ATTACHMENT-3

REPORT

of the

OVERHEAD FLUID GROUTING

TEST PROGRAM

Located at

Consumers Power Company

Midland Nuclear Power Plant

Midland Units 1 & 2

July 15, 1983

TABLE OF CONTENTS

OVERHEAD FLUID GROUTING TEST PROGRAM
REMEDIAL UNDERPINNING
MIDLAND UNITS 1 & 2

I. EXECUTIVE SUMMARY OF TEST PROGRAM

A. Purpose of Test

To insure proper pressure grout placement on the permanent underpinning piers, a series of tests simulating leveling plate installations has been performed using different concrete surface preparations, different methods for venting air, and different grouting techniques for the placement of grout.

B. Summary of Test Results

All pressure grouted test plates provided a fully satisfactory grout pad. None of the special surface preparations appeared to have had any affect on reducing the amount of entrapped air. Multiple injection points seemed to induce more entrapped air than the single injection point. An expanded metal/leadwool forming system had more disadvantages than advantages. The performance of the Masterflow #713 grout and the equipment used all proved to be more than adequate for these tests.

C. Summary of Conclusions

The pressure grouting with Masterflow #713 provided a quality product equal to or better than drypacking with Masterflow #713. The overhead pressure grouting of steel plates can successfully be performed using conventional materials, equipment, and methodology already available and in use on the project. Successful pressure grouting can be accomplished using a single centrally located grout injection point thru the steel plates and by bulkheading around the periphery of the plate with wooden forms.

II. SCOPE OF TEST PROGRAM

A. Objectives

1. To determine the quality of a grout pad that can be achieved by overhead pressure grouting. Of particular concern was the minimizing of voids created by air being entrapped in the grout at the interface between the existing concrete surface and grout surface

2. To determine the optimum methods of surface preparation, formwork and grout placement.

II SCOPE OF TEST PROGRAM

B. Location

Testing was performed in a portion of the northeast corner of the Midland Jobsite Poseyville Laydown Area.

C. Test Facilities

The simulation of actual conditions which exist under a structure being underpinned was accomplished by utilizing concrete blocks (crane counter weights) cribbed by other concrete blocks to create two test bays. (See Exhibit D - Photographs #1 and #5).

D. Personnel

The Mergentime personnel during grouting consisted of four (4) craftsmen, a foreman, and a superintendent. The drypack crew consisted of five (5) craftsmen, a foreman, and a superintendent. In addition to the Mergentime personnel, observers were present from Bechtel's FSO Field engineering and MPQAD for all of the grout placements. Part time observers included Mergentime Field Engineering, Stone & Webster Independent Assessment Team, U .S. Testing (for testing) and Consumers Power Company.

III TEST PROCEDURES

A. Layout of Test Plates

Eight (8) test plates were laid out four (4) in each of the two simulation bays. The north simulation bay test plates were installed to test a multiple injection point system of grout placement under varying bulkheading and concrete preparation conditions. The South simulation bay test plates were installed to test the single grout injection point system with various concrete surface preparations. One plate was formed on three sides and drypacked with Masterflow #713 as a comparison to the pressure grouting techniques. (See Exhibit #A for Grouting Plan Arrangement).

B. Description of Test Plates, Formwork, and Surface Preparation Area*

All test plates were made of ½" x 3'5" x 5'8" steel plates and were held in position by eight (8) 3/4" diameter Hilti kwik bolt expansion anchors. The plates were positioned 1½" beneath the concrete slab by means of short pieces of pipe sleeves placed over the anchor bolts. The sleeves also facilitated easier test plate removal. The steel test plates were sized to represent the maximum size anticipated for actual conditions. In addition, four plates were notched to represent the worst geometric conditions anticipated. The concrete underslab surface was lightly greased

*Also see Exhibit A and Photographs #9 thru #12 of Exhibit D

III. TEST PROCEDURES (Cont'd)

with Union 76 - Multipurpose grease. This was used as a bond breaker. The grease was brushed on with a 2½" wide paint brush with 1¼" bristles. The underslab concrete surfaces above each plate had a combination of surface preparations consisting of grooves cut in the concrete, forming either a figure X, H, or 3 parallel lines or no surface preparation at all. The cut grooves were installed as air venting systems with the grooves extending well beyond the forming at the edges of the steel plates.

Test plates #1 thru #4 had four grout injection points down the center of each plate. Plates #1 and #4 were formed on four sides (bulkheaded) with 2 x 4 lumber and were sealed to the underslab concrete using a silicone caulking. Plates #2 and #3 were bulkheaded using expanded metal backed with leadwool packing. This system of bulkheading also required 2 x 4 framing to retain the expanded metal. In addition to these cut grooves, the 2 x 4 bulkheading had ½" square vents cut into its top surface. These vents were later plugged with wood plugs or leadwool. The backup framing for Plate #2 and #3 had long slots approximately 3/4" deep cut along its top edge to aid in the passage of air thru the leadwool packing.

Test plates #6 thru #8 had one grout injection point each. All were conventionally bulkheaded with 2 x 4 lumber and silicone caulking. Test plate #6 had an injection point at its center and the underslab concrete was prepared by roughening it with a chisel bit tool to simulate an irregular surface. Test plate #7 had an injection point at its center with a pipe extension which protruded up into a 1½" diameter hole cored into the underslab concrete. This was done to provide a positive means of limiting grout loss to the area of the cored hole in the event leakage resulted from failure of the injection shut-off valve. In addition, an "X" groove pattern was cut across the hole extending to each corner. Test plate #8 had one injection point located 3" in from the northwest corner. The underslab concrete was left in its original condition.

Test plate #5 was drypacked utilizing Masterflow #713 grout. This test plate was bulkheaded on the north, south, and east sides with all drypacking being done from the west side. In addition to test plate #5, two additional drypack test plates were prepared from this same location and they were numbered 5A and 5B. Test plate #5A was made with Masterflow #713 grout mix while test plate #5B was made using a 1:1 ratio sand/cement drypack mix.

C. Description of Grouting

The flowable grout used was Masterflow #713 mixed in accordance with Mergentime Grouting Procedure MCP 15.000 (See Exhibit D - Photograph #2 and Exhibit E). Where multiple injection points were used, grouting progressed south to north.

III TEST PROCEDURES (Cont'd)

The grouting was accomplished using an Airplaco model #HG-5, hand operated grout pump, in a five gallon plastic pail. The grout pump was connected to the plate injection point by a flexible hose using Chicago type couplings. Attached to the steel test plate injection nipple was a shut-off valve and a Chicago type coupling. (See Exhibit D - Photographs #4 and #7). Air vents were plugged only after a good flow of grout passed through them. After all vents were plugged the pump was used to apply and maintain a static pressure of 9 to 15 lbs. until the injection point valve was closed.

U.S. Testing was present at the start of grouting and drypacking each day and to take flow cone tests and to make strength cubes (see Exhibit D - Photograph #3) for verification of material characteristics (see Exhibit C). It should be noted that no curing was performed on the grout test pads and that they were all stripped within approximately 20 hours of being placed.

D. Post Test Observations

All test plates were removed the day after placement. The grease bond breaker worked well, however, most test plate grout pads were cracked or otherwise broken during the process of removal.

The results of all test plates grouted with Masterflow #713 were satisfactory. The utilization of various patterns of specially cut grooves in the underslab concrete appeared to have had no influence on relieving entrapped air. In certain instances air bubbles were entrapped continuously across a cut groove. The larger (over ½" diameter and 1/8") air bubbles appeared almost exclusively on the plates with four (4) injection points. (See Exhibit D - Photograph #27). Since the first injection point generally filled the bulk of each test area it appears that these bubbles may be portions of a larger bubble that was formed when grout was placed from a previous injection point. There is no definite pattern on entrapped air bubbles other than they appear to be radially oriented about one or more of the three subsequent injection points.

Both the wood form and expanded metal/leadwool bulkhead methods effectively contained the grout and provided adequate avenues for escaping air. The wood forms left a neat uniform grouted edge while the Expanded metal/leadwool created a void area approximately 3/4" back from the test plate edge. (See Exhibit D - Photograph #28).

The wood plug system used to plug the bulkhead air vents worked well at all locations where it was used. Although the leadwool plugs were satisfactory, in some locations they were pushed as much as 3/4" to 1" into the grout pad itself and thus leaving a void. Also leadwool was used at the only two vent areas that showed evidence of grout leakage after grout shut-off.

III TEST PROCEDURES (Cont'd)

Minor dripping of a clear amber fluid was noted from all pressure grouted test plates, starting at approximately half way thru the grouting time period and extending well beyond completion of grouting. This was apparently bleed water and a visual inspection of the pads could find no damage or voids as a result of the fluid.

E. Test Results

Plate No.	Grouting Time	Grouting Pressure	Plate Deflection	% of Voids Over ¼" Ø	Remarks
1	35 min.	13 psi	3/16 to 1/4	0.9	Many small surface bubbles noted
2	27 min.	12 psi	3/16 to 1/4	0.5	Contained large and deep trapped air pockets
3	39 min.	15 psi	1/4 to 3/8	0.7	Contained air bubbles apparently formed from subsequent injection points
4	40 min.	9 psi	0 to 1/8	1.2	Contained large shallow air pockets
5 (DP)	1 to 1½ hr	n/a	None	14.0	Poor consolidation at east edge of pad
5A (DP)	Not Avail	n/a	3/16 to 1/4	7.0	Poor consolidation at east edge of pad
5B (DP)	2 to 2½ Hr	n/a	3/16 to 1/4	0.1	Actual Void Area is 2.5% When Lost Contact Area is Included
6	25 min.	12 psi	1/16 to 1/8	0.8	Experienced No Problem Filling Irregularities Chipped Into Concrete Surfaces
7	20 min.	12 psi	1/8 to 3/16	0.5	Appears to have had plate movement during grouting
8	30 min.	10 psi	1/8 to 1/4	0.9	Poor consolidation appears to have resulted form excessive grout flow distance

*See Exhibits B and D for additional photographs and test results evaluations.

III TEST PROCEDURES (Cont'd)

Dates of Testing:

- o Plates 1 thru 5 were grouted on 6-28-83 and removed on 6-29-83
- o Plates 5 thru 8 were grouted on 6-29-83 and removed on 6-30-83
- o Plate 5A was drypacked on 6-30-83 and removed on 7-1-83
- o Plate 5B was drypacked on 7-6-83 and removed on 7-7-83

IV. CONCLUSIONS

All pressure grouted test plates provided a fully satisfactory grout pad for transfer of loading into or from an overhead concrete structure. Based upon the comparison of the seven (7) pressure grouted test plates, it appears that the single centrally located injection point type of test gives the best product.

Test plate #7 had a special condition of a pipe extension of the injection nipple up into a 1½" drilled hole in the underslab concrete. No advantages to this system were noted in the resultant underslab/grout contact surface to merit further consideration.

Two drypack test plates were made using Masterflow #713 for comparison purposes. Neither of these two test plates proved to be better than the pressure grouted test plates. Proper consolidation of the drypack on the far side of the test plate and behind anchor bolts appears to be the weak areas for these plates. A third drypack test plate was made using a 1 to 1 sand/cement ratio which proved to be the best test plate except for a loss of contact area in the northwest corner, apparently a result of the plate moving during final stages of drypacking.

One problem noted from the pressure grouting and from two of the three drypack test plates, was the elastic bowing of the ½" steel test plates resulting from the induced pressures. The least affected pressure grout test plate was #4, on which grouting was stopped with a static pressure, indicated at the grout pump, of approximately 8 to 10 psi. All other plates were stopped at static pressures of 12 psi±. It should be noted that only eight (8) expansion bolts were used to support the test plates and that no attempts were made to restrain or limit plate deflections (bowing). It should also be noted that the static shut-off pressure was measured on a 0 to 60 psi pressure dial attached to the grout pump discharge. (See Exhibit #D - Photograph #4). This static pressure includes approximately six (6) feet of head between the gage and the overhead test plate. Consequently ten (10) pounds per square inch pressure at the gage should mean four (4) psi actual pressure within the grout bed itself. Thus it appears that minimal pressure (sufficient to force grout to flow out the bulkhead air vents) is all that is necessary to achieve grout placements.

IV CONCLUSIONS (Cont'd)

An observation noted was that the pressure gage attached to the grout pump indicated high pressure peaks during the initial stages of pumping. This pressure could not have built up under the plates, since all the vents were open during this stage of pumping. This "peaking" was due to a combination of rapid pumping and line losses during the initial filling. As the vents were closed and pumping slowed, the pressures stabilized in the line, reflecting pressures actually transferred to the grouted plates. (This "peaking" phenomena will be a consideration in gage range selection in permanent pier grouting.)

No advantages were noted by use of the expanded metal/leadwool system over the more conventional wooden bulkhead system. A major disadvantage was, however, noted in that there was a definite loss in available grout pad size in the leadwool system. Consequently production plates utilizing this bulkhead system would require larger sized plates to makeup for the lost grout pad area.

The Union 76 multipurpose grease was used as a bondbreaker on the underslab concrete surface and performed its function. The use of this grease as opposed to normal pre-soaking or the use of the weld crete could be expected to result in a larger amount of air entrapped in the grout concrete contact surface due to the grease being impervious and thus not allowing any air to be absorbed by the concrete.

On the whole the amount of small air pockets noted were about equivalent to what might be expected on a vertically formed surface poured with air entrained concrete. A quantitative value for percentage of lost contact surface, due to air or just no contact, was determined by physical measurements of the void areas larger than ¼" equivalent diameter. The results of these measurements for plates #1 thru #4 and #6 thru #8 show a range of from 0.5 percent to 1.2 percent loss. Inclusion of all void areas less than 1/4" Ø should not amount to any more than double the values calculated or in other words a maximum of 2.4 percent loss in total.

The hand pumping of the grout was a satisfactory method for placement of the grout. It was an easy method to control the placing of grout as well as being mobile and requiring little in the way of support facilities or maintenance during placement.

