Techniques for Prevention and Remediation of Non-Load Related Distresses on HMA Airport Pavements

Airfield Asphalt Pavement Technology Program

Project 05-07

Problem

- *80 to 85% of the airfield pavements are Hot Mix Asphalt*
- *The Majority of these are General Aviation Airfields*
- *Limited Funding for Maintenance and Repairs*
- *Result is non-load associated block cracking and surface distress*

Objective

- *To provide comprehensive technical guidance on the causes and measures required to correct and/or prevent non-load related distress on HMA airfield pavements.*

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Definitions

- Block Cracking
  - Interconnected cracks that divide the pavement into approximately rectangular pieces.
  - range in size from approximately 1 by 1 ft to 10 ft by 10 ft.
  - Caused mainly by volume changes within the HMA caused by daily temperature cycling (that results in daily stress/strain cycling). **It is not load associated.**
  - **The occurrence of block cracking usually indicates that the asphalt binder has hardened significantly**.

Definitions

- Longitudinal or Transverse Cracking
  - A poorly constructed paving lane joint.
  - Shrinkage of the HMA pavement **due to low temperatures or hardening of the asphalt binder or**
  - A reflection crack caused by cracks beneath the surface course

Definitions

- Raveling
  - Raveling and weathering are the wearing away of the pavement surface caused by the dislodgement of aggregate particles and loss of asphalt binder.
  - **Such damage may indicate that the asphalt binder has age-hardened significantly.**

OUTLINE

- Factors Contributing to Non-Load Associated (NLA) Distress
- Geographical Distribution of Airfields Potentially Exhibiting NLA Distress
- Steps that can be taken to Prevent NLA Distresses In Airfield Pavements
- Steps that can be taken to Medicate NLA Distress
- Laboratory Test Procedures that can be used to define the Extent and Nature of NLA Distress

Factors Contributing to NLA Distress

- Climate,
- Crude source,
- Mixture variables, and
- Construction variables.

Climate

- Process
  - As the temperature increases the rate of oxidation increases
  - Result is asphalt binder becomes more brittle
  - When temperature drops – thermal stress develops – asphalt binder has lost elasticity and cannot recover and it cracks

Asphalt Crude Source

- Some asphalts age more rapidly than others

Mixture Variables

- Aggregate Absorption
- PG Binder Grade
- Asphalt Additives
  - Polymers
  - Hydrated Lime

Pavement Variables

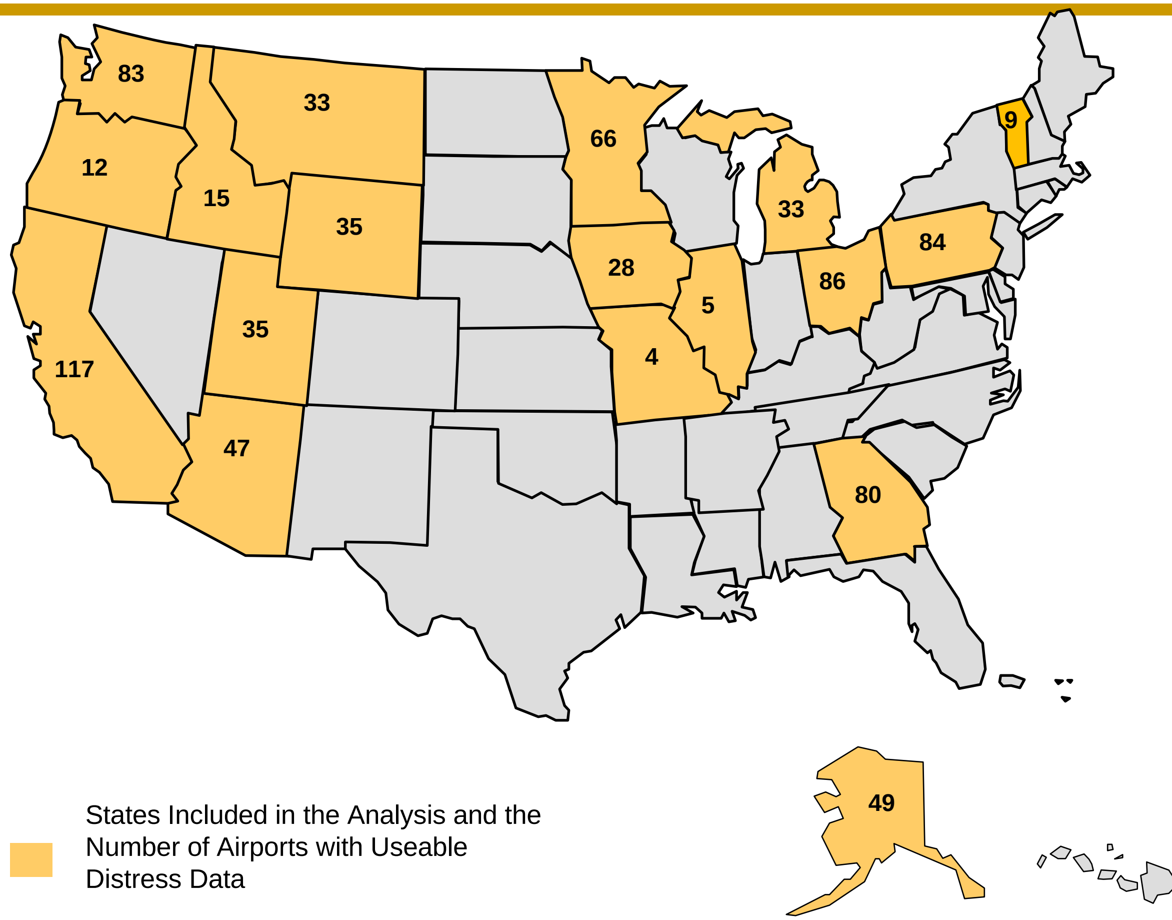
- Age hardening is most prominent at the surface
- Aging will occur primarily in top ½ inch
- Temperature of pavement will drop 6^{o}C per inch of thickness

