

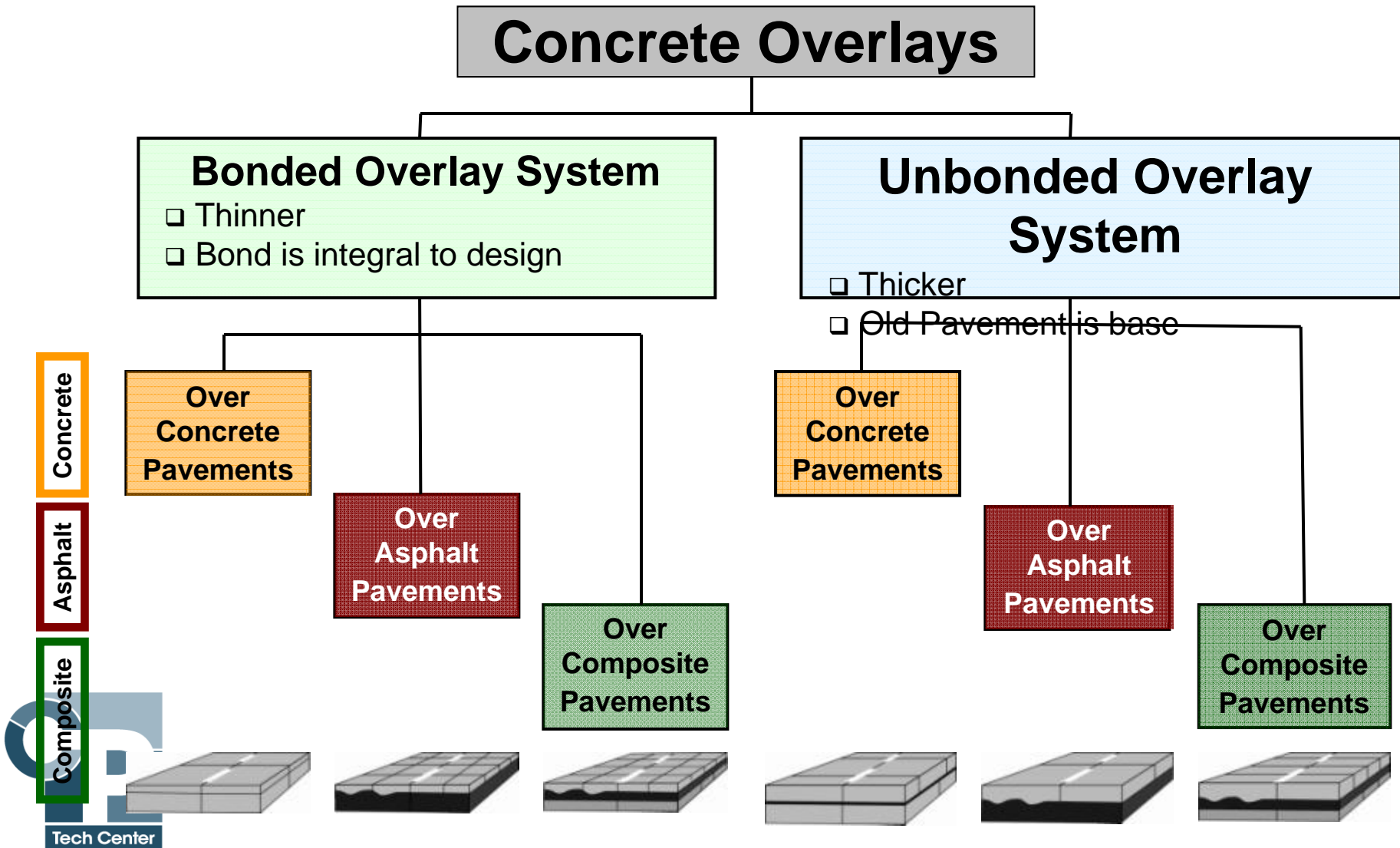
Selecting the Right Concrete Overlay for the Existing Pavement Condition



