RECYCLED PORTLAND CEMENT CONCRETE PAVEMENT IN IOWA

Final Report

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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:

- 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.

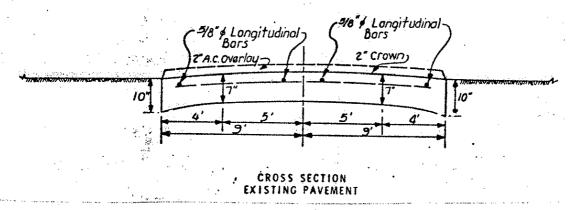
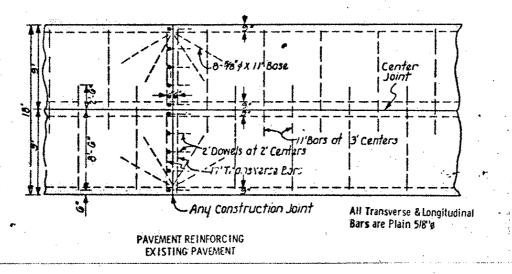
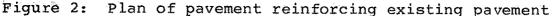


Figure 1: Cross section -- existing pavement





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.

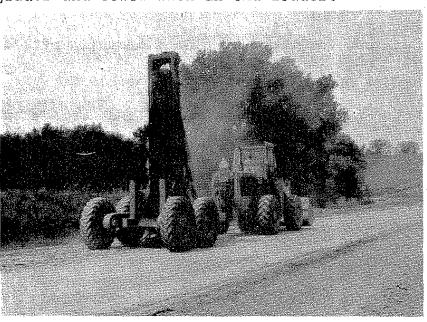


Figure 3: Special pavement breaker



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 booked 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"

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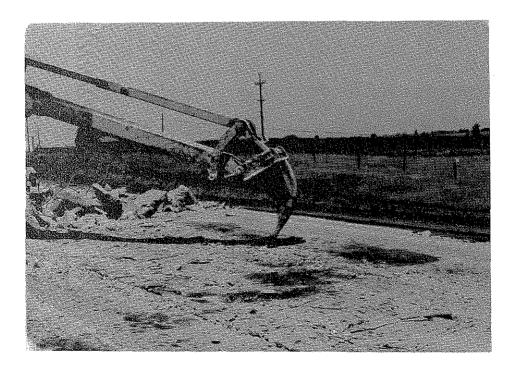


Figure 6: "Rhino horn" ripper tooth



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.

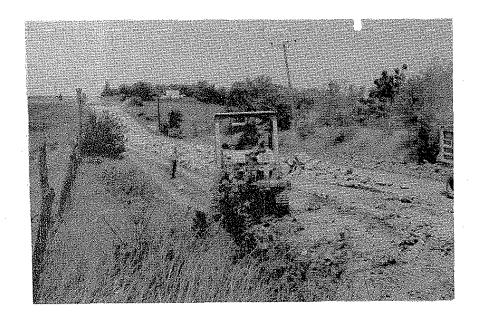


Figure 10: The recycled "Quarry"



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).

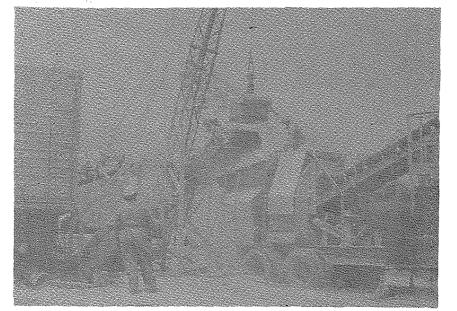


Figure 13: Magnet for final steel removal

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

Sleve Size	Percent Passing
1 ¹ / ₂ inch	100
1 inch	72
3/4 inch	39
¹ z 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	
<u>Sieve Size</u>		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 wash 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 insair, 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 maximal 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 time 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 <u>7 day</u>	Rupture <u>14 day</u>	Density
Page TQF-2-2 (16)29-73 Taylor TOF-2	1.65	6.8	718	778	· · ·
(15) - 29 - 87 Taylor TQF-2	1.46	6.9	745	809	135.8
(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 & crush 127,845 s.y. Removal & crush		
	\$ 547,333.30	
Minus normal removal cost 161,749 s.y.	@ \$1.00 = - 161,749.00	
Plus added cost for Class 1 54,000 tons	0 material @ \$0.30 = + <u>16,300.00</u>	
	TOTAL COST \$ 401,784.30	

Material Cost Using Recycled Concrete

Crushed coarse aggregate 0.542 ton @ \$7.44/ton = \$4.03Crushed fine aggregate 0.319 ton @7.44/ton = 2.37pc sand 0.467 ton @5.60/ton = 2.62Cement 0.313 ton @ $48.00/ton = \frac{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 = \$6.11pc sand 0.873 tons @5.60 = 4.89Cement 610 lbs @48.00 $\frac{14.64}{$25.64}$

8" paving = \$5.70/s.y.

<u>Savings</u>:

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 Tawlon	8.2	3874	7.2
Taylor (15)29-87 Taulon	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 time 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:

	Cracks per		Cracks per
MP	50 Panels	MP	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 time 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 1/2 2	0.6

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.
- 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

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

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8 181			DECEMB	FR 28	5- 1977			
	THE OFFICE OF THE PARTY OF THE FIRST PART UNDER DAT THAT IN CONSIDERATION OF THE FOREGOING, THE PARTY	OF THE FIRST PART HERE	BY AGREES TO	PAY THE P	ARTY OF THE	SECOND PART, P	ROMPTLY AND ACCOR	DING
30 THE 38T	REQUIREMENTS OF THE SPECIFICATIONS THE AMOUNTS SET PARTIES HERETO AGREE THAT THE NOTICE AND INSTRUCTI	FORTH, SUBJECT TO THE ONS TO BIDDERS. THE PRO	CONDITIONS AS	SET FORT	H IN THE SPEC	FICATIONS. ECIFICATIONS OF	THE IOWA DEPARTMEN	TOF
таазр	DRIATION FOR 1977 TOGETHER WITH SPEC							
	<u>-с-3(38)29-87</u>	OGETHER WITH SECOND P						
	ENT CONSTITUTE THE CONTRACT BETWEEN THE PARTIES H HAT IT IS FURTHER UNDERSTOOD AND AGREED BY THE PART		HAT THE ABOVI	E WÓRK SH.	ALL BE COMME	NCED OR COMPLE	TED IN ACCORDANCE V	พาษ
		APPROX. OR SPECIFIED	·····				·	
it to	LLOWING SCHEDULE:	OR NUMBER OF W	ORKING DAYS		OR NUMBE	COMPLETION DA	rs	
		80 WOR	KING DA	YS	0 C T •	20, 1978		
41 71	ME IS THE ESSENCE OF THIS CONTRACT AND THAT SAID CON	****** ***************	THE TERMS AN				·	
WI TI Th	NESS WHEREOF THE PARTILS HERETO HAVE SET THEIR	HANDS FOR THE PURPOSE	HEREIN EXPRE	SSED TO TH	IS AND THREE	OTHER IDENTICAL	LES RERETO. L INSTRUMENTS AS OF	
	IOWA DEPARTMENT OF TRANSPO	RTATION						
	- de C							
81	- Alto B Charles							
	PARTY OF THE FIRST PART							
	IRVING F. JENSEN CO.INC. OF	F SIOUX CITY	• IOWA•				Λ	٨
		********					- Vi	J)
B.	1. I di la companya da la companya d	•					X	Ľ
U.	PARTY OF THE SECOND PART	, , , , , , , , , , , , , , , , , , , 					<u> </u>	•

