Concrete Overlays – What's New and Different

Guide to Concrete Overlays, 4th Edition

July 13, 2021

IOWA STATE UNIVERSITY
Institute for Transportation

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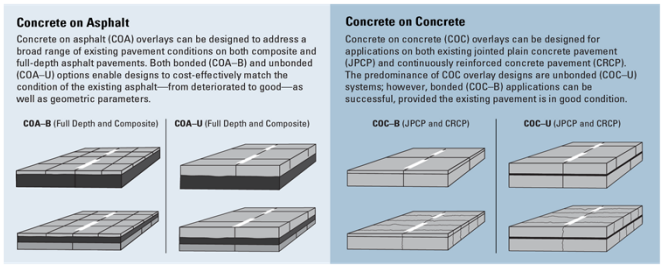
National Concrete Pavement Technology Center
Tech Center

Things to Cover

- Chapter 1 Introduction
- Chapter 2 Evaluation of Existing Pavements and Selection of Concrete Overlay Options
- Chapter 3 Overview of Concrete Overlay Design
- Chapter 4 Concrete Overlays on Existing Asphalt-Surfaced Roads
- Chapter 5 Concrete Overlays on Existing Concrete Pavements
- Chapter 6 Materials and Mixtures
- Chapter 7 Plan Development
- Chapter 8 Construction of Concrete Overlays
- Appendices
- *History of Concrete Overlays in the United States*

Chapter 1

Introduction



Chapter 2

Evaluation of Existing Pavements and Selection of Concrete Overlay Options

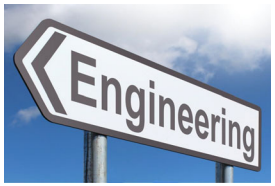
- Determine the existing pavement type and condition
- Make a preliminary determination of the existing typical section layers and thicknesses
- Conduct an on-site review and evaluation
- Determine the need for milling and accommodating adjustments of the profile grade
- Validate the existing pavement condition – Coring and material testing
- Determine the feasibility of a concrete overlay and the appropriate overlay option

Chapter 3

Overview of Concrete Overlay Design

Four common procedures for designing concrete overlays are listed below:

- AASHTOWare Pavement ME Design
- ACPA Pavement Designer
- University of Pittsburgh's BCOA-ME
- University of Pittsburgh's UBOL Design v1.0



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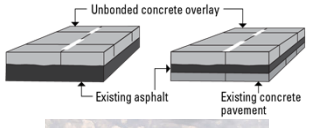
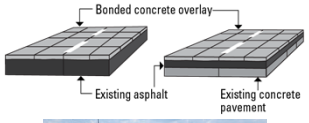
Chapter 4

Concrete Overlays on Existing Asphalt-Surfaced Roads



I-35
OK
2004



SH 13
IA
2002

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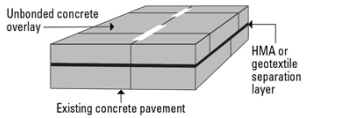
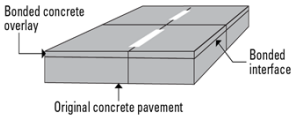
Chapter 5

Concrete Overlays on Existing Concrete Pavements





2007 before overlay in 2008

Route D, MO in 2020

Milling 2" of concrete

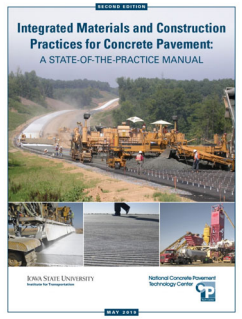
3 ½" on I-70, KS in 2013

7

Chapter 6

Materials and Mixtures

Concrete overlays are constructed with conventional concrete paving materials, which include cement, supplementary cementitious materials (SCMs), aggregate, water, chemical admixtures, dowel bars, tie bars, continuous steel reinforcing (for CRCP overlays), curing compounds, and joint fillers or sealants. They can also include macrofibers as well as separation layers.