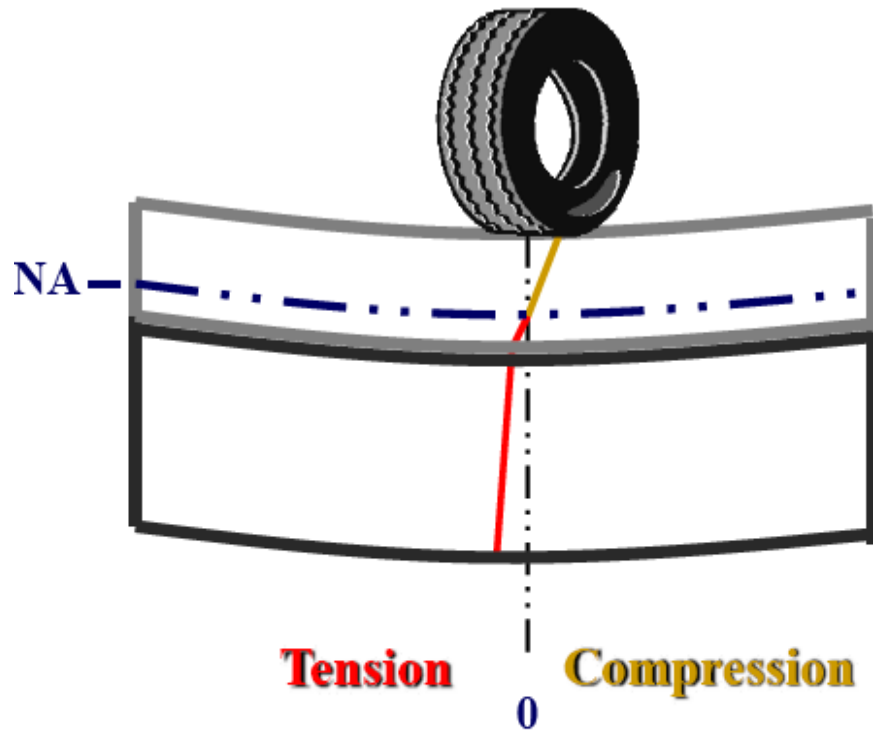
Gary Fick

Representing - National Concrete Pavement Technology Center

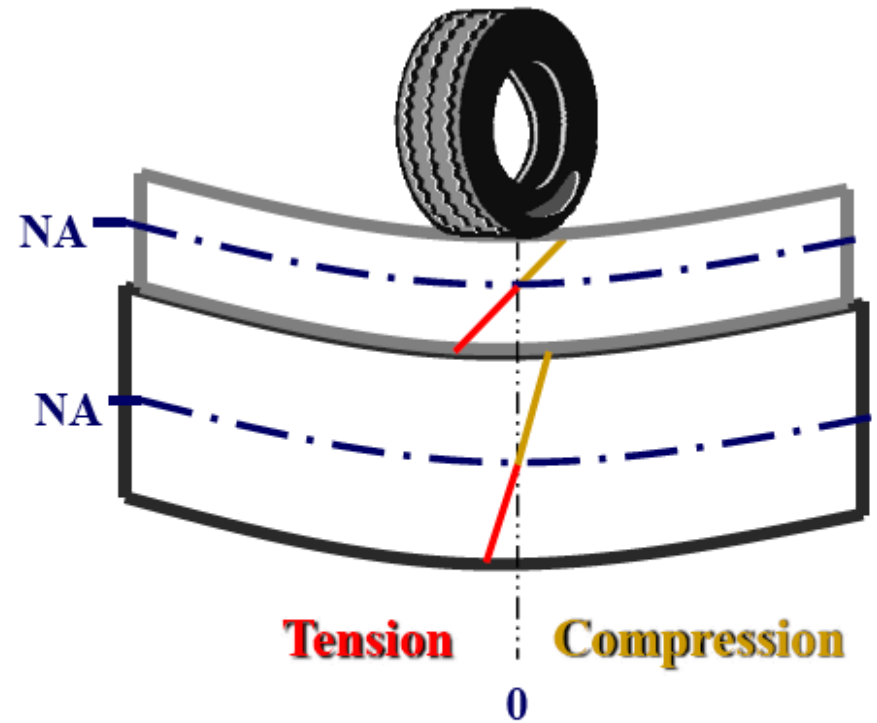
System of Concrete Overlays



Bonded and Unbonded



Bonded



Unbonded



General Feasibility—Bonded PCC Overlays

- **Bonded Concrete of Concrete**

- “Good” PCC pavements with need for:
 - Increased structural capacity
 - Improved surface characteristics

- **Bonded Concrete of HMA & Composite**

- “Good” to “fair” HMA pavements with:
 - Limited structural (fatigue) cracking
 - No stripping/raveling in HMA layers
 - HMA thick > 3-5 inches (after milling)