The Masterflow #713 grout proved to be an acceptable mix in terms of its net physical characteristics as well as the finished product. It should be noted that although the Mergentime Procedures for grouting (MCP 15.000) and drypacking (MCP14.000) were utilized as guidelines, absolute adherence was not expected, nor was it guaranteed by quality control inspections. In particular, no bonding to existing concrete was desired, no grout placement plan was utilized, and no attempts were made to properly cure the test plate grout pads.

IV CONCLUSIONS (Cont'd)

It should be noted also that the expansion anchor bolts were installed at varying depths and in several instances spacer washers had to be utilized in order to tighten the nut without bottoming out on the the threads.

The bowing or elastic bending of virtually all of the test plates was to be expected, but should not be a source of concern. Bowing of the test plates showed up on both the pressure grouted plates as well as the dry-packed plates. To date, no problems have been noted in the Auxiliary Building Underpinning work with drypacked leveling plates. Bowing of pressure grout plates will not be a problem either since the bowing can easily be eliminated by the installation of plate bracing before grout placement.

V. RECOMMENDATIONS

Utilization of leadwool as a form of bulkheading for pressure grouting should be kept as an option for areas where the more conventional wood bulkheading can not be utilized. There may be instances during grouting where the use of leadwool will provide the best and most reasonable means of stopping grout movement. Care will still have to be exercised to ensure that use of leadwool does not reduce the required effective bearing area of the grout pad.

An option, although not tested, that should prove equally as good as the single injection point system would be a dual injection point system (At 1/3 points down the center of plate). This system would use two grout pumps both of which are pumped either simultaneously in a manner so as not to form air pockets/bubbles as noted in Section III D of this report.

Grouting pressure should be kept near the minimal required to obtain grout flow through the air vents. To avoid possible plate bowing or excessive bracing of plates, slow stroking of the handpump to eliminate impulse loading should be utilized.

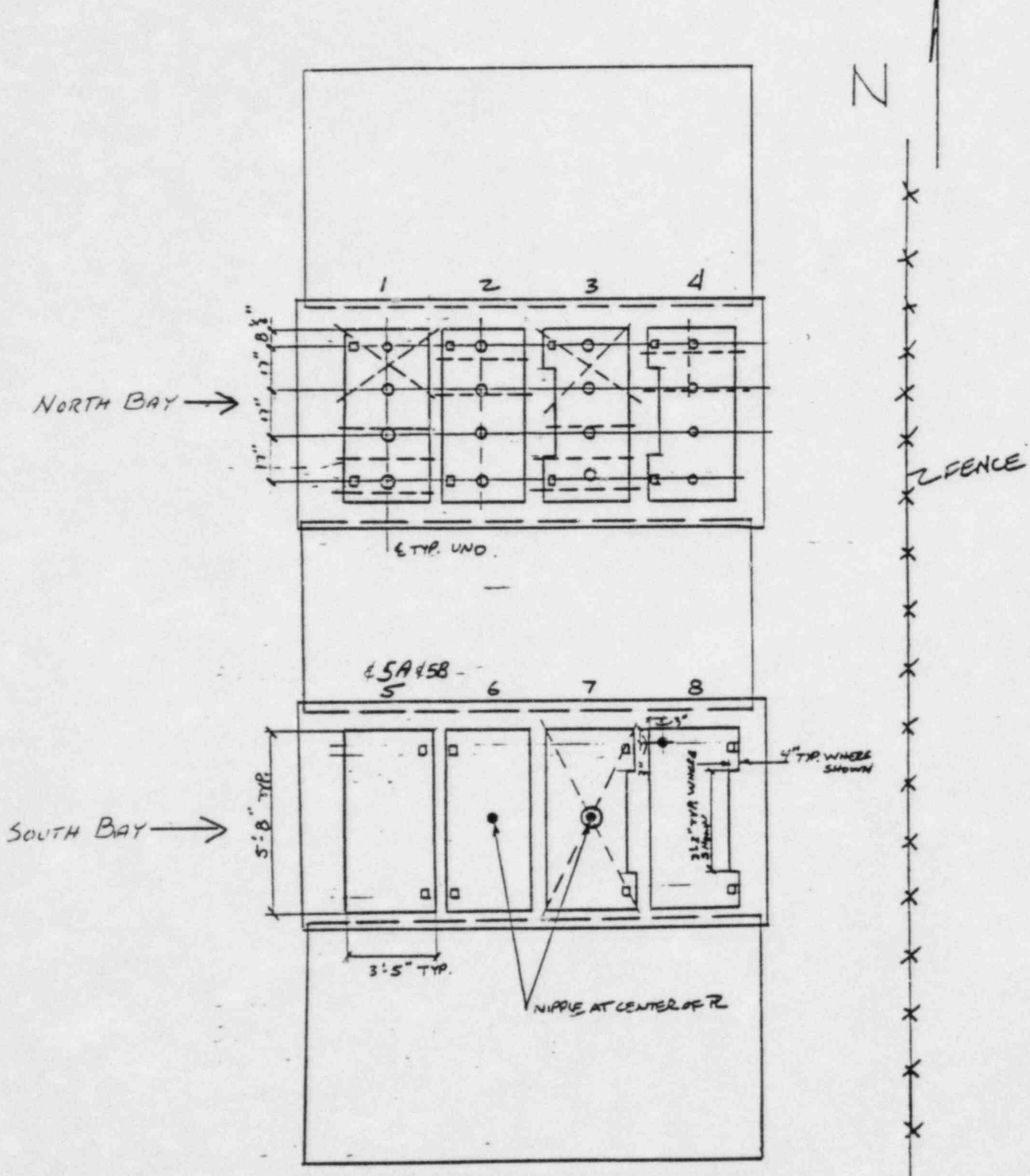
OVERHEAD FLUID GROUTING TEST PROGRAM

EXHIBIT A

GROUTING PLAN ARRANGEMENT

PRESSURE GROUTING PLAN ARRANGEMENT

ATTACHMENT A SHEET 1 of 2



○ – 5/8" ϕ NIPPLE WELDED TO PLATE

● – 3/4" ϕ NIPPLE WELDED TO PLATE

◎ – 1½" ϕ CORE HOLE 3" DEEP

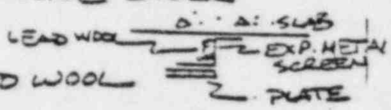
□ – 4" ϕ HOLE IN PLATE

– – – GROOVE CUT IN SLAB FOR AIR PASSAGEWAY (DEPTH VARIES FROM 1½" @ CENTER OF RATE TO ¾" OUTSIDE THE RATE AREH)

1 – TEST RATE LOCATION NUMBER

FORMWORK

PLATE NO.	FORMWORK
1	WOOD FORMS CAULKED W/ SILICONE CAULK
2	EXPANDED METAL SCREEN W/LEAD WOOL
3	EXPANDED METAL SCREEN W/LEAD WOOL
4	WOOD FORMS CAULKED W/ SILICONE CAULK
5	WOOD FORMS (DRYPACK PLATE)
6	WOOD FORMS CAULKED W/SILICONE CAULK
7	WOOD FORMS CAULKED W/ SILICONE CAULK
8	WOOD FORMS CAULKED W/ SILICONE CAULK



NOTES

1. ALL PLATES WITH THE EXCEPTION OF NO. 5 WILL HAVE 12 VENT HOLES BETWEEN THE SLAB AND THE TOP OF THE FORM EVENLY SPACED AROUND THE PERIMETER OF THE PLATE. THESE HOLES WILL BE PLUGGED WITH WOOD WHEN A STEADY STREAM OF GROUT FLOWS FROM THEM.

2. ALL PLATES WILL BE PRESSURE GROUTED BY HAND PUMP WITH THE EXCEPTION OF PLATE NO. 5 WHICH WILL BE DRYPACKED.

3. SLAB AREA TO BE GROUTED OR DRYPACKED AGAINST WILL BE GREASED FOR EASY REMOVAL OF PLATE AND GROUT/DRYPACK.

4. GROUT/DRYPACK WILL BE MASTERFLOW 713.

5. HILTI EXPANSION ANCHORS WILL HAVE A SMOOTH PIPE SLEEVE ON THEM BETWEEN THE LEVELING PLATE AND THE SLAB TO PERMIT EASY REMOVAL OF THE PLATE AND GROUT/DRYPACK.

6. ALL SLAB SURFACES TO BE GROUTED/DRYPACKED WILL BE PREPARED BY REMOVING SURFACE LAITANCE WITH A WIRE BRUSH WITH THE EXCEPTION OF THE SLAB @ PLATE NO. 6 WHICH WILL BE ROUGHENED WITH A HILTI DRILL W/ CHISEL TIP.

7. PLATE NO. 7 WILL HAVE AN ADDITIONAL PIECE OF PIPE ATTACHED AT THE NIPPLE PROJECTING UP INTO A DRILLED CAVITY.

OVERHEAD FLUID GROUTING TEST PROGRAM

EXHIBIT B

FIELD EVALUATION OF VOID AREAS

PLATE NO. 1

1. Peripherial bubbles about nipples?

   #1 (South) No (Peripheral bubbles from #2 over hole) #3 No

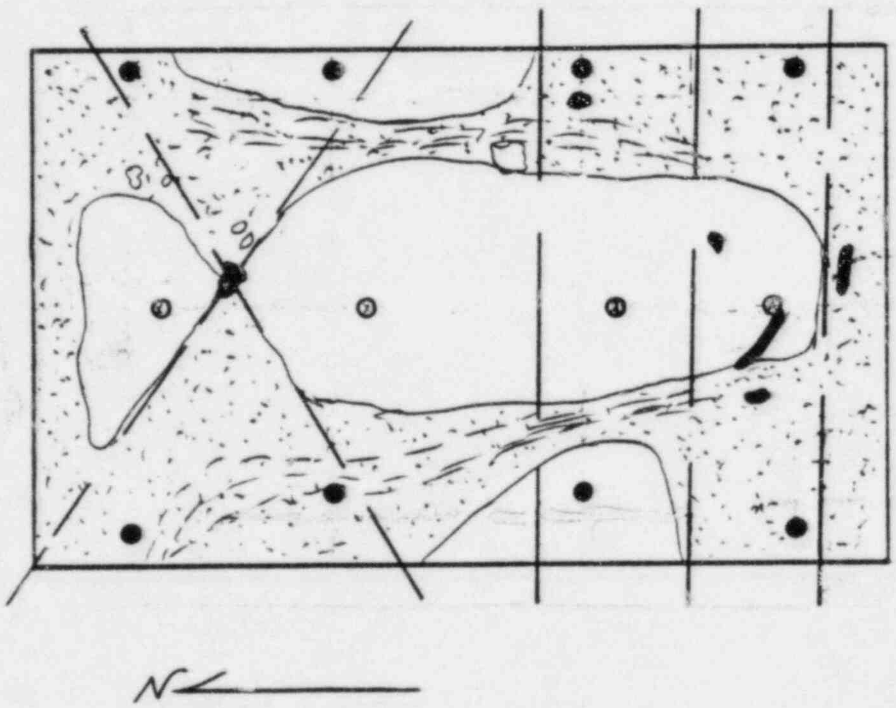
   #2 Yes - Towards #1 #4 (North) No

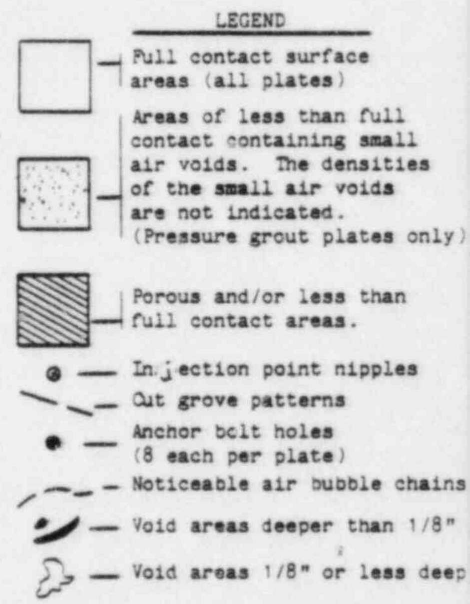
2. Air noted in underslab notch grout projections? Yes

3. Grout leakdown at air vent holes? No, but lead wool hole plugs extending into grout slab 3/4" past plate edge.

4. Noticeable general air bubble pattern? Yes

   Visual interpretation sketch (no scale):





5. Calculated void area in excess of 1/4" Ø nominal sizing = 0.9% percent of surface area.

6. General quality evaluation of grout/concrete contact area.

   North ½: Poor, (satisfactory), good, excellent
   South ½: Poor, (satisfactory), good, excellent

7. General evaluation of test plate: For some reason, this plate has a lot of little air bubbles and they form chains of flow lines. This is by far the worst of the plates (#2, #3, & #4) placed on same day as far as general appearance and numbers of small bubbles are concerned. The cut grooves appear to have had little, if any effect on the pattern of these bubbles. This was the last plate done on this day.

