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USER'S REFERENCE MANUAL: COMPUTER PROGRAM FOR DESIGN AND ANALYS--ET

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LEVEL II

INSTRUCTION REPORT K-80-7

USER'S REFERENCE MANUAL: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA)

by

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December 1980

Final Report

... Structural Engineering (CASE) Project

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

and U. S. Army Engineer Division, Lower Mississippi Valley
P. O. Box 80, Vicksburg, Miss. 39180

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DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

DAEN-CWE-DS

23 February 1981

SUBJECT: Instruction Reports K-80-6, K-80-7, and K-81-3: The Basic User's Guide, User's Reference Manual, and Validation Report for a Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)

All Corps Elements with Civil Works Responsibilities

1. The subject reports document a computer program for analyzing and designing reinforced concrete retaining walls and floodwalls. This computer program was developed according to specifications provided by the members of the Computer-Aided Structural Engineering (CASE) Task Group for T-Walls. As is the goal with all CASE tasks, the intent is to make an organized, cost-effective computer solution available to the Corps' designers for use when the need arises.

2. Engineers will be readily able to tell by the description of the program and by the examples given in the reports of the applicability toward their needs. Detailed documentation of the program may be obtained from the Engineering Computer Programs Library (ECPL) of the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss.

3. We strongly encourage the use of this program where applicable throughout the Corps.

FOR THE CHIEF OF ENGINEERS

X

LLOYD A. DUSCHA
Chief, Engineering Division
Directorate of Civil Works

A

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

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This report was prepared under the Computer-Aided Structural Engineering (CASE) Project. A list of published CASE reports is printed on the inside of the back cover.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Computer programs
Computerized simulation
Design criteria
Floodwalls
Retaining walls

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Computer program TWDA (T-wall design/analysis) is a user-oriented conversationally interactive, modular time-sharing program system for computer-aided structural design of inverted-T retaining walls and floodwalls founded on earth or rock. Its essential characteristics include:

a. List-directed input with prompting available on request or as shown to be needed. Data lists may be entered interactively or in a data file.

(Continued)

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20. ABSTRACT (Continued).

b. Design for minimum cost including excavation, backfill, slab concrete, and stem concrete, with inputted unit costs. Default is to design for minimum concrete volume.

c. Multiple soils strata may be used as existing and/or backfill earth. Either Coulomb's equation or trial wedges may be used to get active earth pressures.

d. Multiple slopes may be used to model existing and/or finished grade surfaces.

e. Time-sharing printout is limited to the minimum needed by the user to make his design decisions. A full analysis report is available in an optional output file that may be listed on any terminal.

f. The program is structured to permit easy updating as criteria change.

g. Up to 10 load cases may be used. The user does not need to reenter any data by hand into subsequent runs.

h. The 1977 edition of ACI code 318 is used. Default procedures conform to the Corps of Engineers' Engineer Manuals in effect in 1980. The user may, however, direct the program to change many of the standard procedures as needed.

i. Earthquakes may be considered using an acceleration factor that is applied to the static load.

j. Input data and output results may be displayed on a Tektronix 4014 terminal.

k. Multiple surcharges may be included in the data.

The program is divided into three major sections: the executive command phase, the stability group of modules, and the structural group of modules:

a. The executive command phase is where the program starts executing and where it returns to after running the computational modules. Commands and data are entered in this phase of the program.

b. The stability group of computational modules computes active earth pressures and determines overturning and sliding stability.

c. The structural group of computational modules performs a stress analysis of the wall or designs for minimum slab thicknesses.

The philosphy of TWDA is to (a) ensure minimum-cost adequate design based on current codes and criteria, independent of the user's experience, and to (b) promote the use of personal judgment and imagination through man-machine interaction.

PREFACE

This manual describes in detail the use of TWDA, a computer program for design and analysis of inverted-T retaining walls and floodwalls. The program is a product of the Computer-Aided Structural Engineering (CASE) Project of the Office, Chief of Engineers, U. S. Army (OCE), and of the Computer-Aided Structural Design (CASD) Project of the U. S. Army Engineer Division, Lower Mississippi Valley (LMVD).

Mr. William A. Price, Chief, Computer-Aided Design Group (CADG), Automatic Data Processing (ADP) Center, U. S. Army Engineer Waterways Experiment Station (WES), provided the overall design of the program and led the program development team. The program and this manual were written by Mr. Price and Messrs. Robert L. Hall, H. Wayne Jones, Reed L. Mosher, and Michael E. George, all of the CADG. The work was managed and coordinated by Dr. N. Radhakrishnan, Special Technical Assistant, ADP Center, assisted by Mr. Paul K. Senter, CADG. Mr. Donald L. Neumann was Chief of the ADP Center. Mr. Donald R. Dressler was the point of contact in OCE.

The program was written according to specifications provided by the members of the CASE Task Group on T-Walls and of LMVD's CASD Committee and by other Corps personnel:

<u>CASE Task Group on T-Walls</u>

Victor M. Agostinelli, LMVD (Chairman)
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Lucian G. Guthrie

Other Corps Personnel

Carl E. Pace, Structures Laboratory, WES
William A. Price, ADP Center, WES
James D. Wall, South Atlantic Division

The following WES personnel contributed to the coding of the program: Messrs. Price, Hall, Jones, Mosher, and George of the CADC and Messrs. Edward F. O'Neil III and Roy E. Campbell of the Structures Laboratory. Dr. William P. Dawkins, Oklahoma State University, and Dr. Michael W. O'Neill, University of Houston, contributed routines under contract to WES.

A basic user's guide and a program validation report will also be published on TWDA. Copies of the Program Criteria Specifications Document are available from LMVD.

Directors of WES during the development of this program and the publication of this user's guide were COL J. L. Cannon, CE, and COL N. P. Conover, CE. Technical Director was Mr. F. R. Brown.

HOW TO USE THIS BOOK

Instructions for the preparation of data are presented in four ways. The user is urged to make himself aware of all four presentations and select the one that best meets his particular needs:

1. For the beginning user: Paragraph 12-3, Data Preparation Checklist. See especially paragraph 12-3-12.

2. Data arrangement reminder: Paragraph 12-2-10. This and the list of commands in paragraph 2-3-1 are available while the program is running by typing a question mark (?) as a command.

3. List of data lists and the variable names in them: Paragraph 12-2 and Figures 3-1 through 3-5. This is intended for use as a checklist for the experienced user.

4. Detailed data definitions, arranged by data list: Chapters 2 and 3, plus the first part of each of Chapters 4 through 8.

A pull-out summary of all data lists is given at the end of Chapter 12.

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CONVERSION FACTORS, INCH-POUND TO METRIC (SI) UNITS OF MEASUREMENT

Inch-pound units of measurement used in this manual can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic yards	0.7645549	cubic metres
feet	0.3048	metres
inches	2.54	centimetres
pounds (force)	4.448222	newtons
pound (force)-feet	1.355818	newton-metres
pounds (force) per foot	14.5939	newtons per metre
pounds (force) per square foot	47.88026	pascals
pounds (force) per square inch	6.894757	kilopascals
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre
square inches	6.4516	square centimetres

ELECTRONIC COMPUTER PROGRAM ABSTRACT

TITLE OF PROGRAM			PROGRAM NO.
TWDA - T-Wall Design Analysis (CORPS No. X0053)			713-F3-R0-027

PREPARING AGENCY
U. S. Army Engineer Waterways Experiment Station, ADP Center, CADG

AUTHOR(S)	DATE PROGRAM COMPLETED	STATUS OF PROGRAM: PHASE	STATUS OF PROGRAM: STAGE
William A. Price, Robert L. Hall, H. Wayne Jones, Reed L. Mosher, and Michael E. George	June 1980	Operational	

A. PURPOSE OF PROGRAM

Analysis or design of an inverted-T wall subjected to retaining wall and/or floodwall loadings. Design comparisons for finding the most economical combination of base embedment, key length, base width, and base slope are based on construction cost of excavation, concrete, and backfill. Performs stability analysis or design and structural analysis or design. Conforms to Engineer Manual 1110-2-2501, EM 1110-2-2505, and other Corps of Engineers standards.

B. PROGRAM SPECIFICATIONS

The program is written in FORTRAN IV. The graphics display option uses the Graphics Compatibility System (GCS).

C. METHODS

Active earth pressures may be calculated by Coulomb's equations or by the incremental wedge method. The program is highly interactive, following a computer-aided design methodology. The analysis procedure considers overturning, sliding, and bearing pressure, relative to the soil immediately adjacent to the wall. Earthquake effects are included. Stress design includes determination of reinforcement.

D. EQUIPMENT DETAILS

Time-sharing mainframe computer (overlaid for 49k words of main memory).

Time-sharing terminal--Tektronix 4014 needed for graphic display option. Rest of program may be run on any interactive terminal.

Remote high-speed job entry terminal (COPE, etc.).

E. INPUT-OUTPUT

Input is by time-sharing keyboard, either directly or via data files. Intermediate data are stored in disc files. Output is to the time-sharing terminal and/or to a high-speed computer terminal.

F. ADDITIONAL REMARKS This program was written under the auspices of the OCE Computer-Aided Structural Engineering (CASE) Project Task Group on T-Walls and the LMVD Computer-Aided Structural Design (CASD) Committee. Call W. A. Price, FTS: 542-3645, for more information. Available publications include the Basic User's Guide, the User's Reference Manual, and the Validation Report. They are available from the ECPL of the WES Technical Information Center. Copies of the Program Criteria Specifications Document are available from LMVD.

USER'S REFERENCE MANUAL: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA)

CHAPTER 1: INTRODUCTION

1-1 PURPOSE OF PROGRAM TWDA AND THIS MANUAL. TWDA is a computer-aided structural design system for analysis and/or design of inverted-T cantilever walls founded on earth or rock. Multiple load cases allow the wall to act as a floodwall or a retaining wall. This manual is intended for use by structural engineers. The program does not attempt to establish any soil design criteria; such data must be entered by the user after consultation with a soil design engineer. There are no default values for soil criteria parameters, except as provided in Corps engineering standards for structural design.

1-2 ORGANIZATION AND SUMMARY DESCRIPTION OF PROGRAM

1-2-1 Structure. TWDA is a series of design/analysis modules,* each performing one specific step in the design or analysis process. These modules are callable, in any logical sequence, from an executive command phase.** While in this executive phase, the user may call various procedures for data entry, data review, saving the current design status, restoring from an old status save, etc. This organization is illustrated in Figure 1-1.

1-2-2 Brief Description of Data Entry. The data entry procedure is similar to that for program TGDA,† except that the data phase is combined with the command phase instead of being separate as in TGDA. Features include:

a. Data are entered by naming the group and listing the values in that group, all on one line.

b. Default values are requested by entering the letter D for the desired data item(s), instead of a numerical value.

c. Values to be left undefined or changed to the undefined state are identified to the program by typing the letter C instead

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* A module is a subprogram that is controlled as one unit and that performs one complete aspect of the purpose of the entire program.

** The executive phase of this program is the central core of the user's flow of control. The user may enter data or start a module while in the executive phase.

† TGDA (three-girder tainter gate design/analysis) is a computer program (713-F3-R0-022) developed for the Lower Mississippi Valley Division's Computer-Aided Structural Design (CASD) Committee in 1976.

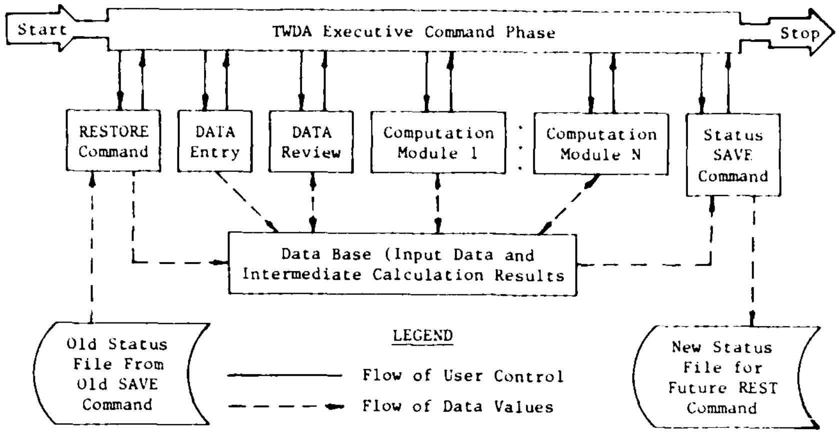


Figure 1-1. Basic program flowchart

of entering a value for the particular item(s).

d. A value to be left unchanged from its previous state is identified to the program by typing the letter S for the particular item, instead of repeating the earlier value.

e. The program looks for illogical and inconsistent data and identifies such items to the user for correction or use anyway.

f. The current status of items of input data or of all data values can be reviewed.

g. Multiple-level prompting is provided, with more detailed information when the user answers with a question mark.

Thus the program will accept several sets of input data, where the following sets contain only the changes to the data comprising the preceding sets. Repetitive data will remain unchanged.

1-2-3 Data Review. Two methods of data reveiw are available:

a. Input data may be reviewed with the LOOK command.

b. Default value review is available at selected points in the interaction as described else where in this manual. Unless reviewed with this option, default values are set automatically by the user's selection of:

(1) Floodwall or retaining wall criteria.

(2) Hydraulic or nonhydraulic structure criteria.

Making the review of default values optional is expected to enable the experienced user to simplify and expedite his preliminary designs. In any case, the values are printed out in the report file. The combination of a nonhydraulic floodwall, being illogical, will be rejected. Default values are taken from Corps engineering publications; nonstandard values set by the user are printed in the report file.

1-2-4 Restart Capability. In addition to the user-controlled SAVE files, the program uses an automatic UPDATE file that is reset (brought up-to-date) after the completion of a calculation module and after many of the commands. The message UPDATE FILE RESET is printed each time this happens. The RESTart command restarts the program from either an old update file or a previously saved snapshot file.

1-2-5 Volume of Printout. Printout is of two types:

a. The printout to the user's time-sharing terminal.

b. A full report of calculations made is written to a report file that can be listed at a time-sharing terminal and/or sent to the high-speed printer in the user's District Office ADP Center.

The amount of terminal printing is controlled by the ALLP and MINP commands. The amount of report file printout is controlled by the TRCE 3 and TRCE 0 commands.

1-2-6 Calculation Modules:

a. SA. Stability analysis active pressures for overturning and sliding; calculated along a vertical plane at the end of the heel:

(1) Coulomb's equations plus surcharge pressure equations assuming elastic soil.

(2) Incremental wedge methods.

(3) As inputted.

b. FA. Foundation stability analysis of a completely defined wall (overturning, sliding, and bearing); uses module SA as needed. (Modules SA and SP need not be called by the user when modulue FA is used.)

c. FD. Foundation stability design, uses modules SA and FA as needed. (Modules SA and FA are called automatically by module FD as needed.)

d. SP. Stem pressures for structural analysis. Same basis as module SA, except that the pressures are calculated at the stem face instead of at the end of the heel. This is for structural analysis of the stem. Heel, toe, and key slabs will use pressures based on the stability analysis from modules FA or FD.

e. WA. Working stress structural analysis.

f. WD. Working stress structural design.

g. UA. Ultimate strength structural analysis. (Not implemented yet.)

h. UD. Ultimate strength structural design. (Not impletement yet.)

1-3 DATA

1-3-1 General Description. Data are of two types, basic data and load case data. Basic data are used as if common to all load cases unless overridden by data for a particular load case. Load case data consist of values applicable to only one load case. Basic data also include unchanging data such as wall dimensions.

1-3-2 Basic General Description Data:

a. Criteria Selection:

(1) Floodwall or retaining wall.

(2) Hydraulic or nonhydraulic structure.

b. Wall geometry (Figure 3-5).

c. Soils data for existing earth (Figure 3-2).

d. Loads common to all load cases (except ones for which value(s) are reset in load case data) (Figure 3-4).

1-3-3 Load Case Data (for each individual load case):

a. Possible Factors For Describing Any ONE Load Case (in addition to or in place of basic data):

(1) Water (Figure 3-1):

(a) Water elevations over heel and over toe; unit weight of water (default = 62.5).

(b) Seepage pressures according to description in paragraph 3-2-2.

(2) Earth (Figures 3-1 and 3-2):

(a) Geometry and soil properties for earth layers over heel and over toe.

(b) Earth pressures on wall (1) calculated from the earth elevations and k value Coulomb theory, (2) calculated from the earth elevations and incremental wedge theory, or (3) as inputted separately.

(3) Horizontal loads (Figure 3-4):

(a) Trapezoidal (linearly varying distributed) loads, horizontal on stem, W_1 and W_3 through W_4 in Figure 3-4.

(b) Concentrated horizontal forces and their elevations, PH_1 and PH_2 .

(4) Surcharges over heel and over toe, values and locations (Figure 3-4):

(a) Distributed, over all or any part of the cross section, W_h and W_t .

(b) Up to five vertical concentrated line loads parallel to the wall (P_{v1} through P_{v5} in Figure 3-3) plus the force P_{v5} centered on the top of the stem and P_{vB} anywhere on the base.

(5) Wind direction and magnitude (Figure 3-1).

(6) Earthquake effect acceleration factors or effective K_a values.

(7) Design criteria

(a) Load factors for reinforced concrete strength design and overstress factors for working stress design.

(b) Allowable bearing capacity, interpolated values over ranges of allowable toe base elevations and base widths (see paragraph 3-2-2), for each layer of existing earth.

(c) Minimum factor of safety against shear friction sliding.

(d) Minimum safety factor for cohesion and tan ϕ data values used in the sliding determination by allowable strength equilibrium methods.

(e) Limiting value of the overturning stability resultant ratio.

(f) Reinforced concrete design parameters.

(g) Specification of "hydraulic" or "nonhydraulic" structure.

(h) Heel earth cover crack control.

b. Typical Application of Load Cases. Any load case may have any or all of the effects described above.

1-4 HIGHLIGHTS OF TWDA DESIGN

1-4-1 The Stability Design/Analysis Phase.

a. This place finds the least-cost combination of values inside user-defined ranges of base width, bottom of tow elevation, base slope, and key length, for a given stem ratio or toe width, that satisfies stability requirements for up to 10 load cases. Cost factors include:

(1) Structural excavation, with separate unit prices in each existing soils layer and for the key.

(2) Concrete, with separate unit prices for the stem, base slab, and key.

(3) Structural backfill, with separate unit prices for each backfill layer.

b. Earth pressures for design are calculated by using either Coulomb's equations for earth pressure and Boussinesq's equations for surcharge pressures or by an incremental wedge technique. Earthquake effects are based on the Mononobe-Okabe method of equivalent K_a for earth pressure and Westergaard theory for dynamic water pressure. Earth pressures for analysis can be either as just described for design or as read in by the user.

c. Hydrostatic pressures are calculated by the line of creep or design and by either the line of creep or as defined by the user for analysis. Control options include:

(1) Crack over heel or not.

(2) Each load case calculates its own pressures or all load cases use the value determined for one selected load case.

(3) Choice of:

(a) Creep.

(b) Hydrostatic over heel and toe; linear variation between heel and toe (as for dams).

(c) User-defined vertical and horizontal pressures.

(d) Water over toe sets the weight on the toe; water over heel sets the weight on the heel and the uplift under the base (as for the wall of a lock with an impervious floor).

1-4-2 The Structural Design/Analysis Phase.

a. This phase uses the working stress (ACI alternate) method and provides for future addition of strength design. Design is for minimum slab thickness within the controls selected by the user in the input data. Default is to a simple, basic wall that the user may elaborate on by adding additional input data as desired. After the concrete dimensions have been set for moment, axial force, shear, and architectural considerations, reinforcing steel requirements at critical and selected locations are calculated directly for the actual thickness, moment, axial force, and shear at each location. The need for multiple layers of steel is checked based on maximum bar size and minimum spacing as selected by the user. Multiple layers are used if needed, including adjustment of slab thickness. The 1977 edition of ACI 318 is used.

b. Maximum wall height from top of stem to bottom of key is 68.0 ft*; maximum base width is 48.0 ft. These maximum dimensions may be increased later.

* A table of factors for converting inch-pound units of measurement to metric (SI) units is presented on page x.

c. The output of an independent stability analysis, such as from a finite element analysis or pressure measurements, may be used as input to the stress analysis or design modules. See Chapter 11 for details on this form of analysis.

2-1 FUNCTION. The executive command and data entry phase controls the restart files, accepts data, reviews data, starts computation modules, directs the report file to storage or a high-speed printer, and performs other miscellaneous chores for the user.

2-2 COMMAND FORMAT

2-2-1 Commands are typed interactively by the user immediately after the question mark (?) under the prompting word COMMAND. For commands that need supplemental information, the terminal asks for that supplemental information unless it is typed in by the user following a blank space after the command word. Do not use commas. For example, the command RUN needs the module name it is to run as supplemental information:

```
COMMAND
?RUN
ENTER MODULE NAME OR A '?' FOR LIST OF MODULES
?
```

An example of entering supplemental information on the command line is

```
COMMAND
?RUN FA
```

where FA is the name of the module to be run. A ? entry by the user will call a list of the modules followed by a repeat of the ? prompt. The ? entry may be used in many places in the program to request additional information on the user's options at those places in the program.

2-2-2 Commands with four letters may be typed as complete words. For example, UPDA may be typed as UPDATE.

2-3 COMMAND OPTIONS

2-3-1 Table of Commands. In this table, supplemental information given in lower case letters describes the information and is not itself acceptable as input when spelled out as shown:

Command Name	Supplemental Information	Action Taken by Program
?		Prints this table
	?	Prints additional information, if available

(Continued)

2-3-1 Table of Commands (Continued):

Command Name	Supplemental Information	Action Taken by Program
HELP		Prints the information file.
NAME	60 characters maximum of alphanumeric job name	Prints the job name and date and time of day at selected locations in the report file
INIT or NEW		Initializes all data (sets data to undefined state) for new start
REST		Restores the data to the values in an old update or snapshot file
NOBE		Removes the bell (or beep) from command and other entry prompting. Does not remove it from important error messages
BELL*		Cancels action of NOBE command (restores bell)
REVI**		Turns on full review of default values before being used
NORE*		Turns off automatic review of default values (automatic with REST command)
TRCE*	0	Cancels action of TRCE 3
TRCE	3	Turns on printing of more information to the report file; mainly verification of input data values and tables of intermediate answers. This status is saved with SAVE and SNAP commands
KEY		Returns control to keyboard if used in data file error recovery procedure

(Continued)

* Assumed at beginning of a run; retained until changed by the opposite command.

** Not yet implemented.

2-3-1 Table of Commands (Continued):

Command Name	Supplemental Information	Action Taken by Program
RELE	old file name (question asked by program)	Releases a file from the user's master catalog to make room for a new status save file that could not otherwise be created. Any file may be released except the current update file
RUN	module name (FA, FD, WA, WD, SA, SP, UA, UD)	Starts execution of the named computation module
LOOK	data list name	Reviews (prints for the user to see) the current values of all variables in the designated data list
LOOK	module name	Reviews all data for the designated module
LOOK	ALL	Review all data for the entire program (takes a long time to print)
LOOK	XY	Prints a table of the X and Y coordinates of the corners of the wall cross section
LOOK	INDI	Prints a table showing the user which modules have been run
LOOK	IL	Prints current values of basic data lists NAME, CASE, HYD, and TYPE and intermediate data lists ACPH, ACPS, BPH, BPV, HSPH, HSPV, PPD, and VLP
UPD or UPDA		Resets the update file values to the current values of all data
RUN or EXE or EXEC	module name module name module name	Starts the designated module
IR6†		Merges the report file with time-sharing terminal output; prints it all to the terminal. Does not work when in a data file.

(Continued)

† For debugging purposes; causes double printing of some items.

2-3-1 Table of Contents (Concluded):

Command Name	Supplemental Information	Action Taken by Program
IR8*		Cancels the IR6 command (automatic with REST command)
SAVE or SNAP	new file name new file name	Creates a new status snapshot file to save the current status of all data and intermediate answers for possible future use in a REST command. Does not save the status of IR6 or REVI commands. Does not save the status of TRCE and ALLP commands
REPT or REPO		Ends the report file and directs it as decided by the user in response to questions that it asks, then starts a new report file
REM	comment	No action, lets user place a remark in a data file or in the terminal printouts
ALLP**		Turns on full prompting. Status is saved with SAVE and SNAP commands
MINP*		Minimum prompting only
END		Terminates the program execution, after asking questions about what to do with the report file
data list name	data items	(See information on data entry)

* Assumed at beginning of a run; retained until changed by the opposite command.

** Not yet implemented.

2-3-2 Special Notes on UPDATE, RESTart, and SAVE Commands. These commands provide a restarting capability that serves four purposes:

a. A run may be restarted after stoping for lunch or to study intermediate answers or at the end of the day by using the REST command with the update file name from the previous run. An old report file cannot be used with the REST command. Neither can a data file.

b. A run may be restarted after a power or computer failure by using the REST command with the update file name from the run underway at the time of failure. This restart will be from the last time that the message UPDATE FILE RESET was printed at the terminal.

c. A run may be backed up to the status of an earlier SAVE file by using the REST command with the name of the SAVE file.

d. The user must have a new name ready to enter for the program to use when creating the update file for that run.

2-3-3 Command Error Recovery. Many of the commands have procedures built in for using question and answer sequences to recover from illogical or unexpected supplemental information. These sequences are not shown in this manual but are believed to be self-explanatory. A response of END will end the run; a null response (a simple carriage return) will return to the "COMMAND ?" prompt.

2-4 STARTING A PROGRAM RUN. The beginning portion of a run can follow any of several scenarios, depending on whether a data file is to be used and whether the INIT or REST commands are used. See paragraph 2-5 for the meaning of "data file." A data file is not the same as an update or a snapshot file.

2-4-1 Starting Sequence, Part 1. The update file in this example is to be named "WP07091"; the report file is to go to the ADP Center, station code "R1," with the ADP Center terminal operator to route the report file output to "WESKD-WAP." It is suggested that the report file instruction questions be answered with meaningful information even if the user wants to make it a permanent file, because any system problem in creating the permanent file will cause automatic directing of the report file to the given station code.

```
PROGRAM TWDA -- 713-F3-RO- 027

    T-WALL DESIGN/ANALYSIS

        REL 0.3   OCT 79

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?WP07091

FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?WESKD-WAP
ENTER YOUR MACON ACCOUNT NUMBER
?8888888
```

(The questions here will depend on the computer system being used)

```
ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
?
```

2-4-2 Starting Sequence, Part 2. Part 2 of the starting sequence depends on the answer to the last question of part 1. Four options are available:

a. Data file used (the data file used in this example was named "XIBITQ"):

```
ENTER NAME OF COMMANE-DATA FILE OR
ENTER A CARAIAGE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
?XIBITQ
PROCESSING DATA FILE ...

COMMAND
?
```

b. Data file used, with last line in the file not containing KEY or END commands (the data file used in this example was named "XIBITX"):

```
ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIABE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
?XIBITX
PROCESSING DATA FILE ...


END OF FILE ON COMMAND DATA FILE
RETURN TO KEYBOARD ENTRY.

COMMAND
?
```

c. Data file not used, and all input to be interactive at the keyboard. In this example, this is a new start, there will be one load case, and the wall is a hydraulic floodwall:

```
ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
? | NO INFORMATION, JUST A CARRIAGE RETURN ANSWER |
```

```
IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' OR 'REST'

COMMAND
?INIT

*- ALL DATA RESET FOR FRESH START -*
ENTER NUMBER OF LOAD CASES (1 TO 10)
?1


IS THE WALL GENERALLY A FLOOD WALL OR A RETAINING WALL?
ENTER 'F' OR 'R'
?F
IS STRUCTURE HYDRAULIC OR NON-HYDRAULIC?
ENTER 'H' OR 'N'
?H

COMMAND
?
```

d. Data file not used; a restart of a previous run. In this example, the file being restarted from is named "WAP1101":

```
ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE
ENTERED INTERACTIVELY
? [ONLY A CARRIAGE RETURN]

IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' OR 'REST'

COMMAND
?REST WAP1101

*- ALL DATA RESET FOR FRESH START -*
*- COMMON DATA RESET FROM RESTART FILE WAP1101 , UPDATE FILE RESET -*

COMMAND
?
```

2-5 DATA FILE INPUT. Input to the program, beginning with the answer to the INIT/REST question in part 2 of the program starting sequence, may be placed in advance in a data file and entered into the program as shown earlier in this manual. This file may contain both data lists and commands. Each line of the data file is printed into the report file as the line is read from the data file. Note that a report file from one program run cannot be used as a data file for a later program run. This is also true of update files, which can be read only by the REST command.

2-5-1 Date File Format. The data file must have line numbers. Each line in file must contain one command and its supplemental information or one data list, arranged with the line number followed by a blank space, followed by the command word or data list name. See paragraph 2-6 for data list information.

2-5-2 Required Information. The data file must begin with lines containing the information shown to be entered by the user in paragraph 2-4-2c for a new run or as shown in paragraph 2-4-2d for a restart run. An example of the beginning of a data file for a new run is shown below. This is to be a new run with two load cases on a hydraulic floodwall. Three lists are shown on the lines following the starting response lines:

```
1000  INIT  }
1010  2     }
1020  F     }  Starting responses as in paragraph 2-4-2c
1030  H     }
1040  NAME STRESS ANALYSIS OF EXHIBIT Q PRESSURES
1050  REM  --  REDEFINE LOAD CASE 2 TO BE HYDRAULIC RETAINING WALL --
1060  TYPE  2  2
```

NOTE: list TYPE was used to change load case 2 from floodwall to retaining wall default values.

2-5-3 Data Error Recovery. An invalid data list line or command will cause one of several interactive error recovery procedures, one of which is illustrated below.

a. Data list line No. 1080 with too many items:

```
1080 CASE 2  1  3  4
```

b. Error recovery:

```
*** ERROR IN DATA FILE-RETURN TO KEYBOARD ***  BAD LINE FOLLOWS:
CASE  2  1  3  4

TOO MANY VALUES ENTERED IN DATA LIST - CASE
COMMAND IGNORED - TRY AGAIN
?CASE  2  1  3
```

c. Control returned to the data file after the corrected line was typed in. If the user had typed the command KEY instead of the corrected data list, control would have remained with the keyboard, and the erroneous line and the rest of the data file would have been ignored.

2-5-4 Supplemental Question and Answer Sequences. Some of the commands (RELE, REPO, and REPT) have supplemental question and answer sequences that are interactive and cannot be placed on the command line. These sequences will occur at the keyboard and be answered by the user just as if the command line had just been typed in instead of being in a data file.

2-5-5 End of Data File. There are three ways to end a data file: use the KEY command or END command or just let it run out of commands and data lists. It is strongly recommended that the last line be the UPDA command to reset the update file so that it will contain the data in the file. It is much faster to restore from an old update file than to re-read a data file. The KEY command returns control to the keyboard. It is interded for use when an error message (paragraph 2-5-3) is printed and the user decides to stop the list processing and finish it interactively. It may also be used at the end of a data list, but is not necessary there. The END command in the last line will cause a normal program termination with report file destination questions and answers.

2-6 DATA ENTRY

2-6-1 General. This program provides for list-directed input of data. Error recovery and two types of prompting are available as requested. A data list consists of the name of the list and the values of the data items (variables) included in the list, separated with one or more blank spaces. Commas may not be used. Data lists in a data file must be preceded by a line number. Data lists entered interactively from the time-sharing keyboard after the ? prompting message must not have line numbers. All of the items in a list must be on one line. Only the lists actually needed for a particular problem need to be used. The data items in a list must be entered in the prescribed order but the lists in a group may be entered in any order. For example, the two groups shown below are equivalent:

CASE	3	2	1	3	group a
TYPE	2	2			
HYD	2	1			
TYPE	2	2			group b
CASE	3	2	1	3	
HYD	2	1			

Chapter 12 includes a listing of the data lists, by subject matter, that can be used to verify lists needed for each module. Other tabulations in Chpater 12 provide additional information.

2-6-2 Prompting. There are two types of data entry prompting available in the executive phase of the program.

a. Simply typing in the name of a data list, with no values given after the list name, will cause printing of a one-line definition of each item in the list. The prompting information will be in the same order as the variables in the data list:

```
COMMAND
?WLD

                         DATA LIST - WLD
VARIABLE     UNITS  -  DEFINITION
   ETS       FOOT   -  TOP OF STEM ELEV. (ALL ELEVATIONS MUST BE +)
   TW2       FOOT   -  HORIZ PROJECTION OF CLEAR WIDTH OF TOE FROM STEM
   STR       RATIO  -  STEM RATIO (TOE WIDTH TW2/BASE WIDTH BW)
  HEELW      FOOT   -  HORIZ PROJECTION OF CLEAR WIDTH OF HEEL FROM STEM
   TSTB      INCH   -  HORIZ PROJECTION OF STEM THICKNESS AT BASE
  TMINB      INCH   -  MINIMUM CONCRETE THICKNESS IN BASE SLAB

COMMAND
?
```

b. Typing a question mark (?) instead of a numeric value in a data list--this type of prompting is available in many places throughout the program besides the executive phase--yields a one-line definition for the one variable. An example of its use in a data list follows.

```
COMMAND
?WLD  100.0  10.0  ?  C  D  S

VARIABLE        UNITS    -   DEFINITION
   STR          RATIO        STEM RATIO (TOE WIDTH TW2/BASE WIDTH BW)
TRY AGAIN ENTER VALUE FOR - STR
?
```

c. Additional prompting will be printed if a nonnumeric value is used as the response to the data list prompting in paragraph 2-6-2b:

```
?
BAD VALUE ENTERED FOR STR
ENTER NEW REAL VAUE
    'D'      -  TO GET DEFAULT VALUE
    'C'      -  TO TELL PROGRAM TO CALCULATE VALUE
    'S'      -  TO KEEP PREVIOUS VALUE
?0.3333
COMMAND
?
```

The kind of information available with repeated use of the ? response depends on the location in the program of the prompting or question being responsed to.

d. Complete information on data entry can be brought to the time-sharing terminal by (1) use of the ? as a command to get the information in paragraphs 12-1-10 and 2-3-1, or by (2) use of the HELP command to get the ? command information plus the paragraph 2-6-2a information for all data lists.

2-6-3 Special Data Identifiers D, C, and S. The use of the identifiers D, S, or C in an executive phase data list, in place of a numeric value, will cause the program to take special action regarding that data item. These identifiers may not be used for load case (LC), reinforcing steel layer number (LN,LNA, or LNB), or location code (LOC).

a. The identifier D will set the value of a new data item to -0.4321E+31 and the value of an integer item to -100010, special values that will cause later substitution of the default value (if there is a default value for that item). If there is no default value, it will leave the value in its undefined state. There may be more than one default value for a particular data item variable, depending on the values of ITYPE (1 for a floodwall, 2 for a retaining wall) and IHYD (1 for a hydraulic structure, 2 for a nonhydraulic structure). Once these two indicator variables are set in the program starting sequence or modified by the data lists TYPE or HYD, the appropriate default value will be substituted automatically. In many cases, the absence of a default value will cause the value of the data item to be changed from D to C. In the LOOK command output, the identifier D will be shown by the message DEFAULT VALUE REQUESTED.

b. The identifier C will set real data item values to -0.1234E+31, and integer data items to -100000, special values that mean that a variable is undefined. One use of this is to tell the program which one of a set of several redundant variables is to be calculated from the others in the set. See paragraph 8-15 for one such set. Another use is to identify an array of pressure values to be calculated (seepage and earth pressures) by setting the first location element to "undefined" or "C" (see Chapter 11). All variables are automatically initialized to this state at the start of a run or by use of the INIT command. Thus, the letter C can stand for either "calculate" or "cancel." The LOOK command output will use the words VALUE NOT DEFINED to indicate the use of the letter C.

c. The identifier S tells the program to leave the value of that data item alone; to keep the same value that it had before the data list was entered.

2-6-4 Redundant Lists. The same variable name may appear in more than one data list. This is for the user's convenience so that only the list most directly useful need be entered. For example, the list SOLW contains all of the data items (ESHW, HS3) in data list SOLC for Coulomb horizontal active earth pressures, plus the additional data items (HS1, DS1H, HS2, WDS2) needed for the wedge method description.

2-6-5 Optional Lists. If a data list contains information needed by an optional capability, the list is to be entered only if the procedure is wanted. Examples of such lists are NAME, TYPE, HYD, TRCE, WLBR, WLDR, SOLF, etc. Lists may also be omitted if all of the items in that list are to be calculated, such as ACPH, ACPS, BPA, etc.

2-6-6 Load Case Dependent Items. Many of the variables may have different values for different load cases. The load case is specified by the first item in the data list containing the "load cased" variable data item. For example, the data list SOLT has three data items. The first data item in this list is the load case number for the other two items in the list. In the example shown below, the values of ESTW and SST can be tabulated by hand as being

Load Case Number	ESTW	SST
1	526.34	100.0
2	528.34	100.0

and entered as data into the program with the following two data lines.

```
SST   1   526.34   100.0
SST   2   528.34   100.0
```

If all of the variables in a list will have the same value, one data list entry will suffice for all of the load cases by using a zero for the load case number. If all except a few of the load cases will have the same values of a data item variable, it can be handled by first entering the majority value with a load case number of zero and then redefining the exception:

```
SST   0   526.34   100.0
SST   2   528.34     S
```

The example pair of data lists, entered in the order shown (load case code 0 first), will set ESTW to 526.34 and SST to 100.0 for load cases 1 and 3 through 10 and will set ESTW to 528.34 and keep SST at 100.0 for load case 2. The zero load case code will set the data items for load cases 1 through 10, not just the load cases numbered in data list CASE.

2-6-7 Partial Lists. An incomplete list may be entered if all of the following conditions are satisfied:

a. All of the missing data values are to be zero.

b. None of the missing values are for load case number (LC), layer number (LN, LNA, or LNB), or location code number (LOC).

c. When a value is omitted, the rest of that list must also be omitted.

2-7 REPORT FILE

2-7-1 Program output is in two parts, time-sharing terminal printout and report file output. The report file is created automatically when the program starts running and at the message FOR NEW REPORT FILE: in the REPO command's question and answer sequence. This sequence is described in paragraph 2-4-1. Each new report file starts with a section of FORTRAN coding that sends the file to the selected station code if the user so elects after the END command or at the message FOR EXISTING REPORT FILE: in the REPO command. The user's other two options are to place the report file in a permanent file in the user's master catalog or to destroy the file. The report file may be listed at a time-sharing terminal but cannot be read later by program TWDA.

2-7-2 A value of -0.1234E+31 in the program printout means that that item has not been defined in the particular program run. A value of -0.1234E+31 means that the default value has been requested (the letter D option described in paragraph 2-6-3) but not yet substituted by the program.

2-7-3 The following tabulation furnishes guidance to the user for obtaining the total program output best suited to his needs:

Purpose of Run	Do This
General design memo or survey report	After the END command, let the program destroy the report file
Feature design memo	Get the report file output, either at your ADP Center high-speed printer or as a permanent file and list it
Contract plans files	Use the TRCE 3 command to get the report file

CHAPTER 3: DATA FOR ALL MODULES

3-1 DATA COMMON TO ALL MODULES. The general, soil, and surcharge data needed to define a particular problem must be defined before any of the modules can be run. The wall description needed will be different for different modules and is explained in Chapters 4 through 10 of this manual. See also Chapter 12 for checklists of required and optional data. Units are in pounds and feet except for slab thickness and batters.

3-2 GENERAL DATA

3-2-1 Data List NAME (optional). The data list NAME provides for up to 60 characters of alphanumeric job identification to be entered after the blank following the command word. This job identification will be placed in the report file at least once in each module. The date and time of day are written on the line following each job identification line in the report file.

3-2-2 Data List CASE (mandatory only if more then one load case and if the load case numbers are not in ascending order from LCS(1) to LCS(NLC)).

a. This is the only data list that has a variable number of data items in it. The list contains, in addition to the list name, the number (quantity) of load cases and the load case numbers (identification codes):

```
CASE  NLC  LCS(1)  LCS(2)  ...  LCS(NLC)
```

where NLC is the quantity of load cases to be activated and LCS(1) is the identification code number of the first load case. LCS(2) is the identification code of the second load case, etc. The identification codes may be in any order, with the one exception that LCS(1) must be the desired load case if the variable ISLC in data list SEEP has a value of 2. The usual procedure, except for the ISLC = 2 situation, is for the numbers to be in ascending order from LCS(1) to LCS(NLC). The value of NLC must be from 1 to 10, and the values of LCS(1) through LCS(NLC) must also be from 1 through 10.

b. The use of a load case number of zero in a data list other than CASE (see paragraph 2-6-6) will cause the values in the list to be assigned to all 10 load case identification codes, whether or not the cases have been activated with the data list CASE.

c. If the question

```
ENTER NUMBER OF LOAD CASES (1 TO 10)
?
```

in part 2 of the program starting sequence is answered with a 1, then NLC and LCS(1) are automatically set to 1, and data list CASE need not be used (unless the user wants another identification code number for the single load case).

3-2-3 Data Lists HYD and TYPE (normally not needed). These two lists are needed to change one or more of the load cases from floodwall default values to retaining wall default values or from hydraulic structure to nonhydraulic structure, or vice versa. One use for such a "mixed" wall might be where the long-term action is as a retaining wall and a short-term case is as a floodwall:

a. Data list HYD is entered in the format

```
HYD  LC  IHYD
```

where

HYD = list name

LC = load case number (or zero)

IHYD = 1 for a hydraulic structure or 2 for a nonhydraulic structure

b. Data list TYPE is entered in the format

```
TYPE  LC  ITYPE
```

where

TYPE = list name

LC = load case number (or zero)

ITYPE = 1 for a floodwall or 2 for a retaining wall

Data items affected include CRACK in data list SEEP, NSLIDE and FSMIN in data list SLID, and NPPD in data list SOLP.

c. The illogical combination of IHYD = 2 and ITYPE = 1 (nonhydraulic floodwall) will not be checked for or rejected if caused by data list entry. It is, however, checked for in part 2 of the program starting sequence.

3-2-4 Data List INDI. This is not actually data--it is only to be "LOOK'd" at. The value names are made up of the letter I and a module name. The values will be zero for "not run," for "run successfully," or 2 for "run aborted."

3-3 SOILS AND SEEPAGE DATA

3-3-1 General. There are three types of soils data: soil surface, soil properties, and soil design parameters. Not all modules need all of this information, as may be seen from the following table. There is a random relationship between existing soil layers 3-4-5 and backfill soil layers FZ-1-2-6-7 as the w .l and its backfill move up and down.

Data List	Page	Mandatory Where Used?	Used in SA-SP	Used in FA-FD	Used in WA-WD-UA-UD	See Figure
BOIL	3-4	no	--	yes	--	--
ONEA	3-5	no	--	yes	--	--
RRD	3-6	no	--	FD	--	--
SEEP	3-6	(5)	--	--	(1)	3-1
SLID	3-9	no	--	yes	--	--
SPHF	3-9	(4)	yes	yes	yes	3-1
SPH1	3-10	(6)	yes	yes	yes	3-1
SPH2	3-10	(4)	yes	yes	yes	3-1
SPE3	3-11	yes	yes	yes	--	3-1
SPE4	3-12	no	yes	yes	--	3-1
SPE5	3-12	no	yes	yes	--	3-1
SPT6	3-13	(3)	--	yes	--	3-1
SPT7	3-13	(6)	--	yes	yes	3-1
SSEE	3-13	(7)	yes	yes	--	3-2, 3-3
SOLP	3-14	no	yes	yes	(2)	--
SST	3-17	yes	--	yes	yes	3-1
SSHW or SSHC	3-17 / 3-18	yes	yes	yes	yes	3-1
WGHT	3-18	no	yes	yes	yes	--

NOTES:

(1) ELWT, ELWH, ISLC are optional; KRACK has a default value; HGSW and ISFT are not used in these modules.

(2) NPPD, RKH, RKV, CFMA have default values; IFEOC, NODF, and IFSOM are not used.

(3) SPT7 data will be assumed to be also for SPT6 if SPT6 is not entered. SPT7, in turn, will be copied from SPE3 if SPT7 is omitted.

(4) Soil layer 1 is assumed over all of the heel unless SPHF or SPH2 is entered for soil below or above soil type 1.

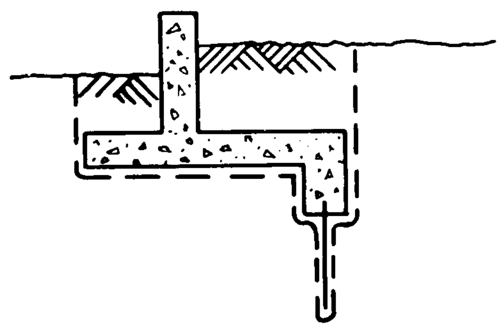
(5) SEEP is mandatory only if water exists.

(6) Soil properties from SPE3 are used for layer 1 (SPH1) if data list SPH1 is omitted. Similarly, SPE3 values are used for SPT7 if SPT7 is omitted.

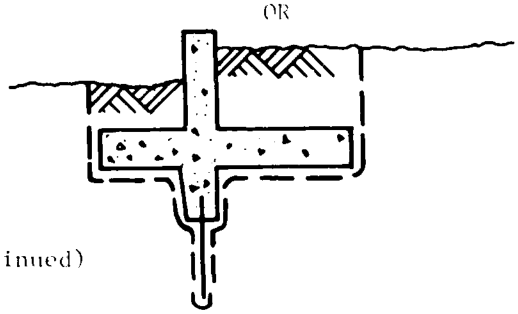
(7) List SSEE is needed only for design (module FD).

3-3-2 Soils and Seepage Data Item Definitions:

List Name	Variable Name	Units	Default Value	Definition
BOIL				Boil control data, optional
	ELSPT	ft	0.0	Elevation of tip of impervious sheet pile cutoff wall below center of key. In module FA (and FD), the presence of this data item variable will cause the program to calculate and print out the average creep ratio to the report file
	CRMIN	ratio	--	Minimum allowable creep ratio. In module FA (and FD), the presence of this data item will cause the program to calculate and print out to the report file the highest ELSPT that will satisfy the CRMIN limit
	IPATH	1 or 2	1	Controls the location of the creep path portion between the bottom of effective length of sheet pile and the end of the toe: 1 to select the path that includes a line along the toe-side face of the sheet pile, key, and bottom of the base:



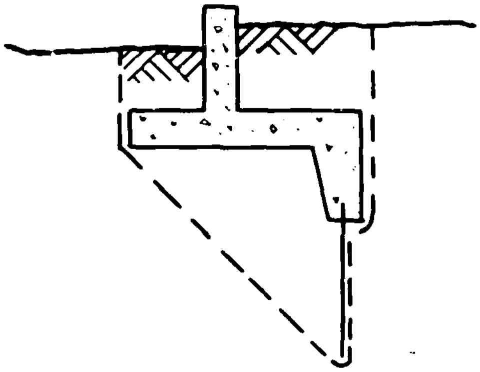
OR



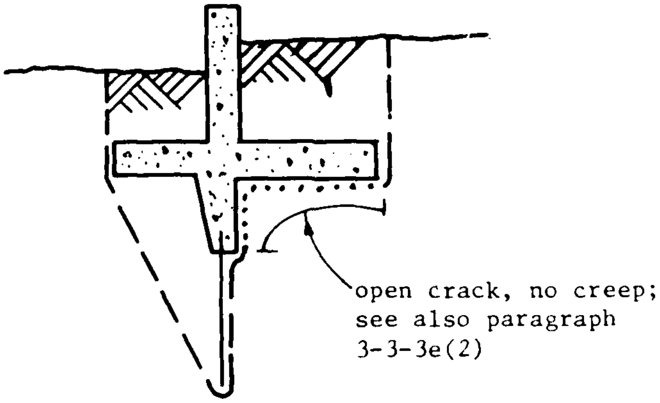
(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
BOIL	IPATH			2 to select the path that includes a single straight line from the tip of the pile to the end of the toe:



OR



List Name	Variable Name	Units	Default Value	Definition
ONEA	OMEGA	deg	C	Single set value for sliding neutral block bottom angle from horizontal. The critical value will be found if left undefined (data list omitted) (see paragraph 3-3-3)

(Continued)

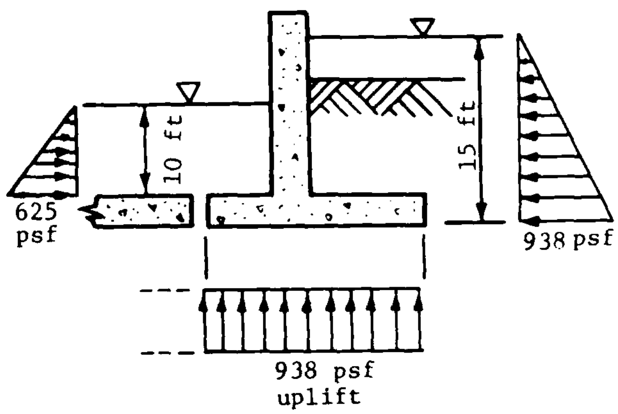
3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
RRD	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	RRMIN	ratio	1/3 unless ELWH is within 1.05 ft of top of stem, in which case the default value is 0.25	Minimum allowable resultant ratio (resultant arm/BW) from both ends of the base. Module FD only
SEEP	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	ELWT	ft	C	Elevation of water over the toe. Must not be between points 2 and 4 in Figure 3-5
	ELWH	ft	C	Elevation of water over the heel
	(The list may be terminated here if defaults below are OK.)			
SEEP	HGSW	--	0.0	Soil weight change due to hydraulic gradient. The effective unit weight is taken to be the buoyant unit weight plus (HGSW times GAMAW) on the wall side with the higher water elevation and the buoyant unit weight minus (HGSW times GAMAW) on the wall side with the lower water elevation. HGSW is equivalent to ΔH/L gradient. Zero value yields no effect
	ISLC	1 or 2	1	One value for all load cases: 1 if each load case is to determine its own seepage pressure 2 if the first load case code number mentioned in data list CASE is to determine the seepage pressures for all load cases

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SEEP	ISFT	1-4	1	Option 1: The line of creep calculations are as described in EM 1110-2-2501 and as illustrated and discussed in detail in Exhibit H for sliding and Exhibit K for overturning of the Program Criteria Specifications Document. This is the default option for this control. Its action combines with the heel earth crack control (KRACK) to determine how the pressures are determined Option 2: Perched water table. Any load case(s) will use the water elevation over the toe for weight and horizontal pressure above the toe only. Uplift will be hydrostatic, based on the water elevation over the heel. This would be selected by the user for a channel with an impervious floor:

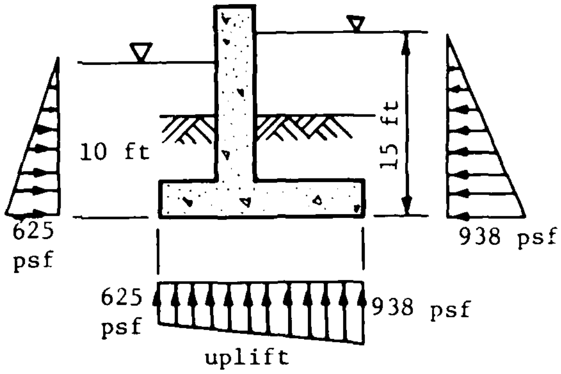


Option 3: Pressures will be those caused by the weight of water over the heel and toe. Uplift will be a linear variation between the heel

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

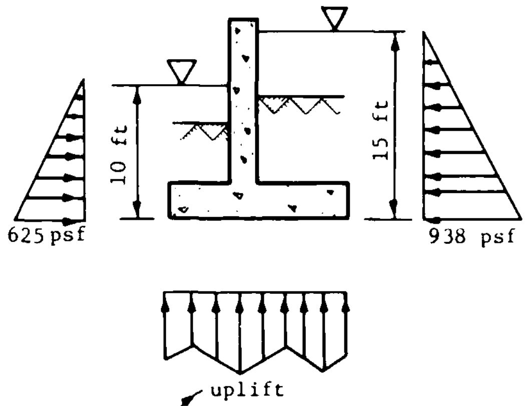
List Name	Variable Name	Units	Default Value	Definition
SEEP	ISFT			and toe hydrostatic pressure. The user might select this option for a wall on rock



Option 4: Water weight and horizontal pressures above the base will be hydrostatic pressures calculated from the input water elevations. Uplift pressures will be input data for analysis only; will be used as zero for design

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SEEP	ISFT			 Values as inputted by user for analysis. May be zero as described in paragraph S-15e of EM 1110-2-2501. Will be taken as zero during design. Use array FV in data list HSPV to input these pressures; to cancel these pressures, use this data list entry: HSPV LC 1 C
	KRACK	1 or 2	(1)*	Option 1 (default for floodwalls) is to have a vertical crack in the earth cover over the heel (see page S-9 and paragraph S-15a on page S-18 of EM 1110-2-2501). This eliminates any active earth pressure at the heel (module SA) and enables the use of W3-W4 surcharge pressures

(Continued)

* This and other reference numbers given in parentheses in this table refer to notes listed on page 3-20.

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SEEP	KRACK			Option 2 (default for retaining walls) is to have no crack over the heel. This enables active earth pressure and disables any W3-W4 surcharge pressures
SLID	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	NSLIDE	1-4	(1)	1 to use ETL 1110-2-184 Shear Friction Method (default for retaining walls). See Exhibit H of the Program Criteria Specifications Document) 2 to use the Allowable Strength Equilibrium Method with c' = c/(FS+2c'), according to Exhibit I of the Program Criteria Specifications Document (default for floodwalls) 3 to use the Allowable Strength Equilibrium Method with c' = c/FS, according to Exhibit J of the Program Criteria Specifications Document 4 is not implemented (see paragraph 3-2-3)
	FSMIN	ratio	1.5 for flood-walls; 2.0 for retaining walls	Minimum allowable factor of safety against sliding [force ratio for NSLIDE = 1 (or NPPD = 5 in data list SOLP); allowable strength ratio FS for NSLIDE = 2 or 3]. (see paragraph 3-2-3)
SPHF				See notes (10), (11), (12), and (13)
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	FZTAH	ft	0.0	Thickness of filter zone at end of heel, measured vertically up from base of slab (top of key if key is at end of heel)

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SPHF	PHIFZ	deg	0.0	Angle of internal friction (2)
	COHFZ	psf	0.0	Cohesive strength of filter zone (2)
	GAMASF	pcf	0.0	Unit weight of filter (including weight of water if submerged) (2)
	RKAFZ	factor	C	Active earth pressure coefficient for filter. Will be calculated from PHIFZ if not defined and if IFWOC = 2. Will be ignored if IFWOC = 1
	DELTAF	deg	0.0	Wall friction angle for pressures on face of stem
	RKAEFZ	factor	C	Mononobe-Okable earthquake active pressure factor. See Chapter 8 of the Program Criteria Specifications Document. Dynamic K_a needs RKH and RKV from data list SOLP if it is to be calculated. Will be ignored if IFWOC = 1
SPH1				See note (10) and note (6) the table in paragraph 3-3-1
	LC	0, 1-10		Load case number (see paragraph 2-5-6)
	PHI1	deg	0.0	Angle of internal friction (9)
	COH1	psf	0.0	Cohesive strength (9)
	GAMAS1	pcf	0.0	Unit weight of soil (including weight of water if submerged)

(The list may be terminated here if defaults below are OK.)

List Name	Variable Name	Units	Default Value	Definition
SPH1	RKA1	factor	C	Active earth pressure coefficient. Will be calculated from PHI1 if not defined and if IFWOC = 2. Will be ignored if IFWOC = 1
	DELTA1	deg	0.0	Wall friction angle for pressures on face of stem
	RKAE1	factor	C	Mononobe-Okabe earthquake active earth pressure factor. See

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SPH1	RKAE1			Chapter 8 of the Program Criteria Specifications Document. RKAE1 needs RKH and RKV from data list SOLP if it is to be calculated. Will be ignored if IFWOC = 1
	HCMIN	ft	*	Minimum allowable earth cover over the heel, measured vertically. This is used as a constraint in module FD and is compared in module FA. It is ignored in modules SA, SP, WA, WD, UA, and UD
SPH2				See note (10)
	LC	0, 1-10		Load case number
	ELTS1	ft	--	Elevation of top of soil layer 1. Soil layer 2 need not be included if it is the same as soil layer 1
	PHI2	deg	0.0	Angle of internal friction
	COH2	psf	0.0	Cohesive strength
	GAMAS2	pcf	0.0	Unit weight of soil (including weight of water if submerged)
	(The list may be terminated here if defaults below are OK.)			
	RKA2	factor	C	Active earth pressure coefficient. Will be calculated from PHI2 if not defined and if IFWOC = 2. Will be ignored if IFWOC = 1
	DELTA2	deg	0.0	Wall friction angle for pressures on face of stem
	RKAE2	factor	C	Mononobe-Okabe earthquake active earth pressure factor. See Chapter 8 of the Program Criteria Specification Document. RKAE2 needs RKH

(Continued)

* The default calculation for HCMIN is (3 + 0.1(ETS-ESHW) [illegible] 5.0 and is calculated separately for each load case if the default is requested and the wall is a floodwall. The default value for retaining walls is zero. If a value is inputted in the data list, it will be used for all load cases.

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SPH2	RKAE2			and RKV from data list SOLP if it is to be calculated. Will be ignored if IFWOC = 1
SPE3				See note (11)
	PHI3	deg	--	Angle of internal friction (3)
	COH3	psf	--	Cohesive strength (3)
	GAMAS3	pcf	--	Unit weight of soil (including weight of water if submerged)
	PHIS3	deg	--	Angle of sliding friction on concrete (4)
	ADHS3	psf	--	Adhesive strength against concrete (4)
(The rest of this list may be omitted if allowable bearing pressure is not to be checked.)				
SPE3	ABP3TN	psf	--	Allowable gross bearing pressure under a base BW1 feet wide (data list WLDB) at top of soil zone 3. See note (5)
	ABP3BN	psf	--	Allowable gross bearing pressure under a base BW1 feet wide (data list WLDB) at elevation ELBS3. See note (5)
	ABP3TW	psf	--	Allowable gross bearing pressure under a base BW2 feet wide (data list WLDB) at the top of soil zone zone 3. See note (5)
	ABP3BW	psf	--	Allowable gross bearing pressure under a base BW2 feet wide (data list WLDB) at elevation ELBS3. See note (5)
	ELBS3	ft	C	Elevation used as a basis for ABP3BN and ABP3BW. Must be below all concrete. The default value is the lowest concrete elevation
SPE4				See note (11)

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SPE4	ELTS3	ft	--	Elevation of top of soil layer 3. See note (6)
	PHI4	deg	0.0	Angle of internal friction (3)
	COH4	psf	0.0	Cohesive strength (3)
	GAMAS4	pcf	0.0	Unit weight of soil (including weight of water if submerged)
	PHIS4	deg	0.0	Angle of sliding friction on concrete (4)
	ADHS4	psf	0.0	Adhesive strength against concrete (4)
		(The rest of this list may be omitted.)		
SPE4	ABP4TN	psf	--	Allowable gross bearing pressure under a base BW1 feet wide (data list WLDB) at the top of soil layer 4. See note (5)
	ABP4BN	psf	--	Allowable gross bearing pressure under a base BW1 feet wide (data list WLDB) at the bottom of soil layer 4. See note (5)
	ABP4TW	psf	--	Allowable gross bearing pressure under a base BW2 feet wide (data list WLDB) at the top of soil layer 4. See note (5)
	ABP4BW	psf	--	Allowable gross bearing pressure under a base BW2 feet wide (data list WLDB) at the bottom of soil layer 4. See note (5)
SPE5				See note (11)
	ELTS4	ft	--	Elevation of top of soil layer 4. See note (6)
	PHI5	deg	0.0	Angle of internal friction. See note (3)
	COH5	psf	0.0	Cohesive strength (3)
	GAMAS5	pcf	0.0	Unit weight of soil (including weight of water if submerged)

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SPE5	PHIS5	deg	0.0	Angle of sliding friction on concrete (4)
	ADHS5	psf	0.0	Adhesive strength against concrete (4)
		(The rest of this list may be omitted.)		
	ABP5TN	psf	0.0	Allowable gross bearing pressure value under a base BW1 feet wide (data list WLDB) at the surface defined by data list SSEE. See note (5)
	ABP5BN	psf	--	Allowable gross bearing pressure under a base BW1 feet wide (data list WLDB) at the bottom of soil layer 5. See note (5)
	ABP5TW	psf	--	Allowable gross bearing pressure value under a base BW2 feet wide (data list WLDB) at the surface defined by data list SSEE. See note (5)
	ABP5BW	psf	--	Allowable gross bearing pressure under a base BW2 feet wide (data list WLDB) at the bottom of soil layer 5. See note (5)
SPT6				See note (10)
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	PHI6	deg	0.0	Angle of internal friction
	COH6	psf	0.0	Cohesive strength
	GAMAS6	pcf	0.0	Unit weight of soil (including weight of water if submerged)
SPT7				See note (11) and note (6) in the table in paragraph 3-3-1
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	PHI7	deg	0.0	Angle of internal friction (9)

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SPT7	COH7	psf	0.0	Cohesive strength (9)
	GAMAS7	pcf	0.0	Unit weight of soil (including weight of water if submerged)
SSEE				See notes (7), (11), (12), and (14). See Figures 3-2 and 3-3. This list is optional
	EXW	ft	2.0	Excavation bottom extra width, each side
	ESS	ratio	1.0	Excavation side slope, 1.0 vertical: ESS horizontal. Must not be zero
	HSS5T	ratio	100.0	Existing ground side slope beyond ELTS5T (toe side), 1.0 vertical: HSS5T horizontal, 100.0 if level
	ELTS5T	ft	--	Elevation of existing ground at a distance from the basic working line of DTS5T toward the toe
	DTS5T	ft	0.0	Horizontal distance from basic working point to ELTS5T toward toe
	ELTS5W	ft	--	Elevation of existing ground directly under basic working point
	ELTS5H	ft	--	Elevation of existing ground at a distance from the basic working line of DTS5H toward the heel
	DTS5H	ft	0.0	Horizontal distance from basic working point to ELTS5H toward heel
	HSS5H	ratio	100.0	Existing ground side slope beyond ELTS5H (heel side), 1.0 vertical: HSS5H horizontal, 100.0 if level
SOLP	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	IFWOC	1 or 2	2	1 if an incremental wedge method is to be used to calculate active earth pressures, and horizontal pressures of surcharge. See notes (12) and (14)

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

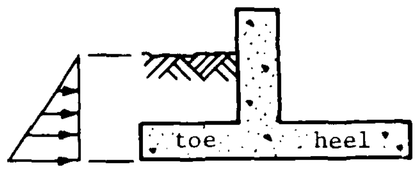
List Name	Variable Name	Units	Default Value	Definition
SOLP	IFWOC			2 if Coulomb's equation is to be used to calculate active earth pressures and if modified theory of elasticity equations described in Addendum B to Exhibit A of the Program Criteria Specifications Document are to be used for horizontal pressures due to vertical surcharges
	NODE	each	C	Number of wedge increments (nodes) to be used in modules SA and SP when IFWOC = 1 and IFSOM = 2. Default (D or C) is to use one node per foot of height, which becomes excessively expensive for higher walls. NODE is ignored in module FD because IFSOM is used as 1 if IFWOC = 1 during the design process. The final analysis of the selected design, however, uses IFSOM and NODE as actually defined by the user
	IFSOM	1 or 2	1	1 for one-piece trial failure surfaces in the incremental wedge method calculations with multiple layers of soil 2 for piece-wise linear trial failure surfaces in the incremental wedge method calculations with multiple layers of soil. Option 2 is not allowed in the design stage of module FD because of the much greater cost. The analysis stage of module FD uses the IFSOM value set by the user. See paragraph 4.3.1.b of the Program Criteria Specifications Document
	NPPD	1-5	(1)	Overturning analysis passive pressure shape code. See Figure 4-1 and pages K-6 through K-11 of the Program Criteria Specifications

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

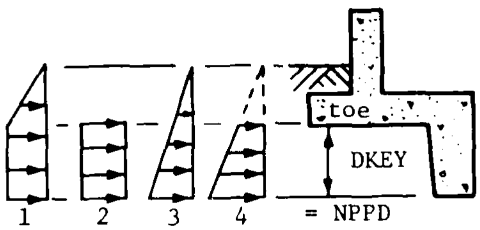
List Name	Variable Name	Units	Default Value	Definition
SOLP	NPPD			Document. Note that the difference between Figures K-1c and K-2b is that the wall in Figure K-1c has a key (0.01 ft long). A quick reference shape diagram follows, but it is important for the user to read pages K-6 through K-11 before coding a wall with a sloping base and no key. Level base, no key (DKEY = 0.0):

NPPD = 1 or 3:



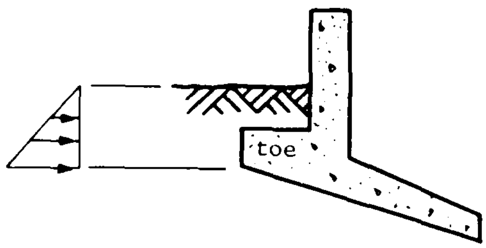
NPPD = 2 or 4: No passive pressure possible

Level base, DKEY at least 0.01 ft long:



Sloping base, no key (DKEY = 0.0):

NPPD = 1 or 3:

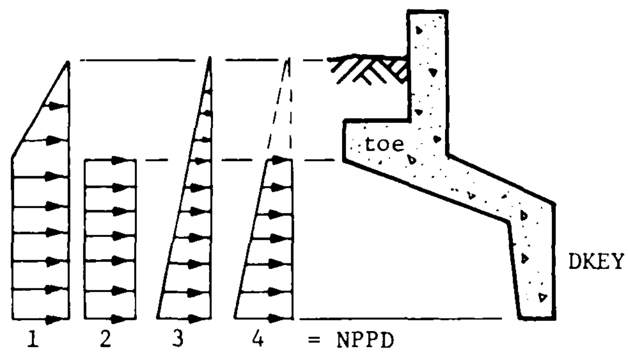


(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

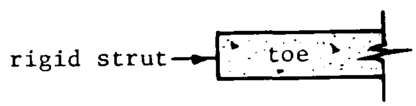
List Name	Variable Name	Units	Default Value	Definition
SOLP	NPPD			NPPD = 2 or 4: No passive pressure possible

Sloping base, DKEY at least 0.01 ft long:



Any base, with or without a key:

NPPD = 5: This option precludes the use of any subgrade friction or passive pressure in either sliding or overturning



Note that in walls with a key at least 0.01 ft long, the horizontal force in the overturning calculations is resisted entirely by passive pressure, with no limit on the magnitude of the passive pressure. Walls without a key have this horizontal force resisted by only a force along the base unless this force exceeds a (N tan Ø + cA) limit, in which case the amount of force in excess of the limit will be taken up by passive pressure shaped according to the value of NPPD

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SOLP	NPPD			The NPPD default value for floodwalls is 1; the default value for retaining wall is 3
	RKH	ratio	0.0	Mononobe-Okabe earthquake horizontal acceleration factor, as a decimal fraction of gravity. See note (8)
	RKV	ratio	0.0	Mononobe-Okabe earthquake vertical acceleration factor, as a decimal fraction of gravity. See note (8)
	CFMA	factor	1.0	Arching-active correction factor for moment arm used to increase moments due to arching active earth pressure. See paragraph 4.3.1.c of the Program Criteria Specifications Document. M = F * arm * CFMA(LC)
SST	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	ESTW	ft	--	Elevation of backfill earth cover over toe, where it passes directly underneath the basic working point. See note (9)
	SST	ratio	--	Slope of backfill earth cover over the toe, 1.0 vertical: SST horizontal, level = 100.0. See note (9). This slope may intersect anywhere on the excavation side slope or on existing ground
SSHW				This data list is used to define the backfill earth cover over the heel when the incremental wedge method is to be used for active earth pressures. If the Coulomb method is to be used, use data list SOLC
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	ESHW	ft	--	Elevation of backfill earth cover over the heel, where it passes

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SSHW	ESHW			directly underneath the basic working point. This earth cover must intersect the heel-side face of the stem and not the top of stem
	HS1	ratio	100.0	Heel earth backfill slope nearest the stem. 100.0 = level. Usable only if IFWOC = 1. Must be "C" unless 3 slopes are used
	DS1H	ft	0.0	Width of slope HS1. Needed only if IFWOC = 1. Must be "C" unless HS1 is defined
	HS2	ratio	100.0	Heel earth backfill slope, beyond DS1H, for a distance of WDS2. Must be used if more than 1 slope. 100.0 = level. Usable only if IFWOC = 1. Must be used if more than 1 slope
	WDS2	ft	0.0	Width of slope HS2. Needed only if IFWOC = 1. Must be "C" unless HS2 is defined
	HS3	ratio	--	Heel earth backfill slope, beyond WDS2 for list SSHW or from stem over heel for list SSHC. Must not intersect the base slab. 100.0 if level. Must always be defined
SSHC				SOLC is a subset of data list SSHW containing LC, ESHW, and HS3 only. If list SSHC is entered, the program will automatically set HS1, DS1H, HS2, and WDS2 to undefined C
WGHT	GAMAC	pcf	150.0	Unit weight of reinforced concrete
	GAMAW	pcf	62.5	Unit weight of water

NOTES: (1) Default values described in definition column.

