NON-GROUTED BONDED PCC OVERLAY CITY OF OSKALOOSA

FINAL REPORT
IOWA DEPARTMENT OF TRANSPORTATION
PROJECT HR-528
AND
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Highway Division

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Final Report
for
Iowa Department of Transportation
Project HR-528

Non-Grouted Bonded PCC Overlay
City of Oskaloosa

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8. ABSTRACT

Based upon the success the Iowa Department of Transportation has had using thin bonded, low slump, dense portland cement concrete on bridge decks for rehabilitation, it was decided to pursue research in the area of bonded portland cement concrete resurfacing of pavements. Since that time, in an effort to reduce costs, research was conducted into eliminating the grouting operation.

On this project a non-grouted overlay was used to modernize an existing urban street. This research project is located in the City of Oskaloosa on 11th Avenue from South M Street to South Market Street.

Construction of the project went well and the non-grouted overlay has performed very well to date.

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DISCLAIMER

INTRODUCTION

The Iowa Department of Transportation has been using the "Iowa Method" of thin bonded, low slump, dense portland cement concrete (PCC) bridge deck overlays for rehabilitation of delaminated decks since 1963. This procedure has been used successfully on over 1,000 bridge decks in the state of Iowa since that time. Based upon that success, the Iowa Department of Transportation began to pursue research in the area of bonded PCC resurfacing of concrete pavements. The current research efforts began in October 1976 with a 2" PCC resurfacing on US 20 at the east edge of Waterloo in Black Hawk County (1). A short section of a Waterloo city street was also resurfaced with PCC at the same time. A 1.3 mile bonded PCC overlay (2) was placed on a Clayton County roadway in September 1977 to increase the structural capacity. In 1978, a bonded PCC overlay was used to rehabilitate a 4-lane divided facility on US 20 in Sioux City.

The short term success of the projects noted above prompted the Iowa DOT to develop a PCC bonded overlay of I-80 in 1979. This 3" thick overlay was placed over both jointed and continuous reinforced concrete pavement. All the projects mentioned to this point were placed with a sand/cement or neat cement grout slurry on the dry original concrete slab. This procedure was a holdover from the procedure used with the dense concrete bridge deck overlays and was intended to give a cement rich bond at the interface.

There have been continued efforts to reduce the cost of the thin bonded PCC overlays through improved equipment and reduced labor. In 1985, in an effort to further reduce the construction costs of the PCC overlay, research was conducted into the elimination of the grouting operation. Good bond strengths were obtained from cores taken from two 250 ft. test sections constructed without grout application on a Monroe-Wapello County project (3).

This report refers to a non-grouted overlay project which was used to modernize an existing urban street.

PROJECT LOCATION AND CONTRACTUAL ARRANGEMENTS

The Iowa DOT and the Iowa Concrete Pavement Association assisted in the project's design of the bonded overlay. The design was completed by Garden and Associates Consultants of Oskaloosa, Iowa. This research project is located in the city of Oskaloosa on 11th Avenue West, from South M Street to South Market Street. The successful bidder on this project let April 1, 1986 as Mahaska M-5258(1)--81-62 was Iowa Paving Contractors Inc. of Ankeny, Iowa.

PRECONSTRUCTION DATA

The jointed 18 ft. wide existing pavement was constructed in the late 1930's using Eddyville gravel coarse aggregate. The existing street was in good condition, but being only 18 feet wide it didn't meet the needs of present-day traffic.

There were problems with edge rutting as well as faulting of the joints and slab movement.

