report no. CDOH-DTP-R-85-11

REHABILITATION OF BRIDGE DECKS DEMONSTRATION

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Demonstration Seminar and Construction Report
September 1985

Prepared in cooperation with the
U. S. Department of Transportation
Federal Highway Administration

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16. Abstract

This report documents the demonstration, Seminar and construction of Bridge Deck Rehabilitation on Interstate 25 between Longmont and Loveland, Colorado. Considerable experience was gained during the rehabilitation of twenty-five structures on this project. This report documents many of the problems encountered during this effort. The report also includes the initial data for a long-term evaluation of six of these structures. They include two latex modified, two low slump and two "DT" mix toppings for the six decks.

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INTRODUCTION

This project, of the Colorado Department of Highways, has been sponsored and financed by the Federal Highway Administration, Demonstration Project No. 51, Bridge Deck Repair and Maintenance. A seminar presenting topics concerning Bridge Deck Repair and Rehabilitation was held north of Denver, Colorado on June 21, 1984. Seminar participants observed field demonstrations of bridge deck evaluation procedures, removal techniques an the placement of a (nighttime paving) low slump concrete overlay on Project IR 25-3(77) between the Longmont and Loveland interchanges.

Twenty-five bridges were repaired and rehabilitated on this project. The work was completed on eleven structures in the southbound lane and three crossover structures during 1984. The remaining eleven structures were rehabilitated in the spring and early summer of 1985. The types of concrete deck topping included were low slump, latex modified and Colorado's class "DT" concrete. Two of each of these types were selected for long-term evaluation.

Figures 1 and 2 show the location of the seminar, demonstration and the construction project.

Project IR 25-3 (77)

Seminar Location
Sheraton Inn

Project and Seminar Location Map

Figure 1

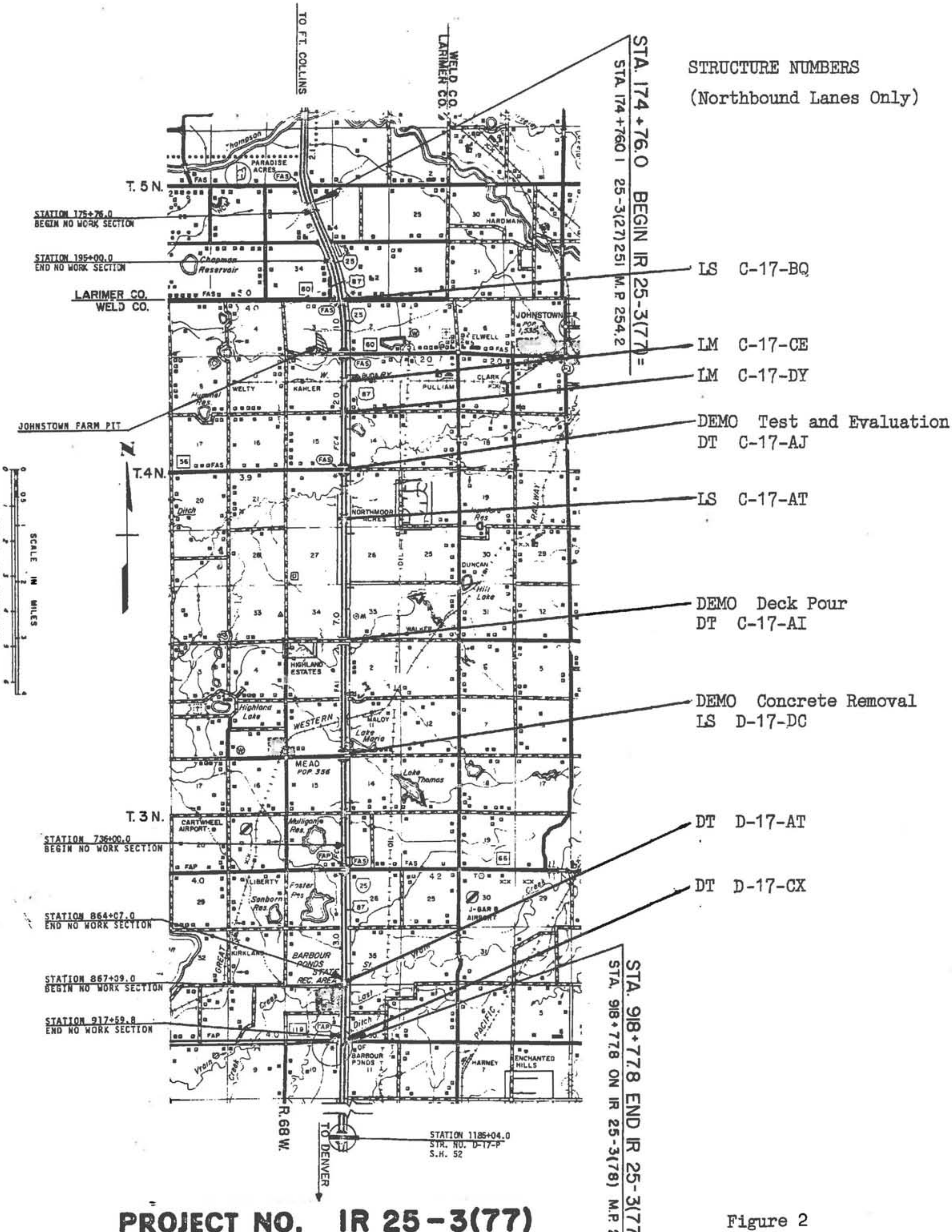

STRUCTURE NUMBERS
(Northbound Lanes Only)
STA. 174+76.0 BEGIN IR 25-3(77) =
STA. 174+76.0 I 25-3(27)251 M.P. 254.2
TO FT. COLLINS
WELD CO.
LARIMER CO.
LS C-17-BQ
LM C-17-CE
LM C-17-DY
DEMO Test and Evaluation
DT C-17-AJ
LS C-17-AT
DEMO Deck Pour
DT C-17-AI
DEMO Concrete Removal
LS D-17-DC
DT D-17-AT
DT D-17-CX
STATION 175+76.0
BEGIN NO WORK SECTION
STATION 195+00.0
END NO WORK SECTION
LARIMER CO.
WELD CO.
JOHNSTOWN FARM PIT
T. 5 N.
T. 4 N.
T. 3 N.
SCALE IN MILES
SCALE IN KILOMETRES
STATION 736+00.0
BEGIN NO WORK SECTION
STATION 864+07.0
END NO WORK SECTION
STATION 867+09.0
BEGIN NO WORK SECTION
STATION 917+59.8
END NO WORK SECTION
R. 68 W.
TO DENVER
STATION 1185+04.0
STR. NO. D-17-P
S.H. 52
STA. 918+77.8 END IR 25-3(77) =
STA. 918+77.8 ON IR 25-3(78) M.P. 240.2
PROJECT NO. IR 25-3(77)

Figure 2

SEMINAR

Colorado DOH, the FHWA, the American Road & Transportation Builders Association, and Associated General Contractors sponsored a Bridge Deck Rehabilitation Seminar and Field Demonstration on June 21, 1984. Over 300 people from several state, city, county, and federal agencies as well as contractors and equipment suppliers attended the half day seminar at the Sheraton Inn north of Denver. Speakers representing industry, federal and state agencies presented the state-of-the-art in all phases of Bridge Deck Rehabilitation.

Formal presentations were given from 8:00 a.m. through 12:30 p.m. Lunch was served from 12:30 to 1:30 after which participants were briefed on the afternoon demonstrations and bus transportation to the construction site. Appendix A contains the agenda from the one-day seminar and field demonstration.

More Than Three Hundred People Attended The Seminar

PHOTO #1

DEMONSTRATION

Deck Evaluation Site

Five buses transported over 200 people on the afternoon field tour of the construction project where they viewed testing and evaluation techniques on a 23-year old deteriorated bridge. The structure was C-17-AJ (as shown on Figure 2) SH 56 over I_25 about 50 miles north of Denver. (see Photo 2)

Several pieces of equipment and test methods were demonstrated and explained to the participants. A delamtect was shown along with a computer plot (Appendix B) of test results on this structure. Chain drag and hammer tests were demonstrated to more closely define areas of delamination. Copper/copper sulfate half cell tests were conducted on a five foot grid. Potential readings at these grid points are used to determine areas where active corrosion is taking place.

An infrared camera and video recorder were used to show delaminated areas in the deck. Chloride sampling equipment was demonstrated. The chloride analysis is used to predict the severity of the corrosion and deterioration.

Appendix B contains the computer plot of this evaluation. Data included in the plot is 1) delaminated areas, 2) half-cell voltage contour lines and 3) chloride analysis.

Appendix C contains preliminary test results obtained by the district and central laboratories. Included are diagrams showing test locations, delaminated areas and half-cell voltages. Appendix C also contains chloride analysis results, concrete design data and fly ash lab analysis.

Concrete Removal Site

Another portion of the field tour included a demonstration of bridge removal techniques and procedures on the construction project. The bridge structure D-17-DC was located over I 25 at the Mead Interchange, as shown on Figure 2.

Approximately 200 people in five buses viewed the bridge deck. Demonstrated for the attendees were the Turbo-Blast, Scabbler, Sand Blaster, Milling Machine and small air powered hand tools. (see Photo 2)

Turbo-Blast

This machine is a gas powered unit designed to propel metallic shot abrasive material at a horizontal surface to abrade away impurities and leave a clean surface. It is capable of recovering nearly 100% of the shot and debris from the blasted surface. Dust and debris are automatically removed from the surface which results in a dust free operation.

It is reported the machine will remove paint, urethane, epoxy and elastomeric coatings.

The attendees of the Bridge Deck Rehabilitation field tour saw this equipment demonstrated as a surface profiler and as a substitute for final sandblast cleaning of a bridge deck. As a profiler, it can be used to etch the surface for preparation of a bridge deck for waterproofing membranes. As a sandblasting substitute, it cleans a bridge deck for a cementitious overlays (on this particular deck a 2" concrete low-slump topping will be placed).

The First Group Of People Arriving At The Nondestructive Test Demo Site

PHOTO #2

Milling Machines Were Used On All Decks For The Class 1 (3/4") Removal

PHOTO #3

Scabbler

The scabbler is an air powered tool designed to remove concrete from bridge decks and floors. Using several pistons, the scabbler converts the energy of compressed air into impact forces, removing the concrete surface. The attendees saw this equipment in operation providing the Class I concrete removal which is 3/4" nominal off the top of the top surface.

Sand Blasting

A portion of the previously milled bridge had been sandblasted for the attendees to visually inspect. This large sand blasting equipment could not be demonstrated for the field tour because it is too dangerous. However, areas where it had been previously cleaned and scoured could be seen by all those interested.

Milling (Class I Removal)

A large C.M.I. milling machine with carbide tipped cutters was used to demonstrate the Class I bridge deck removal. As previously noted, this is approximately 3/4" thick removal from the surface. This machine cuts the material and windrows it behind so that it can be picked up by front end loaders or hand tools. Due to its size and power, it commanded the attention of all those on the bridge deck of the removal demonstration.
(see Photo 3)

Air Operated Hand Tools

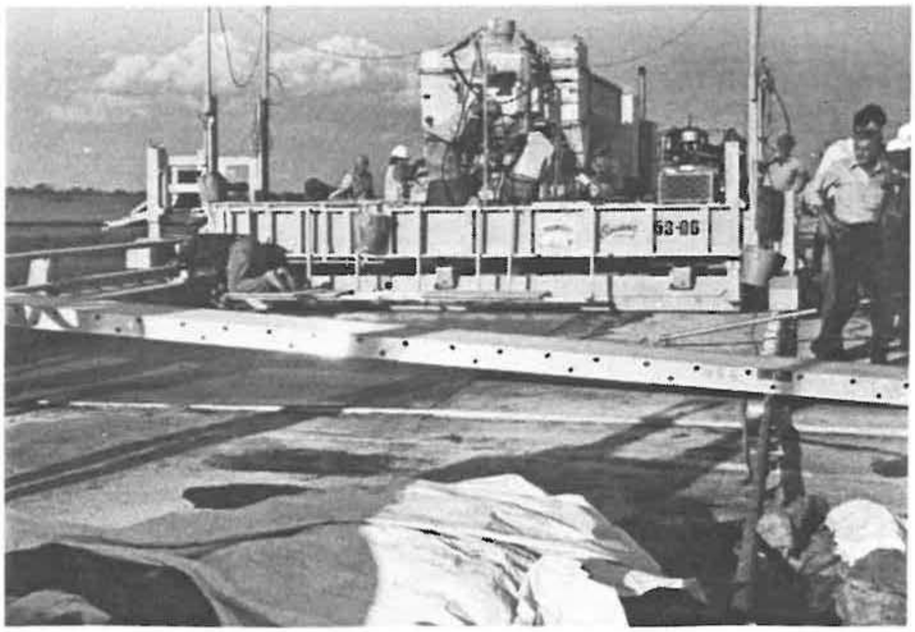
Several 15 to 30 pound air hand tools were demonstrated for the attendees. They were performing the Class 2 removal around the reinforcing steel. Special provisions for the project provide that pneumatic hammers heavier than 15 pounds shall not be used below and around primary steel.

After these two afternoon field demonstrations and while waiting to see the evening deck pour, the participants were treated to a western barbeque in a nearby contractor equipment facility.

Deck Pour Site

At the evening tour, participants viewed night paving of a low-slump deck topping. Night paving was suggested to the contractor on this project to reduce shrinkage cracking by placing the concrete topping under cooler, more humid conditions. The special provisions stated that the ambient and deck temperatures were not to exceed 85°F and not lower than 40°F. The special also said that "nighttime work or other limited work periods will be required", to meet the temperature and humidity requirements. The structure C-17-AI over I 25 at County Road 38 was used for this demonstration. (see Photo 4)

The demonstrations on these three bridge sites provided an excellent opportunity for interested individuals to see modern bridge deck rehabilitation methods all in one afternoon.



Evening Demonstration Of A Deck Pour. The Bidwell Vibrating Screed Paver Has Finished Half Of The Deck Width (Lower Left). Observers Are At Far Right.

Photo #4

CONSTRUCTION

The average daily traffic on I 25 north of the Longmont interchange is over 24,000. This four lane highway traverses the high plains parallel to the front range on gently rolling terrain at about 5500 feet elevations. The average annual precipitation in the semi-arid part of the country is only 14 inches. The drainage is good throughout the gently rolling front range with many small valleys. Soil types range from A-4 through A-6.

Twenty-six structures were rehabilitated on the project IR 25-3(77) north of Denver. These structures were 20 to 28 years old and were badly deteriorated. Preliminary testing showed most of these structures to be in advanced stages of corrosion due to chloride contamination. Tests included half cell, chloride analysis and chain drag as well as visual observations noting cracking, patching and potholes. (see Photo 5)

Fly ash was required in the low-slump concrete deck topping to improve workability. Class F or C fly ash was allowed. Class F fly ash from the Nixon plant in Colorado Springs was used to replace 20% of the cement. The fly ash had 0.85% loss on ignition with 22.2% retained on the 325 screen.

