R-89-15

HEAT OF NEUTRALIZATION METHOD FOR DETERMINING CEMENT CONTENT IN SOILCRETE

JACKSON LAKE DAM MODIFICATION

December 1989

U.S. DEPARTMENT OF THE INTERIOR
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16. ABSTRACT

Use of HON (heat of neutralization) testing to determine cement content of mixed in-place soil cement columns during construction at Jackson Lake Dam modification is presented. The HON test was performed on fresh soil cement slurry sampled immediately after placement. A single calibration curve for average soil type was used. Results were compared to compressive strengths of slurry cylinders cast for testing at 7, 28, and 56 days. Ten samples were tested for hardened cement content and compared to HON data. Results of the study indicate that strengths at any given cement content were highly variable, yet columns with low potential strengths could be readily identified. Cement contents determined by the HON method generally fall between ±5 percent of those determined on hardened specimens using methods for hardened soil cement. HON testing is a rapid, inexpensive method for timely construction control of mixed in-place soil cement columns.

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UNITED STATES DEPARTMENT OF THE INTERIOR ★ BUREAU OF RECLAMATION

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Mission: As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

The research covered by this report was funded under the Bureau of Reclamation WATER (Water Technology and Environmental Research) allocation No. DR-400, Soil Cement Research.

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INTRODUCTION

This report evaluates the usefulness of the HON (heat of neutralization) method for construction quality control of mixed in-place soil-cement columns. HON testing was performed in the second construction season, from June 1 to August 22, 1988, at Jackson Lake Dam, Wyoming.

The Stage II modifications at Jackson Lake Dam, performed under Specifications No. DC-7695, included mixed in-place soilcrete columns installed in the foundation prior to reconstruction of the embankment. The columns were constructed using a new Japanese method termed SMW (soil mixing wall) but also known as DMM (deep mechanical mixing) or DCM (deep chemical mixing) in Japan (Suzuki, 1982). The columns were constructed with a two- or three-shaft rig. Each shaft is rotated by an electric motor. Each shaft consists of a combination of 36-inch-diameter excavation auger blades and mixing blades. As the shaft drills the column, a water-cement slurry is injected at the tip of the shaft. At Jackson Lake Dam, columns were installed under the toe of the embankment in a "honeycomb" pattern of interlocking hexagons (known as upstream and downstream grids). In addition, a cutoff wall was installed upstream of the upstream grid. Column depths reached 100 feet.

Slurry (grout) volume to inject in a column was computed based on a desired amount of cement per linear foot of 36-inch-diameter column. During HON testing at Jackson Lake Dam the second season, a cement dosage of 150 lbf/ft was used with a water to cement ratio of 1.25. Assuming no waste, the percentage of cement with respect to total dry mass of soil and cement would be about 25 percent. In actuality, Jackson Lake Dam foundation soils were saturated and it was impossible to inject grout without waste. As a result, in situ cement contents may be higher. Most of the columns were stroked (bored) twice with 50 percent of the total volume injected during each stroke. Of the 50-percent volume, approximately 60 percent was pumped on the downstroke to lubricate the auger cutting head.

Construction quality control was performed by both the subcontractor, GEOCON, and by Government forces. A wet sample of a freshly completed column was taken on a daily basis using a packer sealed sampling tube (steel pipe). The pipe was lowered to the desired sampling depth which was randomly selected, at which point the packer was deflated to collect soilcrete slurry and reinflated to retain the sample. Maximum sampling depth was on the order of 40 feet. Approximately twelve to fifteen 3-inch-diameter by 6-inch-high cylinders were cast from the slurry sample. Unconfined compression tests were typically performed on the cylinders at 7, 28, and 56 days after casting. Government forces performed density, moisture content, gradation, and HON testing on the fresh slurry. Government forces also performed an extensive coring and in situ testing program on the cured columns.

There was a wide variety of soils present in the foundation which consisted of glaciofluvial deposits variably cutting lacustrine deposits. Glaciofluvial and surficial alluvial deposits were primarily clean gravels and sands (GP-GM, SP-SM) with considerable silty sand (SM) and sandy silt (ML) interbeds. Lacustrine deposits are primarily low-plasticity silts (ML-CL) with layers of lean to fat clays (CL, CL-CH, CH). Average dry unit weight of silty sands was about 85 lbf/ft^3 with a saturated moisture content of about 36 percent. Moisture content of all materials ranged from approximately 25 to 50 percent. The wide variety of soils made strength evaluation and mix design difficult. Generally, excellent soil-grout mixing was observed in the columns.

Data from this report were obtained from Government construction reports (L-29's) and contractor testing submittals. Ten broken 3-inch-diameter by 6-inch-high wet sample cylinders were received

from the Government field laboratory on June 21, 1988, for hardened cement content determinations (Bureau of Reclamation, 1988). All data for SMW testing were incorporated into an electronic spread sheet for analysis.

DISCUSSION

Heat of Neutralization Calibration

The field laboratory performed one calibration curve for the HON test using a mixture of laboratory-prepared soil with varying cement contents. Procedures for calibration followed a draft procedure developed in the Denver Office geotechnical laboratory (appendix A). Calibration data are attached in appendix B. The soil mixture used for calibration was obtained from depths of 20, 40, 60, and 80.5 to 92.5 feet in drill hole DH-911, and was classified as a sandy silt (ML) with no plasticity. Initial soil-cement slurry moisture content was 43 percent which coincided with the average moisture content of slurry tested during the first season of construction. Cement content by total dry mass of material ranged from 17.6 to 70.2 percent. Cement contents in this report are expressed as a percentage of the total ovendry mass (110 °C) of specimen (soil plus cement) since values would be compared to those obtained using methods to determine cement content of hardened soil cement. The percentage of calcium oxide in the native soil was not ascertained. Of a few native specimens of foundation soil tested, calcium oxides were generally less than 1 percent. Calcite blebs were observed in some fat clay layers in lacustrine deposits, and calcium oxide content may vary locally.

Summary of Construction Control Data

Field data on the wet sample slurry and 7-day unconfined compression test data were entered into a spread sheet database along with contract submittals providing 28- and 56-day strength data. Denver Office spread sheet data are shown in appendix C. The data shown on the spread sheet were obtained from the larger spread sheet of all SMW column data by sorting with respect to cement content.

The spread sheet was then sorted with respect to age of unconfined compressive strength. Figures 1, 2, and 3 summarize 7-, 28-, and 56-day strength of wet sample cylinders versus HON cement content. Figure 1 shows considerable scatter in 7-day strength over the range of cement contents from 16 to 58 percent. Note that a trend is more apparent at ages of 28 and 56 days (figs. 2 and 3, respectively). Predominant cement contents ranged from 25 to 35 percent which agree well with calculated injection values.

Since soil type and moisture content vary so much with respect to the selected calibration curve materials, the spread sheet was also sorted with respect to slurry moisture and gravel content for 28-day strengths as shown on figures 4 and 5. On figure 4, all 28-day strength data with moisture contents less than 38 percent and greater than 48 percent were removed from the data to reflect the calibration slurry moisture of 43 percent ±5 percent. On figure 5, 28-day strength data are shown for wet sample slurries containing less than 5 percent gravel. *All HON data after June 16, 1989, were obtained on minus No. 4 wet sample slurries if they contained greater than 5 to 10 percent gravel.* The need to test the minus No. 4 portion became apparent after it was found that excess gravel inhibited temperature rise during HON testing. The effect of gravel content on wet sample

compressive strength has not been evaluated in laboratory-controlled mix studies. By observing the differences between figures 2 and 5, it can be seen that in the majority of cases higher strengths would be obtained at lower cement contents for specimens containing gravels. In addition, cement content data are not adjusted for gravel content, and true cement content by total dry mass for gravelly specimens is lower.

On figure 6, an attempt was made to select data to best represent the calibration soil, neglecting slurry moisture content. The sorting concentrated on including wet sample slurry with sand contents from minus 5 to plus 15 percent of the calibration soil. This sorting effectively removed fine-grained soils. The graph best illustrates applicable materials and the resulting correlation between HON cement content and 28-day compressive strength.

HON cement content determinations can be a useful construction quality control test for mixed-in place soilcrete columns. Test data can be obtained shortly after column completion allowing columns to be redrilled. At Jackson Lake Dam, sufficient long-term strengths would not have been obtained at HON cement contents of less than 20 percent.

Comparison of HON and Hardened Cement Content Determinations

In order to check the validity of field cement content data, ten 7-day broken test cylinders were sent to Denver for laboratory cement content determinations. In addition to checking the HON method, it was desired to check a rapid procedure for determining hardened soil-cement contents developed by the Denver Office chemistry laboratory. Both methods were compared to ASTM method D-806-79, "Standard Test Method for Cement Content of Soil Cement Mixtures" (American Society for Testing and Materials, 1979). The ASTM method consists of titration of calcium hydroxide precipitate of a 5-gram soil-cement sample with potassium permanganate. The rapid procedure developed by the Denver Office chemistry laboratory is described as follows:

"Rapid Procedure for Determining CaO

> "Channel sample the length of the core. Dry at 100 °C. Grind sample to pass #40 sieve. 0.1000 gram sample weighed into 100 ML beaker. 20 ML H_20 added and stirred. 5 ML HCL added. Sample heated to boiling. Sample cooled and filtered into 100 ML volumetric flask. Fill to volume. Aliquot taken and Ca titrated to hydryoxynapthol blue end point using 0.0098 molar ethylene diamine tetra acetic acid (EDTA). Calculate as CaO and % cement."

The rapid procedure was used to evaluate cement contents of cores sent to Denver for testing. A channel approximately 3/8-inch wide and 3/8-inch deep was cut along the complete length of the remaining intact portions of the broken cylinder in strip fashion. Material for both ASTM and rapid procedures was obtained from ground-up material from the channel. Gravel particles encountered were not ground up and were not included in the tested material. Ground material was thoroughly mixed and sampled with a spatula. As discussed earlier, calcium hydroxide in the native soil was assumed to be zero. Previous testing of cements used at Jackson Lake indicated a CaO concentration of 63 percent. Percent cement by total dry mass was calculated using the above assumptions. Cement contents were not adjusted to reflect gravel contents. Table 1 summarizes the results of cement content testing for the 10 cylinders along with other field wet sample data.

As shown on figure 7, cement contents using the rapid method agreed very well with the referenced ASTM procedure.

On figure 8, HON cement content is compared to ASTM cement content. There is some tendency for the HON method to underpredict cement content by as much as 5 percent at high gravel content. These early field HON tests were performed on total material including plus No. 4 material. The 10 wet samples were obtained near the beginning of field HON testing, before recognition of the need to test only minus No. 4 slurry. Since hardened cement content tests were performed on minus No. 40 material, the cement content will be higher than HON tests if not adjusted for total dry mass of specimen.

Plots of 7-, 28-, and 56-day compressive strengths versus HON cement content are presented in figures 9, 10, and 11. Gravel content is shown beside each data point. Moisture content is shown beside each data point on figure 12, plotting cement content versus 56-day strength. Wet sample cylinder data for column D-15 showed high moisture contents of 60 and 66 percent with corresponding low sand (24-28 percent) and gravel (3-4 percent) contents. Data for D-15 do not fit the trend of slurries with properties closer to the calibration slurry (fig. 12).

Results of the comparison of hardened cement contents and HON field data indicate that the HON method is fairly accurate in predicting cement content for SMW slurries. Although more data are needed, it appears that the method may be insensitive to slurry moisture content. With slurry gravel contents of up to 25 percent, cement content may be in error by up to 5 percent if uncorrected for gravel. If the percentage of gravel is known, data can be adjusted in the field.

Prediction of strength from HON data shows more variability, reflecting the influence of many factors which can affect wet sample strength. Factors such as moisture content, mineralogy of fines (calcium hydroxide reactions with clays), slurry density, and curing conditions all affect final strengths. As such, a wide variation in strength at any given cement content must be anticipated. Even with these inconsistencies, it is clear from data trends that SMW columns with potentially low strength can be readily identified using HON data.

CONCLUSIONS

Field construction testing of mixed-in-place soilcrete columns was performed at 107 column locations at Jackson Lake Dam using the HON method. A single calibration curve was developed to model average soil-cement slurry properties. Cement content was compared to 7-, 28-, and 56-day unconfined compression tests of cylinders cast from fresh soil-cement slurry. Strength prediction using HON cement content data was highly variable; however, columns with potential low strengths could be readily identified.

Cement contents of the fresh slurry were compared to hardened cement contents from 10 test cylinders. Results indicate that the HON cement contents fell within 5 percent of hardened values. It appears that the cement content determined was insensitive to slurry moisture content. Corrections for gravel content could, and should, be made in future applications.

The HON test was rapid and inexpensive to perform. It was the only test to provide timely information on potential soilcrete column inadequacy prior to cement hydration and setting of the

soil-cement mixture in the column. Therefore, columns could be restroked without equipment damage. Disadvantages of the method when applied to soilcrete columns are inadequate depth of wet sampling and a wide variation in strength prediction.

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Bureau of Reclamation, Project Construction Engineer, Jackson, Wyoming, memorandum to Assistant Commissioner - Engineering and Research, Subject: "Transmittal of Soil Mix Wall Samples (SMW) - Contract No. 7-CC-10-03550/DC-7695 - Jackson Lake Dam Modification, Stage II - Minidoka Project, Wyoming - National Projects Inc., Contractor," Jackson, Wyoming, June 20, 1988.

Suzuki, Y., "Deep Chemical Mixing Method Using Cement as Hardening Agent," Symposium on Recent Developments in Ground Improvement Techniques, Bangkok, November 29 through December 3, 1982.

Table 1. - SMW cement content analysis

Comparison of HON and hardened methods

SECTOR	COLUMN	DEPTH FT	WET DENSITY LBF/FT3	MOISTURE CONTENT %	GRAVEL CONTENT %	UNCONFINED COMPRESSIVE STRENGTH Qu - PSI			CEMENT BY TOTAL DRY MASS HON METHOD %	CEMENT HARDENED BY D-3743 D.O. LAB %	CEMENT HARDENED BY ASTM D-806 D.O.LAB %
						7 DAY	28 DAY	56 DAY			
D15	68	15	102	60	4	203	510	608	37	38	39
D15	68	30	100	66	3	160	485	591	36	33	33
D16	6	15	107	38	16	100	258	367	21	24	24
D16	6	30	108	41	24	82	242	312	16	21	20
D17	10	20	108	49	11	164	438	529	24	26	26
D17	10	30	108	47	22	152	417	495	23	24	26
D21	4	15	111	45	10	196	503	579	27	28	29
D21	4	30	110	47	7	211	497	601	23	30	29
D22	4	15	109	45	5	156	380	536	26	24	24
D22	4	35	110	44	2	188	453	549	25	27	27

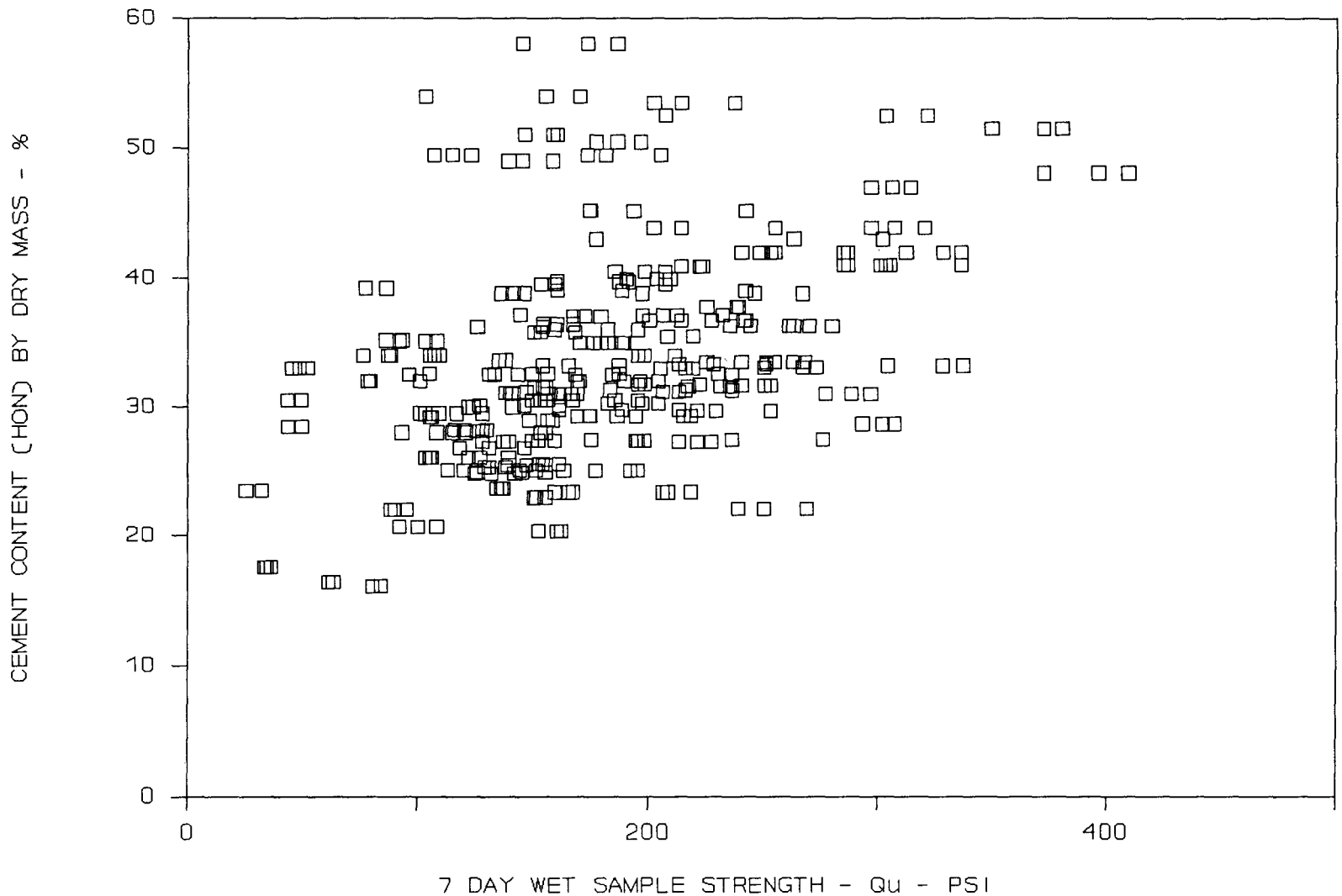


Figure 1. - Cement content vs. 7-day strength - all data.

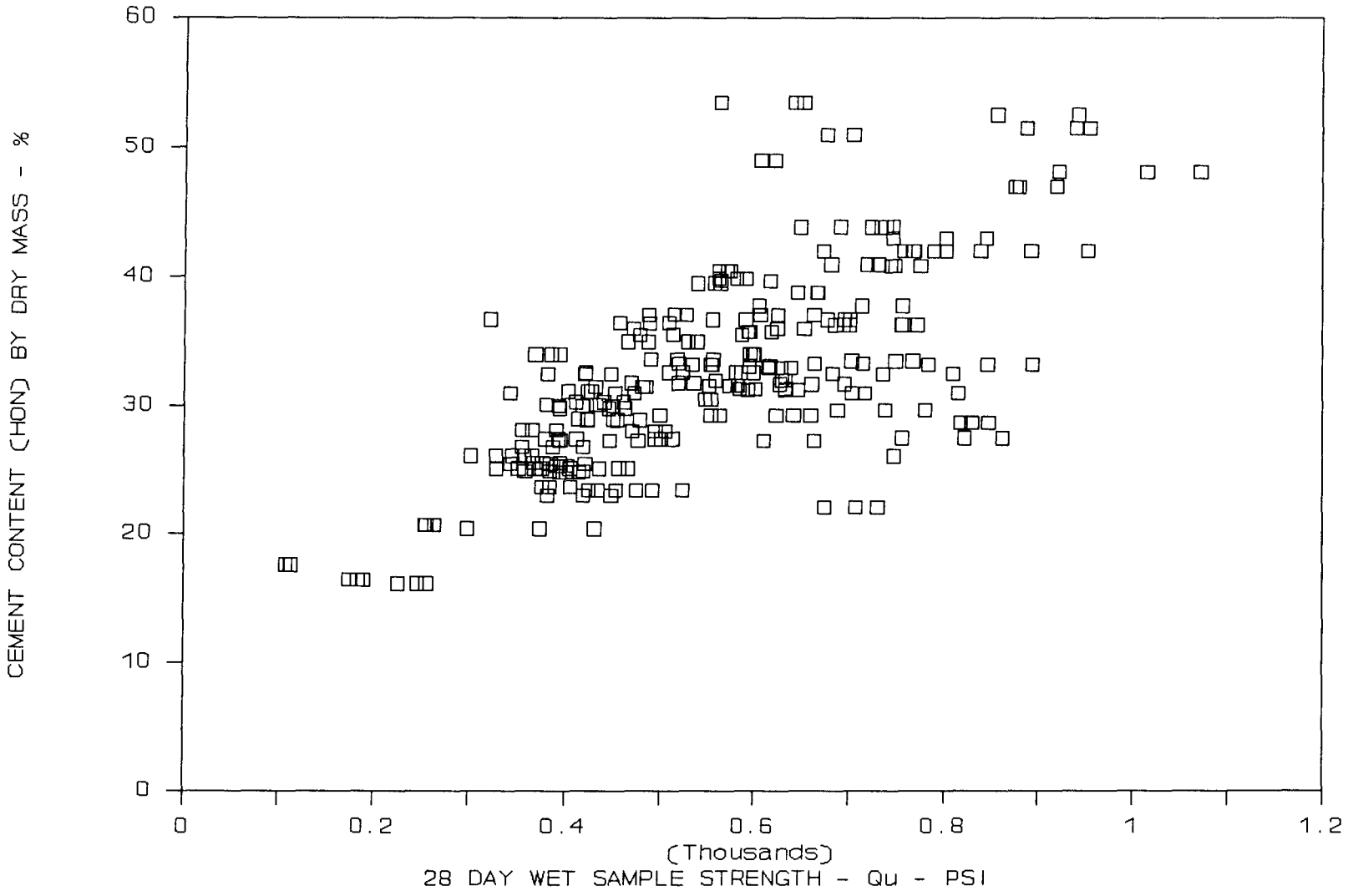


Figure 2. - Cement content vs. 28-day strength - all data.

