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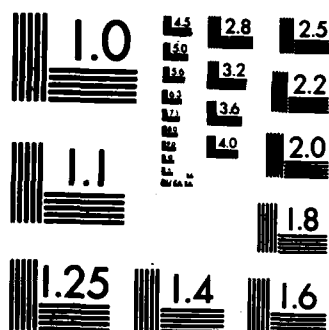
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# ANALYZING SLIDING STABILITY OF STRUCTURES USING THE MODIFIED COMPUTER PROGRAM GWALL

by

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November 1983

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Prepared for U. S. Army Engineer Division, Lower  
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  > This instruction manual provides updated directions for using the com- puter program GWALL which has been modified through usage; GWALL is an interac- tive graphics program for analyzing the sliding stability of structures. The program provides for display of input data for easy checking and editing and requires the use of a Tektronix 4014 or other terminal with the same capabili- ties. The analysis is a wedge method slope stability analysis that follows the  (Continued)		

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20. ABSTRACT (Continued).

design procedures used in the Lower Mississippi Valley Division for analysis of plane failures. The program provides for calculation of uplift by entering a profile of force water seepage pressures.

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## Preface

This report documents an interactive graphics program, GWALL, for analyzing the sliding stability of structures. Use of GWALL was first documented in 1978 in U. S. Army Engineer Waterways Experiment Station (WES) Instruction Report K-78-1. Since that time, GWALL has been modified due to user requests, and this report is a revised instruction manual for GWALL.

The program is an addition to the series of slope stability programs that was developed by Mr. James B. Cheek, Automatic Data Processing (ADP) Center, WES. The analysis portion of GWALL was taken from slope stability program SSW39A. Also, since most of the input for GWALL is identical with that for program SSW39A, most of the documentation in this report came directly from WES Miscellaneous Paper K-77-1, "Analysis of Slope Stability, Wedge Method Using Head Profiles to Model Uplift Pressures," by J. B. Cheek, Jr.

The latest work, supported by the U. S. Army Engineer Division, Lower Mississippi Valley, to allow the use of an inclined neutral block base, crack analysis, horizontal and vertical forces on the neutral block, and the addition of structure geometry was completed by Mr. Robert L. Hall, ADP Center, WES. Dr. N. Radhakrishnan, Special Technical Assistant, ADP Center, was technical coordinator of the work.

COL T. C. Creel, CE, was Commander and Director of WES during the preparation and publication of this report. Mr. F. R. Brown was Technical Director.

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ANALYZING SLIDING STABILITY OF STRUCTURES USING  
THE MODIFIED COMPUTER PROGRAM GWALL

Purpose and Scope

1. This report updates the directions for use of the modified interactive graphics program GWALL to analyze the sliding stability of structures. The report covers only use of the modified program. The user's background in stability analysis is assumed to be sufficient to enable him to properly prepare data and to properly interact and evaluate the computed results.

Computation Procedures

2. The solution process used by GWALL is the same as that explained in Miscellaneous Paper K-77-1.\* It is a slope stability program that uses developed cohesion, and the wedge method of analysis.

Terminals

3. The user must have an interactive graphics terminal with features equivalent to the Tektronix 4014 storage tube terminal. Graphics terminals other than the Tektronix 4014 can be used with GWALL, but only after slight modification to GWALL and/or the graphics software package, Graphics Compatibility System (GCS).

Input Features

4. GWALL is very easy to use because it allows the user to interact with the program in a conversational manner. It does not force the user to follow a sometimes inefficient data preparation procedure, but allows the user to dictate the program action by commands which are easily learned.

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\* James B. Cheek, Jr., "Analysis of Slope Stability, Wedge Method Using Head Profiles to Model Uplift Pressures," Miscellaneous Paper K-77-1, April 1977, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

5. The program assists the user in preparing input data in two ways: It displays the input graphically, as it is being defined, allowing the user to visually check what information has been input. The program also can give data preparation instructions which are printed at the terminal following each command.

6. GWALL checks the input data and prints error messages if the data violates a program requirement. However, this feature does not guarantee good data. Therefore, the program has commands that allow the user to change much of the input.

7. The combination of the graphics, commands, built-in data preparation instructions, and data-checking logic enables the new user to learn quickly how to use the program.

#### Experienced User Convenience

8. As the user becomes proficient in use of GWALL, he will find that the conversational mode, which was helpful during his learning phase, becomes annoying: he must wait for the terminal to type data preparation instructions he has already mastered by repeated program use. To eliminate this waiting, a special command code is provided to delete the instruction preparation associated with data input commands. This feature allows the user to quickly prepare data without unnecessary "back talk" from the terminal. However, even an experienced user may forget the data requirements of an infrequently used command. In such a case, he simply uses another command code to restore the program to full conversational mode.

#### Prepared Data File

9. Time-sharing computer systems do not always respond quickly to the user's commands, especially when there are many users simultaneously on the system. At such times, there may be 1- to 2-minute delays between user commands and program responses. To bypass this difficulty, data can be input from a data file, which may be quickly prepared since its preparation speed is not usually limited by the number of users on the system. Data may also be available as the result of a prior run of the program. In either case, the user may run a long series of computations from data in a file. Once the data

are entered, he may continue with his stability study, using any of the modes of operation.

### Analysis

10. GWALL is a modified slope stability analysis program. The analysis program described in Miscellaneous Paper K-77-1 is used to calculate the sliding stability of the structure.

### Output

11. After completion of each analysis, the user has the option of getting a plot at his storage tube terminal that shows the soil and water profiles, as well as the failure surface.

### Overview of Operating Procedure

12. Although each facet of the operating procedure will subsequently be covered in detail, the following overview of the operating procedure may be helpful to the user in learning how the facets interact.