(2) Soil layer 1 values are used for filter zone if wedge method is used (IFWOC = 1).

(Continued)

(3) Used for sliding strength determination wherever the assumed failure path is in soil (if key present or no key but sloping base) (PHIx and COHx).

(4) Used for sliding strength determination wherever the assumed failure path is along the soil-concrete interface (PHISx and ADHx).

(5) The program uses an isoparametric interpolation procedure to determine the allowable bearing pressure corresponding to the actual base width (BW) and the elevation at each soil layer interface and concrete outline corner along the base. The actual base width must lie at or between BW1 and BW2. Default (D or C) is for the maximum bearing pressure to be ignored. See note (6) and then (7).

(6) Soil layer 3 must always be defined for modules SA, SP, FA, or FP. Soil layer 5 may be omitted if its properties are identical with soil layer 4. Layer 4 may be omitted if layer 5 has been omitted and all of layers 3, 4, and 5 are identical.

(7) If layer 5 has been omitted, then ABP4TN and ABP4TW must be for the surface defined by data list SSEE. If layers 5 and 4 have been omitted, then ABP3TN and ABP3TW must be for the surface defined by data list SSEE.

(8) The equation that uses factors RKH and RKV is in paragraph 8.5.1.b (equation for "angle" θ) of the Program Criteria Specifications Document, for calculating RKAE factors for the filter zone and soil layers 1 through 5. In addition, the factors are multiplied by the various unit weights to get inertial forces within the neutral block. To completely avoid earthquake effects in a load case, all of these data item variables must be zero: RKAEFZ, RKAE1, RKAE2, RKH, and RKV.

(9) The backfill earth surface must never be below the top of the base slab. This affects data lists SPT7, SPH1, SST, and SSHW or SSHC.

(10) See Figure 3-1 for illustration of data lists SPHF, SPH1, SPH2, SPT6, SPT7, SSHW, SSHC, SST, and part of SEEP.

(11) See Figure 3-2 for illustration of lists SSEE, SPE3, SPE4, and SPE5.

(12) Data lists SOLF and SOL5 are ignored by the wedge method option for active earth computation (IFWOC = 1).

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Concluded):

(13) Special notes about the filter zone:

a. Line-of-creep calculations (ISFT = 1 in data list SEEP) assume no loss of head in the filter zone.

b. Soil properties for soil layer 1 are used in the filter zone, instead of the SPHF properties, when IFWOC = 1 (wedge method) in data list SOLP.

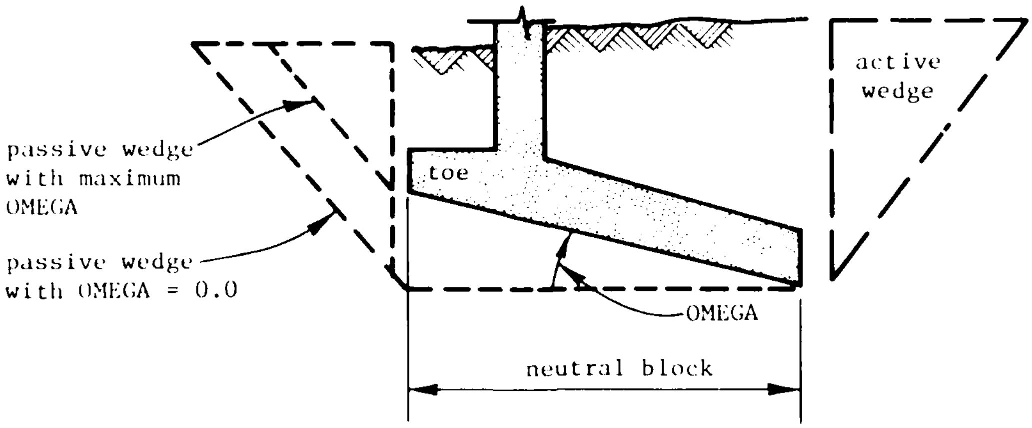
(14) With the wedge method, a line from the lowest concrete at the end of the heel, extending outward at an angle 15 deg upward from the horizontal, must intersect the existing grade line defined by data list SSEE. See Figure 3-2.

3-3-3 Sliding Data. Sliding control data are included in data lists ONEA and SLID, plus the values of KFLAG and DKEY in data lists WLAK and WLDK, and NPPD in data list SOLP. Data lists ONEA and SLID are optional for analysis. Data list ONEA is optional for design.

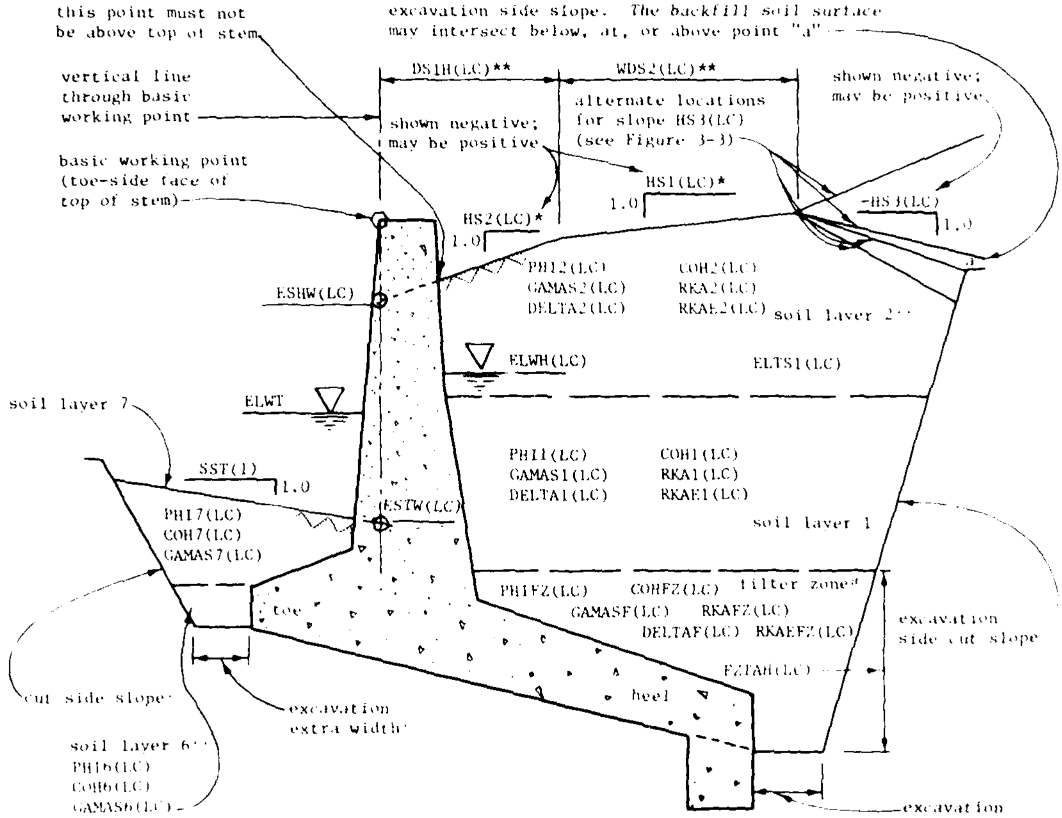
a. Sliding calculations use the method of wedges: an active wedge beyond the heel, a neutral block between the ends of the heel and the key, and a passive wedge beyond the toe. The passive wedge does not include any use of the variable NPPD in data list SOIP unless NPPD = 5, in which case the passive wedge is replaced with a rigid strut.

b. Walls with no key and a level base use neutral block base sliding resistance calculated from the sliding friction angle and adhesion soils data values from soil layers 3, 4, and/or 5 along the base.

c. Walls with no key and a sloping base use a variable angle OMEGA to define the bottom of the neutral block:



(1) With maximum OMEGA, base sliding resistance includes the use of sliding friction and adhesion strength from the



NOTE: There are no limits on elevations ELWT and ELWH.

* 100.0 = "level"; may be C if ** items are 0.0 or C; may be positive or negative.

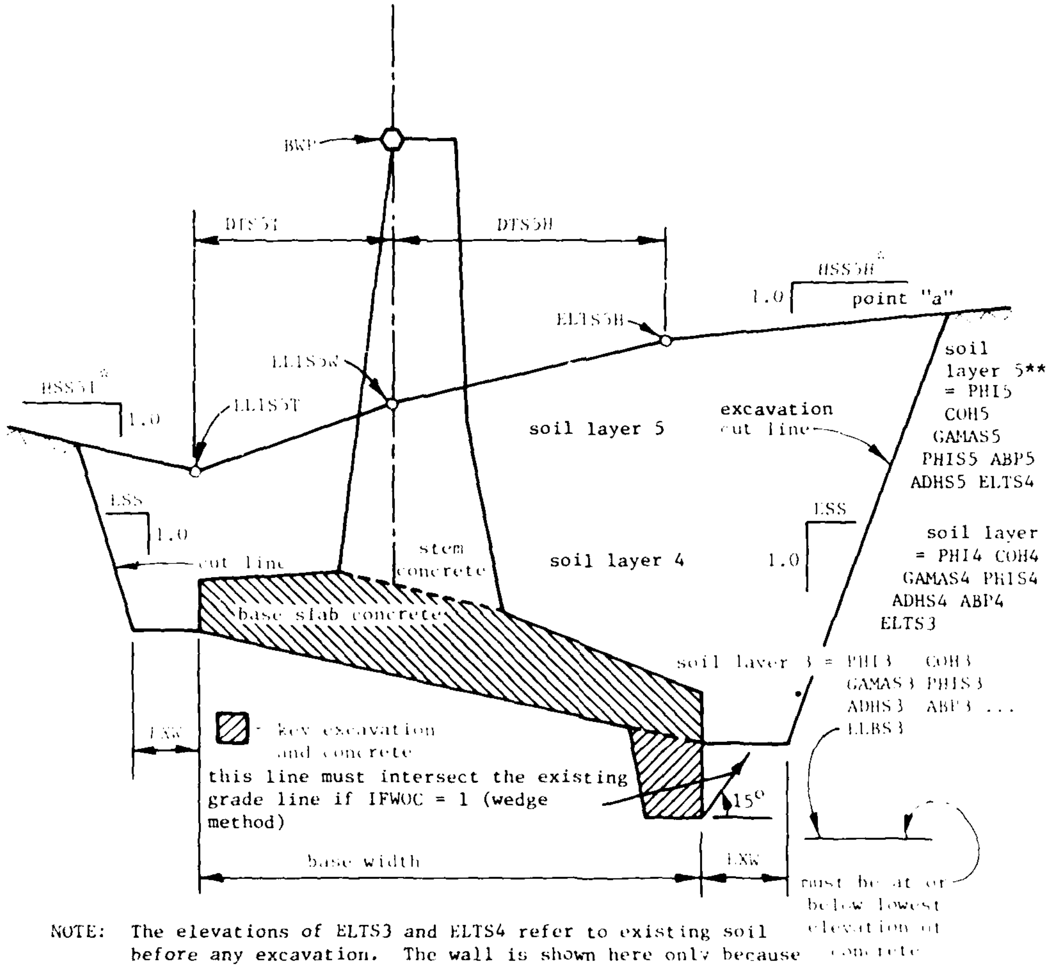
** Must be C or 0.0 for IFWOC=2 (Coulomb).

See data list SSEE.

Optional. Omit this layer and its data list if no such layer exists.

\## See note (13) at the end of paragraph 3-3-2.

Figure 3-1. Backfill soils data (illustration of data lists SPHF, SPH1, SPH2, SPT6, SPT7, SSHW, SSHC, SST, and part of SEEP)



NOTE: The elevations of ELTS3 and ELTS4 refer to existing soil before any excavation. The wall is shown here only because data list SSEE contains EXW and ESS. The cut line may be inside or outside of DTS5T and DTS5H.
All computed excavation and backfill quantities are set to zero when data list SSEE is omitted.

* 100.0 if level; shown positive.

** Soil data for this layer are assumed to be the same as those for layer 4 when IFWOC = 1.

Figure 3-2. Existing ground soil and cost data (Illustration of data lists SPE3, SPE4, SPE5, and SSEE

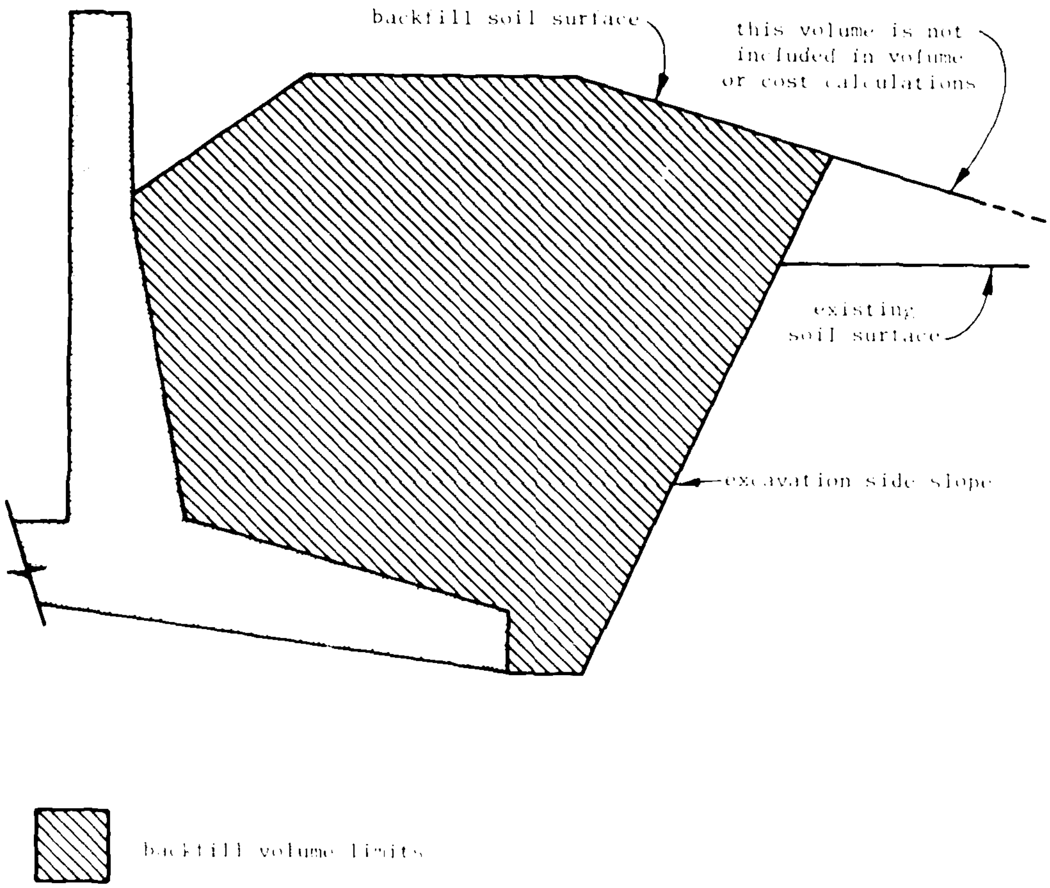


Figure 3-3. Additional notes on intersection of existing and heel backfill soil surfaces

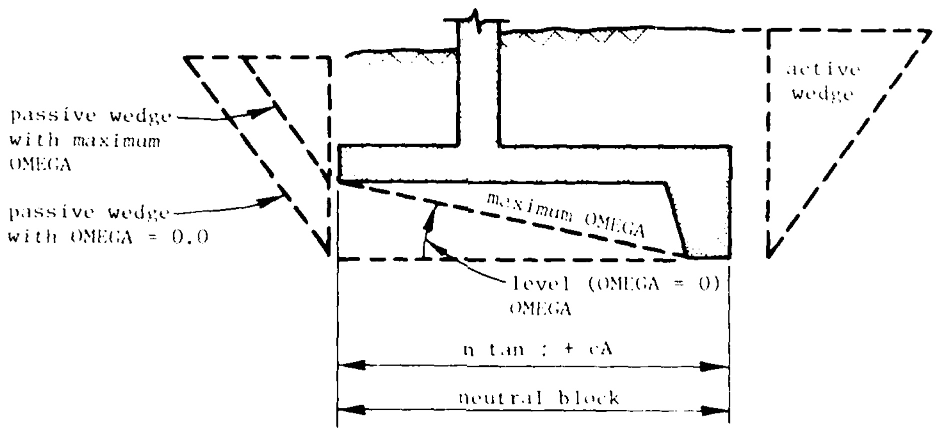
soil layers under the base, as well as the parallel component of the weight of the neutral block.

(2) With OMEGA less than the maximum, base sliding resistance includes the use of soil internal friction and cohesion instead of sliding friction and adhesion.

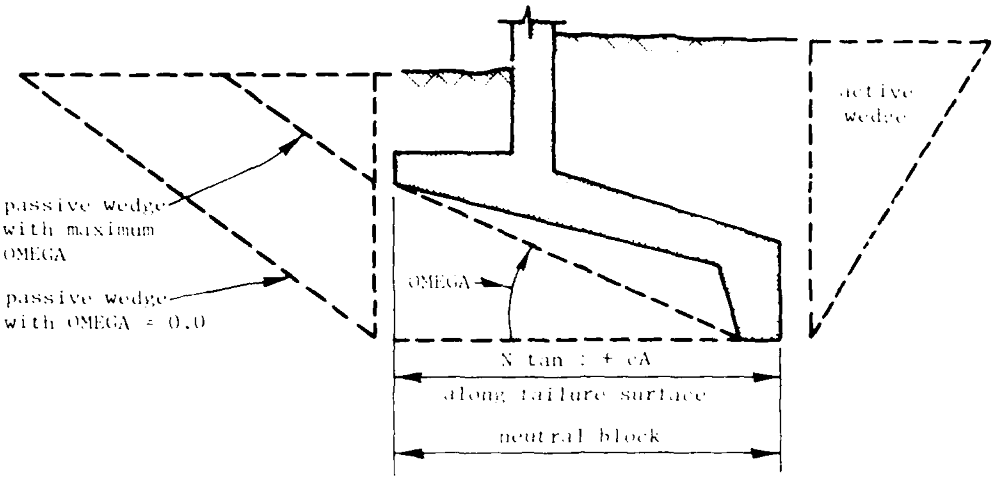
d. A single value of OMEGA may be specified in data list ONEA, or it may be made variable by either not using list ONEA or canceling an input value by reentering the list with the letter C for an OMEGA value.

e. Walls with a key not less than 0.01 ft long (DKEY in data list WLAK or the result of module FD) will use a neutral block base that depends on the value of KFLAG (data list WLAK or WLDK).

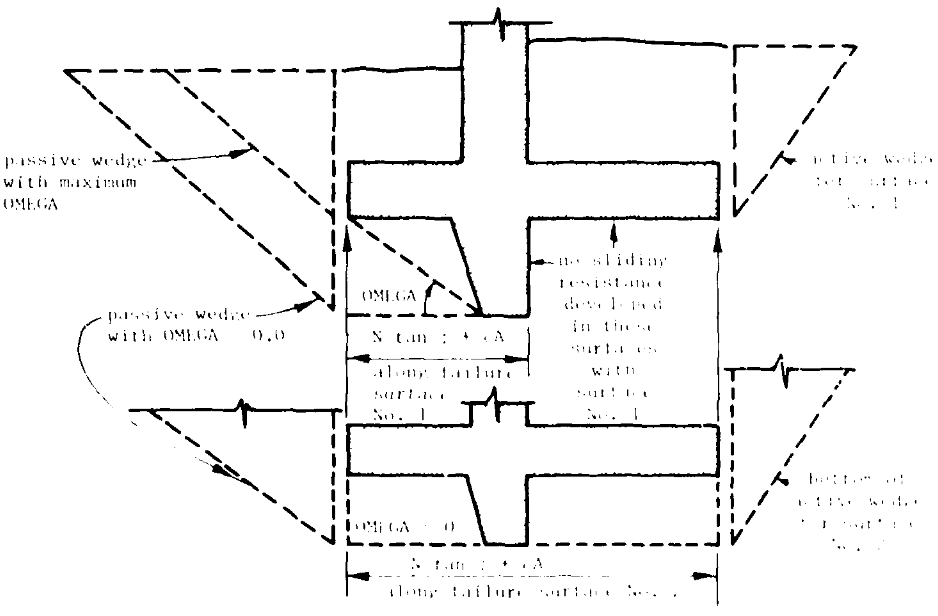
(1) With KFLAG = 0 (key at end of heel), the computation will be as described in Exhibits H, I, and J and in Chapter 6 of the Program Criteria Specifications Document. The bottom of the neutral block will be <u>like the sketch below for a level base:</u>



And <u>like this for a sloping base:</u>



(2) With KFLAG = 1 (key under stem), the computations will be similar to the KFLAG = 0 situation, but will be based on the descriptions given in paragraph 6.3.1 of the Program Criteria Specifications Document and diagrammed below. Read this reference carefully before using this option. Surfaces 1 and 2 are always both considered:



f. All situations with OMEGA greater than zero also include the resisting force of the parallel component of the weight of the neutral block, along the inclined failure surface.

3-4 SURCHARGE DATA

3-4-1 All Surcharge Data Lists Are Optional:

a. All surcharge data lists may be used in modules SA, SP, FA, and FD.

b. Surcharge data lists SCFD, SCFH, and SCWH may be used in modules WA, WD, UA, and UD.

c. Surcharge data lists SCFV and SCWV are not used in modules WA, WD, UA, and UD.

3-4-2 Surcharge Data Item Definitions (See Figure 3-4):

List Name	Variable Name	Units	Default Value	Definition (See Note 1)
SCFD				Vertical forces on concrete
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	PVS	lb/ft	0.0	Line load centered on top of stem
	PVB	lb/ft	0.0	Line load on base slab at X coordinate value DVB from vertical line through the basic working point
	DVB	ft	0.0	X coordinate from basic working point to PVB. Negative if PVB is on toe
SCFH				Horizontal forces on concrete
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	PH1	lb/ft	0.0	Line load at elevation ELPH1. Must be negative if on toe
	ELPH1	ft	--	Elevation of force PH1. May be at any elevation on or above bottom of toe
	PH2	lb/ft	0.0	Line load at elevation ELPH2
	ELPH2	ft	--	Elevation of force PH2. Must be above base, on stem only
SCFV				Vertical line loads on soil surface
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	PV1	lb/ft	0.0	Line surcharge at X coordinate DV1
	DV1	ft	0.0	X coordinate at line load PV1. See note (2)

(Continued)

3-4-2 Surcharge Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition (See Note 1)
SCFV	PV2	lb/ft	0.0	Line surcharge at X coordinate DV2
	DV2	ft	0.0	X coordinate at line load PV2
	PV3	lb/ft	0.0	Line surcharge at X coordinate DV3
	DV3	ft	0.0	X coordinate at line load PV3
	PV4	lb/ft	0.0	Line surcharge at X coordinate DV4
	DV4	ft	0.0	X coordinate at line load PV4
	PV5	lb/ft	0.0	Line surcharge at X coordinate DV5
	DV5	ft	0.0	X coordinate at line load PV5
SCWH				Horizontal pressures
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	W1	psf	0.0	Pressure on any portion of stem above finished grade
	ELW1T	ft	--	Elevation of top of W1. Must be between the top of stem and ELW1B
	ELW1B	ft	--	Elevation of bottom of W1. Must be below ELW1T
	W3	psf	0.0	Pressure at finished grade elevation over end of heel. See note (2)
	W4	psf	0.0	Pressure at bottom of key if key is at end of heel (KFLAG = 0) <u>or</u> at bottom of end of heel if no key or if key is under the stem (KFLAG = positive)
SCWV				Vertical surcharge pressures on soil surface
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	WT	psf	0.0	Area surcharge, over a portion of toe only
	WWT	ft	0.0	Width of WT
	DWT	ft	0.0	Horizontal distance from basic working point to stem-side edge of area covered by WT. Always entered positive, over toe only

(Continued)

3-4-2 Surcharge Data Item Definitions (Concluded):

List Name	Variable Name	Units	Default Value	Definition (See Note 1)
SCWV	WH	psf	0.0	Area surcharge, over a portion of heel only
	WWH	ft	0.0	Width of WH
	DWH	ft	0.0	Horizontal distance from basic working point to stem-side edge of area covered by WH. Always positive, over heel only
WIND	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	W	psf	0.0	Wind pressure (positive from heel, negative from toe) on exposed surface of stem not covered by pressure W1 in data list SCWH

NOTES: (1) All forces and pressures are positive downward or acting toward the toe from beyond the heel.

(2) Used only if KRACK = 1; ignored if KRACK = 2. Pressures W3-W4 are in addition to all seepage pressures. They are intended for use to model the momentary increase in hydrostatic pressure caused by the rise in mean water level as a wave approaches the stem. Pressures W3-W4 act instead of active earth on the neutral block if KRACK = 1.

3-5 COST DATA

3-5-1 Use of Cost Data:

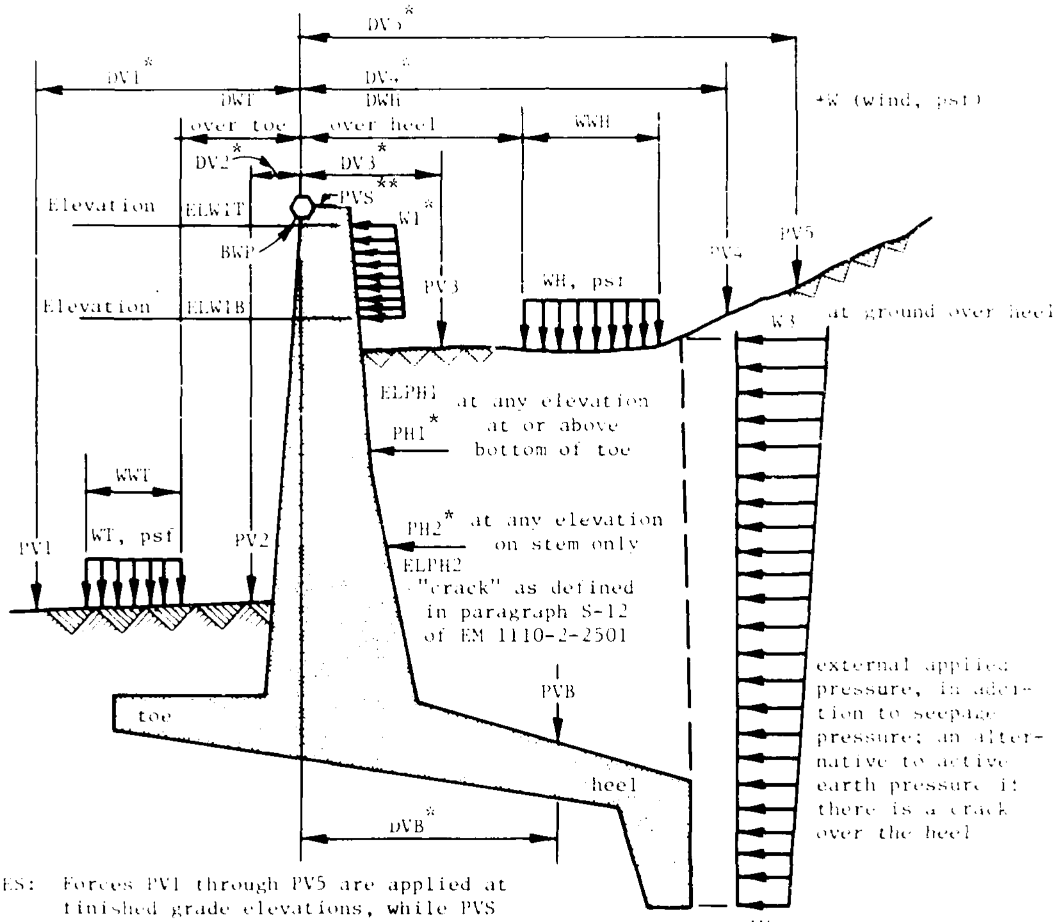
a. Cost data are all optional. Default values will be used if not entered (it is not necessary to enter a list just to use the D option).

b. Module FA calculates the estimated construction cost of the completed wall, in dollars per lineal foot.

c. Module FD uses the construction cost estimated by module FA as its basis of optimization.

d. Modules SA, SP, WA, WD, UA, and UD ignore the cost factors.

e. Cost data are illustrated in Figure 3-2.



NOTES: Forces PV1 through PV5 are applied at finished grade elevations, while PVS and PVB are applied directly to the concrete.

All forces and pressures are shown acting in the positive direction.

* Any value can be used, on either side of the stem (either direction); positive if over heel, negative if over toe.

** Centered on top of stem.

At or below top of stem.

Below ELWIT; may be below ground (must be on stem).

Figure 3-4. Illustration of applied loads and surcharges

3-5-2 Cost Data Item Definitions:

List Name	Variable Name	Units	Default Value	Definition
CSTB*				Unit costs of structural backfill
	UCBFFZ	$\$/ft^3$	0.0	Unit cost of filter zone
	UCBFS1	$\$/ft^3$	0.0	Unit cost of soil layer 1
	UCBFS2	$\$/ft^3$	0.0	Unit cost of soil layer 2
	UCBFS6	$\$/ft^3$	0.0	Unit cost of soil layer 6
	UCBFS7	$\$/ft^3$	0.0	Unit cost of soil layer 7
CSTC				Unit costs of reinforced concrete
	UCWB	$\$/ft^3$	1.0	Unit cost of concrete in base slab
	UCWS	$\$/ft^3$	1.0	Unit cost of concrete in stem
	UCWK	$\$/ft^3$	1.0	Unit cost of concrete in key
CSTE*				Unit costs of structural excavation
	UCEXS3	$\$/ft^3$	0.0	Unit cost of excavation in soil layer 3
	UCEXS4	$\$/ft^3$	0.0	Unit cost of excavation in soil layer 4
	UCEXS5	$\$/ft^3$	0.0	Unit cost of excavation in soil layer 5
	UCEXWK	$\$/ft^3$	0.0	Unit cost of key excavation

* CSTB and CSTE values must be omitted (for default value substitution) or zero when hypothetical existing earth elevations and distances are used in data list SOLE.

3-6 WALL GEOMETRY DATA

3-6-1 Internal Coordinate System. A system of orthogonal coordinates is calculated internally and used to define locations of corners of the concrete outline, as well as of the soils system and sliding failure planes. See the circled numbers in Figure 3-5.

a. X coordinates are measured horizontally from an origin along the Y axis which runs vertically through the basic working point (BWP). Positive values are toward the heel; negative values are toward the toe.

b. Y coordinates are elevations. All values must be positive.

3-6-2 Data Redundancy. The data items are more than sufficient to describe a wall. This redundancy gives the user more flexibility in how a wall can be described, or verifies the consistency of a description calculated elsewhere. Major redundant data sets are described below:

a. Stem location on base. The location of the stem (toe side of stem at base) can be established by defining any one of the following sets of data. See paragraph 3-6-4 for definition of the variables. It is assumed that the base width (BW) has already been established:

(1) TW2 (toe width).

(2) BW, STR (BW times stem ratio).

(3) TSTB, HEELW (toe width is remainder of BW).

b. Heel thickness at stem. The possibilities here are based on the fact that the program always completes the definition of the toe width and thicknesses first. Alternate sets are listed below:

(1) Toe description, IBSAME = 1, HEELT2

(2) HEELT1, HEELT2.

HEELT2 is set to its default value of TMINB if undefined. TMINB is determined from the following rules if undefined. HEELT1 and HEELT2 cannot be less than TMINB; TMINB must be entered if it is to be less than the default value.

ETS-BTE1	TMINB and TMINS Default Values
Up to 15.0 ft	12.0 in.
Over 15 ft	18.0 in.

c. Heel-side bottom panel batter of stem. This value, HSBPB, is always calculated by the program as it closes the perimeter description of the wall cross section. The calculated value is printed in the report file.

3-6-3 Data Lists. Many of the wall geometry data items appear in more than one list to aid the user in entering the fewest number of lists possible. In general, there are two types of lists: those describing the wall for analysis, and those describing the wall for design. The first two letters of the list names are "WL" for "wall." The third letter is either "A" for "analysis" or "D" for "design." The fourth letter, if used, is "B" for "base," "H" for "heel," "K" for "key," "S" for "stem," or "T" for "toe."

a. Lists for analysis:

```
*WLA   ETS  TW2  STR  HEELW
*WLAB  BW   BW1  BW2  BS
```

*WLAH HEELT2 HEELW HEELT1

WLAK KFLAG DKEY WKEY BKTF

*WLAS TSTT TSB TSTB HSTPH HSTPB HSPBP

*WLAT BTE1 TOEHT TS2 TW1 TS1

WLBR BASER

b. Lists for design:

*WLD ETS TW2 STR HEELW TSTB TMINB

*WLDB BW1 BW2 BS1 BS2 (needed only for stability design)

WLDH HEELT2

WLDK KFLAG BKTF DKEY1 DKEY2

WLDS TMINS TSB HSTPH HSTPB HSBPB

*WLDT BTE11 BTE12 TOEHT TW1

WLBR BASER

Note that TMINB in list WLD must be used for slab thicknesses below the default for TMINB and TMINS in list WLDS must be used for stem thickness less than the default for TMINS. Note that this list may not be terminated after TMINS because the rest of the list must be "S," not "D."

3-6-4 Wall Geometry Data Item Definitions (See Figure 3-5). Wall parts are listed in the approximate order that they are used in the program. See Chapters 5 and 6 for illustrations.

Variable Name	Units	Default Value	Definition
			Stem Description
TSTT	in.	TMINS	Stem thickness t at top. See note (11)
ETS	ft	(1)	Elevation of top of stem
TSB	in./ft	0.0	Toe-side batter, inches horizontal per foot vertical
TSTB	in.	(10)	Stem t at base. See note (11)
TMINS	in.	(3)	Minimum allowable stem t . See paragraph 3-6-2b(2)
			(Continued)

* Denotes a required list.

3-6-4 Wall Geometry Data Item Definitions (Continued):

Variable Name	Units	Default Value	Definition
HSTPH	ft	(2)	Heel-side top panel height. Should be 0.0 if no top panel. See note (13)
HSTPB	in./ft	0.0	Heel-side top panel batter, in inches horizontal per foot vertical. See note (13)
HSBPB	in./ft	(3)	Heel-side bottom panel batter, in inches horizontal per foot vertical. There must be a bottom stem t at base (horizontal projection). See notes (10) and (13)
			Toe Description
TW1	ft	0.0	Width of part 1 of toe (at stem)
TS1	ratio	100.0	Slope of top of part 1 of toe, 1.0 vertical to TS1 horizontal, 100.0 = level. Must always be positive
TW2	ft	(4)	Width of entire toe. See note (10)
TS2	ratio	100.0	Slope of top of part 2 of toe (at end), 1.0 vertical to TS2 horizontal, 100.0 = horizontal. Must always be positive
TOEHT	in.	TMINB	Toe t at end; always vertical. See note (12)
BTE1	ft	(1)	Elevation of bottom of toe at end
BTE11	ft	(1)	Lowest value of BTE1 in module FD
BTE12	ft	(5)	Highest value of BTE1 in module FD
STR	ratio	none	Stem ratio (design value for TW2/BW)

Base Bottom Description (The values of TW2 (or STR) and BW must be such that at least one point at the toe-side face of the stem or inside the stem is an integer number of feet from the end of the toe.)

Variable Name	Units	Default Value	Definition
BW	ft	(6)	Base width (horizontal projection). See note (10)
BW1	ft	(1)	Minimum value for BW in module FD. Also needed for allowable bearing pressure interpolation in modules FA and FD

(Continued)

3-6-4 Wall Geometry Data Item Definitions (Continued):

Variable Name	Units	Default Value	Definition
BW2	ft	(1)	Maximum value for BW in module FD. Also needed for allowable bearing pressure interpolation in modules FA and FD. Must be larger than BW1
BS	ratio	0.0	Base bottom-side slope, BS vertical to 1.0 horizontal, 0.0 = level
BS1	ratio	0.0	Minimum value for BS in module FD
BS2	ratio	0.3333	Maximum value for BS in module FD
BASER	ft	0.0	Base horizontal radius defining trapezoidal plan, measured from basic working point, positive over heel. Base is always 1.0 ft wide under the basic working point. 0.0 = rectangular (infinite radius)
TMINB	in.	(3)	Minimum allowable base slab t . See paragraph
			Key Description
KFLAG	0 or 1	1	0 if key is at end of heel; 1 if key is under stem
DKEY	ft	0.0	Key length, measured vertically along heel side
DKEY1	ft	0.0	Minimum value for DKEY in module FD
DKEY2	ft	(3)	Maximum value for DKEY in module FD
BKTF	ratio	3.0	Toe-side face batter, 1.0 horizontal to BKTF vertical
WKEY	in.	TMINB	Width (thickness) at bottom of key. See note (12)
			Heel Description
HEELT1	in.	(8)	Thickness at stem. See note (12)
HEELT2	in.	TMINB	Thickness at end, not including any key. May not be greater than HEELT1
HEELW	ft	(9)	Width (horizontal projection). See note (10)

(Continued)

3-6-4 Wall Geometry Data Item Definitions (Concluded):

NOTES:

(1) Required data item with no default value or default calculation procedure.

(2) Will be calculated to be as large as possible. See Figure 3-6.

(3) Calculated by program.

(4) See paragraph 3-6-2a(1).

(5) Note (1); must be below top of soil layer 7 as defined by data list SOLT.

(6) Three fifths of ETS - BTE1 or, as determined by module FD, between BW1 and BW2.

(7) Default value for a floodwall is 0.8 of ETS - BTE1; default value for a retaining wall is zero.

(8) Default values:

a. TMINB.
b. Top of heel must not slope down toward the stem.
c. Set at top of toe at stem if IBSAME = 1 and if it is strong enough.

(9) See paragraph 3-6-2a(3).

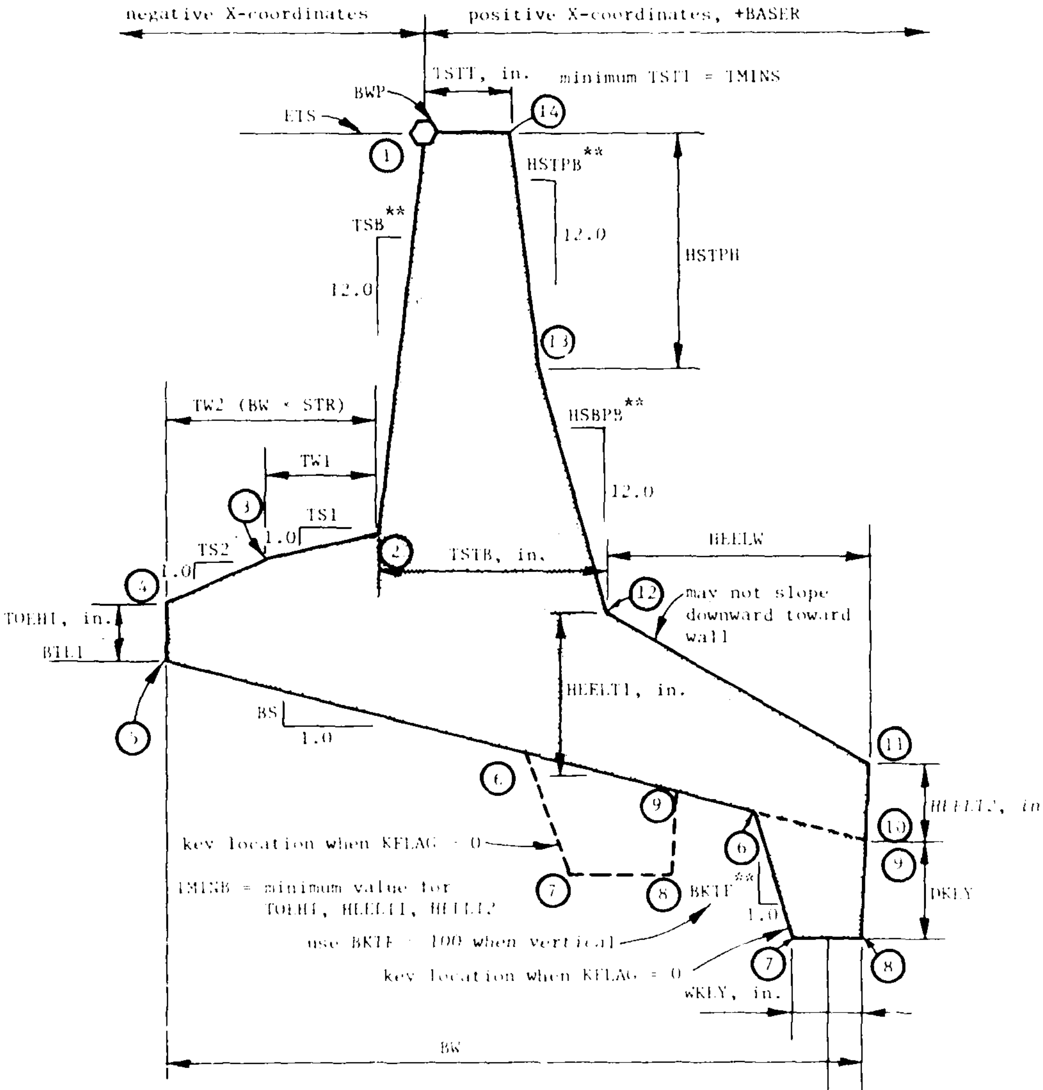
(10) Program verifies consistency of following equations, within 0.01 ft, or calculates values to complete the equations:

BW = TW2/STR = TW2 + (TSTB/12.0) + HEELW

(11) May not be less than TMINS.

(12) May not be less than TMINB.

(13) When a single batter is desired on the heel-side face of the stem, use HSTPH = 0 and HSTPB = anything and use HSBPB for the single batter.



Note: Point 8 is located on a line extended from point 13 through and beyond point 12.

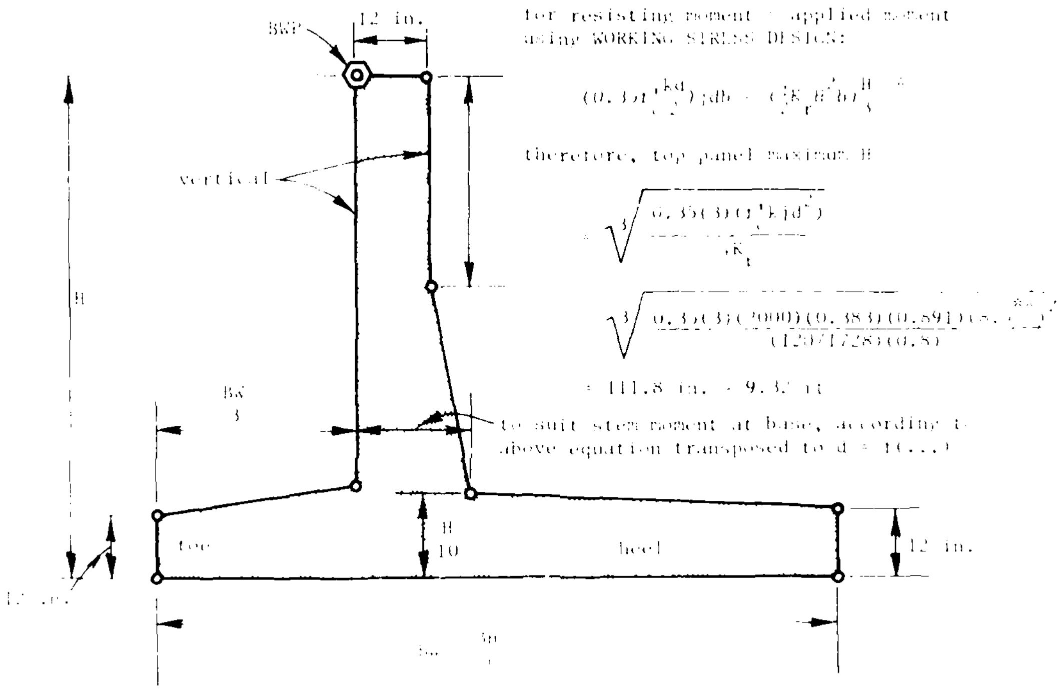
* Circled numbers are cross-sectional corner numbers.

** May never be negative.

Value = 100.0 if level; must never slope downward toward stem.

Controlled by design process in mode 3D.

Figure 3-5. Wall cross-sectional data variables



[illegible]

Figure 3-6. Wall cross section with illustration of all default values for hydraulic structures (default values are taken from EM 1110-2-2501, unless otherwise noted)

CHAPTER 4: MODULES SA AND SP--ACTIVE EARTH PRESSURES

4-1 GENERAL. Modules SA and SP are not normally run separately by the user. Normal use of the program would include running module FA for overall stability analysis or module FD for overall stability design. When modules FA and FD need the output of modules SA and SP, they are called automatically.

4-2 PURPOSE. Module SA calculates active earth and horizontal surcharge effect forces acting on a vertical plane through the end of the heel. Module SP performs the same calculations as module SA, except that the forces are the ones acting on the heel-side face of stem. Calculation procedures are explained in Exhibit A to the Program Criteria Specifications Document.

4-3 ACTIVE EARTH PRESSURE CALCULATION. Active earth forces may be calculated by either Coulomb's equation (IFWOC = 2) or an incremental wedge method (IFWOC = 1). Data lists ACPH and ACPS permit the user to edit the forces so obtained for analysis (not for design) or to input for analysis a complete set of forces obtained elsewhere. Earth pressures for stability design must be as calculated within the program (see Chapter 11).

4-4 REQUIRED DATA

4-4-1 Soils. See paragraph 3-3-2 and Figure 3-1 for details. DELTA1 of data list SPH1 and DELTA2 of data list SPH2 are required for modules SP only.

*SPE3 PHI3 COH3 GAMAS3 PHIS3 ADHS3 ABP3TN ABP3BN ABP3TW ABP3BW ELBS3
SSHW LC ESHW HS1 DS1H HS2 WDS2 HS3

or

SSHC LC ESHW HS3 (HS1, DS1H, HS2, and WDS2 will be cancelled.)

4-4-2 General. See paragraph 3-2-2a for details.

CASE NLC LCS(1) LCS(2) ... LCS(NLC)

4-4-3 Geometry. See paragraph 3-6 and Figure 3-5 for details.

* Only PHI3, COH3, and GAMAS3 are used in module SA. The entire list is ignored if IFWOC = 2 (Coulomb), but the list must be inputted with positive values even if the values are not needed.

*WLA ETS TW2 STR HEELW

*WLAB BW BW1 BW2 BS

*WLAH HEELT2 HEELW HEELT1

WLAK KFLAG DKEY WDEY BKTF

*WLAS TSTT TSB TSTB HSTPH HSTPB HSBPB

*WLAT BTE1 TOEHT TS2 TW1 TS1

Much of this data is redundant, as is described in paragraph 3-3-2. The lists are shown here only as a reminder to the experienced user. The beginning user is urged to refer to Chapter 5.

4-5 OPTIONAL DATA THAT WILL BE USED IF ENTERED

4-5-1 Soils. See paragraph 3-3-2 and Figure 3-1 for details. DELTA2 and DELTAF are used only in module SP.

```
**SPH1  LC  PHI1  COH1  GAMAS1  RKA1  DELTA1  RKAE1  HCMIN
**SPH2  LC  ELTS1  PHI2  COH2  GAMAS2  RKA2  DELTA2  RKAE2
**SPHF  LC  FZTAH  PHIFZ  COHFZ  GAMASF  RKAFZ  DELTAF  RKAEFZ
 †SPE4  ELTS3  PHI4  COH4  GAMAS4  PHIS4  ADHS4  ABP4TN  ABP4BN  ABP4TW
    ABP4BW
 †SPE5  ELTS4  PHI5  COH5  GAMAS5  PHIS5  ADHS5  ABP5TN  ABP5BN  ABP5TW
    ABP5BW
††SEEP  LC  ELWT  ELWH  HGSW  ISLC  ISFT  KRACK
 ‡SOLP  LC  IFWOC  NODE  IFSOM  NPPD  RKH  RKV  CFMA

  SSEE  EXW  ESS  HSS5T  ELTS5T  DTS5T  ELTS5W  ELTS5H  DTS5H  HSS5H

‡‡WGHT  GAMAC  GAMAW
```

---

* Denotes a required list.

** DELTA1, DELTA2 and DELTAF are ignored by module SA; RKA1, RKA2, RKAFZ, and RKAEFZ are optional (see note (8) and the detailed definitions in paragraph 3-3-2). HCMIN is used by module FD only.

† Only PHI, COH, and GAMAS are used in module SA. The values in the entire list are ignored if IFWOC = 2 in modules SA and [illegible]

†† The only variable actually needed is KRACK (LC), [illegible] be set to 2 (no crack) if the wall is a floodwall. ISLC ha[illegible] value. This is also an optional list.

‡ NODE and IFSOM are ignored if IFWOC = 2 (Coulomb); NPPD is ignored by both modules.

‡‡ List WGHT is needed only if ELWH is used to achieve buoyant earth below some elevation. Default values are 150.0 and 62.5.

4-5-2 General. See paragraph 3-2 for details.

```
NAME  (job name, 60 characters maximum)
*TYPE  LC ITYPE(LC)
```

(HYD is ignored by both module SA and module SP.)

4-5-3 Surcharges. See paragraph 3-3-1 and Figure 3-4 for details. Data lists SCFD, SCFH, and SCWH are not used in modules SA and SP.

```
SCFV  LC PV1 DV1 PV2 DV2 PV3 DV3 PV4 DV4 PV5 DV5
SCWV  LC WT  WWT DWT WH  WWH DWH
```

4-5-4 Geometry. The geometry data for analysis (all data lists beginning with the letters "WLA") contain the capability of a highly redundant description. The purpose of this redundancy is to furnish the user with flexibility in completing a wall description. It can also be used to verify the consistency of a description calculated elsewhere, since the program verifies such redundant data. See paragraph 3-6 for details.

4-6 INTERPRETATION OF OUTPUT

4-6-1 Meaning of Values:

a. The values calculated by models SA and SP are in the form of a series of arrays, each element of which is a lumped force summed from the segment of pressure diagram centered on a row of nodal points that are evenly spaced along the vertical surface specified in paragraph 4-2. The spacing may be controlled by the data item variable NODE in data list SOLP described in paragraph 3-3-2. A summation of lumped force values is thus equivalent to the total area under the active earth pressure diagram.

b. Each module produces three arrays--lumped force elevations, static effect forces, and additional forces due to earthquake--as tabulated below:

Module Name	Lumped Force Elevations	Static Force Values	Additional Earthquake Force Values	Acting At
SA	YH(LC,location)	H(LC,location)	EH(LC,location)	heel
SP	YVS(LC,location)	HS(LC,location)	EHS(LC,location)	stem

---

* If the wall is floodwall (ITYPE(LC) = 1) and if KRACK in data list SEEP is 1 (with crack, default for floodwalls), then module SA will produce all zero values. See the detailed definitions of KRACK and W3 in paragraph 3-2-2.

The location subscript for a given module run always starts with 1 and goes until the lowest possible elevation has been reached using the given (NODE set by user) or calculated spacing of nodal points. YVS values will be calculated for elevations below the top of heel, but the total forces shown in the report file will include only the pressure above the top of heel slab.

4-6-2 Report File Output. The report file output includes a table of lumped force values and the total force and its moment about the bottom of the end of the toe. Other information in the report file includes a summary of input data and the wall description. The wall description includes X and Y coordinates of the corners of the concrete outline, where X is positive over the heel and negative over the toe from the basic working point and Y is an elevation.

4-6-3 Time-Sharing Terminal Output. The output arrays and wall corner coordinates described in paragraphs 4-6-1 and 4-6-2 may be seen through use of the LOOK command. "LOOK ACPH" will display the output of module SA; "LOOK ACPS" will display the output of module SP; and "LOOK XY" will display the wall corner coordinates and wall geometry data list values.

4-7 MODIFICATION OF MODULE SA OUTPUT FOR USE BY MODULE FA

4-7-1 After using the LOOK command to inspect the contents of data list ACPH or examining the report file from module SA, the arrays mentioned in paragraph 4-6-1b may be edited by entering new values in data list ACPH. In the example that follows, "LC" refers to the load case number and "LOC" refers to the location code (array element sequence number). The data list is listed below:

```
ACPH  LC LOC H(LC,LOC) EH(LC,LOC) YH(LC,LOC)
```

For diagrams of these variables, see Chapter 11. The LOOK IL command shows their values. An example report file table is shown below. In this example, the backfill earth surface elevation over the end of the heel is 119.5 ft, and nodes are at the default spacing of 1.0 ft.

```
HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 1 FOR CLASSIC (COULOMB)
ANALYSIS IN SA

OUTPUT OF ARRAYS H, EH, AND YH IN MODULE SA FOR CLASSIC ANALYSIS.
```

ARRAY ELEMENT LOCATION CODE	ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS)
1	119.00	6.1467	0.0
2	118.00	36.880	0.0
3	117.00	73.760	0.0
4	116.00	110.64	0.0
5	115.00	147.52	0.0
6	114.00	184.40	0.0
7	113.00	221.28	0.0
8	112.00	258.16	0.0
9	111.00	295.04	0.0
10	110.00	331.92	0.0
11	109.00	368.80	0.0
12	108.00	405.68	0.0
13	107.00	442.56	0.0
14	106.00	479.44	0.0
15	105.00	516.32	0.0
16	104.00	553.20	0.0
17	103.00	590.08	0.0
18	102.00	626.96	0.0
19	101.00	663.84	0.0
20	100.00	344.24	0.0

For example, to change the lumped force H(1,10) at elevation 110.00 from 331.92 to 500.00 lb/ft, with no change in EH(1,10) of 0.0, this data list entry would be made in the executive phase:

ACPH 1 10 500.0 S S

4-7-2 To eliminate these values, for recalculation with changed data, the following data entry must be made. This entry will undefine array element location code number 1 for H(static) and EH(earthquake) forces. It is immaterial whether or not the corresponding elevation array element is undefined once the force element values are canceled.

ACPH LC 1 C C C

where "LC" is a specific load case number or is zero for "all load cases."

4-8 MODIFICATION OF OUTPUT OF MODULE SP FOR USE IN STRUCTURAL DESIGN/ ANALYSIS. The output of module SP is edited as described above for module SA, using data list ACPS.

CHAPTER 5: MODULE FA--FOUNDATION STABILITY ANALYSIS

5-1 ACTION OF MODULE FA

5-1-1 Module FA performs an analysis of a completely defined wall and its environment for the load cases activated with data list CASE. In addition to running under user control, the component routines of module FA are used by module FD during foundation stability design.

5-1-2 Module FA accomplishes the following actions while performing its analysis:

a. Seepage pressure calculations (or uses seepage pressure arrays inputted by the user with data lists HSPH and HSPV).

b. Sliding safety, as controlled by data lists SOLP (data item NPPD), SLID, and ONEA.

c. Overturning stability.

d. Bearing pressure limitations.

e. Boil control, as determined by data list BOIL.

f. Cost analysis, including earthwork and concrete volumes as controlled by data lists CSTB, CSTC, and CSTE.

g. Building arrays of earth and seepage effects for use in a later structural analysis or design.

See Chapter 11 for more detail.

5-2 GENERAL DATA. See paragraph 3-2.

```
NAME  (60 characters maximum of alphanumeric job name)
CASE  NLC  LCS(1)  LCS(2)  ... LCS(NLC)
HYD  LC  IHYD  (optional)
TYPE LC ITYPE (optional)
```

5-3 SOILS AND SEEPAGE DATA.

5-3-1 See paragraph 3-3-2 and Figures 3-1 and 3-2 for detailed descriptions of data items. Major soils data preparation concepts are listed below:

a. Soils data names are modular:

(1) Phi value names always begin with the letters PHI, such as PHIFZ in the filter zone, PHI2 for layer 2, etc.

(2) Cohesion strength value names always begin with the letters COH, such as COH3 for layer 3, etc.

(3) Unit weight names always begin with the letters GAMA, such as GAMAS for soils, GAMAS3 for layer 3, etc.

(4) Allowable bearing pressure data names begin with the letter ABP, followed by the soils layer number, followed by a B for the bottom of the soil layer or a T for the top of the layer, followed by an N for a base width of BW1 or a W for a base width of BW2.

b. PHIx and COHx must be defined or zero in all soil layers before sliding stability can be calculated.

c. In the heel earth backfill soil layers FZ, 1, and 2, RKAx will be calculated from PHIx if RKAx is not defined. (RKAx means RKAFZ, RKA1, RKA2, etc.)

d. See paragraph 3-3-2 for special information on sliding data.

5-3-2 Required Soil Data. See paragraphs 3-3-2 and 3-3-3 for detailed information.

SPE3 PHI3 COH3 GAMAS3 PHIS3 ADHS3 ABP3TN ABP3BN ABP3TW ABP3BW ELBS3

SST LC ESTW SST

SSHW LC ESHW HS1 DS1H HS2 WDS2 HS3

optional portion of list if allowable bearing pressures are not to be considered.

or

SSHC LC ESHW HS3 (HS1, DS1H, HS2, WDS2, are set undefined)

5-3-3 Optional Soil Data. See paragraph 3-3-2 for detailed descriptions.

SLID LC NSLIDE FSMIN

The information in data list SLID is required to run sliding, but the default values

	NSLIDE	FSMIN
floodwall	2	1.5
retaining wall	1	2.0

will be used au tically if not defined by the user's input data, so the list is optional.

BOIL ELSPT CRMIN IPATH

ONEA OMEGA

SEEP LC ELWT ELWH HGSW ISLC* ISFT KRACK

SOLP LC IFWOC NODE IFSOM NPPD RKH RKV CFMA

SPE4 ELTS3 PHI4 COH4 GAMAS4 PHIS4 ADHS4 ABP4TN ABP4BN ABP4TW ABP4BW

optional portion of lists if allowable bearing is not applicable

SPE5 ELTS4 PHI5 COH5 GAMAS5 PHIS5 ADHS5 ABP5TN ABP5BN ABP5TW ABP5BW

SPHF LC FZTAH PHIFZ COHFZ GAMASF RKAFZ DELTAF RKAEFZ

SPH1 LC PHI1 COH1 GAMAS1 RKA1 DELTA1 RKAE1 HCMIN*

SPH2 ELTS1 PHI2 COH2 GAMAS2 RKA2 DELTA2 RKAE2

SPT6 LC PHI6 COH6 GAMAS6

SPT7 LC PHI7 COH7 GAMAS7

SSEE EXW ESS HSS5T ELTS5T DTS5T ELTS5W ELTS5H DTS5H HSS5H

WGHT GAMAC GAMAW

5-4 SURCHARGE DATA. See paragraph 3-4-2 and Figure 3-4 for detailed data descriptions. All surcharge data are optional.

SCFD LC PVS PVB DVB

SCFH LC PH1 ELPH1 PH2 ELPH2

SCFV LC PV1 DV1 PV2 DV2 PV3 DV3 PV4 DV4 PV5 DV5

SCWH LC W1 ELW1T ELW1B W3 W4

SCWV LC WT WWT DWT WH WWH DWH

WIND LC W

5-5 COST DATA. See paragraph 3-5-2 and Figure 3-2 for detailed descriptions of data items. All of these data are optional in that the mandatory items in data list CSTC (concrete) will be used as $1.00/ft^3 if not defined by the user's data. Excavation and backfill costs will default to 0.0.

CSTB UCBFFZ UCBFS1 UCBFS2 UCBFS6 UCBFS7

CSTC UCWB UCWS UCWK

CSTE UCEXS3 UCEXS4 UCEXS5 UCEXWK

5-6 GEOMETRY DATA

---

* This item has only one value and does not vary with the load case number, unless the default identifier D is used.

5-6-1 See paragraph 3-6-2 and Figures 3-5 and 3-6 for detailed descriptions.

WLA ETS TW2 STR HEELW

WLAB BW BW1 BW2 BS

WLAH HEELT2 HEELW HEELT1

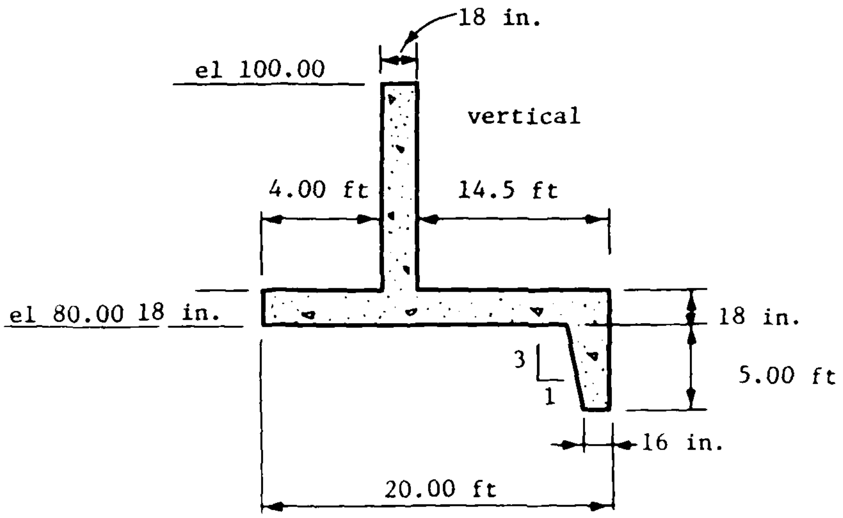
WALK KFLAG DKEY WKEY BKTF

WLAS TSTT TSB TSTB HSTPH HSTPB HSBPB

WLAT BTE1 TOEHT TS2 TW1 TS1

WLBR BASER (optional list)

5-6-2 Typical Geometry Data For Basic Wall:



REM BASIC FLOODWALL, NO TAPERED MEMBERS

WLA 100.0 4.0 C 14.5 see notes (1) and (6)

WLAB 20.0 20.0 20.0 D see note (2)

See note (3).

