BOCA Project Suitability, Design and Construction

Bonded Concrete Overlay of Asphalt Pavements
Mechanistic-Empirical Design Guide (BCOA – ME)

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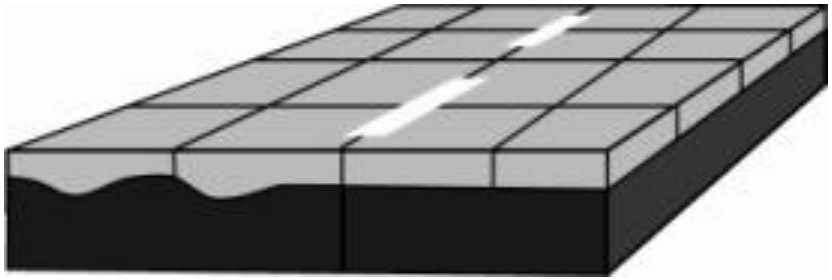
FHWA Pooled Fund Study TPF 5-165

Definition

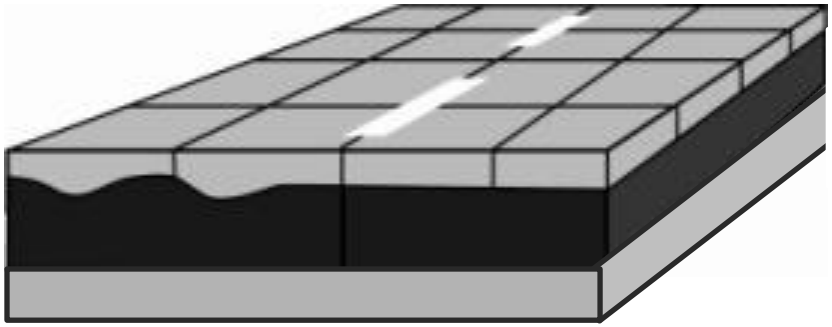
- Whitetopping or BCOA - Bonded concrete overlays of existing HMA surfaces.

(Typically 3 to 5 in thick for highways)



