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DREDGING OPERATIONS TECHNICAL SUPPORT PROGRAM

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PROGRAM DOCUMENTATION AND USER'S GUIDE: PCDDF89, PRIMARY CONSOLIDATION AND DESICCATION OF DREDGED FILL

by

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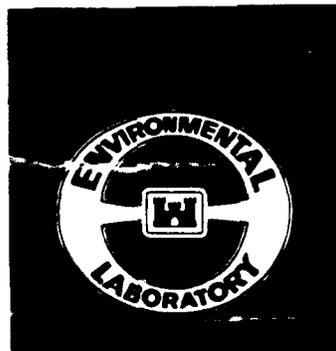
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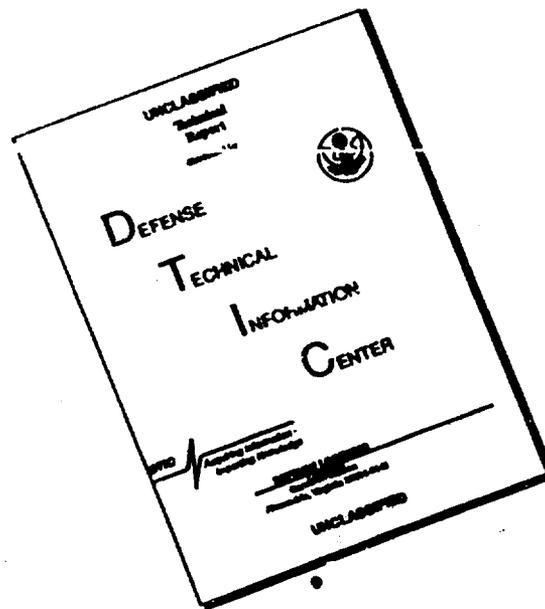


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| 19 ABSTRACT (Continue on reverse if necessary and identify by block number) The US Army Corps of Engineers has developed a computer program to model consolidation and desiccation that occurs in confined dredged material placement sites; the program is entitled "Primary Consolidation and Desiccation of Dredged Fill (PCDDF)." The program is equally applicable to other soft, fine-grained deposits. Although originally written for operation on a mainframe computer, the program has been modified to run on an IBM (or compatible) microcomputer with a math coprocessor. It has recently been extensively revised and modified into a more user-friendly version that is referred to as PCDDF89. This report contains a brief description of the mathematical model used in PCDDF89 and an extensive user's guide. PCDDF89 simulates the consolidation and desiccation processes in fine-grained soils using the finite strain theory of consolidation and an empirical desiccation model. Settlement is calculated for each compressible layer within the area, and a cumulative settlement for all dredged fill and compressible foundation layers is determined. Additional layers of dredged fill can be added at any time. A total of 25 types of dredged fill and 25 foundation layers can be analyzed in one simulation. <p style="text-align: right;">(Continued)</p> | | | | | |
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An interactive interface has been developed for PCDDF89. The interactive data input program, INPCDDF, allows users to easily convert existing PCDDF data files to the new multi-material data format of PCDDF89. The interactive program also allows the creation of new data files and editing of existing files.

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PREFACE

This report describes the user guidelines for implementing the one-dimensional microcomputer program, Primary Consolidation and Desiccation of Dredged Fill, 1989 (PCDDF89). PCDDF89 is an updated version of the original program, PCDDF, developed by CPT Kenneth W. Cargill at the US Army Engineer Waterways Experiment Station (WES). Instructions for data input and details about the output are covered herein. The work was sponsored by the Dredging Operations Technical Support (DOTS) Program funded by the Office, Chief of Engineers, through the Water Resources Support Center, Dredging Division. DOTS is managed through the Environmental Effects of Dredging Programs (EEDP) of the WES Environmental Laboratory (EL). Dr. Robert M. Engler was EEDP Manager during publication, and Mr. Thomas R. Patin was DOTS Coordinator in EEDP.

This report was prepared by Dr. Timothy D. Stark at San Diego State University under contract No. DACW39-89-C-0036 with WES. The modifications to PCDDF were coded by Dr. Arsalan Ghahramani, a visiting scholar at San Diego State University, under the supervision of Dr. Timothy D. Stark. Dr. Marian P. Rollings, Research Civil Engineer, Water Resources Engineering Group (WREG), Environmental Engineering Division (EED), EL, WES, was Contracting Officer's Representative. The report was written under the general supervision of Dr. John J. Ingram, Chief, WREG; Dr. Raymond L. Montgomery, Chief, FED; and Dr. John Harrison, Chief, EL.

The Commander and Director of WES was COL Larry B. Fulton, EN. Technical Director was Dr. Robert W. Whalin.

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PROGRAM DOCUMENTATION AND USER'S GUIDE: PCDDF89, PRIMARY CONSOLIDATION AND DESICCATION OF DREDGED FILL

PART I: INTRODUCTION

Background

1. US Army Corps of Engineers District Offices are continually addressing the disposal problem of fine-grained dredged material from navigable waterways throughout this country. Increasing environmental concerns, together with a general decrease in the number of available disposal areas, have created the need for maximum utilization of existing and planned dredged material containment areas. In order that the maximum long-term benefits are derived from dredged material disposal areas, the design and operation of the areas must accurately account for the increase in storage capacity resulting from future decreases in the height of the previously deposited dredged material. The height of the dredged fill is reduced by sedimentation, consolidation, and desiccation. Both consolidation and desiccation are accounted for in the microcomputer program Primary Consolidation and Desiccation of Dredged Fill, 1989 (PCDDF89). The sedimentation process is complete within a few days after material deposition and therefore is not included in PCDDF89 because it has no effect on the long-term capacity of the disposal area. Tests to ascertain a material's sedimentation characteristics and procedures for calculating the effects on disposal area filling are described in EM 1110-2-5027 (US Army Corps of Engineers 1987).

2. The two most important natural processes affecting the long-term height of confined dredged material are consolidation and desiccation. Many fine-grained dredged materials may undergo strains greater than 50 percent during self-weight consolidation. Greater strains are possible, if the disposal site is managed so that the surface water is removed and desiccation can occur. The resulting problem is to determine the time rate of settlement for dredged material subjected to the effects of a) self-weight consolidation, b) crust formation due to desiccation, and c) additional consolidation due to the surcharge created by the crust.

Purpose and Scope

3. This report contains a brief description of the mathematical model used in PCDDF89 and an extensive user's guide for the microcomputer program. PCDDF89 simulates the consolidation and desiccation processes in fine-grained soils (e.g., dredged fill) using the finite strain theory of consolidation and an empirical desiccation model. PCDDF89 calculates the total settlement of a dredged fill layer based on the consolidation characteristics of the soils below the layer, the consolidation characteristics of the dredged fill, local climatological data, and surface water management within the containment area. This settlement is then accumulated for each compressible layer within the area and a cumulative settlement for all dredged fill and compressible foundation layers is calculated. Additional layers of dredged fill can be added at any time.

4. The major input required by PCDDF89 is the void ratio-effective stress relationship and the void ratio-permeability relationship. Both are obtained from laboratory consolidation tests on the dredged fill and compressible foundation materials. The laboratory testing procedures recommended to obtain these relationships are described by Poindexter (1988). In addition, specific gravity, initial void ratio, and the desiccation characteristics of the dredged fill material are required. Climatological data, anticipated dredging schedules and quantities, water table elevation, and drainage characteristics of the containment site are also required.

Historical Perspective of PCDDF89

5. The original version of PCDDF was developed by Cargill (1985). Subsequently, a version of PCDDF was developed by Goforth (1985), which could run on an IBM (or compatible) microcomputer. The microcomputer version has an added feature that allows the surface elevation history to be displayed on a graphics monitor and compatible printer. An interactive interface for PCDDF was developed so the program could be included in the Automated Dredging and Disposal Alternatives Management System (ADDAMS) software package (Schroeder 1988).

New Features of PCDDF89

6. PCDDF was extensively modified by the author in 1989 and the resulting microcomputer program was named PCDDF89. The modifications are summarized below:

- a. The consolidation and desiccation models were modified so that 25 different types, or layers, of dredged fill could be incorporated into a single simulation. The consolidation and desiccation properties for each dredged material are inputted and used in the calculations of settlement over time. The original version of PCDDF could only analyze one dredged material type.
- b. The consolidation model for the compressible foundation was also modified so that 25 different foundation materials could be incorporated in a single simulation. The consolidation properties of each compressible foundation material are inputted and used in the settlement calculations for any length of time. The original version of PCDDF could only analyze one compressible foundation material type.
- c. The inclusion of multiple dredged fill and compressible foundation material types slowed the execution of the program significantly. As a result, several methods were sought to speed the execution of the program. The numerous interpolations, usually 50,000 or greater, required in a typical simulation were found to be the main function slowing the execution of the program. As a result, several methods for speeding up the four interpolation subroutines, such as curve fitting and various searching techniques, were considered. The majority of the interpolations involve estimating a soil property such as void ratio, permeability at a particular time, or effective stress. Fitting an equation to the void ratio, effective stress void ratio, and permeability relationships was not accepted because the actual laboratory data were not being used and the

curve-fitting criteria added additional variables into the analysis. Various search techniques were considered and a history-dependent search was finally adopted. The history-dependent search remembers the point where the last interpolation took place and then starts the next search from this point. In the original version of PCDDF, the next search always started from the beginning of the data regardless of where the last interpolation occurred. The use of a history-dependent search increased the execution speed of PCDDF89 by 20 percent over the original version of PCDDF. Therefore, even users performing analyses using one dredged fill and/or one compressible foundation material type should upgrade to PCDDF89 to speed the execution and allow longer simulations. More importantly, the program execution speed was increased while still utilizing the measured soil properties instead of a fitted curve.

- d. A comprehensive interactive interface was also developed for PCDDF89. The interactive data input program, INPCDDF, allows users to easily convert existing PCDDF data files to the new multi-material data format of PCDDF89. The interactive program also allows the creation of new data files and the editing of existing data files.
- e. INPCDDF allows the material relationships for the dredged fill and compressible foundation layers, and the monthly evaporation and rainfall data for the containment area, to be loaded from previously created files into new or existing data files. This will permit the future development of a data base of material properties and site characteristics for dredged material containment facilities throughout the country. This will facilitate the selection of input parameters and allow the Districts to conduct parametric studies using data from other dredged material containment areas. INPCDDF also allows direct input of these data.
- f. The material relationships consist of the void ratio-effective stress relationship and the void ratio-permeability relationship measured using laboratory consolidation tests. The monthly evaporation and rainfall data consist of the monthly class A pan evaporation information and the monthly rainfall data expected at the containment site. These two data files can be created using an editor or a word processor and the data format presented in Table 10.

PART II: DESCRIPTION OF MATHEMATICAL MODEL

7. Closed form analytical solutions of the equations governing the consolidation and desiccation processes in dredged materials are not available due to the highly nonlinear nature of the equations' coefficients. However, incremental solutions over relatively short time periods when these coefficients can be assumed practically constant are feasible by computer techniques. In PCDDF89 the consolidation and desiccation processes are solved separately to a certain point in time when the solutions are combined to determine the net impact on the dredged material. This reconciliation occurs monthly in the program to conform with the availability of reasonably accurate average evaporation and rainfall data.

Consolidation Processes

8. The mathematical model of one-dimensional primary consolidation used in PCDDF89 is based on the finite strain theory of consolidation as described in detail by Cargill (1982). Thus, only the main points will be repeated here for reference without presenting the derivations of the finite strain consolidation theory.

9. The governing equation of the consolidation process, developed by Gibson, England, and Hussey (1967), is

$$\left(\frac{\gamma_s}{\gamma_w} - 1 \right) \frac{d}{de} \left[\frac{k(e)}{1+e} \right] \frac{\partial e}{\partial z} + \frac{\partial}{\partial z} \left[\frac{k(e)}{\gamma_w(1+e)} \frac{d\sigma'}{de} \frac{de}{dz} \right] + \frac{\partial e}{\partial t} = 0 \quad (1)$$

where

γ_s = unit weight of solids

γ_w = unit weight of water

e = void ratio

$k(e)$ = coefficient of soil permeability as a function of void ratio

z = vertical material coordinate measured against gravity

σ' = effective stress

t = time

This equation is well suited for the prediction of consolidation in thick deposits of very soft, fine-grained soils, such as dredged material, because it provides for the effects of (a) self-weight consolidation, (b) permeability varying with void ratio, (c) a nonlinear void ratio-effective stress relationship, and (d) large strains.

10. A closed form solution of Equation 1 is not possible so an explicit finite difference scheme is used to reduce Equation 1 to a tractable form. The procedure is fully described by Cargill (1982). Once the initial and boundary conditions are defined and appropriate relationships between void ratio and effective stress ($e-\sigma'$) and void ratio and permeability ($e-k$) are specified, the void ratio in the consolidating layer can be calculated

by the explicit finite difference technique for any future time. The void ratio distribution in the saturated dredged fill layer is used to calculate the corresponding stresses and pore pressures

11. The consolidation calculation is carried forward from the time of material deposition until the time desiccation starts. At the desiccation start time the void ratio for the normally consolidating dredged fill is evaluated. Normal consolidation then proceeds until one month after the desiccation start time, when the void ratio is again evaluated. The difference in these void ratios provides the amount of water supplied from the consolidating soil, which is the value of CS used in Equations 4 and 6. The process is repeated on a monthly basis until a new material is placed and desiccation starts anew or until the entire dredged layer is dried and consolidation ceases.

12. At each monthly interval during times when the desiccation process is active, the material thickness of the consolidating dredged material will decrease by an amount dependent on the amount of effective evaporation. (This will be discussed beginning in paragraph 18.) The top boundary condition of the remaining consolidating material is also modified according to the amount of effective evaporation. The void ratio of the top nodal point in the consolidating layer will have a value greater than or equal to its ultimate void ratio as determined by the effective stress induced by desiccated material above. The desiccated layer then acts as a surcharge on the consolidating layer and is assumed to be free draining.

13. The bottom boundary of the consolidating dredged material and/or compressible foundation is assumed to be unaffected by the desiccation process. Details of how this boundary condition is calculated may be found in the earlier report (Cargill 1982).

14. The use of an explicit finite difference scheme in solving the governing consolidation equation requires that strict stability criteria be observed at all times during the incremental solution process. PCDDF89 is coded to print an error message when certain criteria are not met in choosing an appropriate time step or material node spacing. Theoretically, the solution should be stable if

$$\tau \leq - \frac{(\Delta z)^2 \gamma_w}{2\alpha(e)_{\max}} \quad (2)$$

where

τ = time step

Δz = difference in material coordinates of adjacent nodes

$\alpha(e)_{\max} = \frac{k(e)}{1 + e} \frac{d\sigma'}{de}$ (maximum value within layer)

15. Another criterion that has been found to be useful in selecting a time step for input to the program is

$$\tau < \frac{h}{k(e_{00}) \cdot N}$$

(3)

where

h = layer thickness

e_{00} = void ratio at zero effective stress

N = number of material nodes in a layer

16. An unstable calculation will usually be characterized by void ratios considerably outside the range of possible values or by zero consolidation when consolidation should be taking place. The cure for an unstable calculation is usually to decrease the time step chosen, but other input data should also be checked to ensure consistency.

17. Two options exist for selecting the relationship of the time step and grid size:

- a. Based on the compressibility and permeability characteristics entered as input data, PCDDF89 will determine a simulation time increment and node spacing consistent with the stability criteria presented in Equations 2 and 3. For each problem, the initial dredged fill (and compressible foundation, if present) is represented by 10 equally spaced nodes, and a stable time-step is determined.
- b. The user may determine values of the time step and grid size. An algorithm for choosing a stable time-step and grid size is presented in paragraph 59.

Desiccation Processes

18. The desiccation process is governed by many factors whose predictability is often difficult. The empirical desiccation process described herein may seem inconsistent with the rather sophisticated consolidation model. However, consolidation contributes the largest decrease in volume and thus should be analyzed using the most technically correct model. The development of a sophisticated theoretical model for desiccation is a subject for future research.

19. Desiccation of a dredged material is basically the removal of water by changing the state of the water near the surface from a liquid to a gas. This change of state results primarily from evaporation and transpiration. Plant transpiration is considered insignificant due to the recurrent deposition of dredged fill and is therefore disregarded.

20. It appears that the desiccation process occurs in two major stages. During the first stage, sufficient free water is available at the surface of the material so that evaporation takes place at its full potential rate. In the second stage of evaporation, drying proceeds at some fraction of the potential rate and this fraction decreases as the depth of dried crust increases.

21. The water lost from a dredged material layer during first-stage drying can be expressed as

$$\Delta W' = CS - C_E' \cdot EP + (1 - C_D) RF \quad (4)$$

where

- $\Delta W'$ = water lost during first-stage drying
- CS = water supplied from lower consolidating soil
- C_E' = maximum evaporation efficiency for soil type
- EP = class A pan evaporation
- C_D = drainage efficiency of containment area
- RF = rainfall

Even though some minor cracks may appear in the surface during this stage, the material will remain saturated and vertical settlement is expected to correspond to water loss or

$$\delta_D' = -\Delta W' \quad (5)$$

where δ_D' = settlement due to first-stage drying.

22. Water lost during second-stage drying can be written

$$\Delta W'' = CS - C_E' \left(1 - \frac{h_{wt}}{h_{2nd}} \right) \cdot EP + (1 - C_D) RF \quad (6)$$

where

- $\Delta W''$ = water lost during second-stage drying
- h_{wt} = depth of water table below surface
- h_{2nd} = maximum depth of second-stage drying

Two phenomena prevent an exact correspondence between water loss and settlement during second-stage drying. First is the appearance of an extensive network of cracks which may encompass up to 20 percent (Haliburton 1978) of the volume of the dried layer. Second is the probable loss of saturation within the dried material itself. Combining these two occurrences into one factor enables the vertical settlement to be written as

$$\delta_D'' = -\Delta W'' - \left(1 - \frac{PS}{100} \right) h_{wt} \quad (7)$$

where

- δ_D'' = settlement due to second-stage drying

PS = gross percent saturation of dried crust that includes cracks

Determining the second-stage drying settlement is an iterative procedure because there are two equations and three unknowns.

