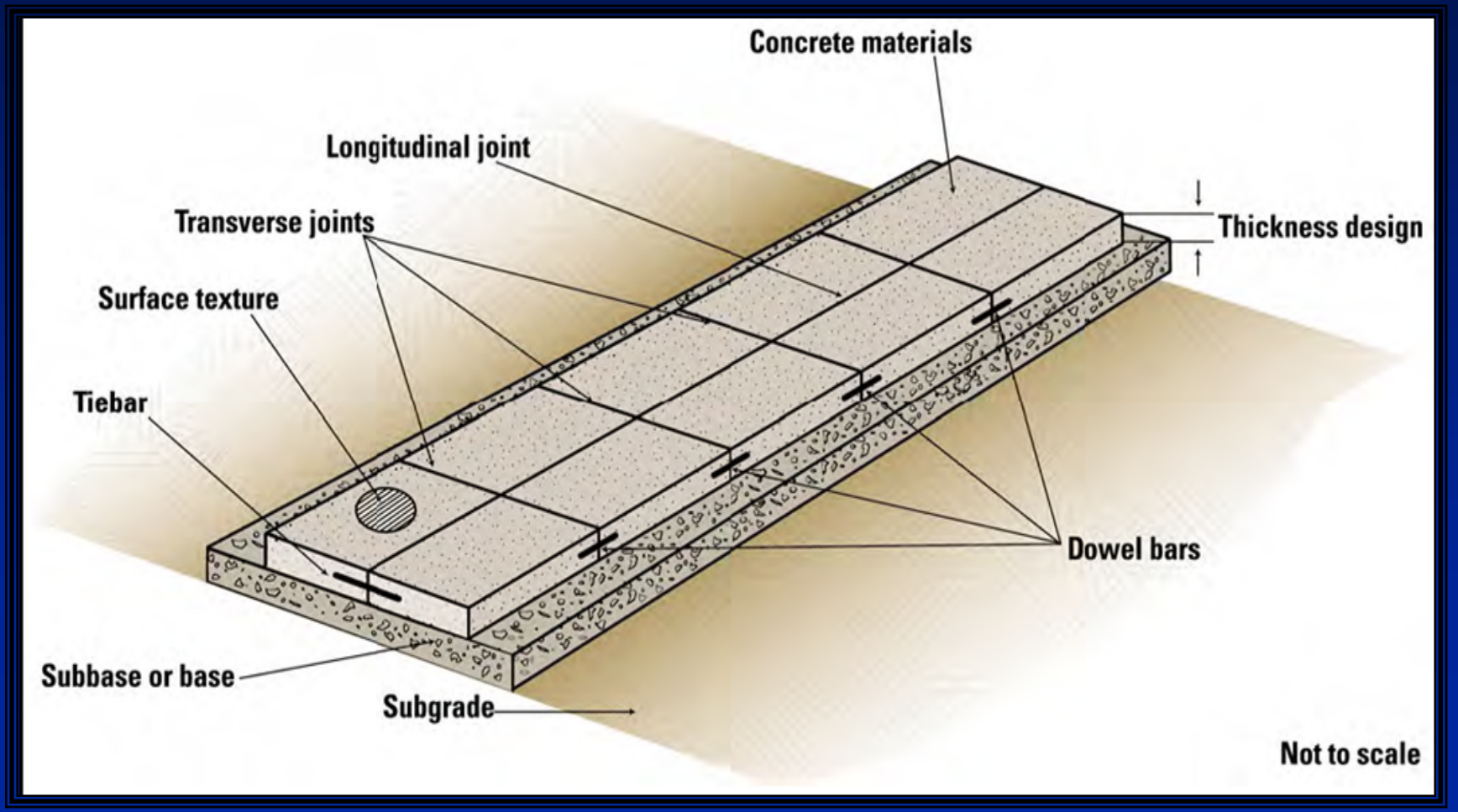
PCC Pavement Types

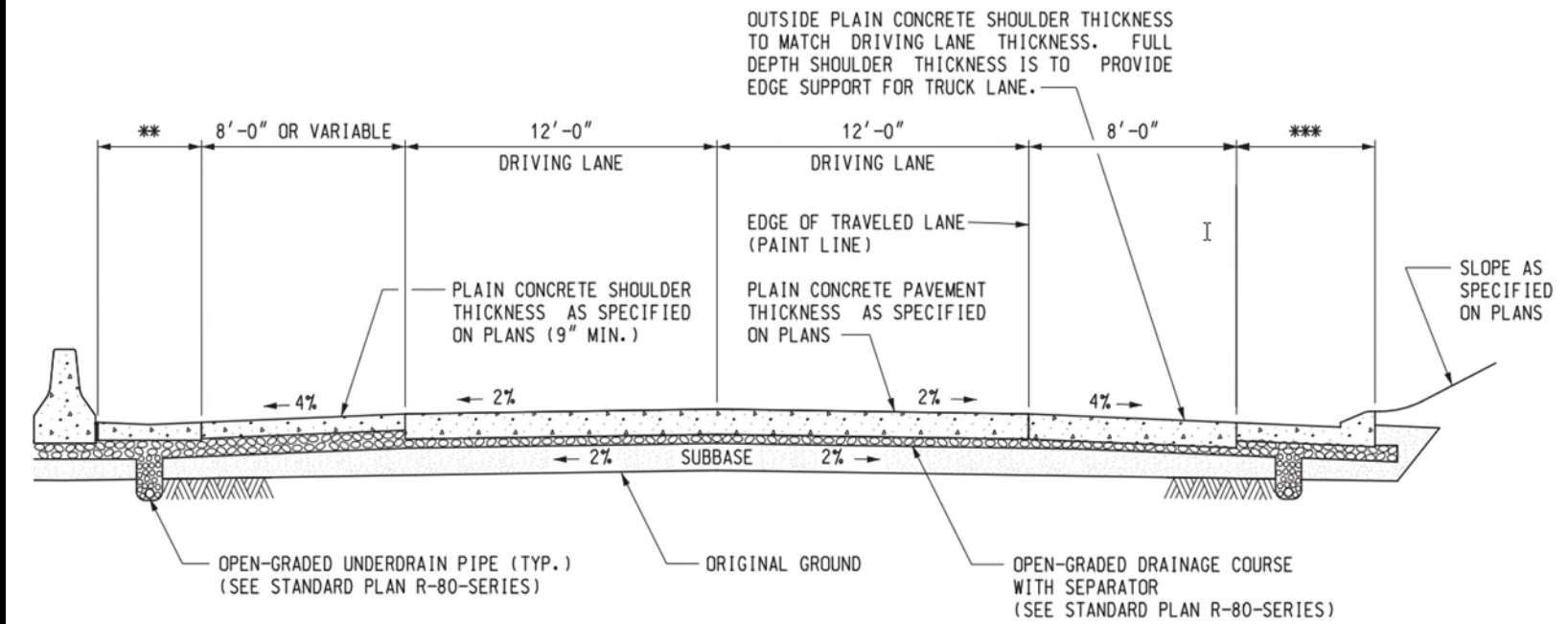
MDOT Design Basic Training

John F. Staton, P.E.
Concrete Paving Operations
Materials Section Manager
