QUEEN'S UNIVERSITY

DEPARTMENT OD CIVIL ENGINEERING

SOIL MECHANICS SECTION

PROGRAM "FEDAR"

USER'S MANUAL

DATE: 7/25/67

LANGUAGE: FORTRAN IV H LEVEL

PROGRAMMERS: R.C. TAYLOR AND C.B. BROWN
/UNIV. OF CALIF., BERKLEY/

DESCRIPTION: FEDAR is a Finite Element analysis of DARcy flow problems. It can handle anisotropy, inhomogeneity, and phreatic surfaces. The material properties must be constant. Both plane and axially symmetric problems can be run.

PROGRAM CAPABILITIES: The program can accept quadrilateral and triangular elements in any combination. The following are the restrictions on input:

Number of nodes:	~~100~~ 250
Number of elements:	~~100~~ 220
Number of materials:	~~50~~ 20
Greatest difference between node numbers in any element:	~~60~~ 40

The program can iterate to find the phreatic surface. The iteration involves regenerating the node and element array at each iteration.

Output includes a reprint of the input problem, nodal pressures or temperatures and equipotential values, and flux rates at the center of each element. For phraetic surface problems the mesh correction is printed at the end of each iteration.

INPUT DATA FORMAT: The first step in the analysis is to select a finite element representation for the region of interest. If a free surface is involved, an estimate of the location should be made to expedite the computations. Elements and nodal points are then numbered in two numerical sequences each starting with one. The following group of punched cards numerically define the region to be analyzed.

A IDENTIFICATION CARD - /20A4/

Columns 1 to 80 of this card contain information to be printed as title with results /Format A/

B CONTROL CARD - /6I5, 3F10.0, I5/

		Format
Columns 1-5	Number of Nodes	I
6-10	Number of Elements	I
11-15	Number of Materials	I
16-20	Number of Free Surface Correction Nodes /variable nodes on phraetic line/	I
21-25	Type of Problem 0 = Axisymmetric flow 1 = Plane flow	I
26-30	Number of Flow Cards	I
31-40	Height for Equipotential Reference	F
41-50	Total Available Head	F
51-60	Free Surface Correction Factor Must be between 0.5 and 1.5	F
61-65	Number of Iterations for free surface	I
66-70	SCALE	I
71-75	FACTOR TO DIVIDE ΔH	I

C MATERIAL IDENTIFICATION CARDS /I5, 3F10.0/

One card for each material /12/

Columns	Item	Format
1-5	Material Number	I
6-15	Principal Permeability 1	F
16-25	Principal Permeability 2	F
26-35	Fluid Weight /ρg/	F

The 1 axis is measured with respect to X/or R/

The equipotential lines are calculated assuming the whole space is filled with a fluid weight equal to the fluid weight of material one. The pressures take into account different fluid pressures. The equipotential lines are calculated after the main matrix has been solved.

D NODAL CARDS - /215, 3F10.0/

One card for each node with the information

Columns	Item	Format
1-5	Node	I
8-10	Boundary Condition	I
11-20	X /of R/ ordinate	F
21-30	Y /or Z/ ordinate	F
31-40	F	F

If the number in column 10 is

Negative - F is the amount of fluid added at a node /i.e.F = 0 means node point on impermeable boundary/

Zero - No fluid lost /internal node/

Positive - F is the pressure at the node in same units as dimensions X and Y

Nodal Cards must be in numerical sequence. If cards are omitted, the omitted nodal points are generated at equal intervals along a straight line between the defined nodal points. The boundary code and F are set equal to zero. An auxiliary non-zero punch in column 6 or 7 causes the boundary code of the node defined to be reproduced until the next node is defined; the force is distributed on a straight line with equal increments.

E ELEMENT CARDS /6I5, F10.0/

One card for each element

Columns	Item	Format
1-5	Element	I
6-10	Node I	I
11-15	Node J	I
16-20	Node K	I
21-25	Node L	I
26-30	Material Identification	I
31-40	Angle in degrees between X /or R/ and principal permeability 1 direction /anticlockwise positive/	F

Element Cards must be in element sequence. If element cards are omitted program automatically generates the omitted information by incrementing the node values of the preceding element by one. The material identification and angle are the same as the preceding element. The last element card must always be supplied. The maximum difference in node values must be less than 40. Nodal sequencing I,J,K,L is counterclockwise around the element. Triangular elements are permitted by setting the last node point to any of the preceding three value /i.e.I.J.K.L./

F DISTRIBUTED FLOW CARDS /2I4, F10.0/

One card per element boundary where flow rate is prescribed.