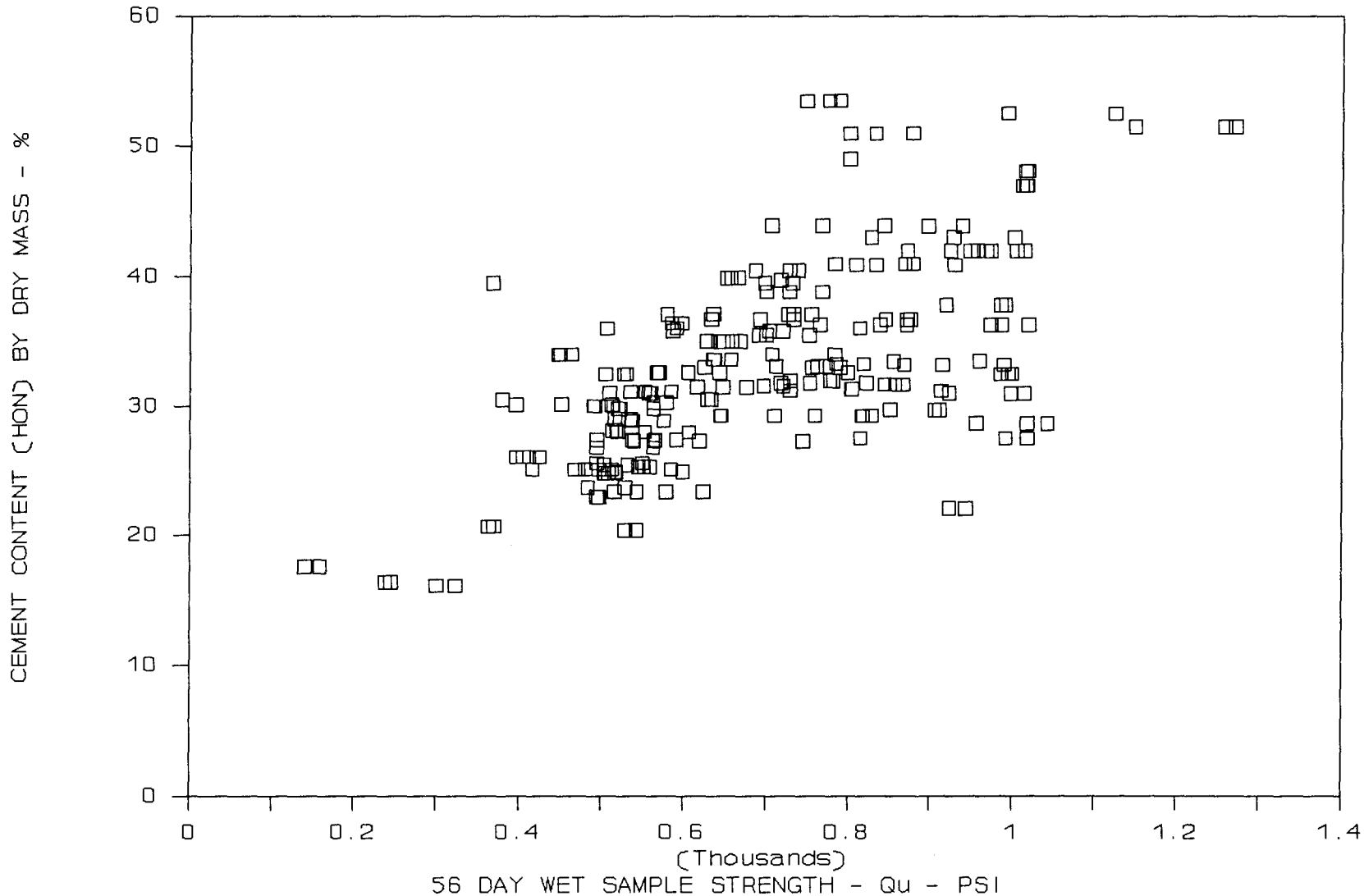


Figure 3. - Cement content vs. 56-day strength - all data.

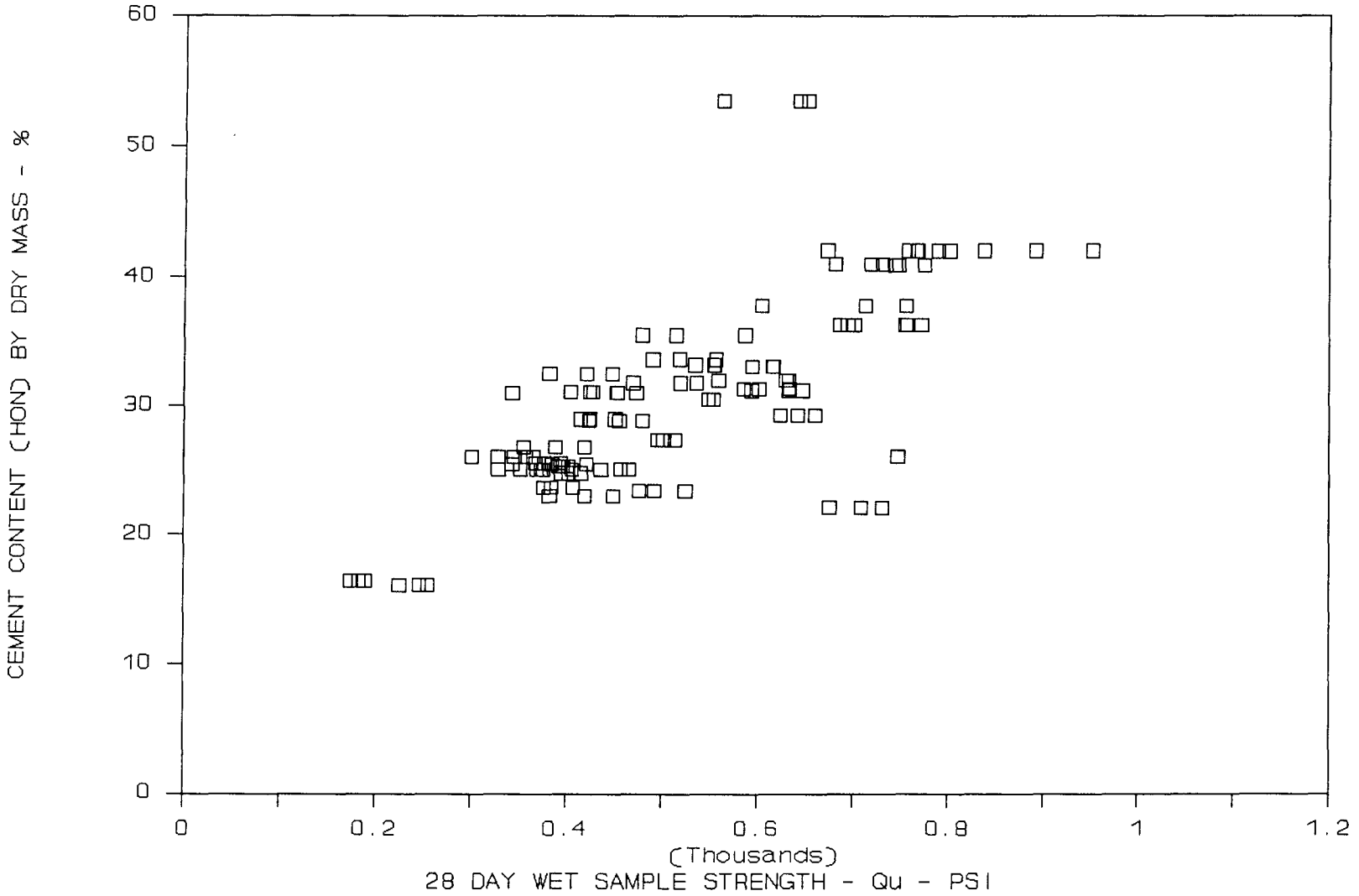


Figure 4. - Cement content vs. 28-day strength - all data with moisture contents from 38 to 48 percent.

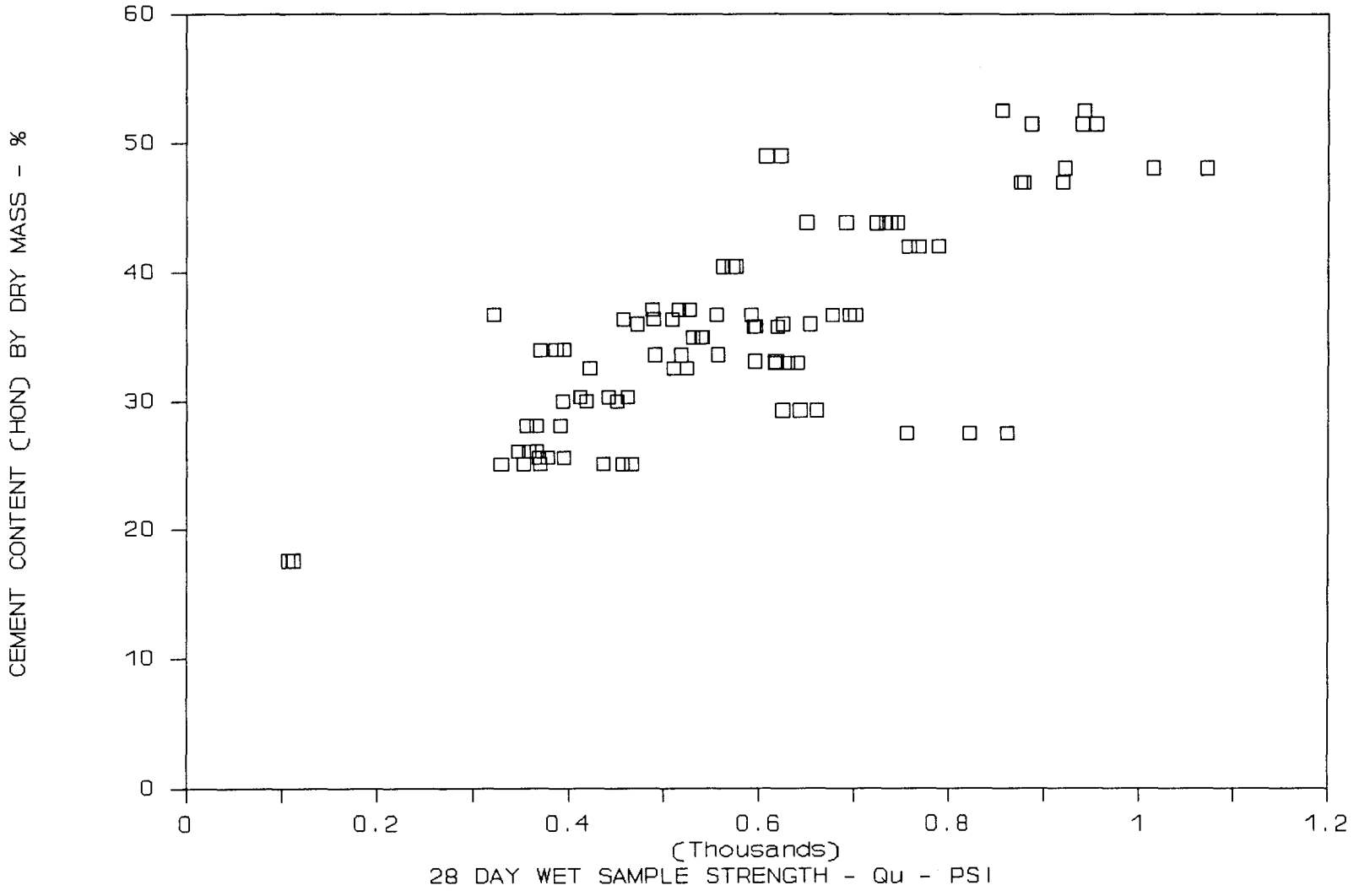


Figure 5. - Cement content vs. 28-day strength - all data with gravel less than 5 percent.

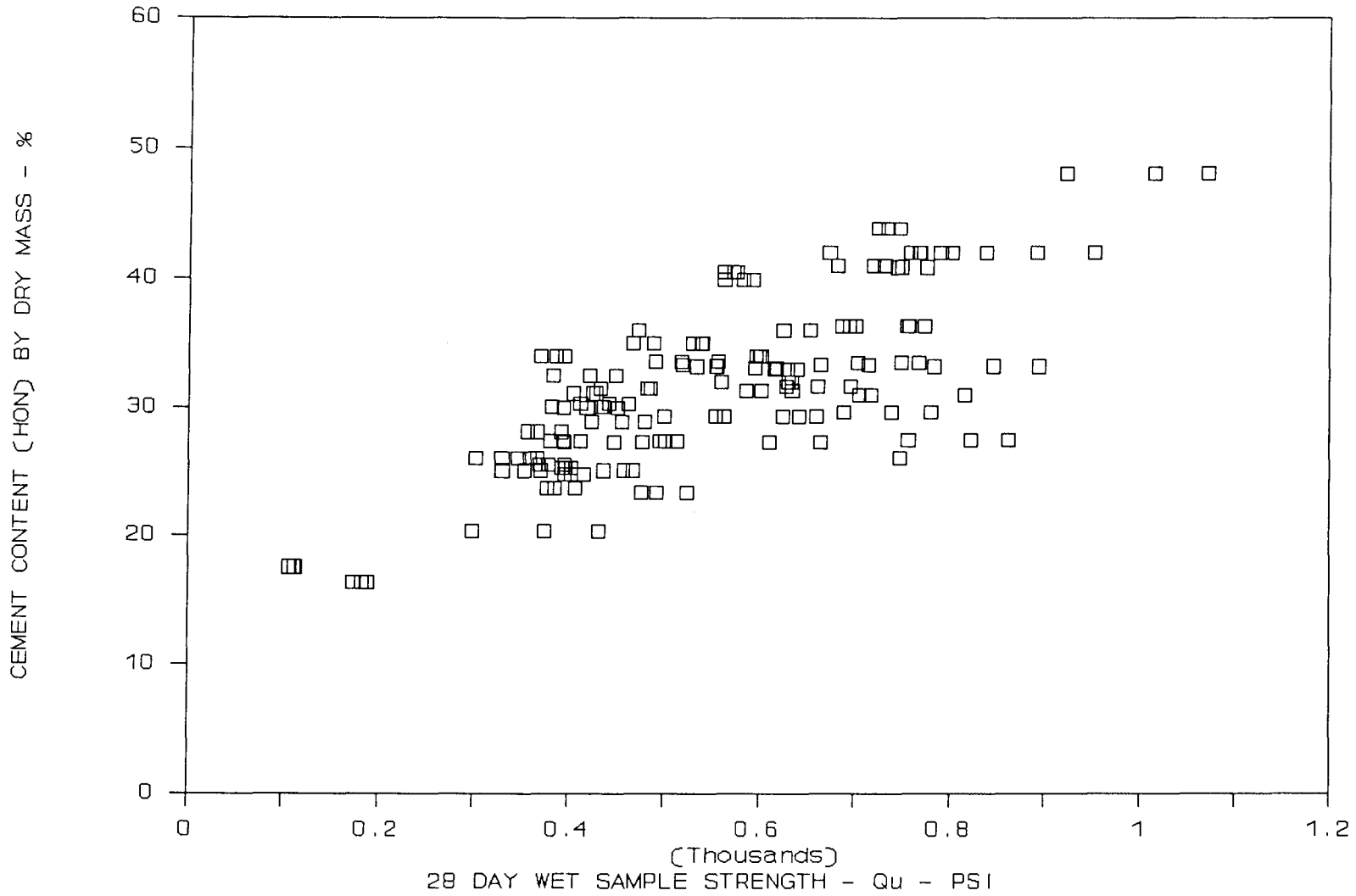


Figure 6. - Cement strength vs. 28-day strength - all data with sand from 38 to 48 percent and gravel less than 20 percent.

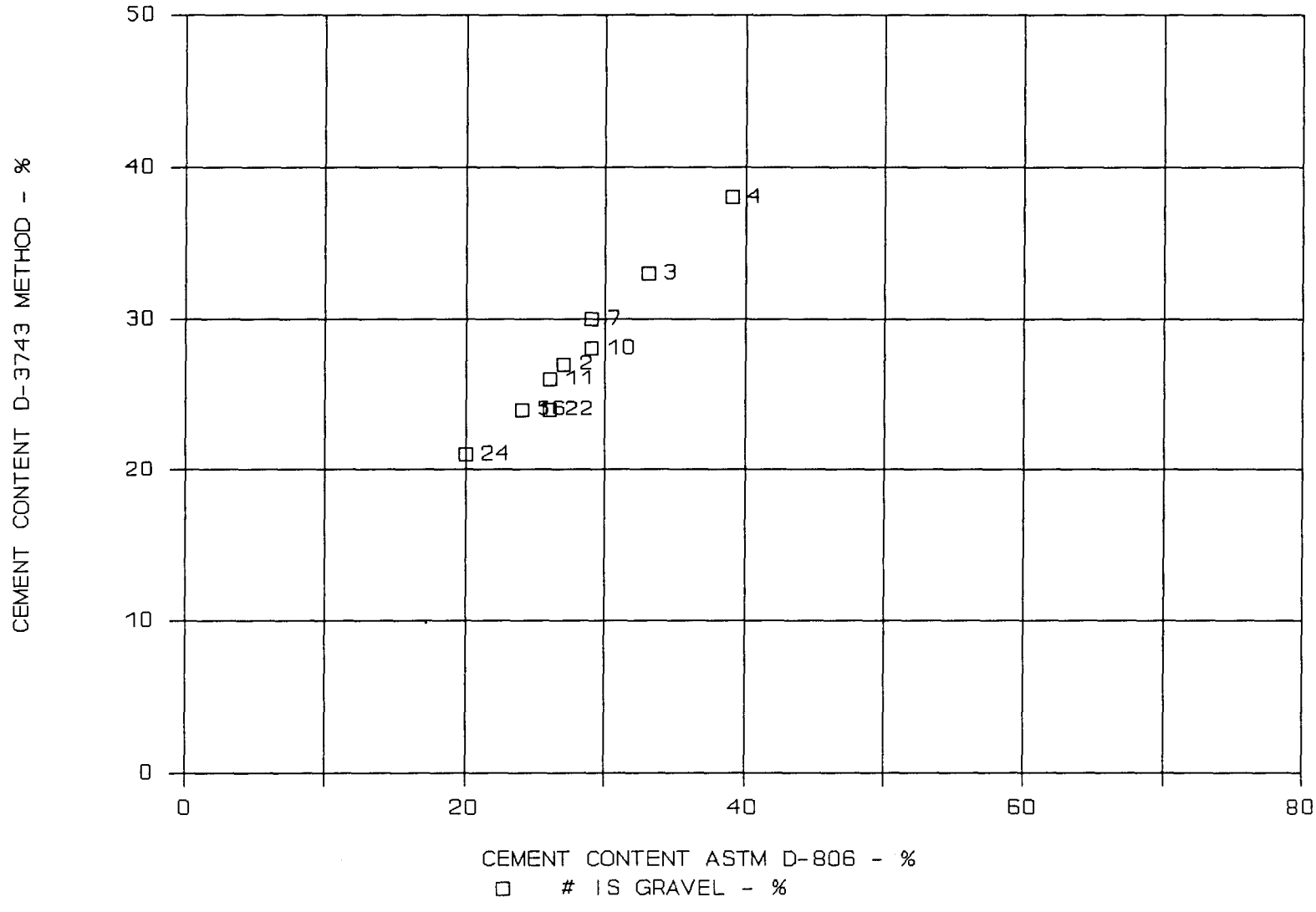


Figure 7. - Comparison of cement content determinations by the Denver Office chemistry laboratory.

