

CORE ANALYSIS OF PORTLAND CEMENT CONCRETE SLIP FORMED BARRIERS

Final Report
For
MLR-98-4

January 2000

Highway Division



**Iowa Department
of Transportation**

**Core Analysis of
Portland Cement Concrete
Slip Formed Barriers**

**Final Report
for
MLR-98-4**

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Core Analysis of Portland Cement Concrete Slip Formed Barriers		Final Report, 10-98 to 9-99			
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ACKNOWLEDGMENT OF COOPERATING ORGANIZATIONS					7.
ABSTRACT					8.
<p>Premature deterioration of slip formed portland cement concrete (PCC) barriers is an ongoing problem in the Iowa Primary and Interstate highway system. The requirement to have a concrete mix which can be sufficiently pliable to be readily molded into the barrier shape and yet be sufficiently stiff to maintain a true shape and height immediately after molding is difficult to meet. A concrete mix which is stiff enough to maintain its shape immediately after molding is usually difficult to work with. It often contains open or hidden tears and large voids. One way to minimize the molding resistance is by additional vibration. If intensive vibration is applied, the entrapped air voids and tears in the concrete can usually be eliminated, however, in that process, the essential entrained air content can also be lost. In the evaluation of slip formed PCC barriers, it is common to find large voids, tears and a low entrained air content, all contributing to premature deterioration.</p> <p>A study was initiated to evaluate core samples taken from good and from bad appearing areas of various median barriers. Evaluations were done covering visual appearance, construction information, air content and chloride content.</p>					
KEY WORDS		10. NO. OF PAGES			9.
Slip formed barrier Concrete deterioration		63			

TABLE OF CONTENTS

	Page
Introduction	1
Objective	1
Project Sites	1
Core Descriptions	1
Results	1
Conclusion	2
Implementation	3
Acknowledgment	3
Appendices	
Appendix A - MLR Proposal	4
Appendix B - Concrete Median Barrier Standard Plan	8
Appendix C - Project Sites, Contractors and Field Notes	10
Appendix D - Core Descriptions	44
Appendix E - Core Photos	46
Appendix F - Core Analysis Tables	58
Appendix G - New Mix Design for Concrete Barrier Rail	61

DISCLAIMER

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

INTRODUCTION

Some PCC median barriers showed signs of having less than desirable qualities in appearance and durability. To achieve the desired molded shape, excessive vibration was often applied to a stiff concrete mix. The finished product was sometimes a barrier with large entrapped air voids, tears and low entrained air content, all contributing to premature deterioration. A Materials Laboratory Research proposal, MLR-98-4 (see Appendix A) was set up to evaluate the problem.

OBJECTIVE

The objective of the research is to evaluate existing PCC median barriers and to find procedures, materials and mix designs which will result in a better appearing, more workable and more durable PCC slip formed median barrier.

PROJECT SITES

The sites for taking median barrier core samples were selected to cover four different construction projects. They were all from Interstate routes in Polk County (see Appendix C). With careful observations in the field, the exact location of the core sampling sites may be visible by the evidence of filled core holes.

CORE DESCRIPTIONS

Cores were taken from the median barrier of I-80 in Polk County, October 1998. The core description, “bad,” means there was significant visual appearance of barrier surface deterioration, i.e., cracking, staining and leachate deposits. The core description, “good,” means there was no visual appearance of deterioration on the barrier surface.

The arrow on the face of each core points to the top position. This position was marked to determine if core voids, cracks or tears show a relevance to direction of paving.

The core sites were selected such that no reinforcing steel should be hit by the coring bit (see Appendix B).

RESULTS

The search for information and construction history for the selected sites gave limited success. The majority of information came from field book notes which often gave minimal details. For project sites, mainly 1 and 3, air content problems were recorded a number of times (see project diary and

daily reports, Appendix C).

The visual appearance of some cores showed major voids or tears within the concrete as a result of construction workability, consolidation or mix design problems (see photos, Appendix E).

The results of coring from some areas of barriers with a bad appearing surface showed no significant “bad” problem deeper into the barrier. Examples are core photos 1A and 1C. In other cases, large voids or tears were exposed during coring which were not detectable from surface visual examinations (see core photos 2A and 2B). The concrete in core 4B was so deteriorated that it could not be prepared for laboratory analysis. The air system for most cores was found to be acceptable except for core 1A (see appendix F).

From the differences in core conditions and surface appearances found, it can be seen that there is a wide range and somewhat unpredictable quality of concrete to be found in the barriers.

CONCLUSION

As a result of the study of median barrier quality problems, a significant amount of work has been done to change the mix design to something which would be more suitable for slip formed barrier applications.

The standard Iowa DOT D-57 mix design has typically been used in slip formed barrier rails. This mix has a high amount of paste and fines, having a cement content of 709 lbs./cu. yd., with 50% coarse aggregate and 50% sand. The typical combined gradation produces a gap-graded aggregate structure and in conjunction with the high paste content it produces a very stiff unworkable mix.

In 1999, slip formed barrier rails were being placed on the dual bridges over the railroad on relocated US 18 in Floyd County, near Rudd. The contractor, Allied Construction, called in with problems concerning entraining air in the D-57 mix. The D-57 mix is typically placed at 3/4 in. slump making it difficult to entrain air. The producer had been using 25 oz./cwt of air entraining agent and was able to achieve only 5.5% plastic air content. It was decided to investigate the use of well-graded aggregates in conjunction with a reduced cement content to facilitate placement and air entraining of the concrete.

The new mix design for the concrete barrier rail (BR) utilized well-graded aggregates through the incorporation of 1/4" (6.35 mm) chips and a reduced cement content of 603 lbs./cu. yd. This mix required only 8 oz./cwt of air entraining agent to achieve 7.4 % plastic air content. They were also able to increase the slump to 1 in. and rate of placement was increased.

Since this project, the BR mix was included in the standard specifications. In the fall of 1999, it was used on a median barrier on I-35/80 in Des Moines from Merle Hay Road to the 2nd Avenue interchange. The BR mix design achieved better placement characteristics and air entraining

capacity than the D-57 mix design.

Additional design adjustments may be needed as material and construction conditions vary. From initial applications, the new mix design appears to be a significant improvement over previously used mix designs. The new mix design specification for BR is now being applied (see Appendix G). At this time, no specific recommendations for changes in vibration energy applied or configuration of vibrators will be made.

IMPLEMENTATION

A major effort has already been put into place to develop a new concrete mix especially designed for use in slip formed barriers. Initial use of the new mix occurred in 1999 in bridge barrier rails in Floyd County on US 18 and in median barriers in Polk County on I-35/80.

The new mix design was already found to be easier to work with and will result in a better finished product.

ACKNOWLEDGMENT

Sincere thanks and appreciation goes to the Special Investigation personnel for their support to obtain core samples and to the Cement and Concrete personnel for their support in the core analysis.

APPENDIX A
MLR Proposal

DATE: October 28, 1998

PROJECT: MLR-98-4

TITLE: Core Analysis of Slip Formed Barriers

PRINCIPAL INVESTIGATOR: Todd Hanson and Bob Steffes

OBJECTIVE: The objective of this research is to determine the air content and void system of low slump Portland cement concrete (PCC) slip formed median barriers in search of causes of premature concrete deterioration.

DISCUSSION: In some areas of some slip formed barrier projects, premature deterioration appears to be occurring. Extensive surface cracking and growth of leachate deposits become visible on the barrier surface within a few years after construction. To slipform a barrier, a relatively dry, stiff mix of concrete is required and extensive vibration is used to facilitate concrete consolidation and forming. It is assumed that an inappropriate mix design for the application and/or excessive vibration may be contributing to the premature deterioration.

PURPOSE: The purpose of this study is to determine if adjustments in mix design, vibration for consolidation or construction techniques could be made which would result in an improved appearance and durability of slip formed PCC barriers.

PROCEDURE: Cores will be taken from median barriers from four different paving projects on I-80 and I-80/I-35 in Polk County. Core sites will be selected to include areas with no visible deterioration and sites which show extensive deterioration. The cores will be 4" diameter and approximately 5" long, perpendicular to the barrier face. They will be taken approximately 30" above the roadway surface.

ANALYSIS: The core analysis will include chloride content at various depths, and a detailed determination of the air void system.

The chloride contents will be checked at 0.5", 1", and 2" intervals using the Phillips XRF. Samples will be analyzed for elemental chlorine (Cl) and used to estimate the amount per cubic yard.

Air content will be checked at 0.5" and 1" intervals using the Hitachi low vacuum SEM in conjunction with an image analysis program. The air content (%), specific surface (α), and spacing factor (L) will be calculated at each depth.

Records of concrete mixes used and construction logs will be evaluated, if core analysis results are found to be abnormal.

RESPONSIBILITIES: Projects for evaluation will be selected by the Portland Cement Pavement Engineer.

Specific sites for cores will be selected by the Materials Research personnel.

Coring will be done by Special Investigations personnel.

Analysis of cores and summation of results will be done by the Technical Services Engineer.

