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 RECIP. NAME: DENTON, H.R. RECIPIENT AFFILIATION: Office of Nuclear Reactor Regulation

SUBJECT: Forwards "Rept on Rock Fill Test Sections, Main Dam."  
 Requests approval of rept as soon as possible.

JUL 27 1979

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Carolina Power & Light Company

July 18, 1979

Mr. Harold R. Denton, Director  
Office of Nuclear Reactor Regulation  
United States Nuclear Regulatory Commission  
Washington, D. C. 20555

REGULATORY DOCKET FILE COPY

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT NOS. 1, 2, 3, AND 4  
DOCKET NOS. 50-400, 50-401, 50-402, AND 50-403  
MAIN DAM IN-PLACE TEST FILL PROGRAM

Dear Mr. Denton:

During the Construction Permit review for the Shearon Harris Nuclear Power Plant (SHNPP), Carolina Power & Light Company (CP&L) committed to provide the results of the in-place test fill program to the NRC for review and approval prior to beginning construction of SHNPP's main and auxiliary dams, as well as the separating dike. Earlier this year, your staff reviewed and approved the test fill program for the auxiliary dam and separating dike.

We request that you review and approve the attached rockfill test report as soon as possible so that construction of the main dam can proceed without delay.

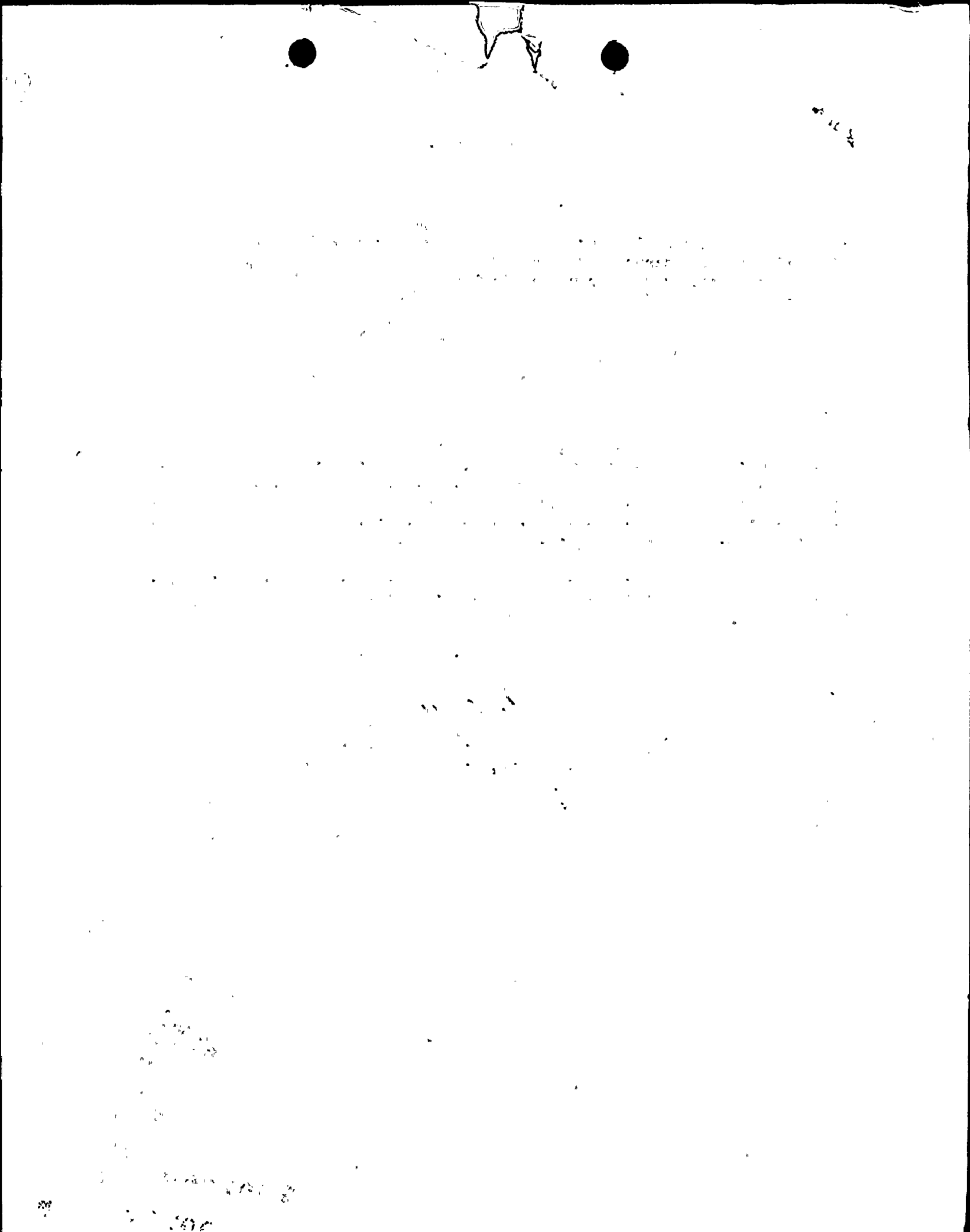
Yours very truly,

M. A. McDuffie  
Senior Vice President  
Engineering and Construction

MAM/tl  
Attachment

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REPORT ON ROCK FILL TEST SECTIONS

MAIN DAM

SHEARON HARRIS NUCLEAR POWER PLANT

CAROLINA POWER & LIGHT COMPANY

JULY, 1979

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## I. Introduction

Rockfill test sections VRMD 24-4-3 and VRMD 24-2-4 were constructed

- 1) to establish and evaluate placement and compaction procedures and
- 2) to evaluate engineering properties of materials to be placed in the rock shell portions of the main dam. Field construction was supervised by Carolina Power and Light and Ebasco Services personnel. Laboratory testing was performed by the Raleigh office of Law Engineering and Testing Company with the exception of large diameter triaxial tests which were performed by the Atlanta offices of the Corps of Engineers.

## II. Summary of Test Fill Construction

Test sections of two gradation ranges were constructed; a) VRMD-24-4-3; maximum allowable particle size of 22 inch greatest dimension and b) VRMD 24-2-4; maximum allowable particle size of 22 inch average dimension. For each test section, slightly to moderately weathered granitics of as excavated gradation were placed in lifts and worked by dozer to exclude oversize and achieve a 24 inch lift thickness. Equipment used was similar to that which will be used during dam construction. Loose lifts were then compacted by 10 passes of a vibratory smooth drum roller with settlement readings surveyed after individual passes. Correlations made between compaction effort and measured settlement were related to visual observations of the condition of the lift surface. From this information, the optimum

compactive effort to minimize post-construction settlement and prevent excessive surface breakage was determined to be 8 passes. Lifts for documentation of engineering properties of rockfill were then compacted by 8 passes of the specified roller. Before and after compaction gradations, inplace density and permeability, and large-scale triaxial strength tests were performed to ensure that methods and materials utilized in the test section(s) satisfied all aspects of design requirements. Test sections were then cut in half to observe distribution of fines, interlock of large particles, and uniformity of compaction.

### III. Conclusions

Test Section VRMD-24-4-3 was constructed using a criteria for maximum allowable particle size of 22 inch length or maximum dimension. Because of the rectangular shape of granitic fragments obtained from the spillway cut, it was found that exclusion of rock of greater than 22 inch length (1) effectively required removal of the majority of desirable fragments greater than 10-12 inch average dimension, and (2) indirectly caused excessive and undesirable overworking of the lift surface. Test Section VRMD-24-4-3 was therefore used only to aid in establishing placement technique and optimum amount of compactive effort.

Based on the above observations, Test Section VRMD 24-2-4 was constructed using a maximum allowable particle of 22 inch average dimension. A



representative after compaction gradation from lift 2 of this test section indicates a  $D_{50}$  size of approximately 4 inches. In order to allow for sample variance and to conservatively measure rockfill strength, a parallel gradation curve with  $D_{50}$  of 3 inches was modelled for large diameter triaxial strength tests. Data obtained from field and laboratory testing of Test Section VRMD-24-2-4 lift 2 are as follows:

a. gradation analysis

1. before compaction  $D_{max} = 18"$   $D_{50} = 6"$
2. after compaction  $D_{max} = 18"$   $D_{50} = 4"$

b. inplace density

1. dry density - 139.9 pcf
2. moisture content - 3.9%

c. settlement

8 passes of vibratory roller produced 3.5% settlement

d. permeability - constant head

an inplace permeability test indicated a permeability (k) of  $1.1 \times 10^{-2}$  cm/sec.

e. effective strength parameters per large scale triaxial shear tests ( $\bar{R}$ )

1. cohesion ( $c'$ ) = 0 psi
2. friction angle ( $\phi'$ ) = 40.5 degrees

Note: Strength parameters represent a rockfill gradation with  $D_{50} = 3$  inches. A replacement gradation was tested at a density of 135 pcf at 4.0% moisture.

Because of the pattern of weathering, fresher granitics of coarser gradation will be obtained as the excavation increases in depth. It is therefore believed that strength and permeability as determined



by test section construction are conservative and will represent lower bounds for materials to be used in the main dam.

Based on our evaluation of these test sections, construction of main dam rockfill shells should be as outlined below:

Materials: Rockfill shall be well-graded durable fragments of granitics, as can be obtained from the spillway excavation. Deeply weathered zones shall be wasted so as to meet gradation requirements as specified below.

Placement: Rockfill shall be blasted by suitable means, loaded and end dumped by Euclid R-50 or equivalent haul truck on the fill surface. The material shall be spread diagonally outward from the core by D-8 dozer to place oversize materials at the exterior of the dam shell and to achieve a nominal 24 inch loose lift.

Compaction: Rockfill shall be compacted by a smooth drum vibratory roller (Raygo Rascal 600A) using forward and backward travel for a total of 8 overlapping passes. Roller frequency shall be between 1400 to 1500 vpm and roller speed shall be less than or equal to 3.0 mph.

Inplace Testing: Tests to document inplace density and gradation shall be performed as per Carolina Power and Light Test Procedure TP08. Requirements shall be as follows:

- a. inplace density: average dry density shall be 135 pcf. Absolute minimum dry density shall be 130 pcf.
- b. inplace gradation: the rockfill shall be well graded with a minimum  $D_{50}$  size of 3 inches. Maximum size shall be of 22 inch average dimension (90% of lift thickness) with a length to width ratio of less than or equal to 3:1.

#### IV. Procedures

As in-place test fill section was constructed on site to simulate the actual hauling, dumping, spreading, and compaction processes of main dam rockfill construction. From this test fill, in-place properties such as gradation, density, permeability, and settlement due to rolling were determined.

A. Description of Test Fill - Test fill sections designated VRMD-24-4-3 and VRMD-24-2-4 were constructed during February and March 1979 in separate areas adjacent to the site of the main dam. The areas selected were free of excessive surface water and reasonably level. The areas were staked out, graded, and then proof rolled with a vibratory roller until no appreciable settlement was detected. The test fills were constructed in accordance with PPCD - SHNPP Technical Procedure TP-01. The test sections were approximately 40 feet by 55 feet in plan dimension with 24 settlement points.

Ramps were constructed with 5 horizontal to 1 vertical slopes. The sides of the test section were maintained at approximately 1.5 H to 1V. The material was end dumped, spread to approximately 24 inch loose thickness, and compacted with 10 passes of a Raygo Rascal 600-A roller. The roller produces a dynamic force of 40,000 pounds for a vibration frequency between 1400 and 1500 VPM. The roller was operated at a maximum speed of 3 mph. Test fill Section VRMD-24-4-3 consisted of four lifts. Test Section VRMD-24-2-4 consisted of 2 lifts.

B. Material - The material used was slightly to moderately weathered granites and granite gneisses obtained from blasting in the spillway excavation. All material came from between Sta 10+50 and 11+75, El 250-260, West of centerline (Photo 1). Maximum particle size allowed for test fill VRMD-24-4-3 was 22 inches length or maximum dimension (corresponding to 90% lift thickness). Maximum particle size allowed for test fill VRMD-24-2-4 was 22 inches average dimension.

C. Settlement Measurement - VRMD-24-4-3 - Prior to placement of the first lift, initial readings were recorded for each of the 24 settlement points. A system of offset control was used to ensure proper relocation of settlement points after each lift placement. The rockfill material was then end dumped by Euclid R 50 trucks and spread in approximately 24 inch lifts by a dozer equivalent to that to be used on the dam (Photos 2 and 3). The method and operating time utilized by both types of equipment simulated anticipated field conditions.

After spreading, each settlement point was marked with paint sprayed directly on the lift surface. Level readings were recorded for each of the points and averaged to determine the initial lift thickness. The vibratory roller then made one pass over the entire surface of the lift without vibration and level readings were taken and averaged to determine the initial lift height. The procedure was then repeated with vibration for a total of 10 passes with settlement readings taken after each pass (Photos 4 thru 6). The settlement points were repainted as necessary.

After completion of the first lift, settlement data was collected in the same manner for the second and third lifts. The final level readings recorded from a previous lift were used as the initial readings in determination of the thickness of the next lift. A plot of percent decrease in lift thickness versus number of passes was constructed from the data collected for each lift. An examination of the settlement plots for the first three lifts revealed that 8 passes of the roller produced an optimum amount of settlement per compaction effort. Therefore, the fourth lift was rolled with only 8 passes.

VRMD-24-2-4 - Settlement measurements for Test Section VRMD-24-2-4 were performed as per the above description except that only the first lift was compacted by 10 passes. After observation of settlement data and confirmation of the suitability of 8 passes, lift 2 was compacted with 8 passes in preparation for testing for documentation.

D. In-Place Density Determination - After the final layer of the respective test fills were compacted and all settlement data was recorded, in-place density test(s) were performed. The following procedure was used to conduct the tests:

1. A wood frame measuring 8 feet x 8 feet x 6 inches high was placed over the test area and held in-place by stakes.
2. Level readings of all four corners of the frame were recorded from a nearby established bench mark.
3. One sheet of polyethylene was laid loosely over the frame to be in as close contact as possible with the inside of the frame and the rock surface.
4. The depression in the slack membrane was filled with water via a calibrated barrel to within 3 or 4 inches of the top of the frame (Photo 7).
5. The volume of water added and the distance from the top of the frame to the water surface was measured and recorded.
6. The water was removed without disturbing the frame or damaging the membrane.
7. The polyethylene sheet was removed and checked for leaks.
8. The material within the frame was then carefully excavated and placed into a truck and enveloped in plastic.
9. The hole was then hand-cleaned to remove all loose or sharp material in the sides and bottom.
10. The weight of the total sampled excavated was determined by weighing the truck full and empty.

11. The polyethylene sheet was again placed loosely over the excavated hole and frame.
12. The hole was filled with water to the same level as in Step 4.
13. Level readings were again taken at all four corners of the frame to assure the frame had not moved.
14. The volume of water added was recorded.
15. Steps 6 and 7 were repeated.

E. Grain Size Distribution Test - Before and after gradation

analyses were performed on the rockfill used in the test fills.

Before compaction gradation samples were taken from the end dumped loose lift of the test fill prior to spreading. The after compaction gradation sample was obtained from the in-place density test.

Samples weighing approximately 3500 lbs. were taken directly to the testing laboratory, spread out on a concrete floor, and heated with space heaters to remove the moisture. The material was graded by hand using square wooden sieves of 6, 12, 18, and 24 inch sizes. The sample was then reduced by quartering and graded down to the #8 sieve using a Gilson Sieve Shaker. A Ro-Tap Sieve Shaker was used to determine particle size down to the #200 sieve. The weights retained on each sieve were carefully measured and the Percent Passing Total was determined for each sieve ranging from 24" down to #200.



F. Permeability Test - In-place permeability tests were performed on the test fills. A constant head method was used to determine the coefficient of permeability of the rockfill material. A brief discussion of the permeability test used is presented below:

1. In-place permeability tests were performed on the test fill in accordance with a modification of the Bureau of Reclamation, Department of the Interior, Field Permeability Test (Well Permeameter Method) Designation E-19. The procedure used was as follows:
  - a. An air track drilling rig drilled a hole in the top of the test fill to a 2.8 ft. depth.
  - b. The sides of the well were scarified and all loose material was removed from the bottom of the well.
  - c. The well was filled to the top with pea gravel of known density and a standpipe placed in the top of the hole.
  - d. The volume and radius of the well were then determined.
3. In order to provide a large enough reservoir of water to conduct each permeability test at anticipated flows, a pump truck was used instead of the calibrated 50 gallon barrel. Flow rates were controlled by pump rate and by valve and were measured by using an in-line calibrated flow meter at the collar of the hole (Photo 8).
- f. Water was kept at a constant head in the well by maintaining the free water surface within the 3 1/2 inch casing a constant distance beneath a string baseline.

- g. Water was allowed to flow into the well for approximately one hour (or until a constant head could be maintained) to ensure saturation of the area adjacent to the well.
- h. Measurements were then made at 15 minute intervals to measure the quantity of water that flowed into the well. This was continued for approximately 2 hours. An average flow rate was then calculated.
- i. All the data was compiled and the permeability of the test fill determined for a constant head, low water table condition per Designation E19.

G. Large-Scale Triaxial Tests - Large diameter (15") triaxial strength testing was performed on material from a rockfill sample representative of material used to construct test section VRMD-24-2-4. Tests were conducted by the U. S. Army Engineer Division Laboratory, South Atlantic, under the direction of Mr. Robert J. Stephenson. The complete laboratory report is included as Appendix C.

- Testing included a controlled strain 15-inch diameter consolidated undrained triaxial shear test with pore pressure measurements ( $\bar{R}$  test). Tests were conducted at confining pressures ( $\bar{\sigma}_3$ ) of 1, 2, and 4 tons per square foot (tsf). Test specimens were reconstituted with material from a rockfill sample taken from test section VRMD-24-2-4. A "replacement gradation" containing minus 3-inch sizes was established for the tests based on the gradation of the total rockfill sample. Test samples were prepared by reconstituting samples of this replacement gradation to densities comparable to that measured from the test section. Individual samples were then saturated, consolidated to the applicable confining pressure, and axially loaded at a strain rate of approximately 0.1 percent per minute. Shear strength parameters were computed at 15 percent axial strain. Total and effective strength envelopes were then plotted.



## V. Discussion of Results

### A. Settlement

Settlement data were analysed using (a) raw settlement data and (b) smoothed data where settlement decreases are discarded. For test section VRMD-24-4-3 raw and smoothed cumulative settlement data are shown in Figures 1 thru 3 for the first through third lifts respectively. Breaks in the average rate of settlement per pass were noted for each lift between passes 1-2, 3 thru 8, and 9-10 as shown in Figures 4 and 5. Correlation between visual field observation (field inspection reports are included in Appendix B) and settlement data showed the following relationship:

Passes 1-2: 0.80% settlement per pass at initial high rate; rocks are repositioned and knit into a moderately compacted mass at a high rate of settlement per pass.

Passes 3-8: 0.30% settlement per pass at constant rate; rocks are tightly compacted, sharp corners are broken to form shards over 10-20% of the surface area.

Passes 9-10: 0.18% settlement per pass at decreasing rate; surface breakage only.

Based on the above, the fourth lift of Test Section VRMD-24-4-3 was compacted with 8 passes of the vibratory roller using forward and backward travel. The number of passes was chosen to minimize post-construction settlement and prevent excessive surface breakage. Settlement data and rates obtained from lift 4 are shown in Figure 6. These data show a relationship similar to data obtained from lifts 1-3.

