Bonded Concrete Overlay on Asphalt Pavements

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UCPRC City and County Pavement Improvement Center

UCPRC UNIVERSITY of CALIFORNIA Davis • Berkeley | PAVEMENT RESEARCH CENTER

- Sponsored by League of California Cities, County Engineers Association of California, and California State Association of Counties
- Chartered 28 September 2018

www.ucprc.ucdavis.edu/ccpic

CCPIC Mission and Vision

- Mission
  - CCPIC works with local governments to increase pavement technical capability through timely, relevant, and practical support, training, outreach and research
- Vision
  - Making local government-managed pavement last longer, cost less, and be more sustainable

CCPIC Scope

- Technology Transfer: training
- Technical resources: technical briefs, guidance, sample specifications, tools, and other resources
- Pavement engineering and management certificate program for working professionals: through UC Berkeley ITS Tech Transfer
- Resource center: outreach, questions, pilot study documentation, and forensic investigations
- Research and development: for local government needs that are not covered by State and Federal efforts

CCPIC Training: Certificate Program

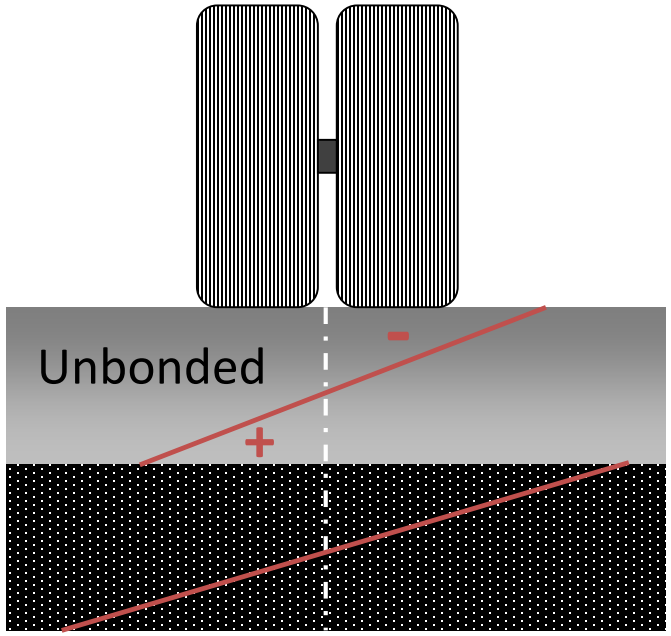
- Pavement Engineering and Management Certificate Overview
  - For engineers, asset managers, upper-level managers, technicians and construction inspectors
  - 92 hours of training
    - 60 hours in core classes, 32 hours elective
    - Majority of classes to be offered online
  - In four categories:
    - Pavement Fundamentals
    - Pavement Management
    - Pavement Materials and Construction
    - Pavement Design

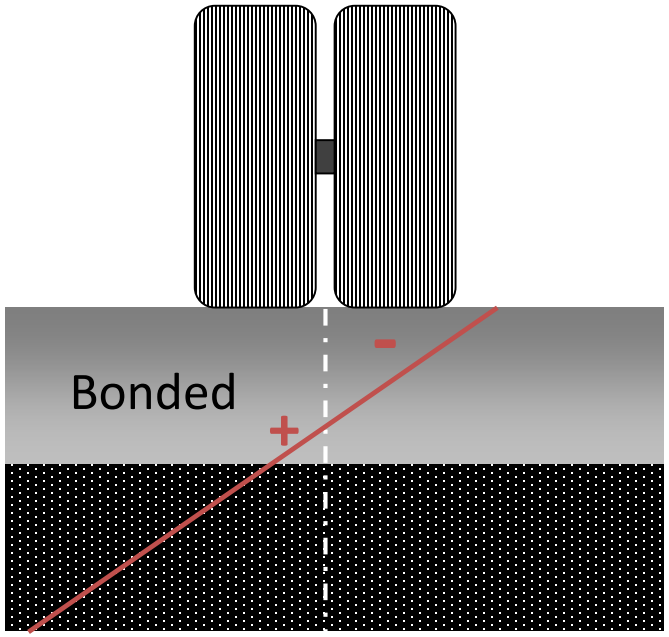
Status

- Plan approved by Governance Board
- Initial classes being delivered, including updated Tech Transfer classes and newly developed classes

