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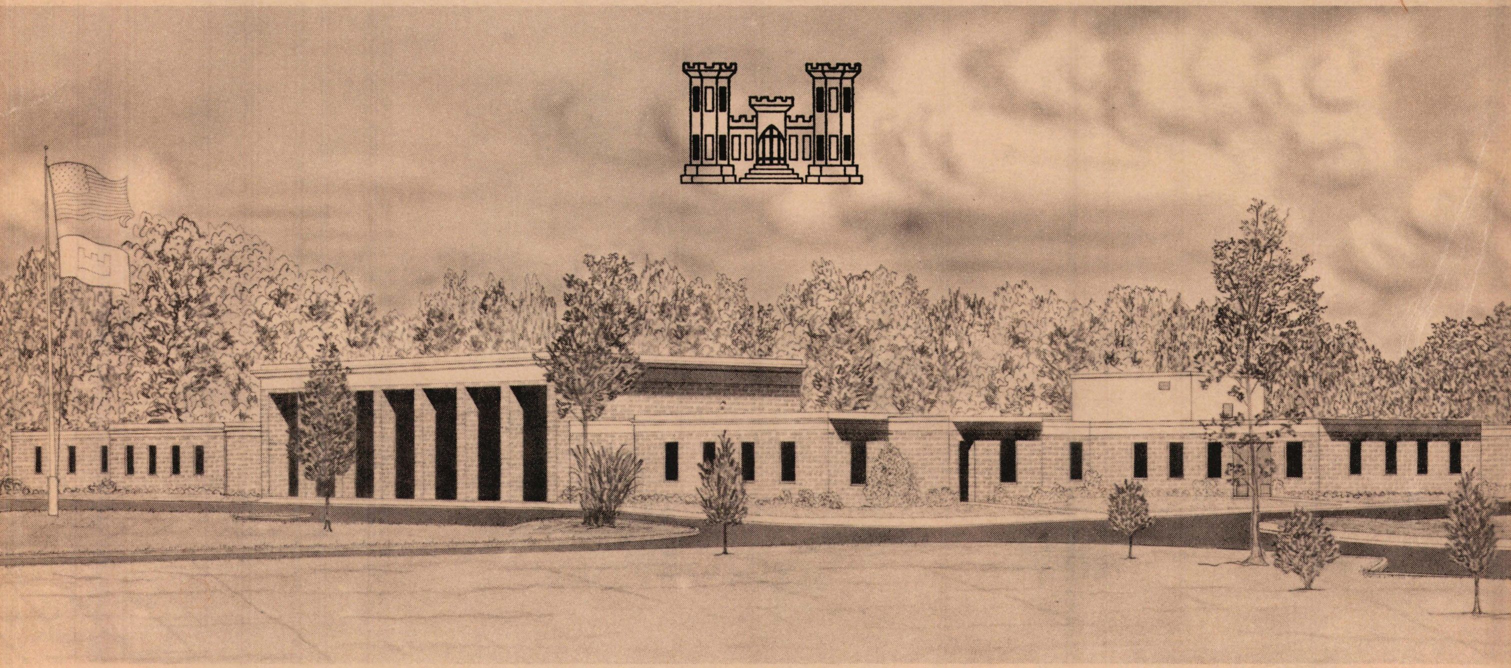
MISCELLANEOUS PAPER M-73-1

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

by

M. H. Smith, M. P. Meyer



January 1973

Sponsored by U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia

Conducted by U. S. Army Engineer Waterways Experiment Station
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ARMY-MRC VICKSBURG, MISS.

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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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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.

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 multi-pass 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.

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

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* 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 in 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.

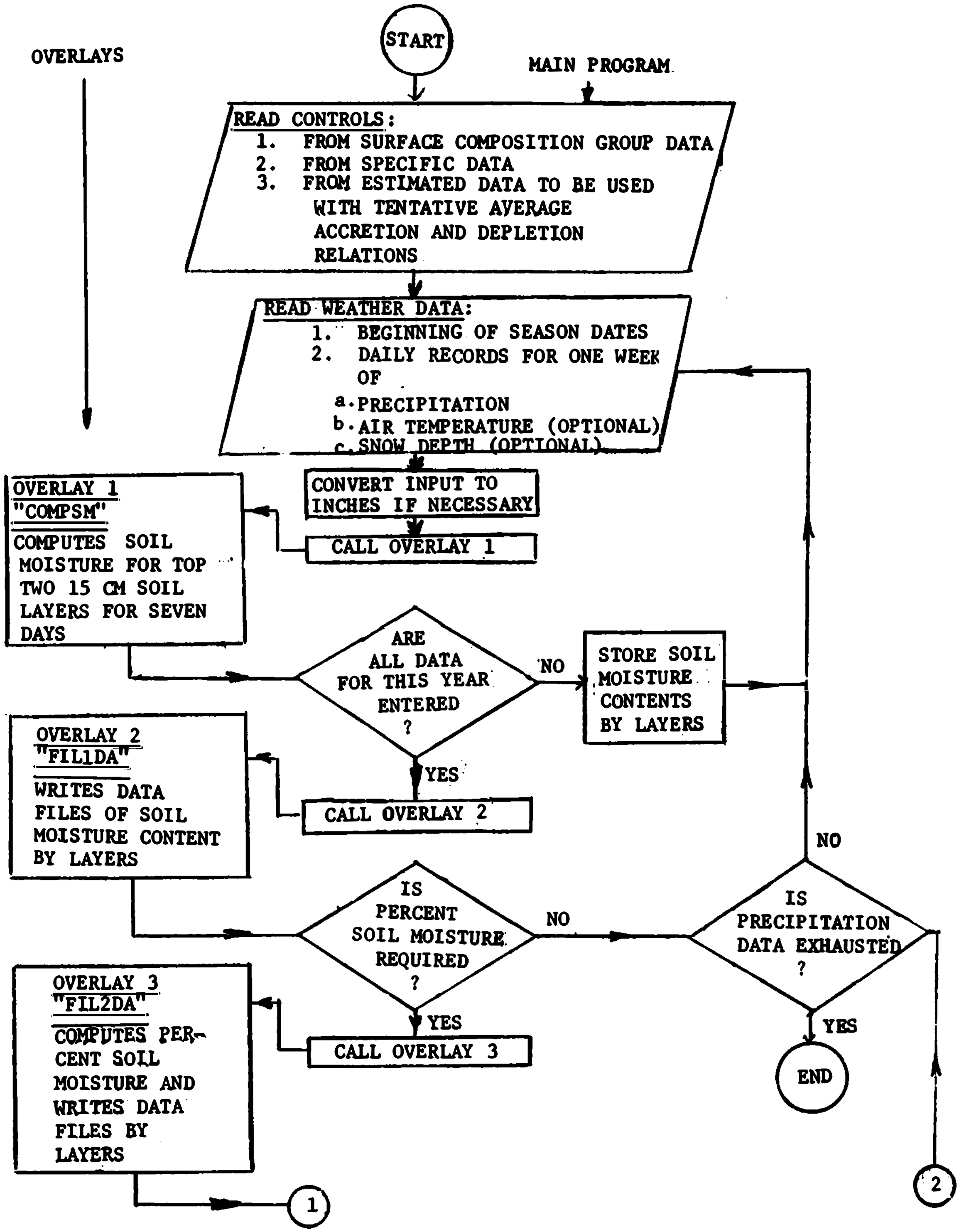

Fig. 1. Computer program flow chart

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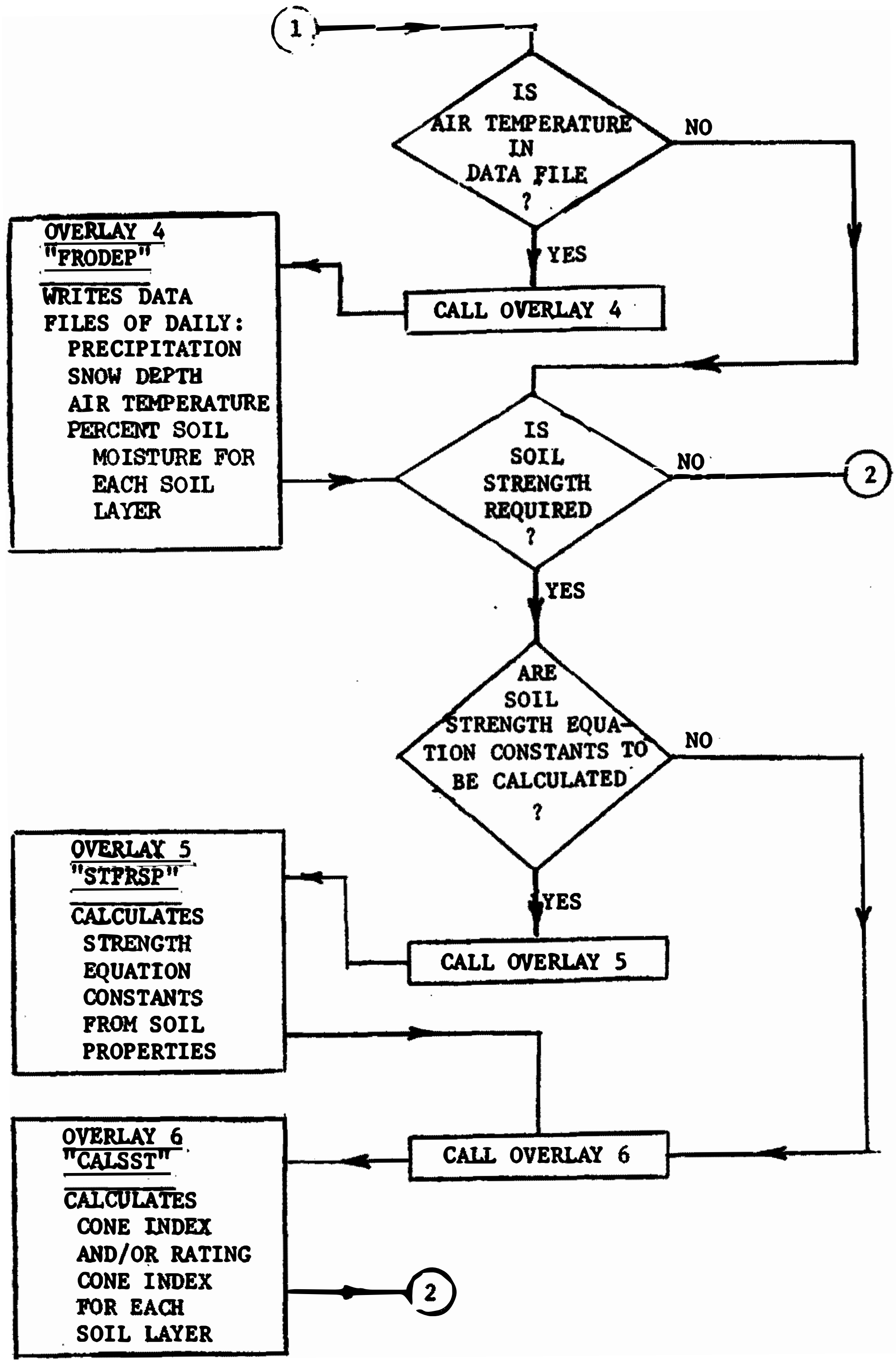

Fig. 1. (Concluded)

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 6-3). 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).

g. 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]

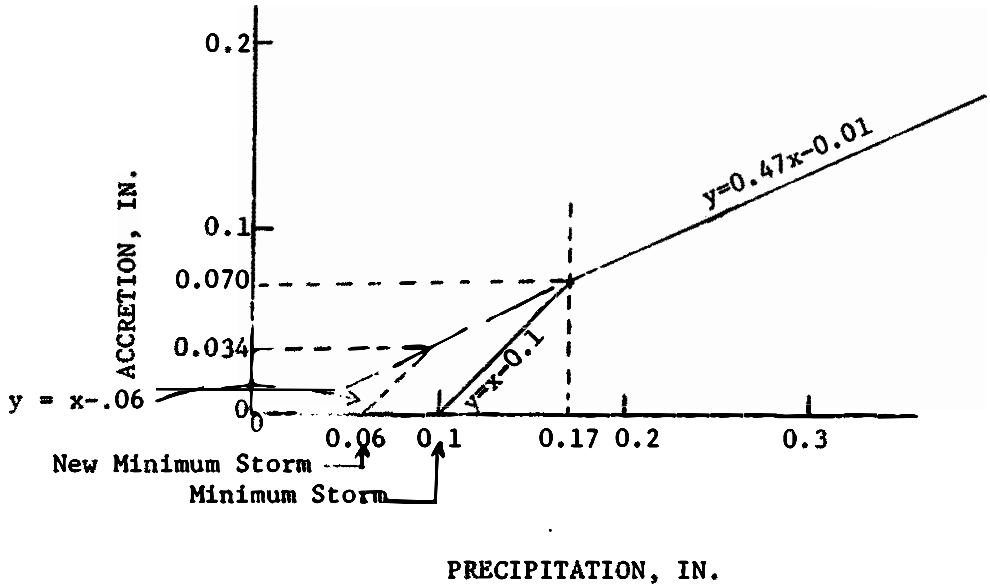


Fig. 2. First-layer Class I accretion

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

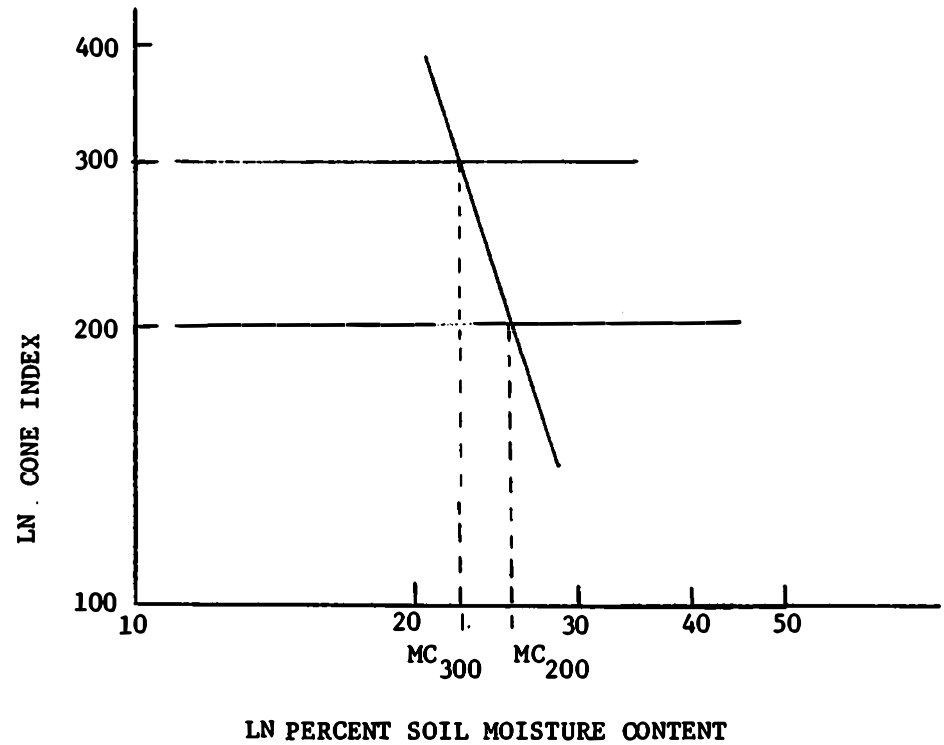
f. Liquid limit

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.

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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%	>0-7	2	0303
		Gravel with fines, P.D. sizes <0.074mm, is >5-50%	>0-7	2	0707 or 1111**
	Sand, P.D. sizes >0.074-4.76mm, is >25%	Clean sand, P.D. sizes <0.074mm is <5%	>0-7	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

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	-	-

Table 3 (continued)

Name	Description	Units	Decimal Places
ISM	Month of new season	-	-
IS1	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,MC,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	-	-

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

$f(x) = 0.15190803x - 0.07720229x^2 - 0.01280603x^3 + 0.01851488x^4$

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

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 $\ln y = a + b_1 x_1 + b_2 x_2 + \ldots + b_i x_i$

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.FIL1OA
C       $OVR.FIL2OA
C       $OVR.FRODEP
C       $OVR.CALSST
C       $OVR.STFRSP
C       $RPC
C       *****COMMON VARIABLES*********************************************
```

```
COMMON IDC1(35).PMC(2).STO(12.31).NSTEO(4).RF(7).IHO(20).CXMIN(2).
TEMPER(12.35).SNO(12.35).CONEW(3.2.6).XRANO(2.3).STCON(2.4).
STRL1(2.4).NMAXO(2).ISINUM(4).C3(2.2).C4(2.2).OWMC(2.7).COEF(108).
MAXO(12).IMOA(4.12).8O(2).RANO(2.3.3).X(2).C1(18.2).C6(16.4.2).
CMAX(2).CMIN(2).C2(4).STORMC(12.31).STORMO(12.31).ADF(2).SOF(2).
IT(2).KIND(3).ISLEW(3).DUM(26).PRECIP(12.36).8(13.2.2).B1(12).
CON1(2.2).O(2).E(2).IMOO(12.2).ABAR(2.2).8BAR(2.2).NMCLA1(2).
NMCLA2(2).NPMLA1(2).NPMLA2(2).NFROEP(2).NCILA1(2).NCILA2(2).
```

```
NRCLA1(2).NRCLA2(2).NSOUR.IUNMEA.NTEMP.NSNOW.NYR.ITEXA.
ITEX8.RMIN.ITYPE.ITEM1.ITEM2.I1.IDEV1.IS1.ISD.ISM.ISY.IIT.IOA.
MO.IYR.ITEMP.ICOUNT.ACCR.DEP.C1COF.C1ROF.NCODE.ACCR1.ACCR2.MOK.
JUL.JIL.JUG.LU8.JOK.MO8.JEM.JAZ.JEL.JEB.
NTYPE.NEWLIM.NEWCOF.NSOST.NR.LL.JU8.I8O.IBM.IBY.NENYR.
MEAOU1.MEAOU2.K.LK.JB.JENO.NTOS.AJBN.JBN.JN.KPMC.SECT1.SECT2.
SECT3.SECT4.SECT5.SECT6.SECT7.SECT8.SECT9.SECT10.NCI.NRCI.
SAM.INO.IOAB.IDAE.JNK.JNI.NO.STON.NUMB.ISEO.NY1SEQ.NY2SEQ
```

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

```
EQUIVALENCE (NMCLA1.OMCLA1).(NMCLA2.OMCLA2).(NPMLA1.OPMLA1).
(NPMLA2.OPMLA2).(NFROEP.OFROEP).(NCILA1.OCILA1).(NCILA2.OCILA2).
(NRCLA1.ORCLA1).(NRCLA2.ORCLA2)
```

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

```
DATA NUMB.ISEO.NY1SEO.NY2SEO.NEWFIL.ACCR1.ACCR2/'001'.0.0.0.
3.0.01.0.03/
```

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

```
DATAMAXO/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.-.30606206.0..0..
.15190803.-.07720229.-.01280603..01861488.0..0..
0.1164190.0.06704479.-0.09112914.0.03120642.0..0..
.09612290..01073670.-.10720766..05648077.0..0..
.14304453.-.10102288.-.02103815..10071069.0..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.
.08321811..11716083.-.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..
```

```
.16564710..32448206.-3.6931164.6.0923182.0..0..
.1685473.-1.2164306.5.0226953.-5.9828479.0..0..
.13851029.-.32294633..51095728.-.23644623.0..0..
.14694158.-.508568.1.2942848.-.74715639.0..0./
```

```
DATA RMIN.STRLI.CICOF.NEWCOF/0.1.760..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.NMAXD/1.0.0/.C3/.47..76..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.
1.25.1.43.0.93.0.64.0.36.0.42.0.30.0.92.0.46/
```

```
DATA RF.PRECIP/7*0..420*0./.MOK.JUL.JIL.JUO.LUB.JOK.MOB.JEM.JAZ.
JEL.JEB/0.0.0.0.0.0.0.0.0.0.3/.JUB.KIND/0.3*0/.ISLEW/6193023.
8366711.8366711/.NEWCOF.NEWLIM.NSOST/0.0.0/.NTOS/1H9/
```