Settlement data and settlement rates for the first lift of Test Section VRMD-24-2-4 are shown in Figures 7 and 8, respectively. Since these data showed consistent settlement rates to that observed in Test Section VRMD-24-4-3, intermediate lifts were believed to be unnecessary and the second lift was compacted to 8 passes for documentary purposes. Settlement data for lift 2 are shown in Figure 9.

#### B. Material Gradation

Before and after gradations for material placed in lift 4 of Test Section VRMD-24-4-3 are shown in Figure 10. A  $D_{max}$  of 24 inches and  $D_{50}$  of 6 inches were measured from a sample obtained prior to spreading the loose lift. After compaction gradations showed a  $D_{max}$  of 18 inches and  $D_{50}$  varying between 1.5 and 2 inches.

The differences in before and after gradation were attributed to three factors:

- a. variance in actual material gradation.
- b. removal of materials exceeding 22 inch length (or maximum dimension) from the loose lift prior to compaction, thereby creating an artificially fine sieve gradation.  
Note that rock fragments available are generally not cubic. With increasing length to width ratios, the difference between maximum dimension and sieve size increases and is believed to be significant.
- c. removal of unacceptable sizes exceeding 22 inch length unavoidably requires removal of significant quantities of acceptable sizes.
- d. particle breakage upon compaction.

Since it was believed that the effects of excluding material of 22 inch or greater dimension were appreciable, Test Section VRMD-24-2-4 was constructed using a maximum size particle of 22 inch average dimension with a length to width ratio not exceeding 3 to 1. Test Section VRMD 24-4-3 was therefore used only to establish placement technique and required compactive effort.

Before and after gradations of material placed in lift 2 of Test Section VRMD-24-2-4 are shown in Figure 11. A  $D_{max}$  of 18 inches and a  $D_{50}$  of 7 inches were measured from a sample obtained prior to spreading the

loose lift. After compaction gradations of a representative sample showed a  $D_{\max}$  of 18 inches and a  $D_{50}$  of 4 inches. Differences in before and after gradation are attributed to:

- a. variance in actual material gradation,
- b. removal of some acceptable sizes, as unacceptable sizes are rolled to the sides of the test area by dozer, and
- c. particle breakage.

Based on visual observation of the compaction process, it is believed that particle breakage is minor and that before and after differences in gradation are due primarily to items a and b. Based on observation of test fill construction, it is believed, that in place after compaction gradations of  $D_{50}$  greater than 3 inches are obtainable on a production basis using a maximum size criteria of 22 inch average dimension.

#### C. In-Place Density

In-place density measurements performed on test section VRMD-24-4-3 indicate densities as follows (see Appendix A for laboratory report):

Test 1 dry density 137.4 pcf at moisture content of 2.3%

Test 2 dry density 134.2 pcf at moisture content of 2.8%

Density measurements performed on Test Section VRMD-24-2-4 indicate a dry density of 139.9 pcf at a moisture content of 3.9%. These results indicate that densities averaging 135 pcf or greater can be reached on a production basis using 8 passes of the roller.



#### D. Permeability Measurement

Inplace permeability measurements (Appendix A) indicate permeabilities (K) =  $8.1 \times 10^{-3}$  cm/sec for Test Section VRMD-24-4-3 and K =  $1.1 \times 10^{-2}$  cm/sec for Test Section VRMD-24-2-4.

#### E. Strength Determinations

A gradation with  $D_{50}$  equal to 3 inches, parallel to that measured after compaction in VRMD-24-2-4, was modelled for testing by the Corps of Engineers (Report included as Appendix C). Figure 12 is a plot of the tested material replacement gradation in comparison to the inplace material gradation of  $D_{50} = 4$  inches and the constructed parallel curve with  $D_{50} = 3$  inches. For a test density of 135 pcf at 4% moisture, the large scale triaxial tests indicate effective strength parameters for this material and gradation as follows:

cohesion (C') - 0 psi

friction angle ( $\phi'$ ) - 40.5 degrees

#### F. Examination of Test Fill Cross Section

After the test fills were completed, cuts were made through all lifts.

Observations made were as follows:

##### 1. Test Section VRMD-24-4-3

A transverse cut was made thru all four lifts of Test Section VRMD-24-4-3. Good bonding between lifts was observed. (Photo 9). No layering or segregation of large particles was observed, fines are distributed throughout and are uniformly compacted. Because of the material gradation, however, not all large particles interlock and in portions of the cross section, well compacted fines separate the larger rock particles (Photo 10).

2. Test Section VRMD-24-2-4

A longitudinal cut was made thru the two lifts of Test Section VRMD-24-2-4. As in Test Section VRMD-24-4-3, good bonding between each lift was observed. No layering or segregation of large particles can be seen (Photo 11). Fines are uniformly distributed and compacted. As in Test Section VRMD-24-4-3, small areas of the cross section have well compacted fines separating the larger rock particles (Photo 12).

APPENDIX A

PERCENT SETTLEMENT VS. NUMBER OF PASSES

SHEIKHON HARRIS - MAIN DATA

TEST FILL VIMS - 54.1-3

LIFT NO. 1 21.4" THICKNESS

RAYED 600A VIBRATOR, SMOOTH DRUM ROLLER

FREQUENCY 14-1500 VPM, SPEED 4.3 MPH

DATE 2/22/79

PREPARED BY ZEL

CHECKED

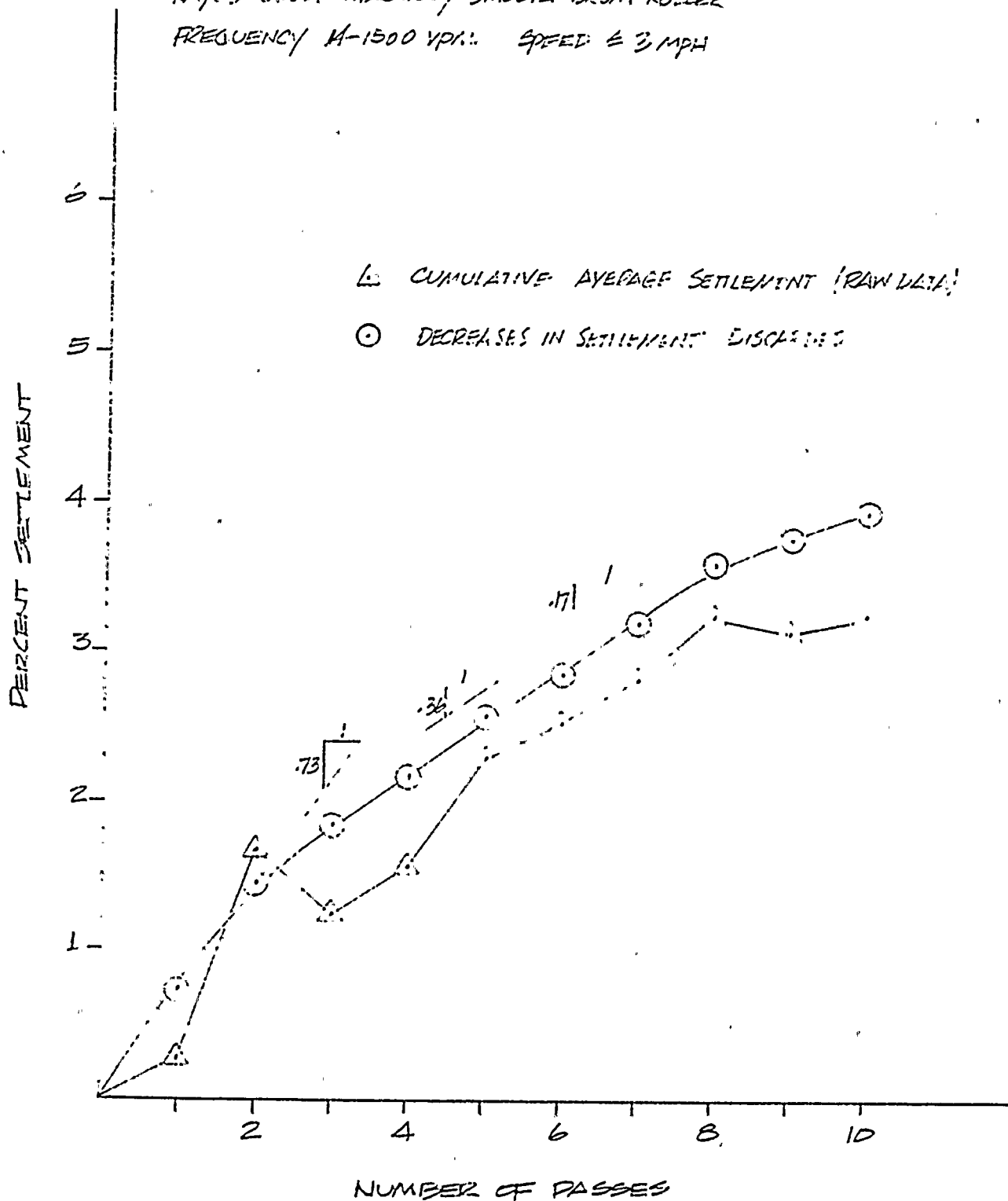


FIGURE 1

PERCENT SETTLEMENT VS. NUMBER OF PASSES

SHEARON HARRIS MAIN DAM

TEST FILL VRMD-24.4-3

LIFT NO 2 22.8" THICKNESS

RAYGO 600A VIBRATORY SHOULDER DRUM ROLLER

FREQUENCY 14-1500 RPM SPEED  $\leq 3$  MPH

DATE 3/1/79

PREPARED BY REL

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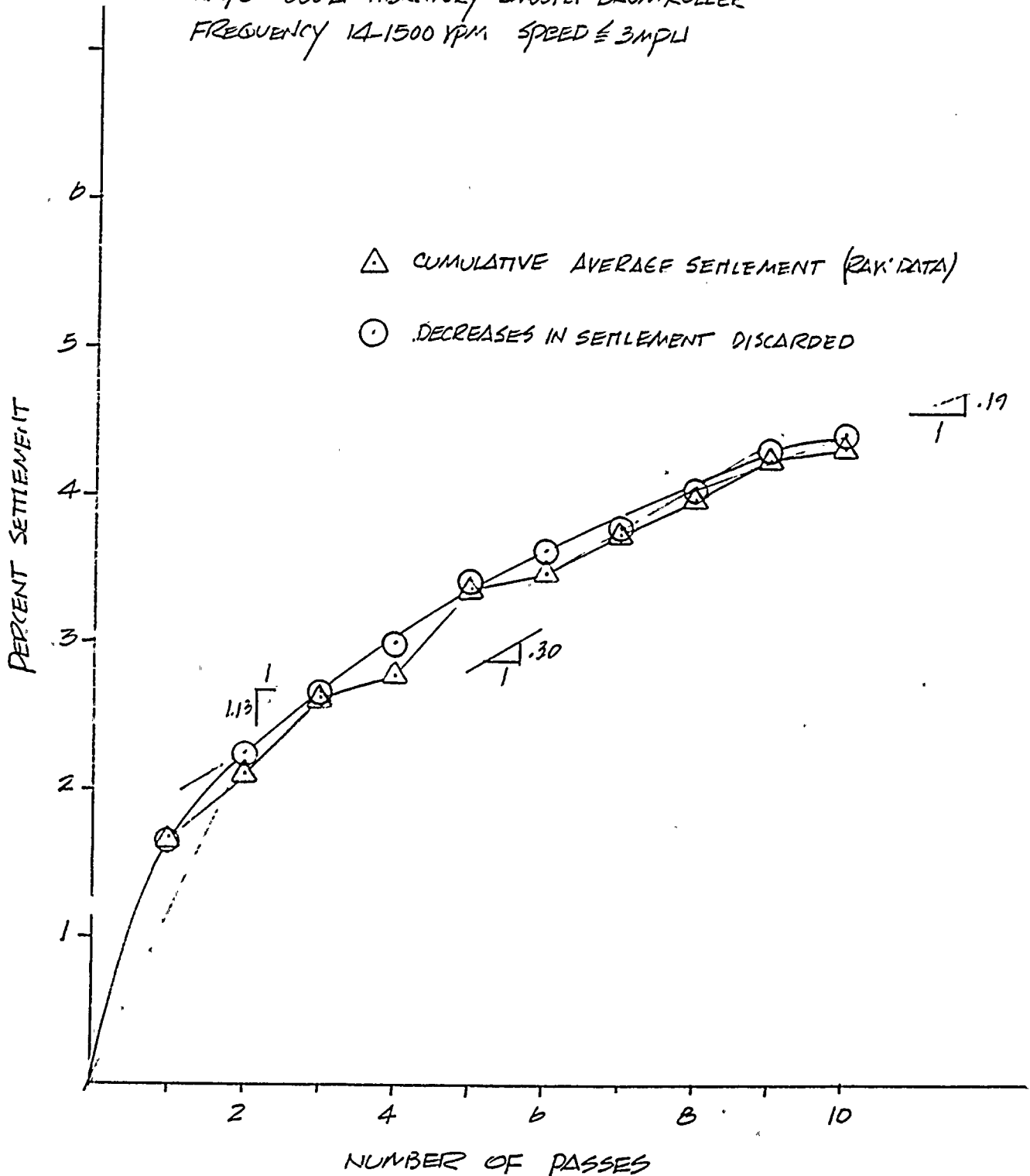


FIGURE 2



# PERCENT SETTLEMENT VS. NUMBER OF PASSES

SHEARON HARRIS MAIN DAM

TEST FILL VRMD-74-4.3

LIFT NO. 3 31.1' THICKNESS

RAYCO 600A VIBRATORY SMOOTH DRUM ROLLER

FREQUENCY 14-1500 VPM SPEED  $\leq 3$  MPH

DATE 3/5/79

PREPARED BY

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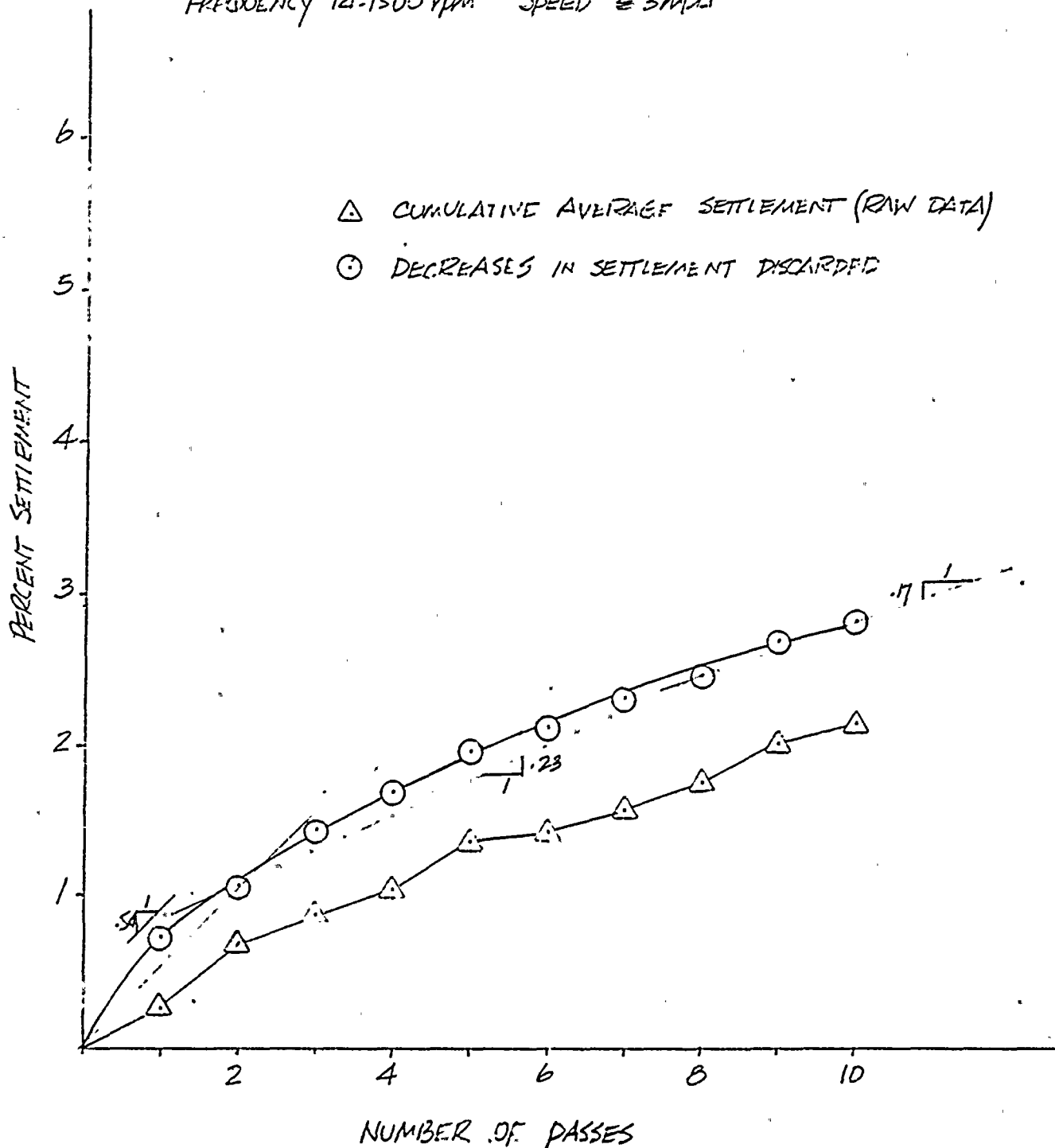


