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BRIDGE FOUNDATION AND SOIL TEST

BFAST Program User Manual

State Department of Highways

and Public Transportation

October 1983

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PREFACE

The BFAST USER MANUAL presents a detailed explanation of a computer program (P224168) designed to perform numerous tasks associated with foundation analysis and print out foundation design. The manual explains how the program may be fully utilized. The technical information needed to understand the mechanics of the program can be found in the Bridge Foundation Exploration and Design Manual.

The engineer can use the output obtained from the BFAST program to develop file data and determine the most appropriate and economical foundation design. The program is used to record and analyze the field exploration and laboratory data and perform design calculations.

The manual is intended to be used as a guide for application of the BFAST program. The report contains example problems, including input data, complete output listings and plots. The examples illustrate the capabilities of the program.

The input data may be in the form of punched cards or 'card images' stored on data entry equipment.

BRIDGE FOUNDATION AND SOIL TEST

BFAST PROGRAM

I. Introduction

The BFAST Program (Bridge Foundation and Soil Test) is a specialized computer program which enables the engineer to input field and laboratory data, request a foundation study of various types and sizes and obtain an output of input and calculated data with a summary of comparative foundation designs.

Specifically, the computer is used as follows:

1. To record and analyze field log and laboratory data,
2. To perform soil strength calculations of these data,
3. To develop file data with plots,
4. To calculate and tabulate resultant pile and/or drilled shaft designs.

This manual assists the engineer in the understanding, use and practical application of all data, since numerous alternative designs can be quickly studied and final designs determined.

Application

The BFAST program may be used for all data record keeping and design studies. It is especially applicable for piling and drilled shaft design, including shafts with or without bells.

Based on available input data, the program produces a print-out of soil strength analysis, and a summary of foundation loads and tip elevations. Soil analysis and foundation strength plots are generated for each test hole.

II. Computer Input Organization

The BFAST program has seven input forms. Forms to be used depend on the available field and laboratory data to be analyzed. The forms available for this program are as follows:

1.	Program Initialization Form	Form 1485
2.	Test Hole Input Form	Form 1486
3.	Design Strata Data Form	Form 1487
4.	Pen (Log) Data Form	Form 1488
5.	Lab Data Form	Form 1489
6.	Explicit Strength Data Form	Form 1490
7.	Foundation Data Form	Form 1491

The following pages contain an explanation of the input for each form and a sample form.

When completing the forms, it should be noted that all preprinted decimal points which are used appear between columns. Data must be entered in accordance with a preprinted decimal point unless the instructions indicate that the user may override it. If it is permissible and the user enters his own decimal point, it must occupy a complete column and be larger than average size to preclude misinterpretation. Preprinted decimal points are not keypunched.

Program Initialization Form (Form 1485)

The Program Initialization Form identifies the project and purpose of the study. It allows the user to specify desired plots and change programmed constants, if indicated by research. There are six cards on this form and each is identified. The data as entered is printed at the top of the first page of the output for each problem.

Project Identification Card. Identification data is entered initially for all test holes on one run. Data entry can be made in any column within each field unless otherwise noted.

1. PSF Number (Columns 1-5)

   Enter a Problem Series File number. This is a unique identifier which the user assigns for each problem. Any alphanumeric entry can be made.

2. County (Columns 8-20)

   Enter county in which the project is located.

3. Highway Number (Columns 23-28)

   Enter highway designation, left-justified.

4. PD/IPE (Columns 31-34)

   Enter IPE or PD number.

5. Cont.-Sect.-Job (Columns 37-47)

   Enter Control/Section/Job number for the project, left-justified.

6. Coded By (Column 50-52)

   Enter initials of person who coded the data for the run.

7. Date (Column 55-66)

   Enter date that the data form was coded; otherwise, if the date is left blank, the date that the program is run will automatically be printed.

8. District (Columns 71-72)

Enter District number, right-justified.

Structure Description Card (Columns 1-32). Enter structure name or appropriate designation.

Problem Description Card (Columns 1-70). Enter an alphanumeric description of the run which will be printed at the top of every output page.

Constants Card. SOIL (Card not required).

1. SOIL (Columns 1-4)

   The preprinted entry, SOIL, identifies the type of data to be entered on the line.

2. SOIL: FR Max 3.25 (Columns 6-10)

   If left blank, the program will automatically use an upper design limit of 3.25 tons per square foot for friction (Figure 5, Foundation Manual). If a different value is coded, the decimal point must be entered and must occupy an entire column.

3. SOIL: PB Max 31.0 (Columns 11-15)

   If left blank, the program will automatically use an upper design limit of 31.0 tons per square foot for point bearing (Figure 5, Foundation Manual). If a different value is coded, the decimal point must be entered and must occupy an entire column.

4. SOIL: Elevation-Depth (Columns 16-20)

   Enter ELEV, left justified, unless data is to be plotted vs. depth only.

5. SOIL: CH, CL, SC, Other (Columns 21-60)

   If left blank, the program for each soil class (CH, CL, SC, Other) will use the recommended constants and factors shown on the form for calculating design frictional and point bearing strengths from Texas cone penetrometer blow counts (Figure 1, Foundation Manual). Otherwise, these fields are provided for inputing other constants determined by research, etc.

6. SOIL: Water Density (Columns 66-70)

   If left blank, the program will automatically use a factor of 62.4 pounds per cubic foot for fresh water. If a different value is coded with a decimal point to allow for the inclusion of higher densities, such as salt or brackish water, the decimal point must be entered and must occupy an entire column.

Plotting Options Card. PLOT (Card not required).

1. PLOT (Columns 1-4)

   The preprinted entry, PLOT, identifies the use of the card. Note that line printer plots and digital drum plots are available. The line printer plots are printed with the output data. They have low resolution but provide quick review of the results. There are six different line printer plots available and four digital drum plots. Leave columns blank if you do not want a plot, or code in the appropriate columns.

2. PLOT: Drilling Report (Columns 7-9)

   Enter YES to obtain a summary of the field log and lab data for each test hole printed with the output. This is required when laboratory data is available. (See example, page C-15.)

3. PLOT: Accumulative Allowable Static Frictional Resistance versus Elevation (Columns 12-14)

   Enter YES to obtain a line printer plot with the output for each test hole. If such a plot is not desired, the columns are left blank or NO is entered.

4. PLOT: Accumulative Reduced Allowable Static Frictional Resistance versus Elevation (Columns 17-19)

   Enter YES to obtain a line printer plot with the output from each test hole for drilled shaft design. If such a plot is not desired, the columns are left blank or NO is entered.

5. PLOT: Design Stress (Columns 22-24)

   Enter YES to obtain a line printer plot of the design stress or 0.5 shear strength of soil with the output for each test hole. If such a plot is not desired, the columns are left blank or NO is entered.

6. PLOT: Point Bearing Strength (Columns 27-29)

Enter YES to obtain a line printer plot of the point bearing strength with the output for each test hole. If such a plot is not desired, the columns are left blank or NO is entered.

7. PLOT: Total Foundation Strength (Columns 32-34)

Enter YES to obtain a line printer plot for all foundations analyzed for each test hole. If such a plot is not desired, the columns are left blank or NO is entered.

8. PLOT: Layout Sheet (Columns 36-44)

Enter YES in columns 42-44 if a drilling log plot scaled on the digital plotter is needed for placing on a layout sheet. The scaling factor must be specified in columns 36-40 in accordance with the preprinted decimal point. If such a plot is not desired, the columns are left blank or NO is entered in columns 43-44.

9. PLOT: Soil and Foundation Results (Columns 47-49)

Enter YES to obtain soil strength plots (equivalent to Form 1101, Foundation Manual) and total foundation strength versus elevation plots on the digital drum plotter. If such a plot is not desired, the columns are left blank or NO is entered.

10. PLOT: Drilling Log (Columns 52-54)

Enter YES to obtain a drilling log plot (equivalent to Form 513, Foundation Manual) on the digital drum plotter. If such a plot is not desired, the columns are left blank or NO is entered.

Driller and Logger Card. DRLG (Columns 1-65) (Card not required). Enter the names of the driller and logger and the latter's title, for the permanent record.

TEXAS STATE DEPT. OF HIGHWAYS AND PUBLIC TRANSPORTATION

BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

SHEET.....OF.....

PROGRAM INITIALIZATION FORM

PROJECT IDENTIFICATION CARD

PSF NUMBER	COUNTY	HIGHWAY NUMBER	PD/IPE	CONT-SEC-JOB	CODED BY	DATE - OPTIONAL	DIST

STRUCTURE DESCRIPTION CARD

STRUCTURE DESCRIPTION	

PROBLEM DESCRIPTION CARD

DESCRIPTION	

CONSTANTS CARD (OPTIONAL)

	FR MAX 3.25 (TONS/SQFT)	PB MAX 31.0 (TONS/SQFT)	ELEVATION DEPTH	CH		CL		SC		OTHER			WATER DENS 62.4 (LBS/CUFT)	
SOIL				50.	2.57	60.	3.62	70.	4.29	80.	4.29			

PLOTTING OPTIONS CARD (OPTIONAL)

	LINE PRINTER OPTIONS (YES/NO)								DIGITAL DRUM PLOTTER OPTIONS (YES/NO)			
	DRILLING REPORT	ACCUM ALLOW STATIC FRIC RESIS	ACCUM REDUC ALLOW FRIC RESIS	DESIGN STRESS	POINT BEARING STRENGTH	TOTAL FOUND-ATION STRENGTH	LAYOUT SHEET SCALE		SOIL AND FOUND-ATION RESULTS	DRILLING LOG		
PLOT												

DRILLER AND LOGGER CARD (OPTIONAL)

	DRILLER	LOGGER	TITLE	
DRLG				

PROGRAM 224168

FORM 1485

Test Hole Input Form - HOLE (Form 1486)

1. HOLE: (Columns 1-4)

   The preprinted entry, HOLE, identifies the use of the card. Data from each test hole must be entered on only one line.

2 HOLE: Hole Number (Columns 8-10)

   Enter hole number, right-justified.

3. HOLE: Ground Elevation (Columns 16-20)

   Enter ground elevation, in feet, of the test hole in accordance with the preprinted decimal point.

4. HOLE: Ground Water Elevation (Columns 21-25)

   Enter ground water elevation, in feet, in accordance with the preprinted decimal point. This data is informational and is also used in lab tests to calculate submerged density.

5. HOLE: Stationing (Columns 27-38)

   Enter stationing of the test hole anywhere in this field with the plus sign and decimal point, each occupying a complete column.

6. HOLE: Offset (Columns 40-51)

   Enter offset distance, in feet, in this field. If a decimal point is used, it must occupy a complete column.

7. HOLE: Remarks (Columns 57-80)

   Alphanumeric remarks coded in this field will appear at the bottom of the drilling log in the remarks section.

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BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

SHEET.....OF.....

TEST HOLE INPUT FORM

HOLE

HOLE NUM		GROUND ELEV (FEET)	GROUND WATER ELEV (FEET)	STATIONING	OFFSET		REMARKS (FOR DRILLING LOG)
8 9 10	11 12 13 14 15	16 17 18 19 20	21 22 23 24 25	26 27 28 29 30 31 32 33 34 35 36 37 38	39 40 41 42 43 44 45 46 47 48 49 50 51	52 53 54 55 56	57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

PROGRAM 224168

FORM 1486

Design Strata Data Form - STRA (Form 1487)

Data for stratum and soil classification for each drilling log is entered on this form. Zero to fifty cards for each test hole may be input. Strata thicknesses should be limited to 15-20 feet to maintain calculation accuracy.

1. STRA: (Columns 1-4)

   The preprinted entry, STRA, identifies the type of entries to be made.

2. STRA: Hole Number (Columns 8-10)

   Enter hole number, right-justified.

3. STRA: Depth Top & Bottom (Columns 13-20)

   Enter depth, in whole feet, from the top of the test hole or stratum in columns 13-15; to the bottom of each stratum in columns 18-20. Both entries are right-justified and related to top of hole elevation.

4. STRA: Soil Reduction Factor (Columns 22-24)

   Enter factor indicated in accordance with the Foundation Manual, page 4-16, and in accordance with the preprinted decimal point. This field is for the soil reduction factor which is used with drilled shaft designs.

5. STRA: Soil Classification (Columns 26-29)

   Enter soil classification symbol (CH,CL,SC, OTHE), left-justified. These classification symbols determine the correct TCP test constants and point bearing factors to be used by the computer.

6. STRA: Sampling Method (Columns 31-38)

   Record the methods used in the drilling and sampling operation which appear on the drilling log.

7. STRA: Description (Columns 45-80)

   Enter a complete alphanumeric description of the soil materials which will be printed on the drilling log, as shown on Form 513, Foundation Manual.

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BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

SHEET.....OF.....