```
DATA C6/0.602.0..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..
-0.364.0..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..0.101.0..0.105.0..0..0..0..0..
0.170.0..0..0.026.0..0..0..0..0.013.0..0.061.0..0..0..0..0./
```

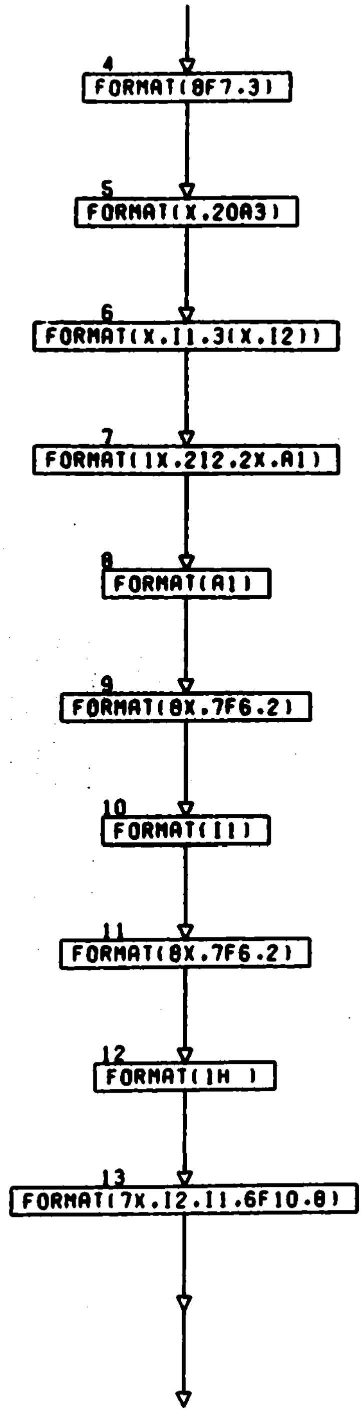
```
C      *****FORMAT STATEMENTS******************************************
```

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

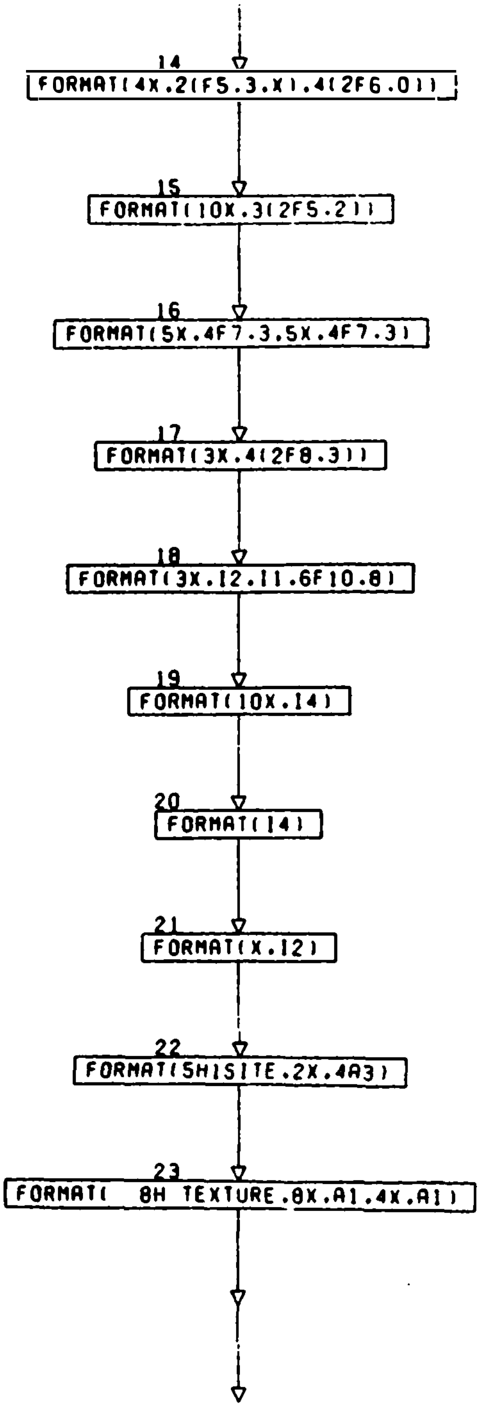
```
2     FORMAT(1X.F9..7F10.)
```

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

CONT. ON PG 3

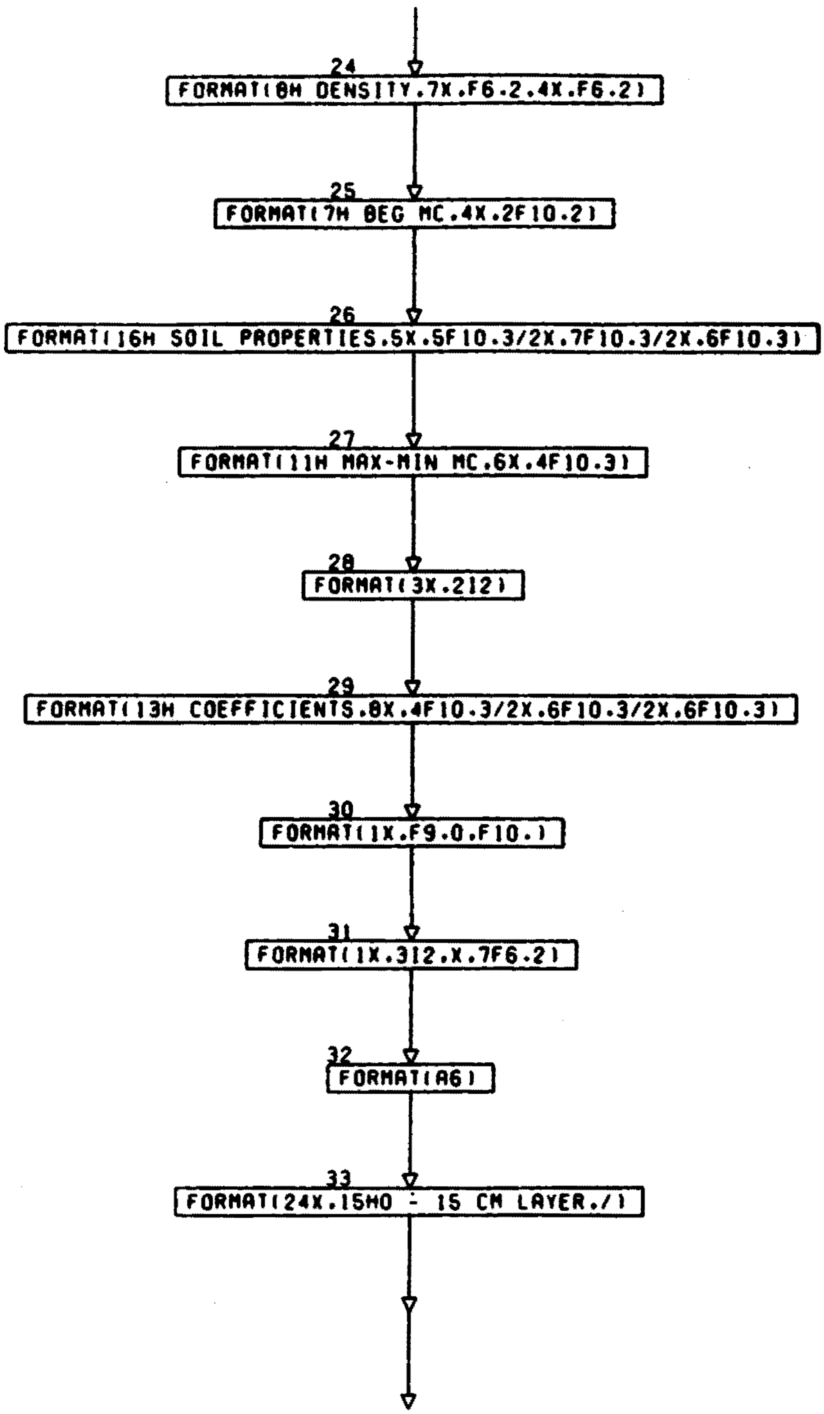

4
FORMAT(8F7.3)
5
FORMAT(X,20A3)
6
FORMAT(X,I1,3(X,I2))
7
FORMAT(1X,2I2,2X,A1)
8
FORMAT(A1)
9
FORMAT(8X,7F6.2)
10
FORMAT(I1)
11
FORMAT(8X,7F6.2)
12
FORMAT(1H)
13
FORMAT(7X,I2,I1,6F10.8)

CONT. ON PG 4

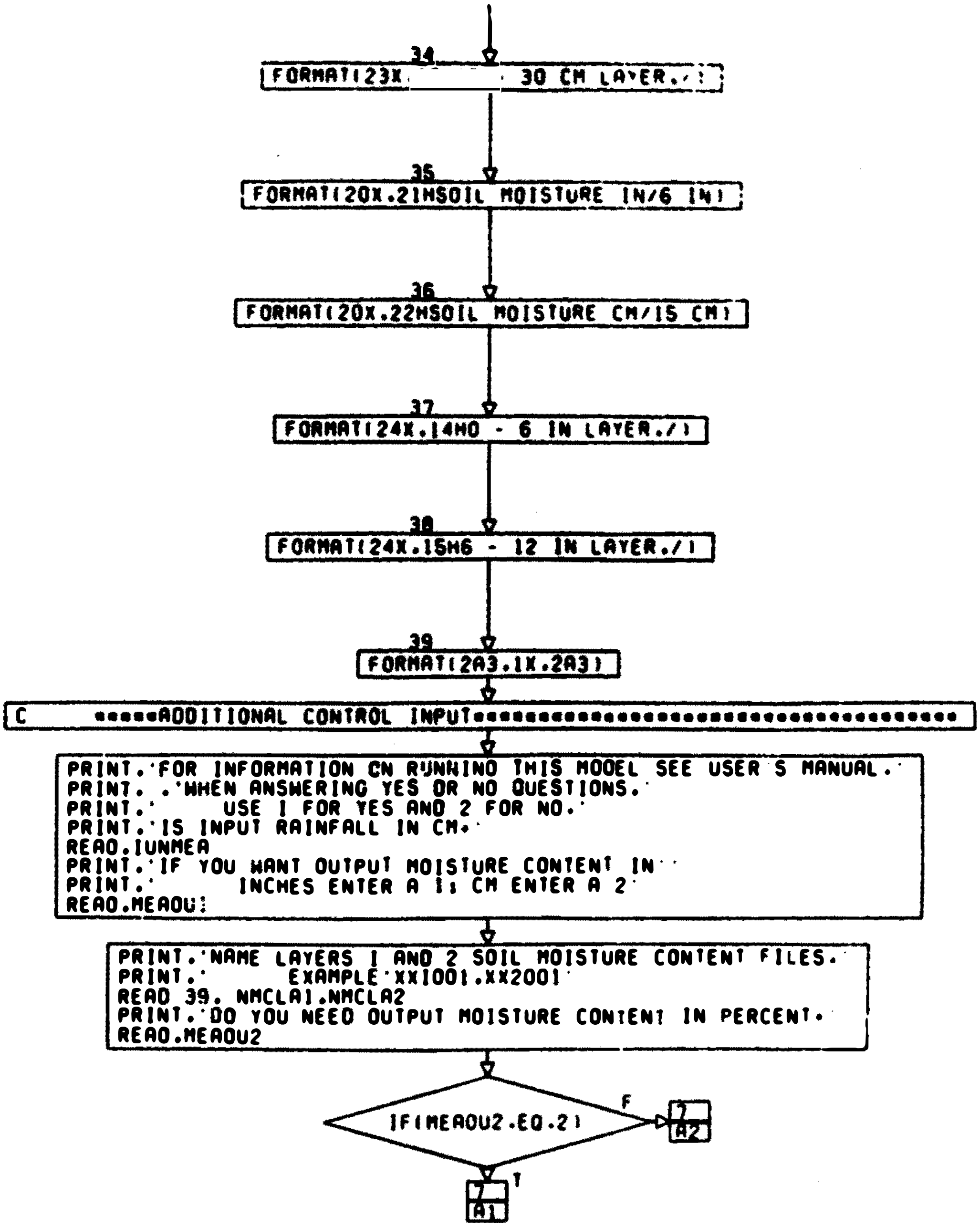


14
FORMAT(4X.2(F5.3.X).4(2F6.0))
15
FORMAT(10X.3(2F5.2))
16
FORMAT(5X.4F7.3.5X.4F7.3)
17
FORMAT(3X.4(2F8.3))
18
FORMAT(3X.I2.I1.6F10.8)
19
FORMAT(10X.I4)
20
FORMAT(I4)
21
FORMAT(X.I2)
22
FORMAT(5H1SITE.2X.4A3)
23
FORMAT(8H TEXTURE.8X.A1.4X.A1)

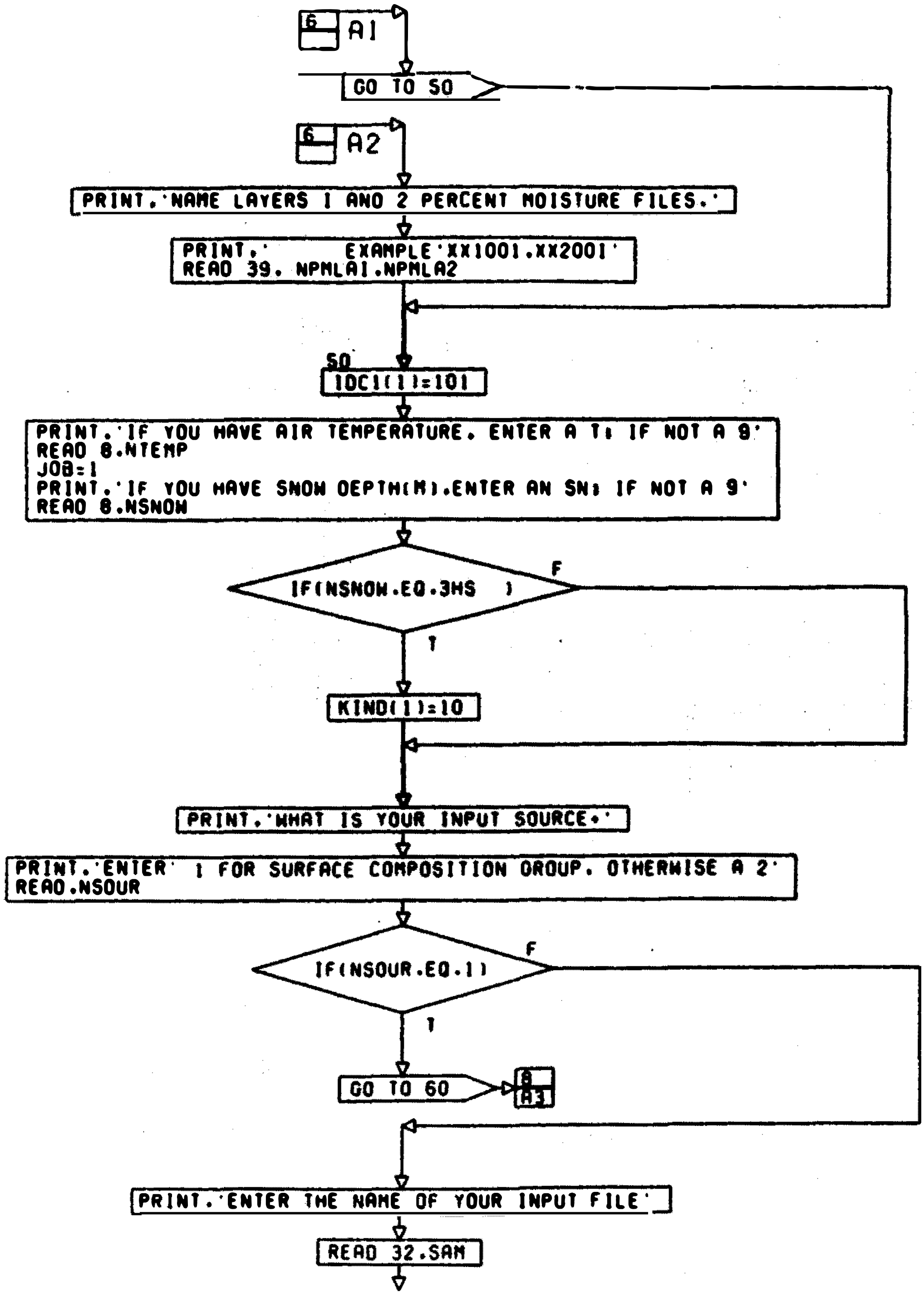
CONT. ON PG 5


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,15H0 - 15 CM LAYER,/)

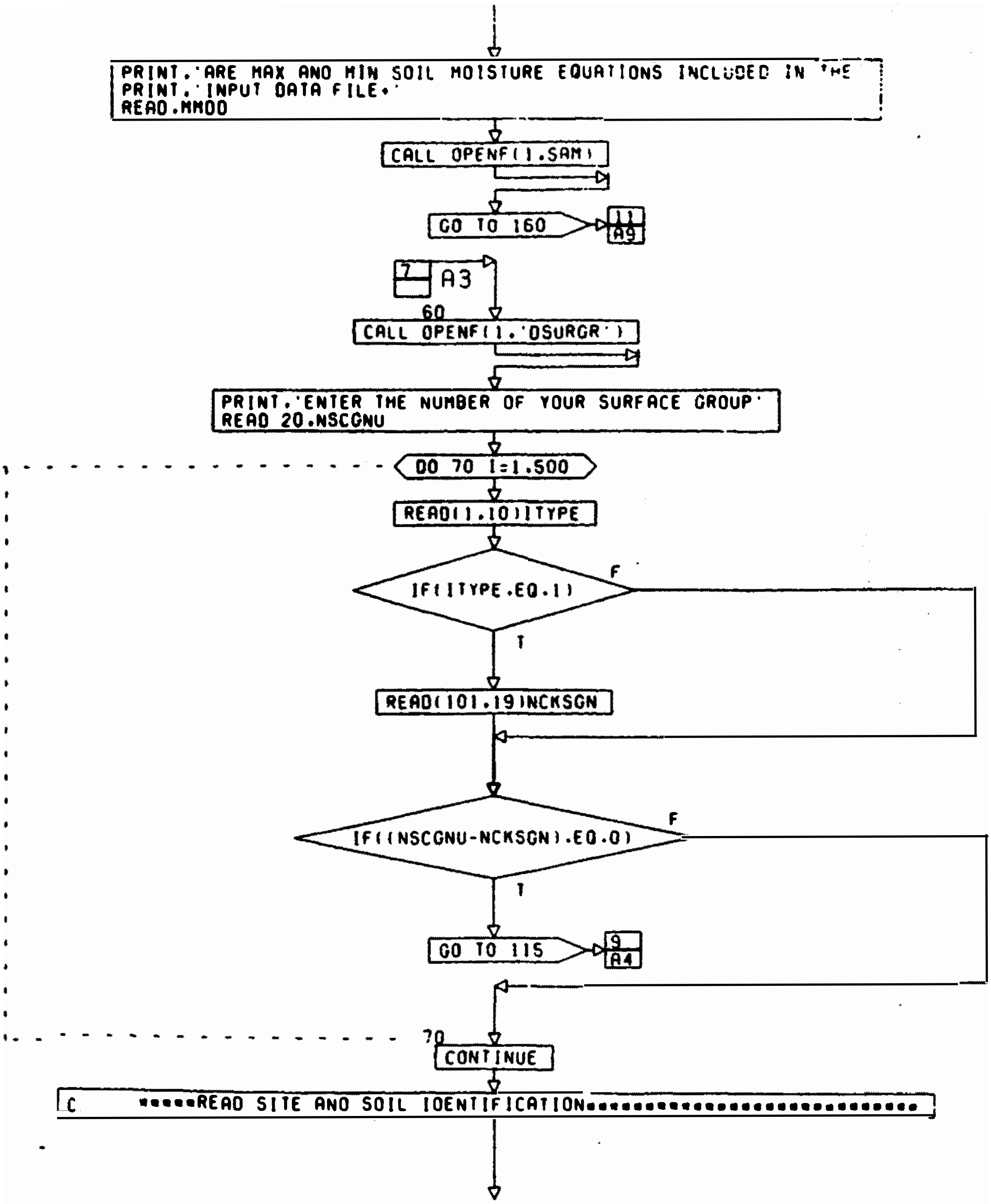
CONT. ON PG 6


34
FORMAT(23X 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.IUNMEA
PRINT.'IF YOU WANT OUTPUT MOISTURE CONTENT IN'
PRINT.' INCHES ENTER A 1; CM ENTER A 2'
READ.MEAOU1
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

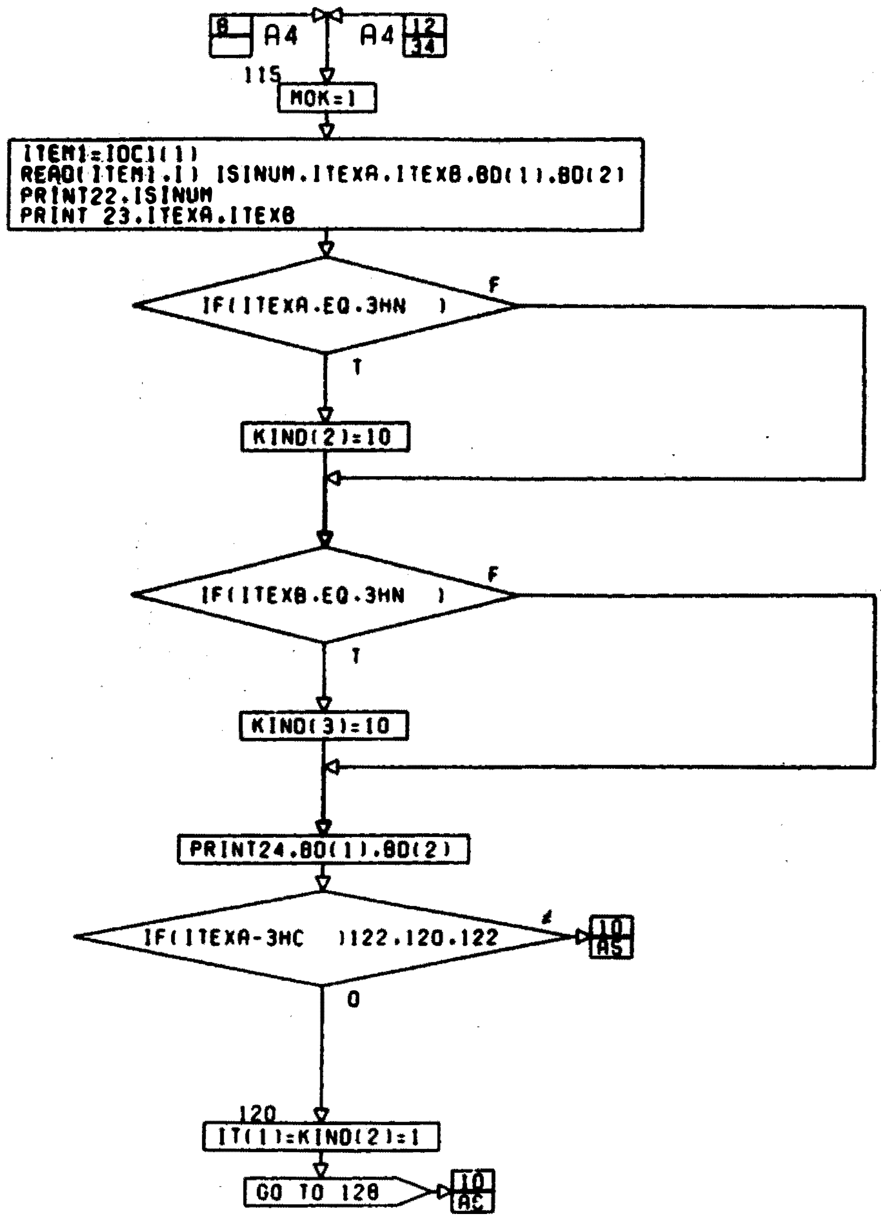
CONT. ON PG 7


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
IDC1(1)=101
PRINT,'IF YOU HAVE AIR TEMPERATURE, ENTER A T; IF NOT A 9'
READ 8.NTEMP
JOB=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
8
A3
PRINT,'ENTER THE NAME OF YOUR INPUT FILE'
READ 32.SAM

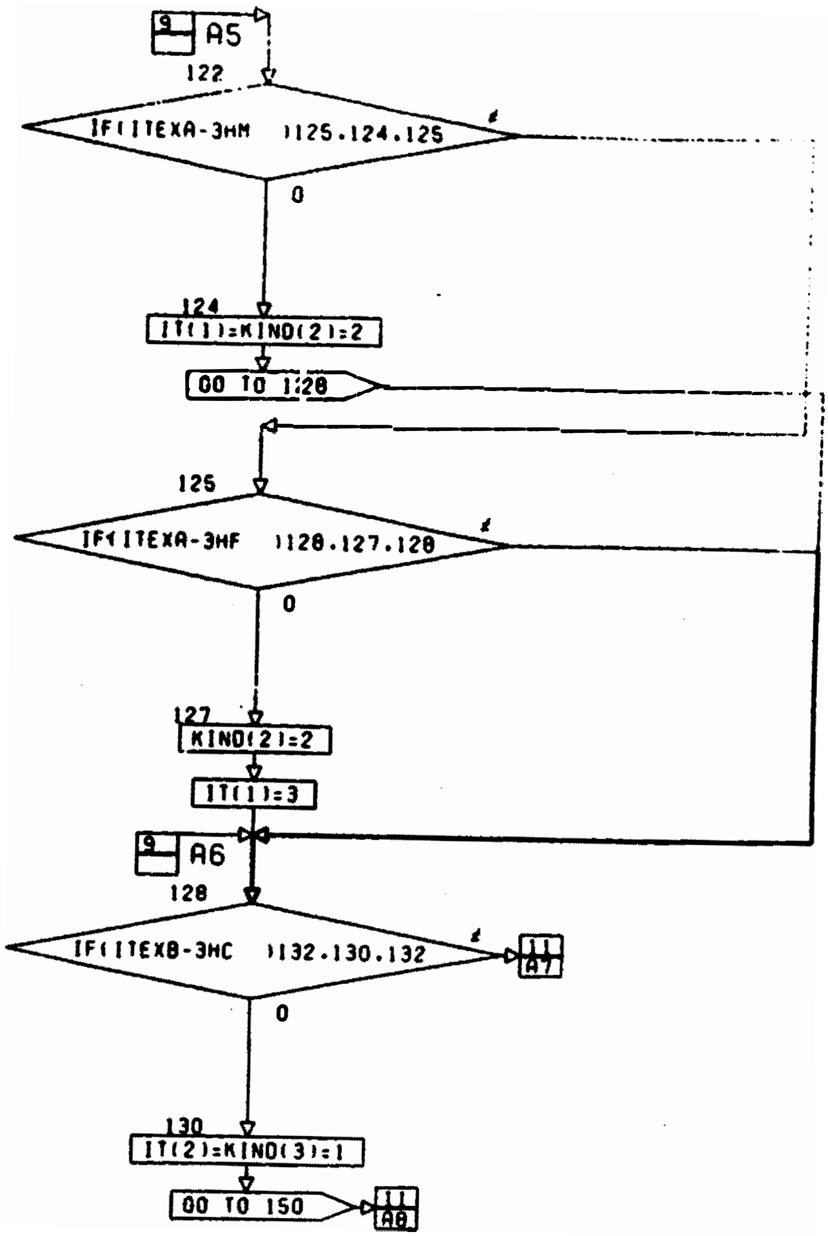
CONT. ON PG 8


PRINT,'ARE MAX AND MIN SOIL MOISTURE EQUATIONS INCLUDED IN THE
PRINT,'INPUT DATA FILE.'
READ,MMOD
CALL OPENF(1,SAM)
GO TO 160
11
A9
7
A3
60
CALL OPENF(1,'DSURGR')
PRINT,'ENTER THE NUMBER OF YOUR SURFACE GROUP'
READ 20,NSCGNU
DO 70 I=1,500
READ(1,10)ITYPE
IF(ITYPE.EQ.1)
F
T
READ(101,19)NCKSGN
IF((NSCGNU-NCKSGN).EQ.0)
F
T
GO TO 115
9
A4
70
CONTINUE
C *****READ SITE AND SOIL IDENTIFICATION*****************************

CONT. ON PG 9

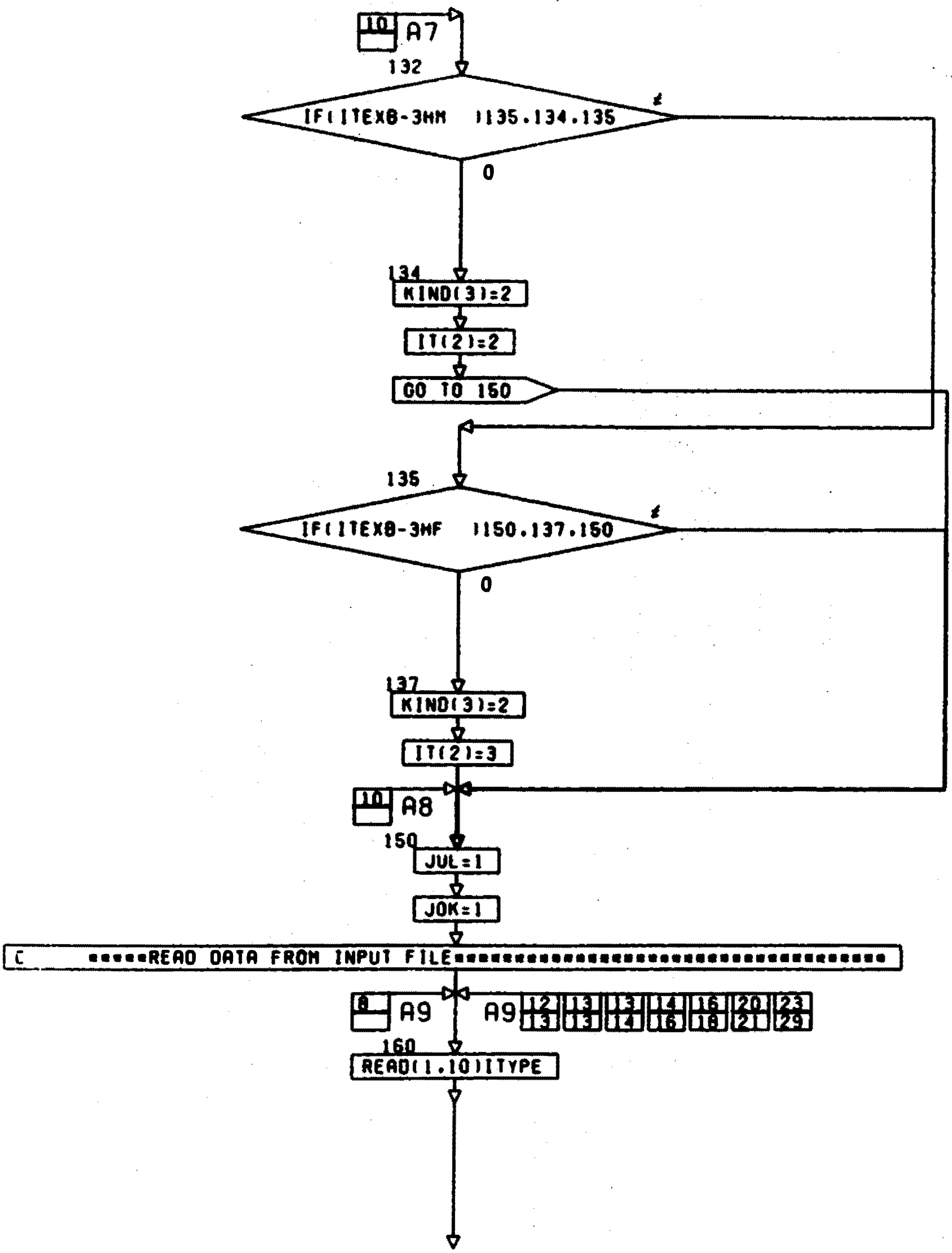

A4
A4
115
MOK=1
ITEM1=IOC1(1)
READ(ITEM1,I) ISINUM,ITEXA,ITEXB,BD(1),BD(2)
PRINT22,ISINUM
PRINT 23,ITEXA,ITEXB
IF(ITEXA.EQ.3HN)
F
T
KIND(2)=10
IF(ITEXB.EQ.3HN)
F
T
KIND(3)=10
PRINT24,BD(1),BD(2)
IF(ITEXA-3HC)122,120,122
≠
0
120
IT(1)=KIND(2)=1
GO TO 128
10
AS
10
AC

CONT. ON PG 10

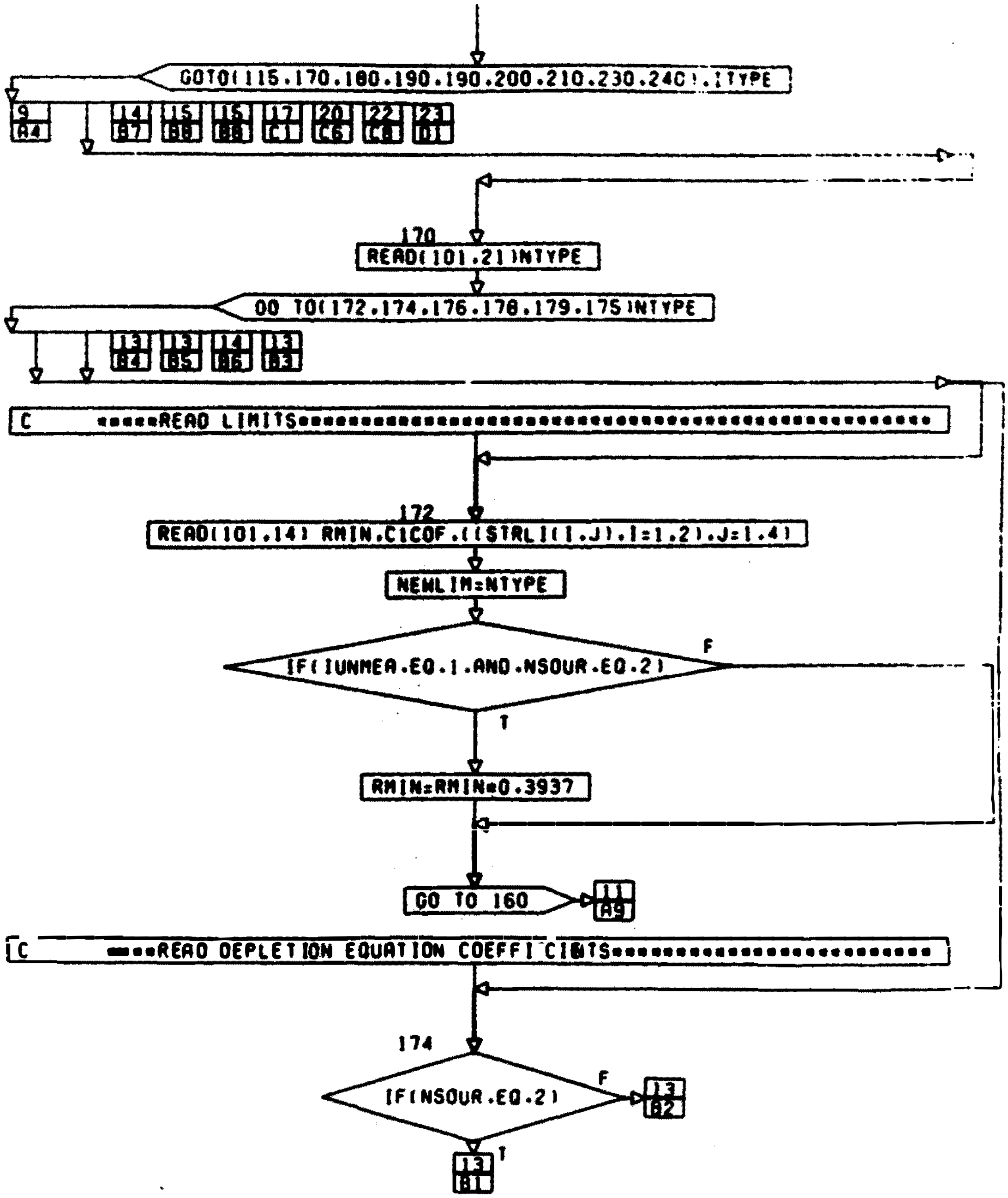


9
A5
122
IF(ITEXA-3HM)125.124.125
0
124
IT(1)=KIND(2)=2
GO TO 128
125
IF(ITEXA-3HF)128.127.128
0
127
KIND(2)=2
IT(1)=3
9
A6
128
IF(ITEXB-3HC)132.130.132
0
11
A7
130
IT(2)=KIND(3)=1
GO TO 150
11
A8

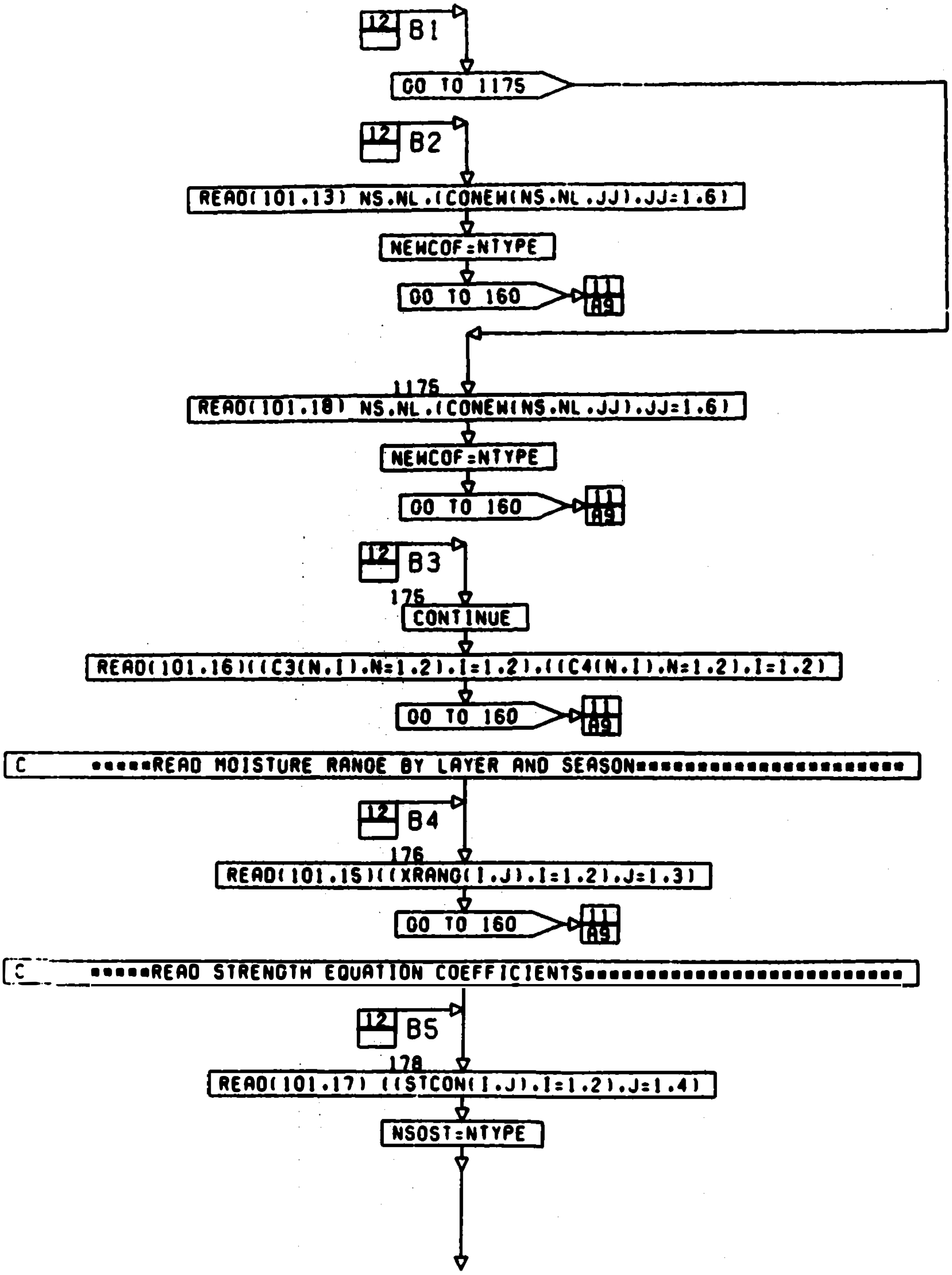
CONT. ON PG 11


10
A7
132
IF(ITEXB-3HM)135,134,135
≠
0
134
KIND(3)=2
IT(2)=2
GO TO 150
135
IF(ITEXB-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************************************
8
A9
A9
12 13 13 14 16 20 23
13 13 14 16 18 21 29
160
READ(1,10)ITYPE

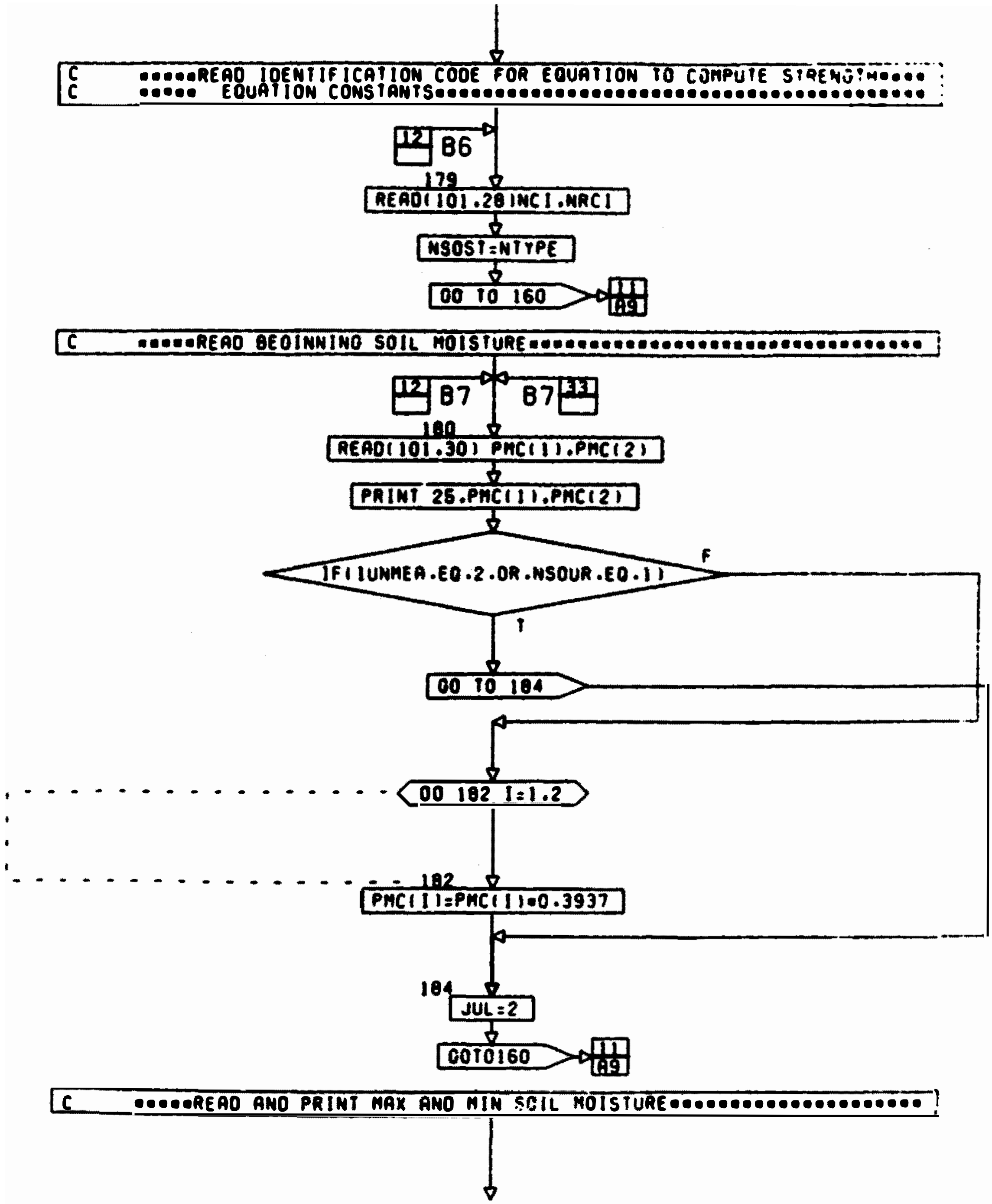
CONT. ON PG 12


GOTO(115.170.180.190.190.200.210.230.240).ITYPE
9 A4
14 B7
15 B8
15 B8
17 C1
20 C6
22 C8
23 D1
170
READ(101.21)NTYPE
DO 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 A2
T
13 B1

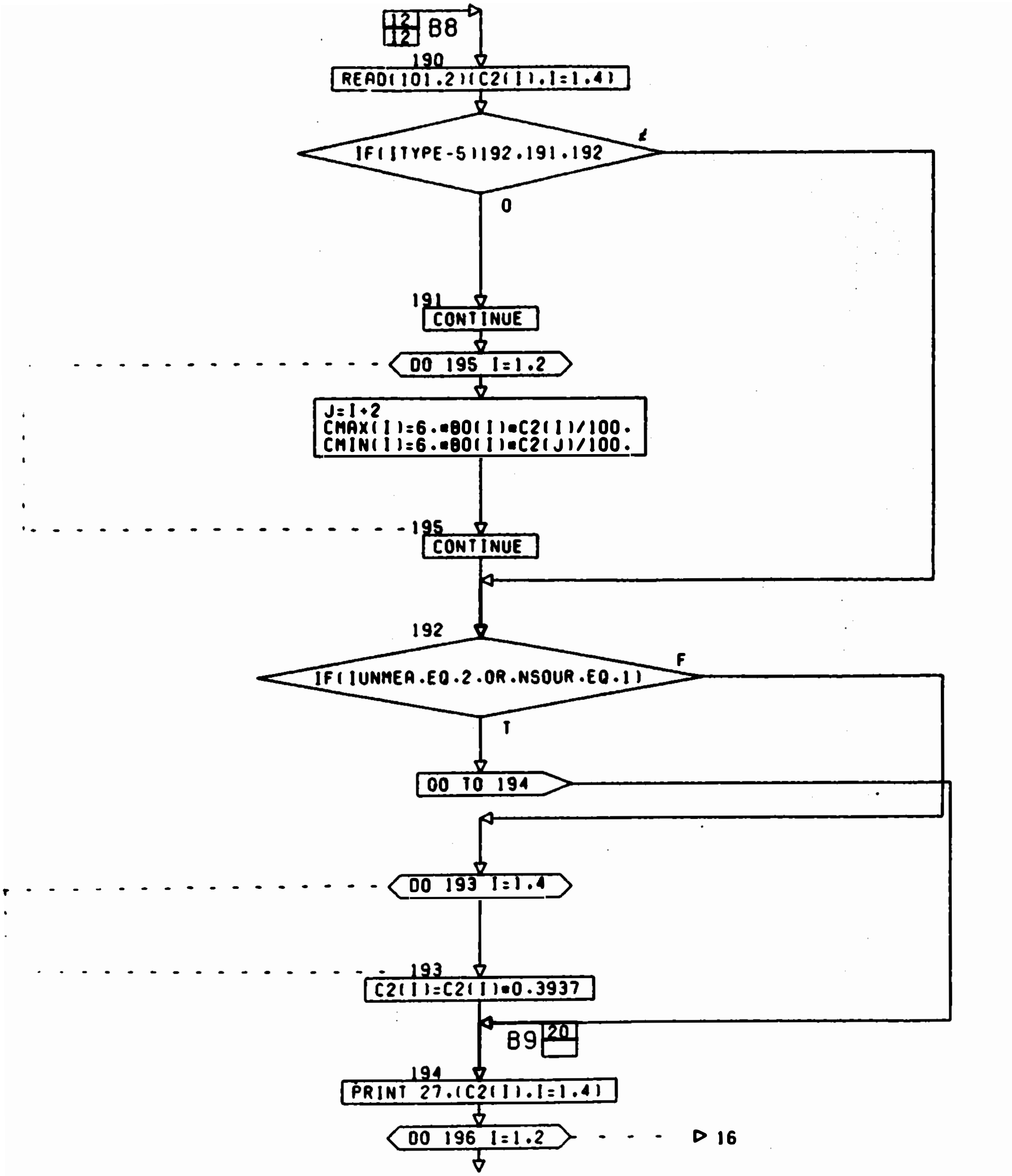
CONT. ON PG 13


12 B1
GO TO 1175
12 B2
READ(101,13) NS,NL,(CONEW(NS,NL,JJ),JJ=1,6)
NEWCOF=NTYPE
GO TO 160
11 A9
1175
READ(101,18) NS,NL,(CONEW(NS,NL,JJ),JJ=1,6)
NEWCOF=NTYPE
GO TO 160
11 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
11 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
11 A9
C *****READ STRENGTH EQUATION COEFFICIENTS**************************
12 B5
178
READ(101,17) ((STCON(I,J),I=1,2),J=1,4)
NSOST=NTYPE

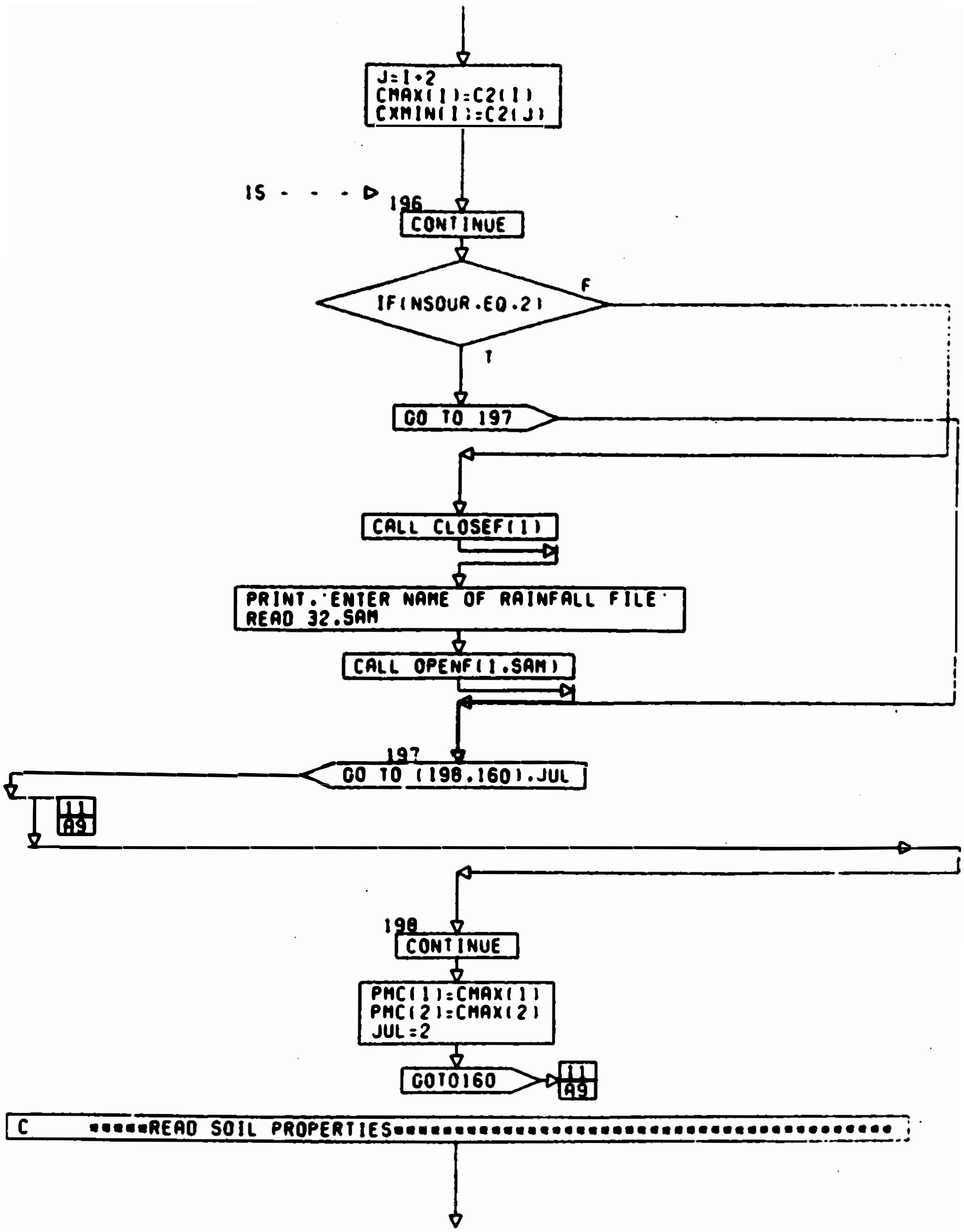
CONT. ON PG 14


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*****

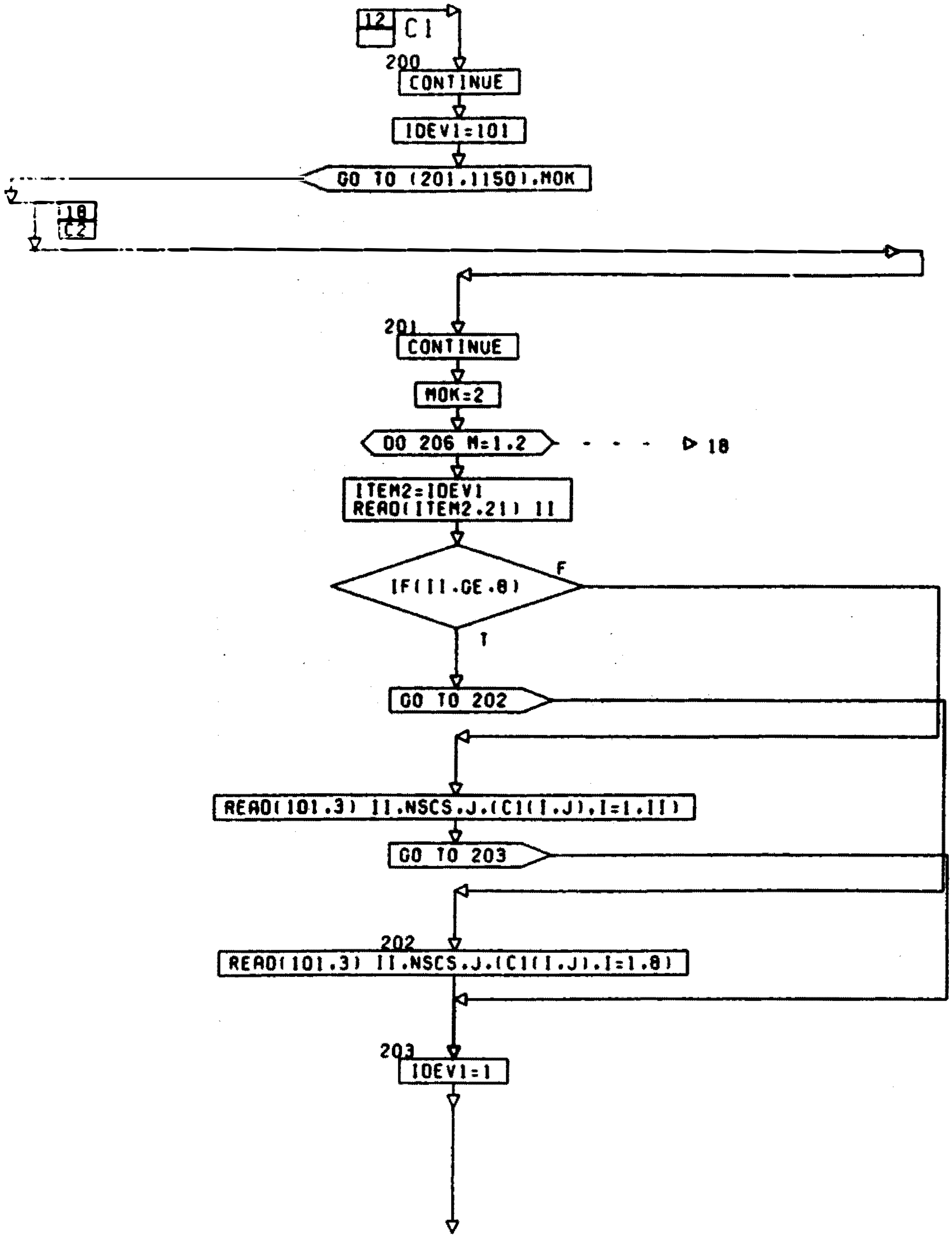
CONT. ON PG 15


12
12
B8
190
READ(101,2)(C2(I),I=1,4)
IF(ITYPE-5)192,191,192
0
191
CONTINUE
DO 195 I=1,2
J=I+2
CMAX(I)=6.*B0(I)*C2(I)/100.
CMIN(I)=6.*B0(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

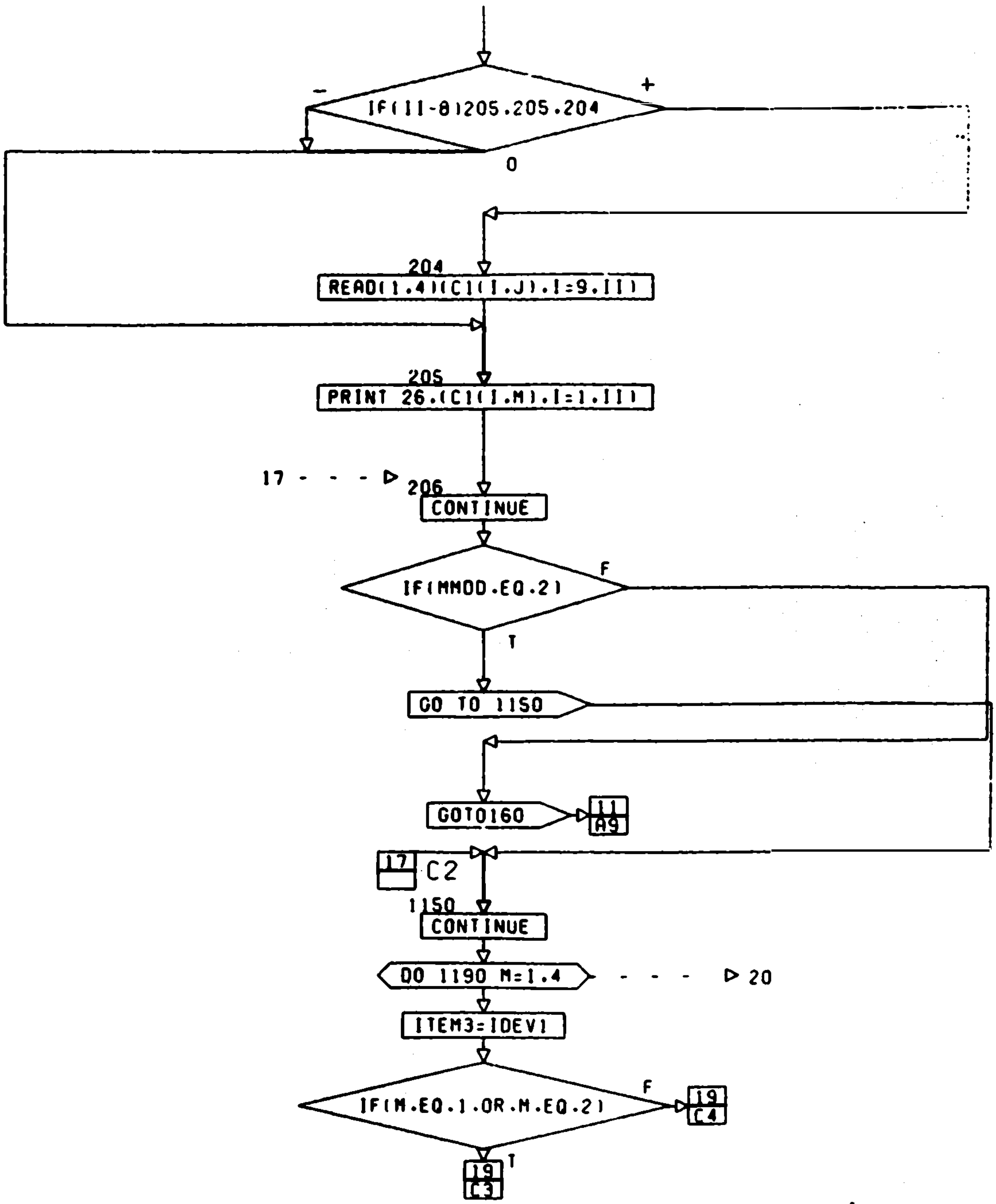
CONT. ON PG 16


J=I+2
CMAX(I)=C2(I)
CXMIN(I)=C2(J)
15
196
CONTINUE
IF(NSOUR.EQ.2)
F
T
GO TO 197
CALL CLOSEF(1)
PRINT,'ENTER NAME OF RAINFALL FILE'
READ 32,SAM
CALL OPENF(1,SAM)
197
GO TO (198,160),JUL
11
A9
198
CONTINUE
PMC(1)=CMAX(1)
PMC(2)=CMAX(2)
JUL=2
GOTO160
11
A9
C *****READ SOIL PROPERTIES***

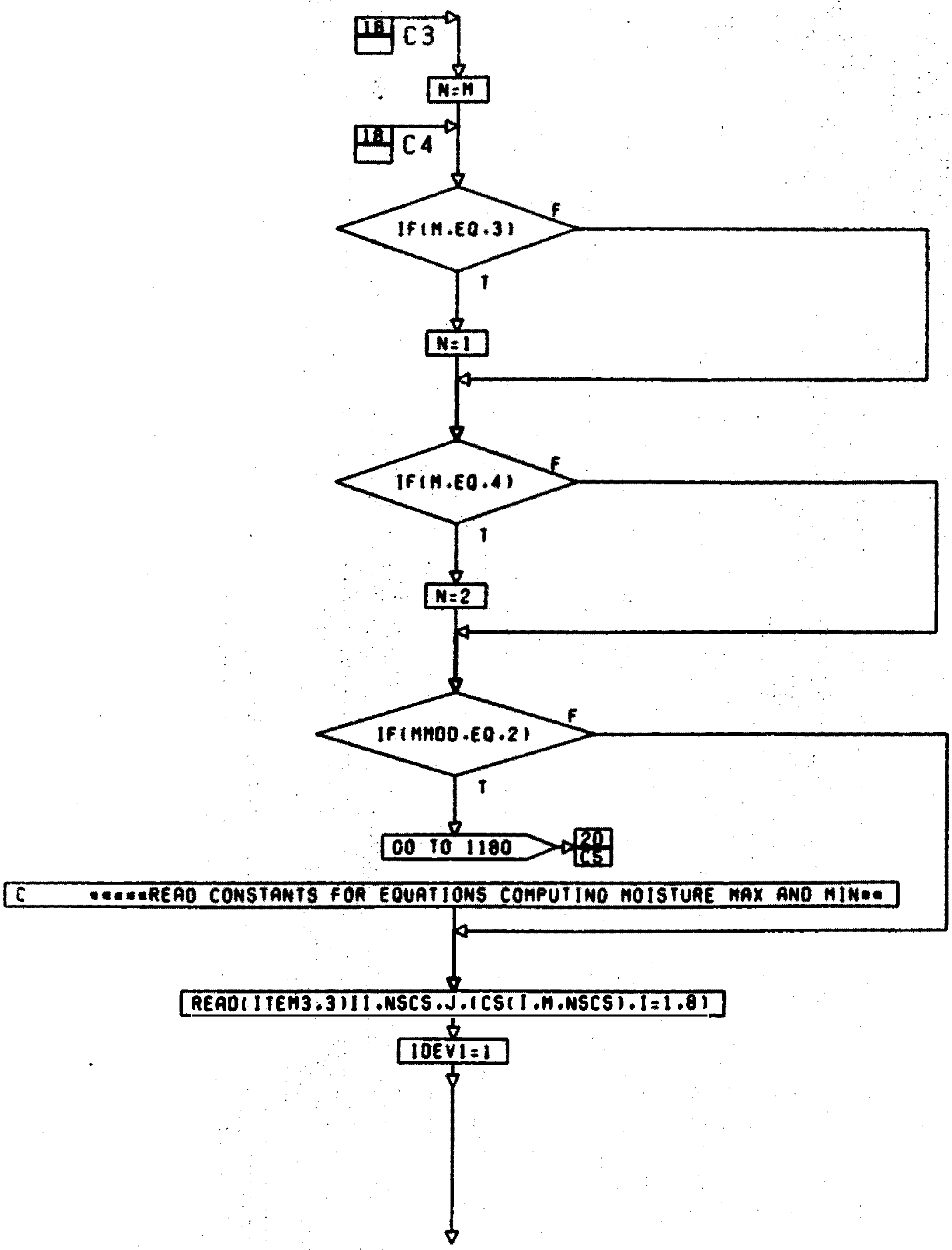
CONT. ON PG 17


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

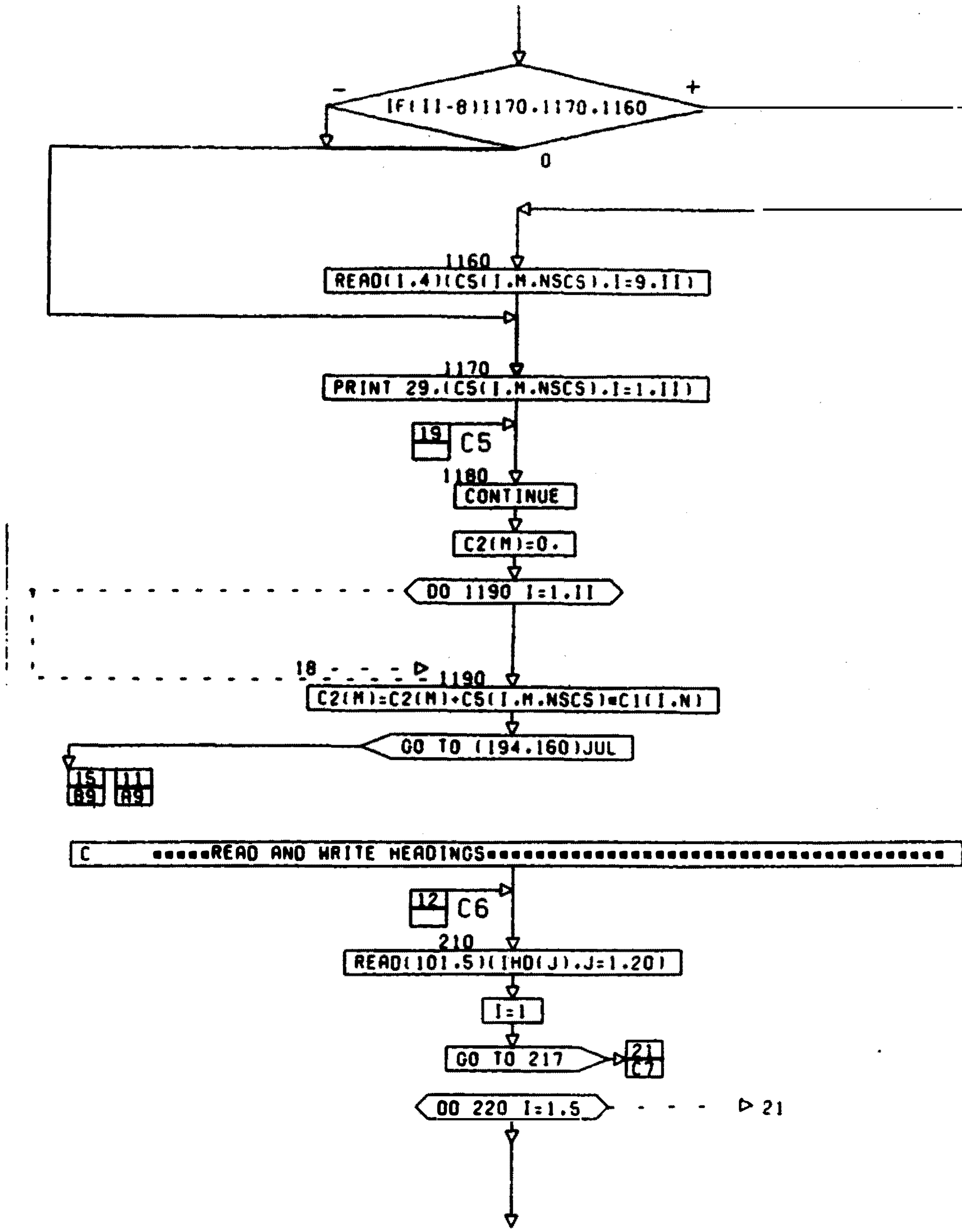
CONT. ON PG 18


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

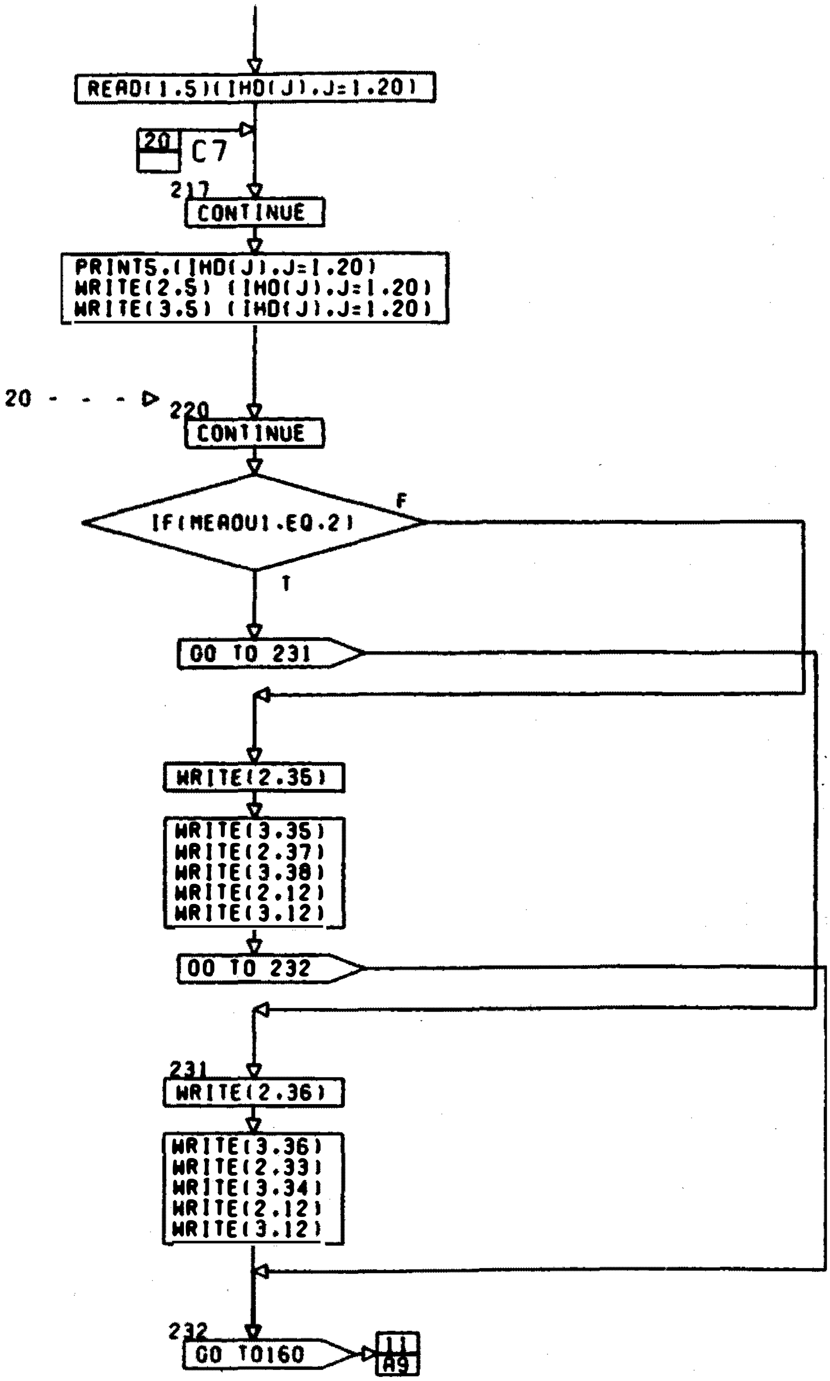
CONT. ON PG 19


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

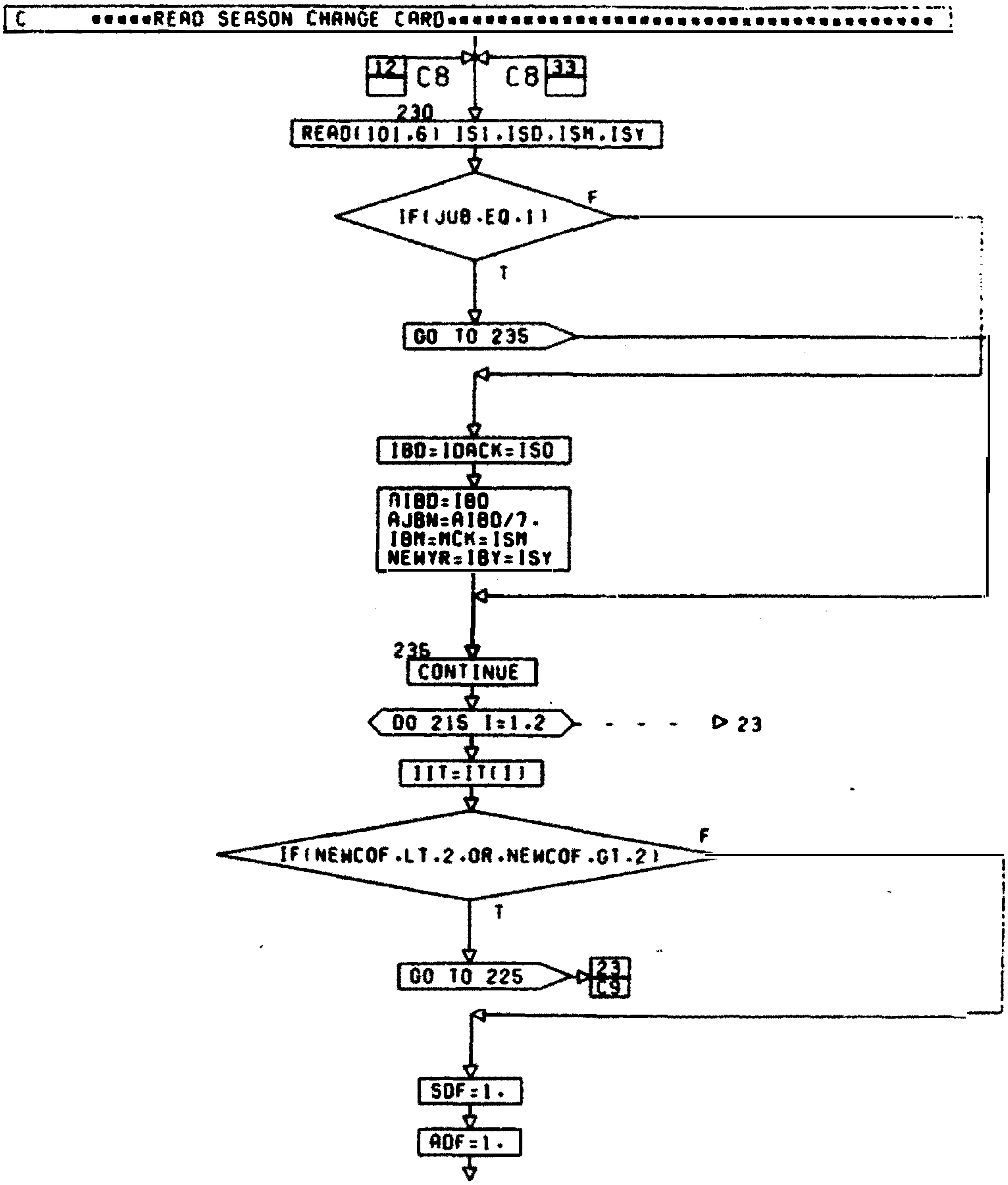
CONT. ON PG 20


IF(II-8)1170,1170,1160
-
+
0
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
B9
11
A9
C *****READ AND WRITE HEADINGS**************************************
12
C6
210
READ(101,5)(IHD(J),J=1,20)
I=1
GO TO 217
21
C7
DO 220 I=1,5
21

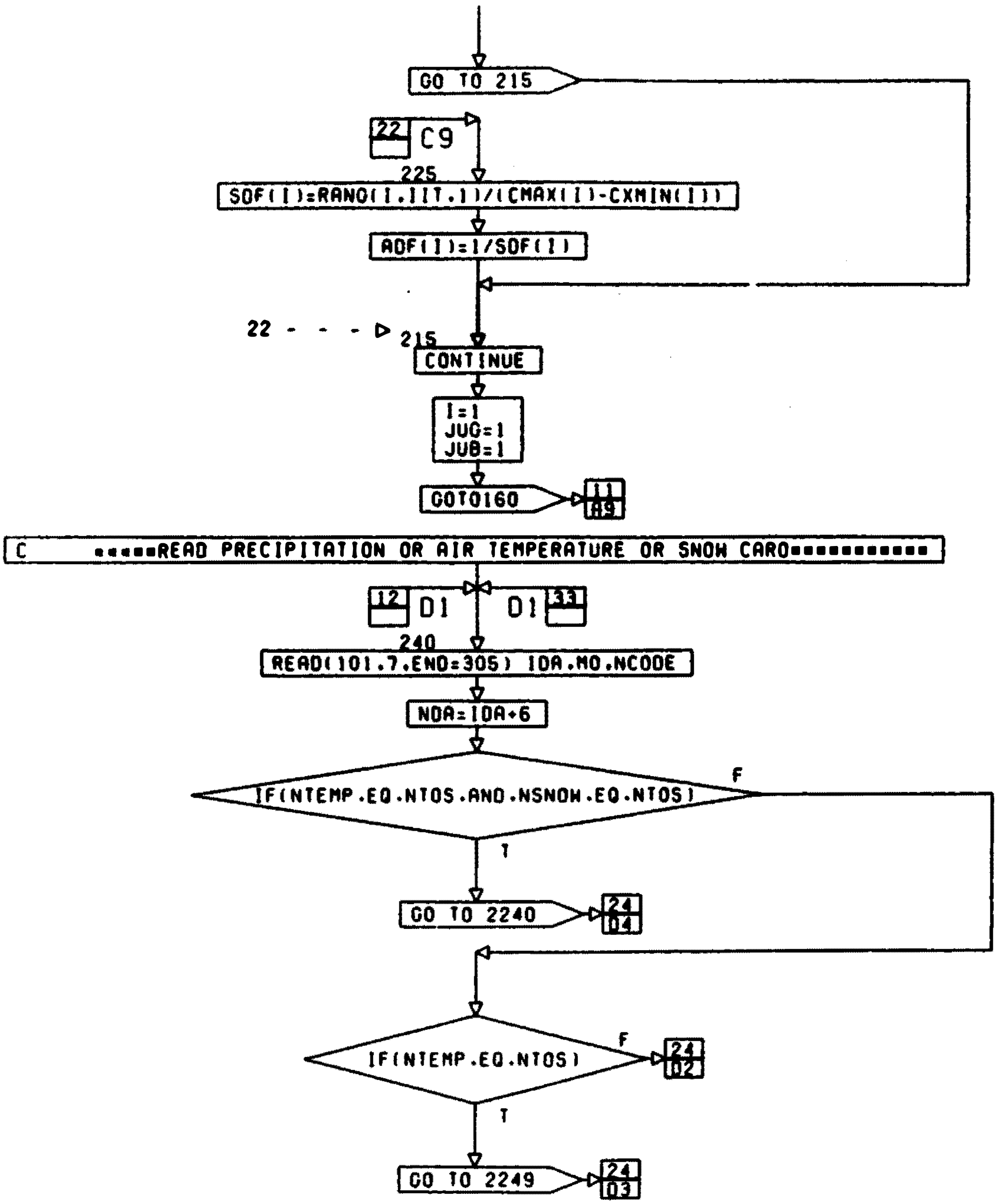
CONT. ON PG 21


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(MEADU).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

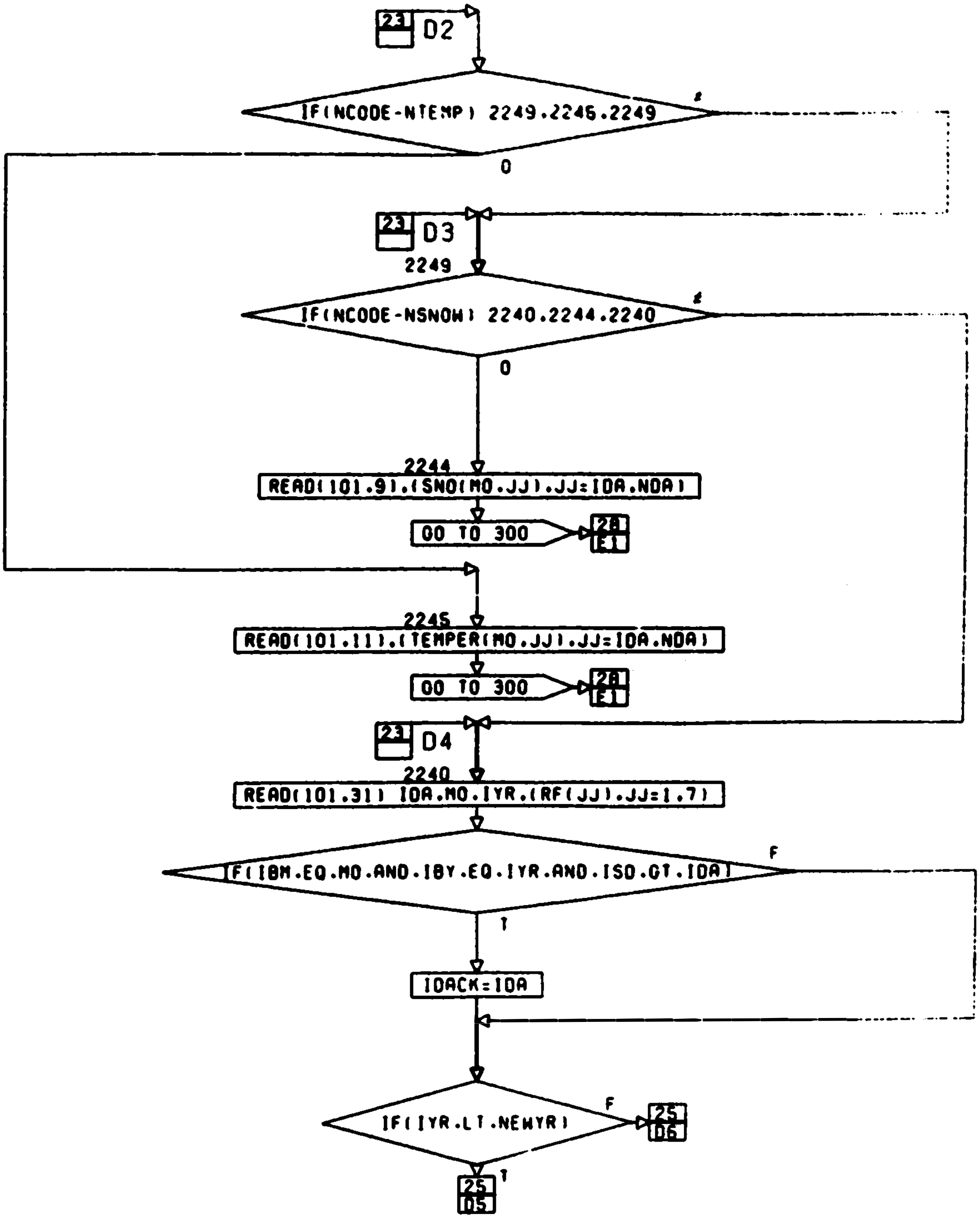
CONT. ON PG 22


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
JIT=IT(I)
IF(NEWCOF.LT.2.OR.NEWCOF.GT.2)
F
T
GO TO 225
23
C9
SDF=1.
ADF=1.

CONT. ON PG 23

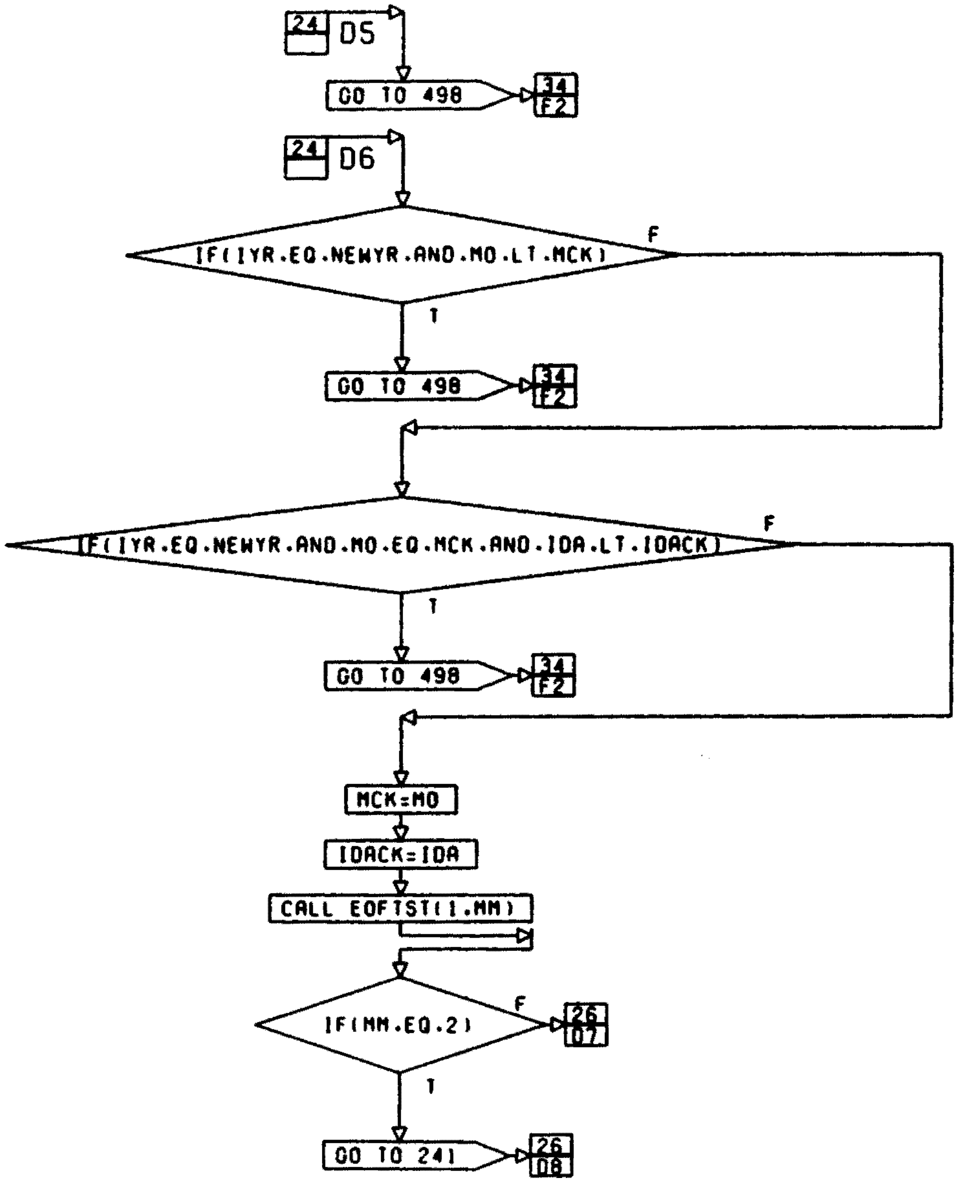

GO TO 215
22
C9
225
SDF(I)=RANO(I,IIT,1)/(CMAX(I)-CXMIN(I))
ADF(I)=1/SDF(I)
22 - - - ▷ 215
CONTINUE
I=1
JUG=1
JUB=1
GOTO160
11
A9
C ******READ PRECIPITATION OR AIR TEMPERATURE OR SNOW CARD************
12
D1
D1
33
240
READ(101,7,END=305) IDA,MO,NCODE
NDA=IDA+6
IF(NTEMP.EQ.NTOS.AND.NSNOW.EQ.NTOS)
F
T
GO TO 2240
24
D4
IF(NTEMP.EQ.NTOS)
F
24
D2
T
GO TO 2249
24
D3

CONT. ON PG 24

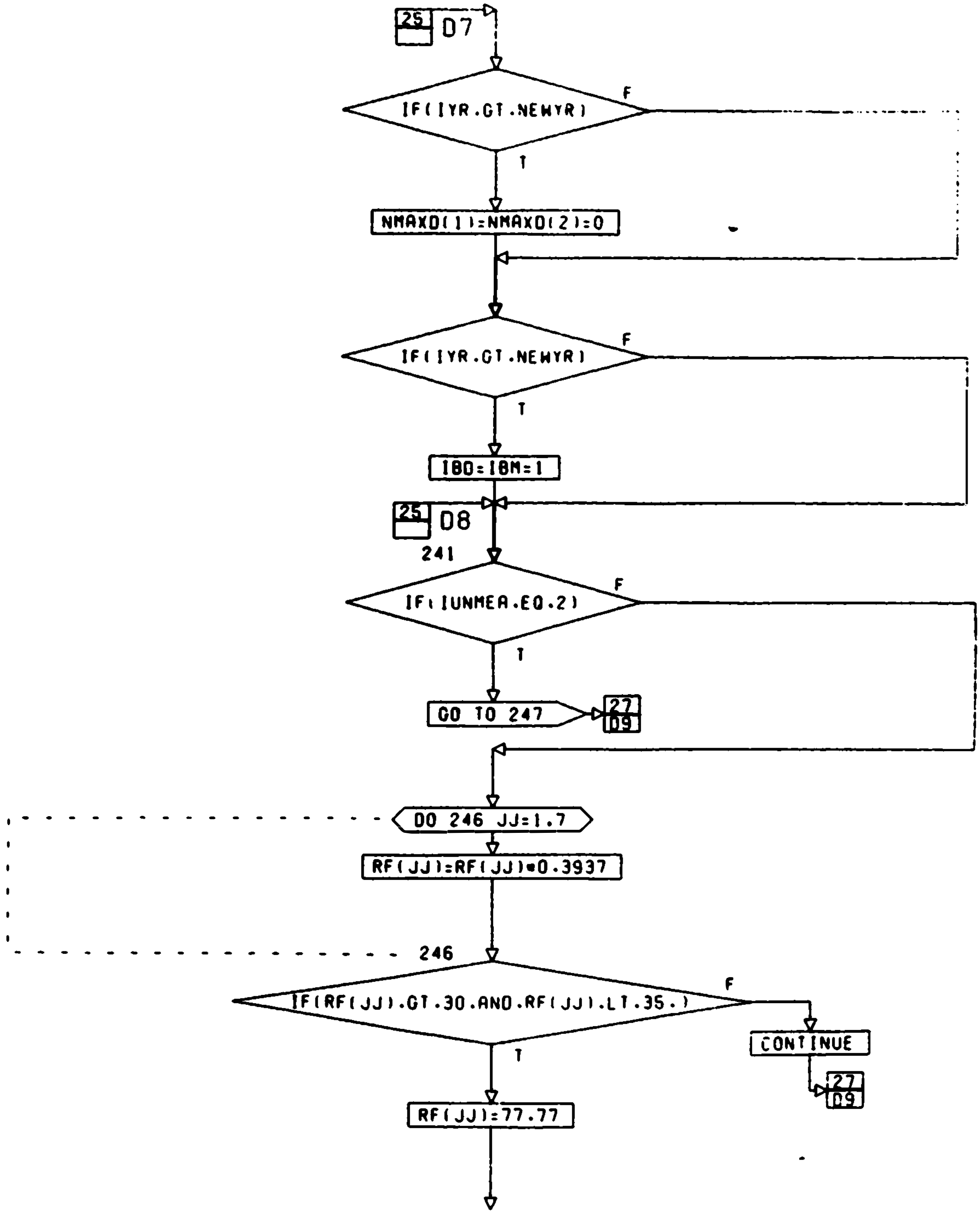


23 D2
IF(NCODE-NTEMP) 2249,2245,2249
0
23 D3
2249
IF(NCODE-NSNOW) 2240,2244,2240
0
2244
READ(101,9),(SNO(MO,JJ),JJ=IDA,NDA)
GO TO 300
28 E1
2245
READ(101,11),(TEMPER(MO,JJ),JJ=IDA,NDA)
GO TO 300
28 E1
23 D4
2240
READ(101,31) IDA,MO,IYR,(RF(JJ),JJ=1,7)
IF(IBM.EQ.MO.AND.IBY.EQ.IYR.AND.ISD.GT.IDA)
F
T
IDACK=IDA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

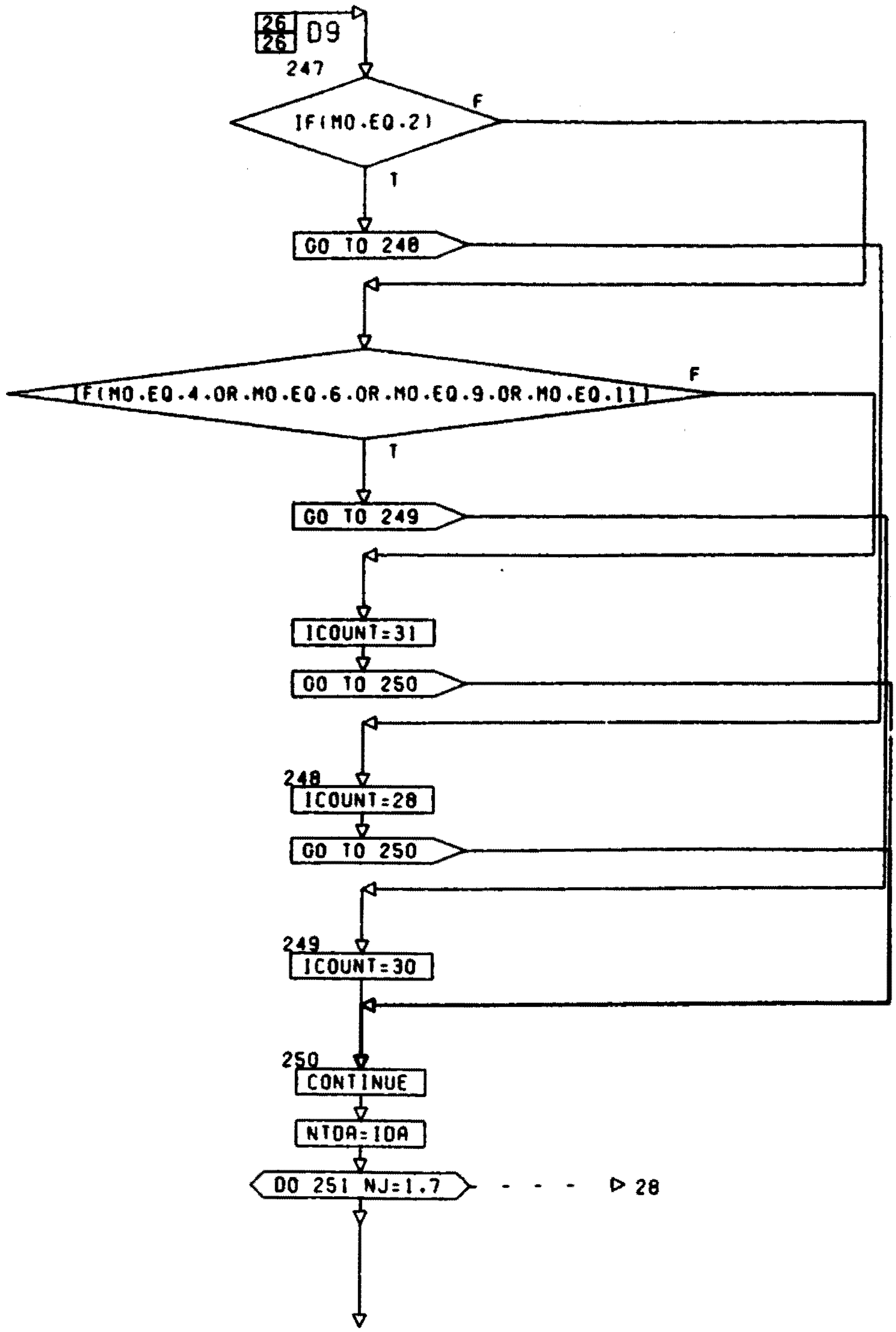
CONT. ON PG 25


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

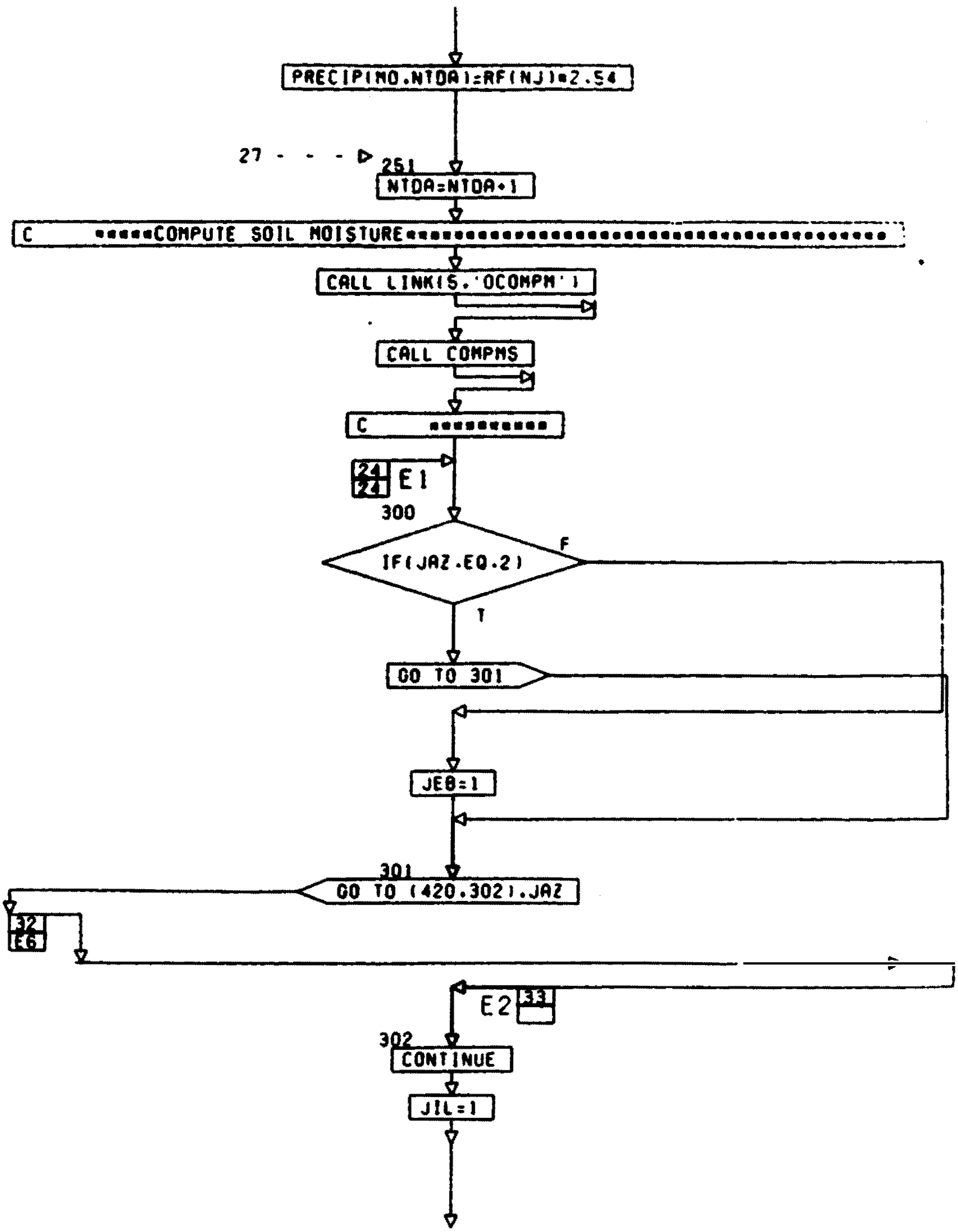
CONT. ON PG 26


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

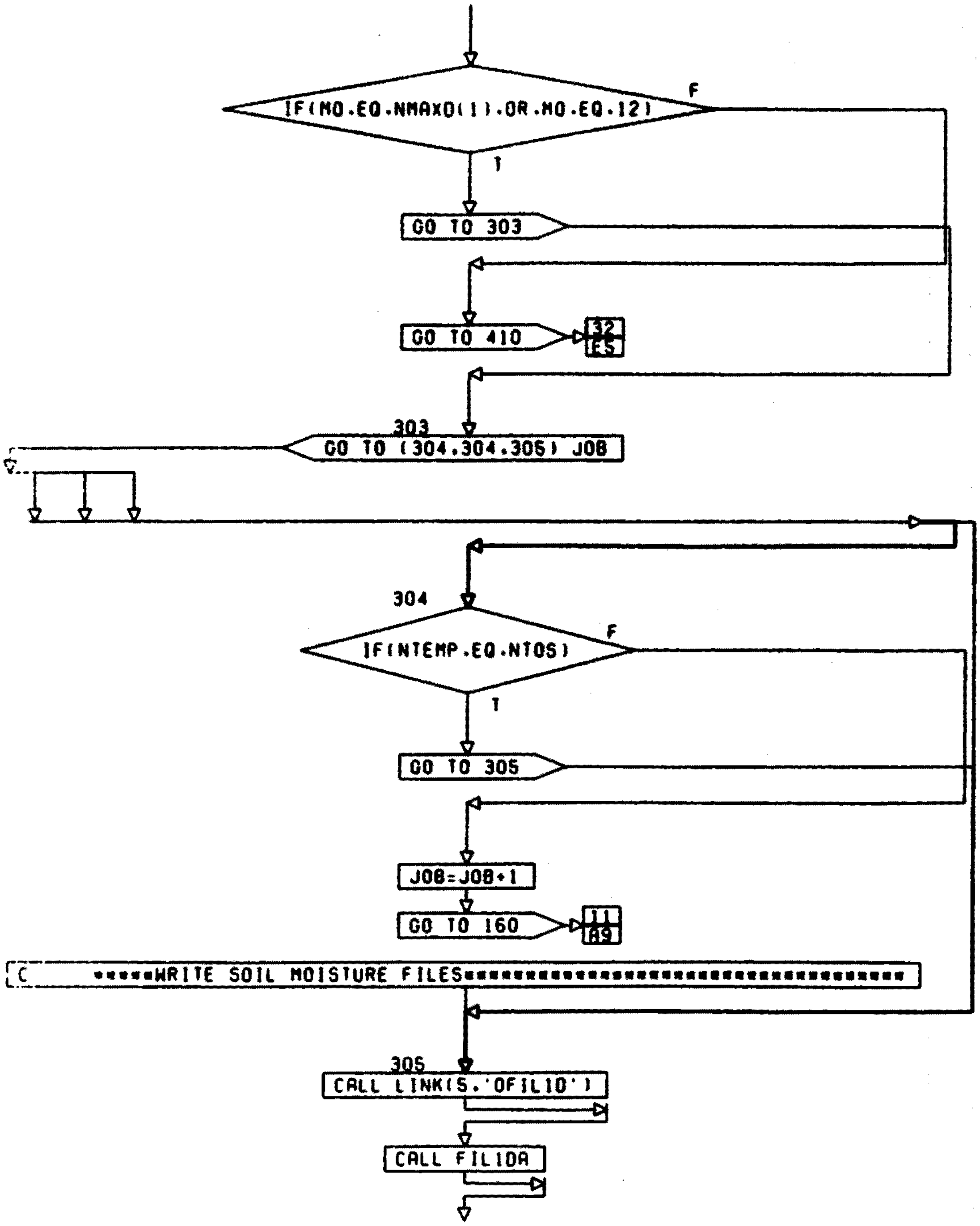
CONT. ON PG 27


26
26
D9
247
IF(MO.EQ.2)
F
T
GO TO 248
IF(MO.EQ.4.OR.MO.EQ.6.OR.MO.EQ.9.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
NTDA=IDA
DO 251 NJ=1,7
28

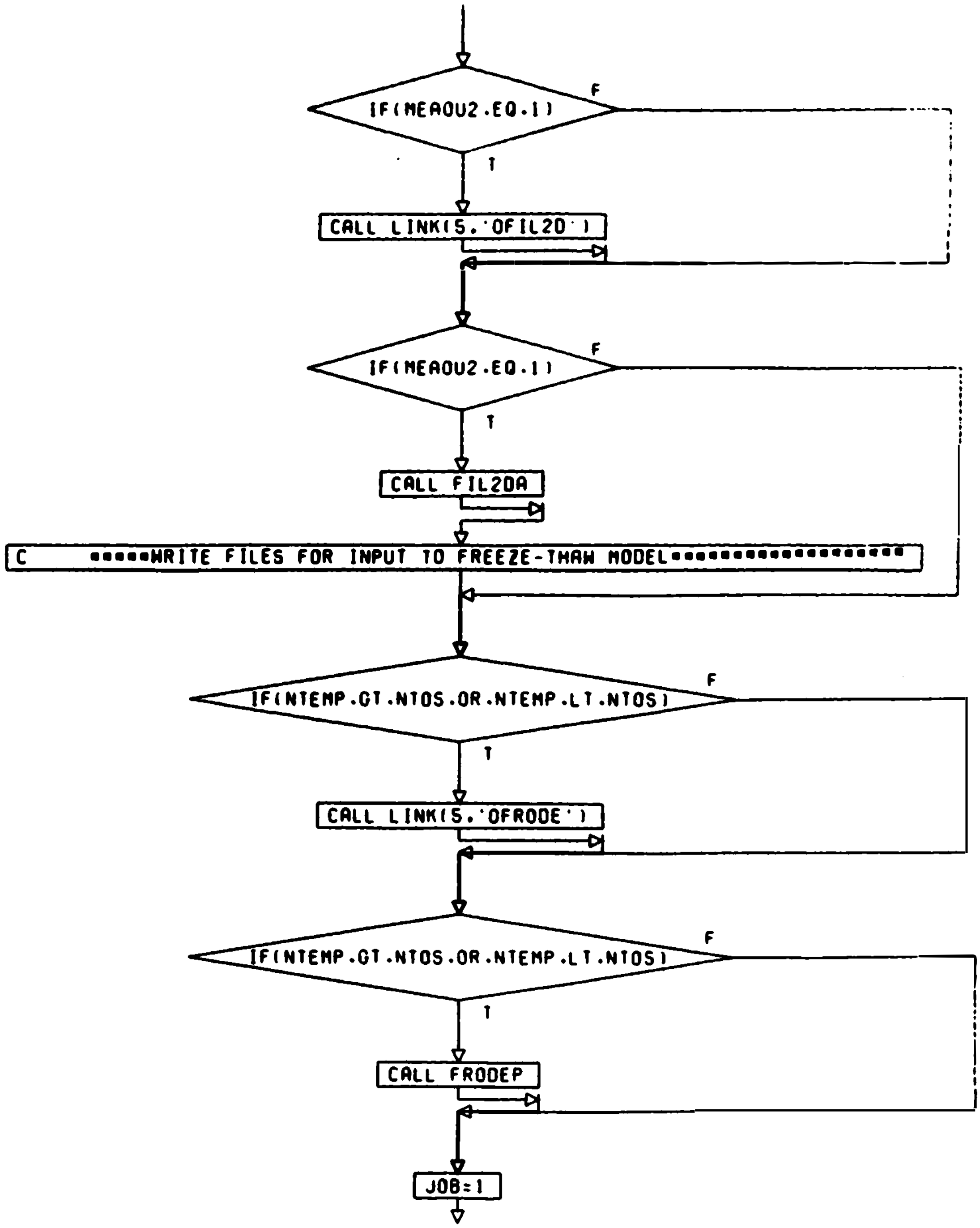
CONT. ON PG 28


PRECIP(NO.NTDA)=RF(NJ)*2.54
27
251
NTDA=NTDA+1
C *****COMPUTE SOIL MOISTURE***
CALL LINK(S.'OCOMPM')
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

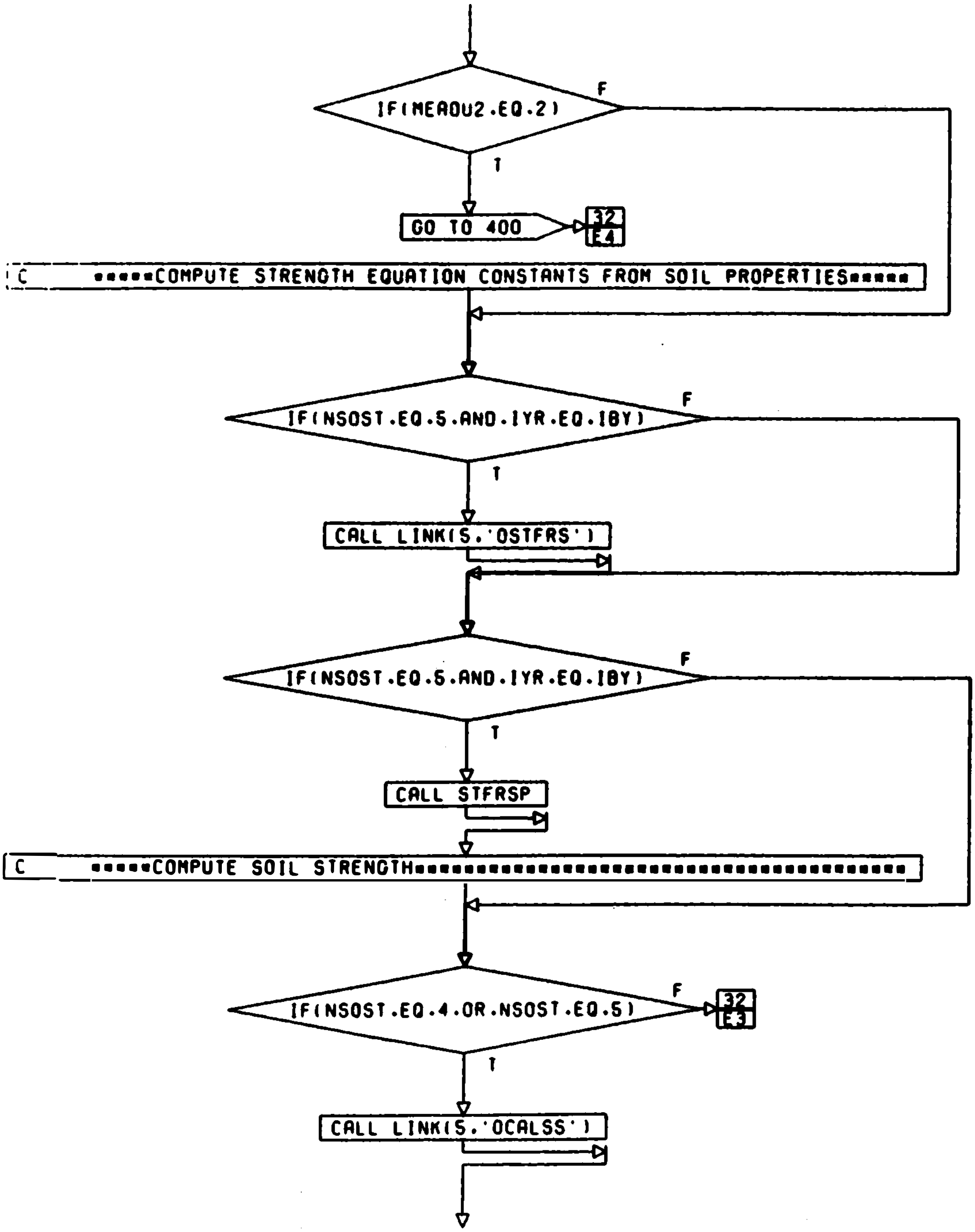
CONT. ON PG 29


IF(MO.EQ.NMAXD(1).OR.MO.EQ.12)
F
T
GO TO 303
GO TO 410
32
ES
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,'OFIL10')
CALL FILIDA

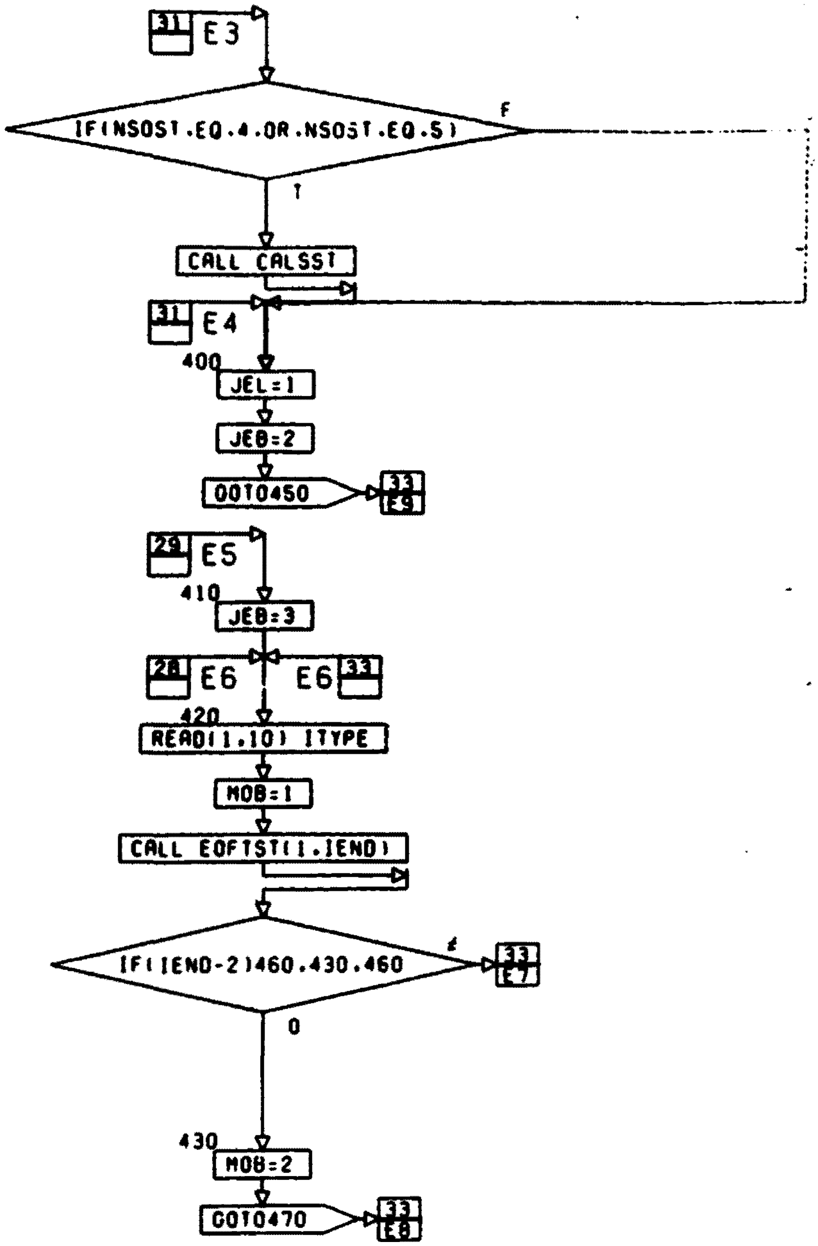
CONT. ON PG 30


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

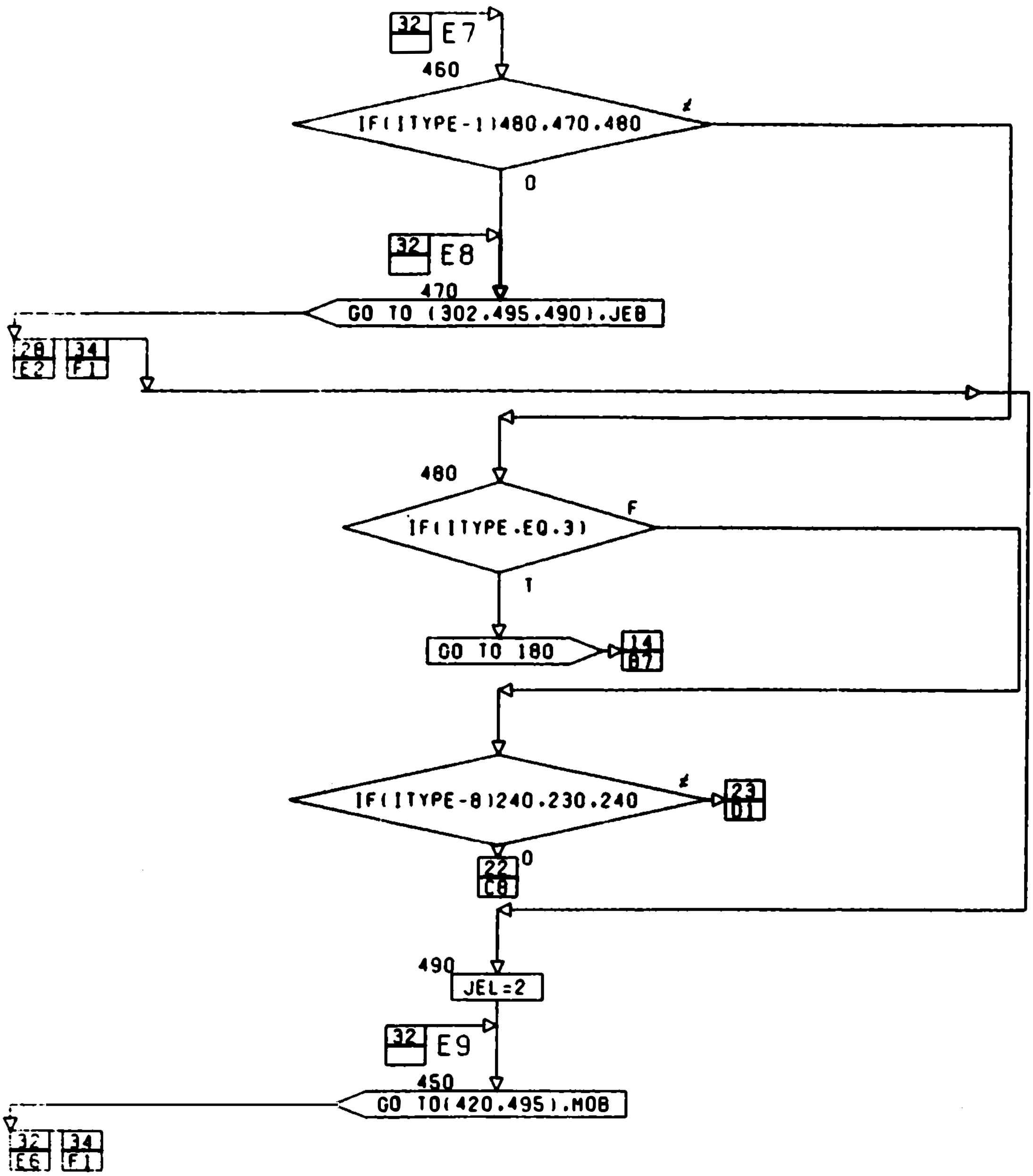
CONT. ON PG 31


IF(MEAOU2.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(S.'OSTFRS')
IF(NSOST.EQ.5.AND.IYR.EQ.IBY)
F
T
CALL STFRSP
C *****COMPUTE SOIL STRENGTH***
IF(NSOST.EQ.4.OR.NSOST.EQ.5)
F
32
E3
T
CALL LINK(S.'OCALSS')

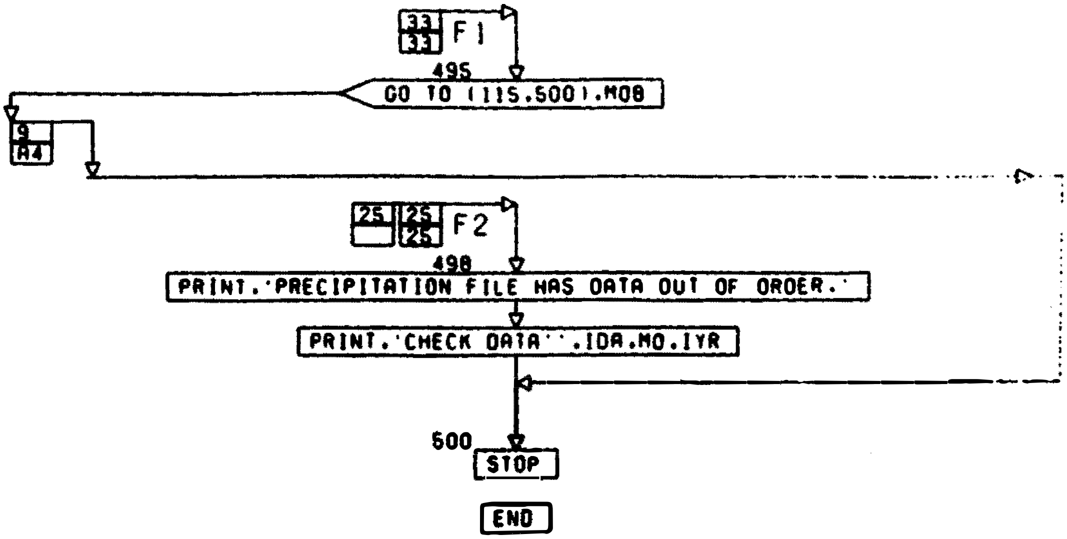
CONT. ON PG 32


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
33 E7
0
430
MOB=2
GOTO470
33 E8

CONT. ON PG 33


32 E7
460
IF(ITYPE-1)480,470,480
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
23 D1
0
22 C8
490
JEL=2
32 E9
450
GO TO(420,495),MOB
32 E6
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. 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,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)

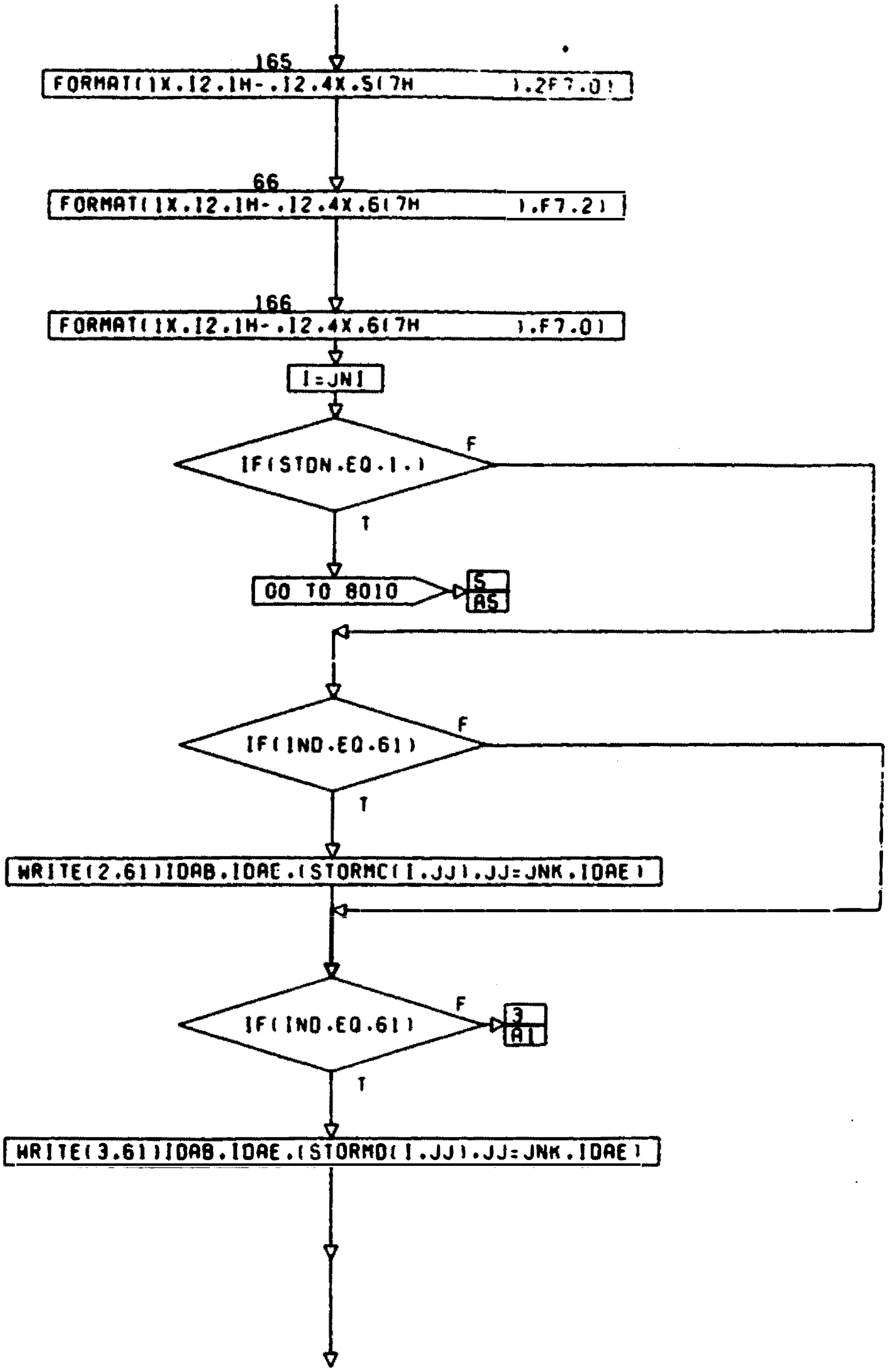
163 FORMAT(1X,I2,1H-,I2,4X,3(7H),4F7.0)

64 FORMAT(1X,I2,1H-,I2,4X,4(7H),3F7.2)

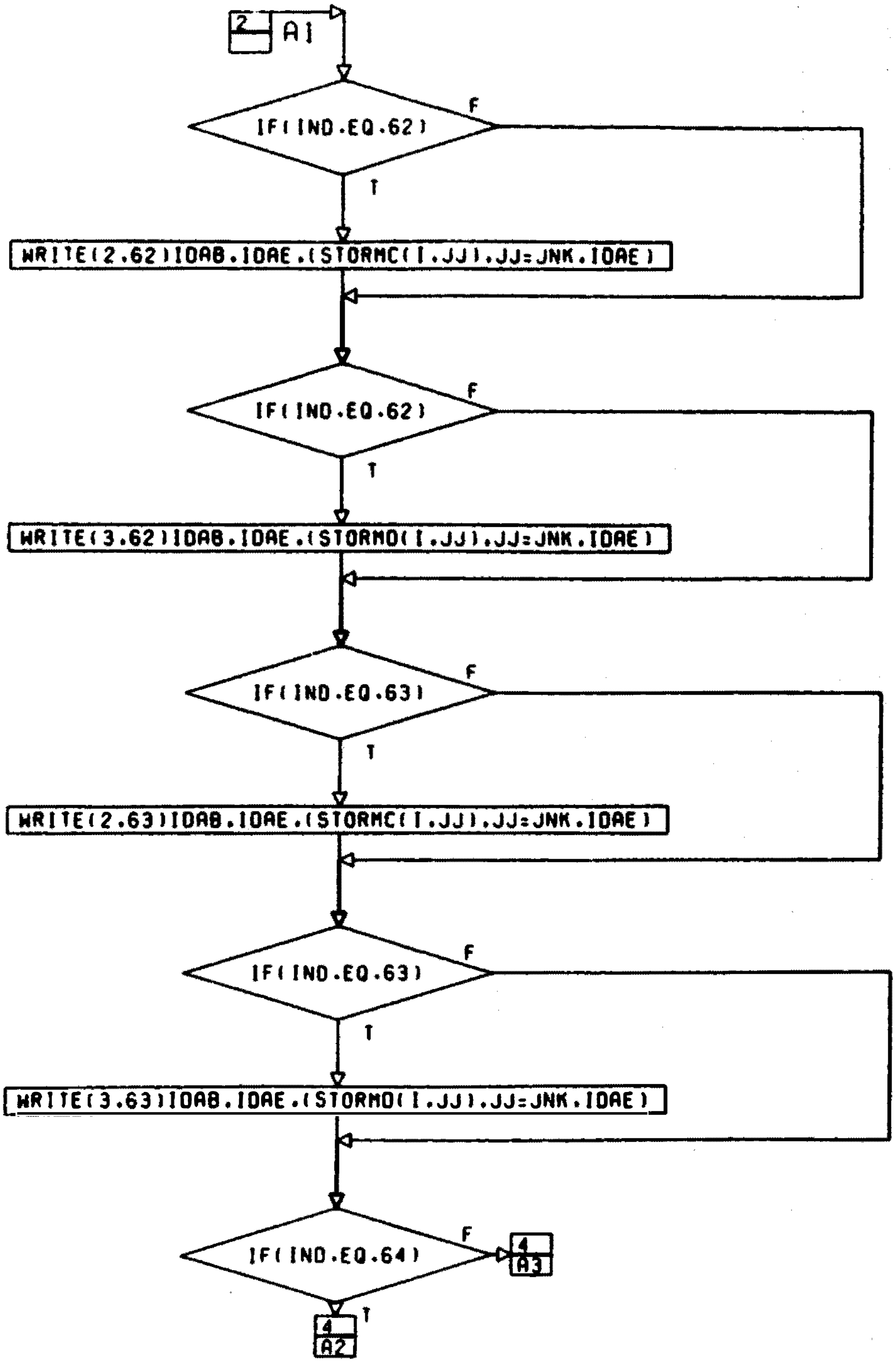
164 FORMAT(1X,I2,1H-,I2,4X,4(7H),3F7.0)

65 FORMAT(1X,I2,1H-,I2,4X,5(7H),2F7.2)

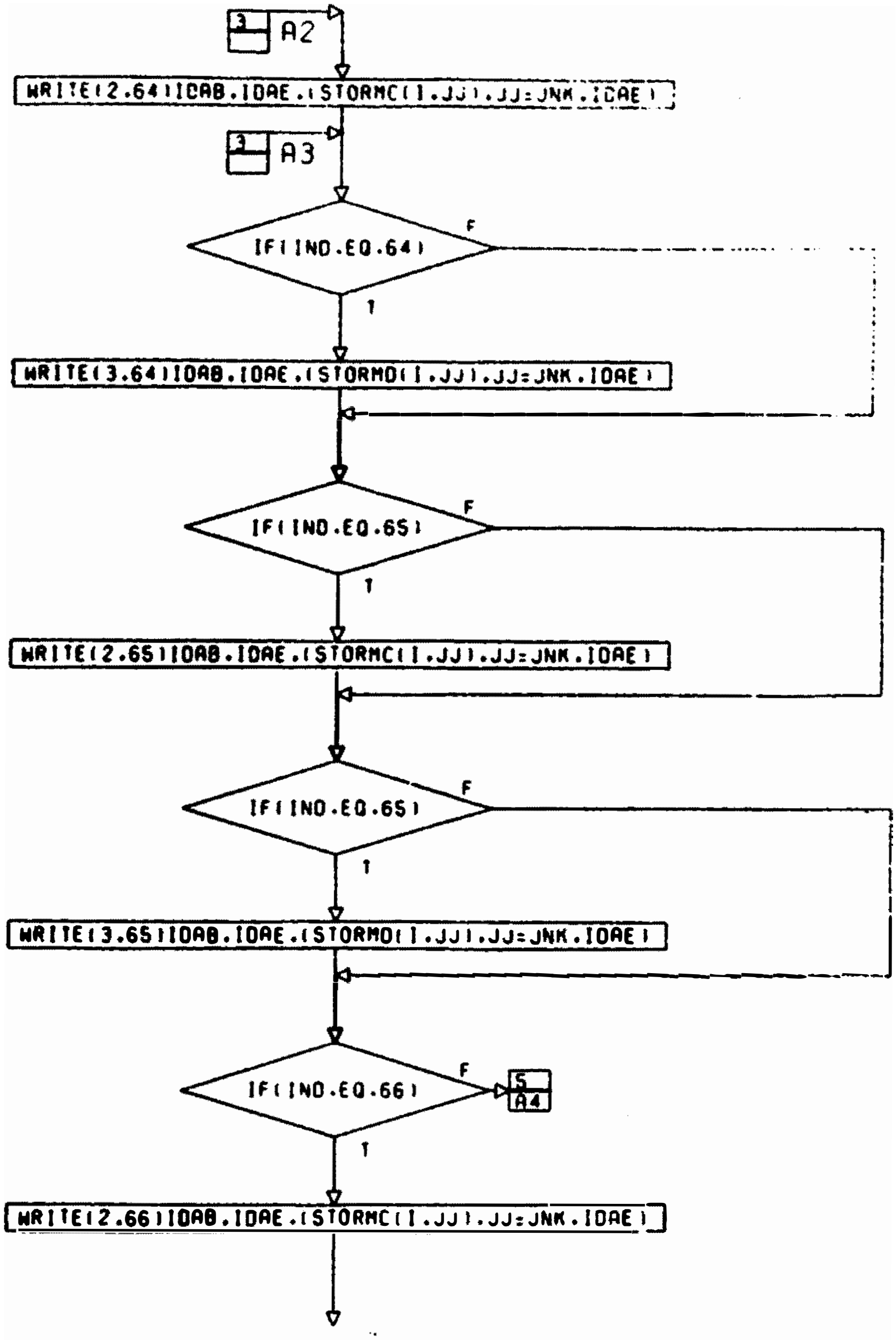
CONT. ON PG 2


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(STON.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)

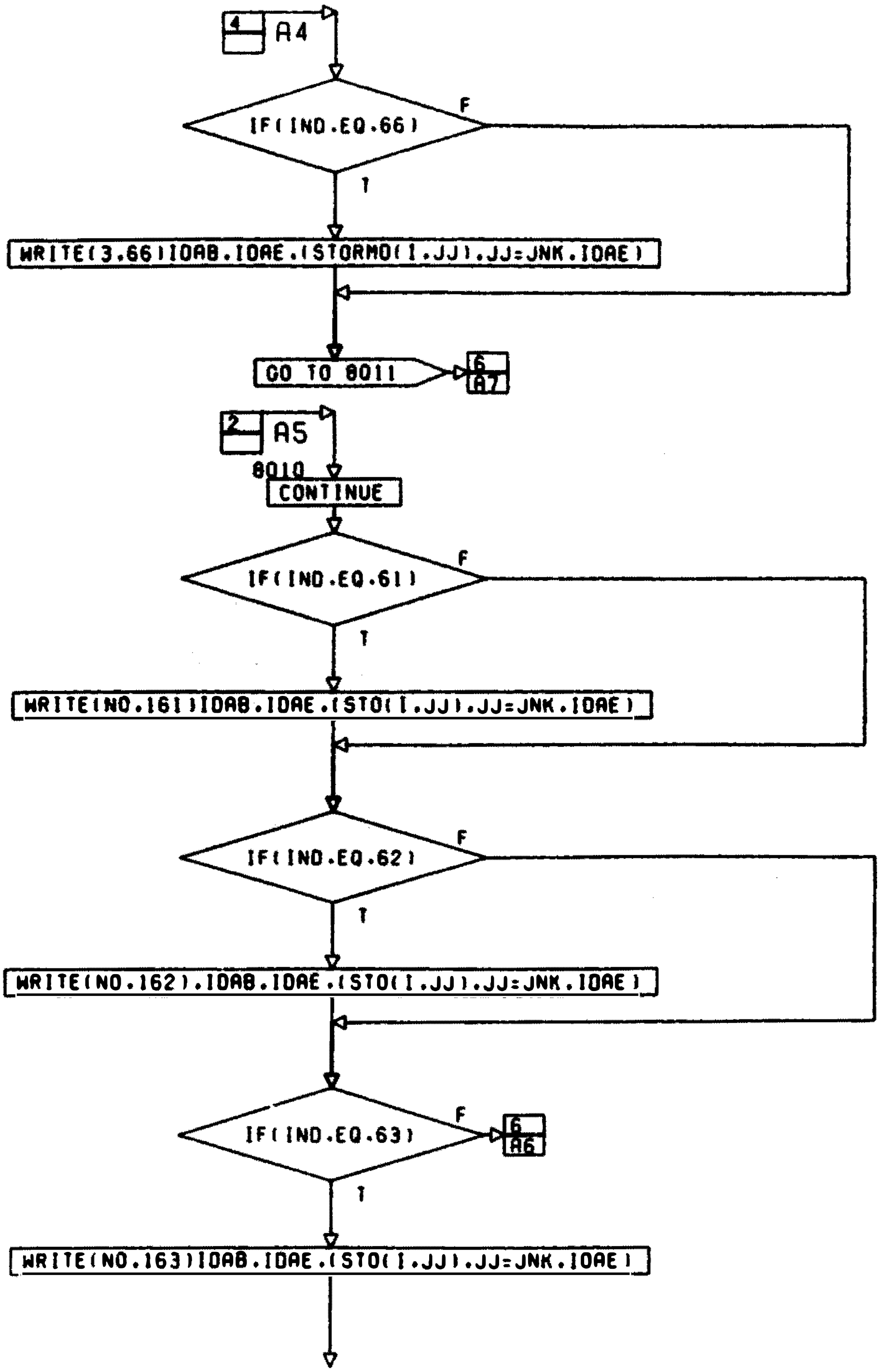
CONT. ON PG 3


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.(STORMO(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.(STORMO(I.JJ).JJ=JNK.IDAE)
IF(IND.EQ.64)
F
4
A3
T
4
A2

CONT. ON PG 4

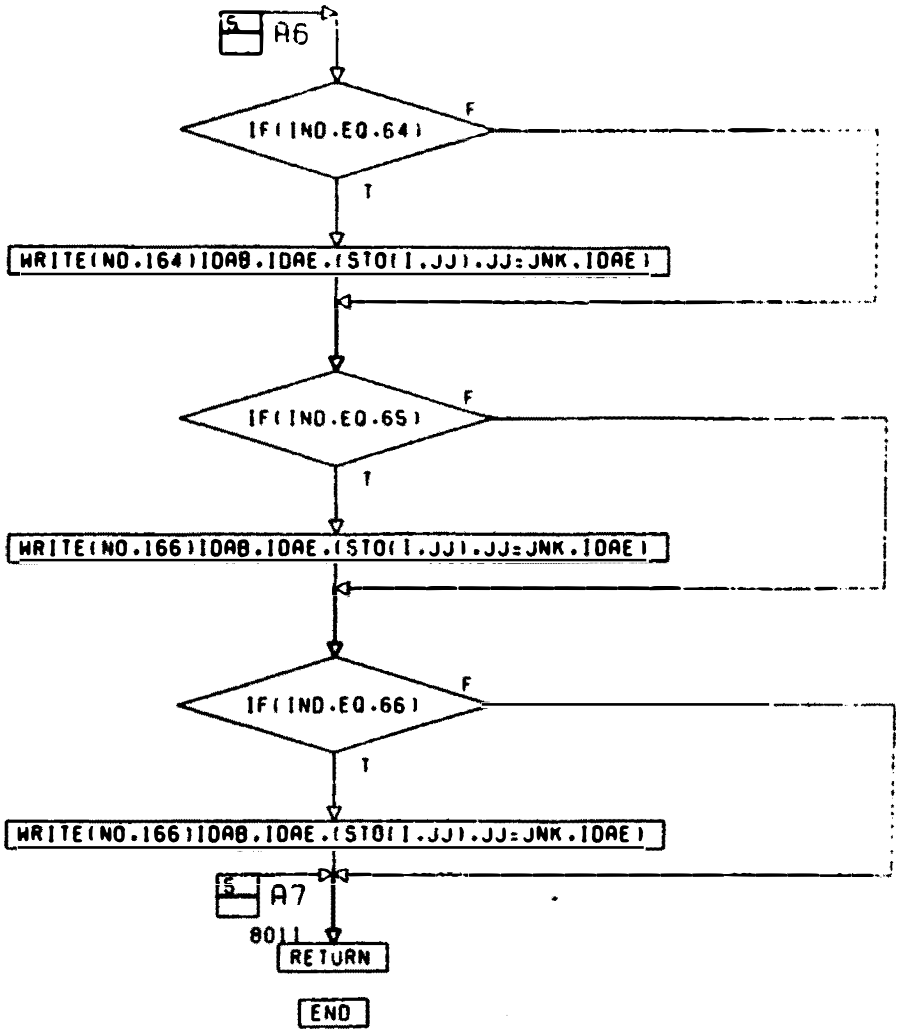

3
A2
WRITE(2.64)IDAB.IDAE.(STORMC(I.JJ).JJ=JNK.IDAE)
3
A3
IF(IND.EQ.64)
F
T
WRITE(3.64)IDAB.IDAE.(STORMD(I.JJ).JJ=JNK.IDAE)
IF(IND.EQ.65)
F
T
WRITE(2.65)IDAB.IDAE.(STORMC(I.JJ).JJ=JNK.IDAE)
IF(IND.EQ.65)
F
T
WRITE(3.65)IDAB.IDAE.(STORMD(I.JJ).JJ=JNK.IDAE)
IF(IND.EQ.66)
F
5
A4
T
WRITE(2.66)IDAB.IDAE.(STORMC(I.JJ).JJ=JNK.IDAE)

CONT. ON PG 5



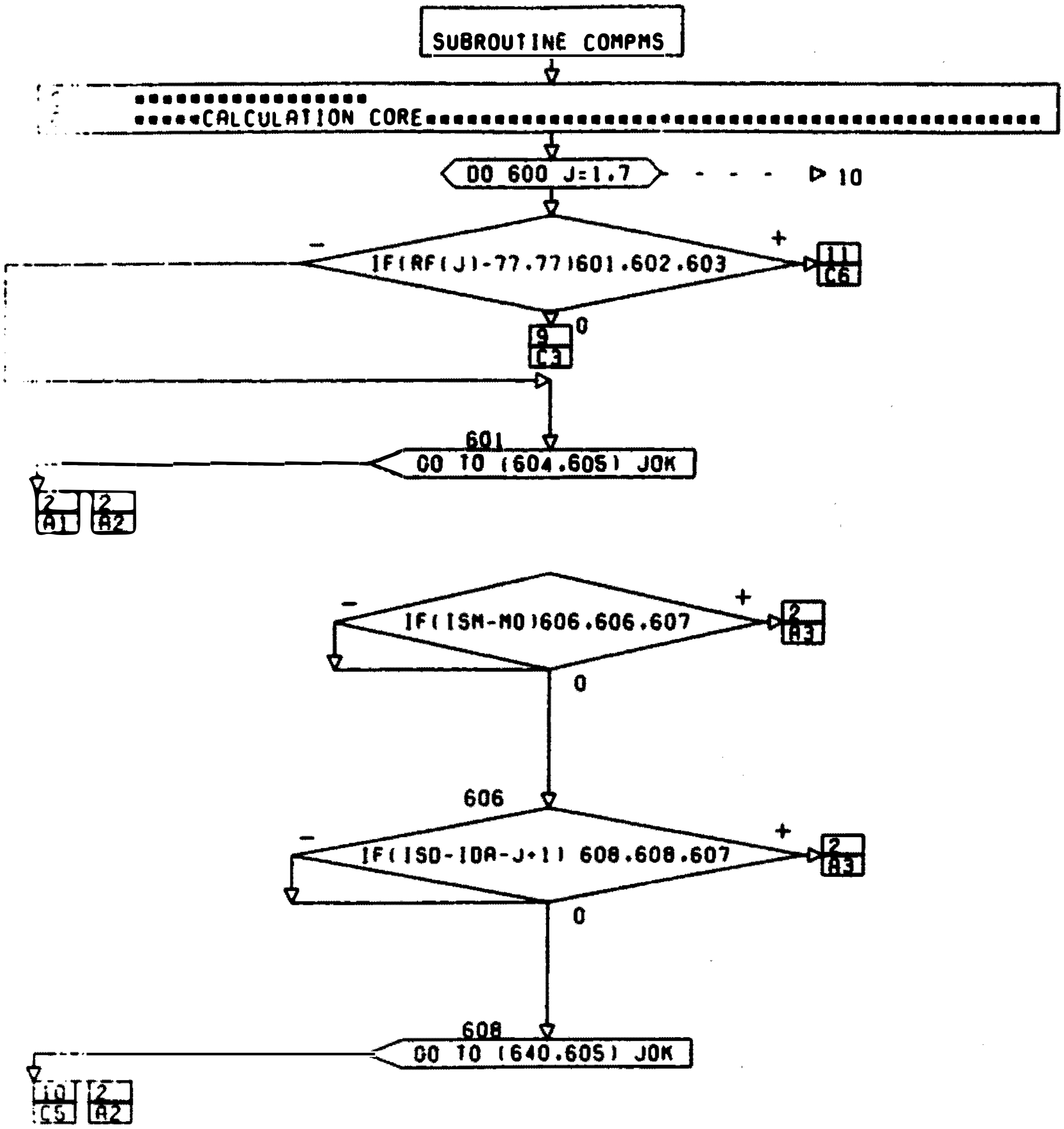
4
A4
IF(IND.EQ.66)
F
T
WRITE(3,66)IDAB,IDAE,(STORMO(I,JJ),JJ=JNK,IDAE)
GO TO 8011
6
A7
2
A5
8010
CONTINUE
IF(IND.EQ.61)
F
T
WRITE(NO,161)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.62)
F
T
WRITE(NO,162),IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)
IF(IND.EQ.63)
F
6
A6
T
WRITE(NO,163)IDAB,IDAE,(STO(I,JJ),JJ=JNK,IDAE)

CONT. ON PG 6

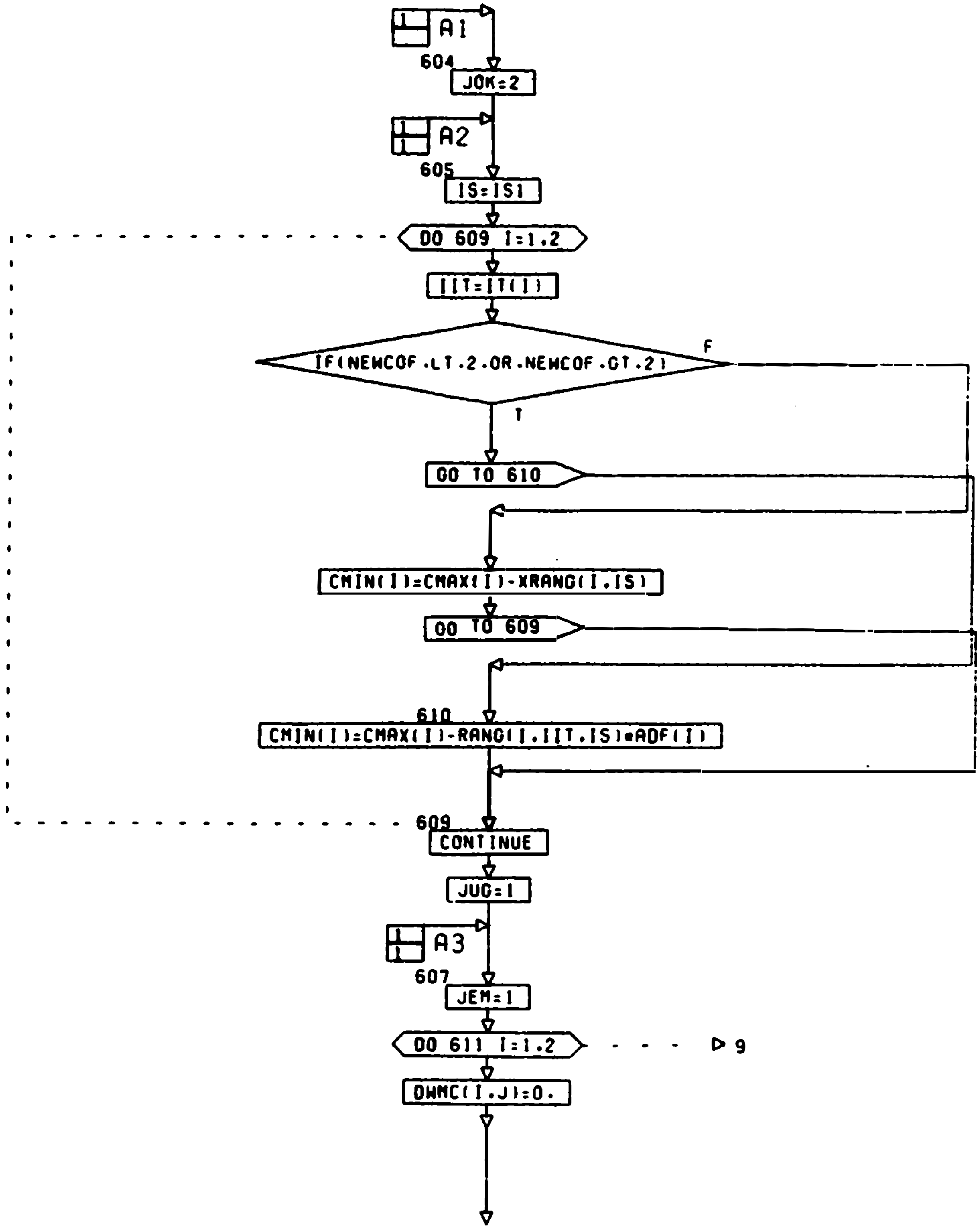


A6
IF(IND.EQ.64)
F
T
WRITE(NO.164)IDAB.IDAE.(STO(I.JJ).JJ=JNK.IDAE)
IF(IND.EQ.65)
F
T
WRITE(NO.166)IDAB.IDAE.(STO(I.JJ).JJ=JNK.IDAE)
IF(IND.EQ.66)
F
T
WRITE(NO.166)IDAB.IDAE.(STO(I.JJ).JJ=JNK.IDAE)
A7
8011
RETURN
END

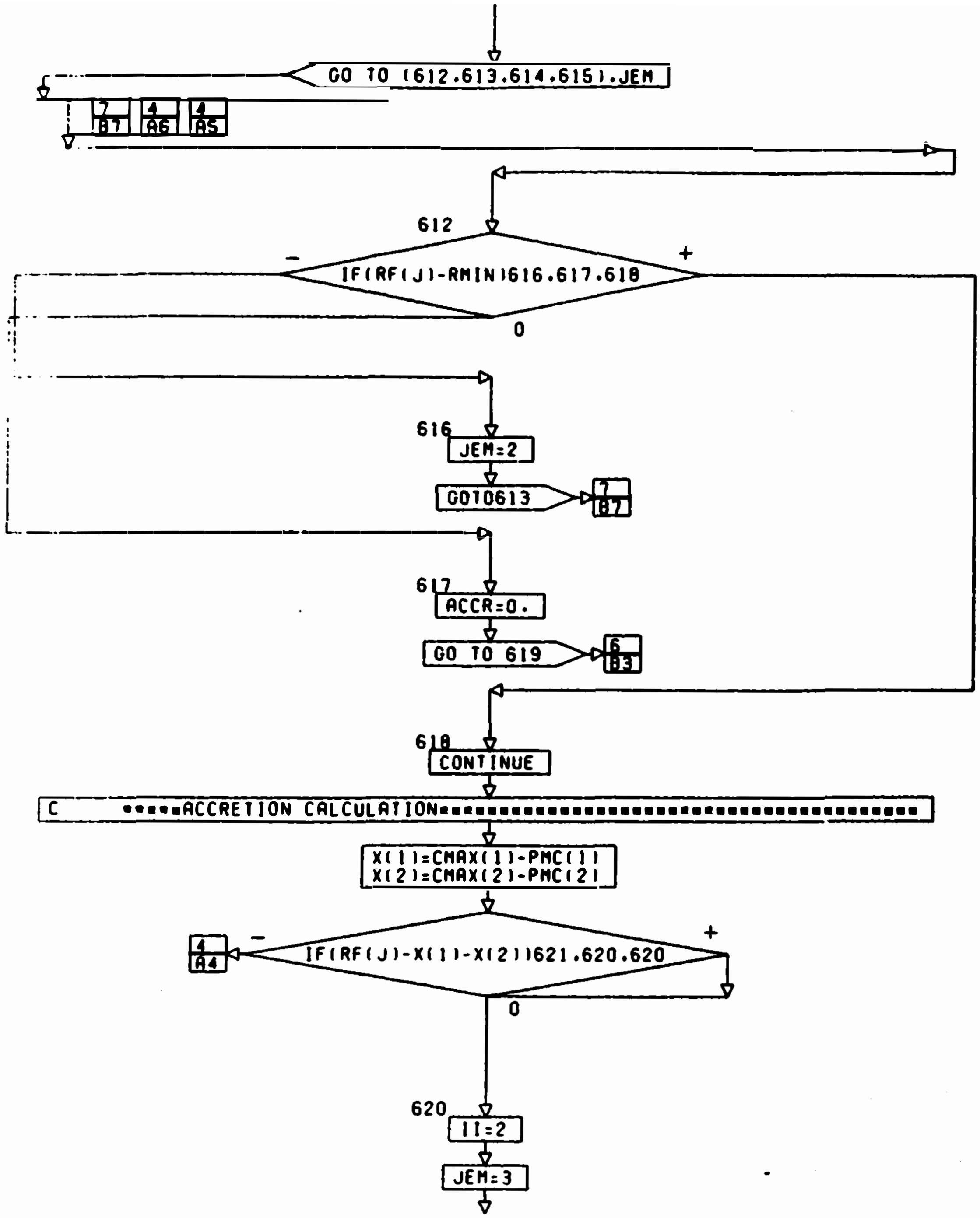
Fig. A3. Detailed Flow Chart of Subroutine COMPMS
(11 pages)


SUBROUTINE COMPMS
*****CALCULATION CORE*****
DO 600 J=1,7
10
IF(RF(J)-77.77)601,602,603
-
+
0
11
C6
9
C3
601
GO TO (604,605) JOK
2
A1
2
A2
IF(ISM-MO)606,606,607
-
+
0
2
A3
606
IF(ISD-IDA-J+1) 608,608,607
-
+
0
2
A3
608
GO TO (640,605) JOK
10
C5
2
A2

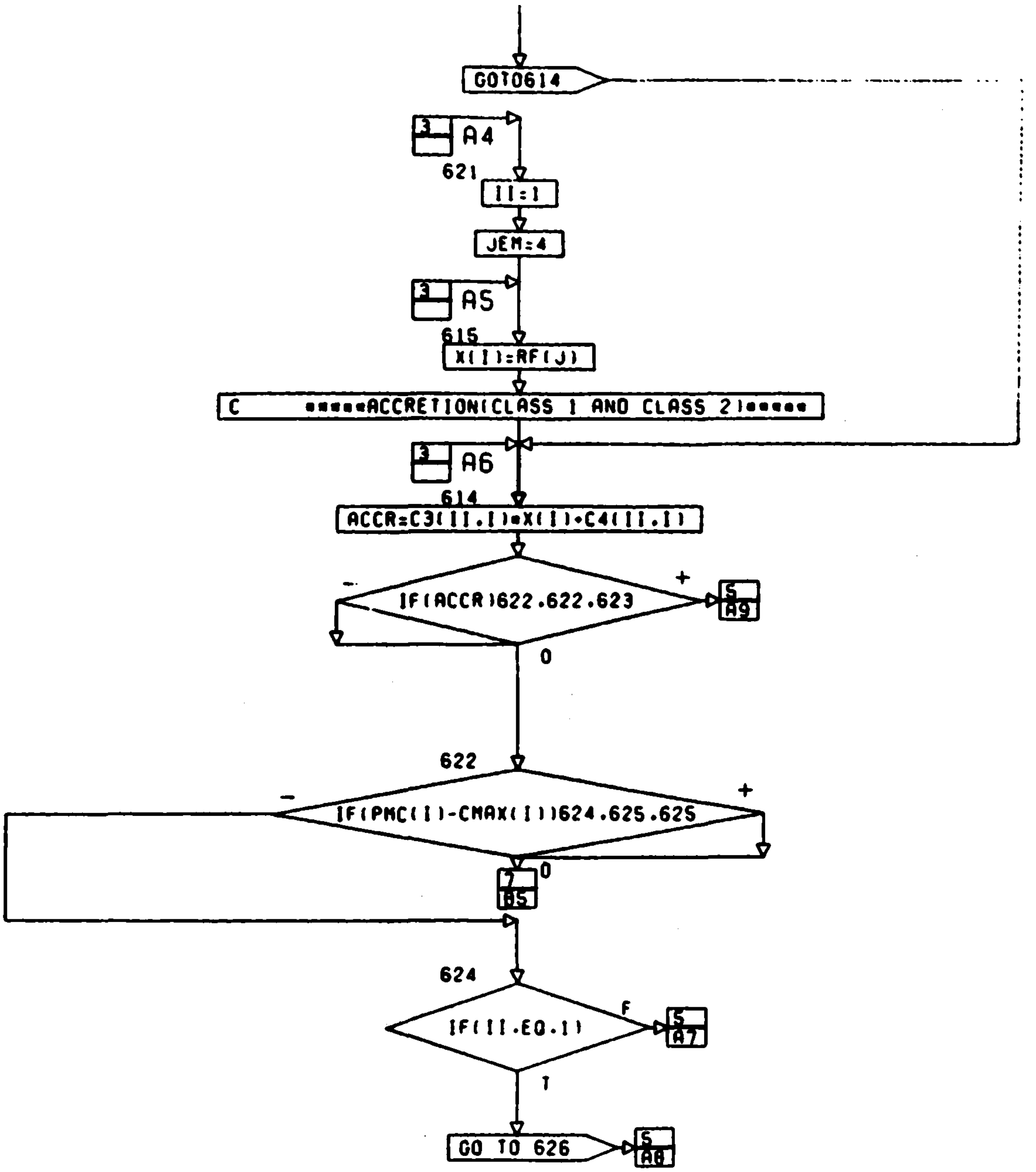
CONT. ON PG 2


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.

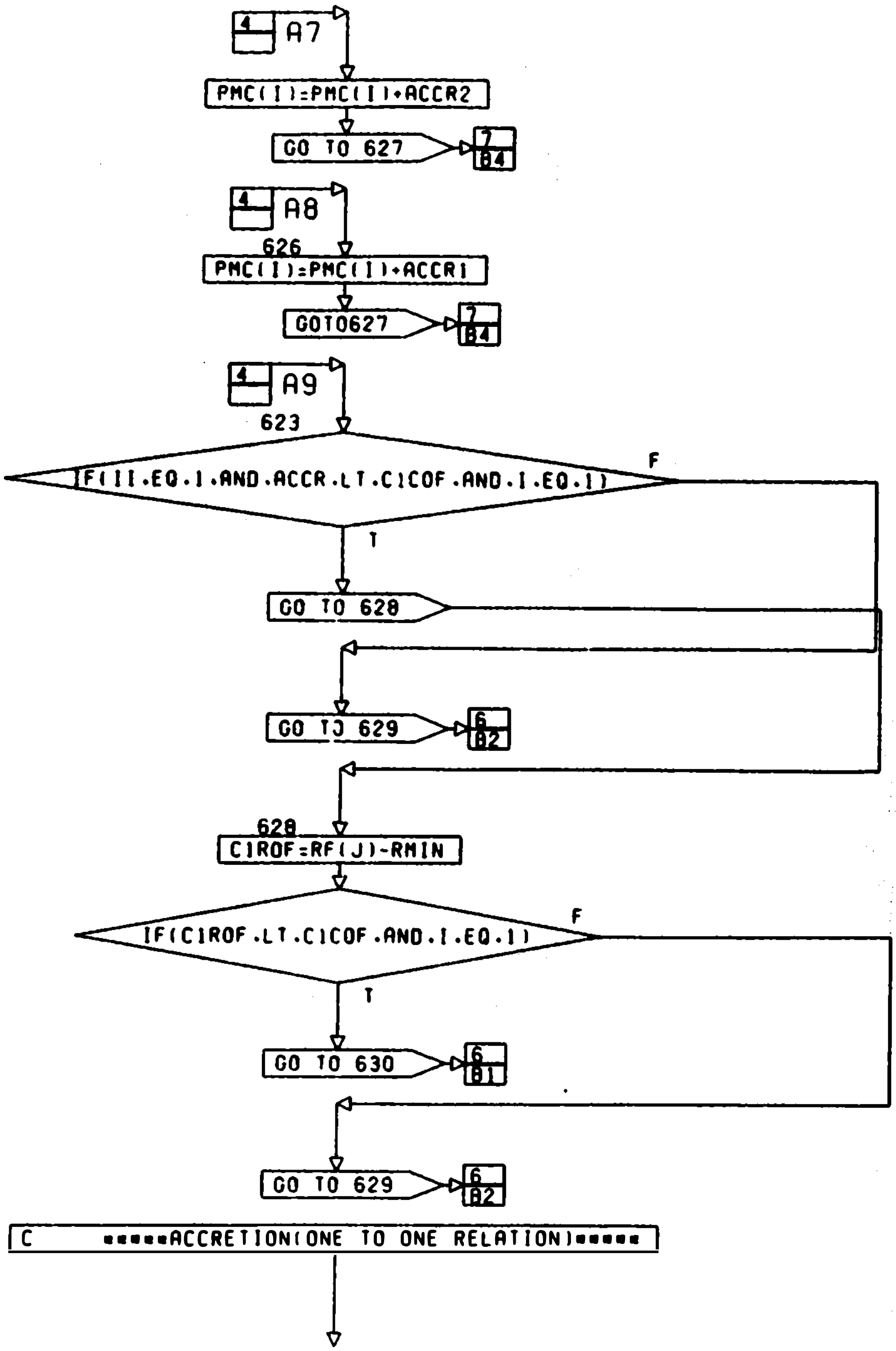
CONT. ON PG 3


GO TO (612,613,614,615),JEM
7
B7
4
A6
4
A5
612
IF(RF(J)-RMIN)616,617,618
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)
IF(RF(J)-X(1)-X(2))621,620,620
4
A4
620
II=2
JEM=3

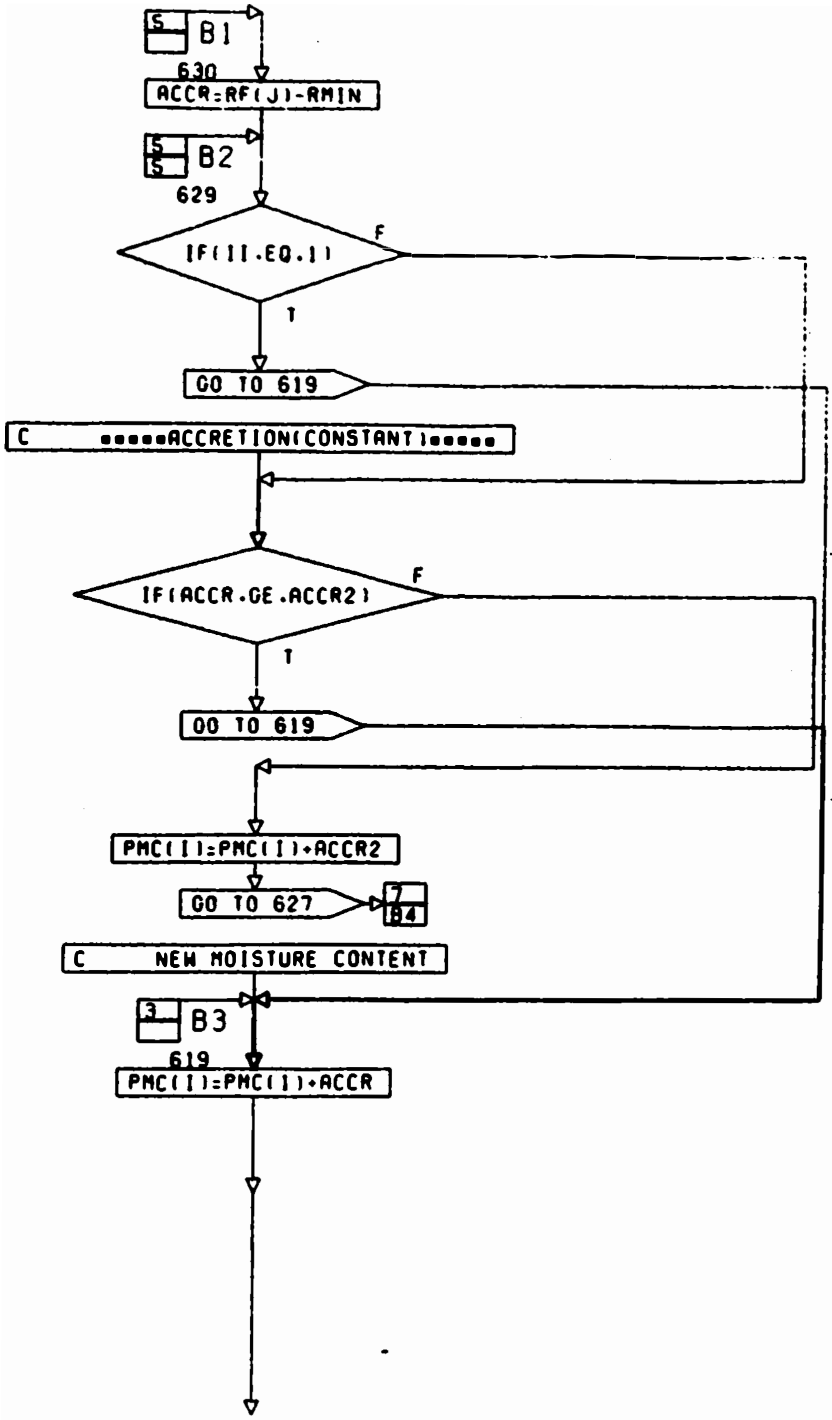
CONT. ON PG 4


GOTO614
3
A4
621
II=1
JEM=4
3
A5
615
X(I)=RF(J)
C *****ACCRETION(CLASS 1 AND CLASS 2)*****
3
A6
614
ACCR=C3(II,I)*X(I)+C4(II,I)
-
+
IF(ACCR)622,622,623
5
A9
0
622
-
+
IF(PMC(I)-CMAX(I))624,625,625
0
7
B5
624
IF(II.EQ.1)
F
5
A7
T
GO TO 626
5
A8

CONT. ON PG 5

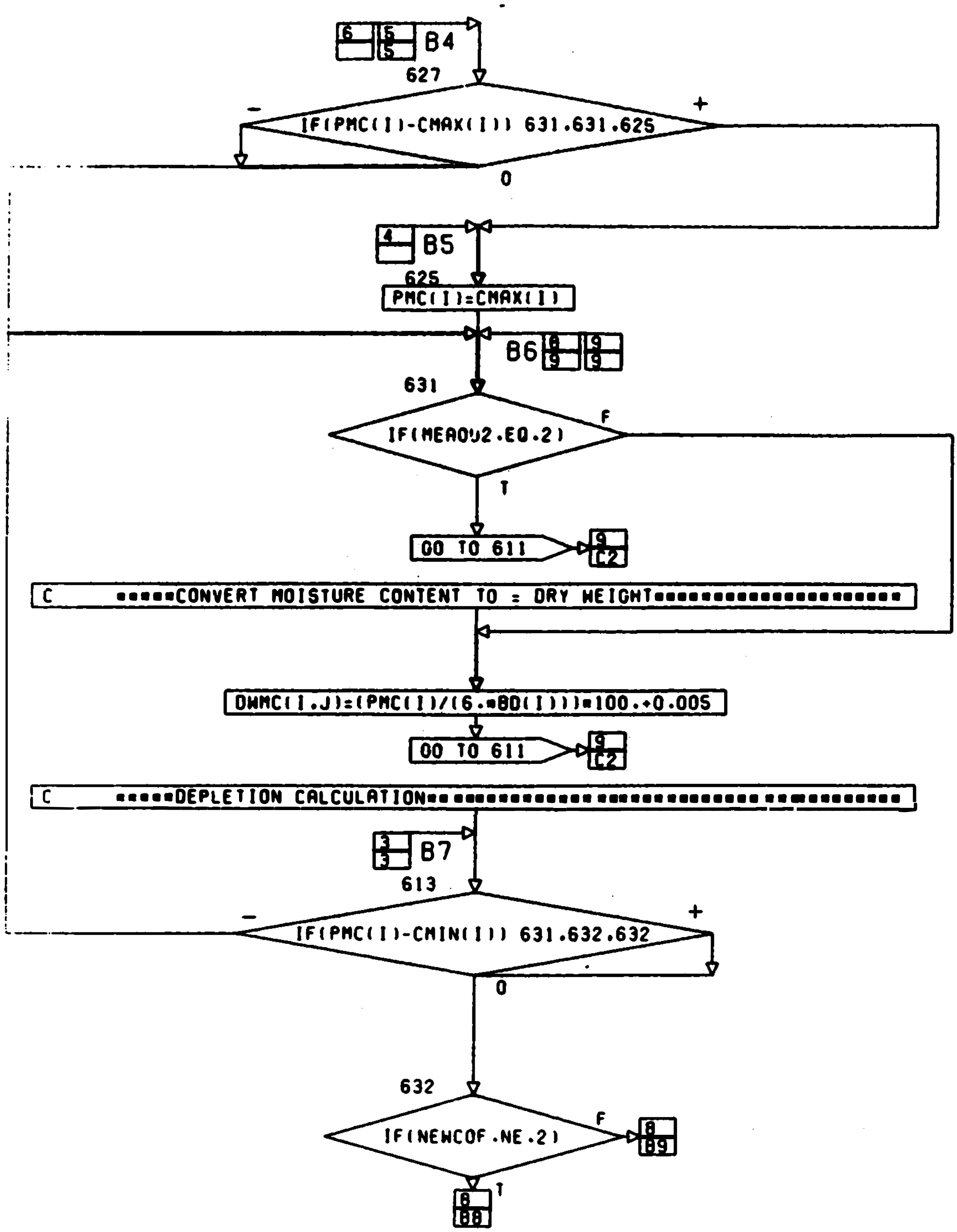

4
A7
PMC(I)=PMC(I)+ACCR2
GO TO 627
7
B4
4
A8
626
PMC(I)=PMC(I)+ACCR1
GOTO627
7
B4
4
A9
623
IF(II.EQ.1.AND.ACCR.LT.C1COF.AND.I.EQ.1)
F
T
GO TO 628
GO TO 629
6
B2
628
C1ROF=RF(J)-RMIN
IF(C1ROF.LT.C1COF.AND.I.EQ.1)
F
T
GO TO 630
6
B1
GO TO 629
6
B2
C *****ACCRETION(ONE TO ONE RELATION)*****

CONT. ON PG 6

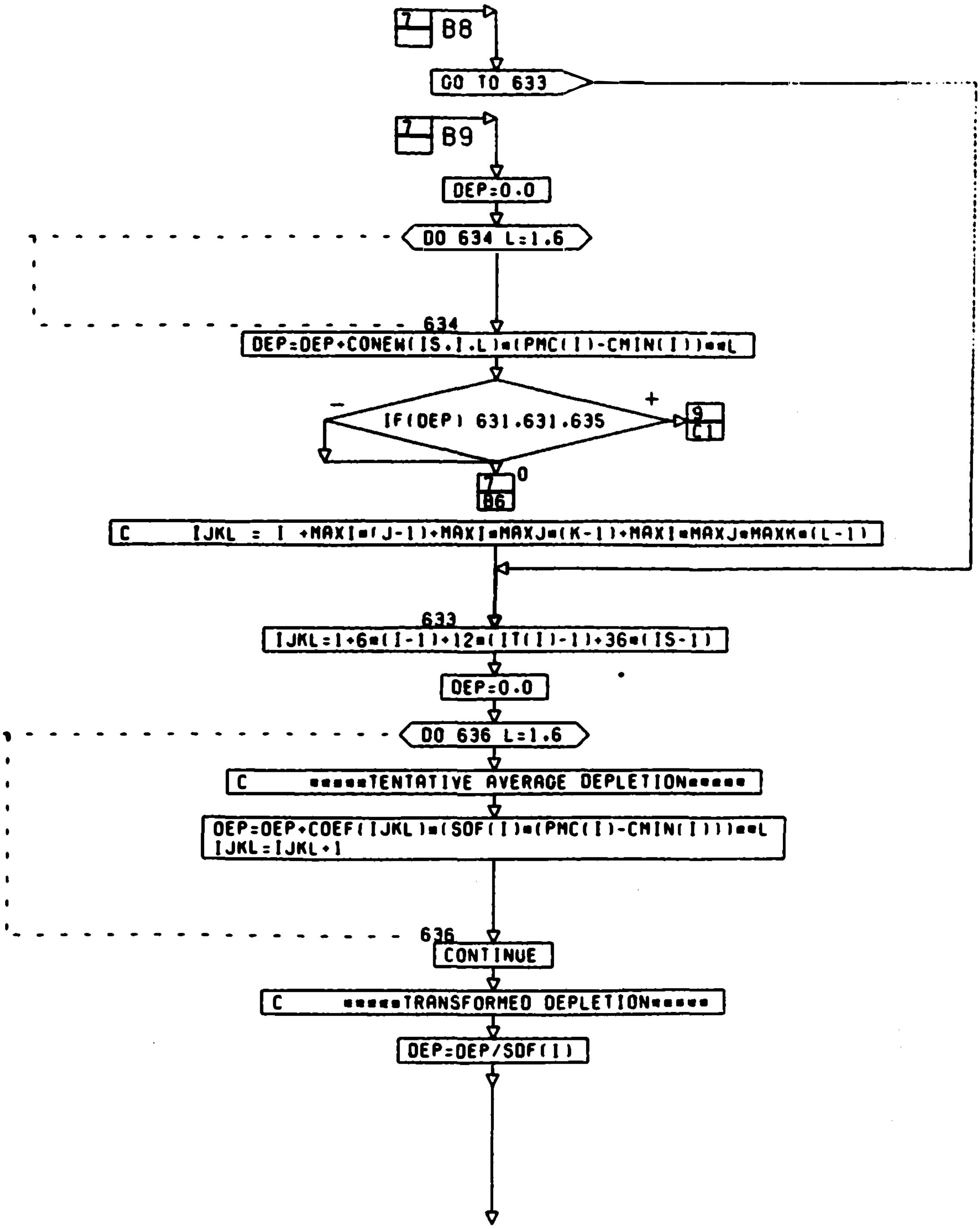


5
B1
630
ACCR=RF(J)-RMIN
5
5
B2
629
IF(I1.EQ.1)
F
T
GO TO 619
C ■■■■■ACCRETION(CONSTANT)■■■■■
IF(ACCR.GE.ACCR2)
F
T
GO TO 619
PMC(I)=PMC(I)+ACCR2
GO TO 627
7
B4
C NEW MOISTURE CONTENT
3
B3
619
PMC(I)=PMC(I)+ACCR

CONT. ON PG 7

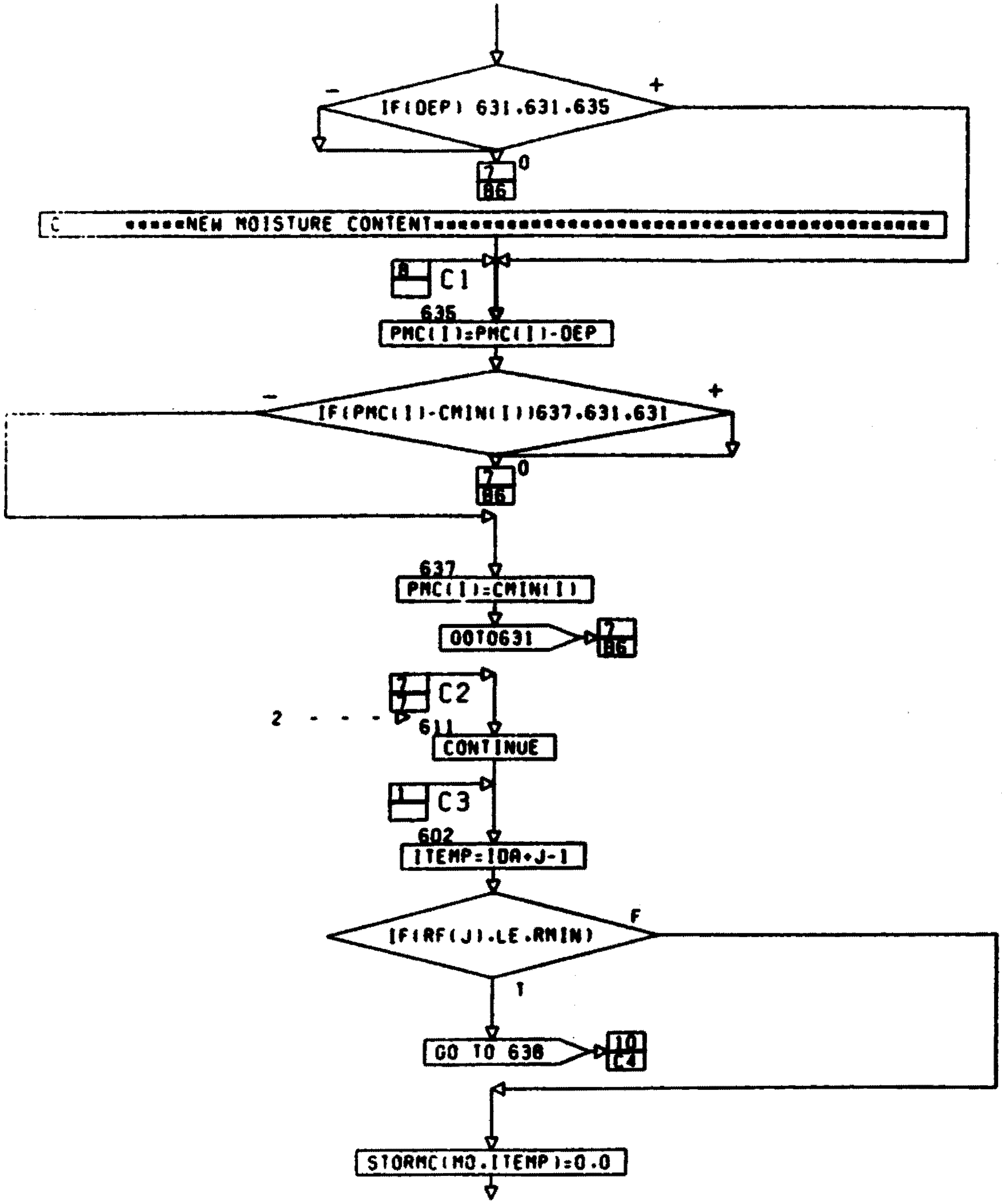

B4
627
IF(PMC(I)-CMAX(I)) 631,631,625
B5
625
PMC(I)=CMAX(I)
B6
631
IF(MEAOU2.EQ.2)
GO TO 611
C *****CONVERT MOISTURE CONTENT TO = DRY WEIGHT*********************
DWMC(I,J)=(PMC(I)/(6.*BD(I)))*100.+0.005
GO TO 611
C *****DEPLETION CALCULATION*************************************
B7
613
IF(PMC(I)-CMIN(I)) 631,632,632
632
IF(NEWCOF.NE.2)

CONT. ON PG 8

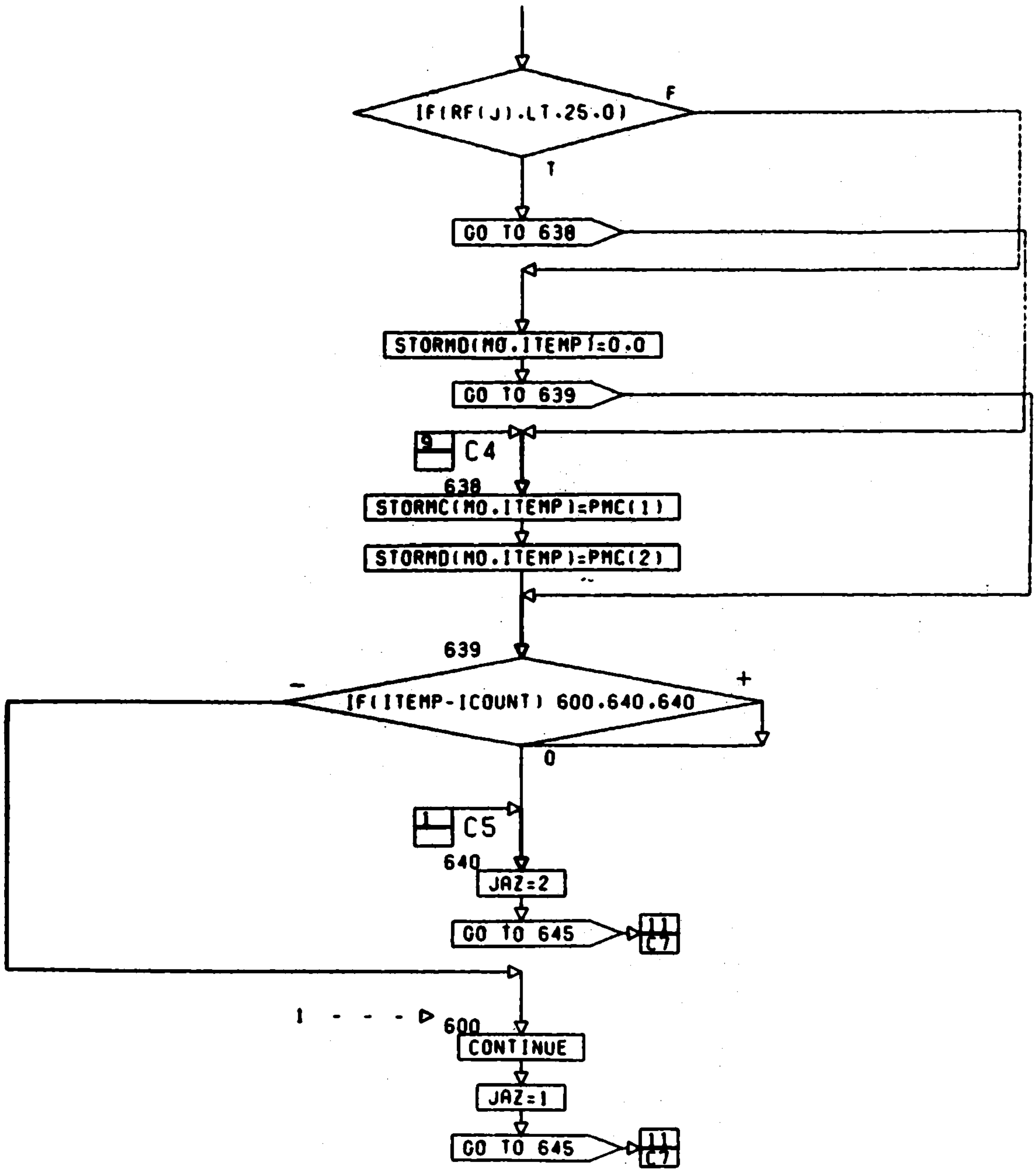


7 B8
GO TO 633
7 B9
DEP=0.0
DO 634 L=1.6
634
DEP=DEP+CONEW(IS.I.L)*(PMC(I)-CMIN(I))**L
IF(DEP) 631.631.635
−
+
0
9 C1
7 B6
C IJKL = I +MAXI*(J-1)+MAXI*MAXJ*(K-1)+MAXI*MAXJ*MAXK*(L-1)
633
IJKL=1+6*(I-1)+12*(IT(I)-1)+36*(IS-1)
DEP=0.0
DO 636 L=1.6
C *****TENTATIVE AVERAGE DEPLETION*****
DEP=DEP+COEF(IJKL)*(SOF(I)*(PMC(I)-CMIN(I)))**L
IJKL=IJKL+1
636
CONTINUE
C *****TRANSFORMED DEPLETION*****
DEP=DEP/SOF(I)

CONT. ON PG 9


IF(DEP) 631,631,635
7
B6
C *****NEW MOISTURE CONTENT*****
C1
635
PMC(I)=PMC(I)-DEP
IF(PMC(I)-CMIN(I))637,631,631
7
B6
637
PMC(I)=CMIN(I)
GOTO631
7
B6
C2
2
611
CONTINUE
C3
602
ITEMP=IDA+J-1
IF(RF(J).LE.RMIN)
F
T
GO TO 638
10
C4
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

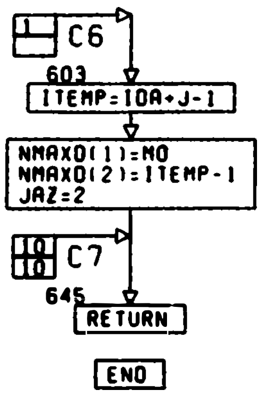

C6
603
ITEMP=IDA+J-1
NMAXD(1)=MO
NMAXD(2)=ITEMP-1
JAZ=2
C7
645
RETURN
END

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

SUBROUTINE FILIDA

•••••••••••••••••
•••••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)

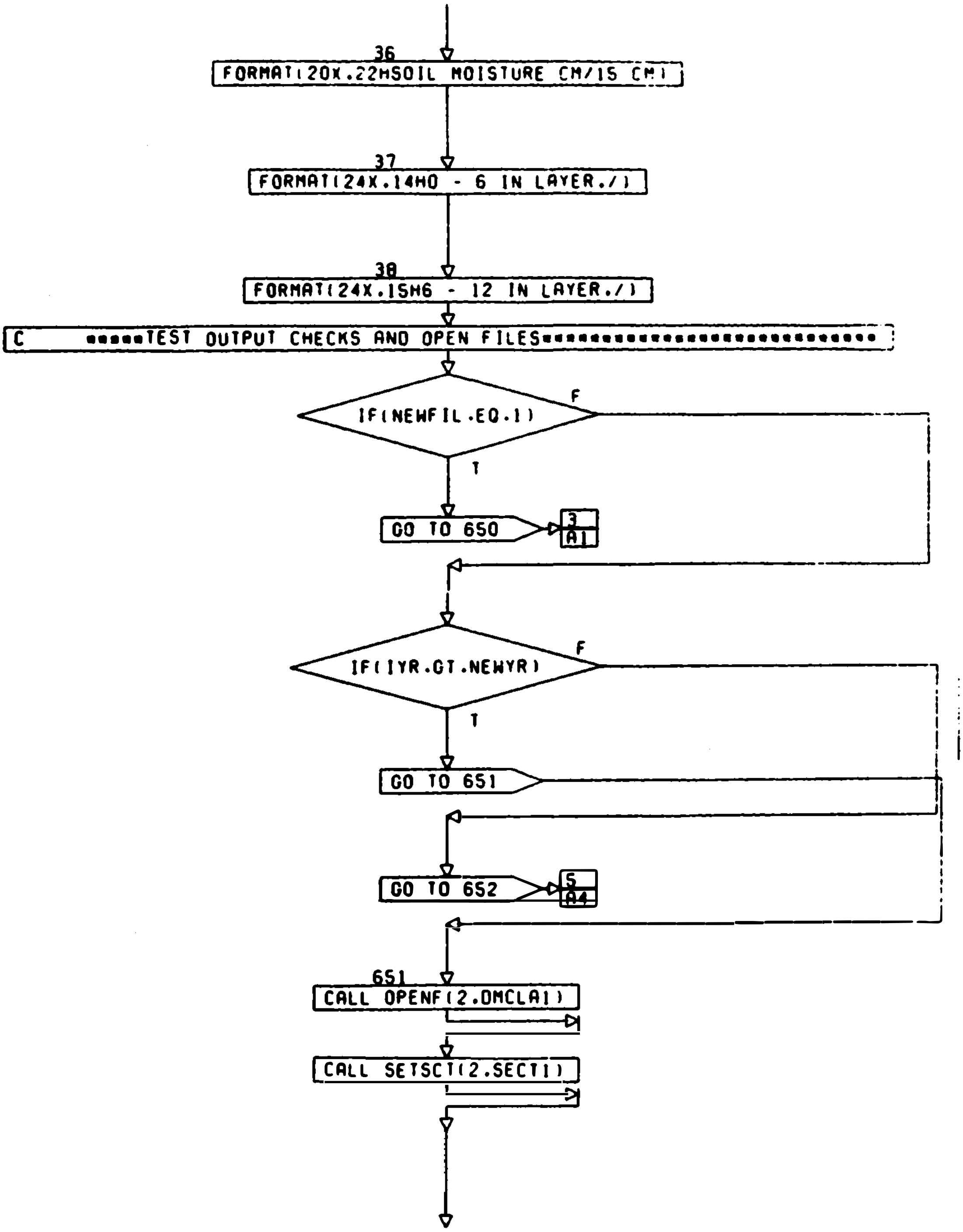
32 FORMAT(1X,I2,1H-,I2,4X,7F7.2)

33 FORMAT(24X,15H0 - 15 CM LAYER,/)

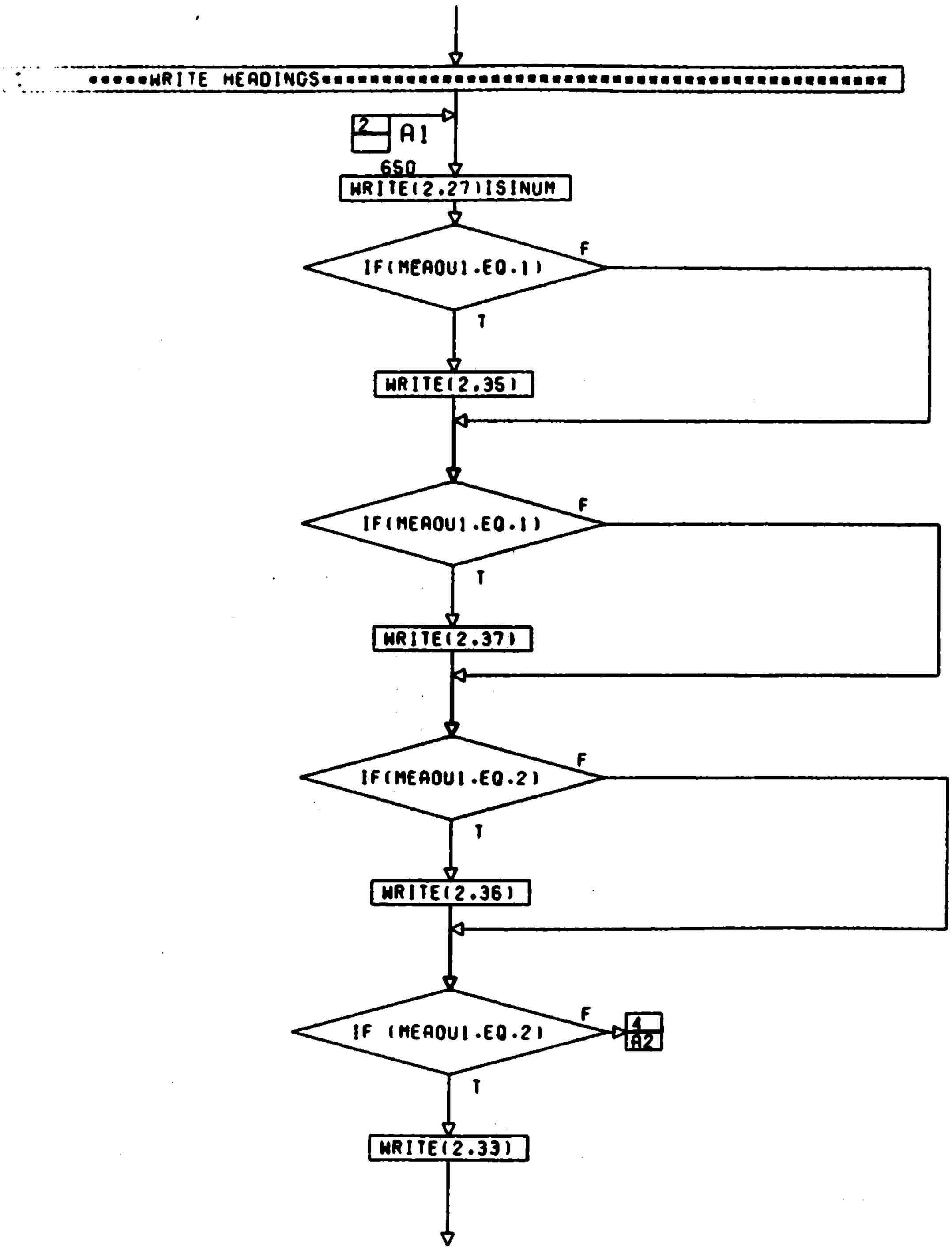
34 FORMAT(23X,16H15 -30 CM LAYER,/)

35 FORMAT(20X,22HSOIL MOISTURE IN/ 6 IN)

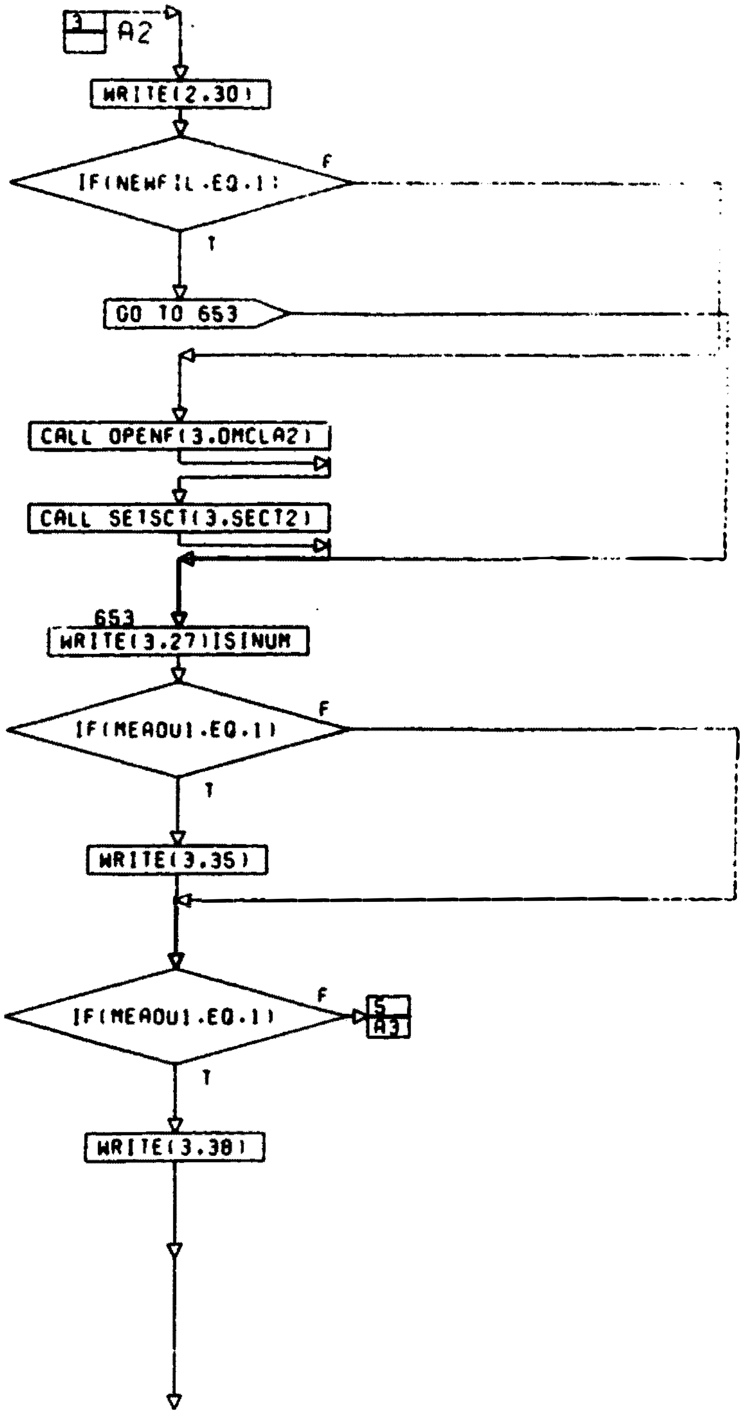
CONT. ON PG 2


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)

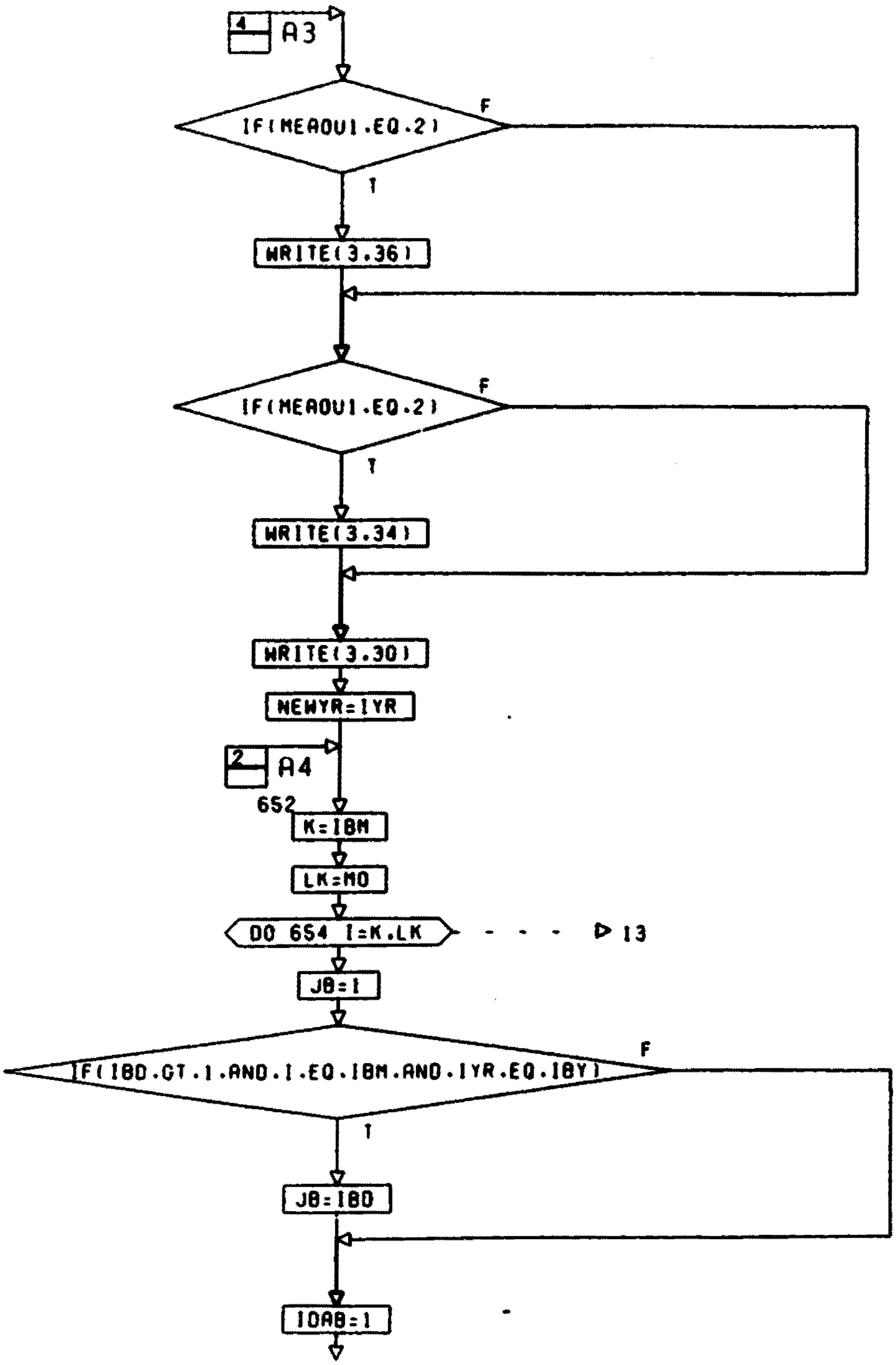
CONT. ON PG 3


*****WRITE HEADINGS***
2
A1
650
WRITE(2,27)ISINUM
IF(MEAOU1.EQ.1)
F
T
WRITE(2,35)
IF(MEAOU1.EQ.1)
F
T
WRITE(2,37)
IF(MEAOU1.EQ.2)
F
T
WRITE(2,36)
IF (MEAOU1.EQ.2)
F
4
A2
T
WRITE(2,33)

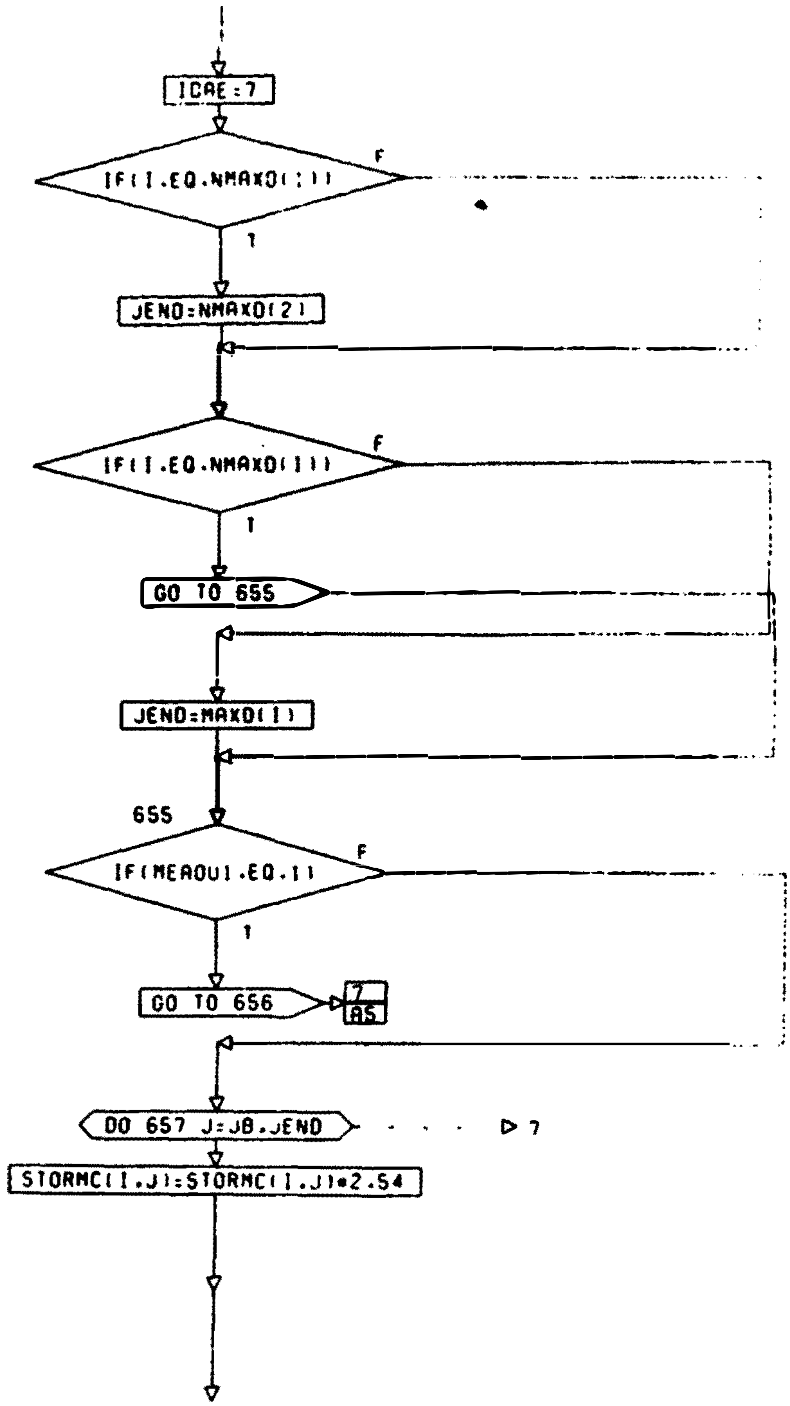
CONT. ON PG 4


3
A2
WRITE(2.30)
IF(NEWFIL.EQ.1)
F
T
GO TO 653
CALL OPENF(3.OMCLA2)
CALL SETSCT(3.SECT2)
653
WRITE(3.27)ISINUM
IF(MEAOU1.EQ.1)
F
T
WRITE(3.35)
IF(MEAOU1.EQ.1)
F
5
A3
T
WRITE(3.38)

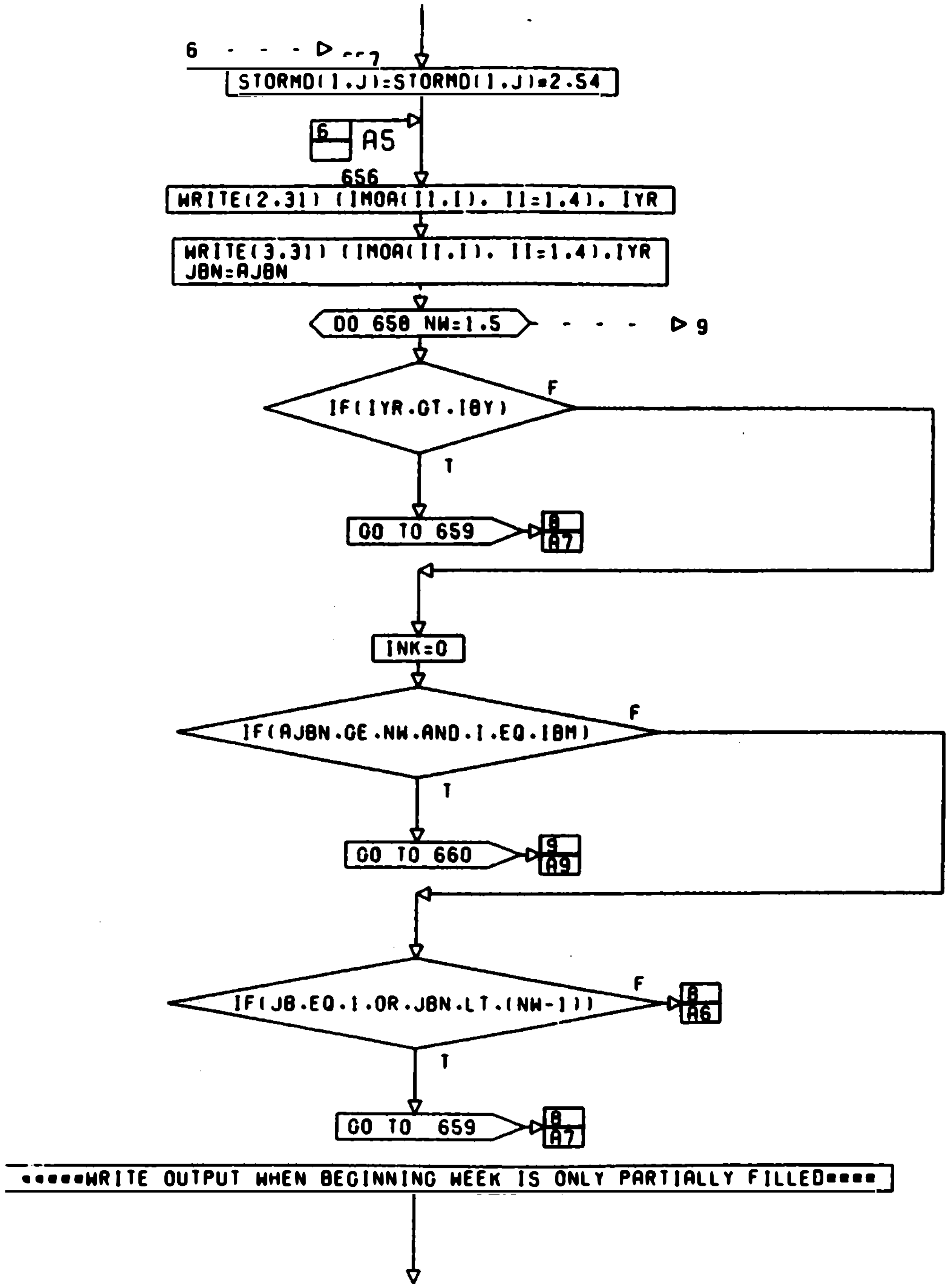
CONT. ON PG 5


A3
4
IF(MEAOUI.EQ.2)
F
T
WRITE(3.36)
IF(MEAOUI.EQ.2)
F
T
WRITE(3.34)
WRITE(3.30)
NEWYR=IYR
A4
2
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

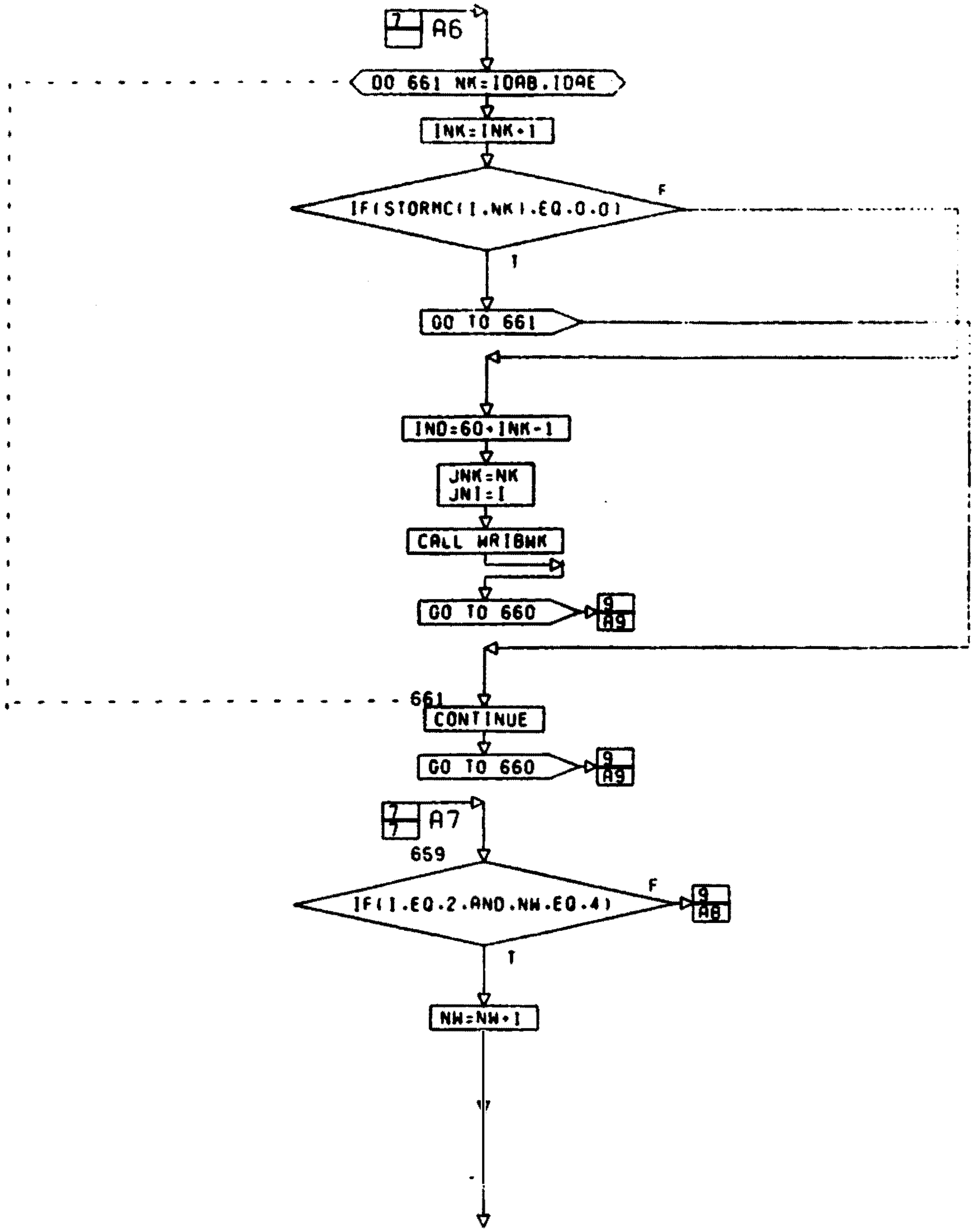
CONT. ON PG 6


ICAE=7
IF(I.EQ.NMAXO(1))
F
T
JEND=NMAXO(2)
IF(I.EQ.NMAXO(1))
F
T
GO TO 655
JEND=MAXO(I)
655
IF(MEAOU1.EQ.1)
F
T
GO TO 656
7
AS
DO 657 J=JB,JEND
7
STORMC(I,J)=STORMC(I,J)*2.54

CONT. ON PG 7

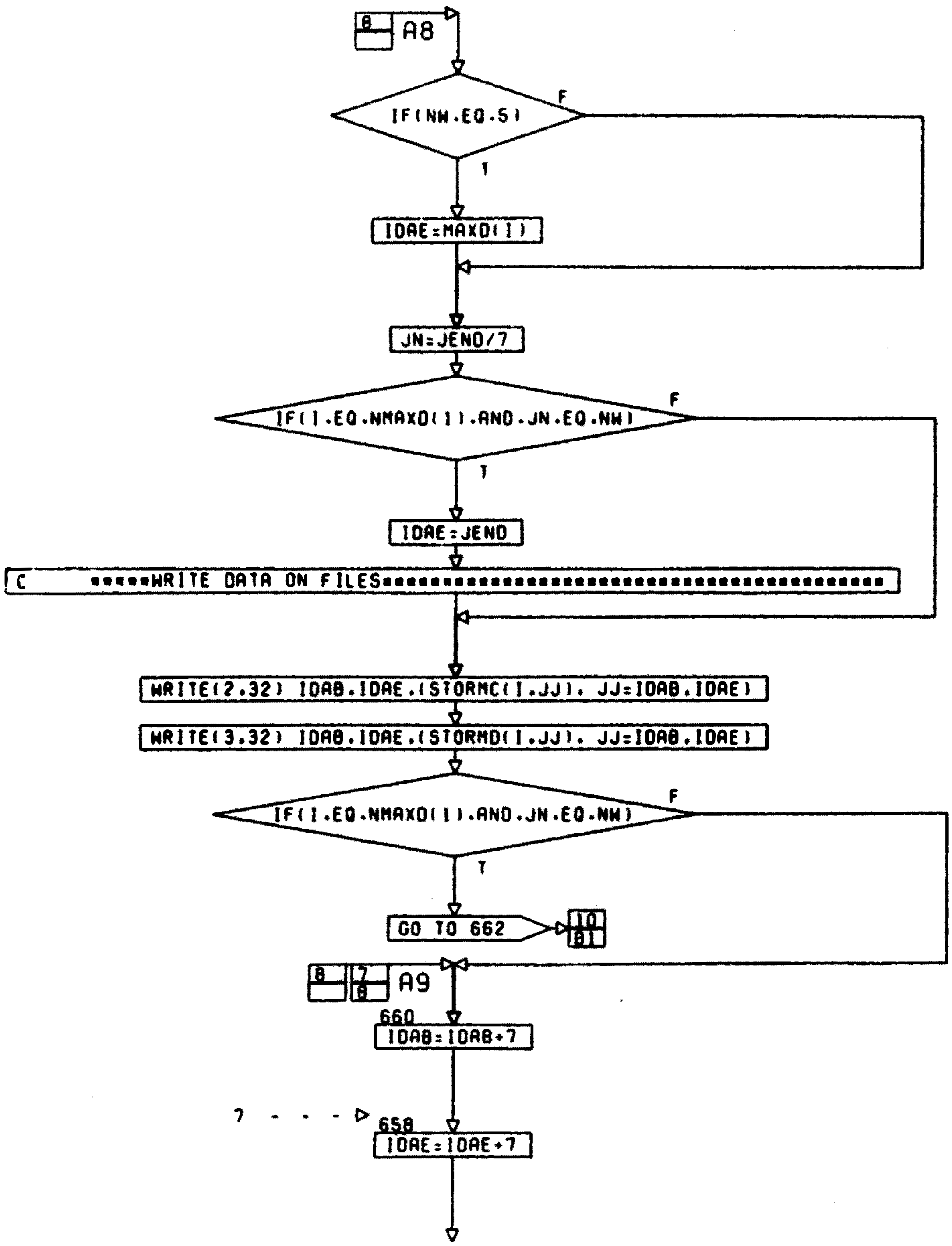

6
7
STORMO(I,J)=STORMO(I,J)*2.54
6
A5
656
WRITE(2,31) (IMOA(II,I), II=1,4), IYR
WRITE(3,31) (IMOA(II,I), II=1,4),IYR
JBN=AJBN
DO 658 NW=1,5
9
IF(IYR.GT.IBY)
F
T
GO TO 659
8
A7
INK=0
IF(AJBN.GE.NW.AND.I.EQ.IBM)
F
T
GO TO 660
9
A9
IF(JB.EQ.1.OR.JBN.LT.(NW-1))
F
8
A6
T
GO TO 659
8
A7
*****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED****

CONT. ON PG 8



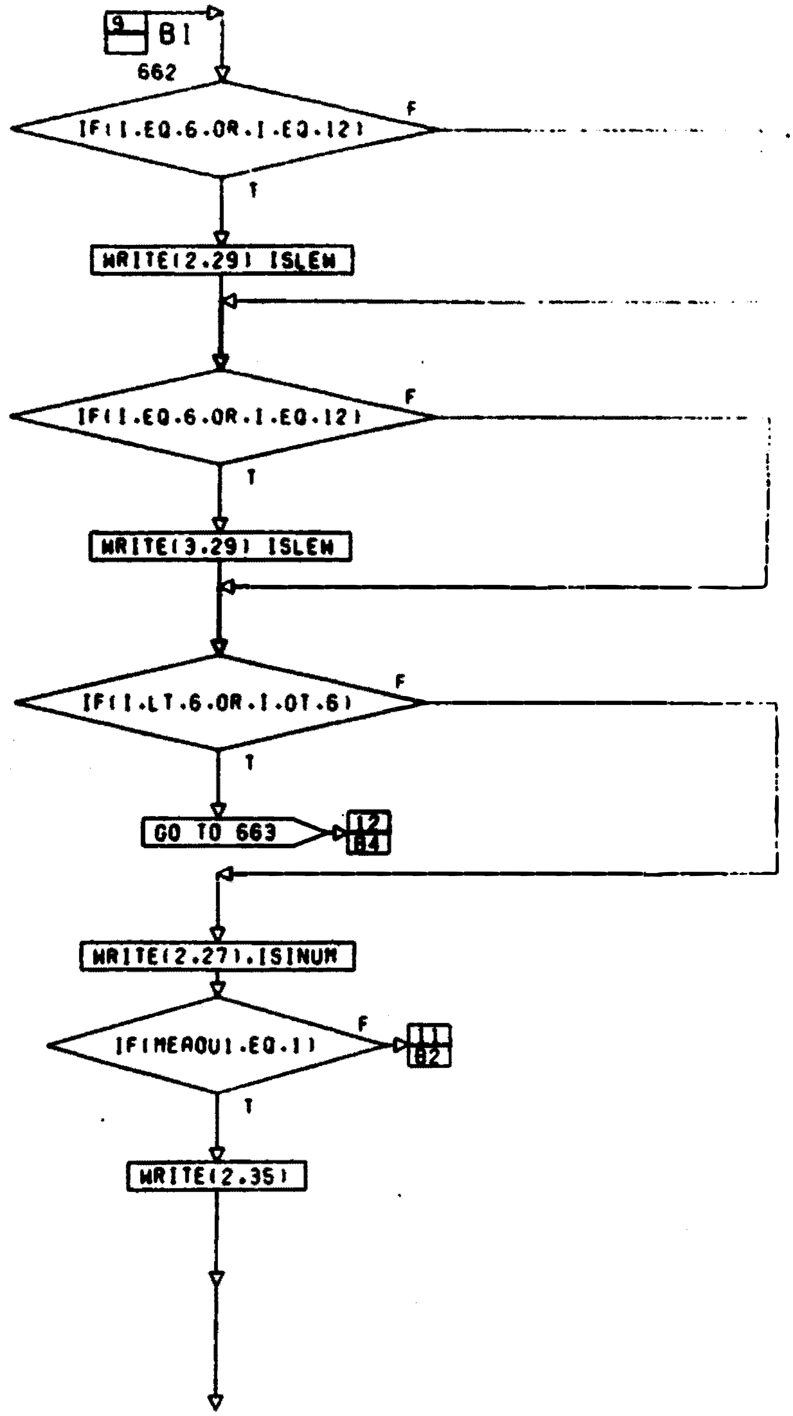
7
A6
DO 661 NK=IDAB,IDAE
INK=INK+1
IF(STORMC(I,NK).EQ.0.0)
F
T
GO TO 661
IND=60*INK-1
JNK=NK
JNI=I
CALL WRIBWK
GO TO 660
9
A9
661
CONTINUE
GO TO 660
9
A9
7
7
A7
669
IF(I.EQ.2.AND.NW.EQ.4)
F
9
A8
T
NW=NW+1

CONT. ON PG 9

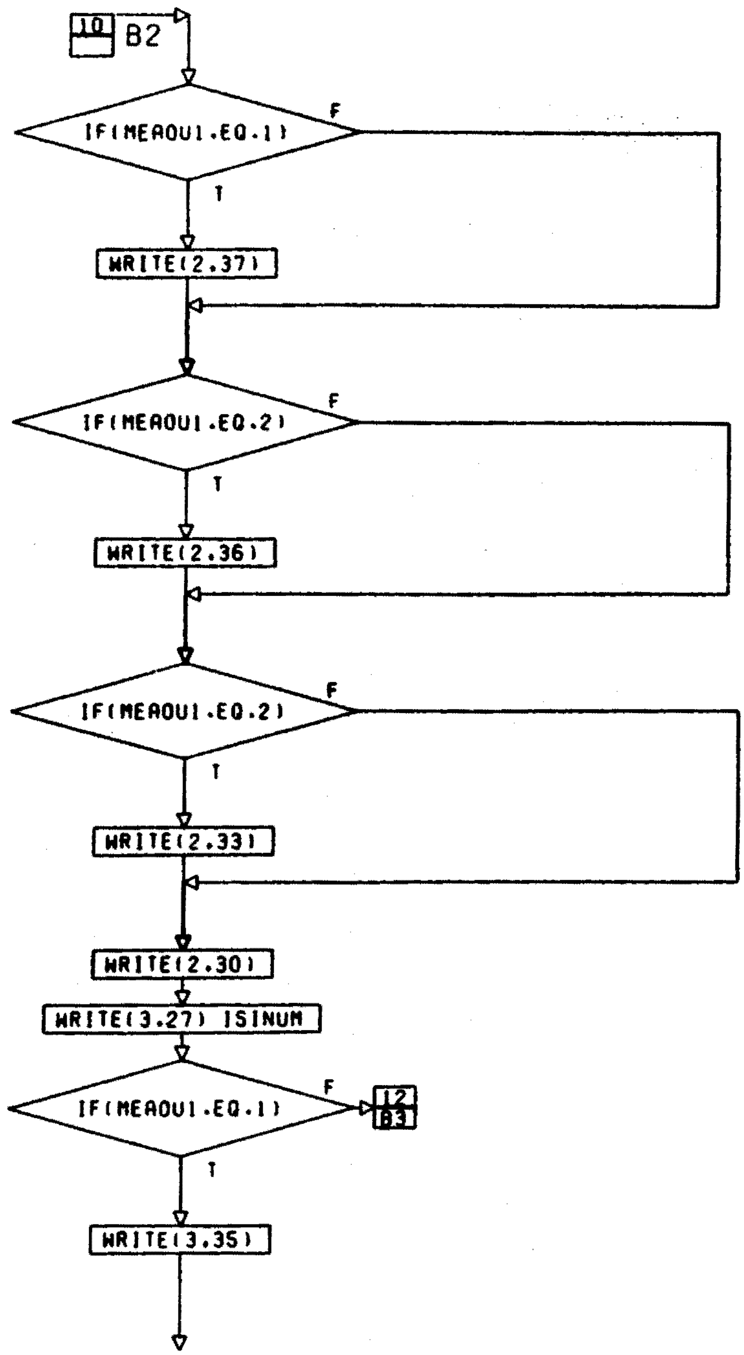


8
A8
IF(NW.EQ.5)
F
T
IDAE=MAXD(I)
JN=JEND/7
IF(I.EQ.NMAXD(I).AND.JN.EQ.NW)
F
T
IDAE=JEND
C *****WRITE DATA ON FILES**
WRITE(2,32) IDAB,IDAE,(STORMC(I,JJ), JJ=IDAB,IDAE)
WRITE(3,32) IDAB,IDAE,(STORMD(I,JJ), JJ=IDAB,IDAE)
IF(I.EQ.NMAXD(I).AND.JN.EQ.NW)
F
T
GO TO 662
10
B1
8
7
8
A9
660
IDAB=IDAB+7
7
658
IDAE=IDAE+7

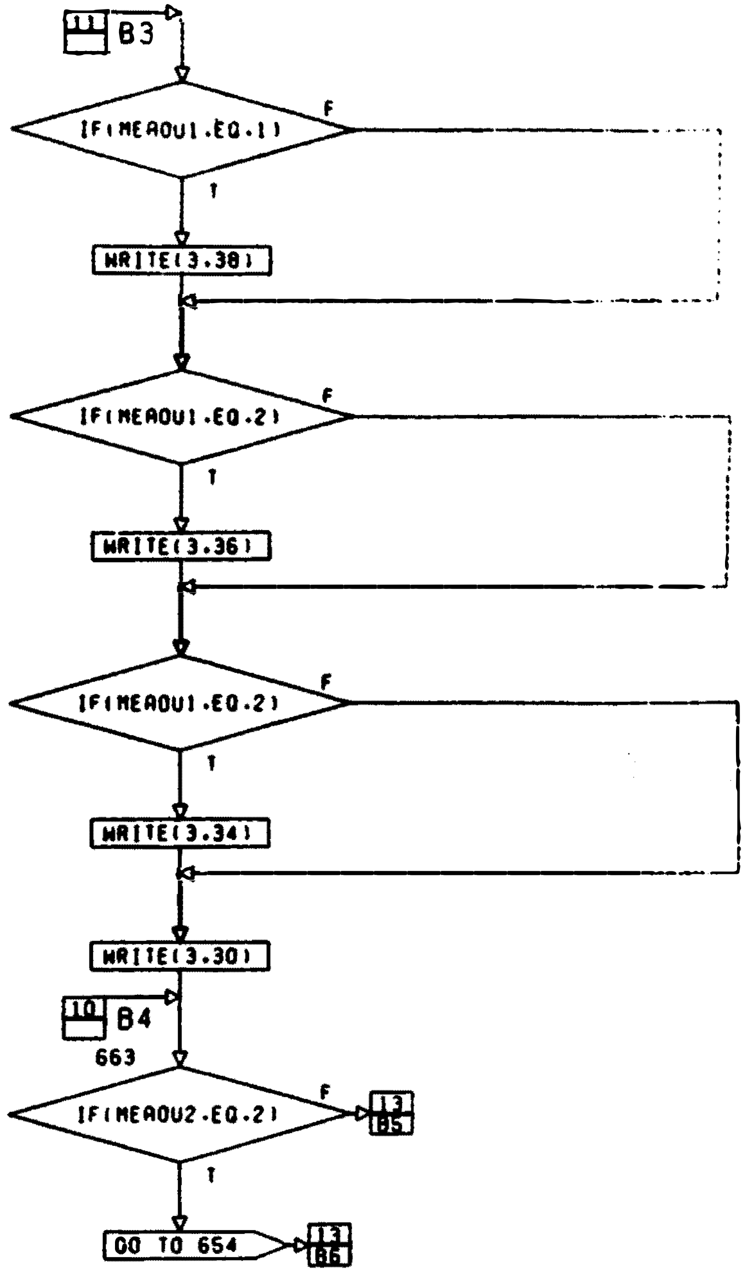
CONT. ON PG 10


9
B1
662
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.6)
F
T
GO TO 663
12
B4
WRITE(2,27),ISINUM
IF(MEAOU).EQ.1)
F
11
B2
T
WRITE(2,35)

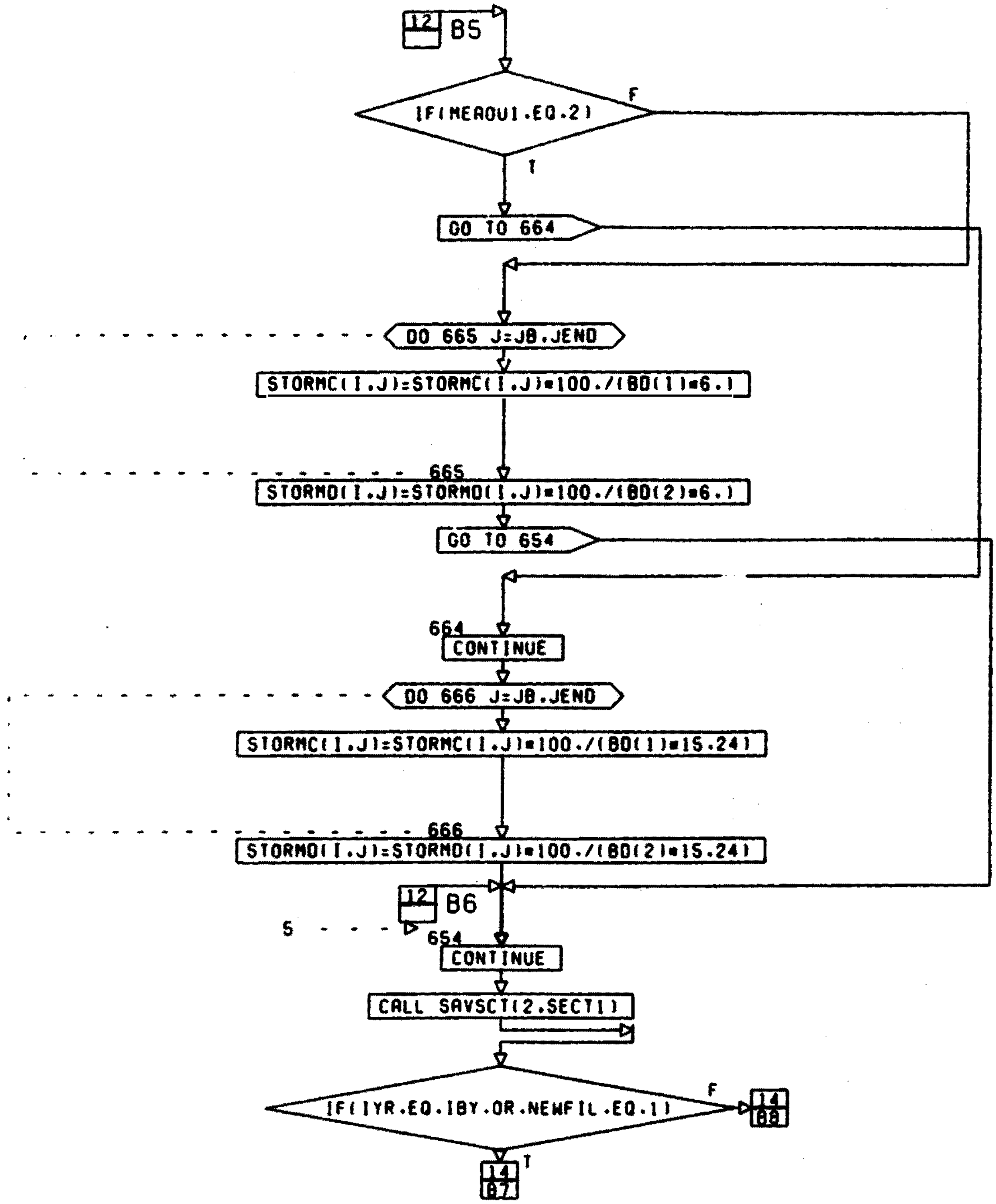
CONT. ON PG 11


10
B2
IF(MEAOU1.EQ.1)
F
T
WRITE(2,37)
IF(MEAOU1.EQ.2)
F
T
WRITE(2,36)
IF(MEAOU1.EQ.2)
F
T
WRITE(2,33)
WRITE(2,30)
WRITE(3,27) ISINUM
IF(MEAOU1.EQ.1)
F
12
B3
T
WRITE(3,35)

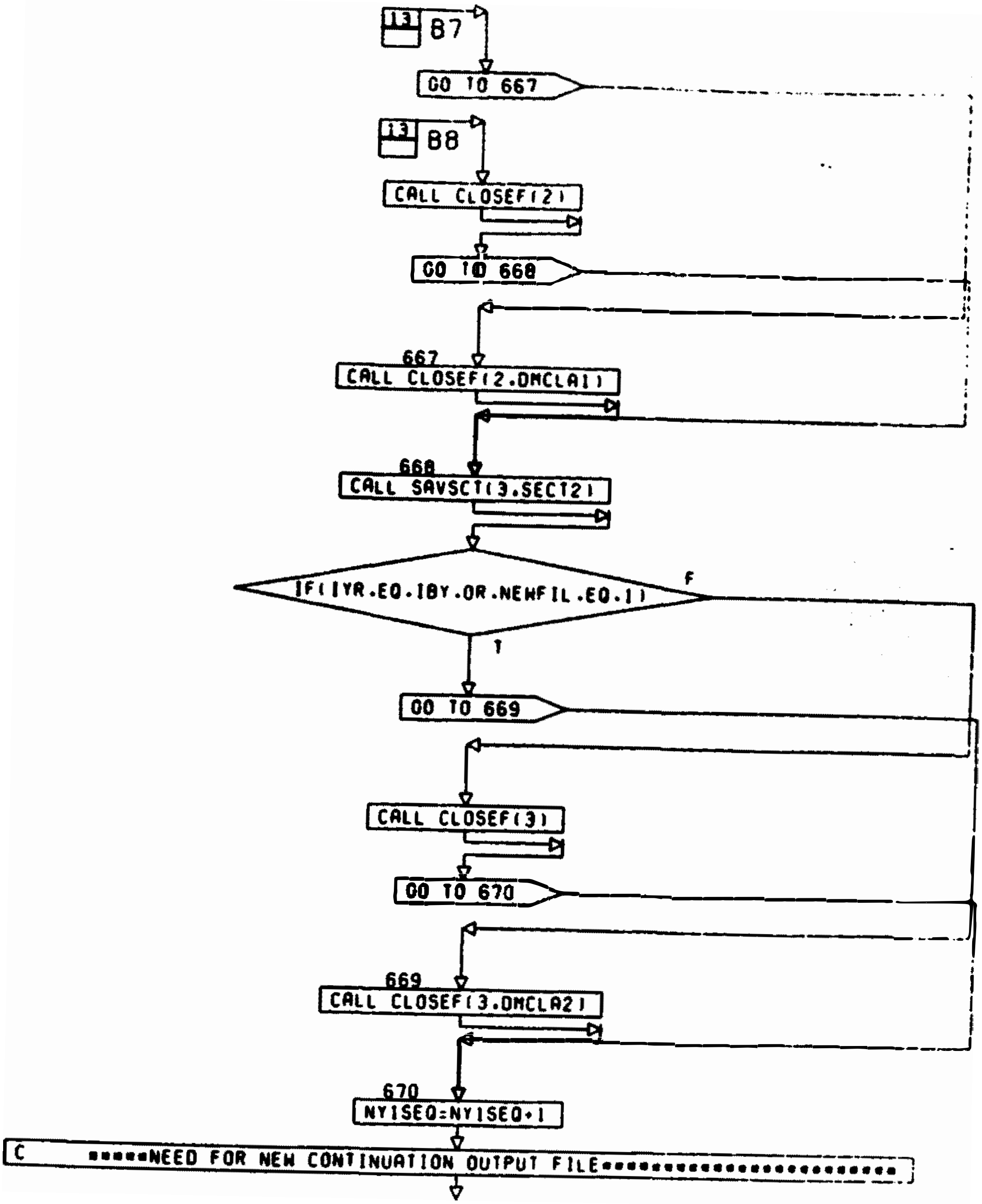
CONT. ON PG 12


11
B3
IF(MEAOU1.EQ.1)
F
T
WRITE(3.38)
IF(MEAOU1.EQ.2)
F
T
WRITE(3.36)
IF(MEAOU1.EQ.2)
F
T
WRITE(3.34)
WRITE(3.30)
10
B4
663
IF(MEAOU2.EQ.2)
F
13
B5
T
GO TO 654
13
B6

CONT. ON PG 13


12
B5
IF(MERAOU).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
NYISEQ=NYISEQ+1
C *****NEED FOR NEW CONTINUATION OUTPUT FILE************************

CONT. ON PG 15

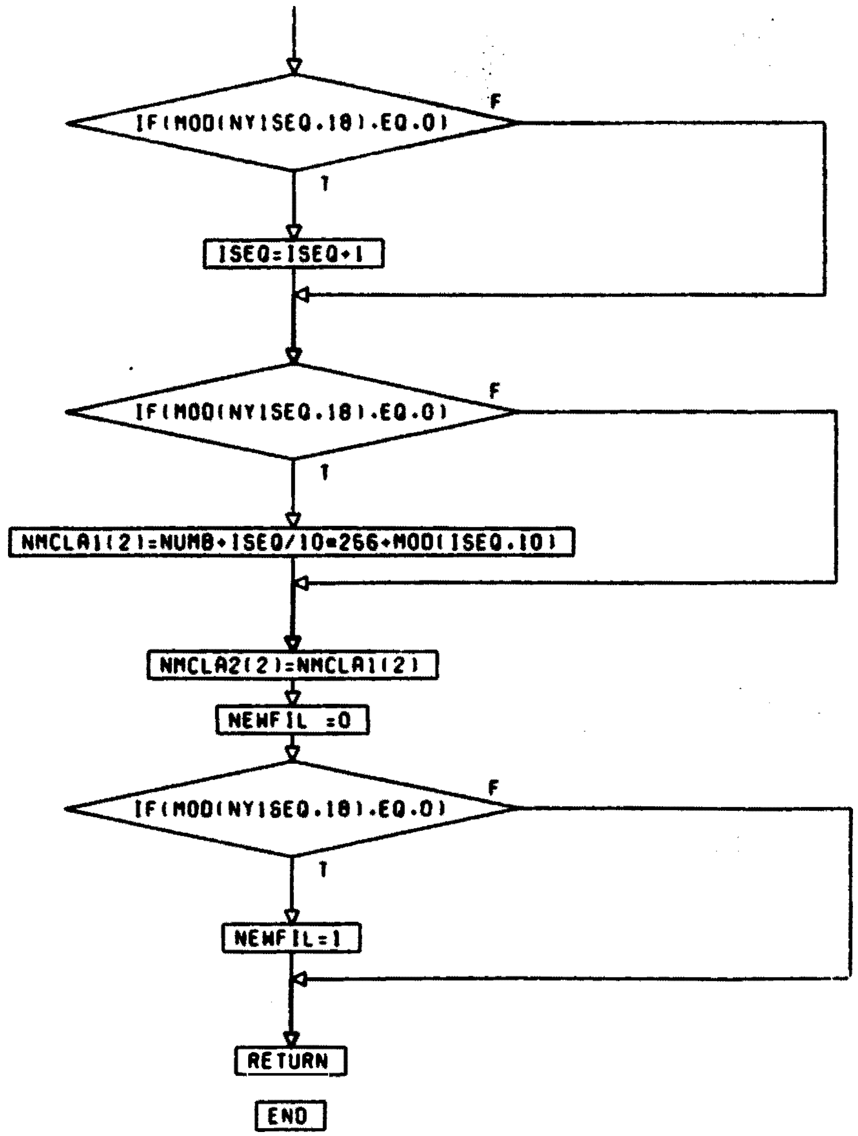
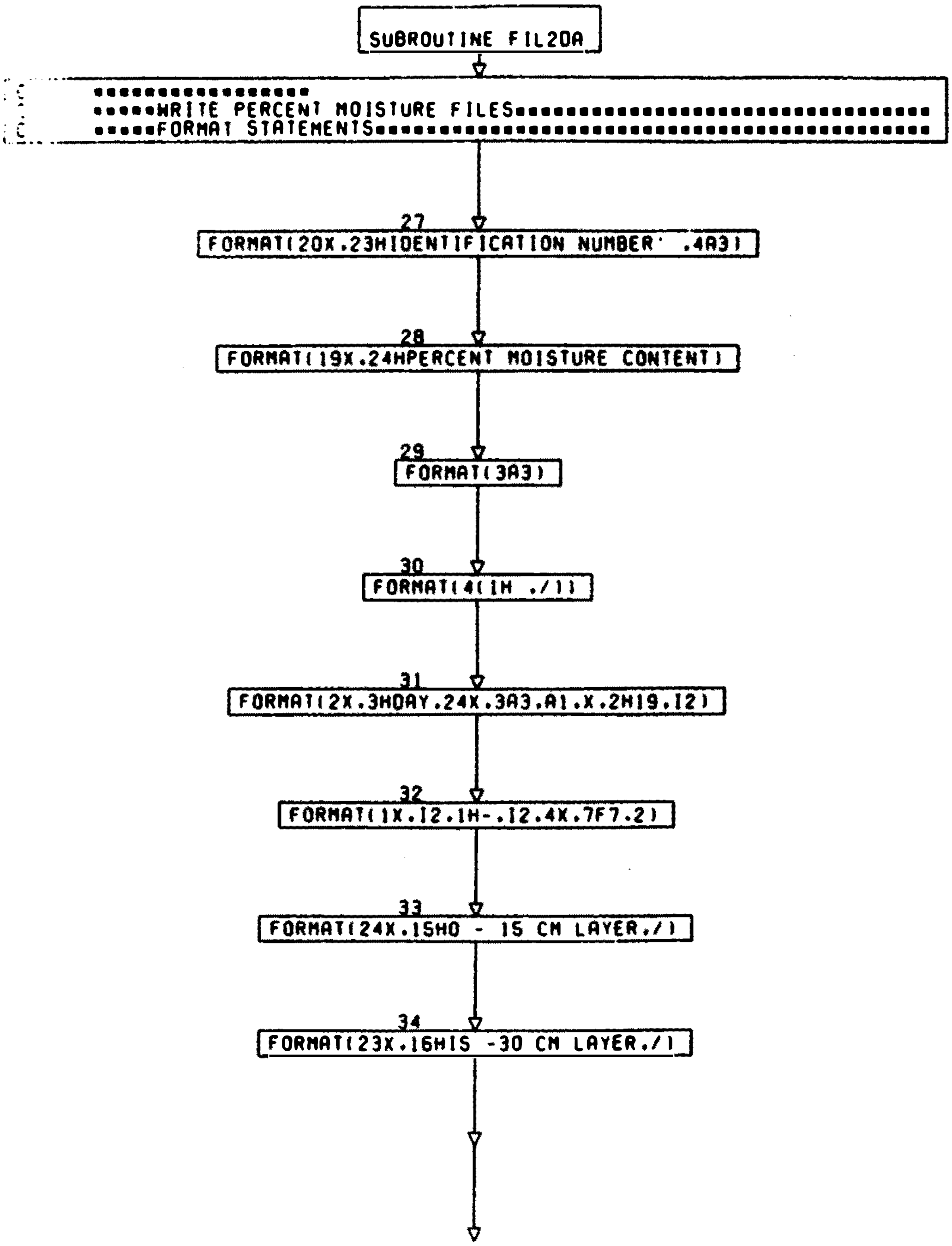
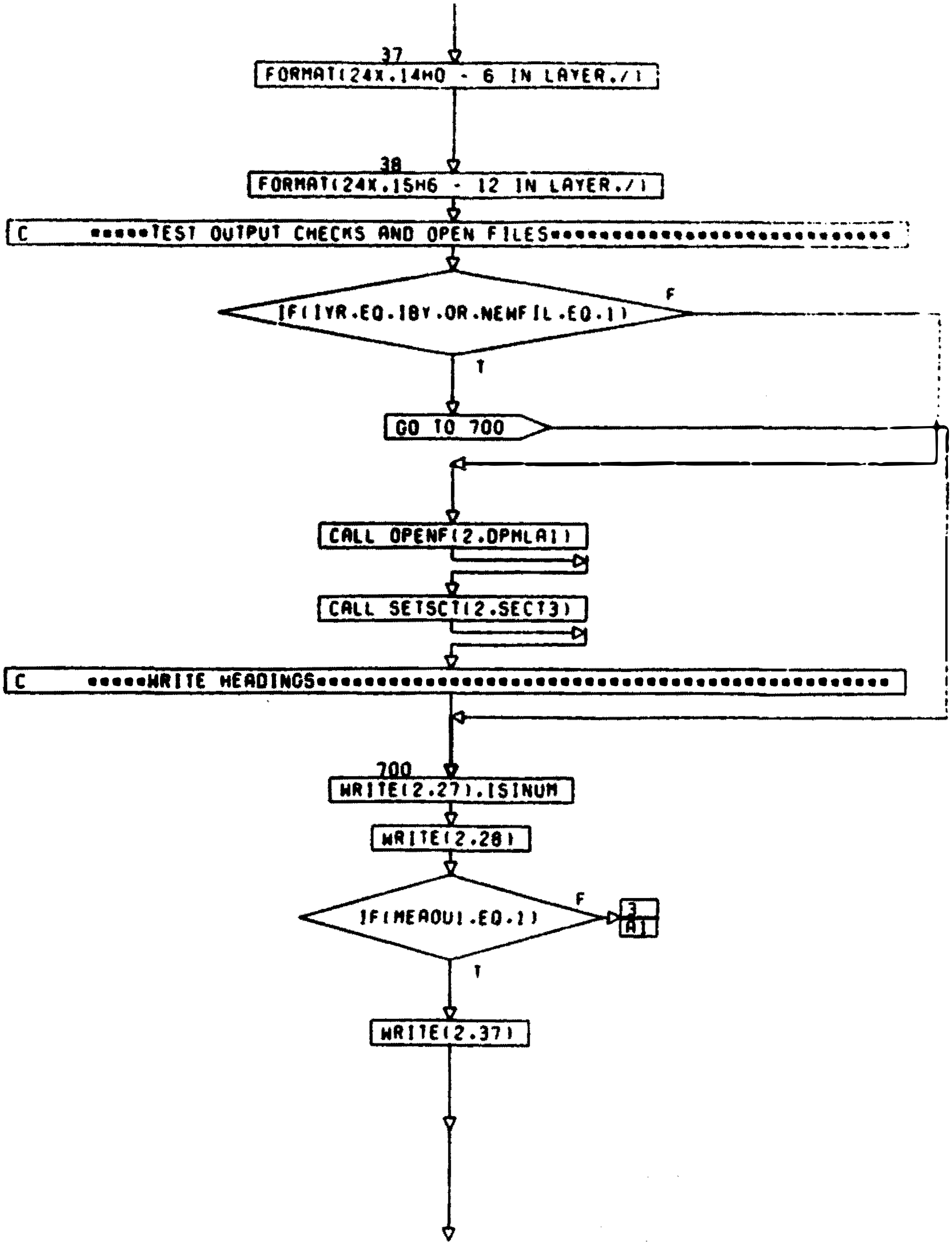

IF(MOD(NYISEQ,18).EQ.0)
F
T
ISEQ=ISEQ+1
IF(MOD(NYISEQ,18).EQ.0)
F
T
NMCLA1(2)=NUMB+ISEQ/10*256+MOD(ISEQ,10)
NMCLA2(2)=NMCLA1(2)
NEWFIL =0
IF(MOD(NYISEQ,18).EQ.0)
F
T
NEWFIL=1
RETURN
END

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

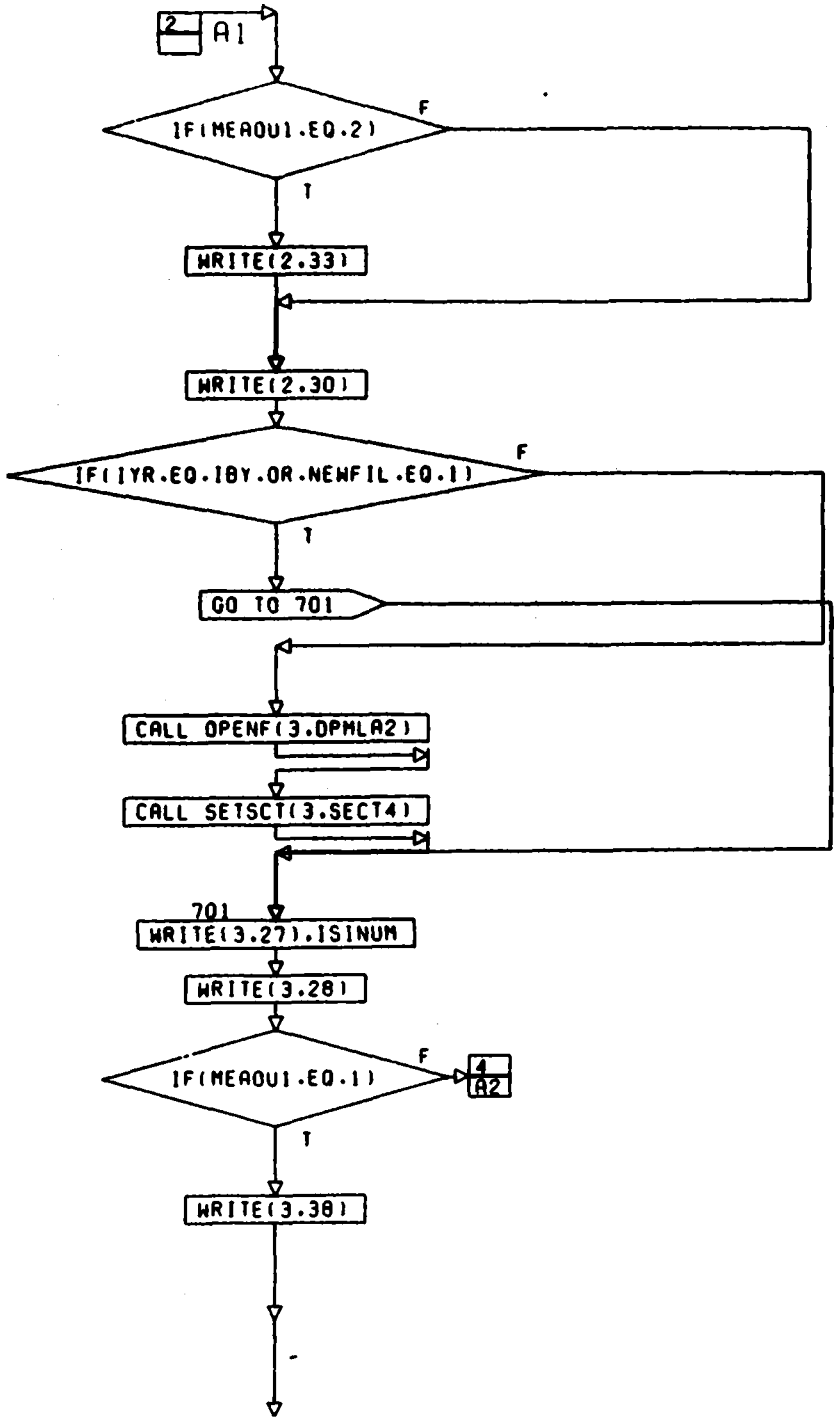

SUBROUTINE FIL20A
****
*****WRITE PERCENT MOISTURE FILES**********************************
*****FORMAT STATEMENTS***
27
FORMAT(20X,23HIDENTIFICATION NUMBER' ,4A3)
28
FORMAT(19X,24HPERCENT MOISTURE CONTENT)
29
FORMAT(3A3)
30
FORMAT(4(1H ,/))
31
FORMAT(2X,3HDAY,24X,3A3,A1,X,2H19,I2)
32
FORMAT(1X,I2,1H-,I2,4X,7F7.2)
33
FORMAT(24X,15H0 - 15 CM LAYER,/)
34
FORMAT(23X,16H15 -30 CM LAYER,/)

CONT. ON PG 2



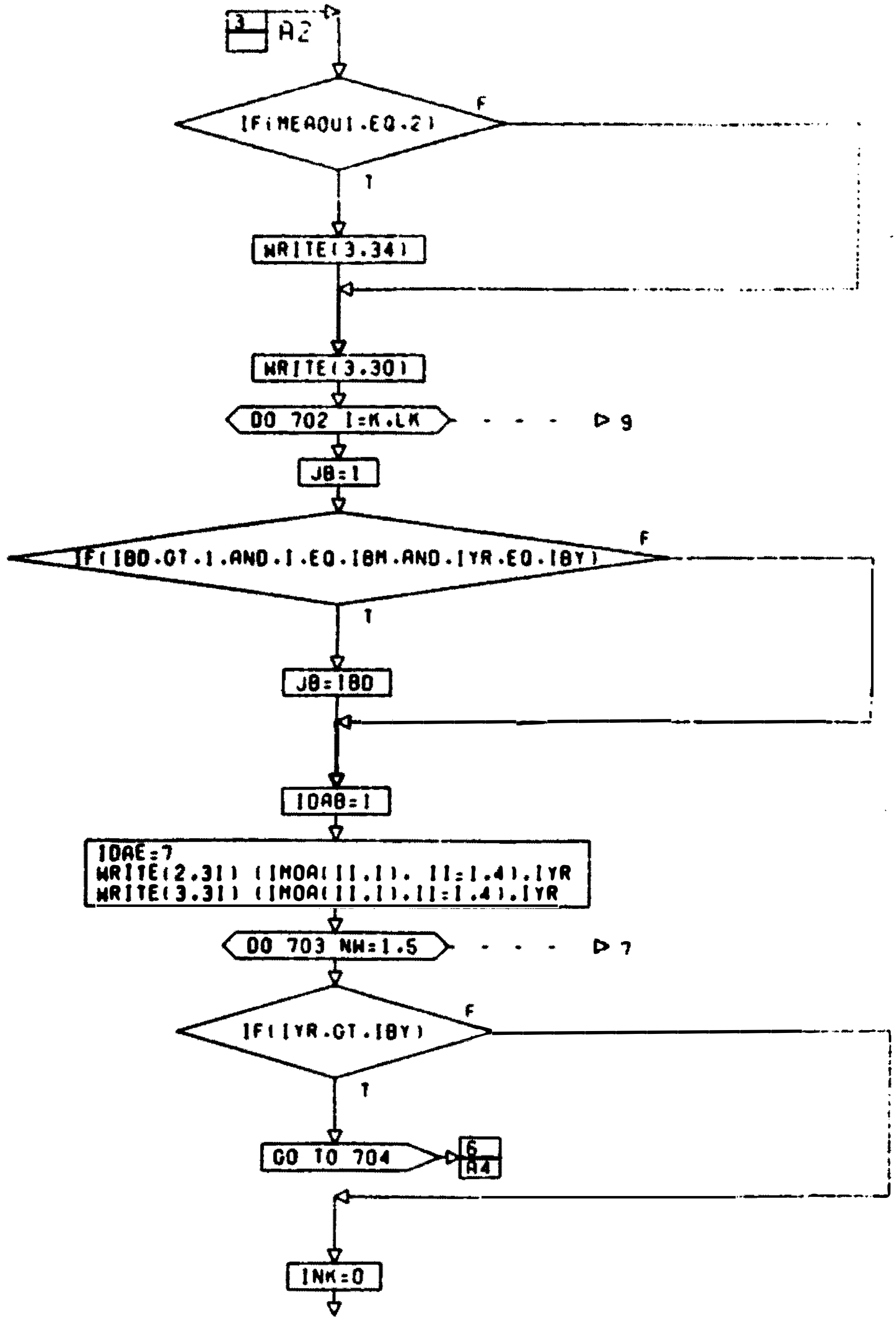
37
FORMAT(24X.14H0 - 6 IN LAYER./)
38
FORMAT(24X.15H6 - 12 IN LAYER./)
C *****TEST OUTPUT CHECKS AND OPEN FILES****************************
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 700
CALL OPENF(2.DPMLA1)
CALL SETSCT(2.SECT3)
C *****WRITE HEADINGS**
700
WRITE(2.27).ISINUM
WRITE(2.28)
IF(MEAOUI.EQ.1)
F
3
A1
T
WRITE(2.37)

CONT. ON PG 3

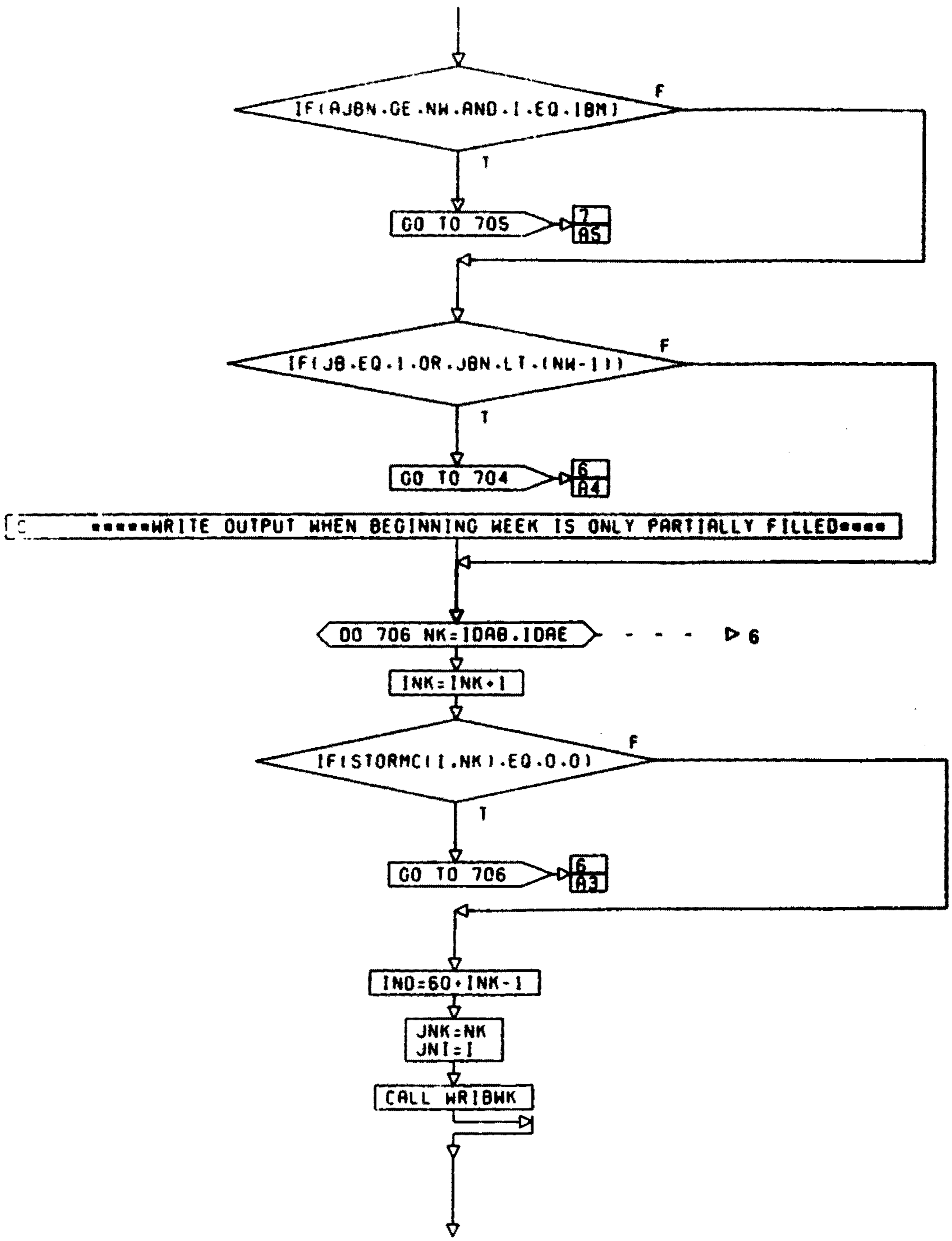


2
A1
IF(MEAOUI.EQ.2)
F
T
WRITE(2.33)
WRITE(2.30)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 701
CALL OPENF(3.OPMLA2)
CALL SETSCT(3.SECT4)
701
WRITE(3.27).ISINUM
WRITE(3.28)
IF(MEAOUI.EQ.1)
F
4
A2
T
WRITE(3.38)

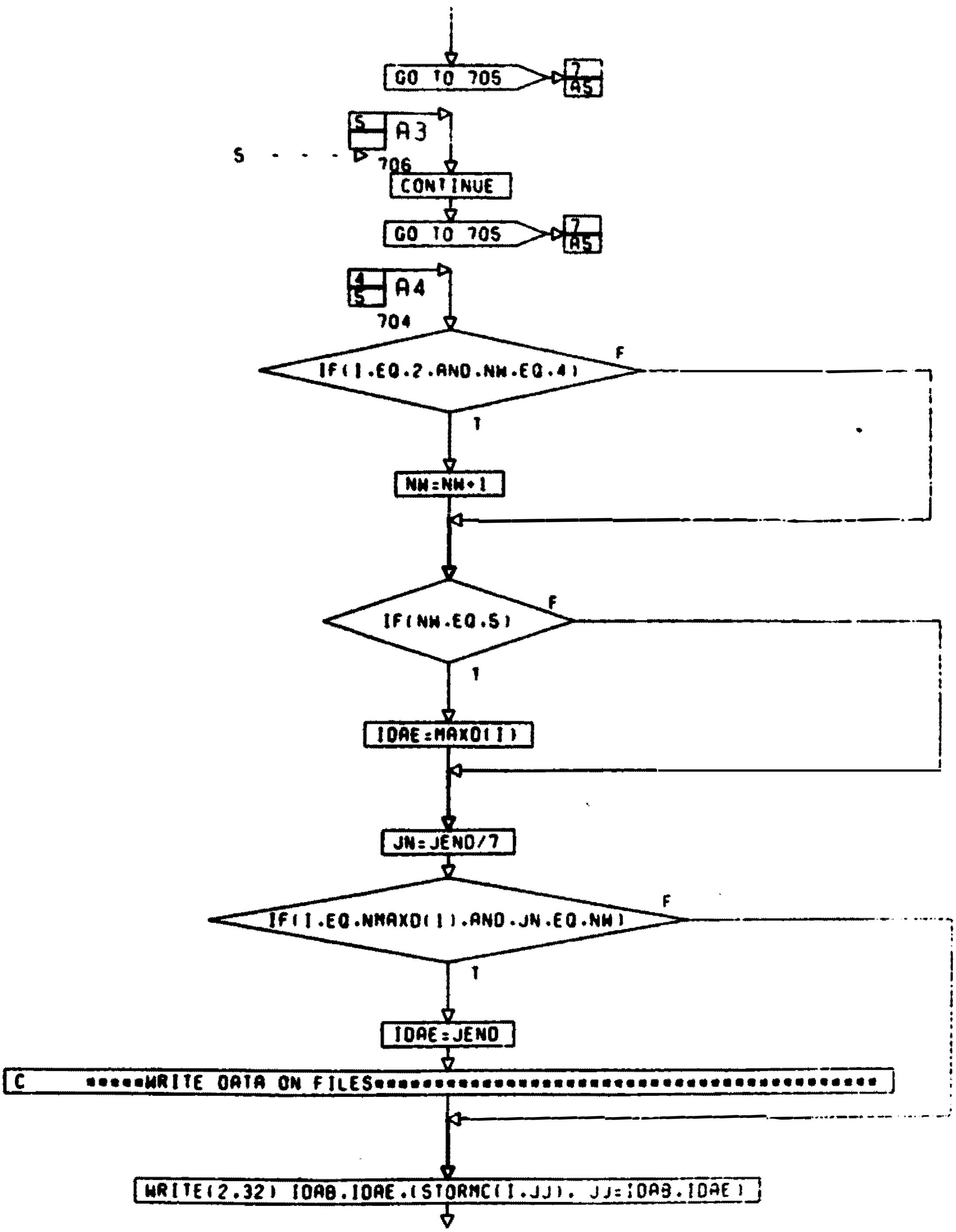
CONT. ON PG 4


3
A2
IF(MEAOUT.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

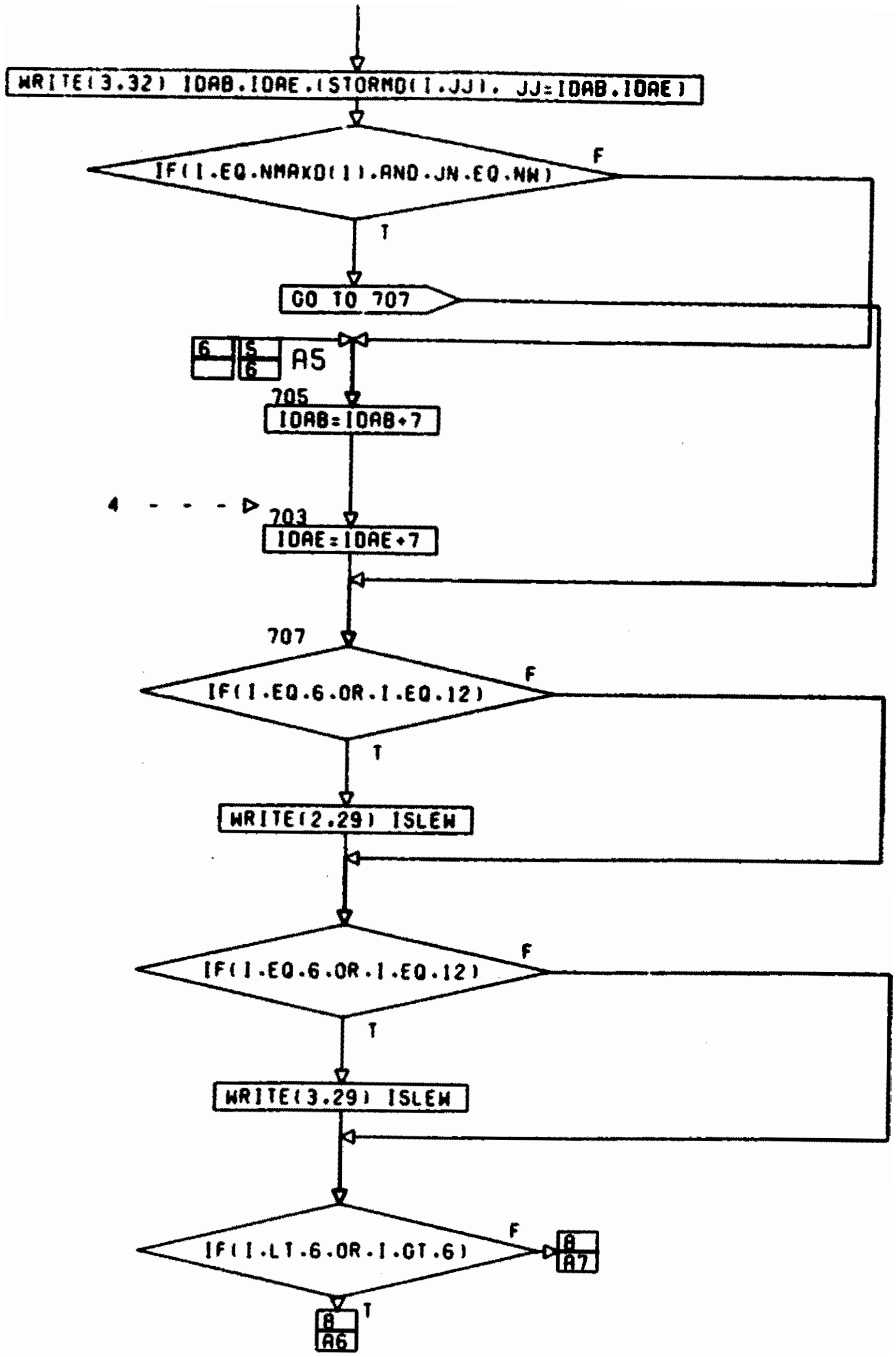
CONT. ON PG 5


IF(AJBN.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
C *****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

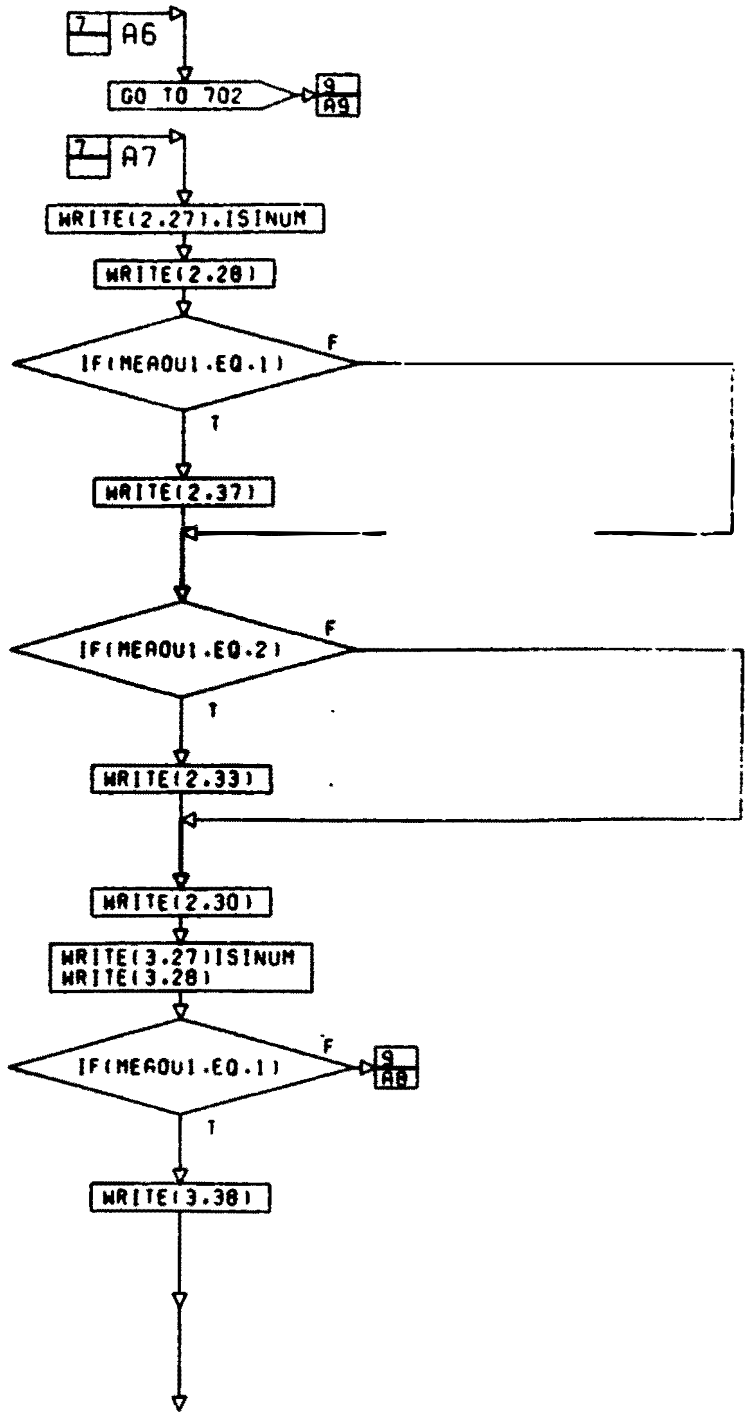
CONT. ON PG 6


GO TO 705
7
A5
5
A3
S
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)

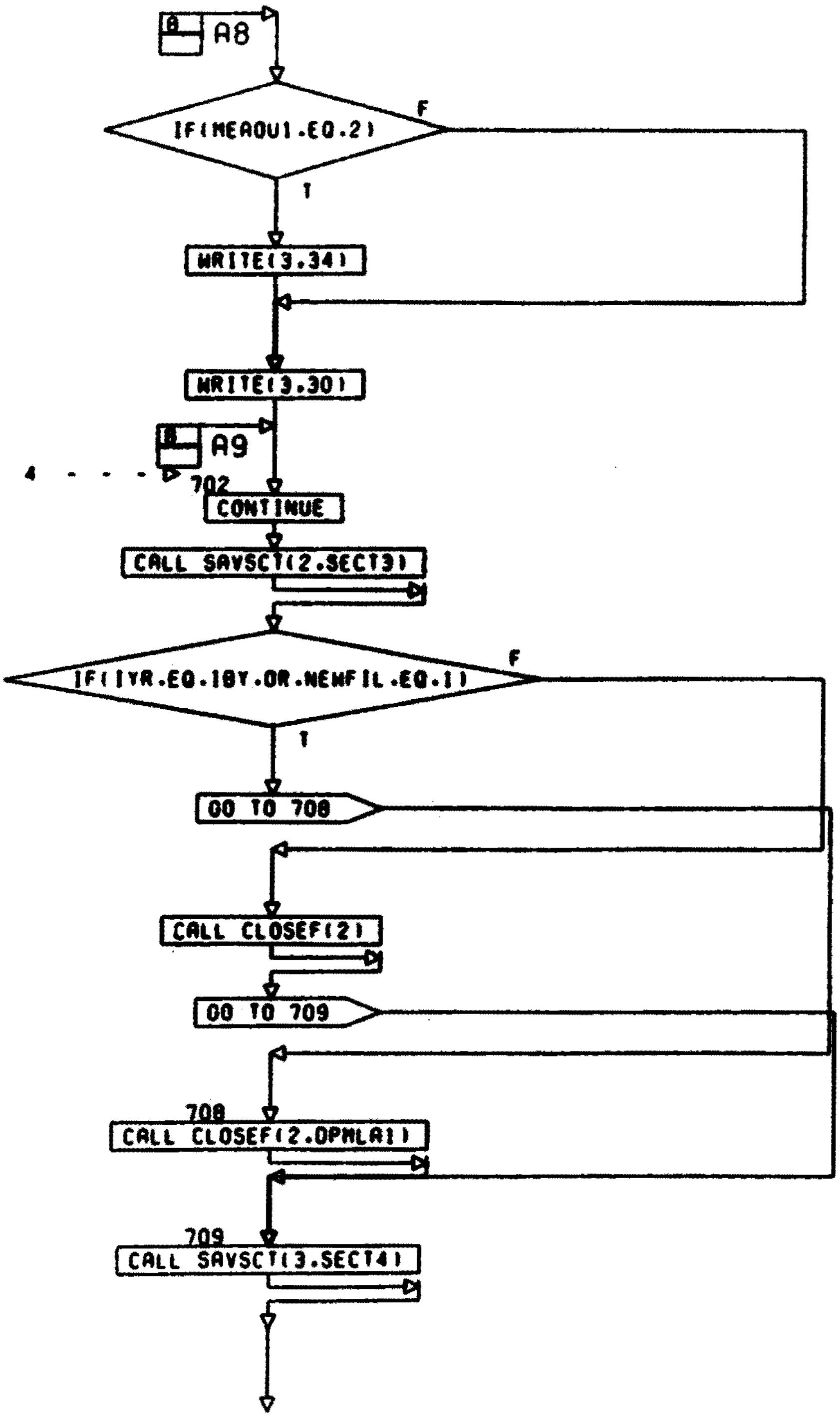
CONT. ON PG 7


WRITE(3,32) IDAB,IDAE,(STORMD(I,JJ), JJ=IDAB,IDAE)
IF(I.EQ.NMAXD(I).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.6)
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(MEAOU1.EQ.1)
F
T
WRITE(2,37)
IF(MEAOU1.EQ.2)
F
T
WRITE(2,33)
WRITE(2,30)
WRITE(3,27)ISINUM
WRITE(3,28)
IF(MEAOU1.EQ.1)
F
9
A8
T
WRITE(3,38)

CONT. ON PG 9


A8
IF(MEAOU1.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,OPNLA1)
709
CALL SAVSCT(3,SECT4)

CONT. ON PG 10

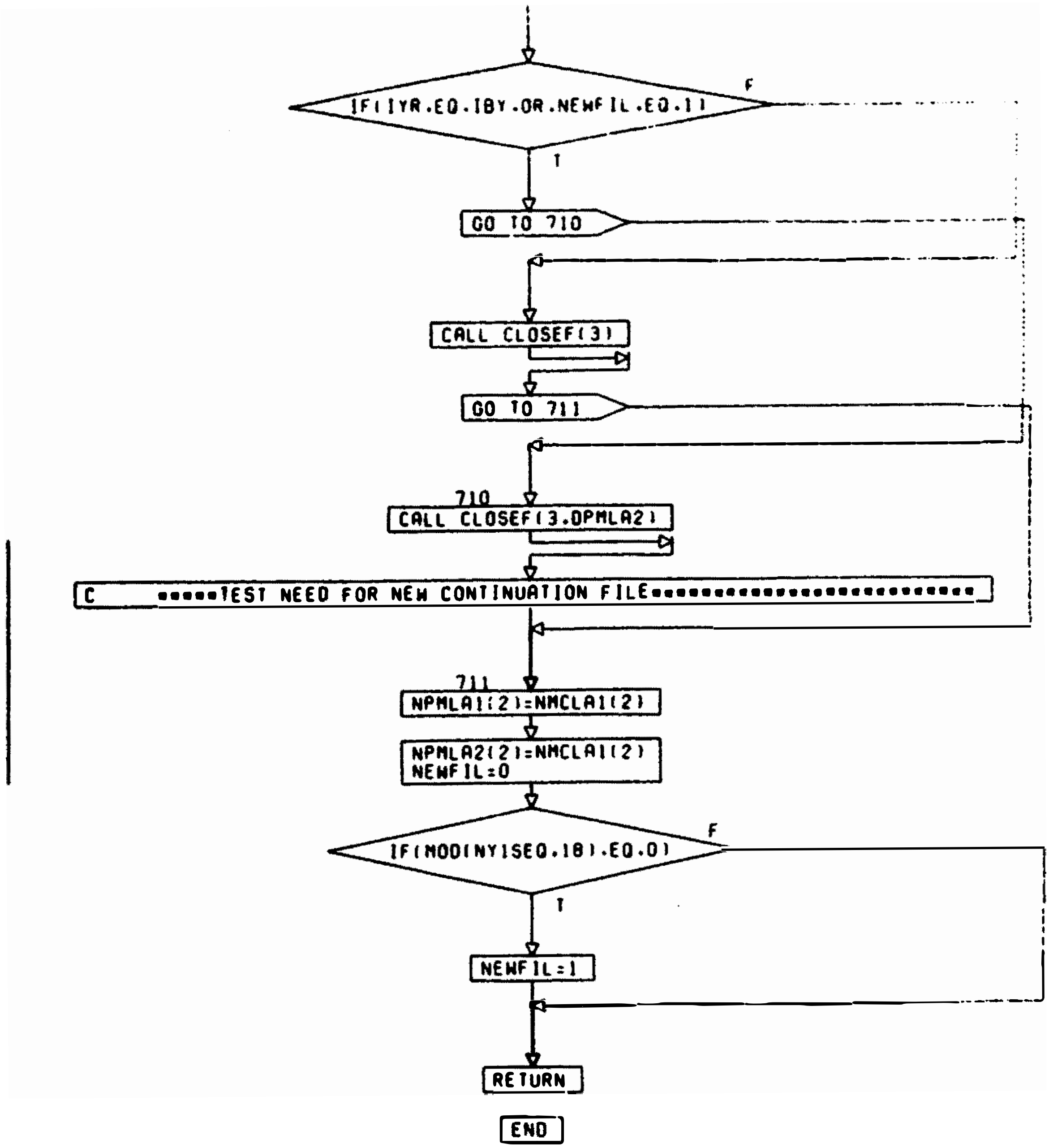
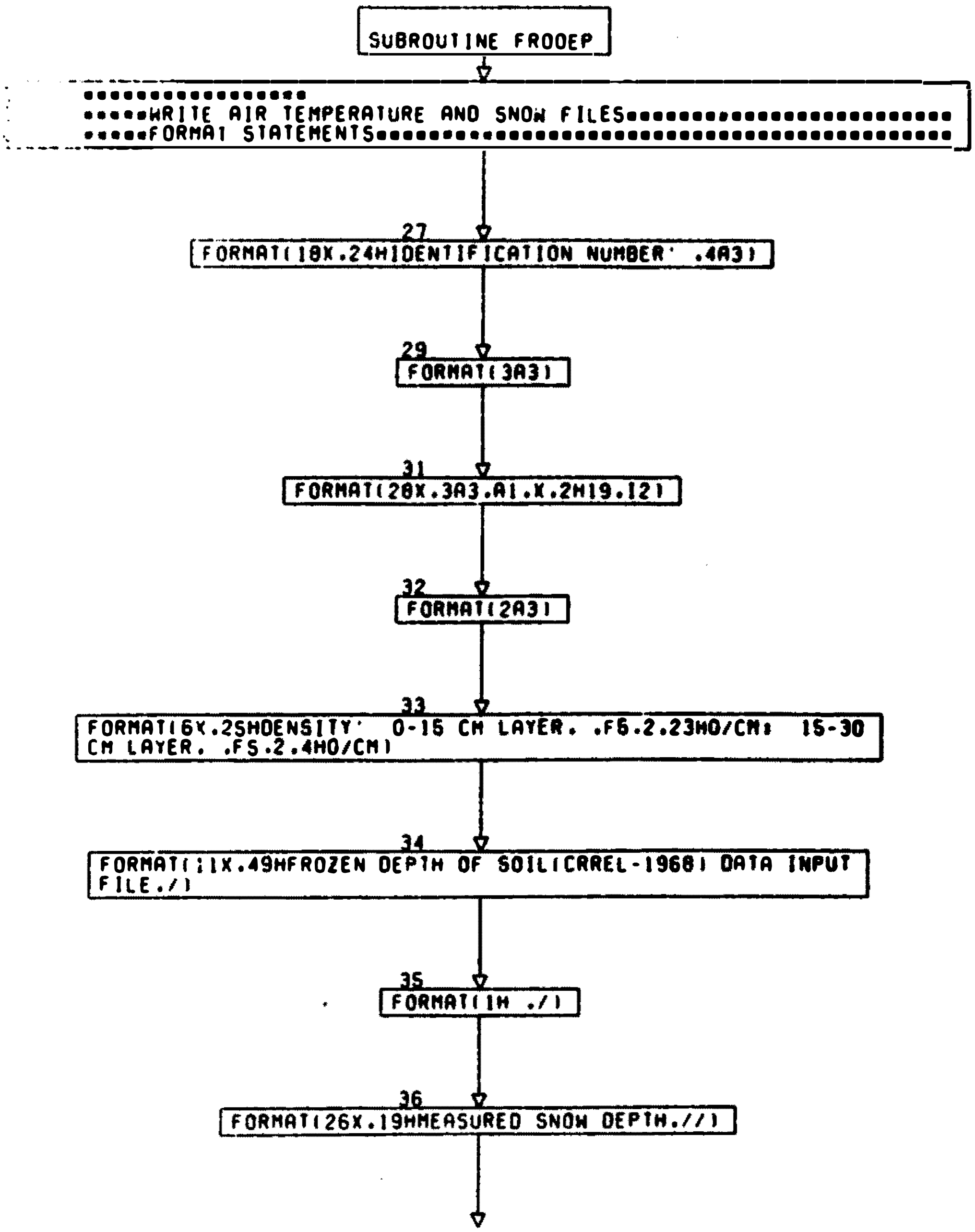
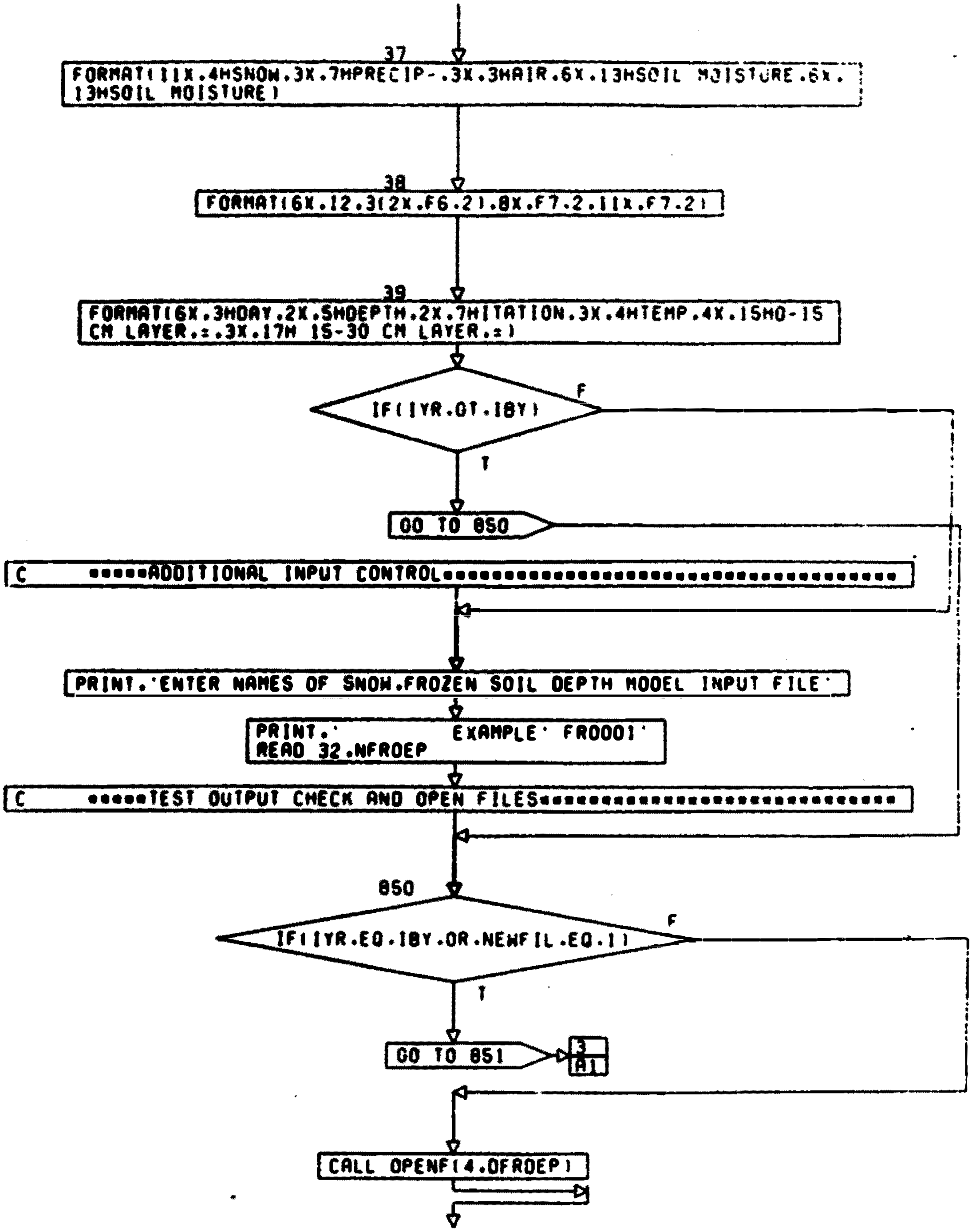

IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 710
CALL CLOSEF(3)
GO TO 711
710
CALL CLOSEF(3.DPMLA2)
C *****TEST NEED FOR NEW CONTINUATION FILE**************************
711
NPMLA1(2)=NMCLA1(2)
NPMLA2(2)=NMCLA1(2)
NEWFIL=0
IF(MOD(NYISEQ.18).EQ.0)
F
T
NEWFIL=1
RETURN
END

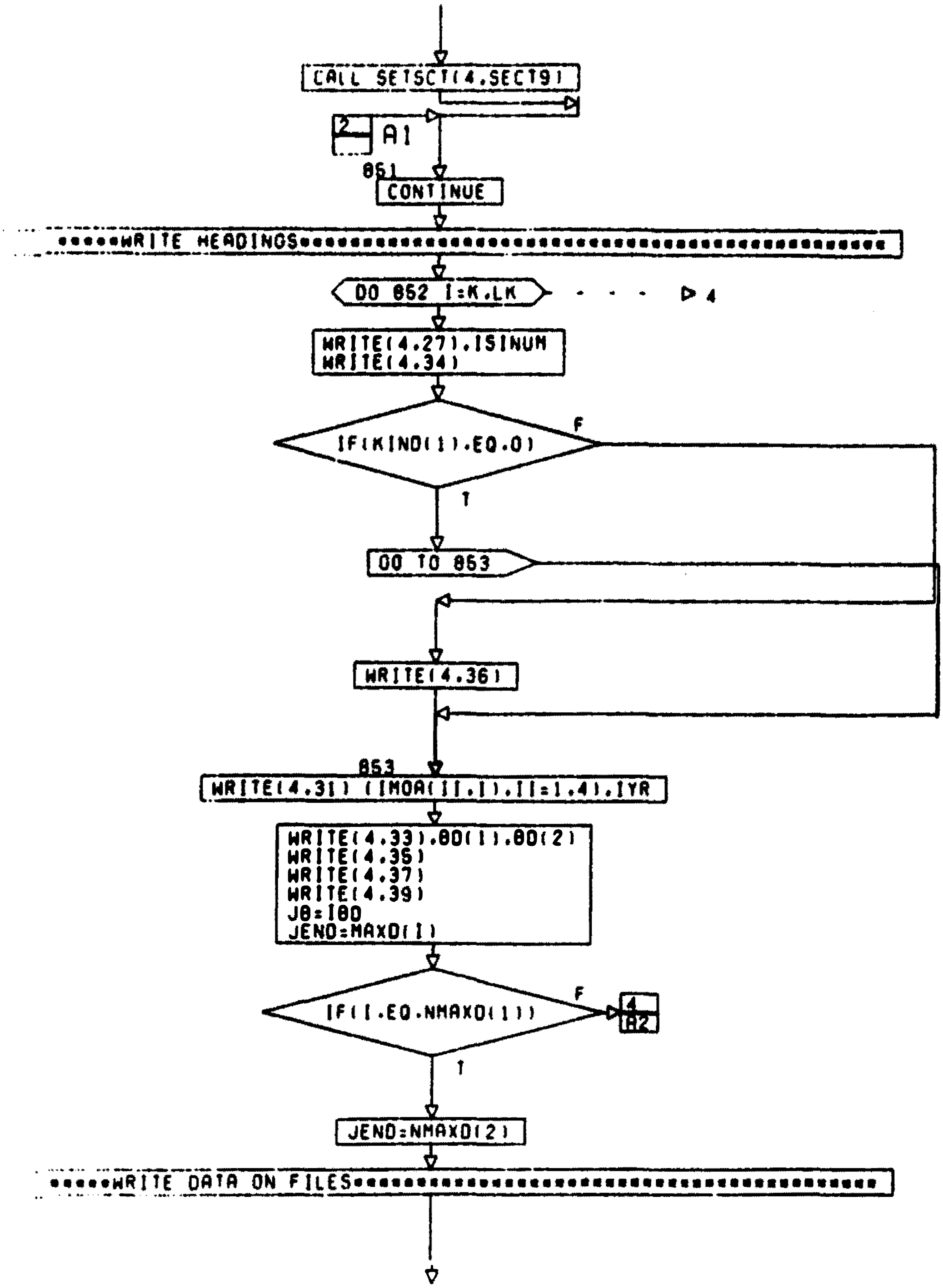
Fig. A6. Detailed Flow Chart of Subroutine FRODEP
(5 pages)


SUBROUTINE FROOEP
****
*****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, ,F5.2,23HO/CM; 15-30 CM LAYER, ,F5.2,4HO/CM)
34
FORMAT(;1X,49HFROZEN DEPTH OF SOIL(CRREL-1968) DATA INPUT FILE,/)
35
FORMAT(1H ,/)
36
FORMAT(26X,19HMEASURED SNOW DEPTH,//)

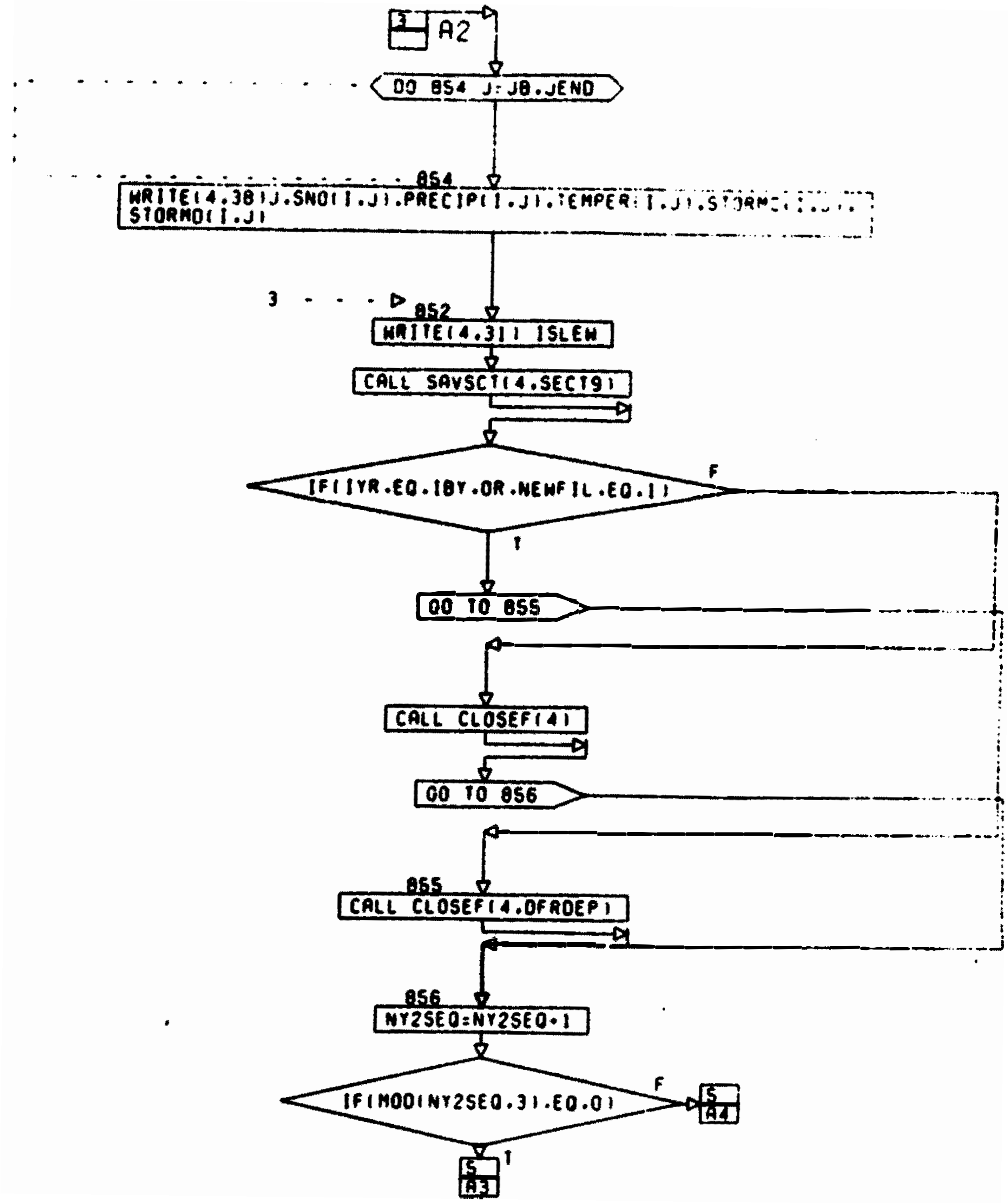
CONT. ON PG 2


37
FORMAT(11X,4HSNOW,3X,7HPRECIP-,3X,3HAIR,6X,13HSOIL MOISTURE,6X,
13HSOIL MOISTURE)
38
FORMAT(6X,I2,3(2X,F6.2),8X,F7.2,11X,F7.2)
39
FORMAT(6X,3HDAY,2X,5HDEPTH,2X,7HITATION,3X,4HTEMP,4X,15H0-15
CM LAYER,=,3X,17H 15-30 CM LAYER,=)
IF(IYR.GT.IBY)
F
T
GO TO 850
C *****ADDITIONAL INPUT CONTROL*************************************
PRINT,'ENTER NAMES OF SNOW,FROZEN SOIL DEPTH MODEL INPUT FILE'
PRINT,' EXAMPLE' FR0001'
READ 32,NFROEP
C *****TEST OUTPUT CHECK AND OPEN FILES******************************
850
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 851
3
A1
CALL OPENF(4,OFROEP)

CONT. ON PG 3


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)
JB=180
JEND=MAXD(I)
IF(I.EQ.NMAXD(1))
F
4
A2
T
JEND=NMAXD(2)
*****WRITE DATA ON FILES*****

CONT. ON PG 4


3
A2
DO 854 J=JB,JEND
854
WRITE(4,38)J,SNO(I,J),PRECIP(I,J),TEMPER(I,J),STORM
STORMD(I,J)
3
852
WRITE(4,31) ISLEW
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,DFRDEP)
856
NY2SEQ=NY2SEQ+1
IF(MOD(NY2SEQ,3).EQ.0)
F
5
A4
T
5
A3

CONT. ON PG 5

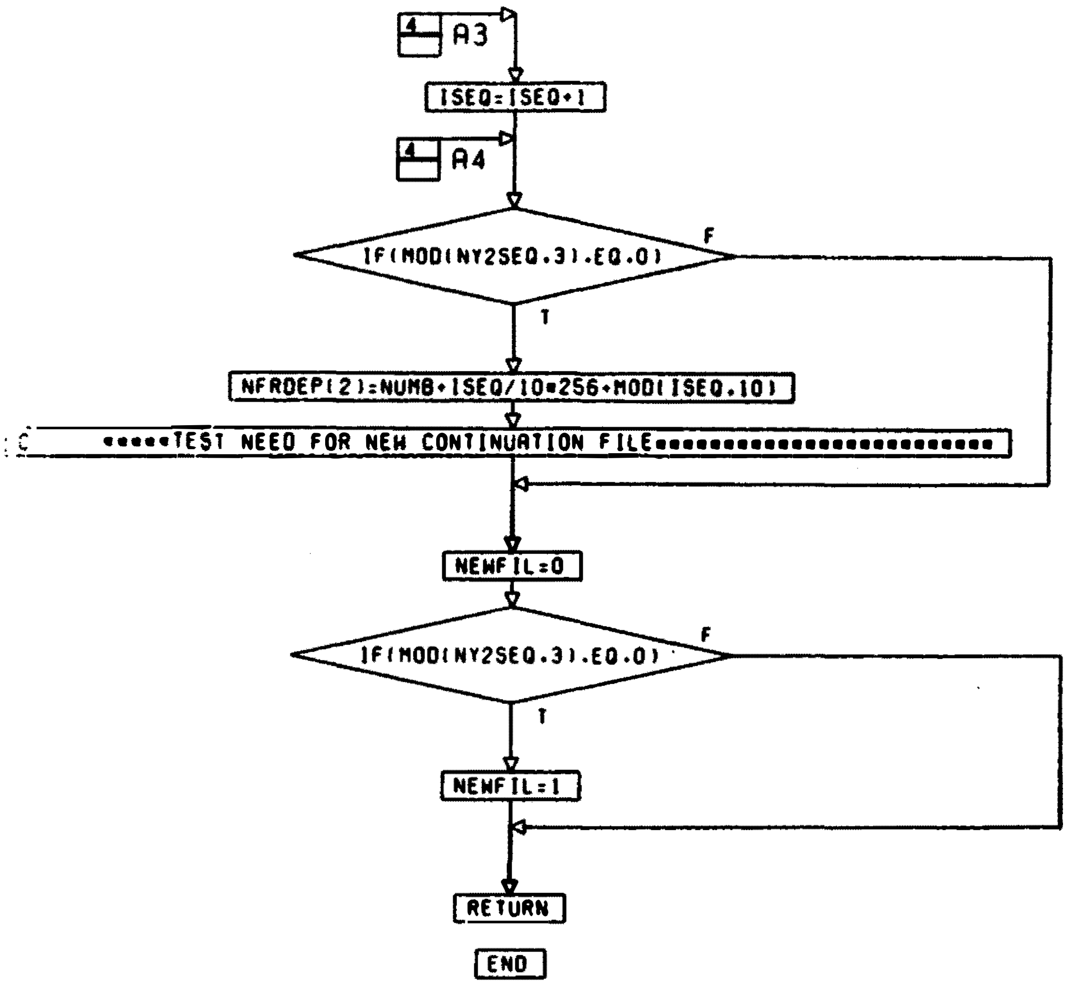
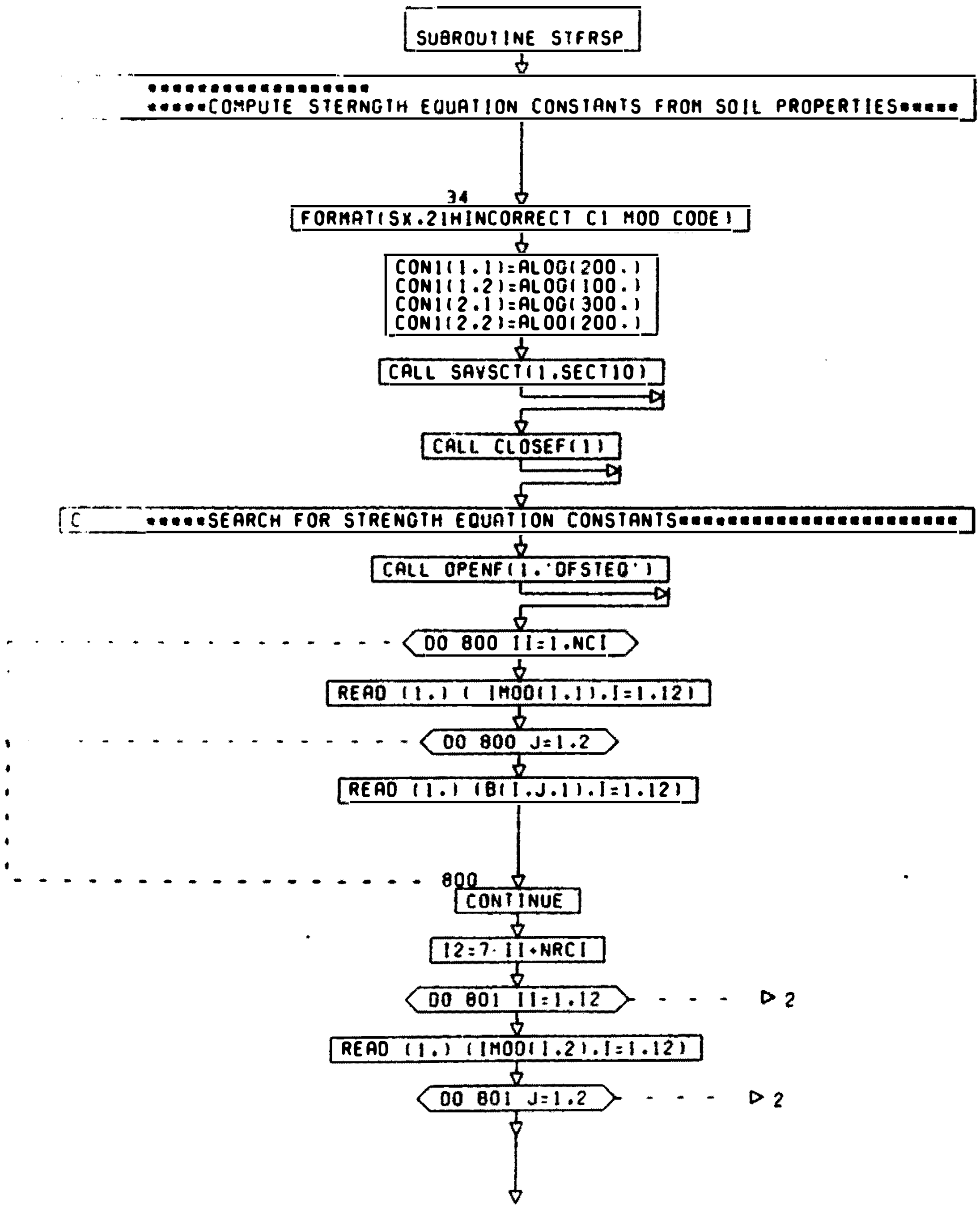
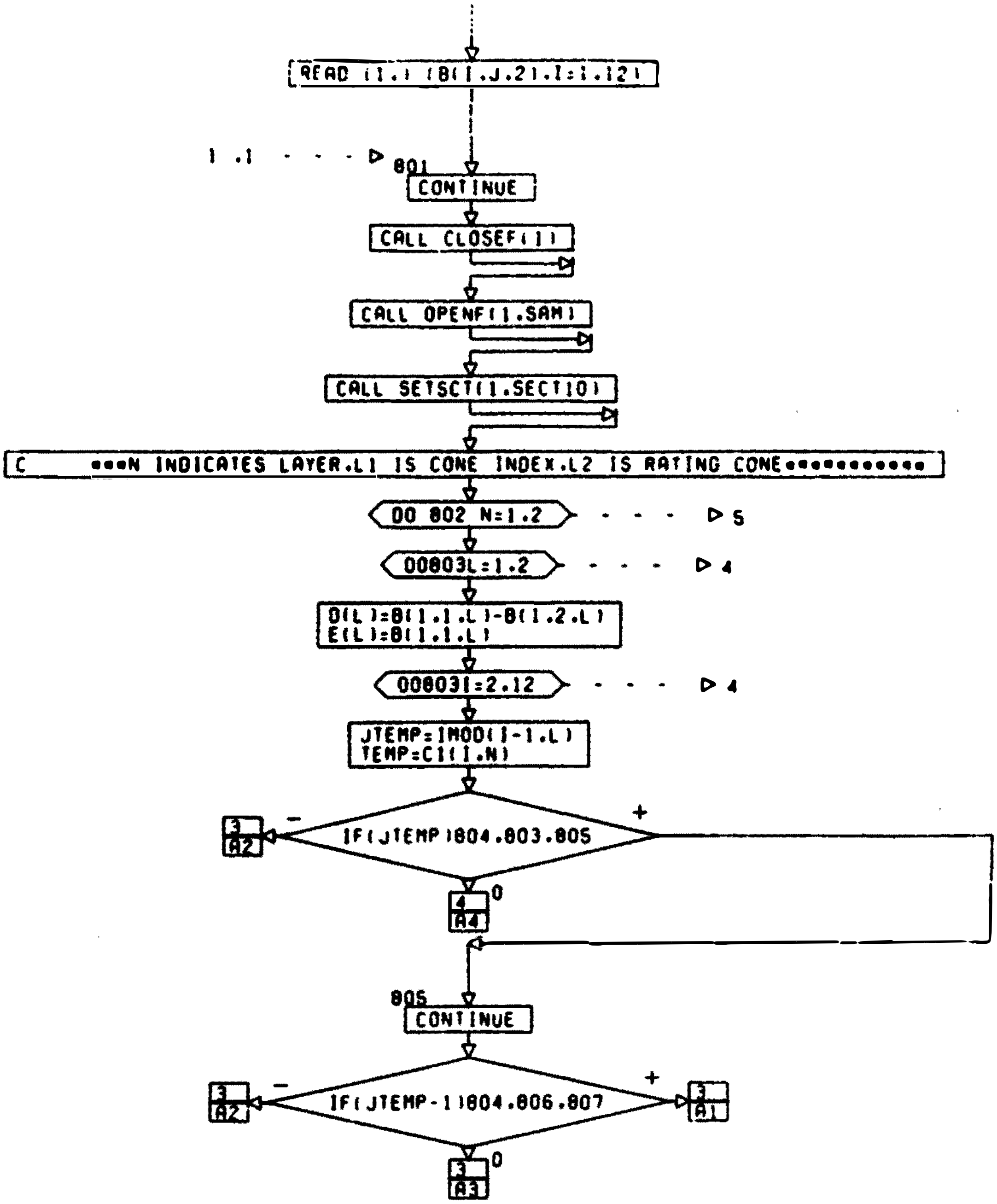

4
A3
ISEQ=ISEQ+1
4
A4
IF(MOD(NY2SEQ,3).EQ.0)
F
T
NFRDEP(2)=NUMB+ISEQ/10*256+MOD(ISEQ,10)
C *****TEST NEED FOR NEW CONTINUATION FILE***************************
NEWFIL=0
IF(MOD(NY2SEQ,3).EQ.0)
F
T
NEWFIL=1
RETURN
END

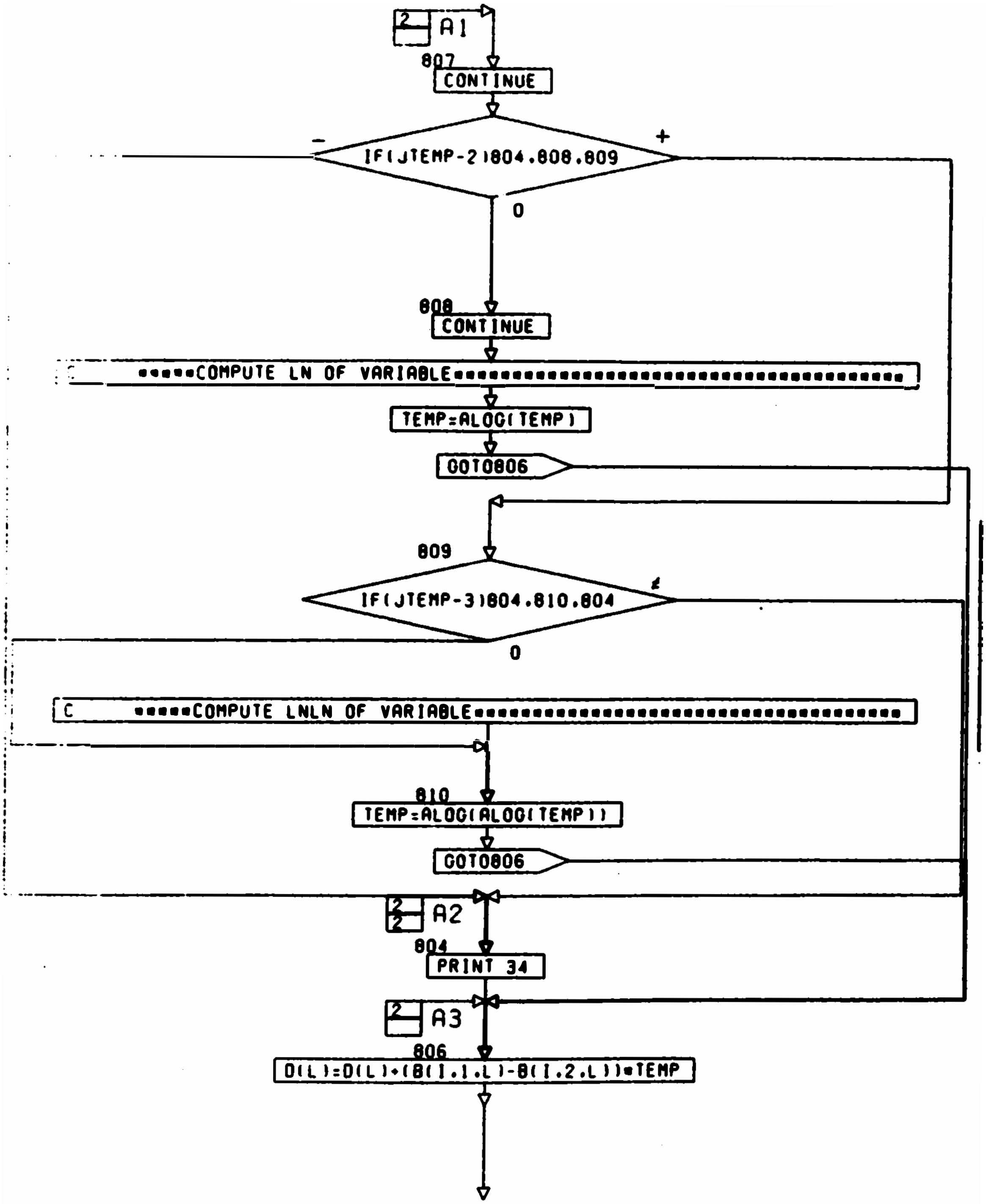
Fig. A7. Detailed Flow Chart of Subroutine STFRSP
(5 pages)


SUBROUTINE STFRSP
****
*****COMPUTE STERNGTH EQUATION CONSTANTS FROM SOIL PROPERTIES*****
34
FORMAT(5X,21HINCORRECT CI MOD CODE)
CONI(1,1)=ALOG(200.)
CONI(1,2)=ALOG(100.)
CONI(2,1)=ALOG(300.)
CONI(2,2)=ALOG(200.)
CALL SAVSCT(1,SECTIO)
CALL CLOSEF(1)
C *****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,I2
2
READ (1,) (IMOD(I,2),I=1,12)
DO 801 J=1,2
2

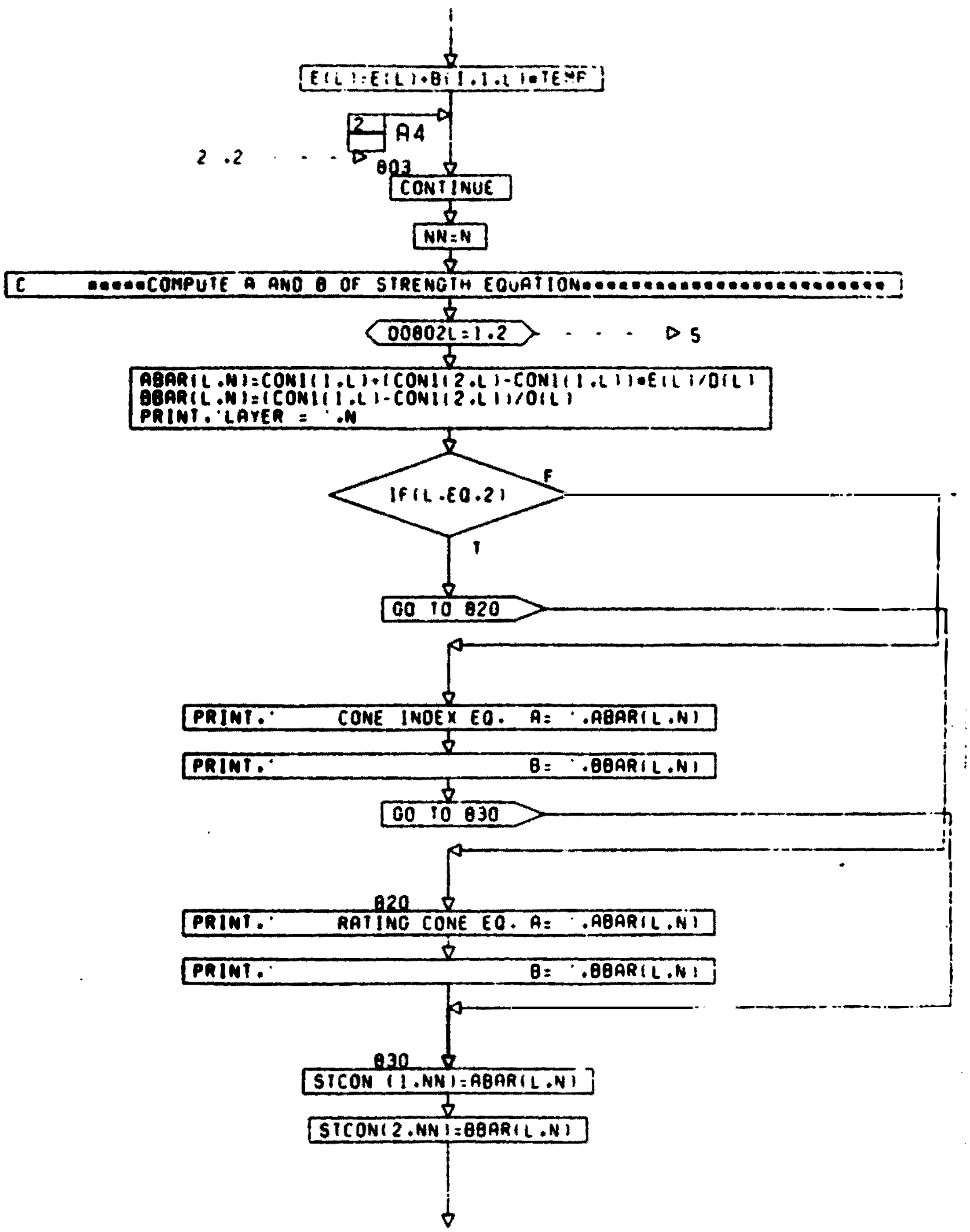
CONT. ON PG 2


READ (1,) (B(I,J,2),I=1,12)
1 ,1
801
CONTINUE
CALL CLOSEF(1)
CALL OPENF(1,SAM)
CALL SETSCT(1,SECTIO)
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
−
+
0
3
A2
4
A4
805
CONTINUE
IF(JTEMP-1)804,806,807
−
+
0
3
A2
3
A1
3
A3

CONT. ON PG 3


2 A1
807
CONTINUE
IF(JTEMP-2)804,808,809
808
CONTINUE
C *****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
2 2 A2
804
PRINT 34
2 A3
806
D(L)=D(L)+(B(I,1,L)-B(I,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

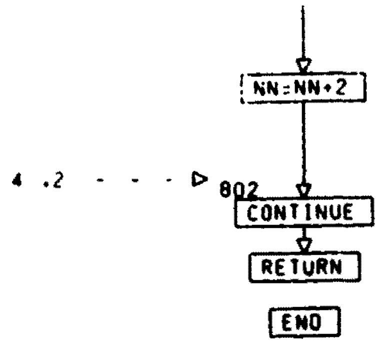

NN=NN+2
4 .2
802
CONTINUE
RETURN
END

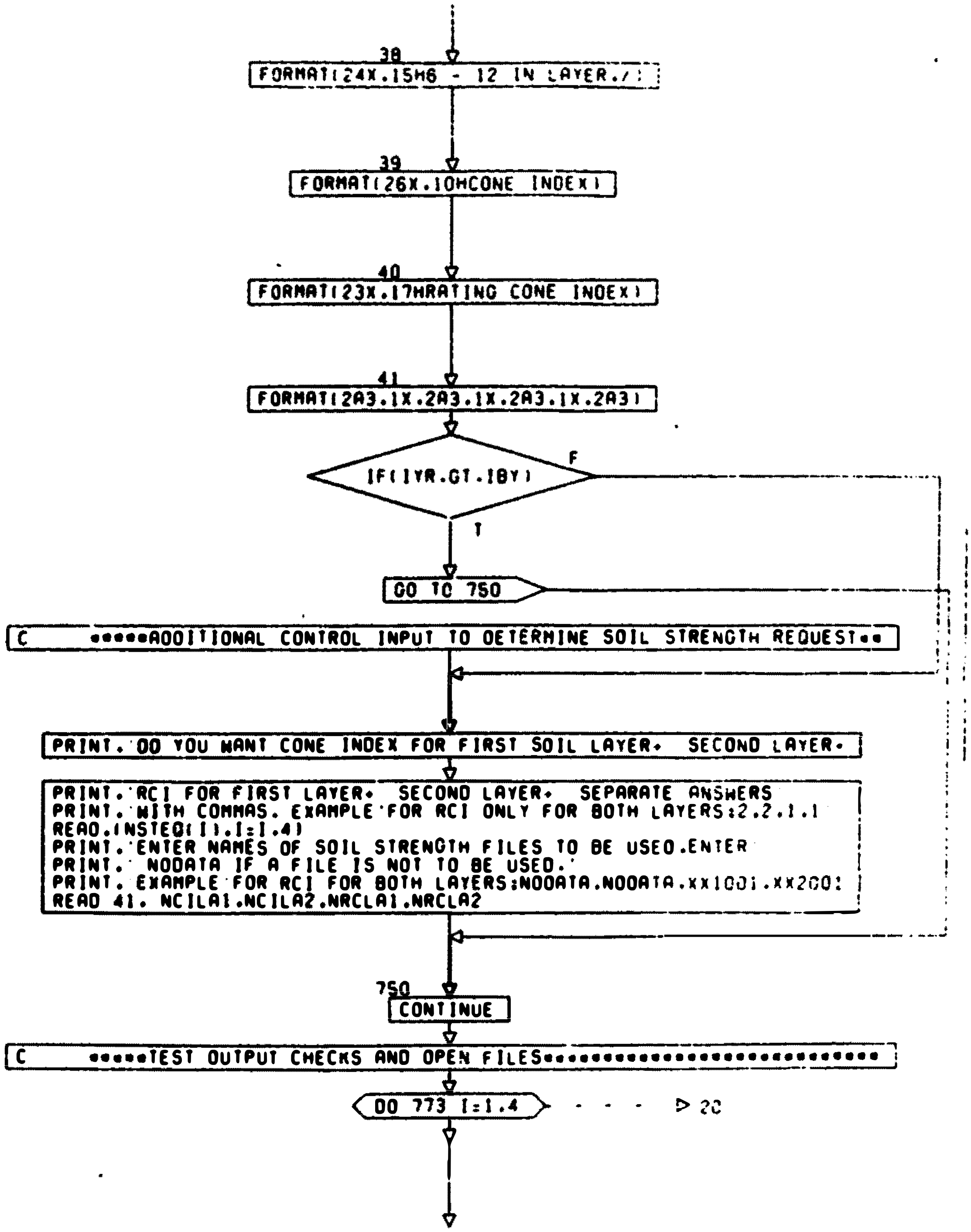
Fig. A8. Detailed Flow Chart of Subroutine CALSST
(21 pages)

SUBROUTINE CALSST

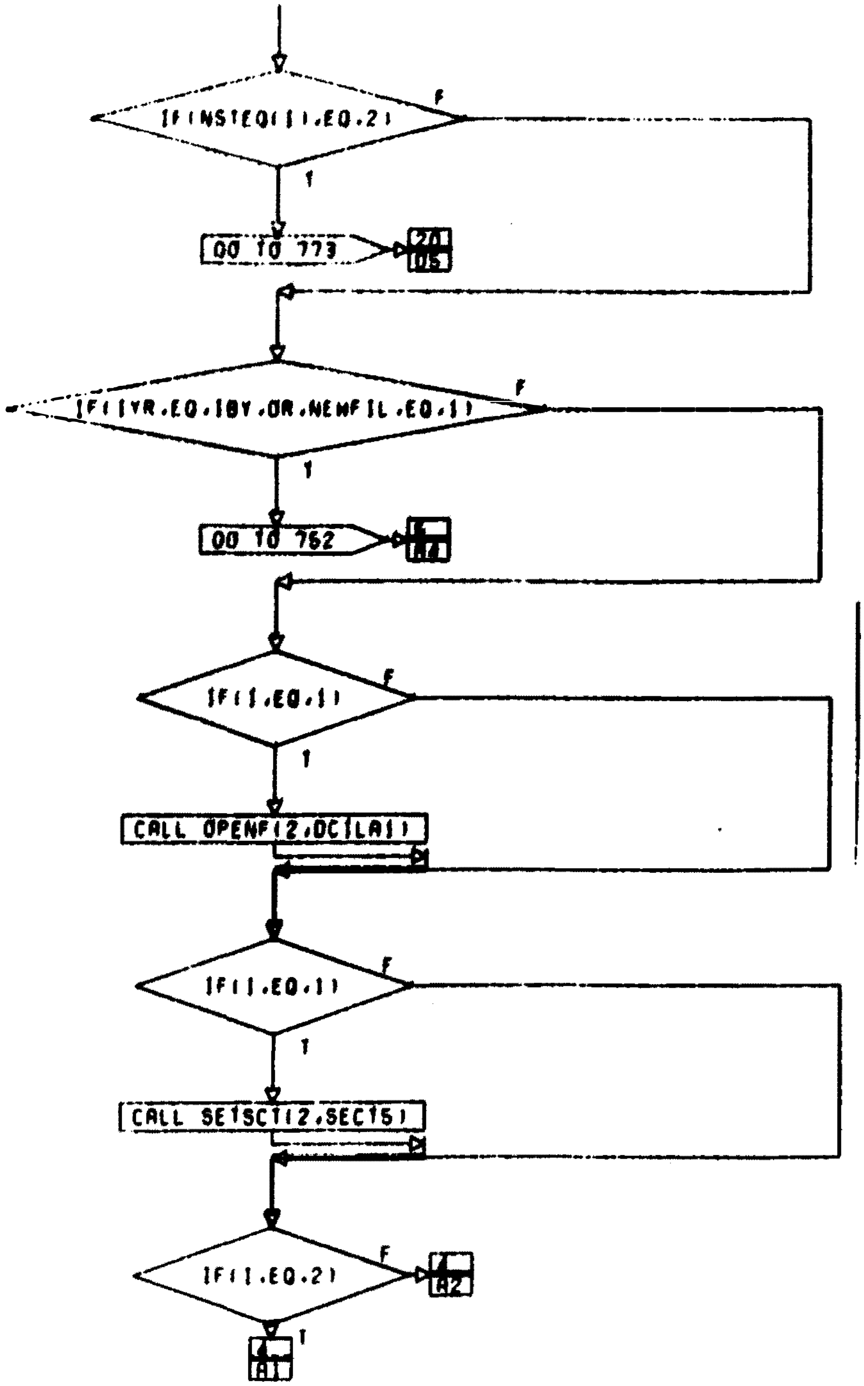
****
*****COMPUTE CONE INDEX AND RATING CONE INDEX********************
*****FORMAT STATEMENTS***