IMPLEMENTATION: The findings from this study will lead to:

1) Improvements in the concrete mix design, workability, durability and appearance of the barriers.

2) Improved consolidation while still maintaining desired entrained air content.

REPORTING: The final report will be coauthored by Todd Hanson and Bob Steffes.

APPENDIX B
Concrete Median Barrier Standard Plan

GENERAL NOTES

Details shown hereon are for construction of a typical concrete barrier. The New Jersey shape barrier shall be cast in place or slipformed. Refer to "Tabulation of Concrete Barrier" and Project Plans for specific details.

Materials and methods of construction shall be in accordance with current Standard and Supplemental Specifications.

Details shown are typical. Alternate design details may be submitted to the Engineer for approval.

Barrier shall be constructed as specified in Section 2513 of the current specifications or by methods approved by the Engineer.

Dowels shall be either installed in supporting surface when placed or installed in drilled holes using epoxy cement or grout approved by the Engineer.

If footings are required, excavation shall be to neat lines. The footing may be poured without the use of forms. The Contractor may, as an option, form the footings and backfill around the completed footing.

Price bid for "Barrier, Concrete RE-44A" or "Barrier, Concrete RE-44A and Footing" per lineal foot shall be considered full compensation for construction of concrete barrier as detailed hereon including reinforcing steel and all necessary excavation and backfill.

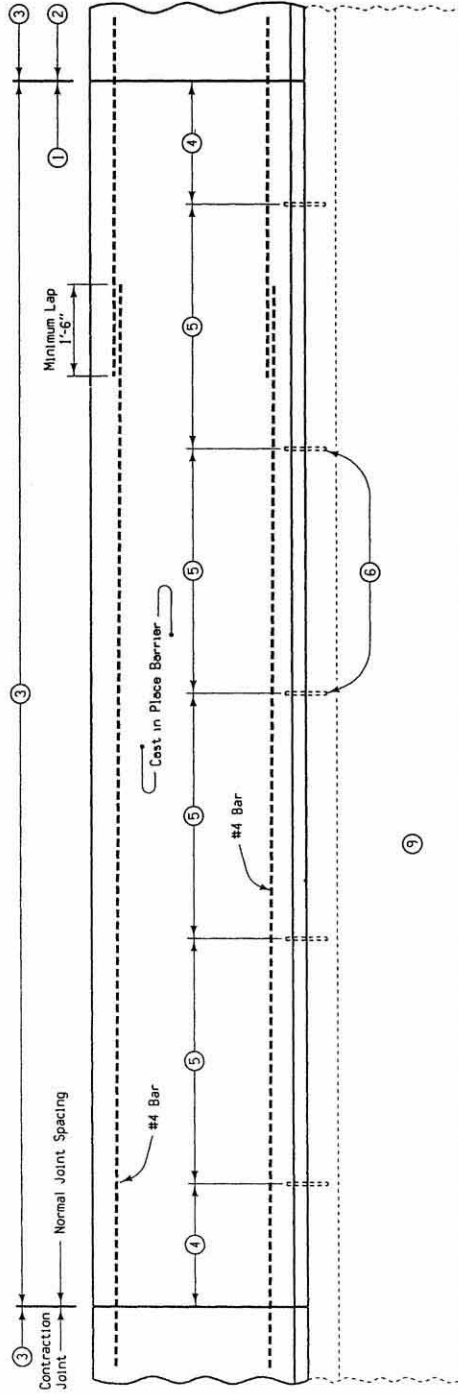
1. Type 'E' joints are necessary to match existing 'E' and 'EF' joints and the expansion material shall conform to shape of barrier. No sealer is required.
2. Connection joints shall be formed by use of pre-molded fiber, pressed wood or other approved material shaped to conform to shape of concrete barrier, or by sawing as indicated hereon. Where abutting sections are placed as separate pours, a butt joint may be used. No filler is required.
3. For barrier dowelled to paved shoulders, match pavement joints. For free standing barrier with integral footings, use 20' maximum, 15' minimum joint spacing.
4. 1'-0" Minimum, 2'-0" Maximum.
5. 4'-0" Typical.
6. #8 deformed bars or 1" diameter smooth dowels of sufficient length to ensure 4" minimum embedment in rail and supporting surface.
7. Possible reinforcing needed such as over imbeds or other unsupported areas of 1' foot or more used #5 bars. Length equals unsupported portion plus two feet beyond each way.
8. All exposed corners are to be filled with a 3/4" dressed and beveled strip.
9. Concrete footing required when not placed on concrete slab.

Iowa Department of Transportation
Project Development Division

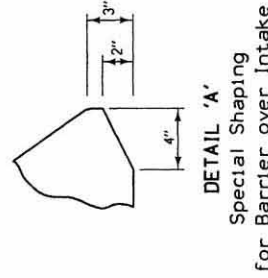
STANDARD ROAD PLAN RE-44A

REVISION: Re-issue of previously issued Standard Road Plan.
REVISION NO. 5
REVISION DATE 08-12-96
APPROVED BY DESIGN METHODS ENGINEER
12-03-96

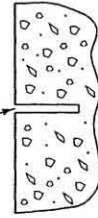
DETAILS OF 42"
CONCRETE MEDIAN BARRIER
(FULL SECTION)



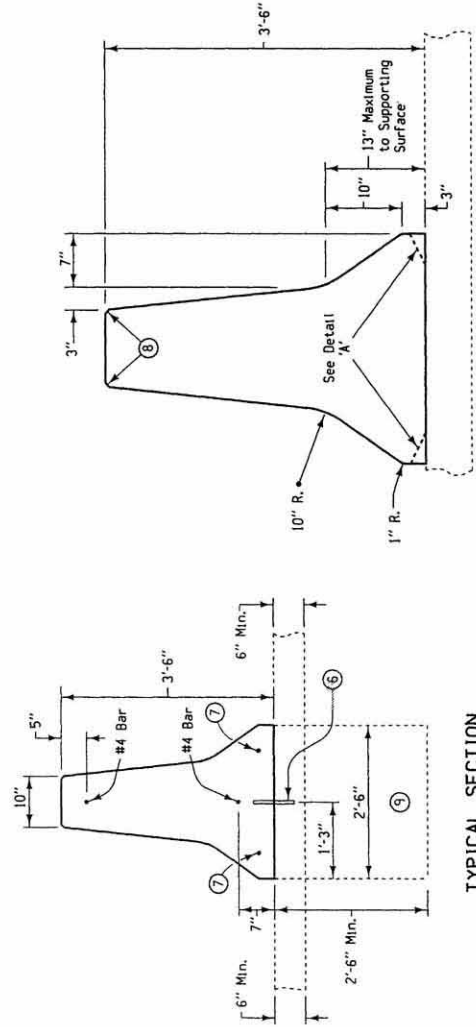
ELEVATION
Cast in Place



1/8" Minimum wide x
2" deep saw cut.
No sealing required.



DETAILS OF
CONTRACTION JOINT
Saw cut back, top and front face.



TYPICAL SECTION

DETAILS OF
BARRIER FACE

APPENDIX C
Project Sites, Contractors and Field Notes

PROJECT SITES, CONTRACTORS AND FIELD NOTES

Site 1

Site Location:

I-80 East bound lane
MP 139.05, MP 140.06
Paved west to east
Used D-57
1994

Contractor:

Dormark Construction Company
P.O. Box 520
303 S 2nd Street
Grimes, IA 50111
515-986-4270

Field Notes:

See pages 13-22

Site 2

Site Location:

I-35/I-80 West bound lane
MP 132.90
Paved west to east
Used D-57-C20 & D-57-C10
1998

Contractor:

Jensen Road Company
Box 3345
5550 NE 22nd Street
Des Moines, IA 50316
515-266-5173

Field Notes:

See pages 23-31

PROJECT SITES, CONTRACTORS AND FIELD NOTES, Continued

Site 3

Site Location:

I-35/I-80 West bound lane
MP 128.25
Paved west to east
Used D-57 & D-57-6-C
1994

Contractor:

Jensen Road Company
Box 3345
5550 NE 22nd Street
Des Moines, IA 50316
515-266-5173

Field Notes:

See pages 32-43

Site 4

Site Location:

I-35/I-80 South bound lane
MP 126.50
Files have been purged
Paved south to north

Contractor:

United Contractors Inc.
P.O. Box 347
6678 N W 62nd Avenue
Johnston, IA 50131
515-276-6162

Field Notes:

Field notes were purged

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

10-17-94

MONDAY

RAINING MOST OF THE DAY. NO ONE
WORKING - GETTING BACK WORK CAUGHT UP.

10-18-94

TUES

LIGHT RAIN SHOWER THIS A.M. EARLY, PJ
WORKING ON GRADING MED. (FORCE ACCOUNT) AND PAVING
MEDIAN, 6'

WILL BE POURING 6 TOPS THIS MORNING 8:30 TO 12:00
AND WILL TRY FOR 2 OR 3 MORE IN AFTERNOON



DOORMARK SETTING UP FOR SLIP FORM BARRIER WALL,
WILL GET STARTED AFTER NOON. WORKING UNTIL

* ABOUT 6:00. SOME PROBLEMS WITH CONCRETE - GETTING
AIR CONTENT UP IN MIX AND KEEPING IT THERE.
FINISHED FORCE ACCOUNT ON MEDIAN GRADING.