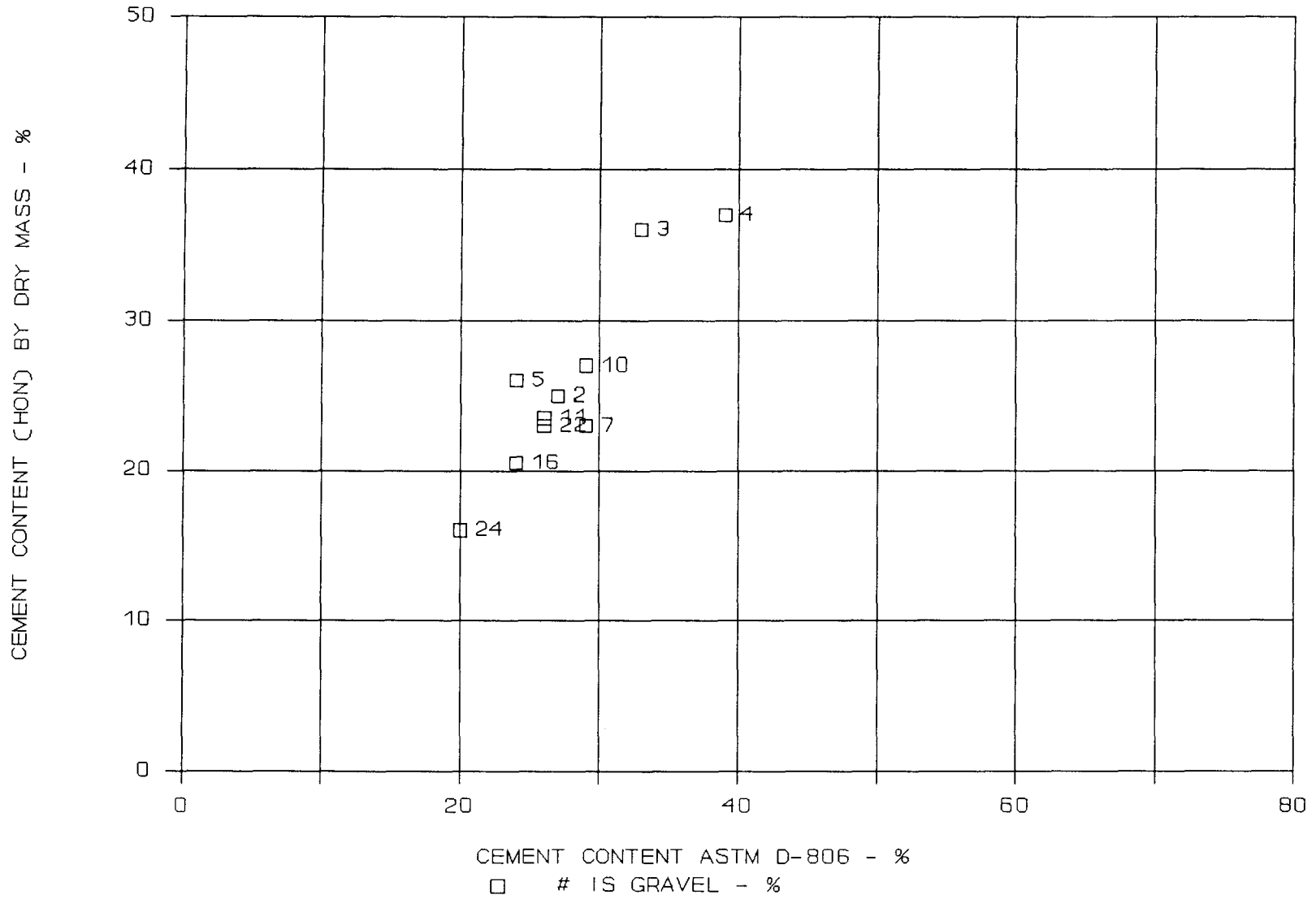


Figure 8. - Comparison of HON and ASTM cement contents - fresh and hardened testing.

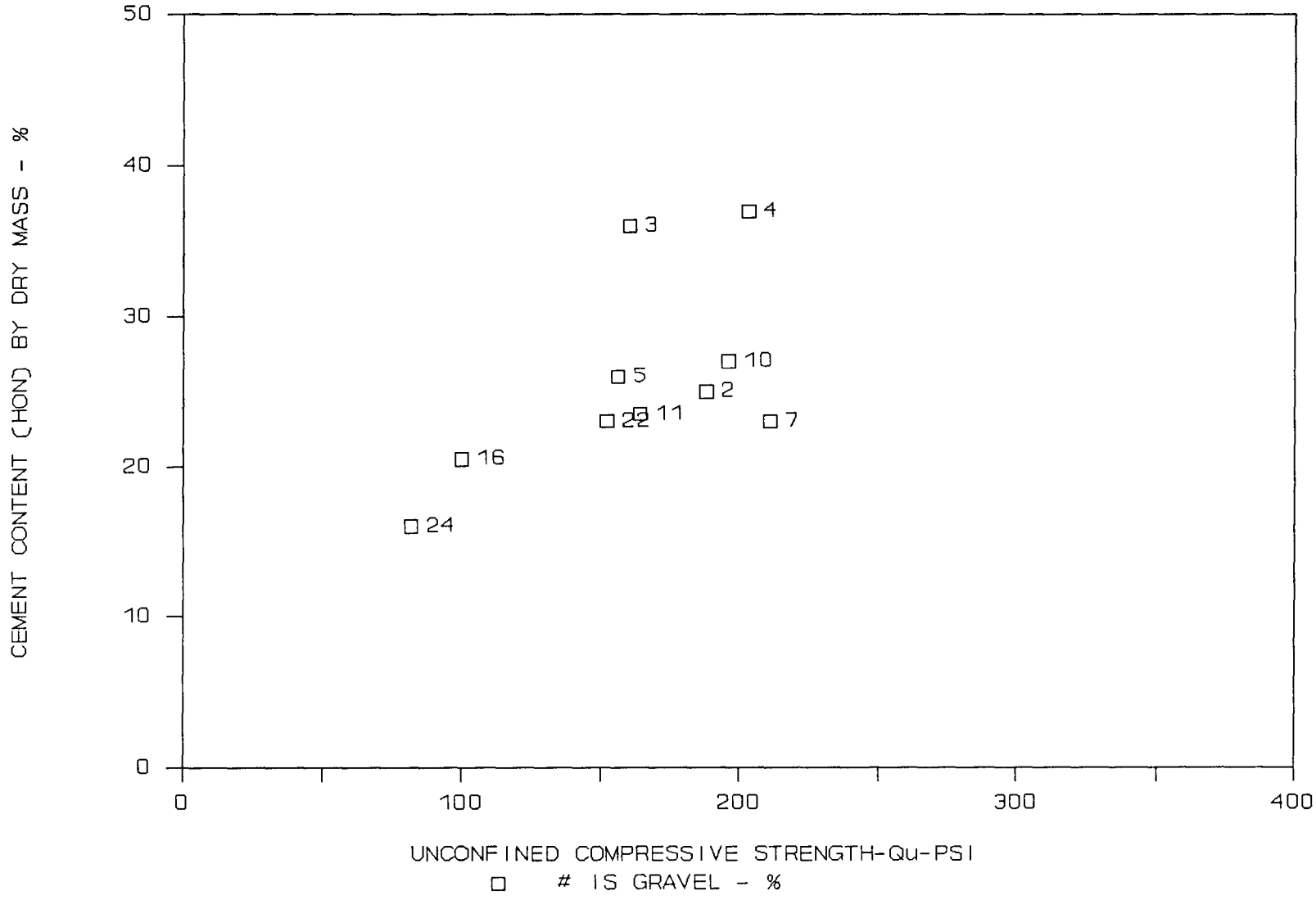


Figure 9. - Cement content vs. 7-day strength for fresh/hardened comparison specimens showing gravel contents.

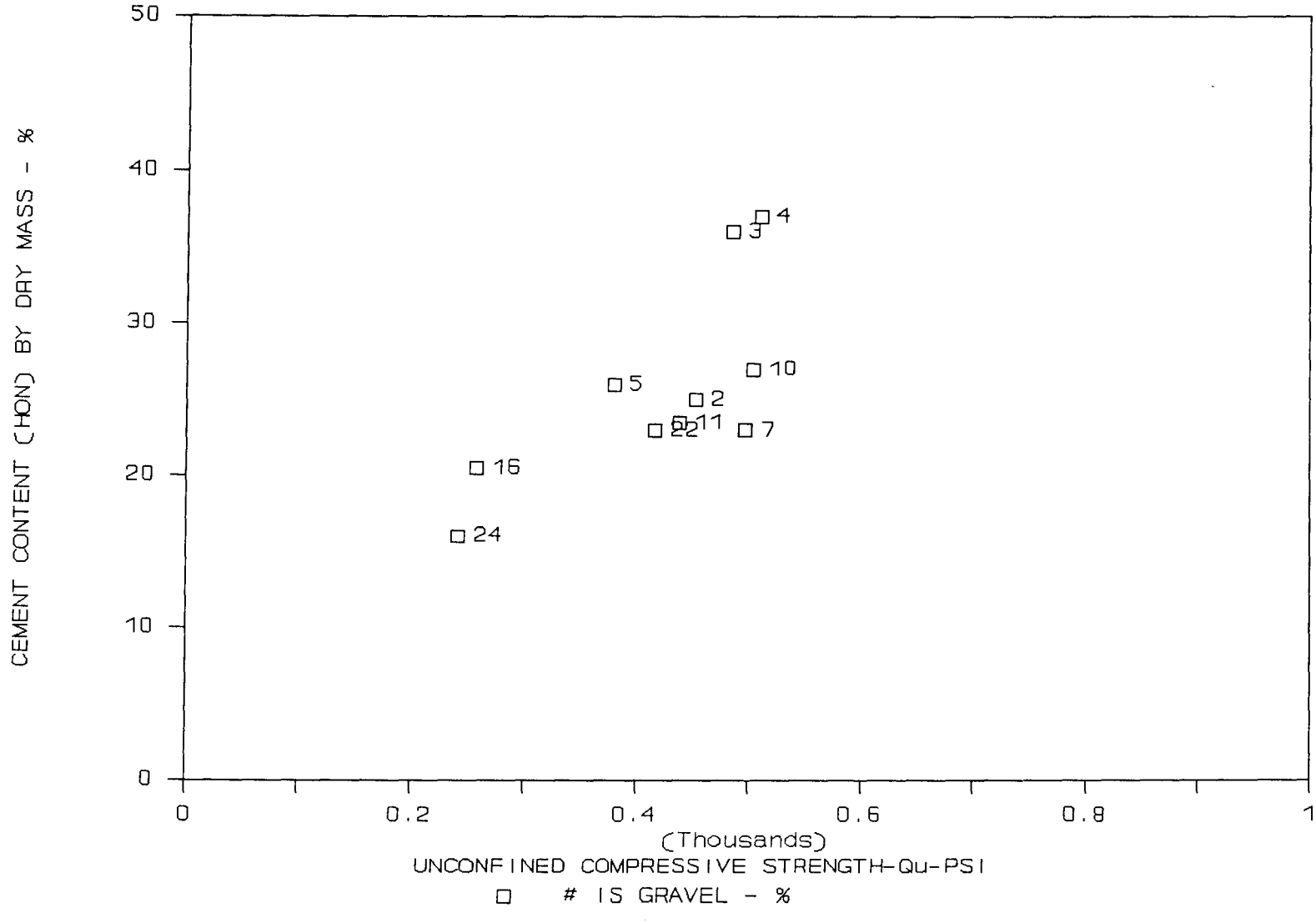


Figure 10. - Cement content vs. 28-day strength for fresh/hardened comparison specimens showing gravel contents.

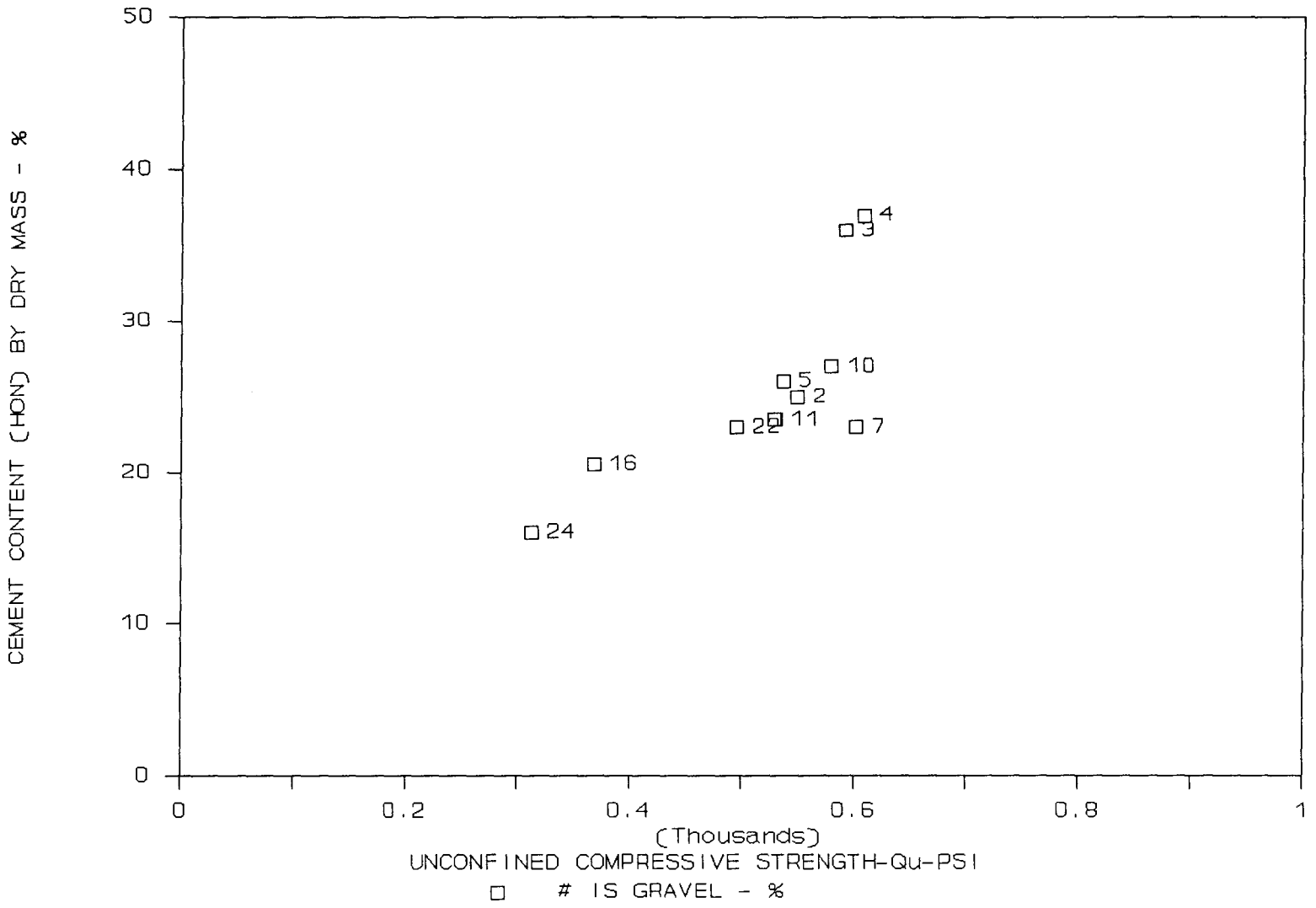


Figure 11. - Cement content vs. 56-day strength for fresh/hardened comparison specimens showing gravel contents.

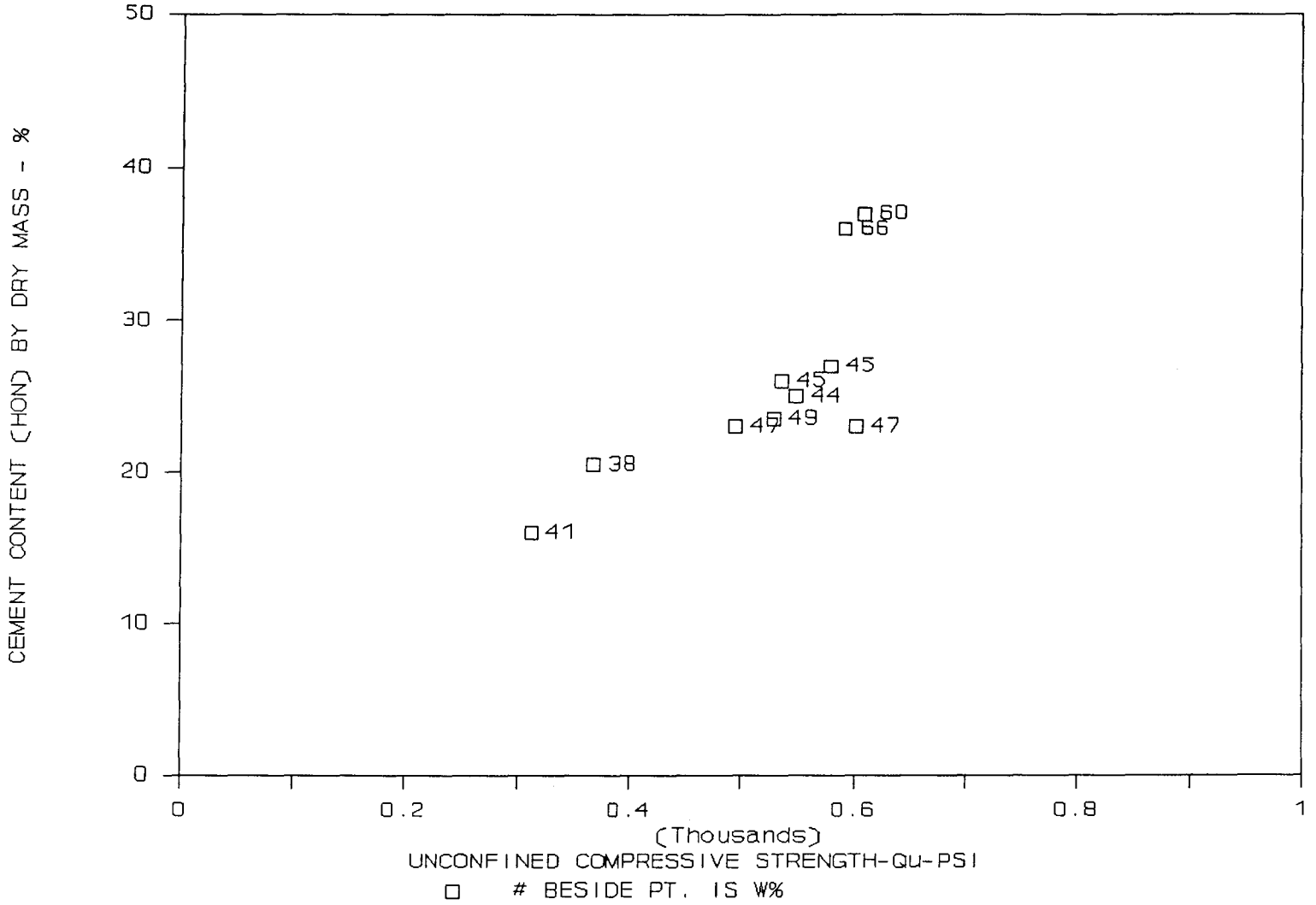


Figure 12. - Cement content vs. 56-day strength for fresh/hardened comparison specimens showing moisture contents.

APPENDIX A

Test Procedure

This test procedure was preliminary at the time of use. The attached copy is a version used for a 1988 round-robin testing program sponsored by Reclamation and the American Society for Testing and Materials.

PROCEDURE FOR DETERMINING CEMENT CONTENT OF SOIL-CEMENT (HEAT OF NEUTRALIZATION METHOD)

1. Scope

1.1 This designation outlines the procedure for determining the cement contents of fresh soil-cement or roller-compacted concrete (RCC). The procedure can be used for determining the cement content of samples that contain 3 to 16 percent cement and can also be used for testing soil-cement or RCC samples that contain a significant percentage of plus No. 4 sieve-size particles.

2. Applicable Documents

2.1 USBR Procedures:

USBR 1012, Calibrating Balances or Scales
USBR 3900, Standard Definitions of Terms and Symbols Relating to Soil Mechanics
USBR 5300, Determining Moisture Content of Soil and Rock by the Oven Method

2.2 ASTM Standard:

E 644, Standard Methods for Testing Industrial Resistance Thermometers

3. Summary of Method

3.1 A soil-cement test specimen is obtained. The temperature of the soil-cement test specimen and a buffer solution are determined separately and recorded. The buffer solution is added to the soil-cement test specimen and vigorously mixed. After mixing, the temperature of the soil-cement/buffer solution mixture is determined and recorded. The heat of neutralization is calculated and, from a previously established calibration curve, the cement content of the test specimen is obtained.

4. Significance and Use

4.1 This procedures provides a means for reliably determining the cement content of soil-cement in approximately 15 to 20 minutes. The procedure can be used to determine the cement content of soil-cement to ± 1 percentage point of actual cement content, which is generally adequate for most construction control application.

5. Terminology

5.1 Definitions are in accordance with USBR 3900.

5.2 A term not included in USBR 3900 specific to this designation is:

5.2.1 Heat of neutralization. - The difference between the temperature of soil-cement/buffer solution after mixing and the average of buffer solution and soil-cement test specimen temperatures before mixing.

6. Apparatus

6.1 Balance or scale. -

6.1.1 A typical balance or scale used for obtaining the soil-cement test specimen must be readable to 0.01 lbm and have a capacity of about 20 lbm.

6.1.2 A typical balance or scale used for preparing the buffer solution (subpar. 7.4) must be readable to 0.1 g and have a capacity of about 3,000 g.

6.2 Digital thermometer (fig. 1a). - 0 to 100 °C range, readable to 0.1 °C, conforming to the requirements of ASTM E 644. The digital thermometer must be equipped with a thermocouple probe approximately 2 inches in length.

6.3 Specimen container (fig. 1b). - Widemouth plastic (Nalgene) container, 1-gallon capacity, with screw cap, minimum of three recommended.

6.4 Timing device (fig. lc). - A stopwatch or other suitable timing device readable to 1 second.

6.5 Glass or plastic beaker (fig. ld). - Approximately 3000-mL capacity.

6.6 Funnel (fig. 1e). - Widemouth funnel to fit mouth of specimen container (subpar. 6.3)

6.7 Hand scoop (fig. 1f). - Flatbottom hand scoop with handle; approximate bowl dimensions, 3-1/2 by 6 inches.

6.8 Gloves (fig. 1g). - Protective gloves to be worn whenever handling buffer solution.

6.9 Specimen container holder (fig. 1h). - Angle irons, woodblocks, or other suitable material capable of holding the specimen container securely in an inverted position.

6.10 Buffer container (fig. 1i). - A suitable container with pouring spout, preferably plastic, of sufficient capacity to hold a buffer solution supply for daily testing. Each test performed requires 1.5 liters of buffer solution.

6.11 Pail. - Plastic pail, minimum 1-gallon capacity.

6.12 Spoon. - Large metal spoon for mixing the soil-cement calibration test specimens as described in paragraph 10.

6.13 Mixing container. - A 3- to 4-gallon container, preferably plastic, used for mixing the soil-cement calibration test specimens as described in paragraph 10.

7. Reagents and Materials

7.1 Distilled water is to be used for preparing the buffer solution as described in subparagraph 7.4. Tapwater that is free of acids, alkalies, or oils and is suitable for drinking should be used for rinsing the thermocouple probe and lid.

7.2 Sodium acetate. - Anhydrous (crystalline) sodium acetate, technical grade or better, 225 g required for each test specimen.

