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AUTOMATION OF A MODEL FOR PREDICTING SOIL MOISTURE AND SOIL STRENGTH (SMSP MODEL)

Margaret H. Smith, et al

Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

January 1973

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by

M. H. Smith, M. P. Meyer

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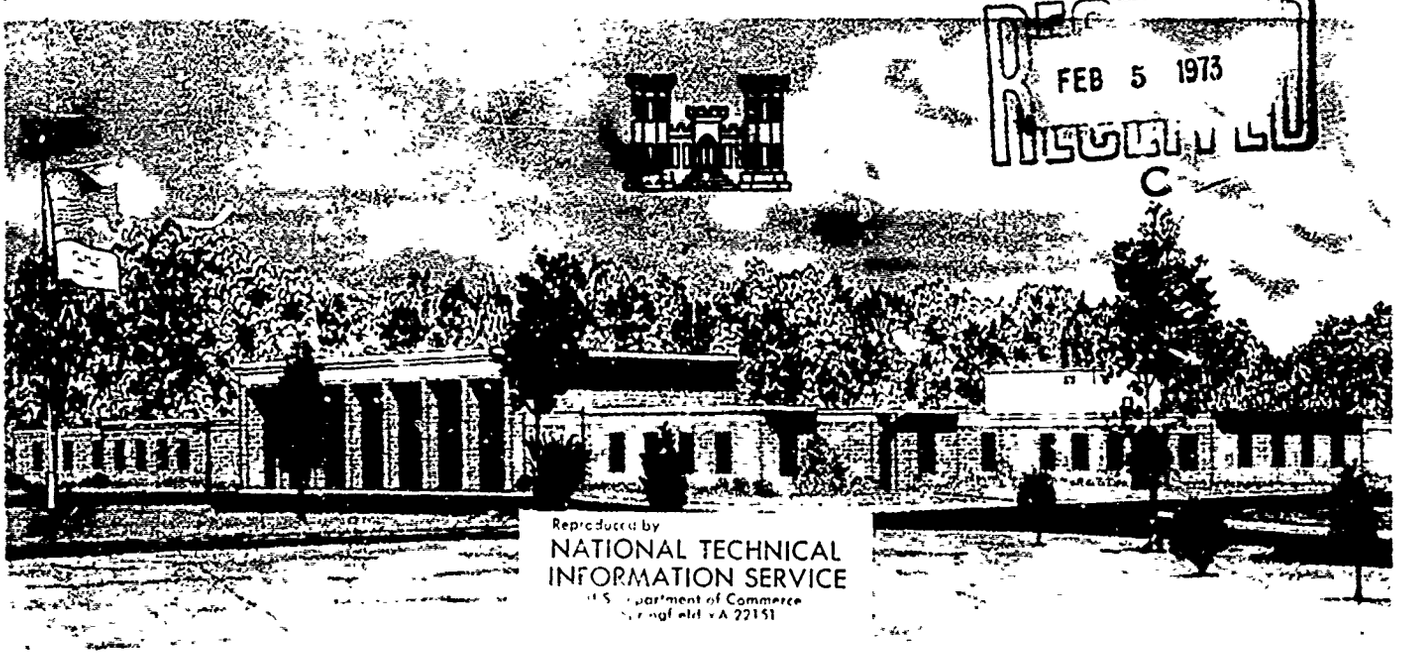

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13. ABSTRACT The soil moisture strength prediction (SMSP) model is a composite of the methods developed at the U. S. Army Engineer Waterways Experiment Station for predicting daily soil moisture contents and strengths (in terms of cone index and rating cone index) of soil layers at depths of 0-15 and 15-30 cm. Information required by the model includes soil moisture accretion and depletion relations, field maximum and minimum soil moisture contents, moisture content at start of prediction, soil dry density, soil moisture-strength relation, daily rainfall amounts, and minimum rainfall amount required for accretion. This information can be obtained from one or more of three sources: (a) directly from measurements at a specific location; (b) indirectly from estimated or averaged data derived from field measurements, literature, or empirical equations built into the model; or (c) indirectly from a surface composition group classification that closely follows the Unified Soil Classification System. The computer program for the model is written in Fortran IV conversational mode for use on a teletype connected to a Honeywell-GE (General Electric) 440 computer. Output data are stored in permanent files for use by other performance prediction models, for printing, or for input to plotting programs. The main text of the report includes a discussion of the structure, operation, use, limitations, and mathematics of the model. Appendixes A-G include detailed flow charts and listings of the computer program; listings, organization, and format of input data; examples of prediction runs and graphic displays of results; and procedures for converting output data to terms required by the airfield construction effort model.

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FOREWORD

The study reported herein was conducted in support of DA Project 4A663712D860, "Military Geographic Systems," Task 04, "MGI Data Base," Work Unit 04, "Automation of Performance Prediction Models," sponsored by the U. S. Army Engineer Topographic Laboratories. The work was performed by personnel of the Terrain Analysis Branch (TAB), Mobility and Environmental Systems Laboratory (MESL), U. S. Army Engineer Waterways Experiment Station (WES), under the general supervision of Messrs. W. G. Shockley, Chief, and S. J. Knight, formerly Assistant Chief, of the MESL, and under the direct supervision of Mr. W. E. Grabau, Chief, TAB; Mr. M. P. Meyer was Project Manager. Computer programs were developed by Miss M. H. Smith; Mr. C. A. Carlson assisted in developing the model. This report was prepared by Miss Smith and Mr. Meyer. Mr. A. Vazquez and Mrs. M. P. Terry assisted in computer programming and compiling information.

COL Ernest D. Peixotto, CE, was Director of the WES during this study and preparation of the report. Mr. F. R. Brown was Technical Director.

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AUTOMATION OF A MODEL FOR PREDICTING SOIL MOISTURE AND SOIL STRENGTH (SMSP MODEL)

PART I: INTRODUCTION

Background

1. The study reported herein is a part of the work to automate performance prediction models of immediate military interest for inclusion in an automated Military Geographic Intelligence data base system. Completed performance prediction models include the Airfield Construction Effort Model[1] in FY 70, the Cross-Country Locomotion Model[2] in FY 71, and the Helicopter Landing Zone Model[3] in FY 72. This report describes an automated model for predicting soil moisture and soil strength (SMSP model).

2. Methods for predicting soil moisture and strength (defined in terms of cone index (CI) and rating cone index (RCI)[4] were developed previously at the U. S. Army Engineer Waterways Experiment Station (WES) for use in predicting the trafficability of fine-grained soils in multipass cross-country vehicular operations.[4,5] For that application, strength predictions were required for the 15- to 30-cm layer, the critical layer influencing performance of many military vehicles. Moisture contents of the 0- to 15- and 15- to 30-cm layers were also provided for use in the prediction process. In a subsequent study of worldwide strength conditions of surface materials,[6] soil strength relations were extrapolated to the 0- to 15-cm layer. These relations have been incorporated in the present model. An earlier version of the model was used to predict long-term trafficability conditions in the vicinity of Saigon, South Vietnam,[7] to provide data for construction of soil moisture and strength records in synthalogous environments,[8] to provide RCI data for use in an analytical

procedure for quantitatively comparing the similarity of terrain sites,[9] and to provide moisture content data input to a model that predicts induced radiation activity of surface soils following nuclear detonations.[10,11]

3. The model presented herein has been used to predict moisture contents for the Seismic Sensor Performance Prediction Model,[12] and strength values for input to the Cross-Country Locomotion Model[2] and the Army Materiel Command (AMC) Model for Predicting Cross-Country Vehicle Performance.[13,14] It can also be used to provide data that can be converted to California Bearing Ratio (CBR) and soil moisture condition for use by the Airfield Construction Effort Model[1] (see Appendix G). The model also includes an option to store data for use in another model that predicts snow depth, snow density, and frost and thaw penetration[15] (herein referred to as the Freeze-Thaw model).*

Description of the Model

4. The SMSP model is a composite of soil moisture and soil strength prediction methods.[4] The prediction method for soil moisture is a daily bookkeeping procedure wherein soil water is added as a result of precipitation or subtracted as a result of depletion (resulting from evaporation, transpiration, and drainage). Predictions are influenced by terrain and weather conditions.[4c,-d,-e,-h;5] Soil strength values are predicted from daily soil moisture predictions by using known relations or relations that are determined by certain soil properties.[4j,5] The model combines

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*The program for this model is on file at the WES.

SUMMARY

The soil moisture strength prediction (SMSP) model is a composite of the methods developed at the U. S. Army Engineer Waterways Experiment Station for predicting daily soil moisture contents and strengths (in terms of cone index and rating cone index) of soil layers at depths of 0-15 and 15-30 cm. Information required by the model includes soil moisture accretion and depletion relations, field maximum and minimum soil moisture contents, moisture content at start of prediction, soil dry density, soil moisture-strength relation, daily rainfall amounts, and minimum rainfall amount required for accretion. This information can be obtained from one or more of three sources: (a) directly from measurements at a specific location; (b) indirectly from estimated or averaged data derived from field measurements, literature, or empirical equations built into the model; or (c) indirectly from a surface composition group classification that closely follows the Unified Soil Classification System.

The computer program for the model is written in Fortran IV conversational mode for use on a teletype connected to a Honeywell-GE (General Electric) 440 computer. Output data are stored in permanent files for use by other performance prediction models, for printing, or for input to plotting programs.

The main text of the report includes a discussion of the structure, operation, use, limitations, and mathematics of the model. Appendixes A-G include detailed flow charts and listings of the computer program; listings, organization, and format of input data; examples of prediction runs and graphic displays of results; and procedures for converting output data to terms required by the airfield construction effort model.

both prediction methods and outputs daily soil moisture content and/or daily soil strength values (CI and RCI) for soil layers at depths of 0-15 cm (designated as layer 1) and 15-30 cm (designated as layer 2).*

Input data

5. Terrain and weather data are required as inputs to the model.

6. Terrain data. The terrain data, which are referred to as control data in the automated program, include minimum rainfall amount required for accretion and the following for each layer of a given soil:

a. Accretion relations.

b. Depletion relations.

c. Field maximum and field minimum soil moisture contents.

d. Soil moisture content at the start of prediction.

e. Soil moisture-strength relation.

f. Dry density.

7. The terrain data may be one or a combination of three different types as follows:

a. Specific data. These data include the above prediction relations and soil property data that are derived from measurements taken at a specific location. Use of these data provides the most accurate predictions of soil moisture and strength for a particular site under a given set of terrain and weather conditions. Procedures for derivation of specific

* Each layer is actually 15.24 cm (6 in.) thick. In converting data from metric to English units the program uses the actual thickness.

prediction relations are given in reference 4c; the preparation of the input data is discussed in Part III of this report.

b. Estimated data. These data refer to averages or estimates derived from (a) field measurements, (b) published literature containing data on terrain analogous to the test area, or (c) equations developed from soil property data from a large number of sites. These equations, called tentative average (TA) relations, are incorporated in the model and require measured or estimated values of soil properties as input. The methodology for deriving these equations is discussed in references 4e and 4j. The moisture equations and variables are shown in table 4 and the strength equations and variables are shown in tables 6 and 7. The mathematics of the equations are discussed in Part IV of this report; the preparation of the input data is discussed in Part III.

c. Surface composition group data. These data are also averages or estimates that have been derived from sources similar to those described above. However, here a set of control data has been generated for each of a number of surface composition groups. The groups correspond closely to soil classes of the Unified Soil Classification System modified by the addition of nonsoil water, pavements and structures, and rock to allow for characterization of the entire surface area. Each soil group has all the information needed for operation of the model stored in a file subject to call by a group code number. Materials of the surface composition groups and the corresponding group code numbers are shown in table 1. The surface composition group can be used when specific data are not available.

8. Weather data. The weather data include daily precipitation amounts (expressed as water equivalent) and dates of the beginning of seasons

when the rates of depletion change. Provision is made to allow input of air temperature and snow depth for future use with the Freeze-Thaw model.[15]

Output data

9. Output data are stored in permanent files for use by other performance prediction models, for printout, or for input to plotting programs. The printing format is suitable for use in reports. Soil moisture content can be presented separately in units of either centimeters or inches of water per soil layer (15 cm thick) or, if desired, by percentage of dry weight. Soil strength can be written as CI and/or RCI. The predictions can start or end at any time during the year as directed, and can run a part of a year or for consecutive years. Predictions can be made for one or more selected years of extreme, unique, or typical rainfall distributions. In these cases yearly starts are controlled by starting moisture content values inserted at the beginning of the year of weather data input. When predictions for another soil are needed, a restart of the model with new terrain input information is required.

Limitations of the Model

Layer

10. The model predicts the moisture contents and strengths of the first and second soil layers (0-15 and 15-30 cm depths). No direct accounting is made of water from precipitation that is absorbed by vegetation, runs off the surface, or drains to lower layers. Depletion is considered a net loss, and losses specifically from evaporation, transpiration, and drainage are not differentiated.

Terrain

11. The model does not include all terrain attributes that can affect soil moisture content and strength. It does not consider the direct influence of attributes such as water tables, frost, snow, and soil tillage. The influence of these attributes has been studied, but relations have not been developed sufficiently for inclusion in the present model. It should be noted, however, that the model was purposely designed in a modular format to allow for their inclusion at a later time.

12. The model does not provide daily moisture contents and strengths for surface materials having strengths that normally are not appreciably affected by moisture fluctuations, such as clean gravels, cobbles, boulders, stones, and rock, or materials in which daily moisture contents seldom vary significantly, such as very poorly drained (water-logged) organic silts and clays, and other organics (peat and muck). A general estimate of water content, density, and strength (in CI) for these materials is shown in table 2.* Also, the model should obviously not be used for prediction on irrigated fields, where the moisture content or strength of the soils is not related to precipitation.

Weather

13. The quality of the weather data, like that of the terrain data, can have an important bearing on the accuracy of soil moisture prediction. The prediction of moisture contents requires input of daily rainfall amounts. Rainfall distributions may be quite variable over an area, and an intense rainfall can occur less than a kilometer away from a light shower. This

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*These data are not included in the automated program. They are presented for use by analysts desiring to characterize entire surface areas.

is especially true in mountainous terrain, where sharp changes in rainfall amount commonly occur with differences in prevailing winds or in elevation. In some of the mountainous areas of Hawaii, for example, the average annual rainfall changes from 50 to 500 cm over a distance of 10 km. The user of the model should recognize this limitation and try to obtain rainfall data that apply to the area of prediction.

14. The tentative average relations used with estimated data (see paragraph 7b) were developed from specific data obtained within the continental United States. Use of these relations, therefore, should be limited to areas of similar climate.

Accuracy of predictions for individual sites

15. Soil moisture content. Prediction accuracies were determined from specific relations developed from 23 test sites. The average deviation of predicted values from measured values for the 15- to 30-cm layer was about ± 1 percent moisture content, dry weight, for the year the prediction relations were derived and about ± 1.5 percent the following year.[4d] The natural variability of moisture content within a site at a given time is of the same magnitude (Appendix D of reference 4e). From average relations and from rainfall data collected some distance from the sites, the average deviation of predicted soil moisture contents from measured values for the 15- to 30-cm layer (for 601 test sites) was about ± 4 percent moisture content.[4e] Prediction accuracy for the 0- to 15-cm layer was somewhat poorer because of the greater variability in the soil at the surface.

16. Soil strength. Strengths for the 15- to 30-cm layer were predicted from measured moisture contents and specific soil moisture-strength relations. The average deviations of these strengths from measured

strengths were about ± 15 CI or RCI units under wet soil conditions; the accuracy decreased at lower moisture contents.[4j] The natural variabilities of CI and RCI within a site are of about the same magnitude.[4h] Strengths for the same layer were also predicted from measured moisture contents and estimated soil moisture-strength relations. The average deviations of these strengths from measured strengths were ± 30 units for CI and ± 20 units for RCI under wet soil conditions;[4j] again, the accuracy decreased at lower moisture contents. No tests were made for prediction accuracy of the 0- to 15-cm layer; but, similar to moisture content, the prediction accuracy is assumed to be poorer because of the greater soil variability at the surface.

Accuracy of predictions for large areas

17. No tests were made to determine the accuracy of predictions for large areas (areas several hundred square meters or more). The limitations of time and money required for the development of the computer program reported herein precluded the design and operation of a field and desk study to collect and analyze the necessary data. It can be assumed, however, that the range of variation between predicted and measured values would be greater than for individual sites because of the greater variability of terrain and weather properties.

PART II; STRUCTURE OF PROGRAM

Computer Orientation

18. The program for this model is written in Fortran IV language for the Honeywell-GE (General Electric) 440* computer at the WES and is to be used remotely by teletype. The system compiler Fortran XFR is used.

19. An average run for two years of daily precipitation with a complete output (soil moisture content in terms of volume or percent, CI and RCI for the two layers) takes from 2 to 2-1/2 min.

20. If graphic displays are required, the data in output files stored by this model can be plotted directly by using the proper programs. The graphic display program is discussed in paragraph 39.

Main Program and Overlays

21. The program is in conversational mode and is of modular construction. It consists of a main program and six overlays, and it accesses up to four input files and creates up to nine output files. If generated data exceed the capacity of a file, the program automatically opens another file and names it in sequential order.

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*The Honeywell 435 was upgraded to the 440 in early 1972.

22. The main program, overlays, and required input control files are on file in the WES Automatic Data Processing Center as tabulated below.

File or Overlay Name	Description or Function	Characters Source	Characters Object	Lines
FTWEMS	Main program	17571	15333	472
COMPMS	Computation core	3234	2628	113
FIL1DA	Stores moisture content file	4128	3546	127
FIL2DA	Stores percent moisture content file	3222	2556	97
FRODEP	Stores output for freeze-thaw program	2364	1626	62
STFRSP	Computes and stores strength from soil properties	2142	2067	70
CALSST	Calculates soil strength	5991	4875	173
DSURGR	Soil composition group descriptors - data file	9906	-	122
DFSTEQ	Coefficients of equations to determine strength relation constants, A and B - data file	1932	-	40

Schematic Flow Chart

23. A schematic flow chart shows the logic used in assembling the program (fig. 1). Detailed flow charts of the program are given in Appendix A.

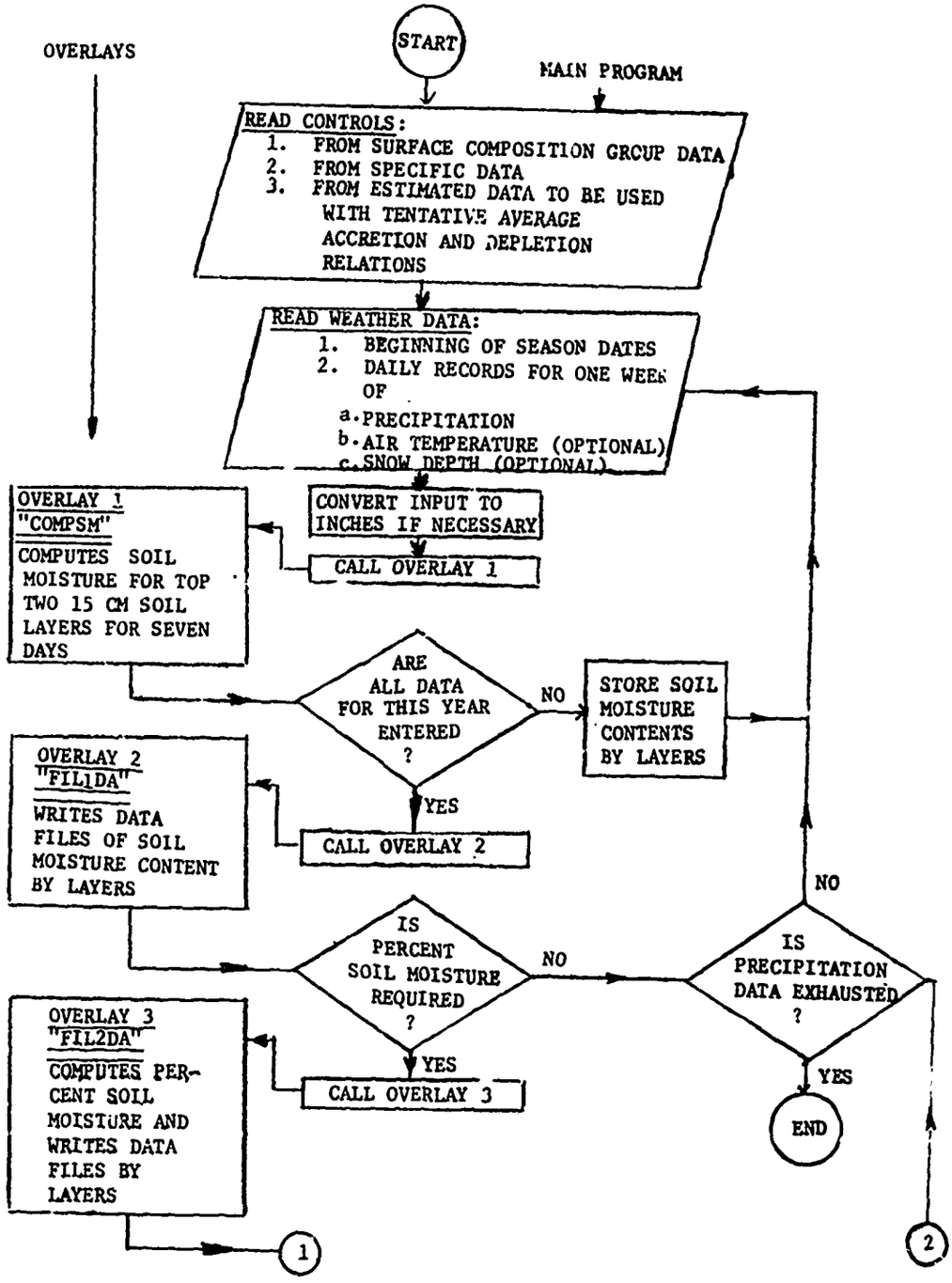

Fig. 1. Computer program flow chart

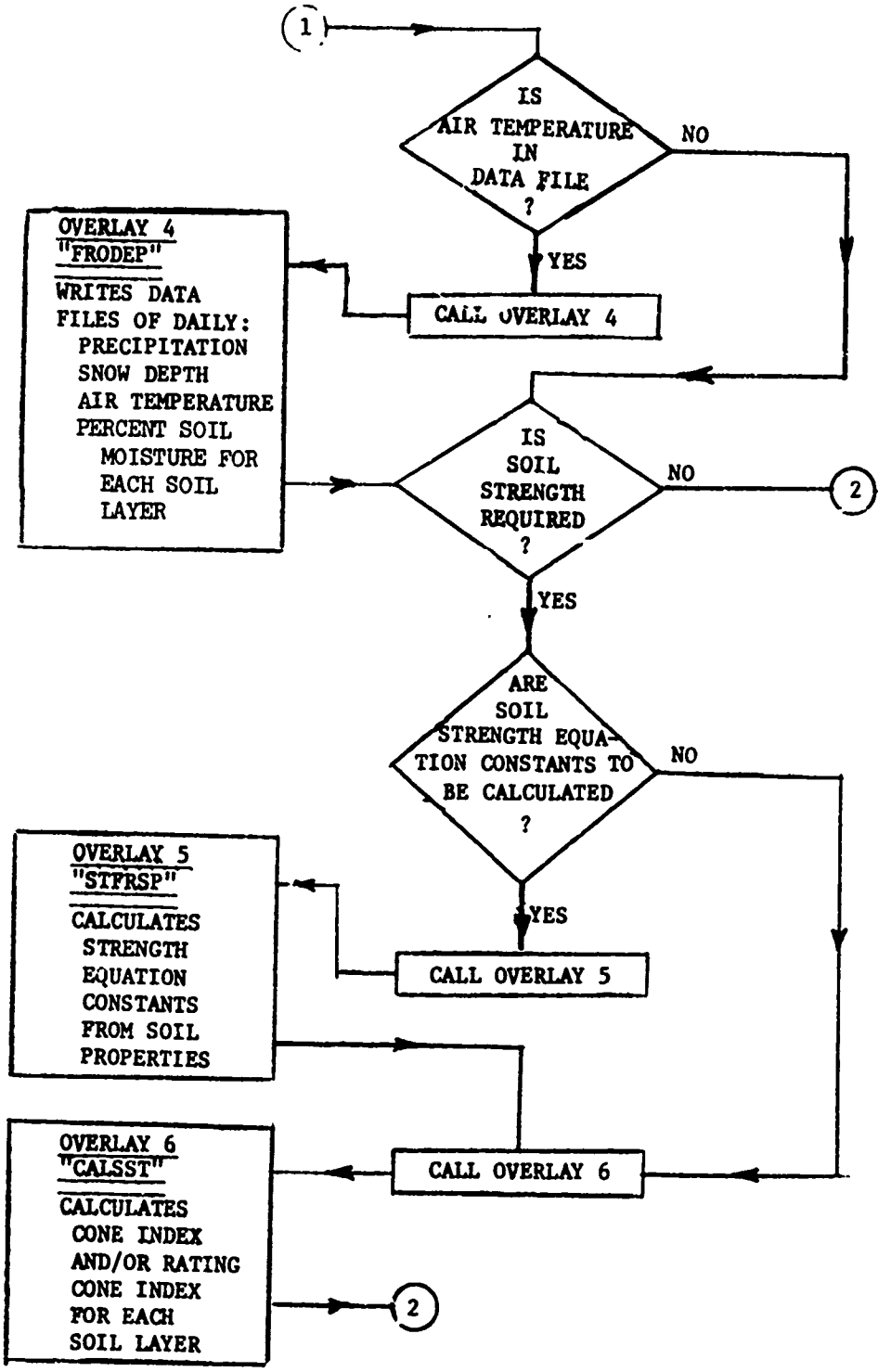

Fig. 1. (Concluded)

Function of Main Program and Overlays

24. The following outline lists the action accomplished in each segment of the program and the order in which each, if required, is called into use:

a. Main program - FTWEMS - a program F developed in the Terrain Analysis Branch of the Mobility and Environmental Systems Laboratory of the WES for predicting soil Moisture content and soil Strength.

(1) Defines dimensions of the array of each variable contained in "common" statements.

(2) Identifies initial data.

(3) Identifies formats of input data.

(4) Reads all input control data.

(5) Reads all weather data.

(6) Converts input as required.

(7) Activates the proper overlay at the proper time.

(8) Contains a subroutine called by overlays for special formatting of output when precipitation record begins other than the first day of a week.

b. Overlay 1 - COMPSM - COMPutes Soil Moisture content.

(1) Computes daily soil moisture contents for the top two soil layers.

(2) Stores daily soil moisture content data in data blocks of one year (January-December).

c. Overlay 2 - FIL1DA - creates FILes for 1st type of output DAta. soil moisture contents by unit layer. Stores

soil moisture content data in a separate file for each layer. If required, converts soil moisture contents to percent dry weight.

d. Overlay 3 - FIL2DA - creates FILes for 2nd type of output DAta, soil moisture content by percent. Stores data in a separate file for each layer.

e. Overlay 4 - FRODEP - creates a file of data for use in models that predict FROzen DEPth or thawed depth of soil. Stores daily precipitation, daily air temperature, measured daily snow depth (if available), and daily percentage of soil moisture content data by layers in an output file.*

f. Overlay 5 - STFRSP - calculates soil STrength equation constants FRom soil moisture contents (at specific values of CI and RCI) that have been derived from Soil Property values. These constants are stored for use in Overlay 6.

g. Overlay 6 - CALSST - CALculates Soil STrength. Calculates daily CI and/or RCI.

Listings of these program files are in Appendix B.

Input and Output Data

25. The computer operator can enter the input data, described in paragraphs 5-8, into a designated input file either by paper tape or directly from the teletype keyboard, or he can punch them on 80-column

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*This overlay is not required for operation of the program. It is included for the convenience of the user.

cards and enter them in a time-sharing file. Some control data are entered from the teletype keyboard only. This input is concerned with input and output options in answer to questions posed during the running of the program.

26. Output data generated by the program are stored in time-sharing files, which are formatted for printing by SYS:MAX (a WES media conversion system) without line numbers. A built-in routine slews the printer to the top of the next page when a page of data is complete. The output files remain in the time-sharing storage until the user unsaves them.

Definitions

27. Table 3 contains a list of device, variable, constant, and flag definitions, and units of measurements with significant decimal places where applicable.

PART III: PROGRAM OPERATION

28. The successful operation of the program depends on careful preparation of the input data, an understanding of the user function in operating the program, knowledge of the limitations and conventions adopted by the program, and the form, restrictions, and location of the program output data.

Input Data Preparation

29. Weather data preparation is the same regardless of the input data source. All other data are control data (see paragraphs 6-7). In this discussion the terms card and line are used synonymously since data from a card fills a teletype data line.

Control data

30. Control data describe the top two soil layers and appear on seven different card types (1-7) as shown in figs. C6-C17 of Appendix C.

31. Specific data. If the user wishes to run a prediction based entirely on specific data he must input on the proper cards all of the control data (see paragraph 6). The card deck setup is shown in fig. C3, Appendix C.

32. Surface composition group data. A user selecting control data input from the surface composition groups needs only to use the five heading cards (type 7) and the cards with weather data (types 8 and 9) to

make a prediction run. If he has information concerning beginning moisture content for each layer, he should add card type 3. He can also add any other card type for which he has specific data. The cards, including card type 3, must precede cards of type 7. The card deck setup is shown in fig. C4, Appendix C. The control data card input for each surface composition group is stored in file DSURGR. The file is discussed in Appendix D.

33. Estimated data. Tentative average control data stored in the main program are:

a. Accretion relation constants.

b. Depletion relation constants.

c. Minimum precipitation causing accretion.

d. Moisture ranges of depletion by soil type, season, and layer.

e. Maximum and minimum soil moisture equation constants.

Table 4 summarizes the relations from which these constants are taken.

34. Other estimated data that are stored are soil property equation constants for calculating strength relation coefficients. These constants with codes that indicate the soil property and its form (ln, lnln, or natural) are stored in file DFSTEQ and are listed in table D2, Appendix D.

Weather data

35. Weather data appear on two different card types (8 and 9) as illustrated in figs. C18 and C19 of Appendix C.

User Function

36. The user is assumed to be familiar with the remote operation of the computer by teletype and to have checked the compatibility of the computer system he is using with the system for which this program was written. He can submit program card decks to the computer operator for loading the model into the time-sharing disc pack, or he can enter them by paper tape through the teletype. The main program, all overlays, and all input files must be present to run the program.

37. The user must prepare control data and weather data as described in paragraphs 29-35 and in Appendix C, and he must be prepared to enter file names descriptive of the type of output data desired. A file name is a six-character alphanumeric, the last three characters of which must be 001 as requested during the running of the program. This makes possible the automatic incrementation of output data files in sequential order--XXX001, XXX002, etc.—if necessary.

38. Three examples of the program operation using specific, surface composition group, and estimated data are shown in Appendix E. Example 1

uses only specific data. Example 2 uses the same weather data, but a surface composition group as a control data source. Example 3 uses estimated data with tentative average relations for the prediction. These examples also illustrate the user's response to questions asked during the running of the program. A run providing data for the Freeze-Thaw model is included as Example 4 in Appendix E.

39. If plotting of the output files is desired, a separate program, FSPMSD, is included for the user's convenience (Appendix F). If this program is used, a CALCOMP drum (pen) plotter and required operating library routines must be available. If the required library routines listed at the beginning of the program are not available in his computer system, the user must write a plotting program that will be accepted by the system.

Program Conventions

40. Program conventions that must be understood by the user, in addition to those observed in data preparation, are as follows:

a. The internal operation of the moisture prediction phase of the program is in inches of moisture per 6-in. soil layer.

b. All data input by the user, except density, must be in the same system of measurement (either all inches or all centimeters).

c. Density is always entered as g/cc.

d. All 72 spaces on a teletype line must be filled by data or accounted for by spaces.

e. The soil strength and freeze-thaw programs use relations in terms of percent soil moisture content; therefore, the percent option must be selected for the running of these programs.

f. Entry of minimum storm data must be in three decimal places (0.100 in. or 0.254 cm).

g. In converting centimeters to inches, the constant 0.3937 is used as a multiplier; and in converting inches to centimeters, the constant 2.54 is used.

h. In converting output from centimeters to percent, 15.24 cm is used for the thickness of the 6-in. increment.

i. Identification of the run on the top of each page that is printed from an output file is made from the identification information on card type 1, and not from the card type 7 heading cards (see Appendix C).

j. The last four characters of the identification must be numeric and must agree with the surface composition group, if a group is used as an input data source.

k. If air temperature data are included, both temperature and snow data cards must follow the last precipitation data card for each year.

l. The program requires a "RUNBIG" call for its initiation.

m. This program uses overlays; thus, object files with the following names are held under the user work number for use in running the program:

(1) FTWEMS - 0(zero)FTWEM

(2) COMPMS - 0(zero)COMPM

(3) FIL1DA - 0(zero)FIL1D

(4) FIL2DA - 0(zero)FIL2D

(5) CALSST - 0(zero)CALSS

(6) FRODEP - 0(zero)FRODE

(7) STFRSF - 0(zero)STFRS

To save compilation time, the user can call the program "OFTWEM" and initiate it with a call to "RUNBIG." This results in a saving of approximately 30 sec of running time.

n. If the predicted moisture content on the last day of a season is lower than the minimum moisture content on the first day of the following season, daily depletion is not computed until soil moisture content has accreted above the new season minimum.

o. If precipitation cards are out of order, an error message is printed on the teletype. If a precipitation card is omitted, no error is printed, but zeros are written into the output file for the days omitted. The output data beyond that point will be in error.

p. The program rounds values as follows:

(1) Soil moisture contents in inches or centimeters are rounded to the nearest hundredth of the measurement unit.

(2) Soil moisture content is rounded to the nearest hundredth of a percent.

(3) Strength data are rounded to the nearest unit (CI or RCI).

q. Some check data are printed by the teletype during the running of the program. Should these check data disagree with those desired, the program can be aborted by hitting the stop button (S).

PART IV: MATHEMATICS

41. The mathematics used by the program are simple straight line and power function relations derived empirically using regression techniques. The overlays "COMPSM" and "CALSST" contain instructions for the calculation of soil moisture content and soil strength using the control data as defined in paragraph 6. The program was written primarily for use with TA (estimated) input data with options to substitute data supplied from specific sources (paragraph 7a) or data characteristic of a surface composition group (paragraph 7c). This main core of computations makes possible the total use, partial use, or the use of a combination of any of the three types of input data (see Appendix C). Provision is also made for the calculations of maximum and minimum soil moisture contents and of the soil moisture-strength relations if desired.

Soil Moisture Prediction

Accretion relations

42. Accretion (wetting) of soil depends primarily upon the amount of precipitation and amount of storage space available in the soil for absorbing water.[4c,4d] Precipitation is the critical variable when the total precipitation for a storm is less than the storage available (in the top two layers of soil). This type of accretion is called "Class I." "Class II" accretion occurs when the precipitation is greater than the available storage; then accretion depends on the amount of available storage. Equations expressing these relations are shown in table 4.

43. "RMIN" (minimum storm) defines the amount of precipitation below which no appreciable wetting of the soil occurs. Unless the user enters a value of RMIN on card 2-1 (see fig. C7, Appendix C), the program assumes an RMIN of 0.1 in. (0.254 cm). If precipitation exactly equals RMIN, no accretion or depletion occurs. For precipitation less than RMIN, depletion is determined in the usual manner.

44. Minimum values of accretion are set at 0.03 in. for Class II accretion for both layers and 0.01 in. for layer 2-Class I accretion. Layer 1-Class I accretion for precipitation between RMIN and RMIN + 0.07 in. (i.e. between 0.1 in. and 0.17 in. in fig. 2) has a 1:1 relation to precipitation above RMIN when the minimum storm is 0.1 in. If RMIN is entered as some value other than 0.10 in., the accretion value 0.07 in. must be recomputed. For example, as shown in fig. 2, a minimum storm (RMIN) of 0.06 in. would result in a minimum accretion of 0.034 in. The user must enter these minimum values on card 2-1 (see fig. C7, Appendix C) if new accretion equation constants are used. Accretion relations can be modified by entering equation constants on card 2-6 (see fig. C12, Appendix C). The same equation form must be used.

Depletion relations

45. The program accepts depletion relation equations in polynomial form up to sixth-degree equations forced through zero. The surface composition groups use fourth-degree equations. The equation coefficients are in file DSURGR (see table D1, Appendix D). TA depletion equations (estimated data) are fourth-degree polynomials, except for two that are sixth-degree polynomials. The equations define depletion curves that were determined empirically.[4e]

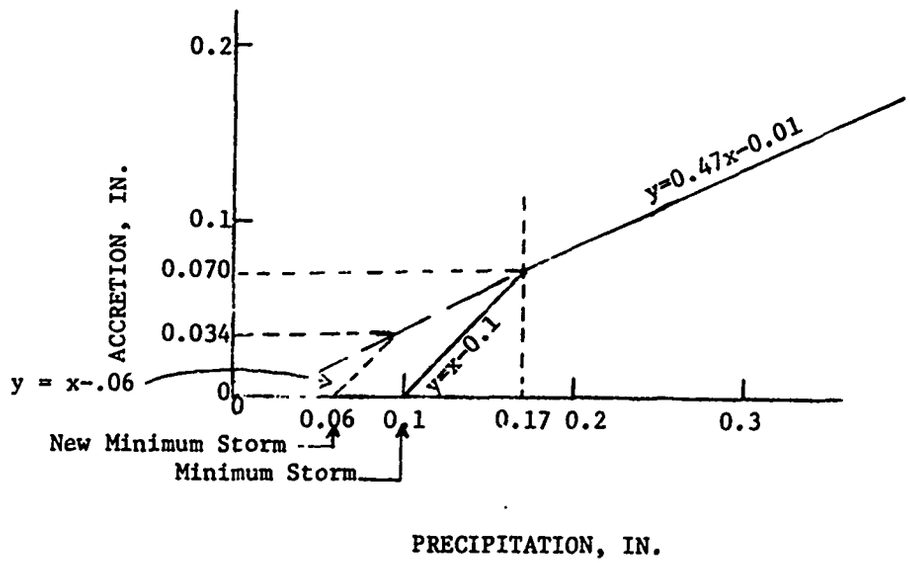


Fig. 2. First-layer Class I accretion

46. The equation coefficients were determined by a multiple linear regression technique with the intercept equal to zero. Daily moisture loss was considered dependent on soil moisture content above minimum moisture content. The equation form is:

$$Y = ax + bx^2 + cx^3 + dx^4 + ex^5 + fx^6$$

47. For a specific location, if the maximum and minimum soil moisture contents for each layer can be determined, these TA depletion equations can be used. If this is the case, the program computes a factor by which the site is referenced to the TA moisture depletion during summer, (site maximum moisture - minimum moisture)/(TA maximum moisture - minimum moisture). This, in effect, stretches or compresses the TA depletion curves to force them into agreement with the specific location depletion relation.

48. There are 18 equations in the set, three for each soil layer for each of three seasons; they are listed in table 4.

Maximum and minimum soil moisture contents

49. TA maximum and minimum soil moisture equations (estimated data) are empirically derived relations. The constant terms were derived by regression analysis. Maximum and minimum moisture contents were considered dependent on soil properties. The properties included in the program are improved revisions of these equations and can be used at the user's option to compute maximum and minimum moisture contents if the soil properties for each soil layer are available. The equations are shown in table 4 and are of the form:

$$Y = a + b(SP_1) + c(SP_2) + \ldots\ldots n(SP_{16})$$

where

Y = maximum or minimum moisture content

SP = soil property

50. The user can supply his own equations, if they are of the same form, by entering soil properties and equation constants on card type 2-2 as shown in fig. C8, Appendix C.

Soil Strength Prediction

51. Both the CI and the RCI relations to soil moisture content were determined empirically to be straight line logarithmic. Natural logarithms are used with specific, estimated, or surface composition group data in this program. Equations have the following form:

$$\ln CI = a + b \ln MC$$
$$\ln RCI = a + b \ln MC$$

where

CI = cone index

RCI = rating cone index

MC = soil moisture content in percent

Given relations

52. If surface composition groups are used for prediction, each group has an associated CI and RCI equation for each soil layer. If the user does not use a group, he must supply the strength equation constants using specific or estimated data. Information for entering these constants can be found on card type 2-4, as shown in fig. C10, Appendix C.

Relations computed from soil properties (estimated data)

53. In a study analyzing the relation of soil strength to soil properties,[4j] six sets of equations were presented to predict moisture content at specific CI's and six sets to predict moisture content at specific RCI's. A multiple linear regression technique was used to determine soil properties most closely associated with moisture contents at CI values of 200 and 300 and RCI values of 100 and 200. Nine soil properties were examined, and only those that made a significant statistical improvement in the relation were actually used. Tables 6 and 7 show the various resulting combinations which were retained in the equation sets. The soil properties used are as follows:

a. Percent sand

b. Percent clay

c. Percent silt

d. Percent organic matter

e. Percent fines

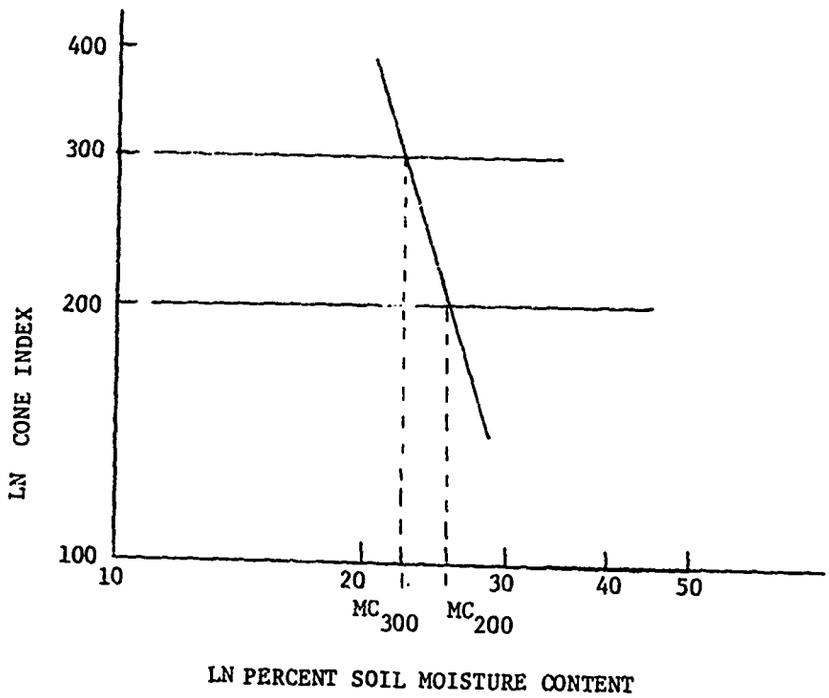
f. Liquid limit

g. Plastic limit

h. Plasticity index

i. Dry density

54. Once these relations were determined for moisture contents at the strengths stated in paragraph 53, a straight-line relation was assumed to exist between ln CI and ln soil moisture content (see paragraph 51). The equation for this straight line was then determined by forcing it through soil moisture contents at a CI of 300 and a CI of 200 (fig. 3). The same



$$\ln CI = \ln 200 - \frac{(\ln 200 - \ln 300)(\ln MC_{200} - \ln MC)}{(\ln MC_{200} - \ln MC_{300})}$$

$$= 5.298 + \frac{(+0.405)(\ln MC_{200} - \ln MC)}{\ln MC_{200} - \ln MC_{300}}$$

where: MC_{200} is the moisture content at a CI of 200

MC_{300} is the moisture content at a CI of 300

MC_{200} and MC_{300} can be determined by any one of the sets of equations for which soil properties are known

MC is the moisture content for the day of prediction

Fig. 3. Cone index - percent soil moisture content relation

sets of equations are considered applicable to both layers. Similarly, straight-line relations were established for ln RCI versus ln soil moisture content.

55. The partial regression coefficients for the six sets of equations used in calculating CI coefficients are listed in table 6. A set consists of equations for calculating moisture contents when CI is 200 and when CI is 300. The soil property coefficients are listed in the order in which they are entered into the equation.

56. Partial regression coefficients for equations used in calculating moisture contents when RCI is 100 and 200 are listed in table 7.

LITERATURE CITED

1. U. S. Army Engineer Waterways Experiment Station, CE, "FY 1970 Progress Report, Automation of Sample Terrain Model," 25 Sep 1970, Vicksburg, Miss.

2. Parks, J. A., and Stoll, J. K., "Automation of Cross-Country Locomotion Model," Miscellaneous Paper M-71-7, Nov 1971, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

3. Smith, M. H., "Automation of Model for Predicting the Clearing of Vegetation by Explosives for Helicopter Landing Zones (HLZ Model)," Miscellaneous Paper M-72-1, Mar 1972, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

4. U. S. Army Engineer Waterways Experiment Station, CE, "Forecasting Trafficability of Soils," Technical Memorandum No. 3-331, Vicksburg, Miss.

   a. Report 1, "Meteorological and Soil Data, Vicksburg, Miss., 1948-1949," Oct 1951.

   b. Report 2, "Meteorological and Soil Data, Vicksburg, Miss., 1949-1951," Jun 1952.

   c. Report 3, "The Development of Methods for Predicting Soil-Moisture Content," Oct 1954.

   d. Report 4, "Information for Predicting Moisture in the Surface Foot of Various Soils," Feb 1957.

   e. Report 5, "Development and Testing of Some Average Relations for Predicting Soil Moisture," May 1959.

   f. Report 6, "Airphoto Approach, Volumes 1 and 2," Jun 1963.

   g. Report 7, "A Pilot Study of Soils Subjected to Freezing and Thawing," Jun 1964.

   h. Report 8, "Variability of Physical Properties of Loess Soils, Warren County, Mississippi," Dec 1967.

   i. Report 9, "Water Table Study at Crossett, Arkansas," Jul 1968.

   j. Report 10, "Relations of Strength to Other Properties of Fine-Grained Soils and Sands with Fines," Jul 1971.

5. U. S. Army Engineer Waterways Experiment Station, CE, "Report of Conference on Soil Trafficability Prediction," Apr 1967, Vicksburg, Miss.

6. Meyer, M. P., and Bohnert, W. P., Jr., "Worldwide Strength Conditions of Surface Materials," Miscellaneous Paper M-70-2, Apr 1970, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

7. Lund, I. A., and Meyer, M. P., "Rainfall, Soil Moisture and Trafficability in the Vicinity of Saigon," Air Force Survey in Geophysics, No. 219, May 1970, Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Bedford, Mass.

8. Grabau, W. E., and Shamburger, J. H., "Intratheatre Transportation Requirement Study, A Procedure for Constructing Synthalogous Environments; Rationale," Technical Report M-70-13, Vol 1, Sep 1970, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

9. Decell, J. L., et al., "A Terrain Comparison Study of Test Sites for TETAM" (in preparation), U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

10. Laumets, E., "Soil-Moisture Prediction Method for NRDL Induced-Activity Prediction System," USNE DL-TR-662, Jul 1963, U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.

11. Laumets, E., and Evans, E. C., III, "A System for Predicting Gamma Radiation Hazards from Neutron-Induced Radioactivity in Earth Materials," USNR DL-TR-1975, Sep 1966, U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.

12. Link, L. E., et al., "A System for Predicting Seismic Sensor Performance" (in preparation), U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

13. Rula, A. A., and Nuttall, C. J., "An Analysis of Ground Mobility Models (ANAMOB)," Technical Report M-71-4, Jul 1971, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

14. U. S. Army Tank-Automotive Comamnd and U. S. Army Engineer Waterways Experiment Station, CE, "AMC Model for Predicting Cross-Country Vehicle Performance" (in preparation).

15. Galate, J. W., "Digital Computer Prediction of Snow Depth, Snow Density, and Frost and Thaw Penetration" (unpublished), U. S. Army Cold Regions Research and Engineering Laboratory, Hanover, N. H.

16. Meyer, M. P., "Comparison of Engineering Properties of Selected Temperate and Tropical Surface Soil," Technical Report No. 3-732, Jun 1966, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

17. Neubauer, C. H., Jr., "The Use of Lime-Soil Stabilization as a Construction Expedient," TR No. AFWL-TR-69-183, Jun 1970, Air Force Weapons Laboratory, Kirtland AFB, N. Mex.

Table 1

Surface Composition Groups

Material			Organic Content %	Drainage* Potential Class	Group Code
Groups with Similar Material in 0- to 15- and 15- to 30-cm Layers					
Water			0	0	8888
Pavement and structures >25% coverage			0	2	0101
Rock, stones, boulders, and cobbles, P.D. sizes ≥0.074mm, is ≥50%, and >76.2mm, is >25%			0	2	0202
Coarse grained P.D. sizes ≥0.074mm, is ≥50%	Gravel, P.D. sizes >4.76-76.2mm, is >25%	Clean gravel, P.D. sizes <0.074mm, is <5%	0	2	0303
		Gravel with fines, P.D. sizes <0.074mm, is >5-50%	0	2	0707 or 1111**
	Sand, P.D. sizes >0.074-4.76mm, is >25%	Clean sand, P.D. sizes <0.074mm, is <5%	0	2	0505
		Sand with fines, P.D. sizes <0.074mm, is ≥5-50%	>0-7	1	0606
			>0-7	2	0707
Fine grained, sizes<0.074mm, is >50%	Silt, LL <35 and PI <15		>0-7	1	0808
			>0-7	2	0909
	Clay, LL >35 or PI >15		>0-7	1	1010
			>0-7	2	1111
Organic silts and clays (plastic)			>7-30	0	1212
			>7-30	1	1313
Peat (nonplastic)			>30	0	1414
Groups with Different Material in 0- to 15- and 15- to 30-cm Layers					
Sand, 0-15 cm, over Clay, 15-30 cm			>0-7	1	0610
			>0-7	2	0711
Silt, 0-15 cm, over Clay, 15-30 cm			>0-7	2	0911

*Drainage potential classified by occurrence of water table as follows:

Class 0 Water table occurs at surface 90% or more of the time

Class 1 Water table occurs at the surface less than 90% and above 120-cm depth 10% or more of the time

Class 2 Water table occurs above 120-cm depth less than 10% of the time

** Gravel with sand matrix coded 0707; gravel with clay matrix coded 1111

NOTE: PD = Particle diameter
LL = Liquid limit
PI = Plasticity index

Table 2

Soil Water, Density, and Strength for Surface Composition Groups with Constant Values

Material	Group Code	Water* Content %	** Density g/cc	Strength CI
Water	8888	100	1.00	0 (liquid)
Pavements & Structures	0101	1	2.50	750+
Rock, Stone, Cobbles, Boulders	0202	1 to 5	2.15	750+
Clean Gravel	0303	1	2.00	100
Saturated Organic Silt-Clay	1212	90†	0.80	25
Peat & Muck	1414	90†	0.80	25

* Percent on dry weight basis except for water

** Dry density except for water

† Represents an average value estimated from a small number of samples. Water contents are highly variable and increase with an increase in the percent organic matter of the material.

Table 3

Device, Variable, Constant, and Flag Definitions

Devices

Dev 1	Device handling input data
Dev 2	Device handling output data for layer 1
Dev 3	Device handling output data for layer 2
Dev 4	Device handling output data to be used as input to Freeze-Thaw model
Dev 5	Device handling linkage with overlay segments of program

Dimensioned Variables and Constants

Name	Description	Units	Decimal Places
	Input-Output		
BD(2)	Bulk density (dry weight)	g/cc	2
C1(16,2)	Individual soil properties	variable	3
C2(4)	Maximum and minimum moisture content	in./6 in. or cm/15 cm	2
IDC1(35)	Storage location for rereading input data	-	-
IHD(20)	Storage for one line of heading	-	-
IMCA(4,12)	Names of months	-	-
ISINUM(4)	Four three-character words making up a site identification number	-	-
ISLEW(3)	Code for slewing to top of next page when printing output by the WES SYS:MAX media conversion system	-	-

Table 3 (continued)

Name	Description	Units	Decimal Places
KIND(3)	Code for type of surface material and layers one and two as needed by Freeze-Thaw model 1 - coarse 2 - fine 3 - other	-	-
MAXD(12)	Number of days in each month	-	-
NMAXD(2)	(1) Number of last month having data for the year	-	-
	(2) Day of month for last data for the year	-	-
PRECIP(12,35)	Storage of daily precipitation for one year by month and day	in. or cm	2
	Moisture Content Prediction		
ADF(2)	Inverse depletion factor	-	-
C3(2,2)	Accretion equation coefficients	-	4
C4(2,2)	Accretion equation constants	-	4
C5(16,4,2)	Maximum and minimum equation constants		
CMAX(2)	Maximum soil moisture content	in./6 in. or cm/15 cm	2
CMIN(2)	Minimum soil moisture content modified by the depletion factor	-	-
COEF(108)	Tentative average depletion equation coefficients	-	8

Table 3 (continued)

Name	Description	Units	Decimal Places
CONEW(3,2,6)	Depletion equation coefficients for specific relations (polynomial - up to sixth degree)	-	7
CXMIN(2)	Minimum soil moisture content	Same as CMAX	2
DWMC(2,7)	Soil moisture content in percent dry weight	%	2
PMC(2)	Present (prior to prediction) soil moisture content	Same as CMAX	2
RANG(2,3,3)	Maximum and minimum soil moisture content limits of the tentative average depletion curves	Same as CMAX	2
SDF(2)	Site depletion factor	-	-
STORMC(12,31)	First layer soil moisture content storage for one year	Same as CMAX	2
STORMD(12,31)	Second layer soil moisture content storage for one year	Same as CMAX	2
X(2)	Available storage for soil moisture content (maximum moisture content less present moisture content)	Same as CMAX	2
XRANG(2,3)	Soil moisture content limits (maximum and minimum) for three climatic seasons for specific depletion equations	Same as CMAX	2

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Table 3 (continued)

Name	Description	Units	Decimal Places
	Strength Prediction		
ABAR(2)	Calculated equation constants for cone index	-	-
B(13,2,2)	Equation coefficients for moisture-strength from soil properties	-	-
BBAR(2,2)	Calculated equation constants for rating cone index	-	-
CON1(2,2)	Natural logarithms of 200, 100, 300, 200	-	-
D(2),E(2)	Intermediate summations in equations determining strength equation constants	-	-
IMOD(12,3)	Form of soil property as it appears in the equation	-	-
STCON(2,4)	Soil strength equation constants (1,4) cone index (2,4) rating cone index	-	3
STC(12,31)	Daily soil strengths for one year by months	-	0
STRLI(2,4)	Maximum and minimum strength limits (1,4) cone index (2,4) rating cone index	-	0
	Freeze-Thaw Model Input		
SNC(12,35)	Daily snow depths for one year by months	m	2
TEMPER(12,35)	Daily temperatures for one year by months	deg C	2

Table 3 (continued)

Other Variables, Constants and Flags

Name	Description	Units	Decimal Places
	Input-Output		
AJBN,JBN,JN	Beginning day number divided by seven	-	-
DMCLA1,DMCLA2	Variables holding unit volume moisture content output file names	-	-
DPMLA1,DPMLA2	Variables holding percent moisture content output file names	-	-
DCILA1,DCILA2	Variables holding cone index output file names	-	-
DRCLA1,DRCLA2	Variables holding rating cone index output file names	-	-
DFRDEP	Variables holding Freeze-Thaw model input name	-	-
IBD,JB	Beginning day of data	-	-
IBM,K	Beginning month of data	-	-
IBY	Beginning year of data	-	-
IDAB	Beginning day of week	-	-
IDAE	Ending day of week	-	-
IND	Computed format no.	-	-
ITEM1,ITEM2,IDEV1	Additional reread storage	-	-
IIT	Number of soil properties to be read	-	-
ISD	Day of new season	-	-

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Table 3 (continued)

Name	Description	Units	Decimal Places
ISM	Month of new season	-	-
ISI	Code for climatic season	-	-
	1 Summer		
	2 Transition (fall or spring)		
	3 Winter		
ISY	Year of new season	-	-
ITYPE	Code indicating data type	-	-
IUNMEA	Code for input unit of measurement	-	-
JEND	Last day of data for year	-	-
JNK	Index for weeks, 1-5	-	-
LK	Last month of data for year	-	-
MEAOU1	Code for output unit of measurement	-	-
MEAOU2	Code for output in percent moisture content	-	-
NEWYR,NYR	New year of data	-	-
NSOUR	Code for input source	-	-
NTYPE	Code for subtype data identification	-	-
SECT1....SECT10	Sector locators	-	-
	Moisture Content Prediction		
ACCR	Amount of day's accretion	in.	2
C1COF	0.07 (point at which accretion equation is modified)	in.	2
C1ROF	Amount precipitation exceeds minimum rain when accretion is less than 0.07 in.	in.	2

Table 3 (concluded)

Name	Description	Units	Decimal Places
ACCR2	0.03 (point at which accretion equation is modified)	in.	2
DEP	Amount of day's depletion	in.	2
IDA,MO,IYR	Present day, month, year	-	-
ICOUNT	Number of days in current month for moisture calculation	-	-
ITEXA,ITEXB	Soil texture for layer 1 and layer 2 C coarse (sands) M medium (silts) F fine (clays)	-	-
RMIN	Minimum precipitation causing accretion	-	-
	Strength Prediction		
NCI	Number identifying cone index equation desired	-	-
NEWLIM	Code for new soil strength limits	-	-
NRCI	Number identifying rating cone index equation	-	-
NSOST	Code for strength equation constants	-	-
	Freeze-Thaw Model Input		
NCODE	Code for air temperature and/or snow depth data	-	-
NSNOW	Code for snow depth data	-	-
NTEMP	Code for air temperature data	-	-

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Table 4
Built-In Program Controls,
Tentative Average Relations

ACCRETION RELATIONS

	0- to 15-cm Layer	15- to 30-cm Layer
Class I	$\hat{Y} = 0.47X - 0.01$	$\hat{Y} = 0.22X - 0.01$
Class II	$\hat{Y} = 0.75Z - 0.05$	$\hat{Y} = 0.60Z - 0.02$

where

$\hat{Y}$ = predicted accretion, in. per 6-in. layer

X = rainfall, in.

Z = available storage at the start of the storm, in. per 6-in. layer

DEPLETION RELATIONS

Summer:

Sand -

First layer moisture range, 1.26

$f(x) = 0.15970948x - 0.28827749x^2 + 0.37098284x^3 - 0.13067845x^4$

Second layer moisture range, 1.00

$f(x) = 0.20865303x - 0.64984646x^2 + 0.87560732x^3 - 0.30605206x^4$

Silt -

First layer moisture range, 1.87

$f(x) = 0.15190809x - 0.07720229x^2 - 0.01280603x^3 + 0.01851488x^4$

Second layer moisture range, 1.63

$f(x) = 0.09612290x + 0.01073670x^2 - 0.10720756x^3 + 0.05548077x^4$

Clay -

First layer moisture range, 1.47

$f(x) = 0.11641490x + 0.06704479x^2 - 0.09112914x^3 + 0.03120642x^4$

Second layer moisture range, 1.08

$f(x) = 0.14304453x - 0.10102288x^2 - 0.02103815x^3 + 0.10071059x^4$

Table 4 (continued)

DEPLETION RELATIONS (con.)

Transition:

Sand -

First layer moisture range, 1.05

$f(x) = 0.08401220x - 0.01562037x^2 - 0.10949078x^3 + 0.12228349x^4$

Second layer moisture range, 0.72

$f(x) = 0.12713529x - 0.53982006x^2 + 1.12524850x^3 - 0.58561447x^4$

Silt -

First layer moisture range, 1.55

$f(x) = 0.1138717x - 0.6558373x^2 + 1.8700644x^3 - 2.3253802x^4 + 1.2952910x^5 - 0.26246686x^6$

Second layer moisture range, 1.25

$f(x) = 0.02789788x + 0.24453131x^2 - 0.86060142x^3 + 1.2998033x^4 - 0.097359290x^5 + 0.29132112x^6$

Clay -

First layer moisture range, 1.43

$f(x) = 0.08321811x + 0.11716883x^2 - 0.14710818x^3 + 0.04910032x^4$

Second layer moisture range, 0.93

$f(x) = 0.03492386x + 0.36829518x^2 - 0.90742210x^3 + 0.61582018x^4$

Winter:

Sand -

First layer moisture range, 0.54

$f(x) = 0.12882001x - 0.32751050x^2 + 1.0509886x^3 - 1.0462256x^4$

Second layer moisture range, 0.35

$f(x) = 0.09068948x + 0.37645999x^2 - 0.79837781x^3 + 1.1306980x^4$

Silt -

First layer moisture range, 0.42

$f(x) = 0.16554710x + 0.32448206x^2 - 3.5931164x^3 + 6.0923182x^4$

Second layer moisture range, 0.30

$f(x) = 0.16854730x - 1.2164306x^2 + 5.0226953x^3 - 5.9828479x^4$

Clay -

First layer moisture range, 0.92

$f(x) = 0.13851029x - 0.32294633x^2 + 0.51095728x^3 - 0.23644523x^4$

Second layer moisture range, 0.46

$f(x) = 0.14694158x - 0.50856800x^2 + 1.2942848x^3 - 0.74715639x^4$

where

x = soil moisture content (in. per 6-in. layer) above minimum moisture content

2 of 3 sheets

Table 4 (concluded)

MAXIMUM SOIL MOISTURE CONTENT AND MINIMUM SOIL MOISTURE CONTENT

USDA Soil Textural Classification Terms

Field maximum

First layer

F. max = 2.01 - 0.013 S + 0.132 OM + 0.189 WI

Second layer

F. max = 2.01 - 0.15 S + 0.008 C + 0.215 WI

Field minimum

First layer

F. min = -0.121 + 0.018 C + 0.101 OM + 0.105 WI

Second layer

F. min = 0.170 + 0.025 C + 0.013 OM + 0.061 WI

Unified Soil Classification System Terms

Field maximum

First layer

F. max = 0.602 + 0.011 F + 0.014 LL + 0.181 WI

Second layer

F. max = 0.221 + 0.014 F + 0.011 LL + 0.224 WI

Field minimum

First layer

F. min = -0.354 - 0.001 F + 0.024 LL + 0.092 WI

Second layer

F. min = -0.094 - 0.001 F + 0.025 LL + 0.044 WI

where

F = fines in percent
LL = liquid limit
WI = wetness index (see table 5)
S = sand in percent
OM = organic matter in percent
C = clay in percent

Table 5

Classification of Sites by Wetness Index

Wetness Index	Potential Wetness	Depth to Water Table	Depth of Wetting	General Characteristics of Sites*
0	Arid	Indeterminable	Less than 1 ft (0.3 m)	Located in desert regions
1	Dry	Indeterminable	1-4 ft (0.3 to 1.2 m)	Steeply sloping, denuded, or severely eroded and gullied. Mostly semiarid to arid regions
2	Average	More than 4 ft (1.2 m)	More than 4 ft (1.2 m)	Well-drained soil with no restricted layers or pans; fair to good internal and external drainage. Slope may be flat to steep
3	Wet	1-4 ft (0.3-1.2m)	To water table	Soil not well drained. Restricted layers or deep pans may be present. May occur at base of slopes, on terraces, upland flats, or bottomlands
4	Saturated	Less than 1 ft (0.3 m)	To water table	Sites waterlogged or flooded at least part of year. Bottomlands subject to frequent overflow. Upland flats with poor internal drainage or shallow pans. Slopes with very poor internal drainage

* For use in classification when water table and wetting depths are not measured.

Table 6

Relation of CI-MC Coefficients to Soil Property Groups

CI-MC Coefficient (Y), MC at CI's of	No. of the Equation Set	Intercept (a)	Partial Regression Coefficients (b)								
			Sand	ln Silt	ln Clay	Fines	ln-ln LL	ln-ln PL	PI	Organic Matter	Dry Density
200	4	+0.866	-0.007	--	--	--	--	+2.20881	--	-0.053	--
300		+0.820	-0.012	--	--	--	--	+2.15453	--	-0.067	--
200	1	+4.059	-0.016	-0.1532	-0.0059					--	--
300		+3.409	-0.019	-0.0871	+0.0677					--	--
200	2	+1.290				+0.008	-1.09364	+2.07387	+0.009		
300		+0.650				+0.013	-0.72716	+1.67302	+0.009		
200	5	+0.272				+0.007	-0.22320	+2.28968	+0.004	-0.055	--
300		-0.846				+0.010	+0.62087	+1.91759	+0.002	-0.081	--
200	3	+1.002					-0.17148	+1.97572	+0.006		
300		+0.208					+0.69014	+1.52218	+0.005		
200	6	-0.321					+0.73907	+2.32219	+0.001	-0.077	--
300		-1.765					+2.11222	+1.96798	-0.004	-0.115	--

☐ Variables not made available for addition to the fit.
Relation is of form $\ln y = a+b_1x_1+b_2x_2+\ldots+b_ix_i$

Table 7

Relation of RCI-MC Coefficients to Soil Property Groups

RCI-MC Coefficient (Y), MC at RCI's of	No. of the Equation Set	Intercept (a)	Partial Regression Coefficients (b)								
			Sand	ln Silt	Clay	Fines	ln-ln LL	PL	PI	Organic Matter	Dry Density
100	4	+0.784					+1.49869	+0.026			
200		+0.985					+1.08056	+0.033			
100	1	+3.025	-0.001	+0.0143	+0.012						
200		+4.740	-0.011	-0.3582	+0.001						
100	2	-0.101				-0.001	+2.39889	+0.023	-0.005		
200		+0.004				+0.002	+1.76424	+0.031	-0.004		
100	5	-0.543				-0.002	+2.44112	+0.031	-0.005		+0.004
200		-0.686				+0.001	+1.83022	+0.042	-0.005		+0.006
100	3	-0.154					+2.34307	+0.023	-0.004		
200		+0.107					+1.87108	+0.030	-0.004		
100	6	-0.583					+2.34990	+0.030	-0.005		+0.003
200		-0.662					+1.88333	+0.042	-0.005		+0.006

Variables not made available for addition to the fit.
Relation is of form $\ln y = a+b_1x_1+b_2x_2+\ldots+b_ix_i$

APPENDIX A: DETAILED FLOW CHARTS OF COMPUTER PROGRAM

Appendix A contains detailed flow charts of the main program and subroutines produced by the computer program, FLOWGEN/F-II, which is on file in the WES Automatic Data Processing Center. Each segment (subroutine) is detailed separately. The flow charts of the main program and subroutines are as follows: main program, fig. A1; subroutine WRIBWK (part of main program), fig. A2; subroutine COMPMS, fig. A3; subroutine FIL1DA, fig. A4; subroutine FIL2DA, fig. A5; subroutine FRODEP, fig. A6; subroutine STFRSP, fig. A7; and subroutine CALSST, fig. A8.

Fig. A1. Detailed Flow Chart of Main Program
(34 pages)

```
C     $OVR.COMPMS
C     $OVR.FIL1DA
C     $OVR.FIL2DA
C     $OVR.FRODEF
C     $OVR.CALSST
C     $OVR.STFRSP
C     $RPC
C     *****COMMON VARIABLES*************************************************
```

```
COMMON IDC1(35).PMC(2).STO(12.31).NSTEQ(4).RF(7).IHD(20).CXMIN(2).
TEMPER(12.35).SNO(12.35).CONEW(3.2.6).XRANG(2.3).STCON(2.4).
STRLI(2.4).NMAXD(2).ISINUM(4).C3(2.2).C4(2.2).DWMC(2.7).COEF(108).
MAXD(12).IMOA(4.12).BD(2).RANG(2.3.3).X(2).C1(16.2).C5(16.4.2).
CMAX(2).CMIN(2).C2(4).STORMC(12.31).STORMD(12.31).ADF(2).SDF(2).
IT(2).KIND(3).ISLEW(3).DUM(25).PRECIP(12.35).B(13.2.2).B1(12).
CON1(2.2).D(2).E(2).IMOD(12.2).ABAR(2.2).BBAR(2.2).NMCLA1(2).
NMCLA2(2).NPMLA1(2).NPMLA2(2).NFRDEP(2).NCILA1(2).NCILA2(2).
```

```
NRCLA1(2).NRCLA2(2).NSOUR.IUNMEA.NTEMP.NSNOW.NYR.ITEXA.
ITEXB.RMIN.ITYPE.ITEM1.ITEM2.II.IDEV1.IS1.ISD.ISM.ISY.IIT.IDA.
MO.IYR.ITEMP.ICOUNT.ACCR.DEP.C1COF.C1ROF.NCODE.ACCR1.ACCR2.MOK.
JUL.JIL.JUG.LUB.JOK.MOB.JEM.JAZ.JEL.JEB.
NTYPE.NEWLIM.NEWCOF.NSOST.NR.LL.JUB.IBD.IBM.IBY.NEWYR.
MEAOU1.MEAOU2.K.LK.JB.JEND.KTOS.AJBN.JBN.JN.KPMC.SECT1.SECT2.
SECT3.SECT4.SECT5.SECT6.SECT7.SECT8.SECT9.SECT10.NCI.NRCI.
SAM.IND.IDAB.IDAE.JNK.JNI.NO.STON.NUMB.ISEQ.NY1SEQ.NY2SEQ
```

```
C     *****EQUIVALENCED VARIABLES*************************************
```

```
EQUIVALENCE (NMCLA1.DMCLA1).(NMCLA2.DMCLA2).(NPMLA1.DPMLA1).
(NPMLA2.DPMLA2).(NFRDEP.DFRDEP).. CILA1.DCILA1).(NCILA2.DCILA2).
(NRCLA1.DRCLA1).(NRCLA2.DRCLA2)
```

```
C     *****DATA INITIALIZATION*****************************************
```

```
DATA NUMB.ISEQ.NY1SEQ.NY2SEQ.NEWFIL.ACCR1.ACCR2/'001'.0.0.0.
0.0.01.0.03/
```

```
DATAIMOA/12HJANUARY     .12HFEBRUARY    .12HMARCH       .
12HAPRIL        .12HMAY         .12HJUNE        .
12HJULY         .12HAUGUST      .12HSEPTEMBER   .
12HOCTOBER      .12HNOVEMBER    .12HDECEMBER    /
```

```
DATAMAXD/31.28.31.30.31.30.31.31.30.31.30.31/
```

```
DATA COEF/0.15970948.-0.28827749.0.37098284.-.13067845.0..0..
0.20865303.-0.64984646.0.87560732.-.30605206.0..0..
.15190803.-.07720229.-.01280603..01851488.0..0..
0.1164190.0.06704479.-0.09112914.0.03120642.0..0..
.09612290..01073670.-.10720756..05648077.0..0..
.14304453.-.10102288.-.02103815..10071059.0..0..
0.08401220.-0.01562037.-0.10949078.0.12228349.0..0..
0.12713529.-0.53982006.1.1252485.-0.58561447.0..0..
```

```
.11387171.-.65583730.1.8700644.-2.3253802.
1.2952910.-.26246686.
```

CONT. ON PG 2

```
0.02789788.0.24453131.-0.86060142.1.2998033.
-.97359290..29132112.
.08321011..11716003.-.14710818..04910032.0..0..
.03492386..36029518.-.90742210..61582018.0..0..
0.12882001.-0.3275105.1.0509886.-1.0462256.0..0..
0.09068948.0.37645999.-0.79837781.1.130698.0..0..
```

```
.16554710..32448206.-3.5931164.6.0923182.0..0..
.1685473.-1.2164306.5.0226953.-5. 828479.0..0..
.13851029.-.32294833..51095728.-.23644623.0..0..
.14694158.-.508568.1.2942848.-.74715639.0..0./
```

```
DATA RMIN.STRLI.CICOF.NEWCOF/0.1.750..0..750..0..300..0..300..0..
0.07.0/.
STORMC.STORMD.TEMPER.SNO.STO/372*0..372*0..420*0..420*0..372*0./.
NYR.NMAXO/1.0.0/.C3/.47..75..22..60/.C4/-.01.-.05.-.01.-.02/
```

```
DATA RANO/1.26.1.00.1.87.1.63.1.47.1.08.1.05.0.72.1.55.
1.25.1.43.0.93.0.54.0.36.0.42.0.30.0.92.0.46/
```

```
DATA RF.PRECIP/7*0..420*0./.MOK.JUL.JIL.JUO.LUB.JOK.MOB.JEM.JAZ.
JEL.JEB/0.0.0.0.0.0.0.0.0.0.0./.JUB.KIND/0.3*0/.ISLEW/6193023.
8356711.8356711/.NEWCOF.NEWLIM.NSOST/0.0.0/.NTOS/1H9/
```

```
DATA C5/0.602.0..0..0..0.011.0.014.0..0..0..0..0.181.0..0..0..0..0
0.221.0..0..0..0.014.0.011.0..0..0..0..0.224.0..0..0..0..0..
-0.354.0..0..0..-0.001.0.024.0..0..0..0..0.092.0..0..0..0..0..
-0.094.0..0..0..-0.001.0.025.0..0..0..0..0.044.0..0..0..0..0..
2.01.-0.013.0..0..0..0..0..0..0.132.0..0.189.0..0..0..0..0..
2.01.-0.015.0..0.008.0..0..0..0..0..0..0.215.0..0..0..0..0..
-0.121.0..0..0.018.0..0..0..0..0..0.101.0..0.196.0..0..0..0..0..
0.170.0..0..0.026.0..0..0..0..0.013.0..0.061.0..0..0..0..0./
```

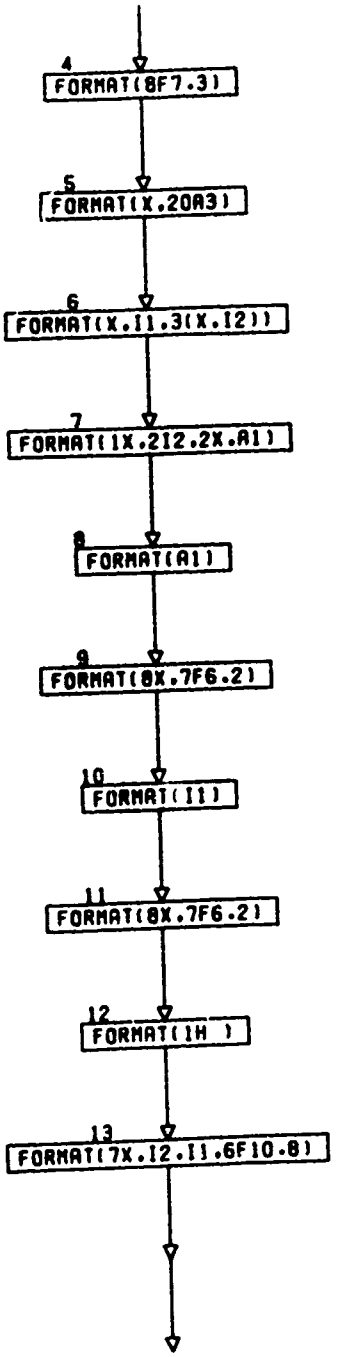
```
C     *****FORMAT STATEMENTS*****************************************
```

```
1
FORMAT(2X.4A3.2X.2(A1.2X1.2F10.0)
```

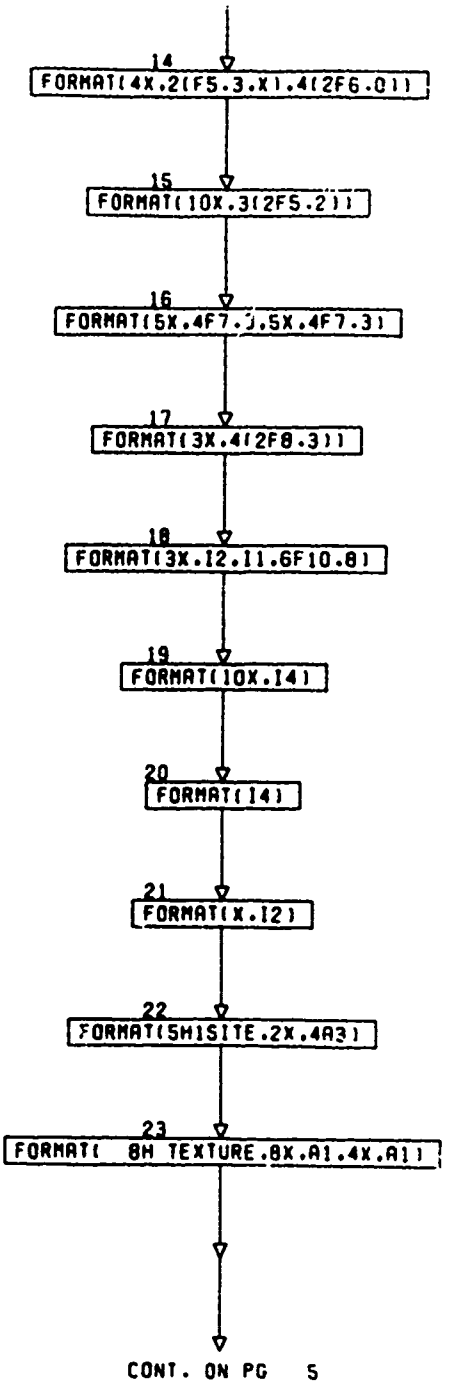
```
2
FORMAT(1X.F9..7F10.)
```

```
3
FORMAT(1X.I2.2I1.4X.8F7.3)
```

CONT. ON PG 3


4
FORMAT(8F7.3)
5
FORMAT(X,20A3)
6
FORMAT(X,I1,3(X,I2))
7
FORMAT(1X,2I2,2X,A1)
8
FORMAT(A1)
9
FORMAT(8X,7F6.2)
10
FORMAT(I1)
11
FORMAT(8X,7F6.2)
12
FORMAT(1H)
13
FORMAT(7X,I2,I1,6F10.8)

CONT. ON PG 4


14
FORMAT(4X,2(F5.3,X),4(2F6.0))
15
FORMAT(10X,3(2F5.2))
16
FORMAT(5X,4F7.0,5X,4F7.3)
17
FORMAT(3X,4(2F8.3))
18
FORMAT(3X,I2,11,6F10.8)
19
FORMAT(10X,I4)
20
FORMAT(I4)
21
FORMAT(X,I2)
22
FORMAT(5H1SITE,2X,4A3)
23
FORMAT(8H TEXTURE,8X,A1,4X,A1)
CONT. ON PG 5

PG 4 OF 54

24
FORMAT(8H DENSITY,7X,F6.2,4X,F6.2)

25
FORMAT(7H BEG MC,4X,2F10.2)

26
FORMAT(16H SOIL PROPERTIES,5X,5F10.3/2X,7F10.3/2X,6F10.3)

27
FORMAT(11H MAX-MIN MC,6X,4F10.3)

28
FORMAT(3X,2I2)

29
FORMAT(13H COEFFICIENTS,8X,4F10.3/2X,6F10.3/2X,6F10.3)

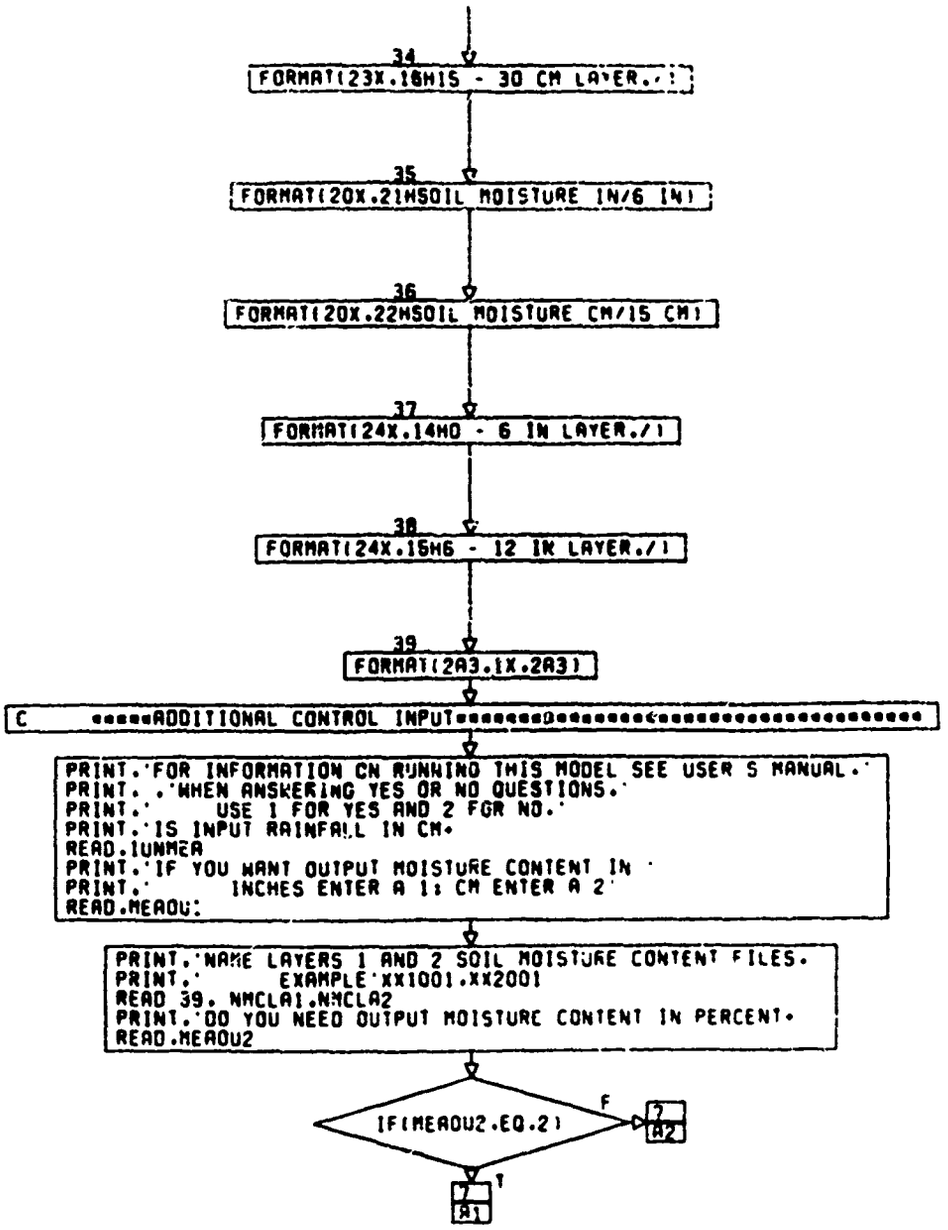
30
FORMAT(1X,F9.0,F10.)

