SUB-SOIL EXPLORATION FOR THE PROPOSED 500 MW GAS BASED COMBINED CYCLE POWER PROJECT AT MONARCHAK MOUJA, SONAMURA, TRIPURA(WEST)

On behalf of

North Eastern Electric Power Corporation Limited (NEEPCO)
Ramchandra Nagar, Agartala
Tripura

Report No : AN/185/C/2001

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OCTOBER 2001

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SOIL EXPLORATION FOR THE PROPOSED 500 MW GAS BASED COMBINED CYCLE POWER PROJECT AT MONARCHAK MOUJA, SONAMURA, TRIPURA (WEST)

1.0 INTRODUCTION :

North Eastern Electric Power Corporation Limited (NEEPCO), Ramchandra Nagar, Agartala, Tripura, requested Director, RRL Jorhat for carrying out sub-soil exploration work for the proposed 500 MW Gas Based Combined Cycle Power Project at Monarchak Mouja, Sonamura, Tripura (West) vide their letter No. NEEPCO/AGTPP/PM/2000-01/T-29/1316 dated 23.12.2000. Accordingly, RRL Jorhat has framed an estimate and sent a letter No. AN/I(4)/S/2001 dated 16.01.2001.

After discussions and negotiation, the NEEPCO has approved the estimate and entrusted the work to RRL, Jorhat vide their Fax Message No. NEEPCO/AGTPP/PM/T-29(B)/2001/1512 dated 05.02.2001. RRL, Jorhat engaged M/s Geotech Consultants Pvt. Ltd., New Delhi to carry out the field work under the supervision of RRL staff.

The report discusses the detail of investigation carried out and analysis of data based on field and laboratory work. The nature of soil has been identified and recommendation of bearing capacity and design of foundation for the proposed structures are made.

2.0 SCOPE OF WORK :

2.1 Field work :

i) Advancing 13 numbers of boreholes upto a maximum depth of 35.0 metres.
ii) Conducting standard penetration tests at an interval of 1.5 m. or change of strata in borehole as per specification
iii) Collection of 100 mm. dia undisturbed soil samples at an interval of 1.5 m. in boreholes for laboratory analysis.
iv) Conduction of plate load tests ... 3 Nos.

2.2 Laboratory work :

i) Atterberg's limit
ii) Natural moisture content
iii) Grain size analysis
   (a) Mechanical sieve analysis
   (b) Hydrometer analysis
iv) Dry & bulk density
v) Specific gravity & void ratio
vi) Unconfined compression test
vii) Triaxial test
viii) Consolidation test
ix) Permeability test
x) Chemical analysis of soil and water

3.0 GENERAL GEOLOGY OF THE AREA :

The Tertiary geology of Tripura and adjoining region is characterized by N-S trending folded belts of synclines and anticlines. The elongated folded belts are represented by mainly Barails and Surma Group of sandstones of Tertiary age. The Surma sandstones rest unconformably atop the Barails and attain a great thickness in Tripura. The top of Surma is marked by the deposition of Siwallik molasse phase, the Tipam sandstones and the clay argellites of Mio-Pliscene age. The termination of Mioplioscene deposit is mared by an unconformity above which the recent sediment and alluvial deposits rest.

In Tripura the major sedimentary sequences are hard massive slate and sandstone of the Barail group to highly ironaies sandstone, sandy shale, aglomerate, and lateritic sandstone of Surma group. Towards top the sandstone of Tipam group are overlain by soft sandy shale and alternates shale and sandstone, clay argellits, fragments of wood fossil and lignite. The clay argellites mark the position of Mio Plicene unconformity.

To the west of Tripura the N-S anticlinal folds trend NNW-SSE and plunge beneath the Bengal alluvial plains. The fold belts are often cut by numerous NNE-SSW to NW-SE faults. The generalized geological succession of Tripura is as given below.

Recent alluvial sediments
------ Unconformity ------
Clay Argellits, Shale and sandstone
Tipam Group of sandstone
Surma sandstone
------ Unconformity ------
Barail Group - sandstone & shale
Eocene Basement

4.0 DESCRIPTION OF SITE :

The area of soil Exploration for the proposed 500 MW Gas Based Combined Cycle Power Project is situated in Monarchak Mouja near village Balardhapa about 8 Kms south of Sonamura Town in Tripura West. The site is about 80 Kms. south to capital Agartala. The area of investigation is bounded by Sonamura Belonia road on North and West side. East boundary is towards hillocks of state forest department. On west side, paddy fields exist. India Bangladesh boarder is approximately 1 Km. west to side.

The approximate area of soil investigation is 510 m. X 520 m. The site is an undulating one having mild contour difference. The plot is by the side of the road Sonamura with Belonia. There is no permanent structure nearby except the road. Transmission towers are there on east side at a distance of 1 to 2 Kms from site. One rubber garden exists parallely on west side of road about 1/2 Km away.

The area is covered mostly by wild bushes. No big trees are there. However, the local people planted some fruit bearing trees. The area is thinly populated and few huts and semi-permanent houses are there. The land is free from water logging except in paddy fields.

There is no evidence of land sliding in hillocks, may be due to mild contour difference. Local aged people were also discussed for such problems but they also confirmed the same. The hillocks appear to be almost flat at top forming form of plateau. No exposed stones or rocks were noticed in the area. The position of test locations were shown in the site plan
(Fig. 1).