PLATE NO. 2

1. Peripherial bubbles about nipples?

   #1 (South) No   #3 No

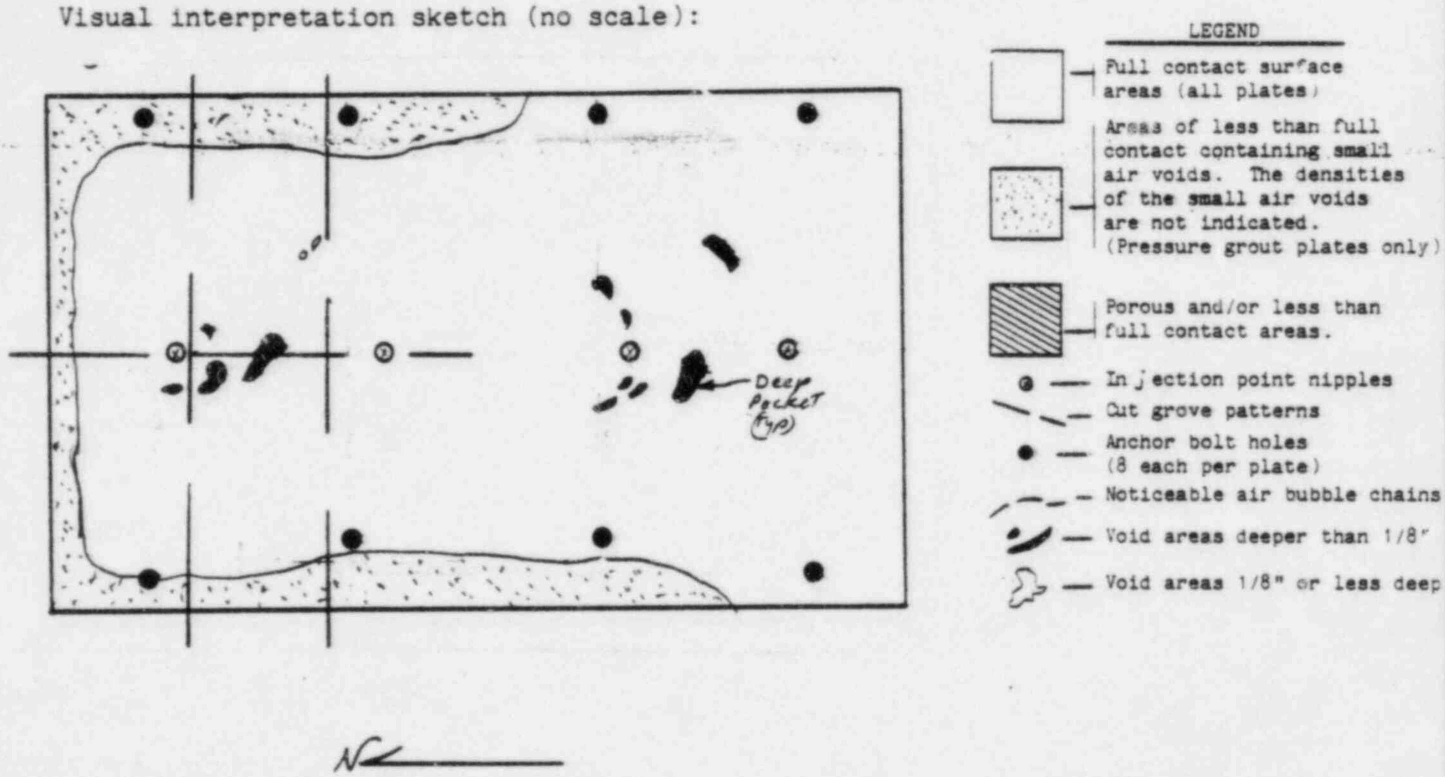
   #2 Yes, Several (one 2½" x 1½")   #4 (North) Yes, (two 1" x ½" & 3½" x ½")

2. Air noted in underslab notch grout projections? Yes, Minor

3. Grout leakdown at air vent holes? n/a
   Leadwool/exp. metal bulkhead

4. Noticeable general air bubble pattern? Yes, minor

   Visual interpretation sketch (no scale):



5. Calculated void area in excess of 1/4" Ø nominal sizing = .05% percent of surface area.

6. General quality evaluation of grout/concrete contact area.
   North ½: Poor, satisfactory, (good), excellent
   South ½: Poor, satisfactory, (good), excellent

7. General evaluation of test plate: The grooved end seemed to have more small air bubbles than the non-grooved end. Both ends had several large trapped air pockets. In general, the non-grooved end looked better. Steel plate size should be increased to account for approximately 3/4" to 1"± grout pad loss, due to lead-wool packing.

PLATE NO. 3

1. Peripherial bubbles about nipples?

   #1 (South) No   #3 Yes, 4 deep approx. 1½" long

   #2 Yes, one (2½" x 1½")   #4 (North) Yes, shallow & minor

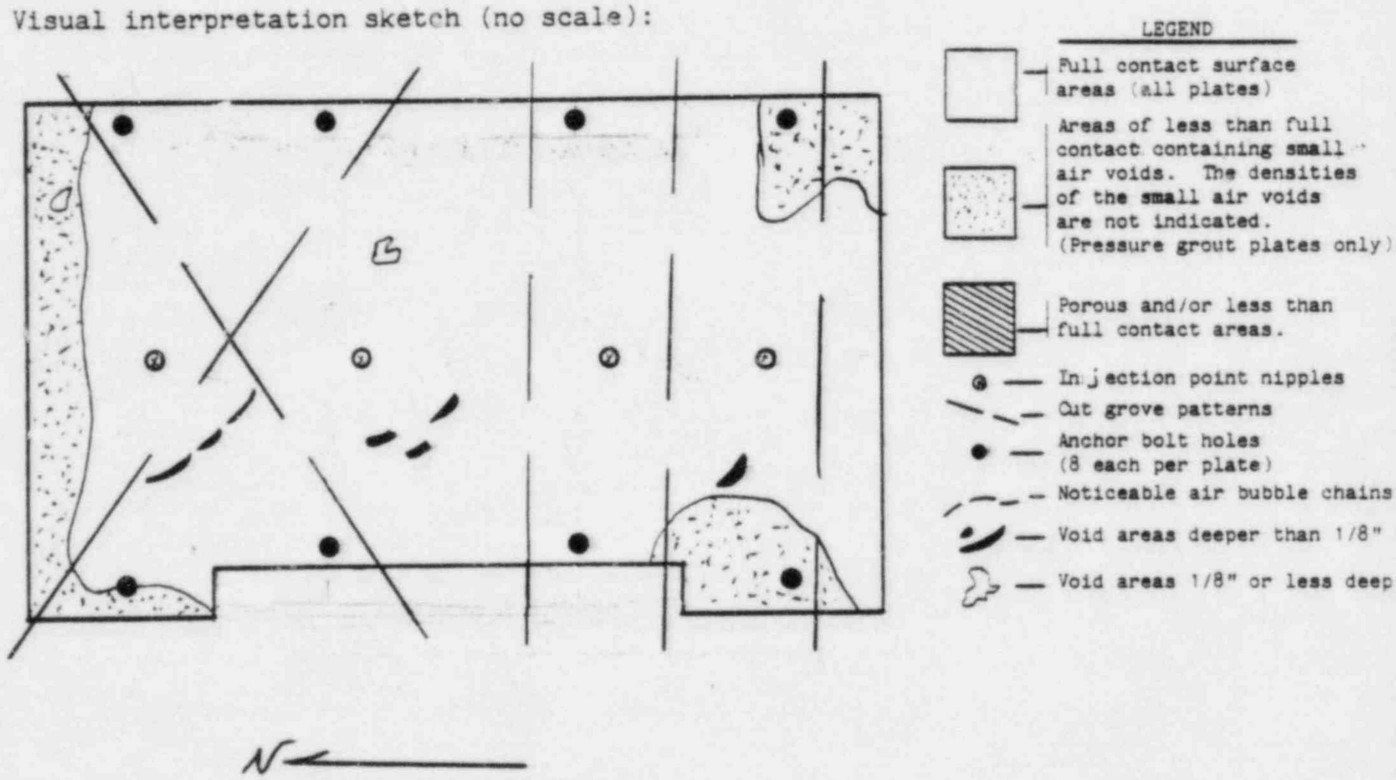
2. Air noted in underslab notch grout projections? Yes, minor

3. Grout leakdown at air vent holes? n/a

   Lead wool/Exp. metal bulkhead

4. Noticeable general air bubble pattern? Yes, minor

   Visual interpretation sketch (no scale):



5. Calculated void area in excess of 1/4" Ø nominal sizing = 0.7% percent of surface area.

6. General quality evaluation of grout/concrete contact area.

   North ½: Poor, satisfactory, (good) excellent
   South ½: Poor, satisfactory, (good) excellent

7. General evaluation of test plate: Overall grout/cement contact surface is good; however, the leadwool packing bulkhead undercuts the grout pad so plate size would have to be increased. No noticable difference between the cut groove patterns.

PLATE NO. 4

1. Peripherial bubbles about nipples?

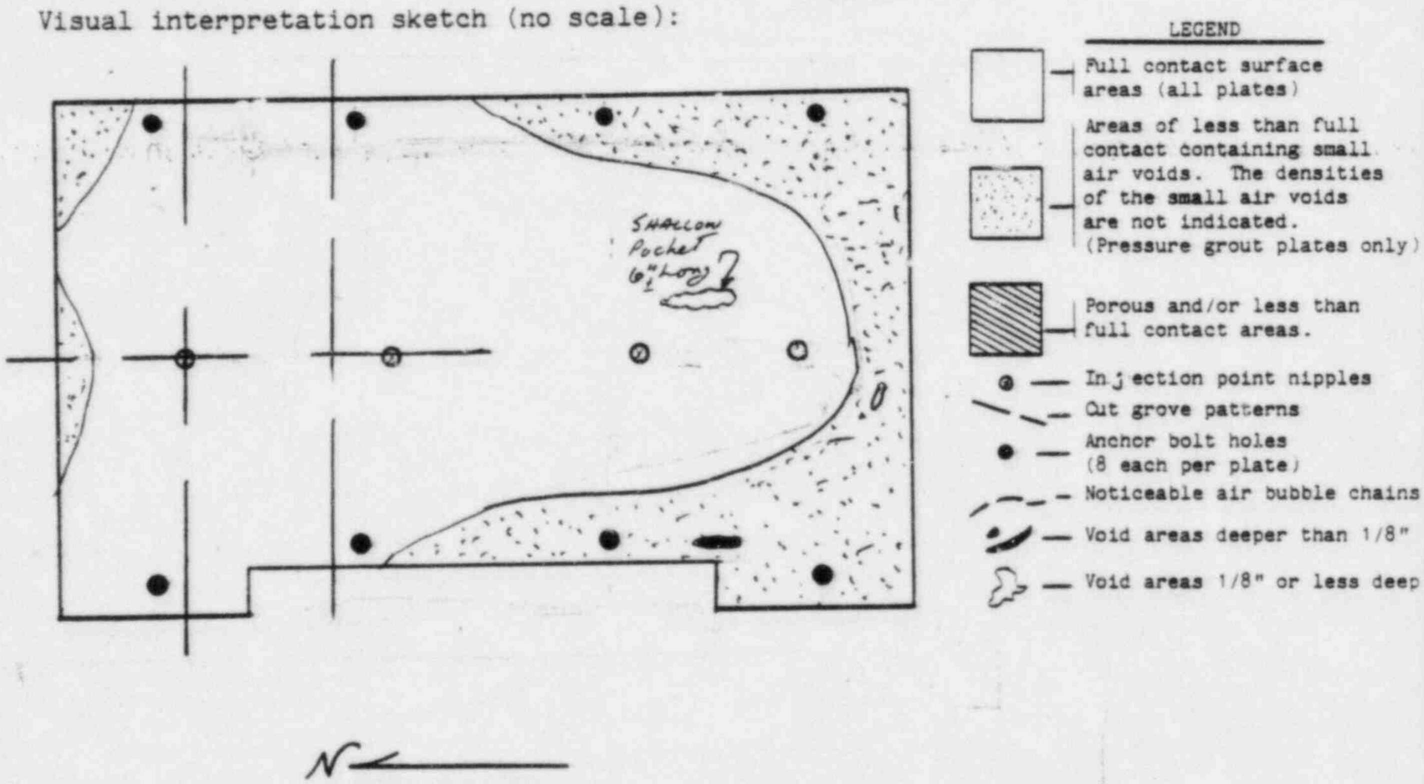
#1 (South) No | #3 No
#2 No | #4 (North) Yes, one

2. Air noted in underslab notch grout projections? Yes

3. Grout leakdown at air vent holes? No, one wood plug too deeply inserted, though.

4. Noticeable general air bubble pattern? Yes

Visual interpretation sketch (no scale):



5. Calculated void area in excess of 1/4" Ø nominal sizing = 1.2% percent of surface area.

6. General quality evaluation of grout/concrete contact area.

North ½: Poor, satisfactory, (good) excellent
South ½: Poor, satisfactory, (good) excellent

7. General evaluation of test plate: The wooden bulkhead with wooden grout hole plugs seem to have worked quite well. No major advantages noted for grooved half.

PLATE NO. 5 - Masterflow #713 Drypack

1. Peripherial bubbles about nipples?

   #1 (South) n/a   #3 n/a

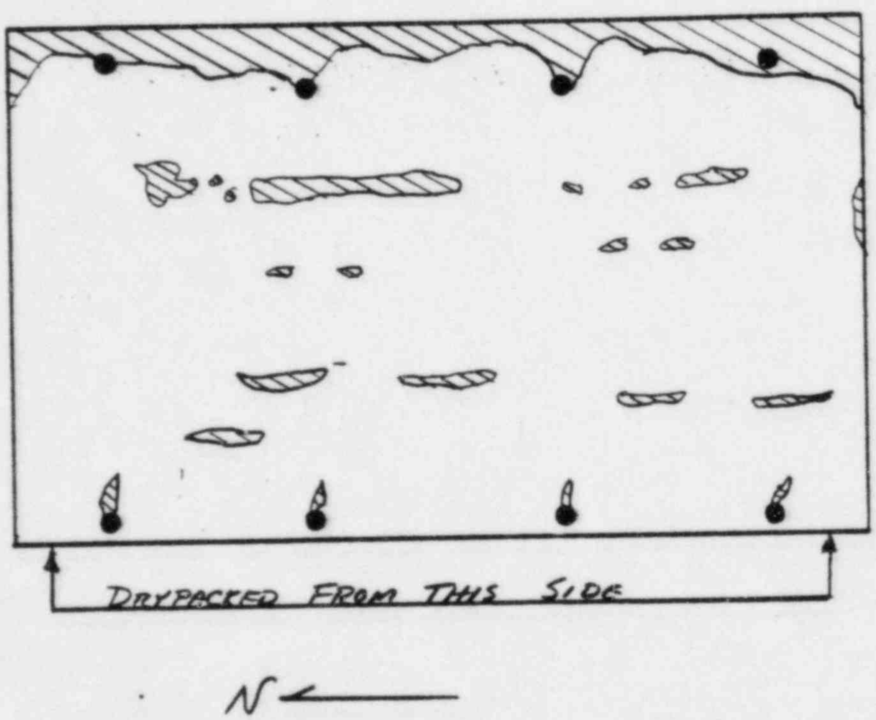
   #2 n/a   #4 (North) n/a

2. Air noted in underslab notch grout projections? n/a

3. Grout leakdown at air vent holes? n/a

4. Noticeable general void pattern? Yes

   Visual interpretation sketch (no scale):



LEGEND

- Full contact surface areas (all plates)
- Areas of less than full contact containing small air voids. The densities of the small air voids are not indicated. (Pressure grout plates only)
- Porous and/or less than full contact areas.
- Injection point nipples
- Cut grove patterns
- Anchor bolt holes (8 each per plate)
- Noticeable air bubble chains
- Void areas deeper than 1/8"
- Void areas 1/8" or less deep

5. Calculated void area in excess of 1/4" Ø nominal sizing = 14.0% percent of surface area.

6. General quality evaluation of grout/concrete contact area.

   North ½: (Poor) satisfactory, good, excellent
   South ½: Poor, (satisfactory) good, excellent

7. General evaluation of test plate: General appearance of concrete/grout contact surface is lesser than the worst fluid pumped grout test plate.