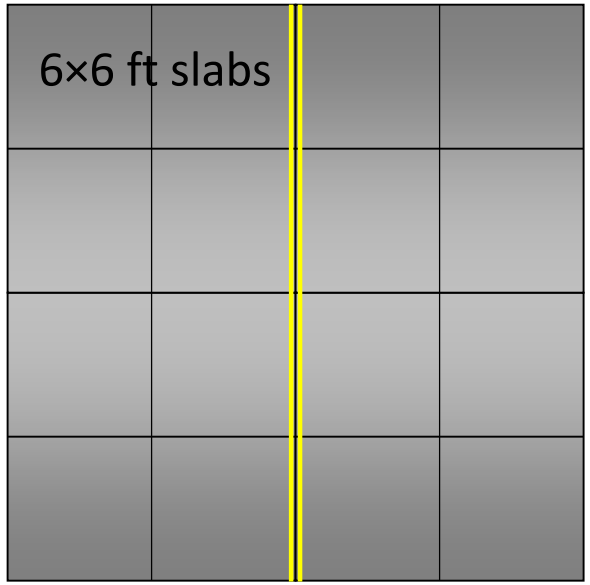
What is BCOA ?

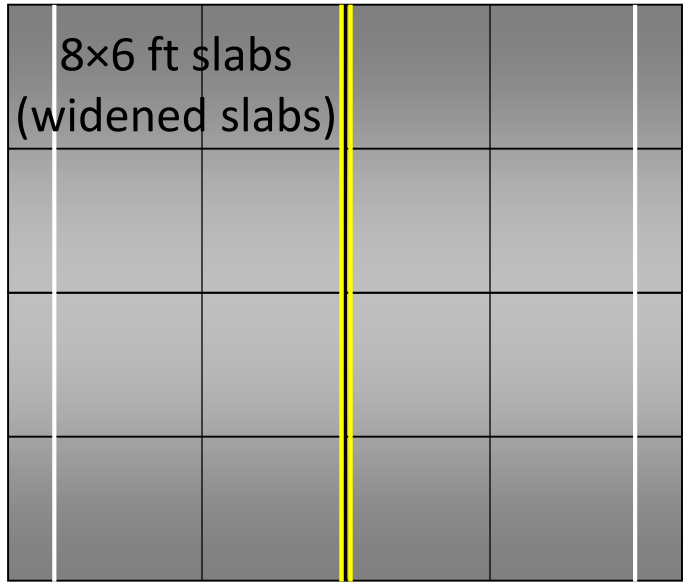
A pavement rehabilitation technique that consists of 4 to 7 in. thick concrete overlay on an existing asphalt pavement.





- PCC-AC composite action lowers the bending neutral axis, thus reducing tensile stress at slab bottom... asphalt helps carry the tension
- PCC-AC bonding is important to BOCA performance





How does BCOA construction differ from regular concrete pavements?

Not much. Need to pay special attention to some tasks.

Milling is typically required...

- To remove surface distressed asphalt
- To provide an even surface that helps achieving a uniform overlay thickness
- Matching geometry requirements, e.g. curbs and gutters, overpass structures clearances

