

Thin Bonded Portland Cement Concrete Overlay

**Final Report for
Iowa DOT Project HR-520**

**Federal Highway Administration
Project DTFH71-83-3502-IA-11**

November 1990

Final Report
for
Iowa Department of Transportation
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THIN BONDED PORTLAND CEMENT
CONCRETE OVERLAY

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DISCLAIMER

The contents of this report reflect the views of the author and do not necessarily reflect the official views of the Iowa Department of Transportation. This report does not constitute a standard, specification or regulation.

ABSTRACT

A four and one-half inch thick, bonded portland cement concrete (PCC) overlay and integral widening were used to rehabilitate a 4.5 mile section of Iowa route 141 from US 169 to Iowa 210 in Dallas County. There was a substantial amount of cracking in the old 20 feet wide PCC pavement. Most of the widening, which was tied to the original slab by dowel bars, was placed as a four feet wide section on one side.

Coring has shown that the overlay is well bonded and testing with the Delamtect has shown less than 1% debonding. Midpanel transverse cracks in the old pavement have reflected through the overlay (as expected). Some new transverse cracking has occurred. This cracking has not caused any significant problems. In general, the overlay is performing quite well.

INTRODUCTION

There are over 13,000 miles of PCC pavement in Iowa. Much of this mileage has given outstanding performance with very little maintenance for the design life. Some have provided 50 years of good service without resurfacing. In view of their age, heavier loads and increased traffic volumes, many are in need of rehabilitation and/or structural improvement.

Recent research on PCC overlays began with a three mile Greene County project in 1973 (1). This project was essentially an unbonded overlay, even though the intent was to have some sections of bonded overlay. The first of our current system of thin bonded PCC overlays was placed on US 20 in Black Hawk County in 1976 (2) followed closely by a 1977 Clayton County project (3). These projects demonstrated a potential for success and generated more bonded PCC overlays leading to a PCC overlay of Interstate 80 in 1979 (4).

OBJECTIVE

The objective of this evaluation is to further determine the potential of thin bonded overlays as a rehabilitation procedure.

PROJECT LOCATION AND HISTORY

This 4.5 mile project of bonded PCC overlay, Dallas County project FR-141-6(29)--2G-25, with integral widening was located on Iowa route 141 from US route 169 to Iowa route 210 in Dallas County (Figure 1). The original pavement was constructed in 1940 and 1941 as Dallas-Boone F.A. project 843A(1). The 20 feet wide reinforced

pavement was 7 1/2 inches thick at the center and 10 inches thick at the edges (Figure 2). Bituminous parting strips were used to form the centerline joint and contraction joints with load transfer at 30 ft. spacings.

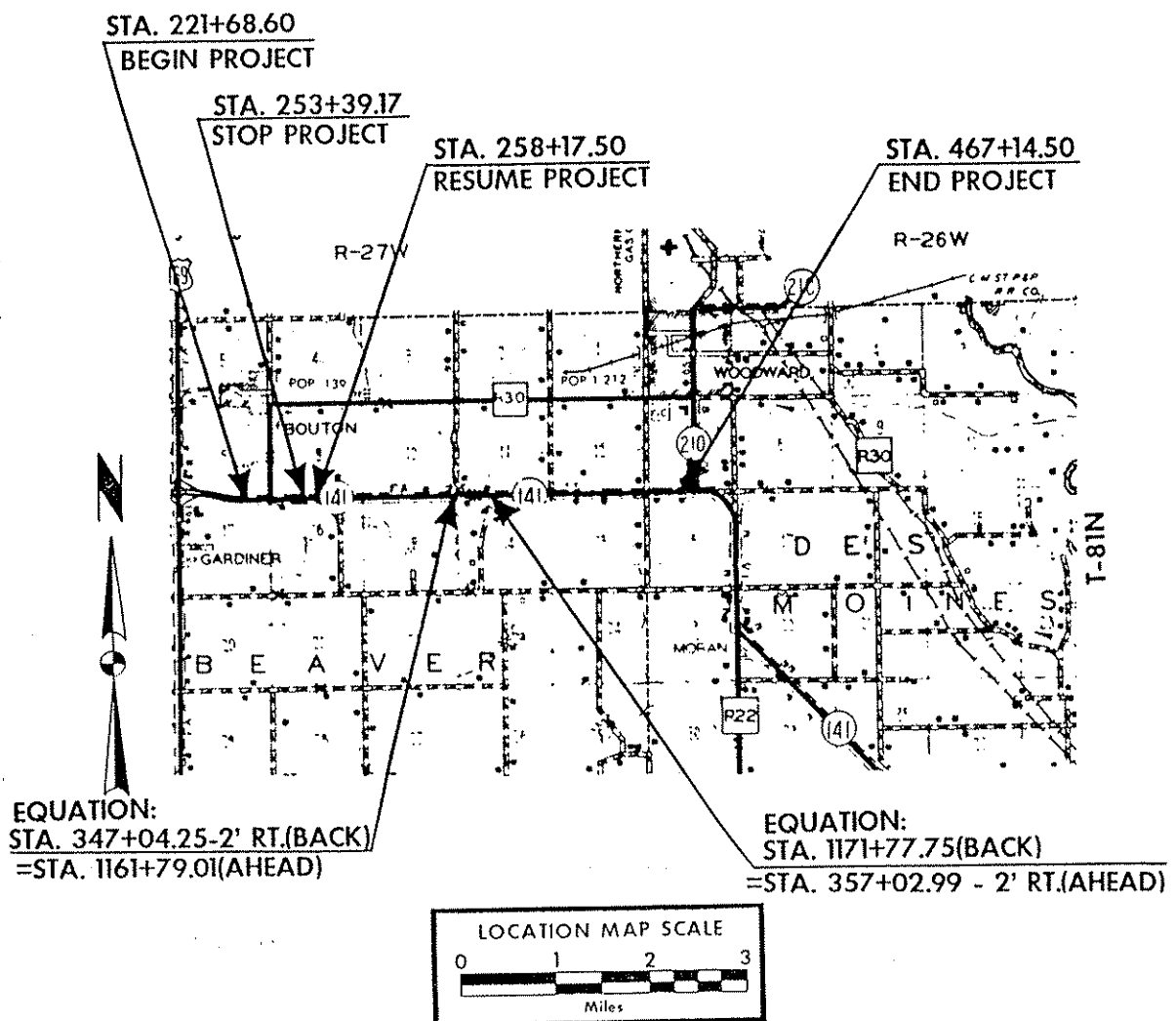


Figure 1 Project Location

The original pavement, made with Moingona Boone County gravel coarse aggregate was in good condition except for some transverse midpanel cracking. No prior rehabilitation had been conducted.

