Slab Replacement in Urban Areas

High-Early-Strength Concrete

Craig Hennings, Executive Director
Southwest Concrete Pavement Association
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California – Many Urban Areas

- ✓ 50,000 Lane Miles
- ✓ 16,000 L.M. Concrete
- ✓ 3,400 L.M. Distressed
- ✓ Exceeded Design Life

Rapid strength concrete (RSC) has been efficiently used for emergency repair and planned rehabilitation of concrete infrastructure and for new construction, where acceleration is a concern. This concrete is produced with hydraulic cements. Accelerators of hardening, if used, are non-chloride in nature.

Emergency rehabilitation of truck bypass tunnel (after vehicle fire) I-5 and CA-14, November 2007.

First used in 1998-1999

Total volume of various types of RSC in 2008 >190,000 CY. RSC for pavement rehabilitation was 130,000 CY.

Rapid strength lean concrete base was approx 37,000 CY.

Pavement replacement at I-10, Pomona, CA, 1999 (4-hrs RSC)

Replacement HOV lane at I-10, Los Angeles, CA, 2009 (12-hrs RSC)

Pavement replacement at I-710, Los Angeles, CA, 2005 (1.5-hrs RSC)

Proportioning for ultra-rapid strength gain in early age is one difference in the design of RSC and regular concrete.

Options:

- **Use of faster hardening hydraulic cements (rapid hardening cements, ASTM C1600; Type III portland cement, ASTM C150)**
- **Use of accelerating admixtures (non-chloride)**
- **Limiting W/C**
- **Optimizing (increasing) initial and curing temperatures of concrete**

Proper design of RSC should account for other properties influencing acceleration of construction, such as:

- **Ability to be placed, spread and consolidated conveniently and quickly without segregation**
- **Time within which fresh RSC retains workable consistency**
- **Ability to be finished promptly upon completion of consolidation**
- **Ambient Temp, Environment**

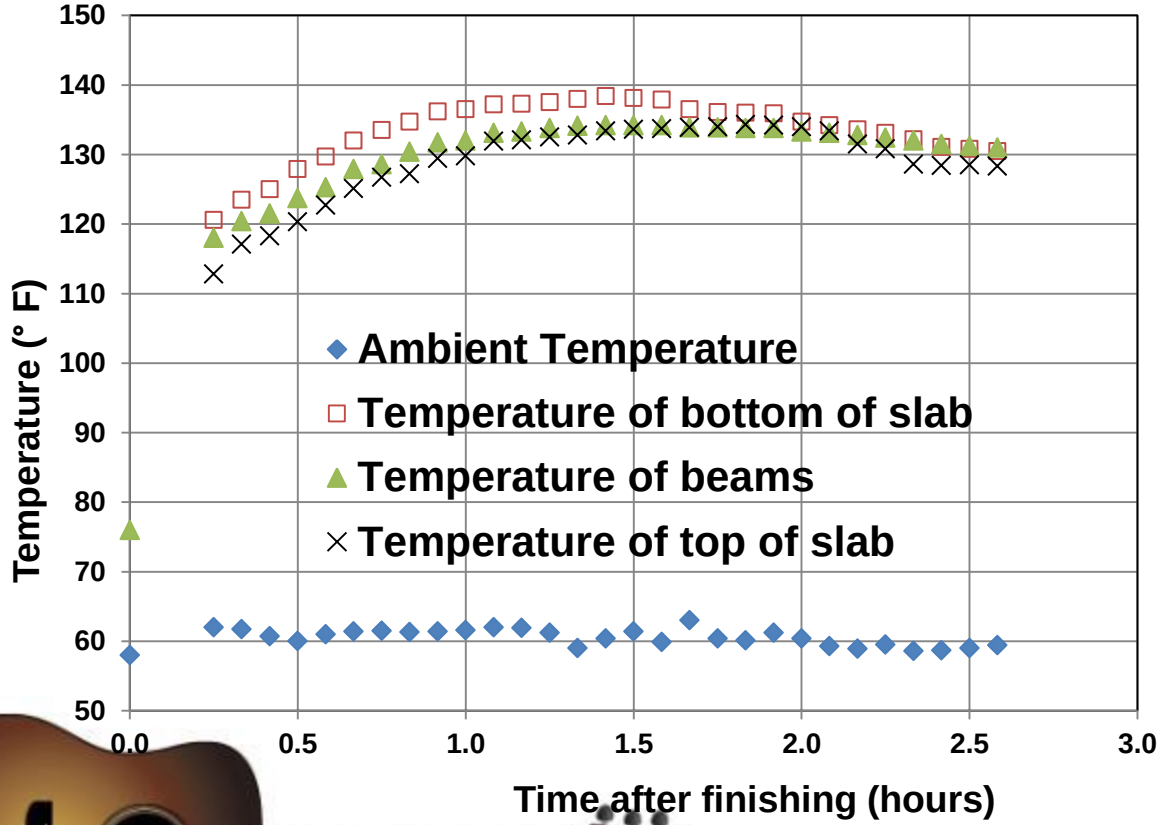
Two types of rapid strength concrete (RSC) mostly used in California for pavement rehabilitation within short-time lane closures are:

- **RSC with rapid hardening cements (examples of such cements are CTS Rapid Set® Cement and Ultimax Cement-DOT®)**
- **RSC with Type III Portland cement and non-chloride accelerator of hardening (this type of RSC is often called "4 x 4" concrete, because it was first developed to achieve flexural strength of 400 psi in 4 hours by Master Builders)**

RATE OF STRENGTH GAIN IN EARLY AGE

Rate of strength gain of RSC is mainly controlled by:

- ✓Type of hydraulic cement
- ✓Chemical admixtures
- ✓Water to cement ratio
- ✓Concrete temperature



Testing Notes:

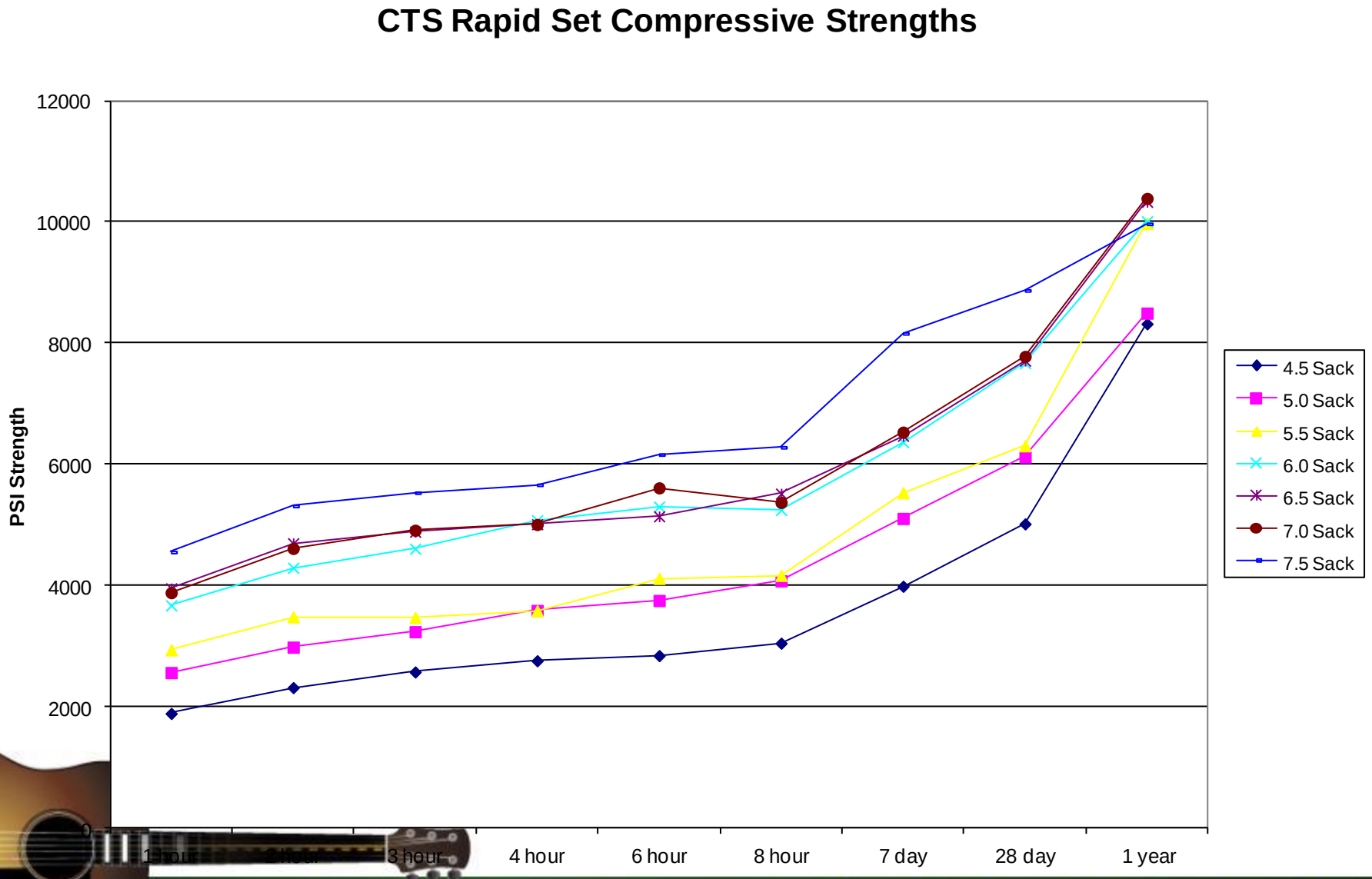
Estimation of strength gain requires matching temperature of concrete in specimens and in pavement during curing.