5.0 REDUCED LEVEL OF DIFFERENT AREAS

Reduced level are given below as supplied by the NEEPCO officials during the field work.

Sl. No.	B.H. No.	Proposed location	Reduced level
1.	1	MCR/Control Room	17.00
2.	2	Colony	22.00
3.	3	Colony	22.00
4.	4	Switch-yard	17.00
5.	5	Switch-yard	19.00
6.	6	Transformer yard	17.00
7.	7	Reservoir Raw water	15.00
8.	8	Cooling Tower	19.00
9.	9	S.T	18.00
10.	10	Transformer	16.00
11.	11	WHRB	18.00
12.	12	G. T. Building	18.00
13.	13	G. T. Building	18.00

The reduced level in the site varies from 15 m. to 22 m. The proposed colony area is at higher level of RL 22 m. (approx.) whereas the raw-water reservoir is at the lower level of 15 m. The reduced level at the plant site varies from 16 m. to 19 m. with a difference of about 3 m. This difference in plant site may be over-come by levelling the ground to a reduced level of 17.5 m. Otherwise the level of 19 m. in plant site may be maintained by filling the necessary portion of land.

However, necessary provision may be kept for proper drainage of run-off water, as it is observed that heavy rainfall occur during the period of execution of field work.

6.0 GEOTECHNICAL INVESTIGATION :

6.1 Field tests :

The following field tests were carried out to determine the sub-soil conditions and to compute the safe bearing capacity for design of foundation structures.

6.1.1 Boreholes and standard penetration test :

Thirteen numbers of boreholes were advanced at different locations for various proposed structures. In each borehole standard penetration test (SPT) was conducted as per Indian Standard Specification (2131-1981) upto the depth of boring. The test measures the resistance of the soil to penetration. The N-values were recorded and the same were also corrected and shown in borelogs (Fig. 2 to 14). The values increases with respect of depth in all the boreholes. However, at some particular depth N-values drop in all the boreholes and then gradully increases.

6.2 Ground water table :

This was observed in the boreholes during the period of investigation (May-June, 2001) and the same varies from 0.50 to 5.20 metres.

6.3 Plate load test :

The plate load tests were carried out in three locations at a depth of 2.20 m, 2.25 m. and 2.35 m. The size of plate used was 60 X 60 Cm2 and maximum pressure applied 6 Kg/Cm2. The load was applied through reaction method of jack and pump arrangement.

The safe bearing capacity with a factor of safety 2.5 comes to be 15.5 T/m2, 11 T/m2 and 14 T/m2 for PLT-1, PLT-2 and PLT-3 respectively (Figs. 15 to 17).

6.4 Laboratory analysis :

The disturbed and undisturbed soil samples collected from boreholes at different depths were analysed in the laboratory

6.4.1 Grain size analysis:

Coarser fraction of the soil samples were separated by mechanical sieve analysis and these values were utilised in soil classification smd given in Table - 1. To determine the percentage of silt and clay in the fine grained soil, hydrometer analysis was carried out on selected samples collected from different boreholes and the graphical representation of the results are shown in (Figs. 18 to 29).

6.4.2 Atterberg's limit

The Atterberg's limit tests were carried out on samples collected at different depth from the boreholes. The liquid limit, plastic limit and plasticity index so found for each borehole are shown with respect to depths in the borelogs. After finding out the Atterberg's limit, the samples were identified and classified as per IS:1498-1970 as shown in (Figs. 2 to 14).

6.4.3 Natural moisture content :

The natural moisture content was determined in the laboratory and shown in borelog details with respect to depth for each borehole (Figs. 2 to 14).

6.4.4 Wet density :

The wet density values were determined from the undisturbed samples collected from boreholes and are given in Table - 2.

6.4.5 Triaxial compression test :

Unconsolidated undrained (Quick) tests were carried out on different soil samples taken out from boreholes to determine their shear properties. These parameters are recorded in Table - 2.

6.4.6 Unconfined compression tests :

The tests were carried out on undisturbed samples collected from boreholes. The values are given in Table - 2.

6.4.7 Consolidation tests :

The tests were carried out on undisturbed samples taken out from boreholes. With the data obtained, a series of curves viz. time-settlement and e-log p curves were plotted and shown in (Figs. 30 to 58).

6.4.8 Specific gravity :

The specific gravity was determined in the laboratory on selected soil samples from the field. The values are tabulated in Table - 3.

6.4.9 Void ratio :

The tests were performed on selected soil samples in the laboratory and the results are given in Table - 3.

6.4.10 Permeability test :

The permeability tests were carried out on 20 numbers of samples and the results are given in Table - 3.

6.4.11 Chemical analysis of soil and water :

Ten numbers of soil samples were analysed in the laboratory to determine the presence of harmful constituents for concrete and steel. The results are given in Table 4.

6.5 AREAWISE INTERPRETATION :

6.5.1 MCR AND CONTROL ROOM AREA :

Borehole No. 1 was advanced in Control Room Area. The sub-soil as revealed by the borehole consists of mainly thin layer of fine grained compressible soil alongwith major portion of non-compressible sand silt mixture in alternate layers. The standard penetration values are increasing with depth however average corrected value is approximately 20.

The cohesion of the compressible layers are found in the range of 0.18 Kg./Cm2 to 0.23 Kg./Cm2 and angle of internal friction varies from 15 to 20 Degree. The average unit weight of the soil is found to be 1.8 Ton/Cum. The design profile of the area is given in (Fig. 59).