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CON ITE NO	TRACT NO. 14115 PROJECT TQF-2-3() M ITEM	8)29-87 QUANTIT	Y UNIT	F	ppendix A PAGE 2 AMOL
, NV	CULVERT, UNCLASSIFIED ENTRANCE		I Т.Ы. ^с с"т	10-00	1.180.0
гР	PIPE, L& IN. DIA. CULVERT, UNCLASSIFIED ENTRANCE	·	LIN. FT.		
17	PIPE, 24 IN• DIA. CULVERT, UNCLASSIFIED ENTRANCE		LIN. FT.	15.00	150.0
С. 18	PIPER 36 INO DÍAO Elbows, corro metal pipe		LIN. FT.	25-00	1,250.0('
. 7	LB IN. DIA.		ONLY	90.00	90.0
15	INTAKE- RA-3 - MODIFIED		ONLY	800.00	800.00
50	INTAKE RA-3		ONLY	J • 500 • 60	1.500.0
51	INTAKE, RA-6		ONLY	1-500-00	1.500.01
55	MANHOLE, RASE		ONLY	1.200.00	1.500.0
53	SEWER, 15000 STORM, 12 IN. DIA.		LINº FTº LINº FTº	1,5°00 1,5°00	1.050.0:
24	SEWER, 2000D STORM, 15 IN. DIA. BRIDGE END DRAIN, RF-35		ONLY	350.00	1x40C+0.
25	GUARDRAIL, FORMED STEEL BEAM	-337.500		6.00	2,025.0
сь 27	GUARDRAIL, POSTS, BEAM		ONLY	27.00	1,436.0
28	GUARDRAIL, END ANCHORAGES, BEAM		w 1463 4		
ι ·	RE-BB	ľ	ONLY	5PD°00	260.02
29	GUARDRAIL, END ANCHORAGES, BEAM	_			, }
	RE-52	Э	ONLY	262.00	795.01
30	BARRICADE ROAD CLOSURE RE-3	1	ONLY	350.00	350.0
3 T	BARRICADES	73	ONLY	150.00	1.950.0()
ŚΕ	REMOVAL OF PAVEMENT	4×032	SQ. YDS.	l.25	5.040.01
33	REMOVAL OF EXISTING STRUCTURES		LUMP SUM		300.0
34	SILT BASIN		ONLY	50.00	1.100.0
35	SILT DITCH		LINº FT.	•50	870.0
36	BALE FOR DITCH CHECKS		ONLY	J0°00	\$50°D
37	SODDING	크	SQUARES	20.00	60.0(
8 E	STABILIZING CROP -	9.300	ACRES	15°00	1-162-5
39	SEEDING AND FERTILIZING MULCHING	5°10		762.00	alpedia.
3 T 4 ()	FERTILIZING		ACRES	00.00	408-0
ч <i>а</i> Ц]	TRAINEE REIMBURSEMENT		HOURS	00°00 08°	400-00
11. 1	(1、M 2.19 m m = 1、m 2.11 D W A、 3 m (1 m 19 1	لي لي في		- UU	t yet tur two t

GRAND TOTAL

\$289~306.6

	CONTRACT	NO. IS		endix A
FORM 383.D 3-74 H-4974		F-2-21	Pag 4)20-73	e 3
Type of Work GRADING	Project No.			877
Milos <u>3 e C 1 1 1</u>	County	PAGE		
ON IOWA 2 FRO	M THE TAYLOR COUN		AT NEW MARKE	TWEST
3.5 WILES				
THIS AGREEMENT made and entered by and between the lowa	Department of Transportation, Des Mol	nos, Jowa, comiisti A C D A comi	ing of the following membe	If\$1
ROBERT R RIGLER. STEPHEN	GARST DONALD K G		ALLAN THUILA	
W. F. MCGRATH. BARBARA DU TERLING MCLAREN CONSTR. CO. I	NC. OF SHENANDOAH		ilAn , par	ty of the first part, and 10200
JOHNSON BROS. INC. OF RED OAK	TOWA		*****	
party of the second part.				
WITNESSETH: That the party of the second part, for and i thats constituting a part of this contract, hereby agrees to const and specifications therefor, and in the locations designated in the	n consideration of \$ ****633 truct various items of work and, or, to notice to bidders, as follows:	supply various in	, payable as set natorials or supplies in acco	forth in the specifica- ordance with the plans
tem ITEM	Quantity	Unit	Unit Price	Amount
] EXCAVATION - CLASS 10 - ROADW	AY &			
BORROW	668-705	CU. YDS		
S EXCAVATION & CLASS 12. BOULD		CU. YDS		
3 OVERHAUL	1.188.045			
4 EXCAVATION CLASS 20		CU · YDS	•	0+57E+E
5 BACKFILL, COMPACTING, ADJAC CULVERTS AND STOCKPASSES		CU. YDS	• 3•00	2,295.0
	87.680			
7 REMOVAL & CRUSHING OF PAVEM				
8 REMOVAL OF EXISTING STRUCTU		LUMP SU		9,000.0
4 REMOVAL OF SIDEWALK	40	SQ. YDS		40.0
O CULVERT. CONCRETE ROADWAY P	IPE			
24 IN. DIA.	5P	LIN. FT	•: 11•75	1.097.0
1. CULVERT CONCRETE ROADWAY P				· · · ·
36 IN. DIA.		LIN. FT	• 21.85	34758.2
LE CULVERT, CONCRETE ROADWAY P		5 3 8 1 10 10	E3.00	6.954.0
LO IN• DIA• J3 APRONS• CONCRETE• 24 IN• DI	۲۰۰ S	LIN. FT ONLY	°. 57.00 122.70	
J∃ APRONS™ CONCRETEN 24 IN⊕ DI 144 APRONSN CONCRETEN 36 IN⊕ DI		ONLY	21,5,40	· · · · · · · · · · · · · · · · · · ·
	Ξ. Ξ.	ONLY	548-05	1.096.1
LE HALF PIPE. CONCRETE. 36 IN.		LIN. FT		
Party of the second part certifies by his signature on this a	interest that he has complied with 3241	7/8) of the 1075 of	Tada af Irwa ar amondad	
Suid specifications and plans are hereby made a part	of and the basis of this agreemen	it, and a true ac	ppy of said plans and spi	ecifications is now on
file in the office of the lowa Department of Transportation under a		ER 30, 1		
That in consideration of the foregoing, the party of the fir the specifications the amounts set forth, subject to the conditions	as set forth in the specifications.	of the second gas	rt, promptly and according	to the requirements of
the parties hereto agroe that the notice and instruction		-		
	l provisions attached, together with the			
stitute the contrast between the parties hereto.	her with second party's performance be			
that it is further understood and agreed by the parties	an a			d shall be completed
on or lectors	Approx. or Specified Starting Date or Number of Working Days		pecified Completion Date Number of Working Days	
	, , , , , , , , , , , , , , , , , , ,			······
	APPROX APR. 4.19	77 1.3	O WORKING DA	YS
That time is the assence of this contract and that sold contract a IN WINESS WHEREOF the parties hereto have set the	r bands for the purpose herein expr	agreed upon by til assed to this an	a parties horeto. d three other instruments	of like tenor, as of
the day of FEB 1.	1 1977 . 19			•
IONVA DEPARTMENT OF TRANSPORTATION	7		ľ	ST CT CAR
Dr. Azmerilli Tresnell			1.1	ECG-VI
Party of the first Part	······································		J P ·	IONA
STERLING MCLAREN CONSTR. CO.	. INC. OF SHENAND	OAH. ION	A CONTRACTOR	
JOHNSON BROS. INC. OF RED OA	K. IOWA			
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By Party of the Second Part		ait	12 Julian	Tel al
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- AN	траст ма зариз родисти с	- 20 - 22			Appendix A PAGE 4
ITEI NO			Y UNIT	UNIT PRICE	
•	ELBOWS CONCRETE PIPE				
	36 INO DIAO	ז.	ONLY	293.70	293.70
18	CULVERT UNCLASSIFIED ROADWAY PIPE 24 IN. DIA.	566	LIN. FT.	11.00	2,926.00
19	CULVERT® UNCLASSIFIED ROADWAY PIPE® 42 IN® DIA®	52	LIN. FT.	21.70	1-562-40
	APRONS. UNCLASSIFIED. 24 IN. DIA.		ONLY	86.90	869.00
55	APRONS UNCLASSIFIED 42 IN. DIA. CULVERT CORR. METAL ROADWAY		ONLY	274.40	548.80
)	PIPE, 24 IN, DIA.	134	LIN. FT.	9.85	1-319-90
53			LIN. FT.	16.80	1,982.40
24	PIPE® 36 IN® DIA® APRONS® METAL® 24 IN® DIA®		ONLY	15.°01 83∘50	83°20
	APRONS METAL BL INO DIAO		ONLY	173-80	1,73,80
- 26	ELBOWS CORR. METAL PIPE			•	
27	24 INO DIAO ELBOWSO CORRO METAL PIPE	ູ່ມ	ONLY	94.30	94.30
	36 IN. DIA.	·],	ONLY	134.40	134.40
85	DIAPHRAGM。 CORR。 METAL。 TYPE A 24 IN。	l	ONLY	80. 30	80.30
25	DIAPHRAGM® CORR® METAL® TYPE A 36 IN®	7.	ONLY	104.85	104.85
30	STOCKPASS, 4º X Lº PRECAST				
31	CONCRETE RF-8 STOCKPASS APRON: 4° X 6° PRECAST	78	LIN• FT•	66.72	5,159,70
32	CONCRETE RF-B	5	ONLY	701.05	1,402,10
	PIPE, LA IN. DIA.	1.742	LIN. FT.	8•3D	14.458.60
33	CULVERT» UNCLASSIFIED ENTRANCE PIPE» 24 IN» DIA»	550	LIN. FT.	9.85	5-41,7.50
34	CULVERT UNCLASSIFIED ENTRANCE			11.20	5~248.60
35	PIPE JL IN. DIA. LOCATING TILE LINES		LIN. FT.	700°00 7P°30	5.000.00
36	BARRICADES		ONLY	700°00	1°900°00
37	SILT DITCH		LIN. FT.	~ 80	2,120,00
•	SURFACING. GRANULAR. CLASS A				
:	CRUSHED STONE - ON ROAD	8,244	TONS	5.70	46.770.80
-39	SUBDRAIN CORR. METAL PIPE	(<u>n</u> n	LIN. FT.	3.40	2,339,20
: 40	L IN• DIA• Subdrain• corr• metal pipe	600	T 7140 1 10	5440	
	PERFORATED. L IN. DIA.	150	LIN. FT.	4.75	712×50
4]	SUBDRAIN OUTLET, RF-22	З	ONLY .	71.00	573.00
42	GRANULAR MATERIAL FOR BLANKETS		CH 455		in regin
43	AND SUBDRAINS BACKFILLS POROUS		CU• YDS• CU• YDS•	4.60 22.50	17~599°60 585°00
цц.	COMPACTING EMBANKMENT WITH	L 0	ς ω∼ ι νο⊽	나나 우그금	یا یا – تا یا ب
45	MOISTURE & DENSITY CONTROL	1.414	CU. YDS.	•75	164-68
	STABILIZING CROP SEEDING AND FERTILIZING	100.100	ACRES	152°00	12.512.50
	FIELD LABORATORY		ONLY	J~000°00	1~000.00
47		1.60.001	y		57°575°05
48	TRAINEE REIMBURSEMENT		HOURS	• 80	800.00
a e e A				ID TOTAL	\$633,970,90
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:	E contra de la c				