Construction Field Services Division

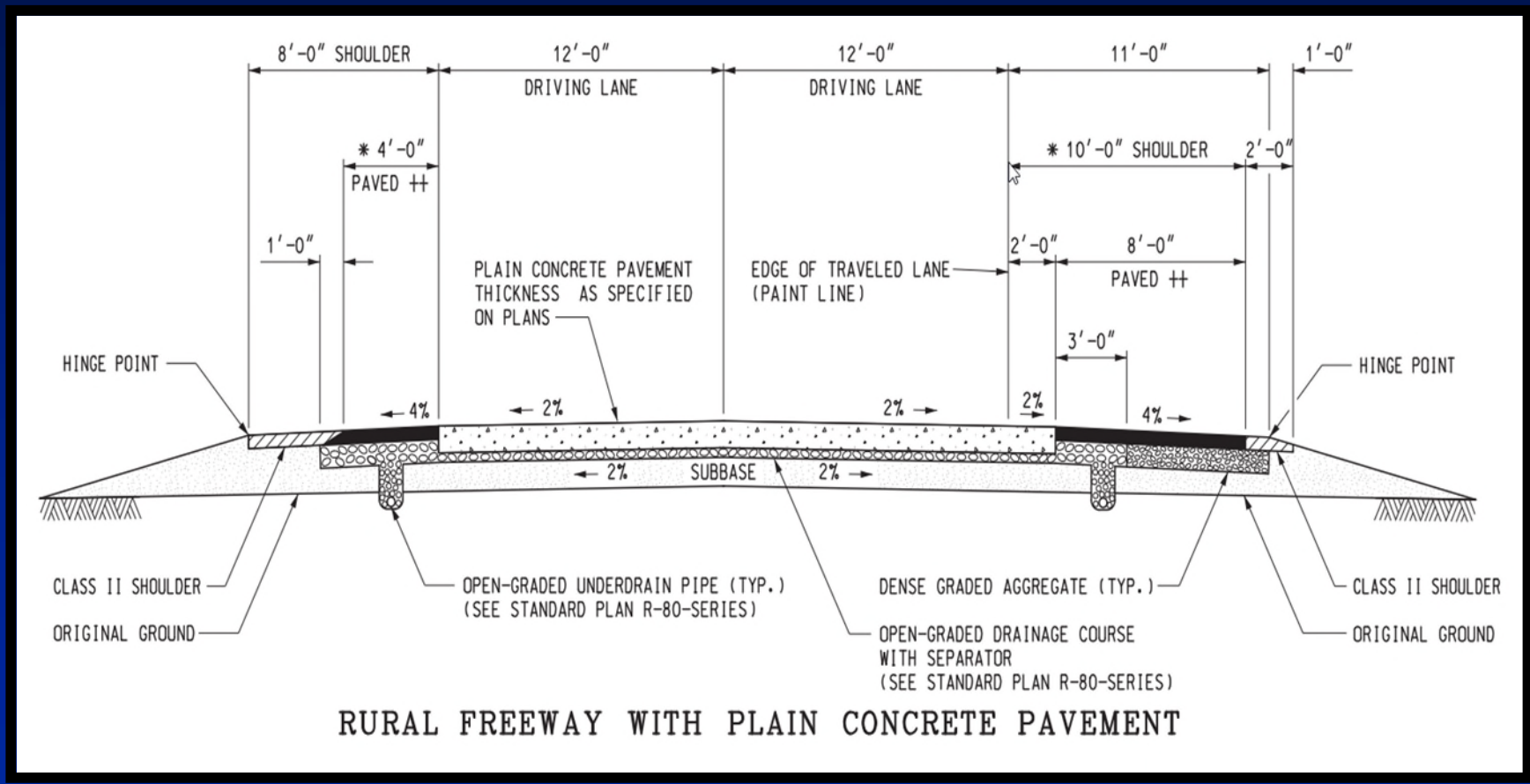
General Features of a PCC Pavement



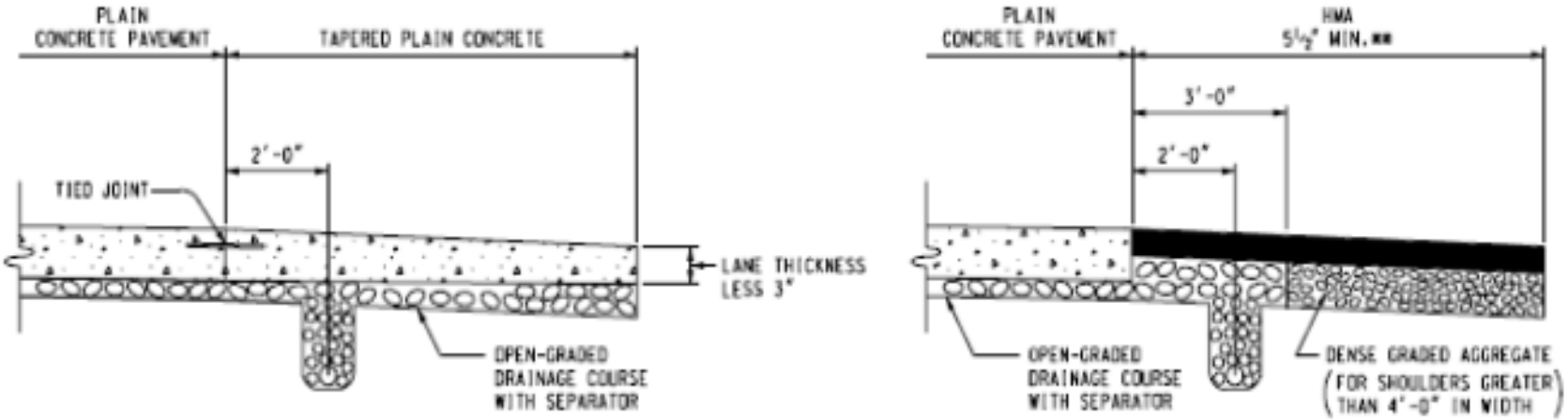
MDOT Urban Freeway with Plain Concrete Pavement