7.3 Glacial acetic acid. - Liquid glacial acetate acid, technical grade or better, 360 g required for each test specimen.

7.4 Preparation of buffer solution. -

7.4.1 Prepare 1.5 liters of buffer solution for each test specimen.

7.4.2 Dissolve 225 g of anhydrous sodium acetate in 500 mL of distilled water, stirring constantly.

7.4.3 Add 360 g of glacial acetic acid to the sodium acetate/water solution prepared in subparagraph 7.4.2.

7.4.4 Add distilled water to bring the final volume to 1.5 liters. Mix thoroughly.

NOTE 1. - Subparagraph 7.4 provides sufficient buffer for one cement content determination. If more than one test is to be performed, the proportions given should be adjusted to provide enough buffer solution to complete testing required for that date (see subpar. 7.5).

7.5 Buffer solution is to be used within 24 hours after it is mixed.

8. Precautions

8.1 Safety precautions. -

8.1.1 Chemicals used in this procedure contain acid that can be irritating to exposed skin. Perform this procedure only with adequate ventilation and with rinse water available. Wear rubber gloves, laboratory coat or apron, and safety glasses or goggles.

8.1.2 After mixing the soil-cement/buffer solution and before removing the lid, place a towel over the top of the specimen container.

8.2 Technical precautions. -

8.2.1 The calibration curve is specific to the mix design and materials used. If any one of these is changed, a new calibration curve must be determined.

8.2.2 Soil-cement test specimens are to be tested as quickly as possible after they are prepared or obtained.

8.2.3 Soil-cement test samples must be protected from moisture loss prior to testing.

8.2.4 The temperature difference between the buffer solution and soil-cement test specimen should be less than 4 °C. If the temperature difference is equal to or greater than 4 °C, the buffer solution and soil-cement test specimen are to be placed in the same environment until the temperatures are within 4 °C.

8.2.5 Gelling or stiffening of the soil-cement/buffer solution mixture may occur when testing specimens having cement contents greater than 16 percent. If this occurs, the ratio of mass of buffer solution to mass of soil-cement test specimen (3.64 to 3.30 lbm) (1.65 to 1.50 kg) given in this test designation cannot be used and a new mass ratio must be established.

9. Sampling, Test Specimens, and Test Units

9.1 Obtain a soil-cement test sample using either the method described in subparagraph 9.1.1 or 9.1.2. The method selected depends upon the reason for testing. Subparagraph 9.1.1 is to be used if the production process at the batch plant is to be checked. Subparagraph 9.1.2 is to be used during placement of soil-cement at the time of construction.

9.1.1 Using a shovel or large scoop, obtain a minimum 5-lbm (2-kg) test sample from the batch plant. The sample should be taken immediately after the soil-cement is dumped from the hopper into the truck. Segregation of the gravel fraction may occur during the dumping. When obtaining the sample, visually observe if it appears representative of the mix design proportions. If the sample does not appear representative, it should be discarded and a new sample obtained. Place the soil-cement test sample in a large bucket or other suitable container (see subpars. 8.2.2 and 8.2.3).

9.1.2 Using a shovel or large scoop, obtain a minimum 5-lbm (2-kg) test sample from the material obtained at the construction site for density and/or compressive strength testing. When obtaining the sample, visually observe if it appears representative of the mix design proportions. If the sample does not appear representative, it should be discarded and a new sample obtained. Place the soil-cement test sample in a large bucket or other suitable container (see subpars. 8.2.2 and 8.2.3).

10. Calibration and Standardization

10.1 All data are to be recorded on the "Cement Content - Heat of Neutralization Calibration Data" form as shown on figure 2.

10.2 A calibration curve is established by determining the heat of neutralization of soil-cement test specimens prepared at known cement contents which bracket the value of percent cement to be used for construction.

10.3 Prepare nine 3.30-lbm (1.50-kg) soil-cement test specimens using the percentages of gravel, minus No. 4 material, and water as determined when the mix was designed. The amount of cement added to each of three test specimens should be 2 percentage points less than that specified for construction, three specimens 2 percentage points greater, and three specimens having the same percent cement as specified for construction (e.g., if a 9-percent cement content is specified for construction, three test specimens are prepared with 7 percent, three with 11 percent, and three test specimens with 9 percent cement). An example mix design calculation for one 3.30-lbm (1.50-kg) specimen is shown on figure 7. Note that, in the example, moisture content values are required and were previously determined in accordance with USBR 5300 in order to calculate the quantity of each size material needed.

10.3.2 Place the mass, determined to the nearest 0.01 lbm (0.01 kg), of gravel, minus No. 4 material, water, and cement for one 3.30-lbm (1.50-kg) soil-cement test specimen in four separate containers.

10.3.3 Combine the gravel and minus No. 4 material along with one-half the water in a 3- to 4-gallon container. Mix thoroughly using a large spoon or other suitable mixing device. Ensure that the gravel is evenly wetted and that no dry clumps of minus No. 4 material are present in the test specimen.

10.3.4 Add the cement and the remainder of the water to the test specimen. Mix thoroughly to ensure an even distribution of cement throughout the test specimen. Ensure that no cement clumps are present or that any cement is sticking to the sides of the container.

10.3.5 Place the funnel in the mouth of the test specimen container.

10.3.6 Using the large spoon, place the soil-cement test specimen into the test specimen container using care to prevent portions of the test specimens sticking to the sides of the funnel. Ensure that all the test specimen is removed from the mixing container and placed in the specimen container.

10.3.7 Remove the funnel and secure the lid on the soil-cement test specimen container.

10.4 Determine the heat of neutralization for the soil-cement test specimen in accordance with subparagraphs 12.5 through 12.20.

10.5 Repeat subparagraphs 10.3.2 through 10.4 eight additional times to obtain nine heat of neutralization determinations.

10.6 Calculate the average of the "temperature difference" values obtained for the three trials performed at each of the three cement contents. Record the value to the nearest 0.1 °C as the "average temperature difference" as shown on figure 2.

10.7 Prepare a plot of heat of neutralization (average temperature difference) versus cement content as shown on figure 2.

10.8 Determine the equation of the calibration line. It is recommended that a programmable calculator be used to perform a linear regression analysis to obtain the best-fit line through the data points obtained.

10.9 Record the calibration line equation as shown on figure 2.

11. Conditioning

11.1 Perform the calibration as described in paragraph 10 and the procedure as described in paragraph 12 in an area that is isolated from drafts and is maintained at a constant temperature. It is recommended that the calibration and the construction control testing be performed at the same location.

12. Procedure

12.1 All data are to be recorded on the "Cement Content - Heat of Neutralization Determination" form as shown on figure 3.

12.2 Place a 1-gallon test specimen container on the scale. Place the funnel into the mouth of the test specimen container.

12.3 Using a small scoop, place 3.30 lbm (1.50 kg) of the soil-cement sample obtained in paragraph 9 into the test specimen container using care to prevent portions of the test specimen sticking to the sides of the funnel.

12.4 Remove the funnel and secure the lid on the soil-cement test specimen container.

12.5 Carefully obtain 3.64 lbm (1.65 kg) of the buffer solution as prepared in subparagraph 7.4 (also see subpar. 8.1.1).

12.6 Submerge the thermocouple probe into the buffer solution as shown on figure 4.

12.7 Determine the temperature of the buffer solution after 1 minute and record the value to the nearest 0.1 °C as the "buffer temperature."

12.8 Thoroughly rinse the thermocouple probe and lid using freshwater. Carefully and thoroughly dry the thermocouple probe and lid.

12.9 Remove the lid from the soil-cement test specimen container.

12.10 Secure the thermocouple probe and lid on the soil-cement test specimen container as shown on figure 5.

12.11 Invert the soil-cement test specimen container onto a stand as shown on figure 6. Shake the specimen container to ensure that the entire specimen is at the bottom and that the thermocouple probe in completely covered by the test specimen.

12.12 Determine the temperature of the soil-cement after 2 minutes, and record the value to the nearest 0.1 °C as the "soil-cement temperature" as shown on figure 3. Remove the test specimen container from the stand, and remove the thermocouple probe and lid.

12.13 Add the buffer solution to the soil-cement.

12.14 Secure a lid onto the soil-cement test specimen container.

12.15 With one hand on the test specimen container top and the other on the test specimen container bottom, vigorously shake the container to mix the soil-cement/buffer solution mixture for 4 minutes. During the mixing process, the test specimen container should be agitated continuously through 180° of rotation by inverting and uprighting the test specimen container to ensure an even and thorough mix of the soil-cement and buffer solution.

12.16 Remove the lid (see note 2), and secure the thermocouple probe and lid onto the soil-cement test specimen container. Invert the soil-cement specimen container onto a stand, and determine the temperature of the soil-cement/buffer solution mixture after 1 minute.

> NOTE 2. - It is recommended that a towel be placed over the top of the lid before removal; the pressure generated while mixing could cause the fluid to spray as the lid is removed.

12.17 Record the value obtained in subparagraph 12.16 to the nearest 0.1 °C as the "mixture temperature."

12.18 Remove the test specimen container from the stand and carefully remove the thermocouple probe and lid.

12.19 Calculate the average of the buffer temperature and the soil-cement temperature and record the value to the nearest 0.1 °C as the "average temperature" (see subpar. 8.2.4).

12.20 Calculate the difference between the mixture temperature and the average temperature and record the value to the nearest 0.1 °C as the "temperature difference."

12.21 Using either the calibration line equation determined in subparagraph 10.8 or the calibration curve as shown on figure 2, determine the cement content of the test specimen.

12.22 Record the value to the nearest 0.1 percent as the "calculated cement content (%)" as shown on figure 3.

12.23 Pour the soil-cement/buffer solution mixture into an appropriate container and cap securely.

12.24 Thoroughly wash the test specimen container, thermocouple probe and lid, and scoop and funnel with water.

13. Calculations

13.1 Calculations required to obtain a calibration line equation as described in paragraph 10 are shown on figure 2.

13.2 Calculations required to determine the cement content (%) of the soil-cement test specimen are shown on figure 3.

13.3 An example mix design calculation for a 3.30-lbm (1.50-kg) soil-cement calibration test specimen is shown on figure 7.

14. Report

14.1 The report is to consist of the following completed and checked forms:

14.1.1 "Cement Content - Heat of Neutralization Calibration Data," fig. 2.

14.1.2 "Cement Content - Heat of Neutralization Determination," fig. 3.

14.2 All calculations are to show a checkmark and all plotting must be checked.

Background Reference

"Cement Content of Cement Treated Materials (Heat of Neutralization)," Test Method No. Q116B - 1978, Main Roads Department - Queensland, Brisbane, Australia.

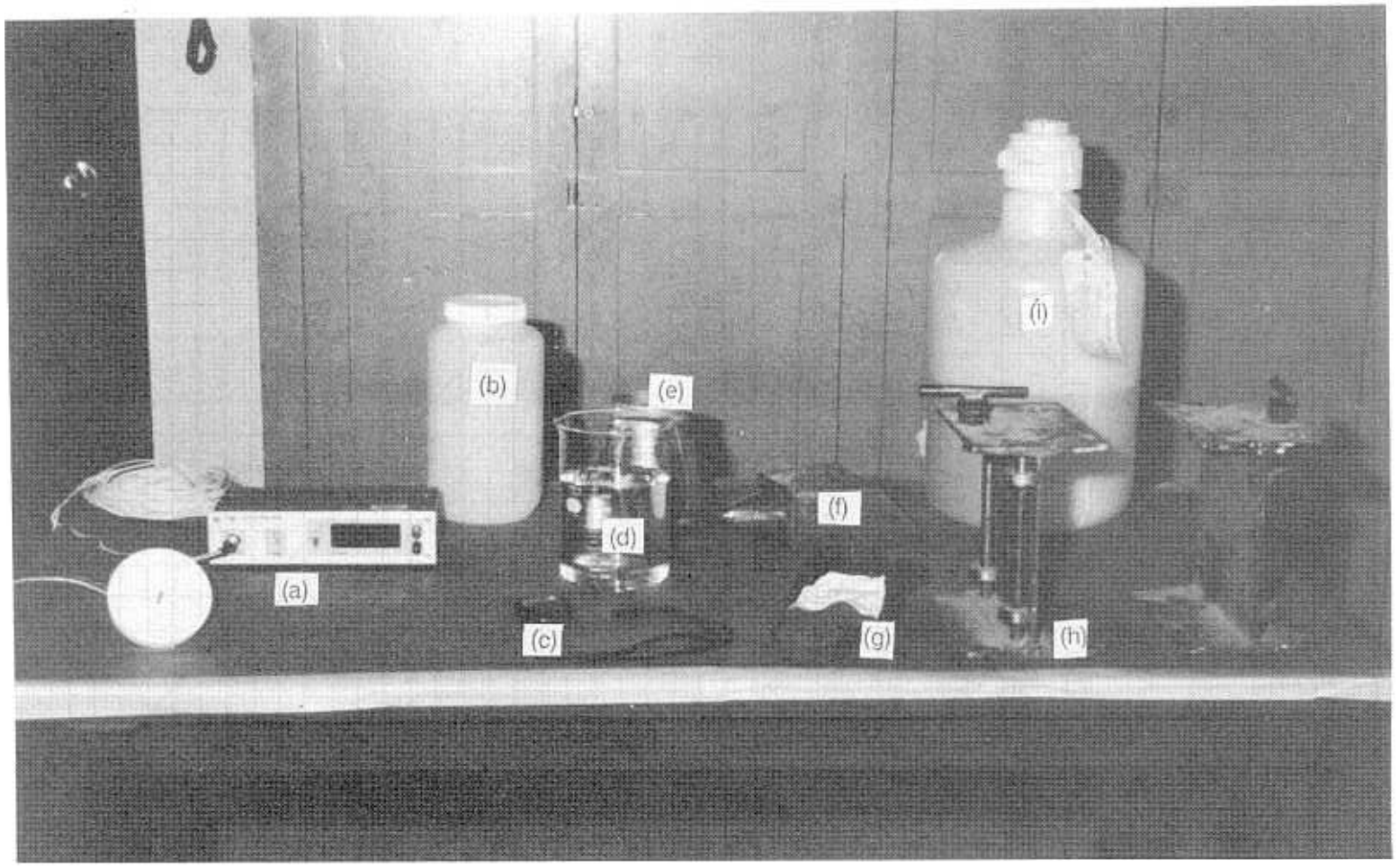


Figure - Heat of neutralization test equipment - (a) digital thermometer, (b) specimen container, (c) timing device, (d) beaker, (e) funnel, (f) hand scoop, (g) gloves, (h) specimen container holder, and (i) buffer container.

	CEMENT CONTENT - HEAT OF NEUTRALIZATION CALIBRATION DATA		Designation USBR____-__
Sample or test No. 1	Project Example	Feature Calibration Example	
Location Laboratory Mix	Test specimen mass 3.30 lbm	Buffer 3.64 lbm	
Tested by Date	Computed by Date	Checked by Date	

Specimen No.		1	2	3	4	5	6	7	8	9
Cement	%	7	7	7	9	9	9	11	11	11
Water	%	6	6	6	6	6	6	6	6	6
Gravel	%	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3
(1) Buffer temperature	°C	19.6	19.6	19.7	20.2	20.1	20.2	20.7	20.8	20.9
(2) Soil-cement temperature	°C	20.2	20.5	20.6	20.3	20.6	20.8	21.1	21.1	21.9
(3) Average temperature ((1)+(2))/2	°C	19.9	20.1	20.2	20.3	20.4	20.5	20.9	21.0	21.4
(4) Mixture temperature	°C	35.7	35.3	35.2	39.7	40.2	39.7	43.4	44.0	44.2
(5) Temperature difference (4)-(3)	°C	15.8	15.2	15.0	19.4	19.8	19.2	22.5	23.0	22.8
(6) Average temperature difference	°C	15.3			19.5			22.8		

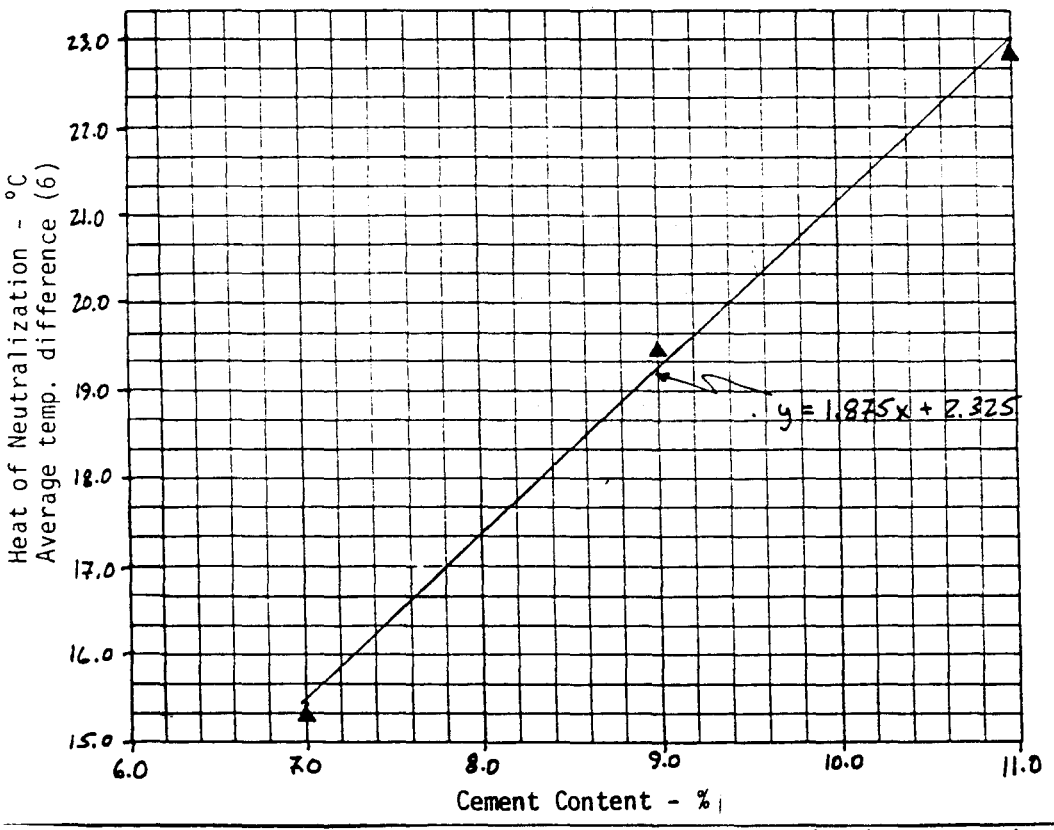


Figure 2. - Cement content - heat of neutralization calibration data - example.

	CEMENT CONTENT - HEAT OF NEUTRALIZATION DETERMINATION	Designation USBR _____-__ __

Project	Feature
Example	CEMENT CONTENT DETERMINATION
Test specimen mass 3.30 lbm	Buffer mass 3.64 lbm

Tested by	Computed by	Date	Checked by	Date

Mix design specifications	Calibration line equation : $y = 1.875x + 2.325$
Cement (%) 9	$y = mx + b$
Water (%) 6	m = 1.875
Gravel (%) 50.3	b = 2.325

Sample or test No.	1				
Location	A				
(1) Buffer temperature °C	22.0				
(2) Soil-cement temperature °C	21.8				
(3) Average temperature [(1)+(2)]/2 °C	21.9				
(4) Mixture temperature °C	40.8				
(5) Temperature difference (4)-(3) °C	18.9				
(6) Calculated cement content $\frac{(5) - b}{m}$ %	8.8				

Remarks: _____

Figure 3. - Cement content - heat of neutralization determination - example.

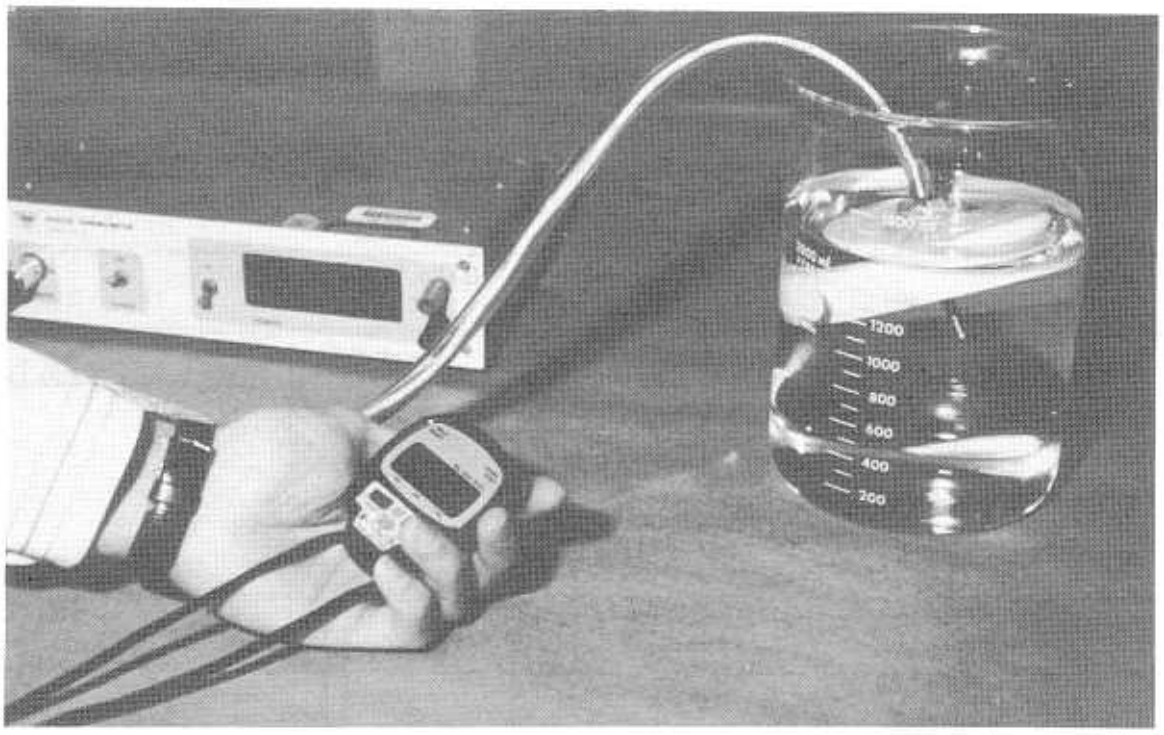


Figure 4. - Buffer temperature determination.

