NOTA 1500 II

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COMPUTER PROGRAM "CAPSEV" TO CALCULATE:
I. SOIL HYDRAULIC CONDUCTIVITY FROM GRAIN SIZE DISTRIBUTION
II. STEADY STATE WATER FLOW IN LAYERED SOIL PROFILES

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C O N T E N T S

I N T R O D U C T I O N

Program "CAPSEV" calculates soil hydraulic conductivity from soil texture and organic matter content according to the method described by BLOEMEN(1980a).

Knowing the hydraulic conductivity the program calculates steady state water flow in a heterogeneous soil in which the groundwater table is present. The flow may be in either upward direction, capillary rise, or in downward direction, infiltration.

In addition to the hydraulic conductivity function of BLOEMEN(1980a) some alternative functions to describe the hydraulic conductivity can be applied in the program.

The program "CAPSEV" is a fully interactive program. Examples of input and output are given.

1. C A L C U L A T I O N O F K(h) R E L A T I O N S H I P F R O M T E X T U R E A N D O R G A N I C M A T T E R C O N T E N T

1.1. Hydraulic conductivity relationship

BLOEMEN (1980a: Fig.9, eq.17) modified the Brooks and Corey expression in order to account for hysteresis. He obtained the following hydraulic conductivity scanning function (see Fig.1, line s):

$$K = K_e \qquad \text{for} \qquad h >= h_w \qquad (1)$$

$$K = K_e \left[\frac{h_w}{h} \right]^{n_s} \qquad \text{for} \qquad h < h_w \qquad (2)$$

where

K = hydraulic conductivity [cm.day^{-1}]

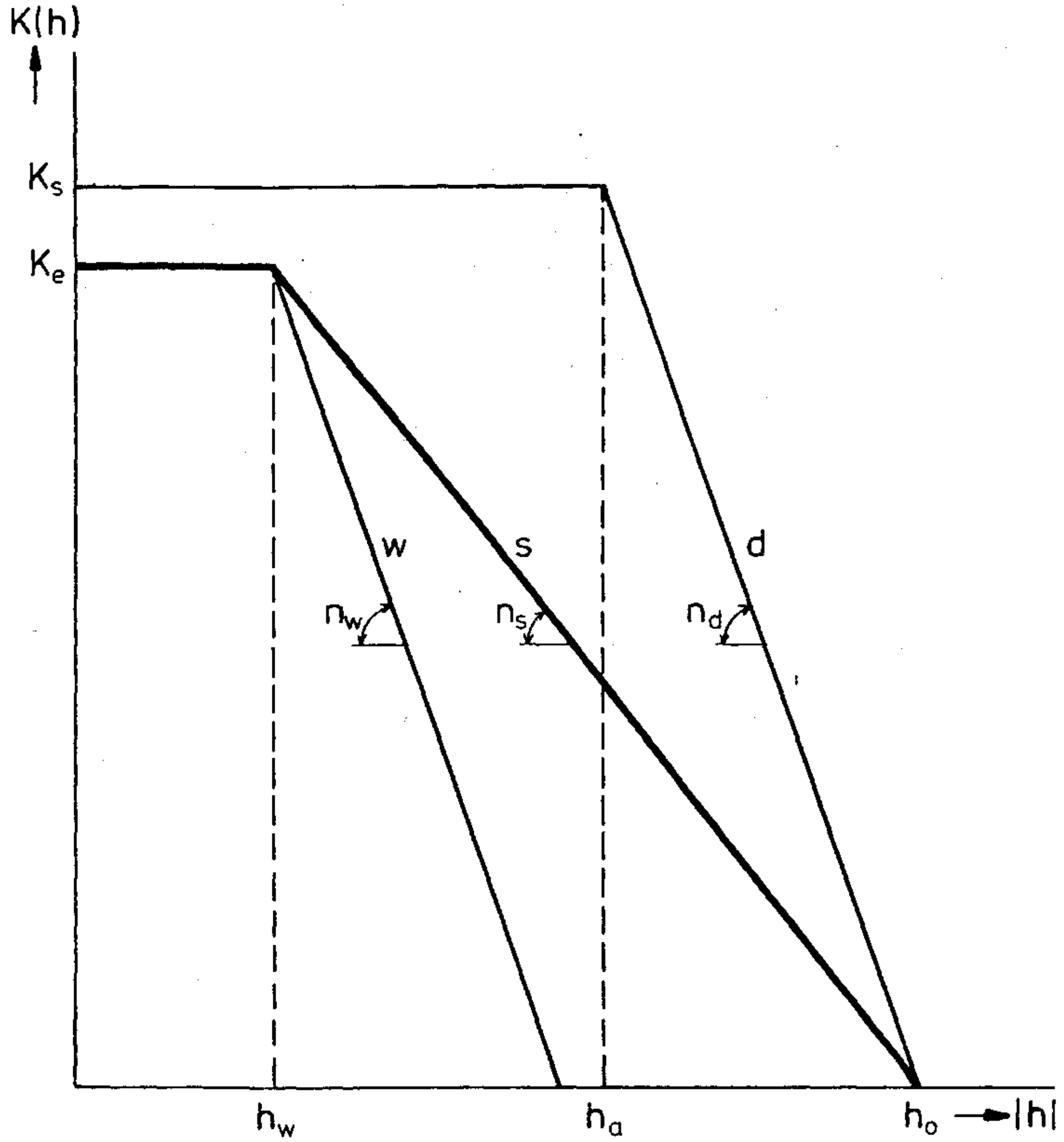


Fig. 1. K(h) description according to Bloemen(1980a).

K_e = effective conductivity [$cm.day^{-1}$] attained after rewetting, assuming $K_e = 0.5\ K_s$, where K_s is the saturated conductivity
h = pressure head [cm]
h_w = pressure head [cm] at which K_e is attained after rewetting
n_s = slope of the average scanning curve between wetting and desorption

According to BLOEMEN (1980a) the eqs. (1) and (2) can in terms of the desorption curve (fig. 1,line d) be rewritten as:

$$K = 0.5\ K_s \qquad \text{for} \qquad h >= h_a \qquad (3)$$

$$K = 0.5\ K_s \left[\frac{h_a/r}{h} \right]^{n_s} \qquad \text{for} \qquad h < h_a \qquad (4)$$

in which
K_s = saturated conductivity [$cm.day^{-1}$]
h_a = pressure head [cm] at air entry point
r = factor to convert h_a into h_w, depending on type of soil, i.e. $r = h_a/h_w$
n_s = slope of the scanning curve (Fig.1, line s)

The expression for n_s is (BLOEMEN, 1980a, eq. 22):

$$n_s = \frac{\log_{10}\left[2\left(\frac{h_a}{h_0}\right)^{n_d}\right]}{\log_{10}\left[\frac{h_a/r}{h_0}\right]} \qquad (5)$$

where

h_0 = pressure head [cm] at which K becomes negligibly small (see Fig. 1)

n_d = slope of the desorption curve, Fig.1, line d

It will now be explained how the parameters K_s, h_a, r, h_0 and n_d can be found.

1.2 Computation of parameters of the hydraulic conductivity function from grain size distribution and organic matter content

BLOEMEN(1980a), BLOEMEN and VAN GILS(1982) described a method to calculate hydraulic conductivity as a function of the soil texture (grain size distribution) and organic matter content.

For applying the method three categories of soils are distinguished:

- Mineral soils: grain size distribution and organic matter content are required.

- Fen peat: only bulk density is required.

- High bog peat: only bulk density is required.

Grain size distribution data, are given either as percentages or fractions of the total amount of grains. For an example see Table 1.

Table 1. Example of the grain size distribution and humus content of a marine clay soil consisting of five different layers.

Description	Thick. (CM)	Hum. %	S - values in microns 2.	16.	50.	75.	105.	150.	210.
Sandy clay	15.0	5.4	19.2	11.3	43.8	12.6	9.4	2.6	1.2
Heavy clay	35.0	3.7	50.0	23.9	21.5	2.3	1.3	0.5	0.5
Peat	25.0		FEN PEAT, BULK DENSITY= 0.24 G . CM**-3						
Clayey sand	75.0	0.8	6.6	2.7	13.9	38.1	34.9	3.7	0.1
Sand	150.0	0.6	3.3	2.6	11.9	19.8	27.7	27.4	6.7

The grain size distribution index, f, is defined as:

$$f = \frac{\sum_{i=2}^{n} f_i}{\sum_{i=2}^{n} (P_i - P_{i-1})} \qquad (6)$$

where

$$f_i = (P_i - P_{i-1}) \frac{\log(P_i / P_{i-1})}{\log(S_i / S_{i-1})} \qquad (7)$$

in which

P_i = cumulative weight percentage

S_i = size interval limit [mu]

The saturated conductivity, K_s, can be found from the following equations:

for mineral soils:

$$K_s = 0.02\ M_d^{1.93}\ f^{-0.74} \qquad [cm.day^{-1}] \qquad (8)$$

for fen peat:

$$K_s = 0.00266\ g_b^{-3.625} \qquad [cm.day^{-1}] \qquad (9)$$

for high bog peat:

$$K_s = 0.0036\ g_b^{-2.83} \qquad [cm.day^{-1}] \qquad (10)$$

where M_d is the median grain size [mu], (Note: M_d differs from M_{50})

g_b is the dry bulk density $[g.cm^{-3}]$

The value of h_a is calculated according to:

for mineral soils:

$$h_a = -2914\ M_d^{-0.96}\ f^{0.79} \qquad [cm] \qquad (11)$$

for fen peat:

$$h_a = -416\ g_b^{1.12} \qquad [cm] \qquad (12)$$

for high bog peat:

$$h_a = -794\ g_b^{1.17} \qquad [cm] \qquad (13)$$

The value of the reduction factor r is depending only on the type of soil:

$r = 4.5$ for sandy soils with $M_d > 50$

$r = 2.9$ for clayey soils with $M_d <= 50$

$r = 3.1$ for fen peat

$r = 1.9$ for high bog peat with $g_b < 0.1\ g.cm^{-3}$

$r = 3.4$ for high bog peat with $g_b >= 0.1\ g.cm^{-3}$

The value of h_0 can be found from the grain size distribution factor f and the median grain size M_d. To find a general relation between h_0, f and M_d, a large amount of soil profiles from the archives of the Soil Survey Institute in Wageningen was investigated. On the base of an iterative method, starting from initially assumed values of h_0 (BLOEMEN and VAN GILS,1982, section 2.10), relationships between h_0, f and M_d were found. The results of these calculations are presented in fig. 2.

The slope n_d of the desorption curve can be calculated according to:

for mineral soils:

$$n_d = 1.41 + 4.536\ (e^{0.3\ f} - 1) - 0.75\ f^{1.6}\ \log M \qquad (14)$$

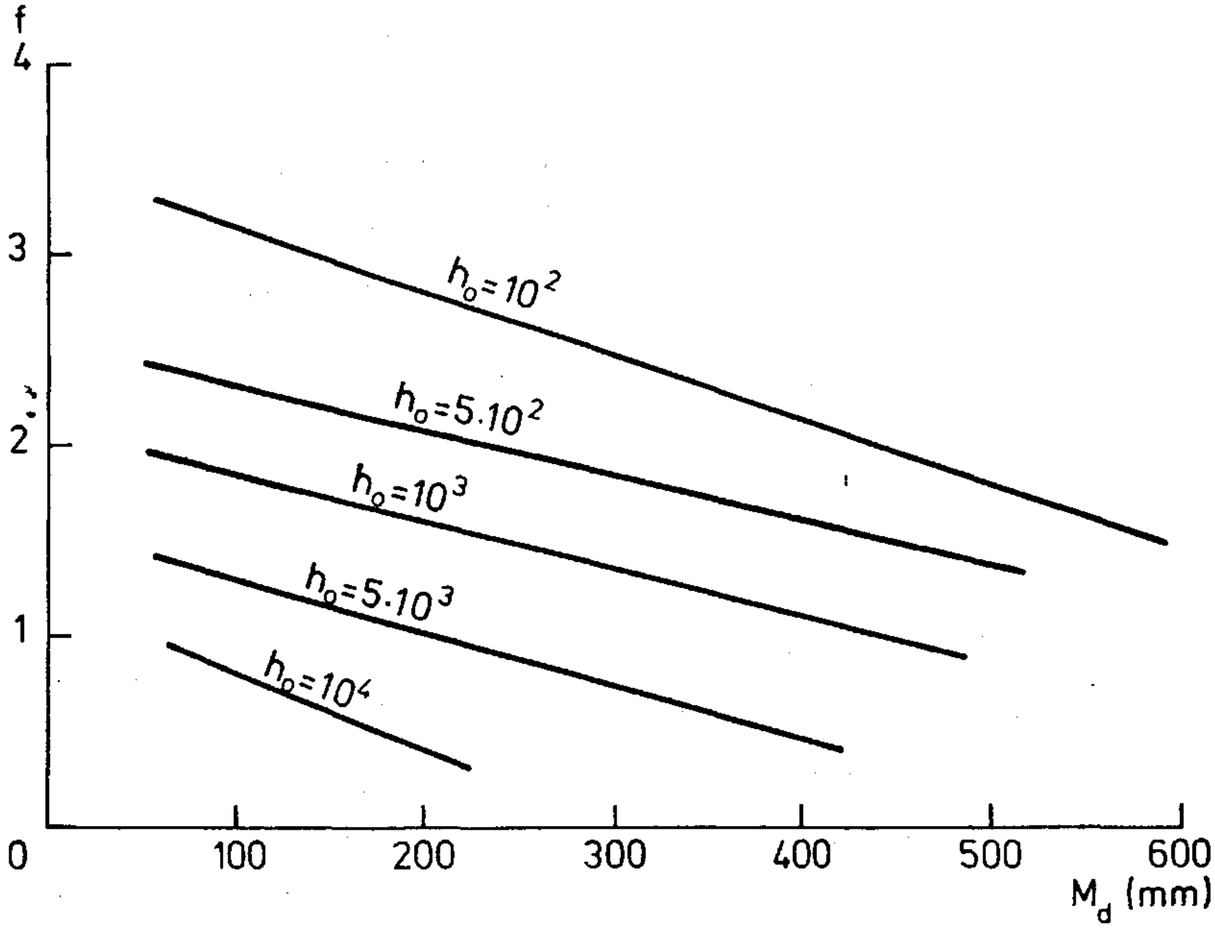


Fig. 2. Values of h_0 of existing combinations of M_d and f. It is assumed that the M_d-values given for the lines are valid for the entire area between two lines.

for fen peat:

$$n_d = 2.54 - 2.42\, g_b \qquad (15)$$

for high bog peat:

$$n_d = 2.57 - 2.27\, g_b \qquad (16)$$

in which H is the humus content of the soil [%].

If in a layer horizontal cracking occurs, the following corrections should be made on the values of h_a/r and n_s (BLOEMEN,1980a,b; BLOEMEN and VAN GILS, 1982):

$$\frac{h_a}{r} = 100 * \left[0.01 \frac{h_a}{r} \right]^{\left(\frac{n_s}{n_s + 1.7}\right)} \qquad \text{for} \quad \frac{h_a}{r} > -100 \qquad (17)$$

$$n_s = n_s + 1.7 \qquad (18)$$

2. STEADY STATE SOIL WATER FLOW

Steady state soil moisture flow in a 1-dimensional, vertical, soil profile is governed by Darcy's equation:

$$q = -K(h) \left(\frac{dh}{dz} + 1 \right) \qquad (19)$$

where

q = soil moisture flux density [cm^3. cm^{-2}. day^{-1}]

z = vertical coordinate with origin at the soil surface, directed positive upward [cm]

Rearranging eq.(19) yields:

$$\frac{dz}{dh} = \frac{-1}{1+q/K(h)} \qquad (20)$$

Integration of eq.(20) for a soil profile consisting of m layers starting at the groundwater table, where h=0, results in:

$$\int_{z_1}^{z_m} z = -\int_{0}^{h_1} \frac{dh}{1 + q/K_1(h)} - \int_{h_1}^{h_2} \frac{dh}{1 + q/K_2(h)} - \ldots - \int_{h_{m-1}}^{h_m} \frac{dh}{1 + q/K_m(h)} \qquad (21)$$

where $h_1, h_2, \ldots, h_m$ are the pressure heads corresponding to the boundaries between the neighbouring layers, $z_1, z_2, \ldots, z_m$. The values of h_1, h_2, etc. are initially not known but must be determined during the integration procedure. Thus starting from zero-values of z and h at the water table, h is steadily decreased until z reaches z_i, the known height of the i-th boundary: the value h_i is thus found, when $z=z_i$ and since the pressure head is continuous across the boundary, h_i is the lower limit of the (i+1)-th term of integration. In this way the integration may proceed until the last value h_m is reached or capillary rise reaches the soil surface.

Discretizing the integration interval into y subintervals of equal size ('delta' h), eq. (21) becomes :

$$z = \sum_{i=1}^{y} \frac{\text{'delta' } h}{\left[1 + \dfrac{q}{K(h_{av})} \right]} \tag{22}$$

where h_i and h_{i+1} are lower and upper boundary of the ith interval and

$h_{av} = (h_i + h_{i+1})/2.$

In case of infiltration, eq. (22) may cause problems because of the possibility that the term q/K(h) may be smaller than -1, thus yielding a decreasing z, which is physically impossible. Therefore we use for infiltration a different approximation.

Rearranging eq. (19) to:

$$dh = -\ (1 + q/k(h))\ dz \tag{23}$$

or

$$h_2 = h_1 - (z_2 - z_1)\ (1 + q/k(h')) \tag{24}$$

where $h' = (h_1 + h_2)/2$

This means that, starting from the groundwater level, where z=0 and h=0, the pressure head at some height z_2 may be found according to eq. (24). As this value is not known at the time of calculation, an iterative procedure is used in CAPSEV.

3. ALTERNATIVE FUNCTIONS TO DESCRIBE THE K(h) RELATIONSHIP

Besides the K(h) relationship given by BLOEMEN (1980a) other expressions may be used, which are described below.

3.1 The first alternative is the description according to Brooks and Corey as given in eqs. 1 and 2.

3.2 The second alternative used in CAPSEV is the approach of RYTEMA(1965):

$$K = K_s \qquad \text{for} \qquad h >= h_a \qquad (25)$$

$$K = K_s . e^{- b (h_a - h)} \qquad \text{for} \qquad h_{lim} <= h < h_a \qquad (26)$$

$$K = a.(-h)^{-n} \qquad \text{for} \qquad h < h_{lim} \qquad (27)$$

where

K_s = saturated hydraulic conductivty [$cm.day^{-1}$]

h_a = pressure head at air entry point [cm]

h_{lim} = some arbitrary pressure head limiting the validity of the conductivity function [cm]

a,b,n = constants

An example of this approach is given in fig. 3.

3.3 The third alternative has been described by WESSELING (1981) who approached the K(h) relationship by three straight line pieces on a log-log scale. Each line piece is described by the following equation:

$$K = a (-h)^b \qquad (28)$$

where a and b are constants.
For an illustration see Fig. 4.

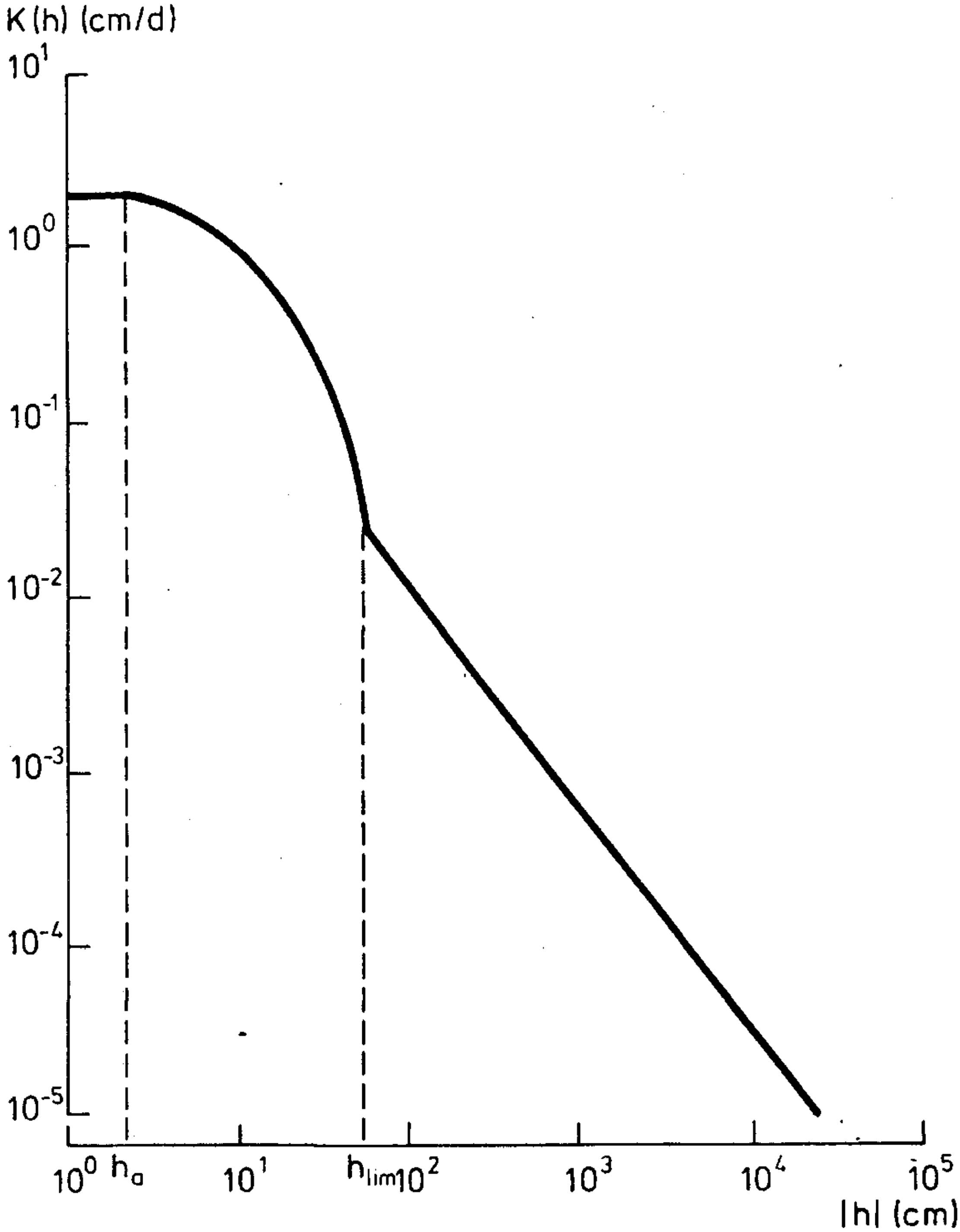


Fig. 3. K(h) description according to Rytema(1965).

