MAINTENANCE AND REHABILITATION OF PAVEMENTS

Pavement Preservation

Some Common Terms

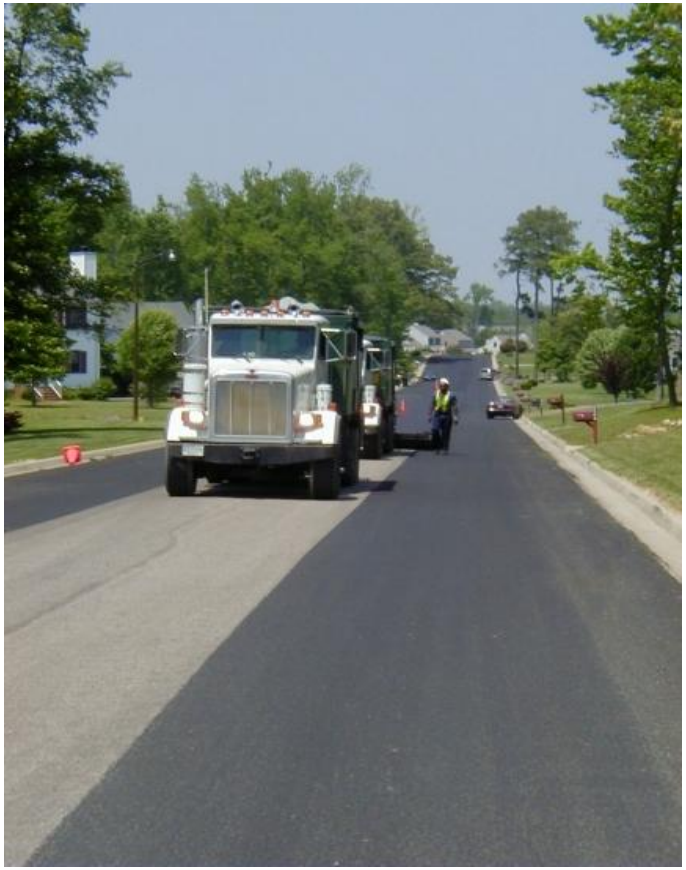
- Preventive Maintenance
- Corrective Maintenance
- Pavement Preservation
- Pavement Rehabilitation

Preventive Maintenance

The planned strategy of cost effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without increasing structural capacity).

- AASHTO's Standing Committee on Highways

- Planned
- Performed on good pavements
- Contributes to long-term performance
- Examples: Fog Seal, Chip Seal, Thin HMA Overlay



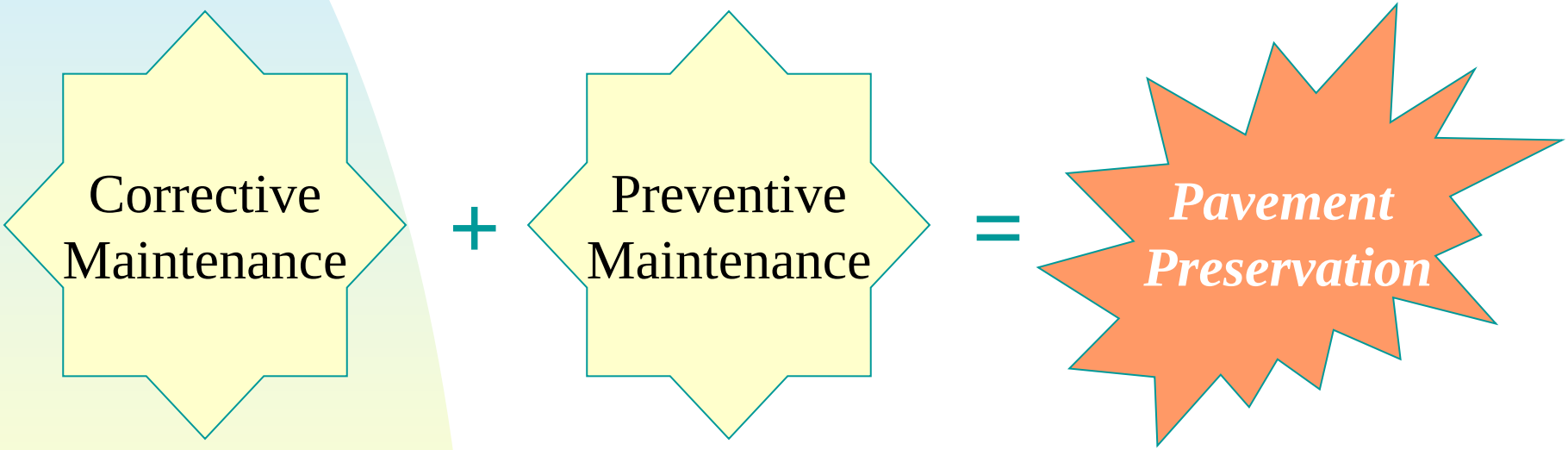
Corrective Maintenance

- Reactive
- Performed on failing pavements
- Does not contribute to long-term performance
- Examples: Patching, Pothole Repair

Pavement Preservation

The sum of all activities undertaken to provide and maintain serviceable roadways; this includes corrective maintenance and preventive maintenance, as well as minor rehabilitation projects

- National Highway Institute


Corrective Maintenance
+
Preventive Maintenance
=
Pavement Preservation

Pavement Rehabilitation

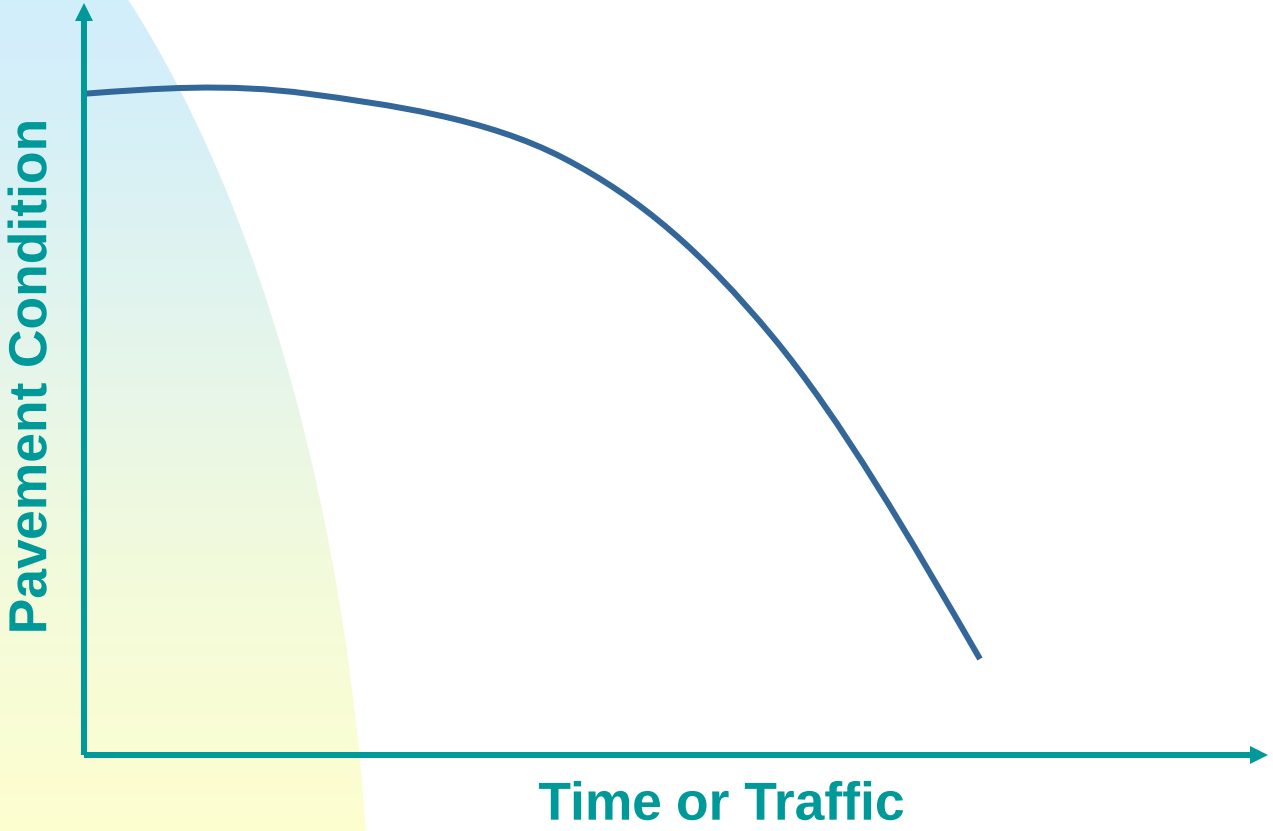
Work undertaken to extend the service life of an existing pavement. This includes the restoration, placing an overlay, and/or other work required to return an existing roadway to a condition of structural and functional adequacy.

