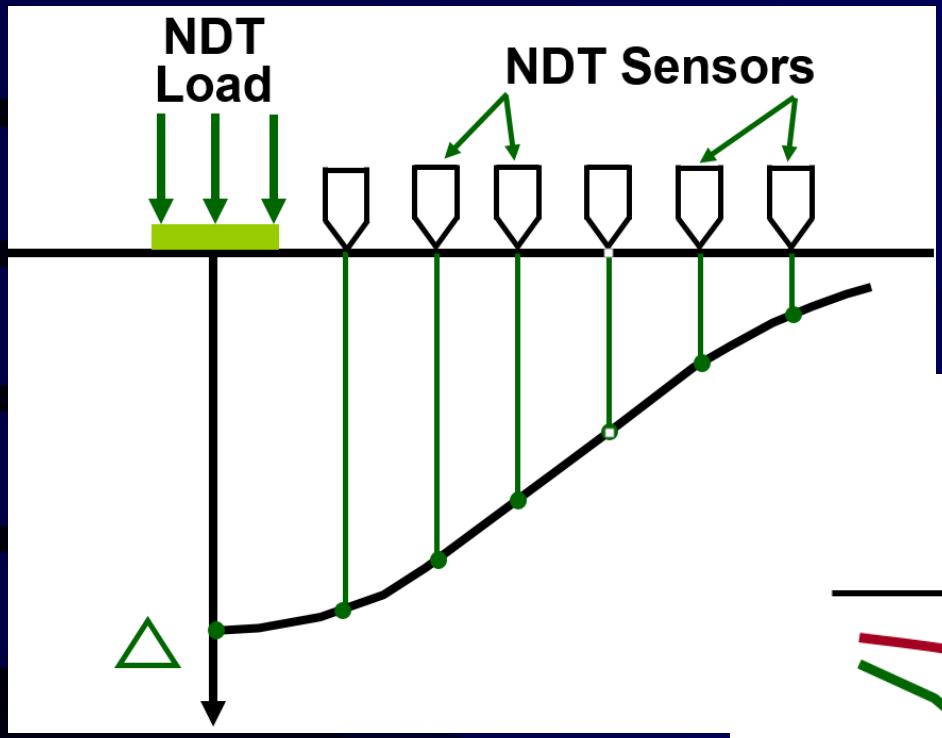
3. Structural Capacity

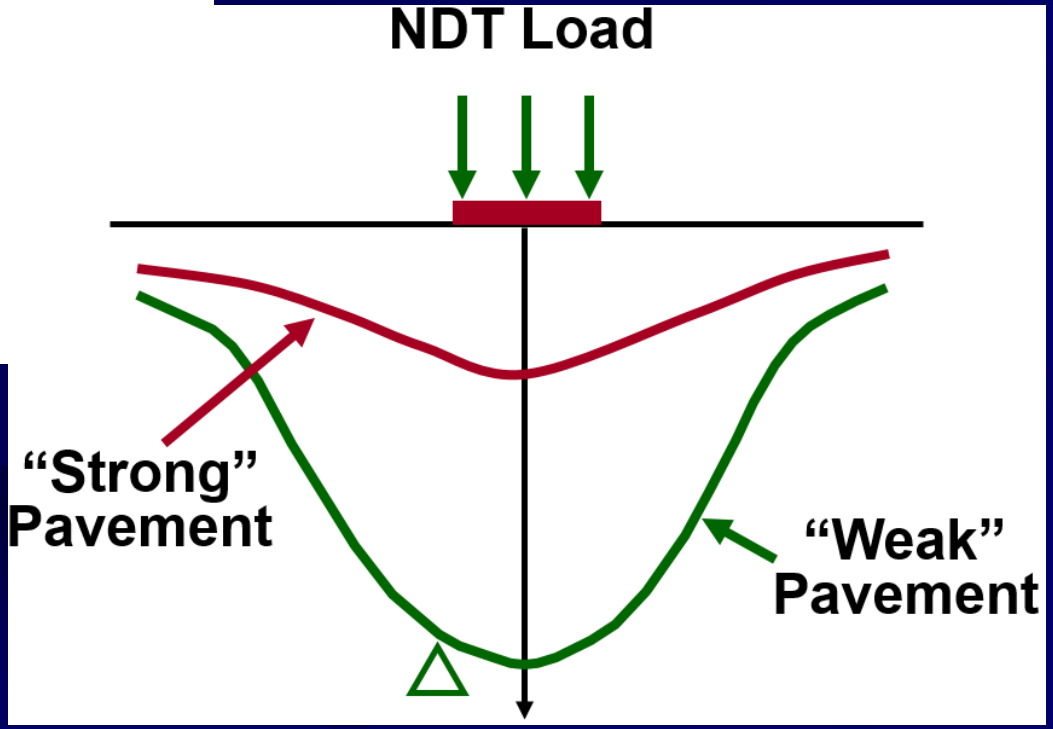
- Directly related load carrying capacity and required overlay thickness
  - Nondestructive testing (NDT)
    - Deflection measurement
    - Faster
    - Provides weighted average of the whole pavement section
  - Lab testing

