EXPERIMENTAL FIELD APPLICATION OF "POZICON" FLY ASH IN THE MEDIAN BARRIER OF I 75 NEAR THE CITY OF FLINT
(Construction Project IS 25032-05292A)

MICHIGAN
RESEARCH LABORATORY SECTION

MICHIGAN DEPARTMENT OF
STATE HIGHWAYS AND TRANSPORTATION

EXPERIMENTAL FIELD APPLICATION OF "POZICON" FLY ASH IN THE MEDIAN BARRIER OF I 75 NEAR THE CITY OF FLINT
(Construction Project IS 25032-05292A)

H. L. Patterson

Research Laboratory Section
Testing and Research Division
Research Project 71 NM-284
Research Report No. R-974

Michigan State Highway Commission
Peter B. Fletcher, Chairman; Carl V. Pellonpaa, Vice-Chairman; Hannes Meyers, Jr., Weston B. Vivian
John P. Woodford, Director
Lansing, April 1976

The information contained in this report was compiled exclusively for the use of the Michigan Department of State Highways and Transportation. Recommendations contained herein are based upon the research data obtained and the expertise of the researchers, and are not necessarily to be construed as Department policy. No material contained herein is to be reproduced—wholly or in part—without the expressed permission of the Engineer of Testing and Research.

INTRODUCTION

On February 2, 1971, the Department's New Materials Committee approved for further consideration a processed fly ash material called "Pozicon," submitted by the Michigan Ash Sales Co., Essexville, Michigan. This firm obtains the fly ash from a coal-burning power plant and processes it to remove the larger ash particles and the residual carbon particles. Upon completion of this process, the resulting product "Pozicon" meets tne Bureau of Reclamation's Fly Ash Specification, as well as ASTM C 618 (Type F), and U. S. Corps of Engineers CRD 262 F.

This product is being considered to determine whether its pozzolanic action will effect a significant improvement in the quality of pavement and bridge concrete, while reducing the quantity of portland cement in the mix. Pozzolanic action describes the chemical reaction that occurs between hydrated lime and finely divided non-crystalline, siliceous particles. The product of this reaction is a natural cement which was commonly used in the construction of roads and structures prior to the development of blended calcined cements. Processed fly ash is composed of spherically shaped, minute glassy mineral particles; when used in modern concrete it combines chemically with the free lime that is generated as the cement hydrates. This reaction occurs at normal atmospheric temperatures to form additional cementing materials and thus enhances the strength of the concrete. Pozicon has a loose weight of 75 lb/cu ft, as compared to 94 lb for portland cement.

Laboratory work to develop the maximum potential of this material has progressed since the material's introduction and the completed portion is described in two reports entitled, "Evaluation of 'Pozicon' Fly Ash Concrete Admixture - Interim Report" (Research Report R-799), and "'Pozicon' Fly Ash Pavement Concrete Development Work" (Research Report R-973). The latter report deals in part with the design of three experimental slip-form pavement concretes, their evaluation, and the observation that one of them was superior to its control mix.

As a result of this work, an experimental work plan was approved to introduce the material into an existing contract. At the August 14, 1973 meeting of the MDSHT and the Michigan Concrete Paving Association, Laboratory personnel described the type of slip-form field application desired, and representatives from the Michigan Ash Sales described the necessary added equipment for the batch plants. It was discovered that no suitable pavement jobs were to be found for the 1973 construction season; however, there were some slip-form median barrier projects. A revised work plan,

STATE OF MICHIGAN
DEPARTMENT OF STATE HIGHWAYS
TESTING AND RESEARCH DIVISION
TESTING LABORATORY SECTION
UNIVERSITY OF MICHIGAN
ANN ARBOR

Form 1830
(Rev. 5-70)

CONCRETE PROPORTIONING DATA

Control Section Indentification	FI 25032 FI 75-2 (156) etc.
Job No.	05292A
Laboratory No.	73MD-1214
Date	September 13, 1973
Mix Design No.	73-829

Intended Use of Concrete: MEDIAN BARRIER (Slip-Form Method)

Grade of Concrete: A   Specification: 1970 Std Specs

CONCRETE MATERIALS

Material	Source	Pit Number	Class	Laboratory Number	Specific Gravity	Absorption Percent
Cement	See Remarks		IA		3.08	
Fine Agg.	Fenton Gravel Company	47-35	2NS	73A-2359	2.63	1.11
Coarse Agg.	Inland Lime & Stone Co.	75-5	6AA	73A-2108	2.66	0.77

Cement Content, Sacks per Cyd. 6.0 b/b_o 0.70

Air Content (Design), percent 6.5   Specification Tolerance, ± 1.5 %

CONCRETE PROPORTIONS

Weight of Coarse Aggregate (Dry, Loose) lb. per cu. ft.	Quantities, lb. per Sack of Cement		
	Fine Agg. (Oven Dry)	Coarse Agg. (Oven Dry)	Total Water
86	240.6	270.9	43.3
87	237.9	274.0	43.2
88	235.1	277.2	43.0
89	232.4	280.3	42.9
90	229.7	283.5	42.7
91	227.0	286.6	42.6
92	224.3	289.8	42.4
93	221.6	292.9	42.2
94	218.9	296.1	42.1
95	216.1	299.2	41.9

MATERIAL PROPERTIES

Fine Aggregate:

Fineness Modulus 2.72

Soundness Loss, percent 5.50

Laboratory No. 73A-2359

Coarse Aggregate:

Soundness Loss, percent 1.30

Laboratory No. 73A-2108

Abrasion, percent of wear 31.1

Laboratory No. 73A-2108

REMARKS:

This chart for use with air-entraining cements from the following sources:

Aetna
Dundee
General-Paulding, Ohio
Jefferson Mariné Terminal
Peerless
Wyandotte

cc:
File (2)
R.W. LaVanway (2)
C.G. Petrie (2)
L.G. Dunn (2)
Concrete Mix Design(2)

Note: This mix designed for use with water-reducing admixture.

SG

Signed Max N. Clyde
Engineer of Testing and Research

Figure 1. Mix design chart for control concrete.

using the material for a slip-form median barrier was approved by the Department's Pavement Selection Committee and the contractor, Champagne-Webber Construction Co., and the Certified Transit Mix Co., agreed to undertake the work, assuming that no delays or inconvenience were encountered with the job. The project was approved by the FHWA and implementation began immediately.

PRELIMINARY WORK

Mix Design Adaptation for Pozicon

Exploratory work in the laboratory with a natural coarse aggregate concrete, which met the 2-in. maximum slump requirement of slip-formed median barriers, revealed great difficulty in obtaining the required air entrainment. The very low slump concrete was too dry to "roll" very long in the mixer and would break into an air-reducing "tumble" soon after mixing began. Preliminary work with crushed limestone, the designated coarse aggregate for this project, revealed much less difficulty in developing the required air entrainment. It was found that a concentrated Vinsol Resin air entraining agent was ideally suited for use with the fly ash in low slump concretes.