Type I, low alkali cement from the Southwest was used. Other additives include a water reducer and air entraining agent at 5-9%. All traffic was detoured until the project was accepted by the resident engineer. Four Thousand Five Hundred PSI field strengths were desired for "DT" mix in the field and 5,625 PSI lab strengths were required.

Shrinkage cracking of deck topping concrete materials has been a persistent problem in previous deck rehabilitation projects in Colorado. Much of this shrinkage cracking has been attributed to hot, dry winds rapidly drying the surface before curing procedures could be performed. The summer daytime humidity is usually below 10% in this semi-arid climate. The special provisions on this project required strict temperature ranges and suggested that deck topping concrete be placed at night to take advantage of lower temperatures, low wind and higher humidity.

Cracking, which usually develops later, can be attributed to 1) thin class 1 removal and thin overlay material which doesn't add much strength to the structure, 2) reflected cracks from old cracks in portions of the old concrete which was not removed and 3) possible segregation of materials. Fly ash/cement segregation has been observed and is suspected to cause non-homogeneous concrete placement.

During the 1984 summer construction season all of the southbound structures and most of the crossovers were completed. Work was suspended in October because of cold weather and traffic safety. The structures on the northbound lanes were rehabilitated during April and May of 1985.

This Is One Of The Most Deteriorated Decks On the Project Showing Cracking & Potholes

PHOTO #5

Thirteen Jackhammers Working At Once To Remove Class 2 & 3 Deteriorated Concrete

PHOTO #6

Six structures on the northbound main line were selected for long-term evaluation. They include two each of low slump, latex modified and Colorado's "DT" mix for deck topping. The bid price for each was: Low slump - $400/cubic yard, latex modified - $575/cubic yard and "DT" - $285/cubic yard.

The top 3/4" to 1" of old concrete was removed with rotomill equipment. The best results were obtained when the equipment made two passes taking only part of the thickness each time. Delaminated and deteriorated concrete around and below reinforcing steel was removed with hand held air hammers. All steel and old concrete surfaces were sand blasted within 72 hours before deck topping was placed. (see Photo 6)

Concrete was mixed and delivered at the site of each structure by mobile mixers. There was considerable variability in materials involving air, water, cement, sand, aggregate and latex from these mobile mixers.

The engineering staff on the project would like to have metering devices required for all components of the concrete mix. It is felt that this would make the job easier for the state and the contractor as well as produce a more homogeneous product. It is also felt that some method to control the sand moisture was needed. The cement/fly ash blend presented a problem with the calibration of mixers and the finished product in the low slump mix. The engineering staff would like to eliminate fly ash and use straight cement. Better results have been realized on other projects where fly ash was not used.

Project personnel and the contractor agreed that the 85°F air temperature limitation wasn't strict enough. The temperature maximum should be reduced.

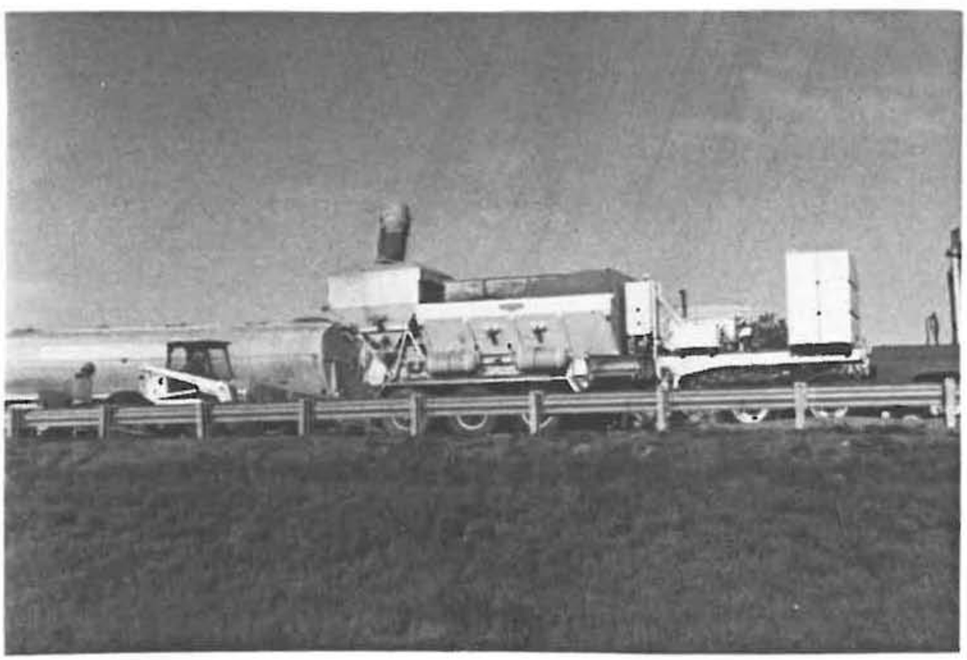
Liquid curing compound was used on the finished surface of the first few "DT" mix toppings and small shrinkage cracks developed within a short time. Wet burlap covered with plastic worked much better and has been used on the remaining "DT" mix, low slump and latex modified toppings on structures on this project.

There were problems with the first attempt to broom on mortar directly from latex modified concrete mix as delivered from the mixer. Aggregate was brought with the mortar making it difficult to broom. Both the mortar and the mix tended to dry rapidly leaving some segregated aggregate and some dryer spots in the mix. This method of taking mortar from the mix leaves a much higher rock percentage and a lower sand and cement percentage in the remaining concrete.

A sand-cement-water-latex mortar was premixed and spread for the remainder of latex modified deck pours on this project. This procedure was much more satisfactory. Mortar was broomed on in advance of the paver for all low slumps and "DT" mix toppings.

The Mobile Mixer Was Placed On The Deck For The First Few Deck Pours

PHOTO #7



Better Results Were Obtained When The Mobile Mixer Was Parked On The Approach And Small Loaders Delivered The Mix To The Paver.

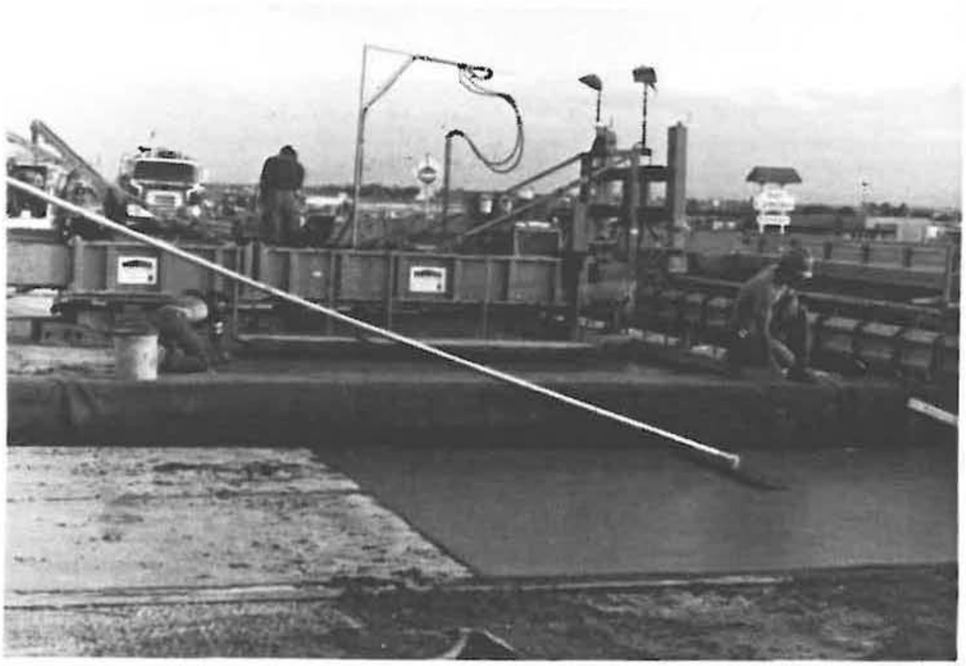
PHOTO #8

A Small Loader Delivering Concrete To The Paver.

PHOTO #9

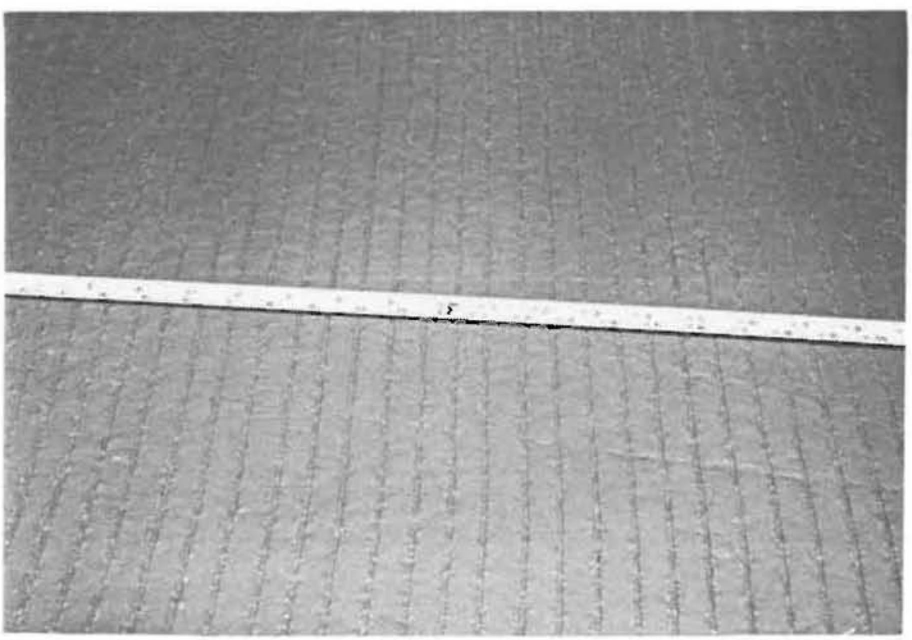
A Sand/Cement Grout Mixture Was Spread And Broomed Onto The Old Concrete And Steel Surfaces Just Ahead Of The Paver

PHOTO #10



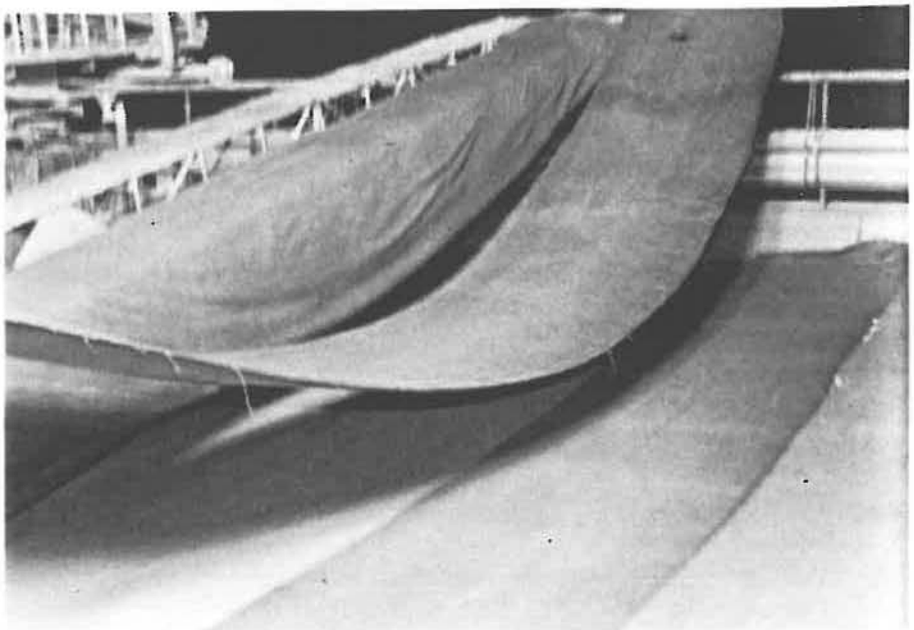
The Concrete Was Finished And The Grade Was Checked Behind The Paver

PHOTO #11



The Surface Was Textured With Tines To About 1/8" Deep And Perpendicular To Traffic Flow

PHOTO #12

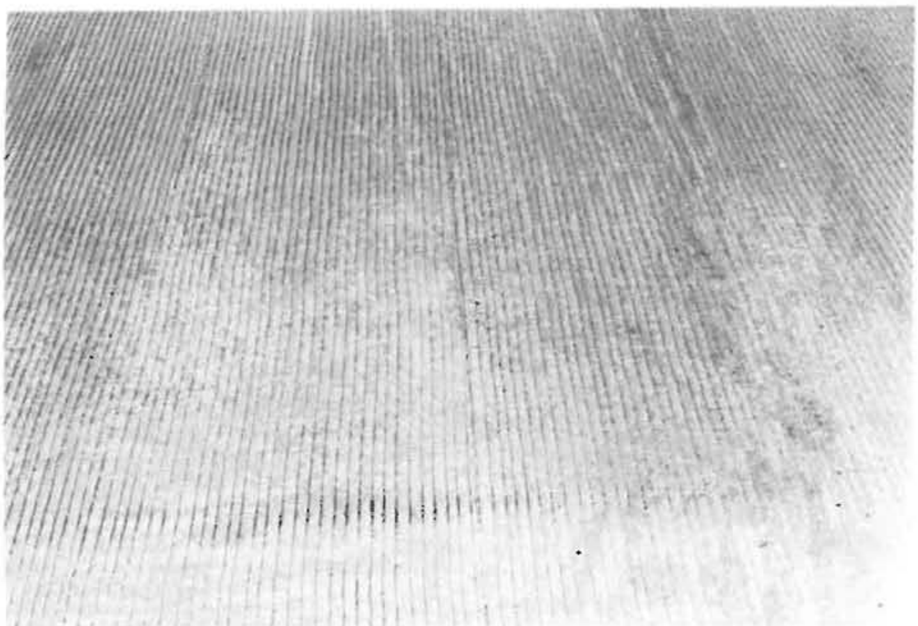


Damp Burlap Was Placed From 10 to 30 Feet Behind The Paver. This Was Generally Within 20 Minutes Of The Concrete Delivery

PHOTO #13

The Burlap Was Covered With White Plastic To Maintain The Moisture For 72 Hours

PHOTO #14



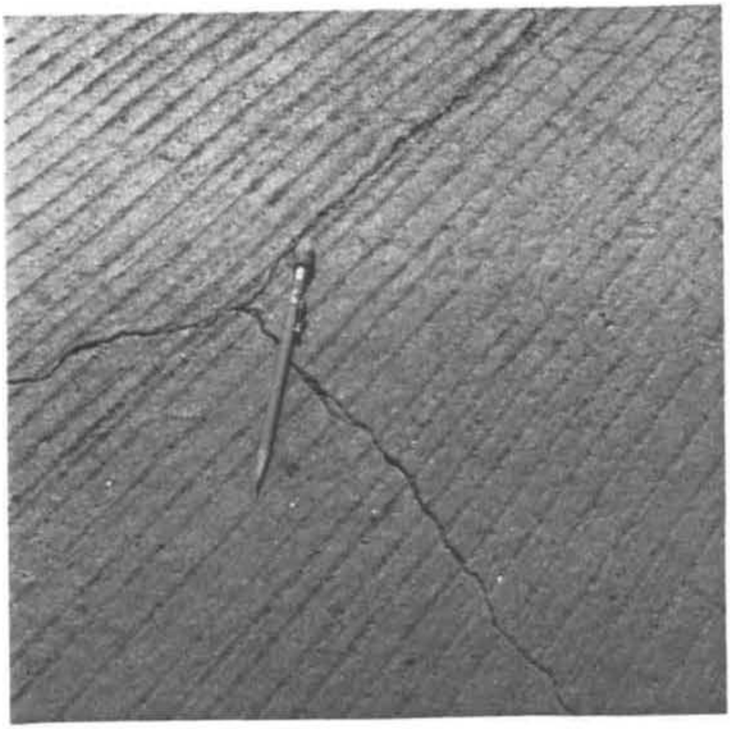
All Of The Deck Surfaces Looked Good After Curing

PHOTO # 15

The two structures at Johnson's corner were finished late in the fall of 1984. Small cracks were noticed on the new surface of these decks within a couple of months. The cracks had widend and several delaminated areas were detected by April and May of 1985. Cold weather during the curing period was thought to have contributed to this cracking. Close inspection of areas where the concrete topping was removed for patching, revealed that these small cracks extended all the way through the old concrete deck. These cracks through the deck, curbs and walkways were directly under the new cracks in the new topping.

