CALTRANS I-8 CONCRETE OVERLAY
PILOT PROJECT

Mehdi Parvini
California Department of Transportation
Outline

• Introduction
• Pilot Project
• Design Process
• Status Update
Concrete overlays are sustainable and cost effective strategies that extend pavement life and improve both functional and structural characteristics of the pavements.
Existing Process

(b) Unbonded rigid overlay with flexible interlayer. To determine the thickness of the rigid layer, use the rigid layer thicknesses for new pavement found in Index 623.1. Include a 0.10 foot

(c) Grouting to correct heaving.
(d) Dust and dust control. Guidelines for selecting and engineering dust control projects can be found on the Department Pavement website.

Unbonded rigid overlay with flexible interlayer. To determine the thickness of the rigid layer, use the rigid layer thicknesses for new pavement found in Index 623.1. Include a 0.10 foot

Table 63.2.1G

Rigid Pavement Catalog (inland Valley, Type II Subgrade Soils)
Concrete Overlay Workshop
For Caltrans HQ and Districts 3 and 4
February 24, 2016, 8:00 am to 3:00 pm

Workshop Background
Introducing a one day workshop for Caltrans on concrete overlay design, traffic strategies, materials, construction and costs using the Overlay Guide and additional documents. The PowerPoint presentation and documents will also be included in the participant's booklet. The documents were developed under the guidance of a Technical Oversight Committee that consisted of industry, State DOT and FHWA representatives and was completed by the National Concrete Pavement Technology Center.

Who Should Attend?
The Concrete Overlay workshop is for Caltrans engineers, their engineering consultants, interested cities and technicians, along with industry contractors and suppliers.

What Will You Learn?
The primary objective of this workshop and accompanying materials is to provide the latest information on concrete overlays. The workshop and informational materials will provide the most up-to-date and cost-effective placement protocol and strategies available on design, construction and selection of the different types of concrete overlays available. The workshop will cover:

- Types and Selection of Overlays
- Design of Concrete Overlays
- Michigan DOT’s Approach to Concrete Overlays
- Construction of Concrete Overlays
- Maintenance of Traffic Strategies

Workshop Location
Room 105
4200 Dudley Blvd, McClellan Park, Sacramento, CA 95832

Who to Contact
Mike Kang at mike.kang@dot.ca.gov
or Amy Pong at amy.pong@dot.ca.gov

Concrete Overlay Technical Assistance Program
Increasing the awareness and knowledge of concrete overlay applications among state DOTs, contractors and engineering consultants.
Memorandum

To: NICKLA BERNARD (NS 340)
Project Manager
Design

DEPARTMENT OF TRANSPORTATION - DISTRICT 11
PAVEMENT ENGINEERING SECTION

Memorandum

This Addendum provides an A4 Main Lane Alternative which removes the existing PCCP, CTB, and a portion of the AB. These layers are replaced with CRCP and HMA-Large Stone Matrix (LSM) leaving the rest of the AB-OI 2 and AB-OI 4 in place to achieve a 0.7 increase in the profile grade.

The structural sections furnished meet or exceed the minimum requirements in the current Highway Design Manual, Section 060, updated November 22, 2012, and Rapid Pavement Catalog Table 0235.1.

The 20 and 40 year Traffic Indicators (TI) were provided by the District Traffic Forecasting Branch on January 23, 2013.

The 40 yl TI charges at PM R47.7 from 14.5 to 14.7.

The rigid pavement design is based upon Continuously Reinforced Concrete Pavement (CRCP) with lateral support.

MAIN LANE STRUCTURAL SECTION ALTERNATIVE 4

CRCP-6 (PM R46.8/B47.2) CRCP Travelled Way (4y) $y \geq 16.6$, Radius 2:10

Remove the existing PCCP, CTB, and 0.10 yl AB all pavement layers, leaving in place the remainder of the existing AB-OI 2 base and AB-OI 4 subbase layers.

The new CRCP and HMA-Large Stone Matrix (LSM) pavement layers will be constructed over the existing base and subbase layers. This eliminates the new AB-OI 2 layer.

This alternative will have a 0.7 net increase to the main lane TW profile grade.
Design Request

To: Mehdi Parvini
Senior Transportation Engineer
Office of Concrete & Pavement Foundations

From: Michael Orozco
Project Engineer
District 11, TCIF Corridor

Subject: STRUCTURAL SECTION RECOMMENDATIONS

This request is for Route 8, located in the Imperial Valley. The project is currently in the Report/Design phase.

The project proposes to construct a CRCP overlay over the existing PCC pavement, shoulders, AC, and partially on the AC ramps. Other locations that require attention are the existing pavement transitions to the overlay, and when the overlay is a full structural section replacement underneath bridges.