DESIGN STRATA DATA FORM

STRA

HOLE NUM		DEPTH (FEET) TOP		BOTTOM		SOIL RED FACT		SOIL CLASS		SAMPLING METHOD		DESCRIPTION
8 9 10	11 12	13 14 15	16 17	18 19 20	21	22 23 24	25	26 27 28 29	30	31 32 33 34 35 36 37 38	39 40 41 42 43 44	45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Log Data Form - LOG (Form 1488)

This form is used to input the Texas cone penetrometer test data from the drilling log. Zero to fifty cards for each test hole may be input with a maximum of ten tests per stratum.

1. LOG: (Columns 1-3)

   The preprinted entry, LOG, identifies the type of entries to be made.

2. LOG: Hole Number (Columns 8-10)

   Enter hole number, right-justified.

3. LOG: Depth (Columns 13-15)

   Enter depth, in whole feet, from the top of the test hole to the TCP test, right-justified.

4. LOG: First 6 Inches (Columns 19-24)

   Enter number of blows needed to drive the pen the first 6 inches, or not more than 50 blows for 6 inches or less, right-justified, in columns 19-20.

   Enter number of inches, up to a total of 6 inches, in columns 22-24, according to the preprinted decimal point. If left blank, the program will default to 6.0 inches.

5. LOG: Second 6 Inches (Columns 26-31)

   Enter number of blows needed to drive the pen the second 6 inches, or not more than 50 blows for 6 inches or less, right-justified, in columns 26-27.

   Enter number of inches, up to a total of 6 inches, in columns 29-31, according to the preprinted decimal point. If left blank, the program will default to 6.0 inches.

6. LOG: Description (Columns 45-80)

   Enter a brief alphanumeric description of the soil in which the Texas cone penetrometer test was made. This entry is optional. If it is made, it is printed with output for the penetrometer test.

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BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

SHEET.....OF.....

LOG

LOG DATA FORM

HOLE NUM		DEPTH (FEET)		FIRST 6 INCHES		SEC 6 INCHES			DESCRIPTION
				NUM BLOWS	INCHES	NUM BLOWS	INCHES		
8 9 10	11 12	13 14 15	16 17 18	19 20 21	22 23 24 25	26 27 28	29 30 31	32 33 34 35 36 37 38 39 40 41 42 43 44	45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

PROGRAM 224168

FORM 1488

Lab Data Form - LAB (Form 1489)

This form is used to input laboratory data. These data are used to produce a soil strength analysis based on the triaxial test (TAT) data. Zero to fifty cards for each test hole may be input with a maximum of ten per stratum. If lab data is not entered, the computer is programmed to base soil strength analysis on Texas cone penetrometer data and/or explicit strength input.

1. LAB: (Columns 1-3)

   The preprinted entry, LAB, identifies the type of data to be entered.

2. LAB: Hole Number (Columns 8-10)

   Enter test hole number, right-justified.

3. LAB: Depth (Columns 13-15)

   Enter depth, in whole feet, from the top of test hole to the top of sample, right-justified.

4. LAB: Sample (Columns 17-18)

   Enter sample number, right-justified.

5. LAB: Lateral Pressure (Columns 20-22)

   Enter lateral pressure, in pounds per square inch, to conform with the preprinted decimal point.

6. LAB: Ultimate Stress (Columns 24-27)

   Enter ultimate stress, in pounds per square inch, to conform with the preprinted decimal point.

7. LAB: Rupture Angle (Columns 29-30)

   Enter rupture angle, in degrees, right-justified.

8. LAB: Density (Columns 32-34)

   Enter wet density, in whole pounds per cubic foot, right-justified.

9. LAB: Moisture (Columns 36-37)

   Enter moisture content as a percent, right-justified.

10. LAB: Liquid Limit (Columns 38-40)

    Enter liquid limit as a percent, right-justified.

11. LAB: Plasticity Index (Columns 42-43)

    Enter plasticity index as a percent, right-justified.

12. LAB: Description (Columns 45-80)

    A brief alphanumeric description of the soil may be input within this field. If one is made, it is printed on the output and on the drilling report.

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SHEET.....OF.....

LAB

LAB DATA FORM

HOLE NUM		DEPTH (FEET)		SAMPLE		LAT PRES (PSI)	ULT STRESS (PSI)		RUPT ANG (DEG)		DENS (LBS/CUFT)		MOIS. %		LIQ LIM %		PLAS IND %		DESCRIPTION
8 9 10	11 12	13 14 15	16	17 18	19	20 21 22	23	24 25 26 27	28	29 30	31	32 33 34	35	36 37	38 39 40	41	42 43	44	45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
8 9 10	11 12	13 14 15	16	17 18	19	20 21 22	23	24 25 26 27	28	29 30	31	32 33 34	35	36 37	38 39 40	41	42 43	44	45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

PROGRAM 224168

FORM 1489

Explicit Strength Data Form - STRG (Form 1490)

This form is used to input explicit strengths for a stratum. These cards are used if Texas cone penetrometer or laboratory data are not available for a stratum, or if the user wishes to override it. An explicit strength input within a stratum alters the strength for the entire stratum.

1. STRG: (Columns 1-4)

   These preprinted letters indicate the type of data entered.

2. STRG: Hole Number (Columns 8-10)

   Enter hole number, right-justified.

3. STRG: Depth (Columns 13-15)

   Enter depth, in whole feet, measured from top of test hole to within the stratum.

4. STRG: Design Stress (Columns 21-30)

   Enter a design stress, or 0.5 shear strength of soil, for each stratum in tons per square foot.

5. STRG: Point Bearing Strength (Columns 41-50)

   Enter a point bearing design value in tons per square foot.

TEXAS STATE DEPT. OF HIGHWAYS AND PUBLIC TRANSPORTATION

BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

SHEET.....OF.....

EXPLICIT STRENGTH DATA FORM

S,T,R,G,

HOLE NUM		DEPTH (FEET)		DESIGN STRESS (TONS/SQFT)		POINT BEARING STRENGTH (TONS/SQFT)	
8 9 10	11 12	13 14 15	16 17 18 19 20	21 22 23 24 25 26 27 28 29 30	31 32 33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48 49 50	51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

PROGRAM 224168

FORM 1490

Foundation Data Form - FNDTYPE (Form 1491)

This form is used to specify foundation designs and design loads to be analyzed for each test hole. Zero to fifty cards for each test hole may be entered.

1. FNDTYPE: (Columns 1-7)

   These preprinted letters indicate the type of data entered.

2. FNDTYPE: * (Column 8)

   Enter type of foundation, either a P for piling or a D for drilled shaft. An explanation of entry in this column is given at the bottom of Form 1491.

3. FNDTYPE: Description (Columns 9-20)

   Enter a brief alphanumeric description of the foundation to be analyzed.

4. FNDTYPE: First Dimension (Columns 22-27)

   Enter, for a square or rectangular piling, the length of one side in whole inches, right-justified. For a drilled shaft, enter the shaft diameter in inches, right-justified.

5. FNDTYPE: Second Dimension (Columns 29-34)

   Enter, for a square or rectangular piling, the length of the other side in whole inches, right-justified. For a drilled shaft, enter the diameter of the bell in inches, right-justified. If a bell is not being used for a drilled shaft, leave blank.

6. FNDTYPE: Load (Columns 36-41)

   Enter the design load of the foundation to be analyzed in whole and fractional tons, right-justified.

7. FNDTYPE: Designated Holes for Design (Columns 44-66)

   The number of entries to be made is dependent on the number of test holes to be used. If data for only one test hole is to be used, the hole number is entered in columns 48-50, right-justified. Additional test holes, up to a maximum of five, are entered in the fields defined on the form. They must be entered right-justified and no blank fields can be left between

entries. The 'ALL' option, columns 44-46, has been deactivated and should be ignored.

8. FNDTYPE: Disregard To Elevation (Columns 69-80)

Enter elevation, in feet, to which frictional resistance is disregarded due to moisture fluctuation, scour, or other design considerations in whole and/or fractional feet, with a decimal point occupying a complete column.

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BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

SHEET.....OF.....

F.N.D.T.Y.P.E

FOUNDATION DATA FORM

*	DESCRIPTION	FIRST DIMENSION (INCHES)	SECOND DIMENSION (INCHES)	LOAD (TONS)	DESIGNATED HOLES FOR DESIGN												DISREGARD TO ELEVATION (FEET)
					ALL												
8	9 10 11 12 13 14 15 16 17 18 19 20	21 22 23 24 25 26 27	28 29 30 31 32 33 34	35 36 37 38 39 40 41	42 43	44 45 46	47	48 49 50	51	52 53 54	55	56 57 58	59	60 61 62	63	64 65 66	67 68	69 70 71 72 73 74 75 76 77 78 79 80

PROGRAM 224168

* ENTER A 'P' FOR PILING OR A 'D' FOR DRILLED

FORM 1491

III. Computer Output Organization

Printed output and plots are generated by this program. The printed output may consist of up to twelve reports based upon requests of the user on the PLOT card. Also, the plotted output consists of four separate plots that may be requested. Each type of output is explained on the following pages.

Input Data Listing Output

Six different listings may be produced from the input data. On all these listings, the data is organized by test hole number, type and depth. The input data listings that the program provides are as follows:

1. Program initialization
2. Pen
3. Lab
4. Strata
5. Explicit strength
6. Foundation

Drilling Report

A drilling report (equivalent to Form 554) is printed. (See example on page C-15.) It presents field and laboratory data with soil description for each test hole.

Soil Strength Analysis Results

This report is printed out on two separate pages for each test hole. (See example, pages C-16 and C-19.) It shows the data for field and/or laboratory data with progressing calcula-

tions. For the same procedures and calculations, see the Foundation Manual, Forms 1091, 1092 and 1190.

Column "Variance TAT" includes three parameters which are intended to give the engineer an indication of how self-consistent the triaxial (lab) data is within a particular stratum.

"TAT to Pen Ratio" is a comparison of triaxial (lab) test strength to penetrometer strength. This output is for any stratum in which pen and lab data have been input.

Soil Analysis Plot

A line printer plot will be produced as requested for each test hole. (See example, pages C-17 and C-18.) Note that these plots provide the engineer with a method to visually compare various strength data.

Foundation Strength Analysis Results

This report is printed out for each foundation type, size, design load and indicated test hole with accumulative frictional and point bearing loads tabulated. Recommended elevation of the foundation tip is given. (See example, pages C-20 or C-21.)

Foundation Strength Plot

In this line printer plot, the total foundation strength versus elevation is plotted for all foundations being analyzed for that hole. (See example, page C-27.) The plot provides a visual comparison of the different types and sizes of piling and drilled shaft designs being studied.

Summary of Foundation Lengths and Loads for Hole Number

This printed report shows a summary for each test hole with

an analysis of each type of foundation design that was requested by the user. (See example, page C-28.)

Digital Drum Plots

The user may request different types of digital drum plots. In addition, one plot will be produced for each test hole. The four types of plots which can be requested are as follows:

1. Foundation Material Properties - A digital drum plot version of the line printer Soil Analysis Plot. (See example, page C-46.)

2. Total Foundation Strength - A digital drum plot version of the line printer Foundation Strength plot. (See example, page C-47.)

3. Foundation Material Profile - A graphical presentation of the log data and strata descriptions intended for use on a bridge layout sheet. (See example, page C-48.)

4. Drilling Log - This plot is equivalent to Form 513. (See example, page C-49.)

Appendices

Appendix A: Equations and Algorithms

The following information used in this program was taken from the Foundation Exploration and Design Manual.

Texas Cone Penetrometer Calculations - N = Number of blows per foot.

Design strength or one-half shear strength of the soil - S

1. For CH soils - S = N/50
2. For CL soils - S = N/60
3. For SC soils - S = N/70
4. For other soils - S = N/80
5. For greater than 100 for all soils - S = N/80

Point Bearing Design Strength - P = NcS

1. For CH soils - P = 2.57S
2. For CL soils - P = 3.62S
3. For CL soils - P = 4.29S
4. For other soils - P = 4.29S
5. For N greater than 100 for all soils - P = 4.29S

TAT (lab) Calculations

1. Rupture Angle (RA) and Cohesion (c) are calculated by a least squares fit of the TAT (lab) test data. If only one lab test is available for a given stratum, then either a rupture angle or cohesion value must be specified with that test. The program then calculates the missing information, fitting the given information to the given lab test.
2. Variance is the perpendicular distance from the best fit least squares line to the point on the Mohr's circle which is the same slope as the least squares line. (See Figure 1.)