13. The user, seated at the graphics terminal, calls the computer, identifies himself, and requests a run of the program. GWALL asks for the name of a restart file, and the user supplies it. This file is used to save the data used as input for the last stability calculations. The program then requests a data title, which the user supplies. This title is stored in the first line of the restart file for identification purposes. The program then asks for a command, which the user supplies. Through this and subsequent commands, GWALL does any or all of the following: receives or alters soil properties, soil profiles, pool elevations, and neutral block base points; modifies the computational procedure; and evaluates stability for the data stored. It also displays soil profiles, pool elevations, piezometric head points, neutral blocks, and the phreatic profile. After investigating several failure surfaces, the user may find it necessary to sign off and attend to other duties, even though the analysis is not complete. He may do so without fear of data loss because all data items used in the last analysis

are stored by the program in the restart file. They are ready for use when he next works on the problem.

#### Data Preparation

14. After the proper log-on procedure and the proper run commands have been given, the program takes control of the terminal and types

GRAPHICAL WALL ANALYSIS

BY  
R. HALL  
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SUPPLY NAME OF RESTART FILE

=

The user supplies the desired file name and a carriage return (CR). Most computer systems will write over the existing data if the file is an existing one. Therefore, the user should give a new file name, and he should be sure that the data stored under the old file name are no longer needed. After this file is established, the program types

SUPPLY TITLE FOR THIS RUN

=

The user can supply a title for this run of up to 60 characters, including blanks. This title is written on the first line of the restart file. By choosing meaningful titles and names for the restart file, the user can keep track of files associated with specific projects. After the title is entered, the screen is erased and the program types:

ENTER COMMAND

=

The user may now begin to use commands to enter, display, and/or run a stability analysis. If an invalid command is entered, the user has the option of getting a list of valid commands, as shown in Figure 1.

#### Optional Output

15. The user can receive optional data preparation instructions with

ENTER COMMAND

-XX

COMMAND UNKNOWN

DO YOU WISH A LIST OF VALID COMMANDS ? ENTER (Y OR N)

-Y

SOIL DATA

STRUCTURE DATA

NEUTRAL BLOCK

EDIT XXXX

POOLS

PIEZOMETRIC HEAD

CONVERSATIONAL OUTPUT

NO CONVERSATION OUTPUT

TABLE OF SOIL PROPERTIES

READ OLD DATA FILE

WINDOW PROFILE

DISPLAY PROFILE

DELETE XXXX

HORZ. FORCE

VERT. FORCE

RUN

RUN CRACK

BRIEF OUTPUT

FAILURE SURFACE PRINTING

END

ENTER COMMAND

-

Figure 1. List of commands

each data input command. The additional instructions are referred to as the "full conversational mode." The optional output is underlined in this report to distinguish it from the normal output.

Soil Input Command = SO

16. The program responds to command soil with

SOIL 1 PROPERTIES

<u>SATURATED</u>	<u>Q TEST</u>	<u>R TEST</u>	<u>S TEST</u>
UNIT WT.,	PHI, COHESION,	PHI, COHESION,	PHI, COHESION

-

Reply with the saturated unit weight in pounds per cubic foot; Q, R, and S test

values for the friction angle ( $\phi$ ) in degrees; and cohesion (C) in pounds per square foot. The last item is followed by CR. Although all these strengths are given, only the S strength values are used at this time. The program stores the properties and requests

#### SOIL PROFILE

X(1), Y(1), X(2), Y(2), ... X(N), Y(N)

=

Supply the points, distance, and elevation in feet on the exterior profile in ascending order by distance X. Note that this exterior profile must extend beyond the surface intersection points of any wedges to be studied. If more than one line of data is required for the profile, insert a comma and then CR after the last point on the line. GWALL stores this portion of the profile. When the program is ready for the remainder of the data, it types an equal sign on the next line. Wait for the equal sign before supplying additional points. Additional SO commands are used to input the properties and profile data for the interior soils. The program numbers each new soil in steps of one, starting with the numeral 1 for the first soil.

17. Soils must be defined working from high elevations to low, because each profile erases all portions of profiles below it. Any valid portion of a profile erased by this procedure must be redefined with an additional lower soil. The first soil profile (outer shell) must extend from the far left to the far right of the area to be studied. Profiles below the first profile must not extend farther in any direction than the first profile. However, profiles below the outer shell do not have to extend to the extremes of the problem. The following are a few additional rules for defining profiles:

- a. All profiles must contain a minimum of two points.
- b. Perfectly vertical profiles are not allowed.
- c. Profiles must not intersect.
- d. Profiles are not confined to only positive coordinates; the profiles may lie anywhere in the planar Cartesian coordinate system.

18. The screen is erased and all data are displayed after each soil profile is defined. The soil profiles are displayed using the same scale factor in both the X and Y directions (see Figure 2). The scale factor is chosen to use as much of the screen as possible. If a soil profile point is improperly input, the X and Y coordinates of this point can be changed by

the Edit Soil command, ED SO. The soil properties can be changed by the Edit Properties command, ED PR. Following is an example of entering soil data. The X and Y coordinates are separated by commas while the pairs are separated by blanks. This is not a necessity since both commas and blanks are valid delineations. This was done to allow the data to be checked easily.

ENTER COMMAND

=SO

SOIL 1 PROPERTIES

SATURATED	Q TEST	R TEST	S TEST
UNIT WT., PHI, COHESION,	PHI, COHESION,	PHI, COHESION,	PHI, COHESION
=112 30 0 30 0 30 0			

SOIL PROFILE

X(1), Y(1), X(2), Y(2), ... X(N), Y(N)  
 =0,0 100,0 150,50 151,89 200,100 300,100

ENTER COMMAND

.