Flexing of the entire concrete structure under traffic is probably the primary cause of the cracks reflecting up through the new concrete overlay. (see Photos 16 & 17)

During the Spring of 1985, inspections were made of all of the 1984 rehabilitated structures. Hairline cracks were found in all of the structures carrying I-25 traffic. These cracks could be located on the underside of the decks in most cases, indicating that they are reflected through from the old concrete decks.



Some Severe Cracking On Twin Structures C-17-EE And C-17-EI At Johnson's Corner During The 1984-85 Winter

PHOTO #16

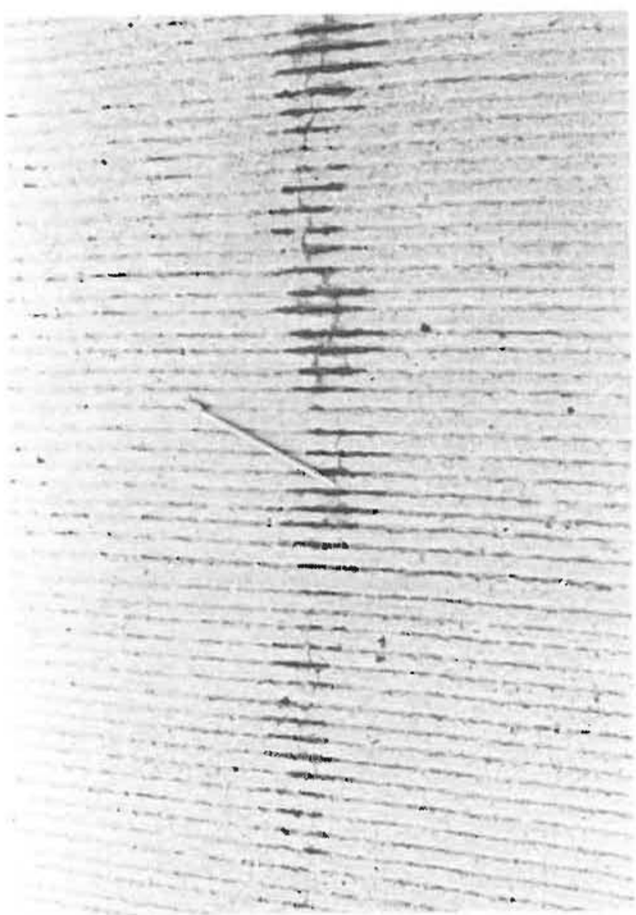


PHOTO #17

Small Hairline Cracks Were Found In The Spring Of 1985, In All Of The 1984 Rehabilitated Structures On The Main Line. This Is A Typical Example Of The Cracks Found During This Inspection

The six structures chosen for long-term evaluation on the Northbound main line were C-17-BQ and C-17-AT for low slump, C-17-CE and C-17-DY with latex modified and D-17-AT and D-17-CX with "DT" and an asphalt membrane (see Figure 2). Some additional work done on these structures before deck toppings were placed, included detailed mapping of class 1, 2 and 3 concrete removal, some half cell tests and the installation of permanent half cell reference cells. The Class 2 and 3 concrete removal was much less than planned quantities.

These small quantities of concrete removal are attributed to a very good concrete excavation crew. They were very careful to use light weight equipment, to avoid vibrations of rebars and to keep their work area clean. Also, the rotomill made two passes when necessary to remove 3/4" to 1" of concrete, thus reducing the total vibration of the deck.

Random half cell tests were taken after all deteriorated concrete had been removed on the six long-term evaluation structures. These test were comparable to the preliminary engineering tests.

Two of the six long-term evaluation structures received "DT" topping covered by a membrane and asphalt overlay. Part of the long-term evaluation includes half cell measurements. Half cell reference electrodes were made and installed on one of the clean prepared decks just prior to the "DT" placement. The half cells are Molybdenum/Molybdenum oxide (Mo/MoO_3). These reference cells were made up in accordance with instructions from Dr. Carl E. Locke of the University of Oklahoma, who has done considerable experimental work with various materials to develop dependable long-term reference cells. (See Photos 18 & 19)

One Mo/MoO_3 reference cell was installed on a low slump deck and one was installed on a latex modified deck to determine the long-term reliability of the reference cells. These can be measured and compared with surface $Cu/Cu\ SO_4$ half cells for several years since these decks are not covered by asphalt.

All six long-term evaluation structures were tested with $Cu/Cu\ SO_4$ half cells after the rehabilitation. These will be initial readings for the long-term evaluation.

Tables A and B located in Appendix D show the results of half-cell readings. Table A is the Mo/MoO_3 half-cell calibrations and initial readings. Table B shows the percentages of half-cell readings over 0.30 volts and over 0.35 volts indicating probable active corrosion and active corrosion respectively.

PHOTO #18

The Mo/MoO_3 Reference Cell Is The Small Diameter Black Tip (center). The Ground Wire Is Attached To The Exposed Rebar And Then Covered With Epoxy. All Connections Are Insulated By A Covering Of Epoxy. Lead Wires Were Routed Down Through A Drilled Hole In The Deck.

PHOTO #19

The Reference Cell Was Covered With A Duracal Patch. (Rt. & Below Volt Meter), Readings Were Taken Of Each Reference Cell And Compared To $Cu/CuSO_4$ Cell (Directly Rt. Of Voltmeter), Before And After "DT" Mix Overlay.

CONCLUSIONS

The construction crew that did the concrete removal in the Spring of 1985 did a very good job. Careful work in this phase provided savings in removal and replacement quantities and resulted in a better finished product.

Night paving did provide better conditions for concrete placement and curing. Temperature, humidity and wind conditions were all better at night. Damp burlap should be placed as soon after finishing as practical even in the less critical conditions of night paving.

Metering devices should be required for all components of the mix on mobile mixers. This would help the contractor and the engineer and would insure a more homogeneous mix.

Hairline reflective cracking has developed in the rehabilitation mainline structures after only one winter. This is attributed mainly to traffic induced vibrations to the structures.

As a point of interest, the resident engineer and his staff much preferred "DT" mix over the low slump or latex modified concrete because of workability and less problems in placement. They also feel that "DT" mix results in a much better end product.

Most of the District materials engineers feel that removal of old concrete should be 100% class 2 (below the top reinforcing steel).

It is hoped that the recently completed northbound structures will perform even better than the southbound and that the hairline cracking is not detrimental. The long-term evaluations and subsequent reports will provide more answers and ultimately better structures and transportation facilities.

APPENDIX A

Seminar Agenda

AGENDA

Bridge Deck Rehabilitation Demonstration and Seminar
Sheraton Graystone Castle
I25 @ 120th Avenue
Denver, Colorado

June 21, 1984

7:00 a.m. - Registration, Fee $15.00

Morning Session

	Presiding	Mr. Harry Lindberg American Road & Transportation Builders Association
8:00 a.m.	Welcoming Remarks	Mr. Robert Clevenger Colorado Department of Highways
		Mr. Morris Reinhardt Federal Highway Administration
8:15 a.m.	Bridge Deck Rehabilitation "The National Scene"	Mr. Richard Morgan Federal Highway Administration
8:40 a.m.	State-of-the-Art	Mr. Kenneth Clear Kenneth C. Clear, Inc.
9:10 a.m.	Effective Bridge Deck Rehabilitation	Mr. Gerald McCarthy Michigan Department of Transportation
9:40 a.m.	Evaluation Techniques	Mr. Dick Hines Colorado Department of Highways
10:00 a.m.	Break	
10:30 a.m.	Construction Specifications and Traffic Control:	
	A State's Viewpoint	Mr. Kenneth Mauro Colorado Department of Highways
	A Contractor's Viewpoint	Mr. Jack Rutter American Road & Transportation Builders Association
11:15 a.m.	Removal Techniques	Mr. Stanley Ihlanfeldt Colorado Department of Highways
11:35 a.m.	Construction Techniques	Mr. George Calvert Iowa Department of Transportation
12:00 noon	Quality Control	Mr. Robert Chapin Chapin & Chapin Construction
12:20 p.m.	Lunch	

Bridge Deck Rehabilitation Demonstration and Seminar

June 21, 1984

Afternoon Session

	Presiding	Mr. Douglas Bernard Federal Highway Administration
1:45 p.m.	Field Demonstration	Mr. Denis Donnelly Colorado Department of Highways

2:00 p.m. Commence Tour to Bridge Deck Demonstration Sites

Nondestructive Testing
- Delamtech
- Chain Drag
- Hammer
- Half Cell
- Pachometer
- Chloride Sample

Surface Removal
- Milling
- Chipping
- Steel Cleaning

5:15 p.m. Adjourn Afternoon Session

5:30 p.m. Barbecue Featuring Daddy Bruce's Ribs at Flatiron Construction Co. office (sponsored by ARTBA/AGC)

Evening Session

7:15 p.m. Evening Tour to Demonstration Site - Bridge Deck Pour Using Low Slump Concrete

APPENDIX B

Computer Plot of Bridge Deck Survery

BRIDGE DECK SURVEY

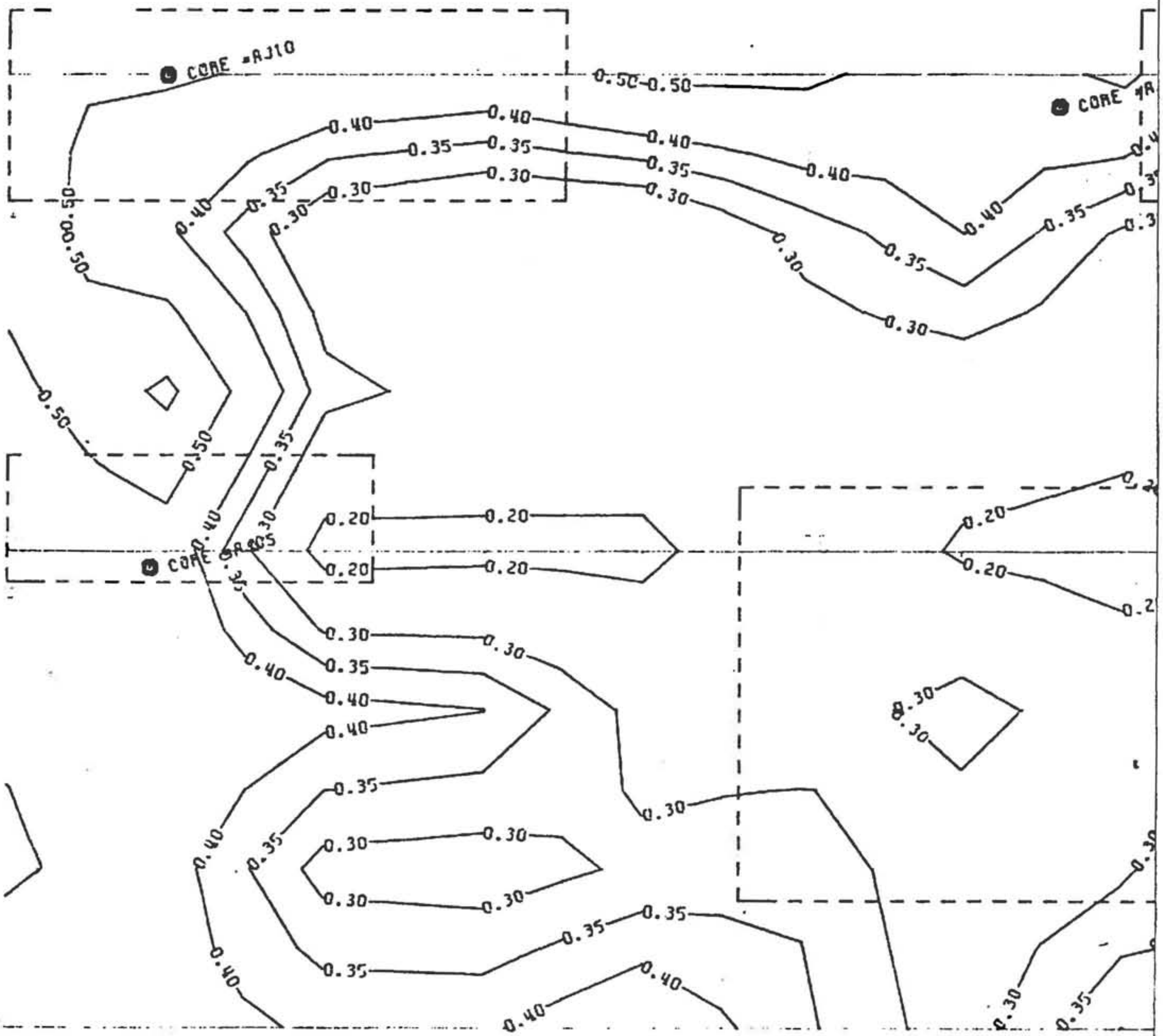
PROJECT: COLO IR 25-3 (77) HWY NO: 56 RE

LOCATION: STATE HIGHWAY 56 OVER INTERSTATE 25

SPANS: 3 CONT DATE

REMARKS----CONTINUOUS T-GIRDER SPANS MASSIVE

CENTER SPAN IN VERY BAD CONTINION



SCALE: 1 INCH = 5 FEET

DELAMINATED AREAS 3044 SQ FT OF 6690 SQ FT = 4[illegible].5 PE[illegible] CEN

CORROSION AREAS:

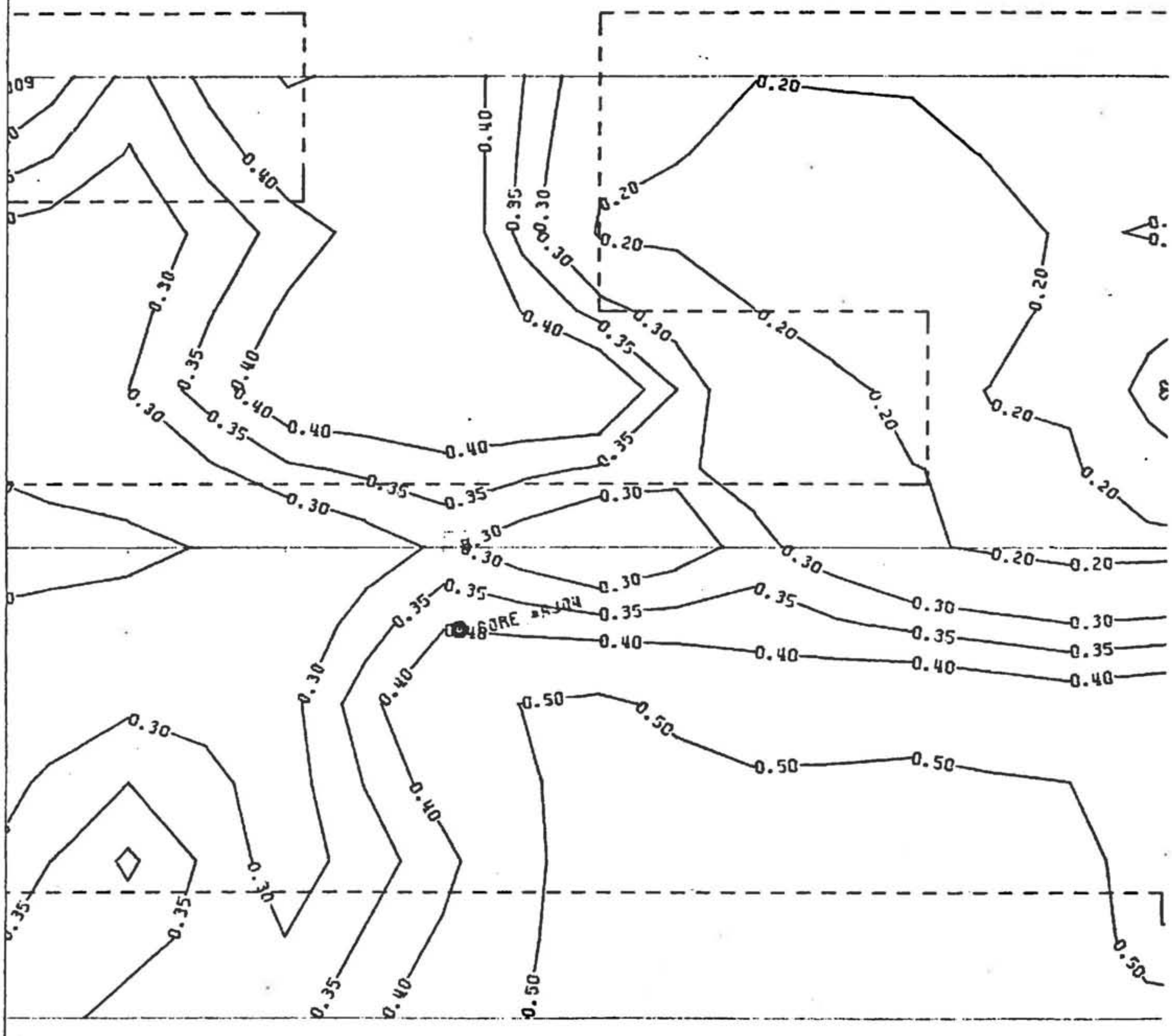
ABOVE 0.20	6442 SQ FT OR 96.3 PER CENT OF TOTAL
ABOVE 0.30	4959 SQ FT OR 72.5 PER CENT OF TOTAL
ABOVE 0.35	3300 SQ FT OR 56.8 PER CENT OF TOTAL
ABOVE 0.40	2512 SQ FT OR 37.5 PER CENT OF TOTAL
ABOVE 0.50	345 SQ FT OR 5.2 PER CENT OF TOTAL
ABOVE 0.50	1 SQ FT OR 0.0 PER CENT OF TOTAL

DELAMINATED AREAS

N

F POST: 250.

DELAMINATION



CHLORIDE ANALYSIS:

CORE	REINFORCING DEPTH (IN.)	CHLORIDES (LB./CU.YD.)
AJ01	1.50	3.60
AJ02	1.50	6.30
AJ03	1.50	5.90
AJ04	1.50	2.90
AJ05	1.50	5.10
AJ06	1.50	4.70

CORE	REINFORCING DEPTH (IN.)	CHLORIDES (LB./CU.YD.)
AJ07	1.50	3.40
AJ08	1.50	4.20
AJ09	1.50	6.30
AJ10	1.50	6.60
AVERAGE	1.50	4.95

APPENDIX C

Preliminary Test Results
For The Project

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	IR 25-3(77)	38	

AS CONSTRUCTED

NO REVISIONS ☐ REVISED ☐ VOID ☐

DETAILS OF AREAS OF BRIDGE DECK REMOVAL

Structure No. C-17-BQ
Location: North Bound Mainline at M.P. 253.0
Date Completed: 6-1-83
Tester: V. Harper
C. Wood
Overlayed: No

Comments:
Rebar depth: Between surface and 1" deep.
Samples taken from 1/2" to 11/2".
Rebar exposed periodically thoughout deck.

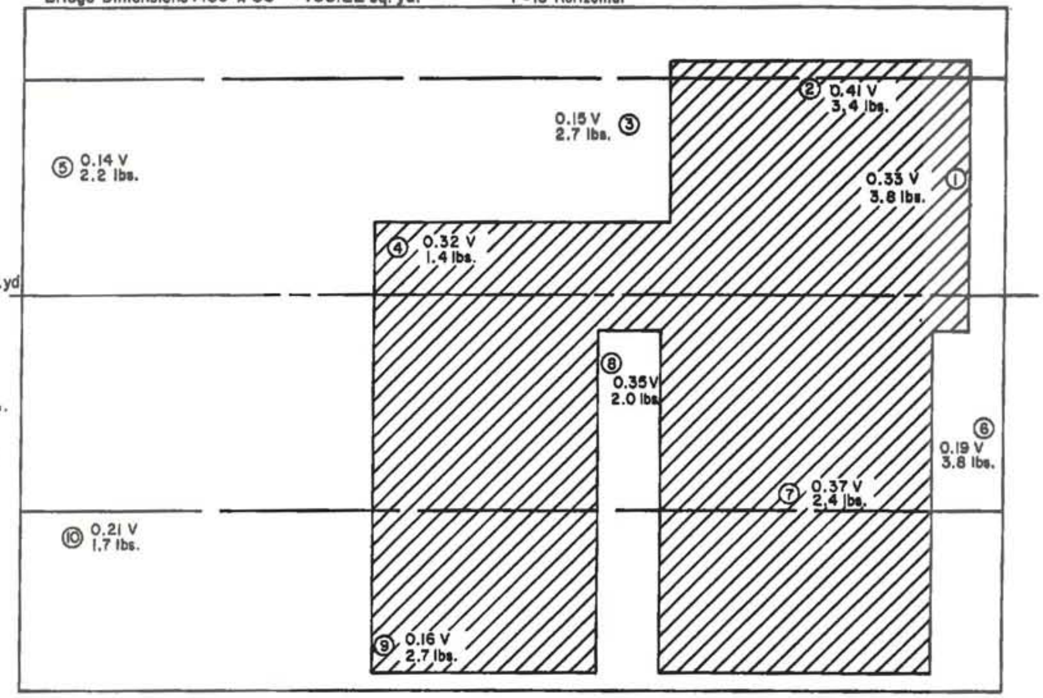
Delamination Area: 207.78 sq.yd
Percentage of deck delaminated: 45.15%

Efflorescence: Has a few random streaks less than 1%.

Conc. Deck Removal (Sq. Yd.)
Class 1: 100% = 460
Class 2A: 65% = 299
Class 2B: 25% = 115

Bridge Dimensions: 109' x 38' = 460.22 sq. yd.

Scale: 1" = 5' Vertical
1" = 10' Horizontal



Structure No. C-17-DY
Location: North Bound Mainline at M.P. 251.25
Date Complete: 6-2-83
Testers: V. Harper
C. Wood
Overlayed: No

Comments:
Rebar depth: Ranging between 1/2" to 11/2" deep.
Samples taken between 1/4" & 2".
Rebar exposed mainly in 10' x 10' area with cracking in other area.

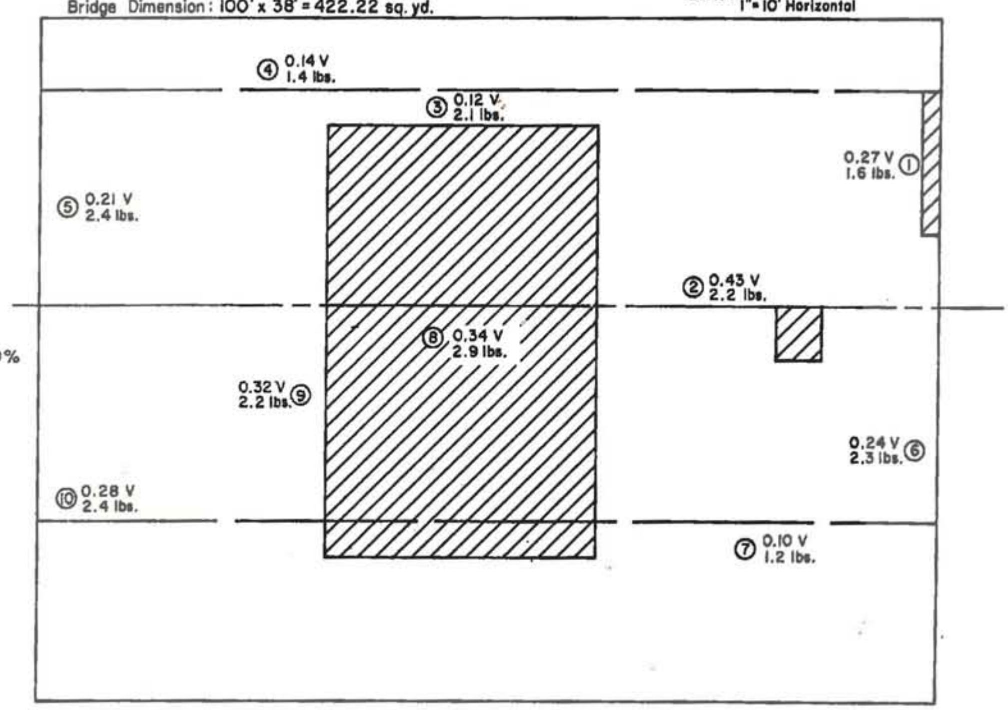
Delaminated Area: 96.78 sq. yd.
Percentage of deck delaminated: 22.9%

Efflorescence: None

Conc. Deck Removal (Sq. Yd.)
Class 1: 100% = 420
Class 2A: 50% = 189
Class 2B: 10% = 42

Bridge Dimension: 100' x 38' = 422.22 sq. yd.

Scale: 1" = 5' Vertical
1" = 10' Horizontal



Legend
(applicable to all sheets)

Delamination

Efflorescence

Structure No. C-17-CE
Location: North Bound Mainline
at M.P. 251.75
Date Completed: 6-2-83
Testers: V. Harper
C. Wood
Overlayed: Yes

Comments:
Rebar depth: Approx. 1 1/2".
Samples taken between 1" & 2"
Overlay thickness approx. 2"
Because of overlay, no delamination test taken.

Percentage of deck delamination: N/A

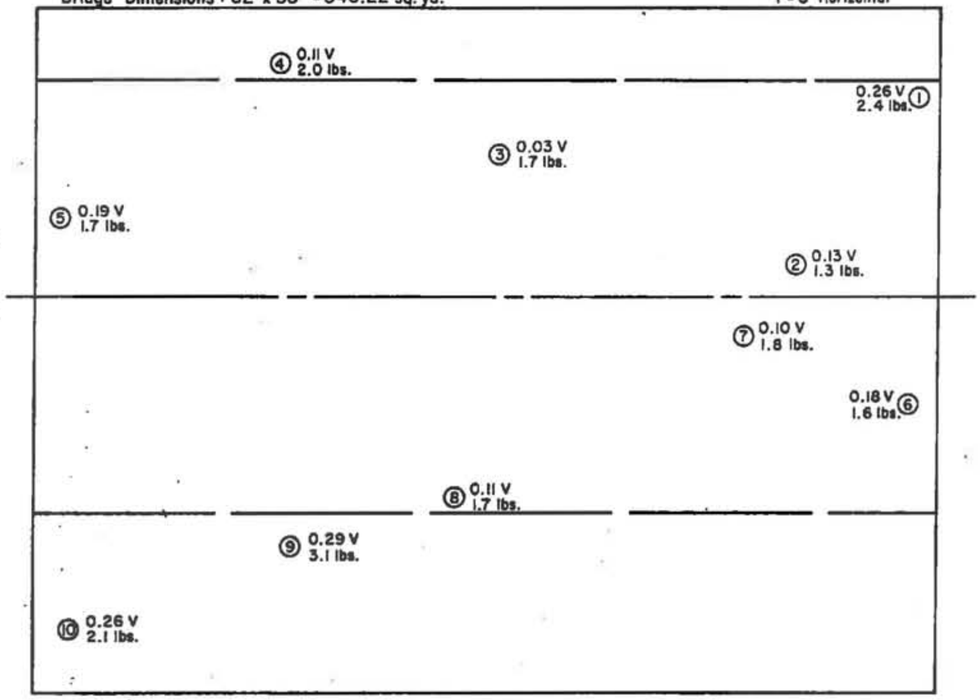
Efflorscence: None

Conc. Deck Removal (Sq. Yd.)
Class I: 100% = 344
Class 2A: 20% = 69
Class 2B: 10% = 34

* Asphalt Overlay Removal (Sq. Yd.)
344

Bridge Dimensions: 82' x 38' = 346.22 sq. yd.