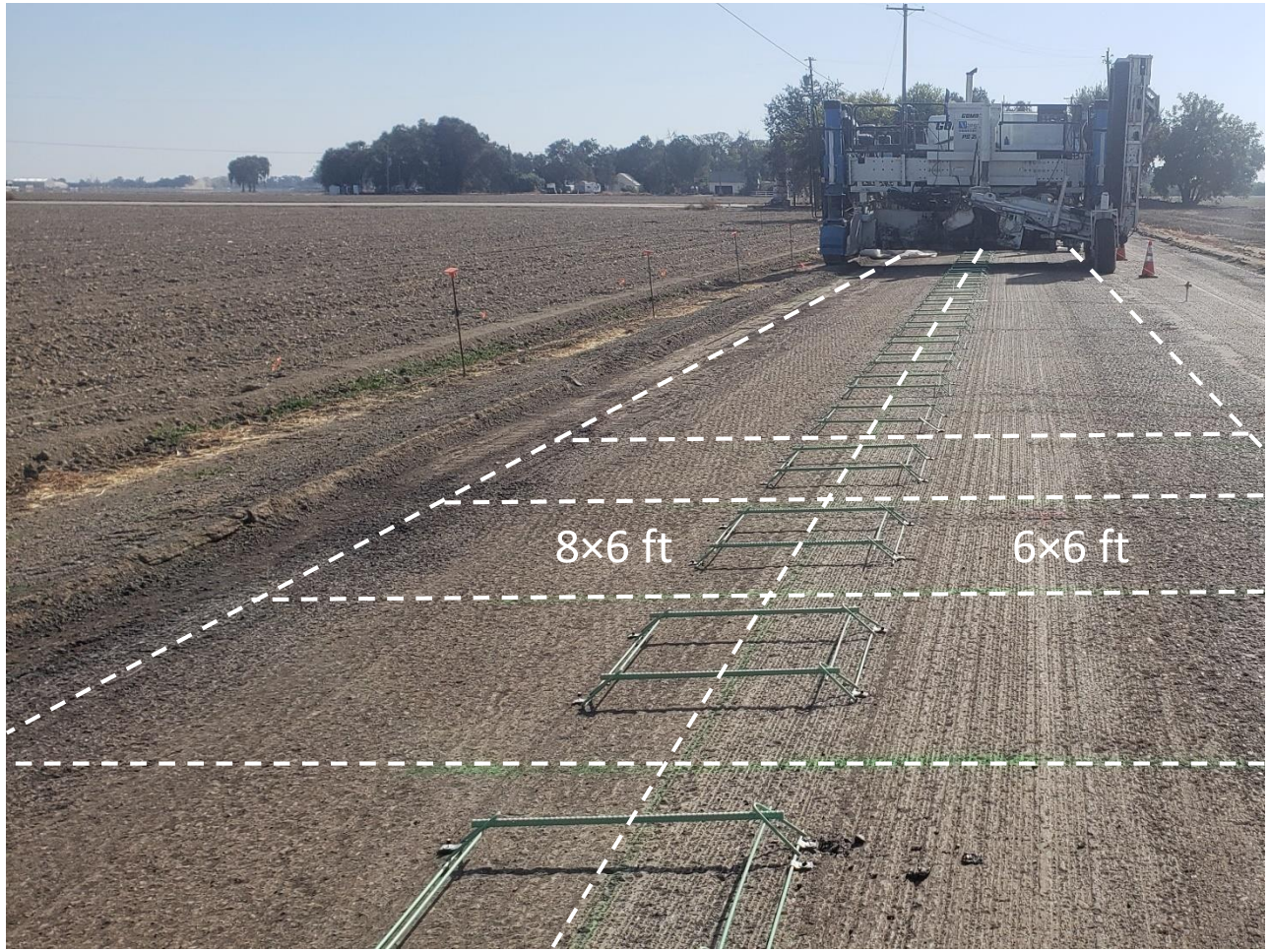
Asphalt patching and localized repairs may be required at some locations

Watch out overmilling!

How does BCOA construction differ from regular concrete pavements?

Any steel required?

- BOCA is seldomly provided with dowels (not cost-effective and may create problems due to the small thickness)
- Sometimes provided with tiebars...



How does BCOA construction differ from regular concrete pavements?

Asphalt surface conditioning is important:

- Sweep/vacuum asphalt surface before concrete overlay construction
- Keep wet surface but no standing water (saturated surface dry condition)
- Keep asphalt surface temperature below 110 °F

How does BCOA construction differ from regular concrete pavements?