PLATE NO. 5A - Masterflow #713 Drypack

1. Peripherial bubbles about nipples?

   #1 (South) n/a　　#3 n/a

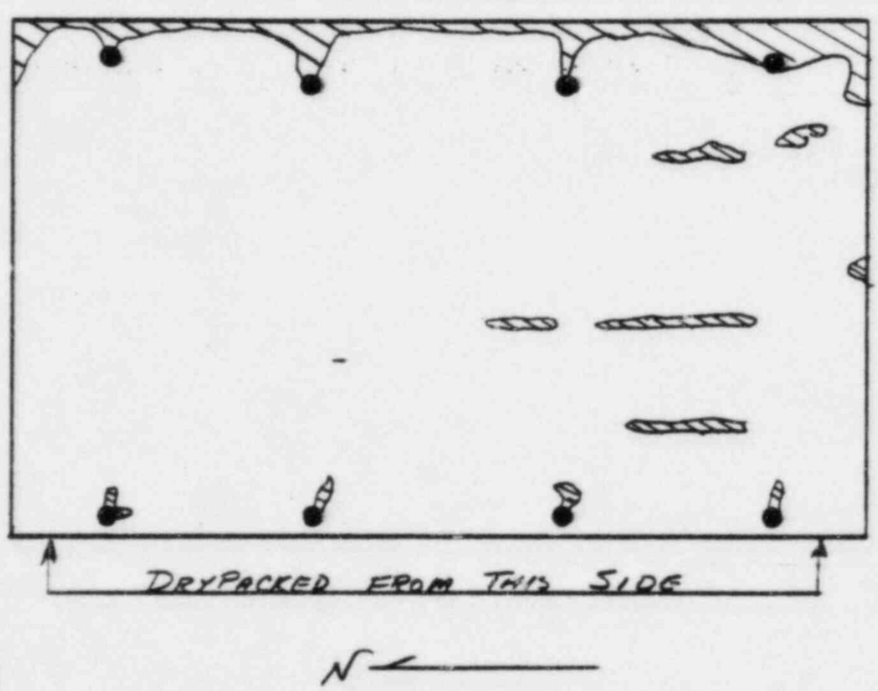
   #2 n/a　　#4 (North) n/a

2. Air noted in underslab notch grout projections? n/a

3. Grout leakdown at air vent holes? n/a

4. Noticeable general void pattern? Yes

   Visual interpretation sketch (no scale):



LEGEND

- Full contact surface areas (all plates)
- Areas of less than full contact containing small air voids. The densities of the small air voids are not indicated. (Pressure grout plates only)
- Porous and/or less than full contact areas.
- Injection point nipples
- Cut grove patterns
- Anchor bolt holes (8 each per plate)
- Noticeable air bubble chains
- Void areas deeper than 1/8"
- Void areas 1/8" or less deep

5. Calculated void area in excess of 1/4" Ø nominal sizing = 7.0% percent of surface area.

6. General quality evaluation of grout/concrete contact area.

   North ½: Poor, satisfactory, (good) excellent

   South ½: Poor, (satisfactory) good, excellent

7. General evaluation of test plate: General appearance of contact surface is not as good as best pumped grout test plate, but as good as the worst.

PLATE NO. 5B - Sand/Cement Drypack

1. Peripherial bubbles about nipples?

   #1 (South) n/a   #3 n/a

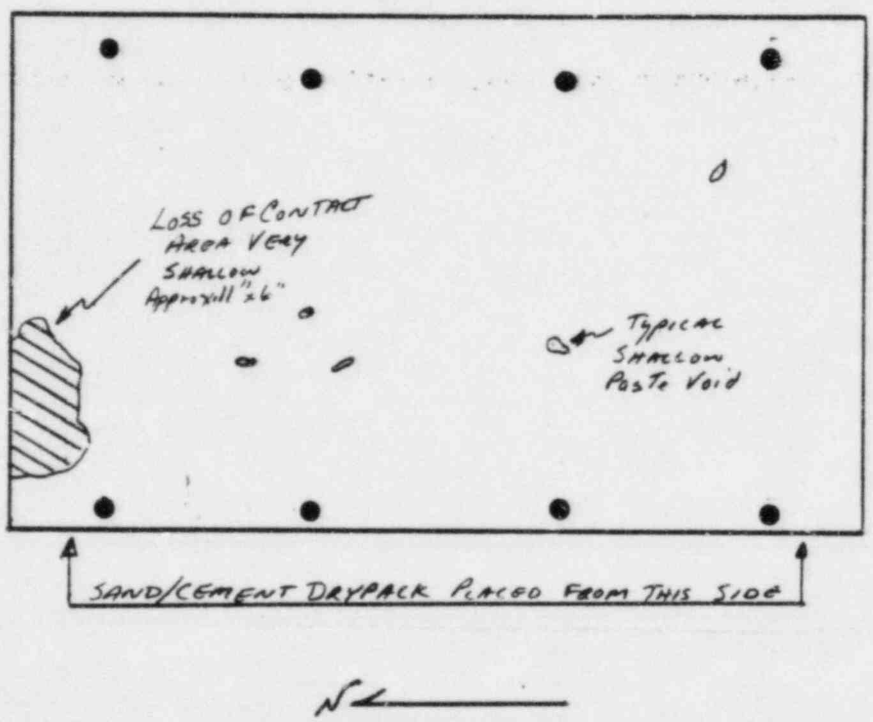
   #2 n/a   #4 (North) n/a

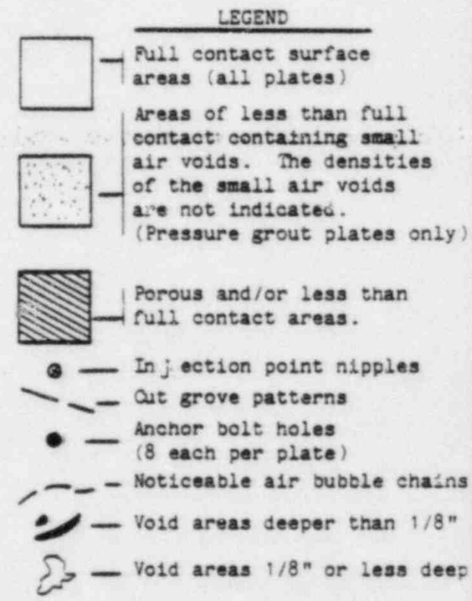
2. Air noted in underslab notch grout projections? n/a

3. Grout leakdown at air vent holes? n/a

4. Noticeable general void pattern? No

   Visual interpretation sketch (no scale):





5. Calculated void area in excess of 1/4" Ø nominal sizing = 2.49% percent of surface area. Neglecting lost contact area = 0.1%

6. General quality evaluation of grout/concrete contact area.

   North ½: Poor, satisfactory, (good) excellent
   South ½: Poor, satisfactory, good, (excellent)

7. General evaluation of test plate: Good sound plate, most voids were in surface paste only. Test plate was solid, however, it appears that some, if not all of the West side anchor bolts have slipped some in the final stages of packing. Basic grout pad thickness is 1½", but West face is 1 3/4" at N&S ends and 2" at midpoint. This is probably when large lost contact area was developed.

PLATE NO. 6

1. Peripherial bubbles about nipples?

   #1 (South) n/a #3 n/a

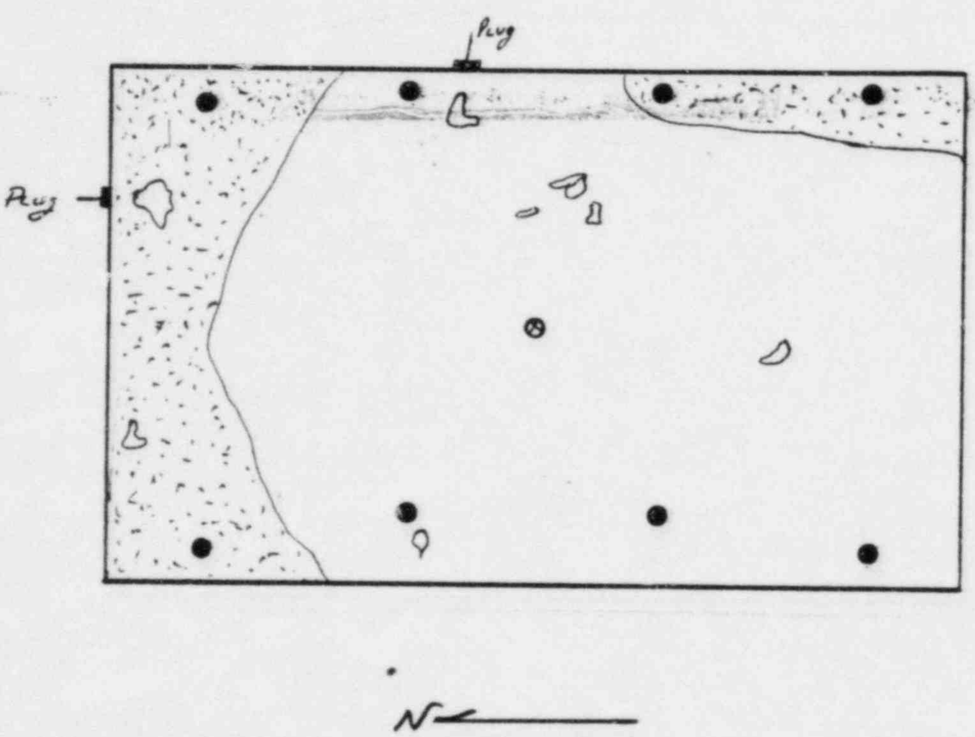
   #2 n/a #4 (North) n/a

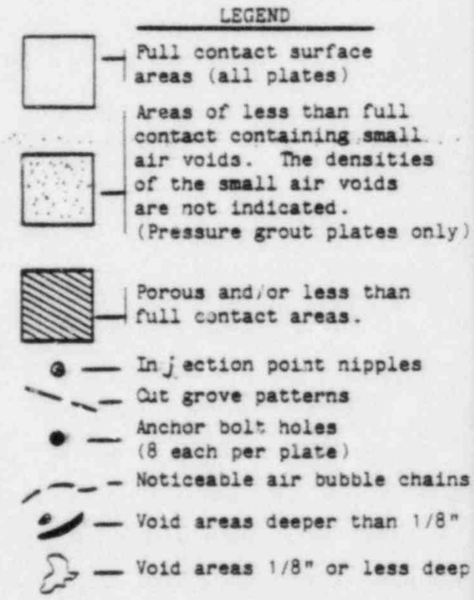
2. Air noted in underslab notch grout projections? n/a

3. Grout leakdown at air vent holes? Yes, at 2 locations, both are lead wool plugs (3" x 2") at North end east plug & 1½" x ½" at East side north middle plug , both are shallow depressions.

4. Noticeable general air bubble pattern? Yes, minor

   Visual interpretation sketch (no scale):





5. Calculated void area in excess of 1/4" Ø nominal sizing = 0.8% percent of surface area.

6. General quality evaluation of grout/concrete contact area.

   North ½: Poor, satisfactory, (good) excellent
   South ½: Poor, satisfactory, (good) excellent

7. General evaluation of test plate: The scarrified contact surface is so irregular that it is hard to evaluate with grooved and non-grooved test plates. Again, the lead wool grout plugs penetrate into grout slab at approximately 3/4". Overall evaluation is that this appears to be one of the better looking less flawed test plates.