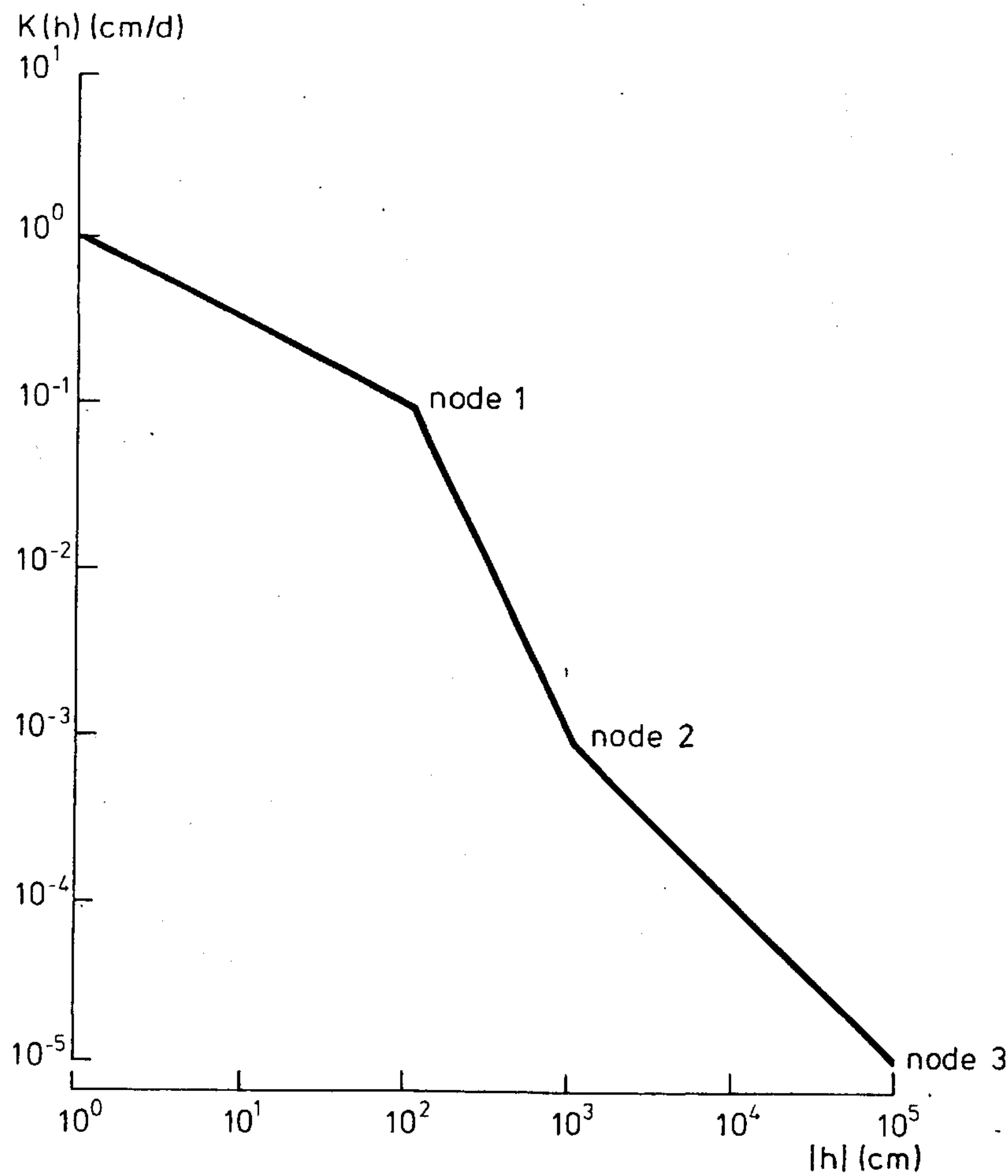


Fig. 4. **Approximation of the K(h) relationship by three power functions.**

3.4 The last alternative is the description of K as a table of h. This alternative can easily be used to enter measured K(h) data. The step size of the table can be chosen freely. The program "CAPSEV" asks for the type of interpolation for values in between the prescribed values. This can be either linear or (double) logarithmic. The K-data in the table should be in ascending order.
An example of such a table is given in Table 2.

Table 2. Example of a K(h) relation given as a table (Pucniew sand; after BRANDYK(1981)). h is given as an absolute value.

K (cm/d)	|h| (cm)	K (cm/d)	|h| (cm)	K (cm/d)	|h| (cm)
0.1796E-11	0.1000E+07	0.4187E-01	0.7900E+02	0.2794E+01	0.3100E+02
0.3700E-09	0.1000E+06	0.7456E-01	0.7300E+02	0.3549E+01	0.2700E+02
0.2558E-07	0.1500E+05	0.1223E+00	0.6800E+02	0.4519E+01	0.2200E+02
0.2461E-06	0.7000E+04	0.1892E+00	0.6300E+02	0.5830E+01	0.1700E+02
0.1753E-05	0.3000E+04	0.2799E+00	0.5900E+02	0.7923E+01	0.1000E+02
0.1834E-04	0.9000E+03	0.3999E+00	0.5500E+02	0.1135E+02	0.9000E+01
0.8563E-04	0.6500E+03	0.5557E+00	0.5100E+02	0.1654E+02	0.8000E+01
0.2867E-03	0.4200E+03	0.7551E+00	0.4800E+02	0.2412E+02	0.7000E+01
0.8659E-03	0.2600E+03	0.1006E+01	0.4500E+02	0.3572E+02	0.5000E+01
0.2894E-02	0.1300E+03	0.1320E+01	0.4200E+02	0.6019E+02	0.2500E+01
0.8715E-02	0.9400E+02	0.1709E+01	0.3800E+02	0.1589E+03	0.0010E+00
0.2089E-01	0.8600E+02	0.2193E+01	0.3500E+02		

4. THE PROGRAM

CAPSEV is able to calculate the pressure head distribution (h,z) for both capillary rise and infiltration in a layered soil profile (max. 10 layers). Pressure head distributions can be calculated for several flux densities q and various groundwater levels (max. 10).
It is also possible to calculate maximally possible capillary fluxes for a number of groundwater levels.
The output of the program is directed to a file called MOIST.OUT, which may be sent to a line printer.

The program CAPSEV consists of the following parts:

- main program
  CAPSEV

- subroutine to show possible commands
  HELP

- subroutines to read soil characteristics
  GRNINP
  LININP
  BRCINP
  TABINP
  RYTINP

- subroutines to compute variables from grain size distribution
  GRAIN
  CALCUL
  COMPHO

- subroutines used in calculations of pressure head distribution
  CAPTOT
  MAXFLX
  INTEGR
  CAPQUE
  FLXQUE
  CAPRIS
  CAPINF
  CONDUC

- subroutines for output
  TABINF
  TABEL

Now a short description of all the program parts is given.

CAPSEV : The main program welcomes the user and reads the commands (variable COMAND), after which it calls the appropriate subroutines.

HELP: Consists of only 1 write statement, resulting in a list of possible commands on the users terminal.

GRNINP: Performs the data input that is required to calculate the parameters of the hydraulic conductivity function from grain size distribution. There are 2 possible ways of input:
  a) From a terminal. In this way the program will ask the user to type in the data it requires.
  b) From a disk file with data prepared according to the questions that would be asked if method a) was chosen.

Which way of input will be chosen depends on the answers to questions that will be asked.
For the grain size classes:
-the valus of the grain sizes between which the distribution must be known, may be typed in or
-the following standard set may be chosen:
2, 16, 50, 75, 105, 150, 210, 300, and 2000 mu.
Maximally 15 grain size classes may be entered.

GRAIN: Used to call the subroutines performing calculations on the soil texture data.

CALCUL: Computes the parameters of the conductivity function according to eqs. 3 to 18.

COMPHO: Assigns values to r and h_0.

CAPTOT: Controls the calculations of pressure head distribution. It reads the required depths of groundwaterlevel from either terminal or file, and checks if the flux densities are positive or negative. A choice has to be made between two alternative ways to prepare the output :

(1) For each groundwater level tables and printplots are prepared ; height of capillary rise versus height above the groundwaterlevel in case of capillary rise, and pressure heads versus height above the groundwaterlevel in case of infiltration.
(2) A table is prepared of maximum capillary flux densities versus depth of the groundwater level for a specified pressure head, a printplot is optional.

MAXFLX: Performs calculations to find the maximally possible flux and creates an output table and (optionally) a printplot.

INTEGR: Function INTEGR performs the numerical integration and checks if a certain flux reaches a given level (e.g. the surface).

CAPQUE: Inquires which conductivity description function should be used. The answer is read into the variable METHOD, which may have one of the following values:

1 : Modified Brooks and Corey (eqs.1,2)
2 : Bloemen (eqs.3,4)
3 : Rijtema (eqs.25,26,27)
4 : Wesseling (eq. 28)
5 : Table

FLXQUE: Reads the flux densities for which the calculations should be

performed. It is possible to use one or both of the following 'standard' sets of flux densities:
a) for infiltration: -0.5, -0.3, -0.2, -0.1, -0.05, 0.0,
b) for capillary rise: 0.0, 0.05, 0.1, 0.2, 0.3 and 0.5 cm/day.
It is also possible to use values read from terminal or data file. A negative flux represents infiltration, a positive flux represents capillary rise. Please keep either a descending or ascending order.

BRCINP: Takes care of the input from terminal or file necessary for the modified Brooks and Corey method.

RYTINP: Reads data required for the K(h) relationship according to Rytema from terminal or file.

LININP: Reads data required for the K(h) relationship according to Wesseling. The K- and h-value of the end points of each line piece are either read from the terminal of from a data file.

TABINP: Reads the data when the K(h) relationship is given as a table. Input is only possible as a file (see example 2).

CAPRIS: Calculates the height of capillary rise z according to eq. (22). The results are stored in the array Z for a range of pressure heads inbetween -1 and -1000000 cm. These pressure heads are divided into the following intervals:

for range	h-interval
-1 to -10^{1}	-1
-10^{1} to -10^{2}	-10^{1}
-10^{2} to -10^{3}	-10^{2}
-10^{3} to -10^{4}	-10^{3}
-10^{4} to -10^{5}	-10^{4}
-10^{5} to -10^{6}	-10^{5}
	Total: 55 h-values

Calculations continue until either the lowest value of h is reached or z reaches the soil surface.

CAPINF: Calculates according to eq. (24) the pressure head distribution in the profile in case of infiltration. In some cases the pressure head may become positive. Then all the pressure heads for the corresponding flux density are set equal to 0. A warning is sent to the users terminal that the flux density as specified is for the soil under consideration physically impossible.

CONDUC: Function CONDUC calculates the unsaturated conductivity.

TABEL: Creates for positive flux densities (upward flow from the groundwater table) a table and printplot of height of capillary rise z as a function of pressure head h.

TABINF: Creates for negative flux densities (downward flow towards the groundwater table) a table and a printplot of pressure head h as a function of z .

The mutual relationship between the sub-programs mentioned is given in Fig. 5.

REMARK : As the calculation of the capillary fluxes is based on the assumption of a steady state situation, it is unrealistic to assume that these fluxes do occur in reality. To calculate the pattern of the fluxes that occur in practice during the growing season, it is necessary to know the sequence of the different pressure heads. The fluxes that occur in reality can therefore differ considerably from those calculated by CAPSEV.
The results from CAPSEV however, may be used to describe the hydrological properties of a profile, and to compare different profiles.

```
CAPSEV --------- HELP
        | | |
        | | --- GRNINP
        | |
        | ----- GRAIN     --------------- CALCUL  ---------- COMPHO
        |
        ------- CAPTOT    --------------- CAPQUE  ---------- BRCINP
                          | | | | | |               | | |
                          | | | | | |               | | --- RYTINP
                          | | | | | |               | |
                          | | | | | |               | ----- LININP
                          | | | | | |               |
                          | | | | | |               ------- TABINP
                          | | | | | |
                          | | | | | --- FLXQUE
                          | | | | |
                          | | | | ----- CAPINF  -------
                          | | | |                      |--- CONDUC
                          | | | ------- CAPRIS  -------
                          | | |
                          | | --------- TABINF
                          | |
                          | ----------- TABEL
                          |
                          ------------- MAXFLX  ---------- INTEGR
```

Fig. 5. Relation between the subprograms of CAPSEV.

5. E x a m p l e s

5.1. Example of input.

CAPSEV is an interactive program with the possibility of reading data from files. As the interactive part of the program is self-explaining, only some examples will be given to show how to create the data files. In the examples a note of exclamation "!" is used to separate the data from some comments that were inserted.

As FORTRAN-77 has the ability of working with wildcards instead of FORMAT-statements, it is not necessary to prepare the input data according to a specific format.

The first example shows a data file that contains the answers to the questions CAPSEV asks when one calculates the parameters of the K(h)-relationship from soil texture and organic matter content.

Example 1. Input prepared for the computation of the K(h) relationship from soil texture and humus content ('Bloemen') of a 5 layer profile.

```
Marine clay                ! Name of soil profile
N                          ! Non-standard grain sizes
2.                         ! First boundary of grain size classes (mu)
16.                        ! Second boundary etc.
50.
75.
105.
150.
210.
X                          ! End of boundaries. Note: max. 15 classes
5                          ! Number of layers in profile
Sandy clay                 ! Description of top layer
15.                        ! Thickness of top layer (cm)
5.4                        ! Humus content of top layer (%), for peat: type P
19.2                       ! Percentage of first grain size class
11.3                       ! Percentage of second class etc.
43.8
12.6
9.4
2.6
1.2
N                          ! No horizontal cracking in this layer
Heavy clay                 ! Second layer
35.
3.7
50.
23.9
21.5
2.3
1.3
0.5
0.5
Y                          ! Horizontal cracking does occur in this layer
Peat                       ! Third layer
25.                        ! Thickness of layer (cm)
P                          ! P for peat
1                          ! 1 for fen peat (2 for high bog peat)
0.24                       ! Bulk density of peat (g/cm**3)
N                          ! No horizontal cracking
Clayey sand                ! Fourth layer
75.
0.8
6.6
```

```
2.7
13.9
38.1
34.9
3.7
0.1
N
Sand                            ! Fifth layer
150.
0.6
3.3
2.6
11.9
19.8
27.7
27.4
6.7
N
```

The second example shows an input file for a 1-layer (homogeneous) profile when the K(h) relation has been given as a table. To save on typing, the h-values are given as positive numbers. The program will make them negative. Note: the sequence of K-values must be ascending, the sequence of h-values must correspond !!

Example 2. The K(h) relationship, given as a table. Input is only possible as a file. When the profile consists of more than one layer, add the data pertaining to these layers to the file. Start with the description of the layer.

```
Pucniew uniform sand                 ! Name of soil profile
Sand                                 ! Description of layer 1
200.                                 ! Thickness of layer 1 (cm)
35                                   ! Number of points in K(h)-table
.1000E+07 .1000E+06 .1500E+05 .7000E+04 .3000E+04 .9000E+03 .6500E+03 .4200E+03
.2600E+03 .1300E+03 .9400E+02 .8600E+02 .7900E+02 .7300E+02 .6800E+02 .6300E+02
.5900E+02 .5500E+02 .5100E+02 .4800E+02 .4500E+02 .4200E+02 .3800E+02 .3500E+02
.3100E+02 .2700E+02 .2200E+02 .1700E+02 .1000E+02 .9000E+01 .8000E+01 .7000E+01
.5000E+01 .2500E+01 .0010E+00        ! (Absolute) values of h (cm)
.1796E-11 .3700E-09 .2559E-07 .2461E-06 .1753E-05 .1834E-04 .8563E-03 .2867E-03
.8659E-03 .2894E-02 .8715E-02 .2089E-01 .4187E-01 .7456E-01 .1223E+00 .1892E+00
.2799E+00 .3999E+00 .5557E+00 .7551E+00 .1006E+01 .1320E+01 .1709E+01 .2193E+01
.2794E+01 .3549E+01 .4519E+01 .5830E+01 .7923E+01 .1135E+02 .1654E+02 .2412E+02
.3572E+02 .6019E+02 .1589E+03        ! Values of K (cm/day)
```

The third example is an input data-file, prepared for the RIJTEMA method.

Example 3. Input file using the K(h) relation according to RIJTEMA (eqs. 25-27)

```
Sandy loam                      ! Name of soil profile
Sandy loam                      ! Description of layer 1
3.52                            ! Parameter Ks (cm/day)
-42.4                           !    "    "  Ha (cm)
0.271                           !    "    "  b
-63.0                           !    "    "  Hlim (cm)
1.39                            !    "    "  a
1.12                            !    "    "  n
200.                            ! Thickness of the layer (cm)
```

The next example shows a file containing the data required for a 4-layered peaty-mucky soil profile. The K(h)-relation is described with 3 straight line pieces.

Example 4. The K(h) relationships of the four layers described according to WESSELING (1981). See eq. (28).

```
Peaty mucky soil                ! Name of the profile
Muck                            ! Description of layer 1
91.5                            ! Saturated cond. (Ks, cm/d) of layer 1
.530E+02 .3092E+00              ! Values of K (cm/d) and h (cm) at 1st node
.910E+03 .1266E-02              ! Values of K and h at second node
.800E+07 .9748E-14              ! Values of K and h at third node
20.                             ! Thickness of layer 1 (cm)
Peat                            ! Description of layer 2
37.5                            ! Ks etc.
.120E+03 .5932E-01
.126E+04 .514E-03
.800E+07 .5045E-14
20.
Peat-sand                       ! Layer 3
264.
.11E+03 .6811E+00
```

```
.100E+04 .1076E-02
.220E+07 .7433E-12
10.
Sand                              ! Layer 4
491.
.73E+02 .1758E+01
.560E+03 .3888E-03
.175E+06 .1921E-09
151.
```

The final example describes a profile consisting of 2 different layers. The K(h) relation is described according to Brooks and Corey.

Example 5. Input file when the K(h) relation is described according to Brooks and Corey (eqs. 1 and 2).

```
Imaginary soil profile            ! Descriprion of soil profile
Cover sand                        ! Description of layer 1
100.                              ! Thickness of layer 1 (cm)
93.5                              ! Effective conductivity (cm/day)
-7.                               ! Effective air entry value (cm)
3.31                              ! Slope
N                                 ! No horizontal cracking
River clay                        ! Description of layer 2
150.
9.0
-17.
1.26
Y
```

When the standard set of flux densities is not sufficient, or when some flux densities are not of interest it is possible to assign flux density values different from the standard set. These flux densities may be either read from the terminal or from a file.

Example 6. A data file containing flux densities (cm/d) different from the standard set. Either a descending or ascending order should be kept !

```
-.1
-.05
-.01
 .0
 .01
 .05
 .075
 .1
```

Before starting the infiltration/capillary rise calculations, it is necessary to specify the depths of the groundwater table for which the computations have to be performed. One way is reading these depths from the terminal. If the groundwater levels are to be used for more profiles, it is advisable to make a data file and to read the depths from this file.

Example 7. Data file with groundwater levels (cm below soil surface) for which the infiltration/capillary rise calculations have to be performed. Use an ascending order !!

```
 70.0
100.0
110.0
140.0
170.0
```

5.2 Examples of output.

In the first example of output the data of example 1 have been used. Both standard sets of flux densities have been applied, and a groundwater depth of 200 cm below the soil surface was taken. For the profile under consideration the infiltration flux densities of -0.5 cm/day and -0.3 cm/day are physically impossible. Therefore the column representing the results of calculations with this flux density is filled with zeroes. The results are also shown in printplots.

The second example shows a table of maximally possible fluxes that reach the calculation level at several groundwater levels, and at a given pressure head. This is also shown in a printplot.