Scale: 1" = 5' Vertical
1" = 8' Horizontal



FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	IR 25-3(77)	39	

AS CONSTRUCTED
NO REVISIONS ☐ REVISED ☐ VOID ☐

Structure No. C-17-AT
Location: North Bound Mainline at M.P. 249.34
Date Completed: 6-3-83
Testers: V. Harper
C. Wood
Overlayed: No

Comments:
Rebar depth: Approx. 1/2" to 3/4"
Samples taken between 1/2" & 1 1/2"
Deck appears woren

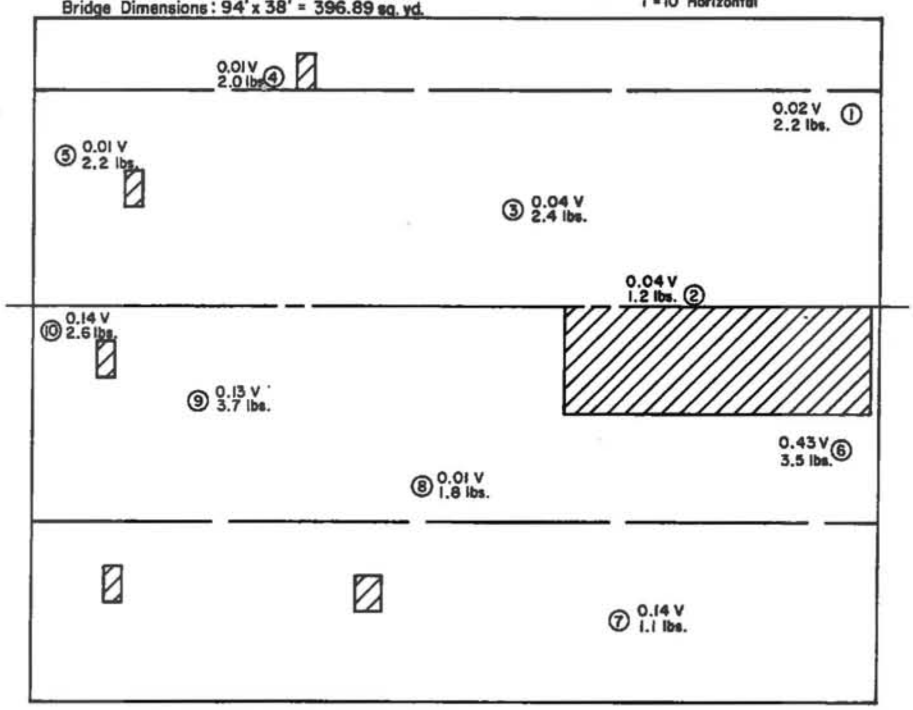
Delaminated Area: 25.11 sq. yd.
Percentage of deck delaminated: 6.32%

Efflorescence: None

Conc. Deck Removal (Sq. Yd.)
Class I: 100% = 395
Class 2A: 40% = 158
Class 2B: 10% = 40

Bridge Dimensions: 94' x 38' = 396.89 sq. yd.

Scale: 1" = 5' Vertical
1" = 10' Horizontal



FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	IR 25-3(77)	44	

AS CONSTRUCTED

NO REVISIONS REVISED VOID

Structure No. C-17-AJ
Location: Exit 250, S.H. 56 Overpass
Date Completed: 6-8-83
Testers: V. Harper
C. Wood
Overlayed: No

Comments:
Rebar depth - Approx. 1 1/2"
Samples taken between 1" & 2"
Many patched and broken-out areas throughout deck. Very poor condition.

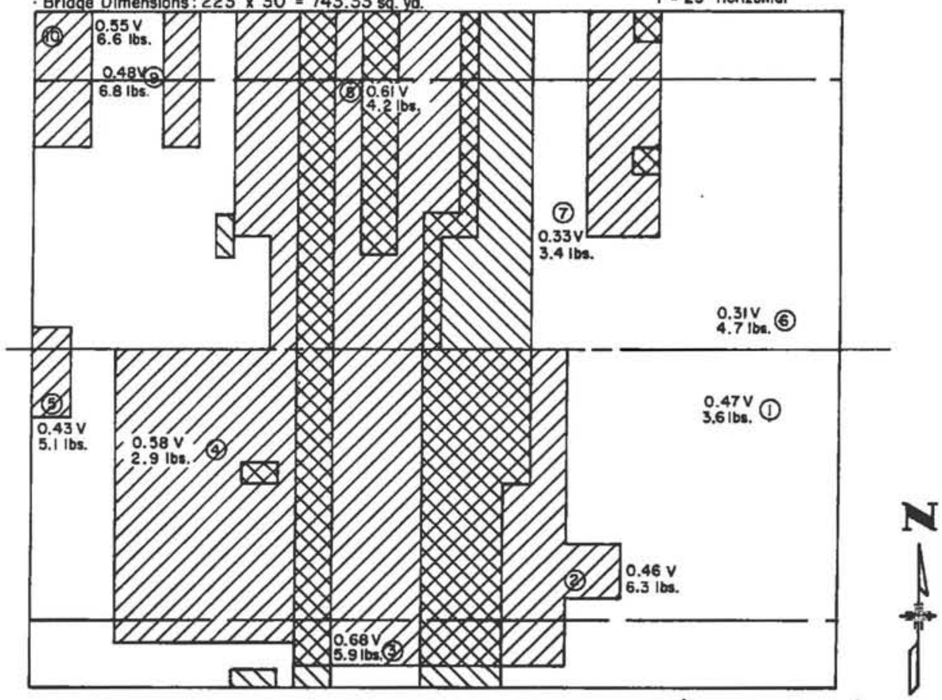
Delamination Area: 322.39 sq. yds.
Percentage of deck delaminated: 43.5 %

Effloresscence: Has approx. 30%

Conc. Deck Removal (Sq. Yd.)
Class 1: 100 % = 743
Class 2A: 90 % = 669
Class 2B: 50 % = 372
Class 3A: 30 % = 223

Bridge Dimensions: 223' x 30' = 743.33 sq. yd.

Scale: 1" = 4' Vertical
1" = 25' Horizontal



Structure No. D-17-DC
Location: Exit 245, Mead Overpass
Date Completed: 6-8-83
Testers: V. Harper
C. Wood
Overlayed: No

Comments:
Rebar depth - Approx. 1 1/4"
Samples taken between 3/4" & 2".
Deck in fairly good condition, besides alligator cracking.

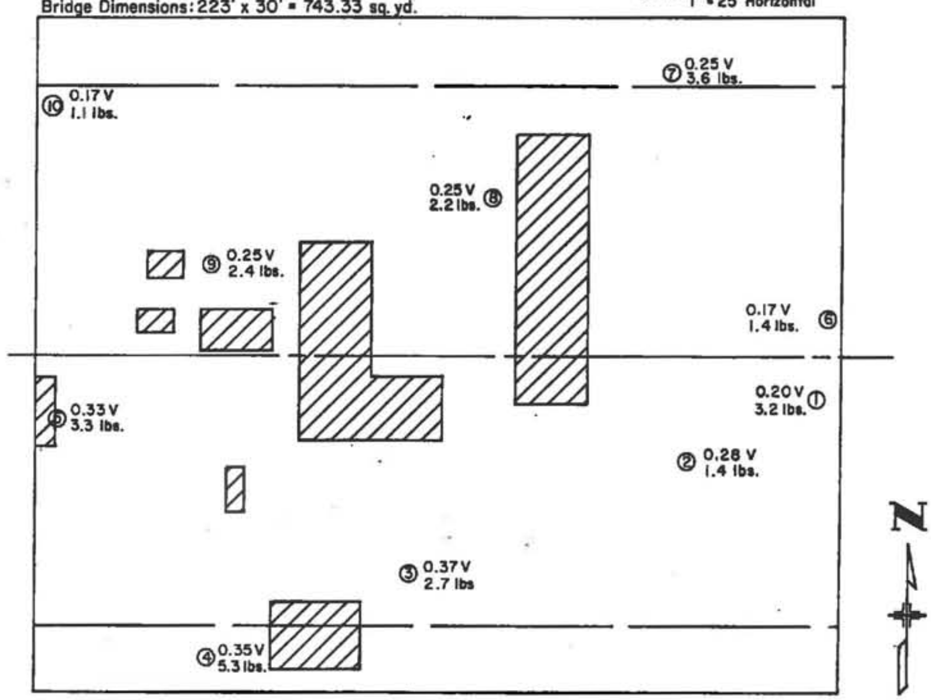
Delaminated Area: Approx. 56.83 sq. yds.
Percentage of deck delaminated: 7.6 %

Efflorescence: Very small amount showing

Conc. Deck Removal (Sq. Yd.)
Class 1: 100 % = 743
Class 2A: 35 % = 260
Class 2B: 10 % = 74

Bridge Dimensions: 223' x 30' = 743.33 sq. yd.

Scale: 1" = 4' Vertical
1" = 25' Horizontal



Structure No. C-17-AI
Location: MP 247, Cty. Rd. 38 Overpass
Date Completed: 6-8-83
Testers: V. Harper
C. Wood
Overlayed: No

Comments:
Rebar depth: Approx. 2 1/2"
Samples taken between 2" & 3"
Minimal visual damage or deteriation
Delaminated testing completed; however, results showed that no delaminations were found.

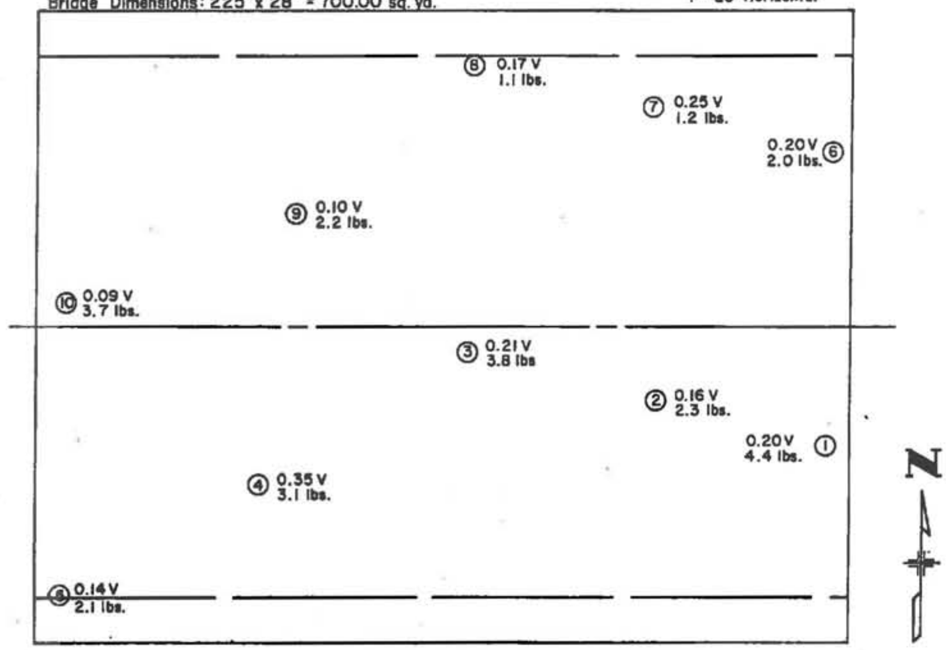
Percentage of deck delamination: 0%

Efflorescence: Very small amount

Conc. Deck Removal (Sq. Yd.)
Class 1: 100% = 700
Class 2A: 40% = 280

Scale: 1" = 4' Vertical
1" = 25' Horizontal

Bridge Dimensions: 225' x 28' = 700.00 sq. yd.



Structure No. D-17-AT
Location: North Bound Mainline
at St. Vrain River
Date Completed: 6-7-83
Testers: V. Harper
C. Wood
Overlayed: Yes

Comments:
Rebar depth: Approx. 2"
Samples taken between 1 1/2" & 2 1/2"
Overlay thickness ± 3"
No delamination tests completed

Percentage of deck delaminated: N/A

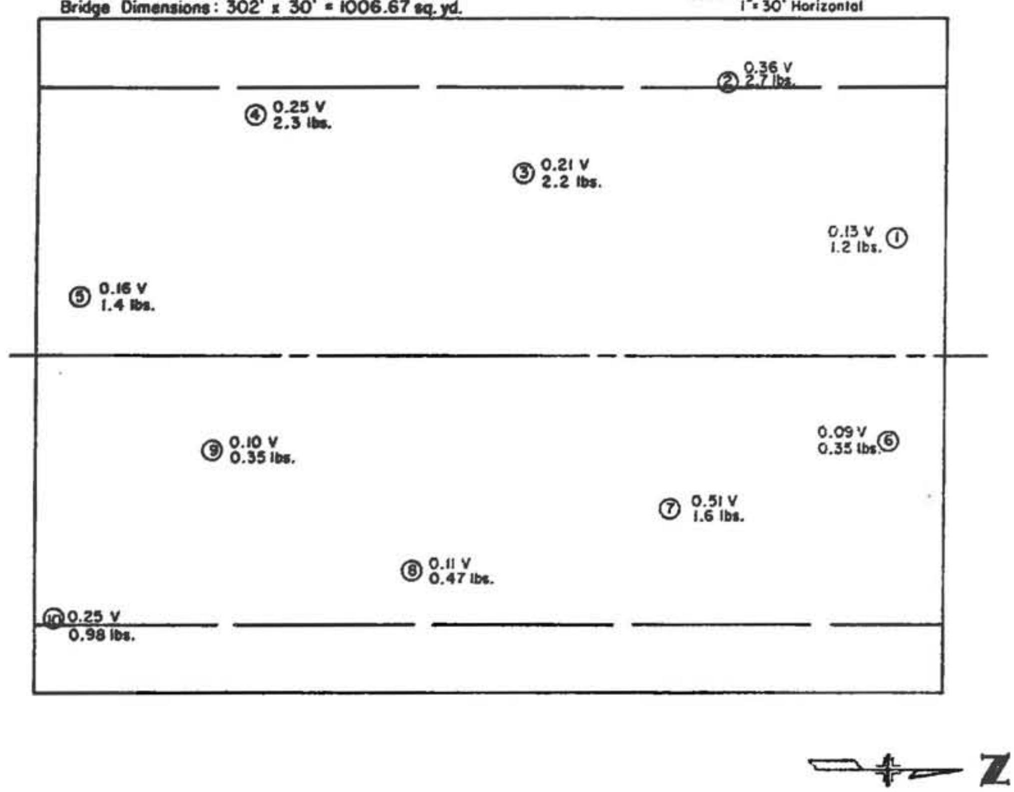
Efflorescence: Has a few random streaks less than 1%.

Conc. Deck Removal (Sq. Yd.)
Class 1: 100% = 1007
Class 2A: 25% = 252
Class 2B: 10% = 101

* Asphalt Overlay Removal (Sq. Yd.)
1007

Scale: 1" = 4' Vertical
1" = 30' Horizontal

Bridge Dimensions: 302' x 30' = 1006.67 sq. yd.



FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	IR 25-3(77)	40	

AS CONSTRUCTED

NO REVISIONS [ ] REVISED [ ] VOID [ ]

Structure No. D-17-CX
Location: North Bound Mainline at M.P. 240.16 & S.H. 119
Date Completed: 6-28-83
Testers: V. Harper
C. Wood
Overlayed: Yes

Comments:
Rebar depth: Approx. 2".
Samples taken between 1 1/2" & 2"
Overlay thickness approx. 2"
No delamination tests taken.