- National Highway Institute

Pavement Management Concepts

- Pavement Life Cycle
- Pavement Condition
- Pavement Condition Index (PCI)
- Pavement Serviceability Index (PSI)
- Critical “PCI”

Pavement Lifecycle

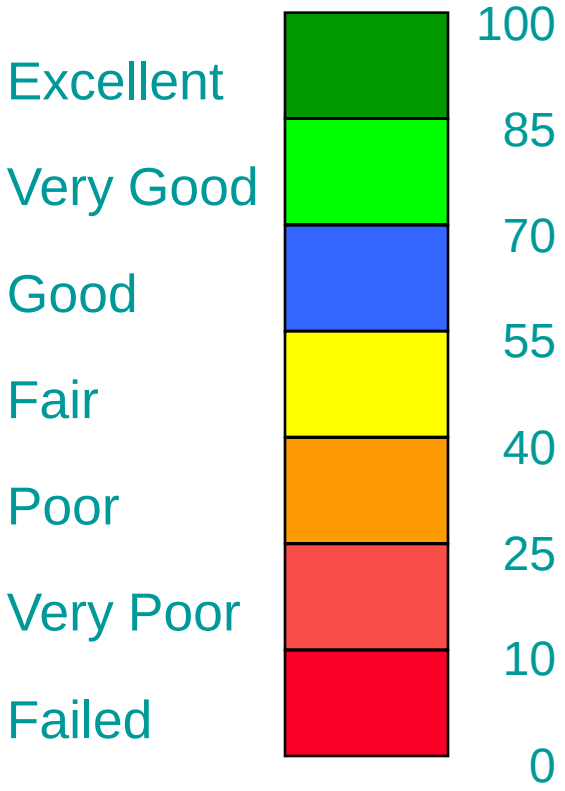


Pavement Condition

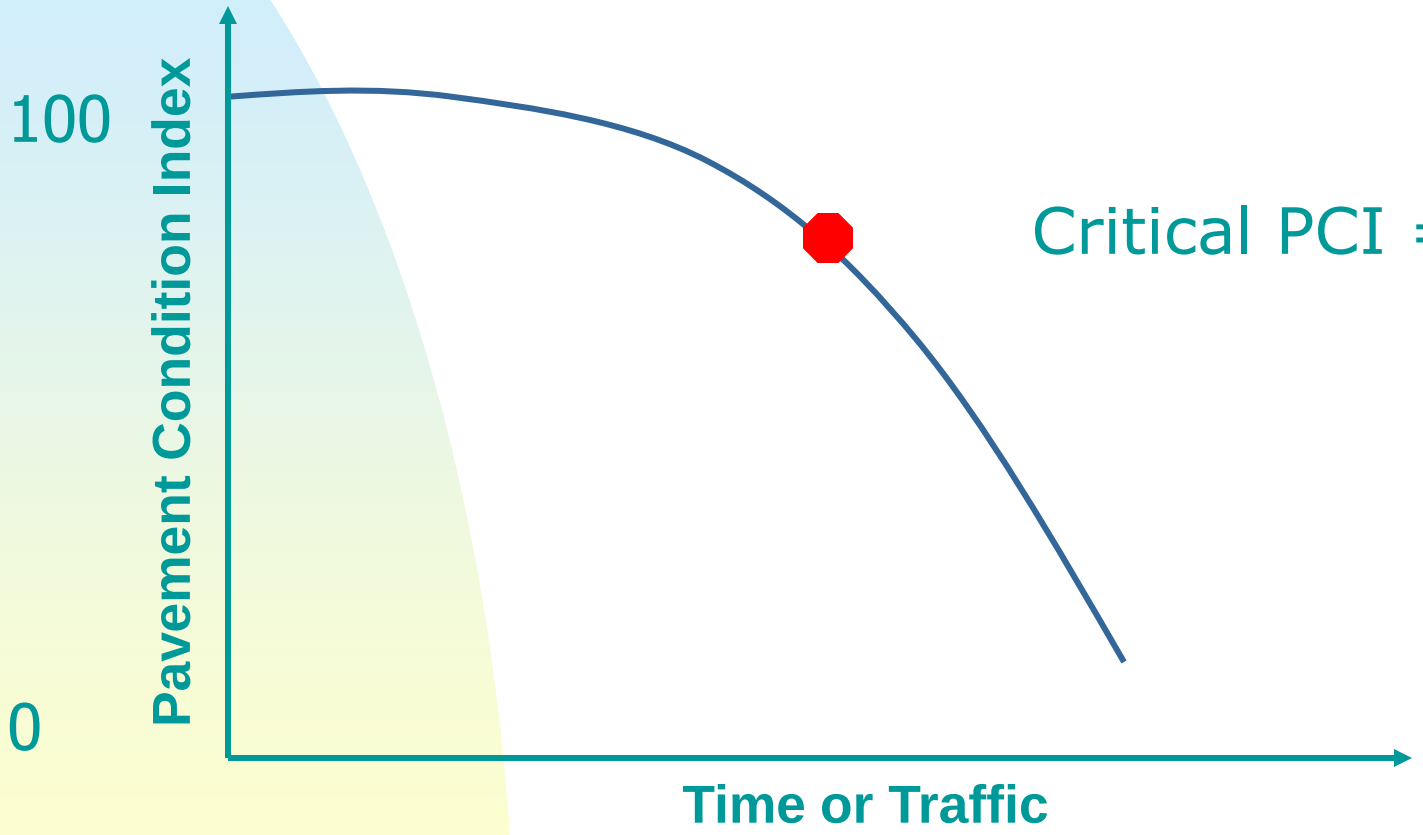
- Pavement Condition can be rated using any number rating systems, including:
  - Pavement Condition Index (PCI)
    - PCI = 100 is New/Excellent and PCI = 0 is Failed
  - Present Serviceablity Index (PSI)
    - PSI = 5 is New and PSI = 0 is Failed
    - Used in the AASHTO Design Methodology
  - International Roughness Index (IRI)
    - Rating is Inches/Mile and is automatically recorded

Pavement Condition Index

- Corps of Engineers (Developed for Airfields)
- ASTM now has standards for both highways and airfields
- Analyze Distresses
  - Type
  - Severity
  - Density