****
* OUTPUT EXAMPLE 1 *
****

Marine clay

DESCRIPT.	THICK. (CM)	HUM. %	MED.	S - VALUES IN MICRONS 2.	16.	50.	75.	105.	150.	210.
Sandy clay	15.0	5.4	31.1	19.2	11.3	43.8	12.6	9.4	2.6	1.2
Heavy clay	35.0	3.7	2.0	50.0	23.9	21.5	2.3	1.3	0.5	0.5
Peat	25.0		FEN PEAT,	BULK DENSITY=	0.24	G . CM**-3				
Clayey sand	75.0	0.8	67.6	6.6	2.7	13.9	38.1	34.9	3.7	0.1
Sand	150.0	0.6	88.4	3.3	2.6	11.9	19.8	27.7	27.4	6.7

LAYER	Thick	F	N	Ns	ha	hO	Ksat	r	Ke	ha/r	Cracks
Sandy clay	15.	0.55	2.01	1.74	-67.22	-1000000.	23.64	2.90	11.82	-23.18	N
Heavy clay	35.	0.19	1.64	1.36	-403.70	-1000000.	0.26	2.90	0.13	-139.21	Y
Peat	25.	-	1.96	1.47	-84.13	-10000.	0.47	3.10	0.23	-27.14	N
Clayey sand	75.	1.61	4.36	3.09	-74.21	-5000.	47.90	4.50	23.95	-16.49	N
Sand	150.	1.27	3.76	2.83	-47.76	-10000.	95.48	4.50	47.74	-10.61	N

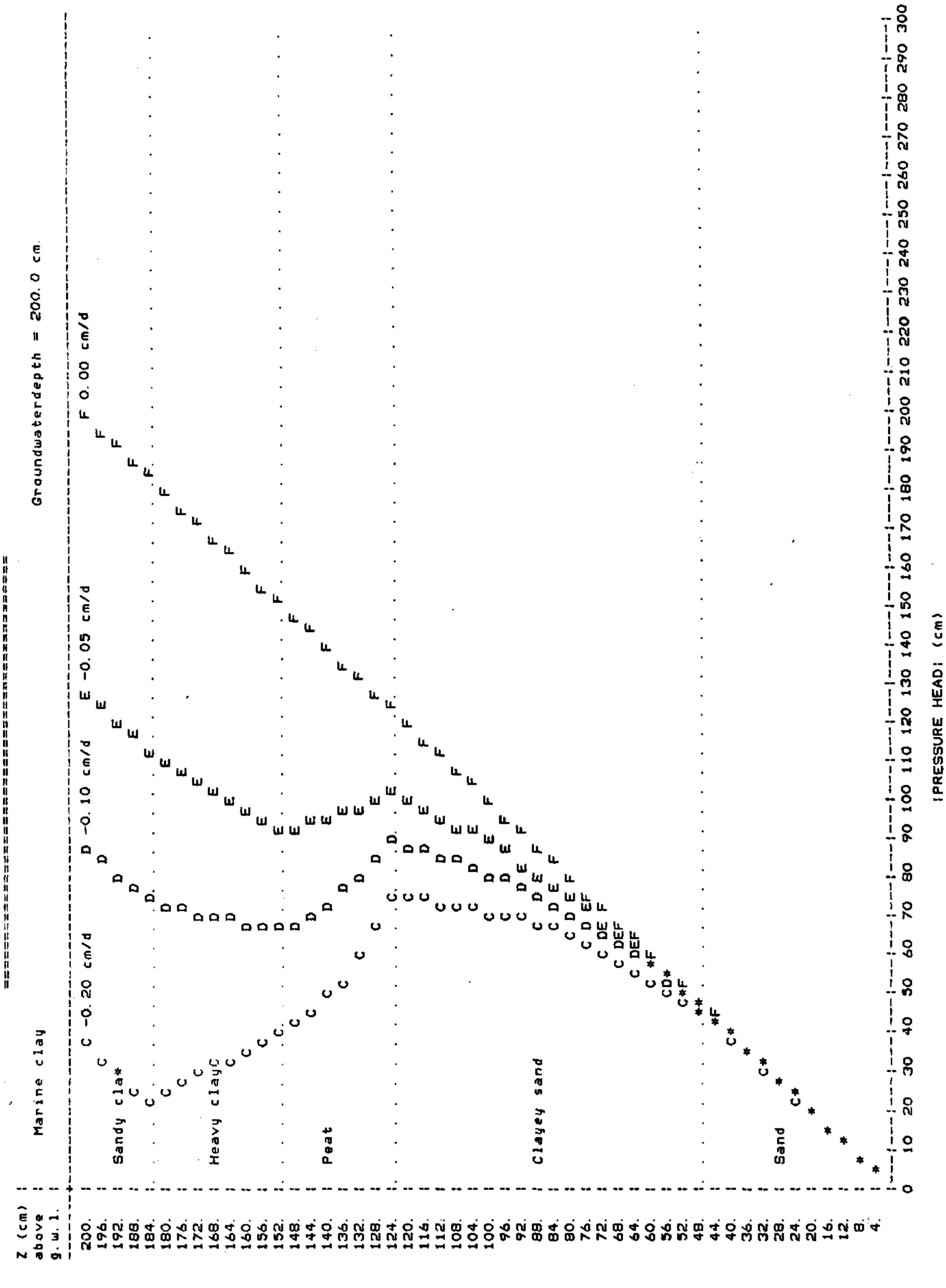
PRESSURE HEADS IN CASE OF INFILTRATION.

Marine clay

GROUNDWATERLEVEL = 200.0 CM.

Z CM.	*	FLUX DENSITIES (CM/DAY) -0.500	-0.300	-0.200	-0.100	-0.050	0.000
4.	*	0.0	0.0	-4.0	-4.0	-4.0	-4.0
8.	*	0.0	0.0	-8.0	-8.0	-8.0	-8.0
12.	*	0.0	0.0	-11.9	-12.0	-12.0	-12.0
16.	*	0.0	0.0	-15.9	-16.0	-16.0	-16.0
20.	*	0.0	0.0	-19.8	-19.9	-20.0	-20.0
24.	*	0.0	0.0	-23.7	-23.9	-23.9	-24.0
28.	*	0.0	0.0	-27.5	-27.8	-27.9	-28.0
32.	*	0.0	0.0	-31.2	-31.6	-31.8	-32.0
36.	*	0.0	0.0	-34.8	-35.4	-35.7	-36.0
40.	*	0.0	0.0	-38.2	-39.1	-39.5	-40.0
44.	*	0.0	0.0	-41.5	-42.7	-43.3	-44.0
48.	*	0.0	0.0	-44.7	-46.2	-47.1	-48.0
52.	*	0.0	0.0	-47.7	-49.7	-50.8	-52.0
56.	*	0.0	0.0	-50.7	-53.1	-54.5	-56.0
60.	*	0.0	0.0	-53.6	-56.5	-58.1	-60.0
64.	*	0.0	0.0	-56.2	-59.6	-61.7	-64.0
68.	*	0.0	0.0	-58.6	-62.7	-65.1	-68.0
72.	*	0.0	0.0	-60.8	-65.6	-68.5	-72.0
76.	*	0.0	0.0	-62.8	-68.3	-71.8	-76.0
80.	*	0.0	0.0	-64.6	-70.9	-74.9	-80.0
84.	*	0.0	0.0	-66.3	-73.3	-78.0	-84.0
88.	*	0.0	0.0	-67.7	-75.5	-80.9	-88.0
92.	*	0.0	0.0	-69.0	-77.6	-83.7	-92.0
96.	*	0.0	0.0	-70.1	-79.5	-86.4	-96.0
100.	*	0.0	0.0	-71.1	-81.2	-88.9	-100.0
104.	*	0.0	0.0	-72.0	-82.9	-91.3	-104.0
108.	*	0.0	0.0	-72.8	-84.3	-93.6	-108.0
112.	*	0.0	0.0	-73.4	-85.7	-95.7	-112.0
116.	*	0.0	0.0	-74.0	-86.9	-97.7	-116.0
120.	*	0.0	0.0	-74.5	-88.0	-99.6	-120.0
124.	*	0.0	0.0	-74.9	-88.9	-101.4	-124.0
128.	*	0.0	0.0	-67.4	-85.1	-100.4	-128.0
132.	*	0.0	0.0	-59.6	-80.3	-98.7	-132.0
136.	*	0.0	0.0	-53.6	-76.3	-97.1	-136.0
140.	*	0.0	0.0	-48.9	-72.8	-95.6	-140.0
144.	*	0.0	0.0	-45.2	-69.7	-94.3	-144.0
148.	*	0.0	0.0	-42.4	-67.1	-93.0	-148.0
152.	*	0.0	0.0	-40.1	-66.4	-93.7	-152.0
156.	*	0.0	0.0	-37.9	-67.3	-96.1	-156.0
160.	*	0.0	0.0	-35.8	-68.3	-98.6	-160.0
164.	*	0.0	0.0	-33.6	-69.2	-101.0	-164.0
168.	*	0.0	0.0	-31.5	-70.1	-103.5	-168.0
172.	*	0.0	0.0	-29.3	-71.0	-106.0	-172.0
176.	*	0.0	0.0	-27.2	-72.0	-108.4	-176.0
180.	*	0.0	0.0	-25.0	-72.9	-110.9	-180.0
184.	*	0.0	0.0	-22.9	-73.8	-113.4	-184.0
188.	*	0.0	0.0	-25.3	-76.8	-116.8	-188.0
192.	*	0.0	0.0	-29.2	-80.6	-120.5	-192.0
196.	*	0.0	0.0	-33.1	-84.3	-124.2	-196.0
200.	*	0.0	0.0	-37.0	-87.9	-127.9	-200.0

PRESSUREHEAD PROFILES IN CASE OF INFILTRATION



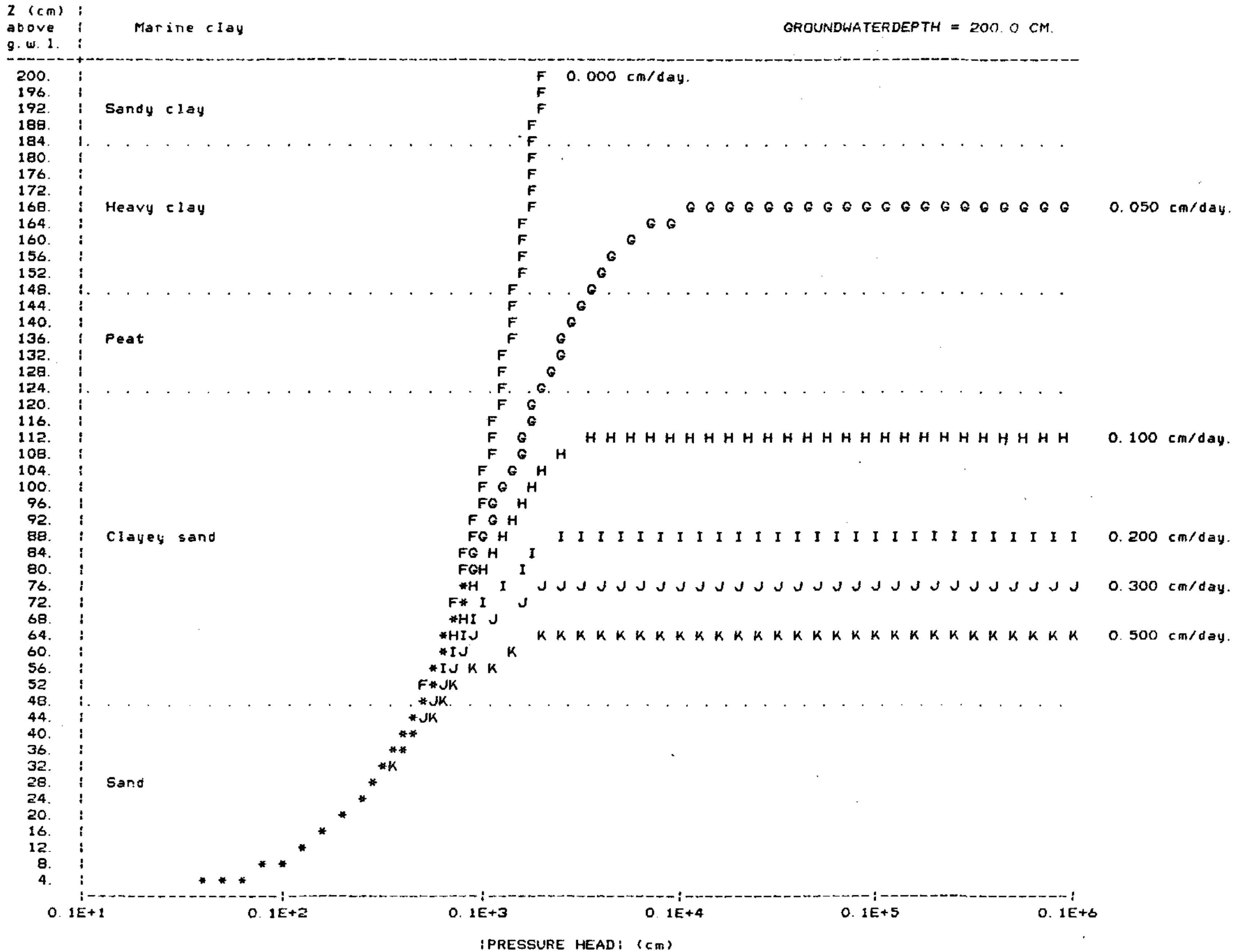
HEIGHT OF CAPILLARY RISE.

Marine clay

GROUNDWATERLEVEL = 200. 0 CM.

PR. HEAD CM.	FLUX DENSITIES (CM/DAY) 0.000	0.050	0.100	0.200	0.300	0.500
-1.	1.0	1.0	1.0	1.0	1.0	1.0
-2.	2.0	2.0	2.0	2.0	2.0	2.0
-3.	3.0	3.0	3.0	3.0	3.0	3.0
-4.	4.0	4.0	4.0	4.0	4.0	4.0
-5.	5.0	5.0	5.0	5.0	5.0	4.9
-6.	6.0	6.0	6.0	6.0	6.0	5.9
-7.	7.0	7.0	7.0	7.0	7.0	6.9
-8.	8.0	8.0	8.0	8.0	8.0	7.9
-9.	9.0	9.0	9.0	9.0	8.9	8.9
-10.	10.0	10.0	10.0	10.0	9.9	9.9
-20.	20.0	20.0	19.9	19.8	19.8	19.6
-30.	30.0	29.8	29.7	29.4	29.1	28.5
-40.	40.0	39.5	39.1	38.3	37.5	36.2
-50.	50.0	48.9	48.0	46.3	44.8	42.3
-60.	60.0	58.1	56.4	53.4	50.9	47.1
-70.	70.0	66.8	64.2	59.7	56.2	50.8
-80.	80.0	75.0	71.0	65.0	60.5	53.9
-90.	90.0	82.5	77.0	69.3	63.8	56.2
-100.	100.0	89.3	82.2	72.8	66.4	57.9
-200.	200.0	125.8	105.4	86.3	76.0	64.0
-300.	0.0	141.4	110.8	89.1	77.9	65.1
-400.	0.0	151.7	112.8	90.1	78.6	65.5
-500.	0.0	158.5	113.6	90.5	78.9	65.7
-600.	0.0	162.3	114.1	90.8	79.0	65.8
-700.	0.0	164.6	114.4	90.9	79.1	65.9
-800.	0.0	166.1	114.6	91.0	79.2	65.9
-900.	0.0	167.1	114.7	91.1	79.2	65.9
-1000.	0.0	167.8	114.8	91.1	79.2	65.9
-2000.	0.0	170.1	115.0	91.2	79.3	66.0
-3000.	0.0	170.5	115.1	91.3	79.3	66.0
-4000.	0.0	170.6	115.1	91.3	79.3	66.0
-5000.	0.0	170.7	115.1	91.3	79.3	66.0
-6000.	0.0	170.7	115.1	91.3	79.4	66.0
-7000.	0.0	170.8	115.1	91.3	79.4	66.0
-8000.	0.0	170.8	115.1	91.3	79.4	66.0
-9000.	0.0	170.8	115.1	91.3	79.4	66.0
-10000.	0.0	170.8	115.1	91.3	79.4	66.0
-20000.	0.0	170.8	115.1	91.3	79.4	66.0
-30000.	0.0	170.8	115.1	91.3	79.4	66.0
-40000.	0.0	170.8	115.1	91.3	79.4	66.0
-50000.	0.0	170.8	115.1	91.3	79.4	66.0
-60000.	0.0	170.8	115.1	91.3	79.4	66.0
-70000.	0.0	170.8	115.1	91.3	79.4	66.0
-80000.	0.0	170.8	115.1	91.3	79.4	66.0
-90000.	0.0	170.8	115.1	91.3	79.4	66.0
-100000.	0.0	170.8	115.1	91.3	79.4	66.0
-200000.	0.0	170.8	115.1	91.3	79.4	66.0
-300000.	0.0	170.8	115.1	91.3	79.4	66.0
-400000.	0.0	170.8	115.1	91.3	79.4	66.0
-500000.	0.0	170.8	115.1	91.3	79.4	66.0
-600000.	0.0	170.8	115.1	91.3	79.4	66.0
-700000.	0.0	170.8	115.1	91.3	79.4	66.0
-800000.	0.0	170.8	115.1	91.3	79.4	66.0

HEIGHT OF CAPILLARY RISE



*** OUTPUT EXAMPLE 2 ***

Testprofile 3

DESCRIPT.	THICK. (CM)	HUM. %	MED.	S - VALUES IN MICRONS 2.	16.	50.	75.	105.	150.	210.	300.	2000.
(1) Sandy clay	30.0	3.5	34.2	20.9	10.7	34.4	17.0	11.0	6.0	0.0	0.0	0.0
(2) Light clay	30.0	1.0	22.2	29.0	15.0	33.0	11.0	8.0	4.0	0.0	0.0	0.0
(3) Peat	25.0		FEN PEAT, BULK DENSITY= 0.18 G . CM**-3									
(4) Fine sand	300.0	0.1	141.6	2.0	2.0	9.5	10.0	7.0	24.0	20.0	11.5	14.0

LAYER	Thick	F	N	Ns	ha	h0	Ksat	r	Ke	ha/r	Cracks
(1) Sandy clay	30.	0.49	1.99	1.73	-56.25	-1000000.	30.76	2.90	15.38	-19.40	N
(2) Light clay	30.	0.36	1.91	1.66	-65.94	-1000000.	16.97	2.90	8.48	-22.74	Y
(3) Peat	25.	-	2.11	1.56	-59.82	-5000.	1.42	3.10	0.71	-19.30	N
(4) Fine sand	300.	0.95	3.59	2.78	-24.14	-10000.	293.91	4.50	146.95	-5.36	N

MAXIMALLY POSSIBLE FLUXES (cm/day)

Testprofile 3 LEVEL OF CALCULATIONS= 0. CM. BELOW SURFACE

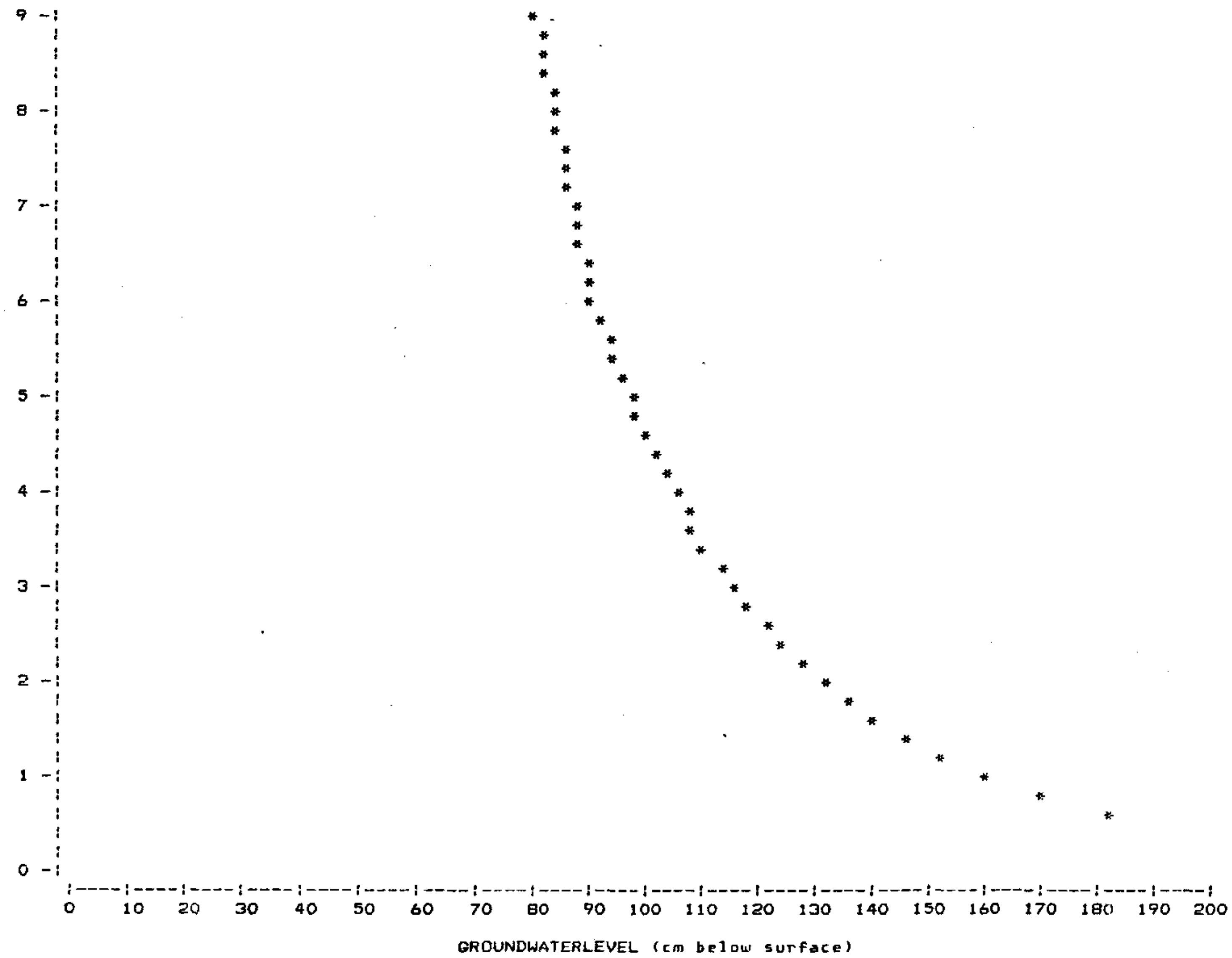
PR.HEAD (CM.)	G R O U N D W A T E R L E V E L (CM. BELOW SURFACE) 60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	170.	180.	190.	200.
-1000.	-1.000	-1.000	0.917	0.615	0.464	0.345	0.266	0.208	0.163	0.128	0.100	0.079	0.063	0.050	0.041

NOTE : The figure -1.000 indicates the occurrence of a flux > 1.0 cm/day !!

PRINTPLOT OF CAPILLARY RISE (mm/day) VERSUS GROUNDWATERDEPTH

Testprofile 3

Pressure head : -1000. cm.