PROPORTIONING FOR EARLY AGE MOR

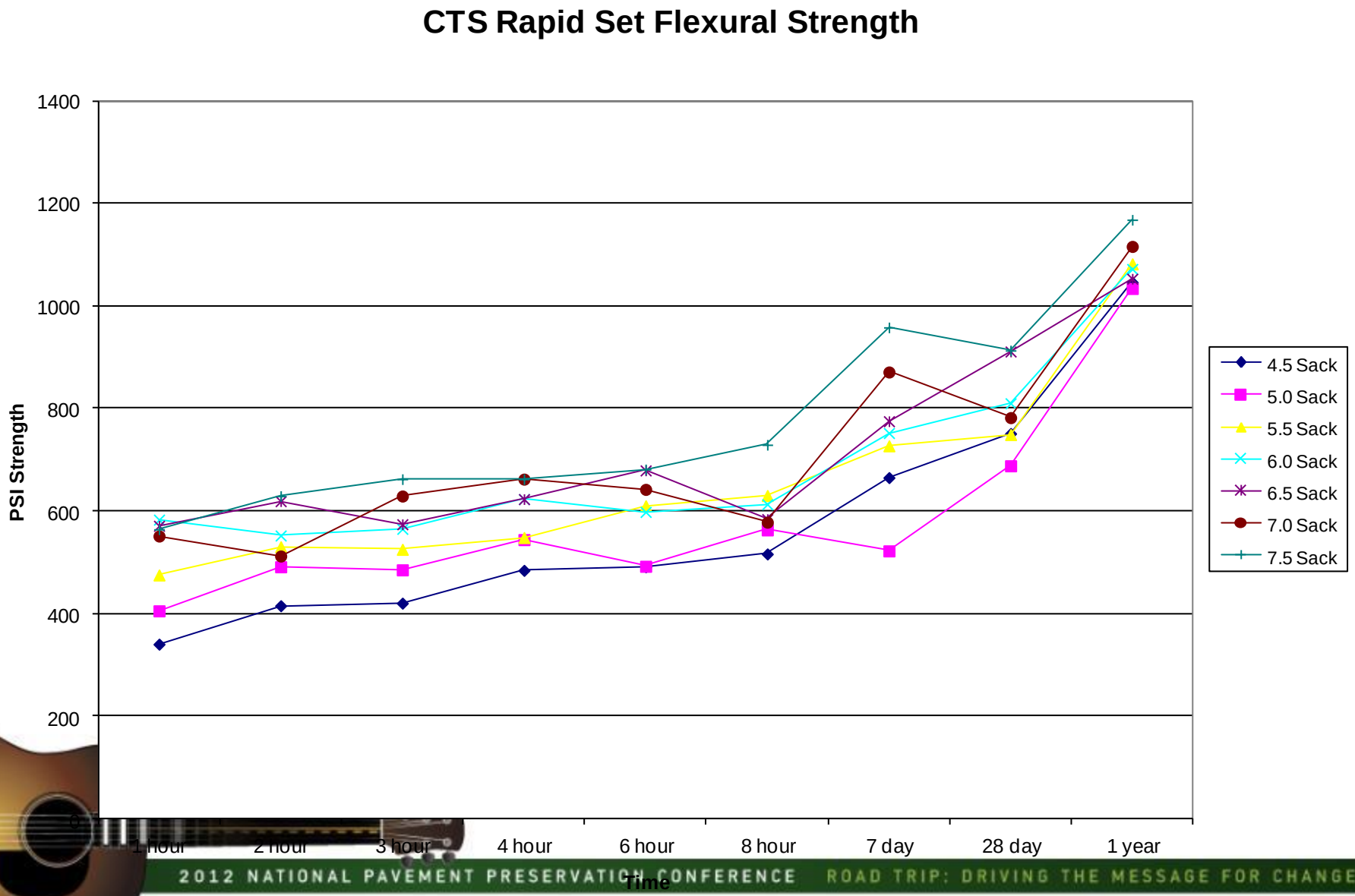
Min Curing Time to Achieve MOR (*)		Proportioning for Early Age Flexural Strength		
400 psi	550 psi	Type of Cement	Accelerator fl. oz./100 # cmt.	Max W/C
1 to 2 hours	2 to 4 hours	Rapid hardening cement, ASTM C1600	-----	~0.41 - 0.43
2.5 to 4 hours	4 to 7 hours	Portland cement Type III, ASTM C150	70 to 100	~0.32 - 0.34
8 to 12 hours	12 to 16 hours	Portland cement Type III, ASTM C150	20 to 40	~034 - 0.36
≥16 hours	≥22 hours	Portland cement Type II, ASTM C150	None	~0.37 - 0.39

NOTE: (*) Since the time RSC has been formed and finished.

Urban Slab Replacement



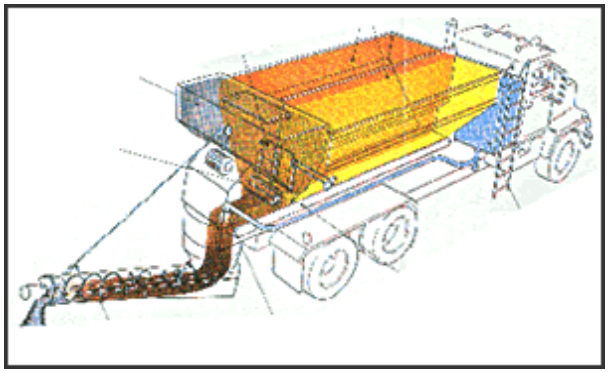
Urban Slab Replacement



RSC is typically proportioned with superplasticizers for achieving desired (often near-flowable) consistency while maintaining low water to cement ratio (W/C). Hydration controlling admixtures extend time within which RSC retains workable consistency. Optimized consistency and cohesiveness accelerate construction of pavements.