31
FORMAT(1X,3I2,X,7F6.2)

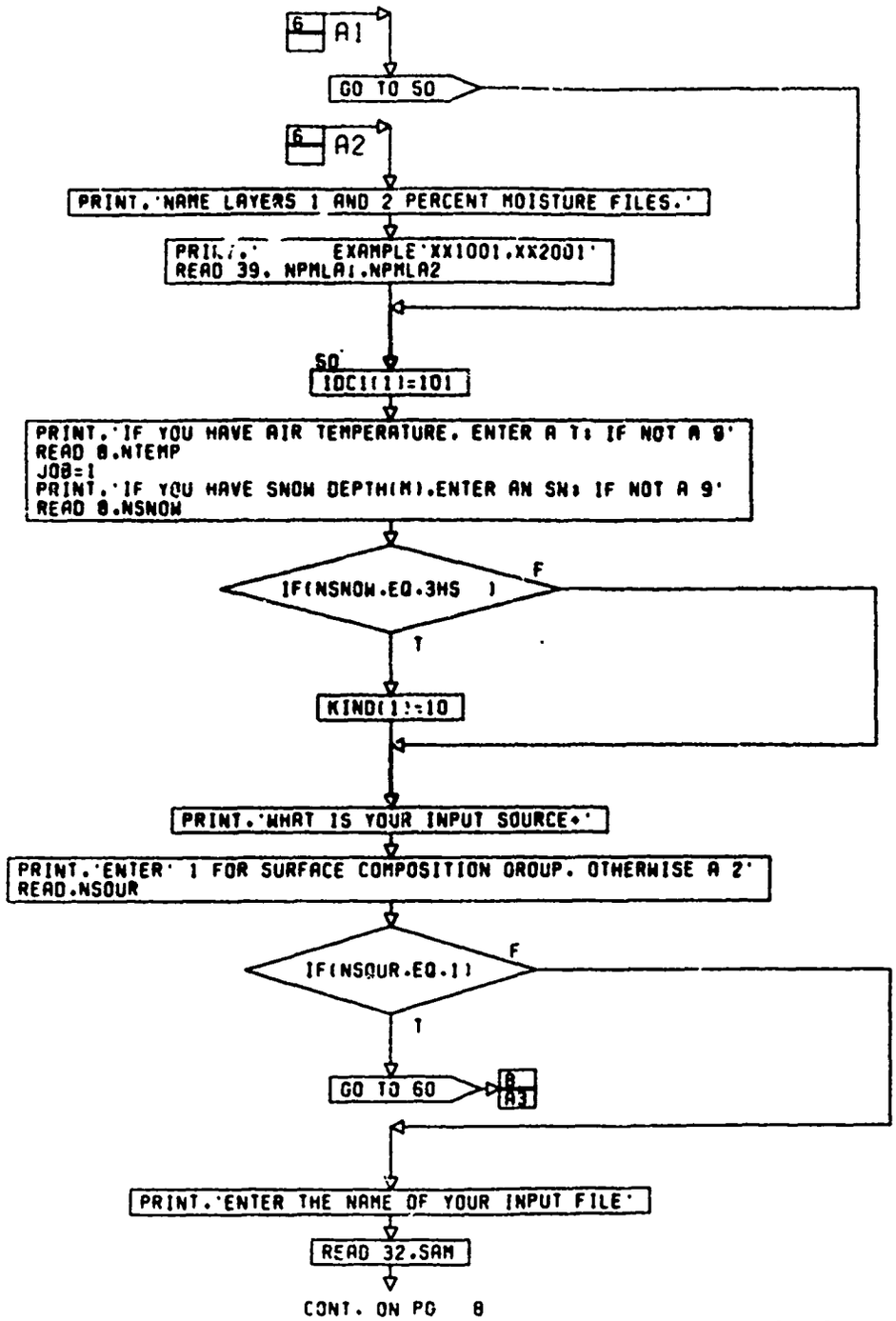
32
FORMAT(A6)

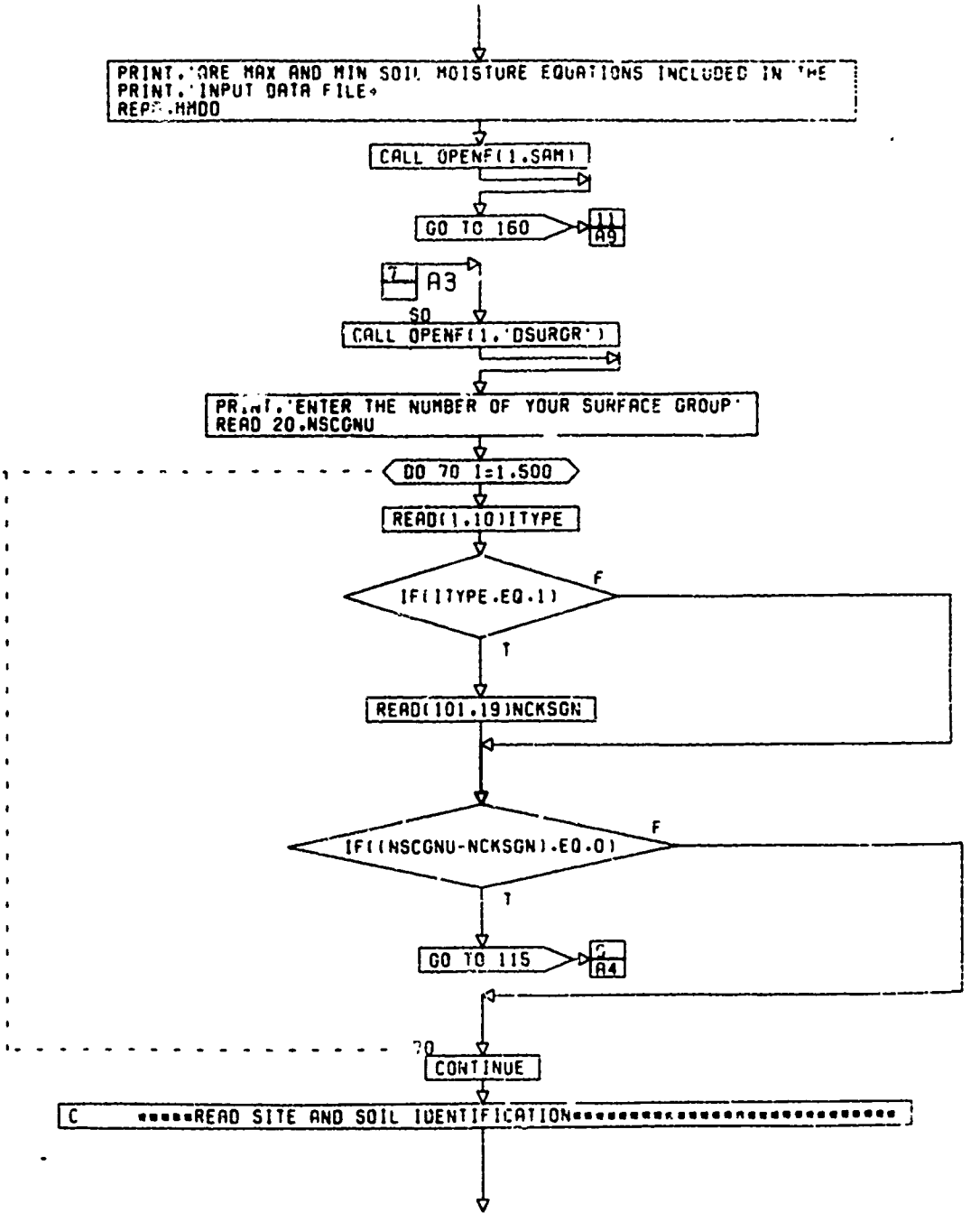
33
FORMAT(24X,15HO - 15 CM LAYER,/)

CONT. ON PG 6


34
FORMAT(23X,16H15 - 30 CM LAYER./)
35
FORMAT(20X,21HSOIL MOISTURE IN/6 IN)
36
FORMAT(20X,22HSOIL MOISTURE CM/15 CM)
37
FORMAT(24X,14H0 - 6 IN LAYER./)
38
FORMAT(24X,15H6 - 12 IN LAYER./)
39
FORMAT(2A3,1X,2A3)
C ******ADDITIONAL CONTROL INPUT*********
PRINT,'FOR INFORMATION ON RUNNING THIS MODEL SEE USER S MANUAL.'
PRINT, ,'WHEN ANSWERING YES OR NO QUESTIONS.'
PRINT,' USE 1 FOR YES AND 2 FOR NO.'
PRINT,'IS INPUT RAINFALL IN CM.
READ,IUNMER
PRINT,'IF YOU WANT OUTPUT MOISTURE CONTENT IN '
PRINT,' INCHES ENTER A 1; CM ENTER A 2'
READ,MEAOU:
PRINT,'NAME LAYERS 1 AND 2 SOIL MOISTURE CONTENT FILES.
PRINT,' EXAMPLE'XX1001,XX2001
READ 39, NMCLA1,NMCLA2
PRINT,'DO YOU NEED OUTPUT MOISTURE CONTENT IN PERCENT.
READ,MEAOU2
IF(MEAOU2.EQ.2)
F
7
A2
T
7
A1

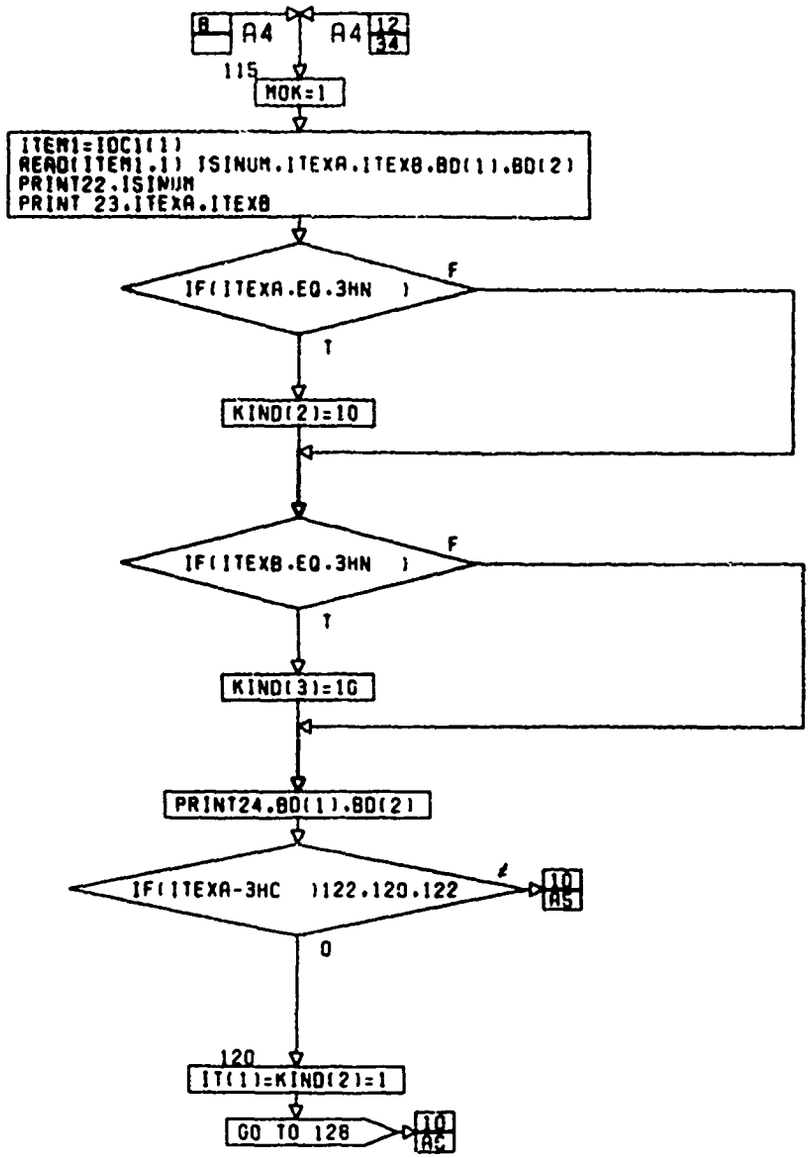
CONT. ON PG 7


6 A1
GO TO 50
6 A2
PRINT.'NAME LAYERS 1 AND 2 PERCENT MOISTURE FILES.'
PRINT.' EXAMPLE'XX1001.XX2001'
READ 39. NPMLA1.NPMLA2
50
IOC1(1)=101
PRINT.'IF YOU HAVE AIR TEMPERATURE. ENTER A T: IF NOT A 9'
READ 8.NTEMP
J08=1
PRINT.'IF YOU HAVE SNOW DEPTH(M).ENTER AN SN: IF NOT A 9'
READ 8.NSNOW
IF(NSNOW.EQ.3HS)
F
T
KIND(1)=10
PRINT.'WHAT IS YOUR INPUT SOURCE+'
PRINT.'ENTER' 1 FOR SURFACE COMPOSITION GROUP. OTHERWISE A 2'
READ.NSOUR
IF(NSOUR.EQ.1)
F
T
GO TO 60
A3
PRINT.'ENTER THE NAME OF YOUR INPUT FILE'
READ 32.SAM
CONT. ON PG 8

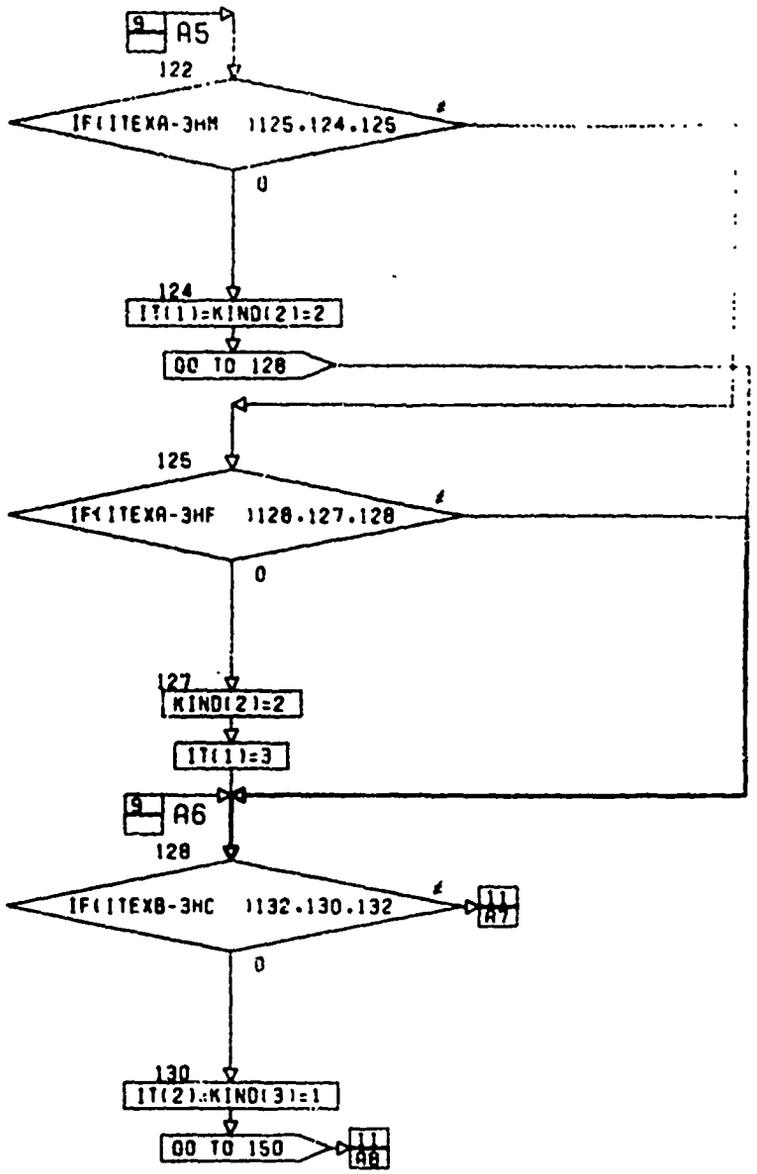


CONT. ON PG 9

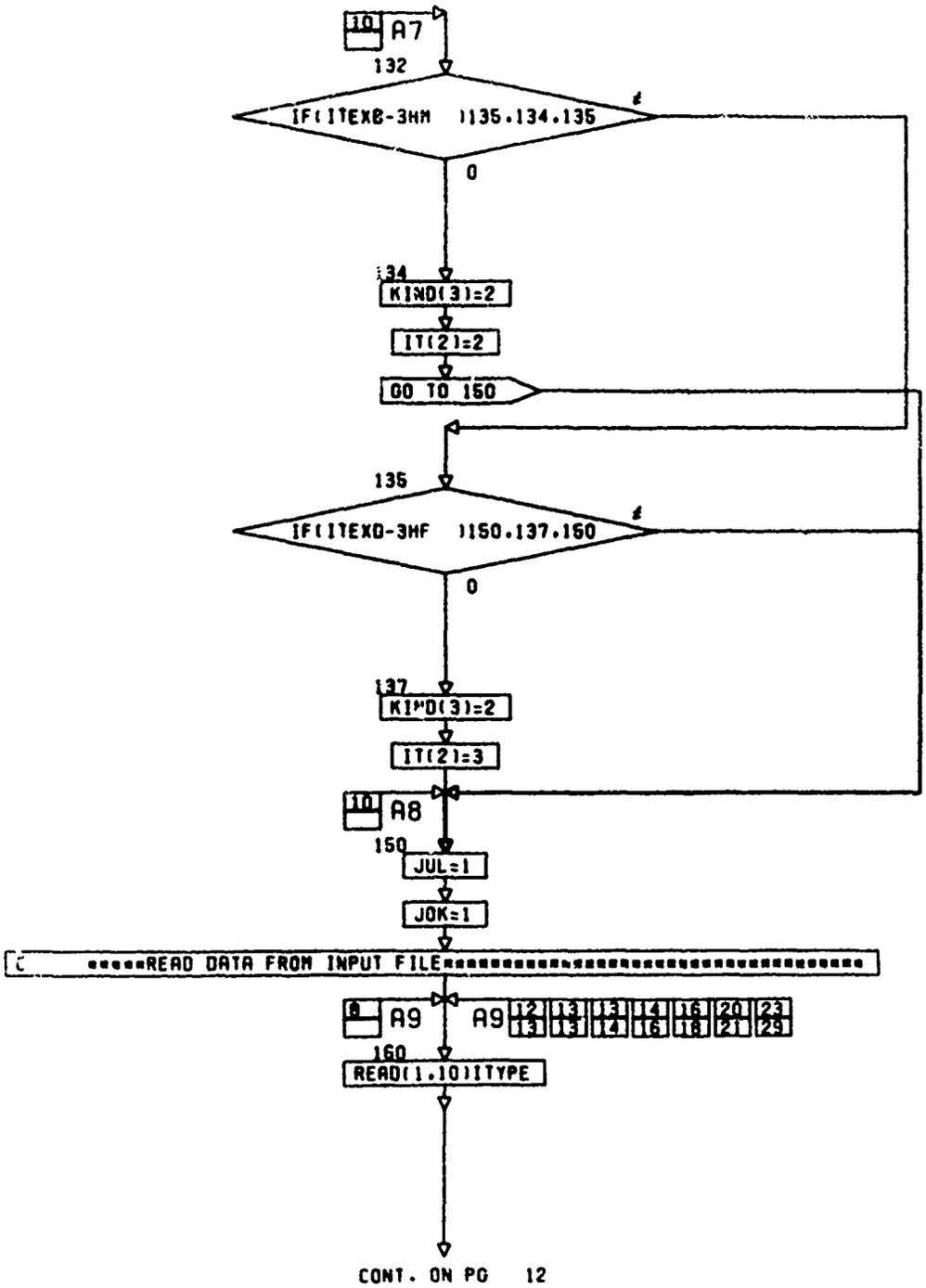
FIG 8 OF 34

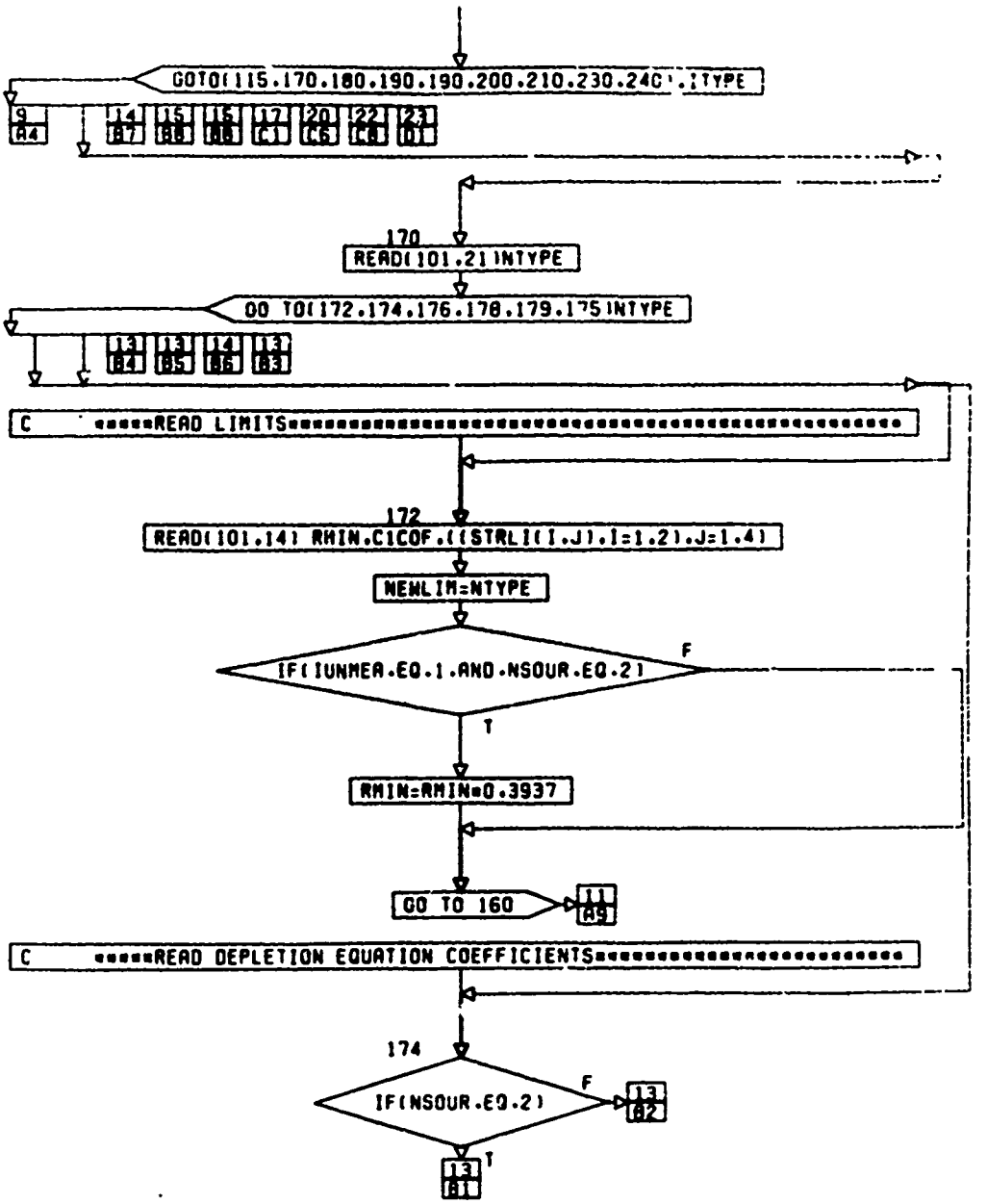

B
A4
A4
12
34
115
MOK=1
ITEM1=IOC1(1)
READ(ITEM1,1) ISINUM,ITEXA,ITEXB,BD(1),BD(2)
PRINT22,ISINUM
PRINT 23,ITEXA,ITEXB
IF(ITEXA.EQ.3HN)
F
T
KIND(2)=10
IF(ITEXB.EQ.3HN)
F
T
KIND(3)=10
PRINT24,BD(1),BD(2)
IF(ITEXA-3HC)122,120,122
10
A5
0
120
IT(1)=KIND(2)=1
GO TO 128
10
A5

CONT. ON PG 10

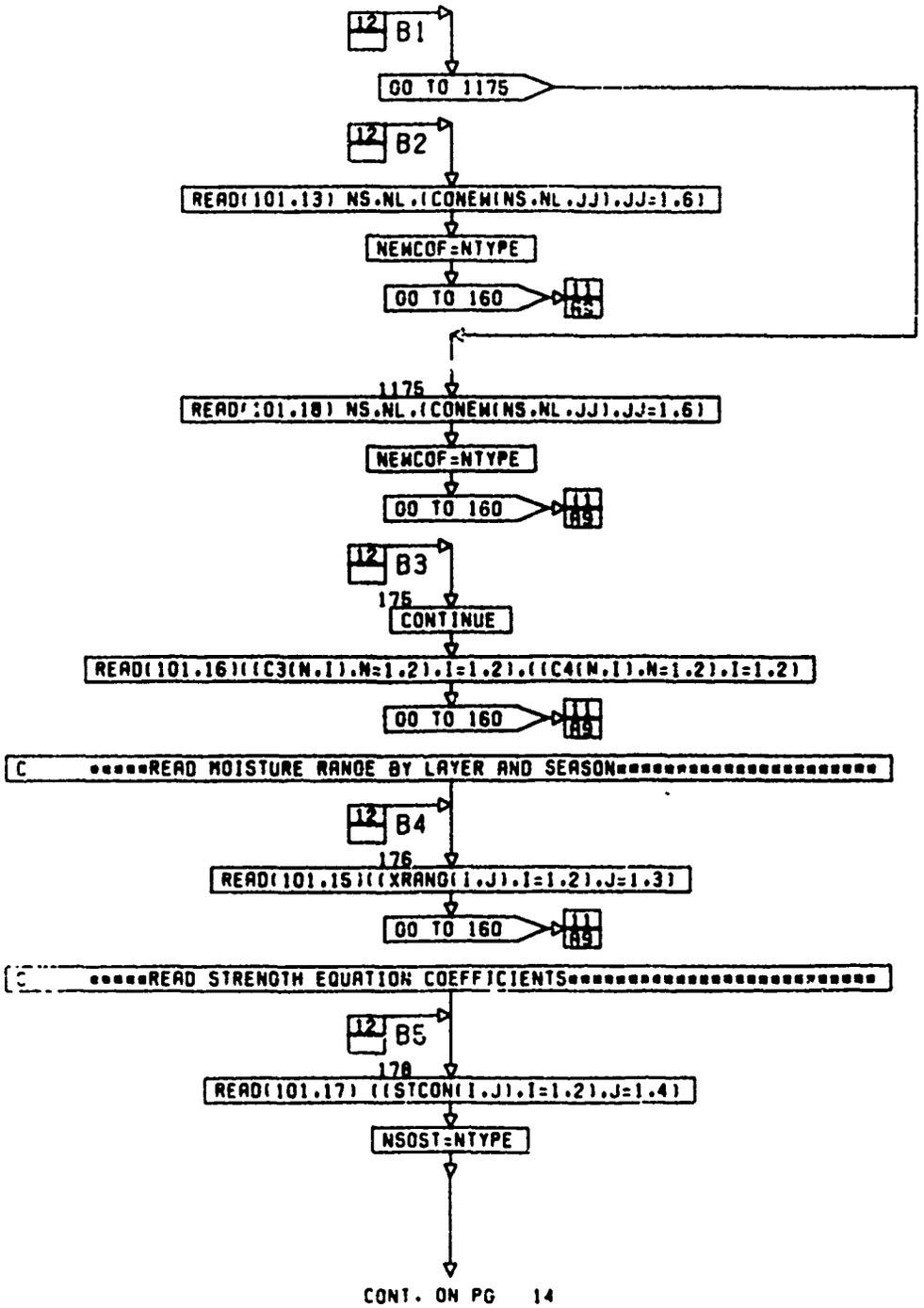

9
A5
122
IF(ITEXA-3HM 1125,124,125
0
124
IT(1)=KIND(2)=2
GO TO 128
125
IF(ITEXA-3HF 1128,127,128
0
127
KIND(2)=2
IT(1)=3
9
A6
128
IF(ITEXB-3HC 1132,130,132
11
A7
0
130
IT(2)=KIND(3)=1
GO TO 150
11
A8

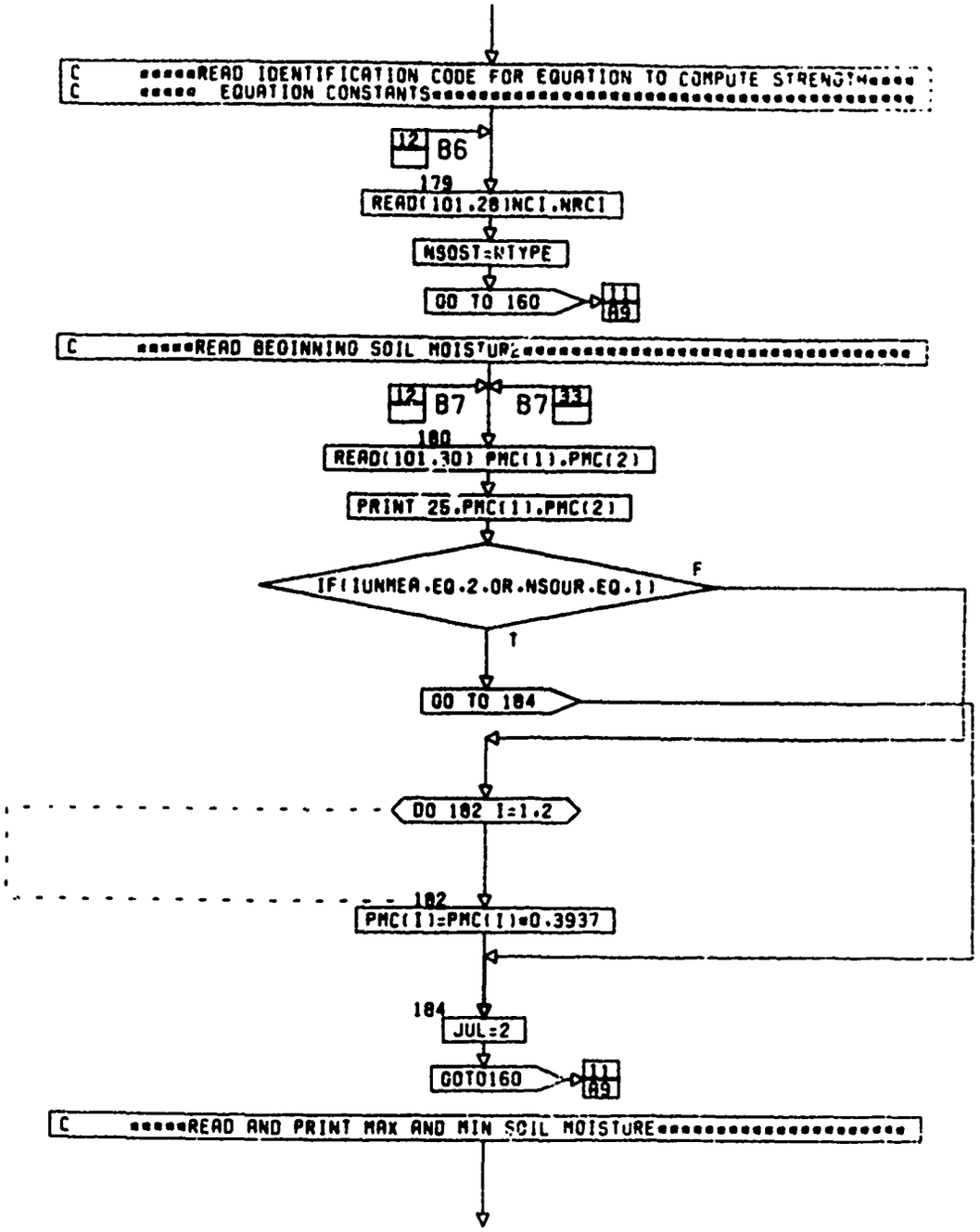
CONT. ON PG 11


10 A7
132
IF(ITEXB-3HM)135,134,135
0
134
KIND(3)=2
IT(2)=2
GO TO 150
135
IF(ITEXD-3HF)150,137,150
0
137
KIND(3)=2
IT(2)=3
10 A8
150
JUL=1
JOK=1
C *****READ DATA FROM INPUT FILE*****
A9
A9 12 13 13 14 16 20 23
13 13 14 16 18 21 29
160
READ(1,10)ITYPE
CONT. ON PG 12

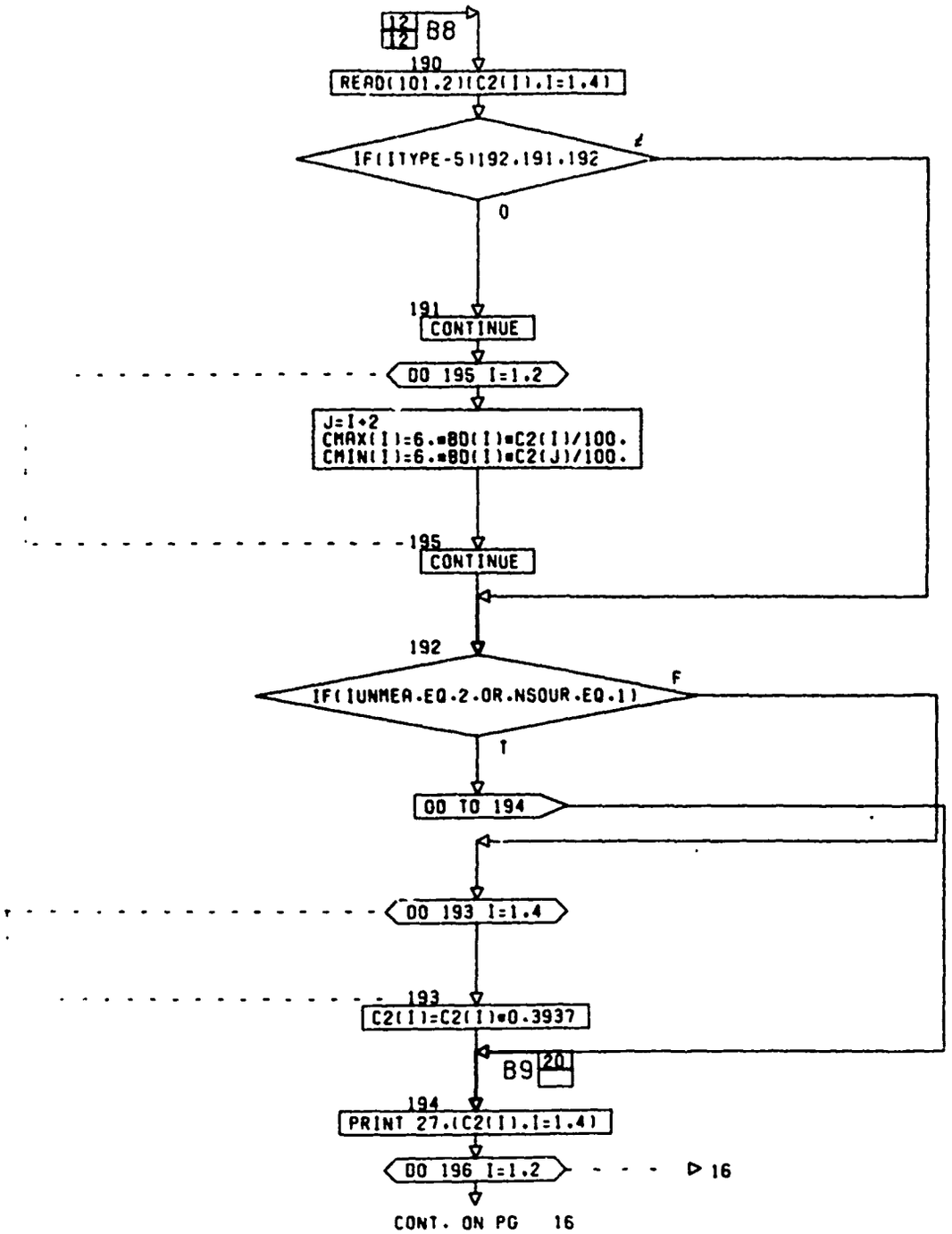

GOTO(115,170,180,190,190,200,210,230,240),ITYPE
9
A4
14
B7
15
B8
16
B9
17
C1
20
C6
22
C8
23
D1
170
READ(101,21)NTYPE
GO TO(172,174,176,178,179,175)NTYPE
13
B4
13
B5
14
B6
13
B3
C *****READ LIMITS*****
172
READ(101,14) RMIN,C1COF,((STRLI(I,J),I=1,2),J=1,4)
NEWLIM=NTYPE
IF(IUNMEA.EQ.1.AND.NSOUR.EQ.2)
F
T
RMIN=RMIN*0.3937
GO TO 160
11
A9
C *****READ DEPLETION EQUATION COEFFICIENTS*****
174
IF(NSOUR.EQ.2)
F
13
B2
T
13
B1

CONT. ON PG 13

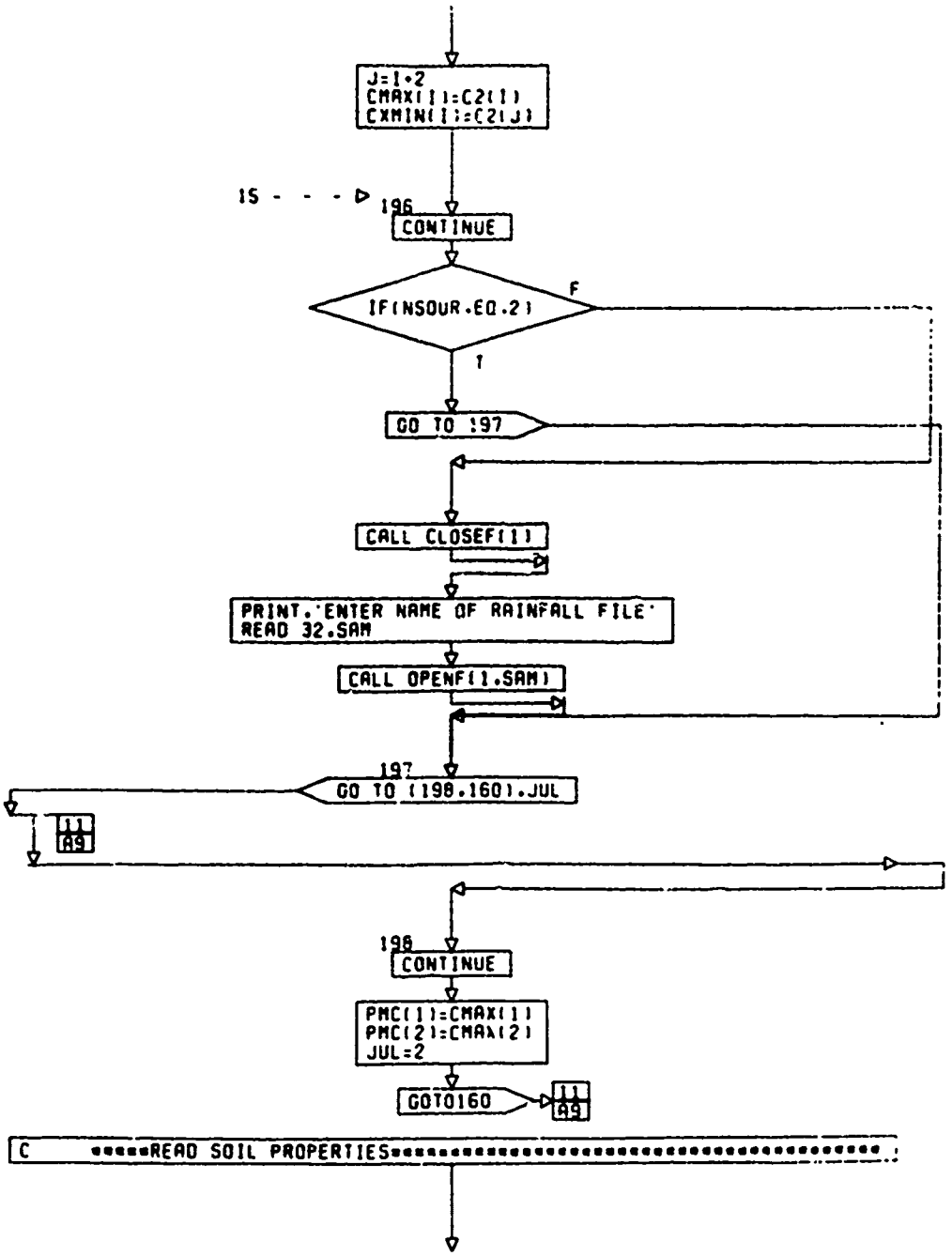

12 B1
GO TO 1175
12 B2
READ(101,13) NS,NL,(CONEW(NS,NL,JJ),JJ=1,6)
NEWCOF=NTYPE
GO TO 160
111 A5
1175
READ(101,18) NS,NL,(CONEW(NS,NL,JJ),JJ=1,6)
NEWCOF=NTYPE
GO TO 160
111 A9
12 B3
175
CONTINUE
READ(101,16)((C3(N,I),N=1,2),I=1,2),((C4(N,I),N=1,2),I=1,2)
GO TO 160
111 A9
C *****READ MOISTURE RANGE BY LAYER AND SEASON*****
12 B4
176
READ(101,15)((XRANG(I,J),I=1,2),J=1,3)
GO TO 160
111 A9
C *****READ STRENGTH EQUATION COEFFICIENTS*****
12 B5
178
READ(101,17) ((STCON(I,J),I=1,2),J=1,4)
NSOST=NTYPE
CONT. ON PG 14


C *****READ IDENTIFICATION CODE FOR EQUATION TO COMPUTE STRENGTH****
C ***** EQUATION CONSTANTS**********
12 B6
179
READ(101,28)NCI,NRCI
NSOST=NTYPE
GO TO 160
11 A9
C *****READ BEGINNING SOIL MOISTURE**********
12 B7
B7 33
180
READ(101,30) PMC(1),PMC(2)
PRINT 25,PMC(1),PMC(2)
IF(IUNMEA.EQ.2.OR.NSOUR.EQ.1)
F
T
GO TO 184
DO 182 I=1,2
182
PMC(I)=PMC(I)*0.3937
184
JUL=2
GOTO160
11 A9
C *****READ AND PRINT MAX AND MIN SOIL MOISTURE**********

CONT. ON PG 15

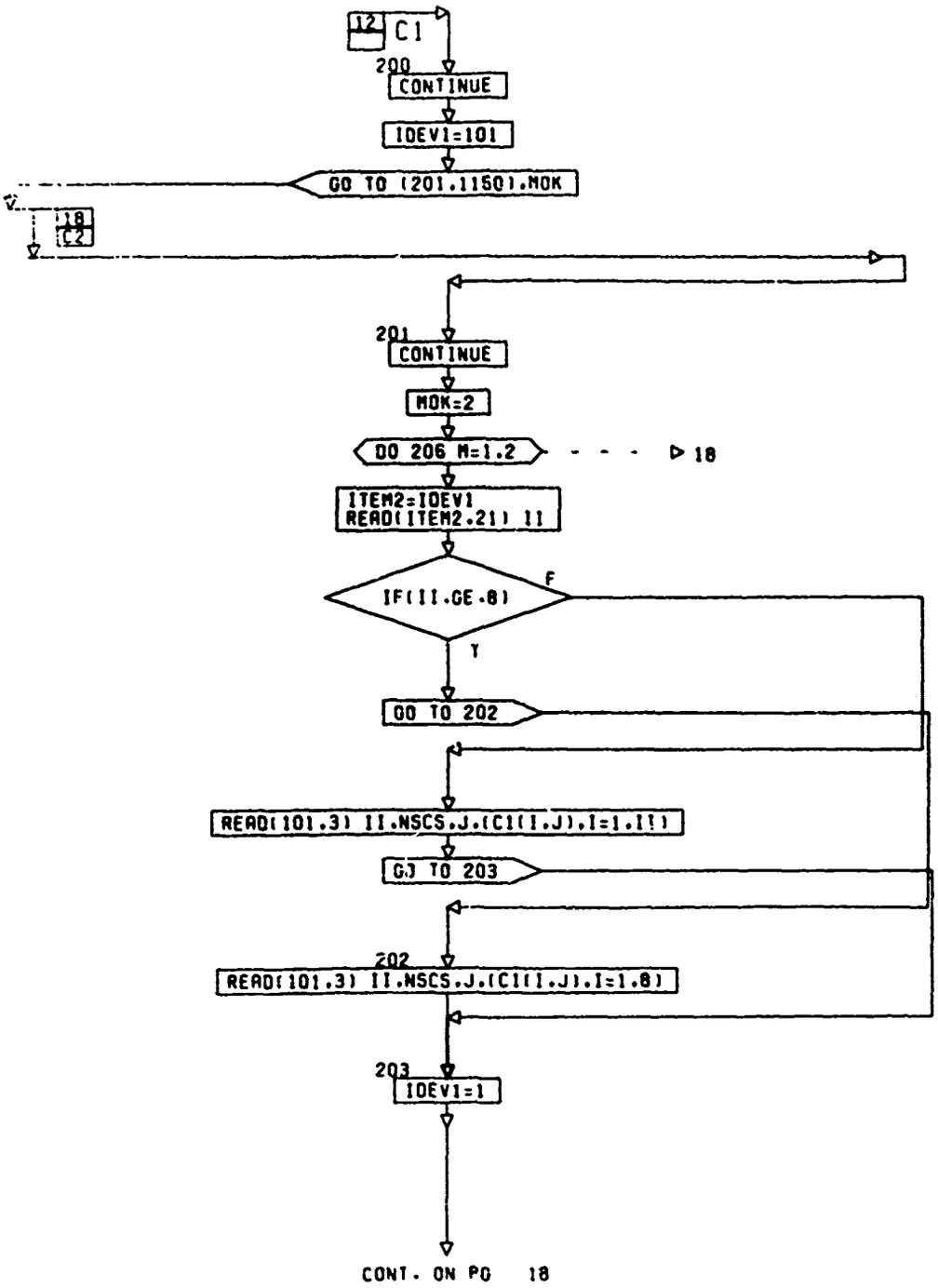

12
12
B8
190
READ(101,2)(C2(I),I=1,4)
IF(ITYPE-5)192,191,192
1
0
191
CONTINUE
DO 195 I=1,2
J=I+2
CMAX(I)=6.*BD(I)*C2(I)/100.
CMIN(I)=6.*BD(I)*C2(J)/100.
195
CONTINUE
192
IF(IUNMEA.EQ.2.OR.NSOUR.EQ.1)
F
T
GO TO 194
DO 193 I=1,4
193
C2(I)=C2(I)*0.3937
B9
20
194
PRINT 27,(C2(I),I=1,4)
DO 196 I=1,2
16
CONT. ON PG 16

PG 15 OF 34

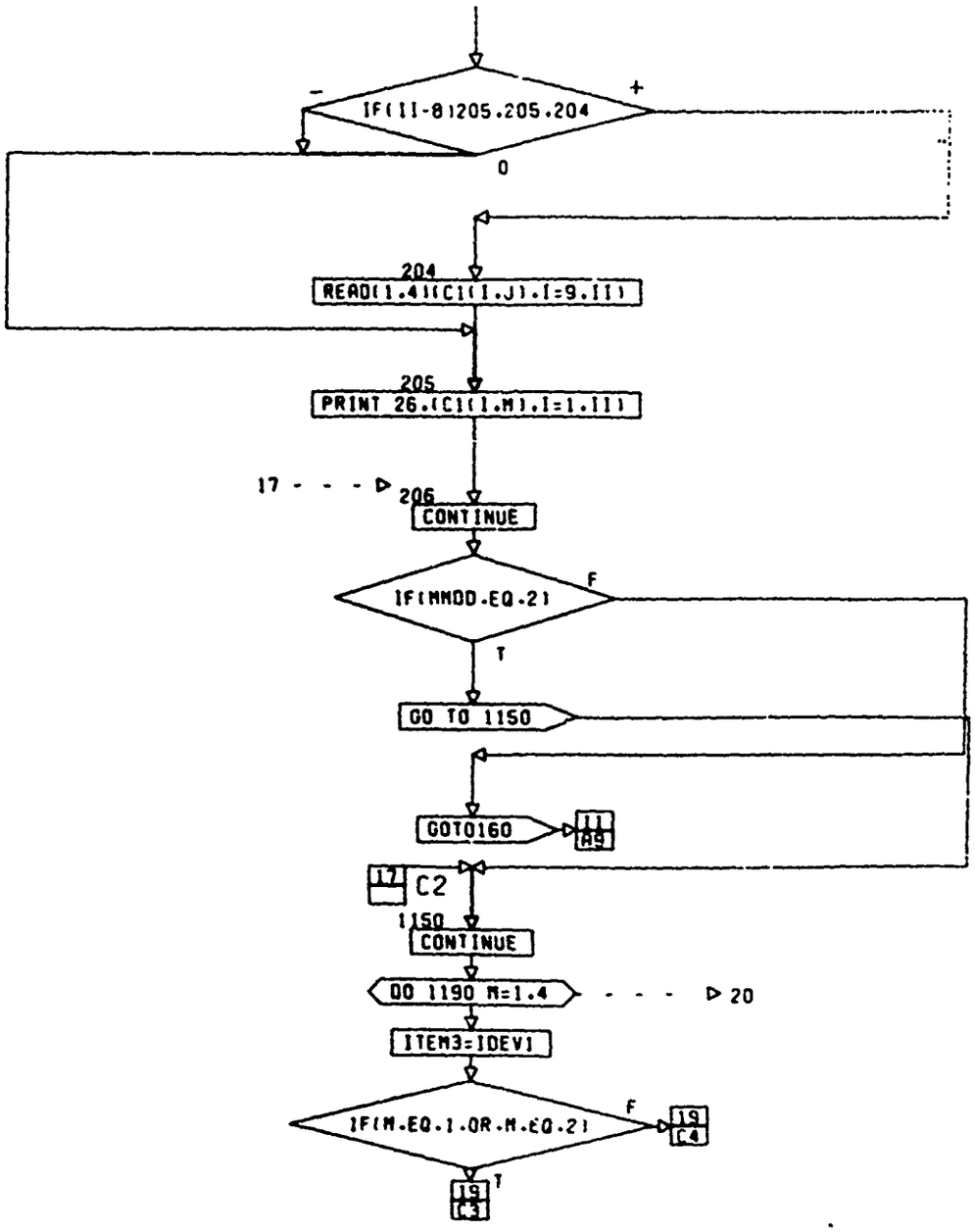


CONT. ON PG 17

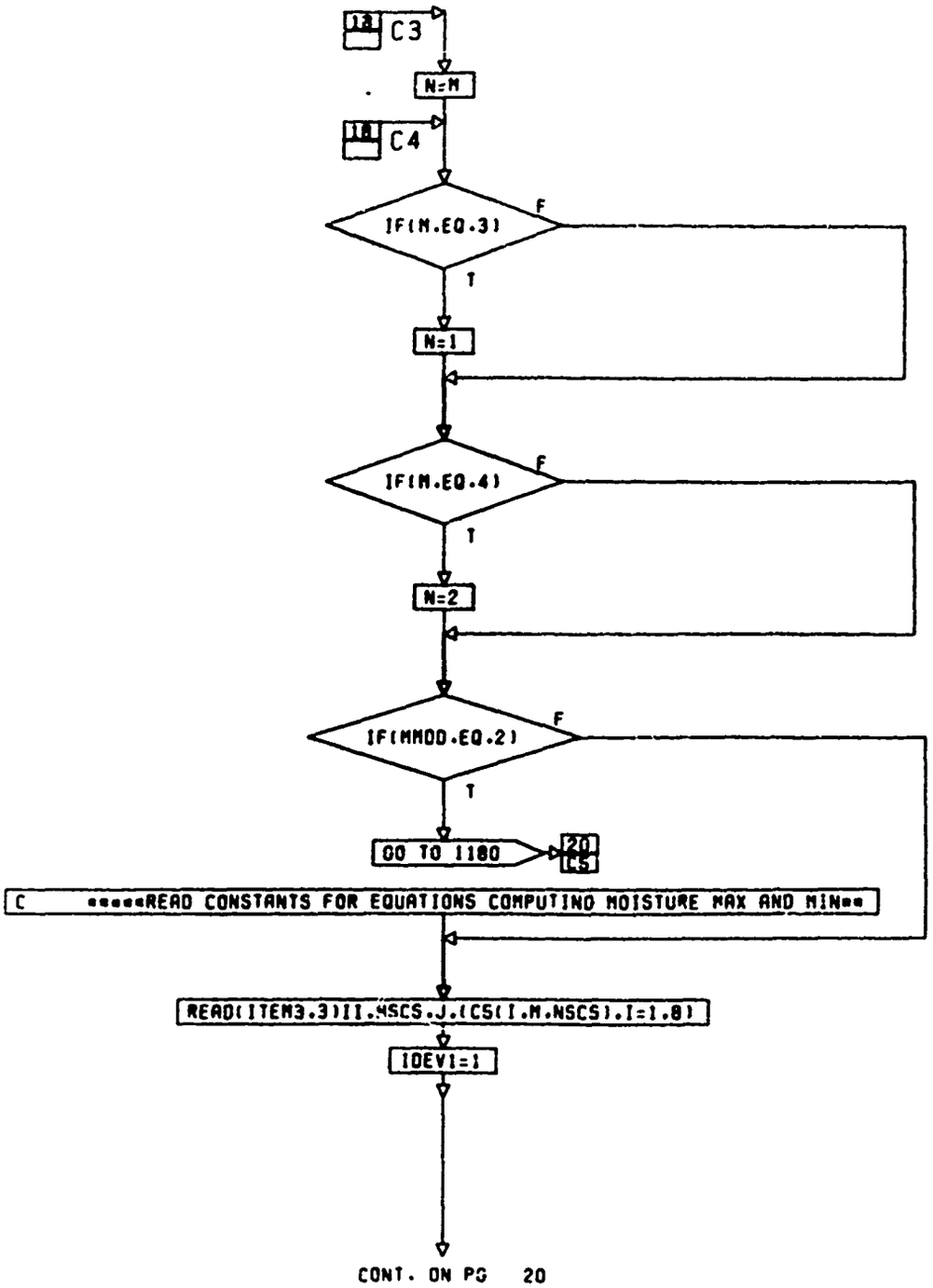
PG 16 OF 34

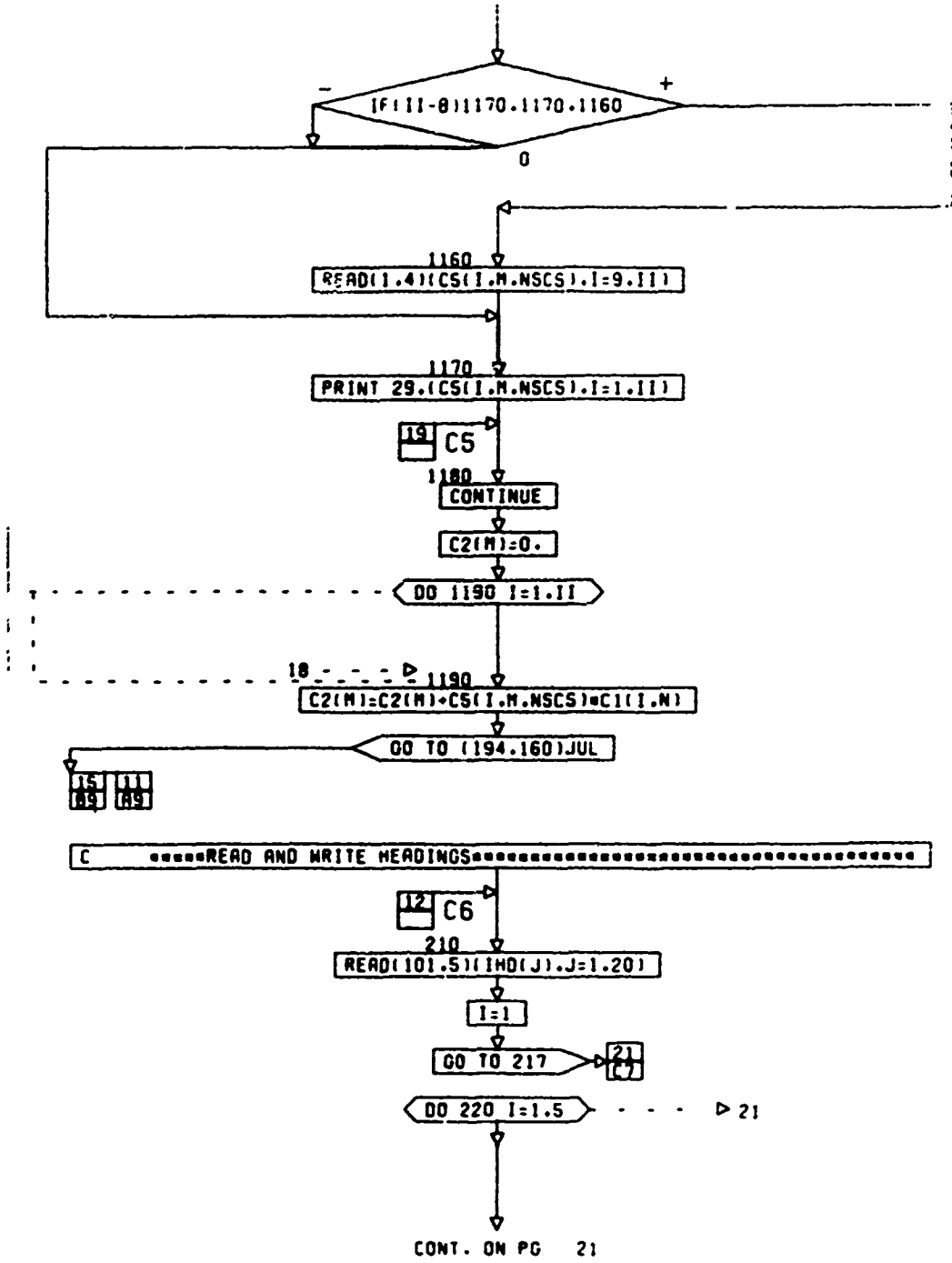

12
C1
200
CONTINUE
IDEV1=101
GO TO (201,1150),MOK
18
C2
201
CONTINUE
MOK=2
DO 206 M=1,2
18
ITEM2=IDEV1
READ(ITEM2,21) II
IF(II.GE.8)
F
T
GO TO 202
READ(101,3) II,NSCS,J,(C1(I,J),I=1,II)
GO TO 203
202
READ(101,3) II,NSCS,J,(C1(I,J),I=1,8)
203
IDEV1=1

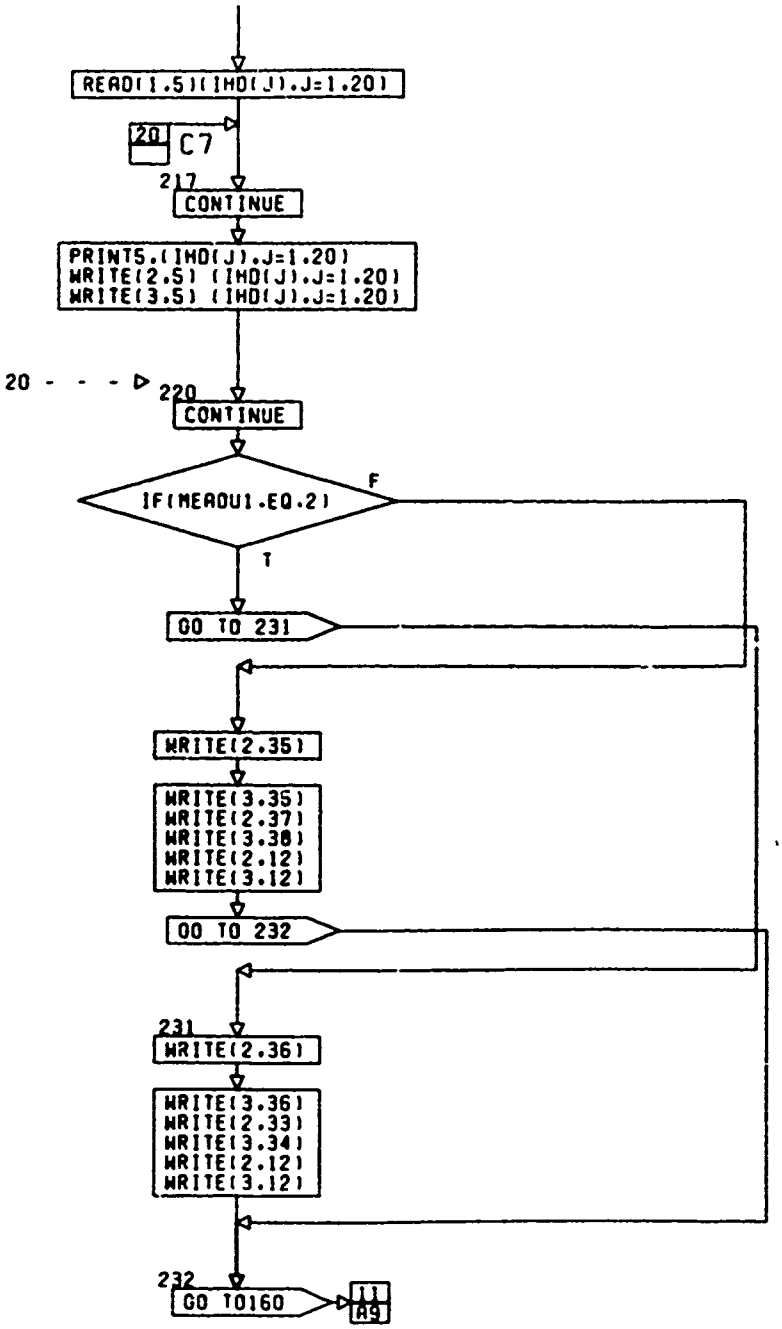
CONT. ON PG 18


IF(II-8)205,205,204
-
+
0
204
READ(1,4)(C1(I,J),I=9,II)
205
PRINT 26,(C1(I,M),I=1,II)
17
206
CONTINUE
IF(MMOD.EQ.2)
F
T
GO TO 1150
GOTO160
11
A9
17
C2
1150
CONTINUE
DO 1190 M=1,4
20
ITEM3=IDEV1
IF(M.EQ.1.OR.M.EQ.2)
F
19
C4
T
19
C3

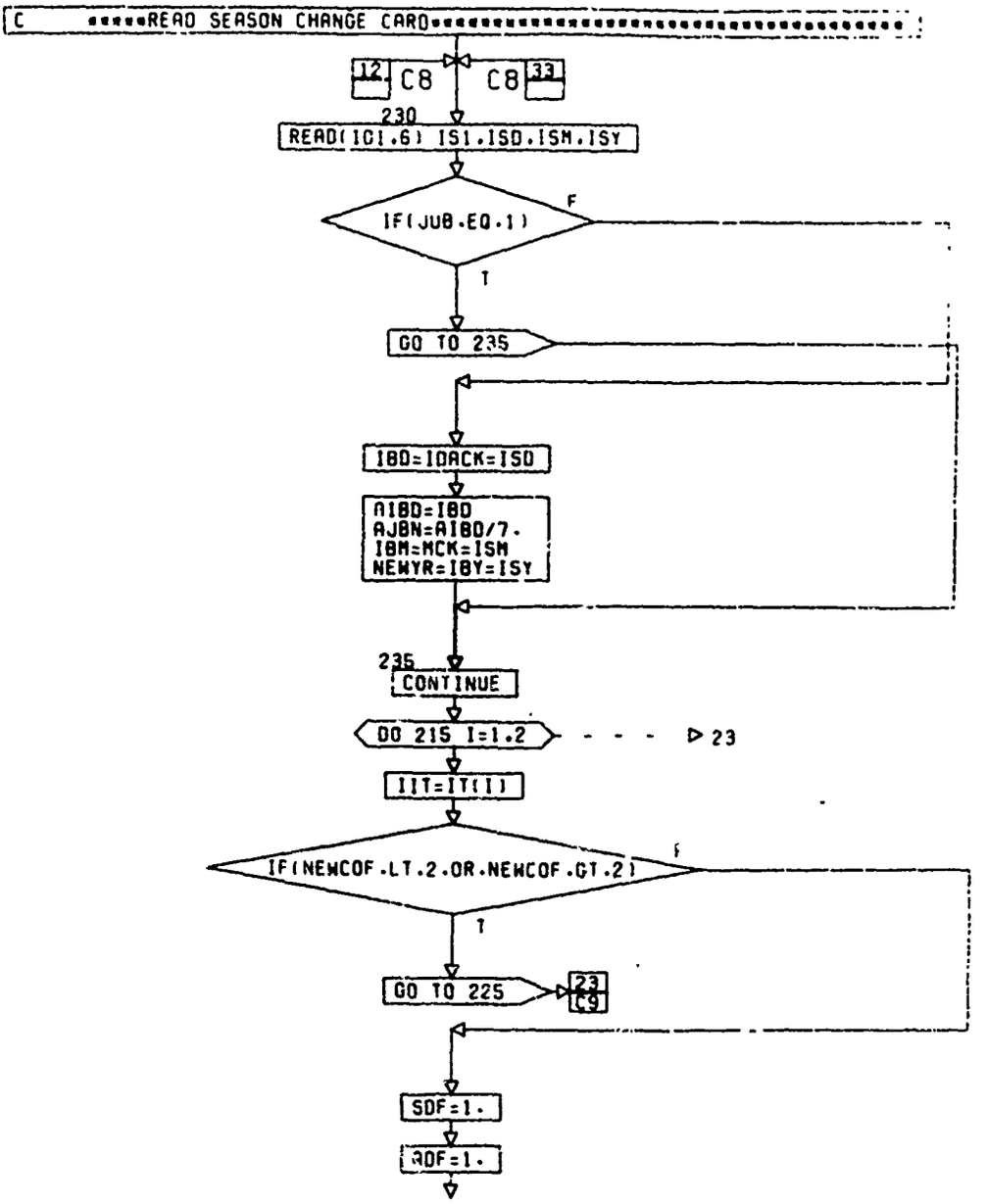
CONT. ON PG 19


18 C3
N=M
18 C4
IF(M.EQ.3)
F
T
N=1
IF(M.EQ.4)
F
T
N=2
IF(MMOD.EQ.2)
F
T
GO TO 1180
20 C5
C *****READ CONSTANTS FOR EQUATIONS COMPUTING MOISTURE MAX AND MIN**
READ(ITEM3,3)II,NSCS,J,(CS(I,M,NSCS),I=1,8)
IDEV1=1
CONT. ON PG 20

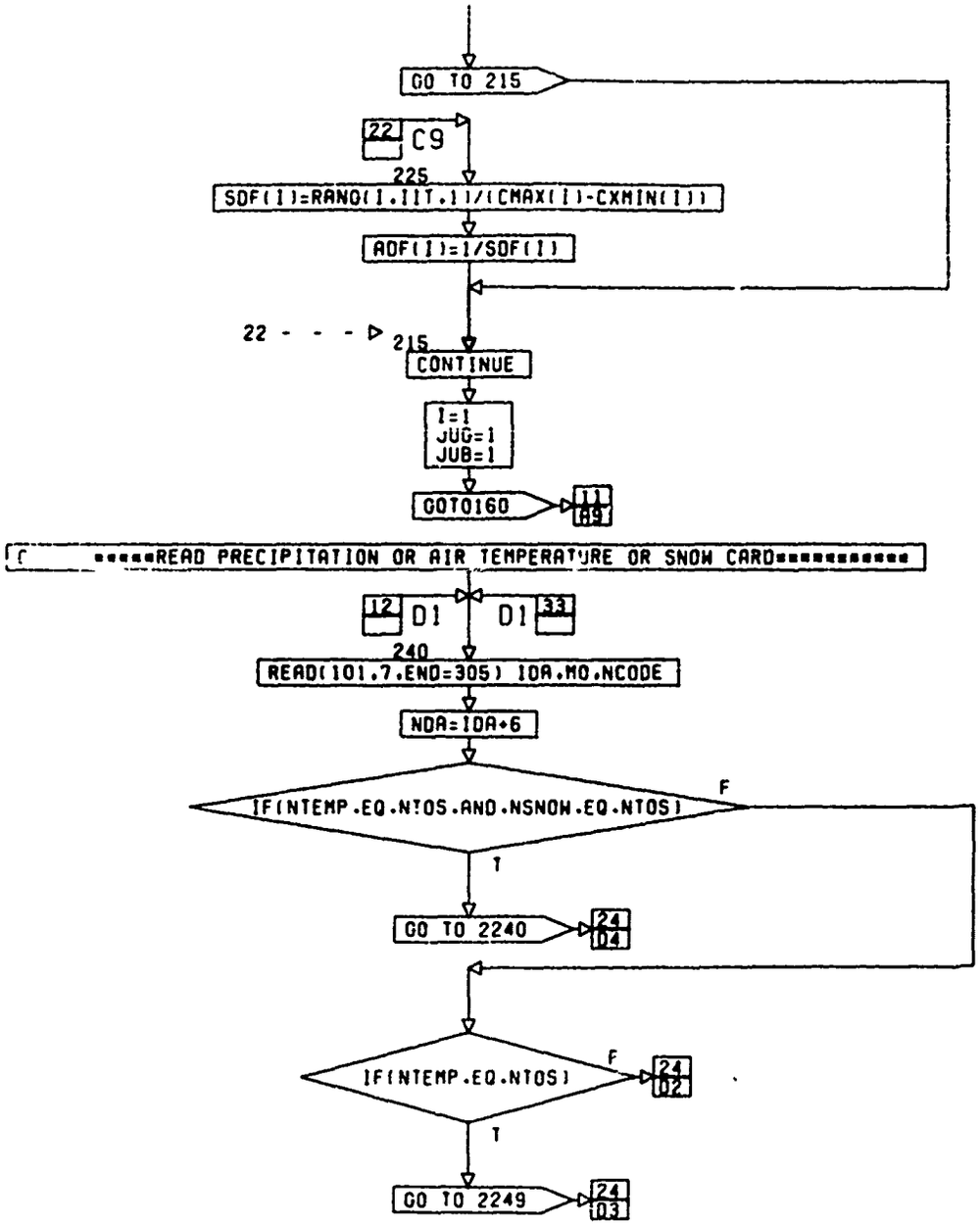

IF(II-8)1170,1170,1160
1160
READ(1,4)(CS(I,M,NSCS),I=9,II)
1170
PRINT 29,(CS(I,M,NSCS),I=1,II)
19
C5
1180
CONTINUE
C2(M)=0.
DO 1190 I=1,II
18
1190
C2(M)=C2(M)+CS(I,M,NSCS)*C1(I,N)
GO TO (194,160)JUL
15
11
C *****READ AND WRITE HEADINGS*****
12
C6
210
READ(101,5)(IHD(J),J=1,20)
I=1
GO TO 217
21
DO 220 I=1,5
21
CONT. ON PG 21


READ(1,5)(IHD(J),J=1,20)
20
C7
217
CONTINUE
PRINT5,(IHD(J),J=1,20)
WRITE(2,5) (IHD(J),J=1,20)
WRITE(3,5) (IHD(J),J=1,20)
20
220
CONTINUE
IF(MEADU1.EQ.2)
F
T
GO TO 231
WRITE(2,35)
WRITE(3,35)
WRITE(2,37)
WRITE(3,38)
WRITE(2,12)
WRITE(3,12)
GO TO 232
231
WRITE(2,36)
WRITE(3,36)
WRITE(2,33)
WRITE(3,34)
WRITE(2,12)
WRITE(3,12)
232
GO TO160
11
A9

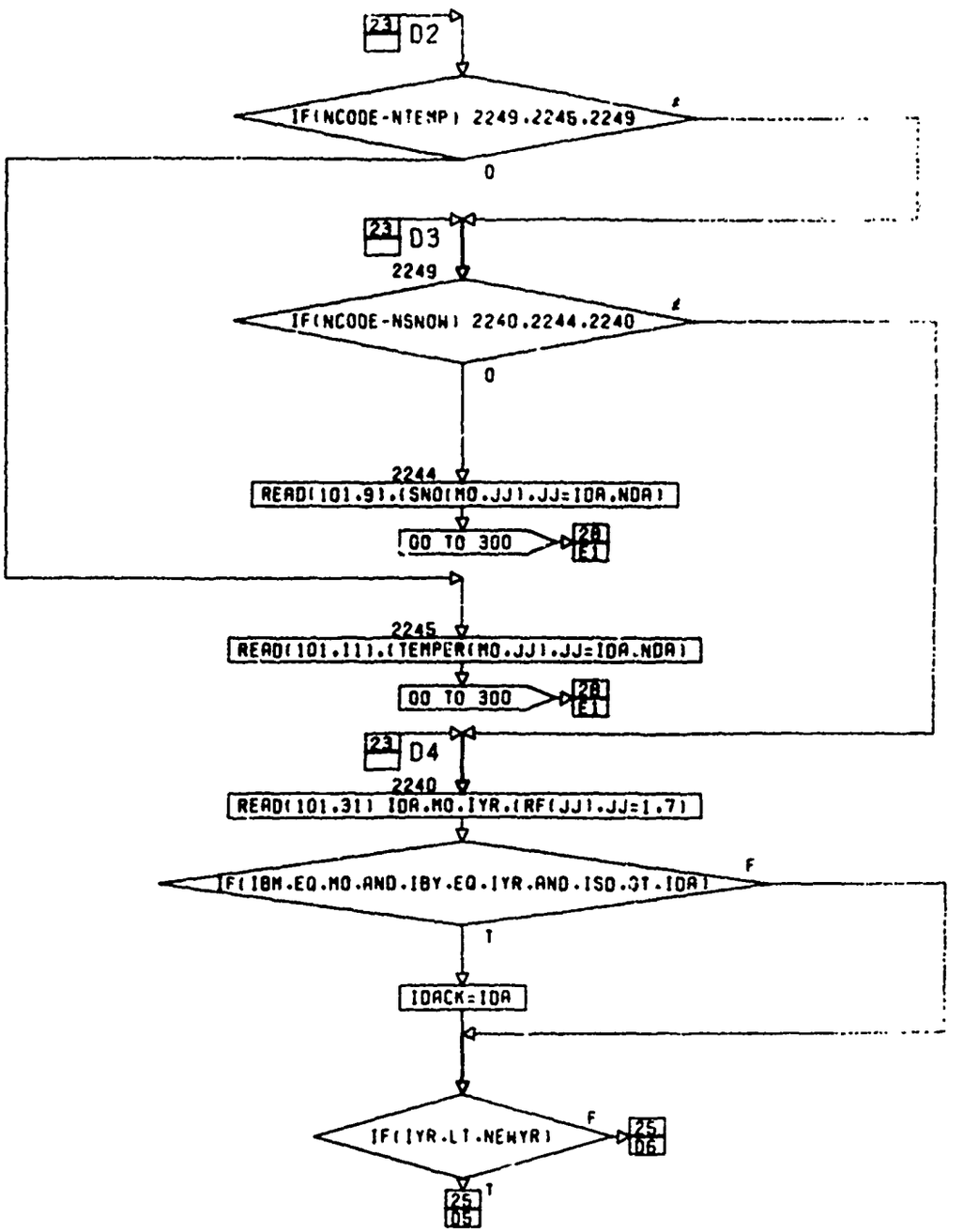
CONT. ON PG 22


C *****READ SEASON CHANGE CARD*****
12
C8
C8
33
230
READ(101,6) IS1,ISD,ISM,ISY
IF(JUB.EQ.1)
F
T
GO TO 235
IBD=IDACK=ISD
AIBD=IBD
AJBN=AIBD/7.
IBM=MCK=ISM
NEWYR=IBY=ISY
235
CONTINUE
DO 215 I=1,2
23
IIT=IT(I)
IF(NEWCOF.LT.2.OR.NEWCOF.GT.2)
F
T
GO TO 225
23
C9
SDF=1.
RDF=1.