Columns	Item	Format
1-5	Node I	I
6-10	Node J	I
11-20	Flow rate along boundary	F

Note - Boundary conditions for nodes I and J must be fixed flow /i.e. columns 8-10 on Node Cards = minus number/

G FREE SURFACE DESCRIPTION /15, F10.0/

One card for each node whose position of Free Surface is unknown. Limit of 40 nodes.

Columns	Item	Format
1-5	Node Number	I
6-15	Correction Direction in degrees with respect to x-axis /anticlockwise positive/	F

Correction directions must be along material interfaces if they exist; otherwise any convenient direction will do. Boundary condition for node must be fixed flow /i.e. columns 8-10 on Node Cards must equal negative number/

OUTPUT INFORMATION

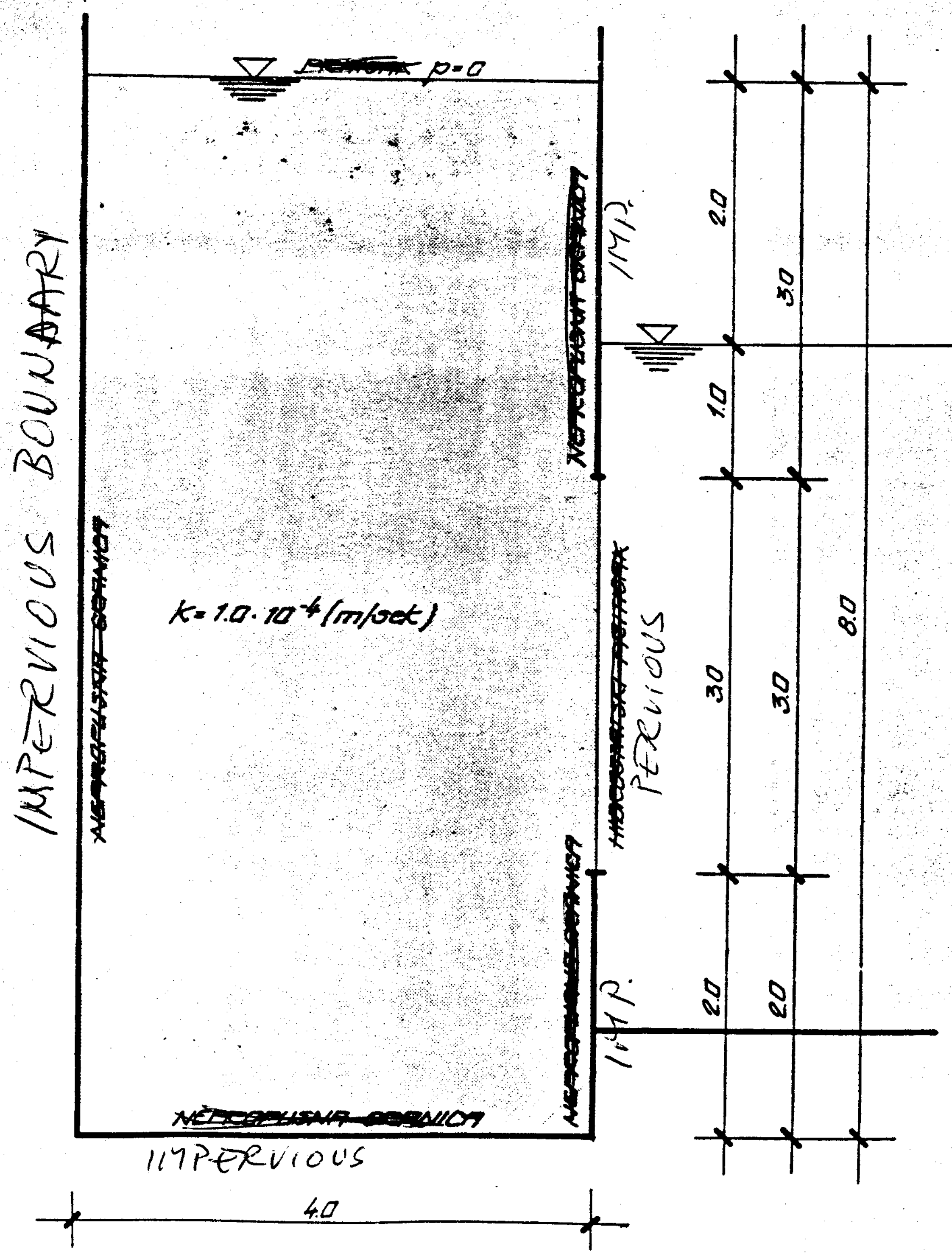
The following information is developed and printed by the program:

1. Reprint of input data.
2. Nodal point pressures and equipotential values.

3. Element Flow rates at the center of each element.
4. For free surface problems the mesh correction is printed for each iteration.

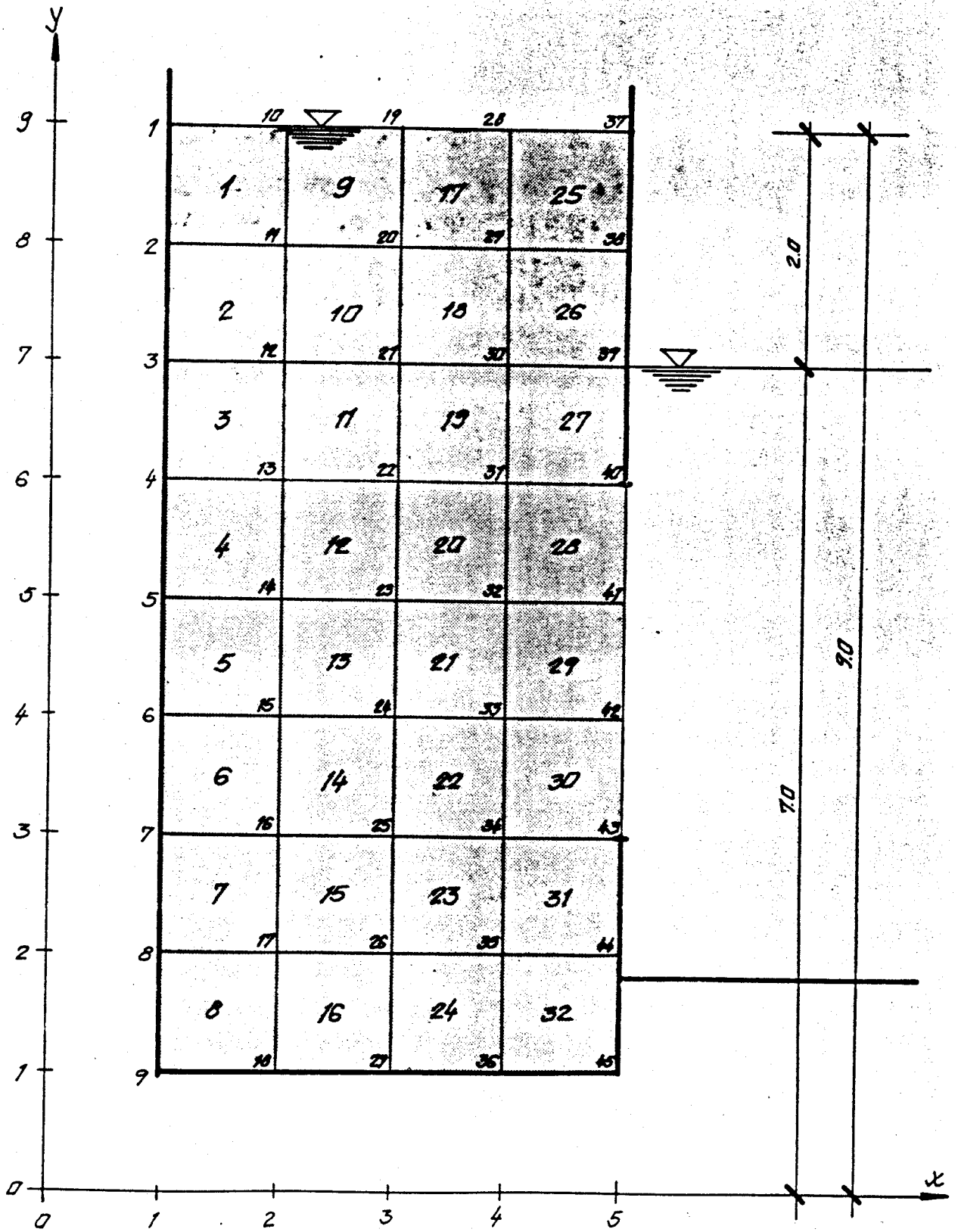
PROGRAM USE: The program uses overlay of subroutines to fit into 112K memory. A disk is used as a scratch pad using file numbers 8 and 9.