Paving operation as normal...

- With slipform paving
- Fixed form paving

Finishing, including texturing, as normal

How does BCOA construction differ from regular concrete pavements?

What type of concrete mixes can be used?

- The same mixes you would use in regular concrete pavements
- Rapid strength concrete if early opening is required...
    - Recent successful BCOA experiences with mixes designed to be open to traffic in 4 to 24 hours

How does BCOA construction differ from regular concrete pavements?

Curing is important...

- Some recommend applying twice the rate of standard pavements...

Joints saw-cutting ...

- Cut to 1/3 slab thickness rather than 1/4

Joint sealing...

- The benefits of sealing BCOA joints are not clear.

Watch out undercutting!

Is BCOA a rehab alternative for any asphalt pavement?

No. Some pavements are and some are not suitable for BCOA rehabilitation.

- Asphalt must be in fair to good condition (not highly deteriorated)
  - Some cracking may be present, but alligator cracking should be limited
  - Asphalt rutting is not a problem
  - Milling/micromilling may be required to remove surface distresses
- At least 2-3 inches of asphalt must remain after milling, more is better
- Subbase/subgrade support must be fair to good, no drainage issues
- Suitable for low and intermediate traffic (6 million ESALS, TI 11.0)
- Particularly suitable for locations where asphalt may rut (low speed traffic)

Is BCOA a rehab alternative for any asphalt pavement??

Ho do I conduct the thickness design? *Several options available.*

- AASHTOWare Pavement ME software (requires license)
- BCOA-ME (free online tool https://www.engineering.pitt.edu/Vandenbossche/BCOA-ME/)
- Caltrans BCOA Catalog (soon)

Is this a new technique?

No. BCOA has been used for more than two decades in other US States and other countries.

- States with large experience with thin BCOA:
  - Colorado, Iowa, Minnesota, Illinois
- Past achievements/milestones:
  - 1998 Colorado design method
  - 2004 NCHRP Synthesis on Thin and Ultra-Thin Whitetopping
  - 2008 ACPA design method
  - 2015 BCOA-ME design method
  - 2016 BCOA introduced in the AASHTOWare Pavement ME
  - 2018 NCHRP Project 01-61 Evaluation of BCOA
  - 2018 First Caltrans BCOA at Interstate Route 8
  - 2020 BCOA included in Caltrans HDM (planned)
- BCOA future:
  - Increasing interest from different countries, states, and cities

Is this a new technique?