) 	FORM 090019 8-77 H-3878	CUNIKAUI		14115	Appen Page	dix A 5
ļ	TYPE OF WORK PORT CEMENT CONC . PAV . 1 MILES 3.211	COST CE	ND. <u>TRF</u> NTER 5 PAG		-29-73 0BJECT	878
	ON IOWA 2 FROM	TAYLOR COUNTY			ILES	
Ĩŀ	THIS AGREEMENT MADE AND ENTERED BY AND BETWEEN THE ROBERT R RIGLER STEPHEN GA W. F. MCGRATH, BARBARA DUNN RVING F. JENSEN CO.INC. OF SIOU)	N & L. STANLEY	GARDNE	R ALLAN	THOMS	FIRST PART, AND
#ITNE TIONS	FARTY OF THE SECOND PART. SSETH, THAT THE PARTY OF THE SECOND PART, FOR AND IN CONSIDE. CONSTITUTING A PART OF THIS CONTRACT, HEREBY AGREES TO CON RDANCE WITH THE PLANS AND SPECIFICATIONS THEREFOR, AND IN TH	RATION OF S <u>****47</u> ISTRUCT VARIOUS ITEMS OF WOR HE LOCATIONS DESIGNATED IN T		20 PAYABLE SUPPLY VARIOUS BIDDERS, AS FOLLO	AS SET FORTH I MATERIALS OR WS :	N THE SPECIFICA- SUPPLIES IN
ITEN NO		QUANTITY	UNIT	UNIT PRI	1	AMOUNT
	L PAVEMENT: STANDARD OR SLIP F P. C. CONC.: CLASS A: 8 IN. P. SURFACE TREATMENT		5 SQ.	YDS.	6.60	321.057.0
-	OF P. C. CONCRETE PAVEMENT STABILIZED SHOULDER MATERIAL SURFACING, GRANULAR, CLASS A	13~71	•		7•93	0° ۵۵۹٬۲۶۹٬۹
	CRUSHED STONE - ON ROAD 5 STABILIZING CROP -		Z NOT E		6.35	19-132-5
	L FIELD LABORATORY	11.80 11.80 3.52 24 ABLE 1	D ACRE 8 LIN.	S S FT.	125.00 160.00 2.65 25.50 300.00 000.00 .80	1*475.0 1*888.0 944.0 9*349.2 5*196.5 3*600.0 1*000.0 400.0
				GRAND T	OTAL	\$473~802°5
ILE I TO TH TH HANS	PARTY OF THE SECOND PART CERTIFIES BY HIS SIGNATURE ON T 324 17:81 OF THE 1975 CODE OF IOWA AS AMENDED IF APPLICABLE SAID SPECIFICATIONS AND PLANS ARE HEREBY MADE A PART OF IN THE OF FICE OF THE PARTY OF THE FIRST PART UNDER DATE OF THAT IN CONSIDERATION OF THE FOREGOING. THE PARTY OF THE E RFOUREMENTS OF THE SPECIFICATIONS THE AMOUNTS SET FORTH IF PARTIES HERETO AGREE THAT THE NOTICE AND INSTRUCTIONS TO PORTATION FOR 1977 TOGETHER WITH SPECIAL PRO -2 - 2 (JL)29 - 73, TOGETH MMENT CONSTITUTE THE CONTRACT BETWEEN THE PARTIES HERETO THAT IT IS FURTHER UNDERSTOOD AND AGREED BY THE PARTIES OF	DECEM FIRST PART HEREBY AGREES T SUBJECT TO THE CONDITIONS BIDDERS. THE PROPOSAL FILED DVISIONS ATTACHED, TOGETHER ER WITH SECOND PARTY'S PERFO	BER 28 O PAY THE PA AS SET FORTH HEREIN, THE WITH THE GEI DRMANCE BON	3 1977 ARTY OF THE SECON IN THE SPECIFICAT GENERAL SPECIFIC NERAL AND DETAILE B, ARE MADE A PAR	D PART, PROM IONS. ATIONS OF THE D PLANS, IF AN T HEREOF, AND	PTLY AND ACCORDING IOWA DEPARTMENT OF Y, FOR SAID PROJECT TOGETHER WITH THIS
₩E. ‡	OLLOWING SCHEDULE:	ROX. OR SPECIFIED STARTING DA OR NUMBER OF WORKING DAYS	TE	SPECIFIED COMP OR NUMBER OF W	LETION DATE ORKING DAYS	
		80 WORKING D				
N WI	THE IS THE ESSENCE OF THIS CONTRACT AND THAT SAID CONTRACT TNESS WHEREOF THE PARTIES HERETO HAVE SET THEIR HANDS UNIDAY OFDAY OFDAY 17 1971	FOR THE PURPOSE HEREIN EXPR	ND CONDITION ESSED TO THI	NS AGREED UPON BY IS AND THREE OTHEF	THE PARTIES H	ERETO. TRUMENTS AS OF
	IOWA DEPARTMENT OF TRANSPORTA BY PARTY OF THE FIRST PART IRVING F. JENSEN CO.INC. OF SI BY PARTY OF THE SECOND PART	al-Solitza	•			M