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```
      PROGRAM CAPSEV
C
C ==============================================================
C =                                                            =
C =     PROGRAM CAPSEV IS DEVELOPED TO CALCULATE:              =
C =                                                            =
C =      -   HYDRAULIC CONDUCTIVITY FROM GRAIN SIZE DISTRIBUTION =
C =            AND ORGANIC MATTER CONTENT                      =
C =                                                            =
C =      -   STEADY STATE CAPILLARY RISE ABOVE THE GROUNDWATER =
C =          TABLE                                             =
C =                                                            =
C =      -   STEADY STATE INFILTRATION TOWARDS THE WATER TABLE =
C =                                                            =
C ==============================================================
C =                                                            =
C =     Program developed by                                   =
C =                                                            =
C =             Ir. J.G.Wesseling , Ing. G.W. Bloemen and      =
C =             Ing. W.A.J.M. Kroonen,                         =
C =             INSTITUTE FOR LAND AND WATER MANAGEMENT,       =
C =             P.O.Box 35,                                    =
C =             6700 AA Wageningen.                            =
C =             The Netherlands                                =
C =                                                            =
C ==============================================================
C =                                                            =
C =     REVISED VERSION.                                       =
C =     NOVEMBER 1983.                                         =
C =                                                            =
C ==============================================================
C
C
      INTEGER PEAT
      LOGICAL CRACK
      CHARACTER DESCR,HEAD,COMAND
      REAL MEDIAN,KSAT,KSATEF
      COMMON/TABDAT/TABPRH(10,80),TABCON(10,80),NUMTAB(10),INTERP
      COMMON/QPONEG/NFLNS,NFLNE,NFLPS,NFLPE
      COMMON/RYTEMA/RYTKO(10),RYTETA(10),RYTA(10),RYTN(10),
     * RYTHA(10),RYTHLM(10)
      COMMON/LINE/SUCLIN(10,4),CONLIN(10,4),ALIN(10,3),BLIN(10,3)
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/INFIL/SUCINF(15,51),ZINF(51),NZINF
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     * SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     * DIFFER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     * MEDIAN(10),NSIZES,CRACK(10)
C
C ----  OPEN OUTPUT FILE
      OPEN(UNIT=10,FILE='MOIST.OUT',STATUS='NEW')
C
C ----  WELCOME
      WRITE(6,1010)
 1010 FORMAT(////,T30,' Welcome to program CAPSEV. ',/,
     * T30,' =========================',///)
C
      CALL HELP
C
```



```
C ----  INPUT COMMAND
  100 WRITE(6,1050)
 1050 FORMAT(//,' Command? ',$)
      READ(5,1060)COMAND
 1060 FORMAT(A1)
C
      IF(COMAND.NE.'C')GO TO 220
C ----  CALCULATE CAPILLARY RISE
      CALL CAPTOT
      GO TO 100
C
  220 IF(COMAND.NE.'E')GO TO 240
C ----  LEAVE PROGRAM
      WRITE(6,1100)
 1100 FORMAT(//,' Your results are written to a file, named',
     * ' MOIST.OUT',//,T30,' Bye.',/,T30,' ===',//)
      CLOSE(UNIT=10)
      CALL EXIT
C
  240 IF(COMAND.NE.'G')GO TO 260
C ----  CALCULATION OF SOIL CHARACTERISTICS FROM GRAIN SIZE DISTRIBUTION
      CALL GRNINP
      CALL GRAIN
      GO TO 100
C
  260 IF(COMAND.NE.'H')GO TO 280
C ----  LIST POSSIBLE COMMANDS
      CALL HELP
      GO TO 100
C
C ----  UNKNOWN COMMAND
  280 WRITE(6,1200)
 1200 FORMAT(/,' ??? Illegal command ???')
      GO TO 100
C
      END
C
C***********************************************************************
C
      SUBROUTINE HELP
C
C ==============================================================
C =                                                            =
C =     Subroutine HELP lists the commands that are allowed.   =
C =                                                            =
C ==============================================================
C
      WRITE(6,1010)
 1010 FORMAT(//,' The possible commands are:',/,
     * T10,' C :',T15,'Compute height of capillary rise',/,
     * T10,' E :',T15,'Leave program',/,
     * T10,' G :',T15,'Compute soil characteristics from grain size',
     * ' distribution',/,
     * T10,' H :',T15,'Show list of commands (this message)',/,
     * //)
C
      RETURN
      END
C
C***********************************************************************
C
```

```
      SUBROUTINE GRNINP
C
C ================================================================
C =                                                              =
C =     SUBROUTINE TO READ DATA FOR CALCULATIONS WITH GRAIN SIZES =
C =                                                              =
C ================================================================
C
      INTEGER PEAT,DEVICE
      LOGICAL CRACK
      CHARACTER DESCR,HEAD,ANSWER,DUM
      CHARACTER*20 FILNAM
      REAL MEDIAN,KSAT,KSATEF
      DIMENSION STSIZE(9)
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     * SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     * DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     * MEDIAN(10),NSIZES,CRACK(10)
      DATA STSIZE/2.,16.,50.,75.,105.,150.,210.,300.,2000./
C
C ----  INITIALIZE
      DO 10 I=1,10
         BULK(I)=0.0
         KSAT(I)=0.0
         PSIA(I)=0.0
         PSIO(I)=0.0
         SLOPE(I)=0.0
         SLOPES(I)=0.0
         F(I)=0.0
         BULK(I)=0.0
         PEAT(I)=0
         CRACK(I)=.FALSE.
   10 CONTINUE
C
C
C     ***********************************
C     *                                 *
C     *  T E R M I N A L   I N P U T    *
C     *                                 *
C     ***********************************
C
      WRITE(6,1020)
 1020 FORMAT(' Did you prepare the answers to the questions',
     * ' in a diskfile? (Y/N) ',$)
      READ(5,1030)ANSWER
 1030 FORMAT(A1)
      IF(ANSWER.NE.'Y')GO TO 40
C ---- READ ANSWERS FROM FILE
      WRITE(6,1040)
 1040 FORMAT('+In what file? ',$)
 1045 READ(5,1050)FILNAM
 1050 FORMAT(A20)
      OPEN(UNIT=21,NAME=FILNAM,TYPE='OLD',ERR=30)
      DEVICE=21
      GO TO 60
C
C ---- ERROR OPENING FILE
   30 WRITE(6,1060)FILNAM
```



```
 1060 FORMAT(' Error opening file ',A20,/,
     * ' Retype filename: ',' ',$)
      GOTO 1045
C
   40 DEVICE=5
C
C ---- INPUT OF DATA
   60 IF(DEVICE.EQ.5)WRITE(6,1090)
 1090 FORMAT(//,' Give a description (name) of the soil profile.')
      READ(DEVICE,2000)(HEAD(I),I=1,80)
 2000 FORMAT(80A1)
      IF(DEVICE.EQ.5)WRITE(6,2010)(STSIZE(I),I=1,9)
 2010 FORMAT(//,' Please answer the following questions. These data',
     * ' are required for the',/,' calculation of conductivities and',
     * ' pressure head boundaries.',//,' Do you want the standard ',
     * 'set of grain sizes?',/,' This standard set is : ',F2.0,',',
     * 3(F3.0,','),4(F4.0,','),F5.0,' (Y/N) ',$)
      READ(DEVICE,1030)ANSWER
      IF(ANSWER.NE.'Y')GO TO 120
C
C ---- STANDARD SET OF GRAIN SIZES
      NSIZES=9
      DO 110 I=1,9
         SIZE(I)=STSIZE(I)
  110 CONTINUE
      GO TO 150
C
C ---- READ GRAIN SIZES FROM TERMINAL
  120 IF(DEVICE.EQ.5)WRITE(6,2030)
 2030 FORMAT(' Please type the grain sizes in units of micrometers ',
     * '(max. 15).',/,' End with a letter X.',//)
      NSIZES=0
  130 NSIZES=NSIZES+1
      IF(NSIZES.EQ.16)GO TO 135
      IF(DEVICE.EQ.5)WRITE(6,2040)NSIZES
 2040 FORMAT('+Size(',I2,')= ',$)
      READ(DEVICE,*,ERR=140)SIZE(NSIZES)
      IF(NSIZES.EQ.1)GOTO 130
      IF(SIZE(NSIZES).GT.SIZE(NSIZES-1))GOTO 130
      WRITE(6,2050)
 2050 FORMAT(//,' The grain sizes should be entered in ascending ',
     * 'order!  Try again.',//)
      GOTO  120
C
C ---- READING A DUMMY VARIABLE IN CASE OF MAXIMUM NUMBER OF CLASSES
  135 IF(DEVICE.EQ.21)READ(DEVICE,1030)DUM
  140 NSIZES=NSIZES-1
C
C ---- NUMBER OF SOIL LAYERS?
  150 IF(DEVICE.EQ.5)WRITE(6,2060)
 2060 FORMAT(/,' Of how many layers does the profile consist? ',
     * '(max. 10)',$)
      READ(DEVICE,*)NLAYER
C
C ---- DESCRIPTION OF LAYERS
      IF(DEVICE.EQ.5)WRITE(6,2080)NLAYER
 2080 FORMAT(' Now type the data for these ',i2,' layers.',/)
      DO 300 LAYER=1,NLAYER
         IF(DEVICE.EQ.5)WRITE(6,2090)LAYER
 2090    FORMAT(/,' Give a description (name) of layer',I3,
     *    ' (max 15. char.): ',T50,' ',$)
```

```
      READ(DEVICE,2100)(DESCR(LAYER,I),I=1,15)
2100  FORMAT(15A1)
      IF(DEVICE.EQ.5)WRITE(6,2103)
2103  FORMAT('+What is thickness (cm) of this layer? ',T50,' ',$)
      READ(DEVICE,*)THKLAY(LAYER)
      IF(DEVICE.EQ.5)WRITE(6,2110)
2110  FORMAT('+Type humuscontent (in %) or P for peat?',T50,' ',$)
      READ(DEVICE,*,ERR=200)HUMUS(LAYER)
      IF(HUMUS(LAYER).LT.0.01)HUMUS(LAYER)=0.01
C
C ----  MINERAL SOIL
 160  PEAT(LAYER)=0
      TOTAL=0.
      IF(DEVICE.EQ.5)WRITE(6,2140)
2140  FORMAT(' Now the percentages between the grain ',
     *'size classes will be asked.',/)
      DO 170 ISIZE=1,NSIZES
 165     IF(DEVICE.EQ.5)WRITE(6,2150)SIZE(ISIZE)
2150     FORMAT('+Percentage belonging to grain size class',F8.1,
     *   ' ?',T50,' ',$)
         READ(DEVICE,*,ERR=165)DIFPER(LAYER,ISIZE)
         TOTAL=TOTAL+DIFPER(LAYER,ISIZE)
         IF(TOTAL.LE.100.1001)GOTO 170
         WRITE(6,2155)
2155     FORMAT(//,' The sum of the percentages exceeds 100% !',
     *   ' Try again.',/)
         GOTO 160
 170  CONTINUE
C
C ----  CALCULATION OF MEDIAN GRAIN SIZE
      SUBTOT=0
      DO 180 ISIZE=1,NSIZES
         I=ISIZE
         SUBTOT=SUBTOT+DIFPER(LAYER,I)
         IF(SUBTOT.GE.50.0)GOTO 190
 180  CONTINUE
 190  SUBTOT=SUBTOT-DIFPER(LAYER,I)
      DIF=50.0-SUBTOT
      MEDIAN(LAYER)=SIZE(I-1)+((DIF/DIFPER(LAYER,I))*
     *(SIZE(I)-SIZE(I-1)))
      GO TO 250
C
C ----  PEAT SOIL
 200  IF(DEVICE.EQ.5)WRITE(6,2160)
2160  FORMAT('+Type 1 for fen peat, 2 for high bog peat?',T50,' ',$)
      READ(DEVICE,*)PEAT(LAYER)
      IF(PEAT(LAYER).NE.1.AND.PEAT(LAYER).NE.2)GO TO 200
      IF(DEVICE.EQ.5)WRITE(6,2170)
2170  FORMAT('+What is bulk density of peat (g/cm3)?',T50,' ',$)
      READ(DEVICE,*)BULK(LAYER)
C
C ----  CRACKING?
 250  IF(DEVICE.EQ.5)WRITE(6,2180)
2180  FORMAT(' Does horizontal cracking occur? (Y/N) ',$)
      READ(DEVICE,2190)ANSWER
2190  FORMAT(A1)
      IF(ANSWER.EQ.'Y')CRACK(LAYER)=.TRUE.
C
 300  CONTINUE
C
      IF(DEVICE.EQ.21)CLOSE(UNIT=21)
```



```
      GO TO 950
C
C
C ----  ***********************************
C ----  *                                 *
C ----  * SHOW  INPUT  DATA               *
C ----  *                                 *
C ----  ***********************************
C
 950  WRITE(10,5010)(HEAD(I),I=1,80)
5010  FORMAT(///,' ',80A1,///)
      WRITE(10,5020)
5020  FORMAT(' ',132('*'))
      WRITE(10,5030)(SIZE(I),I=1,NSIZES)
5030  FORMAT(' DESCRIPT.',T18,'*  THICK.    HUM.    MED.',T42,'*',T55,
     *'S - VALUES IN MICRONS',/,' ',T18,'*    (CM)',T32,'%',
     *T42,'*',3X,15F5.0)
      WRITE(10,5020)
      DO 930 LAYER=1,NLAYER
         IF(PEAT(LAYER).EQ.0)WRITE(10,5040)(DESCR(LAYER,I),I=1,15),
     *   THKLAY(LAYER),HUMUS(LAYER),MEDIAN(LAYER),
     *   (DIFPER(LAYER,ISIZE),ISIZE=1,NSIZES)
         IF(PEAT(LAYER).EQ.1)WRITE(10,5050)(DESCR(LAYER,I),I=1,15),
     *   THKLAY(LAYER),BULK(LAYER)
         IF(PEAT(LAYER).EQ.2)WRITE(10,5060)(DESCR(LAYER,I),I=1,15),
     *   THKLAY(LAYER),BULK(LAYER)
 930  CONTINUE
5040  FORMAT(' ',15A1,T18,'*',F8.1,T28,F5.1,F7.1,T42,'*',3X,15F5.1)
5050  FORMAT(' ',15A1,T18,'*',F8.1,T35,' FEN PEAT, BULK DENSITY=',
     *F7.2,' G . CM**-3')
5060  FORMAT(' ',15A1,T18,'*',F8.1,T35,
     *' HIGH BOG PEAT, BULK DENSITY=',F7.2,' G . CM**-3')
      WRITE(10,5020)
C
      RETURN
      END
C
C**********************************************************************
C
      SUBROUTINE GRAIN
C
C ==============================================================
C =                                                            =
C =    SUBROUTINE TO SHOW THE RESULTS OF CALCULATING THE       =
C =    HYDRAULIC CONDUCTIVITY FUNCTION FROM THE GRAIN SIZE     =
C =    DISTRIBUTION.                                           =
C =                                                            =
C ==============================================================
C
      INTEGER PEAT
      LOGICAL CRACK
      CHARACTER DESCR,HEAD,CRS
      REAL MEDIAN,KSAT,KSATEF,S(14)
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     *SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     *DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     *MEDIAN(10),NSIZES,CRACK(10)
      DATA S/-0.,-0.,-10.,-20.,-31.,-50.,-100.,-250.,-500.,
```

```
     *         -1000.,-2500.,-5000.,-10000.,-16000./
C
C ----  CALCULATION OF CONDUCTIVITY PARAMETERS
        DO 10 LAYER=1,NLAYER
           CALL CALCUL
   10   CONTINUE
C
C ----  SHOW RESULTS
        WRITE(10,2010)
 2010   FORMAT(///)
        WRITE(10,2020)
 2020   FORMAT(' ',132('='))
        WRITE(10,2030)
 2030   FORMAT('  LAYER',T19,'Thick',T33,'F',T44,'N',T54,'Ns',T65,
     *  'ha',T75,'h0',T86,'Ksat',T99,'r',T108,'Ke',T117,
     *  'ha/r',T127,'Cracks',/,' ',132('='))
        DO 100 LAYER=1,NLAYER
           CRS='N'
           IF(CRACK(LAYER))CRS='Y'
           IF(PEAT(LAYER).EQ.0)WRITE(10,2040)(DESCR(LAYER,I),I=1,15),
     *     THKLAY(LAYER),F(LAYER),SLOPE(LAYER),SLOPES(LAYER),
     *     PSIA(LAYER),PSIO(LAYER),KSAT(LAYER),REDUC(LAYER),
     *     KSATEF(LAYER),PSIEFF(LAYER),CRS
           IF(PEAT(LAYER).NE.0)WRITE(10,2050)(DESCR(LAYER,I),I=1,15),
     *     THKLAY(LAYER),SLOPE(LAYER),SLOPES(LAYER),PSIA(LAYER),
     *     PSIO(LAYER),KSAT(LAYER),REDUC(LAYER),KSATEF(LAYER),
     *     PSIEFF(LAYER),CRS
  100   CONTINUE
 2040   FORMAT(' ',15A1,F7.0,4F11.2,F11.0,4F11.2,T129,A1)
 2050   FORMAT(' ',15A1,F7.0,8X,'-',2X,3F11.2,F11.0,4F11.2,T129,A1)
        WRITE(10,2020)
C
        RETURN
        END
C
C**********************************************************************
C
        SUBROUTINE CALCUL
C
C ==============================================================
C =                                                            =
C =     SUBROUTINE CALCUL CALCULATES THE CONSTANTS TO BE USED IN =
C =     THE HYDRAULIC CONDUCTIVITY FUNCTION.                     =
C =                                                            =
C ==============================================================
C
        INTEGER PEAT
        LOGICAL CRACK
        CHARACTER DESCR,HEAD
        REAL MEDIAN,KSAT,KSATEF
        COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
        COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *  METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
        COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     *  SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     *  DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     *  MEDIAN(10),NSIZES,CRACK(10)
C
C ----  MINERAL OR PEAT?
        IF(PEAT(LAYER).NE.0)GO TO 200
C
```



```
C ----  MINERAL
        SUMF=0.0
        SUMPER=0.0
        PPLONE=DIFPER(LAYER,1)
        NST=NSIZES-1
C
        DO 100 II=1,NST
           I=II
           J=I+1
           P=PPLONE
C ----     CALCULATE NEW P(I+1)
           PPLONE=PPLONE+DIFPER(LAYER,J)
C ----     NEW SUM OF PERCENTAGES
           SUMPER=SUMPER+DIFPER(LAYER,J)
C ----     CALCULATION OF F(I)
           ALQP=ALOG10(PPLONE/P)
           ALSZ=ALOG10(SIZE(J)/SIZE(I))
           FI=DIFPER(LAYER,J)*ALQP/ALSZ
           SUMF=SUMF+FI
  100   CONTINUE
C
C ----  CALCULATION OF F(LAYER)
        F(LAYER)=SUMF/SUMPER
C
C ----  CALCULATION OF SLOPE OF HYDRAULIC CONDUCTIVITY CURVE
        SLOPE(LAYER)=1.4 + 4.536 * (EXP(0.3*F(LAYER))-1.0) -
     *  0.75 * (F(LAYER)**1.6) * ALOG10(HUMUS(LAYER))
C
C ----  CALCULATION OF AIR ENTRY VALUE PSIA
        PSIA(LAYER)=-2914.0 * (MEDIAN(LAYER) ** (-0.96)) *
     *  (F(LAYER) ** (0.79))
C
C ----  CALCULATION OF SATURATED CONDUCTIVITY KSAT
        KSAT(LAYER)=0.02 * (MEDIAN(LAYER) **(1.93)) *
     *  (F(LAYER) ** (-0.74))
C
C ----  CALCULATION OF PRESSURE HEAD, PSIO, WHERE THE CONDUCTIVITY
C ----  APPROACHES ZERO AND OF THE REDUCTION FACTOR r
        CALL COMPHO
C
        GO TO 900
C
C ----  PEAT
  200   IF(PEAT(LAYER).NE.1)GO TO 400
C ----  FEN PEAT
C
C ----  CALCULATION OF SLOPE OF HYDRAULIC CONDUCTIVITY CURVE
        SLOPE(LAYER)=2.54 - 2.42 * BULK(LAYER)
C
C ----  CALCULATION OF AIR ENTRY VALUE PSIA
        PSIA(LAYER)=-416.0 * (BULK(LAYER) ** 1.12)
C
C ----  CALCULATION OF SATURATED CONDUCTIVITY KSAT
        KSAT(LAYER)=0.00266 * (BULK(LAYER) ** (-3.625))
C
C ----  CALCULATION OF PSIO AND REDUCTION FACTOR r
        CALL COMPHO
C
        GO TO 900
C
C ----  HIGH BOG PEAT
```