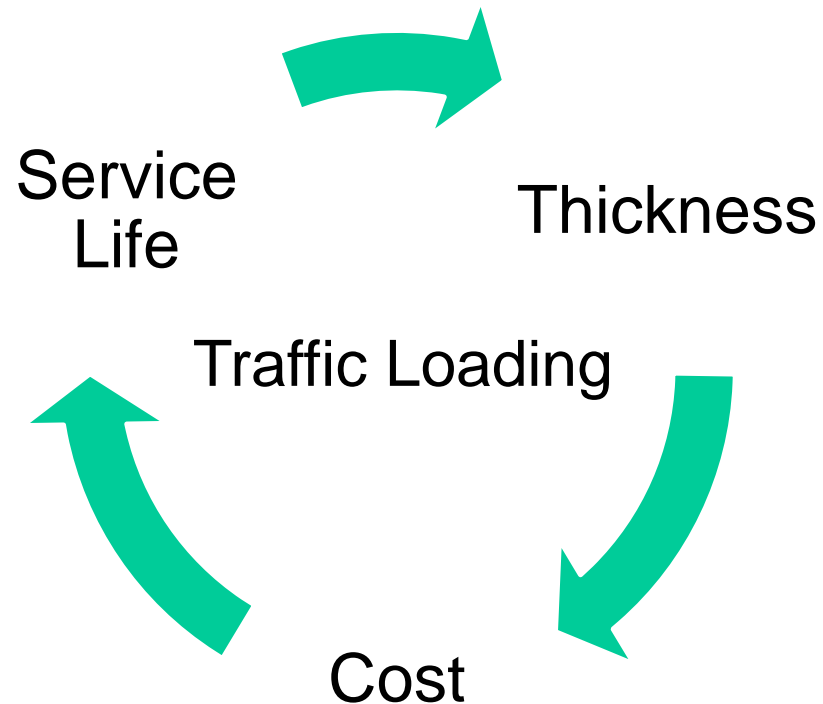
General Feasibility—Unbonded PCC Overlays

- **Unbonded Concrete on Concrete**
 - PCC pavements in “fair” to “deteriorated” condition
 - Any pavement type/traffic level
- **Unbonded Concrete on HMA & Composite**
 - HMA pavements in “fair” to “deteriorated” condition
 - Any traffic level