23. At the end of each monthly period during times when the desiccation process is active, the effect of the previous month's evaporation is applied to the dredged material. For computational simplicity, changes in void ratio are applied only at nodal points beginning at the surface of the dredged material. Also, to avoid the trial-and-error method of solving Equation 7, the program calculates desiccation settlement as

$$\delta_D = -\Delta W - \delta_D''' \quad (8)$$

where δ_D''' represents any carry-over desiccation. Carry-over desiccation normally includes that which is due to the loss of saturation the previous month (a figure that also takes into account the crack network during second-stage drying). It may also include a negative desiccation quantity from the previous month (if water lost due to consolidation exceeds potential evaporation desiccation) and/or a quantity from any necessary adjustment in the void ratio at the top of the consolidating layer.

24. With the desiccation settlement from Equation 8, the program next determines the average void ratio reduction within a dredged material sublayer (that material between adjacent nodes) by

$$\Delta \bar{e} = \frac{\delta_D'''}{\Delta z} \quad (9)$$

Starting with the uppermost adjustable node, void ratios are adjusted in turn toward or to the void ratio at the desiccation limit e_{DL} or the void ratio at the shrinkage limit e_{SL} (depending on whether first- or second-stage drying is effective) until the average required reduction has been achieved.

25. As the dredged material is desiccated below the e_{SL} , the free water table drops below the material's surface. In PCDDF89 the water table is set at the first calculation nodal point having a void ratio less than e_{SL} but not deeper than the maximum depth of second-stage drying.

26. The desiccation subroutine in PCDDF89 also recalculates a new ultimate void ratio distribution for material in the consolidating layer based on the surcharge created by dried material above the new water table. The uppermost void ratio in the consolidating layer is then set to its ultimate value which becomes the top boundary condition for the next series of consolidation calculations.

27. There are obviously some drawbacks to this rather simplistic treatment of the desiccation process in fine-grained dredged material. No attempt has been made to model the complex mechanisms of how a soil gets to its final desiccated volumetric condition or how and to what magnitude stresses and pore pressures develop in the desiccated portion. As previously stated, such a rigorous explanation is not felt to be warranted due to the

overall effect is correctly represented, i.e., desiccation leads to a reduction of voids in the dried material. The presence of a dried surface does change the boundary condition in the consolidating material, and the effect of an extensively cracked crust is to increase the speed and magnitude of consolidation in the underlying material. The accuracy of this method obviously depends on properly defining the proposed quantities e_{SL} and e_{DL} and how well these quantities can be used to represent the true boundary condition of the consolidating layer.

Deposition of Additional Dredged Materials

28. PCDDF89 allows the deposition of additional dredged material types at any time after filling begins. A total of 25 different types of dredged fill material can be used in a simulation. In the absence of any desiccation in prior deposits, there is a natural transition between the old and new material since the void ratio at the top of the old is similar to that of the new. However, when the top of the old layer has been desiccated and extensively cracked, there is no natural transition between the two layers. Again, the program takes a simplistic approach in accordance with the mathematical model previously described.

29. When new material is deposited on top of the desiccated fill, there is a discrepancy in the value of the actual void ratio at the boundary node. Due to probable extensive cracking at this point, it appears quite reasonable to approximate the actual void ratio as an average of the void ratio of the recently deposited material (the zero effective stress void ratio) and the desiccated void ratio. Void ratios in the remainder of previously desiccated material are assumed to be maintained at their desiccated values.

30. While evidence exists to indicate that old dredged fill layer boundaries offer some enhancement to material drainage, it would be overly optimistic to assume these boundaries are free draining for consolidation purposes. Therefore, future consolidation is based on an artificially set initial condition through the previously dried material. The initial condition is shown in Figure 1; in the previously dried zone the conditions are based on a linear variation of void ratio between the boundary node at the zero effective stress void ratio and the node below the dried zone at a void ratio due to prior consolidation. This scheme of calculation is considered a realistic representation of the effect the previously dried zone has on future consolidation.

Stresses and Pore Pressures

31. The total stress at any point in the layer is equal to the total weights of all materials in a unit area above that point. The effective stress at any point is determined using the void ratio and the measured void ratio-effective stress relationship. By the principle of effective stress, the total pore pressure $u_w(z,t)$ is the total stress minus the effective stress. The excess pore pressure $u(z,t)$ is

$$u(z,t) = u_w(z,t) - u_o(z,t) \quad (10)$$

where u_o is the static pore pressure.

32. In the consolidating material, effective stress is dependent on the input void ratio-effective stress relationship and exact values are interpolated between input points. At nodes where the void ratio has been desiccated below its ultimate value based on material weights, excess pore pressures are arbitrarily set to zero and effective stress is set equal to the effective weight of the material above.

PART III: PCDDF89 EXECUTION INFORMATION

33. PCDDF89 is coded in FORTRAN 77 and was compiled using Microsoft's FORTRAN compiler version 4.1. PCDDF89 will execute on IBM (or compatible) microcomputers. A graphics card, at least 640K of random access memory, a math co-processor, and a hard disk are recommended. If a math co-processor is not installed, the user will encounter a "floating point error" message. The executable and example data files provided on the two distribution disks should be copied to an appropriate subdirectory (PCDDF89) on the hard disk using the DOS Copy command. Existing PCDDF data files may also be copied to this subdirectory.

INPCDDF Program

34. To start the interactive data input program, INPCDDF, the user changes to the PCDDF89 subdirectory (using the DOS "Change Directory" [CD] command), types INPCDDF, and presses "ENTER." The interactive program will aid the creation of a new data file or the editing of an existing file. The interactive data input screens are described in Part IV. After the appropriate data file has been created, the user should exit to DOS, type PCDDF89, and press "ENTER" to execute PCDDF89. PCDDF89 will prompt the user for the input data file name, the output data file name, and an indication of whether the user desires a plot of the surface elevations as a function of time. If a plot of the surface elevation over time is desired, PCDDF89 will require the name of a plot file. The number of data points on the surface elevation plot will be equal to the number of print times specified in the input data file. If the input data set specifies a continuation file to be created, the program will also require the name of a continuation file. A continuation file stores the output from a previous simulation so the simulation can be restarted at a later time.

35. After entering the required file names, PCDDF89 will begin solving the consolidation/desiccation problem. The output will be displayed on the screen and recorded in the output file as the calculations progress. Execution of the program will be complete when the cumulative mass error is displayed. If execution of the program is terminated before completion of a particular simulation, the output up to that point will be written to the output file.

GRAPH Program

36. If a plot of the surface elevation as a function of time is desired, the user executes the program GRAPH, which is included on the PCDDF89 distribution disk. This program is started by typing GRAPH and pressing "ENTER." The program will ask the user a series of questions about the computer equipment and how the user wishes to have the graph set up. In order to display the graph on the screen, the user must have a graphics card installed. In order to get a hard copy of the graph, the user must have an IBM Graphics or compatible printer. The plot file, which is created in the ASCII format, can also be plotted with a spreadsheet program or another graphics package. The first line of

the file is the number of data sets in the file, the second line is the number of data points in the data set, and the remainder of the lines contain surface elevation and time data.

Suggestions for Executing PCDDF89

37. This section contains some useful suggestions for executing PCDDF89. If a long-term simulation is planned, a short-term simulation should be conducted first to verify the input data and check for obvious errors in the data set.

38. Thin layers of the same material type may be combined without the loss of accuracy if the total simulation is two to five times the period of the lumped thin layers. For example, a 20-year disposal sequence with annual deposits of 1.0 ft (0.3048 m) can be accurately simulated by combining the first 4 years of the deposits into an initial lift of 4.0 ft (1.22 m). This suggestion is feasible since the time of interest (20 years) is significantly longer than the period over which the dredged material deposits are combined. This approach also has advantages since the time step and grid size (see paragraph 59) are determined from the initial layer characteristics.

39. PCDDF89 is designed to accept any consistent set of engineering units. However, consistency within a particular system must be maintained. For example, if the English unit system is used, the following units must be used for these variables: time in days, length in feet, force in pounds, permeability in feet/day, effective stress in pounds/square foot, and monthly rainfall and evaporation in feet.

PART IV: PCDDF89 INTERACTIVE DATA INPUT PROGRAM

Interactive Data Input Program

40. A comprehensive interactive data input program was developed to facilitate the use of PCDDF89. The interactive program, INPCDDF, is coded in Basic and compiled using Borland's TurboBasic version 1.1. A summary and explanation of the error messages for INPCDDF are given in Appendix A.

41. The interactive program utilizes the screen method of input where values are entered on the screen in the locations or boxes provided. This input technique is very similar to the use of a spreadsheet program. INPCDDF can create new or edit existing PCDDF89 data files and can easily convert existing PCDDF data files to the new PCDDF89 format. INPCDDF also allows the creation of new or the editing of existing restart data files. The restart option allows a previous simulation to be restarted or continued. The output from the last time increment analyzed in the previous simulation is stored in a continuation file and is used in the restart. The restart data file specifies the new time increments, dredged fill heights, and soil properties to be analyzed.

Operation of Interactive Input Data Screens

42. Data is inputted directly from the keyboard and stored in the computer's random access memory. If the file is not saved using one of the options in the main INPCDDF menu, the new data will be lost when the program is terminated. The main menu and data input screens are shown in Appendix B and are described in the following paragraphs.

43. To edit existing data, the user must use the backspace key to delete the current entry before typing in the new data. The backspace key is used instead of just overtyping to reduce the chance of accidentally entering an incorrect character into the data set. The user can move to the next data field using the cursor keys or by pressing "ENTER." To move to the next input screen the user must press one of the function "F" keys depending on the desired destination. The "F" keys were selected in lieu of the "ENTER" key because users have a tendency to press "ENTER" after inputting data.

INPCDDF Input Options

44. In the first INPCDDF menu, Figure B1, the user has four main options: (a) to create a new PCDDF89 data file, (b) to edit an existing PCDDF89 data file, (c) to convert an old PCDDF data file to the new PCDDF89 format, or (d) to create or edit a data file for restarting a previous simulation. The user should press the letter representing the desired INPCDDF input option.

45. **Creating a new PCDDF89 data file.** After pressing "N" at the initial INPCDDF menu, the user will be prompted for the name of the new PCDDF89 data file, Figure B2. The user should enter the full file name, including the drive and/or subdirectory, of the new data file. After entering the file name, the user presses F1 to move to the main INPCDDF menu, Figure B3. The user should type "1" ("CREATE A NEW DATA FILE

OR EDIT CURRENT DATA FILE") and press "ENTER" to create a new data file. The interactive program will prompt the user for all the data required in data groups 2 through 10 shown in the main INPCDDF menu. Paragraphs 50 through 66 describe the data required. At any time during the input process the user can return to the main menu by pressing F2. At the main menu the user can go back and edit a previous data group, save the file, and/or exit the program.

46. The user should finish entering all data in a particular group before returning to the main INPCDDF menu. This will facilitate locating the point where data input was terminated. When data input is continued, the user may select the number that corresponds to the next group of data that must be entered.

47. **Editing an existing PCDDF89 data file.** After pressing "E" at the initial INPCDDF menu, Figure B1, the user will be prompted for the name of the existing PCDDF89 data file, Figure B4. After typing in the full file name, including the drive and/or subdirectory where the file is located, the user presses F1 to move to the next input screen, Figure B5. The user is prompted for the name of the new PCDDF89 data file after editing. If the user enters the same name as the existing data file, the original data file will be overwritten when the file is saved. After entering the new file name, the user presses F1 to move to the main INPCDDF menu. At the main menu, the user should select the number of the data group that requires editing. Paragraphs 50 through 66 describe the input required in each data group.

48. **Converting an existing PCDDF data file to the new PCDDF89 format.** After pressing "C" at the initial INPCDDF menu, Figure B1, the user will be prompted for the name of the existing PCDDF data file, Figure B4. After typing in the full file name, including the drive and/or subdirectory where the file is located, the user will be prompted for the name of the new PCDDF89 data file, Figure B5. If the user enters the same name as the existing PCDDF data file, the original file will be overwritten when the file is saved. After entering the new file name, the user presses F1 to move to the main INPCDDF menu, Figure B3. The user should select the appropriate option, 11 or 12, to save the data file. After saving, the old data file has been successfully converted and can now be used to execute PCDDF89. The data file will be analyzed 20 percent faster using PCDDF89 than the previous version of PCDDF as a result of the recent modifications.

49. **Creating or editing a restart data file.** After pressing "R" at the initial INPCDDF menu, Figure B1, the user will choose whether to create a new restart data file or edit an existing restart data file. The restart option allows the user to restart or continue a previous consolidation/desiccation simulation. The entire restart option is described in Part V of this user's guide.

Main PCDDF89 Data Input Groups

50. INPCDDF prompts the user for the data required in the nine major groups of input required by PCDDF89. The nine groups are shown in the main INPCDDF menu, Figure B3, and are numbered 2 through 10. Data group 1 is used to create a new PCDDF89 data file. The next nine sections describe the input required in the nine data groups listed below:

- a. Program execution data.

- b. Compressible foundation material properties.
- c. Material properties of first dredged fill layer
- d. Incompressible foundation material properties.
- e. Execution time increment and grid size.
- f. Print times and new dredged fill material properties.
- g. Desiccation properties of dredged fill.
- h. Evaporation and precipitation data.
- i. Final dredged fill desiccation parameters.

Program execution data

51. This data input group has two data input screens that can be accessed directly by typing 2 and pressing "ENTER" at the main INPCDDF menu. The data required consist of program execution parameters that are used to determine whether the data file is for a new simulation or a restart of a previous simulation. The data also include a 40-character problem description that may include any character except single quotes, i.e., '. An option to save the output in a continuation file that can be used for restart purposes is also included. The input required is described in Table 1 and copies of the two data input screens are shown in Figure B6.

Compressible foundation material properties

52. If the foundation is determined to be compressible, the material properties required to calculate the resulting settlement must be entered. The compressible foundation option has five data input screens for the first material type. Each additional foundation material type requires data for the last four screens in this group. The input required is described in Table 2; copies of the data input screens are shown in Figures B7 and B8.

53. Normally the laboratory consolidation test results are plotted and a smoothed curve is drawn through the data. Values of effective stress and permeability are then determined for every 0.25 change in void ratio to produce a data set of 30 to 40 points from the smoothed curve. This data interpretation technique results in fewer interpolation errors in PCDDF89.

54. The interactive data input program will repeat screens 2 through 5 for each different material type in the compressible foundation, i.e., NUMBL times. If any dredged fill or compressible foundation layer has the same material properties as a previously entered layer, the same material identification number should be entered in screen 2 and the user will only be prompted for the initial thickness of the layer in screen 3. The material properties for screens 4 and 5 will be automatically loaded using the data entered previously for the same material identification number.

55. If the layer has a new material identification number, the user will be prompted for the data in screens 4, 4A, and 5, which are shown in Figure B8. Data input screen 4A prompts the user for the source of the material properties. The void ratio-effective stress and void ratio-permeability relationships required in screen 5 can be inputted interactively, option 0, or loaded from an existing data file using options 1 or 2. If option 1 or 2 is selected, the user will be prompted for the full file name of the existing data file

containing the material properties using the input screen in Figure B9. If option 1 is selected, input screen 5 will be omitted. If option 2 is selected, the data loaded from the existing file will be displayed in screen 5 and the user may edit the data.

Material properties for first dredged fill layer

56. Two data input screens are required to enter the material properties of the first dredged fill layer. The input required is described in Table 3 and copies of the input screens are shown in Figure B10. Additional layers of dredged fill materials can be added in data input group F. Input screen 1A, Figure B10, will appear before input screen 2 and prompts the user for the source of the material properties for the first dredged fill layer (see paragraph 55 for details).

Incompressible foundation material properties

57. The incompressible foundation material requires one data input screen. Table 4 describes the necessary input parameters which must be entered for all simulations, whether or not the site has a compressible foundation. A copy of the input screen for this data group is shown in Figure B11.

Execution time increment and grid size

58. The execution time increment and grid size used in the execution of PCDDF89 can be determined by the user or by the program. Copies of the input screens are shown in Figure B12; the necessary input parameters are described in Table 5. Only two data input screens are required whether the user or the program determines the time increment and grid size.

59. The following criteria are presented to facilitate the determination of a stable set of values for the time increment and grid size. In particular, guidelines for determining NBDIV1 and TAU are presented.

- a. Determine maximum value of $\alpha(e)$ using the compressibility data where

$$\alpha(e) = \frac{K(e)}{1 + e} \frac{d\sigma'}{de}$$

- b. Select the number of sublayers that the initial dredged fill layer will be divided into for computational purposes, NBDIV. A minimum of three layers is required to simulate the desiccation process. (see paragraphs 60 through 62 for guidelines.)
- c. Calculate the height of solids within one grid height from the relationship

$$\Delta z = \frac{\left(\frac{HDF}{1 + e_{00}} \right)}{NBDIV}$$

where

HDF = initial dredged fill thickness

d. Calculate the maximum time step from the smaller of:

$$\tau_{\max} = \frac{(\Delta z)^2 GW}{2\alpha(e)_{\max}} \qquad \tau_{\max} = \frac{\Delta z}{K(e_{00})}$$

where

$\alpha(e)_{\max}$ = value determined in step a

e_{00} = initial void ratio of the dredged fill

e. Select a time step, TAU, that is less than or equal to τ_{\max} .

f. If a compressible foundation is to be modeled, determine the number of layers, NBDIV1, from

$$NBDIV1 = \frac{\left(\frac{HBL}{1 + e_{00f}} \right)}{\Delta z_{\min}}$$

where

HBL = initial compressible foundation thickness

e_{00f} = initial void ratio of the compressible foundation

$$\Delta z_{\min} = \left(\frac{TAU + 2 + \alpha_1(e)_{\max}}{GW} \right)^{1/2}$$

where

TAU = time step from step e

$\alpha_1(e)_{\max}$ = maximum value of α determined for the foundation using the equation in step a

g. Select an integer value for NBDIV1 that is less than or equal to $NBDIV1_{\max}$. If $NBDIV1_{\max}$ is less than 1.0, repeat steps b through e using a larger value of NBDIV.