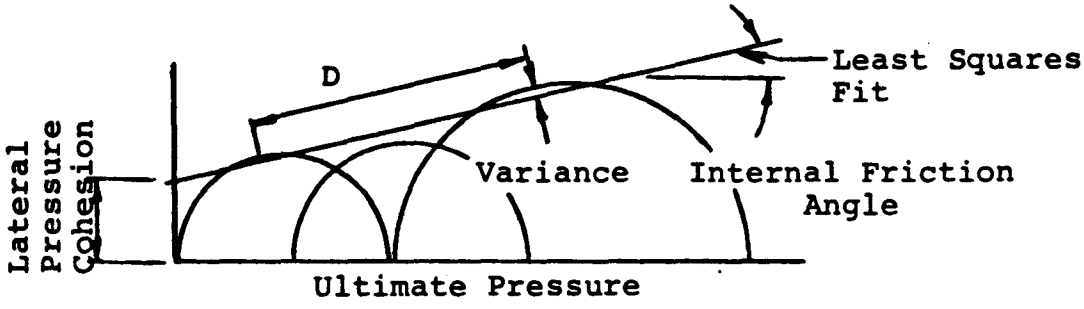


Figure 1

a. Peak - The value of the greatest variance.

b. Avg - The average value of the variance.

c. Ratio - The ratio of the distance "D" (Figure 1) to the average value of the variance. If the ratio is over approximately 10, then there is a reasonably solid self-consistency in the lab data for that stratum. If the ratio is under 10, then the self-consistency is poor and the lab data for that stratum should be re-examined for bad data and to verify if there are really two or more geological strata for that lab data. If the fit is very poor, such that a negative rupture angle is calculated, the program uses a zero degree rupture angle and a cohesion value which is the average of the peak Mohr's circles values.

3. TAT to Pen Ratio - This is the ratio of the soil strength, as computed from lab data, to the soil strength as computed from Texas cone penetrometer data.

4. Shear Strength - s; $s = c+wh* \tan \phi$; where s = shear strength of soil; c = cohesion of soil; w = density of soil; h = depth to centroid of soil stratum, ϕ = rupture angle of soil.

5. Point Bearing Strength - Pmax
   $P_{max} = (c+w(h_0+.4D)* \tan \phi)/F(\phi)+wh_0$
   where c=cohesion of soil; w=density of soil; h_0=depth to tip of foundation; D=foundation diameter or width; ϕ = rupture angle of soil
   $F(\phi) = .2915 \cos \phi - .4485 \tan \phi + .2915 \sin \phi \tan \phi$.
   Pmax is limited to $10(c+wh*(\tan \phi))$.

   *The product of w times h at the depth of investigation reflects the effective soil stresses (σ') in the soil at that depth. This stress is cumulative with increasing depth and reflects the varying soil densities with depth and whether soil is above or below the water table.

Foundation Calculations (Load Capacity - LC)(Strata - Σ)

1. Piling LC = Σ(s * perimeter * (strata thickness less any disregard)) + bearing area * P max.

2. Drilled Shaft LC = Σ(s * perimeter * (strata thickness) * (soil reduction factor)) + (bearing area) * P max.

If the shaft has a bell, the frictional load capacity contributed by the bottom part of the shaft equal in length to the bell diameter is subtracted from the load capacity. (See Foundation Manual, 4-16.)

Appendix B: Error Messages

All of the program's error messages are listed with either the message "ERROR" or "FATAL ERROR". The actual message generated by the program appears on the next line. "EXPL" denotes a detailed explanation of the error message.

Error Messages

********* ERROR *********

DEPTH FOR LOG DATA OUT OF RANGE.

EXPL - This message indicates that the depth entered from the drilling log may be in error. The depth must also be compatible with that entered for strata and lab data.

TOTAL NUMBER OF BLOWS IS GREATER THAN 150.

EXPL - The number of blows for the first and second six inches totaled more than 150.

TOTAL NUMBER OF INCHES IS GREATER THAN 12.

EXPL - The number of inches for the first and second six inches totaled more than 12.

DEPTH FOR LAB DATA OUT OF RANGE.

EXPL - This message indicates that the depth entered from the drilling report may be in error. The depth must also be compatible with that entered for strata and pen data.

SAMPLE NUMBER FOR LAB DATA OUT OF RANGE.

EXPL - Self-explanatory.

LATERAL PRESSURE FOR LAB DATA OUT OF RANGE.

EXPL - Self-explanatory.

ULTIMATE STRENGTH FOR LAB DATA OUT OF RANGE.

EXPL - Self-explanatory.

RUPTURE ANGLE FOR LAB DATA OUT OF RANGE.

EXPL - Self-explanatory.

DENSITY FOR LAB DATA OUT OF RANGE.

EXPL - Self-explanatory.

UPPER DEPTH FOR STRATUM DATA OUT RANGE.

EXPL - This message indicates that the upper depth entered may not be consistent with the drilling report for that stratum.

LOWER DEPTH FOR STRATUM DATA OUT OF RANGE.

EXPL - This message indicates that the lower depth entered may not be consistent with the drilling report for that stratum.

SOIL REDUCTION FACTOR FOR STRATUM DATA OUT OF RANGE.

EXPL - Self-explanatory.

LOWER DEPTH FOR A STRATUM DOES NOT MATCH UP WITH DEPTH FOR NEXT LOWER STRATUM.

EXPL - Self-explanatory.

ORDER OF DEPTH FOR TWO STRATUMS DOES NOT MATCH.

EXPL - Self-explanatory.

DEPTH FOR EXPLICIT SHEAR STRENGTH DATA OUT OF RANGE.

EXPL - The depth must be compatible with the data from the drilling log.

EXPLICIT SHEAR STRENGTH DATA OUT OF RANGE.

EXPL - This error condition exists if the data entered is not within the design limits.

EXPLICIT POINT BEARING STRENGTH DATA OUT OF RANGE.

EXPL - This error condition exists if the data entered is not within the design limits.

FIRST DIMENSION FOR FOUNDATION DATA OUT OF RANGE.

EXPL - Self-explanatory.

SECOND DIMENSION FOR FOUNDATION DATA OUT OF RANGE.

EXPL - Self-explanatory.

DESIGN LOAD FOR FOUNDATION DATA OUT OF RANGE.

EXPL - This error condition exists if the data entered is not within the design limits for the foundation data.

********** FATAL ERRORS **********

UNIDENTIFIED SOIL CLASSIFICATION CODE.

EXPL - Self-explanatory.

UNIDENTIFIED FOUNDATION CODE.

EXPL - Self-explanatory.

MORE THAN 10 LOG DATA CARDS FOR A STRATUM.

EXPL - Self-explanatory.

MORE THAN 10 LAB DATA CARDS FOR A STRATUM.

EXPL - Self-explanatory.

Appendix C: Example Problems

The following pages contain the coded input and the computer printout for a sample problem.

BFAST

C-2

October 1983

TEXAS STATE DEPT. OF HIGHWAYS AND PUBLIC TRANSPORTATION

BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

PROGRAM INITIALIZATION FORM

PROJECT IDENTIFICATION CARD

PSF NUMBER	COUNTY	HIGHWAY NUMBER	PD/IPE	CONT-SEC-JOB	CODED BY	DATE - OPTIONAL	DIST
213	HARRIS	US 290	591	148-2-32	GHO		12

STRUCTURE DESCRIPTION CARD

STRUCTURE DESCRIPTION
ELM CREEK BRIDGE

PROBLEM DESCRIPTION CARD

	DESCRIPTION
	US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

CONSTANTS CARD (OPTIONAL)

	FR MAX 3.25 (TONS/SQFT)	PB MAX 31.0 (TONS/SQFT)	ELEVATION DEPTH	CH		CL		SC		OTHER			WATER DENS 62.4 (LBS/CUFT)	
SOIL			ELEV	50.	2.57	60.	3.62	70.	4.29	80.	4.29			

PLOTTING OPTIONS CARD (OPTIONAL)

	LINE PRINTER OPTIONS (YES/NO)						DIGITAL DRUM PLOTTER OPTIONS (YES/NO)				
	DRILLING REPORT	ACCUM ALLOW STATIC FRIC RESIS	ACCUM REDUC ALLOW FRIC RESIS	DESIGN STRESS	POINT BEARING STRENGTH	TOTAL FOUND-ATION STRENGTH	LAYOUT SHEET SCALE	LAYOUT SHEET	SOIL AND FOUND-ATION RESULTS	DRILLING LOG	
PLOT	YES	YES	YES	YES	YES	YES	5.	YES	YES	YES	

DRILLER AND LOGGER CARD (OPTIONAL)

	DRILLER	LOGGER	TITLE	
DRLG	R. SPRINGER	R. CURSON		

TEXAS STATE DEPT. OF HIGHWAYS AND PUBLIC TRANSPORTATION

BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

TEST HOLE INPUT FORM

HOLE

HOLE NUM		GROUND ELEV (FEET)	GROUND WATER ELEV (FEET)	STATIONING	OFFSET		REMARKS (FOR DRILLING LOG)
1		412	29.	38+20	15 FT LT		
3		43.	29.	40+00	15 FT RT		

TEXAS STATE DEPT. OF HIGHWAYS AND PUBLIC TRANSPORTATION

BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

DESIGN STRATA DATA FORM

STRA

HOLE NUM	DEPTH (FEET) TOP	DEPTH (FEET) BOTTOM	SOIL RED FACT	SOIL CLASS	SAMPLING METHOD	DESCRIPTION
1	0	11	.5	CL		BROWN SL. SILTY CLAY, SOFT
1	11	16	.5	SC		LT. BROWN SANDY CLAY, SOFT
1	16	25	.5	CH		DK. BROWN CLAY, MED., MOI.
1	25	29	.5	OTHE		SILTY SAND, WATER BEARING
1	29	34	.5	CL		GRAY SLTY SNDY CLAY, STIFF
1	34	43	.5	CH		RED BROWN CLAY, SLCS, STIFF
3	0	11	.5	CL		BROWN SL. SILTY CLAY, MED.
3	11	17	.5	SC		LT. BROWN SNDY CLAY, MED.
3	17	30	.5	CL		DARK BROWN SNDY CLAY, MED STIFF, MOI
3	30	32	.5	OTHE		CLEAN SAND, WATER BEARING
3	32	37	.5	CH		RED BROWN CLAY, SLCS, STIFF
3	37	45	.5	CL		LT. GRAY SILTY CLAY, STIFF

PROGRAM 224168

FORM 1487

BFAST

TEXAS STATE DEPT. OF HIGHWAYS AND PUBLIC TRANSPORTATION

BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

LOG

LOG DATA FORM

HOLE NUM	DEPTH (FEET)	FIRST 6 INCHES NUM BLOWS	FIRST 6 INCHES INCHES	SEC 6 INCHES NUM BLOWS	SEC 6 INCHES INCHES	DESCRIPTION
1	5	3	.	4	.	
1	10	1	.	2	.	
1	15	4	.	6	.	
1	20	9	.	10	.	
1	25	10	.	12	.	
1	28	40	.	50	5	
1	30	9	.	12	.	
1	33	12	.	14	.	
1	35	16	.	18	.	
1	40	20	.	20	.	
3	5	6	.	6	.	
3	10	9	.	6	.	
3	15	7	.	8	.	
3	20	7	.	7	.	
3	25	8	.	9	.	
3	30	10	.	20	.	
3	33	10	.	11	.	
3	35	15	.	16	.	
3	39	14	.	16	.	
3	44	20	.	20	.	