DIARY PROJECT NO. _____ CONTRACT _____

DATE	WEATHER/COMMENTS
10-19-94	CLEAR
WED	
	PCI POURING MEDIAN AND REMAINING BOXOUTS.
	PCI ALSO SEALING MEDIAN PAYEMENT.
	WINMOR BUILDING INTAKES WILL POUR THIS AFTERNOON
→	DORMARK SETTING UP MACHINE FOR SLIPFORM RAIL. STARTED RUNNING 11:00 A.M. FINISHED LENGTH WEST OF 29 TH ST. 3:30 DONE FOR THE DAY.
	4:30 WINMOR STARTED POURING TOPS FOR INTAKES 17, 18, 19, 20, 21 DONE 6:30
10-20-94	
T. THURSDAY	PCI FINISHED WITH MEDIAN PAVING AND WITH REMAINING BOXOUTS - DRILLING DOWELS
→	DORMARK WORKING ON SLIPFORM WALL AND FORMING ON CAST IN PLACE. STILL HAVING PROBLEMS
*	WITH AIR (ENTRAINED AIR) IN CONC., RUNNING LOW.
	WINMOR WORKING ON INTAKE TOPS.

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

10-21-94

MOSTLY SUNNY

HIGH 75° LOW 50°

FRIDAY

PCE SAWING AND SEALING ON MEDIAN

PAVEMENT THIS MORNING.

WINMOR WORKING ON INTAKE TOPS, WILL POUR IN
AFTERNOON.

DORMARK WORKING BARRIER WALL - SLIP FORM

*

ALL DAY, STILL HAVING PROBLEMS WITH ENTRAINED
AIR.

10-22-94

SAT

WINMOR FORMING ON INTAKES - NO POUR TODAY



DORMARK HAVING ALL KINDS OF PROBLEMS

WITH GMA TRUCKS AND MIX → SHOT DOWN 11:30 AM

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

10-24-94

HIGH 50 LOW 28°

MONDAY →

DORMARK WORKING AGAIN ON BARRIER,

* STILL FIGHTING AIR PROBLEMS,

9:00 MET WITH PETERSON CONST. ING ABOUT OVER HEAD

TRUSSES AND DISCUSSED PROBLEMS WITH OUTSIDE FOOTINGS

WINMOR WORKING ON TOPS.

FORECAST COLD ENOUGH FOR COVERING BARRIER

WALL TONIGHT

10-25-94

HIGH 52 LOW 26°

TUESDAY →

DORMARK WORKING ON WALL AGAIN SAME
SITUATION AS BEFORE.

WINMOR WORKING ON INTAKE TOPS

MET WITH CITY OF ALTOONA TODAY TO

DISCUSS PATCHING HAUL ROAD SECTION OF ADVENTURELAND
DRIVE

REILLY STARTED REMOVAL OF WB WEIGH STATION.

US

DIARY PROJECT NO. _____ CONTRACT _____

DATE	WEATHER/COMMENTS
10-26-94	HIGH 55 LOW 40°
WED	
	WINMOR FINISHING UP ON INTAKE TOPS (3)
	AND WILL FINISH GROUTING PIPE IN INTAKES.
	<p>→ DORMARK WORKING WALL AGAIN - SEEMS THAT THEIR HEADER LOCATIONS ARE WRONG IN RELATION TO THE TRANSITION BLOCKS FROM 2-½ WALL TO FUEL RM. SOME REMOVE WILL BE NEEDED.</p>
	MEAS. PART OF 6' MEDIAN 1224 TO 1286±
10-27-94	HIGH 60° LOW 45°
THURSDAY	
	WINMOR STRIPPING LAST 3 INTAKES AND GROUTING PIPES THIS MORNING, THEN THEY WILL BE OUT OF HERE!
	<p>→ DORMARK WORKING ON SLIPPED WALL AND FORMING ON ½ WALL AND OVER INTAKES - PLACING JUNCTION BOXES FOR CONDUIT ALSO.</p>

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

10-28-94

VERY WINDY

HIGH 69° LOW 48°

FRIDAY →

DORMARK WORKING ON SLIP FORM
BARRIER WALL, STARTING AT 7:30 THIS A.M.

TALKED TO RON BLOOMQUIST - DIST. MAT.
AFTER HE HAD TALKED WITH MARK TRUEBLOOD
ABOUT COREING OUR 6' MEDIAN PAVEMENT,
MARK SAID WITH WALL WE WOULDN'T HAVE TO
CORE, ALSO HAVE THE GRADE CHECKS FOR VERIFICATION.

RENNY WORKING ON DIRT CUT (DITCH)
ON WB WEIGHT STATION. ALREADY HAVE REMOVED
BROWING AND SCAR PIT.

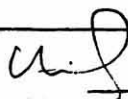
10-29-94

SAT →

DORMARK WORKING ON BARRIER WALL.
DON MEEKER CALLED ME AT HOME TO DISCUSS
THE TEST RESULTS THEY WERE GETTING AND FINALLY
THE MATERIAL STARTED GETTING BETTER.

MITCH PILLIVAN CALLED ME AT HOME TO TALK
ABOUT POURING OVER UNSEALED SLAB. I TOLD HIM I
DID NOT GIVE PERMISSION, HE SAID HE WOULD THINK ABOUT IT
AND TALK TO DORMARK ABOUT IT.

DECIDED TO LET THEM ROPE AND TAPE ENOUGH TO FINISH
OUT SATURDAY.



DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

10-31-94

Monday

PCT HERE TO CONTINUE WITH SEEDING
MEDIAN AND "E" JOINTS.

PCT WILL ALSO BE DOING PATCHING ON HAUL ROAD -
ADVENTURELAND DRIVE, TUESDAY



DORMARK RUNNING WITH DANGER WALL - MED.
AND HALF WALL @ E 29TH ST.

REILLY WORKING DITCH CUT - WB WEIGH
STATION ALL DAY

11-1-94

TUES.

PCT PATCHING HAUL ROAD TODAY
ON OUTSIDE LANES.



DORMARK WORKING ON SUPPED. WALL AND
HALF WALL ON WEST SIDE OF EAST 29TH ST
BRIDGE, INCLUDING ONE TRANSITION BLOCK

REILLY WORKING ON WB WEIGH STATION -
CLEANING IT UP.

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

11-2-94

WED

Renny working on weigh stations, both EB
and WB.

Pete working on sealing and patching
haul road - Adventureland Drive



DORMACK working on full wall and
half wall and sections over intakes.

11-3-94

THURS.

Pete sealing and Renny working EB weigh
stations



DORMACK working on wall above today
started raining around 12:00 saved down for the
afternoon.

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

11-4-94

HIGH 50° LOW 40°

FRIDAY

RAINING TODAY - NOTHING PRODUCTIVE ON
PROJECT, WORKING ON PAY VOUCHER AND BOOKS TODAY.
OUT AT 12:45

11-5-94

CLDY

HIGH 46° LOW 35°

SAT



DORMARK WORKING TODAY ON BOTH FULL AND
HALF WALL. EVERYTHING RUNNING WELL. SHUT OFF
AT PLANT 4:00 AM. COVERED AND OUT BY
5:30.



Iowa Department of Transportation

Daily Report

Contract No. 77-0353-069 Date : Wednesday, May 27, 1998 Initials of Inspector: RJE

High Temperature: 80.0 Low Temperature: 65.0
Sunrise 5:46 AM Sunset 8:38 AM
Weather Comment: Partly sunny, warm and humid

Site Timecharge
00 1.000

Remarks:

→ Wed-Jensen began slipforming the 42" concrete barrier wall RE-44A Today beginning at 11:15 am. The barrier was begun at 831+50 heading east with only about 350 feet being completed today due to minor problems such as inconsistent slump in the mix which caused the wall to have minor sags and repairs required. The superinendant was Randy Friel for jensen with Norm as the lead foreman on the project. Rod Edwards, Michael Dean and Tom Uppena will handle the inspection on the project. Kevin Merryman, John Rullman, Mitch Dillavou, Mark Trueblood and John Adam all visited the project today from the DOT. Kurt Rasmussen, Dan Timmons and Jeff Rasmussen all visited the project today from Jensen construction co.

KDM - I spoke with Mark Bare today and told him that we need to get as much permanent seeding done on the project as we can. I also told him that we would like to install some more silt fence if possible. The storm water reports for this project will reflect our conversation.

Inspector

Date

Printed 6/14/99 09:40:55 09:40:55

Page 1 of 1



Iowa Department of Transportation

Daily ReportContract No. 77-0353-069 Date : Thursday, May 28, 1998 Initials of Inspector: RJEHigh Temperature: 87.0 Low Temperature: 65.0Sunrise 5:45 AM Sunset 8:39 PMWeather Comment: Sunny , hot and humid

Site Timecharge

00 1.000

Remarks:

- Th-Jensen continued slipping the Permanent barrier wall in the median today. Only 300 feet was poured today because the wall had to be set up on the next section east of the Des Moines river bridge. The headers at the drains need to be set and the dowels need to be installed. The concrete tests all complied today with the only problem being the inconsistency of the Mix slump causing tearing of the barrier which all was repaired with no problems. Mark Bortle visited the project today from the dot. The pouring was completed by 12:30 pm with sawing and prep work being performed in the afternoon.