PREREHABILITATION CONDITION

Two conditions which prompted the rehabilitation were the 20 ft. width and random cracking indicating a need for structural improvement. The 1983 traffic volume was 4300 vpd with 12% trucks. The horizontal and vertical alignment were good.

DESIGN

The design included some pavement removal and reconstruction in addition to the monolithic widening and bonded overlay (Figure 3). In some cases, the widening was placed on both sides of the existing slab (Figure 4) but for most of the project, a 4 ft. widening was placed on the right (south) side of the original slab. The widening was 10 inches thick and tied to the original slab with #5 bars at a 24-inch spacing. The bonded overlay design thickness ranged from a 3 inch minimum to 4 1/3 inches.

TYPICAL CROSS SECTIONS- 20 FOOT ROADWAY

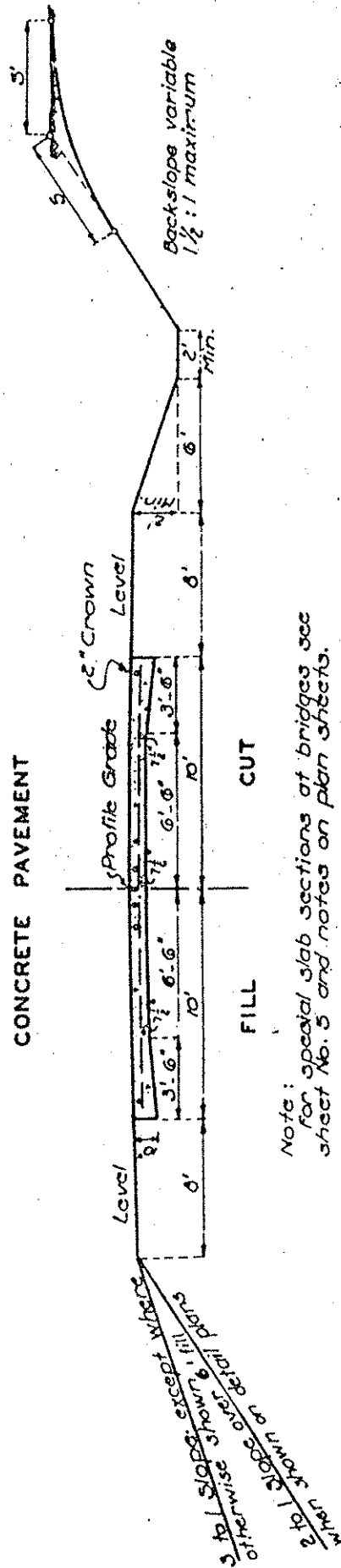
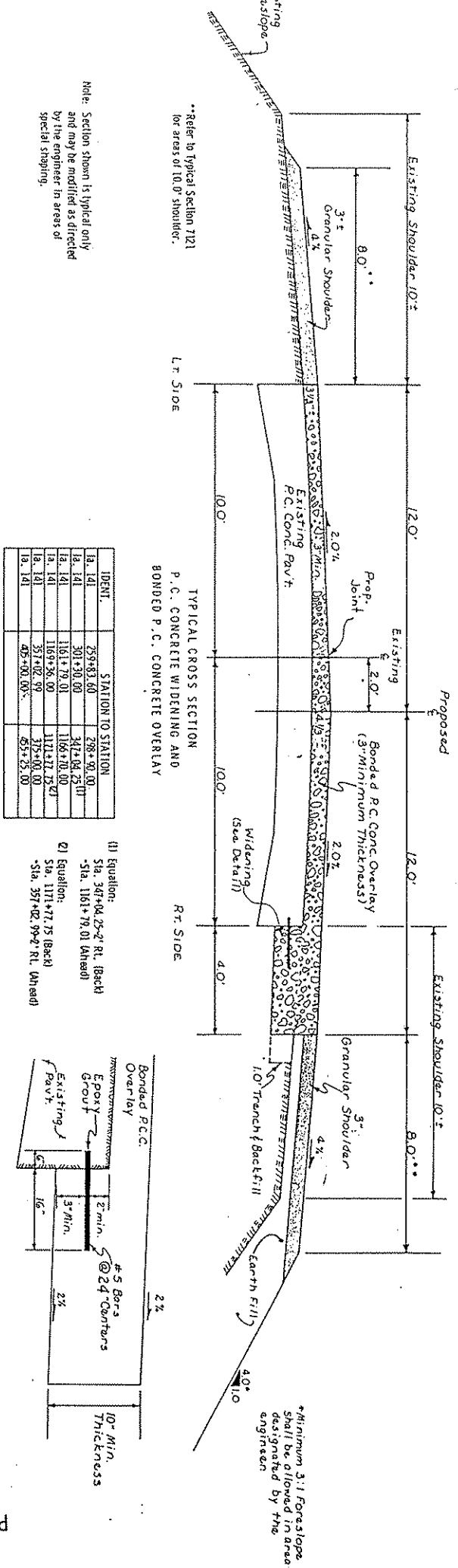