Falling Weight Deflectometer (FWD)

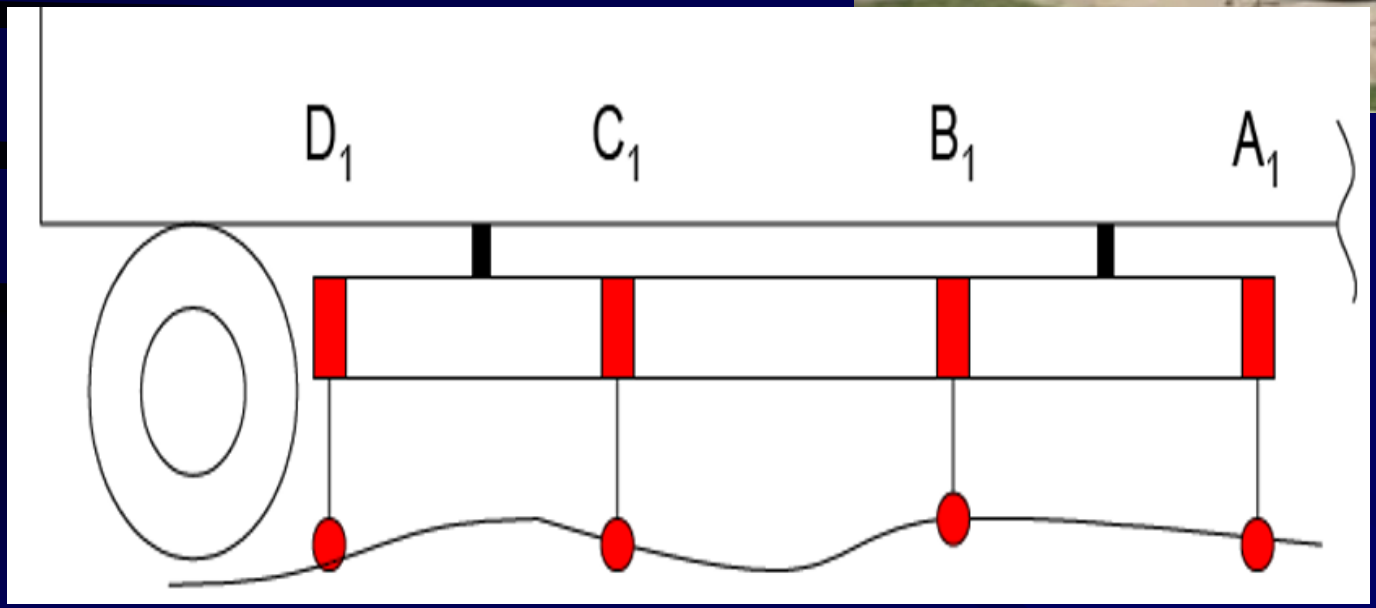
https://www.youtube.com/watch?v=0KDplKQwOAQ

