I-15 Ontario PCC Rehabilitation Project

CPTP Conference

April 24, 2009

Jonathan den Hartog / Caltrans
E.B. Lee / UC Berkeley
David Lim / Caltrans
David Thomas / Parsons
High-Traffic Urban Freeway

- 2003 ADT: 196,500
- Peak-volume: 7000/h
- 2013 ADT: 215,300
- Trucks: 6%

Week: 9/16/2001 to 9/22/2001
Direction: North / South
Traffic Stations: 708

• Sunday
• Mon-Thru
• Friday
• Saturday

9/16/2001
9/17/2001
9/21/2001
9/22/2001
Project Photos

Damaged concrete pavement on freeway lanes

Damaged asphalt pavement on shoulder
Variety of Rehabilitation Techniques

- **Concrete Materials and Mixes**
  - Normal PCC
  - RSC (12-h curing-time mix)
  - FSHCC (4-h curing-time mix)
  - Precast (SuperSlab, FHWA HfL Grant)

- **Closure and Detours**
  - Detour on widened median (no lane closures)
  - Weekend closures: Connector areas
  - Nighttime partial closures: FSHCC (south area)

- **Construction Approaches: Combination**
  - Continuous-lane Reconstruction
  - Random-slab Replacement
Project Objectives and Approach

• Rehabilitate pavement with long-lasting concrete (various materials & approaches)
  – Caltrans LLPRS project (30+ years)
• Minimize disruption to traffic and surrounding businesses
• Performed a detailed analysis of various alternatives, from both a RUC (delay) and Agency cost perspective
• Model (network-simulation) the construction staging to evaluate the traffic impacts
  – Mesoscopic network analysis
  – Include analysis of local arterials
Tool: CA4PRS (FHWA-Technology)
Construction Analysis for Pavement Rehabilitation Strategies

Step 1: Schedule
- Constructable?
  - Yes
  - No

Step 2: Traffic
- Tolerable?
  - Yes
  - No

Step 3: Cost
- Budget?
  - Yes
  - No

Yes: Closure Production Project Duration
No: Queue & Delay Road User Cost

Yes: Project Cost Agency+Traffic+Support
No: PS&E TMP Packages

State DOTs: FHWA
Free-license
More Information
Exhibit & Brochure

Construction Analysis for Pavement Rehabilitation Strategies
# Staging Alternatives Compared

<table>
<thead>
<tr>
<th>ID</th>
<th>Scenario</th>
<th>Construction Window</th>
<th>Closure Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Original</td>
<td>55-hour Weekend + Weekdays</td>
<td>Median + Structure Widening</td>
</tr>
<tr>
<td>2</td>
<td>VA By-pass</td>
<td>55-hour Weekend</td>
<td>Split Detour</td>
</tr>
<tr>
<td>3</td>
<td>Rapid Rehab 1</td>
<td>55-hour Weekend</td>
<td>Full closure One roadbed</td>
</tr>
<tr>
<td>4</td>
<td>Rapid Rehab 2</td>
<td>Progressive Continuous</td>
<td>Full closure One roadbed</td>
</tr>
<tr>
<td>5</td>
<td>Traditional</td>
<td>8-hour Nighttime</td>
<td>Partial closure</td>
</tr>
<tr>
<td>6-1</td>
<td>Long-life CSOL</td>
<td>55-hour Weekend</td>
<td>Full closure One roadbed</td>
</tr>
<tr>
<td>6-2</td>
<td>Traditional AC Overlay</td>
<td>8-hour Nighttime</td>
<td>Partial closure</td>
</tr>
</tbody>
</table>
Alt 1: VA-study Original (Detour on Widened Median)

Traffic Roadbed (SB)

South Bound

Construction Roadbed (NB)

North Bound

Continuous Lane Reconstruction 1

Continuous Lane Reconstruction 2

QCMB C.L.
Alt 3,4: Rapid-Rehab Concept

55-hour Weekend / Continuous Full-closure

Traffic Roadbed (SB)  Construction Roadbed (NB)

South Bound  Quick Change Moveable Barrier  North Bound
Alt 6-1, 6-2: CSOL (AC Overlay)

6-1: Long-life, 6-2: Traditional

Traffic Roadbed (SB)

Construction Roadbed (NB)

Quick Change Moveable Barrier

Crack-Seat AC Overlay (CSOL) including shoulders
### Constructability and Productivity Analysis

