RECYCLED PORTLAND CEMENT CONCRETE PAVEMENT IN IOWA

Final Report

Iowa D.O.T. Project HR-506

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National Experimental and Evaluation Program
Project 22

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Highway Division
Iowa Department of Transportation

Disclaimer

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RECYCLED PORTLAND CEMENT CONCRETE PAVEMENT IN IOWA

INTRODUCTION

In recent years, there has been an increased interest in conservation of our resources, preservation of our environment and maintaining our ecology. Recycling of materials is a procedure that will immediately contribute to all of these desirable end results. Our economy is built on private enterprise and profit incentive and in the past, with abundant inexpensive resources, there was little incentive to recycle. Shortages of materials and energy (once considered abundant) along with regulations to protect the environment have emphasized the need for recycling. These environmental conditions coupled with the loss of purchase power by inflation has generated more interest in recycling in the transportation field.

The Iowa Department of Transportation (Iowa DOT) is interested in recycling portland cement concrete (pcc) pavement to:

1. Provide aggregate where high quality aggregate is no longer economically available.
2. Eliminate the need for locations to waste the large amount of pavement rubble.
3. Conserve the present aggregate sources.
4. Reduce the need for disrupting land for quarrying purposes.
5. Save fuel and energy by reducing aggregate transportation.

6. Reduce damage to haul roads near paving projects.

7. Achieve a monetary savings while constructing high quality roadways.

EARLIER PROJECTS

Lyon County

The first Iowa DOT project (in 1976) utilizing crushed pavement as an aggregate in pcc was located in Lyon County (extreme northwest Iowa).[1] The project consisted of the approaches to two bridges totaling about 1.5 miles of paving. The old pavement was constructed in 1936 using a gravel coarse aggregate and was in good condition prior to recycling. The crushed pcc was used with natural sand in the construction of new 9 inch thick pavement. Some of the old 7 to 10" thick pcc pavement with 3" of asphalt resurfacing was crushed as a mixture and used in a 7" econocrete lower course. The 4" top course of concrete utilized crushed pcc aggregate without A.C. resurfacing. The Lyon County research was very successful and demonstrated the potential for recycling pcc pavement.

Pottawattamie County

Iowa recycled another pcc pavement in 1977 based upon the success of the 1976 Lyon County project. This project was 3 miles of I-680 in Pottawattamie County. The old pavement, constructed in 1952 with a good quality crushed limestone

(Gilmore City) coarse aggregate,was in good condition exhibiting essentially no distress when it was recycled. The crushed pcc aggregate was used with natural sand in the 4" econocrete base and the 6" pcc shoulders on one lane of I-680.

PROJECT LOCATION

Three pcc recycling paving projects (Page TQF-2-2(16)--29-73, Taylor TQF-2-3(15)--29-87 and Taylor TQF-2-3(18)--29-87 located in southwest Iowa were constructed in 1978 with completion in 1979. The material for these projects was crushed in 1977. The combined projects were approximately 16 miles in length beginning near Clarinda and extending easterly to near Bedford.

SOURCE OF RECYCLED AGGREGATE

The old pavement was constructed in 1929 using Platte River sand-gravel aggregate from Oreapolis, Nebraska. The slab thickness varied from 7" in the middle to 10" at the outer edges (Figure 1). The pavement was 18' wide with 3" curb on all but about three of the sixteen miles. In 1964, all curbed sections were resurfaced with Type "A" asphalt concrete for curb elimination.

The old pavement was in generally good condition. There was some surface check cracking that is typical, to varying degrees, of the Feldspathic Platte River material. This surface cracking had little adverse effect on the pavement except in a few localized areas. Twenty-three 4" diamter cores were taken from the old

pavement. The average strength of those cores was 6535 psi (corrected for H/D). The reason for reconstruction of this roadway was obsolescence of width and alignment.

There was substantial reinforcing steel (Figures 1 and 2) with four longitudinal 5/8" diameter smooth round bars. The transverse steel consisted of 11 feet by 5/8" diameter plain bars at 3' centers. They were placed so that they extended within 6" of the edge of pavement and alternate from edge to edge. There were dowels and additional 8 foot by 5/8" diameter bars at all construction joints.

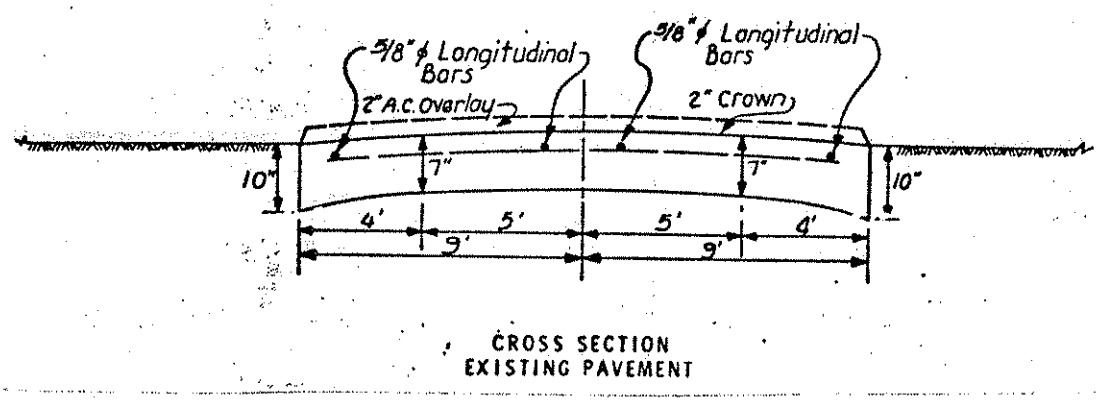

Figure 1: Cross section -- existing pavement

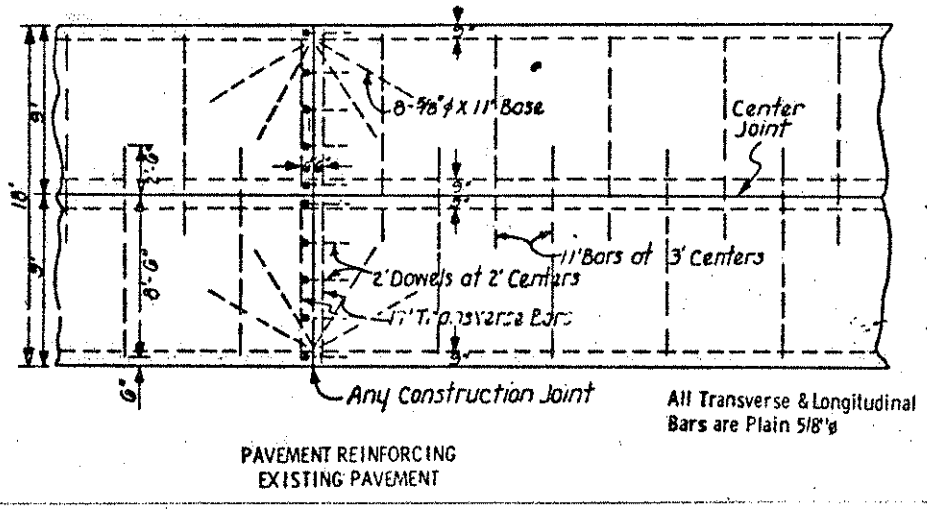

Figure 2: Plan of pavement reinforcing existing pavement

CONTRACTS AND CONTRACTORS

The Iowa DOT let two sets of tied contracts (Appendix A) for the complete reconstruction of the roadway. The first was "grading" which included the "Removal and Crushing of Old Pavement". The special provisions for the removal and crushing of old pavement are included as Appendix B. The contractors for the grading were Sterling McLaren Construction Company, Inc. of Shenandoah, Iowa and Johnson Bros., Inc. of Red Oak, Iowa. Sterling McLaren and Johnson Bros. performed the grading, but subcontracted the breaking and removal to Reilly Construction Company of Ossian, Iowa, and the crushing to Kuhlman Construction Company of Colesburg, Iowa. The second set of tied projects was for the "paving". The successful bidder was Irving F. Jensen Company, Inc. of Sioux City, Iowa.

REMOVAL OF THE ASPHALT OVERLAY

The first phase in the recycling project was the removal of the two to three inches of asphalt resurfacing. In planning for the project, the general consensus was that the asphalt removal would be relatively easy. Unfortunately, this was not true and it required substantial effort and a number of operations to remove the asphalt.

Shattering of the asphalt resurfacing was the first operation in the removal. This was accomplished with a special pavement breaker designed and manufactured by Reilly Construction.

The pavement breaker (Figures 3 & 4) was fabricated using a new diesel pile driving hammer mounted on the running gear of a motor grader and towed with an end loader.

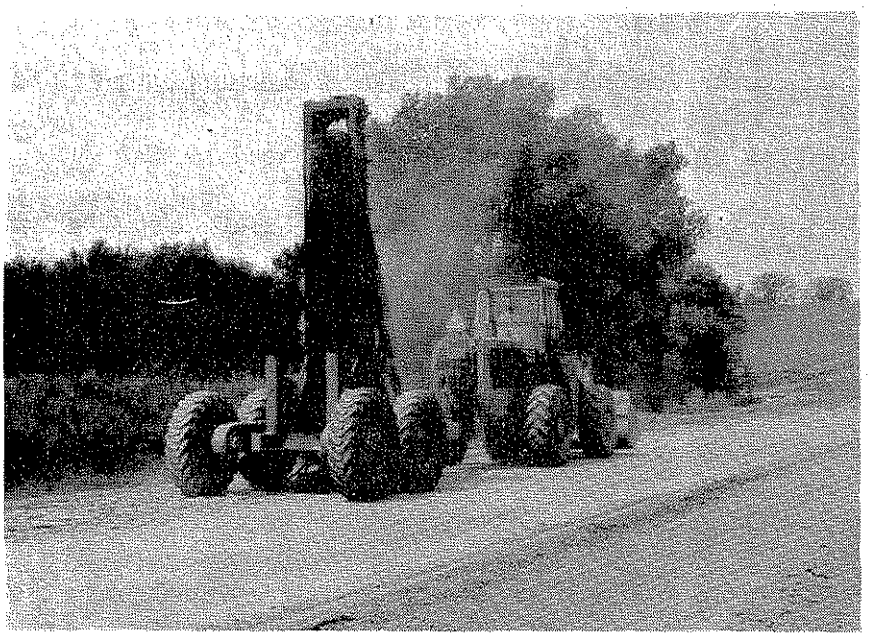

Figure 3: Special pavement breaker

Figure 4: Special pavement breaker

The diesel hammer was adjusted to produce the right amount of energy when coordinated with the forward speed (1 to 3 MPH) to fracture the overlay with minimal damage to the underlying slab.

After the fracturing, a #16 motor patrol equipped with three ripper teeth tore the asphalt from the pcc slab. There were times when the asphalt adhered very tightly and the patrol could not pull three teeth. In some cases, the patrol could pull only two teeth, and in some cases, only one tooth.

A rubber tired end loader was used to remove the loosened material and scrape free any adhering material. The final operation was brooming to remove the fine material.

BREAKING , REMOVAL AND CRUSHING OF THE PAVEMENT

There is no standard method of breaking and removal. The procedure selected is dependent on the contractor's plans for steel removal and crushing. In the first Iowa DOT recycling project (Lyon County) the contractor used a pneumatic hammer mounted on the rear of a backhoe to punch holes in the old slab on 3 foot centers. The concrete rubble was transported in larger chunks and most of the steel was removed at the crushing plant. On the second recycling project, a commercial pavement breaker was used.

This recycling project was much larger and, therefore, allowed the contractor more options and the consideration of more specialized equipment. As noted previously, the old slab of this project

contained more steel than the first two Iowa projects. With this in mind, the contractor intended to extensively shatter the concrete, but because the concrete rubble was to be picked up, care was required not to punch the concrete into the grade. The special diesel pile driver breaker would accomplish these tasks. For breaking of the old pcc slab, a large front end loader towed the special breaker at about 1 MPH with 80 to 90 blows per minute. The breaking operation required 12 passes (6 per lane) to provide the desired shattering on the curbed sections. Another precaution, to avoid including subgrade material, was to blade away the shoulders and expose the edges of the slab.

A rubber tired hydraulic excavator (Figure 5) equipped with a ripper tooth (Figure 6) which was referred to as a "Rhino horn" was used to dislodge and remove part of the reinforcing steel. To avoid punching the concrete rubble into the base, the "Rhino horn" was operated from the excavated shoulder area. The operator would reach the "Rhino horn" to the opposite edge and rip back to the center of the slab.

The steel was hooked and elevated to expose it for removal (Figure 7). This operation was conducted from each shoulder so the rubble was moved toward the center of the old slab.