Deflection Measurement





Traffic Speed Deflectometer (TSD)

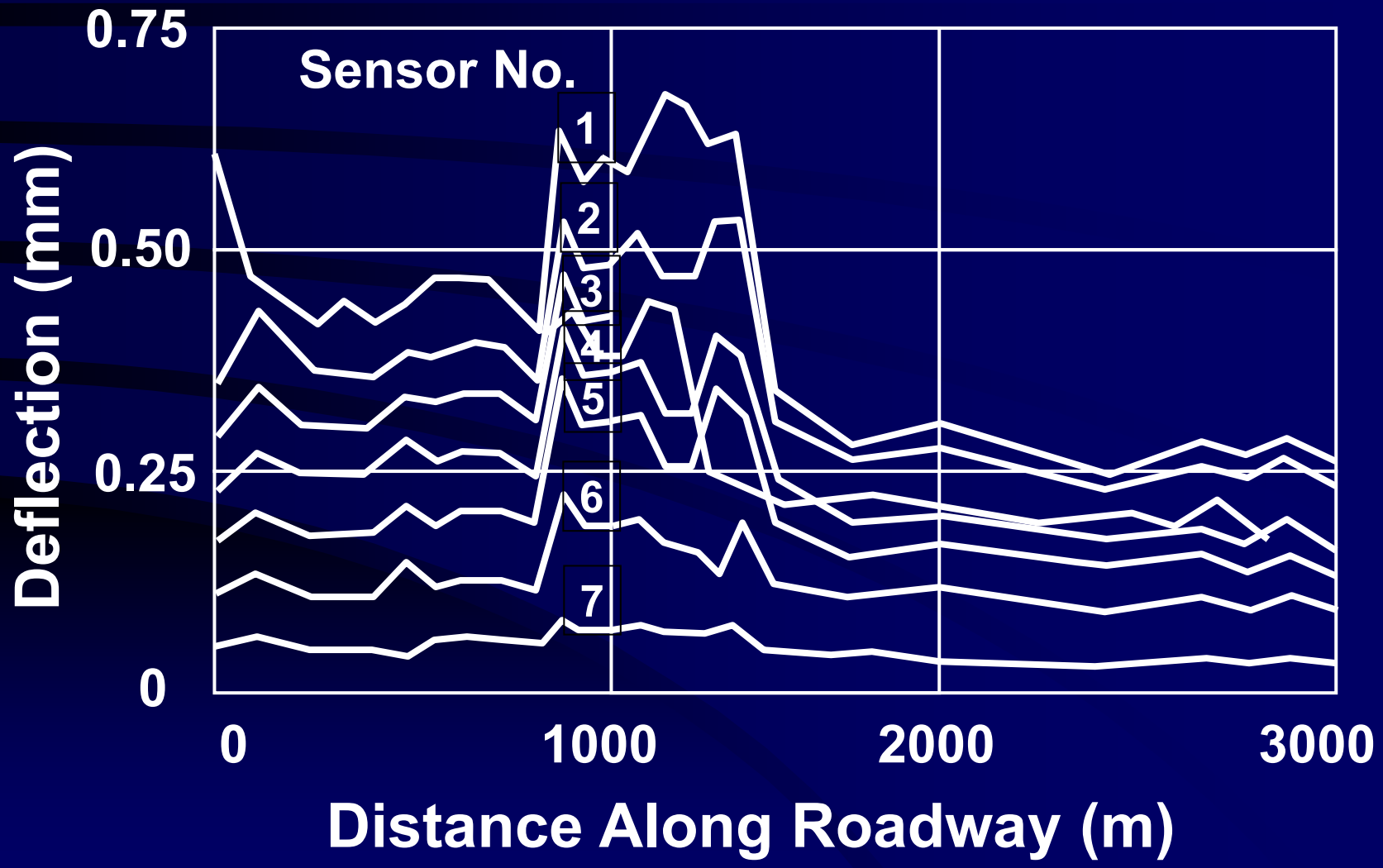


https://vimeo.com/95111238

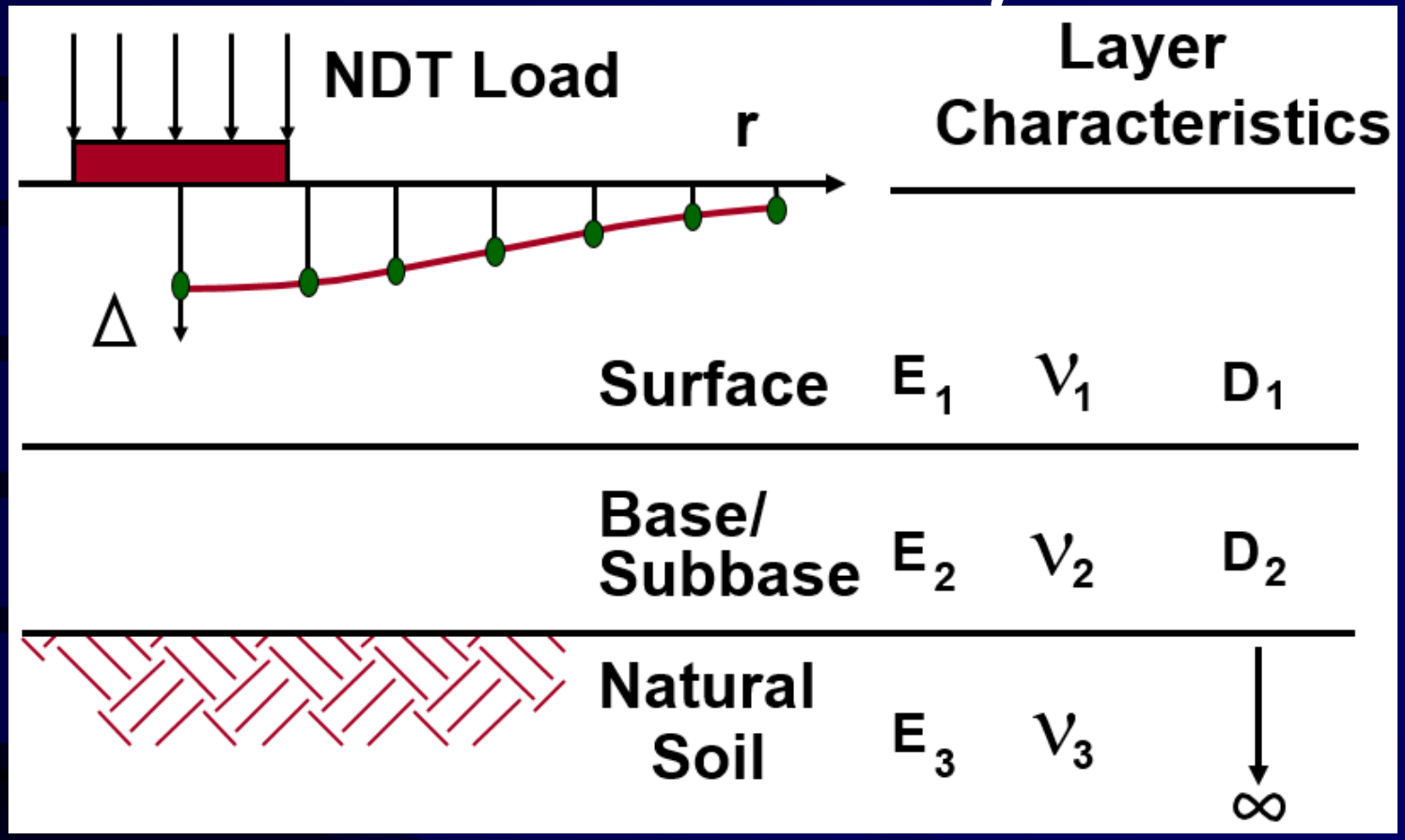
Potential Results From NDT

- Project variability
- Subgrade soil support
- Critical periods
- In-situ material properties
- Structural adequacy