WORKABILITY

RSC with rapid hardening cements is most often produced by mobile (volumetric) mixers to allow for immediate placement. The demand in hydration stabilizers is reduced and uniformity of workability and strength is improved.



RSC with Type III portland cement typically has been produced using transit mixers. Superplasticizer and set controlling admixture are added at the batch plant. Accelerator of hardening is added on site.

INDEX OF SHEETS

No.

Title and Location Map
Typical Cross Sections
Traffic Handling Plan
Construction Area Signs
Pavement Delineation and Sign Plans
12 Summary of Quantities

'ANDARD PLANS LIST APPLICABLE TO THIS CONTRACT
LUDED IN THE NOTICE TO CONTRACTORS AND
L PROVISIONS BOOK.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

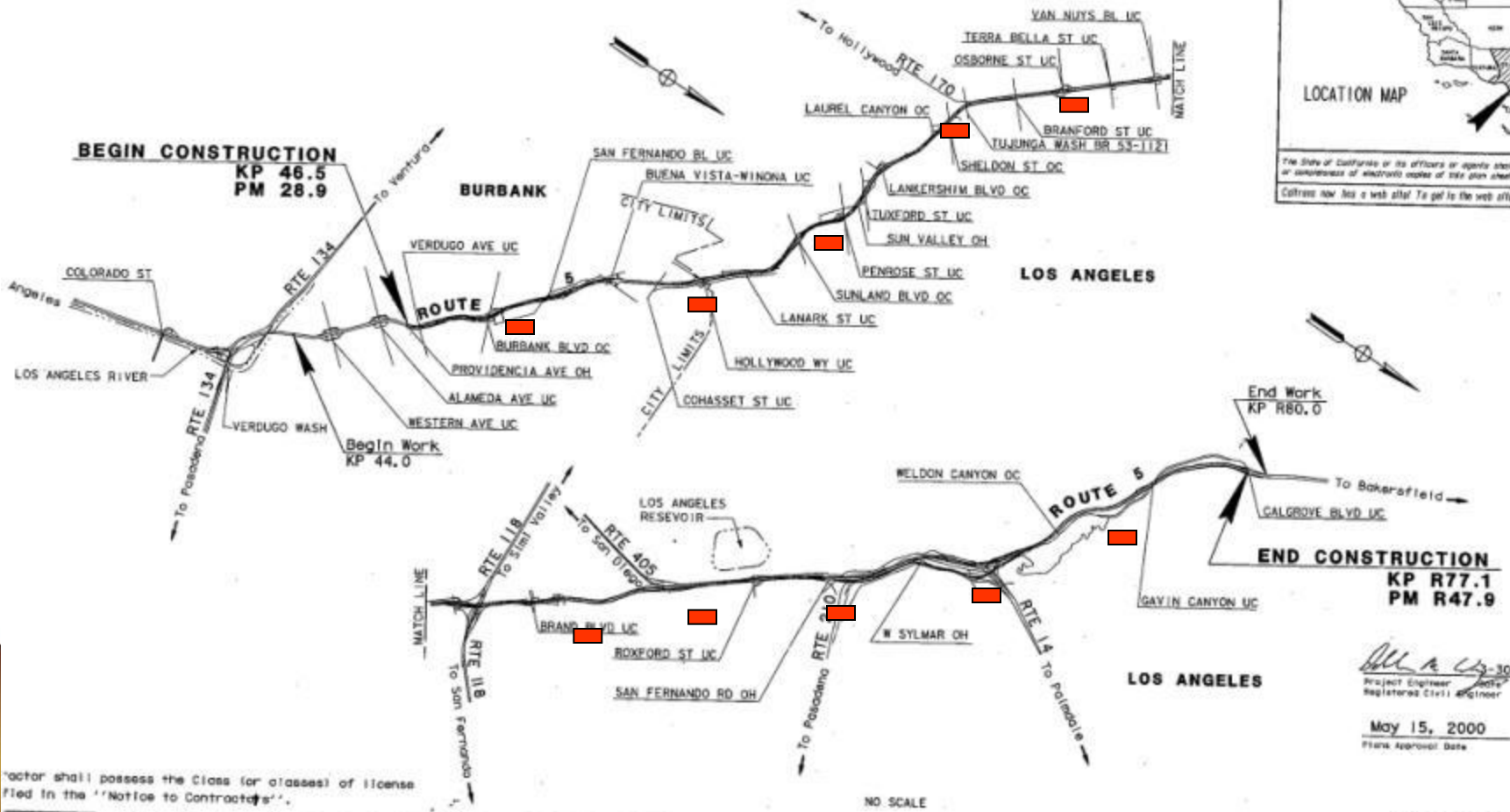
ACIM-005-3(995)E

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO
07	LA	5	46.5/R77.1	1

PROJECT PLANS FOR CONSTRUCTION ON STATE HIGHWAY

IN LOS ANGELES COUNTY
IN BURBANK AND LOS ANGELES
FROM PROVIDENCIA AVENUE OVERHEAD TO