FIGURE 3

AVERAGE PERCENTAGE SETTLEMENT VS NUMBER OF PASSES  
LIFTS 1 THRU 3

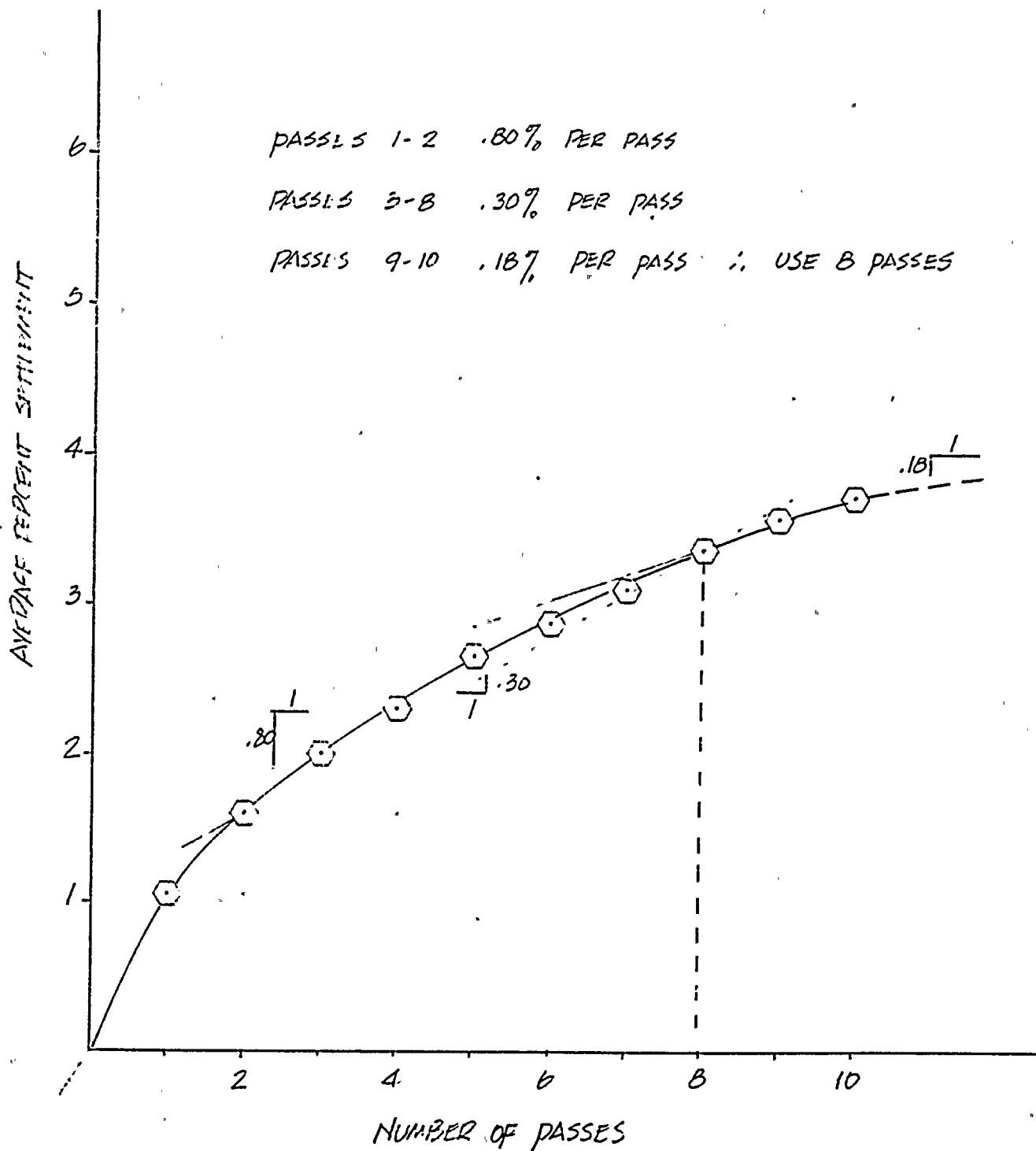


FIGURE 4



AVERAGE PERCENTAGE SETTLEMENT PER PASS  
VS NUMBER OF PASSES  
LIFTS 1-3

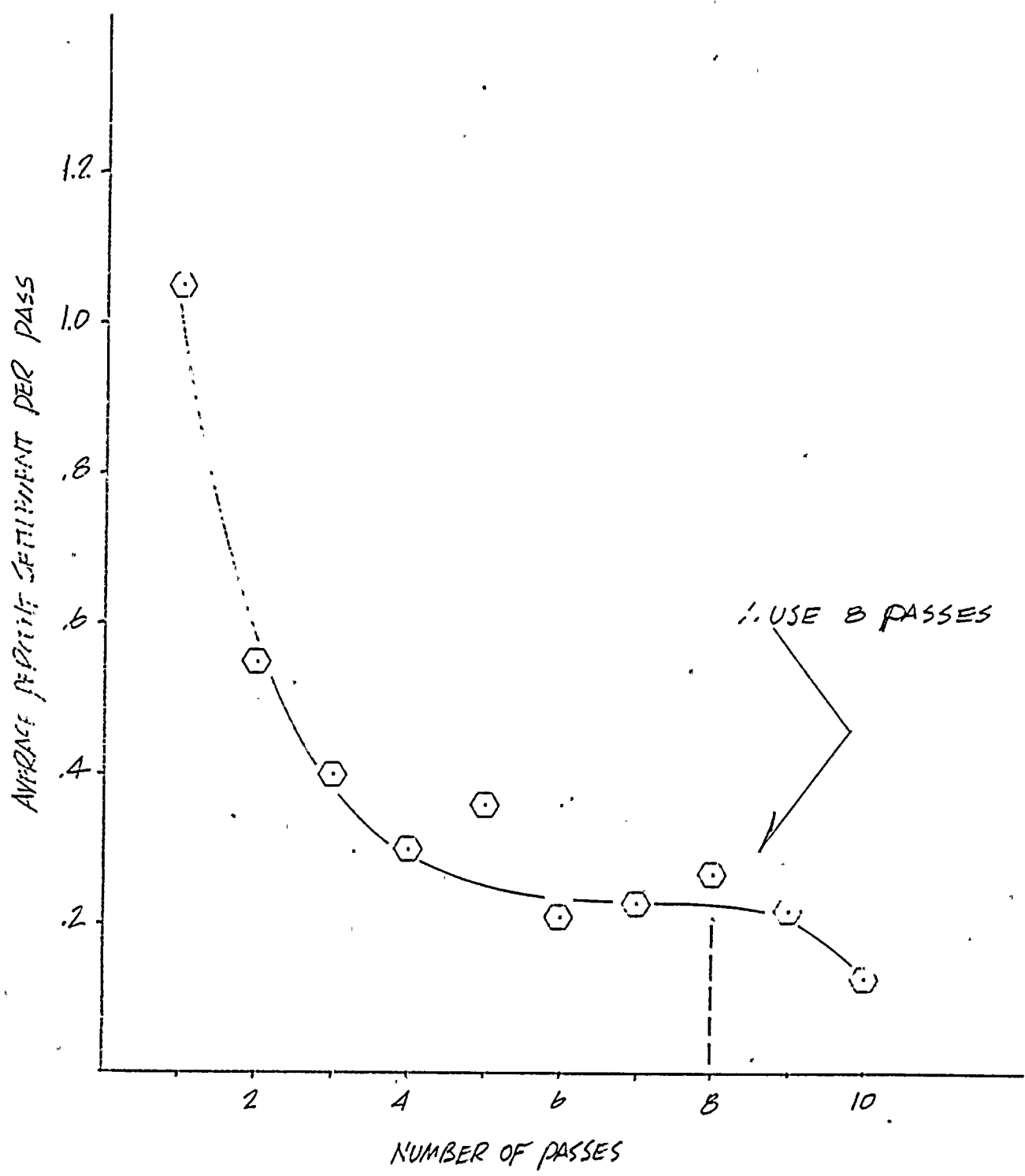


FIGURE 5



PERCENT SETTLEMENT VS NUMBER OF PASSES

SHEARON HARRIS MAIN DAM

TEST FILL VRMD-24-4-3

LIFT NO. 4 24.6" THICKNESS

RAYCO 600A VIBRATORY SMOOTH DRUM ROLLER

FREQUENCY 14-1500 VPM; SPEED  $\leq 3$  MPLI

DATE 3/12/79

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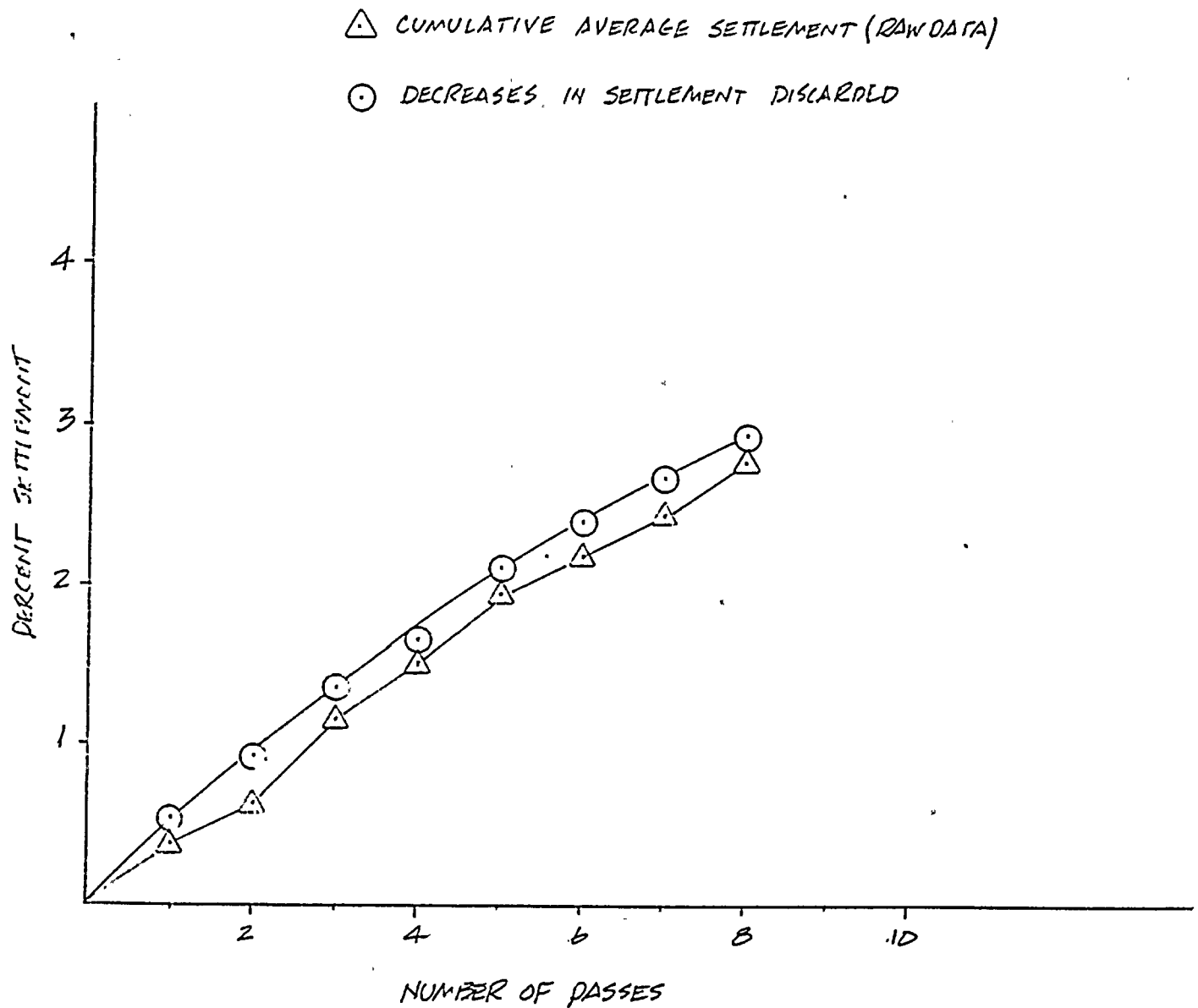