Uniformity of Project

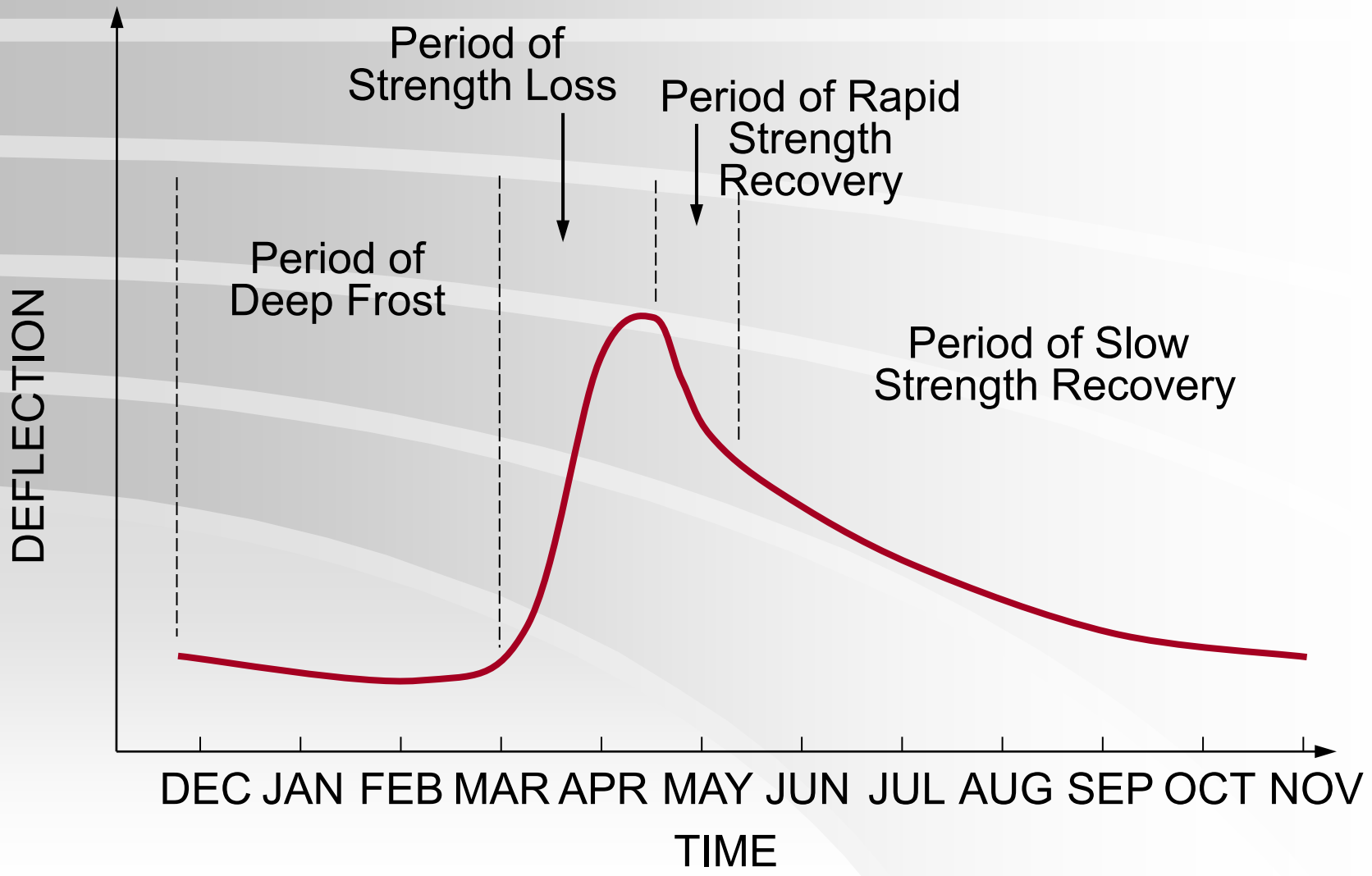


Backcalculation of Layer Moduli



- From the FWD results, we can estimate the stiffness of each layer
  - Used in the mechanistic overlay design

Typical Deflection / Time Plot



Conducting NDT Surveys

Temperature measurements

- Multiple locations
- Air and pavement
- Correction to standard (e.g., 70ºF)

Testing Locations

- 100 to 500 ft intervals
- Typically outer lane only