PROGRAM 224168

FORM 1488

TEXAS STATE DEPT. OF HIGHWAYS AND PUBLIC TRANSPORTATION

BRIDGE FOUNDATION AND SOIL TEST PROGRAM (BFAST)

FOUNDATION DATA FORM

F.N.D.T.Y.P.E

*	DESCRIPTION	FIRST DIMENSION (INCHES)	SECOND DIMENSION (INCHES)	LOAD (TONS)	DESIGNATED HOLES FOR DESIGN ALL	DISREGARD TO ELEVATION (FEET)
D	BT #1 30" RD	30		52	1	36.0
D	BT #2 30" RD	30		72	1 3	28.0
D	BT #3 30" RD	30		52	3	38.0
P	BT #1 15" SQ	15	15	38	1	36.0
P	BT #2 15" SQ	15	15	45	1 3	28.0
P	BT #3 15" SQ	15	15	38	3	38.0

PROGRAM 224168

* ENTER A 'P' FOR PILING OR A 'D' FOR DRILLED

FORM 1491

```
//R224168L JOB (00000000,00000000,,,,,,,,0000),'D-45 GHO 3RD FLR',
//  MSGLEVEL=(1,1),TIME=(0,15),CLASS=A,MSGCLASS=R
/*ROUTE XEQ CENTRAL
/*ROUTE PRINT R0
//* ****** TO PLOT, OMIT ,PLOT='DUMMY,'  AND CHANGE TO  CLASS=C  ********
//  EXEC BFAST,LIB='D59.TESTLIB',PLOT='DUMMY,'
//DATA.CARDS DD *              DATA CARDS FOR BFAST PROGRAM FOLLOW
  213  HARRIS          US 290  591   148-2-32     GHO                    12
ELM CREEK BRIDGE
US 290 AT ELM CREEK  DRILLED SHAFTS AND PILE ALTERNATE DESIGNS
SOIL            ELEV
PLOT  YES  YES  YES  YES  YES  YES   10 YES  YES  YES
DRLG R. SPRINGER          R. CURSON
HOLE     1       412  29  38+20        15' LT.
HOLE     3       43   29  40+00        15' RT.
STRA     1    0   11   5  CL                BROWN SL. SILTY CLAY, SOFT
STRA     1   11   16   5  SC                LT. BROWN SANDY CLAY, SOFT
STRA     1   16   25   5  CH                DK. BROWN CLAY, MED., MOI.
STRA     1   25   29   5  OTHE              SILTY SAND, WATER BEARING
STRA     1   29   34   5  CL                GRAY SLTY SNDY CLAY, STIFF
STRA     1   34   43   5  CH                RED BROWN CLAY, SLCS, STIFF
STRA     3    0   11   5  CL                BROWN SL. SILTY CLAY, MED.
STRA     3   11   17   5  SC                LT. BROWN SANDY CLAY, MED.
STRA     3   17   30   5  CL                DARK BROWN SNDY CLAY, MED STIFF, MOI
STRA     3   30   32   5  OTHE              CLEAN SAND, WATER BEARING
STRA     3   32   37   5  CH                RED BROWN CLAY, SLCS, STIFF
STRA     3   37   45   5  CL                LT. GRAY SILTY CLAY, STIFF
LOG      1    5    3     4
LOG      1   10    1     2
LOG      1   15    4     6
LOG      1   20    9    10
LOG      1   25   10    12
LOG      1   28   40    50 5
LOG      1   30    9    12
LOG      1   33   12    14
LOG      1   35   16    18
LOG      1   40   20    20
LOG      3    5    6     6
LOG      3   10    9     6
LOG      3   15    7     8
LOG      3   20    7     7
LOG      3   25    8     9
LOG      3   30   10    20
LOG      3   33   10    11
LOG      3   35   15    16
LOG      3   39   14    16
LOG      3   44   20    20
FNDTYPEDBT #1 30" RD     30          52       1                      36.0
FNDTYPEDBT #2 30" RD     30          72       1   3                  28.0
FNDTYPEDBT #3 30" RD     30          52       3                      38.0
FNDTYPEPBT #1 15" SQ     15     15   38       1                      36.0
FNDTYPEPBT #2 15" SQ     15     15   45       1   3                  28.0
FNDTYPEPBT #3 15" SQ     15     15   38       3                      38.0
```

TEXAS DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

BFAST BRIDGE FOUNDATION AND SOIL TEST PROG - 224168 VER 1.2

PSF NO	COUNTY	HIGHWAY NO	PD-IPE	CONTROL-SECTION-JOB	CODED BY	DATE	DISTRICT
213	HARRIS	US 290	591	148-2-32	GHO	SEP 30, 1983	12

STRUCTURE DESCRIPTION- ELM CREEK BRIDGE

PROBLEM DESCRIPTION-
US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

MAXIMUM SHEAR STRENGTH 3.25 TONS/SQFT
MAXIMUM POINT BEARING STRENGTH 31.00 TONS/SQFT

CH SOILS- TCP CONSTANT	50.0	BEARING FACTOR	2.57
CL SOILS- TCP CONSTANT	60.0	BEARING FACTOR	3.62
SC SOILS- TCP CONSTANT	70.0	BEARING FACTOR	4.29
OTHER SOILS- TCP CONSTANT	80.0	BEARING FACTOR	4.29

WATER DENSITY IS 62.40 LBS/CUFT

PLOT OPTIONS- Y Y Y Y Y Y LAYOUT SCALE- 1 TO 10.0

DRILLER- R. SPRINGER LOGGER- R. CURSON
TITLE-

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

HOLE	GRND ELEV FEET	GRND WTR ELEV FEET	STATION	OFFSET
1	41.2	29.0	38+20	15' LT.

LOG INPUT DATA HOLE NUMBER 1

DEPTH FEET	NO. OF BLOWS	INCHES	NO. OF BLOWS	INCHES	DESCRIPTION
5	3	6.0	4	6.0	
10	1	6.0	2	6.0	
15	4	6.0	6	6.0	
20	9	6.0	10	6.0	
25	10	6.0	12	6.0	
28	40	6.0	50	5.0	
30	9	6.0	12	6.0	
33	12	6.0	14	6.0	
35	16	6.0	18	6.0	
40	20	6.0	20	6.0	

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

STRATA INPUT DATA HOLE NUMBER 1

STRAT NUM	UPPER DEPTH FEET	LOWER DEPTH FEET	SOIL RED FACT	SAMP METH	SOIL CLASS	DESCRIPTION
1	0	11	0.50		CL	BROWN SL. SILTY CLAY, SOFT
2	11	16	0.50		SC	LT. BROWN SANDY CLAY, SOFT
3	16	25	0.50		CH	DK. BROWN CLAY, MED., MOI.
4	25	29	0.50		OTHE	SILTY SAND, WATER BEARING
5	29	34	0.50		CL	GRAY SLTY SNDY CLAY, STIFF
6	34	43	0.50		CH	RED BROWN CLAY, SLCS, STIFF

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

HOLE	GRND ELEV FEET	GRND WTR ELEV FEET	STATION	OFFSET
2	32.1	29.0	39+10	5' RT.

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

HOLE	GRND ELEV FEET	GRND WTR ELEV FEET	STATION	OFFSET
3	43.0	29.0	40+00	15' RT.

LOG INPUT DATA HOLE NUMBER 3

DEPTH FEET	NO. OF BLOWS	INCHES	NO. OF BLOWS	INCHES	DESCRIPTION
5	6	6.0	6	6.0	
10	9	6.0	6	6.0	
15	7	6.0	8	6.0	
20	7	6.0	7	6.0	
25	8	6.0	9	6.0	
30	10	6.0	20	6.0	
33	10	6.0	11	6.0	
35	15	6.0	16	6.0	
39	14	6.0	16	6.0	
44	20	6.0	20	6.0	

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

STRATA INPUT DATA HOLE NUMBER 3

STRAT NUM	UPPER DEPTH FEET	LOWER DEPTH FEET	SOIL RED FACT	SAMP METH	SOIL CLASS	DESCRIPTION
1	0	11	0.50		CL	BROWM SL. SILTY CLAY, MED.
2	11	17	0.50		SC	LT. BROWN SANDY CLAY, MED.
3	17	30	0.50		CL	DARK BROWN SNDY CLAY, MED STIFF,
4	30	32	0.50		OTHE	CLEAN SAND, WATER BEARING
5	32	37	0.50		CH	RED BROWN CLAY, SLCS, STIFF
6	37	45	0.50		CL	LT. GRAY SILTY CLAY, STIFF

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION DATA

TYPE	NAME	FIRST DIMEN INCHES	SECOND DIMEN INCHES	DESIGN LOAD TONS	DESIGNATED HOLES		DISREGARD TO ELEVATION FEET
DRILLED	BT #1 30" RD	30.0	0.0	52.0	1		36
DRILLED	BT #2 30" RD	30.0	0.0	72.0	1	3	28
DRILLED	BT #3 30" RD	30.0	0.0	52.0	3		38
PILING	BT #1 15" SQ	15.0	15.0	38.0	1		36
PILING	BT #2 15" SQ	15.0	15.0	45.0	1	3	28
PILING	BT #3 15" SQ	15.0	15.0	38.0	3		38

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

DRILLING REPORT

COUNTY- HARRIS
HIGHWAY NO.- US 290
CONTROL- 148-2-32
PROJECT NO.- 591
DATE- SEP 30, 1983
GRD. ELEV.- 41.2
DISTRICT- 12

STRUCTURE- ELM CREEK BRIDGE
HOLE NO.- 1
STATION- 38+20
OFFSET- 15' LT.
CODED BY- GHO
GRD. WATER ELEV.- 29.0

DEPTH	FT.	PEN 1ST 6IN	PEN 2ND 6IN	SAMPLE NO.	TAT LAT-ULT PSI	WET DEN PCF	MOI %	LL %	PI %	DESCRIPTION OF MATERIAL AND REMARKS
5		3	4							
10		1	2							
15		4	6							
20		9	10							
25		10	12							
28		40/6.00	50/5.00							
30		9	12							
33		12	14							
35		16	18							
40		20	20							

RILLER- R. SPRINGER
LOGGER- R. CURSON
TITLE-

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

SOIL STRENGTH ANALYSIS RESULTS

HOLE NUMBER 1

STRAT NUM.	ELEVATION -FEET- FROM	TO	STRAT THICK NESS FEET	CEN-TROID DEPTH FEET	UNIF. SOIL CLASS	PEN TEST BLOWS/ FOOT	TEST CONST	SOIL COHES LBS/ SQFT	WET DENS LBS/ CUFT	INT. FRIC ANG.	VARIANCE TAT PEAK	AVG	RATIO
1	41	30	11.0	5.5	CL	5.0	60						
2	30	25	5.0	13.5	SC	10.0	70						
3	25	16	9.0	20.5	CH	19.0	50						
4	16	12	4.0	27.0	OTHE	60.1	80						
5	12	7	5.0	31.5	CL	23.5	60						
6	7	-2	9.0	38.5	CH	37.0	50						

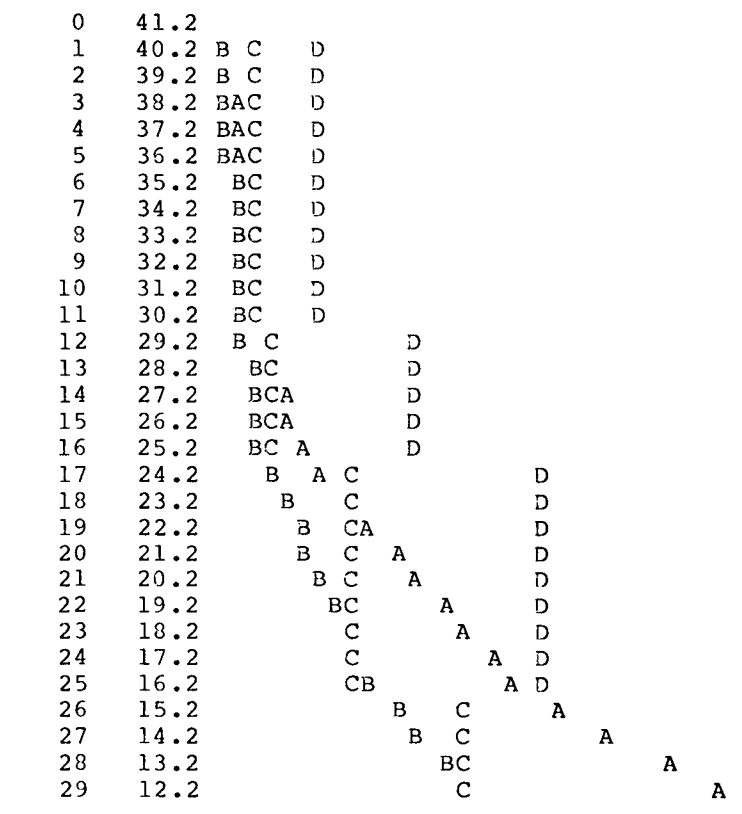
PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

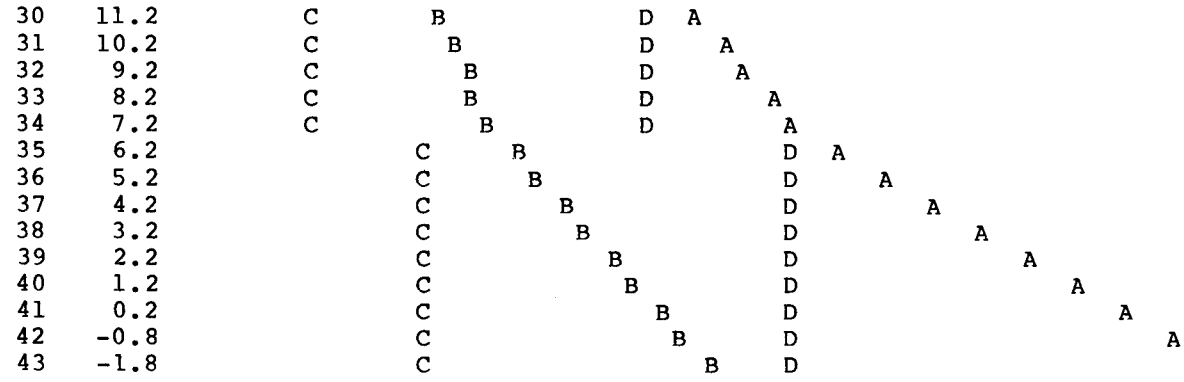
SOIL ANALYSIS PLOT FOR HOLE NUMBER 1
DISREGARD TO ELEVATION IS 36.0 FEET

A ACCUMULATIVE ALLOWABLE STATIC FRICTIONAL RESISTANCE
B ACCUMULATIVE REDUCED ALLOWABLE STATIC FRICTIONAL RESISTANCE
C DESIGN STRESS OR 1/2 SHEAR STRENGTH OF SOIL
D POINT BEARING STRENGTH