Inspector

Date

Printed 6/14/99 10:05:19 10:05:19

Page 1 of 1



Iowa Department of Transportation

Daily ReportContract No. 77-0353-069 Date : Tuesday, June 9, 1998 Initials of Inspector: TPUHigh Temperature: 72.0 Low Temperature: 56.0

Sunrise _____ Sunset _____

Weather Comment: Rain in a.m., Clear in p.m.

Site Timecharge

00 0.500

Subcontractor ID	Name	Comment
Jensen	Jensen Road Co.	

Remarks:

→ Jensen started slipping wall at 10 a.m. due to rain in early morning. New paver didn't work well, switching back to old paver. Mitch stopped by today. Contractor will be switching mix design tomorrow.

Inspector _____

Date _____

Printed 6/14/99 10:07:15 10:07:15

Page 1 of 1



Iowa Department of Transportation

Daily ReportContract No. 77-0353-069 Date : Wednesday, June 10, 1998 Initials of Inspector: TPUHigh Temperature: 73.0 Low Temperature: 53.0

Sunrise _____ Sunset _____

Weather Comment: Pt. Cloudy

Site Timecharge

00 1.000

Subcontractor ID	Name	Comment
Jensen	Jensen Road Co.	

Remarks:

→ Jensen started slipping rail at 11:30 with new machine. Worked until 6:00. New mix seems to work much better. They will continue to use that same mix tomorrow with the new paver.

Inspector

Date

Printed 6/14/99 10:08:23 10:08:23

Page 1 of 1



Iowa Department of Transportation

Daily ReportContract No. 77-0353-069 Date : Friday, June 12, 1998 Initials of Inspector: TPUHigh Temperature: 81.0 Low Temperature: 56.0

Sunrise _____ Sunset _____

Weather Comment: Pt. Cloudy

Site Timecharge

00 1.000

Subcontractor ID	Name	Comment
Jensen	Jensen Road Co.	

Remarks:

→ Jensen started to slip rail again with the new mix and paver at 8:15am. Things went very smooth and they poured 200+ cubic yards. John Adams, Mark Trueblood, and Mitch came out to the project today. Jensen is going to work tomorrow(Sat.) at 7am.

Inspector _____

Date _____

Printed 6/14/99 10:09:51 10:09:51

Page 1 of 1

Page No.: _____

Contract ID: _____

Date: 06/12/98 Friday

Sunrise: _____

High: _____

Day: _____

Sunset: _____

Low: _____

Weather: _____

Checked in @ G.N.A's Johnston plant today. Mid morning. C.A. has been increased and F.A. dropped... Fly Ash is @ 10% in the mix. (P-57-C-10)...

→ Air was tuned in good and wall didn't look too bad. Mix was getting drier through.

Larry Wistern on the grade, Charles H., Stan E., and Rod were in the plant.

Also spoke to Mark Trueblood ~~and~~ on Thursday about 1 1/2 stone in a mix design.

1 1/2 was approx approved in a V mix of some kind. 10,000 sample through

By: MJ.

Date: 06/15/98

Sunrise: _____

High: _____

Day: _____

Sunset: _____

Low: _____

Weather: _____

Plant good to go. Running with P-57-C-10.. continue to see improvement.

Test will run later this week.

Plant good to go

By: MJ.



Iowa Department of Transportation

Daily ReportContract No. 77-0353-069Date : Saturday, June 13, 1998Initials of Inspector: TPUHigh Temperature: 81.0Low Temperature: 62.0Sunrise Sunset Weather Comment: Sunny

Site Timecharge

00 0

Subcontractor ID	Name	Comment
Jensen	Jensen Road Co.	

Remarks:

→ Jensen began promptly at 7am. Only poured two sections which was about 107 cubic yards. Finished around noon. Things went very well. Barring any rain, they will start Mon. at 7am.

Inspector

Date

Printed 6/14/99 10:10:50 10:10:50

Page 1 of 1



Iowa Department of Transportation

Daily ReportContract No. 77-0353-069 Date : Monday, June 15, 1998 Initials of Inspector: TPUHigh Temperature: 70.0 Low Temperature: 58.0

Sunrise _____ Sunset _____

Weather Comment: Cloudy

Site Timecharge

00 1.000

Subcontractor ID	Name	Comment
Jensen	Jensen Road Co.	

Remarks:

→ Jensen slipped rail today from 7am to 4:30pm, finished 4 sections. They will continue to use the new paver until they decide if they want to buy it or not. Rex Kinkade stopped today to run some air tests and take some sample cylinders

Inspector _____

Date _____

Printed 6/14/99 10:12:47 10:12:47

Page 1 of 1



Iowa Department of Transportation

Daily ReportContract No. 77-0353-069 Date : Saturday, June 20, 1998 Initials of Inspector: TPUHigh Temperature: 89.0Low Temperature: 65.0Sunrise Sunset Weather Comment: Pt. Cloudy

Site Timecharge

00 0

Subcontractor ID	Name	Comment
Jensen	Jensen Road Co.	

Remarks:

→ Jensen finished up slipping the rail today. Slipped 4.5 sections. They worked from 6:30am to 1:30pm. Jensen will hand pour the box outs Monday.

Inspector

Date

Printed 6/14/99 10:15:53 10:15:53

Page 1 of 1

**Daily Report**Contract No. 77-0353-069 Date : Friday, June 19, 1998 Initials of Inspector: TPUHigh Temperature: 86.0 Low Temperature: 67.0

Sunrise _____ Sunset _____

Weather Comment: Pt. Cloudy

Site Timecharge

00 1.000

Subcontractor ID	Name	Comment
Jensen	Jensen Road Co.	

Remarks:

→ Jensen slipped 6 sections of rail today. Worked from 7am to 7pm. Only 4.5 sections of rail left, they plan to finish up slipping tomorrow.

Inspector _____

Date _____

Printed 6/14/99 10:14:40 10:14:40

Page 1 of 1

DIARY

PROJECT NO. _____

CONTRACT _____

DATE

WEATHER/COMMENTS

2-1-99

Cldy Humid

Hi 86°

Low 68°

Friday

Carlson Grading & Cleaning out 6' Median
section placing 1" Expansion to Hwy 60.

Winner Building Intake Taps (4 a Day)


→

Jensen Setting String Line conduit and
Steel getting ready to place Barrier Rail.
Tuesday July 5th they said they could
place 4,000' per Day. Should just take 3 1/2 Days
then instead of 2 weeks which they predicted
it would take

Jensen's told Winner they would
Pay the extra cost for them to use M-4
to help them out with cure time.

Informed Charlie Davis at Carlsons to
straighten out temp Barrier Rail on West
End of Project for this long weekend because
No one will be working.

ENTERED BY: _____



DIARY

PROJECT NO. _____

CONTRACT _____

DATE

WEATHER/COMMENTS

2-2-94 P/H v Cldy Mild in A.M. Hi 86° Low 66°
 Saturday Drove through checking on traffic control
 and Storm Water Discharge after Last Night's
 Rain. talked to Charlie Davis he said
 they only poured the 2 Median sections
 under 100th St. Bridge and 86th St. Bridge because
 of the weather said they stopped Paving at
 9:00 or 9:30 PM.
 Filled out Work Day Report Left for
 home!

2-3-94 Clear Sunny Humid Hi 89° Low 70°
 Sunday Checked on traffic Control this AM.
 also Noted that Carlson aren't setting
 the Header Steel Bars in the 6' Median Section
 for the Intakes, very straight will have to
 cut them off and Redrill. Also the
 steel for the 1/2 section of Barrier Rail
 under the two Bridges is Not very straight
 Not 4" out of Concrete Not 11" from
 the Pier!

ENTERED BY: _____

R.S.

DIARY

PROJECT NO. _____

CONTRACT _____

DATE

WEATHER/COMMENTS

7-4-99

Not Humid

Monday

Holiday No Work.

7-5-99

Clear in AM Cloudy PM

Hi 89° Low 74°

Tuesday

Jensen Placing Barrier Rail from Sta.

583 ± 65 ^{+593±80} moving slow in the Beginning but

Picking up As day wears on

Carlson Crew is cleaning up 6' Median area, setting Mastic getting ready for Paving working on Bridge Approach Sections, also Sealing Joints.

Winmor Building Intakes Again today using M-4 at Jensen's Request!