PLATE NO. 7

1. Peripherial bubbles about nipples?

   #1 (South) n/a — #3 n/a

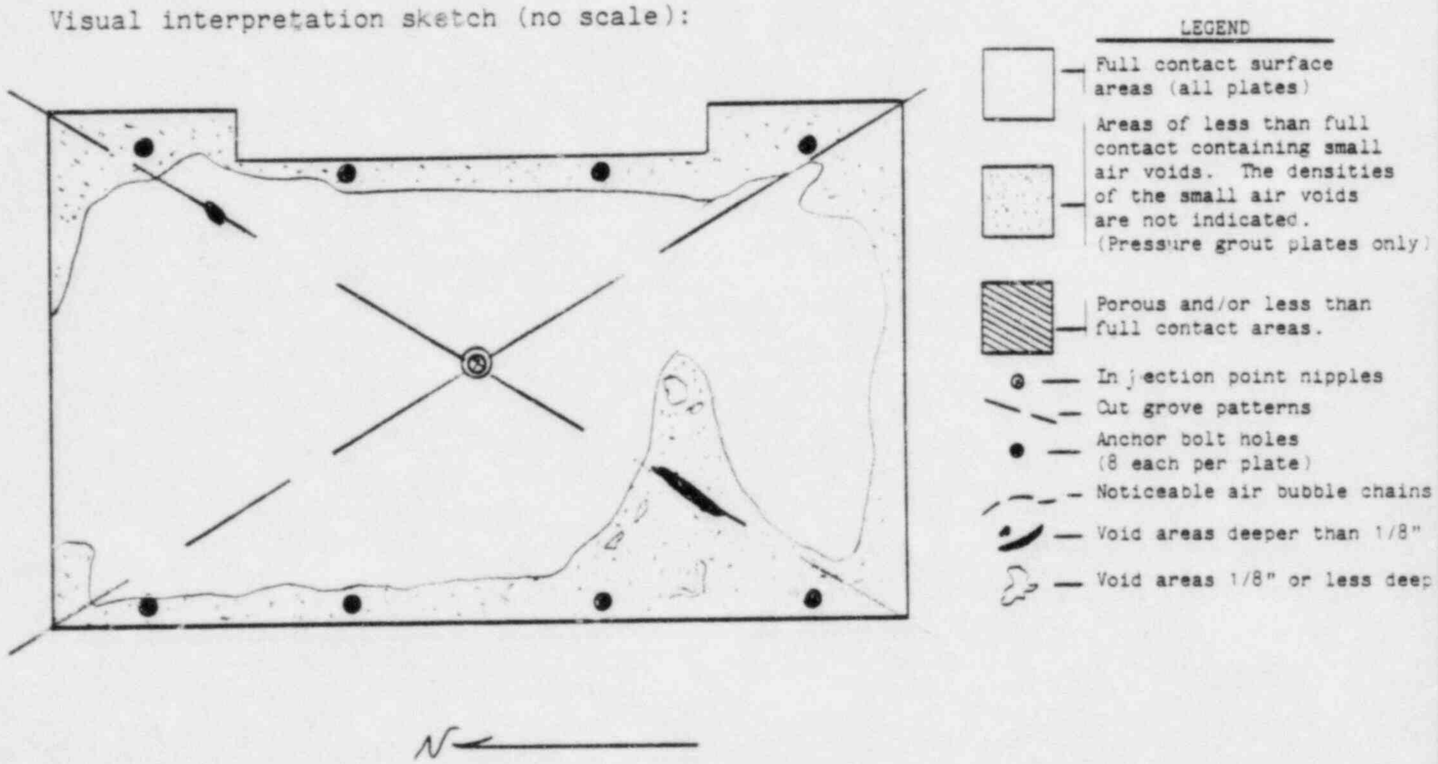
   #2 No — #4 (North) n/a

2. Air noted in underslab notch grout projections? Yes

3. Grout leakdown at air vent holes? No

4. Noticeable general air bubble pattern? Yes, minor

   Visual interpretation sketch (no scale):



5. Calculated void area in excess of 1/4" Ø nominal sizing = 0.5% percent of surface area.

6. General quality evaluation of grout/concrete contact area.

   North ½: Poor, satisfactory, (good) excellent
   South ½: Poor, satisfactory, (good) excellent

7. General evaluation of test plate: The expansion bolts on the East side appear to have pulled or never were snug at 1½". Grout pad thickness increased up to 2½" nominally. Overall evaluation is as good as plate #6. No advantage noted due to fountain or cut grooves.

PLATE NO. 8

1. Peripherial bubbles about nipples?

   #1 (South) n/a   #3 n/a

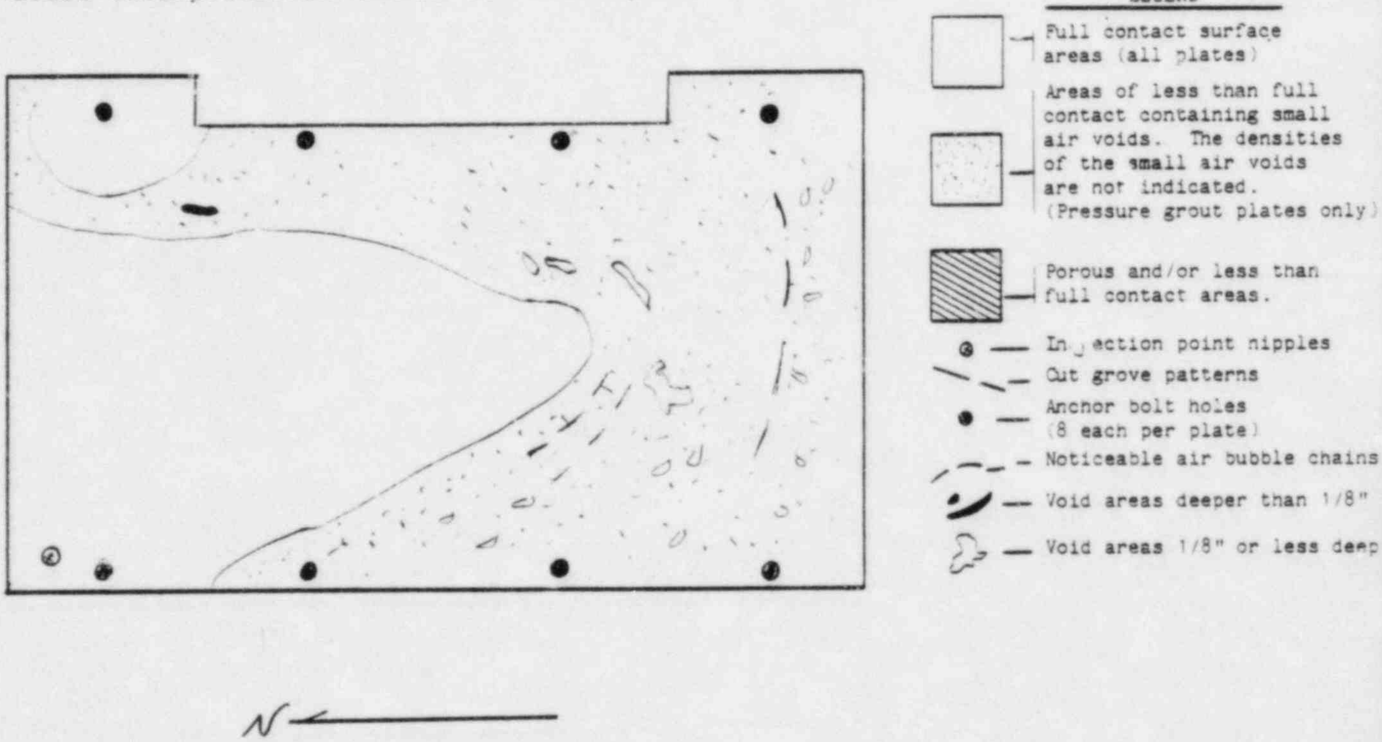
   #2 n/a   #4 (North) No, (in West corner)

2. Air noted in underslab notch grout projections? n/a

3. Grout leakdown at air vent holes? No

4. Noticeable general air bubble pattern? Yes

   Visual interpretation sketch (no scale):



5. Calculated void area in excess of 1/4" Ø nominal sizing = 0.9% percent of surface area.

6. General quality evaluation of grout/concrete contact area.

   North ½: Poor, satisfactory, (good), excellent
   South ½: Poor, (satisfactory), good, excellent

7. General evaluation of test plate: General condition evaluation is that this plate is no worse than plate #1. One injection nipple in the corner gives a lesser quality product than one in the middle of the plate.

OVERHEAD FLUID GROUTING TEST PROGRAM

EXHIBIT C

LABORATORY TEST DATA

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 7220
REPORT OF NON-SHRINK GROUT TESTS

INFORMATION TEST ONLY

1. Placement Identification: NON - Q (TRAINING) Lot No.: *B2662Q3 Exp. Date: 9-84	2. Date Placed: 6-28-83
3. Placement Location: POSEYVILLE LAY DOWN AREA	
3A. PLANT DATA — Source: MERGENTIME HANDMIXER	Grout Brand & Type: MASTERBUILDERS MASTERFLOW 713 FLOW GROUT
4. Mix: 713 FLOW GROUT — 5. Class: II — 6. "Q" List: ☐ Yes ☒ No	7. Required Strength: 4000 PSI At 28 Days
8. Test Data At: @ HANDMIXER IN POSEYVILLE LAY DOWN AREA	9. Stopwatch: 695 — Calibration Date: 11-3-83
10. Flow Data CRD 611-80 Time of Efflux (Sec): No. 1 19.1 No. 2 27.1 No. 3 31.1 Average 25.8 Sec	11. Flowcone: 498 — Calibration Date: 7-22-83
12. Thermometer: 211 — Calibration Date: 9-5-83 — 13. Temp.: Grout 61 °F — 14. Temp.: Air 67 °F	15. Initials: LH SF 6-28-83
16. Initial Curing Thermometer: 780 — Calib. Date: 10-26-83 — 17. Time of Testing: 1331 Hrs at 1 Bags	18. Time of Molding: 1343 Hrs
19. Initial Curing ~~ASTM-C-31-69~~ SF 6-28-83: 71 °F To 77 °F — 20. Stripped ASTM-C109-75: 6-29-83 At 1155 Hrs	21. Initials: SF 6-29-83

COMPRESSIVE STRENGTH DATA ASTM-C-109-75

22. Specimen Identification	23. Date Molded	24. Date Tested	25. Age	26. Total Load in Pounds	27. Actual Cube Dim.	28. Actual Cube Area	29. Type of Break	30. Cure Field	30. Cure Lab	31. Strength PSI
G164 — 2491	6-28-83	7-1-83	3	16,750	2x2	4.0	A	1	2	4,188
2492	↓	↓	3	16,450	2x2	4.0	A	1	2	4,112
2493			3	16,450	2x2	4.0	A	1	2	4,112
Average		7-1-83	3							4,170 ~~4110~~ SF 7-1-83
2494		7-5-83	7	25,200	2x2	4.0	A	1	6	6,300
2495		↓	7	26,150	2x2	4.0	A	1	6	6,538
2496			7	26,300	2x2	4.0	A	1	6	6,575
G164 Average	6-28-83	7-5-83	7							6,470

32. Specimen Size: ☒ 2" x 2" Cube ☐ Other

37. Remarks: * NON - ACCEPTED GROUT

33. Age (Days)	34. Tested By	35. Checked By	36. Reviewed by Q.C.
3	RZ	[initials] 7-4-83 SF 7-2-83	
7	(RTB) KK	[initials] 7-7-83 SF 7-6-83	

38. Laboratory Supervisor Signature:

39. Date:

Type of Breaks: A-Cone. Mortar Failure C-Shear. Mortar Failure E-Other

QCF-74 Rev. 1

G. -0213-1

UNITED STATES TESTING COMPANY, INC.

TRAINING- INFO ONLY!

CEMENT LOCATION: POSEYVILLE LAYDOWN AREA DATE 6-28-83

CEMENT IDENTIFICATION: NON "Q" TRAINING GROUT TYPE: MASTER BUILDERS 713 FLOW GROUT MASTER FLOW

FLOW DATA CRD-C-611-80/QCP-18

Test Number #	1	2	3	4
Set Number #	~~G-164~~ LH 6-28-83 WA	G-164		
Time of Sample	1312	1331		
Ambient Temperature (°F)	71	67		
Grout Bag Temperature (°F)	75	75		
Water Temperature (°F)	66	44		
Mix Temperature (°F)	73	61		
Flow Data				
First (sec.)	22.8	19.1		
Second (sec.)	42.4	27.1		
Third (sec.)	*	31.1		
. (sec.)		25.8		
Tested By	SF, LH 6-28-83	SF, LH 6-28-83		

Equipment Data	M & ID Number	Calibration Due Date
Flow Cone	498	7-22-83
Thermometer	211	9-5-83
Stopwatch	695	11-3-83

Lot Number: B2662Q3 Expiration Date: 9-84 IR No. N/A

Struck off @ 1435 Hrs. on 6-28-83, after initial set.

Workability ended @ N/A Hrs. on N/A

Remarks:

"NON-ACCEPTED" GROUT

* BROKE EARLY

mold @ 1343

INFORMATION TEST ONLY

Checked by: SF

Date: 6-29-83 7-9-83

MEI 123W 6-3-83

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 7220

REPORT OF NON-SHRINK GROUT TESTS

) INFORMATIC... TEST ONLY

1. Placement Identification: NON "Q" -- TRAINING Lot No.: *B266203 Exp. Date: 9-84	2. Date Placed: 6-29-83
3. Placement Location: POSEYVILLE LAYDOWN AREA	
3A. PLANT DATA — Source: MERGENTIME HAND MIXER	Grout Brand & Type: MASTER BUILDERS MASTERFLOW 713 FLOW GROUT
4. Mix: 713 FLOW GROUT; 5. Class: II; 6. "Q" List: ☐ Yes ☒ No	7. Required Strength: 4000 PSI At 28 Days
8. Test Data At: MERGENTIME HANDMIXER POSEYVILLE LAYDOWN AREA	9. Stopwatch: 695; Calibration Date: 11-3-83
10. Flow Data CRD 611-80 Time of Efflux (Sec): No. 1 18.5 No. 2 24.7 No. 3 29.3 Average 24.2 Sec	11. Flowcone: 498; Calibration Date: 7-22-83
12. Thermometer: 211; Calibration Date: 9-5-83; 13. Temp.: Grout 63 °F	14. Temp.: Air 78 °F; 15. Initials: SF, LH 6-29-83
16. Initial Curing Thermometer: 783; Calib. Date: 12-16-83; 17. Time of Testing: 1307 Hrs at 1 Bags	18. Time of Molding: 1320 Hrs
19. Initial Curing ~~ASTM-C-31-69~~ LH 6-29-83: 74 °F To 78 °F; 20. Stripped ASTM-C109-75: 6-30-83 At 1028 Hrs	21. Initials: SF 6-30-83

COMPRESSIVE STRENGTH DATA ASTM-C-109-75

22. Specimen Identification	23. Date Molded	24. Date Tested	25. Age	26. Total Load in Pounds	27. Actual Cube Dim.	28. Actual Cube Area	29. Type of Break	30. Cure Field	Lab	31. Strength PSI
G-166 2515	6-29-83	7-2-83	3	14,475	2x2	4.0	A	1	2	3,619
2516	↕	↕	3	14650	2x2	4.0	A	1	2	3,662
2517			3	14,475	2x2	4.0	A	1	2	3,619
G-166 Average	6-29-83	7-2-83	3							3,630
2518	↕	7-6-83	7	25,000	2x2	4.0	A	1	6	6,250
2519		↕	7	23,000	2x2	4.0	A	1	6	5,750
2520			7	23,500	2x2	4.0	A	1	6	5,875
G-166 Average	6-29-83	7-6-83	7							5,960

32. Specimen Size: ☒ 2" x 2" Cube ☐ Other

37. Remarks: *"NON-ACCEPTED GROUT"

33. Age (Days)	34. Tested By	35. Checked By	36. Reviewed by Q.C.
3	PB	PB 7-6-83 SF 7-5-83	
7	KD	KD 7-9-83 SF 7-7-83	

38. Laboratory Supervisor Signature:

39. Date:

G/M-0213-1

Type of Breaks: A-Cone. Mortar Failure C-Shear. Mortar Failure E-Other

QCF-74 Rev. 1

UNITED STATES TESTING COMPANY, INC.

