STATE OF CALIFORNIA
DEPARTMENT of TRANSPORTATION

MATERIALS ENGINEERING
and TESTING SERVICES

Office of Rigid Pavement
and Structural Concrete

5900 Folsom Boulevard
Sacramento, California 95819

Route 58 - Westbound
KP R189.9 to KP R207.6

NEW CONCRETE PAVEMENT

DISTRICT 6
Kern County
Route 58

CONCTRACT NUMBER:
06-396704

November 2001

NEW CONCRETE PAVEMENT
District 06
Kern County
Contract Number: 06-396704

This report reflects the observations, findings, conclusions, and recommendations of the authors. The contents do not necessarily reflect the official views or policies of the State of California.

This report does not constitute a standard, specification, or regulation. The Office of Rigid Pavement and Structural Concrete is responsible for the accuracy of the information and data presented in this report.

Report Prepared by .... Doran Glauz
Karl Smith
Raul Alarcon

DORAN GLAUZ, P.E.
Senior Materials & Research Engineer

KEN BEEDE, Senior Transportation Engineer
Consultations and Investigations

TOM PYLE, Chief
Office of Rigid Pavement
and Structural Concrete

ACKNOWLEDGEMENTS

The Office of Rigid Pavements and Structural Concrete would like to express its gratitude to the following for their participation, assistance, and support:

DISTRICT 06

Construction – California City
Materials Engineering

HEADQUARTERS

Division of Construction
Division of Maintenance
Pavement Design

PAVING CONTRACTOR

Sapper Construction, Inc.

Cover Photo: Westbound Route 58 near Mojave

TABLE OF CONTENTS

LIST OF FIGURES

SUMMARY

Mutual cooperation is important to the success of any project. The cooperation between the resident engineer and the paving contractor is leading to the successful completion of a $12 million concrete pavement project in District 6.

The current project, started in March 2001 on Route 58 near Mojave in Kern County, is reconstructing a segment of Route 58 between Airport Boulevard and California City Boulevard in the westbound direction. The project is to be completed in 3 stages. Recent counts show that this segment is subjected to an Annual Average Daily Traffic (AADT) of 11,000 vehicles.