Carlson, Peilly & the D.O. are all that Attended our Weekly Meeting today

Carlson going to Pave 6' Median starting this Afternoon

(602±50) Das Mines Asphalt Placing 3' temp Paving at 2:30 PM today. Will probably get about 1/2 or 3/4 of it today and maybe finish up tomorrow weather Permitting

ENTERED BY:

R2

DIARY

PROJECT NO. _____

CONTRACT _____

DATE

WEATHER/COMMENTS

7-6-94 Pthly Cldy Windy, Humid! Hi: 90° Low 74°

Wednesday Carlson Batching concrete without running
Moistures this AM Because they moved their field
Lab office to Jasper Co. Project and we have
no place to run test!

Sent their Plant Man to Jasper Co.
to run test. Informed them we weren't
going to do this Because the Spec. Say we
will have a job trailer for running test as
long as we are working on those Items such as
Paving, granular and/or Special Rockfill Items!

Informed them to have their field Lab
here by tomorrow morning or we wouldn't be
Paving!

their field Lab arrived about 12:30
Mike Pagel said at 2:00 they were running
their gradation

→ Jensen's started Barrier Wall at 8:30
going slow but smooth to start out!

* By Noon they were having Problems with
their Air running Low. they added Air Agent
but No Water which doesn't do any good!

Phil Ketchum told me he ran 14 test on 4
different trucks. this many test is rediclus
it should be corrected with 3 test or reject the load!

Jensen shut down at 3:30 PM.

ENTERED BY: _____

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

7-7-94 Ptlly Cldy Humid Hi: 89° Low 64°

Thursday

Wiinmor working on Intakes today

Carlson Paving 6' Median

→

Jensen Placing median Barrier Rail. Still

*

having problems with the Air, trying to maintain
6%

7-8-94 Ptlly Cldy Mild Hi: 83° Low 68°

Friday

Wiinmor building intakes again today will try and

Pour either 4 or 5 at 3:00 PM.

Carlson's Paving crew should finish up
with 6' Median by Noon or maybe 10:00 today

→

Jensen paving on Barrier Rail again today

*

Still having Problems with the Air. up to
80°/yd. this PM. Sent Sample of Air
Agent to Ames for testing it came back,
OK. Materials Eng. will be out Monday
to check it out & talk to Contractor about
what to do.

ENTERED BY:

DIARY PROJECT NO. _____ CONTRACT _____

DATE	WEATHER/COMMENTS
7-9-94 Saturday	<p>Partly Clear to Clear Hi 83° Low 66°</p> <p>Jensen's working on Placing conduit and tying Steel for Barrier Rail. Also working on Machine (Comander III) Slip Form Paver. Only work being done today filled out Pay Voucher, Working Day Report Left for home. Phil was working on Reports!</p>
7-11-94 Monday	<p>Partly Cloudy Humid Hi 88° Low 70°</p> <p>Jensen's placing Barrier Rail this AM. First truck left Plant air at 6.8% test on grade at 5.5%. Indurmed Plant at this, they added 5" of Air and 7 gal of Water. Said they were going to keep adding water until we reached a slump that would be workable.</p> <p>At 1:00 they switched back to the original Mix to try it again (D-57-6-C)</p> <p>Dick Mann and Champ Naratani were present today to examine the Barrier Rail and the Process of Placing it to maybe enlighten us on what we are doing wrong, and correct the Problem!</p>

ENTERED BY: _____

DIARY PROJECT NO. _____ CONTRACT _____

DATE	WEATHER/COMMENTS
7-11-94 Monday Continued	Larry Skretta and Rick Carlson stopped by the Project this P.M. asked about the Barrier Rail
→	Rick said he would call Jim Rasmussen tonight and talk to him, Rick said the Barrier Rail is holding us back he want to switch traffic on 7-24-94 which is only 2 weeks away.
	Larry Skretta left me their New Progress Report which I will give to Larry Hill or Mitch Dillavou
	Their Machine Broke Down about 2:15 Herman Brown is suppose to be out to fix it will start again tomorrow morning
7-12-94 Tuesday	Cloudy Humid Hi 86° Low 65° Jensons Placing Barrier Rail at 6:15 AM Air tested at 7.8% with a 5/8" slump using a D-57 Mix this AM. with No Fly Ash Concrete reached Job Site with a temperature of 92°. With No fly Ash it appears to be sticking to the Sides of the truck more But working better through Machine.

ENTERED BY: _____

WEATHER/COMMENTS

Continued

Held our Weekly meeting this AM (2:00)
Present were Norm Larson of Carlson, Chris Reilly
Bob Reilly of Reilly Construction Shawn Goodoo of
Tri State Signing and a man from All Towers
didn't get his Name. Mitch Dillon, Larry
Hill, Phil Ketchum Mike Pagel and Myself from
the D.O.T. The Major concern was Jensen's
Barrier Rail Operation. Champ Naratun also
attended the Meeting Introduced him as
Dick Mumms Replacement to Dist Mtl's Engr.
Tri State will place their Glare
Screen Monday as Wiser has to extend
T.R.R. after Reilly Removes Remainder of
Median Barrier Rail which they intend on
doing this PM. or tomorrow.
All Towers says they can paint
all of Main line in 1 day. But they
have to remove alot of Yellow Edgelines
and taper sections

ENTERED BY:

DIARY PROJECT NO. _____ CONTRACT _____

DATE	WEATHER/COMMENTS
7-13-94	Jensen Placing Barrier Rail today. Every thing working well today as they Placed 2300; then it Rained!
Wednesday →	
7-14-94	Pty Cldy Mild Hi: 81° Low 62°
Thursday →	Barrier Rail Machine (Comander III) Not working today wait track straight going forward but works great backing up. Working on Machine wait get started very early today!
	Started about 10:00 quit about 3:00 get 800' today Not good at all!
	Jensen said they would Place the Barrier Rail with M-4 to speed up cure time But were informed No M-4 because it shrinks to much would cause cracking and tares
	Reillys Will Start Stockpiling their Granular Subbase Material tonight at 100 th St. North Side of Interstate

ENTERED BY: _____

DS

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

2-15-94 Ptlly Cldy Warm humid Hi: 86° Low 68°
Friday → Jensen Placing Barrier Rail this AM.
* started at 7:30. Not Very early! Having trouble
with Vibrators again this AM. Has a Man from
Gomaco Co. here working on them.
Reilly's hauled Granular Subbase
in and Stockpiled last night will run
gradation on it to certify Material as
the Engineer doesn't like his Method of
Stockpiling. He is using Belly Dumps over a
Bridge then removing with Rubber tired End Loader
driving up the pile contaminating the pile with
Mud also causing segregation of Materials.
Jensen said they will make the 72nd
St. Bridge tonight even if it is 10:00!
Ames will not allow M-4 to be
placed in Barrier Rail except for the small
gaps over the Intakes!

ENTERED BY: _____

P.S.

DIARY PROJECT NO. _____ CONTRACT _____

DATE

WEATHER/COMMENTS

7-16-94

Cloudy Mild Lite S. Shower Hi 81° Low 62°

Saturday →

Jensen going to place Barrier Rail to 72nd St Bridge today as that is all the cement American has, which is only about 700'

Lite Shower passing through at 7:00 AM.
contractor on hold till it Passes.

Had a Accident at 7:30 this AM. A 16 Year old boy had been delivering papers, was returning when he dropped off South Edge of Slab, on returning went across both Lanes and hit our temp. Barrier Rail. Called 911, Urbandale Police Responded Case No. 94-6799 on 7-16-94

→

Jensen's finished Barrier Rail to 72nd Street Bridge at 12:30 PM then went back and Poured Under 100th St Bridge on the East Bound Side of the Barrier Rail!

Said they Might Form and Pour the rest of 100th St gap tomorrow!

ENTERED BY:



DIARY PROJECT NO. _____ CONTRACT _____

DATE	WEATHER/COMMENTS
2-18-94 Monday	<p>Ptly Cldy Warm Hi 87° Low 72°</p> <p>A chance of Rain Showers this P.M.</p> <p>→ Jensen Plans on Finishing Main Line Barrier Rail with Slip Form Paver today. also forming Gaps over intakes getting ready to Pour them.</p> <p>Setting forms under 86th St. Bridge this Date also getting ready to Pour East Bound Section of Barrier Rail.</p> <p>→ Finished Barrier Rail with Paver at 11:00 AM. went to work on Gaps</p>
2-19-94 Tuesday	<p>Ptly Cldy Hot Hi 91° Low 72</p> <p>Jensen Setting forms under 86th St. Bridge again this P.M. after they made a pour at Noon. Not much going on today, will have our 2100 Meeting with Carlson today.</p> <p>Also Attending the Meeting were Cindy, at Wisser; Dave Merrick of Tri State also Shawn Gooden, Chris Reilly of Reilly Const., Larry Sknehta and Norm Larson of Carlson. Phil Kerdum, Mike Pagel, Mitch Villanova and my self of the D.O.T. Larry Hill is sick.</p> <p>Major Concern is Jensens Barrier Rail and switching traffic this Week End!</p> <p>RS</p>