Figure 2 Typical Section of Existing Pavement



**Refer to Typical Section 7121 for areas of 10.0' shoulder.

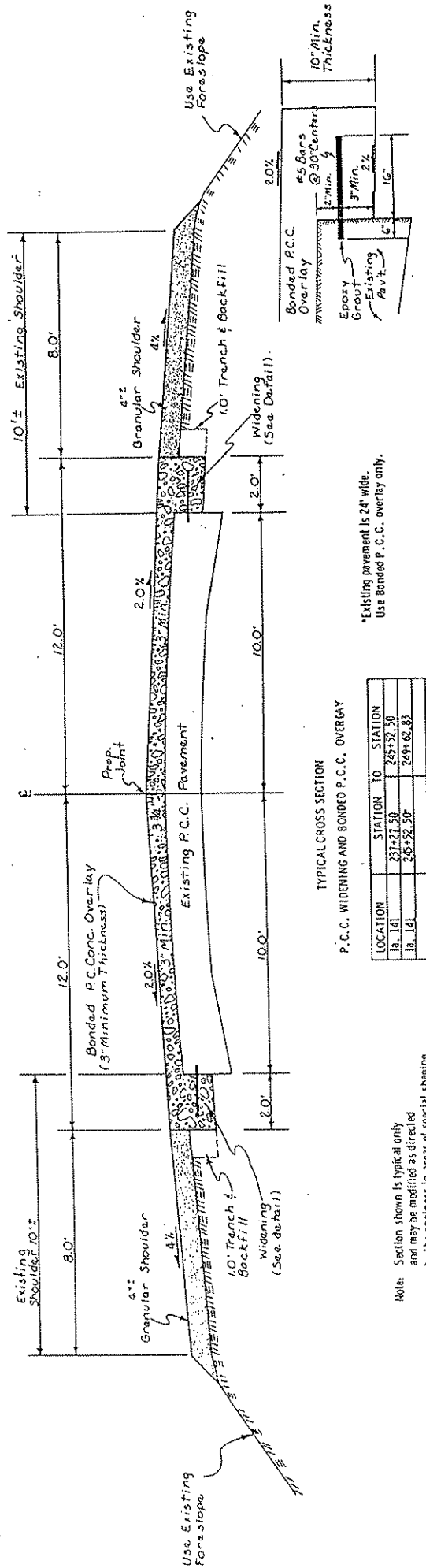
Note: Section shown is typical only and may be modified as directed by the engineer in areas of special shaping.

IDENT.	STATION TO STATION
1A, 141	259+83.60
1A, 141	301+30.00
1A, 141	1161+79.01
1A, 141	1169+36.00
1A, 141	351+02.99
1A, 141	451+00.00
1A, 141	451+00.00

(1) Equation:
Sta. 347+04.25-RT. (Back)
Sta. 1161+79.01 (Ahead)

(2) Equation:
Sta. 1111+77.75 (Back)
Sta. 351+02.99-RT. (Ahead)

Figure 3 Typical Section - Widening on One Side



Note: Section shown is typical only and may be modified as directed by the engineer in areas of special shaping.

TYPICAL CROSS SECTION
P.C.C. WIDENING AND BONDED P.C.C. OVERLAY

LOCATION	STATION	TO STATION
1a, 1d	231+27.50	245+52.50
1b, 1d	246+52.50	249+62.83

*Existing pavement is 24' wide.
Use Bonded P.C.C. overlay only.

Figure 4 Typical Section - Widening on Both Sides

Separate bid items were established for PCC, furnish only-per cubic yard and PCC resurfacing, placement only-per square yard to remove some of the variability and uncertainty for the interested contractors. A total of 9506 lineal feet of longitudinal subdrain was included in the project.

MATERIALS AND PROPORTIONS

Special provision 453 (Appendix A), developed for this project, required a C4WR mix for the overlay and widening. The materials, proportions and batch weights for most of the concrete were:

<u>Material</u>	<u>Absolute Volumes</u>	<u>Producer</u>	<u>Source</u>	<u>Actual Batch Weights</u>
Cement	0.112414	Davenport Cement Co.	Buffalo	595
Water	0.152125			275 (Avg.)
Air	0.06	Contractor Steel Corp.	Des Moines	
Fine Agg.	0.337731	Perry Sand & Gravel	Perry	1519 (Sp.Gr.=2.67)
Coarse Agg.	0.337731	Martin Marietta	Ames	1474 (Sp.Gr.=2.59)

Type I cement was required by specifications. The coarse aggregate was a crushed limestone. The water reducer was WRDA with Hycol produced by W. R. Grace.

The basic water-cement ratio was 0.430 pound per pound but the mix required slightly greater than basic to yield the consistency of 1 1/2 to 2 inches. The air content of the unvibrated concrete ranged from 5.5 to 8.0% (specifications require 6.5% \pm 1.5%).

CONSTRUCTION

The contractor, Fred Carlson Company, began work on this project July 5, 1983. Over 9000 lineal feet of longitudinal subdrain were placed by a subcontractor prior to paving. In preparation for paving, all deteriorated concrete was removed and replaced with either full or partial depth patching. Joints that were in good condition were not cleaned in preparation for the overlay. Shot blasting surface preparation began September 9, 1983, and was completed during September.

Pavement construction began October 17, 1983, and the first portion of bonded overlay and integral widening was placed October 18, 1983. The mainline paving was completed on November 14, 1983. The weather during this period was generally cool with low temperatures ranging from 36°F to 54°F and high temperatures from 44°F to 75°F. There was a number of cloudy days and some rain during the period.

The surface of the old pavement was removed by shot blasting with steel shot to a depth sufficient to remove all traffic film and surface contamination. Just before paving, the surface was blown clean with compressed air. A sand-cement-water grout, supplied from an agitator truck, was spread on the dry concrete slab with brooms and squeegees immediately ahead of concrete placement. The concrete was placed through a conventional slipform paver. An increase in the quantity and thickness of concrete for the overlay was approved to allow the contractor to meet the profile requirements as the old pavement did not have a smooth profile. The tex-

ture was obtained from an Astrograss drag attached to the paver followed by transverse tine grooving. A white pigment curing compound was applied soon after completion of the texturing.

The exact location of each contraction, expansion, and full depth patch joint of the existing pavement was marked ahead of the paving operation. Joints were sawn directly over the existing centerline and all transverse joints. The transverse joints were sawed full depth of the new overlay and a minimum of 2 1/2 inches in the widening as soon as possible without causing excess raveling. The joint over the old centerline was sawn to a depth of 1 inch. All joints were sawn 1/4 inch wide. After sandblast cleaning, a backer rope was inserted before applying the sealant material.