60. The user may allow the program to determine the stability criteria; however, this may cause a systematic error to be introduced into the computations. The program calculates the grid size by dividing the initial thickness of the first dredged fill layer by NBDIV. If the thickness of the first dredged fill layer is different from subsequent layers, then a cumulative mass error may be introduced.

61. To illustrate the cumulative mass error, assume the first dredged fill layer is 4.8 ft (1.46 m) thick and the program selects NBDIV to be 6. The distance between the grid points is 0.8 ft (0.24 m) for the first dredged fill layer and all subsequent dredged fill layers. If the second dredged fill layer is 4.4 ft (1.34 m), only five sublayers will be added to NBDIV because the program truncates the remaining material rather than rounding the material thickness to 4.8 ft (1.46 m). Therefore, in this example, 0.4 ft (0.12 m) of dredged fill is not accounted for.

62. PCDDF89 does monitor the amount of dredged fill that is not accounted for and at the termination of each simulation reports the cumulative mass error. The error is calculated by dividing the amount of dredged fill not accounted for by the total dredged fill added and is expressed as a percent. Generally the program's value of NBDIV is sufficiently small so that the error is negligible. The mass error can be avoided by choosing a grid size that fits all of the anticipated layer thicknesses and/or rounding the layer thicknesses to fit the grid size. If the cumulative mass error is greater than 10 percent, the user should modify the input to reduce the value of cumulative mass error.

Print times and new dredged fill layer material properties

63. This data group specifies the times for which output data will be printed. (Time is measured in days from the time of deposition of the initial dredged material layer.) Input parameters for this group are described in Table 6. Dredged fill layers can be added at any time during the simulation using this option. The new dredged fill layer may have the same or different material properties as previously added layers. If the material properties are the same as a previous layer, only data input screens 1 through 3 will be required. If the material properties are different than previous dredged fill layers, data input screens 1 through 5 will be required. Each set of data screens will be repeated for each print time for a total of NTIME times. Copies of the input screens are shown in Figures B13 and B14. Input screen 4A, Figure B14, will appear before input screen 5 and prompts the user for the source of the material properties for the new dredged fill layer. (See paragraph 55 for details.)

Desiccation properties of dredged fill

64. The desiccation parameters of the dredged fill material are inputted using the single data screen in this group. Input parameters for this group are described in Table 7. The average desiccation parameters for all the dredged fill materials should be used in this data group. Due to the uncertainties involved in the empirical desiccation model and in the interaction of previously dried material with new dredged fill layers, the program was not modified to incorporate desiccation parameters for each material type. The development of a sophisticated desiccation model is a subject for future research. However, the use of average desiccation parameters and the empirical model has been found to provide a good estimate of the settlement due to desiccation. A copy of the data input screen for this group is shown in Figure B15.

Evaporation and precipitation data

65. Average evaporation and rainfall data for the containment area are entered in this data group. Copies of the three data input screens used in this group are shown in Figure B16; the input data are described in Table 8. The required precipitation and evaporation data can be inputted interactively or loaded from an existing data file. As a result, input screen 1 in Figure B16 appears first to determine the source of the data. Option 0 will allow the user to input the data directly into screen 2. Options 1 and 2 will allow the user to load the data from an existing file and omit screen 2 (option 1) or edit the data in screen 2 (option 2). If option 1 or 2 is selected, the user will be prompted for the full file name of the existing data file (including drive and/or subdirectory) containing the evaporation and precipitation data, using input screen 1A in Figure B16.

Final dredged fill desiccation parameters

66. This data group requires the parameters that describe the desiccation and subsequent cracking of the dredged fill. The average values of these parameters for all the dredged fill layers should be used. A copy of the data input screen used in this group is shown in Figure B17. The input data are described in Table 9.

Data file option for PCDDF89 input

67. The data required to execute PCDDF89 are described in the data input screens and can be entered interactively using INPCDDF. However, users can also create data files using an editor or word processor that has a nondocument mode available to generate an ASCII data file, i.e. a file without embedded control characters. For an initial execution of a consolidation and desiccation simulation, the data file should be sequenced as shown in Table 10. The variables have been described previously in Tables 1 through 9, except for NST, which is an integer line number for each line of input data. The data on each line must be separated by a blank space. Real data may be written in either exponential or decimal format, but integer data must be written without a decimal. The variables highlighted in bold type illustrate the additional information required by PCDDF89 to analyze different types of dredged fill and compressible foundation materials.

PART V: PCDDF89 RESTART OPTION

Introduction

68. PCDDF89 is designed such that the results from a previous consolidation/desiccation simulation can be stored in a continuation file. This continuation file can be used to restart or continue the simulation at some future time. To restart a simulation, the continuation file from the previous execution and a restart data file are needed. The restart data file contains information on the number of time periods, the dredged fill layers, and the print options that will be used when the simulation is restarted. Three major groups of data are required to restart a continuation file, and they are described in paragraphs 74 through 77.

INPCDDF Restart Options

69. In the first INPCDDF menu, Figure B1, the user can create or edit a data file for restarting a previous simulation. After pressing "R" at the initial INPCDDF menu, the user will choose whether to create a new restart data file or edit an existing data file using the input screen shown in Figure B18.

70. **Creating a new PCDDF89 restart data file.** After pressing "N" at the initial INPCDDF restart menu, the user will be prompted for the name of the new restart data file, Figure B19. The user should enter the full file name, including the drive and/or subdirectory, of the new data file. After entering the file name, the user presses F1 to move to the next input screen, which requires the name of the previously saved continuation file, Figure B20. After entering the full file name, the user presses F1 to move the user to the main INPCDDF restart menu, Figure B21. The user should type "1" ("CREATE NEW RESTART DATA FILE OR EDIT CURRENT DATA FILE") and press "ENTER" to create a new data file. INPCDDF will prompt the user for all the data required in data groups 2 through 4 shown in the main INPCDDF restart menu. Paragraphs 74 through 77 describe the data required. At any time during the input process the user can return to the main menu by pressing F2. At the main menu the user can go back and edit a previous data group, save the file, and/or exit the program.

71. The user should finish entering all data in a particular group before returning to the main INPCDDF menu. This will facilitate locating the point where data input was terminated. When data input is continued, the user may select the number which corresponds to the next group of data that must be entered.

72. **Editing an existing PCDDF89 restart data file.** After pressing "E" at the initial INPCDDF restart menu, Figure B18, the user will be prompted for the name of the existing restart data file, Figure B22. After typing in the full file name, including the drive and/or subdirectory where the file is located, the user presses F1 to move to the next input screen, Figure B23. This screen prompts the user for the full file name of the previously saved continuation file. After entering the full file name, the user presses F1 to move to the next input screen, Figure B24. This screen prompts for the name of the new PCDDF89 restart data file after editing. If the user enters the same name as the existing data file, the original data file will be overwritten when the file is saved. After ente ing

the new file name, the user presses F1 to move to the main INPCDDF restart menu, Figure B21. At the main menu, the user should select the number of the data group that requires editing. Paragraphs 74 through 77 describe the input required in each data group.

Main PCDDF89 restart data input groups

73. INPCDDF prompts the user for the data required in the three major groups of input required by the restart option in PCDDF89. The three groups are shown in the main INPCDDF restart menu, Figure B21, and are numbered 2 through 4. Data group 1 is used to create a new PCDDF89 restart data file. The next three sections describe the input required in these three groups, which are listed below:

- a. Program execution data.
- b. Print times and dredged fill data from last simulation.
- c. Print times and new dredged fill layer data.

Restart program execution data

74. This restart group has two data input screens which are shown in Figure B25. The data required consist of program execution parameters which are used to determine if a new continuation file will be created and the number of print times used during the restart. This data also includes a 40-character problem description that may include any character except single quotes, i.e., '. The input required is described in Table 11.

Restart dredged fill data from previous simulation

75. This restart group requires data for the last dredged fill layer placed in the previous simulation. One data input screen is required and the information is obtained from the data file for the previous simulation. A copy of this data input screen is shown in Figure B26. The required data are described in Table 12. The data for this restart group must be identical to those entered in the main data group for print times and new dredged fill layer material properties (data fields 2 through 5, see Table 6). Data must be identical to those entered for the last print time analyzed in the previous simulation.

Restart print times and new dredged fill layer data

76. This data group specifies the times for which data will be printed. (Time is measured in days from the time of deposition of the initial dredged material layer.) Dredged fill layers can be added at any time during the restart of a previous simulation using this option. The new dredged fill layer may have the same or different material properties as previously added layers. If the material properties are the same as a previous layer, only data input screens 1 through 3 will be required. If the material properties are different than previous dredged fill layers, data input screens 1 through 5 will be required. Each set of data screens will be repeated for each print time, i.e., NTIME times. Copies of the input screens are shown in Figures B27 and B28; the required data are described in Table 13.

77. If the layer has a new material identification number, the user will be prompted for the data in screens 4, 4A, and 5, which are shown in Figure B28. Data input screen 4A prompts for the source of the material properties. The void ratio-effective stress and void ratio-permeability relationships required in screen 5 can be inputted interactively,

option 0, or loaded from an existing data file using options 1 or 2. If option 1 or 2 is selected, the user will be prompted for the full file name of the existing data file containing the material properties using the input screen in Figure B29. If option 1 is selected, input screen 5 will be omitted. If option 2 is selected, the data loaded from the existing file will be displayed in screen 5 and the user may edit the data.

Data File Option for PCDDF89 Restart Input

78. The data input required to restart a previous PCDDF89 simulation is described in the data input screens and can be entered interactively using INPCDDF. However, users can also create data files using an editor or word processor that has a nondocument mode available to generate an ASCII data file, i.e., a file without embedded characters. For the restart of a previous consolidation/desiccation simulation, the data file should be sequenced as shown in Table 14. The variables have been described previously in Tables 11 through 13 except NST, which is an integer line number for each line of input data. The data on each line must be separated by a blank space. Real data may be written in either exponential or decimal format, but integer data must be written without a decimal. The variables highlighted in bold type illustrate the additional information required by PCDDF89 to analyze different types of dredged fill and compressible foundation materials.

PART VI: PCDDF89 OUTPUT

Description and Explanation of PCDDF89 Output

79. The output from PCDDF89 is written to an ASCII data file that is named by the user. In addition, a partial listing of the output is displayed on the monitor as the program is executing, including the current time of the simulation, the settlement, and the surface elevation. The output data file from the program starts by echoing the execution input data file. Then, PCDDF89 interprets the data file and writes the input data in organized tables. After writing the input data, the program writes the initial conditions of the dredged fill at the nodal points in the initial lift thickness. The output describing the conditions of the compressible foundation and dredged fill materials is printed at the specified print times using the same tabular format as the input data. The restart option only writes the output describing the conditions of the compressible foundation and dredged fill at the specified print times and does not repeat the initial conditions. If English engineering units are used consistently throughout the simulation, the output parameters and their units are listed in Table 15. Sample PCDDF89 outputs are shown in paragraphs 81 and 82, which contain two example simulations.

80. The following two examples are presented to illustrate the use of PCDDF89. The data files for the examples described in this section are included on the PCDDF89 distribution disks.

Example 1: Compressible Foundation and Multiple Dredged Fill Layers

81. This example describes the input for two different layers of dredged fill placed on a compressible foundation. The first dredged fill layer is placed at time equal zero days and has an initial lift thickness of 10 ft (3.048 m). The second dredged fill material type is applied at 300 days with an initial height of 1.2 ft (0.37 m). The settlement of the foundation and dredged fill is calculated at 90, 180, 300, and 450 days. Figure 2 shows the sample input and Figure 3 shows the resulting output. The results were also saved in a continuation file named EX1CONT.OUT, which will be used in Example 2.

Example 2: Restart of Example 1

82. This example illustrates how the results of a previous simulation can be used to restart or continue the simulation. The results of the previous simulation are read to PCDDF89 from a continuation file. A restart data file contains information on the number of time periods, the dredged fill layers, and the print options that will be used when the simulation is restarted. Restart data are shown in Figure 4, which continues the simulation to 600 and 700 days. As shown, no additional dredged fill is added during the restart in this example. Output from the restart is shown in Figure 5.

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Table 1
Program Execution Data

| Input Screen | Data Field | Variable | Description |
|-----------------|---------------|----------|---|
| 1 | 1 | NDATA1 | Integer denoting the following options: 1 = new simulation. 2 = restart or continuation of a previous simulation. |
| 1 | 2 | NDATA2 | Integer denoting the following options: 1 = output not saved in a continuation file. 2 = output saved in a continuation file for subsequent restart of simulation. |
| 1 | 3 | NPROB | Description of simulation which can be a maximum of any 40 characters except a single quote, i.e., '. |
| 2 | 1 | NPT | Integer denoting the following options: 1 = complete program execution, printing soil data, initial conditions, and current conditions for all specified print times. 2 = complete program execution but do not print soil data and initial conditions. 3 = terminate program execution after printing soil data and initial conditions. |
| 2 | 2 | NBL | Integer denoting the following options: 1 = foundation is compressible and consolidation is calculated for foundation and dredged fill. 2 = foundation is incompressible and consolidation is calculated for only dredged fill. |

Table 2
Compressible Foundation Material Properties

| Input Screen | Data Field | Variable | Description |
|--------------|------------|-------------|---|
| 1 | 1 | NUMBL | Number of different material types in the compressible foundation (insert zero if foundation is incompressible). |
| 2 | 1 | IDBL | Material identification number for the compressible foundation layer (any integer from 1 to 25). If the material identification number is similar to a previous foundation layer, only the initial thickness of the layer will be required in screen 3 and the other material properties will be loaded from data entered previously. If the material identification number has not been used previously, the user will skip screen 3 and be prompted for the material properties in screens 4 and 5. |
| 3 | 1 | HBL | Initial thickness of the compressible foundation layer. |
| 4 | 1 | GSBL(IDBL) | Specific gravity of the soil solids of the compressible foundation layer. |
| 4 | 2 | HBL(IDBL) | Initial thickness of the compressible foundation layer. |
| 4 | 3 | LBL (IDBL) | Number of data points used to describe the void ratio-effective stress and void ratio-permeability relationships of the compressible foundation layer (any integer from 1 to 50). |
| 5 | 1 | ES1(IDBL,I) | Measured void ratios of compressible foundation layer under effective stresses applied in laboratory consolidation tests (self-weight consolidation test and/or standard oedometer test). Repeat LBL times. (See paragraph 53.) |
| 5 | 2 | RS1(IDBL,I) | Effective stresses applied in laboratory consolidation tests corresponding to the void ratios entered above. Repeat LBL times. |
| 5 | 3 | RK1(IDBL,I) | Permeabilities from the laboratory consolidation tests on the compressible foundation layer corresponding to the void ratios entered above. Repeat LBL times. |

Table 3
Material Properties for First Dredged Fill Layer

| Input Screen | Data Field | Variable | Description |
|--------------|------------|------------|---|
| 1 | 1 | GSDF(IDDF) | Specific gravity of the soil solids of first dredged fill layer. |
| 1 | 2 | HDF(IDDF) | Initial thickness of first dredged fill layer. |
| 1 | 3 | LDF(IDDF) | Number of data points used to describe the void ratio-effective stress and void ratio-permeability relationships of first dredged fill layer. |
| 1 | 4 | E00(IDDF) | Initial void ratio of first dredged fill layer after sedimentation and before the start of consolidation. (Void ratio at top of self-weight consolidation test specimen at end of test; values usually range from 6 to 13.) |
| 1 | 5 | GW | The unit weight of water in consistent engineering units. |
| 1 | 6 | IDDF | Material identification number for the first layer of dredged fill. (Any integer from 1 to 25.) |
| 2 | 1 | ES(IDDF,I) | Measured void ratios of first dredged fill layer under effective stresses applied in laboratory consolidation tests (self-weight consolidation test and/or standard oedometer test). Repeat LDF times. (See paragraph 53.) |
| 2 | 2 | RS(IDDF,I) | Effective stresses applied in laboratory consolidation tests corresponding to the void ratios entered above. Repeat LDF times. |
| 2 | 3 | RK(IDDF,I) | Permeabilities measured in laboratory consolidation tests on the first layer of dredged fill corresponding to the void ratios entered above. Repeat LDF times. |

Table 4
Incompressible Foundation Material Properties

| Input Screen | Data Field | Variable | Description |
|--------------|------------|----------|---|
| 1 | 1 | E0 | Void ratio at the top of the incompressible foundation (based on field samples or estimates; E0 ranges from 0.5 to 3.0.) |
| 1 | 2 | ZK0 | Permeability at the top of incompressible foundation (based on field measurements; values range from 0.01 ft/day (0.003 m/day) for coarse sands to 1.0E-09 for clays.) |
| 1 | 3 | DU0 | Length of drainage path in incompressible foundation based upon field evaluations; values range from 10 ft (3.048 m) for free-draining boundary to 1,000 ft (304.8 m) for an impervious boundary. |
| 1 | 4 | XEL | Elevation at the top of the incompressible foundation. |
| 1 | 5 | WTELEV | Elevation of the water table at the disposal site. This is the elevation below which desiccation of the dredged fill cannot occur. If the site is not influenced by external water, such as a harbor or lake, user enters an elevation at or below the bottom of the dredged fill. If site is influenced by external water, user enters elevation above the bottom of the dredged fill. Local National Oceanic and Atmospheric Administration (NOAA) tide tables should be consulted for mean sea levels. |