INFORMATION TEST ONLY

PLACEMENT LOCATION: POSEYVILLE LAYDOWN AREA DATE: [illegible]

PLACEMENT IDENTIFICATION: NON "Q" TRAINING GROUT TYPE: MASTER BUILDERS 713 FLOW GROUT MASTER FLOW

FLOW DATA CRD-C-611-80/QCP-18

Test Number #	1	2	3	4
Set Number #	G-166			
Time of Sample	1307			
Ambient Temperature (°F)	78			
Grout Bag Temperature (°F)	74			
Water Temperature (°F)	46			
Mix Temperature (°F)	63			
Flow Data				
First (sec.)	18.5			
Second (sec.)	24.7			
Third (sec.)	29.3 -			
Avg. (sec.)	24.2 -			
Tested By	SF, LH 6-29-83			

Equipment Data	M & TE Number	Calibration Due Date
Flow Cone	498	7-22-83
Thermometer	211	9-5-83
Stopwatch	695	11-3-83

Lot Number: * B2462 03 Expiration Date: 9-84 IR No. N/A

Struck off @ 1400 Hrs. on 6-29-83, after initial set.

Workability ended @ N/A Hrs. on N/A

Remarks:

* "NON-ACCEPTED" GROUT

4000 PSI @ 28 DAYS

molded @ 1320

Checked by: SF [illegible]

Date: 6-30-83 7-6-83

MEI 123W 6-3-83

INFORMATION

TEST ONLY

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 7220

REPORT OF NON-SHRINK GROUT TESTS

1. Placement Identification: NON "Q" - TRAINING Lot No.: * B266202 Exp. Date: 9-84

2. Date Placed: 6-29-83

3. Placement Location: POSEYVILLE LAYDOWN AREA

3A. PLANT DATA — Source: MERGENTIME HAND MIXED — Grout Brand & Type: MASTER BUILDERS MASTERFLOW 713 DRYPACK

4. Mix: 713 DRY PACK

5. Class: II

6. 'Q' List: ☐ Yes ☑ No

7. Required Strength: 4000 PSI At 28 Days

8. Test Data At: MERGENTIME HANDMIXED POSEYVILLE LAYDOWN AREA

9. Stopwatch: N/A Calibration Date: N/A —

10. Flow Data CRD 611-80 Time of Efflux (Sec) No. 1 N/A No. 2 N/A No. 3 N/A Average N/A Sec

11. Flowcone: N/A Calibration Date: N/A

12. Thermometer: 211 Calibration Date: 9-5-83

13. Temp.: Grout 87 °F

14. Temp.: Air MIX 82 / PLACEMENT 77 °F

15. Initials: SF, LH 6-29-83

16. Initial Curing Thermometer: 758 Calib. Date: 9-22-83

17. Time of Testing: 1442 Hrs at 1 Bags

18. Time of Molding: 1444 Hrs

19. Initial Curing ASTM-C-31-69 ______ °F To ______ °F

20. Stripped ASTM-C109-75 ______ At ______ Hrs

21. Initials

COMPRESSIVE STRENGTH DATA ASTM-C-109-75 TAMPER: 741 / 8-3-83

22. Specimen Identification	23. Date Molded	24. Date Tested	25. Age	26. Total Load In Pounds	27. Actual Cube Dim.	28. Actual Cube Area	29. Type of Break	30. Cure Field	Lab	31. Strength PSI
G-168F 2539	6-29-83	7-2-83	3	35,150	2x2	4.0	A	3	0	8788
2540	↓	↓	3	35,100	2x2	4.0	A	3	0	8,775
2541			3	35,150	2x2	4.0	A	3	0	8,788
G-168F Average	6-29-83	7-2-83	3							8,780
2542	↓	7-6-83	7	39,000	2x2	4.0	C	7	0	9,750
2543		↓	7	39,500	2x2	4.0	C	7	0	9,875
2544			7	37,000	2x2	4.0	C	7	0	9,250
G-168F Average	6-29-83	7-6-83	7							9,620

32. Specimen Size: ☒ 2" x 2" Cube ☐ Other

33. Age (Days)	34. Tested By	35. Checked By	36. Reviewed by Q.C.
3	LH	CD 7-6-83 SF 7-5-83	
7	BW	HJ 7-9-83 SF 7-7-83	

37. Remarks

* "NON-ACCEPTED GROUT"

⊛ DURING 6-30-83 SPECIMEN PICK UP OF 28 & HOLD CUBES MOLDS WOOD COVERING MOLDS REPLACED SINCE THEY WERE REMOVED BY SOMEONE AFTER MOLDING

38. Laboratory Supervisor Signature

39. Date

Type of Breaks: A-Con Mortar Failure C-Shear. Mortar Failure E-Other

QCF-74 Rev. 1

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 7220

REPORT OF NON-SHRINK GROUT TESTS

INFORMATION TEST ONLY

1. Placement Identification: NON "Q"—TRAINING	Lot No.: * B2474 P3 Exp. Date: 8-84	2. Date Placed: 7-1-83
3. Placement Location: POSEYVILLE LAYDOWN AREA		
3A. PLANT DATA — Source: HAND MIXED BY MERGENTIME	Grout Brand & Type: MASTER BUILDERS MASTERFLOW 713 DRYPACK	
4. Mix: 713 DRYPACK	5. Class: II	6. "Q" List: ☐ Yes ☑ No
7. Required Strength: 4000 PSI At 28 Days		
8. Test Data At: HAND MIXED BY MERGENTIME POSEYVILLE LAYDOWN AREA	9. Stopwatch: N/A	Calibration Date: N/A
10. Flow Data CRD 611-80 Time of Efflux (Sec) No. 1 N/A No. 2 N/A No. 3 N/A Average N/A Sec	11. Flowcone: N/A	Calibration Date: N/A
12. Thermometer: 211 Calibration Date: 9-5-83	13. Temp.: Grout 77 °F	14. Temp.: Air MIX 80 / PLACEMENT 78 °F
15. Initials: SF, LH 7-1-83		
16. Initial Curing Thermometer: 779 Calib. Date: 10-26-83	17. Time of Testing: 1020 Hrs at 1 Bags	18. Time of Molding: 1022 Hrs
19. Initial Curing ASTM-C-31-69: 67 °F To 81 °F	20. Stripped ASTM-C109-75: 7-2-83 At 1442 Hrs	21. Initials: SF 7-2-83

COMPRESSIVE STRENGTH DATA ASTM-C-109-75 TAMPER: 741 / 8-3-83

22. Specimen Identification	23. Date Molded	24. Date Tested	25. Age	26. Total Load in Pounds	27. Actual Cube Dim.	28. Actual Cube Area	29. Type of Break	30. Cure Field	Lab	31. Strength PSI
G-171F 2563	7-1-83	7-4-83	3	33,000	2x2	4.0	A	3	0	8,250
2564	↓	↓	3	31,250	2x2	4.0	A	3	0	7,812
2565	↓	↓	3	30,250	2x2	4.0	A	3	0	7,562
G-171F Average	7-1-83	7-4-83	3							7870
2566	↓	7-8-83	7	33,500	2x2	4.0	A	7	0	8,375
2567	↓	↓	7	33,500	2x2	4.0	A	7	0	8,375
2568	↓	↓	7	33,500	2x2	4.0	A	7	0	8,375
G-171F Average	7-1-83	7-8-83	7							8,380

32. Specimen Size: ☒ 2" x 2" Cube ☐ Other

37. Remarks: * "NON-ACCEPTED" GROUT

33. Age (Days)	34. Tested By	35. Checked By	36. Reviewed by Q.C.
3	PB	PB 7-6-83 SF 7-5-83	
7	RTB	PB 7-12-83 SF 7-8-83	

38. Laboratory Supervisor Signature | 39. Date

Type of Breaks: A-Cone. Mortar Failure C-Shear. Mortar Failure E-Other

QCF-74 Rev. 1

BECHTEL POWER CORPORATION
MIDLAND NUCLEAR POWER PLANT JOB 7220
REPORT OF NON-SHRINK GROUT TESTS

INFORMATION TEST ONLY

1. Placement Identification: Mergentime Training — Lot No.: NA — Exp. Date: NA
2. Date Placed: 7-6-83
3. Placement Location: Poseyville Laydown Area
3A. PLANT DATA — Source: Mergentime Hand Mix — Grout Brand & Type: AETNA Type I Cement and Sand
4. Mix: Cement/Sand Dry Pack
5. Class: II
6. "Q" List: ☐ Yes ☑ No
7. Required Strength: 4000 PSI At 28 Days
8. Test Data At: Poseyville Laydown Area Mergentime
9. Stopwatch: NA — Calibration Date: NA
10. Flow Data CRD 611-80 Time of Efflux (Sec): No. 1 NA No. 2 NA No. 3 NA Average NA Sec
11. Flowcone: NA — Calibration Date: NA
12. Thermometer: 211 — Calibration Date: 9-5-83
13. Temp.: Grout 70 °F
14. Temp.: Air min 75 placement 78 °F
15. Initials: KH BW 7-6-83
16. Initial Curing Thermometer: 256 — Calib. Date: 9-22-83
17. Time of Testing: 1835 Hrs at 1 Bags
18. Time of Molding: 1835 Hrs
19. Initial Curing ~~ASTM-C-31-69~~ ASTM-C-31-69 (BW 7-6-83): 58 °F To 82 °F
20. Stripped ASTM-C109-75: 7-7-83 At 11:05 Hrs
21. Initials: KH BW 7-7-83

COMPRESSIVE STRENGTH DATA ASTM-C-109-75 — Tamper 241 8-3-83; #4 Sieve 239 9-18-83

22. Specimen Identification	23. Date Molded	24. Date Tested	25. Age	26. Total Load in Pounds	27. Actual Cube Dim	28. Actual Cube Area	29. Type of Break	30. Cure Field	Cure Lab	31. Strength PSI
G-184F 2692	7-6-83	7-9-83	3	35,500	2x2	4.0	A	3	0	8,875
2693	|	|	|	36,500	2x2	4.0	A	3	0	9,125
2694		|	|	~~35,500~~ 35000 (4 7-9-83)	2x2	4.0	A	3	0	8,750
Average	|	7-9-83	3							8.920
2695		7-13-83	7							
2696		|	|							
2697	|	|	|							
G-184F Average	7-6-83	7-13-83	7							

32. Specimen Size: ☑ 2" x 2" Cube ☐ Other

37. Remarks

33. Age (Days)	34. Tested By	35. Checked By	36. Reviewed by Q.C
3	KH	WD 7-12-83 / JF 7-11-83	

38. Laboratory Supervisor Signature — 39. Date

Type of Breaks: A-Cone. Mortar Failure C-Shear. Mortar Failure E-Other

QCF-74 Rev. 1

OVERHEAD FLUID GROUTING TEST PROGRAM

EXHIBIT D

PHOTOGRAPHICS

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N ← #1

6/28/83 GROUTING TEST SITE @ POSEYVILLE YARD.

N ← #2

6/28/83 GROUT MIX STATION FOR TEST PLATES #1 thru #4 POSEYVILLE YARD

#3 → N

6/28/83 U.S. TESTING - FLOW CONE SETUP FOR TEST PLATES #1 thru #4 ONE SUCCESSFULL TEST TAKEN FOR ALL PLATES PER MCP15.000 SECT. 11.2

#4 → N

6/28/83 GROUT PUMP SET UP
PUMP = AIRPLACO MODEL #HG-5, S.N. - 821121, PRESSURE GAGUE 0-60 PSI 2½" Ø DIAL
ALL APPEAR TO BE IN GOOD CONDITION.