FIGURE 6

PERCENT SETTLEMENT VS NUMBER OF PASSES

SILKARON HARRIS MAIN DAM

TEST ALL VRMD 24-2-4

LIFT NO. 1 75.7" THICKNESS

RAYGO 600A VIBRATORY SMOOTH DRUM ROLLER

FREQUENCY 14-1500 VPM SPEED 3 MPH

DATE 4/3/79

PREPARED RBH

CHECKED

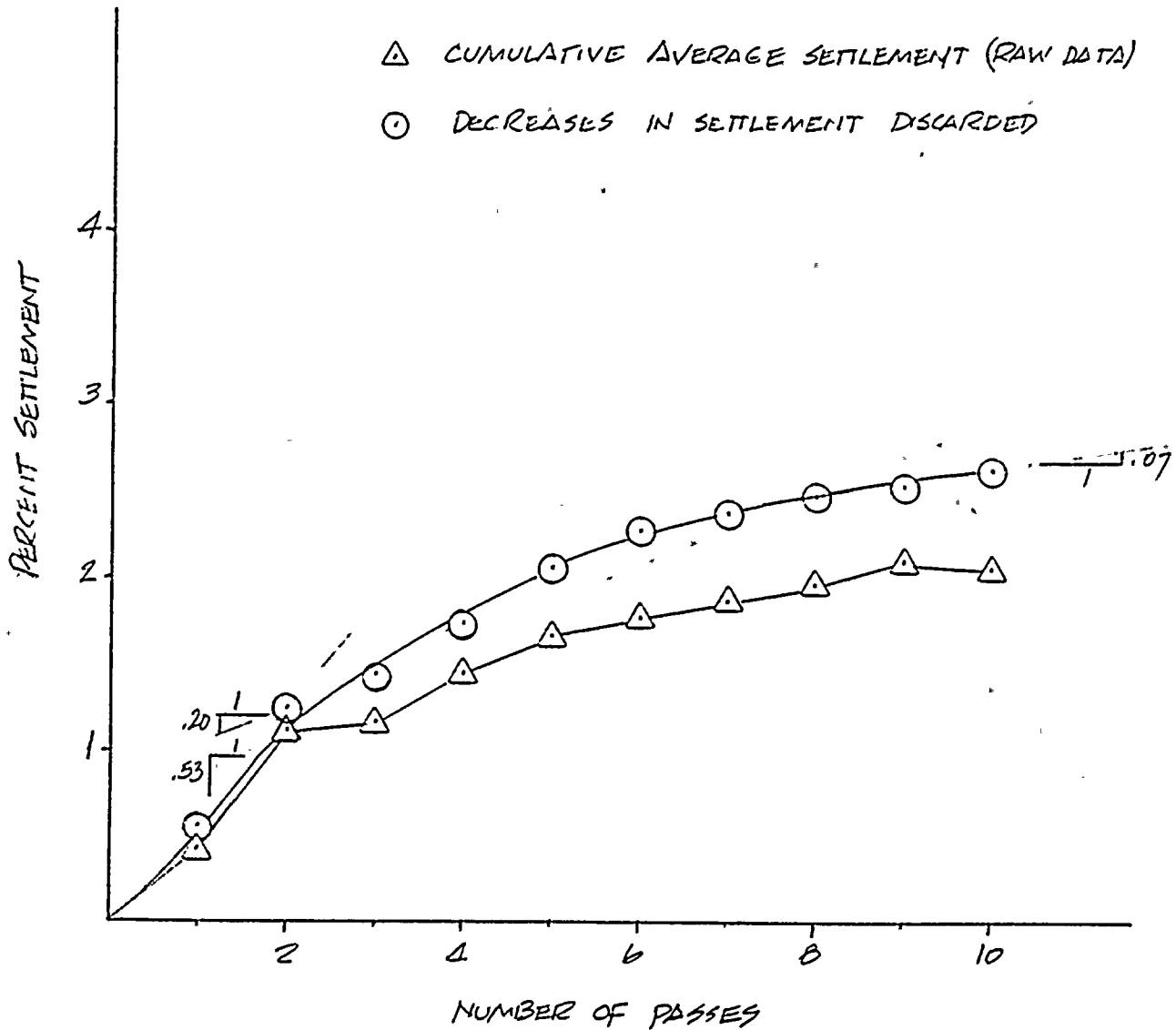


FIGURE 7



VRMD-24-2-4  
4/3/79 REL

PERCENT SETTLEMENT PER PASS  
VS NUMBER OF PASSES

LIFT 1

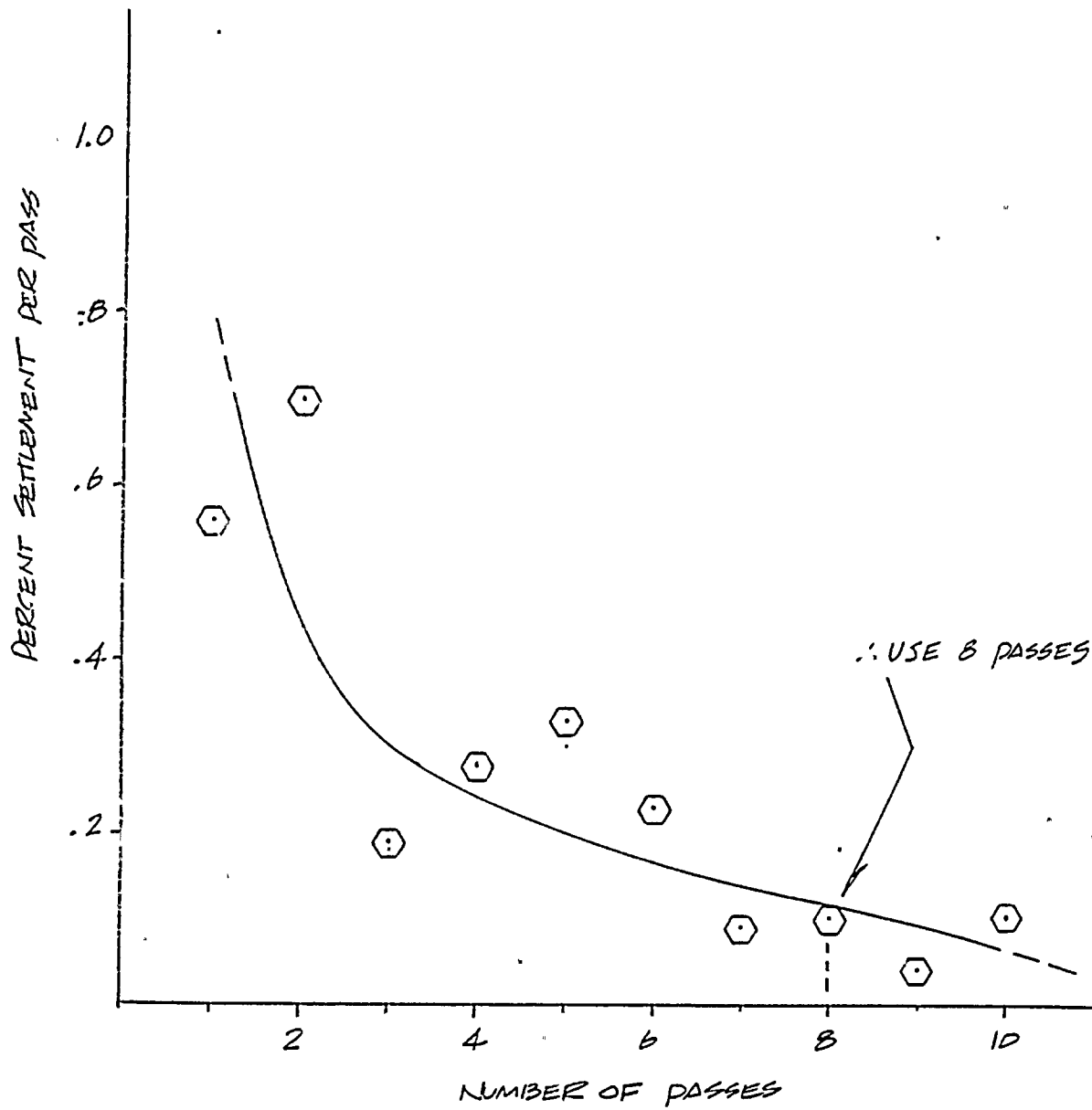


FIGURE 6

PERCENT SETTLEMENT VS NUMBER OF PASSES

SHARON HARRIS MAIN DAM

TEST FILL VRMD 24.2-4

LIFT NO. 2 23.5" THICKNESS

RAYCO 600A VIBRATORY SMOOTH DRUM ROLLER

FREQUENCY 14-1500 VPM SPEED 3 MPH

DATE 4/5/79

PREPARED BY REH

CHECKED

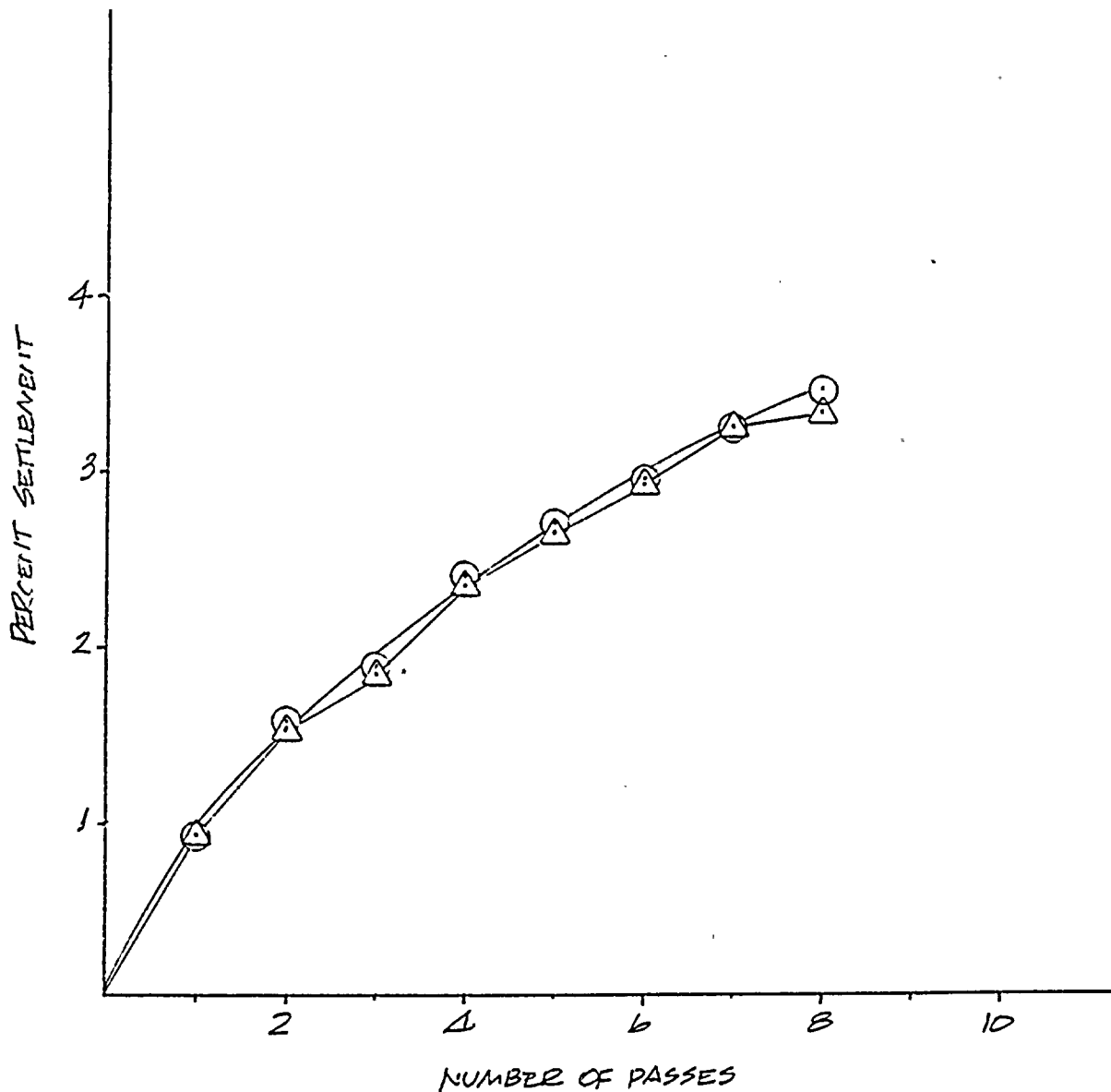
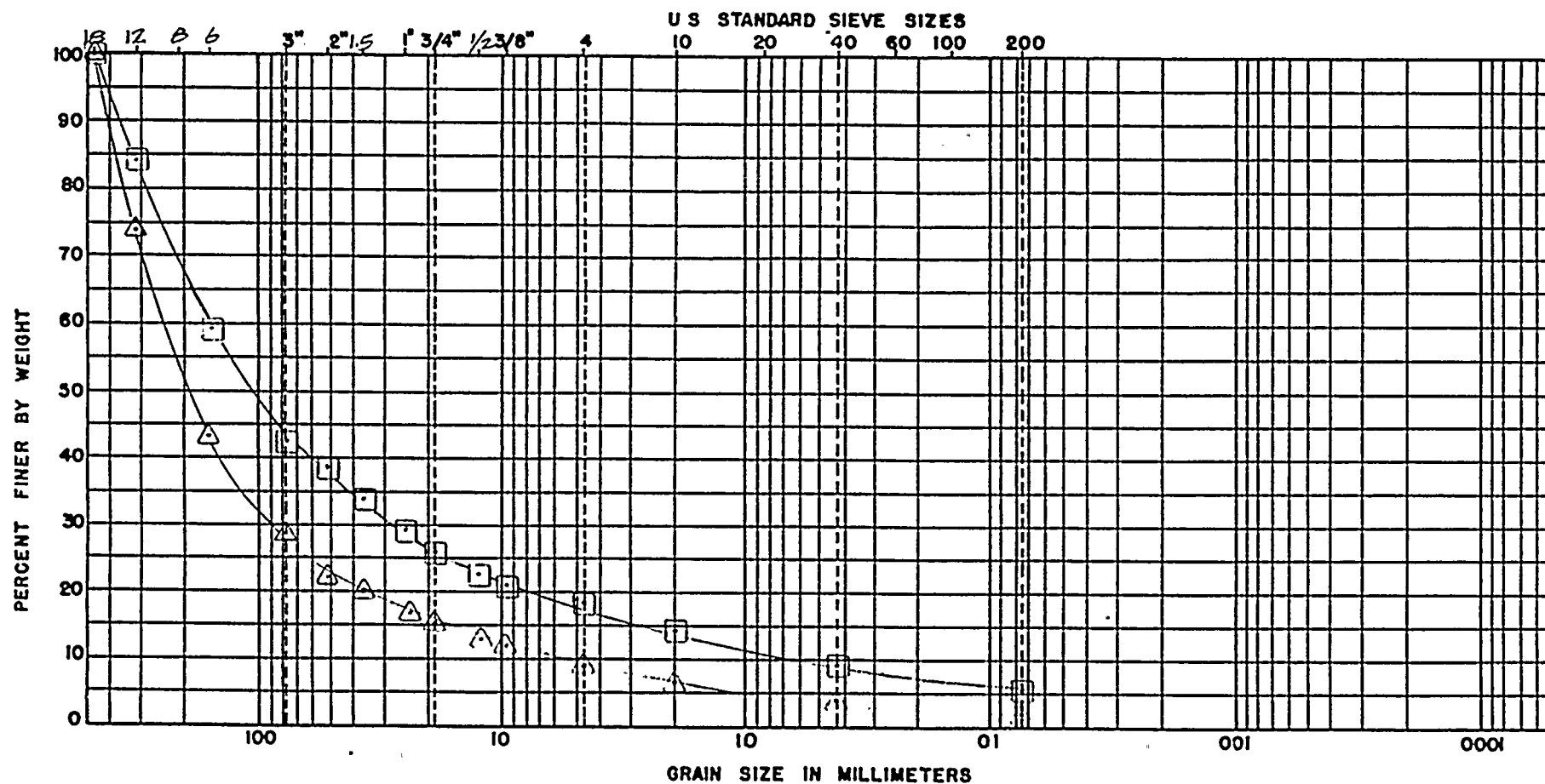


FIGURE 9



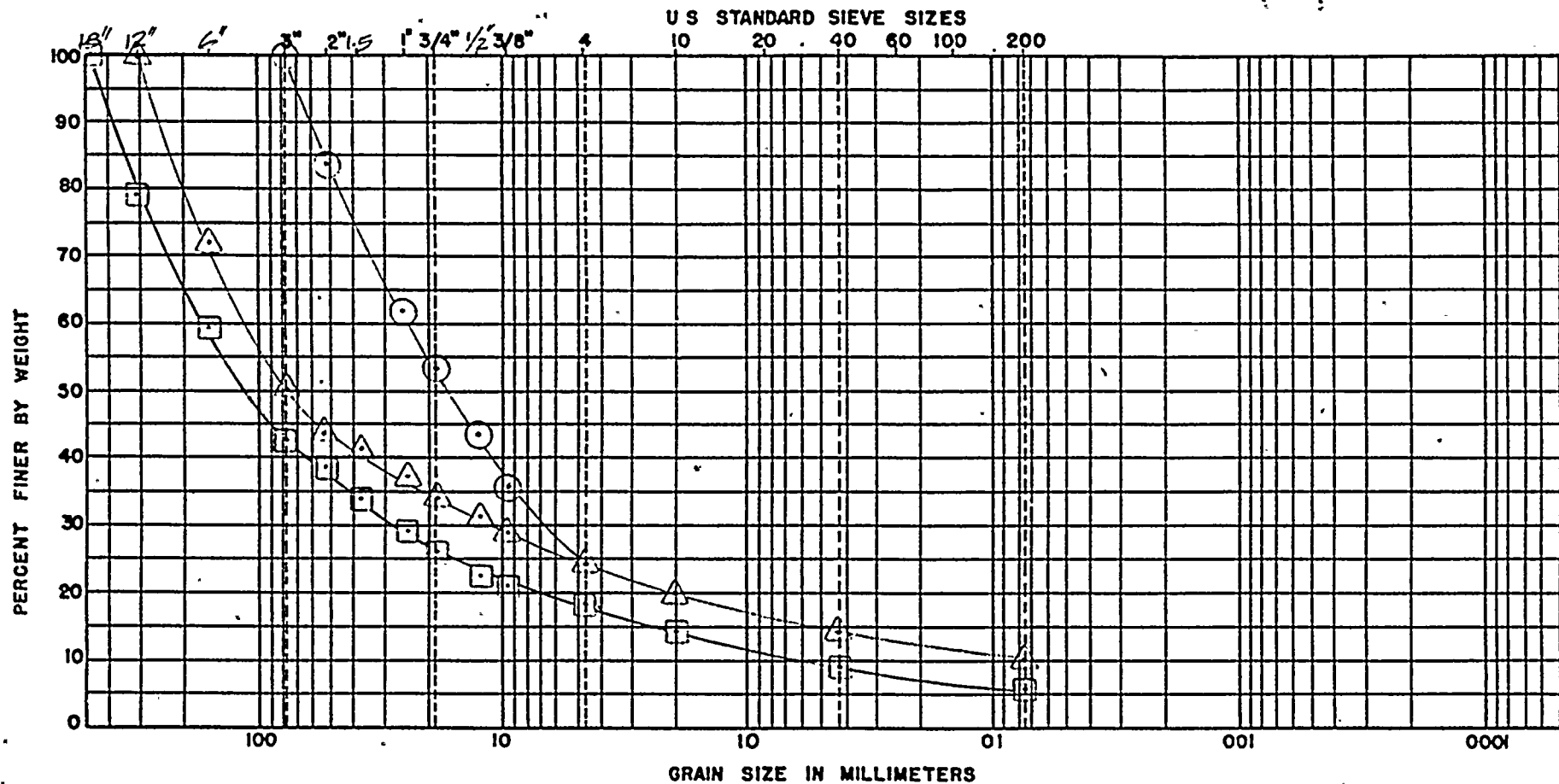


REL 4/12/79



BOUL DERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION	GRAIN SIZE DISTRIBUTION
						△ LIFT 2 BEFORE COMPACTION □ LIFT 2 AFTER COMPACTION (DENSITY)	
							TEST SECTION VRMD-24-7-4 FIGURE 11





TEST FILL PROCEDUREDENSITY TEST DATA

RAG-1136 A

Test Fill No. MDVR 24-4-3DA Date 3-12-79  
Layer Thickness 24 INCHES By Canady  
Number Layers 4 Atwater  
Type Compaction Equip. RAY-GO RASCAL Model 600 A Vibratory Harward  
Material Description Rockfill

DENSITY

1. Volume of water for surface measurement 24 Ft.<sup>3</sup>
2. Top of water to top of frame N.W. 2", N.E. 1 3/4", S.W. 2 1/4", S.E. 2 5/8" In.
3. Weight can (X No. of times filled) 10274 lb.
4. Weight can filled (total) 20680 lb.
5. Sample weight (4-3) 10406 lb.
6. Weight of sand mortar - before 0 lb.
7. Volume of sand mortar bucket - before 0 Ft.<sup>3</sup>
8. Density of sand mortar (6/7) 0 lb/Ft.<sup>3</sup>
9. Weight of sand mortar - after 0 lb.
10. Weight of sand mortar in hole (6-9) 0 lb.
11. Volume of sand mortar in hold (10/5) 0 Ft.<sup>3</sup>
12. Volume of water for hole measurement Gal. 98 Ft.<sup>3</sup>
13. Volume of hole (12 -1+11) 74 Ft.<sup>3</sup>
14. Wet density of material (5/13) 140.6 lb/Ft.<sup>3</sup>
15. Dry density of material (14/one ÷ 21) 137.4 lb/Ft.<sup>3</sup>

MOISTURE CONTENT

16. Weight wet moisture sample ÷ container 10,406 lb.
17. Weight dry moisture sample ÷ container 10,168.4 lb.
18. Weight water (16-17) 237.6 lb.
19. Weight container \* lb.
20. Weight dry material (17-19) 10,168.4 lb.
21. Moisture content (15/20) 2.3% lb.

Shearon Harris Nuclear Power Plant  
Main Dam Rock Fill  
LETCO Job. No. RAG-1136 A

LABORATORY TEST DATA

SIEVE ANALYSIS

SAMPLE NO: BEFORE TEST MDVR 24-4-3

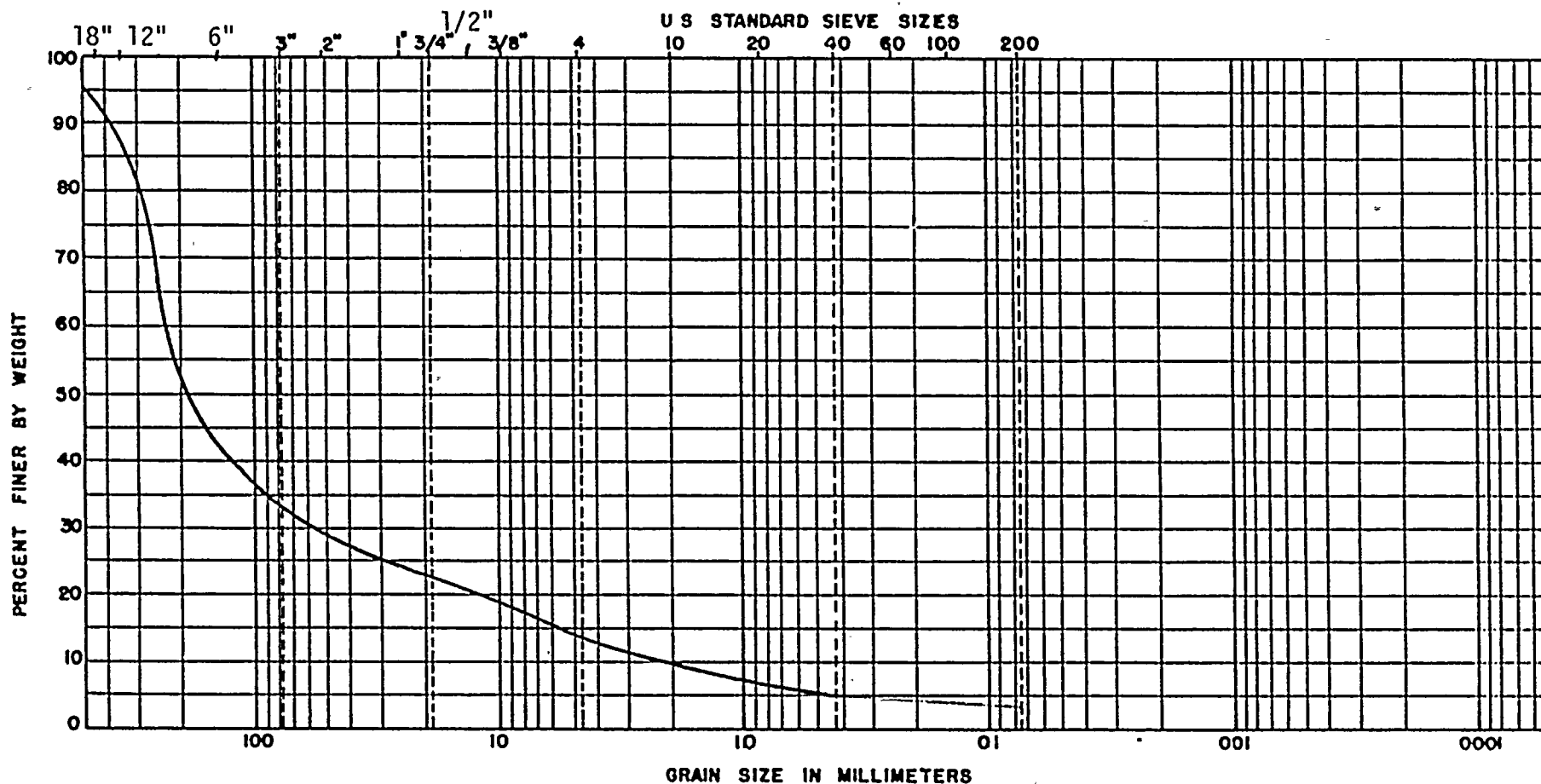
SIEVE SIZE  
U.S. STANDARD

PERCENT, BY WEIGHT, PASSING

24"	100
18"	93
12"	85
6"	46
3"	32
2"	29
1"	25
1/2"	20
3/8"	18
#4	14
#10	10
#40	5
#200	2.9

TOTAL SAMPLE WEIGHT, lbs.:

4886.0



BOUL DERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION	GRAIN SIZE DISTRIBUTION
						RAW STOCKPILE SAMPLE MDVR-24-4-3 BEFORE TEST	
							JOB NO <u>RAG-1136 A</u>
							LAW ENGINEERING TESTING COMPANY

Shearon Harris Nuclear Power Plant  
Main Dam Rock Fill  
LETCO Job No. RAG-1136 A

LABORATORY TEST DATA

SIEVE ANALYSIS

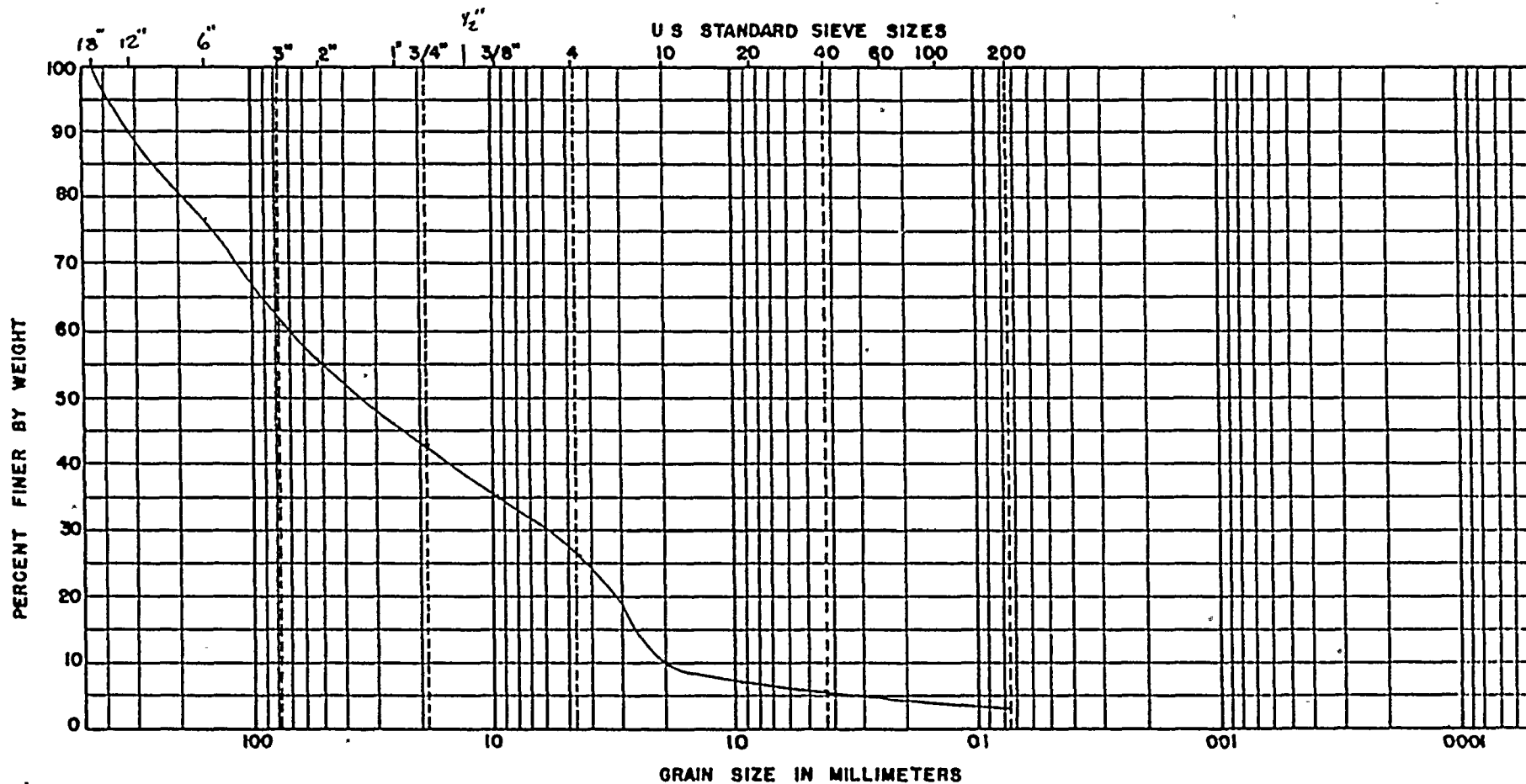
SAMPLE NO:          AFTER TEST          MDVR 24-4-3DA