Table 5
Time Increment and Grid Size

| Input Screen | Data Field | Variable | Description |
|-----------------|---------------|----------|---|
| 1 | 1 | IMPLY | Integer denoting the following options: 1 = PCDDF89 will determine the time increment and grid size to satisfy stability criteria for the number of print times specified in NTIME (input screen 2). 2 = user will input time increment and grid sizes in input screen 3. |
| 2 | 1 | NTIME | Number of output or print times during the simulation. (This screen will appear if IMPLY = 1. The following screen will appear if IMPLY = 2.) |
| 3 | 1 | NBDIV | Number of parts the first layer of dredged fill is divided into for computational purposes. A minimum of three layers is required to simulate the desiccation process. (See paragraphs 60 through 62 for guidelines on determining NBDIV.) |
| 3 | 2 | NBDIV1 | Number of parts the compressible foundation layer is divided into for computational purposes. (See paragraph 59 for guidelines on determining NBDIV1.) |
| 3 | 3 | TAU | Value of the time step used in the finite difference calculations. (See subsequent paragraph 59 for guidelines on determining TAU.) |
| 3 | 4 | NTIME | Number of output or print times during simulation. |

Table 6
Print Times and New Dredged Fill Layer Data

| Input Screen | Data Field | Variable | Description |
|--------------|------------|------------|---|
| 1 | 1 | PRINT(I) | Times at which the properties of the consolidating layers will be printed and/or a new layer of dredged fill will be applied. PRINT(I) should be expressed in cumulative number of time periods (usually days) from the addition of the first layer of dredged fill. This screen will be repeated NTIME times. |
| 1 | 2 | AHDF(I) | Initial thickness of new dredged fill layer to be added at PRINT(I). If no additional dredged fill is being added, AHDF(I) is set to zero. If AHDF(I) is greater than zero, the material identification number and properties must be entered. |
| 1 | 3 | ATDS(I) | Cumulative number of time periods (usually days) from the addition of the first layer of dredged fill to the start of desiccation in the dredged fill placed at PRINT(I). If desiccation will not occur during the entire simulation period, a value of ATDS greater than or equal to the maximum time period of the simulation should be entered. |
| 1 | 4 | NMS(I) | The number of the month at which desiccation starts for this print time (January = 1). This number must correspond to the value input for ATDS. |
| 1 | 5 | NNSC(I) | Integer denoting the following options: 1 = Print the current void ratio, effective stress, and pore pressure profiles for print time, PRINT(I). 2 = Print only the current void ratio profile at PRINT(I). 3 = Do not print void ratio, effective stress, and pore pressure profiles for print time, PRINT(I). |
| 2 | 1 | IDDF | Material identification number for the dredged fill added at PRINT(I). If IDDF is the same as a previous layer, only E00 will be required in screen 3 and the other properties will be loaded automatically from data entered previously. If IDDF has not been used previously, the user will skip screen 3 and be prompted for the material properties in screens 4 and 5. |
| 3 | 1 | E00(IDDF) | Initial void ratio of new dredged fill after sedimentation and before the start of consolidation. (Void ratio at top of self-weight consolidation test specimen at end of test; values usually range from 6 to 13.) |
| 4 | 1 | GSDF(IDDF) | Specific gravity of the soil solids for the new dredged fill material. |
| 4 | 2 | LDF(IDDF) | Number of data points used to describe the void ratio-effective stress and void ratio-permeability relationships of new dredged fill material. |
| 4 | 3 | E00(IDDF) | Initial void ratio of new dredged fill after sedimentation and before the start of consolidation. (Void ratio at top of self-weight consolidation test specimen at end of test; values usually range from 6 to 13.) |
| 5 | 1 | ES(IDDF,I) | Measured void ratios of new dredged fill layer under effective stresses applied in laboratory consolidation tests (self-weight consolidation test and/or standard oedometer test). Repeat LDF times. (See paragraph 53.) |
| 5 | 2 | RS(IDDF,I) | Effective stresses applied in laboratory consolidation tests corresponding to the void ratios entered above. Repeat LDF times. |
| 5 | 3 | RK(IDDF,I) | Permeabilities from laboratory consolidation tests on the new dredged fill layer corresponding to the void ratios entered above. Repeat LDF times. |

Table 7
Desiccation Parameters of Dredged Fill

| Input Screen | Data Field | Variable | Description |
|--------------|------------|----------|---|
| 1 | 1 | DL | Average desiccation limit of the dredged fill defined as the lowest void ratio the material will attain during second-stage drying. An estimate of the moisture content at the desiccation limit is 1.2 times the water content (in decimal form) at the plastic limit of the dredged fill. The corresponding void ratio can be used as the desiccation limit. |
| 1 | 2 | SL | Average saturation limit of the dredged fill defined as the void ratio which separates first-stage desiccation from second-stage desiccation. The moisture content at the saturation limit corresponds to a degree of saturation equal to 100 percent and can be estimated using 1.8 times the water content (in decimal form) at the liquid limit. The corresponding void ratio can be used as the saturation limit. |
| 1 | 3 | TPM | Number of basic time periods in a month. If time is measured in days, TPM is equal to 30. |
| 1 | 4 | DREFF | Drainage efficiency factor of the containment area which is defined as the ratio of the overland runoff volume to the rainfall volume. Values range from 0.0 for areas with no surface drainage that rely only on evaporation for water removal to 1.0 for areas with rapid removal of rainfall volumes. The simulation is relatively insensitive for values between 0.5 and 1.0. |
| 1 | 5 | TDS | Number of time periods (usually days) from the addition of the first layer of dredged fill to the start of desiccation in the first layer of dredged fill. If desiccation will not occur before subsequent dredged material placement, then the value entered for TDS should be greater than or equal to the maximum time period of the simulation. |
| 1 | 6 | MS | The number of the month at which desiccation starts in the first layer of dredged fill (January = 1). This number must correspond to the value input for TDS. |
| 1 | 7 | NSC | Integer denoting the following options: 1 = Print the current void ratio, effective stress, and pore pressure profiles for particular print time, PRINT(I). 2 = Print only the current void ratio at PRINT(I). 3 = Do not print void ratio, effective stress, and pore pressure profiles for print time, PRINT(I). |

Table 8
Evaporation and Precipitation Data

| Input Screen | Data Field | Variable | Description |
|--------------|------------|----------|---|
| 1 | 1 | PEP(I) | Monthly class A pan or maximum environmental potential evaporation expected at the containment area each month of the year. January is month 1. Average monthly values of PEP and RF can be obtained from the US Weather Bureau records of climatic data. |
| 1 | 2 | RF(I) | Average monthly rainfall expected at the containment area for each month of the year. January is month 1. |

Table 9
Final Dredged Fill Desiccation Parameters

| Input Screen | Data Field | Variable | Description |
|--------------|------------|----------|---|
| 1 | 1 | CE | The maximum dredged fill evaporation efficiency for desiccation drying. Observed values range from 0.5 to 1.2; however, the simulation is relatively insensitive to variations in CE between 0.5 and 1.0. Unless data are available, a value of 1.0 is recommended. |
| 1 | 2 | SAT | The average degree of saturation, expressed as a fraction of 1.0, of the dredged fill when dried to the desiccation limit, DL. This value includes the crack network. |
| 1 | 3 | H2 | The maximum depth to which second-stage drying will occur. |

Table 10
Data Input Required for PCDDF89

| Card | Variable(s) |
|------|---|
| A | NST, NPROB, NDATA1, NDATA2 |
| A1 | NST, NPT, NBL |
| B | NST, NUMBL |
| B1 | NST, IDBL(I) |
| B2 | NST, GSBL(IDBL), HBL(IDBL), LBL(IDBL) |
| B3 | NST, ES1(IDBL,I), RS1(IDBL,I), RK(IDBL,I) (Repeat B1, B2, and B3 NUMBL times. If IDBL has been entered previously, only NST and HBL will be required on card B2, and card B3 will be omitted.) |
| C | NST, GSDF(J), HDF(J), LDF(J), E00(J), GW, IDDF(J) |
| C1 | NST, ES(J), RS(J), RK(J) (Input LDF times) |
| D | NST, E0, ZK0, DU0, XEL, WTELEV |
| E | NST, IMPLY |
| E1 | NST, NTIME (If IMPLY equals 1) |
| E2 | NST, NBDIV, NBDIV1, TAU, NTIME (If IMPLY equals 2) |
| F | NST, PRINT(K), AHDF(K), ATDS(K), NMS(K), NNSC(K) |
| F1 | NST, IDDF(K) |
| F2 | NST, GSDF(IDDF), LDF(IDDF), E00(IDDF) |
| F3 | NST, ES(IDDF,K), RS(IDDF,K), RK(IDDF,K) (Repeat cards F, F1, F2, and F3 NTIME times. If IDDF has been entered previously, only NST and E00 will be required on card F2 and card F3 will be omitted.) |
| G | NST, DL, SL, TDM, DREFF, TDS, MS, NSC |
| H | NST, PEP(L), RF(L) (Repeat 12 times) |
| I | NST, CE, SAT, H2 |

Table 11
Restart Program Execution Data

| Input Screen | Data Field | Variable | Description |
|--------------|------------|----------|---|
| 1 | 1 | NDATA1 | Integer denoting following options: 1 = new simulation. 2 = restart previous simulation (NDATA1 should equal 2). |
| 1 | 2 | NDATA2 | Integer denoting following options: 1 = output not saved in a continuation file for subsequent restart of simulation. 2 = output saved in a continuation file for subsequent restart of simulation. |
| 1 | 3 | NPROB | Description of simulation which can be a maximum of any 40 characters except a single quote, i.e., '. |
| 2 | 1 | MTIME | Number of output or print times during restart of previous simulation. |

Table 12
Restart Dredged Fill Data From Previous Simulation

| Input Screen | Data Field | Variable | Description |
|--------------|------------|-------------|--|
| 1 | 1 | AHDF(NTIME) | Initial thickness of last dredged fill layer placed in the previous simulation. |
| 1 | 2 | ATDS(NTIME) | Cumulative number of time periods (usually days) from the addition of the first dredged fill layer to the start of desiccation in the last fill layer placed in the previous simulation. |
| 1 | 3 | NMS(NTIME) | The number of the month at which desiccation starts for this dredged fill layer (January = 1). |
| 1 | 4 | NNSC(NTIME) | Integer denoting the following options: 1 = Print current void ratio, effective stress, and pore pressure profiles. 2 = Print only current void ratio profile. 3 = Do not print current void ratio, effective stress, and pore pressure profiles. |

Table 13
Restart Print Times and New Dredged Fill Layer Data

| Input Screen | Data Field | Variable | Description |
|--------------|------------|------------|---|
| 1 | 1 | PRINT(I) | Times at which the properties of the consolidating layers will be printed and/or a new layer of dredged fill is applied. PRINT(I) should be expressed in cumulative number of time periods (usually days) from the addition of the first layer of dredged fill. This screen will be repeated NTIME times. |
| 1 | 2 | AHDF(I) | Initial thickness of new dredged fill layer to be added at PRINT(I). If no additional dredged fill is being added, AHDF(I) is set to zero. If AHDF(I) is greater than zero, the material identification number and properties must be entered. |
| 1 | 3 | ATDS(I) | Cumulative number of time periods (usually days) from the addition of the first layer of dredged fill to the start of desiccation in the dredged fill placed at PRINT(I). If desiccation will not occur during the entire simulation, a value of ATDS greater than or equal to the maximum time period of the simulation should be entered. |
| 1 | 4 | NMS | The number of the month at which desiccation starts for this print time (January = 1). This number must correspond to the value input for ATDS. |
| 1 | 5 | NNSC(I) | Integer denoting the following options: 1 = Print the current void ratio, effective stress, and pore pressure profiles for print time, PRINT(I). 2 = Print only the current void ratio profile at PRINT(I). 3 = Do not print void ratio, effective stress, and pore pressure profiles for print time, PRINT(I). |
| 2 | 1 | IDDF | Material identification number for the dredged fill added at PRINT(I). If IDDF is the same as a previous layer, only E00 will be required in screen 3 and the other properties will be loaded automatically from data entered previously. If IDDF has not been used previously, the user will skip screen 3 and be prompted for the material properties in screens 4 and 5. |
| 3 | 1 | E00(IDDF) | Initial void ratio of new dredged fill after sedimentation and before consolidation. (Void ratio at top of self-weight consolidation test specimen at end of test; values usually range from 6 to 13.) |
| 4 | 1 | GSDF(IDDF) | Specific gravity of the soil solids for new dredged fill material. |
| 4 | 2 | LDF(IDDF) | Number of data points used to describe the void ratio-effective stress and permeability-void ratio relationships of the new dredged material. |
| 4 | 3 | E00(IDDF) | Initial void ratio of new dredged fill after sedimentation and before consolidation. (Void ratio at top of self-weight consolidation test specimen at end of test; values usually range from 6 to 13.) |
| 5 | 1 | ES(IDDF,I) | Measured void ratio of new dredged fill layer under effective stresses applied in laboratory consolidation tests (self-weight consolidation test and/or standard oedometer test). Repeat LDF times. (See paragraph 53.) |
| 5 | 2 | RS(IDDF,I) | Effective stresses applied in laboratory consolidation tests corresponding to the void ratios entered above. Repeat LDF times. |
| 5 | 3 | RK(IDDF,I) | Permeabilities from laboratory consolidation tests on the new dredged fill layer corresponding to the void ratios entered above. Repeat LDF times. |

Table 14
Data Input Required for PCDDF89 Restart

| Card | Variable(s) |
|------|--|
| A | NST, NPROB, NDATA1, NDATA2 |
| A1 | NST, MTIME |
| B | NST, AHDF(NTIME), ATDS(NTIME), NMS(NTIME), NNSC(NTIME) |
| C | NST, PRINT(I), AHDF(I), ATDS(I), NMS(I), NNSC(I) |
| C1 | NST, IDDF(I) |
| C2 | NST, GSDF(IDDF), LDF(IDDF), E00(IDDF) |
| C3 | NST, ES(IDDF,I), RS(IDDF,I), RK(IDDF,I) (input LDF(K) times) (Repeat C, C1, C2, and C3 MTIME times. If IDDF has been entered previously, only NST and E00 will be required on card C2 and card C3 will be omitted.) |

Table 15
PCDDF89 Output Parameters

| Parameter | Units |
|--|----------|
| Coordinates of the nodal points in initial dredged fill layer | feet |
| Initial void ratio at each of the coordinate points | |
| Current void ratio at each of the coordinate points | |
| Final void ratio at each of the coordinate points | |
| Total stress at each of the coordinate points | lb/sq ft |
| Effective stress at each of the coordinate points | lb/sq ft |
| Total pore pressure at each of the coordinate points | lb/sq ft |
| Static pore pressure at each of the coordinate points | lb/sq ft |
| Excess pore pressure at each of the coordinate points | lb/sq ft |
| Current time for which output is being given | days |
| Degree of consolidation | |
| Settlement | feet |
| Final settlement | feet |
| Settlement due to consolidation | feet |
| Settlement due to desiccation | feet |
| Bottom boundary pore pressure | lb/cu ft |
| Surface elevation | feet |

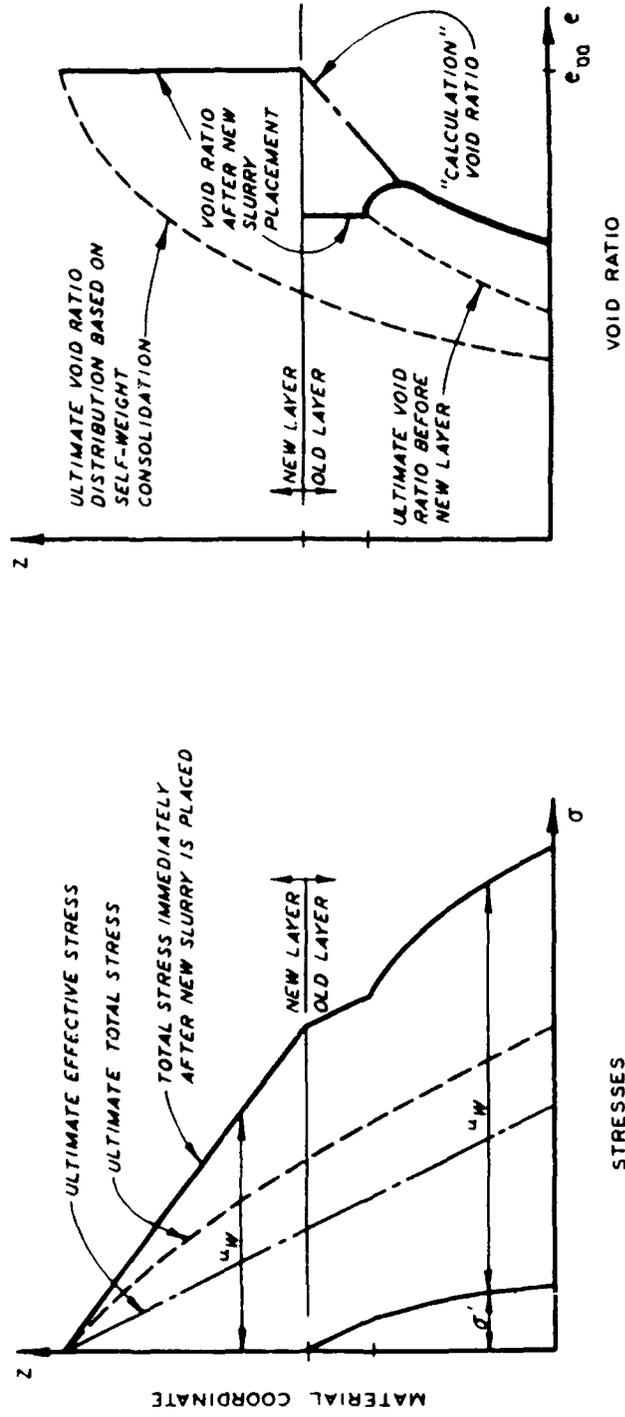


Figure 1. Soil stresses and void ratio distribution immediately after placement of new lift on partially consolidated layer (Cargill 1985)

```
100 'Ex.1-Compressible Found. & 2 Matl. Types' 1 2
101 1 1
102 1
103 3
104 2.83 10 7
105 2.5 12.0 .601E-03
106 2.45 40.0 .534E-03
107 2.38 100.0 .452E-03
108 2.26 200.0 .338E-03
109 2.0 500.0 .173E-03
110 1.82 1000.0 .106E-03
111 1.68 2000.0 .706E-04
112 2.6 6.0 36 12.15 62.4 1
113 12.15 0.00E-00 1.56E-01
114 12.00 5.80E-02 1.44E-01
115 11.50 1.68E-01 1.12E-01
116 11.00 3.56E-01 8.71E-02
117 10.50 6.60E-01 6.77E-02
118 10.00 1.12E+00 5.27E-02
119 9.70 1.50E+00 4.58E-02
120 9.30 2.20E+00 3.74E-02
121 9.00 2.86E+00 3.23E-02
122 8.70 3.68E+00 2.76E-02
123 8.30 4.90E+00 2.29E-02
124 8.00 6.04E+00 1.94E-02
125 7.75 7.16E+00 1.71E-02
126 7.50 8.36E+00 1.47E-02
127 7.25 9.80E+00 1.27E-02
128 7.00 1.14E+01 1.10E-02
129 6.75 1.33E+01 9.36E-03
130 6.50 1.54E+01 7.92E-03
131 6.25 17.9 6.62E-03
132 6.00 21.8 5.57E-03
133 5.75 28.6 4.54E-03
134 5.5 40.2 3.64E-03
135 5.25 57.0 2.87E-03
136 5.0 78.6 2.22E-03
137 4.75 111.0 1.66E-03
138 4.5 153.0 1.25E-03
139 4.25 216.0 9.00E-04
140 4.0 300.0 6.48E-04
141 3.75 420.0 4.57E-04
142 3.5 590.0 3.20E-04
143 3.25 820.0 2.17E-04
144 3.0 1140.0 1.48E-04
145 2.75 1580.0 9.79E-05
146 2.5 2200.0 6.62E-05
147 2.25 3100.0 4.39E-05
148 2.0 4240.0 2.97E-05
149 1. 1.0E-06 10. 100. 0.
150 1
151 4
152 90 0 90 4 1
153 180 0 180 7 1
```