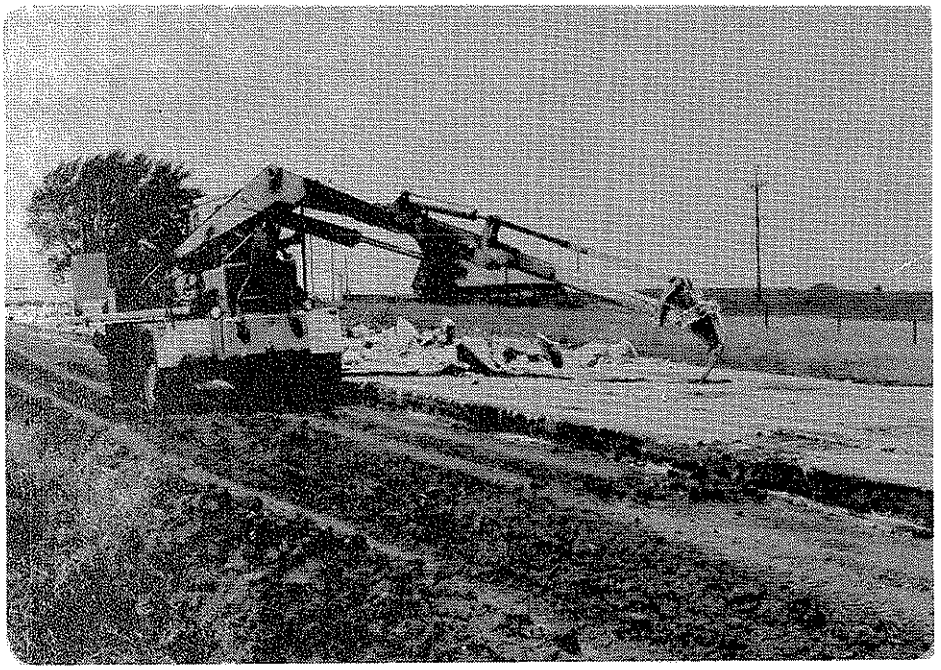

Figure 5: Excavator equipped with "Rhino horn"

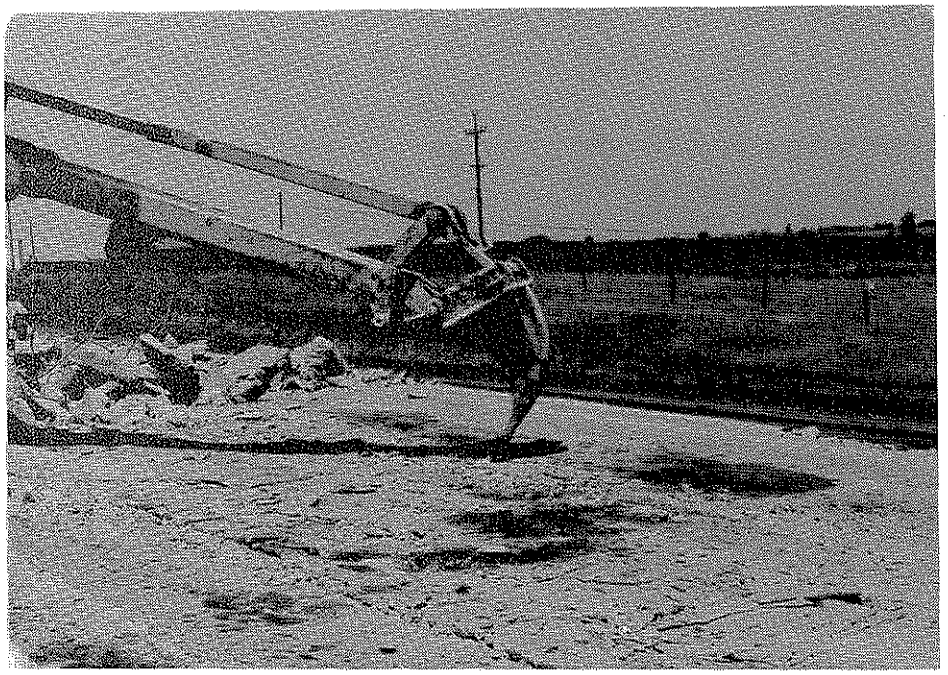

Figure 6: "Rhino horn" ripper tooth

Figure 7: Dislodging and exposing the steel

A cutting torch was used to cut the exposed steel free of the concrete rubble (Figure 8).

Figure 8: Removing the steel with a cutting torch

A shear (Figure 9) was used to cut the steel into two foot lengths to increase its value as scrap. The contractor salvaged 200 tons of scrap from the 16 miles of recycling.

Figure 9: Shearing the steel

The concrete rubble (Figure 10) was then loaded with a track mounted front end loader (Figure 11) for transport to the crushing site.

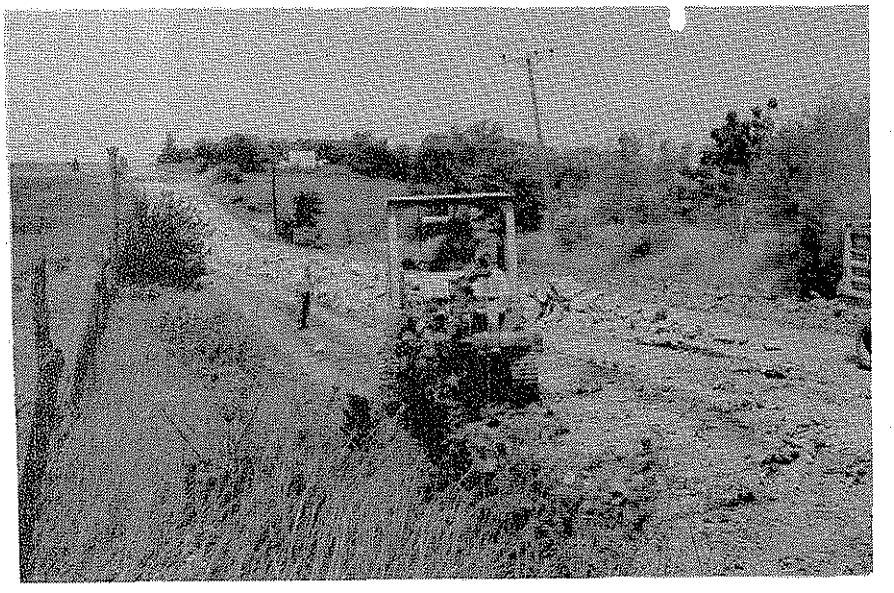

Figure 10: The recycled "Quarry"

Figure 11: Loading the concrete rubble

Operator capability was very important as special provision 183 (Appendix B) required recovery of at least 80% of the old concrete slab. It was necessary to avoid incorporating earth subgrade into the rubble that would cause problems in producing a crushed product with not more than 5% passing the No. 200 sieve. This was different from the normal practice of when all concrete plus some earth is loaded.

The concrete was stockpiled for crushing at two sites that had been leased by the Iowa DOT. Crushing the concrete rubble presented some problems not encountered in quarrying operations. First, a scalper referred to as a "grizzly" was used ahead of the primary jaw (Universal 20-76) crusher to remove mud balls and other fines (Figure 12).

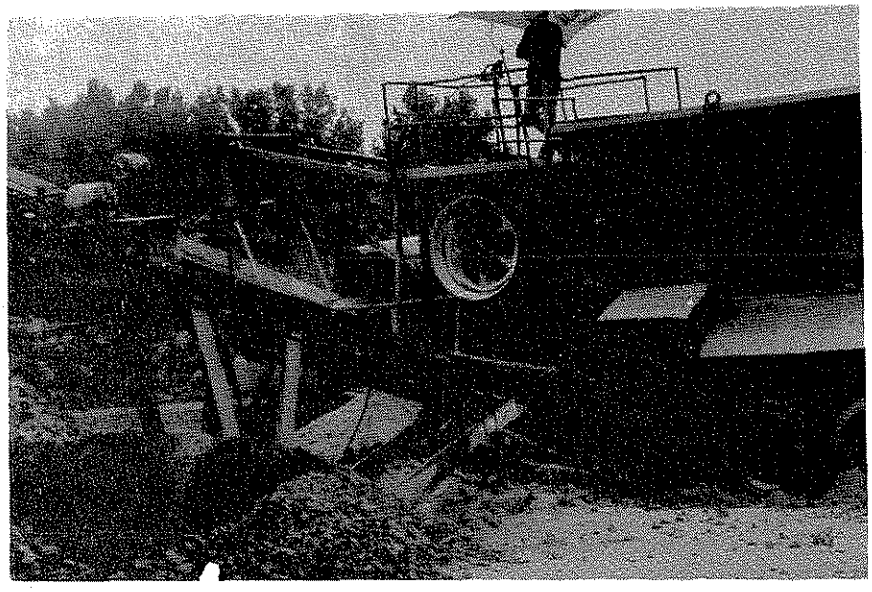

Figure 12: The primary crusher with conveyor from scalper

This was effective in alleviating the problem of meeting the No. 200 sieve specification.

There was still some reinforcing in the rubble. Sufficient clearance of the conveyor belt at the primary crusher was required to allow the metal pieces to leave the jaw. It was then necessary to remove this steel to avoid damage to the secondary crusher. This was accomplished by a large electromagnet (Figure 13).

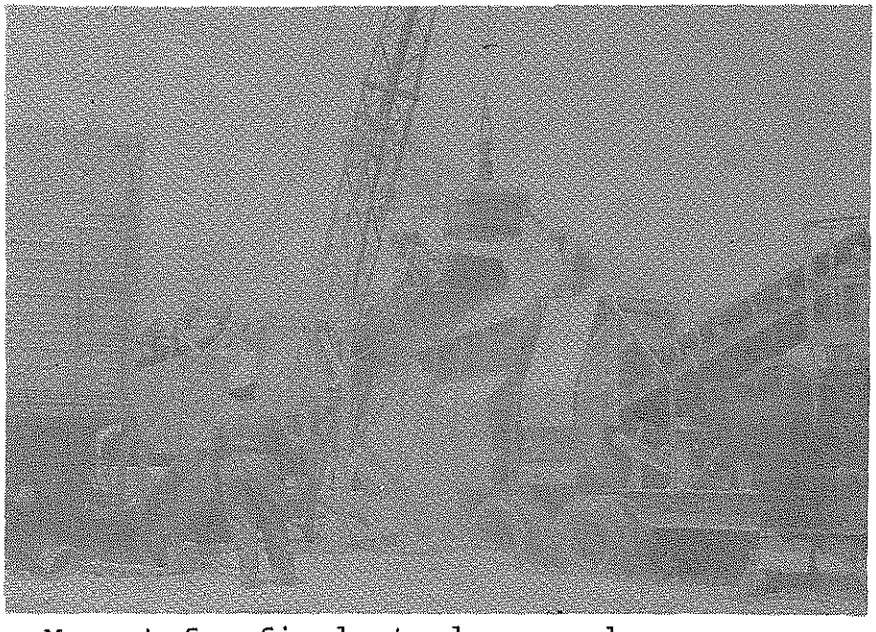

Figure 13: Magnet for final steel removal

A laborer manually removed the steel from the magnet. The contractor indicated that on future recycling, he would use a self-cleaning magnet.

Primary crushing reduced the concrete to approximately 3 inch size material. The crushed product was further processed in the secondary crusher with a Universal 10-36 jaw and separated into 1½ inch to 3/8 inch and minus 3/8 inch size material. At the start, the fines were removed from the minus 3/8" material at the secondary crusher, but after the "grizzly" was opened for scalping, this was no longer necessary. The crushed products were stockpiled by a conveyor belt with radial movement capability.

Typical gradation of the two sizes were:

Coarse Fraction

Sieve Size	Percent Passing
1½ inch	100
1 inch	72
3/4 inch	39
½ inch	21
3/8 inch	9.3
No. 4	2.9
No. 8	2.0
No. 200	0.7
Clay lumps	0.2%

Fine Fraction

Sieve Size	Percent Passing
3/8 inch	100
No. 4	76
No. 8	51
No. 16	30
No. 30	16
No. 50	8.0
No. 100	3.5
No. 200	2.0

The crushing operation produced approximately 65% coarse fraction and 35% fine fraction. The total estimated production for use was 28,000 tons at the New Market site and 26,000 at the Bedford site.

The breaking, removal and crushing operations were completed in 1977 as part of the grading contract.

TESTING OF RECYCLED AGGREGATE

The crushed concrete was evaluated using the conventional aggregate tests (Appendix C). The 59% abrasion loss was slightly above the 50% allowed for crushed stone. The 42% "A" freeze and thaw loss was much higher than the 6% set forth by the standard specification. There is some question whether these tests are applicable to recycled aggregate. The recycled aggregate, may in fact, provide high performance in the new concrete. The recycled aggregate was accepted on the basis of high performance in the original slab.

TRIAL MIXES

A number of trial mixes were made utilizing the recycled aggregate in different proportions (Appendix D). The two earlier Iowa DOT pcc recycling projects had demonstrated that some natural sand was necessary to provide a workable mix, therefore, all trial mixes included a natural sand. Iowa's standard pcc mix proportions use only two aggregates and a Standard Specification C-4 mix would be typical for a primary road pavement.

C-4 Mix Proportions

Material	Absolute Volumes	Quantities per cu.yd.* (pounds)
Cement (Type 1)	0.118330	626
Water	0.159808	269
Entrained Air	0.06	
Fine Agg.	0.330931	1478
Coarse Agg.	0.330931	1478

*Assume aggregate Sp.Gr. = 2.65

An effort was made to use percentages of recycled materials that were in keeping with the quantities available. A number of preliminary trial mixes were made with a sand (Hallett-Ames) that is normally used by the laboratory. Most of the mixes were made with 626 pounds of cement which is typical for primary road paving. Durability of the recycled concrete was 94 when tested by ASTM C666 Method B (freezing in air, thawing in water). A 90-day moist cure conditioning preceeded the freeze-thaw testing. Concrete abrasion tests were conducted on both recycled concrete and

concrete made with virgin aggregate. The results were almost identical.