WLAK 0 5.0 16.0 D see note (4)

See note (5).

```
WLAT  80.0  D  D  D  D      see note (7)
```

NOTES: (1) With BW and TW2 set, either TSTB or HEELW may be left undefined. In this example, TSTB is left undefined and HEELW is defined.

(2) For analysis in module FA, BW1 and BW2 may both be set to BW to simplify the soil data preparation.

(3) List WLAH is omitted since HEELW is already defined and HEELT1 and HEELT2 are both of default thickness (18 inches for walls over 15 ft high).

(4) If there had been no key, this list could have been omitted.

(5) List WLAS is omitted since the stem is of default, constant thickness.

(6) STR is entered as "C" since TW2 is defined.

(7) The letter D for TOEHT will cause it to default to 18 inches for a wall over 15 ft high.

Thus, nine items are needed to describe the plain wall. Two more could have been omitted if there had been no key. The resulting X and Y coordinates are

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

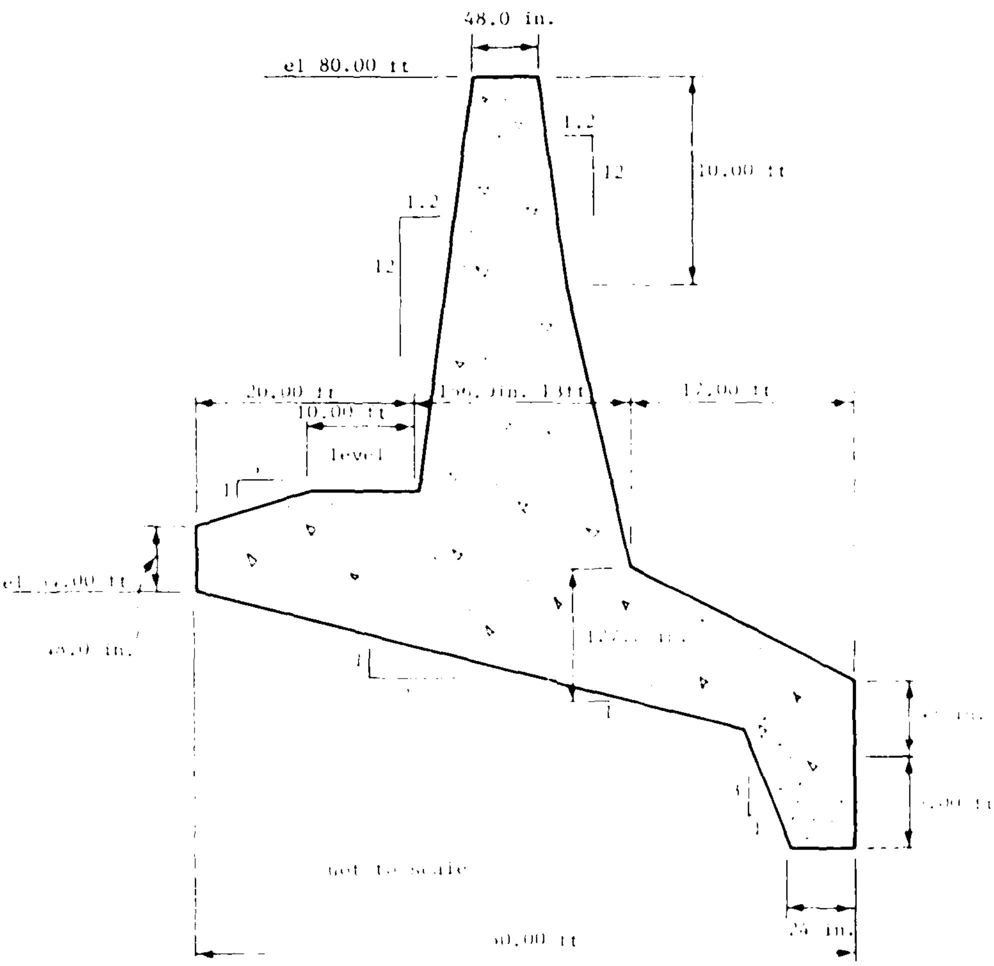
PT.	X	Y	DESCRIPTION OF POINT
1	0.0	100.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.0	81.5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.0	81.5000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-4.0000	81.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-4.0000	80.0000	TOE END OF BASE = AT BTE1
6	12.8333	80.0000	TOP OF TOE-SIDE FACE OF KEY
7	14.5000	75.0000	BOTTOM OF TOE-SIDE FACE OF KEY
8	16.0000	75.0000	BOTTOM OF HEEL-SIDE FACE OF KEY
9	16.0000	80.0000	TOP OF HEEL-SIDE FACE OF KEY
10	16.0000	80.0000	HEEL END OF BASE
11	16.0000	81.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.5000	82.0000	BOTTOM OF HEEL-SIDE FACE OF STEM

PT.	X	Y	DESCRIPTION OF POINT
13	1.5000	100.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	100.0000	TOP OF HEEL-SIDE FACE OF STEM

NOTE: If the toe thickness had not been constant, and if the user had wanted the heel thickness at the stem to match that of the toe at the stem, IBSAME could have been set to 1 ("make them the same") with data list CNWD:

CNWD D D D 1 D

5-6-3 Typical Geometry Data for Special Wall:



```
REM  SPECIAL FLOODWALL WITH TAPERED MEMBERS
WLA  80.0  20.0  C  17.0
WLAB  50.0  50.0  50.0  0.2
WLAH  48.0  S  127.2
WLAK  0  5.0  24.0  D
WLAS  48.0 1.2  156.0  10.0  1.2  C
WLAT  54.0  48.0  5.0  10.0  D
```

either of these could have been "C" or "D" (but not both)

This calculates out to the following X and Y coordinates:

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.0	80.0000	Basic working point = toe-side of stem top
2	-2.0000	60.0000	Bottom of toe-side face of stem (at TS1)
3	-12.0000	60.0000	Between TS1 and TW2, on top face of toe
4	-22.0000	58.0000	Top of TOEHT = at outer end of TW2
5	-22.0000	54.0000	Toe end of base = at BIEL
6	24.0714	44.7857	Top of toe-side face of key
7	26.0000	39.0000	Bottom of toe-side face of key
8	28.0000	39.0000	Bottom of heel-side face of key
9	28.0000	44.0000	Top of heel-side face of key
10	28.0000	44.0000	Heel end of base
11	28.0000	48.0000	Top of HEEL2 = top of outer end of heel
12	11.0000	58.0000	Bottom of heel-side face of stem
13	5.0000	70.0000	Bottom of heel-side top panel of stem
14	4.0000	80.0000	Top of heel-side face of stem

5-7 RESTRICTIONS ON INPUT LOADING CASES. Earth pressure calculations assume that (1) horizontal earth pressures on the heel side are active and that (2) the net applied horizontal force summation produces passive earth pressure on the toe side. Module FA will reject any load case that does not conform to the second assumption. There are, however, no restrictions on the net direction of overturning.

CHAPTER 6: MODULE FD--FOUNDATION STABILITY DESIGN

6-1 ACTION OF MODULE FD

6-1-1 Module FD determines the combination of values for variables

BTE1 (between the limits of BTE11 and BTE12)

BS (between the limits of BS1 and BS2)

DKEY (between the limits of DKEY1 and DKEY2)

BW (between the limits of BW1 and BW2)

that will produce the wall with the least construction cost. The construction cost is determined by the volumes of structural excavation, concrete, and structural backfill, combined with the cost figures in data lists CSTB, CSTC, and CSTE. Program running time and cost increase as the sizes of the ranges for BTE1, BS, DKEY, and BW are made larger by the user.

6-1-2 Module FD uses the elements of module FA in the process summarized below and described in detail in the Program Criteria Specifications Document. The user must set either the key length or the stem ratio in the input data.

- BTE1 varied from BTE11 to BTE12
  - BS varied from BS1 to BS2
    - DKEY varied from DKEY1 to DKEY2
      - Program determines minimum BW, between BW1 and BW2 to nearest 0.25 ft, that satisfies the stability checks for sliding, resultant ratio, bearing pressure, and earth cover over the heel. If a value is found for BW that is within the range and satisfies the checks, the cost is determined. This cost is compared with the previous lowest cost and saved if a new low has been reached. The program then proceeds to the next combination of BTE1, BS, DKEY with the set TW2 or STR.

6-1-3 Module FD calls module FA automatically for a final complete analysis of the selected design.

6-2 GENERAL DATA. See paragraph 3-2 for details.

NAME (60 characters maximum of alphanumeric job name)

CASE NLC LCS(1) LCS(2) ... LCS(NLC)

HYD LC IHYD (optional)

TYPE LC ITYPE (optional)

SPECIAL NOTE ON DESIGN ACTION

The cost of running this module is profoundly affected by the number of variables the user allows to vary out of the list in paragraph 6-1-1:

Variable	Lower Limit	Upper Limit
BTE1	BTE11	BTE12
BS	BS1	BS2
DKEY	DKEY1	DKEY2
BW	BW1	BW2

The cost is proportional to the value of $\$X=11^n$ where n = 1 to 4, depending on how many of the four variables are allowed to vary:

n	$ Factor
1	11
2	121
3	1,331
4	14,641

To keep a value from varying, set both the lower and upper limits to the single desired value. For example, to keep a level base, set both BS1 and BS2 to zero. BS will then hold the single value and will not contribute to increasing the run cost. The increment used for varying BTE1, BS, and DKEY is 1/10 of the range between the specified limits. Thus, if DKEY1 is 1.0 ft and DKEY 2 is 11.0 ft, then the value of DKEY will be calculated to the nearest foot:

$$\frac{11.0 - 1.0}{10} \quad 1.0 \text{ ft}$$

6-3 SOILS AND SEEPAGE DATA

6-3-1 These data are the same as those given in Chapter 5 for module FA except for special limits on ISFE = 4, IFSOM, and NODE:

a. See paragraph 3-3-2 and Figures 3-1 and 3-2 for detailed description of data item variables.

b. See paragraph 5-3 (module FA) for additional explanation.

c. Additional information, for module FD only, is listed below:

6-3-2 <u>Required Soils Data:</u>

SLID LC NSLIDE FSMIN

SPE3 PHI3 COH3 GAMAS3 PHIS3 ADHS3 ABP3TN ABP3BN ABP3TW ABP3BW
ELBS3

SST LC ESTW SST

[SSHW LC ESHW HS1 DS1H HS2 WDS2 HS3
or
SSHT LC ESHW HS3 (HS1, DS1H, HS2, and WDS2 are set to undefined)

6-3-3 <u>Optional Soils and Seepage Data:</u>

BOIL ELSPT CRMIN IPATH

ONEA OMEGA

RRD LC RRMIN

SEEP LC ELWT ELWH HGSW ISLC* ISFT** KRACK

SPHF LC FZTAH PHIFZ COHFZ GAMASF RKAFZ DELTAF RKAEFZ

SPH1 LC PHI COH1 GAMAS1 RKA1 DELTA1 RKAE1 HCMIN*

SPH2 LC ELTS1 PHI2 COH2 GAMAS2 RKA2 DELTA2 RKAE2

SPE4 ELTS3 PHI4 COH4 GAMAS4 PHIS4 ADHS4 ABP4TN ABP4BN ABP4TW
ABP4BW

SPE5 ELTS4 PHI5 COH5 GAMAS5 PHIS5 ADHS5 ABP5TN ABP5BN ABP5TW
ABP5BW

SPT6 LC PHI6 COH6 GAMAS6

SPT7 LC PHI7 COH7 GAMAS7

SOLP LC IFWOC NODE+ IFSOM+ NPPD RKH RKV CFMA

SSEL EXW ESS HSS5T ELTS5T DTS5T ELTS5W ELTS5H DTS5H HSS5H

WGHT GAMAC GAMAW

* This data item has only one value and does not vary with the load case number.

** ISFT = 4 cannot use user-defined uplift pressures during stability design. Uplift is used as zero in module FD.

\+ IFSOM is used as 1 (one-piece trial failure surface) and NODE is controlled automatically during design in module FD.

6-4 SURCHARGE DATA. These data are the same as those given in Chapter 5 for module FA. See paragraph 3-4-2 and Figure 3-3 for detailed descriptions. All surcharge data are optional.

SCFD LC PVS PVB DVB

SCFH LC PH1 ELPH1 PH2 ELPH2

SCFV LC PV1 DV1 PV2 DV2 PV3 DV3 PV4 DV4 PV5 DV5

SCWH LC W1 ELW1T ELW1B W3 W4

SCWV LC WT WWT DWT WH WWH DWH

WIND LC W

6-5 COST DATA. These data are the same as those given in Chapter 5 for module FA. See paragraph 3-5-2 and Figure 3-2 for detailed descriptions of data items. All of these data are optional if the user accepts a design optimization based on zero excavation and backfill costs and a unit cost for all concrete (all items in data list CSTC).

CSTB UCBFFZ UCBFS1 UCBFS2 UCBFS7

CSTC UCWB UCWS UCWK

CSTE UCEXS3 UCEXS4 UCEXS5 UCEXWK

Users who want to optimize on only base width can approximate this by entering data list CSTC as follows:

CSTC 1.0 0.0 0.0

6-6 GEOMETRY DATA. See paragraph 3-6-2 and Figures 3-4 and 3-5 for detailed descriptions.

6-6-1 Required Geometry Data:

WLD ETS TW2 STR HEELW TSTB TMINB

ETS is required. TW2, STR, HEELW, and TSTB form a data set for locating the stem on the base as described in paragraph 3-6-2a. TMINB has a default value that will be used as 12 in. for walls up to 15.0 ft high (ETS - BTEL) or 18 in. for walls over 15.0 ft high. Note that the default value may change as BTEL is varied by the design searching in module FD.

WLDB BW1 BW2 BS1 BS2

WLDT BTEL1 BTEL2 TOEHT TW1

BTE11 and BTE12 are required if BTE1 is to vary. TOEHT defaults to TMINB if entered as D or C. TW1 defaults to zero if entered as D or C. Data list CND is needed only if HSTPH is not set in list WLDS and if the following default values are not acceptable (see paragraph 7-2-2b):

CND RATION FPCON ESTL IFEM

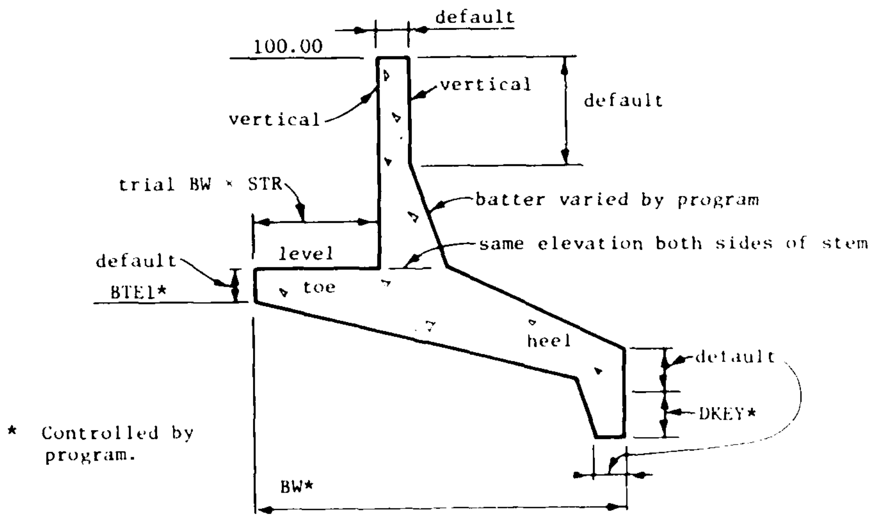
RATION defaults to ESTL/code E_c based on GAMAC value. FPCON default to 3000.0 psi. ESTL defaults to 29,000,000.0 psi. See also data list CNWD in paragraph 7-2-2b.

6-6-2 Optional Geometry Data.

WLDH HEELT2 (defaults to TMINB)
WLDK KFLAG BKTF DKEY1 DKEY2
WLDS TMINS TSB HSTPH HSTPB HSBPB

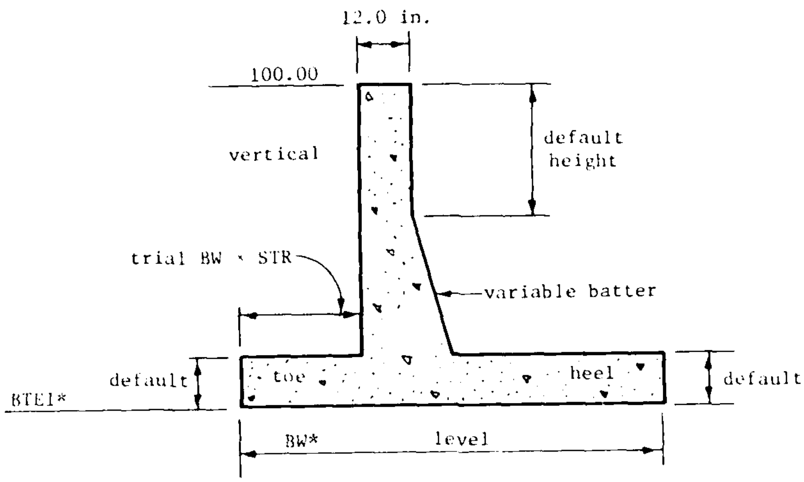
TMINS defaults to TMIN. TSB defaults to 0.0 (vertical). HSTPH will be estimated if not set (use zero if a single slope is wanted). HSTPB defaults to vertical. HSBPB will always be calculated.

6-6-3 Typical Geometry Data for a Basic Floodwall:



CNWD D D D 1 0 (needed to set IBSAME to 1)
WLD 100.0 C 0.333 C C D
WLDB 15.0 25.0 0.0 0.333
WLDK 0 D 0.0 10.0
WLDT 75.0 85.0 D C

6-6-4 Typical Geometry Data for a Basic Retaining Wall:



CNWD D D D 1 0 (needed to set IBSAME to 1)

WLD 100.0 C 0.333 C C D See note (1)

WLDB 15.0 25.0 0.0 0.0

WLDK 0 C 0.0 0.0

WLDT 75.0 85.0 D C

With BW controlled by the design procedure and with TW2 determined from the [illegible] ratio STR, either TSTB or HEELW need to be defined if the value [illegible]own. If both are left undefined, the program will estimate TSTB and then subtract out a corresponding value for HEELW.

CHAPTER 7: MODULE WA--(WORKING) STRESS ANALYSIS

7-1 ACTION OF MODULE WA

7-1-1 Module WA performs a stress analysis of a fully defined wall and reports shear and flexural stresses at locations selected by the user and/or at expected critical locations. Stress analysis procedures conform to Appendix B, "Alternate Design Method," of ACI Code 318-77. The equations used are described in Chapter 9 and Exhibit E of the Program Criteria Specifications Document.

7-1-2 Module WA is highly interactive when the RUN WA command is entered from the keyboard and provides for no interaction when the RUN WA command is in a data file. This feature will be described later in the chapter.

7-2 DATA

7-2-1 Predefined Data:

a. Module WA is normally run after module FA (or, less probably, module FD). Module FA, when run separately or as the final part of module FD, calculates seepage and earth pressures that combine with the data for modules FA and FD to form the predefined portion of the data for module WA.

b. The predefined data can also be entered independently by the user without having run modules FA or FD. This is explained in Chapter 11 of this manual.

7-2-2 Additional Data. Two types of additional data are required for module WA--reinforcing steel descriptions and concrete analysis parameters and data:

a. Reinforcement Description. Reinforcement data are stored in the program in arrays ASTLK for the key, ASTLST (location code) for the toe-side face of the stem, ASTLSH (location code, layer number) for the heel-side face of the stem, ASTLBT (location code, layer number) for the top face of the base slab, and ASTLBB (location code, layer number) for the bottom face of the base slab. The location code (called LOC) and layer number (called LN, LNA, or LNB) are defined in the sketches following this discussion. Only significant locations along the wall need be defined; the program will fill in the intermediate locations. Significant locations include the outer end of each slab and any intermediate location where bars are cut off (theoretical cutoff). Detailed instructions follow this summary.

COVR COVHS COVTS COVTB COVBB SPABL

STLB LOC LNA ASTLBT(LOC,LNA) LNB ASTLBB(LOC,LNB)

STLK ASTLK (may be omitted if no key)

STLS LOC ASTLST(LOC) LN ASTLSH(LOC,LN)

(1) Bar cover (optional data list COVR) from surface to center of the bar layer closest to the surface (layer number 1); units are inches:

Data Item	Location	Default Values: Hydraulic (IHYD = 1)	Default Values: Nonhydraulic (IHYD = 2)
COVHS	Heel side of stem	3.5 in.	2.5 in.
COVTS	Toe side of stem	3.5	2.5
COVTB	Toe of base slab	3.5	2.5
COVBB	Bottom of base, key	4.5	3.5
SPABL	Spacing between layers, normal to face, center-to-center bars	(MAXBAR's diameter (in data list STLD) + 1.0) IF data list STLD has not been entered, then the default value for SPABL is 2.37 in. for the diameter of a #11 bar + 1 in. clearance	

AD-A100 734 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 13/
USER'S REFERENCE MANUAL: COMPUTER PROGRAM FOR DESIGN AND ANALYS--ET
DEC 80 W A PRICE, R L HALL, H W JONES
UNCLASSIFIED WES-INSTRUCTION-K-80-7 NL

2 OF 4
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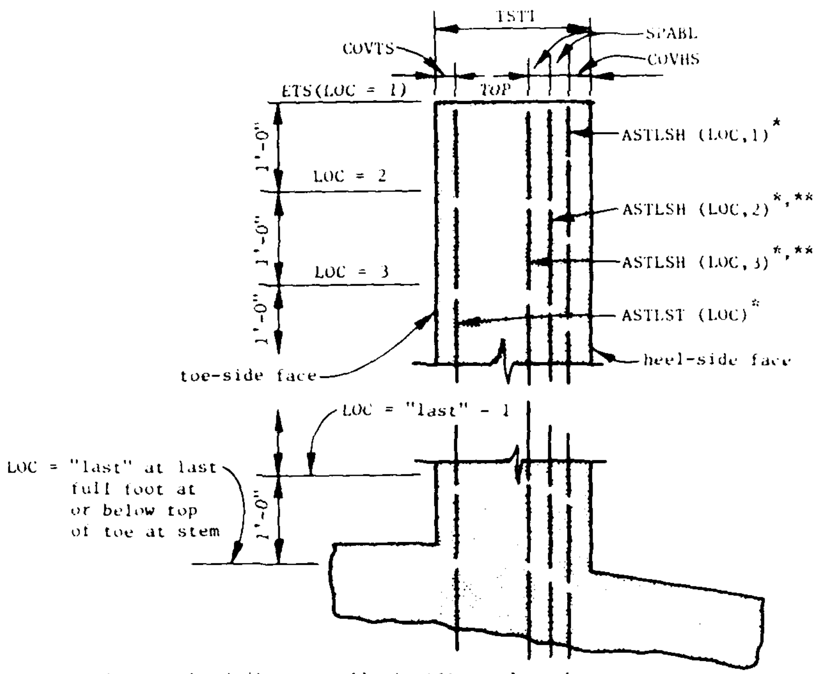
(2) Stem:



* Must be defined at all significant locations.

** Must be zero at LOC = 1 if reinforcement in this layer does not extend to the end of the member.

Example ASTLSH:

Layer 1 has 0.66 in.^{2}/ft at top of stem, changing to 1.32 in.^{2}/ft 4 ft down.

Layer 2 begins 2 ft down with 0.66 in.^{2}/ft.

No layer 3 used.

Example ASTLST:

0.66 in.^{2}/ft for entire height. Stem is 10 ft high.

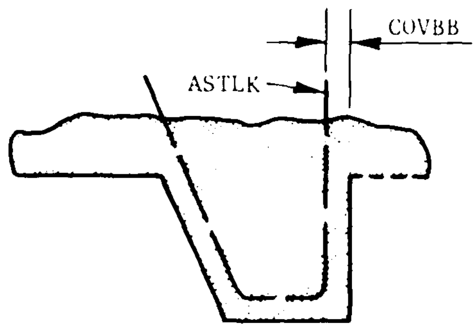
Four data lines will be needed to describe this stem pattern:

STLS	LOC	ASTLST(LOC)*	LN	ASTLSH(LOC,LN)	
STLS	1	0.66	1	0.66	Note 1
STLS	1	0.66	2	0.0	Note 1
STLS	3	0.66	2	0.66	Note 2
STLS	5	0.66	1	1.32	Note 3

NOTES: (1) All layers to be used anywhere in member must be defined (even if zero at this point) at end of member.
(2) LOC = 3 at 2 ft down.
(3) LOC = 3 at 4 ft down.

* LOC = "last" need not be entered.

(3) Key:



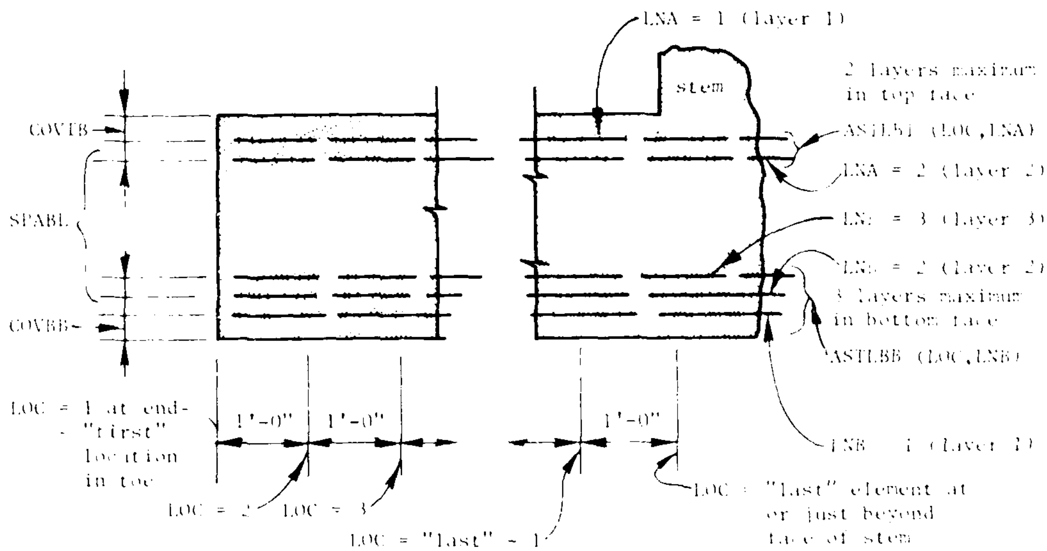
This list may be omitted if DKEY = less than 0.02 ft long or if data lists WLAK and WLDK were not used.

Example for ASTLK = 1.32 in.^{2}/ft:

STLK 1.32

(4) Toe and Heel:

(a) Sketch of toe:

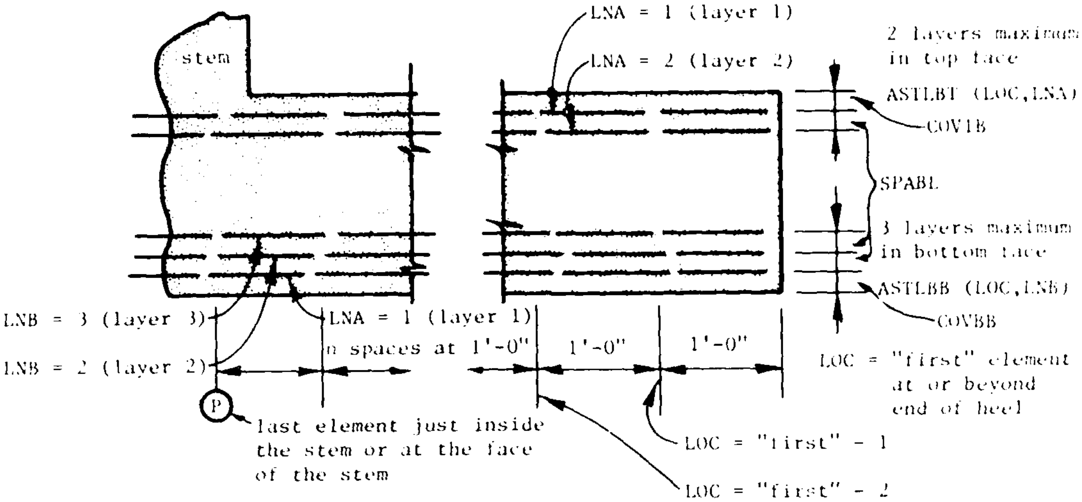


NOTE: Steel definition rules in data list

STLB LOC LNA ASTLBT(LOC,LNA) LNB ASTLBB(LOC,LNB)

are the same as those for a stem with LOC = 1 at the end of the toe.

(b) Sketch of heel:



Rules are the same as for stem and toe, except that the "first" element in the heel sketch has the same special rules as element LOC = 1 for the stem and toe. Element P in the heel sketch is the "last" element for heel reinforcement. All this means that the heel reinforcement is entered working inward toward the stem from the end of the heel. The "first" location code LOC is used as being at the lowest numbered whole foot mark, measured from the toe, at or just beyond the end of the heel. The procedure for getting the LOC value for the "first" location code at the end of the heel is:

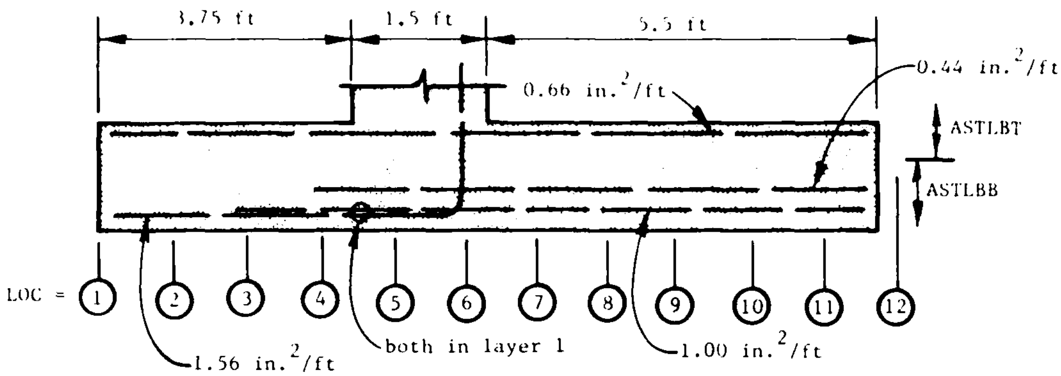
1. Calculate BW + 1.9999.

2. Discard (truncate) the decimals.

For example,

BW	BW + 1.9999	LOC at First Element for Heel
15.0	16.9999	16
15.5	17.4999	17

(c) Example of base slab reinforcement (toe and heel):



Data List STLB contains LOC,LNA,ASTLBT(LOC,LNA), LNB,ASTLBB(LOC,LNB)

	STLB	1	1	0.66	1	1.56
TOE	STLB	1	1	S	2	0.00
REINF	STLB	3	1	S	1	2.56
	STLB	4	1	S	2	0.44
HEEL	STLB	12	1	0.66	1	1.00
REINF	STLB	12	1	S	2	0.44

(5) <u>Changing Steel Description After a Module Has Been Run:</u>

(a) After module WA. Module WA fills in the intermediate location values for the reinforcing steel arrays in data lists STLB and STLS, working from the data entered by the user. It will therefore be necessary to change the intermediate locations, one at a time, as well as the significant locations if the description is to be changed. This can be a lengthy process. A simpler procedure for changing the description in a particular layer is to first enter the letter C for the steel area at location code LOC = 1 in that layer. This will cancel all of the values in that layer. Then, enter the complete (first location and significant locations) new description. For example, to cancel the old toe-side steel in the stem and substitute a new description, do this:

List	LOC	ASTLST(LOC)	LN	ASTLSH(LOC,LN)
Cancel old STLS	1	C	1	S (no change)
Enter new STLS	1	0.44	1	S (no change)
Enter new STLS	5	0.66	1	S (no change)

(b) After module WD. The reinforcing steel description produced by this module is listed at the end of the module's report file. The description may be edited by entering the appropriate data list(s) just as any other data edited. Or, the procedure described in paragraph can be used.

b. Concrete Analysis/Design Parameters. Data lists CND and CNWD are used in both module WA and module WD. Data list STLD is used only in module WD. All of these lists are optional. Default values are based on whether the first load case (No. 1 unless data list CASE is used to designate another number as the "first") is hydraulic or nonhydraulic.

```
CND RATION FPCON ESTL IFEM

CNWD RATIOF FYSTL FSTLMX IBSAME IFDR

STLD MAXBAR SPAMIN
```

Data List	Variable Name	Units	Default Values		Definition
STLD	MAXBAR	ASTM size number	11		Maximum bar size allowed by user (3-11, 14, or 18 only)
	SPAMIN	in.	MAXBAR's diameter × 2 or MAXBAR's diameter + 2.25, whichever is larger		Minimum allowable clear spacing between bars in same row. Used with MAXBAR to determine maximum steel allowed in one layer, square inches per foot
			Hydraulic	Nonhydraulic	
CND	RATION	ratio	(1)	(1)	$N = E_s/E_c$
	FPCON	psi	3,000.0	3,000.0	Concrete ultimate strength
	ESTL	psi	29,000,000.0	29,000,000.0	Reinforcing modulus E_s

(Continued)

b. Concrete Analysis/Design Parameters (Continued).

Data List	Variable Name	Units	Default Values Hydraulic	Default Values Nonhydraulic	Definition
CND	IFEM	0 or 1*	1	1	1 to implement the alternate special loadings of paragraph S-21 on page S-23 of EM 1110-2-2501 0 to use loads as described in load case*
CNWD	RATIOF	ratio	0.35**	0.45**	Allowable f_c/f'_c, EM 1110-1-2101
	FYSTL	psi	40,000.0†	40,000.0†	Reinforcing yield strength
	FSTLMX	psi	20,000.0	(2)	Allowable maximum f_s
	IBSAME	0 or 1	(3)	(3)	1 to force the top of heel at stem to the same elevation as the top of toe at the stem 0 to allow them to vary independently
	IFDR	0 or 1	1	1	1 to conform to ACI 318-77, Appendix B, paragraph B.2.3 (in module WA, report dead and live stresses separately if of opposite sign; in module WD, use 80

(Continued)

* See paragraph 7-4-1d for more information on IFEM = 1. 1 is Corps of Engineers default; others may prefer 0.

** Set for hydraulic/nonhydraulic status of the "first" load case. The "first" load case is number 1 unless data list CASE has been used to designate another number as "first."

† 20,000.0 is the Corps of Engineers' limit for hydraulic structures; nonhydraulic structures may use the default of 50 percent of FYSTL.

b. Concrete Analysis/Design Parameters (Concluded).

Data List	Variable Name	Units	Default Values Hydraulic	Default Values Nonhydraulic	Definition
CNWD	IFDR				percent of dead load moment if in opposition to live load moment) 0 to use total D+L stress

NOTES: (1) E_c is calculated from the expression in ACI 318-77 code paragraph 8-5-1:

$$E_c = (GAMAC - 5.0)^{1.5} \quad 33.0 \sqrt{FPCON}$$

(GAMAC is the weight with reinforcing steel, so 5 pcf is deducted to get to unreinforced concrete.)

(2) FSTLMX is taken at one half of FYSTL for nonhydraulic structures.

(3) IBSAME generally defaults to zero but will be used as one for analysis of a level base of constant thickness.

7-3 USER CONTROL OF MODULE WA

7-3-1 Data Check. The data check procedures at the beginning of module WA perform a variety of checks to make sure that enough data items have been defined to enable the program to:

a. Locate all of the corners of the concrete outline.

b. Describe the outlines of the various pressure diagrams (seepage, passive pressure, vertical earth and surcharge pressures, etc.).

c. Know which option to use in the analysis procedure.

The questions and printout statements possible during the data check are numerous and varied. Care has been taken to make them self-explanatory and to allow interactive recovery where feasible. Where it is not feasible, the module aborts with a message telling the user what to do in the executive phase before trying again to run the module.

7-3-2 Interactive Analysis Control. There are five basic divisions to the analysis. User responses are underlined in the examples to follow. See paragraph 7-3-5 for sign conventions.

a. Preliminary. Three questions control the analysis:

(1) Since locations on the wall are described in terms of X and Y coordinates, the user is offered a table of coordinates for the particular wall unless the IR6 command has been used:

```
ENTER 1 TO SEE A TABLE OF X AND Y CORNER COORDINATES
   OR C TO CONTINUE WITHOUT SEEING THE TABLE
?C
```

The table is not shown here. It will automatically be placed in the report file. This is the table also available with the LOOK XY command.

(2) Location of answers (this is the restart point for option R in the analysis type question). This is omitted if the IR6 command has been used:

```
#
# BEGIN STRESS ANALYSIS
#

ENTER T TO GET THE ANALYSIS RESULTS AT YOUR TERMINAL
   OR R TO PUT THEM IN THE REPORT FILE
   OR B TO PUT THEM BOTH PLACES
?B
```

(3) How complete an analysis is desired:

```
ENTER THE LOAD CASE NUMBER YOU WANT ANALYZED
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST "CASE"
   OR * TO ABORT THE MODULE
?0
```

The preliminary division ends with the milestone message

```
#
# BEGIN STEM STRESS ANALYSIS
#
```

b. Stem Stress Analysis. This begins with the question:

```
SELECT TYPES C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?
```

which will yield the following if answered with a question mark:

```
??
ANALYSIS TYPE SELECTION:
ENTER C FOR ANALYSIS AT CRITICAL SECTIONS
   OR S FOR ANALYSIS AT SELECTED LOCATIONS
   OR F FOR ANALYSIS AT 1-FOOT INTERVALS
   OR ? TO SEE A LIST OF CRITICAL SECTIONS
   OR N TO GO ON TO THE TOE
   OR R TO RESTART MODULE WA TO TAKE ANOTHER LOOK AT SOMETHING
   OR * TO ABORT THE MODULE

SHEAR  MOMENT              CRITICAL SECTION LOCATIONS

  X      X     BETWEEN TOP & BOTTOM PANELS ON HEEL-SIDE FACE (POINT 13)
         X     AT THE BASE
  X            ALTERNATE LOCATIONS:
                  IF THERE IS A TOE, THEN A DISTANCE D ABOVE THE BASE
                  IF NO TOE, THEN AT THE TOP OF THE BASE
  X            IMMEDIATELY BELOW CONCENTRATED FORCES PH1 AND PH2

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?
```

For this sample, a type "C" analysis was selected. A type "S" analysis is demonstrated for the toe.

```
?C

SHEAR AT A DISTANCE D ABOVE THE (POINT 2) BASE--

--- SHEAR ANALYSIS AT ELEVATION 86.25 (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD      V       N (COMP +)      M         UNIT SHEAR   ALLOWABLE    ACI318-77
CASE  LB/SLICE   LB/SLICE    LB-FT/SLICE   STRESS PSI  UNIT STRESS   PROVISION

 1     3407.6     3551.2       12848.        13.318       60.708      B.7.4.5
 2     3447.9     3551.2       12865.        13.475       60.708      B.7.4.5

MOMENT AT THE BASE (POINT 2)--

FLEXURE ANALYSIS AT ELEVATION     84.50 (+ M = TENSION AT HEEL)
LOAD           N (COMP=+)             M               FC          FS
CASE            LB/SLICE          LB-FT/SLICE         PSI         PSI

 1               4069.              19184.            446.        9249.
 2               4069.              19416.            451.        9386.

STEM ANALYSIS COMPLETE TO BASE
```

Each analysis ends with the question:

```
SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?N
```

that is answered with an "N" here to go on to the toe.

c. Toe Stress Analysis:

```
#
# BEGIN TOE STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR TOE (OR ?, N, R, OR *):
?S
BEGIN ANALYSIS AT SELECTED SECTIONS
END OF TOE IS AT X = -5.850, STEM FACE AT -0.250
POINT BETWEEN TOP SLOPE PANELS IS AT -0.250

ENTER THE X-COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
(OMIT SIGN OF X)
?3.0


HERE AND MOMENT AT X = -3.000

-- SHEAR ANALYSIS AT X = -3.000 (2.850 FROM END OF TOE) (+ V = END DOWN)---
LOAD      V      N (COMP +)       M        UNIT SHEAR   ALLOWABLE    ACI318-77
CASE  LB/SLICE   LB/SLICE    LB-FT/SLICE  STRESS PSI  UNIT STRESS  PROVISION

 1    -2191.0     929.40       -2395.6      11.412       60.405      B.7.4.5
      ALTERNATE LOAD CASE  1 ANALYSIS FOR VERT. LOADS ONLY:
 1    -1866.6      0.          -2442.0       9.7221      61.543      B.7.4.4 B
 2    -2404.6     639.15       -2735.8      12.524       60.356      B.7.4.5
      ALTERNATE LOAD CASE  2 ANALYSIS FOR VERT. LOADS ONLY:
 2    -2080.1      0.          -2767.8      10.834       61.543      B.7.4.4 B

FLEXURE ANALYSIS AT X = -3.000 (2.850 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD  N (COMP=+)       M        FC      FS
CASE   LB/SLICE   LB-FT/SLICE   PSI     PSI

1 D       0.         1675.       55.   1375.
1 L     929.        -4071.      152.   2858.
      ALTERNATE LOAD CASE  1 ANALYSIS FOR VERT. LOADS ONLY:
1 D       0.         1675.       55.   1375.
```

Data item IFDR=1 will cause dead and live stresses to be considered separately

If M_{OL} and M_{LL} have

(Continued)

```
LOAD  N (COMP=+)        M          FC     FS
CASE   LB/SLICE    LB-FT/SLICE   PSI    PSI

1 L       0.          -4117.      136.   3380.     different signs in moment
2 D       0.           1675.       55.   1375.     analysis
2 L     639.          -4411.      158.   3289.
      ALTERNATE LOAD CASE  2 ANALYSIS FOR VERT. LOADS ONLY:
2 D       0.           1675.       55.   1375.     Alternate analysis in EM
2 L       0.          -4443.      146.   3648.     1110-2-2501 paragraph S-21

ENTER THE X-COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
OMIT SIGN OF X)
?D

SELECT TYPE C, S, OR F ANALYSIS FOR TOE (OR ?, N, R, OR *):
?_
```

d. Key Stress Analysis. In this example, the preliminary division question about where to put the analysis results is answered with a "R" to put the output only in the report file:

```
#
# BEGIN KEY STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR KEY (OR ?, N, R, OR *):
?F

KEY ANALYSIS COMPLETE TO SLAB

SELECT TYPE C, S, OR F ANALYSIS FOR KEY (OR ?, N, R, OR *):
?N
```

e. Heel Stress Analysis. This example demonstrates a type "S" analysis with the output to the report file:

```
#
# BEGIN HEEL STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?S

BEGIN ANALYSIS AT SELECTED SECTIONS
END OF HEEL IS AT X = 10.450, STEM FACE AT 1.750

ENTER THE X-COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
?5
```

```
ENTER THE X-COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
?D

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?N
```

7-3-3 Critical Sections for Analysis:

a. Stem:

SHEAR	MOMENT	CRITICAL SECTION LOCATIONS
X	X	BETWEEN TOP & BOTTOM PANELS ON HEEL-SIDE FACE (POINT 13)
	X	AT THE BASE
X		ALTERNATE LOCATIONS: IF THERE IS A TOE, THEN A DISTANCE D ABOVE THE BASE IF NO TOE, THEN AT THE TOP OF THE BASE
X		IMMEDIATELY BELOW CONCENTRATED FORCES PH1 AND PH2

b. Toe:

SHEAR	MOMENT	CRITICAL SECTION LOCATIONS
X	X	BETWEEN PANELS 1 (BY STEM) AND 2 (OUTER)
X		AT A DISTANCE D FROM THE STEM
	X	AT THE STEM (POINT 2)
	X	IMMEDIATELY TOWARD STEM FROM FORCE PVB

c. Key (if over 0.01 ft long):

SHEAR	MOMENT	CRITICAL SECTION LOCATIONS
	X	AT TOP OF KEY (POINT 9)
X		ALTERNATE LOCATIONS: IF KEY AT END OF HEEL, AT TOP OF KEY (PT. 6) IF KEY UNDER STEM, DISTANCE D BELOW BASE

d. Heel:

SHEAR	MOMENT	CRITICAL SECTION LOCATIONS
X	X	AT THE STEM (POINT 12)
X	X	AT KEY FACE TOWARD THE STEM (POINT 6) (IF KEY UNDER HEEL AND OVER 0.1 LONG)

7-3-4 Noninteractive Data File Analysis Control:

a. When running from a data file, there is no interaction.

All questions are assumed to be answered in the most general or complete way.

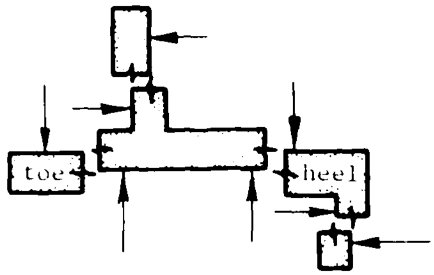
b. Analysis types performed will include types C (critical section) and F (1-ft intervals).

c. All output is to the report file.

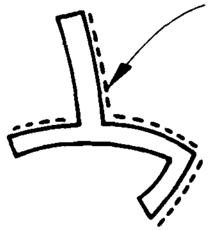
7-3-5 Output Sign Convention:

a. Axial force. Compression is positive.

b. Positive Shear:



c. Positive Moment:



7-4 INTERPRETATION OF OUTPUT

7-4-1 Analysis Results to Time-Sharing Terminal and/or the Report File:

a. The first line describes the location in terms of elevation for stem or toe and X coordinate for toe or heel. See paragraph 7-3-5 for sign conventions.

b. Allowable shear Stress. The ACI code paragraph basis for the allowable unit shear stress is given in the column immediately after the allowable stress:

B.7.4.3 Moment + Axial Tension: $v_c = 1.1\left(1 + 0.004\frac{N}{A_g}\right)\sqrt{f'_c}$

B.7.4.4 Moment Only: $v_c = \sqrt{f'_c} + 1300 p_w \left(\frac{Vd}{M}\right)$ (A)

but $\frac{Vd}{M}$ cannot exceed 1.0 (B)

$$v_c = 1.9\sqrt{f'_c} \quad \text{(C)}$$

B.7.4.5 Moment at Axial Compression:

$$v_c = 1.1\left(1 + 0.0006\frac{N}{A_g}\right)\sqrt{f'_c}$$

c. Dead and live load stresses are reported separately when IFDR = 1 and the effect of adding dead load is to reduce the effect of live load. For shear stress analysis, this can also affect the allowable stress because of the effects of moment and axial force.

d. Alternate load cases are provided when IFEM = 1, as described in paragraph S-21 of EM 1110-2-2501:

(1) Stem. Total load case only.

(2) Toe:

(a) Total load case.

(b) Vertical forces only (to yield more tension in the bottom face reinforcement).

(3) Key:

(a) Total load case.

(b) Vertical forces plus horizontal resisting forces only. Driving forces (from beyond heel) are omitted. This is to yield more tension in the toe-side face reinforcement.

(4) Heel (applicable only if there is a key at the end of the heel):

(a) Total load case.

(b) Ignore passive pressure to get more tension in the top face at the stem. This is an approximation of the requirements in paragraph S-21a(1) of EM 1110-2-2501. To get the full implementation, a special load case must be prepared, using NPPD = 5 in data list SOLP, where overturning analysis is based on a horizontal resisting force that is based on friction instead of passive pressure. The following procedure is one way to do this:

1. Run module FA or FD in the usual way.

2. Run module WA with:

   a. Reinforcement data in the usual way and

   b. IFEM = 1 in data list CND.

3. Change IFEM to zero in list CND and NPPD to 5 in list SOLP.

4. Run module FA. Each load case will be analyzed with the horizontal resisting force acting on the end of the toe and not as pressure on the key.

5. Run module WA. Each load case will be analyzed for the special loading only, but will not be labeled as being an alternate loading.

(c) Ignore all horizontal forces and pressures to get maximum tension in bottom at stem.

(d) Ignore driving forces and pressures to get maximum tension in bottom at the key (if DKEY is at least 0.02 ft long).

(e) Note that paragraph S-21a(3) of EM 1110-2-2501 implies that the top of the heel at the key must not have less reinforcement than is determined for the toe-side face of the key.

e. The combination of IFDR = 1 and IFEM can lead to an output as shown in paragraph 7-3-2c for the toe. In this example, each load case takes 5 lines to print: total load case dead load, total load case live load, the heading for the alternate loading, alternate load case dead load, and alternate load case live load. In the case of the heel, one load case could take 11 lines (total load case plus three alternates).

7-4-2 Analysis Results to the Report File Only. This is for the same loads as the examples just shown for the stem at a distance d above the base:

a. Initial explanation at the beginning of the stress analysis report:

```
=
= BEGIN STRESS ANALYSIS
=

EXPLANATION OF "OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES" (FT,LB/SLICE)

 TAD, TAV, TAW, TAE, TAH, TAF, & CPPA ARE AXIAL FORCES
```

```
TVD, TVV, TVW, TVE, TVH, TVF, WATERV, EWTV, & CPPV ARE SHEARS
TMD, TMV, TMW, TME, TMH, TMF, WATERM, EWTM, & CPPM ARE MOMENTS

TAD, TVD, & TMD ARE DUE TO THE FULL WEIGHT OF CONCRETE
TAV, TVV, & TMV ARE DUE TO VERTICAL SURCHARGES
TAW, TVW, & TMW ARE DUE TO WIND
TAE, TVE, & TME ARE DUE TO EARTHQUAKE EFFECTS
TAH, TVH, & TMH ARE DUE TO HORIZONTAL EARTH + SURCHARGES
TAF, TVF, & TMF ARE DUE TO HORIZONTAL SEEPAGE + UPLIFT
WATERV & WATERM ARE DUE TO THE WEIGHT OF WATER OVER BASE
EWTV & EWTM ARE DUE TO THE WEIGHT OF EARTH OVER BASE EXCLUDING PORE WATER
CPPA, CPPV, & CPPM ARE TOTAL PASSIVE PRESSURE, IF NON-ZERO
   (IF CPPA, ETC., ARE ZERO THEN THE PASSIVE PRESSURE
   EFFECTS ARE INCLUDED WITH THE LOADS CAUSING THEM.)
```

b. Stem stress analysis at critical sections for shear at a distance d above the base. Tables with a ">" mark in column 1 of their first lines are printed only if the TRCE 3 command has been used:

```
#
# BEGIN STEM STRESS ANALYSIS
#

SHEAR AT A DISTANCE d ABOVE THE (POINT 2) BASE--

>OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
 --- LOAD CASE  1 ---
 TAD(LC), TVD(LC), TMD(LC) =          3551.159        0.             0.
 TAV(LC), TVV(LC), TMV(LC) =        0.             0.             0.
 TAW(LC), TVW(LC), TMW(LC) =        0.             0.             0.
 TAE(LC), TVE(LC), TME(LC) =        0.             0.             0.
 TAH(LC), TVH(LC), TMH(LC) =        0.             -129.0833      -53.78472
 TAF(LC), TVF(LC), TMF(LC) =        0.              3536.647       12901.65
 WATERV(LC), WATERM(LC) =                          0.             0.
 EWTV(LC), EWTM(LC) =                              0.             0.
 CPPA(LC), CPPV(LC), CPPM(LC) =     0.             0.             0.

>OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
 --- LOAD CASE  2 ---
 TAD(LC), TVD(LC), TMD(LC) =          3551.159        0.             0.
 TAV(LC), TVV(LC), TMV(LC) =        0.             0.             0.
 TAW(LC), TVW(LC), TMW(LC) =        0.             0.             0.
 TAE(LC), TVE(LC), TME(LC) =        0.             0.             0.
 TAH(LC), TVH(LC), TMH(LC) =        0.             -88.77145      -36.98810
 TAF(LC), TVF(LC), TMF(LC) =        0.              3536.647       12901.65
 WATERV(LC), WATERM(LC) =                          0.             0.
 EWTV(LC), EWTM(LC) =                              0.             0.
 CPPA(LC), CPPV(LC), CPPM(LC) =     0.             0.             0.
```

----------------- SECTION PROPERTIES AT ELEVATION 86.25 -------------

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN.	TENSION FACE	k	j
+	12.00	23.32	21.32	1.00	HEEL		
-	12.00	23.32	21.32	1.00	TOE		

--- SHEAR ANALYSIS AT ELEVATION 86.25 (+ V FROM TOP PUSHED TOWARD TOE)---

LOAD CASE	V LB/SLICE	N (COMP +) LB/SLICE	M LB-FT/SLICE	UNIT SHEAR STRESS PSI	ALLOWABLE UNIT STRESS	ACI318-77 PROVISION
1	3407.6	3551.2	12848.	13.318	60.708	B.7.4.5
2	3447.9	3551.2	12865.	13.475	60.708	B.7.4.5

c. Stem stress analysis at critical section for flexure at the base of the stem:

MOMENT AT THE BASE (POINT 2)--

```
>OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
 --- LOAD CASE  1 ---
 TAD(LC), TVD(LC), TMD(LC) =        4068.750       0.            0.
 TAV(LC), TVV(LC), TMV(LC) =       0.            0.            0.
 TAW(LC), TVW(LC), TMW(LC) =       0.            0.            0.
 TAE(LC), TVE(LC), TME(LC) =       0.            0.            0.
 TAH(LC), TVH(LC), TMH(LC) =       0.           -743.5200     -743.5200
 TAF(LC), TVF(LC), TMF(LC) =       0.            4474.758      19927.50
 WATERV(LC), WATERM(LC) =                        0.            0.
 EWTV(LC), EWTM(LC) =                            0.            0.
 CPPA(LC), CPPV(LC), CPPM(LC) =    0.            0.            0.

>OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
 ---  LOAD CASE  2 ---
 TAD(LC), TVD(LC), TMD(LC) =        4068.750       0.            0.
 TAV(LC), TVV(LC), TMV(LC) =       0.            0.            0.
 TAW(LC), TVW(LC), TMW(LC) =       0.            0.            0.
 TAE(LC), TVE(LC), TME(LC) =       0.            0.            0.
 TAH(LC), TVH(LC), TMH(LC) =       0.           -511.3235     -511.3235
 TAF(LC), TVF(LC), TMF(LC) =       0.            4474.758      19927.50
 WATERV(LC), WATERM(LC) =                        0.            0.
 EWTV(LC), EWTM(LC) =                            0.            0.
 CPPA(LC), CPPV(LC), CPPM(LC) =    0.            0.            0.
```

----------------- SECTION PROPERTIES AT ELEVATION 84.50 -------------

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN.	TENSION FACE	k	j
+	12.00	24.00	22.00	1.00	HEEL	0.226	0.925
-	12.00	24.00	22.00	1.00	TOE	0.226	0.925

FLEXURE ANALYSIS AT ELEVATION 84.50 (+ M = TENSION AT HEEL)

LOAD CASE	N (COMP=+) LB/SLICE	M LB-FT/SLICE	FC PSI	FS PSI
1	4069.	19184.	446.	9249.
2	4069.	19416.	451.	9386.

d. Typical report file information from data check. Tables with a "-" in the first column of first line are printed with the TRCE 3 command:

(1) NAME data list, time, and date:

```
STRESS ANALYSIS OF EXHIBIT Q PRESSURES
          18:23:  7 on  7/6/79
```

(2) Geometry data review:

```
#
# BEGIN MODULE WA
#

DEFAULT VALUE OF    0.            USED FOR BASER

STR     CALCULATED TO BE     0.34356

YOUR YOUR HEELT1 VALUE OF    18.00      INCHES SET THE TOP
OF THE HEEL AT THE STEM (    84.5000) SO CLOSE TO THE TOP
OF THE TOE AT THE STEM THAT BOTH WERE SET TO THE SAME VALUE
OF    84.5000 FEET.

DEFAULT VALUE OF   0.1935483     USED FOR HSBPB

SLOPE OF TOP OF HEEL SLAB = 100.00 H : 1 V (100.0:1 = LEVEL)
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	100.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	-0.2500	84.5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	-0.2500	84.5000	BETWEEN TS1 AND TW2, ON TOP FACE OF TOE
4	-5.8500	84.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-5.8500	83.0000	TOE END OF BASE = AT BTE1
6	8.2500	83.0000	TOP OF TOE-SIDE FACE OF KEY
7	8.9500	77.3000	BOTTOM OF TOE-SIDE FACE OF KEY

(Continued)

PT.	X	Y	DESCRIPTION OF POINT
8	10.4500	77.3000	BOTTOM OF HEEL-SIDE FACE OF KEY
9	10.4500	83.0000	TOP OF HEEL-SIDE FACE OF KEY
10	10.4500	83.0000	HEEL END OF BASE
11	10.4500	84.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.7500	84.5000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	100.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	100.0000	TOP OF HEEL-SIDE FACE OF STEM
15	9.7000	77.3000	BOTTOM OF CUTOFF WALL UNDER KEY

WITH BASE RADIUS ("BASER", 0.0 FOR RECTANGULAR) = 0. FEET,
TOE END OF BASE UNIT WIDTH = 1.0000 FT. AND
HEEL END OF BASE UNIT WIDTH = 1.0000 FT.
(BASIC WORKING POINT IS 1.0 FT. WIDE).

LOWEST CONCRETE = 77.30 FT., AT BOTTOM OF KEY
COMPARED WITH THE PREVIOUS LOW OF-0.12340000E 31 FT.

> Y-COORDINATES OF BASE SLAB SURFACE POINTS OPPOSITE CORNERS

BELOW 3	BELOW 2	ABOVE 6	BELOW 12
83.0000	83.0000	84.5000	83.0000

(3) Reinforcing steel data, with intermediate values inserted by program:

> TABLE OF STEEL VALUES IN STEM, SQ. IN./FT.

M	ELEV.	ASTLST(M)	ASTLSH(M,1)	ASTLSH(M,2)	ASTLSH(M,3)
1	100.00	1.000	1.000	******	******
2	99.00	1.000	1.000	******	******
3	98.00	1.000	1.000	******	******
4	97.00	1.000	1.000	******	******
5	96.00	1.000	1.000	******	
6	95.00			******	
7				******	

(4) Pressure transferred in from module FA (repeated for each load case):

---------- PRESSURE DATA VERIFICATION FOR LOAD CASE 1 ----------------

FH TOP CALCULATED TO BE 97.000
FOR LOAD CASE 1

> FHTOP IS 97.000

> TABLE OF HORIZONTAL NET HYDRO PRESSURES FOR LC = 1

I	ELEV.	FH(LC,I)	EFH(LC,I)
1	97.00	0.	******
2	96.00	62.50	******
3	95.00	125.0	******
4	94.00	187.5	******
5	93.00		******
6			

> TABLE OF VERTICAL UPLIFT PRESSURES FOR LC = 1

I	DIST.	X-COORD.	FV(LC,I)
1	0.	-5.850	-357.5
2	1.00	-4.850	-374.5
3	2.00	-3.850	-391.4
4	3.00	-2.850	-408.4
5	4.00	-1.850	-425.3
6	5.00		-442.3
7			

> TABLE OF VERTICAL EARTH WEIGHT + SURCHARGE PRESSURES FOR LC = 1

I	DIST.	X-COORD.	V(LC,I)
OVER TOE:			
1	0.	-5.850	187.5
2	1.00	-4.850	187.5
3	2.00	-3.850	187.5
4	3.00	-2.850	187.5
5	4.00	-1.850	187.5
6	5.00	-0.8500	187.5
7	6.00	0.1500	187.5
OVER HEEL:			
8	6.00	0.1500	125.0
9	7.00	1.150	125.0
10	8.00	2.150	125.0
11	9.00	3.150	125.0
12	10.00	4.150	125.0
13	11.00	5.150	125.0
14	12.00	6.150	125.0
15	13.00	7.150	125.0
16	14.00	8.150	125.0
17	15.00	9.150	125.0
18	16.00	10.15	125.0
19	17.00	11.15	125.0

> TABLE OF VERTICAL EARTH + SURCHARGE EARTHQUAKE PRESSURES FOR LC = 1

I	DIST.	X-COORD.	EV(LC,I)
OVER TOE :			
OVER HEEL:			

> YTTOP IS 87.500

```
> NPPD    IS        1           trapezoidal shape for floodwell

> KRACK   IS        2           no krack

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE  2 -------------
```

CHAPTER 8: MODULE WD--(WORKING) STRESS DESIGN

8-1 ACTION OF MODULE WD

8-1-1 Module WD selects data values for slab thickness and surface slopes, beginning with the output of module FD. The design process yields minimum total concrete volume for the given value of base width, toe embedment, base slope, toe width, and key length. Certain other geometry data items may be set by the user. The design procedure follows Appendix B, "Alternate Design Method," of ACI Code 318-77. The equations used are described in Chapter 9 and Exhibit G of the Program Criteria Specifications Document and summarized in paragraph 7-4-1 of this user's guide.

8-1-2 The design procedure starts with two baselines. One baseline is the battered (TSB) toe-side face of the stem, extended down along the batter to the bottom of the base slab. The other baseline is the bottom of the base slab. The design procedure is described below. Refer to Figure 3-5 for the locations of coordinate points:

a. Toe. Point 2 is moved upward from the base slab bottom, along the battered toe-side base line, until strength and geometric criteria are satisfied. Points 3 and 4 are moved upward vertically from the base bottom until strength and geometric criteria are satisfied. Geometric criteria include the two items that the absolute minimum thickness is TMINB and that TS1 and TS2 may not be negative (or zero).

b. Stem. Points 12, 13, and 14 are moved horizontally toward the heel side of the wall until strength and geometric criteria are satisfied. Geometric criteria include the two items that the absolute minimum thickness is TMINS and that HSTPB and HSBPB may not be negative (zero is acceptable). Point 12 is temporarily located at the elevation of point 2 and HSBPB is considered extended downward to the bottom of the base slab. Point 12 is then moved temporarily down to the slab bottom along batter HSBPB.

c. Key. The two variable BKTF and WKEY are adjusted until WKEY is at least as large as TMINB or the user's input value, whichever is larger, and BKTF is such that the top of the key is strong enough and an least as thick as WKEY.

d. Heel. Point 11 is moved upward vertically and point 12 is moved upward along batter HSBPB until the strength and geometric criteria are satisfied. Geometric criteria include the two items that the absolute minmum thickness is TMINB and that point 11 may not be above point 12.

8-1-3 Module WD is interactive only during the data checking division of the module. Major error messages (fatal conditions) are printed at the time-sharing terminal and in the report file. Minor warning messages are printed only in the report file. There is no interaction if the module is started by a RUN WD command in a data file.

8-1-4 Alternate load cases are provided when IFEM = 1 in list CND, as described in paragraph 7-4-1d.

8-2 DATA

8-2-1 Predefined Data:

a. Module WD is normally run after module FD (or, less probably, module FA). A module FD run finishes with a run of module FA to get seepage and earth pressures that combine with the data for module FA or FD to form the predefined portion of the data for module WD.

b. The predefined data can also be entered independently by the user without having run module FA or FD. This is explained in Chapter 11 of this manual.

8-2-2 Additional Data. Module WD needs additional data for concrete design parameters:

```
CND   RATION  FPCON  ESTL   IFEM
CNWD  RATIOF  FYSTL  FSTLMX  IBSAME  IFDR
COVR  COVHS  COVTS  COVTB  COVBB  SPABL
OVRS  LC  AOSF(LC)
STLD  MAXBAR  SPAMIN
WGHT  GAMAC  GAMAW
```

All of these lists are optional.

8-2-3 Concrete Data Item Definitions. Data item definitions are repeated here for convenience:

Data List	Variable Name	Units	Default Value Hydraulic	Default Value Nonhydraulic	Definition
CND	RATION	ratio	(1)	(1)	$N = E_s/E_c$
	FPCON	psi	3,000.0	3,000.0	Concrete ultimate strength f'_c
	ESTL	psi	29,000,000.0	29,000,000.0	Reinforcing modulus E_s
	IFEM	0 or 1	1	1	1 to implement the alternate special loadings

(Continued)

8-2-3 Concrete Data Item Definitions (Continued):

Data List	Variable Name	Units	Default Value Hydraulic	Default Value Nonhydraulic	Definition
CND	IFEM				of paragraph S-21 on page S-23 of EM 1110-2-2501 0 to use loads as described in the load case*
CNWD	RATIOF	ratio	0.35**	0.45**	Allowable f_c/f'_c, EM 1110-1-1201
	FYSTL	psi	40000.0+	40000.0+	Reinforcing steel yield strength
	FSTLMX	psi	20000.0	(2)	Allowable maximum f_s
	IBSAME	0 or 1	(3)	(3)	1 to force the top of heel at stem to the same elevation as the top of toe at the stem, if strong enough 0 to allow the tops of toe and heel to vary independently
	IFDR	0 or 1	1	1	1 to conform to ACI 318-77, Appendix B, paragraph B.2.3 (use 80 percent of dead load and its reactions if they oppose the stresses of live load)

(Continued)

* See paragraph 7-4-1d.

** Set for hydraulic (IHYD = 1)/nonhydraulic (IHYD = 2) status for the first load case number in data list CASE. (Load case No. 1 if list CASE is not used).

\+ 20,000.0 is the Corps of Engineers' limit for hydraulic structures; nonhydraulic structures may use the default of 50 percent of FYSTL.

8-2-3 Concrete Data Item Definitions (Continued):

Data List	Variable Name	Units	Default Value Hydraulic	Default Value Nonhydraulic	Definition
CNWD	IFDR				0 to use the actual D + L
COVR					Reinforcing bar placement clearances, measured to center of bars
	COVHS	in.	3.5	2.5	Cover at heel-side face of stem
	COVTS	in.	3.5	2.5	Cover at toe-side face of stem
	COVTB	in.	3.5	2.5	Cover at top face of base slab
	COVBB	in.	4.5	3.5	Cover at bottom of base slab
	SPABL	in.	1.0	1.0	Spacing between layers, measured normal to face of member, from center to center of bars
OVRS	LC	0, 1-10	1	1	Load case number (see paragraph 2-6-6)
	AOSF	factor	1.0	1.0	Allowable overstress factor, multiply by code allowable stresses to get usable allowable stresses (1.0 = no effect)
STLD					The data in this list are used to establish the maximum amount ($in.^2/ft$) of reinforcing steel to be placed in any one row. Checks are made to see that standard size bars are used at a spacing allowed by ACI Code 318-77

(Continued)

8-2-3 Concrete Data Item Definitions (Concluded):

Data List	Variable Name	Units	Default Value Hydraulic	Default Value Nonhydraulic	Definition
STLD	MAXBAR	ASTM size number	11	11	Maximum bar size allowed by user (3-11, 14, or 18 only)
	SPAMIN	in.	MAXBAR's diameter × 2 or MAXBAR's diameter + 2.25, whichever is larger		Minimum acceptable clear spacing for bar size entered for MAXBAR
WGHT	GAMAC	pcf	150.0	150.0	Unit weight of concrete
	GAMAW	pcf	62.5	62.5	Unit weight of water

NOTES: (1) E_c is calculated from the expression in paragraph 8.5.1 of ACI code 318-77: E_c = GAMAC-5.0 33.0 FPCON

(2) FSTLMX is taken at one half of FYSTL for nonhydraulic structures.

(3) IBSAME generally defaults to zero but will be used as one for analysis of a level base of default thickness.

8-3 OUTPUT. Output information is placed in data lists WLA, WLAB, WLAH, WLAK, WLAS, WLAT, STLB, STLK, and STLS.

8-3-1 Data Check. The data check procedures at the beginning of module WD perform a variety of checks to make sure that enough data items have been defined to enable the program to:

a. Establish the concrete dimensions with enough accuracy for the program to be able to compute the total forces from loads in the form of pressure diagrams.

b. Describe the outlines of the various pressure diagrams (seepage, passive pressure, vertical earth and surcharge pressures, ets).

The questions and printout statements possible during the data check are numerous and varied. Care has been taken to make them self-explanatory and to allow interactive recovery where feasible. Where it is not feasible, the module aborts with a message telling the user what to do in the executive phase before trying again to run the module.

8-3-2 Wall Geometry. The wall geometry established by module WD is reported in two ways:

a. A table of analysis geometry data lists is printed in the format shown below. The wall is the one described in Exhibits K-L of the Program Criteria Specifications Document. The table is printed to the time-sharing terminal and the report file:

```
#
# DESIGN SUMMARY
#
WLA          ETS          TW2          STR          HEELW
          100.0000     5.600000     0.4000000     8.700000

WLAB          BW           BS                        BASER (LIST=WLBR)
          16.30000      0.                        0.