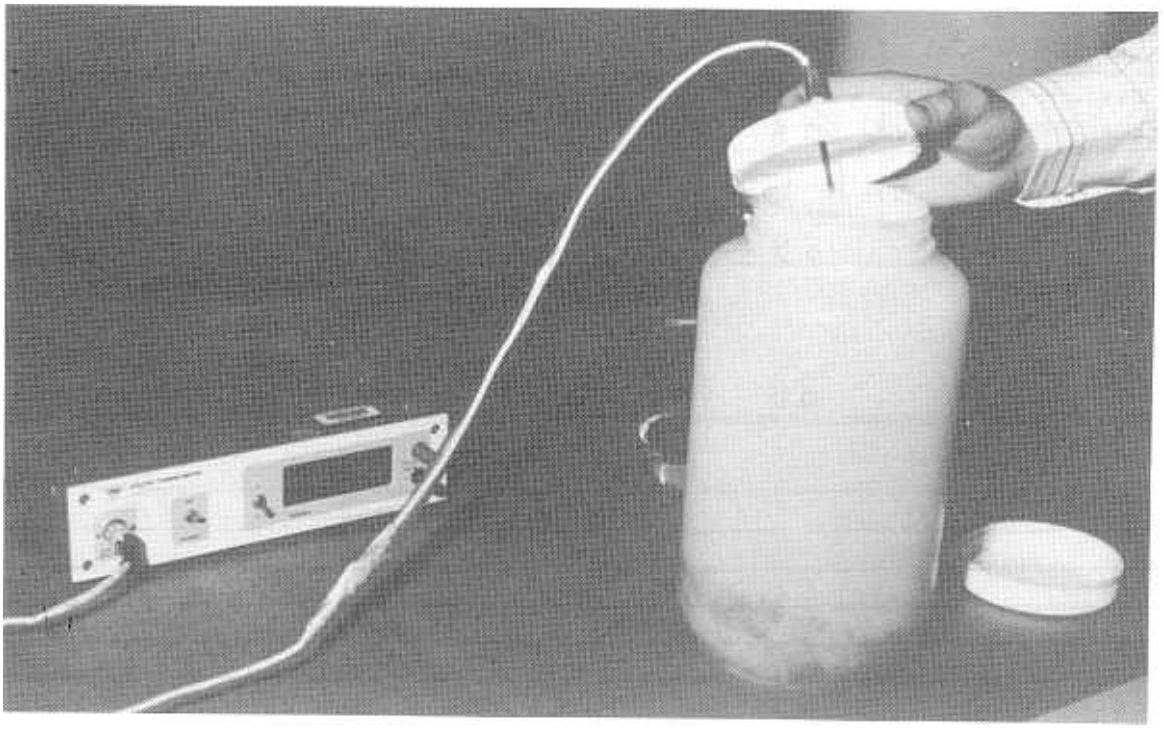


Figure 5. - Placement of thermocouple probe on soil-cement test specimen container.

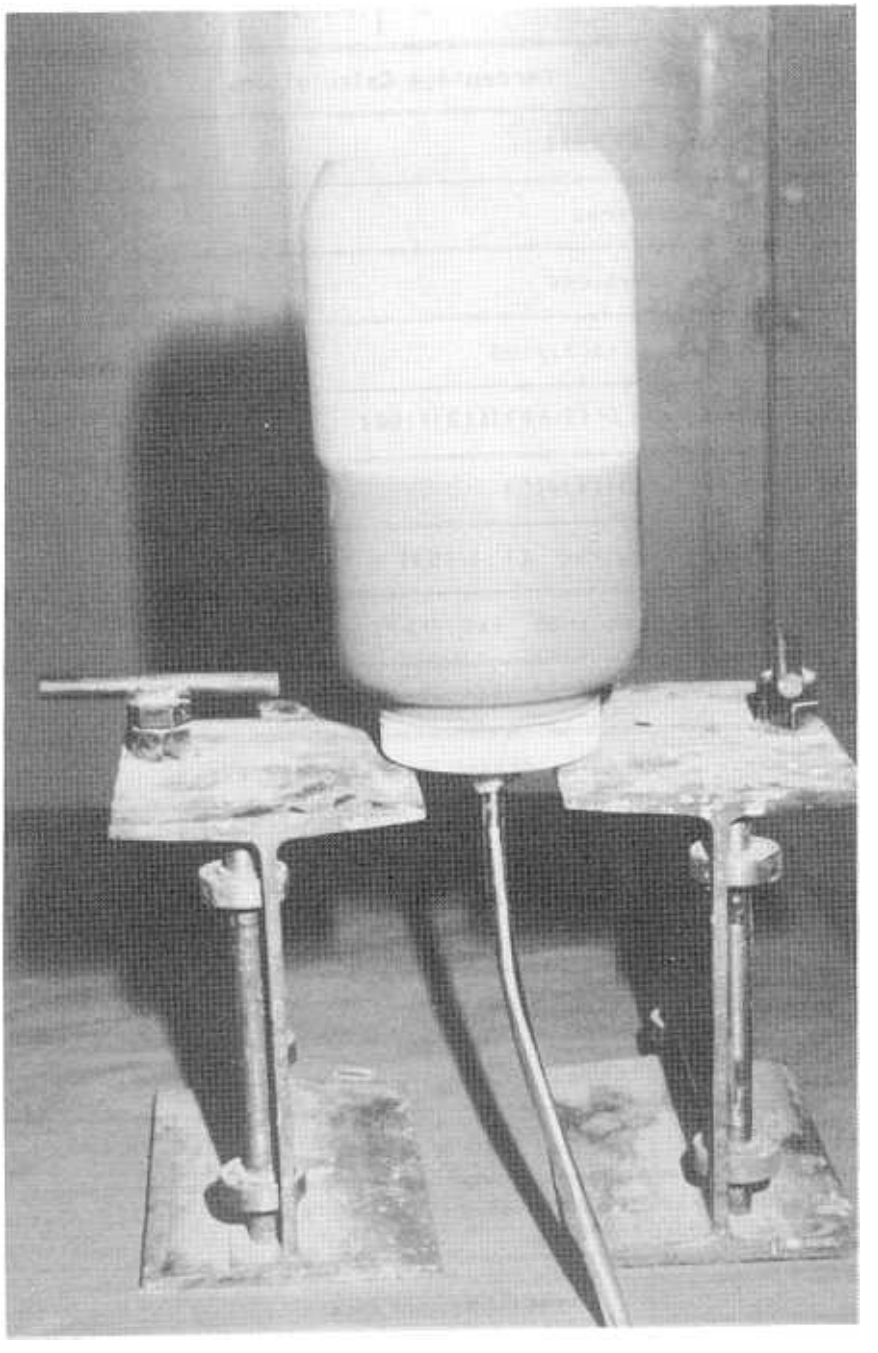


Figure 6. - Soil-cement test specimen inverted on stand for temperature determination.

	CEMENT CONTENT - HEAT OF NEUTRALIZATION (CALIBRATION TEST SPECIMEN PREPARATION)	Designation USBR _____ - __
Sample or test No. 1	Project Example	Feature Calibration specimen preparation
Computed by	Date	Checked by / Date

Percentage Calculations	
(1) Assumed dry mass of soil	100.00 lbm
(2) Cement content desired	9 %
(3) Moisture content desired	6 %
(4) Cement required (1)(2)/100	9.00 lbm
(5) Water required [(1)+(4)][(3)/100]	6.54 lbm
(6) Total mass (1)+(4)+(5)	115.54 lbm
(7) Percent cement required [( )/(6)] x 100	7.79
(8) Percent water required [(5)/(6)] x 100	5.66
(9) Percent dry soil required [(1)/(6)] x 100	86.55

Mix design specifications

Material size in.	Gradation % (10)	Moisture content (USBR 5300) (11) %
3/4 - 1-1/2	14.1	0.14
3/8 - 3/4	19.6	0.17
No.4 - 3/8	16.6	0.25
Minus No.4	49.7	0.90

(12) Percent dry mass of material size required (10)(9)/100		(13) Calculated percent dry mass
3/4 - 1-1/2	(14.1)(86.55)/100	12.20
3/8 - 3/4	(19.6)(86.55)/100	16.96
No.4 - 3/8	(16.6)(86.55)/100	14.37
Minus No.4	(49.7)(86.55)/100	43.02
(14) Total percent dry mass		86.55

Figure 7. - Cement content - heat of neutralization (calibration test specimen preparation) - example.

(15) Percent mass with natural mostuire required [(13)(1 + (11)/100)]		(16) Calculated percent mass with natural moisture
3/4 - 1-1/2	(12.20)(1.0014)	12.22
3/8 - 3/4	(16.96)(1.0017)	16.99
No.4 - 3/8	(14.37)(1.0025)	14.41
Minus No.4	(43.02)(1.009)	43.41
(17) Total percent mass with natural moisture		87.03
(18) Percent moisture in soil (17)-(14)		0.48
(19) Percent water to add (8)-(18)		5.18
(20) Desired calibration test specimen mass		3.30 lbm

Calibration Test Specimen Mass Requirements		
Material in	Mass required (16)(20)/100	(lbm)
3/4 - 1-1/2	(12.22)(3.30)/100	0.40
3/8 - 3/4	(16.99)(3.30)/100	0.56
No.4 - 3/8	(14.41)(3.30)/100	0.48
Minus No.4	(43.41)(3.30)/100	1.43
Cement required (7)(20)/100	(7.79)(3.30)/100	0.26
Water required (19)(20)/100	(5.18)(3.30)/100	0.17
Total mass of calibration test specimen		3.30 lbm

Figure 7. - Cement content - heat of neutralization (calibration test specimen preparation - example. - Continued

APPENDIX B

Field calibration data

JACKSON LAKE MODIFICATION - STAGE II
June 3, 1988

Mix Design for SMW - Percent Cement Calibration Curve - Heat of Neutralization Method

Use 500-gram sample (per Amster Howard)

Material	%	Grams	%	Grams	%	Grams
Cement*	10.0	50.0	25.0	125.5	40.0	200.0
Water**	43.1	215.5	43.1	215.5	43.1	215.5
Soil***		234.5		159.5		84.5
Total		500.0		500.0		500.0

Buffer - 1.65 kilograms per test, use buffer within 24 hours.

* Cement from Geocon batch plant
** Average moisture content of wet SMW samples through June 2, 1988.
*** Soil from DH-911, sector D-44, station 25+67, 123 feet downstream, composite from depths of 20, 40, 60, and 80.5 to 92.5 feet.

SMW - cement calibration curve - heat of neutralization - percentage by wet mass

10% Cement

Buffer temp. °C

#1	#2	#3
28.8	28.6	28.4

Soil cement temp. °C

#1	#2	#3
28.9	28.9	27.7

Weighted avg. temp. °C
(buffer x 0.767) + (SMW x 0.233)

#1	#2	#3
28.82	28.67	28.23

Mixture temp. °C

#1	#2	#3
37.5	37.4	36.2

Temperature diff. °C

#1	#2	#3
8.68	8.73	7.97

Average ΔT = 8.5

25% Cement

Buffer temp. °C

#1	#2	#3
27.5	27.5	29.2

Soil cement temp. °C

#1	#2	#3
29.4	27.2	27.6

Weighted avg. temp. °C
(buffer x 0.767) + (SMW x 0.233)

#1	#2	#3
27.94	27.43	28.83

Mixture temp. °C

#1	#2	#3
49.6	48.8	48.8

Temperature diff. °C

#1	#2	#3
21.66	21.37	19.97

Average ΔT = 21.0

40% Cement

Buffer temp. °C

#1	#2	#3
28.7	28.5	28.4

Soil cement temp. °C

#1	#2	#3
27.0	25.9	26.1

Weighted avg. temp. °C
(buffer x 0.767) + (SMW x 0.233)

#1	#2	#3
28.30	27.89	27.86

Mixture temp. °C

#1	#2	#3
62.7	60.7	61.2

Temperature diff. ° C

#1	#2	#3
34.40	32.81	33.34

Average ΔT = 33.5

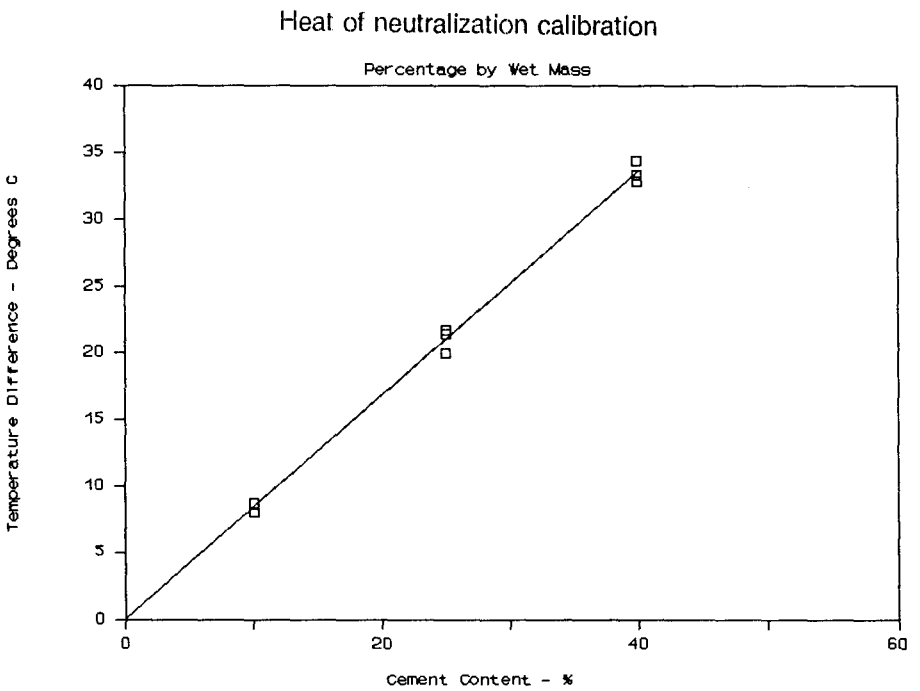


Figure B-1. - Field calibration curve for cement by wet mass.

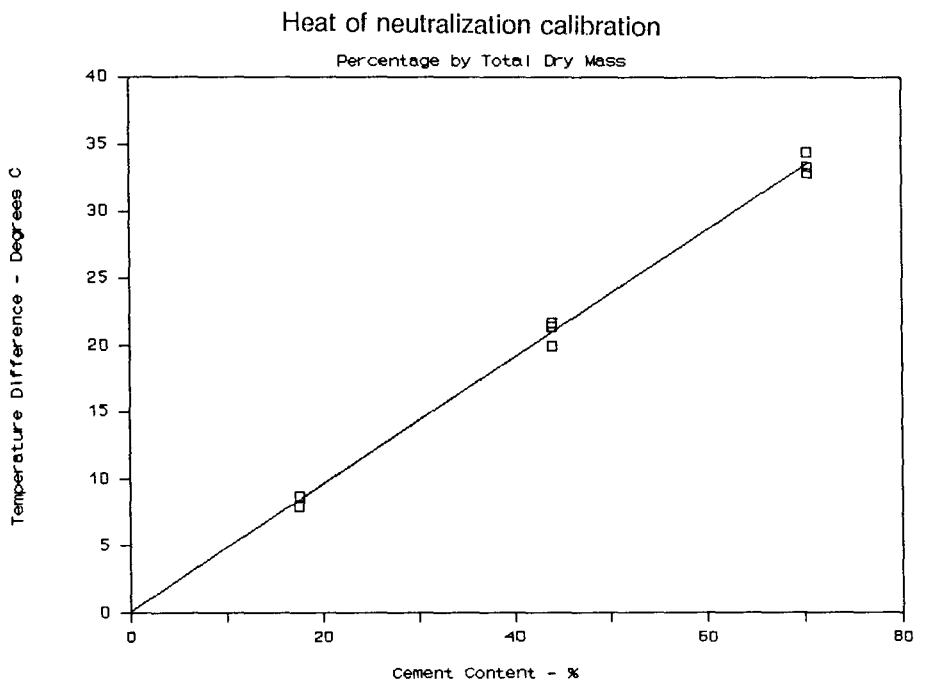
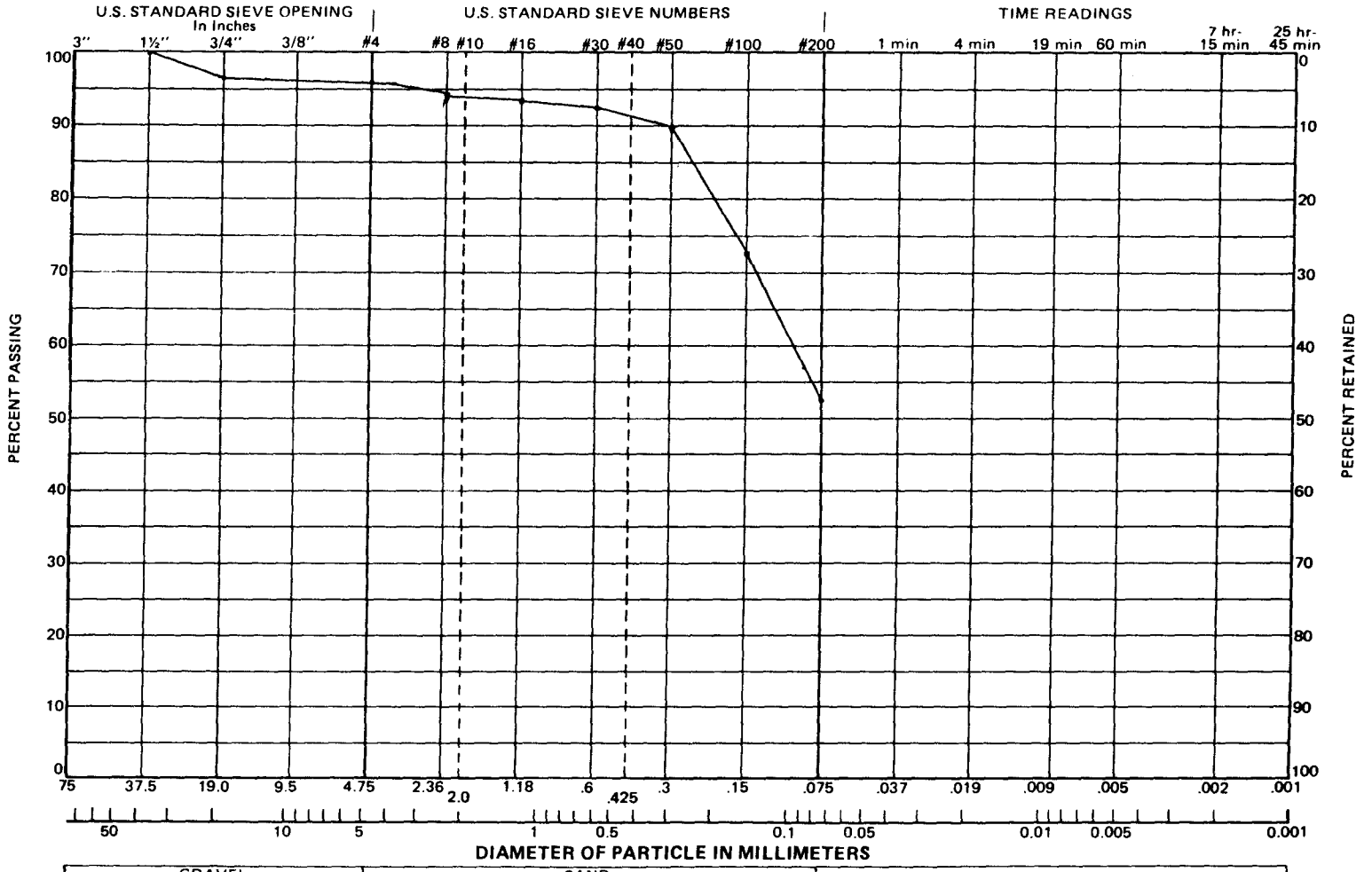


Figure B-2. - Field calibration curve for total dry mass.

7-1415 (10-86)
Bureau of Reclamation

GRADATION TEST

Designation USBR _____



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	HOLE NO.	ELEV. OR DEPTH ☐ft ☐m	UNIFIED SOIL CLASSIFICATION GROUP SYMBOL	% GRAVEL	% SAND	% FINES	ATTERBERG LIMITS LL (%)	PI (%)	SL (%)	SPECIFIC GRAVITY MINUS NO. 4	OTHER	NOTES: SOIL USED FOR SMW HEAT OF NEUTRALIZATION CEMENT CONTENT CALIBRATION 6-3-88
COMPOSITE	DH-911	20,40,60, (80.5-92.5)	ML	4.1	42.6	53.3	-	N.P.				

PREPARED BY _____ CHECKED BY _____ FIGURE B-3

GPO 852-232

Figure B-3. - Gradation of soil used for SMW HON cement content calibration.