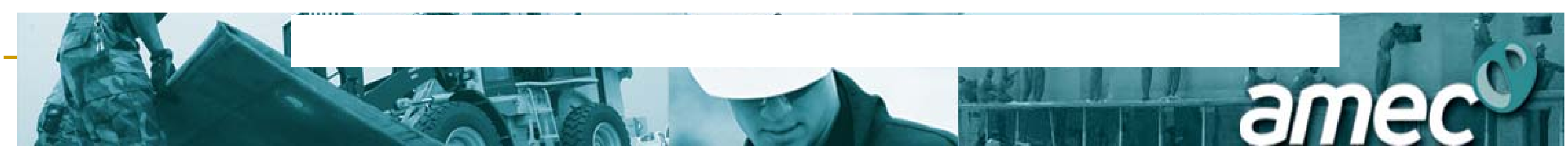
Pavement variables

Geographical Distribution

- Data Sources
  - State Aviation Data Bases
    - Used **MICRO PAVER** pavement distress data from state aviation data bases
  - LTPP Bind
    - Developed by the Federal Highway Administration
    - Uses 30 years of historical records to establish average high and low temperatures at hundreds of weather stations across the country.

Geographical Distribution

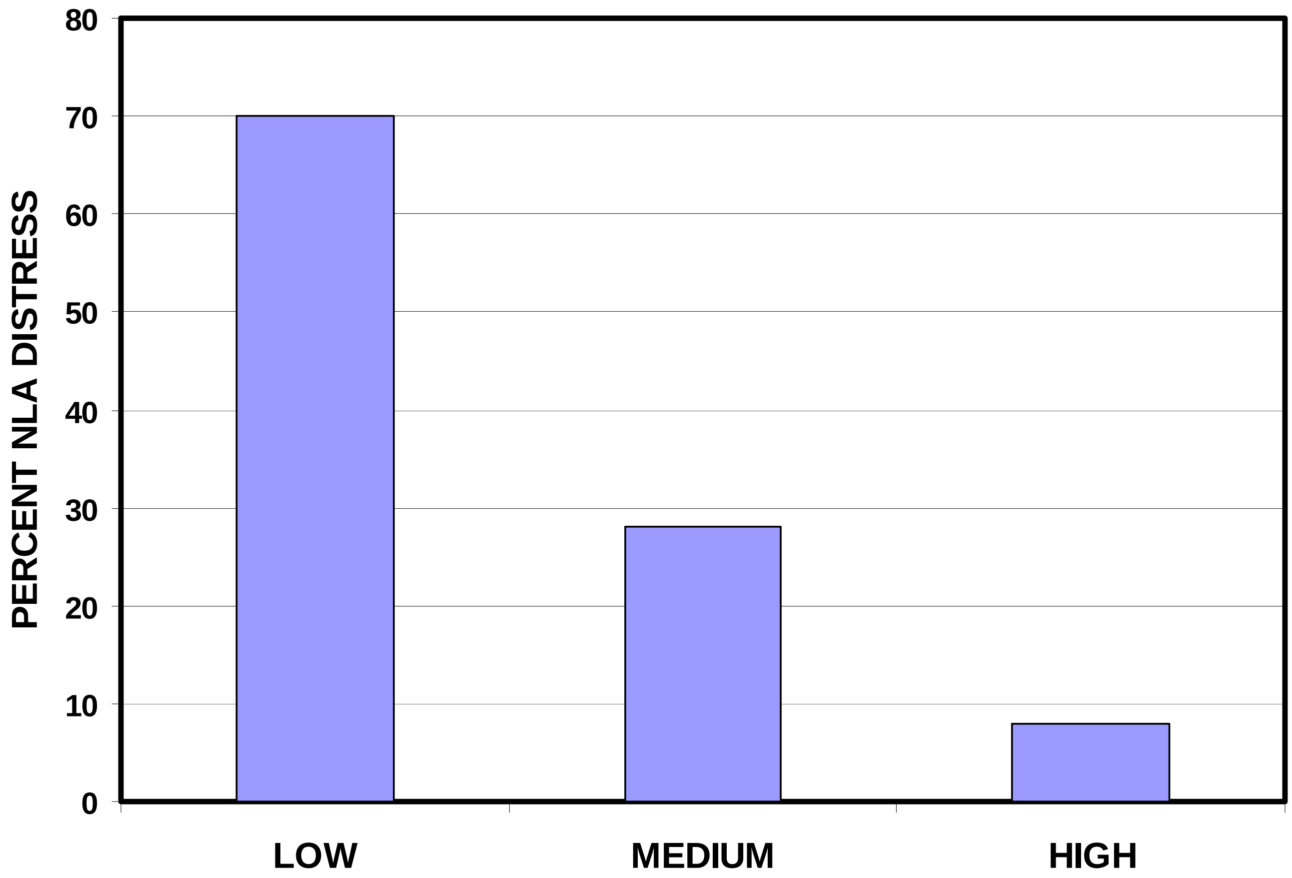




Geographical Distribution

- Size of sample
  - 16 States
  - 781 Million Square Yards of HMA Pavement
  - 142 Million Square Yards of Pavement with NLA Distress
  - Or 18.3%