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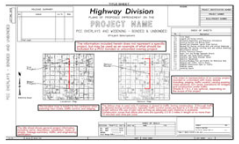
Chapter 7

Plan Development

- Construction drawings for concrete overlays do not need to be complex. The location, geometric features, and maintenance of traffic requirements of a given overlay project should dictate the level of design detail that is required in the plans.
- For decades, asphalt overlay projects on rural roads have been successfully designed and constructed from a set of drawings consisting of a limited number of sheets. This same approach can be used for concrete overlays.



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Chapter 8

Construction of Concrete Overlays

The total construction time required for a concrete overlay project is significantly shorter than that required for a roadway reconstruction project because limited quantities of earthwork and base materials are needed (or not needed at all) and concrete placement normally proceeds at a much faster pace.

Additionally, weather has fewer potential impacts on construction schedules. Projects can be opened to traffic within a short period of time with adequate planning, expedited staging, and efficient operations.

I-44 MO 2009

Uniontown PA 2010

SH 13 CO 2016

10

Included

- Appendix A Fundamentals of Concrete Overlay Design
- Appendix B Continuously Reinforced Concrete Pavement Overlays
- Appendix C Concrete on Concrete-Bonded Overlays
- Appendix D Staging Sequence Diagrams for Various Traffic Control Scenarios
- 93 References, 96 Figures, and 14 Tables
- Interactive pdf with links to other parts of the guide as well as pertinent documents.

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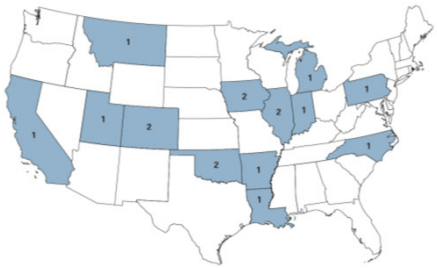
History of Concrete Overlays in the United States



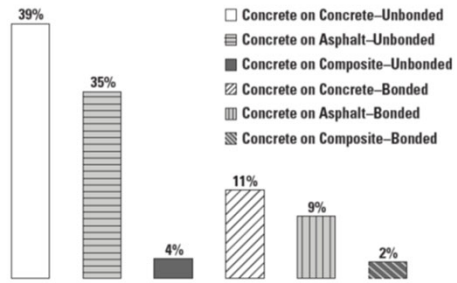
Case history #3
- CR 56 near Peru, Illinois
- 1974 5” w/thickened edge 7”
- Concrete on Asphalt – U
- Estimated ESALs 12.5 million

5 projects COA – B
2 projects COA – U
2 projects COA – B composite
2 projects COA – U composite
2 projects COC – B
2 projects COC – U
2 projects COC – U CRCP

12

Unbonded – 78% Bonded 22%

National Concrete Overlay Explorer (ACPA 2020)



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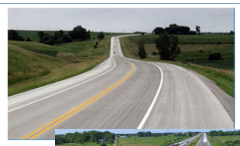
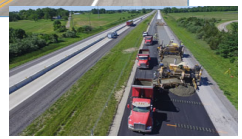
Thank you for your time

Grand Strand Airport
N Myrtle Beach, SC
2018

Carroll Street
Macomb, IL
2013



US 59
IA
2014



I-69
IN
1986

www/cptechcenter.org

14

Concrete Overlays – What's New and Different

Value Proposition/Proven Technology

Tuesday, July 13, 2021

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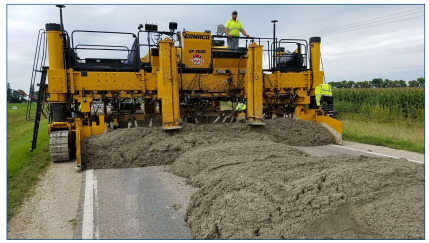
Concrete Overlays: Today's Talking Points