1.9 km SOUTH OF CALGROVE BOULEVARD UNDERCROSSING

To be supplemented by Standard Plans dated July, 1999



NO SCALE

May 15, 2000
Plans Approval Date

DEBORAH WONG
C58313
6-30-02
CIVIL

'actor shall possess the Class (or classes) of license
fled in the ''Notice to Contractors''.

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

Contract No. 07-2025

Urban Slab Replacement

Std Specs - Timeline

- 45 Days Prior Pour: Cement Sample
- 10 Days Prior Trial Slab: Mix Design
- 7 Days Prior Pour: “JITT” Submittal
- 5 Days Prior Pour: Completion “JITT”
- 5 Days Prior Pour: Pre-Const Conference

Urban Slab Replacement

Trial Slab

- ✓ C109 Calibrate Volumetric Mixer
- ✓ Trial Slab Simulate Job Conditions
- ✓ Evaluation of All Parties / Materials:

a) Concrete Producer

b) Contractor

c) Testing Laboratory

Urban Slab Replacement

Construction Procedures

- ✓ 2 Days Prior: Perimeter Saw Cuts
- ✓ Remove Panels: Non-Impact Method
- ✓ Inspect / Analyze Existing Base
- ✓ ¼” Foam Joint Filler Installed
- ✓ Bond Breaker Installed