Figure 2. Example 1: Input data file (Continued)

154 300 1.2 420 11 1
155 2
156 2.75 21 8.3
157 8.3 .944 0.80E-01
158 5.28 28.9 .284E-02
159 5.25 30.1 .273E-02
160 5.07 38.1 .215E-02
161 4.99 43.1 .193E-02
162 4.55 81.6 .104E-02
163 4.54 82.8 .102E-02
164 4.45 94.9 .898E-03
165 4.35 110.6 .774E-03
166 4.15 151.4 .571E-03
167 4.03 183.7 .473E-03
168 3.95 209.4 .418E-03
169 3.55 414.0 .216E-03
170 3.5 452.4 .199E-03
171 3.35 593.0 .153E-03
172 3.2 783.1 .117E-03
173 3.05 1042.5 .890E-04
174 2.99 1172.0 .795E-04
175 2.86 1516.0 .621E-04
176 2.72 2016.8 .472E-04
177 2.55 2884.3 .335E-04
178 450 0 510 6 1
179 3.1 6.7 30 1 90 4 1
180 0.18 0.24
181 .23 .27
182 .36 .40
183 .36 .25
184 .57 .32
185 .49 .53
186 .67 .68
187 .57 .54
188 .41 .43
189 .33 .25
190 .21 .18
191 .16 .26
192 .5 .75 .83

Figure 2. (Concluded)

 CONSOLIDATION AND DESICCATION OF SOFT LAYERS---DREDGED FILL

PROBLEM Ex.1-Compressible Found. & 2 Matl. Types

*****SOIL DATA FOR COMPRESSIBLE FOUNDATION*****

| MATERIAL TYPE | LAYER THICKNESS | | SPECIFIC GRAVITY OF SOLIDS | | | | |
|------------------|--------------------|---------------------|-------------------------------|-------------|----------|-----------|-----------|
| 3 | 10.00 | | 2.83 | | | | |
| | VOID RATIO | EFFECTIVE STRESS | PERM- EABILITY | K/1+E PK | BETA | DSDE | ALPHA |
| 1 | 2.500 | .120E+02 | .601E-03 | .172E-03 | .339E-03 | -.560E+03 | -.962E-01 |
| 2 | 2.450 | .400E+02 | .534E-03 | .155E-03 | .317E-03 | -.733E+03 | -.114E+00 |
| 3 | 2.380 | .100E+03 | .452E-03 | .134E-03 | .269E-03 | -.842E+03 | -.113E+00 |
| 4 | 2.260 | .200E+03 | .338E-03 | .104E-03 | .200E-03 | -.105E+04 | -.109E+00 |
| 5 | 2.000 | .500E+03 | .173E-03 | .577E-04 | .150E-03 | -.182E+04 | -.105E+00 |
| 6 | 1.820 | .100E+04 | .106E-03 | .376E-04 | .979E-04 | -.469E+04 | -.176E+00 |
| 7 | 1.680 | .200E+04 | .706E-04 | .263E-04 | .803E-04 | -.714E+04 | -.188E+00 |

Figure 3. Example 1: Output (Sheet 1 of 15)

*****SOIL DATA FOR DREDGED FILL*****

| LAYER THICKNESS | SPECIFIC GRAVITY OF SOLIDS | INITIAL VOID RATIO | SATURATION LIMIT | DESICCATION LIMIT | | |
|-----------------|----------------------------|--------------------|------------------|-------------------|-----------|-----------|
| 6.00 | 2.60 | 12.15 | 6.70 | 3.10 | | |
| MATERIAL TYPE | | 1 | | | | |
| VOID RATIO | EFFECTIVE STRESS | PERMEABILITY | K/1+E PK | BETA | DSDE | ALPHA |
| 1 12.150 | .000E+00 | .156E+00 | .119E-01 | .524E-02 | -.387E+00 | -.459E-02 |
| 2 12.000 | .580E-01 | .144E+00 | .111E-01 | .447E-02 | -.258E+00 | -.286E-02 |
| 3 11.500 | .168E+00 | .112E+00 | .896E-02 | .382E-02 | -.298E+00 | -.267E-02 |
| 4 11.000 | .356E+00 | .871E-01 | .726E-02 | .307E-02 | -.492E+00 | -.357E-02 |
| 5 10.500 | .660E+00 | .677E-01 | .589E-02 | .247E-02 | -.764E+00 | -.450E-02 |
| 6 10.000 | .112E+01 | .527E-01 | .479E-02 | .201E-02 | -.105E+01 | -.503E-02 |
| 7 9.700 | .150E+01 | .458E-01 | .428E-02 | .166E-02 | -.154E+01 | -.660E-02 |
| 8 9.300 | .220E+01 | .374E-01 | .363E-02 | .150E-02 | -.194E+01 | -.705E-02 |
| 9 9.000 | .286E+01 | .323E-01 | .323E-02 | .131E-02 | -.247E+01 | -.797E-02 |
| 10 8.700 | .368E+01 | .276E-01 | .285E-02 | .110E-02 | -.291E+01 | -.829E-02 |
| 11 8.300 | .490E+01 | .229E-01 | .246E-02 | .985E-03 | -.337E+01 | -.830E-02 |
| 12 8.000 | .604E+01 | .194E-01 | .216E-02 | .924E-03 | -.411E+01 | -.886E-02 |
| 13 7.750 | .716E+01 | .171E-01 | .195E-02 | .852E-03 | -.464E+01 | -.907E-02 |
| 14 7.500 | .836E+01 | .147E-01 | .173E-02 | .830E-03 | -.528E+01 | -.913E-02 |
| 15 7.250 | .980E+01 | .127E-01 | .154E-02 | .709E-03 | -.608E+01 | -.936E-02 |
| 16 7.000 | .114E+02 | .110E-01 | .137E-02 | .663E-03 | -.700E+01 | -.962E-02 |
| 17 6.750 | .133E+02 | .936E-02 | .121E-02 | .638E-03 | -.800E+01 | -.966E-02 |
| 18 6.500 | .154E+02 | .792E-02 | .106E-02 | .589E-03 | -.920E+01 | -.972E-02 |
| 19 6.250 | .179E+02 | .662E-02 | .913E-03 | .521E-03 | -.128E+02 | -.117E-01 |
| 20 6.000 | .218E+02 | .557E-02 | .796E-03 | .481E-03 | -.214E+02 | -.170E-01 |
| 21 5.750 | .286E+02 | .454E-02 | .673E-03 | .471E-03 | -.368E+02 | -.248E-01 |
| 22 5.500 | .402E+02 | .364E-02 | .560E-03 | .427E-03 | -.568E+02 | -.318E-01 |
| 23 5.250 | .570E+02 | .287E-02 | .459E-03 | .380E-03 | -.768E+02 | -.353E-01 |
| 24 5.000 | .786E+02 | .222E-02 | .370E-03 | .341E-03 | -.108E+03 | -.400E-01 |
| 25 4.750 | .111E+03 | .166E-02 | .289E-03 | .285E-03 | -.149E+03 | -.430E-01 |
| 26 4.500 | .153E+03 | .125E-02 | .227E-03 | .235E-03 | -.210E+03 | -.477E-01 |
| 27 4.250 | .216E+03 | .900E-03 | .171E-03 | .195E-03 | -.294E+03 | -.504E-01 |
| 28 4.000 | .300E+03 | .648E-03 | .130E-03 | .150E-03 | -.408E+03 | -.529E-01 |
| 29 3.750 | .420E+03 | .457E-03 | .962E-04 | .117E-03 | -.580E+03 | -.558E-01 |
| 30 3.500 | .590E+03 | .320E-03 | .711E-04 | .903E-04 | -.800E+03 | -.569E-01 |
| 31 3.250 | .820E+03 | .217E-03 | .511E-04 | .682E-04 | -.110E+04 | -.562E-01 |
| 32 3.000 | .114E+04 | .148E-03 | .370E-04 | .499E-04 | -.152E+04 | -.562E-01 |
| 33 2.750 | .158E+04 | .979E-04 | .261E-04 | .362E-04 | -.212E+04 | -.553E-01 |
| 34 2.500 | .220E+04 | .662E-04 | .189E-04 | .252E-04 | -.304E+04 | -.575E-01 |
| 35 2.250 | .310E+04 | .439E-04 | .135E-04 | .180E-04 | -.408E+04 | -.551E-01 |
| 36 2.000 | .424E+04 | .297E-04 | .990E-05 | .144E-04 | -.456E+04 | -.451E-01 |

Figure 3. (Sheet 2 of 15)

*****SOIL DATA FOR DREDGED FILL*****

| LAYER THICKNESS | SPECIFIC GRAVITY OF SOLIDS | INITIAL VOID RATIO | SATURATION LIMIT | DESICCATION LIMIT |
|-----------------|----------------------------|--------------------|------------------|-------------------|
| 1.20 | 2.75 | 8.30 | 6.70 | 3.10 |
| MATERIAL TYPE | | 2 | | |

| I | VOID RATIO | EFFECTIVE STRESS | PERM-EABILITY | K/1+E PK | BETA | DSDE | ALPHA |
|----|------------|------------------|---------------|----------|----------|-----------|-----------|
| 1 | 8.300 | .944E+00 | .800E-01 | .860E-02 | .270E-02 | -.926E+01 | -.796E-01 |
| 2 | 5.280 | .289E+02 | .284E-02 | .452E-03 | .268E-02 | -.956E+01 | -.432E-02 |
| 3 | 5.250 | .301E+02 | .273E-02 | .437E-03 | .467E-03 | -.438E+02 | -.191E-01 |
| 4 | 5.070 | .381E+02 | .215E-02 | .354E-03 | .441E-03 | -.500E+02 | -.177E-01 |
| 5 | 4.990 | .431E+02 | .193E-02 | .322E-03 | .321E-03 | -.837E+02 | -.270E-01 |
| 6 | 4.550 | .816E+02 | .104E-02 | .187E-03 | .307E-03 | -.882E+02 | -.165E-01 |
| 7 | 4.540 | .828E+02 | .102E-02 | .184E-03 | .226E-03 | -.133E+03 | -.245E-01 |
| 8 | 4.450 | .949E+02 | .898E-03 | .165E-03 | .208E-03 | -.146E+03 | -.241E-01 |
| 9 | 4.350 | .111E+03 | .774E-03 | .145E-03 | .180E-03 | -.188E+03 | -.272E-01 |
| 10 | 4.150 | .151E+03 | .571E-03 | .111E-03 | .158E-03 | -.228E+03 | -.253E-01 |
| 11 | 4.030 | .184E+03 | .473E-03 | .940E-04 | .132E-03 | -.290E+03 | -.273E-01 |
| 12 | 3.950 | .209E+03 | .418E-03 | .844E-04 | .970E-04 | -.480E+03 | -.405E-01 |
| 13 | 3.550 | .414E+03 | .216E-03 | .475E-04 | .894E-04 | -.540E+03 | -.256E-01 |
| 14 | 3.500 | .452E+03 | .199E-03 | .442E-04 | .615E-04 | -.895E+03 | -.396E-01 |
| 15 | 3.350 | .593E+03 | .153E-03 | .352E-04 | .546E-04 | -.110E+04 | -.388E-01 |
| 16 | 3.200 | .783E+03 | .117E-03 | .279E-04 | .440E-04 | -.150E+04 | -.417E-01 |
| 17 | 3.050 | .104E+04 | .890E-04 | .220E-04 | .378E-04 | -.185E+04 | -.407E-01 |
| 18 | 2.990 | .117E+04 | .795E-04 | .199E-04 | .310E-04 | -.249E+04 | -.497E-01 |
| 19 | 2.860 | .152E+04 | .621E-04 | .161E-04 | .268E-04 | -.313E+04 | -.503E-01 |
| 20 | 2.720 | .202E+04 | .472E-04 | .127E-04 | .215E-04 | -.441E+04 | -.560E-01 |
| 21 | 2.550 | .288E+04 | .335E-04 | .944E-05 | .191E-04 | -.510E+04 | -.482E-01 |

Figure 3. (Sheet 3 of 15)

SUMMARY OF MONTHLY RAINFALL AND EVAPORATION POTENTIAL

| MONTH | RAINFALL | EVAPORATION |
|-------|----------|-------------|
| 1 | .240 | .180 |
| 2 | .270 | .230 |
| 3 | .400 | .360 |
| 4 | .250 | .360 |
| 5 | .320 | .570 |
| 6 | .530 | .490 |
| 7 | .680 | .670 |
| 8 | .540 | .570 |
| 9 | .430 | .410 |
| 10 | .250 | .330 |
| 11 | .180 | .210 |
| 12 | .260 | .160 |

*****CALCULATION DATA*****

| TAU | LOWER LAYER VOID RATIO | LOWER LAYER PERMEABILITY | DRAINAGE PATH LENGTH |
|------|---------------------------|-----------------------------|-------------------------|
| .500 | 1.000 | .10000E-05 | Z = 5.00 |

Figure 3. (Sheet 4 of 15)

SUMMARY OF DESICCATION PARAMETERS

| PARAMETER | VALUE |
|---------------------------------------|--------|
| SURFACE DRAINAGE EFFICIENCY | 1.00 |
| MAXIMUM EVAPORATION EFFICIENCY | .50 |
| SATURATION AT DESICCATION LIMIT | .75 |
| MAXIMUM CRUST THICKNESS | .83 |
| TIME TO DESIC. AFTER INITIAL FILL | 90.00 |
| MONTH OF INITIAL DESICCATION | 4 |
| ELEVATION OF FIXED WATER TABLE | .00 |
| ELEVATION OF TOP OF INCOMPRES. FOUND. | 100.00 |

SUMMARY OF ADDITIONAL LIFTS AND PRINT DETAIL

| TIME DAYS | FILL HEIGHT FEET | START DESICCATION DAY | MONTH | PRINT DETAIL |
|--------------|---------------------|--------------------------|-------|-----------------|
| 90.00 | .00 | 90.00 | 4 | 1 |
| 180.00 | .00 | 180.00 | 7 | 1 |
| 300.00 | 1.20 | 420.00 | 11 | 1 |
| 450.00 | .00 | 510.00 | 6 | 1 |

Figure 3. (Sheet 5 of 15)

*****INITIAL CONDITIONS IN COMPRESSIBLE FOUNDATION*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|------|-------------------------|------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 9.99 | 9.99 | 3.02 | 2.52 | 2.52 | 2.44 | 3 |
| 8.24 | 8.24 | 2.52 | 2.43 | 2.43 | 2.38 | 3 |
| 6.53 | 6.53 | 2.02 | 2.36 | 2.36 | 2.31 | 3 |
| 4.85 | 4.85 | 1.51 | 2.29 | 2.29 | 2.24 | 3 |
| 3.21 | 3.21 | 1.01 | 2.23 | 2.23 | 2.19 | 3 |
| 1.59 | 1.59 | .50 | 2.18 | 2.18 | 2.14 | 3 |
| .00 | .00 | .00 | 2.13 | 2.13 | 2.09 | 3 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|---------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 9.99 | 419.95 | .00 | 419.95 | 374.40 | 45.55 | 3 |
| 8.24 | 586.65 | 57.55 | 529.10 | 483.55 | 45.55 | 3 |
| 6.53 | 751.00 | 115.09 | 635.90 | 590.35 | 45.55 | 3 |
| 4.85 | 913.16 | 172.64 | 740.52 | 694.97 | 45.55 | 3 |
| 3.21 | 1073.30 | 230.19 | 843.11 | 797.55 | 45.55 | 3 |
| 1.59 | 1231.74 | 287.74 | 944.00 | 898.45 | 45.55 | 3 |
| .00 | 1388.64 | 345.28 | 1043.36 | 997.80 | 45.55 | 3 |

TIME = .00 DEGREE OF CONSOLIDATION = .0000
 SETTLEMENT = .00 FINAL SETTLEMENT = .15
 BOTTOM BOUNDARY GRADIENT = .00

Figure 3. (Sheet 6 of 15)