- The Challenges
- The Value Proposition
- Addressing Barriers to Implementation
- Getting Started
- Case Histories
- Resources



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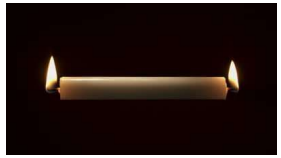
The Challenge to Pavement Owners

- Existing infrastructure is continually deteriorating
  - Weather
  - Traffic
- Demands are increasing
  - Traffic
  - Ride quality
  - Continuous access
- Funding is decreasing
  - Maintenance costs often exceed Agency revenue



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Maintaining Existing Pavements

- We can toss them out and start again
  - A long term solution
  - Creates a disposal headache
  - Takes energy to move them out of the way
  - Takes time = traffic delays

Maintaining Existing Pavements

- We can patch them – buy a few years
  - Limited materials usage, energy and traffic impact
  - Effective
  - A shorter term solution

Maintaining Existing Pavements

- We can overlay them with concrete
  - Use existing equity
  - Minimize sustainability impacts
  - Long term solution
  - Lower life cycle cost
  - Elevations / connections are tricky

Another Tool in the Toolbox

- Concrete Overlays - Concrete placed over an existing paved surface to:
  - Extend life
  - Restore ride
  - Increase capacity

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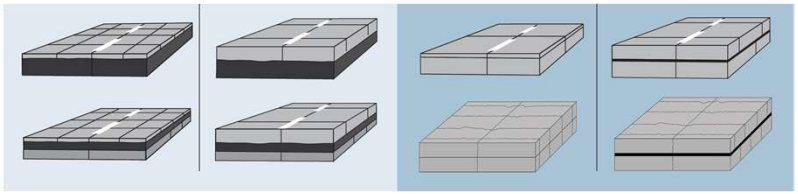
Concrete Overlays

Concrete on Asphalt

Concrete on Concrete



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Proven Applications for Concrete Overlays

Intersections

Rural Secondary Roads

Urban Freeway/Interstates

Airport Runways

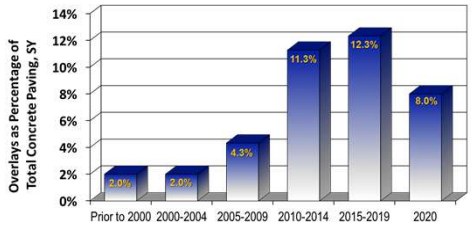
Urban Arterials

Rural Primary/Interstates

Parking Lots

The Value Proposition

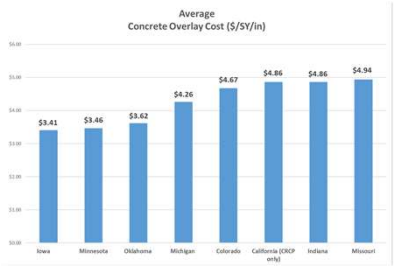
- Costs
- Environmental impacts
- Resiliency
- Effectiveness



10 ACPA

Costs

- Initial costs depend on
  - Competition
  - Local contractor experience
  - Local materials availability
- Can be competitive with other solutions
- Annual ownership costs are reduced
  - Longer life
  - Less maintenance
- Overall network condition is raised



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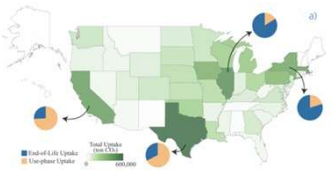
Environmental Impacts

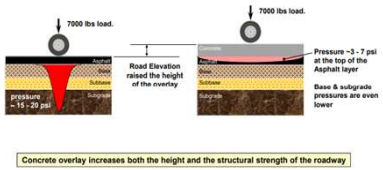
- Long life and low maintenance reduces environmental impacts
- Improved fuel efficiency
- Low albedo, reducing the heat island effect
- Concrete is 100% recyclable
- May absorb CO_2