Most of the widening on this project was placed as a 4 ft. section on one side rather than 2 ft. sections on both sides. This resulted in a sawed joint 2 ft. from the centerline of the overlaid pavement. A white or gray sealant material was required in this joint in an effort to reduce its effect on drivers. The joint material turned very black, possibly from dirt and tire rubber, but it has not caused any significant problems.

ANALYSIS OF COSTS

This project includes an item for square yards of 9.5 in. thick, 24 ft. wide slipform pavement to be used as a comparison (Appendix B). The costs will address only the costs to produce the comparative 24 ft. wide overlaid and widened slab.

The costs per sq. yd. of the bonded overlay and widening are:

Item	Cost per Sq. Yd.
Item 2 Excavation	\$0.13
Item 4 Patches, full depth	1.28
Item 5 Patches, partial	0.19
Item 6 Patches, by count	0.29
Item 7 Surface Prep	2.79
Item 8 PCC Furnish	5.56
Item 9 PCC Place	3.70
	=====
Cost per square yard	\$13.94

All costs above are based on actual costs prorated per square yard of Item 9 PCC resurfacing, placement, only. The cost of pavement construction by using the bonded overlay and integral widening was \$13.94 per sq. yd.

The costs per square yard for reconstruction were:

Item	Cost Per Sq. Yd.
Item 1 Excavation	\$ 0.29
Item 18 Removal of Pavement	2.73
Item 10 9.5 in. PCC Pavement	18.30
	=====
Cost per square yard	\$21.32

Only 1.3 miles were reconstructed which may result in distorted higher values in the above calculation. Using average unit prices from the 1983 summary of bid prices would yield the following:

Item	Cost Per Sq. Yd.
Item 1 Excavation	\$ 0.29
Item 18 Removal of Concrete	2.56
Item 10 9.5 in PCC Pavement	14.92
	=====
Cost per square yard	\$17.77

There were 47,103 sq. yds. of bonded overlay and integral widening at \$13.94 per sq. yd. compared to reconstruction at \$17.77 based on 1983 average bid prices for a \$3.83 per sq. yd. savings by rehabilitating the existing slab. This was a total savings of \$180,400 for 3.2 miles of rehabilitation.

The longitudinal drainage and traffic control would have been essentially the same for both rehabilitation and reconstruction. The delays and inconvenience to the public would be very similar. The maintenance requirement may be somewhat greater for the rehabilitated pavement.

TESTING AND EVALUATION

The profile of both the eastbound and westbound lanes was evaluated with the 25-Foot California Profilometer in October and November 1983. A 3.98 mile length of eastbound lane exhibited a profile index of 16.7 inches per mile while a 4.02 mile length of westbound lane was 23.3 inches per mile. Current Iowa specifications for new PCC pavement allow a maximum of 15 inches per mile without penalty.

Crack surveys were conducted prior to the overlay and annually since the overlay on two representative sections. All of the original cracks have reflected through the surface in those sections.

The structural rating of the pavement was determined with a Road Rater before and after the overlay. Deflection readings were obtained on both the approach and leave slabs near the joints and at midpanel. This testing was conducted in both lanes in three selected sections. A summary of those structural ratings is given in Table 1.

Table 1 Structural Ratings

Station 280+00 to 284+00

	9-14-83 Prior to Overlay	5-25-84	6-2-89
Approach slab near joint	2.8	5.6	4.9
Leave slab near joint	2.8	5.8	5.1
Midpanel	4.2	6.8	6.7

Station 307+00 to 320+00

	9-14-83 Prior to Overlay	5-25-84	6-2-89
Approach slab near joint	2.3	4.9	4.3
Leave slab near joint	2.9	5.7	4.5
Midpanel	3.5	6.0	5.7

Station 328+00 to 330+00

	9-14-83 Prior to Overlay	5-25-84	6-2-89
Approach slab near joint	3.5	6.4	5.3
Leave slab near joint	2.6	6.4	5.8
Midpanel	4.3	7.6	7.1

The Delamtect was operated on longitudinal paths 6 1/2 ft. right and 10 1/2 ft. left of centerline to determine if there was debonding of the overlay. Testing from Station 280 to 284, 307 to 319 and 328 to 330 on May 16, 1984, revealed no delaminations.

Delamtect testing on November 17, 1986, at the two longitudinal paths noted above from Station 261 to 271, 302 to 310 and 360 to 370 (5600 ft.) revealed 38 lineal feet of delamination. This is less than 1% (0.7%). Delamtect testing June 2, 1989 from Station 275 to 285, 307 to 319, and 328 to 335 (5800 ft.) showed 46 lineal feet of delamination. This is 0.8%; still less than 1%.

Cores for shear testing were drilled through the overlay and old concrete November 17, 1986. Tests of three cores on the bond line yielded shear strengths of 660, 550 and 580 psi. Cores taken in 1987 had shear strengths of 630, 490, 590 and 270 psi.

Friction testing with an ASTM E-274 trailer was conducted in the inside wheelpath of both lanes on June 7, 1984. The average Friction Number both directions was 50 which is generally considered good.

PERFORMANCE

One minor problem occurred soon after construction. There was a localized area between Stations 409+50 and 411+00 where the sawcut over the original centerline had been misaligned and a reflected crack occurred parallel to the sawcut. This resulted in a 2 to 3

inch wide strip of loose concrete that required removal and patching. This repair work was completed in 1984.

Cracking over the joint between the original slab and the widening began to occur in 1985. By 1986, there was a substantial amount of cracking at this joint. All widening cracks that could be identified were sawed and sealed in 1986.

The riding quality was somewhat rougher than the average conventional pavement, but has changed very little since construction. In 1984, the psi determined by the IJK Road Meter was 4.09 and in 1988, the psi was 3.29. The pavement had a friction number of 50 in 1984 and 44 in 1987.

Coring in 1986 and 1967 showed that the overlay was still well bonded to the original slab. Testing with the Delamtect of selected areas showed less than 1% debonding in 1986 and 1989.

Midpanel transverse cracks in the old pavement have reflected through the overlay. These reflection cracks were expected and have been sawed using a small diameter crack saw and sealed with hot pour Sof Seal joint seal material. In general, the overlay and integral widening have performed well.