SIEVE SIZE  
U.S. STANDARD

PERCENT, BY WEIGHT, PASSING

24"	100
18"	100
12"	90
6"	77
3"	61
2"	56
1 1/2"	51
1"	46
3/4"	43
1/2"	38
3/8"	35
#4	27
#10	10
#40	5.7
#200	3.0

TOTAL SAMPLE WEIGHT, lbs.:      10168.4



BOUL DERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
						MDVR 24-4-3DA AFTER TEST

## GRAIN SIZE DISTRIBUTION

JOB NO. RAG-1136 A

LAW ENGINEERING TESTING COMPANY



DENSITY TEST DATA

Test Fill No. MDVR-24-4-3DB Date 3-16-79  
Layer Thickness 24 INCHES By Harward  
Number Layers 4 Canady  
Type Compaction Equip. RAY-GO RASCAL Model 600 A Vibratory Hightower  
Material Description Rockfill

DENSITY

1. Volume of water for surface measurement 24 Ft.<sup>3</sup>
2. Top of water to top of frame N.W. 2", N.E. 1 7/8", S.W. 3 1/8", S.E. 2 1/4" In.
3. Weight can (X No. of times filled) 10,040 lb.
4. Weight can filled (total) 20,800 lb.
5. Sample weight (4-3) 10,760 lb.
6. Weight of sand mortar - before 0 lb.
7. Volume of sand mortar bucket - before 0 Ft.<sup>3</sup>
8. Density of sand mortar (6/7) 0 lb/Ft.<sup>3</sup>
9. Weight of sand mortar - after 0 lb.
10. Weight of sand mortar in hole (6-9) 0 lb.
11. Volume of sand mortar in hold (10/5) 0 Ft.<sup>3</sup>
12. Volume of water for hole measurement Gal. 102 Ft.<sup>3</sup>
13. Volume of hole (12 -1+11) 78 Ft.<sup>3</sup>
14. Wet density of material (5/13) 137.9 lb/Ft.<sup>3</sup>
15. Dry density of material (14/one ÷ 21) 134.2 lb/Ft.<sup>3</sup>

MOISTURE CONTENT

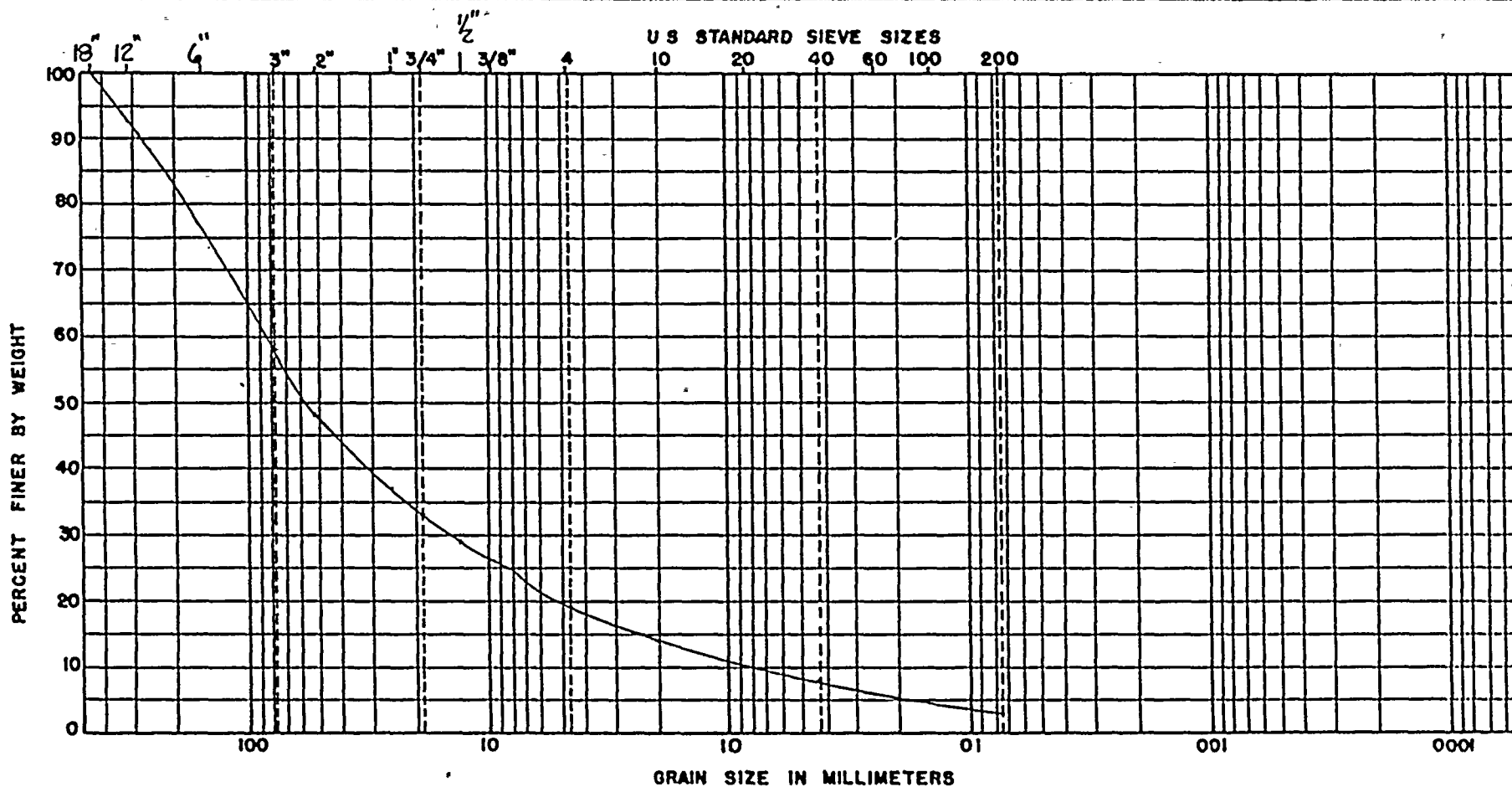
16. Weight wet moisture sample ÷ container 10,760 lb.
17. Weight dry moisture sample ÷ container 10,471 lb.
18. Weight water (16-17) 289 lb.
19. Weight container \* lb.
20. Weight dry material (17-19) 10,471 lb.
21. Moisture content (15/20) 2.8 lb.

\*Container Tared



### SIEVE ANALYSIS





BOUL DERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION	GRAIN SIZE DISTRIBUTION
						MDVR 24-4-3DB AFTER TEST	
							JOB NO. <u>RAG-1136 A</u>
							LAW ENGINEERING TESTING COMPANY G-1

WELL PERMEAMETER TEST  
DETERMINATION OF TEST WELL DIMENSIONS

JOB NAME: Carolina Power & Light Company  
SHNPP, Main Dam, Rock Fill, New Hill, N.C. JOB NO.: RAG-1136A

TEST NO.: 1 GROUND ELEVATION: Top DATE: 5/16/79 MADE BY: FRF  
LOCATION: Rock Fill Test Strip  
I.D. NO.: MDVR 24-4-3PI

OBSERVATION HOLE

SOIL CLASSIFICATION

STRATA DEPTH (ft.)		
FROM	TO	
<u>0</u>	<u>37"</u>	<u>Rock Fill With Moderate Fines</u>

1. DEPTH (ft.) TO WATER TABLE: N/A

WELL DIMENSIONS (DEPTHS FROM STRING BASELINE)

- |   |              |
|---|--------------|
| 2. DEPTH (ft.) TO GROUND SURFACE:             | <u>1.080</u> |
| 3. DEPTH (ft.) TO BOTTOM OF WELL:             | <u>3.917</u> |
| 4. DEPTH (ft.) TO TOP OF SAND:                | <u>1.708</u> |
| 5. DEPTH (ft.) OF SAND (3)-(4):               | <u>2.209</u> |
| 6. DEPTH (ft.) TO WATER SURFACE IN WELL:      | <u>1.542</u> |
| 7. DEPTH (ft.) OF WATER IN WELL $h=(3)-(6)$ : | <u>2.375</u> |

DETERMINATION OF WELL RADIUS

- |  |              |
|--|--------------|
| 8. DENSITY (pcf) OF STANDARD SAND:                         | <u>102.2</u> |
| 9. WEIGHT (lb.) OF GRAVEL + CONTAINER BEFORE FILLING WELL: | <u>50.00</u> |
| 10. WEIGHT (lb.) OF GRAVEL + CONTAINER AFTER FILLING WELL: | <u>19.65</u> |
| 11. WEIGHT (lb.) OF GRAVEL USED (9)-(10):                  | <u>30.35</u> |
| 12. VOLUME (cu. ft.) OF WELL $(11) \div (8)$ :             | <u>0.297</u> |
| 13. RADIUS (ft.) OF WELL $r = \sqrt{\frac{(12)}{(5) \pi}}$ | <u>0.207</u> |

CALIBRATED TOOL ID: C-4353 (Homs Scales)

WELL PERMEAMETER TEST  
RECORD OF TIME AND VOLUME MEASUREMENTS

JOB NAME: SHNPP, Main Dam, Rock Fill, New Hill, N.C. JOB NO.: RAG-1136A  
TEST NO.: MDVR-24-4-3PI DATE: 5/16/79 MADE BY: FRF  
TEST LOCATION: Rock Fill Test Strip SHEET 1 OF 1  
DEPTH FROM STRING BASELINE TO WATER LEVEL: 18½" GROUND TEMP.: 22°C

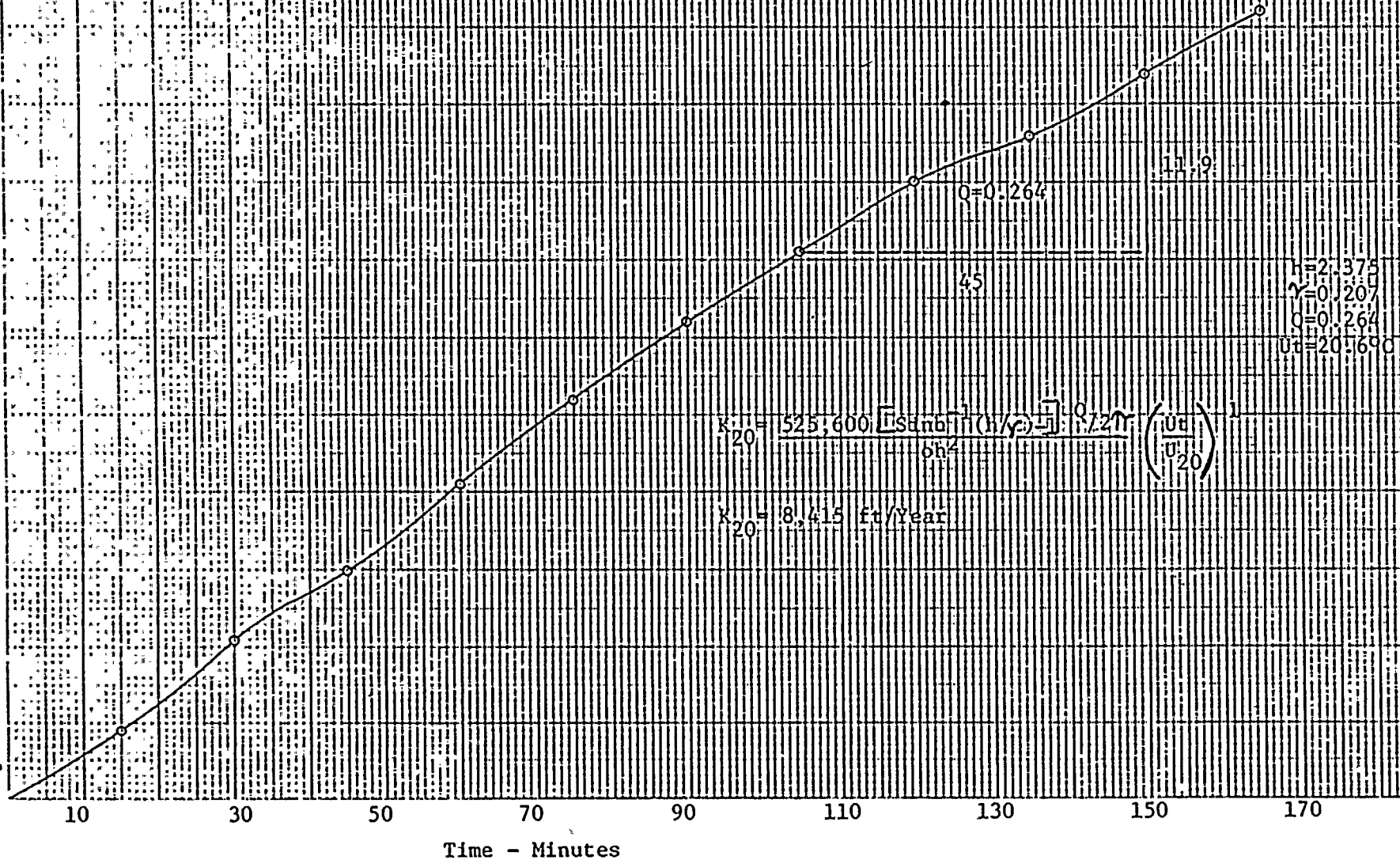
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CALIBRATED TOOL ID: M 4590 (Flow Meter)

Test No: MDVR-24-4-3PI  
 Rock Fill Test Strip  
 Test Method: USBR E-19

SHNPP Main Dam  
 New Hill, N.C.  
 RAG-11136 A  
 5-16-79

ACCUMULATIVE FLOW



1st Fill No. MDVR 24-2-4D Date 4-2-79  
 Layer Thickness 24" By Canady / Harward  
 Number Layers 2  
 Type Compaction Equip. Ray-Go Rascal Model 600 A Vibratory  
 Material Description Rockfill

DENSITY

1. Volume of water for surface measurement 5 barrels 30 Ft.<sup>3</sup>
2. Top of water to top of frame NE 7/8" SE 1 5/8" SW 4" NW 4 15/16" In.
3. Weight can (X No. of times filled) 10280 lb.
4. Weight can filled (total) 18420 lb.
5. Sample weight (4-3) 8140 lb.
6. Weight of sand mortar - before 0 lb.
7. Volume of sand mortar bucket - before 0 Ft.<sup>3</sup>
8. Density of sand mortar (6/7) 0 lb/Ft.<sup>3</sup>
9. Weight of sand mortar - after 0 lb.
10. Weight of sand mortar in hole (6-9) 0 lb.
11. Volume of sand mortar in hold (10/5) 0 Ft.<sup>3</sup>
12. Volume of water for hole measurement Gal. 86 Ft.<sup>3</sup>
13. Volume of hole (12 -1+11) 56 Ft.<sup>3</sup>
14. Wet density of material (5/13) 145.4 lb/Ft.<sup>3</sup>
15. Dry density of material (14/one ÷ 21) 139.9 lb/Ft.<sup>3</sup>

MOISTURE CONTENT

16. Weight wet moisture sample ÷ container 8140 lb.
17. Weight dry moisture sample ÷ container 7833.5 lb.
18. Weight water (16-17) 306.5 lb.
19. Weight container \* \* lb.
20. Weight dry material (17-19) 7833.5 lb.
21. Moisture content (15/20) 3.9 lb.  
 \*Container Tared

Shearon Harris Nuclear Power Plant  
Main Dam Rock Fill  
LETCO Job No. RAG-1136 A

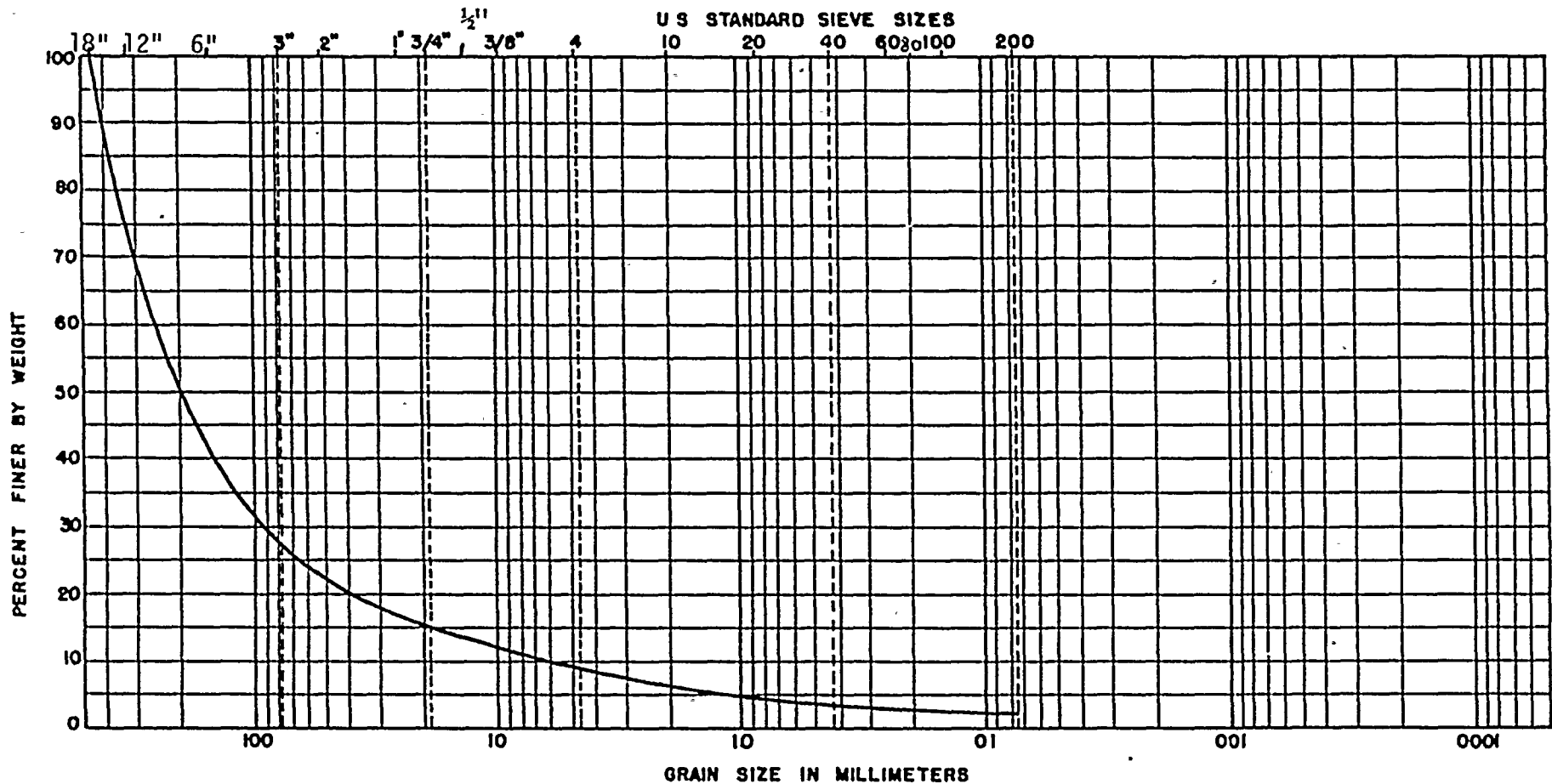
LABORATORY TEST DATA

SIEVE ANALYSIS

SAMPLE NO:        BEFORE TEST    MDVR 24-2-4

<u>SIEVE SIZE</u> <u>U.S. STANDARD</u>	<u>PERCENT, BY WEIGHT, PASSING</u>
24"	100
18"	100
12"	74
6"	43
3"	28
2"	22
1 1/2"	20
1"	17
3/4"	15
1/2"	13
3/8"	12
#4	9
#10	7
#40	4
#200	1.9
TOTAL SAMPLE WEIGHT, lbs.:	4829