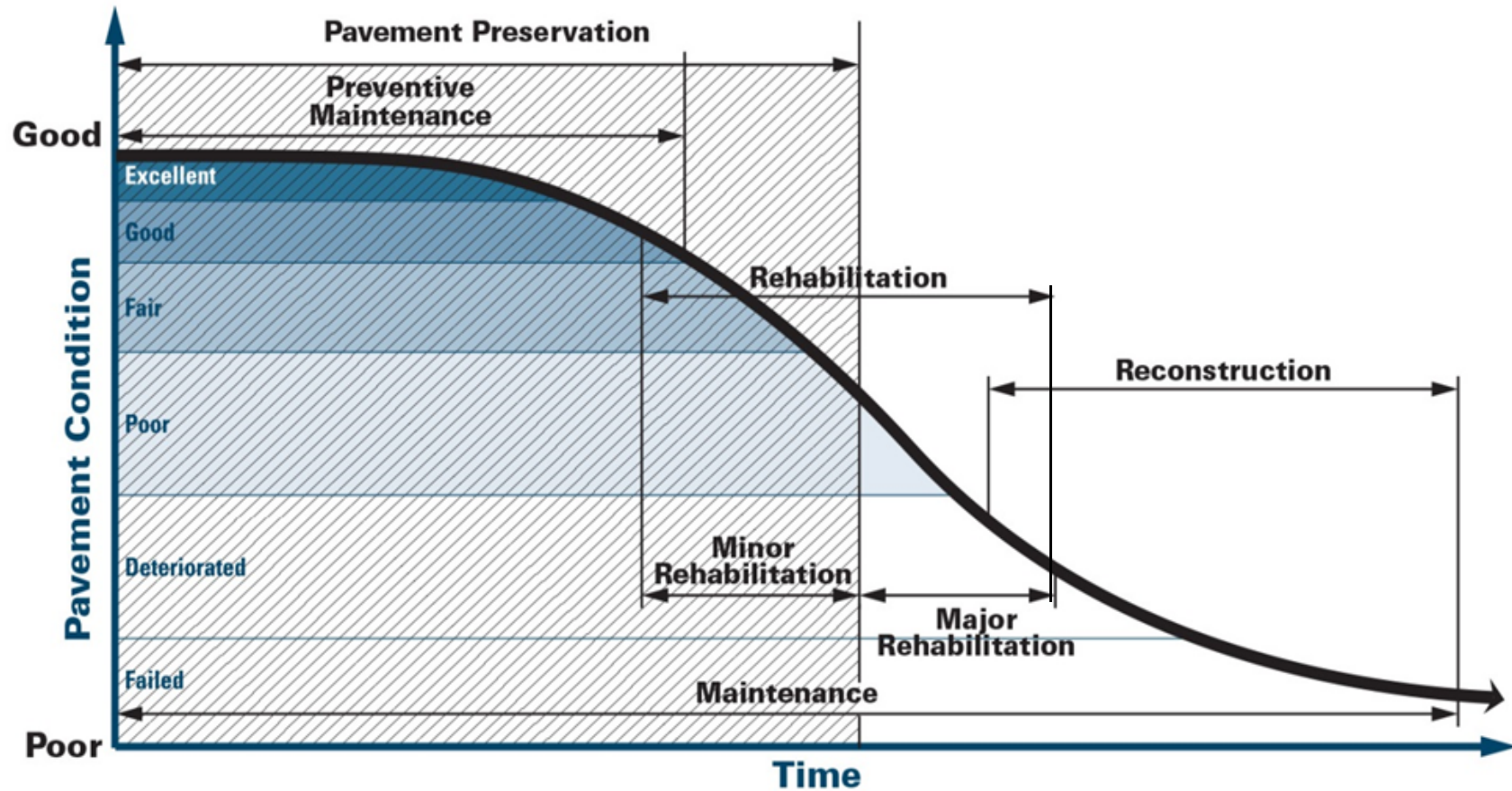


Expectations ...

- How much will it cost?
 - Why? Because our budget is fixed
 - How long do you need it to last?
- Thickness, cost and service life are interrelated



Asset Management Through Concrete Resurfacing



Preservation = Preventative Maintenance + Minor Rehabilitation

Selecting the Appropriate Concrete Overlay Solution

1. Design Objectives
 - Desired pavement life?
 - Desired level of service?
2. Condition of the Existing Pavement
3. Budget Objectives
4. What overlay will achieve these objectives?



Pavement Evaluation



Pavement Evaluation Objectives

- Document existing pavement condition
- Obtain necessary design inputs
- Identify field constraints



Evaluation Steps

1. Pavement History (Records)
2. Field Review of Distresses
2. Coring Pavement
3. Field Tests Where Necessary
4. Condition Assessment Profile



Evaluation of Existing Pavement

- Concrete overlays require uniform support conditions
- Premature overlay failure can be traced to some violation “picking the wrong project” to overlay.
- The evaluation of the existing pavement is paramount to determine if uniform support and movement control exists, or if it can be cost-effectively achieved.



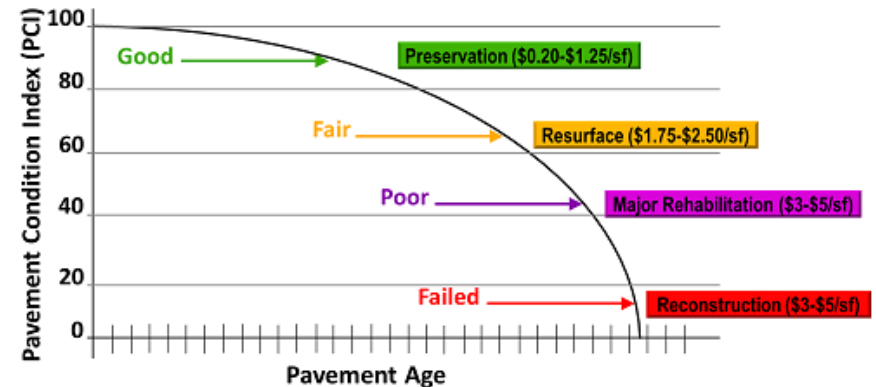
Evaluation of Existing Pavement

- Will a bonded concrete overlay act as a monolithic unit with the underlying pavement?
- Or will an unbonded overlay be necessary to meet the same criteria but with the added burden of meeting critical elevation constraints?
- To have a successful overlay, the good and poor characteristics of the existing pavement must be understood.



1. Pavement History

- Age of Different Thickness Layers
- Estimate Remaining Life
- Mixture materials,
- Design & construction date and method,
- Performance Grades of Lifts (records)
- Type and Amount of Traffic Now and in the Future
- Pavement Management Records
- Desired Design Life
- Elevations and Grade Restrictions



2 Visual Examination

Concrete



Asphalt / Composite



2. Field Review of Distress/Limitations

- Identify distress:
 - Type
 - Amount
 - Severity
- Evaluate uniformity of distress conditions
- Identify areas for further testing/evaluation
- Document repair quantities



Pavement Evaluation Data Elements

- Pavement condition
- Pavement Thickness
- Support Condition
- Materials and soil properties
- Traffic volumes and loadings
- Climatic conditions
- Drainage conditions



Other Project Factors

- Geometric factors
- Vertical restrictions
 - Bridges
 - Curb/gutter
 - Cross streets
- Utilities/fixed structures
- Existing grades & cross slopes
- Shoulders/ditches
- Traffic control constraints



From the Distress Survey

- Does the pavement condition/distress lend itself to a PCC overlay solution?
- What pre-overlay repair (type and amount) may be required?
- Are there other project factors that should be considered?
- What additional field testing is required to help document pavement condition?