Please provide a structural section recommendation for the areas explained above.

Should you have any questions or need additional information, please contact me at 3147 or by email.

Sincerely,

Michael Orozco
Project Engineer

Attachments: Title Sheet, Typical Sections

EA413601
COMPARISON OF OVERLAY OPTION TO ENGINEERS ESTIMATE
8/25/2015

CRCP:
- Saves 11,000 cyds of CRCP, at $230/cyd: $2,530,000 saved (assumes 0.5’ depth in overlay sections, 0.5’ depth in transitions and full replacement sections)

HMA:
- Reduces HMA Type-A by 8,000 TONS. Increases RHMA by 9,200 TONS due to ramp work: $240,000 increase
- Overlay will raise gore areas and a few hundred feet of ramp at 12 ramps

CLASS 2:
- 7400 CYDS more may be needed due to ramp work: $222,000 increase
- Overlay will raise gore areas and a few hundred feet of ramp at 12 ramps

Roadway Excavation:
- Reduces by 103,000 CYDS, at $20/cyd: $2,060,000 saved

Imported Borrow:
- Will need approximately 70,000 CYDS, at $25/cyd: $1,750,000 increase
- Material will need to be mechanically stabilized so that safety edge will not be needed, trucking may increase unit cost

Slab Replacement:
- Assumed 5% replacement needed at 9.5 miles x 4 lanes, at 12’ wide, 0.7’ depth.
- Will need 3100 CYDS rapid set concrete at $300/cyd: $930,000

TOTAL SAVINGS: $1,500,000

Time:
- Reduces Roadway Excavation by approximately 30 days out of 85 (35%)
- Saves 5 to 10 days in CRCP paving (Assuming 2000 cyd/day production rate)
Existing Pavement (As-Built)
Existing Pavement (Pavement Condition Survey)
Existing Pavement (Cores)
Existing Pavement (Field Visit on 4/17/2015)
Industry Partnership

A Brief Discussion on How to Design CRCP Overlay using Pavement ME

Feng Mu and James Mack
8/11/2015

1. Introduction
This article discusses the principles and tools the authors use to establish Level 2/Level 3 inputs and carry out Pavement ME runs for concrete pavement design. Although the Caltrans project of I-8 CRCP overlay was taken as the example to develop the step-by-step guideline, many of the principles are applicable for other applications besides CRCP overlay.

2. Pavement ME Design Process
The AASHTO Pavement ME Design Guide (MEPDG) uses mechanistic-empirical models to analyze the specific traffic, climate, materials, and proposed structure (layer thicknesses and features) for a given project. Unlike most other pavement design procedures (i.e. 1993 AASHTO) which only provide a thickness, the Pavement ME provides prediction performance curves for a given design using key analysis parameters (distresses). By having and using these predicted performance curves, it is possible to compare different designs and evaluate different design features. The curves also help to determine “when” and “what” rehabilitation activities to perform. The critical distresses vary with the pavement type. For this project, i.e. CRCP overlay unbonded to existing JPCC, the dominant distresses are punchouts and IRU.

In general, a concrete pavement design based on Pavement ME is achieved by a 4 step iterative process:

1. Select a pavement Type.
### Design Process (Traffic Data)

#### Traffic

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<th>Initial Design (AADTT)</th>
<th>Traffic Data</th>
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<td>Percent of trucks in design direction (%)</td>
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<td>Percent of trucks in design lane (%)</td>
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<td>Operational speed [mph]</td>
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#### Traffic -- Volume Adjustment Factors

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#### Traffic -- Axle Load Distribution Factors

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<th>Vehicle Class</th>
<th>Single Axle</th>
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<td>0.03</td>
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#### Traffic -- General Traffic Inputs

- Mean wheel location (inches from lane marking)
- Traffic standard deviation (mi)
- Design lane width (ft)
- Number of Axles per Truck
- Axle Configuration

**Axle Configuration**
- Average axle width (edge-to-edge) outside dimension [ft]
- Quad tire spacing [in]
- Axle Configuration
- Tire Pressure [psi]

**Average Axle Spacing**
- Tandem axle (in)
- Tridem axle (in)
- Quad axle (in)
# Pavement ME Design

## I-8 District Traffic Data_8 inch PCC

### Design Inputs
- **Design Life:** 40 years
- **Design Type:** CRCP over JCP (unbonded)
- **Existing construction:** May, 1965
- **Pavement construction:** June, 2017
- **Traffic opening:** September, 2017
- **Climate Data Sources:** (last call)
  - 32,854, 115,579

### Design Structure

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<th>Layer Type</th>
<th>Material Type</th>
<th>Thickness (in)</th>
<th>Steel Reinforcement</th>
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<td>Flexible</td>
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<td>Base</td>
<td>Cement</td>
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<tr>
<td>Subgrade</td>
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</table>