BOUL DERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
						Main Dam Rock Fill MDVR 24-2-4 BEFORE TEST

## GRAIN SIZE DISTRIBUTION

JOB NO. RAG-1136 A

LAW ENGINEERING TESTING COMPANY

Shearon Harris Nuclear Power Plant  
Main Dam Rock Fill  
LETCO Job No. RAG-1136 A

LABORATORY TEST DATA

SIEVE ANALYSIS

SAMPLE NO.: (AFTER TEST) MDVR 24-2-4D

SIEVE SIZE  
U.S. STANDARD

(Percent, By Weight, Passing)

24"	100
18"	100
12"	85
6"	59
3"	43
2"	39
1 1/2"	34
1"	30
3/4"	26
1/2"	22
3/8"	21
#4	18
#10	15
#40	9
#200	5.2

TOTAL SAMPLE WEIGHT, lbs.:

7833.5





WELL PERMEAMETER TEST  
DETERMINATION OF TEST WELL DIMENSIONS

JOB NAME: Carolina Power & Light Company, SHNPP,  
Main Dam, Rock Fill, New Hill, North Carolina JOB NO.: RAG-1136A

TEST NO.: 2 GROUND ELEVATION: Top DATE: 5-16-79 MADE BY: F.R. Foster  
LOCATION: Rock Fill Test Strip  
I.D. NO.: MDVR-24-2-4PI

OBSERVATION HOLE

SOIL CLASSIFICATION

STRATA DEPTH (ft.)		
FROM	TO	
<u>0</u>	<u>39"</u>	<u>Rock Fill with Moderate Fines</u>

1. DEPTH (ft.) TO WATER TABLE: \_\_\_\_\_

WELL DIMENSIONS (DEPTHS FROM STRING BASELINE)

2. DEPTH (ft.) TO GROUND SURFACE:	<u>1.250</u>
3. DEPTH (ft.) TO BOTTOM OF WELL:	<u>4.438</u>
4. DEPTH (ft.) TO TOP OF SAND:	<u>1.833</u>
5. DEPTH (ft.) OF SAND (3)-(4):	<u>2.604</u>
6. DEPTH (ft.) TO WATER SURFACE IN WELL:	<u>1.771</u>
7. DEPTH (ft.) OF WATER IN WELL $h=(3)-(6)$ :	<u>2.667</u>

DETERMINATION OF WELL RADIUS

8. DENSITY (pcf) OF STANDARD SAND:	<u>102.2</u>
9. WEIGHT (lb.) OF GRAVEL + CONTAINER BEFORE FILLING WELL:	<u>50.00</u>
10. WEIGHT (lb.) OF GRAVEL + CONTAINER AFTER FILLING WELL:	<u>18.64</u>
11. WEIGHT (lb.) OF GRAVEL USED (9)-(10):	<u>31.36</u>
12. VOLUME (cu. ft.) OF WELL (11)÷(8):	<u>0.3068</u>
13. RADIUS (ft.) OF WELL $r = \frac{\sqrt{(12)}}{(5) \pi}$	<u>0.194</u>

Calibrated Tool ID: C-4353 (Homs Scales)

WELL PERMEAMETER TEST  
RECORD OF TIME AND VOLUME MEASUREMENTS

JOB NAME: SHNPP, Main Dam, Rock Fill, New Hill, N. C.

JOB NO.: RAG-1136A

TEST NO.: MDVR-24-2-4P1 DATE: 5-16-79

MADE BY:

F. R. Foster

TEST LOCATION: Rock Fill Test Strip

SHEET 1 OF 1

DEPTH FROM STRING BASELINE TO WATER LEVEL: 1.771 ft.

GROUND TEMP.: 21.7°C

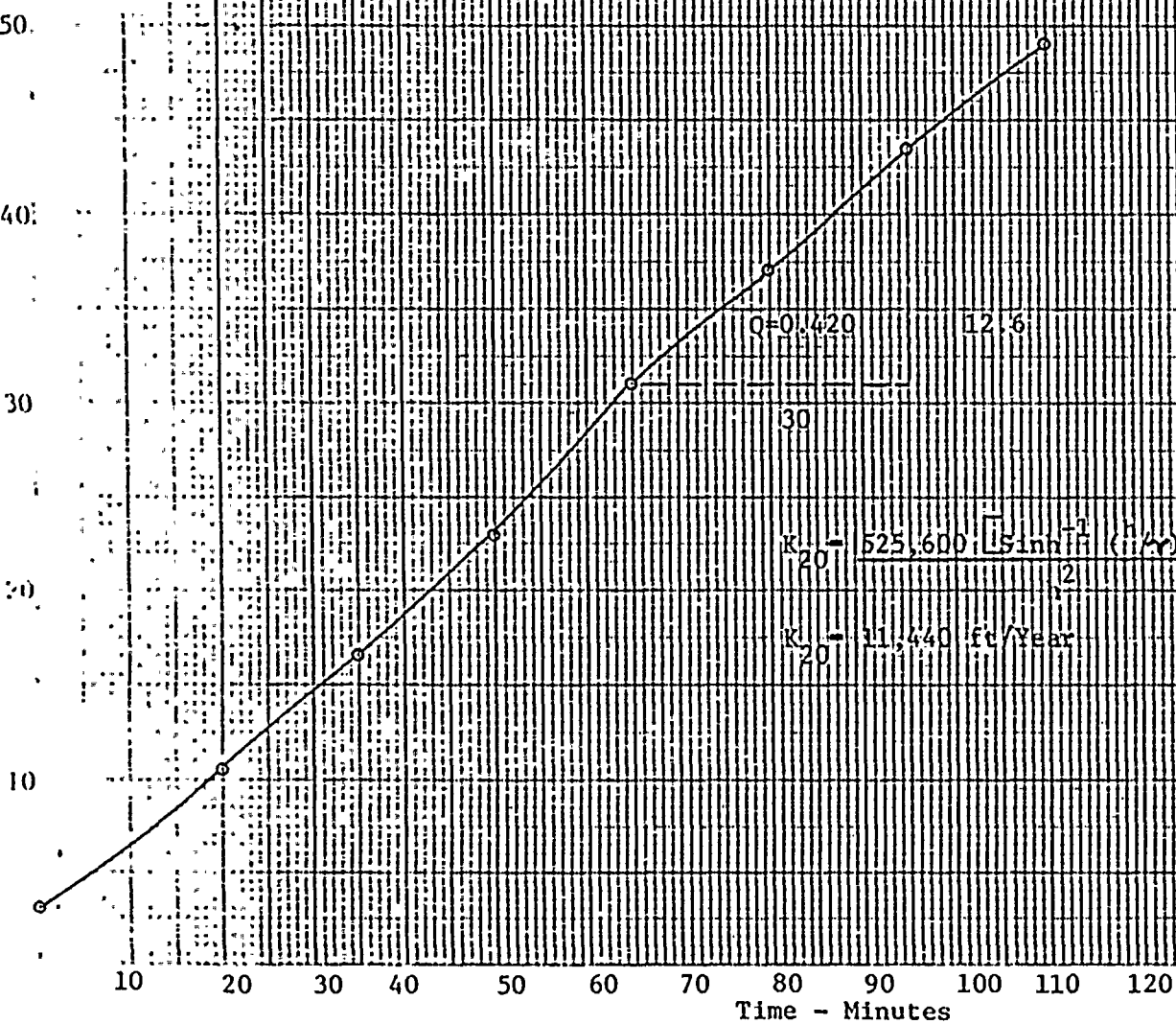
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Calibrated Tool ID: M 4590 (Flow Meter)



Test No: MDVR-24-2-4PI  
 Rock Fill Test Strip  
 Test Method: USBR E-19

SHNPP Main Dam  
 New Hill, N. C.  
 RAC-1136A  
 5-16-79



$n=2.667$   
 $\gamma=0.194$   
 $Q=0.420$   
 $U_t=20.3^\circ\text{C}$



APPENDIX B

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

## FIELD INSPECTION REPORT

Date 2-15-79 Spec. No. CAR-SH-CH-4 & 8 (TP-C1)  
Location N 662,403; E 2,009,077. Inspector D.S. Canady  
Elevation 225 ft. Shift Day  
Weather Clear & Warm

MDR-24-4-3

## COMMENT

THE MORNING WAS SPENT GRADING AND ROLLING OUT THE TESTILL AREA. THE WEATHER WAS THE MAJOR FACTOR IN THE BASE PREPARATION. SHORTLY AFTER LUNCH THE FIRST MARSHAL WAS PLACED FOR THE SOUTH RAMP. THE RAMP WAS BUILT ACCORDING TO THE DESIGN IN TP-C1. AT APPROXIMATELY MID-AFTERNOON THE FIRST LOAD OF ROCK WAS BACK DUMPED BY THE R-22 EDDIES ONTO THE TEST AREA. A D-6 DOZER WAS USED TO LEVEL OUT THE ROCK TO THE 24" LIFT AND WORKED OUT ALL THE OVER 22" ROCK TO THE SIDES OF THE TESTILL. THE ENTIRE LIFT WAS NOT COMPLETED TODAY; THEREFORE, THE ENTIRE AREA WAS COVERED WITH PLASTIC IN CASE OF RAIN. THE RAYGEBODA METAL DRUM VIBRATION ROLLER WAS TESTED FOR THE CORRECT FREQUENCY UTILIZING THE "SINCO" S-2 VIBRATION MONITOR. THE SPEED WAS CHECKED OVER A MEASURED DISTANCE. BOTH THE SPEED AND FREQ. WERE SET ACCORDING TO TPO REQUIREMENTS.

INSPECTOR

D.S. Canady

Q A REVIEW

Eugene Kelly 6/18/79

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

FIELD INSPECTION REPORT

Date 2-16-79 Spec. No. CAR-SACH 4 & 8  
Location N 662,403; E 2,009,077 Inspector D.S. CANADY  
Elevation 225 FT. Shift DAY  
Weather CLOUDY & MILD

MDVR - 24 - 4 - 3

COMMENT

THE FIRST LIFT WAS FINISHED TO GRADE (24" AVERAGE). THE INITIAL  
ROW WAS MADE WITHOUT VIBRATION AS DESCRIBED IN TP-C1. THE  
SETTLEMENT PTS. WERE CHECKED BETWEEN EACH PASS. (TEN LOADS OF  
MATERIAL WERE REQUIRED TO GET ENOUGH MATERIAL THE RIGHT SIDE)  
AFTER BUILDING THE SOUTH RAMP TO ACCOMMODATE THE SECOND  
LIFT. THE SECOND LIFT CONTAINED, AN OVERALL AVERAGE, LESS  
OVERSIZED MATERIAL AND THEREFORE REQUIRED ONLY 8 LOADS TO  
BUILD THE TEST AREA.

THE TEST FILL WAS COVERED WITH PLASTER FOR THE  
WEEKEND.

INSPECTOR

D.S. Canady

Q A REVIEW

Eugene Kelly 6/11/79

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

FIELD INSPECTION REPORT

Date 2-28-79  
Location N 662, 403; E 2, 009, 077  
Elevation 225 FT.

Spec. No. CAR SH-CH-448 (TP-01)  
Inspector D.S. Canada  
Shift Day  
Weather SUNNY & MILD

MDVR-24-4-3

COMMENT

BAD WEATHER HAS HANDICAPPED THE CONSTRUCTION OF THE TEST. ALL  
STARTED THE INITIAL PASS ON SECOND LIFT WITHOUT VIBRATION.  
AFTER CHECKING THE FREQUENCY OF THE RAYGO ROLLER AND  
THE SPEED, TEN PASSES WERE MADE WITH SETTLEMENT  
READINGS BETWEEN EACH PASS. AFTER THE 10<sup>TH</sup> PASS  
THE TEST FILL WAS COVERED WITH PLASTIC UNTIL TEMPERATURES

INSPECTOR

D.S. Canada

Q A REVIEW

Eugene Kelly 6/18/79

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

## FIELD INSPECTION REPORT

Date 3-1-79 Spec. No. CAR-SH-CH 468 (TP.01)  
Location N 662,403 ; E 2,009,097 Inspector D.S. Canady  
Elevation 225 FT. Shift DAY  
Weather OVERCAST & MILD

MOVR - 24-A-3

COMMENT

THE SOUTH Ramp WAS BUILT TO ACCOMMODATE THE 3<sup>RD</sup> LIFT NO. 3 WAS BUILT AS #1 & 2 WITH THE BACKDUMPING OF THE R-SD EXHAUSTS AND CABLES AND SPREADING THE MATERIAL WITH THE D-6-DOZER.

THE ENTIRE DAY WAS USED TO BUILD LIFT NO 3. QUITE A BIT OF OUNSIZE ROCK HAD TO BE WORKED OUT OF THE LIFT. THIS LIFT HAD TO BE WORKED CONSIDERABLY MORE DUE TO THE EXCESSIVE OUNSIZE.

THE TEST FILL WAS COVERED AND PLANS ARE TO COMPLETE THE NORTH Ramp tomorrow morning & START THE SETTLEMENT PLS.

INSPECTOR

Q A REVIEW

D.S. Canady  
Eugene Keagy 9/18/79

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

FIELD INSPECTION REPORT

Date 3-2-79 Spec. No. CAR-SH-LH-418 (TP-01)  
Location N662,403; E 2009,097 Inspector D.S. CANARY  
Elevation 225 FT. Shift Day  
Weather Mild & Sunny

INDUR-24-4-3

COMMENT

THE NORTH DAMP WAS COMPLETED PRIOR TO STARTING THE VIBRATION ROLL. THE INITIAL ROLL WAS MADE WITHOUT VIBRATION AS PER TP-01. THE ROLLER SPEED AND VIBRATION FREQUENCY WERE CHECKED PRIOR TO THE 10 PASSES. SETTLEMENT DATA WAS TAKEN AFTER EACH PASS.

LIFT NUMBER 4 WILL BE STARTED MONDAY WITH AN ANTICIPATED NUMBER OF 8 PASSES FOR MAX. COMPACTION. (DATA OBTAINED FROM THESE 3 LIFTS.)

THE VISUAL OBSERVATIONS ON THE LIFTS WERE AS FOLLOWS:

AFTER 2 PASSES - THE SURFACE ITS. HAVE BEEN BROKEN AND A GENERAL SPLITTING OR FILLING OF THE VOIDS WAS OBSERVED.

3-8 PASSES - A BREAKING OF THE TOP SURFACE TO CREATE MORE FINES AND A MORE UNIFORM COMPACTION WAS OBSERVED.

9-10 PASSES - FURTHER COMPACTION ON THE SURFACE WAS NOT OBSERVED BUT THE SURFACE MATERIAL SEEMS TO BE BREAKING DOWN INTO MOSTLY FINES WITH THE OBSERVATION OF BEING OVERWORKED.

INSPECTOR

Q A REVIEW

*D.S. Canary*  
*Eugene Kelly 4/18/79*

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

## FIELD INSPECTION REPORT

Date 3-7-79 Spec. No. CAR SH-4 - 498 (TP-01)  
Location N 662,403 ; E 2,009, 097 Inspector D.S. CANADY  
Elevation 225 FT. Shift Day  
Weather MILD

COMMENT

AFTER NUMEROUS PROBLEMS OBTAINING OPERATORS TO RUN EQUIPMENT, FINALLY STARTED THE SOUTH RAMP ON LIFT No. 4. THE 4TH LIFT WAS BUILT AS WERE THE PRECEDING 3 LIFTS. APPROXIMATELY 3/4 OF THE LIFT WAS COMPLETED PRIOR TO EQUIP. PROBLEMS. THE DOZER WENT DOWN FOR THE REMAINDER OF THE DAY - THE 4TH LIFT WILL BE CONTINUED TOMORROW.

INSPECTOR

Q A REVIEW

D.S. Canady  
Eugene Kelly 6/12/81

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

## FIELD INSPECTION REPORT

Date 3-8-79 Spec. No. CARSHCH-48 (TP-01)  
Location N 662,403 E 2,009,097 Inspector D.S. CANADY  
Elevation 225 FT. Shift Day  
Weather OVERCAST

COMMENT

CONTINUED ON THE 4TH LIFT. HAD LAW ENGINEERING  
CO. TAKE A LOAD OF MATERIAL TO RUN GRADATION ON  
THE LIFT. THE TEST AREA WAS COMPLETED AT THE NORTH  
RAMP AREA STARTED WHEN RAIN STARTED. THE TEST FILL  
WAS COVERED WITH PLASTIC AND PUT OFF UNTIL TOMORROW.

INSPECTOR

D.S. Canady

Q A REVIEW

Eugene Kelly 6/18/79





CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

## FIELD INSPECTION REPORT

Date 3-9-79 Spec. No. CAR-SH-CH 488 (TP-01)  
 Location N662,403/E 2,001,097 Inspector D.S. CANADY  
 Elevation 225 FT. Shift DAY  
 Weather \_\_\_\_\_

COMMENT

FINISHED BUILDING THE NORTH RAMP. THE EXCHANGERS REPLACED THE TEST GRID AND A PRELIMINARY DEPTH CHECK WAS TAKEN. BY NOON THE FIRST PASS WITHOUT VIBRATION WAS RUN AND THE INITIAL READING WORE MADE. THE 8 PASSES WERE RUN USING AN ALTERNATING FORWARD-REVERSE PASS AND ALTERNATING APPROACHES TO THE SIDES. THE VIBRATIONS OF THE RAYGO 600A WERE CHECKED WITH THE "SINCO" VIBRATION MONITOR AND CROSS-CHECKED WITH THE TACH. ON THE RAYGO. (THE REVERSE OPERATION REQUIRED A GUIDE-IN TO KEEP THE ROLLING OPERATION ON A MINIMAL OVERLAP CENTERING OF THE SETTLEMENT POINTS. EQUIPMENT IS SET UP TO START THE DENSITY TEST MONDAY.