Geographical Distribution



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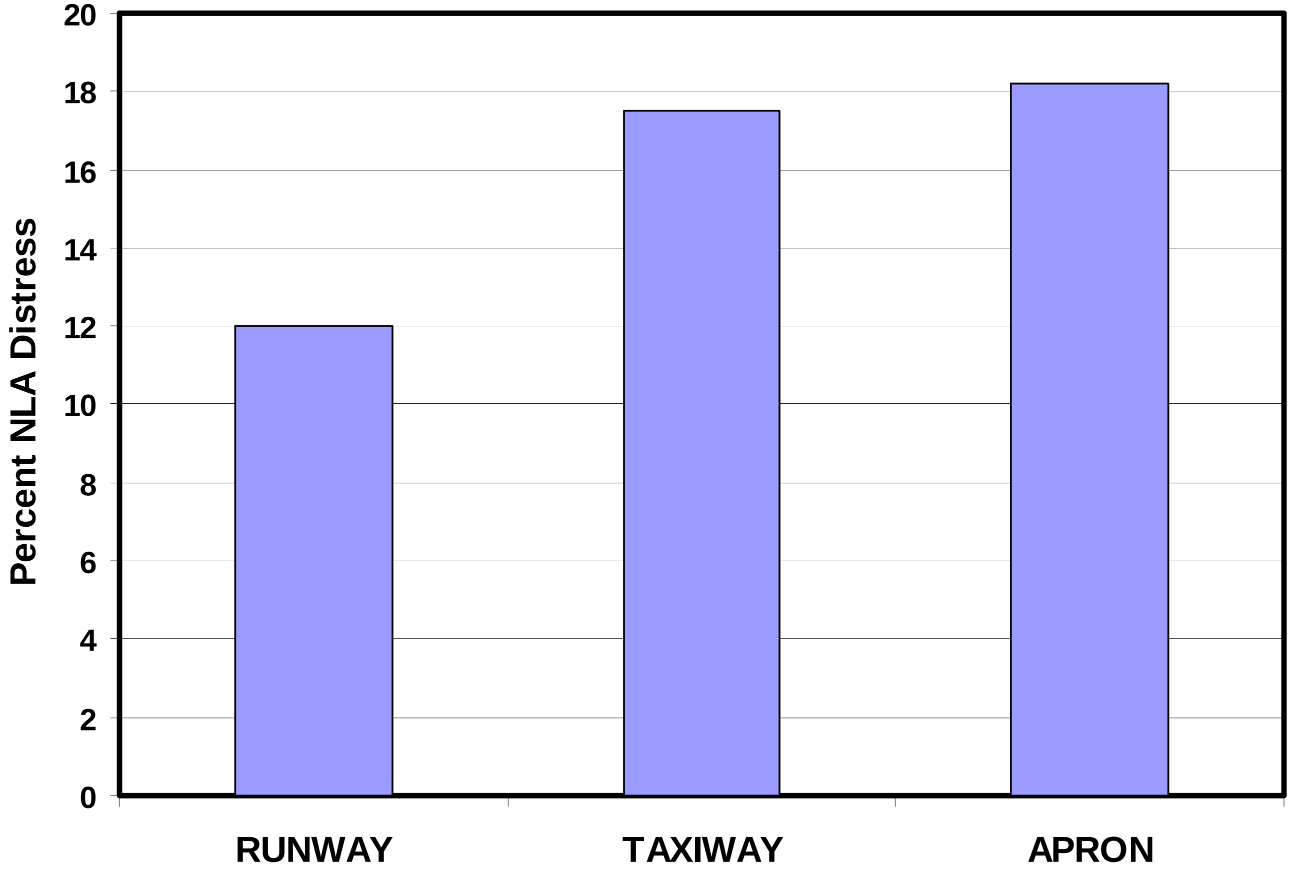
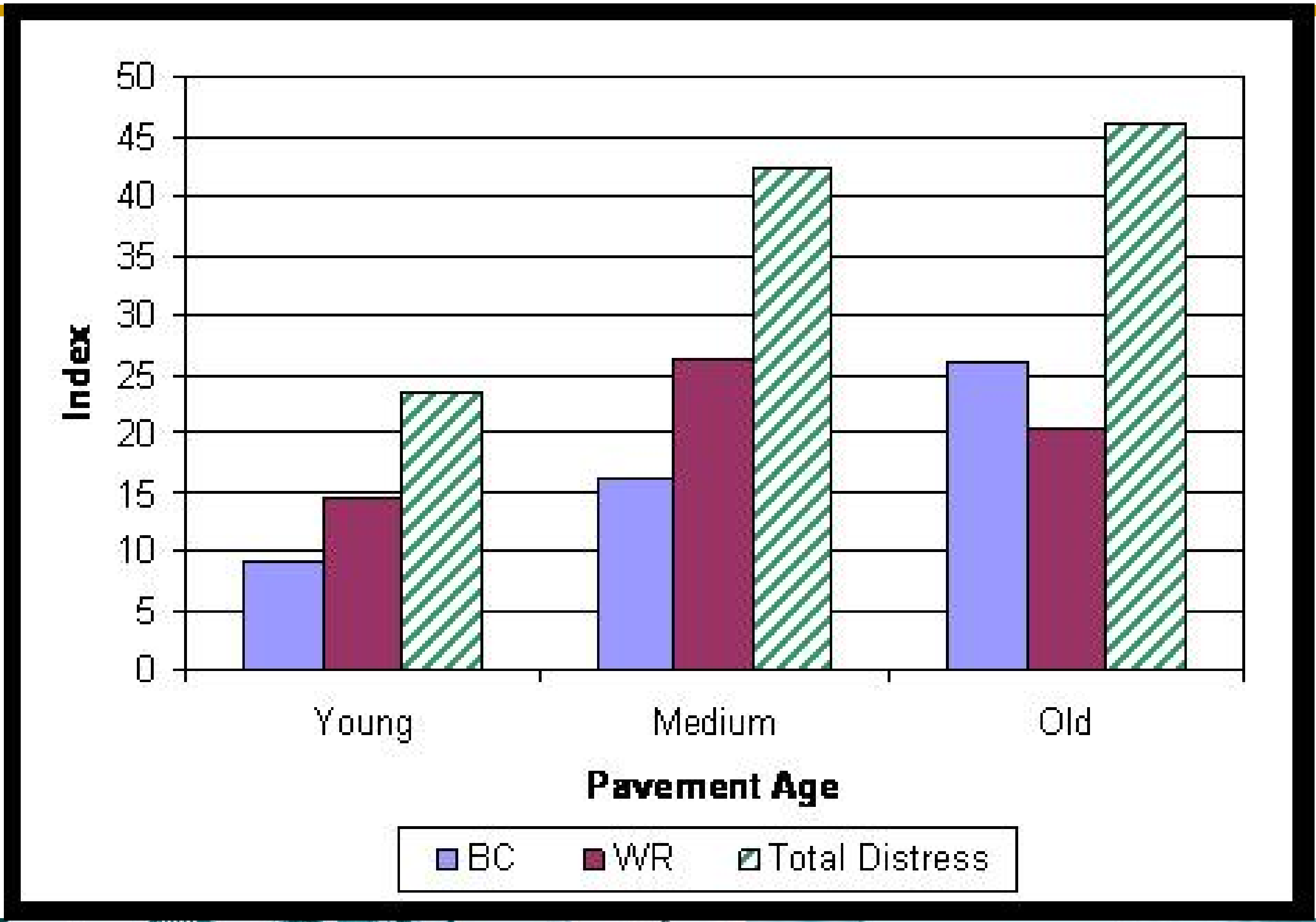