```
C
C ----  CALCULATION OF SLOPE OF HYDRAULIC CONDUCTIVITY CURVE
  400   SLOPE(LAYER)=2.57 - 2.27 * BULK(LAYER)
C
C ----  CALCULATION OF AIR ENTRY VALUE PSIA
        PSIA(LAYER)=-794.0 * (BULK(LAYER) ** 1.17)
C
C ----  CALCULATION OF SATURATED HYDRAULIC CONDUCTIVITY KSAT
        KSAT(LAYER)=0.0036 * (BULK(LAYER) ** (-2.83))
C
C ---   CALCULATION OF PSIO AND REDUCTION FACTOR r
        CALL COMPHO
C
C ----  CALCULATION OF EFFECTIVE CONDUCTIVITY AND PRESSURE HEAD
  900   KSATEF(LAYER)= 0.5*KSAT(LAYER)
        PSIEFF(LAYER)= PSIA(LAYER)/REDUC(LAYER)
C ----  CALCULATION OF NS
        SLOPES(LAYER)=(ALOG10(2.0*((PSIA(LAYER)/PSIO(LAYER))**
     *  SLOPE(LAYER))))/(ALOG10(PSIEFF(LAYER)/PSIO(LAYER)))
C
C ----  CORRECTIONS FOR HORIZONTAL CRACKING
        SLPCOR(LAYER)= SLOPES(LAYER)
        IF(CRACK(LAYER))SLPCOR(LAYER)=SLPCOR(LAYER)+1.7
        PSICOR(LAYER)= PSIEFF(LAYER)
        IF(CRACK(LAYER).AND.PSIEFF(LAYER).GT.-100.)PSICOR(LAYER)=
     *  -100.0*((-0.01*PSIEFF(LAYER))**(SLOPES(LAYER)/SLPCOR(LAYER)))
        RETURN
C
        END
C
C***********************************************************************
C
        SUBROUTINE COMPHO
C
C ====================================================================
C =                                                                  =
C =     SUBROUTINE TO COMPUTE PSIO(LAYER) AND REDUCTION FACTOR r     =
C =     FROM GRAIN SIZE DISTRIBUTION AND MEDIAN GRAIN SIZE          =
C =                                                                  =
C ====================================================================
C
        INTEGER PEAT
        LOGICAL CRACK
        CHARACTER DESCR,HEAD
        REAL MEDIAN,KSAT,KSATEF
        DIMENSION HO(6),BLMA(5),BLMB(5)
        COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
        COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *  METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
        COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     *  SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     *  DIFFER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     *  MEDIAN(10),NSIZES,CRACK(10)
        DATA HO/-1.E6,-1.E4,-5.E3,-1.E3,-5.E2,-2.E2/
        DATA BLMA/0.004,0.00286,0.0025,0.00225,0.00341/
        DATA BLMB/1.2,1.6,2.1,2.5,3.5/
C
C ----  MINERAL SOIL OR PEAT?
        IF(PEAT(LAYER).NE.0)GO TO 400
C
C ----  MINERAL SOIL
```



```
C ----  ===========
C
C ----  REDUCTION FACTOR r
        REDUC(LAYER)=2.9
        IF(MEDIAN(LAYER).GT.50.0)REDUC(LAYER)=4.5
C
C ----  COMPUTATION OF PRESSURE HEAD HO WHERE CONDUCTIVITY APPROACHES Z
        DO 100 I=1,5
           NUVAL=I
           SUM=F(LAYER)+BLMA(I)*MEDIAN(LAYER)
           IF(SUM.LT.BLMB(I))GO TO 200
  100   CONTINUE
        PSIO(LAYER)=HO(6)
        GO TO 500
C
  200   PSIO(LAYER)=HO(NUVAL)
        GO TO 500
C
C
C ----  PEAT
C ----  ====
C
  400   IF(PEAT(LAYER).EQ.2)GO TO 420
C
C ----  FEN PEAT
        REDUC(LAYER)=3.1
        GO TO 450
C
C ----  HIGH BOG PEAT
  420   REDUC(LAYER)=1.9
        IF(BULK(LAYER).GT.0.1)REDUC(LAYER)=3.4
C
C ----  CALCULATION OF PRESSURE HEAD PSIO
  450   IF(BULK(LAYER).LE.0.2)PSIO(LAYER)=-5000.
        IF(BULK(LAYER).GT.0.2)PSIO(LAYER)=-10000.
C
  500   RETURN
        END
C
C***********************************************************************
C
        SUBROUTINE CAPTOT
C ====================================================================
C =                                                                  =
C =     SUBROUTINE CAPTOT CONTROLS INPUT, CALCULATIONS AND OUTPUT    =
C =     FOR THE CALULATION OF THE SOIL MOISTURE DISTRIBUTION IN     =
C =     CASE OF CAPILLARY RISE AND INFILTRATION.                     =
C =                                                                  =
C ====================================================================
C
        INTEGER PEAT
        LOGICAL CRACK,FLN,FLP,ERROR
        CHARACTER DESCR,HEAD,ANSWER
        CHARACTER*20 FILNAM
        REAL MEDIAN,KSAT,KSATEF
        DIMENSION GWLQ(15)
        COMMON/TABDAT/TABPRH(10,80),TABCON(10,80),NUMTAB(10),INTERP
        COMMON/QPONEG/NFLNS,NFLNE,NFLPS,NFLPE
        COMMON/RYTEMA/RYTKO(10),RYTETA(10),RYTA(10),RYTN(10),
     *  RYTHA(10),RYTHLM(10)
        COMMON/LINE/SUCLIN(10,4),CONLIN(10,4),ALIN(10,3),BLIN(10,3)
```

```
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/INFIL/SUCINF(15,51),ZINF(51),NZINF
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     * SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     * DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     * MEDIAN(10),NSIZES,CRACK(10)
C
C ----  WHAT METHOD OF CONDUCTIVITY DESCRIPTION SHOULD BE USED?
      CALL CAPQUE(ERROR)
      IF(ERROR) RETURN
C
C ----  WHAT KIND OF CALCULATIONS?
    2 WRITE(6,1001)
 1001 FORMAT(//' What kind of calculations :',/,' (1) Pressure ',
     * 'head distribution and height of capillary rise (type 1), or',
     * /,' (2) Maximally possible fluxes (type 2)?    ',$)
      READ(5,*)IANS
      IF(IANS.NE.1.AND.IANS.NE.2)GOTO 2
C
C ----  FOR WHICH FLUX DENSITIES SHOULD THE CALCULATIONS BE PERFORMED?
      IF(IANS.EQ.1)CALL FLXQUE
C
C ----  ===========================
C ----  =                         =
C ----  =  GROUNDWATER LEVELS     =
C ----  =                         =
C ----- ===========================
C
C ----  HOW MANY GROUNDWATER LEVELS HAVE TO BE CONSIDERED?
   10 WRITE(6,1010)
 1010 FORMAT(//,' How many groundwater levels should be taken ',
     * '(max. 15)? ',$)
      READ(5,*)NGWLS
      IF(NGWLS.LE.0.OR.NGWLS.GT.15)GO TO 10
C
C ----  FROM WHAT DEVICE SHOULD THEY BE READ?
   20 WRITE(6,1030)
 1030 FORMAT('+Should the groundwater levels be read from a file ',
     * ' (Y/N)? ',$)
      READ(5,1040)ANSWER
 1040 FORMAT(A1)
C
      IF(ANSWER.EQ.'Y')GO TO 200
C
C ----  READING GROUNDWATER LEVELS FROM TERMINAL
      WRITE(6,1100)
 1100 FORMAT(//,' Type the groundwater levels to be used in',
     * ' ascending order'/' (in cm ',
     * 'below the soil surface):',//)
 1108 DO 100 IGWL=1,NGWLS
        WRITE(6,1110)IGWL
 1110   FORMAT('+Groundwaterlevel(',I2,')= ',$)
        READ(5,*)GWLQ(IGWL)
        IF(IGWL.GT.1.AND.GWLQ(IGWL).LT.GWLQ(IGWL-1)) THEN
          WRITE(6,1112)
 1112     FORMAT(/' *** Groundwaterlevels should be entered in',
     *    ' ascending order. Try again ! ***'/)
          GOTO 1108
        END IF
```



```
  100 CONTINUE
      GO TO 300
C
C
C ----  READING GROUNDWATER LEVELS FROM DISK
  200 WRITE(6,1122)
 1122 FORMAT('+What is the name of the file? ',$)
  210 READ(5,1123)FILNAM
 1123 FORMAT(A20)
      OPEN(UNIT=21,NAME=FILNAM,TYPE='OLD',ERR=230)
      DO 220 IGWL=1,NGWLS
        READ(21,*,END=250)GWLQ(IGWL)
        IF(IGWL.GT.1.AND.GWLQ(IGWL).LT.GWLQ(IGWL-1)) THEN
          WRITE(6,1112)
          GOTO 20
        END IF
  220 CONTINUE
      CLOSE(UNIT=21)
      GO TO 300
C
C ----  ERROR IN FILENAME
  230 WRITE(6,1125)FILNAM
 1125 FORMAT(' ??? Error opening file ',A20,'  ???',/,
     * ' Retype filename: ',$)
      GO TO 210
C
C ----  REQUIRED AMOUNT OF GROUNDWATERLEVELS NOT IN FILE
  250 CLOSE(UNIT=21)
      NGWLS=IGWL
      WRITE(6,1130)NGWLS
 1130 FORMAT(//,' ??? Only ',I2,' Groundwaterlevels in file ???',//,
     * ' Stop execution (Y/N)? ',$)
      READ(5,1040)ANSWER
C
      IF(ANSWER.NE.'Y')GO TO 300
      RETURN
C
C ----  CALCULATIONS AND OUTPUT
  300 IF(IANS.EQ.1)GOTO 305
      CALL MAXFLX(GWLQ,NGWLS)
      RETURN
C
C ----  ARE THERE POSITIVE AND NEGATIVE FLUXES?
  305 FLP=.FALSE.
      IF(NFLPS.NE.0)FLP=.TRUE.
      FLN=.FALSE.
      IF(NFLNS.NE.0)FLN=.TRUE.

C ----  CALCULATIONS OF SOIL MOISTURE DISTRIBUTION
      DO 400 IGWL=1,NGWLS
        GWL=GWLQ(IGWL)
        IF(FLN)CALL CAPINF
        IF(FLN)CALL TABINF
        IF(FLP)CALL CAPRIS
        IF(FLP)CALL TABEL
  400 CONTINUE
C
      RETURN
      END
C
C*************************************************************************
```

```
C
      SUBROUTINE CAPQUE(ERROR)
C
C ================================================================
C =                                                              =
C =     SUBROUTINE TO READ THE DATA NECESSARY FOR CALCULATION OF =
C =     THE SOIL MOISTURE DISTRIBUTION IN CASE OF INFILTRATION   =
C =     OR CAPILLARY RISE.                                       =
C =                                                              =
C ================================================================
C
      INTEGER PEAT
      LOGICAL CRACK,ERROR
      CHARACTER DESCR,HEAD
      REAL MEDIAN,KSAT,KSATEF
      COMMON/TABDAT/TABPRH(10,80),TABCON(10,80),NUMTAB(10),INTERP
      COMMON/RYTEMA/RYTKO(10),RYTETA(10),RYTA(10),RYTN(10),
     * RYTHA(10),RYTHLM(10)
      COMMON/LINE/SUCLIN(10,4),CONLIN(10,4),ALIN(10,3),BLIN(10,3)
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     * SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     * DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     * MEDIAN(10),NSIZES,CRACK(10)
C
      ERROR=.FALSE.
C
C ----  WHAT METHOD OF CONDUCTIVITY DESCRIPTION?
   10 WRITE(6,1010)
 1010 FORMAT(//,' What method of conductivity description do you use?'
     * ,/,
     * T10,' 0 = Return to main program',/,
     * T10,' 1 = Brooks and Corey',/,
     * T10,' 2 = Bloemen (data should be in memory)',/,
     * T10,' 3 = Rijtema',/,
     * T10,' 4 = Wesseling',/,
     * T10,' 5 = Data given as a table',/,
     * ' Type the method of your choice:  ',$)
      READ(5,*,ERR=10)METHOD
      IF(METHOD.LT.0.OR.METHOD.GT.5)GO TO 10
C
      GO TO (40,50,100,200,300,400),METHOD+1
C
C ========================
C =                      =
C =  RETURN TO MAIN PROGRAM =
C =                      =
C ========================
C
   40 ERROR=.TRUE.
      RETURN
C
C
C ========================
C =                      =
C =  BROOKS AND COREY    =
C =                      =
C ========================
C
```



```
   50 CALL BRCINP
      RETURN
C
C
C
C =====================
C =                   =
C =   BLOEMEN METHOD  =
C =                   =
C =====================
C
  100 IF(NLAYER.NE.0)GO TO 130
      WRITE(6,2010)
 2010 FORMAT(//,' No data available.  Please calculate them first.',/)
      ERROR=.TRUE.
  130 RETURN
C
C =====================
C =                   =
C =   RYTEMA METHOD   =
C =                   =
C =====================
  200 CALL RYTINP
      RETURN
C
C =====================
C =                   =
C =   WESSELING       =
C =                   =
C =====================
  300 CALL LININP
      RETURN
C
C =====================
C =                   =
C =   TABLE INPUT     =
C =                   =
C =====================
  400 CALL TABINP
      RETURN
      END
C
C*********************************************************************
C
      SUBROUTINE FLXQUE
C
C ================================================================
C =                                                              =
C =     SUBROUTINE TO READ THE VALUES OF THE FLUX DENSITIES FOR  =
C =     WHICH THE CALCULATIONS SHOULD BE PERFORMED.              =
C =                                                              =
C ================================================================
C
      INTEGER PEAT
      LOGICAL CRACK
      CHARACTER DESCR,HEAD,ANSWER
      CHARACTER*20 FILNAM
      REAL MEDIAN,KSAT,KSATEF
      DIMENSION FLUXST(15)
      COMMON/QPONEG/NFLNS,NFLNE,NFLPS,NFLPE
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
```

```
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *  METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     *  SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     *  DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     *  MEDIAN(10),NSIZES,CRACK(10)
      DATA FLUXST/-0.5,-0.3,-0.2,-0.1,-0.05,0.0,
     *  0.05,0.1,0.2,0.3,0.5,0.,0.,0.,0./
C
C ----  SHOULD THE STANDARD SET OF FLUX DENSITIES BE USED?
  20    WRITE(6,1010)
 1010   FORMAT(//' Do you want to use the standard set of flux',
     *  ' densities?'/' (1) Only standard set for capillary rise'
     *  /' (2) Only standard set for infiltration'/' (3) Both',
     *  ' standard sets'/' (4) No standard set'/' Please enter',
     *  ' your choice ',$)
        READ(5,*)IANS
        GOTO (1022,1024,1028,40) IANS
        GOTO 20
C
C ----  CAPILLARY RISE STANDARD SET IS USED
 1022   DO 21 I=1,6
          FLUX(I)=FLUXST(I+5)
  21    CONTINUE
        NFLUXS=6
        GOTO 700
C
C ----  INFILTRATION STANDARD SET IS USED
 1024   DO 22 I=1,6
          FLUX(I)=FLUXST(I)
  22    CONTINUE
        NFLUXS=6
        GOTO 700
C
C ----  BOTH STANDARD SETS OF FLUX DENSITIES ARE USED
 1028   DO 30 I=1,11
          FLUX(I)=FLUXST(I)
  30    CONTINUE
        NFLUXS=11
        GO TO 700
C
C ----  READ THE FLUX DENSITIES FROM FILE OR FROM TERMINAL?
  40    WRITE(6,1025)
 1025   FORMAT('+Did you prepare the values of the flux densities in',
     *  ' a file? (Y/N) ',$)
        READ(5,'(A1)')ANSWER
        IF(ANSWER.EQ.'Y')GO TO 400
C
C ----  READING THE VALUES FROM THE TERMINAL
        WRITE(6,1030)
 1030   FORMAT(//,' Type the flux densities of your choice. ',
     *  ' Maximally 10 fluxes are allowed.',/,
     *  ' End with the letter X.',/)
        NFLUXS=0
  50    NFLUXS=NFLUXS+1
        WRITE(6,1040)NFLUXS
 1040   FORMAT('+Flux(',I2,')= ',$)
        READ(5,*,ERR=60)FLUX(NFLUXS)
        IF(NFLUXS.NE.15)GO TO 50
        GO TO 700
  60    NFLUXS=NFLUXS-1
```



```
        GO TO 700
C
C ----  READ THE FLUX DENSITIES FROM FILE
 400    WRITE(6,4010)
 4010   FORMAT('+What is the name of the file with flux densities? ',$)
 420    READ(5,4020)FILNAM
 4020   FORMAT(A20)
        OPEN(UNIT=21,NAME=FILNAM,TYPE='OLD',ERR=430)
        GO TO 440
C
C ----  ERROR OPENING FILE
 430    WRITE(6,4030)FILNAM
 4030   FORMAT(' ??? Error opening file ',A20,' ???',
     *  /,' Retype filename: ',$)
        GO TO 420
C
 440    NFLUXS=0
C ----  READ FLUXES
 450    NFLUXS=NFLUXS+1
C
C ----  ENOUGH FLUX DENSITIES?
        IF(NFLUXS.GT.15)GO TO 480
        READ(21,*,END=480)FLUX(NFLUXS)
        GO TO 450
C
 480    NFLUXS=NFLUXS-1
        CLOSE(UNIT=21)
C
C
C ----  POSITIVE AND NEGATIVE FLUX DENSITIES?
 700    NFLNS=0
        NFLNE=0
        NFLPS=0
        NFLPE=0
C
        DO 800 I=1,NFLUXS
          IFL=I
          IF(FLUX(IFL).LT.0.0)GO TO 820
 800    CONTINUE
        GO TO 900
C
 820    NFLNS=IFL
        IF(NFLNS.EQ.NFLUXS)GO TO 850
        DO 840 I=IFL+1,NFLUXS
          IFL=I
          IF(FLUX(IFL).GT.0.0)GO TO 860
 840    CONTINUE
C
 850    IFL=IFL+1
C
 860    NFLNE=IFL-1
C
C ----  POSITIVE FLUX DENSITIES
 900    DO 920 I=1,NFLUXS
          IFL=I
          IF(FLUX(IFL).GE.0.0)GO TO 940
 920    CONTINUE
        GO TO 999
C
 940    NFLPS=IFL
        IF(NFLPS.EQ.NFLUXS)GO TO 970
```

```
      DO 960 I=IFL+1,NFLUXS
         IFL=I
         IF(FLUX(IFL).LT.0.0)GO TO 980
  960 CONTINUE
  970 IFL=IFL+1
C
  980 NFLPE=IFL-1
      IF(NFLPE.EQ.NFLPS.AND.ABS(FLUX(NFLPE)).LT.1E-6)THEN
         NFLPE=0
         NFLPS=0
      END IF
C
  999 RETURN
      END
C
C*********************************************************************
C
      SUBROUTINE MAXFLX(GWLQ,NGWLS)
C
C ================================================================
C =                                                              =
C =   SUBROUTINE MAXFLX PERFORMS THE CALCULATIONS TO FIND THE    =
C =   MAXIMALLY POSSIBLE FLUX AT GIVEN PRESSURE HEAD AND         =
C =   GROUNDWATER LEVEL                                          =
C =                                                              =
C ================================================================
C
      LOGICAL INTEGR, OPEN
      CHARACTER HEAD, REGEL(100), CI*5
      DIMENSION PRHQ(10),Q(10,15),GWLQ(15)
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
C
C ---- FOR WHICH PRESSURE HEADS SHOULD CALCULATIONS BE PERFORMED?
    5 WRITE(6,2010)
 2010 FORMAT(//,' How many pressure heads should be ',
     * 'considered? (max. 10) ',$)
      READ(5,*)NPRHQ
      IF(NPRHQ.LT.1.OR.NPRHQ.GT.10)GOTO 5
      DO 6 J=1,NPRHQ
 2015    WRITE(6,2020)J
 2020    FORMAT(' Please type pressure head(',I2,') in cm.? ',$)
         READ(5,*)PRHQ(J)
         IF(AMOD(PRHQ(J),100.0).GT.1.0E-5) THEN
              WRITE(6,2025)
 2025         FORMAT(' *** Presssure heads should be multiples',
     *        ' of 100. Try again. ***')
              GOTO 2015
         END IF
         PRHQ(J)=-1.0*ABS(PRHQ(J))
    6 CONTINUE
C
C ---- FOR WHAT LEVEL SHOULD CALCULATIONS BE PERFORMED?
      WRITE(6,2030)
 2030 FORMAT(//,' For which depth below the surface should ',
     * 'calculations be performed? (cm.) ',$)
      READ(5,*)DEPTH
C
C ---- INITIALIZE ARRAY
      DO 20 J=1,10
```



```
         DO 10 I=1,10
            Q(J,I)=0.0
   10    CONTINUE
   20 CONTINUE
C
C ---- GROUNDWATER LEVELS
      WRITE(6,2032)
 2032 FORMAT(//)
      IGWL=0
   25 IGWL=IGWL+1
      GWL=GWLQ(IGWL)
      WRITE(6,2035)IGWL,GWL
 2035 FORMAT('+','I''m working on groundwater level (',I2,'), ',
     * F4.0,' cm.')
C
C ---- CALCULATE POSITION OF GROUNDWATER LEVEL RELATIVE TO TOP OF
C ---- SOIL PROFILE.
C
      THTOT=0.0
      DO 30 ILAYER=1,NLAYER
         LAY=ILAYER
         THTOT=THTOT+THKLAY(LAY)
         IF(THTOT.GE.GWL)GO TO 40
   30 CONTINUE
C
C ---- GROUNDWATERLEVEL BELOW SOIL PROFILE.
      WRITE(6,2040)GWL,THTOT
 2040 FORMAT(//,'  ??? WARNING: GROUNDWATERLEVEL ',F7.1,' BELOW ',
     * ' SOIL PROFILE ',F7.1,' ???')
      DO 35 IPQ=1,NPRHQ
         Q(IPQ,IGWL)=0.0
   35 CONTINUE
      GOTO 210
C
C ---- POSITION OF BOUNDARIES OF LAYERS
   40 THICK(LAY)=GWL-THTOT+THKLAY(LAY)
      IF(LAY.EQ.1)GO TO 55
      DO 50 I=LAY-1,1,-1
         THICK(I)=THICK(I+1)+THKLAY(I)
   50 CONTINUE
C
C ---- START OF ITERATION PROCEDURE
   55 DO 200 IPQ=1,NPRHQ
         PQ=PRHQ(IPQ)
         DO 60 IFQ=1,10
            IFQ1=IFQ
            FQ=IFQ*0.1
            LAYER=LAY
            IF(.NOT.(INTEGR(PQ,FQ,DEPTH)))GOTO 70
   60    CONTINUE
          GOTO 180
C
C ----   SECOND ITERATION ROUND
   70    FQ=0.1*(IFQ1-1)
         DO 100 IFQ=1,9
            FQ=FQ+0.01
            LAYER=LAY
            IF(.NOT.(INTEGR(PQ,FQ,DEPTH)))GOTO 150
  100    CONTINUE
         FQ=FQ+0.01
C
```