Most of the project trial mixes (with southwest Iowa sand) included a water reducing admixture. The 28-day strengths ranged from 5300 psi to 6010 psi. Workability was not seriously affected by the use of crushed concrete aggregate.

The trial mixes were the basis for development of the mix proportion section of the special provisions (Appendix E).

PAVING PROJECT

The paving was let independent of the project for pavement removal and crushing. The paving began on July 10, 1978 with the majority being constructed during 1978 and completed May 7, 1979.

Paving with recycled aggregate presented only minor differences from a conventional paving operation. First, there were three aggregates instead of the normal two. The second was somewhat of a problem resulting from the recycled aggregate and specifically the fact that the crushing was in 1977 with paving in 1978. The fine crushed concrete aggregate developed a three inch crust apparently from recementing of the crushed product. To minimize this problem, the material was passed through a 3 inch by 3 inch screen prior to batching.

The paving train was completely conventional with the first

piece of equipment being a CMI Autograde with the conveyor to carry the plastic concrete over the subgrade trimmer. A Rexnord Town and Country slipform paver placed the 8" thick 24' wide slab. After a limited amount of handwork, straightedging or floating, a transverse tine grooved texture was imparted by a CMI machine. This was followed by application of a white pigmented wax base curing compound.

Construction testing included slump, air content, flexural strength and density (Appendix F). A summary of the averages of these tests by project is:

Project	Slump	Air	Modulus of Rupture 7 day	Modulus of Rupture 14 day	Density
Page TQF-2-2 (16)--29-73	1.65	6.8	718	778	
Taylor TQF-2-3 (15)--29-87	1.46	6.9	745	809	135.8
Taylor TQF-2-3 (18)--29-87	1.47	7.0	771	843	

The only reinforcing steel other than doweled work joints are #4 x 36" tie bars across centerline at 30" centers. Contraction joints skewed at 1 to 6 were sawed on 20 foot centers. Both the contraction and longitudinal centerline joints were sawed a nominal 1/4" wide and a minimum of 2 inches deep (T/4).

ENVIRONMENTAL FACTORS

Recycling provides a direct benefit in conservation of raw material and energy. On these Page-Taylor projects, 28,124 tons

of coarse and 12,661 tons of fine crushed concrete aggregate were used. This eliminated the need of disposing of 40,785 tons or 20,602 cubic yards (Sp.Gr.=2.35) of concrete rubble. It also saved 45,991 tons of virgin aggregate (Sp.Gr.=2.65). Approximately 200 tons of steel were salvaged for recycling.

If the gasoline and diesel fuel used in reclaiming the old slab are considered similar to that used for removing the overburden and obtaining virgin aggregate, there is a substantial fuel savings in eliminating the aggregate transportation from the quarrry to the project (estimated at 75 miles). It is further estimated that this prevented $27,000 damage to haul roads in the vicinity of the project.

COST COMPARISON

The project was let as a recycled concrete project and bid data using conventional aggregate is not available. The estimated cost analysis summary is:

Average Cost of Recycled Material

33,904 s.y. Removal & crushing	@ $3.70 =	$ 125,444.80
127,845 s.y. Removal & crushing	@ $3.30 =	421,888.50
		$ 547,333.30
Minus normal removal cost 161,749 s.y.	@ $1.00 =	- 161,749.00
Plus added cost for Class 10 material 54,000 tons	@ $0.30 =	+ 16,300.00
	TOTAL COST	$ 401,784.30

Material Cost Using Recycled Concrete

Crushed coarse aggregate 0.542 ton	@ $7.44/ton =	$ 4.03
Crushed fine aggregate 0.319 ton	@ 7.44/ton =	2.37
pc sand 0.467 ton	@ 5.60/ton =	2.62
Cement 0.313 ton	@ 48.00/ton =	15.02
		$24.04

8" paving = $5.34/s.y.

Material Cost Using Locally Available Material for A-6 Mix

Coarse aggregate (Class 2) 0.582 tons @	$10.50 =	$ 6.11
pc sand 0.873 tons @	5.60 =	4.89
Cement 610 lbs @	48.00	14.64
		$25.64

8" paving = $5.70/s.y.

Savings:

243,356 s.y. 8" paving @ $0.36 =	$ 87,608.16
2,765 s.y. 6" paving @ 0.27 =	746.55
Haul Road savings	27,000.00
	$115,354.71

Savings per mile = $115,354.71 ÷ 16.656 miles = $6,925./mile

POST CONSTRUCTION TESTING

The Iowa DOT drills 4" diameter cores to determine the pavement thickness which is a factor in the basis of payment. These cores are tested to determine compressive strength and air content (Appendix G). The averages for the three projects are:

Project TQF-2-2	Slab Thickness	Computed Strength 28 day	%Air Hardened Concrete
Page (16)--29-73	8.2	3874	7.2
Taylor (15)--29-87	8.3	3885	7.6
Taylor (18)--29-87	8.4	3802	6.4

PERFORMANCE EVALUATION

The riding quality was determined using the BPR Type Roughometer with 101, 94 and 99 inches per mile on the three projects (Appendix H). These values indicate a relatively poor riding pavement which is attributed to the quality of workmanship during construction, not from problems caused by the use of recycled aggregate. There were three end-of-day work joints that were so rough, they were not acceptable and were repaved.

The frictional quality has been determined by ASTM E-274 (Appendix I). The initial friction values were exceptionally good with project averages of 50, 56, and 61 (SN_{40}). Friction numbers at 40 MPH have been determined annually from 1979 through 1982. The friction numbers in 1982 after three years of traffic were 45, 52, and 49. These values would be typical of transverse tine textured PCC pavement.

A field review of the three projects was made in October, 1979. The general surface appearance was very similar to that of conventional paving projects. The joints appeared to be in good condition exhibiting no faulting or deterioration even though some did not appear to be well sealed. An October 1982 field review found very little joint faulting, but faulting up to 1/8 inch was measured at a few joints. The joint faulting had increased to an average of 1/8" by November 1983. The most recent joint faulting survey was conducted in September 1984. Three joints were measured at each of 15 milepost markers. The average faulting at the 45 joints was 0.09 inches. The faulting just before and after the recycled project ranges from 1/8 to 1/4 inch. Both the pavement prior to and beyond the project are slightly older than the recycled project. The joint faulting appears to be progressing very similar to the comparative sections on either end. Load transfer devices were not used on any of these projects.

There is a number of surface popouts which have little adverse effect on the integrity of the pavement. They are more numerous than would be expected on a conventional pavement resulting from iron oxides in gravel or unsound chert in crushed limestone. The cause of the popouts in the recycled concrete were chunks of the crushed material from the fine crushed concrete stockpile. The weakly cemented chunks came to the surface during consolidation and through the freezing of one winter season resulted in

popouts. The popouts resulting from the fine crushed aggregate chunks have not caused any significant problem. There has been little change in this problem since the initial popouts.

A substantial amount of random cracking has occurred beginning soon after construction. There are areas exhibiting a significant amount of longitudinal 1/4 point cracking. This 1/4 point cracking is probably attributed to differential settlement of the grade.

The frequently occurring midpanel cracking is of greater concern. It is suprising that these are so prevalant considering the skewed joints at intervals of 20 feet. A survey of this midpanel cracking was conducted in September 1984. The number of midpanel cracks were counted in the 50 panels immediately east of each milepost marker. The results were:

MP	Cracks per 50 Panels	MP	Cracks per 50 Panels
54	6	62	11
55	16	63	18
56	14	64	2
57	4	65	0
58	16	66	7
59	15	67	17
60	18	68	8
61	2		

The range is from 0 to 36% with an average of 20% of the panels having cracked. The project to the east with transverse tine texturing and skewed joints at 20 feet had 6% midpanel cracking east of milepost 70.

Cores were drilled in July 1982 to investigate the reason for this problem. The strength of three cores taken from an area with a predominance of midpanel cracking ranged from 7,080 to 7,140 psi with an average of 7,120 psi. These relatively good strengths were very consistent and the midpanel cracking is apparently not due to poor strength. Four cores were also drilled through contraction joints in this area to verify that they had cracked and

were functioning. All four cracked as intended and were functioning. The midpanel cracking generally follows the transverse tine texturing. In addition to the reduced section at this point, subsequent laboratory evaluations have shown that the standard cure application of 1978-79 was not fully effective in sealing the transverse tine texturing. This in conjunction with the relatively porous recycled aggregate may have allowed drying shrinkage which contributed to the cracking.

The chloride content of the pavement was determined from the cores taken in 1982. The chloride contents at various depths were:

Depth Inches	Chloride Content Pounds per Cubic Yard
1/2	2.6
1	0.9
1 1/2	0.6
2	0.4

The general appearance of the recycled pavement is very good. There is no indication of deterioration even though the joint sealant has not prevented water infiltration. The pavement has performed very well to date with no maintenance problems.

CONCLUSIONS

This study of PCC pavement constructed with recycled aggregate supports the following conclusions:

1. The recycled PCC pavement has exhibited a good performance.
2. The major problem with this recycled PCC pavement has been a high frequency of midpanel cracking.
3. The faulting is typical of conventional pavement without load transfer assemblies.

4. There is a substantial economic benefit for recycling PCC pavement in areas where quality aggregate are not in close proximity.
5. The recycled PCC pavement has exhibited good frictional characteristics.

RECOMMENDATION

Recycling of PCC pavement should be considered as an alternate on all future reconstruction or rehabilitation projects.

ACKNOWLEDGEMENT

A special thanks to Bob Rielly of Rielly Construction and Bill Burgan, O. J. Lane, Jr., Jerry Bergren, Tom Cackler and Richard Smith of the Iowa DOT who assisted in this report.

REFERENCE

1. "Portland Cement Concrete Utilizing Recycled Pavement", 1977, Iowa Department of Transportation.

FORM 050049 8-77 H-3878

CONTRACT NO. 14115

Appendix A
Page 1

TYPE OF WORK GRADE & PCC PAV'T. PROJECT NO. TQF-2-3(18)--29-87

MILES 1.394 COST CENTER 611000 OBJECT 878

COUNTY TAYLOR

ON RELOCATED IOWA 2 FROM THE E. JCT. IOWA 148 IN BEDFORD EASTERLY 1.4 MILES TO PRESENT IOWA 2

THIS AGREEMENT MADE AND ENTERED BY AND BETWEEN THE IOWA DEPARTMENT OF TRANSPORTATION ROBERT R RIGLER, STEPHEN GARST, DONALD K GARDNER, ALLAN THOMS, W. F. MCGRATH, BARBARA DUNN, & L. STANLEY SCHOELERMAN PARTY OF THE FIRST PART, AND IRVING F. JENSEN CO.INC. OF SIOUX CITY, IOWA. 21400

PARTY OF THE SECOND PART

WITNESSETH, THAT THE PARTY OF THE SECOND PART, FOR AND IN CONSIDERATION OF $ ****289,306.68 , 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
1	EXCAVATION, CLASS 10, ROADWAY & BORROW	10,902	CU. YDS.	1.00	10,902.00
2	EXCAVATION, CLASS 12, BOULDERS	10	CU. YDS.	10.00	100.0
3	EXCAVATION, CLASS 20	17	CU. YDS.	5.00	85.0
4	BACKFILL, SPECIAL	4,060	TONS	6.88	27,932.8
5	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	728	TONS	6.10	4,440.8
6	STABILIZED SHOULDER MATERIAL	6,321	TONS	7.70	48,671.7
7	PAVEMENT, STANDARD OR SLIP FORM P. C. CONC., CLASS A, 8 IN.	24,642	SQ. YDS.	6.60	162,637.2
8	MEDIAN, 6 IN. P. C. CONCRETE	44	SQ. YDS.	15.00	660.0
9	BRIDGE APPROACH SECTION REINFORCED AS PER PLAN	107	SQ. YDS.	30.00	3,210.0
10	SURFACE TREATMENT OF P. C. CONCRETE PAVEMENT	24,793	SQ. YDS.		.0
11	CONCRETE, INCIDENTAL P. C.	4	CU. YDS.	125.00	500.0
12	CULVERT, CONCRETE ROADWAY PIPE 36 IN. DIA.	64	LIN. FT.	26.00	1,664.0
13	APRONS, CONCRETE, 12 IN. DIA.	1	ONLY	120.00	120.0
14	APRONS, CONCRETE, 36 IN. DIA.	2	ONLY	290.34	580.6

PARTY OF THE SECOND PART CERTIFIES BY HIS SIGNATURE ON THIS CONTRACT, UNDER PAIN OF PENALTIES FOR FALSE CERTIFICATION, THAT HE HAS COMPLIED WITH 324.17(8) 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 DECEMBER 28, 1977

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 TQF-2-3(18)--29-87 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
80 WORKING DAYS	OCT. 20, 1978

AND 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 JAN 17 1978 , 19__

IOWA DEPARTMENT OF TRANSPORTATION

BY _____
PARTY OF THE FIRST PART

IRVING F. JENSEN CO.INC. OF SIOUX CITY, IOWA.