Example #1

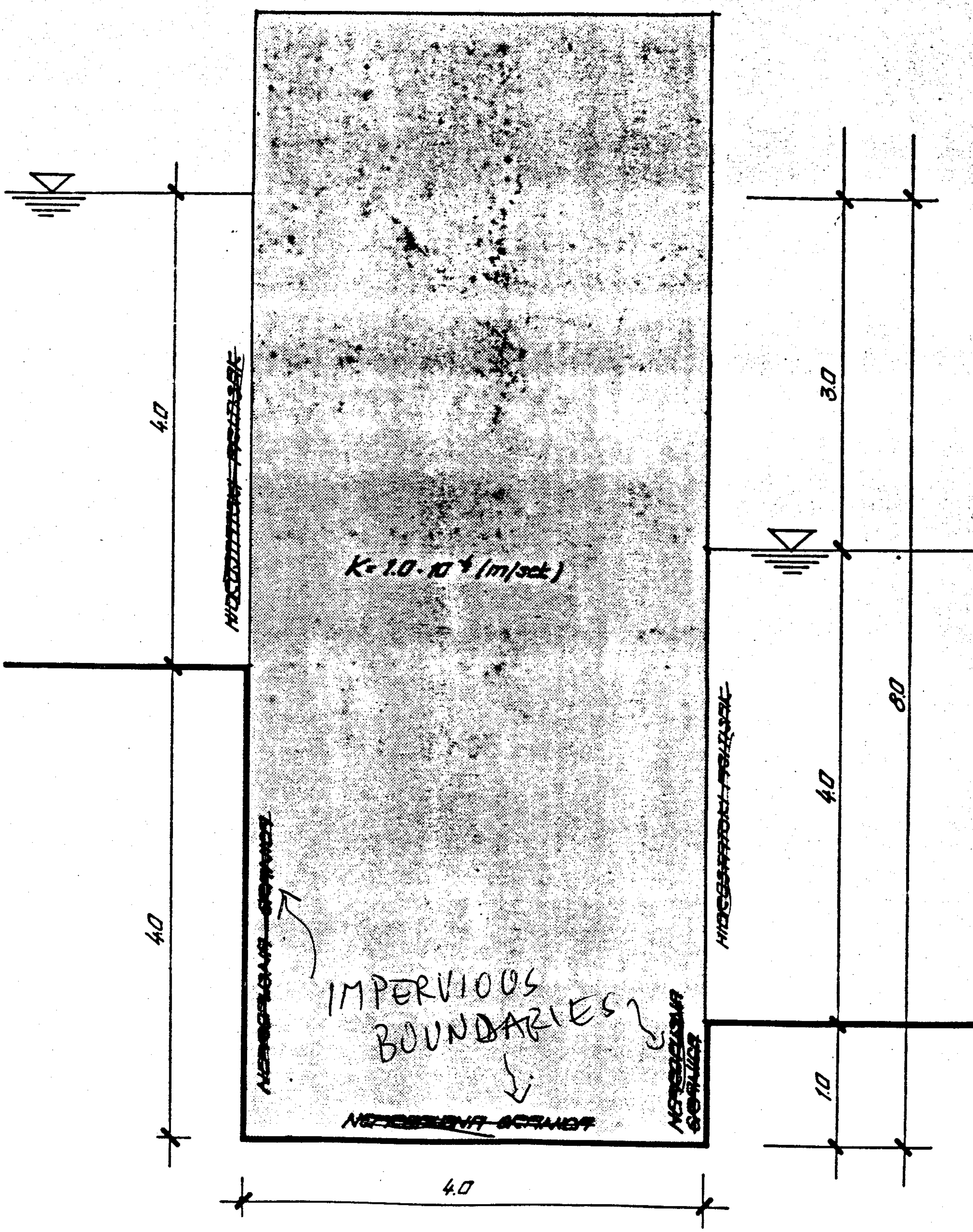


p=0
IMPERVIOUS BOUNDARY
IMP.
PERVIOUS
IMP.
IMPERVIOUS
k=1.0·10^-4 (m/sek)
2.0
3.0
1.0
3.0
3.0
8.0
2.0
2.0