12 MIT CSHub

Resiliency

- Flooding saturates and weakens a pavement's underlying foundation
- Concrete overlays reduce the stress at the top of the asphalt layer
- Sensitivity to softening is reduced



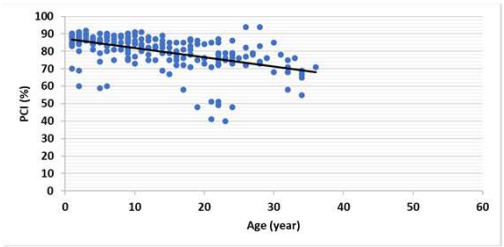
Concrete overlay increases both the height and the structural strength of the roadway

Effectiveness

- A long history
  - As early as 1901
  - A number of overlays built in the 1970s remain in service today

Effectiveness

- Performance
  - Depends on thickness
  - Condition of existing layer
  - Detailing
  - Life can be up to 35 years



Effectiveness

- Versatility
  - Can be applied to all surface types
  - Many degrees of distress can be accommodated
  - Used for a range of applications:
    - Roadways
    - Streets and Intersections
    - Parking lots
    - Airfields

SGL[4

Effectiveness

- Rapid Construction
  - Depends on preparation effort
  - Placement is fast with thinner sections

17

Effectiveness

- Traffic Impact
  - Maintenance of traffic is simpler than reconstruction
  - Construction under traffic is possible
  - Early opening is possible (Maturity)

18

Effectiveness

- New technologies improve everything
  - New design methodologies
  - Performance Engineered Mixtures (PEM)
    - Reduced CO_2 footprint
  - Stringless machine control
  - Larger paving machines
  - Vibrator monitoring
  - Real time smoothness
  - Fiber reinforcement

19

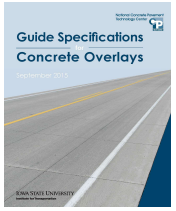
Effectiveness

- Safety
  - Reduced frequency of closures

20

Effectiveness

- Efficiency
  - Similar practices to conventional concrete paving
  - Simple plan sets are possible
  - Guide specifications available
  - Guidance documents available



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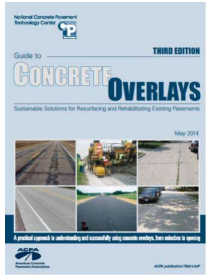
Challenges

- Exclusion from Agency Project Management System
  - Most PMS reflect local institutional experience and practices
    - Innovation is hard
    - Alternative solutions are not considered
- *Change needs to come from above*

22

Challenges

- Technical Experience
  - Lack of technical competency of SHA staff can be a concern.
    - *Building technical competency is not difficult.*
    - *Help is available from CP Tech Center and recently, the FHWA EDC-6 program*
  - Lack of concrete paving contractors with experience may also be a concern.
    - *Help is available from ACPA*



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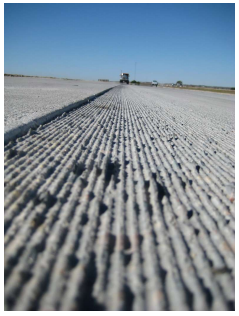
Challenges

- Agency Focus on Surface Condition Only
  - Pressure to “cover as much as possible”
    - Unsustainable short term fixes
    - Ignores traffic disruptions and safety impacts
- *Diamond grinding can be a cost-effective surface treatment*



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Challenges

- Difficulty Identifying Candidate Projects
  - Suitable overlay type for the existing system
  - Elevation issues
    - Bridges
    - Connections
    - Services
- *A range of solutions are available*

25

Challenges

- Traffic Management/Detour Options
  - *An overlay can be built faster than a reconstruct*
  - *Construction under traffic is possible*
- *Experience has proven that communication and planning are the key…*

26

Challenges

- Perceived Federal Funding Limitations
- *Concrete overlays can be considered preventative maintenance, qualifying them for use of federal aid funds.*