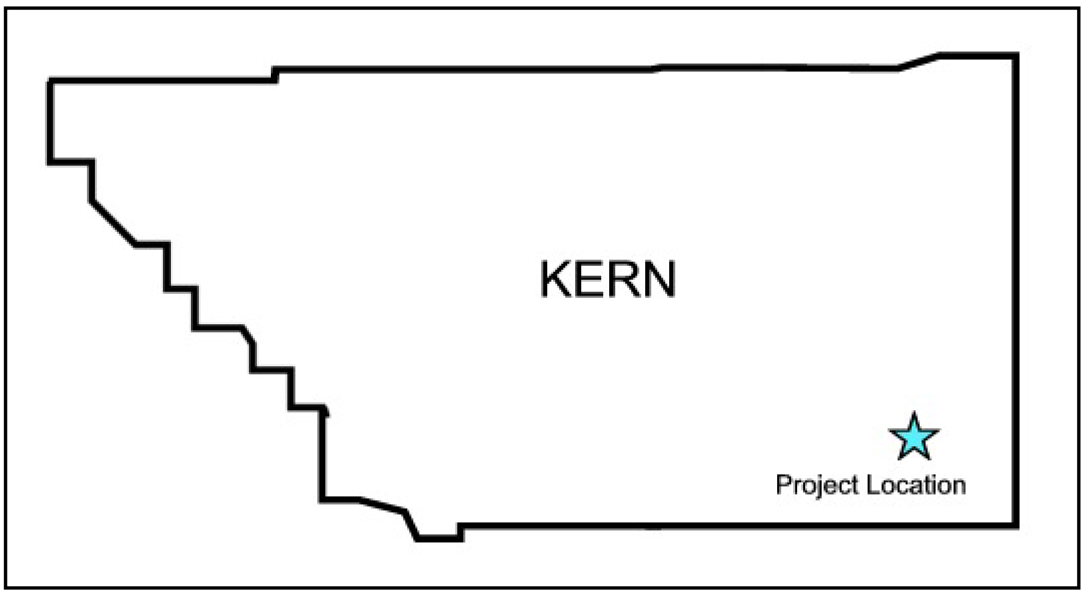

Figure 1. Project Location

The resident engineer solicited the Office of Rigid Pavement and Structural Concrete for assistance and recommendations before and during the construction of the concrete pavement for Stage 2.

Pavement construction for Stage 2 was from May 29 to June 26, 2001. An average of 1,000 meters of pavement was placed per day. Site visits were made to monitor the construction progress.

Data and information were obtained from the following sources:

a. Project documents, records, and plans
b. Meetings and verbal communication with the District 06 staff
c. Observations during the on-site visits.
d. Core samples

PROJECT DESCRIPTION

This project is reconstructing a 18.1-km long segment of Route 58 by removing the asphalt concrete (AC) pavement in the existing westbound travel way, lanes 1 and 2, and replacing it with portland cement concrete (PCC) pavement. The project limits extended from 6.4 km east of Airport Boulevard (Station 330+04.21) to 2.2 km east of California City Boulevard (Station 510+60).

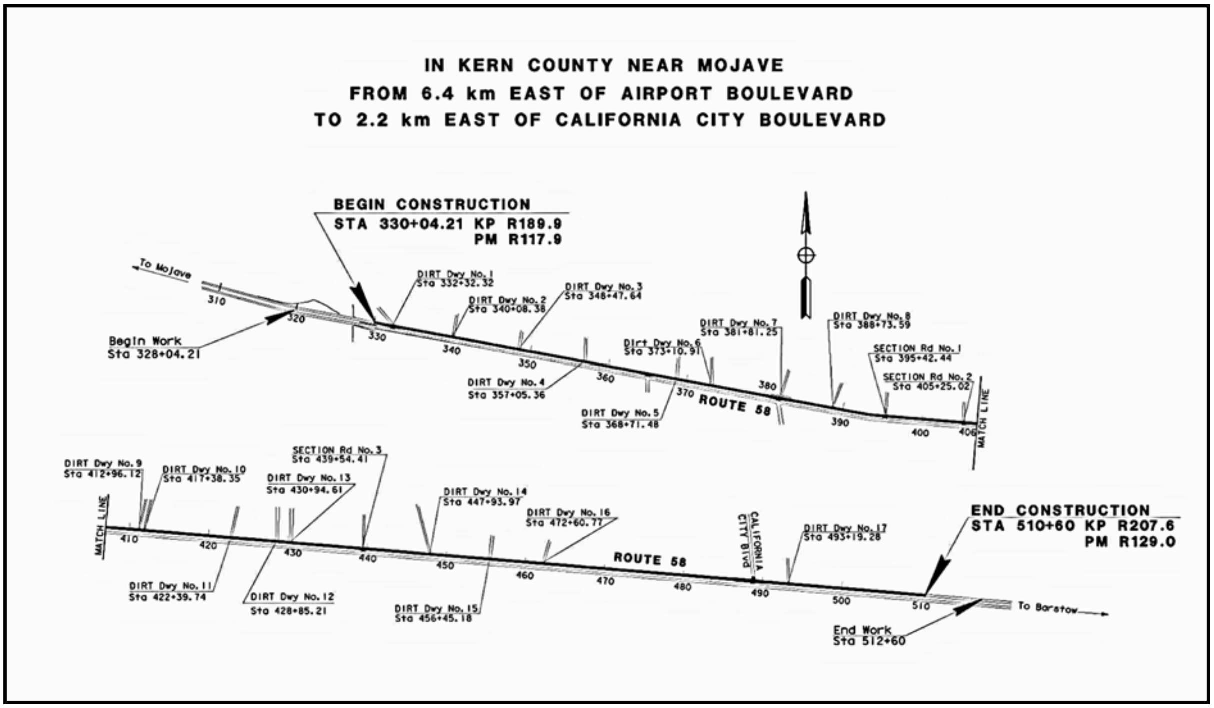

Figure 2. Project Limits

Construction Details

The project has 3 construction stages. Stage 1 requires that the outside shoulder of the travel way to be reconstructed with asphalt concrete (AC), type A, and used as a temporary roadway.