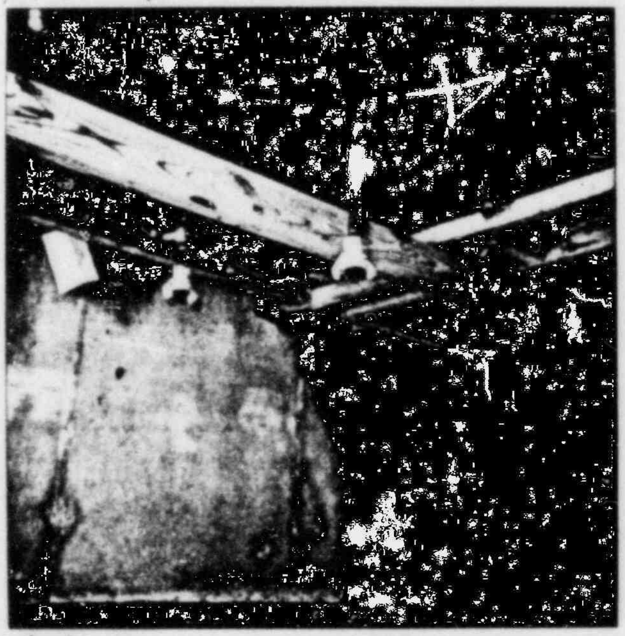
N ← #5

6/28/83 GROUTING TEST SITE NORTH BAY (PLATES #1—#4)
LOOKING EAST SHOWING WIND BREAK ON FAR END AND BULKHEAD with BRACING

N ← #6

6/28/83 WOODEN BULKHEAD AT PLATES #2 & #3. BOTH WITH LEADWOOL/EXP. METAL BEHIND

#7 → N

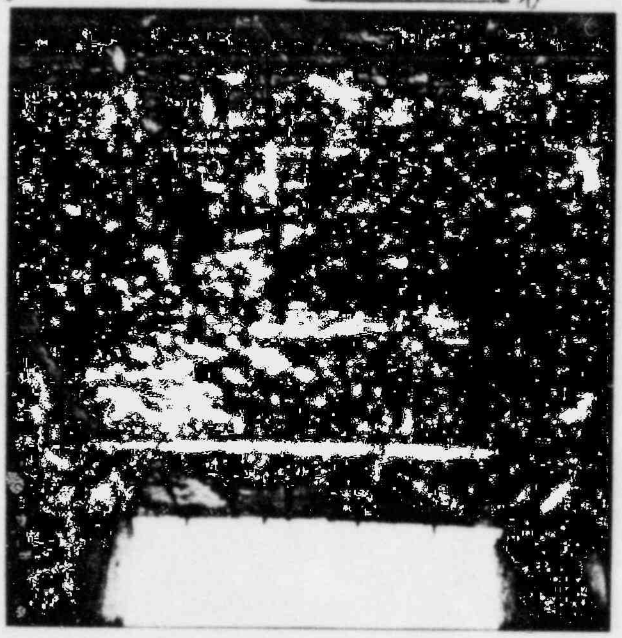


6/28/83 TYPICAL GROUT NIPPLE SET-UP WITH C.P. COUPLING, PIPE NIPPLE, VALVE and WELDED NIPPLE. (SHOWN @ PLATE No. 4)

#8 → N

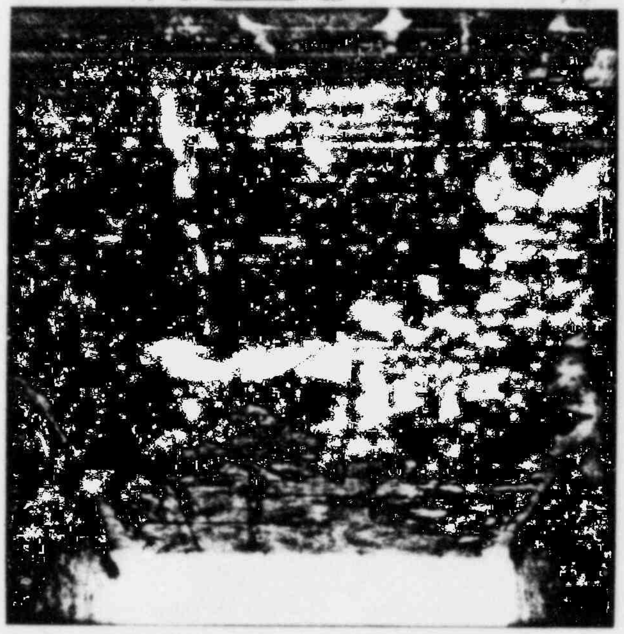
6/28/83 WOOD BULKHEAD WITH AIR VENTS PLUGGED @ EAST SIDE OF PLATE No. 4. PLATES SUPPORTED BY ANCHOR BOLTS ONLY

A #9 → N



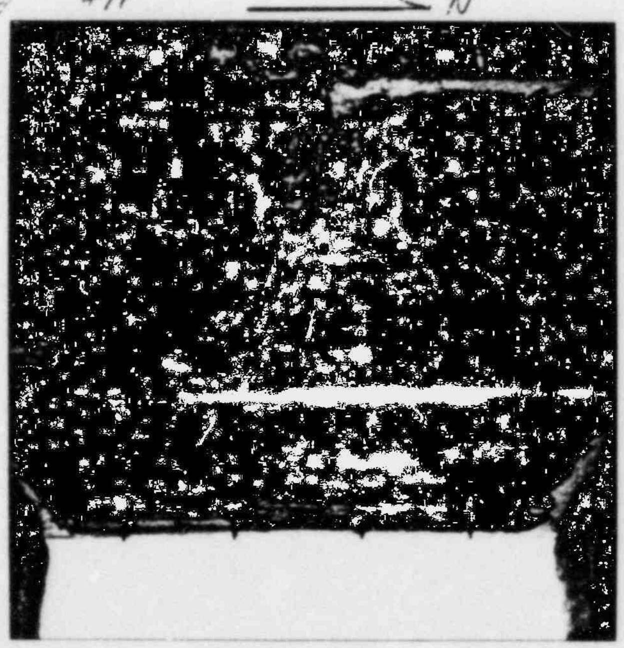
7/2/83 NORTH BAY UNDERSLAB LOOKING WEST. CUT GROVE PATERNS VISABLE.

N ← #10 A



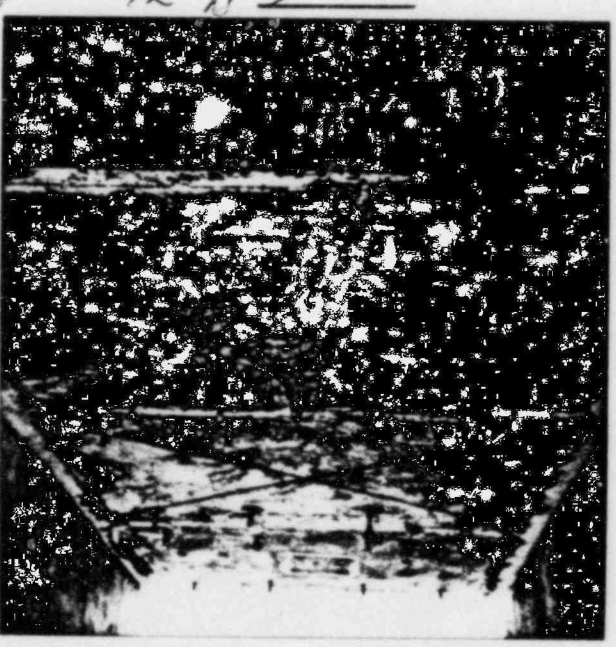
7/2/83 NORTH BAY UNDERSLAB LOOKING EAST. CUT GROVE PATTERNS VISABLE

A #11 → N



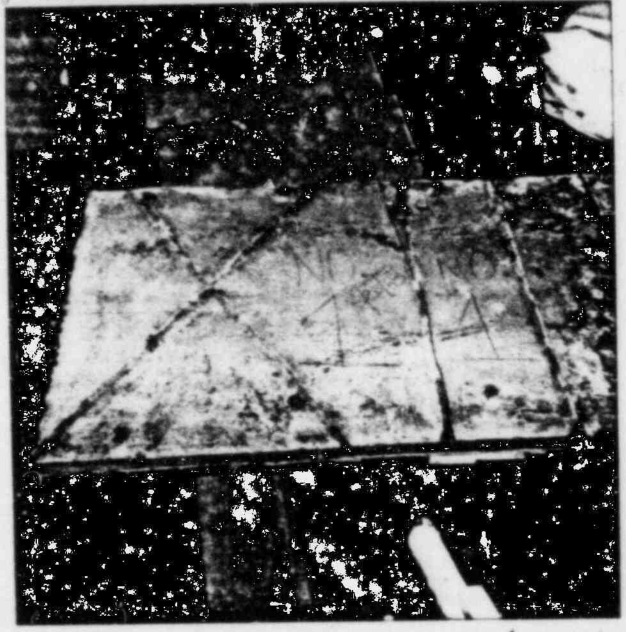
7/2/83 SOUTH BAY UNDERSLAB LOOKING WEST. SCARIFIED PAD #6 and DRYPACK PAD #5(#5A) AT FAR END

A #12 N ←



7/2/83 SOUTH BAY UNDERSLAB LOOKING EAST. SCARIFIED AND CUT GROOVES VISABLE.

N ← #13

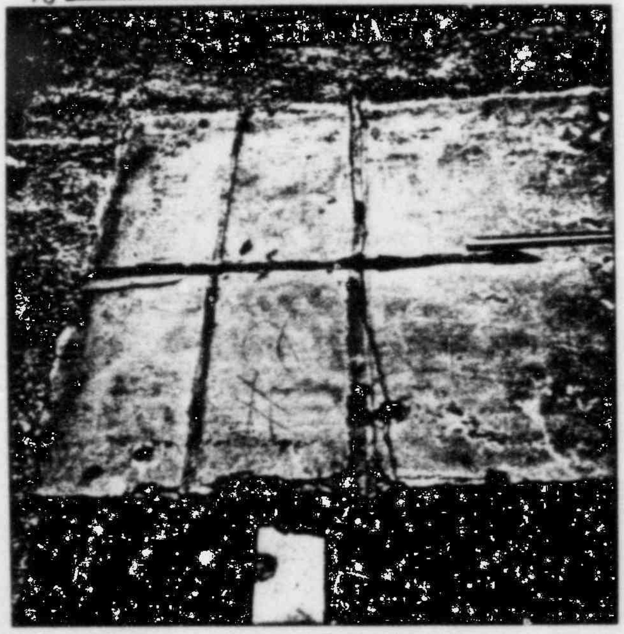


6/29/83 PLATE No. 1 (North END)
CONCRETE CUT "X" PATTERN, 4 NIPPLES FOR PLATE, WOOD BULKHEAD

N ← #14

6/29/83 PLATE No. 1 (SOUTH END)
CONCRETE CUT PARALELL LINES, 4 NIPPLES FOR PLATE, WOOD BULKHEAD

N ← #15

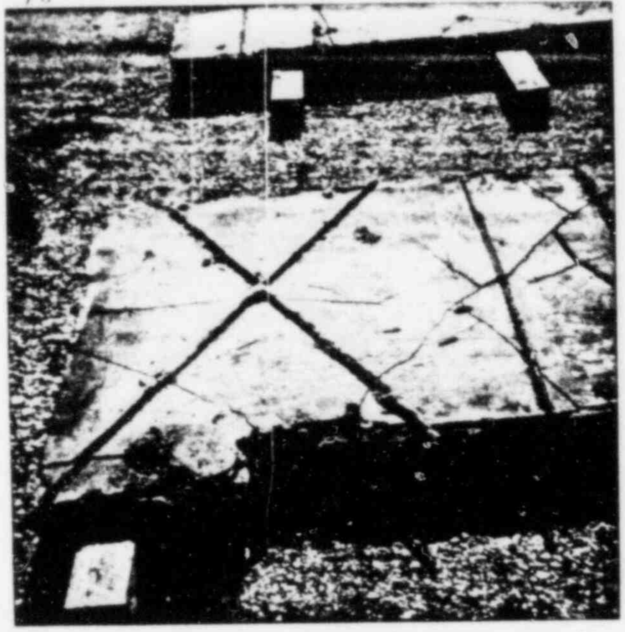


6/29/83 PLATE No. 2 (NORTH END)
CONCRETE CUT "H" PATTERN
LEAD WOOL/EXP. METAL BULKHEAD
4 GROUT NIPPLES FOR WHOLE PLATE

N ← #16

6/29/83 PLATE No. 2 (SOUTH END)
NO CONCRETE CUT, 4 NIPPLES,
LEAD WOOL/EXP. METAL BULKHEAD

N ← #17



6/29/83 PLATE No. 3 (NORTH END)
CONCRETE CUT "X" PATTERN, 4 NIPPLES FOR PLATE, LEADWOOL/EXP. METAL

N ← #18

6/29/83 PLATE No. 3 (SOUTH END)
CONCRETE PARALELL LINES, 4 NIPPLES FOR PLATE, LEADWOOL/EXP. METAL BULKHEAD

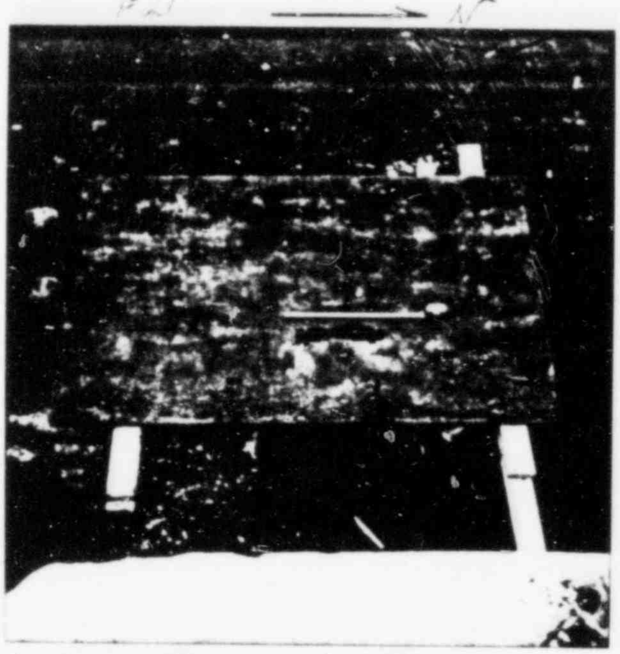
N ← #19

6/29/83 PLATE No. 4 (SOUTH END)
NO CONCRETE CUT, 4 NIPPLES FOR PLATE, WOOD BULKHED

N ← #20

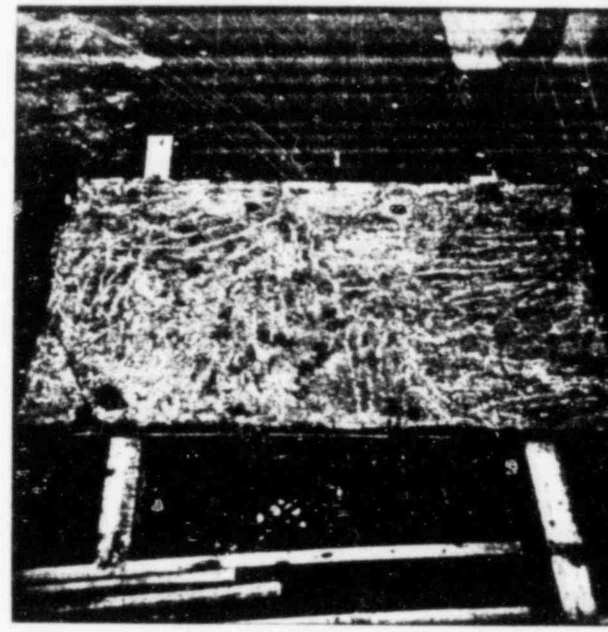
6/29/83 PLATE No. 4 (NORTH END)
CONCRETE CUT "H" PATTERN, 4 NIPPLES FOR PLATE, WOOD BULKHEAD