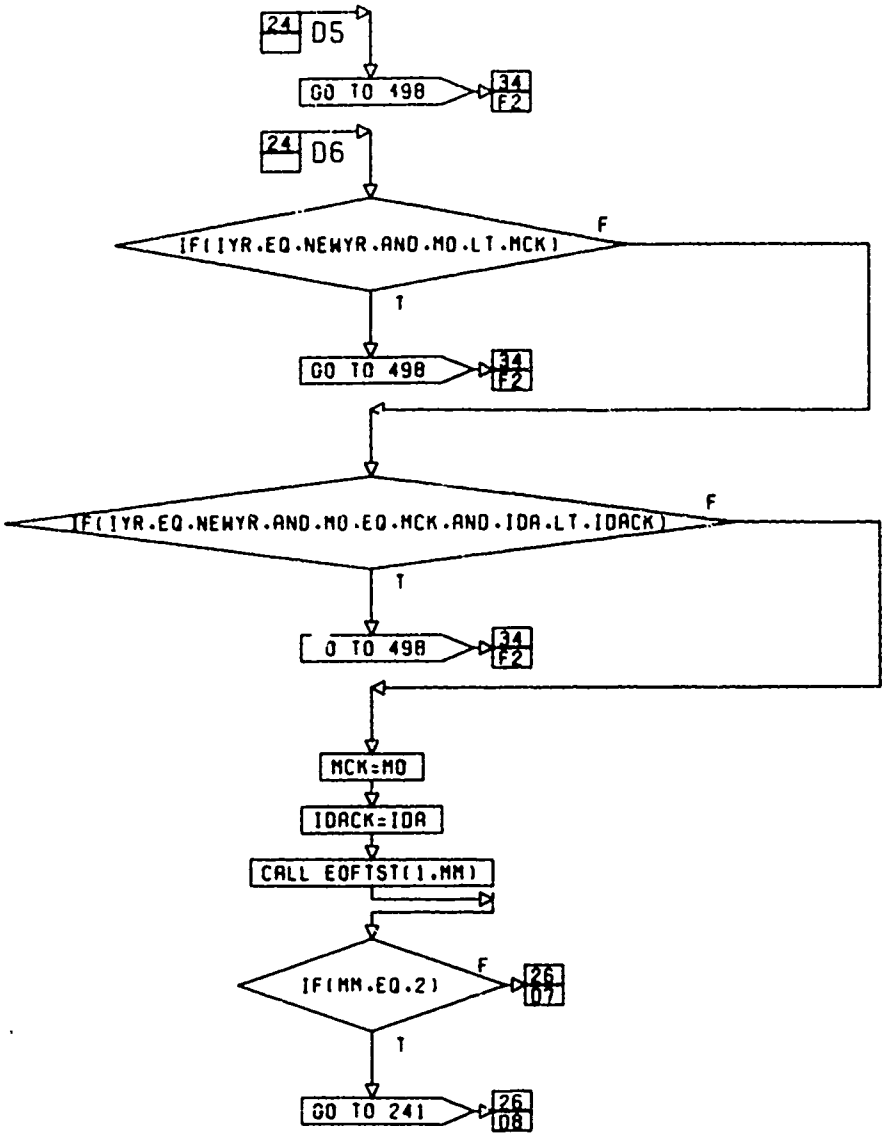
CONT. ON PG 23


GO TO 215
22 C9
225
SDF(I)=RANO(I.IIT.1)/(CMAX(I)-CXMIN(I))
ADF(I)=1/SDF(I)
22 - - - ▷ 215
CONTINUE
I=1
JUG=1
JUB=1
GOTO160
11 A9
C ******READ PRECIPITATION OR AIR TEMPERATURE OR SNOW CARD**********
12 D1
D1 33
240
READ(101.7.END=305) IDA.MO.NCODE
NDA=IDA+6
IF(NTEMP.EQ.NTOS.AND.NSNOW.EQ.NTOS)
F
T
GO TO 2240
24 04
IF(NTEMP.EQ.NTOS)
F
24 02
T
GO TO 2249
24 03

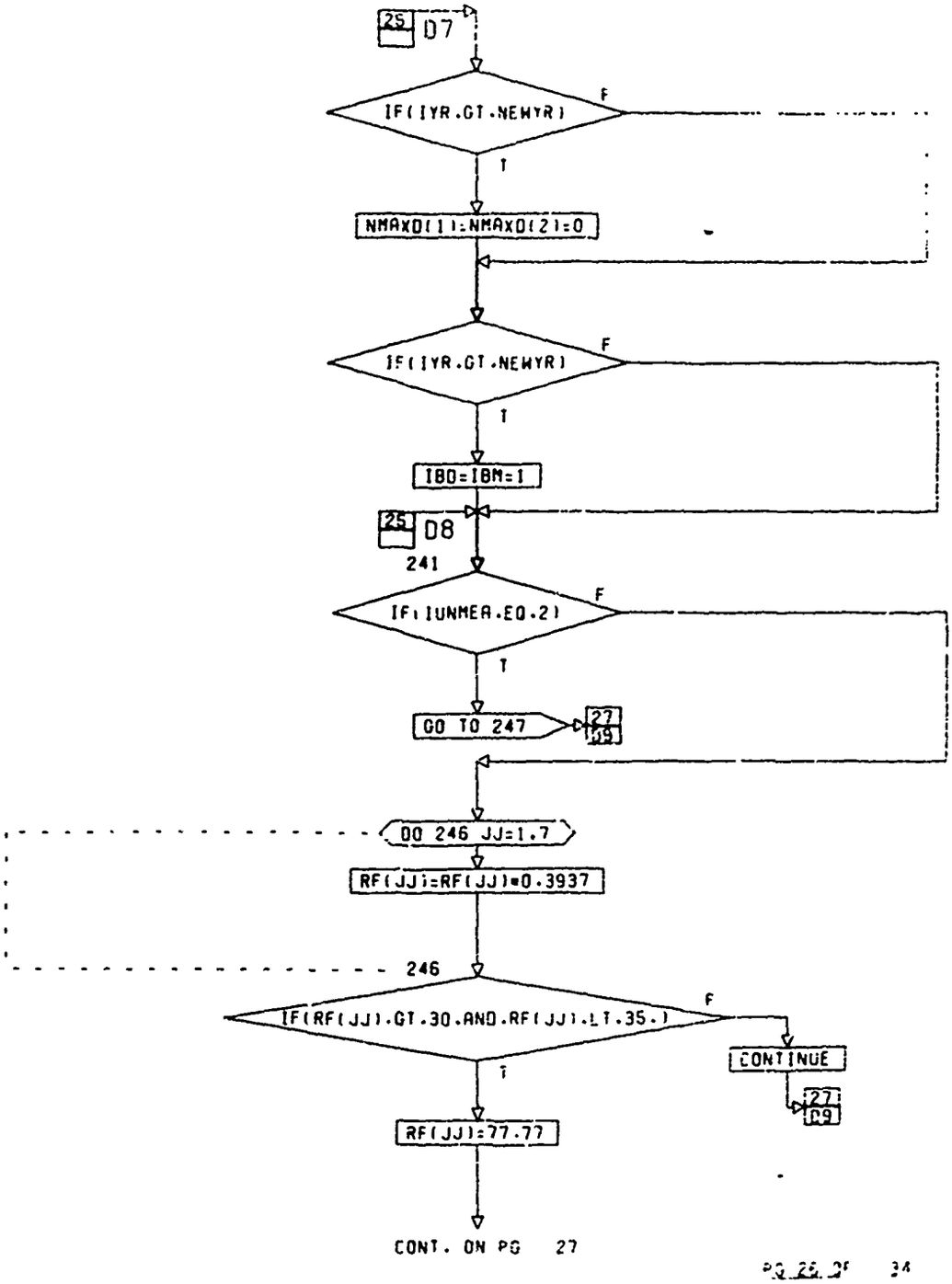
CONT. ON PG 24


23 D2
IF(NCODE-NTEMP) 2249,2245,2249
E
0
23 D3
2249
IF(NCODE-NSNOW) 2240,2244,2240
E
0
2244
READ(101,9),(SNO(MO,JJ),JJ=IDA,NDA)
GO TO 300
28 E1
2245
READ(101,11),(TEMPER(MO,JJ),JJ=IDA,NDA)
GO TO 300
28 E1
23 D4
2240
READ(101,31) IDA,MO,IYR,(RF(JJ),JJ=1,7)
IF(IBM.EQ.MO.AND.IBY.EQ.IYR.AND.ISD.GT.IDA)
F
T
IDACK=IDA
IF(IYR.LT.NEWYR)
F
25 D6
T
25 D5

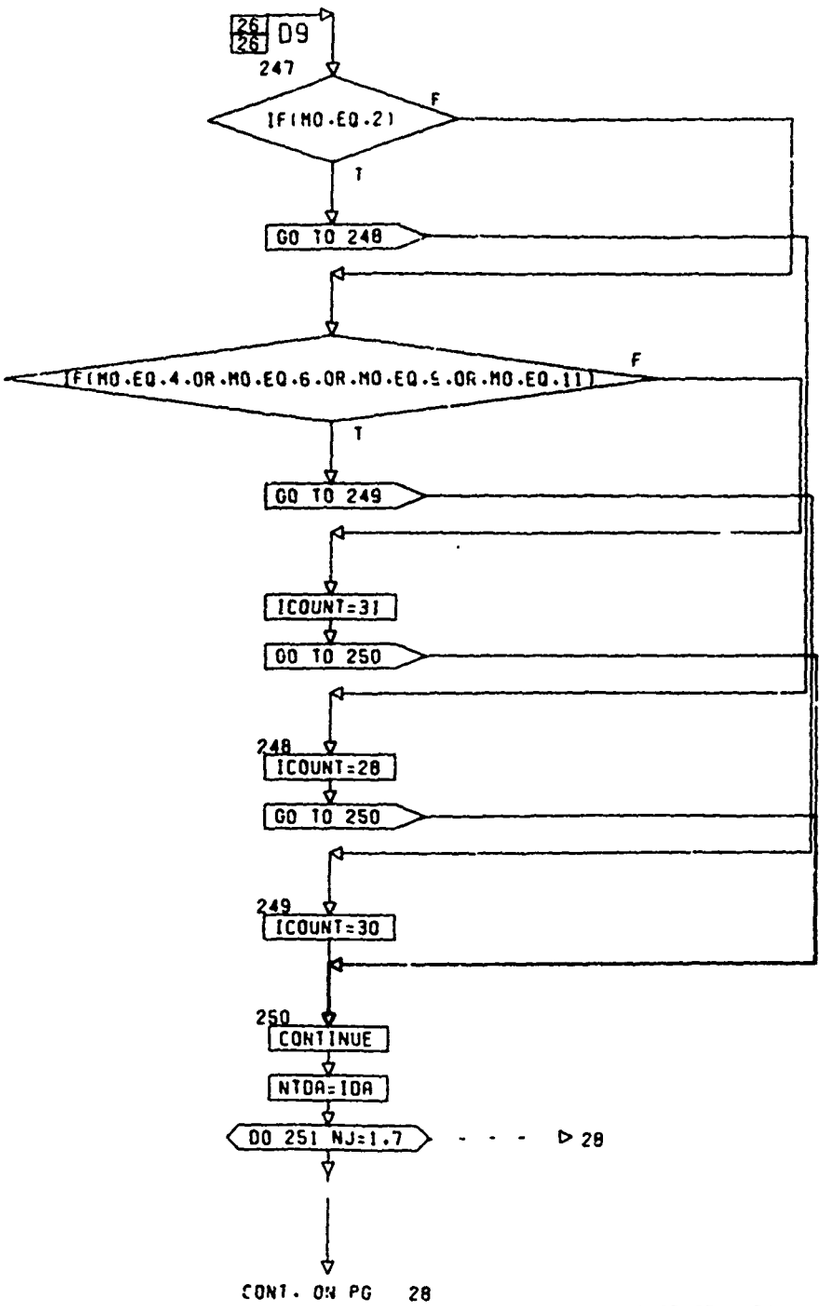
CONT. ON PG 25


24
D5
GO TO 498
34
F2
24
D6
IF(IYR.EQ.NEWYR.AND.MO.LT.MCK)
F
T
GO TO 498
34
F2
IF(IYR.EQ.NEWYR.AND.MO.EQ.MCK.AND.IDA.LT.IDACK)
F
T
GO TO 498
34
F2
MCK=MO
IDACK=IDA
CALL EOFTST(1,MM)
IF(MM.EQ.2)
F
26
07
T
GO TO 241
26
08

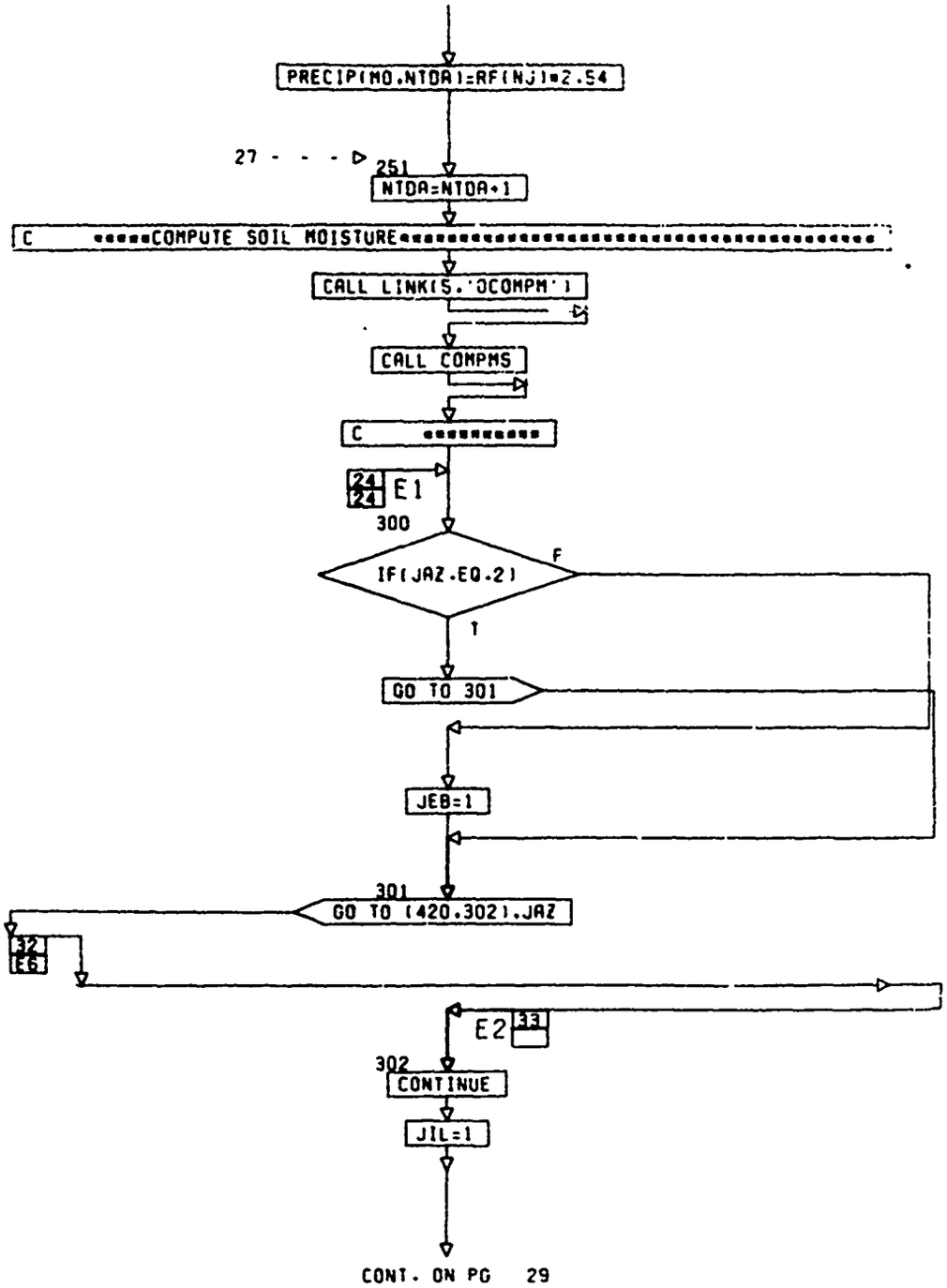
CONT. ON PG 26

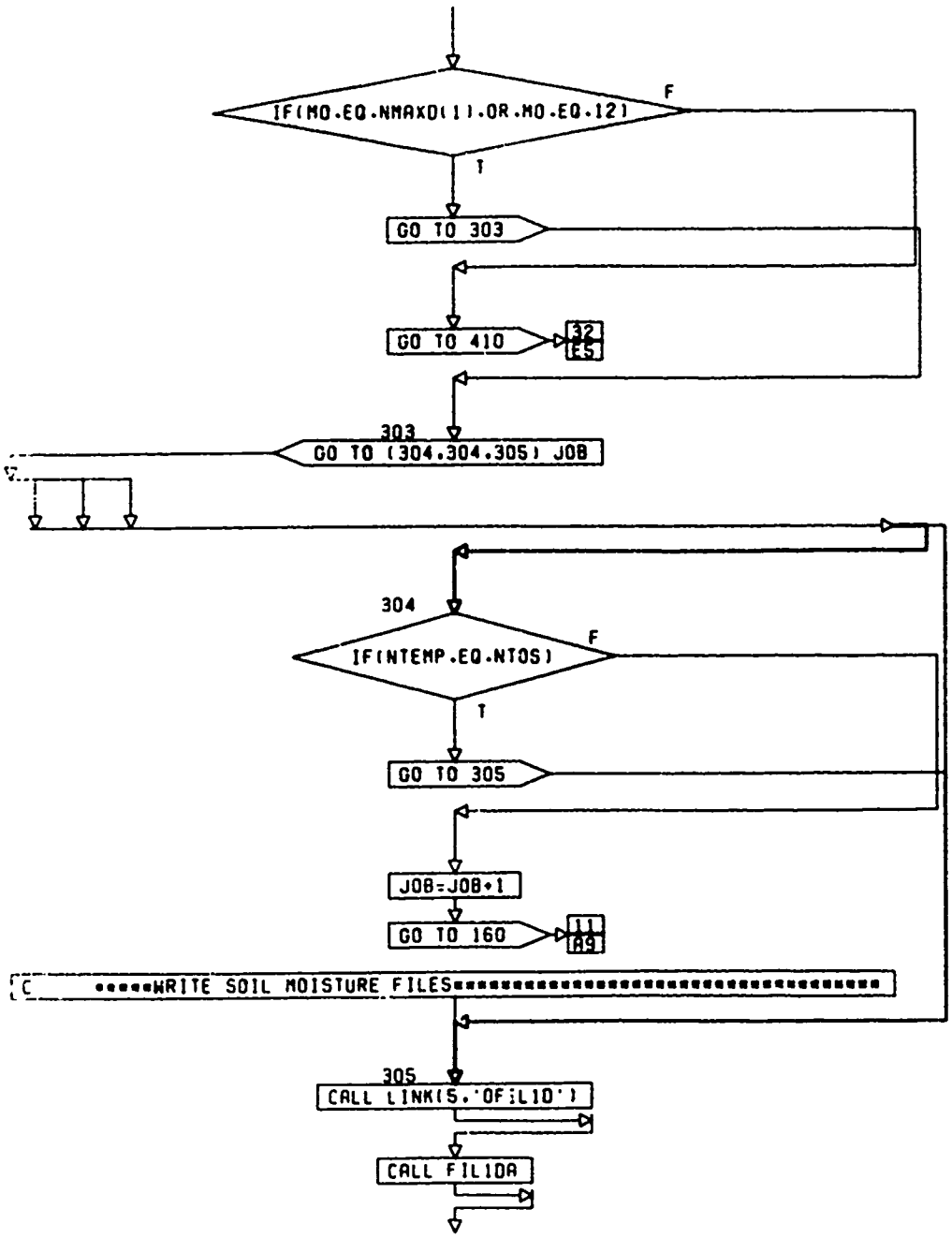

25 D7
IF(IYR.GT.NEWYR)
F
T
NMAXD(1):NMAXD(2)=0
IF(IYR.GT.NEWYR)
F
T
IBD=IBM=1
25 D8
241
IF(IUNMEA.EQ.2)
F
T
GO TO 247
27 D9
DO 246 JJ=1,7
RF(JJ)=RF(JJ)*0.3937
246
IF(RF(JJ).GT.30.AND.RF(JJ).LT.35.)
F
T
CONTINUE
27 D9
RF(JJ)=77.77
CONT. ON PG 27

PG 25 OF 34

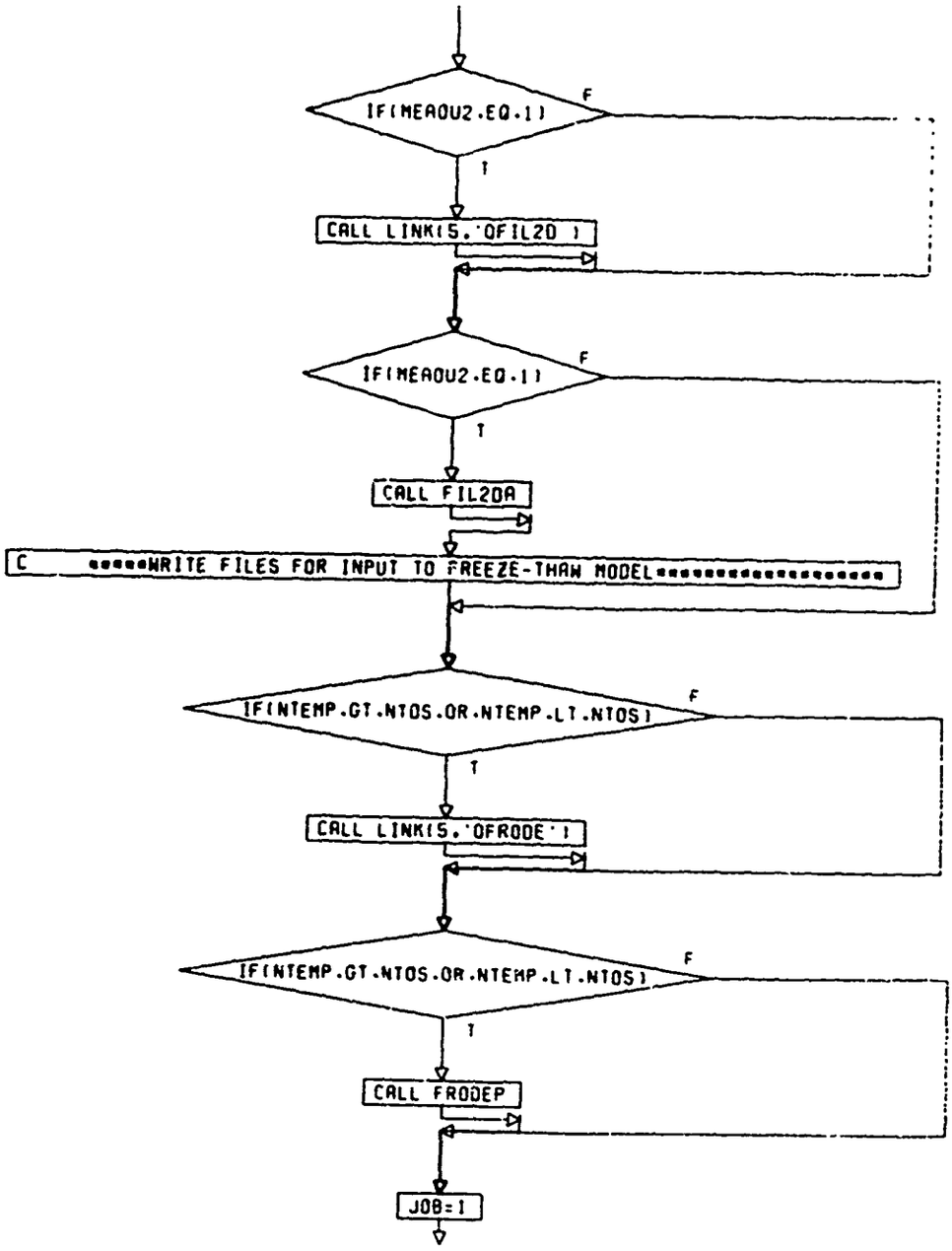

26
26
D9
247
IF(MO.EQ.2)
F
T
GO TO 248
IF(MO.EQ.4.OR.MO.EQ.6.OR.MO.EQ.5.OR.MO.EQ.11)
F
T
GO TO 249
ICOUNT=31
GO TO 250
248
ICOUNT=28
GO TO 250
249
ICOUNT=30
250
CONTINUE
NTOA=IOA
DO 251 NJ=1,7
28
CONT. ON PG 28

PG 27 OF 34

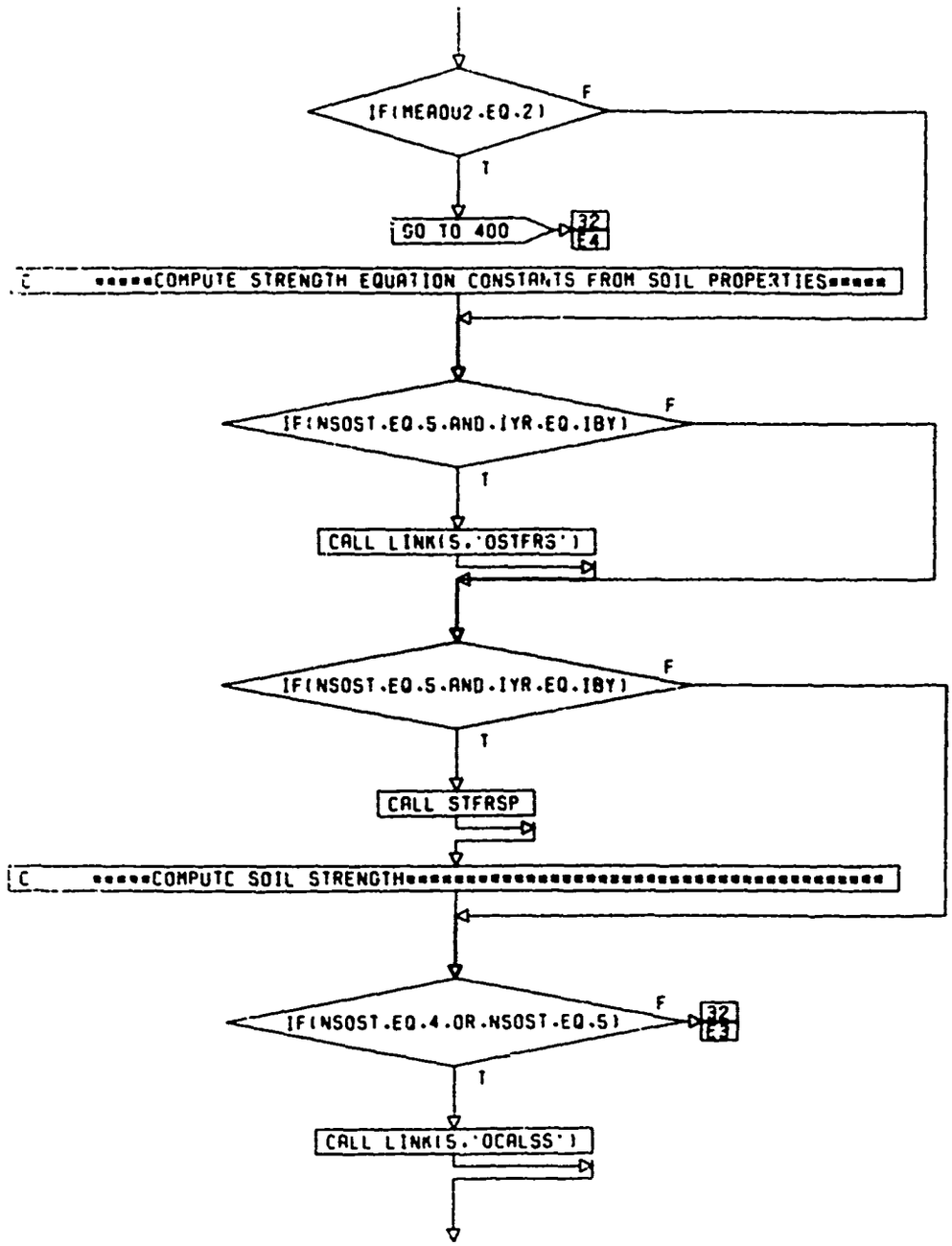

PRECIP(MO,NTDA)=RF(NJ)*2.54
27
251
NTDA=NTDA+1
C *****COMPUTE SOIL MOISTURE*****
CALL LINK(5,'DCOMPM')
CALL COMPMS
C *********
24
24
E1
300
IF(JAZ.EQ.2)
F
T
GO TO 301
JEB=1
301
GO TO (420,302),JAZ
32
E6
E2
33
302
CONTINUE
JIL=1
CONT. ON PG 29


IF(MO.EQ.NMAXD(1).OR.MO.EQ.12)
F
T
GO TO 303
GO TO 410
32
E5
303
GO TO (304,304,305) JOB
304
IF(NTEMP.EQ.NTOS)
F
T
GO TO 305
JOB=JOB+1
GO TO 160
11
A9
C *****WRITE SOIL MOISTURE FILES*****
305
CALL LINK(5,'OFILID')
CALL FILIDA

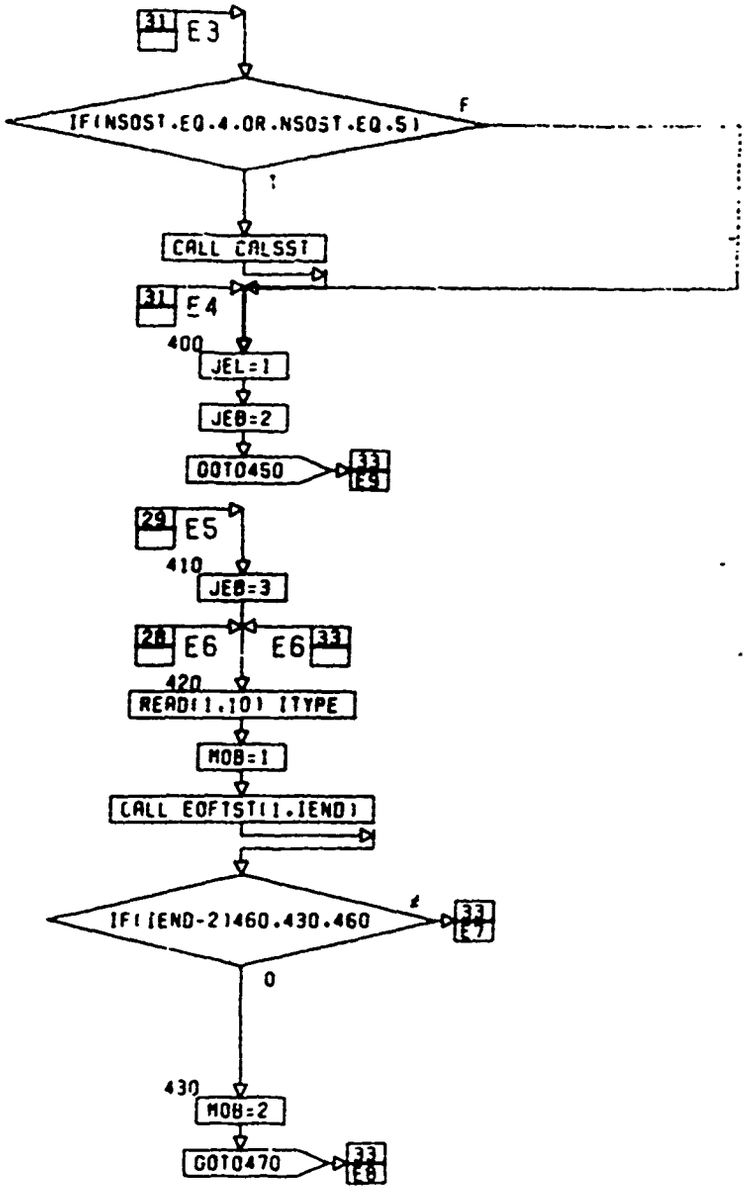
CONT. ON PG 30


IF(MEAOU2.EQ.1)
F
T
CALL LINK(5,'OFIL2D)
IF(MEAOU2.EQ.1)
F
T
CALL FIL2DA
C *****WRITE FILES FOR INPUT TO FREEZE-THAW MODEL*****
IF(NTEMP.GT.NTOS.OR.NTEMP.LT.NTOS)
F
T
CALL LINK(5,'OFRODE')
IF(NTEMP.GT.NTOS.OR.NTEMP.LT.NTOS)
F
T
CALL FRODEP
JOB=1

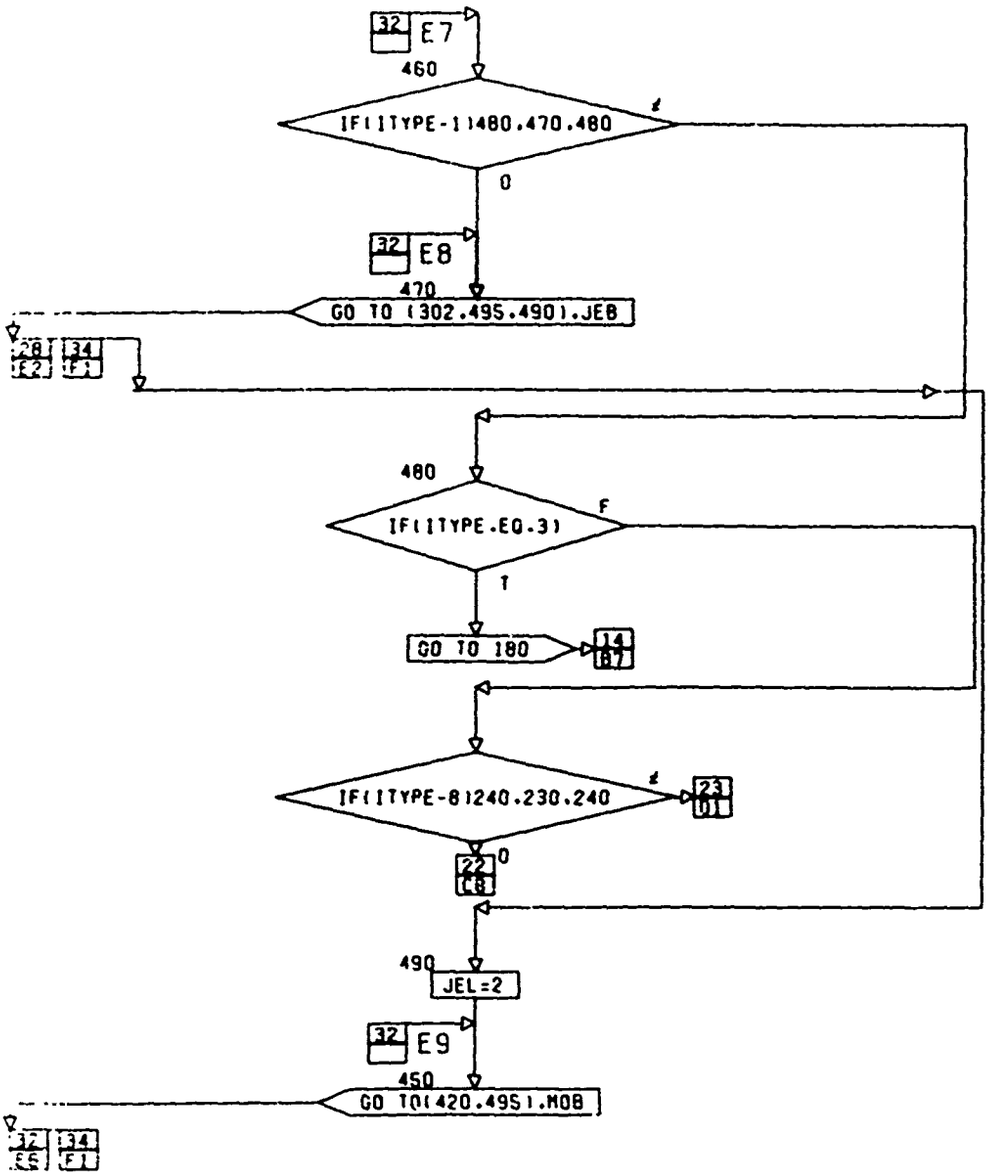
CONT. ON PG 31


IF(MEADU2.EQ.2)
F
T
GO TO 400
32
E4
C *****COMPUTE STRENGTH EQUATION CONSTANTS FROM SOIL PROPERTIES*****
IF(NSOST.EQ.5.AND.IYR.EQ.IBY)
F
T
CALL LINK(5,'OSTFRS')
IF(NSOST.EQ.5.AND.IYR.EQ.IBY)
F
T
CALL STFRSP
C *****COMPUTC SOIL STRENGTH**********
IF(NSOST.EQ.4.OR.NSOST.EQ.5)
F
32
E3
T
CALL LINK(5,'OCALSS')

CONT. ON PG 32


31 E3
IF(NSOST.EQ.4.OR.NSOST.EQ.5)
F
T
CALL CALSST
31 E4
400
JEL=1
JEB=2
GOTO450
33 E9
29 E5
410
JEB=3
28 E6
E6 33
420
READ(1,10) ITYPE
MOB=1
CALL EOFTST(1,IEND)
IF(IEND-2)460,430,460
4
33 E7
0
430
MOB=2
GOTO470
33 E8

CONT. ON PG 33


32 E7
460
IF(ITYPE-1)480,470,480
1
0
32 E8
470
GO TO (302,495,490),JEB
28 E2
34 F1
480
IF(ITYPE.EQ.3)
F
T
GO TO 180
14 B7
IF(ITYPE-8)240,230,240
1
23 D1
22 C8
0
490
JEL=2
32 E9
450
GO TO(420,495),MOB
32 E5
34 F1

CONT. ON PG 34

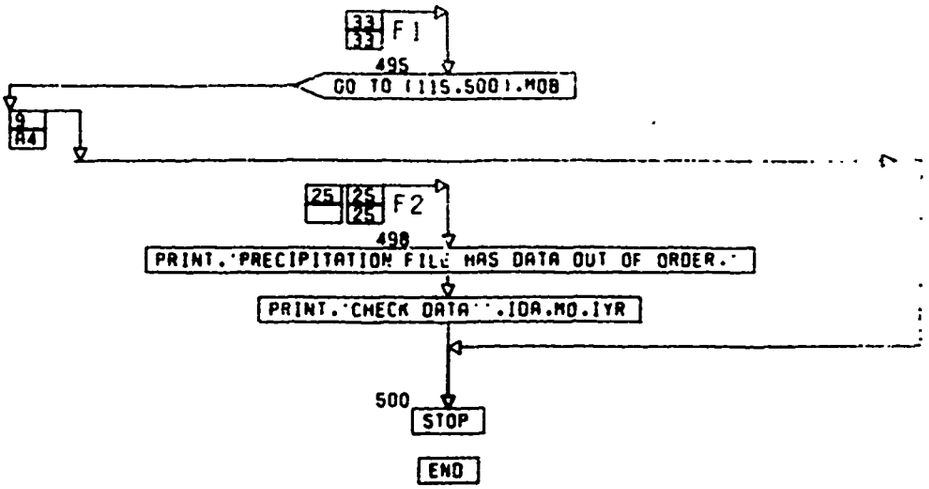
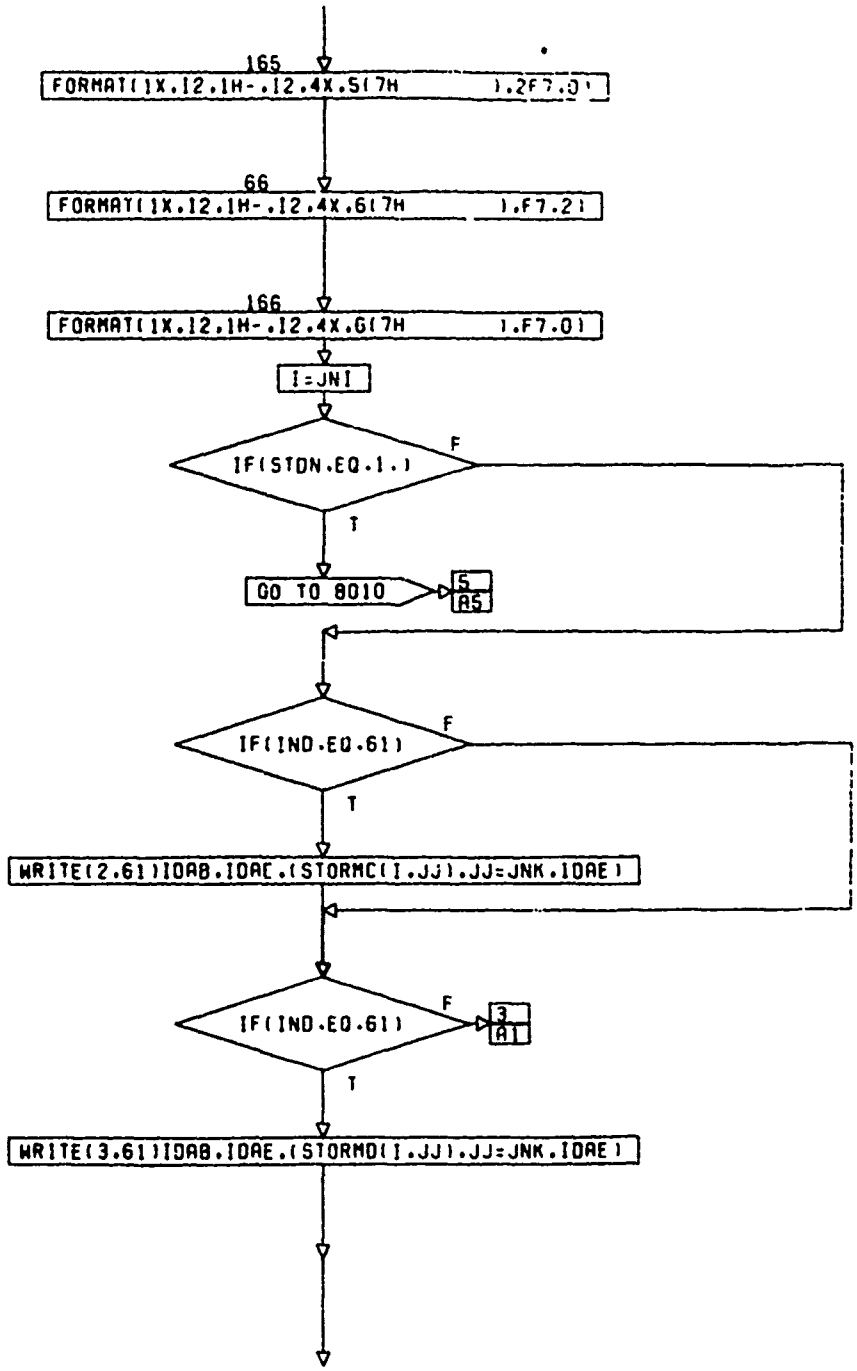

33
33
F1
495
GO TO (115,500),MOB
9
A4
25
25
25
F2
498
PRINT,'PRECIPITATION FILE HAS DATA OUT OF ORDER.'
PRINT,'CHECK DATA',IDA,MO,IYR
500
STOP
END

FIG 34 FINAL

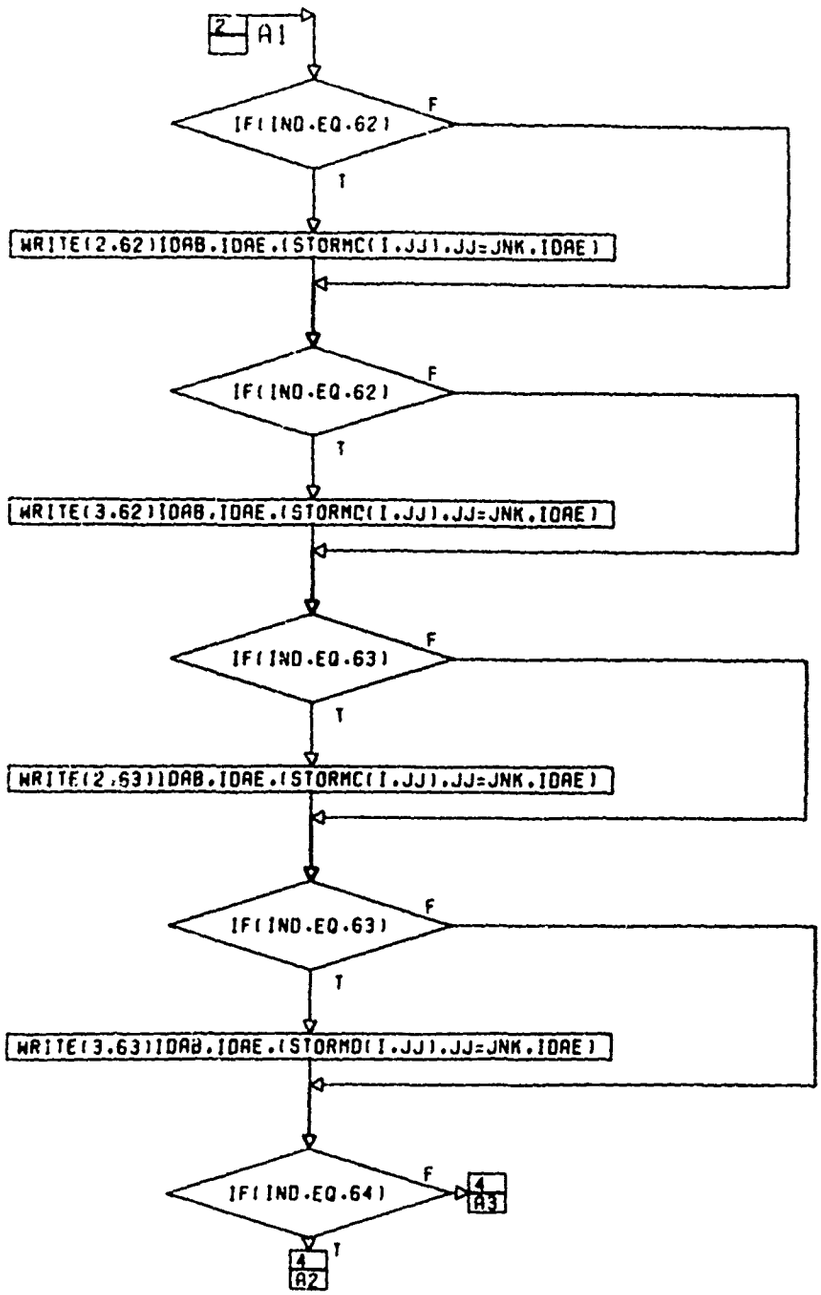
Fig. A2. Detailed Flow Chart of Subroutine WRIBWK
(6 pages)

```
SUBROUTINE WRIBWK
*****************
*****WRITE FIRST WEEK OF OUTPUT DATA FILES WITH BEGINNING DAY*****
*****      OTHER THAN THE FIRST DAY OF WEEK*********************

61
FORMAT(1X,I2,1H-,I2,4X,7H        ,6F7.2)

161
FORMAT(1X,I2,1H-,I2,4X,7H        ,6F7.0)

62
FORMAT(1X,I2 1H-,I2,4X,27H        ,5F7.2)

162
FORMAT(1X,I2,1H-,I2,4X,27H        ,5F7.0)

63
FORMAT(1X,I2,1H-,I2,4X,37H        ,4F7.2)

163
FORMAT(1X,I2,1H-,I2,4X,37H        ,4F7.0)

64
FORMAT(1X,I2,1H-,I2,4X,47H        ,3F7.2)

164
FORMAT(1X,I2,1H-,I2,4X,47H        ,3F7.0)

65
FORMAT(1X,I2,1H-,I2,4X,57H        ,2F7.2)
```

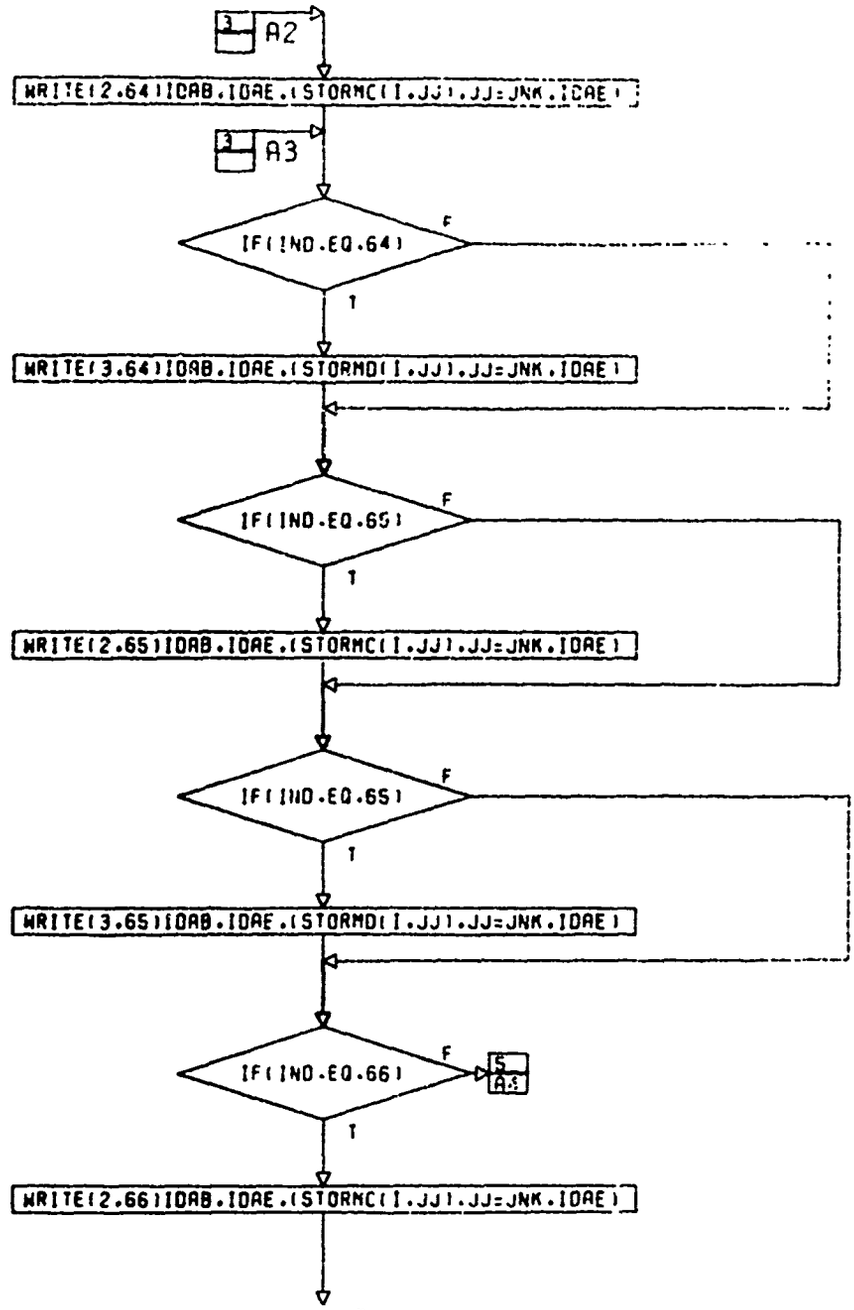
CONT. ON PG 2


165
FORMAT(1X,I2,1H-,I2,4X,5(7H),2F7.0)
66
FORMAT(1X,I2,1H-,I2,4X,6(7H),F7.2)
166
FORMAT(1X,I2,1H-,I2,4X,6(7H),F7.0)
I=JNI
IF(STDN.EQ.1.)
F
T
GO TO 8010
5
A5
IF(IND.EQ.61)
F
T
WRITE(2,61)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.61)
F
3
A1
T
WRITE(3,61)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
CONT. ON PG 3

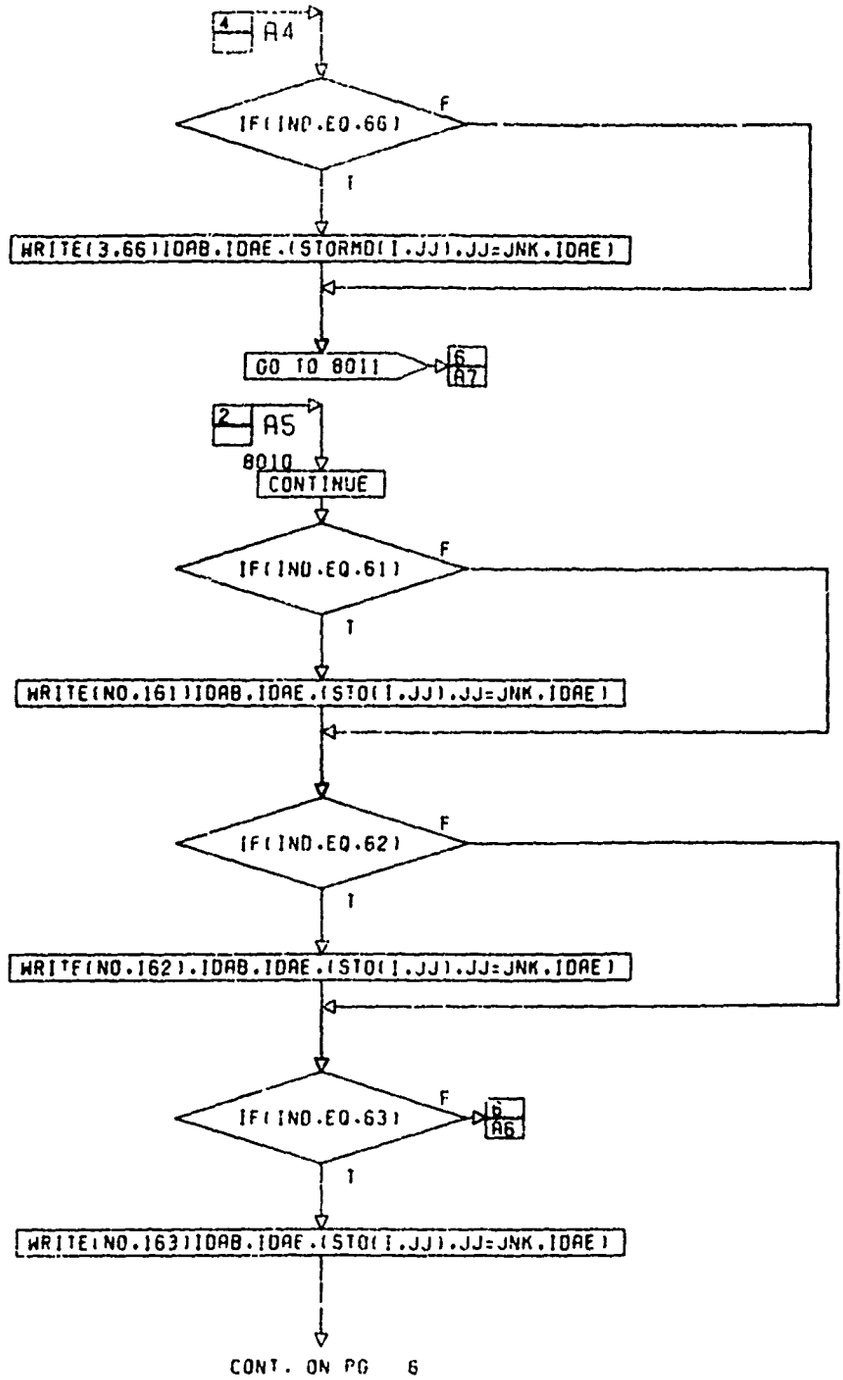
PG 2 OF 2


2
A1
IF(IND.EQ.62)
F
T
WRITE(2,62)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.62)
F
T
WRITE(3,62)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.63)
F
T
WRITE(2,63)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.63)
F
T
WRITE(3,63)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.64)
F
4
A3
T
4
A2

CONT. ON PG 4


A2
WRITE(2,64)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
A3
IF(IND.EQ.64)
F
T
WRITE(3,64)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.65)
F
T
WRITE(2,65)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.65)
F
T
WRITE(3,65)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.66)
F
5
A4
T
WRITE(2,66)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)

CONT. ON PG 5


4
A4
IF(IND.EQ.66)
F
T
WRITE(3,66)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
GO TO 8011
6
A7
2
A5
8010
CONTINUE
IF(IND.EQ.61)
F
T
WRITE(NO,161)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.62)
F
T
WRITE(NO,162),IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.63)
F
6
A6
T
WRITE(NO,163)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
CONT. ON PG 6

PG 5 OF 6

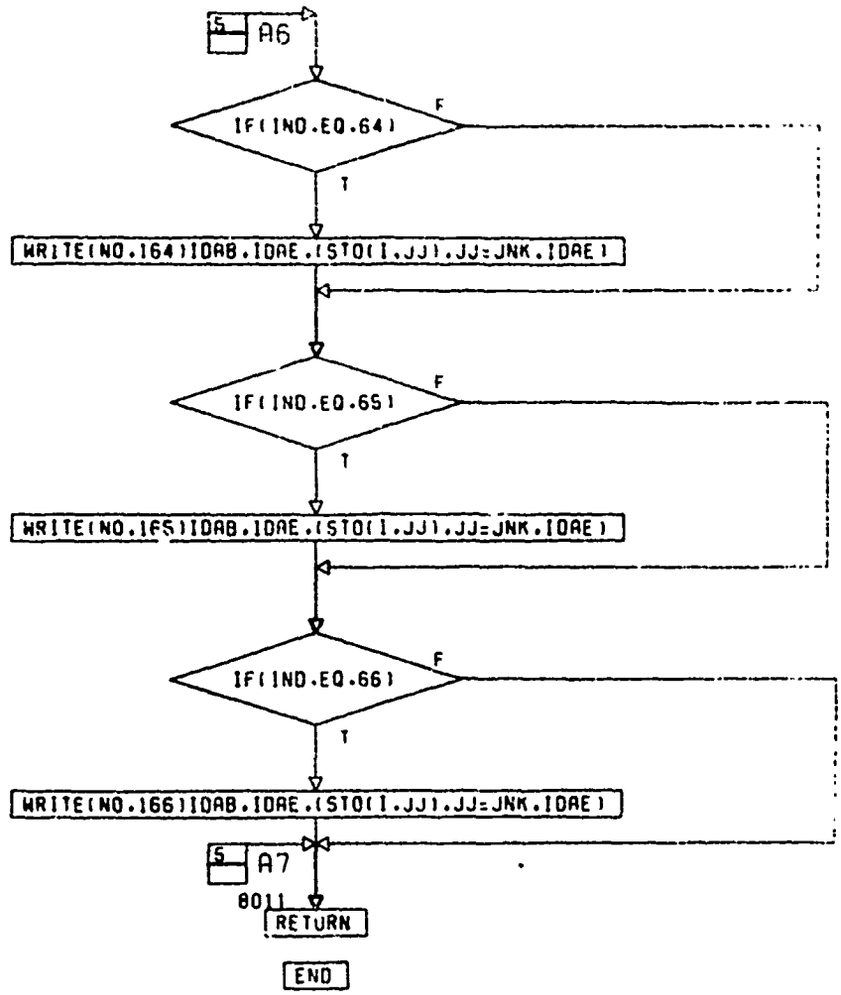
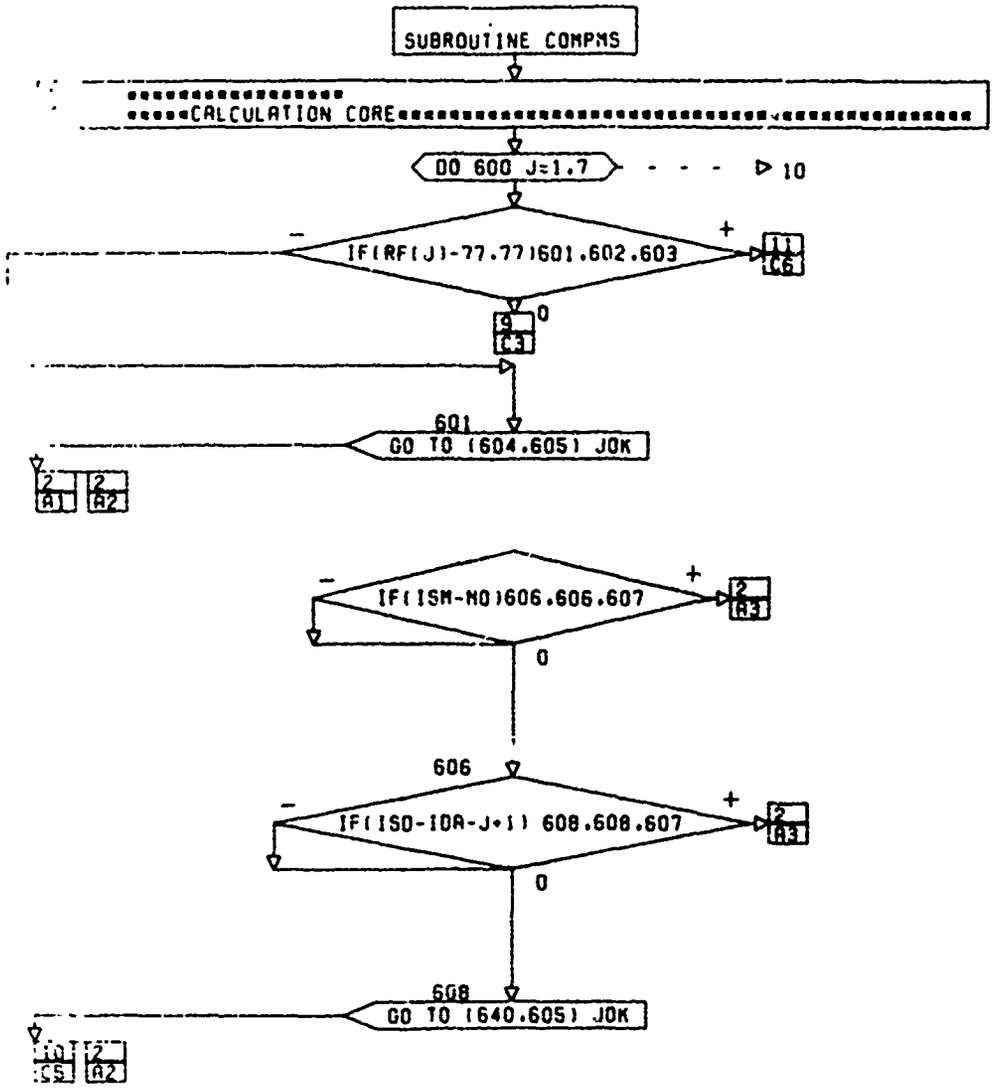
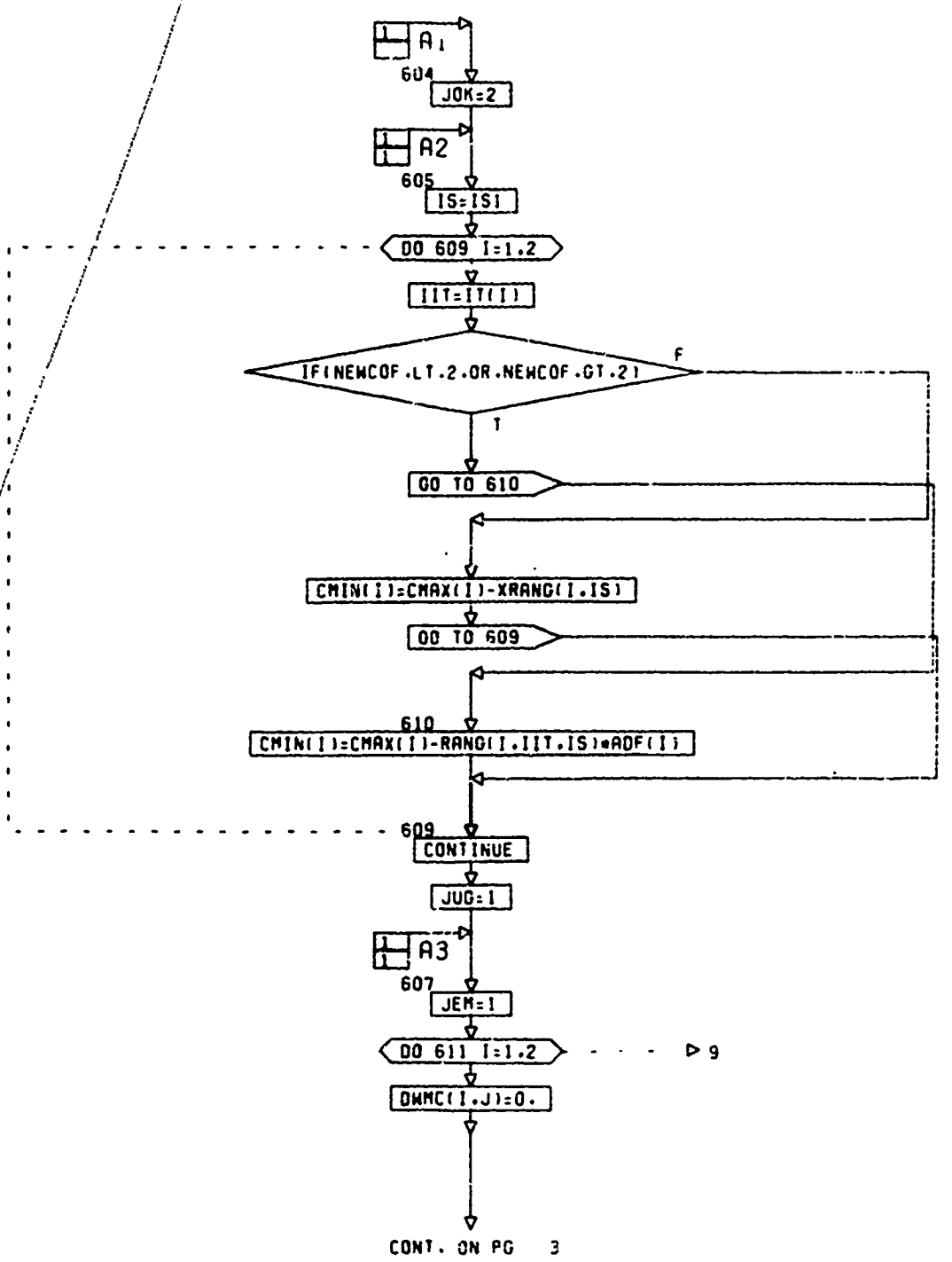

5
A6
IF(IND.EQ.64)
F
T
WRITE(NO,164)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.65)
F
T
WRITE(NO,165)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.66)
F
T
WRITE(NO,166)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
5
A7
8011
RETURN
END

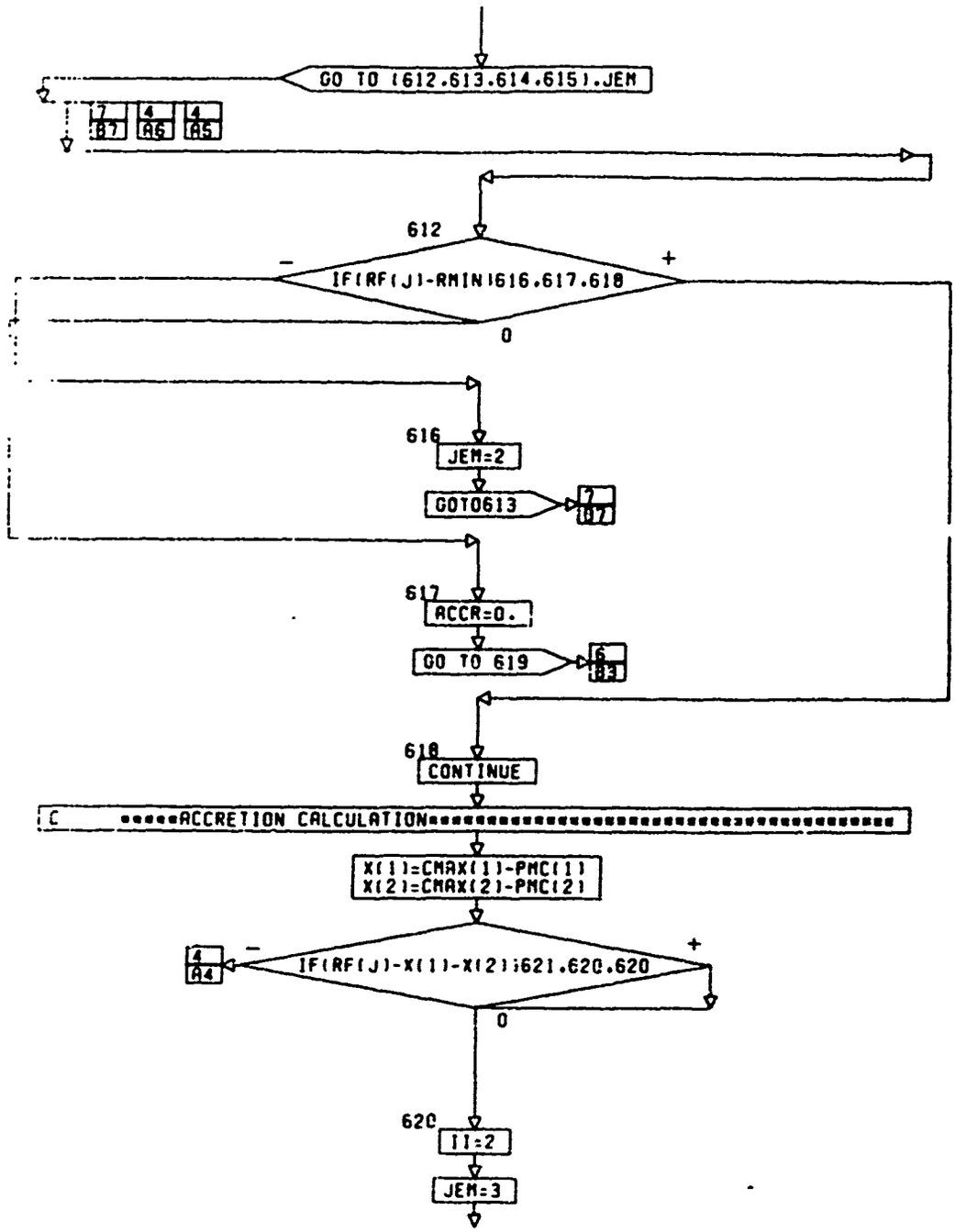
Fig. A3. Detailed Flow Chart of Subroutine COMPMS
(11 pages)


SUBROUTINE COMPMS
CALCULATION CORE
DO 600 J=1,7
10
IF(RF(J)-77.77)601,602,603
11
C6
0
9
C3
601
GO TO (604,605) JOK
2
A1
2
A2
IF(ISM-MO)606,606,607
2
A3
0
606
IF(ISO-IOA-J+1) 608,608,607
2
A3
0
608
GO TO (640,605) JOK
10
S5
2
A2

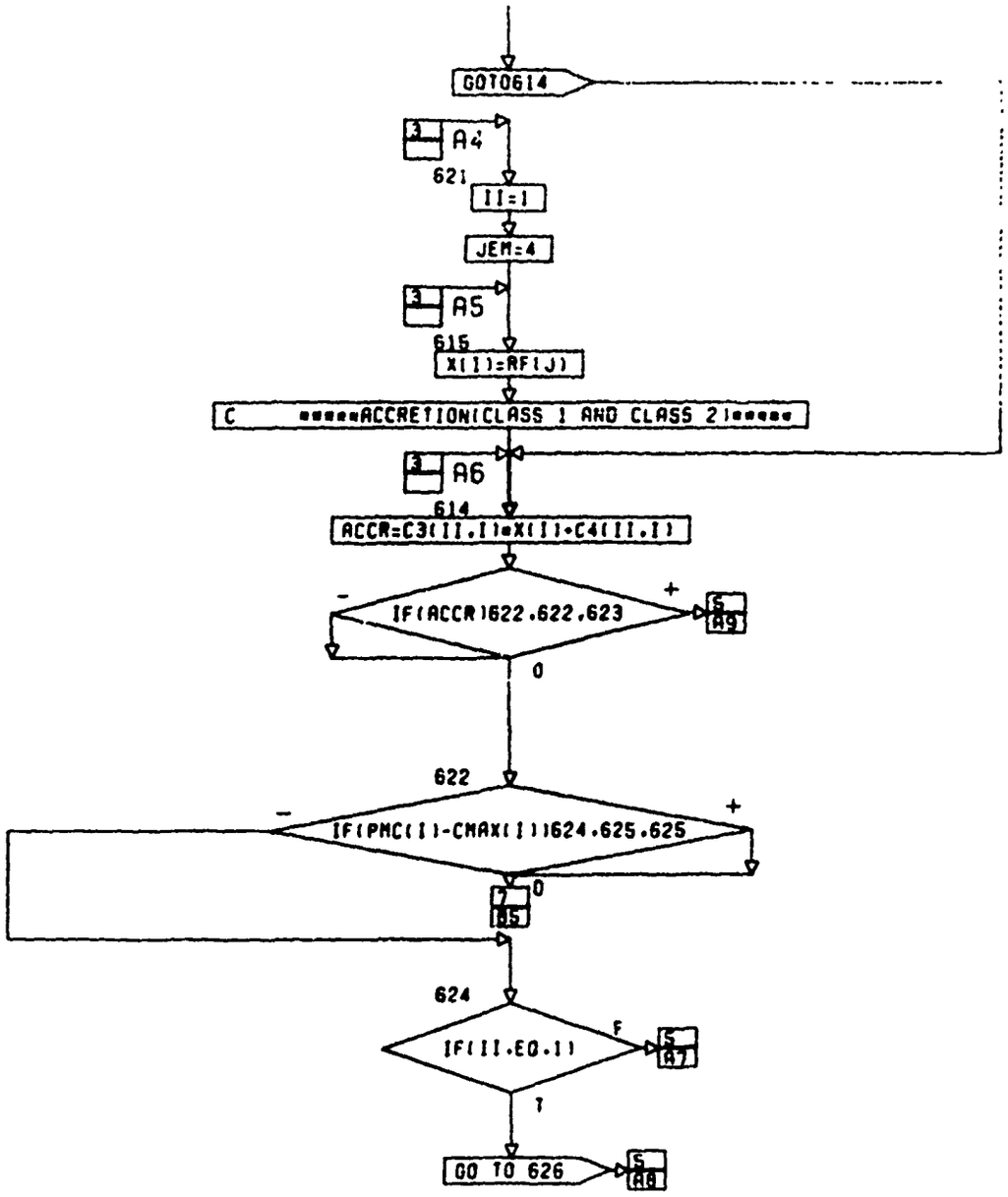
CONT. ON PG 2


A1
604
JOK=2
A2
605
IS=IS1
DO 609 I=1,2
IIT=IT(I)
IF(NEWCOF.LT.2.OR.NEWCOF.GT.2)
F
T
GO TO 610
CMIN(I)=CMAX(I)-XRANG(I,IS)
GO TO 609
610
CMIN(I)=CMAX(I)-RANG(I,IIT,IS)*ADF(I)
609
CONTINUE
JUG=1
A3
607
JEM=1
DO 611 I=1,2
9
DWMC(I,J)=0.
CONT. ON PG 3

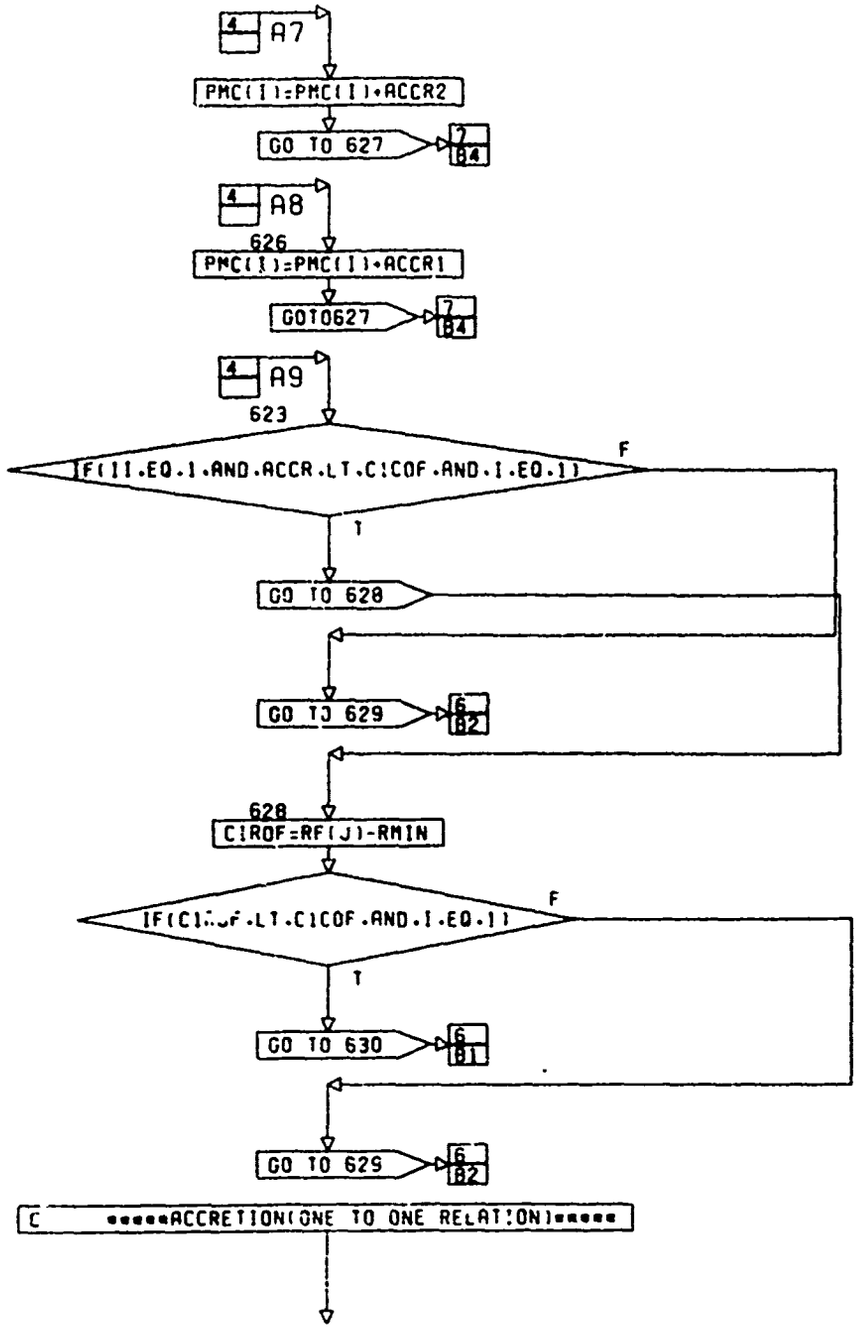
PG 2 OF 11


GO TO (612,613,614,615),JEM
7 B7
4 A6
4 A5
612
IF(RF(J)-RMIN)616,617,618
-
+
0
616
JEM=2
GOTO613
7 B7
617
ACCR=0.
GO TO 619
6 B3
618
CONTINUE
C *****ACCRETION CALCULATION*****
X(1)=CMAX(1)-PMC(1)
X(2)=CMAX(2)-PMC(2)
4 A4
IF(RF(J)-X(1)-X(2))621,620,620
-
+
0
620
II=2
JEM=3

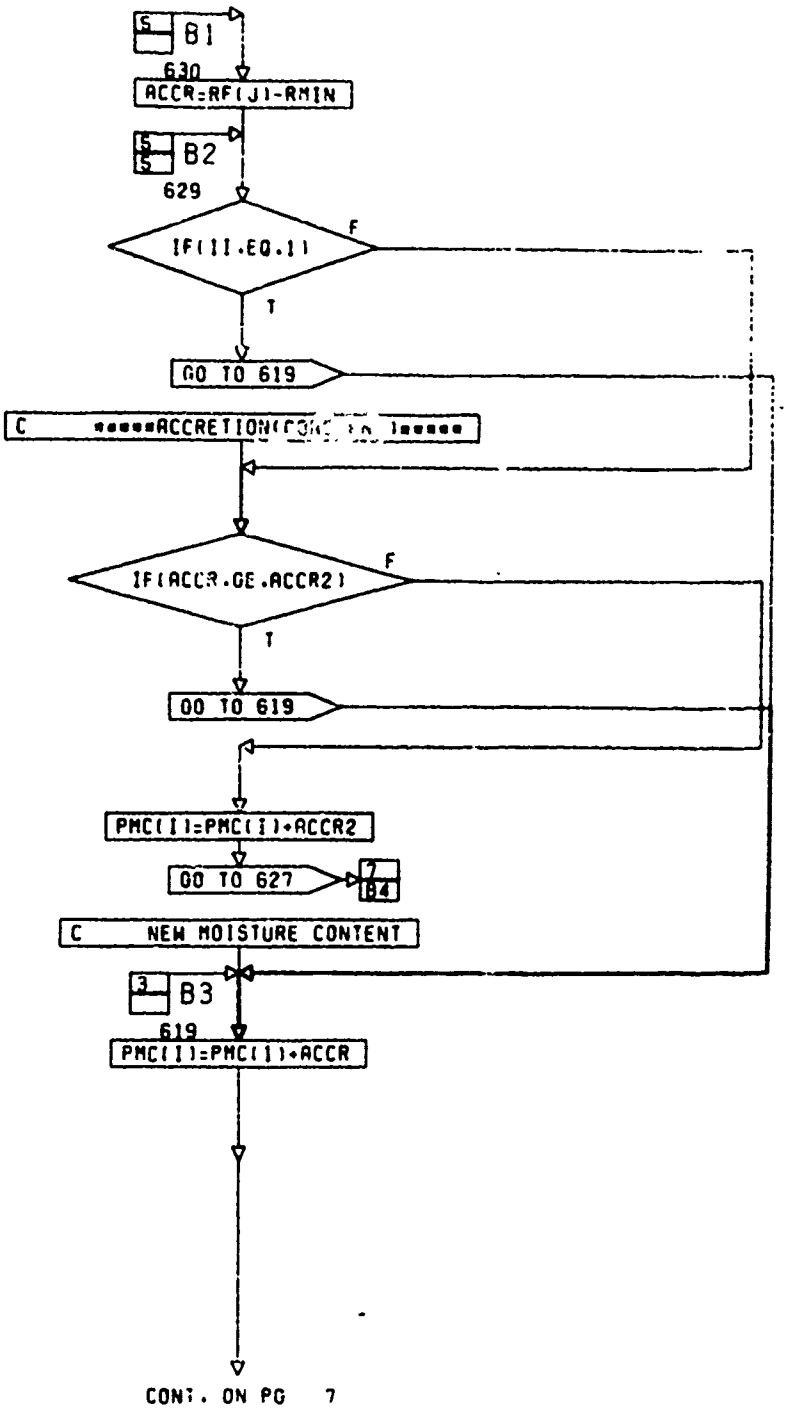
CONT. ON PG 4


GOTO614
A4
621
II=1
JEM=4
A5
615
X(I)=RF(J)
C *****ACCRETION(CLASS 1 AND CLASS 2)*****
A6
614
ACCR=C3(II,I)*X(I)+C4(II,I)
IF(ACCR)622,622,623
A9
0
622
IF(PMC(I)-CMAX(I))624,625,625
0
A5
624
IF(II.EQ.1)
F
A7
T
GO TO 626
A8

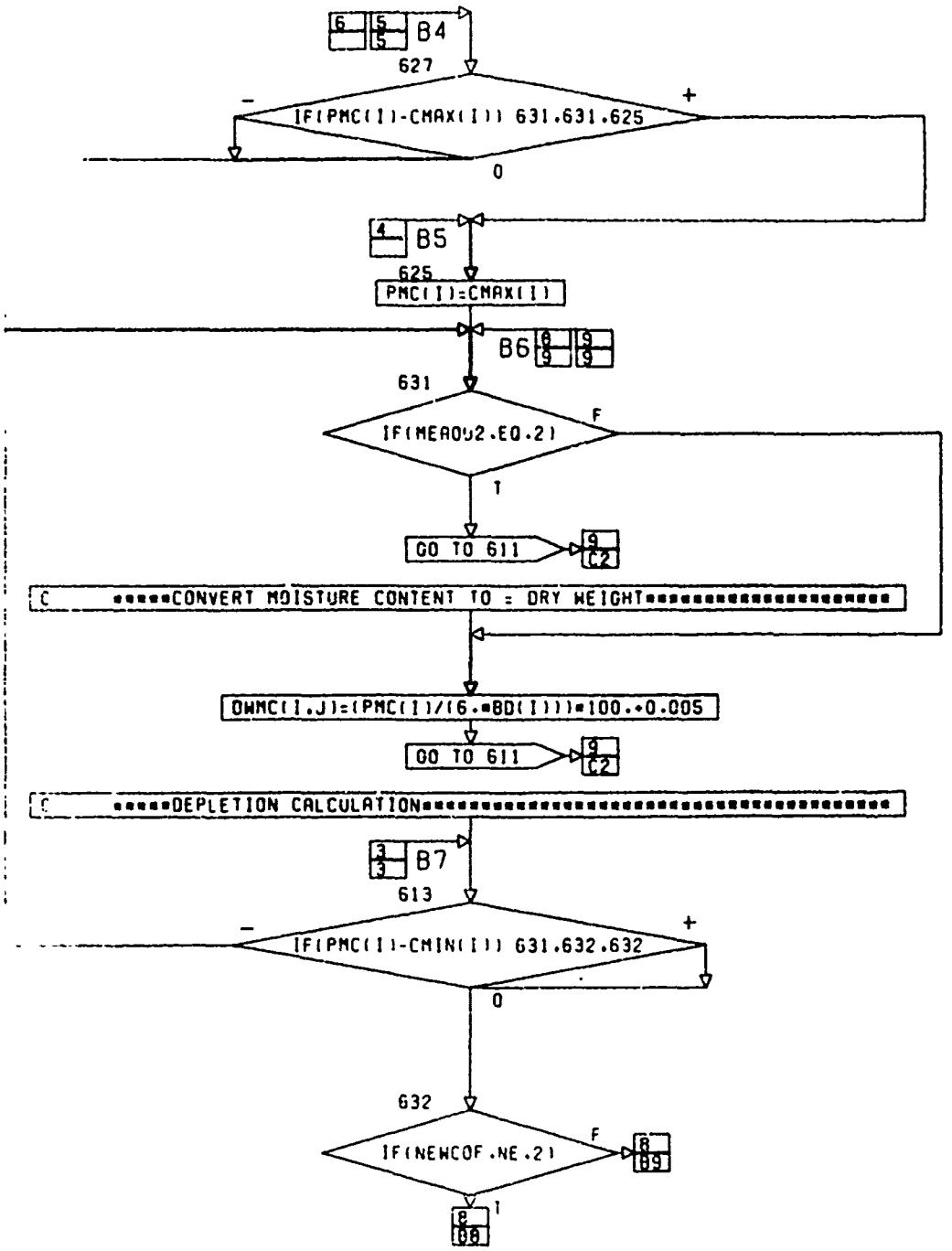
CONT. ON PG 5


4 A7
PMC(I):PMC(I)+ACCR2
GO TO 627
7 B4
4 A8
626
PMC(I):PMC(I)+ACCR1
GOTO627
7 B4
4 A9
623
IF(I.EQ.1.AND.ACCR.LT.CICOF.AND.I.EQ.1)
F
T
GO TO 628
GO TO 629
6 B2
628
CIROF=RF(J)-RMIN
IF(CIROF.LT.CICOF.AND.I.EQ.1)
F
T
GO TO 630
6 B1
GO TO 629
6 B2
C *****ACCRETION(ONE TO ONE RELATION)*****

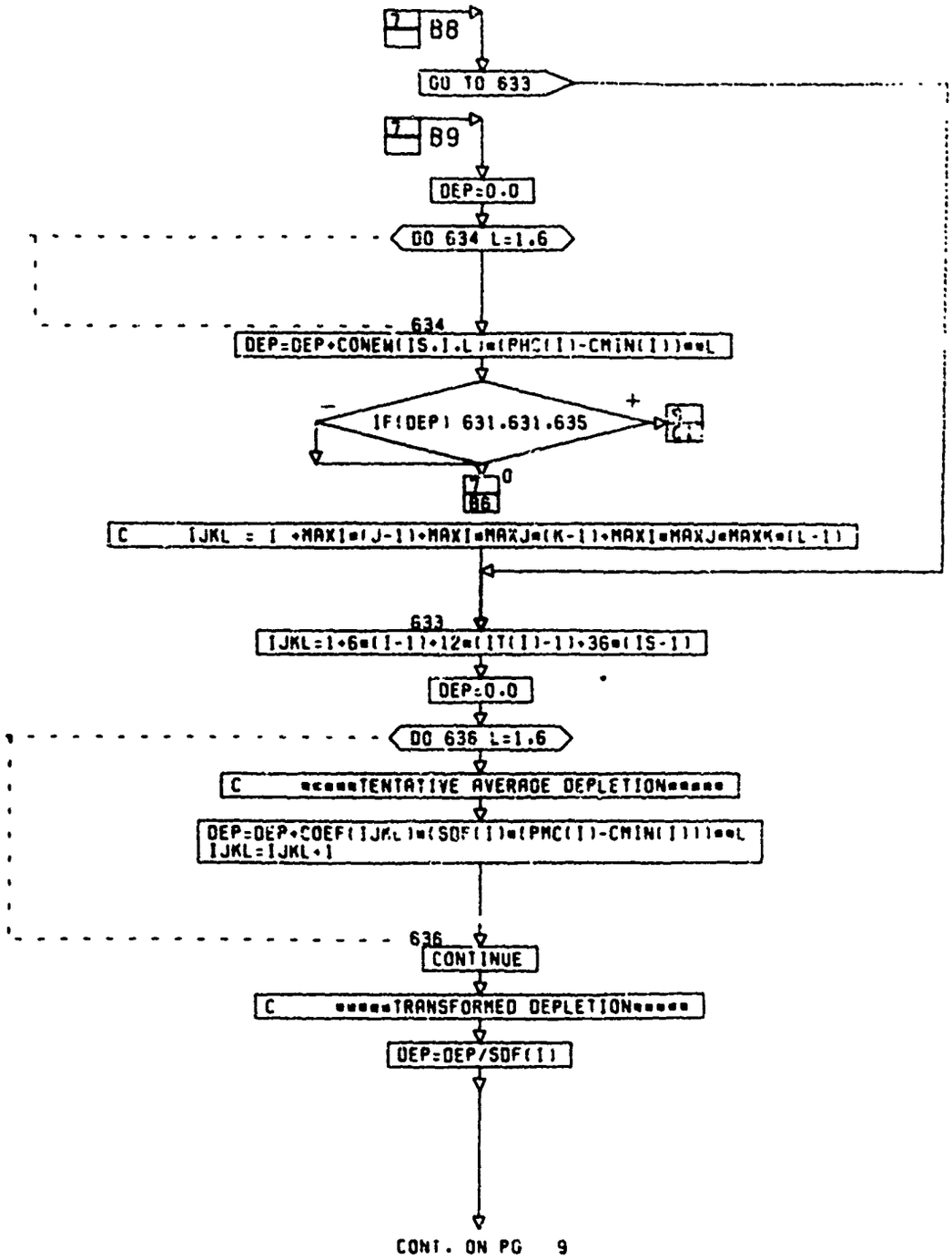
CONT. ON PG 6


B1
630
ACCR=RF(J)-RMIN
B2
629
IF(II.EQ.1)
F
T
GO TO 619
C *****ACCRETION(
IF(ACCR.GE.ACCR2)
F
T
GO TO 619
PMC(I)=PMC(I)+ACCR2
GO TO 627
C NEW MOISTURE CONTENT
B3
619
PMC(I)=PMC(I)+ACCR
CONT. ON PG 7

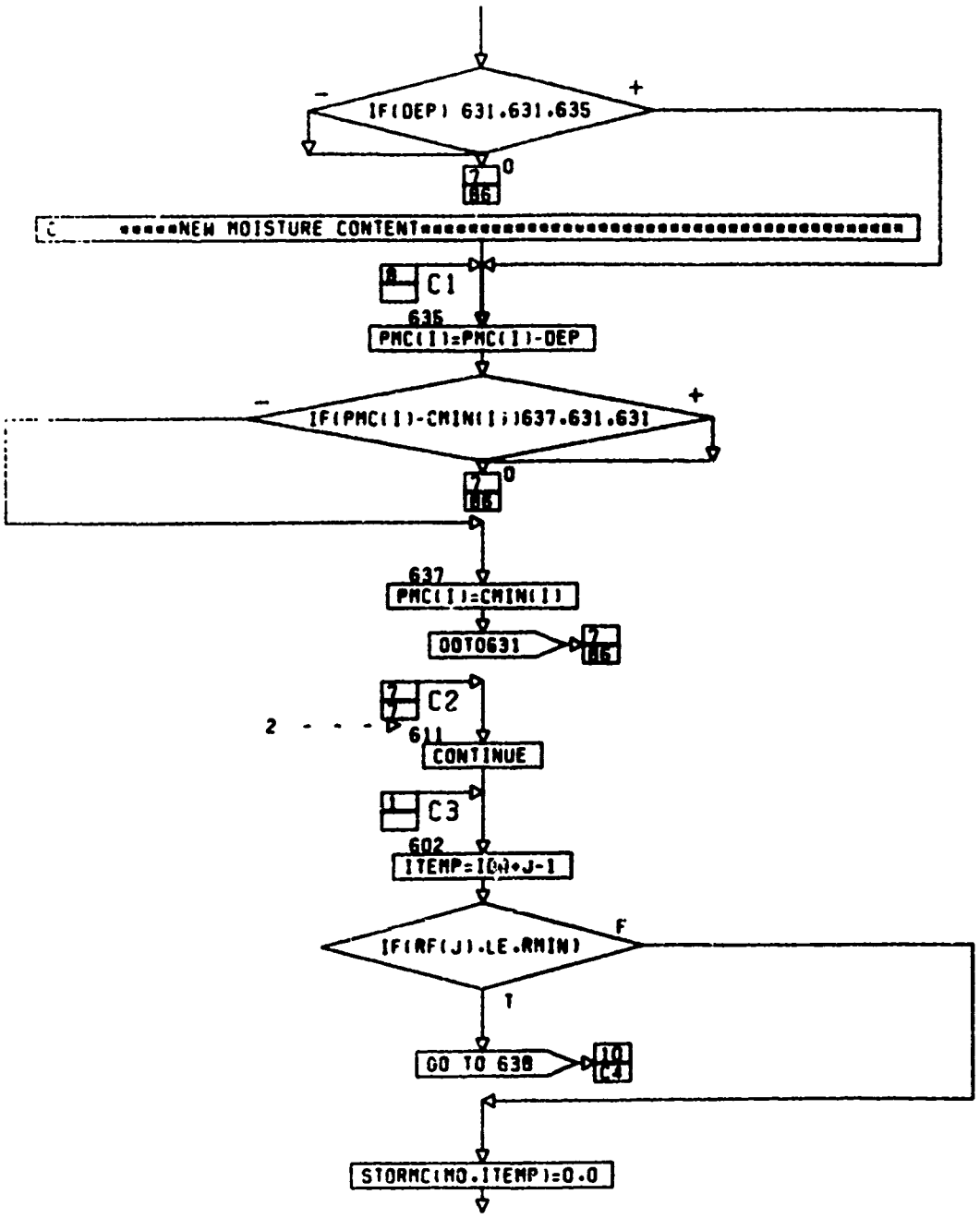
PG 6 OF


B4
627
IF(PMC(I)-CMAX(I)) 631,631,625
B5
625
PMC(I)=CMAX(I)
B6
631
IF(MEAOV2.EQ.2)
GO TO 611
C *****CONVERT MOISTURE CONTENT TO = DRY WEIGHT*****
OWMC(I,J)=(PMC(I)/(6.*BD(I)))*100.+0.005
GO TO 611
C *****DEPLETION CALCULATION*****
B7
613
IF(PMC(I)-CMIN(I)) 631,632,632
632
IF(NEWCOF.NE.2)