Stage 2 is the reconstruction of lane 1 and the inside shoulder with PCC pavement from station 330+04.21 to Station 510+60 (Figure 3). The existing structural section for lane 1 and the shoulder consisted of AC pavement on an aggregate base (AB). The AC pavement was 315-mm thick in lane 1 and 75-mm thick in the shoulder. The new section for lane 1 is PCC, 260-mm thick, and an AC base (Type A) varying in thickness from 45 to 189-mm over the cold-planed AC. The inside shoulder has PCC with a thickness that varies from 260 to 200-mm with an AC base (Type A), 150-mm thick, over the cold-planed AC. All construction work is behind k-rail.

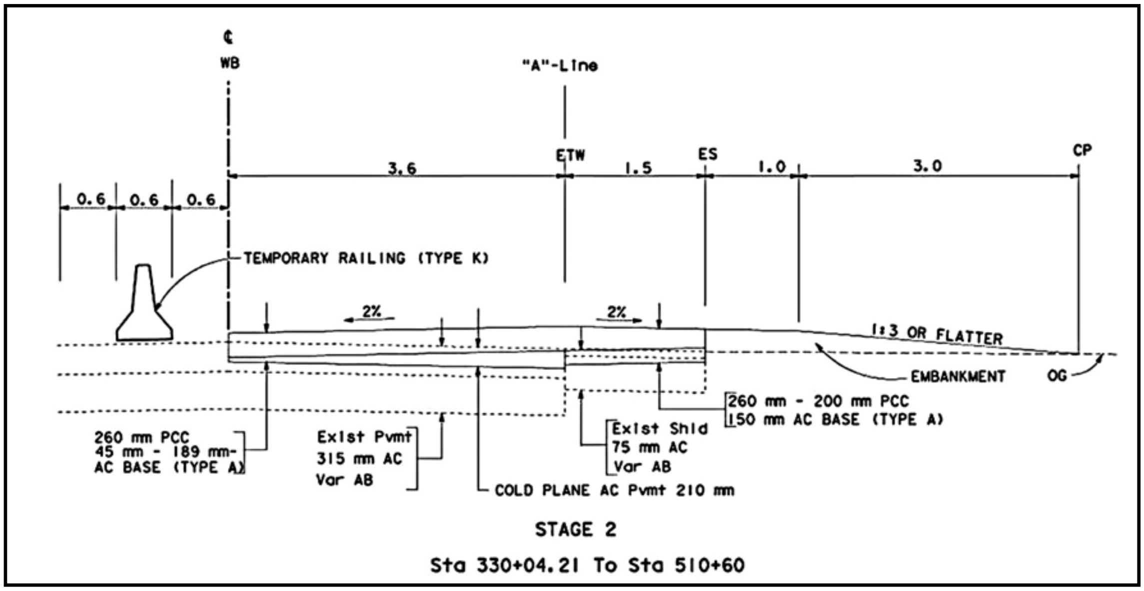

Figure 3. Stage 2 – Pavement Structural Section

The longitudinal joint between lane 1 and the shoulder is required to have tie bars and be constructed by the sawing method. The tie bars specified are epoxy-coated #19 deformed bars, 750 mm long. Tie bars are spaced at 710-mm intervals, on center, and at least 380-mm from transverse joints (Figure 4).