WLAH       HEELT2,        HEELW        HEELT1
          18.00000     8.700000     18.00000

WLAK        KFLAG         DKEY         WKEY         BKTF
             0         5.700000     18.00000     8.142857

WLAS        TSTT          TSB          TSTB         HSTPH         HSTPB
          18.00000     0.1935484    24.00000      0.            0.
           HSBPB
         0.1935484

WLAT        BTE1         TOEHT         TS2          TW1           TS1
          83.00000     18.00000     100.0000      0.          100.0000

----       TMINB        TMINS
          18.00000     18.00000
```

A value of -.1234E30 means that that item is not defined.

b. A table of wall corner coordinates is printed to the report file. This table is illustrated in paragraph 7-4-2d(2) and is also available with the LOOK XY command.

8-3-3 Reinforcement data are printed in the report file in tabular form as shown in paragraph 7-4-2d(3) for module WA. This is also available with the LOOK command for data lists STLB, STLK, and STLS. Reed paragraph 7-2-2a(5) about editing the reinforcing steel description produced by module WD before running module WA to analyze that description.

CHAPTER 9: MODULE UA--(ULTIMATE) STRENGTH ANALYSIS

9-1 ACTION OF MODULE UA

9-1-1 Module UA is similar to module WA, except that the concrete analysis is according to the strength design concepts in ACI Code 318-77 and Exhibit F to the Program Criteria Specifications Document.

9-1-2 Coding on this module has been deferred pending adoption of strength design procedures for Corps of Engineers hydraulic structures.

9-1-3 Output is expected to be in the form of:

a. Available flexural and shear strengths/ultimate strengths.

b. Serviceability indicators.

CHAPTER 10: MODULE UD--(ULTIMATE) STRENGTH DESIGN

10-1 ACTION OF MODULE UD

10-1-1 Module UD is similar to module WD, except that the concrete analysis is according to the strength design concepts in ACI Code 318-77 and Exhibit F to the Program Criteria Specifications Document.

10-1-2 Coding on this module has been deferred pending adoption of strength design procedures for Corps of Engineers hydraulic structures.

10-1-3 Output is expected to be similar to that of module WD.

CHAPTER 11: LINKAGE BETWEEN FA/FD STABILITY AND WA/WD/UA/UD STRESS ANALYSIS/DESIGN MODULES

11-1 The variables used to transfer the earth pressure and horizontal surcharge lumped forces, vertical earth and surcharge pressures, seepage pressures, bearing pressures, and passive earth pressures calculated in the foundation stability modules (FA and FD) are transferred to the structural design/analysis modules (WA, WD, UA, UD) by a series of arrays. These arrays have been made available to the data entry and review process in the form of the following data lists. The information in this chapter is intended for the experienced user and is not described in the detail used elsewhere in this manual.

11-1-1 Horizontal lumped forces of active earth pressures and surcharges:

a. On a vertical plane at the end of the heel, from modules SA, FA, and FD. See paragraph 4-6-1 for details:

```
ACPH  LC  LOC  H(LC,LOC)  EH(LC,LOC)  YH(LC,LOC)
```

b. On the heel-side face of the stem, from modules SP, FA, and FD. See paragraph 4-6-1 for details:

```
ACPS  LC  LOC  HS(LC,LOC)  EHS(LC,LOC)  YVS(LC,LOC)
```

11-1-2 Bearing pressures from modules FA and FD:

a. From horizontal load groups W, H, EH, and FH:

```
BPH  LC  N  IRLT(LC)  EPBW(LC)  WB(LC,N)  HB(LC,N)  EHB(LC,N)  FHB(LC,N)
```

b. From vertical load groups D, V, EV, FV:

```
BPV  LC  N  IRLT(LC)  EPBW(LC)  DB(LC,N)  VB(LC,N)  EVB(LC,N)  FVB(LC,N)
```

11-1-3 Hydrostatic seepage pressures, net horizontal, from modules FA and FD:

```
HSPH  LC  LOC  FH(LC,LOC)  EFH(LC,LOC)
```

11-1-4 Hydrostatic uplift pressure from modules FA and FD:

```
HSPV  LC  LOC  FV(LC,LOC)
```

11-1-5 Passive pressures from modules FA and FD:

PPD LC YTTOP(LC) WPE(LC) EHPE(LC) HPE(LC) FHPE(LC)

11-1-6 Vertical pressures of earth over base and surcharges, from modules FA and FD:

VLP LC LOC V(LC,LOC) EV(LC,LOC)

11-2 LOAD GROUPS

11-2-1 The following load groups were selected to enable the use of various load factors in the application of ACI 318-77 code requirements for structural design. See Exhibit F of the Program Criteria Specifications Document:

Load Group Code	Strength Design Load Factor Data Item Name	Description
D	DLF	Weight of concrete and water above base
E	ELF	Earthquake effects to be added to static loads
F	FLF	Hydrostatic pressure (not including the direct weight of water over the base)
H	HLF	Horizontal earth and surcharges pressures
V	VLF	Vertical earth and surcharge pressures
W	WLF	Wind

11-2-2 These load group code letters are used in the names of program data and internal variables to aid the user in identifying them. See paragraph 7-4-2a for additional use of these codes in module WA:

Load Group Code	Bearing Pressure Array	Passive Pressure Array	Direct Surcharge Data Item	Other Intermediate Arrays
D	DB(LC,N)	n/a	--	--
E	EHB(LC,N)	EHPE(LC)	--	EH,EFH,EHS
	EVB(LC,N)	n/a	--	EV
F	FHB(LC,N)	FHPE(LC)	W1, W3-W4	FH
	FVB(LC,N)	n/a	--	FV
H	HB(LC,N)	HPE(LC)	PH1, PH2	H
V	VB(LC,N)	n/a	PVS, PVB	V
W	WB(LC,N)	WPE(LC)	W	--

11-3 ILLUSTRATIONS. Illustrations are shown below for the following data lists:

Data List	Array Names	Paragraph References
ACPH	H EH YH	4-6-1 11-1-1a
ACPS	HS EHS YVS	4-6-1 11-1-1b
BPH	WB HB EHB FHB	11-1-2a
BPV	DB VB EVB FVB	11-1-2b
HSPH	FH EFH	11-1-3
HSPV	FV	11-1-4
PPD	WPF EHPE HPE FHPE	11-1-5
VLP	V EV	11-1-6

11-3-1 ACPH:

ACPH LC LOC H(LC,LOC) EH(LC,LOC) YH(LC,LOC)

LC = load case subscript (0 or 1-10)

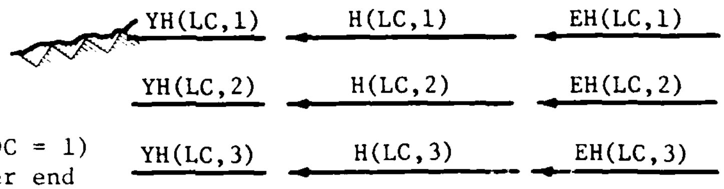
LOC = location subscript (1-68)

H(LC,n) = static horizontal lumped force on vertical plane at heel, at elevation YH(LC,n), lb/horizontal ft

EH(LC,n) = dynamic horizontal lumped aditional force on vertical plane at heel, at elevation YH(LC,n), lb/horizontal ft

NOTES:

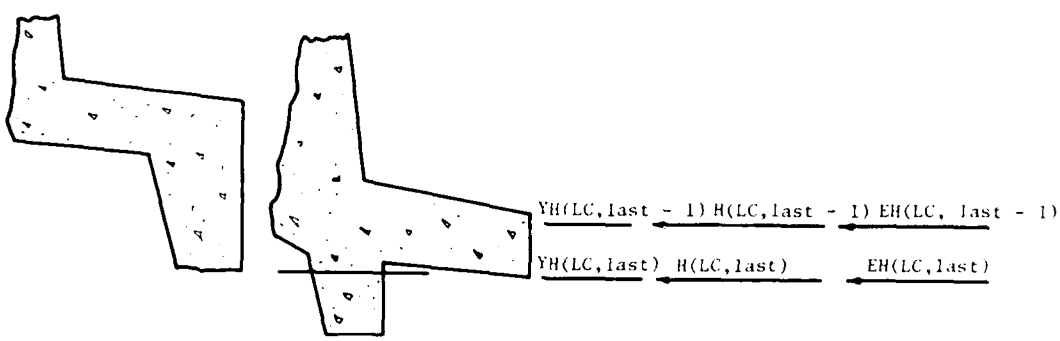
1. Intermodular transfer of intermediate answers:



   a. Top element (LOC = 1) is at grade over end of heel.
   b. One element at each node. (See NODE and IFWOC in data list SOLP in paragraph 3-3-2.
   c. Bottom element (LOC = last) is at lowest concrete elevation on vertical plane at end of heel.

2. User-defined input:

   a. Elements may be at any convenient elevations, but the LOC subscripts must start with 1 and be in order.
   b. The first element not used must have YH(LC,last + 1) = undefined (C).
   c. Once the user has assumed manual control of data list ACPH by using it, he must use the data entry line "ACPH LC 1 C C" before calling modules SA, SP, FA, or FD to return to having new values calculated. This same procedure applies also to data lists ACPS, HSPH, and HSPV.



Data List ACPH--Arrays H, EH, YH from Modules SA, FA

11-3-2 ACPS:

ACPS LC LOC HS(LC,LOC) EHS(LC,LOC) YVS(LC,LOC)

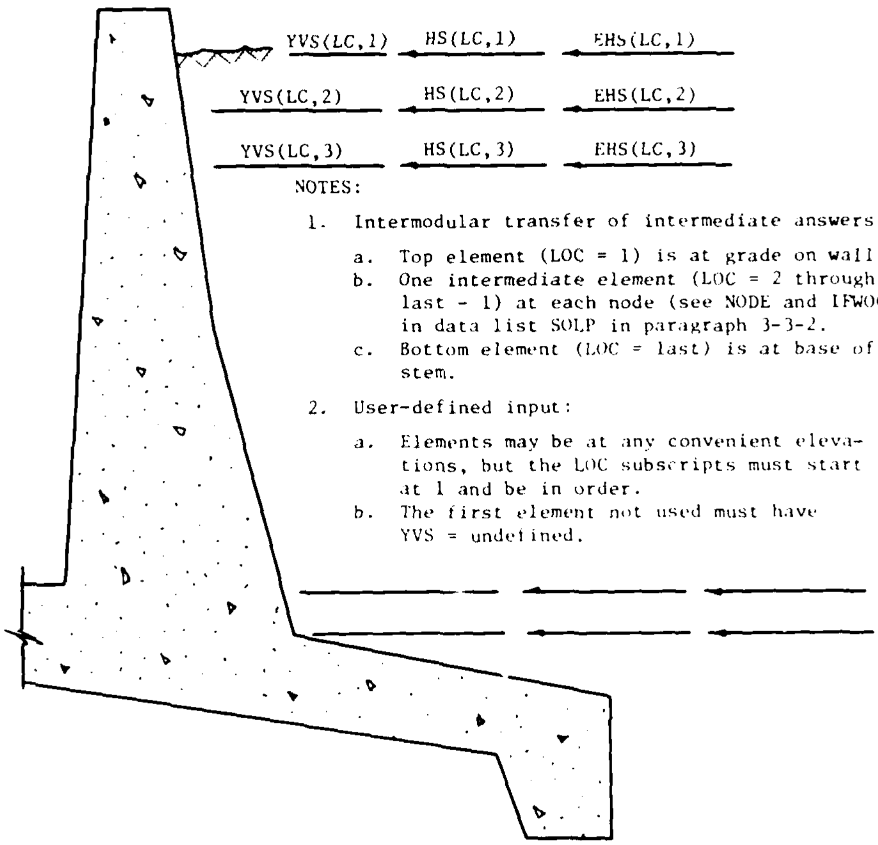
LC = load case subscript (0 or 1-10)

LOC = location subscript (1-68 maximum)

HS(LC,n) = static horizontal lumped force on stem, at YVS(LC,n), lb/horizontal ft

EHS(LC,n) = dynamic horizontal lumped additional force on stem, at YVS(LC,n), lb/horizontal ft

YVS(LC,n) = elevation of HS(LC,n) and EHS(LC,n)



NOTES:

1. Intermodular transfer of intermediate answers:
   a. Top element (LOC = 1) is at grade on wall.
   b. One intermediate element (LOC = 2 through last - 1) at each node (see NODE and IFWOC in data list SOLP in paragraph 3-3-2.
   c. Bottom element (LOC = last) is at base of stem.
2. User-defined input:
   a. Elements may be at any convenient elevations, but the LOC subscripts must start at 1 and be in order.
   b. The first element not used must have YVS = undefined.
3. See note 2c for data list ACPB (paragraph 11-3-1) for a warning about use of data list ACPS.

Data List ACPS--Arrays HS, EHS, YVS from Modules SP, FA

11-3-3 BPH and BPV:

```
BPH  LC  N  IRLT(LC)  EPBW(LC)  WB(LC,N)  HB(LC,N)  EHB(LC,N)  FHB(LC,N)
BPV  LC  N  IRLT(LC)  EPBW(LC)  DB(LC,N)  VB(LC,N)  EVB(LC,N)  FVB(LC,N)
```

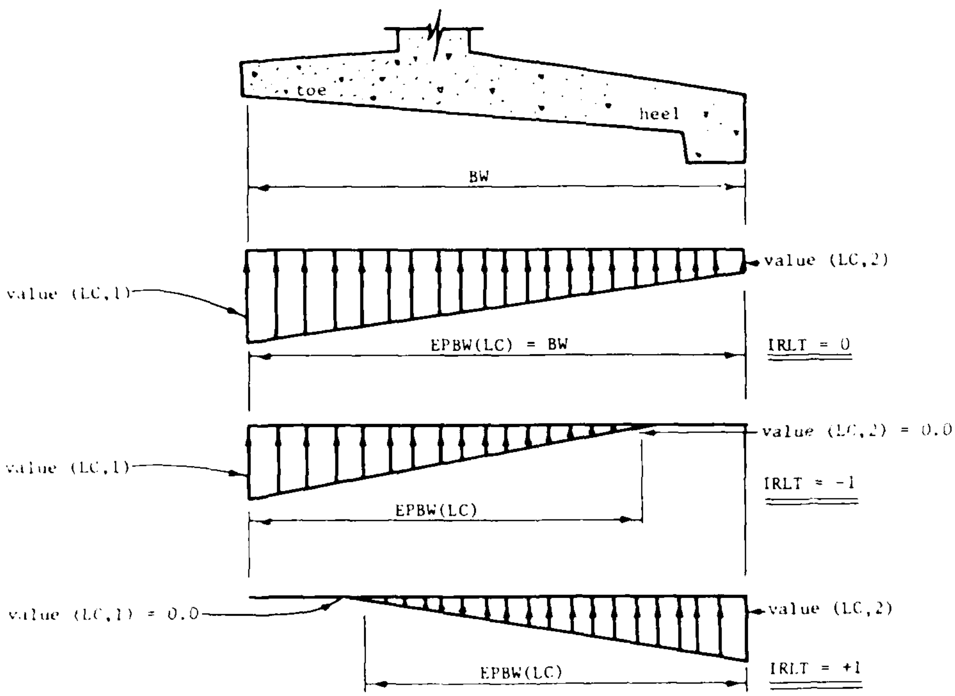
LC = load case subscript (0, 1-10)

N = base end code subscript (1 or 2)

IRLT(LC) = resultant location code (-1, 0, or +1)

EPBW(LC) = effective portion of base width, ft

See paragraph 11--12. Array VB(LC,N) contains the total bearing pressures calculated by module FA.



Values are illustrated with negative direction (the usual one)

Value ( ) = WB ( ) for wind load
(psf) = HB ( ) for earth horizontal + surcharge horizontal
= EHB ( ) for horizontal earthquake additional pressures
= FHB ( ) for horizontal net hydrostatic
= DB ( ) for weight of concrete
= VB ( ) for applied forces vertical (see array V)
= EVB ( ) for vertical earthquake additional pressures
= FVB ( ) for uplift

Data Lists BPH and BPV--General Description.

11-3-4 HSPH:

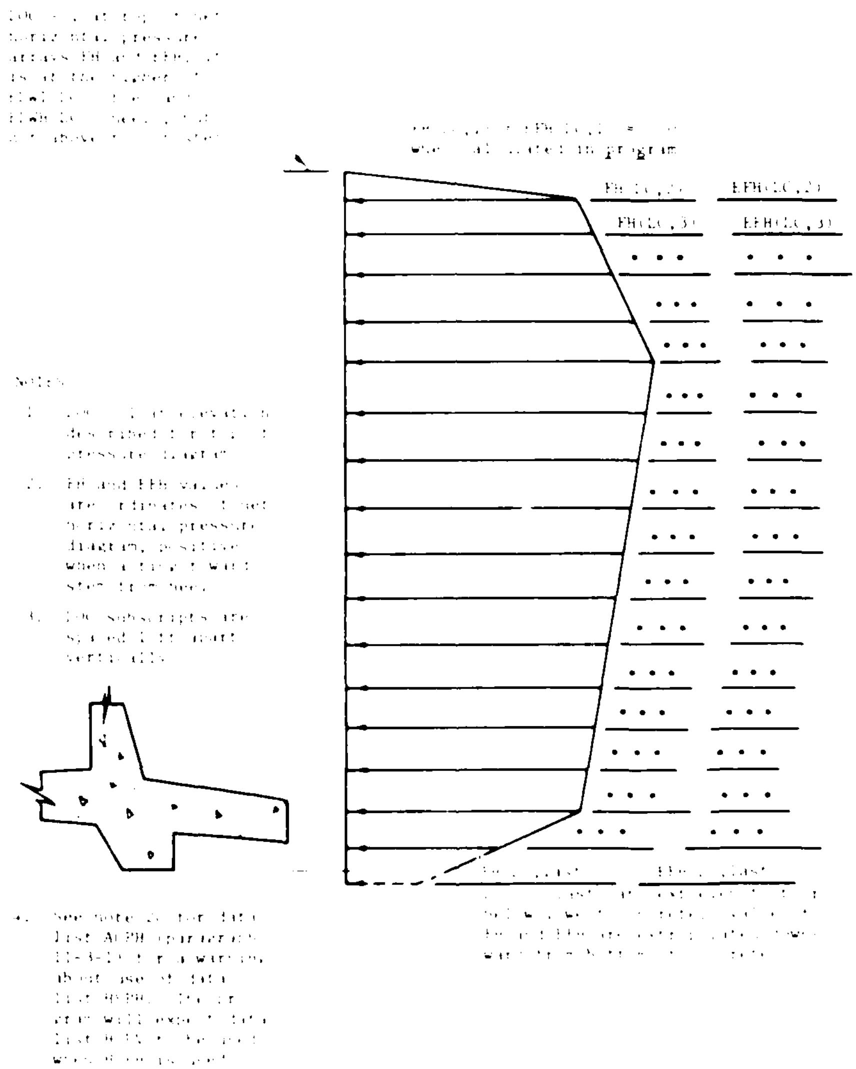
HSPH LC LOC FH(LC,LOC) EFH(LC,LOC)

LC = load case number (0, 1-10)

LOC = location code (1-68 maximum)

FH(LC,LOC) = net horizontal hydrostatic pressures

EFH(LC,LOC) = net horizontal additional hydrodynamic pressures



Data List HSPH--Arrays FH and EFH from Module FA

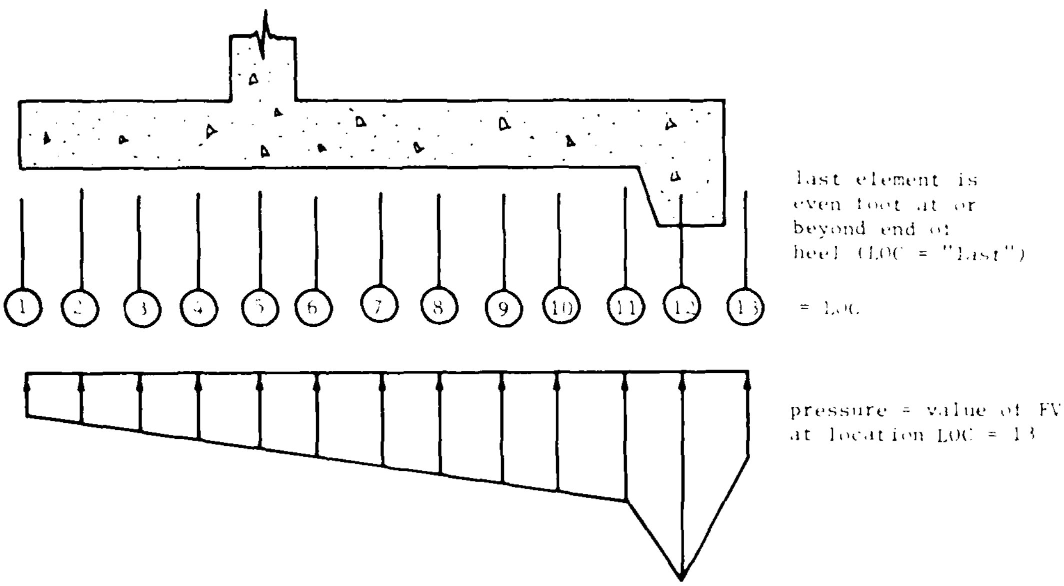
11-3-5 HSPV:

```
HSPV  LC  LOC  FV(LC,LOC)
```

LC = load case (0, 1-10)

LOC = location code (1-48)

FV(LC,LOC) = uplift hydrostatic pressure at location LOC for load case LC



NOTES:

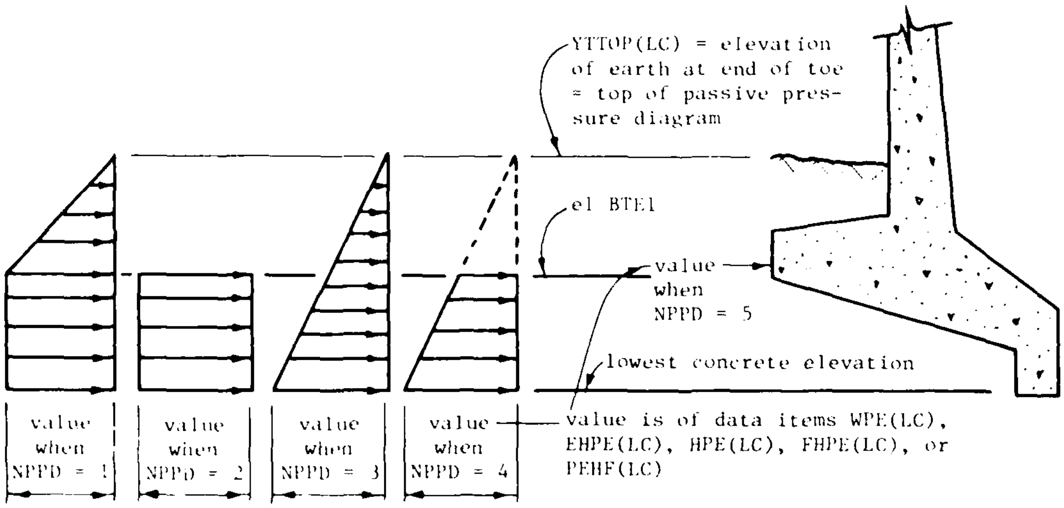
1. Values are illustrated in negative direction (the usual one).
2. LOC = 1 at end of toe.
3. Location values are spaced 1 ft apart.
4. Data list HSPV must be used when data list HSPH is used, until HSPV is cancelled as described in note 2c (paragraph 11-3-1) for data list ACPH.

Data List HSPV--Array FV from Module FA

11-3-6 PPD:

PPD LC YTTOP(LC) WPE(LC) EHPE(LC) HPE(LC) FHPE(LC)

See data list PPD in paragraph 3-3-2 for more detail.



NOTES:

1. Value for NPPD = 1, 2, 3, or 4 = pressure, psf.
2. Value for NPPD = 5 = force, lb/ft, at el BTEl.
3. Values shown above are negative (the usual case).
4. This list is ignored if put in by the user, if module FA is run. Module FA calculates a combined passive pressure, PEHF(LC), that can be seen with the LOOK PPD or LOOK IL commands.

Data List PPD--Passive Pressures from Module FA

11-3-7 VLP:

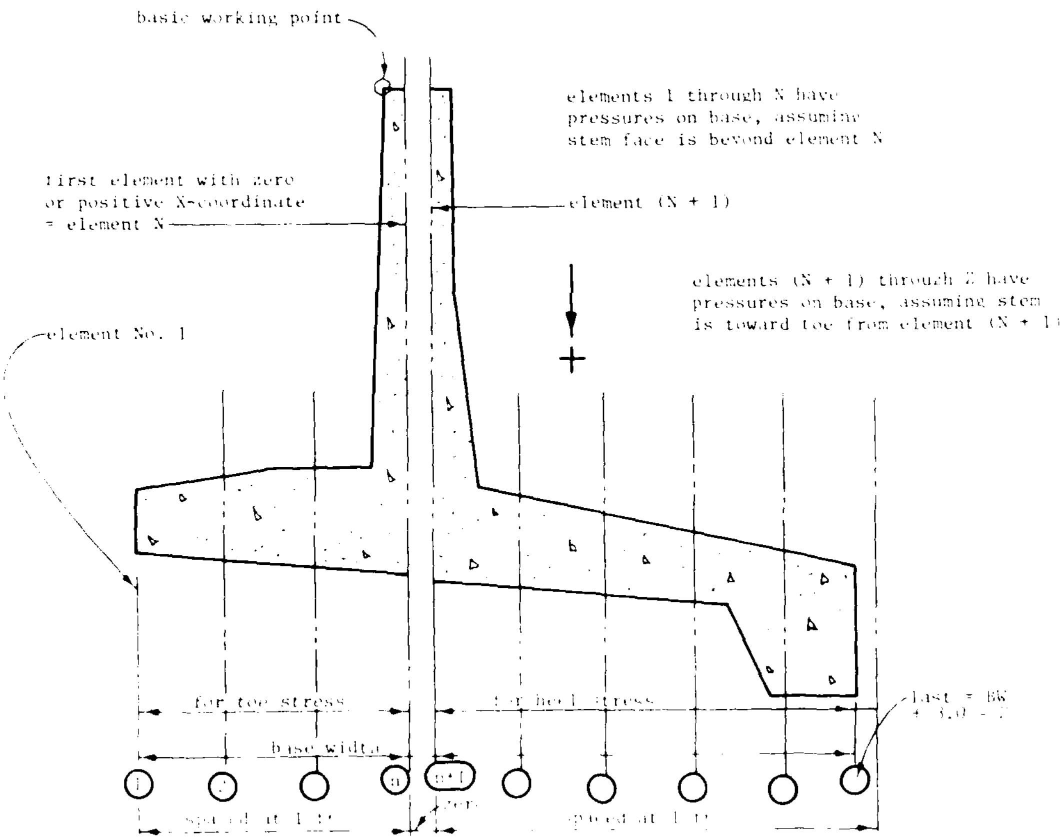
VLP LC LOC V(LC,LOC) EV(LC,LOC)

LC = load case subscript (0, 1-10)

LOC = location subscript (1-49 maximum)

V(LC,LOC) = vertical pressures due to earth over base, plus vertical pressures due to surcharges, both in psf. Pore water weight is not included

EV(LC,LOC) = additional pressures due to earthquake, psf



Data List VLP--Arrays V and EV from Module FA

11-4 EXAMPLES. These examples are taken from Exhibit K of the Program Criteria Specifications Document.

11-4-1 Active earth pressures are all zero because of the relatively large cohesive strength (700 psf).

11-4-2 Bearing pressures (use VB for total pressures):

BPV LC N IRLT(LC) EPBW(LC) DB(LC,N) VB(LC,N) EVB(LC,N) FVB(LC,N)

Use C for EPBW(LC,N) when IRLT = 0 (within kern). Note that the (upward) values have negative signs.

a. Floodwall, load case 1 (page K-13)--1177.24 psf at toe, 110.62 psf at heel; resultant within kern:

BPV 1 1 0 C C -1177.24 C C

BPV 1 2 0 C C -110.62 C C

b. Retaining wall, load case 2 (page K-15)--1268.03 psf at toe, 19.82 psf at heel; resultant within kern:

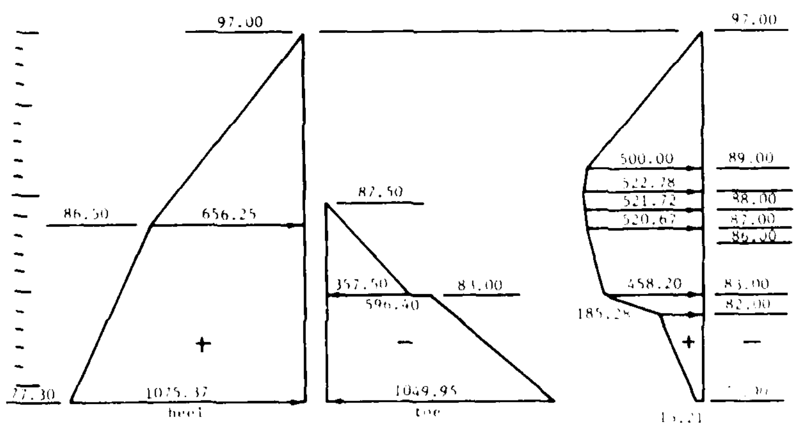
BPV 2 1 0 C C -1268.03 C C

BPV 2 2 0 C C -19.83 C C

11-4-3 Net Horizontal Seepage Pressures (page K-2):

HSPH LC LOC FH(LC,LOC) EFH(LC,LOC)

Only the points of change of slope need to be described.



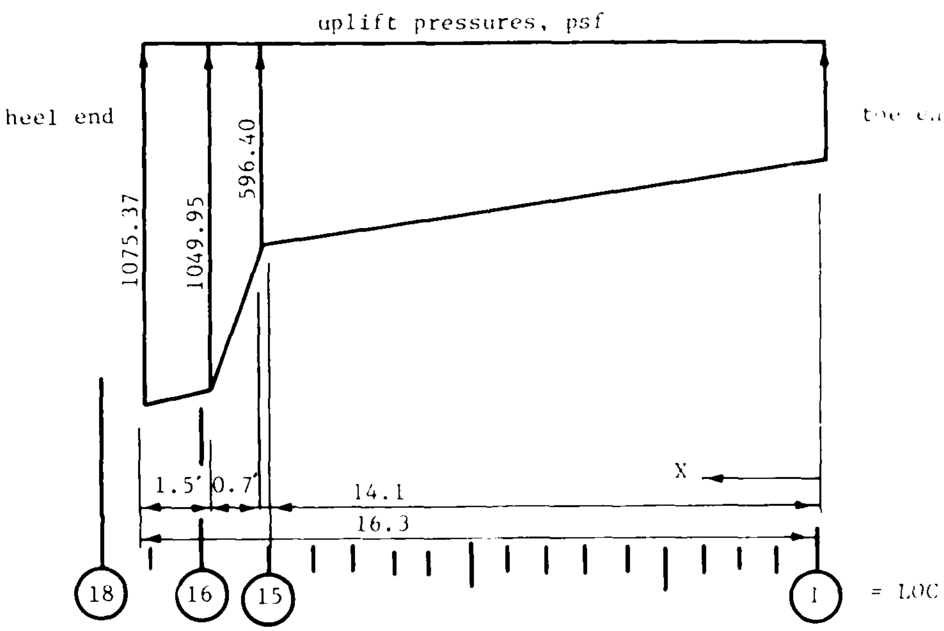
The approximations of even-foot description points and use of net values cause an error of -74.27 lb per slice out of an exact value of 5914.29 lb per slice; i.e., 1.26 percent. Values are positive because ELWH is greater than ELWT.

HSPH	0	1	0.0	C
HSPH	0	9	500.0	C
HSPH	0	10	522.78	C
HSPH	0	11	521.72	C
HSPH	0	12	520.67	C
HSPH	0	15	458.20	C
HSPH	0	16	185.28	C
HSPH	0	21	15.21	C

Note: the value of the last FH element defined (15.21 ft for LOC = 21) was extrapolated 0.3 ft below the lowest concrete elevation of 77.3 ft (top elevation = 97.0 ft).

11-4-4 Uplift (page K-2):

HSPV LC LOC FV(LC,LOC)



The approximation of even-foot description points causes an error of -151.75 lb per slice out of an exact value of -8895.18 lb per slice; i.e., 1.71 percent. Note that the (upward) values are negative.

HSPV 0 1 -357.5

HSPV 0 15 -594.71 (interpolated between X = 0 and X = 14.1)

HSPV 0 16 -1179.5 (extrapolated beyond X = 14.8 from X = 14.1)

HSPV 0 18 -1087.2 (extrapolated beyond X = 16.3 from X = 14.8)

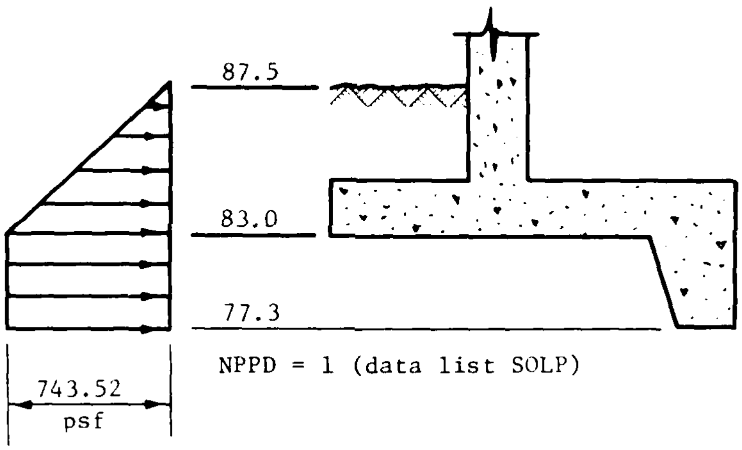
11-4-5 <u>Passive Pressure</u> (use HPE for total pressure):

PPD LC YTTOP WPE EHPE HPE FHPE

SOLP LC IFWOC NODE IFSOM NPPD RKH RKV CFMA

Use HPE for total pressure (which one of WPE, EHPE, HPE, or FHPE is actually immaterial) and use C for the other pressures. Note that the values pushing on the toe are negative.

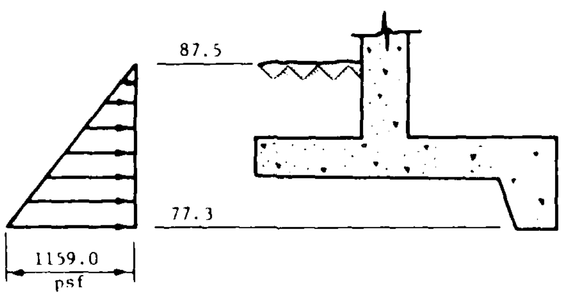
a. Floodwall, load case 1 (page K-12):



PPD 1 87.5 C C -743.52 C

SOLP 1 2 C C 1 C C 1.0

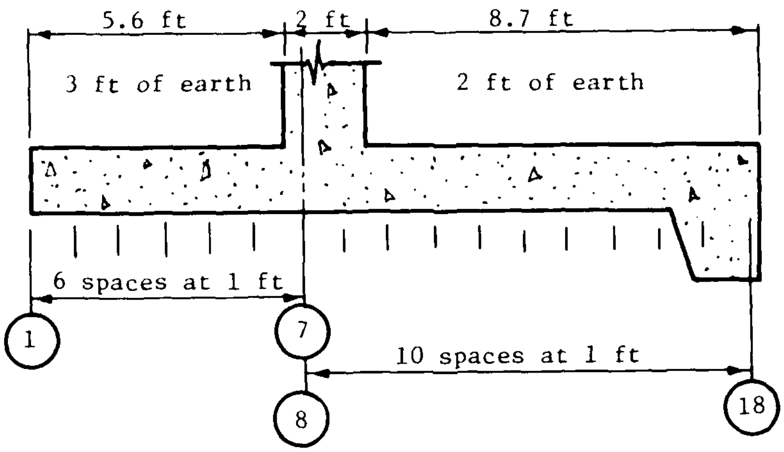
b. Retaining wall, load case 2 (page K-14):



PPD 2 87.5 C C -1159.0 C
SOLP 2 2 C C 3 C C 1.0

11-4-6 Vertical Pressures of Earth over Base Slab (page K-5):

VLP LC LOC V(LC,LOC) EV(LC,LOC)



With earth unit weight = 62.5 pcf buoyant, positive down.

VLP 0 1 187.5 C
VLP 0 7 187.5 C
VLP 0 8 125.0 C
VLP 0 18 125.0 C

CHAPTER 12: DATA LISTS AND OTHER TABULATIONS

12-1 PURPOSE. Paragraph 12-2 is a summary of data lists, intended for the experienced user of this program. Paragraph 12-3 is a data preparation checklist, intended for the beginning user. Paragraph 12-4 is an alphabetized list of all data variables, with the list name and the numbers of the pages where each data variable is defined and otherwise mentioned. Paragraph 12-5 is an alphabetized list of all data lists, with one-line definitions of the variables in each list.

12-2 DATA LISTS (Some lists are in more than one group). This presentation is intended as a checklist for the experienced user.

12-2-1 General. See paragraph 3-2:

NAME (60 characters maximum of alphanumeric job name)

*CASE NLC LCS(1) LCS(2) ... LCS(NLC) (see page 3-1)

HYD LC IHYD (see page 3-2)

REM (remarks or user's notes; this command is not processed)

TYPE LC ITYPE (see page 3-2)

12-2-2 Soils Description. See paragraph 3-3-2:

a. Backfill. See also Figure 3-1:

(1) Soil properties (all lists are optional unless different from the values in data list SPE3):

SPHF LC FZTAH PHIFZ COHFZ GAMASF RKAFZ DELTAF RKAEFZ (see page 3-9)

SPH1 LC PHI1 COH1 GAMAS1 RKA1 DELTA1 RKAE1 HCMIN** (see page 3-10)

SPH2 LC ELTS1 PHI2 COH2 GAMAS2 RKA2 DELTA2 RKAE2 (see page 3-10)

SPT6 LC PHI6 COH6 GAMAS6 (see page 3-13)

SPT7 LC PHI7 COH7 GAMAS7 (see page 3-13)

(2) Top surface geometry:

---

* Required only if loadcase numbers are not 1, 2, 3, ..., n in ascending order with no missing numbers.

** HCMIN is not load case dependent if a value is entered. The last value entered is used for all load cases. The default value, however, will be recalculated for each load case.

*SSHC LC ESHW HS3 (see page 3-18)

**SST LC ESTW SST (see page 3-17)

*SSHW LC ESHW HS1 DS1H HS2 WDS2 HS3 (see page 3-17)

b. Existing Earth. See also Figure 3-2:

(1) Soil properties. See pages 3-11 through 3-13:

**SPE3 PHI3 COH3 GAMAS3 PHIS3 ADHS3 ABP3TN ABP3BN ABP3TW ABP3BW ELBS3

SPE4 ELTS3 PHI4 COH4 GAMAS4 PHIS4 ADHS4 ABP4TN ABP4BN ABP4TW ABP4BW

this much of lists SPE3, SPE4, SPE5 is optional+

SPE5 ELTS4 PHI5 COH5 GAMAS5 PHIS5 ADHS5 ABP5TN ABP5BN ABP5TW ABP5BW

(2) Soil surface geometry. See page 3-13:

+SSEE EXW ESS HSS5T ELTS5T DTS5T ELTS5W ELTS5H DTS5H HSS5H

12-2-3 Soils and Foundation Stability Parameters. See paragraph 3-3-2 and Figure 3-1:

ONEA OMEGA (see page 3-5)

RRD LC RRMIN (see page 3-6)

SLID LC NSLIDE FSMIN (see page 3-9)

SOLP LC IFWOC NODE IFSOM NPPD RKH RKV CFMA (see page 3-14)

12-2-4 Surcharges and Direct Loads. See paragraph 3-4-2 and Figure 3-3:

SCFD LC PVS PVB DVB

SCFH LC PH1 ELPH1 PH2 ELPH2

SCFV LC PV1 DV1 PV2 DV2 PV3 DV3 PV4 DV4 PV5 DV5

---

* One of these two lists is required. Entering list SOLC automatically undefines data items HS1, DS1H, HS2, and WDS2 out of list SOLW.

** Required.

+ Required for design only.

SCWH LC W1 ELW1T ELW1B W3 W4

SCWV LC WT WWT DWT WH WWH DWH

WGHT GAMAC GAMAW (see page 3-18)

WIND LC W

12-2-5 Seepage and Boil Control:

BOIL ELSPT CRMIN IPATH (see page 3-4)

*SEEP LC ELWT ELWH HGSW ISLC ISFT KRACK (see page 3-6)

12-2-6 Wall Geometry. See pages 3-30 through 3-35. There is no set condition of required or optional. See the notes for each module.

a. For Analysis:

WGHT GAMAC GAMAW

**WLA ETS TW2 STR HEELW

**WLAB BW BW1 BW2 BS

**WLAH HEELT2 HEELW HEELT1

WLAK KFLAG DKEY WKEY DKTF

**WLAS TSTT TSB TSTB HSTPH HSTPB HSBPB

**WLAT BTE1 TOEHT TS2 TW1 TS1

WLBR BASER

b. For Design (see also IBSAME in lists CUND and CNWD):

WGHT GAMAC GAMAW

WLBR BASER

**WLD ETS TW2 STR HEELW TSTB TMINB

**WLDB BW1 BW2 BS1 BS2

WLDH HEELT2

WLDK KFLAG BKTF DKEY1 DKEY2

WLDS TMINS TSB HSTPH HSTPB HSBPB

---

* ISLC is not load case dependent. The last value entered is used for all load cases.

** Required.

*WLDT   BTE11   BTE12   TOEHT   TW1

12-2-7 Costs. See paragraph 3-5-2 and Figure 3-2:

CSTB   UCBFFZ   UCBFS1   UCBFS2   UCBFS6   UCBFS7
CSTC   UCWB   UCWS   UCWK
CSTE   UCEXS3   UCEXS4   UCEXS5   UCESWK

12-2-8 Stress Analysis and Design:

a. Paragraph 7-2-2b (modules WA, WD):

CND   RATION   FPCON   ESTL   IFEM
CNWD   RATIOF   FYSTL   FSTLMX   IBSAME   IFDR
**OVRS   LC   AOSF
WGHT   GAMAC   GAMAW

b. Paragraph 8-2-2 (modules UA, UD):

CND   RATION   FPCON   ESTL   IFEM
CNUD   FYSTL   IBSAME   PHIFLX   PHISHR   RLIMIT   EPSC   SRM   BETA1
**LDF   DLF   VLF   WLF   ELF   HLF   FLF
**OVRS   LC   AOSF
WGHT   GAMAC   GAMAW

c. Reinforcing Steel. See pages 7-1 through 7-8.

(1) Required for stress analysis (see paragraph 7-2-2a):

COVR   COVHS   COVTS   COVTB   COVBB   SPABL
*STLB   LOC   LNA   ASTLBT(LOC,LNA)   LNB   ASTLBB(LOC,LNB)
+STLK   ASTLK
*STLS   LOC   ASTLST(LOC)   LN   ASTLSH(LOC,LN)

(2) Optional for design (see paragraph 8-2-3):

---

* Required.

** Design only.

\+ Required only if there is a key.

STLD MAXBAR SPAMIN

12-2-9 Intermediate. See Chapter 11:

ACPH LC LOC H(LC,LOC) EH(LC,LOC) YH(LC,LOC)

ACPS LC LOC HS(LC,LOC) EHS(LC,LOC) YVS(LC,LOC)

BPH LC N IRLT(LC) EPBW(LC) WB(LC,N) HB(LC,N) EHB(LC,N) FHB(LC,N)

BPV LC N IRLT(LC) EPBW(LC) DB(LC,N) VB(LC,N) EVB(LC,N) FVB(LC,N)

HSPH LC LOC FH(LC,LOC) EFH(LC,LOC)

HSPV LC LOC FV(LC,LOC)

PPD LC YTTOP WPE EHPE HPE FHPE

VLP LC LOC V(LC,LOC) EV(LC,LOC)

12-2-10 Main Modules and Their Data Lists (see table in paragraph 12.1):

a. Module FA--Foundation Analysis:

(1) Required data lists: SSHC or SSHW SST SPE3 WLA WLAB WLAH WLAS (or WLDS to use TMINS) WLAT

(2) Other usable data lists: CASE HYD TYPE NAME SSEE SPHF SPH1 SPH2 SPT6 SPT7 SPE4 SPE5 ONEA SLID SOLP SCFD SCFV SCWH SCWV WGHT BOIL SEEP WLBR CSTB CSTC CSTE WIND WLAK

b. Module FD--Foundation Design:

(1) Required data lists: SSHC or SSHW SST SPE3 WLD WLDB WLDT

(2) Other usable data lists: CASE HYD TYPE NAME SSEE SPHF SPH1 SPH2 SPT6 SPT7 SPE4 SPE5 ONEA SLID SOLP RRD SCFD SCFH SCFV SCWH SCWV WGHT BOIL SEEP WLBR WLDH WLDK WLDS CSTB CSTC CSTE WIND

c. Module WA--(Working) Stress Analysis:

(1) Usual Set:

(a) Required: Modules FA or FD; STLB STLK STLS

(b) Other usable data lists: CND CNWD COVR ACPH ACPS BPH BPV HSPH HSPV VLP

(2) Alternate data set (modules FA and FD not run): Lists SPH1 and SPT7 may be omitted if list SPE3 is used.

(a) Required data lists: SPH1 SPT7 SSHC or SSHW SST SOLP WLA WLAB WLAH WLAS WLAT STLB STLK STLS

(b) Other usable data lists: CASE HYD TYPE NAME SPHF SPH2 SPT6 SCFD SCFH SCFV SCWH SCWV

WGHT WIND BOIL SEEP WLBR CND CNWD COVR ACPH ACPS BPH BPV HSPH HSPV PPD VLP WLAK

d. Module WD--(Working) Stress Design:

(1) Usual Set:

(a) Required: Module FA or FD.

(b) Other usable data lists: CND CNWD COVR ACPH ACPS BPH BPV HSPH HSPV VLP

(2) Alternate set (modules FA and FD not run): Lists SPH1 and SPT7 may be omitted if list SPE3 is used.

(a) Required data lists: SPH1 SPT7 SSHC or SSHW SST SOLP WLD(or WLA) WLAB WLDH WLAT

(b) Other usable data lists: CASE HYD TYPE NAME SPHF SPH2 SPT6 SCFD SCFH SCFV SCWH SCWV WIND BOIL SEEP WLAK WLDS WGHT CND CNWD COVR OVRS WLBR ACPH ACPS BPH BPV HSPH HSPV PPD VLP STLD

12-3 DATA PREPARATION CHECKLISTS. This checklist is intended for the beginning user. See also paragraph 12-2-10 for a list of required and optional data lists, arranged by module name.

12-3-1 General Information Data. See paragraph 3-2.

12-3-2 Backfill Soil Properties Data. See Figure 3-1:

a. Soil over toe--data list SPT7. This list is optional. Its values will be copied from list SPE3 if SPT7 is omitted.

SPT7 LC PHI7 COH7 GAMAS7

b. Soil at end of toe--data list SOL6. If it is the same as the soil above the toe end, use only list SPT7 and ignore list SPT6. If different, use both lists.

SPT6 LC PHI6 COH6

c. Soil over heel--Read also the notes at the end of paragraph 3-3-2.

(1) Data list SPH1. This list is optional. Its value will be copied from list SPE3 if SPH1 is omitted.

SPH1 LC PHI1 COH1 GAMAS1 RKA1 DELTA1 RKAE1 HCMIN

(2) Are there two soil layers? If so, add data list SPH2.

SPH2 LC ELTS1 PHI2 COH2 GAMAS2 RKA2 DELTA2 RKAE2

(3) Is there a filter zone under the backfill soil? If so, add data list SPHF, unless the wedge method will be used, in which case read note (13)b at the end of paragraph 3-3-2 and remember that the filter zone is always taken as being a zone where creep head loss does not occur.

SPHF LC FZTAH PHIFZ COHFZ GAMASF RKAFZ DELTAF RKAEFZ

12-3-3 Backfill Finished Grade Data. See Figure 3-1:

a. Over toe--data list SST (mandatory):

SST LC ESTW SST

b. Over heel--data list SSHC or data list SSHW (see also data item IFWOC in data list SOLP):

(1) Wedge method for active earth pressures? If so, use data list SSHW:

SSHW LC ESHW HS1 DS1H HS2 WDS2 HS3

If there is only one slope to the surface, data list SSHC maybe used instead of SSHW.

(2) Coulomb's method for active earth pressures (the default value for IFWOC in data list SOLP)? If so, data list SSHC must be used:

SSHC LC ESHW HS3

The use of data list SSHC automatically cancels any previous values in variables HS1, DS1H, HS2, and WDS2 in data list SSHW.

12-3-4 Existing Soil Properties. See Figure 3-2:

a. Data list SPE3 for soil layer 3 (mandatory):

SPE3 PHI3 COH3 GAMAS3 PHIS3 ADHS3 ABP3TN ABP3BN ABP3TW ABP3BW ELBS3

b. Are there two soil layers? If so, add data list SPE4:

SPE4 ELTS3 PHI4 COH4 GAMAS4 PHIS4 ADHS4 ABP4TN ABP4BN ABP4TW ABP4BW

c. Are there three soil layers? Add data list SPE5 to lists SPE3 and SPE4, unless you are using the wedge method. The wedge method (IFWOC = 1) ignores SPE5 and assumes that soil layer 4 (data list SPE4) extends up to existing grade.

12-3-5 Existing Grade Data. See Figures 3-2 and 3-3. Use data list SSEE on page 3-13. If there actually is no existing grade (wall on fill, for example), this list may be omitted.

12-3-6 Foundation Design Parameters. All of this information is covered by default values and need not be entered if all of the default values and procedures are acceptable. This paragraph describes the use of several data lists:

ONEA OMEGA

RRD LC RRMIN

SLID LC NSLIDE FSMIN

SOLP LC IFWOC NODE IFSOM NPPD RKH RKV CFMA

These data lists are explained below:

a. Active earth forces. Two methods are available for calculating active earth forces, the trial wedge method and Coulomb's equations:

(1) Trial wedge method (available option):

(a) IFWOC in data list SOLP must be set to a value of 1.

(b) If you want the nodes (points at which the earth pressure lumped forces are calculated) to be at a spacing other than 1 ft apart, use data item NODE in data list SOLP to enter the number of nodes that will space out to the desired spacing. If the default spacing is acceptable, use the letter "D" instead of a numeric value. See paragraph 2-6-3 for an explanation of the use of the letters D, S, or C as data values. If the wall is unusually tall, computer costs can be reduced by using special values for NODE to put the nodes at a spacing of several feet.

(c) If you have several soil layers in the backfill over the heel and/or the existing soil, then the variable IFSOM in data list SOLP must be considered. The default value of 1 averages out a single planar wedge failure surface through a multiple-layer soil system. The optional value of 2 (which may not be used with module FD) uses a multiplanar failure surface that is explained in paragraph 3-3-2.

(d) The following variables are ignored when the wedge method is selected (IFWOC = 1):

Variable Name	Data List Name
Entire list	SPHF
RKA1, RKAE1	SPH1
RKA2, RKAE2	SPH2
Entire list	SPE5

(2) Classic Coulomb's method (the default procedure):

(a) IFWOC in data list SOLP must be set to a value of 2.

(b) The following combinations of variables are optional, separately in the heel earth backfill soil layers:

Data List	Coulomb Equation Option	Alternate Option
SPHF	PHIFZ, COHFZ, DELTAF	RKAFZ
SPH1	PHI1, COH1, DELTA	RKA1
SPH2	PHI2, COH2, DELTA2	RKA2

If the RKA... option is selected, the input value will be used in getting active earth pressure forces. If the letters C or D are entered as the value, then Coulomb's equation will use the input values of PHI..., COH..., DELTA..., and HS3.

(c) IFSOM and NODE will be ignored and may have any value (such as C).

(3) Wedge or Coulomb's methods. Data item CFMA in data list SOLP has a default value of 1, for no effect. It is used as a multiplier for the active earth pressure moment arm, to allow for the arching active case.

b. Passive pressures. See NPPD in data list SOLP and read paragraph 3-3-3 for selecting the appropriate value. Default values are 1 for floodwalls (trapezoidal shape) and 3 for retaining walls (triangular shape).

c. Earthquake calculations:

(1) If earthquake calculations are to be omitted, the following data items must be zero or the letter C: RKH and RKV in data list SOLP.

(2) The equivalent additional dynamic "active" earth pressure coefficients, RKAEFZ, RKAE1, and RKAE2, are calculated from the PHI, DELTA, and HS3 data

for heel earth backfill, using acceleration coefficients RKH (horizontal) and RKV (vertical) in data list SOLP.

(3) This means that RKH and RKV must be specified (and non-zero) for the earthquake inertial effects of earth, water, and soil above the base to be included. Also, RKAEFZ, RKAE1, and RKAE2 may be specified by the user, in which case they will be used as they are instead of being calculated. If they are left undefined (C or D as values), they will be calculated.

d. Sliding calculations. Variables involved in controlling sliding are listed below. All are optional data with default values, in data lists ONEA, SLID, and SOLP:

Variable Name	List Name	Paragraph Reference
FSMIN	SLID	3-3-3
NPPD	SOLP	3-3-2 and 3-3-3
NSLID	SLID	3-3-2
OMEGA	ONEA	3-3-2 and 3-3-3

e. Overturning control in stability design (module FD). Data variable RRMIN is the minimum allowable resultant ratio control for the stability design checks in module FD. Other controls include the allowable bearing pressures (variable names that start with the letters ABP in data lists SOL3, SOL4, and SOL5). See paragraph 6-1-2 for more information.

12-3-7 Surcharges and Direct Loads. See Figure 3-4 and paragraph 3-4-2. All data lists in this group are optional:

```
SCFD  LC  PVS  PVB  DVB
SCFH  LC  PH1  ELPH1  PH2  ELPH2
SCFV  LC  PV1  DV1  PV2  DV2  PV3  DV3  PV4  DV4  PV5  DV5
SCWH  LC  W1  ELW1T  ELW1B  W3  W4
SCWV  LC  WT  WWT  DWT  WH  WWH  DWH
WGHT  GAMAC  GAMAW
WIND  LC  W
```

The following items should be noted:

a. Distributed load WWT is usable only over (or beyond) the toe, not on the stem. DWT is always positive.

b. Distributed load WWH is usable only over (or beyond) the heel and not on the stem.

c. Concentrated loads PV1 through PV5 may be over the toe or heel (or beyond them), but not on the stem or directly on the base.

d. PVB may be on the toe (with DVB negative) or on the heel (DVB positive), but not on the stem.

e. PVS in considered centered on the top of the stem.

f. PH1 may be anywhere on the end of the toe or on the stem. PH2 may be on the stem only.

g. W1 may act on either side of the stem (positive if from the heel, negative if from the toe) above finished grade at the stem.

h. Wind may be in either direction, as for W1. It acts on the exposed portion of the stem not covered by load W1.

12-3-8 Seepage and Boil Control. See Figure 3-1 and paragraph 3-3-2:

a. The minimum data if all default values are acceptable consists on one list, SEEP:

```
SEEP  LC  ELWT  ELWH  HGSW  ISLC  ISFT  KRACK
```

which can be simplified down to

```
SEEP  LC  ELWT  ELWH  0.0  1  1  D
```

b. Is boil control desired? If so, add data list BOIL in paragraph 3-3-2:

```
BOIL  ELSPT  CRMIN  IPATH
```

12-3-9 Wall Geometry. Read paragraph 3-6 for wall description instructions. There are several ways to describe a wall:

a. For analysis. See also paragraph 5-6.

b. For design. See also paragraph 6-6.

12-3-10 Additional Data for Structural Analysis and Design. See paragraph 7-2-2b (analysis) or paragraph 8-2-3 (design) for definitions. All of the data items in this group of data lists have default values. The data lists therefore should be used only if the default values are not acceptable. The first three lists are applicable for both analysis and design:

```
CND  RATION  FPCON  ESTL  IFEM
CNWD  RATIOF  FYSTL  FSTLMX  IBSAME  IFDR
COVR  COVHS  COVTS  COVTB  COVBB  SPABL
```

The fourth list is applicable to design only:

```
STLD  MAXBAR  SPAMIN
```

12-3-11 Additional Data for Structural Analysis Only (description of reinforcing steel). See paragraph 7-2-2.