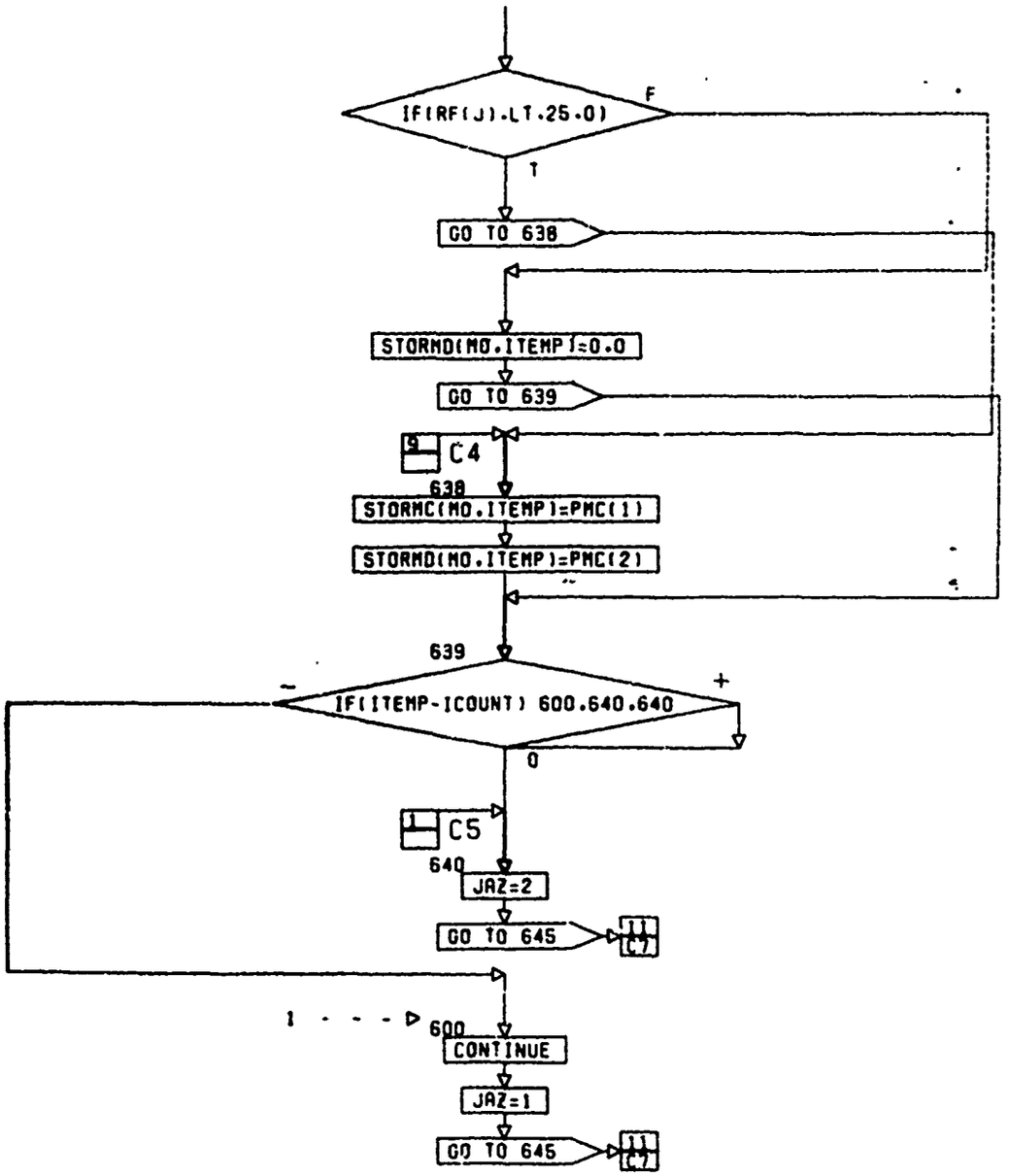
CONT. ON PG 8


B8
GO TO 633
B9
DEP=0.0
DO 634 L=1,6
634
DEP=DEP+CONEW(IS,I,L)*(PMC(I)-CMIN(I))**L
IF(DEP) 631,631,635
B6
C IJKL = I +MAXI*(J-1)+MAXI*MAXJ*(K-1)+MAXI*MAXJ*MAXK*(L-1)
633
IJKL=1+6*(I-1)+12*(IT(I)-1)+36*(IS-1)
DEP=0.0
DO 636 L=1,6
C ****TENTATIVE AVERAGE DEPLETION*****
DEP=DEP+COEF(IJKL)*(SDF(I)*(PMC(I)-CMIN(I)))**L
IJKL=IJKL+1
636
CONTINUE
C *****TRANSFORMED DEPLETION*****
DEP=DEP/SDF(I)

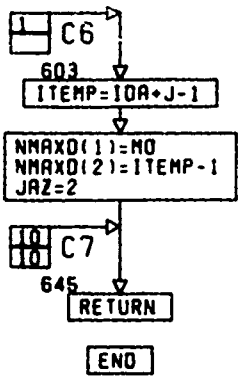
CONT. ON PG 9


IF(DEP) 631,631,635
C *****NEW MOISTURE CONTENT*****
C1
635
PMC(I)=PMC(I)-DEP
IF(PMC(I)-CMIN(I))637,631,631
637
PMC(I)=CMIN(I)
GOTO631
C2
2
611
CONTINUE
C3
602
ITEMP=IQ+J-1
IF(RF(J).LE.RMIN)
GO TO 638
STORMC(MO,ITEMP)=0.0

CONT. ON PG 10

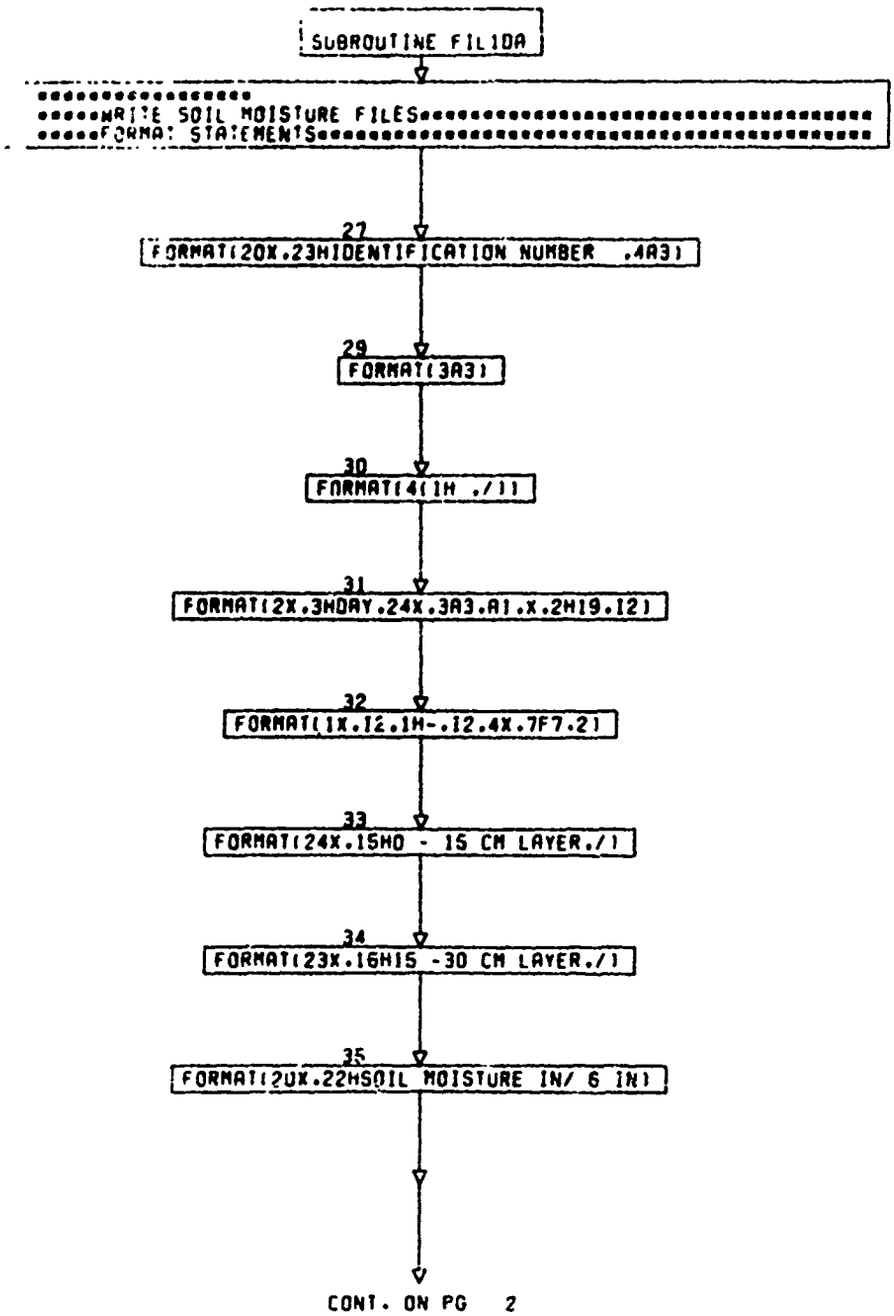

IF(RF(J).LT.25.0)
F
T
GO TO 638
STORMD(MO.ITEMP)=0.0
GO TO 639
9
C4
638
STORMC(MO.ITEMP)=PMC(1)
STORMD(MO.ITEMP)=PMC(2)
639
IF(ITEMP-ICOUNT) 600.640.640
-
+
0
1
C5
640
JAZ=2
GO TO 645
11
C7
1
600
CONTINUE
JAZ=1
GO TO 645
11
C7

CONT. ON PG 11

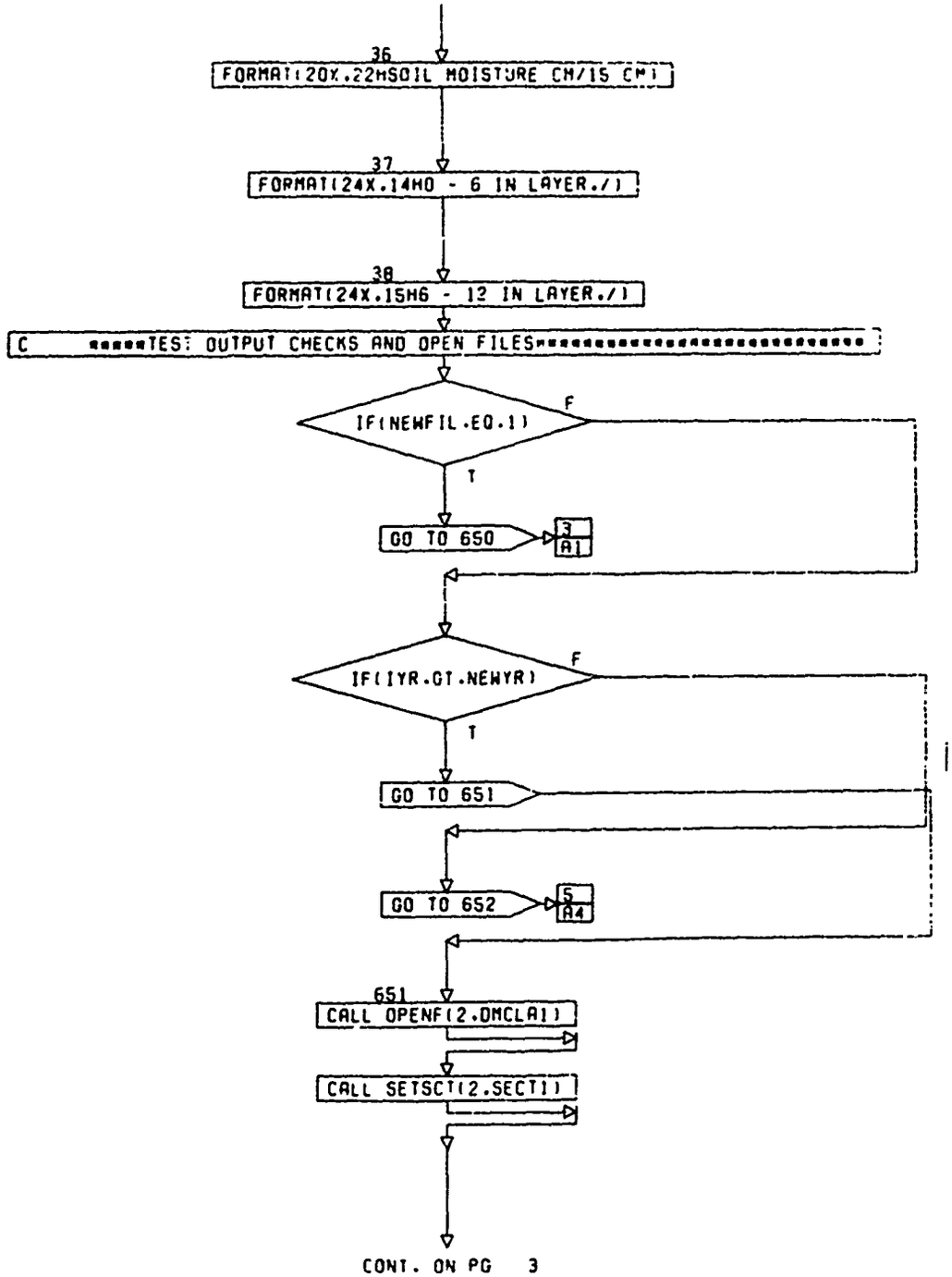

C6
603
ITEMP=IOA+J-1
NMAXO(1)=MO
NMAXO(2)=ITEMP-1
JAZ=2
C7
645
RETURN
END

PG 11 FINAL

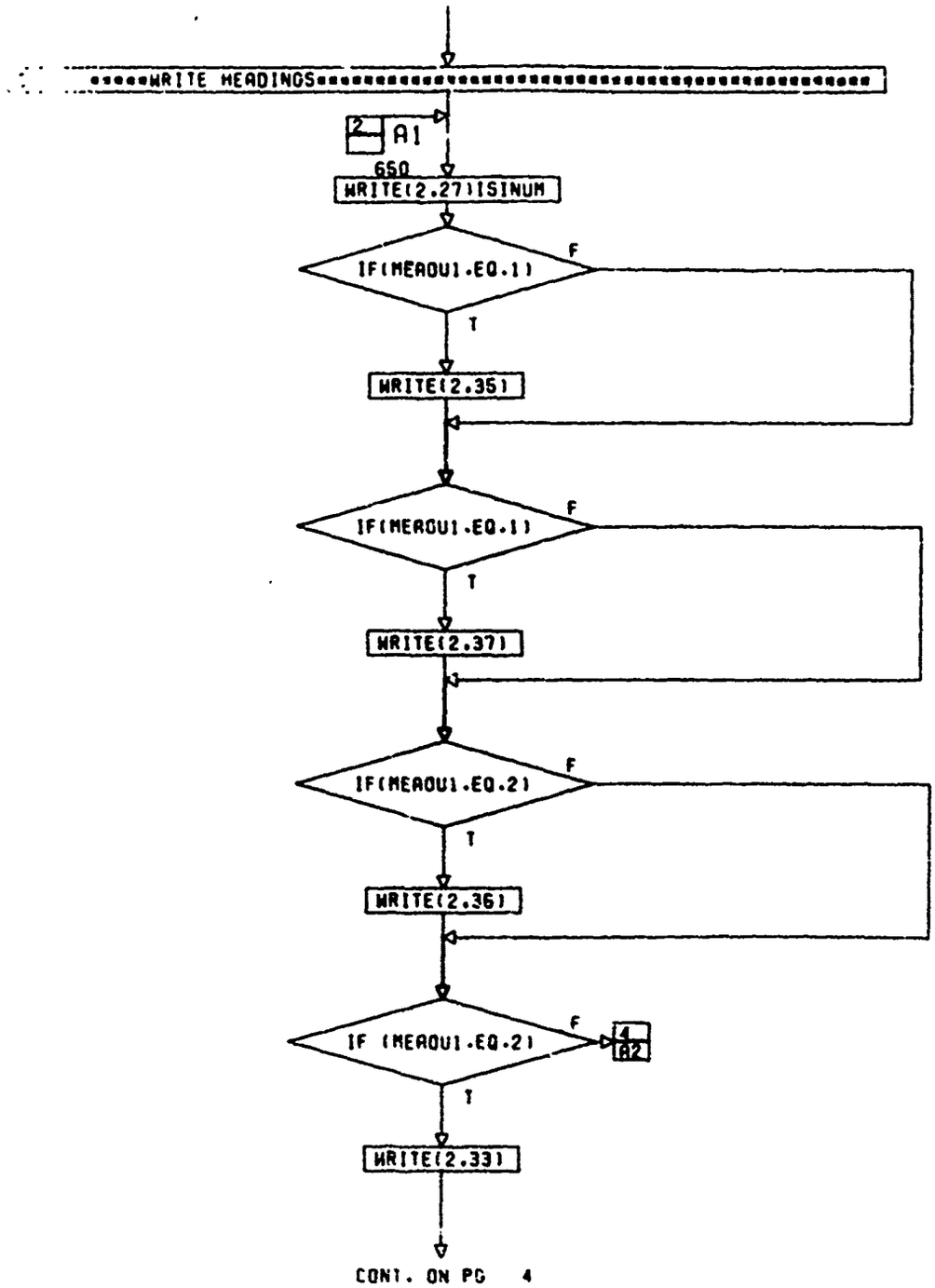
Fig. A4. Detailed Flow Chart of Subroutine FIL1DA
(15 pages)


SUBROUTINE FIL1DA
*****WRITE SOIL MOISTURE FILES*****
*****FORMAT STATEMENTS*****
27
FORMAT(20X,23HIDENTIFICATION NUMBER ,4A3)
29
FORMAT(3A3)
30
FORMAT(4(1H ,/))
31
FORMAT(2X,3HDAY,24X,3A3,A1,X,2H19,I2)
32
FORMAT(1X,I2,1H-,I2,4X,7F7.2)
33
FORMAT(24X,15H0 - 15 CM LAYER,/)
34
FORMAT(23X,16H15 -30 CM LAYER,/)
35
FORMAT(20X,22HSOIL MOISTURE IN/ 6 IN)
CONT. ON PG 2

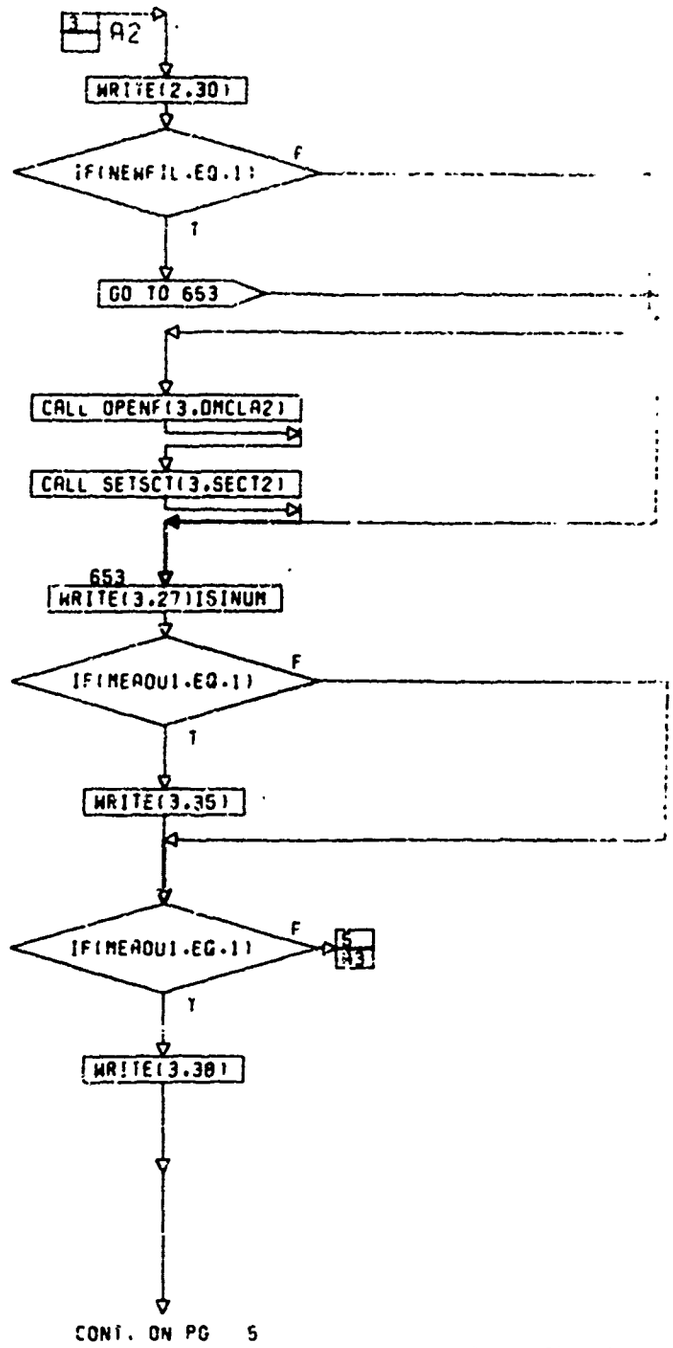
PG 1 OF 15

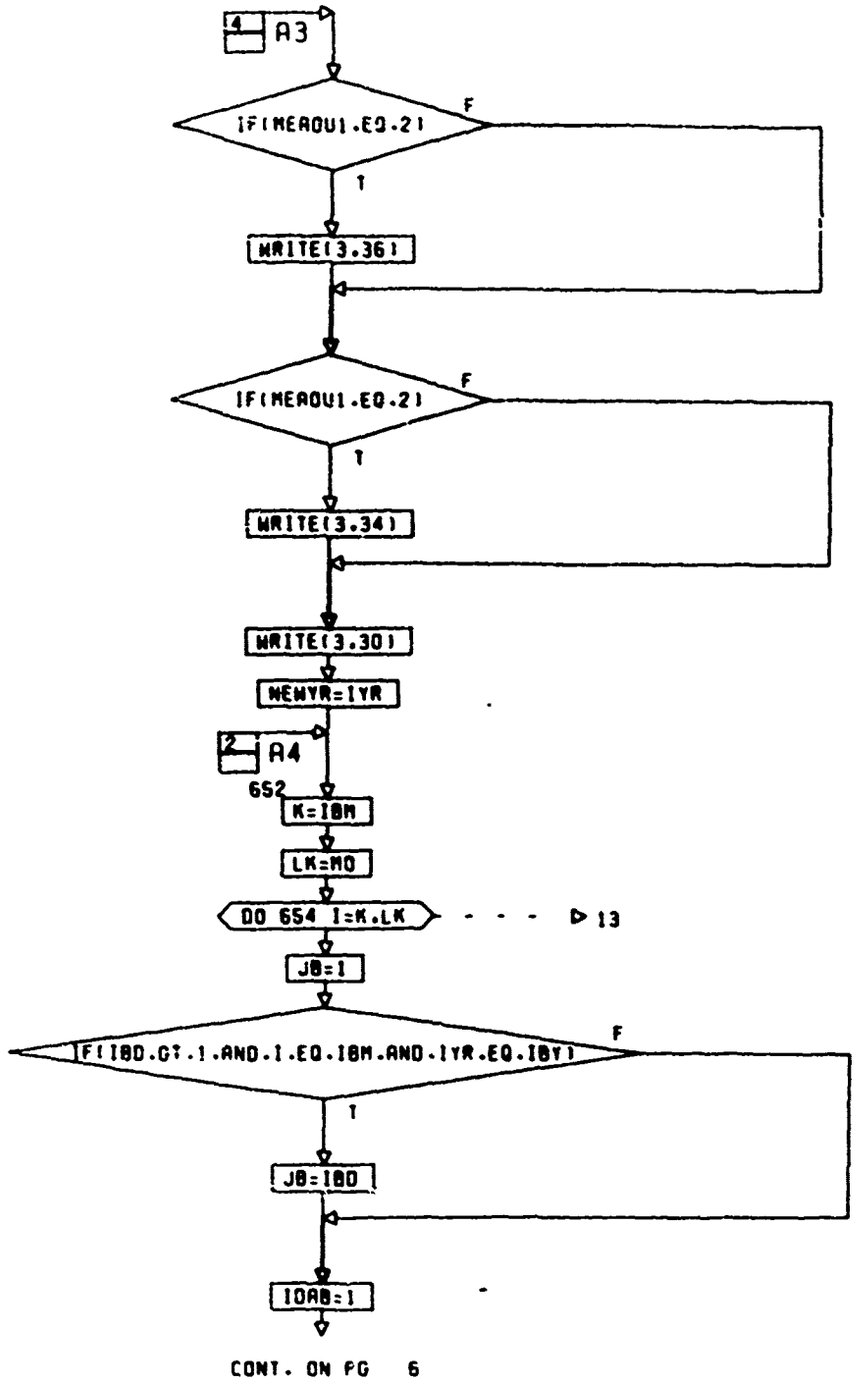

36
FORMAT(20X,22HSOIL MOISTURE CM/15 CM)
37
FORMAT(24X,14H0 - 6 IN LAYER./)
38
FORMAT(24X,15H6 - 12 IN LAYER./)
C ******TEST OUTPUT CHECKS AND OPEN FILES**********
IF(NEWFIL.EQ.1)
F
T
GO TO 650
3
A1
IF(IYR.GT.NEWYR)
F
T
GO TO 651
GO TO 652
5
A4
651
CALL OPENF(2,DMCLA1)
CALL SETSCT(2,SECT1)
CONT. ON PG 3

PG 2 OF

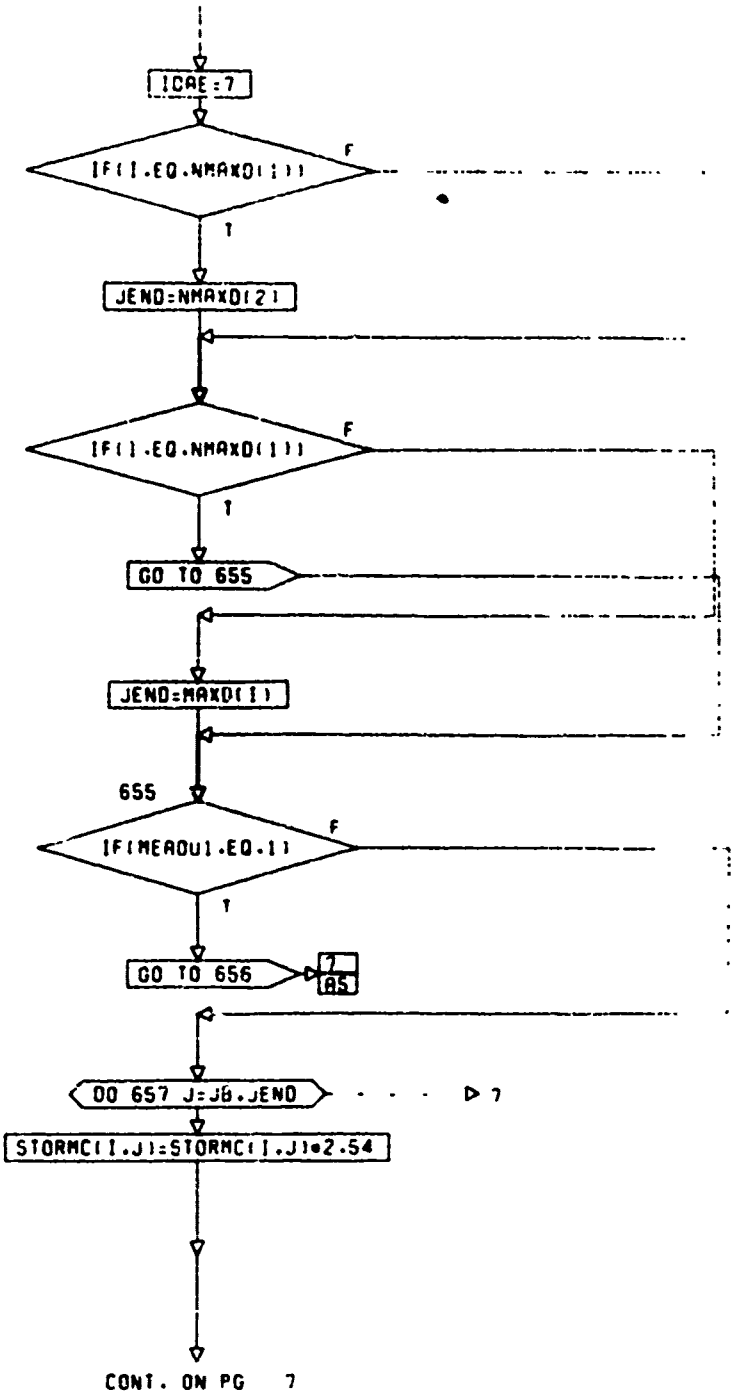

*****WRITE HEADINGS*****
2
A1
650
WRITE(2,27)ISINUM
IF(MEADU1.EQ.1)
F
T
WRITE(2,35)
IF(MEADU1.EQ.1)
F
T
WRITE(2,37)
IF(MEADU1.EQ.2)
F
T
WRITE(2,36)
IF (MEADU1.EQ.2)
F
4
A2
T
WRITE(2,33)
CONT. ON PG 4

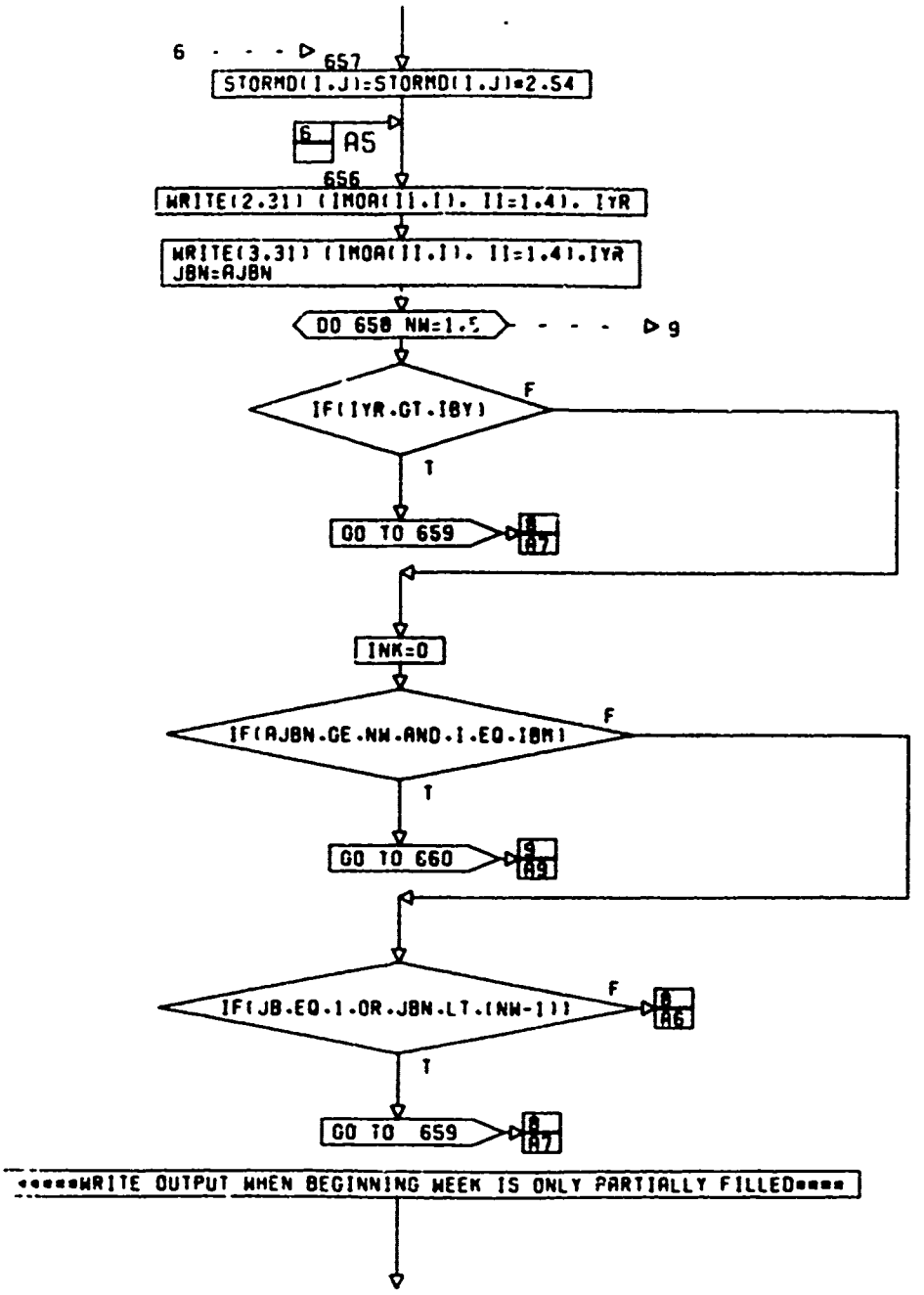
PG 3 OF 15


3
A2
WRITE(2,30)
IF(NEWFIL.EQ.1)
F
T
GO TO 653
CALL OPENF(3,DMCLA2)
CALL SETSCT(3,SECT2)
653
WRITE(3,27)ISINUM
IF(MEADU1.EQ.1)
F
T
WRITE(3,35)
IF(MEADU1.EQ.1)
F
5
A3
T
WRITE(3,38)
CONT. ON PG 5

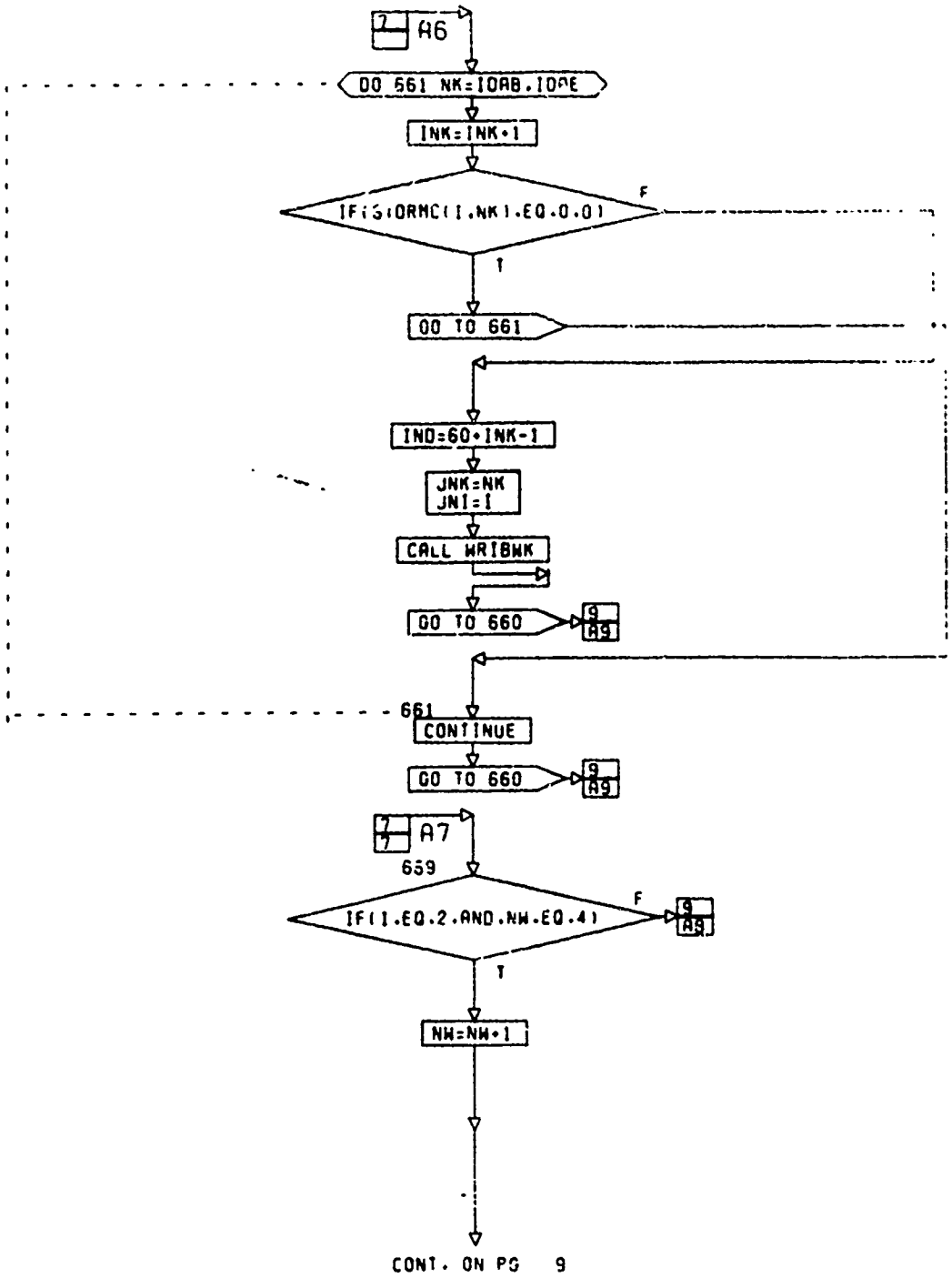

4 A3
IF(MEAOU1.EQ.2)
F
T
WRITE(3,36)
IF(MEAOU1.EQ.2)
F
T
WRITE(3,34)
WRITE(3,30)
NEWYR=IYR
2 A4
652
K=IBM
LK=MO
DO 654 I=K,LK
13
JB=1
IF(IBD.GT.1.AND.I.EQ.IBM.AND.IYR.EQ.IBY)
F
T
JB=IBD
IDAB=1

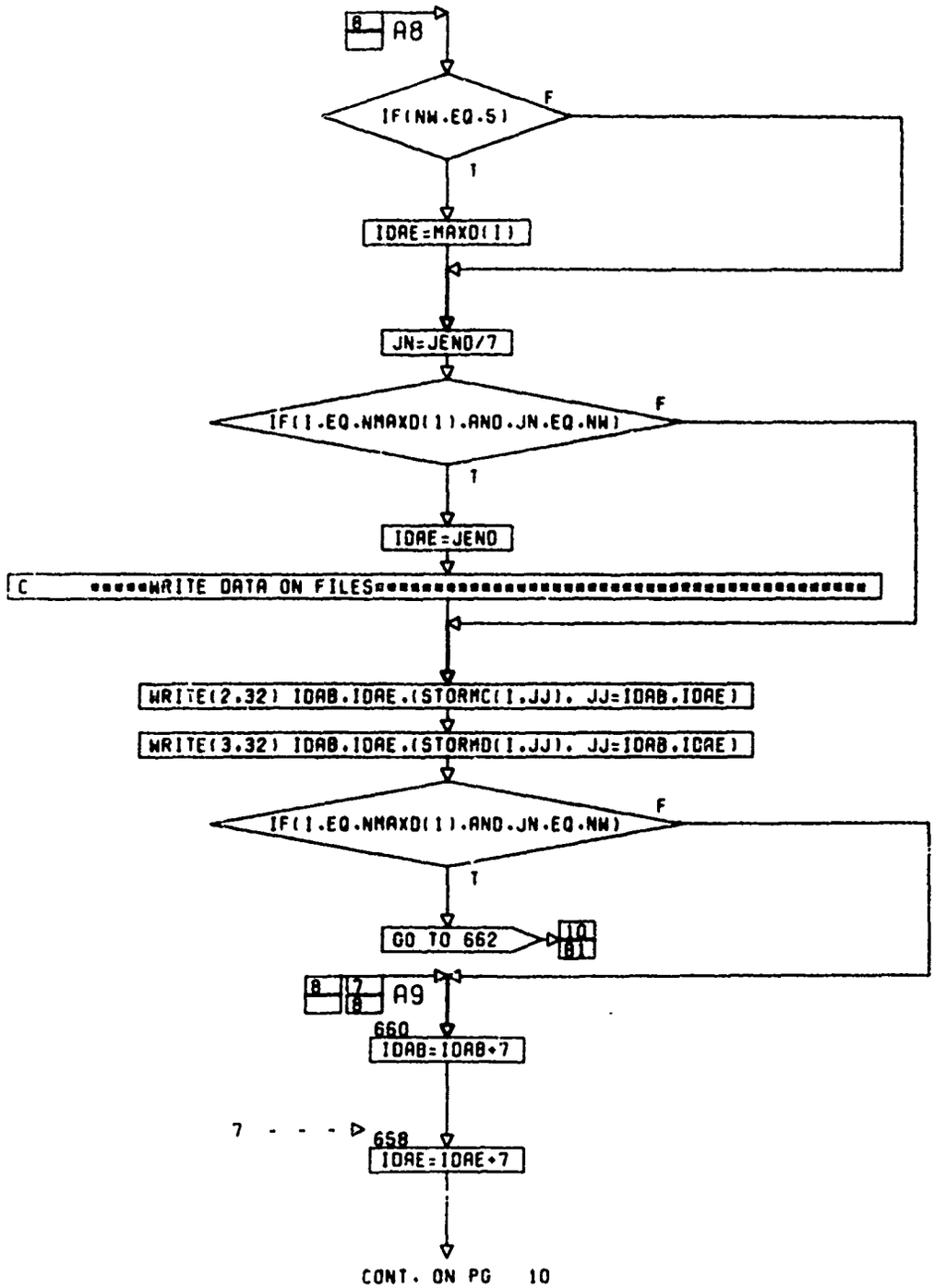
CONT. ON PG 6


ICAE=7
IF(I.EQ.NMAXD(1))
F
T
JEND=NMAXD(2)
IF(I.EQ.NMAXD(1))
F
T
GO TO 655
JEND=MAXD(1)
655
IF(MEADU1.EQ.1)
F
T
GO TO 656
7
A5
DO 657 J=J6,JEND
7
STORMC(I,J)=STORMC(I,J)*2.54
CONT. ON PG 7

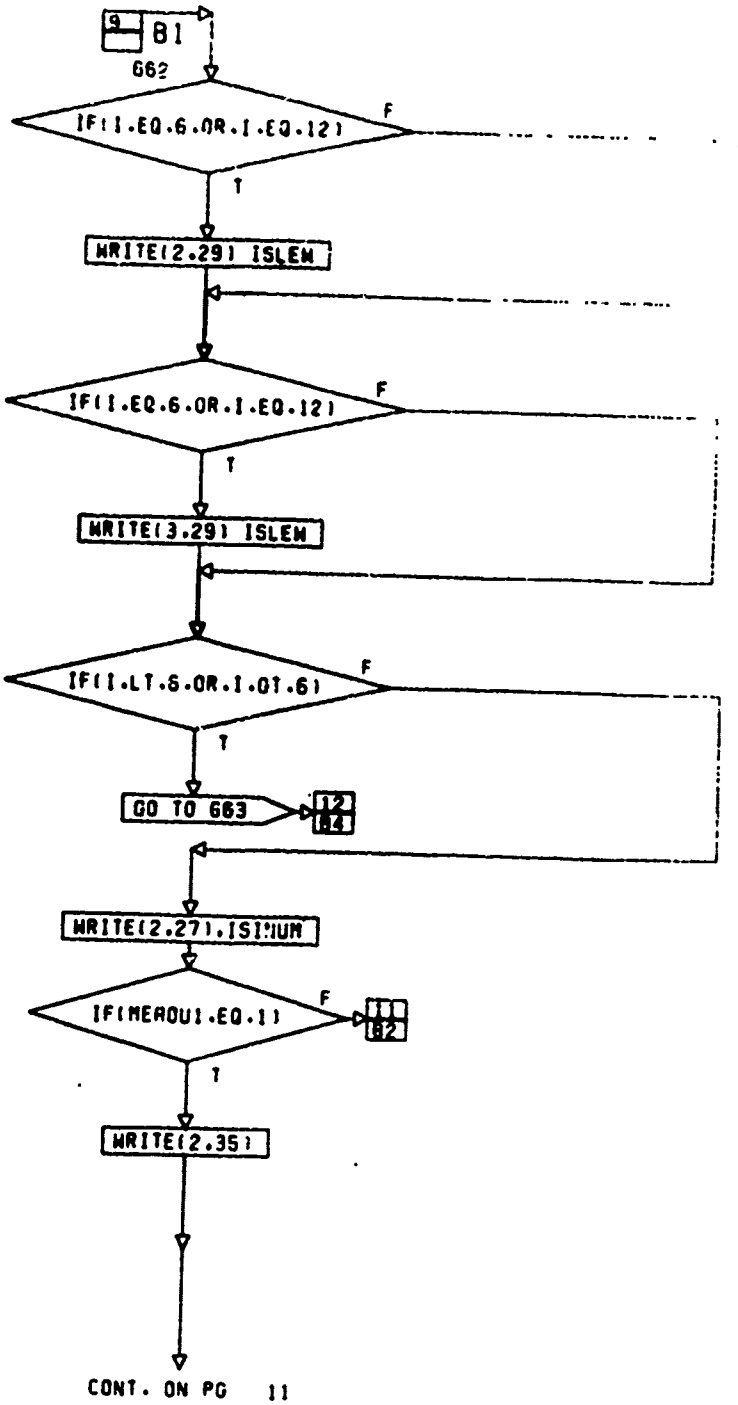

6
657
STORMD(I,J)=STORMD(I,J)*2.54
6
A5
656
WRITE(2,31) (IMOA(II,I), II=1,4), IYR
WRITE(3,31) (IMOA(II,I), II=1,4),IYR
JBN=AJBN
DO 650 NW=1,5
9
IF(IYR.GT.IBY)
F
T
GO TO 659
8
A7
INK=0
IF(AJBN.GE.NW.AND.I.EQ.IBM)
F
T
GO TO 660
9
A9
IF(JB.EQ.1.OR.JBN.LT.(NW-1))
F
8
A6
T
GO TO 659
8
A7
*****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED****

CONT. ON PG 8

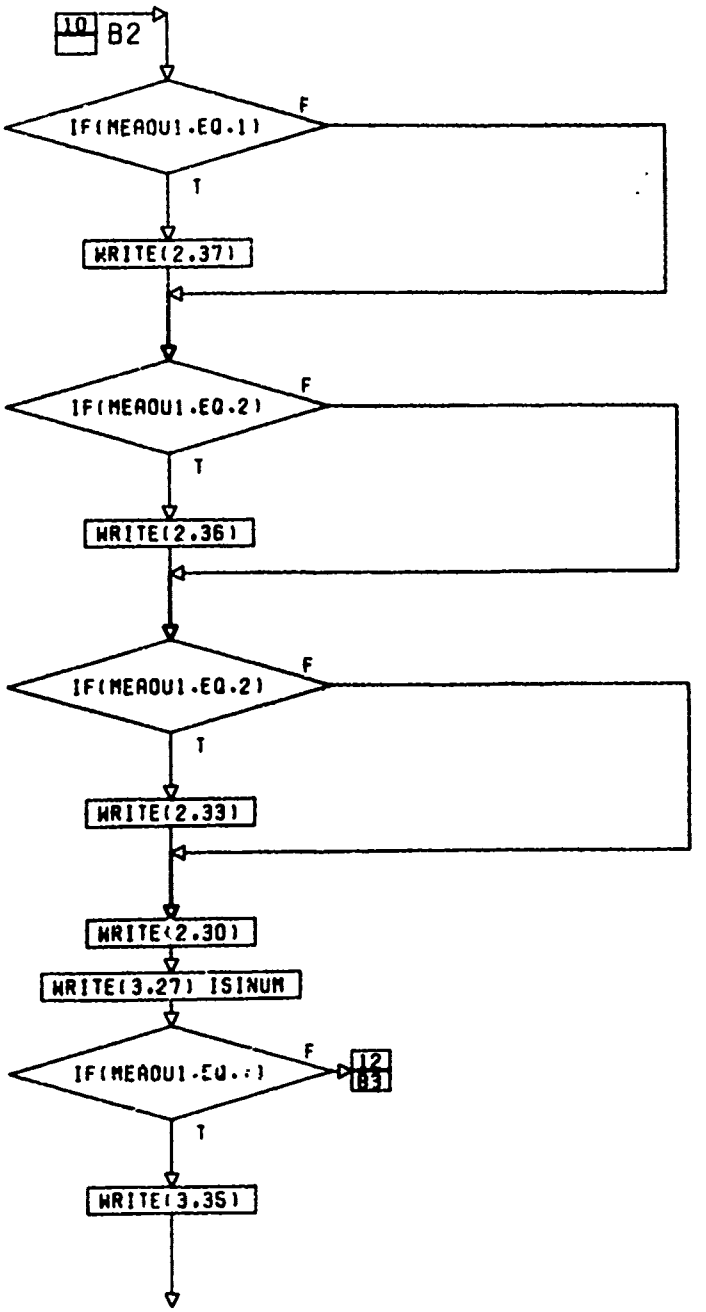

A6
DO 661 NK=IOAB,IOPE
INK=INK+1
IF(SIORMC(I,NK).EQ.0.0)
F
T
GO TO 661
IND=60*INK-1
JNK=NK
JNI=I
CALL WRIBWK
GO TO 660
A9
661
CONTINUE
GO TO 660
A9
A7
659
IF(I.EQ.2.AND.NW.EQ.4)
F
A9
T
NW=NW+1
CONT. ON PG 9


8 A8
IF(NW.EQ.5)
F
T
IDAE=MAXD(I)
JN=JEND/7
IF(I.EQ.NMAXD(1).AND.JN.EQ.NW)
F
T
IDAE=JEND
C *****WRITE DATA ON FILES*****
WRITE(2,32) IDAB,IDAE,(STORMC(I,JJ), JJ=IDAB,IDAE)
WRITE(3,32) IDAB,IDAE,(STORMD(I,JJ), JJ=IDAB,IDAE)
IF(I.EQ.NMAXD(1).AND.JN.EQ.NW)
F
T
GO TO 662
10
81
8 7 8 A9
660
IDAB=IDAB+7
7
658
IDAE=IDAE+7
CONT. ON PG 10

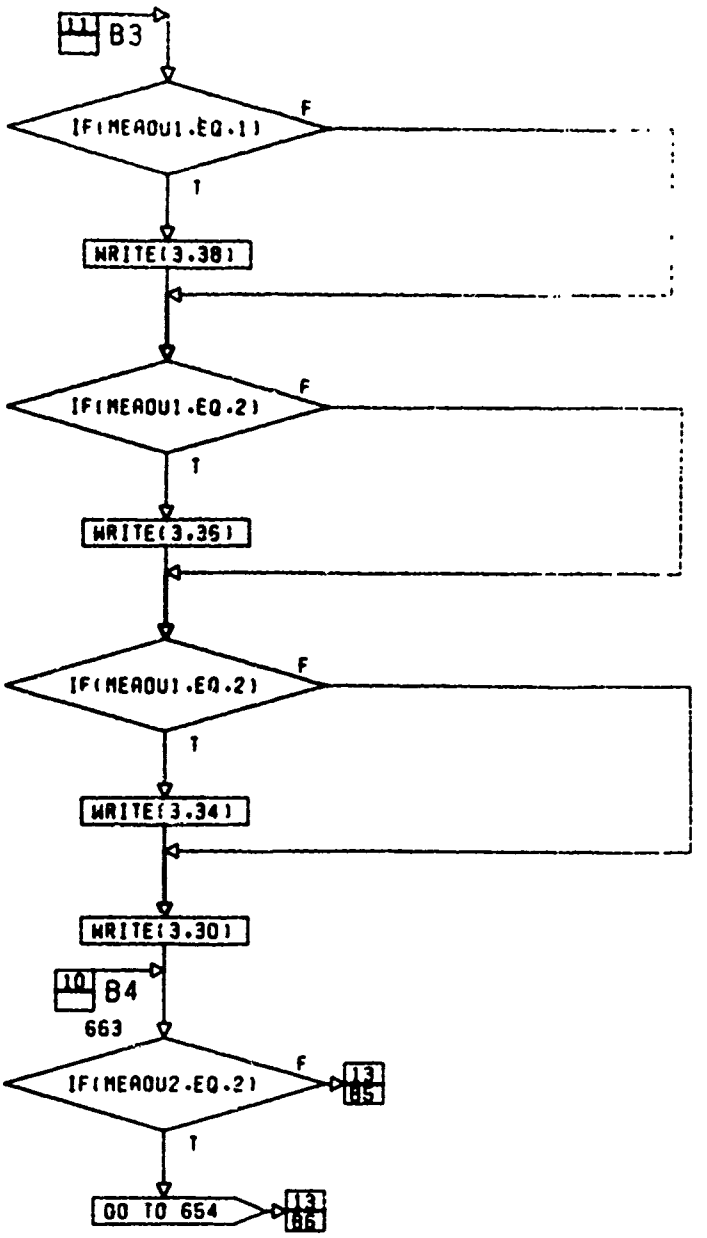
PG 9 OF 15


9
B1
662
IF(I.EQ.6.OR.I.EQ.12)
F
T
WRITE(2.29) ISLEM
IF(I.EQ.6.OR.I.EQ.12)
F
T
WRITE(3.29) ISLEM
IF(I.LT.6.OR.I.GT.6)
F
T
GO TO 663
12
B4
WRITE(2.27).ISIMUM
IF(MEADU1.EQ.1)
F
11
B2
T
WRITE(2.35)
CONT. ON PG 11

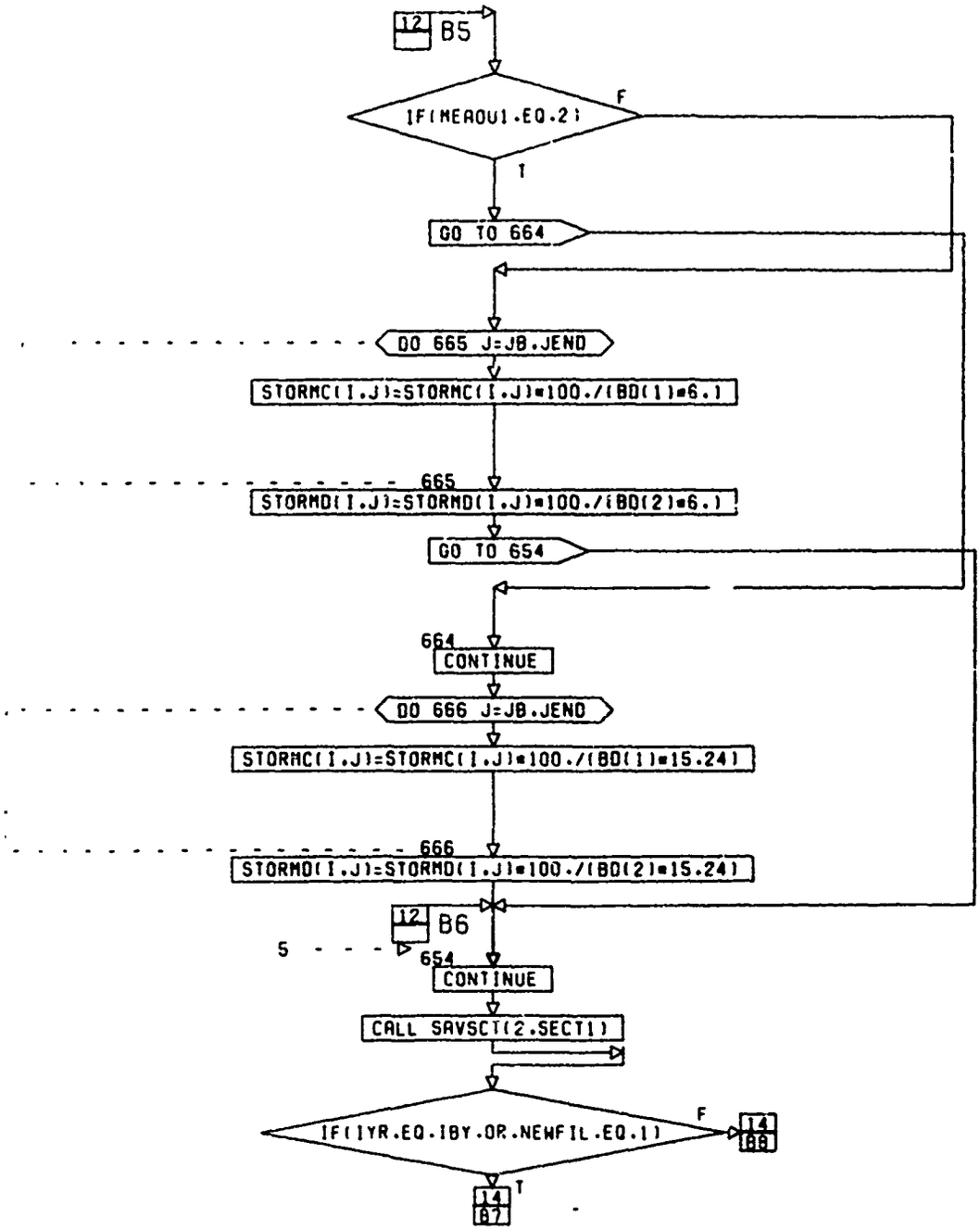
PG 10 OF 15


10
B2
IF(MEADU1.EQ.1)
F
T
WRITE(2,37)
IF(MEADU1.EQ.2)
F
T
WRITE(2,36)
IF(MEADU1.EQ.2)
F
T
WRITE(2,33)
WRITE(2,30)
WRITE(3,27) ISINUM
IF(MEADU1.EQ.
F
12
B3
T
WRITE(3,35)

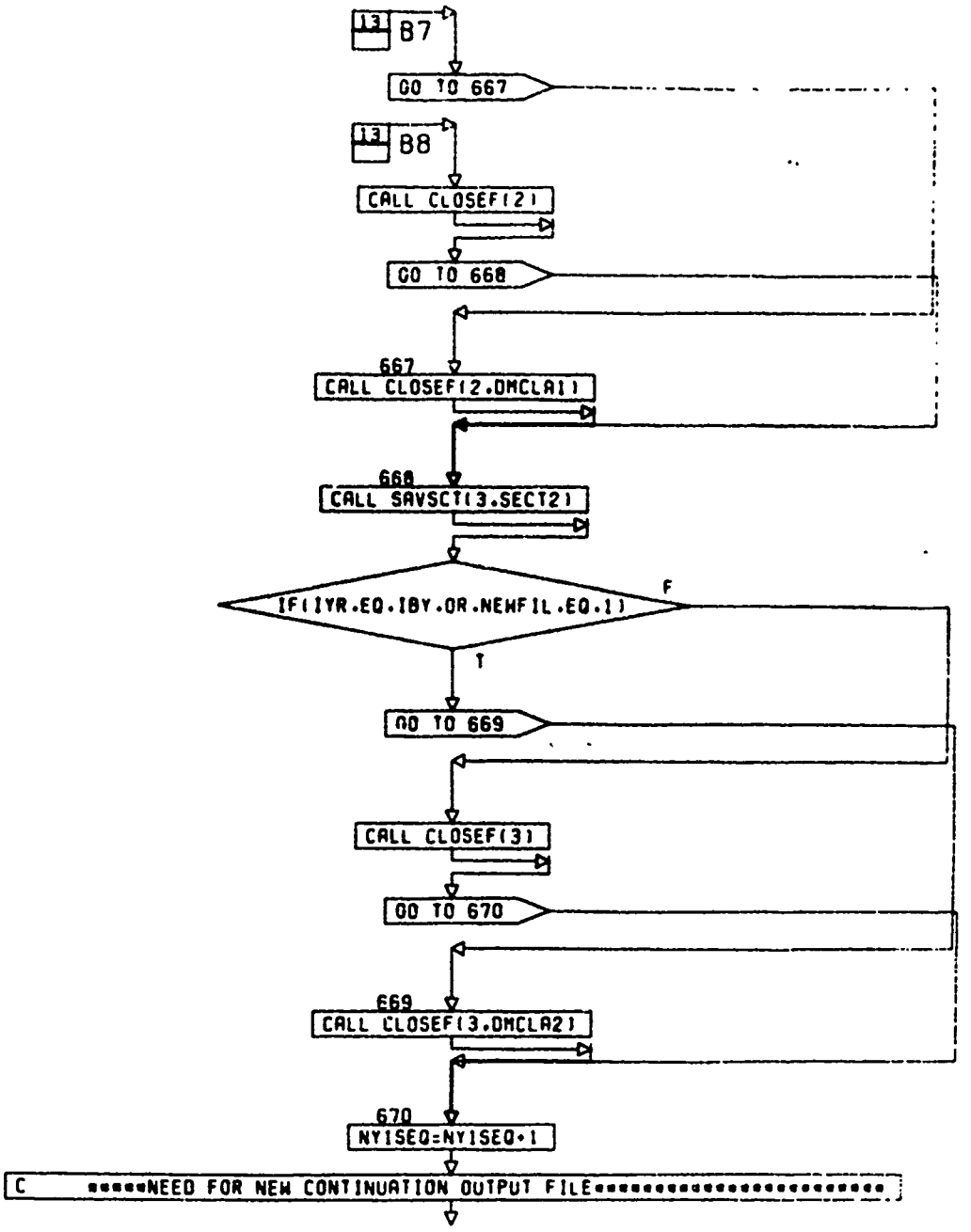
CONT. ON PG 12


11
B3
IF(MEADU1.EQ.1)
F
T
WRITE(3,38)
IF(MEADU1.EQ.2)
F
T
WRITE(3,36)
IF(MEADU1.EQ.2)
F
T
WRITE(3,34)
WRITE(3,30)
10
B4
663
IF(MEADU2.EQ.2)
F
13
B5
T
GO TO 654
13
B6

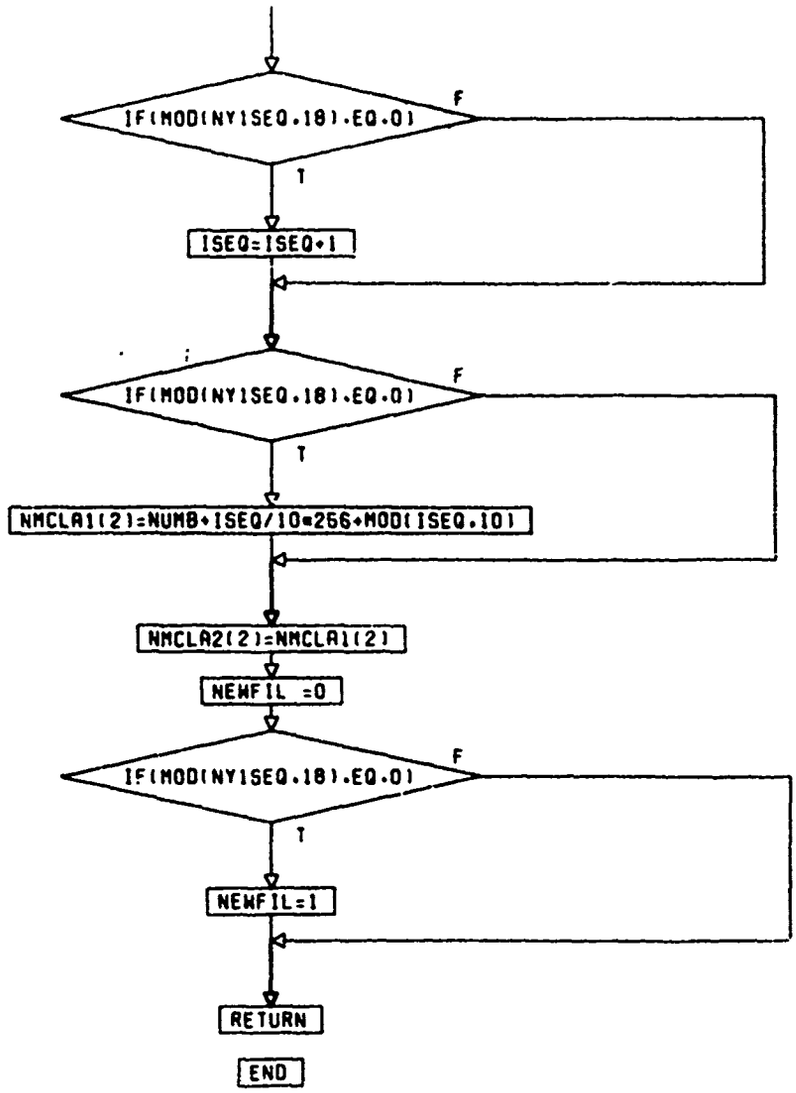
CONT. ON PG 13


12 B5
IF(MEAOU1.EQ.2)
F
T
GO TO 664
DO 665 J=JB,JEND
STORMC(I,J)=STORMC(I,J)*100./(BD(1)*6.)
665
STORMD(I,J)=STORMD(I,J)*100./(BD(2)*6.)
GO TO 654
664
CONTINUE
DO 666 J=JB,JEND
STORMC(I,J)=STORMC(I,J)*100./(BD(1)*15.24)
666
STORMD(I,J)=STORMD(I,J)*100./(BD(2)*15.24)
12 B6
5
654
CONTINUE
CALL SAVSCT(2,SECT1)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
14 B8
T
14 B7

CONT. ON PG 14


13 B7
GO TO 667
13 B8
CALL CLOSEF(2)
GO TO 668
667
CALL CLOSEF(2,DMCLA1)
668
CALL SAVSCT(3,SECT2)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 669
CALL CLOSEF(3)
GO TO 670
669
CALL CLOSEF(3,DMCLA2)
670
NY1SEQ=NY1SEQ+1
C ******NEED FOR NEW CONTINUATION OUTPUT FILE**********

CONT. ON PG 15

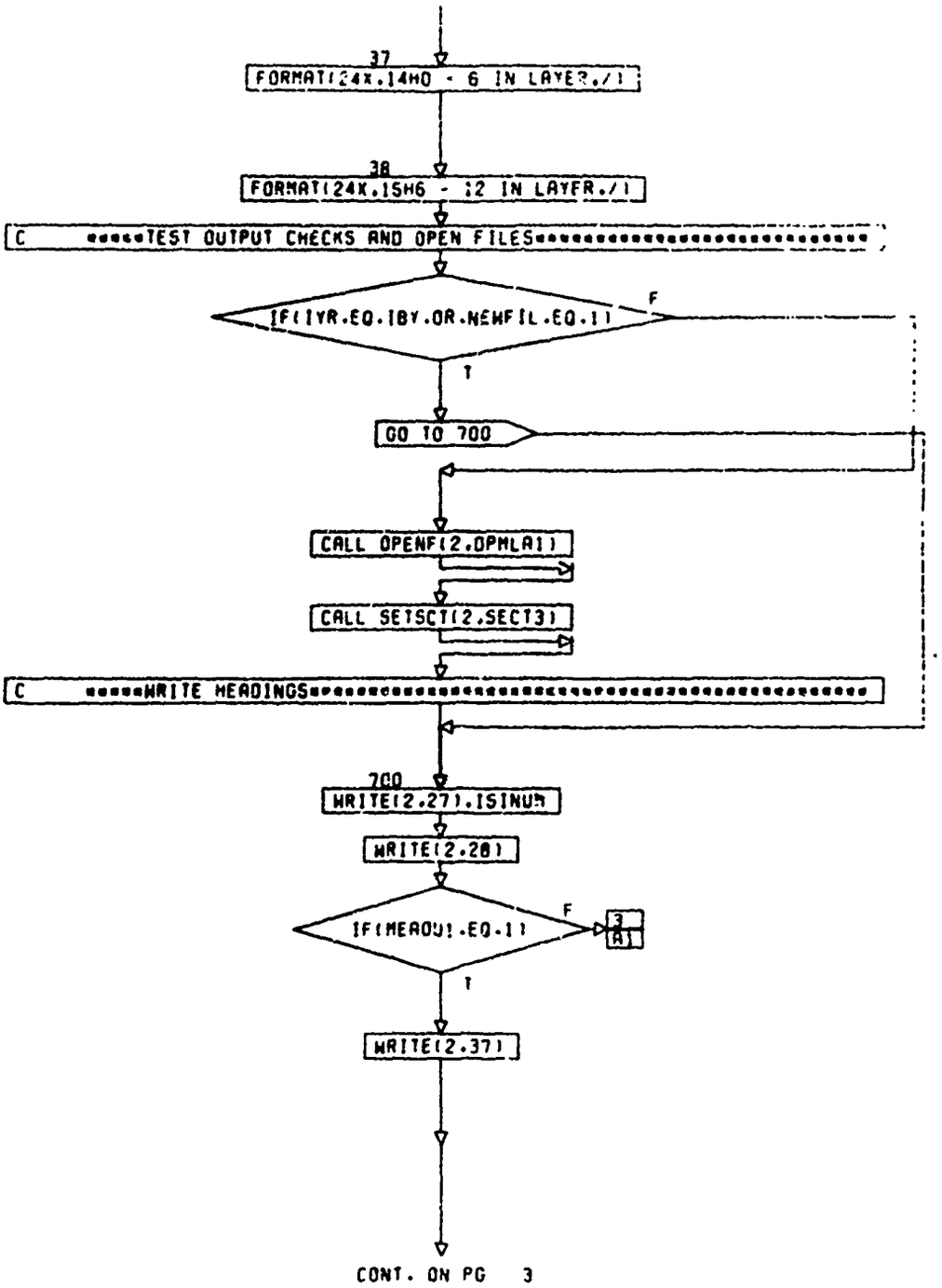

IF(MOD(NY1SEQ,18).EQ.0)
F
T
ISEQ=ISEQ+1
IF(MOD(NY1SEQ,18).EQ.0)
F
T
NMCLA1(2)=NUMB+ISEQ/10*256+MOD(ISEQ,10)
NMCLA2(2)=NMCLA1(2)
NEWFIL =0
IF(MOD(NY1SEQ,18).EQ.0)
F
T
NEWFIL=1
RETURN
END

PG 15 FINAL

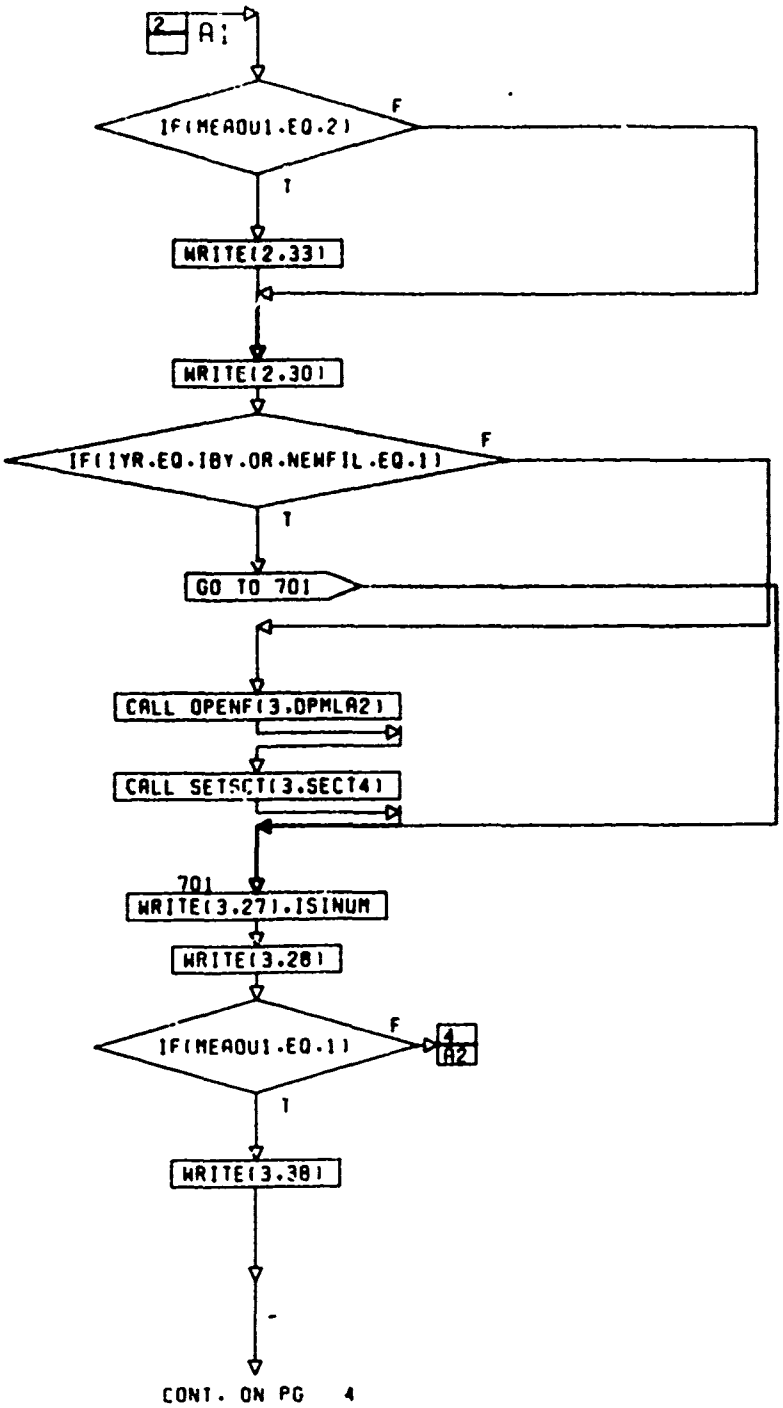
Fig. A5. Detailed Flow Chart of Subroutine FIL2DA
(10 pages)

```
SUBROUTINE FIL2DA
*****************
*****WRITE PERCENT MOISTURE FILES*****************************
*****FORMAT STATEMENTS****************************************
27
FORMAT(20X,23HIDENTIFICATION NUMBER' ,4A3)
28
FORMAT(19X,24HPERCENT MOISTURE CONTENT)
29
FORMAT(3A3)
30
FORMAT(4(1H ,/))
31
FORMAT(2X,3HDAY,24X,3A3,A1,X,2H19,I2)
32
FORMAT(1X,I2,1H-,I2,4X,7F7.2)
33
FORMAT(24X,15H0 - 15 CM LAYER,/)
34
FORMAT(23X,16H15 -30 CM LAYER,/)
```

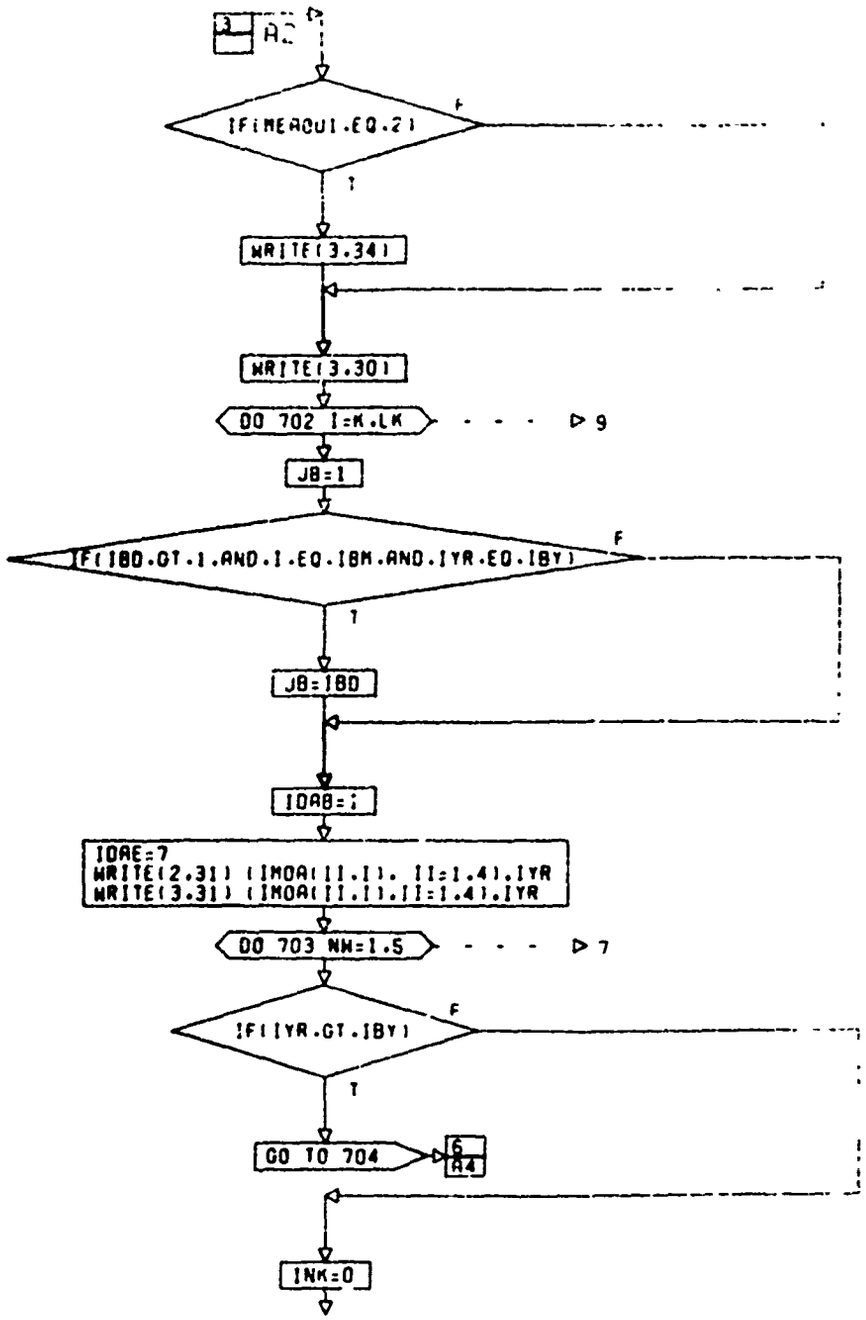
CONT. ON PG 2


37
FORMAT(24X,14HO - 6 IN LAYER,/)
38
FORMAT(24X,15H6 - 12 IN LAYER,/)
C ******TEST OUTPUT CHECKS AND OPEN FILES*****
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 700
CALL OPENF(2,OPMLA1)
CALL SETSCT(2,SECT3)
C ******WRITE HEADINGS*****
700
WRITE(2,27),ISINUM
WRITE(2,28)
IF(MEADU1.EQ.1)
F
3
A1
T
WRITE(2,37)
CONT. ON PG 3

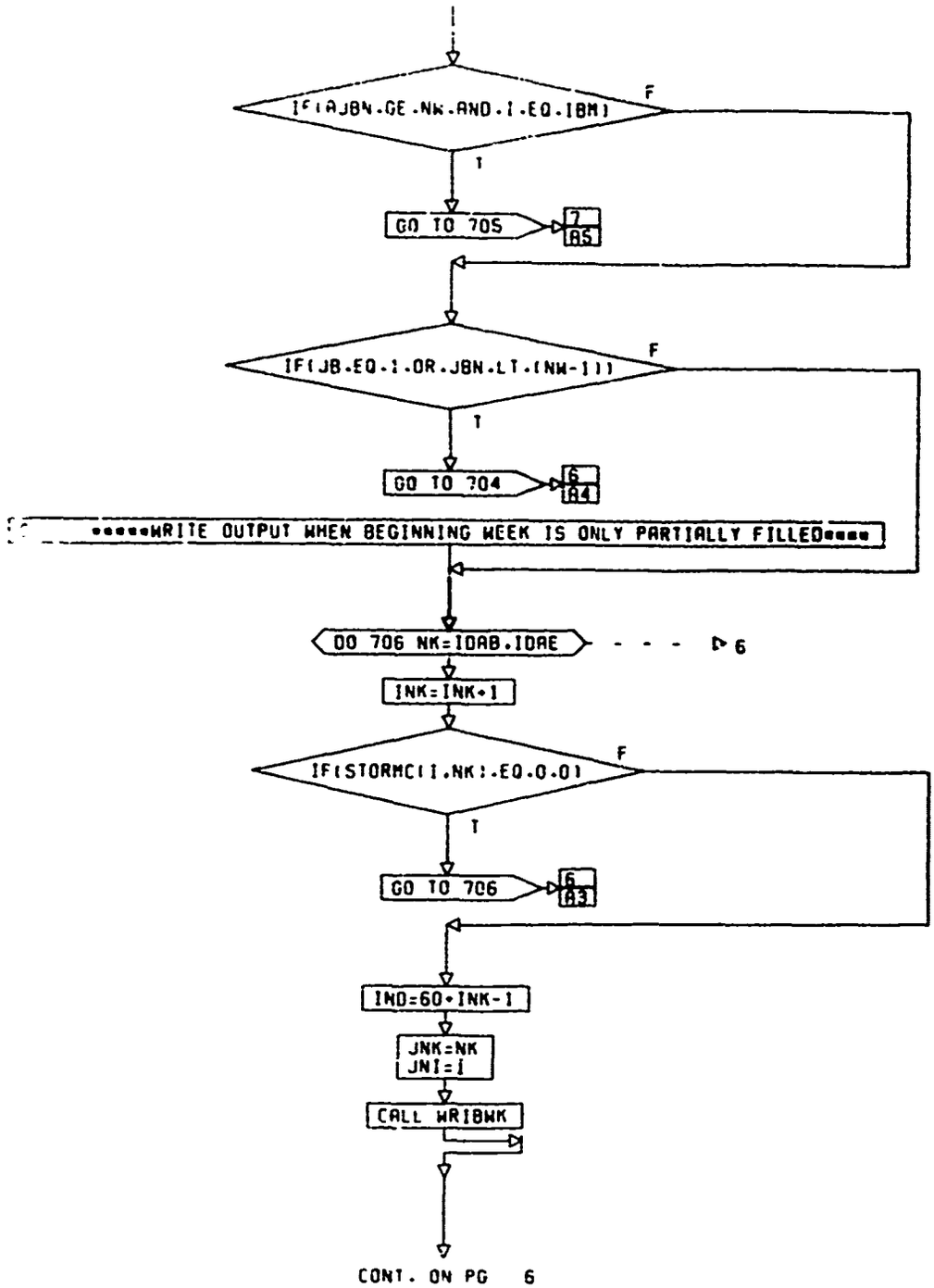
PG. 2 OF 19


2
A1
IF(MEADU1.EQ.2)
F
T
WRITE(2,33)
WRITE(2,30)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 701
CALL OPENF(3,DPMLA2)
CALL SETSCT(3,SECT4)
701
WRITE(3,27),ISINUM
WRITE(3,28)
IF(MEADU1.EQ.1)
F
4
A2
T
WRITE(3,38)
CONT. ON PG 4