- Outer wheel path
- Both directions - staggered

Condition Assessment / Pavement Evaluation

1. Surface condition / distress
2. Serviceability / roughness
3. Structural capacity
4. Surface friction

4. Surface Friction

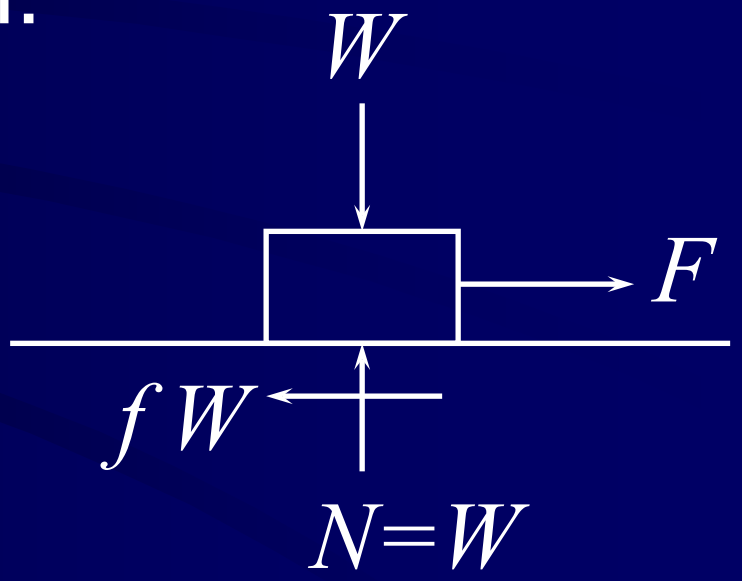
Surface friction

- Skid resistance
- Safety concerns
  - ✓Hydroplaning
  - ✓Wet weather accidents

Skid Resistance

- Interaction between tire and pavement
- Coefficient of friction:

$$f = \frac{F}{W}$$



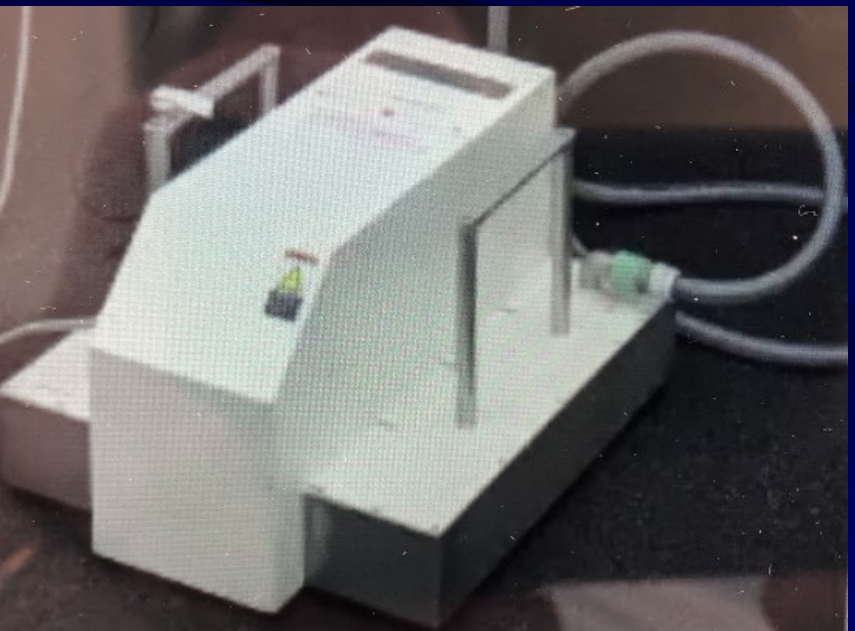
- Wet condition is more critical

Common Friction Measurement Equipment

Locked wheel skid resistance

https://www.youtube.com/watch?v=AnoWN4utBsY

MU-Meter

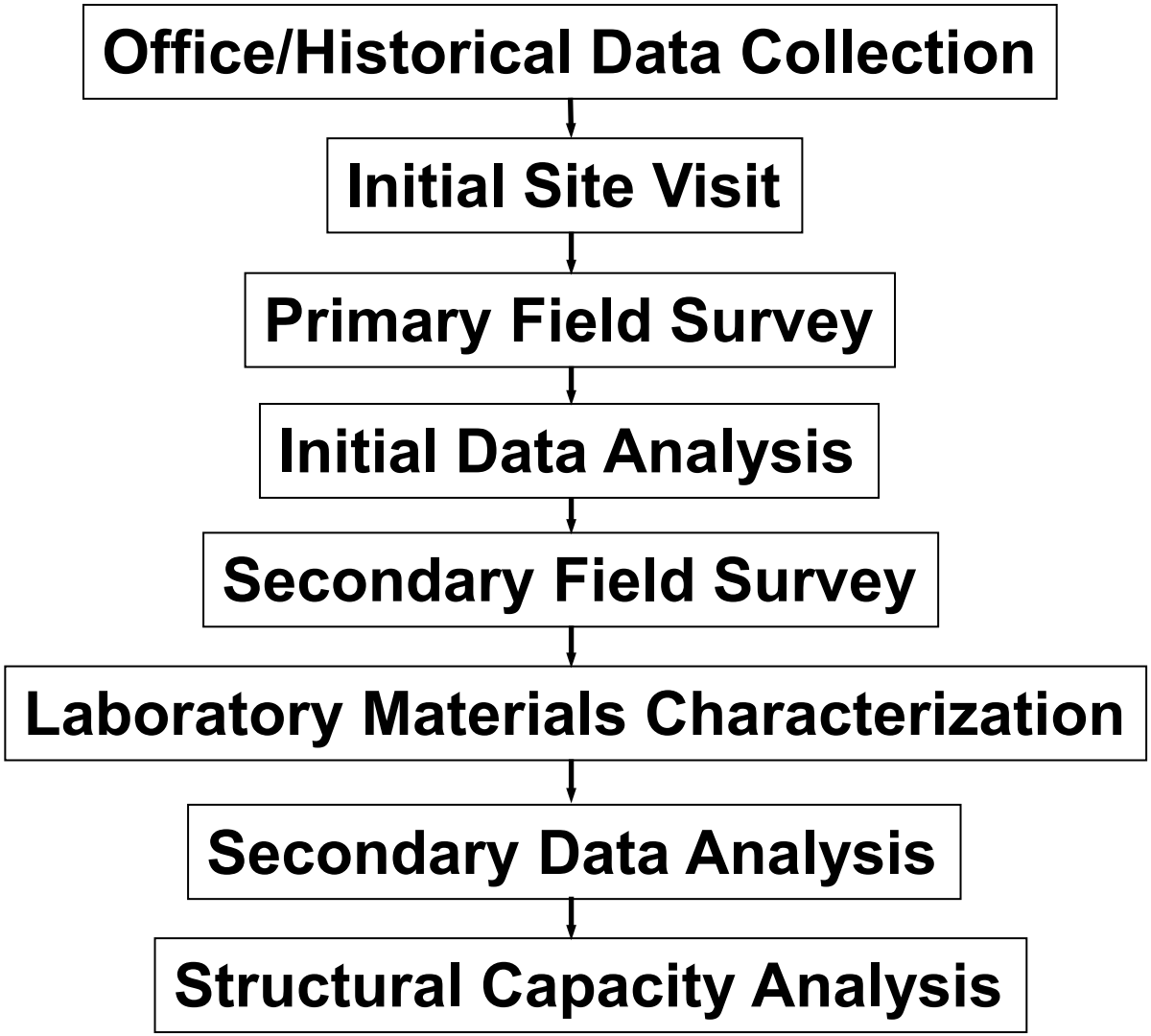


Dynamic Friction Tester