Geographical Distribution



What do you do to prevent?

- Climate,
- Crude source/Binder Grade,
- Mixture Design
- Construction

Crude Source/Binder Grade

- Canada and the US are now using the SuperPave binder system for the purchase of asphalt binders such as a PG 64-22
- SUGGESTION – Drop the low temperature PG grade one grade
  - Example if you should use a 58-22 use a a 58-28.

Mix Design

- The key is film thickness
- Therefore
  - Sufficient asphalt
  - Consider dropping the design air voids from 4% to 3 ½ % or even 3%. The result is increased asphalt and film thickness
  - Be sure you do not accomplish this by increasing the fines
- Look at using low permeability mixes, such as SMA

Construction

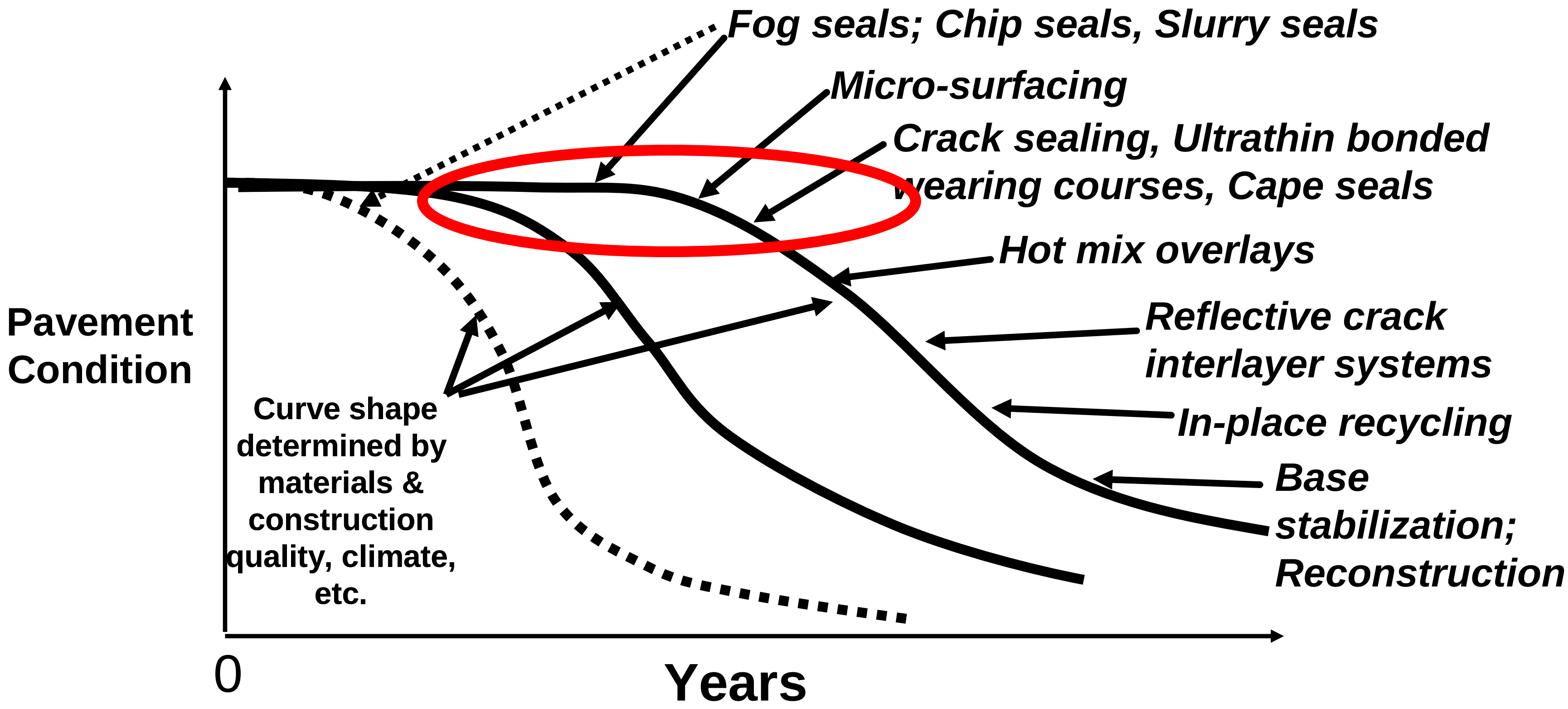
- Goal is to restrict the supply of oxygen into the pavement

- Therefore:
  - Insure that you achieve compaction
  - Then seal the pavement to zero permeability soon after placement

What do you to Mitigate?

- Implement an active pavement preservation program to include:
  - Preventive maintenance,
  - Minor rehabilitation (non-structural), and
  - Some routine maintenance activities.
- The goal is to reduce aging and extend service life and in some cases restore the function of the existing pavement.
- Or – apply the **“Right Treatment at the Right Time”**

What do you to mitigate?