```
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,15H0 - 15 CM LAYER,/)
34 FORMAT(23X,16H15 - 30 CM LAYER,/)
37 FORMAT(24X,14H0 - 6 IN LAYER,/)
```

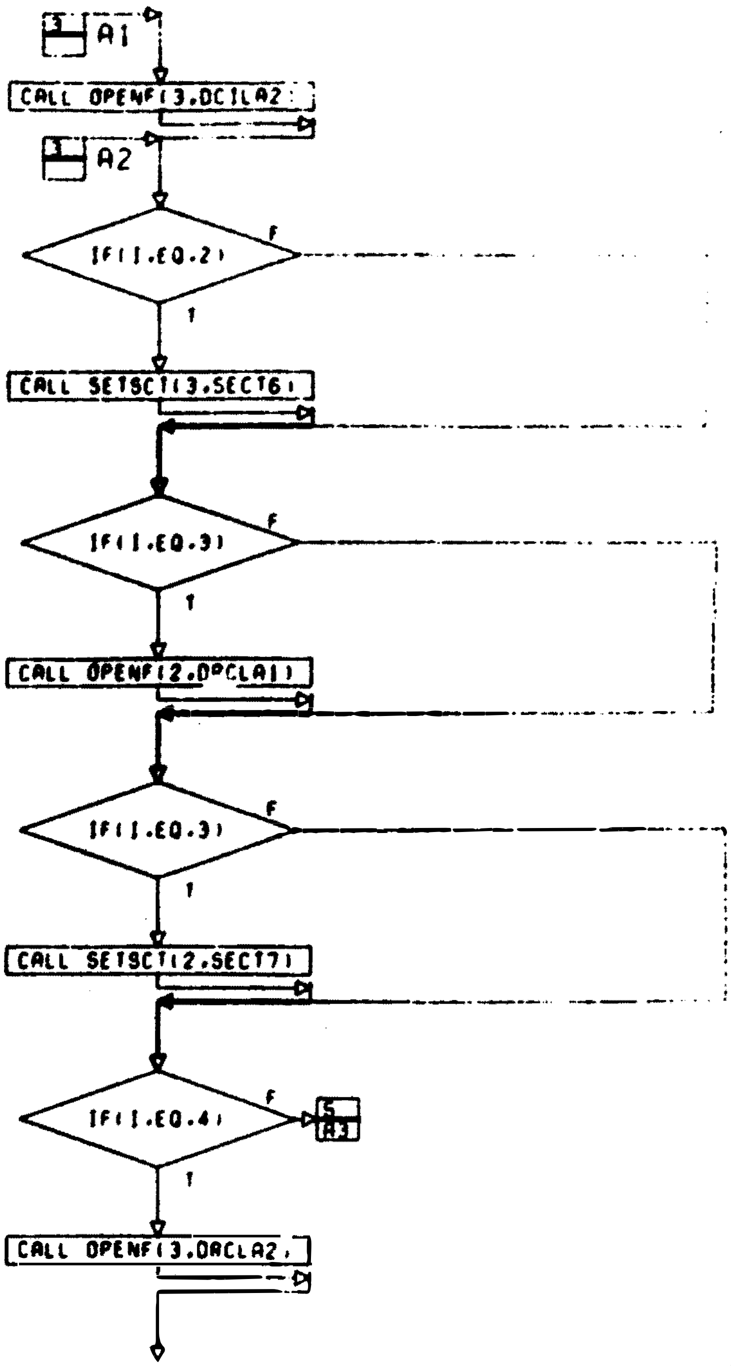
CONT. ON PG 2


38
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.IBY)
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.(INSTEQ(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

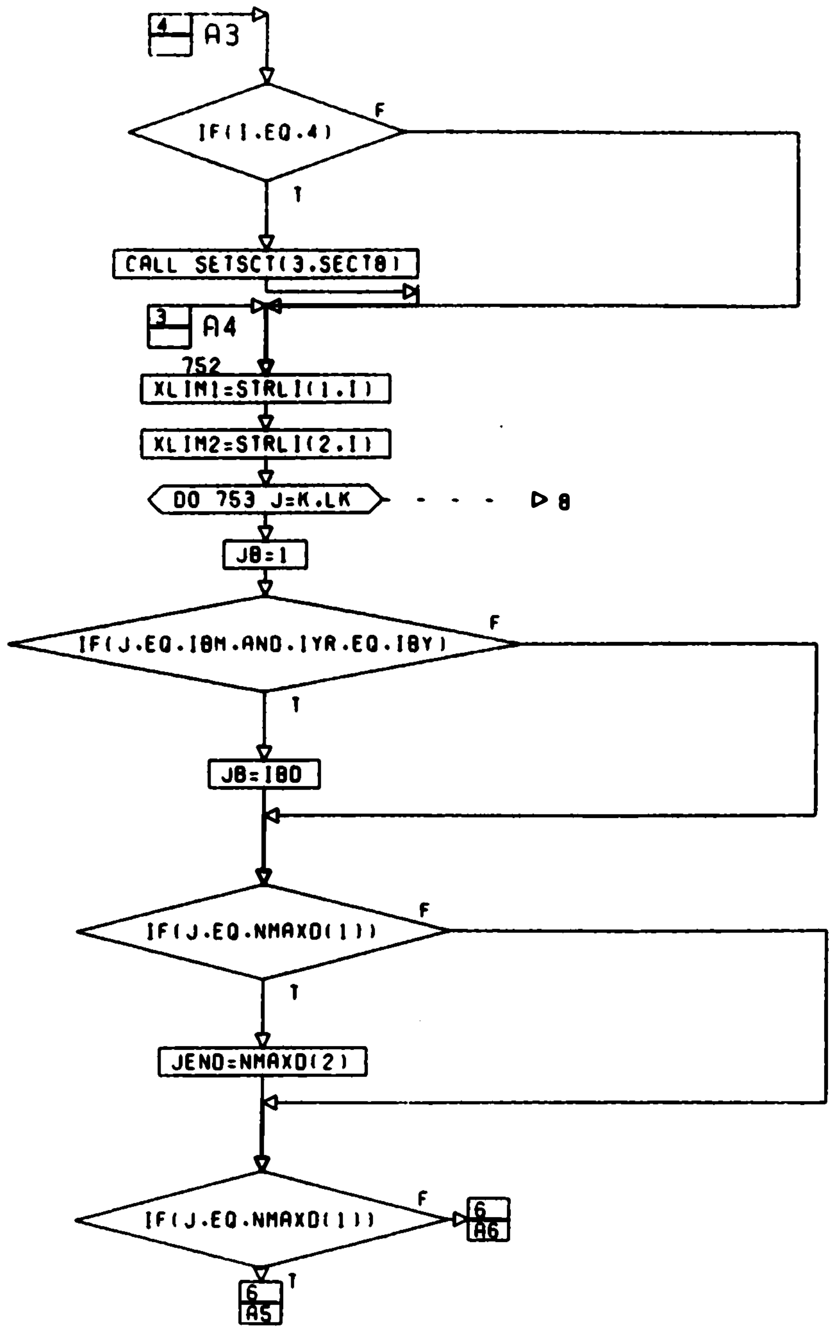

IF(NSTEQ(I).EQ.2)
F
T
GO TO 773
20
D5
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1)
F
T
GO TO 752
A4
IF(I.EQ.1)
F
T
CALL OPENF(2,DC(LA))
IF(I.EQ.1)
F
T
CALL SETSCT(2,SECT5)
IF(I.EQ.2)
F
4
A2
T
4
A1

CONT. ON PG 4

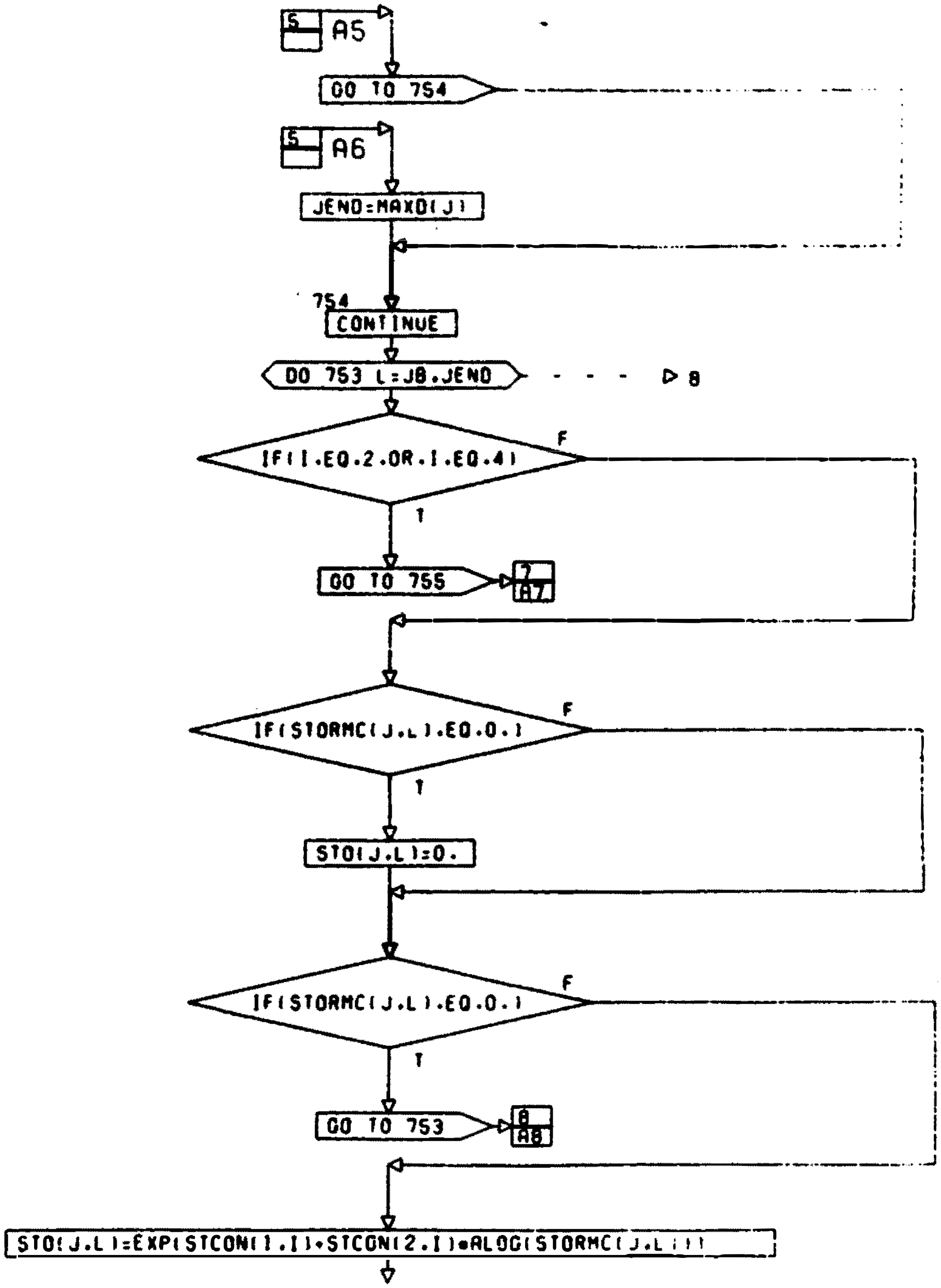


A1
CALL OPENF(3,DCILA2)
A2
IF(I.EQ.2)
F
T
CALL SETSCT(3,SECT6)
IF(I.EQ.3)
F
T
CALL OPENF(2,DPCLA1)
IF(I.EQ.3)
F
T
CALL SETSCT(2,SECT7)
IF(I.EQ.4)
F
5
A3
T
CALL OPENF(3,DACLA2)

CONT. ON PG 5

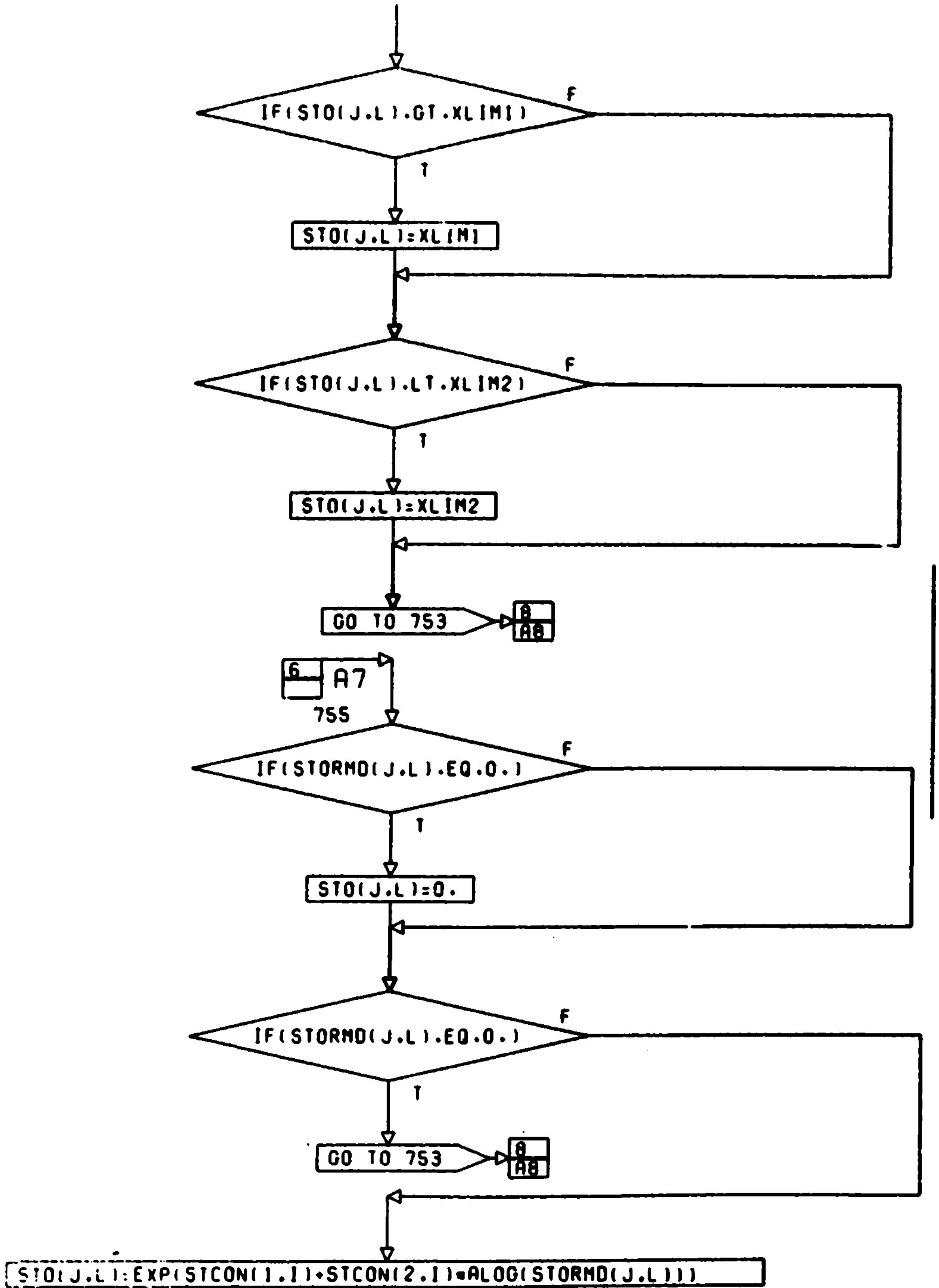

4
A3
IF(I.EQ.4)
F
T
CALL SETSCT(3,SECT8)
3
A4
752
XLIM1=STRLI(1,I)
XLIM2=STRLI(2,I)
DO 753 J=K,LK
8
JB=1
IF(J.EQ.IBM.AND.IYR.EQ.IBY)
F
T
JB=IBD
IF(J.EQ.NMAXD(1))
F
T
JEND=NMAXD(2)
IF(J.EQ.NMAXD(1))
F
6
A6
T
6
A5

CONT. ON PG 6

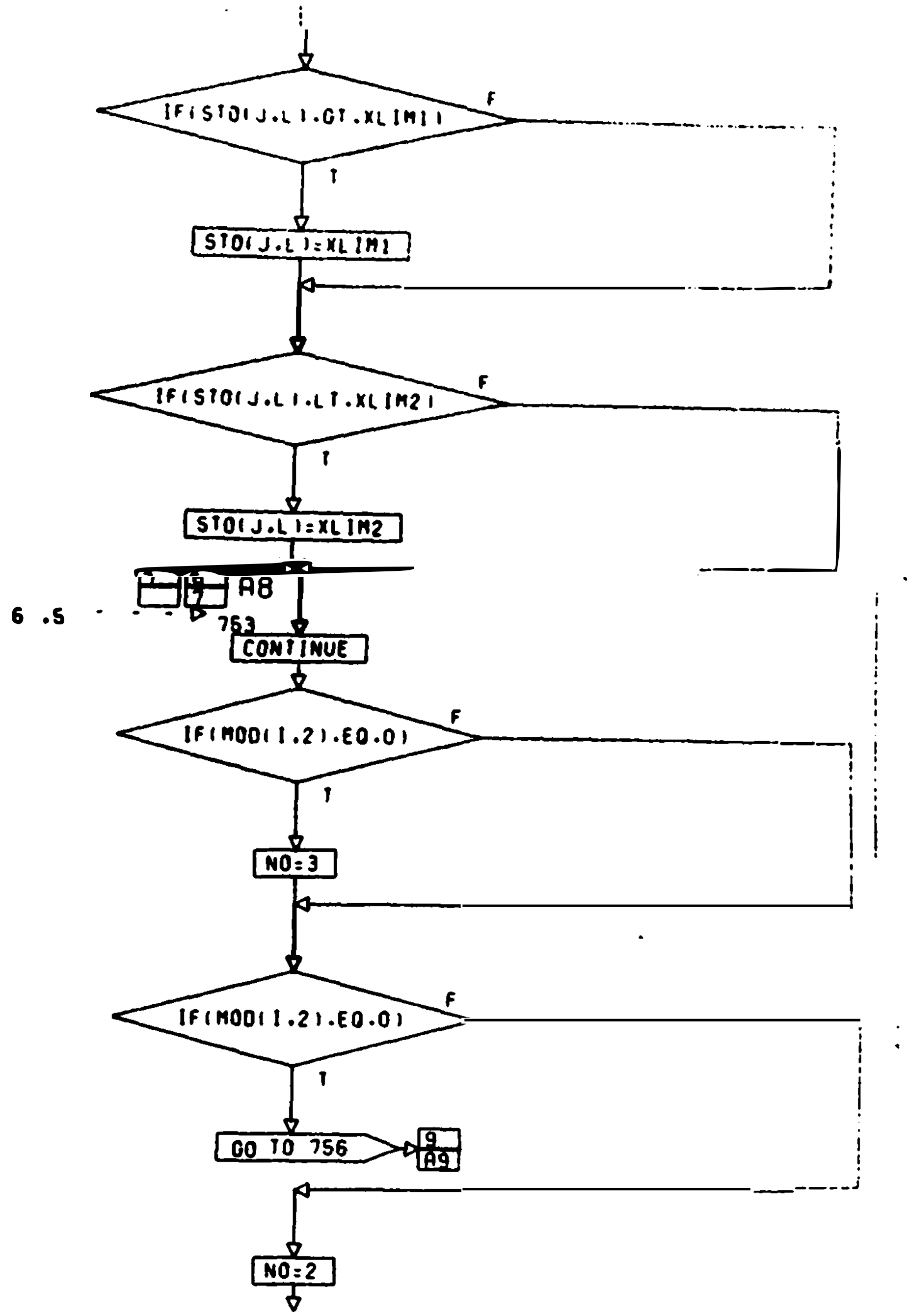


5
A5
GO TO 754
5
A6
JEND=MAX0(J)
754
CONTINUE
DO 753 L=JB,JEND
8
IF(I.EQ.2.OR.I.EQ.4)
F
T
GO TO 755
7
A7
IF(STORMC(J,L).EQ.0.)
F
T
STO(J,L)=0.
IF(STORMC(J,L).EQ.0.)
F
T
GO TO 753
8
A8
STO(J,L)=EXP(STCON(1,I)+STCON(2,I)*ALOG(STORMC(J,L)))

CONT. ON PG 7

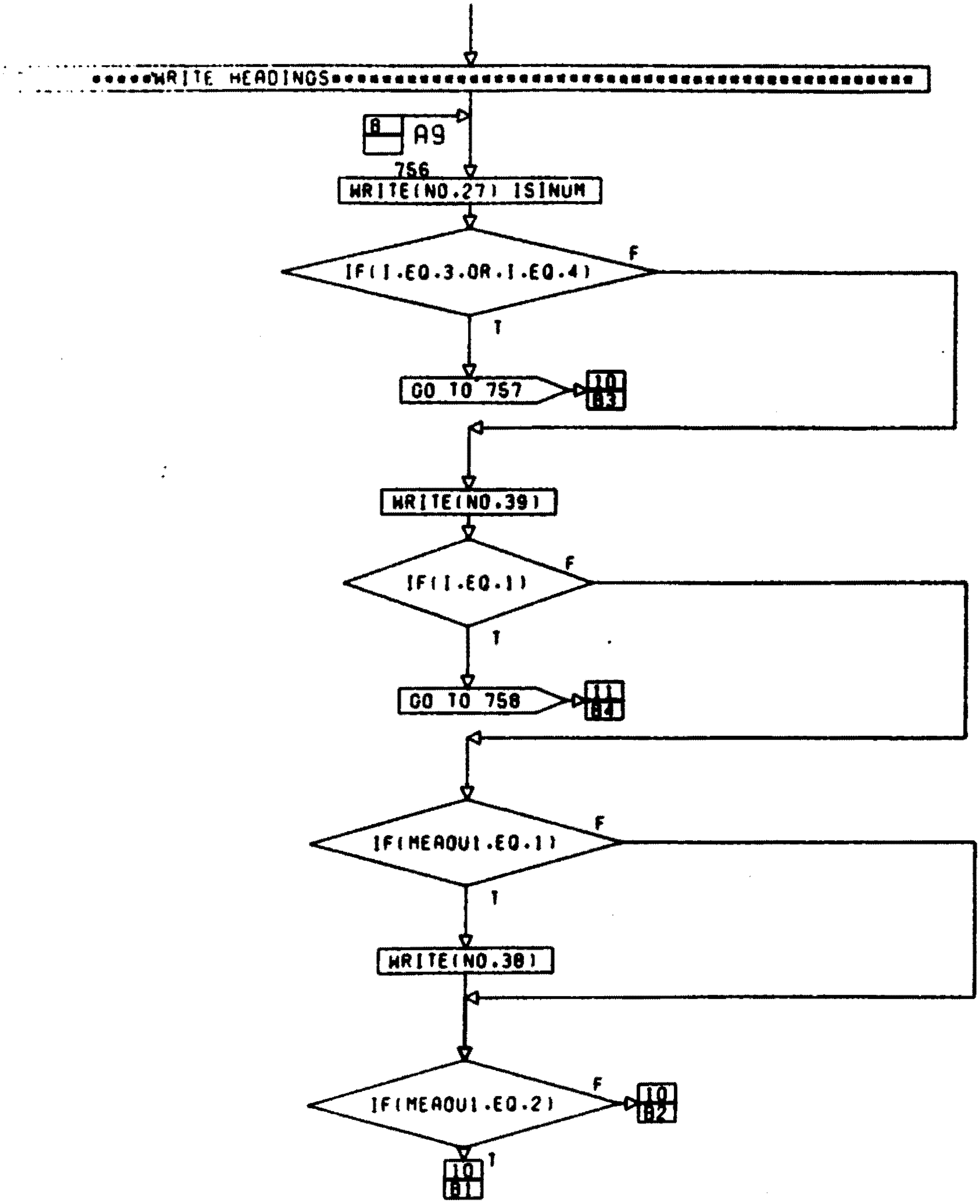

IF(STO(J.L).GT.XLIM1)
F
T
STO(J.L)=XLIM1
IF(STO(J.L).LT.XLIM2)
F
T
STO(J.L)=XLIM2
GO TO 753
8
A8
6
A7
755
IF(STORMD(J.L).EQ.0.)
F
T
STO(J.L)=0.
IF(STORMD(J.L).EQ.0.)
F
T
GO TO 753
8
A8
STO(J.L)=EXP(STCON(1.I)+STCON(2.I)*ALOG(STORMD(J.L)))

CONT. ON PG 8

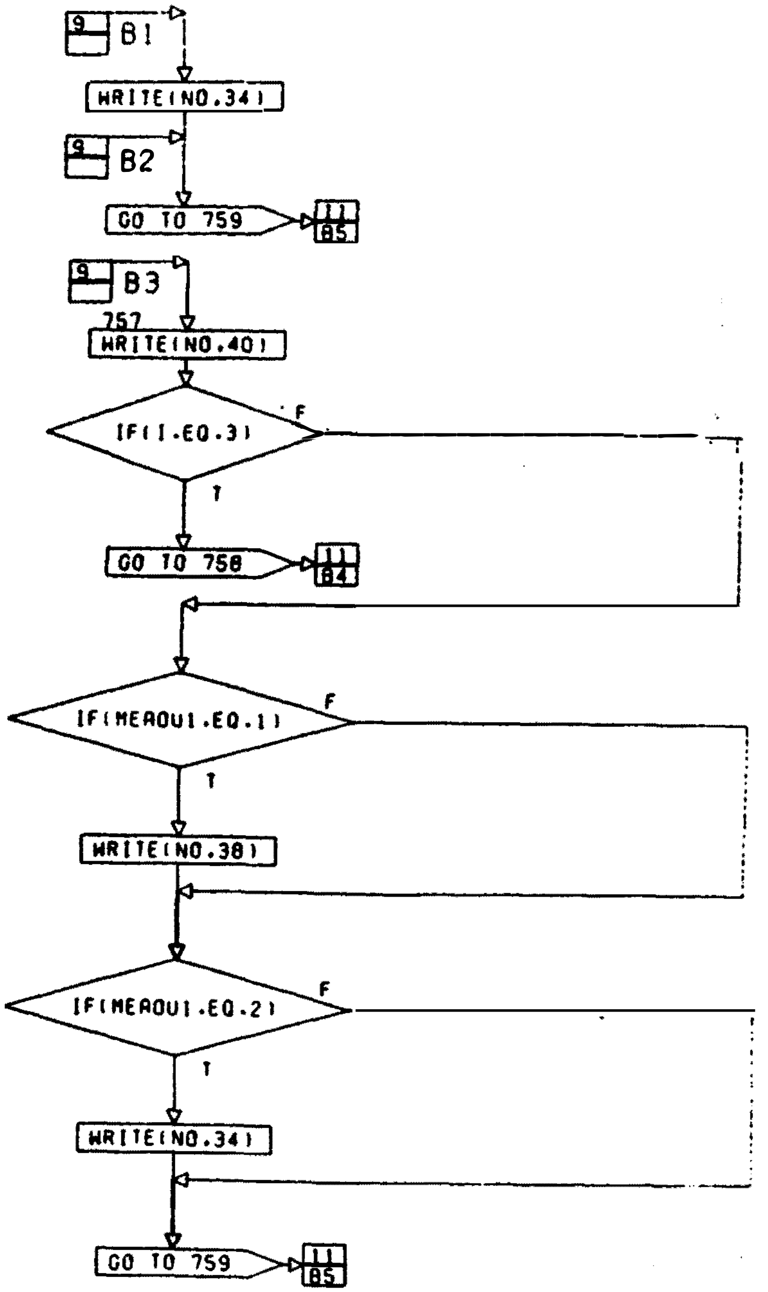


IF(STO(J,L).GT.XLIM1)
F
T
STO(J,L)=XLIM1
IF(STO(J,L).LT.XLIM2)
F
T
STO(J,L)=XLIM2
A8
763
CONTINUE
IF(MOD(I,2).EQ.0)
F
T
NO=3
IF(MOD(I,2).EQ.0)
F
T
GO TO 756
9
A9
NO=2

CONT. ON PG 9

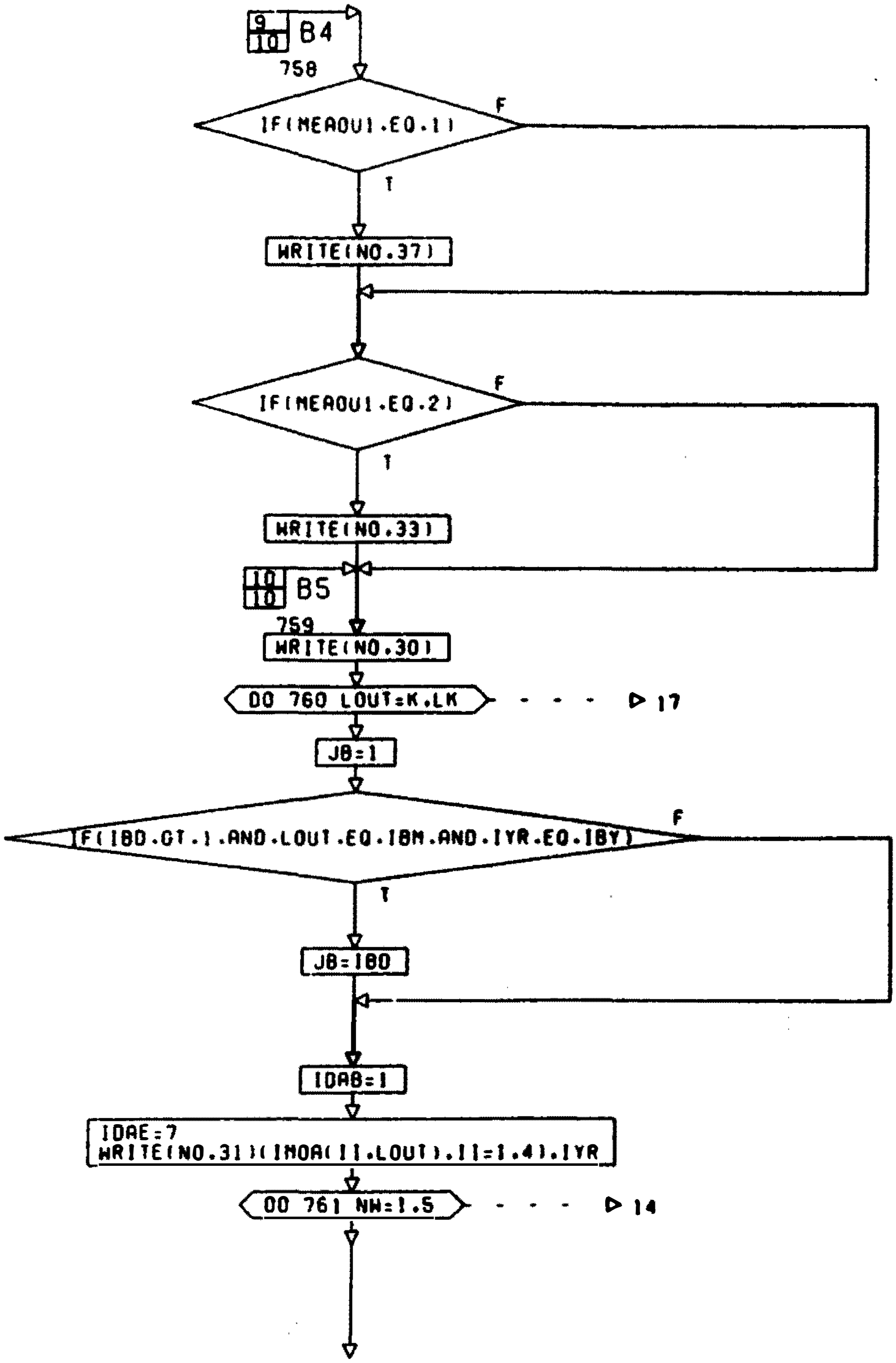

*****WRITE HEADINGS*****
A9
756
WRITE(NO.27) ISINUM
IF(I.EQ.3.OR.I.EQ.4)
F
T
GO TO 757
10
B3
WRITE(NO.39)
IF(I.EQ.1)
F
T
GO TO 758
11
B4
IF(MEAOUI.EQ.1)
F
T
WRITE(NO.38)
IF(MEAOUI.EQ.2)
F
10
B2
T
10
B1

CONT. ON PG 10



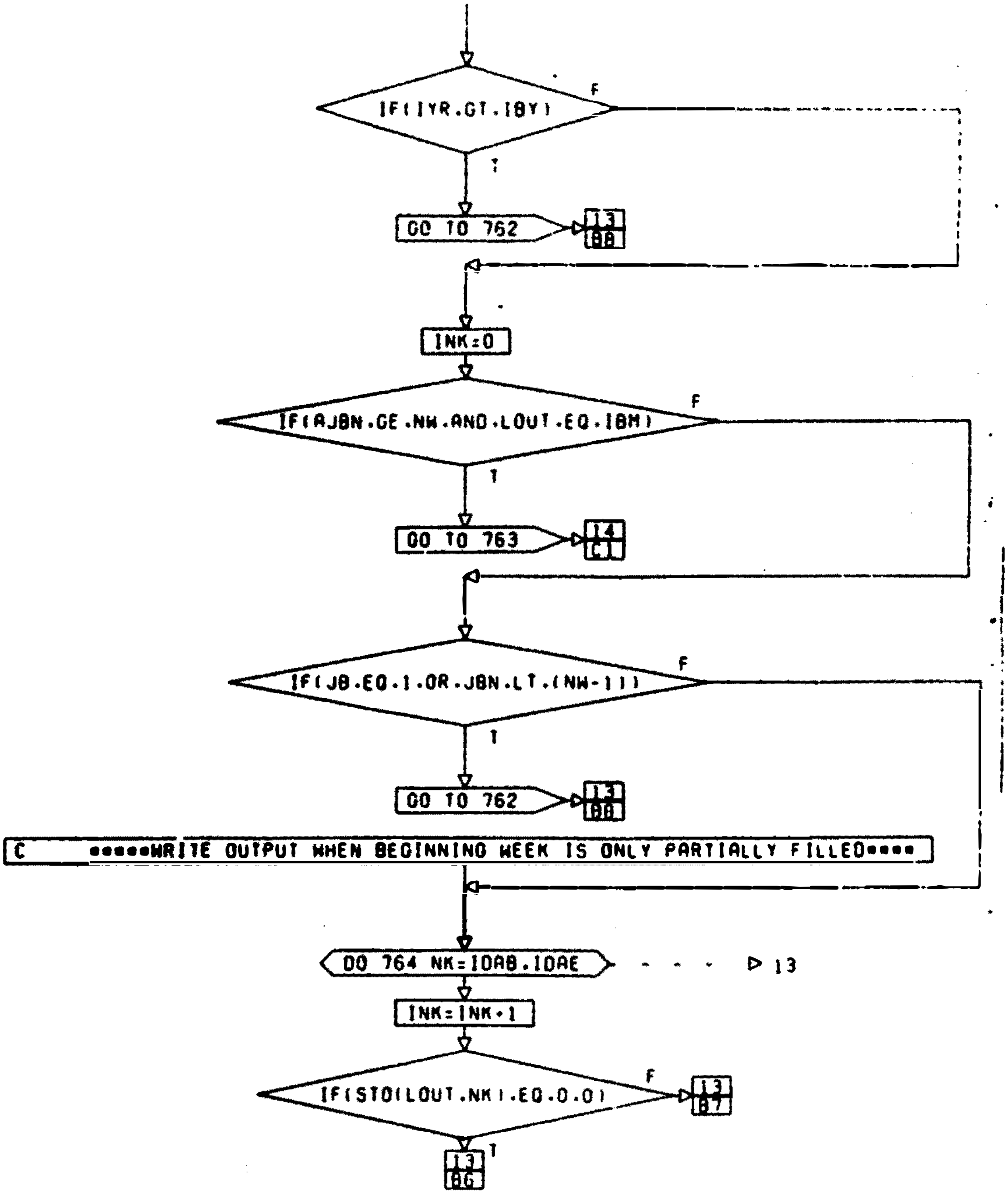
9 B1
WRITE(NO.34)
9 B2
GO TO 759
11 B5
9 B3
757
WRITE(NO.40)
IF(I.EQ.3)
F
T
GO TO 758
11 B4
IF(MEAOUT.EQ.1)
F
T
WRITE(NO.38)
IF(MEAOUT.EQ.2)
F
T
WRITE(NO.34)
GO TO 759
11 B5

CONT. ON PG 11

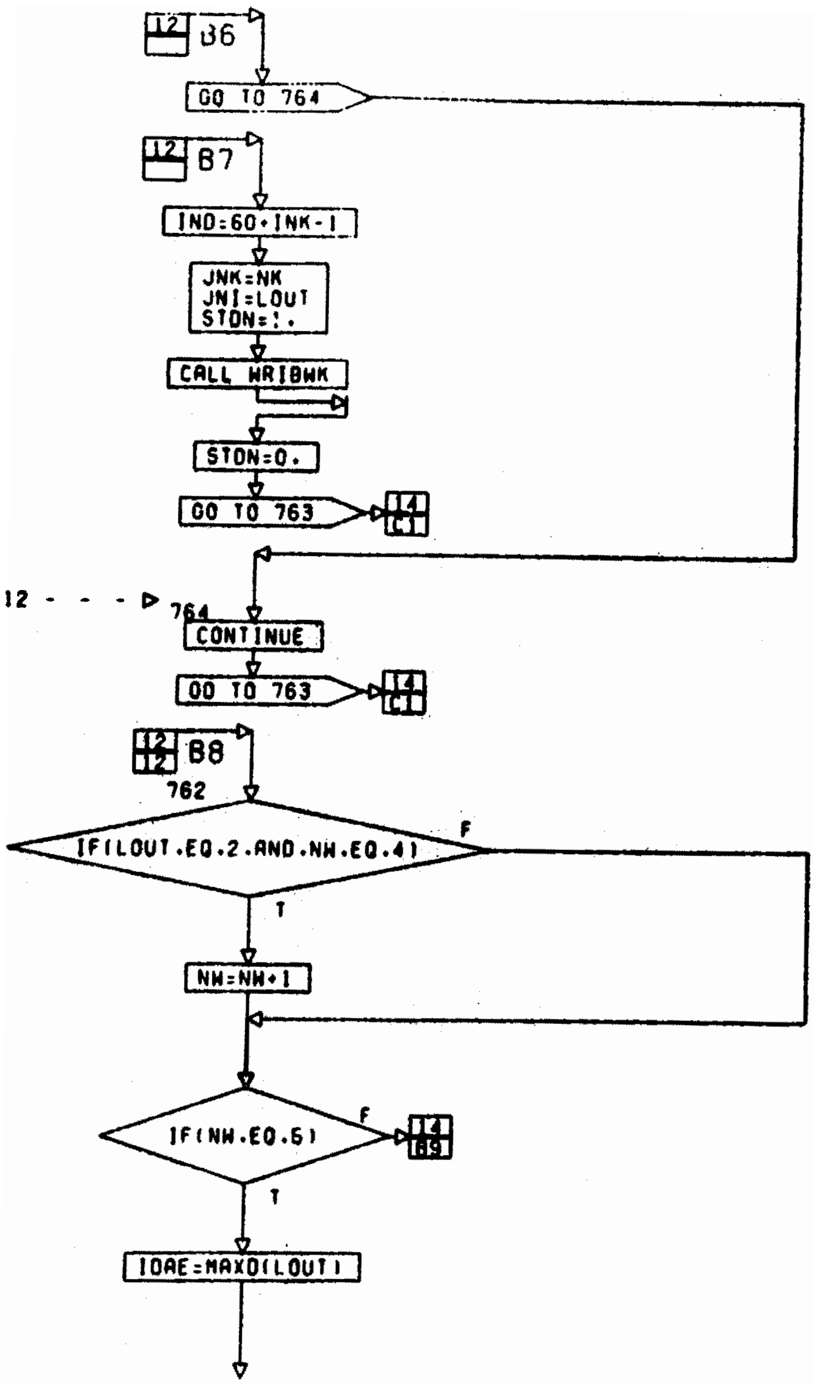


9/10 B4
758
IF(MEAOUI.EQ.1)
F
T
WRITE(NO.37)
IF(MEAOUI.EQ.2)
F
T
WRITE(NO.33)
10/10 B5
759
WRITE(NO.30)
DO 760 LOUT=K,LK
17
JB=1
IF(IBD.GT.1.AND.LOUT.EQ.IBM.AND.IYR.EQ.IBY)
F
T
JB=IBD
IDAB=1
IDAE=7
WRITE(NO.31)(IMOA(II,LOUT),II=1,4),IYR
DO 761 NW=1,5
14

CONT. ON PG 12

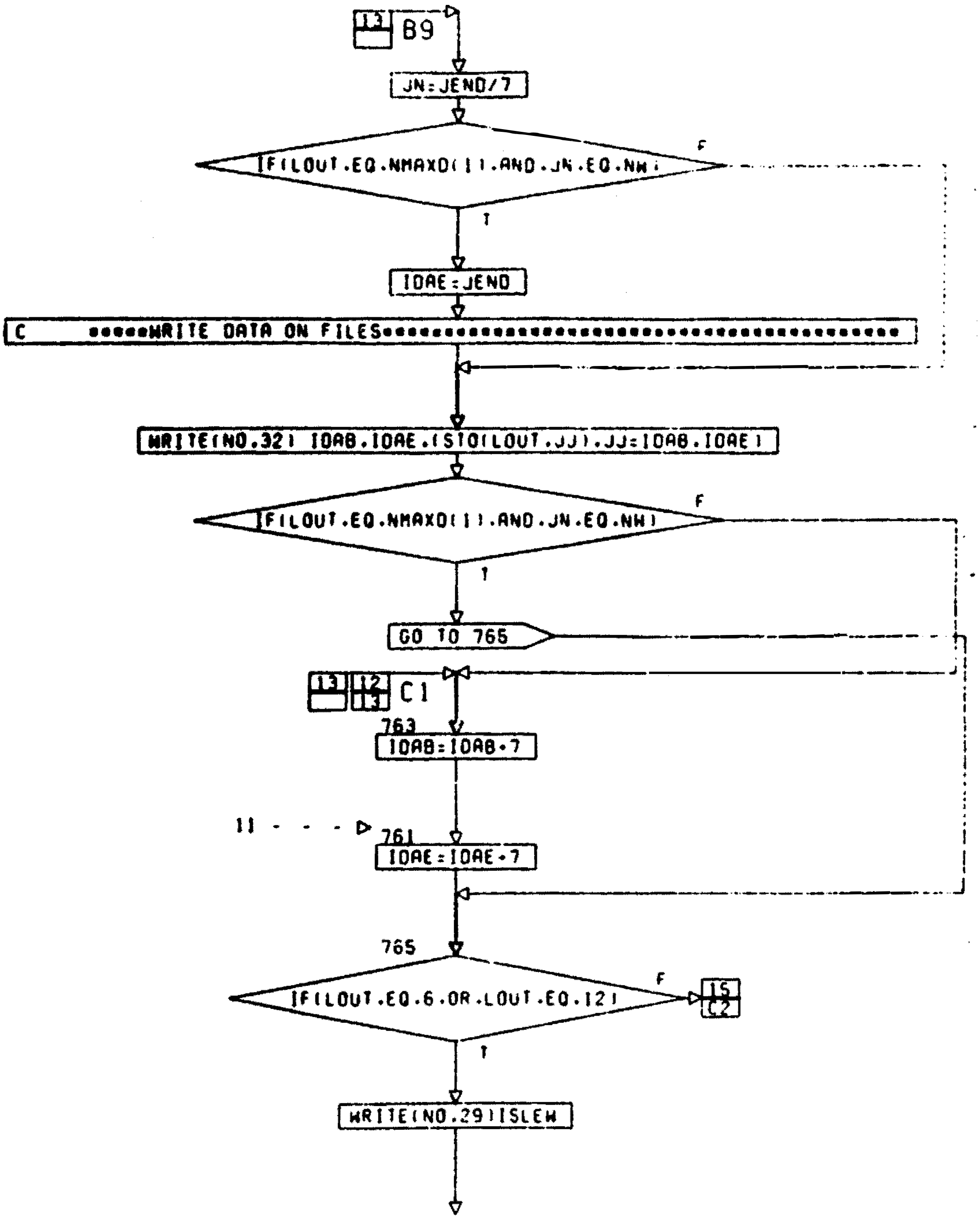

IF(IYR.GT.IBY)
F
T
GO TO 762
13
BB
INK=0
IF(AJBN.GE.NW.AND.LOUT.EQ.IBM)
F
T
GO TO 763
14
C
IF(JB.EQ.1.OR.JBN.LT.(NW-1))
F
T
GO TO 762
13
BB
C *****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED****
DO 764 NK=IDAB,IDAE
13
INK=INK+1
IF(STO(LOUT,NK).EQ.0.0)
F
13
B7
T
13
BG

CONT. ON PG 13

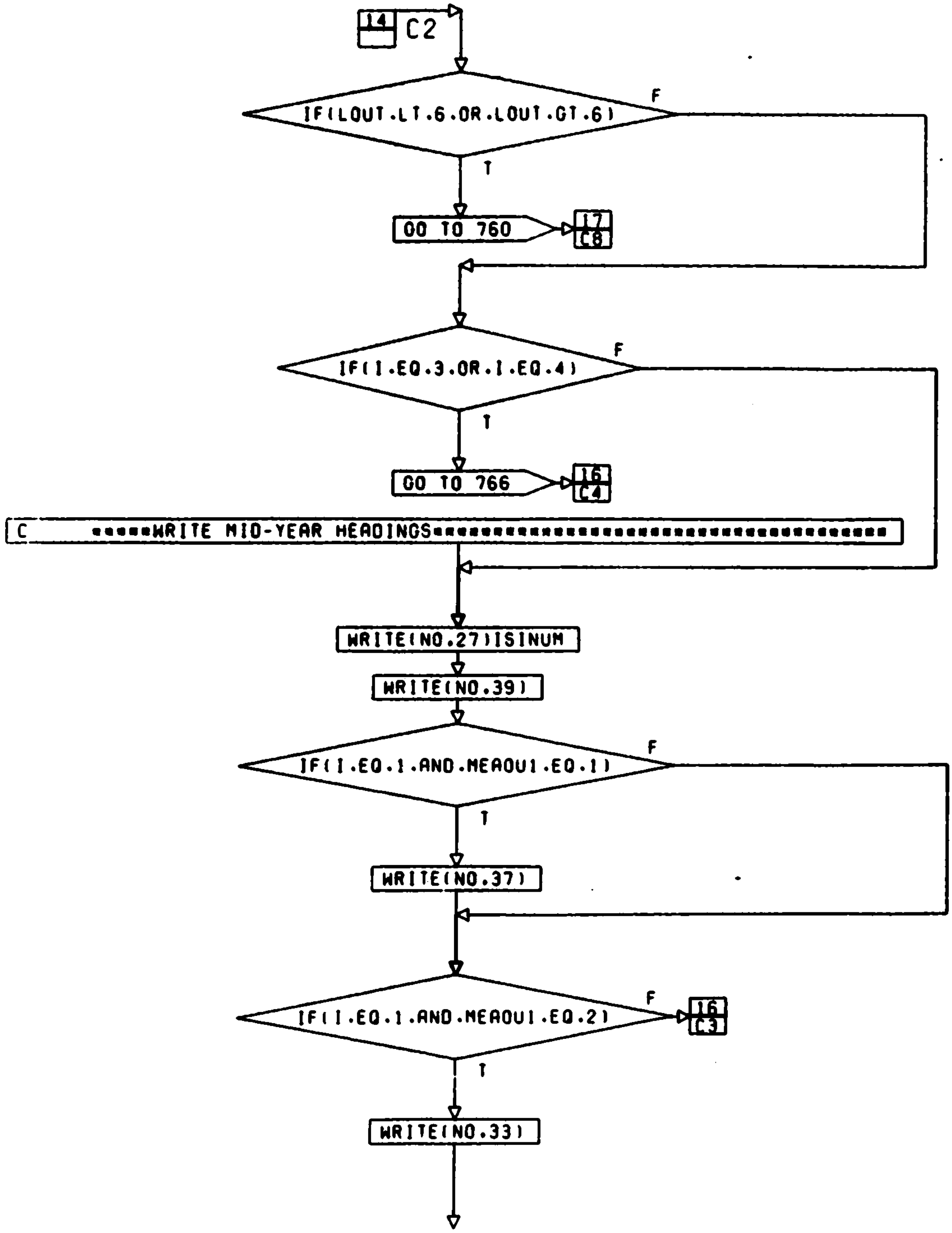


12 B6
GO TO 764
12 B7
IND=60+INK-1
JNK=NK
JNI=LOUT
STON=1.
CALL WRIBWK
STON=0.
GO TO 763
14 C1
12
764
CONTINUE
GO TO 763
14 C1
12 12 B8
762
IF(LOUT.EQ.2.AND.NW.EQ.4)
F
T
NW=NW+1
IF(NW.EQ.5)
F
14 B9
T
IOAE=MAXO(LOUT)

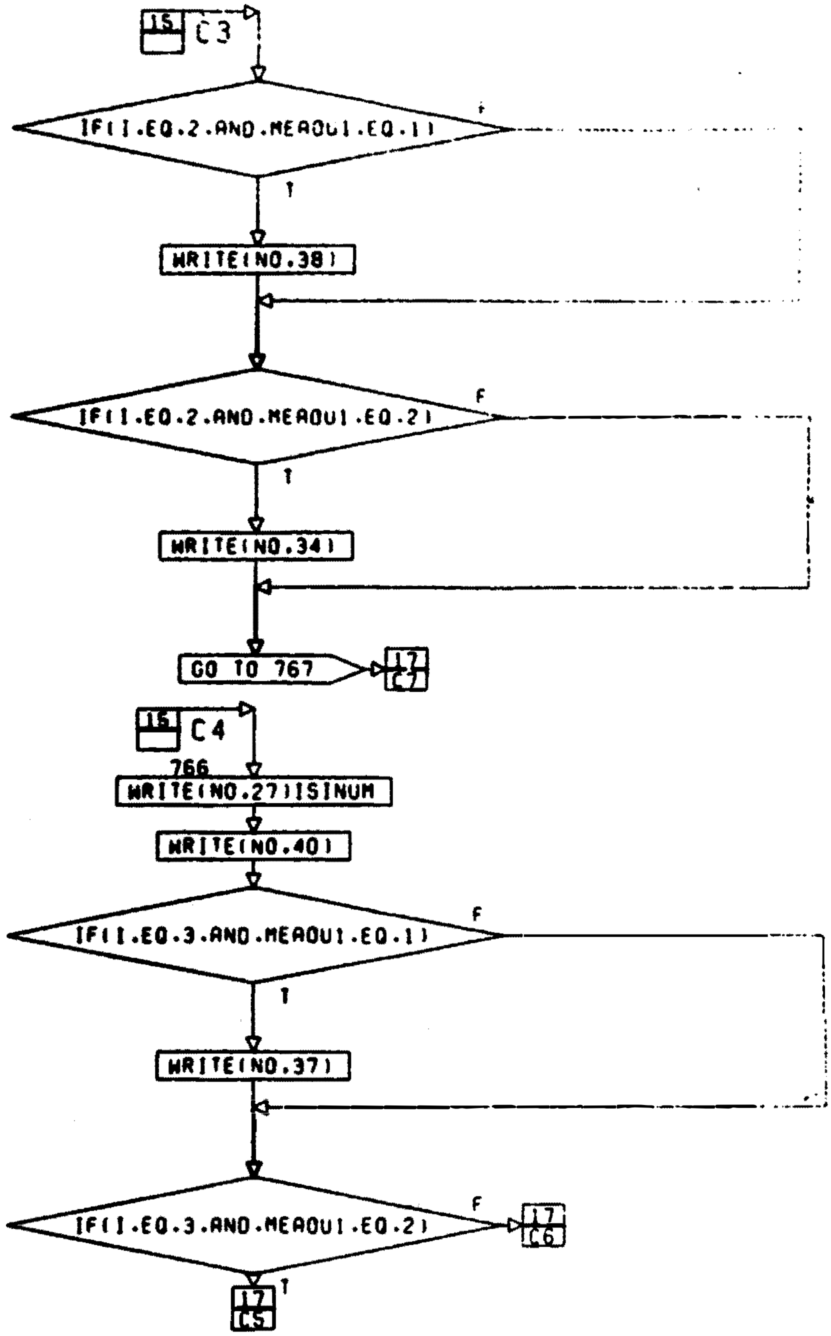
CONT. ON PG 14


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

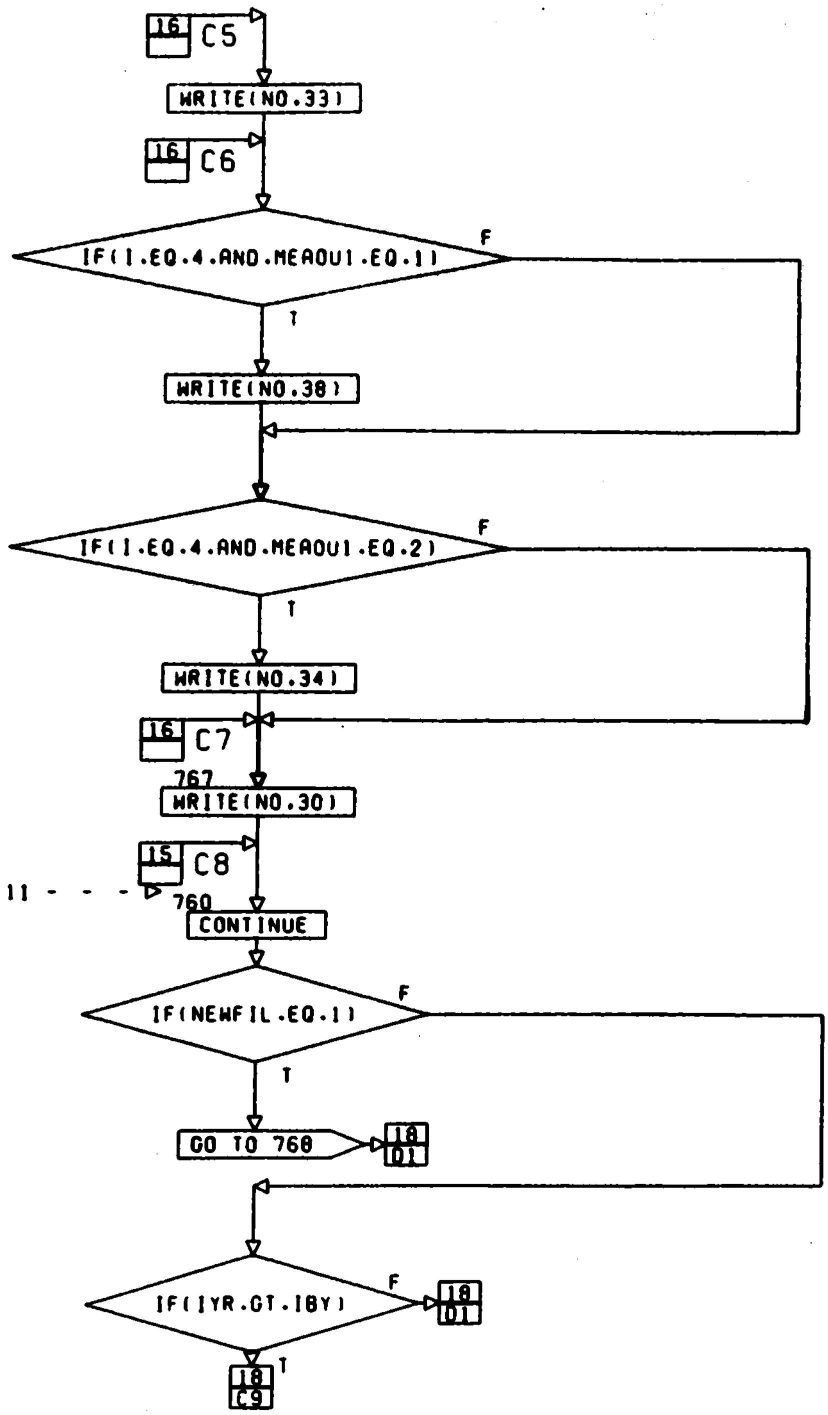
CONT. ON PG 15


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.MEAOUT.EQ.1)
F
T
WRITE(NO.37)
IF(I.EQ.1.AND.MEAOUT.EQ.2)
F
16
C3
T
WRITE(NO.33)

CONT. ON PG 16

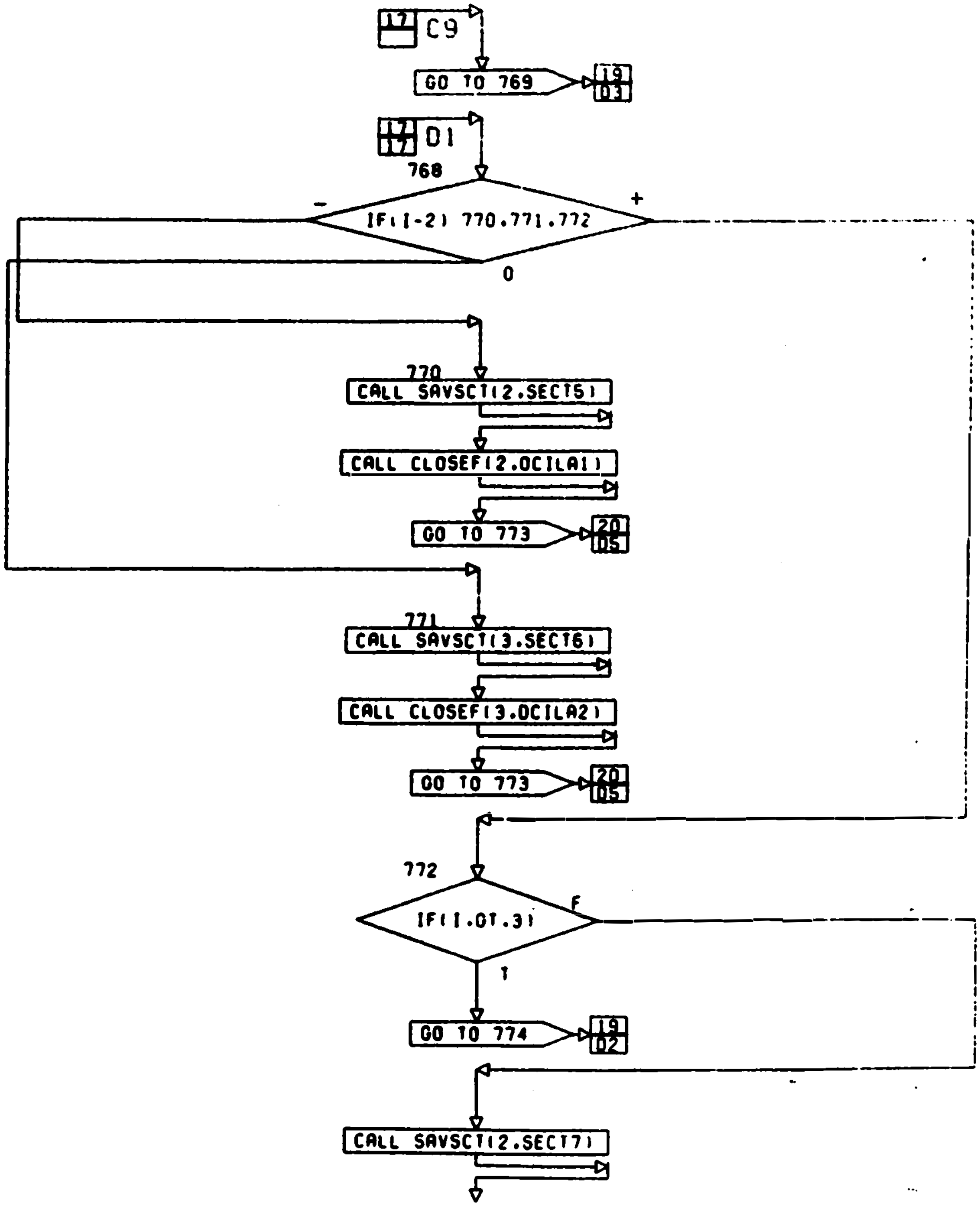

15
C3
IF(I.EQ.2.AND.MEAOUI.EQ.1)
T
WRITE(NO.38)
F
IF(I.EQ.2.AND.MEAOUI.EQ.2)
T
WRITE(NO.34)
GO TO 767
17
C7
15
C4
766
WRITE(NO.27)ISINUM
WRITE(NO.40)
F
IF(I.EQ.3.AND.MEAOUI.EQ.1)
T
WRITE(NO.37)
F
IF(I.EQ.3.AND.MEAOUI.EQ.2)
17
C6
T
17
C5

CONT. ON PG 17

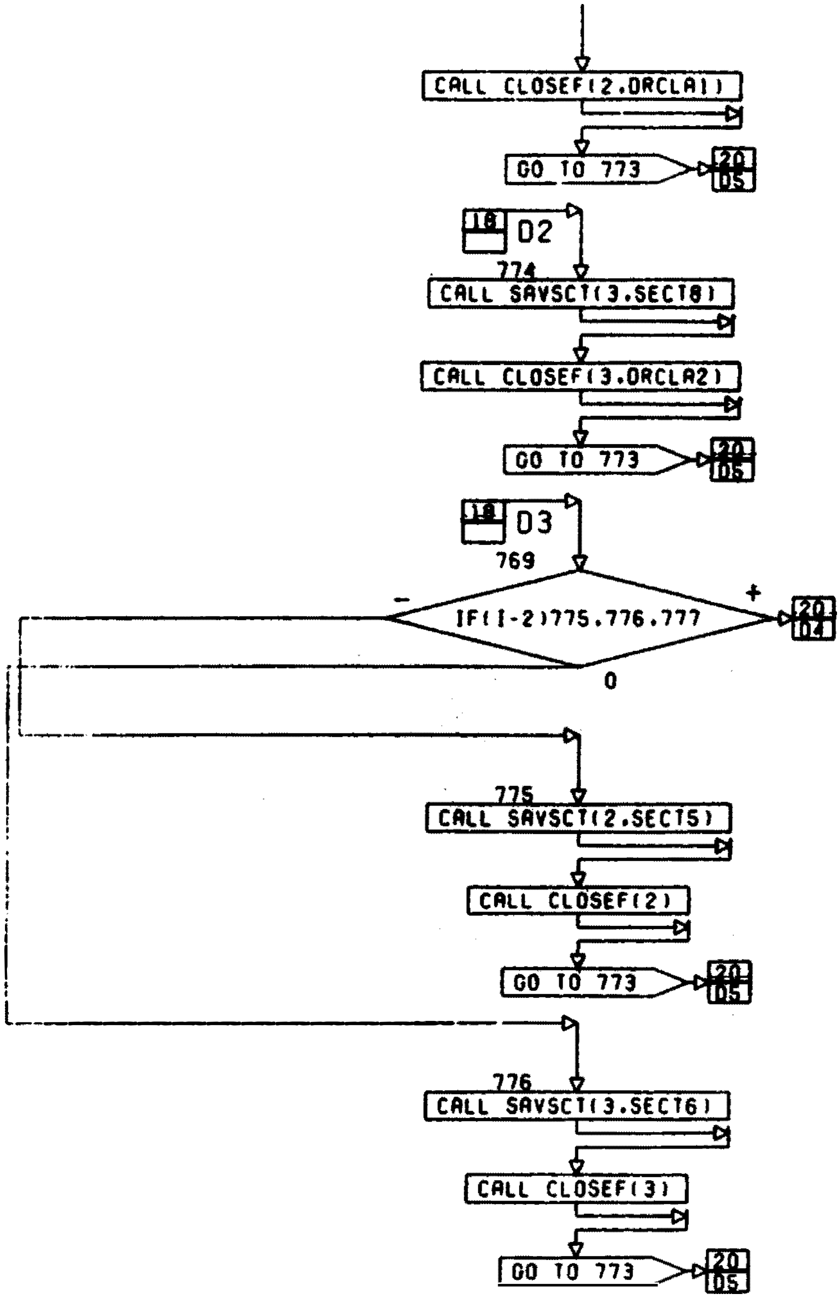


16
C5
WRITE(NO.33)
16
C6
IF(I.EQ.4.AND.MEAOUI.EQ.1)
F
T
WRITE(NO.38)
IF(I.EQ.4.AND.MEAOUI.EQ.2)
F
T
WRITE(NO.34)
16
C7
767
WRITE(NO.30)
15
C8
11
760
CONTINUE
IF(NEWFIL.EQ.1)
F
T
GO TO 768
18
D1
IF(IYR.GT.IBY)
F
18
D1
T
18
C9

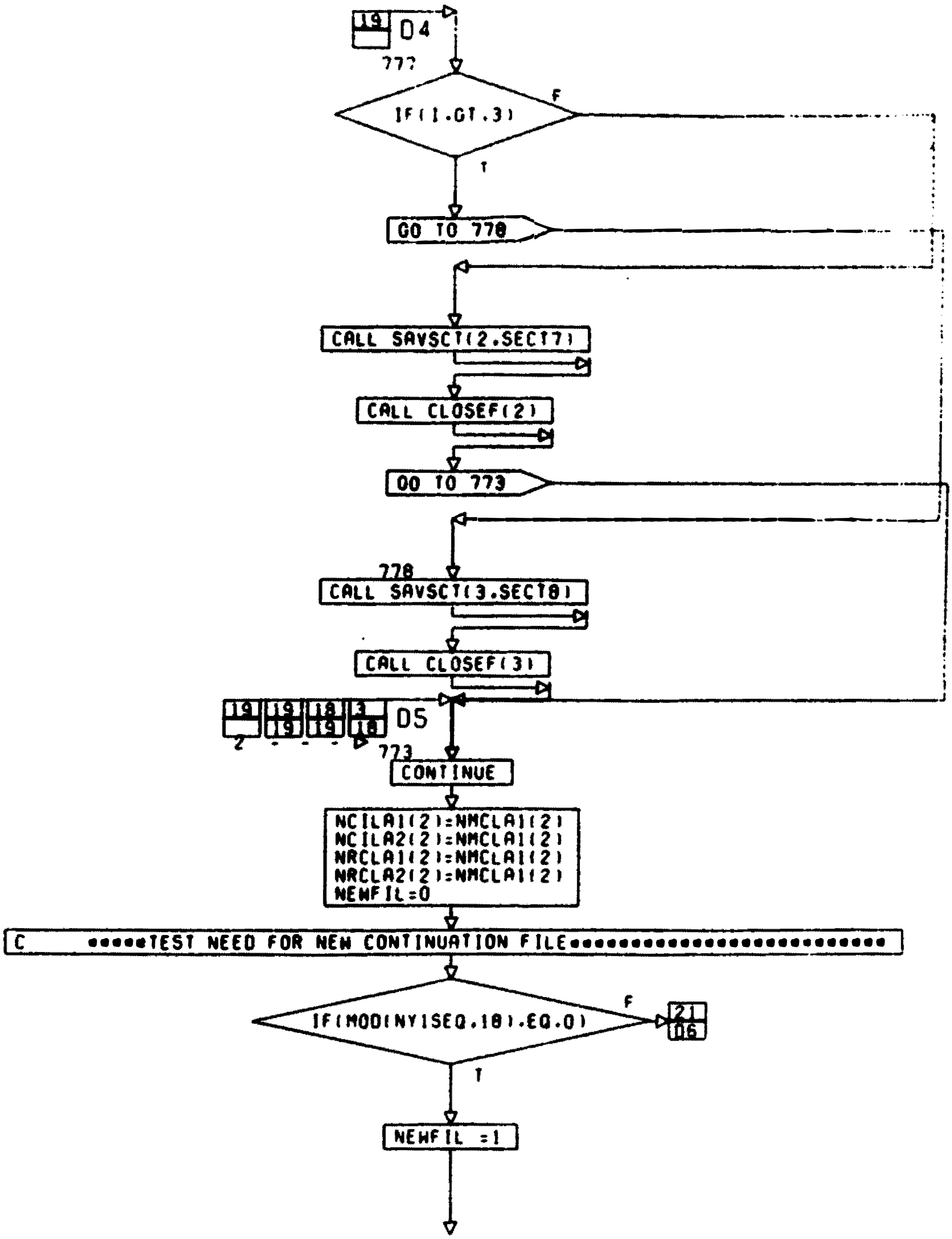
CONT. ON PG 18


17
C9
GO TO 769
19
D3
17
17
D1
768
IF(I-2) 770,771,772
-
+
0
770
CALL SAVSCT(2,SECT5)
CALL CLOSEF(2,OCILA1)
GO TO 773
20
D5
771
CALL SAVSCT(3,SECT6)
CALL CLOSEF(3,OCILA2)
GO TO 773
20
D5
772
IF(I.GT.3)
F
T
GO TO 774
19
D2
CALL SAVSCT(2,SECT7)

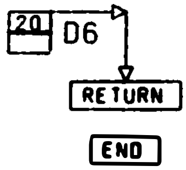
CONT. ON PG 19


CALL CLOSEF(2.ORCLA1)
GO TO 773
20
D5
18
D2
774
CALL SAVSCT(3.SECT8)
CALL CLOSEF(3.ORCLA2)
GO TO 773
20
D5
18
D3
769
IF(I-2)775.776.777
-
+
0
20
D4
775
CALL SAVSCT(2.SECT5)
CALL CLOSEF(2)
GO TO 773
20
D5
776
CALL SAVSCT(3.SECT6)
CALL CLOSEF(3)
GO TO 773
20
D5

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 2
19 19
18 19
3 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


20
D6
RETURN
END

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 FRODEP, table B5; subroutine STFRSP, table B6; and subroutine CALSST, table B7.

Table B1

Listing of Main Program, FTWEMS