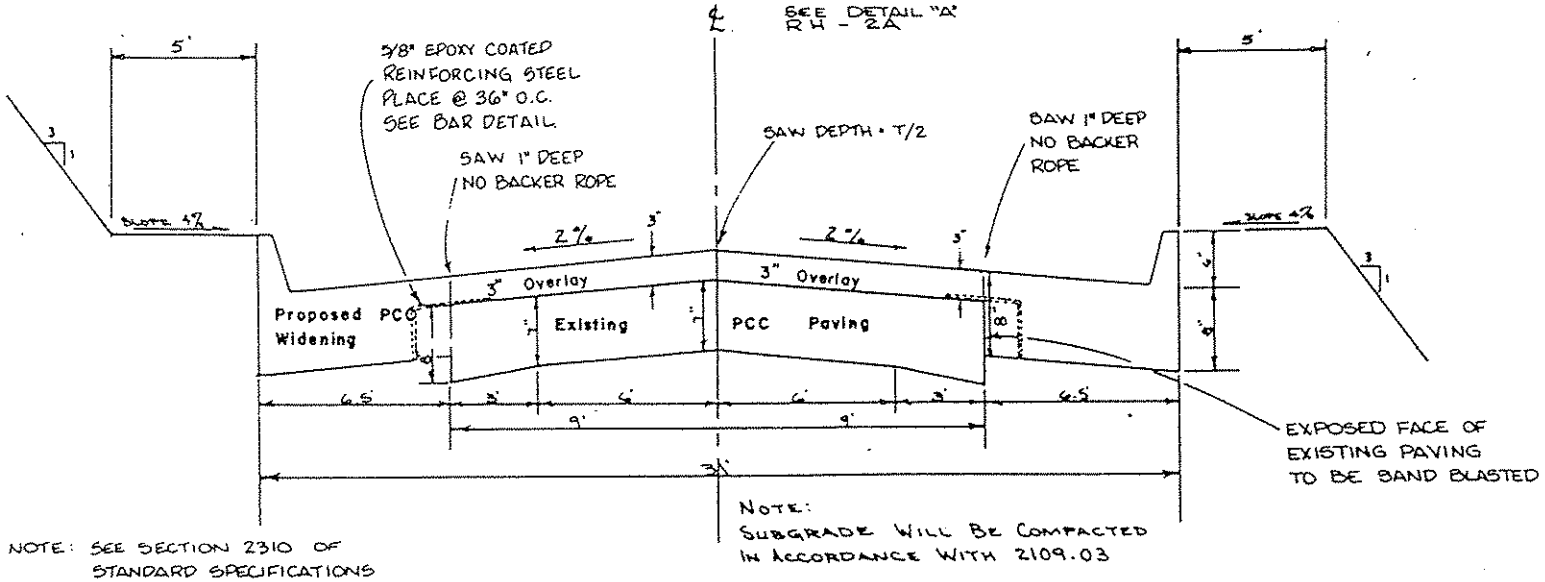
The average daily traffic on this section of city street in 1985 was 2,720 with approximately 5% trucks. The thickness of the existing pavement (Figure 1) was 7 in. at the center and remained a uniform 7 in. thick, 6 ft. either side of center, then tapered to 8 in. in the outside 3 ft.

MATERIALS AND PROPORTIONS

The concrete mix proportion was an Iowa DOT C-3WR. The quantities of dry material per cu. yd. of concrete were:

Material	Weight - lbs
Type I Cement	488 lbs
Fly Ash (Class C)	86 lbs
Water	238 lbs
Fine Aggregate	1,386 lbs
Coarse Aggregate	1,650 lbs

The Type I cement was from Monarch Cement Company of West Des Moines, Iowa. Mid-West Fly Ash supplied the Class C fly ash from the Ottumwa Generating Station at Chillicothe, Iowa. The coarse aggregate for concrete was produced by Kaser Corp. from their Sully quarry in Jasper County, Iowa. The fine aggregate was also produced by the Kaser Corp. from their New Harvey pit in Marion County, Iowa. The water reducing admixture was a Pro-Krete N-3 produced by Protex Industries. The concrete was produced at the Ideal Ready Mix plant in Oskaloosa and transported to the project by transit mixers.



NOTE: SEE SECTION 2310 OF STANDARD SPECIFICATIONS FOR THIN-BONDED OVERLAY
SEE SECTION 2302 OF STANDARD SPECIFICATIONS FOR P.C.C. WIDENING.

Scale
1" = 1' Vert.
1/4" = 1' Horiz.

Typical Cross-Section Of New Concrete Paving

Sta. 84+11 to Sta. 123+64

Figure 1

CONSTRUCTION

The construction was typical with no special equipment necessary. The rock shoulders were graded out, and the grade edge was loosened and recompacted at the specified depth. A small trimming machine was used to trim the grade. The pavement surface was cleaned by the use of shotblasting machines. Asphalt cement from the filling of the edge ruts left on the pavement was removed by grinding. There was spalling at the joints which were ground to get to sound concrete. Partial depth patches were filled with the overlay concrete mixture. The worst expansion joints were milled and filled with the overlay concrete. The edges of the 18 ft. slab were cleaned so the widening would bond to the outside edge of the existing pavement. Tie bars were laid on top of the existing pavement and paved over rather than drilling the bars into the existing pavement.