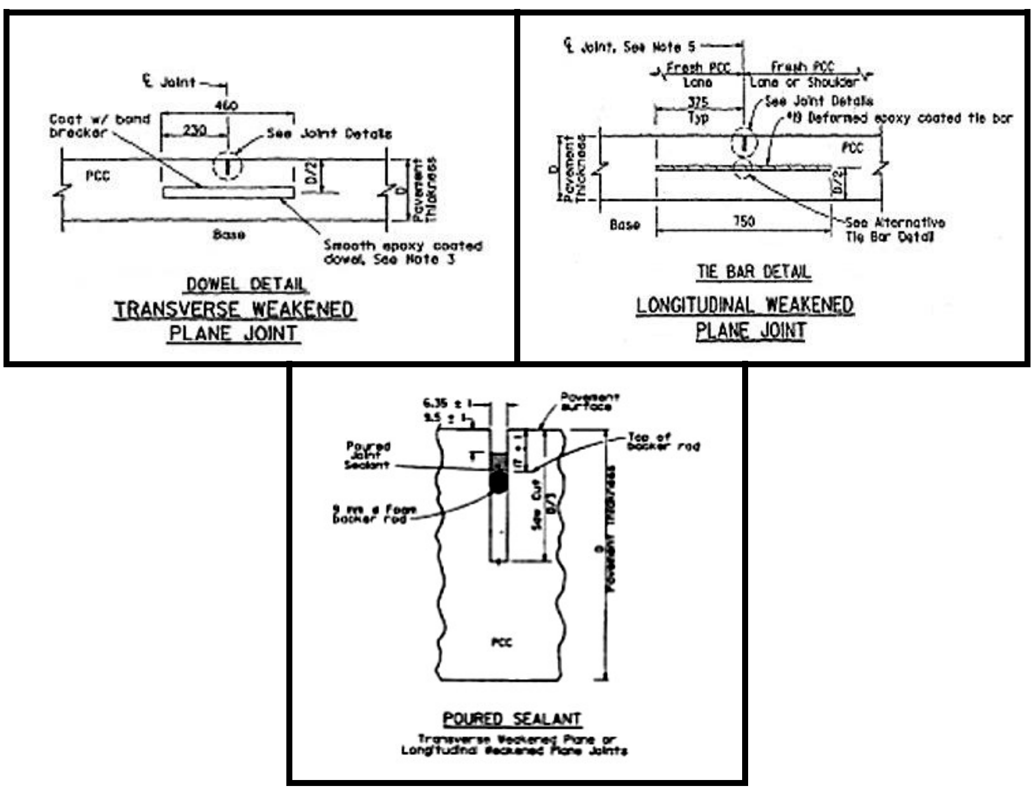

Figure 4. Miscellaneous Joint Details

The transverse joints are also to be constructed by the sawing method, except at the contact joints. Only the transverse joints in lane 1 are required to have dowel bars, those in the shoulder do not. The dowel bars specified are 460-mm long, 38-mm diameter epoxy-coated smooth bars evenly spaced at 300-mm intervals, on center.

Stage 3 is the reconstruction of lane 2 and the outside shoulder with PCC pavement from station 330+04.21 to Station 510+60 (see Figure 5). The existing structural section for lane 2 and the shoulder consisted of AC pavement on an AB. The AC pavement was 315-mm thick in lane 2 and varying from 130 to 289-mm thick in the shoulder. The new section for lane 2 is also PCC, 260-mm thick, with an AC base (Type A), 45-mm thick, over the cold-planed AC. The outside shoulder is PCC with a thickness that varies from 260 to 170-mm with an AC base (Type A), 45-mm thick, over the cold-planed AC. All construction work is behind k-rail.