```
$OVR,COMPMS
$OVR,FIL1DA
$OVR,FIL2DA
$OVR,FRODEP
$OVR,CALSST
$OVR,STFRSP
$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,NTOS,AJBN,JBN,JN,KPMC,SECT1,SECT2,
&SECT3,SECT4,SECT5,SECT6,SECT7,SECT8,SECT9,SECT10,NCI,NRCI,
&SAM,IND,IDAB,IDAE,JNK,JNI,NO,STDN,NUMB,ISEQ,NY1SEQ,NY2SEQ
C*****EQUIVALENCED VARIABLES********************************************
 EQUIVALENCE (NMCLA1,DMCLA1),(NMCLA2,DMCLA2),(NPMLA1,DPMLA1),
&(NPMLA2,DPMLA2),(NFRDEP,DFRDEP),(NCILA1,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.,
&.09612290,.01073670,-.10720756,.05548077,0.,0.,
&0.1164190,0.06704479,-0.09112914,0.03120642,0.,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,
&0.02789788,0.24453131,-0.86060142,1.2998033,
&-.97359290,.29132112,
&.08321811,.11716883,-.14710818,.04910032,0.,0.,
&.03492386,.36829518,-.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,-5.9828479,0.,0.,
```

Listing of Main Program, FTWEMS

