

FHWA/CRSI/CALTRANS CRCP Workshop

***Creating Long Life Pavement Solutions
Continuously Reinforced Concrete Pavements***

February 2012



CRSI – FHWA Workshop

FHWA – CRSI Cooperative Agreement

“Advancement of CRCP through Technology Transfer and Delivery of Industry Guidance for Design and Engineering”

- *Design / Construction Manual*
- *Repair / Rehabilitation Manual (future)*
- *Newsletters, Website, and TT Bulletins*
- *Workshops*
- *Expert Task Group*

Primary Message

- Continuously reinforced concrete pavement is a ***viable pavement option*** that provides long term pavement performance with low maintenance during its operational life at competitive whole life costs.

Long-Life Pavement*

- 40+ years of service
- No premature construction or material-related distresses
- Reduced or minimal cracking, faulting, spalling, punchouts
- Smoothness maintained
- Texture maintained

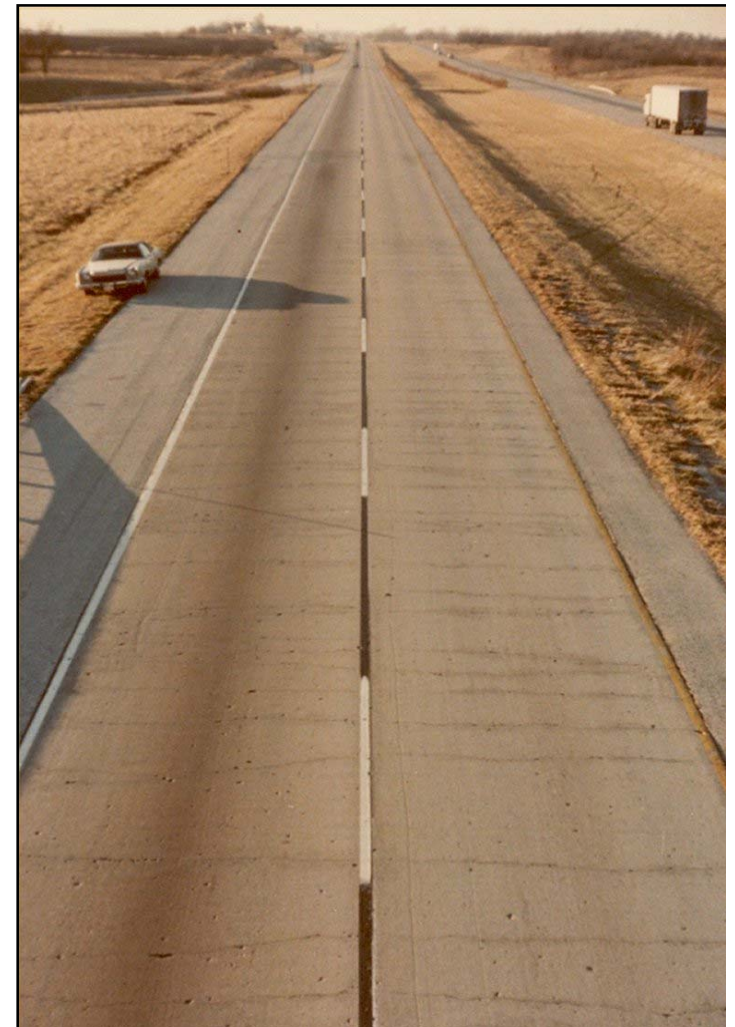
** Per FHWA in Long Life Initiatives Program*

CRCP - Long Life Pavement

- No man-made “joints”
- Steel reinforcement bars
- Numerous transverse cracks

History

- 1921 First used
- 1940’s Experimental Sections
- Today: More than 28,000 miles



CRCP Long Life Factors

- Excellent Performance History
 - TX, IL, OK, VA, GA, OR, BE, AU, UK
 - Problems identified and resolved
- Established design/construction practices
- Competitive whole life costs
- Minimal maintenance