The safe bearing capacities of the soil were evaluated and given below :

TABLE - 5(a)

SAFE BEARING CAPACITY FOR MCR AND CONTROL ROOM AREA
BOREHOLE NO. 1

Depth (m)	Size of footing (m)	Safe Bearing Capacity (T/m2)
1	1.0 x 1.0	7.88
	2.0 x 2.0	7.74
	3.0 x 3.0	7.66
	4.0 x 4.0	7.73
	5.0 x 5.0	7.86
	6.0 x 6.0	8.02
2	1.0 x 1.0	11.23
	2.0 x 2.0	9.59
	3.0 x 3.0	9.10
	4.0 x 4.0	9.09
	5.0 x 5.0	9.12
	6.0 x 6.0	9.21
3	1.0 x 1.0	14.32
	2.0 x 2.0	11.56
	3.0 x 3.0	10.78
	4.0 x 4.0	10.51
	5.0 x 5.0	10.43
	6.0 x 6.0	10.44

6.5.2 COLONY AREA

Borehole Nos. 2 and 3 were advanced in Colony Area. The sub-soil consists of mainly compressible silt and clay layer upto a depth of 5 metres underlained by non-cohesive sand silt mixture upto the depth of boring.

The cohesion in the compressible layer varies from 0.14 Kg/Cm2 to 0.15 Kg/Cm2 and angle of internal friction varies from 18 to 20 Degree. The unit weight of soil varies from 1.8 Ton/Cum. to 1.89 Ton/Cum. The design profile of the area is given in (Fig. 60).

The safe bearing capacities of the soil is evaluated and given below.

TABLE - 5(6)

SAFE BEARING CAPACITY FOR COLONY AREA
BOREHOLE NOS. 2 & 3

Depth (m)	size of footing (m)	Safe bearing capacity T/m2
1	1.0 X 1.0	5.30
	2.0 X 2.0	5.20
	3.0 X 3.0	5.18
	4.0 X 4.0	5.25
	5.0 X 5.0	5.37
	6.0 X 6.0	5.50
2	1.0 X 1.0	7.59
	2.0 X 2.0	6.56
	3.0 X 3.0	6.33
	4.0 X 4.0	6.30
	5.0 X 5.0	6.35
	6.0 X 6.0	6.43
3	1.0 X 1.0	9.78
	2.0 X 2.0	8.02
	3.0 X 3.0	7.55
	4.0 X 4.0	7.39
	5.0 X 5.0	7.37
	6.0 X 6.0	7.40

6.5.3 SWITCH YARD

Borehole Nos. 4 and 5 were advanced in Switch yard Area. As revealed by the boreholes, the switch yard area consists of silty clay of low and medium plasticity upto a maximum depth of 6 metres underlained by non-cohesive sand silt mixture upto the depth of boring. The standard penetration values are increasing with depth and high values are encountered from a depth of about 10 metres.

The cohesion of the compressible layer varies from 0.14 Kg/Cm2 to 0.25 Kg/Cm2 and angle of internal friction is 13 to 19 degree. The average unit weight of the soil is found to be 1.82 ton/Cum. The design profile of the area is given in (Fig. 61).

The safe bearing capacities of the soil were evaluated and given below.

TABLE - 5(c)

SAFE BEARING CAPACITY FOR SWITCH YARD
BOREHOLE NOS. 4 & 5

Depth (m)	size of footing (m)	Safe bearing capacity T/m2
1	1.0 X 1.0	6.64
	2.0 X 2.0	6.44
	3.0 X 3.0	6.36
	4.0 X 4.0	6.40
	5.0 X 5.0	6.40
	6.0 X 6.0	6.58
2	1.0 X 1.0	9.19
	2.0 X 2.0	7.80
	3.0 X 3.0	7.54
	4.0 X 4.0	7.45
	5.0 X 5.0	7.45
	6.0 X 6.0	7.50
3	1.0 X 1.0	11.58
	2.0 X 2.0	9.40
	3.0 X 3.0	8.78
	4.0 X 4.0	8.54
	5.0 X 5.0	8.46
	6.0 X 6.0	8.45

6.5.4 TRANSFORMER YARD

Borehole Nos. 6 and 10 were advanced in Transformer yard. This borehole consists of alternate layer of cohesive and non-cohesive soil upto a maximum depth of about 17 metres underlain by non-cohesive sand silt mixture upto the depth of boring. The standard penetration values were increasing with depth and observed values are more than 30 from a depth of about 7 meters.

The cohesion of the soil varies from 0.17 Kg/Cm2 to 0.22 Kg/Cm2 and angle of internal friction varies from 17 to 20 Degree. The unit weight of the soil varies from 1.77 Ton/Cum. to 1.92 Ton/Cum. The design profile is given in (Fig. 62).

The safe bearing capacities of the soil of Transformer yard is given below.