In the proportioning of the Pozicon mixes from the project mix design charts, the development technique employed with Pozicon Mix BB (Research Report R-973) was carried one step further; the coarse aggregate and mortar volumes were maintained as a constant between Pozicon and control mixes. Within the mortar, the volume of Pozicon added equaled the volume of cement and water removed, plus whatever volume of sand was required to make up the difference. This resulted in a Pozicon mix having a slightly higher ratio of fine aggregate to total aggregate (FA/TA) than would have been obtained with the Mix BB proportioning technique where the Pozicon replaced cement and sand only. This revised technique kept the Pozicon mix directly related to its control and was thought to slightly improve its consolidation characteristics. The mix design chart for the control mix is shown in Figure 1 and the mix design measurements per cu yd for both the control and Pozicon concretes are shown in Table 1.

Fly Ash Auxiliary Equipment at Batch Plant

The concrete mix plant at the site did not have an extra circuit for metering an additional material so Michigan Ash Sales Co. engineers de-

TABLE 1

CONTROL AND EXPERIMENTAL CONCRETE MIXES

Project IS 25032 05292A

Mix	Max. Slump, in.	Entr. Air, percent	Mix Vol., cu ft	Mix Components, lb/cu yd								Net Water-Cement Ratio		Total Water, lb/cu yd	Admixtures, fl oz/cu yd	
				Cement	Pozicon	Fine Agg. 2NS Sand		FA/TA percent by Vol.	Coarse Agg. 6AA crushed limestone		Net Mix Water	W/C	W/C + Fly Ash		A-E Daravair	Water Red. and Ret. WRDA-17
						Oven Dry Wt.	Absorbed Water		Oven Dry Wt.	Absorbed Water						
Control	1.5	6.5	27	564	--	1,394	15	45.6	1,682	13	229	0.41	--	257	6.0	18.0
Pozicon	1.5	6.5	27	517	78	1,374	15	45.2	1,682	13	220	0.43	0.37	249	13.7	16.5

signed and built an auxiliary hopper. This enclosed vented hopper sat on a portable platform scale which could be tared, and measured the weight of Pozicon being pneumatically pumped inside. Input and discharge lines were connected to the hopper by flexible rubber tubes so as to not transfer any load to the hopper; the discharge line ran down between the plant's sand and stone hoppers and opened directly above the conveyor belt. With this arrangement, the hopper could be filled with the desired weight of fly ash and manually discharged onto the belt without excessive dusting. The ash would fall onto the sand from the first hopper and be immediately covered with limestone from the second hopper. Views of the plant and a view of the Pozicon hopper in place at the plant are shown in Figure 2.

Mix Design Field Adjustments

Discussion at the job site with Department personnel, indicated that the concrete used in constructing the median barrier in the adjacent contract, also by Champagne-Webber, had a harsh consistency and had yielded a deficient volume. To rectify the situation, 12 lb more sand per sack of cement than was shown on the design chart was used and a similar amount of sand was added per cu yd in the Pozicon concrete to maintain compatability. Hence, it was determined that 12 lb per sack additional sand in the control mix equated to 13 lb per sack in the Pozicon concrete.

A review of the project inspector's reports suggested that the harsh consistency and volume deficiency in the concrete could have been the result of two contributing factors; first, the water requirements were consistently less than the calculated value, which suggested that the calculated moisture content of the sand was probably not representative of the true average value; second, entrained air measurements taken at the batch plant would not be representative of the concrete discharged from the truck, because low slump concrete transported in transit mix trucks will lose air in transit due to its inevitable stiffening and continuous agitation.

Securing a representative value of the moisture content in a pile of sand, which has been exposed to the weather, is very difficult because of the non-linear variation of moisture with depth. Sand near the bottom of the pile may contain up to twice the moisture content of sand in the center depending upon the permeability of the surface it is piled upon. Many times a close idea of the actual moisture content can be obtained by averaging the moisture of samples taken at the middle and bottom of the pile.