ENTERED BY: _____

APPENDIX D
Core Descriptions

**POLK COUNTY PROJECT SITES
AND
CORE DESCRIPTIONS**

Core 1A, I-80, EBL

MP 139.05, 20 ft. west - BAD

Core 1B, I-80, EBL

MP 139.05, 70 ft. west - GOOD

Core 1C, I-80, EBL

MP 140.06 - BAD

Core 2A, I-35, I-80, WBL

MP 132.9, 4 ft. east of drain panel - GOOD

Core 2B, I-35, I-80, WBL

MP 132.9, 54 ft. east of drain panel - GOOD

Core 2C, I-35, I-80, WBL

MP 132.9, 4 ft. west of drain panel - GOOD

Core 2D, I-35, I-80, WBL

MP 132.9, 24 ft. west of drain panel - GOOD

Core 3A, I-35, I-80, WBL

MP 128.25 - GOOD

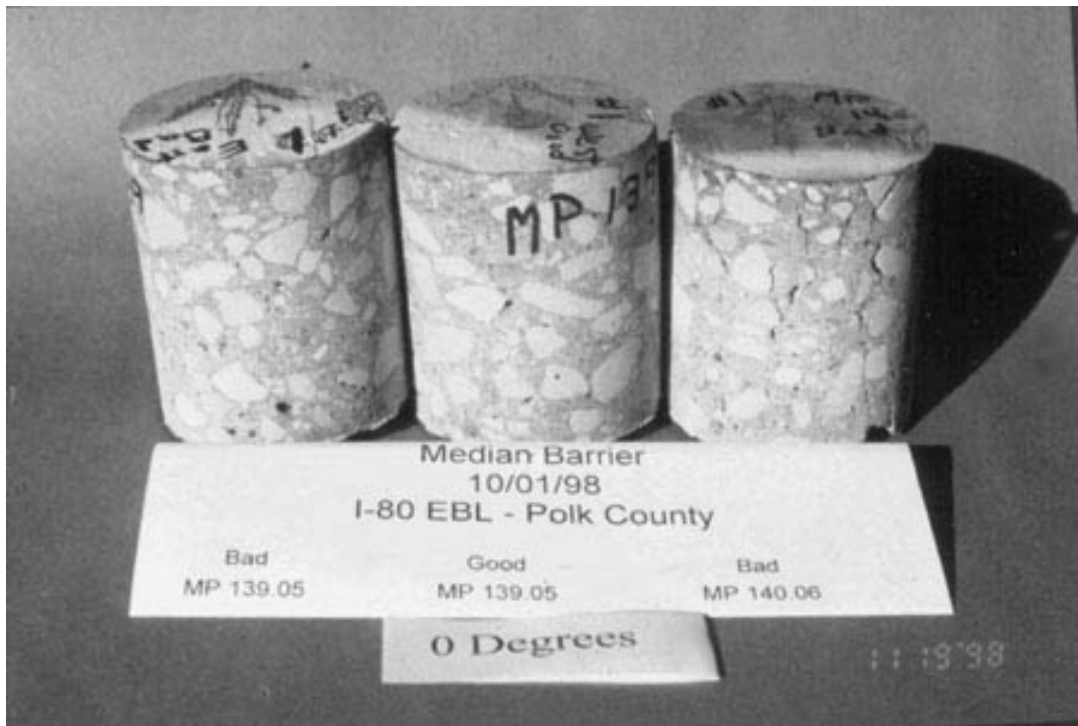
Core 4A, I-35, I-80, SBL

MP 126.5 - GOOD

Core 4B, I-35, I-80, SBL

MP 126.5 - BAD

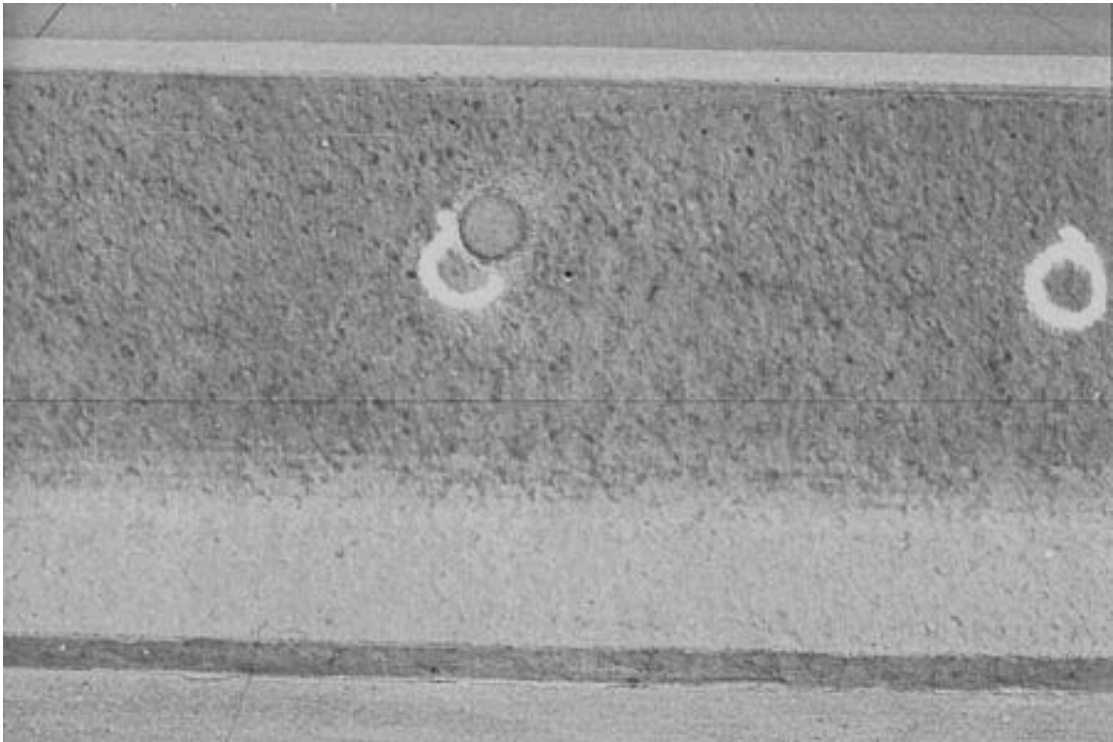
APPENDIX E
Core Photos



Cores 1A, 1B and 1C



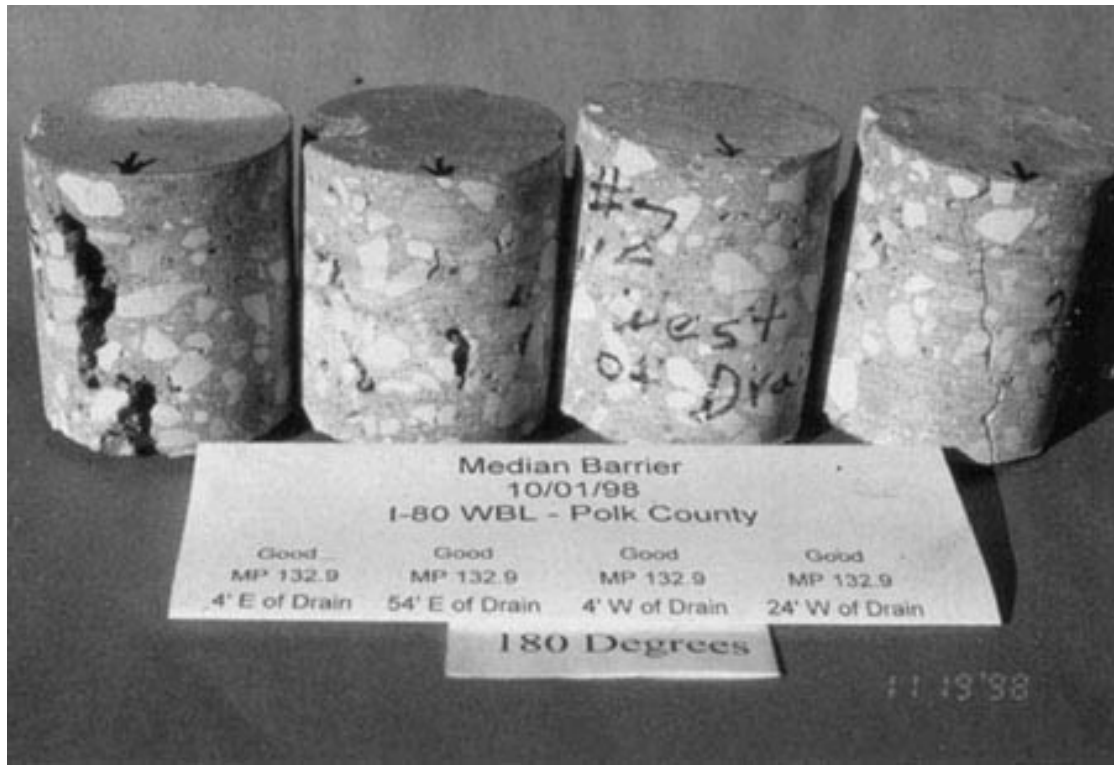
Barrier showing sites (dark 4" diameter circle) for core 1A