INSPECTOR

Q A REVIEW

*D.S. Canady*  
*Eugene Keeg* 6/18/79

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

## FIELD INSPECTION REPORT

Date 3-12-79 Spec. No. CAR-SH-CH 48 (TP.01)  
Location N662, 403 / E 2009, 097 Inspector D. S. CANADY  
Elevation 22.5 FT. Shift Day  
Weather MILD

COMMENT

IN PREP. FOR THE DENSITY TEST, THE 8'X8' WOODEN FRAME WAS PLACED ON THE INTENDED TEST AREA. THE CORNERS WERE CHECKED FOR OVERALL LEVELNESS. A PICTURE WAS TAKEN OF THE SURFACE PRIOR TO LINING THE FRAME WITH PLASTIC. FOUR 6 ft<sup>3</sup> BARRELS OF WATER WERE CAREFULLY POURED INTO THE FRAME FOR THE SURFACE MEASUREMENT. ALL CORNERS WERE CHECKED FOR WATER TO TOP OF FRAME HEIGHT. UTILIZED THE SUMP VALVUM TRUCK TO GET THE WATER OUT OF THE FRAME. USED THE GRADALL WITH A 2 FT BUCKET TO DIG THE MATERIAL OUT OF THE HOLE, (WITH THE BUCKET & THE TENDENCY OF THE RUCK TO PULL OUT FROM UNDER THE FRAME, MOST EXCAVATION WAS MANUAL - SHOVEL & HAND. THE FLAT-BED TRUCK WAS LINED WITH PLASTIC TO AVOID LOOSEING MATERIAL ON THE BED. A BAG SAMPLE WAS TAKEN TO OBTAIN MOISTURE CONTENT. THE HOLE WAS DUG TO A DEPTH OF 24", (THE DEPTH OF THE LIFT.) THE MATERIAL WAS OBSERVED TO CONTAIN A LARGE PORTION OF FINES. THE DIGGING REQUIRED THE REMAINDER OF THE WORK DAY, THEREFORE THE TRUCK WILL REMAIN COVERED ON SITE UNTIL TOMORROW MORNING BEFORE SENDING THE SAMPLE TO THE LAB LAB, DOWNTOWN. THE AREA WAS COVERED WITH PLASTIC FOR THE NIGHT

INSPECTOR

Q A REVIEW

*D. S. Canady*  
*Eugene Kelly 6/18/79*

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

## FIELD INSPECTION REPORT

Date 3-13-79 Spec. No. CAR SH-CH 498 (TP-01)  
 Location N662,403/E 2,009,097 Inspector D.S. CANADY  
 Elevation 225 FT. Shift DAY  
 Weather \_\_\_\_\_

COMMENT

ELEVATIONS WERE CHECKED ON THE CORNERS PRIOR TO PLASTIC LINING THE DENZING TEST HOLE. THE FRAME WAS STILL IN PLACE. DUMPING OF THE MEASURED BARRELS OF WATER BEGAN TO FILL THE LINED HOLE TO THE TOP OF THE FRAME. (THE ORIGINAL MARKS.) WATER TEMP. WAS 58°F. SIXTEEN BARRELS (6 ft<sup>3</sup>) PLUS FOUR 1/2 ft<sup>3</sup> BUCKETS WERE REQUIRED TO FILL THE WATER UP TO THE ORIGINAL MARK. SUBTRACTING THE BEGINNING SURFACE MEASUREMENT OF 24 ft<sup>3</sup> FROM THE FINAL VOLUME, 98 ft<sup>3</sup> YIELDED THE VOLUME OF THE HOLE TO BE 74 CUBIC FT. THE SUMP VACUUM TRUCK WAS AGAIN USED TO REMOVE THE WATER. THE HOLE WAS CHECKED UNDER THE PLASTIC FOR LEAKS - NONE WERE FOUND. (NO MONITOR WAS REQUIRED, BECAUSE THE LARGE AMT. OF FINES LEFT THE EXCAVATED SIDES WITHOUT ANY SHARP CORNERS OR VOIDS.)

INSPECTOR

Q A REVIEW

*D.S. Canady*  
*Eugene Kelly 6/18/79*

Sheet 1 of 1

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

FIELD INSPECTION REPORT

Date 3-23-79 Spec. No. CAR-SH-CH-148 (TP-01)  
Location N 661030.74 / E 2.009, 774.38 Inspector D. S. Conady  
Elevation 242 Shift DAY  
Weather OVERCAST, WINDY & COOL

MOUR - 24-2-4

COMMENT

TUNNELLED IN THE TEST PATTERN AS SPECIFIED IN TP 01. ROLL  
SECTIONS PASSED WITH THE ROLLER OVER THE ROAD AND  
CHECKED FOR SETTLEMENT. AT APPROXIMATELY 9:00 AM STARTED  
LOADING MATERIAL FOR THE SOUTH RAMP. ON THIS REFILL, A D-5 WAS  
USED TO SPREAD THE MATERIAL SINCE THE D-6 WAS DOWN. THE FIRST  
LIFT WAS DONE ACCORDING TO TP 01, USING A R-50 GRADER TO  
BACKDUMP THE MATERIAL ON THE PAVED SIDE AND THEN SPREAD  
THE MATERIAL WITH THE D-5.

AFTER BUILDING THE LIFT AND THE RIMMS, THE FIRST ROLL  
WAS MADE WITHOUT VIBRATION, TO GENERALLY LEVEL OUT THE ROAD  
PLOTS. THE FIRST ROUND OF SETTLEMENT POINTS WERE MADE TO  
CHECK ROAD THICKNESS. THEN TEN PASSES WERE MADE WITH THE  
Egyo 6000 ROLLER WITH SETTLEMENT POINTS CHECKED BETWEEN  
EACH ROLLER PASS. THE ROLLER WAS CHECKED WITH THE  
SILCO VIBRATION MONITOR TO CHECK THE FREQUENCY OF THE ROLLER.  
THE ROLLER SPEED WAS CALIBRATED WITH STROUT TIME OVER A  
MEASURED DISTANCE.

THE FIRST LIFT WAS COMPLETED AT 300 PM.

THE SURFACE BREAKDOWN WAS SIMILAR TO AS PREVIOUSLY  
DESCRIBED

INSPECTOR

Q A REVIEW

*D. S. Conady*  
*Eugene Kelly 6/18/79*

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

FIELD INSPECTION REPORT

Date 3-15-79 Spec. No. CARSHCH 448 (TP-01)  
Location N662,403/E 2,009,097 Inspector D.S. CANADY  
Elevation 225 FT. Shift DAY  
Weather CLEAR, COOL, WINDY

COMMENT

BIASED ON THE FACT THAT AN UNUSUALLY LARGE AMT.  
OF FINES OBSERVED IN THE 1<sup>ST</sup> TEST HOLE, WERE NOT REPRESENTATIVE  
OF THE ENTIRE LIFT; A SECOND TEST HOLE HAS BEEN  
STARTED ON THE 4<sup>TH</sup> LIFT. A PLACE WAS CHOSEN FOR  
THE FILLING THAT APPEARED TO BE MORE REPRESENTATIVE. THE  
SAME PROCEDURES WERE FOLLOWED AS WERE DESCRIBED IN THE  
DUBOIS HOLE (3-12, 3-13 REPORTS). THIS SECOND HOLE WAS ON  
THE NORTH EASTERN PORTION OF THE TEST GRID. THE SURFACE  
LOCID TO BE MORE REPRESENTATIVE OF THE ENTIRE TEST FILL.

INSPECTOR

Q A REVIEW

*[Signature]*  
*[Signature]* 6/18/79

Sheet 1 of 1

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

FIELD INSPECTION REPORT

Date 3-26-79  
Location N 661030 / E 2009,774  
Elevation 247-

Spec. No. CAE SH-CH-448 (TR-01)  
Inspector D.S. CANADY  
Shift DAY  
Weather \_\_\_\_\_

11012-2.4-2-4

COMMENT

STARTED BUILDING LIFT NUMBER 2 AT 9:00 AM.  
THE LOADER WAS LOADING MATERIAL FROM THE SPILLWAY  
EXCAVATION. THE MATERIAL FROM THE UPPER ELEVATION  
APPEARS TO CONTAIN A LARGE AMOUNT OF FINE MATERIALS.  
VERY LITTLE COARSE WAS OBSERVED IN THIS LIFT.

LAWSON CO. CAME OUT TO GET A SAMPLE OF MATERIAL  
FOR THE BEFORE COMPACTION GRADATION.

BY 11:30 THE LIFT HAD BEEN COMPLETED AND WAS READY  
FOR THE 1ST ROLL WITHOUT VIBRATION

STARTED THE 8 PASSES WITH SETTLEMENT CHECKS BETWEEN  
EACH PASS. (SETTLEMENT WAS DETERMINED FROM THE PREVIOUS  
TEST FILL AND THE COMPACTION BECAME ON THE FIRST LIFT OF  
THIS TEST FILL.)

SURFACE OBSERVATIONS AS BEFORE, MOST SURFACE  
EVIDENCE OF COMPACTION OBSERVED AFTER 2 PASSES. 3 TO 4  
PASSES OBSERVED TO FILL VOIDS AND GENERALLY BRING THE  
SURFACE AROUND TO A GENERALLY LEVEL TOP. SURFACE  
CHANGE NOT EVIDENT AFTER THE 4 OR 5 PASSES.

INSPECTOR

Q A REVIEW

*[Signature]*  
*[Signature]* 6/18/79

CAROLINA POWER & LIGHT COMPANY  
SHEARON HARRIS NUCLEAR POWER PLANT

FIELD INSPECTION REPORT

Date 4-2-79 Spec. No. CAR-SH-CH-4<sup>1</sup>B (TP-01)  
Location N661,030 / E 2009,774 Inspector D. S. CANADY  
Elevation 242 Shift DAY  
Weather OVERCAST

VRMD - 24-24

COMMENT

IN PREPARATION FOR THE DENSITY TEST, AN AREA THAT LIKED TO BE REPRESENTATIVE WAS CHOSEN TO PLACE THE 8'X8' WOODEN FRAME. LEVELS WERE RUN TO CHECK THE EDGE OF THE FRAME. THE FRAME WAS LINED WITH PLASTIC AND THE INITIAL CALIBRATED BUCKETS OF WATER WERE DUMPED FOR THE INITIAL READING. THE 8'X8'X24" HOLE WAS DUG AND THE MATERIAL WAS LOADED ON A PLASTIC LINED FLATBED TRUCK. THE TRUCK WAS SENT TO BE WEIGHED & SEIRED. THE DUG HOLE WAS AGAIN LINED WITH PLASTIC AND CAREFULLY FILLED TO THE ORIGINAL LEVEL. THE DIFFERENCE WAS CALCULATED TO DETERMINE THE VOLUME OF THE SAMPLE REMOVED.

INSPECTOR

D. S. Canady

Q A REVIEW

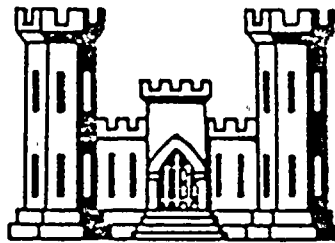
Eugene Kelly 6/18/79



APPENDIX C



# U.S. ARMY ENGINEER DIVISION LABORATORY SOUTH ATLANTIC



LARGE SCALE TRIAXIAL SHEAR AND GRADATION TESTS  
ON  
ROCK TEST FILL MATERIAL

SHEARON HARRIS NUCLEAR POWER PLANT  
CAROLINA POWER AND LIGHT COMPANY

12 JULY 1979  
CORPS OF ENGINEERS  
MARIETTA, GEORGIA

REQUISITION NO.  
H-11291

WORK ORDER NO.  
1366

13 July 1979

## PREFACE

By letter dated 26 July 1978, the Carolina Power and Light Company (CP&L), Raleigh, North Carolina, requested the U. S. Army Engineer Division Laboratory, South Atlantic, perform laboratory tests on material from a rock test fill at the Shearon Harris Nuclear Power Plant main dam site. The sample was delivered to the Laboratory in April 1979 and the work was accomplished under the provisions of ER 1140-1-210. The tests conducted were: one 15-in. diameter, consolidated, undrained triaxial shear ( $\bar{R}$ ) test and an after-test gradation analysis.

The work was performed under the general direction of Mr. Robert J. Stephenson, P. E., Director, South Atlantic Division Laboratory. The tests were supervised by Mr. Coy A. Colwell, Supervisory Civil Engineering Technician. Messrs. Colwell and Stephenson analyzed the data and prepared this report.

13 July 1979

CONVERSION FACTORSBRITISH TO METRIC UNITS OF MEASUREMENT

British units of measurement used in this report can be converted to metric units as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
inches	2.54	centimeters
pounds	0.45336	kilograms
cubic feet	0.028317	cubic meters
pounds per square inch (psi)	703.1	kilograms per square inch
tons per square foot	0.9765	kilograms per square centimeter
centimeters per second	1.969	feet per minute

13 July 1979

LARGE SCALE TRIAXIAL SHEAR AND GRADATION TESTS  
on  
ROCK TEST FILL MATERIAL

SHEARON HARRIS NUCLEAR POWER PLANT  
CAROLINA POWER AND LIGHT COMPANY

1. OBJECT:

The object of this test program was to determine the triaxial shear ( $\bar{R}$ -test) and the after-test gradation of a rockfill sample. The test specimens were reconstituted using material in a test sample obtained from a rock test fill at the Carolina Power and Light Company (CP&L) Shearon Harris Nuclear Power Plant main dam site.

2. REFERENCES:

a. Previous report: "Large Scale Triaxial Shear and Permeability Tests, Shearon Harris Nuclear Power Plant, Carolina Power and Light Company," Requisition No. H-02022, Corps of Engineers, South Atlantic Division Laboratory, Marietta, Georgia, April 1975.

13 July 1979

b. Engineering Manual 1110-2-1906, Laboratory Soils Testing, Department of the Army, Office of the Chief of Engineers, 30 Nov 1970.

3. SPECIAL EQUIPMENT:.

The controlled-strain triaxial apparatus and the gradation equipment were the same used in the previous test program and described in paragraph 3 of reference 2a.

4. DESCRIPTION OF SAMPLE:

The test sample was provided by CP&L already separated on various sieves ranging from minus 3-in. to minus No. 4 sieve sizes. The material, which was shipped sealed in 55-gallon metal drums, was received 17 April 1979. According to CP&L's letter dated 9 May 1979, the test sample had been obtained from a rock test fill at the Shearon Harris Nuclear Power Plant main dam site. The same letter contained the field gradation data to use as the basis for computing the replacement gradation for the test specimens. Based on the field gradation, the sample classified as a tan, poorly graded, silty gravel (GP-GM) with about 50 percent cobble sizes up to 12-in. maximum size.

13 July 1979

## 5. SCOPE OF TESTS:

The rockfill material was recombined at the replacement gradation for each of the three 15-in. diameter triaxial specimens which were then tested in consolidated undrained triaxial shear with pore pressure measurements ( $\bar{R}$ -tests). In the CP&L letter of 9 May, it was requested that the specimens be compacted to 138 pcf dry density at 4 percent moisture content. After the first specimen was tested at a confining pressure ( $\sigma_3$ ) of 2.0 tons/sq. ft., Messrs. Alex Fuller (CP&L) and Mike Pavone (Ebasco) telephoned instructions to reduce the specimen density to 135 pcf in the other two specimens. After the triaxial tests, a gradation analysis was performed on the specimen tested at the highest confining pressure.

## 6. TEST PROCEDURES:

The test procedures were the same as those used in the previous test program and described in paragraph 6b of reference 2a. Only the specimen densities and moisture contents were changed to comply with the current request and instructions from CP&L representatives.





13 July 1979

## 7. TEST RESULTS:

The results of all the tests are shown on the attached standard forms as listed below.

<u>Test</u>	<u>Attachment No.</u>
Gradation Curves, ENG Form 2087	1
Triaxial Compression Test Report, ENG Form 2089	2

## 8. DISCUSSION OF TEST RESULTS:

a. Gradation Curves. The sample furnished for this test program was not well graded like the 1975 sample. It contained more gravel sizes and less sand sizes. The percentage of fines (minus No. 200 sieve sizes) was about the same in both samples. As a result, there was less sand available to "cushion" the gravel size particles in the specimens prepared for these tests. That probably caused more apparent degradation in these tests than occurred in the sample tested earlier.

b. Triaxial Shear.

(1) The shear strength parameters were arbitrarily

13 July 1979

computed at 15 percent axial strain. As noted above, the No. 2 test specimen was prepared at a higher density than the others, so it was not surprising that the strength circles did not generate a "good" total strength envelope. Hence, no total strength envelope is shown on the report sheet. The induced pore pressures, however, caused the strength circles to shift and line up very well tangent to an effective strength envelope with an angle of internal friction ( $\phi'$ ) of 40.5 degrees. This compares favorably with the  $\phi'$  of 40.0 degrees obtained in the previous test program.

(2) The negative induced pore pressures indicate the specimens tested under the lower confining pressures dilated. The specimens tested in the previous program did not exhibit this characteristic. This change in behavior between the two samples, however, is consistent with the higher percentage of gravel sizes in the current sample.

c. Photographs. Photographs were made as the tests progressed. Unfortunately, the entire roll of film was bad and no pictures are available. For all practical

13 July 1979

purposes, however, the photographs in the previous report are also typical for these tests.

9. CONCLUSIONS:

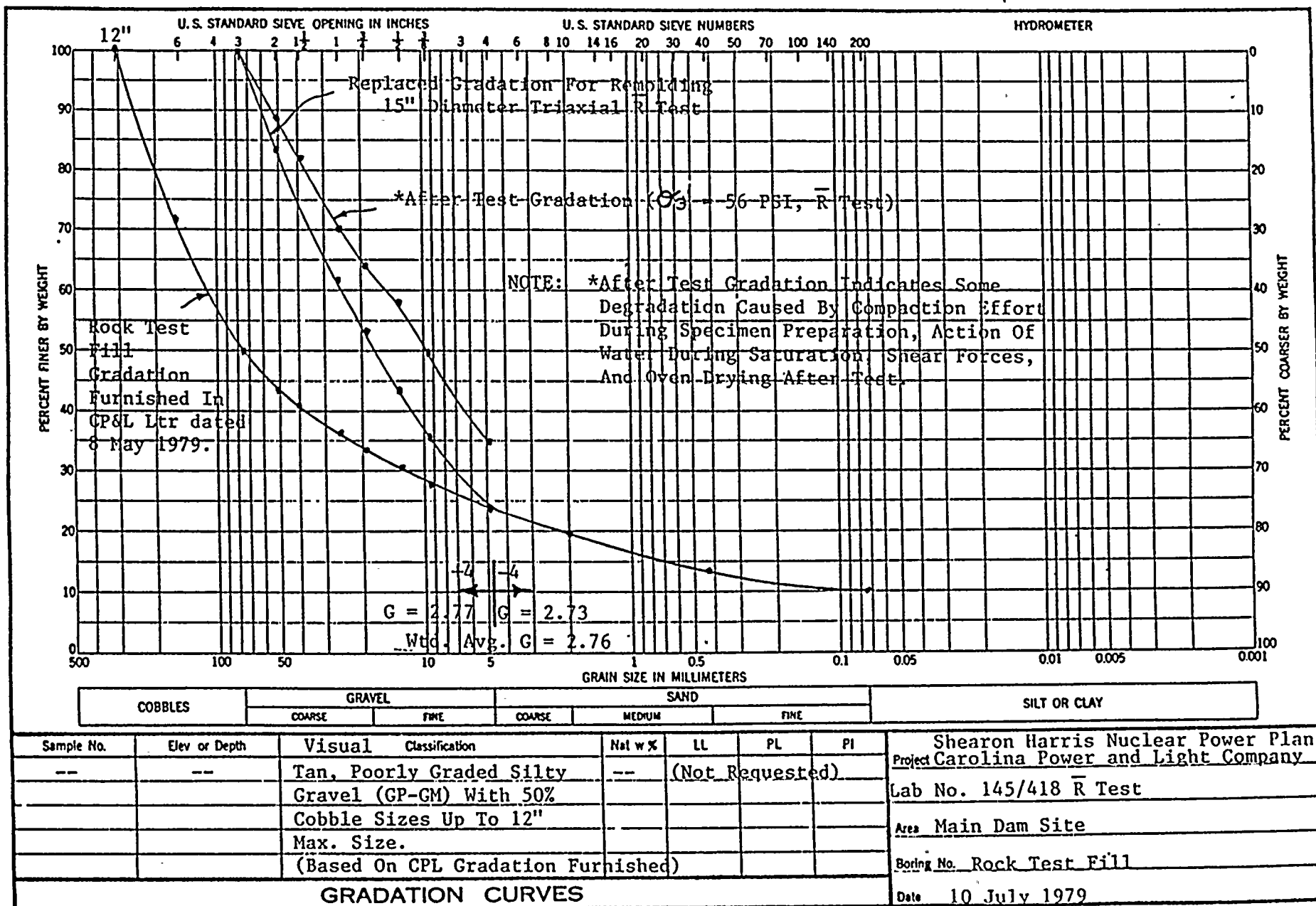
a. This material exhibits some sensitivity to changes in gradation and density. The maximum deviator stresses,  $(\sigma_1 - \sigma_3)_{\max}$  measured in these tests were consistently higher than those obtained in the previous sample which was more well graded. The one specimen tested at a higher density was also relatively stronger than the others, but more data would be required to confirm this apparent phenomena.