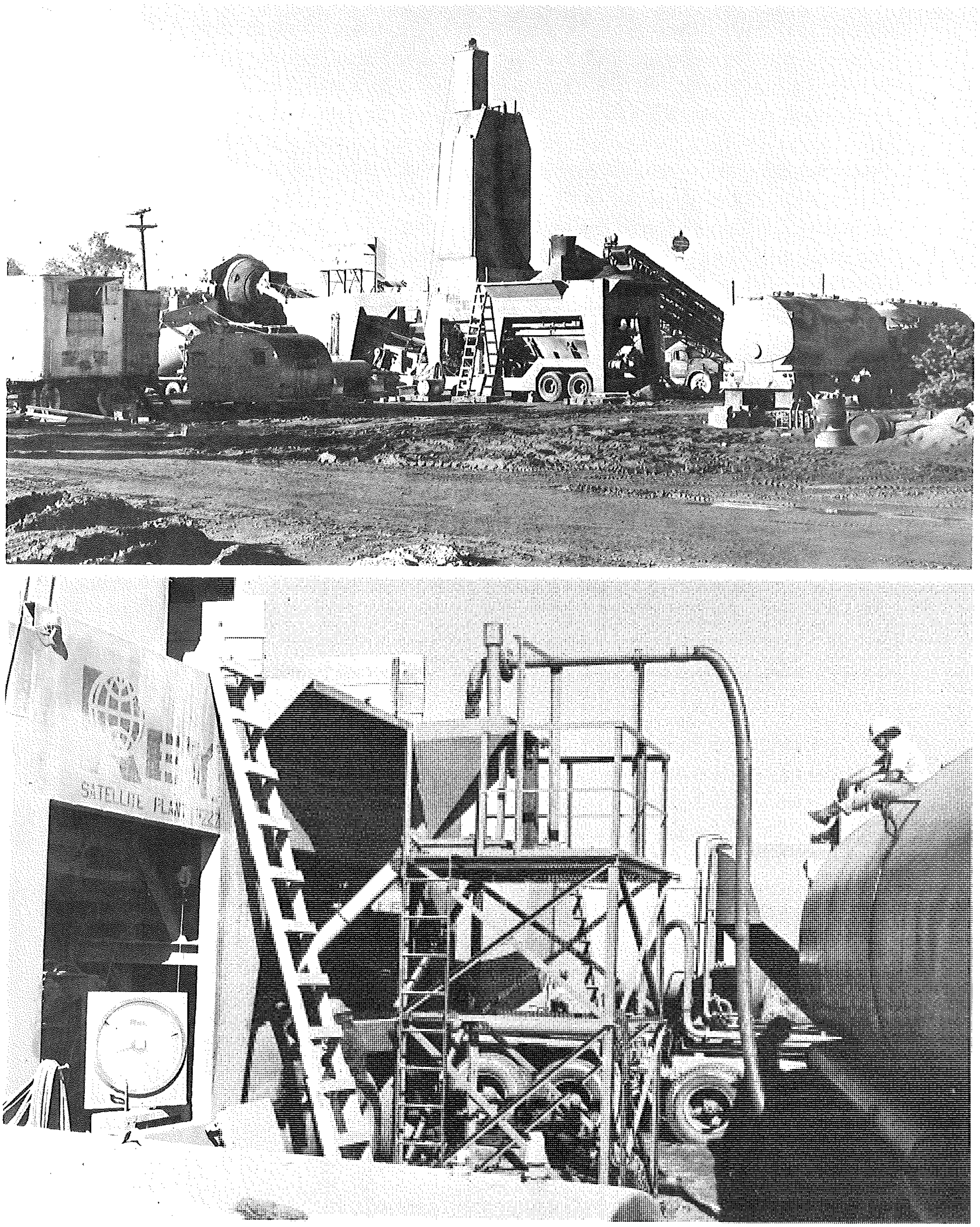
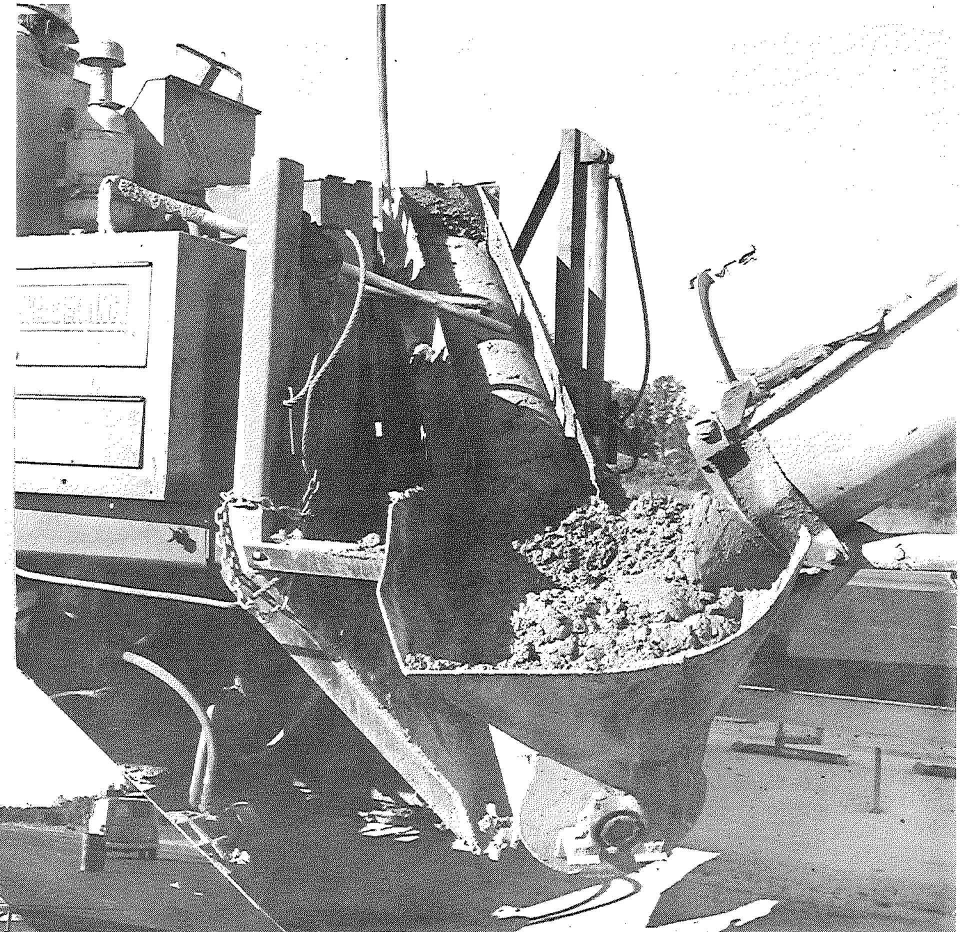


Figure 2. Batch plant (above) and special weigh hopper (below) used to discharge Pozicon onto the plant's conveyor belt.

CONSTRUCTION TECHNIQUE

As a subcontractor in the I 75 widening project, Champagne-Webber was responsible for the construction of the concrete valley gutters, the shoulder, and the median barrier; together, they completely covered the strip between the new inside 12 ft lanes of the northbound and southbound roadways. The valley gutters, shoulders, and barrier wall were all independently constructed by the slip-form technique using a machine manufactured by the Miller-Formless Co. of McHenry, Illinois; different attachments for consolidating and forming made it possible for this one machine to do the entire job. As the shoulder was poured, staggered lines of vertical tie bars were embedded in the concrete so as to provide anchorage for the barrier wall. During the construction of the barrier, grade A concrete was transported in 8 cu yd batches from the batch plant to the job site in transit mix trucks. Figure 3 shows a view of the shoulder and valley gutters just ahead of the slip-form machine and a transit mix truck discharging concrete into the hopper of the slip-form machine. The consolidation compartment of the slip-form machine used for forming the barrier wall contained three 3-in. diameter probe vibrators extending only a short distance into the forming portion of the compartment. The top vibrator was located on the vertical center line of the barrier wall 8 in. below the top surface; at this position it was virtually centered in the upper slope portion of the wall. The other two vibrators were located within 1 in. of the forming surface, and were centered on the lower slope; this placed them at an 8-in. elevation above the base of the wall. A cross-sectional diagram of the wall in Figure 4 shows the location of these vibrators. As with most slip-form machines their alignment and elevation are governed by electronic sensors which follow along a reference line. A rear view of the machine in Figure 5 shows these sensors and the finished wall surface emerging from the machine. After the crew became accustomed to the work they established a good production rate and the machine advanced at a speed of about 6 ft per minute. Finishing men behind the machine trowelled the wall surface blemishes; it was then given a broom finish. Plans required that contraction joints be placed in the wall at a maximum spacing of 24 ft, and expansion joints at a maximum spacing of 72 ft. The contraction joints were made with false joint edging tools but proved to be ineffective as the wall shrank and cracked at random locations. The expansion joints were placed in the finished wall by cutting out a slot and inserting the expansion joint material. Figure 6 shows a view of this operation.

After transit-mix truck discharges mix into the hopper, an auger conveys the concrete from the hopper to the consolidation compartment.



Valley gutter and barrier footings immediately ahead of the slip-form machine.

Figure 3. Slip-form median barrier project, I 75 near Flint.