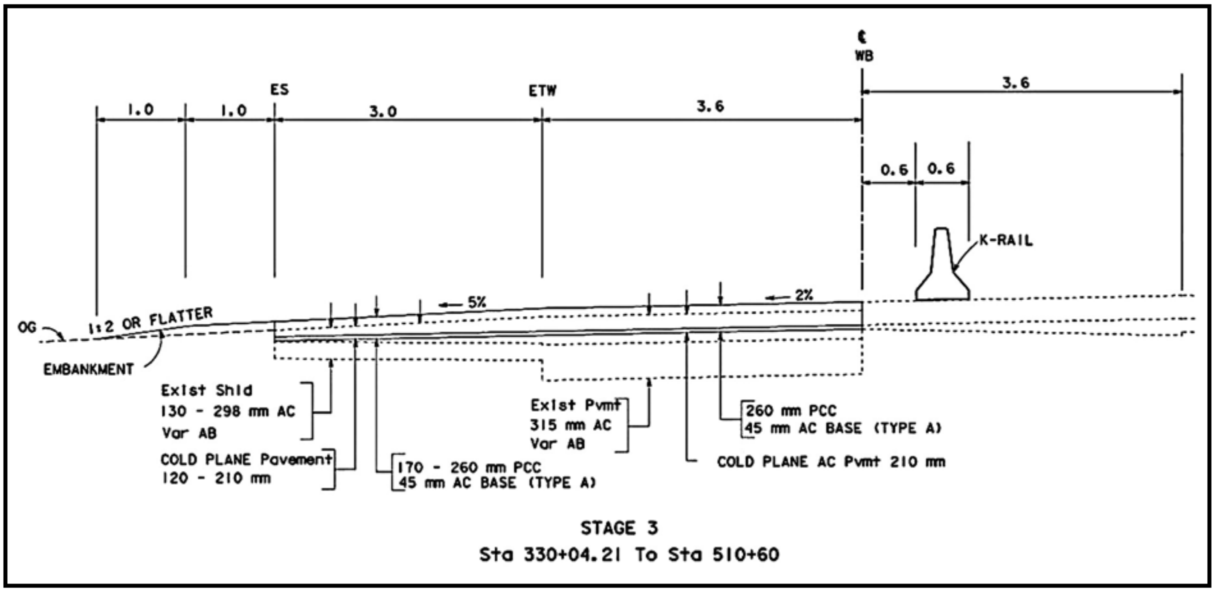

Figure 5. Stage 3 – Pavement Structural Section

Tie bars are required in the longitudinal joint between lanes 1 and 2, and between lane 2 and the outside shoulder. The longitudinal joint between lane 2 and the outside shoulder is to be constructed by the sawing method. The tie bars between the lanes are drilled and bonded into the pavement of lane 1 prior to placing the concrete for lane 2. Only the transverse joints in lane 2 are required to have dowel bars, those in the shoulder do not.

Concrete Specification

The Project Special Provisions specified "The concrete for pavement shall contain a minimum amount of 400 kilograms of portland cement per cubic meter." However, the specification was modified, by change order, for the concrete to contain 340 kg of portland cement and 60 kg of fly ash per cubic meter.

PAVEMENT CONSTRUCTION

Mix Design

The Contractor submitted the proposed aggregate gradations along with suggested proportions. The submittal proposed using 40% sand in the concrete. The resident engineer ordered proportions using 35% sand. The contractor expressed concerns about the potential workability of the concrete with the lower proportion of sand.

Weather

Mojave has weather conditions that consist of high daytime temperatures, low humidity, and high velocity winds. At the pre-construction conference, Caltrans expressed their concerns about placing and curing the concrete pavement under these conditions. The Transportation Laboratory also provided the resident engineer with a portable weather station. On two occasions during Stage 2, the contractor stopped paving operations due to high winds.

Concrete Placement

The test strip for Stage 2 was placed on Tuesday, May 22, 2001. Paving operations began at approximately 8:45 a.m. The concrete was placed monolithically at a width of 5.1-m (3.6 m for lane 1 and 1.5 m for the shoulder) in the direction of travel (Figure 6).