27

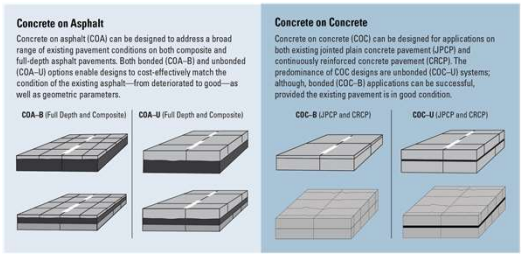
Getting Started

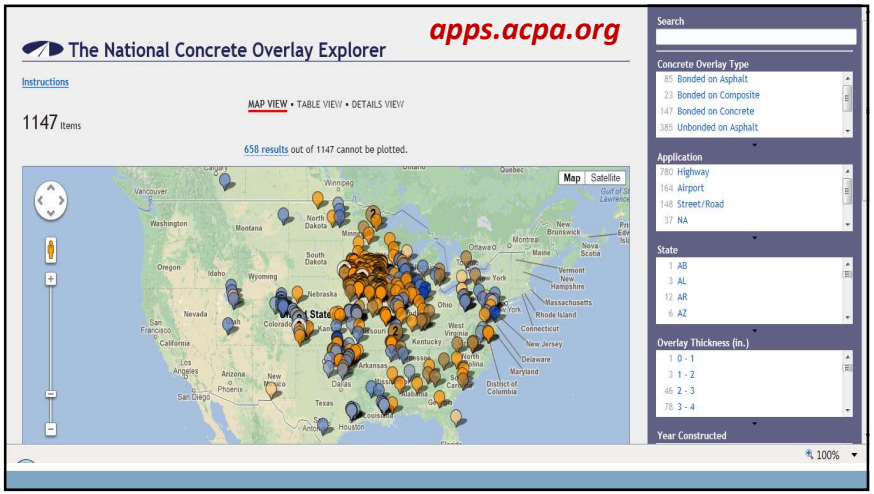
- Start with a simple project
- Get help
- Evaluate performance
- Build competency and confidence
- Integrate the process into a mix of fixes

28

The Process

- Identify the type of pavement to be overlaid
- Assess the condition of the existing pavement
- Design
- Build
- Repeat





CP Tech Technical Guides on Overlays

https://cptechcenter.org

Advancing the Use of Concrete Overlays in California

July 13, 2021

Charles Stuart, SWCPA, cstuart@swcpa.org

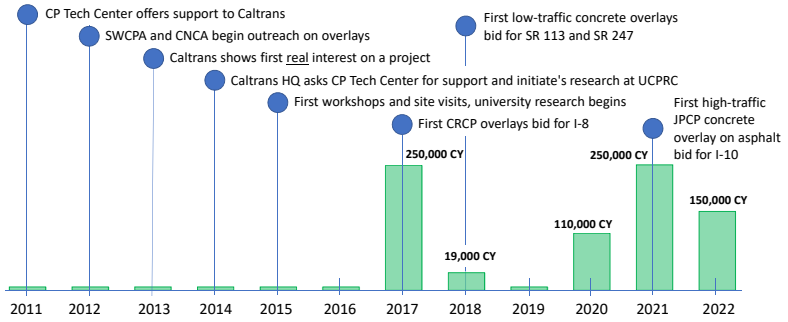
OUR EXCEPTIONAL COLLABORATIVE PARTNERS

CP Tech Center · Southwest Concrete Pavement Association · Caltrans · CNCA · UCPRC University of California Pavement Research Center · ACPA