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ŕ		CEMENT CONC.	PAV º T.					
*	1.2.0.5.J			COST CET		LOR LOR	OBJECT	0,70
		ON IOWA 2 P					TO WEST J	INCTION
	a second and the second s	148 IN BEDFOR	M A (JA DEPARTME	NT OF	TRANS	PORTATION	· · · · · · · · · · · · · · · · · · · ·
ĭ	ROBERTR	RIGLERN STEPHE	IN GARSTY	DONALD K	GARDNE	R. ALL	AN THOMS .	**************************************
້ຳ		GRATH & BARBARA EN CO.INC. OF			SCHOE	LERMAN	PARTY OF TH	E FIRST PART, AND 21400
			<u> 1007 (11)</u>	IN JVWA®			······································	UUU
	ARTY OF THE SECOND PA					10		UN THE OPENING
T	I TH THAT THE PARTY OF CASH TUTING A PART OF ANCT WITH THE PLANS A	THE SECOND PART, FOR AND IN THIS CONTRACT, HEREBY AGREE NU SPECIFICATIONS THEREFOR, I	S TO CONSTRUCT VAND IN THE LOCATIC	ARIOUS ITEMS OF WORK	AND, OR, TI E NOTICE TO	SUPPLY VA	RIOUS MATERIALS OF	R SUPPLIES IN
NO	• •	ITEM	QU	ANTITY	UNIT	רואט	PRICE	AMOUNT
·	FXCAVATION	VOR * CLASS 10* ROA	IDWAY R					
در .	BORROW			5-11i	2 (U•	YDS.	J • O 🛛	5,11,2.0
3		STANDARD OR SLI	IP FORM	`l70~06°	1 50.	YDS:	6.61	7*755*462*4.
З		STANDARD OR SLI					0-00	· · · · · ·
• <i>•</i> •			IN		5 52.		2.20	19,908.0
ц S		IN. P. C. CON(ROACH SECTION	KE IE	~	i SQ.	1720	15.00	75.0
5	REINFORCED	AS PER PLAN		573	3 50.	YDS.	30.00	6-390-0
Ь	SURFACE TR	EATMENT ONCRETE PAVEMEN	17	173,041	50.	V DS-	е.,	• 0
7		FORMED STEEL E			LIN.		6.00	4,500.0
В		POSTS, BEAM		<u> 1,4</u> լ	ONLY		27.00	3,942,0
٩	GUARDRAIL * RE-S2	END ANCHORAGES	BEAM	n	ONLY		265.00	5,150.0
10	GUARDRAIL	CABLE			LIN.		2.65	5,056,2
רך ד		POSTS & CABLE			ONLY		25.50	3,51,9,0
73 75		END ANCHORAGES DRAIN RF-35	IN CABLE) ONLY S ONLY		300-00 350-00	0~000~C 0~000&C
ĵų	SODDING				SQUA		50°00	140.0
	PARTY OF THE SECOND	PART CERTIFIES BY HIS SIGNATU	IRE ON THIS CONTRA	CT. UNDER PAIN OF P	ENALTIES FI	OR FALSE CER	TIFICATION, THAT H	E HAS COMPLIED
-961 H 12-	SAID SPECIFICATIONS /	OF IOWA AS AMENDED, IF APPLIC ND PLANS ARE HEREBY MADE A	PART OF AND THE B	ASIS OF THIS AGREEME	INT, AND A	TRUE COPY OF	SAID PLANS AND SP	ECIFICATIONS IS NOW ON
FILEIN		Y OF THE FIRST PART UNDER D				<u>, 1977</u>		
347-01 111	REQUIREMENTS OF THE S PARTIES HERETO AGREE	OF THE FOREGOING, THE PART PECIFICATIONS THE AMOUNTS SE THAT THE NOTICE AND INSTRUC	OF THE FIRST PAR T FORTH, SUBJECT TIONS TO BIDDERS T	T HEREBY AGREES TO TO THE CONDITIONS AS THE PROPOSAL FILED	PAY THE PAY THE PAY SET FORTH	IN THE SPEC	SECOND PART, PRO FICATIONS. ECIFICATIONS OF TH	MPTLY AND ACCORDING
	HIATION FOR	1977 TOGETHER WITH SPE						
T.Q.E - Instrum	2:3(15)29	NTRACT BETWEEN THE PARTIES	HERETO.					D TOGETHER WITH THIS
11	HAT IT IS FURTHER UNDE	RSTOOD AND AGREED BY THE PA	RTIES OF THIS CONT	RACT THAT THE ABOV	E WORK SHA	LL BE COMME	NCED OR COMPLETE	IN ACCORDANCE WITH
тне э ос	LOWING SCHEDULE	ſ		CIFIED STARTING DAT	E	SPECIFIED OR NUMBE	COMPLETION DATE	
			80	WORKING DA	ZY	0CT•	20, 1978	
18437 10 18 98 16	TESS WHEREOF THEP	IS CONTRACT AND THAT SAID CO ARTIES HERETO HAVE SET THEI	NTRACT CONTAINS RHANDS FOR THE PL	ALL OF THE TERMS AN	ID CONDITIO SSED TO TH	NS AGREED UP	ON BY THE PARTIES	HERETO. NSTRUMENTS AS OF
1.11	- (Frankers all - Angen valadeau) saustin is die tris - An Angen (Soussenier) van Fran	DAY OFJAN 1	1 157(0	. 19				
۰۰. مىلىنە	TOWA DEPART	MENT OF TRANSPO	RTATION					· · · ·
ΒY		RE Carol	<u>ر</u>					
	/	CANSEN CO THE FIRST PART	C CTAUN	-TTV TAUX				٨
	JRVING F. J	ENSEN CO.INC. (<u>) X U 012 - 10</u>	TIL TOMA	3			V N
-	2270							NL
BY	Contraction of the start	OF THE SECOND PART	- arrow water and a constant area and a			anna an		* *

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XON	TRACT NO. 14114 PROJECT TQF-2-	Appendix A PAGE 7			
ITE		QUANTITY	UNIT	UNIT PRICE	AMC
15	STABILIZED SHOULDER MATERIAL	53v07l	ZNOT	7.70	408-646.7
ĴЬ	SHOULDER CONSTRUCTION - EARTH	75°240	STAS .	50 • 00	634.5
1,7	SURFACING, GRANULAR, CLASS A				
•	CRUSHED STONE - ON ROAD	10,488		6.10	63,976.8
18	SILT BASIN	17	ONLY	50 • 00	850°ť
19	BALE FOR DITCH CHECKS	520	ONLY	10.00	5-200-C
05	STABILIZING CROP -		1. State 1.	· · ·	•
• .	SEEDING AND FERTILIZING	44.700	ACRES	J5.00	5-587-5
51	MUI, CHING		ACRES	700.00	7-152-0
5.5	FERTILIZING	44.700	ACRES	80.00	3,576.0
2 3	SEWER, CORR. METAL STORM				
N	BITUMIN. COATED. 15 IN. DIA.	115	LIN. FT.	75°00	1.J.380.(
- 24	APRONS, METAL, 15 IN. DIA.	Г	ONLY	700 •00	J00°C
<u>25</u>	FIELD LABORATORY	l	ONLY	1-000-00	J. 000.C
- 2 L	TRAINEE REIMBURSEMENT	J~000	HOURS	• 80	800.0

GRAND TOTAL \$1.47.421.1

JOHNSON BROS. INC. OF RED OAK. IOWA perty of the second part. WITNESSTH: Then the party of the second part, for and in consideration of s **1+81+81+81+80 two constituting a part of this centrat, bardy agrees to construct various, ferm of varie and specifications methods or supplies in accordance with the and specifications therefore, and in the location diginant of in the term of varies and term of varies	
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	•
on or befores ar Number of Working Days ar Number of Working Days	
ADDDAV ADD H DET DE DAVENC NAVE	
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 WIINESS WHEREOF the parties hereto have set their hands for the purpose herein expressed to this and three other instruments of like tenor, $r = 0.1.4$	as of
	IR da
IOWA DEPARTMENT OF TRANSPORTATION	
By fame, H. Tresnell	NI.
Party of the First Part	*
STERLING MCLAREN CONSTR. CO., INC. OF SHENANDOAH, IOWA	
JOHNSON BROS- INC. OF RED OAK. IOWA	
A MATE A AND A AND I	
By All fam Carlo Anon	
Party of the Second Part	