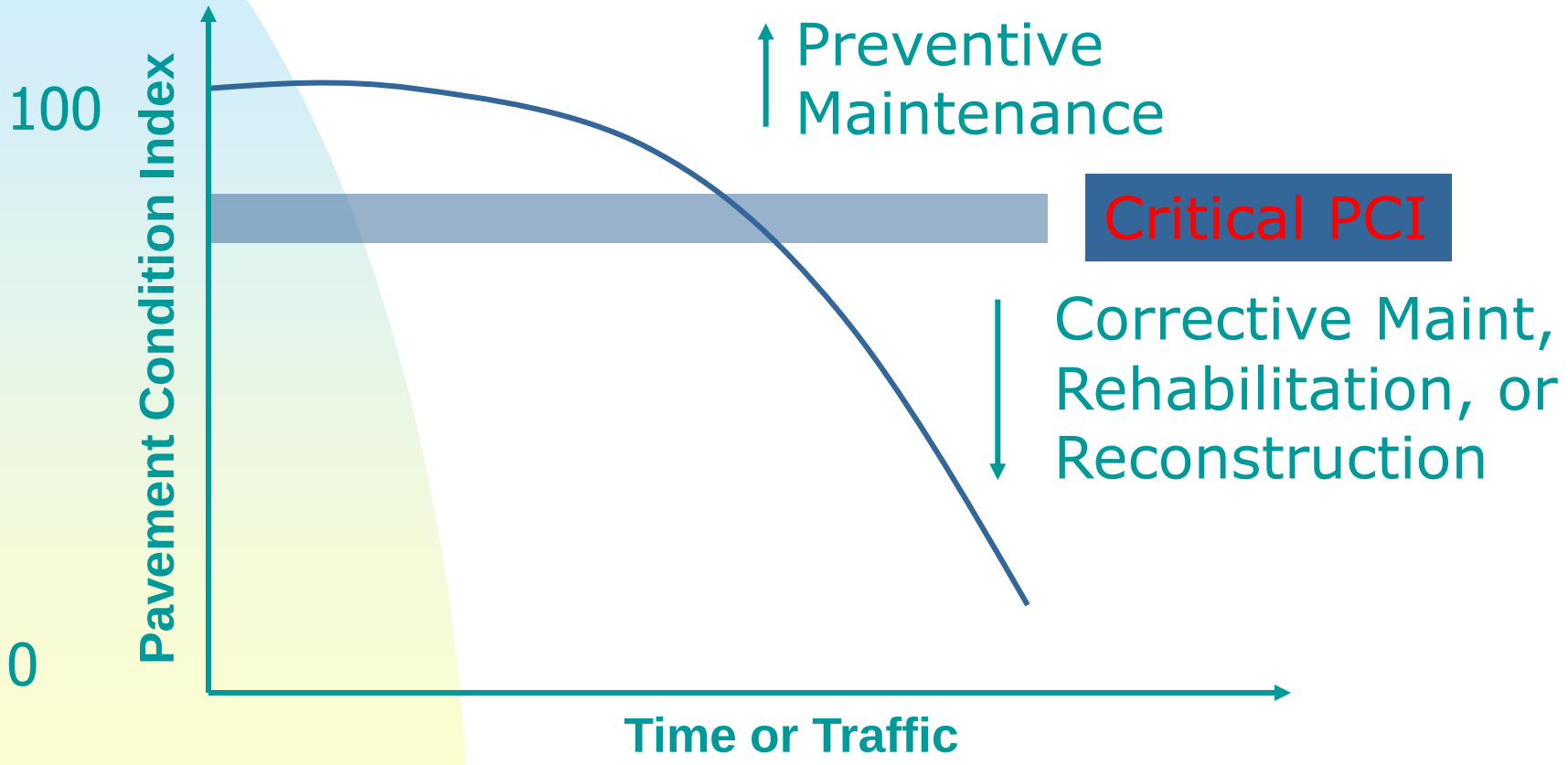


Pavement Condition

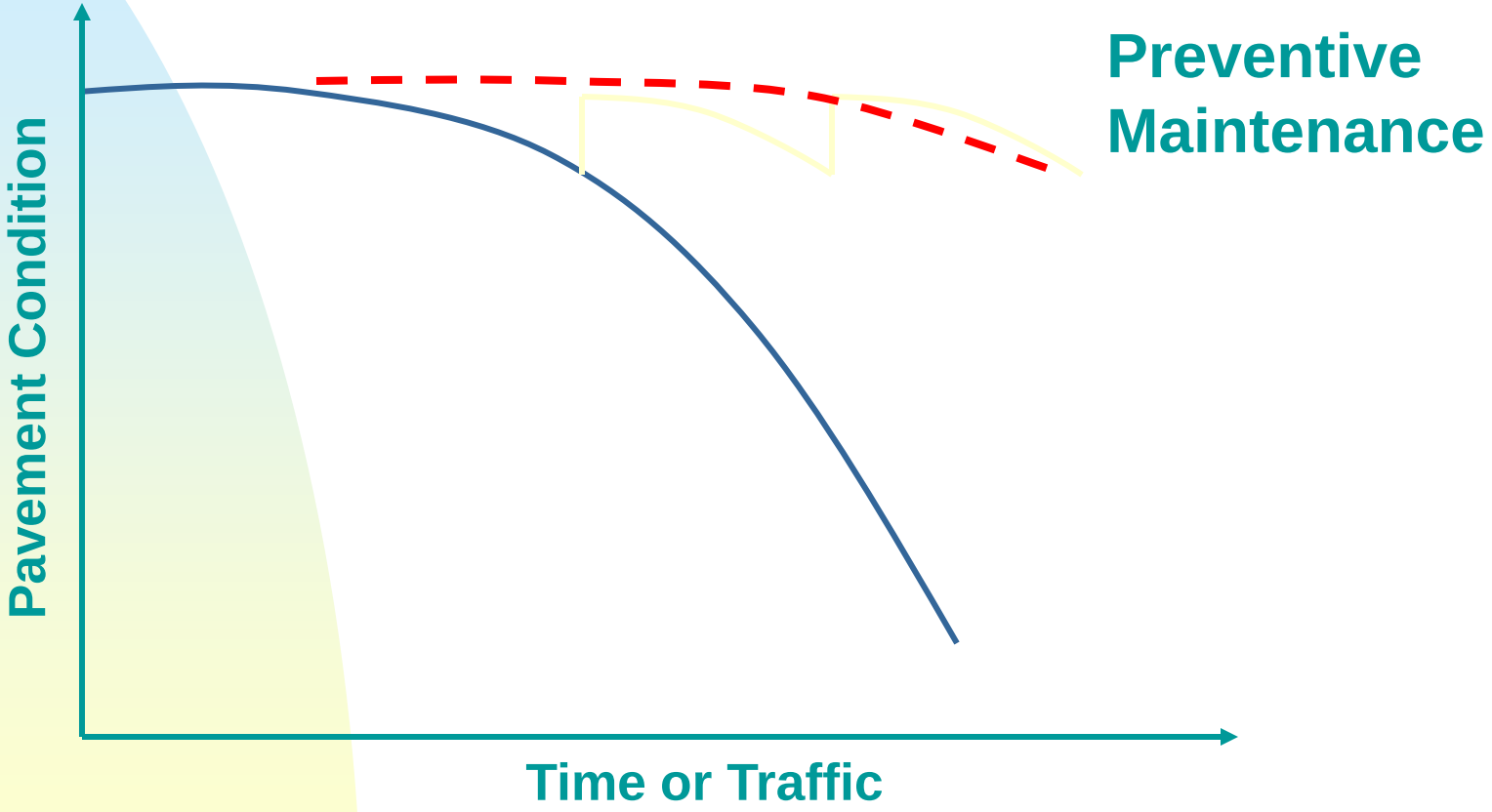


Critical PCI = 65 - 70

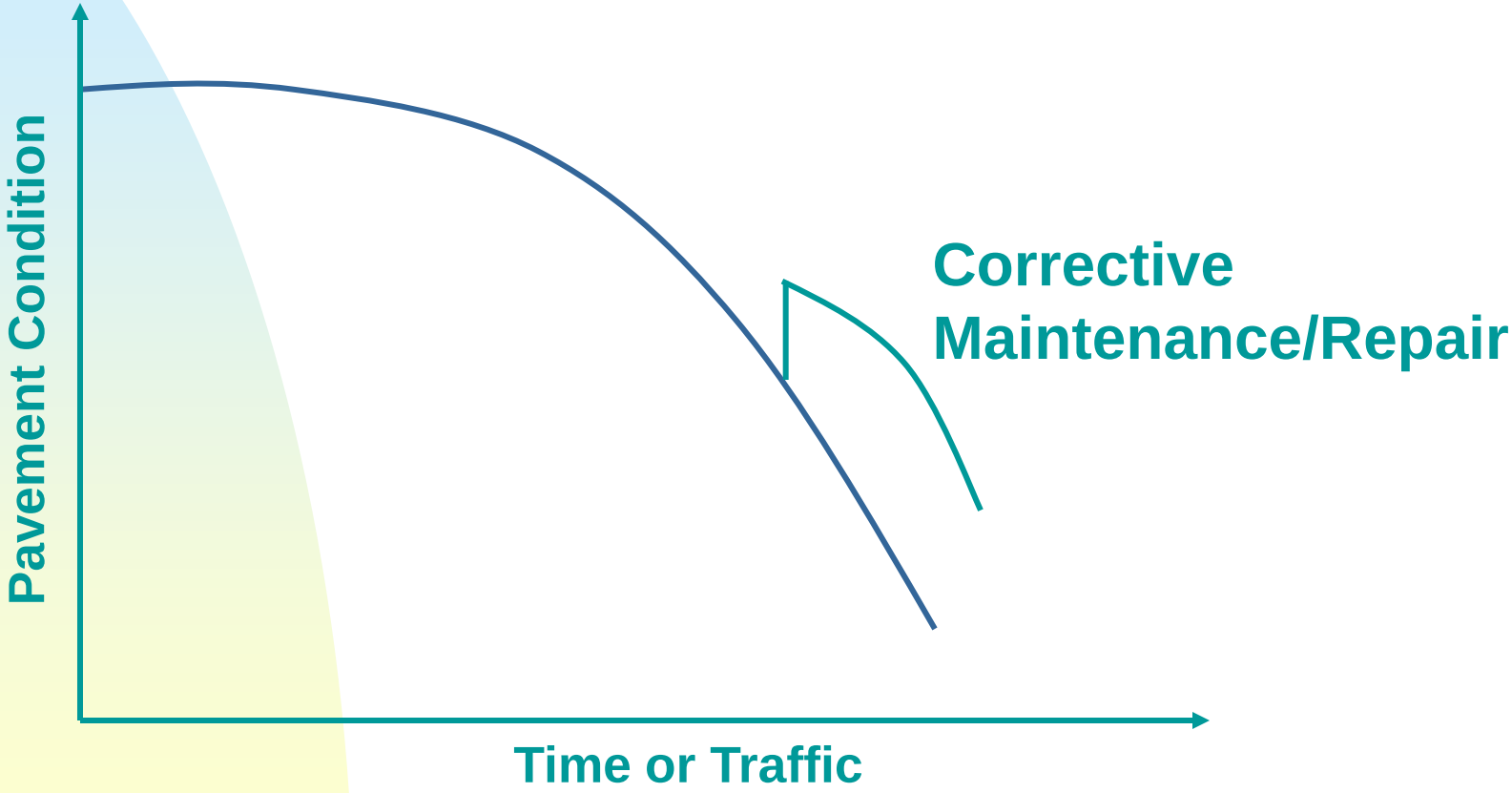
Critical PCI



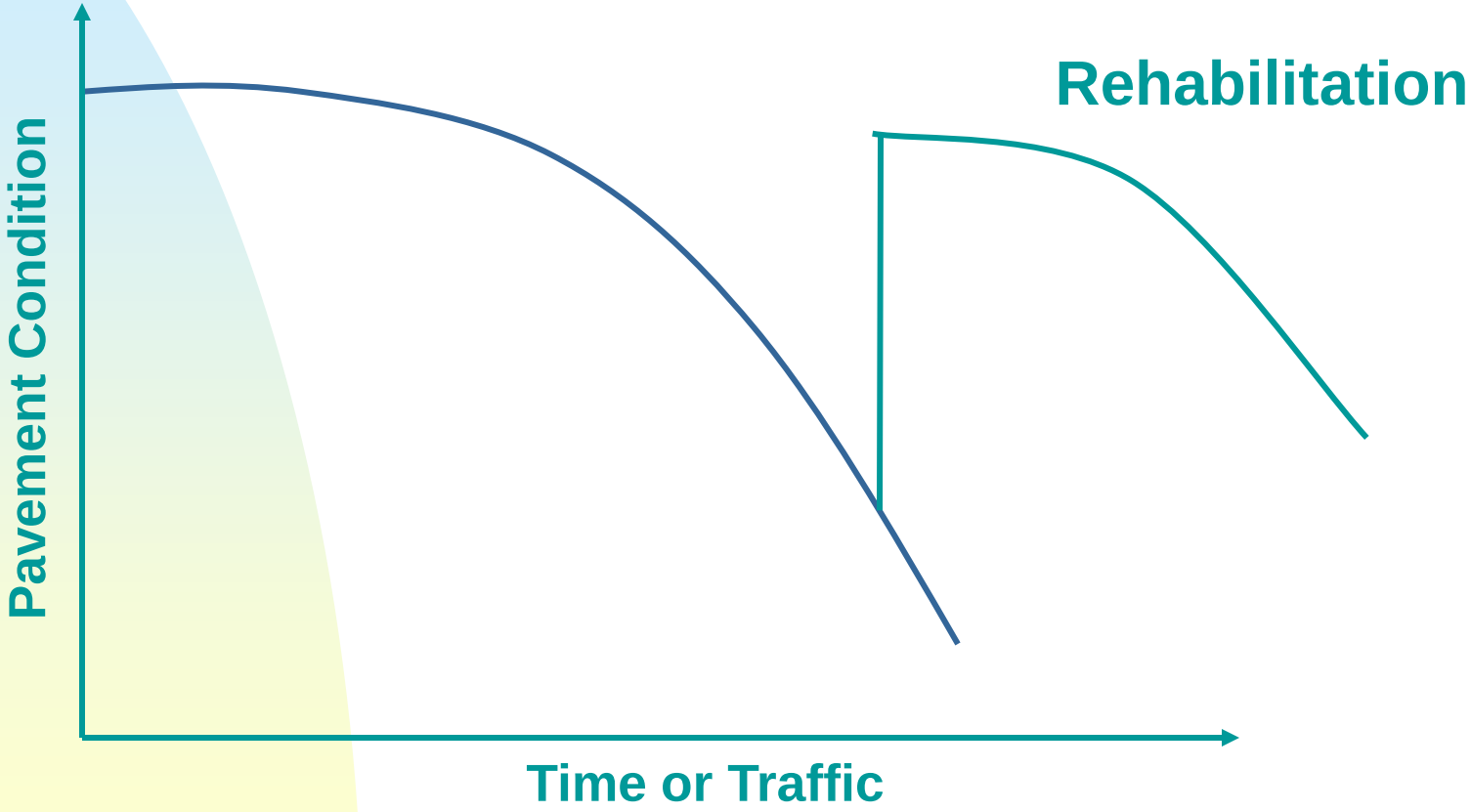
Preventive Maintenance



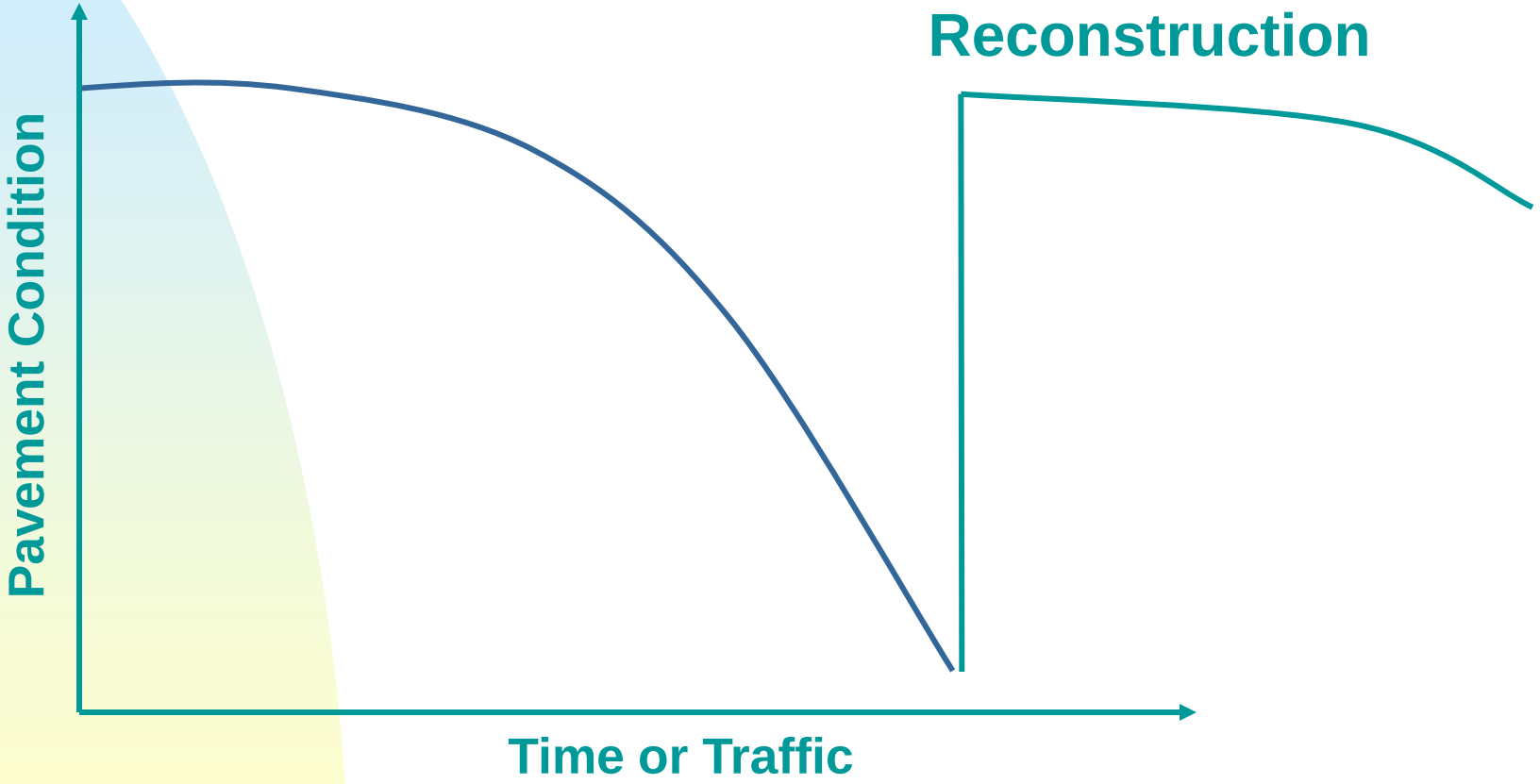
Corrective Repairs



Rehabilitation

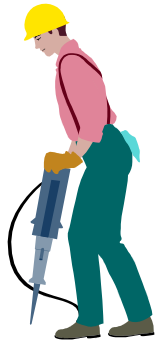


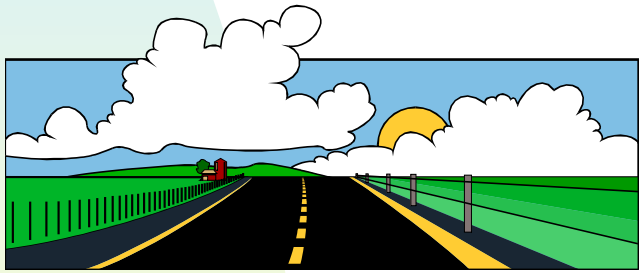
Reconstruction



Philosophy of Pavement Preservation

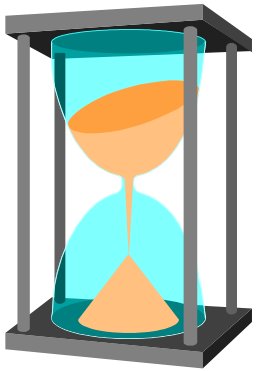
Applying the right treatment





. . . To the right pavement

. . . At the right time



Improved Pavement Condition

- Preventive maintenance helps to preserve a pavement and extend its performance
- Overall condition of network improves
  - Fair, Poor, and Failed Pavements are reconstructed and returned to a high pavement condition
  - Excellent and Good Pavements are kept in high condition

Cost Savings