APPENDIX C

Spread sheet database of all field data with HON testing

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
C15-9	62188	25.0	3.4	51.2	45.4	0.37	108.9	46.1	28	789		42.0
C15-9	62188	25.0	3.4	51.2	45.4	0.37	108.9	46.1	56	957		42.0
C15-9	62188	25.0	3.4	51.2	45.4	0.37	108.9	46.1	28	758		42.0
C15-9	62188	25.0	3.4	51.2	45.4	0.37	108.9	46.1	7		240	42.0
C15-9	62188	25.0	3.4	51.2	45.4	0.37	108.9	46.1	56	948		42.0
C15-9	62188	25.0	3.4	51.2	45.4	0.37	108.9	46.1	7		248	42.0
C15-9	62188	25.0	3.4	51.2	45.4	0.37	108.9	46.1	28	768		42.0
C15-9	62188	25.0	3.4	51.2	45.4	0.37	108.9	46.1	7		255	42.0
C15-9	62188	50.0	0.0	50.5	49.5	0.09	108.1	48.5	7		409	48.1
C15-9	62188	50.0	0.0	50.5	49.5	0.09	108.1	48.5	7		396	48.1
C15-9	62188	50.0	0.0	50.5	49.5	0.09	108.1	48.5	28	1015		48.1
C15-9	62188	50.0	0.0	50.5	49.5	0.09	108.1	48.5	28	922		48.1
C15-9	62188	50.0	0.0	50.5	49.5	0.09	108.1	48.5	7		372	48.1
C15-9	62188	50.0	0.0	50.5	49.5	0.09	108.1	48.5	28	1071		48.1
C15-9	62188	50.0	0.0	50.5	49.5	0.09	108.1	48.5	56	1017		48.1
C15-9	62188	50.0	0.0	50.5	49.5	0.09	108.1	48.5	56	1015		48.1
C16-14	62288	20.0	15.9	51.5	32.6	0.75	120.0	31.0	56	619		27.3
C16-14	62288	20.0	15.9	51.5	32.6	0.75	120.0	31.0	56	744		27.3
C16-14	62288	20.0	15.9	51.5	32.6	0.75	120.0	31.0	7		221	27.3
C16-14	62288	20.0	15.9	51.5	32.6	0.75	120.0	31.0	7		213	27.3
C16-14	62288	20.0	15.9	51.5	32.6	0.75	120.0	31.0	28	611		27.3
C16-14	62288	20.0	15.9	51.5	32.6	0.75	120.0	31.0	7		227	27.3
C16-14	62288	20.0	15.9	51.5	32.6	0.75	120.0	31.0	28	664		27.3
C16-14	62288	20.0	15.9	51.5	32.6	0.75	120.0	31.0	28	611		27.3
C16-14	62288	40.0	29.1	42.9	28.0	0.75	119.0	31.9	28	600		32.6
C16-14	62288	40.0	29.1	42.9	28.0	0.75	119.0	31.9	7		149	32.6
C16-14	62288	40.0	29.1	42.9	28.0	0.75	119.0	31.9	7		230	32.6
C16-14	62288	40.0	29.1	42.9	28.0	0.75	119.0	31.9	56	643		32.6
C16-14	62288	40.0	29.1	42.9	28.0	0.75	119.0	31.9	28	580		32.6
C16-14	62288	40.0	29.1	42.9	28.0	0.75	119.0	31.9	28	586		32.6
C16-14	62288	40.0	29.1	42.9	28.0	0.75	119.0	31.9	56	799		32.6
C16-14	62288	40.0	29.1	42.9	28.0	0.75	119.0	31.9	7		156	32.6
C17-17	62388	20.0	19.6	48.9	31.5	0.37	115.0	36.0	7		198	34.0
C17-17	62388	20.0	19.6	48.9	31.5	0.37	115.0	36.0	28	596		34.0
C17-17	62388	20.0	19.6	48.9	31.5	0.37	115.0	36.0	7		195	34.0
C17-17	62388	20.0	19.6	48.9	31.5	0.37	115.0	36.0	56	707		34.0
C17-17	62388	20.0	19.6	48.9	31.5	0.37	115.0	36.0	56	783		34.0
C17-17	62388	20.0	19.6	48.9	31.5	0.37	115.0	36.0	7		211	34.0
C17-17	62388	20.0	19.6	48.9	31.5	0.37	115.0	36.0	28	601		34.0
C17-17	62388	20.0	19.6	48.9	31.5	0.37	115.0	36.0	28	599		34.0
C17-17	62388	40.0	5.5	55.7	38.8	0.37	108.2	47.1	7		165	33.2
C17-17	62388	40.0	5.5	55.7	38.8	0.37	108.2	47.1	28	555		33.2
C17-17	62388	40.0	5.5	55.7	38.8	0.37	108.2	47.1	28	554		33.2
C17-17	62388	40.0	5.5	55.7	38.8	0.37	108.2	47.1	7		187	33.2
C17-17	62388	40.0	5.5	55.7	38.8	0.37	108.2	47.1	7		154	33.2
C17-17	62388	40.0	5.5	55.7	38.8	0.37	108.2	47.1	28	534		33.2
C19-3	62488	25.0	17.5	44.7	37.8	0.37	115.9	35.2	7		255	33.5
C19-3	62488	25.0	17.5	44.7	37.8	0.37	115.9	35.2	28	767		33.5
C19-3	62488	25.0	17.5	44.7	37.8	0.37	115.9	35.2	7		263	33.5
C19-3	62488	25.0	17.5	44.7	37.8	0.37	115.9	35.2	28	703		33.5
C19-3	62488	25.0	17.5	44.7	37.8	0.37	115.9	35.2	56	959		33.5
C19-3	62488	25.0	17.5	44.7	37.8	0.37	115.9	35.2	56	855		33.5

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
C19-3	62488	25.0	17.5	44.7	37.8	0.37	115.9	35.2	28	749		33.5
C20-14	62788	15.0	13.3	49.0	37.7	0.37	112.8	39.9	7		183	31.3
C20-14	62788	15.0	13.3	49.0	37.7	0.37	112.8	39.9	7		236	31.3
C20-14	62788	15.0	13.3	49.0	37.7	0.37	112.8	39.9	28	634		31.3
C20-14	62788	15.0	13.3	49.0	37.7	0.37	112.8	39.9	56	804		31.3
C20-14	62788	15.0	13.3	49.0	37.7	0.37	112.8	39.9	56	803		31.3
C20-14	62788	30.0	19.9	41.5	38.6	0.75	112.2	32.1	56	818		33.3
C20-14	62788	30.0	19.9	41.5	38.6	0.75	112.2	32.1	28	664		33.3
C20-14	62788	30.0	19.9	41.5	38.6	0.75	112.2	32.1	7		251	33.3
C20-14	62788	30.0	19.9	41.5	38.6	0.75	112.2	32.1	28	715		33.3
C20-14	62788	30.0	19.9	41.5	38.6	0.75	112.2	32.1	7		213	33.3
C20-14	62788	30.0	19.9	41.5	38.6	0.75	112.2	32.1	56	785		33.3
C20-14	62788	30.0	19.9	41.5	38.6	0.75	112.2	32.1	28	519		33.3
C20-14	62788	30.0	19.9	41.5	38.6	0.75	112.2	32.1	7		228	33.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	56	765		36.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	56	870		36.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	28	694		36.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	7		261	36.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	28	686		36.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	56	838		36.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	7		244	36.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	28	772		36.3
C21-11	62888	15.0	8.0	48.8	43.2	0.37	115.0	41.9	7		235	36.3
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	7		304	33.2
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	28	783		33.2
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	56	868		33.2
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	56	915		33.2
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	28	894		33.2
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	56	989		33.2
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	28	846		33.2
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	7		328	33.2
C21-11	62888	30.0	17.0	45.3	37.7	0.37	118.9	32.4	7		337	33.2
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	7		221	29.7
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	28	780		29.7
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	56	905		29.7
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	28	738		29.7
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	7		253	29.7
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	56	850		29.7
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	7		229	29.7
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	28	688		29.7
C22-7	7688	15.0	14.8	45.2	40.0	0.75	117.0	33.6	56	911		29.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	56	1017		28.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	28	847		28.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	7		307	28.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	28	829		28.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	28	817		28.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	56	1042		28.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	7		293	28.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	7		302	28.7
C22-7	7688	30.0	20.5	46.4	33.1	0.75	121.0	29.5	56	956		28.7
C24-15	71388	15.0	1.2	45.0	53.8	0.19	109.2	46.4	7		138	33.6

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
C24-15	71388	15.0	1.2	45.0	53.8	0.19	109.2	46.4	28	518		33.6
C24-15	71388	15.0	1.2	45.0	53.8	0.19	109.2	46.4	7		138	33.6
C24-15	71388	15.0	1.2	45.0	53.8	0.19	109.2	46.4	28	556		33.6
C24-15	71388	30.0	1.1	43.7	55.2	0.19	110.9	42.6	7		174	29.3
C24-15	71388	30.0	1.1	43.7	55.2	0.19	110.9	42.6	28	642		29.3
C24-15	71388	30.0	1.1	43.7	55.2	0.19	110.9	42.6	28	660		29.3
C24-15	71388	30.0	1.1	43.7	55.2	0.19	110.9	42.6	28	624		29.3
C24-15	71388	30.0	1.1	43.7	55.2	0.19	110.9	42.6		759		29.3
C24-15	71388	30.0	1.1	43.7	55.2	0.19	110.9	42.6		816		29.3
C24-15	71388	30.0	1.1	43.7	55.2	0.19	110.9	42.6		828		29.3
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	7		109	34.0
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	7		107	34.0
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	28	386		34.0
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	7		105	34.0
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	28	369		34.0
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	28	394		34.0
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	56	448		34.0
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	56	446		34.0
C24-6	71288	20.0	0.2	42.9	56.9	0.37	103.7	57.9	56	462		34.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	7		122	30.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	7		124	30.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	28	393		30.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	28	418		30.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	28	451		30.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	7		141	30.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	56	489		30.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	56	491		30.0
C24-6	71288	40.0	0.8	43.7	55.5	0.19	105.5	53.6	56	513		30.0
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	28	592		39.9
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	28	562		39.9
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	7		190	39.9
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	28	582		39.9
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	7		203	39.9
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	7		209	39.9
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	56	665		39.9
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	56	657		39.9
C25-15	71588	15.0	6.6	41.7	51.7	0.37	108.0	48.3	56	652		39.9
C25-15	71588	35.0	8.6	34.7	56.7	0.75	106.3	41.6	7		185	30.5
C25-15	71588	35.0	8.6	34.7	56.7	0.75	106.3	41.6	7		156	30.5
C25-15	71588	35.0	8.6	34.7	56.7	0.75	106.3	41.6	28	548		30.5
C25-15	71588	35.0	8.6	34.7	56.7	0.75	106.3	41.6	28	554		30.5
C25-15	71588	35.0	8.6	34.7	56.7	0.75	106.3	41.6	7		195	30.5
C25-15	71588	35.0	8.6	34.7	56.7	0.75	106.3	41.6	56	634		30.5
C25-15	71588	35.0	8.6	34.7	56.7	0.75	106.3	41.6	56	379		30.5
C25-15	71588	35.0	8.6	34.7	56.7	0.75	106.3	41.6	56	629		30.5
C26-1	71888	50.0	0.4	41.0	58.6	0.37	108.9	52.0	7		202	43.9
C26-1	71888	50.0	0.4	41.0	58.6	0.37	108.9	52.0	28	723		43.9
C26-1	71888	50.0	0.4	41.0	58.6	0.37	108.9	52.0	7		214	43.9
C26-1	71888	50.0	0.4	41.0	58.6	0.37	108.9	52.0	28	734		43.9
C26-1	71888	50.0	0.4	41.0	58.6	0.37	108.9	52.0	28	746		43.9
C26-1	71888	50.0	0.4	41.0	58.6	0.37	108.9	52.0	7		255	43.9

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C26-1	71888	50.0	0.4	41.0	58.6	0.37	108.9	52.0	56	897		43.9
C26-1	71888	50.0	0.4	41.0	58.6	0.37	108.9	52.0	56	843		43.9
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	7		250	31.7
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	7		240	31.7
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	28	661		31.7
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	7		253	31.7
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	28	695		31.7
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	28	628		31.7
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	56	856		31.7
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	56	866		31.7
C26-14	71988	15.0	11.6	49.6	38.8	0.37	118.2	33.2	56	844		31.7
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	7		215	29.3
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	7		218	29.3
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	7		194	29.3
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	28	563		29.3
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	28	500		29.3
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	28	554		29.3
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	56	644		29.3
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	56	645		29.3
C26-14	71988	35.0	17.4	43.2	39.4	0.75	120.0	30.9	56	710		29.3
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	28	676		51.0
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	28	676		51.0
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	28	704		51.0
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	7		160	51.0
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	7		158	51.0
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	7		146	51.0
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	56	801		51.0
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	56	832		51.0
C27-12	72688	20.0	5.1	33.9	61.0	0.37	98.9	63.2	56	877		51.0
C27-12	72688	35.0	0.0	34.9	65.1	0.09	96.0	79.5	7		158	49.0
C27-12	72688	35.0	0.0	34.9	65.1	0.09	96.0	79.5	28	622		49.0
C27-12	72688	35.0	0.0	34.9	65.1	0.09	96.0	79.5	7		139	49.0
C27-12	72688	35.0	0.0	34.9	65.1	0.09	96.0	79.5	7		145	49.0
C27-12	72688	35.0	0.0	34.9	65.1	0.09	96.0	79.5	28	607		49.0
C27-12	72688	35.0	0.0	34.9	65.1	0.09	96.0	79.5	56	801		49.0
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	7		214	40.9
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	28	744		40.9
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	7		222	40.9
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	28	775		40.9
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	28	748		40.9
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	7		223	40.9
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	56	929		40.9
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	56	833		40.9
C28-2	72788	20.0	6.7	40.1	53.2	0.37	107.3	47.5	56	809		40.9
C28-2	72788	40.0	5.8	39.6	54.6	0.37	108.1	44.9	7		312	42.0
C28-2	72788	40.0	5.8	39.6	54.6	0.37	108.1	44.9	28	952		42.0
C28-2	72788	40.0	5.8	39.6	54.6	0.37	108.1	44.9	28	892		42.0
C28-2	72788	40.0	5.8	39.6	54.6	0.37	108.1	44.9	28	838		42.0
C28-2	72788	40.0	5.8	39.6	54.6	0.37	108.1	44.9	7		336	42.0
C28-2	72788	40.0	5.8	39.6	54.6	0.37	108.1	44.9	7		328	42.0
C28-2	72788	40.0	5.8	39.6	54.6	0.37	108.1	44.9	56	1004		42.0
C28-2	72788	40.0	5.8	39.6	54.6	0.37	108.1	44.9	56	1014		42.0

COLUMN NO.	DATE CONST	SAMP. DEPTH	WET SAMPLE GRAVEL	WET SAMPLE SAND	WET SAMPLE FINES	WET SAMPLE MAX. SIZE	WET SAMPLE WET DENSITY	WET SAMPLE MOISTURE CONTENT	AGE	GEOCON Qu	USBR Field Qu	CEMENT CONTENT
		FT.	%	%	%	in.	LB/FT^3	%	DAYS	lb/in2	lb/in2	(%)
C29-1	72888	20.0	39.5	34.1	26.4	0.37	106.7	24.6	7		184	32.5
C29-1	72888	20.0	39.5	34.1	26.4	0.37	106.7	24.6	7		236	32.5
C29-1	72888	20.0	39.5	34.1	26.4	0.37	106.7	24.6	28	683		32.5
C29-1	72888	20.0	39.5	34.1	26.4	0.37	106.7	24.6	28	809		32.5
C29-1	72888	20.0	39.5	34.1	26.4	0.37	106.7	24.6	28	736		32.5
C29-1	72888	20.0	39.5	34.1	26.4	0.37	106.7	24.6	56	999		32.5
C29-1	72888	20.0	39.5	34.1	26.4	0.37	106.7	24.6	56	985		32.5
C29-1	72888	20.0	39.5	34.1	26.4	0.37	106.7	24.6	56	994		32.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	7		175	27.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	7		236	27.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	28	862		27.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	28	756		27.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	28	822		27.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	7		276	27.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	56	814		27.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	56	1017		27.5
C29-1	72888	40.0	0.5	51.8	47.7	0.75	101.5	30.6	56	991		27.5
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	7		212	37.1
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	7		232	37.1
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	7		144	37.1
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	28	663		37.1
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	28	626		37.1
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	28	607		37.1
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	56	755		37.1
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	56	733		37.1
C29-13	81988	15.0	20.4	52.5	27.1	0.37	119.7	28.5	56	727		37.1
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	7		263	43.0
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	7		302	43.0
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	7		177	43.0
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	28	844		43.0
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	28	801		43.0
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	28	746		43.0
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	56	827		43.0
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	56	928		43.0
C29-13	81988	35.0	23.6	43.9	32.5	0.37	114.9	31.2	56	1002		43.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	7		336	41.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	7		303	41.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	7		305	41.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	28	681		41.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	28	731		41.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	28	719		41.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	56	868		41.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	56	878		41.0
C29-23	81888	15.0	5.3	46.1	48.6	0.37	112.8	41.1	56	783		41.0
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	7		285	42.0
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	7		287	42.0
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	7		253	42.0
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	28	801		42.0
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	28	673		42.0
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	28	767		42.0
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	56	872		42.0
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	56	924		42.0

COLUMN NO.	DATE CONST	SAMP. DEPTH	WET SAMPLE GRAVEL	WET SAMPLE SAND	WET SAMPLE FINES	WET SAMPLE MAX. SIZE	WET SAMPLE WET DENSITY	WET SAMPLE MOISTURE CONTENT	AGE	GEOCON Qu	USBR Field Qu	CEMENT CONTENT
		FT.	%	%	%	in.	LB/FT^3	%	DAYS	lb/in2	lb/in2	(%)
C29-23	81888	35.0	7.0	46.2	46.8	0.37	113.7	39.5	56	967		42.0
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	7		127	30.1
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	7		146	30.1
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	7		161	30.1
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	28	436		30.1
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	28	433		30.1
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	28	381		30.1
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	56	511		30.1
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	56	395		30.1
C29-8	82288	20.0	12.8	50.2	37.0	0.75	116.7	35.3	56	450		30.1
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	7		161	29.8
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	7		188	29.8
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	7		213	29.8
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	28	446		29.8
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	28	394		29.8
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	28	463		29.8
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	56	519		29.8
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	56	522		29.8
C29-8	82288	40.0	30.2	38.9	30.9	0.75	117.7	34.1	56	563		29.8
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	7		273	33.1
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	7		267	33.1
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	7		250	33.1
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	28	617		33.1
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	28	595		33.1
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	28	616		33.1
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	56	772		33.1
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	56	762		33.1
C30-16	81788	15.0	0.2	57.8	42.0	0.19	110.8	43.3	56	712		33.1
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	7		280	36.3
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	7		270	36.3
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	7		263	36.3
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	28	701		36.3
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	28	757		36.3
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	28	755		36.3
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	56	986		36.3
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	56	972		36.3
C30-16	81788	30.0	8.3	51.5	40.2	0.37	110.3	38.3	56	1018		36.3
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	7		154	31.5
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	7		155	31.5
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	7		150	31.5
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	28	432		31.5
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	28	485		31.5
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	28	482		31.5
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	56	647		31.5
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	56	616		31.5
C33-20	81188	20.0	14.0	49.9	36.1	0.37	113.4	37.9	56	675		31.5
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	7		189	32.0
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	7		196	32.0
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	7		204	32.0
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	28	630		32.0
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	28	633		32.0
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	28	559		32.0

COLUMN NO.	DATE CONST	SAMP. DEPTH	WET SAMPLE GRAVEL	WET SAMPLE SAND	WET SAMPLE FINES	WET SAMPLE MAX. SIZE	WET SAMPLE WET DENSITY	WET SAMPLE MOISTURE CONTENT	AGE	GEOCON Qu	USBR Field Qu	CEMENT CONTENT
		FT.	%	%	%	in.	LB/FT^3	%	DAYS	lb/in2	lb/in2	(%)
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	56	781		32.0
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	56	729		32.0
C33-20	81188	35.0	15.4	41.5	43.1	0.75	111.6	42.9	56	777		32.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	7		141	31.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	7		161	31.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	7		169	31.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	28	453		31.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	28	344		31.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	28	473		31.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	56	509		31.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	56	560		31.0
C34-22	8988	35.0	10.9	37.9	51.2	0.37	110.1	44.0	56	558		31.0
C36-11	8888	15.0							7		153	39.5
C36-11	8888	15.0							7		159	39.5
C36-11	8888	15.0							7		207	39.5
C36-11	8888	15.0							28	540		39.5
C36-11	8888	15.0							28	558		39.5
C36-11	8888	15.0							28	564		39.5
C36-11	8888	15.0							56	368		39.5
C36-11	8888	15.0							56	698		39.5
C36-11	8888	15.0							56	732		39.5
C36-11	8888	30.0							7		155	28.0
C36-11	8888	30.0							7		153	28.0
C36-11	8888	30.0							7		121	28.0
C36-11	8888	30.0							28	495		28.0
C36-11	8888	30.0							28	471		28.0
C36-11	8888	30.0							28	506		28.0
C36-11	8888	30.0							56	519		28.0
C36-11	8888	30.0							56	553		28.0
C36-11	8888	30.0							56	607		28.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	7		205	33.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	28	629		33.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	28	639		33.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	7		216	33.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	28	615		33.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	7		219	33.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	56	756		33.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	56	625		33.0
C36-6	8588	20.0	3.7	40.4	55.9	0.37	106.6	49.3	56	790		33.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	7		297	31.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	28	717		31.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	7		277	31.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	28	815		31.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	28	704		31.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	7		288	31.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	56	997		31.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	56	1014		31.0
C36-6	8588	30.0	11.4	42.0	46.6	0.75	115.0	35.8	56	923		31.0
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	7		207	40.5
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	28	572		40.5
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	7		198	40.5
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	7		185	40.5