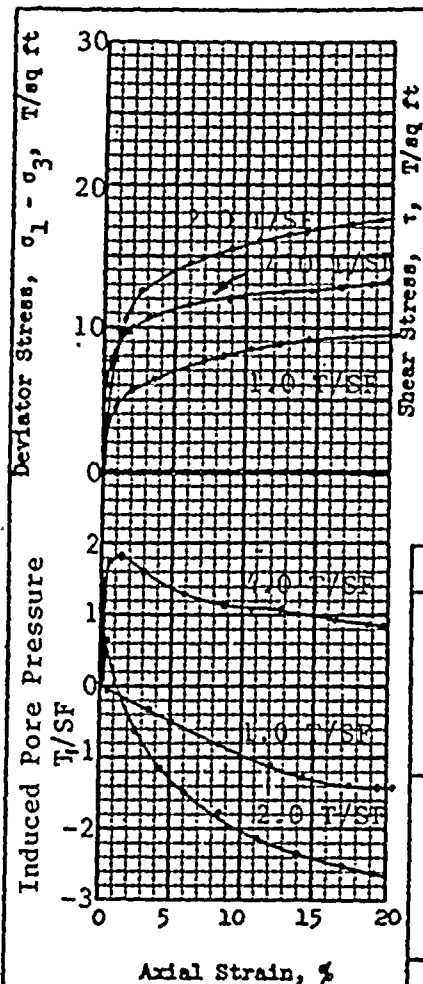
b. Notwithstanding the differences in the measured deviator stresses, the effective shear strength parameters for this material under  $\bar{R}$ -test conditions are essentially constant for the range of gradations and densities tested on this sample and the sample tested in 1975.

2 Attachments  
ENG Form 2087  
ENG Form 2089

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY  
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30061

WORK ORDER NO. 1366  
Req. No. P.O. H11291 Dated 15 Feb 1979

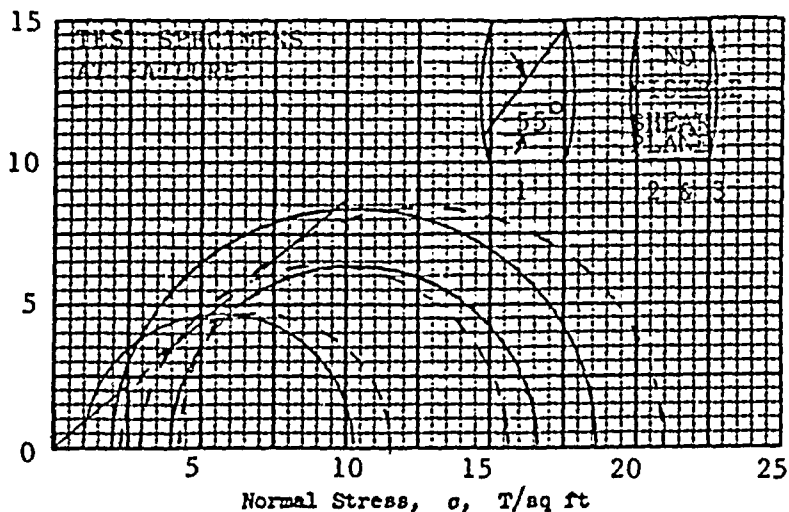




Shear Strength Parameters  
Total Effective  
• = - 40.5  
tan • = - 0.854  
c = - 0.0 T/sq ft

Method of saturation Vacuum  
Seepage and Back Pressure.

☐ Controlled stress  
☒ Controlled strain



Test No.		1	2	3	
Initial	Water content	w <sub>o</sub>	3.6 %	4.2 %	4.7 %
	Void ratio	e <sub>o</sub>	.272	.252	.285
	Saturation	s <sub>o</sub>	36.8%	46.6%	45.5%
	Dry density, lb/cu ft	γ <sub>d</sub>	*135.5	*137.7	*134.1
Before Shear	Water content	w <sub>c</sub>	9.7%	8.6%	9.8%
	Void ratio	e <sub>c</sub>	.267	.236	.271
	Saturation	s <sub>c</sub>	100.0%	100.0%	100.0%
	Final back pressure, T/sq ft	u <sub>o</sub>	5.00	5.00	5.00
Final	Water content	w <sub>f</sub>	9.7 %	8.6 %	9.8 %
	Void ratio	e <sub>f</sub>	.267	.236	.271
Minor principal stress, T/sq ft		σ <sub>3</sub>	1.00	2.00	4.00
Max deviator stress, T/sq ft (σ <sub>1</sub> -σ <sub>3</sub> ) <sub>max</sub>			9.23	16.70	12.60
Time to failure, min		t <sub>f</sub>	140	140	150
Rate of strain, percent/min			0.10	0.10	0.10
%Strain @ (σ <sub>1</sub> -σ <sub>3</sub> ) <sub>Max</sub>			15.00	15.00	15.00
Ult deviator stress, T/sq ft (σ <sub>1</sub> -σ <sub>3</sub> ) <sub>ult</sub>			9.23	16.70	12.60
Initial diameter, in.		D <sub>o</sub>	14.88	14.88	14.88
Initial height, in.		H <sub>o</sub>	32.00	32.00	32.00

Type of test R

Type of specimen Remolded\*

Visual Classification Tan, Poorly Graded Silty Gravel (GP-GM) with 50% Cobble Sizes Up to 12" Max Size.

LL --

PL --

PI --

D<sub>10</sub> = 0.075 mm  
Before Test

G<sub>s</sub> Wtd. Avg. 2.76

Remarks 1. See Gradation Curve on ENG Form 2087.  
2. \*Specimens Initially Requested to be Remolded to 138.0 PCF Dry Density at 4.0% Moisture Content. After Specimen No. 2 Was Tested, Requested Density Reduced to 135 PCF.

Project Shearon Harris Nuclear Power Plant  
Carolina Power and Light Company

Lab No. 145/418

Area Main Dam Site

Boring No. Rock Test Fil

Sample No. --

Depth

Date 10 July 1979

TRIAXIAL COMPRESSION TEST REPORT

APPENDIX D



Photo 1

Stockpile of blasted rock used in construction of Test Sections. Base of stockpile is at El 250+. Spillway Excavation invert to be El 203 at this location.







Photo 2 End dumping of Rock on Test Section VRMD 24-4-3.



Photo 3 Spreading of Rock to 24 inch nominal lift thickness with dozer.





Photo 4 Test Section VRMD-24-2-4 after spreading but prior to rolling.

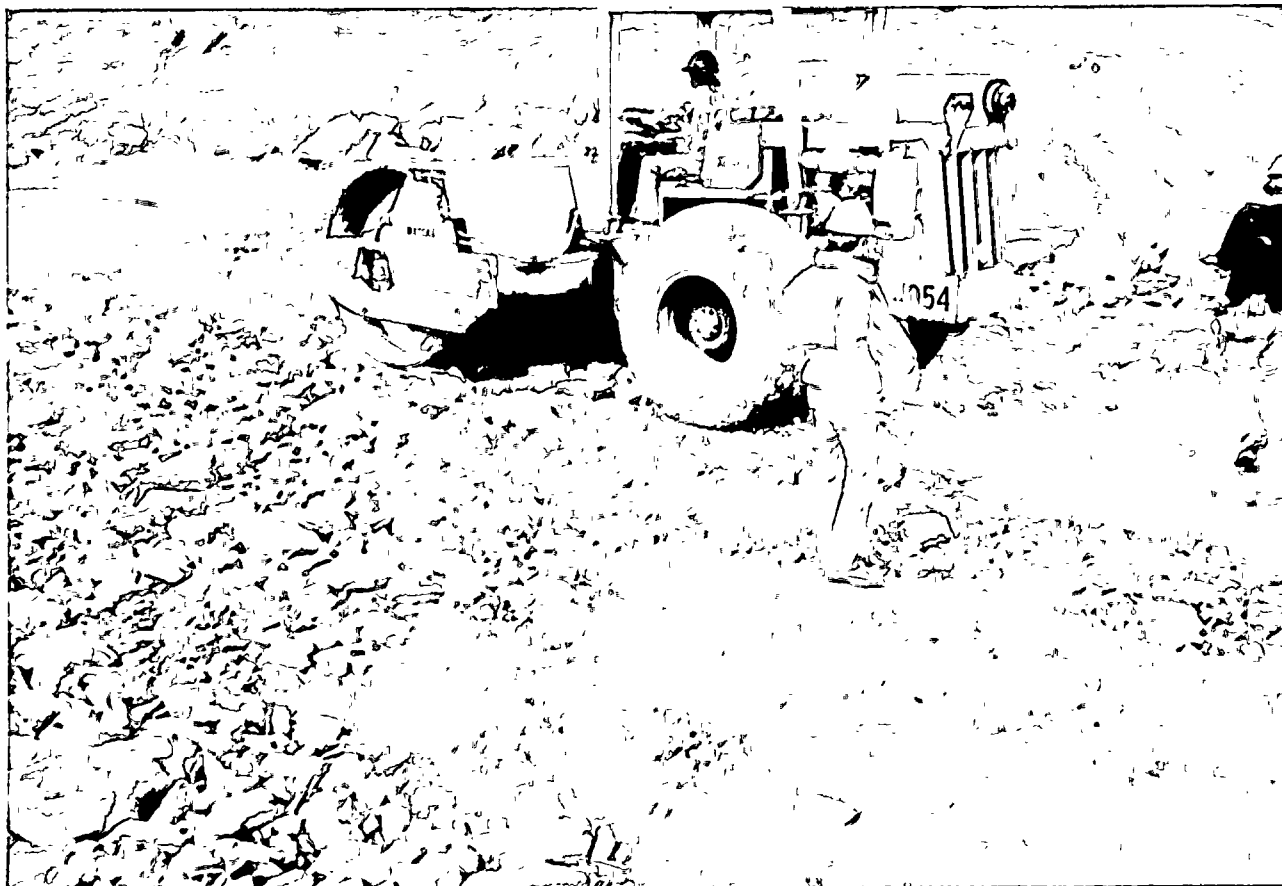


Photo 5 Test Section VRMD-24-4-3 during rolling with smooth drum vibratory roller.  
(Raygo Rascal 600A)





Photo 6 Test Section VRMD-24-2-4 lift surface after rolling (8 passes)



Photo 7 Volume measurement of density hole.



Photo 8 Test Equipment used in in-place permeability test.

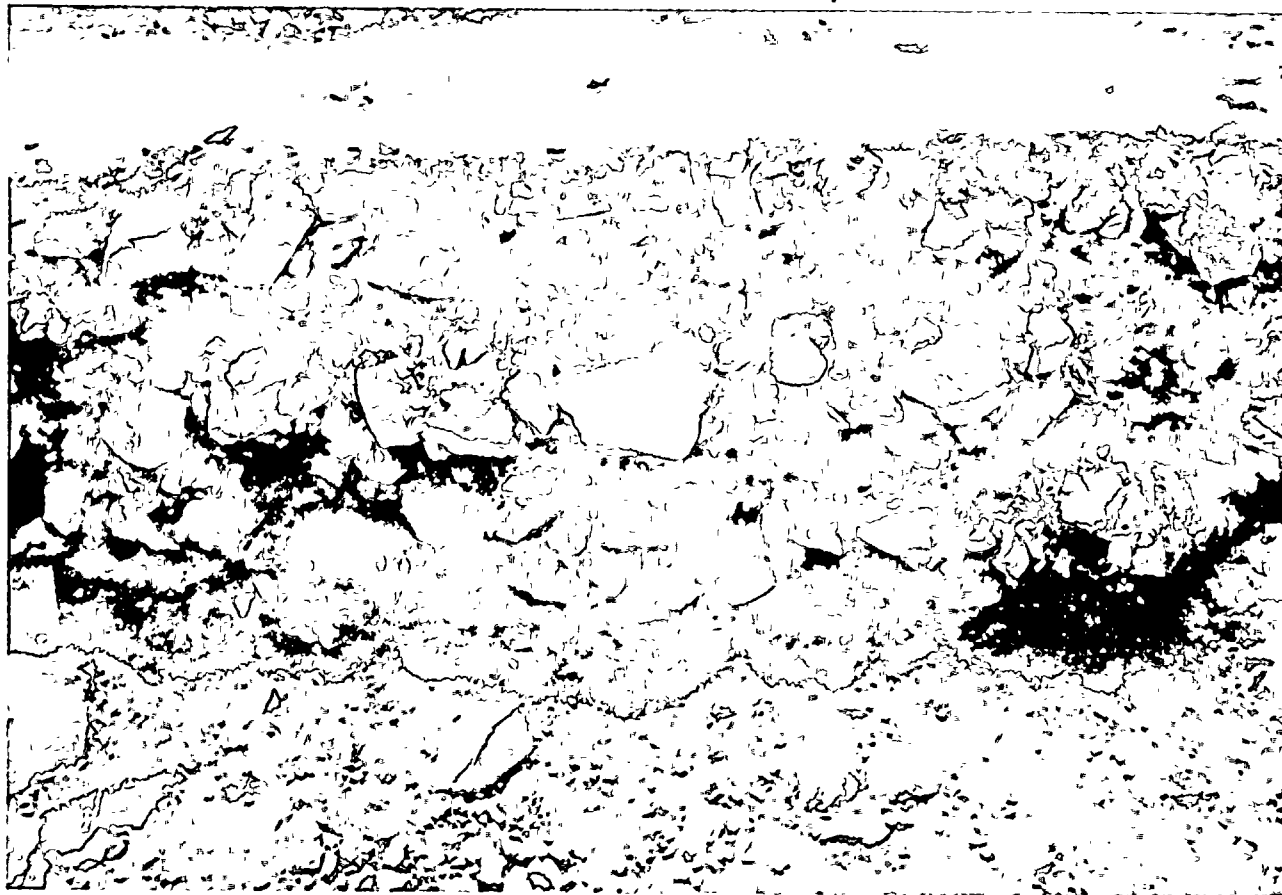


Photo 9 Overall View of Cross Section of Test Section VRMD-24-4-3. Four 24" lifts shown





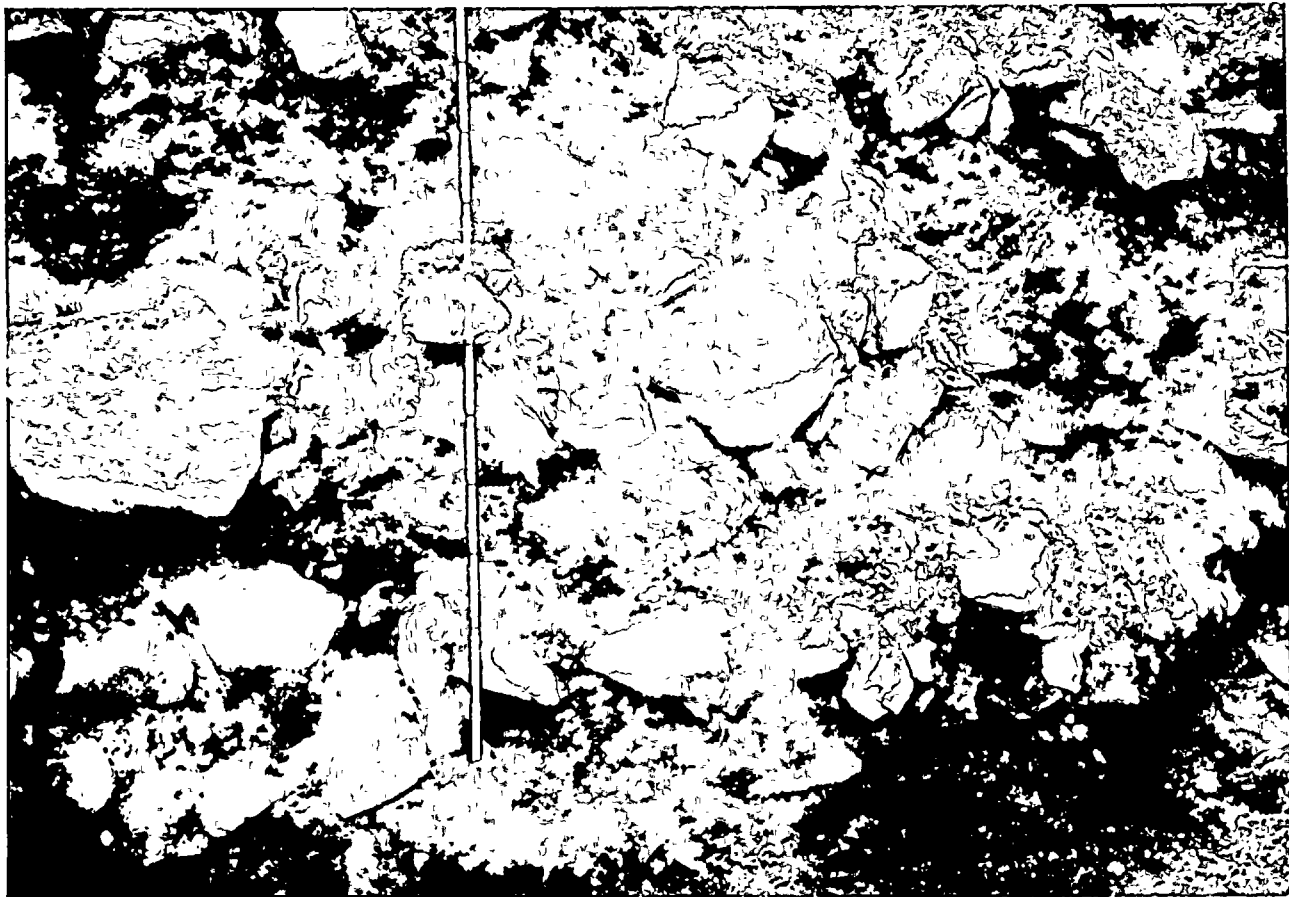


Photo 10 Close-up of Cross Section of Test Section VRMD-24-4-3



Photo 11 Overall View of Cross Section of Test Section VRMD-24-2-4. Two 24" lifts shown.





Photo 12 Close-up of Cross Section of Test Section VRMD-24-2-4