3 Core Analysis

- **Type of distress**
- **Depth of distress**
- **Verification of thickness for pavement base/subbase**

3. Coring

- Layer confirmation
- Layer thicknesses
 - Variability
 - Minimum requirements for thin overlays
- Subsurface conditions
 - Stripping
 - Delaminations
- Samples for laboratory testing
 - Material properties



4 Optional Analyses

(depending on extent of problems)

4-a. Material-Related Tests

(indicated by core analysis)

Conduct if (a) material or durability issues are indicated or (b) roadway provides service for high levels of traffic, especially if a bonded overlay is being considered.

- Petrography analysis
 - Concrete material-related distress (MRD)
 - Poor air-void system
- Asphalt stripping
- CTE

4-b. Subsurface Tests

Conduct if (a) pavement or subgrade support issues are indicated or (b) roadway provides service for high levels of traffic, especially if a bonded overlay is being considered.

- FWD tests
 - Subgrade/subbase support (*k* value)
 - Subgrade/subbase variability
 - Pavement properties
 - Load transfer efficiency
 - Presence of voids
 - Asphalt stiffness
 - Concrete flexural strength
- Subgrade tests
 - Freeze-thaw characteristics
 - Shrink-swell characteristics
 - Soil strength (dynamic cone penetration or standard penetration test)

4-c. Surface Texture Tests

Conduct if (a) materials or durability issues are indicated, or (b) roadway provides service for high levels of traffic, especially if a bonded overlay is being considered.

- International roughness index (IRI)
- Friction (skid resistance) tests

- Distress (type, severity, amount) and level of roadway drives the need for and amount of field testing
- Bonded systems generally require more detailed and thorough field testing and evaluation than unbonded systems



Evaluations of Existing Pavements

- Evaluation is also used to determine:
 - Required repairs where needed
 - Establish the concrete overlay design thickness
 - When combined with an overlay can the existing pavement help carry anticipated traffic as:
 - an integrated part of the pavement (bonded)
 - or serve as a base or subbase (unbonded)



Initial Evaluation (step 5)

5 Condition Assessment Profile

Concrete

Surface Deficiencies

- Friction loss
- Joint deterioration (low to medium)
- Map cracking (non-ASR)
- Popouts
- Noise
- Scaling
- Roughness (not distress-related)
- Plastic shrinkage cracks
- Thermal shrinkage cracks
- IRI
- Other

Structural Deficiencies

- Corner breaks
- Joint deterioration (severe)
- Tented panels
- Longitudinal cracking
- Pumping/faulting
- Punchout
- MRD (medium to severe)
- Transverse cracking
- Subgrade/subbase condition
- Other

Asphalt / Composite

Surface Deficiencies

- Bleeding/flushing
- Block cracking
- Friction loss
- Noise
- Corrugation
- Joint reflective cracking
- Roughness (not distress-related)
- Rutting
- Weathering/raveling
- Shoving
- Slippage
- IRI
- Other

Structural Deficiencies

- Fatigue (alligator) cracking
- Depressions
- Heaves
- Longitudinal cracking
- Potholes
- Transverse thermal cracking
- Rutting/shoving
- Subgrade /subbase condition
- Other

**Pavement
Evaluation
Report
and
Pavement
Condition
Rankings**

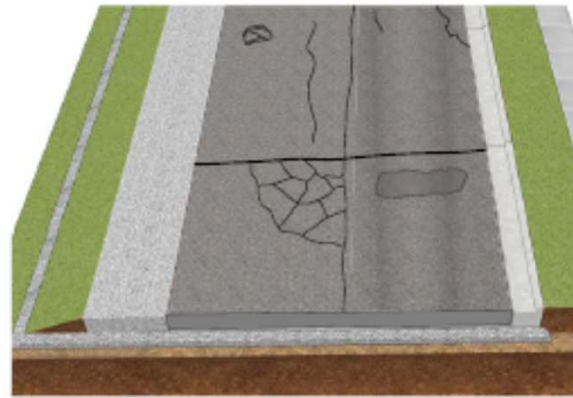
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- Pavement aggregate (thickness, I)
- Existing traffic
- Design life