```
&.13851029,-.32294633,.51095728,-.23644523,0.,0.,
&.14694158,-.508568,1.2942848,-.74715639,0.,0./
 DATA RMIN,STRLI,C1COF,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,NMAXD/1,0,0/,C3/.47,.75,.22,.60/,C4/-.01,-.05,-.01,-.02/
 DATA RANG/1.26,1.00,1.87,1.63,1.47,1.08,1.05,0.72,1.55,
&1.25,1.43,0.93,0.54,0.35,0.42,0.30,0.92,0.46/
 DATA RF,PRECIP/7*0.,420*0./,MOK,JUL,JIL,JUG,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,
&8355711,8355711/,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.,0.101,0.,0.105,0.,0.,0.,0.,0.,
&0.170,0.,0.,0.025,0.,0.,0.,0.,0.013,0.,0.061,0.,0.,0.,0.,0./
C****FORMAT STATEMENTS**********************************************
 1 FORMAT(2X,4A3,2X,2(A1,2X),2F10.0)
 2 FORMAT(1X,F9.,7F10.)
 3 FORMAT(1X,I2,2I1,4X,8F7.3)
 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)
 14 FORMAT(4X,2(F5.3,X),4(2F6.0))
 15 FORMAT(10X,3(2F5.2))
 16 FORMAT(5X,4F7.3,5X,4F7.3)
 17 FORMAT(3X,4(2F8.3))
 18 FORMAT(3X,I2,I1,6F10.8)
 19 FORMAT(10X,I4)
 20 FORMAT(I4)
 21 FORMAT(X,I2)
 22 FORMAT(5H1SITE,2X,4A3)
 23 FORMAT(  8H TEXTURE,8X,A1,4X,A1)
 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,15H0 - 15 CM LAYER,/)
 34 FORMAT(23X,16H15 - 30 CM LAYER,/)
```

<u>Listing of Main Program, FTWEMS</u>