Appendix A CONTRACT NO. 12942 PROJECT F-2-3(4)--20-87 PAGE 9 QUANTITY UNIT UNIT PRICE .AMOUN TTEM ITEM 10 236 LIN. FT. 15 HALF PIPE, CONCRETE, 30 INc. 15.85 3.740.60 CULVERT CONCRETE ROADWAY PIPE 256 LIN. FT. 36 INO DIAO 22.85 5~849.60 CULVERT CONCRETE ROADWAY PIPE 12 112 LIN. FT. 42 INO DIAO 30°00 3~3P0°00 CULVERT. CONCRETE ROADWAY PIPE 144 LIN. FT. 43 INO DIAC 38.35 5,522,40 35 ONLY 20 ONLY 4 ONLY 2 ONLY 2 ONLY 2 ONLY 19 APRONS & CONCRETE & 24 IN. DIA. 155°20 4-294-50 APRONS CONCRETE 30 IN. DIA. APRONS CONCRETE 36 IN. DIA. 3~059~00 151.40 901.60 225.40 APRONS & CONCRETE +2 IN. DIA. 282,90 565.80 55 697.40 73 APRONSS CONCRETES 48 INC DIAC 348.70. I ELBOWS & CONCRETE PIPE 24 INº DIAº 11 ONLY 162.50 1-817-20 25 ELBOWS CONCRETE PIPE RO INCEDIAS 8 ONLY 218.80 1.750.40 LJ STOCKPASS 4" X 6" PRECAST 162 LIN. (FT. 62.15 10.068.30 CONCRETE RF-8 T? STOCKPASS APRONS 4° X 6° PRECAST CONCRETE RF-8 4 ONLY 651.05 2.604.20 28 CULVERT, UNCLASSIFIED ROADWAY PIPE, 24 IN. DIA. L72 LIN. FT. 12.00 8.064.00 F CULVERT UNCLASSIFIED ROADWAY PIPE, 36 INC DIAC. 132 LING FTG / 19.00 2~508~00 CULVERT, UNCLASSIFIED ROADWAY 30 PIPE: 42 IN. DIA. 82 LIN. FT. 21.70 1.779.40 L CULVERT UNCLASSIFIED ROADWAY 132 LIN. Fr. PIPE V 48 IN. DIA. 24.50 3~234~00 26 ONLY APRONS UNCLASSIFIED 24 IN. DIA. 32 86.90 2.259.40 B APRONS UNCLASSIFIED EL IN. DIA. 4 ONLY 2 ONLY 190.50 762.00 558.80 APRONS UNCLASSIFIED 4 42 IN. DIA. 4 279.40 35 APRONS UNCLASSIFIED 48 IN. DIA. 4 ONLY 1.517.90 304.15 CULVERT, CORR. METAL ROADWAY а 0E.085.1 PIPE: 24 IN. DIA. 118 LIN. FT. 10.85 Ξ?-CULVERT CORR. METAL ROADWAY PIPES 30 INC DIAC. 74 LIN. FT. 14.60 1.080.40 3 CULVERT & CORR. METAL ROADWAY PIPE JL IN. DIA. 344 LINO FTO 17.30 5.951.20 39 CULVERT CORR. METAL ROADWAY PIPE, 48 IN. DIA. 72 LIN. FT. 21.90 1.576.80] CULVERT CORR. METAL ROADWAY PIPE: 54 IN. DIA. 200 LIN. FT. 5.340.00 - 5P • 90 4 ONLY 2 ONLY 3 ONLY 3 ONLY 4 JONLY ս լ APRONS METAL 24 IN. DIA. 83.50 334.00 3 APRONS , METAL , 30 IN. DIA. 535.90 116.40 APRONS METAL 36 IN. DIA. 183.80 551.40 44 APRONS METAL 48 IN. DIA. 874.05 291.35 5 APRONS, METAL, SY IN. DIA. J ONLY 345°70 392.10 DIAPHRAGN, CORR. METAL, TYPE A - 24 INo 2 ONLY 70.30 140.60 47 DIAPHRAGM& CORR. METAL, TYPE A 30 IN. 1 ONLY 88.75 88.75 HA DIAPHRAGH CORR. METAL TYPE A 36 IN. 2 ONLY 99.85 199.70 BECEIVED & SALA TAL SUBJECT & METAL SUBJECT & 48 IN. L ONLY 135.55 135.55 50 ELBOWS CORR. METAL PIPE OIS WORK OF NOT 201

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53,4	48 IN. DIA.	5	ONLY	182.75	365.50	
54	SUBDRAIN CORR METAL PIPE L IN DIA SUBDRAIN CORR METAL PIPE	167	LIN. FT.	2.47	402.47	
56	SUBDRAINS CORRS HETAL PIPE SUBDRAINS CORRS METAL PIPE	743	LIN. FT.	3.15	607.55	
57 58	PERFORATED & L IN. DIA. SUBDRAIN OUTLET. RF-22 SUBDRAIN. TRENCH	µ סכפינ י	LIN° FT° ONLY LIN° FT°	5°00 5°00	1,228,50 324,00 3,240,00	•
59 60 61	LOCATING TILE LINES SODDING TOPSOIL® STRIP®® SALVAGE AND	`?	STAS. SQUARES	100°00 50°00	3°000°00 320°00	
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67 68 69 70	REMOVAL & CRUSHING OF PAVEMENT REMOVAL OF SIDEWALK REMOVAL OF FLUMES BARRICADE® ROAD CLOSURE® RE-3	63 80	SQ. YDS. SQ. YDS. ONLY ONLY	3•30 1•00 30•00 504•00	2.400.00	· · · · · · · · · · · · · · · · · · ·
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74	BALE FOR DITCH CHECKS STABILIZING CROP -		ONLY	? •50	3.900.00	
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. 78	FIELD LABORATORY	Ţ	ONL Y	J~000°00	7°00°00	I,

GRAND TOTAL

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IOWA DEPARTMENT OF TRANSPORTATION Ames, Iowa SPECIAL PROVISIONS

for

REMOVAL AND CRUSHING OF OLD PAVEMENT

Page F-2-2(4) = -20-73Taylor 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 lapinch 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.

SP-183

Form 258 Speciel 8.72 Appendix C	va State Highway Comm materials department TEST REPORT — MISCELLANEOUS AMES LABORATORY		<pre>Bit. Agg. B. Ortgies J. Bergren R. Britson Geology Projects listed below</pre>
Material	1 ¹ ₂ " crushed concrete (P.C.)	Laboratory No	AAt7-75
Intended Use	P. C. Concrete		
	Page & Taylor		- (4)20-73 - (4)20-87
Producer	Kuhlman Contractor	· ·	
Source	New Market Hwy 2		
Unit of Material	2 bags		*********
Sampled by	H. Wayne Jackson	Sender's No	······································
te Sampled	Date Rec'd	Date Reported	4-19-77
% Psg. #8	after 16 cycles F&T, Water-Alc. So	1. 42	
% Wear, L	a Abrasion, Grading A	59	
Specific	Gravity (S.S.D.)	2.3	46
% Absorpt	ion (S. S. D.)	5.1	0

æ Bes C.

.

DISPOSITION:

F&T and Abr. do not comply Signed .

Appendix D Page 1

TRIAL MIXES

A. Preliminary Trial Mixes

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

55% coarse aggregate)recycled25% fine aggregate)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 <u>concrete to abrasion</u>. 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% 35% C.A. crushed Recycled 30% F.A. natural sand Aggregate 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

Appendix D Page 4

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	% <u>Air</u>	Slump (inch)	W/C Ratio	Compressive	Average Strength 14 day	lb/sq.in. 28 day
#1 Control	Cement 626 lbs. Crushed C.A. 42.5% Crushed F.A. 25.0% Concrete Sand 32.5 % (Finley)		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	9	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%	(Plastocrete) 161 3	6.5	1 3/4	0.422	4350	••• ••• ••	5510
	Concrete Sand 30% (Hallett)		•					

Appendix D Page 5

B. Project Trial Mixes Continued

Mix <u>No.</u>	Mix <u>Proportions</u>	Water Reducer ft.oz/100 CL of cement	% <u>Air</u>	Slump <u>(inch</u>)	W/C <u>Ratio</u>	Compressive <u>7 day</u>	Average Strength <u>14 day</u>	lb/sq.in. 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 5 600.0	5070 Tests 650	5380

The above quantities are based on the following assumptions:

Specific gravity of	cement	3.4	
Specific gravity of	crushed conc	rete, coarse	2.35
Specific gravity of	crushed conc	rete, 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.