HMA pavement

or

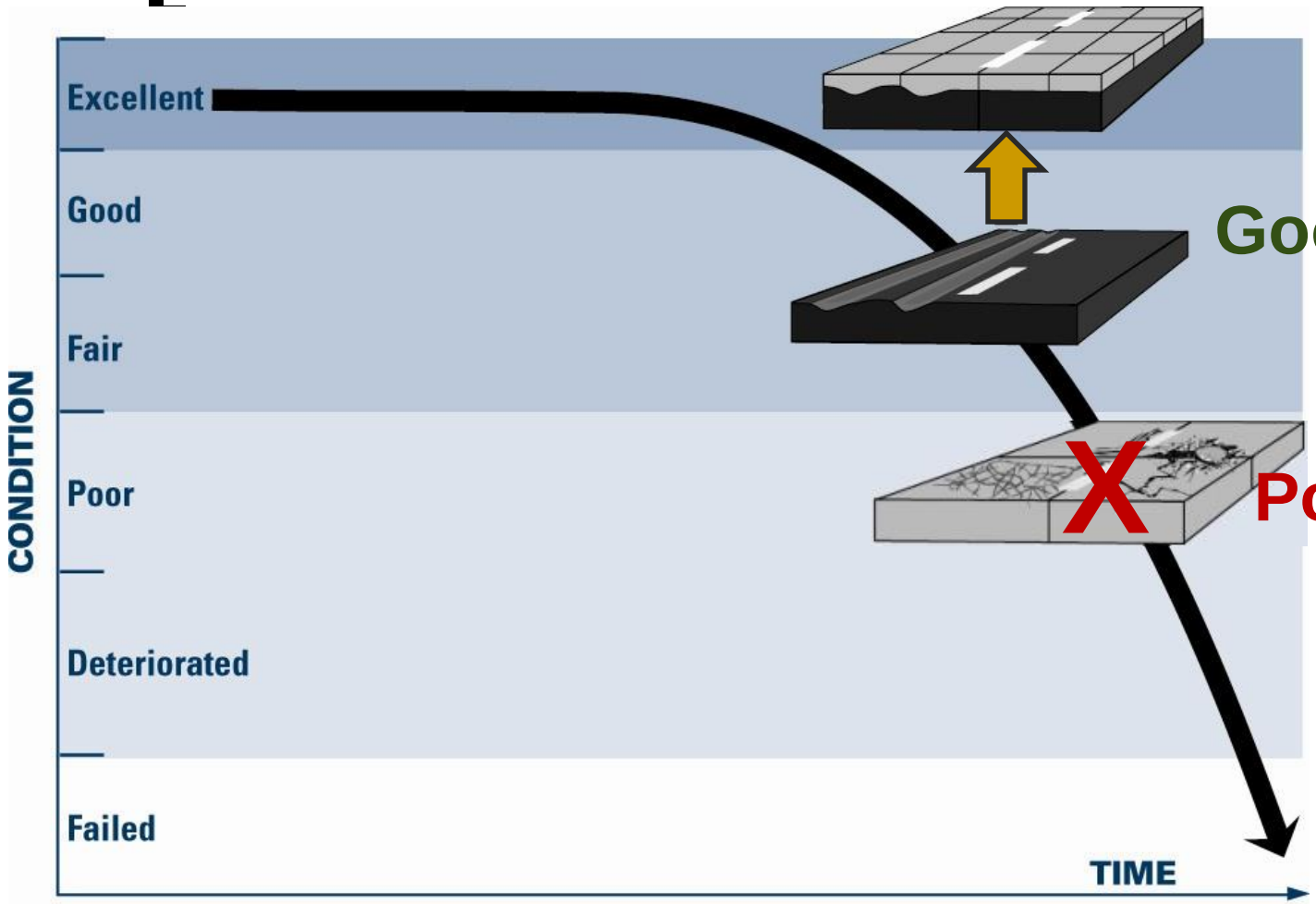


Composite pavement

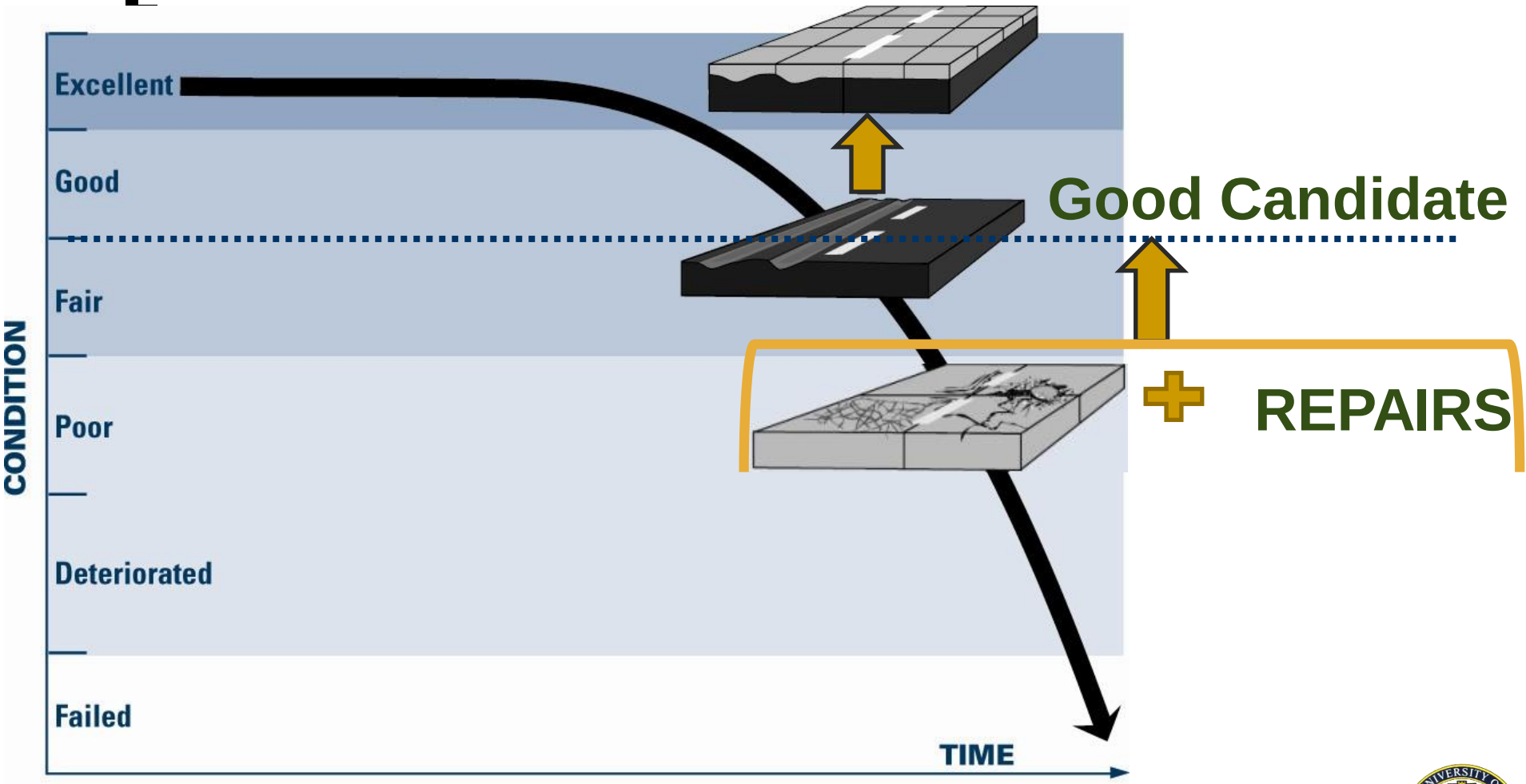
Purpose

- Increase structural capacity
- Eliminate surface defects
- Improve surface friction, noise and rideability

Suitable candidates



Suitable candidates



Adapted from CP Tech Center Overlay Guide

Suitable candidates

- Good Candidate:
  - Stable support conditions (Localized weak areas can be strengthened)
  - Surface distresses
  - Temperature cracking
  - Min. of 3 to 4 in of HMA remaining after milling
- Poor Candidate:
  - Significant structural deterioration
  - Stripping of HMA layers
  - Poor drainage
  - Inadequate or uneven support conditions

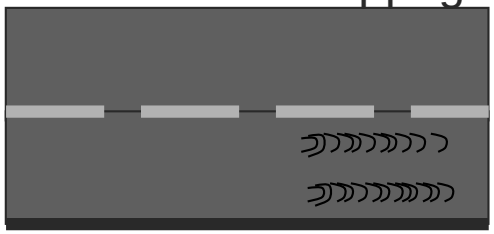
Suitable candidates

Top-down cracking