COLUMN NO.	DATE CONST	SAMP. DEPTH	WET SAMPLE GRAVEL	WET SAMPLE SAND	WET SAMPLE FINES	WET SAMPLE MAX. SIZE	WET SAMPLE WET DENSITY	WET SAMPLE MOISTURE CONTENT	AGE	GEOCON Qu	USBR Field Qu	CEMENT CONTENT
		FT.	%	%	%	in.	LB/FT^3	%	DAYS	lb/in2	lb/in2	(%)
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	28	575		40.5
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	28	562		40.5
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	56	739		40.5
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	56	686		40.5
C37-11	8388	20.0	0.1	57.5	42.4	0.19	107.3	53.1	56	728		40.5
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	28	540		35.0
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	28	530		35.0
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	7		182	35.0
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	7		176	35.0
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	7		170	35.0
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	28	539		35.0
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	56	668		35.0
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	56	658		35.0
C37-11	8388	40.0	0.9	49.3	49.8	0.37	110.3	49.4	56	647		35.0
C38-7	82888	20.0	10.7	41.1	48.2	0.37	110.9	40.5	7		188	39.0
C38-7	82888	20.0	10.7	41.1	48.2	0.37	110.9	40.5	7		160	39.0
C38-7	82888	20.0	10.7	41.1	48.2	0.37	110.9	40.5	7		242	39.0
C38-7	82888	30.0	12.8	38.4	48.8	0.75	108.4	43.3	7		242	45.2
C38-7	82888	30.0	12.8	38.4	48.8	0.75	108.4	43.3	7		193	45.2
C38-7	82888	30.0	12.8	38.4	48.8	0.75	108.4	43.3	7		174	45.2
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	7		267	38.8
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	7		246	38.8
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	28	667		38.8
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	7		197	38.8
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	28	646		38.8
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	28	666		38.8
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	56	700		38.8
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	56	728		38.8
C39-16	8188	15.0	29.5	33.5	37.0	0.75	109.9	22.1	56	768		38.8
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	28	653		36.0
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	7		195	36.0
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	28	472		36.0
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	28	625		36.0
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	7		159	36.0
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	7		182	36.0
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	56	591		36.0
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	56	505		36.0
C39-16	8188	30.0	4.7	41.9	53.4	0.37	107.4	21.9	56	813		36.0
D10-48	62788	15.0	5.3	40.5	54.2	0.37	108.1	48.1	28	477		27.3
D10-48	62788	15.0	5.3	40.5	54.2	0.37	108.1	48.1	28	395		27.3
D10-48	62788	15.0	5.3	40.5	54.2	0.37	108.1	48.1	8		176	27.3
D10-48	62788	15.0	5.3	40.5	54.2	0.37	108.1	48.1	56	539		27.3
D10-48	62788	15.0	5.3	40.5	54.2	0.37	108.1	48.1	28	447		27.3
D10-48	62788	15.0	5.3	40.5	54.2	0.37	108.1	48.1	56	563		27.3
D10-48	62788	15.0	5.3	40.5	54.2	0.37	108.1	48.1	8		188	27.3
D10-48	62788	15.0	5.3	40.5	54.2	0.37	108.1	48.1	8		173	27.3
D10-48	62788	30.0	10.3	41.4	48.3	0.37	109.4	44.9	56	537		28.9
D10-48	62788	30.0	10.3	41.4	48.3	0.37	109.4	44.9	28	423		28.9
D10-48	62788	30.0	10.3	41.4	48.3	0.37	109.4	44.9	56	576		28.9
D10-48	62788	30.0	10.3	41.4	48.3	0.37	109.4	44.9	8		174	28.9
D10-48	62788	30.0	10.3	41.4	48.3	0.37	109.4	44.9	28	479		28.9
D10-48	62788	30.0	10.3	41.4	48.3	0.37	109.4	44.9	8		182	28.9

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
D10-48	62788	30.0	10.3	41.4	48.3	0.37	109.4	44.9	8		193	28.9
D10-48	62788	30.0	10.3	41.4	48.3	0.37	109.4	44.9	28	455		28.9
D10-52	62488	15.0	2.8	52.5	44.7	0.37	104.0	55.4	7		33	17.6
D10-52	62488	15.0	2.8	52.5	44.7	0.37	104.0	55.4	28	107		17.6
D10-52	62488	15.0	2.8	52.5	44.7	0.37	104.0	55.4	56	140		17.6
D10-52	62488	15.0	2.8	52.5	44.7	0.37	104.0	55.4	28	113		17.6
D10-52	62488	15.0	2.8	52.5	44.7	0.37	104.0	55.4	56	159		17.6
D10-52	62488	15.0	2.8	52.5	44.7	0.37	104.0	55.4	7		36	17.6
D10-52	62488	15.0	2.8	52.5	44.7	0.37	104.0	55.4	28	112		17.6
D10-52	62488	15.0	2.8	52.5	44.7	0.37	104.0	55.4	7		34	17.6
D10-52	62488	35.0	7.8	50.8	41.4	0.37	107.4	47.8	7		63	16.4
D10-52	62488	35.0	7.8	50.8	41.4	0.37	107.4	47.8	28	183		16.4
D10-52	62488	35.0	7.8	50.8	41.4	0.37	107.4	47.8	28	189		16.4
D10-52	62488	35.0	7.8	50.8	41.4	0.37	107.4	47.8	28	174		16.4
D10-52	62488	35.0	7.8	50.8	41.4	0.37	107.4	47.8	7		63	16.4
D10-52	62488	35.0	7.8	50.8	41.4	0.37	107.4	47.8	56	238		16.4
D10-52	62488	35.0	7.8	50.8	41.4	0.37	107.4	47.8	7		61	16.4
D10-52	62488	35.0	7.8	50.8	41.4	0.37	107.4	47.8	56	245		16.4
D10-88	62988	15.0	3.2	54.9	41.9	0.37	111.5	41.1	7		105	26.1
D10-88	62988	15.0	3.2	54.9	41.9	0.37	111.5	41.1	7		106	26.1
D10-88	62988	15.0	3.2	54.9	41.9	0.37	111.5	41.1	7		103	26.1
D10-88	62988	15.0	3.2	54.9	41.9	0.37	111.5	41.1	28	366		26.1
D10-88	62988	15.0	3.2	54.9	41.9	0.37	111.5	41.1	28	346		26.1
D10-88	62988	15.0	3.2	54.9	41.9	0.37	111.5	41.1	28	358		26.1
D10-88	62988	15.0	3.2	54.9	41.9	0.37	111.5	41.1	56	424		26.1
D10-88	62988	15.0	3.2	54.9	41.9	0.37	111.5	41.1	56	411		26.1
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	7		132	24.8
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	7		142	24.8
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	7		125	24.8
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	28	402		24.8
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	28	394		24.8
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	28	415		24.8
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	56	503		24.8
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	56	515		24.8
D10-88	62988	30.0	7.6	48.4	44.0	0.75	111.3	41.1	56	507		24.8
D11-41	62188	15.0						38.6	7		206	31.2
D11-41	62188	15.0						38.6	7		147	31.2
D11-41	62188	15.0						38.6	7		213	31.2
D11-41	62188	15.0						38.6	28	647		31.2
D11-41	62188	15.0						38.6	28	594		31.2
D11-41	62188	15.0						38.6	28	633		31.2
D11-41	62188	15.0						38.6	56	913		31.2
D11-41	62188	15.0						38.6	56	729		31.2
D11-41	62188	25.0						33.8	7		235	31.6
D11-41	62188	25.0						33.8	7		231	31.6
D11-41	62188	25.0						33.8	7		217	31.6
D11-41	62188	25.0						33.8	28	583		31.6
D11-41	62188	25.0						33.8	28	573		31.6
D11-41	62188	25.0						33.8	28	552		31.6
D11-41	62188	25.0						33.8	56	696		31.6
D11-41	62188	25.0						33.8	56	721		31.6
D12-61	61388	15.0	0.7	51.8	47.5	0.37	107.7	48.4	56	512		28.1

COLUMN NO.	DATE CONST	SAMP. DEPTH	WET SAMPLE GRAVEL	WET SAMPLE SAND	WET SAMPLE FINES	WET SAMPLE MAX. SIZE	WET SAMPLE WET DENSITY	WET SAMPLE MOISTURE CONTENT	AGE	GEOCON Qu	USBR Field Qu	CEMENT CONTENT
		FT.	%	%	%	in.	LB/FT^3	%	DAYS	lb/in2	lb/in2	(%)
D12-61	61388	15.0	0.7	51.8	47.5	0.37	107.7	48.4	28	366		28.1
D12-61	61388	15.0	0.7	51.8	47.5	0.37	107.7	48.4	56	517		28.1
D12-61	61388	15.0	0.7	51.8	47.5	0.37	107.7	48.4	28	356		28.1
D12-61	61388	15.0	0.7	51.8	47.5	0.37	107.7	48.4	28	391		28.1
D12-61	61388	15.0	0.7	51.8	47.5	0.37	107.7	48.4	7		128	28.1
D12-61	61388	15.0	0.7	51.8	47.5	0.37	107.7	48.4	7		128	28.1
D12-61	61388	15.0	0.7	51.8	47.5	0.37	107.7	48.4	7		126	28.1
D12-61	61388	30.0	5.0	47.8	47.2	0.37	108.1	47.2	7		134	23.7
D12-61	61388	30.0	5.0	47.8	47.2	0.37	108.1	47.2	56	528		23.7
D12-61	61388	30.0	5.0	47.8	47.2	0.37	108.1	47.2	56	483		23.7
D12-61	61388	30.0	5.0	47.8	47.2	0.37	108.1	47.2	28	384		23.7
D12-61	61388	30.0	5.0	47.8	47.2	0.37	108.1	47.2	7		136	23.7
D12-61	61388	30.0	5.0	47.8	47.2	0.37	108.1	47.2	7		137	23.7
D12-61	61388	30.0	5.0	47.8	47.2	0.37	108.1	47.2	28	406		23.7
D12-61	61388	30.0	5.0	47.8	47.2	0.37	108.1	47.2	28	376		23.7
D13-25	61788	20.0	39.6	25.5	34.9	0.75	119.1	31.8	28	419		24.9
D13-25	61788	20.0	39.6	25.5	34.9	0.75	119.1	31.8	7		145	24.9
D13-25	61788	20.0	39.6	25.5	34.9	0.75	119.1	31.8	28	359		24.9
D13-25	61788	20.0	39.6	25.5	34.9	0.75	119.1	31.8	28	384		24.9
D13-25	61788	20.0	39.6	25.5	34.9	0.75	119.1	31.8	7		155	24.9
D13-25	61788	20.0	39.6	25.5	34.9	0.75	119.1	31.8	56	517		24.9
D13-25	61788	20.0	39.6	25.5	34.9	0.75	119.1	31.8	7		126	24.9
D13-25	61788	20.0	39.6	25.5	34.9	0.75	119.1	31.8	56	599		24.9
D13-25	61788	40.0	25.4	23.4	51.2	0.75	112.0	40.6	7		118	26.8
D13-25	61788	40.0	25.4	23.4	51.2	0.75	112.0	40.6	7		131	26.8
D13-25	61788	40.0	25.4	23.4	51.2	0.75	112.0	40.6	7		146	26.8
D13-25	61788	40.0	25.4	23.4	51.2	0.75	112.0	40.6	28	356		26.8
D13-25	61788	40.0	25.4	23.4	51.2	0.75	112.0	40.6	28	388		26.8
D13-25	61788	40.0	25.4	23.4	51.2	0.75	112.0	40.6	56	563		26.8
D13-25	61788	40.0	25.4	23.4	51.2	0.75	112.0	40.6	56	494		26.8
D13-25	61788	40.0	25.4	23.4	51.2	0.75	112.0	40.6	28	419		26.8
D13-46	61688	15.0	6.5	42.7	50.8	0.37	106.8	50.7	28	412		27.4
D13-46	61688	15.0	6.5	42.7	50.8	0.37	106.8	50.7	56	494		27.4
D13-46	61688	15.0	6.5	42.7	50.8	0.37	106.8	50.7	7		159	27.4
D13-46	61688	15.0	6.5	42.7	50.8	0.37	106.8	50.7	7		149	27.4
D13-46	61688	15.0	6.5	42.7	50.8	0.37	106.8	50.7	28	380		27.4
D13-46	61688	15.0	6.5	42.7	50.8	0.37	106.8	50.7	28	393		27.4
D13-46	61688	15.0	6.5	42.7	50.8	0.37	106.8	50.7	56	537		27.4
D13-46	61688	15.0	6.5	42.7	50.8	0.37	106.8	50.7	7		152	27.4
D13-46	61688	30.0	14.2	36.4	49.4	0.75	110.3	44.1	56	480		25.1
D13-46	61688	30.0	14.2	36.4	49.4	0.75	110.3	44.1	56	467		25.1
D13-46	61688	30.0	14.2	36.4	49.4	0.75	110.3	44.1	7		163	25.1
D13-46	61688	30.0	14.2	36.4	49.4	0.75	110.3	44.1	7		113	25.1
D13-46	61688	30.0	14.2	36.4	49.4	0.75	110.3	44.1	28	374		25.1
D13-46	61688	30.0	14.2	36.4	49.4	0.75	110.3	44.1	28	405		25.1
D13-46	61688	30.0	14.2	36.4	49.4	0.75	110.3	44.1	28	376		25.1
D13-46	61688	30.0	14.2	36.4	49.4	0.75	110.3	44.1	7		120	25.1
D14-1	61588	10.0	1.8	26.7	71.5	0.37	104.5	56.7	56	938		43.9
D14-1	61588	10.0	1.8	26.7	71.5	0.37	104.5	56.7	7		307	43.9
D14-1	61588	10.0	1.8	26.7	71.5	0.37	104.5	56.7	7		297	43.9
D14-1	61588	10.0	1.8	26.7	71.5	0.37	104.5	56.7	28	739		43.9
D14-1	61588	10.0	1.8	26.7	71.5	0.37	104.5	56.7	7		320	43.9

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
D14-1	61588	10.0	1.8	26.7	71.5	0.37	104.5	56.7	28	649		43.9
D14-1	61588	10.0	1.8	26.7	71.5	0.37	104.5	56.7	56	706		43.9
D14-1	61588	10.0	1.8	26.7	71.5	0.37	104.5	56.7	28	691		43.9
D14-1	61588	20.0	23.6	26.0	50.4	0.75	114.0	38.6	56	943		22.1
D14-1	61588	20.0	23.6	26.0	50.4	0.75	114.0	38.6	28	675		22.1
D14-1	61588	20.0	23.6	26.0	50.4	0.75	114.0	38.6	28	708		22.1
D14-1	61588	20.0	23.6	26.0	50.4	0.75	114.0	38.6	7		239	22.1
D14-1	61588	20.0	23.6	26.0	50.4	0.75	114.0	38.6	28	731		22.1
D14-1	61588	20.0	23.6	26.0	50.4	0.75	114.0	38.6	7		250	22.1
D14-1	61588	20.0	23.6	26.0	50.4	0.75	114.0	38.6	7		269	22.1
D14-1	61588	20.0	23.6	26.0	50.4	0.75	114.0	38.6	56	923		22.1
D14-57	61488	15.0	3.5	47.6	48.9	0.37	107.7	48.2	7		204	30.3
D14-57	61488	15.0	3.5	47.6	48.9	0.37	107.7	48.2	56	579		30.3
D14-57	61488	15.0	3.5	47.6	48.9	0.37	107.7	48.2	28	462		30.3
D14-57	61488	15.0	3.5	47.6	48.9	0.37	107.7	48.2	7		182	30.3
D14-57	61488	15.0	3.5	47.6	48.9	0.37	107.7	48.2	56	563		30.3
D14-57	61488	15.0	3.5	47.6	48.9	0.37	107.7	48.2	28	441		30.3
D14-57	61488	15.0	3.5	47.6	48.9	0.37	107.7	48.2	7		197	30.3
D14-57	61488	15.0	3.5	47.6	48.9	0.37	107.7	48.2	28	411		30.3
D14-57	61488	30.0	19.9	40.8	39.3	0.75	114.3	36.6	56	528		20.4
D14-57	61488	30.0	19.9	40.8	39.3	0.75	114.3	36.6	7		162	20.4
D14-57	61488	30.0	19.9	40.8	39.3	0.75	114.3	36.6	56	542		20.4
D14-57	61488	30.0	19.9	40.8	39.3	0.75	114.3	36.6	28	374		20.4
D14-57	61488	30.0	19.9	40.8	39.3	0.75	114.3	36.6	7		160	20.4
D14-57	61488	30.0	19.9	40.8	39.3	0.75	114.3	36.6	7		152	20.4
D14-57	61488	30.0	19.9	40.8	39.3	0.75	114.3	36.6	28	431		20.4
D14-57	61488	30.0	19.9	40.8	39.3	0.75	114.3	36.6	28	299		20.4
D15-68	61088	15.0	4.1	24.5	71.4	0.75	102.1	59.9	56	580		37.1
D15-68	61088	15.0	4.1	24.5	71.4	0.75	102.1	59.9	28	488		37.1
D15-68	61088	15.0	4.1	24.5	71.4	0.75	102.1	59.9	7		206	37.1
D15-68	61088	15.0	4.1	24.5	71.4	0.75	102.1	59.9	56	636		37.1
D15-68	61088	15.0	4.1	24.5	71.4	0.75	102.1	59.9	28	527		37.1
D15-68	61088	15.0	4.1	24.5	71.4	0.75	102.1	59.9	28	515		37.1
D15-68	61088	15.0	4.1	24.5	71.4	0.75	102.1	59.9	7		197	37.1
D15-68	61088	15.0	4.1	24.5	71.4	0.75	102.1	59.9	7		206	37.1
D15-68	61088	30.0	3.0	27.5	69.5	0.37	100.2	66.1	56	597		36.4
D15-68	61088	30.0	3.0	27.5	69.5	0.37	100.2	66.1	28	509		36.4
D15-68	61088	30.0	3.0	27.5	69.5	0.37	100.2	66.1	56	585		36.4
D15-68	61088	30.0	3.0	27.5	69.5	0.37	100.2	66.1	7		160	36.4
D15-68	61088	30.0	3.0	27.5	69.5	0.37	100.2	66.1	7		154	36.4
D15-68	61088	30.0	3.0	27.5	69.5	0.37	100.2	66.1	28	489		36.4
D15-68	61088	30.0	3.0	27.5	69.5	0.37	100.2	66.1	7		167	36.4
D15-68	61088	30.0	3.0	27.5	69.5	0.37	100.2	66.1	28	458		36.4
D16-6	6888	15.0	16.2	24.5	59.3	0.37	107.3	37.7	28	264		20.7
D16-6	6888	15.0	16.2	24.5	59.3	0.37	107.3	37.7	7		100	20.7
D16-6	6888	15.0	16.2	24.5	59.3	0.37	107.3	37.7	28	255		20.7
D16-6	6888	15.0	16.2	24.5	59.3	0.37	107.3	37.7	7		108	20.7
D16-6	6888	15.0	16.2	24.5	59.3	0.37	107.3	37.7	56	363		20.7
D16-6	6888	15.0	16.2	24.5	59.3	0.37	107.3	37.7	7		92	20.7
D16-6	6888	15.0	16.2	24.5	59.3	0.37	107.3	37.7	56	370		20.7
D16-6	6888	15.0	16.2	24.5	59.3	0.37	107.3	37.7	28	254		20.7
D16-6	6888	30.0	24.3	18.2	57.5	0.75	108.4	41.0	28	246		16.1

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
D16-6	6888	30.0	24.3	18.2	57.5	0.75	108.4	41.0	28	225		16.1
D16-6	6888	30.0	24.3	18.2	57.5	0.75	108.4	41.0	56	323		16.1
D16-6	6888	30.0	24.3	18.2	57.5	0.75	108.4	41.0	7		80	16.1
D16-6	6888	30.0	24.3	18.2	57.5	0.75	108.4	41.0	7		84	16.1
D16-6	6888	30.0	24.3	18.2	57.5	0.75	108.4	41.0	28	255		16.1
D16-6	6888	30.0	24.3	18.2	57.5	0.75	108.4	41.0	56	300		16.1
D17-10	6688	20.0	11.3	23.6	65.1	1.00	108.0	48.7	56	515		23.4
D17-10	6688	20.0	11.3	23.6	65.1	1.00	108.0	48.7	7		167	23.4
D17-10	6688	20.0	11.3	23.6	65.1	1.00	108.0	48.7	7		159	23.4
D17-10	6688	20.0	11.3	23.6	65.1	1.00	108.0	48.7	56	543		23.4
D17-10	6688	20.0	11.3	23.6	65.1	1.00	108.0	48.7	28	454		23.4
D17-10	6688	20.0	11.3	23.6	65.1	1.00	108.0	48.7	28	435		23.4
D17-10	6688	20.0	11.3	23.6	65.1	1.00	108.0	48.7	28	425		23.4
D17-10	6688	20.0	11.3	23.6	65.1	1.00	108.0	48.7	7		165	23.4
D17-10	6688	30.0	21.7	17.2	61.1	1.00	108.3	46.6	28	419		23.0
D17-10	6688	30.0	21.7	17.2	61.1	1.00	108.3	46.6	56	496		23.0
D17-10	6688	30.0	21.7	17.2	61.1	1.00	108.3	46.6	56	493		23.0
D17-10	6688	30.0	21.7	17.2	61.1	1.00	108.3	46.6	28	382		23.0
D17-10	6688	30.0	21.7	17.2	61.1	1.00	108.3	46.6	28	449		23.0
D17-10	6688	30.0	21.7	17.2	61.1	1.00	108.3	46.6	7		150	23.0
D17-10	6688	30.0	21.7	17.2	61.1	1.00	108.3	46.6	7		151	23.0
D17-10	6688	30.0	21.7	17.2	61.1	1.00	108.3	46.6	7		155	23.0
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	28	510		32.6
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	7		105	32.6
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	28	422		32.6
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	7		133	32.6
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	7		187	32.6
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	28	524		32.6
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	56	568		32.6
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	56	606		32.6
D17-68	71288	15.0	4.7	24.6	70.7	0.37	102.7	57.4	56	570		32.6
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	7		168	35.8
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	28	596		35.8
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	7		153	35.8
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	28	619		35.8
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	7		150	35.8
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	28	594		35.8
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	56	703		35.8
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	56	720		35.8
D17-68	71288	25.0	2.4	23.3	74.3	0.19	105.0	57.8	56	587		35.8
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	28	677		36.7
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	28	695		36.7
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	28	701		36.7
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	7		214	36.7
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	7		200	36.7
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	7		227	36.7
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	56	875		36.7
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	56	845		36.7
D18-6	71188	15.0	3.3	32.0	64.7	0.37	108.4	48.9	56	871		36.7
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	28	713		37.8
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	28	756		37.8
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	28	605		37.8