CRCP Workshop Series

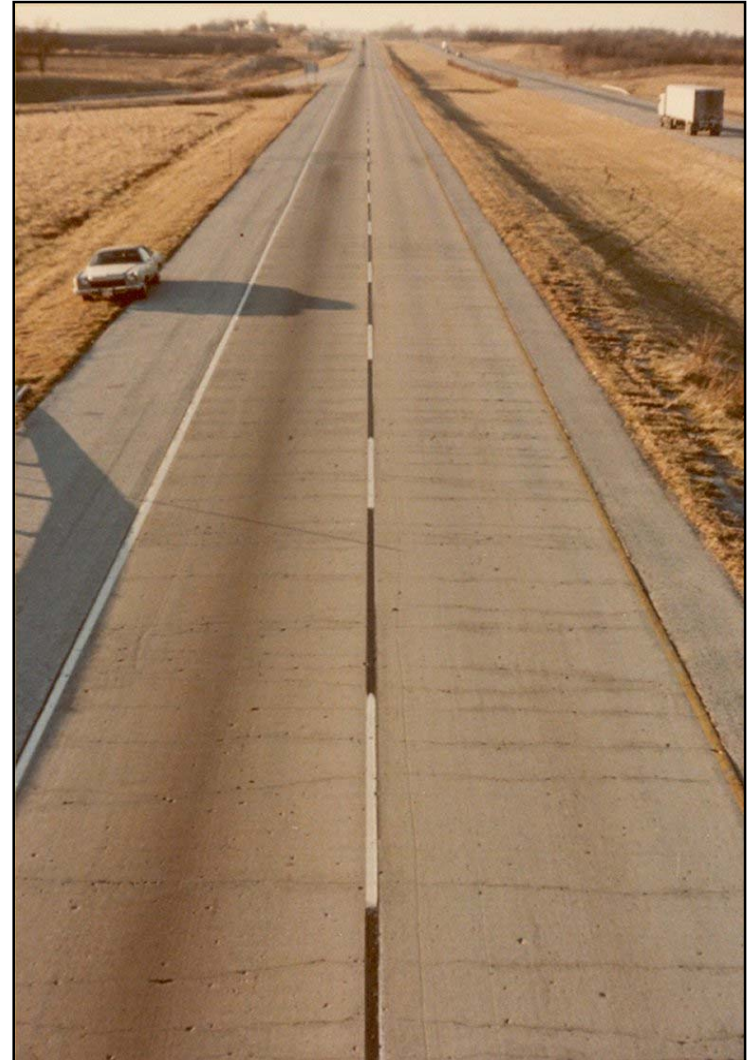
CRCP Expert Panel

- Industry, state, federal, academia
- Best Minds / New Minds
 - IL, VA, TX, OR, OK, CA, GA
 - CRSI, ACPA
 - Tx A&M, TxTech, ISU, U of IL, Cleveland State
 - ARA, Transtec

CRCP 101

ETG - What does the world think?

- Asphalt
 - Easier to build
 - Cheaper **
 - Easier to fix
 - Smoother / Quieter
- Concrete
 - Longer life
 - Whole life cost competitive
 - Heavy traffic



CRCP 101

CRCP Strengths

- Handles heavy duty, high volume traffic
 - Solution for increased freight loading
- Eliminates joints, leading to:
 - Less maintenance
 - Lower noise
 - Smoother over lifetime
- Exceptional foundation for overlays

CRCP 101

CRCP Strengths

- Competitive whole life cost
- Environmentally sustainable
- Reduces work zones and related safety impact

CRCP 101

Weaknesses

- Too few CRCP States
- Lack of Knowledge
- Lingering Poor Long Performance
- High initial costs

Solutions

- Teach and train
- Learned from the past
- Great performance now
- Explain costs
- Get out there!!

CRCP Workshop Series

- Engineers, Contractors, and Managers
- Green States – “we do it and believe in it.”
- Yellow States – “we need to revisit it.”
- Red States – “we are wide open to learn.”
- States on the Tour
 - **VA, LA, OK, AZ, OR, GA, CA**
 - Upper Midwest, Northeast and ...

Today's Workshop

- Objectives
 - To present CRCP details (easy-to-understand)
 - To stimulate CRCP discussion
 - To give adequate background to rethink CRCP
 - To solicit feedback on course and manual

Today's Workshop

Workshop Program

- Pre-Workshop Discussions and Planning
- Opening Session: CRCP 101
- Caltrans: Where are we?
- Design: Methodologies, Practices, and ME PDG Guide
- Performance: Whole Life Costs
- Construction: Methods and Cautions, plus Traffic
- Repair and Maintenance: How to's
- Unbonded Overlays: Rehabilitation Strategy for Today?

Today's Workshop

A Word About the Manual

- www.crcpavement.org
- Unprecedented input from world's best minds
- Virtual Manual
 - Continuous review
 - Continuous update