MAXIMUM ACCUMULATIVE FRICTIONAL RESISTANCE IS 16.24 TONS/FT OF PERIMETER

MAXIMUM DESIGN STRESS OR POINT BEARING STRENGTH IS 3.22 TONS/SQFT




30 11.2 C B D A
31 10.2 C B D A
32 9.2 C B D A
33 8.2 C B D A
34 7.2 C B D A
35 6.2 C B D A
36 5.2 C B D A
37 4.2 C B D A
38 3.2 C B D A
39 2.2 C B D A
40 1.2 C B D A
41 0.2 C B D A
42 -0.8 C B D A
43 -1.8 C B D

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

SOIL STRENGTH ANALYSIS RESULTS
DISREGARD TO ELEVATION IS 36.0 FEET

HOLE NUMBER 1

STRATA NUMBER	ELEVATION -FEET- FROM	TO	DESIGN STRESS OF SOIL TONS/SQFT PER STRAT	ALLOWABLE STATIC FRICTIONAL RESISTANCE (DS) TONS PER FT OF PERIMETER PER STRATUM	ACCUM-ULATIVE	SR	REDUCED ALLOWABLE STATIC FRICTIONAL RESISTANCE PER STRATUM	ACCUM-ULATIVE	BEAR FACTOR NC	POINT BEARING STRENGTH SNC TONS/SQFT
1	41.2	30.2	0.08	0.92	0.48	0.5	0.46	0.24	3.62	0.30
2	30.2	25.2	0.14	0.71	1.20	0.5	0.36	0.60	4.29	0.61
3	25.2	16.2	0.38	3.42	4.62	0.5	1.71	2.31	2.57	0.98
4	16.2	12.2	0.75	3.00	7.62	0.5	1.50	3.81	4.29	3.22
5	12.2	7.2	0.39	1.96	9.58	0.5	0.98	4.79	3.62	1.42
6	7.2	-1.8	0.74	6.66	16.24	0.5	3.33	8.12	2.57	1.90

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH ANALYSIS

HOLE NUMBER 1 BT #1 30" RD 30.0 INCH DRILLED SHAFT
DISREGARD TO ELEVATION IS 36.0 FEET

STRATA NUMBER	ELEVATION -FEET- FROM	TO	FRICTIONAL RESISTANCE PER STRATUM (TONS)	ACCUMULATIVE FRICTIONAL RESISTANCE (TONS)	POINT BEARING RESISTANCE (TONS)	ACCUMULATIVE ALLOWABLE FRICTION AND POINT BEARING (TONS)
1	41.2	30.2	3.6	1.9	1.5	3.4
2	30.2	25.2	2.8	4.7	3.0	7.7
3	25.2	16.2	13.4	18.1	4.8	22.9
4	16.2	12.2	11.8	29.9	15.8	45.7
5	12.2	7.2	7.7	37.6	7.0	44.6
6	7.2	-1.8	26.2	63.8	9.3	73.1

DESIGN LOAD 52.0 TONS

DEPTH TO DESIGN LOAD 35.9 FEET

ELEVATION OF FOUNDATION TIP 5.3 FEET

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH ANALYSIS

HOLE NUMBER 1 BT #1 15" SQ 15.0 INCH SQUARE PILING
DISREGARD TO ELEVATION IS 36.0 FEET

STRATA NUMBER	ELEVATION -FEET- FROM	TO	FRICTIONAL RESISTANCE PER STRATUM (TONS)	ACCUMULATIVE FRICTIONAL RESISTANCE (TONS)	POINT BEARING RESISTANCE (TONS)	ACCUMULATIVE ALLOWABLE FRICTION AND POINT BEARING (TONS)
1	41.2	30.2	4.6	2.4	0.5	2.9
2	30.2	25.2	3.6	6.0	1.0	6.9
3	25.2	16.2	17.1	23.1	1.5	24.6
4	16.2	12.2	15.0	38.1	5.0	43.1
5	12.2	7.2	9.8	47.9	2.2	50.1
6	7.2	-1.8	33.3	81.2	3.0	84.2

DESIGN LOAD 38.0 TONS

DEPTH TO DESIGN LOAD 27.8 FEET

ELEVATION OF FOUNDATION TIP 13.4 FEET

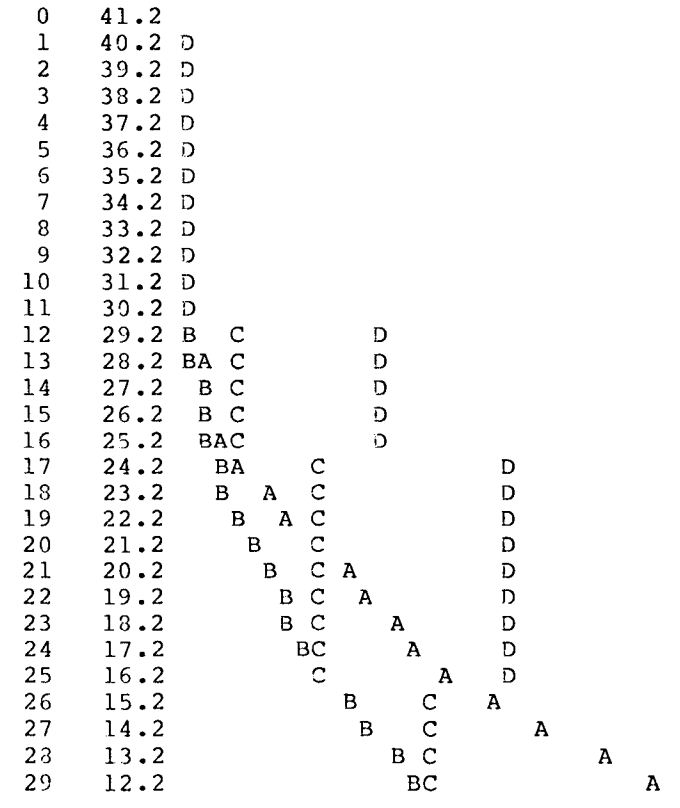
PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

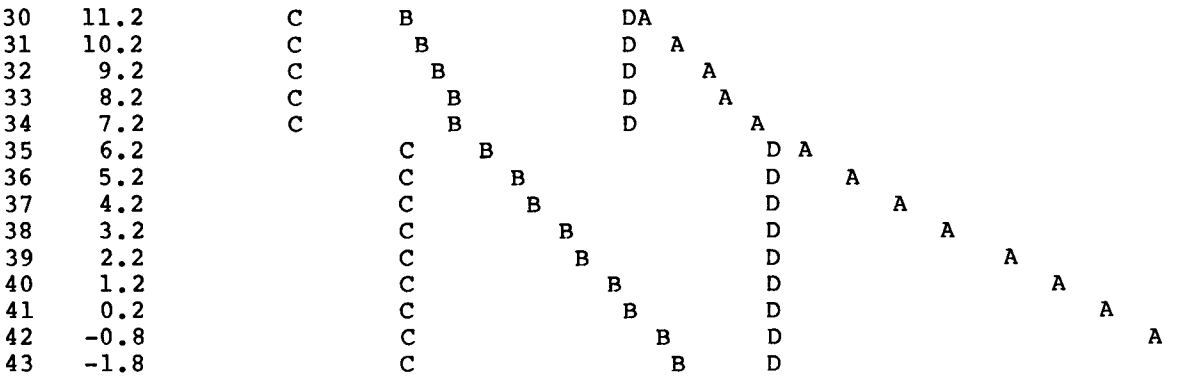
SOIL ANALYSIS PLOT FOR HOLE NUMBER 1
DISREGARD TO ELEVATION IS 28.0 FEET

A ACCUMULATIVE ALLOWABLE STATIC FRICTIONAL RESISTANCE
B ACCUMULATIVE REDUCED ALLOWABLE STATIC FRICTIONAL RESISTANCE
C DESIGN STRESS OR 1/2 SHEAR STRENGTH OF SOIL
D POINT BEARING STRENGTH

MAXIMUM ACCUMULATIVE FRICTIONAL RESISTANCE IS 15.44 TONS/FT OF PERIMETER

MAXIMUM DESIGN STRESS OR POINT BEARING STRENGTH IS 3.22 TONS/SQFT




30 11.2 C B DA
31 10.2 C B D A
32 9.2 C B D A
33 8.2 C B D A
34 7.2 C B D A
35 6.2 C B D A
36 5.2 C B D A
37 4.2 C B D A
38 3.2 C B D A
39 2.2 C B D A
40 1.2 C B D A
41 0.2 C B D A
42 -0.8 C B D A
43 -1.8 C B D

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

SOIL STRENGTH ANALYSIS RESULTS
DISREGARD TO ELEVATION IS 28.0 FEET

HOLE NUMBER 1

STRATA NUMBER	ELEVATION -FEET- FROM	TO	DESIGN STRESS OF SOIL TONS/SQFT PER STRAT	ALLOWABLE STATIC FRICTIONAL RESISTANCE (DS) TONS PER FT OF PERIMETER PER STRATUM	ACCUM-ULATIVE	SR	REDUCED ALLOWABLE STATIC FRICTIONAL RESISTANCE PER STRATUM	ACCUM-ULATIVE	BEAR FACTOR NC	POINT BEARING STRENGTH SNC TONS/SQFT
1	41.2	30.2	0.00	0.00	0.00	0.5	0.00	0.00	3.62	0.00
2	30.2	25.2	0.14	0.71	0.40	0.5	0.36	0.20	4.29	0.61
3	25.2	16.2	0.38	3.42	3.82	0.5	1.71	1.91	2.57	0.98
4	16.2	12.2	0.75	3.00	6.82	0.5	1.50	3.41	4.29	3.22
5	12.2	7.2	0.39	1.96	8.78	0.5	0.98	4.39	3.62	1.42
6	7.2	-1.8	0.74	6.66	15.44	0.5	3.33	7.72	2.57	1.90

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH ANALYSIS

HOLE NUMBER 1 BT #2 30" RD 30.0 INCH DRILLED SHAFT
DISREGARD TO ELEVATION IS 28.0 FEET

STRATA NUMBER	ELEVATION -FEET- FROM	TO	FRICTIONAL RESISTANCE PER STRATUM (TONS)	ACCUMULATIVE FRICTIONAL RESISTANCE (TONS)	POINT BEARING RESISTANCE (TONS)	ACCUMULATIVE ALLOWABLE FRICTION AND POINT BEARING (TONS)
1	41.2	30.2	0.0	0.0	0.0	0.0
2	30.2	25.2	2.8	1.6	3.0	4.6
3	25.2	16.2	13.4	15.0	4.8	19.8
4	16.2	12.2	11.8	26.8	15.8	42.6
5	12.2	7.2	7.7	34.5	7.0	41.4
6	7.2	-1.8	26.2	60.6	9.3	70.0

*** NOTE ***** FOUNDATION DID NOT REACH DESIGN LOAD WITHIN GIVEN DATA

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH ANALYSIS

HOLE NUMBER 1 BT #2 15" SQ 15.0 INCH SQUARE PILING
DISREGARD TO ELEVATION IS 28.0 FEET

STRATA NUMBER	ELEVATION -FEET- FROM	TO	FRICTIONAL RESISTANCE PER STRATUM (TONS)	ACCUMULATIVE FRICTIONAL RESISTANCE (TONS)	POINT BEARING RESISTANCE (TONS)	ACCUMULATIVE ALLOWABLE FRICTION AND POINT BEARING (TONS)
1	41.2	30.2	0.0	0.0	0.0	0.0
2	30.2	25.2	3.6	2.0	1.0	3.0
3	25.2	16.2	17.1	19.1	1.5	20.6
4	16.2	12.2	15.0	34.1	5.0	39.2
5	12.2	7.2	9.8	43.9	2.2	46.1
6	7.2	-1.8	33.3	77.2	3.0	80.2