```
C ----      ROUNDING THE FLUX
  150       FQ=FQ-0.005
            LAYER=LAY
            IF(.NOT.(INTEGR(PQ,FQ,DEPTH))) THEN
                Q(IPQ,IGWL)=FQ-0.005
            ELSE
                Q(IPQ,IGWL)=FQ+0.005
            END IF
            GOTO 200
C
C ----      FLUX > 10 MM
  180       Q(IPQ,IGWL)=-1.0
C
  200   CONTINUE
C
C ----  NEXT GROUNDWATERLEVEL
  210   IF(IGWL.LT.NGWLS)GOTO 25
        WRITE(6,2045)
 2045   FORMAT('+','I''m ready
     *  '              ')
C
C ----  PREPARING THE OUTPUT
C ----  HEADING
        WRITE(10,2050)(HEAD(I),I=1,80),DEPTH
 2050   FORMAT(///,T45,'MAXIMALLY POSSIBLE FLUXES (cm/day)',/,
     *  T45,'=================================',///,' ',80A1,
     *  T85,'LEVEL OF CALCULATIONS=',F5.0,' CM.  BELOW SURFACE',/)
        WRITE(10,2060)
 2060   FORMAT(' ',130('='))
        WRITE(10,2070)(GWLQ(I),I=1,NGWLS)
 2070   FORMAT('    PR.HEAD',T13,'*',T40,'G R O U N D W A T E R',
     *  '     L E V E L  (CM. BELOW SURFACE)',/,'     (CM.)',
     *  T13,'*',15F7.0)
        WRITE(10,2060)
C
C ----  FLUXES
        DO 300 IPRH=1,NPRHQ
           WRITE(10,2080)PRHQ(IPRH),(Q(IPRH,IGWL),IGWL=1,NGWLS)
 2080      FORMAT(' ',F8.0,T13,'*',15F7.2)
  300   CONTINUE
        WRITE(10,2060)
        WRITE(10,2090)
 2090   FORMAT(/,' NOTE : The figure -1.00 indicates the occurrence',
     *  ' of a flux > 1.0 cm/day !!',/,' ----',///)
C
C ----  PREPARING A PRINTPLOT OF THE RESULTS
  310   WRITE(6,2095)
 2095   FORMAT(/' For which pressure head (cm) do you want a printplot?'/
     *  ' Standard is -1000 cm.    ',$)
        READ(5,*,ERR=410)IPR
        PR=-1.0*ABS(IPR)
        DO 400 J=1,NPRHQ
           IF(ABS(PRHQ(J)-PR).LE.1E-4) THEN
              IPR=J
              GOTO 450
           END IF
  400   CONTINUE
C
C ----  NOT FOUND
  410   WRITE(6,2098)PR
 2098   FORMAT(' Pressure head ',F6.0,' not in memory, try again!')
```



```
        GOTO 310
C
C ----  PRINTPLOT
  450   WRITE(10,2099)(HEAD(I),I=1,80),PR
 2099   FORMAT('1'///T35,'PRINTPLOT OF CAPILLARY RISE (mm/day) VERSUS',
     *  ' GROUNDWATERDEPTH'/T35,60('=')//T12,80A1,T95,'Pressure',
     *  ' head : ',F8.0,' cm.'/)
        DO 900 I=100,0,-2
           DO 480 J=1,100
              REGEL(J)=' '
  480      CONTINUE
           RI=I/100.0
           CI='    !'
           IF (MOD(I,10).EQ.0) THEN
              II=I/10
              WRITE(CI,'(I2)')II
              CI(3:5)=' -!'
           END IF
           DO 500 IGWL=1,NGWLS
              IF ((Q(IPR,IGWL).GE.0.0).AND.(Q(IPR,IGWL).LE.RI)) GOTO 600
  500      CONTINUE
C
C ----     NOT FOUND
           GOTO 800
C
C ----     INTERPOLATION
  600      IF (Q(IPR,IGWL-1).LT.0.0) GOTO 900
           PART=(Q(IPR,IGWL-1)-RI)/(Q(IPR,IGWL-1)-Q(IPR,IGWL))
           PLGWL=GWLQ(IGWL-1)+(GWLQ(IGWL)-GWLQ(IGWL-1))*PART
           IPLGWL=(PLGWL)/2.0+1.5
           REGEL(IPLGWL)='*'
  800      WRITE(10,3000)CI,REGEL
 3000      FORMAT(5X,A5,100A1)
  900   CONTINUE
C
C ----  X-AXIS
        WRITE(10,3010)(I,I=10,200,10)
 3010   FORMAT(10X,20('!----'),'!'/10X,'0 ',20(2X,I3)//T45,'GROUNDWATER',
     *  'LEVEL (cm below surface)')
        RETURN
        END
C
C*************************************************************************
C
        LOGICAL FUNCTION INTEGR(PQ,FQ,DEPTH)
C
C ==============================================================
C =                                                            =
C =     FUNCTION INTEGR PERFORMS THE NUMERICAL INTEGRATION     =
C =                                                            =
C ==============================================================
C
        INTEGER COUNT
        COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
        COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *  METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
C
        INTEGR=.FALSE.
C
C ----  CALCULATION OF HEIGHT OF CAPILLARY RISE
        STEP=-1.0
```

```
      SIZINT=-0.1
      COUNT=-1
      SUCT=0.0
      ZOLD=0.0
      ZH=0.0
      DO 200 ISTEP=1,54
         IF(ISTEP.EQ.1)GO TO 100
C ----   SET HEIGHT EQUAL TO THAT IN PREVIOUS STEP
         IS1=ISTEP-1
         ZOLD=ZH
 100     COUNT=COUNT+1
         IF(COUNT.NE.10)GO TO 110
         COUNT=1
C ----   NEW STEP SIZES
         SIZINT=STEP
         STEP=10.0*STEP
 110     SUCB=SUCT
         SUCT=SUCT+STEP
         SUCL=SUCB-SIZINT
         SUCU=SUCB
C
C ----   DIVIDE INTERVAL IN 10 PIECES AND INTEGRATE
         DO 170 ISIZE=1,10
            SUCL=SUCL+SIZINT
            SUCU=SUCU+SIZINT
            SUCAV=0.5*(SUCL+SUCU)
C
C ----      CONDUCTIVITY
            CAPCON=CONDUC(SUCAV)
C
C ----      HEIGHT OF CAPILLARY RISE
            IF(CAPCON.LT.1.E-16)GO TO 170
            DZ=SIZINT/(1.0 + (FQ/CAPCON))
            IF(DZ.GT.-1.E-16)GO TO 170
            ZH=ZH-DZ
C
C ----      BOUNDARY BETWEEN LAYERS?
            IF(LAYER.EQ.1.OR.ZH.LT.THICK(LAYER))GO TO 140
C
C ----      CORRECTION. FIND BOUNDARY SUCTION
            ZN=THICK(LAYER)
            BOUND=SUCL-(THICK(LAYER)-ZOLD)*(SIZINT/DZ)
C
C ----      NEXT LAYER
            LAYER=LAYER-1
            SUCAV=0.5*(SUCU+BOUND)
C
C ----      CONDUCTIVITY
            CAPCON=CONDUC(SUCAV)
C
C ----      CAPILLARY HEIGHT
            IF(CAPCON.LT.1.E-16)GO TO 170
            DZ=(SUCU-BOUND)/(1.0 + (FQ/CAPCON))
            IF(DZ.GT.-1.E-16)GO TO 170
            ZH=ZN-DZ
C
C ----      HEIGHT
 140        ZOLD=ZH
C
C ----      READY?
            IF(ZH.GE.THICK(1)-DEPTH)GOTO 220
```



```
            IF(SUCAV.LT.FQ)GOTO 250
 170     CONTINUE
C
C ----   READY
C
 200  CONTINUE
      GOTO 250
C
 220  INTEGR=.TRUE.
 250  RETURN
      END
C
C*****************************************************************
C
      SUBROUTINE CAPRIS
C
C ===============================================================
C =                                                             =
C =   SUBROUTINE CAPRIS PERFORMS THE CALCULATIONS TO FIND THE  =
C =   SOIL MOISTURE DISTRIBUTION IN THE PROFILE IN CASE OF     =
C =   CAPILLARY RISE.                                           =
C ===============================================================
C
      INTEGER PEAT,COUNT
      LOGICAL CRACK,HALT,FINISH(15)
      CHARACTER DESCR,HEAD
      REAL MEDIAN,KSAT,KSATEF
      DIMENSION INTPOS(15)
      COMMON/TABDAT/TABPRH(10,80),TABCON(10,80),NUMTAB(10),INTERP
      COMMON/QPONEG/NFLNS,NFLNE,NFLPS,NFLPE
      COMMON/RYTEMA/RYTKO(10),RYTETA(10),RYTA(10),RYTN(10),
     * RYTHA(10),RYTHLM(10)
      COMMON/LINE/SUCLIN(10,4),CONLIN(10,4),ALIN(10,3),BLIN(10,3)
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     * SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     * DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     * MEDIAN(10),NSIZES,CRACK(10)
C
C ---- INITIALIZE ARRAYS
      DO 20 J=1,15
         DO 10 I=1,54
            Z(J,I)=0.0
  10     CONTINUE
         FINISH(J)=.FALSE.
  20  CONTINUE
C
C ---- CALCULATE POSITION OF GROUNDWATER LEVEL RELATIVE TO TOP OF
C ---- SOIL PROFILE.
C
      THTOT=0.0
      DO 30 ILAYER=1,NLAYER
         LAYER=ILAYER
         THTOT=THTOT+THKLAY(LAYER)
         IF(THTOT.GE.GWL)GO TO 40
  30  CONTINUE
C
C ---- GROUNDWATERLEVEL BELOW SOIL PROFILE.
      WRITE(6,1010)GWL,THTOT
```

```
 1010   FORMAT(//,'  ??? WARNING: GROUNDWATERLEVEL ',F7.1,' BELOW ',
     *  ' SOIL PROFILE ',F7.1,' ???')
        GWL=THTOT
C
C ----  POSITION OF BOUNDARIES OF LAYERS
   40   THICK(LAYER)=GWL-THTOT+THKLAY(LAYER)
        IF(LAYER.EQ.1)GO TO 60
        DO 50 I=LAYER-1,1,-1
           THICK(I)=THICK(I+1)+THKLAY(I)
   50   CONTINUE
C
   60   DO 70 I=NFLPS,NFLPE
           INTPOS(I)=LAYER
   70   CONTINUE
C
C ----  CALCULATION OF HEIGHT OF CAPILLARY RISE
        STEP=-1.0
        SIZINT=-0.1
        COUNT=-1
        SUCT=0.0
        DO 200 ISTEP=1,54
           IF(ISTEP.EQ.1)GO TO 100
C ----     SET HEIGHT EQUAL TO THAT IN PREVIOUS STEP
           IS1=ISTEP-1
           DO 90 J=NFLPS,NFLPE
              Z(J,ISTEP)=Z(J,IS1)
   90      CONTINUE
  100      COUNT=COUNT+1
           IF(COUNT.NE.10)GO TO 110
           COUNT=1
C ----     NEW STEP SIZES
           SIZINT=STEP
           STEP=10.0*STEP
  110      SUCB=SUCT
           SUCT=SUCT+STEP
           H(ISTEP)=SUCT
           SUCL=SUCB-SIZINT
           SUCU=SUCB
C
C ----     DIVIDE INTERVAL IN 10 PIECES AND INTEGRATE
           DO 170 ISIZE=1,10
              SUCL=SUCL+SIZINT
              SUCU=SUCU+SIZINT
              DO 150 IFL=NFLPS,NFLPE
                 IFLUX=IFL
C
C ----           ALREADY ABOVE SOIL SURFACE?
                 IF(FINISH(IFLUX))GO TO 150
                 LAYER=INTPOS(IFLUX)
                 SUCAV=0.5*(SUCL+SUCU)
C
C ----           CONDUCTIVITY
                 CAPCON=CONDUC(SUCAV)
C
C ----           HEIGHT OF CAPILLARY RISE
                 IF(CAPCON.LT.1.E-16)GO TO 150
                 DZ=SIZINT/(1.0 + (FLUX(IFLUX)/CAPCON))
                 IF(DZ.GT.-1.E-16)GO TO 150
                 ZH=Z(IFLUX,ISTEP)-DZ
C
C ----           BOUNDARY BETWEEN LAYERS?
```



```
                 IF(LAYER.EQ.1.OR.ZH.LT.THICK(LAYER))GO TO 140
C
C ----           CORRECTION. FIND BOUNDARY SUCTION
                 ZH=THICK(LAYER)
                 BOUND=SUCL-(THICK(LAYER)-Z(IFLUX,ISTEP))*
     *           (SIZINT/DZ)
C
C ----           NEXT LAYER
                 LAYER=LAYER-1
                 INTPOS(IFLUX)=LAYER
                 SUCAV=0.5*(SUCU+BOUND)
C
C ----           CONDUCTIVITY
                 CAPCON=CONDUC(SUCAV)
C
C ----           CAPILLARY HEIGHT
                 IF(CAPCON.LT.1.E-16)GO TO 150
                 DZ=(SUCU-BOUND)/(1.0 + (FLUX(IFLUX)/CAPCON))
                 IF(DZ.GT.-1.E-16)GO TO 150
                 ZH=ZH-DZ
C
C ----           HEIGHT
  140            Z(IFLUX,ISTEP)=ZH
  150         CONTINUE
  170      CONTINUE
C
C ----     READY
           HALT=.TRUE.
           DO 180 I=1,NFLUXS
              IF(FINISH(I))GO TO 180
              IF(Z(I,ISTEP).GT.THICK(1))GO TO 175
              HALT=.FALSE.
              GO TO 180
  175         FINISH(I)=.TRUE.
  180      CONTINUE
           IF(HALT)GO TO 250
  200   CONTINUE
C
  250   RETURN
        END
C
C**********************************************************************
C
        SUBROUTINE CAPINF
C
C =============================================================
C =                                                           =
C =     SUBROUTINE TO CALCULATE PRESSURE HEADS IN CASE OF     =
C =     INFILTRATION.                                         =
C =                                                           =
C =============================================================
C
        INTEGER PEAT,COUNT
        LOGICAL CRACK,ILLFLX(15)
        CHARACTER DESCR,HEAD
        REAL MEDIAN,KSAT,KSATEF
        COMMON/TABDAT/TABPRH(10,80),TABCON(10,80),NUMTAB(10),INTERP
        COMMON/QPONEG/NFLNS,NFLNE,NFLPS,NFLPE
        COMMON/RYTEMA/RYTKO(10),RYTETA(10),RYTA(10),RYTN(10),
     *  RYTHA(10),RYTHLM(10)
        COMMON/LINE/SUCLIN(10,4),CONLIN(10,4),ALIN(10,3),BLIN(10,3)
```

```
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/INFIL/SUCINF(15,51),ZINF(51),NZINF
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     * SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     * DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     * MEDIAN(10),NSIZES,CRACK(10)
C
C
C ---- MAXIMUM ALLOWED NUMBER OF ITERATIONS.
      MAXITR=25
C
C ---- INITIALISATION OF ARRAYS
      DO 5 I=1,15
         ILLFLX(I)=.FALSE.
    5 CONTINUE
C
      DO 20 J=1,51
         DO 10 I=1,15
            SUCINF(I,J)=0.0
   10    CONTINUE
         ZINF(J)=0.0
   20 CONTINUE
C
C ---- POSITION OF GROUNDWATER LEVEL
      THTOT=0.0
      DO 30 ILAYER=1,NLAYER
         LAYER=ILAYER
         THTOT=THTOT+THKLAY(LAYER)
         IF(THTOT.GE.GWL)GO TO 40
   30 CONTINUE
C
C ---- GROUNDWATER LEVEL BELOW DEPTH OF SOIL PROFILE
      WRITE(6,1010)GWL,THTOT
 1010 FORMAT(//,'  ??? WARNING: GROUNDWATERLEVEL ',F7.1,' BELOW ',
     * ' SOIL PROFILE ',F7.1,' ???')
      THTOT=GWL
C
   40 THICK(LAYER)=GWL-THTOT+THKLAY(LAYER)
      IF(LAYER.EQ.1)GO TO 60
      DO 50 I=LAYER-1,1,-1
         THICK(I)=THICK(I+1)+THKLAY(I)
   50 CONTINUE
C
C
C ---- WHAT STEP SIZE?
   60 DZ=IFIX(GWL/50. + 0.999)
C
C
C ---- INTEGRATION
      LAYER=NLAYER
      ZH=0.0
      DZ1=0.05*DZ
      ZAV=-0.25*DZ1
      DO 300 I=2,51
         DO 90 IFLUX=1,NFLUXS
            SUCINF(IFLUX,I)=SUCINF(IFLUX,I-1)
   90    CONTINUE
         DO 290 KL=1,20
            ZH=ZH+DZ1
```



```
C
C ----      AVERAGES
            ZAV=ZAV+DZ1
            IF(ZH.GT.GWL)GO TO 400
            NZINF=I
            ZINF(NZINF)=ZH
            IF(ZAV.LT.THICK(LAYER))GO TO 110
            LAYER=LAYER-1
  110       DO 200 IFLUX=NFLNS,NFLNE
C
C ----         INTEGRATION NECESSARY?
               IF(ILLFLX(IFLUX))GO TO 200
C
C ----         START OF INTEGRATION
               NUMITR=0
               SUCOLD=SUCINF(IFLUX,NZINF)
               SUCNEW=SUCOLD
               SUCANT=SUCOLD
               DO WHILE (NUMITR.LE.MAXITR)
                  SUCAV=(SUCNEW+SUCOLD+SUCANT)/3.0
C
C ----            CONDUCTIVITY
                  CAPCON=CONDUC(SUCAV)
C
C ----            NEW PRESSURE HEAD
                  SUCTST=SUCOLD-DZ1*(1.0+(FLUX(IFLUX)/CAPCON))
C
C ----            IS IT GOOD ENOUGH?
                  IF(ABS(SUCTST-SUCNEW).LT.ABS(0.01*SUCTST))GO TO 150
C
C ----            NO. START ANOTHER ITERATION
                  SUCANT=SUCNEW
                  SUCNEW=SUCTST
                  NUMITR=NUMITR+1
               END DO
C
C ----         REQUIRED ACCURACY NOT REACHED
               WRITE(6,3010)IFLUX,NZINF,MAXITR,SUCTST
 3010          FORMAT(' ??? AT FLUX',I3,' AND HEIGTH',I3,' MAXIMUM',
     *         ' ALLOWED NUMBER OF ITERATIONS (',I3,' ) REACHED.',/,
     *         ' PRESURE HEAD ',F7.2,' CM.  ASSUMED.',//)
C
C ----         CORRECT VALUE
  150          SUCINF(IFLUX,NZINF)=SUCTST
               IF(SUCINF(IFLUX,NZINF).GT.0.0)ILLFLX(IFLUX)=.TRUE.
  200       CONTINUE
  290    CONTINUE
  300 CONTINUE
C ---- ILLEGAL FLUXES?
  400 DO 500 IFLUX=NFLNS,NFLNE
         IF(.NOT.ILLFLX(IFLUX))GO TO 500
         WRITE(6,1090)FLUX(IFLUX)
 1090    FORMAT(///,' ?????  FLUX OF ',F7.4,' CM/DAY IS NOT',
     *   ' REALISTIC FOR THIS SOIL ???')
         DO 450 I=1,51
            SUCINF(IFLUX,I)=0.0
  450    CONTINUE
  500 CONTINUE
C
      RETURN
```

```
      END
C
C*****************************************************************************
C
      SUBROUTINE BRCINP
C
C ===================================================================
C =                                                                 =
C =     SUBROUTINE TO TAKE CARE OF THE INPUT NECESSARY FOR THE      =
C =     CALCULATIONS WHEN THE CONDUCTIVITY IS DESCRIBED ACCORDING TO =
C =     THE BROOKS AND COREY METHOD.                                =
C =                                                                 =
C ===================================================================
C
      INTEGER PEAT
      LOGICAL CRACK
      CHARACTER DESCR,HEAD,ANSWER
      CHARACTER*20 FILNAM
      REAL MEDIAN,KSAT,KSATEF
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     * SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     * DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     * MEDIAN(10),NSIZES,CRACK(10)
C
C ----  INPUT FROM TERMINAL OR FILE?
      WRITE(6,1000)
 1000 FORMAT(/,' Did you prepare the data in a file? (Y/N) ',$)
      READ(5,1010)ANSWER
 1010 FORMAT(A1)
      IF(ANSWER.EQ.'Y')GO TO 300
C
C ----  INPUT FROM TERMINAL
      WRITE(6,1020)
 1020 FORMAT(/,' Give a description of the soil profile.')
      READ(5,1030)(HEAD(I),I=1,80)
 1030 FORMAT(80A1)
C
C ----  READ THE NUMBER OF LAYERS IN THE PROFILE
  110 WRITE(6,1040)
 1040 FORMAT(/,' How many layers are in the profile? ',T60,' ',$)
      READ(5,*,ERR=110)NLAYER
C
C ----  READ THE DATA FOR EACH LAYER
      DO 280 LAYER=1,NLAYER
         WRITE(6,1060)LAYER
 1060    FORMAT(/,' Type a short description of layer ',I2,
     *   ' (max. 15 char.) ? ',T60,' ',$)
         READ(5,1030)(DESCR(LAYER,I),I=1,15)
  150    WRITE(6,1070)LAYER
 1070    FORMAT('+What is the thickness of layer ',I2,
     *   ' (cm.) ?',T60,' ',$)
         READ(5,*,ERR=150)THKLAY(LAYER)
  180    WRITE(6,1090)LAYER
 1090    FORMAT('+What is the effective conductivity of layer ',I2,
     *   ' (cm/day)?',T60,' ',$)
         READ(5,*,ERR=180)KSATEF(LAYER)
  200    WRITE(6,1100)LAYER
 1100    FORMAT('+What is the effective air entry value of layer ',
```