```
STLB  LOC  LNA  ASTLBT(LOC,LNA)  LNB  ASTLBB(LOC,LNB)
STLK  ASTLK
STLS  LOC  ASTLST(LOC)  LN  ASTLSH(LOC,LN)
```

12-3-12 The beginning user is encouraged to read the following items before starting preparation of data:

a. Chapter 1, especially Figure 1-1.

b. Chapter 2.

c. Chapter 3, paragraph 3-3-1.

d. The warning on page 6-2.

e. Chapter 11.

f. The list in paragraph 12-2-10.

The remainder of this manual is intended to be reference for the experienced user.

12-4 DATA ITEM REFERENCES:

Data Item Name	Name of Data List(s)	Page(s) on Which Defined	Page Number(s) of Other References
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ABP3TN	SPE3	3-13	3-22, 6-3, 12-2, 12-7
ABP3TW	SPE3	3-13	3-22, 6-3, 12-2, 12-7
ABP4BN	SPE4	3-14	5-3, 6-3, 12-2, 12-8
ABP4BW	SPE4	3-14	5-3, 6-3, 12-2, 12-8
ABP4TN	SPE4	3-14	3-22, 5-3, 6-3, 12-2, 12-8
ABP4TW	SPE4	3-14	3-22, 5-3, 6-3, 12-2, 12-8
ABP5BN	SPE5	3-15	5-3, 6-3, 12-2
ABP5BW	SPE5	3-15	5-3, 6-3, 12-2
ABP5TN	SPE5	3-15	5-3, 6-3, 12-2
ABP5TW	SPE5	3-15	5-3, 6-3, 12-2
ADHS3	SPE3	3-13	3-25, 6-3, 12-2, 12-7
ADHS4	SPE4	3-14	3-25, 5-3, 6-3, 12-2, 12-8
ADHS5	SPE5	3-15	3-25, 5-3, 6-3, 12-2
AOSF	OVRS	8-4	12-4
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ASTLSH(LOC,LN)	STLS	7-3	7-2, 7-6, 12-4, 12-12
ASTLST(LOC)	STLS	7-3	7-1, 7-2
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12-4 DATA ITEM REFERENCES (Continued):

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BTE11	WLDT	3-36	6-1, 6-2, 6-4, 6-5, 12-4
BTE12	WLDT	3-36	6-1, 6-2, 6-4, 6-5, 12-4
BW	WLAB	3-36	3-22, 3-34, 3-39, 3-40, 5-4, 5-5, 6-2, 6-5, 6-6, 7-5, 8-6, 11-6, 11-10, 12-3
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CFMA	SOLP	3-20	3-3, 5-3, 6-3, 11-13, 12-2 12-8, 12-9
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COH2	SPH2	3-12	5-3, 6-3, 12-1, 12-7, 12-9
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DKEY2	WLDK	3-37	6-1, 6-2, 6-5, 12-3
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DTS5T	SSEE	3-16	3-25, 5-3, 6-3, 12-2
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DV4	SCFV	3-30	3-32, 5-3, 6-4, 12-2, 12-10
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DVB	SCFD	3-29	3-32, 5-3, 6-4, 12-2, 12-10, 12-11
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DWT	SCWV	3-30	3-32, 5-3, 6-4, 12-3, 12-10
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EH(LC,LOC)	ACPH	11-4	4-3, 11-1, 11-2, 11-3, 12-5
EHB(LC,N)	BPH	11-6	11-1, 11-2, 11-3, 12-5
EHPE	PPD	11-9	11-2, 11-3, 11-13, 12-5
EHS(LC,LOC)	ACPS	11-5	4-3, 11-1, 11-2, 11-3, 12-5
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ELTS1	SPH2	3-12	5-3, 6-3, 12-7
ELTS3	SPE4	3-14	3-25, 5-3, 6-3, 12-2, 12-8
ELTS4	SPE5	3-14	3-25, 5-3, 6-3, 12-2
ELTS5H	SSEE	3-16	3-25, 5-3, 6-3, 12-2
ELTS5T	SSEE	3-16	3-25, 5-3, 6-3, 12-2
ELTS5W	SSEE	3-16	3-25, 5-3, 6-3, 12-2
ELW1B	SCWH	3-30	3-32, 5-3, 6-4, 12-3, 12-10
ELW1T	SCWH	3-30	3-32, 5-3, 6-4, 12-3, 12-10
ELWH	SEEP	3-6	3-3, 3-24, 5-3, 6-3, 11-7, 11-11, 12-3, 12-11
ELWT	SEEP	3-6	3-3, 3-24, 5-3, 6-3, 11-7, 11-11, 12-3, 12-11
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EPSC	CNUD		12-4
ESHW	SSHW,SSHC	3-20	2-10, 3-21, 6-3, 12-2, 12-7
ESS	SSEE	3-16	3-25, 5-3, 6-3, 12-2
ESTL	CND	7-7, 8-2	6-5, 7-7, 12-4, 12-11
ESTW	SST	3-20	2-12, 6-3, 12-2, 12-7
ETS	WLA,WLD	3-35	2-10, 3-34, 3-39, 5-4, 6-4, 8-6, 12-3
EV(LC,LOC)	VLP	11-10	11-2, 11-9, 11-3, 12-5
EVB(LC,N)	BPV	11-6	11-1, 11-2, 11-3, 11-11, 12-5
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FH(LC,LOC)	HSPH	11-7	11-1, 11-2, 11-3, 11-11, 12-5
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FHPE	PPD	11-9	11-2, 11-3, 11-13, 12-5

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12-4 DATA ITEM REFERENCES (Continued):

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GAMAS2	SPH2	3-12	5-3, 6-3, 12-1, 12-7
GAMAS3	SPE3	3-13	3-25, 4-1, 5-2, 6-3, 12-2, 12-7
GAMAS4	SPE4	3-14	3-25, 5-3, 6-3, 12-2, 12-8
GAMAS5	SPE5	3-14	3-25, 5-3, 6-3, 12-2
GAMAS6	SPT6	3-15	5-3, 6-3, 12-1
GAMAS7	SPT7	3-16	5-3, 6-3, 12-1, 12-6
GAMASF	SPHF	3-11	5-3, 6-3, 12-1, 12-7
GAMAW	WGHT	8-5	3-6, 5-3, 6-3, 12-3, 12-4, 12-10
H(LC,LOC)	ACPH	11-4	4-3, 11-1, 11-2, 11-3, 12-5
HB	BPH	11-6	11-1, 11-2, 11-3
HCMIN	SPH1	3-12	4-2, 5-3, 6-3, 12-1, 12-6
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HEELT2	WLAH	3-37	3-34, 3-39, 5-4, 5-5, 5-7, 6-5, 7-21, 8-6, 12-3

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12-4 DATA ITEM REFERENCES (Continued):

Data Item Name	Name of Data List(s)	Page(s) on Which Defined	Page Number(s) of Other References
HEELW	WLA,WLAH,WLD	3-37	2-10, 3-34, 3-39, 5-4, 5-5, 6-4, 6-6, 8-6, 12-3
HGSW	SEEP	3-6	3-3, 3-6, 5-3, 6-3, 12-3, 12-11
HLF	LDF	11-2	12-4
HPE	PPD	11-9	11-2, 11-3, 11-13, 12-5
HS(LC,LOC)	ACPS	11-5	4-3, 11-1, 11-4, 12-5
HS1	SSHW	3-21	2-12, 6-3, 12-2, 12-7
HS2	SSHW	3-21	2-12, 6-3, 12-2, 12-7
HS3	SSHC,SSHW	3-21	2-12, 3-21, 6-3, 12-2, 12-7, 12-9
HSBPB	WLAS,WLDS	3-36	3-34, 3-39, 5-4, 6-5, 7-20, 8-1, 8-6, 12-3
HSS5H	SSEE	3-16	3-25, 6-3, 12-2
HSS5T	SSEE	3-16	3-25, 5-3, 6-3, 12-2
HSTPB	WLAS,WLDS	3-36	3-39, 5-4, 6-5, 8-1, 8-6, 12-3
HSTPH	WLDS	3-36	3-39, 5-4, 6-5, 8-6, 12-3
IBSAME	CNWD,CNUD	7-8, 8-3	3-34, 5-6, 6-5, 6-6, 7-7, 7-9, 8-5, 12-4, 12-11
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IFEM	CND	7-8, 8-2	6-5, 7-7, 7-16, 7-17, 8-2, 12-4, 12-11
IFSOM	SOLP	3-17	3-3, 4-2, 4-3, 4-4, 5-3, 6-2, 6-3, 11-13, 12-2, 12-8, 12-9
IFWOC	SOLP	3-16	3-3, 3-11, 3-21, 3-22, 3-23, 3-25, 4-1, 4-2, 5-3, 6-3, 11-4, 11-5, 11-13, 12-2, 12-7, 12-8, 12-9
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ISLC	SEEP	3-6	3-3, 4-2, 5-3, 6-3, 12-3, 12-11
ITYPE	TYPE	3-2	2-9, 2-11, 4-3, 6-1, 12-1
KFLAG	WLAK,WLDK	3-37	3-23, 3-27, 3-28, 3-39, 5-4, 6-5, 8-6, 12-3
KRACK	SEEP	3-9	3-2, 3-3, 3-7, 4-2, 4-3, 5-3, 6-3, 7-23, 12-3, 12-11
LC		*	NOTE: LC is a subscript for other data items.
LCS	CASE	3-1	2-9
LN	STLS	7-3	7-2, 7-6, 12-4, 12-12
LNA	STLB	7-4, 7-5	2-11, 7-1, 7-6, 12-4, 12-12
LNB	STLB	7-4, 7-5	2-11, 7-1, 7-6, 12-4, 12-12
LOC	(LOC is a location subscript for many data lists)		2-11, 7-1, 7-2, 7-3, 7-4, 7-5, 7-6, 11-1, 11-4, 11-5, 11-7, 11-8, 11-10, 11-11, 11-12, 11-14, 12-4, 12-5, 12-11
MAXBAR	STLD	7-7, 8-5	7-2, 7-5
N	BPH,BPV	11-6	11-1, 11-11, 12-5
NODE	SOLP	3-14, 3-17	3-3, 4-2, 4-3, 4-4, 5-3, 6-2, 6-3, 11-4, 11-5, 11-13, 12-8
NPPD	SOLP	3-17, 3-18, 3-19, 3-20	3-2, 3-3, 3-10, 3-23, 4-2, 5-1, 5-3, 6-3, 7-16, 7-17, 7-23, 11-9, 11-13, 12-2, 12-8, 12-9, 12-10
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PHI2	SPH2	3-12	3-32, 5-1, 5-3, 6-3, 12-1, 12-7
PHI3	SPE3	3-13	3-25, 4-1, 6-3, 12-2, 12-7
PHI4	SPE4	3-14	3-25, 5-3, 6-3, 12-2, 12-8
PHI5	SPE5	3-14	3-25, 5-3, 6-3, 12-2
PHI6	SPT6	3-15	5-3, 6-3, 12-1, 12-6
PHI7	SPT7	3-15	5-3, 6-3, 12-1, 12-6
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PHIFZ	SPHF	3-11	5-1, 5-3, 6-3, 12-1, 12-7
PHIS3	SPE3	3-13	3-25, 6-3, 12-2, 12-7
PHIS4	SPE4	3-14	3-25, 5-3, 6-3, 12-2, 12-7
PHIS5	SPE5	3-15	3-25, 5-3, 6-3, 12-2
PHISHR	CNUD		12-4
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PV2	SCFV	3-30	3-32, 5-3, 6-4, 12-2, 12-10
PV3	SCFV	3-30	3-32, 5-3, 6-4, 12-2, 12-10
PV4	SCFV	3-30	3-32, 5-3, 6-4, 12-2, 12-10
PV5	SCFV	3-30	3-32, 5-3, 6-4, 12-2, 12-10
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RKAEFZ	SPHF	3-11	3-22, 4-2, 5-2, 5-13, 6-3, 12-1, 12-7, 12-9, 12-10
RKAFZ	SPHF	3-11	4-2, 5-3, 6-3, 12-1, 12-7, 12-9
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SST	SST	3-20, 3-22	2-12, 6-3, 12-2, 12-7
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TW2	WLA,WLD	3-36	2-10, 3-34, 3-39, 5-4, 5-5, 5-7, 6-4, 6-6, 7-20, 8-6, 12-3
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UCBFS1	CSTB	3-33	5-3, 6-4, 12-4
UCBFS2	CSTB	3-33	5-3, 6-4, 12-4
UCBFS6	CSTB	3-33	5-3, 12-4
UCBFS7	CSTB	3-33	5-3, 6-4, 12-4
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UCEXS4	CSTE	3-33	5-3, 6-4, 12-4
UCEXS5	CSTE	3-33	5-3, 6-4, 12-4
USCEXWK	CSTE	3-33	5-3, 6-4, 12-4
UCWB	CSTC	3-33	5-3, 6-4, 12-4
UCWK	CSTC	3-33	5-3, 6-4, 12-4
UCWS	CSTC	3-33	5-3, 6-4, 12-4
V(LC,N)	VLP	11-10	11-2, 11-3, 11-13
VB(LC,N)	VPV	11-6	11-1, 11-2, 11-3, 11-11, 12-5
VLF	LDF	11-2	12-4
W	WIND	3-31	5-3, 6-4, 11-2, 12-3, 12-10
W1	SCWH	3-30	3-32, 5-3, 6-4, 11-2, 12-3, 12-10, 12-11

(Continued)

12-4 DATA ITEM REFERENCES (Concluded):

Data Item Name	Name of Data List(s)	Page(s) on Which Defined	Page Number(s) of Other References
W3	SCWH	3-30	3-32, 4-3, 5-3, 6-4, 11-2, 12-3, 12-10
W4	SCWH	3-30	3-32, 5-3, 6-4, 11-2, 12-3, 12-10
WB(LC,N)	BPH	11-6	11-1, 11-2, 11-3, 12-5
WDS2	SSHW	3-21	2-12, 6-3, 12-2, 12-7
WH	SCWV	3-31	3-32, 5-3, 6-4, 12-3, 12-10
WKEY	WLAK	3-37	3-39, 5-4, 8-1, 8-6, 12-3
WLF	LDF	11-2	12-4
WPE	PPD	11-9	11-2, 11-3, 11-13, 12-5
WT	SCWV	3-30	3-32, 5-3, 6-4, 12-3, 12-10
WWH	SCWV	3-31, 3-32	5-3, 6-4, 12-3, 12-10
WWT	SCWV	3-30	3-32, 5-3, 6-4, 12-3
YH	ACPH	11-4	4-3, 11-1, 11-3, 11-4
YVS(LC,LOC)	ACPS	11-5	4-3, 11-1, 11-3, 12-5
YTTOP	PPD	11-9	7-22, 11-13, 12-5

12-5 SUMMARY OF DATA LIST CONTENTS:

Data List	Data Item	Units	Definition
ACPH			Active earth lumped forces over end of heel
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	LOC	EACH	SEQUENCE NO. OF VALUES OF H, EH & YH (TOP = NO 1)
	H	LB/FT	ACTIVE EARTH + SURCH. LUMPED VERTICALLY, LB/FT HOR
	EH	LB/FT	DYNAMIC EARTH + SURCH. LUMPED VERTICALLY, LB/FT HOR
	YH	FEET	ELEV OF CORRESPONDING H VALUE (SAME LOC NUMBER)
ACPS			Active earth lumped forces on face of stem
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	LOC	EACH	SEQUENCE NO. OF VALUES OF HS, EHS & YHS(TOP = NO 1)
	HS	LB/FT	HORZ(EARTH + SURCHARGE) ON STEM AT YVS
	EHS	LB/FT	DYNAMIC HORIZ (EARTH + SURCH) ON STEM AT YVS
	YVS	FOOT	ELEV OF VALUES OF HS & EHS FORCES
BOIL			Boil control data
	ELSPT	FEET	ELEV [illegible] 100 PERCENT EFFECTIVE SHEET PILE TIP
	CRMIN	RATIO	MIN ALLOWABLE CREEP RATIO FOR BOIL CONTROL
	IPATH	1-2	BOIL CONTROL SEEPAGE PATH CONTROL PAR [illegible]
BPH			Bearing pressures due to vertical effect
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	N	1-2	1 FOR END VALUE TOWARD TOE, 2 FOR END TOWARD HEEL
	IRLT		VERT. RESULTANT AT [illegible] 1=TOE, 0 = IN KERN, +1 HEEL
	EFBW	FEET	EFFECTIVE WIDTH OF BASE IN CONTACT
	WB	PSF	BEARING PRESS. FROM WIND LOAD
	HB	PSF	BEARING PRESS. FROM HORIZ(EARTH + SURCHARGE)
	EHB	PSF	BEARING PRESS. FROM HORIZ DYNAMIC EFFECT
	FHB	PSF	BEARING PRESS. FROM NET HORIZ SEEPAGE
BPV			Bearing pressures due to horizontal effect
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	N	1-2	1 FOR END VALUE TOWARD TOE, 2 FOR END TOWARD HEEL
	IRLT		VERT. RESULTANT AT [illegible] 1 TOE, 0 IN KERN, +1 HEEL
	EFBW	FEET	EFFECTIVE WIDTH OF BASE IN CONTACT
	DB	PSF	BEARING PRESS. FROM CONCRETE + WATER ON BASE
	VB	PSF	BEARING PRESS. FROM VERT. (FORCE + EARTH W[illegible])
	EVB	PSF	BEARING PRESS. FROM VERT. DYNAMIC EFFECT
	FVB	PSF	BEARING PRESS. FROM UPLIFT VERTICAL
CASE			Load case numbers (1 - 10 only)
	NLC	EACH	NUMBER OF LOAD CASES (20 MAX)
	LCS	EACH	LOAD CASE NUMBERS (2 DIGITS MAX. NOTE [illegible])
CND			Concrete design base data
	RATION	RATIO	[illegible]
	FPCON	PSI	SPECIFIED COMPRESSIVE CONCRETE STRENGTH
	ESTE	PSI	MODULUS OF ELASTICITY OF [illegible]
	ITEM	0-1	[illegible]
CNDG			Concrete strength design [illegible]
	[illegible]	PSI	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	RATIO	[illegible]
	[illegible]	RATIO	[illegible]
	[illegible]	RATIO	MAX [illegible]
	EPSU	RATIO	MAX ASSUMED CONCRETE COMPRESSIVE STRAIN
	SRM	RATIO	CONC COMPRESSIVE STRESS / FPCON [illegible]
	BETA1	RATIO	USD FACTOR DEFINED IN ACI 318 [illegible]

(Continued)

12-5 SUMMARY OF DATA LIST CONTENTS (Continued)

Data List	Data Item	Units	Definition
CNWD			Concrete (Working) Stress Design add'l data
	RATIOF	RATIO	MAX ALLOW CONC STRESS / FPCON (WSD)
	FYSTL	PSI	YIELD STRENGTH OF STEEL REINFORCEMENT
	FSTLMX	PSI	MAX ALLOWABLE WSD REINF STEEL STRESS
	[illegible]	[illegible]	[illegible] HEEL & [illegible] TOES FORCED TO SAME [illegible] NOT
	[illegible]	[illegible]	[illegible] USE ACI 318 [illegible]
COVR			Concrete cover to center of [illegible]
	[illegible]	INCH	CONCRETE FACE TO REINF BAR CENTER [illegible] STEM
	[illegible]	INCH	CONCRETE FACE TO REINF BAR CENTER [illegible] STEM
	[illegible]	INCH	CONCRETE FACE TO REINF BAR CENTER [illegible]
	[illegible]	INCH	CONCRETE FACE TO REINF BAR CENTER [illegible]
	[illegible]	INCH	CLEAR SPACE BETWEEN REINF BAR [illegible]
[illegible]			Unit cost of backfill [illegible]
	[illegible]	$/CF	UNIT COST OF BACKFILL [illegible]
	[illegible]	$/CF	UNIT COST OF BACKFILL SOIL LAYER [illegible]
	[illegible]	$/CF	UNIT COST OF BACKFILL SOIL LAYER [illegible]
	[illegible]	$/CF	UNIT COST OF BACKFILL SOIL LAYER [illegible]
	[illegible]	$/CF	UNIT COST OF BACKFILL SOIL LAYER [illegible]
[illegible]			Unit cost of reinforced concrete
	[illegible]	$/CY	UNIT COST OF CONCRETE [illegible] BASE SLAB
	UCWS	$/CY	UNIT COST OF CONCRETE STEM ABOVE BASE SLAB
	UCWK	$/CY	UNIT COST OF CONCRETE - KEY BELOW BASE SLAB
[illegible]			Unit cost of structural excavation
	UCEXS3	$/CF	UNIT COST OF EXCAVATION [illegible] LAYER [illegible]
	UCEXS4	$/CF	UNIT COST OF EXCAVATION [illegible] LAYER [illegible]
	UCEXS5	$/CF	UNIT COST OF EXCAVATION SOIL LAYER [illegible]
	UCEXWK	$/CF	UNIT COST OF EXCAVATION KEY BELOW BASE SLAB
HSPH			Horizontal seepage net pressure values
	[illegible]	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASE
	[illegible]	EACH	[illegible] INTERVALS [illegible] 1 AT HIGHER WATER [illegible]
	[illegible]	PSI	NET HORIZONTAL SEEPAGE PRESSURE [illegible] STAT [illegible]
	[illegible]	PSI	NET HORIZONTAL SEEPAGE PRESSURE [illegible] DYNAMIC
[illegible]			Vertical uplift pressure diagram values
	[illegible]	EACH	LOAD CASE NUMBER [illegible] TO [illegible] OR 0 FOR ALL LOAD CASE [illegible]
	[illegible]	EACH	[illegible] INTERVALS, POINT 1 AT [illegible]
	[illegible]	PSI	[illegible] HYDROSTATIC PRESSURE [illegible]
[illegible]			Hydraulic [illegible] hydraulic [illegible]
	[illegible]	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASE
	[illegible]	0-1	1 IF HYDRAULIC STRUCTURE, 0 IF NON HYDRAULIC
[illegible]			Job name and alphanumeric [illegible]
	[illegible]	ALPHA	JOB NAME [illegible] ALPHANUMERIC [illegible]
[illegible]			[illegible]
	[illegible]	DEG	[illegible]
[illegible]			[illegible]
	[illegible]	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASE
	[illegible]	RATIO	ALLOWABLE OVERSTRESS FACTOR [illegible]

(Continued)

12-5 SUMMARY OF DATA LIST CONTENTS (Continued):

Data List	Data Item	Units	Definition
PPD			Passive pressure diagram ordinates
	LC	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASES)
	YTOPP	FOOT	ELEV OF TOP OF PASSIVE PRESSURE DIAGRAM
	WPP	PSF	MAX PASSIVE PRESSURE FROM WIND LOAD
	[illegible]	PSF	MAX PASSIVE PRESSURE FROM EQ HORIZ ADDITIONAL
	[illegible]	PSF	MAX PASSIVE PRESSURE FROM HORIZ EARTH + [illegible]
	[illegible]	PSF	MAX PASSIVE PRESSURE FROM HORIZ [illegible]
RRD			Minimum allowable resultant ratio
	LC	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASES)
	RRMIN	RATIO	MIN ALLOWABLE OVERTURNING RESULTANT RATIO
SCLD			Direct vertical line loads on stem and base
	LC	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASES)
	PVS	LB/FT	LINE LOAD DOWN ON CENTER OF TOP OF STEM
	PVB	LB/FT	LINE LOAD DOWN ON BASE SLAB CONCRETE
	DVB	FOOT	HORIZONTAL DISTANCE WORKING PT TO PVB, + TO [illegible]
SCLH			Direct horizontal line load [illegible]
	LC	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASES)
	PH1	LB/FT	LINE LOAD HORIZ ON STEM OR [illegible]
	ELPH1	FOOT	ELEV OF PH1 (ON TOE OR STEM)
	PH2	LB/FT	LINE LOAD HORIZ ON STEM ONLY [illegible]
	ELPH2	FOOT	ELEV OF PH2 (ON STEM ONLY)
SCLV			Surcharge line loads on backfill
	LC	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASES)
	PV1	LB/FT	LINE SURCHARGE VERTICAL, NO. 1
	DV1	FOOT	HORIZ DIST, BASIC WORK PT TO PV1, + [illegible]
	PV2	LB/FT	LINE SURCHARGE VERTICAL, NO. 2
	DV2	FOOT	HORIZ DIST, BASIC WORK PT TO PV2, + [illegible]
	PV3	LB/FT	LINE SURCHARGE VERTICAL, NO. 3
	DV3	FOOT	HORIZ DIST, BASIC WORK PT TO PV3, + [illegible]
	PV4	LB/FT	LINE SURCHARGE VERTICAL, NO. 4
	DV4	FOOT	HORIZ DIST, BASIC WORK PT TO PV4, + [illegible]
	PV5	LB/FT	LINE SURCHARGE VERTICAL, NO. 5
	DV5	FOOT	HORIZ DIST, BASIC WORK PT TO PV5, + [illegible]
SCWH			[illegible]
	LC	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASES)
	W1	PSF	HORIZ PRESSURE LOAD ON STEM, + [illegible]
	ELWLT	FOOT	ELEV OF TOP OF LOAD [illegible]
	ELWLB	FOOT	ELEV OF BOTTOM OF LOAD [illegible]
	W3	PSF	EXTERNAL HORIZ PRESSURE AT [illegible]
	W4	PSF	EXTERNAL HORIZ PRESSURE AT [illegible]
SCWV			Surcharge [illegible] loads on backfill
	LC	EACH	LOAD CASE NUMBER (1 TO [illegible] OR 0 FOR ALL LOAD CASES)
	WT	PSF	VERT DISTRIBUTED SURCHARGE [illegible]
	WWT	FOOT	WIDTH OF STRIP LOADED BY SURCHARGE WT
	DWT	FOOT	HORIZ DISTANCE, BASIC WORK POINT TO SURCHARGE WT
	WH	PSF	VERT DISTRIBUTED SURCHARGE [illegible]
	WWH	FOOT	WIDTH OF STRIP LOADED BY SURCHARGE WH
	DWH	FOOT	HORIZ DISTANCE, BASIC WORK POINT TO SURCHARGE [illegible]

(Continued)

12-5 SUMMARY OF DATA LIST CONTENTS (Continued):

Data List	Data Item	Units	Definition
SEEP			Water elevations and seepage options
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ELWT	FOOT	ELEV. OF WATER LEVEL OVER TOE
	ELWH	FOOT	ELEV. OF WATER LEVEL OVER HEEL (WAVE, STILL WATER)
	HGSW		SOILS WEIGHT CHANGE DUE TO HYDRAULIC GRADIENT
	ISLC	1-2	1 = EACH LOAD CASE SEPARATE ... 2 = ALL AS NO. 1
	ISLT	1234	1, 2, 3, OR 4 FOR TYPE OF SEEPAGE FLOW, 1 = ...
	NRACK	1-2	1 FOR CRACK (+ W3,W4) OVER HEEL, 2 FOR ACTIVE SOIL
SLID			Sliding control data - see also ONEA
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	NSLIDE	1234	1, 2, 3, OR 4 FOR SLIDING CALCULATION TYPE OPTION
	FSMIN	RATIO	MINIMUM FACTOR OF SAFETY AGAINST SLIDING
SOIL			Soils design parameters
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	IEWOC	1OR2	1 FOR INCREMENTAL WEDGE METHOD OR 2 FOR COULOMB
	NODE	EACH	NUMBER OF NODES TO USE WHEN IEWOC = 1 & IESOM = 2
	IESOM	1OR2	1 FOR SINGLE WEDGE TRIAL SURFACE, 2 FOR MULTIPLE
	NPPD	1-5	OVERTURNING PASSIVE PRESSURE SHAPE CODE, 5 = ...
	RKH	RATIO	HORIZ. EARTHQUAKE ACCELERATION FACTOR
	RKV	RATIO	VERT. EARTHQUAKE ACCELERATION FACTOR
	CFMA	RATIO	ACTIVE PRESSURE MOMENT ARM FACTOR FOR ARCHING CASE
SPL3			Soil properties, exist. soil layer 3 (basic)
	PHI3	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 3
	COH3	PSF	COHESIVE STRENGTH OF SOIL LAYER 3
	GAMAS3	LB/CF	UNIT WEIGHT OF SOIL LAYER 3, SATURATED IF BELOW WT
	PHIS3	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER 3
	ADHS3	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 3
	ABP3TN	PSF	ALLOW. BRNG. PRESSURE, TOP OF LAYER 3, NARROW BASE
	ABP3BN	PSF	ALLOW. BRNG. PRESSURE, BOTT OF LAYER 3, NARROW BASE
	ABP3TW	PSF	ALLOW. BRNG. PRESSURE, TOP OF LAYER 3, WIDE BASE
	ABP3BW	PSF	ALLOW. BRNG. PRESSURE, BOTT OF LAYER 3, WIDE BASE
	ELBS3	FOOT	ELEVATION CORRESPONDING TO ABP3BN AND ABP3BW
SPL4			Soil properties, existing soil layer 4
	ELTS3	FOOT	ELEV OF TOP OF SOIL LAYER 3
	PHI4	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 4
	COH4	PSF	COHESIVE STRENGTH OF SOIL LAYER 4
	GAMAS4	LB/CF	UNIT WEIGHT OF SOIL LAYER 4, SATURATED IF BELOW WT
	PHIS4	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER 4
	ADHS4	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 4
	ABP4TN	PSF	ALLOW. BRNG. PRESSURE, TOP OF LAYER 4, NARROW BASE
	ABP4BN	PSF	ALLOW. BRNG. PRESSURE, BOTT OF LAYER 4, NARROW BASE
	ABP4TW	PSF	ALLOW. BRNG. PRESSURE, TOP OF LAYER 4, WIDE BASE
	ABP4BW	PSF	ALLOW. BRNG. PRESSURE, BOTT OF LAYER 4, WIDE BASE
SPL5			Soil properties, existing soil layer 5
	ELTS4	FOOT	ELEV. OF TOP OF SOIL LAYER 4
	PHI5	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 5
	COH5	PSF	COHESIVE STRENGTH OF SOIL LAYER 5
	GAMAS5	LB/CF	UNIT WEIGHT OF SOIL LAYER 5, SATURATED IF BELOW WT
	PHIS5	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER 5
	ADHS5	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 5
	ABP5TN	PSF	ALLOW. BRNG. PRESSURE, TOP OF LAYER 5, NARROW BASE
	ABP5BN	PSF	ALLOW. BRNG. PRESSURE, BOTT OF LAYER 5, NARROW BASE
	ABP5TW	PSF	ALLOW. BRNG. PRESSURE, TOP OF LAYER 5, WIDE BASE
	ABP5BW	PSF	ALLOW. BRNG. PRESSURE, BOTT OF LAYER 5, WIDE BASE

(Continued)

12-5 SUMMARY OF DATA LIST CONTENTS (Continued):

Data List	Data Item	Units	Definition
SPH1			Soil properties, heel backfill layer 1
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	PHI1	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 1
	COH1	PSF	COHESIVE STRENGTH OF SOIL LAYER 1
	GAMAS1	LB/CF	UNIT WEIGHT OF SOIL LAYER 1, SATURATED IF BELOW WT
	KA1	RATIO	ACTIVE EARTH PRESSURE COEFFICIENT FOR SOIL LAYER 1
	DELTA1	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	KAE1	RATIO	EARTHQUAKE ACTIVE EARTH PRESSURE COEFFICIENT
	HCMIN	FOOT	MINIMUM HEEL EARTH COVER (HEEL SIDE)
SPH2			Soil properties, heel backfill layer 2
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	ELTS1	FOOT	ELEV OF TOP OF SOIL LAYER 1
	PHI2	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 2
	COH2	PSF	COHESIVE STRENGTH OF SOIL LAYER 2
	GAMAS2	LB/CF	UNIT WEIGHT OF SOIL LAYER 2, SATURATED IF BELOW WT
	KA2	RATIO	ACTIVE EARTH PRESSURE COEFFICIENT FOR SOIL LAY
	DELTA2	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	KAE2	RATIO	EARTHQUAKE ACTIVE EARTH PRESSURE COEFFICIENT
SPHF			Soil properties, filter zone over heel
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	FZTAH	FOOT	FILTER ZONE THICKNESS AT END OF HEEL
	PHIFZ	DEG	ANGLE OF INTERNAL FRICTION, FILTER ZONE
	COHFZ	PSF	COHESIVE STRENGTH OF FILTER ZONE
	GAMAFZ	LB/CF	UNIT WEIGHT OF FILTER ZONE, SATURATED IF BELOW WT
	KAFZ	RATIO	ACTIVE PRESSURE COEFFICIENT FOR FILTER ZONE
	DELTAF	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE, FILTER ZON
	KAEFZ	RATIO	EARTHQUAKE ACTIVE PRESSURE COEFF. FOR FILTER ZONE
SPT6			Soil properties, toe backfill layer 6
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	PHI6	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 6
	COH6	PSF	COHESIVE STRENGTH OF SOIL LAYER 6
	GAMAS6	LB/CF	UNIT WEIGHT OF SOIL LAYER 6, SATURATED BELOW WT
SPT7			Soil properties, toe backfill layer 7
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	PHI7	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 7
	COH7	PSF	COHESIVE STRENGTH OF SOIL LAYER
	GAMAS7	LB/CF	UNIT WEIGHT OF SOIL LAYER 7, SATURATED IF BELOW WT
SSEX			Soil surfaces, Existing grade & Excavation
	EXW	FOOT	EXCAVATION BOTTOM EXTRA WIDTH EACH SIDE OF BASE
	ESS	1V: XH	EXCAVATION SIDE SLOPE
	HSSGT	1V: XH	EXIST. GROUND SIDE SLOPE BEYOND ELTSGT (TOE SIDE)
	ELTSGT	FOOT	EXIST. GRADE, OFFSET FT. FROM ELTSGW (TOE SIDE)
	DTSGT	FOOT	HORIZ. DISTANCE FROM ELTSGW TO ELTSGT (TOE SIDE)
	ELTSGW	FOOT	EXIST. GRADE DIRECTLY UNDER BASE WORKING POINT
	ELTSGH	FOOT	EXIST. GRADE, OFFSET FT. FROM ELTSGW (HEEL SIDE)
	DTSGH	FOOT	HORIZ. DISTANCE FROM ELTSGW TO ELTSGH (HEEL SIDE)
	HSSGH	1V: XH	EXIST GROUND SIDE SLOPE BEYOND ELTSGH (HEEL SIDE)

(Continued)

12-5 SUMMARY OF DATA LIST CONTENTS (Continued):

Data List	Data Item	Units	Definition
SSHC			Soil surface geometry over heel. Coulomb
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ESHW	FOOT	ELEV OF HEEL SLOPE HS1, EXTENDED UNDER B. WORK [illegible]
	HS3	IV XH	SLOPE OF THIRD HEEL SURFACE SEGMENT [illegible]
SSHW			Soil surface geometry over heel. Wedge method
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ESHW	FOOT	ELEV OF HEEL SLOPE HS1, EXTENDED UNDER B. WORK [illegible]
	HS1	IV XH	SLOPE OF FIRST HEEL SURFACE SEGMENT [illegible]
	WS1H	FOOT	HORIZ DISTANCE FROM BASE WORK [illegible]
	HS2	IV XH	SLOPE OF 2ND HEEL SURFACE SEGMENT [illegible]
	WDS2	FOOT	WIDTH OF 2ND HEEL SURFACE SEGMENT
	HS3	IV XH	SLOPE OF OUTER (3RD) HEEL SURFACE [illegible]
SST			Soil surface over the toe
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ESTW	FOOT	ELEV OF TOE SLOPE TS1, EXTENDED UNDER B. WORK
	TS1	IV XH	SLOPE OF SURFACE OF SOIL LAYER OVER TOE [illegible]
STLB			Reinforcing steel in the base slab
	LOC	EACH	INTEGER FT FROM TOE TOWARD HEEL [illegible]
	LNA	EACH	LAYER NO. (1 OUTER, 2 MAX FOR ASTLBT)
	ASTLBT	SQ"/F	SQ IN / FT. REINF IN TOP FACE OF BASE SLAB
	LNB	EACH	LAYER NO. (1 OUTER, 3 MAX FOR ASTLBB)
	ASTLBB	SQ"/F	SQ IN / FT. REINF IN BOTTOM FACE OF BASE SLAB
STLD			Reinforcing steel design parameters
	MAXBAR	NUMBR	ASTM REINF BAR NUMBER (3-11, 14, OR 18 ONLY) MAX
	SPAMIN	INCH	MINIMUM CLEAR SPACING BETWEEN BARS IN SAME [illegible]
STLK			Reinforcing steel in the key
	ASTLK	SQ"/F	SQ IN / FT. REINF IN KEY
STLS			Reinforcing steel in the stem
	LOC	EACH	INTEGER FT BELOW TOP OF STEM. [illegible]
	ASTLST	SQ"/F	SQ IN / FT. REINF IN TOE SIDE FACE OF STEM
	LAYER	EACH	LAYER NO. (1 OUTER, [illegible] MAX FOR ASTLST)
	ASTLSH	SQ"/F	SQ IN / FT. REINF IN HEEL SIDE FACE OF STEM
TRCE			Renumber file & debug trace control
	ITRACE	0/1	1 FOR DEBUGGING TRACE ON, 0 FOR OFF
TYPE			Flood wall / Retaining wall indicator
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ITYPE	1/2	1 FOR FLOOD WALL, 2 FOR RETAINING WALL
VEF			Earth weight & [illegible]
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	LOC	EACH	LOCATION NUMBER (SEE USER GUIDE)
	V	PSF	EARTH WEIGHT (VERTICAL SURCHARGE)
	EV	PSF	DYNAMIC (EARTHQ.) VERT SURCHARGE
WGHT			Unit weight
	GAMAC	LB/CF	UNIT WEIGHT OF REINFORCED CONCRETE (DEFAULT = [illegible])
	GAMAW	LB/CF	UNIT WEIGHT OF WATER (DEFAULT = [illegible])

(Continued)

12-5 SUMMARY OF DATA LIST CONTENTS (Continued):

Data List	Data Item	Units	Definition
WIND			Wind loads
	LC	EACH	LOAD CASE NUMBER [illegible] FOR ALL LOAD CASES [illegible]
	W	PSF	WIND PRESSURE ON OTHERWISE UNLOADED STEM AREA
WLA[illegible]			Wall geometry for [illegible]
	[illegible]	FOOT	TOP OF STEM [illegible]
	TW[illegible]	FOOT	HORIZ PROJECTION OF CLEAR WIDTH OF [illegible] FROM [illegible]
	[illegible]	RATIO	STEM RATIO [illegible] WIDTH [illegible]
	HEELW	FOOT	HORIZ PROJECTION OF CLEAR WIDTH OF HEEL FROM STEM
WLAB			Wall geometry for Analysis [illegible]
	BW	FOOT	HORIZ PROJECTION OF BASE WIDTH [illegible] TO HEEL [illegible]
	BW1	FOOT	MINIMUM VALUE FOR BW (BASE WIDTH) [illegible]
	BW2	FOOT	MAXIMUM VALUE FOR BW (BASE WIDTH) [illegible]
	[illegible]	RATIO	BASE BOTTOM SLOPE [illegible]
WLAH			Wall geometry for Analysis [illegible] heel
	HEELT	INCH	HEEL THICKNESS AT END (NOT LESS THAN [illegible])
	HEELW	FOOT	HORIZ PROJECTION OF CLEAR WIDTH OF HEEL FROM STEM
	HEEL[illegible]	INCH	HEEL THICKNESS AT STEM (NOT LESS THAN [illegible])
WLAK			Wall geometry for Analysis [illegible] key
	KFLAG	[illegible]	[illegible] KEY IS AT HEEL END OF BASE [illegible]
	DKEY	FOOT	KEY VERTICAL LENGTH AT SIDE TOWARD END OF [illegible]
	WKEY	INCH	KEY WIDTH AT BOTTOM (NOT LESS THAN [illegible])
	[illegible]	RATIO	KEY BATTER OF FACE TOWARD [illegible]
WLAS			Wall geometry for Analysis [illegible] stem
	[illegible]	INCH	STEM THICKNESS AT TOP (NOT LESS THAN [illegible])
	[illegible]	INCH	STEM TOP SIDE BATTER, IN H [illegible] VERTICAL [illegible]
	[illegible]	INCH	HORIZ PROJECTION OF STEM THICKNESS AT BASE
	[illegible]	FEET	STEM HEEL SIDE TOP PANEL HEIGHT
	[illegible]	INCH	STEM HEEL SIDE TOP PANEL BATTER [illegible]
	[illegible]	INCH	STEM HEEL SIDE BOTTOM PANEL BATTER [illegible]
WLAT			Wall geometry for Analysis [illegible]
	[illegible]	FOOT	BOTTOM OF TOE [illegible] AT END OF TOE
	[illegible]	INCH	THICKNESS OF TOE AT OUTER END (NOT LESS THAN [illegible])
	[illegible]	RATIO	SLOPE OF TOP OF OUTER PANEL OF TOE [illegible]
	TWI	FOOT	WIDTH OF TOP OF INNER PANEL OF TOE FROM STEM FACE
	[illegible]	RATIO	SLOPE OF TOP OF INNER PANEL OF TOE [illegible]
WLR[illegible]			Wall [illegible]
	BASER	FOOT	BASE RADIUS FROM BASIC WORKING POINT [illegible]

(Continued)

12-5 SUMMARY OF DATA LIST CONTENTS (Continued):

Data List	Data Item	Units	Definition
WLD			Wall geometry for design (modules [illegible] or WL[illegible])
	ELS	FOOT	TOP OF STEM ELEV. (ALL ELEVATIONS MUST BE [illegible]
	BWS	FOOT	HORIZ PROJECTION OF CLEAR WIDTH OF TOE FROM STEM
	STR	RATIO	STEM RATIO (TOE WIDTH TW / BASE WIDTH BW)
	HLEFW	FOOT	HORIZ PROJECTION OF CLEAR WIDTH OF HEEL FROM STEM
	TSTB	INCH	HORIZ PROJECTION OF STEM THICKNESS AT BASE
	TMINB	INCH	MINIMUM CONCRETE THICKNESS IN BASE SLAB
WLBW			Wall geometry for design [illegible]
	BW1	FOOT	MINIMUM VALUE FOR BW (BASE WIDTH) [illegible]
	BW2	FOOT	MAXIMUM VALUE FOR BW (BASE WIDTH) [illegible]
	RS1	RATIO	MINIMUM VALUE FOR RS (BASE [illegible]
	RS2	RATIO	MAXIMUM VALUE FOR RS (BASE [illegible]
WLDH			Wall geometry for design: heel
	HEELT2	INCH	HEEL THICKNESS AT END [illegible] NOT LESS THAN TMINB
WLDK			Wall geometry for design: key
	KEYLOC	0, 1	0 IF KEY IS AT HEEL END OF BASE, [illegible] UNDER STEM
	BKEF	RATIO	BATTER OF KEY FACE TOWARD TOE [illegible]
	DKEY1	FOOT	MINIMUM VALUE OF DKEY FOR [illegible]
	DKEY2	FOOT	MAXIMUM VALUE OF DKEY FOR [illegible]
WLDS			Wall geometry for design: stem
	TMINS	INCH	MINIMUM CONCRETE THICKNESS IN STEM
	TSB	IN/FT	STEM TOE SIDE BATTER, IN/FT [illegible]
	HSTPH	FOOT	STEM HEEL SIDE TOP PANEL HEIGHT
	HSTPB	IN/FT	STEM HEEL SIDE TOP PANEL BATTER, IN/FT V
	HSBPB	IN/FT	STEM HEEL SIDE BOTTOM PANEL BATTER, IN/FT V
WLDT			Wall geometry for design: toe
	BTEL1	FOOT	MINIMUM (LOWEST) VALUE FOR BTEL [illegible]
	BTEL2	FOOT	MAXIMUM (HIGHEST) VALUE FOR BTEL [illegible]
	TOERT	INCH	THICKNESS OF TOE AT OUTER END, NOT LESS THAN TMINB
	TWI	FOOT	WIDTH OF TOP OF INNER PANEL OF TOE, FROM STEM FACE

CHAPTER 13: GRAPHICS DISPLAY OF DATA AND RESULTS

13-1 GENERAL. Module FA has the capability of displaying the input data and computed applied and reactive pressures in graphical form on a Tektronix 4014 graphics display terminal. Output examples are shown later in this Chapter. The program may be run without graphics, on any kind of terminal.

13-2 EQUIPMENT VARIATION EFFECTS. The nongraphics portion of the time-sharing terminal printout from the program does not keep track of how much has been printed on a page. It keeps on printing line after line in typical paper copy fashion. Allowing for this makes the following alternate procedure necessary, depending on which type of Tektronix terminal is available.

13-2-1 Tektronix 4014 terminal with option 40-41 installed. Use these switch settings:

a. OFF key to setting 1.

b. AUTO PRINT key to the left, for automatic printing of each page.

The screen will automatically be printed, then cleared for the next page as the printout continues with nothing lost. Use the program in the usual way, getting a stack of paper copies in the hard copy unit hopper. Answer the question at the end of module FA

```
ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR Ø TO OMIT THE PLOTS
?
```

with a 1. A hard copy will automatically be taken. The screen will be erased and execution will proceed as described in paragraph 13-3.

13-2-2 Tektronix 4014 terminal without the 40-41 option installed. Use a regular paper copy printing terminal such as Teletype, Texas Instruments Silent 700, DECWRITER, etc., and answer the question at the end of module FA with a zero. When module FA is complete, either stop the program run with the END command or let the terminal sit waiting for the next command while you move to a Tektronix 4014 terminal. Start the program running on the 4014 and restore (REST command in the program starting sequence) from the UPDATE file from the printing terminal program run. Note that this will not interfere with the program still running on the printing terminal provided that it is waiting for a command. Then RUN module GA, ignoring the printout until the question appears. Answer it with a 1 and proceed to paragraph 13-3. This process may be repeated each time the UPDATE file is reset in the run in the printing terminal using the REST command as described above.

13-2-3 <u>No Tektronix 4014 terminal available.</u> Plots are not possible.

13-3 <u>DISPLAY OPTIONS.</u> After the user responds to the first question with a 1, the screen is erased and the following is written:

```
NOTE --- A BELL WILL RING AT SELECTED TIMES
         TO ALLOW YOU TO MAKE A HARDCOPY IF
         YOU SO DESIRE. TO RESUME EXECUTION
         SIMPLY ENTER A CARRIAGE RETURN

ENTER 1 TO PLOT INPUT DATA
      1 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?
```

13-4 <u>INPUT DATA.</u> Responding to the above question with a 1 starts the input plotting portion of the code. The *active load cases* will be printed. The user must then enter the number of the load case he wants plotted:*

```
ACTIVE LOAD CASES
====== ==== =====
                1
                2
ENTER DESIRED ACTIVE LOAD CASE
      OR AN * TO RETURN
?
```

13-4-1 If the user responds with a load case not available, the following message is written:

```
LOAD CASE SELECTION NOT ACTIVE
```

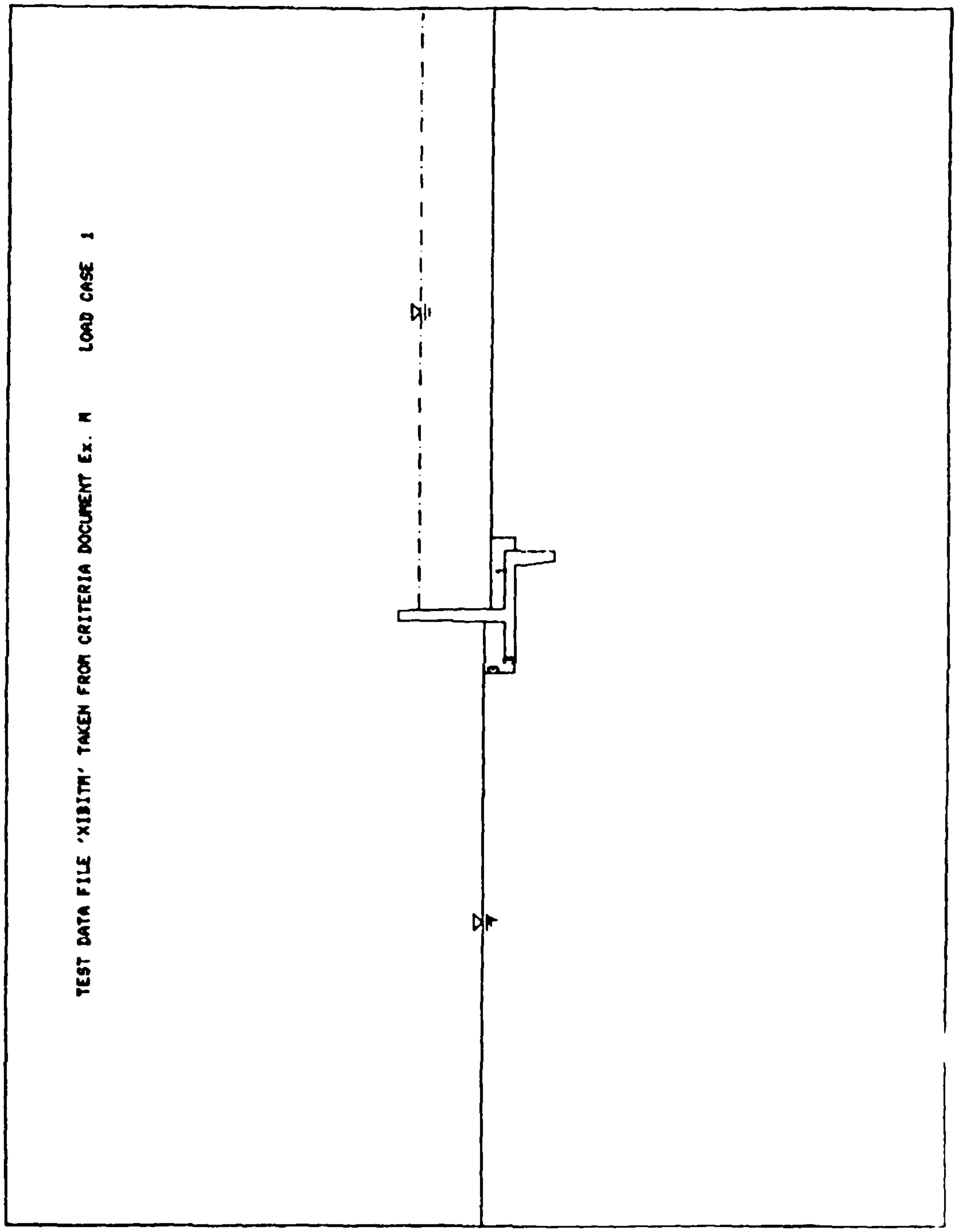
The load case question is then repeated. If the user enters an *, the input graphics portion of the code is terminated.

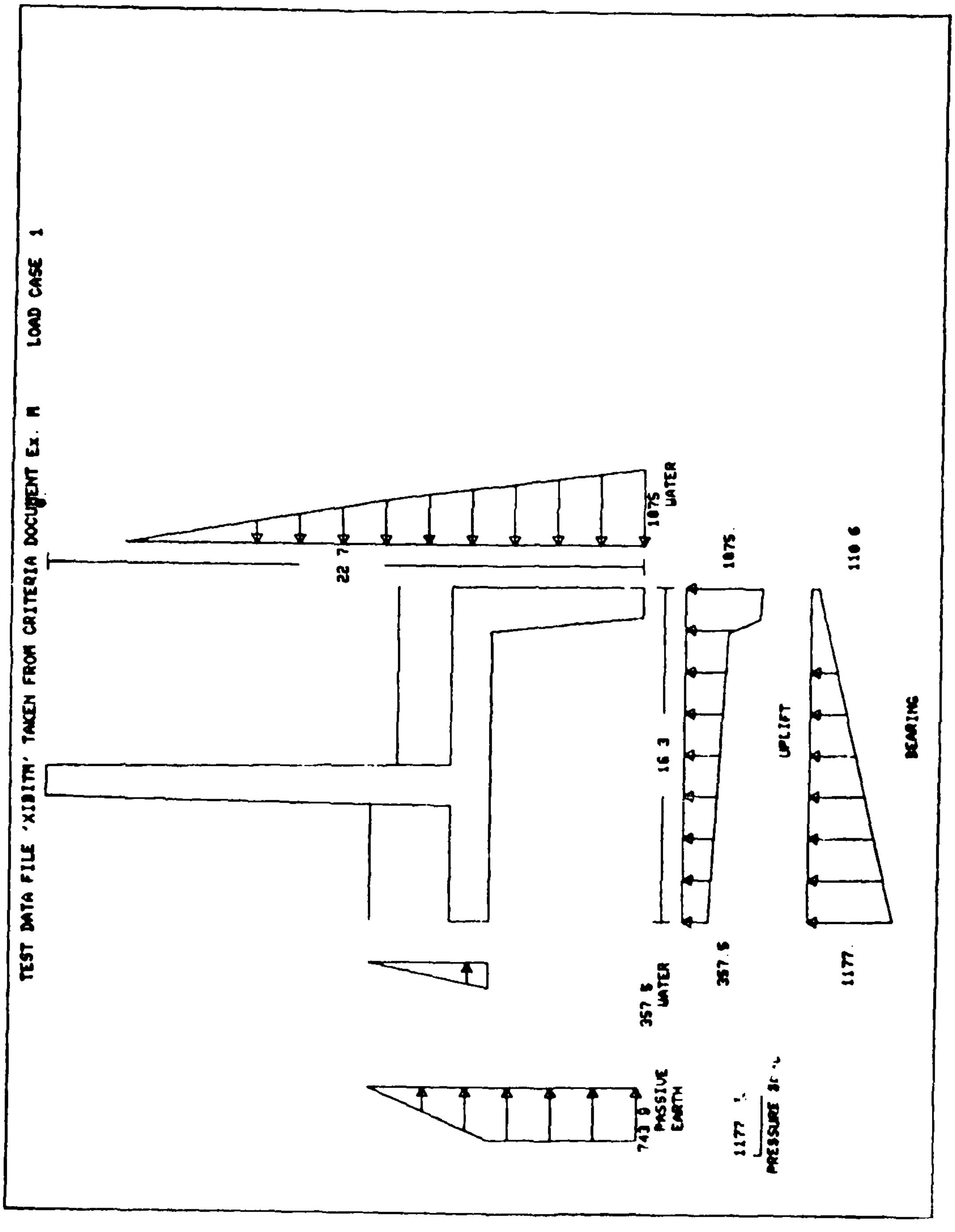
13-4-2 If the user responds with a load case number that has been processed, the screen is erased and the following pictures are output:

---

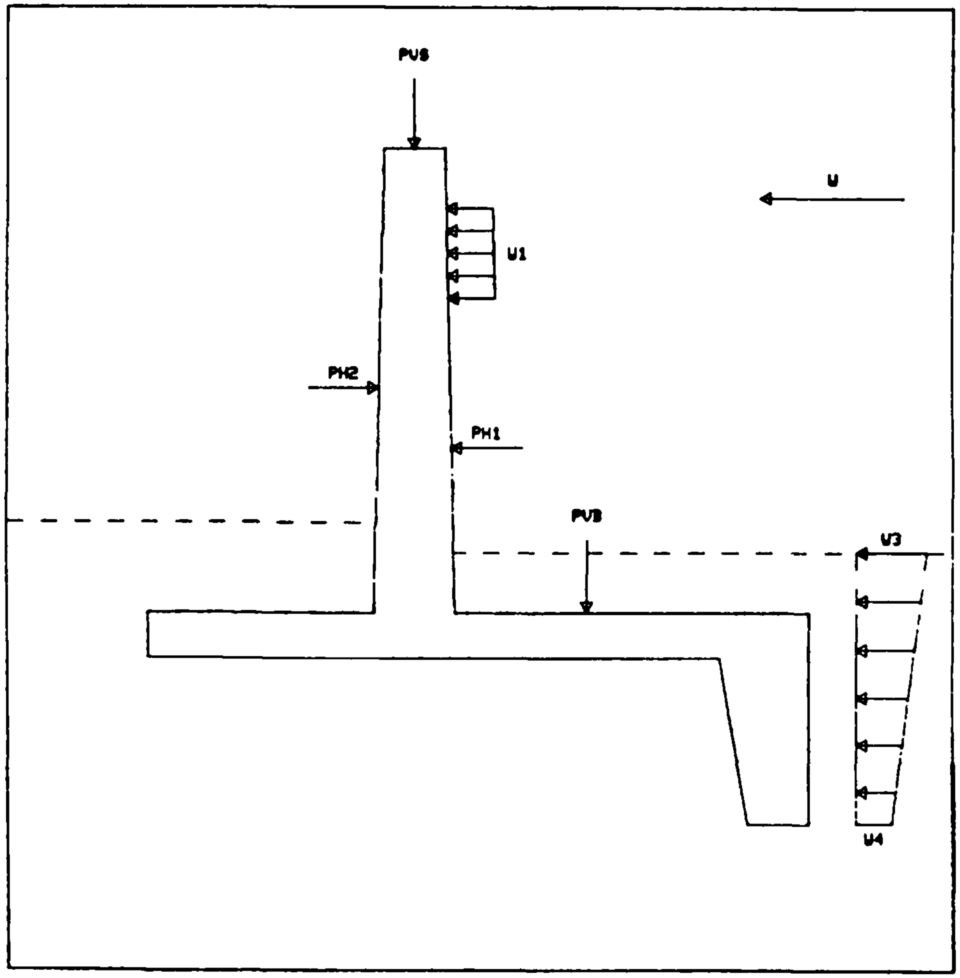
* NOTE: If there is only one load case, the question will be skipped.

a. Earth and water data and resulting pressures:




TEST DATA FILE 'XIBITH' TAKEN FROM CRITERIA DOCUMENT Ex. R LOAD CASE 1
1875
WATER
22 7
1875
16 3
UPLIFT
110 6
BEARING
357 5
WATER
357 5
1177
743 0
PASSIVE
EARTH

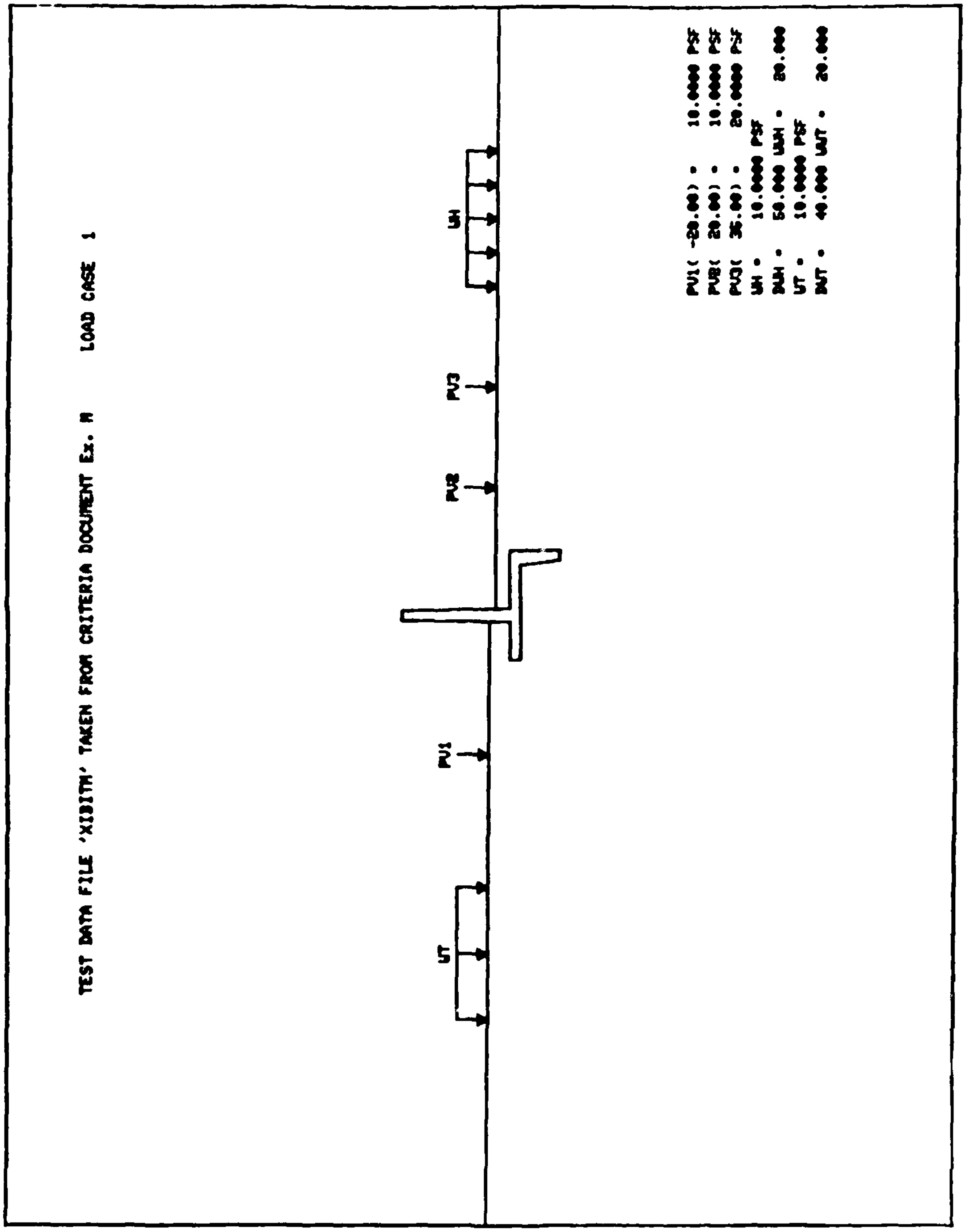
TEST DATA FILE 'XIBITH' TAKEN FROM CRITERIA DOCUMENT Ex. M   LOAD CASE 1



LEGEND

PVS(0.75) =   100.0000 PSF
PH1(90.00) =   75.0000 PSF
PH2(92.00) =   -75.0000 PSF
PVB(5.00) =   100.0000 PSF
U1 =   50.0000 PSF
ELU1T =   98.0000 FEET
ELU1B =   95.0000 FEET
U3 =   100.0000 PSF
U4 =   50.0000 PSF
W =   40.0000 PSF

b. <u>Surcharges and direct loads.</u> If any loads have been applied to the structure or the top soil layer, the following graphs are output:



13-4-3 The user is then given the opportunity to plot the input for another load case:

```
ENTER 1 TO PLOT ANOTHER LOAD CASE
      Ø TO CONTINUE
?
```

Responding with a 1 returns the user to the question in paragraph 13-4. A response of 0 terminates the input plotting section of the code and returns the user to the question in paragraph 13-3.

13-5 COMPUTED MEMBER FORCES AND MOMENTS

13-5-1 If the user responds with a 2 to the question in paragraph 13-3, the output portion of TWDA is invoked. The available load case numbers are output and the user is given the opportunity to select a load case to be processed:*

```
ACTIVE LOAD CASES
====== ==== =====
                1
                2
ENTER DESIRED ACTIVE LOAD CASE
      OR AN * TO RETURN
?
```

If the user selects a load case other than the ones output, the following is output:

```
LOAD CASE SELECTION NOT ACTIVE
```

The load case question is then repeated. If the user enters an *, the output graphics portion of the code is terminated.

13-5-2 Once a correct load case has been selected, the user must then choose which member of the wall he wants output displayed for:

```
ENTER MEMBER NUMBER
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
        * --- RETURN
?
```

---

* NOTE: If there is only one load case, the question will be skipped.

If the user responds with any number other than $1 \leq n \leq 4$, the following is output and the user is given another chance to input a member number:

```
THE 'TOE' IS NOT DEFINED FOR THIS GEOMETRY
```

The user is then given the opportunity to select another member or return:

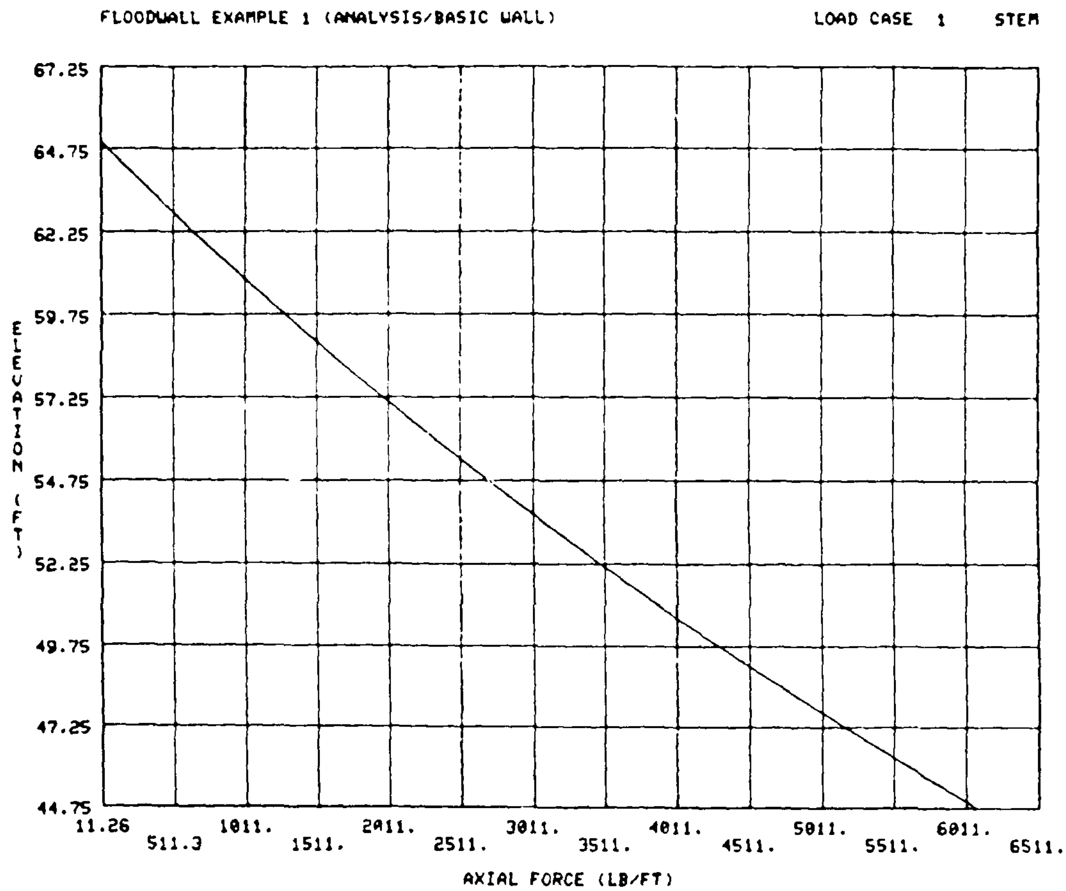
```
ENTER 1 TO PLOT ANOTHER MEMBER
      Ø TO CONTINUE
?
```

A response of 1 returns the user to the question in paragraph 13-5-2. A response of 0 returns the user to the load case selection question in paragraph 13-5-1. Any other response repeats the question. The user must enter either 0 or 1.

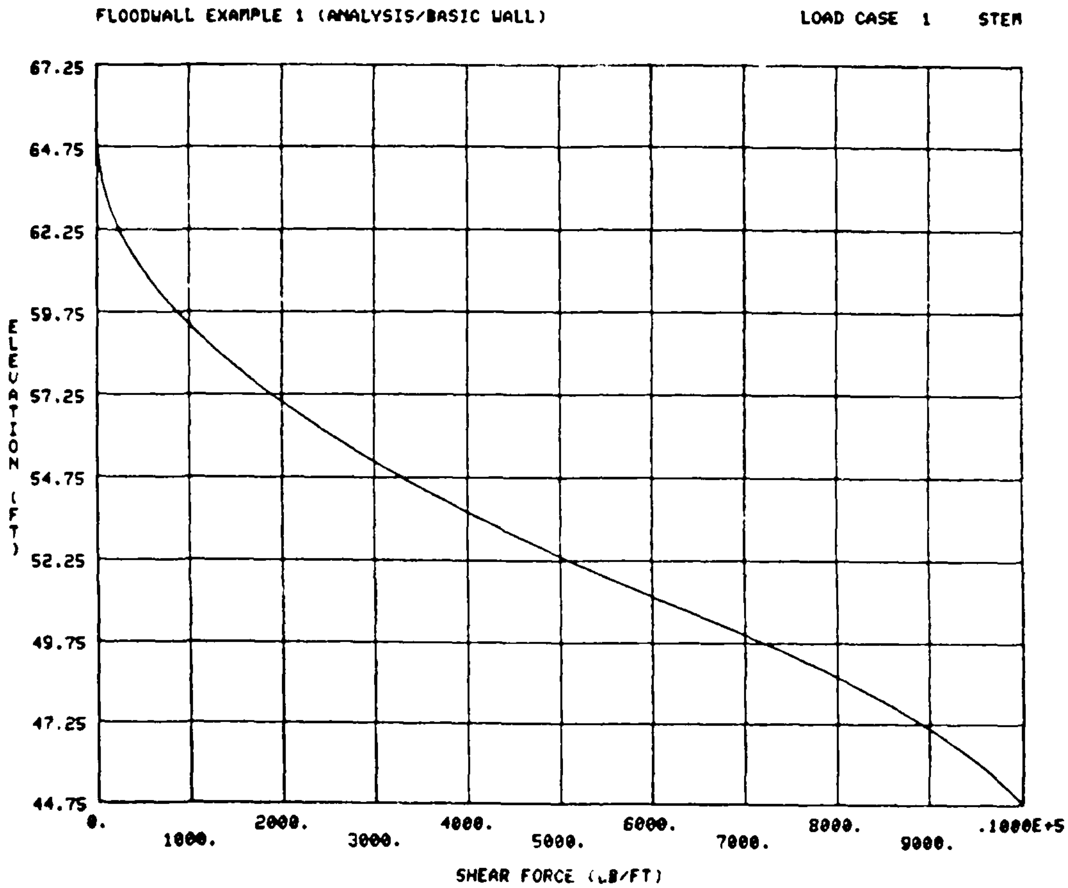
13-5-3 If the selection of a member (paragraph 13-5-2) is successful, the screen is erased and the plot selection is displayed to the user:

```
ENTER PLOT SELECTION
TYPE 1 --- AXIAL FORCE
     2 --- SHEAR FORCE
     3 --- MOMENT
     4 --- ALL PLOTS
     * --- RETURN
?
```

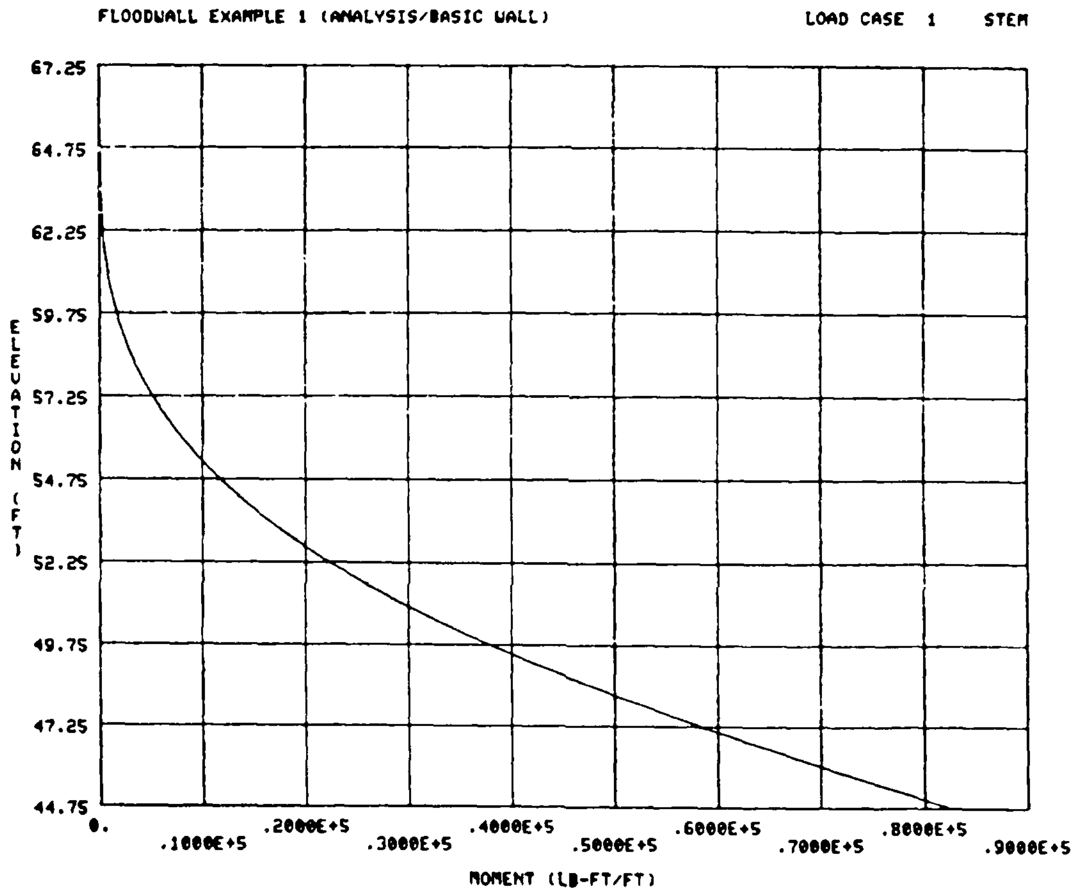
a. A response of 1 gives the user a plot of axial force versus elevation for the member selected. An example of this is as follows:



b. A response of 2 gives the user a plot of shear force versus elevation for the member selected. An example of this plot is below:



c. A response of 3 allows the user to display moment versus elevation for the member selected. An example of this is as follows:



If the user responds with 4, all of the preceding plots will be displayed sequentially with a pause between each one.

13-5-4 If the user responds with an *, the member selection portion of the output graphics routine is again invoked:

```
ENTER 1 TO PLOT ANOTHER MEMBER
      Ø TO CONTINUE
?
```

A response of 1 allows the user to select another member for plotting (paragraph 13-5-2). A response of 0 returns the user to the load case level of selection.