- Most persuasive argument for shifting to preventive maintenance strategies
- Forms of cost savings
  - Less expensive treatments
  - Longer pavement life
  - Reduction of user delay costs

Cost Comparison of Options

- Preventive maintenance: (minimum)
- Rehabilitation: (intermediate)
- Reconstruction: (maximum)

Anticipated benefits

- Higher customer satisfaction
- Improved strategies and techniques
- Improved pavement condition
- Cost savings
- Increased safety
- Stability

What is Pavement Management ?

- Systematic method for routinely collecting, storing, and retrieving decision-making data needed to make maximum use of limited amount
- It also creates a set of steps or computer routines for quickly accessing the data to arrive at educated decisions.

Distress Identification

What pavement characteristics indicate pavement *condition*?

- *Visible* performance indicators
  - Functional indicators
  - Structural indicators
- *Non-Visible* defects
  - Environmental effects on materials
  - Load-related damage

What techniques are used to assess pavement condition?

- Visual distress surveys
- Roughness surveys
- Friction surveys
- Drainage evaluation
- Shoulder surveys
- Deflection testing

Data Collection Platforms

Video – distress, roughness

Friction

Laser - distress, roughness

- Sample and test (destructive)
  - essential to evaluate causes of distress
- Test in-place (non-destructive)
  - Important to delineate uniform sections

Subgrade Support

- From soils sampling/lab testing
- In-situ - DCP, Field CBR
- From deflection testing

Material Properties

- Bound layers
  - Thickness
  - Strength
  - Durability - reactive aggregate, stripping
- Granular base
  - Gradation
  - Quality
- Subgrade
  - Index properties
  - Resilient modulus

Non-Destructive Testing

HWD

GPR

Why Non-Destructive Pavement Testing?