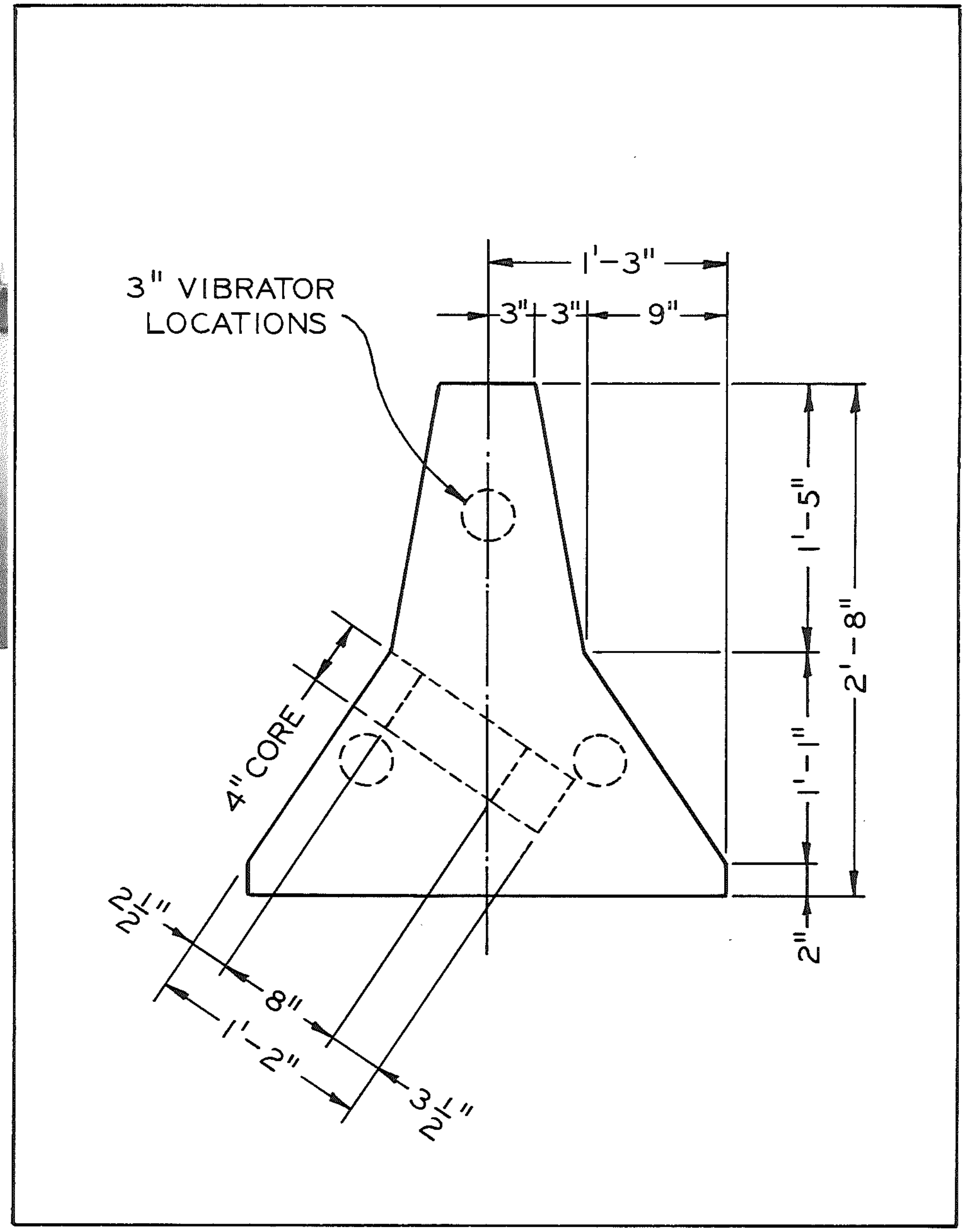
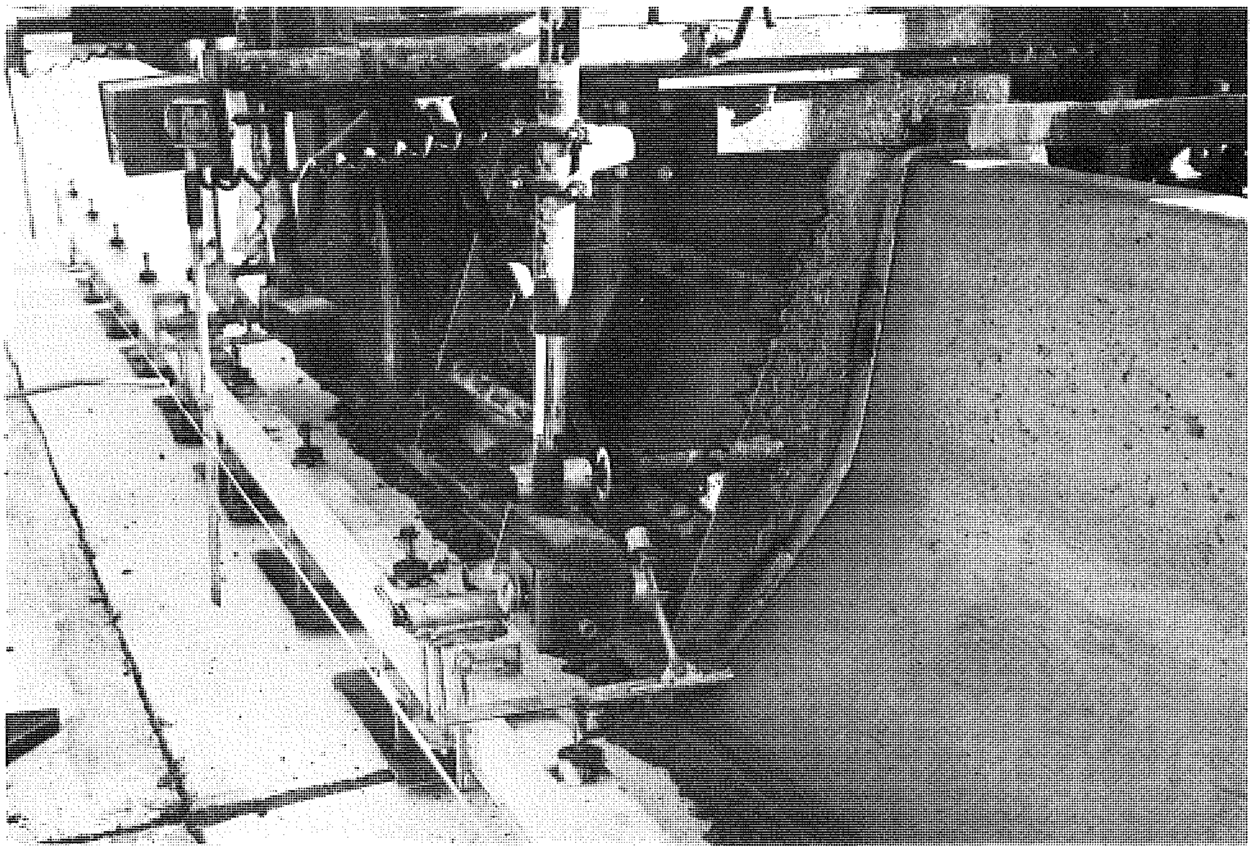


Figure 4. Core samples being taken from the barrier as per the diagram.