Barrier showing site (dark 4" diameter circle) for core 1B



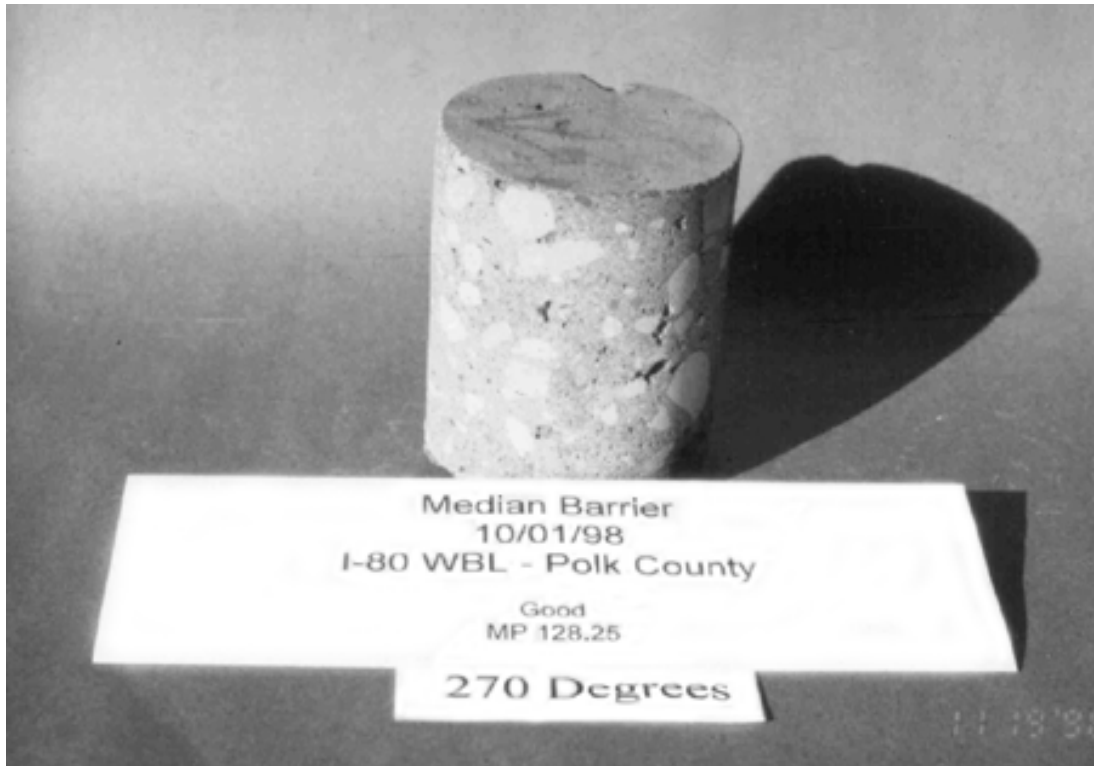
Barrier showing site (gray 4" diameter circle) for core 1C



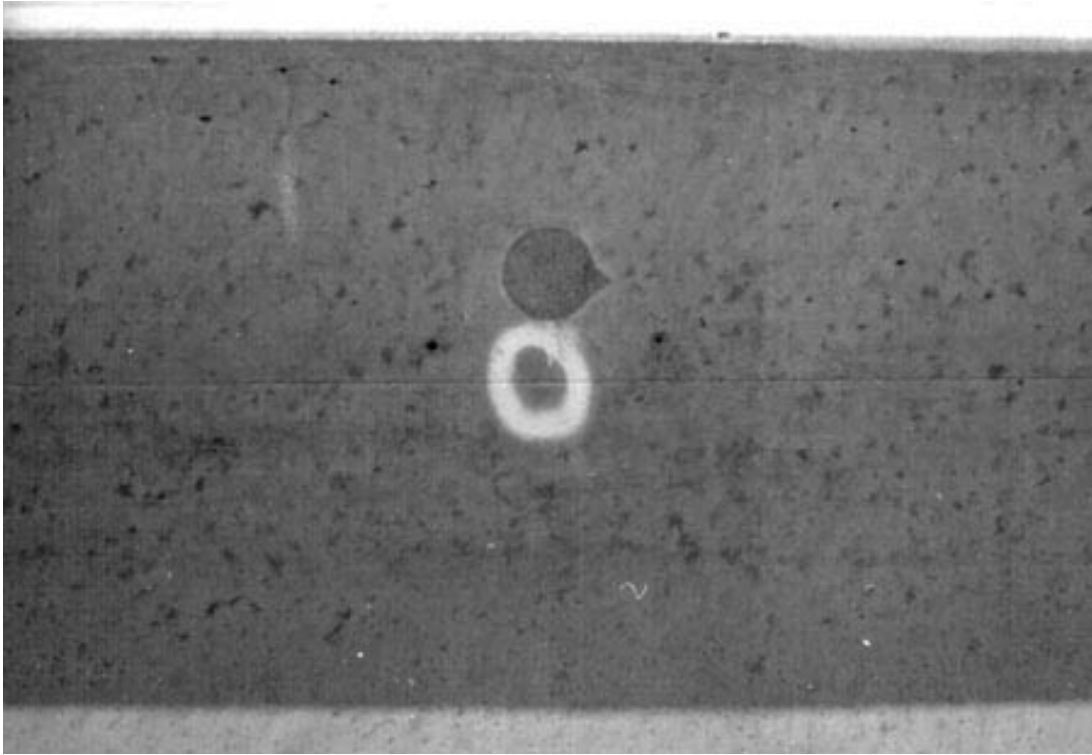
Cores 2A, 2B, 2C and 2D



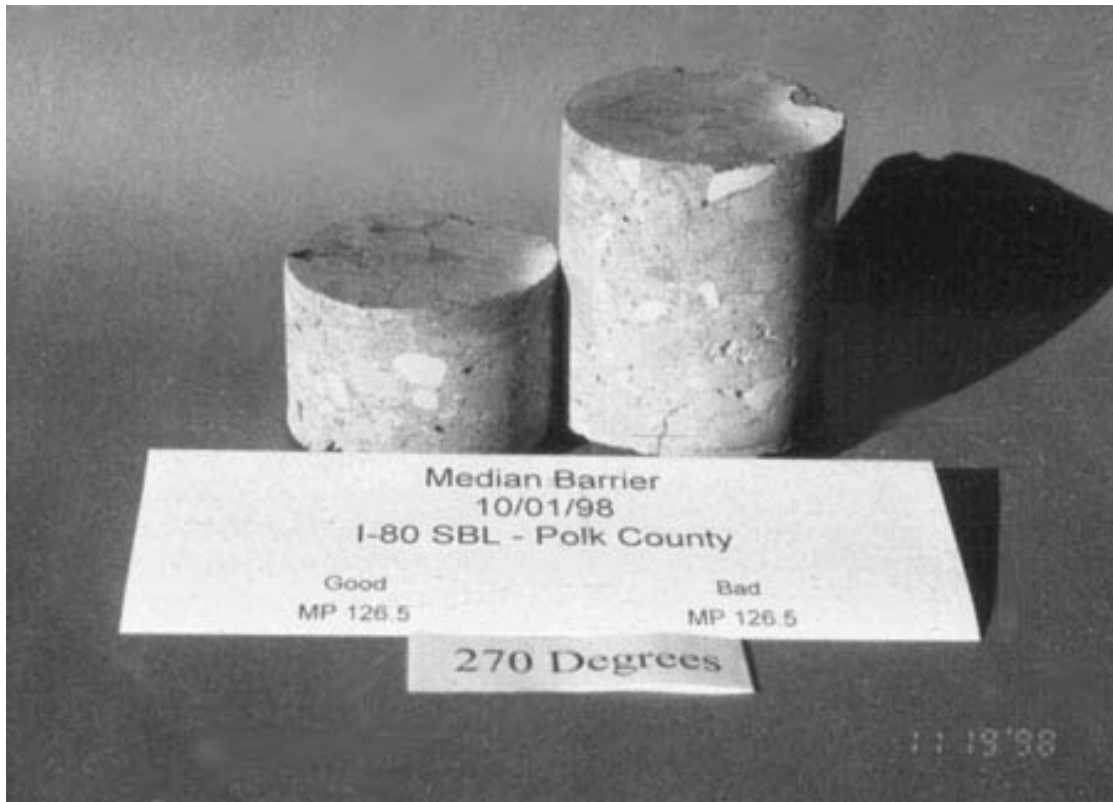
Barrier showing site (dark 4" diameter circle) for cores 2A and 2C