BY _____
PARTY OF THE SECOND PART

CONTRACT NO. 14115 PROJECT TØF-2-3(18)--29-87

ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMO
15	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 18 IN. DIA.	118	LIN. FT.	10.00	1,180.0
16	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 24 IN. DIA.	10	LIN. FT.	15.00	150.0
17	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 36 IN. DIA.	50	LIN. FT.	25.00	1,250.0
18	ELBOWS, CORR. METAL PIPE 18 IN. DIA.	1	ONLY	90.00	90.0
19	INTAKE, RA-3 - MODIFIED	1	ONLY	800.00	800.0
20	INTAKE, RA-3	1	ONLY	1,200.00	1,200.0
21	INTAKE, RA-6	1	ONLY	1,500.00	1,500.0
22	MANHOLE, RA-2	1	ONLY	1,200.00	1,200.0
23	SEWER, 1500D STORM, 12 IN. DIA.	4	LIN. FT.	15.00	60.0
24	SEWER, 2000D STORM, 15 IN. DIA.	70	LIN. FT.	15.00	1,050.0
25	BRIDGE END DRAIN, RF-35	4	ONLY	350.00	1,400.0
26	GUARDRAIL, FORMED STEEL BEAM	337.500	LIN. FT.	6.00	2,025.0
27	GUARDRAIL, POSTS, BEAM	68	ONLY	27.00	1,836.0
28	GUARDRAIL, END ANCHORAGES, BEAM RE-33	1	ONLY	260.00	260.0
29	GUARDRAIL, END ANCHORAGES, BEAM RE-52	3	ONLY	265.00	795.0
30	BARRICADE, ROAD CLOSURE, RE-3	1	ONLY	350.00	350.0
31	BARRICADES	13	ONLY	150.00	1,950.0
32	REMOVAL OF PAVEMENT	4,032	SQ. YDS.	1.25	5,040.0
33	REMOVAL OF EXISTING STRUCTURES		LUMP SUM		300.0
34	SILT BASIN	22	ONLY	50.00	1,100.0
35	SILT DITCH	1,740	LIN. FT.	.50	870.0
36	BALE FOR DITCH CHECKS	55	ONLY	10.00	550.0
37	SODDING	3	SQUARES	20.00	60.0
38	STABILIZING CROP - SEEDING AND FERTILIZING	9.300	ACRES	125.00	1,162.5
39	MULCHING	5.100	ACRES	160.00	816.0
40	FERTILIZING	5.100	ACRES	80.00	408.0
41	TRAINEE REIMBURSEMENT	500	HOURS	.80	400.0
				GRAND TOTAL	$289,306.6

FORM 383.D 3-74 H-4974

CONTRACT

NO. 12941

Appendix A
Page 3

Type of Work GRADING,

Project No. F-2-2(4)--20-73

Miles 3.211

COST CENTER 611000 OBJECT 877

County PAGE

ON IOWA 2 FROM THE TAYLOR COUNTY LINE AT NEW MARKET WEST

3.2 MILES

THIS AGREEMENT made and entered by and between the Iowa Department of Transportation, Des Moines, Iowa, consisting of the following members:

ROBERT R RIGLER, STEPHEN GARST, DONALD K GARDNER, ALLAN THOMS,
W. F. MCGRATH, BARBARA DUNN, & L. STANLEY SCHOELERMAN, party of the first part, and

STERLING MCLAREN CONSTR. CO., INC. OF SHENANDOAH, IOWA 90200
JOHNSON BROS. INC. OF RED OAK, IOWA

party of the second part.

WITNESSETH: That the party of the second part, for and in consideration of $ ****633,970.90, 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
1	EXCAVATION, CLASS 10, ROADWAY & BORROW	668,705	CU. YDS.	.40	267,482.00
2	EXCAVATION, CLASS 12, BOULDERS	225	CU. YDS.	5.00	1,125.00
3	OVERHAUL	1,188,045	STA. YDS.	.01	11,880.45
4	EXCAVATION, CLASS 20	843	CU. YDS.	4.00	3,372.00
5	BACKFILL, COMPACTING, ADJACENT TO CULVERTS AND STOCKPASSES	765	CU. YDS.	3.00	2,295.00
6	BACKFILL, SELECTED, SOIL	87,680	CU. YDS.	.54	47,347.20
7	REMOVAL & CRUSHING OF PAVEMENT	33,904	SQ. YDS.	3.70	125,444.80
8	REMOVAL OF EXISTING STRUCTURES		LUMP SUM		9,000.00
9	REMOVAL OF SIDEWALK	40	SQ. YDS.	1.00	40.00
10	CULVERT, CONCRETE ROADWAY PIPE 24 IN. DIA.	92	LIN. FT.	11.75	1,081.00
11	CULVERT, CONCRETE ROADWAY PIPE 36 IN. DIA.	172	LIN. FT.	21.85	3,758.20
12	CULVERT, CONCRETE ROADWAY PIPE 60 IN. DIA.	122	LIN. FT.	57.00	6,954.00
13	APRONS, CONCRETE, 24 IN. DIA.	2	ONLY	122.70	245.40
14	APRONS, CONCRETE, 36 IN. DIA.	1	ONLY	215.40	215.40
15	APRONS, CONCRETE, 60 IN. DIA.	2	ONLY	548.05	1,096.10
16	HALF PIPE, CONCRETE, 36 IN.	24	LIN. FT.	29.80	715.20

Party of the second part certifies by his signature on this contract that he has complied with 324.17(8) of the 1975 Code of Iowa as amended.
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 Iowa Department of Transportation under date of DECEMBER 30, 1976

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 1972, together with special provisions attached, together with the general and detailed plans, if any, for said project F-2(4)--20-73, 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 on or before, and shall be completed on or before:

Approx. or Specified Starting Date or Number of Working Days	Specified Completion Date or Number of Working Days
APPROX APR. 4,1977	130 WORKING DAYS

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 instruments of like tenor, as of the day of FEB 14 1977, 19

IOWA DEPARTMENT OF TRANSPORTATION

By [signature]
Party of the First Part

STERLING MCLAREN CONSTR. CO., INC. OF SHENANDOAH, IOWA
JOHNSON BROS. INC. OF RED OAK, IOWA

By [signature]
Party of the Second Part

[signature]

CONTRACT NO. 12941 PROJECT F-2-2(4)--20-73

ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUN
17	ELBOWS, CONCRETE PIPE, 36 IN. DIA.	1	ONLY	293.70	293.70
18	CULVERT, UNCLASSIFIED ROADWAY PIPE, 24 IN. DIA.	266	LIN. FT.	11.00	2,926.00
19	CULVERT, UNCLASSIFIED ROADWAY PIPE, 42 IN. DIA.	72	LIN. FT.	21.70	1,562.40
20	APRONS, UNCLASSIFIED, 24 IN. DIA.	10	ONLY	86.90	869.00
21	APRONS, UNCLASSIFIED, 42 IN. DIA.	2	ONLY	274.40	548.80
22	CULVERT, CORR. METAL ROADWAY PIPE, 24 IN. DIA.	134	LIN. FT.	9.85	1,319.90
23	CULVERT, CORR. METAL ROADWAY PIPE, 36 IN. DIA.	118	LIN. FT.	16.80	1,982.40
24	APRONS, METAL, 24 IN. DIA.	1	ONLY	83.50	83.50
25	APRONS, METAL, 36 IN. DIA.	1	ONLY	173.80	173.80
26	ELBOWS, CORR. METAL PIPE 24 IN. DIA.	1	ONLY	94.30	94.30
27	ELBOWS, CORR. METAL PIPE 36 IN. DIA.	1	ONLY	134.40	134.40
28	DIAPHRAGM, CORR. METAL, TYPE A 24 IN.	1	ONLY	80.30	80.30
29	DIAPHRAGM, CORR. METAL, TYPE A 36 IN.	1	ONLY	104.85	104.85
30	STOCKPASS, 4' X 6' PRECAST CONCRETE RF-8	78	LIN. FT.	66.15	5,159.70
31	STOCKPASS APRON, 4' X 6' PRECAST CONCRETE RF-8	2	ONLY	701.05	1,402.10
32	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 18 IN. DIA.	1,742	LIN. FT.	8.30	14,458.60
33	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 24 IN. DIA.	550	LIN. FT.	9.85	5,417.50
34	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 36 IN. DIA.	322	LIN. FT.	16.30	5,248.60
35	LOCATING TILE LINES	20	STAS.	100.00	2,000.00
36	BARRICADES	18	ONLY	100.00	1,800.00
37	SILT DITCH	2,650	LIN. FT.	.80	2,120.00
38	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	8,244	TONS	5.70	46,990.80
39	SUBDRAIN, CORR. METAL PIPE 6 IN. DIA.	688	LIN. FT.	3.40	2,339.20
40	SUBDRAIN, CORR. METAL PIPE PERFORATED, 6 IN. DIA.	150	LIN. FT.	4.75	712.50
41	SUBDRAIN OUTLET, RF-22	3	ONLY	71.00	213.00
42	GRANULAR MATERIAL FOR BLANKETS AND SUBDRAINS	3,826	CU. YDS.	4.60	17,599.60
43	BACKFILL, POROUS	26	CU. YDS.	22.50	585.00
44	COMPACTING EMBANKMENT WITH MOISTURE & DENSITY CONTROL	1,414	CU. YDS.	.12	169.68
45	STABILIZING CROP - SEEDING AND FERTILIZING	100.100	ACRES	125.00	12,512.50
46	FIELD LABORATORY	1	ONLY	1,000.00	1,000.00
47	CLEARING & GRUBBING	150.00%			21,217.02
48	TRAINEE REIMBURSEMENT	1,000	HOURS	.80	800.00
			GRAND TOTAL		$633,970.90

FORM 650019 8-77 H-3878

CONTRACT

NO. 14112

TYPE OF WORK: PORT. CEMENT CONC. PAV'T. PROJECT NO. TQF-2-2(16)--29-73

MILES 3.211 COST CENTER 611000 OBJECT 878

COUNTY PAGE

ON IOWA 2 FROM TAYLOR COUNTY LINE WEST 3.2 MILES

THIS AGREEMENT MADE AND ENTERED BY AND BETWEEN THE IOWA DEPARTMENT OF TRANSPORTATION
ROBERT R RIGLER, STEPHEN GARST, DONALD K GARDNER, ALLAN THOMS,
W. F. MCGRATH, BARBARA DUNN, & L. STANLEY SCHOELERMAN, PARTY OF THE FIRST PART, AND
IRVING F. JENSEN CO.INC. OF SIOUX CITY, IOWA. 21400

PARTY OF THE SECOND PART.

WITNESSETH, THAT THE PARTY OF THE SECOND PART, FOR AND IN CONSIDERATION OF $ ****473,802.20, 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
1	PAVEMENT, STANDARD OR SLIP FORM P. C. CONC., CLASS A, 8 IN.	48,645	SQ. YDS.	6.60	321,057.0
2	SURFACE TREATMENT OF P. C. CONCRETE PAVEMENT	48,645	SQ. YDS.		.0
3	STABILIZED SHOULDER MATERIAL	13,715	TONS	7.93	108,759.9
4	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	3,013	TONS	6.35	19,132.5
5	STABILIZING CROP - SEEDING AND FERTILIZING	11.800	ACRES	125.00	1,475.0
6	MULCHING	11.800	ACRES	160.00	1,888.0
7	FERTILIZING	11.800	ACRES	80.00	944.0
8	GUARDRAIL, CABLE	3,528	LIN. FT.	2.65	9,349.2
9	GUARDRAIL, POSTS, CABLE	243	ONLY	25.50	6,196.5
10	GUARDRAIL, END ANCHORAGES, CABLE	12	ONLY	300.00	3,600.0
11	FIELD LABORATORY	1	ONLY	1,000.00	1,000.0
12	TRAINEE REIMBURSEMENT	500	HOURS	.80	400.0
				GRAND TOTAL	$473,802.2

PARTY OF THE SECOND PART CERTIFIES BY HIS SIGNATURE ON THIS CONTRACT, UNDER PAIN OF PENALTIES FOR FALSE CERTIFICATION, THAT HE HAS COMPLIED WITH 324.17.81 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 DECEMBER 28, 1977

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 TQF-2-2(16)--29-73, 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
80 WORKING DAYS	OCT. 20, 1978

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 JAN 17 1978, 19____

IOWA DEPARTMENT OF TRANSPORTATION

BY _____
PARTY OF THE FIRST PART

IRVING F. JENSEN CO.INC. OF SIOUX CITY, IOWA.

BY _____
PARTY OF THE SECOND PART

FORM 650419 8-77 H-3878

CONTRACT

NO. 14114

TYPE OF WORK PORT. CEMENT CONC. PAV'T. PROJECT NO. TQF-2-3(15)--29-87

MILES 12.051 COST CENTER 611000 OBJECT 878

COUNTY TAYLOR

ON IOWA 2 FROM PAGE COUNTY LINE EASTERLY TO WEST JUNCTION WITH IOWA 148 IN BEDFORD

THIS AGREEMENT MADE AND ENTERED BY AND BETWEEN THE IOWA DEPARTMENT OF TRANSPORTATION ROBERT R RIGLER, STEPHEN GARST, DONALD K GARDNER, ALLAN THOMS, W. F. MCGRATH, BARBARA DUNN, & L. STANLEY SCHOELERMAN PARTY OF THE FIRST PART, AND IRVING F. JENSEN CO.INC. OF SIOUX CITY, IOWA. 21400

PARTY OF THE SECOND PART.