4.0

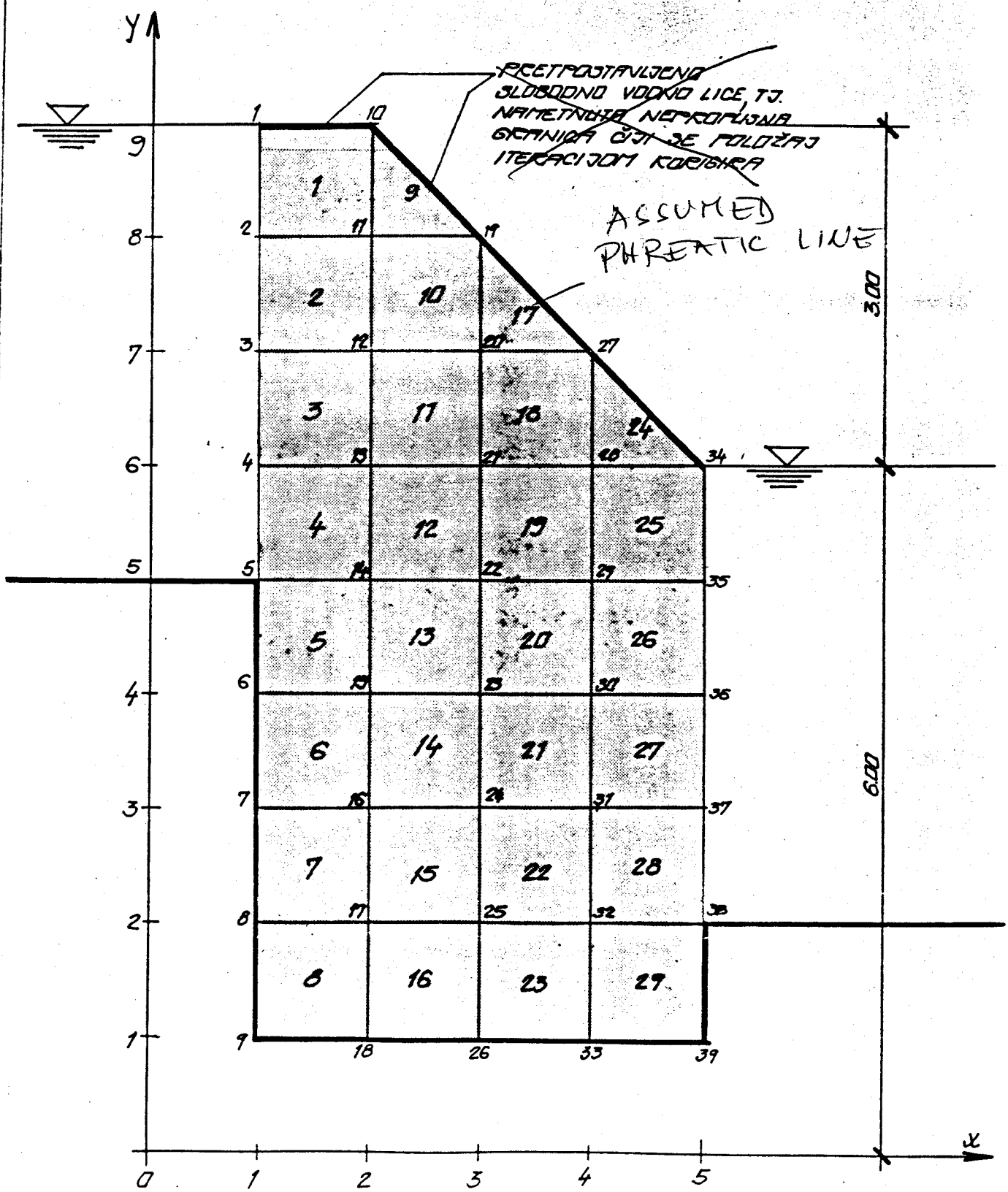
Example # 1


y
x
2.0
9.0
7.0
1
9
17
25
2
10
18
26
3
11
19
27
4
12
20
28
5
13
21
29
6
14
22
30
7
15
23
31
8
16
24
32