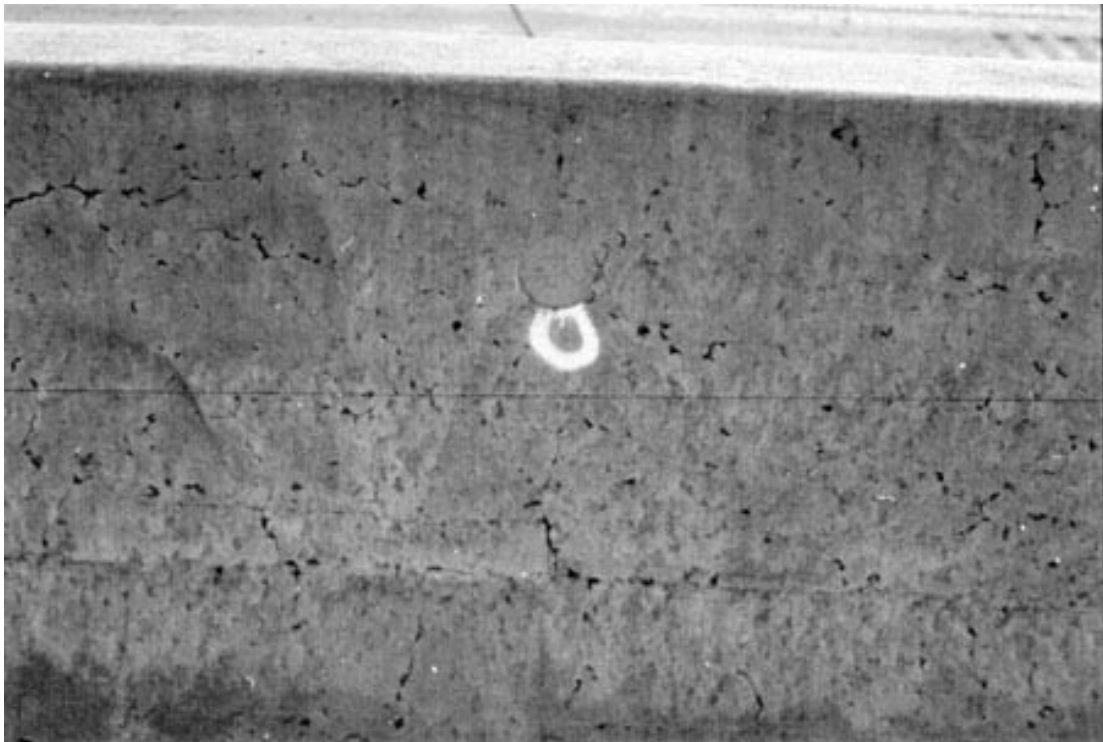
Core 3A



Barriers showing site (dark 4" diameter circle) for core 3A



Cores 4A and 4B



Barrier showing site (gray 4" diameter circle) for core 4A



Barrier showing site (dark 4" diameter circle) for core 4B

APPENDIX F
Core Analysis Tables

MLR-98-4 - Chloride Content Analysis
7-23-99 IOWA STATSuperQ
Results Quantitative

SEQUENCE	CORE NUMBER	TEST DEPTH (IN.)	CHLORIDE (%)
1	1A	0.5	0.126
2	1A	1	0.044
3	1A	2.5	0.026
4	1B	0.5	0.222
5	1B	1	0.061
6	1B	2.5	0.032
7	1C	0.5	0.184
8	1C	1	0.058
9	1C	2.5	0.031
10	2A	0.5	0.021
11	2A	1	0.018
12	2A	2.5	0.015
13	2B	0.5	0.018
14	2B	1	0.014
15	2B	2.5	0.017
16	2C	0.5	0.022
17	2C	1	0.022
18	2C	2.5	0.017
19	2D	0.5	0.017
20	2D	1	0.025
21	2D	2.5	0.021
22	3A	0.5	0.167
23	3A	1	0.040
24	3A	2.5	0.021
25	4A	0.5	0.105
26	4A	1	0.037

MLR-98-4 - Slipform Barrier Rail Cores I-80 Polk County

Core #	MP	Location	Visual Appearance	Core Depth (in.)	Mortar Air, %	Total Air, %	Avg. Dia. (microns)	Specific Surface (mm-1)	Spacing Factor (mm)
1A	139.05	20' W., EBL	Map cracking	0.5	1.40	0.84	369	16.260	0.609
				1.0	2.10	1.27	296	20.270	0.403
				2.5	2.60	1.58	350	17.143	0.428
1B	139.05	70' W., EBL	Okay	0.5	6.00	3.68	182	32.967	0.142
				1.0	5.60	3.43	183	32.787	0.149
				2.5	7.70	4.75	226	26.549	0.152
1C	140.06	EBL	Map cracking	0.5	7.10	4.37	222	27.027	0.157
				1.0	6.90	4.24	272	22.059	0.196
				2.5	7.90	4.87	354	16.949	0.235
2A	132.90	4' E. of drain panel, WBL	Okay	0.5	8.00	4.94	336	17.857	0.221
				1.0	8.90	5.51	366	16.393	0.226
				2.5	6.50	3.99	344	17.442	0.256
2B	132.90	54' E. of drain panel, WBL	Okay	0.5	8.30	5.13	327	18.349	0.210
				1.0	9.80	6.08	293	20.478	0.170
				2.5	7.00	4.30	258	23.256	0.184
2C	132.90	4' W. of drain panel, WBL	Okay	0.5	7.90	4.87	258	23.256	0.171
				1.0	9.30	5.76	333	18.018	0.200
				2.5	9.40	5.83	326	18.405	0.194
2D	132.90	24' W. of drain panel, WBL	Okay	0.5	8.60	5.32	348	17.241	0.219
				1.0	8.30	5.13	329	18.237	0.212
				2.5	8.50	5.25	364	16.484	0.231
3A	128.25	WBL	Okay	0.5	7.40	4.56	263	22.814	0.181
				1.0	9.50	5.89	273	21.978	0.162
				2.5	10.20	6.34	263	22.814	0.149
4A	126.50	SBL	Okay	0.5	7.80	4.81	277	21.661	0.185
				1.0	7.90	4.87	201	29.851	0.133

NOTE: Core 4B was too deteriorated for lab analysis.

APPENDIX G
New Mix Design for Concrete Barrier Rail

Section 2513. Concrete Barrier

ADD the following new sentence to the first paragraph of Article 2513.01, Description:
The provisions of Section 2403 shall apply.

ADD the following new paragraph to the end of Article 2513.01, Description:
The Contractor shall use only F-shape temporary concrete barrier rail on roadways with a posted speed limit greater than 45 mph. On any projects let on or after October 1, 2002 the Contractor shall use the F-shape temporary concrete barrier rail.

REPLACE the first sentence of the first paragraph of Article 2513.03, Concrete, with the following:
Concrete shall be Class D concrete, unless otherwise specified in the contract documents.

REPLACE all of Article 2513.03, Concrete, with the following:

A. Precast

Concrete shall be as specified in Article 2513.03, Paragraph B, or as approved by the Engineer, and in accordance with Section 2403. The concrete shall be proportioned, mixed, placed, and cured in a manner that will produce the minimum compressive strength at the time designated, as specified below:

	Strength Before Moving From <u>Casting Bed (psi)</u>	Strength At Age 28 Days (psi)
Precast	1750	5000

Strength at Age 28 Days shall be reached before storing in multilayers or shipping.

The air content of fresh unvibrated concrete shall be 6.5 percent, as a target value, with a maximum variation of plus or minus 1.0 percent.

B. Cast-in-Place and Slip Form

Section 2403 shall apply, except the concrete shall meet the following mix design requirements:

1. Cement. Cement content shall be 603 pounds per cubic yard.
2. Water. The total mixing water and free moisture in the aggregate shall not exceed the following:

<u>Class of Concrete</u>	Pounds of Water Per Pound <u>Of Cementitious Material</u>
BR (Slip Form)	0.450
BR (Cast-in-Place)	0.480

3. **Aggregates.** The combination of aggregates shall be uniformly graded in accordance with Materials I.M. 532, meeting the following gradation limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 1/2 inch	100
3/4 inch	81-93
1/2 inch	67-79
3/8 inch	57-69
No. 4	41-53
No. 8	29-41
No. 16	21-33
No. 200	0-1.5

4. **Admixtures.** Air entrainment shall be used. The air content of fresh unvibrated concrete shall be 6.5 percent, as a target value, with a maximum variation of plus or minus 1.0 percent. To improve workability and aid in air entrainment, water reducing or retarding admixtures may be used in accordance with Article 2513.02, Paragraph C.
5. **Fly Ash.** The conditions and allowable rates of fly ash substitution shall be in accordance with Article 2301.04, Paragraph E. Article 2301.04, Paragraph F, shall also apply.

Class D concrete may be substituted and Section 2403 shall apply.

REPLACE all of Article 2513.09, Tolerances, with the following:

A newly fabricated unit of temporary barrier rail shall be free from honeycomb, surface spalling, and surface defects. Corner breaks and bottom spalls after shipping and placement shall not exceed 1 square foot of total surface area, which includes the base.

Other than honeycomb, shallow voids, not exceeding 3/4 inch diameter, which appear on the formed surface after proper consolidation will not be considered as surface defects and need not be filled unless they appear in an abnormal concentration.

A used unit of temporary barrier rail shall not have spalls, corner breaks, and bottom spalls totaling more than 5 square feet of surface area, which includes the base.

Connecting loops on all barriers shall not be deformed and shall be true to dimensions.

Gaps between units shall not exceed the dimensions shown in the contract documents.

DELETE the third paragraph of Article 2513.11, Method of Measurement.

DELETE the second paragraph of Article 2513.12, Basis of Payment.