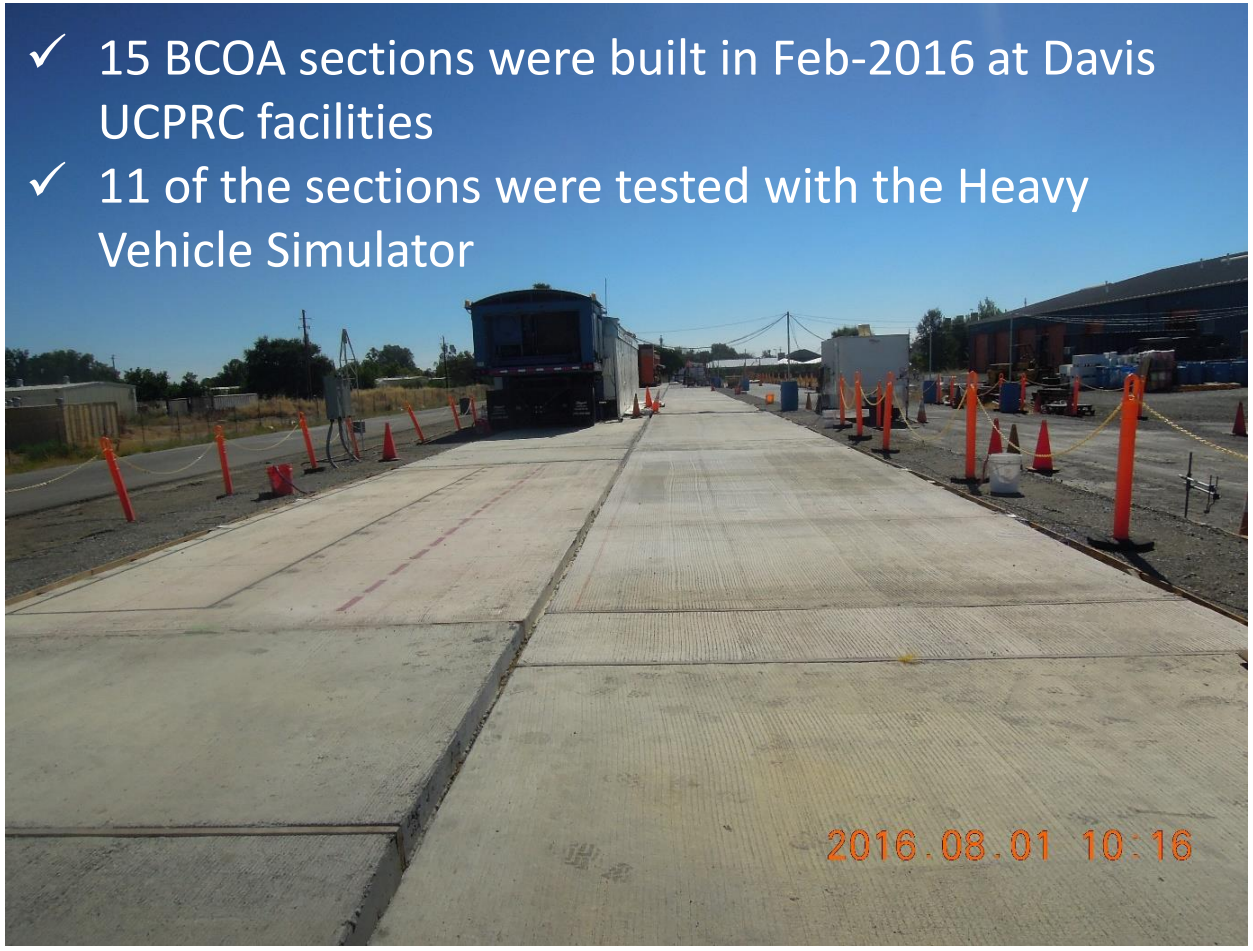
Very positive outcome from research project NCHRP 1-61 (Evaluation of Bonded Concrete Overlays on Asphalt Pavements, NCE, 2018-2020)

- Goal: Document and evaluate condition of 20 BCOA projects in the USA
  - 13 of the 20 projects have 6×6 ft slabs
- Design and experimental data collected (including cracking, faulting, and roughness)
- Overall, condition of all the projects with 6×6 ft slabs is excellent:
  - Cracking below 3% and faulting below 0.1 in.
  - ...despite four of the projects are subjected to relatively high traffic (AADTT over 500) and have been in service between 9 and 19 years

    (around 68 percent of Caltrans non-interstate highway network supports less than 500 trucks per day in the design lane)

Is there any previous experience with BCOA in California?

Yes. Caltrans Research Project 4.58b (2014-2017)



4.58b Project Goal:
Develop recommendations and guidance for use of BCOA in California

The Heavy Vehicle Simulator is a full-scale accelerated pavement testing machine

Is there any previous experience with BCOA in California?

- Despite the critical testing conditions (over twice the legal load limit, channelized traffic, and flooding), the HVS traffic did not produce any crack in any of the sections
- Extended HVS testing was conducted on a 12×12 section
  - The section resisted 13.3 mill ESALs before corner cracking took place
  - Post cracking behavior (1 million ESALs) was excellent

Is there any previous experience with BCOA in California?

The main conclusions from 4.58b research project:

A well-designed, well-built 6×6 BCOA placed on top of an asphalt base that is in fair to good condition can provide 20 years of good serviceability on most of California's non-interstate roadways.