```
ENTER 1 TO PLOT ANOTHER LOAD CASE
      Ø TO CONTINUE
?
```

A response of 1 allows the user to select another load case to be displayed (paragraph 13-5-1). A response of 0 returns the user to input-output selection (paragraph 13-3).

13-6 TERMINATION. Referring to the question in paragraph 13-3, a response of an * terminates the graphics portion of TWDA.

CHAPTER 14: EXAMPLES

14-1 EXAMPLE A: ANALYSIS OF A COMPLEX RETAINING WALL:

Extreme Operating Condition

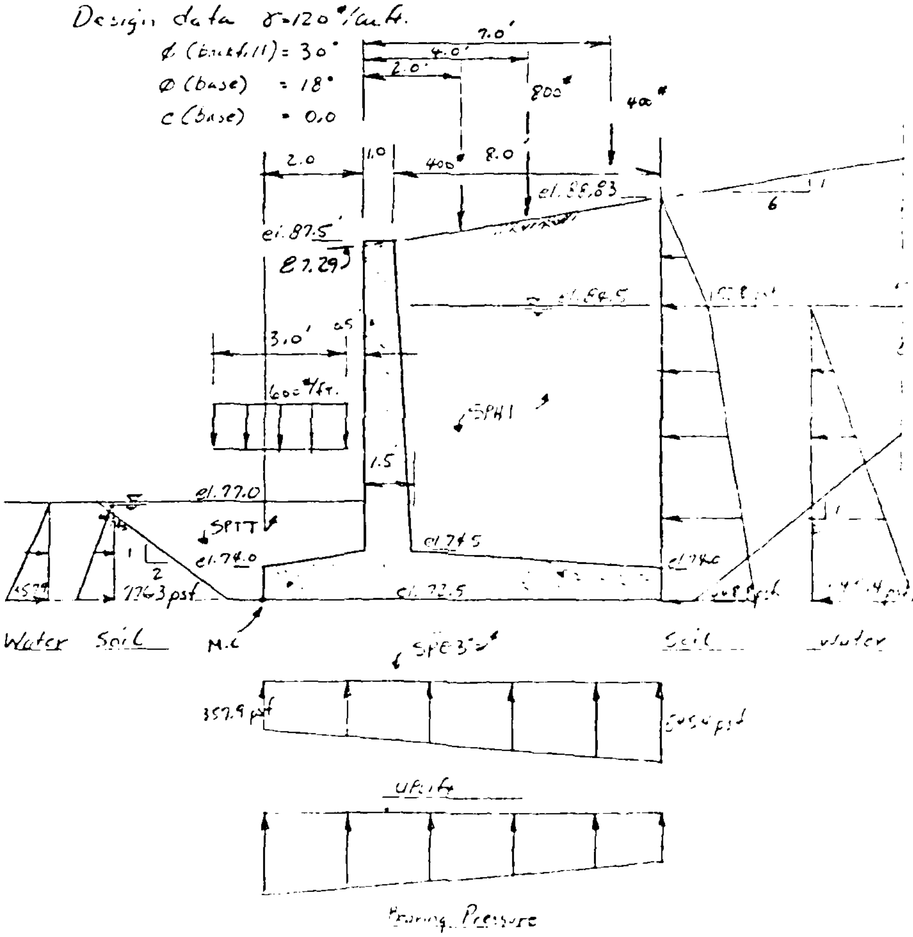
CASE III STRUCTURE Complete, backfill in place, collector system clogged, water in backfill to elev. 84.5, backfill on passive side submerged, surcharge loads over toe and heel.

Design data $\gamma = 120$ #/cu.ft.

ϕ (backfill) = 30°

ϕ (base) = 18°

c (base) = 0.0



Reinforcing steel = 0.89 in²/ft each face all members

STARTING SEQUENCE DATA, paragraph 2-5-2:

* INIT = Start of fresh run

* 1 = 1 load case

* R = Retaining wall default values wanted:

list name	variable name	page number	default values flood wall	default values retaining wall
SEEP	KRACK	3-8	1 (yes)	2 (no)
SLID	NSLIDE	3-9	2	1
"	FSMIN	3-9	1.5	2.0
SOLP	NPPD	3-15	1(∅)	3(Δ)

* H = hydraulic structure default values wanted – see paragraphs 7.4.2 (1) and 7.12.

* NAME ANALYSIS OF COMPLEX RET WALL

Use data list CASE to designate the one load case as case no. 3, to match the problem description:

* CASE 1 3

BACKFILL SOILS PROPERTIES DATA, para 12-3-2

a. Soils over toe – Data list SPT7 is needed because the properties are different from those in the subgrade.

list name	LC	PHI7 ϕ	COH7 C, psf	GAMAS7 γ_s pcf
* SPT7	0	30.0	0.0	120.0

b. The soil at the end of the toe is the same as the soil over the toe, so data list SPT6 is not needed.

c. Soil Over heel – Data list SPH1 is needed because the properties are different from those in the subgrade.

list name	LC	PHI1 ϕ	COH1 psf	GAMAS1 γ_s pcf	RKA1 k_2	DELTA1 δ	RKAE1 K_{ae}	HCMIN ft.
A SPH1	0	30.0	0.0	120.0	C	0.0	C	C

Only one layer, so data lists SPH2 and SPHF are not used.

With all of these being C or default value this last part of the list may be truncated.

BACKFILL FINISHED SOIL SURFACE DATA, para 12-3-3

a. Over toe

list name	LC	ESTW ft.	SST 1:x
★ SST	0	77.0	100.0 ← (level)

b. Over heel: (Coulomb method)

list name	LC	ESHW ft	HS3 1:x
★ SSHC	0	87.29	6.0

EXISTING SOIL PROPERTIES, para 12-3-4

Data list SPE3 is required. With only one layer of subgrade soil, data lists SPE4 and SPES are not needed. Since no allowable bearing pressures are specified, omit that part of the list:

list name	PHI3 ϕ	COH3 psf	GAMAS3 γ_s, pcf	PHIS3 ϕ sliding	ADHS3 adhesion psf
A SPE3	18.0	0.0	120.0	18.0	0.0

omit
ABF3TN
ABP3BN
ABPJTN
ABPJON
ELBS3

EXISTING SOIL SURFACE DATA, para 12-3-5

Data list SPE6 is not needed for an analysis problem. While it could be used its data are not specified.

FOUNDATION DESIGN PARAMETERS, para. 12-3-6

With a pure retaining wall, all of the retaining wall default values and procedures are acceptable. So, none of these lists are needed:

ONEA, RRD, SLID, SOLP

SURCHARGES AND DIRECT LOADS para 12-3-7

Vertical forces on backfill are in data list SCFV:

list name	LC	PV1 lb/ft	DV1 ft	PV2 lb/ft	DV2 ft	PV3 lb/ft	DV3 ft	
★ SCFV	3	400.0	2.0	800.0	4.0	400.0	7.0	PV4, DV4, PV5, DV5 are not needed so are omitted. #

Vertical area loads on backfill are in list SCWV:

list name	LC	WT psf	WWT ft	DWT ft	WH psf	WWH ft	DWH ft
★ SCWV	3	600.0	3.0	0.5	C	C	C

with all values = C the last part of this list may be omitted #

SEEPAGE AND BOIL CONTROL, para 12-3-8

a. Water levels and seepage calculation control

list name	LC	ELWT ft.	ELWH ft	HGSW	ISLC	ISFT	KRACK
★ SEEP	3	77.0	84.5	D=0.0	D=1	D=1	D

with all values = default rest of list is not needed # ("NO", since this is a retaining wall)

b. Boil control criteria not specified so not used

= but could have been included as "D" or "C" as appropriate

WALL GEOMETRY, para 12-3-9

list name	ETS ft.	TW2 ft.	STR ratio	HEELW ft.
★ WLA	87.5	2.0	C	C

(HEELW) Calculated from $BW - TW2 - \frac{TSTB}{12}$

list name	BW ft.	BW1	BW2	BS slope
★ WLAB	11.0	10.0	12.0	0.0

(BW2) With allowable bearing pressures not to be calculated, BW1 & BW2 are immaterial, but they must not be equal and BW must be BW1 ≷ BW ≷ BW2

list name	TSTT in.	TSB in/ft	TSTB in	HSTPH ft	HSTPB in/ft	HSBPB in/ft
★ WLAS	12.0	0.0	18.0	0.0	0.0	C

Check TSTT for compliance with TMINS default limitation: (paragraph 3-6-2 b(2)):

$ETS - BTE1 = 87.5 - 72.5 = 15.0$ default = 12", so OK

with default for TMINS ≦ TSTT, list WLDS is not needed.

list name	BTE1 ft	TOEAT in.	TS2	TW1 ft.	TS1
★ WLAT	72.5	18.0	100.0	0.0	100.0

With no key, list WLAK is not needed.

list name	HEELT2 in	HEELW	HEELT1 in
WLAH	18.0	C	24.0

ADD'L DATA FOR STRUCTURAL ANALYSIS, para 12-3-10

All of the default values in data lists C, D, [illegible] are acceptable, so the lists are not needed.

Reinforcing steel, para 12-3-11

Stem:

list name	LOC	ASTLST(LOC) [11]/1	LN	ASTLSH (LOC, LN) [11]/1
* STLS	1 (top)	0.89	1	0.89

toe:

list name	LOC	LNA	ASTLBT (LOC, LNA) [11]/1	LNB	ASTLBB (LOC, LNB) [11]/1
* STLB	1 (end)	1	0.89	1	0.89

heel: LOC at outer end: BW+1.9999 = 11+1.9999

= 12.9999

use LOC = 12 @ end

list name	LOC	LNA	ASTLBT (LOC, LNA)	LNB	ASTLBB (LOC, LNB)
* STLB	12	1	0.89	1	0.89

Put into data list form, with line numbers.

```
#LIST EXDATA

1000 INIT
1010 1
1020 R
1030 H
1040 NAME   ANALYSIS OF COMPLEX RETAINING WALL
1050 CASE 1  3
2000 SPTZ   0   30 0   0 0   120 0
2010 SPH1   0   30 0   0 0   120 0
3000 SST    0   77 0   100 0
3010 SSHC   0   87 29   6 0
4000 SPE3   18 0   0 0   120 0   18 0   0 0
5000 SCFV   3   400 0   7 0   800 0   4 0    400 0   7 0
5010 SCWV   3   600 0   3 0   0 5
6000 SLLP   3   77 0   84 5
7000 WLA   87 5   2 0   C   C
7010 WLAB   11 0   10 0   12 0   0 0
7020 WLAS   12 0   0 0   18 0   0 0   0 0   C
7030  WLAT   72 5   18 0   100 0   0 0   100 0
7040 WLAH   18 0   C   24 0
8000 STLS   1   0 89   1   0 89
8010 STLB   1   1   0 89   1   0 89
8020 STLB   12   1   0 89   1   0 89
9000 UPDATE

#



#RUN WES LIB/TWDA,R

         12/01/80     14 520


PROGRAM TWDA -- 713 F3 R0 027
    T WALL DESIGN/ANALYSIS
         REL 1 0   AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXUPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR  MAX
 ?T  WALLS
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EXDATA
PROCESSING DATA FILE

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPH1
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST   SPE3
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST   SCFV
TRAILING VALUES SET TO 'C'
```

```
NOT ENOUGH VALUES ENTERED IN DATA LIST - SCWV
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

*
* UPDATE FILE RESET
*

*
* DATA FILE PROCESSING DONE
*
* RETURN TO INTERACTIVE INPUT
*

COMMAND
=[illegible]



THE RESULTANT RATIO          0.3541, FOR LOAD CASE  3


FINAL FACTOR OF SAFETY AGAINST SLIDING =       1.01, FOR LOAD CASE  3
BY SHEAR FRICTION METHOD


TOTAL CONCRETE VOLUME =           35.38 (CU FT / LF), FOR LOAD CASE  3

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
         (MAKE HARD COPY BEFORE CARRIAGE RETURN)
         (NOTE   DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WC.)
   OR 0 TO OMIT THE PLOTS
=[illegible]

*
* UPDATE FILE RESET
*


*
* COMMAND DATA PHASE ENTERED
*

COMMAND
=RUN WA
*
* BEGIN MODULE WA
*

ENTER 1 TO SEE A TABLE OF X AND Y CORNER COORDINATES
   OR C TO CONTINUE WITHOUT SEEING THE TABLE
[illegible]

TO GET DEFAULT VALUE FOR "IFEM", ANSWER NEXT QUESTION WITH A CARRIAGE RETURN.

*** IFEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR     1 TO ALSO USE EM ALTERNATE SPECIAL LOADINGS
             (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
             VALUE OF 1)
    OR     ? FOR MORE INFORMATION
    OR     C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR     * TO ABORT THE MODULE

DEFAULT VALUE OF              1 USED
```

```
#
# BEGIN STRESS ANALYSIS
#

ENTER T TO GET THE ANALYSIS RESULTS AT YOUR TERMINAL
   OR R TO PUT THEM IN THE REPORT FILE
   OR B TO PUT THEM BOTH PLACES
?R

ENTER THE LOAD CASE NUMBER YOU WANT ANALYZED
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST "CASE"
   OR * TO STOP THE MODULE
?0
  0



### NUMBERS MUST BE INTEGER ### UNEXPECTED CHARACTER IN "0
                                                        0          " ###
TRY AGAIN (OR ? FOR PROMPTING OR * TO ABORT)--
?0

#
# BEGIN STEM STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *)
?N

#
# BEGIN TOE STRESS ANALYSIS
#

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *)
?C
  --> ANALYSIS WITHIN 1-FOOT OF END OF TOE IS MEANINGLESS <---

TOE ANALYSIS COMPLETE TO STEM

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *)
?S

BEGIN ANALYSIS AT SELECTED SECTIONS
END OF TOE IS AT X =  -7.000, STEM FACE AT    0.
POINT BETWEEN TOE SLOPE PANELS IS AT    0.

ENTER THE X COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
(OMIT SIGN OF X)
   OR N, R, OR * FROM TYPE SELECTION
?0 0

ENTER THE X COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
(OMIT SIGN OF X)
   OR N, R, OR * FROM TYPE SELECTION
?N



#
# BEGIN HEEL STRESS ANALYSIS
#
```

```
SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *)
?F

HEEL ANALYSIS COMPLETE TO END

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *)
 N

#
# MODULE WA COMPLETE
#

#
# UPDATE FILE RESET
#


#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?RO

SNUMB # 7790A

your update file for future restart is named EXAUPD
stop    OK (release unneeded files)

*


KKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKK
          14:32:29 ON 12/ 1/80



 NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE--

 THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
 THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

 A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.


 END OF NOTES.

 COMMAND ENTERED:
 INIT

 ** ALL DATA RESET FOR FRESH START **

 COMMAND ENTERED:
 R

 COMMAND ENTERED:
 H
```

AD-A100 734 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 13/
USER'S REFERENCE MANUAL: COMPUTER PROGRAM FOR DESIGN AND ANALYS--ETC
DEC 80 W A PRICE, R L HALL, H W JONES
UNCLASSIFIED WES-INSTRUCTION-K-80-7 NL

3 OF 4
AD A
0100734

END
DATE
FILMED
7-81
DTIC

Cont

```
14:32:51 ON 12/ 1/80

WALL DECLARED TO BE A HYDRAULIC RETAINING WALL

COMMAND ENTERED:
NAME  ANALYSIS OF COMPLEX RETAINING WALL

COMMAND ENTERED:
CASE 1  3

COMMAND ENTERED:
SPT7  0  30.0  0.0  120.0

COMMAND ENTERED:
SPH1  0  30.0  0.0  120.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPH1
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SST   0  77.0  100.0

COMMAND ENTERED:
SSHC  0  87.29  6.0

COMMAND ENTERED:
SPE3  18.0  0.0  120.0  18.0  0.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPE3
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SCEV  3  400.0  2.0  800.0  4.0   400.0  7.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SCEV
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SCWV  3  600.0  3.0  0.5

NOT ENOUGH VALUES ENTERED IN DATA LIST - SCWV
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SEEP  3  77.0  84.5

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
WLA  87.5  2.0  C  C

COMMAND ENTERED:
WLAB  11.0  10.0  12.0  0.0

COMMAND ENTERED:
WLAS  12.0  0.0  18.0  0.0  0.0  C

COMMAND ENTERED:
 WLAT  72.5  18.0  100.0  0.0  100.0

COMMAND ENTERED:
WLAH  18.0  C  24.0
```

```
COMMAND ENTERED:
STLS  1  0.89  1  0.89

COMMAND ENTERED:
STLB  1  1  0.89  1  0.89

COMMAND ENTERED:
STLB  12  1  0.89  1  0.89

COMMAND ENTERED:
UPDATE

*
* UPDATE FILE RESET
*


COMMAND ENTERED:


COMMAND ENTERED:
RUN FA



ANALYSIS OF COMPLEX RETAINING WALL
          14:36:51 ON 12/ 1/80


*
* BEGIN BASIC STABILITY DATA CHECK
*

DEFAULT VALUE OF     62.50000     USED FOR GAMAW      (LOAD CASE  3)

DEFAULT VALUE OF     150.0000     USED FOR GAMAC      (LOAD CASE  3)

DEFAULT VALUE OF     1.000000     USED FOR ESS        (LOAD CASE  3)

DEFAULT VALUE OF     2.000000     USED FOR EXW        (LOAD CASE  3)

DEFAULT VALUE OF   0.             USED FOR UCEXS3     (LOAD CASE  3)

DEFAULT VALUE OF   0.             USED FOR UCEXS4     (LOAD CASE  3)

DEFAULT VALUE OF   0.             USED FOR UCEXS5     (LOAD CASE  3)

DEFAULT VALUE OF   0.             USED FOR UCBFS1     (LOAD CASE  3)

DEFAULT VALUE OF   0.             USED FOR UCBFS2     (LOAD CASE  3)

DEFAULT VALUE OF   0.             USED FOR UCBFFZ     (LOAD CASE  3)

DEFAULT VALUE OF   0.             USED FOR UCBFS7     (LOAD CASE  3)

DEFAULT VALUE OF   0.             USED FOR UCBFS6     (LOAD CASE  3)

DEFAULT VALUE OF     1.000000     USED FOR UCWS       (LOAD CASE  3)

DEFAULT VALUE OF     1.000000     USED FOR UCWB       (LOAD CASE  3)

DEFAULT VALUE OF     1.000000     USED FOR UCWK       (LOAD CASE  3)

DEFAULT VALUE OF            2     USED FOR IFWOC      (LOAD CASE  3)

DEFAULT VALUE OF            1     USED FOR IFSOM      (LOAD CASE  3)
```

```
DEFAULT VALUE OF      1.000000      USED FOR CEMA         (LOAD CASE  3)

DEFAULT VALUE OF    0.3333333       USED FOR RRMIN        (LOAD CASE  3)

DEFAULT VALUE OF            2       USED FOR KRACK        (LOAD CASE  3)

DEFAULT VALUE OF     2.000000       USED FOR FSMIN        (LOAD CASE  3)

DEFAULT VALUE OF            1       USED FOR NSLIDE       (LOAD CASE  3)

DEFAULT VALUE OF    0.                USED FOR HGSW         (LOAD CASE  3)

DEFAULT VALUE OF     120.0000       USED FOR HSSSH        (LOAD CASE  3)

DEFAULT VALUE OF    0.                USED FOR DISSH        (LOAD CASE  3)




ANALYSIS OF COMPLEX RETAINING WALL
         14:36:51 ON 12/ 1/80


*
* BEGIN PART 2 OF STABILITY DATA CHECK
*


ANALYSIS OF COMPLEX RETAINING WALL
         14:36:51 ON 12/ 1/80


*
* BEGIN MODULE FA
*

VARIABLE HEELW CALCULATED          7.50 (BW-TW2-TSTB)
VARIABLE HSAPR CALCULATED OR DEFAULTED TO CLOSE COORDINATES,
         HSAPR =  0.461538 IN/FT.
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	87.5000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	74.0000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	73.0000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-2.0000	74.0000	TOP OF TOEHT = AT OUTER END OF TW2
5	-2.0000	72.5000	TOE END OF BASE = AT BTE1
10	9.0000	72.5000	HEEL END OF BASE
11	9.0000	74.0000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.5000	74.5000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.0000	87.5000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.0000	87.5000	TOP OF HEEL-SIDE FACE OF STEM

ANALYSIS OF COMPLEX RETAINING WALL
14:36:55 ON 12/ 1/80

*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

DEFAULT VALUE OF 0. USED FOR DELTA1(LC) (LOAD CASE 3)

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.3711
2	0.3711

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 3
FOR CLASSIC(COULOMB) ANALYSIS IN SA (END OF HEEL)

OUTPUT OF ARRAYS H, EH, AND VH IN MODULE SA FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
88.790	7.4212	0.
87.790	44.527	0.
86.790	89.055	0.
85.790	133.58	0.
84.790	176.73	0.
83.790	206.08	0.
82.790	227.51	0.
81.790	248.84	0.
80.790	270.18	0.
79.790	291.51	0.
78.790	312.85	0.
77.790	334.19	0.
76.790	355.52	0.
75.790	376.86	0.
74.790	398.19	0.
73.790	419.53	0.
72.790	281.10	0.
72.500	64.524	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 4238.20 LBS/HORIZ FT
ACTING AT ELEVATION 78.49

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE [illegible] WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 3

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	5306.25	0.	22028.13
ACTIVE EARTH	0.	4236.20	-25401.20
SOIL+WATER	13631.94	0.	93789.52
SURCHARGES	1593.12	0.	8824.35
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	20531.31	4236.20	99240.80

ANALYSIS OF COMPLEX RETAINING WALL
14:37:19 ON 12/ 1/80

*
* BEGIN THE OVERTURNING COMPUTATION
*

LOAD CASE 3

DEFAULT VALUE OF 1 USED FOR ISFT(LC) (LOAD CASE 3)

DEFAULT VALUE OF 3 USED FOR NPPD(LC) (LOAD CASE 3)

RESULTANT IS WITHIN THE KERN

CREEP PATH DESCRIPTION FOR LOAD CASE 3

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
9.00	84.50	0.
9.00	72.50	545.45
-2.00	72.50	357.95
-2.00	77.00	0.

OVERTURNING HYDRAULIC GRADIENT = 0.2727

```
> VALUE OF NPPD(LC)   FOUND =          3       IN S/R CHEKIT (LOAD CASE  3)
> VALUE OF ADHS3      FOUND =   0.             IN S/R CHEKRT (LOAD CASE  3)
> VALUE OF PHIS3      FOUND =    18.00000      IN S/R CHEKRT (LOAD CASE  3)
> VALUE OF ADHS4      FOUND =   0.             IN S/R CHEKRT (LOAD CASE  3)
> VALUE OF ADHS5      FOUND =   0.             IN S/R CHEKRT (LOAD CASE  3)
> VALUE OF PHIS4      FOUND =   0.             IN S/R CHEKRT (LOAD CASE  3)
> VALUE OF PHIS5      FOUND =   0.             IN S/R CHEKRT (LOAD CASE  3)
```

```
  AT BASE-SOIL INTERFACE:
    WEIGHTED AVERAGE COEFFICIENT OF FRICTION =        0.32
    WEIGHTED AVERAGE ADHESION                =        0.    (LBS/SQ.FT)
    EFFECTIVE BASE WIDTH                     =       11.00 (FEET)
    EFFECTIVE LENGTH ALONG BASE SLOPE        =       11.00 (FEET)
    NORMAL FORCE ACTING ON BASE              =    15562.56 (LBS/SLICE)
    FRICTIONAL FORCE                         =     5056.58 (LBS/SLICE)
    FORCE DUE TO ADHESION                    =        0.    (LBS/SLICE)
    TOTAL FORCE ALONG BASE                   =     5056.58 (LBS/SLICE)
    HORIZONTAL COMPONENT OF TOTAL FORCE      =     5056.58 (LBS/SLICE)
```

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  3

NPPD                                =        3
ELEVATION OF TOP OF SOIL            =   77.020      (FT)
PRESSURE AT TOP OF SOIL             =  0.           (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL   =   72.500      (FT)
PRESSURE AT LOWEST POINT ON WALL    =  -729.62      (LBS/SQ.FT)
PASSIVE EARTH FORCE                 =  -1648.9      (LBS/SLICE)
PASSIVE EARTH MOMENT                =   2484.4      (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT           =  3.90 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -4968.75 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     2467.33 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   =   -41101.56 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.3541, FOR LOAD CASE  3
```

```
ANALYSIS OF COMPLEX RETAINING WALL
        14:37:20 ON 12/ 1/80


*
* BEGIN SLIDING COMPUTATION
*


FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.01, FOR LOAD CASE  3
BY SHEAR FRICTION METHOD

    SUM OF DRIVING FORCES   =  6705.529 (LBS/SLICE)
    SUM OF RESISTING FORCES =  6802.335 (LBS/SLICE)

    PASSIVE EARTH FORCE                   =   1745.75 (LBS/SLICE)
    ACTIVE EARTH FORCE                    =   4238.20 (LBS/SLICE)
    UPLIFT FORCE                          =  -4968.75 (LBS/SLICE)
    SUMMATION OF HORIZONTAL WATER FORCES  =   2467.33 (LBS/SLICE)

     FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
         X          Y
       -2.00      72.50
        9.00      72.50


ANALYSIS OF COMPLEX RETAINING WALL
        14:37:21 ON 12/ 1/80


*
*  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
*


ELBSS SET TO 10 FEET BELOW LOWEST POINT ON BASE


ALLOWABLE BEARING PRESSURES WILL NOT BE COMPARED
TO THE ACTUAL BEARING PRESSURES BECAUSE THE ALLOWABLES WERE NOT DEFINED.


FOR LOAD CASE  3,

FOR THE BASE COORDINATES  X= -2.00  Y= 72.50, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =   2652.98 (LBS/SQ.FT)

FOR THE BASE COORDINATES  X=  9.00  Y= 72.50, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =    176.58 (LBS/SQ.FT)
```

ANALYSIS OF COMPLEX RETAINING WALL
14:37:21 ON 12/ 1/80

*
* BEGIN COST ANALYSIS
*

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	0.	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	0.	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	16.63	1.00	16.63
BASE	18.75	1.00	18.75
KEY	0.	1.00	0.

TOTAL CONCRETE VOLUME = 35.38 (CU FT / LF), FOR LOAD CASE 3

*
* BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE 3
*

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 72.50 IS 3.1898

```
ANALYSIS OF COMPLEX RETAINING WALL
        14:57:23 ON 12/ 1/80


*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*


 COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
    BACKFILL LAYER           KA VALUE
    ..............           ........
          1                   0.3886
          2                   0.3886

        HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  3
        FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

        OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

          ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                           STATIC FORCE          EARTHQUAKE FORCE
             (FT)           (LBS/FT)               (LBS/FT)
          ---------  ----------------------  ----------------------
          87.457            18.227                  0.
          86.457            105.75                  0.
          85.457            192.51                  0.
          84.457            249.94                  0.
          83.457            272.62                  0.
          82.457            282.26                  0.
          81.457            289.18                  0.
          80.457            296.85                  0.
          79.457            306.58                  0.
          78.457            318.57                  0.
          77.457            332.61                  0.
          76.457            348.36                  0.
          75.457            357.21                  0.
          74.500            180.20                  0.

        FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

        RESULTANT HORIZONTAL STATIC ACTIVE FORCE =     3550.87 LBS/HORIZ FT
        ACTING AT ELEVATION     79.95

        RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
        DUE TO EARTHQUAKE =         0.    LBS/HORIZ FT
        ACTING AT ELEVATION      0.


*
* EXIT MODULE EA
*


 *
 * UPDATE FILE RESET
 *

 COMMAND ENTERED:
 RUN KA
```

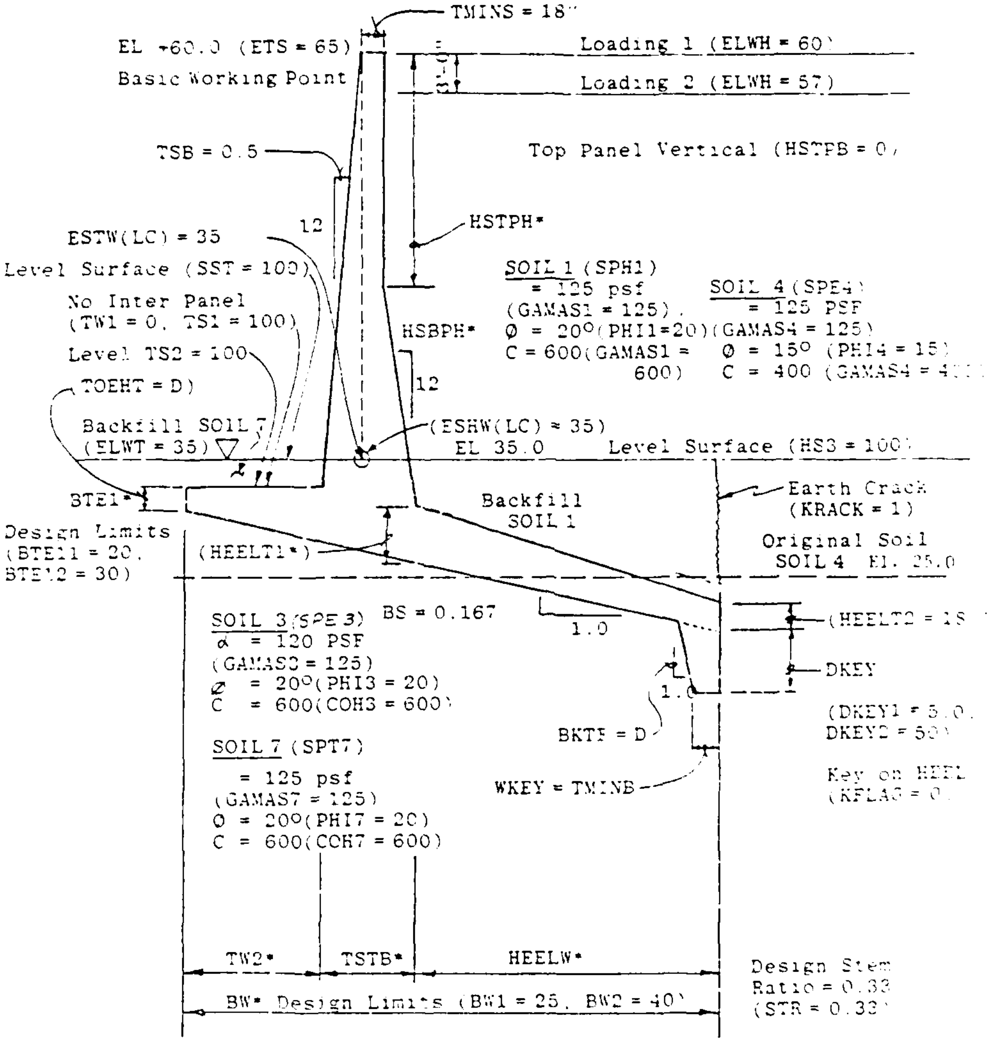
```
ANALYSIS OF COMPLEX RETAINING WALL
        14:39:41 ON 12/ 1/80

*
* BEGIN MODULE WA
*

DEFAULT VALUE OF    0.              USED FOR BASER       (LOAD CASE  3)

DEFAULT VALUE OF           0        USED FOR KFLAG       (LOAD CASE  3)

DEFAULT VALUE OF    0.              USED FOR OKEY        (LOAD CASE  3)

HEELW  CALCULATED TO BE      7.5000

STR    CALCULATED TO BE     0.18182

SLOPE OF TOP OF HEEL SLAB =  15.00 H : 1 V (100.0:1 = LEVEL)


             COORDINATES OF CORNERS OF WALL CROSS-SECTION

     X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
     Y-COORDINATES ARE ELEVATIONS

  PT.      X           Y                 DESCRIPTION OF POINT
  --   --------   ----------    ----------------------------------------
   1     0.        87.5000      BASIC WORKING POINT = TOE-SIDE OF STEM TOP
   2     0.        74.0000      BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
   3     0.        74.0000      BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
   4    -2.0000    74.0000      TOP OF TOEHT = AT OUTER END OF TW2
   5    -2.0000    72.5000      TOE END OF BASE = AT BTE1
  10     9.0000    72.5000      HEEL END OF BASE
  11     9.0000    74.0000      TOP OF HEELT2 = TOP OF OUTER END OF HEEL
  12     1.5000    74.5000      BOTTOM OF HEEL-SIDE FACE OF STEM
  13     1.0000    87.5000      BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
  14     1.0000    87.5000      TOP OF HEEL-SIDE FACE OF STEM
  15     8.5000    72.5000      BOTTOM OF CUTOFF WALL UNDER KEY


WITH BASE RADIUS ("BASER", 0.0 FOR RECTANGULAR) =       0.    FEET,
TOE END OF BASE UNIT WIDTH =   1.0000 FT. AND
HEEL END OF BASE UNIT WIDTH =  1.0000 FT.
(BASIC WORKING POINT IS 1.0 FT. WIDE).


WALL DATA LISTS:

WLA     ETS            TW2            STR           HEELW
    87.50000       2.000000       0.1818182       7.500000

WLAB    BW             HS                             BASER (LIST=WLBB)
    11.00000     0.                               0.

WLAH  HEELT2          HEELW          HEELT1
    18.00000       7.500000       23.00000
```

```
WLAK   KFLAG              DKEY            WKEY            HKTF
         0           0.              0.            100.0000

WLAS    TSTI              TSB             TSTH            HSTPH            HSTPB
      12.00000       0.             18.00000        0.               0.
       HSRPH
     0.4615385

WLAT    HTF1              TOFHT           TS2             TW1              TS1
      72.50000       18.00000       100.0000        0.               100.0000

----   TMINB              TMINS
    -0.1234000E 31 -0.1234000E 31


LOWEST CONCRETE =       72.50 FT., AT HEEL END OF BASE
COMPARED WITH THE PREVIOUS LOW OF  72.500000     FT.

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   3 ----------

EH TOP CALCULATED TO BE      84.500
FOR LOAD CASE  3

> NPPD    IS           3

  --------------- END OF PRESSURE DATA VERIFICATION ----------------

DEFAULT VALUE OF     3000.000      USED FOR    FPCON     (LOAD CASE   3)

DEFAULT VALUE OF   0.2900000E 08  USED FOR    ESTL      (LOAD CASE   3)

DEFAULT VALUE OF     9.190000      USED FOR    RATION    (LOAD CASE   3)

DEFAULT VALUE OF    0.3500000      USED FOR    RATIOF    (LOAD CASE   3)

DEFAULT VALUE OF     20000.00      USED FOR    FSTLMX    (LOAD CASE   3)

DEFAULT VALUE OF            0      USED FOR    IFDR      (LOAD CASE   3)

DEFAULT VALUE OF     3.500000      USED FOR    COVHS     (LOAD CASE   3)

DEFAULT VALUE OF     3.500000      USED FOR    COVTS     (LOAD CASE   3)

DEFAULT VALUE OF     3.500000      USED FOR    COVTH     (LOAD CASE   3)

DEFAULT VALUE OF     4.500000      USED FOR    COVBB     (LOAD CASE   3)

DEFAULT VALUE OF     2.370000      USED FOR    SPAHL     (LOAD CASE   3)

COMBINED PASSIVE PRESSURE VALUE OF  -729.6231      USED FOR LOAD CASE   3


ANALYSIS OF COMPLEX RETAINING WALL
         14:40:44 ON 12/ 1/80


#
# BEGIN STRESS ANALYSIS
#


ANALYSIS OF COMPLEX RETAINING WALL
         14:50:43 ON 12/ 1/80


#
# BEGIN STEM STRESS ANALYSIS
#
```

```
ANALYSIS OF COMPLEX RETAINING WALL
        14:51:27 ON 12/ 1/80

#
# BEGIN TOE STRESS ANALYSIS
#

SHEAR AT A DISTANCE D FROM THE STEM--
---> ANALYSIS WITHIN 1-FOOT OF END OF TOE IS MEANINGLESS <---

MOMENT AT THE STEM (POINT 2)--

----- SECTION PROPERTIES AT X = -0.001  ( 1.999 FEET FROM END OF TOE) -----
MOM.  COMP. FACE   OVERALL    EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----   -----
 +       12.00      18.00       14.50        0.89       TOP   0.263   0.912
 -       12.00      18.00       13.50        0.89       BOTT  0.271   0.910

FLEXURE ANALYSIS AT X = -0.001 ( 1.999 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC      FS
CASE  LB / SLICE  LB-FT/SLICE    PSI      PSI
----  ----------  -----------  -----   ------
 3        913.        -3891.    188.    3623.
     ALTERNATE LOAD CASE  3 ANALYSIS FOR VERT. LOADS ONLY:
 3          0.        -3936.    175.    4322.

SHEAR AND MOMENT AT X =    0.

----- SECTION PROPERTIES AT X =  0.      ( 2.000 FEET FROM END OF TOE) -----
MOM.  COMP. FACE   OVERALL    EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----   -----
 +       12.00      18.00       14.50        0.89       TOP   0.263   0.912
 -       12.00      18.00       13.50        0.89       BOTT  0.271   0.910

--- SHEAR ANALYSIS AT X =  0.     ( 2.000 FROM END OF TOE) (+ V = END DOWN) ---
LOAD       V            N (COMP +)        M          UNIT SHEAR   ALLOWABLE  ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS PSI  UNIT STRESS PROVISION
----  ----------    ----------   -----------   ----------  ----------- ---------
 3    -3898.0        912.84       -3937.1        24.062       60.402    8.7.4.5
     ALTERNATE LOAD CASE  3 ANALYSIS FOR VERT. LOADS ONLY:
 3    -3898.0        0.           -3982.5        24.062       61.914    8.7.4.4 B

FLEXURE ANALYSIS AT X =  0.     ( 2.000 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC      FS
CASE  LB / SLICE  LB-FT/SLICE    PSI      PSI
----  ----------  -----------  -----   ------
 3        915.        -3937.    190.    3673.
     ALTERNATE LOAD CASE  3 ANALYSIS FOR VERT. LOADS ONLY:
 3          0.        -3983.    177.    4373.
```

```
ANALYSIS OF COMPLEX RETAINING WALL
        14:54: 6 ON 12/ 1/80

#
# BEGIN HEEL STRESS ANALYSIS
#

SHEAR AND MOMENT AT THE STEM--

----- SECTION PROPERTIES AT X =  1.501  ( 7.499 FEET FROM END OF HEEL) ----
MOM.  COMP. FACE   OVERALL   EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----   -----
 +       12.00      24.00      20.50        0.89        TOP   0.227  0.924
 -       12.00      24.00      19.50        0.89        BOTT  0.232  0.923

--- SHEAR ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V          N (COMP +)       M          UNIT SHEAR   ALLOWABLE  ACI318-77
CASE  LB / SLICE   LB / SLICE  LB-FT/SLICE   STRESS PSI  UNIT STRESS PROVISION
----  ----------   ----------  -----------   -----------  ----------- ---------
 3      3556.8       679.03      20858.        14.459       60.335    8.7.4.5
     ALTERNATE LOAD CASE  3 ANALYSIS WITHOUT PASSIVE (MAX +M AT STEM):
 3      3556.8       1176.5      21355.        14.459       60.397    8.7.4.5
     ALTERNATE LOAD CASE  3 ANALYSIS WITHOUT HORIZ. EFFECTS (MAX -M AT STEM):
 3      3556.8       0.          21225.        14.459       56.119    8.7.4.4 A

FLEXURE ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD   N (COMP=+)        M          FC       FS
CASE  LB / SLICE   LB-FT/SLICE    PSI      PSI
----  ----------   -----------   -----   ------
 3        679.         20858.     484.   14420.
     ALTERNATE LOAD CASE  3 ANALYSIS WITHOUT PASSIVE (MAX +M AT STEM):
 3       1177.         21355.     504.   14466.
     ALTERNATE LOAD CASE  3 ANALYSIS WITHOUT HORIZ. EFFECTS (MAX -M AT STEM):
 3          0.         21225.     482.   15102.

#
# MODULE HA COMPLETE
#

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
```

The objective of this example is to demonstrate stability and member design of a complex floodwall. Data will be in a Command-Data file named FWTEX3. Program control will be interactive at the time-share-terminal.



*To be calculated by Program Input C in Data File.

Data Preparation.

The data file begins with four lines of data which.

(1) initiates the data for a new run,
(2) designates that there will be two load cases,
(3) designates the wall as a floodwall,
(4) designates the wall as a hydraulic structure.

```
50 INIT
60 2
70 F
80 H
```

The fifth data line is optional and it will cause the message "Floodwall Example 3 (Design/Complex Wall)" to be printed in the output.

```
90 NAME FLOODWALL EXAMPLE 3 (DESIGN/COMPLEX WALL)
```

The next five data lines describe the wall concrete geometry.

Stem Lists.

```
    WLD  ETS  TW2  STR   HEELW  TSTB  TMINB
100 WLD  60   C    0.33  C      C     18
```

LIST WLD

ETS -------------- Elevation of top of stem in feet.
TW2 -------------- Width of entire toe in feet.
STR -------------- Stem ratio.
HEELW ------------ Width of heel in feet.
TSTB ------------- Stem thickness at base in inches.
TMINB ------------ Minimum allowable base slab in inches.

```
    WLDS  TMINS  TSB  HSTPH  HSTPB  HSBPB
110 WLDS  18     0.5  C      0      C
```

LIST WLDS

TMINS ------------ Minimum allowable stem thickness in inches.
TSB -------------- Stem toe-side batter, inches horizontal per foot vertical.
HSTPH ------------ Stem heel side top panel height in feet.
HSTPB ------------ Stem heel side top panel batter, inches horizontal per foot vertical.
HSBPB ------------ Stem heel side bottom panel batter, inches horizontal per foot vertical.

Base Lists.

```
    WLDB   BW1    BW2    BS1    BS2
120 WLDB    25     40   0.167  0.167
```

<u>LIST WLDB</u>

```
BW1 -------------- Minimum trial value for base width in feet.
BW2 -------------- Maximum trial value for base width in feet.
BS1 -------------- Minimum trial base bottom slope ratio,
                   BS1 vertical to 1.0 horizontal, BS1 = 0
                   for horizontal.
BS2 -------------- Maximum trial base bottom slope ratio,
                   BS2 vertical to 1.0 horizontal.
```

```
    WLDT   BTE11   BTE12   TOEHT   TW1
130 WLDT    20      30       D      0
```

<u>LIST WLDT</u>

```
BTE11 ------------ Lowest trial value of elevation of bottom
                   of toe at end.
BTE12 ------------ Highest trial value of elevation of bottom
                   of toe at end.
TOEHT ------------ Toe thickness at end in inches. default = TMINB.
```

```
    WLDK   KFLAG   BKTF   DKEY1   DKEY2
140 WLDK     0      D       5       5
```

<u>LIST WLDK</u>

```
KFLAG ------------ 0 if key is at end of heel; 1 if key is
                   under stem.
BKTF ------------- Key toe side face batter, 1.0 horizontal
                   to BKTF vertical, default = 3.0.
DKEY1 ------------ Minimum trial value for key length in feet.
DKEY2 ------------ Maximum trial value for key length in feet.
```

The next seven data lines describe the soil geometry and properties.

First describe the original soil before the wall is constructed.

Describe original ground surface and excavation limits.

```
    SSEE   EXW   ESS   HSS5T   ELTS5T   DTS5T   ELTS5W   ELTS5H
                                                DTS5H    HSS5H
150 SSEE    D     D     100      35       0       35       35
                                                   0      100
```

LIST SSEE

EXW -------------- Extra Width of excavation at each side for construction in feet. Default = 2.0.
ESS -------------- Excavation side slope, 1.0 vertical to ESS horizontal. Default = 1.0.
HSS5T ------------ Existing ground slope beyond ELTS5T (toe side), 1.0 vertical to HSS5T horizontal. Level = 100.
ELTS5T ----------- Elevation of existing ground at a distance of DTS5T from the basic working line.
DTS5T ------------ Horizontal distance from basic working point to ELTS5T, toward toe in feet.
ELTS5W ----------- Elevation of existing ground directly under basic working point.
ELTS5H ----------- Elevation of existing ground at a distance of ELTS5H from the basic working point toward the heel.
DTS5H ------------ Horizontal distance in feet from the basic working point to ELTS5H, toward the heel.
HSS5H ------------ Existing ground side slope key and ELTS5H (heel side), 1.0 vertical to HSS5H horizontal, 100.0 if level.

Original Soil Properties.

	SPE3	PHIS	COHS	GAMAS3	PHIS3	ADHS3 ABP3TW	ABP3TN ABP3BW	ABP3BN ELBS3
160	SPE3	20	600	120	20	600 3150	2150 6150	5150 0

LIST SPE3

PHI3 ------------- Soil angle of internal friction in degrees.
COH3 ------------- Soil cohesive strength, psf.
GAMAS3 ----------- Soil unit weight including water if submerged, psf.
PHIS3 ------------ Angle of sliding friction between soil and concrete in degrees.
ADHS3 ------------ Adhesive strength between soil and concrete, psf.
ABP3TN ----------- Allowable gross bearing pressure under a base BW1 feet wide at top of soil zone SPE3, psf.
ABP3BN ----------- Allowable gross bearing pressure under a base BW1 feet wide at elevation ELBS3, psf.
ABP3TW ----------- Allowable gross bearing pressure under a base BW2 feet wide at top of soil zone SPE3, psf.
ABP3BW ----------- Allowable gross bearing pressure under a base BW2 feet wide at elevation EKBS3, psf.
ELBS3 ------------ Elevation used as a base for ABP3BN and ABP3BW. Must be below all concrete.

```
    SPE4   ELTS3   PHI4   COH4   GAMAS4   PHIS4    ADHS4    ABP4TN
                                          ABP4BN   ABP4TW   ABP4BW
170 SPE4    25      15     400    125      15       400      1500
                                           2500     2150     3150
```

LIST SPE4

ELTS3 ------------ Elevation of top of layer SPE3.
PHI4 ------------- Soil angle of internal friction in degrees.
COH4 ------------- Soil cohesive strength, psf.
GAMAS4 ----------- Soil unit weight including water if submerged, psf.
PHIS4 ------------ Angle of sliding friction between soil and concrete in degrees.
ADHS4 ------------ Adhesive strength between soil and concrete, psf.
ABP4TN ----------- Allowable gross bearing pressure under a base BW1 feet wide at the top of SPE4, psf.
ABP4BN ----------- Allowable gross bearing pressure under a base BW1 feet wide at the bottom of SPE4, psf.
ABP4TW ----------- Allowable gross bearing pressure under a base BW2 feet wide at the top of SPE4, psf.
ABP4BW ----------- Allowable gross bearing pressure under a base BW2 feet wide at the bottom of SPE4, psf.

Describe the final soil after the wall is constructed.

Final Soil Surface.

```
    SSHC   LC   ESHW   HS3
180 SSHC   0     35    100
```

LIST SSHC

LC --------------- Load case number for remainder of items in list. 0 for all load cases.
ESHW ------------- Elevation of backfill earth cover over the heel where it passes directly underneath the basic working point.
HS3 -------------- Slope of backfill earth cover over the toe 1.0 vertical to HS3 horizontal, Level = 100.0.

```
    SST   LC   ESTW   SST
190 SST   0     35    100
```

LIST SST

LC --------------- Load case number for remainder of items in list. 0 for all load cases.
ESTW ------------- Elevation of backfill earth cover over the toe where it passes directly underneath the basic working point.
SST -------------- Slope of backfill earth cover over the toe. 1.0 vertical to SST horizontal. Level = 100.0

Backfill Soil Over the Heel.

```
    SPH1   LC   PHI1   COH1   GAMAS1   RKA1   DELTA1   RKAE1   HCMIN
200 SPH1   0    20     600    125      C      0        0       0
```

<u>LIST SPH1</u>

```
LC -------------- Load case number for remainder of items in
                  list.  0 for all load cases.
PHI1 ------------ Angle of internal friction in degrees.
COH1 ------------ Cohesive strength in psf.
GAMAS1 ---------- Unit weight of soil including weight of
                  water if submerged in psf.
RKA1 ------------ Active earth pressure coefficient.  Will be
                  ignored if IFWOC = 1.0.
DELTA1 ---------- Wall friction angle for pressures on face
                  of stem.
RKAE1 ----------- Monobe-Okabe earthquake active pressure factor.
HCMIN ----------- Minimum allowable earth cover over the heel,
                  measured vertically in feet.  Default value
                  follows EM 1110-2-2501.
```

Backfill Soil Over the Toe.

```
    SPT7   LC   PHI7   COH7   GAMAS7
210 SPT7   0    20     600    125
```

<u>LIST SPT7</u>

```
LC -------------- Load case number for remainder of items in
                  list.  0 for all load cases.
PHI7 ------------ Angle of internal friction in degrees.
COH7 ------------ Cohesive strength in psf.
GAMAS7 ---------- Unit weight of soil including weight of
                  water if submerged in psf.
```

The next two data lines describe the water elevations and design seepage conditions to be used for the two design loading conditions.

```
    SEEP   LC   ELWT   ELWH   HGSW   ISLC   ISFT   KRACK
220 SEEP   1    35     60     0      1      1      1
230 SEEP   2    35     57     0      1      1      1
```

<u>LIST SEEP</u>

```
LC -------------- Load case number for remainder of items in
                  list.  0 for all load cases.
ELWT ------------ Elevation of water over the toe.
ELWH ------------ Elevation of water over the heel.
HGSW ------------ Soils weight change due to hydraulic gradient.
```

ISLC ------------ 1 if each load case is to determine its own seepage pressure; 2 if first load case number in list CASE is to determine seepage pressure for all cases.

ISFT ------------ 1 for line of creep calculations as described in EM 1110-2-2501. 2 4, see user reference manual for description.

KRACK ----------- 1 is to have a vertical crack in the earth cover over the heel. 2 is to have no crack over the heel.

No data lists are needed for concrete design parameters if default values specified in program are to be used. See user reference manual for default values and for lists to input values different from default values.

The next data line is optional and it will update the update file (FWUEX3) after the data is read from the command data file (FWIEX2). This is desirable so that the program may be restarted from the update file.

240 UPDATE

The next data list will return control to the time-share-terminal keyboard after the data is read from the command data file (FWIEX3).

250 KEY

End of data preparation.

```
#RUN WESEED TWDA,R

        12/02/80    15.015

:

PROGRAM TWDA     713 E3 RO 027
   T WALL DESIGN/ANALYSIS
       REL 1.2  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (2 CHAR MAX)
[illegible]


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
[illegible]
ENTER YOUR MACON ACCOUNT NUMBER
=[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
=EXDATA
PROCESSING DATA FILE...

*
* UPDATE FILE RESET
*

COMMAND
=RUN ED
*
* BEGIN [illegible] ED
*


***
***  PROGRAM WAS UNABLE TO DESIGN WALL WITHIN
***  THE DESIGN LIMITS SPECIFIED
***
***  AN ANALYSIS OF THE LAST TRY AT A DESIGN
***  WITHIN THE SPECIFIED LIMITS FOLLOWS:
***


BASE DEFLECTION:
   DATA    LOWEST     BETWEEN THE LIMITS
   ITEM    COST
   NAME    VALUE       LOWER      UPPER              DESCRIPTION

   ELEL    [illegible]   50.00      60.00    ELEV. OF BOTTOM OF TOE END
   BW        30.00      25.00      35.00    BASE WIDTH
   B       [illegible]  0.16?00    0.12?00   BASE SLOPE, [illegible]
   DELS    [illegible]    5.00       5.00    [illegible]
```

```
THE RESULTANT RATIO        0.2624, FOR LOAD CASE  1

THE RESULTANT RATIO =      0.3523, FOR LOAD CASE  2

FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.84, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  ( [illegible] )     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING        2.31, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  ( [illegible] )     TANPHI'=TANPHI/FS

*** ALLOWABLE BASE PRESSURE IS LESS THAN THE ACTUAL FOR LOAD CASE  1

FOR THE BASE COORDINATES  X= 14.94  Y= 20.00, THE ABSOLUTE VALUE OF:
THE  ALLOWABLE BEARING PRESSURE    =   3182.63 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =   3404.56 (LBS/SQ.FT)

TOTAL CONCRETE VOLUME          292.50 (CU FT / LF), FOR LOAD CASE  1

TOTAL CONCRETE VOLUME          292.50 (CU FT / LF), FOR LOAD CASE  2

*** WITH UPDATE FILE NOT RESET,

*
* UPDATE FILE RESET
*

*
* COMMAND DATA PHASE ENTERED
*

COMMAND
SOLVE  [illegible]  48  [illegible]  S

COMMAND
[illegible]
*
* BEGIN MODULE [illegible]
*

FOUNDATION STABILITY DESIGN SUMMARY

BASE DESCRIPTION:
```

BASE ITEM NAME	FOUND VALUE	BETWEEN THE LIMITS LOWER	UPPER	DESCRIPTION
[illegible]	14.00	[illegible]	30.00	ELEV. OF BOTTOM OF TOE END
[illegible]	13.50	25.00	48.00	BASE WIDTH
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```
*
* BEGIN MODULE FA
*

THE RESULTANT RATIO =       0.3430, FOR LOAD CASE  1

THE RESULTANT RATIO =       0.3880, FOR LOAD CASE  2

FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.50, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.91, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

TOTAL CONCRETE VOLUME =        261.34 (CU FT / LF), FOR LOAD CASE  1

TOTAL CONCRETE VOLUME =        261.34 (CU FT / LF), FOR LOAD CASE  2

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR 0 TO OMIT THE PLOTS
?0

*
* UPDATE FILE RESET
*

*
* COMMAND-DATA PHASE ENTERED
*

COMMAND
?RUN WD
*
* BEGIN DATA CHECK FOR MODULE WD
*

COMPLETE THE TRIAL WALL DESCRIPTION:

TO GET DEFAULT VALUE FOR 'IFEM', ANSWER NEXT QUESTION WITH A CARRIAGE RETURN:

*** IFEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR     1 TO ALSO USE EM ALTERNATE SPECIAL LOADINGS
             (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
             VALUE OF 1)
    OR     ? FOR MORE INFORMATION
    OR     C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR     * TO ABORT THE MODULE
?
DEFAULT VALUE OF            1 USED.
```

```
ENTER THE LOAD CASE NUMBER YOU WANT TO DESIGN FOR
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST 'CASE'
   OR A * TO ABORT THE MODULE
?0

*
* DESIGN SUMMARY
*

WLA      ETS            TW2           STR          HEELW
     60.00000       14.15892      0.3331511     23.55008

WLAB     RW             BS                         BASER (LIST=WLBR)
     42.50000       0.1670000                   0.

WLAH   HEELT2          HEELW         HEELT1
     18.00000       23.55008      45.92278

WLAK   KFLAG            DKEY          WKEY         BKTF
        0           5.000000      18.00000      28.15253

WLAS    TSTT            TSB           TSTB         HSTPH          HSTPB
     18.00000       0.5000000     57.49196      20.18084      0.
      HSBPB
     1.462572

WLAT    BTE1           TOEHT          TS2          TW1            TS1
     24.00000       18.00000      100.0000      0.             100.0000

----   TMINB          TMINS
     18.00000       18.00000

*
* UPDATE FILE RESET
*


*
* COMMAND-DATA PHASE ENTERED
*

COMMAND
?END

ENTER S TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?S
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?RO

SNUMB * 3131B


your update file for future restart is named EXBUFD
stop    OK (release unneeded files)

*
```

```
&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
          15: 61 1 ON 12/ 2/80


 NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE--

 THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
 THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

 A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.


 END OF NOTES.

 COMMAND ENTERED:
 INIT

 *- ALL DATA RESET FOR FRESH START -*

 COMMAND ENTERED:
 F

 COMMAND ENTERED:
 H



          15: 6:23 ON 12/ 2/80

WALL DECLARED TO BE A HYDRAULIC FLOOD WALL


COMMAND ENTERED:
NAME FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)

COMMAND ENTERED:
WLD 60 C .33 C C 18

COMMAND ENTERED:
WLDS 18 .5 C 0 C

COMMAND ENTERED:
WLDB 25 40 .167 .167

COMMAND ENTERED:
WLDT 20 30 D 0

COMMAND ENTERED:
WLDK 0 D 5 5

COMMAND ENTERED:
SSEE D D 100 35 0 35 35 0 100

COMMAND ENTERED:
SPE3 20 600 120 20 600 2150 5150 3150 6150 0

COMMAND ENTERED:
SPE4 25 15 400 125 15 400 1500 2500 2150 3150

COMMAND ENTERED:
SSHC 0 35 100
```

```
COMMAND ENTERED:
SST 0 35 100

COMMAND ENTERED:
SPH1 0 20 600 125 C 0 0 D

COMMAND ENTERED:
SPT7 0 20 600 125

COMMAND ENTERED:
SEEP 1 35 60 0 1 1 1

COMMAND ENTERED:
SEEP 2 35 57 0 1 1 1

COMMAND ENTERED:
UPDATE

*
* UPDATE FILE RESET
*




COMMAND ENTERED:
KEY

COMMAND ENTERED:
RUN FD




FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
          15: 8:25 ON 12/ 2/80


 *
 * BEGIN BASIC STABILITY DATA CHECK
 *

 DEFAULT VALUE OF     62.50000      USED FOR GAMAW       (LOAD CASE  1)

 DEFAULT VALUE OF     150.0000      USED FOR GAMAC       (LOAD CASE  1)

 DEFAULT VALUE OF     1.000000      USED FOR ESS         (LOAD CASE  1)

 DEFAULT VALUE OF     2.000000      USED FOR EXW         (LOAD CASE  1)

 DEFAULT VALUE OF    0.             USED FOR UCEXS3      (LOAD CASE  1)

 DEFAULT VALUE OF    0.             USED FOR UCEXS4      (LOAD CASE  1)

 DEFAULT VALUE OF    0.             USED FOR UCEXS5      (LOAD CASE  1)
```

```
DEFAULT VALUE OF    0.          USED FOR UCBFS1     (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFS2     (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFFZ     (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFS7     (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFS6     (LOAD CASE  1)
DEFAULT VALUE OF     1.000000   USED FOR UCWS       (LOAD CASE  1)
DEFAULT VALUE OF     1.000000   USED FOR UCWB       (LOAD CASE  1)
DEFAULT VALUE OF     1.000000   USED FOR UCWK       (LOAD CASE  1)
DEFAULT VALUE OF            2   USED FOR IFWOC      (LOAD CASE  1)
DEFAULT VALUE OF            1   USED FOR IFSOM      (LOAD CASE  1)
DEFAULT VALUE OF     1.000000   USED FOR CFMA       (LOAD CASE  1)
NO DEFAULT VALUE FOR RRMIN    SO SET TO UNDEFINED   (LOAD CASE  1)
DEFAULT VALUE OF     1.500000   USED FOR FSMIN      (LOAD CASE  1)
DEFAULT VALUE OF            2   USED FOR NSLIDE     (LOAD CASE  1)
DEFAULT VALUE OF            2   USED FOR IFWOC      (LOAD CASE  2)
DEFAULT VALUE OF            1   USED FOR IFSOM      (LOAD CASE  2)
DEFAULT VALUE OF     1.000000   USED FOR CFMA       (LOAD CASE  2)
NO DEFAULT VALUE FOR RRMIN    SO SET TO UNDEFINED   (LOAD CASE  2)
DEFAULT VALUE OF     1.500000   USED FOR FSMIN      (LOAD CASE  2)
DEFAULT VALUE OF            2   USED FOR NSLIDE     (LOAD CASE  2)
```

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
          15: 8:25 ON 12/ 2/80

 #
 # BEGIN MODULE FD
 #

SUBR FD, WARNING, VARIABLE ELSPT UNDEFINED,
CREEP RATIO WILL BE CALCULATED WITHOUT SHEET PILE CUTOFF,
SUBR FD, WARNING, VARIABLE CRMIN UNDEFINED,
SHEET PILE TIP ELEVATION WILL NOT BE CALCULATED,

###
###  PROGRAM WAS UNABLE TO DESIGN WALL WITHIN
####  THE& DESIGN &LIMITS SPECIFIED
###
###  AN ANALYSIS OF THE LAST TRY AT A DESIGN
###  WITHIN THE SPECIFIED LIMITS FOLLOWS:
###


BASE DESCRIPTION:
   DATA   LOWEST    BETWEEN THE LIMITS
   ITEM    COST     ------------------
   NAME    VALUE     LOWER      UPPER              DESCRIPTION
   ----  ---------  --------   -------   ------------------------------
   BTE1     20,00      20,00     30,00   ELEV, OF BOTTOM OF TOE END
   BW       40,00      25,00     40,00   BASE WIDTH
   BS     0,16700    0,16700   0,16700   BASE SLOPE, X VERT, TO 1 HORIZ,
   DKEY      5,00       5,00      5,00   KEY LENGTH BELOW BASE


 #
 # BEGIN MODULE FA
 #




FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
          15:21:48 ON 12/ 2/80



 #
 # BEGIN PART 2 OF STABILITY DATA CHECK
 #
```

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
          15:21:48 ON 12/ 2/80


*
* BEGIN MODULE FA
*

VARIABLE TW2 CALCULATED =       13.33 (BW-STB)
VARIABLE HEELW CALCULATED        19.72 (BW-TW2-TSTB)
VARIABLE HEELT1 UNDEF, NO DEFAULT REQUESTED.
VARIABLE HEELT1 ASSIGNED DEFAULT TO PRECLUDE ABORT.


                  COORDINATES OF CORNERS OF WALL CROSS-SECTION

             X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
             Y-COORDINATES ARE ELEVATIONS

     PT.     X           Y                  DESCRIPTION OF POINT
     --   --------   ----------   ----------------------------------------------
      1     0.         60.0000    BASIC WORKING POINT = TOE-SIDE OF STEM TOP
      2    -1.6042     21.5000    BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
      3    -1.6042     21.5000    BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
      4   -14.9375     21.5000    TOP OF TOEHT = AT OUTER END OF TW2
      5   -14.9375     20.0000    TOE END OF BASE = AT BTE1
      6    21.7092     13.8800    TOP OF TOE-SIDE FACE OF KEY
      7    23.5625      8.3200    BOTTOM OF TOE-SIDE FACE OF KEY
      8    25.0625      8.3200    BOTTOM OF HEEL-SIDE FACE OF KEY
      9    25.0625     13.3200    TOP OF HEEL-SIDE FACE OF KEY
     10    25.0625     13.3200    HEEL END OF BASE
     11    25.0625     14.8200    TOP OF HEELT2 = TOP OF OUTER END OF HEEL
     12     5.3453     20.6128    BOTTOM OF HEEL-SIDE FACE OF STEM
     13     1.5000     42.0000    BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
     14     1.5000     60.0000    TOP OF HEEL-SIDE FACE OF STEM
     15-.1234E 31       8.3200    BOTTOM OF CUTOFF WALL UNDER KEY


*** NOTE *** T-WALLS OVER 28.0 FEET HIGH MAY BE UNECONOMICAL
WITH CANTILEVER STEMS.


* HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
* BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
* AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
* ARE UNDEFINED, ZERO, OR NEGATIVE.


THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND
THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT
ARE NOT INCLUDED HERE.  "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE
IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.
```