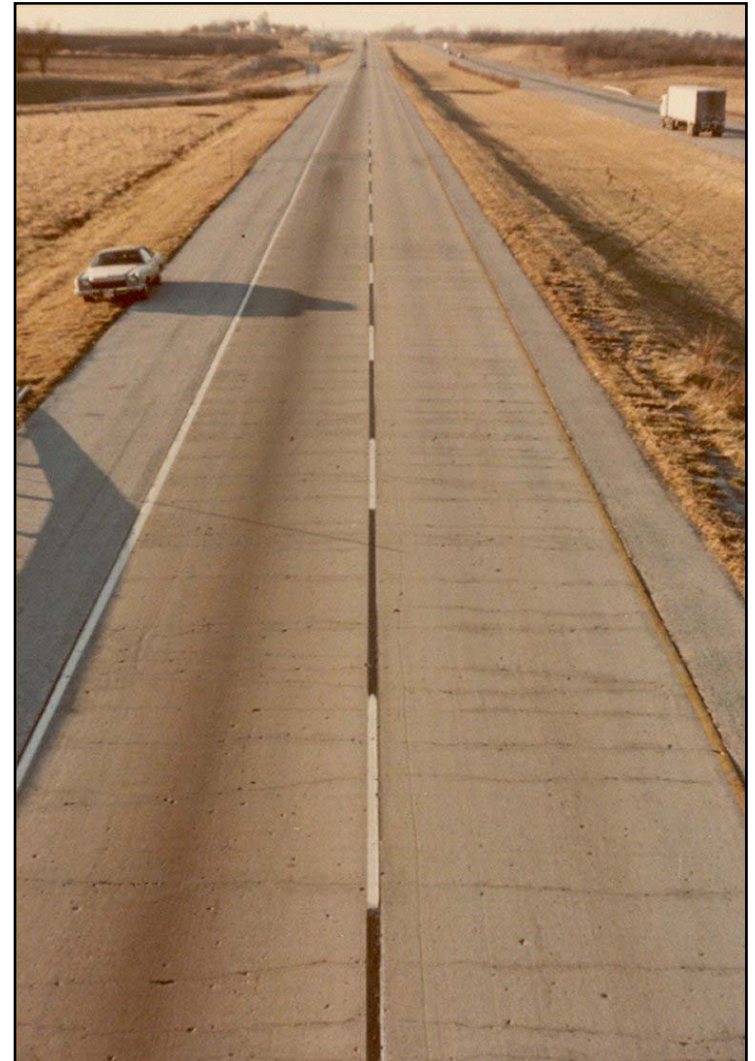
Today's Workshop

CRCP 101

CRCP 101

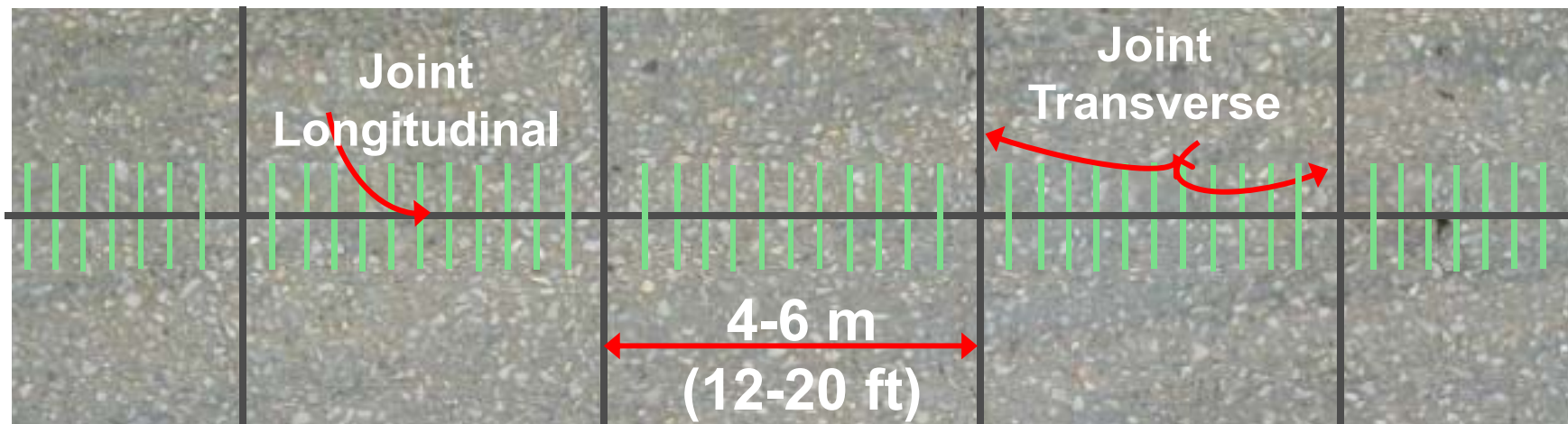
Pavement Choices

- Asphalt
- Concrete
 - Jointed
 - Continuous
- Composites



CRCP 101

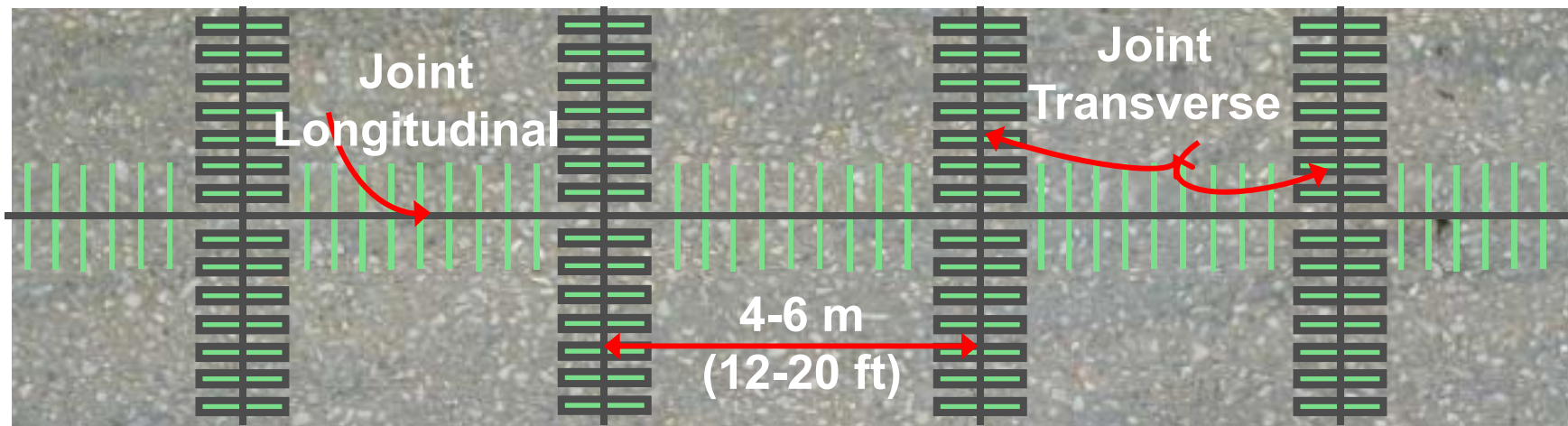
(Plain Jointed)