Excerpt from PAVING SPECIAL PROVISIONS

Mix Proportion

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

	Basic Abs. 	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 cr	rushed concrete, coarse	2.35
Specific gravity of ci	rushed concrete, fine	2.35
Specific gravity of ci	rushed sand (4110)	2.65
Specific gravity of ce	ement	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 <u>No.</u>	Modulus (<u>7 day</u>	of Rupture <u>14 day</u>	Nuclear <u>Density</u>
7-14-78	1 3/4 1 3/4	7.8 7.8	16-1	718	817	· · · ·
	1 3/4	6.2	16-2	563	639	·
7-17-78	2 1 1/2 2 2	7.8 6.3 6.4 5.2	16-3 16-4	759 735	798 780	
7-18-78	1 3/4 2 1 1/2	5.5 7.3 6.7	16-5	748	794	
	$1 \frac{3}{4}$ 1 $\frac{3}{4}$	6.5 6.6	16-6	749	795	
7-19-78	2 1 3/4 1 3/4	6.2 6.7 7.0	16-7 16-8	726 634	775 704	
7-21-78	1 3/4 1 3/4	7.0	16-9 16-10	792 (M-4	858 mix)	
7-24-78	1 3/4 1 3/4	6.8 6.9	16-11	713	821	
7-26-78	1 1/4	7.0	16-16	733	744	- ,š
8-1-78	1 1/4	7.6	16-21	744	811	
Average Maximum Minimum	1.65 2 1.25	6.8 7.8 5.2		718 759 563	778 858 639	

Appendix F Page 2

Taylor TQF-2 ~ ~

<i>L</i> -	- 5	(12)	2	9	-0	1	
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Date	Slump	Air	Beam <u>No.</u>	Modulus c 7 day	of Rupture 14 day	Nuclear Density
7-10-7	8 1/2 1/2	6.0	15-1	778	898	. ·
	$1 \frac{3}{4}$ 1 1/2	7.2 7.1	15 <u></u> 2	764	824	
7-11-7	8 1.1/2	5.0				· · · · · ·
	1 1/2	5.8	15-3	767	857	
	2	7.8	15-4	(M-4		
·	2	6.1	15-5	843	883	
7-13-7		7.1	15-6	734	691	
	1 1/4	6.2	15-7	(M-4		
. · ·	1 1/2 1 3/4	7.6 7.7	15-8	727	692	
7-24-7	8 11/2	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				
7-25-7	•	6.8	15-11	(M-4		
·	1 1/2	6.7	15-12	744	791	
	1 1/2 1 3/4	6.5				· · · ·
	1 3/4	6.5				· · · · · · · · · · · · · · · · · · ·
7-26-7	-	7.7	15-13	812	853	1
	1 1/4	7.2				
7-27-7	8 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				
7-31-7	8 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	
0 0 70		/].	060	D.C.A	+127 0 6 6 0
8-8-78	1 1/4	7.7 7.6	15-21 15-22	869 737	864 789	*137.0 @ 6.2 134.5
	F	7.0	.J-66		109	134.5

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

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

			Beam	Modulus o	f Rupture	Nuclear
Date	Slump	Air	No.	7 day	<u>14 day</u>	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				
0 11 /0	1 1/2	8.0	15-25	706	739	:
	2	7.0	15-26		mix)	
	- 1 1/4	7.5		(*** *		
	$1 \frac{1}{4}$	7.4	15-27	714	780	
	1 1/7	/ . **	1.)-27	7	/00	
0 14 70	ר ד <i>ו</i> א	·7 1	1 = 20		748	
8-14-78	1 1/4	7.1	15-28	712		·
	1 1/4	7.9	15-29	626	763	
•	1.	7.8				· · ·
8-17-7 8	1 1/4	8.0	15-31	742	866	
	1 1/2	8.0	15-30	•	mix)	
	1 1/4	7.9	15-32	771	807	
	1 1/4	7.7	15-33	(Han	idwork)	
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	
	$1 \frac{1}{2}$	7.1				
3-22-78	1 3/4	7.8	15 / 37	744	798	
0 10	2	7.3				
	- 1 1/2	7.1	15-38	760	824	
	$1 \frac{1}{2}$	8.0	10 00	100	024	
	1 1/6	0.0				
8-23-78	1 1/2	7.3	15-39	775	796	
0-23-70						
	1 1/4	7.0	15-40	759	808	
0.04.70	1 7 /0	<i>c</i> 0	7 - 47	700	050	
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				
	<u>1/1/2</u>	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

Appendix F Page 4

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			Beam	Modulus	of Rupture	Nuclear
Date	<u>Slump</u>	<u>Air</u>	No.	7 day	14 day	Density
8-4-78	1 1/2	7.1	18-1	778	thur was	
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	

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

MATER Ami	E HIGHWAY COMMISS. A IALS DEPARTMENT ES LABORATORY		V• SNY ER L• BURGAN
PROJECT T&F-2-2(16)29-73 COUNT	Y PAGE LAB.	NO: ACE8-1578-	·1F52
LENGTH OF PROJECT 03-211 MILES	YEAR BUILT 1978	ROAD NUMBER	R IOWA 2
CONTRACTOR IRVING F. JENSEN	CORE FORM- NIDENING	BASE	FAVERENT X
FINE AGG. G.A. FINLEY INC. SHENANDOAN PIT	수 승규들에서 도망한 상전에서는 눈도가 바람에서	LED AL PLANT S)11C
CEMENT MISSOURI PORTLAND	MIX NUMBER	DATE	REPORTED 12/19/
DISTANCE AGE LAB. CORE STATION FROM AT UNCUT NO. NUMBER CNTRLINE TEST LENGTH FT. DAYS IN.	INFORMATIONAL STEEL HT CORR COMPU FROM BSE STREN. P IN. PSI. 20DAY	TESTS TED STR ZAIR SI• HARD• ZYEAR CONC•	REMARKS
1601 4-2051 219+00 5.58 114 8-20 1602 4-2052 229+00 9.61 6.10	4305 3580 4005 3330 4435 3690 5130 4270	5945	
1603 E4-2053 228+00 10.0L 114 8.00 1604 E4-2054 230+00 9.6L 114 8.20 1605 4-2055 238+00 1.5R 114 8.50	4140 3445 4235 3520 4195 3490	4475 4575 7.5 4575	
Loss Loss <thloss< th=""> Loss Loss <thl< td=""><td>4160 3460 4505 3750 4450 3700</td><td>4500</td><td></td></thl<></thloss<>	4160 3460 4505 3750 4450 3700	4500	
1610 4-2060 265+00 2.06 113 7.90 1611 4-2061 274+00 6.78 113 8.20 1612 4-2062 284+00 10.06 113 8.50	4470 3715 4655 3875 9640 3860	4830 9.3 5035 5015 7.1	
1613 4-2063 293*00 2.0R 113 8.00 1614 4-2064 302+00 5.3L 112 8.00 1615 4-2065 311+00 9.0R 112 8.10 1616 4-2066 320+00 1.8L 112 9.70	4485 3730 4320 3595 4415 3675 3935 3265	uton 3.2	
LL17 4-2067 329+00 5.6R LL0 7.80 LL18 4-2068 338+00 9.2L LL0 6.90	4700 3975 5050 4265 4180 3530	5165 5550 7.1 4580	CLIMBING LAN OM EDGE OF SLAB
LE20 4-2070 35L+00 L.3L 107 8.30 LE21 4-2071 220+00 8.7R 103 7.90	4415 3735 5650 4775	4855 6.6 6210 Fro	CLIMBING LAN

CORING COMPLET	E - 1997		IOWA STAT	E HIGHWAY COMP	us. In 1	age 2	PROJ Je Ve	ECT FILES BERGRAN	
			MATER	IALS DEPARTMEN ES LABORATORY	IT		V . S	NY DER UR GAN	· .
PROJECT TOF-2-	5(16)54-2		COUNT	Y PAGE	LAB.	NO. ACE8	-1598-1625		• •
LENGTH OF PROJ	ECL 03.57	MILES	ىش قايىشقەتلەت	YEAR BUILT	1978	ROAD	NUMBER IO	S AU	
CONTRACTOR IRV.					n in a tha an th		the second s		
FINE AGG. G.A.	FINLEY INC	 SHENANDO 	AH PIT						
CEMENT MISSOUR	I PORTLAND			MIX NUMBER			DATE REPO	RTED 12/19	/78
LAB* CORE S' NO* NUMBER	TATION FI	ROM AT Rline test	UNCUT LENGTH	INFC STEEL HT (From BSE S IN=	ORR COMF	UTED STR : PSI.	KAIR HARD•	REMARKS	
	00+P55	2•08 99				5 6355			
1624 E4-2074 1625 E4-2075	237400	6.0R 99	× 8∙00		5750 48L	0564 0	•••		
				SLIP FORM DESI		Caller 1997 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
	· · · ·	:							
							nan an ann an Anna an A Anna an Anna an Anna an Anna an		
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	a <u>1975 - Sana</u> na Sana Sana Sana Sana Sana Sana S	11. Al Al Andrew Al Andrew				te te station de la section			
· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·		n an		···· ·· ·	· · · · · ·		مدينينين و مارينين و
	and the second	بالمطب طبيحين الباد والبا	a second and second	a and and a second a	ومنتابات والمتكافر ويدومك بمكته ومرا	يەرمەردىر مەماردە مەمەمەرىي بىيە يېرىپى بار. 1	تسارت المرسانينين برنست		محقد الملاء
	ng men ng ng panganan na pa		•		ta, s				•