Implementation on of concrete overlays in California

2

Concrete Overlays: Timeline for implementation



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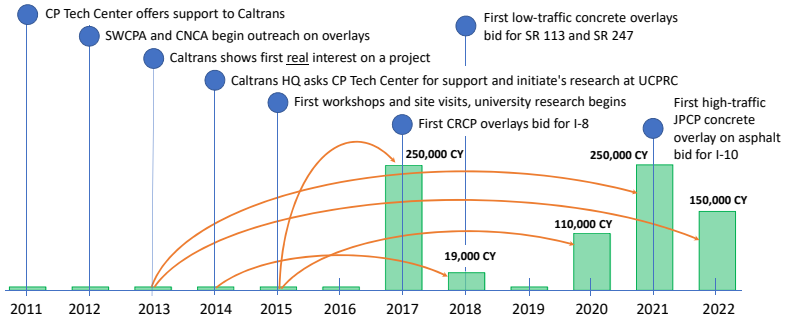
Concrete Overlays: Timeline for implementation



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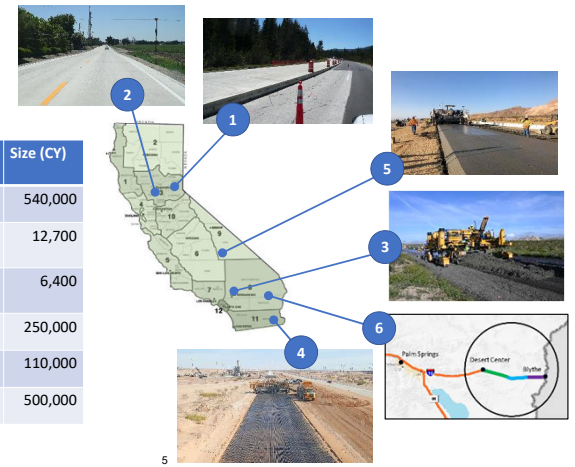
Caltrans Concrete Overlay Projects, 1992-2021

	District	Rt.	Pavement Type	Size (CY)
1	D3	I-80	JPCP-COC	540,000
2	D3	SR-113	JPCP-COA, Low-traffic	12,700
3	D8	SR-247	JPCP-COA, Low traffic	6,400
4	D11	I-8	CRCP-COC	250,000
5	D9	SR-14	CRCP-COC	110,000
6	D8	I-10	JPCP-COA	500,000



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I-80, Sierra Nevada Mountains

- Bid dates: 1992-2010
- Caltrans District 3
- 12 projects
- 540,000 CY of JPCP-COC

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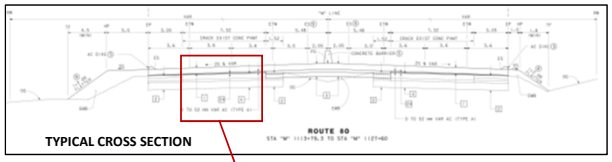

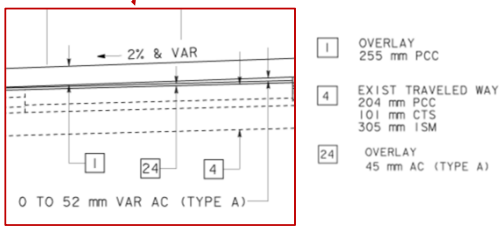

1992-2010 Concrete Overlay on Concrete (COC) projects

- Caltrans District 3
- I-80, Sierra Nevada Mountains
- 12 projects
- 540,000 CY of JPCP-COC

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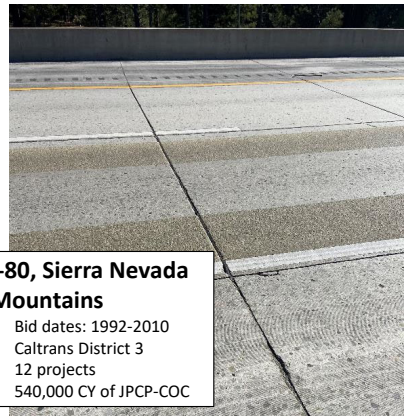