DESIGN LOAD 45.0 TONS

DEPTH TO DESIGN LOAD 33.6 FEET

ELEVATION OF FOUNDATION TIP 7.6 FEET

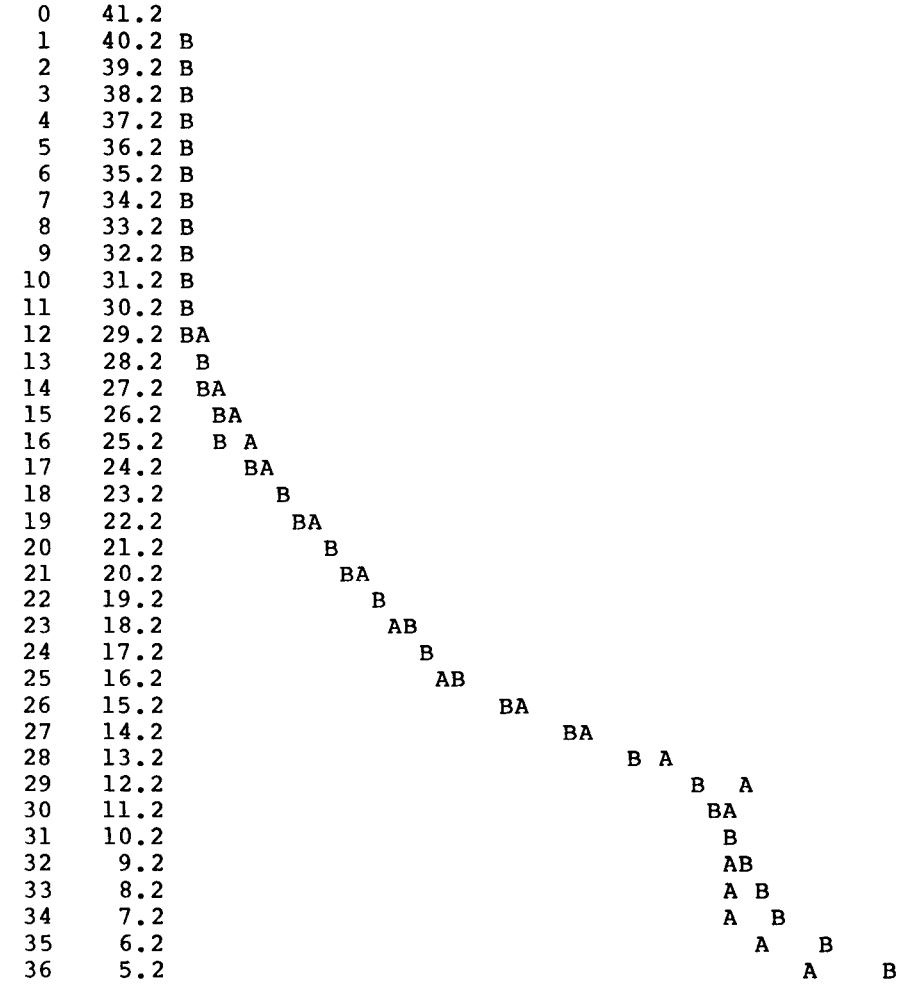
PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH PLOT FOR HOLE NUMBER 1

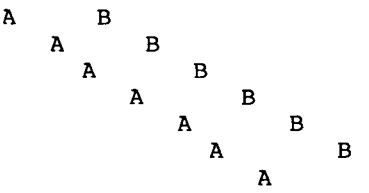
A BT #2 30" RD 30.0 INCH DRILLED SHAFT
B BT #2 15" SQ 30.0 INCH DRILLED SHAFT

THE MAXIMUM FOUNDATION STRENGTH IS 80.19 TONS

DEPTH ELEV IN FEET



37	4.2
38	3.2
39	2.2
40	1.2
41	0.2
42	-0.8
43	-1.8



PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

SUMMARY OF FOUNDATION LENGTHS AND LOADS FOR HOLE NUMBER 1

BT #1 30" RD	30.0 INCH DRILLED SHAFT			
	DISREGARD TO ELEVATION IS	36.0 FEET		
	ELEVATION OF FOUNDATION TIP IS	5.3 FEET		
	DEPTH TO DESIGN LOAD	35.9 FEET	DESIGN LOAD	52.0 TONS
BT #2 30" RD	30.0 INCH DRILLED SHAFT			
	DISREGARD TO ELEVATION IS	28.0 FEET		
	ELEVATION OF FOUNDATION TIP IS	-9958.8 FEET		
	DEPTH TO DESIGN LOAD	****** FEET	DESIGN LOAD	72.0 TONS
BT #1 15" SQ	15.0 INCH SQUARE PILING			
	DISREGARD TO ELEVATION IS	36.0 FEET		
	ELEVATION OF FOUNDATION TIP IS	13.4 FEET		
	DEPTH TO DESIGN LOAD	27.8 FEET	DESIGN LOAD	38.0 TONS
BT #2 15" SQ	15.0 INCH SQUARE PILING			
	DISREGARD TO ELEVATION IS	28.0 FEET		
	ELEVATION OF FOUNDATION TIP IS	7.6 FEET		
	DEPTH TO DESIGN LOAD	33.6 FEET	DESIGN LOAD	45.0 TONS

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

DRILLING REPORT

COUNTY- HARRIS
HIGHWAY NO.- US 290
CONTROL- 148-2-32
PROJECT NO.- 591
DATE- SEP 30, 1983
GRD. ELEV.- 32.1
DISTRICT- 12

STRUCTURE- ELM CREEK BRIDGE
HOLE NO.- 2
STATION- 39+10
OFFSET- 5' RT.
CODED BY- GHO
GRD. WATER ELEV.- 29.0

DEPTH	F. PEN 1ST 6IN	PEN 2ND 6IN	SAMPLE NO.	TAT-ULT PSI	WET DEN PCF	MOI %	LL %	PI %	DESCRIPTION OF MATERIAL AND REMARKS

RILLER- R. SPRINGER
LOGGER- R. CURSON
TITLE-

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

DRILLING REPORT

COUNTY- HARRIS
HIGHWAY NO.- US 290
CONTROL- 148-2-32
PROJECT NO.- 591
DATE- SEP 30, 1983
GRD. ELEV.- 43.0
DISTRICT- 12

STRUCTURE- ELM CREEK BRIDGE
HOLE NO.- 3
STATION- 40+00
OFFSET- 15' RT.
CODED BY- GHO
GRD. WATER ELEV.- 29.0

DEPTH	FT.	PEN 1ST 6IN	PEN 2ND 6IN	SAMPLE NO.	TAT-ULT PSI	WET DEN PCF	MOI %	LL %	PI %	DESCRIPTION OF MATERIAL AND REMARKS
5		6	6							
10		9	6							
15		7	8							
20		7	7							
25		8	9							
30		10	20							
33		10	11							
35		15	16							
39		14	16							
44		20	20							

RILLER- R. SPRINGER
LOGGER- R. CURSON
TITLE-

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

SOIL STRENGTH ANALYSIS RESULTS

HOLE NUMBER 3

STRAT NUM.	ELEVATION -FEET- FROM	TO	STRAT THICKNESS FEET	CENTROID DEPTH FEET	UNIF. SOIL CLASS	PEN TEST BLOWS/ FOOT	TEST CONST	SOIL COHES LBS/ SQFT	WET DENS LBS/ CUFT	INT. FRIC ANG.	VARIANCE TAT PEAK	AVG	RATIO
1	43	32	11.0	5.5	CL	13.5	60						
2	32	26	6.0	14.0	SC	15.0	70						
3	26	13	13.0	23.5	CL	15.5	60						
4	13	11	2.0	31.0	OTHE	30.0	80						
5	11	6	5.0	34.5	CH	26.0	50						
6	6	-2	8.0	41.0	CL	35.0	60						

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

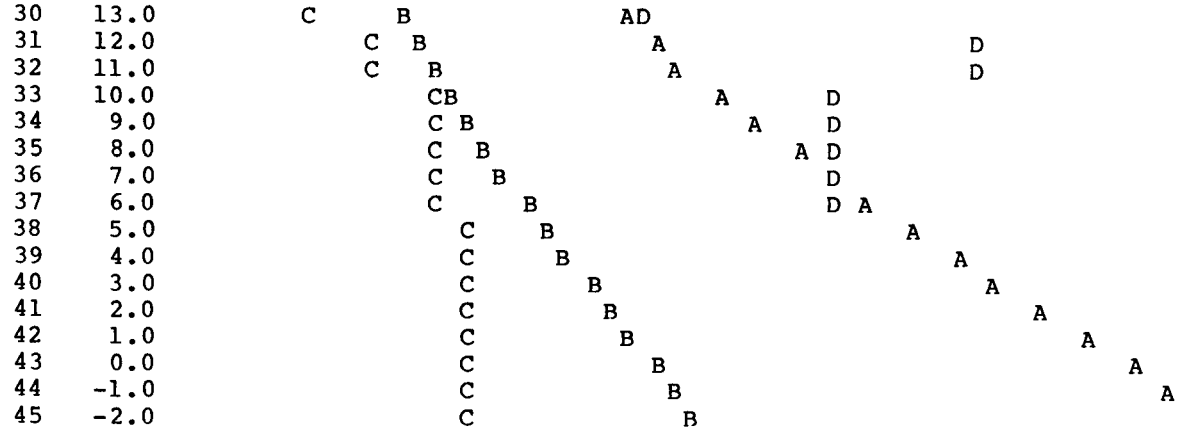
SOIL ANALYSIS PLOT FOR HOLE NUMBER 3
DISREGARD TO ELEVATION IS 28.0 FEET

A ACCUMULATIVE ALLOWABLE STATIC FRICTIONAL RESISTANCE
B ACCUMULATIVE REDUCED ALLOWABLE STATIC FRICTIONAL RESISTANCE
C DESIGN STRESS OR 1/2 SHEAR STRENGTH OF SOIL
D POINT BEARING STRENGTH

MAXIMUM ACCUMULATIVE FRICTIONAL RESISTANCE IS 11.80 TONS/FT OF PERIMETER

MAXIMUM DESIGN STRESS OR POINT BEARING STRENGTH IS 2.11 TONS/SQFT

DEPTH	ELEV	IN FEET
0	43.0	
1	42.0	D
2	41.0	D
3	40.0	D
4	39.0	D
5	38.0	D
6	37.0	D
7	36.0	D
8	35.0	D
9	34.0	D
10	33.0	D
11	32.0	D
12	31.0	B C D
13	30.0	BA C D
14	29.0	B C D
15	28.0	BA C D
16	27.0	BA C D
17	26.0	BA C D
18	25.0	B A C D
19	24.0	B A C D
20	23.0	B AC D
21	22.0	B C D
22	21.0	B CA D
23	20.0	B C A D
24	19.0	B C A D
25	18.0	BC A D
26	17.0	C A D
27	16.0	C A D
28	15.0	CB A D
29	14.0	C B A D


30 13.0
31 12.0
32 11.0
33 10.0
34 9.0
35 8.0
36 7.0
37 6.0
38 5.0
39 4.0
40 3.0
41 2.0
42 1.0
43 0.0
44 -1.0
45 -2.0

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

SOIL STRENGTH ANALYSIS RESULTS
DISREGARD TO ELEVATION IS 38.0 FEET

HOLE NUMBER 3

STRATA NUMBER	ELEVATION -FEET- FROM	TO	DESIGN STRESS OF SOIL TONS/SQFT PER STRAT	ALLOWABLE STATIC FRICTIONAL RESISTANCE (DS) TONS PER FT OF PERIMETER PER STRATUM	ACCUM-ULATIVE	SR	REDUCED ALLOWABLE STATIC FRICTIONAL RESISTANCE PER STRATUM	ACCUM-ULATIVE	BEAR FACTOR NC	POINT BEARING STRENGTH SNC TONS/SQFT
1	43.0	32.0	0.22	2.47	1.35	0.5	1.24	0.67	3.62	0.81
2	32.0	26.0	0.21	1.29	2.64	0.5	0.64	1.32	4.29	0.92
3	26.0	13.0	0.26	3.36	5.99	0.5	1.68	3.00	3.62	0.94
4	13.0	11.0	0.38	0.75	6.74	0.5	0.38	3.37	4.29	1.61
5	11.0	6.0	0.52	2.60	9.34	0.5	1.30	4.67	2.57	1.34
6	6.0	-2.0	0.58	4.67	14.01	0.5	2.33	7.01	3.62	2.11

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH ANALYSIS

HOLE NUMBER 3 BT #3 30" RD 30.0 INCH DRILLED SHAFT
DISREGARD TO ELEVATION IS 38.0 FEET

STRATA NUMBER	ELEVATION -FEET- FROM	TO	FRICTIONAL RESISTANCE PER STRATUM (TONS)	ACCUMULATIVE FRICTIONAL RESISTANCE (TONS)	POINT BEARING RESISTANCE (TONS)	ACCUMULATIVE ALLOWABLE FRICTION AND POINT BEARING (TONS)
1	43.0	32.0	9.7	5.3	4.0	9.3
2	32.0	26.0	5.0	10.4	4.5	14.9
3	26.0	13.0	13.2	23.5	4.6	28.1
4	13.0	11.0	2.9	26.5	7.9	34.4
5	11.0	6.0	10.2	36.7	6.6	43.3
6	6.0	-2.0	18.3	55.0	10.4	65.4