MDOT Rural Freeway with Plain Concrete Pavement



MDOT Freeway Shoulders with Plain Concrete Pavement



* RIGHT (OUTSIDE): CONSIDER 12' PAVED SHOULDER WHERE TRUCK TRAFFIC EXCEEDS 250 DDHV.

* LEFT (MEDIAN): FOR THREE OR MORE DRIVING LANES, USE A 10' PAVED SHOULDER SECTION. CONSIDER 12' PAVED SHOULDER WHERE TRUCK TRAFFIC EXCEEDS 250 DDHV AND THREE OR MORE DRIVING LANES EXIST.

** SHOULDER THICKNESS DETERMINATION MUST ALSO FOLLOW OTHER DEPARTMENT GUIDELINES INCLUDING THE HMA MIXTURE AND SELECTION GUIDELINES.

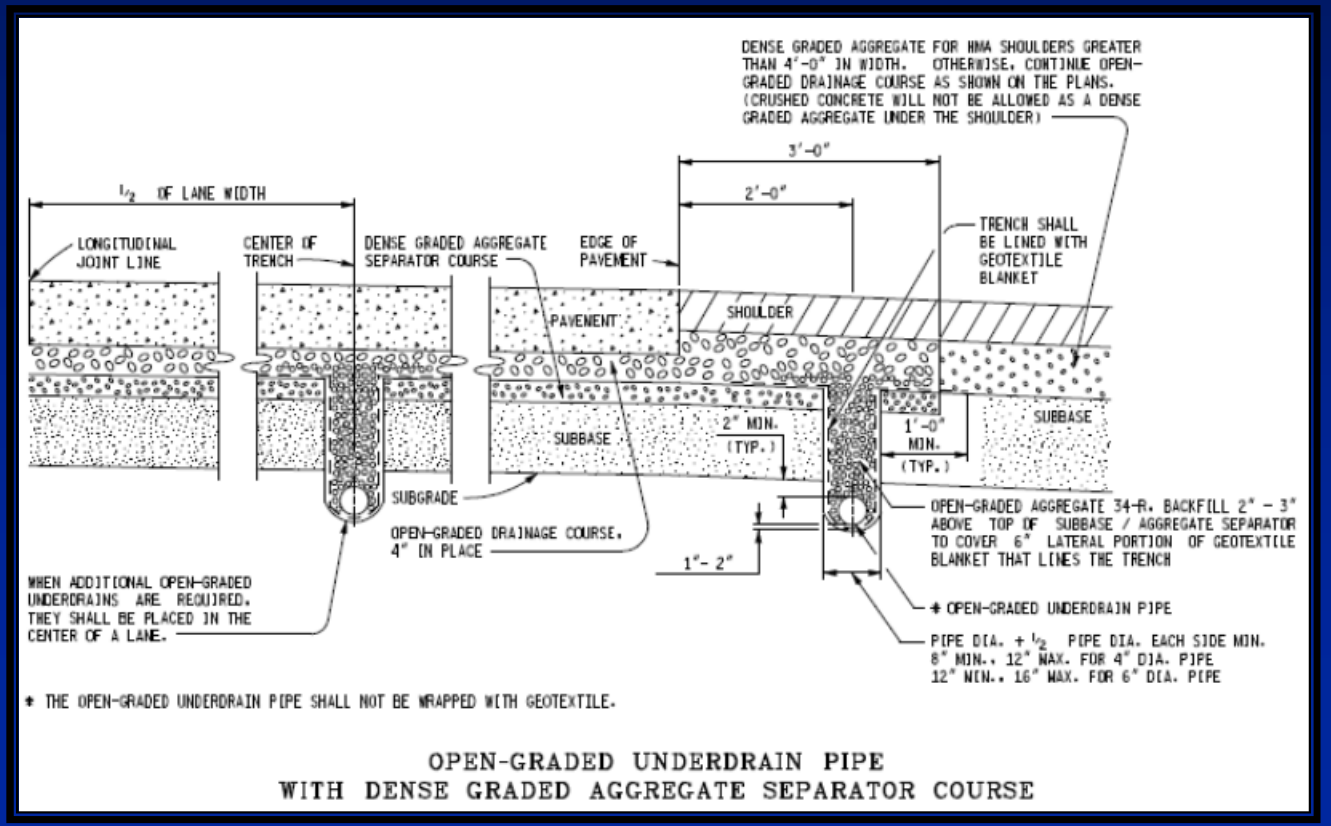
FREEWAY SHOULDER OPTIONS

(OUTSIDE SHOULDER ILLUSTRATED)