WITNESSETH THAT THE PARTY OF THE SECOND PART, FOR AND IN CONSIDERATION OF $ **1,677,921.10, 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
1	EXCAVATION, CLASS 10, ROADWAY & BORROW	5,112	CU. YDS.	1.00	5,112.0
2	PAVEMENT, STANDARD OR SLIP FORM P. C. CONC., CLASS A, 8 IN.	170,069	SQ. YDS.	6.60	1,122,455.4
3	PAVEMENT, STANDARD OR SLIP FORM P. C. CONC., CLASS A, 6 IN.	2,765	SQ. YDS.	7.20	19,908.0
4	MEDIAN, 6 IN. P. C. CONCRETE	5	SQ. YDS.	15.00	75.0
5	BRIDGE APPROACH SECTION REINFORCED AS PER PLAN	213	SQ. YDS.	30.00	6,390.0
6	SURFACE TREATMENT OF P. C. CONCRETE PAVEMENT	173,047	SQ. YDS.		.0
7	GUARDRAIL, FORMED STEEL BEAM	750	LIN. FT.	6.00	4,500.0
8	GUARDRAIL, POSTS, BEAM	146	ONLY	27.00	3,942.0
9	GUARDRAIL, END ANCHORAGES, BEAM RE-52	8	ONLY	265.00	2,120.0
10	GUARDRAIL, CABLE	1,908	LIN. FT.	2.65	5,056.2
11	GUARDRAIL, POSTS, CABLE	138	ONLY	25.50	3,519.0
12	GUARDRAIL, END ANCHORAGES, CABLE	10	ONLY	300.00	3,000.0
13	BRIDGE END DRAIN, RF-35	8	ONLY	350.00	2,800.0
14	SODDING	7	SQUARES	20.00	140.0

PARTY OF THE SECOND PART CERTIFIES BY HIS SIGNATURE ON THIS CONTRACT, UNDER PAIN OF PENALTIES FOR FALSE CERTIFICATION, THAT HE HAS COMPLIED WITH 324.17-81 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 DECEMBER 28, 1977

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 TQF-2-3(15)--29-87 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
80 WORKING DAYS	OCT. 20, 1978

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 JAN 17 1978 19____

IOWA DEPARTMENT OF TRANSPORTATION

BY _____
PARTY OF THE FIRST PART

IRVING F. JENSEN CO.INC. OF SIOUX CITY, IOWA.

BY _____
PARTY OF THE SECOND PART

CONTRACT NO. 14114 PROJECT TQF-2-3(15)--29-87

ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMC
15	STABILIZED SHOULDER MATERIAL	53,071	TONS	7.70	408,646.7
16	SHOULDER CONSTRUCTION, EARTH	12.690	STAS.	50.00	634.5
17	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	10,488	TONS	6.10	63,976.8
18	SILT BASIN	17	ONLY	50.00	850.0
19	BALE FOR DITCH CHECKS	520	ONLY	10.00	5,200.0
20	STABILIZING CROP - SEEDING AND FERTILIZING	44.700	ACRES	125.00	5,587.5
21	MULCHING	44.700	ACRES	160.00	7,152.0
22	FERTILIZING	44.700	ACRES	80.00	3,576.0
23	SEWER, CORR. METAL STORM BITUMIN. COATED, 15 IN. DIA.	115	LIN. FT.	12.00	1,380.0
24	APRONS, METAL, 15 IN. DIA.	1	ONLY	100.00	100.0
25	FIELD LABORATORY	1	ONLY	1,000.00	1,000.0
26	TRAINEE REIMBURSEMENT	1,000	HOURS	.80	800.0

GRAND TOTAL $1,677,921.1

FORM 563 D 3-74 H-4974

Highway Division

CONTRACT

NO. 12942

Type of Work GRADING

Project No. F-2-3(4)--20-87

Miles 12.051

COST CENTER 611000 OBJECT 877

County TAYLOR

ON IOWA 2 FROM PAGE COUNTY LINE AT WEST EDGE OF NEW MARKET EAST, SOUTH AND EAST TO WEST JCT. IA. 148 IN BEDFORD

THIS AGREEMENT made and entered by and between the Iowa Department of Transportation, Des Moines, Iowa, consisting of the following members:

ROBERT R RIGLER, STEPHEN GARST, DONALD K GARDNER, ALLAN THOMS, W. F. MCGRATH, BARBARA DUNN, & L. STANLEY SCHOELERMAN, party of the first part, and

STERLING MCLAREN CONSTR. CO., INC. OF SHENANDOAH, IOWA 90200

JOHNSON BROS. INC. OF RED OAK, IOWA

party of the second part.

WITNESSETH: That the party of the second part, for and in consideration of $ **1,816,039.30, 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
1	EXCAVATION, CLASS 10, ROADWAY & BORROW	1,546,839	CU. YDS.	.42	649,672.38
2	EXCAVATION, CLASS 10, CHANNEL	150	CU. YDS.	.50	75.00
3	EXCAVATION, CLASS 12, BOULDERS	200	CU. YDS.	10.00	2,000.00
4	OVERHAUL	8,850,156	STA. YDS.	.01	88,501.56
5	EXCAVATION, CLASS 20	2,994	CU. YDS.	3.00	8,982.00
6	BACKFILL, SELECTED, SOIL	120,423	CU. YDS.	.59500	71,651.68
7	BACKFILL, COMPACTING, ADJACENT TO CULVERTS AND STOCKPASSES	1,292	CU. YDS.	2.00	2,584.00
8	BACKFILL, POROUS	91	CU. YDS.	15.00	1,365.00
9	GRANULAR MATERIAL FOR BLANKETS AND SUBDRAINS	3,347	CU. YDS.	6.00	20,082.00
10	CULVERT, CONCRETE ROADWAY PIPE 24 IN. DIA.	2,088	LIN. FT.	12.75	26,622.00
11	CULVERT, 3000D CONCRETE ROADWAY PIPE, 24 IN. DIA.	322	LIN. FT.	14.30	4,604.60
12	HALF PIPE, CONCRETE, 24 IN.	350	LIN. FT.	19.55	6,842.50
13	CULVERT, CONCRETE ROADWAY PIPE 30 IN. DIA.	1,658	LIN. FT.	17.15	28,434.70
14	CULVERT, 3000D CONCRETE ROADWAY PIPE, 30 IN. DIA.	158	LIN. FT.	31.00	4,898.00

Party of the second part certifies by his signature on this contract that he has complied with 324.17(8) of the 1975 Code of Iowa as amended.

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 Iowa Department of Transportation under date of DECEMBER 30, 1976

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 1972, together with special provisions attached, together with the general and detailed plans, if any, for said project F-2-3(4)--20-87, 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 on or before, and shall be completed on or before:

Approx. or Specified Starting Date or Number of Working Days	Specified Completion Date or Number of Working Days
APPROX APR. 4,1977	160 WORKING DAYS

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 instruments of like tenor, as of the day of FEB 14 1977, 19

IOWA DEPARTMENT OF TRANSPORTATION

By James H. Tresnell
Party of the First Part

STERLING MCLAREN CONSTR. CO., INC. OF SHENANDOAH, IOWA

JOHNSON BROS. INC. OF RED OAK, IOWA

By [illegible]
Party of the Second Part

Carl O Johnson

CONTRACT NO. 12942 PROJECT F-2-3(4)--20-87

ITEM	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUN
10					
15	HALF PIPE, CONCRETE, 30 IN.	236	LIN. FT.	15.85	3,740.60
,	CULVERT, CONCRETE ROADWAY PIPE 36 IN. DIA.	256	LIN. FT.	22.85	5,849.60
17	CULVERT, CONCRETE ROADWAY PIPE 42 IN. DIA.	112	LIN. FT.	30.00	3,360.00
)	CULVERT, CONCRETE ROADWAY PIPE 48 IN. DIA.	144	LIN. FT.	38.35	5,522.40
19	APRONS, CONCRETE, 24 IN. DIA.	35	ONLY	122.70	4,294.50
)	APRONS, CONCRETE, 30 IN. DIA.	20	ONLY	151.40	3,028.00
)	APRONS, CONCRETE, 36 IN. DIA.	4	ONLY	225.40	901.60
22	APRONS, CONCRETE, 42 IN. DIA.	2	ONLY	282.90	565.80
7	APRONS, CONCRETE, 48 IN. DIA.	2	ONLY	348.70	697.40
)	ELBOWS, CONCRETE PIPE, 24 IN. DIA.	11	ONLY	165.20	1,817.20
25	ELBOWS, CONCRETE PIPE 30 IN. DIA.	8	ONLY	218.80	1,750.40
)	STOCKPASS, 4' X 6' PRECAST CONCRETE RF-8	162	LIN. FT.	62.15	10,068.30
7	STOCKPASS APRON, 4' X 6' PRECAST CONCRETE RF-8	4	ONLY	651.05	2,604.20
28	CULVERT, UNCLASSIFIED ROADWAY PIPE, 24 IN. DIA.	672	LIN. FT.	12.00	8,064.00
3	CULVERT, UNCLASSIFIED ROADWAY PIPE, 36 IN. DIA.	132	LIN. FT.	19.00	2,508.00
30	CULVERT, UNCLASSIFIED ROADWAY PIPE, 42 IN. DIA.	82	LIN. FT.	21.70	1,779.40
6	CULVERT, UNCLASSIFIED ROADWAY PIPE, 48 IN. DIA.	132	LIN. FT.	24.50	3,234.00
32	APRONS, UNCLASSIFIED, 24 IN. DIA.	26	ONLY	86.90	2,259.40
3	APRONS, UNCLASSIFIED, 36 IN. DIA.	4	ONLY	190.50	762.00
4	APRONS, UNCLASSIFIED, 42 IN. DIA.	2	ONLY	279.40	558.80
35	APRONS, UNCLASSIFIED, 48 IN. DIA.	4	ONLY	304.15	1,216.60
3	CULVERT, CORR. METAL ROADWAY PIPE, 24 IN. DIA.	118	LIN. FT.	10.85	1,280.30
37	CULVERT, CORR. METAL ROADWAY PIPE, 30 IN. DIA.	74	LIN. FT.	14.60	1,080.40
3	CULVERT, CORR. METAL ROADWAY PIPE, 36 IN. DIA.	344	LIN. FT.	17.30	5,951.20
39	CULVERT, CORR. METAL ROADWAY PIPE, 48 IN. DIA.	72	LIN. FT.	21.90	1,576.80
1	CULVERT, CORR. METAL ROADWAY PIPE, 54 IN. DIA.	200	LIN. FT.	26.80	5,360.00
41	APRONS, METAL, 24 IN. DIA.	4	ONLY	83.50	334.00
2	APRONS, METAL, 30 IN. DIA.	2	ONLY	116.40	232.80
3	APRONS, METAL, 36 IN. DIA.	3	ONLY	183.80	551.40
44	APRONS, METAL, 48 IN. DIA.	3	ONLY	291.35	874.05
5	APRONS, METAL, 54 IN. DIA.	1	ONLY	392.10	392.10
3	DIAPHRAGM, CORR. METAL, TYPE A 24 IN.	2	ONLY	70.30	140.60
47	DIAPHRAGM, CORR. METAL, TYPE A 30 IN.	1	ONLY	88.75	88.75
48	DIAPHRAGM, CORR. METAL, TYPE A 36 IN.	2	ONLY	99.85	199.70
9	DIAPHRAGM, CORR. METAL, TYPE A 48 IN.	1	ONLY	135.55	135.55
50	ELBOWS, CORR. METAL PIPE				

RECEIVED

CONTRACT NO. 12942 PROJECT F-2-3(4)--20-87

ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUN
	24 IN. DIA.	1	ONLY	94.30	94.30
51	ELBOWS, CORR. METAL PIPE 30 IN. DIA.	2	ONLY	114.30	228.60
52	ELBOWS, CORR. METAL PIPE 36 IN. DIA.	1	ONLY	144.40	144.40
53	ELBOWS, CORR. METAL PIPE 48 IN. DIA.	2	ONLY	182.75	365.50
54	SUBDRAIN, CORR. METAL PIPE 6 IN. DIA.	167	LIN. FT.	2.41	402.47
55	SUBDRAIN, CORR. METAL PIPE BITUMIN. COATED, 6 IN. DIA.	193	LIN. FT.	3.15	607.95
56	SUBDRAIN, CORR. METAL PIPE PERFORATED, 6 IN. DIA.	378	LIN. FT.	3.25	1,228.50
57	SUBDRAIN OUTLET, RF-22	4	ONLY	81.00	324.00
58	SUBDRAIN, TRENCH	1,620	LIN. FT.	2.00	3,240.00
59	LOCATING TILE LINES	30	STAS.	100.00	3,000.00
60	SODDING	7	SQUARES	50.00	350.00
61	TOPSOIL, STRIP., SALVAGE AND SPREADING	84,216	CU. YDS.	.70	58,951.20
62	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	29,326	TONS	5.50	161,293.00
63	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 18 IN. DIA.	3,806	LIN. FT.	8.30	31,589.80
64	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 24 IN. DIA.	1,786	LIN. FT.	9.85	17,592.10
65	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 54 IN. DIA.	102	LIN. FT.	27.80	2,835.60
66	REMOVAL OF EXISTING STRUCTURES		LUMP SUM		15,400.00
67	REMOVAL & CRUSHING OF PAVEMENT	127,845	SQ. YDS.	3.30	421,888.50
68	REMOVAL OF SIDEWALK	83	SQ. YDS.	1.00	83.00
69	REMOVAL OF FLUMES	80	ONLY	30.00	2,400.00
70	BARRICADE, ROAD CLOSURE, RE-3	2	ONLY	504.00	1,008.00
71	BARRICADES	27	ONLY	100.00	2,700.00
72	SILT DITCH	17,354	LIN. FT.	.60	10,412.40
73	SILT BASIN	17	ONLY	30.00	510.00
74	BALE FOR DITCH CHECKS	520	ONLY	7.50	3,900.00
75	STABILIZING CROP - SEEDING AND FERTILIZING	335.200	ACRES	125.00	41,900.00
76	TRAINEE REIMBURSEMENT	2,000	HOURS	.80	1,600.00
77	CLEARING & GRUBBING	150.00%			31,894.71
78	FIELD LABORATORY	1	ONLY	1,000.00	1,000.00

GRAND TOTAL $1,816,039.30

IOWA DEPARTMENT OF TRANSPORTATION
Ames, Iowa
SPECIAL PROVISIONS

for

REMOVAL AND CRUSHING OF OLD PAVEMENT

Page F-2-2(4)--20-73
Taylor F-2-3(4)--20-87

January 4, 1977

183.01 REMOVAL. All mainline pavement on the project is to be removed and salvaged as described below, unless specifically excluded by the plans.