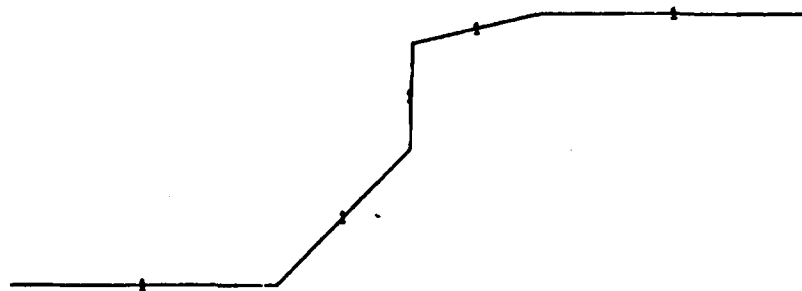


Figure 2. Display of soil data

Structure Input Command = ST

19. GWALL responds to command ST with

UNIT WT. OF CONCRETE

=

Reply with the unit weight of the concrete in pounds per cubic foot.

20. The program stores the weight and requests

STRUCTURE PROFILE

X(1), Y(1), X(2), Y(2), ... X(N), Y(N)

Supply the points, distance, and elevation, in counterclockwise order. The first and last points must be outside the outer soil profile. The structure input must be given after all soil data have been defined. Perfectly vertical profile segments must be avoided. Following shows the data entry of the structures coordinates. The use of commas and blanks are used as they were for the soil profile. The display of structure is seen in Figure 3.

ENTER COMMAND

\*ST

UNIT WT. OF CONCRETE

=150.

STRUCTURE PROFILE

X(1), Y(1), X(2), Y(2), ... X(N), Y(N)

=140,90 139.9,20 127,18 126.9,10 180,8,

=185,-2 190,-2 189.9,15 151,20 150.9,90

ENTER COMMAND

.

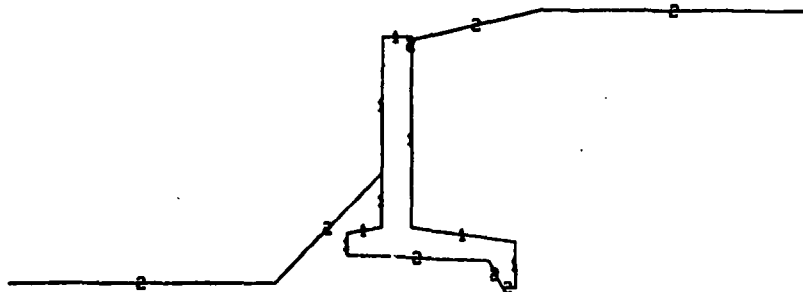


Figure 3. Display of structure data



### Neutral Block Command = NE

21. The neutral block command, NE, is used to input the end points of the neutral block base. The neutral block does not have to be horizontal, but a number to indicate the direction of failure is required. A positive number indicates that sliding will occur, with the right wedge being the active wedge and the left wedge being passive. A negative number indicates that the left wedge is active and the right wedge is passive.

22. The program responds to the NE command with

NEUTRAL BLOCK BASE n

LEFT	RIGHT	FAILURE
X,Y,	X,Y	DIRECTION
=		

where n is the neutral block number assigned by the program.

23. The user may continue to use the NE command to establish a group of up to 25 neutral blocks for subsequent analysis. After each neutral block is defined, it is displayed with the soil profile, as shown in Figure 4. The following is the data entry for the neutral block.

ENTER COMMAND  
•NE

NEUTRAL BLOCK BASE NUMBER 1

LEFT	RIGHT	FAILURE
X, Y,	X, Y,	DIRECTION
•125,-5 200,-3 -1		

ENTER COMMAND  
•

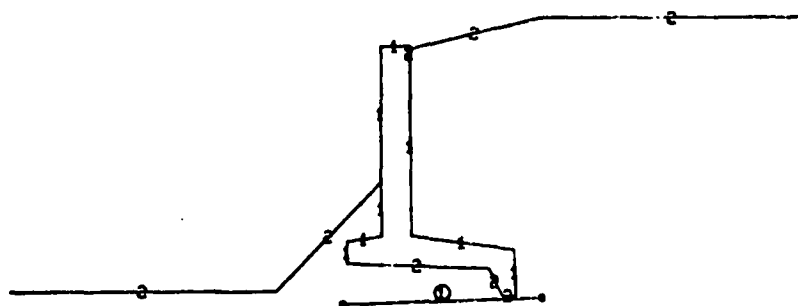


Figure 4. Input and display of neutral block

Pool Command = PO

24. The program responds to this command with

POOL EL

HEADWATER, TAILWATER

Reply with elevations for the pools. Pool elevations must use the same coordinate system as the soil profiles, neutral blocks, and phreatic profile. GWALL assumes the headwater elevation and tailwater elevations to be zero until properly defined. After the pools have been defined, they are displayed as shown in Figure 5. The headwater pool is assumed to be located behind the structure (over the heel), while the tailwater pool is assumed to be located in front of the structure (over the toe). These pool elevations are only used to calculate proper soil weights and additional surcharge loading when located above the outer shell soil profile.

ENTER COMMAND  
=PO

POOL EL.

HEADWATER, TAILWATER  
=78,30

ENTER COMMAND  
=

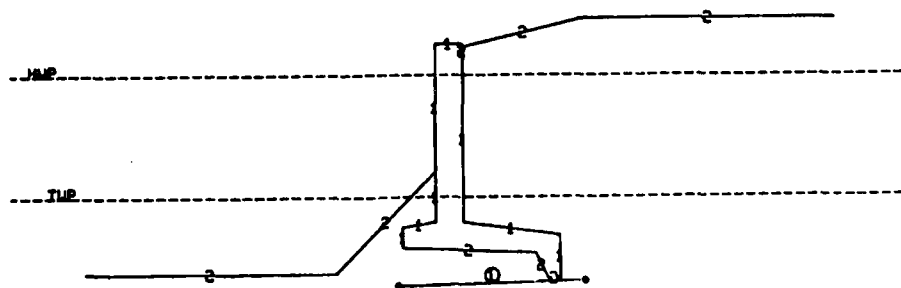


Figure 5. Input and display of pool elevation

Horizontal Force Command = H0

25. The program responds to this command with

ENTER HORZ. FORCE FOR NEUTRAL BLOCK

=

Enter the value, in pounds, for the horizontal force acting on the neutral block. A positive force is assumed to be acting to the right. After the force is entered, it is displayed, as in Figure 6.