++ FREEWAY SHOULDERS CAN BE HMA OR PLAIN CONCRETE AT THE CONTRACTOR'S OPTION

Pipe OGDC Underdrains with Dense-Graded Separator

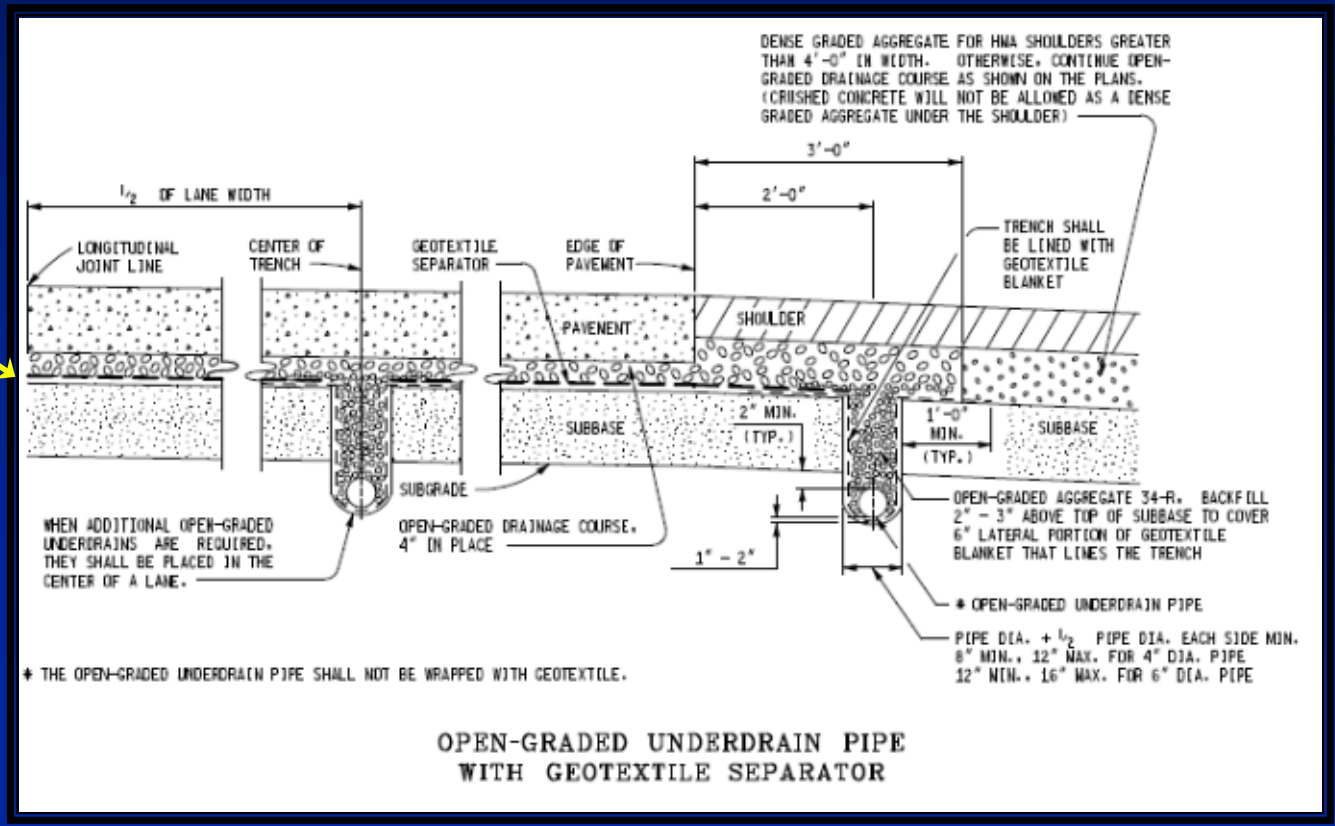
Separator prevents intermixing between base and sub base materials →



Pipe OGDC Underdrains with Geotextile Separator

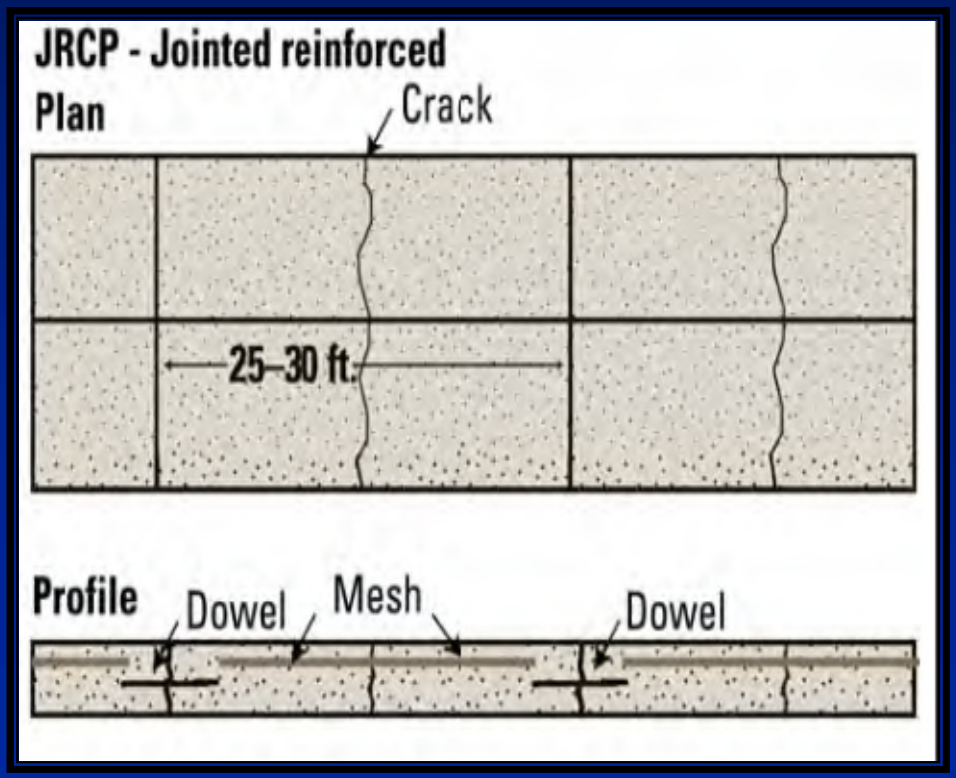
Separator prevents intermixing between base and subbase materials

CFS has observed improved long-term performance using geotextile compared to dense-graded separator layer