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	7		238	37.8
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	7		225	37.8
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	7		239	37.8
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	56	991		37.8
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	56	919		37.8
D18-6	71188	30.0	11.0	36.5	52.5	0.75	109.2	45.0	56	985		37.8
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	28	466		35.0
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	56	642		35.0
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	56	648		35.0
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	28	466		35.0
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	28	488		35.0
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	56	628		35.0
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	7		189	35.0
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	7		188	35.0
D19-29	7788	20.0	7.4	38.4	54.2	0.37	107.8	48.1	7		179	35.0
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	56	733		36.7
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	28	322		36.7
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	28	555		36.7
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	56	692		36.7
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	56	633		36.7
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	28	591		36.7
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	7		241	36.7
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	7		242	36.7
D19-29	7788	30.0	1.2	32.6	66.2	0.19	103.7	56.9	7		227	36.7
D19-44	7688	15.0	0.0	22.3	77.7	0.09	103.6	59.3	7	207		52.5
D19-44	7688	15.0	0.0	22.3	77.7	0.09	103.6	59.3	28	942		52.5
D19-44	7688	15.0	0.0	22.3	77.7	0.09	103.6	59.3	7	321		52.5
D19-44	7688	15.0	0.0	22.3	77.7	0.09	103.6	59.3	56	993		52.5
D19-44	7688	15.0	0.0	22.3	77.7	0.09	103.6	59.3	7	303		52.5
D19-44	7688	15.0	0.0	22.3	77.7	0.09	103.6	59.3	28	856		52.5
D19-44	7688	15.0	0.0	22.3	77.7	0.09	103.6	59.3	56	1123		52.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	56	1270		51.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	28	955		51.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	28	887		51.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	7	372		51.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	7	349		51.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	28	940		51.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	56	1148		51.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	7	380		51.5
D19-44	7688	30.0	0.4	35.8	63.8	0.19	104.6	54.7	56	1258		51.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	56	752		35.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	7		219	35.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	7		219	35.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	56	700		35.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	28	587		35.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	28	479		35.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	56	691		35.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	7		208	35.5
D20-16	7188	20.0	10.5	34.4	55.1	0.37	111.6	42.0	28	514		35.5
D20-16	7188	35.0	10.3	35.0	54.7	0.75	110.7	40.7	56	503		25.5
D20-16	7188	35.0	10.3	35.0	54.7	0.75	110.7	40.7	56	531		25.5

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
D20-16	7188	35.0	10.3	35.0	54.7	0.75	110.7	40.7	28	344		25.5
D20-16	7188	35.0	10.3	35.0	54.7	0.75	110.7	40.7	28	421		25.5
D20-16	7188	35.0	10.3	35.0	54.7	0.75	110.7	40.7	28	385		25.5
D20-16	7188	35.0	10.3	35.0	54.7	0.75	110.7	40.7	7		155	25.5
D20-16	7188	35.0	10.3	35.0	54.7	0.75	110.7	40.7	7		139	25.5
D20-16	7188	35.0	10.3	35.0	54.7	0.75	110.7	40.7	7		147	25.5
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	28	404		31.1
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	56	553		31.1
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	56	585		31.1
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	28	424		31.1
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	56	534		31.1
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	7		140	31.1
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	7		138	31.1
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	28	428		31.1
D20-22	7588	20.0	6.6	41.2	52.2	0.37	108.8	45.8	7		141	31.1
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	7		131	25.3
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	7		138	25.3
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	7		129	25.3
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	56	545		25.3
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	28	392		25.3
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	28	402		25.3
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	28	396		25.3
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	56	552		25.3
D20-22	7588	35.0	6.3	40.3	53.4	0.37	111.2	43.4	56	559		25.3
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	28	519		31.8
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	28	536		31.8
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	56	753		31.8
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	28	470		31.8
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	7		222	31.8
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	7		195	31.8
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	56	821		31.8
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	56	718		31.8
D20-35	63088	30.0	8.4	35.4	56.2	0.37	110.8	44.1	7		198	31.8
D21-4	6988	15.0	9.8	42.0	48.2	0.37	110.8	45.1	7		195	27.4
D21-4	6988	15.0	9.8	42.0	48.2	0.37	110.8	45.1	56	566		27.4
D21-4	6988	15.0	9.8	42.0	48.2	0.37	110.8	45.1	28	501		27.4
D21-4	6988	15.0	9.8	42.0	48.2	0.37	110.8	45.1	56	591		27.4
D21-4	6988	15.0	9.8	42.0	48.2	0.37	110.8	45.1	28	513		27.4
D21-4	6988	15.0	9.8	42.0	48.2	0.37	110.8	45.1	7		198	27.4
D21-4	6988	15.0	9.8	42.0	48.2	0.37	110.8	45.1	7		194	27.4
D21-4	6988	15.0	9.8	42.0	48.2	0.37	110.8	45.1	28	495		27.4
D21-4	6988	30.0	6.7	44.4	48.9	0.37	109.6	47.1	7		218	23.4
D21-4	6988	30.0	6.7	44.4	48.9	0.37	109.6	47.1	7		208	23.4
D21-4	6988	30.0	6.7	44.4	48.9	0.37	109.6	47.1	28	492		23.4
D21-4	6988	30.0	6.7	44.4	48.9	0.37	109.6	47.1	28	476		23.4
D21-4	6988	30.0	6.7	44.4	48.9	0.37	109.6	47.1	56	624		23.4
D21-4	6988	30.0	6.7	44.4	48.9	0.37	109.6	47.1	28	524		23.4
D21-4	6988	30.0	6.7	44.4	48.9	0.37	109.6	47.1	7		206	23.4
D21-4	6988	30.0	6.7	44.4	48.9	0.37	109.6	47.1	56	579		23.4
D22-4	6788	15.0	4.7	48.8	46.5	0.37	109.5	44.9	7		161	25.6
D22-4	6788	15.0	4.7	48.8	46.5	0.37	109.5	44.9	28	368		25.6

COLUMN NO.	DATE CONST	SAMP. DEPTH	WET SAMPLE GRAVEL	WET SAMPLE SAND	WET SAMPLE FINES	WET SAMPLE MAX. SIZE	WET SAMPLE WET DENSITY	WET SAMPLE MOISTURE CONTENT	AGE	GEOCON Qu	USBR Field Qu	CEMENT CONTENT
		FT.	%	%	%	in.	LB/FT^3	%	DAYS	lb/in2	lb/in2	(%)
D22-4	6788	15.0	4.7	48.8	46.5	0.37	109.5	44.9	28	377		25.6
D22-4	6788	15.0	4.7	48.8	46.5	0.37	109.5	44.9	28	394		25.6
D22-4	6788	15.0	4.7	48.8	46.5	0.37	109.5	44.9	7		152	25.6
D22-4	6788	15.0	4.7	48.8	46.5	0.37	109.5	44.9	56	493		25.6
D22-4	6788	15.0	4.7	48.8	46.5	0.37	109.5	44.9	7		154	25.6
D22-4	6788	35.0	2.1	48.9	49.0	0.37	110.4	43.8	7		195	25.1
D22-4	6788	35.0	2.1	48.9	49.0	0.37	110.4	43.8	28	436		25.1
D22-4	6788	35.0	2.1	48.9	49.0	0.37	110.4	43.8	56	585		25.1
D22-4	6788	35.0	2.1	48.9	49.0	0.37	110.4	43.8	28	457		25.1
D22-4	6788	35.0	2.1	48.9	49.0	0.37	110.4	43.8	7		192	25.1
D22-4	6788	35.0	2.1	48.9	49.0	0.37	110.4	43.8	56	512		25.1
D22-4	6788	35.0	2.1	48.9	49.0	0.37	110.4	43.8	28	466		25.1
D22-4	6788	35.0	2.1	48.9	49.0	0.37	110.4	43.8	7		177	25.1
D9-87	62888	15.0	9.6	45.3	45.1	0.75	108.6	43.7	56	396		26.1
D9-87	62888	15.0	9.6	45.3	45.1	0.75	108.6	43.7	28	302		26.1
D9-87	62888	15.0	9.6	45.3	45.1	0.75	108.6	43.7	7		139	26.1
D9-87	62888	15.0	9.6	45.3	45.1	0.75	108.6	43.7	7		122	26.1
D9-87	62888	15.0	9.6	45.3	45.1	0.75	108.6	43.7	28	747		26.1
D9-87	62888	15.0	9.6	45.3	45.1	0.75	108.6	43.7	7		127	26.1
D9-87	62888	15.0	9.6	45.3	45.1	0.75	108.6	43.7	28	329		26.1
D9-87	62888	15.0	9.6	45.3	45.1	0.75	108.6	43.7	56	404		26.1
D9-87	62888	30.0	3.0	51.3	45.7	0.37	111.2	44.7	56	487		25.1
D9-87	62888	30.0	3.0	51.3	45.7	0.37	111.2	44.7	7		151	25.1
D9-87	62888	30.0	3.0	51.3	45.7	0.37	111.2	44.7	28	352		25.1
D9-87	62888	30.0	3.0	51.3	45.7	0.37	111.2	44.7	28	329		25.1
D9-87	62888	30.0	3.0	51.3	45.7	0.37	111.2	44.7	28	369		25.1
D9-87	62888	30.0	3.0	51.3	45.7	0.37	111.2	44.7	7		144	25.1
D9-87	62888	30.0	3.0	51.3	45.7	0.37	111.2	44.7	56	503		25.1
D9-87	62888	30.0	3.0	51.3	45.7	0.37	111.2	44.7	56	415		25.1
RW1-10	72288	10.0							7		52	33.0
RW1-10	72288	10.0							7		45	33.0
RW1-10	72288	10.0							7		48	33.0
RW1-10	72288	20.0	0.0	40.4	59.6	0.05	101.6	63.2	7		92	35.1
RW1-10	72288	20.0	0.0	40.4	59.6	0.05	101.6	63.2	7		103	35.1
RW1-10	72288	20.0	0.0	40.4	59.6	0.05	101.6	63.2	7		108	35.1
RW1-10	72288	30.0	0.1	40.5	59.4	0.19	104.1	57.7	7		146	38.8
RW1-10	72288	30.0	0.1	40.5	59.4	0.19	104.1	57.7	7		141	38.8
RW1-10	72288	30.0	0.1	40.5	59.4	0.19	104.1	57.7	7		136	38.8
RW1-10	72288	35.0							7		***	36.2
RW1-10	72288	35.0							7		154	36.2
RW1-10	72288	35.0							7		126	36.2
RW1-13	72288	10.0							7		***	23.5
RW1-13	72288	10.0							7		32	23.5
RW1-13	72288	10.0							7		25	23.5
RW1-13	72288	25.0	0.8	43.1	56.9	0.19	107.4	53.0	7		43	28.5
RW1-13	72288	25.0	0.8	43.1	56.9	0.19	107.4	53.0	7		49	28.5
RW1-13	72288	25.0	0.8	43.1	56.9	0.19	107.4	53.0	7		49	28.5
RW1-13	72288	30.0							7		108	28.0
RW1-13	72288	30.0							7		93	28.0
RW1-13	72288	30.0							7		115	28.0
RW1-13	72288	35.0							7		130	28.2

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
RW1-13	72288	35.0							7		116	28.2
RW2-19	72688	5.0	0.0	15.8	84.2	0.09	92.1	104.2	7		107	49.5
RW2-19	72688	5.0	0.0	15.8	84.2	0.09	92.1	104.2	7		123	49.5
RW2-19	72688	5.0	0.0	15.8	84.2	0.09	92.1	104.2	7		115	49.5
RW2-19	72688	10.0	0.0	14.5	85.5	0.05	90.8	102.3	7		155	54.0
RW2-19	72688	10.0	0.0	14.5	85.5	0.05	90.8	102.3	7		170	54.0
RW2-19	72688	10.0	0.0	14.5	85.5	0.05	90.8	102.3	7		103	54.0
RW2-19	72688	20.0	0.0	30.4	69.6	0.09	98.6	72.7	7		205	49.5
RW2-19	72688	20.0	0.0	30.4	69.6	0.09	98.6	72.7	7		173	49.5
RW2-19	72688	20.0	0.0	30.4	69.6	0.09	98.6	72.7	7		181	49.5
RW2-19	72688	30.0	2.8	42.4	54.8	0.37	105.8	48.6	7		167	37.0
RW2-19	72688	30.0	2.8	42.4	54.8	0.37	105.8	48.6	7		179	37.0
RW2-19	72688	30.0	2.8	42.4	54.8	0.37	105.8	48.6	7		172	37.0
RW2-4	72588	20.0	0.4	43.8	55.8	0.19	108.0	50.4	7		170	32.0
RW2-4	72588	20.0	0.4	43.8	55.8	0.19	108.0	50.4	7		169	32.0
RW2-4	72588	20.0	0.4	43.8	55.8	0.19	108.0	50.4	7		169	32.0
RW2-4	72588	30.0	0.7	43.9	55.4	0.19	103.2	14.9	7		149	30.5
RW2-4	72588	30.0	0.7	43.9	55.4	0.19	103.2	14.9	7		167	30.5
RW2-4	72588	30.0	0.7	43.9	55.4	0.19	103.2	14.9	7		153	30.5
RW2-4	72588	35.0	5.2	43.3	51.5	0.75	105.1	46.1	7		166	31.0
RW2-4	72588	35.0	5.2	43.3	51.5	0.75	105.1	46.1	7		163	31.0
RW2-4	72588	35.0	5.2	43.3	51.5	0.75	105.1	46.1	7		156	31.0
RW3-13	72788	15.0	0.1	39.4	60.5	0.19	102.5	63.1	7		43	30.5
RW3-13	72788	15.0	0.1	39.4	60.5	0.19	102.5	63.1	7		49	30.5
RW3-13	72788	25.0	0.4	46.1	53.5	0.19	109.0	49.0	7		128	27.3
RW3-13	72788	25.0	0.4	46.1	53.5	0.19	109.0	49.0	7		139	27.3
RW3-13	72788	25.0	0.4	46.1	53.5	0.19	109.0	49.0	7		137	27.3
RW3-13	72788	35.0	1.6	45.3	53.1	0.37	109.6	47.9	7		105	29.2
RW3-13	72788	35.0	1.6	45.3	53.1	0.37	109.6	47.9	7		105	29.2
RW3-13	72788	35.0	1.6	45.3	53.1	0.37	109.6	47.9	7		106	29.2
RW3-3	72688	10.0	8.3	41.2	50.5	0.37	103.6	40.7	7		101	32.0
RW3-3	72688	10.0	8.3	41.2	50.5	0.37	103.6	40.7	7		78	32.0
RW3-3	72688	10.0	8.3	41.2	50.5	0.37	103.6	40.7	7		79	32.0
RW3-3	72688	20.0	9.4	41.6	49.0	0.37	109.8	40.9	7		103	29.5
RW3-3	72688	20.0	9.4	41.6	49.0	0.37	109.8	40.9	7		109	29.5
RW3-3	72688	20.0	9.4	41.6	49.0	0.37	109.8	40.9	7		101	29.5
RW3-3	72688	30.0	7.6	42.3	50.1	0.37	109.6	42.6	7		88	22.0
RW3-3	72688	30.0	7.6	42.3	50.1	0.37	109.6	42.6	7		90	22.0
RW3-3	72688	30.0	7.6	42.3	50.1	0.37	109.6	42.6	7		95	22.0
RW3-3	72688	35.0	21.5	37.2	41.3	0.75	107.5	15.9	7		128	29.5
RW3-3	72688	35.0	21.5	37.2	41.3	0.75	107.5	15.9	7		117	29.5
RW3-3	72688	35.0	21.5	37.2	41.3	0.75	107.5	15.9	7		117	29.5
RW4-13	72888	10.0	0.0	27.0	73.0	0.09	*****	88.2	7		196	50.5
RW4-13	72888	10.0	0.0	27.0	73.0	0.09	*****	88.2	7		186	50.5
RW4-13	72888	10.0	0.0	27.0	73.0	0.09	*****	88.2	7		177	50.5
RW4-13	72888	15.0	3.8	39.6	56.6	0.37	108.2	47.4	7		287	41.0
RW4-13	72888	15.0	3.8	39.6	56.6	0.37	108.2	47.4	7		285	41.0
RW4-13	72888	15.0	3.8	39.6	56.6	0.37	108.2	47.4	7		301	41.0
RW4-13	72888	25.0	1.3	44.3	54.4	0.19	106.8	51.0	7		145	58.0
RW4-13	72888	25.0	1.3	44.3	54.4	0.19	106.8	51.0	7		186	58.0
RW4-13	72888	25.0	1.3	44.3	54.4	0.19	106.8	51.0	7		173	58.0

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
RW4-13	72888	40.0	35.2	23.9	40.9	1.50	118.8	24.5	7		240	33.5
RW4-13	72888	40.0	35.2	23.9	40.9	1.50	118.8	24.5	7		268	33.5
RW4-15	72888	10.0	0.3	48.3	51.4	0.19	102.2	59.2	7		77	39.2
RW4-15	72888	10.0	0.3	48.3	51.4	0.19	102.2	59.2	7		86	39.2
RW4-15	72888	20.0	0.0	47.5	52.5	0.09	103.2	55.0	7		88	34.0
RW4-15	72888	20.0	0.0	47.5	52.5	0.09	103.2	55.0	7		87	34.0
RW4-15	72888	20.0	0.0	47.5	52.5	0.09	103.2	55.0	7		76	34.0
RW4-15	72888	30.0	0.0	42.0	58.0	0.09	104.7	51.5	7		93	35.2
RW4-15	72888	30.0	0.0	42.0	58.0	0.09	104.7	51.5	7		86	35.2
RW4-15	72888	30.0	0.0	42.0	58.0	0.09	104.7	51.5	7		86	35.2
RW4-15	72888	40.0	0.9	44.3	54.8	0.19	106.3	50.2	7		96	32.5
RW4-15	72888	40.0	0.9	44.3	54.8	0.19	106.3	50.2	7		131	32.5
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	7		297	47.0
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	7		314	47.0
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	28	875		47.0
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	28	920		47.0
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	28	879		47.0
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	7		306	47.0
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	56	1010		47.0
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	56	1015		47.0
U48-36	71388	30.0	4.9	24.5	70.6	0.37	104.7	23.6	56	1016		47.0
U48-66	71488	25.0	7.3	34.9	57.8	0.37	107.7	49.1	28	618		39.7
U48-66	71488	25.0	7.3	34.9	57.8	0.37	107.7	49.1	7		187	39.7
U48-66	71488	25.0	7.3	34.9	57.8	0.37	107.7	49.1	28	565		39.7
U48-66	71488	25.0	7.3	34.9	57.8	0.37	107.7	49.1	7		191	39.7
U48-66	71488	25.0	7.3	34.9	57.8	0.37	107.7	49.1	7		160	39.7
U48-66	71488	25.0	7.3	34.9	57.8	0.37	107.7	49.1	56	718		39.7
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	28	652		53.5
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	28	643		53.5
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	28	563		53.5
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	7		214	53.5
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	7		237	53.5
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	7		202	53.5
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	56	748		53.5
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	56	776		53.5
U49-46	71888	30.0	14.5	30.6	54.9	0.75	110.1	46.4	56	789		53.5
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	28	414		29.0
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	7		156	29.0
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	28	424		29.0
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	7		148	29.0
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	7		158	29.0
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	28	451		29.0
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	56	535		29.0
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	56	515		29.0
U49-7	71588	15.0	21.9	37.6	40.5	0.75	115.0	38.4	56	521		29.0
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	7		168	32.5
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	28	421		32.5
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	7		143	32.5
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	7		133	32.5
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	28	448		32.5
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	28	382		32.5

COLUMN NO.	DATE CONST	SAMP. DEPTH FT.	WET SAMPLE GRAVEL %	WET SAMPLE SAND %	WET SAMPLE FINES %	WET SAMPLE MAX. SIZE in.	WET SAMPLE WET DENSITY LB/FT^3	WET SAMPLE MOISTURE CONTENT %	AGE DAYS	GEOCON Qu lb/in2	USBR Field Qu lb/in2	CEMENT CONTENT (%)
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	56	530		32.5
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	56	526		32.5
U49-7	71588	25.0	12.1	38.6	49.3	0.37	108.4	47.5	56	504		32.5

Mission of the Bureau of Reclamation

The Bureau of Reclamation of the U.S. Department of the Interior is responsible for the development and conservation of the Nation's water resources in the Western United States.

The Bureau's original purpose "to provide for the reclamation of arid and semiarid lands in the West" today covers a wide range of interrelated functions. These include providing municipal and industrial water supplies; hydroelectric power generation; irrigation water for agriculture; water quality improvement; flood control; river navigation; river regulation and control; fish and wildlife enhancement; outdoor recreation; and research on water-related design, construction, materials, atmospheric management, and wind and solar power.

Bureau programs most frequently are the result of close cooperation with the U.S. Congress, other Federal agencies, States, local governments, academic institutions, water-user organizations, and other concerned groups.

A free pamphlet is available from the Bureau entitled "Publications for Sale." It describes some of the technical publications currently available, their cost, and how to order them. The pamphlet can be obtained upon request from the Bureau of Reclamation, Attn D-7923A, PO Box 25007, Denver Federal Center, Denver CO 80225-0007.