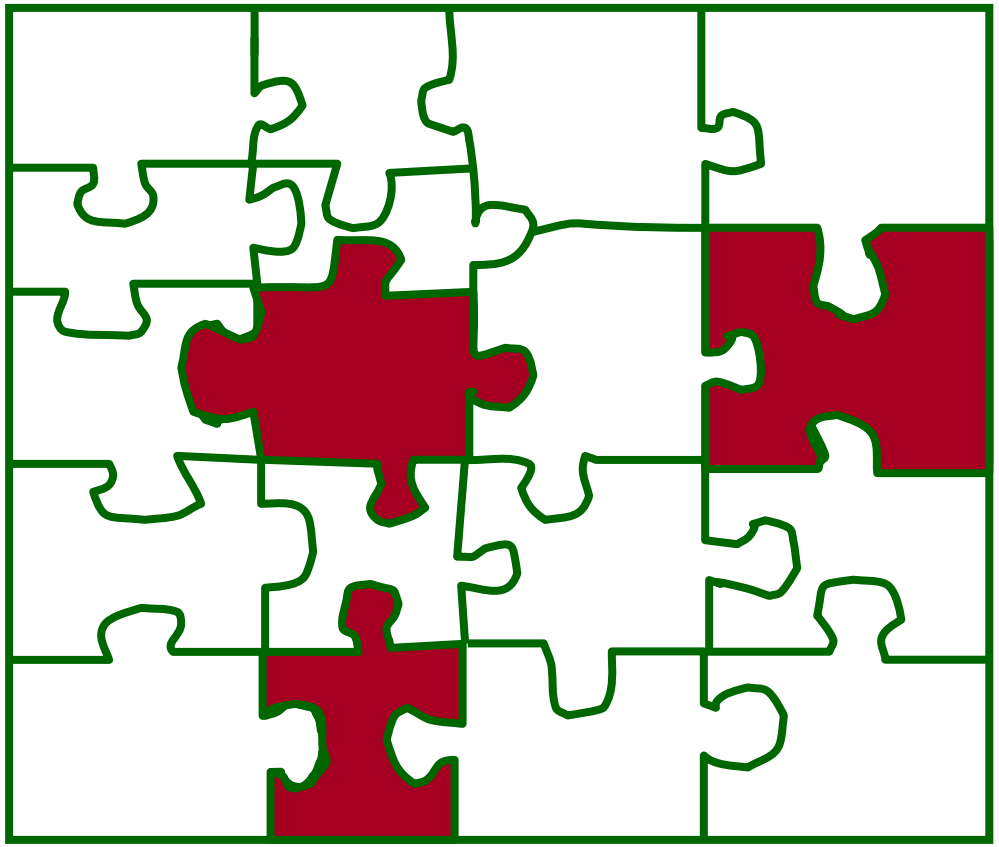
Overall Project Evaluation

- Cost-effective solution
- Address deficiencies
- Satisfy constraints
- Project size versus thoroughness of evaluation

Project Evaluation Flowchart



Data Analysis



Quit Complaining About Your Job