- Load Transfer: Aggregate Interlock

CRCP 101

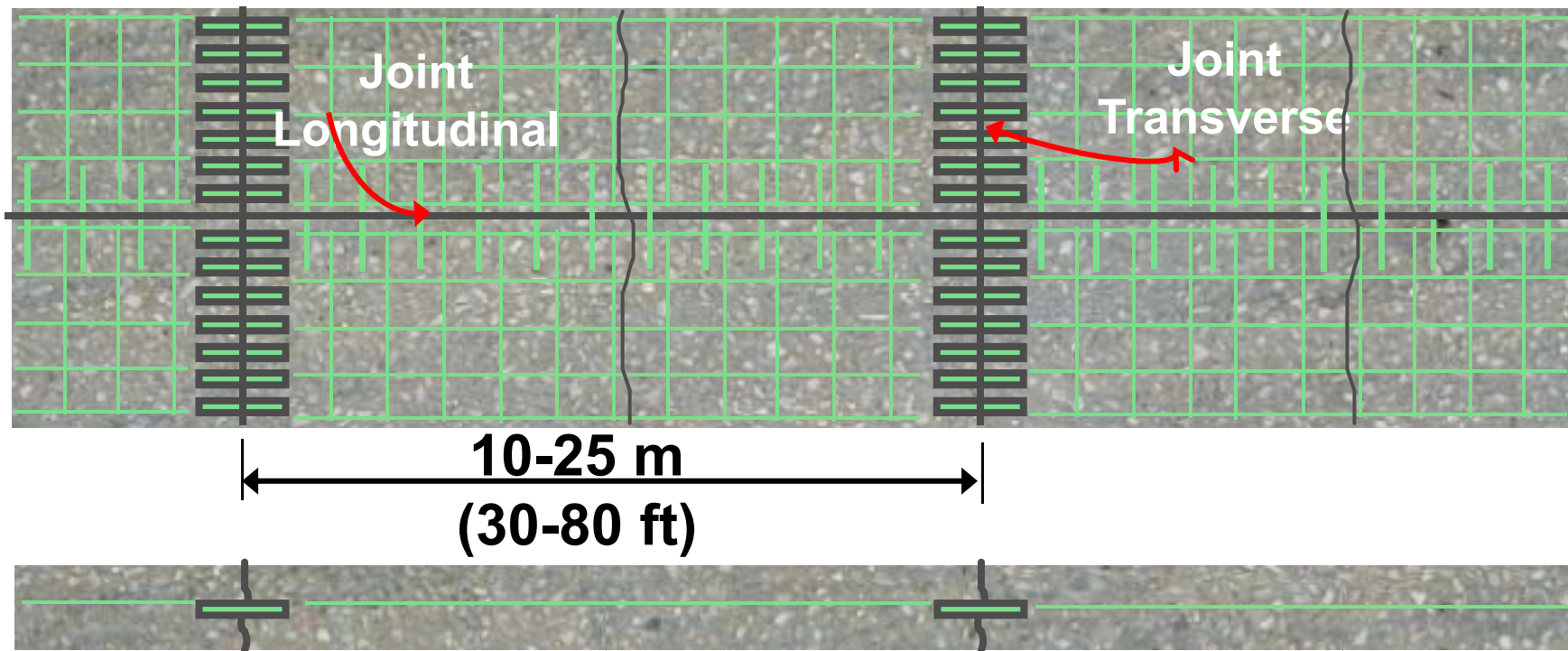
(Jointed Concrete Pavement - w/Dowels)



- Combination of Load Transfer and Aggregate Interlock

CRCP 101

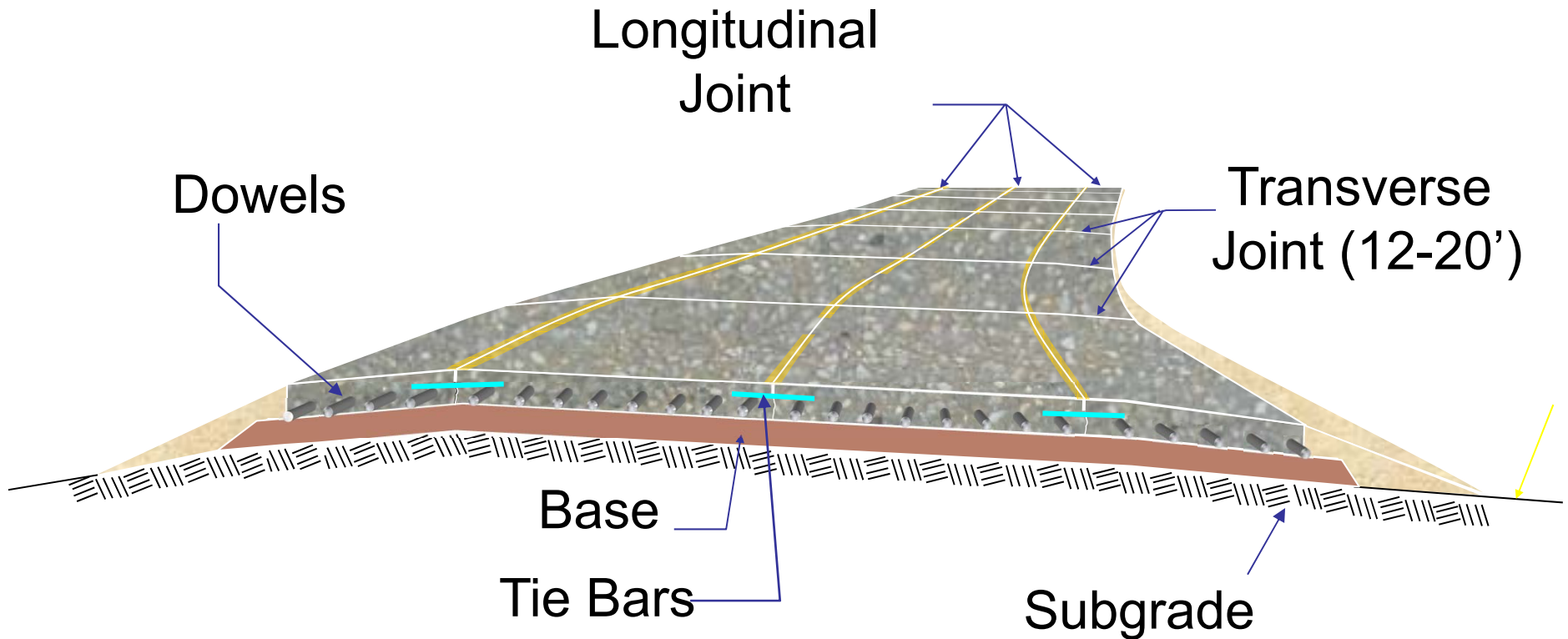
(Jointed Reinforced Concrete - Mesh)



- Rarely used in practice today
- Two-lift aspects is, however.