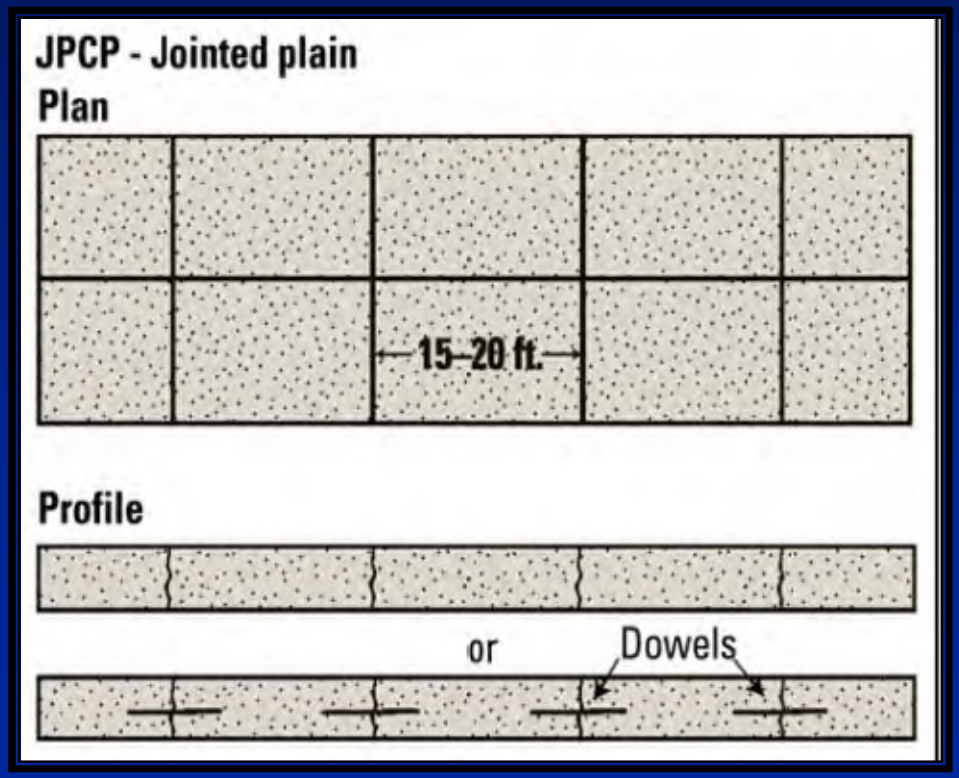
Jointed Reinforced Concrete Pavement (JRCP)

- *MDOT standard pavement type prior to the early 2000's*
- *MDOT joint spacing, vintage date of official adoption:*
  - *Prior to 1965 – 99 ft*
  - *1966 to 1975 – 71 ft*
  - *1976 to 1979 – 70 ft*
  - *1979 to 1996 – 41 ft*
  - *1996 to 2002 – 27 ft*



Jointed Plain Concrete Pavement (JPCP)

- *Generally, JPCP is a national standard*
- *First official JPCP in Michigan - 1996*
- *Officially adopted by MDOT in 2002*
- *MDOT does not recognize non-dowelled JPCP for mainline use*



Jointed Plain Concrete Pavement (JPCP)

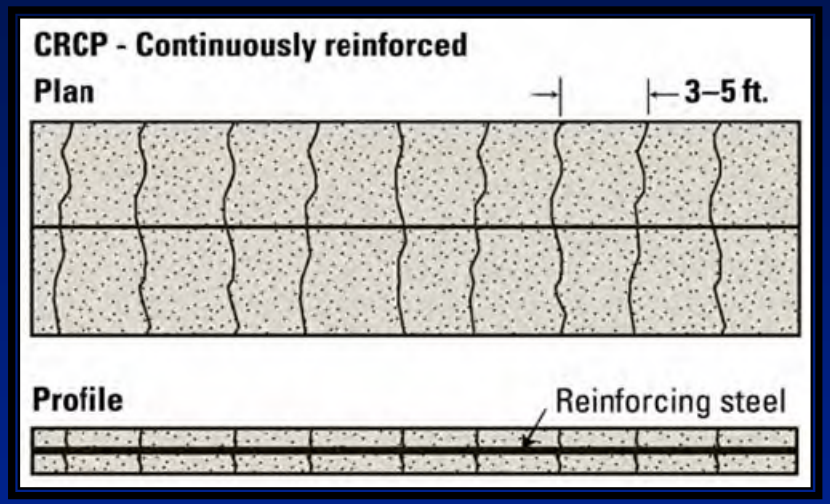
- *Single lift construction*
- *No mesh*
- *Joint spacing is based on pavement thickness (Std. Plans Series R-43-P)*
  - *6.5” to 8.75” – 12 ft*
  - *9.0” to 11.75” – 14 ft*
  - *12” or more – 16 ft*
- *Short joint spacing does not reduce cracking … it controls transverse crack locations*
- *More joints … more emphasis must be placed on concrete and materials quality*
- *High performance concrete mixture (Grade P1M)*

JPCP on Stabilized Permeable Base

- *"Premium" high performance pavement structure*
- *19 projects, to date;*
  - *13 - (1990 –1995)*
    - *11 – Asphalt emulsion stabilized*
    - *2 – Portland cement stabilized*
  - *2 - (ARRA, 2010)*
  - *2 - (Long-life pavement demos, 2017-18)*
  - *2 - (I-75 Monroe Co., 2016-20)*
- *Performance of these bases is outstanding !!*

Continuously Reinforced Concrete Pavement (CRCP)