```
     *   I2,' (cm.) ?',T60,' ',$)
         READ(5,*,ERR=200)PSIEFF(LAYER)
         PSIEFF(LAYER)=-1.0*ABS(PSIEFF(LAYER))
  220    WRITE(6,1110)LAYER
 1110    FORMAT('+What is the slope of the pF-curve for layer ',
     *   I2,' ?',T60,' ',$)
         READ(5,*,ERR=220)SLOPES(LAYER)
  240    WRITE(6,1120)LAYER
 1120    FORMAT('+Does horizontal cracking occur in layer ',
     *   I2,' (Y/N) ?',T60,' ',$)
         READ(5,1010)ANSWER
         CRACK(LAYER)=.FALSE.
         IF(ANSWER.EQ.'Y')CRACK(LAYER)=.TRUE.
  280 CONTINUE
      GO TO 500
C
C
C ----  READ DATA FROM FILE
  300 WRITE(6,2010)
 2010 FORMAT(' What is the name of the file? ',$)
  320 READ(5,2015)FILNAM
 2015 FORMAT(A20)
      OPEN(UNIT=21,NAME=FILNAM,TYPE='OLD',ERR=350)
      GO TO 400
C
C ----  ERROR OPENING FILE
  350 WRITE(6,2020)FILNAM
 2020 FORMAT(' ???? Error opening file ',A20,/,
     * ' Retype filename: ',' ',$)
      GO TO 320
C
C ----  READING DATA FROM FILE
  400 READ(21,1030)(HEAD(I),I=1,80)
      NLAYER=1
  430 READ(21,1030,END=450)(DESCR(NLAYER,I),I=1,15)
      READ(21,*)THKLAY(NLAYER),KSATEF(NLAYER),PSIEFF(NLAYER),
     * SLOPES(NLAYER)
      PSIEFF(NLAYER)=-1.0*ABS(PSIEFF(NLAYER))
      READ(21,1010)ANSWER
      CRACK(NLAYER)=.FALSE.
      IF(ANSWER.EQ.'Y')CRACK(NLAYER)=.TRUE.
      NLAYER=NLAYER+1
      IF(NLAYER.LT.11)GO TO 430
C
  450 NLAYER=NLAYER-1
      CLOSE(UNIT=21)
C
C ----  CORRECTION OF CHARACTERISTICS IN CASE OF CRACKING
  500 DO 520 LAYER=1,NLAYER
         SLPCOR(LAYER)= SLOPES(LAYER)
         IF(CRACK(LAYER))SLPCOR(LAYER)=SLPCOR(LAYER)+1.7
         PSICOR(LAYER)= PSIEFF(LAYER)
         IF(CRACK(LAYER).AND.PSIEFF(LAYER).GT.-100.)PSICOR(LAYER)=
     *   -100.0*((-0.01*PSIEFF(LAYER))**(SLOPES(LAYER)/SLPCOR(LAYER))
  520 CONTINUE
C
C
C ----  SHOW DATA JUST READ
      WRITE(10,3010)(HEAD(I),I=1,80)
 3010 FORMAT(///,' ',80A1)
      WRITE(10,3020)
```

```
 3020    FORMAT(///,' ',100('='),/,'  DESCR. ',T20,'THICKNESS',T35,
     *   'EFF. COND. ',T53,'PSIA',T70,'SLOPE',T90,'CRACKING',/,
     *   T23,'(CM)',T35,'(CM/DAY)',T53,'(CM)',/,' ',100('='))
C
         DO 600 LAYER=1,NLAYER
           ANSWER='N'
           IF(CRACK(LAYER))ANSWER='Y'
           WRITE(10,3030)(DESCR(LAYER,I),I=1,15),THKLAY(LAYER),
     *     KSATEF(LAYER),PSIEFF(LAYER),SLOPES(LAYER),ANSWER
  600    CONTINUE
 3030    FORMAT(' ',15A1,T20,F7.2,T35,F8.3,T50,F7.1,T70,F5.2,T94,A1)
         WRITE(10,3040)
 3040    FORMAT(' ',100('='))
C
         RETURN
         END
C
C***********************************************************************
C
         SUBROUTINE RYTINP
C
C =====================================================================
C =                                                                   =
C =      SUBROUTINE TO READ THE DATA REQUIRED WHEN THE HYDRAULIC      =
C =      CONDUCTIVITY IS TO BE DESCRIBED ACCORDING TO RYTEMA.         =
C =                                                                   =
C =====================================================================
C
         REAL KSAT
         CHARACTER HEAD,ANSWER,DESCR
         CHARACTER*20 FILNAM
         COMMON/RYTEMA/RYTKO(10),RYTETA(10),RYTA(10),RYTN(10),
     *   RYTHA(10),RYTHLM(10)
         COMMON/LINE/SUCLIN(10,4),CONLIN(10,4),ALIN(10,3),BLIN(10,3)
         COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
         COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *   METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
C
C ----   READ DATA FROM TERMINAL OR FROM DISK?
         WRITE(6,1010)
 1010    FORMAT(/,' Did you prepare the data in a diskfile? ',
     *   ' (Y/N) ',$)
         READ(5,1020)ANSWER
 1020    FORMAT(A1)
C
         IF(ANSWER.EQ.'Y') GO TO 300
C
C===========================
C=                         =
C=      INPUT FROM TERMINAL  =
C=                         =
C===========================
C
         WRITE(6,2010)
 2010    FORMAT(' Give a description of the soil profile (max. 80 ch.): ')
         READ(5,2020)(HEAD(I),I=1,80)
 2020    FORMAT(80A1)
C
         WRITE(6,2030)
 2030    FORMAT(' Of how many layers does the soil profile consist? ',$)
         READ(5,*)NLAYER
```



```
C
         DO 200 LAYER=1,NLAYER
           WRITE(6,2045)LAYER
 2045      FORMAT(/,' Give a short description of layer',I3,
     *     ' (max. 15 char.) ?',T60,' ',$)
           READ(5,2020)(DESCR(LAYER,I),I=1,15)
           WRITE(6,2050)LAYER
 2050      FORMAT(' What is the saturated conductivity (cm/d) of layer',
     *     I3,' ?',T60,' ',$)
           READ(5,*)RYTKO(LAYER)
           WRITE(6,2070)LAYER
 2070      FORMAT('+What is the air entry value (cm) of layer',I3,
     *     ' ?',T60,' ',$)
           READ(5,*)RYTHA(LAYER)
           RYTHA(LAYER)=-1.0*ABS(RYTHA(LAYER))
           WRITE(6,2080)LAYER
 2080      FORMAT('+What is the value of b for layer',I3,' ?',
     *     T60,' ',$)
           READ(5,*)RYTETA(LAYER)
           WRITE(6,2090)LAYER
 2090      FORMAT('+What is the limiting pressure head (cm) ',
     *     'for layer',I3,' ?',T60,' ',$)
           READ(5,*)RYTHLM(LAYER)
           RYTHLM(LAYER)=-1.0*ABS(RYTHLM(LAYER))
           WRITE(6,2100)LAYER
 2100      FORMAT('+What is the value of the coefficient a of layer',
     *     I3,' ?',T60,' ',$)
           READ(5,*)RYTA(LAYER)
           WRITE(6,2110)LAYER
 2110      FORMAT('+What is the value of coefficient n of layer',I3,
     *     ' ?',T60,' ',$)
           READ(5,*)RYTN(LAYER)
           RYTN(LAYER)=ABS(RYTN(LAYER))
           WRITE(6,2120)LAYER
 2120      FORMAT('+What is the thickness (cm) of layer',I3,' ?',
     *     T60,' ',$)
           READ(5,*)THKLAY(LAYER)
  200    CONTINUE
         GO TO 500
C
C========================
C=                      =
C=      INPUT FROM DISK  =
C=                      =
C========================
C
  300    WRITE(6,3005)
 3005    FORMAT('+What is the name of the datafile? ',$)
  305    READ(5,3006)FILNAM
 3006    FORMAT(A20)
         OPEN(UNIT=21,NAME=FILNAM,TYPE='OLD',ERR=310)
         GO TO 315
C
C ----   ERROR OPENING FILE
  310    WRITE(6,3007)FILNAM
 3007    FORMAT(' ???? Error opening file ',A20,/,' Type correct',
     *   ' filename? ',$)
         GO TO 305
C
C ----   READING DATA
  315    READ(21,3010)(HEAD(I),I=1,80)
```

```
3010  FORMAT(80A1)
      NLAYER=0
 320  NLAYER=NLAYER+1
      READ(21,3015,END=330)(DESCR(NLAYER,I),I=1,15)
3015  FORMAT(15A1)
      READ(21,*)RYTKO(NLAYER),RYTHA(NLAYER),RYTETA(NLAYER),
    * RYTHLM(NLAYER),RYTA(NLAYER),RYTN(NLAYER),THKLAY(NLAYER)
      RYTHA(NLAYER)=-1.0*ABS(RYTHA(NLAYER))
      RYTHLM(NLAYER)=-1.0*ABS(RYTHLM(NLAYER))
      RYTN(LAYER)=ABS(RYTN(LAYER))
      GO TO 320
C
 330  NLAYER=NLAYER-1
      CLOSE(UNIT=21)
C
C
C ----  SHOW THE READ DATA
C       =================
C
 500  WRITE(10,7000)(HEAD(I),I=1,80)
7000  FORMAT(//,' ',80A1,///)
      DO 710 LAYER=1,NLAYER
         WRITE(10,7030)LAYER,(DESCR(LAYER,I),I=1,15),THKLAY(LAYER),
    *    RYTKO(LAYER),RYTHA(LAYER),RYTKO(LAYER),RYTETA(LAYER),
    *    RYTHA(LAYER),RYTHLM(LAYER),RYTHA(LAYER),RYTA(LAYER),
    *    RYTN(LAYER),RYTHLM(LAYER)
 710  CONTINUE
7030  FORMAT(///,' LAYER',I3,T30,15A1,T60,'THICKNESS=',F7.1,' CM.',
    * //,T10,' K =',F10.1,'  CM/DAY',T80,'IF ',F7.1,' <=  H',/,
    * T10,' K =',F10.1,' * EXP(',F8.5,' * (  ',F7.1,' + H ))',
    * T80,'IF ',F7.1,' <= H < ',F7.1,/,T10,' K =',F10.2,
    * ' * ( (-H) ** -',F7.4,')',T80,'IF H < ',F7.1)
C
      RETURN
      END
C
C*************************************************************************
C
      SUBROUTINE LININP
C
C ==============================================================
C =                                                            =
C =     This subroutine reads the data and gives them in a table =
C =     when an approximation of the hydraulic conductivity      =
C =     function by three straight line pieces has been chosen.  =
C =                                                            =
C ==============================================================
C
      REAL KSAT
      CHARACTER HEAD,ANSWER,DESCR
      CHARACTER*20 FILNAM
      COMMON/LINE/SUCLIN(10,4),CONLIN(10,4),ALIN(10,3),BLIN(10,3)
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
    * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
C
C ----  From where should the data be read?
      WRITE(6,1010)
1010  FORMAT(/,' Did you prepare the data in a datafile ',
    * ' (Y/N)? ',$)
      READ(5,1020)ANSWER
```



```
1020  FORMAT(A1)
C
      IF(ANSWER.EQ.'Y') GO TO 300
C
C ----  INPUT FROM TERMINAL
C       ==================
C
      WRITE(6,2010)
2010  FORMAT(' Give a description of the soil profile (max. 80 ch.):'
      READ(5,2020)(HEAD(I),I=1,80)
2020  FORMAT(80A1)
C
      WRITE(6,2030)
2030  FORMAT(' Of how many layers does the profile consist?',T60,
    * ' ',$)
      READ(5,*)NLAYER
C
      DO 200 LAYER=1,NLAYER
         SUCLIN(LAYER,1)=1.0
         WRITE(6,2045)LAYER
2045     FORMAT(' Give a short description of layer',I3,
    *    '(max. 15 char.)?',T60,' ',$)
         READ(5,2020)(DESCR(LAYER,I),I=1,15)
         WRITE(6,2050)LAYER
2050     FORMAT('+Type the saturated conductivity of layer',I3,
    *    ' (cm/d) ?',T60,' ',$)
         READ(5,*)CONLIN(LAYER,1)
         WRITE(6,2070)LAYER
2070     FORMAT('+What is the pressure head (cm) at the first',
    *    ' node of layer',I3,' ?',T60,' ',$)
         READ(5,*)SUCLIN(LAYER,2)
         WRITE(6,2075)LAYER
2075     FORMAT('+What is the conductivity (cm/d) at the first',
    *    ' node of layer',I3,' ?',T60,' ',$)
         READ(5,*)CONLIN(LAYER,2)
         WRITE(6,2080)LAYER
2080     FORMAT('+Type the pressure head (cm) at the second ',
    *    'node of layer',I3,' ?',T60,' ',$)
         READ(5,*)SUCLIN(LAYER,3)
         WRITE(6,2085)LAYER
2085     FORMAT('+Type the conductivity(cm/d) at the second node ',
    *    'of layer',I3,' ?',T60,' ',$)
         READ(5,*)CONLIN(LAYER,3)
         WRITE(6,2090)LAYER
2090     FORMAT('+What is the pressure head (cm) at the last node of'
    *    ' layer',I3,' ?',T60,' ',$)
         READ(5,*)SUCLIN(LAYER,4)
         WRITE(6,2095)LAYER
2095     FORMAT('+What is the conductivity (cm/d) at the last node',
    *    ' of layer',I3,' ?',T60,' ',$)
         READ(5,*)CONLIN(LAYER,4)
         WRITE(6,2100)LAYER
2100     FORMAT('+What is the thickness of layer',I3,' (cm) ?',
    *    T60,' ',$)
         READ(5,*)THKLAY(LAYER)
 200  CONTINUE
      GO TO 500
C
C
C ----  INPUT FROM FILE
C       ==============
C
```

```
C
C ----  FILENAME
  300   WRITE(6,3010)
 3010   FORMAT('+What is the name of the file? ',$)
  310   READ(5,3020)FILNAM
 3020   FORMAT(A20)
        OPEN(UNIT=21,NAME=FILNAM,TYPE='OLD',ERR=317)
        GO TO 319
C
C ----  ERROR IN FILENAME
  317   WRITE(6,3030)FILNAM
 3030   FORMAT(' ???? Error opening file ',A20,/,
     *  ' Please retype filename: ',$)
        GO TO 310
C
C ----  READ SOIL DESCRIPTION
  319   READ(21,3040)(HEAD(I),I=1,80)
 3040   FORMAT(80A1)
C
C ----  DATA FOR EVERY LAYER
        NLAYER=0
  320   NLAYER=NLAYER+1
        READ(21,3050,END=330)(DESCR(NLAYER,I),I=1,15)
 3050   FORMAT(15A1)
        READ(21,*)CONLIN(NLAYER,1),SUCLIN(NLAYER,2),
     *  CONLIN(NLAYER,2),SUCLIN(NLAYER,3),CONLIN(NLAYER,3),
     *  SUCLIN(NLAYER,4),CONLIN(NLAYER,4),THKLAY(NLAYER)
        SUCLIN(NLAYER,1)=1.
        GO TO 320
C
  330   NLAYER=NLAYER-1
        CLOSE(UNIT=21)
C
C
C ----  CHECK THE PRESSURE HEADS
C       =======================
C
  500   DO 520 LAYER=1,NLAYER
           DO 510 I=1,4
              SUCLIN(LAYER,I)=-1.0*ABS(SUCLIN(LAYER,I))
  510      CONTINUE
  520   CONTINUE
C
C ----  CALCULATION OF A AND B IN CONDUCTIVITY = A*(PRESSURE HEAD **B)
        DO 600 LAYER=1,NLAYER
           ALIN(LAYER,1)=CONLIN(LAYER,1)
           BLIN(LAYER,1)=(ALOG(CONLIN(LAYER,2))-ALOG(ALIN(LAYER,1)))/
     *     ALOG(-1.0*SUCLIN(LAYER,2))
           DO 550 I=2,3
              I1=I+1
              BLIN(LAYER,I)=ALOG(CONLIN(LAYER,I1)/CONLIN(LAYER,I))/
     *        ALOG((-1.0*SUCLIN(LAYER,I1))/(-1.0*SUCLIN(LAYER,I)))
              ALIN(LAYER,I)=CONLIN(LAYER,I)/((-1.0*SUCLIN(LAYER,I))**
     *        BLIN(LAYER,I))
  550      CONTINUE
  600   CONTINUE
C
C ----  SHOW THE DATA
C       =============
C
        WRITE(10,7000)(HEAD(I),I=1,80)
```



```
 7000   FORMAT(//,' ',80A1,///)
        WRITE(10,7010)
 7010   FORMAT(' ',132('='))
        WRITE(10,7020)
 7020   FORMAT(' LAYER',T12,4('SUCTION',8X,'CONDUC',7X),/,' ',T14,
     *  4('(CM)',8X,'(CM/DAY)',8X))
        WRITE(10,7010)
        DO 710 LAYER=1,NLAYER
           WRITE(10,7030)LAYER,(SUCLIN(LAYER,I),CONLIN(LAYER,I),I=1,4)
 7030      FORMAT(' ',I3,6X,4(E11.4,2X,E11.4,4X))
  710   CONTINUE
        WRITE(10,7010)
C
        WRITE(10,7050)
 7050   FORMAT(/////)
        WRITE(10,7010)
        WRITE(10,7060)(I,I,I=1,3)
 7060   FORMAT(T10,' LAYER',T37,3('A',I1,13X,'B',I1,13X),T121,
     *  'THICKNESS',/,T122,' (CM)')
        WRITE(10,7010)
        DO 740 LAYER=1,NLAYER
           WRITE(10,7070)LAYER,(DESCR(LAYER,I),I=1,15),(ALIN(LAYER,I),
     *     BLIN(LAYER,I),I=1,3),THKLAY(LAYER)
 7070      FORMAT(' ',I3,3X,15A1,10X,3(E10.3,3X,E10.3,6X),T120,F8.1)
  740   CONTINUE
        WRITE(10,7010)
C
        RETURN
        END
C
C*********************************************************************
C
        SUBROUTINE TABINP
C =========================================================
C =                                                       =
C =     SUBROUTINE TO READ THE K-H RELATION OF A SOIL WHEN  =
C =     IT IS DESCRIBED BY A TABLE OF VALUES.               =
C =                                                       =
C =========================================================
C
        CHARACTER DESCR,HEAD
        CHARACTER*20 FILNAM
        CHARACTER*11 INTTXT(2)
        REAL KSAT
        COMMON/TABDAT/TABPRH(10,80),TABCON(10,80),NUMTAB(10),INTERP
        COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
        COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *  METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
        DATA INTTXT/'LINEAR     ','LOGARITHMIC'/
C
C
C ----  INITIALISATION
        DO 20 I=1,10
           DO 10 J=1,80
              TABPRH(I,J)=0.0
              TABCON(I,J)=0.0
   10      CONTINUE
           NUMTAB(I)=0
   20   CONTINUE
C
C
```

```
C ----  WHERE ARE THE DATA?
        WRITE(6,1010)
 1010   FORMAT(//,' What file contains the required data? ',$)
  110   READ(5,1020)FILNAM
 1020   FORMAT(A20)
        OPEN(UNIT=21,NAME=FILNAM,TYPE='OLD',ERR=120)
        GO TO 130
C
C ----  ERROR
  120   WRITE(6,1030)FILNAM
 1030   FORMAT(' ???? Error opening file ',A20,/,
     *  ' Please retype filename: ',$)
        GO TO 110
C
C ----  READING THE DATA
  130   READ(21,1040)(HEAD(I),I=1,80)
 1040   FORMAT(80A1)
C
        NLAYER=0
  140   NLAYER=NLAYER+1
        IF(NLAYER.GT.10)GO TO 200
        READ(21,1050,END=200)(DESCR(NLAYER,I),I=1,15)
 1050   FORMAT(15A1)
        READ(21,*,END=200)THKLAY(NLAYER)
        READ(21,*,END=200)NT
        NUMTAB(NLAYER)=NT
        READ(21,*)(TABPRH(NLAYER,I),I=1,NT)
        READ(21,*)(TABCON(NLAYER,I),I=1,NT)
        DO 190 I=1,NT
           TABPRH(NLAYER,I)=-1.0*ABS(TABPRH(NLAYER,I))
  190   CONTINUE
        GO TO 140
C
  200   NLAYER=NLAYER-1
        CLOSE(UNIT=21)
C
C ----  KIND OF INTERPOLATION
 1100   WRITE(6,1110)
 1110   FORMAT(//,' What kind of interpolation between the',
     *  ' points in the table do you want?',/,' Linear (type 1),',
     *  ' or logarithmic (type 2)     ',$)
        READ(5,1120)INTERP
 1120   FORMAT(I1)
        IF((INTERP.NE.1).AND.(INTERP.NE.2))GOTO 1100
C
C ----  SHOW THE DATA
        WRITE(10,2010)(HEAD(I),I=1,80)
 2010   FORMAT(///,' ',80A1,///)
C
        DO 300 LAYER=1,NLAYER
           WRITE(10,2020)LAYER,(DESCR(LAYER,I),I=1,15),THKLAY(LAYER),
     *     INTTXT(INTERP)
 2020      FORMAT(//,T10,' LAYER ',I2,T30,15A1,T50,'THICKNESS=',F7.1,
     *     ' CM.',T85,'INTERPOLATION:  ',A11,/,' ',131('='),/,
     *     T4,4(' PRESS.HEAD',2X,'CONDUCTIVITY',6X),/,131('='))
           NROW=0.25 * NUMTAB(LAYER) + 1.0
           IF(MOD(NUMTAB(LAYER),4).EQ.0)NROW=NROW-1
           DO 250 NR=1,NROW
              NRX=NR
              WRITE(10,2030)(TABPRH(LAYER,NRX+J*NROW),
     *        TABCON(LAYER,NRX+J*NROW),J=0,3)
```