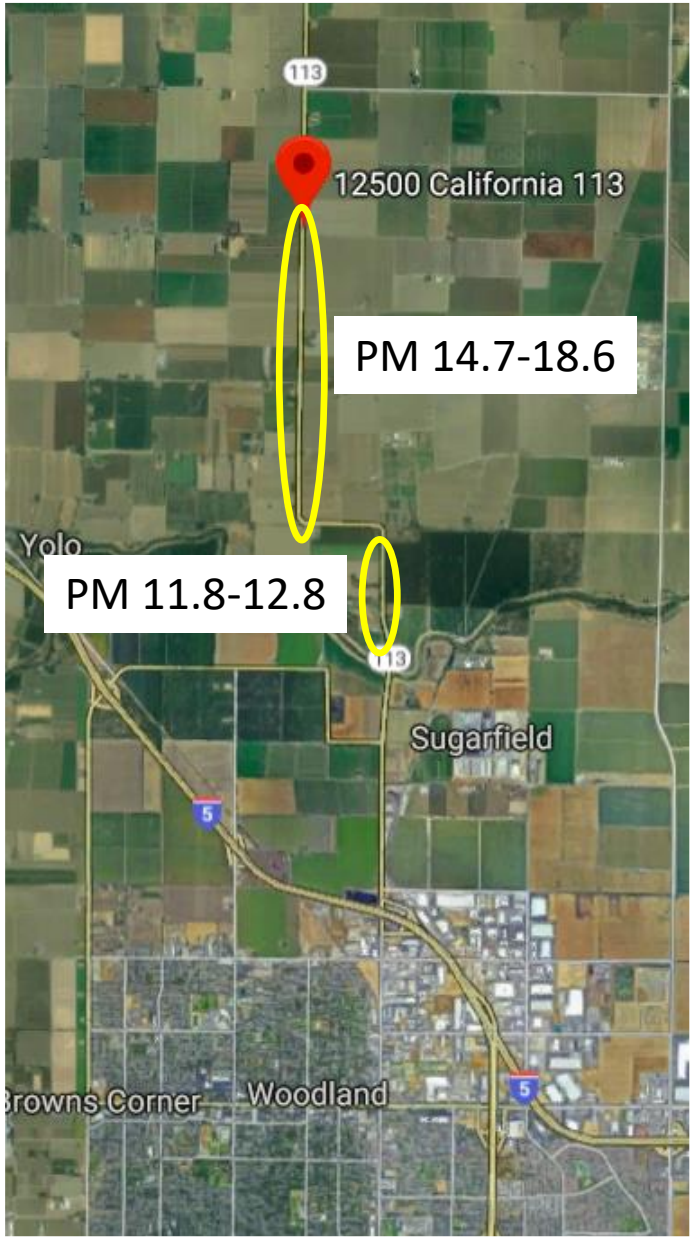
Is there any previous experience with BCOA in California?

Yes. Caltrans has recently implemented BCOA technique.

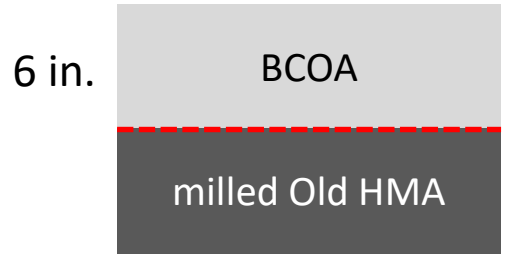
Pilot implementation in several projects (2018-2019):

- District 11, Interstate Route 8
- District 3, State Route 113
- District 8, State Route 247

Caltrans BCOA Pilot in Woodland SR113



- Two-lane road, AADTT around 600
- Final solution included milling 6 in. (to maintain road surface elevation, potential flooding area)
- 6×6 and 8×6 slabs (widened lane), tiebars, unsealed joints
- Rapid strength concrete, 450 psi in 24 hours
- Overlay was built Oct-Nov 2018 (PM 14.7-18.6) and Apr-May 2019 (PM 11.8-12.8)
- No major construction issues other than initial lack of contractor experience, quickly overcome on the job