Wall surface emerging from the slip-form machine. Note the alignment and elevation sensors which control the machines direction.

Finishing and brooming the fresh concrete wall. The conveyor belt returns excess concrete to the consolidation hopper.

Figure 5.

Figure 6. Workmen cutting expansion joint in wall with two-man cross-cut "Saw." Bottom view shows edge of joint being refinished after insertion of fiberous expansion material.

EVALUATION PROCEDURES

Sampling of Fresh Concrete

In the afternoon of October 4, 1973, following an all morning rain, the contractor began construction on the median barrier with the control concrete. Research Laboratory personnel sampled the fresh concrete for slump and air measurements and cast several test specimens. Following the first sampling at 3:10 p.m., it was noted that the entrained air was only 4.3 percent so the air-entraining admixture was increased from 1/2 fl ox per sack of cement to 3/4 fl oz. The sampling at 4:00 p.m. showed the air level to be only up to 5.3 percent so the admixture was raised to one full fl oz. On October 5, a third sample of the control concrete was taken at 11:07 a.m., and the air level was noted as being at 7.7 percent which was considered good. Since the greatest threat of deterioration to the wall comes from freeze-thaw attack, high air entrainment is not considered objectionable; in fact, a higher limit was specified for an earlier barrier wall contract, but was lowered because of the difficulty in building entrained air in a very low slump concrete containing natural coarse aggregate.

On October 6, construction on the median barrier started with the experimental Pozicon concrete. Samples were taken at 10:20 a.m., 12:50 p.m., and 2:10 p.m. Inspectors and workmen on the project noted the following characteristics of the Pozicon concrete.

1) It was stickier than the control concrete and took longer to empty out of the mixing drum at the batch plant. It mixed thoroughly in the same one-minute mix time used for the control, but seemed to cause more of a residual build-up which required both water and scrubbing to dislodge at the end of the day.

2) When arriving at the job site in transit mix trucks the Pozicon concrete proved to be much more sensitive to slump adjustment water than was the control. Due to its internal fluidity, it required much less water to produce the desired consistency, but remained at that consistency for a shorter time interval.

3) When the concrete was wet enough to come down the truck chute conventionally, it gave the finishing crew problems because it would slump after coming out of the machine; when they had it about right for the slipform machine, it was too stiff to come out of the truck properly. They finally arrived upon a solution of lightly spraying the chute from the truck to help the stiff concrete slide down, and also lightly spraying the concrete

as it was conveyed up the auger into the consolidation compartment. Once in the consolidation compartment the probe vibrators easily consolidated the concrete and it slip-formed readily through the machine.

4) The concrete surface extruded from the machine was much smoother than the control concrete and this significantly reduced the amount of finishing work.

The remaining portion of the slip-forming work on the project was completed with Pozicon concrete on October 7, but was not sampled. Figure 7 is a diagram of the project area which shows the distance completed each day and the type of concrete used. The slump and entrained air measurements made on the fresh concrete are shown in Table 2 along with the test results obtained from the specimens molded from this concrete.

Sampling of Hardened Concrete

On October 30, 1973, it was planned to cut three cores from the completed wall at the locations where the fresh concrete samples had been taken. The cores were to be drilled at the top of--and normal to--the lower slope of the wall such that at least 12 in. and preferably 14 in. of core could be recovered. Figure 4 shows a cross-sectional diagram of the wall, its dimensions, and the location where the core was to be cut. This drilling attitude permitted the bit to pass over the top of any anchor dowel on the near side and hopefully miss any dowel on the far side. It was intended that the core be of sufficient length to provide surface and interior core segments for specific gravity and permeability work as well as an 8-in. section for a compression test. The core holes were patched with hand mixed fresh concrete. Views of the cores cut from the wall are shown in Figures 8 and 9.

The cores drilled at the sampling location were drilled at 5 ft intervals.

Concrete Specimen Test Results

Fresh Concrete Test Specimens - Each set of fresh concrete test specimens that were molded in the field and the test intervals are described below:

Nine 6 by 12-in. cylinders to be tested in compression in groups of three after moist curing three days, seven days, and the 28-day special cure; this latter cure was designed to simulate a 28-day field cure and consisted of one week moist curing, two weeks air drying, and an additional week of moist curing.