*****INITIAL CONDITIONS IN DREDGED FILL*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|-----|-------------------------|-------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 6.00 | 6.00 | .46 | 12.15 | 12.15 | 12.15 | 1 |
| 5.25 | 5.25 | .40 | 12.15 | 12.15 | 8.09 | 1 |
| 4.50 | 4.50 | .34 | 12.15 | 12.15 | 7.00 | 1 |
| 3.75 | 3.75 | .29 | 12.15 | 12.15 | 6.33 | 1 |
| 3.00 | 3.00 | .23 | 12.15 | 12.15 | 5.96 | 1 |
| 2.25 | 2.25 | .17 | 12.15 | 12.15 | 5.75 | 1 |
| 1.50 | 1.50 | .11 | 12.15 | 12.15 | 5.63 | 1 |
| .75 | .75 | .06 | 12.15 | 12.15 | 5.51 | 1 |
| .00 | .00 | .00 | 12.15 | 12.15 | 5.42 | 1 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|--------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 6.00 | .00 | .00 | .00 | .00 | .00 | 1 |
| 5.25 | 52.49 | .00 | 52.49 | 46.80 | 5.69 | 1 |
| 4.50 | 104.99 | .00 | 104.99 | 93.60 | 11.39 | 1 |
| 3.75 | 157.48 | .00 | 157.48 | 140.40 | 17.08 | 1 |
| 3.00 | 209.98 | .00 | 209.98 | 187.20 | 22.78 | 1 |
| 2.25 | 262.47 | .00 | 262.47 | 234.00 | 28.47 | 1 |
| 1.50 | 314.97 | .00 | 314.97 | 280.80 | 34.17 | 1 |
| .75 | 367.46 | .00 | 367.46 | 327.60 | 39.86 | 1 |
| .00 | 419.95 | .00 | 419.95 | 374.40 | 45.55 | 1 |

TIME = .00 DEGREE OF CONSOLIDATION = .0000
 SETTLEMENT = .00 FINAL SETTLEMENT = 2.55
 BOTTOM BOUNDARY GRADIENT = .00

Figure 3. (Sheet 7 of 15)

*****CURRENT CONDITIONS IN COMPRESSIBLE FOUNDATION*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|------|-------------------------|------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 9.99 | 9.98 | 3.02 | 2.52 | 2.50 | 2.44 | 3 |
| 8.24 | 8.24 | 2.52 | 2.43 | 2.42 | 2.38 | 3 |
| 6.53 | 6.53 | 2.02 | 2.36 | 2.36 | 2.31 | 3 |
| 4.85 | 4.85 | 1.51 | 2.29 | 2.29 | 2.24 | 3 |
| 3.21 | 3.21 | 1.01 | 2.23 | 2.24 | 2.19 | 3 |
| 1.59 | 1.59 | .50 | 2.18 | 2.18 | 2.14 | 3 |
| .00 | .00 | .00 | 2.13 | 2.13 | 2.09 | 3 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|---------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 9.98 | 327.67 | 14.64 | 313.03 | 282.12 | 30.92 | 3 |
| 8.24 | 494.01 | 61.72 | 432.29 | 390.90 | 41.39 | 3 |
| 6.53 | 658.20 | 118.41 | 539.79 | 497.55 | 42.24 | 3 |
| 4.85 | 820.32 | 171.98 | 648.34 | 602.12 | 46.22 | 3 |
| 3.21 | 980.50 | 228.67 | 751.82 | 704.75 | 47.07 | 3 |
| 1.59 | 1138.94 | 289.23 | 849.71 | 805.65 | 44.06 | 3 |
| .00 | 1295.80 | 345.28 | 950.52 | 904.96 | 45.55 | 3 |

TIME = 90.00 DEGREE OF CONSOLIDATION = .0607
 SETTLEMENT = .01 FINAL SETTLEMENT = .15
 BOTTOM BOUNDARY GRADIENT = .06

Figure 3. (Sheet 8 of 15)

*****CURRENT CONDITIONS IN DREDGED FILL*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|-----|-------------------------|-------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 6.00 | 4.52 | .46 | 12.15 | 12.15 | 12.15 | 1 |
| 5.25 | 3.85 | .40 | 12.15 | 10.15 | 8.09 | 1 |
| 4.50 | 3.21 | .34 | 12.15 | 9.96 | 7.00 | 1 |
| 3.75 | 2.60 | .29 | 12.15 | 9.49 | 6.33 | 1 |
| 3.00 | 2.02 | .23 | 12.15 | 9.00 | 5.96 | 1 |
| 2.25 | 1.46 | .17 | 12.15 | 8.47 | 5.75 | 1 |
| 1.50 | .94 | .11 | 12.15 | 7.87 | 5.63 | 1 |
| .75 | .45 | .06 | 12.15 | 7.23 | 5.51 | 1 |
| .00 | .00 | .00 | 12.15 | 6.59 | 5.42 | 1 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|--------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 4.52 | .00 | .00 | .00 | .00 | .00 | 1 |
| 3.8 | 47.75 | .98 | 46.77 | 42.05 | 4.72 | 1 |
| 3.2 | 92.92 | 1.17 | 91.76 | 81.53 | 10.22 | 1 |
| 2.60 | 136.79 | 1.87 | 134.92 | 119.70 | 15.21 | 1 |
| 2.02 | 178.96 | 2.85 | 176.11 | 156.18 | 19.93 | 1 |
| 1.46 | 219.34 | 4.37 | 214.96 | 190.87 | 24.10 | 1 |
| .94 | 257.68 | 6.62 | 251.06 | 223.52 | 27.54 | 1 |
| .45 | 293.82 | 9.90 | 283.92 | 253.96 | 29.96 | 1 |
| .00 | 327.67 | 14.64 | 313.03 | 282.12 | 30.92 | 1 |

TIME = 90.00 DEGREE OF CONSOLIDATION = .5801
 SETTLEMENT = 1.48 FINAL SETTLEMENT = 2.55
 SETTLEMENT DUE TO CONSOLIDATION = 1.48
 SETTLEMENT DUE TO DESICCATION = .00
 BOTTOM BOUNDARY GRADIENT = -3.19
 SURFACE ELEVATION = 114.51

Figure 3. (Sheet 9 of 15)

*****CURRENT CONDITIONS IN COMPRESSIBLE FOUNDATION*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|------|-------------------------|------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 9.99 | 9.97 | 3.02 | 2.52 | 2.48 | 2.44 | 3 |
| 8.24 | 8.23 | 2.52 | 2.43 | 2.42 | 2.38 | 3 |
| 6.53 | 6.53 | 2.02 | 2.36 | 2.35 | 2.31 | 3 |
| 4.85 | 4.85 | 1.51 | 2.29 | 2.29 | 2.24 | 3 |
| 3.21 | 3.21 | 1.01 | 2.23 | 2.24 | 2.19 | 3 |
| 1.59 | 1.59 | .50 | 2.18 | 2.18 | 2.14 | 3 |
| .00 | .00 | .00 | 2.13 | 2.13 | 2.09 | 3 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|---------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 9.97 | 282.09 | 21.08 | 261.02 | 236.54 | 24.48 | 3 |
| 8.23 | 448.15 | 67.52 | 380.63 | 345.05 | 35.58 | 3 |
| 6.53 | 612.18 | 121.26 | 490.91 | 451.53 | 39.38 | 3 |
| 4.85 | 774.23 | 172.62 | 601.62 | 556.04 | 45.58 | 3 |
| 3.21 | 934.41 | 228.54 | 705.87 | 658.67 | 47.20 | 3 |
| 1.59 | 1092.86 | 289.47 | 803.39 | 759.56 | 43.82 | 3 |
| .00 | 1249.71 | 345.28 | 904.43 | 858.87 | 45.55 | 3 |

TIME = 180.00 DEGREE OF CONSOLIDATION = .1171
 SETTLEMENT = .02 FINAL SETTLEMENT = .15
 BOTTOM BOUNDARY GRADIENT = .06

Figure 3. (Sheet 10 of 15)

*****CURRENT CONDITIONS IN DREDGED FILL*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|-----|-------------------------|------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 6.00 | 3.79 | .46 | 12.15 | 6.70 | 12.15 | 1 |
| 5.25 | 3.34 | .40 | 12.15 | 7.58 | 8.09 | 1 |
| 4.50 | 2.81 | .34 | 12.15 | 8.50 | 7.00 | 1 |
| 3.75 | 2.28 | .29 | 12.15 | 8.05 | 6.33 | 1 |
| 3.00 | 1.78 | .23 | 12.15 | 7.63 | 5.96 | 1 |
| 2.25 | 1.30 | .17 | 12.15 | 7.21 | 5.75 | 1 |
| 1.50 | .84 | .11 | 12.15 | 6.78 | 5.63 | 1 |
| .75 | .41 | .06 | 12.15 | 6.36 | 5.51 | 1 |
| .00 | .00 | .00 | 12.15 | 6.05 | 5.42 | 1 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|--------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 3.79 | .00 | .00 | .00 | .00 | .00 | 1 |
| 3.34 | 34.03 | 5.69 | 28.33 | 28.33 | .00 | 1 |
| 2.81 | 72.52 | 4.28 | 68.25 | 61.14 | 7.11 | 1 |
| 2.28 | 111.21 | 5.86 | 105.36 | 94.13 | 11.23 | 1 |
| 1.78 | 148.36 | 7.75 | 140.61 | 125.58 | 15.03 | 1 |
| 1.30 | 184.01 | 10.06 | 173.95 | 155.54 | 18.41 | 1 |
| .84 | 218.17 | 13.07 | 205.10 | 184.00 | 21.10 | 1 |
| .41 | 250.80 | 16.75 | 234.04 | 210.94 | 23.11 | 1 |
| .00 | 282.09 | 21.08 | 261.02 | 236.54 | 24.48 | 1 |

TIME = 180.00 DEGREE OF CONSOLIDATION = .7700
 SETTLEMENT = 2.21 FINAL SETTLEMENT = 2.55
 SETTLEMENT DUE TO CONSOLIDATION = 1.96
 SETTLEMENT DUE TO DESICCATION = .25
 BOTTOM BOUNDARY GRADIENT = -4.49
 SURFACE ELEVATION = 113.77

Figure 3. (Sheet 11 of 15)

*****CURRENT CONDITIONS IN COMPRESSIBLE FOUNDATION*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | | |
|-------------------------|------|------|-------------------------|------|-----------------|---|--|
| A | XI | Z | EINITIAL | E | EFINAL MATERIAL | | |
| 9.99 | 9.96 | 3.02 | 2.52 | 2.47 | 3.03 | 3 | |
| 8.24 | 8.23 | 2.52 | 2.43 | 2.41 | 2.93 | 3 | |
| 6.53 | 6.53 | 2.02 | 2.36 | 2.35 | 2.82 | 3 | |
| 4.85 | 4.85 | 1.51 | 2.29 | 2.29 | 2.72 | 3 | |
| 3.21 | 3.21 | 1.01 | 2.23 | 2.23 | 2.62 | 3 | |
| 1.59 | 1.59 | .50 | 2.18 | 2.18 | 2.52 | 3 | |
| .00 | .00 | .00 | 2.13 | 2.13 | 2.43 | 3 | |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|---------|-----------|----------------------------|--------|-----------------|---|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS MATERIAL | |
| 9.96 | 233.28 | 31.09 | 202.19 | 173.01 | 29.18 | 3 |
| 8.23 | 398.93 | 75.18 | 323.75 | 281.12 | 42.63 | 3 |
| 6.53 | 562.75 | 125.39 | 437.36 | 387.39 | 49.97 | 3 |
| 4.85 | 724.70 | 174.40 | 550.30 | 491.79 | 58.51 | 3 |
| 3.21 | 884.84 | 229.34 | 655.50 | 594.38 | 61.12 | 3 |
| 1.59 | 1043.27 | 289.72 | 753.54 | 695.26 | 58.28 | 3 |
| .00 | 1200.12 | 345.28 | 854.83 | 794.57 | 60.27 | 3 |

TIME = 300.00 DEGREE OF CONSOLIDATION = .2025
 SETTLEMENT = .03 FINAL SETTLEMENT = .15
 BOTTOM BOUNDARY GRADIENT = .06

Figure 3. (Sheet 12 of 15)

*****CURRENT CONDITIONS IN DREDGED FILL*****

***** COORDINATES *****

***** VOID RATIOS *****

| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
|------|------|-----|----------|------|--------|----------|
| 6.00 | 3.04 | .46 | 12.15 | 3.10 | 3.10 | 1 |
| 5.25 | 2.77 | .40 | 12.15 | 4.57 | 5.91 | 1 |
| 4.50 | 2.40 | .34 | 12.15 | 6.02 | 5.72 | 1 |
| 3.75 | 2.00 | .29 | 12.15 | 6.16 | 5.60 | 1 |
| 3.00 | 1.59 | .23 | 12.15 | 6.20 | 5.48 | 1 |
| 2.25 | 1.18 | .17 | 12.15 | 6.12 | 5.40 | 1 |
| 1.50 | .78 | .11 | 12.15 | 5.98 | 5.32 | 1 |
| .75 | .39 | .06 | 12.15 | 5.83 | 5.23 | 1 |
| .00 | .00 | .00 | 12.15 | 5.70 | 5.17 | 1 |

***** STRESSES *****

***** PORE PRESSURES *****

| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
|------|--------|-----------|--------|--------|--------|----------|
| 3.04 | .00 | .00 | .00 | .00 | .00 | 1 |
| 2.77 | 20.41 | 20.41 | .00 | .00 | .00 | 1 |
| 2.40 | 49.07 | 21.53 | 27.55 | 22.97 | 4.57 | 1 |
| 2.00 | 80.00 | 19.38 | 60.62 | 48.20 | 12.42 | 1 |
| 1.59 | 111.28 | 18.73 | 92.55 | 73.79 | 18.76 | 1 |
| 1.18 | 142.47 | 19.98 | 122.49 | 99.29 | 23.20 | 1 |
| .78 | 173.25 | 22.42 | 150.83 | 124.37 | 26.46 | 1 |
| .39 | 203.52 | 26.38 | 177.14 | 148.95 | 28.19 | 1 |
| .00 | 233.28 | 31.09 | 202.19 | 173.01 | 29.18 | 1 |

TIME = 300.00 DEGREE OF CONSOLIDATION = .9537
 SETTLEMENT = 2.96 FINAL SETTLEMENT = 2.55
 SETTLEMENT DUE TO CONSOLIDATION = 2.43
 SETTLEMENT DUE TO DESICCATION = .53
 BOTTOM BOUNDARY GRADIENT = -6.61
 SURFACE ELEVATION = 113.01

Figure 3. (Sheet 13 of 15)

*****CURRENT CONDITIONS IN COMPRESSIBLE FOUNDATION*****

***** COORDINATES *****

***** VOID RATIOS *****

| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
|------|------|------|----------|------|--------|----------|
| 9.99 | 9.94 | 3.02 | 2.52 | 2.44 | 2.43 | 3 |
| 8.24 | 8.22 | 2.52 | 2.43 | 2.39 | 2.36 | 3 |
| 6.53 | 6.52 | 2.02 | 2.36 | 2.34 | 2.29 | 3 |
| 4.85 | 4.85 | 1.51 | 2.29 | 2.29 | 2.23 | 3 |
| 3.21 | 3.21 | 1.01 | 2.23 | 2.23 | 2.18 | 3 |
| 1.59 | 1.59 | .50 | 2.18 | 2.18 | 2.13 | 3 |
| .00 | .00 | .00 | 2.13 | 2.13 | 2.08 | 3 |

***** STRESSES *****

***** PORE PRESSURES *****

| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
|------|---------|-----------|--------|--------|--------|----------|
| 9.94 | 301.08 | 48.34 | 252.74 | 238.80 | 13.95 | 3 |
| 8.22 | 466.10 | 88.02 | 378.08 | 346.27 | 31.81 | 3 |
| 6.52 | 629.57 | 132.07 | 497.50 | 452.19 | 45.31 | 3 |
| 4.85 | 791.33 | 177.71 | 613.62 | 556.41 | 57.21 | 3 |
| 3.21 | 951.38 | 231.37 | 720.01 | 658.91 | 61.10 | 3 |
| 1.59 | 1109.78 | 290.45 | 819.33 | 759.76 | 59.57 | 3 |
| .00 | 1266.62 | 345.28 | 921.33 | 859.05 | 62.28 | 3 |

TIME = 450.00 DEGREE OF CONSOLIDATION = .2670

SETTLEMENT = .05 FINAL SETTLEMENT = .19

BOTTOM BOUNDARY GRADIENT = .09

Figure 3. (Sheet 14 of 15)

*****CURRENT CONDITIONS IN DREDGED FILL*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|-----|-------------------------|------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 7.50 | 3.83 | .57 | 8.30 | 6.70 | 8.30 | 2 |
| 6.75 | 3.38 | .51 | 8.30 | 6.87 | 7.73 | 2 |
| 6.00 | 2.95 | .46 | 12.15 | 5.70 | 7.00 | 1 |
| 5.25 | 2.64 | .40 | 12.15 | 4.57 | 6.33 | 1 |
| 4.50 | 2.27 | .34 | 12.15 | 5.96 | 5.96 | 1 |
| 3.75 | 1.88 | .29 | 12.15 | 5.82 | 5.75 | 1 |
| 3.00 | 1.49 | .23 | 12.15 | 5.71 | 5.63 | 1 |
| 2.25 | 1.11 | .17 | 12.15 | 5.62 | 5.51 | 1 |
| 1.50 | .74 | .11 | 12.15 | 5.54 | 5.42 | 1 |
| .75 | .37 | .06 | 12.15 | 5.46 | 5.34 | 1 |
| .00 | .00 | .00 | 12.15 | 5.38 | 5.25 | 1 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|--------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 3.83 | .00 | .00 | .00 | .00 | .00 | 2 |
| 3.38 | 33.84 | 5.69 | 28.15 | 28.15 | .00 | 2 |
| 2.95 | 65.82 | 11.39 | 54.43 | 54.43 | .00 | 1 |
| 2.64 | 91.18 | 17.08 | 74.09 | 74.09 | .00 | 1 |
| 2.27 | 119.87 | 22.78 | 97.09 | 97.09 | .00 | 1 |
| 1.88 | 150.08 | 26.59 | 123.49 | 121.61 | 1.88 | 1 |
| 1.49 | 179.86 | 30.23 | 149.63 | 145.70 | 3.94 | 1 |
| 1.11 | 209.29 | 34.57 | 174.71 | 169.43 | 5.29 | 1 |
| .74 | 238.39 | 38.51 | 199.88 | 192.84 | 7.04 | 1 |
| .37 | 267.20 | 43.13 | 224.07 | 215.96 | 8.12 | 1 |
| .00 | 295.74 | 48.34 | 247.40 | 238.80 | 8.61 | 1 |