ENTER COMMAND

=H0

ENTER HORZ. FORCE FOR NEUTRAL BLOCK

=1200.

ENTER COMMAND

.

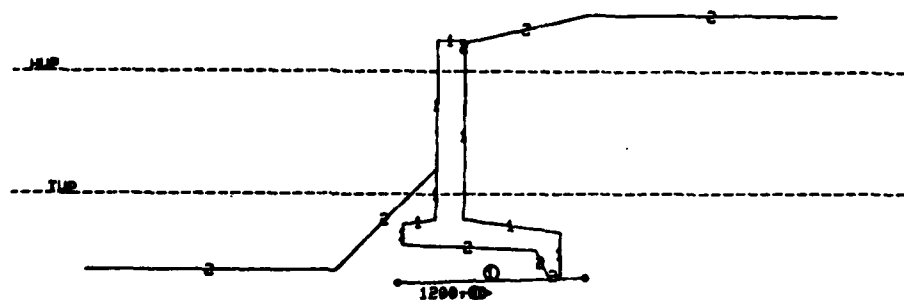


Figure 6. Input and display of horizontal force

Vertical Force Command = VE

26. The program responds to this command with

ENTER VERT. FORCE FOR NEUTRAL BLOCK

Enter the value, in pounds, for the vertical force acting on the neutral block. A positive force is assumed to be acting upward. After the force has been entered, it is displayed as shown in Figure 7.

ENTER COMMAND

=VE

ENTER VERT. FORCE FOR NEUTRAL BLOCK

=2000.

ENTER COMMAND

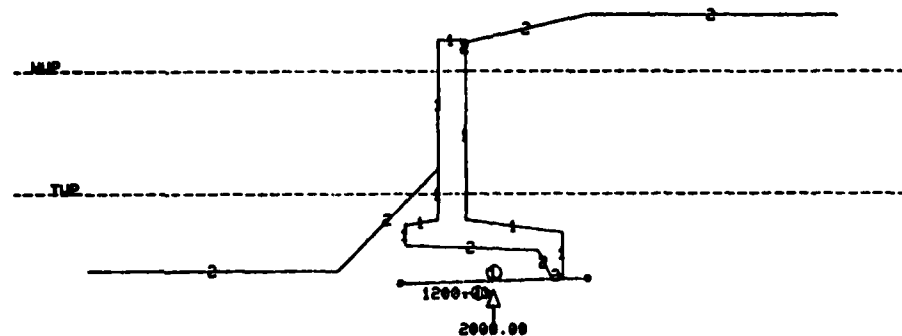


Figure 7. Input and display of vertical force

### Piezometric Profile Command = PI

27. The program responds to the command PI with

#### PIEZOMETRIC HEAD POINTS

X(1), Y(1), H(1), X(2), Y(2), H(2), ... X(N), Y(N), H(N)

=

Enter the head data profile points consisting of the distance and elevation of a point and the piezometric head, in feet, at that point. The points on each head data profile must be entered in ascending order of distance. If more than one line of data is required for the head of any profile, follow the last head value on the line with a comma then a CR. GWALL will store this portion of the piezometric head data. When the program is ready for additional data, it will type an equal sign on the next line. Note that the first profile must define the phreatic surface (head values must be zero). Each additional profile is supplied by giving command PI, followed by the data for that profile. Figure 8 shows the command as well as a display of data input. The user must provide a minimum of two piezometric head profiles, and the profiles must consist of at least two points. The piezometric head profiles do not have any effect on calculations of weights. The piezometric head profiles are used to calculate the uplift pressures along the assumed failure path.

ENTER COMMAND

=PI

PIEZOMETRIC HEAD POINTS

X(1),Y(1),H(1),X(2),Y(2),H(2), ... X(N),Y(N),H(N)

=0,0,0 100,0,0 150,50,0 300,50,0

ENTER COMMAND

=PI

PIEZOMETRIC HEAD POINTS

X(1),Y(1),H(1),X(2),Y(2),H(2), ... X(N),Y(N),H(N)

=0,-30,30 100,-30,30 150,-30,80 300,-30,80

ENTER COMMAND

=

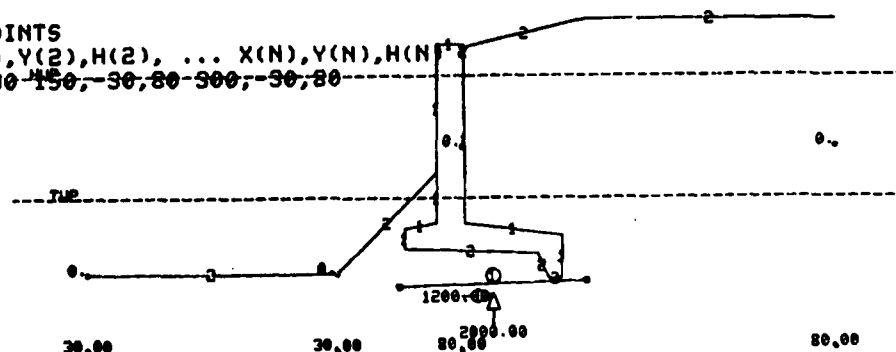


Figure 8. Input and display of piezometric head data

Change Material Properties Command = ED MA

28. The program responds to this command with:

SOIL NUMBER TO BE CHANGED

=

Reply with the number of any soil previously defined. An error message will be typed if a soil having this number is not present.