TABLE - 5(d)

SAFE BEARING CAPACITY FOR TRANSFORMER YARD
BOREHOLE NOS. 6 & 10

Depth (m)	Size of footing (m)	Safe bearing capacity T/m2
1	1.0 X 1.0	8.13
	2.0 X 2.0	7.75
	3.0 X 3.0	7.88
	4.0 X 4.0	7.95
	5.0 X 5.0	8.08
	6.0 X 6.0	8.24
2	1.0 X 1.0	11.61
	2.0 X 2.0	9.94
	3.0 X 3.0	9.52
	4.0 X 4.0	9.43
	5.0 X 5.0	9.46
	6.0 X 6.0	9.55
3	1.0 X 1.0	14.87
	2.0 X 2.0	12.05
	3.0 X 3.0	11.26
	4.0 X 4.0	10.97
	5.0 X 5.0	10.88
	6.0 X 6.0	10.90

6.5.5 COOLING TOWER

Borehole No. 8 was advanced in Cooling Tower area. This borehole consists of fine grained cohesive soil in two distinct zones viz. at 0-5 metre and 22 to 25 metre. The other portion of the borehole consists of mainly non-cohesive sand silt mixture upto the depth of boring.

The cohesion of the compressible layer varies from 0.2 Kg/Cm2 to 0.24 Kg/Cm2 and angle of internal friction varies from 15 to 19 Degree. The unit weight of the soil varies from 1.78 Ton/Cum. to 1.80 Ton/Cum.

The design profile of the area is given in (Fig. 63).

The safe bearing capacities of the soil in the area is given below.

TABLE - 5(e)

SAFE BEARING CAPACITY FOR COOLING TOWER
BOREHOLE NO. 8

Depth (m)	Size of footing (m)	Safe Bearing Capacity (T/m2)
1	1.0 x 1.0	7.89
	2.0 x 2.0	7.62
	3.0 x 3.0	7.49
	4.0 x 4.0	7.50
	5.0 x 5.0	7.56
	6.0 x 6.0	7.66
2	1.0 x 1.0	9.52
	2.0 x 2.0	8.38
	3.0 x 3.0	8.11
	4.0 x 4.0	8.04
	5.0 x 5.0	8.06
	6.0 x 6.0	8.13
3	1.0 x 1.0	13.41
	2.0 x 2.0	10.81
	3.0 x 3.0	10.04
	4.0 x 4.0	9.73
	5.0 x 5.0	9.60
	6.0 x 6.0	9.57

6.5.6 RAW WATER RESERVOIR

Borehole No. 7 was advanced in this area. The sub soil consists of mainly non cohesive layer upto a depth of 2.5 m. underlained by fine grain cohesive of low and high plasticity upto a depth of 10 m. Below this depth, the soil is non cohesive in nature.

Standard penetration values are increasing with depth.

The cohesion of the compressible layer varies from 0.18 Kg/Cm2 to 0.2 Kg/Cm2 and average values of internal friction is 18 Degree. The unit weight of the soil is 1.76 Ton/Cum. to 1.80 Ton/Cum. The design profile of the area is given in (Fig. 64).

The safe bearing capacities of the soil in the area is given below.

TABLE - 5(f)

SAFE BEARING CAPACITY FOR RAW WATER RESERVOIR
BOREHOLE NO. 7

Depth (m)	Size of footing (m)	Safe Bearing Capacity (T/m2)
1	1.0 x 1.0	6.89
	2.0 x 2.0	6.71
	3.0 x 3.0	6.63
	4.0 x 4.0	6.68
	5.0 x 5.0	6.77
	6.0 x 6.0	6.89
2	1.0 x 1.0	9.61
	2.0 x 2.0	8.23
	3.0 x 3.0	7.89
	4.0 x 4.0	7.80
	5.0 x 5.0	7.8
	6.0 x 6.0	7.88
3	1.0 x 1.0	12.15
	2.0 x 2.0	9.86
	3.0 x 3.0	9.20
	4.0 x 4.0	8.96
	5.0 x 5.0	8.88
	6.0 x 6.0	8.89

6.5.7 S.T. AREA

Borehole No. 9 was advanced in S.T. Area. The sub-soil consists of cohesive soil upto a depth of 14 metres and below this depth the soil is non-cohesive upto the depth of boring. The corrected N-values are less than 20 upto a depth of 14 metres.

The cohesion of the soil varies from 0.05 Kg/Cm2 to 0.10 Kg/Cm2 and angle of internal friction is 15 to 16 degree. The unit weight of the soil varies from 1.75 ton/Cum. to 1.78 Ton/Cum. The design profile is given in (Fig. 65).

The safe bearing capacities of the soil are given below.

TABLE - 5(g)

SAFE BEARING CAPACITY FOR S.T. AREA
BOREHOLE NO. 9

Depth (m)	size of footing (m)	Safe bearing capacity T/m2
1	1.0 X 1.0	6.08
	2.0 X 2.0	6.02
	3.0 X 3.0	6.03
	4.0 X 4.0	6.14
	5.0 X 5.0	6.30
	6.0 X 6.0	6.47
2	1.0 X 1.0	8.90
	2.0 X 2.0	7.70
	3.0 X 3.0	7.45
	4.0 X 4.0	7.43
	5.0 X 5.0	7.51
	6.0 X 6.0	7.64
3	1.0 X 1.0	11.62
	2.0 X 2.0	9.51
	3.0 X 3.0	8.95
	4.0 X 4.0	8.79
	5.0 X 5.0	8.78
	6.0 X 6.0	8.84

6.5.8 WHRB AREA

Borehole No. 11 was advanced in this area. This area consists of alternative layers of cohesive and non-cohesive soil upto the depth of boring.

The standard penetration values are uniformly increasing. The cohesion of the soil varies from 0.21 Kg/Cm2 to 0.24 Kg/Cm2 and angle of internal friction varies from 16 to 17 Degree. The unit weight of the soil is from 1.89 Ton/Cum. to 1.92 Ton/Cum. The design profile of the area is given in (Fig. 66).