Where asphaltic concrete resurfacing is present, the asphaltic concrete shall be removed before the portland cement concrete pavement is removed. The asphaltic concrete that is removed is to be buried in the fill. It is intended that all of the asphaltic concrete be removed. Isolated areas of adhering asphaltic concrete up to one inch in thickness will be considered acceptable, including patches of asphaltic concrete.

The portland cement concrete pavement shall be removed in a manner that does not develop a large amount of fines in the salvaged concrete and which excludes subgrade and subbase material to the maximum extent practicable. It is intended that this operation will produce a maximum amount of salvaged portland cement concrete that is crushed and stockpiled, suitable for use in new portland cement concrete; the operation is to be conducted in such a manner as to salvage, in the stockpile, at least 80 percent of the portland cement concrete to be removed. The method of breaking and removing shall be subject to approval of the engineer.

All reinforcing steel shall be removed from the salvaged pavement, either prior to or during the crushing operation.

183.02 CRUSHING AND STOCKPILING. The salvaged pavement shall be crushed and stockpiled at the site designated on the plans for stockpiling.

Salvaged portland cement concrete shall be crushed to pass a 1½-inch sieve. A hammermill secondary crusher is prohibited. The crushed material shall be separated by screening on a 3/8-inch screen, and the two products shall be stockpiled separately. Processing equipment shall include a screen by which excessive fines in the minus 3/8-inch product can be controlled by removal of fines passing a No. 8 screen. Control will be as directed by the engineer, so that the maximum passing the No. 200 sieve in the minus 3/8-inch material is 5 percent. Washing will not be required. Fines removed from the minus 3/8-inch material shall be stockpiled separately.

The two main products of the operation, 1½ inch to 3/8 inch and minus 3/8 inch shall be stockpiled in accordance with 2301.16, in locations designated by the engineer at the designated site.

Reinforcement removed from the pavement shall become property of the contractor and shall be disposed of off the project.

183.03 LIMITATIONS. All pavement shall be removed during the 1977 construction season. At the option of the contractor, crushing operations may be postponed until all of the pavement has been removed. The crushing may be done during the following winter period, to be completed by February 1, 1978.

The contractor shall maintain the stockpiles and the stockpile sites until completion of the work on the contract.

183.04 MEASUREMENT AND PAYMENT. Removal and Crushing of Old Pavement shall be based on the plan quantity computed in accordance with 2301.39G. Payment shall be in accordance with 2301.40G, and this shall be full payment for all removal, transportation, crushing and stockpiling, removal and disposal of reinforcement, and other incidentals necessary to complete this work in accordance with the plans and specifications.

Form 268 Special
6-72

Appendix C

Iowa State Highway Commission

MATERIALS DEPARTMENT

TEST REPORT — MISCELLANEOUS MATERIALS

AMES LABORATORY

Bit. Agg.
B. Ortgies
J. Bergren
R. Britson
Geology
Projects listed below

Material 1½" crushed concrete (P.C.) **Laboratory No.** AAt7-75

Intended Use P. C. Concrete

County Page & Taylor **Proj. No.** F-2-2-(4)--20-73 F-2-3-(4)--20-87

Producer Kuhlman **Contractor**

Source New Market Hwy 2

Unit of Material 2 bags

Sampled by H. Wayne Jackson **Sender's No.**

Date Sampled **Date Rec'd** 4-14-77 **Date Reported** 4-19-77

% Psg. #8 after 16 cycles F&T, Water-Alc. Sol.	42
% Wear, La Abrasion, Grading A	59
Specific Gravity (S.S.D.)	2.346
% Absorption (S. S. D.)	5.10

DISPOSITION: F&T and Abr. do not comply with standard specifications

Signed [illegible] C. [illegible]

Testing Engineer

TRIAL MIXES

A. Preliminary Trial Mixes

1. Recycled aggregates were used in C-3 mix with:

55% coarse aggregate)	recycled
25% fine aggregate)	
20% Hallett sand	virgin agg.

2. Recycled aggregates were used in C-4 mix with:

C.A. crushed 40%
F.A. crushed 30%
F.A. sand 30%

Results of concrete compression, flexural strength and durability tests on specimens made with these materials and 626 lbs. of cement are as follows:

Compression	4350 psi @ 7 days
	5510 psi @ 28 days
Flexural	700 psi @ 14 days
Durability Factor	300 cycles 94

Concrete test slabs were also made for determining the resistance of the concrete to abrasion. Test slabs made with crushed recycled concrete as aggregate were compared with concrete made using a typical conventional aggregate. The test results were almost identical.

3. C-4 mix - Recycled Concrete

50% C.A. crushed
20% F.A. crushed
30% F.A. (Natural Sand)
w/c = 0.497
Flexural strengths @ 14 days was 740 psi.

4. C-4 mix - Recycled Concrete

626 lbs. cement
45% C.A. crushed
35% F.A. crushed
20% F.A. natural sand

Compressive strength test results:

Avg. 7 day 4350 psi
Avg. 28 day 5520 psi

5. Concrete core test - old pavement between New Market and Bedford

total cores 23 cores
total average strength in psi - 6535 (corrected)

6. C-4 mix - Recycled Concrete

626 lbs. cement

70% Recycled Aggregate	35% C.A. crushed
	30% F.A. natural sand
	35% F.A. crushed

Compressive strength test results:

Avg. 7 day 4130 psi
Avg. 28 day 5300 psi

7. Abrasion resistance tests were run using Gilmore City coarse aggregate and recycled aggregates. From the graphs and test data, it is found that the recycled coarse aggregates and the Gilmore City coarse aggregate have very similar wear characteristics. With the results obtained, it can be presumed that replacing Gilmore City aggregate with recycled concrete aggregate will hive no significant change in abrasion resistance.

8. C-4 mix (626 lbs. cement)

Coarse aggregate (crushed) 47%
Fine aggregate (crushed) 23%
Fine aggregate (Hallett sand) 30%

Avg. compressive strength @ 7 days 5050
Avg. compressive strength @ 28 days 5890

9. C-4 mix (626 lbs. cement)

Coarse aggregate (crushed) 42.5%
Fine aggregate (crushed) 25.0%
Fine aggregate (crushed) 32.5%

Avg. compressive strength @ 7 days 5010
Avg. compressive strength @ 28 days 4570

Avg. compressive strength @ 38 days 6270
Avg. compressive strength @ 28 days with w/r 6020

B. Project Trial Mixes

We have completed evaluations of C-4 mixture utilizing recycled concrete and containing water reducing admixture. All mixes evaluated utilized recycled concrete for coarse and fine aggregate from Page and Taylor Counties, Hallett and Finley Sand Type 1 Standard Blend Cement and a conventional water reducer Plastocrete 161 meeting requirements of ASTM C494 Type A. Results of the compressive strengths for the trial mixes are listed below:

Mix No.	Mix Proportions	Water Reducer ft.oz/100 CL of cement	% Air	Slump (inch)	W/C Ratio	Average Compressive Strength lb/sq.in. 7 day	14 day	28 day
#1 Control	Cement 626 lbs. Crushed C.A. 42.5% Crushed F.A. 25.0% Concrete Sand-- 32.5 % (Finley)	(Plastocrete) 161 3	6.2	2 1/4	0.460	4570	---	6016
#2	Cement 626 lb. Crushed C.A. 42.5% Crushed F.A. 25.0% Concrete Sand-- 32.5% (Finley)	----	6.2	2 1/4	0.444	4230	---	5660
#3	Cement 626 lbs. Crushed C.A. 47% Crushed F.A. 23% Concrete Sand-- 30% (Hallett)	(Plastocrete) 161 3	7.3	2.0	0.478	5050	---	5890
#4	Cement 626 lbs. Crushed C.A. 45% Crushed F.A. 35% Concrete Sand-- 30% (Hallett)	(Plastocrete) 161 3	6.5	1 3/4	0.422	4350	---	5510

B. Project Trial Mixes Continued

Mix No.	Mix Proportions	Water Reducer ft.oz/100 CL of cement	% Air	Slump (inch)	W/C Ratio	Compressive Strength lb/sq.in. 7 day	14 day	28 day
#5	Cement 626 lbs. Crushed C.A. 35% Crushed F.A. 35% Concrete Sand 30% (Hallett)	(Plastocrete) 161 3	6.5	2 1/2	0.518	4130	---	5300
#6	Cement 626 lbs. Crushed C.A. 30% Virgin Fine Aggregate 70% Finley Sand	PDA-25DP 4	7.8	2.0	0.416	4420 Flexural Tests 600.0	5070 650	5380 ---

The above quantities are based on the following assumptions:

Specific gravity of cement	3.4
Specific gravity of crushed concrete, coarse	2.35
Specific gravity of crushed concrete, fine	2.35
Specific gravity of crushed sand (4110)	2.65
Weight of water per cubic foot	62.4

Based on the above studies, it seems that the use of crushed concrete as aggregate imposed no problems with respect to workability and handling. However, the compressive strength of concrete containing recycled concrete aggregate is slightly lower than that of concrete of the same water-cement ratio but with virgin aggregates. Equal strengths may be obtained by using appropriately reduced water cement ratios, keeping in mind that the recycled concrete aggregates have lower specific gravity and higher absorbtion than the virgin aggregates.

Appendix E

Excerpt from PAVING SPECIAL PROVISIONS

Mix Proportion

In lieu of proportions specified in 2301.04, the following proportions shall be used:

	Basic Abs. Volume	Approximate Dry Quantities/c.y.
Cement	0.118330	626 lbs.
Water	0.178063	
Air	0.060000	
Crushed Concrete, Coarse	0.273533	1083 lbs.
Crushed Concrete, Fine	0.160902	637 lbs.
Concrete Sand	0.209172	934 lbs.

Design water - cement ratio 0.48

Maximum water- cement ratio 0.545

The quantities are based on the following assumptions:

Specific gravity of crushed concrete, coarse	2.35
Specific gravity of crushed concrete, fine	2.35
Specific gravity of crushed sand (4110)	2.65
Specific gravity of cement	3.14
Weight of water	62.4 lbs. per cu.ft.

A water reducing admixture, approved in accordance with IMM. 403, will be required.