29. After locating this soil, the program types:

SOIL i PROPERTIES

SATURATED	Q TEST	R TEST	S TEST
UNIT WT., PHI, COHESION,	PHI, COHESION,	PHI, COHESION,	PHI, COHESION

=

The symbol i is the number of the soil requested. Respond to this request with the new soil properties, as described in the section on the SO command. All values requested must be input, even though they are the same as the previously stored data.

Edit Soil Profile Command = ED SO

30. The program responds to this command by first displaying the cross hairs. The user must then move the cross hairs to the soil profile point and enter any character and CR. GWALL then responds with

PRESENT X AND Y COORDINATES ARE

X Y

INPUT NEW COORDINATES

=

The program then changes all soil profiles that contain the X-Y coordinates selected using the cross hairs to the new input. The screen is erased and the new data displayed, as shown in Figures 9 and 10.

Edit Piezometric Head Data = ED PI

31. The program responds to this command by first displaying the cross hairs. The user must then move the cross hairs to the desired piezometric head

ENTER COMMAND  
 -ED 50

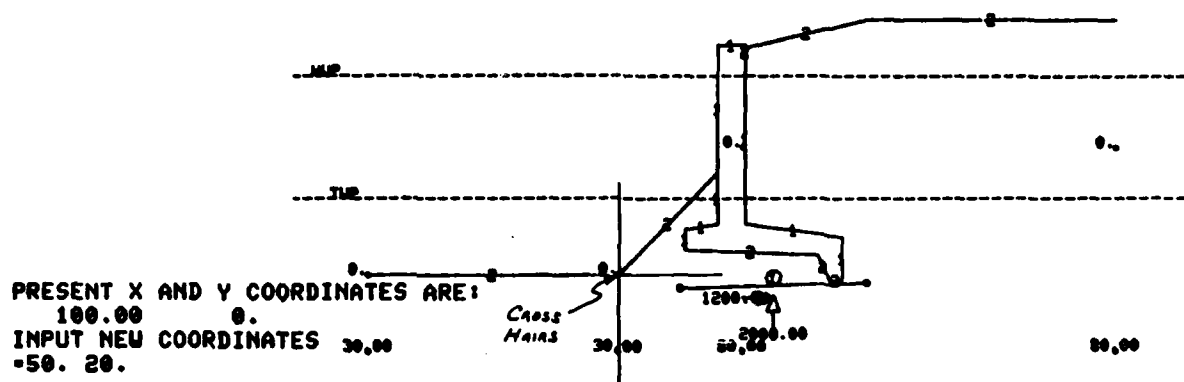


Figure 9. Editing soil data

ENTER COMMAND  
 -

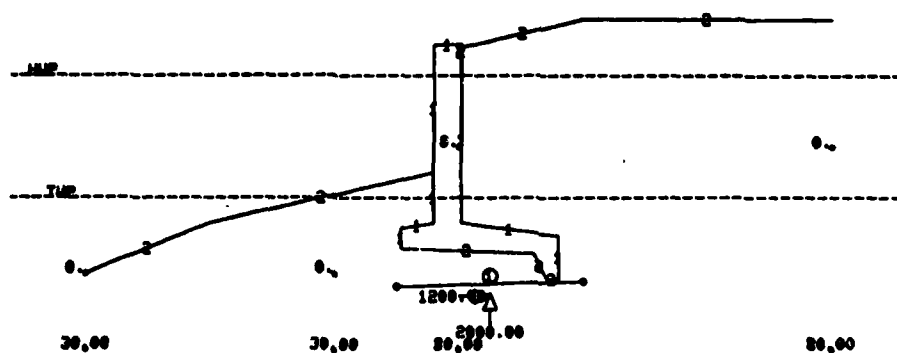


Figure 10. Display of edited soil data

point and enter any character and CR. The program then responds with

PRESENT X AND Y COORDINATES ARE  
 X Y  
 INPUT NEW COORDINATES AND HEAD  
 -

GWALL then changes the piezometric head profile data. The screen is erased and the new data displayed, as with the ED SO command.

Delete Neutral Block Command = DE NE

32. The program responds to this command with:

ENTER NEUTRAL BLOCK NUMBER=

The user then enters the number of the neutral block to be deleted; GWALL then renumbers the neutral blocks following the one that was deleted.

Delete Horizontal Force Command = DE HO

33. The program deletes the use of horizontal force on the neutral block. The display of the horizontal force is deleted after the present display is erased and redisplayed.

Delete Vertical Force Command = DE VE

34. The program deletes the use of the vertical force on the neutral block. The display of the vertical force is deleted after the present display is erased and redisplayed.

Window Command = WI

35. This command allows the user to pick any rectangular area of the display and to magnify it to fill the entire screen. This feature provides the user with all the necessary details required in checking the input data. The program responds to this command by displaying the cross hairs. The cross hairs should then be moved to the bottom left corner of the area to be magnified; a character must then be entered, followed by CR. The cross hairs reappear and should be moved to the upper right corner of the desired area; another character and CR should be entered. The user can continue giving the WI command to window an area of the previous window. To redisplay the entire problem again, the command DI should be entered. The WI command is demonstrated in Figures 11 and 12.