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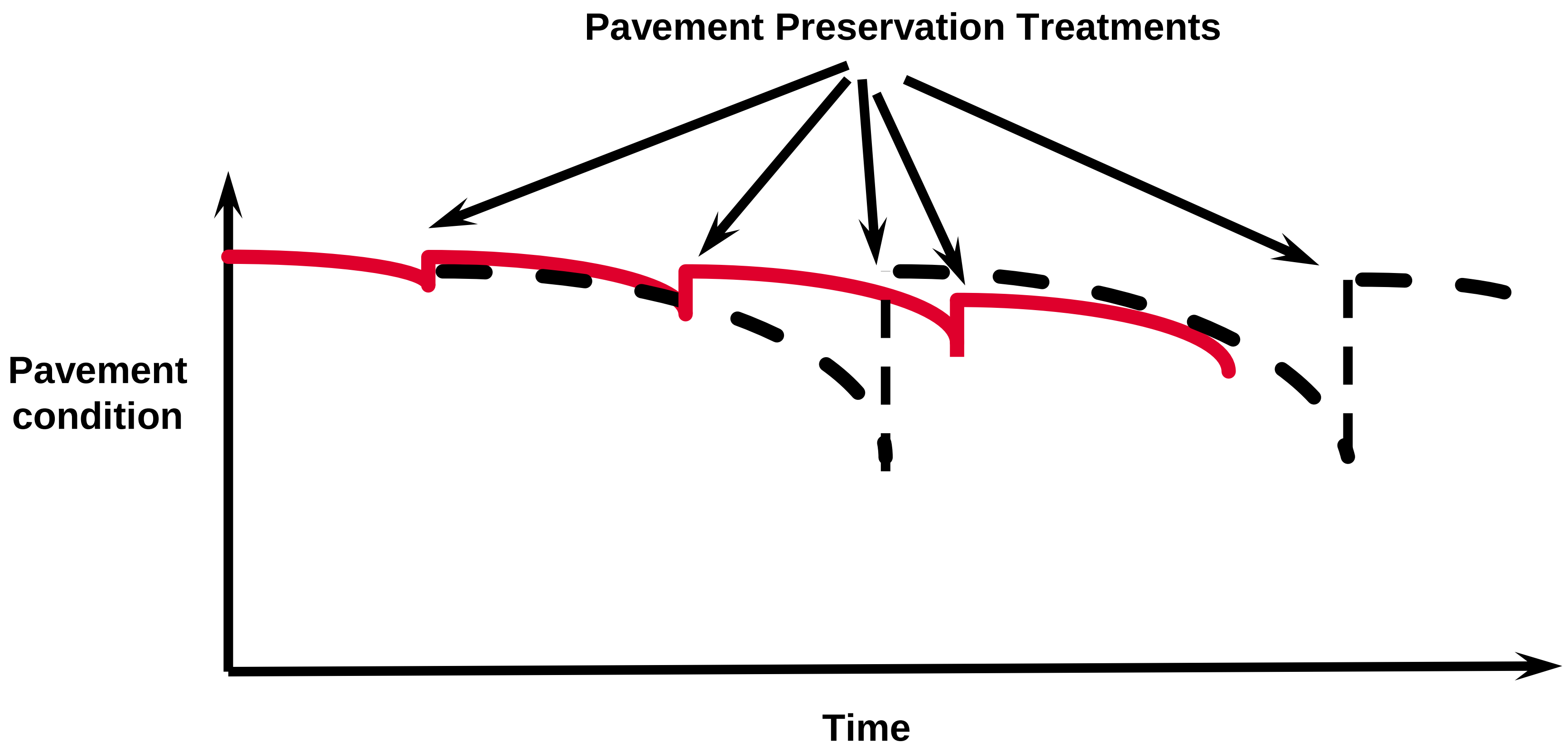
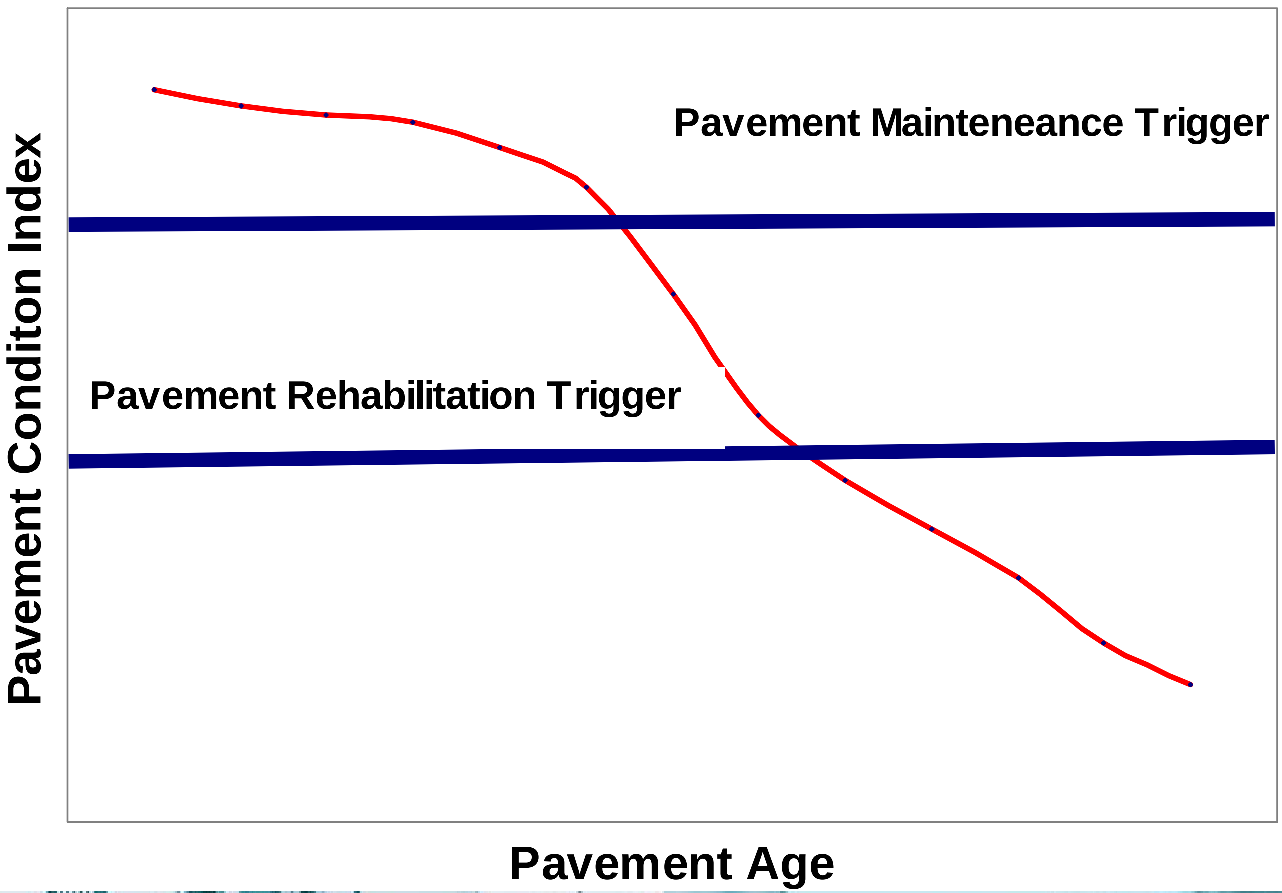


What do you do to mitigate?