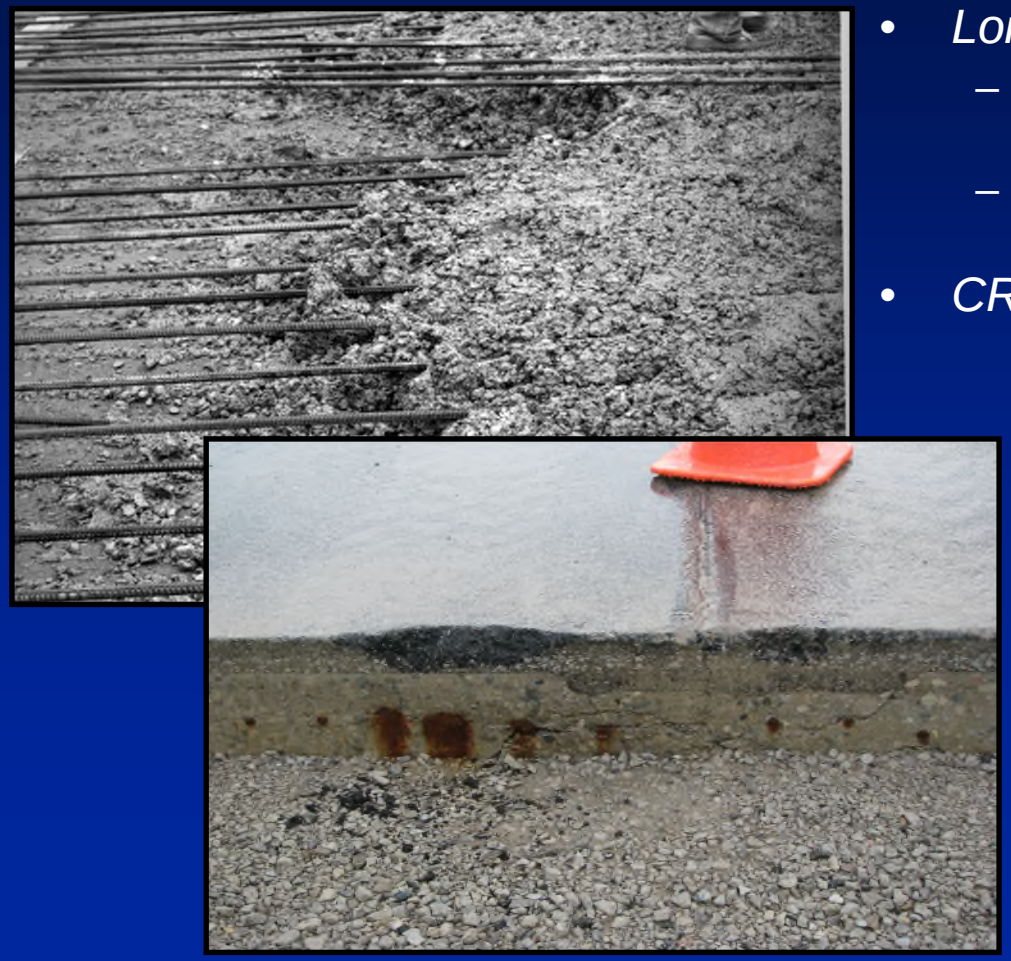
- *MDOT constructed 341 (two-lane) miles of CRCP*
- *First CRCP in Michigan – 1958*
  - *I-96 from M-66 to Portland Road*
- *Concept*
  - *Jointless pavement*
  - *Terminal joints*
  - *Fine cracks at 3-5 ft. held tight by reinforcement*
  - *Reduced concrete thickness*
- *CRCP is still being constructed outside Michigan*



Continuously Reinforced Concrete Pavement (CRCP)

- *Michigan Historical Issues with CRCP*
  - *Contractor proposed innovations*
    - *Extruding Longitudinal Steel*
    - *Elimination of transverse steel*
    - *Hand placing steel mats with two-lift paving*

Continuously Reinforced Concrete Pavement (CRCP)

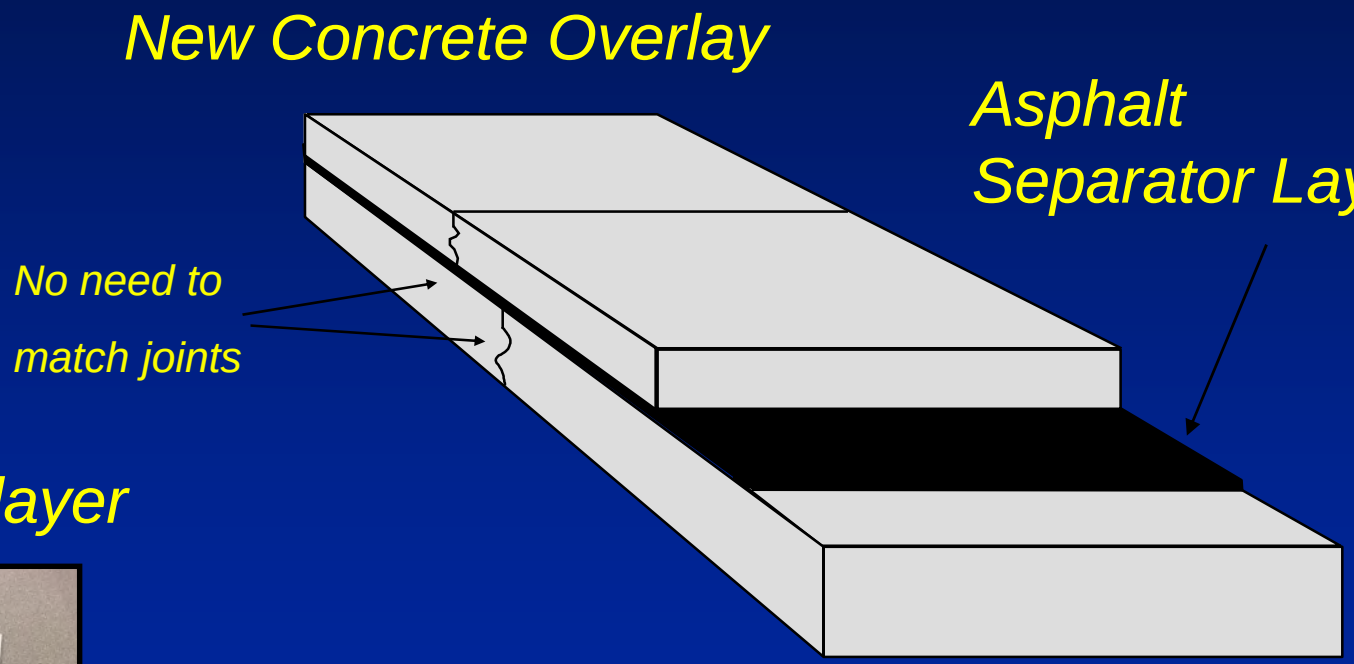


- *Long-term consequences in Michigan*
  - *Uncontrolled steel – blowups, and surface spalling due to corrosion*
  - *Cutting CRCP into short panels prior to HMA overlay resulted in blowups*
- *CRCP got a bad rap in Michigan*