I-80, Sierra Nevada Mountains

- Bid dates: 1992-2010
- Caltrans District 3
- 12 projects
- 540,000 CY of JPCP-COC

8

SR-113, Woodland, CA

- Bid date: 2018
- Caltrans District 3
- 12,700 CY of JPCP-COA, Low traffic
- Pilot project with research aspect
- 6X6x6 and 6x6x8 design

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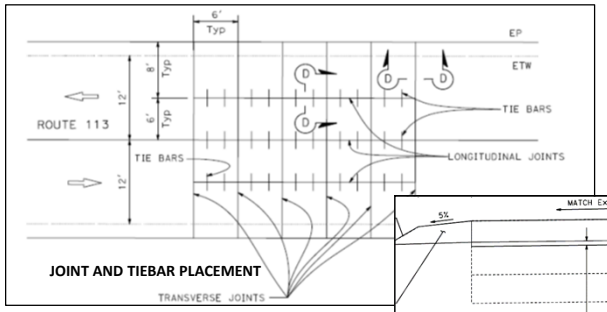
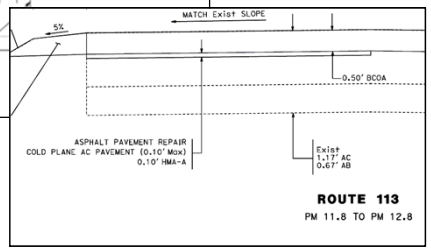


JOINT AND TIEBAR PLACEMENT



SR-113, Woodland, CA

- Bid date: 2018
- Caltrans District 3
- 12,700 CY of JPCP-COA, Low traffic
- Pilot project with research aspect
- 6X6x6 and 6x6x8 design

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SR-247, Lucerne Valley

- Bid date: 2018
- Caltrans District 8
- 6,400 CY of JPCP-COA Low traffic

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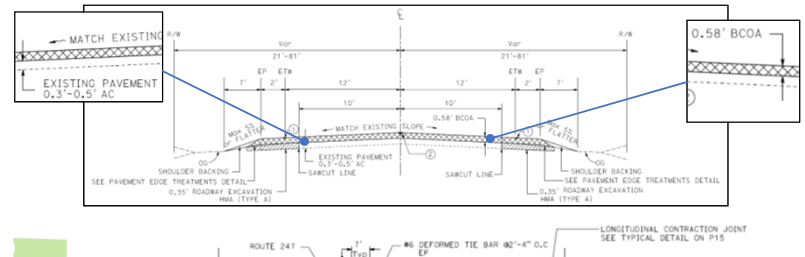