Estimated Life Extensions (years)			
Surface Treatment	Good Condition (PCI=80)	Fair Condition (PCI=60)	Poor Condition (PCI=40)
Spray Applied Seal	3 - 5	1 - 3	1 - 2
Chip Seal	7 - 10	3 - 5	1 - 3
Slurry Seal	7 – 10	3 - 5	1 - 3
Microsurfacing	8 – 12	5 - 7	2 - 4

What do you do to mitigate?



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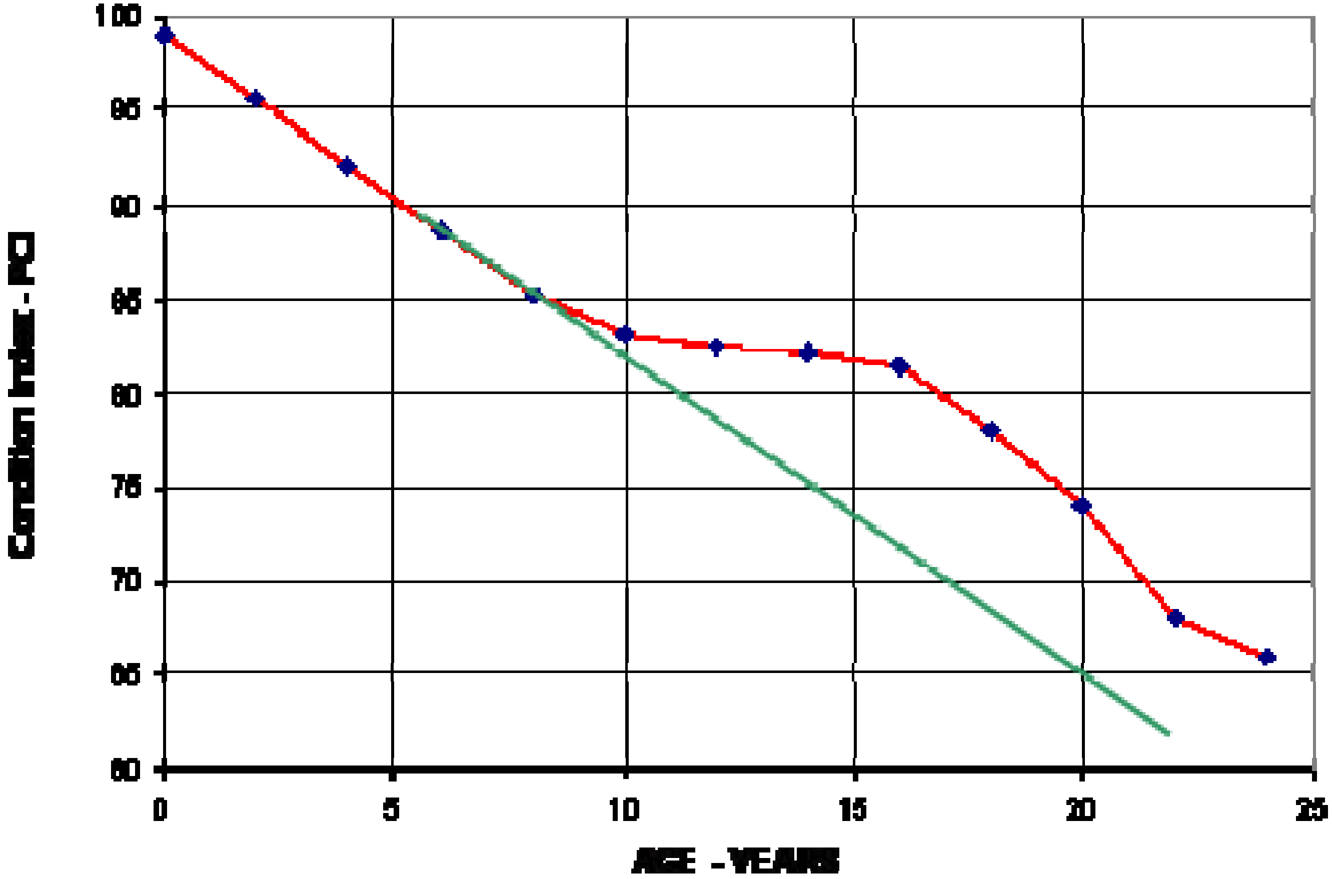