Block

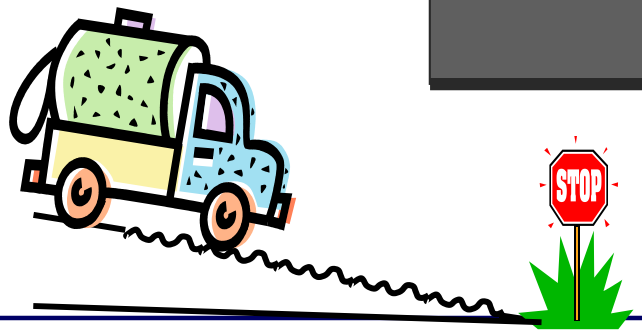
Fatigue

Slippage

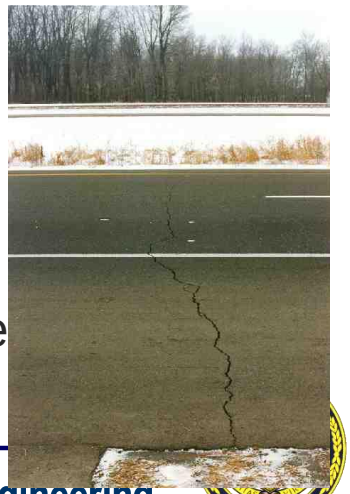


Rutting

Corrugations



Temperature Cracking



Pre-Design activities

- Gather historical records
- Site visit
- Coring
- FWD testing (optional)

Pre-Design activities

- Gather historical records
  - Original design, construction and material testing records
  - Traffic data
  - Performance data
  - Previous maintenance and repair records

Pre-Design activities

- Site visit
  - Distress type, severity & quantity
  - Min. vertical clearance
  - Grade restrictions
  - Drainage issues
  - Shoulder condtion

Pre-Design activities

- Coring
  - Layer thicknesses
  - Location of HMA lifts
  - Evidence of raveling
  - Sampling and material testing (optional)