The safe bearing capacities of the soil are given below.

TABLE - 5(h)

SAFE BEARING CAPACITY FOR WHRB AREA
BOREHOLE NO. 11

Depth (m)	size of footing (m)	Safe bearing capacity T/m2
1	1.0 X 1.0	7.57
	2.0 X 2.0	7.28
	3.0 X 3.0	7.16
	4.0 X 4.0	7.17
	5.0 X 5.0	7.22
	6.0 X 6.0	7.31
2	1.0 X 1.0	10.29
	2.0 X 2.0	8.71
	3.0 X 3.0	8.37
	4.0 X 4.0	8.23
	5.0 X 5.0	8.20
	6.0 X 6.0	8.23
3	1.0 X 1.0	12.82
	2.0 X 2.0	11.36
	3.0 X 3.0	9.36
	4.0 X 4.0	9.33
	5.0 X 5.0	9.21
	6.0 X 6.0	9.17

6.5.9 G. T. BUILDING

Borehole Nos. 12 and 13 were advanced in G. T. Building Area. In these boreholes alternative layers of cohesive and non-cohesive soils are observed but a distinct layer of poorly graded sand with silt mixtures (SM) encountered at a depth of about 3.50 metres to 19.0 meters in borehole No. 12.

The standard penetration values are increasing with depth. The cohesion of the soil varies from 0.09 Kg/Cm2 to 0.10 Kg/Cm2 and the angle of internal friction varies from 22 to 23 Degree. The unit weight of the soil is from 1.80 Ton/Cum. to 1.82 Ton/Cum. The design profile of the area is given in (Fig. 67).

The safe bearing capacities of the soil are given below.

TABLE - 5(i)

SAFE BEARING CAPACITY FOR G.T. BUILDING
BOREHOLE NOS. 12 & 13

Depth (m)	size of footing (m)	Safe bearing capacity T/m2
1	1.0 X 1.0	6.85
	2.0 X 2.0	6.76
	3.0 X 3.0	6.74
	4.0 X 4.0	6.84
	5.0 X 5.0	6.99
	6.0 X 6.0	7.16
2	1.0 X 1.0	9.94
	2.0 X 2.0	11.56
	3.0 X 3.0	11.24
	4.0 X 4.0	11.20
	5.0 X 5.0	11.26
	6.0 X 6.0	11.41
3	1.0 X 1.0	12.87
	2.0 X 2.0	10.49
	3.0 X 3.0	9.84
	4.0 X 4.0	9.68
	5.0 X 5.0	9.59
	6.0 X 6.0	9.64

6.6 Recommendations :

i) Sub-soil :

The sub-soil mainly consists major portion of non-cohesive soil alongwith layers of cohesive soil upto the depth of investigations. Standard penetration values (N) increases with respect to depth. However, in most of the boreholes at a particular depth N-values suddenly drops and then gradully increases in all the boreholes.

ii) Ground water table :

The position of ground water tables were established which varies from 0.50 to 5.20 metres during the period of investigation (May/June 2001).

iii) Safe bearing capacity :

Safe bearing capacities were computed for various depth and width of footing which varies from 5.20 to 14.07 T/m2. The values for different areas are shown separately in different tables 5(a) to 5(i).

(iv) Chemical analysis of soil :

Results of chemical analysis of soil indicate that there is no harmful constituents present in the soil.

The above recommendations are based on soil strata encountered at site. If actual sub-soil condition during excavation for foundation varies substantially from what have been reported or anything unusual is observed, the soil consultant may be referred to for advice.

NOTE :- (a) The report relates to the soil exploration for the proposed 500 MW Gas Based Combined Cycle Power Project at Monarchak Mouja, Sonamura, Tripura (West).

(b) The report is not to be used for legal purpose and will not be produced in the court of law.

(c) The report shall not be utilised for sales-promotion or for advertisement

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TABLE - 1

SIEVE ANALYSIS

Sl No.	B.H. No.	Depth (m)	Percent passing		
			4.75 mm.	0.40 mm.	0.075 mm.
1		0.95 - 1.50	95	82	54
2		2.45 - 3.50	100	90	22
3		5.00 - 5.45	100	88	25
4		12.95 -13.50	100	83	27
5		14.45 -15.00	100	97	30
6	1	15.95 -16.50	95	92	35
7		17.00 -17.45	100	93	62
8		18.95 -19.50	100	99	40
9		22.00 -23.00	100	97	38
10		25.60 -25.70	100	99	96
11		26.70 -27.50	100	67	20
12		29.00 -29.45	100	70	22
1		0.50 - 0.95	100	96	50
2		3.95 - 4.50	98	91	45
3		5.45 - 6.50	100	91	32
4		8.00 - 8.45	100	87	28
5		9,50 - 9.95	100	93	40
6	2	11.45 -12.50	100	88	35
7		14.00 -14.45	100	82	25
8		17.45 -18.50	100	96	30
9		20.00 -20.45	100	99	93
10		23.00 -23.45	100	99	26
11		27.50 -27.95	100	95	27
12		29.00 -29.45	100	98	35
1		0.95 - 1.50	100	91	47
2		3.95 - 4.50	99	92	54
3		6.50 - 6.95	100	95	30
4		9.50 - 9.95	100	98	35
5		12.95 -13.50	100	87	31
6	3	15.50 -15.95	100	90	28
7		17.00 -17.45	100	98	40
8		18.50 -18.95	100	99	98
9		20.45 -21.50	100	86	24
10		23.00 -23.45	100	88	27
11		26.45 -27.50	100	90	14
12		29.00 -29.45	100	92	20