CONCLUSIONS AND RECOMMENDATIONS

This project supports the following conclusions and recommendations:

1. A bonded portland cement concrete overlay is an acceptable method of rehabilitating old pcc pavements.
2. Widening may be successfully placed on only one side of the original pavement.
3. The location of saw cuts over joints is critical to prevent the overlay from breaking parallel to the joint.
4. It is recommended the overlay be a minimum of 4 inches thick.
5. The overlay should be sawn over the widening joint.

REFERENCES

1. R. M. Betterton, M. J. Knutson and V. J. Marks. Fibrous Portland Cement Concrete Overlay Research in Greene County, Iowa. Transportation Research Board, TRR 1040, Washington, D.C. 1985.
2. C. J. Schroeder, R. A. Britson and J. V. Bergren. Bonded, Thin-Lift Nonreinforced Portland Cement Concrete Resurfacing. Iowa Department of Transportation. May 1977.
3. M. L. Johnson. Bonded Thin-Lift, Non-Reinforced Portland Cement Concrete Resurfacing. Project HR-191 Final Report. Clayton County, Iowa, June 1980.

4. J. V. Bergren. Bonded Portland Cement Concrete Resurfacing.
Transportation Research Board, TRR 814, Washington, D.C. 1981.

Appendix A



Iowa Department of Transportation

SPECIAL PROVISION

for

PORTLAND CEMENT CONCRETE RESURFACING
(Thin-bonded Overlay)

FR-141-6(29)--26-25, Dallas County

June 7, 1983

453.01 DESCRIPTION. This special provision describes PCC resurfacing of an existing PCC pavement, and it includes full-depth and partial-depth patching and pavement widening associated with the resurfacing work.

453.02 MATERIALS. All material shall meet the requirements for the respective items in Part IV of the Standard Specifications, with the following exceptions:

- A. Cement. Article 4101 shall apply. The use of Type III (high early strength) cement will not be permitted.
- B. Aggregate. Sections 4110 and 4115 shall apply, and the coarse aggregate shall be a Class 2 durability, crushed limestone meeting the number 3 or 5 gradation requirements of Section 4109.
- C. Concrete. Mix No. C-4WR, as specified in 2301.04, shall be used for resurfacing.
- D. Grout for bonding new concrete to previously placed concrete shall consist of equal parts by weight of portland cement and concrete sand, mixed with sufficient water to form a stiff slurry. The consistency of this slurry shall be such that it can be applied with a stiff brush or broom to the old concrete in a thin, even coating that will not run or puddle in low spots. The grout shall be agitated prior to and during its use. The cement-to-water contact time of the grout shall not exceed 90 minutes before it is placed. An equivalent grout of portland cement and water, applied by pressure spray, may be substituted with approval of the engineer.
- E. Joint Filler and Sealer shall meet requirements of Section 4136. For a part of this material, a white or gray filler is required by 453.08E.

453.03 EQUIPMENT. Equipment used shall be subject to approval of the engineer and shall comply with the following:

- A. Surface Preparation Equipment shall be of the following types:
 1. Sawing Equipment shall be capable of sawing concrete to the specified depth.
 2. Sand-Blasting Equipment shall be capable of removing rust, oil, and concrete laitance from the existing surface of the pavement.
 3. Scarifying Equipment shall be a power-operated, mechanical scarifier capable of uniformly scarifying or removing the old surface to depths required in a satisfactory manner. Other types of removal devices may be used if their operation is suitable and if they can be demonstrated to the satisfaction of the engineer.
- B. Proportioning and Mixing Equipment shall meet requirements of 2001.20 and 2001.21. Sufficient mixing capacity of mixers shall be provided to permit the intended pour to be placed without interruption.
- C. Placing and Finishing Equipment. A slip-form paving machine meeting requirements of 2301.07B shall be used. The machine shall be inspected and approved before work is started. The contractor shall construct the pavement in a manner and with a system that will provide a smooth-riding surface. The placing equipment shall be either controlled to the proper elevation by stringline or operated on a pad line that is constructed to a controlled, proper elevation.

453.04 FULL-DEPTH PATCHES. Full-depth patches shall be PCC patches constructed according to the plans. Dowels will be required as shown on the plans. The patches will be full-lane width and the minimum length of patch, measured parallel to the centerline, will be 6 feet. Full-depth patches shall be completed in a area before widening or resurfacing work is done.

Construction of full-depth patches shall be according to the Standard Specifications. However, calcium chloride shall not be used, and traffic shall not be permitted on the patches for 36 hours.

453.05 PAVEMENT WIDENING. Pavement widening will be required at locations and as detailed on the plans.

The pavement widening shall be tied to the existing pavement as shown on the plans. Holes for tiebars shall be drilled 1/8 inch larger in diameter than the tiebar. The holes shall be clean and dry, with no particles of dust remaining in the hole. The tiebars shall be grouted in place with an epoxy material listed in I.M. 491.11 and recommended for horizontal installation. Approval will be based on a pull-out load of 10,000 pounds. A positive injection and retaining procedure for the epoxy will be required, as approved by the engineer. Epoxy-grouted dowels shall have a minimum cure time of 24 hours before being subjected to any stress. Tiebars shall be located at least 12 inches from existing transverse joints.

The pavement widening shall be placed monolithically with the overlay in a single pass.

453.06 PARTIAL-DEPTH PATCHES. Partial-depth patches shall be constructed at locations designated by the engineer. The deteriorated concrete shall be removed to a minimum width and maximum depth as indicated on the plans, but no deeper than the reinforcing steel. It is intended and desired that the edges of the partial-depth patch areas be reasonably straight and vertical. Near vertical edges, resulting from using self-propelled milling machines, will be considered acceptable. Each partial-depth patch will have a minimum area of 5 square feet.

Partial-depth patches shall be filled with resurfacing concrete as an integral part of the resurfacing operation.

SP-453-2

453.07 PREPARATION OF SURFACE. Preparation shall include the entire surface to be resurfaced. The surface shall be scarified, followed by sandblasting. Scarification shall be to a normal depth of 1/4 inch. At the contractor's option, the surface may be prepared by shotblasting in accord with SP-423. In either case, the preparation shall be of such an extent as to remove all dirt, oil, and other foreign materials, as well as any laitance or loose material from the surface and edges against which new concrete is to be placed.