	alan da ana ang ang ang ang ang ang ang ang an	a a sur a	e de la companya de La companya de la comp			100A	STATE I	НІбныач со	onniss.	Page	3		Java E	i fills Iergren	
				• •		· ·	MATS STAL	S DEPARTI LABORATO	ncat				V. SNY H. Bur	' IER	
	PROJE	CT TRF-i	2-3(15)	29-87	ر اور میں اور آیاد اور اور ایک در دور اور		COUNTY 1	AYLOR		LA8. 1	10. ACE	8-3514	-1586		
	LENGTI	H OF PRC)JECT L2.	OSI MILES			<u>28926</u>	'EAR BUIL'	t 1978		ROAD	NUMBE	R IOWA	<u>.</u>	
	CONTRI	ACTOR IF	WING F.	JENSEN		and the second second		CORE FOR	n- WIDEN	ING	E	ASE	PA	VEMENT	X_
1. 1. an											a shekarar				
	1 1 14 5. P	1009 09 4	IS I ANLLE	INC. SHE	nnavv	MU LTI		COARSE /	AB200 X	NE 7 3 7 7	<i>C </i>	PLANI ,	JUIC .		
	CEMENT	I MISSOL	JRI PORTL	AND				MIX NUMBE	ER			DATE	REPORT	ED 7517	91
12				DISTANCE	AGE	-	,	11	NFORMATI	ONAL T	2723				
	LAB-	CORE	STATION	FROM	AT	UNCUT		STEEL H	T CORR	COMPUT	ED STR	R ZAIR	÷	REMARKS	
200 200 200	A10 .	NUMBER		CNTRLINE FT.	TEST	LENGT	Н	FROM BSI	E STREN.	PS	z.	HARD.	<i></i>		
	-			<u>Er.</u>	DAYS	<u>IN-</u>		<u>IN</u> .	PSI-T	28DAY	JYEAR	CONCe	د و المراجع (مارد) مرجع مرجع المرجع (مارد)		
	1514	4-2103	2+00	2.0L	122	8° PO			4160	3460	4500				
	1515	4-5704	17+00	L-2R					3475	2890		8. 3			
				9-AL					4645		5025				
	1517		29+00			7.95			and the second second	2	4900	8.2		a	
				6• AL		8. 50		<u>bira (11)</u>	4530 5340	4445	5775	and the second	and the second second	مسيد الأجاد	:
- 5	3519	4-2108	48+00			7-95			4852	4045	5255	6.9			
		4-2109	57+00			8 • SO			4935	4105	5335				
	109 ·····		66+00		152	8-60		ina i garana ang ing Ngga manana ing	2515	4265	5540	- deb		and and a second se	
		4-2111	75+00			8-00	and the second		4945	4035	S255			No.	
		4-2113	84+00 93+00	2.2R 5.8L		8.35 7.90	and a set of the		4990	W075		6.2			
1	and the second se	4-2114	103+00			<u> </u>	an in the second second	an anna a saige an	4795 Nunn	3910	<u>\$090</u> 4675	7.2	الفحيلة متنيت تهيد		
		4-2115	175+00			8-25			1700 1715	33 10	5035	105			
			157+00		141	A.65			5380	4390	5715	5. 8			
			130+00	9.5L	141	8.20	ب المحاد المحاد	an a	SHAD	4470	5820	- - -		and an	•
		4-2118	139+00	1.8R		7-95	n an		F500	5060	6585	5.4			
22	1590	9-2119	148+00		142	8.00			5210	4250			۰۰۰ . ۱۰۰ سهر میرا شدند و اورد		
	1531	4-2150	157+00	7. 8R	142	8.65			5180	4225	5500	6+A			
		4-5757	JPP+00			8-15		· .	4535	3700	4815				
بيده درور .	1833	2512-4	175+00			8.30	• *		5120	4175	5435	7.3			
	1534	E542-4	183+00			8.90			4765	3965	5150		· · · .		
		4-2124	195+00			8.05			5230	4350	5655	7= 0			47.1
- 18 S. A.		4-2125	201+00	<u>5.7L</u>	123	7.90			5235	N355	SLLD				

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CORING COMPLETE	LOWA STATE	HIGHWAY COMMISS.	Appendix G Page 4	CONCRETE CORES PROJECT FILES J+V+ BERGREN V- SNY DER
	· · · · · · · · · · · · · · · · · · ·	ALS DEPARTMENT S Laboratory		W- BURGAN
PROJECT TOF-2-3(15)29-87		TAYLOR	LAB. NO. ACE8-1514-	·158L
LENGTH OF PROJECT 12-051 MILES	<u>inter de marine de la construcción de la construcción de la construcción de la construcción de la construcción</u> de la construcción de la const	YEAR BUILT 1978	ROAD NUMBER	S ANOI S
CONTRACTOR IRVING F. JENSEN		CORE FORM- WIDE	NING BASE	PAVENENT X
FINE AGG. G.A. FINLEY INC. SHEN		المراجع والمحمولة والمحمولة والمحمولة المراجع والمحمولة والمحمولة والمحمولة والمحمولة والمحمولة والمحمولة والم		
CEMENT MISSOURI PORTLAND	<u>e di kui le sikat</u> fak <u>a</u> an	MIX NUMBER	DATE	REPORTED 12/19/75
DISTANCE LAB. CORE STATION FROM NO. NUMBER CNTRLINE FT. 1	GE TUNCUT ESTLENGTH AYS IN-			REMARKS
1538 4-2127 219+00 1.3L 1539 4-2128 229+00 5.4R 1540 4-2129 238+00 9.9L 1541 4-2129 248+00 1.8R	23 7•75 27 <u>8-25</u> 27 8-25		4725 6140 4000 5195 7.4 3620 4705	
1542 4-2131 256+00 6.213 1543 4-2132 265+00 2.3R 1 1553 4-2142 357+00 1.6R 1 2 -	28 8+85	4780 4375 3695	3980 5170 3640 4730 7.4 3120 4060 11.5	
1544 4-2133 274+00 2-4L 1 1554 4-2143 367+00 6-0L 1	09 A-40 02 8-40	4315 4060	3645 4740 3430 4460	
1545 4-2134 284+00 6.48 1 1555 4-2144 378+00 9.78 1 2 -	.09 8•05 .02 7•95	306 5	2590 3370 9.9 3370 4380 9.5	······································
1546 4-2135 293+00 9.7L 1 1556 4-2145 387+00 1.3L 1	03 8•30	ing a star of the second star and the second star in the second star is a second star of the second star is a s	370s 4820	
1547 4-2136 302+00 1.5R 1 2557 4-2346 396+00 5.7R 1 2 -	109 7•95 101 7•90	4115	3475 4520 9.4 3730 4850 8.0	
1548 4-2137 312+00 6-21 1 1558 4-2147 406+00 9-31	06.8.00 05.8 20	4135 5430	3495 4545 4590 5970	
1549 4-2138 321+00 9.7R 1	.0L &•10	4520	3820 4915 8-3	