Figure 6. Concrete Placement

Tie bars and dowel bars were placed using inserters (Figure 7). The dowel bar inserter was computer controlled and programmed to insert the dowels automatically at the required joint spacing of 3.6, 4.0, 4.3, and 4.6-m. The insertion of the tie bars between the inside shoulder and lane 1 was similarly controlled.

Figure 7. Dowel Bar Inserter

The paving crew and foreman were favorably impressed with the workability of the concrete and ease with which it could be finished (Figure 8).

Figure 8. Finished Concrete

Figure 9. Curing Compound Application

Shortly after finishing and tine texturing the pavement, the curing compound was applied. The application was even and thoroughly covered the concrete surface (Figure 9). The standard specifications require the curing compound application rate to be 3.7±0.5 square meters per liter. The application rate, measured in accordance with California Test 535, was determined to be within this range.

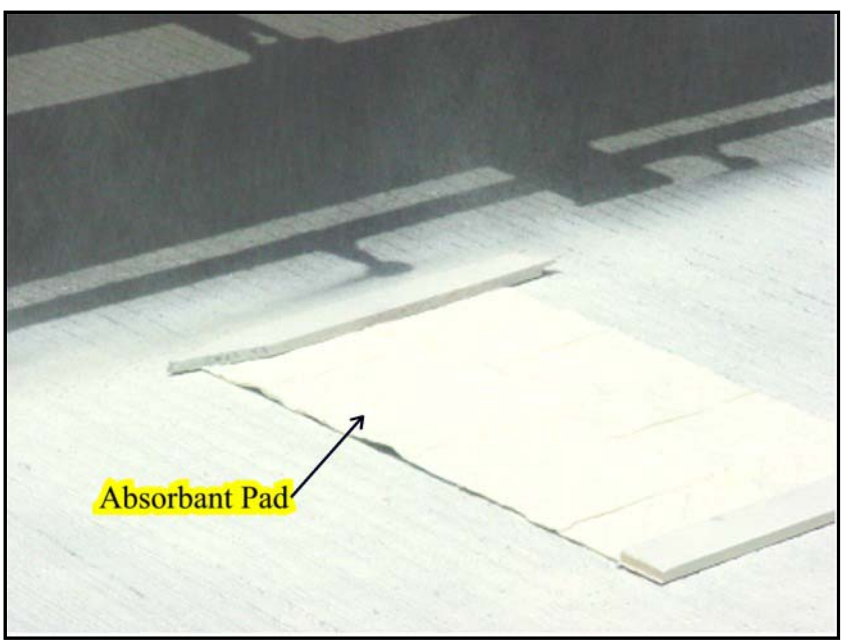

Figure 10. Application Rare Measurement

Joint Forming

Eight to twelve hours after placement, the transverse joints were initially saw cut using a 3-mm wide, single blade to prevent unnecessary spalling (Figure 11). Longitudinal joints were usually cut within 15 hours. The joints were later saw cut again to required shape and to widen the joint opening to 6 mm.

Figure 11. Saw Cutting Joints

The slurry was washed away to minimize buildup of unwanted contaminants in the joint. After the widened joints had dried, they were simultaneously sand blasted and air blasted to remove any remaining residue and clean the inside of the joint.

Figure 12. Sand Blasting Joints

Figure 13. Clean and Prepared Joint

After the joint has been cleaned and prepared, the backer rod was installed. A double-wheeled steel roller was used to push the backer rod into the joint and place it at the desired depth.