ENTER COMMAND  
-UI

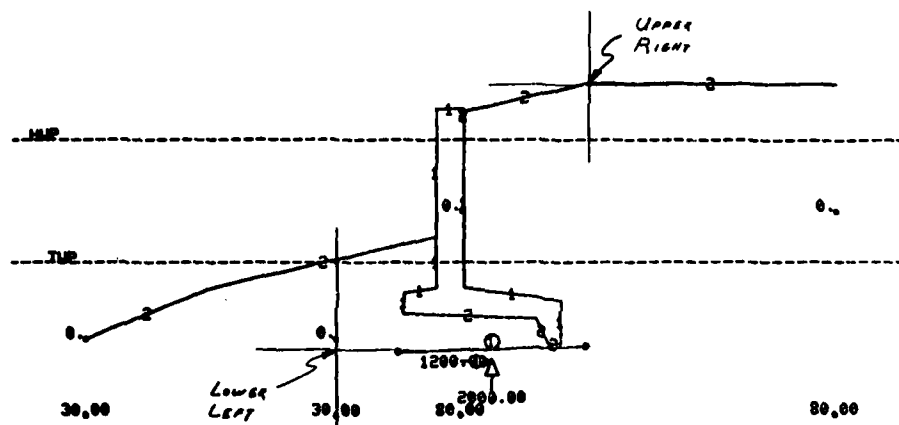


Figure 11. Window command

ENTER COMMAND  
.

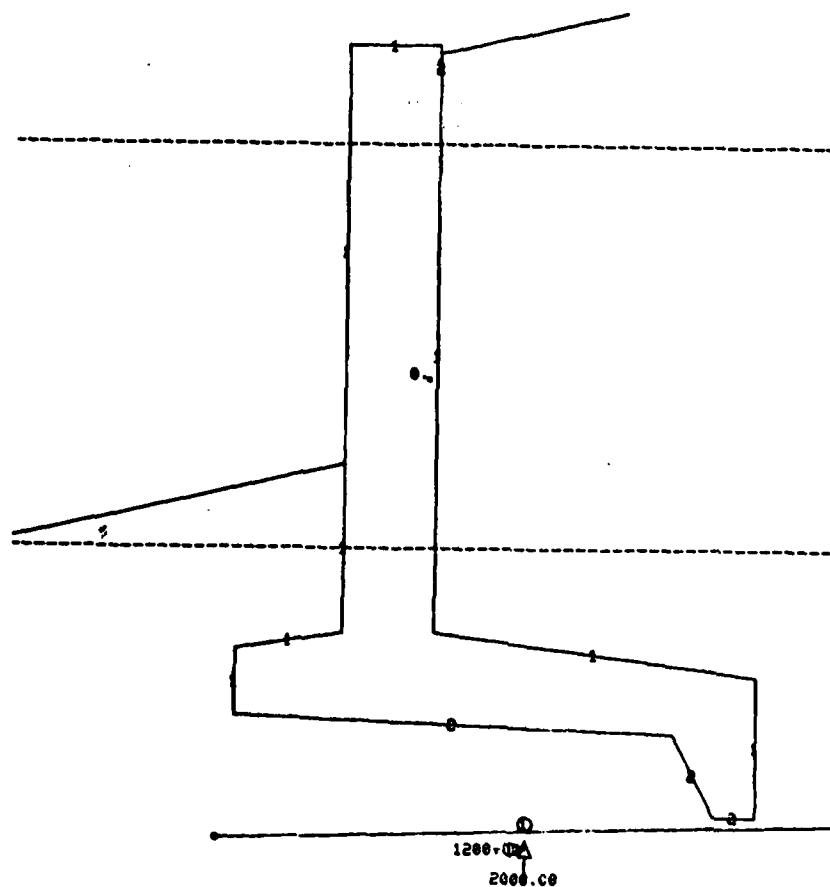


Figure 12. Result of windowing

Display All Data Command = DI

36. The response to this command is the erasing of the screen and the displaying of all defined data. The display data uses as much of the screen as possible, using the same X- and Y-scale factors.

Conversational Mode Command = CO

37. The conversational mode is an optional feature that does not become effective until an invalid command or the CO command is given. The CO command causes the program to provide additional input instructions for the data input command codes. The underlined portions of the commands in this report are the results of the conversational mode.

Delete Conversational Mode Command = NO

38. This command deletes the conversational text associated with the program's response to the command CO. As mentioned previously, the terminal output controlled by command CO is underlined in this report.

Table of Soil Properties Command = TA

39. This command provides the user with a current listing of each soil's unit weight, angle of internal friction, and angle of cohesion for the Q, R, and S strength tests. If improper data have been entered, the user may change the material properties with an ED MA command. Use of command TA is shown in Figure 13.

Execute Command = RU

40. This command causes the program to calculate the stability of the structure by a wedge method of analysis. At this time, GWALL also saves all data in a restart file. The following is sample output with display of failure surface shown in Figure 14:

SOIL	GAM	PHI	-	C	PHI	-	C	PHI	-	C
1	150.	0.		0.	0.		0.	0.		0.
2	112.	30.00		0.	30.00		0.	30.00		0.

NEUTRAL BLOCK BASE	1		
125.00,	-5.00	200.00,	-3.00

X	Y	WEIGHT	HEAD	SOIL
106.24	6.24	48366.	0.	2
125.00	-5.00	7006.	30.00	
126.89	-4.95	60725.	31.83	
139.97	-4.60	147946.	44.57	
150.82	-4.31	443035.	22.09	
190.00	-3.27	114238.	53.27	
200.00	-3.00	356131.	53.00	
261.74	100.00	0.	0.	0

	L WEDGE	N BLOCK	R WEDGE	TOTAL
FD'	28992.86	-19411.98	-594104.01	-584523.13
FR	32899.20	280671.73	271329.95	584900.88

DO YOU WANT A TEK PLOT - YES OR NO?  
-YES

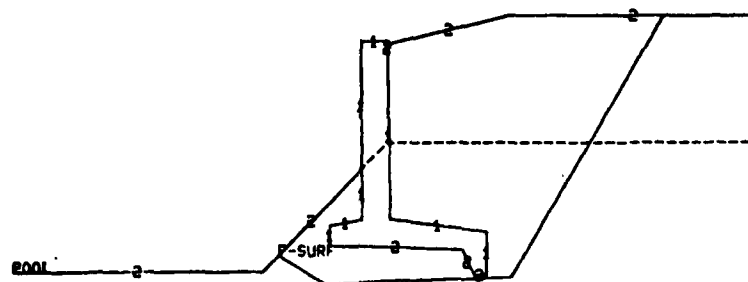


Figure 14. Display of results

Execute Crack Analysis = RU CK

41. This command causes the program to calculate the stability, as with the RUN command, except that the active wedge is completely neglected. The program responds with

ENTER COMMAND  
=RU CR

and then presents the results as follows and a display (Figure 15).