Materials removed in the preparation operation shall be disposed of in the shoulder area.

453.08 PLACING AND FINISHING RESURFACING CONCRETE. Resurfacing concrete shall be placed in accord with applicable requirements of Section 2301 with the following modifications.

A. **Surface Cleaning.** Prior to applying grout to the surface, the entire surface shall be cleaned with an air blast. After cleaning, no traffic will be permitted on the cleaned surface except that necessary for overlay construction.

B. **Surface Grouting.** After the surface has been cleaned and immediately before placing concrete, a thin coating of bonding grout shall be scrubbed into the dry, prepared surface. At the contractor's option, the grout may be sprayed onto the surface in a manner subject to approval of the engineer. Care shall be exercised to insure that all parts receive a thorough, even coating and that no excess grout is permitted to collect in pockets. The rate of progress in applying grout shall be limited so that the grout does not become dry before it is covered with new concrete.

During delays in the surfacing operation, should the surface of the grout indicate an extensive amount of drying, additional grout shall be brushed on the area as directed by the engineer. In areas where the grout becomes thoroughly dried, the grout shall be removed by sandblasting, or other methods as approved by the engineer.

It is not intended or desired that the existing concrete, prepared for resurfacing, be presaturated before grout and new concrete are placed. The prepared surface shall be dry to allow some absorption of the grout.

C. **Joint Identification.** The exact location of each contraction and expansion joint in the existing pavement and the joint to be sawn at each full-depth patch shall be identified on both sides of the pavement by a reliable method.

D. **Placing and Finishing Resurfacing Concrete.** The contractor shall take every reasonable precaution to secure a smooth-riding surface. Prior to placement operations, he shall review his equipment, procedures, personnel, and previous results with the engineer, and the inspection procedures will be reviewed to assure coordination. Precautions shall include the following:

Assurance that concrete can be produced and placed to the proper thickness and cross section within the specified limits, continuously and with uniformity.

After finishing, the contractor shall check the surface with a 10-foot, light straightedge; causes for irregularities exceeding 1/8 inch should be eliminated, and corrections should be made, if practical.

The thickness of all new concrete above the prepared surface shall be as specified on the plans.

The concrete shall be placed for the full width and full depth in one operation, so as to provide for the thickness and cross section shown on the plans. This placement is to include both the widening and the depressed areas at partial-depth patches.

The surface shall be finished, textured and transversely grooved, and the concrete shall be cured, according to the Standard Specifications. A white-pigmented curing compound shall be used, and it shall be applied at 150 percent of the rate specified.

E. **Joints** shall be sawn in the resurfacing directly over existing transverse joints. A joint shall be sawn directly over the existing centerline. Transverse joints shall be to the full depth of new resurfacing concrete, including depressions created in the existing surface, and to 1/4 in the widening areas. Transverse joints shall be sawn as soon as possible without causing excessive raveling. The joint over the existing centerline shall be sawn within 48 hours after placement and to a depth of 1 inch.

All joints shall be sawn to a nominal 1/4-inch width.

Joints shall be cleaned and filled in accord with 2301.30, including the backer rope. The longitudinal joint which is not at the centerline of the new pavement shall be filled with a white or gray filler material.

453.09 LIMITATION OF OPERATIONS. No traffic shall be permitted on the resurfacing until 7 days after placement and until test specimens show a modulus of rupture of 500 pounds or more per square inch. At temperatures below 55 degrees F., the engineer may require a longer waiting time. No resurfacing concrete shall be placed when the air or pavement temperature is below 40 degrees F.

The contractor shall place fence barricades described in 2301.24 at intervals of approximately 1,000 feet. The contractor shall construct a road closure at each point of public access. In addition, a Type II barricade shall be erected at the edge of the overlay at each point of residential or commercial access, and at other locations, as necessary so the barricades are not more than 250 feet apart. These controls shall be maintained for the closure period.

The contractor will be permitted to use the shoulders for construction activities. It will be the contractor's responsibility to repair the shoulders at his expense, as deemed necessary by the engineer, to restore the shoulders to a condition acceptable for shoulder work. The contractor may elect to limit the use and vehicle loadings to minimize this work and its cost.

453.10 METHOD OF MEASUREMENT. The quantity of the various items of work involved in the construction of portland cement concrete resurfacing will be measured by the engineer in accordance with the following provisions:

A. **Portland Cement Concrete Resurfacing, Furnish Only.** The amount of resurfacing concrete of the mix proportions and admixture specified will be measured in cubic yards, using a count of batches incorporated. This quantity shall include concrete placed in the widening sections and partial-depth patches.

B. **Portland Cement Concrete Resurfacing, Placement Only.** The area of portland cement concrete resurfacing, placement only, will be computed in square yards from surface measure longitudinally and the nominal plan width, including widening sections. For work done according to the plans, this will be the plan quantity.

C. **Surface Preparation.** The amount of pavement prepared in accordance with specifications will be measured in square yards from surface measure longitudinally and the nominal width of existing pavement.

D. **Partial-Depth Patches.** The engineer will measure the surface area of partial-depth patches.

453.11 BASIS OF PAYMENT. For the performance of acceptable work, measured as provided above, the contractor will be paid the contract unit price in accordance with the following provisions.

A. **Portland Cement Concrete, Furnish Only.** For the number of cubic yards of portland cement concrete incorporated, payment will be made at the contract price per cubic yard. This shall be full compensation for furnishing all raw materials, and for proportioning, mixing, and delivery of concrete to the paving machine.

B. **Portland Cement Concrete Resurfacing, Placement Only.** For the number of square yards of portland cement concrete resurfacing, placement only, constructed, the contractor will be paid the contract price per square yard. This shall be full compensation for furnishing all materials, labor, and equipment necessary to place, finish, texture and groove, and cure the concrete, including the placement of dowels for widening, placement of the grout, and sawing, cleaning, and sealing the joints, in accordance with the plans and specifications.

C. **Surface Preparation.** For the square yards of pavement prepared - scarification followed by sandblasting - the contractor will be paid the contract price per square yard. This shall be full compensation for preparation of the existing pavement, sandblasting, and for removal and disposal of the old pavement surface material.