- Measure structural condition in place
- High production rate:

  more information = better decisions

- Identify rehabilitation needs
- Knowledge-based selection of actions

Successful GPR Applications for Pavements

- Thickness of Pavement Layers
- Pavement Rehabilitation studies (identifying changes in structure)
- Defects in Base (Wet areas)
- Defects in Hot Mix layers (stripping, trapped moisture)
- Identifying areas of segregation and poor joint density
- Deterioration in asphalt covered bridge decks
- Base wash-outs (<3 ft down)

- Limited success on concrete pavements

Findings…

- Distresses
- Materials Properties
  - Subgrade, bases, surface
- Structural Properties
  - Deflection response
  - Layer thickness

Pavement Distress Categories

- Load
- Climate
- Other
  - Construction

Load Related Distresses

- Fatigue Cracking
- Potholes
- Rutting
- Edge Cracking
- Shoving

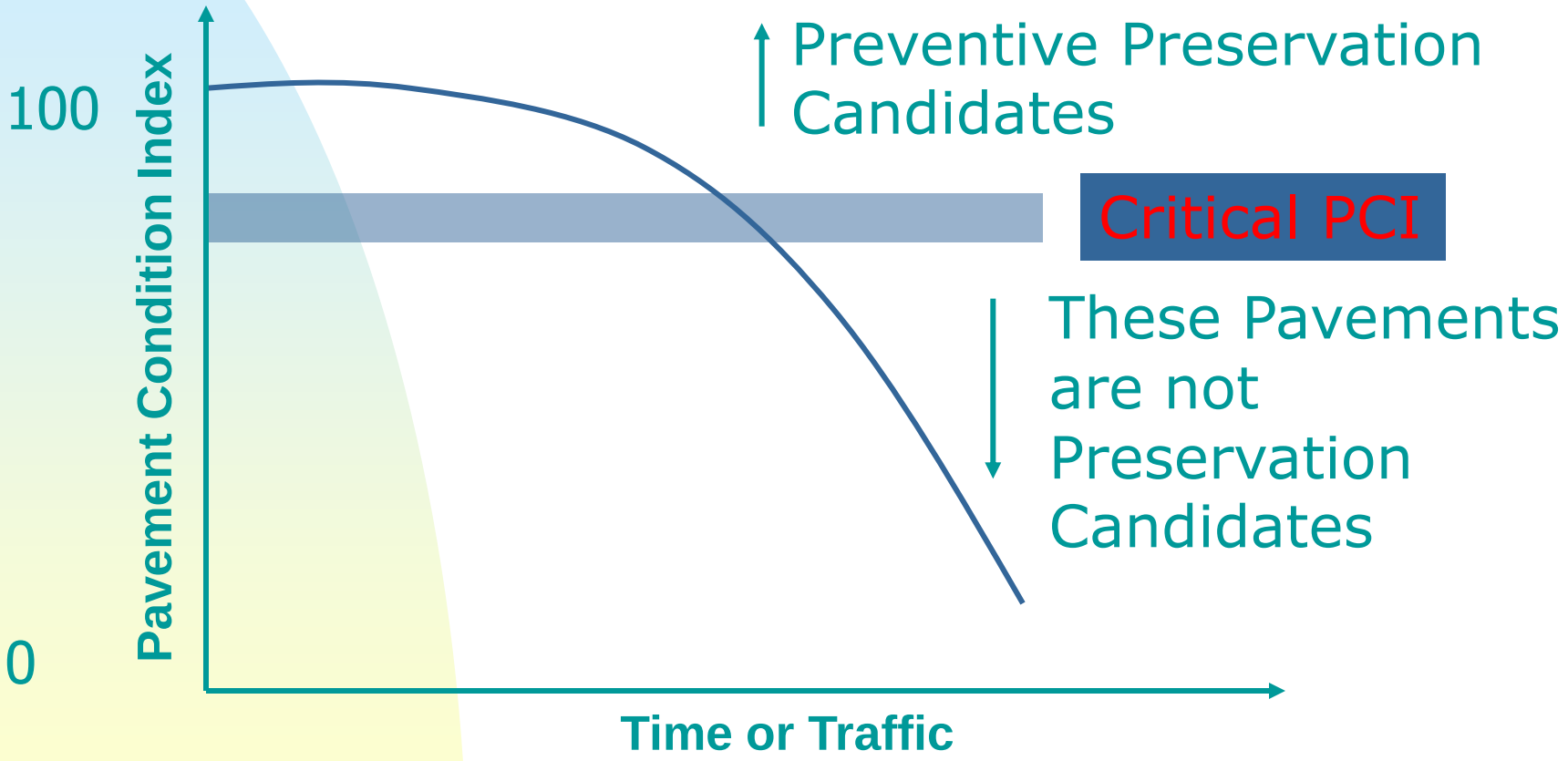
Climate Related Distresses

- Block Cracking
- Joint Reflective Cracking
- Thermal Cracking
- Weathering/Raveling

Preservation Candidates

- Preservation treatments must be applied when:
  - Pavements are in good condition
  - Corrective actions required on only a small area of the total pavement

- Pavements are not candidates for preservation:
  - Pavements in poor condition
  - Substantial repairs required
  - Structural deficiencies


100
0
Pavement Condition Index
Time or Traffic
Preventive Preservation Candidates
Critical PCI
These Pavements are not Preservation Candidates

Rehabilitation Alternatives

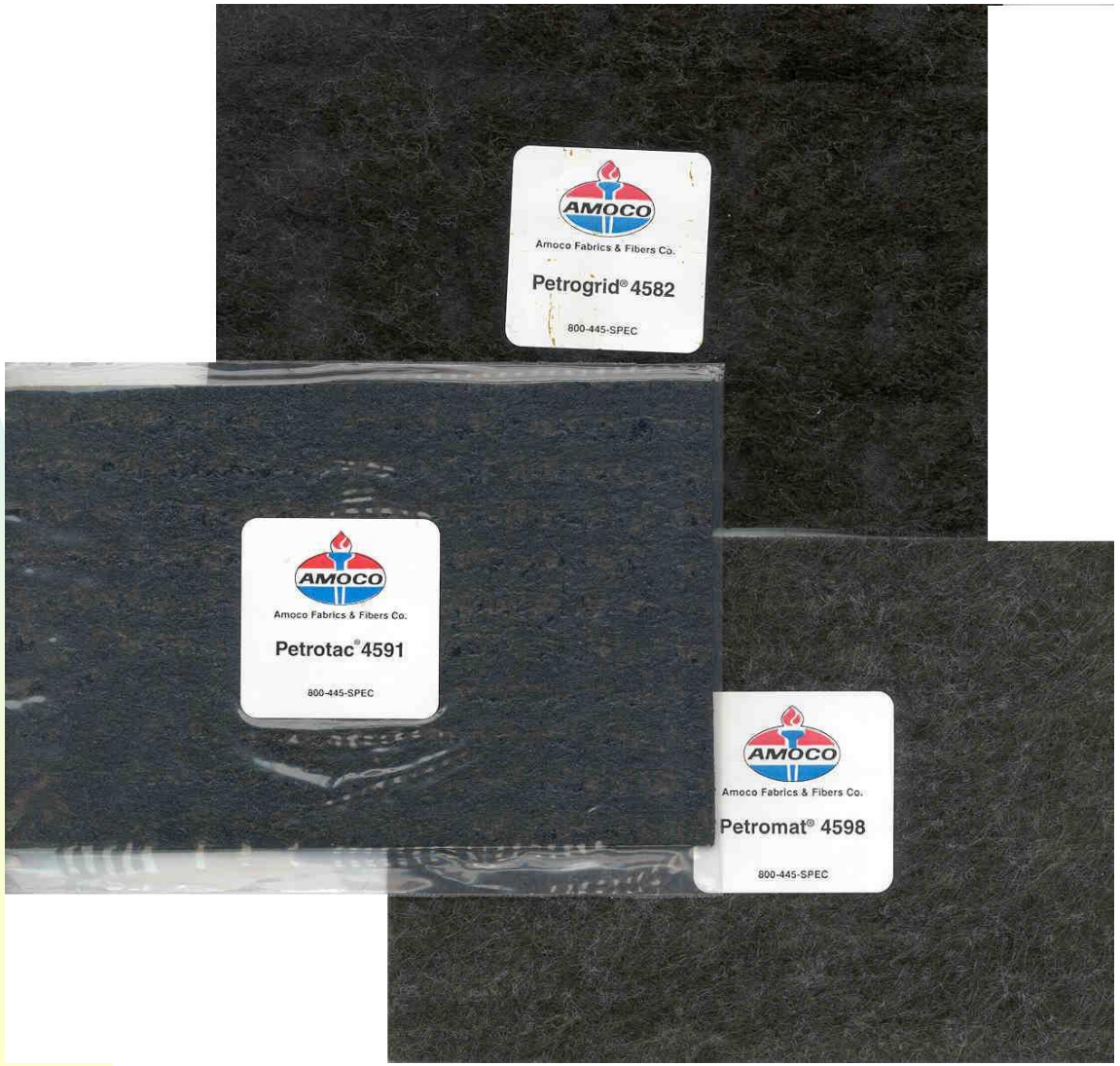
When to Rehabilitate?