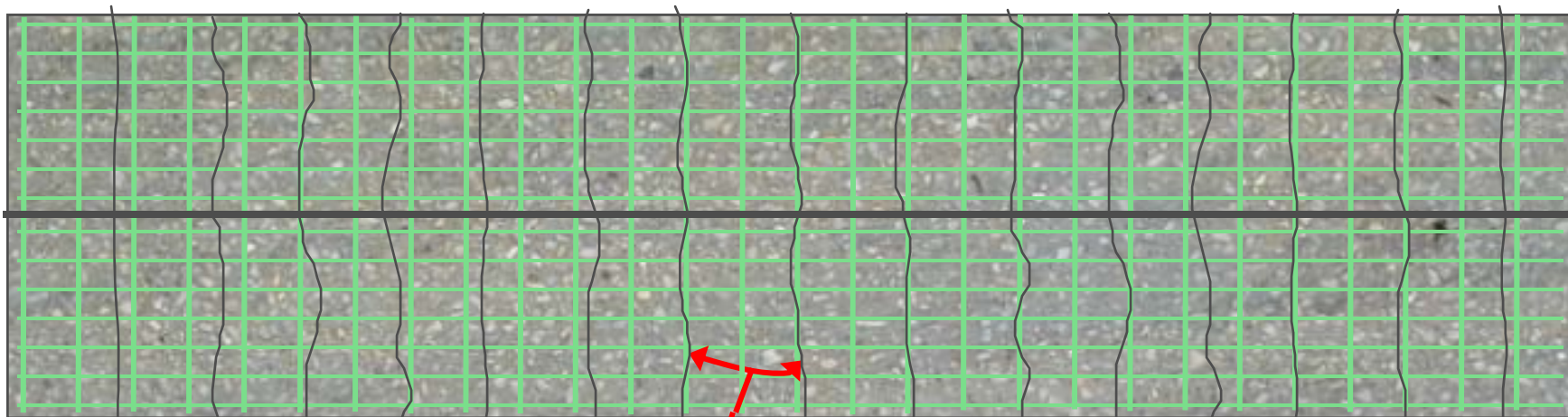
CRCP 101

(Jointed Concrete Pavement - w/Dowels)



CRCP 101

(Continuously Reinforced)