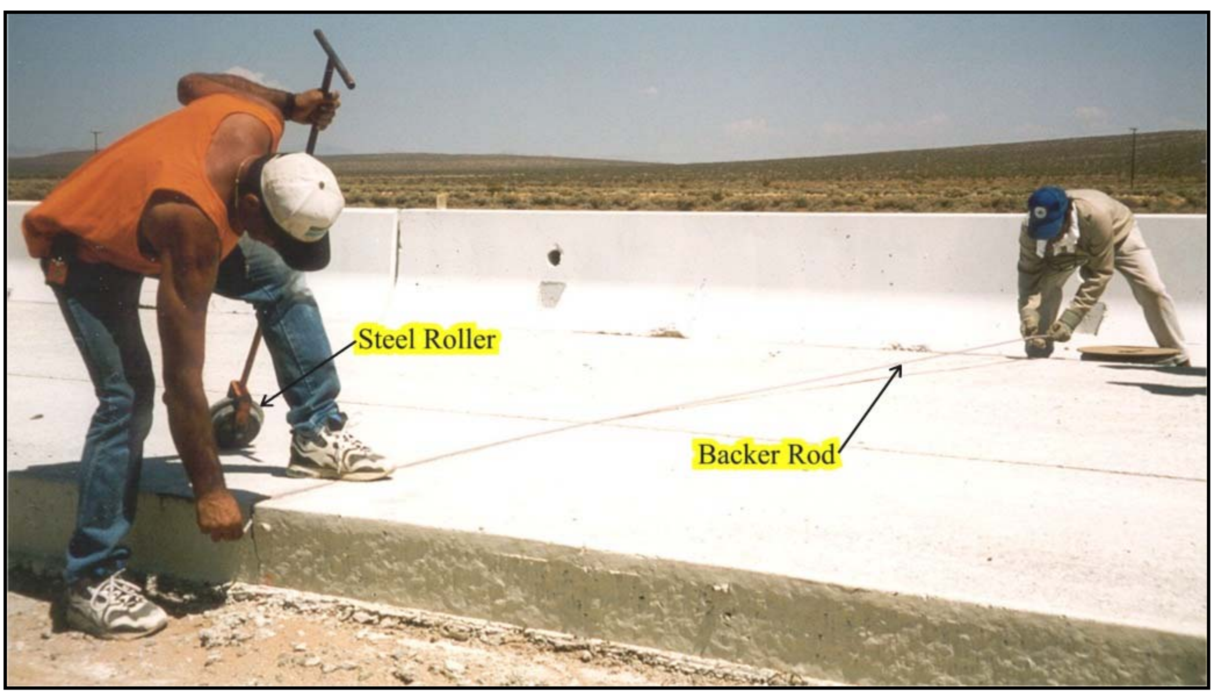

Figure 14. Backer Rod Installation

Once the backer rod was securely placed in the joint, the silicone sealant was applied. Sealant was applied into the joint with a nozzle to ensure the joint is filled uniformly

Figure 15. Applying Joint Sealant

The sealant was also tooled to make sure contact is made with the sides of the joint and the desired shape is obtained.

Figure 16. Tooling the Joint Sealant

On Thursday, June 21,2001, a second site visit was made. The resident engineer made available some core samples taken by the contractor. The cores showed that the concrete was well consolidated throughout.

Figure 17. Core Sample by Contractor

Pavement Distresses

A total of 18,000 linear meters of concrete pavement were placed during Stage 2, only minor distresses developed. Two transverse cracks were observed. The cracks developed as a result of late saw cutting. Also, some limited plastic shrinkage cracks developed.