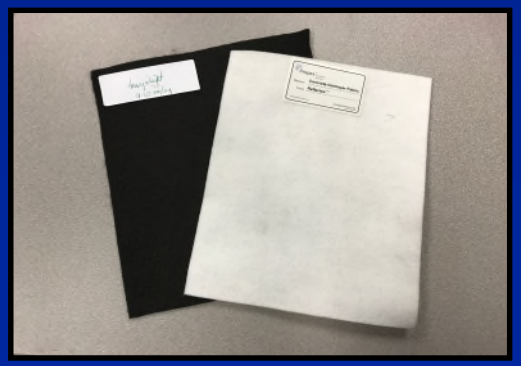
Continuously Reinforced Concrete Pavement (CRCP)

- *Recent CRCP in Michigan*
  - *I-94 Jackson, 2019*
    - *2000+ feet long*
    - *Bridging abandoned coal mines*

Unbonded Concrete Overlay



Geotextile Interlayer



Unbonded Concrete Overlay

- *First "modern" unbonded concrete overlay*
  - *1984*
  - *I-96, Ionia County*
  - *Still in service (25+ years)*
- *Early accounts back to the 1950's*
- *To date, 237 (roadbed) miles (23 projects) constructed in Michigan*
- *Nationally, MDOT has perhaps the most experience with unbonded overlays*
- *"Guide to Concrete Overlays"*
  - *http://www.cptechcenter.org*
- *LCCA Equivalent to HMA Rubblization*

Unbonded Concrete Overlay

(Rural Application)

- *Prior: Uniform concrete pavement on variable thickness HMA separator layer*
- *Today: Variable thickness concrete pavement on 1-inch thick HMA separator layer*
- *Can profile mill prior to separator to reduce corrections*
- *High performance concrete mixture (Grade P1M)*
- *Sealing joints is important*

Unbonded Concrete Overlay

(Urban Application)

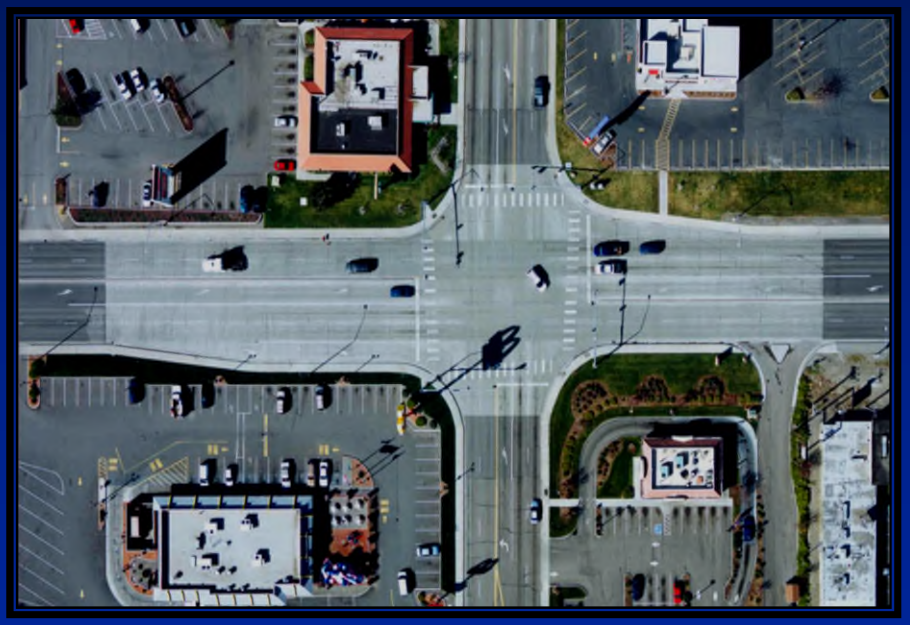
- *Uniform 1-inch open-graded HMA separator*
- *Can profile mill prior to separator to reduce corrections*
- *High performance concrete mixture (Grade P1M)*
- *Sealed and non- sealed section*

Two-Lift Demonstration Project,
(Kansas DOT 2008)

- *Demonstration projects in Kansas and other states*
- *Wet-on-wet construction*
- *Current two-lift focus is for lower quality materials to be incorporated into bottom lift and higher quality materials to be used in top half of concrete pavement*
- *MDOT's JRCP could be considered an early form of two-lift paving*
- *MDOT's 1993 "European Pavement" Demonstration is considered one of the first two-lift technology*

PCC for Intersections

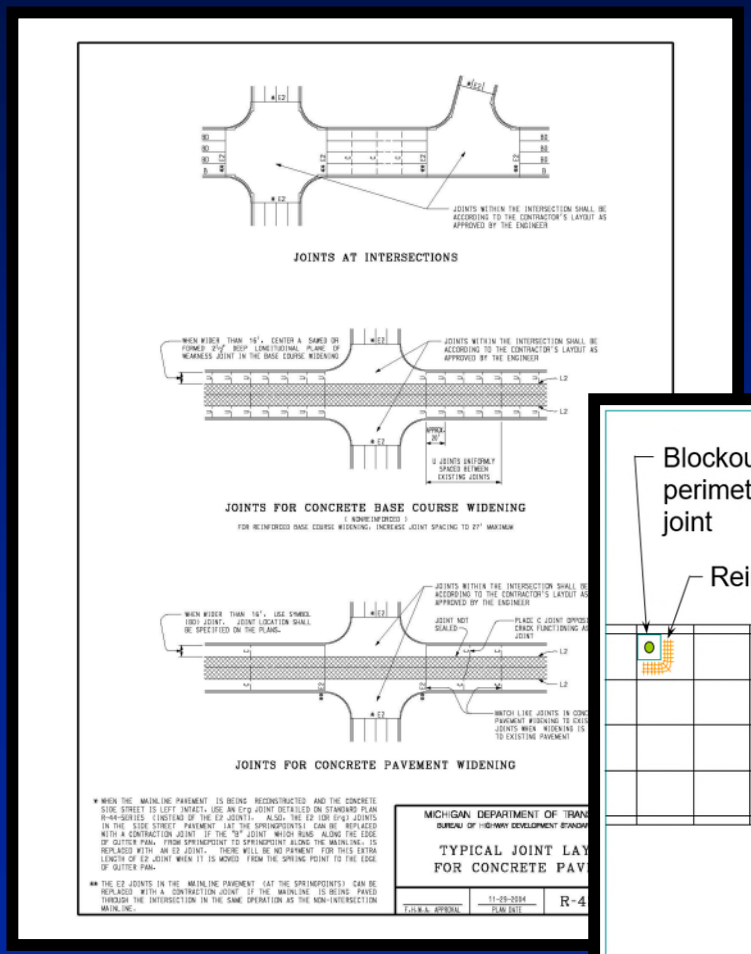
- *Resistant to deformations:*
  - *Braking and turning*
  - *Rutting and shoving*
  - *Heavy truck corridors*
  - *Extend past brake zone*