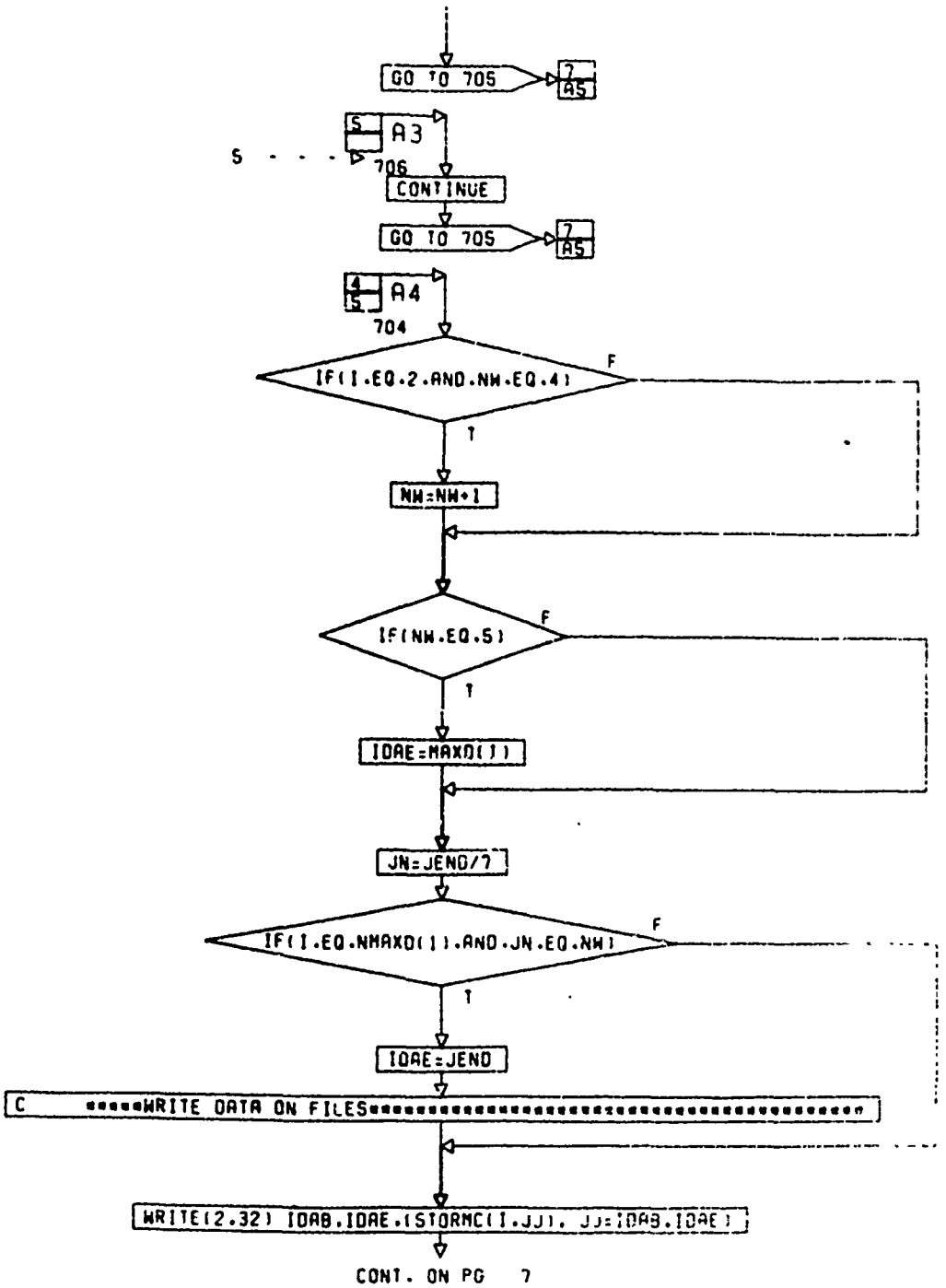
PG 3 OF 10

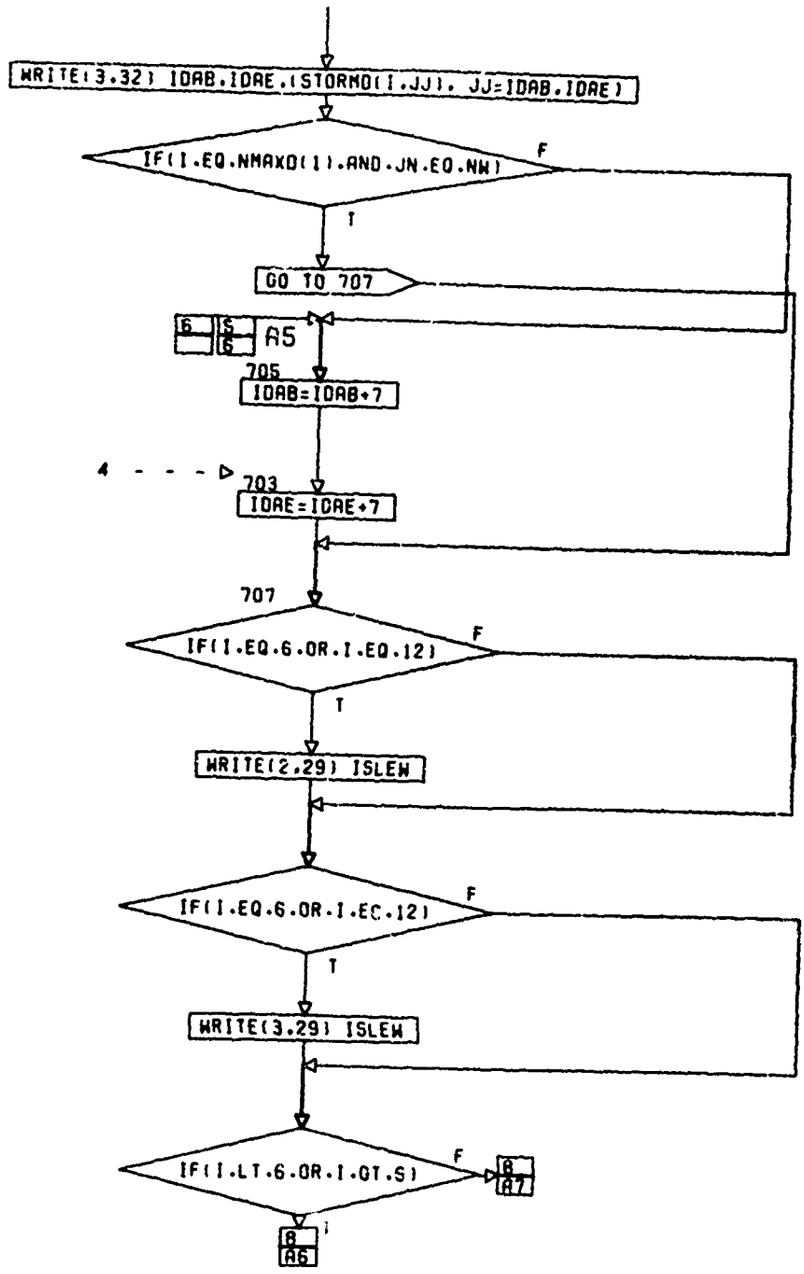

3 A2
IF(MEACUI.EQ.2)
F
T
WRITE(3,34)
WRITE(3,30)
DO 702 I=K,LK
9
JB=1
IF(IBD.GT.1.AND.I.EQ.IBM.AND.IYR.EQ.IBY)
F
T
JB=IBD
IDAB=1
IDAE=7
WRITE(2,31) (IMOA(II,I), II=1,4),IYR
WRITE(3,31) (IMOA(II,I),II=1,4),IYR
DO 703 NW=1,5
7
IF(IYR.GT.IBY)
F
T
GO TO 704
6
A4
INK=0

CONT. ON PG 5

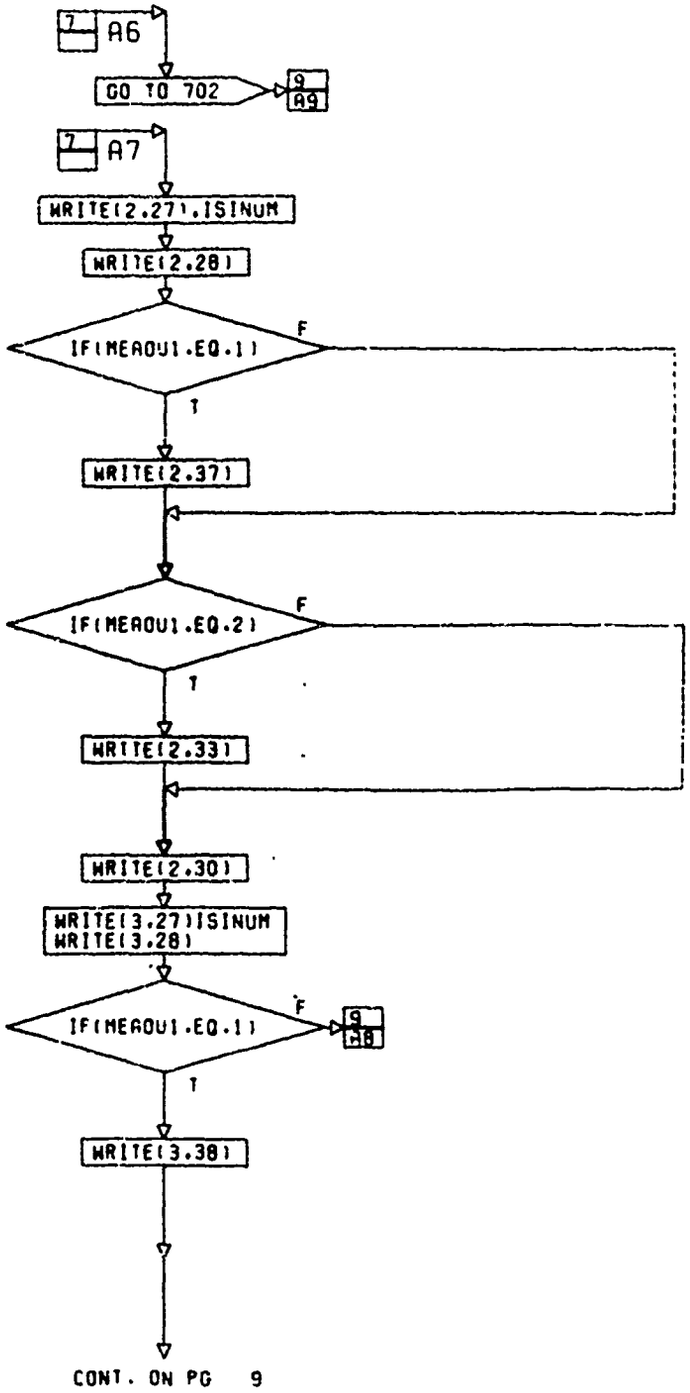

IF(JBN.GE.NW.AND.I.EQ.IBM)
F
T
GO TO 705
7
A5
IF(JB.EQ.1.OR.JBN.LT.(NW-1))
F
T
GO TO 704
6
A4
*****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED****
DO 706 NK=IDAB,IDAE
6
INK=INK+1
IF(STORMC(I,NK).EQ.0.0)
F
T
GO TO 706
6
A3
IND=60*INK-1
JNK=NK
JNI=I
CALL WRIBWK
CONT. ON PG 6

PG 5 OF 10

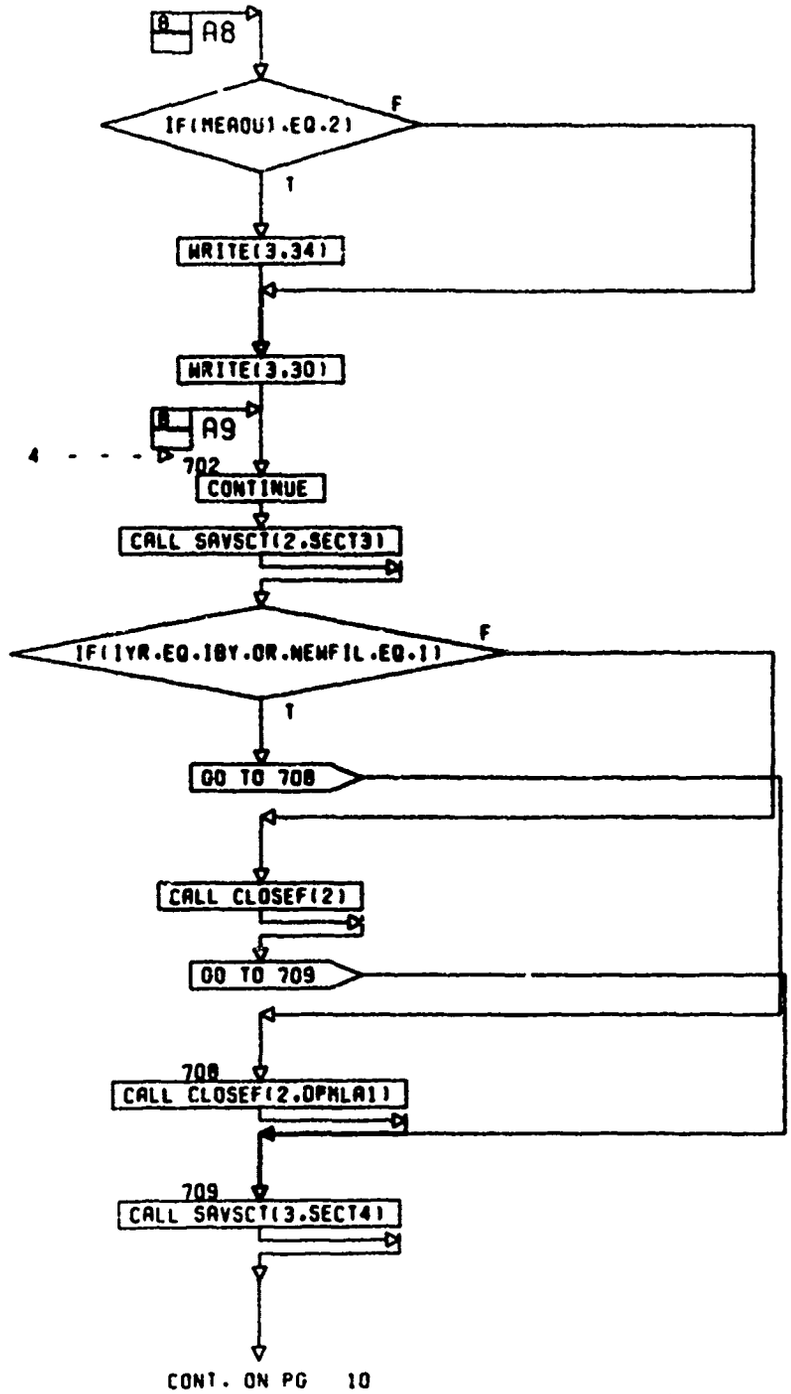

GO TO 705
7
A5
5
A3
5
706
CONTINUE
GO TO 705
7
A5
4
5
A4
704
IF(I.EQ.2.AND.NW.EQ.4)
F
T
NW=NW+1
IF(NW.EQ.5)
F
T
IDAE=MAXD(I)
JN=JEND/7
IF(I.EQ.NMAXD(I).AND.JN.EQ.NW)
F
T
IDAE=JEND
C *****WRITE DATA ON FILES*****
WRITE(2,32) IDAB,IDAE,(STORMC(I,JJ), JJ=IDAB,IDAE)
CONT. ON PG 7


WRITE(3,32) IDAB,IDAE,(STORMD(I,JJ), JJ=IDAB,IDAE)
IF(I.EQ.NMAXD(1).AND.JN.EQ.NW)
F
T
GO TO 707
6
5
6
A5
705
IDAB=IDAB+7
4
703
IDAE=IDAE+7
707
IF(I.EQ.6.OR.I.EQ.12)
F
T
WRITE(2,29) ISLEW
IF(I.EQ.6.OR.I.EQ.12)
F
T
WRITE(3,29) ISLEW
IF(I.LT.6.OR.I.GT.5)
F
8
A7
T
8
A6

CONT. ON PG 8


7 A6
GO TO 702
9 A9
7 A7
WRITE(2.27).ISINUM
WRITE(2.28)
IF(MEADU1.EQ.1)
F
T
WRITE(2.37)
IF(MEADU1.EQ.2)
F
T
WRITE(2.33)
WRITE(2.30)
WRITE(3.27)ISINUM
WRITE(3.28)
IF(MEADU1.EQ.1)
F
9 A8
T
WRITE(3.38)
CONT. ON PG 9

PG 8 OF 12


A8
IF(MEADU).EQ.2)
F
T
WRITE(3,34)
WRITE(3,30)
A9
4
702
CONTINUE
CALL SAVSCT(2,SECT3)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 708
CALL CLOSEF(2)
GO TO 709
708
CALL CLOSEF(2,DFNLA1)
709
CALL SAVSCT(3,SECT4)
CONT. ON PG 10

PG 9 OF 10

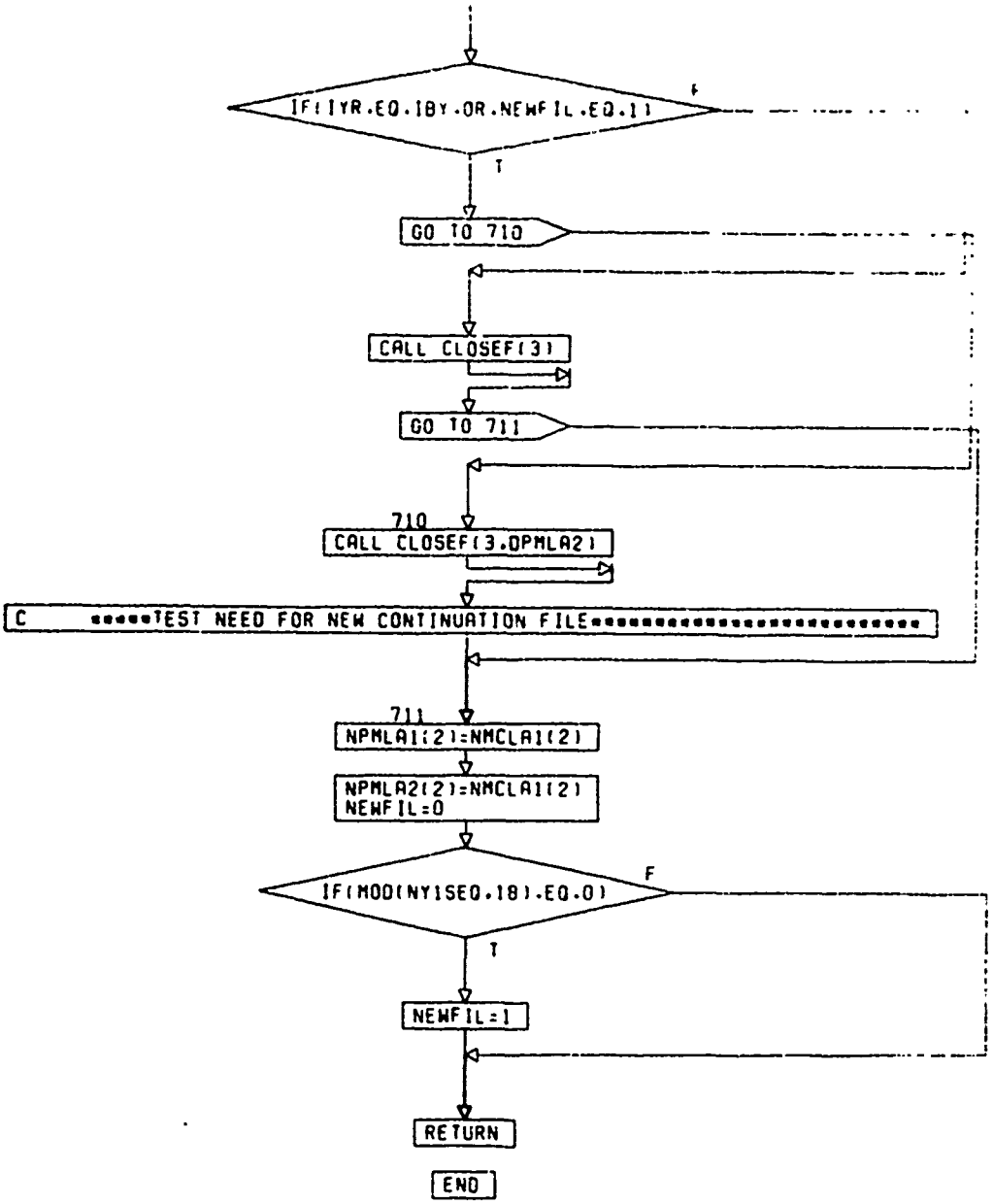
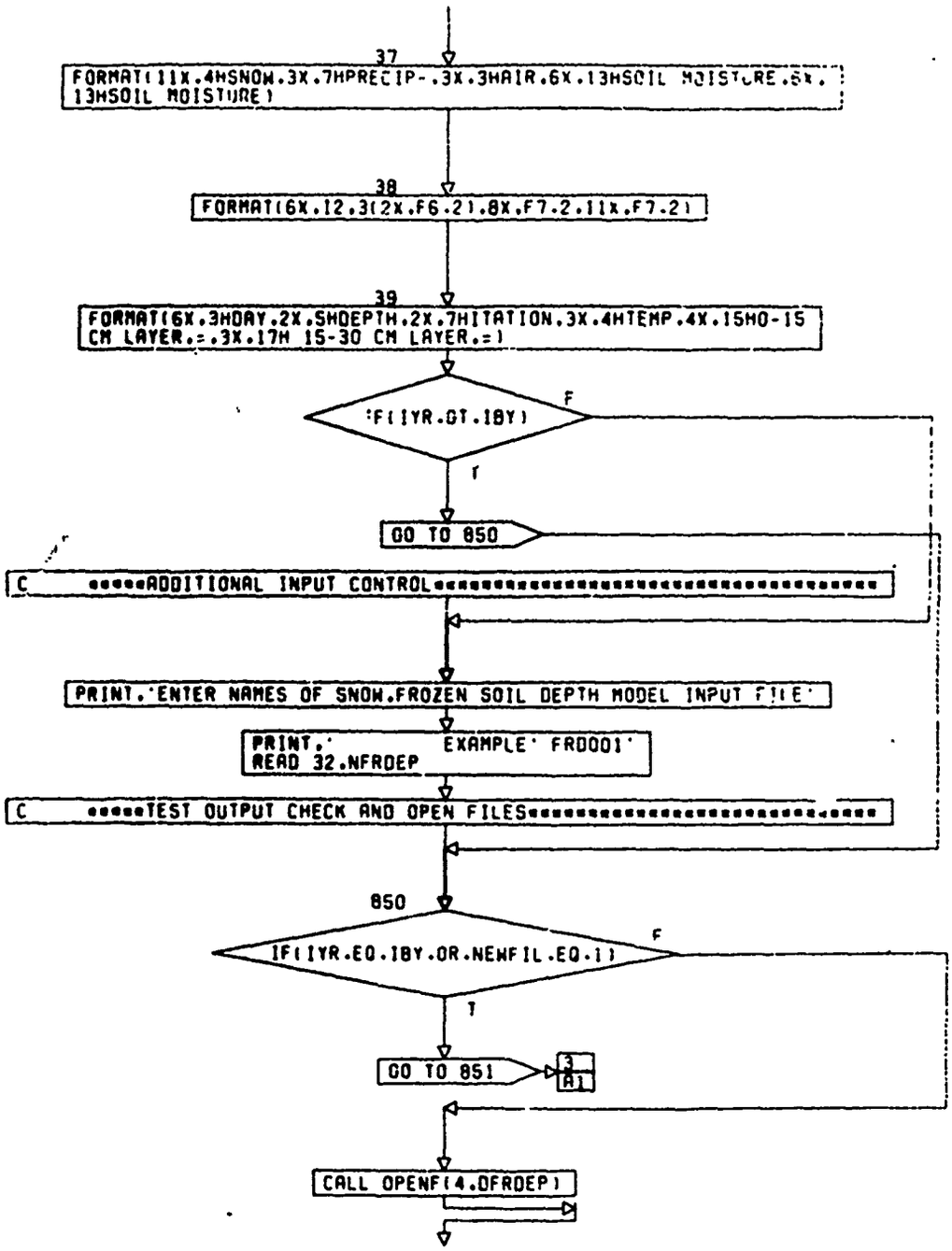

IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 710
CALL CLOSEF(3)
GO TO 711
710
CALL CLOSEF(3,DPMLA2)
C *****TEST NEED FOR NEW CONTINUATION FILE*****
711
NPMLA1(2)=NMCLA1(2)
NPMLA2(2)=NMCLA1(2)
NEWFIL=0
IF(MOD(NY1SEQ,18).EQ.0)
F
T
NEWFIL=1
RETURN
END

Fig. A6. Detailed Flow Chart of Subroutine FRODEP
(5 pages)

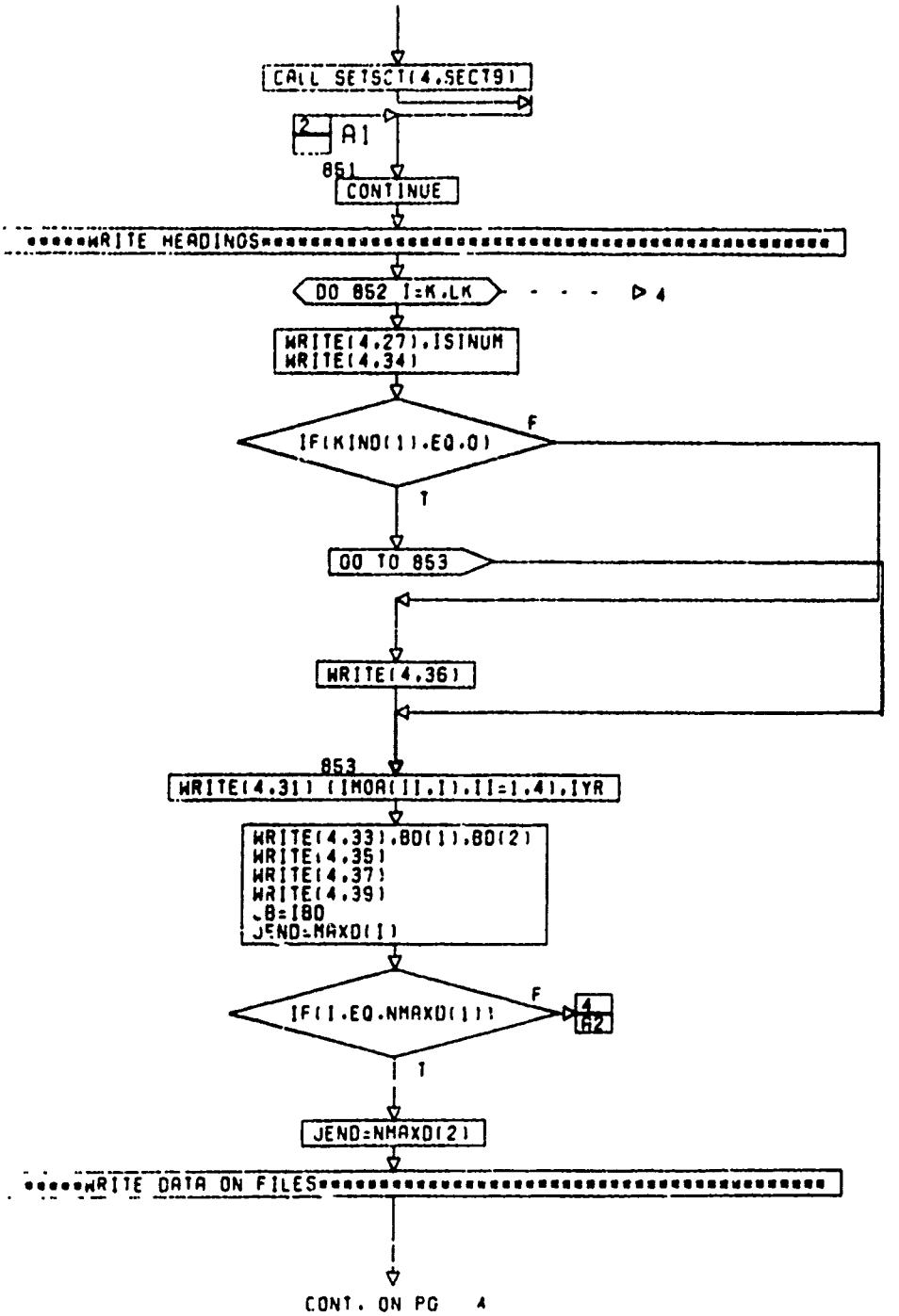
```
SUBROUTINE FRODEP
**********
*****WRITE AIR TEMPERATURE AND SNOW FILES**********
*****FORMAT STATEMENTS**********
27
FORMAT(18X,24HIDENTIFICATION NUMBER' ,4A3)
29
FORMAT(3A3)
31
FORMAT(28X,3A3,A1,X,2H19,I2)
32
FORMAT(2A3)
33
FORMAT(6X,25HDENSITY' 0-15 CM LAYER. ,F6.2,23HG/CM: 15-30
CM LAYER. ,F5.2,4HG/CM)
34
FORMAT(;1X,49HFROZEN DEPTH OF SOIL(CRREL-1968) DATA INPUT
FILE./)
35
FORMAT(1H ./)
36
FORMAT(26X,19HMEASURED SNOW DEPTH.//)
```

CONT. ON PG 2

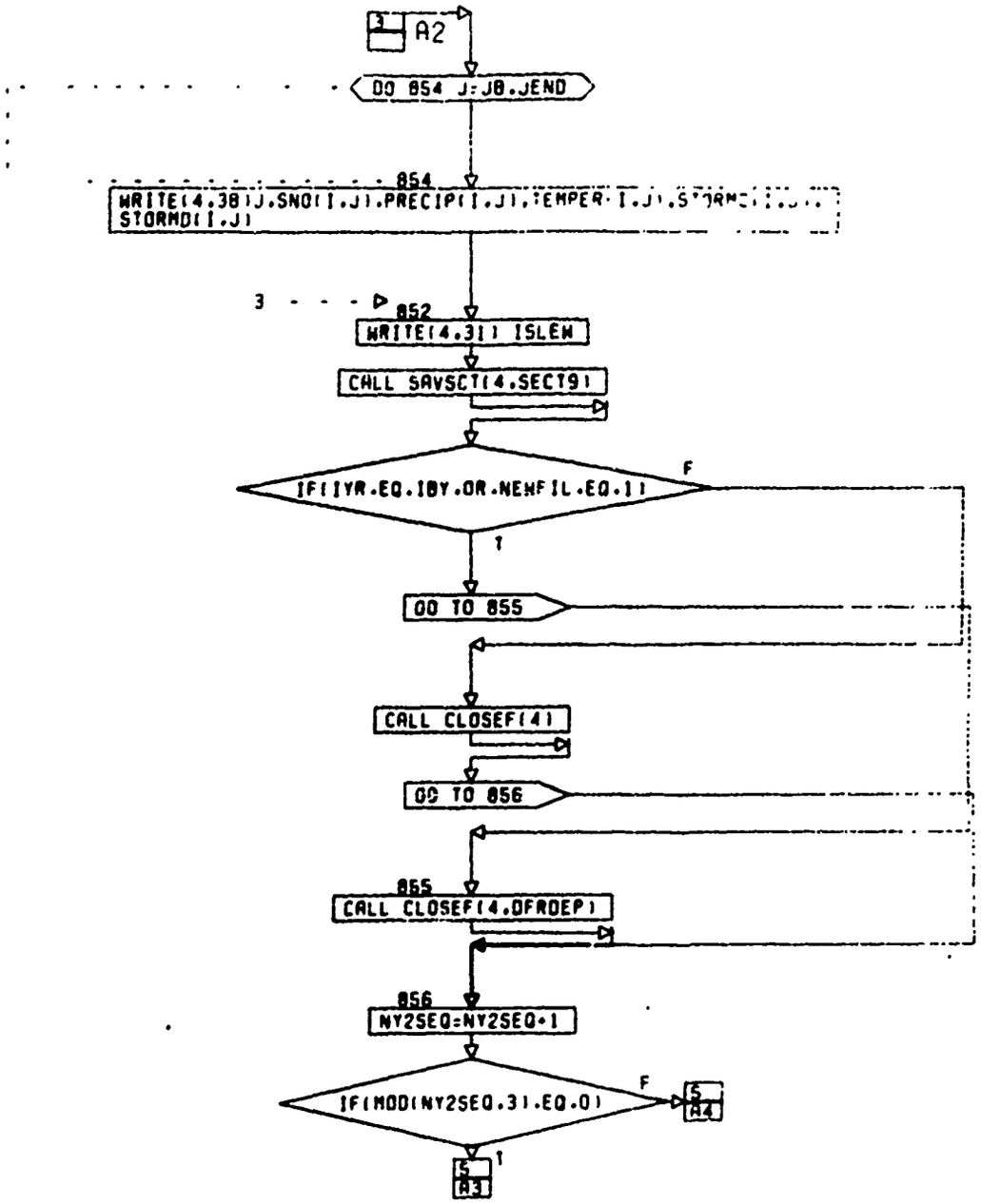


CONT. ON PG 3

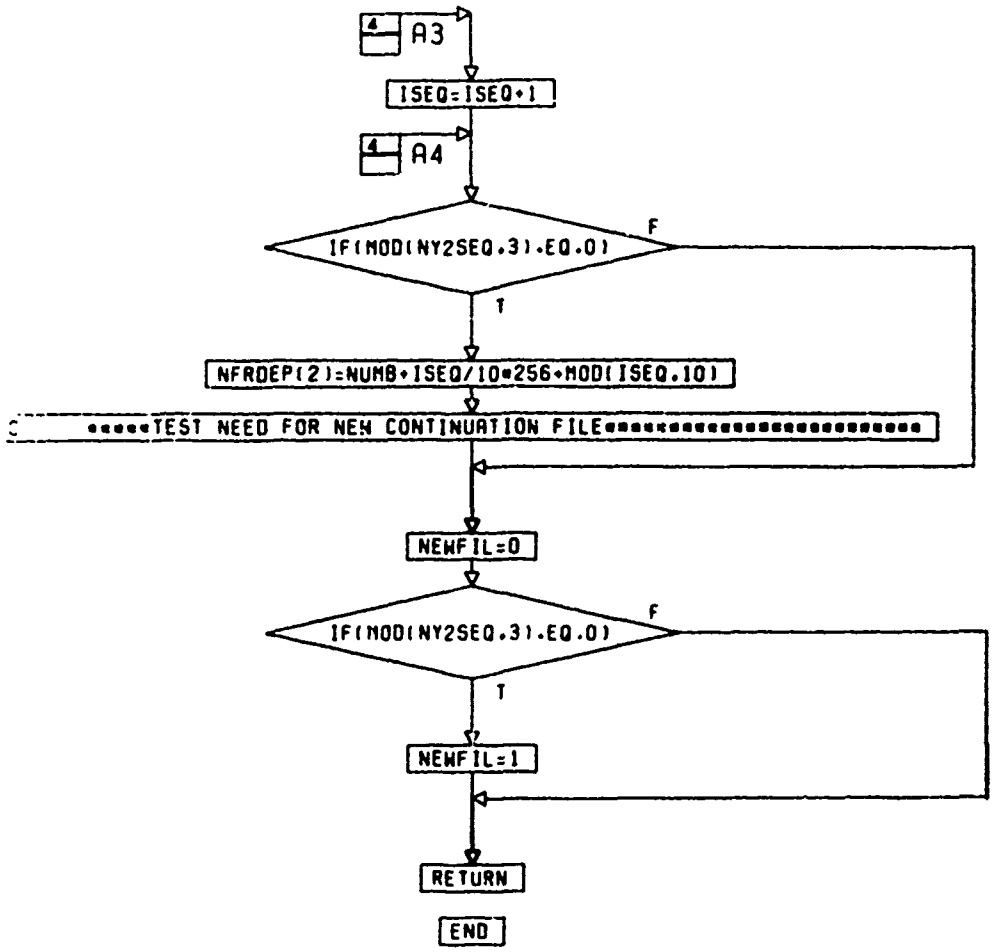
PG 2 OF 2


CALL SETSCT(4,SECT9)
2
A1
851
CONTINUE
WRITE HEADINGS
DO 852 I=K,LK
4
WRITE(4,27),ISINUM
WRITE(4,34)
IF(KIND(I).EQ.0)
F
T
GO TO 853
WRITE(4,36)
853
WRITE(4,31) (IMOA(II,I),II=1,4),IYR
WRITE(4,33),BD(1),BD(2)
WRITE(4,35)
WRITE(4,37)
WRITE(4,39)
LB=180
JEND=MAXD(1)
IF(I.EQ.NMAXD(1))
F
4
A2
T
JEND=NMAXD(2)
WRITE DATA ON FILES
CONT. ON PG 4

PG 3 OF 5

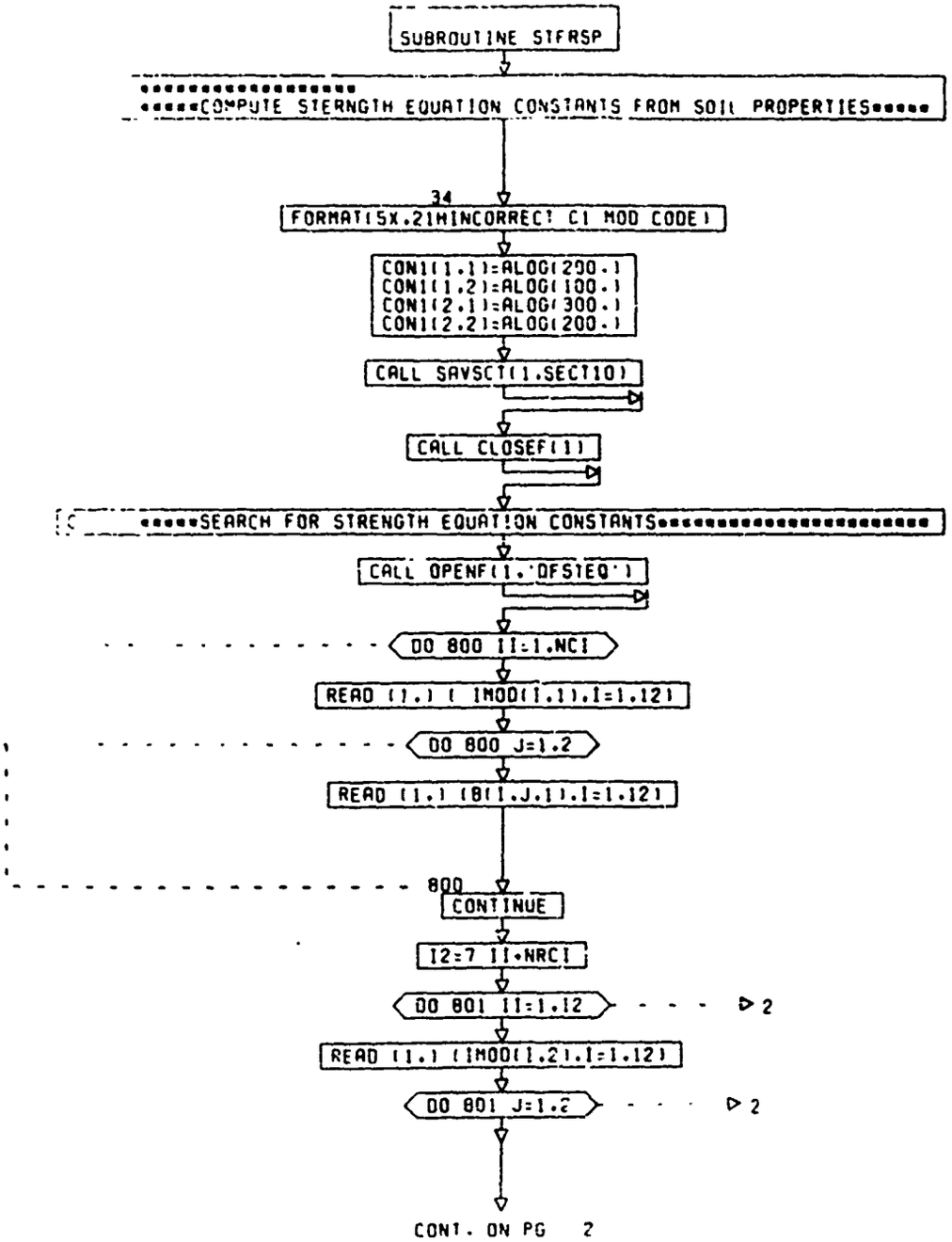

3
A2
DO 854 J=JB,JEND
854
WRITE(4,381)J,SNO(I,J),PRECIP(I,J),TEMPER(I,J),STORMD(I,J)
3
852
WRITE(4,311) ISLEN
CALL SAVSCT(4,SECT9)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 855
CALL CLOSEF(4)
GO TO 856
855
CALL CLOSEF(4,DFROEP)
856
NY2SEQ=NY2SEQ+1
IF(MOD(NY2SEQ,31).EQ.0)
F
5
A4
T
5
A3

CONT. ON PG 5

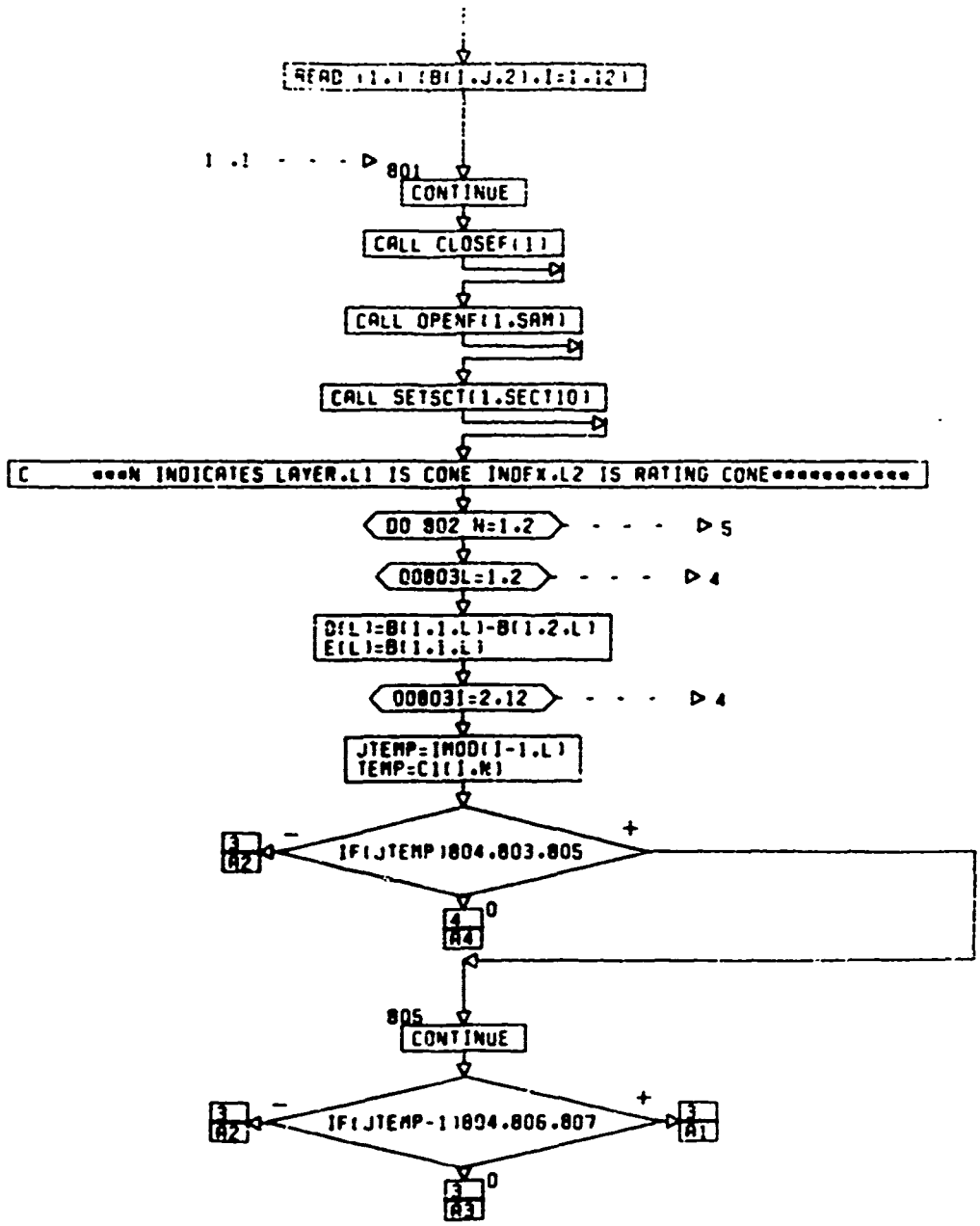

4 A3
ISEQ=ISEQ+1
4 A4
IF(MOD(NY2SEQ,3).EQ.0)
F
T
NFRDEP(2)=NUMB+ISEQ/10*256+MOD(ISEQ,10)
C *****TEST NEED FOR NEW CONTINUATION FILE*****
NEWFIL=0
IF(MOD(NY2SEQ,3).EQ.0)
F
T
NEWFIL=1
RETURN
END

PG 5 FINAL

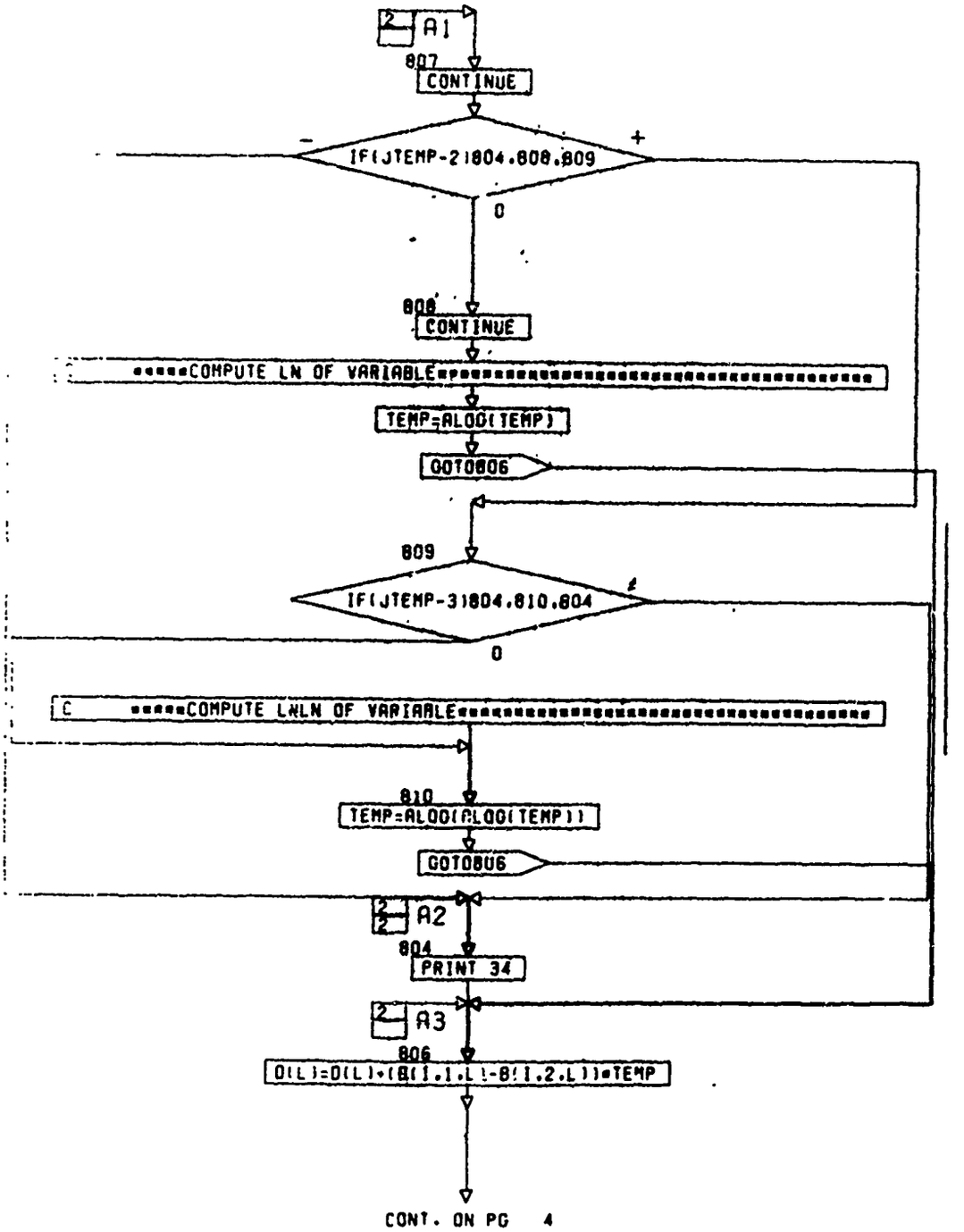
Fig. A7. Detailed Flow Chart of Subroutine STFRSP
(5 pages)


SUBROUTINE STFRSP
*****COMPUTE STERNGTH EQUATION CONSTANTS FROM SOIL PROPERTIES*****
34
FORMAT(5X,21HINCORRECT CI MOD CODE)
CON1(1,1)=ALOG(200.)
CON1(1,2)=ALOG(100.)
CON1(2,1)=ALOG(300.)
CON1(2,2)=ALOG(200.)
CALL SAVSCT(1,SECT10)
CALL CLOSEF(1)
*****SEARCH FOR STRENGTH EQUATION CONSTANTS*****
CALL OPENF(1,'DFSTEQ')
DO 800 II=1,NCI
READ (1,) (IMOD(I,1),I=1,12)
DO 800 J=1,2
READ (1,) (B(I,J,1),I=1,12)
800
CONTINUE
I2=7 II+NRCI
DO 801 II=1,12
2
READ (1,) (IMOD(I,2),I=1,12)
DO 801 J=1,2
2
CONT. ON PG 2

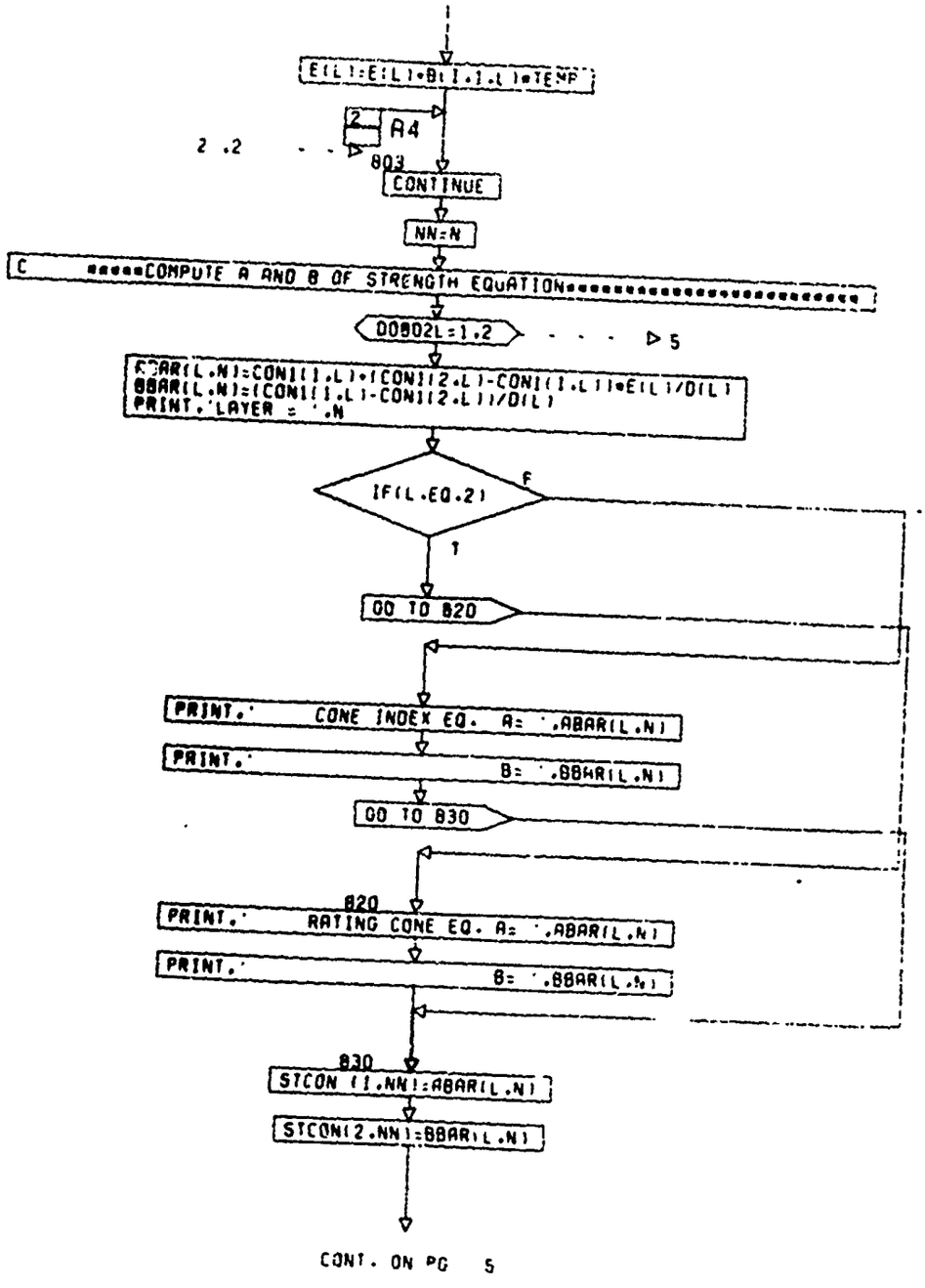
PG 1 OF 5


READ (1,1) (B(I,J,2),I=1,12)
1 ,1 - - - ▷ 801
801
CONTINUE
CALL CLOSEF(1)
CALL OPENF(1,SAM)
CALL SETSCT(1,SECT10)
C ***N INDICATES LAYER,L1 IS CONE INDEX,L2 IS RATING CONE**********
DO 802 N=1,2
- - - ▷ 5
DO803L=1,2
- - - ▷ 4
D(L)=B(1,1,L)-B(1,2,L)
E(L)=B(1,1,L)
DO803I=2,12
- - - ▷ 4
JTEMP=IMOD(I-1,L)
TEMP=C1(I,N)
IF(JTEMP)804,803,805
-
+
3
A2
0
4
A4
805
CONTINUE
IF(JTEMP-1)804,806,807
-
+
3
A2
3
A1
0
3
A3

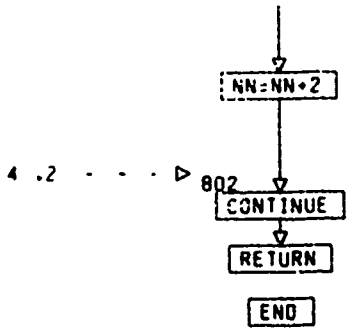
CONT. ON PG 3


A1
807
CONTINUE
IF(JTEMP-2)804,808,809
808
CONTINUE
*****COMPUTE LN OF VARIABLE*****
TEMP=ALOG(TEMP)
GOTO806
809
IF(JTEMP-3)804,810,804
C *****COMPUTE LNLN OF VARIABLE*****
810
TEMP=ALOG(ALOG(TEMP))
GOTO806
A2
804
PRINT 34
A3
806
D(L)=D(L)+(B(1,1,L)-B(1,2,L))*TEMP

CONT. ON PG 4


E(L):E(L)+B(I,1,L)*TEMP
2
A4
2 .2
803
CONTINUE
NN=N
C *****COMPUTE A AND B OF STRENGTH EQUATION*****
DO802L=1,2
5
ABAR(L,N)=CON1(1,L)+(CON1(2,L)-CON1(1,L))*E(L)/D(L)
BBAR(L,N)=(CON1(1,L)-CON1(2,L))/D(L)
PRINT,'LAYER = ',N
IF(L.EQ.2)
F
T
GO TO 820
PRINT,' CONE INDEX EQ. A= ',ABAR(L,N)
PRINT,' B= ',BBAR(L,N)
GO TO 830
820
PRINT,' RATING CONE EQ. A= ',ABAR(L,N)
PRINT,' B= ',BBAR(L,N)
830
STCON(1,NN):ABAR(L,N)
STCON(2,NN):BBAR(L,N)

CONT. ON PG 5

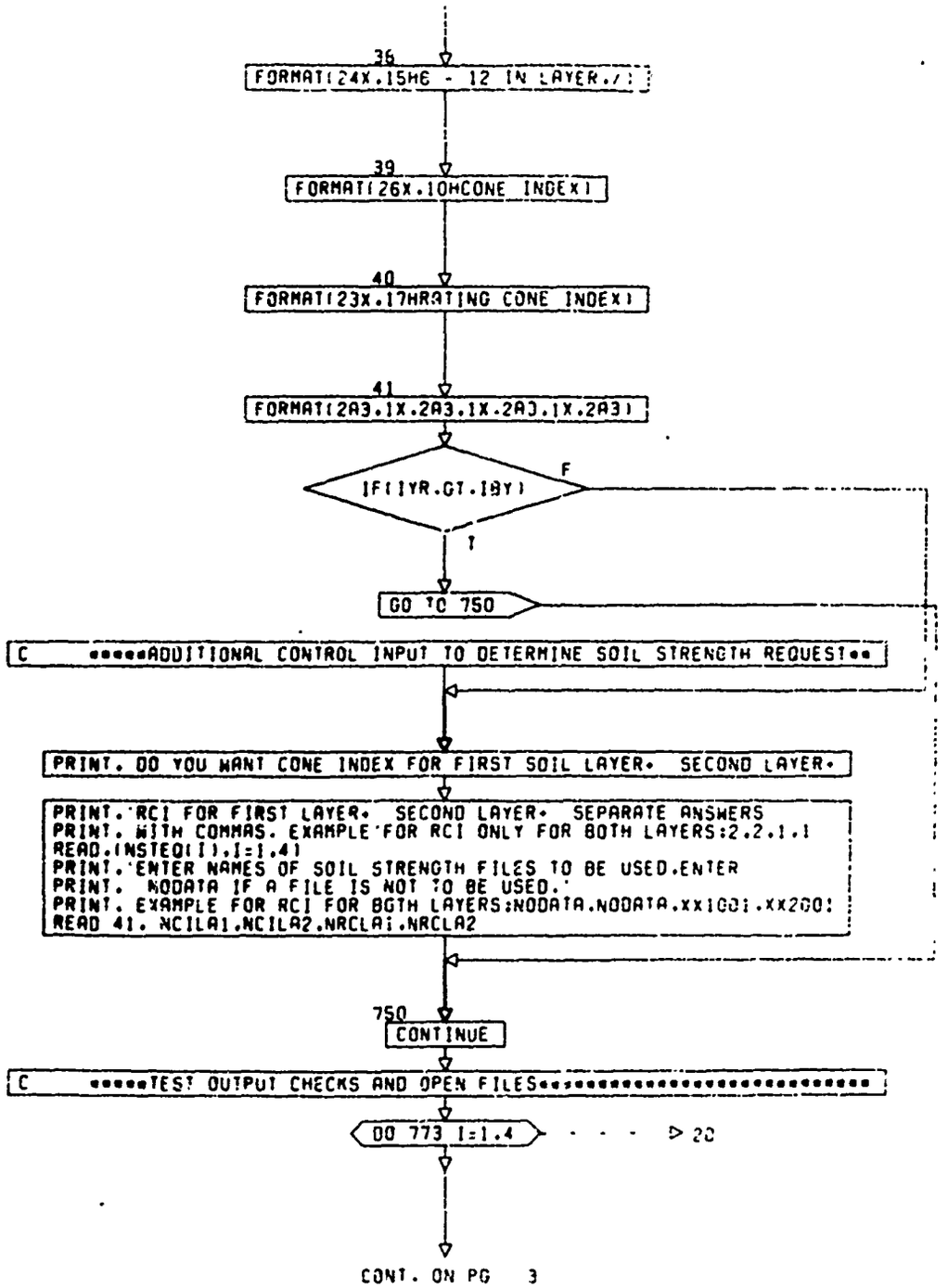


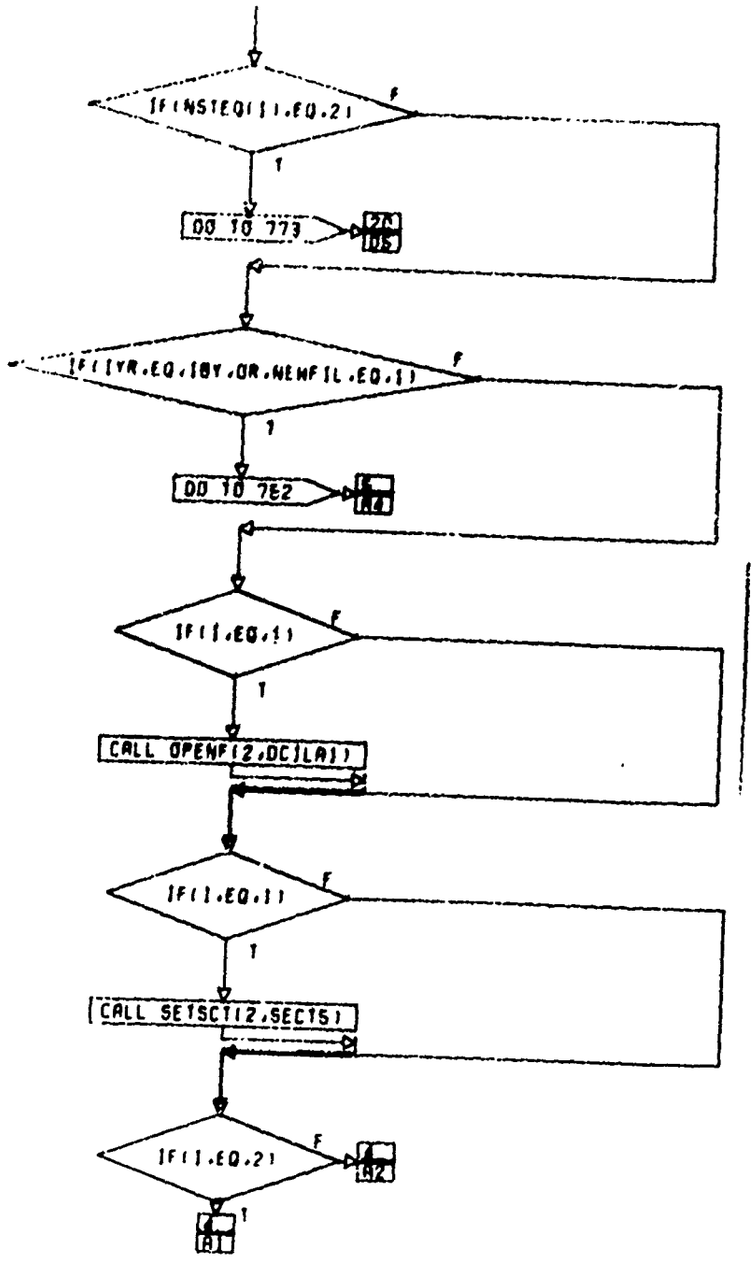
PG 5 FINAL

Fig. A8. Detailed Flow Chart of Subroutine CALSST
(21 pages)

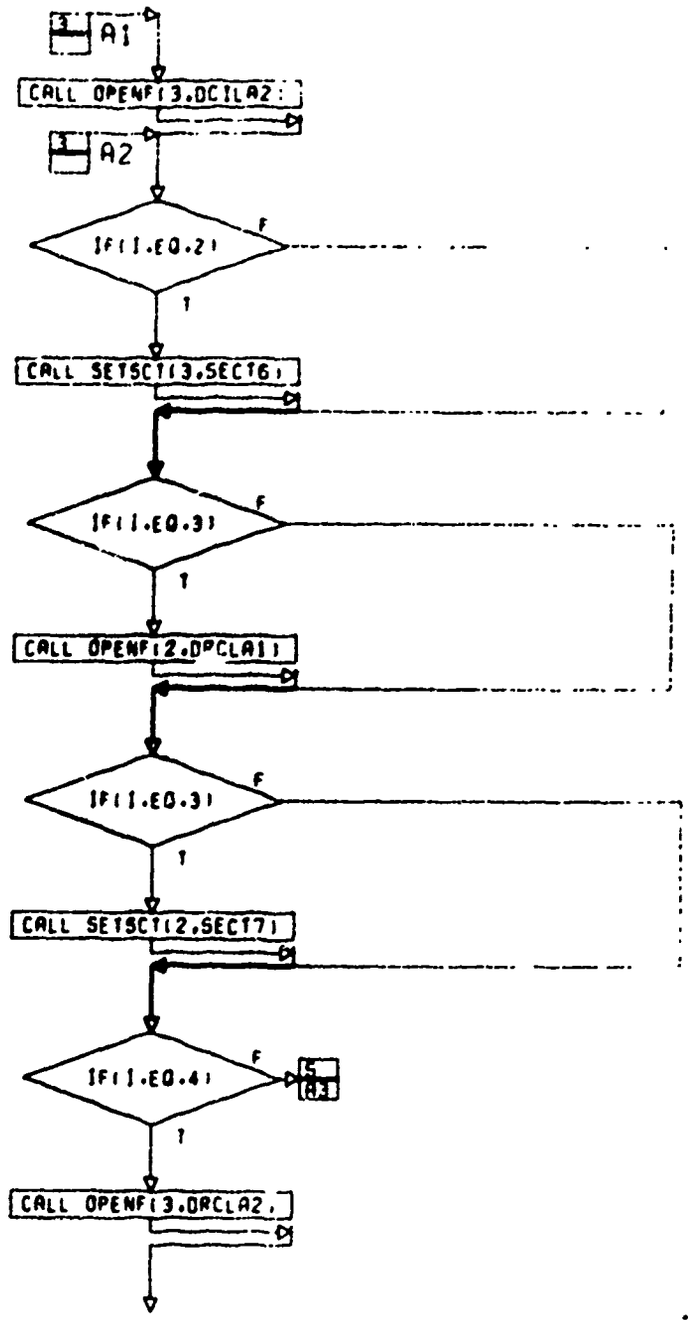
```
SUBROUTINE CALSST
*****************
*****COMPUTE CONE INDEX AND RATING CONE INDEX*******************
*****FORMAT STATEMENTS*****************************************

27
FORMAT(20X,23HIDENTIFICATION NUMBER' ,4A3)

29
FORMAT(3A3)

30
FORMAT(4(1H ,/))

31
FORMAT(2X,3HDAY,24X,3A3,A1,X,2H19,I2)

32
FORMAT(1X,I2,1H-,I2,4X,7F7.0)

33
FORMAT(24X,15HO - 15 CM LAYER,/)

34
FORMAT(23X,16H15 - 30 CM LAYER,/)

37
FORMAT(24X,14HO - 6 IN LAYER,/)
```

CONT. ON PG 2

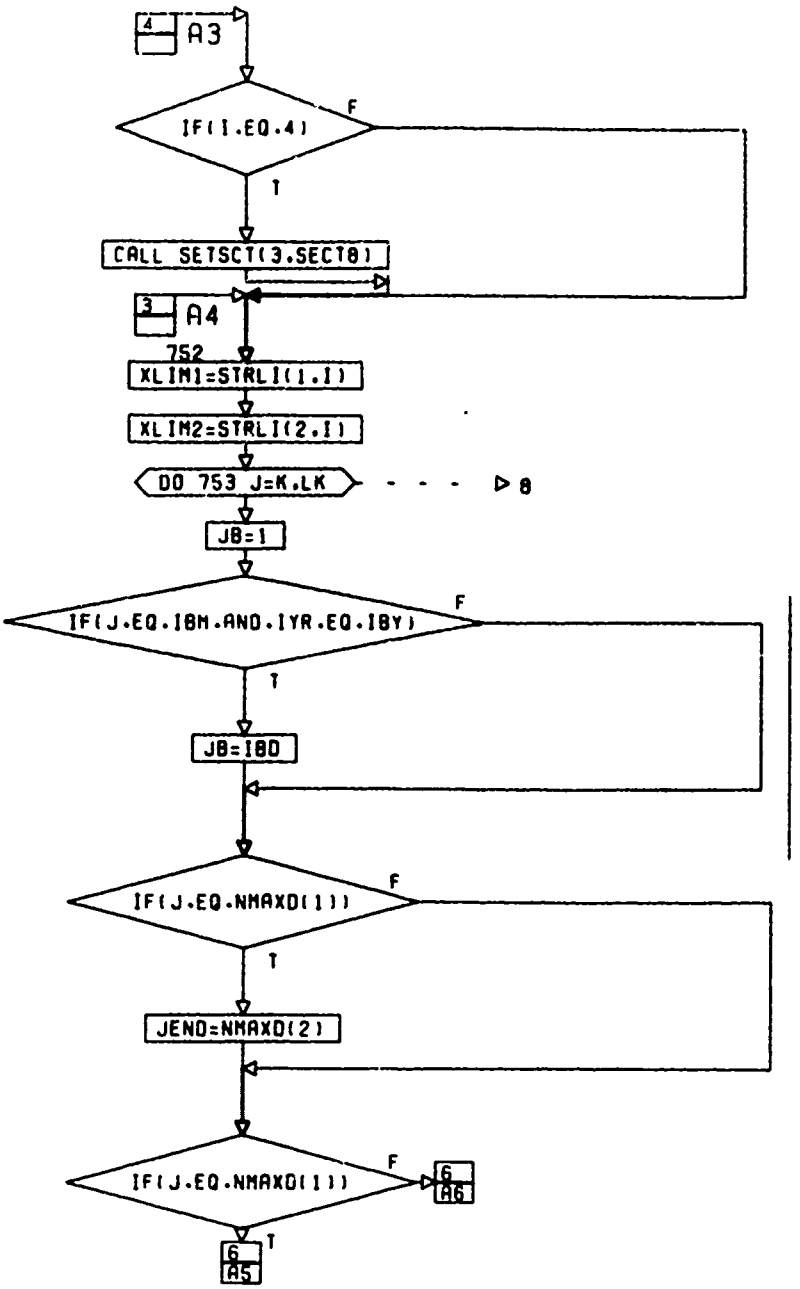

36
FORMAT(24X,15H6 - 12 IN LAYER,/)
39
FORMAT(26X,10HCONE INDEX)
40
FORMAT(23X,17HRATING CONE INDEX)
41
FORMAT(2A3,1X,2A3,1X,2A3,1X,2A3)
IF(IYR.GT.18Y)
F
T
GO TO 750
C *****ADDITIONAL CONTROL INPUT TO DETERMINE SOIL STRENGTH REQUEST**
PRINT, DO YOU WANT CONE INDEX FOR FIRST SOIL LAYER, SECOND LAYER,
PRINT, RCI FOR FIRST LAYER, SECOND LAYER, SEPARATE ANSWERS
PRINT, WITH COMMAS. EXAMPLE FOR RCI ONLY FOR BOTH LAYERS:2,2,1,1
READ,(NSTEQ(I),I=1,4)
PRINT,'ENTER NAMES OF SOIL STRENGTH FILES TO BE USED.ENTER
PRINT, NODATA IF A FILE IS NOT TO BE USED.'
PRINT, EXAMPLE FOR RCI FOR BOTH LAYERS:NODATA,NODATA,XX1001,XX2001
READ 41, NCILA1,NCILA2,NRCLA1,NRCLA2
750
CONTINUE
C *****TEST OUTPUT CHECKS AND OPEN FILES**
DO 773 I=1,4
20
CONT. ON PG 3


IF(NSTEQ(I).EQ.2)
F
T
DO TO 773
2A
D5
IF((YR.EQ.18Y.OR.NEWFIL.EQ.1)
F
T
DO TO 782
A4
IF(I.EQ.1)
F
T
CALL OPENF(2,DC(LA1))
IF(I.EQ.1)
F
T
CALL SETSCT(2,SECTS)
IF(I.EQ.2)
F
A2
T
A1

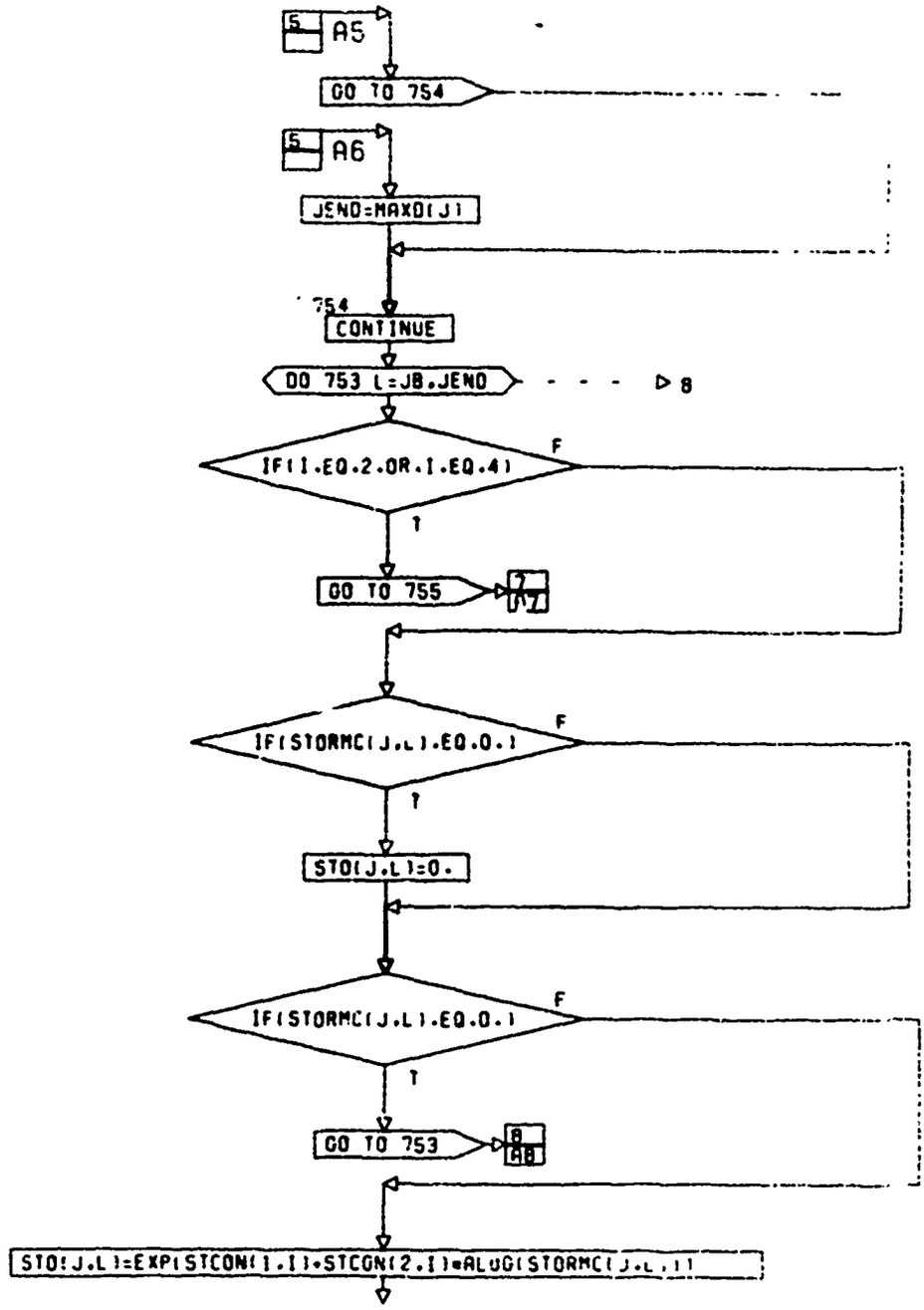
CONT. ON PG 4


3
A1
CALL OPENF(3,DCILA2:
3
A2
IF(I.EQ.2)
F
T
CALL SETSCT(3,SECT6)
IF(I.EQ.3)
F
T
CALL OPENF(2,DPCLA1)
IF(I.EQ.3)
F
T
CALL SETSCT(2,SECT7)
IF(I.EQ.4)
F
5
A3
T
CALL OPENF(3,DRCLA2,

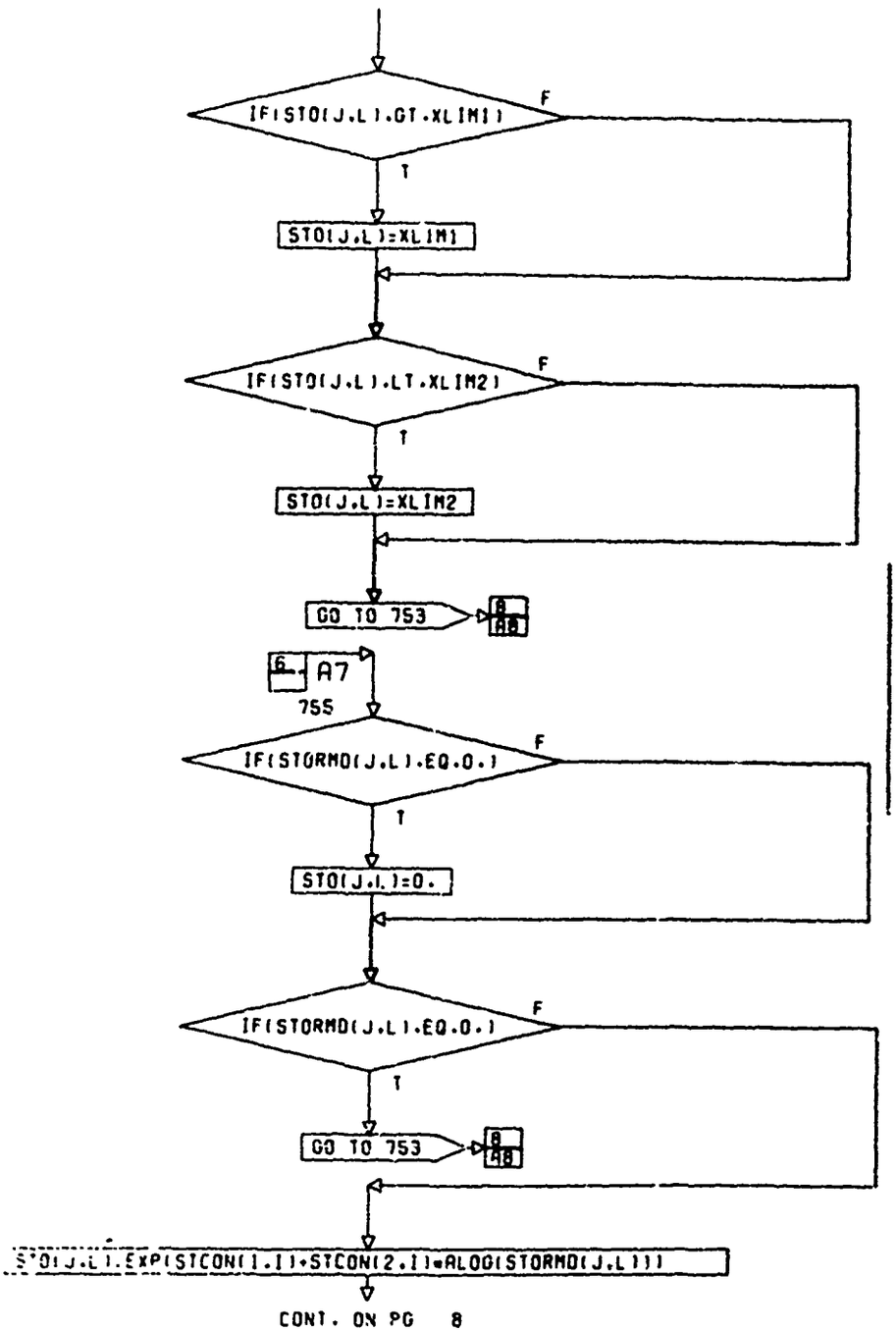
CONT. ON PG 5

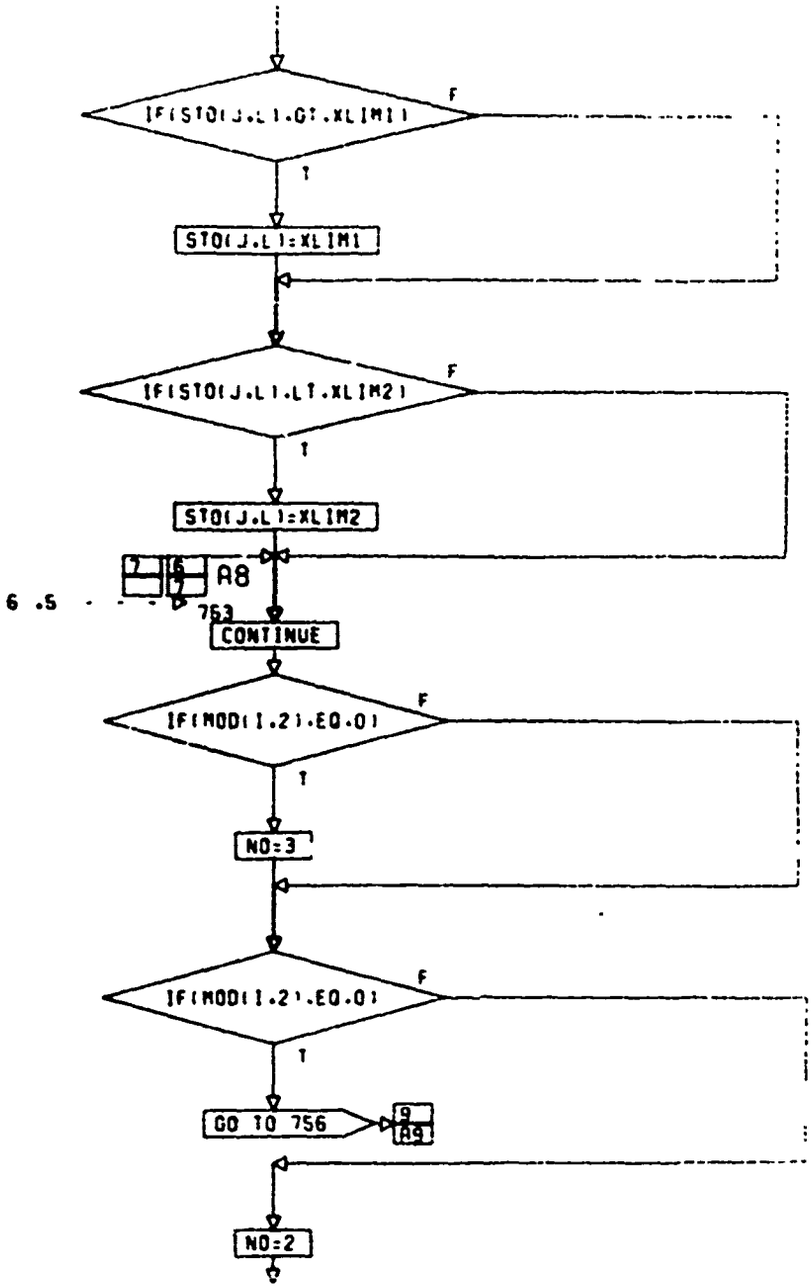

4
A3
IF(I.EQ.4)
F
T
CALL SETSCT(3,SECT8)
3
A4
752
XLIM1=STRLI(1,I)
XLIM2=STRLI(2,I)
DO 753 J=K,LK
8
JB=1
IF(J.EQ.IBM.AND.IYR.EQ.IBY)
F
T
JB=IBD
IF(J.EQ.NMAXD(1))
F
T
JEND=NMAXD(2)
IF(J.EQ.NMAXD(1))
F
6
A6
T
6
A5

CONT. ON PG 6

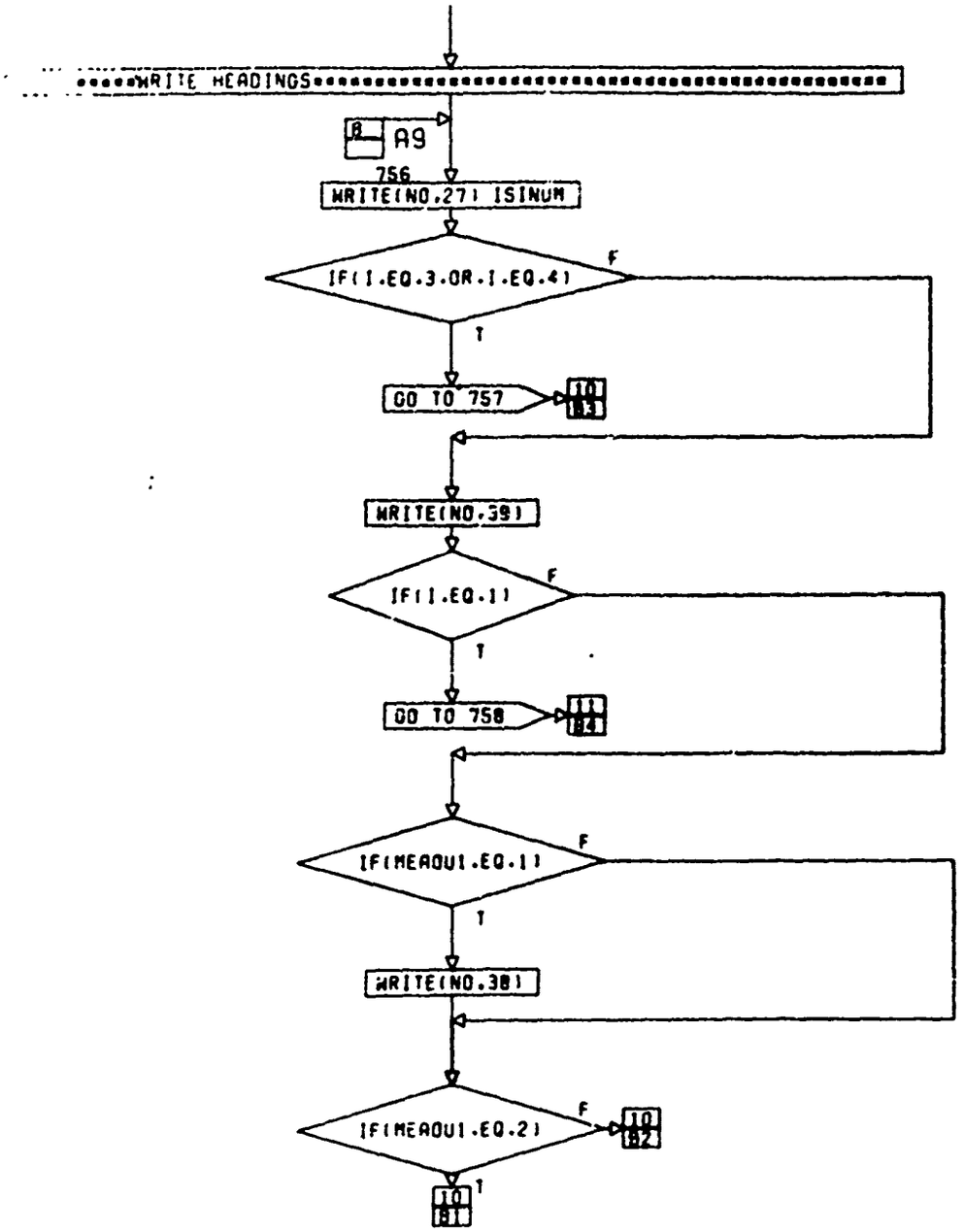

5
A5
GO TO 754
5
A6
JEND=MAXO(J)
754
CONTINUE
DO 753 L=JB,JEND
8
IF(I.EQ.2.OR.I.EQ.4)
F
T
GO TO 755
7
A7
IF(STORMC(J,L).EQ.0.)
F
T
STO(J,L)=0.
IF(STORMC(J,L).EQ.0.)
F
T
GO TO 753
8
A8
STO(J,L)=EXP(STCON(1,I)+STCON(2,I)*ALOG(STORMC(J,L,I)