PAVING PROJECT CONSTRUCTION TESTS

(Does not include handwork concrete)

Page TQF-2-2(16)--29-73

Date	Slump	Air	Beam No.	Modulus of Rupture 7 day	Modulus of Rupture 14 day	Nuclear Density
7-14-78	1 3/4	7.8	16-1	718	817	
	1 3/4	7.8				
	1 3/4	6.2	16-2	563	639	
7-17-78	2	7.8	16-3	759	798	
	1 1/2	6.3	16-4	735	780	
	2	6.4				
	2	5.2				
7-18-78	1 3/4	5.5	16-5	748	794	
	2	7.3				
	1 1/2	6.7				
	1 3/4	6.5	16-6	749	795	
	1 3/4	6.6				
7-19-78	2	6.2	16-7	726	775	
	1 3/4	6.7	16-8	634	704	
	1 3/4	7.0				
7-21-78	1 3/4	7.0	16-9	792	858	
	1 3/4	6.7	16-10	(M-4 mix)		
7-24-78	1 3/4	6.8	16-11	713	821	
	1 3/4	6.9				
7-26-78	1 1/4	7.0	16-16	733	744	
8-1-78	1 1/4	7.6	16-21	744	811	
Average	1.65	6.8		718	778	
Maximum	2	7.8		759	858	
Minimum	1.25	5.2		563	639	

Taylor TQF-2-3(15)--29-87

Date	Slump	Air	Beam No.	Modulus of Rupture 7 day	14 day	Nuclear Density
7-10-78	1/2	6.0	15-1	778	898	
	1/2	6.0				
	1 3/4	7.2	15-2	764	824	
	1 1/2	7.1				
7-11-78	1 1/2	5.0				
	1 1/2	5.8	15-3	767	857	
	2	7.8	15-4	(M-4 mix)		
	2	6.1	15-5	843	883	
7-13-78	2	7.1	15-6	734	691	
	1 1/4	6.2	15-7	(M-4 mix)		
	1 1/2	7.6	15-8	727	692	
	1 3/4	7.7				
7-24-78	1 1/2	6.3	15-9	751	810	
	1 1/2	6.2	15-10	(M-4 mix)		
	1 3/4	6.2				
	1 3/4	6.4				
7-25-78	1 1/2	6.8	15-11	(M-4 mix)		
	1 1/2	6.7	15-12	744	791	
	1 1/2	6.5				
	1 3/4	6.5				
7-26-78	1 1/4	7.7	15-13	812	853	
	1 1/4	7.2				
7-27-78	1 1/2	6.2	15-14	765	797	
	1 3/4	6.7				
	1 1/2	6.2	15-15	725	752	
	1 1/2	7.7				
7-31-78	1 3/4	5.8	15-17	705	797	
	1 3/4	7.6	15-19	700	827	
	1	6.6	15-18	(M-4 mix)		
8-1-78	1 1/2	6.5	15-20	702	892	
8-8-78	1 1/4	7.7	15-21	869	864	*137.0 @ 6.2
	1	7.6	15-22	737	789	134.5
						136.0

*Rodded density = 135.1 lb/cu. @ 6.0% air

Cont. Taylor TQF-2-3(15)--29-87

Date	Slump	Air	Beam No.	Modulus of Rupture 7 day	14 day	Nuclear Density
8-9-78	1 1/4	7.5				*137.0 @ 7.0
	1 1/4	7.0	15-23			137.0
	1 1/4	7.1	15-24	716	751	133.5
	1 1/4	7.5		627	703	
8-11-78	1 3/4	7.8				
	1 1/2	8.0	15-25	706	739	
	2	7.0	15-26	(M-4 mix)		
	1 1/4	7.5				
	1 1/4	7.4	15-27	714	780	
8-14-78	1 1/4	7.1	15-28	712	748	
	1 1/4	7.9	15-29	626	763	
	1	7.8				
8-17-78	1 1/4	8.0	15-31	742	866	
	1 1/2	8.0	15-30	(M-4 mix)		
	1 1/4	7.9	15-32	771	807	
	1 1/4	7.7	15-33	(Handwork)		
8-21-78	1 1/4	7.1	15-34	661	803	
	1 1/2	8.0	15-35	(M-4 mix)		
	1 3/4	6.0	15-36	730	803	
	1 1/2	7.1				
8-22-78	1 3/4	7.8	15-37	744	798	
	2	7.3				
	1 1/2	7.1	15-38	760	824	
	1 1/2	8.0				
8-23-78	1 1/2	7.3	15-39	775	796	
	1 1/4	7.0	15-40	759	808	
8-24-78	1 1/2	6.0	15-41	798	852	
	1 1/2	6.0	15-42	833	939	
	1 1/4	5.5				
8-25-78	1 1/2	5.6	15-43	724	821	
	1 1/2	6.0				
	1 1/2	7.0	15-44	826	901	
Average	1.46	6.9		745	809	
Maximum	2	8.0		869	939	
Minimum	1.25	5.0		626	703	

*Rodded density = 135.1 lb/cu. @ 6.0% air

Taylor TQF-2-3(18)--29-87

Date	Slump	Air	Beam No.	Modulus of Rupture 7 day	14 day	Nuclear Density
8-4-78	1 1/2	7.1	18-1	778	--	
8-5-78	1 1/2	7.1	18-2	809	773	
	1 1/2	6.6	18-3	778	865	
	1 1/2	7.8				
8-7-78	1 1/2	6.7	18-4	740	849	
	1 1/4	6.0	18-5	748	886	
	1 1/2	7.5				
8-8-78	1 1/2	7.1				
Average	1.47	7.0		771	843	
Maximum	1.50	7.8		809	886	
Minimum	1.25	6.0		740	773	

IOWA STATE HIGHWAY COMMISS.
MATERIALS DEPARTMENT
AMES LABORATORY

CONCRETE CORES
PROJECT FILES
J.V. BERGRAN
V. SNYDER
L. BURGAN

PROJECT T@F-2-2(16)--29-73 COUNTY PAGE LAB. NO. ACE8-1598-1625

LENGTH OF PROJECT 03.211 MILES YEAR BUILT 1978 ROAD NUMBER IOWA 2

CONTRACTOR IRVING F. JENSEN CORE FORM- WIDENING BASE PAVEMENT X

FINE AGG. G.A. FINLEY INC. SHENANDOAH PIT COARSE AGG. RECYCLED AT PLANT SITE

CEMENT MISSOURI PORTLAND MIX NUMBER DATE REPORTED 12/19/78

LAB. NO.	CORE NUMBER	STATION	DISTANCE FROM CNTRLINE FT.	AGE AT TEST DAYS	UNCUT LENGTH IN.	INFORMATIONAL TESTS STEEL HT FROM BSE IN.	CORR STREN. PSI.	COMPUTED STR PSI. 28DAY	1YEAR	%AIR HARD. CONC.	REMARKS
1598	4-2048	192+00	5.4L	117	9.00		4305	3580	4655	6.3	
1599	4-2049	201+00	9.8R	117	8.30		4005	3330	4325		
1600	4-2050	210+00	2.0L	117	8.60		4435	3690	4790	7.8	
1601	4-2051	219+00	5.5R	114	8.20		5130	4270	5545		
1602	4-2052	229+00	9.6L		6.80						
1603	E4-2053	228+00	10.0L	114	8.00		4140	3445	4475		
1604	E4-2054	230+00	9.6L	114	8.20		4235	3520	4575	7.5	
1605	4-2055	238+00	1.5R	114	8.50		4195	3490	4535		
1606	4-2056	247+00	6.5L		7.00						
1607	E4-2057	246+00	6.5L	114	7.80		4160	3460	4500		
1608	E4-2058	248+00	6.5L	114	8.00		4505	3750	4870	7.0	
1609	4-2059	256+00	9.5R	113	8.50		4450	3700	4810		
1610	4-2060	265+00	2.0L	113	7.90		4470	3715	4830	9.3	
1611	4-2061	274+00	6.7R	113	8.20		4655	3875	5035		
1612	4-2062	284+00	10.0L	113	8.50		4640	3860	5015	7.1	
1613	4-2063	293+00	2.0R	113	8.00		4485	3730	4850		
1614	4-2064	302+00	5.3L	112	8.00		4320	3595	4670	7.8	
1615	4-2065	311+00	9.0R	112	8.10		4415	3675	4775		
1616	4-2066	320+00	1.8L	112	9.70		3925	3265	4240	9.3	
1617	4-2067	329+00	5.6R	110	7.80		4700	3975	5165		
1618	4-2068	338+00	9.2L	110	8.90		5050	4265	5550	7.1	
1619	4-2069	347+00	2.1R	107	9.10		4180	3530	4590		
1620	4-2070	356+00	6.3L	107	8.30		4415	3735	4855	6.6	
1621	4-2071	220+00	8.7R	103	7.90		5650	4775	6210		CLIMBING LANE M FROM EDGE OF SLAB

CORING COMPLETE

CONCRETE CORES
PROJECT FILES
J.V. BERGRAN
V. SNYDER
L. BURGAN

IOWA STATE HIGHWAY COMMISSION
MATERIALS DEPARTMENT
AMES LABORATORY

PROJECT TQF-2-2(16)--29-73 COUNTY PAGE LAB. NO. ACE8-1598-1625

LENGTH OF PROJECT 03.211 MILES YEAR BUILT 1978 ROAD NUMBER IOWA 2

CONTRACTOR IRVING F. JENSEN CORE FORM- WIDENING BASE PAVEMENT X

FINE AGG. G.A. FINLEY INC. SHENANDOAH PIT COARSE AGG. RECYCLED AT PLANT SITE

CEMENT MISSOURI PORTLAND MIX NUMBER DATE REPORTED 12/19/78

LAB. NO.	CORE NUMBER	STATION	DISTANCE FROM CNTRLINE FT.	AGE AT TEST DAYS	UNCUT LENGTH IN.	INFORMATIONAL TESTS STEEL FROM BSE IN.	HT CORR STREN. PSI.	COMPUTED STR PSI. 28DAY	1YEAR	%AIR HARD. CONC.	REMARKS
1622	4-2072	229+00	2.0R	99	8.30		5755	4865	6325	4.5	
1623	4-2073	238+00	5.5R		7.70						
1624	E4-2074	237+00	6.0R	99	8.00		5750	4860	6320	6.2	
1625	E4-2075	239+00	5.8R	99	7.90		5785	4890	6360		

SLIP FORM DESIGNED DEPTH = 8 INCH

CORING COMPLETE

CONCRETE CORES
PROJECT FILES
J.V. BERGREN
V. SNYDER
W. BURGAN

IOWA STATE HIGHWAY COMMISSION
MATERIALS DEPARTMENT
AMES LABORATORY

PROJECT TQF-2-3(15)--29-87 COUNTY TAYLOR LAB. NO. ACE8-1514-1586

LENGTH OF PROJECT 12.051 MILES YEAR BUILT 1978 ROAD NUMBER IOWA 2

CONTRACTOR IRVING F. JENSEN CORE FORM- WIDENING BASE PAVEMENT X

FINE AGG. G.A. FINLEY INC. SHENANDOAH PIT COARSE AGG. RECYCLED AT PLANT SITE

CEMENT MISSOURI PORTLAND MIX NUMBER DATE REPORTED 12/19/78

LAB. NO.	CORE NUMBER	STATION	DISTANCE FROM CNTRLINE FT.	AGE AT TEST DAYS	UNCUT LENGTH IN.	INFORMATIONAL TESTS STEEL FROM BSE IN.	HT CORR STREN. PSI.	COMPUTED STR PSI. 28DAY	1YEAR	%AIR HARD. CONC.	REMARKS
1514	4-2103	2+00	2.0L	128	8.60		4160	3460	4500		
1515	4-2104	11+00	6.2R	128	8.25		3475	2890	3760	8.3	
1516	4-2105	20+00	9.8L	128	8.40		4645	3865	5025		
1517	4-2106	29+00	2.4R	128	7.95		4530	3770	4900	8.2	
1518	4-2107	38+00	6.8L	127	8.50		5340	4445	5775		
1519	4-2108	48+00	9.9R	127	7.95		4865	4045	5255	6.9	
1520	4-2109	57+00	2.0L	127	8.50		4935	4105	5335		
1521	4-2110	66+00	6.0R	127	8.60		5125	4265	5540	8.6	
1522	4-2111	75+00	9.9L	139	8.00		4945	4035	5255		
1523	4-2112	84+00	2.2R	139	8.35		4990	4075	5300	6.2	
1524	4-2113	93+00	5.8L	139	7.90		4795	3910	5090		
1525	4-2114	103+00	9.8R	139	8.25		4400	3590	4675	7.2	
1526	4-2115	112+00	1.8L	141	8.25		4745	3870	5035		
1527	4-2116	121+00	5.6R	141	8.65		5380	4390	5715	5.8	
1528	4-2117	130+00	9.5L	141	8.20		5480	4470	5820		
1529	4-2118	139+00	1.8R	141	7.95		6200	5060	6585	5.4	
1530	4-2119	148+00	5.9L	142	8.00		5210	4250	5535		
1531	4-2120	157+00	9.8R	142	8.65		5180	4225	5500	6.8	
1532	4-2121	166+00	1.9L	142	8.15		4535	3700	4815		
1533	4-2122	175+00	6.2R	142	8.30		5120	4175	5435	7.3	
1534	4-2123	183+00	10.0L	120	8.90		4765	3965	5150		
1535	4-2124	192+00	1.6R	121	8.05		5230	4350	5655	7.0	
1536	4-2125	201+00	5.7L	123	7.90		5235	4355	5660		
1537	4-2126	210+00	10.0R	123	9.35		4410	3670	4765	7.7	