Crack Spacing
3-6 ft

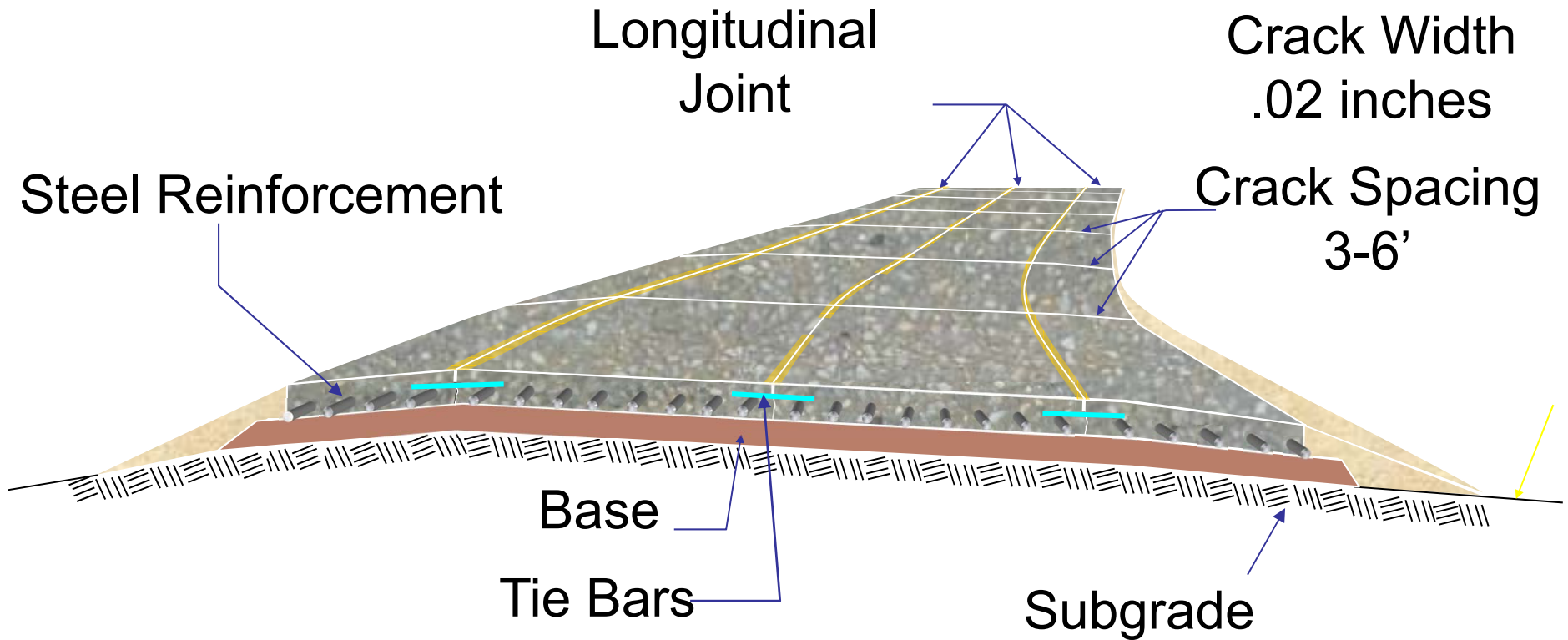
Crack Width
.02 inches



Highest Performer IF designed/built properly

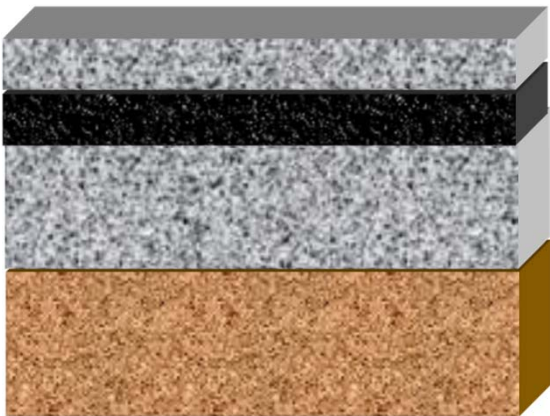
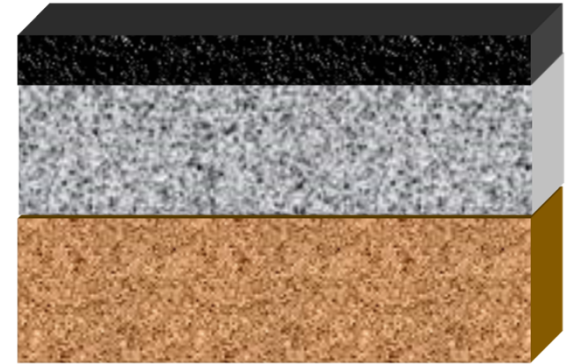
CRCP 101

CRCP - Typical

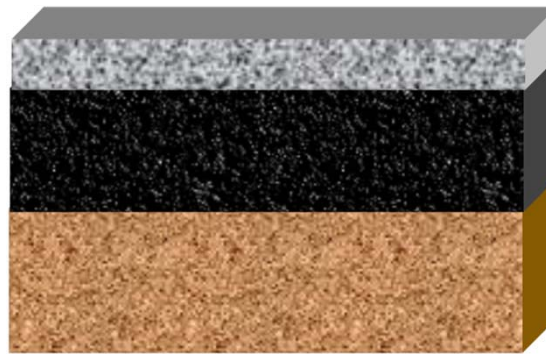


CRCP 101

- Asphalt “Carpet” over CRCP
- Concrete Overlay w/CRCP on Top



Unbonded



Whitetopping

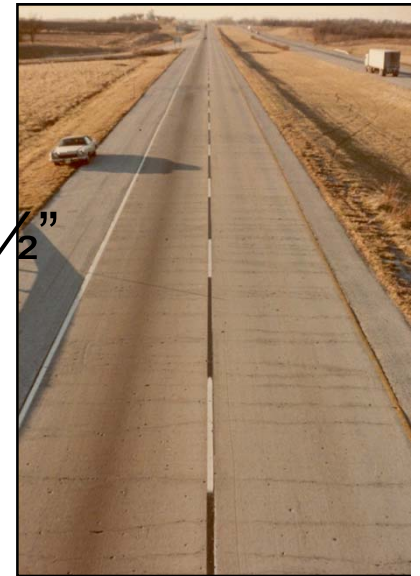


Bonded

CRCP 101

Jointed Pavement Principle

- Concrete slab wants to crack
- Typically, transverse cracks occur from 12-20'
- Typically, transverse cracks open up about $\frac{1}{8}$ - $\frac{1}{2}$ "
- Solution: Saw cut pavement BEFORE it cracks



CRCP Pavement Principle

- Concrete slab wants to crack
- With steel, transverse crack spacing occurs (3-6')
- With steel, transverse crack widths remain tight (.02")
- Solution: Let it happen!!

CRCP 101

Percent of Steel

0.6% - 0.8%



Almost Always

#5, #6, #7

Black Steel

CRCP 101

Tons of Steel

9" CRCP = 93 Tons per Lane Mile

10" CRCP = 104 Tons per Lane Mile

11" CRCP = 110 Tons per Lane Mile

12" CRCP = 118 Tons per Lane Mile

26-35 pounds per square yard

Note: 41-55 pounds of cement per sq yd

Note: 4-6 pounds of steel per sq yd jointed

CRCP 101

Design and Construction

- Design Procedure
- Concrete Materials
- Support System
- Steel Placement
- Concrete Placement
- Texturing and Cure

CRCP 101

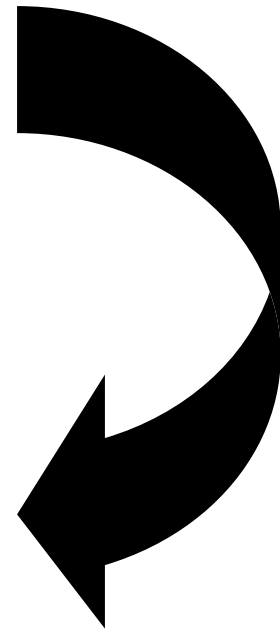
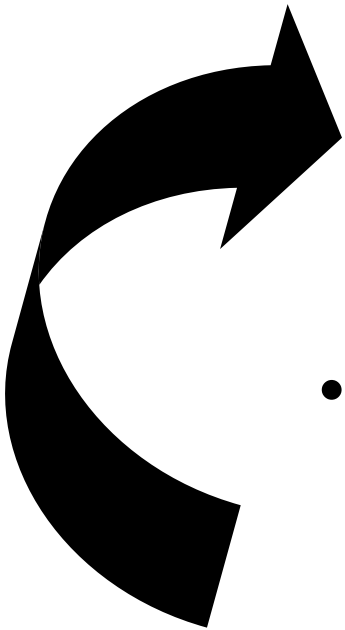
Design

- **Methods**

- AASHTO 86/93 Design Guide
- IL, TX, CRSI, Belgium, etc
- AASHTO 2007 MEPDG
- Engineering Understanding!!