Percentage of deck delaminated: N/A

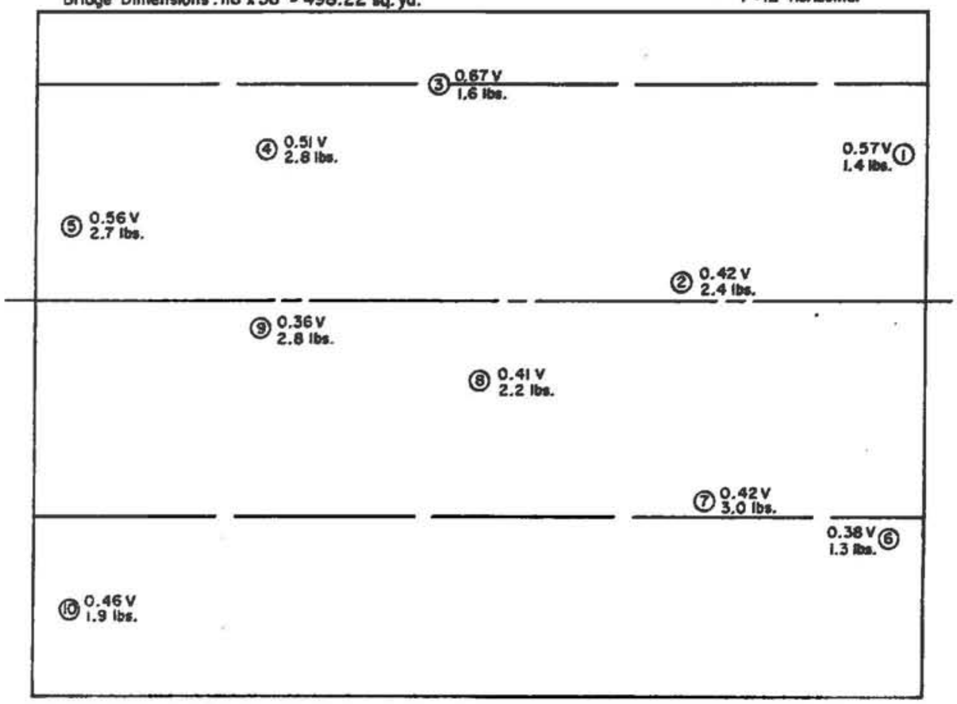
Efflorescence: Has a few random streaks less than 1%

Conc. Deck Removal (Sq. Yd.)
Class 1: 100% = 498
Class 2A: 100% = 498
Class 2B: 20% = 100
Class 3A: 10% = 50

* Asphalt Overlay Removal (Sq. Yd.)
498

Scale: 1" = 5' Vertical
1" = 12' Horizontal

Bridge Dimensions: 118' x 38' = 498.22 sq. yd.



STATE OF COLORADO
Department of Highways
Division of Highways
DOH Form No. 157
Revised: October, 1978

FIELD SHEET NO. 09958

PROJECT IR 25-3(77)

LOCATION S.H. 119 - North

DISTRICT 4 DATE 6-17-83

FIELD REPORT FOR SAMPLE IDENTIFICATION OR MATERIALS DOCUMENTATION

3020 FUNCTION P PART. 83166 PROJECT ID NO

SAMPLE SUBMITTED: Concrete Dust for Chloride Analysis C/881-1136
(Soil, aggregate, steel, water, surfacing, asphalt mix, asphalt cement, etc.)

ITEM ____ CLASS ____ GRADING ____ SPECIAL PROVISIONS APPLICABLE: YES ☐ NO ☐

PREVIOUSLY USED ON PROJECT ____ DOH 157 NO. ____ DOH 158 NO. ____

DESCRIBE TESTS REQUIRED, USE TO BE MADE OF MATERIAL, AND/OR DOCUMENTATION DETAILS:

Submitting 250 samples of concrete dust. Please test to determine pounds of chloride per cubic yard.

Ten samples from each of the following structures:

D-17-AS, D-17-AT, D-17-G, D-17-CZ, D-17-CY, D-17-DC, D-17-DB, D-17-DA, C-17-AI, C-17-AT, C-17-AS, C-17-N, C-17-A, C-17-AJ, C-17-DY, C-17-DH, C-17-CE, C-17-CB, C-17-BB, C-17-BQ, C-17-BR, C-17-EI, C-17-EE, C-17-G, and C-17-BN

PRELIMINARY ☒ CONSTRUCTION ☐ MAINTENANCE ☐ EMERGENCY ☐: Date Needed ____

CONTRACTOR ____ SUPPLIER ____

SAMPLED FROM Bridge Decks (Pit, roadway, windrow, stock, etc.) PIT NAME OR OWNER ____

QUANTITY REPRESENTED ____ PREVIOUS QUANTITY ____ TOTAL QUANTITY TO DATE ____

SAMPLE SUBMITTED: YES ☒ NO ☐ SHIPPED TO: CENT. LAB ☒ DIST. LAB ☐ VIA State Car DATE 6-17-83

SAMPLED BY OR INSPECTED BY V.G. Harper (Name) E.T. III (Title) SUPERVISOR Leo O'Connor (Proj./Res./Matls. Engr./Maint. Supt.)

TITLE District Materials Engineer

ADDRESS P.O. Box 850, Greeley, CO 80632

ORANGE COPY: STAFF CONSTRUCTION BRANCH
PINK COPY: STAFF MATERIALS BRANCH
BLUE COPY: DISTRICT OFFICE
GREEN COPY: DISTRICT MATERIALS ENGINEER
CANARY COPY: RESIDENT ENGINEER

RMA Sample No.	Sample Description	% Chloride	lbs./yd^3
2843-98	D-17-G 8	0.218	8.5
2843-99	D-17-G 9	0.093	3.6
2843-100	D-17-G 10	0.087	3.4
2843-101	D-17-AT 1	0.031	1.2
2843-102	D-17-AT 2	0.068	2.7
2843-103	D-17-AT 3	0.056	2.2
2843-104	D-17-AT 4	0.059	2.3
2843-105	D-17-AT 5	0.037	1.4
2843-106	D-17-AT 6	0.009	0.35
2843-107	D-17-AT 7	0.041	1.6
2843-108	D-17-AT 8	0.012	0.47
2843-109	D-17-AT 9	0.009	0.35
2843-110	D-17-AT 10	0.025	0.98
2843-111	D-17-CZ 1	0.055	2.2
2843-112	D-17-CZ 2	0.030	1.2
2843-113	D-17-CZ 3	0.025	0.98
2843-114	D-17-CZ 4	0.034	1.3
2843-115	D-17-CZ 5	0.019	0.74
2843-116	D-17-CZ 6	0.069	2.7
2843-117	D-17-CZ 7	0.047	1.8
2843-118	D-17-CZ 8	0.056	2.2
2843-119	D-17-CZ 9	0.062	2.4
2843-120	D-17-CZ 10	0.027	1.1
2843-121	D-17-DC 1	0.081	3.2
2843-122	D-17-DC 2	0.036	1.4
2843-123	D-17-DC 3	0.069	2.7
2843-124	D-17-DC 4	0.135	5.3
2843-125	D-17-DC 5	0.084	3.3
2843-126	D-17-DC 6	0.037	1.4
2843-127	D-17-DC 7	0.092	3.6
2843-128	D-17-DC 8	0.056	2.2
2843-129	D-17-DC 9	0.062	2.4
2843-130	D-17-DC 10	0.028	1.1
2843-131	D-17-DA 1	0.037	1.4
2843-132	D-17-DA 2	0.070	2.7
2843-133	D-17-DA 3	0.025	0.98
2843-134	D-17-DA 4	0.025	0.98
2843-135	D-17-DA 5	0.066	2.6
2843-136	D-17-DA 6	0.056	2.2
2843-137	D-17-DA 7	0.100	3.9
2843-138	D-17-DA 8	0.106	4.2
2843-139	D-17-DA 9	0.131	5.1
2843-140	D-17-DA 10	0.109	4.3
2843-141	D-17-CY 1	0.041	1.6
2843-142	D-17-CY 2	0.140	5.5
2843-143	D-17-CY 3	0.034	1.3
2843-144	D-17-CY 4	0.037	1.4
2843-145	D-17-CY 5	0.062	2.4
2843-146	D-17-CY 6	0.031	1.2
2843-147	D-17-CY 7	0.184	7.2
2843-148	D-17-CY 8	0.075	2.9
2843-149	D-17-CY 9	0.035	1.4

RMA Sample No.	Sample Description	% Chloride	lbs./yd^3
2843-150	D-17-CY 10	0.081	3.2
2843-151	D-17-DB 1	0.044	1.7
2843-152	D-17-DB 2	0.012	0.47
2843-153	D-17-DB 3	0.044	1.7
2843-154	D-17-DB 4	0.055	2.2
2843-155	D-17-DB 5	0.050	2.0
2843-156	D-17-DB 6	0.047	1.8
2843-157	D-17-DB 7	0.044	1.7
2843-158	D-17-DB 8	0.050	2.0
2843-159	D-17-DB 9	0.031	1.2
2843-160	D-17-DB 10	0.042	1.6
2843-161	C-17-AI 1	0.111	4.4
2843-162	C-17-AI 2	0.059	2.3
2843-163	C-17-AI 3	0.097	3.8
2843-164	C-17-AI 4	0.080	3.1
2843-165	C-17-AI 5	0.053	2.1
2843-166	C-17-AI 6	0.094	3.7
2843-167	C-17-AI 7	0.056	2.2
2843-168	C-17-AI 8	0.030	1.1
2843-169	C-17-AI 9	0.031	1.2
2843-170	C-17-AI 10	0.051	2.0
2843-171	C-17-AT 1	0.056	2.2
2843-172	C-17-AT 2	0.031	1.2
2843-173	C-17-AT 3	0.061	2.4
2843-174	C-17-AT 4	0.050	2.0
2843-175	C-17-AT 5	0.056	2.2
2843-176	C-17-AT 6	0.090	3.5
2843-177	C-17-AT 7	0.028	1.1
2843-178	C-17-AT 8	0.047	1.8
2843-179	C-17-AT 9	0.094	3.7
2843-180	C-17-AT 10	0.066	2.6
2843-181	C-17-EI 1	0.050	2.0
2843-182	C-17-EI 2	0.056	2.2
2843-183	C-17-EI 3	0.066	2.6
2843-184	C-17-EI 4	0.059	2.3
2843-185	C-17-EI 5	0 031	1.2
2843-186	C-17-EI 6	0.069	2.7
2843-187	C-17-EI 7	0.044	1.7
2843-188	C-17-EI 8	0.111	4.4
2843-189	C-17-EI 9	0.078	3.0
2843-190	C-17-EI 10	0.044	1.7
2843-191	C-17-BQ 1	0.097	3.8
2843-192	C-17-BQ 2	0.086	3.4
2843-193	C-17-BQ 3	0.069	2.7
2843-194	C-17-BQ 4	0.037	1.4
2843-195	C-17-BQ 5	0.056	2.2
2843-196	C-17-BQ 6	0.097	3.8
2843-197	C-17-BQ 7	0.062	2.4
2843-198	C-17-BQ 8	0.050	2.0
2843-199	C-17-BQ 9	0.069	2.7
2843-200	C-17-BQ 10	0.044	1.7
2843-201	C-17-CB 1	0.041	1.6

RMA Sample No.	Sample Description	% Chloride	lbs./yd^3
2843-202	C-17-CB 2	0.056	2.2
2843-203	C-17-CB 3	0.031	1.2
2843-204	C-17-CB 4	0.034	1.3
2843-205	C-17-CB 5	0.062	2.4
2843-206	C-17-CB 6	0.039	1.5
2843-207	C-17-CB 7	0.050	2.0
2843-208	C-17-CB 8	0.062	2.4
2843-209	C-17-CB 9	0.031	1.2
2843-210	C-17-CB 10	0.042	1.6
2843-211	C-17-DH 1	0.031	1.2
2843-212	C-17-DH 2	0.056	2.2
2843-213	C-17-DH 3	0.050	2.0
2843-214	C-17-DH 4	0.030	1.2
2843-215	C-17-DH 5	0.069	2.7
2843-216	C-17-DH 6	0.031	1.2
2843-217	C-17-DH 7	0.025	0.98
2843-218	C-17-DH 8	0.025	0.98
2843-219	C-17-DH 9	0.056	2.2
2843-220	C-17-DH 10	0.047	1.8
2843-221	C-17-DY 1	0.040	1.6
2843-222	C-17-DY 2	0.056	2.2
2843-223	C-17-DY 3	0.053	2.1
2843-224	C-17-DY 4	0.037	1.4
2843-225	C-17-DY 5	0.062	2.4
2843-226	C-17-DY 6	0.059	2.3
2843-227	C-17-DY 7	0.031	1.2
2843-228	C-17-DY 8	0.075	2.9
2843-229	C-17-DY 9	0.056	2.2
2843-230	C-17-DY 10	0.062	2.4
2843-231	C-17-AJ 1	0.091	3.6
2843-232	C-17-AJ 2	0.162	6.3
2843-233	C-17-AJ 3	0.151	5.9
2843-234	C-17-AJ 4	0.075	2.9
2843-235	C-17-AJ 5	0.131	5.1
2843-236	C-17-AJ 6	0.121	4.7
2843-237	C-17-AJ 7	0.087	3.4
2843-238	C-17-AJ 8	0.106	4.2
2843-239	C-17-AJ 9	0.175	6.8
2843-240	C-17-AJ 10	0.168	6.6
2843-241	C-17-N 1	0.062	2.4
2843-242	C-17-N 2	0.069	2.7
2843-243	C-17-N 3	0.044	1.7
2843-244	C-17-N 4	0.037	1.4
2843-245	C-17-N 5	0.050	2.0
2843-246	C-17-N 6	0.056	2.2
2843-247	C-17-N 7	0.031	1.2
2843-248	C-17-N 8	0.050	2.0
2843-249	C-17-N 9	0.044	1.7
2843-250	C-17-N 10	0.037	1.4
2843-251	C-17-BB 1	0.125	4.9
2843-252	C-17-BB 2	0.194	7.6
2843-253	C-17-BB 3	0.100	3.9

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS
DOH Form No. 157
Revised March, 1983

SEP 1984
LABORATORY
CDOH

FIELD SHEET NO. 23519
PROJECT IR-25-3-77
LOCATION SH-119-N. on I-25
DISTRICT 4 DATE 9-24-84

FIELD REPORT FOR SAMPLE IDENTIFICATION OR MATERIALS DOCUMENTATION

C47-84

3200 FUNCTION | P PART. | 83166 PROJECT ID NO.

SAMPLE SUBMITTED: Aggregate - (Bridge Deck Mix)
(Soil, aggregate, steel, water, surfacing, asphalt mix, asphalt cement, etc.)

ITEM 601 CLASS Latex GRADING ______ SPECIAL PROVISIONS APPLICABLE: YES ☒ NO ☐

PREVIOUSLY USED ON PROJECT IR-25-3-77 DOH 157 NO. 09943 DOH 158 NO. ______

DESCRIBE TESTS REQUIRED, USE TO BE MADE OF MATERIAL, AND/OR DOCUMENTATION DETAILS:

Submitting 5 Sacks of Sand, 5 Sacks of #7 Rock for Bridge Deck Re Design Mix Latex Modified using 60% Sand 40% Rock as per Recommendations of Dow Chemical, Design previous ly submitted under 157 # 09943

PRELIMINARY ☐ CONSTRUCTION ☒ MAINTENANCE ☐ EMERGENCY ☐: Date Needed ASAP

CONTRACTOR Eisenhour SUPPLIER Sterling Paving - Ags / Dow Chemical - Latex

SAMPLED FROM Stockpile PIT NAME OR OWNER Sterling Triber
(Pit, roadway, windrow, stock, etc.)