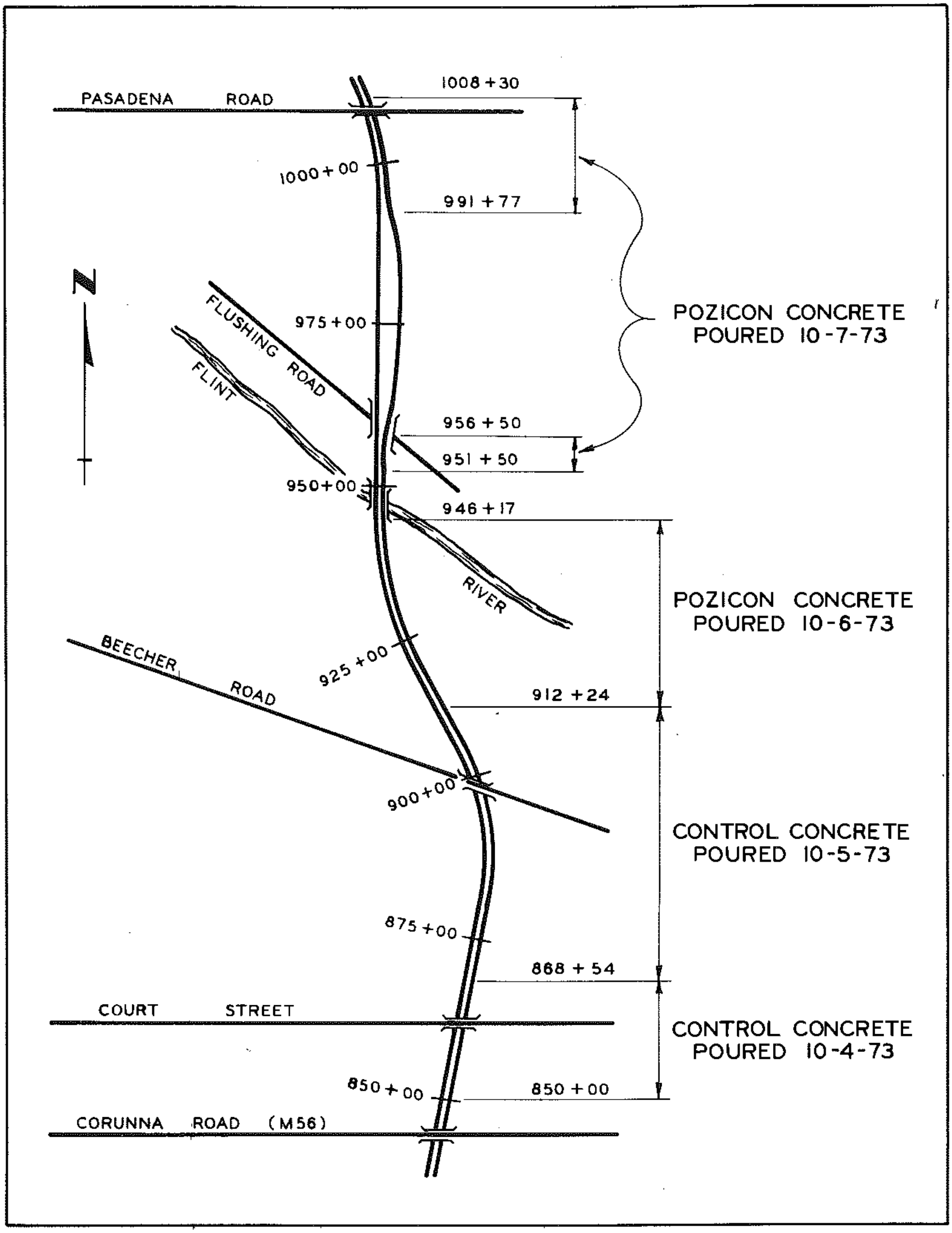


Figure 7. Location of experimental and control concrete on I 75 median barrier (Project IS 25032-05292A).

TABLE 2
POZICON FRESH CONCRETE FIELD EVALUATION
SLIP-FORMED CONCRETE MEDIAN BARRIER
Project IS 25032 05292A

	Set No.	Pour Date and Time	Station	Slump	Air, percent	Six Months Shrinkage, mil/in.	Freeze-Thaw Beams after 336 cycles		7-Day Specific Gravity (wet bulk)	Cylinder Compressive Strength, psi			Flexural Strength, psi		
							Dynamic Modulus, percent Initial	Flexural Strength, psi		3 Day	7 Day	28 Day Special Cure	3 Day	7 Day	28 Day Special Cure
Control Concrete	1	10-4-73 3:10 p.m.	855+50	7/8	4.3	0.52	99.7	800	2.405	3,710	4,140	4,750	755	750	915
	2	10-4-73 4:00 p.m.	859+00	3/4	5.3	0.51	99.6	850	2.392	3,670	3,980	4,860	780	890	905
	3	10-5-73 11:07 a.m.	882+50	1-1/4	7.7	0.50	101.4	800	2.328	2,890	3,540	3,840	775	780	775
	Avg			1	5.8	0.51	100.0	815	2.375	3,420	3,890	4,480	770	805	865
Pozicon Concrete	4	10-6-73 10:20 a.m.	920+25	3/4	7.1	0.47	101.9	795	2.353	3,290	3,580	4,650	735	740	800
	5	10-6-73 12:50 p.m.	929+00	1-1/8	6.3	0.54	101.6	775	2.374	3,280	3,710	4,500	750	825	860
	6	10-6-73 2:10 p.m.	933+50	3/8	5.3	0.46	101.5	860	2.408	3,810	4,320	4,110	795	850	960
	Avg			3/4	6.2	0.49	101.7	810	2.378	3,460	3,870	4,420	760	805	875