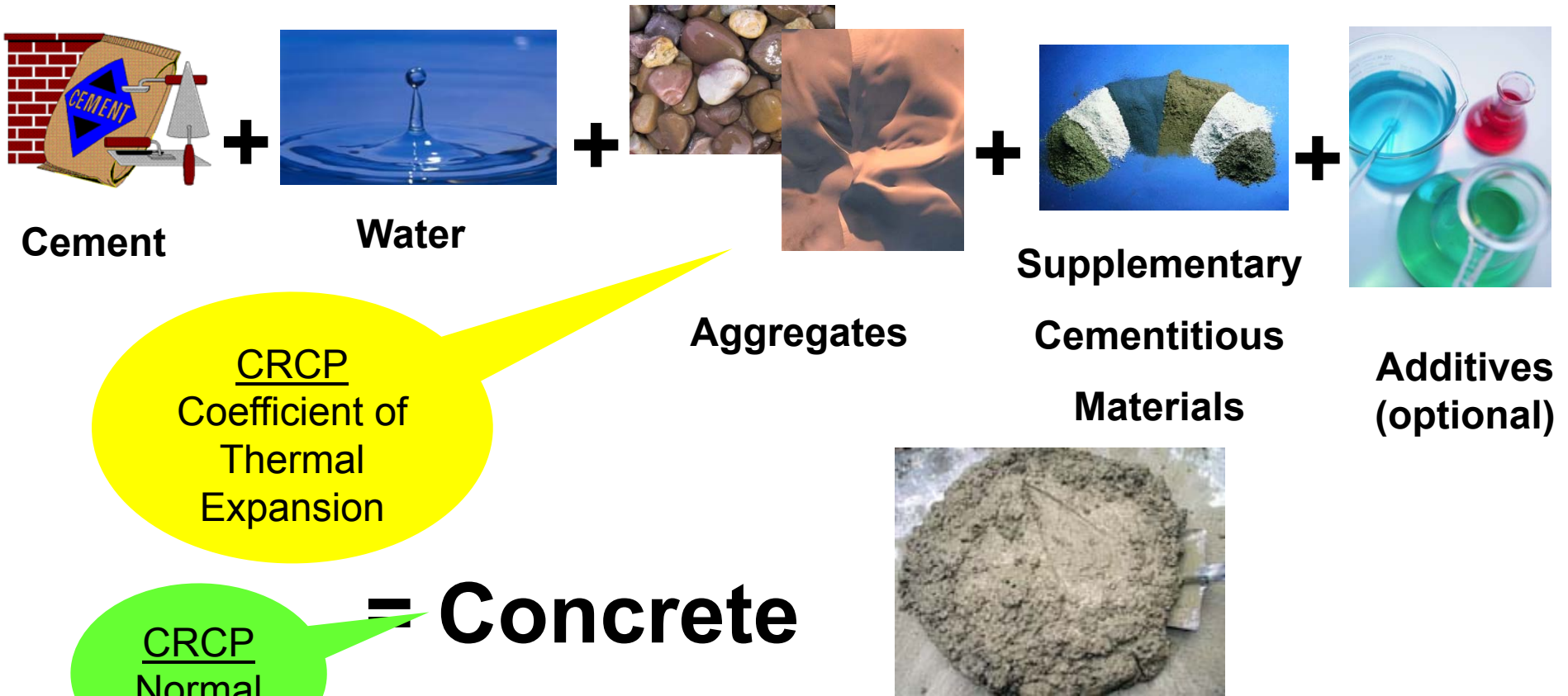
- **Outputs**

- Subgrade and Base: Thickness, Strength
- Slab: Thickness, Strength, CTE
- Steel: Steel Ratio, Crack Spacing and Width
- Performance: Time to Distress
- Costs: Initial and Whole Life Costs