Caltrans BCOA Pilot in Woodland SR113

Milling operation

Milled asphalt

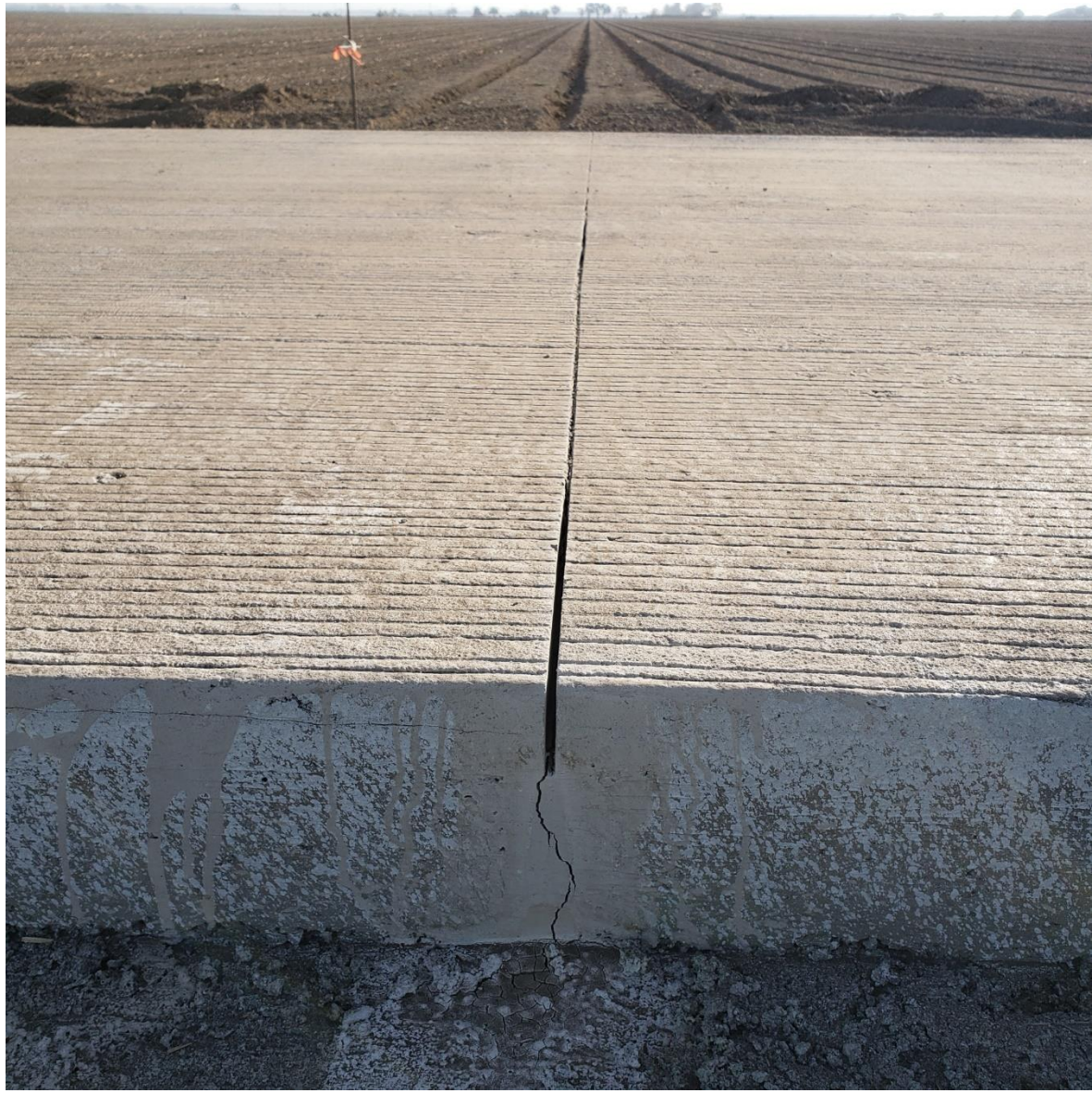
Caltrans BCOA Pilot in Woodland SR113

North part was paved during weekdays, nighttime

South part was paved during weekends, daytime

Caltrans BCOA Pilot in Woodland SR113

Standard curing compound at standard rate

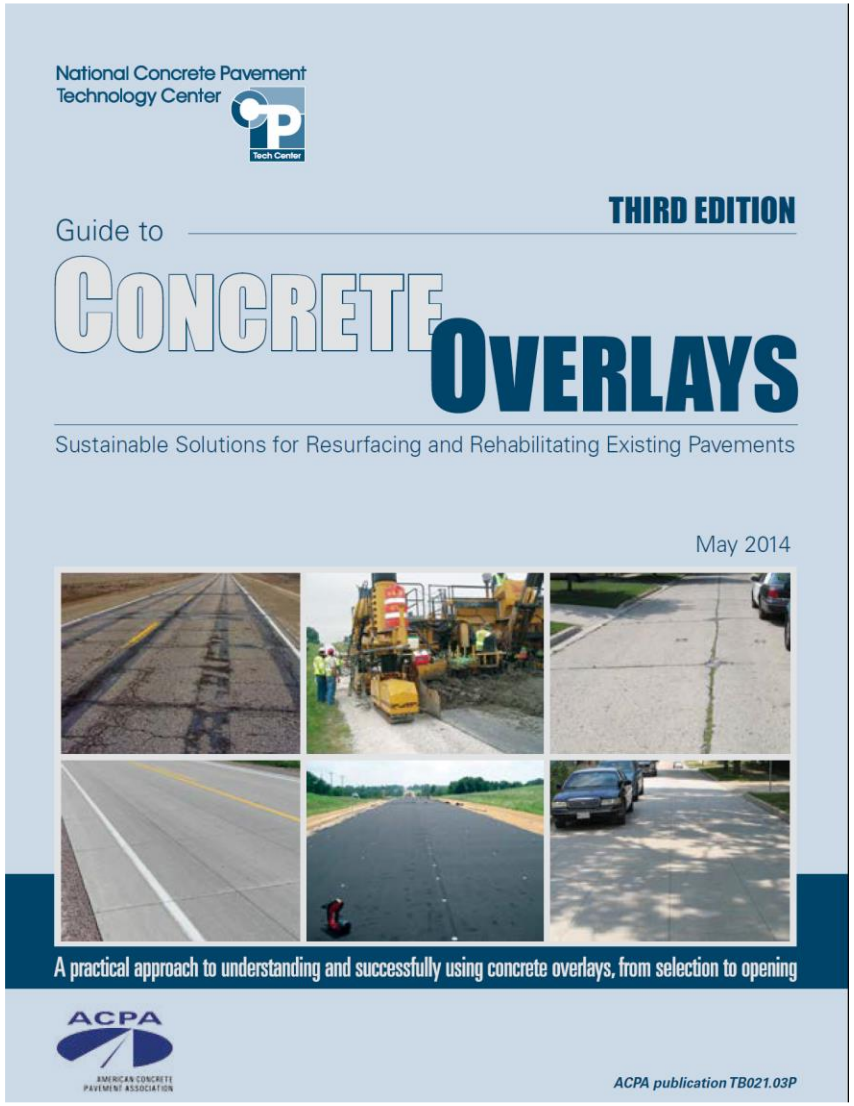


Sawcutting at 1/3 depth

Caltrans BCOA Pilot in Woodland SR113

Are there design and construction recommendations?

Yes, several documents may be consulted.



https://intrans.iastate.edu/app/uploads/2018/08/Overlays_3rd_edition.pdf

http://www.ucprc.ucdavis.edu/PDF/UCPRC-SR-2018-01.pdf

Conclusions

- BCOA is a mature technology that has long been used in other US States and in other countries as well.
- The use of BCOA in streets and most non-interstate roadways should not present major problems.