D. **Partial-Depth Patches.** For the number of square yards of partial-depth patches prepared, the contractor will be paid the contract price per square yard. This shall be full compensation for removal of material in the patch area.

Payment may be modified because of smoothness, as provided in Specification 913. The modification will be made to payments described in both Paragraphs A and B, above.

Appendix B

COST CENTER 611000 OBJECT 883
 PROJ NO. FR-141-6(29)--26-25 COUNTY DALLAS
 RES ENGR HARVEY OLSON ADDRESS 5244CE CRESTON
 LETTING DATE JUNE 2, 1983 LIQUIDATED DAMAGES \$200.00
 SPECIAL PROV 6/18/82 #PR-1273, 11/9/82 #915, 6/8/82 #906
3/17/83 #920, 2/24/81 #880, 7/21/81 #889, 7/9/82 SP-423,
6/7/83 SP-453, 6/7/83 SP-454, 9/28/82 #913,
2/15/83 SP-440, 3/17/83 #925, 7/18/78 #834
 DATE STARTED _____ FIELD COMP _____ CERT. COMP _____

FORM 860019 9-77 H-383

CONTRACT

NO. 21322

TYPE OF WORK PORT. CEMENT CONC. PAVT. PROJECT NO. FR-141-6(29)--26-25
 MILES 4.492 COST CENTER 611000 OBJECT 883
 COUNTY DALLAS
ON IOWA 141 FROM APPROX. 0.7 MILE EAST OF U S 149 EAST TO
NEAR JCT. IOWA 210

THIS AGREEMENT MADE AND ENTERED BY AND BETWEEN THE IOWA DEPARTMENT OF TRANSPORTATION
ROBERT R RIGLER, DARREL RENSINK, DENNIS VOY, DEL VAN HORN,
BARBARA LUNN, AUSTIN TURNER, & C ROGER FAIR PARTY OF THE FIRST PARTY, AND
FRED CARLSON CO., INC., OF DECORAH, IOWA 06700
 PARTY OF THE SECOND PARTY.

WITNESSETH THAT THE PARTY OF THE SECOND PART FOR AND IN CONSIDERATION OF \$ 81,354,240.99 PAYABLE AS SET FORTH IN THE SPECIFICATIONS, CONSTITUTING A PART OF THIS CONTRACT, HEREBY AGREES TO CONSTRUCT VARIOUS ITEMS OF WORK AND, OR, TO SUPPLY VARIOUS MATERIALS OR SUPPLIES IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS THEREFOR, AND IN THE LOCATIONS DESIGNATED IN THE NOTICE TO BIDDERS AS FOLLOWS

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
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INCLUDES P.C.C. WIDENING & BONDED P.C.C. OVERLAY

1	EXCAVATION, CLASS 10, ROADWAY & BORROW	11,928	CU. YDS.	3.50	41,748.00
2	EXCAVATION, CLASS 13 FOR WIDENING	1,576	CU. YDS.	4.00	6,304.00
3	EXCAVATION, CLASS 20, FOR ROADWAY PIPE CULVERT	6	CU. YDS.	20.00	120.00
4	PATCHES, FULL DEPTH	377	SQ. YDS.	100.00	37,700.00
5	PATCHES, PARTIAL DEPTH	71	SQ. YDS.	100.00	7,100.00
6	PATCHES, BY COUNT	85	ONLY	100.00	8,500.00
7	SURFACE PREPARATION	38,562	SQ. YDS.	3.32	128,025.84
8	PORTLAND CEMENT CONCRETE FURNISH ONLY	5,918	CU. YDS.	43.50	257,433.00
9	PORTLAND CEMENT CONCRETE RESURFACING - PLACEMENT ONLY	46,056	SQ. YDS.	3.70	170,407.20
10	PAVEMENT, STANDARD OR SLIPFORM P. C. CONC., CLASS C, 5.5 INCH	17,044	SQ. YDS.	18.30	311,905.20
11	BRIDGE APPROACH SECTION REINFORCED AS PER PLAN	400	SQ. YDS.	50.00	20,000.00
12	BACKFILL, SPECIAL	3,866	TONS	11.00	42,526.00

PARTY OF THE SECOND PART CERTIFIES BY HIS SIGNATURE ON THIS CONTRACT, UNDER PAIN OF PENALTIES FOR FALSE CERTIFICATION, THAT HE HAS COMPLIED WITH 324 (175) OF THE 1975 CODE OF IOWA AS AMENDED, IF APPLICABLE, SAID SPECIFICATIONS AND PLANS ARE HEREBY MADE A PART OF AND THE BASIS OF THIS AGREEMENT, AND A TRUE COPY OF SAID PLANS AND SPECIFICATIONS IS NOW ON

FILE IN THE OFFICE OF THE PARTY OF THE FIRST PART UNDER DATE OF JUNE 2, 1983
 THAT IN CONSIDERATION OF THE FOREGOING, THE PARTY OF THE FIRST PART HEREBY AGREES TO PAY THE PARTY OF THE SECOND PART, PROMPTLY AND ACCORDING TO THE REQUIREMENTS OF THE SPECIFICATIONS THE AMOUNTS SET FORTH, SUBJECT TO THE CONDITIONS AS SET FORTH IN THE SPECIFICATIONS.
 THE PARTIES HERETO AGREE THAT THE NOTICE AND INSTRUCTIONS TO BIDDERS, THE PROPOSAL FILED HEREIN, THE GENERAL SPECIFICATIONS OF THE IOWA DEPARTMENT OF TRANSPORTATION FOR 1977 TOGETHER WITH SPECIAL PROVISIONS ATTACHED, TOGETHER WITH THE GENERAL AND DETAILED PLANS, IF ANY, FOR SAID PROJECT FR-141-6(29)--26-25 TOGETHER WITH SECOND PARTY'S PERFORMANCE BOND, ARE MADE A PART HEREOF, AND TOGETHER WITH THIS INSTRUMENT CONSTITUTE THE CONTRACT BETWEEN THE PARTIES HERETO.