Sl No.	B.H. No.	Depth (m)	Percent passing		
			4.75 mm.	0.40 mm.	0.075 mm.
1		0.50 - 0.95	100	98	73
2		2.00 - 2.45	100	85	20
3		5.00 - 5.45	100	90	25
4		6.95 - 7.50	100	95	76
5		12.00 - 12.20	100	98	40
6	4	12.50 -12.95	100	99	81
7		15.95 -17.00	100	89	17
8		18.50 -18.95	100	96	22
9		20.45 -21.00	100	91	20
10		23.00 - 23.45	100	94	25
11		26.45 - 27.00	100	98	30
12		29.00 -29.45	100	91	14
1		0.95 - 1.50	99	89	56
2		2.00 - 2.45	100	94	60
3		3.50 - 3.95	100	95	53
4		5.00 - 5.45	100	96	55
5		8.45 - 9.50	100	93	45
6	5	12.50 -12.95	100	99	43
7		15.50 -15.95	100	86	4
8		17.45 - 18.50	100	88	4
9		20.00 -20.45	100	05	4
10		24.95 -25.50	100	84	3
11		27.50 -27.95	100	86	3
12		29.00 - 29.45	100	85	3
1		0.95 - 1.50	100	96	59
2		3.50 - 3.95	100	95	41
3		5.45 - 6.00	37	28	19
4		6.95 - 8.00	100	92	73
5		9.50 - 9.95	100	89	52
6	6	10.00 -10.50	100	98	94
7		14.00 -14.45	100	90	45
8		17.00 -17.45	100	96	40
9		21.95 - 22.50	100	92	7
10		24.95 - 25.50	100	92	8
11		30.50 -30.95	100	00	7
12		33.50 -33.95	100	84	8

Sl No.	B.H. No.	Depth (m)	Percent passing		
			4.75 mm.	0.40 mm.	0.075 mm.
1		0.95 - 1.50	100	96	48
2		5.00 - 5.45	97	93	84
3		6.95 - 7.50	100	100	99
4		8.00 - 8.45	100	99	95
5		11.00 -11.45	100	85	31
6	7	14.00 -14.45	100	88	30
7		15.95 -16.50	100	86	28
8		17.45 -18.50	100	85	30
9		20.00 -20.45	100	87	31
10		21.50 -21.95	100	84	32
11		23.00 -23.45	100	86	20
12		25.00 -25.45	100	85	22
1		0.95 - 1.50	100	95	65
2		5.45 - 6.00	100	80	15
3		8.00 - 8.45	100	71	12
4		9.95 -10.50	100	76	13
5		11.45 -12.50	100	85	25
6	8	14.00 -14.45	100	94	28
7		17.00 -17.45	100	96	30
8		20.00 -20.45	100	95	31
9		23.00 -23.45	100	98	95
10		26.45 -27.50	100	90	12
11		30.50 -30.95	100	88	11
12		32.00 -32.45	100	87	11
1		0.95 - 1.50	100	78	35
2		3.95 - 4.50	100	74	51
3		6.95 - 7.50	100	98	90
4		9.95 -10.50	100	80	32
5		11.00 -11.45	100	98	94
6	9	12.95 -13.50	100	96	90
7		15.00 -15.50	100	89	43
8		17.00 -17.45	100	85	48
9		20.00 -20.45	100	90	48
10		24.50 -24.95	100	84	40
11		26.00 -26.45	100	86	35
12		27.50 -27.95	100	81	12

Sl No.	B.H. No.	Depth (m)	Percent passing		
			4.75 mm.	0.40 mm.	0.075 mm.
1		0.95 - 1.50	100	93	41
2		5.00 - 5.45	100	84	31
3		6.95 - 7.50	97	92	46
4		9.95 -10.50	100	97	42
5		11.45 -12.50	100	88	45
6	10	15.95 -16.50	100	96	92
7		18.95 -19.50	100	93	48
8		20.45 -21.50	100	99	46
9		23.00 -23.45	100	72	10
10		24.50 -24.95	100	70	6
11		26.00 -26.45	100	68	6
12		29.45 -30.00	100	65	5
1		0.50 - 0.95	100	96	69
2		5.00 - 5.45	100	92	29
3		6.50 - 6.94	100	95	31
4		8.00 - 8.45	100	94	28
5		9.95 -10.50	100	86	69
6	11	12.50 -12.95	100	88	35
7		15.50 -15.95	100	92	36
8		17.45 -18.50	100	100	95
9		21.50 -21.95	100	85	30
10		23.00 -23.45	100	99	92
11		26.00 -26.45	100	75	7
12		29.45 -30.00	100	72	5
1		0.50 - 0.95	100	98	55
2		2.45 - 3.00	100	94	33
3		6.50 - 6.95	100	88	28
4		9.50 - 9.95	100	85	31
5		11.45 -12.50	100	90	36
6	12	14.45 -15.50	100	86	30
7		18.95 -19.50	100	98	47
8		20.00 -20.45	100	78	28
9		21.95 -22.50	100	84	32
10		23.45 -24.50	100	95	48
11		27.50 -27.95	100	79	17
12		30.00 -30.45	100	82	20