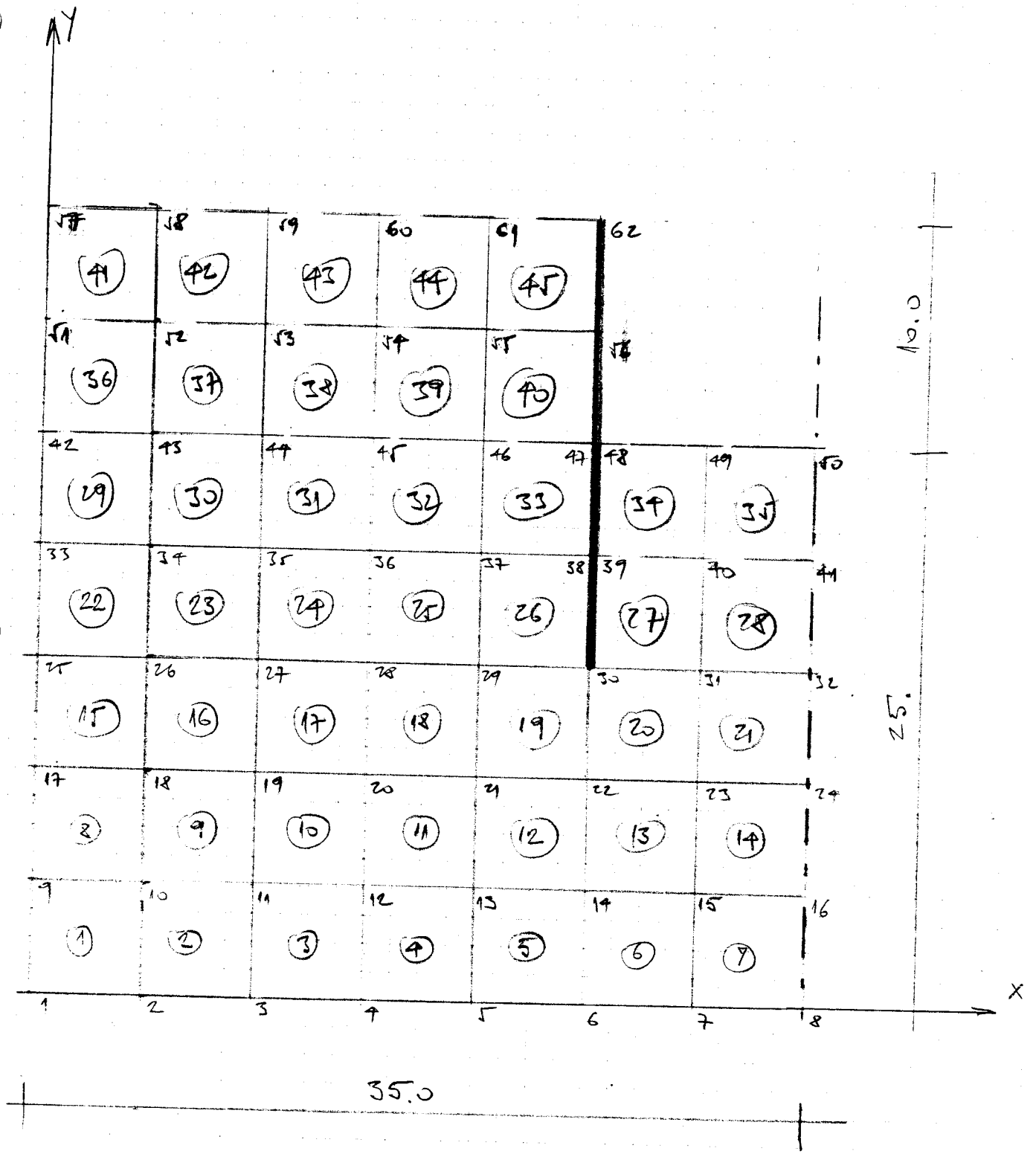
Example #2



Example #2


y
x
PRETPOSTAVLJENO SLOBODNO VODNO LICE, TJ. NAMETNUTA NEPROPUSNA GRANICA ČIJI SE POLOŽAJ ITERACIJOM KORIGIRA
ASSUMED PHREATIC LINE
3.00
6.00
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
0
1
2
3
4
5

Example #3



Example #4 — 3/4 187