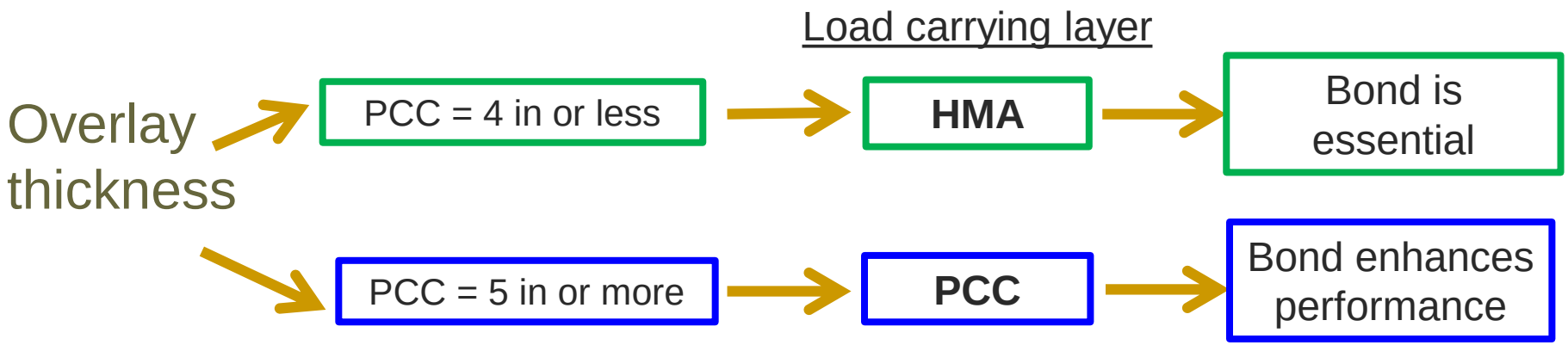
Pre-Design activities

- FWD testing (optional)
  - Backcalculate elastic modulus of layers below the HMA to be used in estimating k-value

Note: The elastic modulus of the HMA layer is established based on the % fatigue cracking and does not need to be determined using FWD data.

Design considerations

- Overlay thickness



Design considerations

- Overlay thickness

10 in HMA

4 in PCC
6 in HMA

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4 in HMA

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Critical Stress for 6ft x 6ft slab, psi			
PCC Thickness	**3 in**	**4 in**	**6 in**
HMA Thickness			
4 in	352	339	274
6 in	246	234	211
8 in	198	191	177

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Design considerations

- Joint layout selection
  - Try to avoid placing longitudinal joints in the wheelpath
  - Smaller slab sizes reduces overlay thickness with slab sizes $\geq$ 6ft
    - Economics (Smaller slab size requires more lineal ft of joints to saw, seal and maintain but less concrete needed.)
    - Vertical clearance issues
  - Thicker milling depth required to remove surface distress: Lager slab size can be accommodated if existing pavement elevation must be maintained

Design considerations

- Consider using dowel and tie bars when…
  - Overlay thickness ≥ 5 in
  - Extended life is desired on heavily trafficked roadways
- Sawing and sealing
  - T/3 saw depth needed
  - ¼ reservoir with asphalt sealant (min. requirements)

*Limited amount of data available indicates increase in performance achieved b
sealing was equivalent to an overlay thickness of 0.5 in

Design considerations

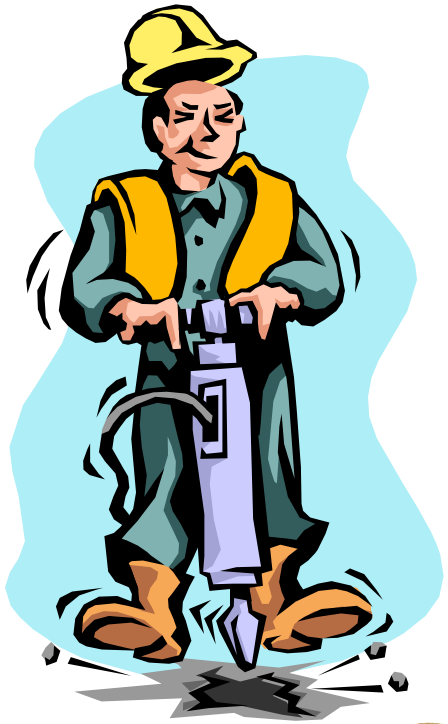
Increase in performance achieved by sealing was equivalent to an increase in overlay thickness of 0.5 in.