- Rough road,
- Excessive pavement distress,
- Loss of skid resistance,
- Excessive maintenance needs,
- Inadequate structure for planned use.

Rehabilitation Alternatives

- Thick overlay with paving fabric,
- Thin overlay,
- Cold in place recycle (CIR),
- Full depth reclamation.

Paving Fabrics



Paving Fabric Basics

- Keeps water out of the base and subgrade
- Provides support to retard reflection of existing cracks and distresses
- Controls evaporation over the long-term, keeping uniform moisture content in the subgrade.

How does it work?

AC Overlay

Fabric

Existing AC Pavement

Base or Subgrade

Selection Considerations

- Can provide strength up to equivalent of 1.0 inch of AC (if pavement is stable and fabric is properly installed)
- Cost of fabric (based on DOT studies) is about the same as 0.5 inches of AC

Application Considerations

- Not suitable for severely distressed pavements.
- Generally not suitable where there is inadequate base/subgrade support.
- Do not use where free water problems exist.

Construction Considerations

- Minimum overlay thickness when using a fabric is 1.5 inches.
- Major contributor to failure is lack of tack and/or uniformity of tack coat application.
- *Read manufacturer's literature for detailed instructions.*

1/4 inch

3/8 inch

1/2 inch

What is a “Thin” HMA Overlay?

Overlay ≤ 1.5”

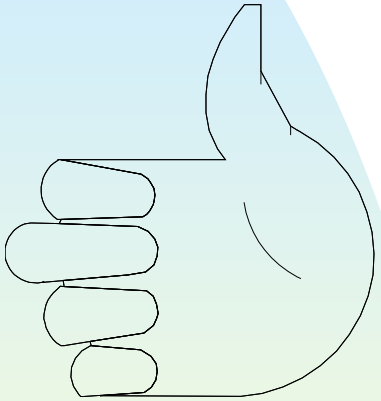
Why Thin Hot Mix Overlays?

- Restores Serviceability
- Low Initial Cost & Life Cycle Cost
- Minimal Road User Delays/Impacts
- Adds Structure
- Reduces Noise

Cost Comparison of Pavement Treatments

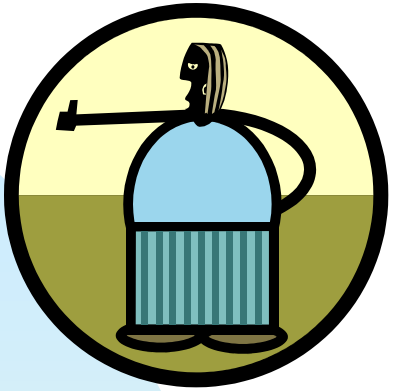
Treatment	Life, years	Cost ($/yd$^{2)}$)
Fog seal	1 - 2	0.25 - 0.35
Slurry seal	3 - 5	0.85 - 1.00
Chip seal	4 - 7	0.90 - 1.20
Thin HMA O'lay	10 - 15	2.50 - 3.50

Thin Overlays: Rules of Thumb



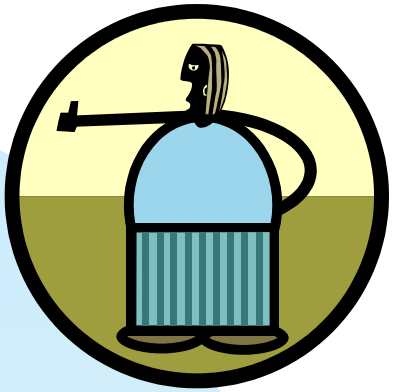
- Pre-level rutted areas
- Minimum lift thickness is 1 1/2”
- Roll while mix is hot (>185ºF)
- Minimum of 3 passes

Introduction to Cold In-Place Recycling



Advantages

- Reduced cost of construction
- Conservation of aggregate and binders
- Preservation of existing pavement geometrics
- Hauling Costs Minimized
- Minimal Air Quality Problems
- Conservation of energy
- Less user delay