#### Project Identifier:
- **I-15 72-H (DEMONSTRATION)**

#### Dump Truck (Demolition)
- **Rated Capacity (kg):** 22000.0
- **Trucks per Hour:** 10.0
- **Packing Efficiency:** 0.65
- **Number of Team:** 2.0
- **Team Efficiency:** 0.90

#### Batch Plant
- **Capacity (cu. m):** 150.0
- **Number of Plants:** 1

#### End Dump Truck (PCC)
- **Capacity (cu. m):** 6.0
- **Trucks per Hour:** 15
- **Packing Efficiency:** 1.00

#### Paver
- **Speed (m/min):** 2.0
- **Number of Pavers:** 1

---

Buttons:
- **Save**
- **Close**
<table>
<thead>
<tr>
<th>Resource</th>
<th>Allocated</th>
<th>Utilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dump Truck (per hour)</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>End Dump Truck (New Base) (per hour)</td>
<td>8.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Batch Plant (cu-m/hour)</td>
<td>150.0</td>
<td>76.5</td>
</tr>
<tr>
<td>End Dump Truck (PCC) (per hour)</td>
<td>15.0</td>
<td>12.8</td>
</tr>
<tr>
<td>Paver Speed (m/min)</td>
<td>2.0</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Construction Window:** Continuous Closure/Continuous Operation

**Working Method:** Concurrent Double Lane (T1+T2)

**Section Profile:** 305 mm (12 inches)

**Curing Time:** 12-Hours

**Objective (lane-km):** 17.00

**Maximum Possible (lane-km):** 2.81

**Maximum Possible (cft/1-km):** 1.41

**Construction Windows Needed To Meet Objective:** 6.04

**Demolition Quantity (cu. m):** 4705.9

**New Base Quantity (cu. m):** 1568.6

**Concrete Quantity (cu. m):** 3137.3

**Constraint Resource:** DT(Demo)

**Demolition to Paving:** N/A

**Demolition Hours:** 41.0
## Schedule-Traffic Cost Comparison

### CA4PRS Analysis Summary

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Closure Duration</th>
<th>Traffic*</th>
<th>Cost ($millions)</th>
<th>Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>RUC ($M)</td>
<td>Delay (min)</td>
<td>Agency</td>
</tr>
<tr>
<td>1 VA Original Median-Detour</td>
<td>35 weekends</td>
<td>3</td>
<td>16</td>
<td>78</td>
</tr>
<tr>
<td>3 PCC 55-hour Weekend</td>
<td>35 weekends</td>
<td>119</td>
<td>363</td>
<td>83</td>
</tr>
<tr>
<td>4 Progressive Continuous</td>
<td>8 weeks</td>
<td>123</td>
<td>363</td>
<td>77</td>
</tr>
<tr>
<td>5 Traditional Nighttime</td>
<td>1,220 nights</td>
<td>133</td>
<td>22</td>
<td>88</td>
</tr>
<tr>
<td>6 CSOL 55-hour weekend</td>
<td>20 weekends</td>
<td>69</td>
<td>363</td>
<td>60</td>
</tr>
</tbody>
</table>

* With 30% demand reduction except nighttime (10%)

** Total cost = (1/3 RUC) + (Agency Cost)
Project Update (On-going)

- **Bid Opened:** December 11, 2008
  - Contractor: Security Paving Company
  - Low Bid: $52M
  - Engineer’s estimate: $68M
- **Construction Schedule:** 2009-2010
  - Widening: Apr 2009 to Jan 2010
  - SB Rehab: Feb 2010 to Apr 2010
  - NB Rehab: May 2010 to Oct 2010
  - Precast: Jun, Jul 2010
  - Project Completion: Nov 2010
Construction-Staging Plans

- Pave the median and bridge-structures
- Shift SB traffic two lanes over into the median.
- Rehab outside lanes on weekdays
- Rehab ramps, connectors, weaving areas on 55-hour weekend closures
- Repeat for NB side

Construction-Staging Traffic Analysis
- Complicated process: 26 Stages
- Up to 32 weekend closures
- Too costly and time-consuming to analyze all
- Choose ones with highest potential impact
Mesoscopic Simulation: DynamEq

• Mesoscopic Network Simulation
  – Equilibrium-based Mesoscopic Model
  – Useful for very large-scale applications
  – More detail than macroscopic
  – Less work to set up than microscopic
  – Base model from SCAG
  – Count data and 67 Traffic signals
  – Lane-level geometry
  – Intensive calibration process

• Objectives: TMP Implementation
  – Plan/revise detours
  – Identify ‘problem’ intersections
  – Improve with signal timing and COZEEP
  – Compare results with observe: Construction
Q & A: Thank you!