2 Visu

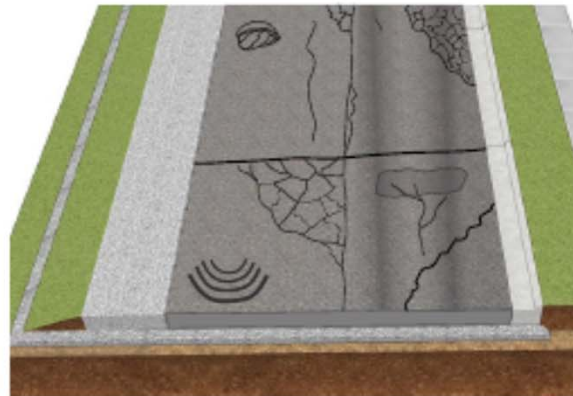
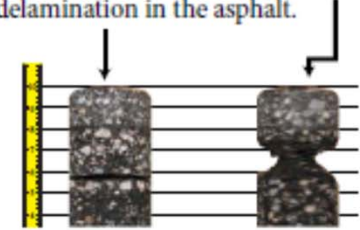


Overlay Selection – Existing Asphalt



Fair Condition

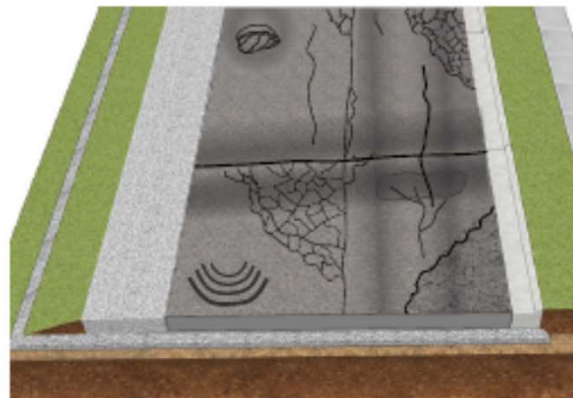
Structurally sound but has minor surface distresses such as potholes, block cracking, random thermal cracking. Check for undulating profile grade to determine if sub drainage issues exist. Check cores to ensure no measurable stripping or delamination in the asphalt.



Poor Condition

Has measurable distresses beyond those described as Fair conditions such as alligator cracking, rutting, shoving, slippage, stripping, raveling and freeze-thaw damage.

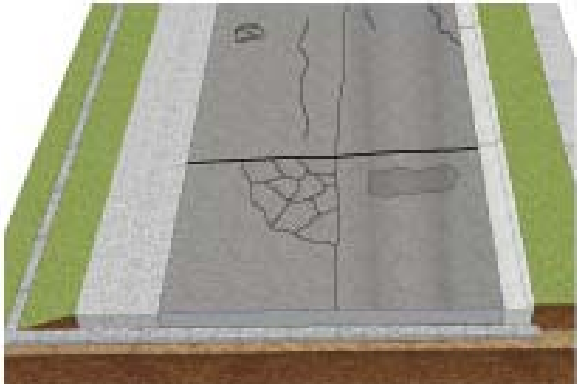
Note: Asphalt is a good reflector of underlying distresses such as a poor subbase conditions.



Deteriorated Condition

Exhibits Poor Conditions as well as significant deterioration, raveling, thermal expansion, stripping and structural distresses.

Overlay Selection for Existing Asphalt or Composite Pavements in "Good" to "Fair" Condition



Pavement is structurally sound but has surface distresses such as potholes, block cracking, or random thermal cracking.

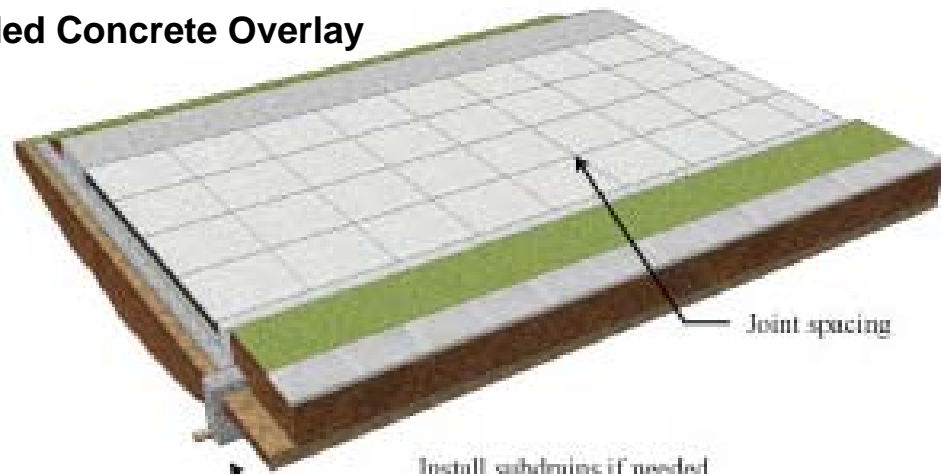
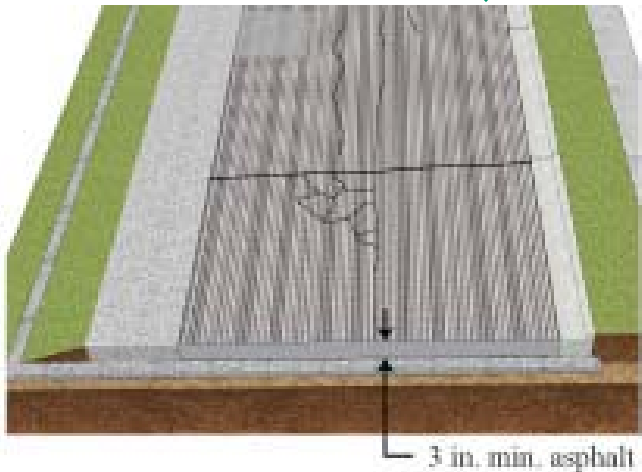
Pre-Overlay Question