Sl No.	B.H. No.	Depth (m)	Percent passing		
			4.75 mm.	0.40 mm.	0.075 mm.
1		0.50 - 0.95	60	48	24
2		2.00 - 2.45	65	45	25
3		3.95 - 4.50	100	86	28
4		6.50 - 6.95	100	88	31
5		8.00 - 8.45	100	97	83
6	13	14.45 -15.00	100	94	90
7		17.45 -18.00	100	85	20
8		18.95 -20.00	100	80	18
9		21.95 -23.00	100	86	16
10		24.50 -24.95	100	80	6
11		27.50 -27.95	100	76	6
12		29.00 -29.45	100	79	5

TABLE - 2

Sl. No.	B.H. No.	Depth (m)	Wet density gm/cc	Unconfined compression strength Kg/Cm2	Shear parameter	
					Cohesion Kg/Cm2 'C'	Angle of Internal friction θ
1	1	1.50- 1.90	1.75	0.70	.18	20
2	1	15.00-15.30	1.80	1.02	.23	16
3	1	16.50-16.80	1.84	1.04	.02	15
4	2	1.50- 1.90	1.89	0.56	.14	20
5	2	4.50- 4.90	1.77	0.64	.15	20
6	3	1.50- 1.90	1.80	0.54	.12	18
7	3	4.50- 4.90	1.82	0.50	.10	17
8	4	1.50- 1.90	1.75	0.75	.15	19
9	5	3.00- 3.40	1.83	0.52	.14	18
10	5	4.50- 4.90	1.81	1.09	.25	13
11	6	1.50- 1.90	1.92	0.72	.19	20
12	6	3.00- 3.40	1.86	0.04	.05	18
13	6	10.50-10.90	1.88	0.94	.22	17
14	7	3.00- 3.40	1.80	0.90	.18	18
15	7	7.50- 7.90	1.76	1.04	.22	18
16	8	1.50- 1.90	1.78	0.72	.20	19
17	8	3.00- 3.40	1.80	1.10	.24	15
18	8	4.50- 4.90	1.82	-	-	-
19	8	22.50-22.90	1.81	0.68	.20	18
20	9	1.50- 1.90	1.78	0.51	.05	16
21	9	3.00- 3.40	1.75	0.45	.01	15
22	10	1.50- 1.90	1.77	-	-	-
23	10	7.50- 7.90	1.77	0.62	.17	17
24	10	3.00- 3.40	1.78	0.58	.14	19
25	11	1.50- 1.90	1.89	1.02	.21	17
26	11	3.00- 3.40	1.92	1.10	.24	16
27	12	1.50- 1.90	1.84	0.32	.08	23
28	12	3.00- 3.90	1.86	0.04	.01	22
29	13	1.50- 1.90	1.80	0.35	.09	21
30	13	3.00- 3.40	1.82	0.30	.01	24

TABLE - 3

SPECIFIC GRAVITY, VOID RATIO AND PERMEABILITY TEST

Sl. No.	B.H. No.	Depth (m)	Specific gravity	Void Ratio	Permeability (Cm/Sec)
1	1	1.50 - 1.90	2.68	0.58	4.50×10^{-5}
2	2	1.50 - 1.90	2.66	0.59	2.34×10^{-4}
3	3	1.50 - 1.90	2.65	0.82	$2.15 - 10^{-4}$
4	3	4.50 - 4.90	2.69	0.80	2.60×10^{-4}
5	4	1.50 - 1.90	2.67	0.74	1.23×10^{-5}
6	5	1.50 - 1.90	2.68	0.39	9.60×10^{-4}
7	5	3.00 - 3.40	2.63	0.52	1.34×10^{-4}
8	5	4.50 - 4.90	2.70	0.38	1.27×10^{-4}
9	6	1.50 - 1.90	2.68	0.48	2.09×10^{-4}
10	6	3.00 - 3.40	2.67	0.31	3.26×10^{-5}
11	7	7.50 - 7.90	2.63	0.60	1.10×10^{-5}
12	8	1.50 - 1.90	2.69	0.70	2.80×10^{5}
13	8	3.00 - 3.40	2.65	0.68	1.60×10^{5}
14	8	4.50 - 4.90	2.68	0.60	3.20×10^{-4}
15	9	1.50 - 1.90	2.70	0.72	6.20×10^{-4}
16	10	1.50 - 1.90	2.66	0.65	1.55×10^{-4}
17	10	7.50 - 7.90	2.68	0.91	1.39×10^{-4}
18	11	1.50 - 1.90	2.67	0.71	1.21×10^{-4}
19	11	3.00 - 3.40	2.69	0.35	2.08×10^{-4}
20	13	15.00 -15.40	2.68	0.75	1.14×10