The shotblast surface preparation was completed by August 1, 1986. Concrete placement began July 24, 1986 and was completed August 18, 1986. The concrete was placed through a Gomaco 2500 slipform paver with longitudinal control from a stringline. The surface texture was imparted by an AstoTurf drag. White pigmented curing compound was applied by a Gomaco machine at 1 1/2 times the normal application rate for conventional paving for an application rate of 0.1 gallons per sq. yd. or 10 sq. yd. per gallon.

Construction problems were minimal. The ambient temperatures during the placement of the concrete ranged from 50°F to 70°F at night and from 72°F to 88°F during the daytime.

PROJECT COSTS

The bid items for the concrete furnishing and placement were let as two separate items. Item 6, portland cement concrete, furnish only, was 2,370 cu. yds. at $46.80 per cu. yd. Item 7, portland cement concrete resurfacing and widening, placement only, was in units of station yards. There was an estimated quantity of 14,220 station yards at $5.75 per station yard.

POST CONSTRUCTION EVALUATION AND DISCUSSION

When constructing this project, the existing transverse joints were handled two different ways. Half the joints were sawed and half were allowed to crack through and were subsequently routed and sealed. If the joints varied by more than 3 inches from a straight line they were allowed to crack through, otherwise, they were saw cut from back of curb to back of curb. In all cases the widened sections were sawed soon after the paving operations. There were a few sawed joints where the saw cut apparently was to the side of the original joint and there were some short areas of cracks parallel and close to the saw cut. In a recent field trip to the project, it was noticed that some of the joint seals are coming out of the joints.

The final crack survey was completed in 1992 showing three full width intermediate cracks, six cracks across only the widening and seventeen cracks from centerline to the edge.

Delamtect testing was also conducted at the time of the crack survey 2 ft. and 7 ft. either side of centerline on the full length of the project. Minimal delamination was found.

Four inch diameter cores were taken and tested for compressive strength and bond at 14 days and 110 days. Cores were drilled and tested again in 1987, 1990 and 1991. The bond or shear strength and compressive strength test results are shown in Appendix A. The shear strength increased through the first year but 1990 and 1991 testing yielded lower values. The last tests completed still showed an average of 480 psi. The compressive tests showed an increase through the first year then lower in 1990, then raised again in 1991. All shear strengths are considered adequate to provide bond.

Profilometer testing using a California 25-Foot Profilometer was completed in November 1986, August 1987 and February 1992. The original readings were somewhat high but considering the condition of the pavement that it was going over and being urban paving, the readings were considered to be acceptable. The smoothness readings have remained close to the same from construction until present time. The results of this testing are in Appendix B.

CONCLUSION

It can be concluded by testing performed and visual observation that this non-grouted, thin bonded PCC overlay has performed very well.

REFERENCES

1. Schroeder, C. J., Britson, R. A., Bergren, J. V., "Bonded, Thin-Lift Non-Reinforced Portland Cement Concrete Resurfacing," MLR-77-2, Iowa Department of Transportation, May 1977.

2. Johnson, M.L., "Bonded, Thin-Lift Non-Reinforced Portland Cement Concrete Resurfacing," Final Report HR-191, Iowa Highway Research Board, June 1980.

3. Kaler, M. K., Lane, O. J., Johnson, M. L., "Performance of Nongrouted Thin Bonded P.C.C. Overlays," Construction Report Project HR-291, Iowa Highway Research Board, August 1986.

Appendix A

Bond and Compressive Strength Averages

Appendix A
Bond and Compressive Strength Averages

Date	Compressive Strength PSI		Bond (shear) Strength PSI	
8-7-86 (14 days)	5690	(3 tests)	580	(2 tests)
11-10-86 (110 days)	8190	(3 tests)	500	(3 tests)
8-13-87 (1 year)	8270	(3 tests)	620	(3 tests)
10-4-90 (4 years)	7370	(3 tests)	510	(3 tests)
10-11-91 (5 years)	9490	(3 tests)	480	(3 tests)

Appendix B

Profilometer Readings

Appendix B
Profilometer Readings

Date	EB(in./mi.)	Station	WB(in./mi.)	Station
11-10-86	20.2	84+11 to 123+64	22.7	123+64 to 84+11
8-13-87	20.5	84+11 to 123+64	23.8	123+64 to 84+11
2-27-92	19.7	89+10 to 123+59	18.6	123+59 to 89+10