#21 ——→ N



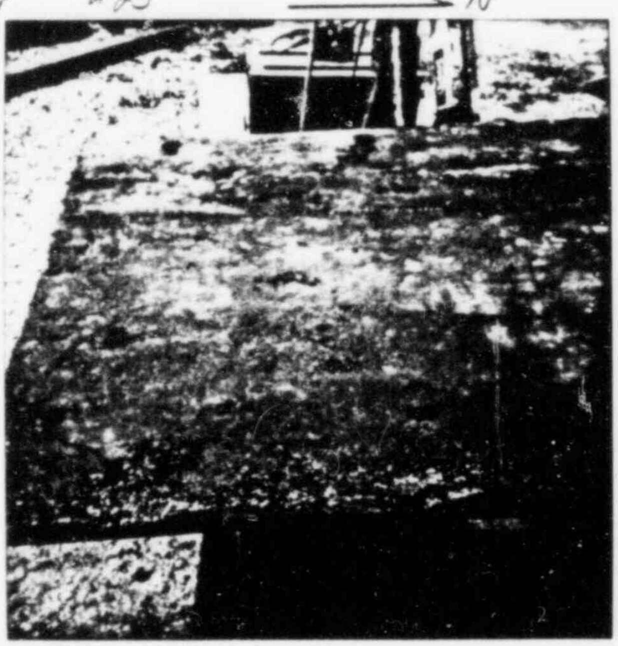
6/30/83 PLATE No. 5
TEST PLATE WITH 713 MASTERFLOW DRY PACK (BEFORE STEEL PLATE REMOVAL)

#22 ——→ N



6/30/83 PLATE No. 6
TEST PLATE WITH CHISEL PREP. ON CONCRETE SURFACE

AJ #23 ——→ N

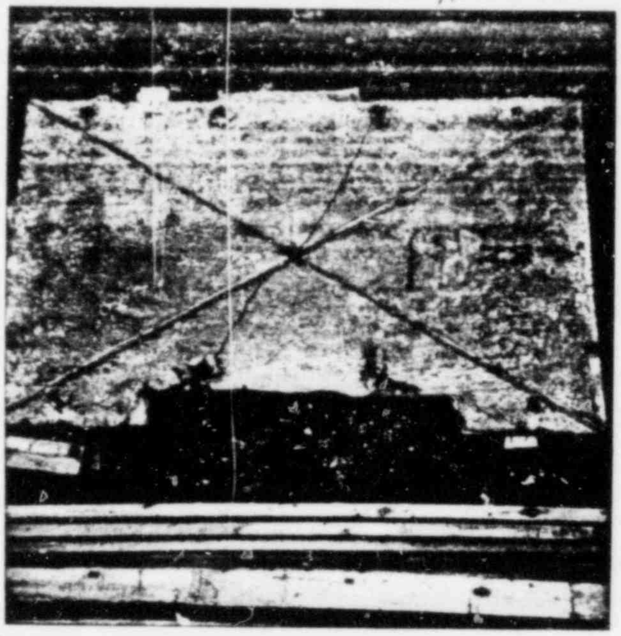


7/2/83 PLATE No. 5A (SOUTH END)
SECOND DRYPACK TEST PLATE AT SAME LOCATION ALSO USING MASTERFLOW #713

AJ #24 ——→ N

7/2/83 PLATE #5A (NORTH END)
SECOND DRYPACK TEST PLATE AT SAME LOCATION AS PLATE #5

#25 → N



6/30/83 PLATE No. 7
TEST PLATE WITH CORE HOLE IN SLAB @ CENTER.

N #26

7/1/83 PLATE No. 8
TEST PLATE WITH GROUTING NIPPLE IN NORTH WEST CORNER

#27 LW

7/1/83 PLATE No. 2
NOTING PERIPHERALLY ORIENTED AIR HOLES AROUND INJECTION HOLE #2 (from SOUTH END)

#28 → N LW

7/1/83 TEST PLATE No. 2
SHOWING LOST GROUT PAD AREA DUE TO LEAD WOOL PACKING TYPE BULKHEAD

AJ → N #29

7/7/83 PLATE No. 5B (SOUTH END)
3RD DRYPACK TEST PLATE BUT MADE WITH SAND/CEMENT NOT #713

AJ #30 → N

7/7/83 PLATE No. 5B (NORTH END)
3RD DRYPACK TEST PLATE BUT MADE WITH SAND/CEMENT MIX NOT #713

AJ #31 → N

7/7/83 PLATE No. 5B (NORTH WEST. CORNER)
APPEARANT LOSS OF CONTACT AREA ≈ 11"x6". THE A.B. APPEAR TO HAVE SLIPPED ON THE WEST SIDE (1½" TO 2" GROUT PAD)

OVERHEAD FLUID GROUTING TEST PROGRAM

EXHIBIT E

PROCEDURE #MCP-15.000 (EXCERPT)

10.1.1 Forms will be mortar tight and well braced.

QAP 10.1.2 Sufficient air relief holes of adequate size will be provided to avoid entrapment of air as determined by the MFE and concurred with by the RSG FE.

10.1.3 If required, forms will be caulked to prevent leakage of grout and loss of head.

10.2 When pouring grout in a form, the form will be extended high enough to facilitate rapid, continuous and complete filling of the space to be grouted.

11.0 MIXING

QAP 11.1 The approximate amount of water/bag to be used for mixing grout will be as listed in Attachment B.

11.1.1 Graduated buckets or containers will be used for determining quantity of water.

11.2 The subcontractor will determine the amount of water to be used in the grout mix at the beginning of each days production, for each type of grout used, excluding Set 45, based on the flow cone tests performed by the contractor's approved testing agency. Acceptance criteria for flow cone tests will be as shown in Attachment B. The amount of water added to Set 45 will always be as listed in Attachment B. | 8

11.3 Any time the amount of water to be used in the grout mix needs to be adjusted, the adjusted amount of water will be based on the results of a flow cone test performed by the contractor's approved testing agency. The subcontractor will notify the RSG FE when additional flow cone tests are required.

11.4 Discard any grout batched for flow cone tests that does not pass the test requirements given in Attachment B.

11.5 Compressive strength test cubes will be cast by the contractor's approved testing agency at the beginning of each days production for each type of grout used. The subcontractor will notify the RSG FE when grout test cubes are required.

11.6 A paddle mixer, vertical shaft vane mixer, or Jiffler-type mixer revolving at less than 300 rpm will be used for mixing grout. In no case will the grout be mixed by hand.

F7220-C195-28-7(Q)

QAP 11.7 Water to be used for mixing will be potable water (i.e., drinking water) having a temperature range indicated in Attachment B.

11.8 Grout as mixed will be between temperature ranges specified in Attachment B. The use of ice water in hot weather and warm water in cold weather is recommended.

11.9 Place at least 90% of the water in the mixer first, then with the mixer operating, steadily add grout and water and mix for the time period shown in Attachment B. If lumps exist, mixing may be continued one additional minute beyond the times listed in Attachment B. If lumps still exist, the grout will be filtered through a 1/8" mesh sieve or discarded.

11.10 Do not mix a grout quantity greater than what can be placed in approximately 15 minutes.

QAP 11.11 Grout will not be re-tempered. Discard any material that becomes unworkable.

12.0 PLACING

QAP 12.1 The grouting sequence for structural plates will be in accordance with approved grout placement plan (Attachment C). Grout placement operations will be observed by the RSG FE for compliance with the approved plan.

12.2 Grout will be placed quickly and continuously to avoid segregation, bleeding, and change in the initial set.

QAP 12.3 During the grout operation, the surfaces which are to come in contact with grout will have a temperature range as indicated in Attachment B.

12.4 Sufficient head will be maintained so that all the spaces become full with grout.

QAP 12.5 Subcontractor may drill additional holes in the form to determine whether grout has filled all the spaces. These holes shall be plugged by wood, ethafoam or cork once the grout starts oozing out of these holes.

12.6 When grout is being placed by means of tube, the tube will be withdrawn slowly in such a manner that the end of the tube is always in grout. Sufficient holes in the form will be provided to facilitate in making this determination. These holes shall be plugged by wood, ethafoam, or cork once the grout starts oozing out of these holes.

F7220-C195-28-7(Q)

QAP

12.9.4 For grouting spin lock rock bolts, a steel plate with two keyholes for inserting grout tube and de-air tube will be used. The grout tube will be inserted to the top of the thrust ring. Grout will then be pumped with a hand pump until grout starts oozing out of the de-air tube. The grout tube will be gradually removed once grout starts oozing from the de-air tube. Discharge of grout in a steady stream from the de-air tube is positive proof that the entire hole is filled and entire area of the bolt, including seams, is well grouted. Plug the de-air tube and continue pumping briefly. Then plug the grout hole.

12.9.5 For grouting hollow core spin lock rock bolts, a steel plate with one keyhole for inserting grout tube (for bolting to surface above) or de-air tube (for bolting to surface below) will be used. The hollow tube in the rock bolt is the de-air tube (for bolting to surface above) or the grout tube (for bolting to surface below). Grout will be pumped with a hand pump until grout starts oozing from the de-air tube. Discharge of grout in a steady stream from the de-air tube is positive proof that the entire hole is filled and entire area of the bolt is well grouted. Plug the de-air tube and continue pumping briefly. Then plug the grout hole.

13.0 PRESSURE GROUTING

QAP

13.1 The grouting sequence for structural plates will be in accordance with approved grout placement plan (Attachment C). Grout placement operations will be observed by the RSG FE for compliance with the approved plan.

13.2 Pressure grouting will be used where necessary and at the Subcontractor's option. Pressure grouting will be necessary where indicated on the approved grout placement plan (Attachment C) and at other locations determined by the MFE and concurred with by the RSG FE.

13.3 The pump must be a positive displacement type, such as the piston, or a progressive cavity type.

13.4 The pump, the hose, and the nozzle will first be rinsed with water.

F7220-C195-28-7(—)

QAP

13.5 The grout to be used will be made into a slurry and pumped through the line prior to pumping grout to ensure that neither water nor cement are removed from the grout during pumping, and that the pump and hose will not clog. Slurry will be discarded.

13.6 If a nozzle is not used on a mechanically driven grout pump, first pump water through the line, followed by a pig, and immediately followed by a pump grade grout.

13.7 Grout pressure will be monitored when using mechanically driven pumps to place grout. Maximum grout pumping pressure will be 40 psi or as noted on the approved grout placement plan (Attachment C).

13.7.1 Pressure gauges for monitoring grout pressures will be supplied and calibrated by the Contractor. The range of the gauge will be between 0 and 100 psi (maximum).

13.8 On mechanically driven grout pumps, a pressure gauge will be installed on the pump discharge line, for indicating to the operator incipient line blockage or a plugged insert pipe.

13.9 When grout is pumped into place, grouting is started at the far end of the space to be grouted or as shown on the approved grout placement plan (Attachment C).

13.10 As the grout is pumped in, the nozzle will be backed out slowly so that it always remains within the grout, preventing air entrapment.

14.0 CURING

QAP

14.1 After placement, the grout will be cured in accordance with the methods and temperatures listed in Attachment B until the grout has attained its specified compressive strength.

F7220-C195-28-7′ 2)

ATTACHMENT B
To MCP 15.000 | 8

	Embeco 636	Masterflow 713	Masterflow 814	Set 45
Quantity of Water Per Bag	1.26 gals.*	1.32 gals.*	2.55 gals.*	0.5 gals.
Water Temperature	32°F to 80°F	32°F to 80°F	32°F to 80°F	32°F to 80°
Grout Temperature	45°F to 70°F	45°F to 70°F	45°F to 75°F	50°F to 85°
Surface Temperature	45°F to 85°F	55°F to 85°F	55°F to 85°F	50°F to 85°
Curing Temperature	45°F to 75°F	45°F to 85°F	45°F to 85°F	50°F to 85°
Curing Method	Cover exposed grout with clean wet rags (not burlap) a minimum of 3 days then apply appropriate Contractor approved and supplied curing compound.	Cover exposed grout with clean wet rags (not burlap) a minimum of 3 days then apply appropriate Contractor approved and supplied curing compound.	Cover exposed grout with clean wet rags (not burlap) a minimum of 3 days then apply appropriate Contractor approved and supplied curing compound.	Air dry. Do not use curing compound. D not wet cur
Flow Cone Values	25 ±5 Sec.	25 ±5 Sec.	25 ±5 Sec.	N/A
Mixing Time	2-3 Min.	2-3 Min.	Until Uniform 3 Min. Max.	1-1 1/2 Mir

*These are recommended quantities of water to be added and may be adjusted as specified in Section 11.2 and 11.3 of this procedure.

F7220-C195-28-7(a)