QUANTITY REPRESENTED ______ PREVIOUS QUANTITY ______ TOTAL QUANTITY TO DATE ______

SAMPLE SUBMITTED: YES ☒ NO ☐ SHIPPED TO: CENT. LAB ☒ DIST. LAB ☐ VIA DOH Vehicle DATE 9-24-84

SAMPLED BY OR INSPECTED BY [signature] ET-I SUPERVISOR Don Atkins
(Name) (Title) (Proj./Res./Matls. Engr./Maint. Supt.)

TITLE Res. Engr.
ADDRESS PO Box 576, Loveland

WHITE COPY: STAFF CONSTRUCTION BRANCH
PINK COPY: STAFF MATERIALS BRANCH
BLUE COPY: DISTRICT OFFICE
GREEN COPY: DISTRICT MATERIALS ENGINEER
CANARY COPY: RESIDENT ENGINEER

STATE OF COLORADO
Department of Highways
Division of Highways
DOH Form No. 157
Revised: October, 1978

JUN 1984
LABORATORY
CDOH

FIELD SHEET NO. 09943
PROJECT IR-25-3-(77)
LOCATION SH-119-North
DISTRICT 4 DATE 6-8-84

FIELD REPORT FOR SAMPLE IDENTIFICATION OR MATERIALS DOCUMENTATION

47 84

3200 P 83166
FUNCTION PART. PROJECT ID NO

SAMPLE SUBMITTED: Aggregate For Concrete Design Mixs
(Soil, aggregate, steel, water, surfacing, asphalt mix, asphalt cement, etc.)

ITEM 601 CLASS DT LS ~~Latex~~ Latex Modified GRADING ______ SPECIAL PROVISIONS APPLICABLE: YES ☒ NO ☐

PREVIOUSLY USED ON PROJECT ______ DOH 157 NO. ______ DOH 158 NO. ______

DESCRIBE TESTS REQUIRED, USE TO BE MADE OF MATERIAL, AND/OR DOCUMENTATION DETAILS:

Submitting 10 Sacks of Fine Aggregate & 10 Sacks of Coarse Agg (#7 spec) for Concrete Design Mixs Class DT, Low Slump & Latex Modified - For Mixes Requiring Fly Ash - Supplier will be Don Tabor making Cement Fly ash Blend with South West Lyons Cement Clinker From Utah Class F Fly ash From Nixon
Mixes Requiring only Cement Source will be (South West Lyons Clinker From Utah)
Add mixtures will be Master Builders for AEA & WRA

ANY Questions Contact Pat @ Eisenhour

Red Ball

PRELIMINARY ☐ CONSTRUCTION ☒ MAINTENANCE ☐ EMERGENCY ☐: Date Needed Yesterday

CONTRACTOR Eisenhour Const. SUPPLIER ~~Same~~ Sterling

SAMPLED FROM Stock pile
(Pit, roadway, windrow, stock, etc.)
PIT NAME OR OWNER Sterling Triber

QUANTITY REPRESENTED ______ PREVIOUS QUANTITY ______ TOTAL QUANTITY TO DATE ______

SAMPLE SUBMITTED: YES ☒ NO ☐ SHIPPED TO: CENT. LAB ☐ DIST. LAB ☐ VIA Doh Vehicle DATE 6-8-84

SAMPLED BY OR INSPECTED BY [signature] ET-I SUPERVISOR Dan Atkins
(Name) (Title) (Proj./Res./Matls. Engr./Maint. Supt.)

TITLE Res. Engineer
ADDRESS PO Box 576

ORANGE COPY: STAFF CONSTRUCTION BRANCH
PINK COPY: STAFF MATERIALS BRANCH
BLUE COPY: DISTRICT OFFICE
GREEN COPY: DISTRICT MATERIALS ENGINEER
CANARY COPY: RESIDENT ENGINEER

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119-North
Fine Aggregate Field Sheet No. 09943
Coarse Aggregate Field Sheet No. Same
Date Submitted 6/8/84

PAGE 1

TEST OF CONCRETE AGGREGATES

LOCATION OF AGGREGATE SOURCE AND SUPPLIER:

FINE AGGREGATE Triber/Sterling

COARSE AGGREGATE Same

SCREEN ANALYSIS (Fine Aggregate)

% Passing	As Rec'd.		Specs.
3/8"	100		100
#4	100		95-100
#8	97		
16	74		45-80
30	46		
50	20		5 ~~10~~-30
100	7		0~~2~~-10
Fineness Modulus	2.57		2.50-3.~~25~~50

Sp. Gr. (Bulk, Sat. Surface Dry)	2.65
% -#200	1.3
% Absorption	.9
Colorimetric	Clear
% Soundness (Sodium Sulfate)	
Sand Equivalent	84.6

SCREEN ANALYSIS (Coarse Aggregate)

Primary Size	½" to #4	to	Combined	Specs. #7	Specs.
Passing					
2"					
1½"					
1"					
3/4"	100			100	
1/2"	100			90/100	
3/8"	69			40/70	
#4	3			0/15	
#8				0/5	

Sp. Gr. Bulk, SSD ~~3/4"~~ ½"	2.68
Sp. Gr. Bulk, SSD 1½"	
% Abrasion	
% Absorption ~~3/4"~~ ½"	.7
% Absorption 1½"	
% Soundness (Sodium Sulfate)	

Aggregate Size ______ to ______ ______%
______ to ______ ______%

* Indicates ______________ deviation from specifications.

Meets specification requirements for Item 601.

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2)

lb: 6/27/84

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119 No. on I 25
Fine Aggregate Field Sheet No. 23519 - 09943
Coarse Aggregate Field Sheet No. Same
Date Submitted 9/24/84

TEST OF CONCRETE AGGREGATES

LOCATION OF AGGREGATE SOURCE AND SUPPLIER:

FINE AGGREGATE Sterling Paving Aggregate

COARSE AGGREGATE Same

SCREEN ANALYSIS (Fine Aggregate)

% Passing	As Rec'd.		Specs.
3/8"	100		100
#4	100		95-100
#8	94		
16	70		45-80
30	44		
50	21		10-30
100	9		2-10
Fineness Modulus	2.68		2.50 ~~XXXXX~~ 3.50

Sp. Gr. (Bulk, Sat. Surface Dry)	2.65 (1)
% -#200	2.0
% Absorption	.9 (1)
Colorimetric	Clear
% Soundness (Sodium Sulfate)	
Sand Equivalent	80

SCREEN ANALYSIS (Coarse Aggregate)

Primary Size	Rec'd ½" to #8	As Used ½" to #8	Combined	Specs. #7	Specs.
Passing					
2"					
1½"					
1"					
3/4"	100	100		100	
1/2"	99	99		90/100	
3/8"	67	64		40/70	
#4	14	8		0/15	
#8	9*	5		0/5	
#200	1.0	.5		0/1	
Aggregate Size		to		%	
		to		%	

Sp. Gr. Bulk, SSD ~~XX/XX~~' ½"	2.68 (1)
Sp. Gr. Bulk, SSD 1½"	
% Abrasion	
% Absorption ~~XX/XX~~' ½"	.7 (1)
% Absorption 1½"	
% Soundness (Sodium Sulfate)	

* Indicates significant deviation from specifications. Material adjusted to meet size No. 7 spec's. in order to run the trial mix with no delay to project.

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins (2)

lb: 10/11/84

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119-North
Sand Field Sheet No. 09943
Gravel Field Sheet No. Same

PAGE 2

Class of Concrete		LS		LS	
% Fine Agg. by Absolute Vol.		50		50	
Air Entraining Agent		MBVR		MBVR	
Quantity of Air Entraining Agent		30 oz		33 oz	
Admixture		MBMP(1)		MBMP(2)	
Quantity of Admixture		50 oz		25 oz	
Cement: Source S.W. Leam Type 2					
Cement	Lbs.	700		700	
Fly Ash Nixon	Lbs. Class F	140		140	
Fine Aggregate	Lbs.	1380		1360	
Intermediate Aggregate	Lbs.	1415		1390	
Coarse Aggregate	Lbs.	0		0	
Miscellaneous Aggregate	Lbs.	0		0	
Water	Lbs.	263		281	
Water	Gals.	31.5		33.7	
Slump	Inches	1"		1"	
Water Cement Ratio (% by Weight)		.313		.335	
Cement Factor (CWT per Yard)					
Gals/CWT		3.8		4.0	

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)	152.0		151.0	
C. Theoretical (calculated 5 % air)	144.5		143.4	
W. Determined (actual Wt./cu.ft.)	142.0		143.1	
Air Content Air Meter (Total Air)	6.6		5.7	
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$	6.6		5.2	

7 days

Compressive Strength (P.S.I.)	4890		4670	
	4850		4770	
Average	4870		4720	

28 days

Compressive Strength (P.S.I.)				
Average				

NOTE: Quantities shown for admixtures are for information only.

REMARKS: (1) Master Builders - Master Pave @ 6.0 ozs/100 cwt.
(2) " " " " @ 3.0 ozs/100 cwt.

S. W. Lyons Type 1 which will be used on this project was not yet available.

Stuart C. Tapp

Staff Materials Engineer

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119-North
Sand Field Sheet No. 09943
Gravel Field Sheet No. Same

PAGE 2

Class of Concrete	4.5		4.5	
% Fine Agg. by Absolute Vol.				
Air Entraining Agent				
Quantity of Air Entraining Agent				
Admixture				
Quantity of Admixture				
Cement: Source ____ Type ____				
Cement Lbs.				
Fly Ash Lbs.				
Fine Aggregate Lbs.				
Intermediate Aggregate Lbs.				
Coarse Aggregate Lbs.				
Miscellaneous Aggregate Lbs.				
Water Lbs.				
Water Gals.				
Slump Inches				
Water Cement Ratio (% by Weight)				
Cement Factor (CWT per Yard)				
Gals/CWT				

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)				
C. Theoretical (calculated ___% air)				
W. Determined (actual Wt./cu.ft.)				
Air Content Air Meter (Total Air)				
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$				

7 days

Compressive Strength (P.S.I.)				
Average				

28 days

Compressive Strength (P.S.I.)	6610		7270	
	6600		6380	
Average	6610		6850	

NOTE: Quantities shown for admixtures are for information only.

REMARKS:
cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2)

lb: 7/12/84

Stuart C. Tapp
Staff Materials Engineer

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119-North
Sand Field Sheet No. 09943
Gravel Field Sheet No. Same

PAGE 2

Class of Concrete		DT			
% Fine Agg. by Absolute Vol.		50			
Air Entraining Agent		MBVR			
Quantity of Air Entraining Agent		6.0 oz			
Admixture		MBMP (1)			
Quantity of Admixture		21 oz			
Cement: Source S.W. Utatt Type II					
Cement Low Alkali	Lbs.	700 (2)			
Fly Ash	Lbs.	0			
Fine Aggregate	Lbs.	1440			
Intermediate Aggregate	Lbs.	1455			
Coarse Aggregate	Lbs.	0			
Miscellaneous Aggregate	Lbs.	0			
Water	Lbs.	298			
Water	Gals.	35.7			
Slump	Inches	1.50			
Water Cement Ratio (% by Weight)		.426			
Cement Factor (CWT per Yard)		7.0			
Gals/CWT		5.1			

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)	151.3			
C. Theoretical (calculated 5 % air)	144.3			
W. Determined (actual Wt./cu.ft.)	144.4			
Air Content Air Meter (Total Air)	5.2			
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$	4.6			

7 days

Compressive Strength (P.S.I.)	4340			
	4280			
Average	4310			

28 days

Compressive Strength (P.S.I.)				
Average				

NOTE: Quantities shown for admixtures are for information only.

REMARKS: (1) Master Builders - Master Pave
(2) Type II cement from Southwesterns Leamington Utah plant was used since the low alkali Type I from Southwesterns Lyons plant was not yet available.

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2) lb: 6/27/84

Staff Materials Engineer

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119-North
Sand Field Sheet No. 09943
Gravel Field Sheet No. Same

PAGE 2

Class of Concrete	DT			
% Fine Agg. by Absolute Vol.				
Air Entraining Agent				
Quantity of Air Entraining Agent				
Admixture				
Quantity of Admixture				
Cement: Source ______ Type ____				
Cement Lbs.				
Fly Ash Lbs.				
Fine Aggregate Lbs.				
Intermediate Aggregate Lbs.				
Coarse Aggregate Lbs.				
Miscellaneous Aggregate Lbs.				
Water Lbs.				
Water Gals.				
Slump Inches				
Water Cement Ratio (% by Weight)				
Cement Factor (CWT per Yard)				
Gals/CWT				

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)				
C. Theoretical (calculated ___ % air)				
W. Determined (actual Wt./cu.ft.)				
Air Content Air Meter (Total Air)				
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$				

7 days

Compressive Strength (P.S.I.)				
Average				

28 days

Compressive Strength (P.S.I.)	6360			
	6410			
Average	6390			

NOTE: Quantities shown for admixtures are for information only.

REMARKS:

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2)

lb: 7/20/84

Stuart C. Tapp
Staff Materials Engineer

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119 North
Sand Field Sheet No. 09943
Gravel Field Sheet No. Same

PAGE 2

Class of Concrete	Latex Modified			
% Fine Agg. by Absolute Vol.	50			
Air Entraining Agent				
Quantity of Air Entraining Agent				
Admixture — Latex	DPSA			
Quantity of Admixture	206			
Cement: Source Monolith Type 1				
Cement Lbs.	658			
Fly Ash Lbs.	0			
Fine Aggregate Lbs.	1410			
Intermediate Aggregate Lbs.	1440			
Coarse Aggregate Lbs.	0			
Miscellaneous Aggregate Lbs.	0			
Water Lbs.	121			
Water Gals.	14.5			
Slump Inches	4.0"			
Water Cement Ratio (% by Weight)	.347			
Cement Factor (CWT per Yard)				
Gals/CWT				

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)	148.9			
C. Theoretical (calculated 5 % air)	142.0			
W. Determined (actual Wt./cu.ft.)	142.4			
Air Content Air Meter (Total Air)	4.5			
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$	4.0			

	7 days			4-days
Compressive Strength (P.S.I.)	3420			2550
	3560			2470
Average	3490			2510

	28 days			
Compressive Strength (P.S.I.)				
Average				

NOTE: Quantities shown for admixtures are for information only.

REMARKS: It is unlikely that this trial mix will achieve 5625 psi in 28-days.

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2)

lb: 8/8/84

Stuart C. Tapp
Staff Materials Engineer

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119 North I 25
Sand Field Sheet No. 09943
Gravel Field Sheet No. Same

PAGE 2

Class of Concrete		Latex/Modified			
% Fine Agg. by Absolute Vol.		50			
Air Entraining Agent					
Quantity of Air Entraining Agent					
Admixture					
Quantity of Admixture					
Cement: Source Monolith Type I					
Cement	Lbs.				
Fly Ash	Lbs.				
Fine Aggregate	Lbs.				
Intermediate Aggregate	Lbs.				
Coarse Aggregate	Lbs.				
Miscellaneous Aggregate	Lbs.				
Water	Lbs.				
Water	Gals.				
Slump	Inches				
Water Cement Ratio (% by Weight)					
Cement Factor (CWT per Yard)					
Gals/CWT					

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)				
C. Theoretical (calculated ___% air)				
W. Determined (actual Wt./cu.ft.)				
Air Content Air Meter (Total Air)				
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$				

7 days

Compressive Strength (P.S.I.)	3420			
	3560			
Average	3490			

28 days

Compressive Strength (P.S.I.)	4620			
	4660			
Average	4640			

NOTE: Quantities shown for admixtures are for information only.