Can milling and minor spot repairs cost effectively solve deficiencies, bring the pavement to "Good Condition" and meet other constraints (i.e., vertical clearance, shoulders, safety rails, foreslopes, etc.) to allow for bonded overlay?

NO →

Yes ↓

Bonded Concrete Overlay

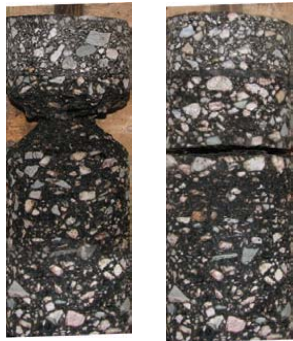


Note: Concrete overlay thickness must be appropriately designed considering estimated traffic, desired design life, and budget

Overlay Selection for Existing Asphalt or Composite Pavements in Poor to Deteriorated Condition



Pavement has measurable distresses such as alligator cracking, rutting, delamination, shoving, slippage, stripping, raveling thermal expansion, cracking and structural distresses.



Pre-Overlay Question

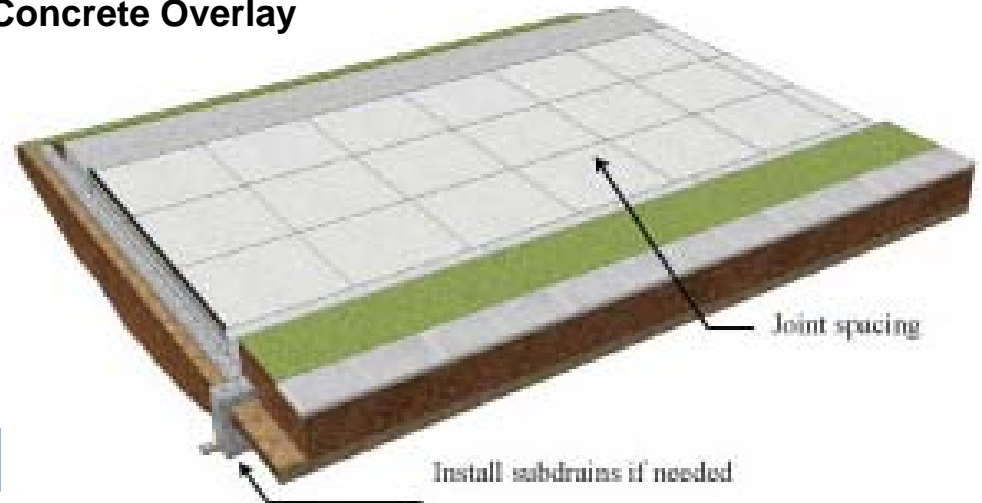
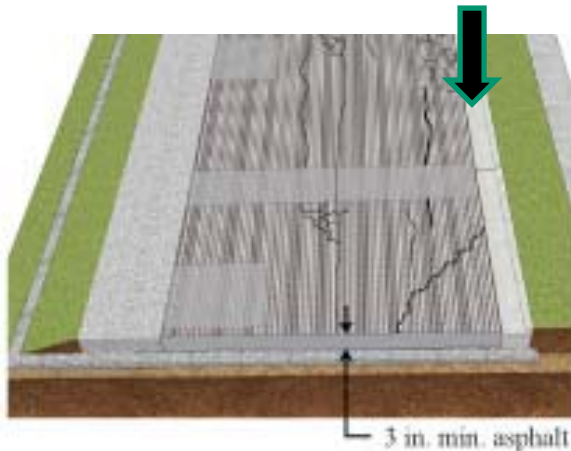
Can milling and/or structural repairs cost effectively solve deficiencies, bring the existing pavement to a condition that will provide uniform support as a subbase, meet other constraints (i.e., vertical clearance, shoulders, safety rails, foreslopes, etc.), that allow for an unbonded overlay?