CONT. ON PG 7

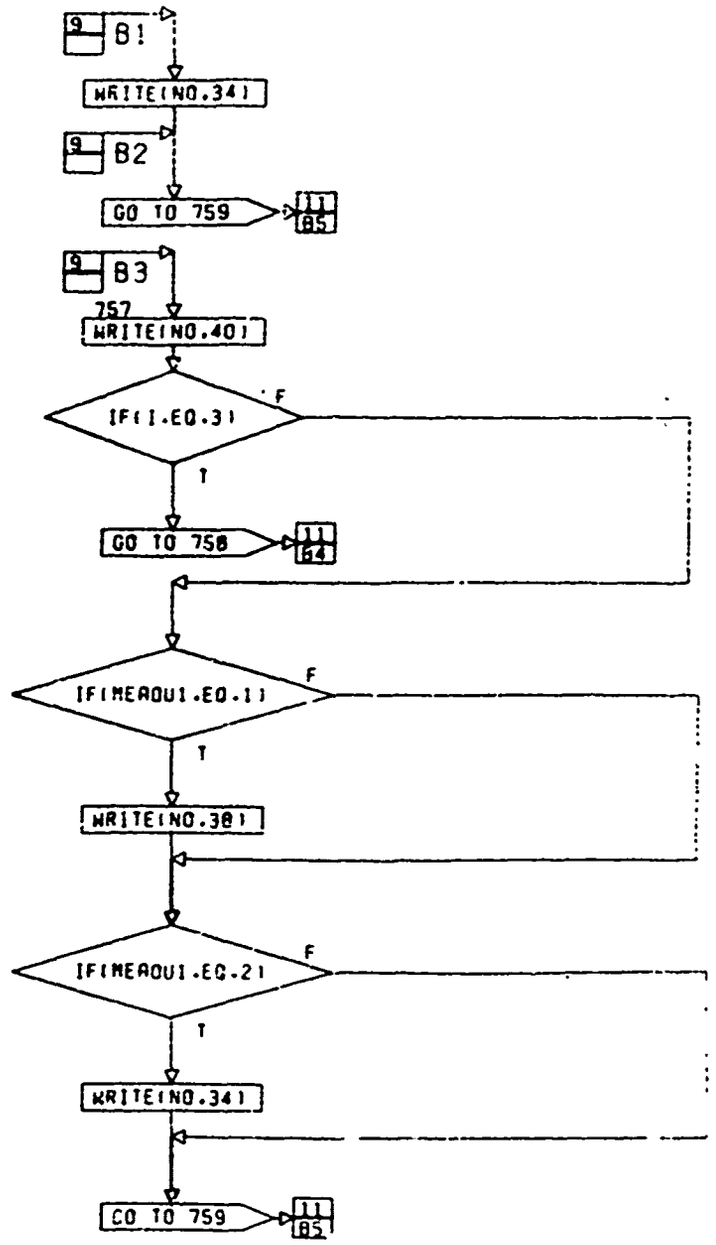

IF(STO(J,L).GT.XLIM1)
F
T
STO(J,L)=XLIM1
IF(STO(J,L).LT.XLIM2)
F
T
STO(J,L)=XLIM2
GO TO 753
8
A8
6
A7
755
IF(STORMD(J,L).EQ.0.)
F
T
STO(J,L)=0.
IF(STORMD(J,L).EQ.0.)
F
T
GO TO 753
8
A8
STO(J,L)=EXP(STCON(1,I)+STCON(2,I)*ALOG(STORMD(J,L)))
CONT. ON PG 8


IF(STO(J,L).GT.XLIM1)
F
T
STO(J,L)=XLIM1
IF(STO(J,L).LT.XLIM2)
F
T
STO(J,L)=XLIM2
A8
6 .5
753
CONTINUE
IF(MOD(I,2).EQ.0)
F
T
NO=3
IF(MOD(I,2).EQ.0)
F
T
GO TO 756
9
A9
NO=2

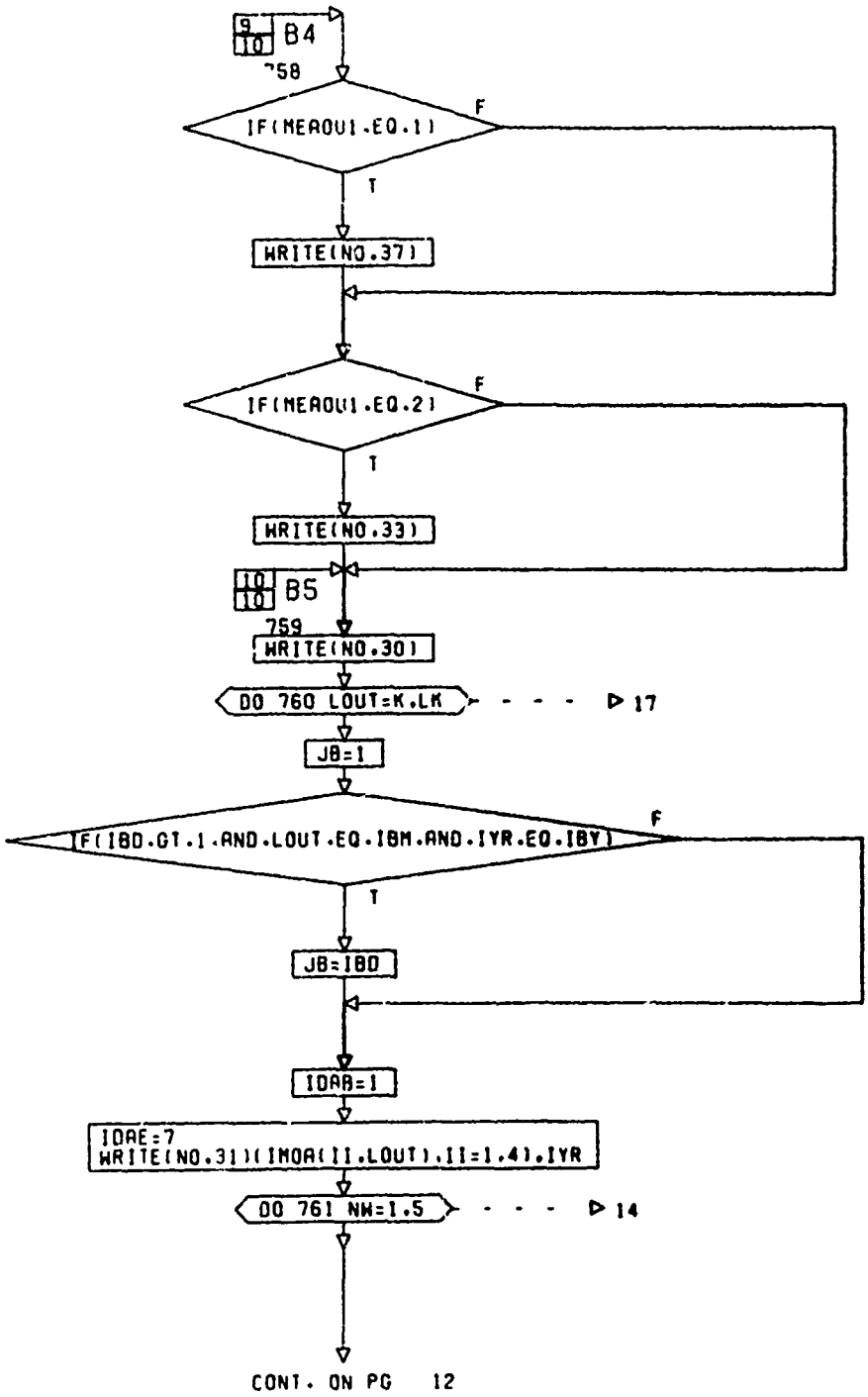
CONT. ON PG 9

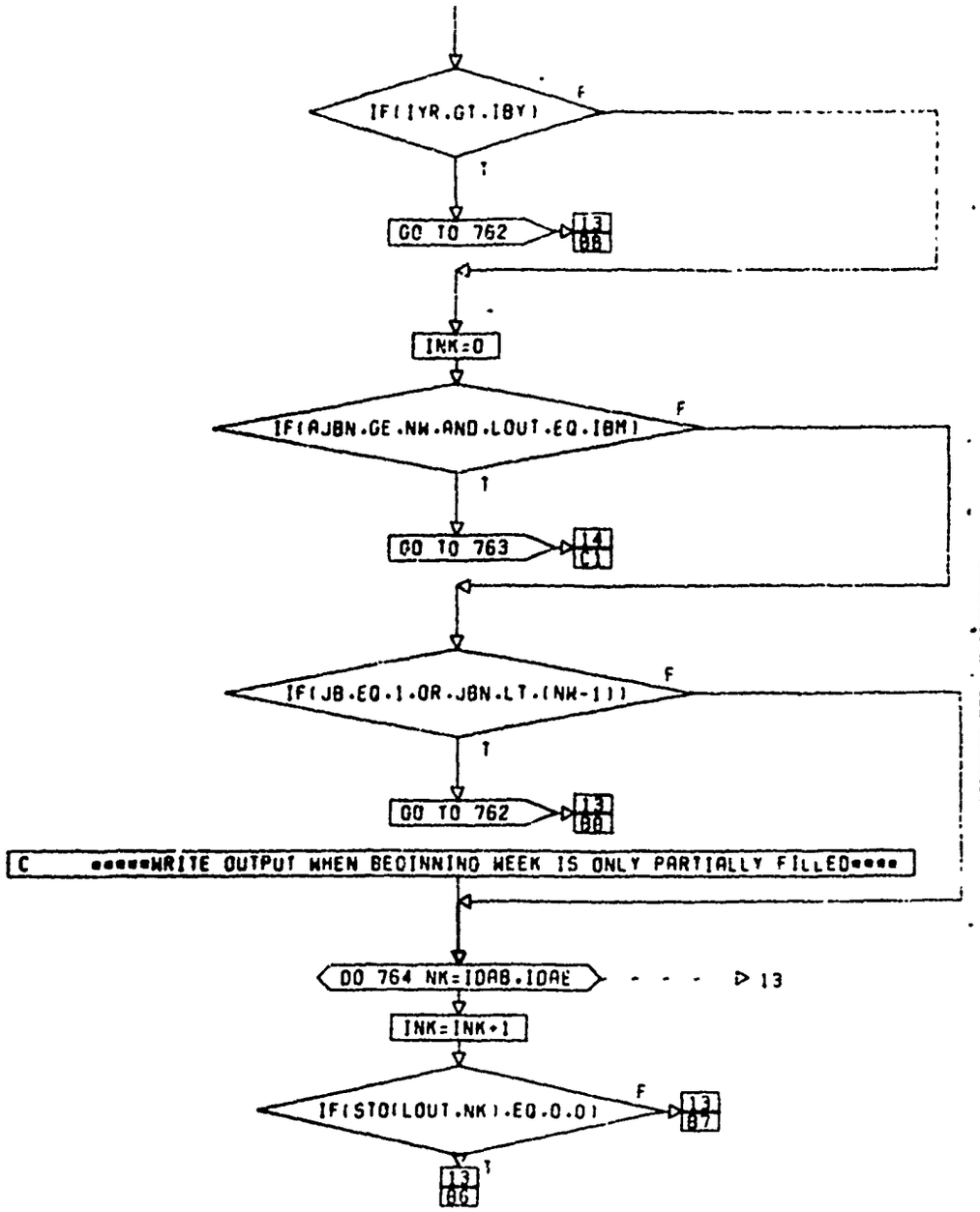

WRITE HEADINGS
A9
756
WRITE(NO,27) ISINUM
IF(I.EQ.3.OR.I.EQ.4)
F
T
GO TO 757
WRITE(NO,39)
IF(I.EQ.1)
F
T
GO TO 758
IF(MEADU1.EQ.1)
F
T
WRITE(NO,38)
IF(MEADU1.EQ.2)
F
T

CONT. ON PG 10

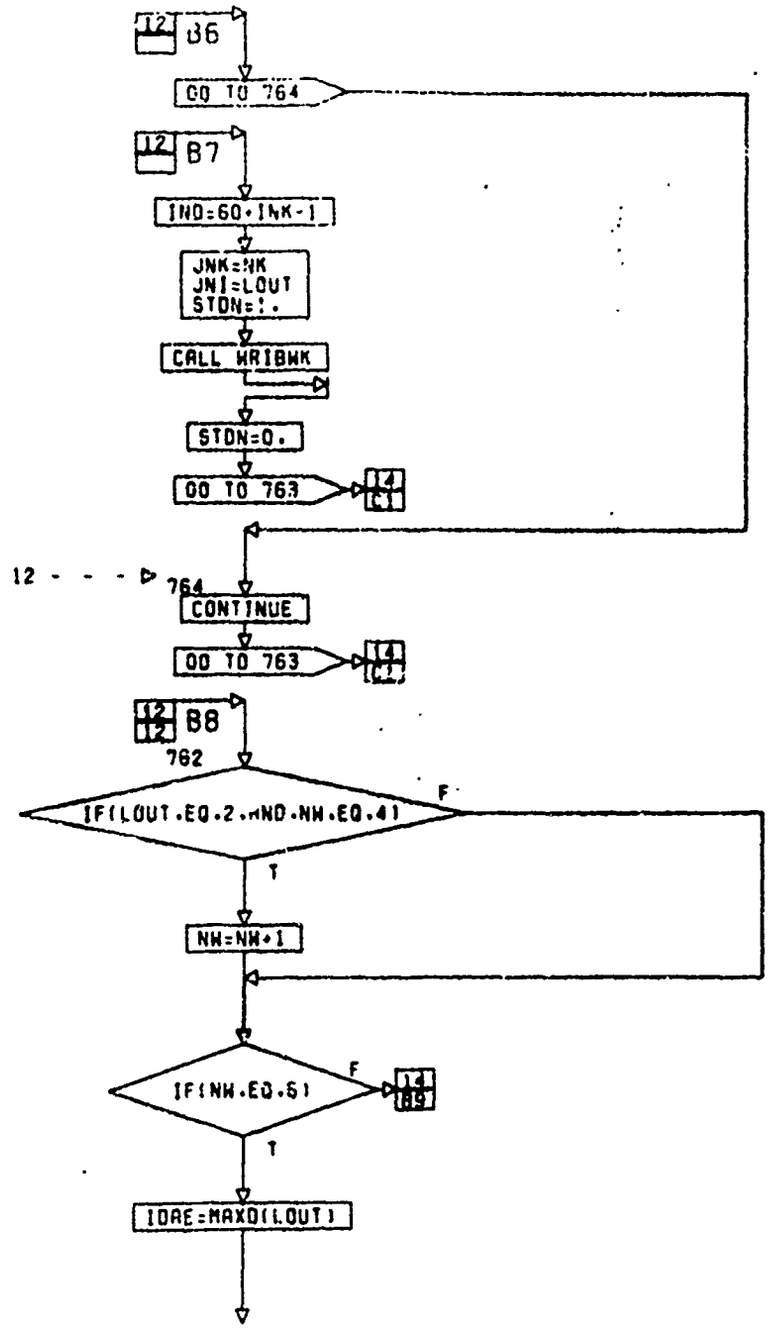

9
B1
WRITE(NO.34)
9
B2
GO TO 759
11
B5
9
B3
757
WRITE(NO.40)
IF(I.EQ.3)
F
T
GO TO 758
11
B4
IF(MEADU1.EQ.1)
F
T
WRITE(NO.38)
IF(MEADU1.EQ.2)
F
T
WRITE(NO.34)
GO TO 759
11
B5

CONT. ON PG 11

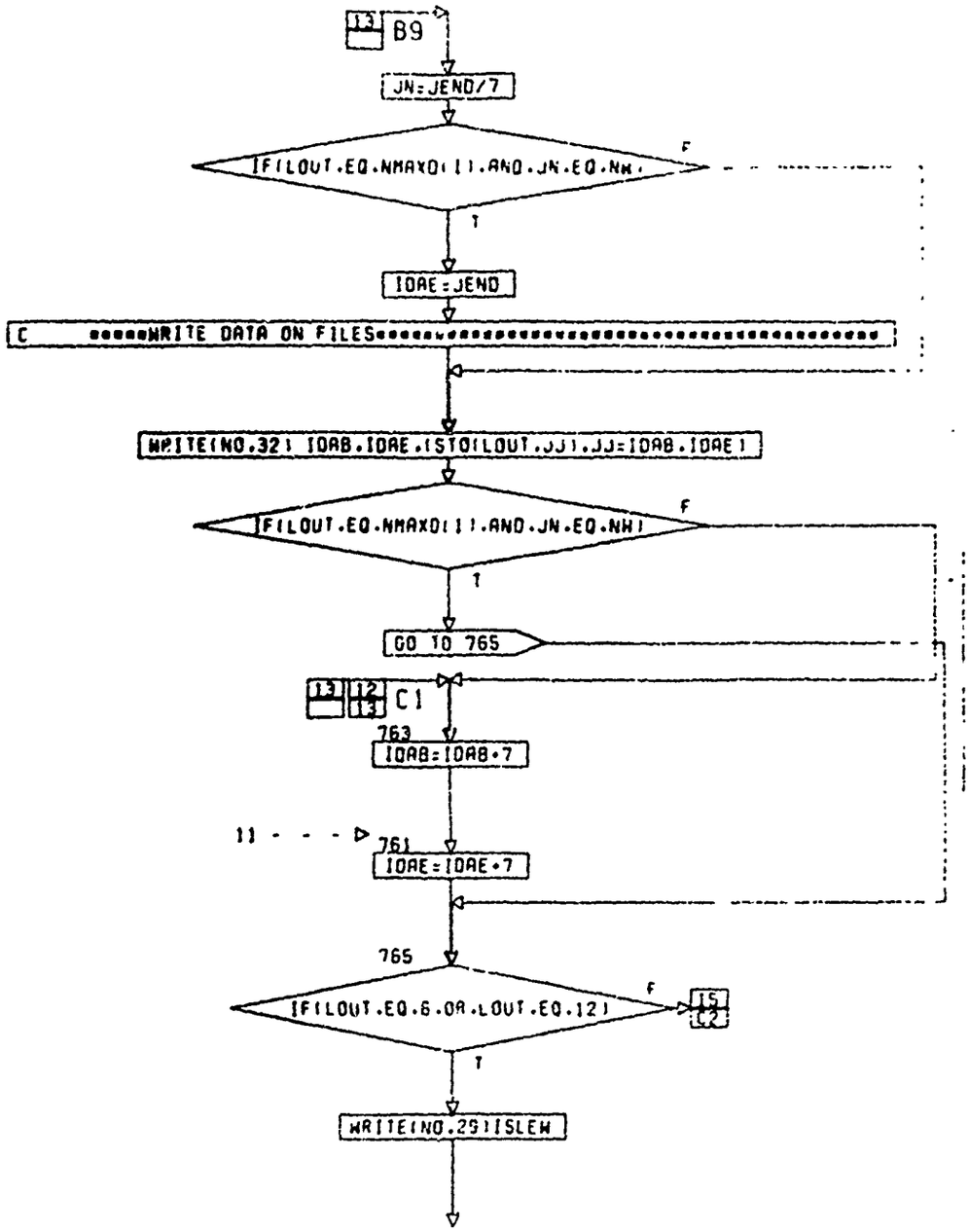

9/10 B4
758
IF(MEAOU1.EQ.1)
F
T
WRITE(NO,37)
IF(MEAOU1.EQ.2)
F
T
WRITE(NO,33)
10/10 B5
759
WRITE(NO,30)
DO 760 LOUT=K,LK
17
JB=1
IF(IBD.GT.1.AND.LOUT.EQ.IBM.AND.IYR.EQ.IBY)
F
T
JB=IBD
IDAB=1
IDAE=7
WRITE(NO,31)(IMOA(II,LOUT),II=1,4),IYR
DO 761 NW=1,5
14
CONT. ON PG 12


IF(IYR.GT.IBY)
F
T
GO TO 762
13
B8
INK=0
IF(AJBN.GE.NW.AND.LOUT.EQ.IBM)
F
T
GO TO 763
14
C1
IF(JB.EQ.1.OR.JBN.LT.(NW-1))
F
T
GO TO 762
13
B8
C ****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED****
DO 764 NK=IDAB,IDAE
13
INK=INK+1
IF(STO(LOUT,NK).EQ.0.0)
F
13
B7
T
13
B6

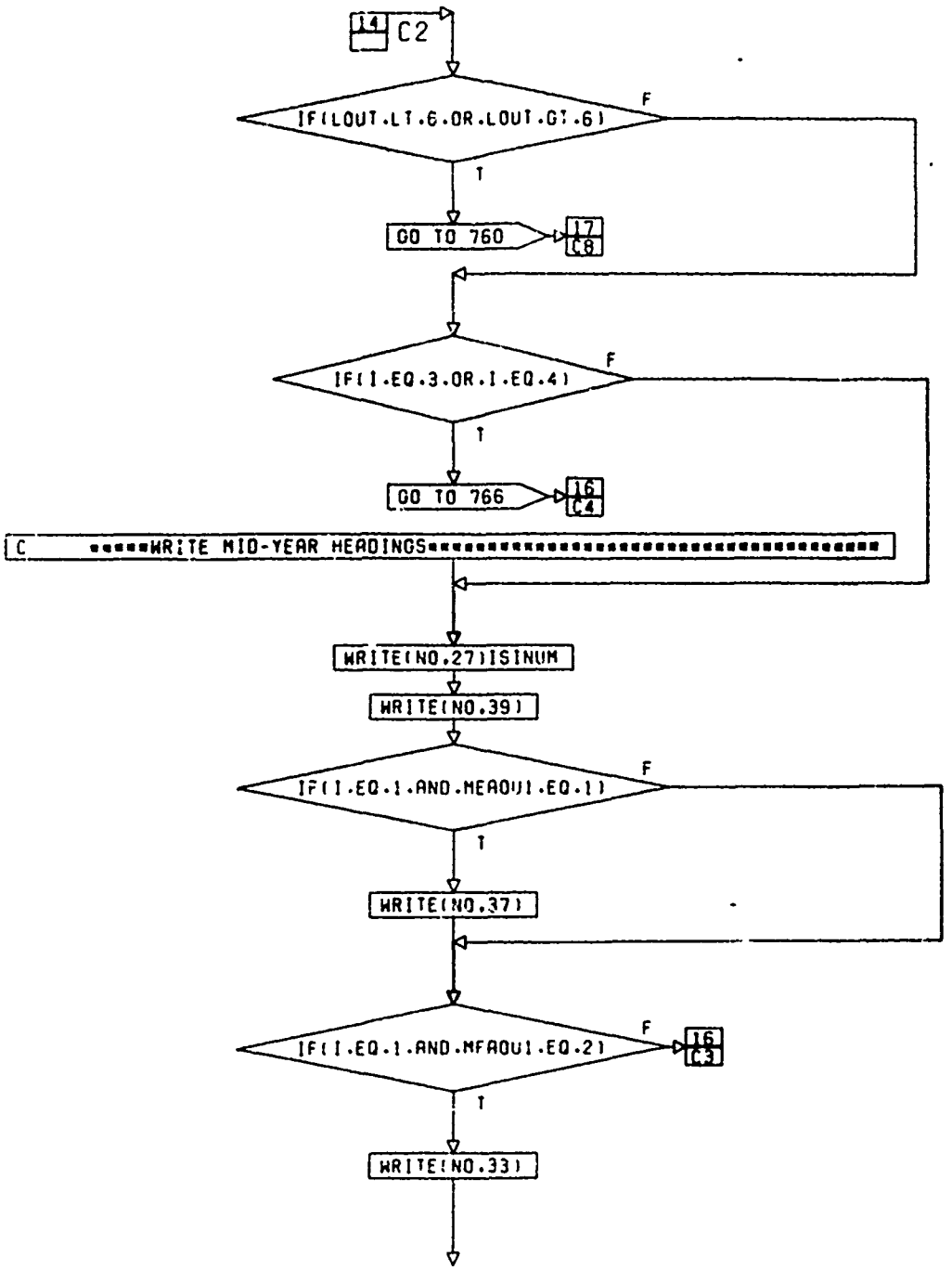
CONT. ON PG 13


12 B6
GO TO 764
12 B7
IND=60+INK-1
JNK=NK
JNI=LOUT
STON=1.
CALL WRIBWK
STON=0.
GO TO 763
14 C1
12
764
CONTINUE
GO TO 763
14 C1
12 12 B8
762
IF(LOUT.EQ.2.AND.NW.EQ.4)
F
T
NW=NW+1
IF(NW.EQ.5)
F
14 B9
T
IDAE=MAXO(LOUT)

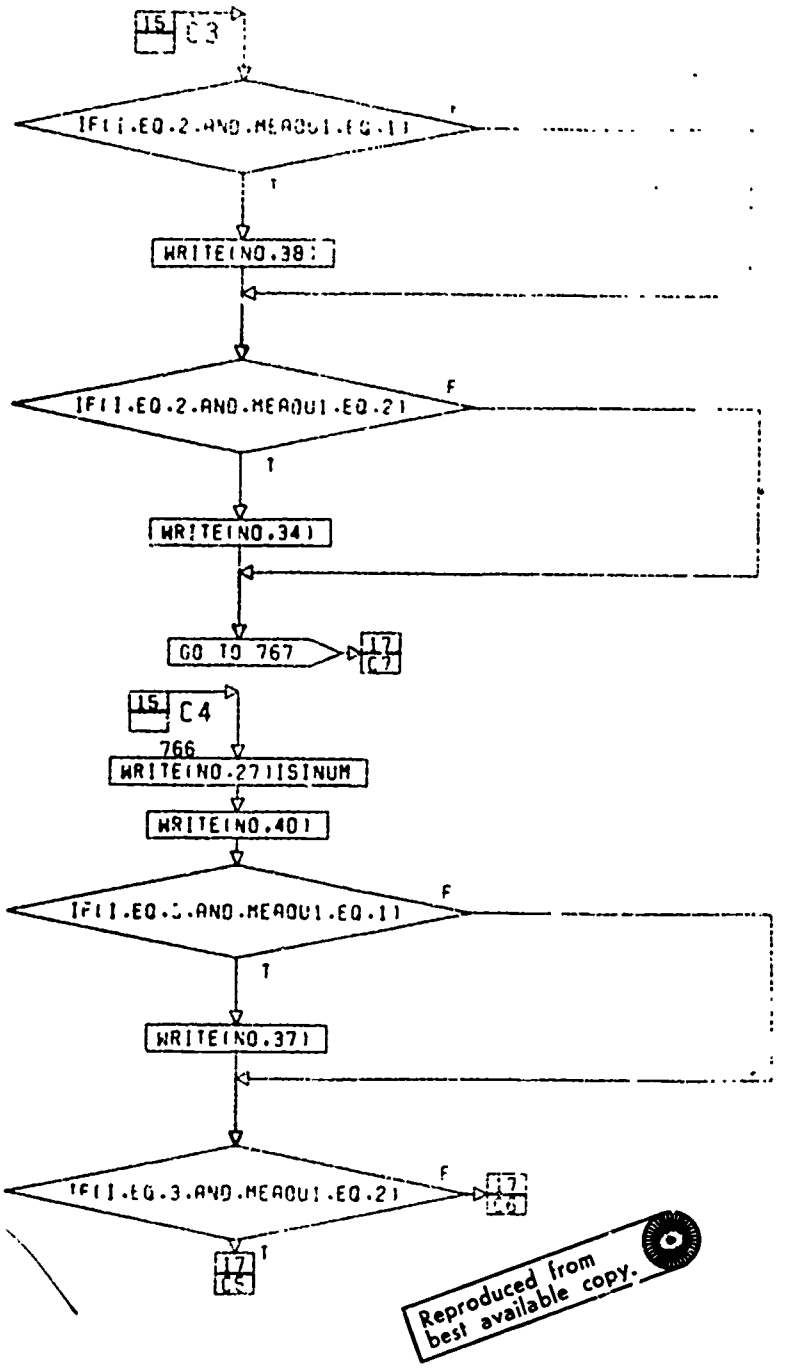
CONT. ON PG 14


13
B9
JN=JEND/7
IF(LOUT.EQ.NMAXD(1).AND.JN.EQ.NW)
F
T
IDAE=JEND
C *****WRITE DATA ON FILES**********
WRITE(NO.32) IDAB.IDAE.(STO(LOUT.JJ).JJ=IDAB.IDAE)
IF(LOUT.EQ.NMAXD(1).AND.JN.EQ.NW)
F
T
GO TO 765
13
12
13
C1
763
IDAB=IDAB+7
11
761
IDAE=IDAE+7
765
IF(LOUT.EQ.6.OR.LOUT.EQ.12)
F
15
C2
T
WRITE(NO.29)ISLEW

CONT. ON PG 15


14 C2
IF(LOUT.LT.6.OR.LOUT.GT.6)
F
T
GO TO 760
17 C8
IF(I.EQ.3.OR.I.EQ.4)
F
T
GO TO 766
16 C4
C *****WRITE MID-YEAR HEADINGS*****
WRITE(NO,27)ISINUM
WRITE(NO,39)
IF(I.EQ.1.AND.MEAOU1.EQ.1)
F
T
WRITE(NO,37)
IF(I.EQ.1.AND.MFAOU1.EQ.2)
F
16 C3
T
WRITE(NO,33)

CONT. ON PG 16



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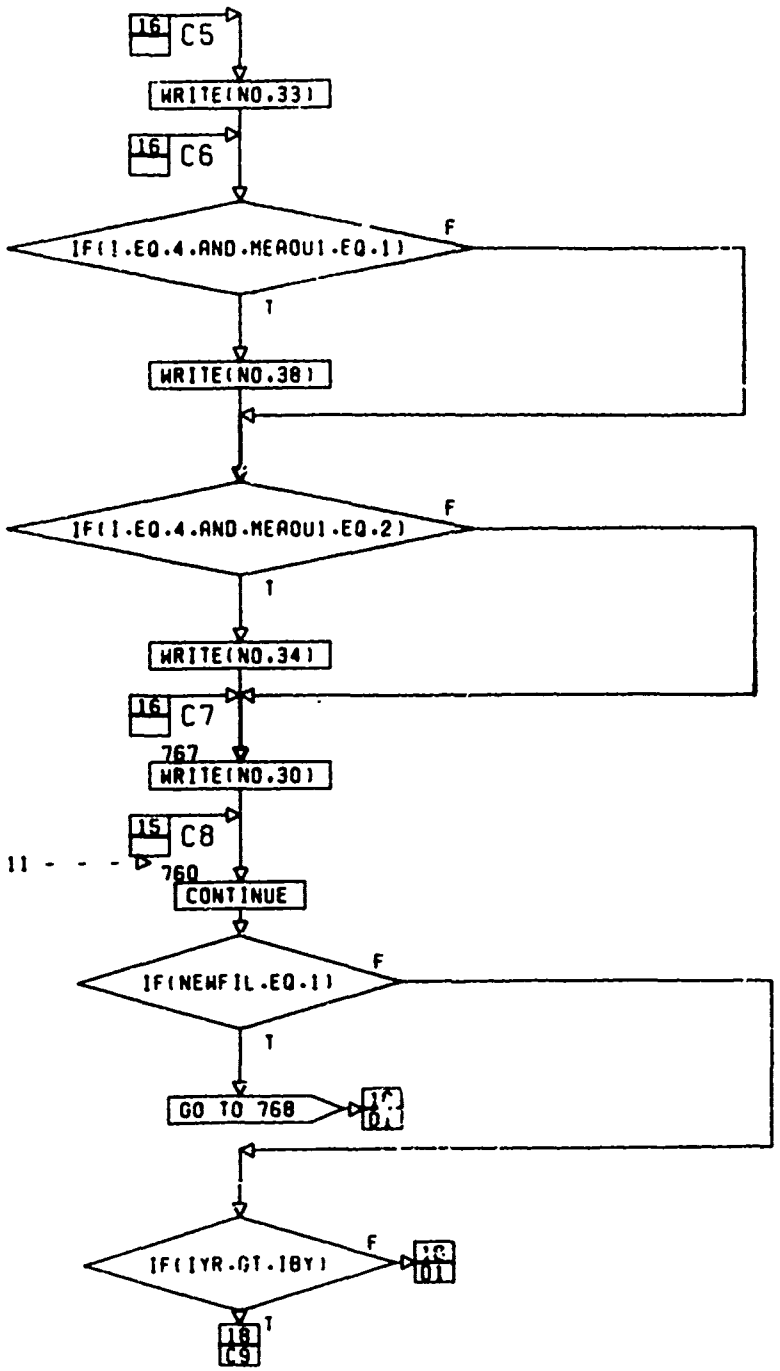
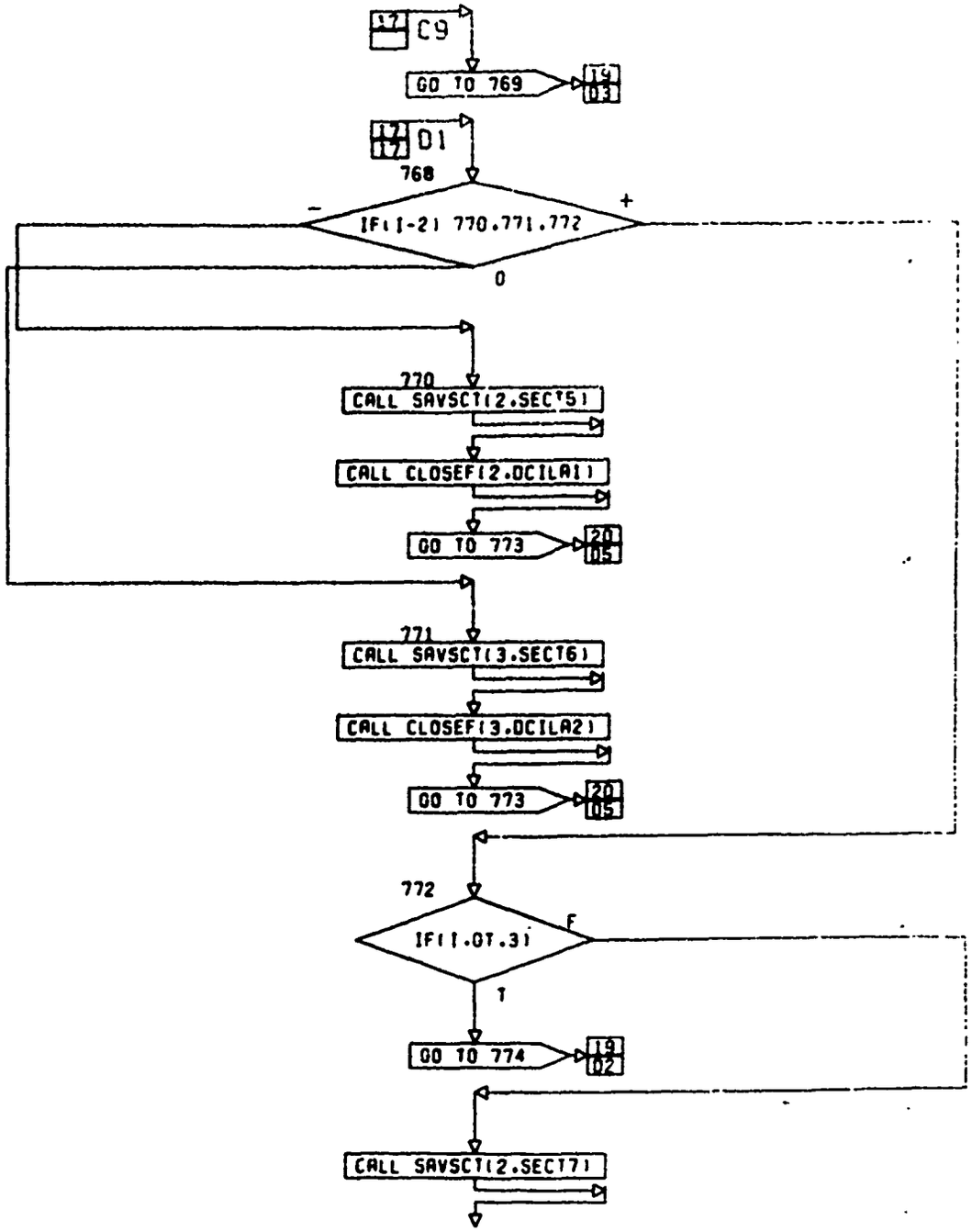
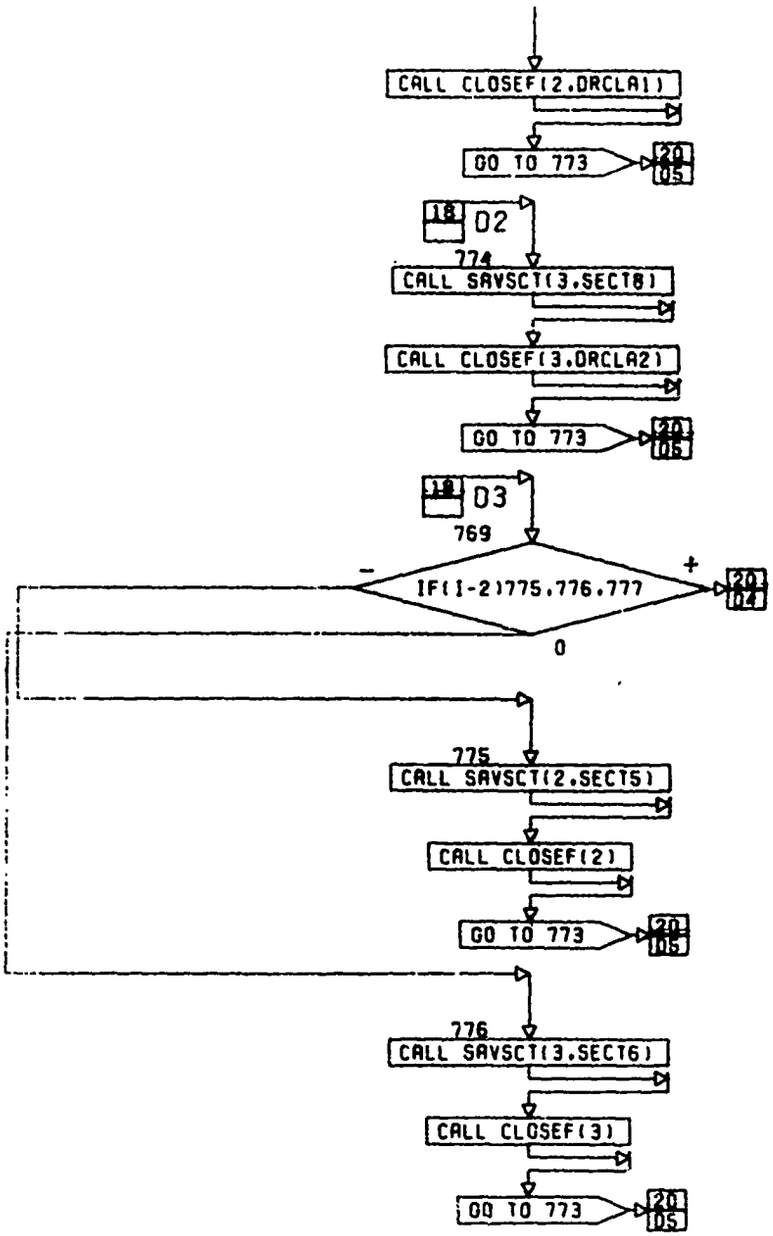
CONT. ON PG 17


16 C5
WRITE(NO,33)
16 C6
IF(I.EQ.4.AND.MEAOUI.EQ.1)
F
T
WRITE(NO,38)
IF(I.EQ.4.AND.MEAOUI.EQ.2)
F
T
WRITE(NO,34)
16 C7
767
WRITE(NO,30)
15 C8
11 - - - -
760
CONTINUE
IF(NEWFIL.EQ.1)
F
T
GO TO 768
IF(IYR.GT.IBY)
F
T
18 C9

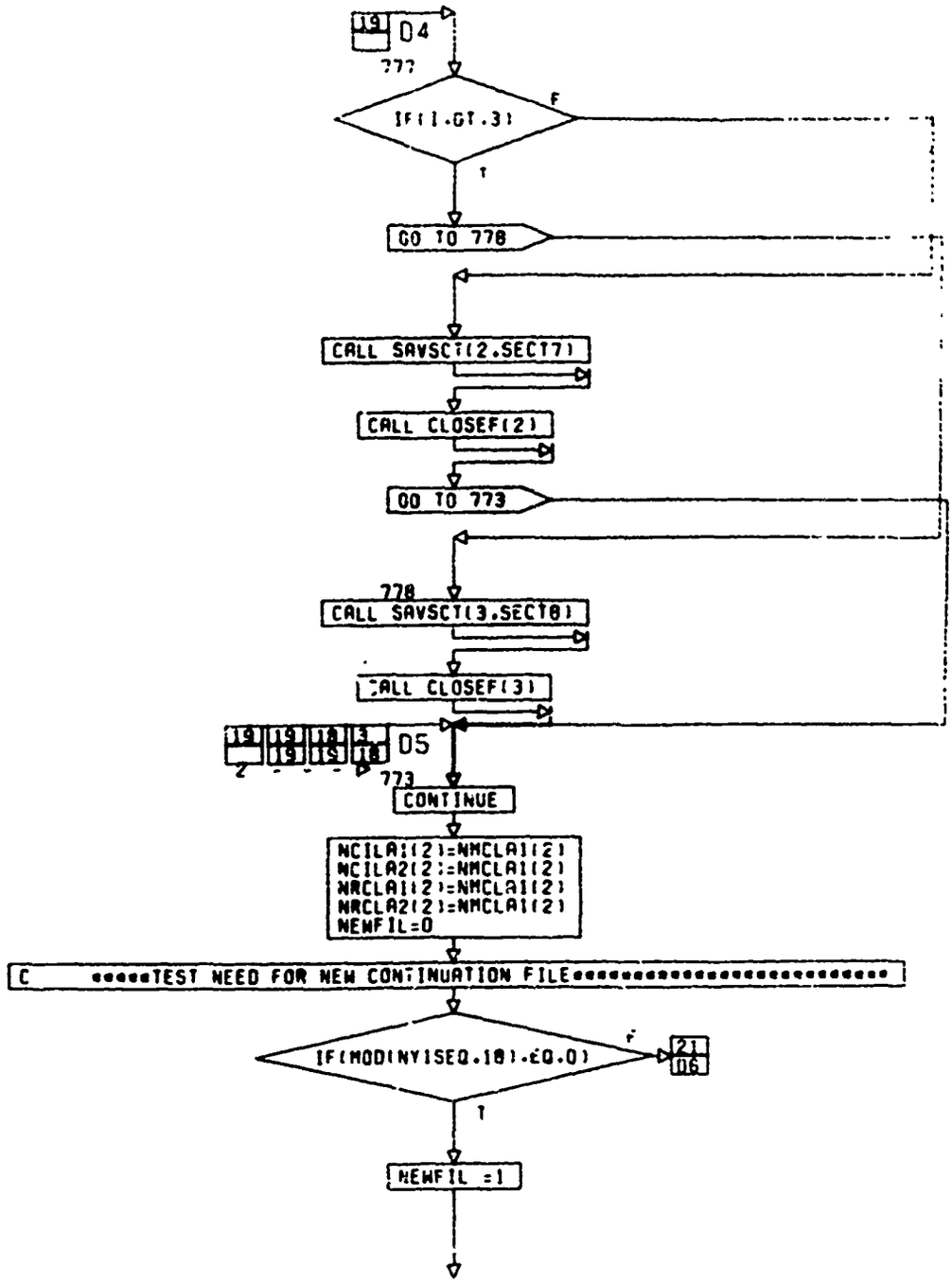
CONT. ON PG 18


17
C9
GO TO 769
19
03
17
17
D1
768
IF(I-2) 770,771,772
-
+
0
770
CALL SAVSCT(2,SECT5)
CALL CLOSEF(2,DCILA1)
GO TO 773
20
05
771
CALL SAVSCT(3,SECT6)
CALL CLOSEF(3,DCILA2)
GO TO 773
20
05
772
IF(I.GT.3)
F
T
GO TO 774
19
02
CALL SAVSCT(2,SECT7)

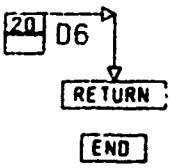
CONT. ON PG 19


CALL CLOSEF(2,DRCLA1)
GO TO 773
20
05
18
D2
774
CALL SAVSCT(3,SECT8)
CALL CLOSEF(3,DRCLA2)
GO TO 773
20
05
18
D3
769
IF(I-2)775,776,777
-
+
20
04
0
775
CALL SAVSCT(2,SECT5)
CALL CLOSEF(2)
GO TO 773
20
05
776
CALL SAVSCT(3,SECT6)
CALL CLOSEF(3)
GO TO 773
20
05

CONT. ON PG 20


19
D4
777
IF(I.GT.3)
F
T
GO TO 778
CALL SAVSCT(2,SECT7)
CALL CLOSEF(2)
GO TO 773
778
CALL SAVSCT(3,SECT8)
CALL CLOSEF(3)
19 19 18 3
19 15 18
D5
773
CONTINUE
NCILA1(2)=NMCLA1(2)
NCILA2(2)=NMCLA1(2)
NRCLA1(2)=NMCLA1(2)
NRCLA2(2)=NMCLA1(2)
NEWFIL=0
C *****TEST NEED FOR NEW CONTINUATION FILE*****
IF(MOD(NY1SEQ,18).EQ.0)
F
21
D6
T
NEWFIL =1

CONT. ON PG 21



PG 21 FINAL

APPENDIX B: COMPUTER LISTINGS

1. This appendix contains the computer listings with line numbers of the main program and subroutines as follows: main program, table B1; subroutine COMPMS, table B2; subroutine FIL1DA, table B3; subroutine FIL2DA, table B4; subroutine FRUDEP, table B5; subroutine STFRSP, table B6; and subroutine CALSST, table B7.

Table B1

Listing of Main Program, FTWEMS

```
100$OVR,COMPMS
110$OVR,FIL1DA
120$OVR,FIL2DA
130$OVR,FRODEP
140$OVR,CALSST
150$OVR,STFRSP
160$RPC
165C****COMMON VARIABLES*****************************************
170 COMMON IDC1(35),PMC(2),STO(12,31),NSTEO(4),RF(7),IHD(20),CXMIN(2),
180&TEMPER(12,35),SNO(12,35),CONEW(3,2,6),XRANG(2,3),STCON(2,4),
190&STRLI(2,4),NMAXD(2),ISINUM(4),C3(2,2),C4(2,2),DWMC(2,7),COEF(108),
200&MAXD(12),IMOA(4,12),BD(2),RANG(2,3,3),X(2),C1(16,2),C5(16,4,2),
210&CMAX(2),CMIN(2),C2(4),STORMC(12,31),STORMD(12,31),ADF(2),SDF(2),
220&II(2),KIND(3),ISLEW(3),DUM(25),PRECIP(12,35),B(13,2,2),B1(12),
230&CON1(2,2),D(2),E(2),IMOD(12,2),ABAR(2,2),BBAR(2,2),NMCLA1(2),
240&NMCLA2(2),NPMLA1(2),NPMLA2(2),NFRDEP(2),NCILA1(2),NCILA2(2),
250&NRCLA1(2),NRCLA2(2),NSOUR,IUNMEA,NTEMP,NSNOW,NYR,ITEXA,
260&IEXB,RMIN,ITYPE,ITEM1,ITEM2,II,IDEV1,IS1,ISD,ISM,ISY,IIT,IDA,
270&MO,IYR,ITEMP,ICOUNT,ACCR,DEP,C1COF,C1ROF,NCODE,ACCR1,ACCR2,MOK,
280&JUL,JIL,JUG,LUB,JOK,MOB,JEM,JAZ,JEL,JEB,
360&NTYPE,NEWLIM,NEWCOF,NSOST,NR,LL,JUB,IBD,IBM,IBY,NEWYR,
370&MEAOU1,MEAOU2,K,LK,JB,JEND,NTOS,AJBN,JBN,JN,KPMC,SECT1,SECT2,
380&SECT3,SECT4,SECT5,SECT6,SECT7,SECT8,SECT9,SECT10,NCI,NRCI,
390&SAM,IND,IDAB,IDAE,JNK,JNI,NO,STDN,NUMB,ISEQ,NY1SEQ,NY2SEQ
395C****EQUIVALENCED VARIABLES*****************************************
450 EQUIVALENCE (NMCLA1,DMCLA1),(NMCLA2,DMCLA2),(NPMLA1,DPMLA1),
460&(NPMLA2,DPMLA2),(NFRDEP,DFRDEP),(NCILA1,DCILA1),(NCILA2,DCILA2),
470&(NRCLA1,DRCLA1),(NRCLA2,DRCLA2)
475C****DATA INITIALIZATION*****************************************
480 DATA NUMB,ISEQ,NY1SEQ,NY2SEQ,NEWFIL,ACCR1,ACCR2/"001",0,0,0,
490&0.01,0.03/
500 DATAIMOA/12HJANUARY     ,12HFEBRUARY    ,12HMARCH       ,
510&12HAPRIL       ,12HMAY         ,12HJUNE        ,
520&12HJULY        ,12HAUGUST      ,12HSEPTEMBER   ,
530&12HOCTOBER     ,12HNOVEMBER    ,12HDECEMBER    /
540 DATAMAXD/31,28,31,30,31,30,31,31,30,31,30,31/
550 DATA COEF/0.15970948,-0.28827749,0.37098284,-.13067845,0.,0.,
570&0.20865303,-0.64984646,0.87560732,-.30605206,0.,0.,
590&.15190803,-.07720229,-.01280603,.01851488,0.,0.,
610&.09612290,.01073670,-.10720756,.05548077,0.,0.,
630&0.11641900,0.06704479,-0.09112914,0.03120642,0.,0.,
650&.14304453,-.10102288,-.02103815,.10071059,0.,0.,
670&0.08401220,-0.01562037,-0.10949073,0.12228349,0.,0.,
690&0.12713529,-0.53982006,1.1252485,-0.58561447,0.,0.,
710&.11387171,-.65583730,1.8700644,-2.3253802,
720&1.2952910,-.26246686,
730&0.02789788,0.24453131,-0.86060142,1.2998033,
740&-.97359290,.29132112,
750&.08321811,.11716883,-.14710818,.04910032,0.,0.,
770&.03492386,.36829518,-.90742210,.61582018,0.,0.,
790&0.12882001,-0.3275105,1.0509886,-1.0462256,0.,0.,
810&0.09068948,0.37645999,-0.79837781,1.130698,0.,0.,
830&.16554710,.32448206,-3.5931164,6.0923182,0.,0.,
850&.1685473,-1.2164306,5.0226953,-5.9828479,0.,0.,
```

1 of 9 Sheets

Table B1 (continued)

Listing of Main Program, FTWEMS

```
8708.13851029,-.32294633..51095728,-.23644523,0.,0.,
8908.14694158,-.508568,1.2942848,-.74715639,0.,0./
910 DATA RMIN,STRL1,C1COF,NEWCOF/0.1,750.,0.,750.,0.,300.,0.,300.,0.,
9158 0.07,0/,
9208STORMC,STORMD,TEMPER,SNO,STO/372*0.,372*0.,420*0.,420*0.,372*0./,
930&NYR,NMAXD/1,0,0/,C3/.47,.75,.22,.60/,C4/-.01,-.05,-.01,-.02/
970 DATA RANG/1.26,1.00,1.87,1.63,1.47,1.08,1.05,0.72,1.55,
98061.25,1 43,0.93,0.54,0.35,0.42,0.30,0.92,0.46/
990 DATA RF,PRECIP/[illegible]0.,420*0./,MOK,JUL,JIL,JUG,LUB,JOK,MOB,JEM,JAZ,
1000&JEL,JEB/0,0,0,0  [illegible] 0,0,0,0,0/,JUB,KIND/0,3*0/,ISLEW/6193023,
1010&8355711,8355711, [illegible] COF,NEWLIM,NSOST/0,0,0/,NTOS/1H9/
1050 DATA C5/0.602,0.,0.,0.,0.011,0.014,0.,0.,0.,0.,0.101,0.,0.,0.,0.,0.,
1060&0.221,0.,0.,0.,0.014,0.011,0.,0.,0.,0.,0.224,0.,0.,0.,0.,0.,
1070&-0.354,0.,0.,0.,-0.001,0.024,0.,0.,0.,0.,0.092,0.,0.,0.,0.,0.,
1080&-0.094,0.,0.,0.,-0.001,0.025,0.,0.,0.,0.,0.044,0.,0.,0.,0.,0.,
1090&2.01,-0.013,0.,0.,0.,0.,0.,0.,0.,0.132,0.,0.189,0.,0.,0.,0.,0.,
1100&2.01,-0.015,0.,0.008,0.,0.,0.,0.,0.,0.,0.215,0.,0.,0.,0.,0.,
1110&-0.121,0.,0.,0.018,0.,0.,0.,0.,0.101,0.,0.105,0.,0.,0.,0.,0.,
1120&0.170,0.,0.,0.025,0.,0.,0.,0.,0.013,0.,0.061,0.,0.,0.,0.,0./
1125C*****FORMAT STATEMENTS*****************************************
1130 1 FORMAT(2X,4A3,2X,2(A1,2X),2F10.0)
1140 2 FORMAT(1X,F9.,7F10.)
1150 3 FORMAT(1X,I2,2I1,4X,8F7.3)
1160 4 FORMAT(8F7.3)
1170 5 FORMAT(X,20A3)
1180 6 FORMAT(X,I1,3(X,I2))
1190 7 FORMAT(1X,2I2,2X,A1)
1200 8 FORMAT(A1)
1210 9 FORMAT(8X,7F6.2)
1220 10 FORMAT(I1)
1230 11 FORMAT(8X,7F6.2)
1240 12 FORMAT(1H )
1250 13 FORMAT(7X,I2,I1,6F10.8)
1260 14 FORMAT(4X,2(F5.3,X),4(2F6.0))
1270 15 FORMAT(10X,3(2F5.2))
1280 16 FORMAT(5X,4F7.3,5X,4F7.3)
1290 17 FORMAT(3X,4(2F8.3))
1300 18 FORMAT(3X,I2,I1,6F10.3)
1310 19 FORMAT(10X,I4)
1320 20 FORMAT(I4)
1330 21 FORMAT(X,I2)
1340 22 FORMAT(5H1SITE,2X,4A3)
1350 23 FORMAT(  8H TEXTURE,8X,A1,4X,A1)
1360 24 FORMAT(8H DENSITY,7X,F6.2,4X,F6.2)
1370 25 FORMAT(7H BEG MC,4X,2F10.2)
1380 26 FORMAT(16H SOIL PROPERTIES,5X,5F10.3/2X,7F10.3/2X,6F10.3)
1390 27 FORMAT(11H MAX-MIN MC,6X,4F10.3)
1400 28 FORMAT(3X,2I2)
1410 29 FORMAT(13H COEFFICIENTS,8X,4F10.3/2X,6F10.3/2X,6F10.3)
1420 30 FORMAT(1X,F9.0,F10.)
1430 31 FORMAT(1X,3I2,X,7F6.2)
1440 32 FORMAT(A6)
1450 33 FORMAT(24X,15H0 - 15 CM LAYER,/)
1460 34 FORMAT(23X,16H15 - 30 CM LAYER,/)
```

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Table B1 (continued)

Listing of Main Program, FTWEMS

```
1470 35 FORMAT(20X,21HSOIL MOISTURE IN/6 IN)
1480 36 FORMAT(20X,22HSOIL MOISTURE CM/15 CM)
1490 37 FORMAT(24X,14H0 - 6 IN LAYER,/)
1500 38 FORMAT(24X,15H6 - 12 IN LAYER,/)
1510 39 FORMAT(2A3,1X,2A3)
1515C*****ADDITIONAL CONTROL INPUT*****************************************
1520 PRINT,"FOR INFORMATION ON RUNNING THIS MODEL SEE USER'S MANUAL."
1530 PRINT,*,"WHEN ANSWERING YES OR NO QUESTIONS,"
1540 PRINT,"     USE 1 FOR YES AND 2 FOR NO."
1550 PRINT,"IS INPUT RAINFALL IN CM?"
1560 READ,IUNMEA
1570 PRINT,"IF YOU WANT OUTPUT MOISTURE CONTENT IN:"
1580 PRINT,"      INCHES ENTER A 1; CM ENTER A 2"
1590 READ,MEAOU1
1600 PRINT,"NAME LAYERS 1 AND 2 SOIL MOISTURE CONTENT FILES."
1610 PRINT,"      EXAMPLE:XX1001,XX2001"
1620 READ 39, NMCLA1,NMCLA2
1630 PRINT,"DO YOU NEED OUTPUT MOISTURE CONTENT IN PERCENT?"
1640 READ,MEAOU2
1650 IF(MEAOU2.EQ.2) GO TO 50
1660 PRINT,"NAME LAYERS 1 AND 2 PERCENT MOISTURE FILES."
1670 PRINT,"      EXAMPLE:XX1001,XX2001"
1680 READ 39, NPMLA1,NPMLA2
1690 50 IDC1(1)=101
1700 PRINT,"IF YOU HAVE AIR TEMPERATURE, ENTER A T; IF NOT A 9"
1710 READ 8,NTEMP
1720 JOB=1
1730 PRINT,"IF YOU HAVE SNOW DEPTH(M),ENTER AN SN; IF NOT A 9"
1740 READ 8,NSNOW
1750 IF(NSNOW.EQ.3HS  )KIND(1)=10
1760 PRINT,"WHAT IS YOUR INPUT SOURCE?"
1770 PRINT,"ENTER: 1 FOR SURFACE COMPOSITION GROUP, OTHERWISE A 2"
1780 READ,NSOUR
1790 IF(NSOUR.EQ.1) GO TO 60
1800 PRINT,"ENTER THE NAME OF YOUR INPUT FILE"
1810 READ 32,SAM
1820 PRINT,"ARE MAX AND MIN SOIL MOISTURE EQUATIONS INCLUDED IN THE"
1830 PRINT,"INPUT DATA FILE?"
1840 READ,MMDD
1850 CALL OPENF(1,SAM)
1860 GO TO 160
1870 60 CALL OPENF(1,"DSURGR")
1880 PRINT,"ENTER THE NUMBER OF YOUR SURFACE GROUP"
1890 READ 20,NSCGNU
1900 DO 70 I=1,500
1910 READ(1,10)ITYPE
1920 IF(ITYPE.EQ.1)READ(101,19)NCKSGN
1930 IF((NSCGNU-NCKSGN).EQ.0) GO TO 115
1940 70 CONTINUE
1945C*****READ SITE AND SOIL IDENTIFICATION*****************************
1950 115 FOK=1
1960 ITEM1=IDC1(1)
1970 READ(ITEM1,1) ISINUM,ITEXA,ITEXB,BD(1),BD(2)
1980 PRINT22,ISINUM
```

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Table B1 (continued)

Listing of Main Program, FTWEMS

```
1990 PRINT 23,ITEXA,ITEXB
2000 IF(ITEXA.EQ.3HN  )KIND(2)=10
2010 IF(ITEXB.EQ.3HN  )KIND(3)=10
2020 PRINT24,BD(1),BD(2)
2030 IF(ITEXA-3HC  )122,120,122
2040 120 IT(1)=KIND(2)=1
2050 GO TO 128
2060 122 IF(ITEXA-3HM  )125,124,125
2070 124 IT(1)=KIND(2)=2
2080 GO TO 128
2090 125 IF(ITEXA-3HF  )128,127,128
2100 127 KIND(2)=2
2110 IT(1)=3
2120 128 IF(ITEXB-3HC  )132,130,132
2130 130 IT(2)=KIND(3)=1
2140 GO TO 150
2150 132 IF(ITEXB-3HM  )135,134,135
2160 134 KIND(3)=2
2170 IT(2)=2
2180 GO TO 150
2190 135 IF(ITEXB-3HF  )150,137,150
2200 137 KIND(3)=2
2210 IT(2)=3
2220 150 JUL=1
2230 JOK=1
2235C*****READ DATA FROM INPUT FILE*****************************************
2240 160 READ(1,10)ITYPE
2250 GOTO(115,170,180,190,190,200,210,230,240),ITYPE
2260 170 READ(101,21)NTYPE
2270 GO TO(172,174,176,178,179,175)NTYPE
2275C*****READ LIMITS*******************************************************
2280 172 READ(101,14) RMIN,C1COF,((STRLI(I,J),I=1,2),J=1,4)
2290 NEWLIM=NTYPE
2300 IF(IUNMEA.EQ.1.AND.NSOUR.EQ.2) RMIN=RMIN*0.3937
2310 GO TO 160
2315C*****READ DEPLETION EQUATION COEFFICIENTS*****************************
2320 174 IF(NSOUR.EQ.2) GO TO 1175
2330 READ(101,13) NS,NL,(CONEW(NS,NL,JJ),JJ=1,6)
2340 NEWCOF=NTYPE
2350 GO TO 160
2360 1175 READ(101,18) NS,NL,(CONEW(NS,NL,JJ),JJ=1,6)
2370 NEWCOF=NTYPE
2380 GO TO 160
2390 175 CONTINUE
2400 READ(101,16)((C3(N,I),N=1,2),I=1,2),((C4(N,I),N=1,2),I=1,2)
2420 GO TO 160
2425C*****READ MOISTURE RANGE BY LAYER AND SEASON*****************************
2430 176 READ(101,15)((XRANG(I,J),I=1,2),J=1,3)
2440 GO TO 160
2445C*****READ STRENGTH EQUATION COEFFICIENTS*****************************
2450 178 READ(101,17) ((STCON(I,J),I=1,2),J=1,4)
2460 NSOST=NTYPE
2465C*****READ IDENTIFICATION CODE FOR EQUATION TO COMPUTE STRENGTH********
2466C*****  EQUATION CONSTANTS*****************************************
```

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Table B1 (continued)

Listing of Main Program, FTWEMS

```
2470 179 READ(101,28)NCI,NRCI
2480 NSOST=NTYPE
2490 GO TO 160
2495C*****READ BEGINNING SOIL MOISTURE*****************************************
2500 180 READ(101,30) PMC(1),PMC(2)
2510 PRINT 25,PMC(1),PMC(2)
2520 IF(IUNMEA.EQ.2.OR.NSOUR.EQ.1) GO TO 184
2530 DO 182 I=1,2
2540 182 PMC(I)=PMC(I)*0.3937
2550 184 JUL=2
2560 GOTO160
2565C*****READ AND PRINT MAX AND MIN SOIL MOISTURE*************************
2570 190 READ(101,2)(C2(I),I=1,4)
2580 IF(ITYPE-5)192,191,192
2590 191CONTINUE
2600 DO 195 I=1,2
2610 J=I+2
2620 CMAX(I)=6.*BD(I)*C2(I)/100.
2630 CMIN(I)=6.*BD(I)*C2(J)/100.
2640 195CONTINUE
2650 192 IF(IUNMEA.EQ.2.OR.NSOUR.EQ.1) GO TO 194
2660 DO 193 I=1,4
2670 193 C2(I)=C2(I)*0.3937
2680 194 PRINT 27,(C2(I),I=1,4)
2690 DO 196 I=1,2
2700 J=I+2
2710 CMAX(I)=C2(I)
2720 CXMIN(I)=C2(J)
2730 196 CONTINUE
2740 IF(NSOUR.EQ.2) GO TO 197
2750 CALL CLOSEF(1)
2760 PRINT,"ENTER NAME OF RAINFALL FILE"
2770 READ 32,SAM
2780 CALL OPENF(1,SAM)
2790 197 GO TO (198,160),JUL
2800 198CONTINUE
2810 PMC(1)=CMAX(1)
2820 PMC(2)=CMAX(2)
2830 JUL=2
2840 GOTO160
2845C*****READ SOIL PROPERTIES*****************************************
2850 200CONTINUE
2860 IDEV1=101
2870 GO TO (201,1150),MOK
2880 201CONTINUE
2890 MOK=2
2900 DO 206 M=1,2
2910 ITEM2=IDEV1
2920 READ(ITEM2,21) II
2930 IF(II.GE.8)GO TO 202
2940 READ(101,3) II,NSCS,J,(C1(I,J),I=1,II)
2950 GO TO 203
2960 202 READ(101,3) II,NSCS,J,(C1(I,J),I=1,8)
2970 203 IDEV1=1
```

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Table B1 (continued)

Listing of Main Program, FTWEMS

```
2980 IF(II-8)205,205,204
2990 204 READ(1,4)(C1(I,J),I=9,II)
3000 205 PRINT 26,(C1(I,M),I=1,II)
3010 206CONTINUE
3020 IF(MMDD.EQ.2) GO TO 1150
3030 GOTO160
3040 1150CONTINUE
3050 DO 1190 M=1,4
3060  ITEM3=IDEV1
3070 IF(M.EQ.1.OR.M.EQ.2)N=M
3080 IF(M.EQ.3)N=1
3090 IF(M.EQ.4)N=2
3100 IF(MMDD.EQ.2)GO TO 1180
3105C*****READ CONSTANTS FOR EQUATIONS COMPUTING MOISTURE MAX AND MIN******
3110 READ(ITEM3,3)II,NSCS,J,(C5(I,M,NSCS),I=1,8)
3120 IDEV1=1
3130 IF(II-8)1170,1170,1160
3140 1160 READ(1,4)(C5(I,M,NSCS),I=9,II)
3150 1170 PRINT 29,(C5(I,M,NSCS),I=1,II)
3160 1180 CONTINUE
3170 C2(M)=0.
3180 DO 1190 I=1,II
3190 1190 C2(M)=C2(M)+C5(I,M,NSCS)*C1(I,N)
3200 GO TO (194,160)JUL
3205C*****READ AND WRITE HEADINGS*****************************************
3210 210 READ(101,5)(IHD(J),J=1,20)
3220 I=1
3230 GO TO 217
3240 DO 220 I=1,3
3250 READ(1,5)(IHD(J),J=1,20)
3260 217CONTINUE
3270 PRINT5,(IHD(J),J=1,20)
3280 WRITE(2,5) (IHD(J),J=1,20)
3290 WRITE(3,5) (IHD(J),J=1,20)
3300 220 CONTINUE
3310 IF(MEAOU1.EQ.2) GO TO 231
3320 WRITE(2,35)
3330 WRITE(3,35)
3340 WRITE(2,37)
3350 WRITE(3,38)
3360 WRITE(2,12)
3370 WRITE(3,12)
3380 GO TO 232
3390 231 WRITE(2,36)
3400 WRITE(3,36)
3410 WRITE(2,33)
3420 WRITE(3,34)
3430 WRITE(2,12)
3440 WRITE(3,12)
3450 232 GO TO160
3455C*****READ SEASON CHANGE CARD*****************************************
3460 230 READ(101,6) IS1,ISD,ISM,ISY
3470 IF(JUB.EQ.1)GO TO 235
3480 IBD=IDACK=ISD
```

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Table B1 (continued)

Listing of Main Program, FTWEMS

```
3490 AIBD=IBD
3500 AJBN=AIBD/7.
3510 IBM=MCK=ISM
3520 NEWYR=IBY=ISY
3530 235 CONTINUE
3540 DO 215 I=1,2
3550 IIT=IT(I)
3560 IF(NEWCOF.LT.2.OR.NEWCOF.GT.2) GO TO 225
3570 SDF=1.
3580 ADF=1.
3590 GO TO 215
3600 225 SDF(I)=RANG(I,IIT,1)/(CMAX(I)-CXMIN(I))
3610 ADF(I)=1/SDF(I)
3620 215 CONTINUE
3630 I=1
3640 JUG=1
3650 JUB=1
3660 GOTO160
3665C*****READ PRECIPITATION OR AIR TEMPERATURE OR SNOW CARD*****************
3670 240 READ(101,7,END=3 5) IDA,MO,NCODE
3680 NDA=IDA+6
3690 IF(NTEMP.EQ.NTOS.AND.NSNOW.EQ.NTOS) GO TO 2240
3700 IF(NTEMP.EQ.NTOS)GO TO 2249
3710 IF(NCODE-NTEMP) 2249,2245,2249
3720 2249 IF(NCODE-NSNOW) 2240,2244,2240
3730 2244 READ(101,9),(SNO(MO,JJ),JJ=IDA,NDA)
3740 GO TO 3 0
3750 2245 READ(101,11),(TEMPER(MO,JJ),JJ=IDA,NDA)
3760 GO TO 3 0
3770 2240 READ(101,31) IDA,MO,IYR,(RF(JJ),JJ=1,7)
3780 IF(IBM.EQ.MO.AND.IBY.EQ.IYR.AND.ISD.GT.IDA)IDACK=IDA
3790 IF(IYR.LT.NEWYR) GO TO 498
3800 IF(IYR.EQ.NEWYR.AND.MO.LT.MCK)GO TO 498
3810 IF(IYR.EQ.NEWYR.AND.MO.EQ.MCK.AND.IDA.LT.IDACK)GO TO 498
3820 MCK=MO
3830 IDACK=IDA
3840 CALL EOFTST(1,MM)
3850 IF(MM.EQ.2) GO TO 241
3860 IF(IYR.GT.NEWYR) NMAXD(1)=NMAXD(2)=0
3870 IF(IYR.GT.NEWYR) IBD=IBM=1
3880 241 IF(IUNMEA.EQ.2) GO TO 247
3890 DO 246 JJ=1,7
3900 RF(JJ)=RF(JJ)*0.3937
3910 246 IF(RF(JJ).GT.30.AND.RF(JJ).LT.35.)RF(JJ)=77.77
3920 247 IF(MO.EQ.2) GO TO 248
3930 IF(MO.EQ.4.OR.MO.EQ.6.OR.MO.EQ.9.OR.MO.EQ.11) GO TO 249
3940 ICOUNT=31
3950 GO TO 250
3960 248 ICOUNT=28
3970 249 ICOUNT=30
3980 250 CONTINUE
3990 NTDA=IDA
4000 DO 251 NJ=1,7
```

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Table B1 (continued)

Listing of Main Program, FTWEMS

```
4010 PRECIP(MO,NTDA)=RF(NJ)*2.54
4020 251 NTDA=NTDA+1
4025C****COMPUTE SOIL MOISTURE*****************************************
4030 CALL LINK(5,"0COMPM")
4040 CALL COMPMS
4050C*********
4060 300 IF(JAZ.EQ.2) GO TO 301
4070 JEB=1
4080 301 GO TO (420,302),JAZ
4090 302CONTINUE
4100 JEL=1
4110 IF(MO.EQ.NMAXD(1).OR.MO.EQ.12) GO TO 303
4120 GO TO 410
4130 303 GO TO (304,304,305) JOB
4140 304 IF(NTEMP.EQ.NTOS) GO TO 305
4150 JOB=JOB+1
4160 GO TO 160
4165C*****WRITE SOIL MOISTURE FILES*****************************************
4170 305 CALL LINK(5,"0FIL1D")
4180 CALL FIL1DA
4190 IF(MEAOU2.EQ.1)CALL LINK(5,"0FIL2D")
4200 IF(MEAOU2.EQ.1)CALL FIL2DA
4210C*****WRITE FILES FOR INPUT TO FREEZE-THAW MODEL*********************
4220 IF(NTEMP.GT.NTOS.OR.NTEMP.LT.NTOS)CALL LINK(5,"0FRODE")
4230 IF(NTEMP.GT.NTOS.OR.NTEMP.LT.NTOS)CALL FRODEP
4240 JOB=1
4245 IF(MEAOU2.EQ.2) GO TO 400
4247C*****COMPUTE STRENGTH EQUATION CONSTANTS FROM SOIL PROPERTIES*********
4250 IF(NSOST.EQ.5.AND.IYR.EQ.IBY) CALL LINK(5,"0STFRS")
4260 IF(NSOST.EQ.5.AND.IYR.EQ.IBY) CALL STFRSP
4265C*****COMPUTE SOIL STRENGTH*****************************************
4270 IF(NSOST.EQ.4.OR.NSOST.EQ.5)CALL LINK(5,"0CALSS")
4280 IF(NSOST.EQ.4.OR.NSOST.EQ.5)CALL CALSST
4290 400 JEL=1
4300 JEB=2
4310 GOTO450
4320 410 JEB=3
4330 420 READ(1,10) ITYPE
4340 MOB=1
4350 CALL EOFTST(1,IEND)
4360 IF(IEND-2)460,430,460
4370 430 MOB=2
4380 GOTO470
4390 460 IF(ITYPE-1)480,470,480
4400 470 GO TO (302,495,490),JEB
4410 480 IF(ITYPE.EQ.3) GO TO 180
4420 IF(ITYPE-8)240,230,240
4430 490 JEL=2
4440 450 GO TO(420,495),MOB
4450 495 GO TO (115,500),MOB
4460 498 PRINT,"PRECIPITATION FILE HAS DATA OUT OF ORDER."
4470 PRINT,"CHECK DATA:",IDA,MO,IYR
4480 500 STOP
4490 END
```

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Table B1 (concluded)

Listing of Main Program, FTWEMS

```
SUBROUTINE WRIBWK
C*****************
C*****WRITE FIRST WEEK OF OUTPUT DATA FILES WITH BEGINNING DAY*********
C*****      OTHER THAN THE FIRST DAY OF WEEK*****************************
61 FORMAT(1X,I2,1H-,I2,4X,7H        ,6F7.2)
161 FORMAT(1X,I2,1H-,I2,4X,7H        ,6F7.0)
62 FORMAT(1X,I2,1H-,I2,4X,2(7H        ),5F7.2)
162 FORMAT(1X,I2,1H-,I2,4X,2(7H        ),5F7.0)
63 FORMAT(1X,I2,1H-,I2,4X,3(7H        ),4F7.2)
163 FORMAT(1X,I2,1H-,I2,4X,3(7H        ),4F7.0)
64 FORMAT(1X,I2,1H-,I2,4X,4(7H        ),3F7.2)
164 FORMAT(1X,I2,1H-,I2,4X,4(7H        ),3F7.0)
65 FORMAT(1X,I2,1H-,I2,4X,5(7H        ),2F7.2)
165 FORMAT(1X,I2,1H-,I2,4X,5(7H        ),2F7.0)
66 FORMAT(1X,I2,1H-,I2,4X,6(7H        ),F7.2)
166 FORMAT(1X,I2,1H-,I2,4X,6(7H        ),F7.0)
I=JNI
IF(STDN.EQ.1.) GO TO 8010
IF(IND.EQ.61) WRITE(2,61)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.61) WRITE(3,61)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.62) WRITE(2,62)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.62) WRITE(3,62)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.63) WRITE(2,63)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.63) WRITE(3,63)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.64) WRITE(2,64)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.64) WRITE(3,64)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.65) WRITE(2,65)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.65) WRITE(3,65)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.66) WRITE(2,66)IDAB,IDAE,(STORMC(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.66) WRITE(3,66)IDAB,IDAE,(STORMD(I,JJ),JJ=JNK,IDAE)
GO TO 8011
8010 CONTINUE
IF(IND.EQ.61) WRITE(NO,161)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.62) WRITE(NO,162),IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.63) WRITE(NO,163)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.64) WRITE(NO,164)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.65) WRITE(NO,165)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.66) WRITE(NO,166)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
8011 RETURN
END
```

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Table B2

Listing of Subroutine COMPMS

```
6000 SUBROUTINE COMPMS
6010C*****************
6020C*****CALCULATION CORE*****************************************
6030 DO 600 J=1,7
6050 IF(RF(J)-77.77)601,602,603
6070 601 GO TO (604,605) JOK
6080 IF(ISM-MO)606,606,607
6090 606 IF(ISD-IDA-J+1) 608,608,607
6100 608 GO TO (640,605) JOK
6110 604 JOK=2
6120 605 IS=ISI
6130 DO 609 I=1,2
6140 IIT=IT(I)
6150 IF(NEWCOF.LT.2.OR.NEWCOF.GT.2) GO TO 610
6160 CMIN(I)=CMAX(I)-XRANG(I,IS)
6170 GO TO 609
6180 610 CMIN(I)=CMAX(I)-RANG(I,IIT,IS)*ADF(I)
6190 609 CONTINUE
6200 JUG=1
6210 607 JEM=1
6220 DO 611 I=1,2
6230 DWMC(I,J)=0.
6240 GO TO (612,613,614,615),JEM
6250 612 IF(RF(J)-RMIN)616,617,618
6260 616 JEM=2
6270 GOTO613
6280 617 ACCR=0.
6290 GO TO 619
6300 618CONTINUE
6310C*****ACCRETION CALCULATION*****************************************
6340 X(1)=CMAX(1)-PMC(1)
6350 X(2)=CMAX(2)-PMC(2)
6360 IF(RF(J)-X(1)-X(2))621,620,620
6370 620 II=2
6380 JEM=3
6390 GOTO614
6400 621 II=1
6410 JEM=4
6420 615 X(I)=RF(J)
6430C*****ACCRETION(CLASS 1 AND CLASS 2)*****
6450 614 ACCR=C3(II,I)*X(I)+C4(II,I)
6460 IF(ACCR)622,622,623
6470 622 IF(PMC(I)-CMAX(I))624,625,625
6480 624 IF(II.EQ.1)GO TO 626
6490 PMC(I)=PMC(I)+ACCR2
6500 GO TO 627
6510 626 PMC(I)=PMC(I)+ACCR1
6520 GOTO627
6530 623 IF(II.EQ.1.AND.ACCR.LT.C1COF.AND.I.EQ.1) GO TO 628
6540 GO TO 629
6550 628 C1ROF=RF(J)-RMIN
6560 IF(C1ROF.LT.C1COF.AND.I.EQ.1) GO TO 630
6570 GO TO 629
6580C*****ACCRETION(ONE TO ONE RELATION)*****
```

1 of 3 Sheets

Table B2 (continued)

Listing of Subroutine COMPMS

```
630 ACCR=RF(J)-RMIN
629 IF(II.EQ.1) GO TO 619
C****ACCRETION(CONSTANT)*****
IF(ACCR.GE.ACCR2)GO TO 619
PMC(I)=PMC(I)+ACCR2
GO TO 627
C  NEW MOISTURE CONTENT
619 PMC(I)=PMC(I)+ACCR
627 IF(PMC(I)-CMAX(I)) 631,631,625
625 PMC(I)=CMAX(I)
631 IF(MEADU2.EQ.2) GO TO 611
C****CONVERT MOISTURE CONTENT TO % DRY WEIGHT*****************************
DWMC(I,J)=(PMC(I)/(6.*BD(I)))*100.
GO TO 611
C****DEPLETION CALCULATION*****************************************
613 IF(PMC(I)-CMIN(I)) 631,632,632
632 IF(NEWCOF.NE.2) GO TO 633
DEP=0.0
DO 634 L=1,6
634 DEP=DEP+CONEW(IS,I,L)*(PMC(I)-CMIN(I))**L
IF(DEP) 631,631,635
C
C      IJKL = I +MAXI*(J-1)+MAXI*MAXJ*(K-1)+MAXI*MAXJ*MAXK*(L-1)
C
633 IJKL=1+6*(I-1)+12*(IT(I)-1)+36*(IS-1)
DEP=0.0
DO 636 L=1,6
C****TENTATIVE AVERAGE DEPLETION*****
DEP=DEP+COEF(IJKL)*(SDF(I)*(PMC(I)-CMIN(I)))**L
IJKL=IJKL+1
636CONTINUE
C****TRANSFORMED DEPLETION*****
DEP=DEP/SDF(I)
IF(DEP) 631,631,635
C****NEW MOISTURE CONTENT*****************************************
635 PMC(I)=PMC(I)-DEP
IF(PMC(I)-CMIN(I))637,631,631
637PMC(I)=CMIN(I)
GOTO631
611 CONTINUE
602 ITEMP=IDA+J-1
IF(RF(J).LE.RMIN)GO TO 638
STORMC(MO,ITEMP)=0.0
IF(RF(J).LT.25.0) GO TO 638
STORMD(MO,ITEMP)=0.0
GO TO 639
638 STORMC(MO,ITEMP)=PMC(1)
STORMD(MO,ITEMP)=PMC(2)
639 IF(ITEMP-ICOUNT) 600,640,640
640 JAZ=2
GO TO 645
600 CONTINUE
JAZ=1
GO TO 645
```

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Table B2 (concluded)

Listing of Subroutine COMPMS

```
7220 603 ITEMP=IDA+J-1
7230 NMAXD(1)=MO
7240 NMAXD(2)=ITEMP-1
7250 JAZ=2
7260 645 RETURN
7270 END
```

3 of 3 sheets

Table B3

Listing of Subroutine FIL1DA

```
8000 SUBROUTINE FIL1DA
8010C*****************
8015C*****WRITE SOIL MOISTURE FILES*****************************
8016C*****FORMAT STATEMENTS*****************************************
8020 27 FORMAT(20X,23HIDENTIFICATION NUMBER: ,4A3)
8030 29 FORMAT(3A3)
8040 30 FORMAT(4(1H ,/))
8050 31 FORMAT(2X,3HDAY,24X,3A3,A1,X,2H19,I2)
8060 32 FORMAT(1X,I2,1H-,I2,4X,7F7.2)
8070 33 FORMAT(24X,15H0 - 15 CM LAYER,/)
8080 34 FORMAT(23X,16H15 -30 CM LAYER,/)
8090 35 FORMAT(20X,22HSOIL MOISTURE IN/ 6 IN)
8100 36 FORMAT(20X,22HSOIL MOISTURE CM/15 CM)
8110 37 FORMAT(24X,14H0 - 6 IN LAYER,/)
8120 38 FORMAT(24X,15H6 - 12 IN LAYER,/)
8125C*****TEST OUTPUT CHECKS AND OPEN FILES*********************
8130 IF(NEWFIL.EQ.1) GO TO 650
8140 IF(IYR.GT.NEWYR) GO TO 651
8150 GO TO 652
8160 651 CALL OPENF(2,DMCLA1)
8170 CALL SETSCT(2,SECT1)
8175C*****WRITE HEADINGS*****************************************
8180 650 WRITE(2,27)ISINUM
8190 IF(MEAOU1.EQ.1)WRITE(2,35)
8200 IF(MEAOU1.EQ.1) WRITE(2,37)
8210 IF(MEAOU1.EQ.2) WRITE(2,36)
8220 IF (MEAOU1.EQ.2) WRITE(2,33)
8230 WRITE(2,30)
8240 IF(NEWFIL.EQ.1) GO TO 653
8250 CALL OPENF(3,DMCLA2)
8260 CALL SETSCT(3,SECT2)
8270 653 WRITE(3,27)ISINUM
8280 IF(MEAOU1.EQ.1) WRITE(3,35)
8290 IF(MEAOU1.EQ.1) WRITE(3,38)
8300 IF(MEAOU1.EQ.2) WRITE(3,36)
8310 IF(MEAOU1.EQ.2) WRITE(3,34)
8320 WRITE(3,30)
8330 NEWYR=IYR
8340 652 K=IBM
8350 LK=MO
8360 DO 654 I=K,LK
8370 JB=1
8380 IF(IBD.GT.1.AND.I.EQ.IBM.AND.IYR.EQ.IBY)JB=IBD
8390 IDAB=1
8400 IDAE=7
8410 IF(I.EQ.NMAXD(1)) JEND=NMAXD(2)
8420 IF(I.EQ.NMAXD(1)) GO TO 655
8430 JEND=MAXD(I)
8440 655 IF(MEAOU1.EQ.1) GO TO 656
8450 DO 657 J=JB,JEND
8460 STORMC(I,J)=STORMC(I,J)*2.54
8470 657 STORMD(I,J)=STORMD(I,J)*2.54
8480 656 WRITE(2,31) (IMOA(II,I), II=1,4), IYR
8490 WRITE(3,31) (IMOA(II,I), II=1,4),IYR
```

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Table B3 (continued)