Replacing Base

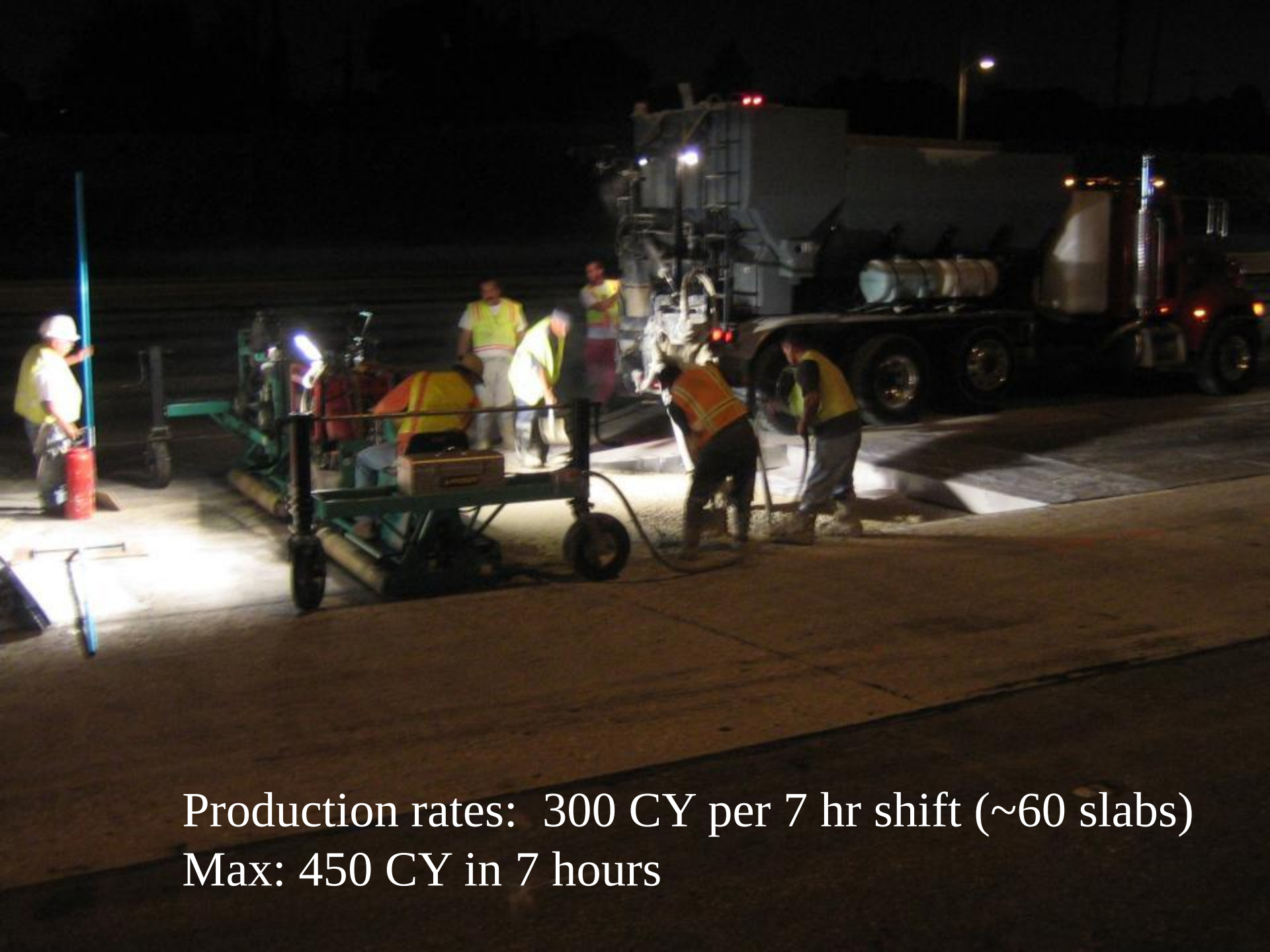
Urban Slab Replacement

Construction Procedures – cont.

- ✓ Nightly Material Samples Taken
- ✓ Load Materials Volumetric Mixers
- ✓ Begin Concrete Production Process
  - a) Place Concrete
  - b) Consolidation
  - c) Finishing
  - d) Curing

9.5 CY per truck


Ultra
Coolant



Production rates: 300 CY per 7 hr shift (~60 slabs)
Max: 450 CY in 7 hours


WET
CONCRETE

Continuous panels need to be saw cut < 1 hr. Depth =T/3
Dowels on baskets can be used.

Urban Slab Replacement

Quality Control Program

- ✓ 21 Days Prior Trial Slab Submit QCP
- ✓ QCM Current ACI Field Tech I & ACI Lab Test Tech Grade II
- ✓ Technicians Caltrans Certified
- ✓ Contractor / QCM / Eng. Meeting

Urban Slab Replacement

Quality Control Program – cont.