```
 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,IUNMEA
 PRINT,"IF YOU WANT OUTPUT MOISTURE CONTENT IN:"
 PRINT,"      INCHES ENTER A 1; CM ENTER A 2"
 READ,MEAOU1
 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) GO TO 50
 PRINT,"NAME LAYERS 1 AND 2 PERCENT MOISTURE FILES."
 PRINT,"      EXAMPLE:XX1001,XX2001"
 READ 39, NPMLA1,NPMLA2
 50 IDC1(1)=101
 PRINT,"IF YOU HAVE AIR TEMPERATURE, ENTER A T; IF NOT A 9"
 READ 8,NTEMP
 JOB=1
 PRINT,"IF YOU HAVE SNOW DEPTH(M),ENTER AN SN; IF NOT A 9"
 READ 8,NSNOW
 IF(NSNOW.EQ.3HS  )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) GO TO 60
 PRINT,"ENTER THE NAME OF YOUR INPUT FILE"
 READ 32,SAM
 PRINT,"ARE MAX AND MIN SOIL MOISTURE EQUATIONS INCLUDED IN THE"
 PRINT,"INPUT DATA FILE?"
 READ,MMDD
 CALL OPENF(1,SAM)
 GO TO 160
 60 CALL OPENF(1,"DSURGR")
 PRINT,"ENTER THE NUMBER OF YOUR SURFACE GROUP"
 READ 20,NSCGNU
 DO 70 I=1,500
 READ(1,10)ITYPE
 IF(ITYPE.EQ.1)READ(101,19)NCKSGN
 IF((NSCGNU-NCKSGN).EQ.0) GO TO 115
 70 CONTINUE
C*****READ SITE AND SOIL IDENTIFICATION***********************************
 115 MOK=1
 ITEM1=IDC1(1)
 READ(ITEM1,1) ISINUM,ITEXA,ITEXB,BD(1),BD(2)
 PRINT22,ISINUM
```

Listing of Main Program, FTWEMS