NEUTRAL BLOCK BASE            1  
125.00,            -5.00            200.00,            -3.00

X	Y	WEIGHT	HEAD	SOIL
109.06	9.06	39695.	0.	2
125.00	-5.00	7006.	30.00	2
126.89	-4.95	60725.	31.83	2
139.97	-4.60	147946.	44.57	2
150.82	-4.31	443035.	22.09	2
190.00	-3.27	114238.	53.27	2
200.00	-3.00	6.	53.00	2
200.00	100.00	0.	0.	0

	L WEDGE	N BLOCK	R WEDGE	TOTAL
FD	35021.98	-19411.98	-87781.25	-72171.25
FR	6216.87	65956.24	0.	72173.11

S.F. = -4.598

DO YOU WANT A TEKPLOT - YES OR NO?  
=YES

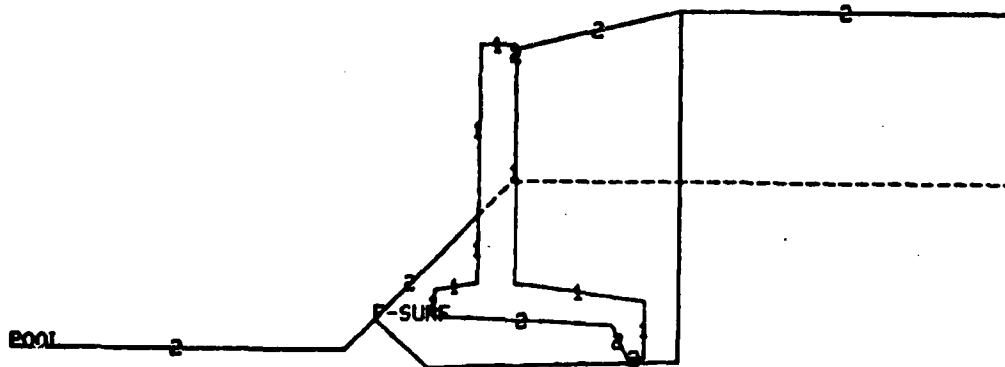


Figure 15. Display of results of crack analysis

### Analysis Output

42. The results listed previously, has the output for the stability analysis for neutral block 1. This output includes the following:

- a. The coordinates, in feet, of the end points of the neutral block's base.
- b. The coordinates, in feet, of the end points that define the line segments that make up the failure surface.
- c. The weight, in pounds, of the soil above each failure surface segment.
- d. The head of water, in feet, that is effective at each end point.
- e. The number of the soil through which each failure segment passes.
- f. A tabulation of the horizontal components of the driving and resisting forces for the left wedge, neutral block, right wedge, and the total. Note that this tabulation is for the forces that were calculated for the last trial using the developed friction angle.
- g. The safety factor for this problem, which is printed as the last line in the output. Note that a negative sign on the safety factor indicates that the direction of failure is from right to left.

### Failure Surface Plots

43. After each analysis, the following question is displayed:

DO YOU WANT A TEKPLOT - YES OR NO?

=

If a NO response is given, the program continues to the next analysis or returns to the command level. If a YES response is given, the soil and structure are plotted with a plot of the failure surface as seen in Figures 20 and 22. The cross hairs appear allowing the following options when the corresponding characters are entered:

- a. c: Continue to the next analysis.
- b. w: Plot a window of data.
- c. t: Plot the total picture again.

When the character w is entered, the user must place the cross hairs at the lower left of the desired window and then enter a character and CR. The cross hairs will reappear for entering the upper right position of the window.

When the cross hairs are properly located, a character and CR are entered. When the cross hairs reappear the user has the options of continuing to the next analysis, making another window plot, or plotting the entire data.

Command for Reading = RE

44. The response to this command is

SUPPLY NAME OF INPUT DATA FILE

=

The user must give the name (maximum eight characters) of the file that contains the input data, followed by CR. GWALL then reads the data file and displays the data. When all the data have been entered, control of the program is returned to the user. The user can then edit data, add additional data, and/or analyze data.

45. The format of the data in an input file is identical with that of data supplied to the program when in the command mode, except for the addition of line numbers. (The input data file, GWPROB, used for this example was obtained from the Foundation and Materials Branch, Engineering Division, U. S. Army Engineer District, Vicksburg.) The following is a listing of data file, GWPROB, which will be used as an input data file.

\*LIST GUPROB

```

100 HOLLIE LAKE DR. STR., EXTREME CASE
110 S0
120 135 40 0 40 0 40 0
130 0 118.5 19.5 113 35 111 40.5 110.25 40.6 104.5 60 104.5
140 S0
150 125 35 0 35 0 35 0
160 0 118.5 19.5 113 35 111 40.5 110.25 40.6 104.5,
170 40.61 103.5 60 103.5
180 S0
190 113 20 0 20 0 20 0
200 0 118.5 19.5 113 35 111 40.5 110.25 40.55 103 60 103
220 S0
230 120 30 0 30 0 30 0
240 0 104 25 104 35 111 40.5 110.25
260 S0
270 113 20 0 20 0 20 0
280 0 104 25 104 34.3 101 60 101
294 ST
295 150
300 40.5 110.75 40.3 101.5 34 101.4 33.8 98.5,
310 35 98.5 35.1 100.5 44 100.5 43.9 101.4 42 101.5,
315 41.5 110.75
340 PI
350 0 104.5 0 34 104.5 0 44 101.5 0 60 101.5 0
360 PI
370 0 90 14.5 34 90 14.5 44 90 11.5 60 90 11.5
380 NE
390 33.8 98.49 44 98.49 1
400 PO
410 104.5 101.5

```

\*

46. The following shows the question for input of restart file name and title which will appear in restart file unless data is entered from a previous defined data file.