T.S.---

COBIN	G COMPLE	TE			LOWA S Ma	TATE HIG TERIALS I AMES LAN	HWAY COM Departme Boratory	MISS_ NT	Apper Page	ndix G 5		CONC PROJ J.V. V. S V. B	RETE CO ECT FIL BERGRI NY BER URGAN)RES ES N
PROJE	CT TQF-2	-3(15)27	1-87		CO	UNTY TAYI	OR		LAB. N	10. ACE	8-1514	1-158L		
LENGT	H OF PRO	JECT 12-05	I MILES	,	بالمشارعين أراحتمت	YEAI	R BUILT	1978	er en la	RCAD	NUMBE	R 10	NA 2	·
CONTR	ACTOR IR	VING F. JE	NSEN			COL	RE FORM-	WIDE	NING	8	ASE		PAVENE	Y TW
A Caracteria Caracteria														
FINE	AGGo Go A	• FINLEY I	NC• SHEP	iando <i>i</i>	AH PIT	C(DARSE AG	6.	RECYCL	ED AT	PLANT	SITE		8. J
FENCA	11A22TM T	RI PORTLAN				80.77	< 111100 INT CI	5	, i , , , , , , , , , , , , , , , , , ,		19.4 CP /		09888 9	
3an £r € f £an 19	I HASSVU	N& FVAILAN	. #			1127	N NUMBEN				VAIC	. KEPV	KIED AI	:/ <u>k</u>]/ (
		D	ISTANCE	AGE			INF	ORMATI	CONAL 1	ESTS				
LA8.	CORE	D STATION C	FROM	AT	UNCUT	51	FEEL HT	CORR	COMPUT	ED STR	ZAIR		REMAI	4K 2
NO =	NUMBER		NTRL INE	TEST	LENGTH	the second states	RON BSE	STREN	PS	Io	HARD.		• : •	
			FT	DAYS	<u> </u>		IN.	PSI.	YADAS	IVEAR	CONC.			
3 C C D	1. "3" 1. D	No. 60		* ~ *							3			
רגבע ב	4-6340	415+00	a • >k	404	0 • E3			- 77 7A	4312	3882	607	-		
icon	4-21.19	240400 S	•	anc.	37. as			u190	3540	HLAE	e en	· ·····	سينېو يې يې د د د د رې د چې د	<u>, je se</u>
1510	4-21.49	330+00 424+00	1 LAT	ini	4.31			HICC	ario	HELE		· · · · ·		
					2 6 4 77 94 14	a da far far an star an star Star an star an st	an a		3510	the talking a The talking the	A A States		2	
1551	4-2140	339+00 433+00	5.7R	106	8-05	ayong banker and e you along banke		3655	3090	4015	10.7			
1561	4-2150	433+00	9.6R	700	8.20				3820		6.0			1
2		348+00 492+00				and an electron of the structure systems and			e beinn te ffiction that and the second of		· · · · · · · · · · · · · · · ·		a	
1852	4-2141	Эча+оо	15.eP	105	8•35		A garage	4750	3485	4590				3 - 200
3562	4-5121	145+00	1.7 L	300	8•30			3860	3260	0424	- 22 - 1999 - 19 92 - 4		in an	
		and the second second second		iec.			مرد المحمد المحمد المحمد الم	2.827.622		Strand Stranger	19. 19. 19. 19. 19. 19. 19. 19. 19. 19. 19.	n An shar an ini	and a start of the second s	
	مریک کست خطرت جیزی و ا	فيباليبة " تشتريبه	JI	700	7-90			4635	391.5	5095	7. 4			
1564		461+00		97	8-40					5490				
	4-2154	470+00	J- 5R.	99	8-80		دی محمود میں یہ دی سے ا	5705	4850	P530	60 4			
	4-2155	479+00	5.AL		6.95		ter and an and a second se			an a	,		5	
	E4-8156	478+00	6• SC	871 20	H•70			554U	чьви	6U85	bel		1. 16 60	
		480+00	<u>6.5L</u>		8-55	<u></u>			<u>4645</u>	<u>L040</u>		<u>i i ka i na i</u> na i		
	4-2158	487+00		99	8.05	-		5580	4715	F730	F*0			
	4-2159	492+00	5.0r	98	8-40			4855	4200	5335	· _ ·			
	4-5770	501+00	5.6R	98	8-40	العامين مرجد	· · · · ·	4435	<u>. 3745</u>	4870	7-8	· ·		
	4-2161	510+00	9.6L		7•90		د. من معاد مراجع	6045	5105	6640		× ···	د. ایک رستید	
	A-5165		1*5R	- A - A - A - A - A - A - A - A - A - A	8.05			90,90	4210	5470	92 A		· · · · · · · · · · · · · · · · · · ·	
	4-2163	528+00	6.0R		8.10	*****		_ 46 2U_	4050	bch5		بأنفقت والم		
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PROJE	ct taf-2	-3(15)2	9-87		CO	UNTY T	AYLOR		LAB.	NO. ACE	8-1514-	·lSal	· · · · · · · · · · · · · · · · · · ·	
LENGT	H OF PRO	JECT 35-0	51 MILES			Y	EAR BUT	LT 197	8	ROAD	NUMBER	R IOWA	2	
CONTR	ACTOR IR	VING F. J	ENSEN	سېدېند تندر سايد د -			CORE FO	RM- WID	ENING	- <u>Service</u>	ASE	FA\	ENENTX	
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LAB. NO.	CORE NUMBER	STATION	DISTANCE FROM CNTRLINE	AGE AT TEST	UNCUT LENGTH		STEEL FROM B	INFORMA HT CORR SE STRE	TIONAL COMPU N. P	TESTS TED STR SI.	ZAIR Hard-		ENARKS	
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Appendix H Page l

IOWA DEPARTMENT OF TRANSPORTATION Materials Department AMES LABORATORY

ROAD ROUGHNESS REPORT

Lab. No. RRReport Date	•	C	ounty Page	······································
Proj. Miles <u>3.211</u> Year Built		<u>3 R</u>	oad No. <u>Ia 2</u>	
Contractor Irving F. Jensen		Proj.	No. $TQF-2-2(16)$	29-73
Location From Taylor County	/ line	Asph.	ConcA.C. onc. <u></u> Slip	Resur. Form X
westerly 3.2 miles	<u> </u>		r 1xec	i Form
Date Tested <u>11-2-78</u>	Wea	ther cl	ear	
Test Observers <u>Twohey - Vel</u>	and	<u>.</u>		
		W	Bound Lane	E Bound Lane
4 point Terminus Transverse Groove	Sect. <u>No.</u>	Length (Miles)	Roughness Inches/Mile	Roughness Inches/Mile
Start Taylor County line	<u> </u>	0.50	76	88
		0.50	90	100
۲۰۰۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰۰ ۲۰۰۰	3	0.50	96	100
· · · · · · · · · · · · · · · · · · ·		0.50	90	110
	5	0.50	86	104
	6	0.50	124	132
Stop N-26	7	0.36	117	106
- 1			944-9	
		147111-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1		
		<u></u>		
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******	er			Marine Construction and a second s
		ferences		
	<u> </u>			
······································	leasured	3.36	Ave. 96	Ave 106

Miles Measured

IOWA DEPARTMENT OF TRANSPORTATION Materials Department AMES LABORATORY

ROAD ROUGHNESS REPORT

Lab. No. RRReport Date	2	c	ounty Taylo)r
Proj. Miles <u>12.051</u> Year Built_	1978	R	oad No. <u>Ia 2</u>	
Contractor Irving F. Jensen		Proj.	NO. TQF-2	2-3(15)
Location From Page County li		Aspn.	ConcA.C.	Form X
to west junction of	Iowa 14	8	r 1×6	d Form
Date Tested <u>11-2-78</u>	Wea	ther <u>c</u> l	ear	
Test Observers <u>Twohey - Vela</u>	and			
		<u>N</u>	Bound Lane	E Bound Lane
4 point Terminus Transverse groove	Sect. No.		Roughness Inches/Mile	Roughness Inches/Mile
Start 20 Rev. W of Ia 148		1.00	95	81
	_2	1.00	96	
Omit bridge		1.00	101	
	4	1.00	103	89
	5	1.00		86
	6	1.00	97	90
		1.00		83
	8	1.00	94	97
Omit bridge	9	1.00	90	90
	_10	1.00	119	114
	_11	_1.00_	98	105
<u>Stop - County line</u>	12	0.71	87	89
· · · · · · · · · · · · · · · · · · ·				
		and the second		
	waardingtooth of the state of the		•••	
Miles M	easured	11.71	Ave96	Ave. 92

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IOWA DEPARTMENT OF TRANSPORTATION Materials Department AMES LABORATORY

ROAD ROUGHNESS REPORT

Lab. No. RRReport Date	e	Ce	ounty Tav	Lor
Proj. Miles 1.394 Year Built			oad No. Ia	
Contractor Irving F. Jensen		Proj. 1 Asph. 9	No. <u>TQF-2-3(18)</u> Conc. <u> </u>)29-87 Resur
Location From E Jct. Ia 148	3 in Bedfe	ord P.C. C	onc. <u>x</u> Slip	Form X
easterly 1.4 miles	to old i	<u>Ea. 2</u>	Fixed	form
Date Tested 11-2-78	Wea	ther C	lear	•
Test ObserversTwohey - Vel			an a	
Test Obberversiwoneyver				
1			E_Bound Lane	Bound Lane
1/4 point Terminus	Sect. No.		Roughness Inches/Mile	Roughnes s 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
<u>Stop = Old Ia 2</u>	5	0.23	91	87
			•	
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			1997 - Young Start, and a start of the start	
		and and a state of the State of		
Miles	leasured	1.23	Ave. 99	Ave 99
mites M	igasured	1+23	WA6' 22	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