TIME = 450.00 DEGREE OF CONSOLIDATION = .8723
 SETTLEMENT = 3.67 FINAL SETTLEMENT = 3.50
 SETTLEMENT DUE TO CONSOLIDATION = 3.05
 SETTLEMENT DUE TO DESICCATION = .62
 BOTTOM BOUNDARY GRADIENT = -10.55
 SURFACE ELEVATION = 113.78

*** A CUMULATIVE MASS ERROR OF 2.15% WAS DETECTED. ***

Figure 3. (Sheet 15 of 15)

```
100 'Example 2 - Restart of Example1' 2 1
101 2
102 1.20 300 11 1
102 600 0 650 1 1
103 700 0 710 1 1
```

Figure 4. Example 2: Input data file

*****CURRENT CONDITIONS IN COMPRESSIBLE FOUNDATION*****

***** COORDINATES *****

***** VOID RATIOS *****

| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
|------|------|------|----------|------|--------|----------|
| 9.99 | 9.92 | 3.02 | 2.52 | 2.41 | 2.93 | 3 |
| 8.24 | 8.20 | 2.52 | 2.43 | 2.38 | 2.83 | 3 |
| 6.53 | 6.51 | 2.02 | 2.36 | 2.33 | 2.73 | 3 |
| 4.85 | 4.85 | 1.51 | 2.29 | 2.28 | 2.62 | 3 |
| 3.21 | 3.21 | 1.01 | 2.23 | 2.23 | 2.52 | 3 |
| 1.59 | 1.59 | .50 | 2.18 | 2.18 | 2.43 | 3 |
| .00 | .00 | .00 | 2.13 | 2.13 | 2.36 | 3 |

***** STRESSES *****

***** PORE PRESSURES *****

| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
|------|---------|-----------|--------|--------|--------|----------|
| 9.92 | 310.00 | 72.27 | 237.74 | 195.14 | 42.60 | 3 |
| 8.20 | 474.37 | 101.47 | 372.89 | 301.96 | 70.94 | 3 |
| 6.51 | 637.44 | 139.89 | 497.56 | 407.48 | 90.07 | 3 |
| 4.85 | 798.98 | 182.14 | 616.85 | 511.48 | 105.37 | 3 |
| 3.21 | 958.91 | 234.48 | 724.43 | 613.86 | 110.58 | 3 |
| 1.59 | 1117.25 | 291.69 | 825.56 | 714.65 | 110.92 | 3 |
| .00 | 1274.07 | 345.28 | 928.79 | 813.92 | 114.86 | 3 |

TIME = 600.00 DEGREE OF CONSOLIDATION = .3921

SETTLEMENT = .07 FINAL SETTLEMENT = .19

BOTTOM BOUNDARY GRADIENT = .09

Figure 5. Example 2: Output (Sheet 1 of 4)

*****CURRENT CONDITIONS IN DREDGED FILL*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|-----|-------------------------|------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 9.00 | 3.88 | .68 | 8.30 | 3.10 | 3.10 | 2 |
| 8.25 | 3.63 | .63 | 8.30 | 3.10 | 3.10 | 2 |
| 7.50 | 3.41 | .57 | 8.30 | 3.10 | 3.10 | 2 |
| 6.75 | 3.13 | .51 | 8.30 | 4.81 | 4.81 | 2 |
| 6.00 | 2.77 | .46 | 12.15 | 5.27 | 5.11 | 1 |
| 5.25 | 2.45 | .40 | 12.15 | 4.57 | 5.04 | 1 |
| 4.50 | 2.11 | .34 | 12.15 | 5.22 | 4.98 | 1 |
| 3.75 | 1.76 | .29 | 12.15 | 5.21 | 4.94 | 1 |
| 3.00 | 1.40 | .23 | 12.15 | 5.20 | 4.90 | 1 |
| 2.25 | 1.05 | .17 | 12.15 | 5.18 | 4.85 | 1 |
| 1.50 | .70 | .11 | 12.15 | 5.15 | 4.81 | 1 |
| .75 | .35 | .06 | 12.15 | 5.11 | 4.76 | 1 |
| .00 | .00 | .00 | 12.15 | 5.07 | 4.73 | 1 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|--------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 3.88 | .00 | .00 | .00 | .00 | .00 | 2 |
| 3.63 | 18.06 | 18.06 | .00 | .00 | .00 | 2 |
| 3.41 | 36.12 | 36.12 | .00 | .00 | .00 | 2 |
| 3.13 | 58.81 | 58.81 | .00 | .00 | .00 | 2 |
| 2.77 | 86.73 | 55.33 | 31.40 | 22.22 | 9.17 | 1 |
| 2.45 | 112.42 | 70.20 | 42.22 | 42.22 | .00 | 1 |
| 2.11 | 139.39 | 59.71 | 79.68 | 63.49 | 16.19 | 1 |
| 1.76 | 167.20 | 60.54 | 106.66 | 85.61 | 21.05 | 1 |
| 1.40 | 194.96 | 61.74 | 133.22 | 107.68 | 25.54 | 1 |
| 1.05 | 222.67 | 63.47 | 159.21 | 129.70 | 29.51 | 1 |
| .70 | 250.30 | 65.79 | 184.50 | 151.63 | 32.88 | 1 |
| .35 | 277.82 | 68.74 | 209.07 | 173.45 | 35.62 | 1 |
| .00 | 305.20 | 72.27 | 232.93 | 195.14 | 37.79 | 1 |

TIME = 600.00 DEGREE OF CONSOLIDATION = .8791

SETTLEMENT = 5.12 FINAL SETTLEMENT = 4.44

SETTLEMENT DUE TO CONSOLIDATION = 3.91

SETTLEMENT DUE TO DESICCATION = 1.22

BOTTOM BOUNDARY GRADIENT = -24.24

SURFACE ELEVATION = 113.80

Figure 5. (Sheet 2 of 4)

*****CURRENT CONDITIONS IN COMPRESSIBLE FOUNDATION*****

| ***** COORDINATES ***** | | | ***** VOID RATIOS ***** | | | |
|-------------------------|------|------|-------------------------|------|--------|----------|
| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
| 9.99 | 9.90 | 3.02 | 2.52 | 2.39 | 2.93 | 3 |
| 8.24 | 8.19 | 2.52 | 2.43 | 2.36 | 2.83 | 3 |
| 6.53 | 6.51 | 2.02 | 2.36 | 2.32 | 2.73 | 3 |
| 4.85 | 4.84 | 1.51 | 2.29 | 2.28 | 2.62 | 3 |
| 3.21 | 3.21 | 1.01 | 2.23 | 2.23 | 2.52 | 3 |
| 1.59 | 1.59 | .50 | 2.18 | 2.18 | 2.43 | 3 |
| .00 | .00 | .00 | 2.13 | 2.13 | 2.36 | 3 |

| ***** STRESSES ***** | | | ***** PORE PRESSURES ***** | | | |
|----------------------|---------|-----------|----------------------------|--------|--------|----------|
| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
| 9.90 | 304.19 | 94.73 | 209.45 | 189.32 | 20.13 | 3 |
| 8.19 | 467.93 | 113.39 | 354.54 | 295.52 | 59.02 | 3 |
| 6.51 | 630.67 | 146.39 | 484.28 | 400.71 | 83.57 | 3 |
| 4.84 | 792.02 | 185.72 | 606.30 | 504.52 | 101.78 | 3 |
| 3.21 | 951.85 | 237.08 | 714.77 | 606.80 | 107.97 | 3 |
| 1.59 | 1110.14 | 292.78 | 817.36 | 707.54 | 109.82 | 3 |
| .00 | 1266.95 | 345.28 | 921.66 | 806.80 | 114.86 | 3 |

TIME = 700.00 DEGREE OF CONSOLIDATION = .5030
 SETTLEMENT = .09 FINAL SETTLEMENT = .19
 BOTTOM BOUNDARY GRADIENT = .14

Figure 5. (Sheet 3 of 4)

*****CURRENT CONDITIONS IN DREDGED FILL*****

***** COORDINATES *****

***** VOID RATIOS *****

| A | XI | Z | EINITIAL | E | EFINAL | MATERIAL |
|------|------|-----|----------|------|--------|----------|
| 9.00 | 3.79 | .68 | 8.30 | 3.10 | 3.10 | 2 |
| 8.25 | 3.54 | .63 | 8.30 | 3.10 | 3.10 | 2 |
| 7.50 | 3.32 | .57 | 8.30 | 3.10 | 3.10 | 2 |
| 6.75 | 3.03 | .51 | 8.30 | 4.81 | 4.81 | 2 |
| 6.00 | 2.69 | .46 | 12.15 | 5.11 | 5.11 | 1 |
| 5.25 | 2.36 | .40 | 12.15 | 4.57 | 5.04 | 1 |
| 4.50 | 2.03 | .34 | 12.15 | 4.98 | 4.98 | 1 |
| 3.75 | 1.69 | .29 | 12.15 | 4.97 | 4.94 | 1 |
| 3.00 | 1.35 | .23 | 12.15 | 4.96 | 4.90 | 1 |
| 2.25 | 1.01 | .17 | 12.15 | 4.94 | 4.85 | 1 |
| 1.50 | .67 | .11 | 12.15 | 4.92 | 4.81 | 1 |
| .75 | .34 | .06 | 12.15 | 4.90 | 4.76 | 1 |
| .00 | .00 | .00 | 12.15 | 4.88 | 4.73 | 1 |

***** STRESSES *****

***** PORE PRESSURES *****

| XI | TOTAL | EFFECTIVE | TOTAL | STATIC | EXCESS | MATERIAL |
|------|--------|-----------|--------|--------|--------|----------|
| 3.79 | .00 | .00 | .00 | .00 | .00 | 2 |
| 3.54 | 18.06 | 18.06 | .00 | .00 | .00 | 2 |
| 3.32 | 36.12 | 36.12 | .00 | .00 | .00 | 2 |
| 3.03 | 58.81 | 58.81 | .00 | .00 | .00 | 2 |
| 2.69 | 86.22 | 64.50 | 21.72 | 21.72 | .00 | 1 |
| 2.36 | 111.95 | 70.20 | 41.76 | 41.76 | .00 | 1 |
| 2.03 | 138.40 | 75.89 | 62.51 | 62.51 | .00 | 1 |
| 1.69 | 165.37 | 82.24 | 83.13 | 83.78 | -.65 | 1 |
| 1.35 | 192.30 | 83.92 | 108.38 | 105.01 | 3.36 | 1 |
| 1.01 | 219.17 | 85.91 | 133.26 | 126.20 | 7.06 | 1 |
| .67 | 245.99 | 88.34 | 157.64 | 147.32 | 10.33 | 1 |
| .34 | 272.73 | 91.28 | 181.45 | 168.36 | 13.08 | 1 |
| .00 | 299.38 | 94.73 | 204.65 | 189.32 | 15.32 | 1 |

TIME = 700.00 DEGREE OF CONSOLIDATION = .8989

SETTLEMENT = 5.21 FINAL SETTLEMENT = 4.44

SETTLEMENT DUE TO CONSOLIDATION = 3.99

SETTLEMENT DUE TO DESICCATION = 1.22

BOTTOM BOUNDARY GRADIENT = -35.73

SURFACE ELEVATION = 113.69

*** A CUMULATIVE MASS ERROR OF 4.51% WAS DETECTED. ***

Figure 5. (Sheet 4 of 4)

Appendix A: Summary and Explanation of INPCDDF Error Messages

The following is a complete listing of the run-time errors for the Interactive Data Input Program, INPCDDF, which accompanies PCDDF89. INPCDDF is coded in BASIC and was compiled using Borland's TurboBasic compiler version 1.1. (Note that the error messages are listed in numerical order; however, the error numbers are not sequential.)

| <u>Error Number</u> | <u>Description</u> |
|---------------------|---|
| 2 | Syntax error A run-time syntax error has been created by a READ statement trying to load string data into a numeric variable. |
| 3 | RETURN without GOSUB A RETURN was encountered without a matching GOSUB; that is, there is nothing to RETURN from. |
| 4 | Out of data A READ statement ran out of DATA statement values. |
| 5 | Illegal function call This is a catch-all error related to passing an inappropriate argument to some statement or function. |
| 6 | Overflow An overflow is the result of a calculation producing a value too large to be represented in the indicated numeric type. |
| 7 | Out of memory Many different situations can cause this message, including dimensioning too large an array or passing many arrays to a subprocedure or function. |
| 9 | Subscript out of range User attempted to use a subscript larger than the maximum value established when the array was dimensioned. |
| 10 | Duplicate definition User attempted to dynamically dimension an array for the second time, without first erasing it. |
| 11 | Division by zero User attempted to divide by zero or to raise zero to a negative power. |
| 13 | Type mismatch User entered a string value where a numeric value was expected or vice versa. This can occur in PRINT USING, DRAW, or PLAY statements. |
| 14 | Out of string space String storage space is exhausted; string memory is limited to 64K. |
| 15 | String too long The string produced by a string expression is longer than 32,767 bytes. |

- 19 **No RESUME**
Program execution ran to the physical end of the program while in an error-trapping routine. There may be a missing RESUME statement in an error handler.
- 20 **RESUME without error**
User executed a RESUME statement without an error occurring; that is, there is no error-handling subroutine to RESUME from.
- 24 **Device time-out**
The specified time-out value for a communication status line has expired.
- 25 **Device fault**
A hardware error has occurred; for example, with the printer interface or a communications adapter.
- 27 **Out of paper**
The printer interface indicates that the printer is out of paper.
- 50 **Field overflow**
Given the file's record length, user attempted to define too long a set of field variables in a FIELD statement.
- 51 **Internal error**
A malfunction occurred within the Turbo Basic run-time system. User should call Borland's Technical Support Group with information about the program.
- 52 **Bad file number**
The file number given in a file statement doesn't match one given in an OPEN statement or the file number may be out of the range of valid file numbers.
- 53 **File not found**
The file name specified could not be found on the indicated drive.
- 54 **Bad file mode**
User attempted a PUT or a GET (or PUT\$ or GET\$) on a sequential file.
- 55 **File already open**
User attempted to open a file that was already open or user tried to delete an open file.
- 57 **Device I/O error**
A serious hardware problem occurred when trying to carry out some command.
- 58 **File already exists**
The new name argument specified by the NAME command already exists.
- 61 **Disk full**
There isn't enough free space on the indicated or default disk to carry out a file operation.
- 62 **Input past end**
User tried to read more data from a file than the file contained.
- 63 **Bad record number**
A negative number or one larger than 16,777,215 was specified as the record argument to a random file PUT or GET statement.

- 64 **Bad file name**
The file name specified in a FILES, KILL, or NAME statement contains invalid characters.
- 67 **Too many files**
This error can be caused either by trying to create too many files in a drive's root directory or by an invalid file name that affects the performance of DOS's Create File system call.
- 68 **Device unavailable**
User tried to OPEN a device file on a machine without that device; for example, COM1 on a system without a serial adapter or modem.
- 69 **Communications buffer overflow**
User executed a statement to INPUT characters into an already full communications buffer. The program should either check and empty the buffer more often or provide a larger buffer size.
- 70 **Permission denied**
User tried to write to a write-protected disk.
- 71 **Disk not ready**
The door of a floppy disk drive is open or there is no disk in the indicated drive.
- 72 **Disk media error**
The controller board of a floppy or hard disk indicates a hard media error in one or more sectors.
- 74 **Rename across disks**
User cannot rename a file across disks.
- 75 **Path/File access error**
During a command capable of specifying a path name (OPEN, RENAME, MKDIR, for example), user used a path inappropriately; for example, trying to OPEN a subdirectory or to delete an in-use directory.
- 76 **Path not found**
User specified a path during CHDIR, MKDIR, OPEN, etc., which cannot be found.
- 201 **Out of stack space**
User has run out of stack space.
- 202 **Out of string temp space**
A string expression required the use of too many temporary string buffers.
- 203 **Mismatched common variables**
User attempted to CHAIN between two program segments that did not contain matching COMMON statements.
- 204 **Mismatched program options**
User attempted to CHAIN between two program segments that were compiled with different program options (different math library, math coprocessor required, and so forth).

- 205 **Mismatched program revisions**
User attempted to CHAIN between two program segments that were created with different versions of the Turbo Basic compiler.
- 206 **Invalid program file**
User attempted to CHAIN or RUN a program segment that was not compiled with Turbo Basic.
- 242 **String/array memory corrupt**
The string memory area has been improperly overwritten. This could be caused by the improper action of an assembler subroutine, string array access outside of the dimensioned limits, or by an error within the Turbo Basic run-time system.
- 243 **CHAIN/RUN from .EXE file only**
User attempted to CHAIN or RUN a program segment from within the Turbo Basic environment.