Listing of Subroutine FILIDA

```
8500 JBN=AJBN
8510 DO 658 NW=1,5
8520 IF(IYR.GT.IBY) GO TO 659
8530 INK=0
8540 IF(AJBN.GE.NW.AND.I.EQ.IBM)GO TO 660
8550 IF(JB.EQ.1.OR.JBN.LT.(NW-1)) GO TO  659
8555C*****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED******
8560 DO 661 NK=IDAB,IDAE
8570 INK=INK+1
8580 IF(STORMC(I,NK).EQ.0.0)GO TO 661
8590 IND=60+INK-1
8600 JNK=NK
8610 JNI=I
8620 CALL WRIBWK
8630 GO TO 660
8640 661 CONTINUE
8650 GO TO 660
8660 659 IF(I.EQ.2.AND.NW.EQ.4)NW=NW+1
8670 IF(NW.EQ.5)IDAE=MAXD(I)
8680 JN=JEND/7
8690 IF(I.EQ.NMAXD(1).AND.JN.EQ.NW)IDAE=JEND
8695C*****WRITE DATA ON FILES*****************************************
8700 WRITE(2,32) IDAB,IDAE,(STORMC(I,JJ), JJ=IDAB,IDAE)
8710 WRITE(3,32) IDAB,IDAE,(STORMD(I,JJ), JJ=IDAB,IDAE)
8720 IF(I.EQ.NMAXD(1).AND.JN.EQ.NW)GO TO 662
8730 660 IDAB=IDAB+7
8740 658 IDAE=IDAE+7
8750 662 IF(I.EQ.6.OR.I.EQ.12) WRITE(2,29) ISLEW
8760 IF(I.EQ.6.OR.I.EQ.12) WRITE(3,29) ISLEW
8770 IF(I.LT.6.OR.I.GT.6) GO TO 663
8780 WRITE(2,27),ISINUM
8790 IF(MEADU1.EQ.1)WRITE(2,35)
8800 IF(MEADU1.EQ.1)WRITE(2,37)
8810 IF(MEADU1.EQ.2) WRITE(2,36)
8820 IF(MEADU1.EQ.2) WRITE(2,33)
8830 WRITE(2,30)
8840 WRITE(3,27) ISINUM
8850 IF(MEADU1.EQ.1)WRITE(3,35)
8860 IF(MEADU1.EQ.1) WRITE(3,38)
8870 IF(MEADU1.EQ.2) WRITE(3,36)
8880 IF(MEADU1.EQ.2) WRITE(3,34)
8890 WRITE(3,30)
8900 663 IF(MEADU2.EQ.2) GO TO 654
8910 IF(MEADU1.EQ.2) GO TO 664
8920 DO 665 J=JB,JEND
8930 STORMC(I,J)=STORMC(I,J)*100./(BD(1)*6.)
8940 665 STORMD(I,J)=STORMD(I,J)*100./(BD(2)*6.)
8950 GO TO 654
8960 664 CONTINUE
8970 DO 666 J=JB,JEND
8980 STORMC(I,J)=STORMC(I,J)*100./(BD(1)*15.24)
8990 666 STORMD(I,J)=STORMD(I,J)*100./(BD(2)*15.24)
9000 654 CONTINUE
9010 CALL SAVSCT(2,SEC11)
```

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Table B3 (concluded)

Listing of Subroutine FIL1DA

```
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)GO TO 667
CALL CLOSEF(2)
GO TO 668
667 CALL CLOSEF(2,DMCLA1)
668 CALL SAVSCT(3,SECT2)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)GO TO 669
CALL CLOSEF(3)
GO TO 670
669 CALL CLOSEF(3,DMCLA2)
670 NY1SEQ=NY1SEQ+1
C****NEED FOR NEW CONTINUATION OUTPUT FILE**************************
IF(MOD(NY1SEQ,18).EQ.0) ISEQ=ISEQ+1
IF(MOD(NY1SEQ,18).EQ.0)NMCLA1(2)=NUMB*ISEQ/10*256+MOD(ISEQ,10)
NMCLA2(2)=NMCLA1(2)
NEWFIL =0
IF(MOD(NY1SEQ,18).EQ.0)NEWFIL=1
RETURN
END
```

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Table B4

Listing of Subroutine FIL2DA

```
10000 SUBROUTINE FIL2DA
10010C*****************
10015C*****WRITE PERCENT MOISTURE FILES*****************************************
10016C*****FORMAT STATEMENTS*****************************************************
10020 27 FORMAT(20X,23HIDENTIFICATION NUMBER: ,4A3)
10030 28 FORMAT(19X,24HPERCENT MOISTURE CONTENT)
10040 29 FORMAT(3A3)
10050 30 FORMAT(4(1H ,/))
10060 31 FORMAT(2X,3HDAY,24X,3A3,A1,X,2H19,I2)
10070 32 FORMAT(1X,I2,1H-,I2,4X,7F7.2)
10080 33 FORMAT(24X,15H0 - 15 CM LAYER,/)
10090 34 FORMAT(23X,16H15 -30 CM LAYER,/)
10100 37 FORMAT(24X,14H0 - 6 IN LAYER,/)
10110 38 FORMAT(24X,15H6 - 12 IN LAYER,/)
10115C*****TEST OUTPUT CHECKS AND OPEN FILES*****************************
10120 IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)GO TO 700
10130 CALL OPENF(2,DPMLA1)
10140 CALL SETSCT(2,SECT3)
10145C*****WRITE HEADINGS*****************************************************
10150 700 WRITE(2,27),ISINUM
10160 WRITE(2,28)
10170 IF(MEAOU1.EQ.1) WRITE(2,37)
10180 IF(MEAOU1.EQ.2) WRITE(2,33)
10190 WRITE(2,30)
10200 IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 701
10210 CALL OPENF(3,DPMLA2)
10220 CALL SETSCT(3,SECT4)
10230 701 WRITE(3,27),ISINUM
10240 WRITE(3,28)
10250 IF(MEAOU1.EQ.1) WRITE(3,38)
10260 IF(MEAOU1.EQ.2) WRITE(3,34)
10270 WRITE(3,30)
10280 DO 702 I=K,LK
10290 JB=1
10300 IF(IBD.GT.1.AND.I.EQ.IBM.AND.IYR.EQ.IBY)JB=IBD
10310 IDAB=1
10320 IDAE=7
10330 WRITE(2,31) (IMOA(II,I), II=1,4),IYR
10340 WRITE(3,31) (IMOA(II,I),II=1,4),IYR
10350 DO 703 NW=1,5
10360 IF(IYR.GT.IBY)GO TO 704
10370 INK=0
10380 IF(AJBN.GE.NW.AND.I.EQ.IBM) GO TO 705
10390 IF(JB.EQ.1.OR.JBN.LT.(NW-1))GO TO 704
10395C*****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED*****
10400 DO 706 NK=IDAB,IDAE
10410 INK=INK+1
10420 IF(SIORMC(I,NK).EQ.0.0)GO TO 706
10430 IND=60+INK-1
10440 JNK=NK
10450 JNI=I
10460 CALL WRIBWK
10470 GO TO 705
10480 706 CONTINUE
```

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Table B4 (concluded)

Listing of Subroutine FIL2DA

```
GO TO 705
704 IF(I.EQ.2.AND.NW.EQ.4) NW=NW+1
IF(NW.EQ.5) IDAE=MAXD(I)
JN=JEND/7
IF(I.EQ.NMAXD(1).AND.JN.EQ.NW)IDAE=JEND
C****WRITE DATA ON FILES*****************************************
WRITE(2,32) IDAB,IDAE,(STORMC(I,JJ), JJ=IDAB,IDAE)
WRITE(3,32) IDAB,IDAE,(STORMD(I,JJ), JJ=IDAB,IDAE)
IF(I.EQ.NMAXD(1).AND.JN.EQ.NW)GO TO 707
705 IDAB=IDAB+7
703 IDAE=IDAE+7
707 IF(I.EQ.6.OR.I.EQ.12) WRITE(2,29) ISLEW
IF(I.EQ.6.OR.I.EQ.12)WRITE(3,29) ISLEW
IF(I.LT.6.OR.I.GT.6) GO TO 702
WRITE(2,27),ISINUM
WRITE(2,28)
IF(MEAOU1.EQ.1)WRITE(2,37)
IF(MEAOU1.EQ.2)WRITE(2,33)
WRITE(2,30)
WRITE(3,27)ISINUM
WRITE(3,28)
IF(MEAOU1.EQ.1)WRITE(3,38)
IF(MEAOU1.EQ.2)WRITE(3,34)
WRITE(3,30)
702 CONTINUE
CALL SAVSCT(2,SECT3)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 708
CALL CLOSEF(2)
GO TO 709
708 CALL CLOSEF(2,DPMLA1)
709 CALL SAVSCT(3,SECT4)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)GO TO 710
CALL CLOSEF(3)
GO TO 711
710 CALL CLOSEF(3,DPMLA2)
C****TEST NEED FOR NEW CONTINUATION FILE*****************************
711 NPMLA1(2)=NMCLA1(2)
NPMLA2(2)=NMCLA1(2)
NEWFIL=0
IF(MOD(NY1SEQ,18).EQ.0) NEWFIL=1
RETURN
END
```

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Table B5

Listing of Subroutine FRODEP

```
12000 SUBROUTINE FRODEP
12001C*****************
12002C*****WRITE AIR TEMPERATURE AND SNOW FILES*****************************
12003C*****FORMAT STATEMENTS*****************************************
12010 27 FORMAT(18X,24HIDENTIFICATION NUMBER: ,4A3)
12020 29 FORMAT(3A3)
12030 31 FORMAT(28X,3A3,A1,X,2H19,I2)
12040 32 FORMAT(2A3)
12050 33 FORMAT(6X,25HDENSITY:  0-15 CM LAYER, ,F5.2,23HG/CM:  15-30
12060&& CM LAYER, ,F5.2,4HG/CM)
12070 34 FORMAT(11X,49HFROZEN DEPTH OF SOIL(CRREL-1968) DATA INPUT
12080& FILE,/)
12090 35 FORMAT(1H ,/)
12100 36 FORMAT(26X,19HMEASURED SNOW DEPTH,//)
12110 37 FORMAT(11X,4HSNOW,3X,7HPRECIP-,3X,3HAIR,6X,13HSOIL MOISTURE,6X,
12120&13HSOIL MOISTURE)
12130 38 FORMAT(6X,I2,3(2X,F6.2),8X,F7.2,11X,F7.2)
12140 39 FORMAT(6X,3HDAY,2X,5HDEPTH,2X,7HITATION,3X,4HTEMP,4X,15H0-15
12150& CM LAYER,%,3X,17H 15-30 CM LAYER,%)
12160 IF(IYR.GT.IBY) GO TO 850
12165C*****ADDITIONAL INPUT CONTROL*****************************************
12170 PRINT,"ENTER NAMES OF SNOW,FROZEN SOIL DEPTH MODEL INPUT FILE"
12180 PRINT,"          EXAMPLE: FRD001"
12190 READ 32,NFRDEP
12195C*****TEST OUTPUT CHECK AND OPEN FILES*****************************
12200 850 IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 851
12210 CALL OPENF(4,DFRDEP)
12220 CALL SETSCT(4,SECT9)
12230 851 CONTINUE
12235C*****WRITE HEADINGS*****************************************
12240 DO 852 I=K,LK
12250 WRITE(4,27),ISINUM
12260 WRITE(4,34)
12270 IF(KIND(1).EQ.0) GO TO 853
12280 WRITE(4,36)
12290 853 WRITE(4,31) (IMOA(II,I),II=1,4),IYR
12300 WRITE(4,33),BD(1),BD(2)
12310 WRITE(4,35)
12320 WRITE(4,37)
12330 WRITE(4,39)
12340 JB=IBD
12350 JEND=MAXD(I)
12360 IF(I.EQ.NMAXD(1))JEND=NMAXD(2)
12365C*****WRITE DATA ON FILES*****************************
12370 DO 854 J=JB,JEND
12380 854 WRITE(4,38)J,SNO(I,J),PRECIP(I,J),TEMPER(I,J),STORMC(I,J),
12390&&STORMD(I,J)
12400 852WRITE(4,31) ISLEW
12410 CALL SAVSCT(4,SECT9)
12420 IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 855
12430 CALL CLOSEF(4)
12440 GO TO 856
12450 855 CALL CLOSEF(4,DFRDEP)
12460 856 NY2SEQ=NY2SEQ+1
```

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Table B5 (concluded)

Listing of Subroutine FRODEP

```
12470 IF(MOD(NY2SEQ,3).EQ.0)ISEQ=ISEQ+1
12480 IF(MOD(NY2SEQ,3).EQ.0)NFRDEP(2)=NUMB+ISEQ/10*256+MOD(ISEQ,10)
12485C*****TEST NEED FOR NEW CONTINUATION FILE*************************
12490 NEWFIL=0
12500 IF(MOD(NY2SEQ,3).EQ.0) NEWFIL=1
12510 RETURN
12520 END
```

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Table B6

Listing of Subroutine STFRSP

```
15000 SUBROUTINE STFRSP
15010C*****************
15015C*****COMPUTE STERNGTH EQUATION CONSTANTS FROM SOIL PROPERTIES*********
15020 34 FORMAT(5X,21HINCORRECT C1 MOD CODE)
15030 CON1(1,1)=ALOG(200.)
15040 CON1(1,2)=ALOG(100.)
15050 CON1(2,1)=ALOG(300.)
15060 CON1(2,2)=ALOG(200.)
15070 CALL SAVSCT(1,SECT10)
15080 CALL CLOSEF(1)
15085C*****SEARCH FOR STRENGTH EQUATION CONSTANTS*************************
15090 CALL OPENF(1,"DFSTEQ")
15100     DO 800 II=1,NCI
15110     READ (1,) ( IMOD(I,1),I=1,12)
15120     DO 800 J=1,2
15130     READ (1,) (B(I,J,1),I=1,12)
15140  800 CONTINUE
15150     I2=7-II+NRCI
15160     DO 801 II=1,I2
15170     READ (1,) (IMOD(I,2),I=1,12)
15180     DO 801 J=1,2
15190    READ (1,) (B(I,J,2),I=1,12)
15200 801 CONTINUE
15210 CALL CLOSEF(1)
15220 CALL OPENF(1,SAM)
15230 CALL SETSCT(1,SECT10)
15232C***N INDICATES LAYER,L1 IS CONE INDEX,L2 IS RATING CONE***********
15240 DO 802 N=1,2
15250 DO803L=1,2
15260 D(L)=B(1,1,L)-B(1,2,L)
15270 E(L)=B(1,1,L)
15280 DO803I=2,12
15290 JTEMP=IMOD(I-1,L)
15300 TEMP=C1(I,N)
15310 IF(JTEMP)804,803,805
15320 805CONTINUE
15330 IF(JTEMP-1)804,806,807
15340 807CONTINUE
15350 IF(JTEMP-2)804,808,809
15360 808CONTINUE
15365C*****COMPUTE LN OF VARIABLE*****************************************
15370 TEMP=ALOG(TEMP)
15380 GOTO806
15390 809 IF(JTEMP-3)804,810,804
15395C*****COMPUTE LNLN OF VARIABLE***************************************
15400 810 TEMP=ALOG(ALOG(TEMP))
15410 GOTO806
15420 804 PRINT 34
15430 806 D(L)=D(L)+(B(I,1,L)-B(I,2,L))*TEMP
15440 E(L)=E(L)+B(I,1,L)*TEMP
15450 803CONTINUE
15460 NN=N
15465C*****COMPUTE A AND B OF STRENGTH EQUATION*************************
15470 DO802L=1,2
```

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Table B6 (concluded)

Listing of Subroutine STFRSP

```
15480 ABAR(L,N)=CON1(1,L)+(CON1(2,L)-CON1(1,L))*E(L)/D(L)
15490 BBAR(L,N)=(CON1(1,L)-CON1(2,L))/D(L)
15500 PRINT,"LAYER = ",N
15501 IF(L.EQ.2)GO TO 820
15502 PRINT,"     CONE INDEX EQ.  A= ",ABAR(L,N)
15504 PRINT,"                     B= ",BBAR(L,N)
15505 GO TO 830
15506 820 PRINT,"     RATING CONE EQ. A= ",ABAR(L,N)
15508 PRINT,"                     B= ",BBAR(L,N)
15510 830 STCON (1,NN)=ABAR(L,N)
15520 STCON(2,NN)=BBAR(L,N)
15530 NN=NN+2
15540 802 CONTINUE
15550 RETURN
15560 END
```

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Table B7

Listing of Subroutine CALSST

```
13000 SUBROUTINE CALSST
13010C*************  **
13015C*****COMPUTE CONE INDEX AND RATING CONE INDEX*************************
13016C*****FORMAT STATEMENTS*****************************************
13020 27 FORMAT(20X,23HIDENTIFICATION NUMBER: ,4A3)
13030 29 FORMAT(3A3)
13040 30 FORMAT(4(1H ,/))
13050 31 FORMAT(2X,3HDAY,24X 3A3,A1,X,2H19,I2)
13060 32 FORMAT(1X,I2,1H-,I2,4X,7F7.0)
13070 33 FORMAT(24X,15H0 - 15 CM LAYER,/)
13080 34 FORMAT(23X,16H15 - 30 CM LAYER,/)
13090 37 FORMAT(24X,14H0 - 6 IN LAYER,/)
13100 38 FORMAT(24X,15H6 - 12 IN LAYER,/)
13110 39 FORMAT(26X,10HCONE INDEX)
13120 40 FORMAT(23X,17HRATING CONE INDEX)
13130 41 FORMAT(2A3,1X,2A3,1X,2A3,1X,2A3)
13140 IF(IYR.GT.IBY)GO TO 750
13145C*****ADDITIONAL CONTROL INPUT TO DETERMINE SOIL STRENGTH REQUEST**
13150 PRINT,"DO YOU WANT CONE INDEX FOR FIRST SOIL LAYER?  SECOND LAYER?"
13160 PRINT,"RCI FOR FIRST LAYER?  SECOND LAYER?  SEPARATE ANSWERS"
13170 PRINT,"WITH COMMAS. EXAMPLE:FOR RCI ONLY FOR BOTH LAYERS;2,2,1,1"
13180 READ,(NSTEQ(I),I=1,4)
13190 PRINT,"ENTER NAMES OF SOIL STRENGTH FILES TO BE USED,ENTER"
13200 PRINT," NODATA IF A FILE IS NOT TO BE USED."
13210 PRINT,"EXAMPLE:FOR RCI FOR BOTH LAYERS;NODATA,NODATA,XX1001,XX2001"
13220 READ 41, NCILA1,NCILA2,NRCLA1,NRCLA2
13230 750 CONTINUE
13235C*****TEST OUTPUT CHECKS AND OPEN FILES*****************************
13240 DO 773 I=1,4
13250 IF(NSTEQ(I).EQ.2) GO TO 773
13260 IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 752
13270 IF(I.EQ.1)CALL OPENF(2,DCILA1)
13280 IF(I.EQ.1) CALL SETSCT(2,SECT5)
13290 IF(I.EQ.2)CALL OPENF(3,DCILA2)
13300 IF(I.EQ.2) CALL SETSCT(3,SECT6)
13310 IF(I.EQ.3) CALL OPENF(2,DRCLA1)
13320 IF(I.EQ.3) CALL SETSCT(2,SECT7)
13330 IF(I.EQ.4) CALL OPENF(3,DRCLA2)
13340 IF(I.EQ.4) CALL SETSCT(3,SECT8)
13350 752 XLIM1=STRLI(1,I)
13360 XLIM2=STRLI(2,I)
13370 DO 753 J=K,LK
13380 JB=1
13390 IF(J.EQ.IBM.AND.IYR.EQ.IBY)JB=IBD
13400 IF(J.EQ.NMAXD(1)) JEND=NMAXD(2)
13410 IF(J.EQ.NMAXD(1)) GO TO 754
13420 JEND=MAXD(J)
13430 754 CONTINUE
13440 DO 753 L=JB,JEND
13450 IF(I.EQ.2.OR.I.EQ.4)GO TO 755
13460 IF(STORMC(J,L).EQ.0.)STO(J,L)=0.
13470 IF(STORMC(J,L).EQ.0.) GO TO 753
13480 STO(J,L)=EXP(STCON(1,I)+STCON(2,I)*ALOG(STORMC(J,L)))
13490 IF(STO(J,L).GT.XLIM1)STO(J,L)=XLIM1
```

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Table B7 (continued)

Listing of Subroutine CALSST

```
13500 IF(STO(J,L).LT.XLIM2)STO(J,L)=XLIM2
13510 GO TO 753
13520 755 IF(STORMD(J,L).EQ.0.)STO(J,L)=0.
13530 IF(STORMD(J,L).EQ.0.)GO TO 753
13540 STO(J,L)=EXP(STCON(1,I)+STCON(2,I)*ALOG(STORMD(J,L)))
13550 IF(STO(J,L).GT.XLIM1)STO(J,L)=XLIM1
13560 IF(STO(J,L).LT.XLIM2)STO(J,L)=XLIM2
13570 753 CONTINUE
13580 IF(MOD(I,2).EQ.0) NO=3
13590 IF(MOD(I,2).EQ.0)GO TO 756
13600 NO=2
13605C*****WRITE HEADINGS*****************************************
13610 756 WRITE(NO,27) ISINUM
13620 IF(I.EQ.3.OR.I.EQ.4) GO TO 757
13630 WRITE(NO,39)
13640 IF(I.EQ.1)GO TO 758
13650 IF(MEAOU1.EQ.1)WRITE(NO,38)
13660 IF(MEAOU1.EQ.2)WRITE(NO,34)
13670 GO TO 759
13680 757 WRITE(NO,40)
13690 IF(I.EQ.3)GO TO 758
13700 IF(MEAOU1.EQ.1)WRITE(NO,38)
13710 IF(MEAOU1.EQ.2)WRITE(NO,34)
13720 GO TO 759
13730 758 IF(MEAOU1.EQ.1) WRITE(NO,37)
13740 IF(MEAOU1.EQ.2)WRITE(NO,33)
13750 759 WRITE(NO,30)
13760 DO 760 LOUT=K,LK
13770 JB=1
13780 IF(IBD.GT.1.AND.LOUT.EQ.IBM.AND.IYR.EQ.IBY)JB=IBD
13790 IDAB=1
13800 IDAE=7
13810 WRITE(NO,31)(IMOA(II,LOUT),II=1,4),IYR
13820 DO 761 NW=1,5
13830 IF(IYR.GT.IBY)GO TO 762
13840 INK=0
13850 IF(AJBN.GE.NW.AND.LOUT.EQ.IBM)GO TO 763
13860 IF(JB.EQ.1.OR.JBN.LT.(NW-1))GO TO 762
13865C*****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED******
13870 DO 764 NK=IDAB,IDAE
13880 INK=INK+1
13890 IF(STO(LOUT,NK).EQ.0.0)GO TO 764
13900 IND=60+INK-1
13910 JNK=NK
13920 JNI=LOUT
13930 STDN=1.
13940 CALL WRIBWK
13950 STDN=0.
13960 GO TO 763
13970 764 CONTINUE
13980 GO TO 763
13990 762 IF(LOUT.EQ.2.AND.NW.EQ.4)NW=NW+1
14000 IF(NW.EQ.5) IDAE=MAXD(LOUT)
14010 JN=JEND/7
```

2 of 4 sheets

Table B7 (continued)

Listing of Subroutine CALSST

```
14020 IF(LOUT.EQ.NMAXD(1).AND.JN.EQ.NW)IDAE=JEND
14025C*****WRITE DATA ON FILES*****************************************
14030 WRITE(NO,32) IDAB,IDAE,(STO(LOUT,JJ),JJ=IDAB,IDAE)
14040 IF(LOUT.EQ.NMAXD(1).AND.JN.EQ.NW)GO TO 765
14050 763 IDAB=IDAB+7
14060 761 IDAE=IDAE+7
14070 765 IF(LOUT.EQ.6.OR.LOUT.EQ.12) WRITE(NO,29)ISLEW
14080 IF(LOUT.LT.6.OR.LOUT.GT.6) GO TO 760
14090 IF(I.EQ.3.OR.I.EQ.4) GO TO 766
14095C*****WRITE MID-YEAR HEADINGS*****************************************
14100 WRITE(NO,27)ISINUM
14110 WRITE(NO,39)
14120 IF(I.EQ.1.AND.MEAOU1.EQ.1)WRITE(NO,37)
14130 IF(I.EQ.1.AND.MEAOU1.EQ.2)WRITE(NO,33)
14140 IF(I.EQ.2.AND.MEAOU1.EQ.1)WRITE(NO,38)
14150 IF(I.EQ.2.AND.MEAOU1.EQ.2)WRITE(NO,34)
14160 GO TO 767
14170 766 WRITE(NO,27)ISINUM
14180 WRITE(NO,40)
14190 IF(I.EQ.3.AND.MEAOU1.EQ.1)WRITE(NO,37)
14200 IF(I.EQ.3.AND.MEAOU1.EQ.2)WRITE(NO,33)
14210 IF(I.EQ.4.AND.MEAOU1.EQ.1)WRITE(NO,38)
14220 IF(I.EQ.4.AND.MEAOU1.EQ.2)WRITE(NO,34)
14230 767 WRITE(NO,30)
14240 760 CONTINUE
14250 IF(NEWFIL.EQ.1) GO TO 768
14260 IF(IYR.GT.IBY)GO TO 769
14270 768 IF(I-2) 770,771,772
14280 770 CALL SAVSCT(2,SECT5)
14290 CALL CLOSEF(2,DCILA1)
14300 GO TO 773
14310 771 CALL SAVSCT(3,SECT6)
14320 CALL CLOSEF(3,DCILA2)
14330 GO TO 773
14340 772 IF(I.GT.3) GO TO 774
14350 CALL SAVSCT(2,SECT7)
14360 CALL CLOSEF(2,DRCLA1)
14370 GO TO 773
14380 774 CALL SAVSCT(3,SECT8)
14390 CALL CLOSEF(3,DRCLA2)
14400 GO TO 773
14410 769 IF(I-2)775,776,777
14420 775 CALL SAVSCT(2,SECT5)
14430 CALL CLOSEF(2)
14440 GO TO 773
14450 776 CALL SAVSCT(3,SECT6)
14460 CALL CLOSEF(3)
14470 GO TO 773
14480 777 IF(I.GT.3)GO TO 778
14490 CALL SAVSCT(2,SECT7)
14500 CALL CLOSEF(2)
14510 GO TO 773
14520 778 CALL SAVSCT(3,SECT8)
14530 CALL CLOSEF(3)
```

3 of 4 sheets

Table B7 (concluded)

Listing of Subroutine CALSST

```
14540 773 CONTINUE
14550 NCILA1(2)=NMCLA1(2)
14560 NCILA2(2)=NMCLA1(2)
14570 NRCLA1(2)=NMCLA1(2)
14580 NRCLA2(2)=NMCLA1(2)
14590 NEWFIL=0
14595C*****TEST NEED FOR NEW CONTINUATION FILE*****************************
14600 IF(MOD(NY1SEQ,18).EQ.0)NEWFIL =1
14610 RETURN
14620 END
```

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APPENDIX C: INPUT DATA ORGANIZATION AND FORMAT

1. The format for preparing control and weather data on cards is described in this appendix (see Part III of the main report). Figure C1 shows the texture code for soils of the U. S. Department of Agriculture textural classification system that is entered on type 1 card (see fig. C6). Figure C2 shows a complete card deck setup; and figs. C3-C5 show the card deck setup for each of three examples illustrating the use of specific, surface composition group and estimated (tentative average) data, respectively.

2. Figures C6-C19 show the positions of the variables on each of the cards with a brief description of the variables. The decimal point as shown is preferred; however, it may appear anywhere in the area reserved for the variable. It should be remembered that the decimal point as entered takes precedence over the format call by the program. Double-headed arrows show the column limits of the area reserved for the variable. If there are no arrows, the variable must appear in that column only. A "Δ" indicates a space that must be left in the column.

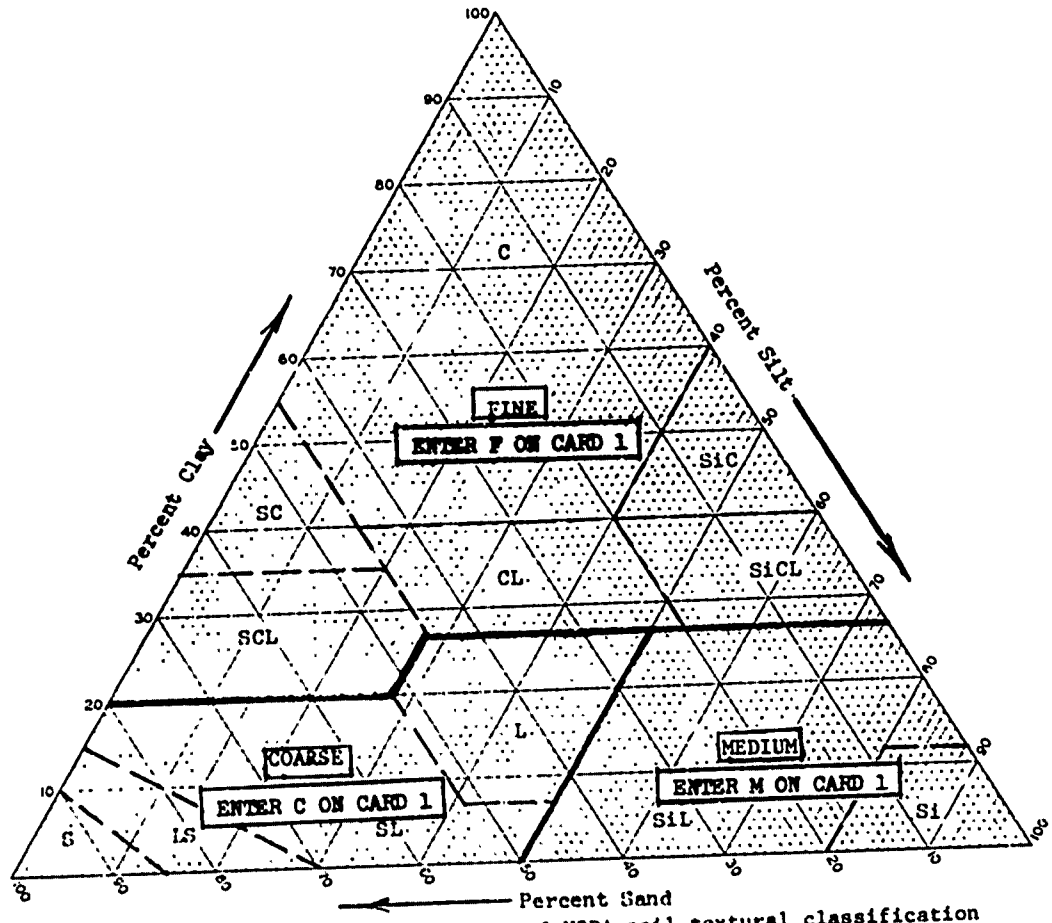
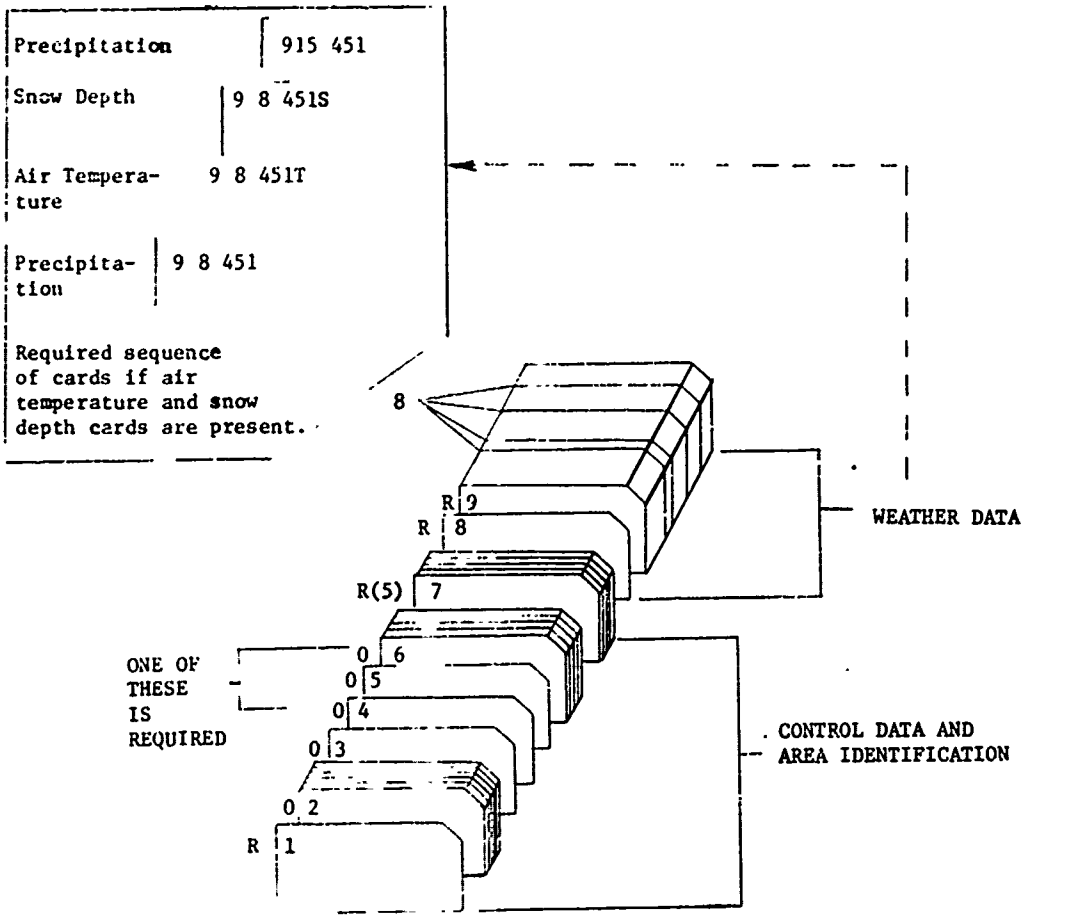
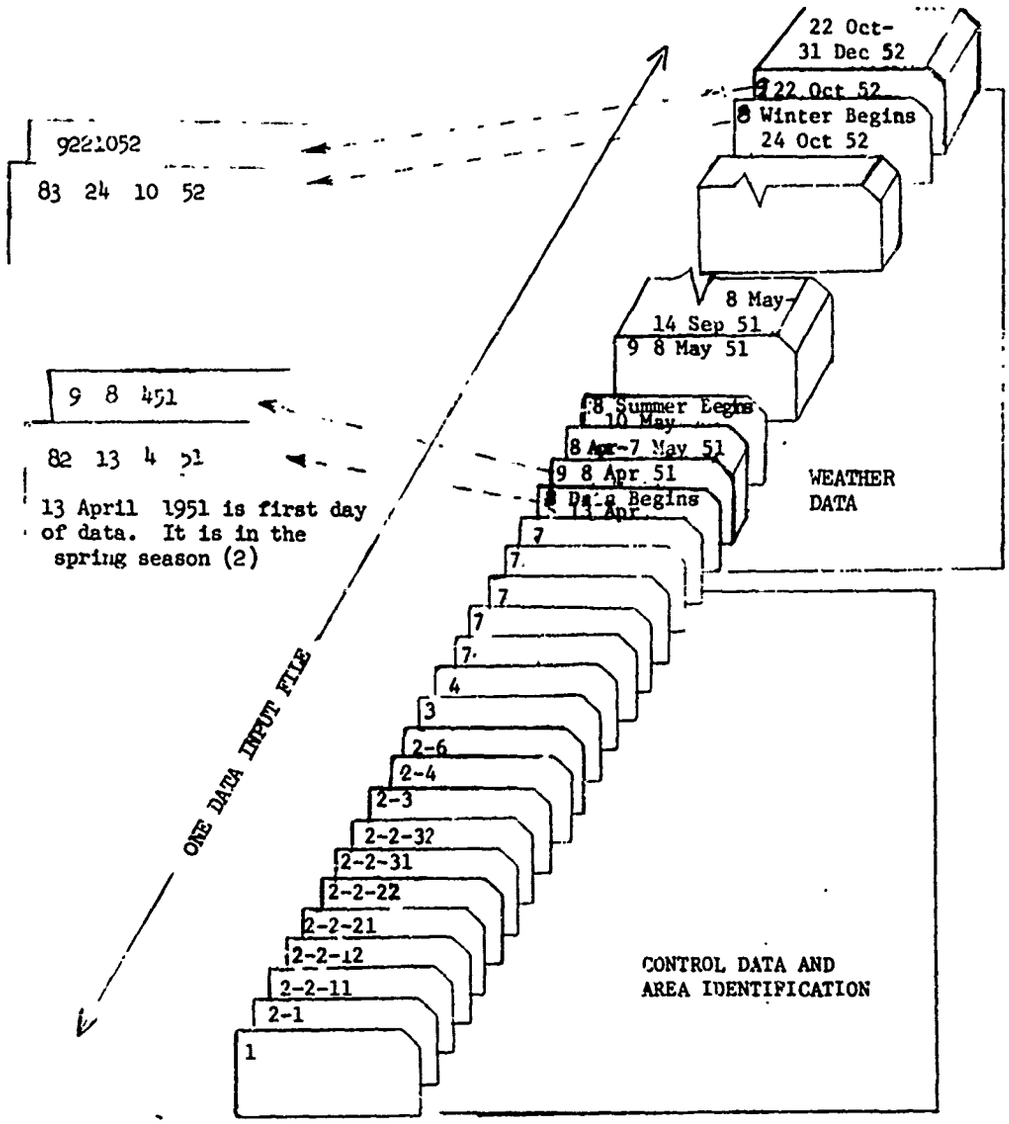


Fig. C1. Texture code for soils of USDA soil textural classification



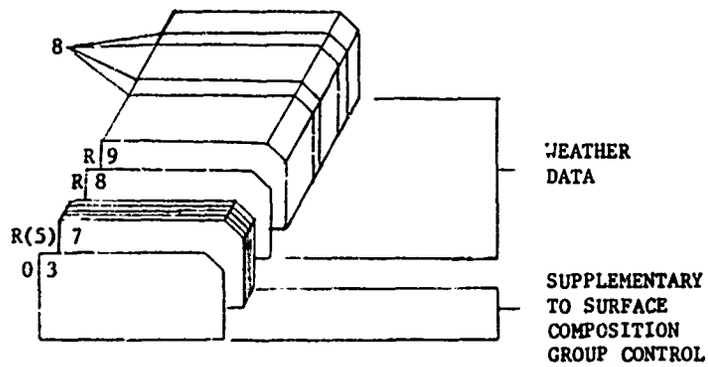
NOTE: R - REQUIRED IN PROGRAM
O - OPTIONAL IN PROGRAM

Fig. C2. Card deck setup for a time-sharing file



NOTE: These data can be entered by computer operator or by user through the teletype (keyboard or punched paper tape). One card corresponds to one line. An example using this setup is presented in Appendix E, Example 1.

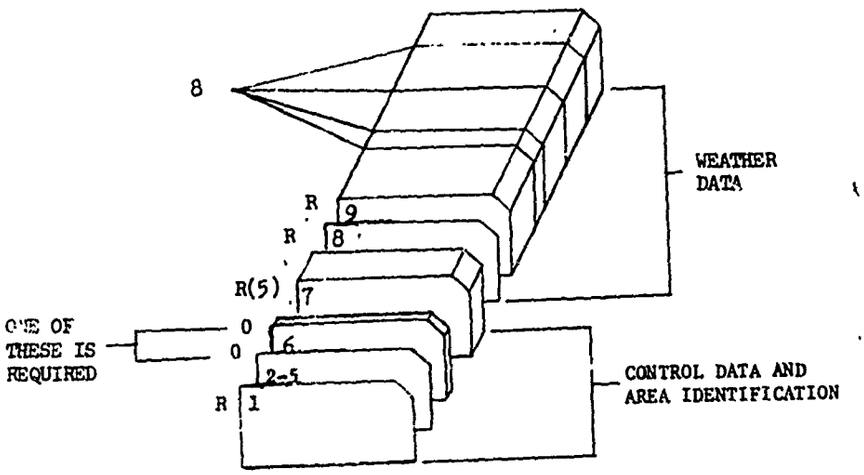
Fig. C3. Card deck setup using specific data



NOTE:
R - REQUIRED IN PROGRAM
O - OPTIONAL IN PROGRAM

An example using this setup is presented in Appendix E, Example 2.

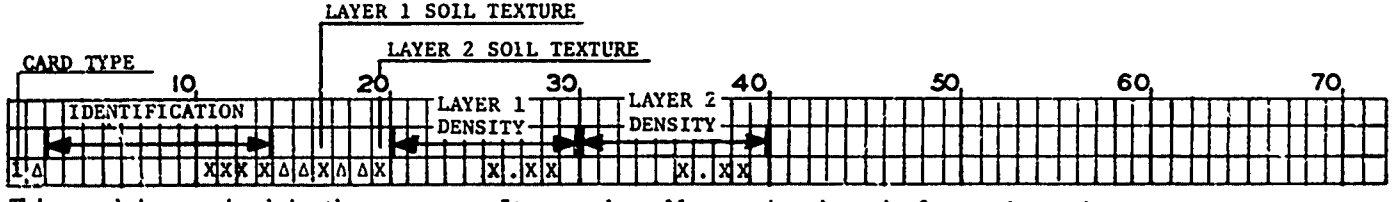
Fig. C4. Card deck setup using surface composition group data



NOTE:
R-REQUIRED IN PROGRAM
O-OPTIONAL IN PROGRAM

An example using this setup is presented in Appendix E, Example 3.

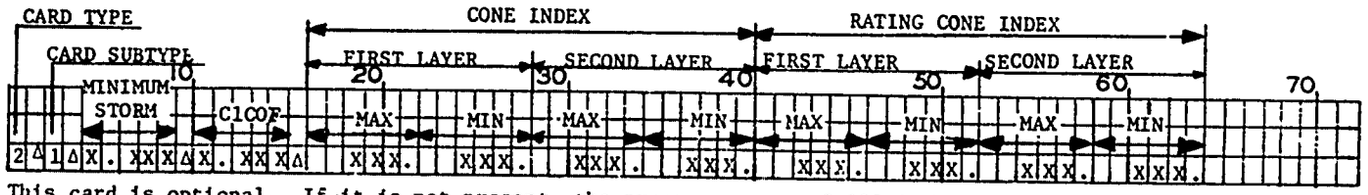
Fig. C5. Card deck setup using estimated (tentative average) data



This card is required in the program. It precedes all associated cards for a given site.

COLUMN	CONTENTS
1	1
3-14	Alphanumeric identification. Last four characters must be numeric.
17	Layer 1 texture code. Select one of following codes from USDA textural triangle (fig. C1). F for fine (clay) M for medium (silt) C for coarse (sand)
20	Layer 2 texture code (code is same as for layer 1).
21-30	Layer 1 dry density (g/cc). Enter to two decimal places.
31-40	Layer 2 dry density (g/cc). Enter to two decimal places.

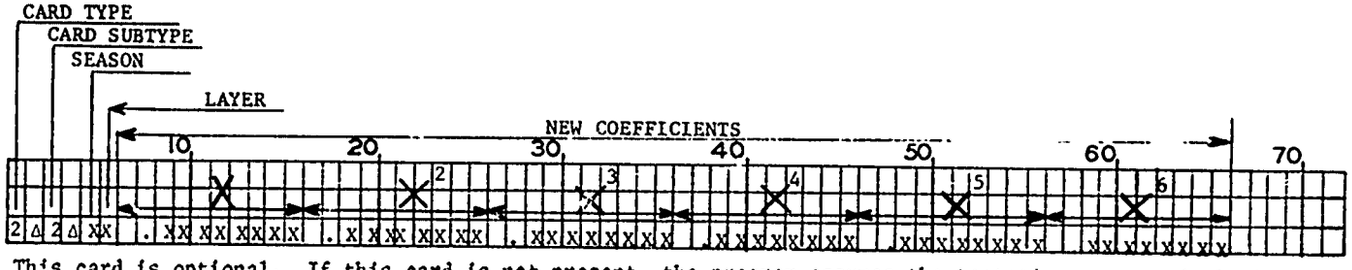
Fig. C6. Type 1 Card - Site Identification, Soil Texture and Soil Density



This card is optional. If it is not present, the program assumes 0.100 inches for minimum precipitation; 750 maximum CI and 0 minimum CI for layers one and two; 300 maximum RCI and 0 minimum RCI for both layers. If this card is used it must be filled completely as indicated.

COLUMN	CONTENTS
1	2
3	1
5-9	Minimum storm (in. or cm). Enter with three decimal places.
11-15	C1COF. Accretion value at which accretion-precipitation relation changes to one-to-one relation.
17-22	Layer 1 maximum CI
23-28	Layer 1 minimum CI
29-34	Layer 2 maximum CI
35-40	Layer 2 minimum CI
41-46	Layer 1 maximum RCI
47-52	Layer 1 minimum RCI
53-58	Layer 2 maximum RCI
59-64	Layer 2 minimum RCI

Fig. C7. Type 2-1 Card - Minimum Precipitation and Limits of Cone Index and Rating Cone Index

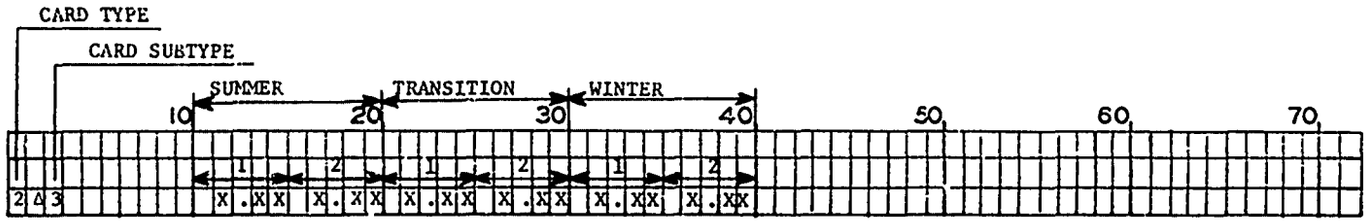


This card is optional. If this card is not present, the program assumes the tentative average depletion equation coefficients (table 4 of main text) are applicable. Negative coefficients must include the sign in the space allowed for that variable. The number of decimal places is optional. The decimal point must be entered. Separate cards must be filled out for each layer and each season.

COLUMN	CONTENTS
1	2
3	2
5	Code for season 1 for summer 2 for transition (spring or fall) 3 for winter
6	Soil layer (1 or 2)
7-16	Coefficient of X term
17-26	Coefficient of X^2 term
27-36	Coefficient of X^3 term
37-46	Coefficient of X^4 term
47-56	Coefficient of X^5 term
57-66	Coefficient of X^6 term

If a term is not used a zero must be entered as the coefficient. "X" is the difference between present moisture content and the minimum moisture content. This is calculated daily by the program.

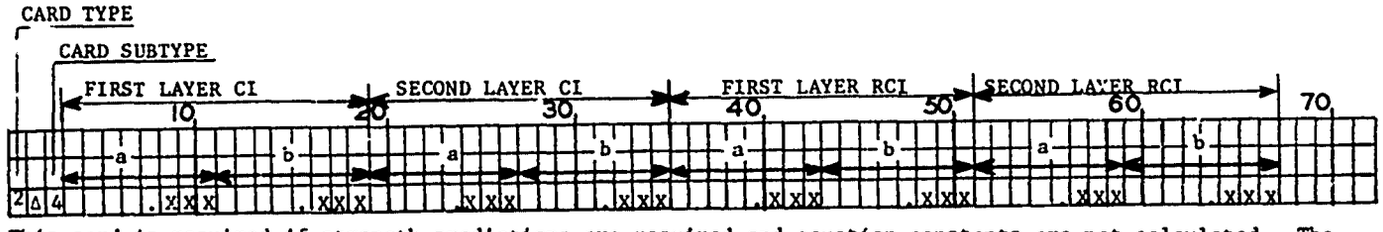
Fig. C8. Type 2-2 Card - Depletion Equation Coefficients



This card is required if card 2-2 is present. Data on the card includes the soil moisture content maximum to minimum range by layers for each season. For example, the first surface composition group, 0505, has maximum and minimum moisture contents of 1.04 and 0.05 in. respectively for the first layer (see line 511 of table D1). Therefore, the range for the driest season (summer) is 0.99 in. Ranges for the transition and winter are 0.80 in. and 0.43 in., respectively (see line 509 of table D1).

COLUMN	CONTENTS
1	2
3	3
11-15	Summer layer 1 moisture range for relation on card 2-2
16-20	Summer layer 2 moisture range for relation on card 2-2
21-25	Transition layer 1 moisture range for relation on card 2-2
26-30	Transition layer 2 moisture range for relation on card 2-2
31-35	Winter layer 1 moisture range for relation on card 2-2
36-40	Winter layer 2 moisture range for relation on card 2-2

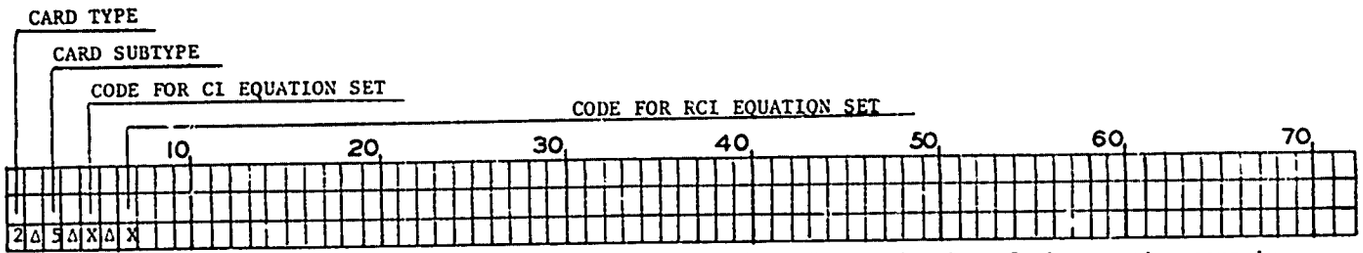
Fig. C9. Type 2-3 Card - Range of Soil Moisture Contents



This card is required if strength predictions are required and equation constants are not calculated. The decimal point may appear anywhere in the eight spaces allocated to the constant. Terms a and b listed below are used in strength equations discussed in paragraph 51 of the main text.

COLUMN	CONTENTS
1	2
3	4
4-11	Term a in layer 1 CI equation
12-19	Term b in layer 1 CI equation
20-27	Term a in layer 2 CI equation
28-35	Term b in layer 2 CI equation
36-43	Term a in layer 1 RCI equation
44-51	Term b in layer 1 RCI equation
52-59	Term a in layer 2 RCI equation
60-67	Term b in layer 2 RCI equation

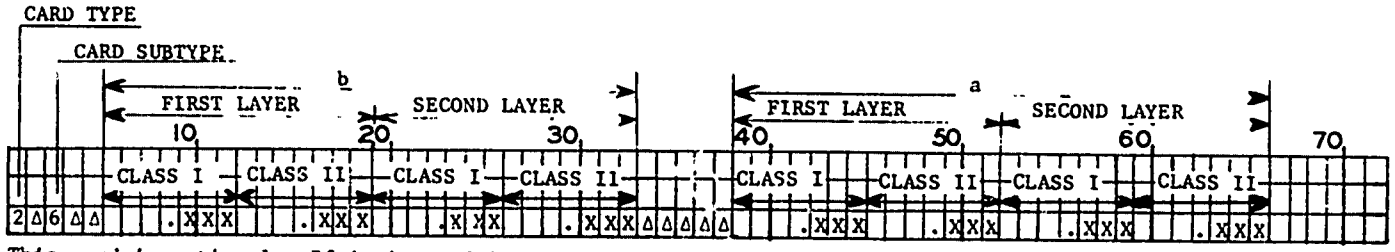
Fig. C10. Type 2-4 Card - Strength Equation Constants



This card is required if strength equation constants are to be calculated. One of six equation sets is required to calculate a and b of CI equations and one of six sets is required to calculate a and b of RCI equations. The equation sets relate various combinations of soil properties to soil strength (see paragraphs 53-56 of main text and fig. C16-a). A listing of these equation sets is given in table D2.

COLUMN	CONTENTS
1	2
3	5
5	Code (1-6) of equation set computing CI constants
7	Code (1-6) of equation set computing RCI constants

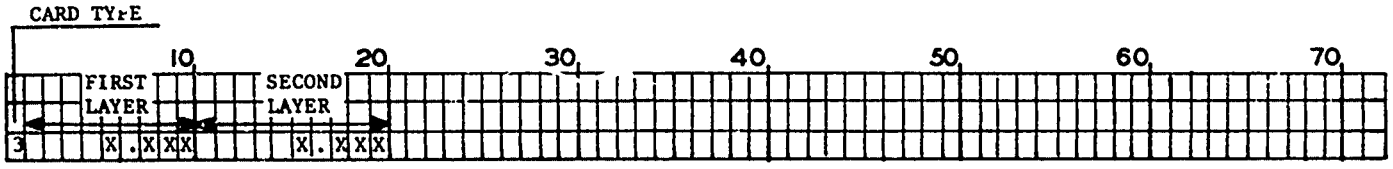
Fig. C11. Type 2-5 Card - Codes for Equations used in Calculating Strength Equation Constants



This card is optional. If it is used it must be filled completely as indicated. The equation form must be $\hat{Y} = bX + a$.

COLUMN	CONTENTS
1	2
3	6
6-12	Coefficient of variable for Class I, layer 1 equation
13-19	Coefficient of variable for Class II, layer 1 equation
20-26	Coefficient of variable for Class I, layer 2 equation
27-33	Coefficient of variable for Class II, layer 2 equation
39-45	Constant term of variable for Class I, layer 1 equation
46-52	Constant term of variable for Class II, layer 1 equation
53-59	Constant term of variable for Class I, layer 2 equation
60-66	Constant term of variable for Class II, layer 2 equation

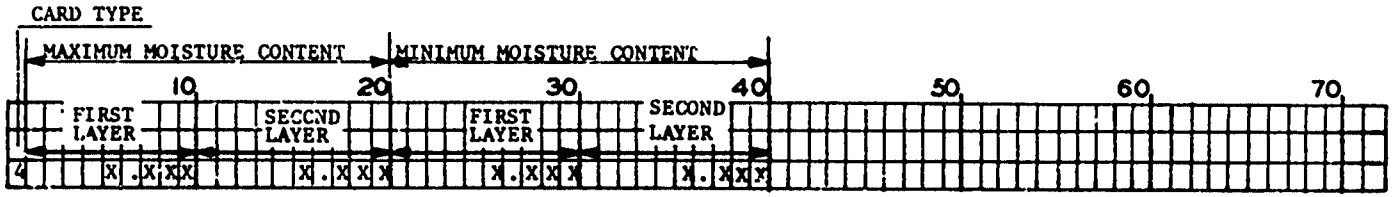
Fig. C12. Type 2-6 Card - New Accretion Equation Constants



This card is optional. If this card is not present, the maximum moisture content is used as the beginning moisture content.

COLUMN	CONTENTS
1	3
2-10	Layer 1 beginning soil moisture content (in. or cm)
11-20	Layer 2 beginning soil moisture content (in. or cm)

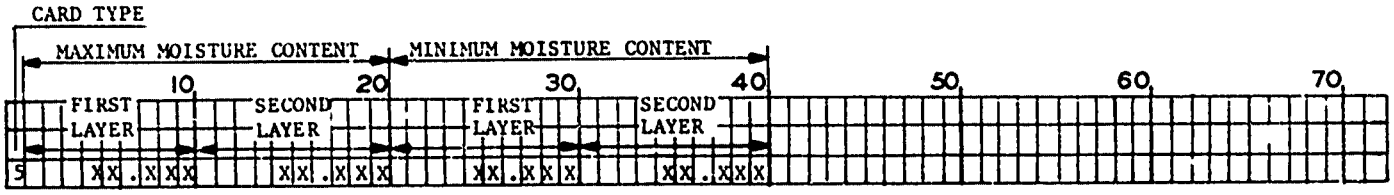
Fig. C13. Type 3 Card - Beginning Soil Moisture Content



This card is required if card type 5 or 6 is not present. The maximum and minimum soil moisture contents establish the limits of the moisture variable against which each new moisture content prediction is checked.

COLUMN	CONTENTS
1	4
2-10	Layer 1 maximum moisture content (in. or cm)
11-20	Layer 2 maximum moisture content (in. or cm)
21-30	Layer 1 minimum moisture content (in. or cm)
31-40	Layer 2 minimum moisture content (in. or cm)

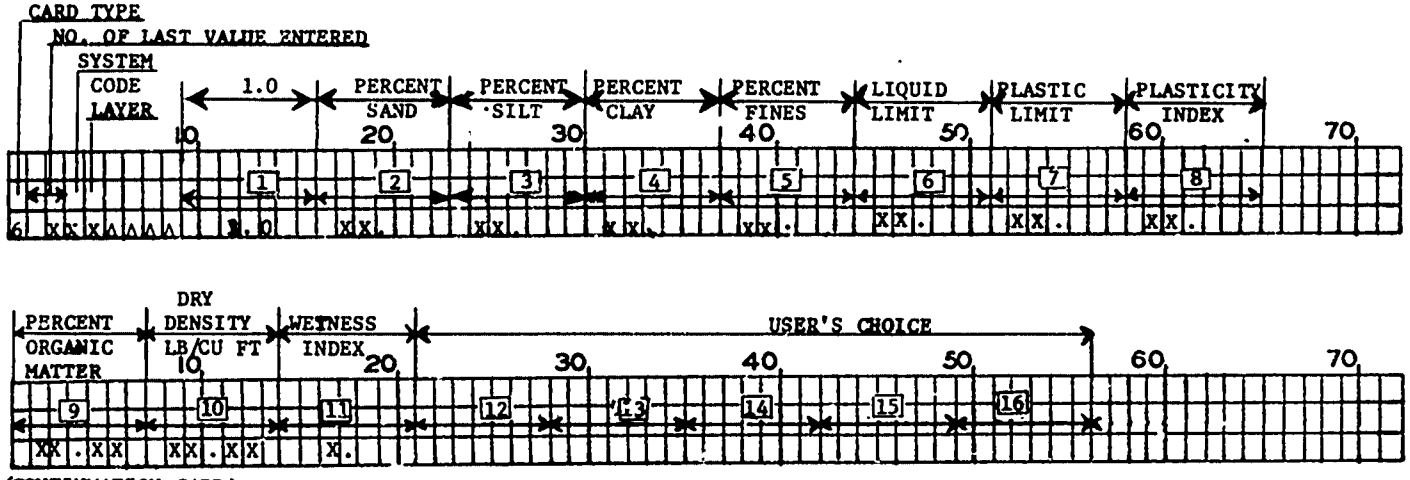
Fig. C14. Type 4 Card - Maximum and Minimum Soil Moisture Contents in Measurement Unit



This card is required if card type 4 or 6 is not present. The program accepts the moisture content in percent, then converts the values to inches for use in calculations.

COLUMN	CONTENTS
1	5
2-10	Maximum moisture content in percent for layer 1
11-20	Maximum moisture content in percent for layer 2
21-30	Minimum moisture content in percent for layer 1
31-40	Minimum moisture content in percent for layer 2

Fig. C15. Type 5 Card - Maximum and Minimum Soil Moisture Contents in Percent



(CONTINUATION CARD)

This type card is required if maximum and minimum moisture contents or strength equation constants (a and b of an intercept, slope in equation) are to be computed. All type 6a cards must precede type 6b cards. The continuation card is not required if values of soil properties on this card are not required.

Soil property values must be entered in the order shown. Values for 15 soil properties may be entered.

A zero must be entered for properties not included in the equation up to the last property value in the equation (see the control input for table E11 in Appendix E).

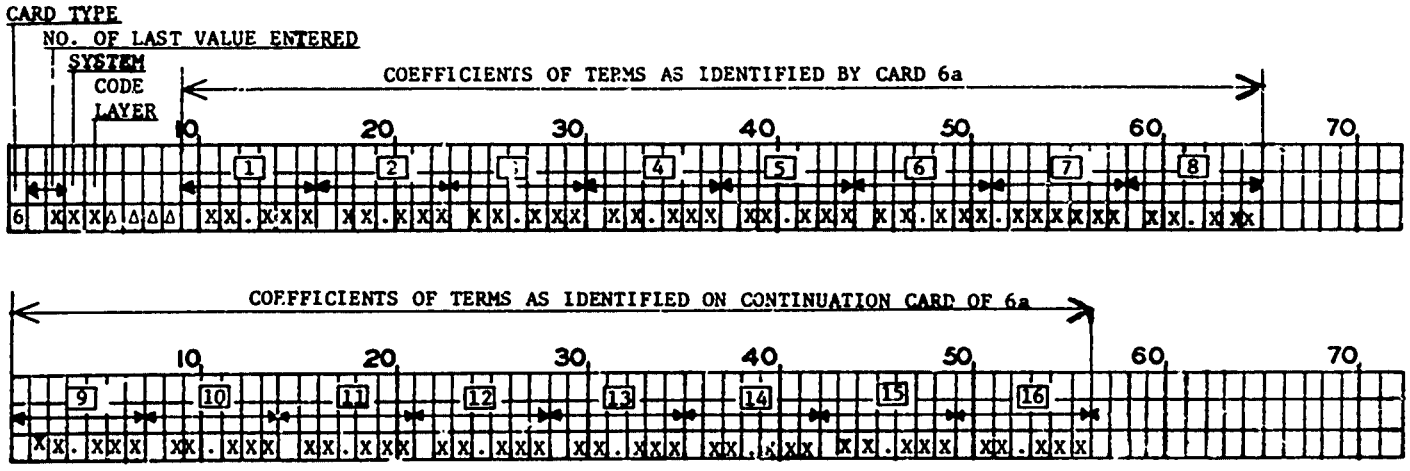
Fig. C16a. Type 6a Card - Soil Property Values

1 of 2 sheets

COLUMN (First Card)	CONTENT
1	6
2-3	Number of the last variable entered as prescribed by the order on the layout above
4	Code for soil classification system 1. USCS 2. USDA
5	Soil layer 1. Layer 1 2. Layer 2
10-16	1.0
17-23	Percent sand
24-30 ⋮ 59-65	Value of appropriate soil property
(Continuation Card)	
1-7	Percent organic matter
8-14	Dry density, lb/cu ft
15-21	Wetness index
22-28 ⋮ 49-56	Values of other appropriate soil properties in the equation required by user

Fig. C16a. (concluded)

2 of 2 sheets



(CONTINUATION CARD)

This type card is required only if user is estimating maximum and minimum moisture contents using soil property values entered on type 6a cards. The decimal point must be included in the space reserved for constant or coefficient as indicated. Cards of this type must be preceded by type 6a cards. The items on type 6b cards are in the same order as those on card type 6a, i.e., the value of clay is in the fourth position on type 6a cards and the coefficient for use with the clay term in the equation is in the fourth position on type 6b cards.

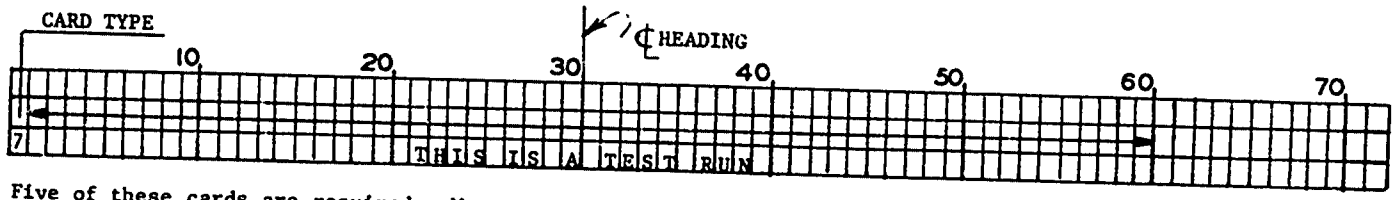
Also, similar to instructions for type 6a cards, a zero must be entered for properties not included in the equation up to the last property value in the equation; the continuation card is not required if coefficients of soil properties on this card are not required.

Fig. C16b. Type 6b Card - Maximum and Minimum Moisture Equation Coefficients

1 of 2 sheets

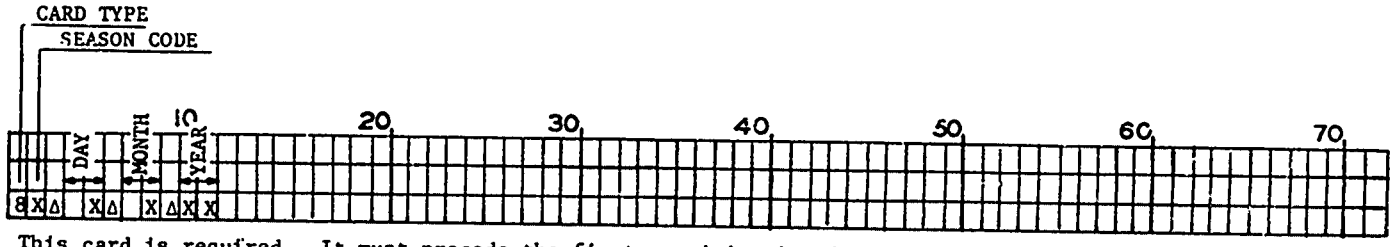
COLUMN	CONTENTS
(First Card)	
1	6
2-3	Number of the last coefficient entered as prescribed by the order on the layout above.
4	Code for soil classification system 1. USCS 2. USDA
5	Code for maximum or minimum equation 1. Maximum for layer 1 2. Maximum for layer 2 3. Minimum for layer 1 4. Minimum for layer 2
10-16	Constant term in the equation
17-23	Coefficient of sand term in the equation. If sand term is not used in the equation, enter 0.0
24-30	Coefficient of silt term in the equation. If silt term is not used and the preceeding term is not the last term in the equation enter 0.0
31-37 ⋮ 59-65	Coefficients of other soil property terms in the equation
(Continuation Card)	
1-7	Coefficient of organic matter term in the equation
8-14	Coefficient of dry density term in the equation
15-21	Coefficient of wetness index
22-28 ⋮ 49-56	Coefficients of other appropriate soil property terms in the equation

Fig. C16b. (concluded)



Five of these cards are required. Memory storage is available for only one line of heading; therefore, the card is read and immediately written into the proper output files. The next heading card is read into the same memory location thus overlaying the first. All but the first heading card are read without testing card type. For this reason there must be exactly five of these heading cards.

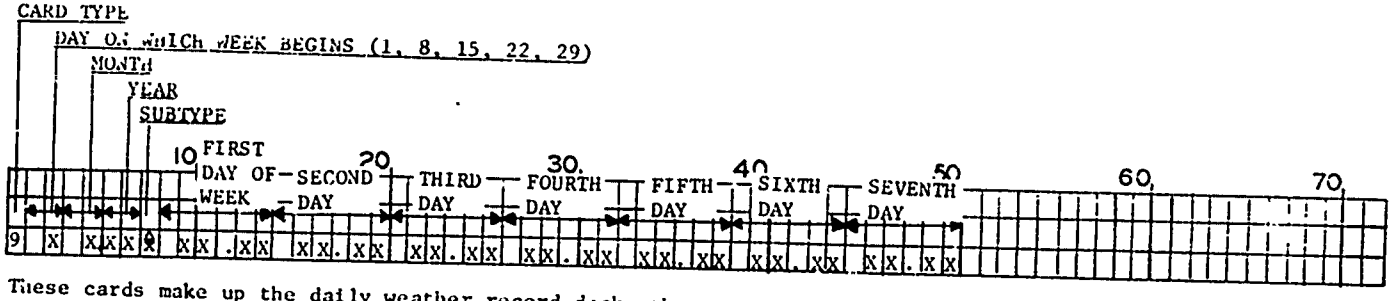
Fig. C17. Type 7 Card - Heading Information



This card is required. It must precede the first precipitation data card (type 9) and carry the date of the first day of data. For each new season, a similar card, carrying the date of season change, is entered preceding the precipitation card containing that date. (A precipitation card contains seven days of precipitation record.) For example, a card with the season beginning on the twelfth of October would be placed immediately before the precipitation card beginning on October eighth.

COLUMN	CONTENTS
1	8
2	Season code
	1 summer
	2 transition
	3 winter
4-5	Day of month (1-31) that season begins
7-8	Month of year (1-12) that season begins
10-11	Last two digits of year of record

Fig. C18. Type 8 Card - Season Beginning Date



These cards make up the daily weather record deck; the precipitation subtype cards are required, whereas the air temperature and snow depth subtype cards are optional.

Each card contains the date, the type of weather data, and a one week record of data. For convenience in programming, each month (except February) is considered to have five weeks beginning on days 1, 8, 15, 22, and 29. The 29th of February on leap year is deleted from the record and any precipitation recorded on that day is added to either of, or prorated between, the adjoining days. A code, 99.99, following the last day of data indicates the data ends before 31 December.

If data begins on a day other than 1, 8, 15, 22, or 29, a code (77.77) is entered on each day preceding the beginning day (see weather input listing, table E1 of Appendix E).

Precipitation is entered in inches or centimeters to two decimal places. Air temperature is entered in degrees centigrade to one decimal place. Snow depth is entered in meters to two decimal places.

Column	Contents
1	9
2-3	Day of the month (1, 8, 15, 22, 29) indicating the beginning of a week (right justified)
4-5	Month of the year (1-12, right justified)
6-7	Last two digits of the year
8	Code for subtype Δ (blank) - precipitation T - air temperature S - snow depth on the ground
9-14	Precipitation, air temperature, or snow depth on day 1
15-20 ⋮ 45-50	Same type data as 9-14 for days 2 through 7

Fig. C19. Type 9 Card - Precipitation, Air Temperature, and Snow Depth

APPENDIX D: STORED INPUT DATA FILE LISTINGS

1. This appendix includes listings of two files containing control information for the surface composition groups and tentative average soil strength relations, respectively. Table D1, file "DSURGR", contains the required control data input to the program for each of the surface composition groups. The first set of figures on each line is the line number. The remainder of the line follows the organization of input data as described in Appendix C. For example, on the first line, 501, the first number, 1, identifies card type 1 with the following information: the surface composition group is 0505; the two "C's" indicate a storage location within the program for holding the depletion equation coefficients for the two soil layers. The remaining two values, 1.50 and 1.50, are the soil densities for the two layers.

2. Table D2, file DFSTEQ, contains data for the variables in the tentative average soil strength relations. The information to the left of the line number is not in the file. It is included for identification of the information only and matches the number of the equation set as defined in tables 6 and 7 of the main text. The numbers on the first line of each set to the right of the line number identify the form for each of the variables required in the two equations of the set. For example, equation set 4 for RCI (table 7, main text) provides data on variables for liquid limit and plastic limit, respectively. (The data, soil property values, are input on card 6, see fig. C16a, Appendix C.) On line 370 of the file a 3 in the fifth slot indicates the ln ln form for liquid limit and a 1 in the sixth slot indicates the natural form for

plastic limit. Zeros for the other variables indicate that they are not used in the equation. The appropriate sets of equations are identified by numbers 1-6 entered on card 2-5 illustrated in fig. C11, Appendix C. Line 380 of file DFSTEQ contains the constants of the equation for calculating the moisture content of a soil with an RCI of 100 when the liquid and plastic limits are known. In this case, the equation is:

$$\hat{MC} \text{ (of a soil with an RCI of 100)} = 0.783718 + 1.498687\ (\ln\ln LL) + 0.026353(PL)$$

Table D1

FILE - DSURGR

```
501 1          0505  C  C       1.50       1.50
502 2 1     .1  0.07   200.    75.     0.     0.     0.     0.     0.     0.
503 2 2     11  0.110707-0.0231589 -0.105756  0.141049        0.0        0.0
504 2 2     12  0.100238 0.0238269 -0.363323  0.363148        0.0        0.0
505 2 2     21 0.0501935  0.212765 -0.707042  0.618552        0.0        0.0
506 2 2     22 0.0969137 -0.253245  0.367966 0.0206268        0.0        0.0
507 2 2     31  0.152511 -0.859015   3.01405  -2.66872        0.0        0.0
508 2 2     32 0.0622643  0.817522  -3.81712   6.40615        0.0        0.0
509 2 3          .99  .99  .80  .68  .43  .35
510 2 4   3.987   0.815   0.       0.       0.       0.       0.       0.
511 4   1.04      1.08      0.05      0.09
601 1          0606  C  C       1.55       1.65
602 2 1     .1  0.07   750.     0.  750.     0.  300.     0.  300.     0.
603 2 2     11  0.146609 -0.149675 0.0626695-.00911799        0.0        0.0
604 2 2     12  0.137576 -0.217303  0.141294  -0.03234        0.0        0.0
605 2 2     21   0.09387-0.0846743 0.01983610.00216961        0.0        0.0
606 2 2     22 0.0949594 -0.196022  0.181068 -0.061218        0.0        0.0
607 2 2     31  0.164312 -0.417828  0.429489 -0.154277        0.0        0.0
608 2 2     32  0.118524 -0.376805  0.525502 -0.271716        0.0        0.0
609 2 3        1.92 1.72 1.68 1.16 1.09  .60
610 2 4  15.864  -3.759  10.237  -1.889  15.864  -3.759  10.237  -1.889
611 4   2.42      2.26      0.50      0.54
626 1          0610  C  C       1.55       1.29
627 2 1     .1  0.07   750.     0.  750.     0.  300.     0.  300.     0.
628 2 2     11   .146609  -.149675  .0626695-.00911799 0.0        0.0
629 2 2     12   .151167  -.161474  .0633498-.00672157 0.0        0.0
630 2 2     21   .09387  -.0846743  .0198381 .00216961 0.0        0.0
631 2 2     22   .099932  -.150325  .0819444-.0106633  0.0        0.0
632 2 2     31   .164312  -.417828  .429469 -.154277   0.0        0.0
633 2 2     32  .0436099   .527193  -2.32341  2.41855  0.0        0.0
634 2 3        1.92 1.68 1.68 1.11 1.09  .53
635 2 4  15.864  -3.759  13.641  -2.417  15.864  -3.759  13.641  -2.417
637 4   2.42      3.08      0.50      1.40
```

1 of 4 sheets

Table D1 (continued)

FILE - DSURGR

```
701 1          0707  C  C       1.55       1.65
702 2 1     .1  0.07    750.     0.   750.     0.   300.     0.   300.     0.
703 2 2     11  0.120502-0.0524178-.00284354 0.0259163        0.0        0.0
704 2 2     12  0.090336 0.0509247 -0.358181  0.327398        0.0        0.0
705 2 2     21 0.0309516  0.176284 -0.320559  0.172292        0.0        0.0
706 2 2     22 0.0999866 -0.312412  0.541498 -0.174273        0.0        0.0
707 2 2     31  0.147569 -0.392467  0.832866 -0.532128        0.0        0.0
708 2 2     32  0.033461   0.95145  -2.92207   3.30366        0.0        0.0
709 2 3         1.45 1.03 1.21 0.74 0.62 0.36
710 2 4  15.864  -3.759  10.237  -1.889  15.864  -3.759  10.237  -1.889
711 4   1.95       1.57       0.50       0.54
726 1          0711  C  C       1.55       1.46
728 2 1     .1  0.07    750.     0.   750.     0.   300.     0.   300.     0.
730 2 2     11  0.120502-0.0524178-.00284354 0.0259163        0.         0.
732 2 2     12  .0363197    .418133  -.731765  .35784        0.0        0.0
734 2 2     21 0.0309516  0.176284 -0.320559  0.172292        0.0        0.0
736 2 2     22-0.0171618  0.448802 -0.752844  0.381092        0.0        0.0
738 2 2     31  0.147569 -0.392467  0.832868 -0.532128        0.         0.
740 2 2     32 0.0616587   0.51296  -2.24252   2.69611        0.0        0.0
742 2 3         1.45 1.28 1.21 1.10 0.62 0.54
744 2 4  15.864  -3.759  15.008  -3.193  15.864  -3.759  14.958  -3.254
746 4   1.95       2.28       0.50       1.00
801 1          0808  C  C       1.34       1.41
802 2 1     .1  0.07    750.     0.   750.     0.   300.     0.   300.     0.
803 2 2     11   .124665 -.0915969  .0233589 -.0011482 0.0        0.0
804 2 2     12   .110878 -.10916    .0435618-.00601796 0.0        0.0
805 2 2     21  .0764369 -.0803309  .0347412-.00512833 0.0        0.0
806 2 2     22   .077366 -.120503   .0779171 -.0177912 0.0        0.0
807 2 2     31   .197605 -.78094   1.26458   -.718446  0.0        0.0
808 2 2     32   .109453 -.457144   .763806  -.441766  0.0        0.0
809 2 3         2.25 2.10 1.64 1.28  .70  .71
810 2 4  13.074  -2.534  13.585  -2.534  12.843  -2.614  12.821  -2.546
811 4   2.90       2.80       0.65       0.70
```

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Table D1 (continued)

FILE - DSURGR

```
901 1          0909  C  C       1.34       1.41
902 2 1     .1  0.07   750.     0.  750.     0.  300.     0.  300.     0.
903 2 2      11   .129208 -.0116793 -.0589193  .0260517 0.0        0.0
904 2 2      12  .0536875  .116592  -.184512   .0701473 0.0        0.0
905 2 2      21  .0415562  .0830014 -.175168   .0904789 0.0        0.0
906 2 2      22   .142549 -.314464   .29825   -.0911122 0.0        0.0
907 2 2      31   .110865  .759634 -4.75675   6.77918   0.0        0.0
908 2 2      32   .121556 -.673037  3.40772  -5.42114   0.0        0.0
909 2 3        2.0   1.70 1.39 1.15  .45  .31
910 2 4  13.074  -2.534  13.585  -2.534  12.843  -2.614  12.821  -2.546
911 4   2.65      2.40      0.65      0.70
926 1          0911  C  C       1.34       1.46
927 2 1     .1  0.07   750.     0.  750.     0.  300.     0.  300.     0.
928 2 2      11   .129208 -.0116793 -.0589193  .0260517 0.0        0.0
929 2 2      12  .0363197  .418133  -731765    .35784   0.0        0.0
930 2 2      21  .0415562  .0830014 -.175168   .0904789 0.0        0.0
931 2 2      22 -.0171616  .448802  -.752844   .381092  0.0        0.0
•932 2 2      31   .110865  .759634 -4.75675   6.77918   0.0        0.0
933 2 2      32  .0616587  .51296  -2.24252   2.69611   0.0        0.0
934 2 3        2.00 1.28 1.39 1.10  .45  .54
935 2 4  13.074  -2.534  15.008  -3.193  12.843  -2.614  14.958  -3.254
937 4   2.65      2.28      0.65      1.00
1001 1          1010  C  C       1.26       1.29
1002 2 1     .1  0.07   750.     0.  750.     0.  300.     0.  300.     0.
1003 2 2      11  0.184265 -0.165133 0.0458207-.00083453       0.0       0.0
1004 2 2      12  0.151167 -0.161474 0.0633498-.00672157       0.0       0.0
1005 2 2      21 0.0784167-0.0366654-0.01327750.00892756       0.0       0.0
1006 2 2      22  0.099932 -0.150325 0.0819444-0.0106633       0.0       0.0
1007 2 2      31  0.116053 -0.173597  0.104796-0.0218575       0.0       0.0
1008 2 2      32 0.0436099  0.527193  -2.32341   2.41855       0.0       0.0
1009 2 3        1.95 1.68 1.71 1.11 1.40 0.53
1010 2 4  13.130  -2.417  13.641  -2.417  13.130  -2.417  13.641  -2.417
1011 4   3.10      3.08      1.15      1.40
```

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Table D1 (concluded)

FILE - DSURGR

```
1101 1          1111  C  C       1.38       1.46
1102 2 1     .1  0.07   750.     0.  750.     0.  300.     0.  300.     0.
1103 2 2     11 0.0985818  0.121609  -0.15411 0.0521654        0.0        0.0
1104 2 2     12 0.0363197  0.418133 -0.731765   0.35784        0.0        0.0
1105 2 2     21  0.139897 -0.233305  0.285204-0.0979788        0.0        0.0
1106 2 2     22-0.0171618  0.448802 -0.752844  0.381092        0.0        0.0
1107 2 2     31 0.0742744 0.0324442 -0.129626  0.105992        0.0        0.0
1108 2 2     32 0.0616587   0.51296  -2.24252   2.69611        0.0        0.0
1109 2 3         1.64 1.28 1.44 1.10 1.03 0.54
1110 2 4  14.024  -2.903  15.008  -3.193  13.517  -2.823  14.958  -3.254
1111 4   2.44      2.28      0.80      1.00
1301 1          1313  C  C       0.80       0.80
1302 2 1     .1  0.07   750.     0.  750.     0.  300.     0.  300.     0.
1303 2 2     11  .0914088  -.127858   .097528 -.0258745 0.0        0.0
1304 2 2     12  .0920077  -.133981  .0889643 -.0208478 0.0        0.0
1305 2 2     21  .0910546  -.164201   .126329 -.0330897 0.0        0.0
1306 2 2     22  .0735553  -.154462   .139078 -.0429461 0.0        0.0
1307 2 2     31  .0997909  -.310384   .412761 -.188311  0.0        0.0
1308 2 2     32  .083431   -.406992   .856876 -.618321  0.0        0.0
1309 2 3         1.80 1.80 1.34 1.20 0.92 0.60
1310 2 4  16.478  -2.870  16.478  -2.870  16.255  -2.870  16.255  -2.870
1311 4   4.32      4.32      2.52      2.52
```

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Table D2

File DFSTEQ

	Description of File Data		Line No.	File Data
CI 1	VARIABLE MOD. CODE*		00100	1,2,2,0,0,0,0,0,0,0,0,0
		200	00110	4.058688,-.015583,-.133208,-.005868,0,0,0,0,0,0,0,0
		300	00120	3.408689,-.018647,-.087059,.06774,0,0,0,0,0,0,0,0
CI 2	VARIABLE MOD. CODE		00130	0,0,0,1,3,3,1,0,0,0,0,0
		200	00140	1.289572,0,0,0,.008378,-0.093638,2.073866,.009393,0,0,0,0
		300	00150	.649613,0,0,0,.012876,-0.727161,1.673019,.009355,0,0,0,0
CI 3	VARIABLE MOD. CODE		00160	0,0,0,0,3,3,1,0,0,0,0,0
		200	00170	1.002382,0,0,0,0,-.171477,1.975720,.006373,0,0,0,0
		300	00180	.208219,0,0,0,0 .690143,1.522174,.004713,0,0,0,0
CI 4	VARIABLE MOD. CODE		00190	1,0,0,0,0,3,0,1,0,0,0,0
		200	00200	.865592,-.006905,0,0,0,0,2.208814,0,-0.052790,0,0,0,0
		300	00210	.820054,-.011654,0,0,0,0,2.154533,0,-0.067230,0,0,0
CI 5	VARIABLE MOD. CODE		00220	0,0,0,1,3,3,1,1,0,0,0,0
		200	00230	.271604,0,0,0,.006551,-.223204,2.289678,.004494,-.055121,0,0,0
		300	00240	-.846172,0,0,0,.010153,.620867,1.917589,.002012,-.081351,0,0,0
CI 6	VARIABLE MOD. CODE		00250	0,0,0,0,3,3,1,1,0,0,0,0
		200	00260	-.321422,0,0,0,0,0.739068, 2.322191, 0.000577,-0.076648,0,0,0
		300	00270	-1.765256,0,0,0,0,2.112215, 1.967978,-0.004058,-0.114715,0,0,0
RCI 1	VARIABLE MOD. CODE		00280	1,2,1,0,0,0,0,0,0,0,0,0
		100	00290	3.024829,-0.001245,0.014260,0.011616,0,0,0,0,0,0,0,0
		200	00300	4.739997,-0.010870,-0.358211,0.001490,0,0,0,0,0,0,0,0
RCI 2	VARIABLE MOD. CODE		00310	0,0,0,1,3,1,1,0,0,0,0,0
		100	00320	-0.100719,0,0,0,-0.001300,2,398889,0.023212,-0.004657,0,0,0,0
		200	00330	0.003995,0,0,0,0.002488,1.764239,0.030534,0.003866,0,0,0,0
RCI 3	VARIABLE MOD. CODE		00340	0,0,0,0,3,1,1,0,0,0,0,0
		100	00350	-0,154484,0,0,0,0,2,343072,0.023854,-0.004483,0,0,0,0
		200	00360	0.106906,0,0,0,0,1.871078,0.030243,-0,004197,0,0,0,0
RCI 4	VARIABLE MOD. CODE		00370	0,0,0,0,3,1,0,0,0,0,0,0
		100	00380	0.783718,0,0,0,0,1,498687,0,026343,0,0,0,0,0
		200	00390	0.985254,0,0,0,0,1.080560,0.033070,0,0,0,0,0
RCI 5	VARIABLE MOD. CODE		00400	0,0,0,1,3,1,1,0,1,0,0,0
		100	00410	-0.543385,0,0,0,-0.002109,2,441173,0.0306323,-0.005442,0,
			00415	0.003741,0,0
		200	00420	-0.685705,0,0,0,0,0.001227,1.8300217,0.042095,-0.005089,
			00425	0.005829,0,0
RCI 6	VARIABLE MOD. CODE		00430	0,0,0,0,3,1,1,0,1,0,0,0
		100	00440	-0.583421,0,0,0,0,2,349903,0,030118,-0.005094,0,
			00445	0.003370,0,0
		200	00450	-0.662423,0,0,0,0,1.883330,0,042394,-0.005292,0,0,006045,0,0

*Variable Modification Code: 1 = (refers to code numbers opposite line numbers 00100, 00130, 00160, etc.). 1 = natural form, 2 = ln form, 3 = lnln form (see tables 6 and 7, main text).

APPENDIX E: EXAMPLES OF PREDICTION RUNS

1. The purpose of the examples in this appendix is to illustrate the input data setup required for prediction of soil moisture content and soil strength and for input to the Freeze-Thaw model. Example 1 illustrates a prediction run using specific (measured) data and relations derived from measured data and example 2 shows the setup for a run using the surface composition group data. In example 3 the only soil and terrain data available are those that have been derived from estimated or averaged values and from weather records from a nearby weather station. In this case tentative average relations, which are built into the program, are used. Example 4 shows input and output data required for use in the Freeze-Thaw model.