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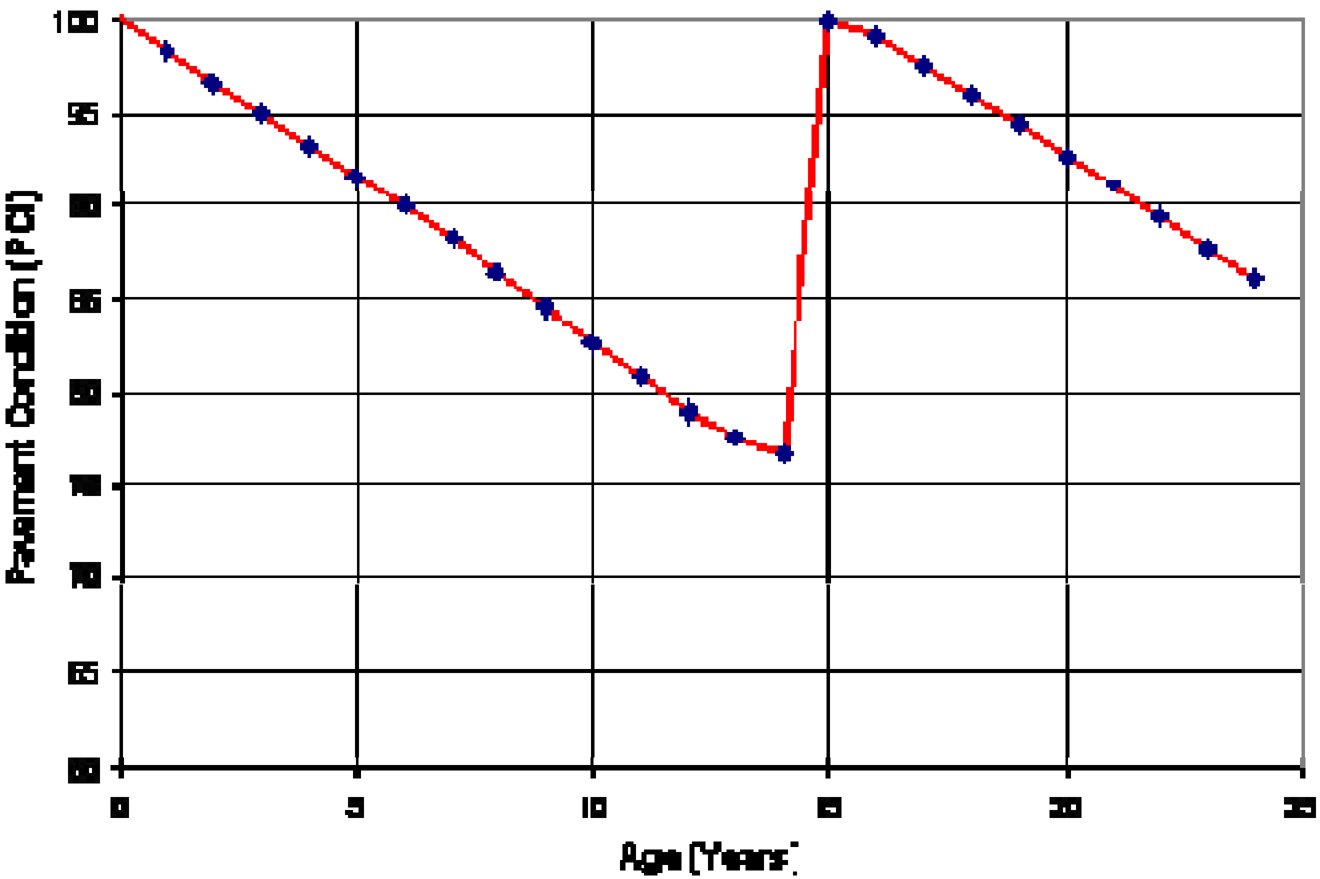
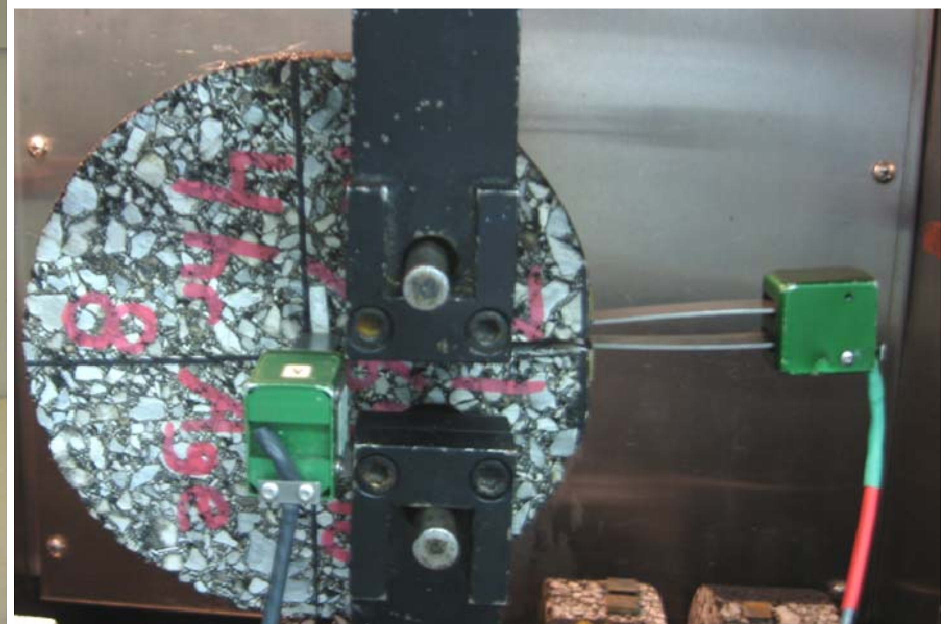


LABORATORY TEST PROCEDURE

Test Procedure – DC(T)



Summary & Conclusions

- NLA Distress is the result of age hardening of the asphalt binder
  - As the binder hardens it loses it ductility
- Oxygen must penetrate the surface of the pavement to before it can react
  - Therefore – take steps to reduce the permeability of the pavement!!!!!!!
- “Apply the right treatment at the right time”

QUESTIONS