DESIGN LOAD 52.0 TONS

DEPTH TO DESIGN LOAD 39.3 FEET

ELEVATION OF FOUNDATION TIP 3.7 FEET

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH ANALYSIS

HOLE NUMBER 3 BT #3 15" SQ 15.0 INCH SQUARE PILING
DISREGARD TO ELEVATION IS 38.0 FEET

STRATA NUMBER	ELEVATION -FEET- FROM	TO	FRICTIONAL RESISTANCE PER STRATUM (TONS)	ACCUMULATIVE FRICTIONAL RESISTANCE (TONS)	POINT BEARING RESISTANCE (TONS)	ACCUMULATIVE ALLOWABLE FRICTION AND POINT BEARING (TONS)
1	43.0	32.0	12.4	6.7	1.3	8.0
2	32.0	26.0	6.4	13.2	1.4	14.6
3	26.0	13.0	16.8	30.0	1.5	31.4
4	13.0	11.0	3.8	33.7	2.5	36.2
5	11.0	6.0	13.0	46.7	2.1	48.8
6	6.0	-2.0	23.3	70.1	3.3	73.4

DESIGN LOAD 38.0 TONS

DEPTH TO DESIGN LOAD 33.0 FEET

ELEVATION OF FOUNDATION TIP 10.0 FEET

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

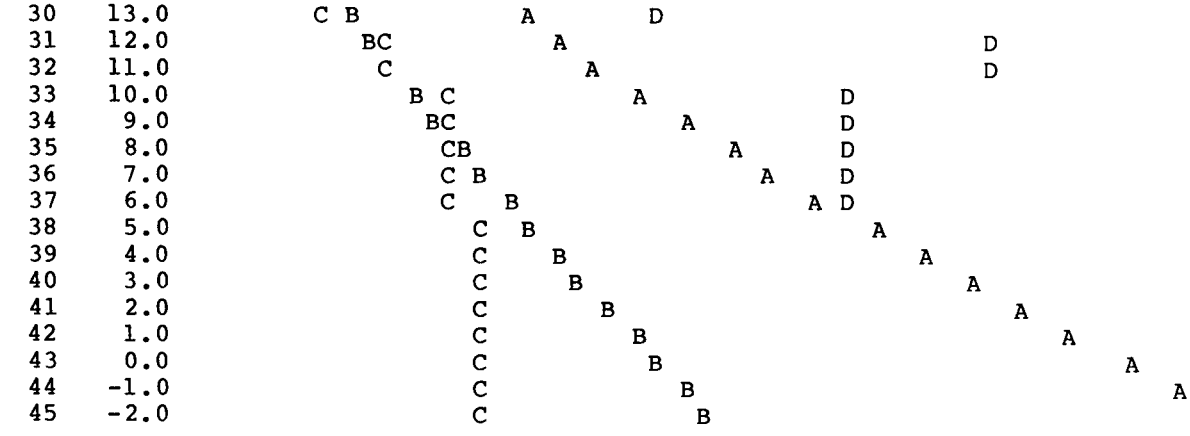
SOIL ANALYSIS PLOT FOR HOLE NUMBER 3
DISREGARD TO ELEVATION IS 38.0 FEET

A ACCUMULATIVE ALLOWABLE STATIC FRICTIONAL RESISTANCE
B ACCUMULATIVE REDUCED ALLOWABLE STATIC FRICTIONAL RESISTANCE
C DESIGN STRESS OR 1/2 SHEAR STRENGTH OF SOIL
D POINT BEARING STRENGTH

MAXIMUM ACCUMULATIVE FRICTIONAL RESISTANCE IS 14.01 TONS/FT OF PERIMETER

MAXIMUM DESIGN STRESS OR POINT BEARING STRENGTH IS 2.11 TONS/SQFT

DEPTH	ELEV IN FEET	
0	43.0	
1	42.0	BA C D
2	41.0	B C D
3	40.0	BA C D
4	39.0	BA C D
5	38.0	B A C D
6	37.0	BA C D
7	36.0	B A C D
8	35.0	B A C D
9	34.0	B A C D
10	33.0	B AC D
11	32.0	B AC D
12	31.0	B C D
13	30.0	B CA D
14	29.0	B C A D
15	28.0	B C A D
16	27.0	BC A D
17	26.0	BC A D
18	25.0	BC A D
19	24.0	BC A D
20	23.0	C A D
21	22.0	CB A D
22	21.0	CB A D
23	20.0	C B A D
24	19.0	C B A D
25	18.0	C B A D
26	17.0	C B A D
27	16.0	C B A D
28	15.0	C B A D
29	14.0	C B A D


30 13.0
31 12.0
32 11.0
33 10.0
34 9.0
35 8.0
36 7.0
37 6.0
38 5.0
39 4.0
40 3.0
41 2.0
42 1.0
43 0.0
44 -1.0
45 -2.0

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

SOIL STRENGTH ANALYSIS RESULTS
DISREGARD TO ELEVATION IS 28.0 FEET

HOLE NUMBER 3

STRATA NUMBER	ELEVATION -FEET- FROM	TO	DESIGN STRESS OF SOIL TONS/SQFT PER STRAT	ALLOWABLE STATIC FRICTIONAL RESISTANCE (DS) TONS PER FT OF PERIMETER PER STRATUM	ACCUM-ULATIVE	SR	REDUCED ALLOWABLE STATIC FRICTIONAL RESISTANCE PER STRATUM	ACCUM-ULATIVE	BEAR FACTOR NC	POINT BEARING STRENGTH SNC TONS/SQFT
1	43.0	32.0	0.00	0.00	0.00	0.5	0.00	0.00	3.62	0.00
2	32.0	26.0	0.21	1.29	0.43	0.5	0.64	0.21	4.29	0.92
3	26.0	13.0	0.26	3.36	3.79	0.5	1.68	1.89	3.62	0.94
4	13.0	11.0	0.38	0.75	4.54	0.5	0.38	2.27	4.29	1.61
5	11.0	6.0	0.52	2.60	7.14	0.5	1.30	3.57	2.57	1.34
6	6.0	-2.0	0.58	4.67	11.80	0.5	2.33	5.90	3.62	2.11

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH ANALYSIS

HOLE NUMBER 3 BT #2 30" RD 30.0 INCH DRILLED SHAFT
DISREGARD TO ELEVATION IS 28.0 FEET

STRATA NUMBER	ELEVATION -FEET- FROM	TO	FRICTIONAL RESISTANCE PER STRATUM (TONS)	ACCUMULATIVE FRICTIONAL RESISTANCE (TONS)	POINT BEARING RESISTANCE (TONS)	ACCUMULATIVE ALLOWABLE FRICTION AND POINT BEARING (TONS)
1	43.0	32.0	0.0	0.0	0.0	0.0
2	32.0	26.0	5.0	1.7	4.5	6.2
3	26.0	13.0	13.2	14.9	4.6	19.5
4	13.0	11.0	2.9	17.8	7.9	25.7
5	11.0	6.0	10.2	28.0	6.6	34.6
6	6.0	-2.0	18.3	46.4	10.4	56.7

*** NOTE ***** FOUNDATION DID NOT REACH DESIGN LOAD WITHIN GIVEN DATA

PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH ANALYSIS

HOLE NUMBER 3 BT #2 15" SQ 15.0 INCH SQUARE PILING
DISREGARD TO ELEVATION IS 28.0 FEET

STRATA NUMBER	ELEVATION -FEET- FROM	TO	FRICTIONAL RESISTANCE PER STRATUM (TONS)	ACCUMULATIVE FRICTIONAL RESISTANCE (TONS)	POINT BEARING RESISTANCE (TONS)	ACCUMULATIVE ALLOWABLE FRICTION AND POINT BEARING (TONS)
1	43.0	32.0	0.0	0.0	0.0	0.0
2	32.0	26.0	6.4	2.1	1.4	3.6
3	26.0	13.0	16.8	18.9	1.5	20.4
4	13.0	11.0	3.8	22.7	2.5	25.2
5	11.0	6.0	13.0	35.7	2.1	37.8
6	6.0	-2.0	23.3	59.0	3.3	62.3

DESIGN LOAD 45.0 TONS

DEPTH TO DESIGN LOAD 39.2 FEET

ELEVATION OF FOUNDATION TIP 3.8 FEET

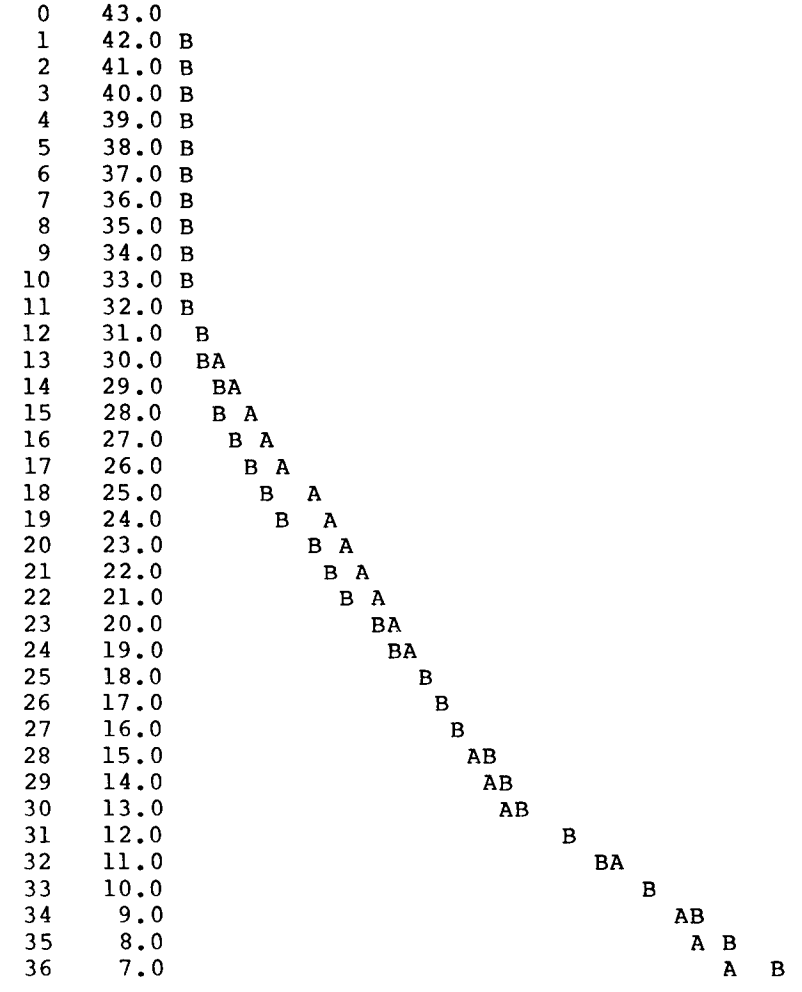
PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