```
PRINT 23,ITEXA,ITEXB
IF(ITEXA.EQ.3HN  )KIND(2)=10
IF(ITEXB.EQ.3HN  )KIND(3)=10
PRINT24,BD(1),BD(2)
IF(ITEXA-3HC  )122,120,122
120 IT(1)=KIND(2)=1
GO TO 128
122 IF(ITEXA-3HM  )125,124,125
124 IT(1)=KIND(2)=2
GO TO 128
125 IF(ITEXA-3HF  )128,127,128
127 KIND(2)=2
IT(1)=3
128 IF(ITEXB-3HC  )132,130,132
130 IT(2)=KIND(3)=1
GO TO 150
132 IF(ITEXB-3HM  )135,134,135
134 KIND(3)=2
IT(2)=2
GO TO 150
135 IF(ITEXB-3HF  )150,137,150
137 KIND(3)=2
IT(2)=3
150 JUL=1
JOK=1
C*****READ DATA FROM INPUT FILE*****************************************
160 READ(1,10)ITYPE
GOTO(115,170,180,190,190,200,210,230,240),ITYPE
170 READ(101,21)NTYPE
GO TO(172,174,176,178,179,175)NTYPE
C*****READ LIMITS******************************************************
172 READ(101,14) RHIN,C1COF,((STRLI(I,J),I=1,2),J=1,4)
NEWLIM=NTYPE
IF(IUNHEA.EQ.1.AND.NSOUR.EQ.2) RHIN=RHIN*0.3937
GO TO 160
C*****READ DEPLETION EQUATION COEFFICIENTS*****************************
174 IF(NSOUR.EQ.2) GO TO 1175
READ(101,13) NS,NL,(CONEW(NS,NL,JJ),JJ=1,6)
NEWCOF=NTYPE
GO TO 160
1175 READ(101,18) NS,NL,(CONEW(NS,NL,JJ),JJ=1,6)
NEWCOF=NTYPE
GO TO 160
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
C*****READ MOISTURE RANGE BY LAYER AND SEASON*************************
176 READ(101,15)((XRANG(I,J),I=1,2),J=1,3)
GO TO 160
C*****READ STRENGTH EQUATION COEFFICIENTS******************************
178 READ(101,17) ((STCON(I,J),I=1,2),J=1,4)
NSOST=NTYPE
C*****READ IDENTIFICATION CODE FOR EQUATION TO COMPUTE STRENGTH********
C*****  EQUATION CONSTANTS*********************************************
```

```
179 READ(101,28)NCI,NRCI
NSOST=NTYPE
GO TO 160
C*****READ BEGINNING SOIL MOISTURE****************************************
180 READ(101,30) PMC(1),PMC(2)
PRINT 25,PMC(1),PMC(2)
IF(IUNMEA.EQ.2.OR.NSOUR.EQ.1) GO TO 184
DO 182 I=1,2
182 PMC(I)=PMC(I)*0.3937
184 JUL=2
GOTO160
C*****READ AND PRINT MAX AND MIN SOIL MOISTURE****************************
190 READ(101,2)(C2(I),I=1,4)
IF(ITYPE-5)192,191,192
191CONTINUE
DO 195 I=1,2
J=I+2
CMAX(I)=6.*BD(I)*C2(I)/100.
CMIN(I)=6.*BD(I)*C2(J)/100.
195CONTINUE
192 IF(IUNMEA.EQ.2.OR.NSOUR.EQ.1) GO TO 194
DO 193 I=1,4
193 C2(I)=C2(I)*0.3937
194 PRINT 27,(C2(I),I=1,4)
DO 196 I=1,2
J=I+2
CMAX(I)=C2(I)
CMIN(I)=C2(J)
196 CONTINUE
IF(NSOUR.EQ.2) GO TO 197
CALL CLOSEF(1)
PRINT,"ENTER NAME OF RAINFALL FILE"
READ 32,SAM
CALL OPENF(1,SAM)
197 GO TO (198,160),JUL
198CONTINUE
PMC(1)=CMAX(1)
PMC(2)=CMAX(2)
JUL=2
GOTO160
C*****READ SOIL PROPERTIES************************************************
200CONTINUE
IDEV1=101
GO TO (201,1150),MOK
201CONTINUE
MOK=2
DO 206 M=1,2
ITEM2=IDEV1
READ(ITEM2,21) II
IF(II.GE.8)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
```

Listing of Main Program, FTWEMS

```
IF(II-8)205,205,204
204 READ(1,4)(C1(I,J),I=9,II)
205 PRINT 26,(C1(I,M),I=1,II)
206CONTINUE
IF(MMDD.EQ.2) GO TO 1150
GOTO160
1150CONTINUE
DO 1190 M=1,4
 ITEM3=IDEV1
IF(M.EQ.1.OR.M.EQ.2)N=M
IF(M.EQ.3)N=1
IF(M.EQ.4)N=2
IF(MMDD.EQ.2)GO TO 1180
C*****READ CONSTANTS FOR EQUATIONS COMPUTING MOISTURE MAX AND MIN*******
READ(ITEM3,3)II,NSCS,J,(C5(I,M,NSCS),I=1,8)
IDEV1=1
IF(II-8)1170,1170,1160
1160 READ(1,4)(C5(I,M,NSCS),I=9,II)
1170 PRINT 29,(C5(I,M,NSCS),I=1,II)
1180 CONTINUE
C2(M)=0.
DO 1190 I=1,II
1190 C2(M)=C2(M)+C5(I,M,NSCS)*C1(I,N)
GO TO (194,160)JUL
C*****READ AND WRITE HEADINGS*******************************************
210 READ(101,5)(IHD(J),J=1,20)
I=1
GO TO 217
DO 220 I=1,5
READ(1,5)(IHD(J),J=1,20)
217CONTINUE
PRINT5,(IHD(J),J=1,20)
WRITE(2,5) (IHD(J),J=1,20)
WRITE(3,5) (IHD(J),J=1,20)
220 CONTINUE
IF(MEAOU1.EQ.2) 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
C*****READ SEASON CHANGE CARD*******************************************
230 READ(101,6) IS1,ISD,ISM,ISY
IF(JUB.EQ.1)GO TO 235
IBD=IDACK=ISD
```

Listing of Main Program, FTWEMS

```
AIBD=IBD
AJBN=AIBD/7.
IBM=MCK=ISM
NEWYR=IBY=ISY
235 CONTINUE
DO 215 I=1,2
IIT=IT(I)
IF(NEWCOF.LT.2.OR.NEWCOF.GT.2) GO TO 225
SDF=1.
ADF=1.
GO TO 215
225 SDF(I)=RANG(I,IIT,1)/(CMAX(I)-CXMIN(I))
ADF(I)=1/SDF(I)
215 CONTINUE
I=1
JUG=1
JUB=1
GOTO160
C*****READ PRECIPITATION OR AIR TEMPERATURE OR SNOW CARD***************
240 READ(101,7,END=3[illegible]5) IDA,MO,NCODE
NDA=IDA+6
IF(NTEMP.EQ.NTOS.AND.NSNOW.EQ.NTOS) GO TO 2240
IF(NTEMP.EQ.NTOS)GO TO 2249
IF(NCODE-NTEMP) 2249,2245,2249
2249 IF(NCODE-NSNOW) 2240,2244,2240
2244 READ(101,9),(SNO(MO,JJ),JJ=IDA,NDA)
GO TO 3[illegible]0
2245 READ(101,11),(TEMPER(MO,JJ),JJ=IDA,NDA)
GO TO 3[illegible]0
2240 READ(101,31) IDA,MO,IYR,(RF(JJ),JJ=1,7)
IF(IBM.EQ.MO.AND.IBY.EQ.IYR.AND.ISD.GT.IDA)IDACK=IDA
IF(IYR.LT.NEWYR) GO TO 498
IF(IYR.EQ.NEWYR.AND.MO.LT.MCK)GO TO 498
IF(IYR.EQ.NEWYR.AND.MO.EQ.MCK.AND.IDA.LT.IDACK)GO TO 498
MCK=MO
IDACK=IDA
CALL EOFTST(1,MM)
IF(MM.EQ.2) GO TO 241
IF(IYR.GT.NEWYR) NMAXD(1)=NMAXD(2)=0
IF(IYR.GT.NEWYR) IBD=IBM=1
241 IF(IUNMEA.EQ.2) GO TO 247
DO 246 JJ=1,7
RF(JJ)=RF(JJ)*0.3937
246 IF(RF(JJ).GT.30.AND.RF(JJ).LT.35.)RF(JJ)=77.77
247 IF(MO.EQ.2) GO TO 248
IF(MO.EQ.4.OR.MO.EQ.6.OR.MO.EQ.9.OR.MO.EQ.11) GO TO 249
ICOUNT=31
GO TO 250
248 ICOUNT=28
GO TO 250
249 ICOUNT=30
250 CONTINUE
NTDA=IDA
DO 251 NJ=1,7
```

Listing of Main Program, FTWEMS

```
PRECIP(MO,NTDA)=RF(NJ)*2.54
251 NTDA=NTDA+1
C*****COMPUTE SOIL MOISTURE*******************************************
CALL LINK(5,"0COMPM")
CALL COMPMS
C**********
300 IF(JAZ.EQ.2) GO TO 301
JEB=1
301 GO TO (420,302),JAZ
302CONTINUE
JIL=1
IF(MO.EQ.NMAXD(1).OR.MO.EQ.12) GO TO 303
GO TO 410
303 GO TO (304,304,305) JOB
304 IF(NTEMP.EQ.NTOS) GO TO 305
JOB=JOB+1
GO TO 160
C*****WRITE SOIL MOISTURE FILES***************************************
305 CALL LINK(5,"0FIL1D")
CALL FIL1DA
IF(MEAOU2.EQ.1)CALL LINK(5,"0FIL2D")
IF(MEAOU2.EQ.1)CALL FIL2DA
C*****WRITE FILES FOR INPUT TO FREEZE-THAW MODEL***********************
IF(NTEMP.GT.NTOS.OR.NTEMP.LT.NTOS)CALL LINK(5,"0FRODE")
IF(NTEMP.GT.NTOS.OR.NTEMP.LT.NTOS)CALL FRODEP
JOB=1
IF(MEAOU2.EQ.2) GO TO 400
C*****COMPUTE STRENGTH EQUATION CONSTANTS FROM SOIL PROPERTIES*********
IF(NSOST.EQ.5.AND.IYR.EQ.IBY) CALL LINK(5,"0STFRS")
IF(NSOST.EQ.5.AND.IYR.EQ.IBY) CALL STFRSP
C*****COMPUTE SOIL STRENGTH********************************************
IF(NSOST.EQ.4.OR.NSOST.EQ.5)CALL LINK(5,"0CALSS")
IF(NSOST.EQ.4.OR.NSOST.EQ.5)CALL CALSST
400 JEL=1
JEB=2
GOTO450
410 JEB=3
420 READ(1,10) ITYPE
MOB=1
CALL EOFTST(1,IEND)
IF(IEND-2)460,430,460
430 MOB=2
GOTO470
460 IF(ITYPE-1)480,470,480
470 GO TO (302,495,490),JEB
480 IF(ITYPE.EQ.3) GO TO 180
IF(ITYPE-8)240,230,240
490 JEL=2
450 GO TO(420,495),MOB
495 GO TO (115,500),MOB
498 PRINT,"PRECIPITATION FILE HAS DATA OUT OF ORDER."
PRINT,"CHECK DATA:",IDA,MO,IYR
500 STOP
END
```

Listing of Main Program, PTWEMS

```
      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,(STORHD(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
```

Table B2

Listing of Subroutine COMPMS

```
      SUBROUTINE COMPMS
C*****************
C*****CALCULATION CORE*********************************************************
      DO 600 J=1,7
      IF(RF(J)-77.77)601,602,603
  601 GO TO (604,605) JOK
      IF(ISM-MO)606,606,607
  606 IF(ISD-IDA-J+1) 608,608,607
  608 GO TO (640,605) JOK
  604 JOK=2
  605 IS=IS1
      DO 609 I=1,2
      IIT=IT(I)
      IF(NEWCOF.LT.2.OR.NEWCOF.GT.2) 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
  607 JEM=1
      DO 611 I=1,2
      DWMC(I,J)=0.
      GO TO (612,613,614,615),JEM
  612 IF(RF(J)-RMIN)616,617,618
  616 JEM=2
      GOTO613
  617 ACCR=0.
      GO TO 619
  618CONTINUE
C*****ACCRETION CALCULATION*****************************************************
      X(1)=CMAX(1)-PMC(1)
      X(2)=CMAX(2)-PMC(2)
      IF(RF(J)-X(1)-X(2))621,620,620
  620 II=2
      JEM=3
      GOTO614
  621 II=1
      JEM=4
  615 X(I)=RF(J)
C*****ACCRETION(CLASS 1 AND CLASS 2)*****
  614 ACCR=C3(II,I)*X(I)+C4(II,I)
      IF(ACCR)622,622,623
  622 IF(PMC(I)-CMAX(I))624,625,625
  624 IF(II.EQ.1)GO TO 626
      PMC(I)=PMC(I)+ACCR2
      GO TO 627
  626 PMC(I)=PMC(I)+ACCR1
      GOTO627
  623 IF(II.EQ.1.AND.ACCR.LT.C1COF.AND.I.EQ.1) GO TO 628
      GO TO 629
  628 C1ROF=RF(J)-RMIN
      IF(C1ROF,LT.C1COF.AND.I.EQ.1) GO TO 630
      GO TO 629
C*****ACCRETION(ONE TO ONE RELATION)*****
```

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(MEAOU2.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
```

Table B2 (concluded)

Listing of Subroutine COMPMS

```
603 ITEMP=IDA+J-1
NMAXD(1)=MO
NMAXD(2)=ITEMP-1
JAZ=2
645 RETURN
END
```

Table B3

Listing of Subroutine FIL1DA

```
SUBROUTINE FIL1DA
C****************
C*****WRITE SOIL MOISTURE FILES*****************************************
C*****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)
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) GO TO 650
IF(IYR.GT.NEWYR) GO TO 651
GO TO 652
651 CALL OPENF(2,DMCLA1)
CALL SETSCT(2,SECT1)
C*****WRITE HEADINGS****************************************************
650 WRITE(2,27)ISINUM
IF(MEAOU1.EQ.1)WRITE(2,35)
IF(MEAOU1.EQ.1) WRITE(2,37)
IF(MEAOU1.EQ.2) WRITE(2,36)
IF (MEAOU1.EQ.2) WRITE(2,33)
WRITE(2,30)
IF(NEWFIL.EQ.1) GO TO 653
CALL OPENF(3,DMCLA2)
CALL SETSCT(3,SECT2)
653 WRITE(3,27)ISINUM
IF(MEAOU1.EQ.1) WRITE(3,35)
IF(MEAOU1.EQ.1) WRITE(3,38)
IF(MEAOU1.EQ.2) WRITE(3,36)
IF(MEAOU1.EQ.2) WRITE(3,34)
WRITE(3,30)
NEWYR=IYR
652 K=IBM
LK=MO
DO 654 I=K,LK
JB=1
IF(IBD.GT.1.AND.I.EQ.IBM.AND.IYR.EQ.IBY)JB=IBD
IDAB=1
IDAE=7
IF(I.EQ.NMAXD(1)) JEND=NMAXD(2)
IF(I.EQ.NMAXD(1)) GO TO 655
JEND=MAXD(I)
655 IF(MEAOU1.EQ.1) GO TO 656
DO 657 J=JB,JEND
STORMC(I,J)=STORMC(I,J)*2.54
657 STORMD(I,J)=STORMD(I,J)*2.54
656 WRITE(2,31) (IMOA(II,I), II=1,4), IYR
WRITE(3,31) (IMOA(II,I), II=1,4),IYR
```

Table B3 (continued)

Listing of Subroutine FIL1DA

```
JBN=AJBN
DO 658 NW=1,5
IF(IYR.GT.IBY) GO TO 659
INK=0
IF(AJBN.GE.NW.AND.I.EQ.IBM)GO TO 660
IF(JB.EQ.1.OR.JBN.LT.(NW-1)) GO TO  659
C*****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED******
DO 661 NK=IDAB,IDAE
INK=INK+1
IF(STORMC(I,NK).EQ.0.0)GO TO 661
IND=60+INK-1
JNK=NK
JNI=I
CALL WRIBWK
GO TO 660
661 CONTINUE
GO TO 660
659 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 662
660 IDAB=IDAB+7
658 IDAE=IDAE+7
662 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 663
WRITE(2,27),ISINUM
IF(MEAOU1.EQ.1)WRITE(2,35)
IF(MEAOU1.EQ.1)WRITE(2,37)
IF(MEAOU1.EQ.2) WRITE(2,36)
IF(MEAOU1.EQ.2) WRITE(2,33)
WRITE(2,30)
WRITE(3,27) ISINUM
IF(MEAOU1.EQ.1)WRITE(3,35)
IF(MEAOU1.EQ.1) WRITE(3,38)
IF(MEAOU1.EQ.2) WRITE(3,36)
IF(MEAOU1.EQ.2) WRITE(3,34)
WRITE(3,30)
663 IF(MEAOU2.EQ.2) GO TO 654
IF(MEAOU1.EQ.2) 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)
654 CONTINUE
CALL SAVSCT(2,SECT1)
```

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
```

Table B4

Listing of Subroutine FIL2DA

```
SUBROUTINE FIL2DA
C****************
C*****WRITE PERCENT MOISTURE FILES*************************************
C*****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,/)
37 FORMAT(24X,14H0 - 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)GO TO 700
CALL OPENF(2,DPMLA1)
CALL SETSCT(2,SECT3)
C*****WRITE HEADINGS**********************************************
700 WRITE(2,27),ISINUM
WRITE(2,28)
IF(MEAOU1.EQ.1) WRITE(2,37)
IF(MEAOU1.EQ.2) WRITE(2,33)
WRITE(2,30)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 701
CALL OPENF(3,DPMLA2)
CALL SETSCT(3,SECT4)
701 WRITE(3,27),ISINUM
WRITE(3,28)
IF(MEAOU1.EQ.1) WRITE(3,38)
IF(MEAOU1.EQ.2) WRITE(3,34)
WRITE(3,30)
DO 702 I=K,LK
JB=1
IF(IBD.GT.1.AND.I.EQ.IBM.AND.IYR.EQ.IBY)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
IF(IYR.GT.IBY)GO TO 704
INK=0
IF(AJBN.GE.NW.AND.I.EQ.IBM) GO TO 705
IF(JB.EQ.1.OR.JBN.LT.(NW-1))GO TO 704
C*****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED*****
DO 706 NK=IDAB,IDAE
INK=INK+1
IF(STORMC(I,NK).EQ.0.0)GO TO 706
IND=60+INK-1
JNK=NK
JNI=I
CALL WRIBWK
GO TO 705
706 CONTINUE
```

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
```

Table B5

Listing of Subroutine FRODEP

```
SUBROUTINE FRODEP
C****************
C*****WRITE AIR TEMPERATURE AND SNOW FILES******************************
C*****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, ,F5.2,23HG/CM;  15-30
& CM LAYER, ,F5.2,4HG/CM)
34 FORMAT(11X,49HFROZEN DEPTH OF SOIL(CRREL-1968) DATA INPUT
& FILE,/)
35 FORMAT(1H ,/)
36 FORMAT(26X,19HMEASURED SNOW DEPTH,//)
37 FORMAT(11X,4HSNOW,3X,7HPRECIP-,3X,3HAIR,6X,13HSOIL MOISTURE,6X,
&13HSOIL MOISTURE)
38 FORMAT(6X,I2,3(2X,F6.2),8X,F7.2,11X,F7.2)
39 FORMAT(6X,3HDAY,2X,5HDEPTH,2X,7HITATION,3X,4HTEMP,4X,15H0-15
& CM LAYER,%,3X,17H 15-30 CM LAYER,%)
IF(IYR.GT.IBY) GO TO 850
C*****ADDITIONAL INPUT CONTROL*****************************************
PRINT,"ENTER NAMES OF SNOW,FROZEN SOIL DEPTH MODEL INPUT FILE"
PRINT,"          EXAMPLE: FRD001"
READ 32,NFRDEP
C*****TEST OUTPUT CHECK AND OPEN FILES*******************************
850 IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 851
CALL OPENF(4,DFRDEP)
CALL SETSCT(4,SECT9)
851 CONTINUE
C*****WRITE HEADINGS***************************************************
DO 852 I=K,LK
WRITE(4,27),ISINUM
WRITE(4,34)
IF(KIND(1).EQ.0) 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)
JB=IBD
JEND=MAXD(I)
IF(I.EQ.NMAXD(1))JEND=NMAXD(2)
C*****WRITE DATA ON FILES**********************************************
DO 854 J=JB,JEND
854 WRITE(4,38)J,SNO(I,J),PRECIP(I,J),TEMPER(I,J),STORMC(I,J),
&STORMD(I,J)
852WRITE(4,31) ISLEW
CALL SAVSCT(4,SECT9)
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 855
CALL CLOSEF(4)
GO TO 856
855 CALL CLOSEF(4,DFRDEP)
856 NY2SEQ=NY2SEQ+1
```

1 of 2 sheets

Table B5 (concluded)

Listing of Subroutine FRODEP

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

Table B6

Listing of Subroutine STFRSP

```
SUBROUTINE STFRSP
C*****************
C*****COMPUTE STERNGTH EQUATION CONSTANTS FROM SOIL PROPERTIES*********
 34 FORMAT(5X,21HINCORRECT C1 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)
C*****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,I2
     READ (1,) (IMOD(I,2),I=1,12)
     DO 801 J=1,2
    READ (1,) (B(I,J,2),I=1,12)
 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
 DO803L=1,2
 D(L)=B(1,1,L)-B(1,2,L)
 E(L)=B(1,1,L)
 DO803I=2,12
 JTEMP=IMOD(I-1,L)
 TEMP=C1(I,N)
 IF(JTEMP)804,803,805
 805CONTINUE
 IF(JTEMP-1)804,806,807
 807CONTINUE
 IF(JTEMP-2)804,808,809
 808CONTINUE
C*****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
 804 PRINT 34
 806 D(L)=D(L)+(B(I,1,L)-B(I,2,L))*TEMP
 E(L)=E(L)+B(I,1,L)*TEMP
 803CONTINUE
 NN=N
C*****COMPUTE A AND B OF STRENGTH EQUATION******************************
 DO802L=1,2
```

1 of 2 sheets

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
```

Table B7

Listing of Subroutine CALSST

```
SUBROUTINE CALSST
C****************
C*****COMPUTE CONE INDEX AND RATING CONE INDEX*************************
C*****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,15H0 - 15 CM LAYER,/)
34 FORMAT(23X,16H15 - 30 CM LAYER,/)
37 FORMAT(24X,14H0 - 6 IN LAYER,/)
38 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.IBY)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
IF(NSTEQ(I).EQ.2) GO TO 773
IF(IYR.EQ.IBY.OR.NEWFIL.EQ.1) GO TO 752
IF(I.EQ.1)CALL OPENF(2,DCILA1)
IF(I.EQ.1) CALL SETSCT(2,SECT5)
IF(I.EQ.2)CALL OPENF(3,DCILA2)
IF(I.EQ.2) CALL SETSCT(3,SECT6)
IF(I.EQ.3) CALL OPENF(2,DRCLA1)
IF(I.EQ.3) CALL SETSCT(2,SECT7)
IF(I.EQ.4) CALL OPENF(3,DRCLA2)
IF(I.EQ.4) CALL SETSCT(3,SECT8)
752 XLIM1=STRLI(1,I)
XLIM2=STRLI(2,I)
DO 753 J=K,LK
JB=1
IF(J.EQ.IBM.AND.IYR.EQ.IBY)JB=IBD
IF(J.EQ.NMAXD(1)) JEND=NMAXD(2)
IF(J.EQ.NMAXD(1)) GO TO 754
JEND=MAXD(J)
754 CONTINUE
DO 753 L=JB,JEND
IF(I.EQ.2.OR.I.EQ.4)GO TO 755
IF(STORMC(J,L).EQ.0.)STO(J,L)=0.
IF(STORMC(J,L).EQ.0.) GO TO 753
STO(J,L)=EXP(STCON(1,I)+STCON(2,I)*ALOG(STORMC(J,L)))
IF(STO(J,L).GT.XLIM1)STO(J,L)=XLIM1
```

Table B7 (continued)

Listing of Subroutine CALSST

```
IF(STO(J,L).LT.XLIM2)STO(J,L)=XLIM2
GO TO 753
755 IF(STORMD(J,L).EQ.0.)STO(J,L)=0.
IF(STORMD(J,L).EQ.0.)GO TO 753
STO(J,L)=EXP(STCON(1,I)+STCON(2,I)*ALOG(STORMD(J,L)))
IF(STO(J,L).GT.XLIM1)STO(J,L)=XLIM1
IF(STO(J,L).LT.XLIM2)STO(J,L)=XLIM2
753 CONTINUE
IF(MOD(I,2).EQ.0) NO=3
IF(MOD(I,2).EQ.0)GO TO 756
NO=2
C****WRITE HEADINGS*************************************************
756 WRITE(NO,27) ISINUM
IF(I.EQ.3.OR.I.EQ.4) GO TO 757
WRITE(NO,39)
IF(I.EQ.1)GO TO 758
IF(MEAOU1.EQ.1)WRITE(NO,38)
IF(MEAOU1.EQ.2)WRITE(NO,34)
GO TO 759
757 WRITE(NO,40)
IF(I.EQ.3)GO TO 758
IF(MEAOU1.EQ.1)WRITE(NO,38)
IF(MEAOU1.EQ.2)WRITE(NO,34)
GO TO 759
758 IF(MEAOU1.EQ.1) WRITE(NO,37)
IF(MEAOU1.EQ.2)WRITE(NO,33)
759 WRITE(NO,30)
DO 760 LOUT=K,LK
JB=1
IF(IBD.GT.1.AND.LOUT.EQ.IBM.AND.IYR.EQ.IBY)JB=IBD
IDAB=1
IDAE=7
WRITE(NO,31)(IMOA(II,LOUT),II=1,4),IYR
DO 761 NW=1,5
IF(IYR.GT.IBY)GO TO 762
INK=0
IF(AJBN.GE.NW.AND.LOUT.EQ.IBM)GO TO 763
IF(JB.EQ.1.OR.JBN.LT.(NW-1))GO TO 762
C****WRITE OUTPUT WHEN BEGINNING WEEK IS ONLY PARTIALLY FILLED******
DO 764 NK=IDAB,IDAE
INK=INK+1
IF(STO(LOUT,NK).EQ.0.0)GO TO 764
IND=60+INK-1
JNK=NK
JNI=LOUT
STDN=1.
CALL WRIBWK
STDN=0.
GO TO 763
764 CONTINUE
GO TO 763
762 IF(LOUT.EQ.2.AND.NW.EQ.4)NW=NW+1
IF(NW.EQ.5) IDAE=MAXD(LOUT)
JN=JEND/7
```

Table B7 (continued)

Listing of Subroutine CALSST

```
IF(LOUT.EQ.NMAXD(1).AND.JN.EQ.NW)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)GO TO 765
763 IDAB=IDAB+7
761 IDAE=IDAE+7
765 IF(LOUT.EQ.6.OR.LOUT.EQ.12) WRITE(NO,29)ISLEW
IF(LOUT.LT.6.OR.LOUT.GT.6) GO TO 760
IF(I.EQ.3.OR.I.EQ.4) GO TO 766
C*****WRITE MID-YEAR HEADINGS*************************************
WRITE(NO,27)ISINUM
WRITE(NO,39)
IF(I.EQ.1.AND.MEAOU1.EQ.1)WRITE(NO,37)
IF(I.EQ.1.AND.MEAOU1.EQ.2)WRITE(NO,33)
IF(I.EQ.2.AND.MEAOU1.EQ.1)WRITE(NO,38)
IF(I.EQ.2.AND.MEAOU1.EQ.2)WRITE(NO,34)
GO TO 767
766 WRITE(NO,27)ISINUM
WRITE(NO,40)
IF(I.EQ.3.AND.MEAOU1.EQ.1)WRITE(NO,37)
IF(I.EQ.3.AND.MEAOU1.EQ.2)WRITE(NO,33)
IF(I.EQ.4.AND.MEAOU1.EQ.1)WRITE(NO,38)
IF(I.EQ.4.AND.MEAOU1.EQ.2)WRITE(NO,34)
767 WRITE(NO,30)
760 CONTINUE
IF(NEWFIL.EQ.1) GO TO 768
IF(IYR.GT.IBY)GO TO 769
768 IF(I-2) 770,771,772
770 CALL SAVSCT(2,SECT5)
CALL CLOSEF(2,DCILA1)
GO TO 773
771 CALL SAVSCT(3,SECT6)
CALL CLOSEF(3,DCILA2)
GO TO 773
772 IF(I.GT.3) GO TO 774
CALL SAVSCT(2,SECT7)
CALL CLOSEF(2,DRCLA1)
GO TO 773
774 CALL SAVSCT(3,SECT8)
CALL CLOSEF(3,DRCLA2)
GO TO 773
769 IF(I-2)775,776,777
775 CALL SAVSCT(2,SECT5)
CALL CLOSEF(2)
GO TO 773
776 CALL SAVSCT(3,SECT6)
CALL CLOSEF(3)
GO TO 773
777 IF(I.GT.3)GO TO 778
CALL SAVSCT(2,SECT7)
CALL CLOSEF(2)
GO TO 773
778 CALL SAVSCT(3,SECT8)
CALL CLOSEF(3)
```

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Table B7 (concluded)

Listing of Subroutine CALSST

