Deck cracking is a long standing problem.
WEBBER CREEK
DECK CRACK STUDY

Final Report

March 1972

Prepared in Cooperation With
The U.S. Dept. of Transportation,
Federal Highway Administration
We spend annually on deck crack mitigation.

$50 Million
We have a solution.
The 28 day shrinkage required maximum of 0.032%.

Minimum SRA dosage of $\frac{3}{4}$ gal/cy.

Require 1 lb/cy of micro fibers and 3 lb/cy of macro fibers (polyolefin).

Continuous misting from finished strike off until curing medium is applied.
Shrinkage Measurement

- AASHTO T 160, modified as follows:
- 4 X 4 prism.
- Cure 7 days.
- Take a comparator reading at 7 days age and record it as the initial reading.
- Take subsequent readings at 7, 14, 21, and 28 days drying.
This is what it costs.

- The pilot projects show no measurable change to the price bid for structure concrete.
- When implemented via CCO the cost has been about:
  - SRA @ 1 Gal/CY = $25/CY
  - Fibers @ 4 lb/CY = $25/CY
At about 1 year, Structure Maintenance deck evaluation.

“The westbound (left) structure exhibited no visible cracks on the surface. This is remarkable given the volume of concrete placed and the application (deck on deck)…”
Memorandum

To: ALL STRUCTURE DESIGN STAFF

Date: March 18, 2016

From: JANICE BENTON
Deputy Division Chief (Interim)
Structure Design
Division of Engineering Services

Subject: STRUCTURE DESIGN ALERT

Subject Area:
Concrete Bridge Decks

Purpose:
The purpose of this memorandum is to alert Structure Design staff that new construction specifications for concrete bridge decks, including a new bid item, are being implemented.

Background:
A 2013 fact sheet produced by Structure Maintenance & Investigations estimated Caltrans spends $50,000,000 annually on sealing deck cracks. In order to prevent early-age bridge deck cracking from occurring, the Concrete Committee and the Bridge Preservation Committee, over a 14-year period, have developed new construction specifications for concrete bridge decks, including deck overlays. These new construction specifications include:

1. Limiting the 28-day shrinkage performance of the deck concrete to 0.032 percent.
2. Requiring a minimum dosage of shrinkage reducing admixture
3. Requiring polymer fibers in deck concrete
4. Revising the concrete deck curing specifications

The new specifications are designed to improve the durability and longevity of bridge decks, reducing maintenance costs and enhancing public safety.
Memorandum

To:
JEFF WILEY, Deputy Division Chief, Structure Design
STEVE ALTMAN, Deputy Division Chief, Structure Construction
SHIRA RAJENDRA, Deputy Division Chief, Program/Project & Resource Management
ROBERTO LACALLE, Deputy Division Chief, Materials Engineering & Testing Services &/Geotechnical Services
DOLORES VALLS, Chief, Structure Maintenance & Investigation

From:
THOMAS A OSTROM
State Bridge Engineer
Structure Policy & Innovation
Division of Engineering Services

Date: August 11, 2016

Subject: CONSTRUCTION SPECIFICATIONS FOR BRIDGE DECK CRACK PREVENTION

The Bridge Preservation and Concrete Committees have developed new construction specifications to reduce concrete bridge deck cracks caused by volumetric changes of concrete, see attached. The new construction specifications should significantly reduce long-term costs associated with the repair of deck cracking and mitigate safety risks associated with use of methacrylate currently used for crack repair.

For projects that have not been advertised, the plans, specifications and estimate must be updated to include the new specifications.

For projects that have been advertised, the Project Engineer shall request that an addendum be issued to incorporate the revisions. See “Structure Design Alert”.

For projects in construction, it is recommended that these changes be incorporated by Contract Change Order, if it is administratively appropriate.

Forward technical questions related to the crack-less deck specifications to Craig Knapp, Concrete Committee Chairperson, at 916-227-8554.

Attachments:
1) Construction Special Provisions 51-1.01C(1), 51-1.02B, 51-1.03H, 90-1.01C, 90-1.02A, and 90-1.02K
2) Structure Design Alert, Concrete: Bridge Decks, March 18, 2016
Memorandum

To: DEPUTY DISTRICT DIRECTORS, Construction
   DEPUTY DIVISION CHIEF, Structure Construction
   CONSTRUCTION MANAGERS
   SENIOR CONSTRUCTION ENGINEERS
   RESIDENT ENGINEERS

From: RACHEL FALSETTI, Chief
       Division of Construction

Date: October 11, 2016
File: Division of Construction
       CPD 16-13

Subject: Bridge Deck Crack Prevention

This directive allows for implementing new specifications to prevent premature bridge deck cracking. Structure Maintenance & Investigations estimated the California Department of Transportation spends $50,000,000 annually on sealing deck cracks. To prevent early-age bridge deck cracking, the Concrete Committee and the Bridge Preservation Committee, over a 14-year period, have developed new construction specifications for concrete bridge decks, including deck overlays.

The new specifications include:

- Limiting the 28-day shrinkage performance of the deck concrete to 0.032 percent.
- Requiring a minimum dosage of shrinkage reducing admixture.
- Requiring polymer fibers in deck concrete.
- Revising the concrete deck curing specifications.

The attached memorandum from the State Bridge Engineer dated August 11, 2016 describes the recommendation that these specification changes be incorporated by change order for ongoing construction projects where administratively possible.

This change will require a new concrete mix design, addition of polymer fibers, and use of shrinkage reducing admixture for bridge deck concrete which will result in increased cost for this change. If the bridge deck concrete placement affects the controlling activity, contract time adjustment may be required for performing concrete shrinkage performance testing and for compressive strength testing for bridge deck concrete that is designated by compressive strength.

A sample change order memorandum, sample change order, and a Federal Highway Administration order will be provided via email and Discord.
Specifications to prevent premature bridge deck cracking were included:

- In all new projects.
- Included via CCO on existing Projects.
- Incorporated via addendum on advertised projects.
Summary

- Rigorous attention to best curing practices
- Fibers
- .032% max shrinkage at 28 days
- Minimum SRA .75gal/cy
- Thanks to my predecessors for the launch pad.
- Special thanks to my colleagues Ric Maggenti and Sonny Fereira
Questions?

For more information:

Controlling Shrinkage Cracking
Available technologies can provide nearly crack-free concrete bridge decks
by Ric Maggenti, Craig Knapp, and Sonny Fereira
Concrete International, July 2013
Drying Shrinkage (Percent)
28-Days Drying at 7 ½ Sacks per Cubic Yard

SHRINKAGE (PERCENT)

Bear River
Healdsburg
Aromas-Hollister
Centerville
Irwindale
Sun Valley
El Rio
Mission Valley
Aromas-Hollister
District 3
District 4
District 5
District 6
District 7
District 7
District 7
District 11
District 5
Average

3/4 inch
Not crushed aggregate
Crushed aggregate
4 year old
4.75 years old
5 years old
6 years old
11 years old
28 shrinkage = .032 with SRA
28 shrinkage = .032 with SRA
28 shrinkage = .032 without SRA