2. Appendix F contains graphic displays of the results of runs for the first three examples.

Example 1, Run Using Specific Data

3. Assume that daily prediction of soil moisture content in inches and percent and CI and RCI for the two layers is needed at a site for the period 13 April 1951 - 31 December 1952. Records are available for data as follows:

a. Physical soil properties

	% Sand	% Silt	% Clay	% Organic Matter	Dry Density, g/cc
Layer 1	5	78	17	1.71	1.35
Layer 2	4	78	18	1.24	1.53

b. The site is located on the levee of a bottomland, which is classified as wetness index 4 (table 5, main text).

c. The soil is a Collins silt loam.

d. The following relations have been determined from measured data:

(1) Accretion relations

	Layer 1	Layer 2
Class I	0.7X-0.04	0.44X-0.10
Class II	0.96Z-0.06	0.76Z-0.02

Minimum storm - 0.10 in. Layer 1-Class I relation changes to a 1:1 relation when the soil moisture content prior to accretion is 0.10 in.

(2) Depletion relations

	X	X^2	X^3	X^4	X^5	X^6
Summer						
Layer 1	0.112577	0.892538	-2.41564	2.34487	-1.01126	0.163761
Layer 2	0.0875938	0.148577	-0.303785	0.127866	0	0
Transition						
Layer 1	0.233207	-0.454052	0.359594	-0.0938728	0	0
Layer 2	0.404195	-2.2826	5.68009	-6.27261	2.52196	0
Winter						
Layer 1	0.198281	-1.61755	7.46858	-10.673	0	0
Layer 2	1.01464	-24.9913	255.935	-1102.69	1693.1	0

(3) Strength relations

	CI	RCI
Layer 2	lnCI = 10.72 lnMC-1.64	lnRCI = 23.864 lnMC-5.815

e. Limits of soil moisture content

	Maximum	Minimum By Seasons		
		Summer	Transition	Winter
Layer 1	2.52 in.	0.66 in.	1.02 in.	2.13 in.
Layer 2	2.43 in.	0.90 in.	1.53 in.	2.19 in.

f. Measured soil moisture contents on 13 April 1951 were 2.12 in. for the first layer and 2.26 for the second layer.

g. Beginning of season dates

Spring	Summer	Fall	Winter
10 Mar	10 May	21 Sept	24 Oct

h. Precipitation as listed in data file (table E1) beginning with line 20.

4. From this information the required control data (lines 1-13 of table E1) and weather records (beginning line 19 of table E1) are set up for a daily soil moisture-soil strength prediction. A card deck would be set up in accordance with fig. C3, Appendix C. The teletype input during the running of the program is shown in table E2. Partial lists of predicted soil-moisture contents in inches and percent and CI for the 6- to 12-in. (15- to 30-cm) layer are shown in tables E3-E5.

Example 2, Run Using Surface Composition Group Data

5. Suppose all that is known about the area in example 1 is that: (a) it is on the levee of a bottomland; (b) the water table occurs at

the surface less than 90 percent of the time and above the 120-cm depth more than 10 percent of the time; (c) the soil is silt with an organic content less than 7 percent; and (d) the starting moisture contents for the two layers and the weather data (daily precipitation and beginning of season dates) are known. Daily predictions of soil moisture content and soil strength can be made by using the program controls from file DSURGR (table D1, Appendix D). To determine the surface composition group for this area, a search is made of table 1 of the main text, and Group 0808 is selected for obtaining control data. The card deck setup is shown in fig. C4, Appendix C. Table E6 lists the input data file printout for Group 0808, and table E7 shows the teletype input during the run. Partial outputs of soil moisture content in inches and percent and CI are shown in tables E8-E10.

Example 3, Run Using Estimated Data

6. Assume that all that is known about the area in example 1 is that it is a bottomland with an estimated wetness index of 4. Percentages of sand, silt, clay, and organic matter, and values of dry density are obtained from soil samples. With this information and weather data, an input deck is set up and a data file is output as shown in table E11. The program then computes maximum and minimum soil moisture contents. The maximum moisture content is used as beginning moisture content. The program proceeds with daily predictions by using tentative average relations for accretion and depletion. (See fig. C5, Appendix C, for the deck setup.) The teletype input and response during run time is shown in table E12.

Tables E13-E15 show partial outputs of soil moisture content in inches and percent and CI predictions.

Example 4, Run Providing Data for Freeze-Thaw Model

7. An example of a data file with air temperature and snow depth input data is shown in table E16. The weather data setup is shown in figs. C2 and C3, Appendix C. The teletype input and response for the Freeze-Thaw model are presented in table E17. Table E18 is a listing of the required soil moisture content and weather data output by the program.

Table E1

Example 1, Data File Printout

```
00001 1 RIFLE TS0002  M M      1.35       1.53
00002 2 1 0.100 0.100   750.    0.  750.    0.  300.    0.  300.    0.
00003 2 2 11  .112577    .892538  -2.41564   2.34487  -1.01126   .163761
00004 2 2 12  .0875938   .148577  -.303785   .127866       0.        0.
00005 2 2 21  .233207   -.454052   .359594 -.0938728       0.        0.
00006 2 2 22  .404195   -2.2826   5.68009  -6.27261    2.52196       0.
00007 2 2 31  .198281  -1.61755   7.46858   -10.673        0.        0.
00008 2 2 32  1.01464  -24.9913   255.935   -1102.69   1693.1        0.
00009 2 3        1.86 1.53 1.50 0.90 0.39 0.24
00010 2 4      0.0      0.0  10.72   -1.64      0.0      0.0   23.864  -5.815
00011 2 6    0.700  0.960  0.440  0.760       -0.04  -0.06  -0.10  -0.02
00012 3    2.12      2.26
00013 4    2.52      2.43      0.66      0.90
00014 7                    SPECIFIC RELATIONS
00015 7          LOCATION - RIFLE RANGE, VICKSBURG, MISS.
00016 7                  SOIL - COLLINS SILT LOAM
00017 7                   VEGETATION - HERBACEOUS
00018 7              RECORD - 13 APR 1951-31 DEC 1952
00019 82 13  4 51
00020 9 8 451  77.77  77.77  77.77  77.77  77.77          .02
00021 915 451                                .63         2.69
00022 922 451
00023 929 451    .02
00024 9 1 551                                        .03
00025 81 1[illegible]  5 51
00026 9 8 551          .47   .22
00027 915 551                                .01
00028 922 551
00029 929 551
00030 9 1 651
00031 9 8 651          .43  1.79          .02          .64
00032 915 651          .47          .40   .13
00033 922 651                                          .88
00034 929 651    .40   .24
00035 9 1 751    .81   .72
00036 9 8 751
00037 915 751
00038 922 751    .28   .05          .06   .01         2.66
00039 929 751
00040 9 1 851
00041 9 8 851
00042 915 851                .06                      1.61
00043 922 851
00044 929 851
```

Table E2

Example 1, Teletype Input

```
FOR INFORMATION ON RUNNING THIS MODEL SEE USER'S MANUAL.

WHEN ANSWERING YES OR NO QUESTIONS,
     USE 1 FOR YES AND 2 FOR NO.
IS INPUT RAINFALL IN CM?
INPUT:01560
 ? 2

IF YOU WANT OUTPUT MOISTURE CONTENT IN:
      INCHES ENTER A 1; CM ENTER A 2
INPUT:01590
 ? 1

NAME LAYERS 1 AND 2 SOIL MOISTURE CONTENT FILES.
      EXAMPLE:XX1001,XX2001
INPUT:01620
 ? AM1001,AM2001

DO YOU NEED OUTPUT MOISTURE CONTENT IN PERCENT?
INPUT:01640
 ? 1

NAME LAYERS 1 AND 2 PERCENT MOISTURE FILES.
      EXAMPLE:XX1001,XX2001
INPUT:01680
 ? AP1001,AP2001

IF YOU HAVE AIR TEMPERATURE, ENTER A T; IF NOT A 9
INPUT:01710
 ? 9

IF YOU HAVE SNOW DEPTH(M),ENTER AN SN; IF NOT A 9
INPUT:01740
 ? 9

WHAT IS YOUR INPUT SOURCE?
ENTER: 1 FOR SURFACE COMPLEX GROUPS, OTHERWISE A 2
INPUT:01780
 ? 2
```

1 of 2 sheets

Table E2 (concluded)

```
ENTER THE NAME OF YOUR INPUT FILE
INPUT:01810
 ? DARIFH

ARE MAX AND MIN SOIL MOISTURE EQUATIONS INCLUDED IN THE
INPUT DATA FILE?
INPUT:01840
 ? 2

 SITE  RIFLE TS0002
 TEXTURE        M     M
 DENSITY         1.35       1.53
 BEG MC          2.12       2.26
 MAX-MIN MC            2.520      2.430      0.660      0.900
                     SPECIFIC RELATIONS
          LOCATION - RIFLE RANGE, VICKSBURG, MISS.
                  SOIL - COLLINS SILT LOAM
                   VEGETATION - HERBACEOUS
              RECORD - 13 APR 1951-31 DEC 1952
DO YOU WANT CONE INDEX FOR FIRST SOIL LAYER?  SECOND LAYER?
RCI FOR FIRST LAYER?  SECOND LAYER?  SEPARATE ANSWERS
WITH COMMAS. EXAMPLE:FOR RCI ONLY FOR BOTH LAYERS;2,2,1,1
INPUT:13180
 ? 1,1,1,1

ENTER NAMES OF SOIL STRENGTH FILES TO BE USED,ENTER
 NODATA IF A FILE IS NOT TO BE USED.
EXAMPLE:FOR RCI FOR BOTH LAYERS;NODATA,NODATA,XX1001,XX2001
INPUT:13220
 ? AC1001,AC2001,AR1001,AR2001

STOP

RUNNING TIME:   78.1 SECS   I/O TIME :   42.6 SECS
```

2 of 2 sheets

Table E3

Example 1, Predicted Soil Moisture Content in Inches

SPECIFIC RELATIONS
LOCATION - RIFLE RANGE, VICKSBURG, MISS.
SOIL - COLLINS SILT LOAM
VEGETATION - HERBACEOUS
RECORD - 13 APR 1951-31 DEC 1952
SOIL MOISTURE IN/6 IN
6 - 12 IN LAYER

DAY			APRIL		1951		
8-14						2.23	2.20
15-21	2.17	2.14	2.11	2.08	2.25	2.22	2.36
22-28	2.33	2.31	2.28	2.25	2.22	2.19	2.16
29-30	2.12	2.09					
DAY			MAY		1951		
1- 7	2.06	2.03	2.01	1.98	1.95	1.93	1.90
8-14	1.88	1.98	1.99	1.93	1.87	1.81	1.75
15-21	1.69	1.63	1.57	1.51	1.45	1.40	1.34
22-28	1.30	1.26	1.22	1.18	1.15	1.13	1.10
29-31	1.08	1.06	1.04				
DAY			JUNE		1951		
1- 7	1.03	1.02	1.00	0.99	0.98	0.98	0.97
8-14	1.96	1.05	1.74	1.68	1.62	1.55	1.74
15-21	1.67	1.78	1.72	1.79	1.80	1.74	1.68
22-28	1.62	1.56	1.50	1.44	1.39	1.34	1.63
29-30	1.70	1.71					

Table E4

Example 1, Predicted Soil Moisture Content in Percent

IDENTIFICATION NUMBER: RIFLE TS0002
PERCENT MOISTURE CONTENT
6 - 12 IN LAYER

DAY			JANUARY		1952		
1- 7	24.18	24.03	23.91	25.64	25.35	25.12	24.94
8-14	24.78	24.80	24.66	24.52	24.38	24.22	24.07
15-21	23.94	23.87	23.86	23.86	23.86	24.59	24.45
22-28	24.30	24.14	24.00	23.89	23.86	25.63	25.34
29-31	25.11	24.93	24.78				
DAY			FEBRUARY		1952		
1- 7	25.85	25.54	25.27	25.38	25.14	24.95	24.80
8-14	24.66	24.52	24.38	24.22	25.71	25.42	25.17
15-21	25.94	26.27	25.96	25.65	25.36	25.99	25.68
22-28	26.06	25.76	25.46	26.01	26.34	26.02	25.71
DAY			MARCH		1952		
1- 7	25.42	25.17	25.94	25.63	25.35	25.12	24.93
8-14	24.78	24.89	25.87	25.58	25.28	24.97	24.66
15-21	24.03	24.00	23.66	25.58	25.28	24.97	24 66
22-28	25.62	25.52	25.22	24.91	24.60	24.27	23.94
29-31	23.60	23.26	22.92				
DAY			APRIL		1952		
1- 7	22.59	22.27	21.96	23.26	22.93	22.60	22.27
8-14	21.96	21.66	21.77	21.47	24.22	23.88	23.54
15-21	23.20	22.87	22.54	22.22	21.91	22.02	21.71
22-28	21.42	25.04	24.73	24.41	24.08	23.74	23.40
29-30	23.06	22.73					
DAY			MAY		1952		
1- 7	22.40	24.86	24.54	24.21	23.88	23.54	23.20
8-14	22.87	22.54	23.27	22.61	21.97	21.33	20.68
15-21	20.03	19.36	18.69	23.78	25.61	24.75	24.01
22-28	24.11	25.69	26.06	25.13	24.34	23.63	25.57
29-31	26.04	25.10	24.32				
DAY			JUNE		1952		
1- 7	23.61	22.95	22.30	21.66	21.01	20.36	19.70
8-14	19.03	18.36	17.68	17.01	16.37	15.74	15.16
15-21	14.61	14.10	13.64	13.23	12.86	12.53	12.24
22-28	11.97	11.74	11.54	11.36	11.20	11.06	10.93
29-30	10.82	10.72					

Table E5

Example 1, Predicted Cone Index

IDENTIFICATION NUMBER: RIFLE TS0002
CONE INDEX
6 - 12 IN LAYER

DAY			JANUARY		1952		
1- 7	244.	247.	249.	222.	226.	229.	232.
8-14	234.	234.	236.	239.	241.	243.	246.
15-21	248.	249.	250.	250.	250.	238.	240.
22-28	242.	245.	247.	249.	250.	222.	226.
29-31	230.	232.	235.				
DAY			FEBRUARY		1952		
1- 7	219.	223.	227.	226.	229.	232.	234.
8-14	236.	239.	241.	243.	221.	225.	229.
15-21	218.	213.	217.	222.	226.	217.	221.
22-28	216.	220.	224.	217.	212.	217.	221.
DAY			MARCH		1952		
1- 7	225.	229.	218.	222.	226.	229.	232.
8-14	235.	233.	219.	223.	227.	232.	236.
15-21	242.	247.	253.	223.	227.	232.	236.
22-28	219.	224.	228.	233.	237.	243.	248.
29-31	254.	260.	266.				
DAY			APRIL		1952		
1- 7	273.	279.	286.	260.	266.	273.	279.
8-14	286.	292.	290.	297.	244.	249.	255.
15-21	261.	267.	274.	280.	287.	285.	291.
22-28	298.	231.	235.	240.	246.	252.	258.
29-30	264.	270.					
DAY			MAY		1952		
1- 7	277.	233.	238.	244.	249.	255.	261.
8-14	268.	274.	260.	272.	286.	300.	315.
15-21	332.	351.	372.	251.	222.	235.	247.
22-28	245.	221.	216.	229.	242.	254.	223.
29-31	216.	230.	242.				
DAY			JUNE		1952		
1- 7	254.	266.	279.	292.	307.	323.	341.
8-14	361.	383.	408.	434.	463.	493.	525.
15-21	557.	590.	623.	656.	687.	717.	745.
22-28	750.	750.	750.	750.	750.	750.	750.
29-30	750.	750.					

Table E6

Example 2, Data File Printout

```
00012 3    2.12      2.26
00014 7                SURFACE COMPOSITION GROUP 0808
00015 7          LOCATION - RIFLE RANGE. VICKSBURG, MISS.
00016 7        SILT, FINE GRAINED, ORGANIC MATTER 0-7 PERCENT
00017 7                  INTERNAL DRAINAGE-CLASS 1
00018 7               RECORD - 13 APR 1951-31 DEC 1952
00019 82 13  4 51
00020 9 8 451  77.77 77.77 77.77 77.77 77.77          .02
00021 915 451                              .63        2.69
00022 922 451
00023 929 451    .02
00024 9 1 551                                   .03
00025 81 10  5 51
00026 9 8 551          .47   .22
00027 915 551                              .01
00028 922 551
00029 929 551
00030 9 1 651
00031 9 8 651          .43  1.79           .02         .64
00032 915 651          .47         .40    .13
00033 922 651                                           .88
00034 929 651    .40   .24
00035 9 1 751    .81   .72
00036 9 8 751
00037 915 751
00038 922 751    .28   .05         .06    .01        2.66
00039 929 751
00040 9 1 851
00041 9 8 851
00042 915 851                .06                      1.61
00043 922 851
00044 929 851
00045 9 1 951                      .58         .03
00046 9 8 951                .71          .07  2.14
00047 82 21  9 51
00048 915 951                                           .03
00049 922 951    .89        3.82
00050 929 951
00051 9 11051                                           .04
00052 9 81051
00053 9151051
00054 83 24 10 51
00055 9221051          .84
00056 9291051          .01   .33
```

Table E7

Example 2, Teletype Input

```
FOR INFORMATION ON RUNNING THIS MODEL SEE USER'S MANUAL.

WHEN ANSWERING YES OR NO QUESTIONS,
     USE 1 FOR YES AND 2 FOR NO.
IS INPUT RAINFALL IN CM?
INPUT:01560
 ? 2

IF YOU WANT OUTPUT MOISTURE CONTENT IN:
      INCHES ENTER A 1; CM ENTER A 2
INPUT:01590
 ? 1

NAME LAYERS 1 AND 2 SOIL MOISTURE CONTENT FILES.
      EXAMPLE:XX1001,XX2001
INPUT:01620
 ? MC1001,MC2001

DO YOU NEED OUTPUT MOISTURE CONTENT IN PERCENT?
INPUT:01640
 ? 1

NAME LAYERS 1 AND 2 PERCENT MOISTURE FILES.
      EXAMPLE:XX1001,XX2001
INPUT:01680
 ? PM1001,PM2001

IF YOU HAVE AIR TEMPERATURE, ENTER A T; IF NOT A 9
INPUT:01710
 ? 9

IF YOU HAVE SNOW DEPTH(M),ENTER AN SN; IF NOT A 9
INPUT:01740
 ? 9

WHAT IS YOUR INPUT SOURCE?
ENTER: 1 FOR SURFACE COMPOSITION GROUP, OTHERWISE A 2
INPUT:01780
 ? 1
```


1 of 2 sheets

Table E7 (concluded)

```
ENTER THE NUMBER OF YOUR SURFACE GROUP
INPUT:01890
 ? 0808

 SITE          0808
 TEXTURE        C    C
 DENSITY         1.34      1.41
 MAX-MIN MC            2.900     2.800     0.650     0.700
ENTER NAME OF RAINFALL FILE
INPUT:02770
 ? DA0808

 BEG MC          2.12      2.26
                SURFACE COMPOSITION GROUP 0806
          LOCATION - RIFLE RANGE, VICKSBURG, MISS.
        SILT, FINE GRAINED, ORGANIC MATTER 0-7 PERCENT
                  INTERNAL DRAINAGE-CLASS 1
              RECORD - 13 APR 1951-31 DEC 1952
DO YOU WANT CONE INDEX FOR FIRST SOIL LAYER?  SECOND LAYER?
RCI FOR FIRST LAYER?  SECOND LAYER?  SEPARATE ANSWERS
WITH COMMAS. EXAMPLE:FOR RCI ONLY FOR BOTH LAYERS;2,2,1,1
INPUT:13180
 ? 1,1,1,1

ENTER NAMES OF SOIL STRENGTH FILES TO BE USED,ENTER
 NODATA IF A FILE IS NOT TO BE USED.
EXAMPLE:FOR RCI FOR BOTH LAYERS;NODATA,NODATA,XX1001,XX2001
INPUT:13220
 ? AC1001,AC2001,AR1001,AR2001

STOP

RUNNING TIME:   81.5 SECS   I/O TIME :   42.6 SECS
```

2 of 2 sheets

Table E8

Example 2, Predicted Soil Moisture Content in Inches

SURFACE COMPOSITION GROUP 0808
LOCATION - RIFLE RANGE, VICKSBURG, MISS.
SILT, FINE GRAINED, ORGANIC MATTER 0-7 PERCENT
INTERNAL DRAINAGE-CLASS 1
RECORD - 13 APR 1951-31 DEC 1952
SOIL MOISTURE IN/6 IN
6 - 12 IN LAYER

DAY			APRIL		1951		
8-14						2.24	2.22
15-21	2.21	2.19	2.17	2.15	2.28	2.27	2.57
22-28	2.55	2.53	2.52	2.50	2.48	2.46	2.45
29-30	2.43	2.41					
DAY			MAY		1951		
1- 7	2.40	2.38	2.36	2.34	2.33	2.31	2.29
8-14	2.27	2.37	2.41	2.37	2.33	2.30	2.26
15-21	2.22	2.18	2.15	2.11	2.07	2.03	2.00
22-28	1.96	1.92	1.88	1.84	1.80	1.76	1.73
29-31	1.69	1.65	1.61				
DAY			JUNE		1951		
1- 7	1.57	1.53	1.49	1.45	1.41	1.38	1.34
8-14	1.30	1.39	1.77	1.73	1.69	1.65	1.78
15-21	1.74	1.84	1.80	1.88	1.90	1.86	1.82
22-28	1.78	1.74	1.70	1.66	1.62	1.58-	1.77
29-30	1.84	1.89					

Table E9

Example 2, Predicted Soil Moisture Content in Percent

IDENTIFICATION NUMBER: 0808
PERCENT MOISTURE CONTENT
6 - 12 IN LAYER

DAY			JANUARY		1952		
1- 7	32.33	32.22	32.11	32.47	32.36	32.26	32.15
8-14	32.05	32.53	32.42	32.32	32.21	32.11	32.00
15-21	31.90	31.79	31.69	31.58	31.48	32.21	32.11
22-28	32.00	31.90	31.79	31.69	31.59	32.26	32.15
29-31	32.05	31.94	31.84				
DAY			FEBRUARY		1952		
1- 7	32.36	32.25	32.15	32.52	32.42	32.31	32.21
8-14	32.10	32.00	31.89	31.79	32.34	32.23	32.13
15-21	32.48	32.83	32.73	32.63	32.52	32.88	32.78
22-28	33.10	33.00	32.90	33.10	33.10	33.00	32.90
DAY			MARCH		1952		
1- 7	32.80	32.69	33.05	32.95	32.85	32.74	32.64
8-14	32.54	32.73	33.08	32.88	32.68	32.47	32.27
15-21	32.07	31.87	31.67	32.29	32.09	31.89	31.68
22-28	32.30	32.09	31.89	31.69	31.49	31.29	31.09
29-31	30.89	30.69	30.49				
DAY			APRIL		1952		
1- 7	30.29	30.09	29.89	31.07	30.87	30.67	30.47
8-14	30.27	30.07	30.60	30.40	31.78	31.58	31.38
15-21	31.18	30.98	30.78	30.58	30.38	30.60	30.40
22-28	30.20	31.70	31.50	31.30	31.10	30.90	30.70
29-30	30.50	30.30					
DAY			MAY		1952		
1- 7	30.10	31.66	31.46	31.26	31.06	30.86	30.66
8-14	30.46	30.26	31.13	30.69	30.25	29.82	29.38
15-21	28.95	28.51	28.08	30.85	31.96	31.52	31.08
22-28	31.30	32.14	32.50	32.05	31.61	31.17	32.09
29-31	32.46	32.01	31.57				
DAY			JUNE		1952		
1- 7	31.13	30.69	30.26	29.82	29.39	28.95	28.52
8-14	28.08	27.65	27.21	26.78	26.34	25.90	25.46
15-21	25.02	24.57	24.12	23.68	23.22	22.77	22.32
22-28	21.86	21.40	20.94	20.47	20.01	19.55	19.08
29-30	18.62	18.16					

Table E10

Example 2, Predicted Cone Index

IDENTIFICATION NUMBER: 0808
CONE INDEX
6 - 12 IN LAYER

DAY			JANUARY		1952		
1- 7	119.	120.	121.	118.	119.	120.	121.
8-14	122.	117.	118.	119.	120.	121.	122.
15-21	123.	124.	125.	126.	128.	120.	121.
22-28	122.	123.	124.	125.	126.	120.	121.
29-31	122.	123.	124.				
DAY			FEBRUARY		1952		
1- 7	119.	120.	121.	117.	118.	119.	120.
8-14	121.	122.	123.	124.	119.	120.	121.
15-21	118.	115.	116.	116.	117.	114.	115.
22-28	112.	113.	114.	112.	112.	113.	114.
DAY			MARCH		1952		
1- 7	115.	116.	113.	114.	115.	115.	116.
8-14	117.	116.	112.	114.	116.	118.	120.
15-21	122.	124.	126.	120.	122.	123.	125.
22-28	120.	121.	123.	125.	127.	129.	132.
29-31	134.	136.	138.				
DAY			APRIL		1952		
1- 7	141.	143.	145.	132.	134.	136.	139.
8-14	141.	143.	137.	139.	124.	127.	129.
15-21	131.	133.	135.	137.	140.	137.	139.
22-28	142.	125.	127.	129.	132.	134.	136.
29-30	138.	140.					
DAY			MAY		1952		
1- 7	143.	126.	128.	130.	132.	134.	136.
8-14	139.	141.	131.	136.	141.	146.	152.
15-21	158.	164.	170.	134.	123.	127.	132.
22-28	129.	121.	118.	122.	126.	131.	121.
29-31	118.	122.	127.				
DAY			JUNE		1952		
1- 7	131.	136.	141.	146.	152.	158.	164.
8-14	170.	177.	184.	192.	200.	209.	218.
15-21	228.	238.	250.	262.	275.	289.	304.
22-28	321.	338.	358.	378.	401.	425.	452.
29-30	481.	513.					

Table E11

Example 3, Data File Printout

```
0001 1 RIFLE TS0002  M  M      1.35       1.53
0002 2 5 1 1
0003 61121       1.      5.      78.     17.     0.      0.      0.      0.
0004   1.71   0.      4.
0005 61122       1.      4.      78.     18.     0.      0.      0.      0.
0006   1.24   0.      4.
0014 7            TENTATIVE AVERAGE PREDICTION RELATIONS
0015 7          LOCATION - RIFLE RANGE, VICKSBURG, MISS.
0016 7                  SOIL - COLLINS SILT LOAM
0017 7                   VEGETATION - HERBACEOUS
0018 7              RECORD - 13 APR 1951-31 DEC 1952
0019 82 13  4 51
0020 9 8 451  77.77 77.77 77.77 77.77 77.77          .02
0021 915 451                              .63        2.69
0022 922 451
0023 929 451    .02
0024 9 1 551                                   .03
0025 81 10  5 51
0026 9 8 551          .47   .22
0027 915 551                              .01
0028 922 551
0029 929 551
0030 9 1 651
0031 9 8 651          .43  1.79          .02          .64
0032 915 651          .47         .40    .13
0033 922 651                                           .88
0034 929 651    .40   .24
0035 9 1 751    .81   .72
0036 9 8 751
0037 915 751
0038 922 751    .28   .05         .06    .01        2.66
0039 929 751
0040 9 1 851
0041 9 8 851
0042 915 851                .06                      1.61
0043 922 851
0044 929 851
0045 9 1 951                      .58          .03
0046 9 8 951                .71          .07  2.14
0047 82 21  9 51
0048 915 951                                           .03
0049 922 951    .89        3.82
0050 929 951
```

Table E12

Example 3, Teletype Input

```
FOR INFORMATION ON RUNNING THIS MODEL SEE USER'S MANUAL.

WHEN ANSWERING YES OR NO QUESTIONS,
     USE 1 FOR YES AND 2 FOR NO.
IS INPUT RAINFALL IN CM?
INPUT:01560
 ? 2

IF YOU WANT OUTPUT MOISTURE CONTENT IN:
      INCHES ENTER A 1; CM ENTER A 2
INPUT:01590
 ? 1

NAME LAYERS 1 AND 2 SOIL MOISTURE CONTENT FILES.
      EXAMPLE:XX1001,XX2001
INPUT:01620
 ? MC1001,MC2001

DO YOU NEED OUTPUT MOISTURE CONTENT IN PERCENT?
INPUT:01640
 ? 1

NAME LAYERS 1 AND 2 PERCENT MOISTURE FILES.
      EXAMPLE:XX1001,XX2001
INPUT:01680
 ? PM1001,PM2001

IF YOU HAVE AIR TEMPERATURE, ENTER A T; IF NOT A 9
INPUT:01710
 ? 9

IF YOU HAVE SNOW DEPTH(M),ENTER AN SN; IF NOT A 9
INPUT:01740
 ? 9

WHAT IS YOUR INPUT SOURCE?
ENTER: 1 FOR SURFACE COMPOSITION GROUP, OTHERWISE A 2
INPUT:01780
 ? 2

ENTER THE NAME OF YOUR INPUT FILE
INPUT:01810
 ? DTARIF
```

1 of 2 sheets

Table E12 (concluded)

```
ARE MAX AND MIN SOIL MOISTURE EQUATIONS INCLUDED IN THE
INPUT DATA FILE?
INPUT:01840
 ? 2

 SITE  RIFLE TS0002
 TEXTURE        M    M
 DENSITY         1.35       1.53
 SOIL PROPERTIES            1.000      5.000     78.000     17.000      0.000

       0.000      0.000      0.000      1.710      0.000      4.000
 SOIL PROPERTIES            1.000      4.000     78.000     18.000      0.000

       0.000      0.000      0.000      1.240      0.000      4.000
 MAX-MIN MC            2.927     2.954     0.778     0.880
            TENTATIVE AVERAGE PREDICTION RELATIONS
          LOCATION - RIFLE RANGE, VICKSBURG, MISS.
                  SOIL - COLLINS SILT LOAM
                   VEGETATION - HERBACEOUS
              RECORD - 13 APR 1951-31 DEC 1952
LAYER =          1
     CONE INDEX EQ.  A=    1.322739227E+01
                     B=   -2.405180618E+00
LAYER =          1
     RATING CONE EQ. A=    2.237862116E+01
                     B=   -5.421705970E+00
LAYER =          2
     CONE INDEX EQ.  A=    1.362313798E+01
                     B=   -2.513599087E+00
LAYER =          2
     RATING CONE EQ. A=    2.237869960E+01
                     B=   -5.400542561E+00
DO YOU WANT CONE INDEX FOR FIRST SOIL LAYER?  SECOND LAYER?
RCI FOR FIRST LAYER?  SECOND LAYER?  SEPARATE ANSWERS
WITH COMMAS. EXAMPLE:FOR RCI ONLY FOR BOTH LAYERS;2,2,1,1
INPUT:13180
 ? 1,1,1,1

ENTER NAMES OF SOIL STRENGTH FILES TO BE USED,ENTER
 NODATA IF A FILE IS NOT TO BE USED.
EXAMPLE:FOR RCI FOR BOTH LAYERS;NODATA,NODATA,XX1001,XX2001
INPUT:13220
 ? IC1001,IC2001,MR1001,MR2001

STOP

RUNNING TIME:   88.6 SECS   I/O TIME :   39.7 SECS
```

2 of 2 sheets

Table E13

Example 3, Predicted Soil Moisture Content in Inches

TENTATIVE AVERAGE PREDICTION RELATIONS
LOCATION - RIFLE RANGE, VICKSBURG, MISS.
SOIL - COLLINS SILT LOAM
VEGETATION - HERBACEOUS
RECORD - 13 APR 1951-31 DEC 1952
SOIL MOISTURE IN/6 IN
6 - 12 IN LAYER

DAY			APRIL		1951		
8-14						2.80	2.68
15-21	2.59	2.50	2.42	2.35	2.48	2.40	2.71
22-28	2.61	2.52	2.44	2.37	2.29	2.22	2.15
29-30	2.09	2.02					
DAY			MAY		1951		
1-7	1.96	1.90	1.84	1.79	1.74	1.69	1.65
8-14	1.61	1.71	1.74	1.66	1.57	1.50	1.43
15-21	1.37	1.31	1.26	1.21	1.17	1.13	1.10
22-28	1.07	1.05	1.02	1.00	0.99	0.97	0.96
29-31	0.95	0.94	0.93				
DAY			JUNE		1951		
1-7	0.92	0.92	0.91	0.91	0.90	0.90	0.90
8-14	0.90	0.98	1.36	1.31	1.26	1.21	1.34
15-21	1.28	1.38	1.32	1.40	1.42	1.35	1.30
22-28	1.25	1.20	1.16	1.13	1.09	1.07	1.25
29-30	1.33	1.37					

Table E14

Example 3, Predicted Soil Moisture Content in Percent

IDENTIFICATION NUMBER: RIFLE TS0002
PERCENT MOISTURE CONTENT
6 - 12 IN LAYER

DAY							
			JANUARY		1952		
1- 7	29.63	29.50	29.37	30.84	30.61	30.41	30.23
8-14	30.46	30.50	30.31	30.13	29.96	29.81	29.66
15-21	29.52	29.39	29.26	29.14	29.03	29.83	29.69
22-28	29.54	29.41	29.28	29.16	29.05	30.71	30.50
29-31	30.31	30.13	29.96				
DAY							
			FEBRUARY		1952		
1- 7	31.08	30.83	30.61	30.96	30.72	30.51	30.32
8-14	30.14	29.97	29.82	29.67	30.69	30.48	30.29
15-21	31.21	31.57	31.27	31.00	30.76	31.39	31.11
22-28	31.53	31.23	30.97	31.46	31.79	31.45	31.16
DAY							
			MARCH		1952		
1- 7	30.91	30.68	31.36	31.08	30.84	30.62	30.41
8-14	29.95	30.13	31.14	30.61	30.14	29.69	29.26
15-21	28.84	28.43	28.03	29.76	29.33	28.91	28.50
22-28	30.49	30.02	29.58	29.15	28.74	28.33	27.93
29-31	27.53	27.13	26.74				
DAY							
			APRIL		1952		
1- 7	26.34	25.95	25.57	26.66	26.27	25.88	25.49
8-14	25.11	24.73	25.22	24.84	26.64	26.25	25.86
15-21	25.48	25.09	24.71	24.34	23.97	24.17	23.81
22-28	23.44	25.83	25.44	25.06	24.68	24.31	23.94
29-30	23.57	23.22					
DAY							
			MAY		1952		
1- 7	22.87	24.53	24.16	23.79	23.43	23.08	22.73
8-14	21.98	21.24	22.04	21.30	20.57	19.86	19.16
15-21	18.48	17.83	17.20	20.18	21.08	20.36	19.65
22-28	19.85	22.43	23.88	23.10	22.35	21.60	23.36
29-31	24.52	23.74	22.97				
DAY							
			JUNE		1952		
1- 7	22.21	21.47	20.74	20.02	19.32	18.64	17.98
8-14	17.34	16.74	16.16	15.61	15.10	14.62	14.18
15-21	13.76	13.38	13.03	12.71	12.42	12.15	11.91
22-28	11.69	11.49	11.31	11.14	10.99	10.86	10.73
29-30	10.62	10.52					

Table E15

Example 3, Predicted Cone Index

IDENTIFICATION NUMBER: RIFLE TS0002
CONE INDEX
6 - 12 IN LAYER

DAY			JANUARY		1952		
1- 7	165.	167.	169.	150.	152.	155.	157.
8-14	161.	154.	156.	159.	161.	163.	165.
15-21	167.	169.	171.	172.	174.	163.	165.
22-28	167.	168.	170.	172.	174.	151.	154.
29-31	156.	159.	161.				
DAY			FEBRUARY		1952		
1- 7	147.	150.	152.	148.	151.	154.	156.
8-14	158.	161.	163.	165.	151.	154.	156.
15-21	145.	141.	145.	148.	151.	143.	146.
22-28	141.	145.	148.	142.	139.	142.	146.
DAY			MARCH		1952		
1- 7	149.	152.	143.	147.	150.	152.	155.
8-14	161.	159.	146.	152.	159.	165.	171.
15-21	177.	183.	190.	164.	170.	176.	182.
22-28	154.	160.	166.	172.	179.	185.	192.
29-31	199.	206.	214.				
DAY			APRIL		1952		
1- 7	222.	230.	239.	216.	224.	232.	241.
8-14	251.	260.	248.	257.	216.	224.	233.
15-21	241.	251.	261.	271.	281.	275.	286.
22-28	297.	233.	242.	252.	262.	272.	282.
29-30	293.	305.					
DAY			MAY		1952		
1- 7	317.	266.	276.	287.	298.	310.	322.
8-14	350.	381.	347.	379.	413.	451.	494.
15-21	540.	591.	647.	433.	388.	424.	463.
22-28	452.	332.	284.	309.	336.	365.	300.
29-31	266.	288.	313.				
DAY			JUNE		1952		
1- 7	341.	371.	405.	442.	483.	529.	579.
8-14	634.	693.	750.	750.	750.	750.	750.
15-21	750.	750.	750.	750.	750.	750.	750.
22-28	750.	750.	750.	750.	750.	750.	750.
29-30	75 .	750.					

Table E16

Example 4, Data File Printout with Air Temperature and Snow Depth

```
15 3   6.15       5.74
30 7                          SENSOR STUDY
40 7                 WEST GERMANY WURZBURG AREA 18
50 7            SURFACE COMPOSITION COMPLEX GROUP 0606
60 7               SAND WITH FINES, POORLY DRAINED
70 7
80 83  1  1 58
90 9 1 158                  .01          .13   .31  1.96
100 9 1 158T  4.9   1.6  -3.6  -4.3   2.7   6.7   3.7
110 9 8 158    .14   .30  1.33   .01   .03   .66   .46
120 9 8 158T  1.6   2.6   2.8   5.0   2.3   2.5   2.0
130 915 158    .02                .02   .10   .64   .09
140 915 158T  1.0   0.8   1.3   2.7   2.0  -2.3  -1.9
150 915 158S                                  .04   .04
160 922 158          .01          .40               .01
170 922 158T -0.6  -3.4  -3.8  -3.0  -3.1  -1.2  -4.0
180 922 158S   .04   .02   .02   .09   .06   .05   .05
190 929 158
200 929 158T -6.9  -5.0  -1.4
210 929 158S   .04   .04   .04
220 9 1 258                       .04   .38  1.18   .64
230 9 1 258T -3.2  -1.8   1.2  -1.3   3.0   0.0  -2.8
240 9 1 258S   .04   .04   .04          .01   .02   .07
250 9 8 258    .40   .60   .14         1.08   .10   .12
260 9 8 258T  3.0   7.2   7.4   6.8  10.6   9.0  14.7
270 9 8 258S   .09

280 915 258                 .24          .07   .53   .97
290 915 258T 13.3   9.9   2.1  -1.6  -1.2   1.7   3.3
300 915 258S                             .01   .07
310 922 258   1.54   .01  1.74  1.00   .03   .37
320 922 258T -0.6   0.9   4.0   8.2  -0.6  -3.4  -1.7
330 922 258S   .01                             .03
340 9 1 358                                    .04   .59
350 9 1 358T -1.9   1.9   2.0   2.6   4.6   2.0  -0.2
360 9 8 358    .06   .17  1.44   .09          .02   .61
370 9 8 358T -0.4  -2.2  -4.2  -6.0  -4.2  -3.2  -2.3
380 9 8 358S   .01   .02   .12   .12   .08   .05   .14
390 915 358    .07
400 915 358T -3.6  -2.7  -2.3  -2.3  -0.6  -2.1  -3.7
410 915 358S   .08   .06   .04
420 922 358    .01                                  .43
430 922 358T -4.6  -3.3  -0.1   3.4   5.4   9.4   9.6
440 929 358    .55
450 929 358T 10.6   6.6   1.0
460 9 1 458                             .45   .03   .27
470 9 1 458T  1.0   2.1   8.4  10.7   6.0   6.5   2.4
480 82 10  4 58
```

Table E17

Example 4, Teletype Input

```
FOR INFORMATION ON RUNNING THIS MODEL SEE USER'S MANUAL.

WHEN ANSWERING YES OR NO QUESTIONS,
     USE 1 FOR YES AND 2 FOR NO.
IS INPUT RAINFALL IN CM?
INPUT:01560
 ? 1

IF YOU WANT OUTPUT MOISTURE CONTENT IN:
      INCHES ENTER A 1; CM ENTER A 2
INPUT:01590
 ? 1

NAME LAYERS 1 AND 2 SOIL MOISTURE CONTENT FILES.
      EXAMPLE:XX1001,XX2001
INPUT:01620
 ? CM1001,CM2001

DO YOU NEED OUTPUT MOISTURE CONTENT IN PERCENT?
INPUT:01640
 ? 1

NAME LAYERS 1 AND 2 PERCENT MOISTURE FILES.
      EXAMPLE:XX1001,XX2001
INPUT:01680
 ? MP1001,MP2001

IF YOU HAVE AIR TEMPERATURE, ENTER A T; IF NOT A 9
INPUT:01710
 ? T

IF YOU HAVE SNOW DEPTH(M),ENTER AN SN; IF NOT A 9
INPUT:01740
 ? SN

WHAT IS YOUR INPUT SOURCE?
ENTER: 1 FOR SURFACE COMPOSITION GROUP, OTHERWISE A 2
INPUT:01780
 ? 1
```

1 of 2 sheets

Table E17 (concluded)

Example 4, Teletype Input

```
ENTER THE NUMBER OF YOUR SURFACE GROUP
INPUT:01890
 ? 0606

 SITE          0606
 TEXTURE        C    C
 DENSITY         1.55      1.65
 MAX-MIN MC            2.420     2.260     0.500     0.540
ENTER NAME OF RAINFALL FILE
INPUT:02770
 ? DT2RIF

                        SENSOR STUDY
                 WEST GERMANY WURZBURG AREA 18
            SURFACE COMPOSITION COMPLEX GROUP 0606
               SAND WITH FINES, POORLY DRAINED

ENTER NAMES OF SNOW,FROZEN SOIL DEPTH MODEL INPUT FILE
         EXAMPLE: FRD001
INPUT:12190
 ? FR100DELETED
 ? FRD001

DO YOU WANT CONE INDEX FOR FIRST SOIL LAYER?  SECOND LAYER?
RCI FOR FIRST LAYER?  SECOND LAYER?  SEPARATE ANSWERS
WITH COMMAS. EXAMPLE:FOR RCI ONLY FOR BOTH LAYERS:2,2,1,1
INPUT:13180
 ? 1,1,1,1

ENTER NAMES OF SOIL STRENGTH FILES TO BE USED,ENTER
 NODATA IF A FILE IS NOT TO BE USED.
EXAMPLE:FOR RCI FOR BOTH LAYERS;NODATA,NODATA,XX1001,XX2001
INPUT:13220
 ? IC1001,IC2001,CR1001,CR2001

STOP

RUNNING TIME:  175.1 SECS   I/O TIME :   51.8 SECS
```

2 of 2 sheets

Table E18

Example 4, Input Data for Freeze-Thaw Model

IDENTIFICATION NUMBER: , 0606
FROZEN DEPTH OF SOIL(CRREL-1968) DATA INPUT FILE,

MEASURED SNOW DEPTH

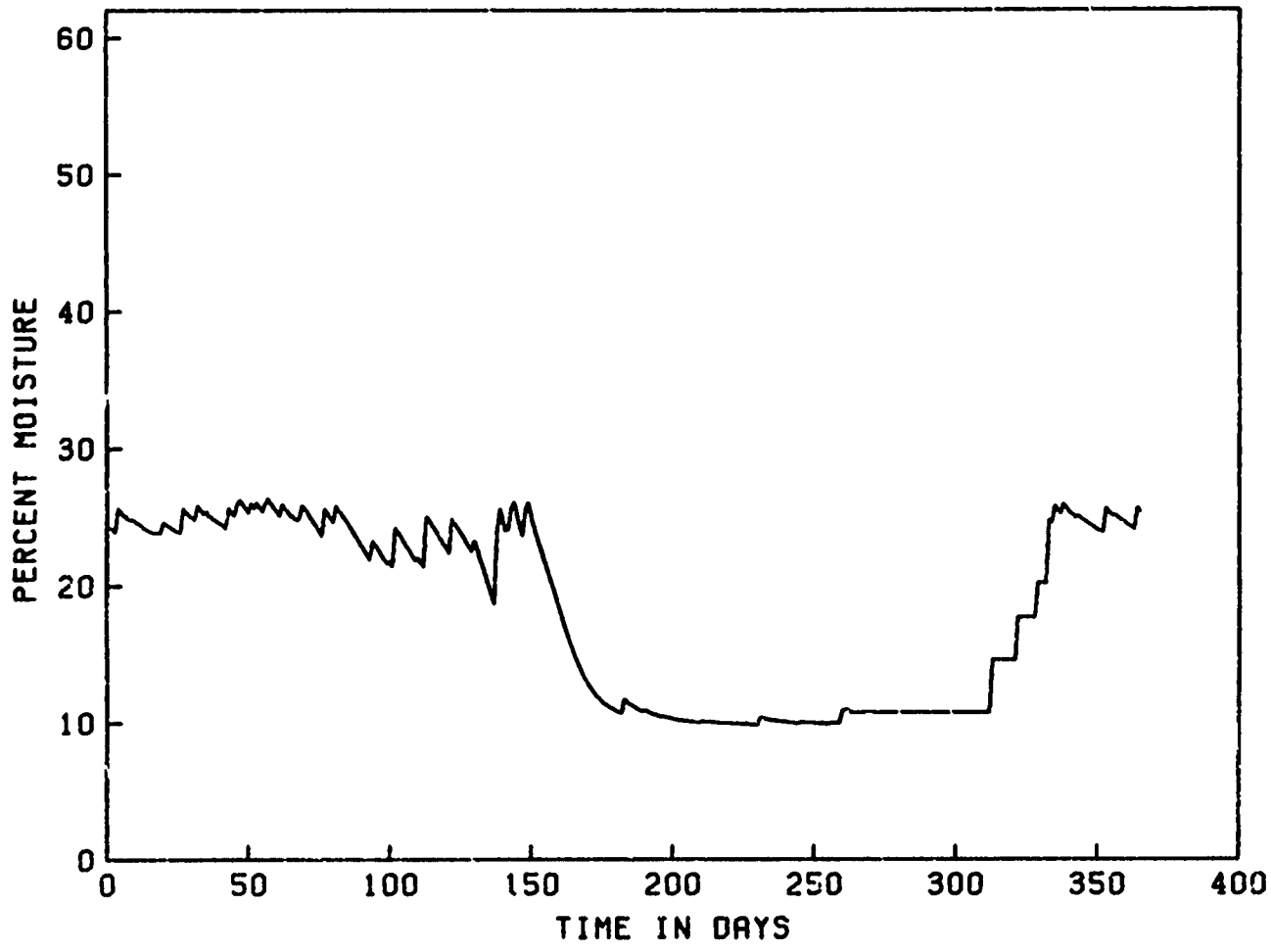
JANUARY 1958
DENSITY: 0-15 CM LAYER, 1.55G/CM; 15-30 CM LAYER, 1.65G/CM

DAY	SNOW DEPTH,M	PRECIP-ITATION,CM	AIR TEMP, C	SOIL MOISTURE 0-15 CM LAYER,%	SOIL MOISTURE 15-30 CM LAYER,%
1	[illegible]	0.00	4.90	25.79	22.69
2	[illegible]	0.00	1.60	25.56	22.55
3	[illegible]	0.01	-3.60	25.33	22.41
4	[illegible]	0.00	-4.30	25.10	22.27
5	[illegible]	0.13	2.70	24.87	22.13
6	[illegible]	0.31	6.70	25.10	22.30
7	[illegible]	1.96	3.70	25.43	22.61
8	[illegible]	0.14	1.60	25.19	22.47
9	[illegible]	0.30	2.60	25.52	22.77
10	[illegible]	1.37	2.80	25.84	22.83
11	[illegible]	0.01	5.00	25.61	22.69
12	[illegible]	0.03	2.30	25.38	22.55
13	[illegible]	0.66	2.50	25.70	22.83
14	[illegible]	0.46	2.00	26.02	22.83
15	[illegible]	0.02	1.00	25.79	22.69
16	[illegible]	0.00	0.80	25.56	22.55
17	[illegible]	0.00	1.30	25.33	22.41
18	[illegible]	0.02	2.70	25.10	22.27
19	[illegible]	0.10	2.00	24.87	22.13
20	[illegible]	0.64	-2.30	25.20	22.44
21	[illegible]	0.09	-1.90	24.96	22.30
22	[illegible]	0.00	- 60	24.73	22.16
23	[illegible]	0.01	-3.40	24.50	22.02
24	[illegible]	0.00	-3.80	24.26	21.88
25	[illegible]	0.40	-3.00	24.88	22.13
26	[illegible]	0.00	-3.10	24.65	21.99
27	[illegible]	0.00	-1.20	24.42	21.85
28	[illegible]	0.01	-4.00	24.18	21.71
29	[illegible]	0.0[illegible]	-6.90	23.95	21.57
30	[illegible]	0.0[illegible]	-5.00	23.73	21.43
31	[illegible]	0.00	-1.40	23.50	21.29

APPENDIX F: GRAPHIC DISPLAYS OF RESULTS

1. Appendix F contains examples of graphic displays of results for the first three examples described in Appendix E. The graphs were run on the CALCOMP drum plotter. The program is listed in table F1. To run these programs, the user must check the system, program compatibility, and the system library subroutines called by the program. A run-time input by teletype is shown in table F2. Figs. F1-F6 are graphs of predicted soil moisture content and CI for the first three examples described in Appendix E.

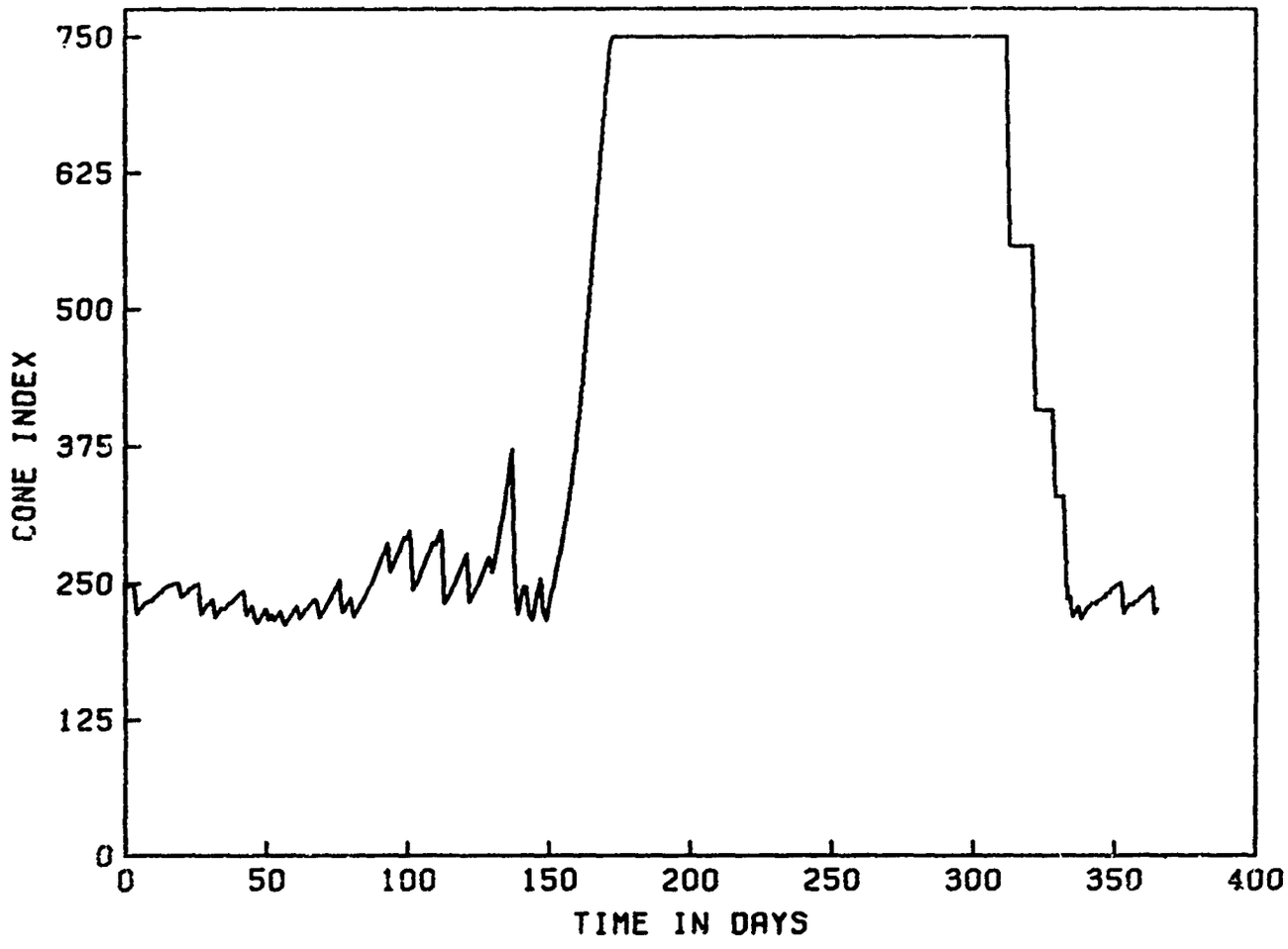
2. Fig. F7 illustrates an option of the plotting program. Data for each of two (or more) years are plotted on one axis. Ten or more years' output could be plotted with this option, thereby giving a long-term visual display of season wetness and/or soil strength.



RIFLE RANGE, VICKSBURG, MISS. 1952

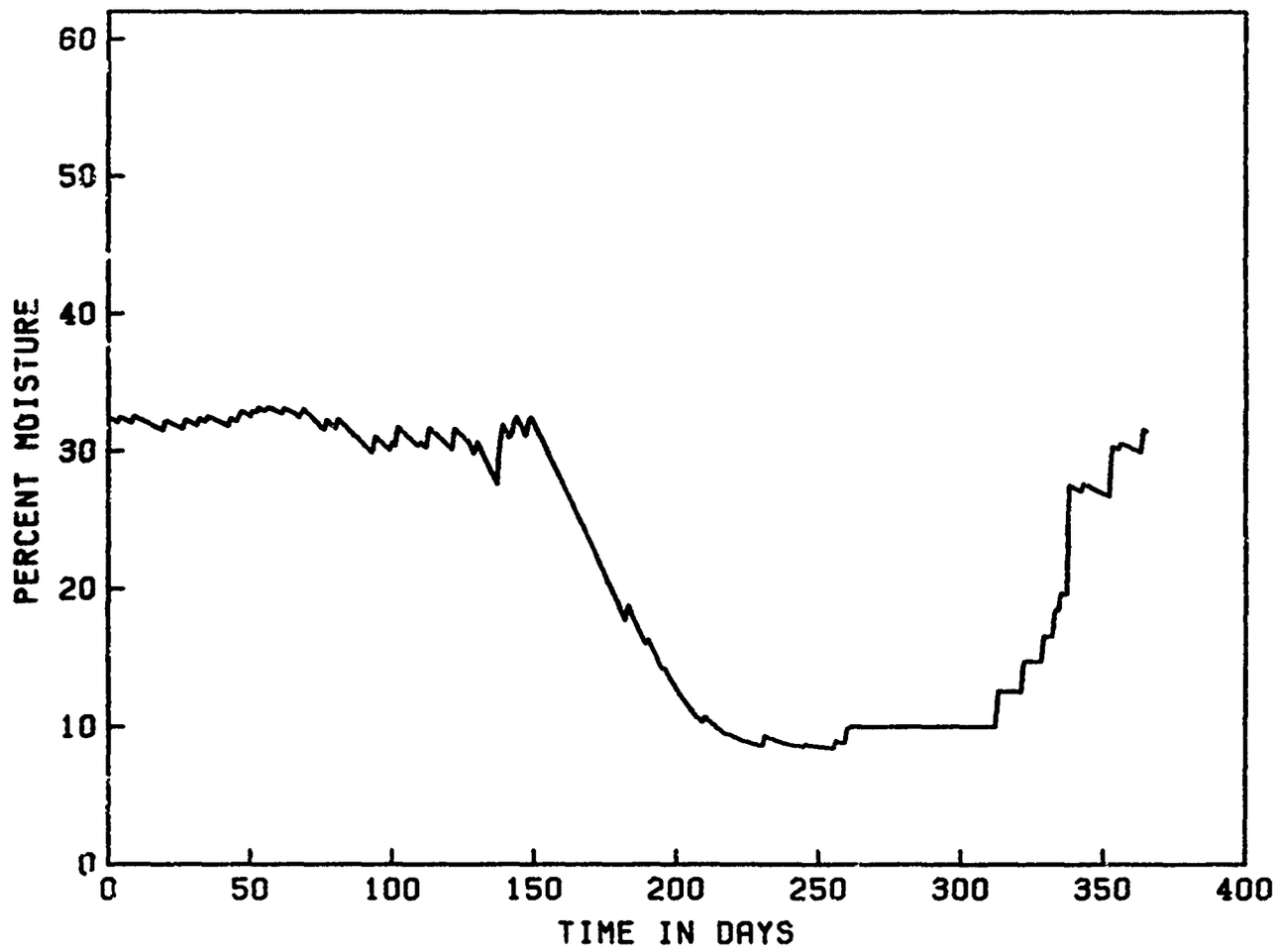
PERCENT SOIL MOISTURE - SECOND LAYER

Fig. F1. Predicted soil moisture content for Example 1, Appendix E



RIFLE RANGE, VICKSBURG, MISS. 1952
CONE INDEX - SECOND LAYER

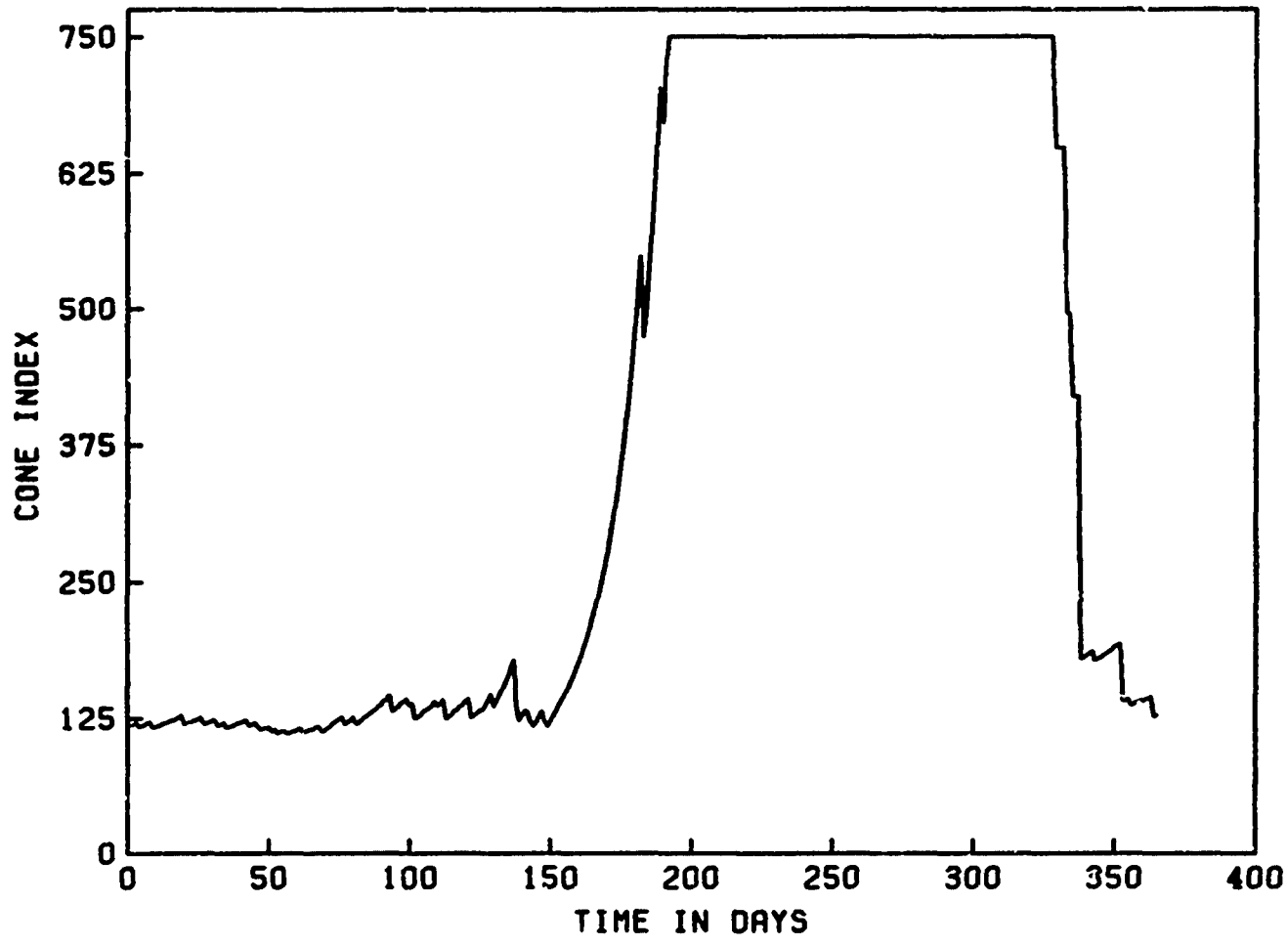
Fig. F2. Predicted CI for Example 1, Appendix E



RIFLE RANGE. VICKSBURG. MISS. GROUP 0808 1952

PERCENT SOIL MOISTURE - SECOND LAYER

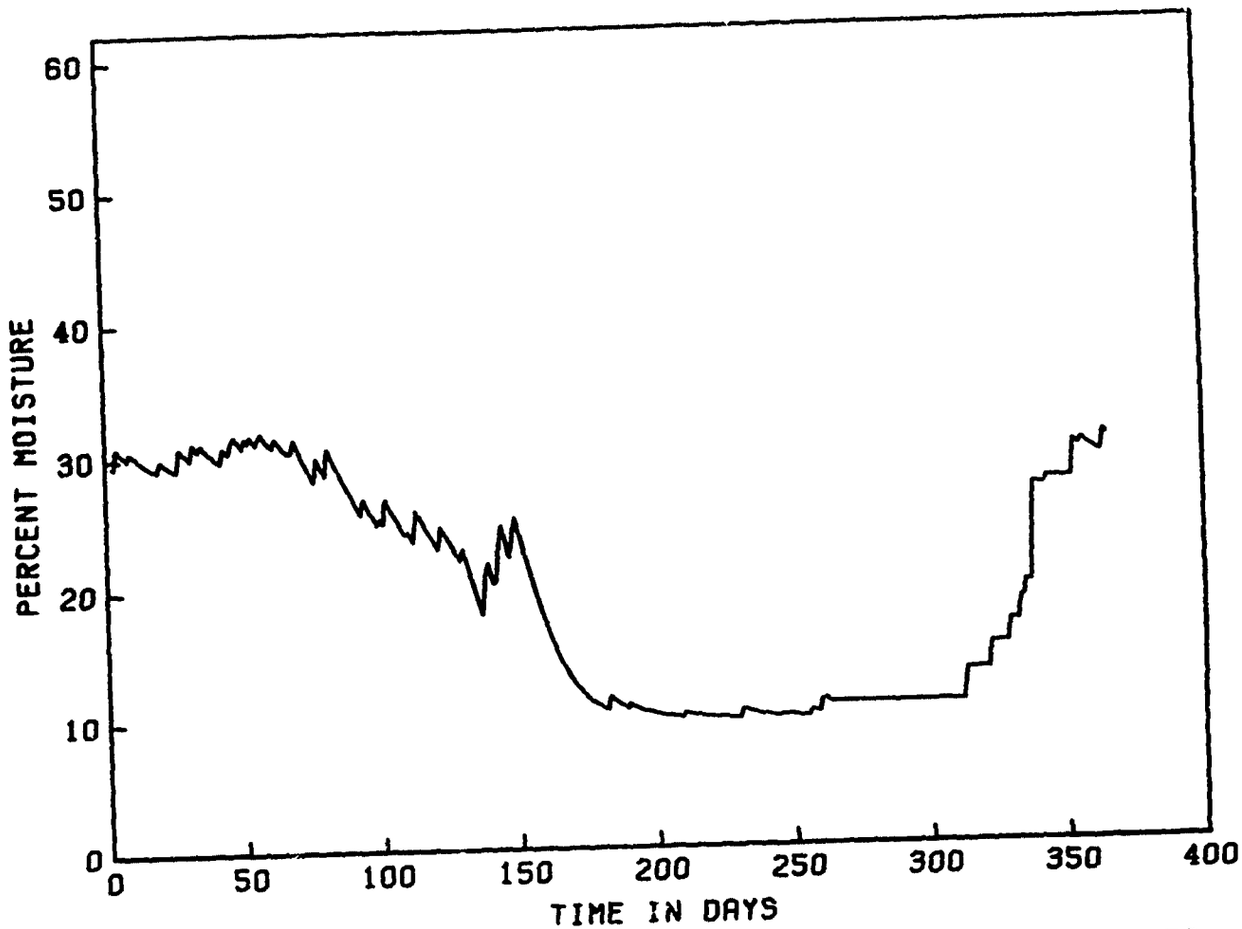
Fig. F3. Predicted soil moisture content for Example 2, Appendix E



RIFLE RANGE VICKSBURG, MISS. GROUP 0808 1952

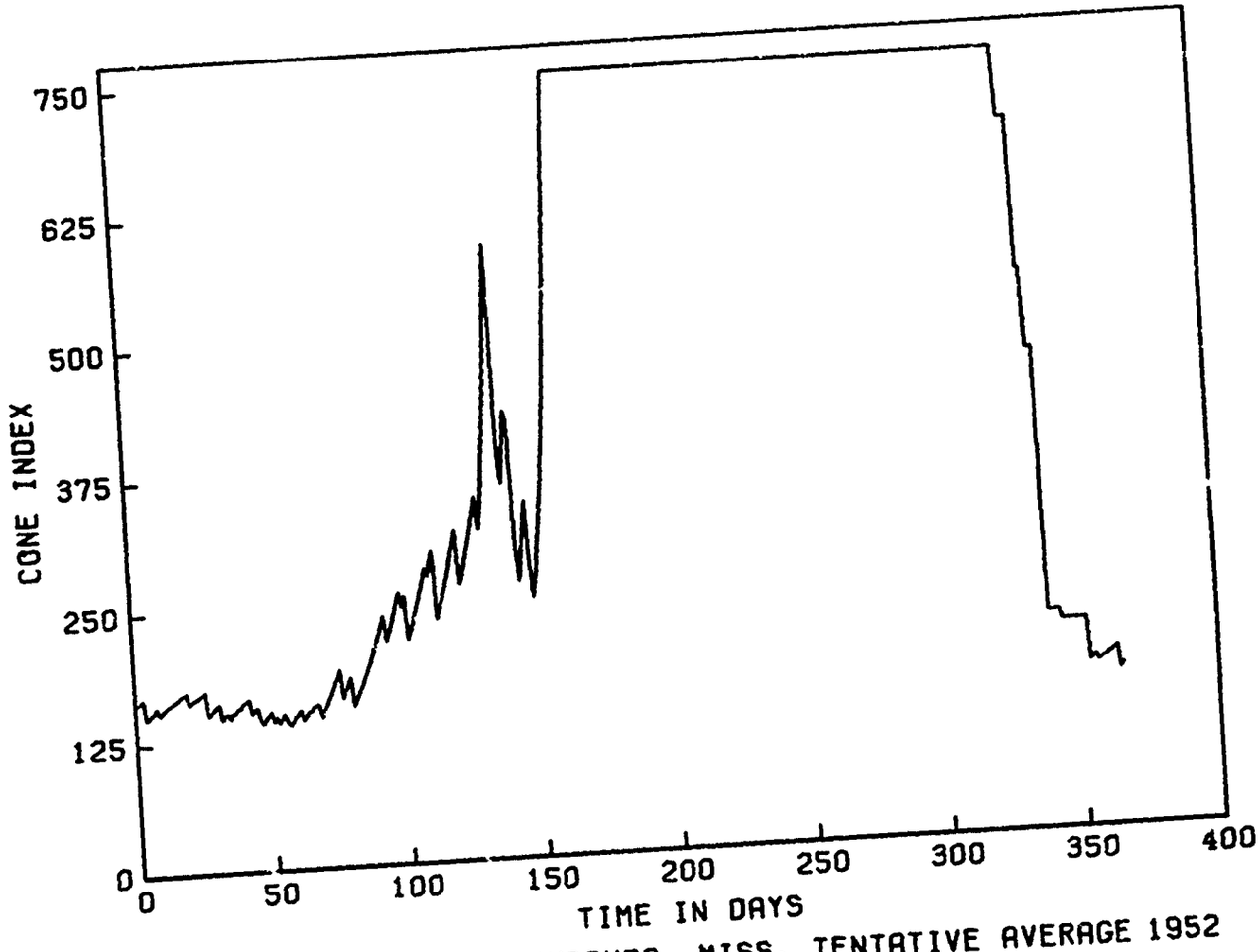
CONE INDEX - SECOND LAYER

Fig. F4. Predicted CI for Example 2, Appendix E



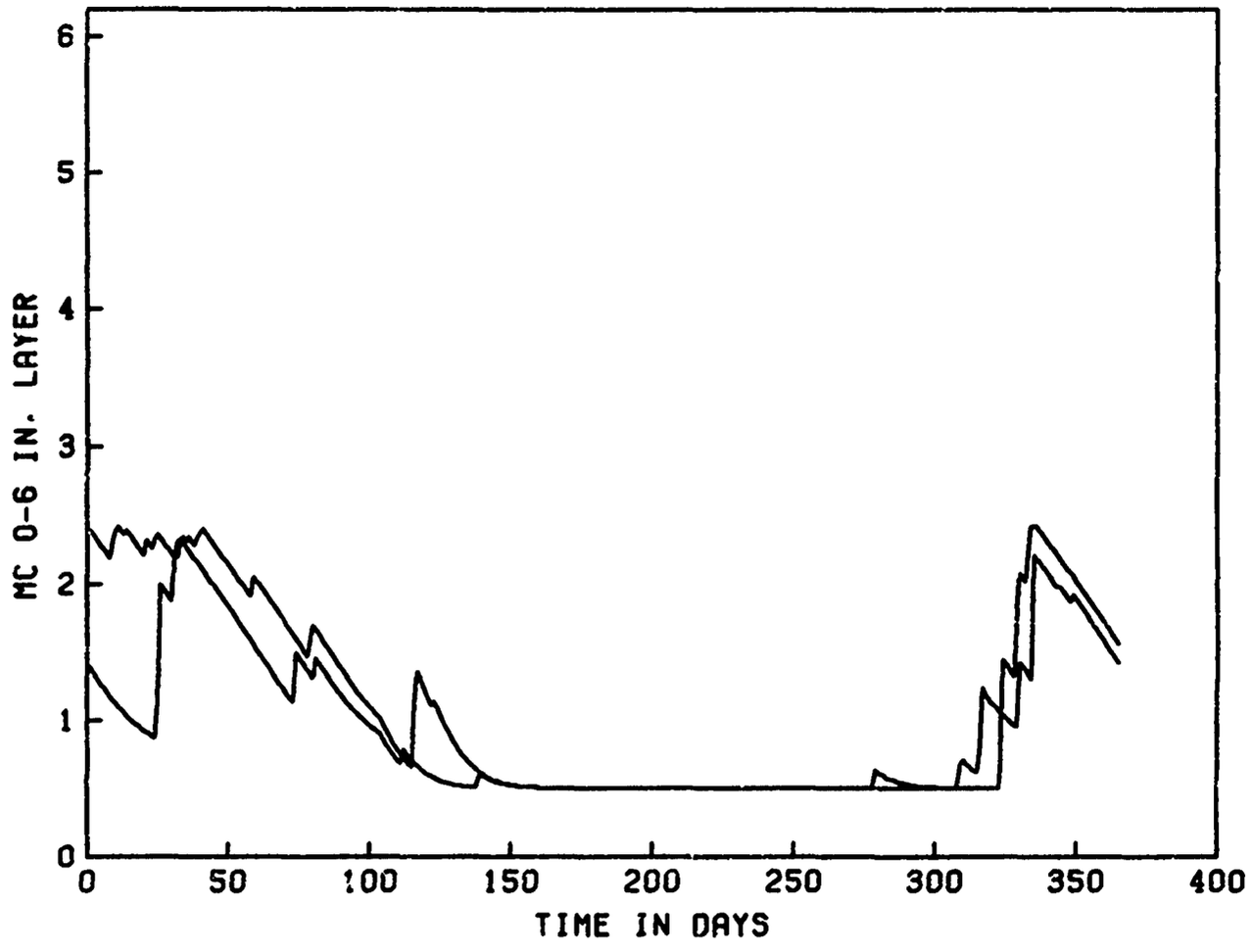
RIFLE RANGE, VICKSBURG, MISS. TENTATIVE AVERAGE 1952
PERCENT SOIL MOISTURE - SECOND LAYER

Fig. F5. Predicted soil moisture content for Example 3, Appendix E



RIFLE RANGE, VICKSBURG, MISS. TENTATIVE AVERAGE 1952
CONE INDEX - SECOND LAYER

Fig. F6. Predicted CI for Example 3, Appendix E



TEST PLOT OF TWO YEARS OF DATA ON ONE GRAPH 1960
(CALIFORNIA RAINFALL 1960-1961)

Fig. F7. Data for more than one year

Table F1

Program Listing for Graphic Display of Results

```
$LIB,AXIS;3,,,***
$LIB,LATIC,,,***
$LIB,PLOTT,,,***
      DIMENSION X(365),Y(365),LAB1(16),LAB2(16),LAB3(6)
      DIMENSION MAXD(12),ICDM(2),IDLS(2),IDYR(2)
      COMMON IDUMMY(400),DUM(20)
      DATA JX/1H+/
      DATA MAXD/31,28,31,30,31,30,31,31,30,31,30,31/
      LDEV=3
      PRINT,"ENTER XMAX AND XMIN"
      PRINT,"       EXAMPLE:   400.,   0."
      READ,XMAX,XMIN
      SCX=(XMAX-XMIN)/8.
      SCALEX=8.0/(XMAX-XMIN)
      PRINT,"ENTER YMAX AND YMIN"
      PRINT,"       EXAMPLE:   40.,   0."
      READ,YMAX,YMIN
      SCY=(YMAX-YMIN)/6.
      SCALEY=6.0/(YMAX-YMIN)
      N=1
      CALL PLOTS(LDEV)
      PRINT,"TYPE IN DATA FILE NAME."
      READ 14,FILNAM
   14 FORMAT(A6)
      PRINT,"ENTER NUMBER OF YEARS TO BE PLOTTED."
      READ,NPL
      PRINT,"DO YOU WANT ALL THE YEARS PLOTTED ON ONE GRAPH?"
      PRINT,"   TYPE 1 FOR YES; 2 FOR NO"
      READ,NOP
      CALL OPENF(1,FILNAM)
      PRINT,"ENTER FIRST LINE OF HEADING CENTERED IN 48 SPACES."
      READ 1 2,LAB1
      PRINT,1,"ENTER SECOND LINE OF HEADING IN THE SAME MANNER."
      PRINT,"SPACE AT THE END OF FIRST HEADING LINE IS RESERVED"
      PRINT,"BY THE PROGRAM FOR THE YEAR."
      READ102,LAB2
  102 FORMAT(16A3)
      PRINT,"ENTER VERTICAL AXIS TITLE CENTERED IN 18 SPACES."
      READ 1 4,LAB3
    1 4 FORMAT(6A3)
      DO 200 K=1,NPL
      L=1
      NI=1
      ME=0
      PRINT,"ENTER BEGINNING DAY AND MONTH AND ENDING DAY AND MONTH"
      PRINT,"FOR THIS YEAR.  EXAMPLE:BEGIN 13 APR. AND END 28 DEC."
      PRINT,"              ENTER: 13,4,28,12"
      READ,IBEG,IMB,IEND,IME
      JDA=7
      DO 105 IJ=1,5
      IF(IBEG.LE.JDA)IBEG=(IJ-1)*7+1
      IF(IBEG.LE.JDA) GO TO 106
  105 JDA=JDA+7
  106 PRINT,"ENTER YEAR AS FOLLOW"
```

1 of 3 sheets

Table F1 (continued)

Program Listing for Graphic Display of Results

```
PRINT,"2BLANKS,4NUMBER"
READ 15,IDYR(1),IDYR(2)
15 FORMAT(2A3)
DO 195 M=1,2
READ(1,1 ) (DUM(NN),NN=1,9)
1 FORMAT(A3)
DO 190 J=1,6
IF(M.EQ.1.AND.J.LT.IMB)ME=ME+MAXD(L)
IF(M.EQ.1.AND.J.LT.IMB)GO TO 188
IF(L.GT.IME)GO TO 190
READ(1,1 )DUM(1)
 IF(L.EQ.IME)ME=IEND+ME
IF(L.EQ.IME) GO TO 107
ME=ME+MAXD(L)
IF(M.EQ.1.AND.J.EQ.IMB)NBEG=NI=NI+IBEG-1
107 READ(1,2),(Y(I),I=NI,ME)
2 FORMAT(10X,7F7.0)
IF(M.EQ.1.AND.J.EQ.IMB)NI=NI+MAXD(L)-IBEG+1
IF(M.EQ.1.AND.J.EQ.IMB) GO TO 189
108 NI=NI+MAXD(L)
109 L=L+1
190 CONTINUE
READ(1,1 )DUM(1)
195 CONTINUE
IF(NOP.EQ.1.AND.N.GE.2) GO TO 45
IF(N-1)16,16,18
16 CALL PLOT(0.,-30.,-3)
GO TO 80
18 IF(MOD(N,2).EQ.0)GO TO 70
CALL PLOT(15.,-12.,-3)
GO TO 80
7  CALL PLOT(0.,12.,-3)
GO TO 82
8  CALL PLOT(2.,3.,-3)
82 CONTINUE
CALL AXIS13(0.,0.,12HTIME IN DAYS,-12,.14,8.,-1,0,XMIN,SCX,1.,1,0)
CALL AXIS13(0.,0.,LAB3,18,0.14,6.,-1,1,YMIN,SCY,1.,1,0)
CALL SYMBOL(0.71,-0.90,0.14,LAB1,0.,48)
CALL SYMBOL(7.10,-0.90,0.14,IDYR,0.,6)
CALL SYMBOL(0.71,-1.18,0.14,LAB2,0.,48)
CALL LATIC(0.,0.,6.2,8.,1,1)
45 CONTINUE
CALL PLOT(0.,0.,3)
DO 40 I=NBEG,ME
X(I)=I
X(I)=(X(I)-XMIN)*SCALEX
Y(I)=(Y(I)-YMIN)*SCALEY
IPEN=3
40 CONTINUE
DO 50 I=NBEG,ME
IF(Y(I).LE.0) GO TO 65
IF(Y(I).LE.6.0) GO TO 60
```

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Table F1 (concluded)

Program Listing for Graphic Display of Results

```
1180 CALL PLOT(X(I),Y(I),IPEN)
1190 IPEN=3
1200 GO TO 5
1210 55 IPEN=3
1220 GO TO 5
1230 50 CALL PLOT(X(I),Y(I),IPEN)
1240 IPEN=2
1250 40 CONTINUE
1260 IF(N.EQ.NPL) GO TO 90
1270 N=N+1
1280 200 CONTINUE
1290 90 CALL PLOT(0.,0.,3)
1300 CALL PLOT(0.,0.,999)
1310 STOP
1320 END
```


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Table F2

Example of Teletype Input for Graphic Display of Results

```
ENTER XMAX AND XMIN
      EXAMPLE:   400.,  0.
INPUT:00210
 ? 400.,0.

ENTER YMAX AND YMIN
     EXAMPLE:   48.,   0.
INPUT:00260
 ? 60.,0.

 ****FROM PLOTTER - PLEASE INPUT A PLOT FILE NAME
INPUT:00145
 ? AMSP01


TYPE IN DATA FILE NAME.
INPUT:00320
 ? PM2001

ENTER NUMBER OF YEARS TO BE PLOTTED.
INPUT:00350
 ? 2

DO YOU WANT ALL THE YEARS PLOTTED ON ONE GRAPH?
   TYPE 1 FOR YES; 2 FOR NO
INPUT:00380
 ? 2

ENTER FIRST LINE OF HEADING CENTERED IN 48 SPACES.
INPUT:00410
 ?     RIFLE RANGE, VICKSBURG, MISS. GROUP 0808


ENTER SECOND LINE OF HEADING IN THE SAME MANNER.
SPACE AT THE END OF FIRST HEADING LINE IS RESERVED
BY THE PROGRAM FOR THE YEAR.
INPUT:00450
 ?       PERCENT SOIL MOISTURE - SECOND LAYER

ENTER VERTICAL AXIS TITLE CENTERED IN 18 SPACES.
INPUT:00480
 ?  PERCENT MOISTURE
```

1 of 2 sheets

Table F2 (concluded)

Example of Teletype Input for Graphic Display of Results

```
ENTER BEGINNING DAY AND MONTH AND ENDING DAY AND MONTH
FOR THIS YEAR.  EXAMPLE:BEGIN 13 APR. AND END 28 DEC.
          ENTER: 13,4,28,12
INPUT:00570
 ? 13,4,31,12

ENTER YEAR AS FOLLOW
2BLANKS,4NUMBER
INPUT:00650
 ?   1951

ENTER BEGINNING DAY AND MONTH AND ENDING DAY AND MONTH
FOR THIS YEAR.  EXAMPLE:BEGIN 13 APR. AND END 28 DEC.
          ENTER: 13,4,28,12
INPUT:00570
 ? 1,1,31,12

ENTER YEAR AS FOLLOW
2BLANKS,4NUMBER
INPUT:00650
 ?   1952

STOP

RUNNING TIME:   21.7 SECS   I/O TIME :   12.6 SECS
```


2 of 2 sheets

APPENDIX G: PROCEDURES FOR CONVERTING MOISTURE CONTENT AND CONE INDEX TO TERMS REQUIRED FOR THE AIRFIELD CONSTRUCTION EFFORT (ACE) MODEL

1. The Airfield Construction Effort (ACE) model requires as input the moisture condition (wet or dry) and the California Bearing Ratio (CBR) of the upper layer of surface material. Wet or dry conditions of the soil and CBR can be derived from percent soil moisture content and CI values, respectively, that are output from the SMSP model. As previously discussed, the SMSP model outputs data for the 0- to 15-cm and 15- to 30-cm layers, respectively. Since the properties of the 15- to 30-cm layer more nearly approximate the average properties of an upper layer of several feet of soil thickness, which is of direct pertinence to the required airfield construction effort, this second layer is the only layer considered in the conversion procedures that follow.

Conversion of CI to CBR

2. The CBR for the ACE model can be derived from the following equation:

$$CBR = 0.02\ CI\ (15\text{-}30\ \text{cm layer})$$

This equation was derived from an analysis of data presented in plate 43 of reference 16, and closely approximates the relation shown in fig. 4.11 of reference 17. The following table shows CI class values derived from the above equation, that are equivalent to CBR classes used in the ACE model:

Subgrade CBR	Equivalent Subgrade CI
3-9	150-<500
10-20	500-1000

It should be noted that a CI less than 150 or a CBR less than 3 indicates that construction effort is not considered because the soil is too soft to permit efficient operation of equipment.

Conversion of Moisture Content to Wet or Dry States

3. The soil moisture content at the plastic limit (PL)* is considered to be the boundary line between the dry and wet states of the soil. Soils with moisture contents above PL act as plastic materials, adhere to equipment, and, in general, are more difficult to work than soils with moisture contents below PL.

4. The wet or dry conditions of the soil can be determined from one of the two following procedures, depending upon the availability of PL information for the soil:

a. PL of the soil is known:

% MC (15- to 30-cm layer) from SMSP Model	Soil Moisture Condition
<PL	Dry
≥PL	Wet

b. PL of soil is not known: Use data from the following tabulation to estimate the PL of the soil, and then compare the PL with the

*Plastic limit units are in percent moisture content.

percent moisture content (15- to 30-cm layer), as in a above, to determine the dry or wet condition of the soil:

Region	Soil Type	Average PL
Tropical	Sand	16
	Silt	26
	Clay	33
	Laterite	22
Temperate	Sand	18
	Silt	23
	Clay	22
Arid	Sand	16
	Silt	21
	Clay	21

Data in the above table were obtained from table 18 of reference 8. Soil samples from 1066 sites were used to derive values of average PL.