THAT IT IS FURTHER UNDERSTOOD AND AGREED BY THE PARTIES OF THIS CONTRACT THAT THE ABOVE WORK SHALL BE COMMENCED OR COMPLETED IN ACCORDANCE WITH

THE FOLLOWING SCHEDULE

APPROX. OR SPECIFIED STARTING DATE OR NUMBER OF WORKING DAYS	SPECIFIED COMPLETION DATE OR NUMBER OF WORKING DAYS
<u>JULY 5, 1983</u>	<u>80 WORKING DAYS</u>

THAT TIME IS THE ESSENCE OF THIS CONTRACT AND THAT SAID CONTRACT CONTAINS ALL OF THE TERMS AND CONDITIONS AGREED UPON BY THE PARTIES HERETO, IN WITNESS WHEREOF THE PARTIES HERETO HAVE SET THEIR HANDS FOR THE PURPOSE HEREIN EXPRESSED TO THIS AND THREE OTHER IDENTICAL INSTRUMENTS AS OF THE _____ DAY OF _____, 19____

IOWA DEPARTMENT OF TRANSPORTATION

BY _____
 PARTY OF THE FIRST PART
FRED CARLSON CO., INC., OF DECORAH, IOWA

CONTRACT NO. 21322 PROJECT FR-141-6(29)--26-25					PAGE	2
ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	
13	BACKFILL, POROUS	3.500	CU. YDS.	30.00	105.00	
14	FABRIC, ENGINEERING	1.947	SQ. YDS.	1.50	2,920.50	
15	SUBDRAIN, LONGITUDINAL, (SHOULDER) 4 IN. DIA.	9.506	LIN. FT.	4.25	40,400.50	
16	SUBDRAIN, PERFORATED 4 IN. DIA.	80	LIN. FT.	8.00	640.00	
17	SUBDRAIN OUTLET, CORR. METAL PIPE 6 IN. DIA.	15	ONLY	60.00	900.00	
18	REMOVAL OF PAVEMENT	14.309	SQ. YDS.	3.25	46,504.25	
19	SALVAGING AND PROCESSING OLD PAVEMENT	6.150	TONS	8.50	52,275.00	
20	SHOULDERS, GRANULAR SURFACING OF, FURNISH ONLY	3.964	TONS	8.50	33,694.00	
21	SHOULDERS, GRANULAR SURFACING OF, PLACE ONLY	11.914	TONS	3.50	41,699.00	
22	SHOULDER CONSTRUCTION, EARTH	2.060	STAS.	200.00	412.00	
23	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	900	TONS	10.00	9,000.00	
24	LOCATING TILE LINES	10	STAS.	150.00	1,500.00	
25	SAMPLES		LUMP SUM		1,600.00	
26	REMOVAL OF EXISTING STRUCTURES		LUMP SUM		2,000.00	
27	CULVERT, CONCRETE ROADWAY PIPE 66 IN. DIA.	4	LIN. FT.	400.00	1,600.00	
28	APRONS, CONCRETE, 24 IN. DIA.	6	ONLY	250.00	1,500.00	
29	APRONS, CONCRETE, 30 IN. DIA.	4	ONLY	350.00	1,400.00	
30	APRONS, CONCRETE, 36 IN. DIA.	2	ONLY	450.00	900.00	
31	APRONS, CONCRETE, 42 IN. DIA.	2	ONLY	550.00	1,100.00	
32	APRONS, CONCRETE, 66 IN. DIA.	1	ONLY	1,000.00	1,000.00	
33	GUARDRAIL, FORMED STEEL BEAM	200	LIN. FT.	8.00	1,600.00	
34	GUARDRAIL, FORMED STEEL BEAM, INSTALL ONLY	425	LIN. FT.	3.70	1,572.50	
35	REMOVE & REINSTALL FORMED STEEL BEAM GUARDRAIL	100	LIN. FT.	4.50	450.00	
36	POSTS, REMOVE AND REINSTALL	20	ONLY	32.00	640.00	
37	GUARDRAIL, POSTS, BEAM	54	ONLY	60.00	3,240.00	
38	GUARDRAIL, POSTS, BEAM INSTALL ONLY	78	ONLY	23.00	1,794.00	
39	GUARDRAIL, END ANCHORAGES, BEAM RE-52	8	ONLY	320.00	2,560.00	
40	REMOVE AND REINSTALL OBJECT MARKERS	4	ONLY	10.00	40.00	
41	OBJECT MARKER, TYPE 3	8	ONLY	50.00	400.00	
42	DELINEATOR, TRIPLE YELLOW VERTICAL	4	ONLY	25.00	100.00	
43	DELINEATORS, SINGLE WHITE	3	ONLY	20.00	60.00	
44	TOPSOIL, STRIP., SALVAGE AND SPREADING	2,090	CU. YDS.	3.50	7,315.00	
45	SILT BASIN	7	ONLY	150.00	1,050.00	
46	SILT FENCE	4,000	LIN. FT.	1.50	6,000.00	
47	SILT FENCE FOR DITCH CHECKS	345	LIN. FT.	2.00	690.00	
48	PAVEMENT MARKINGS	606	STAS.	20.00	12,120.00	
49	TRAFFIC CONTROL		LUMP SUM		12,000.00	
50	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 24 IN. DIA.	54	LIN. FT.	25.00	1,350.00	
51	SODDING	3	SQUARES	90.00	270.00	
52	SPECIAL DITCH CONTROL, JUTE MESH OVER SOD	3	SQUARES	50.00	150.00	

CONTRACT NO. 21322 PROJECT FR-141-6(29)--26-25				PAGE 3	
ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
53	SEEDING & FERTILIZING	17.500	ACRES	300.00	5,250.00
54	MULCHING	17.500	ACRES	300.00	5,250.00
55	SPECIAL DITCH CONTROL, WOOD EXCELSIOR MAT	204	SQUARES	20.00	4,080.00
56	WATER FOR SPECIAL DITCH CONTROL AND SLOPE PROTECTION	81.600	M-GALS.	25.00	2,040.00
57	BARRICADES	21	ONLY	300.00	6,300.00
58	FIELD LABORATORY	1	ONLY	1,800.00	1,800.00
59	CLEARING & GRUBBING	300.00%			2,400.00
60	TRAINEE REIMBURSEMENT	1.000	HOURS	.80	800.00
GRAND TOTAL					\$1,354,240.00