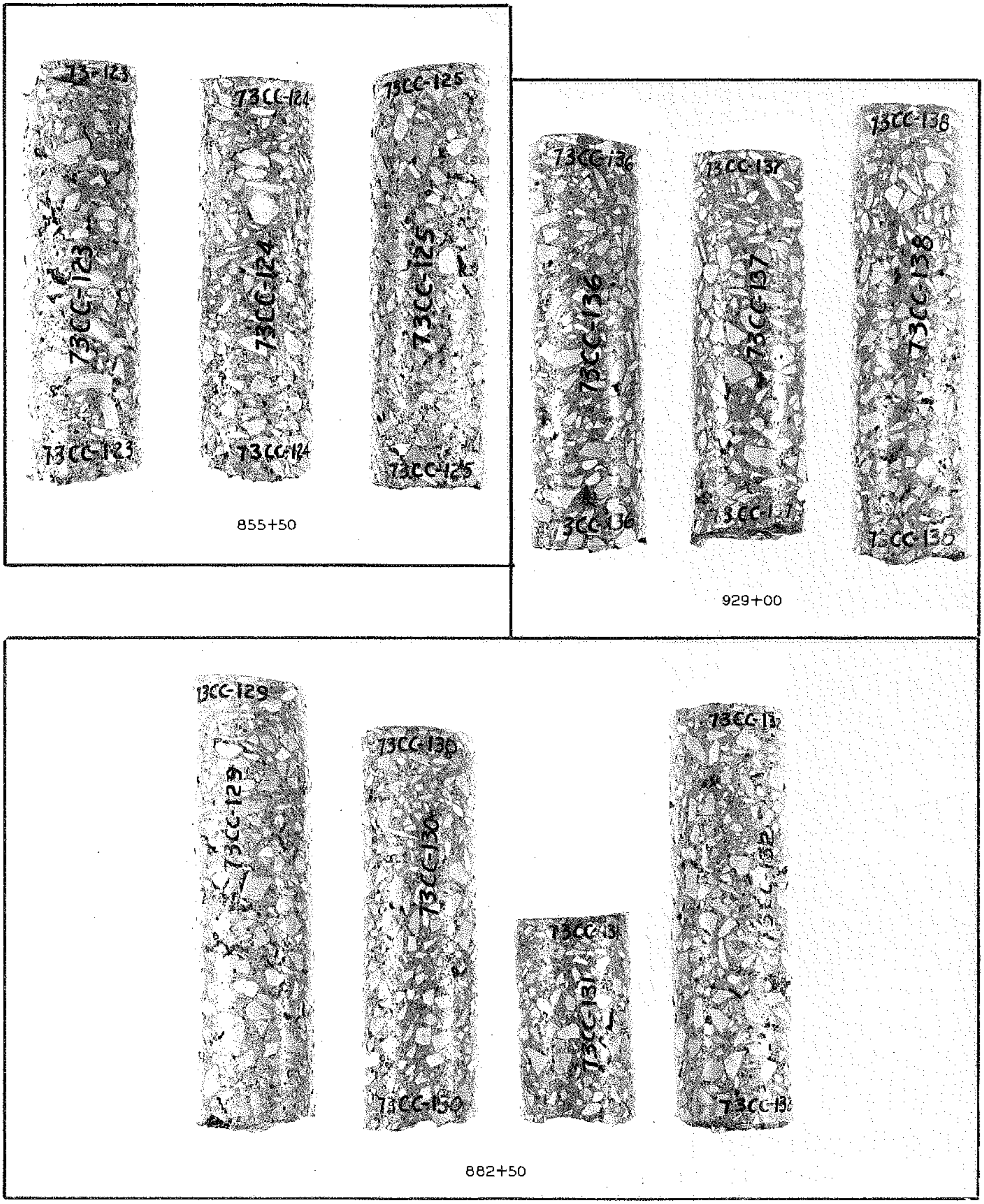


Figure 8. Control concrete cores cut from median barrier near sampling stations shown.

Figure 9. Pozicon concrete cores cut from median barrier near sampling stations shown.

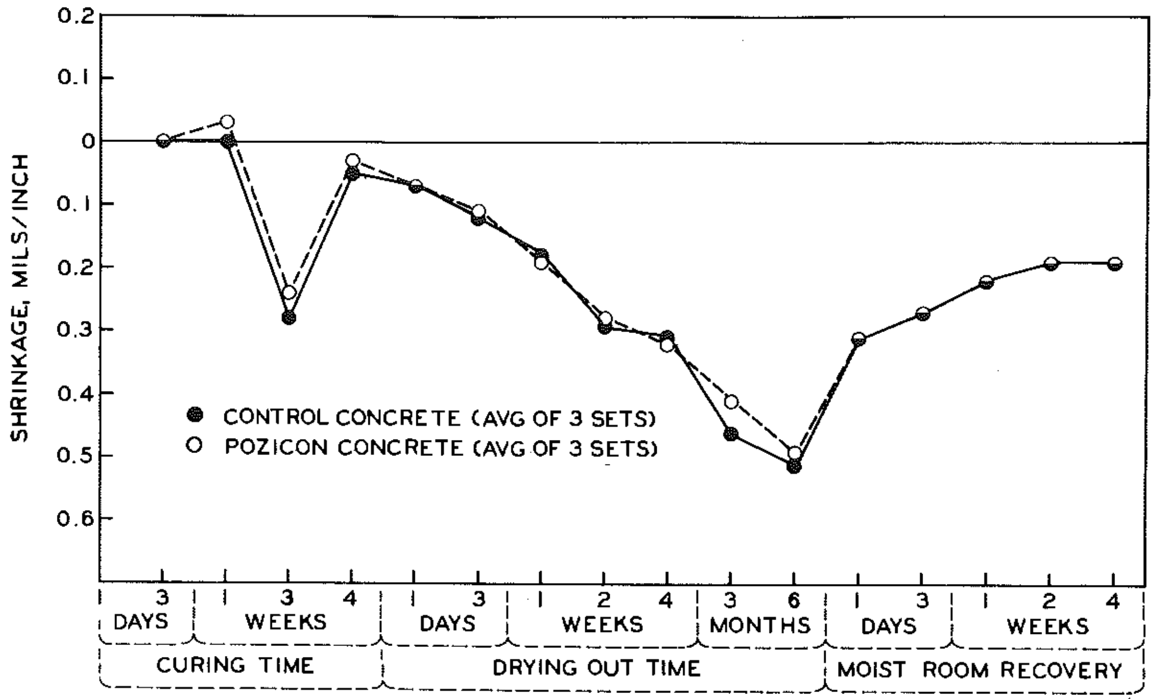


Figure 10. Shrinkage prism length variation.

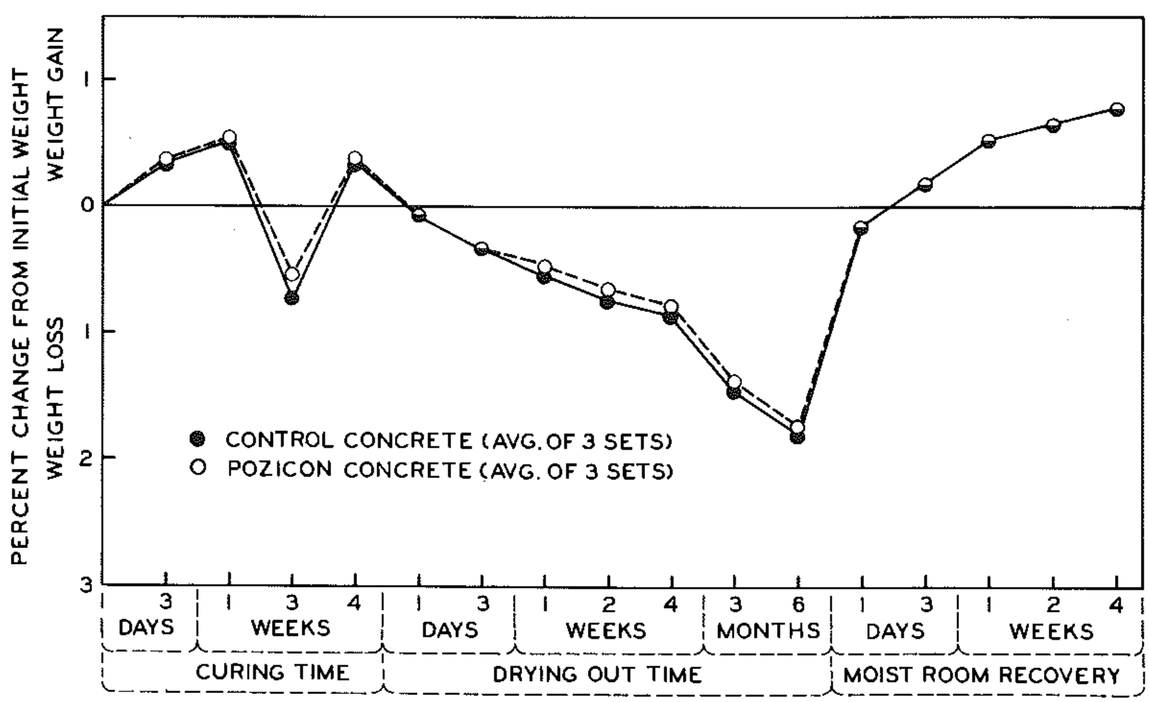


Figure 11. Shrinkage prism weight variation.

Six 4 by 4 by 16-in. flexural beams that were tested in groups of two after the same cure intervals used for the cylinders. The wet bulk specific gravity was measured from the beam ends of the seven-day cure specimens.