LOAD CASE 1	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	43874,73	0,	816349,17
ACTIVE EARTH	0,	0,	0,
SOIL+WATER	102113,69	0,	2496563,63
SURCHARGES	0,	0,	0,
DIRECT LOADS	0,	0,	0,
WIND	0,	0,	0,
EARTHQUAKE	0,	0,	0,
TOTAL	145988,42	0,	3312912,78

* HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
* BECAUSE YOUR KREACH VALUE OF 1 CANCELS ACTIVE EARTH
* AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
* ARE UNDEFINED, ZERO, OR NEGATIVE.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 2	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	43874,73	0,	816349,17
ACTIVE EARTH	0,	0,	0,
SOIL+WATER	97695,73	0,	2371894,06
SURCHARGES	0,	0,	0,
DIRECT LOADS	0,	0,	0,
WIND	0,	0,	0,
EARTHQUAKE	0,	0,	0,
TOTAL	141570,46	0,	3188243,22

```
FLOODWALL EXAMPLE   (DESIGN/COMPLEX WALL)
         15:21:51 ON 12/ 2/80


*
* BEGIN THE OVERTURNING COMPUTATION
*



     LOAD CASE   1



RESULTANT IS OUTSIDE THE KERN ON THE TOE SIDE

 EFFECTIVE BASE =  31.49 (FT),
 COORDINATES OF ZERO PRESSURE ON THE BASE:
    XZ =  16.55 AND YZ =  14.74

CREEP PATH DESCRIPTION FOR LOAD CASE 1

X-COORDINATES     Y-COORDINATES     HYDROSTATIC PRESSURE
   25.06              60.00                    0.
   25.06               8.32                 3230.00
   25.06               8.32                 3230.00
   23.56               8.32                 3230.00
   21.71              13.88                 2882.50
   16.55              14.74                 2828.67
  -14.94              20.00                 1436.96
  -14.94              35.00                    0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.5328


 > VALUE OF NPPD(LC)   FOUND =         1      IN S/R CHEKIT (LOAD CASE  1)



 PASSIVE EARTH PRESSURES FOR LOAD CASE  1

 NPPD                              =        1
 ELEVATION OF TOP OF SOIL          =   35.149     (FT)
 PRESSURE AT TOP OF SOIL           =  0.          (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE        =   20.000     (FT)
 PRESSURE AT BOTTOM OF TOE         =  -2182.2     (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL =   8.3200     (FT)
 PRESSURE AT LOWEST POINT ON WALL  =  -2182.2     (LBS/SQ.FT)
 PASSIVE EARTH FORCE               =  -42018.     (LBS/SLICE)
 PASSIVE EARTH MOMENT              =  -65581.     (FT-LBS/SLICE)
```

```
DISTANCE FROM THE TOE TO THE RESULTANT          = 10,49 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -92384,68 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     42021,48 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   = -2685008,63 (FT-LBS/SLICE)


THE RESULTANT RATIO =       0,2624, FOR LOAD CASE   1



    LOAD CASE    2



RESULTANT IS WITHIN THE KERN


CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   25,06              57,00                   0,
   25,06               8,32                3042,50
   23,56               8,32                3007,84
   21,71              13,88                2524,94
  -14,94              20,00                1284,05
  -14,94              35,00                   0,00
 OVERTURNING HYDRAULIC GRADIENT  =  0,3697


 > VALUE OF NPPD(LC)   FOUND =           1       IN S/R CHEKIT (LOAD CASE  2)



 PASSIVE EARTH PRESSURES FOR LOAD CASE  2

 NPPD                               =          1
 ELEVATION OF TOP OF SOIL           =    35,149     (FT)
 PRESSURE AT TOP OF SOIL            =  0,           (LBS/SQ,FT)
 ELEVATION AT BOTTOM OF TOE         =    20,000     (FT)
 PRESSURE AT BOTTOM OF TOE          =  -1941,7      (LBS/SQ,FT)
 ELEVATION OF LOWEST POINT ON WALL  =    8,3200     (FT)
 PRESSURE AT LOWEST POINT ON WALL   =  -1941,7      (LBS/SQ,FT)
 PASSIVE EARTH FORCE                =  -37387,      (LBS/SLICE)
 PASSIVE EARTH MOMENT               =  -58175,      (FT-LBS/SLICE)

 DISTANCE FROM THE TOE TO THE RESULTANT          = 14,09 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -79458,24 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     37387,40 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   = -2254838,50 (FT-LBS/SLICE)



 THE RESULTANT RATIO =       0,3523, FOR LOAD CASE  2
```

```
FLOODWALL EXAMPLE   (DESIGN/COMPLEX WALL)
        15:21:52 ON 12/ 2/80


#
# BEGIN SLIDING COMPUTATION
#



     FACTOR OF SAFETY FOR MIN. OMEGA (LEVEL) =     1.84

     SUM OF DRIVING FORCES   = 52878.750 (LBS/SLICE)
     SUM OF RESISTING FORCES = 52929.433 (LBS/SLICE)

     PASSIVE EARTH FORCE                        =  27409.14 (LBS/SLICE)
     ACTIVE EARTH FORCE                         =      0.   (LBS/SLICE)
     UPLIFT FORCE                               =-110453.75 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =  52878.75 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
         X            Y
      -14.94        8.32
       23.56        8.32



     FACTOR OF SAFETY FOR MAX. OMEGA (TOE TO KEY) =     1.85

     SUM OF DRIVING FORCES   = 44807.377 (LBS/SLICE)
     SUM OF RESISTING FORCES = 44819.056 (LBS/SLICE)

     PASSIVE EARTH FORCE                        =  20629.65 (LBS/SLICE)
     ACTIVE EARTH FORCE                         =      0.   (LBS/SLICE)
     UPLIFT FORCE                               = -92195.72 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =  46823.98 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
         X            Y
      -14.94       20.00
       23.56        8.32

 FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.84, FOR LOAD CASE  1
 BY ALLOWABLE STRENGTH METHOD
   C'=C/FS+2C'     TANPHI'=TANPHI/FS

     SUM OF DRIVING FORCES   = 52878.750 (LBS/SLICE)
     SUM OF RESISTING FORCES = 52929.433 (LBS/SLICE)

     PASSIVE EARTH FORCE                        =  27409.14 (LBS/SLICE)
     ACTIVE EARTH FORCE                         =      0.   (LBS/SLICE)
```

```
UPLIFT FORCE                              =-110453.75 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =  52878.75 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X            Y
   -14.94        8.32
    23.56        8.32



FACTOR OF SAFETY FOR MIN. OMEGA (LEVEL) =     2.39

SUM OF DRIVING FORCES  = 44470.800 (LBS/SLICE)
SUM OF RESISTING FORCES = 44499.361 (LBS/SLICE)

PASSIVE EARTH FORCE                       =  24227.51 (LBS/SLICE)
ACTIVE EARTH FORCE                        =       0.   (LBS/SLICE)
UPLIFT FORCE                              =-105203.30 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =  44470.80 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X            Y
   -14.94        8.32
    23.56        8.32



FACTOR OF SAFETY FOR MAX. OMEGA (TOE TO KEY) =     2.31

SUM OF DRIVING FORCES  = 37456.819 (LBS/SLICE)
SUM OF RESISTING FORCES = 37471.564 (LBS/SLICE)

PASSIVE EARTH FORCE                       =  17888.63 (LBS/SLICE)
ACTIVE EARTH FORCE                        =       0.   (LBS/SLICE)
UPLIFT FORCE                              = -87449.93 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =  39142.60 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X            Y
   -14.94       20.00
    23.56        8.32

FINAL FACTOR OF SAFETY AGAINST SLIDING =      2.31, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

SUM OF DRIVING FORCES  = 37456.819 (LBS/SLICE)
SUM OF RESISTING FORCES = 37471.564 (LBS/SLICE)

PASSIVE EARTH FORCE                       =  17888.63 (LBS/SLICE)
ACTIVE EARTH FORCE                        =       0.   (LBS/SLICE)
UPLIFT FORCE                              = -87449.93 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =  39142.60 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X            Y
   -14.94       20.00
    23.56        8.32
```

```
[illegible]
        15.23.32 ON 12/ 2/81)


*
*  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
*


THE BASE LIES IN SOIL 3


 FOR LOAD CASE  1,

 FOR THE BASE COORDINATES  X=-14.94  Y= 20.00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    3182.63 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    3404.56 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=-14.94  Y= 20.00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    3182.63 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    3404.56 (LBS/SQ.FT)

*** ALLOWABLE BASE PRESSURE IS LESS THAN THE ACTUAL FOR LOAD CASE  1

 FOR THE BASE COORDINATES  X= 21.71  Y= 13.88, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    3917.02 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =      0.    (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 23.56  Y=  8.32, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    4584.22 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =      0.    (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 25.06  Y=  8.32, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    4584.22 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =      0.    (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  1


 FOR LOAD CASE  2,

 FOR THE BASE COORDINATES  X=-14.94  Y= 20.00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    3750.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    2929.11 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 21.71  Y= 13.88, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    4480.40 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =     407.26 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 23.56  Y=  8.32, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    5151.60 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =     279.72 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 25.06  Y=  8.32, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =    5151.60 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =     176.50 (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  2


 THE  ALLOWABLE BEARING PRESSURE     =    5151.60 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =     176.50 (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  2
```

FLOODWALL EXAMPLE (DESIGN/COMPLEX WALL)
15:23:32 ON 12/ 2/80

\#
\# BEGIN COST ANALYSIS
\#

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
4	1154.47	0.	0.
5	1154.47	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	619.40	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	315.12	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	164.03	1.00	164.03
BASE	115.91	1.00	115.91
KEY	12.55	1.00	12.55

TOTAL CONCRETE VOLUME = 292.50 (CU FT / LF), FOR LOAD CASE 1

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
4	1154.47	0.	0.
5	1154.47	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	619.40	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	315.12	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	164.03	1.00	164.03
BASE	115.91	1.00	115.91
KEY	12.55	1.00	12.55

TOTAL CONCRETE VOLUME = 292.50 (CU FT / LF), FOR LOAD CASE 2

*
* BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE 1
*

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 8.32 IS 2.1267

*
* BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE 2
*

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 8.32 IS 2.4166

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
         15:23:35 ON 12/ 2/80


*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*


  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER              KA VALUE
     --------------              --------
           1                      0.5609

         HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  1
         FOR COULOMB ANALYSIS IN SP (FACE OF STEM)

           RESULTS IN ARRAYS HS, FHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

           ELEVATION   INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                            STATIC FORCE          EARTHQUAKE FORCE
             (FT)            (LBS/FT)                (LBS/FT)
          *********  **********************  **********************
          35.000               0.                      0.
          34.000               0.                      0.
          33.000               0.                      0.
          32.000               0.                      0.
          31.000               0.                      0.
          30.000               0.                      0.
          29.000               0.                      0.
          28.000               0.                      0.
          27.000               0.                      0.
          26.000               0.                      0.
          25.000               0.                      0.
          24.000               0.                      0.
          23.000               0.                      0.
          22.000               0.                      0.
          21.000               0.                      0.
          20.613               0.                      0.

         FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

         RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.    LBS/HORIZ FT
         ACTING AT ELEVATION      0.

         RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
         DUE TO EARTHQUAKE =        0.    LBS/HORIZ FT
         ACTING AT ELEVATION      0.
```

FLOODWALL EXAMPLE (DESIGN/COMPLEX WALL)
15123135 ON 12/ 2/80

*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.5609

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 2
FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
35.000	0.	0.
34.000	0.	0.
33.000	0.	0.
32.000	0.	0.
31.000	0.	0.
30.000	0.	0.
29.000	0.	0.
28.000	0.	0.
27.000	0.	0.
26.000	0.	0.
25.000	0.	0.
24.000	0.	0.
23.000	0.	0.
22.000	0.	0.
21.000	0.	0.
20.613	0.	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

```
*
* EXIT MODULE FA
*

CREEP RATIO CALCULATED WITHOUT SHEET PILE CUTOFF =      2.42

*
* UPDATE FILE RESET
*

COMMAND ENTERED:
*LOB  25  48  S  S

COMMAND ENTERED:
RUN FD
```

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
          16:14:34 ON 12/ 2/80

*
* BEGIN MODULE FD
*

SUBR FD, WARNING, VARIABLE ELSPT UNDEFINED.
CREEP RATIO WILL BE CALCULATED WITHOUT SHEET PILE CUTOFF.
SUBR FD, WARNING, VARIABLE CRMIN UNDEFINED.
SHEET PILE TIP ELEVATION WILL NOT BE CALCULATED.

FOUNDATION STABILITY DESIGN SUMMARY--


BASE DESCRIPTION:
```

DATA ITEM NAME	LOWEST COST VALUE	BETWEEN THE LIMITS LOWER	UPPER	DESCRIPTION
BTE1	24.00	20.00	30.00	ELEV. OF BOTTOM OF TOE END
BW	42.50	25.00	48.00	BASE WIDTH
BS	0.16700	0.16700	0.16700	BASE SLOPE, X VERT. TO 1 HORIZ.
DKEY	5.00	5.00	5.00	KEY LENGTH BELOW BASE

```
*
* BEGIN MODULE FA
*
```

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
          17:31: 2 ON 12/ 2/80


*
* BEGIN PART 2 OF STABILITY DATA CHECK
*
```

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
        17:31: 2 ON 12/ 2/80


#
# BEGIN MODULE FA
#

VARIABLE TW2 CALCULATED =       14.17 (BW*STR)
VARIABLE HEELW CALCULATED       22.32 (BW-TW2-TSTR)
VARIABLE HEELT1 UNDEF, NO DEFAULT REQUESTED.
VARIABLE HEELT1 ASSIGNED DEFAULT TO PRECLUDE ABORT.
VARIABLE HSBPR CALCULATED OR DEFAULTED TO CLOSE COORDINATES,
        HSBPR =  2.075234 IN/FT.
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	60.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	-1.4375	25.5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	-1.4375	25.5000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-15.6042	25.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-15.6042	24.0000	TOE END OF BASE = AT BTE1
6	23.5425	17.4625	TOP OF TOE-SIDE FACE OF KEY
7	25.3958	11.9025	BOTTOM OF TOE-SIDE FACE OF KEY
8	26.8958	11.9025	BOTTOM OF HEEL-SIDE FACE OF KEY
9	26.8958	16.9025	TOP OF HEEL-SIDE FACE OF KEY
10	26.8958	16.9025	HEEL END OF BASE
11	26.8958	18.4025	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	4.5730	24.2304	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	42.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	60.0000	TOP OF HEEL-SIDE FACE OF STEM
15	24.5625	11.9025	BOTTOM OF CUTOFF WALL UNDER KEY

```
### NOTE ### T-WALLS OVER 28.0 FEET HIGH MAY BE UNECONOMICAL
WITH CANTILEVER STEMS.


# HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
# BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
# AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
# ARE UNDEFINED, ZERO, OR NEGATIVE.


THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND
THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT
ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE
```

IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 1

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	39201.32	0.	768254.99
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	94656.05	0.	2527281.47
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	133857.38	0.	3295536.47

* HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
* BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
* AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
* ARE UNDEFINED, ZERO, OR NEGATIVE.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 2

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	39201.32	0.	768254.99
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	89894.33	0.	2385372.34
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	129095.66	0.	3153627.34

```
FLOODWALL EXAMPLE   (DESIGN/COMPLEX WALL)
         17:31: 7 ON 12/ 2/80


*
* BEGIN THE OVERTURNING COMPUTATION
*


     LOAD CASE   1


RESULTANT IS WITHIN THE KERN


CREEP PATH DESCRIPTION FOR LOAD CASE 1

X-COORDINATES     Y-COORDINATES     HYDROSTATIC PRESSURE
   26.90              60.00                   0.
   26.90              11.90                3006.09
   25.40              11.90                2965.72
   23.54              17.46                2460.47
  -15.60              24.00                 983.58
  -15.60              35.00                   0.00
 OVERTURNING HYDRAULIC GRADIENT  =  0.4307


 > VALUE OF NPPD(LC)   FOUND =         1      IN S/R CHEKIT (LOAD CASE  1)


 PASSIVE EARTH PRESSURES FOR LOAD CASE  1

 NPPD                                =          1
 ELEVATION OF TOP OF SOIL            =   35.156      (FT)
 PRESSURE AT TOP OF SOIL             =  0.           (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE          =   24.000      (FT)
 PRESSURE AT BOTTOM OF TOE           =  -2293.6      (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL   =   11.902      (FT)
 PRESSURE AT LOWEST POINT ON WALL    =  -2293.6      (LBS/SQ.FT)
 PASSIVE EARTH FORCE                 =  -40541.      (LBS/SLICE)
 PASSIVE EARTH MOMENT                = -0.12026E 06 (FT-LBS/SLICE)
```

```
 DISTANCE FROM THE TOE TO THE RESULTANT          = 14.58 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -76918.65 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     40540.55 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   = -2345267.31 (FT-LBS/SLICE)


THE RESULTANT RATIO =       0.3430, FOR LOAD CASE  1



     LOAD CASE   2



RESULTANT IS WITHIN THE KERN


CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   26.90              57.00                   0.
   26.90              11.90                2818.59
   25.40              11.90                2783.06
   23.54              17.46                2296.74
  -15.60              24.00                 948.05
  -15.60              35.00                   0.
 OVERTURNING HYDRAULIC GRADIENT  =  0.3790


 > VALUE OF NPPD(LC)   FOUND =          1        IN S/R CHEKIT (LOAD CASE  2)



 PASSIVE EARTH PRESSURES FOR LOAD CASE  2

 NPPD                                 =          1
 ELEVATION OF TOP OF SOIL             =    35.156      (FT)
 PRESSURE AT TOP OF SOIL              =  0.            (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE           =    24.000      (FT)
 PRESSURE AT BOTTOM OF TOE            =  -1901.7       (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL    =    11.902      (FT)
 PRESSURE AT LOWEST POINT ON WALL     =  -1901.7       (LBS/SQ.FT)
 PASSIVE EARTH FORCE                  =  -33613.       (LBS/SLICE)
 PASSIVE EARTH MOMENT                 =  -99709.       (FT-LBS/SLICE)

 DISTANCE FROM THE TOE TO THE RESULTANT          = 16.49 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -72419.98 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     33613.19 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   = -2119273.22 (FT-LBS/SLICE)


THE RESULTANT RATIO =       0.3880, FOR LOAD CASE  2
```

```
FLOODWALL EXAMPLE   (DESIGN/COMPLEX WALL)
        17:31: 7 ON 12/ 2/80


*
* BEGIN SLIDING COMPUTATION
*



     FACTOR OF SAFETY FOR MIN, OMEGA (LEVEL) =     1.50

     SUM OF DRIVING FORCES  = 49267.307 (LBS/SLICE)
     SUM OF RESISTING FORCES = 49315.160 (LBS/SLICE)

     PASSIVE EARTH FORCE                    =  19007.50 (LBS/SLICE)
     ACTIVE EARTH FORCE                     =       0.  (LBS/SLICE)
     UPLIFT FORCE                           =-106246.99 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =  49267.31 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X          Y
       -15.60      11.90
        25.40      11.90



     FACTOR OF SAFETY FOR MAX, OMEGA (TOE TO KEY) =     1.66

     SUM OF DRIVING FORCES  = 41082.679 (LBS/SLICE)
     SUM OF RESISTING FORCES = 41106.996 (LBS/SLICE)

     PASSIVE EARTH FORCE                    =  14171.99 (LBS/SLICE)
     ACTIVE EARTH FORCE                     =       0.  (LBS/SLICE)
     UPLIFT FORCE                           = -85703.88 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =  42833.71 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X          Y
       -15.60      24.00
        25.40      11.90

 FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.50, FOR LOAD CASE  1
 BY ALLOWABLE STRENGTH METHOD
   C'=C/FS+2C'    TANPHI'=TANPHI/FS

     SUM OF DRIVING FORCES  = 49267.307 (LBS/SLICE)
     SUM OF RESISTING FORCES = 49315.160 (LBS/SLICE)

     PASSIVE EARTH FORCE                    =  19007.50 (LBS/SLICE)
     ACTIVE EARTH FORCE                     =       0.  (LBS/SLICE)
```

```
UPLIFT FORCE                                  =-106246.99 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =  49267.31 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
      X             Y
   -15.60         11.90
    25.40         11.90



FACTOR OF SAFETY FOR MIN. OMEGA (LEVEL) =     1.91

SUM OF DRIVING FORCES  = 41292.729 (LBS/SLICE)
SUM OF RESISTING FORCES = 41308.793 (LBS/SLICE)

PASSIVE EARTH FORCE                           =  16587.77 (LBS/SLICE)
ACTIVE EARTH FORCE                            =       0.   (LBS/SLICE)
UPLIFT FORCE                                  =-100859.68 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =  41292.73 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
      X             Y
   -15.60         11.90
    25.40         11.90



FACTOR OF SAFETY FOR MAX. OMEGA (TOE TO KEY) =     2.96

SUM OF DRIVING FORCES  = 34174.571 (LBS/SLICE)
SUM OF RESISTING FORCES = 34199.275 (LBS/SLICE)

PASSIVE EARTH FORCE                           =  12172.59 (LBS/SLICE)
ACTIVE EARTH FORCE                            =       0.   (LBS/SLICE)
UPLIFT FORCE                                  = -80921.75 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =  35631.17 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
      X             Y
   -15.60         24.00
    25.40         11.90

FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.91, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

SUM OF DRIVING FORCES  = 41292.729 (LBS/SLICE)
SUM OF RESISTING FORCES = 41308.793 (LBS/SLICE)

PASSIVE EARTH FORCE                           =  16587.77 (LBS/SLICE)
ACTIVE EARTH FORCE                            =       0.   (LBS/SLICE)
UPLIFT FORCE                                  =-100859.68 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =  41292.73 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
      X             Y
   -15.60         11.90
    25.40         11.90
```

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
          17:32:22 ON 12/ 2/80


#
#  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
#


THE BASE LIES IN SOIL 3


 FOR LOAD CASE  1,

 FOR THE BASE COORDINATES  X=-15.60  Y= 24.00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   3030.87 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =   2601.81 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 23.54  Y= 17.46, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   3815.37 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    276.82 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 25.40  Y= 11.90, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   4482.57 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    166.75 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 26.90  Y= 11.90, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   4482.57 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =     77.66 (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  1


 FOR LOAD CASE  2,

 FOR THE BASE COORDINATES  X=-15.60  Y= 24.00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   3030.87 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =   2229.48 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 23.54  Y= 17.46, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   3815.37 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    579.00 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 25.40  Y= 11.90, THE     LUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   4482.57 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    500.86 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 26.90  Y= 11.90, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   4482.57 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    437.61 (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  2
```

FLOODWALL EXAMPLE (DESIGN/COMPLEX WALL)
17:32:22 ON 12/ 2/80

\#
\# BEGIN COST ANALYSIS
\#

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
4	900.78	0.	0.
5	900.78	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	505.61	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	210.77	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	131.42	1.00	131.42
BASE	117.37	1.00	117.37
KEY	12.55	1.00	12.55

TOTAL CONCRETE VOLUME =   261.34 (CU FT / LF), FOR LOAD CASE 1

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
4	900.78	0.	0.
5	900.78	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	505.61	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	210.77	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	131.42	1.00	131.42
BASE	117.37	1.00	117.37
KEY	12.55	1.00	12.55

TOTAL CONCRETE VOLUME =   261.34 (CU FT / LF), FOR LOAD CASE 2

```
#
# BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE  1
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF    11.90 IS      2.1373

#
# BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE  2
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF    11.90 IS      2.4287
```

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
         17:32:24 ON 12/ 2/80


*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*


  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER           KA VALUE
     --------------           --------
           1                   0.5579

          HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  1
          FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)


          OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

            ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                            STATIC FORCE          EARTHQUAKE FORCE
               (FT)          (LBS/FT)                 (LBS/FT)
            ---------  ----------------------  ----------------------
           35.000             0.                       0.
           34.000             0.                       0.
           33.000             0.                       0.
           32.000             0.                       0.
           31.000             0.                       0.
           30.000             0.                       0.
           29.000             0.                       0.
           28.000             0.                       0.
           27.000             0.                       0.
           26.000             0.                       0.
           25.000             0.                       0.
           24.230             0.                       0.

          FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

          RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.    LBS/HORIZ FT
          ACTING AT ELEVATION      0.

          RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
          DUE TO EARTHQUAKE =        0.    LBS/HORIZ FT
          ACTING AT ELEVATION      0.
```

```
FLOODWALL EXAMPLE   (DESIGN/COMPLEX WALL)
         17:32:24 ON 12/ 2/80


#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#


  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER              KA VALUE
     ..............              ........
           1                      0.5579

          HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  2
          FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

          OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

            ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                            STATIC FORCE           EARTHQUAKE FORCE
              (FT)           (LBS/FT)                 (LBS/FT)
            ---------  ----------------------  ----------------------
           35.000              0.                      0.
           34.000              0.                      0.
           33.000              0.                      0.
           32.000              0.                      0.
           31.000              0.                      0.
           30.000              0.                      0.
           29.000              0.                      0.
           28.000              0.                      0.
           27.000              0.                      0.
           26.000              0.                      0.
           25.000              0.                      0.
           24.230              0.                      0.

          FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

          RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.    LBS/HORIZ FT
          ACTING AT ELEVATION      0.

          RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
          DUE TO EARTHQUAKE =        0.    LBS/HORIZ FT
          ACTING AT ELEVATION      0.


#
# EXIT MODULE EA
#


CREEP RATIO CALCULATED WITHOUT SHEET PILE CUTOFF =      2.43

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
RUN WD
```

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
          17:35:11 ON 12/ 2/80

 #
 # BEGIN DATA CHECK FOR MODULE WD
 #

 COMPLETE THE TRIAL WALL DESCRIPTION:

 DEFAULT VALUE OF    0.              USED FOR BASER       (LOAD CASE  1)

 ### NOTE ### T-WALLS OVER 28.0 FEET HIGH MAY BE UNECONOMICAL
 WITH CANTILEVER STEMS.

 DEFAULT VALUE OF    18.00000     USED FOR TSTT        (LOAD CASE  1)

 DEFAULT VALUE OF    18.00000     USED FOR TOEHT       (LOAD CASE  1)

 DEFAULT VALUE OF    100.0000     USED FOR TS2         (LOAD CASE  1)

 DEFAULT VALUE OF    18.00000     USED FOR HEELT2      (LOAD CASE  1)

 DEFAULT VALUE OF    18.00000     USED FOR WKEY        (LOAD CASE  1)

 DEFAULT VALUE OF    3.000000     USED FOR BKTF        (LOAD CASE  1)

 TW2    CALCULATED TO BE      14.167

 DEFAULT VALUE OF            0      USED FOR IBSAME      (LOAD CASE  1)

 WITH BASE RADIUS ("BASER", 0.0 FOR RECTANGULAR) =       0.    FEET,
 TOE END OF BASE UNIT WIDTH =   1.0000 FT. AND
 HEEL END OF BASE UNIT WIDTH =  1.0000 FT.
 (BASIC WORKING POINT IS 1.0 FT. WIDE).

 LOWEST CONCRETE =       11.90 FT., AT BOTTOM OF KEY

 DEFAULT VALUE OF           11      USED FOR   MAXBAR   (LOAD CASE  1)

 SPAMIN CALCULATED TO BE      3.6600

 MAXIMUM STEEL AREA PER FOOT, CALCULATED FROM
 NO. 11 BARS (MAXBAR) AT  3.66 INCHES (SPAMIN),
 IS  5.115 SQ. IN. / FT.

   ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   1 ----------

 FH TOP CALCULATED TO BE      60.000
 FOR LOAD CASE  1

 > NPPD   IS           1

 DEFAULT VALUE OF    1.000000     USED FOR  AOSF(LC)  (LOAD CASE  1)

   ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   2 ----------

 FH TOP CALCULATED TO BE      57.000
 FOR LOAD CASE  2
```

> NPPD IS 1

DEFAULT VALUE OF 1.000000 USED FOR AOSF(LC) (LOAD CASE 2)

--------------- END OF PRESSURE DATA VERIFICATION ---------------

DEFAULT VALUE OF 3000.000 USED FOR FPCON (LOAD CASE 1)

DEFAULT VALUE OF 0.2900000E 08 USED FOR ESTL (LOAD CASE 1)

DEFAULT VALUE OF 9.190000 USED FOR RATION (LOAD CASE 1)

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	60.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	-1.4375	25.5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	-1.4375	25.5000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-15.6042	25.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-15.6042	24.0000	TOE END OF BASE = AT BTE1
6	23.5425	17.4625	TOP OF TOE-SIDE FACE OF KEY
7	25.3958	11.9025	BOTTOM OF TOE-SIDE FACE OF KEY
8	26.8958	11.9025	BOTTOM OF HEEL-SIDE FACE OF KEY
9	26.8958	16.9025	TOP OF HEEL-SIDE FACE OF KEY
10	26.8958	16.9025	HEEL END OF BASE
11	26.8958	18.4025	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	3.9007	22.2427	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	60.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	60.0000	TOP OF HEEL-SIDE FACE OF STEM
15	26.1458	11.9025	BOTTOM OF CUTOFF WALL UNDER KEY

DEFAULT VALUE OF 0.3500000 USED FOR RATIOF (LOAD CASE 1)

DEFAULT VALUE OF 20000.00 USED FOR FSTLMX (LOAD CASE 1)

DEFAULT VALUE OF 0 USED FOR IFOR (LOAD CASE 1)

DEFAULT VALUE OF 3.500000 USED FOR COVHS (LOAD CASE 1)

DEFAULT VALUE OF 3.500000 USED FOR COVTS (LOAD CASE 1)

DEFAULT VALUE OF 3.500000 USED FOR COVTB (LOAD CASE 1)

DEFAULT VALUE OF 4.500000 USED FOR COVBB (LOAD CASE 1)

DEFAULT VALUE OF 2.375000 USED FOR SPABL (LOAD CASE 1)

COMBINED PASSIVE PRESSURE VALUE OF -2293.599 USED FOR LOAD CASE 1

COMBINED PASSIVE PRESSURE VALUE OF -1901.680 USED FOR LOAD CASE 2

```
FLOODWALL EXAMPLE    (DESIGN/COMPLEX WALL)
         17:35:45 ON 12/ 2/80


 #
 # BEGIN ALTERNATE METHOD (WSD) DESIGN
 #

 THE ABOVE TABLE OF X- AND Y-COORDINATES AND THE FOLLOWING TABLE OF DATA
 LISTS DESCRIBE THE WALL ASSUMED FOR THE DESIGN ANALYSIS FREE BODIES.
 IF THE FINAL DIMENSIONS TURN OUT TO BE SUBSTANTIALLY DIFFERENT,
 YOU MAY WANT TO RUN MODULE WD AGAIN.


 WLA      FTS              TW2          STR             HEELW
      60.00000          14.16667      0.3333333       22.99518

 WLAR     BW               BS                            BASER (LIST=WLBR)
      42.50000          0.1670000                      0.

 WLAH   HEELT2           HEELW         HEELT1
      18.00000          22.99518      18.00000

 WLAK   KFLAG             DKEY          WKEY            BKTF
         0              5.000000      18.00000        5.000000

 WLAS    TSTT              TSB          TSTB            HSTPH           HSTPB
      18.00000          0.5000000    -64.05789      -0.1234000E 31   0.
        HSBPB
      2.075234

 WLAT    BTE1             TOEHT         TS2             TW1             TS1
      24.00000          18.00000      100.0000        0.            -0.1234000E 31

 ----   TMINB             TMINS
      18.00000          18.00000

 #
 # BEGIN TOE DESIGN
 #

 PUT REINF. IN AND INCREASE THICKNESS AS NEEDED FOR SHEAR

 #
 # BEGIN STEM DESIGN
 #

 PUT REINF. IN AND INCREASE THICKNESS AS NEEDED FOR SHEAR

 #
 # BEGIN KEY DESIGN
 #

 PUT REINF. IN AND INCREASE THICKNESS AS NEEDED FOR SHEAR

 KEY DATA WKEY, BKTF ARE   18.00000      AND   28.15253
 WITH DKEY =    5.000000
```

```
*
* HEEL DESIGN
*

PUT REINF. IN AND INCREASE THICKNESS AS NEEDED FOR SHEAR

*
* DESIGN SUMMARY
*

WLA      FTS          TW2          STR          HEELW
       60.00000     14.15892     0.3331511     23.55008

WLAB     BW           BS                        BASER (LIST=WLBR)
       42.50000     0.1670000                  0.

WLAH   HEELT2         HEELW        HEELT1
       18.00000     23.55008     45.92278

WLAK   KFLAG          DKEY         WKEY          BKTF
          0          5.000000     18.00000      28.15253

WLAS    TSTT          TSB          TSTB          HSTPH          HSTPB
       18.00000     0.5000000    57.49196      20.18084        0.
        HSBPH
       1.462572

WLAT    BTE1          TOEHT        TS2           TW1            TS1
       24.00000     18.00000     100.0000      0.             100.0000

----   TMINB          TMINS
       18.00000     18.00000
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	60.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	-1.4452	25.3142	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	-1.4454	25.3142	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-15.6042	25.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-15.6042	24.0000	TOE END OF BASE = AT BTE1
6	25.2082	17.1843	TOP OF TOE-SIDE FACE OF KEY
7	25.3958	11.9025	BOTTOM OF TOE-SIDE FACE OF KEY
8	26.8958	11.9025	BOTTOM OF HEEL-SIDE FACE OF KEY
9	26.8958	16.9025	TOP OF HEEL-SIDE FACE OF KEY
10	26.8958	16.9025	HEEL END OF BASE
11	26.8958	18.4025	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	3.3458	24.6753	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	39.8192	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	60.0000	TOP OF HEEL-SIDE FACE OF STEM
15	26.1458	11.9025	BOTTOM OF CUTOFF WALL UNDER KEY

THE REINFORCING IN THE FOLLOWING TABLE SATISFIES STRENGTH AND
EM 1110-2-2103 MINIMUM REQUIREMENTS (.125 PERCENT OF AREA IN EACH FACE).

TABLE OF STEEL VALUES IN STEM, SQ. IN. / FT.

M	ELEV.	ASTLST(M)	ASTLSH(M,1)	ASTLSH(M,2)	ASTLSH(M,3)
1	60.00	0.277	0.277	******	******
2	59.00	0.277	0.277	******	******
3	58.00	0.285	0.285	******	******
4	57.00	0.293	0.293	******	******
5	56.00	0.300	0.300	******	******
6	55.00	0.308	0.308	******	******
7	54.00	0.315	0.315	******	******
8	53.00	0.323	0.323	******	******
9	52.00	0.330	0.330	******	******
10	51.00	0.337	0.337	******	******
11	50.00	0.345	0.345	******	******
12	49.00	0.352	0.362	******	******
13	48.00	0.360	0.476	******	******
14	47.00	0.367	0.608	******	******
15	46.00	0.375	0.761	******	******
16	45.00	0.383	0.933	******	******
17	44.00	0.390	1.128	******	******
18	43.00	0.398	1.344	******	******
19	42.00	0.405	1.584	******	******
20	41.00	0.413	1.808	******	******
21	40.00	0.420	2.136	******	******
22	39.00	0.440	2.318	******	******
23	38.00	0.440	2.482	******	******
24	37.00	0.440	2.653	******	******
25	36.00	0.440	2.833	******	******
26	35.00	0.440	3.023	******	******
27	34.00	0.440	3.221	******	******
28	33.00	0.440	3.418	******	******
29	32.00	0.440	3.612	******	******
30	31.00	0.440	3.798	******	******
31	30.00	0.440	3.975	******	******
32	29.00	0.440	4.138	******	******
33	28.00	0.440	4.288	******	******
34	27.00	0.440	4.422	******	******
35	26.00	0.440	4.540	******	******

TABLE OF STEEL VALUES IN BASE, SQ. IN. / FT.
(M = 1 AT END OF TOE)

M	DIST.	ASTLBT(M,1)	ASTLBT(M,2)	ASTLBB(M,1)	ASTLBB(M,2)	ASTLBB(M,3)
1	0.	0.300	******	0.300	******	******
2	1.00	0.300	******	0.300	******	******
3	2.00	0.330	******	0.330	******	******
4	3.00	0.360	******	0.360	******	******
5	4.00	0.390	******	0.499	******	******
6	5.00	0.420	******	0.714	******	******
7	6.00	0.440	******	0.947	******	******
8	7.00	0.440	******	1.192	******	******
9	8.00	0.440	******	1.447	******	******
10	9.00	0.440	******	1.708	******	******
11	10.00	0.440	******	1.974	******	******
12	11.00	0.440	******	2.243	******	******
13	12.00	0.440	******	2.514	******	******
14	13.00	0.440	******	2.785	******	******
15	14.00	0.440	******	3.299	******	******
16	15.00	******	******	******	******	******
17	16.00	******	******	******	******	******
18	17.00	******	******	******	******	******

19	18.00	******	******	******	******	******
20	19.00	******	******	******	******	******
21	20.00	2.283	******	0.440	******	******
22	21.00	2.138	******	0.440	******	******
23	22.00	1.988	******	0.440	******	******
24	23.00	1.834	******	0.440	******	******
25	24.00	1.676	******	0.440	******	******
26	25.00	1.515	******	0.440	******	******
27	26.00	1.350	******	0.440	******	******
28	27.00	1.183	******	0.440	******	******
29	28.00	1.015	******	0.440	******	******
30	29.00	0.440	******	0.440	******	******
31	30.00	0.440	******	0.440	******	******
32	31.00	0.440	******	0.440	******	******
33	32.00	0.440	******	0.440	******	******
34	33.00	0.440	******	0.440	******	******
35	34.00	0.440	******	0.883	******	******
36	35.00	0.423	******	1.049	******	******
37	36.00	0.405	******	1.217	******	******
38	37.00	0.387	******	1.384	******	******
39	38.00	0.369	******	1.547	******	******
40	39.00	0.351	******	1.705	******	******
41	40.00	0.333	******	1.852	******	******
42	41.00	0.316	******	1.986	******	******
43	42.00	0.316	******	1.986	******	******

ASTLK = 1.098 SQ IN / FT

****** = "UNDEFINED"

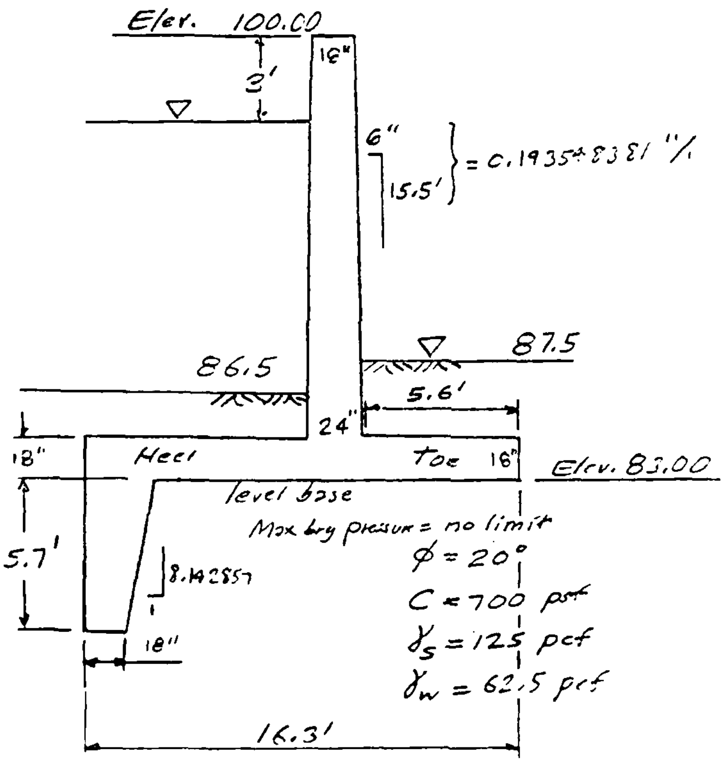
NOTE: PARAGRAPH 8-21A(3) OF EM 1110-2-2501 CAN BE INTERPRETED
TO MEAN THAT THE TOP OF HEEL AT THE KEY MUST HAVE AT LEAST AS
MUCH REINFORCEMENT AS THE TOE-SIDE FACE OF THE KEY. THIS REQUIREMENT
WAS NOT CONSIDERED WHEN DETERMINING THE REINFORCING SHOWN IN THE TABLE
ABOVE FOR ASTLRT(LOC,LNA) WHERE LOC IS THE LOCATION
AND LNA IS THE LAYER NUMBER.

#
UPDATE FILE RESET
#

COMMAND ENTERED:
END

14-3 EXAMPLE C: STABILITY ANALYSIS AND STRUCTURAL DESIGN OF EXHIBIT H WALL:

Take the wall shown in the sliding exhibits to the Criteria Specifications Document and perform a stability analysis on the wall, then do a structural design for the pressures resulting from the stability analysis. Set up 3 load cases #1 by flood wall rules; #2 by retaining wall; and #3 by the hybrid (trapezoidal passive pressure diagram, no crack in the heel corner), to show the differences. Use IFDR and ITEM = 0 to get the structural design exactly for the loads specified.



Soils Preparation Data:

Required Data Lines: SOL1, SOL5, SOL7

Optional Data Lines: not used

Finished Grade Data: same as example #1

Water: Line of creep, no boil control

Soil Perm. Parameters

	Loadcase	NPRD	KRACK
FW	1	D= 1	D= 1
RW	2	D= 3	D=2
Hybrid	3	1	2

Structural: All default values OK except use IFEM = IPRT = 0
CNO D D D D, CNNO D D D 1 0 (IB... = 1)

Demonstrate Commands in the data file: RUNFA, RUNRW, SOL:

Note use of REM command to annotate the data file. These lines will not be executed and are solely to make the data file more readable to the user.

```
*OLD EXCDATA
*LIST

1000 INIT
1010 3
1020 F
1030 H
1040 NAME EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE W
1045 REM
1050 REM  BASIC GENERAL WALL EXAMPLE -- STABILITY ANALYSIS, STRESS DESIGN
1100 REM
1110 REM  LINE 1020 (ANSWER F) SET ALL LOAD CASES FOR FLOOD WALL ACTION,
1120 REM  USE DATA LIST TYPE TO RESET LOAD CASE 2 FOR RETAINING WALL ACT
1130 TYPE  2  2
1140 REM
1150 REM  LINE 1030 (ANSWER H) SET ALL LOAD CASES FOR HYDRAULIC OPTIONS)
1160 REM  THIS IS NOT CHANGEABLE
1170 REM
2000 SPH1  0  20  700  125  C  0  C  0
2010 REM  DATA LIST SPT7 WILL BE COPIED AUTOMATICALLY FROM DATA LIST SPE3
2015 REM
2020 SSHC  0  86.5  100.0
2030 SST   0  87.5  100.0
2035 REM
2040 SPE3  20  700  125  20  700  8000  8000  8000  8000  50
2100 SOLE  2  1  100.0  87.5  0  87.0  86.5  0  100.0
2110 REM
2200 SEEP  0  87.5  97.0  0  0  1  1
2300 REM
3000 WLA  100.0  5.6  C  C
3010 WLAB 16.3  10.0  20.0  0.0
3020 WLAH  18.0  C  18.0
3030 WLAK 0  5.7  18.0  8.142857
3040 WLAS 18.0  0.193548387  24.0  0.0  0.0  C
3050 WLAT  83.0  18.0  100.0  0.0  C
3060 REM
3070 REM  NOTE USE OF.REM COMMAND TO ANNOTE DATA FILE (NOT EXECUTED)
3080 REM  (THERE ARE ACTUALLY ONLY 10 LINES OFDATA FOR 3 LOAD CASES)
4000 REM
4100 UPDATE
```

```
*RUN TWDA,R

        12/03/80    11.689

:

PROGRAM TWDA - 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
      REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXCUPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?M.L. WAITES
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EXCDATA
PROCESSING DATA FILE...

*
* UPDATE FILE RESET
*

*
* DATA FILE PROCESSING DONE
*
* RETURN TO INTERACTIVE INPUT
*

COMMAND
?RUN FA


THE RESULTANT RATIO =       0.3214, FOR LOAD CASE  1


THE RESULTANT RATIO =       0.2175, FOR LOAD CASE  2


THE RESULTANT RATIO =       0.3214, FOR LOAD CASE  3

FINAL FACTOR OF SAFETY AGAINST SLIDING =       3.99, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS12C'     TANPHI'=TANPHI/FS


FINAL FACTOR OF SAFETY AGAINST SLIDING         5.18, FOR LOAD CASE  2
BY SHEAR FRICTION METHOD


FINAL FACTOR OF SAFETY AGAINST SLIDING         3.99, FOR LOAD CASE  3
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS12C'     TANPHI'=TANPHI/FS
```

```
TOTAL CONCRETE VOLUME =          62.12 (CU FT / LF), FOR LOAD CASE  1


TOTAL CONCRETE VOLUME =          62.12 (CU FT / LF), FOR LOAD CASE  2


TOTAL CONCRETE VOLUME =          62.12 (CU FT / LF), FOR LOAD CASE  3

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR 0 TO OMIT THE PLOTS
?0

#
# UPDATE FILE RESET
#


#
# COMMAND DATA PHASE ENTERED
#

COMMAND
?RUN WD
#
# BEGIN DATA CHECK FOR MODULE WD
#

COMPLETE THE TRIAL WALL DESCRIPTION:

TO GET DEFAULT VALUE FOR 'IFEM', ANSWER NEXT QUESTION WITH A CARRIAGE RETURN:

### IFEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR    1 TO ALSO USE EM ALTERNATE SPECIAL LOADINGS
            (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
            VALUE OF 1)
    OR    ? FOR MORE INFORMATION
    OR    C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR    * TO ABORT THE MODULE
?0

#
# BEGIN ALTERNATE METHOD (WSD) DESIGN
#

ENTER THE LOAD CASE NUMBER YOU WANT TO DESIGN FOR
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST 'CASE'
   OR A * TO ABORT THE MODULE
?0

#
# DESIGN SUMMARY
#
```

```
WLA      FTS              TW2             STR             HEELW
     100.0000         5.600000       0.3435583        8.950000

WLAB     BW               BS                              BASER (LIST WLBR)
     16.30000      0.                               0.

WLAH  HEELT2           HEELW           HEELT1
     18.00000         8.950000        18.00000

WLAK  KFLAG             DKEY            WKEY            BKTF
        0             5.700000        18.00000         8.142857

WLAS   TSTT              TSB             TSTB            HSTPH          HSTPB
     18.00000      0.1935484          21.00000       0.              0.
      HSBPB
    0.

WLAT   BTET             TOEHT            TS2             TW1             TS1
     83.00000         18.00000        100.0000       0.              100.0000

----  TMIND            TMINS
     18.00000         18.00000

*
* UPDATE FILE RESET
*


*
* COMMAND DATA PHASE ENTERED
*

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?RO

SNUMB # 2215C


your update file for future restart is named EXCUPD
stop     OK (release unneeded files)

*
```

```
&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
          11:42:15 ON 12/ 3/80


 NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE--

 THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
 THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

 A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.


 END OF NOTES.

 COMMAND ENTERED:
 INIT

 *- ALL DATA RESET FOR FRESH START -*

 COMMAND ENTERED:
 F

 COMMAND ENTERED:
 H


        11:42:42 ON 12/ 3/80

WALL DECLARED TO BE A HYDRAULIC FLOOD WALL


COMMAND ENTERED:
NAME EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE W

COMMAND ENTERED:
REM

COMMAND ENTERED:
REM  BASIC GENERAL WALL EXAMPLE -- STABILITY ANALYSIS, STRESS DESIGN

COMMAND ENTERED:
REM

COMMAND ENTERED:
REM  LINE 1020 (ANSWER F) SET ALL LOAD CASES FOR FLOOD WALL ACTION.

COMMAND ENTERED:
REM  USE DATA LIST TYPE TO RESET LOAD CASE 2 FOR RETAINING WALL ACT

COMMAND ENTERED:
TYPE  2  2

COMMAND ENTERED:
REM

COMMAND ENTERED:
REM  LINE 1030 (ANSWER H) SET ALL LOAD CASES FOR HYDRAULIC OPTIONS)

COMMAND ENTERED:
REM  THIS IS NOT CHANGEABLE

COMMAND ENTERED:
REM
```

```
COMMAND ENTERED:
SPH1  0  20  700  125  C  0  C  0

COMMAND ENTERED:
REM  DATA LIST SPT7 WILL BE COPIED AUTOMATICALLY FROM DATA LIST SPE3

COMMAND ENTERED:
REM

COMMAND ENTERED:
SSHC  0  86.5  100.0

COMMAND ENTERED:
SST   0  87.5  100.0

COMMAND ENTERED:
REM

COMMAND ENTERED:
SPE3  20  700  125  20  700  8000  8000  8000  8000  50

COMMAND ENTERED:
SOLE  2  1  100.0  87.5  0  87.0  86.5  0  100.0

COMMAND ENTERED:
REM

COMMAND ENTERED:
SEEP  0  87.5  97.0  0  0  1  1

COMMAND ENTERED:
REM

COMMAND ENTERED:
WLA  100.0  5.6  C  C

COMMAND ENTERED:
WLAB 16.3  10.0  20.0  0.0

COMMAND ENTERED:
WLAH  18.0  C  18.0

COMMAND ENTERED:
WLAK 0  5.7  18.0  8.142857

COMMAND ENTERED:
WLAS 18.0  0.193548387   24.0  0.0  0.0  C

COMMAND ENTERED:
WLAT  83.0  18.0  100.0  0.0  C

COMMAND ENTERED:
REM

COMMAND ENTERED:
REM  NOTE USE OF REM COMMAND TO ANNOTE DATA FILE (NOT EXECUTED)

COMMAND ENTERED:
REM  (THERE ARE ACTUALLY ONLY 10 LINES OFDATA FOR 3 LOAD CASES)

COMMAND ENTERED:
REM

COMMAND ENTERED:
UPDATE

*
* UPDATE FILE RESET
*
```

```
COMMAND ENTERED:

COMMAND ENTERED:
RUN FA

EXAMPLE 2 -- ANALYZE EXHIBIT W WALL, THEN DESIGN WITH MODULE
          11:53:25 ON 12/ 3/80

 *
 * BEGIN BASIC STABILITY DATA CHECK
 *

 DEFAULT VALUE OF     62.50000     USED FOR GAMAW        (LOAD CASE   1)

 DEFAULT VALUE OF     150.0000     USED FOR GAMAC        (LOAD CASE   1)

 DEFAULT VALUE OF    0.            USED FOR UCEXS3       (LOAD CASE   1)

 DEFAULT VALUE OF    0.            USED FOR UCEXS4       (LOAD CASE   1)

 DEFAULT VALUE OF    0.            USED FOR UCEXS5       (LOAD CASE   1)

 DEFAULT VALUE OF    0.            USED FOR UCBFS1       (LOAD CASE   1)

 DEFAULT VALUE OF    0.            USED FOR UCBFS2       (LOAD CASE   1)

 DEFAULT VALUE OF    0.            USED FOR UCBFFZ       (LOAD CASE   1)

 DEFAULT VALUE OF    0.            USED FOR UCBFS7       (LOAD CASE   1)

 DEFAULT VALUE OF    0.            USED FOR UCBFS6       (LOAD CASE   1)

 DEFAULT VALUE OF     1.000000     USED FOR UCWS         (LOAD CASE   1)

 DEFAULT VALUE OF     1.000000     USED FOR UCWB         (LOAD CASE   1)

 DEFAULT VALUE OF     1.000000     USED FOR UCWK         (LOAD CASE   1)

 DEFAULT VALUE OF            2     USED FOR IFWOC        (LOAD CASE   1)

 DEFAULT VALUE OF            1     USED FOR IFSOM        (LOAD CASE   1)

 DEFAULT VALUE OF     1.000000     USED FOR CFMA         (LOAD CASE   1)

 NO DEFAULT VALUE FOR RRMIN      SO SET TO UNDEFINED    (LOAD CASE   1)

 DEFAULT VALUE OF     1.500000     USED FOR FSMIN        (LOAD CASE   1)

 DEFAULT VALUE OF            2     USED FOR NSLIDE       (LOAD CASE   1)

 DEFAULT VALUE OF            2     USED FOR IFWOC        (LOAD CASE   2)

 DEFAULT VALUE OF            1     USED FOR IFSOM        (LOAD CASE   2)

 DEFAULT VALUE OF     1.000000     USED FOR CFMA         (LOAD CASE   2)

 DEFAULT VALUE OF    0.3333333     USED FOR RRMIN        (LOAD CASE   2)

 DEFAULT VALUE OF     2.000000     USED FOR FSMIN        (LOAD CASE   2)

 DEFAULT VALUE OF            1     USED FOR NSLIDE       (LOAD CASE   2)

 DEFAULT VALUE OF            2     USED FOR IFWOC        (LOAD CASE   3)
```

DEFAULT VALUE OF 1 USED FOR IFSOM (LOAD CASE 3)

DEFAULT VALUE OF 1.000000 USED FOR CFMA (LOAD CASE 3)

NO DEFAULT VALUE FOR RRMIN SO SET TO UNDEFINED (LOAD CASE 3)

DEFAULT VALUE OF 1.500000 USED FOR FSMIN (LOAD CASE 3)

DEFAULT VALUE OF 2 USED FOR NSLIDE (LOAD CASE 3)

EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
11:53:26 ON 12/ 3/80

*
* BEGIN PART 2 OF STABILITY DATA CHECK
*

EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
11:53:26 ON 12/ 3/80

*
* BEGIN MODULE FA
*

VARIABLE HEELW CALCULATED 8.70 (BW-TW2-TSTB)
VARIABLE HSBPR CALCULATED OR DEFAULTED TO CLOSE COORDINATES,
HSBPR = 0.193548 IN/FT.

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	100.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	-0.2500	84.5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	-0.2500	84.5000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-5.8500	84.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-5.8500	83.0000	TOE END OF BASE = AT BTE1
6	8.2500	83.0000	TOP OF TOE-SIDE FACE OF KEY
7	8.9500	77.3000	BOTTOM OF TOE-SIDE FACE OF KEY
8	10.4500	77.3000	BOTTOM OF HEEL-SIDE FACE OF KEY
9	10.4500	83.0000	TOP OF HEEL-SIDE FACE OF KEY
10	10.4500	83.0000	HEEL END OF BASE
11	10.4500	84.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.7500	84.5000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	100.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	100.0000	TOP OF HEEL-SIDE FACE OF STEM

* HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
* BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
* AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
* ARE UNDEFINED, ZERO, OR NEGATIVE.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 1

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	9318.00	0.	81045.82
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	10069.06	0.	100719.42
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	19387.06	0.	181765.24

\# HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
\# BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
\# AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
\# ARE UNDEFINED, ZERO, OR NEGATIVE.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 2

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	9318.00	0.	81045.82
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	10069.06	0.	100719.42
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	19387.06	0.	181765.24

\# HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
\# BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
\# AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
\# ARE UNDEFINED, ZERO, OR NEGATIVE.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 3

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	9318.00	0.	81045.82
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	10069.06	0.	100719.42
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	19387.06	0.	181765.24

EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
11:53:30 ON 12/ 3/80

\#
\# BEGIN THE OVERTURNING COMPUTATION
\#

LOAD CASE 1

DEFAULT VALUE OF 1 USED FOR NPPD(LC) (LOAD CASE 1)

RESULTANT IS OUTSIDE THE KERN ON THE TOE SIDE

EFFECTIVE BASE = 15.73 (FT),
COORDINATES OF ZERO PRESSURE ON THE BASE:
XZ = 9.88 AND YZ = 77.30

CREEP PATH DESCRIPTION FOR LOAD CASE 1

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
10.45	97.00	0.
10.45	77.30	1231.25
10.45	77.30	1231.25
9.88	77.30	1231.25
8.95	77.30	1209.45
8.25	83.00	718.27
-5.85	83.00	386.98
-5.85	87.50	0.

OVERTURNING HYDRAULIC GRADIENT = 0.3759

> VALUE OF NPPD(LC) FOUND = 1 IN S/R CHEKIT (LOAD CASE 1)

PASSIVE EARTH PRESSURES FOR LOAD CASE 1

```
NPPD                                    =        1
ELEVATION OF TOP OF SOIL                =   87.559      (FT)
PRESSURE AT TOP OF SOIL                 =   0.          (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE              =   83.000      (FT)
PRESSURE AT BOTTOM OF TOE               =   -722.26     (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL       =   77.300      (FT)
PRESSURE AT LOWEST POINT ON WALL        =   -722.26     (LBS/SQ.FT)
PASSIVE EARTH FORCE                     =   -5763.1     (LBS/SLICE)
PASSIVE EARTH MOMENT                    =   -9231.7     (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT            =  5.24 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE     =  -10302.76 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES     =   5763.58 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES    =  -124942.20 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.3214, FOR LOAD CASE 1
```

LOAD CASE 2

```
DEFAULT VALUE OF          3      USED FOR NPPD(LC)   (LOAD CASE 2)

RESULTANT IS OUTSIDE THE KERN ON THE TOE SIDE

EFFECTIVE BASE =   6.88 (FT),
COORDINATES OF ZERO PRESSURE ON THE BASE:
   XZ =   1.03 AND YZ =  83.00
```

CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
10.45	97.00	0.
10.45	77.30	1231.25
10.45	77.30	1231.25
8.95	77.30	1231.25
8.25	83.00	875.00
1.03	83.00	875.00
-5.85	83.00	516.12
-5.85	87.50	0.

```
OVERTURNING HYDRAULIC GRADIENT  =  0.8351


> VALUE OF NPPD(LC)   FOUND =         3      IN S/R CHEKIT (LOAD CASE 2)
```

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  2

NPPD                                    =          3
ELEVATION OF TOP OF SOIL                =    87.559     (FT)
PRESSURE AT TOP OF SOIL                 =   0.          (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL       =    77.300     (FT)
PRESSURE AT LOWEST POINT ON WALL        =   -967.73     (LBS/SQ.FT)
PASSIVE EARTH FORCE                     =   -4963.7     (LBS/SLICE)
PASSIVE EARTH MOMENT                    =   -11320.     (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT          =  3.54 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =    -13898.36 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =      4920.84 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =   -151088.37 (FT-LBS/SLICE)

THE RESULTANT RATIO =       0.2175, FOR LOAD CASE  2



    LOAD CASE    3

  DEFAULT VALUE OF            1       USED FOR NPPD(LC)   (LOAD CASE  3)

 RESULTANT IS OUTSIDE THE KERN ON THE TOE SIDE


  EFFECTIVE BASE =  15.73 (FT),
  COORDINATES OF ZERO PRESSURE ON THE BASE:
     XZ =    9.88 AND YZ =  77.30

 CREEP PATH DESCRIPTION FOR LOAD CASE 3


 X-COORDINATES       Y-COORDINATES      HYDROSTATIC PRESSURE
    10.45               97.00                   0.
    10.45               77.30                1231.25
    10.45               77.30                1231.25
     9.88               77.30                1231.25
     8.95               77.30                1209.45
     8.25               83.00                 718.27
    -5.85               83.00                 386.98
    -5.85               87.50                   0.

  OVERTURNING HYDRAULIC GRADIENT  =  0.3759


  > VALUE OF NPPD(LC)   FOUND =           1       IN S/R CHEKIT (LOAD CASE  3)



  PASSIVE EARTH PRESSURES FOR LOAD CASE  3

  NPPD                                    =          1
  ELEVATION OF TOP OF SOIL                =    87.559     (FT)
  PRESSURE AT TOP OF SOIL                 =   0.          (LBS/SQ.FT)
  ELEVATION AT BOTTOM OF TOE              =    83.000     (FT)
  PRESSURE AT BOTTOM OF TOE               =   -722.26     (LBS/SQ.FT)
  ELEVATION OF LOWEST POINT ON WALL       =    77.300     (FT)
  PRESSURE AT LOWEST POINT ON WALL        =   -722.26     (LBS/SQ.FT)
  PASSIVE EARTH FORCE                     =   -5763.1     (LBS/SLICE)
  PASSIVE EARTH MOMENT                    =   -9231.7     (FT-LBS/SLICE)
```

```
DISTANCE FROM THE TOE TO THE RESULTANT         =  5.24 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =   -10302.76 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =     5763.98 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =  -124942.20 (FT-LBS/SLICE)


THE RESULTANT RATIO =       0.3214, FOR LOAD CASE  3



 *
 * BEGIN SLIDING COMPUTATION
 *



     FACTOR OF SAFETY FOR MIN. OMEGA (LEVEL) =     7.43

     SUM OF DRIVING FORCES  =  7711.020 (LBS/SLICE)
     SUM OF RESISTING FORCES =  7715.337 (LBS/SLICE)

     PASSIVE EARTH FORCE                   =   5579.80 (LBS/SLICE)
     ACTIVE EARTH FORCE                    =      0.    (LBS/SLICE)
     UPLIFT FORCE                          = -17092.89 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =   7711.02 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X          Y
        -5.85      77.30
         8.95      77.30


     FACTOR OF SAFETY FOR MAX. OMEGA (TOE TO KEY) =     3.99

     SUM OF DRIVING FORCES  =  6230.984 (LBS/SLICE)
     SUM OF RESISTING FORCES =  6234.935 (LBS/SLICE)

     PASSIVE EARTH FORCE                   =   2417.22 (LBS/SLICE)
     ACTIVE EARTH FORCE                    =      0.    (LBS/SLICE)
     UPLIFT FORCE                          = -13611.81 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =   6677.13 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X          Y
        -5.85      83.00
         8.95      77.30

  FINAL FACTOR OF SAFETY AGAINST SLIDING =      3.99, FOR LOAD CASE  1
  BY ALLOWABLE STRENGTH METHOD
    C'=C/FS+2C'     TANPHI'=TANPHI/FS

     SUM OF DRIVING FORCES  =  6230.984 (LBS/SLICE)
     SUM OF RESISTING FORCES =  6234.935 (LBS/SLICE)

     PASSIVE EARTH FORCE                   =   2417.22 (LBS/SLICE)
     ACTIVE EARTH FORCE                    =      0.    (LBS/SLICE)
     UPLIFT FORCE                          = -13611.81 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =   6677.13 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X          Y
        -5.85      83.00
         8.95      77.30
```

```
FACTOR OF SAFETY FOR MIN, OMEGA (LEVEL) =     5,58

SUM OF DRIVING FORCES  =  7711,020 (LBS/SLICE)
SUM OF RESISTING FORCES = 43010,358 (LBS/SLICE)

PASSIVE EARTH FORCE                      =  27018,05 (LBS/SLICE)
ACTIVE EARTH FORCE                       =        0,    (LBS/SLICE)
UPLIFT FORCE                             = -17092,89 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =    7711,02 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X          Y
   -5,85      77,30
    8,95      77,30


FACTOR OF SAFETY FOR MAX, OMEGA (TOE TO KEY) =     5,18

SUM OF DRIVING FORCES  =  6677,129 (LBS/SLICE)
SUM OF RESISTING FORCES = 34579,668 (LBS/SLICE)

PASSIVE EARTH FORCE                      =  10285,56 (LBS/SLICE)
ACTIVE EARTH FORCE                       =        0,    (LBS/SLICE)
UPLIFT FORCE                             = -13611,81 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =    6677,13 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X          Y
   -5,85      83,00
    8,95      77,30

FINAL FACTOR OF SAFETY AGAINST SLIDING =     5,18, FOR LOAD CASE  2
BY SHEAR FRICTION METHOD

SUM OF DRIVING FORCES  =  6765,836 (LBS/SLICE)
SUM OF RESISTING FORCES = 35014,312 (LBS/SLICE)

PASSIVE EARTH FORCE                      =  11772,51 (LBS/SLICE)
ACTIVE EARTH FORCE                       =        0,    (LBS/SLICE)
UPLIFT FORCE                             = -13978,44 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =    6765,84 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X          Y
   -5,85      82,43
    8,95      77,30
```

```
FACTOR OF SAFETY FOR MIN. OMEGA (LEVEL) =     7.43

SUM OF DRIVING FORCES  =  7711.020 (LBS/SLICE)
SUM OF RESISTING FORCES =  7715.337 (LBS/SLICE)

PASSIVE EARTH FORCE                     =   5579.80 (LBS/SLICE)
ACTIVE EARTH FORCE                      =      0.   (LBS/SLICE)
UPLIFT FORCE                            = -17092.89 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =   7711.02 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X          Y
   -5.85      77.30
    8.95      77.30



FACTOR OF SAFETY FOR MAX. OMEGA (TOE TO KEY) =     3.99

SUM OF DRIVING FORCES  =  6230.984 (LBS/SLICE)
SUM OF RESISTING FORCES =  6234.935 (LBS/SLICE)

PASSIVE EARTH FORCE                     =   2417.22 (LBS/SLICE)
ACTIVE EARTH FORCE                      =      0.   (LBS/SLICE)
UPLIFT FORCE                            = -13611.81 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =   6677.13 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X          Y
   -5.85      83.00
    8.95      77.30

FINAL FACTOR OF SAFETY AGAINST SLIDING =      3.99, FOR LOAD CASE  3
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

SUM OF DRIVING FORCES  =  6230.984 (LBS/SLICE)
SUM OF RESISTING FORCES =  6234.935 (LBS/SLICE)

PASSIVE EARTH FORCE                     =   2417.22 (LBS/SLICE)
ACTIVE EARTH FORCE                      =      0.   (LBS/SLICE)
UPLIFT FORCE                            = -13611.81 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =   6677.13 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
     X          Y
   -5.85      83.00
    8.95      77.30
```

```
EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
         12: 0150 ON 12/ 3/80


#
#  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
#


THE BASE LIES IN SOIL 3


 FOR LOAD CASE  1,

 FOR THE BASE COORDINATES  X= -5,85  Y= 83,00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   8000,00 (LBS/SQ,FT)
THE ACTUAL BEARING PRESSURE         =   1155,18 (LBS/SQ,FT)

 FOR THE BASE COORDINATES  X=  8,25  Y= 83,00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   8000,00 (LBS/SQ,FT)
THE ACTUAL BEARING PRESSURE         =    119,57 (LBS/SQ,FT)

 FOR THE BASE COORDINATES  X=  8,95  Y= 77,30, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   8000,00 (LBS/SQ,FT)
THE ACTUAL BEARING PRESSURE         =     68,16 (LBS/SQ,FT)

 FOR THE BASE COORDINATES  X= 10,45  Y= 77,30, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   8000,00 (LBS/SQ,FT)
THE ACTUAL BEARING PRESSURE         =      0,    (LBS/SQ,FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  1


 FOR LOAD CASE  2,


THE EFFECTIVE BASE WIDTH IS LESS THAN BW1(DATA LIST WLAB),
SO A LINEAR EXTRAPOLATION AT A CONSTANT ELEVATION WAS MADE ON THE
BEARING CAPACITY(ABP3TN,ABP3TW,ABP4TN,ETC) TO FIT THE RANGE


 FOR THE BASE COORDINATES  X= -5,85  Y= 83,00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   8000,00 (LBS/SQ,FT)
THE ACTUAL BEARING PRESSURE         =   1596,47 (LBS/SQ,FT)

 FOR THE BASE COORDINATES  X=  8,25  Y= 83,00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   8000,00 (LBS/SQ,FT)
THE ACTUAL BEARING PRESSURE         =      0,    (LBS/SQ,FT)

 FOR THE BASE COORDINATES  X=  8,95  Y= 77,30, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE     =   8000,00 (LBS/SQ,FT)
THE ACTUAL BEARING PRESSURE         =      0,    (LBS/SQ,FT)
```

```
FOR THE BASE COORDINATES  X= 10.85  Y= 77.30, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =       0.    (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  2


 FOR LOAD CASE  3,

 FOR THE BASE COORDINATES  X= -5.85  Y= 83.00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =   1155.18 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=  8.25  Y= 83.00, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =    119.57 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=  8.95  Y= 77.30, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =     68.16 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 10.85  Y= 77.30, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE    =   8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE        =       0.    (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  3




EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
          12: 0150 ON 12/ 3/80



*
* BEGIN COST ANALYSIS
*
```

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	95.15	0.	0.