NO

Stripping /delamination

Yes

Unbonded Concrete Overlay



Stripping

- Stripping occurs in the asphalt interlayer of an unbonded concrete overlay pavement when the interlayer contains trapped water and under repeated heavy truck traffic, results in the water stripping the asphalt binder from the aggregate.

- Prevention

- Drainage of the interlayer
- Open-graded interlayer
- Anti-strip additives
- Seal Joints



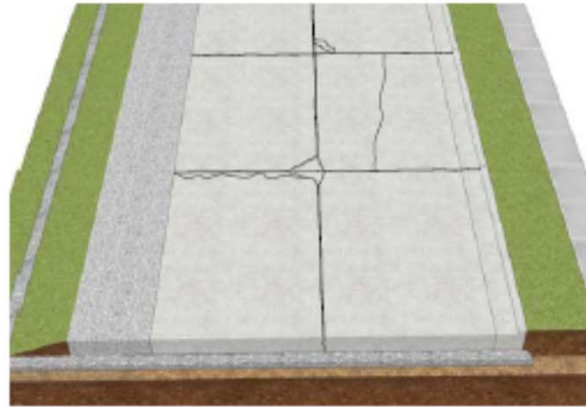
CAUTIONS ABOUT MILLING

- Milling should be minimized to retain structural support of pavement
- Preferable to mill to depth that will minimize the potential for delamination between lifts
- Grade corrections should be made in the thickness of the concrete overlay



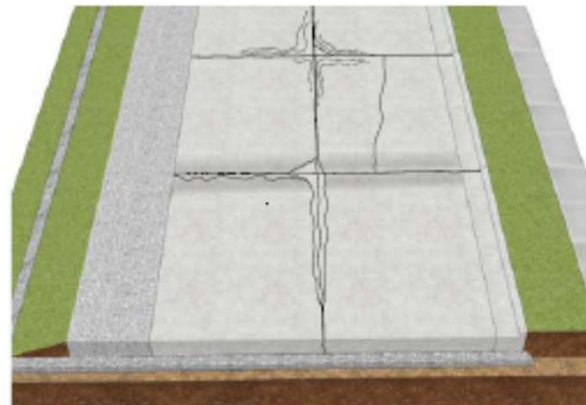
Excessive milling of existing asphalt beyond asphalt lifts (tack line)

Overlay Selection – Existing Conc.



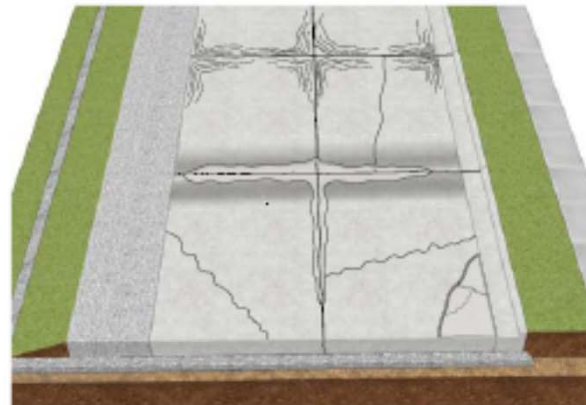
Fair Condition

Structurally sound but has minor surface distresses such as random cracking, periodic partial-depth joint spalling and shadowing. Check for undulating profile grade to determine if sub drainage issues exist or other foundation issues such as secondary consolidation of an open graded base exists.



Poor Condition

Has measurable surface distresses beyond those described as fair condition. These include: full-depth joint deterioration, working cracks, spot structural failures, faulting and/or material related distresses (MRD).



Deteriorated Condition

Exhibits Poor Conditions as well as significant surface deterioration and structural distresses. If severe or potentially severe joint deterioration from freeze-thaw damage or MRD is present and it exists 3' to 4' beyond joint at nearly every joint, then overlays are not normally a good candidate unless the service life is reduced.

UNBONDED OVERLAYS CAN BE PLACED OVER POOR CONCRETE PAVEMENTS



D35-Kansas City Metro
Area- 9000 ADT- 5"
Unbonded Overlay
Excellent Condition



SPOT REPAIRS FOR UNBONDED OVERLAYS OF CONCRETE



Joint Patching

Material Related Distress and Concrete Overlays

If severe or potentially severe joint deterioration from freeze-thaw damage or MRD is present and it exists 3 to 4 ft. beyond the joint at nearly every joint, then the pavement is not normally a good candidate for an unbonded overlay unless the service life is reduced.



QUESTIONS?



THANK YOU!