APPENDIX B: INPCDDF INTERACTIVE INPUT SCREENS

The following is a complete listing of the interactive data input screens in INPCDDF.

```
PCDDF89 INTERACTIVE DATA PROGRAM

By: Dr. Timothy D. Stark & Dr. Arsalan Ghahramani
    Department of Civil Engineering
    San Diego State University
    Version 1.0

Enter Letter for Desired Option:

N = To create a new data file
E = To edit an existing data file
C = To convert an old PCDDF data file to PCDDF89 format
R = To create or edit a Restart data file
```

Figure B1. Initial INPCDDF menu

NEW PCDDF89 DATA FILE

Name of Data File (e.g. C:PCDDF89.DAT) **T_D_Stark**

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Continue

Figure B2. Input screen for name of new PCDDF89 data file

MAIN INPCDDF MENU

ENTER INTEGER FOR DESIRED OPTION 1

- 1 = Create a New Data File or Edit Current Data File
- 2 = Program Execution Data
- 3 = Compressible Foundation Material Properties
- 4 = Material Properties of First Dredged Fill Layer
- 5 = Incompressible Foundation Material Properties
- 6 = Execution Time Increment and Grid Size
- 7 = Print Times and New Dredged Fill Material Properties
- 8 = Desiccation Properties of Dredged Fill
- 9 = Evaporation and Precipitation Data
- 10 = Final Dredged Fill Desiccation Parameters
- 11 = Save Data File and Remain in INPCDDF
- 12 = Save Data File and Exit to DOS
- 13 = Exit to DOS
- 14 = Restart Interactive Data Program
- 15 = Shell to DOS (Return by typing 'Exit' and Enter)

THE CURRENT DATAFILE BEING EDITED IS : T_D_Stark

Figure B3. Main INPCDDF menu

EXISTING PCDDF OR PCDDF89 DATA FILE

Name of Data File (e.g. C:PCDDF89.DAT) **D:OLDPCDDF.DAT**

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Continue

Figure B4. Input screen for name of existing PCDDF89 data file

NEW PCDDF89 DATA FILE

Name of Data File (e.g. C:PCDDF89.DAT) **D:NEWPCDDF.DAT**

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Continue

Figure B5. Input screen for name of new PCDDF89 data file

PCDDF89 PROBLEM INFORMATION

A.) Enter Integer for Desired Option

- 1 = New Problem
- 2 = Restart Old Problem

B.) Enter Integer for Desired Option

- 1 = Do Not Save Output in Continuation
File for Restart
- 2 = Save Output in Continuation
File for Restart

C.) Enter Problem Description ==>

(1)

PCDDF89 EXECUTION DATA

A.) Enter Integer for Desired Option

- 1 = complete execution and printing of soil data, initial conditions, and current condition for specified print times
- 2 = complete execution and printing of only current conditions for specified print times
- 3 = terminate execution after printing soil data and initial conditions

B.) Foundation Layer is, Compressible = 1, Incompressible = 2

(2)

Figure B6. Input screens for program execution data

NUMBER OF COMPRESSIBLE FOUNDATION LAYERS

Number of Compressible Foundation Layers

(1)

No. OF COMPRESSIBLE FOUNDATION LAYERS = 1, MATERIAL ID. OF LAYER No. 1

Material Identification Number of Compressible Foundation Layer

(2)

2 BASE LAYERS, THICKNESS OF LAYER NO. 2

Initial Thickness of Compressible Foundation

(3)

Figure B7. Input screens 1 through 3 for compressible foundation layers

MATERIAL PROPERTIES OF COMPRESSIBLE FOUNDATION LAYER NO. 1, MATERIAL ID. 0

Specific Gravity of Compressible Foundation Layer

Initial Thickness of Compressible Foundation layer

No. of Data Points used to define Void Ratio,
Permeability and Effective Stress Relationships

(4)

SOURCE OF INPUT DATA FOR MATERIAL ID. 0

Enter Integer for Desired Option

- 0 = Input data interactively or display current material properties
- 1 = Load data from existing datafile only
- 2 = Load data from existing datafile and edit data

(4A)

PROPERTIES OF MATERIAL ID. 0

| | Void Ratio | Effective Stress | Permeability | | Void Ratio | Effective Stress | Permeability |
|----|----------------------|------------------|--------------|----|------------|------------------|--------------|
| 1 | <input type="text"/> | | | 16 | | | |
| 2 | | | | 17 | | | |
| 3 | | | | 18 | | | |
| 4 | | | | 19 | | | |
| 5 | | | | 20 | | | |
| 6 | | | | 21 | | | |
| 7 | | | | 22 | | | |
| 8 | | | | 23 | | | |
| 9 | | | | 24 | | | |
| 10 | | | | 25 | | | |
| 11 | | | | 26 | | | |
| 12 | | | | 27 | | | |
| 13 | | | | 28 | | | |
| 14 | | | | 29 | | | |
| 15 | | | | 30 | | | |

(5)

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
 Press F1 to Save Current Edit and Advance to Next Menu
 Press F2 to Save Current Edit and Return to Main Menu
 Press F3 to Undo Edit on Current Screen

Figure B8. Input screens 4 through 5 for compressible foundation layers

EXISTING DATA FILE FOR DREDGED FILL MATERIAL ID. 0

Name of Existing Data File (e.g. C:PCDDF89.DAT)

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Save Current Edit and Advance to Next Menu
Press F2 to Save Current Edit and Return to Main Menu
Press F3 to Undo Edit on Current Screen

Figure B9. Input screens for name of data file containing the compressible foundation material properties

MATERIAL PROPERTIES OF FIRST DREDGED FILL LAYER

Specific Gravity of Dredged Fill █

Initial Thickness of Dredged Fill

Initial Void Ratio of Dredged Fill

Unit Weight of Water

No. of data points used to define Soil Relationships

Material Identification No. of First Dredged Fill Layer

(1)

SOURCE OF INPUT DATA FOR DREDGED FILL MATERIAL ID. θ

Enter Integer for Desired Option █

θ = Input data interactively or display current material properties
 1 = Load data from existing datafile only
 2 = Load data from existing datafile and edit data

(1A)

SOIL PROPERTIES OF DREDGED FILL MATERIAL ID. θ

| | Void Ratio | Effective Stress | Permeability | | Void Ratio | Effective Stress | Permeability |
|----|------------|------------------|--------------|----|------------|------------------|--------------|
| 1 | █ | | | 16 | | | |
| 2 | | | | 17 | | | |
| 3 | | | | 18 | | | |
| 4 | | | | 19 | | | |
| 5 | | | | 20 | | | |
| 6 | | | | 21 | | | |
| 7 | | | | 22 | | | |
| 8 | | | | 23 | | | |
| 9 | | | | 24 | | | |
| 10 | | | | 25 | | | |
| 11 | | | | 26 | | | |
| 12 | | | | 27 | | | |
| 13 | | | | 28 | | | |
| 14 | | | | 29 | | | |
| 15 | | | | 30 | | | |

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
 Press F1 to Save Current Edit and Advance to Next Menu
 Press F2 to Save Current Edit and Return to Main Menu
 Press F3 to Undo Edit on Current Screen

(2)

Figure B10. Input screens for first dredged fill layer

MATERIAL PROPERTIES OF INCOMPRESSIBLE FOUNDATION LAYER

Material Properties at the top of the Incompressible Foundation

Void ratio

Permeability

Length of Drainage Path in Incompressible Foundation

Elevation at Top of Incompressible Foundation

Elevation of Water Table in Foundation

Figure B11. Input screen for incompressible foundation layer

EXECUTION TIME INCREMENT AND GRID SIZE

Enter Integer for Desired Option █

1 = Program will determine stable time increment and grid size
2 = User will input time increment and grid size (see User's Manual for Guidelines)

(1)

TOTAL NUMBER OF PRINT TIMES IN SIMULATION

Total number of print times in simulation █

(2)

EXECUTION TIME INCREMENT AND GRID SIZE

Time Step Used in Finite Difference Calculation ██████████

No. of Parts First Dredged Fill Layer is divided into

No. of Parts First Compressible Foundation Layer is divided into

Total no. of print times in simulation

(See Data Input Group 6 in User's Guide for Assistance)

(3)

Figure B12. Input screens for execution time increment and grid size

DREDGED FILL DATA AT PRINT TIME NO. 0 OF 0

Time Periods (days) after addition of First Dredged Fill Layer ██████████

Initial Thickness of New Dredged Fill (if greater than zero properties of Dredged Fill will be required)

Mo. of Time Periods after addition of First Dredged Fill Layer at which Desiccation starts in the New Dredged Fill Layer

Month Mo. at which Desiccation starts in New Fill (January = 1)

Enter Integer for Desired Print Option

1 - Print current void ratio, effective stress and pore pressure profiles
 2 - Print only current void ratio profile
 3 - Do not print any current profile

Use Cursor Keys to Move Through Menu. Use Backspace Key to Edit Data
 Press F1 to Save Current Edit and Advance to Next Menu
 Press F2 to Save Current Edit and Return to Main Menu
 Press F3 to Undo Edit on Current Screen

(1)

IDENTIFICATION No. OF NEW DREDGED FILL LAYER No. 2

Material Identification Number of New Dredged Fill Layer ██████████

(2)

INITIAL VOID RATIO OF DREDGED FILL NO. 2

Initial Void Ratio of Dredged Fill ██████████

(3)

Figure B13. Input screens 1 through 3 for print times and new dredged fill data

SOIL PROPERTIES OF DREDGED FILL LAYER No. 2

Specific Gravity of Dredged Fill █

Initial Void Ratio of Dredged Fill

No. of Data Points used to define Void Ratio, Permeability,
and Effective Stress Relationships

(4)

SOURCE OF INPUT DATA FOR MATERIAL ID. 1

Enter Integer for Desired Option █

0 = Input data interactively or display current material properties
1 = Load data from existing datafile only
2 = Load data from existing datafile and edit data

(4A)

PROPERTIES OF MATERIAL ID. 1

| | Void Ratio | Effective Stress | Permeability | | Void Ratio | Effective Stress | Permeability |
|----|------------|------------------|--------------|----|------------|------------------|--------------|
| 1 | █ | | | 16 | | | |
| 2 | | | | 17 | | | |
| 3 | | | | 18 | | | |
| 4 | | | | 19 | | | |
| 5 | | | | 20 | | | |
| 6 | | | | 21 | | | |
| 7 | | | | 22 | | | |
| 8 | | | | 23 | | | |
| 9 | | | | 24 | | | |
| 10 | | | | 25 | | | |
| 11 | | | | 26 | | | |
| 12 | | | | 27 | | | |
| 13 | | | | 28 | | | |
| 14 | | | | 29 | | | |
| 15 | | | | 30 | | | |

(5)

Use Cursor Keys to Move Through Menu. Use Backspace Key to Edit Data
Press F1 to Save Current Edit and Advance to Next Menu
Press F2 to Save Current Edit and Return to Main Menu
Press F3 to Undo Edit on Current Screen

Figure B14. Input screens 4 through 5 for print times and new dredged fill data

DREDGED FILL DESICCATION DATA

Desiccation Limit ██████████

Shrinkage Limit

No. of Time Periods (days) per month

Surface Drainage Efficiency (well drained = 1)

No. of Time Periods (days) to start of Desiccation
in First Dredged Fill Layer

Month No. at which Desiccation starts for this print time (Jan.=1)

Enter Integer for Desired Print Option

- 1 = Print current void ratio, effective stress and
pore pressure profiles
- 2 = Print only current void ratio profile
- 3 = Do not print any current profile

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Save Current Edit and Advance to Next Menu
Press F2 to Save Current Edit and Return to Main Menu
Press F3 to Undo Edit on Current Screen

Figure B15. Input screen for dredged fill desiccation data

PRECIPITATION AND RAINFALL SOURCE OF DATA

Enter Integer for Desired Option █

0 = Input data interactively or display current material properties
 1 = Load data from existing datafile only
 2 = Load data from existing datafile and edit data

(1)

EXISTING PRECIPITATION AND RAINFALL DATA FILE

Name of Existing Data File (e.g. C:\PCDD\F89.DAT) ██████████

(1A)

ANNUAL EVAPORATION AND PRECIPITATION DATA

| | Class A Pan Evaporation Potential during | Rainfall Expected during |
|-----------|---|-----------------------------|
| January | ██████████ | |
| February | | |
| March | | |
| April | | |
| May | | |
| June | | |
| July | | |
| August | | |
| September | | |
| October | | |
| November | | |
| December | | |

(2)

Figure B16. Input screens for evaporation and precipitation data

FINAL DREDGED FILL DESICCATION PARAMETERS

Maximum Dredged Fill Evaporation Efficiency for Desiccation

Degree of Saturation (decimals) of Dredged Fill at Desiccation Limit

Maximum Depth to which Second-Stage Drying will occur

Figure B17. Input screen for final dredged fill desiccation parameters

INPCDDF RESTART OPTION

Enter Letter for Desired Option:

M = To create a new RESTART data file
E = To edit an existing RESTART data file

Figure B18. Initial INPCDDF restart menu

NEW RESTART DATA FILE

Name of Data File (e.g. C:PCDDF89.DAT) T_D_Stark

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Continue

Figure B19. Input screen for name of new PCDDF89 restart data file

PREVIOUSLY SAVED CONTINUATION FILE FOR RESTART

Name of Data File (e.g. C:PCDDF89.DAT) D:EX1CONT.OUT

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Continue

Figure B20. Input screen for name of previously saved continuation file

```
MAIN INPCDDF RESTART MENU

ENTER INTEGER FOR DESIRED OPTION                                1

1 = Create New Restart Data File or Edit Current Data File
2 = Program Execution Data
3 = Print Times and Dredged Fill Data from Last Simulation
4 = Print Times and New Dredged Fill Layer Data
5 = Save Data File and Remain in INPCDDF
6 = Save Data File and Exit to DOS
7 = Exit to DOS
8 = Restart Interactive Data Program
9 = Shell to DOS (Return by typing 'Exit' and Enter)

THE CURRENT DATAFILE BEING EDITED IS : T_D_Stark
```

Figure B21. Main INPCDDF restart menu

```
EXISTING RESTART DATA FILE

Name of Data File (e.g. C:\PCDDF89.DAT) D:\EXAMPLE2.DAT

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Continue
```

Figure B22. Input screen for name of existing PCDDF89 restart data file

PREVIOUSLY SAVED CONTINUATION FILE FOR RESTART

Name of Data File (e.g. C:PCDDF89.DAT)

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Continue

Figure B23. Input screen for name of previously saved continuation file

NEW RESTART DATA FILE

Name of Data File (e.g. C:PCDDF89.DAT)

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Continue

Figure B24. Input screen for name of new PCDDF89 data file

PCDDF89 PROBLEM INFORMATION

A.) Enter Integer for Desired Option
1 = New Problem
2 = Restart Old Problem

B.) Enter Integer for Desired Option
1 = Do Not Save Output in Continuation
File for Restart
2 = Save Output in Continuation
File for Restart

C.) Enter Problem Description ==>

NEW RESTART PRINT TIMES

Number of Restart Print Times

Number of Print Times Detected in Continuation File

4

(Total Number of Print Times for Initial Execution and
Restart is the sum of the above)

Figure B25. Restart input screens for program execution data

DREDGED FILL DATA FROM LAST LAYER OF PREVIOUS SIMULATION

Initial Thickness of Last Dredged Fill Layer Placed

No. of Time periods after addition of First
Dredged Fill Layer at which Desiccation started

Month Number at which Desiccation started (January = 1)

Integer for Desired Print Option

- 1 = Print current void ratio, effective stress and pore pressure profiles
- 2 = Print only current void ratio profile
- 3 = Do not print any current profile

Figure B26. Restart input screen for dredged fill data from previous simulation

DREDGED FILL DATA AT PRINT TIME NO. 5 OF 6

Time Periods (days) after addition of First Dredged Fill Layer

Initial Thickness of New Dredged Fill (if greater than zero properties of Dredged Fill will be required)

No. of Time Periods after addition of First Dredged Fill Layer at which Desiccation starts in the New Dredged Fill Layer

Month No. at which Desiccation starts in New Fill (January = 1)

Enter Integer for Desired Print Option

1 = Print current void ratio, effective stress and pore pressure profiles
 2 = Print only current void ratio profile
 3 = Do not print any current profile

Use Cursor Keys to Move Through Menu. Use Backspace Key to Edit Data
 Press F1 to Save Current Edit and Advance to Next Menu
 Press F2 to Save Current Edit and Return to Main Menu
 Press F3 to Undo Edit on Current Screen

(1)

IDENTIFICATION No. OF NEW DREDGED FILL LAYER No. 2

Material Identification Number of New Dredged Fill Layer

(2)

INITIAL VOID RATIO OF DREDGED FILL NO. 2

Initial Void Ratio of Dredged Fill

(3)

Figure B27. Restart input screens 1 through 3 for print times and new dredged fill layer data

SOIL PROPERTIES OF DREDGED FILL LAYER No. 2

Specific Gravity of Dredged Fill █

Initial Void Ratio of Dredged Fill

No. of Data Points used to define Void Ratio, Permeability,
and Effective Stress Relationships

(4)

SOURCE OF INPUT DATA FOR MATERIAL ID. 0

Enter Integer for Desired Option █

0 = Input data interactively or display current material properties
1 = Load data from existing datafile only
2 = Load data from existing datafile and edit data

(4A)

PROPERTIES OF MATERIAL ID. 0

| | Void Ratio | Effective Stress | Permeability | | Void Ratio | Effective Stress | Permeability |
|----|------------|------------------|--------------|----|------------|------------------|--------------|
| 1 | █ | | | 16 | | | |
| 2 | | | | 17 | | | |
| 3 | | | | 18 | | | |
| 4 | | | | 19 | | | |
| 5 | | | | 20 | | | |
| 6 | | | | 21 | | | |
| 7 | | | | 22 | | | |
| 8 | | | | 23 | | | |
| 9 | | | | 24 | | | |
| 10 | | | | 25 | | | |
| 11 | | | | 26 | | | |
| 12 | | | | 27 | | | |
| 13 | | | | 28 | | | |
| 14 | | | | 29 | | | |
| 15 | | | | 30 | | | |

Use Cursor Keys to Move Through Menu. Use Backspace Key to Edit Data
Press F1 to Save Current Edit and Advance to Next Menu
Press F2 to Save Current Edit and Return to Main Menu
Press F3 to Undo Edit on Current Screen

(5)

Figure B28. Restart input screens 4 through 5 for print times and new dredged fill layer data

EXISTING DATA FILE FOR MATERIAL ID. 0

Name of Existing Data File (e.g. C:PCDDF89.DAT)

Use Cursor Keys to Move Through Menu, Use Backspace Key to Edit Data
Press F1 to Save Current Edit and Advance to Next Menu
Press F2 to Save Current Edit and Return to Main Menu
Press F3 to Undo Edit on Current Screen

Figure B29. Input screen for name of data file containing dredged fill material properties