FOUNDATION STRENGTH PLOT FOR HOLE NUMBER 3

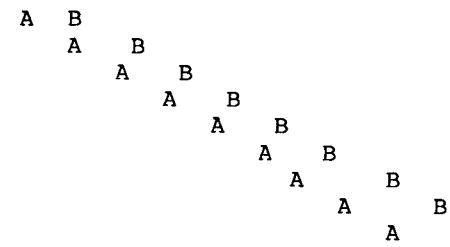
A BT #2 30" RD 30.0 INCH DRILLED SHAFT
B BT #2 15" SQ 30.0 INCH DRILLED SHAFT

THE MAXIMUM FOUNDATION STRENGTH IS 62.32 TONS

DEPTH ELEV IN FEET



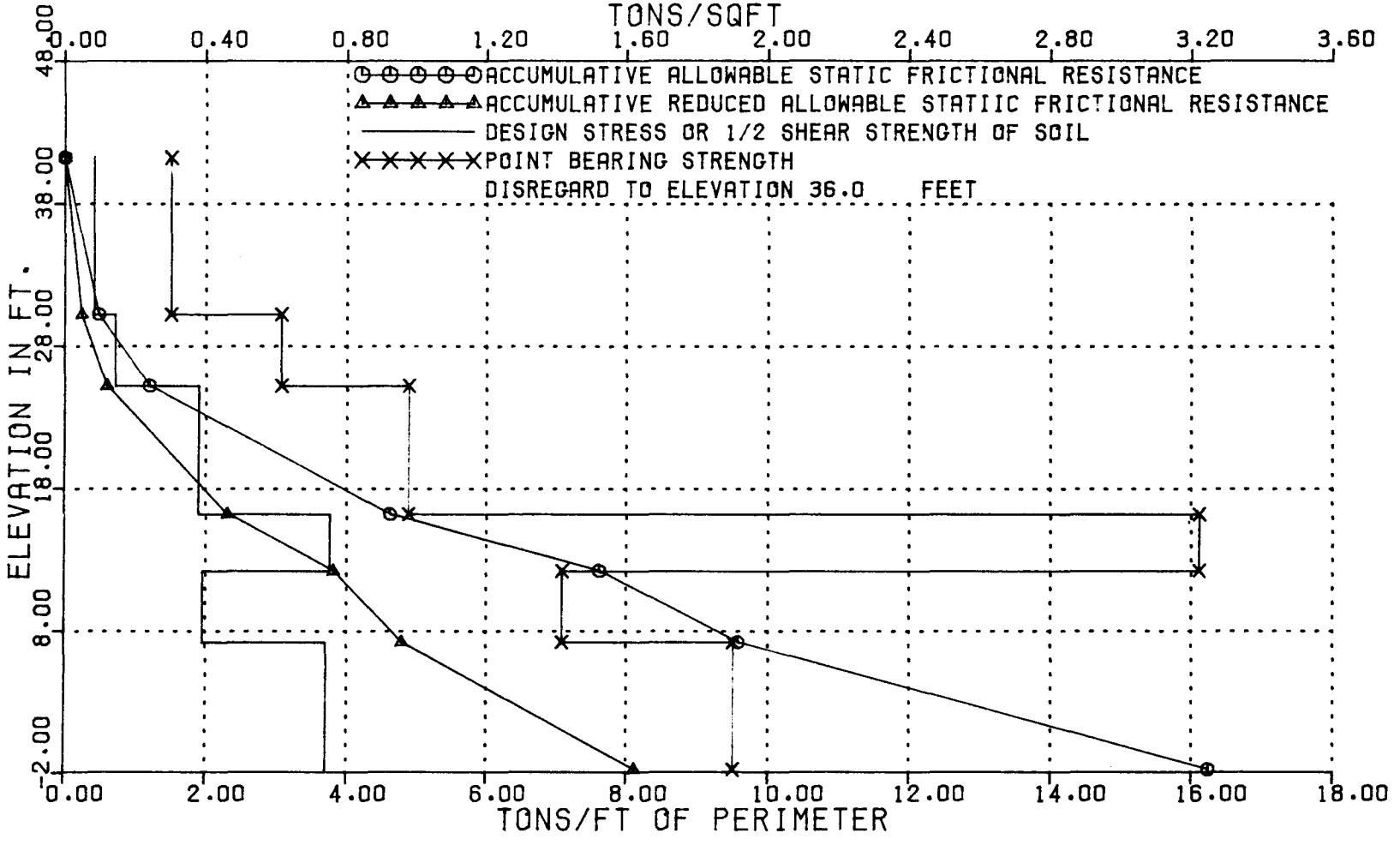
37	6.0
38	5.0
39	4.0
40	3.0
41	2.0
42	1.0
43	0.0
44	-1.0
45	-2.0



PROB (CONTD)
213 US 290 AT ELM CREEK DRILLED SHAFTS AND PILE ALTERNATE DESIGNS

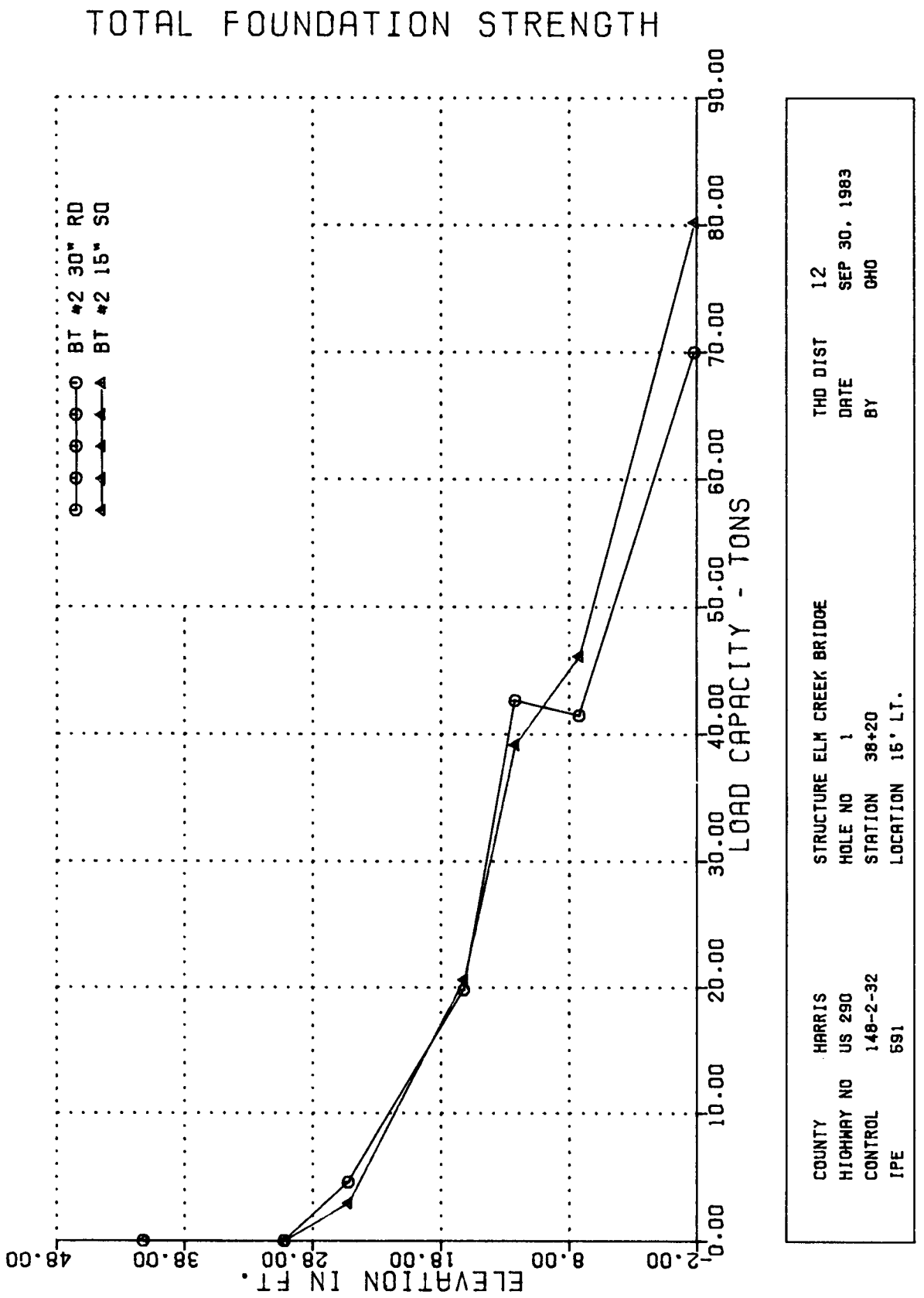
SUMMARY OF FOUNDATION LENGTHS AND LOADS FOR HOLE NUMBER 3

BT #2 30" RD	30.0 INCH DRILLED SHAFT	
	DISREGARD TO ELEVATION IS 28.0 FEET	
	ELEVATION OF FOUNDATION TIP IS -9957.0 FEET	
	DEPTH TO DESIGN LOAD ****** FEET DESIGN LOAD	72.0 TONS
BT #3 30" RD	30.0 INCH DRILLED SHAFT	
	DISREGARD TO ELEVATION IS 38.0 FEET	
	ELEVATION OF FOUNDATION TIP IS 3.7 FEET	
	DEPTH TO DESIGN LOAD 39.3 FEET DESIGN LOAD	52.0 TONS
BT #2 15" SQ	15.0 INCH SQUARE PILING	
	DISREGARD TO ELEVATION IS 28.0 FEET	
	ELEVATION OF FOUNDATION TIP IS 3.8 FEET	
	DEPTH TO DESIGN LOAD 39.2 FEET DESIGN LOAD	45.0 TONS
BT #3 15" SQ	15.0 INCH SQUARE PILING	
	DISREGARD TO ELEVATION IS 38.0 FEET	
	ELEVATION OF FOUNDATION TIP IS 10.0 FEET	
	DEPTH TO DESIGN LOAD 33.0 FEET DESIGN LOAD	38.0 TONS



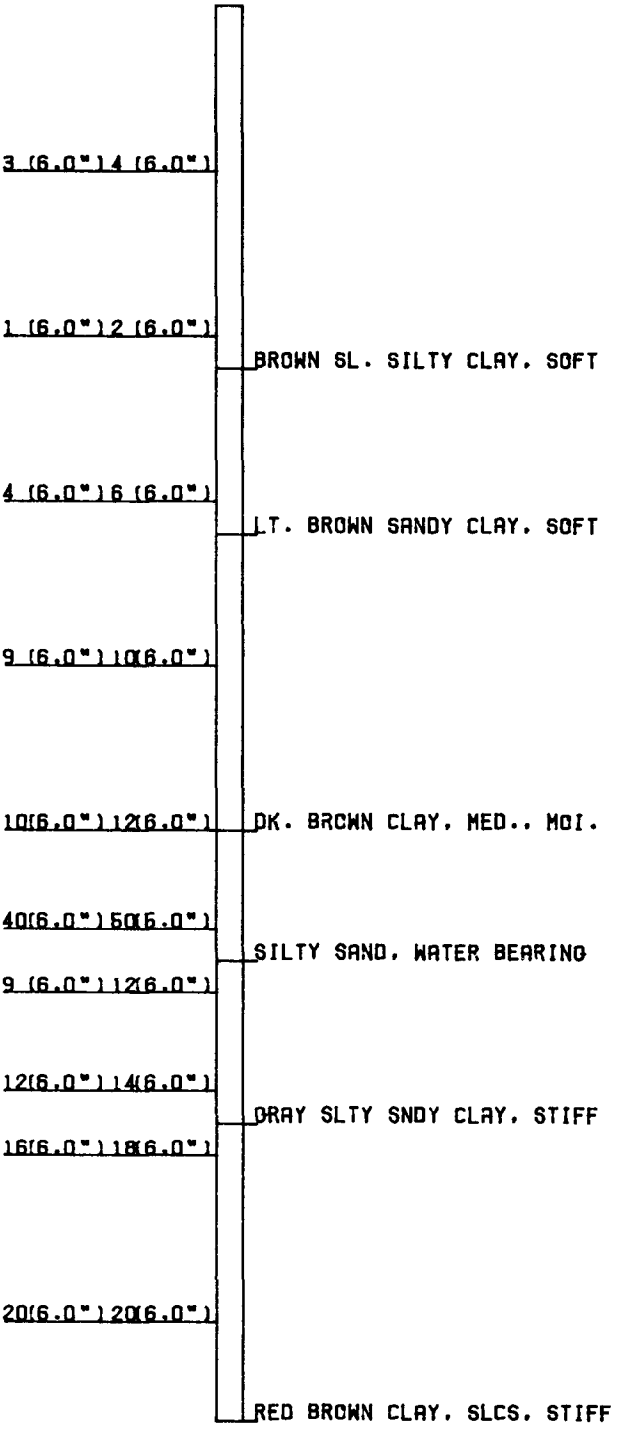
FOUNDING MATERIAL PROPERTIES

COUNTY	HARRIS	STRUCTURE	ELM CREEK BRIDGE	THD DIST	12
HIGHWAY NO	US 290	HOLE NO	1	DATE	SEP 30, 1983
CONTROL	148-2-32	STATION	38+20	BY	OHO
IPE	591	LOCATION	15' LT.		


TOTAL FOUNDATION STRENGTH
BT #2 30" RD
BT #2 15" SQ
LOAD CAPACITY - TONS
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
ELEVATION IN FT.
-2.00
8.00
18.00
28.00
38.00
48.00
COUNTY HARRIS
HIGHWAY NO US 290
CONTROL 148-2-32
IPE 691
STRUCTURE ELM CREEK BRIDGE
HOLE NO 1
STATION 38+20
LOCATION 15' LT.
THD DIST 12
DATE SEP 30, 1983
BY OHO

TEST HOLE NO. 1

GROUND ELEV. 41.2



DRILLING LOG

COUNTY	HARRIS	STRUCTURE	ELM CREEK BRIDGE	THD DIST	12
HIGHWAY NO	US 290	HOLE NO	1	DATE	OCT 04, 1983
CONTROL	148-2-32	STATION	38+20	ORD. ELEV.	41.2
IPE	591	LOCATION	15' LT.	ORD.WATER ELEV.	29.0

ELEV FT.		LOG	THD PEN. TEST NO. OF BLOWS 1ST 6"	2ND 6"	DESCRIPTION OF MATERIAL	METHOD OF CORING
41.2	0				0	
			3 (6.0")	4 (6.0")	BROWN SL. SILTY CLAY. SOFT	
	10		1 (6.0")	2 (6.0")	10	
30.2			4 (6.0")	6 (6.0")	LT. BROWN SANDY CLAY. SOFT	
25.2			9 (6.0")	10(6.0")	DK. BROWN CLAY. MED.. MOI.	
	20				20	
18.2			10(6.0")	12(6.0")		
			40(6.0")	50(5.0")	SILTY SAND. WATER BEARING	
12.2	30		9 (6.0")	12(6.0")	GRAY SLTY SNDY CLAY. STIFF	
			12(6.0")	14(6.0")	30	
7.2			16(6.0")	18(6.0")	RED BROWN CLAY. SLCS. STIFF	
	40		20(6.0")	20(6.0")	40	

*REMARKS:

DRILLER R. SPRINGER LOGGER R. CURSON TITLE