COST & VOLUME OF BACKFILL MATERIAL,

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	30.59	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	32.64	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	27.13	1.00	27.13
BASE	24.45	1.00	24.45
KEY	10.54	1.00	10.54

TOTAL CONCRETE VOLUME = 62.12 (CU FT / LF), FOR LOAD CASE 1

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	95.15	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	30.59	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	32.64	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	27.13	1.00	27.13
BASE	24.45	1.00	24.45
KEY	10.54	1.00	10.54

TOTAL CONCRETE VOLUME = 62.12 (CU FT / LF), FOR LOAD CASE 2

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	95.15	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	30.59	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	32.64	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	27.13	1.00	27.13
BASE	24.45	1.00	24.45
KEY	10.54	1.00	10.54

TOTAL CONCRETE VOLUME = 62.12 (CU FT / LF), FOR LOAD CASE 3

```
*
* BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE  1
*

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF    77.30 IS       2.6323


*
* BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE  2
*

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF    77.30 IS       2.6323


*
* BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE  3
*




EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
          12: 0?53 ON 12/ 3/80



*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*


  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER              KA VALUE
     ..............              ........
           1                      0.4961

          HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  1
          FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

          OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

            ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                            STATIC FORCE           EARTHQUAKE FORCE
              (FT)           (LBS/FT)                 (LBS/FT)
          ---------  ----------------------  ----------------------
           86.500            0.                       0.
           85.500            0.                       0.
           84.500            0.                       0.

          FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE

          RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.   LBS/HORIZ FT
          ACTING AT ELEVATION       0.

          RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
          DUE TO EARTHQUAKE =        0.   LBS/HORIZ FT
          ACTING AT ELEVATION       0.
```

EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
12: 0:53 ON 12/ 3/80

```
*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*
```

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.4961

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 2
FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
86.500	0.	0.
85.500	0.	0.
84.500	0.	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

```
EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
        12: 0154 ON 12/ 3/80


#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#


  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER          KA VALUE
     ..............          ........
           1                  0.4961

        HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  3
        FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

        OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

          ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                          STATIC FORCE           EARTHQUAKE FORCE
            (FT)           (LBS/FT)                  (LBS/FT)
          ---------  ----------------------  ----------------------
          86.500            0.                          0.
          85.500            0.                          0.
          84.500            0.                          0.

        FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

        RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.   LBS/HORIZ FT
        ACTING AT ELEVATION       0.

        RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
        DUE TO EARTHQUAKE =        0.   LBS/HORIZ FT
        ACTING AT ELEVATION       0.


#
# EXIT MODULE EA
#


 #
 # UPDATE FILE RESET
 #

 COMMAND ENTERED:
 RUN WD
```

```
121 2121 ON 12/ 3/80

*
* BEGIN DATA CHECK FOR MODULE WD
*

COMPLETE THE TRIAL WALL DESCRIPTION:

DEFAULT VALUE OF    0.              USED FOR BASER       (LOAD CASE  1)

STR    CALCULATED TO BE     0.34356

DEFAULT VALUE OF             0       USED FOR IBSAME      (LOAD CASE  1)

WITH BASE RADIUS ("BASER", 0.0 FOR RECTANGULAR) =       0.   FEET,
TOE END OF BASE UNIT WIDTH =   1.0000 FT. AND
HEEL END OF BASE UNIT WIDTH =  1.0000 FT.
(BASIC WORKING POINT IS 1.0 FT. WIDE).

LOWEST CONCRETE =       77.30 FT.. AT BOTTOM OF KEY

DEFAULT VALUE OF           11       USED FOR   MAXBAR    (LOAD CASE  1)

SPAMIN CALCULATED TO BE      3.6600

MAXIMUM STEEL AREA PER FOOT, CALCULATED FROM
NO. 11 BARS (MAXBAR) AT  3.66 INCHES (SPAMIN),
IS  5.115 SQ. IN. / FT.

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE    1 ----------

FH TOP CALCULATED TO BE      97.000
FOR LOAD CASE  1

> NPPD    IS            1

DEFAULT VALUE OF     1.000000      USED FOR  AOSF(LC)  (LOAD CASE  1)

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE    2 ----------

FH TOP CALCULATED TO BE      97.000
FOR LOAD CASE  2

> NPPD    IS            3

DEFAULT VALUE OF     1.000000      USED FOR  AOSF(LC)  (LOAD CASE  2)

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE    3 ----------

FH TOP CALCULATED TO BE      97.000
FOR LOAD CASE  3

> NPPD    IS            1

DEFAULT VALUE OF     1.000000      USED FOR  AOSF(LC)  (LOAD CASE  3)

  --------------- END OF PRESSURE DATA VERIFICATION ---------------
```

DEFAULT VALUE OF 3000,000 USED FOR FPCON (LOAD CASE 1)

DEFAULT VALUE OF 0,2900000E 08 USED FOR ESTL (LOAD CASE 1)

DEFAULT VALUE OF 9,190000 USED FOR RATION (LOAD CASE 1)

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	100,0000	BASIC WORKING POINT * TOE-SIDE OF STEM TOP
2	-0,2500	84,5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	-0,2500	84,5000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-5,8500	84,5000	TOP OF TOEHT * AT OUTER END OF TW2
5	-5,8500	83,0000	TOE END OF BASE * AT BTE1
6	8,2500	83,0000	TOP OF TOE-SIDE FACE OF KEY
7	8,4500	77,3000	BOTTOM OF TOE-SIDE FACE OF KEY
8	10,4500	77,3000	BOTTOM OF HEEL-SIDE FACE OF KEY
9	10,4500	83,0000	TOP OF HEEL-SIDE FACE OF KEY
10	10,4500	83,0000	HEEL END OF BASE
11	10,4500	84,5000	TOP OF HEELT2 * TOP OF OUTER END OF HEEL
12	1,7500	84,5000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1,5000	100,0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1,5000	100,0000	TOP OF HEEL-SIDE FACE OF STEM
15	9,7000	77,3000	BOTTOM OF CUTOFF WALL UNDER KEY

DEFAULT VALUE OF 0,3500000 USED FOR RATIOF (LOAD CASE 1)

DEFAULT VALUE OF 20000,00 USED FOR FSTLMX (LOAD CASE 1)

DEFAULT VALUE OF 0 USED FOR IFOR (LOAD CASE 1)

DEFAULT VALUE OF 3,500000 USED FOR COVHS (LOAD CASE 1)

DEFAULT VALUE OF 3,500000 USED FOR COVTS (LOAD CASE 1)

DEFAULT VALUE OF 3,500000 USED FOR COVTB (LOAD CASE 1)

DEFAULT VALUE OF 4,500000 USED FOR COVBB (LOAD CASE 1)

DEFAULT VALUE OF 2,375000 USED FOR SPABL (LOAD CASE 1)

COMBINED PASSIVE PRESSURE VALUE OF -722,2640 USED FOR LOAD CASE 1

COMBINED PASSIVE PRESSURE VALUE OF -967,7305 USED FOR LOAD CASE 2

COMBINED PASSIVE PRESSURE VALUE OF -722,2640 USED FOR LOAD CASE 3

```
EXAMPLE 2 -- ANALYZE EXHIBIT M WALL, THEN DESIGN WITH MODULE
          12: 2150 ON 12/ 3/80


 #
 # BEGIN ALTERNATE METHOD (WSD) DESIGN
 #

 THE ABOVE TABLE OF X- AND Y-COORDINATES AND THE FOLLOWING TABLE OF DATA
 LISTS DESCRIBE THE WALL ASSUMED FOR THE DESIGN ANALYSIS FREE BODIES.
 IF THE FINAL DIMENSIONS TURN OUT TO BE SUBSTANTIALLY DIFFERENT,
 YOU MAY WANT TO RUN MODULE WD AGAIN.


 WLA     FTS             TW2             STR             HEELW
      100.0000        5.600000        0.3435583       8.700000

 WLAH     BW              BS                              BASER (LIST=WLBR)
      16.30000        0.                              0.

 WLAH  HEELT2           HEELW           HEELT1
      18.00000        8.700000        18.00000

 WLAK  KFLAG            DKEY            WKEY            BKTF
         0            5.700000        18.00000        8.142857

 WLAS   TSTT            TSB             TSTB            HSTPH           HSTPB
      18.00000        0.1935484       24.00000        0.              0.
       HSBPB
     0.1935484

 WLAT   BTE1            TOEHT           TS2             TW1             TS1
      83.00000        18.00000        100.0000        0.            -0.1234000E 31

 ----  TMINB            TMINS
      18.00000        18.00000

 #
 # BEGIN TOE DESIGN
 #

 PUT REINF. IN AND INCREASE THICKNESS AS NEEDED FOR SHEAR

 #
 # BEGIN STEM DESIGN
 #

 PUT REINF. IN AND INCREASE THICKNESS AS NEEDED FOR SHEAR

 #
 # BEGIN KEY DESIGN
 #

 PUT REINF. IN AND INCREASE THICKNESS AS NEEDED FOR SHEAR

 KEY DATA WKEY, BKTF ARE   18.00000      AND   8.142857
 WITH DKEY =   5.700000
```

```
*
* HEEL DESIGN
*

PUT REINF. IN AND INCREASE THICKNESS AS NEEDED FOR SHEAR

*
* DESIGN SUMMARY
*

WLA      ETS            TW2            STR            HEELW
     100.0000       5.600000       0.3435583      8.950000

WLAB     BW             BS                            BASER (LIST=WLAB)
     16.30000       0.                            0.

WLAH   HEELT2         HEELW          HEELT1
     18.00000       8.950000       18.00000

WLAK   KFLAG          DKEY           WKEY           BKTF
        0           5.700000       18.00000       8.142857

WLAS    TSTT          TSH            TSTB           HSTPH          HSTPB
     18.00000       0.1935484      21.00000       0.             0.
       HSAPB
    0.

WLAT    BTE1          TOEHT          TS2            TW1            TS1
     83.00000       18.00000       100.0000       0.             100.0000

****   TMINH          TMINS
     18.00000       18.00000


              COORDINATES OF CORNERS OF WALL CROSS-SECTION

      X=COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
      Y=COORDINATES ARE ELEVATIONS

 PT.     X           Y                     DESCRIPTION OF POINT
 --  ---------  ----------   ----------------------------------------------
  1    0.         100.0000   BASIC WORKING POINT = TOE-SIDE OF STEM TOP
  2   -0.2500      84.5000   BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
  3   -0.2500      84.5000   BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
  4   -5.8500      84.5000   TOP OF TOEHT & AT OUTER END OF TW2
  5   -5.8500      83.0000   TOE END OF BASE = AT BTE1
  6    8.2500      83.0000   TOP OF TOE-SIDE FACE OF KEY
  7    8.9500      77.3000   BOTTOM OF TOE-SIDE FACE OF KEY
  8   10.4500      77.3000   BOTTOM OF HEEL-SIDE FACE OF KEY
  9   10.4500      83.0000   TOP OF HEEL-SIDE FACE OF KEY
 10   10.4500      83.0000   HEEL END OF BASE
 11   10.4500      84.5000   TOP OF HEELT2 = TOP OF OUTER END OF HEEL
 12    1.5000      84.5000   BOTTOM OF HEEL-SIDE FACE OF STEM
 13    1.5000     100.0000   BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
 14    1.5000     100.0000   TOP OF HEEL-SIDE FACE OF STEM
 15    9.7000      77.3000   BOTTOM OF CUTOFF WALL UNDER KEY
```

```
THE REINFORCING IN THE FOLLOWING TABLE SATISFIES STRENGTH AND
EM 1110-2-2103 MINIMUM REQUIREMENTS (.125 PERCENT OF AREA IN EACH FACE).
```

TABLE OF STEEL VALUES IN STEM, SQ. IN. / FT.

M	ELEV.	ASTLST(M)	ASTLSH(M,1)	ASTLSH(M,2)	ASTLSH(M,3)
1	100.00	0.273	0.273	******	******
2	99.00	0.273	0.273	******	******
3	98.00	0.276	0.276	******	******
4	97.00	0.279	0.279	******	******
5	96.00	0.282	0.282	******	******
6	95.00	0.285	0.285	******	******
7	94.00	0.287	0.287	******	******
8	93.00	0.290	0.290	******	******
9	92.00	0.293	0.293	******	******
10	91.00	0.296	0.296	******	******
11	90.00	0.299	0.299	******	******
12	89.00	0.302	0.302	******	******
13	88.00	0.305	0.305	******	******
14	87.00	0.308	0.308	******	******
15	86.00	0.311	0.410	******	******
16	85.00	0.314	0.532	******	******

TABLE OF STEEL VALUES IN BASE, SQ. IN. / FT.
(M = 1 AT END OF TOE)

M	DIST.	ASTLBT(M,1)	ASTLBT(M,2)	ASTLBB(M,1)	ASTLBB(M,2)	ASTLBB(M,3)
1	0.	0.270	******	0.270	******	******
2	1.00	0.270	******	0.270	******	******
3	2.00	0.270	******	0.270	******	******
4	3.00	0.270	******	0.270	******	******
5	4.00	0.270	******	0.428	******	******
6	5.00	0.270	******	0.795	******	******
7	6.00	******	******	******	******	******
8	7.00	******	******	******	******	******
9	8.00	0.392	******	0.270	******	******
10	9.00	0.270	******	0.270	******	******
11	10.00	0.270	******	0.270	******	******
12	11.00	0.270	******	0.313	******	******
13	12.00	0.270	******	0.419	******	******
14	13.00	0.270	******	0.536	******	******
15	14.00	0.270	******	0.632	******	******
16	15.00	0.270	******	0.632	******	******
17	16.00	0.270	******	0.632	******	******

```
ASTLK =   0.396   SQ IN / FT

****** = UNDEFINED

NOTE:  PARAGRAPH 5-21A(5) OF EM 1110-2-2501 CAN BE INTERPRETED
TO MEAN THAT THE TOE OF HEEL AT THE KEY MUST HAVE AT LEAST AS
MUCH REINFORCEMENT AS THE TOE-SIDE FACE OF THE KEY.  THIS REQUIREMENT
WAS NOT CONSIDERED WHEN DETERMINING THE REINFORCING SHOWN IN THE TABLE
ABOVE FOR ASTLHT(LOC,LNA) WHERE LOC IS THE LOCATION
AND LNA IS THE LAYER NUMBER.

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
```

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

[illegible]

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

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AD-A100 734 USER'S REFERENCE MANUAL: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVE..(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS W A PRICE ET AL. 4/4

UNCLASSIFIED DEC 80 WES-INSTRUCTION-K-80-7 F/G 13/13 NL

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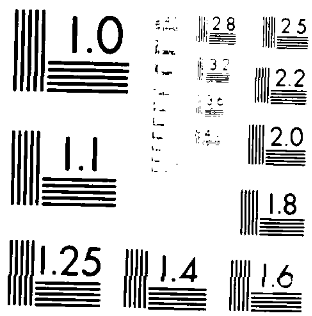


MICROCOPY RESOLUTION TEST CHART

SUPPLEMENTARY

INFORMATION

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

REPLY TO
ATTENTION OF

WESKD 24 January 1983

SUBJECT: Replacement Sheets for WES Instruction Report K-80-7, User's Reference Manual: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)

AD-A1..734

TO: All Corps Elements with Civil Works Responsibilities

1. Those sheets containing pages, iv, 1-1, 1-5, 3-3, 3-7, 3-8, 3-10, 3-12, 3-28.1, 3-29, 3-37, 3-38, 8-5, 11-6, and 12-28 should be replaced with the attached sheets containing identically numbered revised pages.

2. We hope that a set of these changes will be replaced into every copy of the original documents in your office. Additional copies of these changes or of the basic documents can be obtained through informal request to Mrs. Rosemary Peck, Engineering Computer Programs Library, FTS: 542-2581.

HOW TO USE THIS BOOK

Instructions for the preparation of data are presented in four ways. The user is urged to make himself aware of all four presentations and select the one that best meets his particular needs:

1. For the beginning user: Paragraph 12-3, Data Preparation Checklist. See especially paragraph 12-3-12.

2. Data arrangement reminder: Paragraph 12-2-10. This and the list of commands in paragraph 2-3-1 are available while the program is running by typing a question mark (?) as a command.

3. List of data lists and the variable names in them: Paragraph 12-2 and Figures 3-1 through 3-5. This is intended for use as a checklist for the experienced user.

4. Detailed data definitions, arranged by data list: Chapters 2 and 3, plus the first part of each of Chapters 4 through 8.

A pull-out summary of all data lists is given at the end of Chapter 12.

MAJOR CONTENTS

CONTENTS

USER'S REFERENCE MANUAL: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (CTWDA)

CORPS X0053

CHAPTER 1: INTRODUCTION

1-1 PURPOSE OF PROGRAM TWDA AND THIS MANUAL. CTWDA is a computer-aided structural design system for analysis and/or design of inverted-T cantilever walls founded on earth or rock. Multiple load cases allow the wall to act as a floodwall or a retaining wall. This manual is intended for use by structural engineers. The program does not attempt to establish any soil design criteria; such data must be entered by the user after consultation with a soil design engineer. There are no default values for soil criteria parameters, except as provided in Corps engineering standards for structural design.

1-2 ORGANIZATION AND SUMMARY DESCRIPTION OF PROGRAM

1-2-1 Structure. CTWDA is a series of design/analysis modules,* each performing one specific step in the design or analysis process. These modules are callable, in any logical sequence, from an executive command phase.** While in this executive phase, the user may call various procedures for data entry, data review, saving the current design status, restoring from an old status save, etc. This organization is illustrated in Figure 1-1.

1-2-2 Brief Description of Data Entry. The data entry procedure is similar to that for program TGDA,† except that the data phase is combined with the command phase instead of being separate as in TGDA. Features include:

a. Data are entered by naming the group and listing the values in that group, all on one line.

b. Default values are requested by entering the letter D for the desired data item(s), instead of a numerical value.

c. Values to be left undefined or changed to the undefined state are identified to the program by typing the letter C instead

---

* A module is a subprogram that is controlled as one unit and that performs one complete aspect of the purpose of the entire program.

** The executive phase of this program is the central core of the user's flow of control. The user may enter data or start a module while in the executive phase.

† TGDA (three-girder tainter gate design/analysis) is a computer program (713-F3-RO-022) developed for the Lower Mississippi Valley Division's Computer-Aided Structural Design (CASD) Committee in 1976.

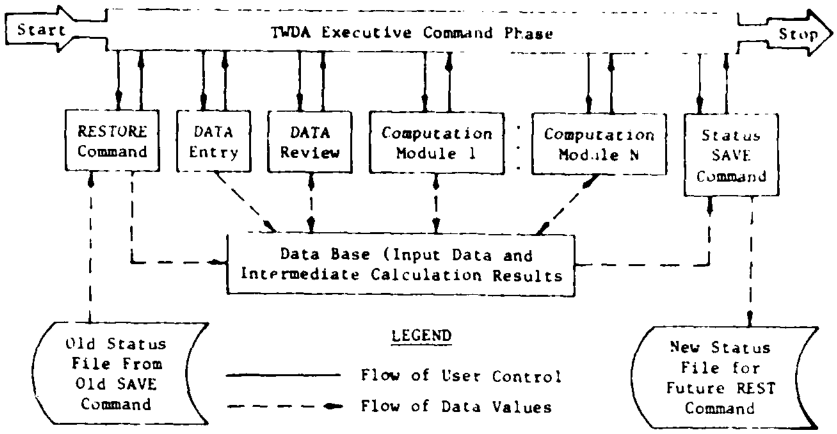


Figure 1-1. Basic program flowchart

of entering a value for the particular item(s).

d. A value to be left unchanged from its previous state is identified to the program by typing the letter S for the particular item, instead of repeating the earlier value.

e. The program looks for illogical and inconsistent data and identifies such items to the user for correction or use anyway.

f. The current status of items of input data or of all data values can be reviewed.

g. Multiple-level prompting is provided, with more detailed information when the user answers with a question mark.

Thus the program will accept several sets of input data, where the following sets contain only the changes to the data comprising the preceding sets. Repetitive data will remain unchanged.

1-2-3 Data Review. Two methods of data reveiw are available:

a. Input data may be reviewed with the LOOK command.

b. Default value review is available at selected points in the interaction as described else where in this manual. Unless reviewed with this option, default values are set automatically by the user's selection of:

(1) Floodwall or retaining wall criteria.

(2) Hydraulic or nonhydraulic structure criteria.

Making the review of default values optional is expected to enable the experienced user to simplify and expedite his preliminary designs. In any case, the values are printed out in the report file. The combination of a nonhydraulic floodwall, being illogical, will be rejected. Default values are taken from Corps engineering publications; nonstandard values set by the user are printed in the report file.

(b) Up to five vertical concentrated line loads parallel to the wall (P_{V1} through P_{V5} in Figure 3-3) plus the force P_{V5} centered on the top of the stem and P_{VB} anywhere on the base.

(5) Wind direction and magnitude (Figure 3-1).

(6) Earthquake effect acceleration factors or effective K_a values.

(7) Design criteria

(a) Load factors for reinforced concrete strength design and overstress factors for working stress design.

(b) Allowable bearing capacity, interpolated values over ranges of allowable toe base elevations and base widths (see paragraph 3-2-2), for each layer of existing earth.

(c) Minimum factor of safety against shear friction sliding.

(d) Minimum safety factor for cohesion and tan ϕ data values used in the sliding determination by allowable strength equilibrium methods.

(e) Limiting value of the overturning stability resultant ratio.

(f) Reinforced concrete design parameters.

(g) Specification of "hydraulic" or "nonhydraulic" structure.

(h) Heel earth cover crack control.

b. Typical Application of Load Cases. Any load case may have any or all of the effects described above.

1-4 HIGHLIGHTS OF CTWDA DESIGN

1-4-1 The Stability Design/Analysis Phase.

a. This place finds the least-cost combination of values inside user-defined ranges of base width, bottom of tow elevation, base slope, and key length, for a given stem ratio or toe width, that satisfies stability requirements for up to 10 load cases. Cost factors include:

(1) Structural excavation, with separate unit prices in each existing soils layer and for the key.

(2) Concrete, with separate unit prices for the stem, base slab, and key.

(3) Structural backfill, with separate unit prices for each backfill layer.

b. Earth pressures for design are calculated by using either Coulomb's equations for earth pressure and Boussinesq's equations for surcharge pressures or by an incremental wedge technique. Earthquake effects are based on the Mononobe-Okabe method of equivalent K_a for earth pressure and Westergaard theory for dynamic water pressure. Earth pressures for analysis can be either as just described for design or as read in by the user.

c. Hydrostatic pressures are calculated by the line of creep or design and by either the line of creep or as defined by the user for analysis. Control options include:

(1) Crack over heel or not.

(2) Each load case calculates its own pressures or all load cases use the value determined for one selected load case.

(3) Choice of:

(a) Creep.

(b) Hydrostatic over heel and toe; linear variation between heel and toe (as for dams).

(c) User-defined vertical and horizontal pressures.

(d) Water over toe sets the weight on the toe; water over heel sets the weight on the heel and the uplift under the base (as for the wall of a lock with an impervious floor).

1-4-2 The Structural Design/Analysis Phase.

a. This phase uses the working stress (ACI alternate) method and provides for future addition of strength design. Design is for minimum slab thickness within the controls selected by the user in the input data. Default is to a simple, basic wall that the user may elaborate on by adding additional input data as desired. After the concrete dimensions have been set for moment, axial force, shear, and architectural considerations, reinforcing steel requirements at critical and selected locations are calculated directly for the actual thickness, moment, axial force, and shear at each location. The need for multiple layers of steel is checked based on maximum bar size and minimum spacing as selected by the user. Multiple layers are used if needed, including adjustment of slab thickness. The 1977 edition of ACI 318 is used.

b. Maximum wall height from top of stem to bottom of key is 68.0 ft*; maximum base width is 48.0 ft. These maximum dimensions may be increased later.

---

* A table of factors for converting inch-pound units of measurement to metric (SI) units is presented on page x.

a random relationship between existing soil layers 3-4-5 and backfill soil layers FZ-1-2-6-7 as the wall and its backfill move up and down.

Data List	Page	Mandatory Where Used?	Used in SA-SP	Used in FA-FD	Used in WA-WD-UA-UD	See Figure
BOIL	3-4	no	--	yes	--	--
ONEA	3-5	no	--	yes	--	--
RRD	3-6	no	--	FD	--	--
SEEP	3-6	(5)	--	--	(1)	3-1
SLID	3-9	no	--	yes	--	--
SPHF	3-9	(4)	yes	yes	yes	3-1
SPH1	3-10	(6)	yes	yes	yes	3-1
SPH2	3-10	(4)	yes	yes	yes	3-1
SPE3	3-11	yes	yes	yes	--	3-1
SPE4	3-12	no	yes	yes	--	3-1
SPE5	3-12	no	yes	yes	--	3-1
SPT6	3-13	(3)	--	yes	--	3-1
SPT7	3-13	(6)	--	yes	yes	3-1
SSEE	3-13	(7)	yes	yes	--	3-2,3-3
SOLP	3-14	no	yes	yes	(2)	--
SST	3-17	yes	--	yes	yes	3-1
SSHW or SSHC	3-17 / 3-18	yes	yes	yes	yes	3-1
WGHT	3-18	no	yes	yes	yes	--

NOTES:

(1) ELWT, ELWH, ISLC are optional; KRACK has a default value; HGSW and ISFT are not used in these modules.

(2) NPPD, RKH, RKV, CFMA have default values; IFWOC, NODE, and IFSOM are not used.

(3) SPT7 data will be assumed to be also for SPT6 if SPT6 is not entered. SPT7, in turn, will be copied from SPE3 if SPT7 is omitted.

(4) Soil layer 1 is assumed over all of the heel unless SPHF or SPH2 is entered for soil below or above soil type 1.

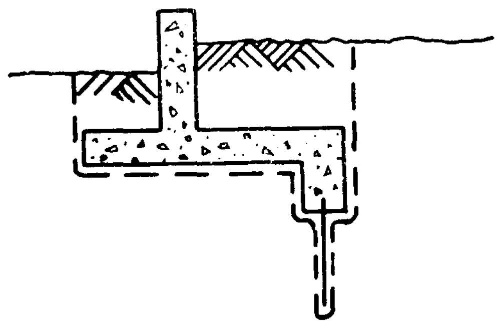
(5) SEEP is mandatory only if water exists.

(6) Soil properties from SPE3 are used for layer 1 (SPH1) if data list SPH1 is omitted. Similarly, SPE3 values are used for SPT7 if SPT7 is omitted. This is true only if modules FA and FD have <u>not</u> been run. If PHI and COH are changed in List SPE3 <u>after</u> modules FA or FD have been run, then lists SPT7 and SPH1 may be needed to change backfill soil properties.

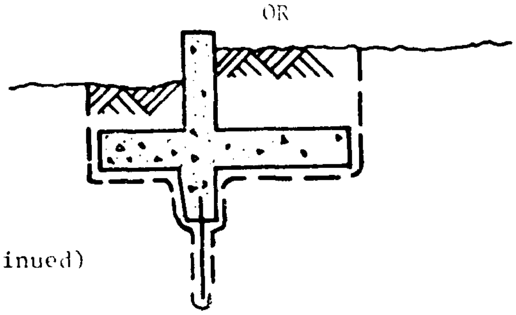
(7) List SSEE is needed only for design (module FD).

3-3-2 Soils and Seepage Data Item Definitions:

List Name	Variable Name	Units	Default Value	Definition
BOIL				Boil control data, optional
	ELSPT	ft	0.0	Elevation of tip of impervious sheet pile cutoff wall below center of key. In module FA (and FD), the presence of this data item variable will cause the program to calculate and print out the average creep ratio to the report file
	CRMIN	ratio	--	Minimum allowable creep ratio. In module FA (and FD), the presence of this data item will cause the program to calculate and print out to the report file the highest ELSPT that will satisfy the CRMIN limit
	IPATH	1 or 2	1	Controls the location of the creep path portion between the bottom of effective length of sheet pile and the end of the toe: 1 to select the path that includes a line along the toe-side face of the sheet pile, key, and bottom of the base:



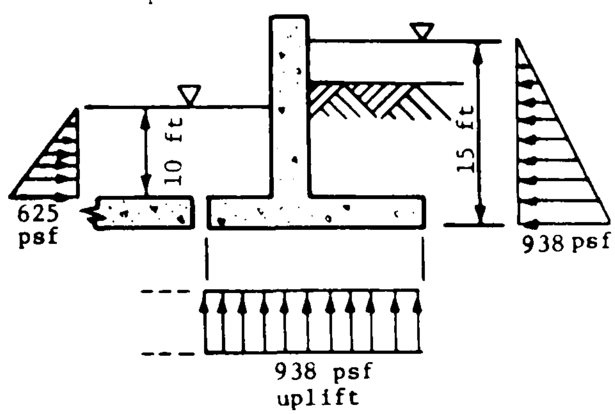
OR



(Continued)

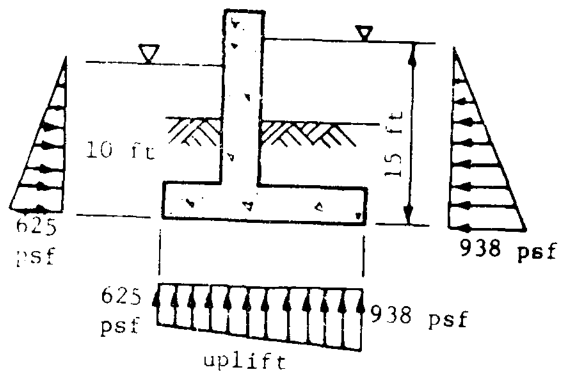
3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SEEP	ISFT	1-4	1	Option 1: The line of creep calculations are as described in EM 1110-2-2501 and as illustrated and discussed in detail in Exhibit H for sliding and Exhibit K for overturning of the Program Criteria Specifications Document. This is the default option for this control. Its action combines with the heel earth crack control (KRACK) to determine how the pressures are determined. When point "Z" (shown on page 11-6 for IRLT = -1) is toward the toe from point 5 (shown in Figure 3-5 on page 3-39), only the effective portion of the base width (between points 5 and Z) is included in the creep path and in sliding adhesion strength. In this case, the toe-side face of the key will not be included either if ISFT = 1. To have this face of the key included in the creep path, use a value of -1 for ISFT.
				Option 2: Perched water table. Any load case(s) will use the water elevation over the toe for weight and horizontal pressure above the toe only. Uplift will be hydrostatic, based on the water elevation over the heel. This would be selected by the user for a channel with an impervious floor:



(Continued)

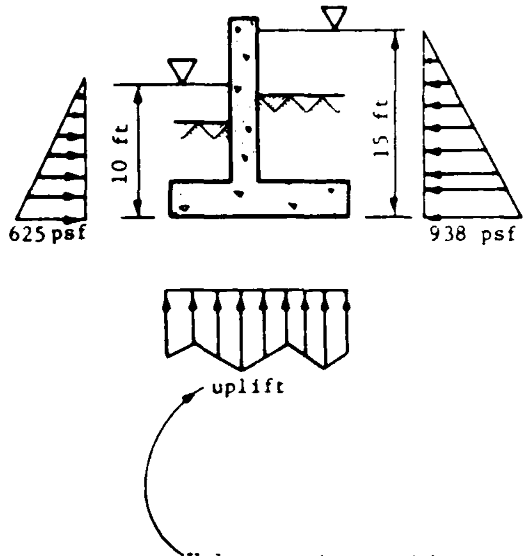
List Name	Variable Name	Units	Default Value	Definition
SEEP	ISFT			Option 3: Pressures will be those caused by the weight of water over the heel and toe. Uplift will be a linear variation between the heel and toe hydrostatic pressure. The user might select this option for a wall on rock



Option 4: Water weight and horizontal pressures above the base will be hydrostatic pressures calculated from the input water elevations. Uplift pressures will be input data for analysis only; will be used as zero for design

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SEEP	ISFT			 Values as inputted by user for analysis. May be zero as described in paragraph S-15e of EM 1110-2-2501. Will be taken as zero during design. Use array FV in data list HSPV to input these pressures; to cancel these pressures, use this data list entry: HSPV LC 1 C
	KRACK	1 or 2	(1)*	Option 1 (default for floodwalls) is to have a vertical crack in the earth cover over the heel (see page S-9 and paragraph S-15a on page S-18 of EM 1110-2-2501). This eliminates any active earth pressure at the heel (module SA) and enables the use of W3-W4 surcharge pressures

(Continued)

* This and other reference numbers given in parentheses in this table refer to notes listed on page 3-20.

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SEEP	KRACK			Option 2 (default for retaining walls) is to have no crack over the heel. This enables active earth pressure and disables any [illegible] surcharge pressures
SLID	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	NSLIDE	1-4	(1)	1 to use ETL 1110-2-184 Shear Friction Method (default for retaining walls). See Exhibit F of the Program Criteria Specifications Document) 2 to use the Allowable Strength Equilibrium Method with c' = c/(FS+2c'), according to Exhibit I of the Program Criteria Specifications Document (default for floodwalls) 3 to use the Allowable Strength Equilibrium Method with c' = c/FS, according to Exhibit [illegible] of the Program Criteria Specifications Document. This conforms to the sense of ETL 1110-2-256, June 1981 4 is not implemented (see paragraph 3-2-3)
	FSMIN	ratio	1.5 for flood-walls; 2.0 for retaining walls	Minimum allowable factor of safety against sliding [force ratio for NSLIDE = 1 (or NPPD = 5 in data list SOLP); allowable strength ratio FS for NSLIDE = 2 or 3]. (see paragraph 3-2-3)
SPHF				See notes (10), (11), (12), and (13)
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	FZTAH	ft	0.0	Thickness of filter zone at end of heel, measured vertically up from base of slab (top of key if key is at end of heel)

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SPHF	PHIFZ	deg	0.0	Angle of internal friction (2)
	COHFZ	psf	0.0	Cohesive strength of filter zone (2)
	GAMASF	pcf	0.0	Unit weight of filter (including weight of water if submerged) (2)
	RKAFZ	factor	C	Active earth pressure coefficient for filter. Will be calculated from PHIFZ if not defined and if IFWOC = 2. Will be ignored if IFWOC = 1
	DELTAF	deg	0.0	Wall friction angle for pressures on face of stem
	RKAEFZ	factor	C	Mononobe-Okable earthquake active pressure factor. See Chapter 8 of the Program Criteria Specifications Document. Dynamic K_a needs RKH and RKV from data list SOLP if it is to be calculated. Will be ignored if IFWOC = 1
SPH1				See note (10) and note (6) the table in paragraph 3-3-1
	LC	0, 1-10		Load case number (see paragraph 2-5-6)
	PHI1	deg	0.0	Angle of internal friction (9)
	COH1	psf	0.0	Cohesive strength (9)
	GAMAS1	pcf	0.0	Unit weight of soil (including weight of water if submerged)
	(The list may be terminated here if defaults below are OK.)			
SPH1	RKA1	factor	C	Active earth pressure coefficient. Will be calculated from PHI1 if not defined and if IFWOC = 2. Will be ignored if IFWOC = 1
	DELTA1	deg	0.0	Wall friction angle for pressures on face of stem
	RKAE1	factor	C	Mononobe-Okabe earthquake active earth pressure factor. See

(Continued)

3-3-2 Soils and Seepage Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition
SPH1	RKAE1			Chapter 8 of the Program Criteria Specifications Document. RKAE1 needs RKH and RKV from data list SOLP if it is to be calculated. Will be ignored if IFWOC = 1
	HCMIN	ft	*	Minimum allowable earth cover over the end of the heel, measured vertically. This is used as a constraint in module FD and is compared in module FA. It is ignored in modules SA, SP, WA, WD, UA, and UD
SPH2				See note (10)
	LC	0, 1-10		Load case number
	ELTS1	ft	—	Elevation of top of soil layer 1. Soil layer 2 need not be included if it is the same as soil layer 1
	PHI2	deg	0.0	Angle of internal friction
	COH2	psf	0.0	Cohesive strength
	GAMAS2	pcf	0.0	Unit weight of soil (including weight of water if submerged)
	(The list may be terminated here if defaults below are OK.)			
	RKA2	factor	C	Active earth pressure coefficient. Will be calculated from PHI2 if not defined and if IFWOC = 2. Will be ignored if IFWOC = 1
	DELTA2	deg	0.0	Wall friction angle for pressures on face of stem
	RKAE2	factor	C	Mononobe-Okabe earthquake active earth pressure factor. See Chapter 8 of the Program Criteria Specification Document. RKAE2 needs RKH

(Continued)

* The default calculation for HCMIN is (3 + 0.1(ETS-ESHW) $\geq$ 5.0 and is calculated separately for each load case if the default is requested and the wall is a floodwall. The default value for retaining walls is zero. If a value is inputted in the data list, it will be used for all load cases.

f. All situations with OMEGA greater than zero also include the resisting force of the parallel component of the weight of the neutral block, along the inclined failure surface.

g. Users should consider the impact of ETL 1110-2-256, 24 June 1981, "Sliding Stability for Concrete Structures", when selecting their values of NSLIDE in optional data list SLID.

NSLIDE = 1 is the default action for retaining walls. Its action is described in para 2-5-1 of the Basic User's Guide, page 3-10 of the User's Reference Manual, and Exhibit H of the Program Criteria Specifications Document. It is based on ETL 1110-2-184 and uses a limit state force ratio.

NSLIDE = 2 is the default action for flood walls. Its action is described in para 2-5-2 of the Basic User's Guide, page 3-10 of the User's Reference Manual, and Exhibit I of the Program Criteria Specifications Document. It is based on EM 1110-2-2501 and uses allowable soil strengths in force equilibrium.

NSLIDE = 3 is available in the program through use of data list SLID, to conform <u>to the sense of</u> ETL 1110-2-256. See Exhibit J of the Program Criteria Specifications Document for a description of the action when NSLIDE = 3. Data list SLID is described below:

SLID LC NSLIDE FSMIN

where

SLID = name of data list

LC = load case number (1-10, or 0 for all cases)

NSLIDE = 3

FSMIN = minimum factor of safety on material properties, for design, using:

$$C_{allow} = \frac{C_{ultimate}}{FS}$$

$$\tan(\phi_{allow}) = \frac{\tan(\phi_{test})}{FS}$$

See para 9, page 20, of ETL 1110-2-256 for suitable values for FSMIN when NSLIDE = 3.

3-4 SURCHARGE DATA

3-4-1 All Surcharge Data Lists Are Optional:

a. All surcharge data lists may be used in modules SA, SP, FA, and FD.

b. Surcharge data lists SCFD, SCFH, and SCWH may be used in modules WA, WD, UA, and UD.

c. Surcharge data lists SCFV and SCWV are not used in modules WA, WD, UA, and UD.

3-4-2 Surcharge Data Item Definitions (See Figure 3-4):

List Name	Variable Name	Units	Default Value	Definition (See Note 1)
SCFD				Vertical forces on concrete
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	PVS	lb/ft	0.0	Line load centered on top of stem
	PVB	lb/ft	0.0	Line load on base slab at X coordinate value DVB from vertical line through the basic working point
	DVB	ft	0.0	X coordinate from basic working point to PVB. Negative if PVB is on toe
SCFH				Horizontal forces on concrete
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	PH1	lb/ft	0.0	Line load at elevation ELPH1. Must be negative if on toe
	ELPH1	ft	--	Elevation of force PH1. May be at any elevation on or above bottom of toe
	PH2	lb/ft	0.0	Line load at elevation ELPH2
	ELPH2	ft	--	Elevation of force PH2. Must be above base, on stem only
SCFV				Vertical line loads on soil surface
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	PV1	lb/ft	0.0	Line surcharge at X coordinate DV1
	DV1	ft	0.0	X coordinate at line load PV1. See note (2)

(Continued)

3-4-2 Surcharge Data Item Definitions (Continued):

List Name	Variable Name	Units	Default Value	Definition (See Note 1)
SCFV	PV2	lb/ft	0.0	Line surcharge at X coordinate DV2
	DV2	ft	0.0	X coordinate at line load PV2
	PV3	lb/ft	0.0	Line surcharge at X coordinate DV3
	DV3	ft	0.0	X coordinate at line load PV3
	PV4	lb/ft	0.0	Line surcharge at X coordinate DV4
	DV4	ft	0.0	X coordinate at line load PV4
	PV5	lb/ft	0.0	Line surcharge at X coordinate DV5
	DV5	ft	0.0	X coordinate at line load PV5
SCWH				Horizontal pressures
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	W1	psf	0.0	Pressure on any portion of stem above finished grade
	ELW1T	ft	--	Elevation of top of W1. Must be between the top of stem and ELW1B
	ELW1B	ft	--	Elevation of bottom of W1. Must be below ELW1T
	W3	psf	0.0	Pressure at finished grade elevation over end of heel. See note (2)
	W4	psf	0.0	Pressure at bottom of key if key is at end of heel (KFLAG = 0) or at bottom of end of heel if no key or if key is under the stem (KFLAG = positive)
SCWV				Vertical surcharge pressures on soil surface
	LC	0, 1-10		Load case number (see paragraph 2-6-6)
	WT	psf	0.0	Area surcharge, over a portion of toe only
	WWT	ft	0.0	Width of WT
	DWT	ft	0.0	Horizontal distance from basic working point to stem-side edge of area covered by WT. Always entered positive, over toe only

(Continued)

3-6-4 Wall Geometry Data Item Definitions (Continued):

Variable Name	Units	Default Value	Definition
BW2	ft	(1)	Maxinum value for BW in module FD. Also needed for allcwable bearing pressure interpolation in modules FA and FD. Must be larger than BW1
BS	ratio	0.0	Base bottom-side slope, BS vertical to 1.0 horizontal, 0.0 = level
BS1	ratio	0.0	Minimum value for BS in module FD
BS2	ratio	0.3333	Maximum value for BS in module FD
BASER	ft	0.0	Base horizontal radius defining trapezoidal plan, measured from basic working point, positive over heel. Base is always 1.0 ft wide under the basic working point. 0.0 = rectangular (infinite radius)
TMINB	in.	(3)	Minimum allowable base slab t . See paragraph
			Key Description
KFLAG	0 or 1	1	0 if key is at end of heel; 1 if key is under stem
DKEY	ft	0.0	Key length, measured vertically along heel side
DKEY1	ft	0.0	Minimum value for DKEY in module FD
DKEY2	ft	(7)	Maximum value for DKEY in module FD
BKTF	ratio	3.0	Toe-side face batter, 1.0 horizontal to BKTF vertical
WKEY	in.	TMINB	Width (thickness) at bottom of key. See note (12)
			Heel Description
HEELT1	in.	(8)	Thickness at stem. See note (12)
HEELT2	in.	TMINB	Thickness at end, not including any key. May not be greater than HEELT1
HEELW	ft	(9)	Width (horizontal projection). See note (10)

(Continued)

3-6-4 Wall Geometry Data Item Definitions (Concluded):

NOTES:

(1) Required data item with no default value or default calculation procedure.

(2) Will be calculated to be as large as possible. See Figure 3-6.

(3) Calculated by program.

(4) See paragraph 3-6-2a(1).

(5) Note (1); must be below top of soil layer 7 as defined by data list SOLT.

(6) Three fifths of ETS - BTE1 or, as determined by module FD, between BW1 and BW2.

(7) Default value for a floodwall is 0.8 of ETS-BTE1 if KFLAG is defined or 0.0 if KFLAG is not defined.

(8) Default values:

a. TMINB.
b. Top of heel must not slope down toward the stem.
c. Set at top of toe at stem if IBSAME = 1 and if it is strong enough.

(9) See paragraph 3-6-2a(3).

(10) Program verifies consistency of following equations, within 0.01 ft, or calculates values to complete the equations:

BW = TW2/STR = TW2 + (TSTB/12.0) + HEELW

(11) May not be less than TMINS.

(12) May not be less than TMINB.

(13) When a single batter is desired on the heel-side face of the stem, use HSTPH = 0 and HSTPB = anything and use HSBPB for the single batter.

8-2-3 Concrete Data Item Definitions (Concluded):

Data List	Variable Name	Units	Default Value Hydraulic	Default Value Nonhydraulic	Definition
STLD	MAXBAR	ASTM size number	11	11	Maximum bar size allowed by user (3-11, 14, or 18 only)
	SPAMIN	in.	MAXBAR's diameter × 2 or MAXBAR's diameter + 2.25, whichever is larger		Minimum acceptable clear spacing for bar size entered for MAXBAR
WGHT	GAMAC	pcf	150.0	150.0	Unit weight of concrete
	GAMAW	pcf	62.5	62.5	Unit weight of water

NOTES: (1) E_c is calculated from the expression in paragraph 8.5.1 of ACI code 318-77: $E_c = (GAMAC-5.0)^{1.5}\ 33.0\sqrt{FPCON}$.

(2) FSTLMX is taken at one half of FYSTL for nonhydraulic structures.

(3) IBSAME generally defaults to zero but will be used as one for analysis of a level base of default thickness.

8-3 OUTPUT. Output information is placed in data lists WLA, WLAB, WLAH, WLAK, WLAS, WLAT, STLB, STLK, and STLS.

8-3-1 Data Check. The data check procedures at the beginning of module WD perform a variety of checks to make sure that enough data items have been defined to enable the program to:

a. Establish the concrete dimensions with enough accuracy for the program to be able to compute the total forces from loads in the form of pressure diagrams.

b. Describe the outlines of the various pressure diagrams (seepage, passive pressure, vertical earth and surcharge pressures, ets).

The questions and printout statements possible during the data check are numerous and varied. Care has been taken to make them self-explanatory and to allow interactive recovery where feasible. Where it is not feasible, the module aborts with a message telling the user what to do in the executive phase before trying again to run the module.

8-3-2 Wall Geometry. The wall geometry established by module WD is reported in two ways:

a. A table of analysis geometry data lists is printed in the format shown below. The wall is the one described in Exhibits K-L of the Program Criteria Specifications Document. The table is printed to the time-sharing terminal and the report file:

```
#
# DESIGN SUMMARY
#
WLA         ETS          TW2           STR          HEELW
         100.0000     5.600000     0.4000000     8.700000

WLAB        BW           BS                          BASER (LIST=WLBR)
         16.30000     0.                         0.

WLAH     HEELT2,        HEELW         HEELT1
         18.00000     8.700000      18.00000

WLAK      KFLAG         DKEY          WKEY          BKTF
            0         5.700000      18.00000     8.142857

WLAS       TSTT          TSB          TSTB          HSTPH          HSTPB
         18.00000    0.1935484      24.00000      0.             0.
          HSBPB
        0.1935484

WLAT       BTE1         TOEHT          TS2          TW1             TS1
         83.00000     18.00000      100.0000      0.           100.0000

----      TMINB         TMINS
         18.00000     18.00000
```

A value of -.1234E30 means that that item is not defined.

b. A table of wall corner coordinates is printed to the report file. This table is illustrated in paragraph 7-4-2d(2) and is also available with the LOOK XY command.

8-3-3 Reinforcement data are printed in the report file in tabular form as shown in paragraph 7-4-2d(3) for module WA. This is also available with the LOOK command for data lists STLB, STLK, and STLS. Reed paragraph 7-2-2a(5) about editing the reinforcing steel description produced by module WD before running module WA to analyze that description.

11-3-2 ACPS:

ACPS LC LOC HS(LC,LOC) EHS(LC,LOC) YVS(LC,LOC)

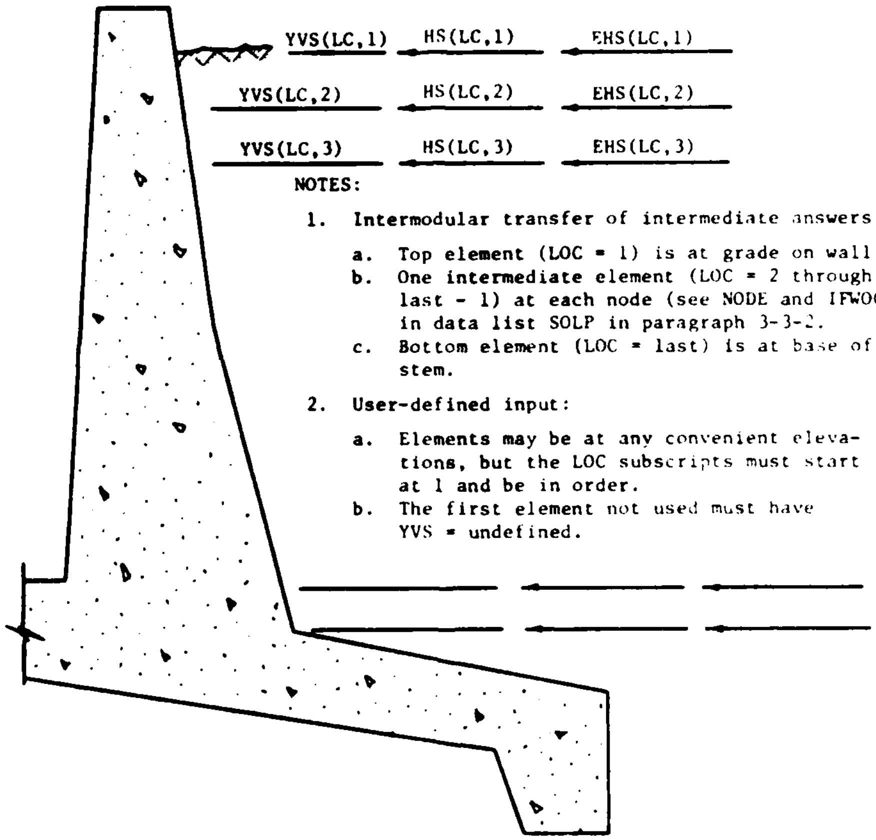
LC = load case subscript (0 or 1-10)

LOC = location subscript (1-68 maximum)

HS(LC,n) = static horizontal lumped force on stem, at YVS(LC,n), lb/horizontal ft

EHS(LC,n) = dynamic horizontal lumped additional force on stem, at YVS(LC,n), lb/horizontal ft

YVS(LC,n) = elevation of HS(LC,n) and EHS(LC,n)



NOTES:

1. Intermodular transfer of intermediate answers:
   a. Top element (LOC = 1) is at grade on wall.
   b. One intermediate element (LOC = 2 through last - 1) at each node (see NODE and IFWOC in data list SOLP in paragraph 3-3-2.
   c. Bottom element (LOC = last) is at base of stem.
2. User-defined input:
   a. Elements may be at any convenient elevations, but the LOC subscripts must start at 1 and be in order.
   b. The first element not used must have YVS = undefined.
3. See note 2c for data list ACPH (paragraph 11-3-1) for a warning about use of data list ACPS.

Data List ACPS--Arrays HS, EHS, YVS from Modules SF, FA

11-3-3 BPH and BPV:

```
BPH  LC  N  IRLT(LC)  EPBW(LC)  WB(LC,N)  HB(LC,N)  EHB(LC,N)  FHB(LC,N)
BPV  LC  N  IRLT(LC)  EPBW(LC)  DB(LC,N)  VB(LC,N)  EVB(LC,N)  FVB(LC,N)
```

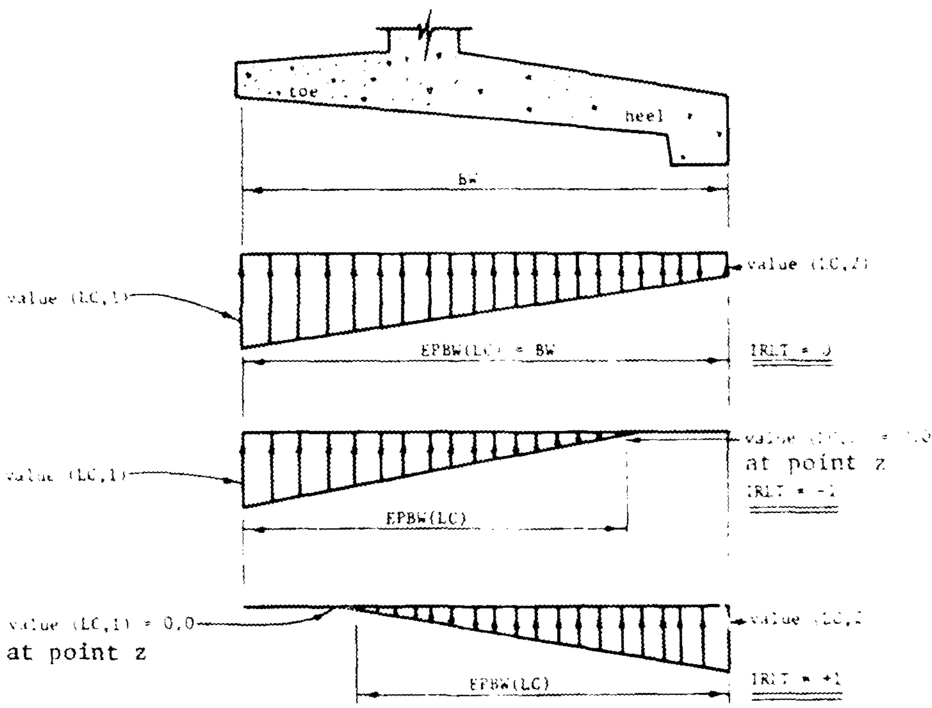
LC = load case subscript (0, 1-10)

N = base end code subscript (1 or 2)

IRLT(LC) = resultant location code (-1, 0, or +1)

EPBW(LC) = effective portion of base width, ft

See paragraph 11--12. Array VB(LC,N) contains the total bearing pressures calculated by module FA.



Values are illustrated with negative direction (the usual one)

Value ( ) (psf)
= WB ( ) for wind load
= HB ( ) for earth horizontal + surcharge horizontal
= EHB ( ) for horizontal earthquake additional pressures
= FHB ( ) for horizontal net hydrostatic
= DB ( ) for weight of concrete
= VB ( ) for applied forces vertical (see array V)
= EVB ( ) for vertical earthquake additional pressures
= FVB ( ) for uplift

Data Lists BPH and BPV--General Description.

The coordinates of point Z (XZ and YZ) are shown in the report file from the overturning computations in Module FA.

12-5 SUMMARY OF DATA LIST CONTENTS (Continued):

Data List	Data Item	Units	Definition
SEEP			Water elevations and seepage options
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	ELWT	FOOT	ELEV OF WATER LEVEL OVER TOE
	ELWH	FOOT	ELEV OF WATER LEVEL OVER HEEL (WAVE STILL WATER)
	HGSW		SOILS WEIGHT CHANGE DUE TO HYDRAULIC GRADIENT OVRX
	ISLC	1-2	1 = EACH LOAD CASE SEPARATE CHECK, 2 = ALL AS NO 1
	ISFT	1234	1, 2, 3, OR 4 FOR TYPE OF SEEPAGE FLOW, 1=CREEP
	KRACK	1-2	1 FOR CRACK (+ W3,W4) OVER HEEL, 2 FOR ACTIVE SOIL
SLID			Sliding control data - see also ONEA
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	NSLIDE	1234	1, 2, 3, OR 4 FOR SLIDING CALCULATION TYPE OPTION
	FSMIN	RATIO	MINIMUM FACTOR OF SAFETY AGAINST SLIDING
SOLP			Soils design parameters
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	IFWOC	1OR2	1 FOR INCREMENTAL WEDGE METHOD OR 2 FOR COULOMB
	NODE	EACH	NUMBER OF NODES TO USE WHEN IFWOC = 1 & IFSOM = 2
	IFSOM	1OR2	1 FOR SINGLE WEDGE TRIAL SURFACE, 2 FOR MULTIPLE
	NPPD	1-5	OVERTURNING PASSIVE PRESSURE SHAPE CODE, 5 = STRUT
	RKH	RATIO	HORIZ. EARTHQUAKE ACCELERATION FACTOR
	RKV	RATIO	VERT. EARTHQUAKE ACCELERATION FACTOR
	CFMA	RATIO	ACTIVE PRESSURE MOMENT ARM FACTOR FOR ARCHING CASE
SPE3			Soil properties, exist. soil layer 3 (basic)
	PHI3	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 3
	COH3	PSF	COHESIVE STRENGTH OF SOIL LAYER 3
	GAMAS3	LB/CF	UNIT WEIGHT OF SOIL LAYER 3, SATURATED IF BELOW WT
	PHIS3	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER 3
	ADHS3	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 3
	ABP3TN	PSF	ALLOW BRNG PRESSURE, TOP OF LAYER 3, NARROW BASE
	ABP3BN	PSF	ALLOW BRNG PRESSURE, BOTT OF LAYER 3, NARROW BASE
	ABP3TW	PSF	ALLOW BRNG PRESSURE, TOP OF LAYER 3, WIDE BASE
	ABP3BW	PSF	ALLOW BRNG PRESSURE, BOTT OF LAYER 3, WIDE BASE
	ELBS3	FOOT	ELEVATION CORRESPONDING TO ABP3BN AND ABP3BW
SPE4			Soil properties, existing soil layer 4
	ELTS3	FOOT	ELEV OF TOP OF SOIL LAYER 3
	PHI4	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 4
	COH4	PSF	COHESIVE STRENGTH OF SOIL LAYER 4
	GAMAS4	LB/CF	UNIT WEIGHT OF SOIL LAYER 4, SATURATED IF BELOW WT
	PHIS4	DEG	MAX ANGLE OF SLIDING FRICTION ON SOIL LAYER 4
	ADHS4	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 4
	ABP4TN	PSF	ALLOW BRNG PRESSURE TOP OF LAYER 4, NARROW BASE
	ABP4BN	PSF	ALLOW BRNG PRESSURE BOTT OF LAYER 4, NARROW BASE
	ABP4TW	PSF	ALLOW BRNG PRESSURE TOP OF LAYER 4, WIDE BASE
	ABP4BW	PSF	ALLOW BRNG PRESSURE BOTT OF LAYER 4, WIDE BASE
SPE5			Soil properties, existing soil layer 5
	ELTS4	FOOT	ELEV OF TOP OF SOIL LAYER 4
	PHI5	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 5
	COH5	PSF	COHESIVE STRENGTH OF SOIL LAYER 5
	GAMAS5	LB/CF	UNIT WEIGHT OF SOIL LAYER 5, SATURATED IF BELOW WT
	PHIS5	DEG	MAX. ANGLE OF SLIDING FRICTION ON SOIL LAYER 5
	ADHS5	PSF	SLIDING ADHESIVE STRENGTH FOR SOIL LAYER 5
	ABP5TN	PSF	ALLOW BRNG PRESSURE TOP OF LAYER 5, NARROW BASE
	ABP5BN	PSF	ALLOW BRNG PRESSURE BOTT OF LAYER 5, NARROW BASE
	ABP5TW	PSF	ALLOW BRNG PRESSURE TOP OF LAYER 5, WIDE BASE
	ABP5BW	PSF	ALLOW BRNG PRESSURE BOTT OF LAYER 5, WIDE BASE

(Continued)

12-5 SUMMARY OF DATA LIST CONTENTS (Continued):

Data List	Data Item	Units	Definition
SPH1			Soil properties, heel backfill layer 1
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	PHI1	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 1
	COH1	PSF	COHESIVE STRENGTH OF SOIL LAYER 1
	GAMAS1	LB/CF	UNIT WEIGHT OF SOIL LAYER 1, SATURATED IF BELOW WT
	RKA1	RATIO	ACTIVE EARTH PRESSURE COEFFICIENT FOR SOIL LAYER 1
	DELTA1	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	RKAE1	RATIO	EARTHQUAKE ACTIVE EARTH PRESSURE COEFFICIENT
	HCMIN	FOOT	MINIMUM END OF HEEL EARTH COVER CHECK VALUE
SPH2			Soil properties, heel backfill layer 2
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	ELTS1	FOOT	ELEV OF TOP OF SOIL LAYER 1
	PHI2	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 2
	COH2	PSF	COHESIVE STRENGTH OF SOIL LAYER 2
	GAMAS2	LB/CF	UNIT WEIGHT OF SOIL LAYER 2, SATURATED IF BELOW WT
	RKA2	RATIO	ACTIVE EARTH PRESSURE COEFFICIENT FOR SOIL LAYER 2
	DELTA2	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE PRESSURE
	RKAE2	RATIO	EARTHQUAKE ACTIVE EARTH PRESSURE COEFFICIENT
SPHF			Soil properties, filter zone over heel
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	FZTAH	FOOT	FILTER ZONE THICKNESS AT END OF HEEL
	PHIFZ	DEG	ANGLE OF INTERNAL FRICTION, FILTER ZONE
	COHFZ	PSF	COHESIVE STRENGTH OF FILTER ZONE
	GAMASF	LB/CF	UNIT WEIGHT OF FILTER ZONE, SATURATED IF BELOW WT
	RKAFZ	RATIO	ACTIVE PRESSURE COEFFICIENT FOR FILTER ZONE
	DELTAF	DEG	WALL FRICTION ANGLE FOR COULOMB ACTIVE, FILTER ZON
	RKAEFZ	RATIO	EARTHQUAKE ACTIVE PRESSURE COEFF FOR FILTER ZONE
SPT6			Soil properties, toe backfill layer 6
	LC	EACH	LOAD CASE NUMBER (1-10 OR 0 FOR ALL LOAD CASES)
	PHI6	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 6
	COH6	PSF	COHESIVE STRENGTH OF SOIL LAYER 6
	GAMAS6	LB/CF	UNIT WEIGHT OF SOIL LAYER 6, SATURATED BELOW WT
SPT7			Soil properties, toe backfill layer 7
	LC	EACH	LOAD CASE NUMBER (1 10 OR 0 FOR ALL LOAD CASES)
	PHI7	DEG	ANGLE OF INTERNAL FRICTION, SOIL LAYER 7
	COH7	SF	COHESIVE STLNGTH OF SOIL LAYER 7
	GAMAS7	LB/CF	UNIT WEIGHT OF SOIL LAYER 7, SATURATED IF BELOW WT
SSLE			Soil surface, Existing grade & Excavation
	EXW	FOOT	EXCAVATION BOTTOM EXTRA WIDTH EACH SIDE OF BASE
	ESS	1V XH	EXCAVATION SIDE SLOPE
	HSS5T	1V XH	EXIST GROUND SIDE SLOPE BEYOND ELTS5T (TOE SIDE)
	ELTS5T	FOOT	EXIST GRADE, DTS5T FT FROM ELTS5W (TOE SIDE)
	DTS5T	FOOT	HORIZ DISTANCE FROM ELTS5W TO ELTS5T (TOE SIDE)
	ELTS5W	FOOT	EXIST GRADE DIRECTLY UNDER BASIC WORKING POINT
	ELTS5H	FOOT	EXIST GRADE, DTS5H FT FROM ELTS5W (HEEL SIDE)
	DTS5H	FOOT	HORIZ DISTANCE FROM ELTS5W TO ELTS5H (HEEL SIDE)
	HSS5H	1V XH	EXIST GROUND SIDE SLOPE BEYOND ELTS5H (HEEL SIDE)

(Continued)

DATE
ILME