REMARKS:

cc: Fritts
Chorvacs-O'Connor
Peterson
Atkins(2)
lb: 8/28/84

[signature]
Staff Materials Engineer

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119-North
Sand Field Sheet No. 09943
Gravel Field Sheet No. Same

PAGE 2

Class of Concrete		Latex Modified			
% Fine Agg. by Absolute Vol.		50			
Air Entraining Agent					
Quantity of Air Entraining Agent					
Admixture		Latex DPSA			
Quantity of Admixture		206 Pounds			
Cement: Source South West Type 1					
Cement Lyons, Utah	Lbs.	658			
Fly Ash Clinker	Lbs.	0			
Fine Aggregate	Lbs.	1410			
Intermediate Aggregate	Lbs.	1440			
Coarse Aggregate	Lbs.	0			
Miscellaneous Aggregate	Lbs.	0			
Water	Lbs.	115			
Water	Gals.	14			
Slump	Inches	3.5			
Water Cement Ratio (% by Weight)		.337			
Cement Factor (CWT per Yard)					
Gals/CWT					

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)	149.3			
C. Theoretical (calculated 5 % air)	141.8			
W. Determined (actual Wt./cu.ft.)	140.5			
Air Content Air Meter (Total Air)	5.8			
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$	5.9			

7 days

				5-day
Compressive Strength (P.S.I.)	3460			~~3180~~
	3440			~~3120~~
Average	3450			3150

28 days

Compressive Strength (P.S.I.)				
Average				

NOTE: Quantities shown for admixtures are for information only.

REMARKS: It is unlikely that strengths will achieve 5625 psi in 28-days.

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2)

lb: 7/27/84

Staff Materials Engineer

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119-North
Sand Field Sheet No. 09943
Gravel Field Sheet No. Same

Class of Concrete	LMC			
% Fine Agg. by Absolute Vol.				
Air Entraining Agent				
Quantity of Air Entraining Agent				
Admixture				
Quantity of Admixture				
Cement: Source ______ Type ___				
Cement Lbs.				
Fly Ash Lbs.				
Fine Aggregate Lbs.				
Intermediate Aggregate Lbs.				
Coarse Aggregate Lbs.				
Miscellaneous Aggregate Lbs.				
Water Lbs.				
Water Gals.				
Slump Inches				
Water Cement Ratio (% by Weight)				
Cement Factor (CWT per Yard)				
Gals/CWT				

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)				
C. Theoretical (calculated ___ % air)				
W. Determined (actual Wt./cu.ft.)				
Air Content Air Meter (Total Air)				
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$				

7 days

Compressive Strength (P.S.I.)				
Average				

28 days

Compressive Strength (P.S.I.)	4740			
	4740			
Average	4740			

NOTE: Quantities shown for admixtures are for information only.

REMARKS:

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2)

lb: 8/8/84

Staff Materials Engineer

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 330
Revised: August, 1982

Project IR 25-3(77)
Location SH 119 No. on I 25
Sand Field Sheet No. 23519 - 09943
Gravel Field Sheet No. Same

PAGE 2

Class of Concrete		LMC	LMC	LMC	
% Fine Agg. by Absolute Vol.		60	50	60	
Air Entraining Agent					
Quantity of Air Entraining Agent					
Admixture Latex DPSA		24.5	24.5	24.5 gal/yd^3 (1)	
Quantity of Admixture					
Cement: Source South West Type 1/11					
Cement Low Alkali - Utah Clinker	Lbs.	700	700	660	
Fly Ash	Lbs.	0	0	0	
Fine Aggregate	Lbs.	1645	1371	1688	
Intermediate Aggregate	Lbs. -½"	1109	1387	1138	
Coarse Aggregate	Lbs.	0	0	0	
Miscellaneous Aggregate	Lbs.	0	0	0	
Water	Lbs.	77	102	117	
Water	Gals.	9.2	12.0	14.0	
Slump	Inches	3.0"	6.0	6.50 Average	
Water Cement Ratio (% by Weight)		.263	.298	.339	
Cement Factor (CWT per Yard)					
Gals/CWT					

WEIGHT PER CU. FT. OF CONCRETE:

T. Theoretical (calculated-air free)	151.5	150.2	149.1	
C. Theoretical (calculated 5 % air)	138.4	139.5	141.1	
W. Determined (actual Wt./cu.ft.)	138.6	139.0	138.6	
Air Content Air Meter (Total Air)	7.4	7.7	7.3	
Air Content - Gravimetric Method $\% A = \frac{T - W}{T} \times 100$	8.9	7.5	7.1	

7 days

Compressive Strength (P.S.I.)	3920	3860	3440	
	3920	3940	3500	
Average	3920	3910	3470	

28 days

Compressive Strength (P.S.I.)	5230			
Average	5290	5180	4890	

NOTE: Quantities shown for admixtures are for information only.

REMARKS: Trial mixes made using suppliers/manufactures submitted guidelines.
(1) Equal to 206 lbs. per yard^3.

Stuart C. Tapp

Staff Materials Engineer

DOW CHEMICAL U.S.A.

SEP 1984
LABORATORY
CDOH

LARKIN LABORATORY
1691 N. SWEDE RD.
MIDLAND, MICHIGAN 48640

September 7, 1984

Mr. Dick Hines
Colorado Department of Highways
4201 East Arkansas Avenue
Denver, CO 80222

Mr. Ken Schaeffer/Fred Holland
Eisenhower Construction Co.
P.O. Box 440135
Aurora, CO 80044

C 4-7-84
From Dow

Gentlemen:

Bev Fletcher, of our Seattle Sales Office, has asked me to comment on the compressive data on latex modified concrete samples that have been determined for Project IR 25-3(77). The following has been reported for the three mixes that were evaluated by the Highway Department lab:

copies to Leo O'Connor
Don Atkins

Concrete	Latex	Latex	Conventional Air Entrained
Cement	Monolith Type I	Southwest Type I	Southwest Type II
Coarse/fine ratio	50/50	50/50	50/50
Cement content	658 lb.	658 lb.	700 lb.
Water/cement	0.347	0.337	0.426
Slump	4.0 in.	3.5 in.	1.5 in.
Air	4.5%	5.7%	5.2%
Density	142.4 pcf	140.5 pcf	144.4 pcf
Compressive			
4 day	2510 psi	(5 day)3150 psi	---
7	3490	3450	4310
28	4640	4740	6390

The above compressive strengths for the latex modified mixes are not unusual compared to other mix designs that we have seen around the country. It has been our position that since the primary purpose of the overlay is to provide impermeability, bond, and freeze/thaw durability, the compressive strength is not the major criterion for evaluation. In fact, many state specifications require only 3500 psi for 28 day compressive strength for their overlays.

C47-84

The slump and water/cement ratio values reported for the latex mixes look very good. If, however, the 50/50 mix is too coarse for adequate finishing, two courses are available: 1) increase the cement one quarter to one half sack per cubic yard, or 2) change aggregate ratio to a higher sand fraction, ie 60/40, and maintain the same cement factor.

Sincerely,

Thomas R. Clapp
Polymer Concrete and Highway Products
Specialty Chemicals Department
Phone: (517) 636-8082

ser

DOW CHEMICAL U.S.A.

P.O. BOX 3547 (98009)
600-108th N.E.
BELLEVUE, WASHINGTON 98004
206 · 455-7250

May 9, 1984

Mr. H. Henrie Henson
Department of Highways
Staff Bridge Branch
4201 East Arkansas Avenue, Room 330
Denver, Colorado 80222

Dear Henrie:

SUBJECT: Latex Modified Concrete--I-25 Bridge Rehabilitation

We are extremely pleased that the State of Colorado has set aside two structures for latex overlay in conjunction with the I-25 rehabilitation project.

In late March we visited with Frank Abel and Dick Hines from the Materials Lab and received a copy of your existing latex overlay specification for review and updating.

Since there were numerous comments regarding those specifications, we returned the specifications to Dick Hines, as well as had a conversation with Ken Geiser early in April to clarify those comments.

During our conversation the following areas were commented on:

1. Mix design

    a. Cement content--to be lowered to 658 pounds per cubic yard.

    b. Latex content--to be lowered to 24.5 gallons per cubic yard.

    c. Express the water added to the mix in terms of a "water to cement ratio" of 0.40 maximum.

    d. The total air content should be lowered to 6.5% maximum.

2. Deco - Rez 4776--is no longer a product.

3. Subsection 601.12 (B)--The addition of an evaporation rate limitation of 0.20 pounds per square foot per hour.

4. Subsection 601.12 (C)--Lowering the lowest curing temperature to freezing versus the 50° F level, necessitating insulating blankets.

5. Subsection 601.15--The deck shall be <u>wet</u> when the grout is brushed into the surface.

   Also, the industry has found that using the latex modified concrete as the base coat can be less expensive and/or time consuming than using a separate grout.

6. The approved finishing machine should be a machine with double or single rollers, augars and 3,000-6,000 vpm vibratory pans, capable of forward and reverse movements.

   Screeded finishing machines have been relatively unsuccessful when used with latex overlays, and unfortunately has been left over in state specifications that had previously used low slump concrete.

   Therefore, all the references to screeds and screeded machines for the latex overlay specification should be deleted.

I understand that the other structures in the project may be overlayed with other systems using the vibratory screed finishing machines. However, if we are looking for an honest comparative evaluation of the different deck rehabilitative systems, then using the proper equipment is a necessity.

7. Subsection 601.16--The industry curing procedure is 24 hours moist cure and 72 hours air dry cure. The moist cure period should consist of a single layer of moist (but not dripping) burlap and a single layer of 3 mil white polyethylene film.

   Latex modified concrete gains strength during the dry cure period. Therefore, after 72 hours or when a four inch cylinder that has been curred under the exact same conditions as the latex overlay reaches 3,000 psi, the overlay is ready to be opened to traffic.

The "corrected" specifications which we reviewed on April 26 referenced the above items #2, #5 and #7.

Although some portions of the existing specifications may be particular to Colorado's weather conditions, we certainly feel that the reviewed areas mentioned throughout the specification (especially #6) will provide you with the best specifications for providing a basis for a fair and honest evaluation of latex modified concrete for bridge deck overlays.

Should you have any questions, please call me.

47-84

Sincerely,

Bev Fletcher/asd

Beverly J. Fletcher
Industrial Specialties

AAD

Enclosures

cc: John Eisenhour, Eisenhour Construction, Aurora, Colorado
Dennis Donelley, Denver, Colorado
Ken Giesert, Denver, Colorado

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 199
Revised: August, 1982

Project IR 25-3(77) Dist. 4
Location
Field Sheet No. 09943
Date 8/20/84

FLY ASH TEST REPORT

Supplier Rocky Mtn. Fly Ash Plant Nixon Class F

PHYSICAL PROPERTIES

Lab No.	I				
Pozzolanic Activity Index					SPECS
With portland cement, at 28 days, % of control	100.3				Min. 75
H_2O requirement, % of control	97.5				Max. 105
Soundness					
Autoclave expansion or contraction, %	-0.02				Max. 0.8
Fineness					
Amount retained on No. 325 sieve, %	18.26				34.0 max.
Uniformity Requirements					
Specific Gravity, variation from average, %					
No. 325 Sieve, variation from average, %					

* *

CHEMICAL ANALYSIS

Lab No.	C/983				
Silicone dioxide (SiO_2) plus aluminum dioxide (Al_2O_3) plus iron oxide (Fe_2O_3), %	80.00				SPECS 70.0 max.
Sulfur trioxide (SO_3)	1.09				5.0 max.
Moisture content, %	0.21				3.0 max.
Loss on ignition, %	0.89				12.0 max.
TABLE 1A: Magnesium oxide (MgO)	---				5.0 max.
TABLE 1A: Available alkalies, as Na_2O, %	Not Run				

REMARKS:

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2)

lb: 9/25/84

Stuart C. Tapp
STAFF MATERIALS ENGINEER

STATE OF COLORADO
DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS
DOH Form No. 199
Revised: August, 1982

Project IR 25-3(77)
Location SH 119-North
Field Sheet No. 18857
Date

FLY ASH TEST REPORT

Supplier Eisenhour Plant Cherokee Class F

PHYSICAL PROPERTIES

Lab No.	L				
Pozzolanic Activity Index					SPECS
With portland cement, at 28 days, % of control	73.2*				Min. 75
H_2O requirement, % of control	99.2				Max. 105
Soundness					
Autoclave expansion or contraction, %	-0.04				Max. 0.8
Fineness					
Amount retained on No. 325 sieve, %	22.16				
Uniformity Requirements					
Specific Gravity, variation from average, %					
No. 325 Sieve, variation from average, %					

* *

CHEMICAL ANALYSIS

Lab No.	C/1140				
Silicone dioxide (SiO_2) plus aluminum dioxide (Al_2O_3) plus iron oxide (Fe_2O_3), %	86.48			Min. %	SPECS 70.0
Sulfur trioxide (SO_3)	0.43			Max. %	5.0
Moisture content, %	0.12			Max. %	3.0
Loss on ignition, %	0.85			Max. %	12.0
TABLE 1A Magnesium oxide (MgO)	1.24			Max. %	5.0
TABLE 1A Available alkalies, as Na_2O, %	1.39			Max. %	1.50

REMARKS: CaO % 6.97

cc: Fritts
Chotvacs-O'Connor
Peterson
Atkins(2)

lb: 9/13/84

STAFF MATERIALS ENGINEER

APPENDIX D

Post Construction Half-Cell Test Results

Table A

Mo/MoO_3 Half-cell Calibrations
And Initial Readings

		#1		#2		#3		#4		#5		#6		#7		#8	
	Date	Cu	Mo	Cu	Mo	Cu	Mo	Cu	Mo	Cu	Mo	Cu	Mo	Cu	Mo	Cu	Mo
Lab Voltage in CaOH	5/6/85		.122		.222		.145		.109								
Installation	5/8/85	+.32V	-.15	+.25	-.23	+.27	-.76	+.27	-.18	+.20	-.33	+.30	+.02	+.40	+.002		
	5/9/85	+.29	-.25	+.24	-.24	+.22	-.21	+.26	-.21	+.22	-.04	+.34	-.10	+.40	-.06	+.38	-.11
DT. In Place Before Memb.	5/23/85	+.26	-.26	+.26	-.24	+.17	-.27	+.21	-.26	+.22	-.20	+.20	-.18				
	8/1/85		-.29		-.21		-.11		-.21		-.19		-.14	+.25	-.26	+.29	-.25

TABLE B

POST CONSTRUCTION HALF CELL RESULTS
ON THE SIX LONG-TERM EVALUATION STRUCTURES

Structurs #	% over .30V	% Over .35V
C-17-CE	24	7
C-17-AT	12	0
C-17-BQ	15	8
C-17-DY	22	2
D-17-CX	0	0
D-17-AT	2	0