Three 3 by 4 by 16-in. beams were given the special cure and then tested through 336 freeze-thaw cycles in a rapid cycle machine where the beams froze in air and thawed in water. Their condition was monitored every 42 cycles on a sonometer that determined the transverse vibration frequency at which the beam resonated. This testing was carried out in accordance with the procedure described in ASTM C 666-73, Method B.

Three 3 by 3 by 15-in. shrinkage prisms were given the special cure and were measured for length and weight changes during the cure at one, three, seven, 21, and 28 days, and during the dry-out period at one and three days, one, two, and four weeks, and three and six months. The dry-out period was followed by a 28-day moist room recovery period with measurements at one, three, seven, 14, and 28 days.

Fresh Concrete Specimen Test Results

The test results from the fresh concrete specimens are shown in Table 2 and in Figures 10 and 11. The data shown in Table 2 includes slump and entrained air measurements of the fresh concrete, the individual average values for each set, and the three set average values for both control and Pozicon concretes. Figures 10 and 11 show the three set average values of the shrinkage prism length and weight variations for both concretes. A close examination of the data in Table 2 and Figures 10 and 11 shows the control and Pozicon concretes to both have excellent characteristics and to be very comparable to each other.

Hardened Concrete Test Results

An 8-in. compression specimen was cut from the center of the concrete cores taken from the wall; while the two ends, having an approximate length of 2.5 in. each, were measured for absorption, specific gravity, and permeable voids in accordance with ASTM C 642. For the cores from each sampling station, the results of these tests were averaged and are shown in Table 3; also shown is the combined average for each concrete.

A study of the table shows a more dense concrete existing at the surface of the wall than is present in the interior. This is indicated by all three related measurements; absorption, specific gravity, and permeable

TABLE 3
POZICON CONCRETE CORE FIELD EVALUATION
SLIP-FORMED CONCRETE MEDIAN BARRIER
Project IS 25032 05292A

Concrete	Set No.	Pour Date and Time	Station	Fresh Concrete Data		Core Strength (Avg. of three) psi	Surface Concrete Properties[1] (2-1/2-in. depth)			Interior Concrete Properties[1]		
				Slump in.	Air percent		Absorption, percent	Specific Gravity (dry bulk)	Permeable Voids, percent	Absorption, percent	Specific Gravity (dry bulk)	Permeable Voids, percent
Control	1	10-4-73 3:10 p.m.	855+50	7/8	4.3	3220	5.7	2.25	12.8	6.2	2.23	13.8
	2	10-4-73 4:00 p.m.	859+00	3/4	5.3	3120	5.6	2.23	12.4	5.8	2.21	12.9
	3	10-5-73 11:07 a.m.	882+50	1-1/4	7.7	2690	5.2	2.19	11.4	6.0	2.17	13.0
	Avg			1	5.8	3010	5.5	2.22	12.2	6.0	2.20	13.2
Pozicon	4	10-6-73 10:20 a.m.	920+25	3/4	7.1	3220	4.8	2.23	10.6	5.2	2.23	11.6
	5	10-6-73 12:50 p.m.	929+00	1-1/8	6.3	4250	4.6	2.29	10.5	5.4	2.24	12.0
	6	10-6-73 2:10 p.m.	933+50	3/8	5.3	4310	4.7	2.30	10.5	5.1	2.25	11.5
	Avg			3/4	6.2	3930	4.7	2.27	10.5	5.2	2.24	11.7

[1] ASTM C642

voids. It will also be noted from the table that the Pozicon concrete is generally denser than the control concrete; an apparent contradiction to this is at station 855+50 of the control and 920+25 of the Pozicon, where the respective specific gravities at the surface are 2.25 and 2.23. It will be noted at these locations that the entrained air level of the Pozicon concrete was much higher than it was for the control concrete while the absorption and permeability were less. This would indicate that although there was a greater number of tiny isolated air bubbles of entrained air in the Pozicon concrete, there must have been fewer of the larger trapped air voids, at least those that were interconnected. This fact itself would suggest that the Pozicon concrete was better consolidated.

The strength measurements shown in Table 3 indicate the Pozicon concrete is substantially stronger in compression than the control concrete, again reflecting better consolidation.

CONCLUSIONS

From the strength, specific gravity, absorption, and permeability averages in Table 3, a comparison was made which is presented in Table 4. It shows the average values for both concretes and the improvement in the Pozicon over the control. As shown, the improvement of the Pozicon over the control is substantial.

Recalling the fresh concrete values from Table 2, where only a negligible difference existed between the performance of the Pozicon and control concretes, and the substantial improvement shown by the cores in Table 4, two facts must be concluded: first, that the rapid pozzolanic activity of

TABLE 4
SUMMARY OF POZICON IMPROVEMENTS OVER CONTROL CONCRETE
SLIP-FORMED CONCRETE MEDIAN BARRIER
Project IS 25032 05292A

Characteristic	Pozicon	Control	Improvement
Average Compressive Strength	3,930 psi	3,010 psi	31 percent increase
Average Specific Gravity (dry bulk)	2.25	2.21	0.04 increase
Average Absorption	4.9 percent	5.7 percent	14 percent reduction
Average Permeable Voids	11.1 percent	12.7 percent	13 percent reduction

the Pozicon was adequate to produce a 6 sack performance with 5.5 sacks of cement under simulated field curing; second, that the internal fluidity provided by the Pozicon gave it a substantially improved consolidation in an actual field application.

In view of this revelation, the natural conclusion is to surmise that if a 5.5 sack mix with Pozicon will effect this substantial improvement, that a 6 sack mix with the proper amount of Pozicon will provide a concrete vastly superior to the 6 sack control. However, in view of the substantial reduction in the volume of fine aggregate to accommodate the Pozicon and the additional required water, it is doubtful if this concrete will have a sufficiently increased workability to give further improvement in consolidation. Laboratory work is presently in progress to explore this supposition.

RECOMMENDATIONS

Since a slip-formed concrete mix has been developed that will conserve the valuable commodity, cement, utilize the waste product fly ash to its fullest potential, and produce a moderately superior concrete at a modest savings in cost, there can be no other course than to recommend its usage. At present this recommendation must be restricted to specifying it as a preferred alternate to conventional concrete in the slip-form construction of concrete median barriers and other similar outdoor structures. Its application in slip-form concrete pavements was explored in an experimental paving project constructed during the 1974 construction season and the results contained in another report.

The decision to use the fly ash concrete option in a project will necessitate that the contractor make arrangements with the Michigan Ash Sales Co. of Essexville, Michigan, to supply him with Pozicon and to modify his batch plant, if necessary, to accommodate it. The proper mix with Pozicon would be designed by the Department.