CRCP 101

Materials



CRCP 101

Support System



CRCP
Normal
Asphalt
Aggregate

CRCP 101

Steel Placement



60', Bundled

No Kinks/Bends



CRCP
Unique



CRCP 101

Steel Placement



Single Layer

CRCP
Unique

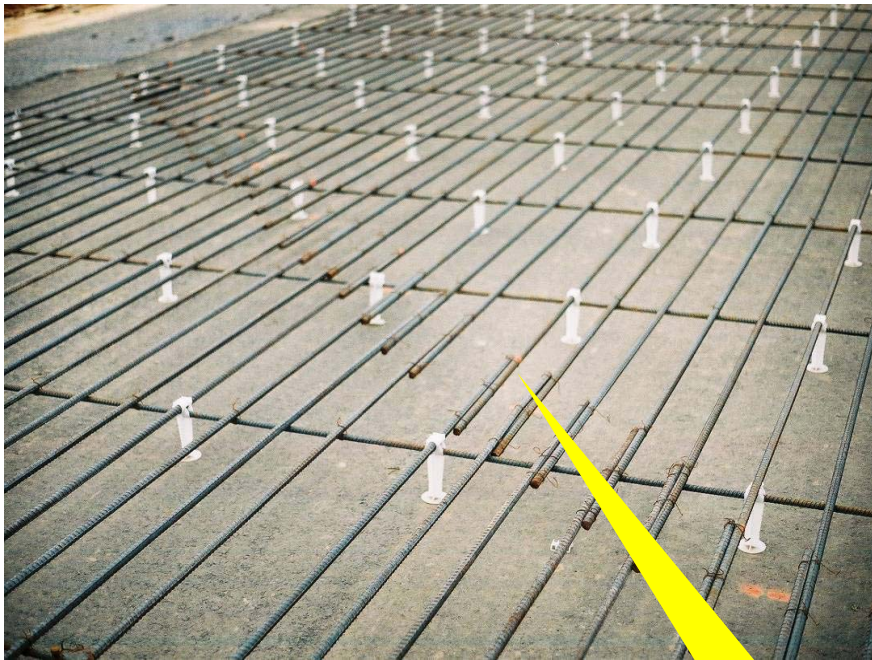
CRCP
Unique

~~Double Layer~~



CRCP 101

Steel Placement



Bar Splices

CRCP
Unique

CRCP
Unique

End Restraint



CRCP 101

Concrete Placement



Transport



CRCP
Normal

Placement

CRCP
Normal



CRCP 101

Concrete Placement



CRCP
Normal

Consolidation

Finishing

CRCP
Normal



CRCP 101

Concrete Placement



CRCP
Normal

Texturing

Curing



CRCP
Normal



CRCP 101

Concrete Placement

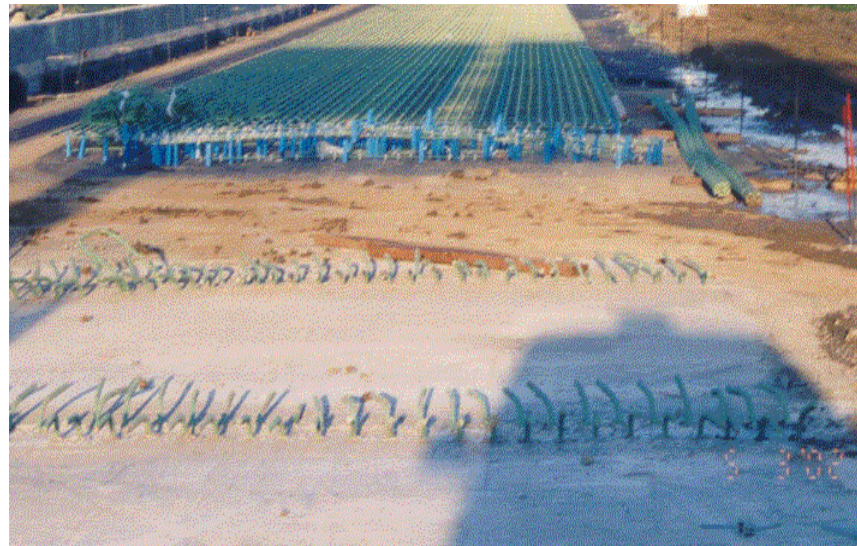


CRCP
Unique

Construction
Joints

CRCP
Unique

End Treatment

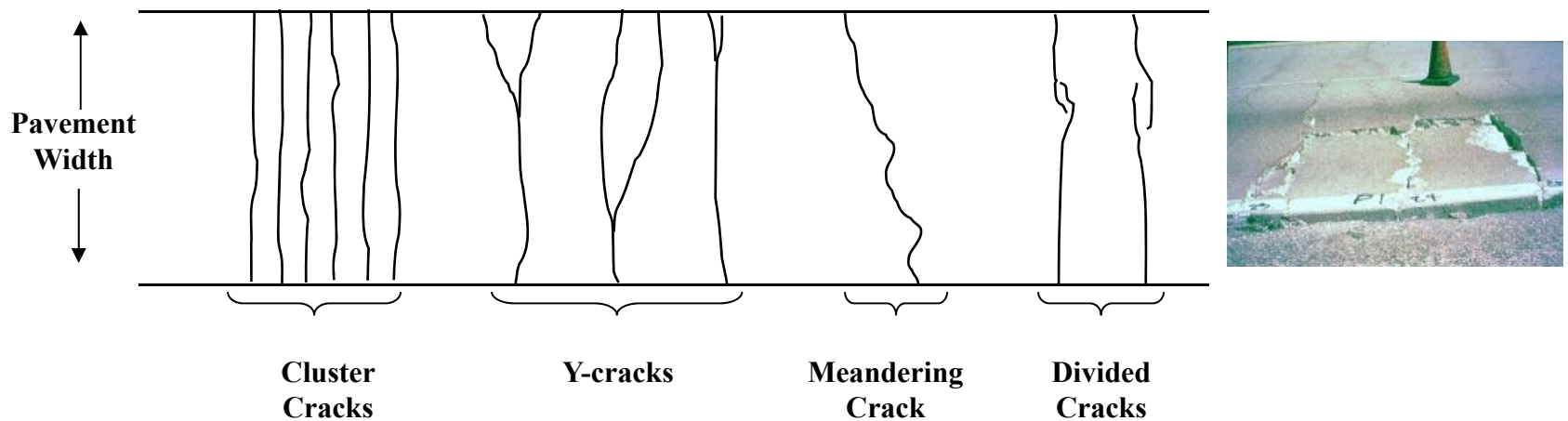


CRCP 101

- Early Performance
 - Cracks form within 24 – 72 hours (60%) and gradually for up to a year (100%).
 - Some times you see them.
 - Sometimes you don't.
 - Very hard to measure.

CRCP 101

- Long Term Performance



- Non-uniform crack patterns are detrimental and common
- They lead to spalling and punchouts

Generally do not occur on today's CRCP pavements

CRCP Repair



CRCP 101

Keys to Success

- Non-erodible subbase
- Good drainage
- Widened lanes
- Tied shoulders
- Proper thickness
- Proper steel amount
- Proper steel placement
- Good construction practices

Results

- Proper crack spacing
- Proper crack width
- Smooth
- Durable

CRCP 101

At the end of the day, will you agree?

- CRCP can carry heavier loads than alternates.
- CRCP can last longer than jointed concrete and asphalt.
- CRCP has been studied extensively, with problems resolved.
- CRCP is a whole cost value.
- CRCP is a smooth, quiet option.
- CRCP is excellent for composite construction
- CRCP is a long term sustainable solution.
- CRCP technical assistance is now available.

CRCP 101

- Continuously reinforced concrete pavement is a ***viable pavement option*** that provides long term pavement performance with low maintenance during its operational life at competitive whole life costs.