### Traffic
- **Age (years):**
  - 2017 (initial): 2.400
  - 2017: 2027 (20 years): 8.025, 470
  - 2017 (40 years): 24,305,000

### Design Outputs

#### Distress Prediction Summary

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Distress Specified Reliability</th>
<th>Reliability (%)</th>
<th>Criterion Satisfied?</th>
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<tbody>
<tr>
<td>Terminal RRI (in/mile)</td>
<td>Target</td>
<td>Predicted</td>
<td>Target</td>
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<tr>
<td>CRCP punchouts (1/mile)</td>
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<td>10.70</td>
<td>90.00</td>
</tr>
</tbody>
</table>

#### Distress Charts

- **Predicted RRI**
- **Predicted Punchout**
October 26, 2015
11:25.41A, E 4:185 & 4:182
Page 2

Initial two-way ADT (P): 2,400
Number of lanes in design direction: 2
Percent of trucks in design direction: 51
Percent of trucks in design lane: 70
Operational speed (mph): 55

The above data results in an equivalent single axle load (ESAL) of 3,490,000. The AADTT value and a 51% percent of trucks in design lane are the relative low-tier ESAL.

Design recommendation:
CRCP overlay: 0.5'-0.75' (includes 0.5' for two rounds of gravel).
Existing CRCP: 0' + 0' - 0' + 0'.

Reinforcement:
Steel (2): 0.60
Bar diameter (in.): 0.63

The details of the analysis, including input data and expected performance, are attached in the spreadsheet.

Note: The predicted failure at around 20 years with a 95% reliability is 0.005 t/ft^2 for a 40-year design life.

Transition & Fall Replacements (under construction):
At transitions, the existing CRCP needs to be removed.

New CRCP: 0.5’ (U) includes 0.5’ for two rounds of gravel
Existing CRCP: 0’ + 0’ - 0’ + 0’

Reinforcement:
Steel (2): 0.60
Bar diameter (in.): 0.63

Note: For ease of construction, the HMA base thickness at the start of the overlay side could be increased to 4” to fill the depth of the removed embankment and trimmed to 0” at the end of the transition (on the removal side).
40 CONCRETE PAVEMENT

40-1 GENERAL

40-1.01 Summary
Section 40-1 includes general specifications for constructing concrete pavement.

40-1.01.02 Definitions
- action limit: Test results at which corrective action must be made while production continues.
- full-depth crack: Crack other than a working crack that runs from one edge of a slab to the opposite or adjacent side of the slab.
- running: Progressive disintegration of the concrete pavement surface resulting in dislodged aggregate.
- suspension limit: Test results at which production must be suspended while corrections are made.
- working crack: Crack that extends through the full depth of a slab and is parallel to and within 0.5 foot of a planned contraction joint.

40-1.01.03 Submittals
40-1.01.03(1) General
At least 15 days before delivery to the job site, submit the manufacturer’s instructions for storage and installation of:
1. Splice couplers for threaded tie bars
2. Joint filler

Submit calibration documentation and operational guidelines for frequency measuring devices for concrete vibration as an informational submittal.

Submit updated QC charts each pay period as an informational submittal.

If repair or replacement of noncompliant concrete is required, submit a repair or replacement plan.

40-1.01.03(2) Certificates of Compliance
Submit a certificate of compliance for:
1. Tie bars
2. Splice couplers for threaded tie bars
3. Dowel bars
4. Tie bar bas-relief
5. Dowel bar bas-relief
6. Joint filler
7. Bond-over crack coating

40-1.01.03(3) Quality Control Plan
Submit a concrete pavement QC plan. Allow 30 days for review.

40-1.01.03(4) Mix Design
At least 15 days before leading for mix proportions, submit a copy of the AASHTO accreditation for the laboratory determining the mix proportions as an informational submittal.

At least 15 days before starting field qualification, submit the proposed concrete mix proportions, the corresponding mix identification, and laboratory test results, including measurements of the modulus of rupture, for each trial mixture at 10, 21, 28, and 42 days.

40-1.01.03(5) Just-In-Time Training
Reserved
Using the winning bidders unit cost and the quantities for each project, there is approximately a $270,000 per mile per lane savings when constructing the overlay versus replacement.
Project Status

• Segment 4 (Overlay) – 56 lane-miles
• Segment 5 (Overlay) – 28 lane-miles

Construction began July 2017
Construction
Construction (cont.)
Construction (cont.)
Construction (cont.)
Future Plans

• Monitoring and Evaluation
• Policy Improvement (design, standards, guides)
• Construction Quality
  – Training
Questions?

Contact:
Mehdi Parvini
mehdi.parvini@dot.ca.gov
(510) 286-4813