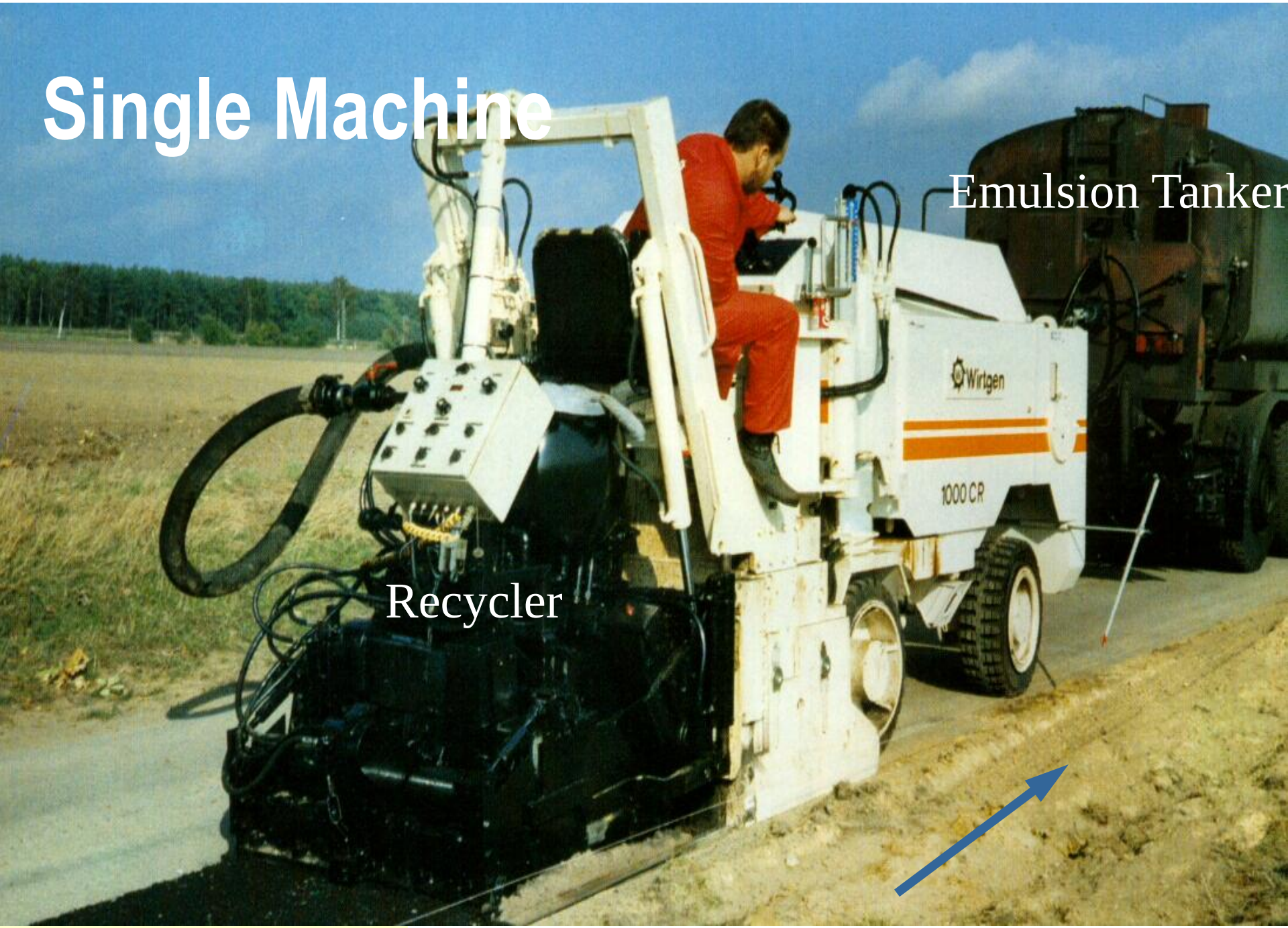


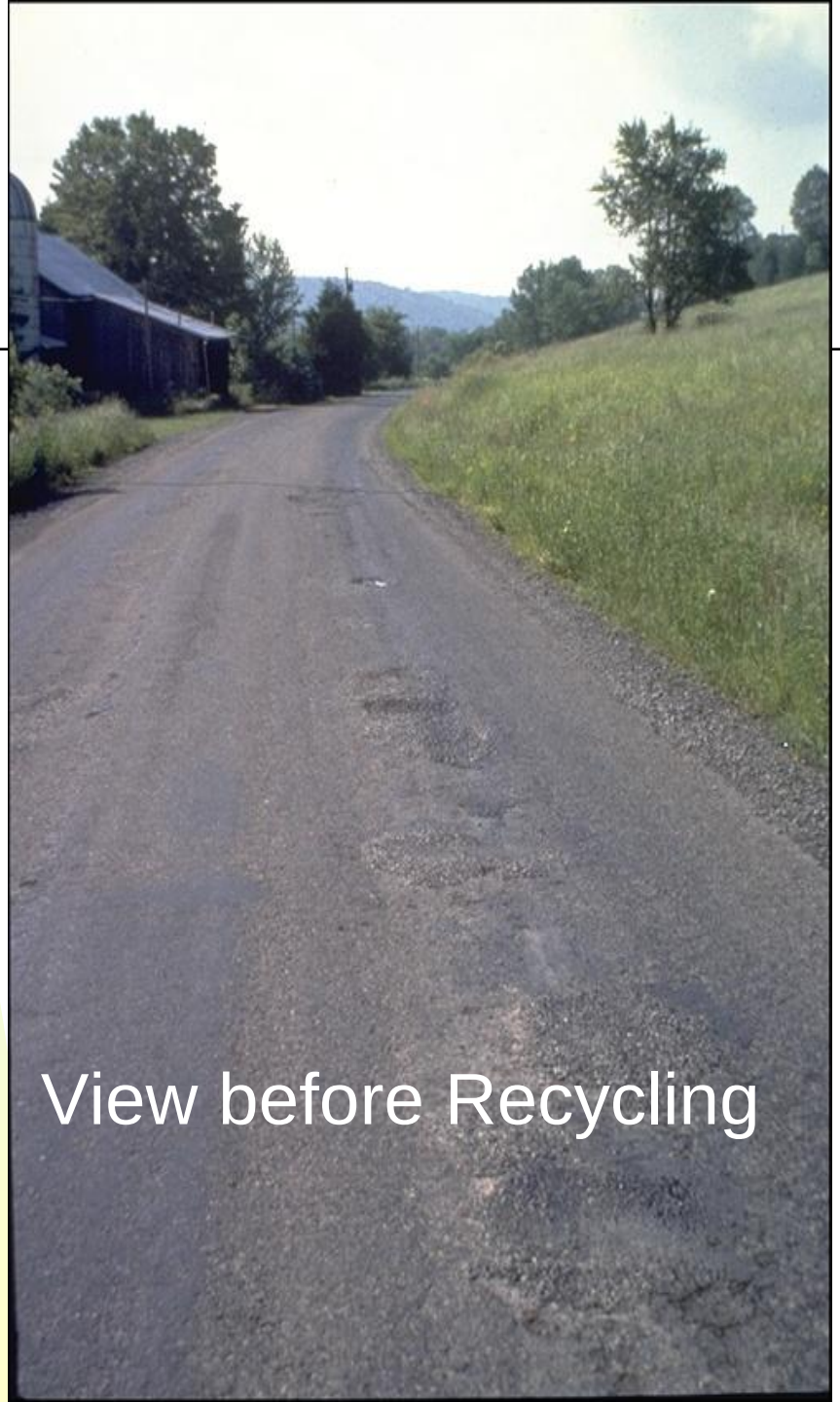
Advantages for the Road

- Significant Structural Improvements
- Most Pavement Distress Treated
- Ride Quality Improved


Cold In-Place Recycling Train
Emulsion
Milling Machine
Paver

Single Machine




View before Recycling

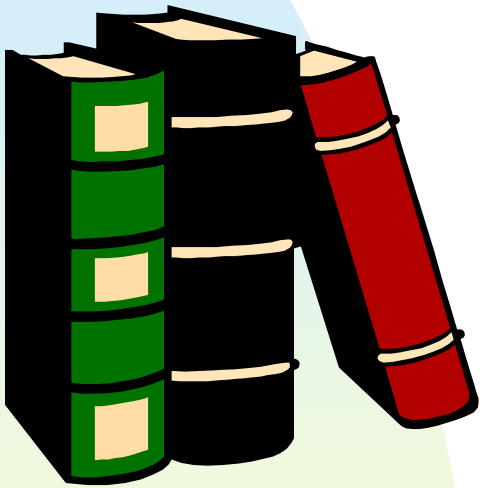

View after Recycling

Final Considerations

- Availability of Equipment
- Availability of Experienced Contractor
- First cost
- Life cycle cost

Full Depth Reclamation Construction Methods

Definition



Recycling method where all of asphalt pavement section and a predetermined amount of underlying materials are treated to produce a stabilized base course.

Advantages

- Pavement structure (especially poor base) improved without significantly affecting pavement geometry,
- Eliminates ruts, rough areas, and potholes and restores desired profile,
- Eliminates alligator, transverse, longitudinal and reflection cracking,
- Provides a uniform pavement structure.

Advantages (continued)

- Frost susceptibility may be improved,
- Low production cost,
- Conservation of materials and energy,
- No air quality problems.

Common Recycling Additives

- Emulsified Asphalts (MS and SS)
- Portland Cement
- Lime
- Fly Ash
- Calcium Chloride
- Foamed Asphalt

Main Steps

- Pulverize existing pavement,
- Introduce additive and mix,
- Shape the mixed material,
- Compact,
- Apply a wearing course.