```
 2030         FORMAT(' ',T4,4(E11.4,3X,E11.4,6X))
  250      CONTINUE
           WRITE(10,2040)
 2040      FORMAT(' ',131('='),//)
  300   CONTINUE
C
        RETURN
        END
C
C***********************************************************************
C
        FUNCTION CONDUC(SUC)
C
C ======================================================================
C =                                                                    =
C =     FUNCTION TO CALCULATE THE HYDRAULIC CONDUCTIVITY BELONGING     =
C =     TO A SPECIFIED PRESSURE HEAD.                                  =
C =                                                                    =
C ======================================================================
C
        INTEGER PEAT
        LOGICAL CRACK
        CHARACTER DESCR,HEAD
        REAL MEDIAN,KSAT,KSATEF
        COMMON/TABDAT/TABPRH(10,80),TABCON(10,80),NUMTAB(10),INTERP
        COMMON/RYTEMA/RYTKO(10),RYTETA(10),RYTA(10),RYTN(10),
     *  RYTHA(10),RYTHLM(10)
        COMMON/LINE/SUCLIN(10,4),CONLIN(10,4),ALIN(10,3),BLIN(10,3)
        COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
        COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *  METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
        COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     *  SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     *  DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     *  MEDIAN(10),NSIZES,CRACK(10)
C
C ----  WHAT METHOD OF CONDUCTIVITY DESCRIPTION IS IN USE?
        GO TO (90,90,200,300,400),METHOD
C
C
C ============================
C =                          =
C =     METHODS BLOEMEN AND  =
C =        BROOKS AND COREY  =
C =                          =
C ============================
C
   90   IF(SUC.LT.PSIEFF(LAYER))GO TO 100
        CONDUC=KSATEF(LAYER)
        GO TO 800
C
C ----  EFFECTIVE CRACKS?
  100   IF(CRACK(LAYER).AND.SUC.LT.-100.0)GO TO 120
C ----  NO CRACKS
        CONDUC=KSATEF(LAYER)*((PSIEFF(LAYER)/SUC)**SLOPES(LAYER))
        GO TO 800
C
C ----  CRACKS.
  120   CONDUC=KSATEF(LAYER)*((PSICOR(LAYER)/SUC)**SLPCOR(LAYER))
C
        GO TO 800
```

```
C
C
C =========================
C =                       =
C =     METHOD RIJTEMA    =
C =                       =
C =========================
C
  200   IF(SUC.LT.RYTHA(LAYER))GO TO 220
        CONDUC=RYTKO(LAYER)
        GO TO 800
C
  220   IF(SUC.LT.RYTHLM(LAYER))GO TO 240
        CONDUC=RYTKO(LAYER)*EXP(RYTETA(LAYER)*(SUC-RYTHA(LAYER)))
        GO TO 800
C
  240   CONDUC=RYTA(LAYER)*((-1.0*SUC)**(-1.0*RYTN(LAYER)))
        GO TO 800
C
C
C ============================
C =                          =
C =     STRAIGHT LINES       =
C =                          =
C ============================
C

  300   IF(SUC.LE.SUCLIN(LAYER,1))GO TO 310
        CONDUC=CONLIN(LAYER,1)
        GO TO 800
C
  310   IF(SUC.LE.SUCLIN(LAYER,4))GO TO 340
        IF(SUC.LE.SUCLIN(LAYER,2))GO TO 320
        CONDUC=ALIN(LAYER,1)*((-1.0*SUC)**BLIN(LAYER,1))
        GO TO 800
C
  320   IF(SUC.GT.SUCLIN(LAYER,3))GO TO 330
        CONDUC=ALIN(LAYER,2)*((-1.0*SUC)**BLIN(LAYER,2))
        GO TO 800
C
  330   CONDUC=ALIN(LAYER,3)*((-1.0*SUC)**BLIN(LAYER,3))
        GO TO 800
C
  340   CONDUC=0.0
        GO TO 800
C
C =========================
C =                       =
C =     TABEL             =
C =                       =
C =========================
C
  400   IF(SUC.GT.TABPRH(LAYER,1))GO TO 420
        CONDUC=TABCON(LAYER,1)
        GO TO 800
C
  420   NT=NUMTAB(LAYER)
        IF(SUC.LT.TABPRH(LAYER,NT))GO TO 440
        CONDUC=TABCON(LAYER,NT)
        GO TO 800
C
```



```
  440   DO 460 I=2,NT
           IPOS=I
           IF(SUC.LT.TABPRH(LAYER,IPOS))GO TO 480
  460   CONTINUE
C
        WRITE(6,4010)SUC,TABCON(LAYER,NT)
 4010   FORMAT(' ???? Conductivity belonging to pressure head ',
     *  E11.3,' was not found.  ',E11.3,' cm/day assumed ????')
        CONDUC=TABCON(LAYER,NT)
        GO TO 800
C
  480   IP1=IPOS-1
        IF(INTERP.EQ.2)GOTO 500
C
C ----  LINEAR INTERPOLATION
        CONDUC=TABCON(LAYER,IP1)+(SUC-TABPRH(LAYER,IP1))*
     *  (TABCON(LAYER,IPOS)-TABCON(LAYER,IP1))/
     *  (TABPRH(LAYER,IPOS)-TABPRH(LAYER,IP1))
        GOTO 800
C
C ----  LOGARITHMIC INTERPOLATION
  500   PRHLOGL=ALOG10(ABS(TABPRH(LAYER,IP1)))
        PRHLOGU=ALOG10(ABS(TABPRH(LAYER,IPOS)))
        PRHLOG=ALOG10(ABS(SUC))
        CONLOGL=ALOG10(TABCON(LAYER,IP1))
        CONLOGU=ALOG10(TABCON(LAYER,IPOS))
C
        CONLOG=CONLOGL+(CONLOGU-CONLOGL)*(PRHLOGL-PRHLOG)
     *  /(PRHLOGL-PRHLOGU)
        CONDUC=10.0**CONLOG
C
  800   RETURN
        END
C
C*********************************************************************
C
        SUBROUTINE TABINF
C ==================================================================
C =                                                                =
C =     SUBROUTINE TO MAKE A TABLE AND A PRINTPLOT OF PRESSURE     =
C =     HEADS BELONGING TO SOME HEIGHTS ABOVE THE GROUNDWATER      =
C =     LEVEL IN CASE OF INFILTRATION AND SOME SPECIFIED FLUX      =
C =     DENSITIES.                                                 =
C =                                                                =
C ==================================================================
C
        INTEGER PEAT
        LOGICAL CRACK,JUMP,BOUND(50),TXT(50),FILL
        CHARACTER DESCR,HEAD,PLCHAR(15),REGEL(120),DOT,TEXT*10
        REAL MEDIAN,KSAT,KSATEF
        DIMENSION OUT(15),IOLPOS(15)
        COMMON/GPONEG/NFLNS,NFLNE,NFLPS,NFLPE
        COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
        COMMON/INFIL/SUCINF(15,51),ZINF(51),NZINF
        COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     *  METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
        COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     *  SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     *  DIFPER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     *  MEDIAN(10),NSIZES,CRACK(10)
C
```

```
      DATA PLCHAR/'A','B','C','D','E','F','G','H','I','J',
     *'K','L','M','N','O'/,DOT/'.'/
C
C ----   THE HEADING AND THE USED GROUNDWATERLEVEL
      WRITE(10,1010)(HEAD(I),I=1,80),GWL
 1010 FORMAT('1',T50,' PRESSURE HEADS IN CASE OF INFILTRATION.',/,
     *          T50,' ======================================',//,
     *' ',80A1,T95,' GROUNDWATERLEVEL =',F7.1,' CM.',//)
C
C ----   THE FLUX DENSITIES
      WRITE(10,1020)
 1020 FORMAT(' ',130('='))
      WRITE(10,1030)(FLUX(I),I=NFLNS,NFLNE)
 1030 FORMAT('     Z',T13,'*',T45,'F L U X   D E N S I T I E S ',
     *'(CM/DAY)',/,'    CM.',T13,'*',15F7.3)
      WRITE(10,1020)
C
C ----   THE PRESSURE HEADS
      DO 100 IZ=2,NZINF
         WRITE(10,1040)ZINF(IZ),(SUCINF(IFL,IZ),IFL=NFLNS,NFLNE)
  100 CONTINUE
 1040 FORMAT(' ',F6.0,T13,'*',15F7.1)
C
  200 WRITE(10,1020)
C
C ----   PRINTPLOT OF RESULTS
      DO 12 I=1,15
         IOLPOS(I)=0
   12 CONTINUE
      DO 13 I=1,50
         BOUND(I)=.FALSE.
         TXT(I)=.FALSE.
   13 CONTINUE
C
      WRITE(10,1050)(HEAD(I),I=1,80),GWL
 1050 FORMAT(T30,'PRESSUREHEAD PROFILES IN CASE OF INFILTRATION'
     */T30,45('=')/' Z (cm) !'/' above  !',5X,80A1,T80,'Ground'
     *'waterdepth =',F6.1,' cm.'/' g.w.l.  !'/' ',7('-'),'+',121('-'))
C
      IL=1
C
C ----   SEARCHING FOR BOUNDARIES AND TEXTPOSITIONS
      IF ((NLAYER.EQ.1).OR.(ABS(THICK(2)-GWL).LE.1E-6)) THEN
           TXT(25)=.TRUE.
           GOTO 57
      END IF
      ILAY=2
      IGOLD=1
      ITEL=0
      DO 51 IZ=NZINF,2,-1
         ITEL=ITEL+1
         RZ=ZINF(IZ)
         IF (RZ.LE.THICK(ILAY)) THEN
            IF (ZINF(IZ+1)-THICK(ILAY).LT.THICK(ILAY)-RZ) THEN
               IGNEW=ITEL-1
            ELSE
               IGNEW=ITEL
            END IF
            BOUND(IGNEW)=.TRUE.
            ITXT=(IGNEW+IGOLD)/2
            TXT(ITXT)=.TRUE.
```



```
            IGOLD=IGNEW
            ILAY=ILAY+1
            IF (ILAY.GT.NLAYER) GOTO 56
         END IF
   51 CONTINUE
   56 ITXT=(50+IGOLD)/2
      TXT(ITXT)=.TRUE.
C
C ----   BUILDING THE LINES
   57 ITEL=0
      DO 80 IZ=NZINF,2,-1
         ITEL=ITEL+1
         RZ=ZINF(IZ)
         DO 52 I=1,120
           REGEL(I)=' '
   52    CONTINUE
         FLX='                    '
C
C ----   INSERTING BOUNDARIES AND TEXT
         IF (BOUND(ITEL)) THEN
            DO 53 I=1,120,2
              REGEL(I)=DOT
   53       CONTINUE
         END IF
         IF (TXT(ITEL)) THEN
            DO 54 I=1,15
               REGEL(I+2)=DESCR(IL,I)
   54       CONTINUE
            IL=IL+1
         END IF
C
         DO 70 IFLUX=NFLNS,NFLNE
            POS=ABS(SUCINF(IFLUX,IZ))
            IPOS=INT(POS/2.5+0.5)
            IF(IPOS.EQ.0)GOTO 70
C
C ----      INSERTING TEXT
            IF(IZ.EQ.NZINF)THEN
               WRITE(TEXT,'(F5.2)')FLUX(IFLUX)
               TEXT(6:10)=' cm/d'
               DO 62 I=1,10
                 REGEL(IPOS+1+I)=TEXT(I:I)
   62          CONTINUE
            END IF
C
C ----      FILLING LARGE GAPS
            FILL=.FALSE.
            IF(IZ.NE.NZINF)THEN
               IF (IOLPOS(IFLUX)-IPOS.GT.2) THEN
                  IFROM=IPOS
                  ITO=IOLPOS(IFLUX)
                  FILL=.TRUE.
               ELSE IF (IPOS-IOLPOS(IFLUX).GT.2) THEN
                  IFROM=IOLPOS(IFLUX)
                  ITO=IPOS
                  FILL=.TRUE.
               END IF
               IF (FILL) THEN
                  DO 63 I=IFROM+2,ITO-2,2
                     IF (REGEL(I).EQ.' '.OR.REGEL(I).EQ.DOT) THEN
                        REGEL(I)=PLCHAR(IFLUX)
```

```
                  ELSE
                     REGEL(I)='*'
                  END IF
   63          CONTINUE
            END IF
         END IF
C
C ----   INSERTING PLOTCHARACTERS
         IF (REGEL(IPOS).EQ.' '.OR.REGEL(IPOS).EQ.DOT) THEN
            REGEL(IPOS)=PLCHAR(IFLUX)
         ELSE
            REGEL(IPOS)='*'
         END IF
         IOLPOS(IFLUX)=IPOS
   70   CONTINUE
        WRITE(10,1100)RZ,REGEL
 1100   FORMAT(F6.0,T9,'|',120A1)
   80 CONTINUE
      WRITE(10,1110)(I,I=0,300,10)
 1110 FORMAT(T9,30('|---'),'|'/T9,I1,1X,30(1X,I3)
     * //T50,'|PRESSURE HEAD| (cm)')
      RETURN
      END
C
C************************************************************************
C
      SUBROUTINE TABEL
C ==================================================================
C =                                                                =
C =   SUBROUTINE TO MAKE A TABLE AND A PRINTPLOT OF THE            =
C =   CALCULATED VALUES OF THE HEIGHT OF CAPILLARY RISE RELATED    =
C =   TO THE USED PRESSURE HEADS.                                  =
C ==================================================================
C
      INTEGER PEAT
      LOGICAL CRACK,JUMP,EERSTE(15),TOP,BOUND(50),TXT(50)
      CHARACTER DESCR,HEAD,PLCHAR(15),REGEL(100),FLX*13,TOPFLX*13,DOT
      REAL MEDIAN,KSAT,KSATEF
      DIMENSION OUT(15),IOLPOS(15)
      COMMON/QPONEG/NFLNS,NFLNE,NFLPS,NFLPE
      COMMON/SOIL/THICK(10),THKLAY(10),GWL,DESCR(10,15)
      COMMON/RISE/KSAT(10),PSIA(10),Z(15,54),H(54),FLUX(15),
     * METHOD,NFLUXS,NLAYER,LAYER,HEAD(80)
      COMMON/BLOEM/KSATEF(10),PSICOR(10),PSIEFF(10),PSIO(10),
     * SLOPES(10),SLOPE(10),SLPCOR(10),F(10),REDUC(10),
     * DIFFER(10,15),SIZE(15),BULK(10),PEAT(10),HUMUS(10),
     * MEDIAN(10),NSIZES,CRACK(10)
C
      DATA PLCHAR/'A','B','C','D','E','F','G','H','I','J',
     * 'K','L','M','N','O'/,DOT/'.'/
C
      TOP=.FALSE.
      DO 12 I=1,15
         IOLPOS(I)=0
         EERSTE(I)=.TRUE.
   12 CONTINUE
      DO 13 I=1,50
         BOUND(I)=.FALSE.
         TXT(I)=.FALSE.
   13 CONTINUE
C
```



```
C ----  THE HEADING AND USED GROUNDWATER LEVEL
      WRITE(10,1010)(HEAD(I),I=1,80),GWL
 1010 FORMAT('1',T50,' HEIGHT OF CAPILLARY RISE.',/,
     * T50,' =========================',/,' ',80A1,T95,
     * ' GROUNDWATERLEVEL =',F7.1,' CM.')
C
C ----  THE FLUX DENSITIES FOR WHICH THE HEIGHTS ARE CALCULATED
      WRITE(10,1020)
 1020 FORMAT(' ',130('='))
      WRITE(10,1030)(FLUX(I),I=NFLPS,NFLPE)
 1030 FORMAT(' PR.HEAD',T13,'*',T45,'F L U X   D E N S I T I E S ',
     * '(CM/DAY)',/,'    CM.',T13,'*',15F7.3)
      WRITE(10,1020)
C
C ----  THE HEIGHTS
      DO 100 ISUCT=1,53
         JUMP=.TRUE.
         DO 50 IFLUX=NFLPS,NFLPE
            OUT(IFLUX)=0.0
            IF(Z(IFLUX,ISUCT).LT.1.0E-3)GO TO 50
            IF(Z(IFLUX,ISUCT).LE.THICK(1))GO TO 40
            IF(Z(IFLUX,ISUCT-1).LE.THICK(1))GO TO 40
            GO TO 50
   40       JUMP=.FALSE.
            OUT(IFLUX)=Z(IFLUX,ISUCT)
   50    CONTINUE
         IF(JUMP)GO TO 200
           WRITE(10,1040)H(ISUCT),(OUT(IFLUX),IFLUX=NFLPS,NFLPE)
  100 CONTINUE
 1040 FORMAT(' ',F8.0,T13,'*',15F7.1)
C
  200 WRITE(10,1020)
C
C
C ----  PRINTPLOT OF RESULTS
      WRITE(10,1050)(HEAD(I),I=1,80),GWL
 1050 FORMAT(T50,'HEIGHT OF CAPILLARY RISE'/T50,24('=')/
     * ' Z (cm) |'/' above  |',5X,80A1,T80,'GROUNDWATERDEPTH =',
     * F6.1,' CM.'/' g.w.l.  |'/' ',7('-'),'+',100('-'))
C
      STEP=GWL/50.
      ISTEP=INT(STEP+0.5)
      IGWL=INT(GWL+0.5)
      IL=1
C
C ----  SEARCHING FOR BOUNDARIES AND TEXTPOSITIONS
      IF ((NLAYER.EQ.1).OR.(ABS(THICK(2)-GWL).LE.1E-6)) THEN
           TXT(25)=.TRUE.
           GOTO 57
      END IF
      ILAY=2
      IGOLD=1
      ITEL=0
      DO 51 IZ=IGWL,ISTEP,-1*ISTEP
         ITEL=ITEL+1
         RZ=IZ*1.0
         IF (RZ.LE.THICK(ILAY)) THEN
            IF (RZ+STEP-THICK(ILAY).LT.THICK(ILAY)-RZ) THEN
               IGNEW=ITEL-1
            ELSE
               IGNEW=ITEL
```

```
         END IF
         BOUND(IGNEW)=.TRUE.
         ITXT=(IGNEW+IGOLD)/2
         TXT(ITXT)=.TRUE.
         IGOLD=IGNEW
         ILAY=ILAY+1
         IF (ILAY.GT.NLAYER) GOTO 56
      END IF
   51 CONTINUE
   56 ITXT=(50+IGOLD)/2
      TXT(ITXT)=.TRUE.
C
C ----  BUILDING THE LINES
   57 ITEL=0
      DO 80 IZ=IGWL,ISTEP,-1*ISTEP
         ITEL=ITEL+1
         RZ=IZ*1.0
         DO 52 I=1,100
           REGEL(I)=' '
   52    CONTINUE
         FLX='
C
C ----   INSERTING BOUNDARIES AND TEXT
         IF (BOUND(ITEL)) THEN
            DO 53 I=1,100,2
              REGEL(I)=DOT
   53       CONTINUE
         END IF
         IF (TXT(ITEL)) THEN
            DO 54 I=1,15
               REGEL(I+2)=DESCR(IL,I)
   54       CONTINUE
            IL=IL+1
         END IF
C
         DO 70 IFLUX=NFLPS,NFLPE
            DO 55 ISUC=1,53
              IF (Z(IFLUX,ISUC).GT.RZ) GOTO 60
   55       CONTINUE
C ----      NOT FOUND
            GOTO 70
   60       POS=(RZ-Z(IFLUX,ISUC-1))/(Z(IFLUX,ISUC)-Z(IFLUX,ISUC-1))
     *      *(H(ISUC)-H(ISUC-1))+H(ISUC-1)
            IF (ABS(POS).LE.1E-6) GOTO 70
            IPOS=INT(ALOG10(ABS(POS))*20+0.5)
C
C ----      FILLING LARGE GAPS
            IF (IOLPOS(IFLUX)-IPOS.GT.2.AND..NOT.EERSTE(IFLUX)) THEN
              DO 63 I=IPOS+2,IOLPOS(IFLUX)-2,2
                 IF (REGEL(I).EQ.' '.OR.REGEL(I).EQ.DOT) THEN
                    REGEL(I)=PLCHAR(IFLUX)
                 ELSE
                    REGEL(I)='*'
                 END IF
   63         CONTINUE
              IOLPOS(IFLUX)=I
            END IF
C
C ----      INSERTING PLOTCHARACTERS
            IF (REGEL(IPOS).EQ.' '.OR.REGEL(IPOS).EQ.DOT) THEN
               REGEL(IPOS)=PLCHAR(IFLUX)
            ELSE
               REGEL(IPOS)='*'
            END IF
            IOLPOS(IFLUX)=IPOS
            IF (EERSTE(IFLUX)) THEN
               IF (IZ.EQ.IGWL) THEN
                  TOP=.TRUE.
                  WRITE(TOPFLX,'(F5.3)').FLUX(IFLUX)
                  TOPFLX(6:13)=' cm/day.'
                  ITOPOS=IPOS+3
               ELSE
                  DO 65 I=IPOS+2,100,2
                     REGEL(I)=PLCHAR(IFLUX)
   65             CONTINUE
                  WRITE(FLX,'(F5.3)')FLUX(IFLUX)
                  FLX(6:13)=' cm/day.'
               END IF
               EERSTE(IFLUX)=.FALSE.
            END IF
   70    CONTINUE
         IF (TOP.AND.IZ.EQ.IGWL) THEN
            DO 75 I=ITOPOS,ITOPOS+12
               REGEL(I)=TOPFLX(I-ITOPOS+1:I-ITOPOS+1)
   75       CONTINUE
            WRITE(10,1090)RZ,REGEL
 1090       FORMAT(F6.0,T9,'!',100A1)
         ELSE
            WRITE(10,1100)RZ,REGEL,FLX
 1100       FORMAT(F6.0,T9,'!',100A1,3X,A13)
         END IF
   80 CONTINUE
      WRITE(10,1110)(1E0,1E1,1E2,1E3,1E4,1E5)
 1110 FORMAT(T9,5('!',19('-')),'!'/T6,5(E6.1E1,14X),E6.1E1,
     *//T50,'!PRESSURE HEAD! (cm)')
      RETURN
      END
```