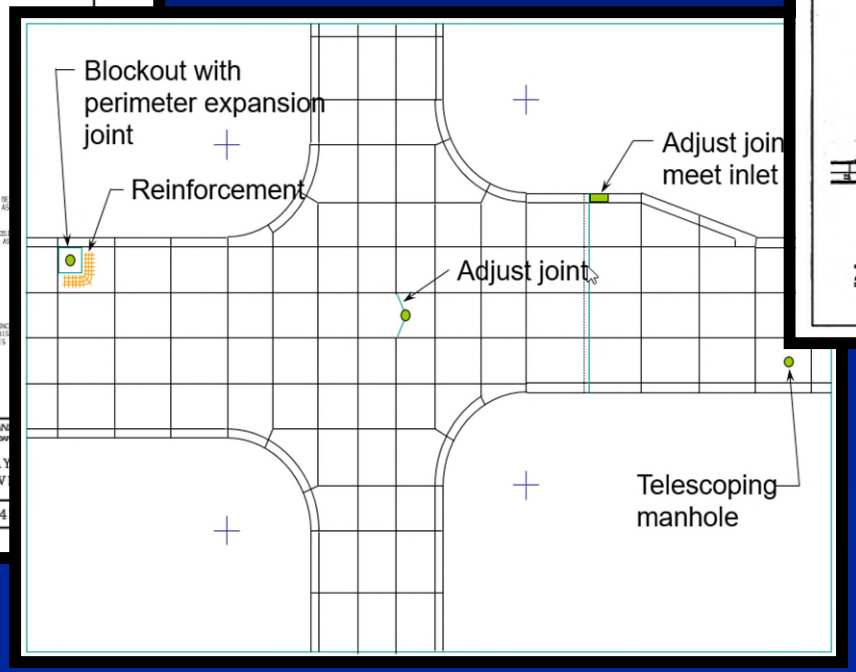


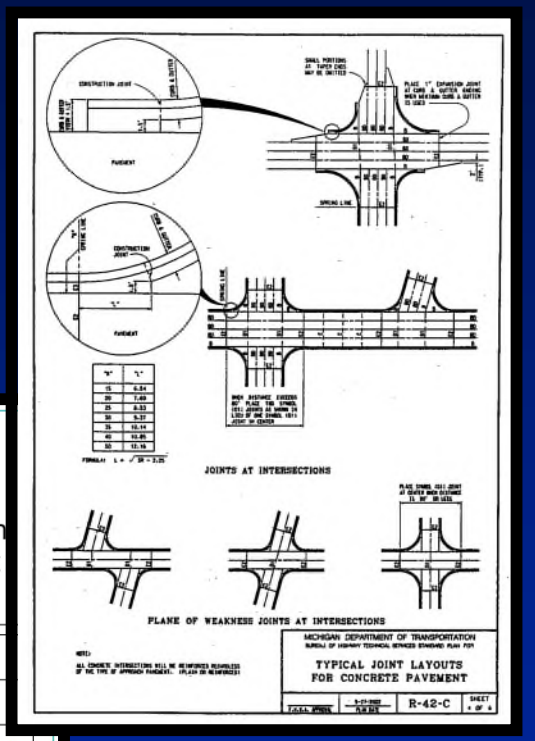
PCC Inlay over HMA or Composite Pavement

- *Option for rutted intersections*
- *Heavy trucked pavements*
- *Comparable to a mill-and-fill*
- *Bonded inlay on composite pavement*
- *Important to match joints and cracks*
- *Again, Extend past brake zone*

Intersection Joint Layout







PCC Roundabout

Rapidly gaining local interest

Urban Brick Pavers

- *Nostalgic*
- *Roadway pavers are not typical pedestrian pavers*
- *Vehicular pavers for heavy load applications*
- *Isolation of intersections is critical*
- *Reliable and effective subsurface drainage is critical*

Colored Stamped Slipform PCC Pavement

- *Solution to brick pavers*
- *Nearly unlimited patterns and effects*
- *Periodic Sealing*
- *Deicer concerns?*

Roller Compacted Concrete

- *New concept*
- *Limited applications*
- *Primarily for non-roadway applications*
- *Utilizes HMA equipment and concept*
  - *Paver*
  - *roller*

Pervious Concrete

- *Limited application*
- *Green !!*
  - *Reduces storm water runoff*
  - *Recharges the ground water*
- *Must have very drainable subsurface*
- *Winter deicing is a concern*
- *Attractive in southern states*

One last thing…

- *High Performance Concrete Mixture (Grade P1M)*
  - *2012 spec book reference – FUSP*
    - *Use for all freeway pavements, ramps, shoulders*
    - *Also any pavements with federal participation*
    - *Use for pavements, and other applications (as approved by the Engineer)*
  - *2020 spec book reference – Division 10 Concrete Mixtures*
- *Also, "Quality Initiative" pay item for positive pay adjustment applies only to HP pavement mixtures included as part of PWL analysis*

Thank You