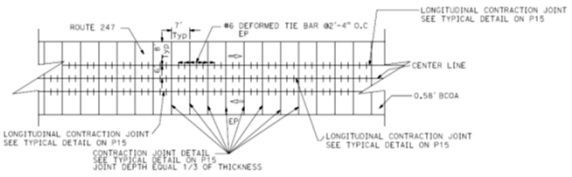

PM 33.0 TO 35.0

CONCRETE OVERLAY OVER ASPHALT – TIE BAR LAYOUT

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SR-247, Lucerne Valley

- Bid date: 2018
- Caltrans District 8
- 6,400 CY of JPCP-COA Low traffic

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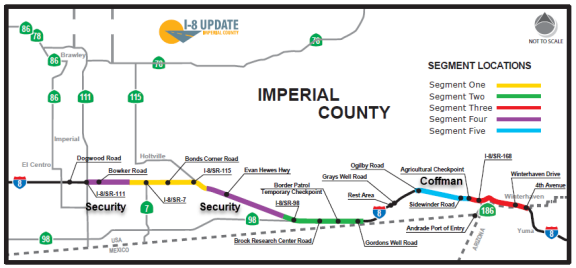
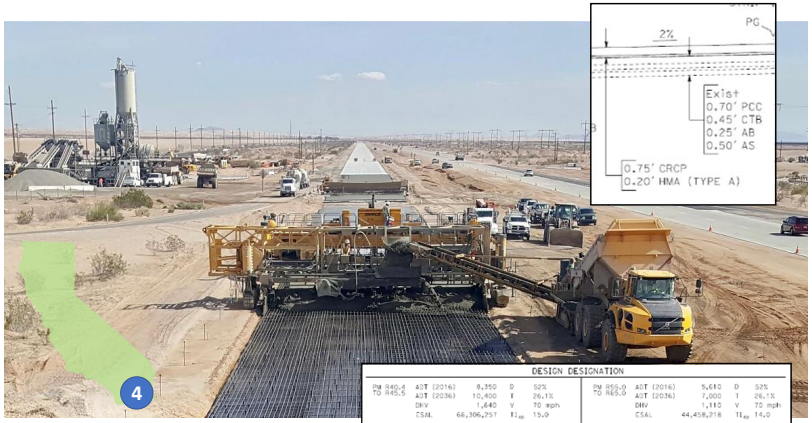


I-8, Imperial County to Arizona border

- Bid dates: 2017
- Caltrans District 11
- Two projects with a total of 250,000 CY of CRCP-COC

- 130,000 CY CRCP, awarded 10/15,
- 128,000 CY, CRCP, awarded 11/15
- 90,000 CY, CRCP, awarded 11/15
- 170,000 CY, CRCP Overlay, awarded 1/17
- 84,000 CY, CRCP Overlay, awarded 2/17

14

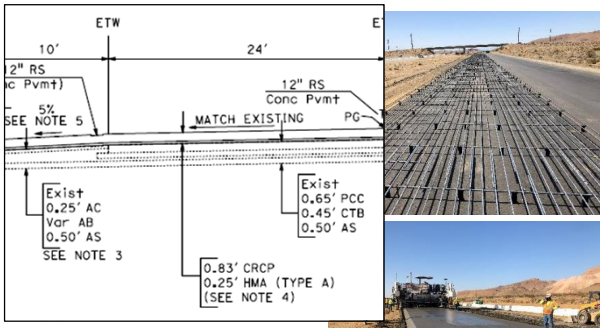


15

SR-14, Mojave, CA

- Bid date: 2018
- Caltrans District 9
- 110,000 CY of CRCP-COC

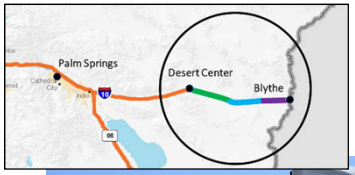
16

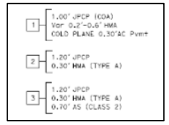


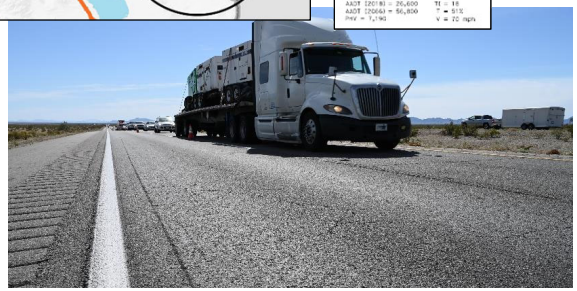
SR-14, Mojave, CA

- Bid date: 2018
- Caltrans District 9
- 110,000 CY of CRCP-COC

17







I-10, Desert Center to Blythe

- Bid dates: 2021-22
- Caltrans District 8
- Three projects with a total of 500,000 CY of JPCP-COA

18

Concrete Overlays: Next steps

- Continue supporting Caltrans through training
- Work with our partners through the EDC-6 TOPS initiative
- Develop standard structural sections for low traffic concrete overlays
- Analyze the sustainability benefits of concrete overlays
- Improve initial IRI smoothness and construction quality
- Communicate clearly and frequently about the many benefits
- Be thankful for exceptional collaborative partners!

19

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20