CORING COMPLETE

CONCRETE CORES
PROJECT FILES
J.V. BERGREN
V. SNYDER
W. BURGAN

IOWA STATE HIGHWAY COMMISS..N
MATERIALS DEPARTMENT
AMES LABORATORY

PROJECT TQF-2-3(15)--29-87 COUNTY TAYLOR LAB. NO. ACE8-1514-1586

LENGTH OF PROJECT 12.051 MILES YEAR BUILT 1978 ROAD NUMBER IOWA 2

CONTRACTOR IRVING F. JENSEN CORE FORM- WIDENING BASE PAVEMENT X

FINE AGG. G.A. FINLEY INC. SHENANDOAH PIT COARSE AGG. RECYCLED AT PLANT SITE

CEMENT MISSOURI PORTLAND MIX NUMBER DATE REPORTED 12/19/78

LAB. NO.	CORE NUMBER	STATION	DISTANCE FROM CNTRLINE FT.	AGE AT TEST DAYS	UNCUT LENGTH IN.	INFORMATIONAL TESTS STEEL FROM BSE IN.	HT CORR STREN. PSI.	COMPUTED STR PSI. 28DAY	COMPUTED STR PSI. 1YEAR	%AIR HARD. CONC.	REMARKS
1538	4-2127	219+00	1.3L	123	7.75		5680	4725	6140		
1539	4-2128	229+00	5.4R	127	8.25		4805	4000	5195	7.4	
1540	4-2129	238+00	9.9L	127	8.25		4350	3620	4705		
1541	4-2130	247+00	1.8R	127	8.45		4025	3350	4350	8.7	
1542	4-2131	256+00	6.2L	128	8.65		4780	3980	5170		
1543	4-2132	265+00	2.3R	128	8.85		4375	3640	4730	7.4	
1553	4-2142	357+00	1.6R	102	7.85		3695	3120	4060	11.5	
2	-										
1544	4-2133	274+00	2.4L	109	8.40		4315	3645	4740		
1554	4-2143	367+00	6.0L	102	8.40		4060	3430	4460		
	-										
1545	4-2134	284+00	6.4R	109	8.05		3065	2590	3370	9.9	
1555	4-2144	378+00	9.7R	102	7.95		3985	3370	4380	9.5	
2	-										
1546	4-2135	293+00	9.7L	109	7.85		4325	3655	4750		
1556	4-2145	387+00	1.3L	101	8.30		4385	3705	4820		
	-										
1547	4-2136	302+00	1.5R	109	7.95		4115	3475	4520	9.4	
1557	4-2146	396+00	5.7R	101	7.90		4415	3730	4850	8.0	
2	-										
1548	4-2137	312+00	6.2L	106	8.00		4135	3495	4545		
1558	4-2147	406+00	9.3L	101	8.20		5430	4590	5970		
	-										
1549	4-2138	321+00	9.7R	106	8.10		4520	3820	4965	8.3	

CORING COMPLETE

CONCRETE CORES
PROJECT FILES
W.V. BERGREN
V. SNYDER
W. BURGAN

IOWA STATE HIGHWAY COMMISSION
MATERIALS DEPARTMENT
AMES LABORATORY

PROJECT TQF-2-3(15)--29-87 COUNTY TAYLOR LAB. NO. ACE8-1514-1586

LENGTH OF PROJECT 12.051 MILES YEAR BUILT 1978 ROAD NUMBER IOWA 2

CONTRACTOR IRVING F. JENSEN CORE FORM- WIDENING BASE PAVEMENT X

FINE AGG. G.A. FINLEY INC. SHENANDOAH PIT COARSE AGG. RECYCLED AT PLANT SITE

CEMENT MISSOURI PORTLAND MIX NUMBER DATE REPORTED 12/19/78

LAB. NO.	CORE NUMBER	STATION	DISTANCE FROM CNTRLINE FT.	AGE AT TEST DAYS	UNCUT LENGTH IN.	INFORMATIONAL TESTS STEEL FROM BSE IN.	HT CORR STREN. PSI.	COMPUTED STR PSI. 28DAY	COMPUTED STR PSI. 1YEAR	%AIR HARD. CONC.	REMARKS
1559	4-2148	415+00	1.5R	101	8.25		5110	4315	5615	6.9	
2	-										
1550	4-2139	330+00	1.8L	106	7.85		4190	3540	4605		
1560	4-2149	424+00	6.1L	101	8.30		4155	3510	4565		
	-										
1551	4-2140	339+00	5.7R	106	8.05		3655	3090	4015	10.7	
1561	4-2150	433+00	9.6R	100	8.20		4520	3820	4965	6.6	
2	-										
1552	4-2141	348+00	9.2L	102	8.35		4120	3485	4530		
1562	4-2151	442+00	1.7L	100	8.30		3860	3260	4240		
	-										
1563	4-2152	451+00	5.3R	100	7.90		4635	3915	5095	7.4	
1564	4-2153	461+00	9.4L	99	8.40		4995	4225	5490		
1565	4-2154	470+00	1.5R	99	8.80		5705	4820	6270	6.4	
1566	4-2155	479+00	5.8L		6.95						
1567	E4-2156	478+00	6.2L	99	9.10		5540	4680	6085	6.1	
1568	E4-2157	480+00	6.5L	99	8.55		5495	4645	6040		
1569	4-2158	487+00	9.8R	99	8.05		5580	4715	6130	6.0	
1570	4-2159	492+00	2.0L	98	8.40		4855	4100	5335		
1571	4-2160	501+00	5.6R	98	8.40		4435	3745	4870	7.8	
1572	4-2161	510+00	9.6L	98	7.90		6045	5105	6640		
1573	4-2162	519+00	1.5R	112	8.05		5060	4210	5470	6.0	
1574	4-2163	528+00	6.0R	112	8.10		4870	4050	5265		
1575	4-2164	537+00	5.8L	112	8.50		4425	3680	4785	7.0	

CORING COMPLETE

CONCRETE CORES
PROJECT FILES
J.V. BERGREN
V. SNYDER
W. BURGAN

IOWA STATE HIGHWAY COMMISSION
MATERIALS DEPARTMENT
AMES LABORATORY

PROJECT TQF-2-3(15)--29-87 COUNTY TAYLOR LAB. NO. ACE8-1514-1586

LENGTH OF PROJECT 12.051 MILES YEAR BUILT 1978 ROAD NUMBER IOWA 2

CONTRACTOR IRVING F. JENSEN CORE FORM- WIDENING BASE PAVEMENT X

FINE AGG. G.A. FINLEY INC. SHENANDOAH PIT COARSE AGG. RECYCLED AT PLANT SITE

CEMENT MISSOURI PORTLAND MIX NUMBER DATE REPORTED 12/19/78

LAB. NO.	CORE NUMBER	STATION	DISTANCE FROM CNTRLINE FT.	AGE AT TEST DAYS	UNCUT LENGTH IN.	INFORMATIONAL TESTS: STEEL FROM BSE IN.	HT CORR STREN. PSI.	COMPUTED STR PSI. 28DAY	COMPUTED STR PSI. 1YEAR	%AIR HARD. CONC.	REMARKS
1576	4-2165	546+00	9.0R	112	8.05		4775	3970	5160		
1577	4-2166	555+00	2.0L	112	7.95		3665	3045	3960	7.6	
1578	4-2167	564+00	6.0R	112	8.35		3970	3305	4295		
1579	4-2168	573+00	9.0L	119	8.35		4760	3960	5145	6.3	
1580	4-2169	582+00	6.7R	114	8.55		4935	4105	5335		
1581	4-2170	591+00	9.5L	114	8.00		4540	3780	4930	5.7	
1582	4-2171	600+00	1.8R	114	8.95		3525	2935	3810		
1583	4-2172	609+00	5.5L	119	7.95		3775	3140	4080	8.3	
1584	4-2173	618+00	9.6R	120	8.70		5045	4200	5455		
1585	4-2174	627+00	1.8L	120	8.20		4560	3795	4930	7.8	
1586	4-2175	636+00	6.0R	120	9.20		4480	3730	4845		

SLIP FORM DESIGNED DEPTH = 8 INCH

CORING COMPLETE

CONCRETE ..RES
PROJECT FILES
J.Y. BERGREN
V. SNYDER
L. BURGAN

IOWA STATE HIGHWAY COMMISS..N
MATERIALS DEPARTMENT
AMES LABORATORY

PROJECT TQF-2-3(18)--29-87 COUNTY TAYLOR LAB. NO. ACE8-1587-1597

LENGTH OF PROJECT 01.394 MILES YEAR BUILT 1978 ROAD NUMBER IOWA 2

CONTRACTOR IRVING F. JENSEN CORE FORM- WIDENING BASE PAVEMENT X

FINE AGG. G.A. FINLEY INC. SHENANDOAH PIT COARSE AGG. RECYCLED AT PLANT SITE

CEMENT MISSOURI PORTLAND MIX NUMBER DATE REPORTED 12/19/78

LAB. NO.	CORE NUMBER	STATION	DISTANCE FROM CNTRLINE FT.	AGE AT TEST DAYS	UNCUT LENGTH IN.	INFORMATIONAL TESTS STEEL FROM BSE IN.	HT CORR STREN. PSI.	COMPUTED STR PSI. 28DAY	1YEAR	%AIR HARD. CONC.	REMARKS
1587	4-2076	1713+00	10.2L	92	8.40		4385	3745	4870	5.8	
1588	4-2077	1720+00	1.8R	93	8.40		4425	3780	4910		
1589	4-2078	1730+00	6.0L	93	7.80		3915	3345	4345	8.3	
1590	4-2079	1740+00	9.8R	93	8.50		4370	3730	4850		
1591	4-2080	1750+00	1.6L	93	8.00		4255	3635	4725	5.4	
1592	4-2081	1758+00	5.8R	95	8.00		5085	4340	5640		
1593	4-2082	1768+00	3.0L	95	8.20		4865	4155	5400	6.6	
1594	4-2083	1774+00	1.7R	95	8.80		4625	3950	5135		
1595	4-2084	1784+00	5.4L		7.10						
1596	E4-2085	1783+00	5.4L	96	7.90		5100	4310	5605		
1597	E4-2086	1784+90	6.0L	96	11.10		3590	3030	3945	5.9	

SLIP FORM DESIGNED DEPTH = 8 INCH

IOWA DEPARTMENT OF TRANSPORTATION
Materials Department
AMES LABORATORY

ROAD ROUGHNESS REPORT

Lab. No. RR_____ Report Date_____ County Page

Proj. Miles 3.211 Year Built 1978 Road No. Ia 2

Contractor Irving F. Jensen Proj. No. TQF-2-2(16)--29-73

Asph. Conc._____ A.C. Resur._____

Location From Taylor County line P.C. Conc. x Slip Form x

Fixed Form_____

westerly 3.2 miles

Date Tested 11-2-78 Weather clear

Test Observers Twohey - Veland

¼ point Terminus Transverse Groove	Sect. No.	Length (Miles)	W Bound Lane Roughness Inches/Mile	E Bound Lane Roughness Inches/Mile
Start Taylor County line	1	0.50	76	88
	2	0.50	90	100
	3	0.50	96	100
	4	0.50	90	110
	5	0.50	86	104
	6	0.50	124	132
Stop N-26	7	0.36	117	106
Miles Measured		3.36	Ave. 96	Ave. 106

IOWA DEPARTMENT OF TRANSPORTATION
Materials Department
AMES LABORATORY

ROAD ROUGHNESS REPORT

Lab. No. RR_____ Report Date_____ County Taylor

Proj. Miles 12.051 Year Built 1978 Road No. Ia 2

Contractor Irving F. Jensen Proj. No. TQF-2-3(15)
Asph. Conc. ____ A.C. Resur. ____
Location From Page County line easterly P.C. Conc. x Slip Form x
Fixed Form ____
to west junction of Iowa 148

Date Tested 11-2-78 Weather clear

Test Observers Twohey - Veland

¼ point Terminus Transverse groove	Sect. No.	Length (Miles)	W Bound Lane Roughness Inches/Mile	E Bound Lane Roughness Inches/Mile
Start 20 Rev. W of Ia 148	1	1.00	95	81
	2	1.00	96	85
Omit bridge	3	1.00	101	97
	4	1.00	103	89
	5	1.00	85	86
	6	1.00	97	90
	7	1.00	89	83
	8	1.00	94	97
Omit bridge	9	1.00	90	90
	10	1.00	119	114
	11	1.00	98	105
Stop - County line	12	0.71	87	89
Miles Measured		11.71	Ave. 96	Ave. 92

IOWA DEPARTMENT OF TRANSPORTATION
Materials Department
AMES LABORATORY

ROAD ROUGHNESS REPORT

Lab. No. RR_____ Report Date_____ County Taylor

Proj. Miles 1.394 Year Built 1978 Road No. Ia 2

Contractor Irving F. Jensen Proj. No. TQF-2-3(18)--29-87

Asph. Conc.____ A.C. Resur.____

Location From E Jct. Ia 148 in Bedford P.C. Conc. x Slip Form x

Fixed Form____

easterly 1.4 miles to old Ia. 2

Date Tested 11-2-78 Weather Clear

Test Observers Twohey - Veland

¼ point Terminus	Sect. No.	Length (Miles)	E Bound Lane Roughness Inches/Mile	W Bound Lane Roughness Inches/Mile
Start 20 Rev. E of Ia 148	1	0.25	104	116
	2	0.25	108	112
Omit RR & Bridge	3	0.25	108	96
	4	0.25	84	84
Stop - Old Ia 2	5	0.23	91	87
Miles Measured		1.23	Ave. 99	Ave. 99

FRICTION TESTING SUMMARY

Date:	6-20-79	6-25-80	6-17-81	6-16-82
Page TQF-2-2(16)	50			45
Taylor TQF-2-3(15)	56	55	52	52
Taylor TQF-2-3(18)	61	47	46	49