- ✓ List Testing Equipment
- ✓ First 25cy Testing/then every 100cy
- ✓ Testing Shall Included:

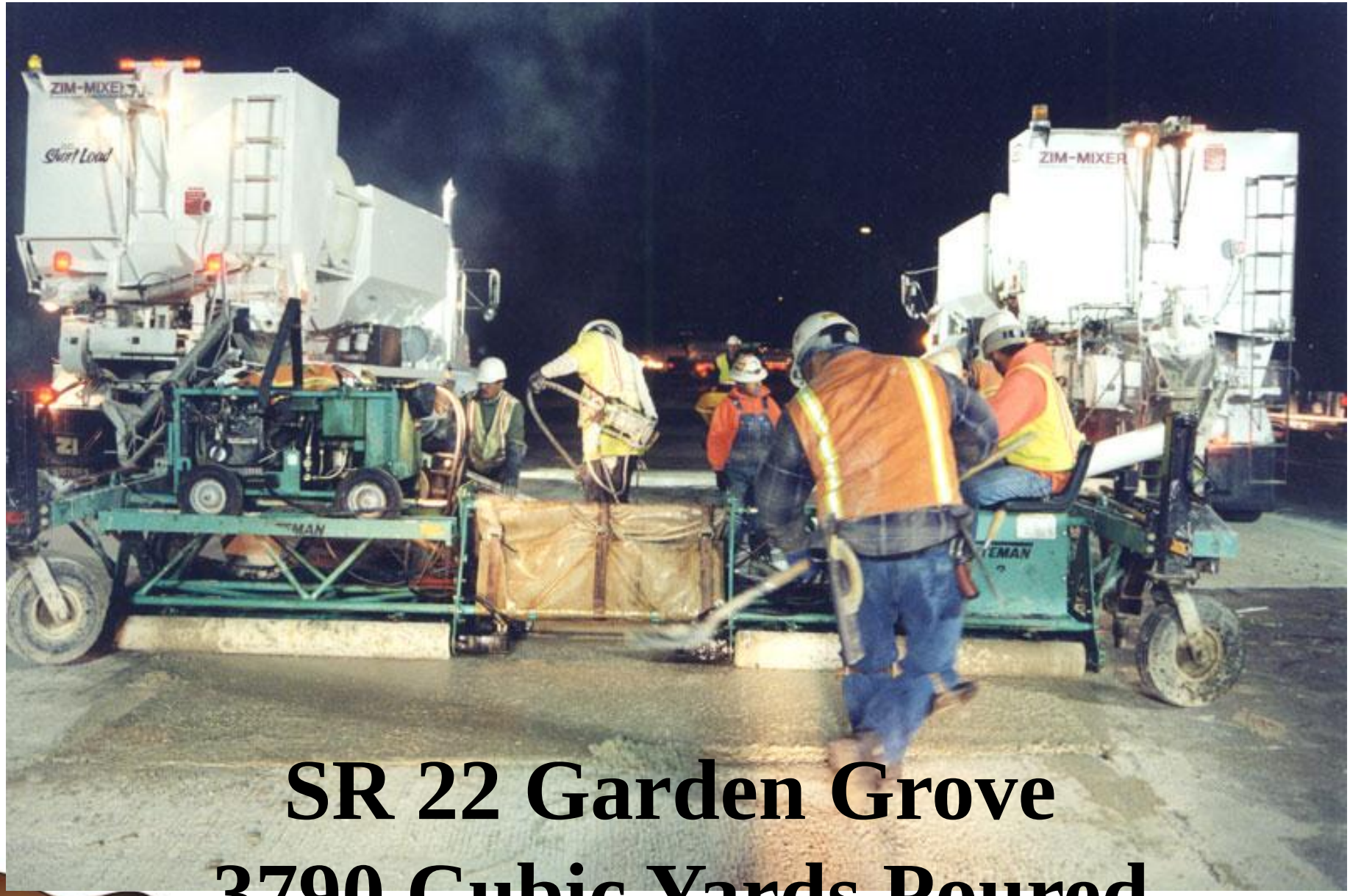
a) Yield
b) Penetration
c) Air
d) Unit Weight
e) Slump
f) Flex Beams
g) Temperature


CALL
BOX


Forney Test Equipment
DR

Calibrated Portable Testing equipment


Caltrans Project
Interstate 5
2167 Cubic Yards



SR 22 Garden Grove
3790 Cubic Yards Poured

Thank you

Craig Hennings
chennings@swcpa.org