Design considerations

- Fiber in concrete mixture
  - Consider using when overlay thickness ≤ 4in
  - Only structural fibers should be considered
  - Fiber type and quantity should be selected such that a minimum residual strength of 20 % is achieved

Pre-overlay repairs

HMA Distress	Possible repair
Rutting ≥ 2 in	Milling
Corrugations & slippage	Milling
Temperature cracking	Clean and fill or localized debonding
High or med. severity fatigue cracking	Full-depth concrete patch*
Pothole	Full-depth concrete patch*



*Must patch with concrete (not HMA) to obtain a strong bond between the overlay and repair.

Pre-overlay repairs

Temperature cracking:

- Crack width > max. agg size in overlay

  Fill prior to paving

  - Emulsion
  - Slurry
  - Sand

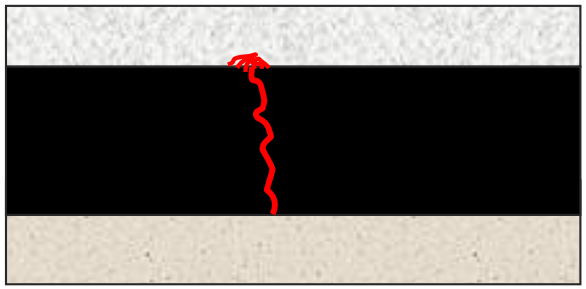
Pre-overlay repairs

Temperature cracking

- Crack width < max. agg size in overlay
- Flexural stiffness of PCC < flexural stiffness of HMA

$$\text{Flexural Stiffness} = D = \frac{Eh^3}{12(1-\mu^2)}$$

$$\frac{D_{PCC}}{D_{HMA}} < 1 \Rightarrow \text{Reflective Cracking}$$



Debond locally along the crack to prevent reflective cracking

Pre-overlay repairs

Temperature cracking

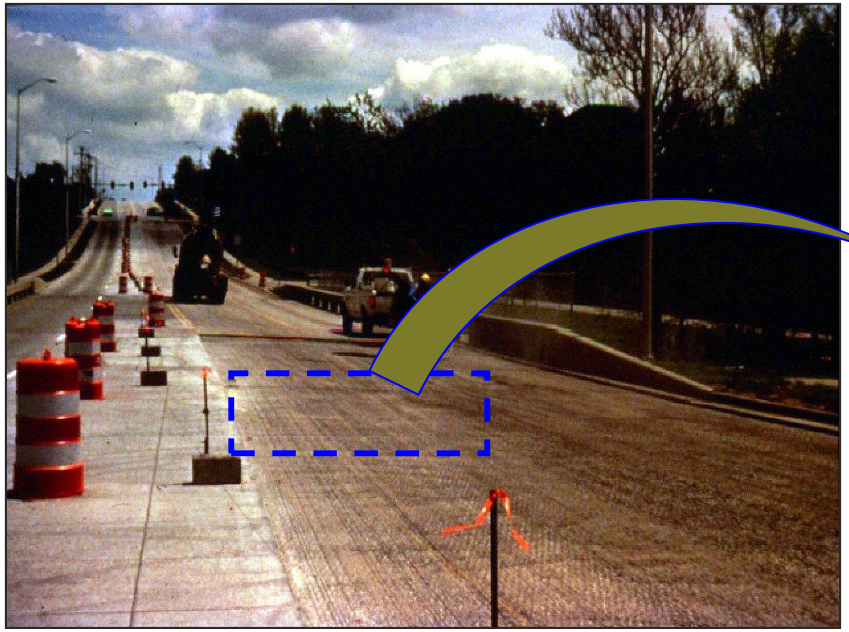
- Crack width < max. agg size in overlay
- Flexural stiffness of PCC < flexural stiffness of HMA

Debond locally along the crack to prevent reflective cracking.

Construction

- Milling enhances bond, especially for overlays < 4 in thick
- Milling depth required
  - Remove surface distortions > 2 in deep
  - Match curb or adjacent structure elevations
  - Meet min. vertical clearance requirements
  - Changes in the cross slope should be accounted for in the surface layer

Construction



- Clean surface
  - Sweeper
  - Compressed air

Construction

- Mist surface
  - Reduces surface temp.
  - Reduces moisture absorption from concrete mix
- Place concrete
  - Paver
  - Clarey screed

Construction

- Finish
- Apply curing compound
  Good curing practices are essential!
- Saw joints to depth of T/3
- Seal joint

Concrete Overlay Guide

Excellent Resource!