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SUPPLY NAME OF RESTART FILE  
=RES  
SUPPLY TITLE FOR THIS RUN  
=INPUT FROM FILE

The RE is given below in order to name data file GWPROB. The display of the data file is shown in Figure 16.

ENTER COMMAND  
=RE  
SUPPLY NAME OF INPUT DATA FILE  
=GWPROB

ENTER COMMAND  
=RU

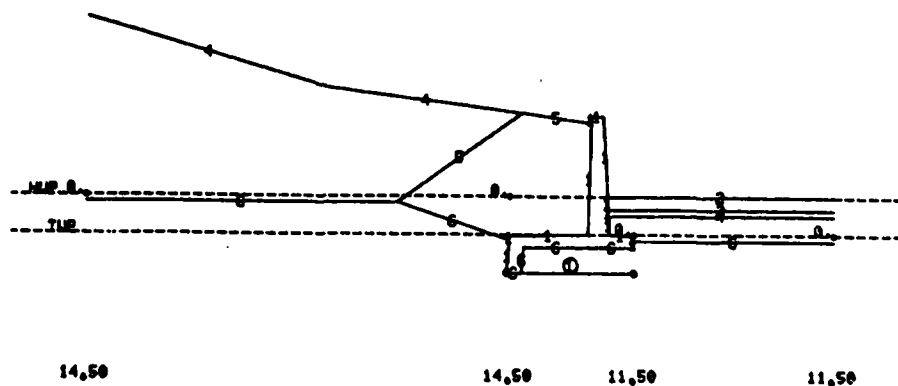


Figure 16. Display of input data and run command

47. The following is the results of the analysis.

NEUTRAL BLOCK BASE 1  
 33.80, 98.49 44.00, 98.49

X	Y	WEIGHT	HEAD	SOIL
23.24	112.52	1507.	0.	4
28.17	106.22	2480.	0.	5
31.00	102.06	3643.	2.44	6
33.80	98.49	281.	6.01	6
33.98	98.49	9745.	6.01	6
40.50	98.49	2196.	4.06	6
41.83	98.49	45.	3.66	6
41.89	98.49	22.	3.64	6
41.91	98.49	1508.	3.64	6
43.94	98.49	42.	3.03	6
44.00	98.49	1813.	3.01	6
47.21	101.00	794.	0.50	4
49.76	103.00	132.	0.	3
50.55	103.50	116.	0.	2
52.28	104.50	0.	0.	0

	L WEDGE	N BLOCK	R WEDGE	TOTAL
FD	10218.65	0.	-2190.57	8028.09
FR	3963.37	2710.28	1355.09	8028.74
S.F. -	1.470			



48. The following is the restart file from the previous run. The file is identical to GWPROB except for its format. If any changes had been made to GWPROB, those changes would be in the file RES.

\*LIST RES

```

10000 HOLLIE LAKE DR. STR.,EXTREME CASE
10010 SO
10015 135.00, 40.00, 0. , 40.00, 0. , 40.00, 0.
10020 0. , 118.50,
10040 19.50, 113.00,
10060 35.00, 111.00,
10080 40.50, 110.25,
10100 40.60, 104.50,
10120 60.00, 104.50
10130 SO
10135 125.00, 35.00, 0. , 35.00, 0. , 35.00, 0.
10140 0. , 118.50,
10160 19.50, 113.00,
10180 35.00, 111.00,
10200 40.50, 110.25,
10220 40.60, 104.50,
10240 40.61, 103.50,
10260 60.00, 103.50
10270 SO
10275 113.00, 20.00, 0. , 20.00, 0. , 20.00, 0.
10280 0. , 118.50,
10300 19.50, 113.00,
10320 35.00, 111.00,
10340 40.50, 110.25,
10360 40.55, 103.00,
10380 60.00, 103.00
10390 SO
10395 120.00, 30.00, 0. , 30.00, 0. , 30.00, 0.
10400 0. , 104.00,
10420 25.00, 104.00,
10440 35.00, 111.00,
10460 40.50, 110.25
10470 SO
10475 113.00, 20.00, 0. , 20.00, 0. , 20.00, 0.
10480 0. , 104.00,
10500 25.00, 104.00,
10520 34.30, 101.00,
10540 60.00, 101.00
10550 ST
10555 150.00
10560 40.50, 110.75,
10580 40.30, 101.50,
10600 34.00, 101.40,
10620 33.80, 98.50,
10640 35.00, 98.50,
10660 35.10, 100.50,
10680 44.00, 100.50,
10700 43.90, 101.40,
10720 42.00, 101.50,
10740 41.50, 110.75
10750 NE
10755 33.80, 98.49, 44.00, 98.49, 1
10760 PO
10765 104.50 101.50
10770 PI
10780 0. , 104.50, 0. ,
10790 34.00, 104.50, 0. ,
10800 44.00, 101.50, 0. ,
10810 60.00, 101.50, 0. ,
10820 PI
10830 0. , 90.00, 14.50,
10840 34.00, 90.00, 14.50,
10850 44.00, 90.00, 11.50,
10860 60.00, 90.00, 11.50

```

\*

**END**

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