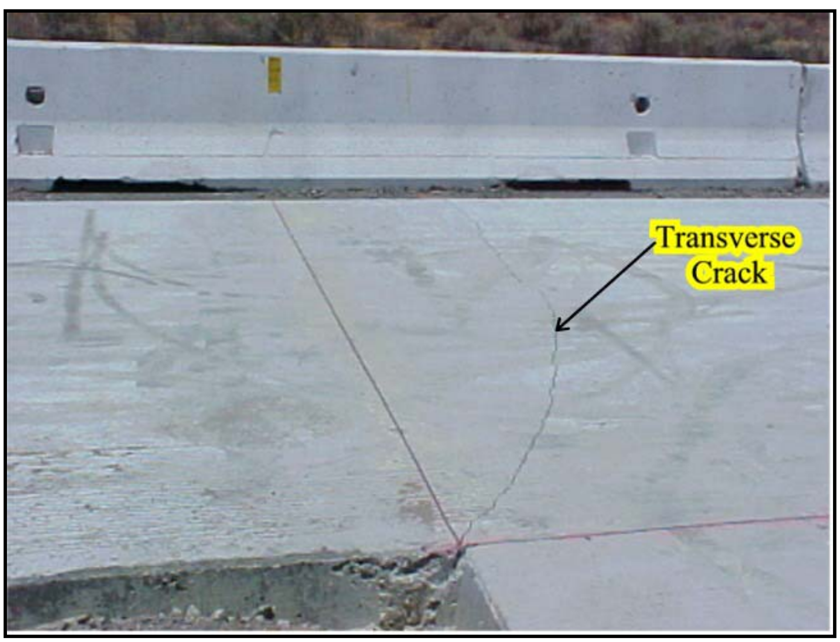

Figure 18. Transverse Crack at Formed Corner

The crack shown in Figure 18 is due to the stress raising effect of the formed inside corner. It began at the formed corner and extended the entire width of the concrete panel. The crack was measured to be about 5 mm wide. At formed corners, the timing of the saw cut is very critical. The repair strategy was to remove the damaged section of the concrete and replace it with a new panel, including dowel bars.

The other crack developed along a transverse joint approximately 300 mm from the edge of the inside shoulder (Figure 19). This crack was routed, cleaned and sealed.

Figure 19. Runaway Transverse Crack

Near the western end of the project, some isolated areas developed plastic shrinkage cracks. The cracking may be related to weather conditions, unintentional variations in the batching of the placed concrete, or a combination of both. These areas were paved on June 25.

Figure 20. Repaired Plastic Shrinkage Crack

The recorded high temperature on this day was 35.5°C; the relative humidity was 30%; and the wind ranged from 18 to 32 km/h. According to inspection records, the paving mix varied from wet to dry. The cracks were routed, cleaned and filled with epoxy (Figure 20).

Stage 3 Construction

Pavement construction for Stage 3 is scheduled to begin in December 2001.

CONCLUSIONS

Concrete pavements constructed in the desert during the summer can be successfully completed when all the parties are aware of the potential obstacles in advance. Hot weather is generally considered to be undesirable for concrete placement. Both the contractor and inspectors expressed their concerns about working under these conditions. Through their cooperation and efforts, a well-constructed concrete pavement has been completed.

CONGRATULATIONS!!! District 06 Construction – California City and Sapper Construction, Inc., on a job well done. Keep Up the good work in Stage 3.

Figure 21. Westbound Route 58 near Mojave

POINTS OF CONTACT

Office of Rigid Pavement and Structural

Tom Pyle	Office Chief	(916) 227-7281
Ken Beede	Consultations and Investigations	(916) 227-7060
Doran Glauz	Materials & Research	(916) 227-7272
Karl Smith	Maintenance Liaison	(916) 227-7230
Raul Alarcon	Consultations and Investigations	(916) 227-7913

Headquarters

Rob Marsh	HQ HA22 Advisor	(916) 654-5640
Agustin Perez	Construction	(916) 227-5705
Ray Tsztoo	Design	(916) 227-5704

District 06 Construction

Roger Henderson	Senior Construction Engineer	(661) 824-5440
Raul Gallo	Project Resident Engineer	(661) 824-5443
Hamid Alizadeh	Project Inspector	(661) 824-5401
Kevin Lai	Project Inspector	
Don Minyard	Project Inspector	
Larry Quang	Project Inspector	(213) 897-0459
Bryan Rails	Project Inspector	

Sapper Construction, Inc.

Michael Sapper	Vice President, Sapper Construction, Inc	(619) 465-7222