```
 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)NEWFIL =1
     RETURN
     END
```

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.

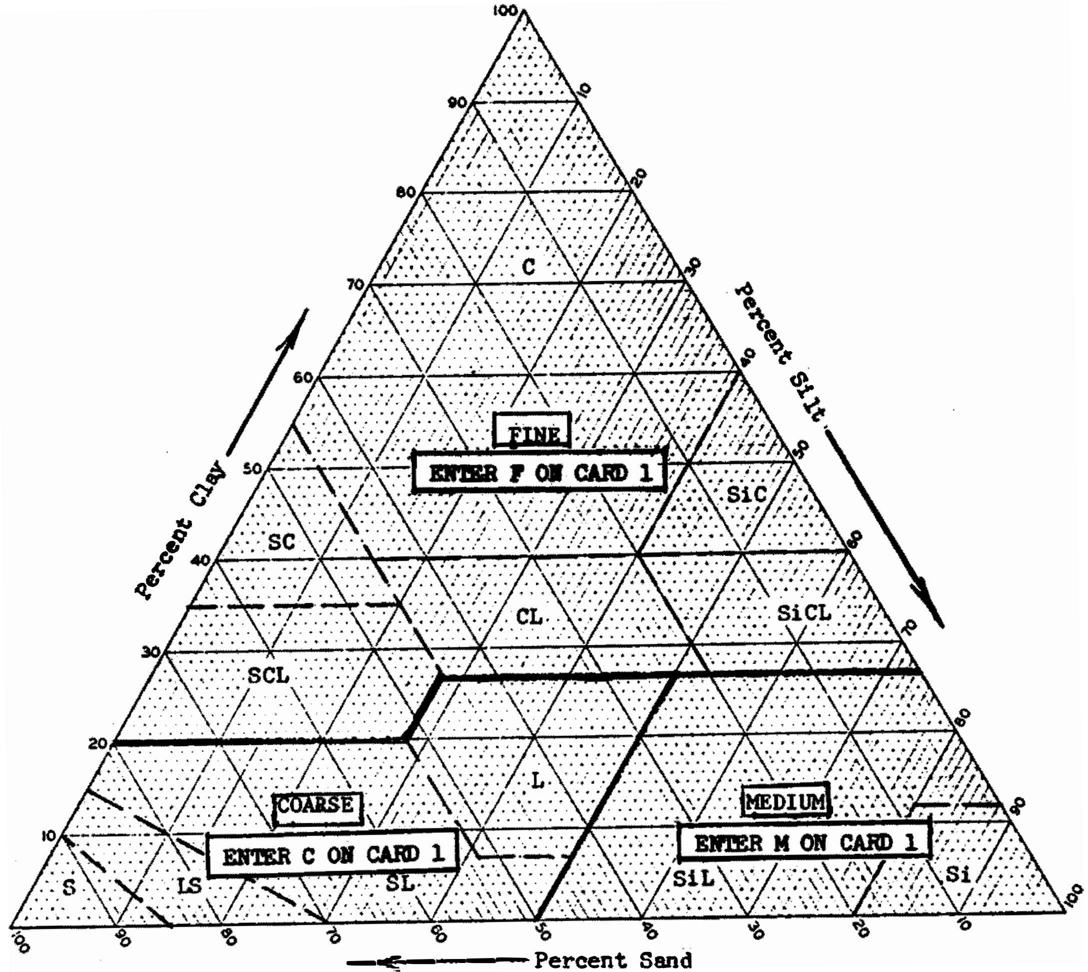
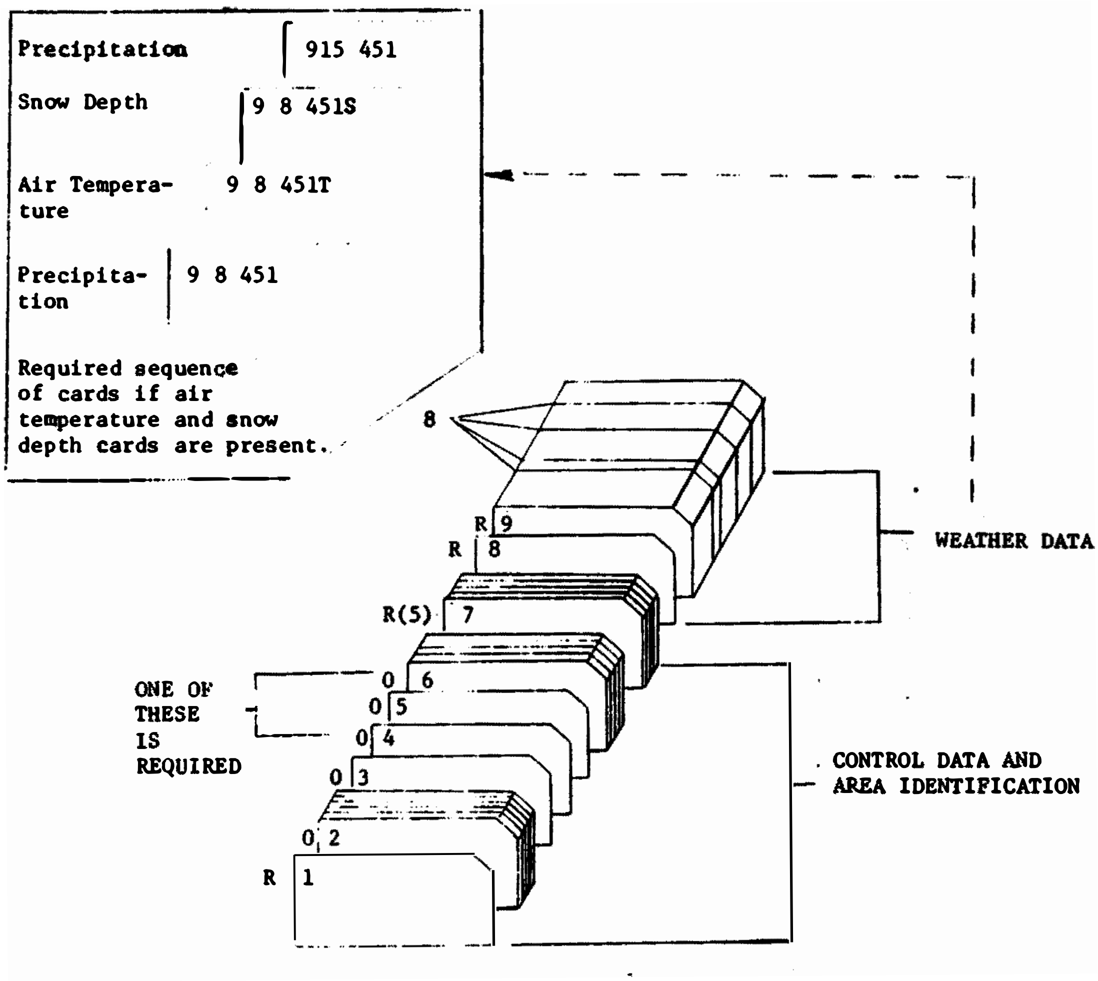
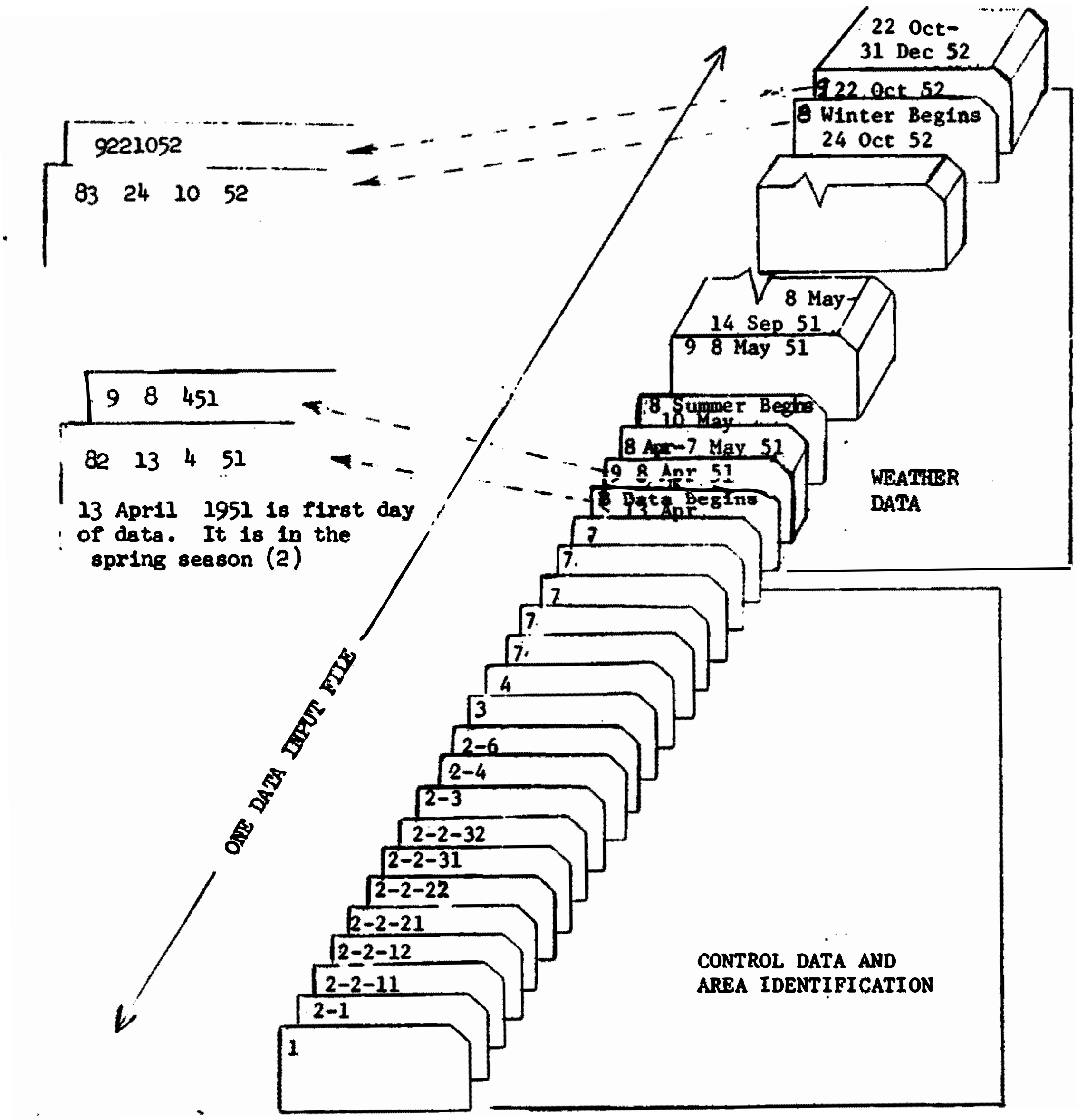


Fig. C1. Texture code for soils of USDA soil textural classification



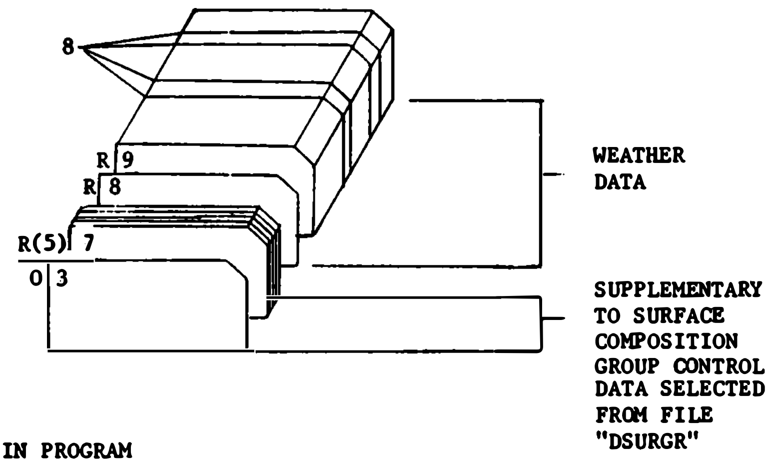
NOTE: R - REQUIRED IN PROGRAM
O - OPTIONAL IN PROGRAM

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.

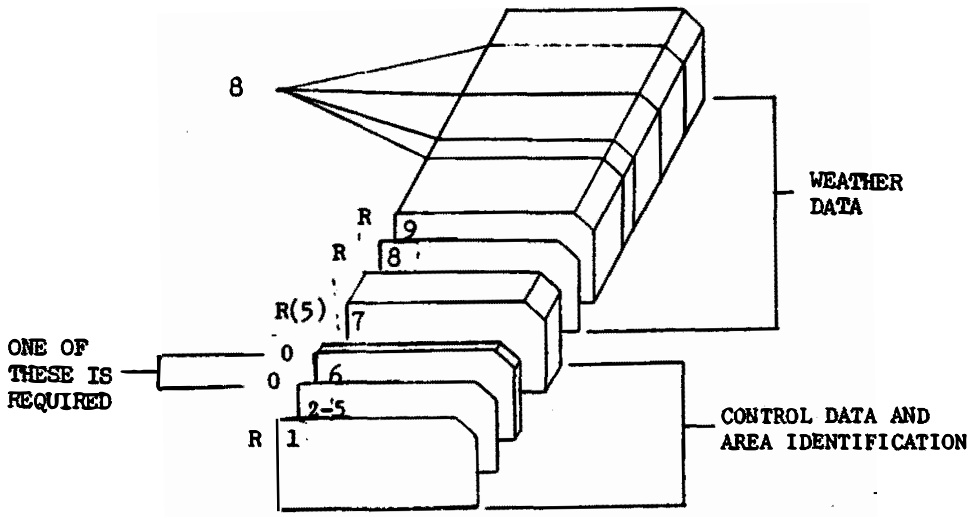
Fig. C3. Card deck setup using specific data



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

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

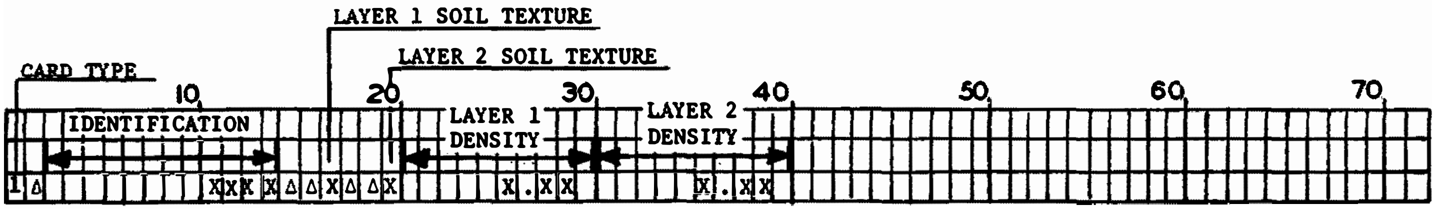
Fig. C4. Card deck setup using surface composition group data



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

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

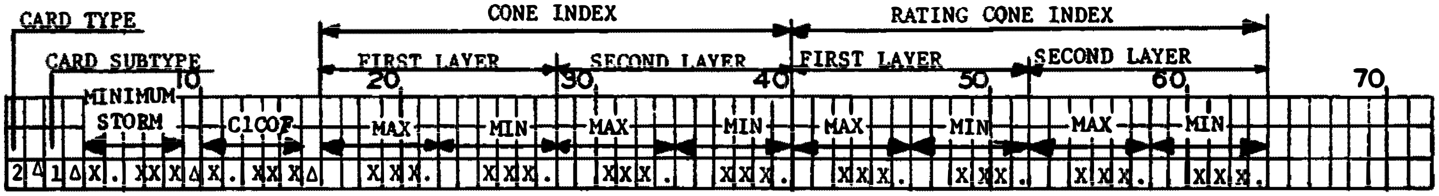
Fig. C5. Card deck setup using estimated (tentative average) data



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.

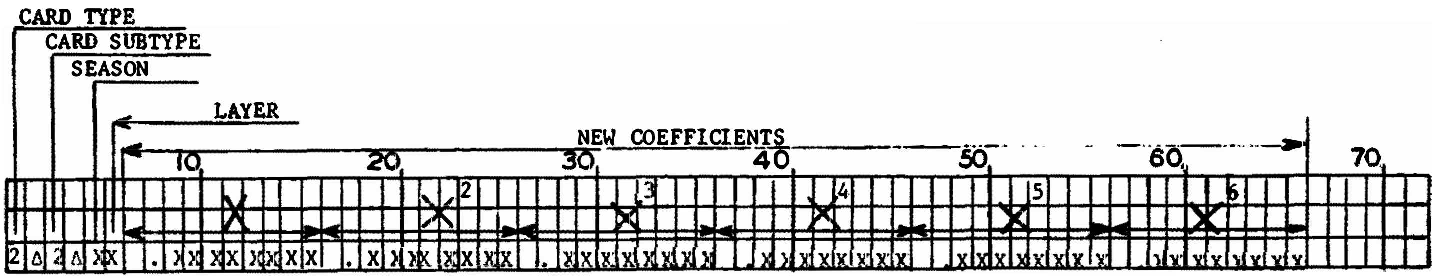
Fig. C6. Type 1 Card - Site Identification, Soil Texture and Soil Density



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

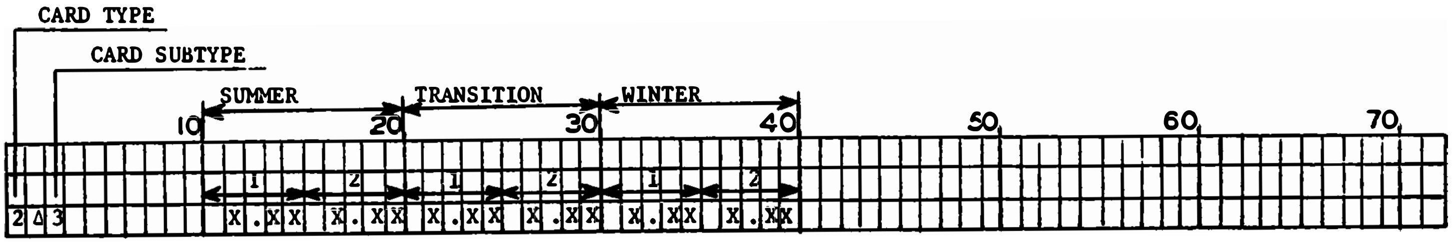


This card is optional. If this card is not present, the program assumes the tentative average depletion equation coefficients (table 4 of main text) are applicable. Negative coefficients must include the sign in the space allowed for that variable. The number of decimal places is optional. The decimal 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.

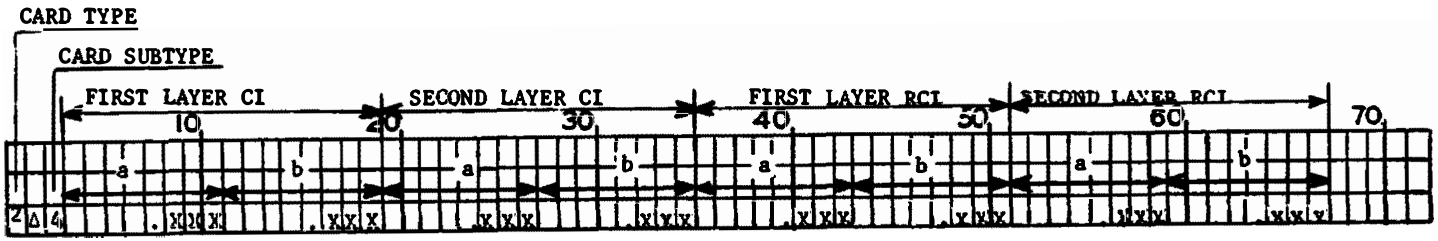
Fig. C8. Type 2-2 Card - Depletion Equation Coefficients



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

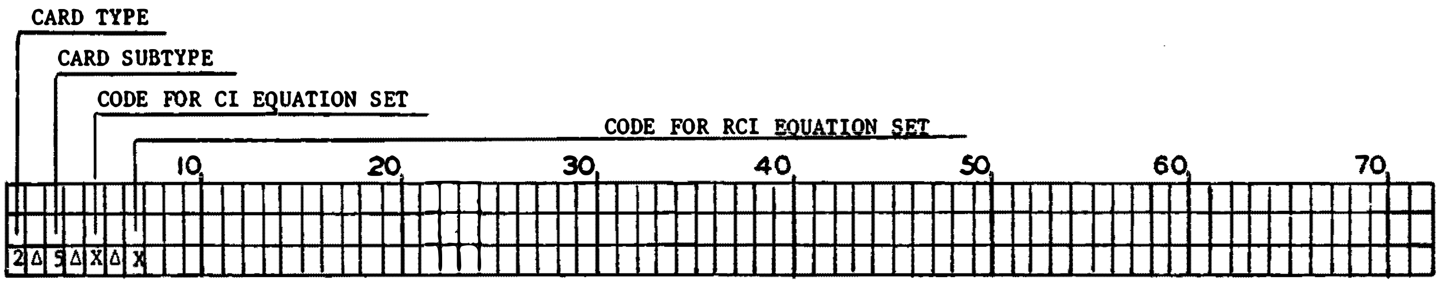
Fig. C9. Type 2-3 Card - Range of Soil Moisture Contents



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

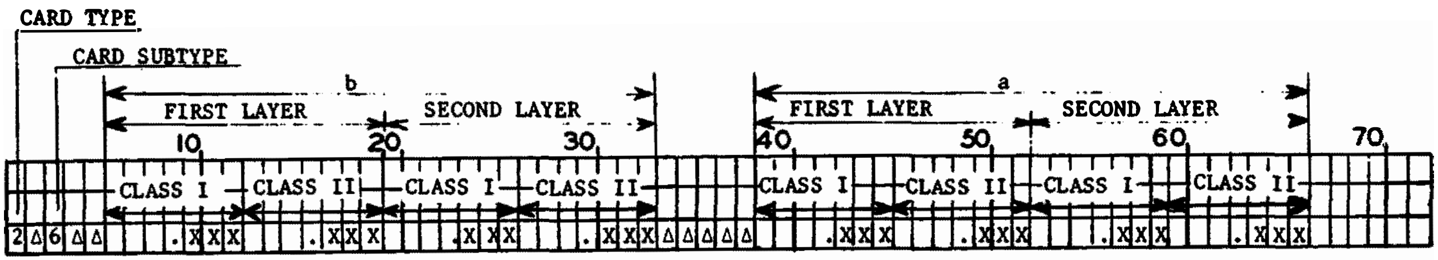
Fig. C10. Type 2-4 Card - Strength Equation Constants



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

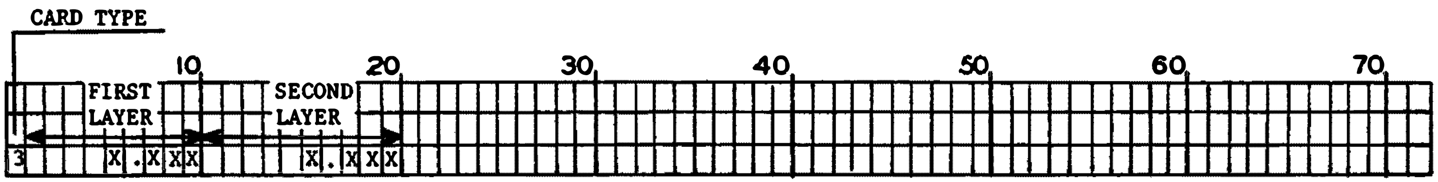
Fig. C11. Type 2-5 Card - Codes for Equations used in Calculating Strength Equation Constants



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

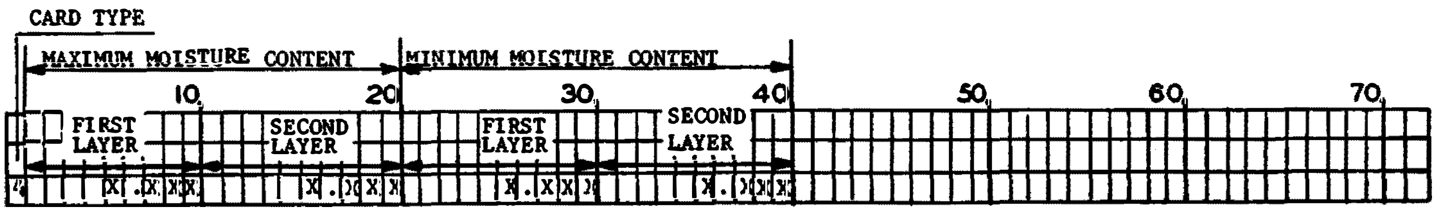
Fig. C12. Type 2-6 Card - New Accretion Equation Constants



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)

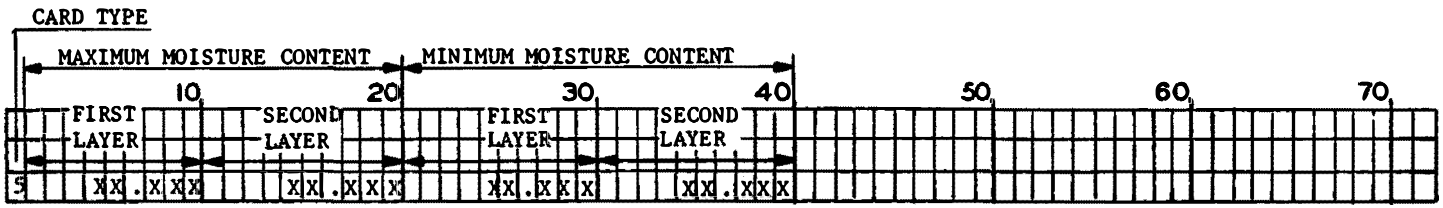
Fig. C13. Type 3 Card - Beginning Soil Moisture Content



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)

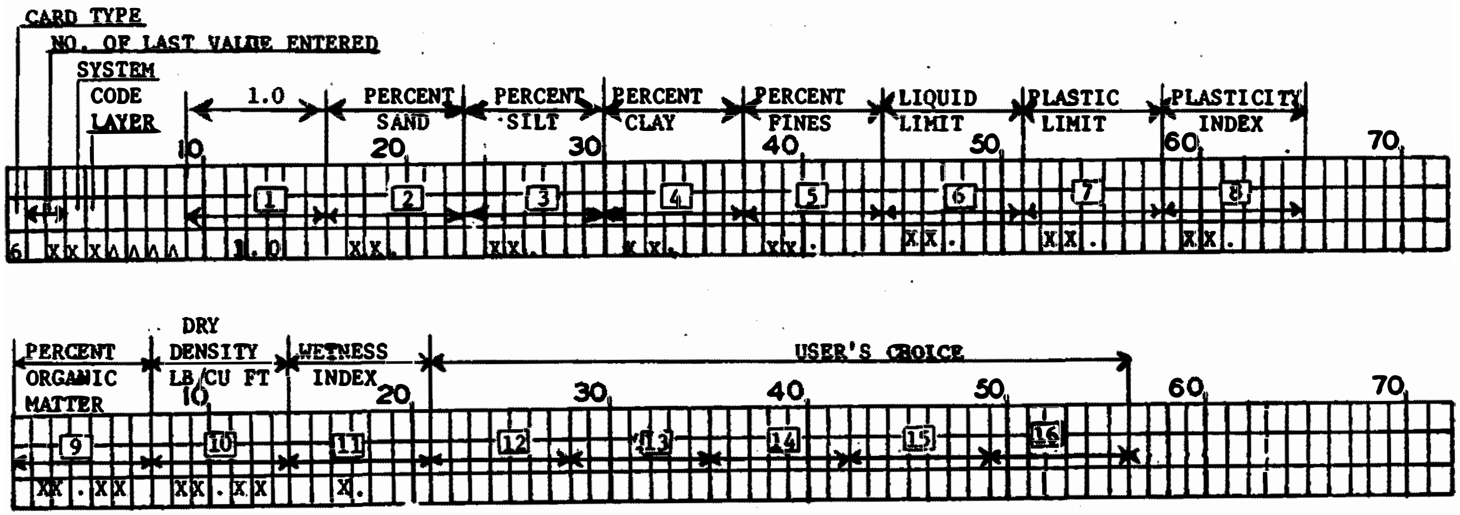
Fig. C14. Type 4 Card - Maximum and Minimum Soil Moisture Contents in Measurement Unit



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 ln 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.

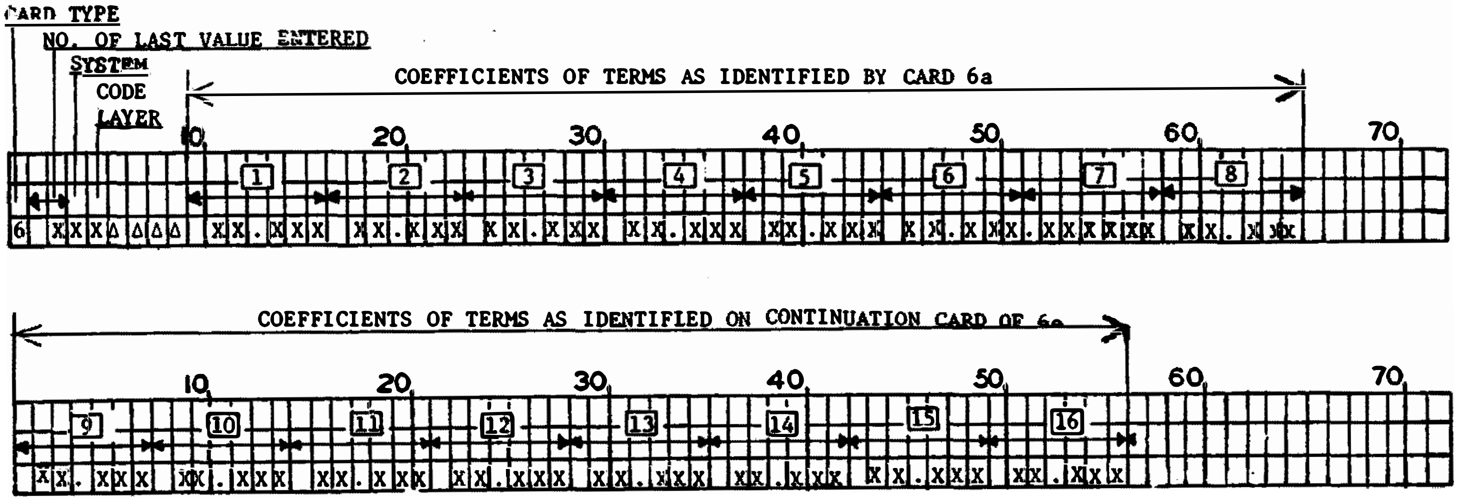
A zero must be entered for properties not included in the equation up to the last property value in the equation (see the control input for table E11 in Appendix E).

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)



(CONTINUATION CARD)

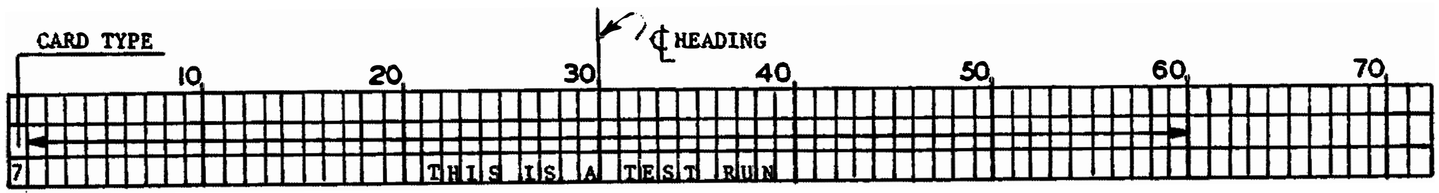
This type card is required only if user is estimating maximum and minimum moisture contents using soil property values entered on type 6a cards. The decimal point must be included in the space reserved for constant or coefficient as indicated. Cards of this type must be preceded by type 6a cards. The 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

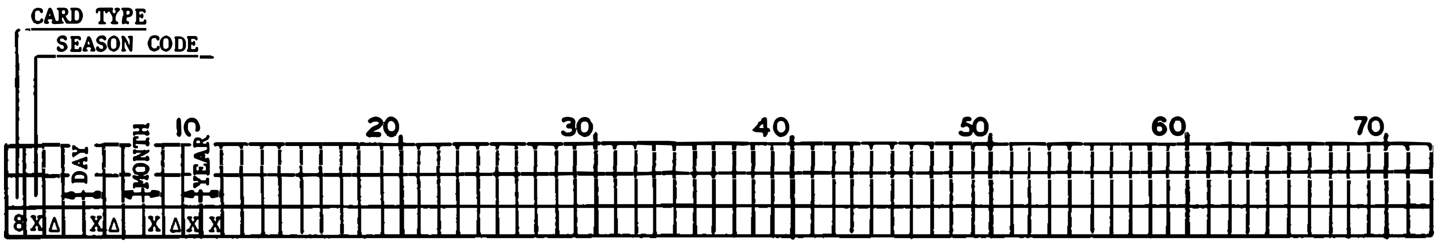
COLUMN	CONTENTS
(First Card)	
1	6
2-3	Number of the last coefficient entered as prescribed by the order on the layout above.
4	Code for soil classification system 1. USCS 2. USDA
5	Code for maximum or minimum equation 1. Maximum for layer 1 2. Maximum for layer 2 3. Minimum for layer 1 4. Minimum for 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.

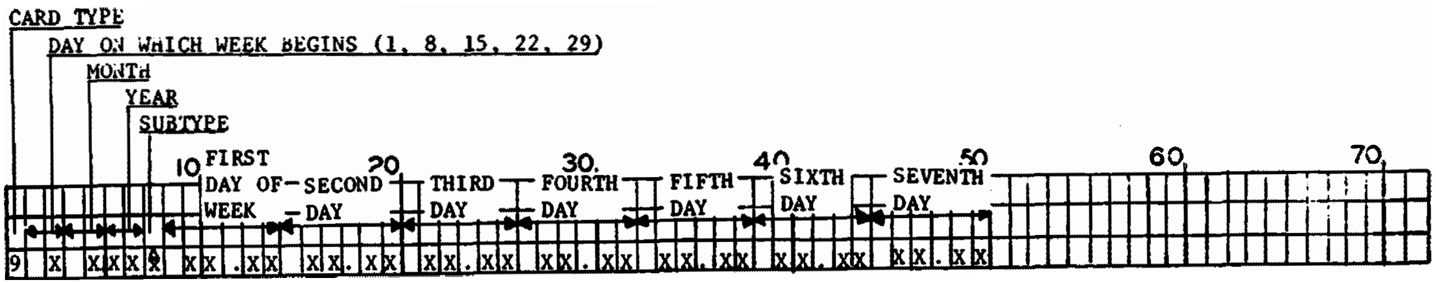
Fig. C17. Type 7 Card - Heading Information



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:

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

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  0.181008 -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
```

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 0.0999868 -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
```

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 -.0171618   .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
```

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
```

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,-.153208,-.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 .690143,1.522175,.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
	VARIABLE MOD. CODE	00310	0,0,0,1,3,1,1,0,0,0,0,0
RCI 2	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	-0.154484,0,0,0,0,2.343072,0.023354,-0.004483,0,0,0,0
	200	00360	0.106906,0,0,0,0,1.871078,0.030243,-0.004197,0,0,0,0
	VARIABLE MOD. CODE	00370	0,0,0,0,3,1,0,0,0,0,0,0
RCI 4	100	00380	0.783718,0,0,0,0,1.498687,0.026353,0,0,0,0,0
	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,-0.002109,2.441123,0.0306323,-0.005442,0,
		00415	0.003741,0,0
	200	00420	-0.685705,0,0,0,0.001227,1.830027,0.042095,-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	$\ln CI = 10.72 \ln MC - 1.64$	$\ln RCI = 23.864 \ln MC - 5.815$

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

<u>Example 1, Teletype Input</u>

```
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
```

```
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
```

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	0.96	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	24.33	24.00	23.66	25.58	25.28	24.97	24.66
22-28	25.82	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
```

```
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 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
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
```

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
```

```
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
```

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.[illegible]6	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.[illegible]8	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	165.	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	750.	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
```

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
```

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]	1.33	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]	[illegible]	-6.90	23.95	21.57
30	[illegible]	0.00	-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.

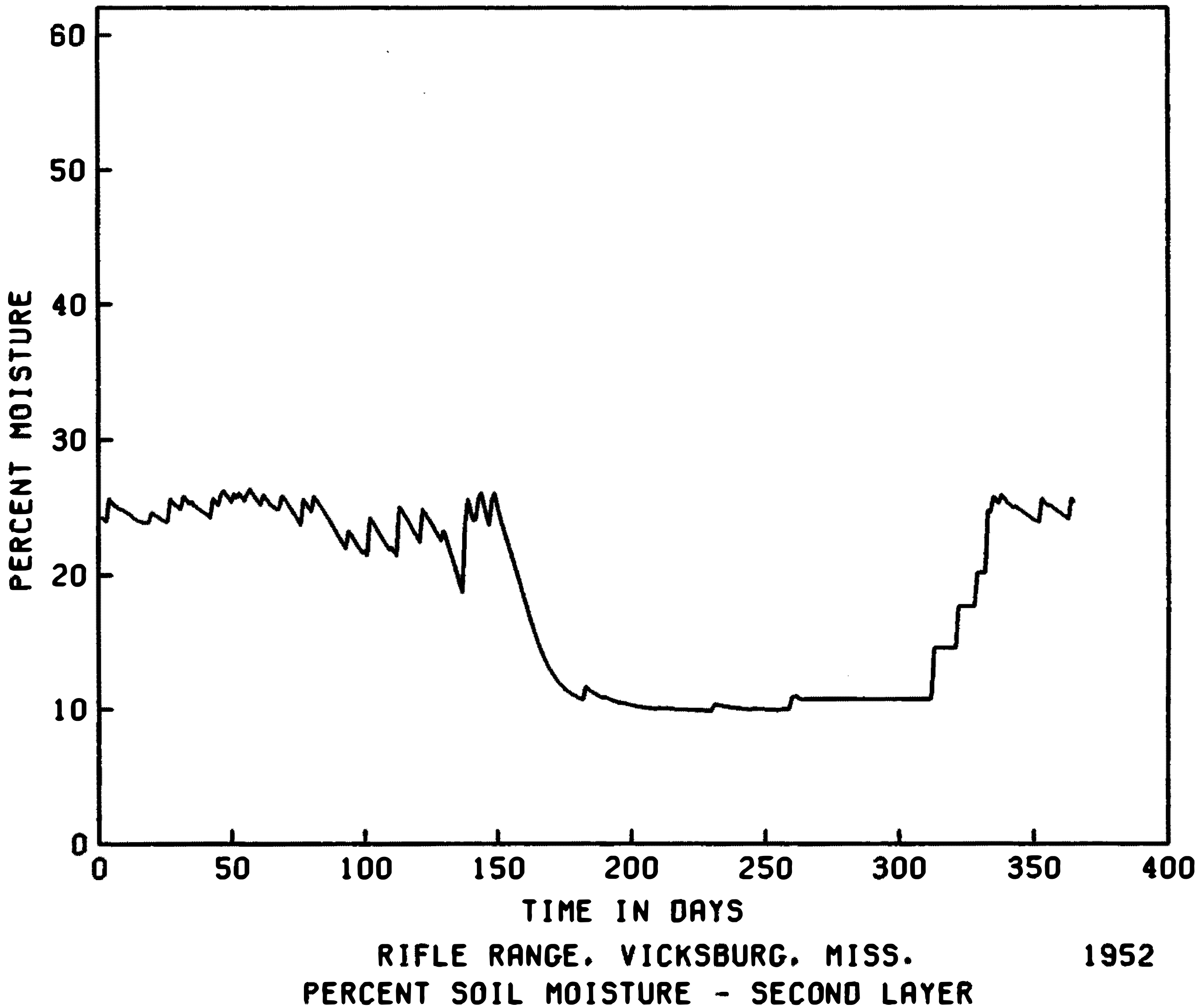


Fig. F1. Predicted soil moisture content for Example 1, Appendix E

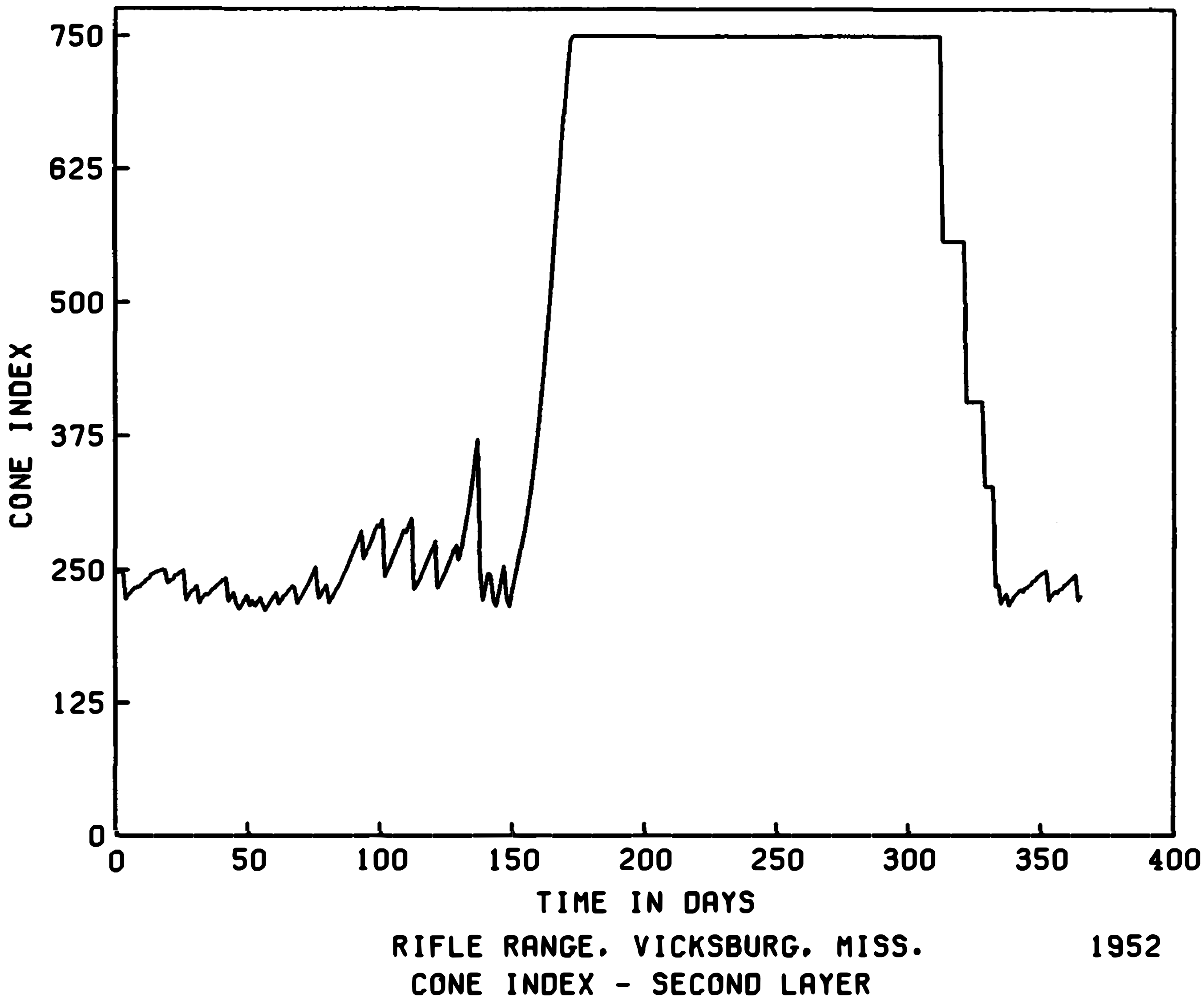


Fig. F2. Predicted CI for Example 1, Appendix E

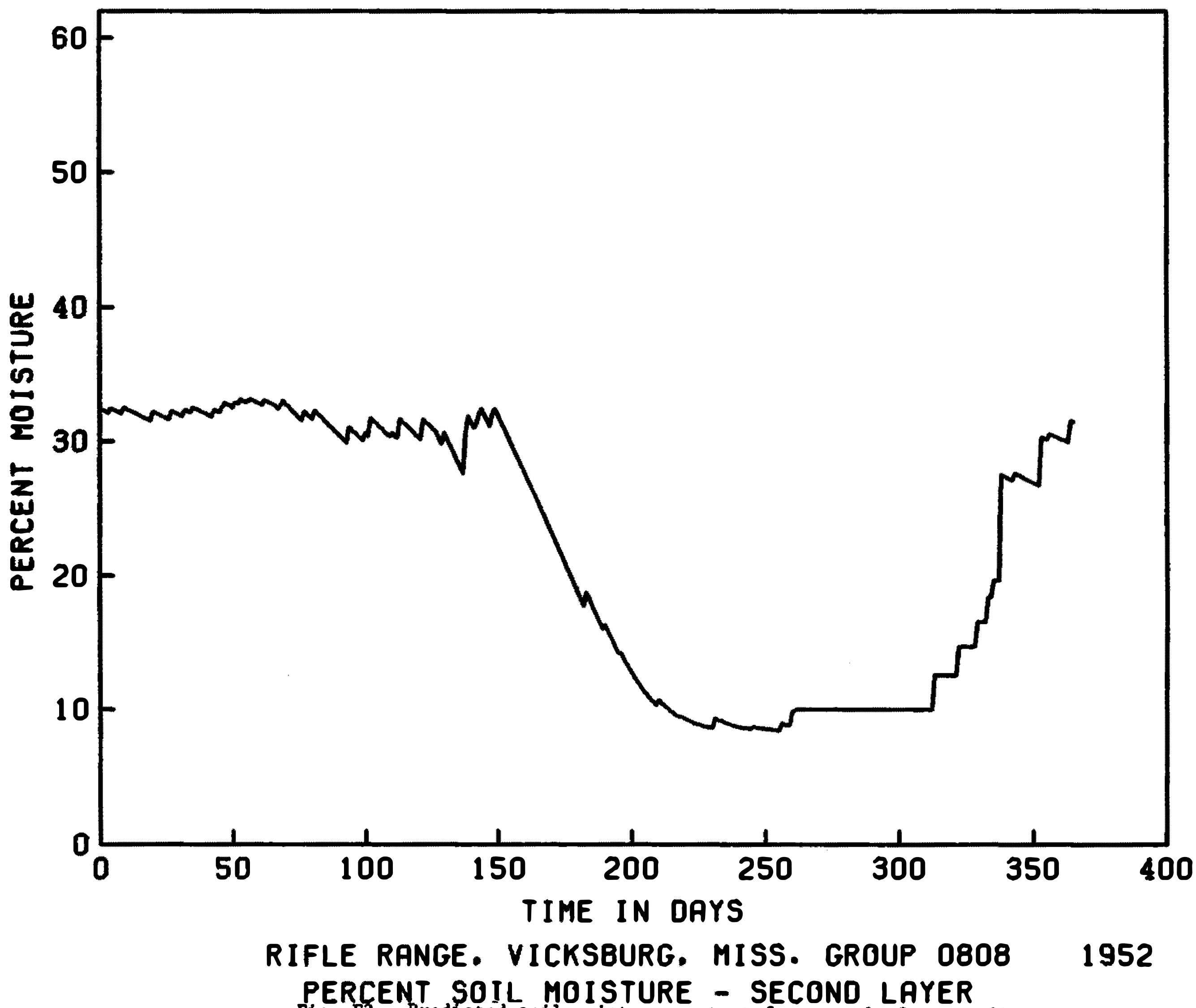


Fig. F3. Predicted soil moisture content for Example 2, Appendix E

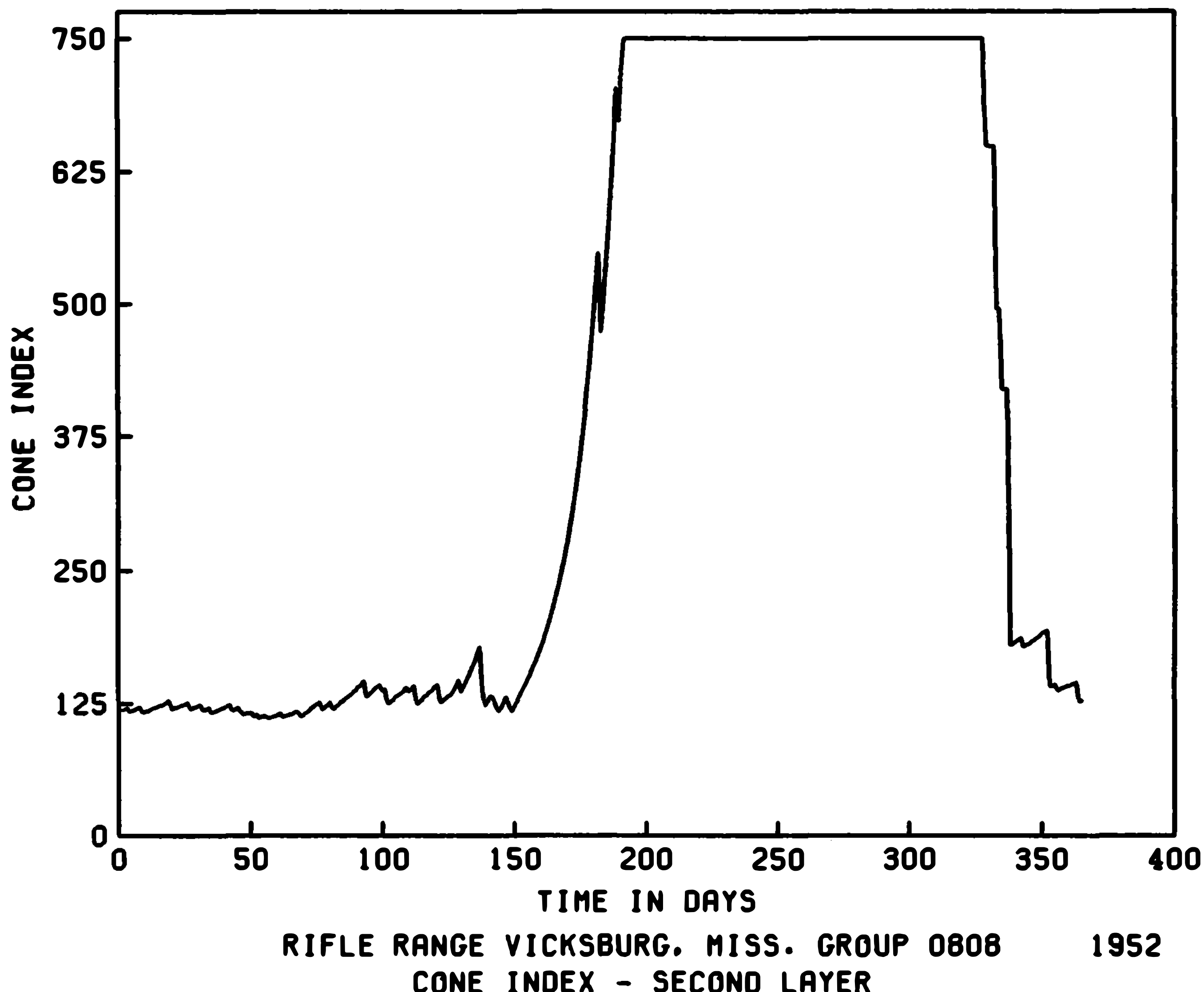


Fig. F4. Predicted CI for Example 2, Appendix E

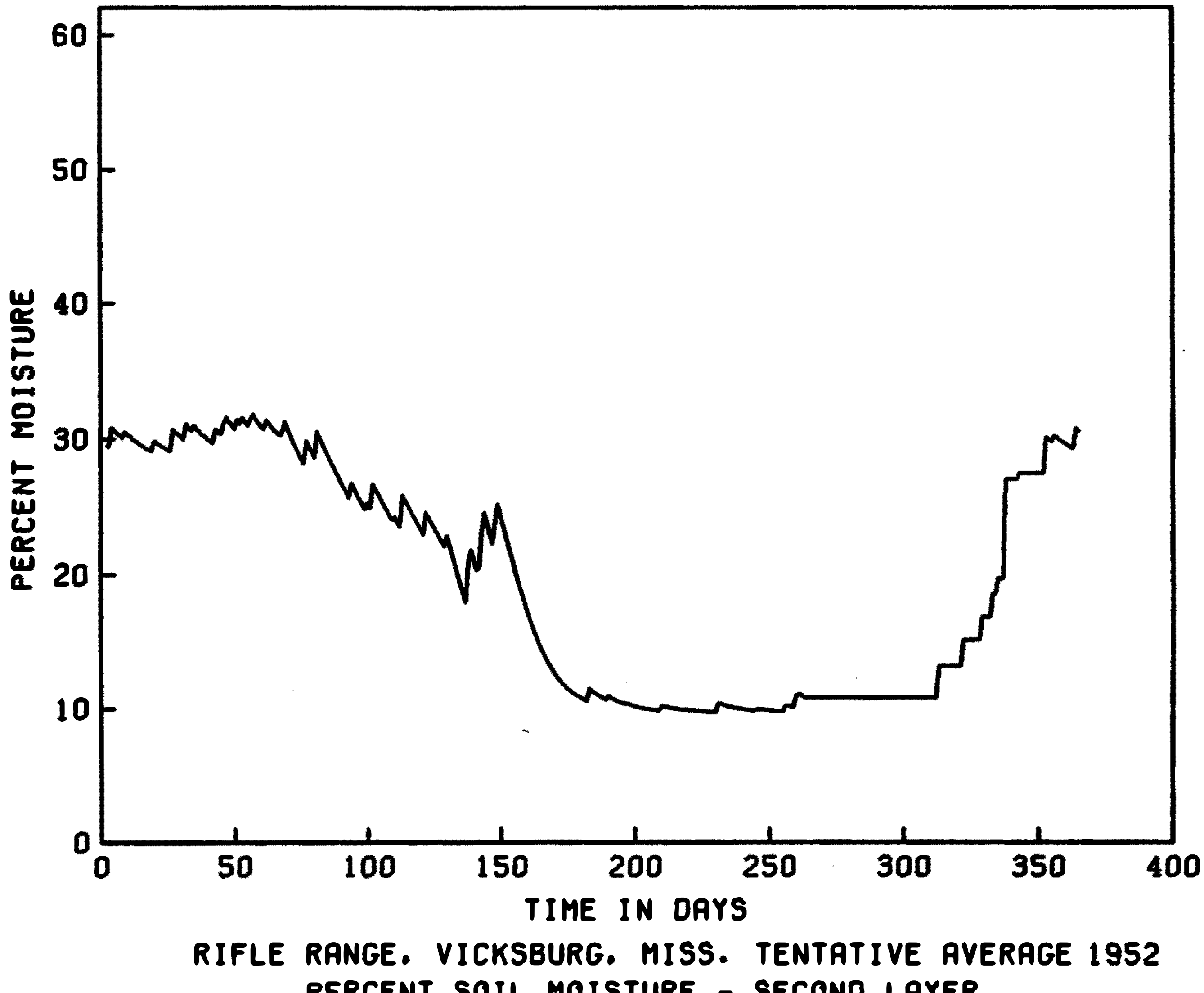
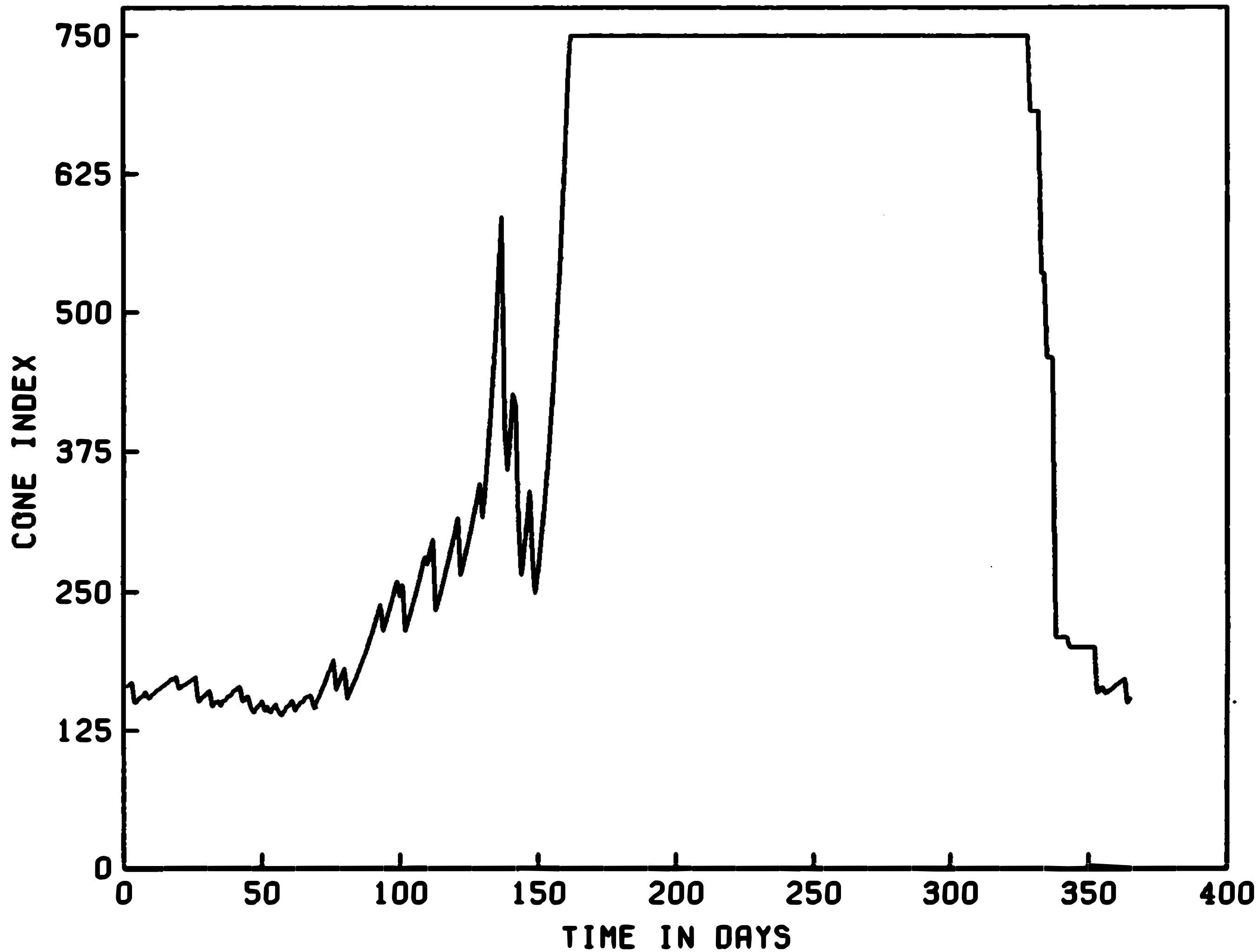
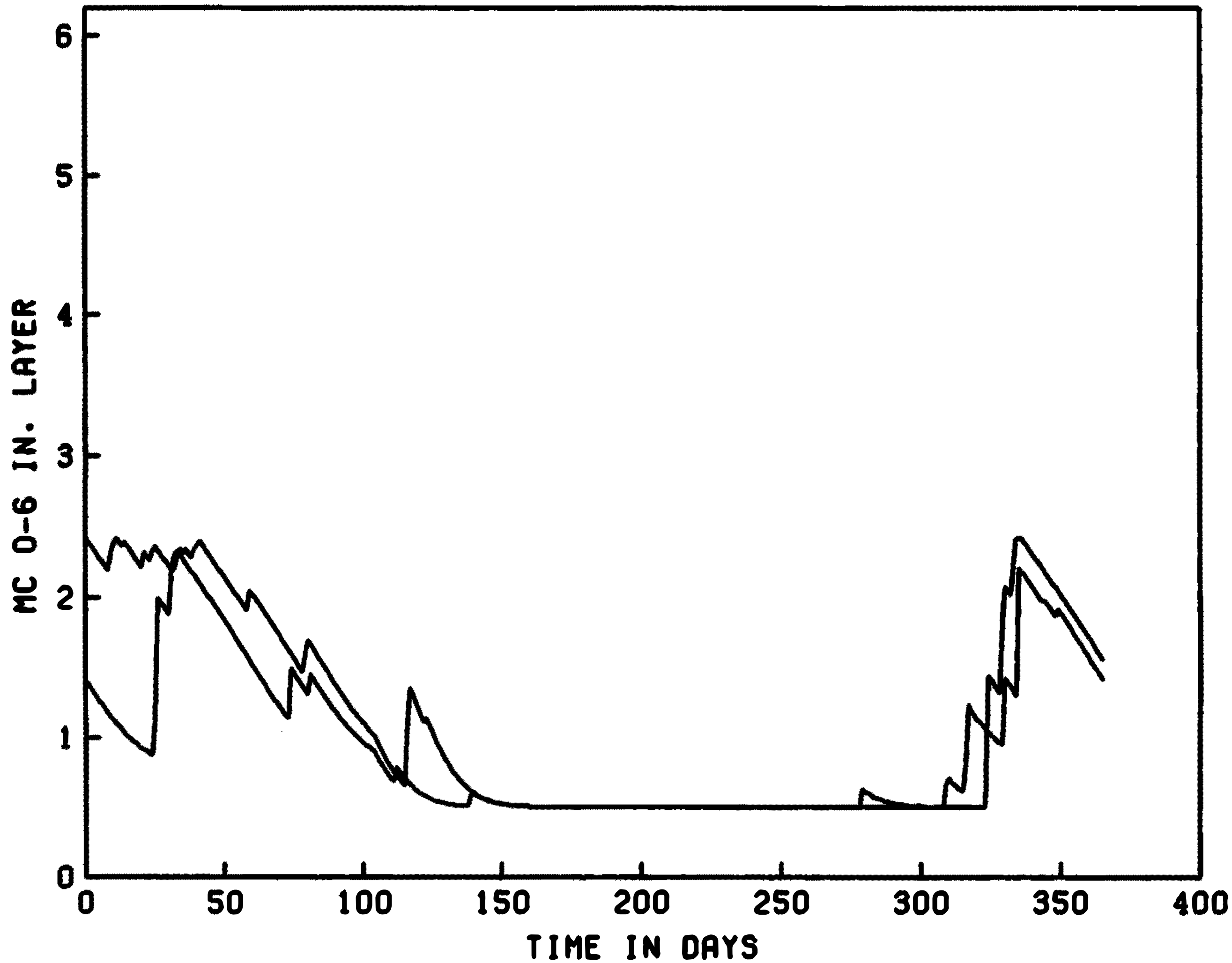


Fig. F5. Predicted soil moisture content for Example 3, Appendix E



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:   48.,   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 102,LAB1
 PRINT,+,"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 104,LAB3
 104 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"
```

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(1,10) (DUM(NN),NN=1,9)
10 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(1,10)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
188 NI=NI+MAXD(L)
189 L=L+1
190 CONTINUE
READ(1,10)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
70 CALL PLOT(0.,12.,-3)
GO TO 82
80 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
```

Table F1 (concluded)

Program Listing for Graphic Display of Results

```
      CALL PLOT(X(I),Y(I),IPEN)
      IPEN=3
      GO TO 50
   95 IPEN=3
      GO TO 50
   50 CALL PLOT(X(I),Y(I),IPEN)
      IPEN=2
   90 CONTINUE
      IF(N.EQ.NPL) GO TO 99
      N=N+1
  200 CONTINUE
   99 CALL PLOT(0.,0.,3)
      CALL PLOT(0.,0.,999)
      STOP
      END
```

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
```

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
```

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:

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

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
$\geq$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.

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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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