TABLE-4

CHEMICAL ANALYSIS OF SOIL SAMPLES

Sl. No.	Constituent Determined	BH/NO. 1	BH/NO. 2	BH/NO. 3	BH/NO. 4	BH/NO. 5	BH/NO. 6	BH/No. 7	BH/NO. 8	BH/NO. 9	BH/NO. 11
1	pH values	: 6.47	5.38	5.17	5.30	6.85	6.12	6.75	6.45	6.80	5.87
2	Moistura (%)	: 1.98	1.66	2.3	4.8	2.5	2.1	2.2	3.1	4.4	2.8
3	Loss on Ignition (%)	: 3.37	3.24	4.06	5.39	7.6	6.3	4.3	3.8	5.4	3.9
4	Org. matter (%)	: 0.18	0.17	0.18	0.54	0.52	0.42	0.20	0.28	0.18	0.45
5	Water soluble salt (%)	: 0.10	Trace	0.12	0.25	0.22	0.20	0.15	0.15	0.16	0.21
6	Silica as SiO_2	:86.42	89.7	86.1	79.8	79.8	83.6	83.15	81.45	81.9	84.4
7	Iron as Fe_2O_3 (%)	: 2.8	0.54	1.95	3.81	3.48	2.60	1.71	0.54	1.97	3.60
8	Al. as Al_2O_3 (%)	: 3.15	3.05	3.45	4.06	4.45	2.75	2.26	3.85	4.17	3.26
9	Ca. as CaO (%)	: 0.35	0.33	0.25	0.18	0.32	0.45	0.36	0.17	0.15	0.22
10	Mg. as MgO (%)	: 0.15	0.12	0.10	Trace	0.12	0.16	0.13	Trace	Trace	0.16
11	Sulphate (%)	: Trace	Trace	Trace	0.15	0.10	0.15	0.10	Trace	0.10	Trace

L Borah 24/09/01

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Technical Officer.

24/9/01

Dr. N.C. Dey
Head,
Analytical Chemistry Divn.

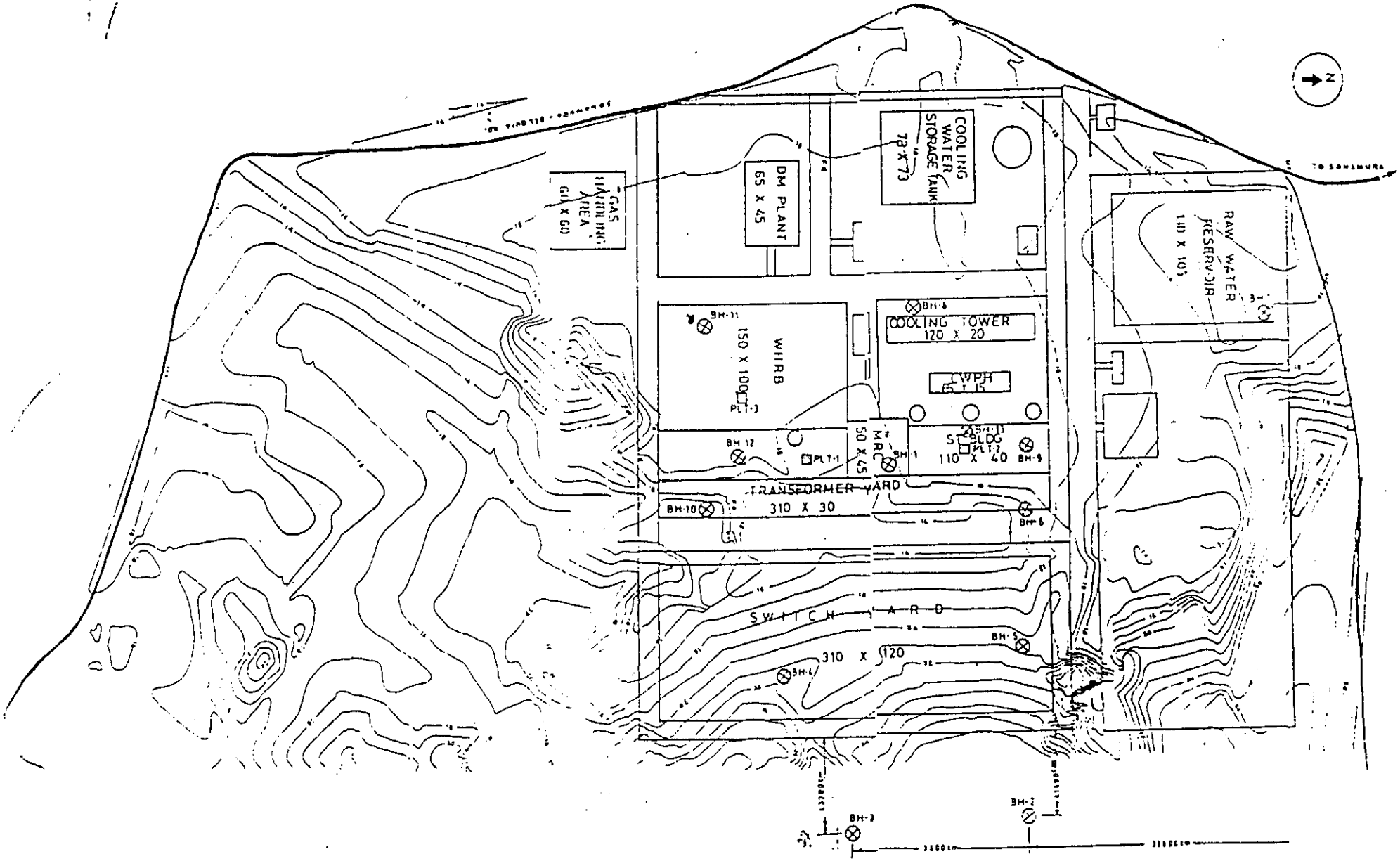


Fig. 1 SITE PLAN SHOWING THE TEST LOCATIONS FOR THE PROPOSED 500 MW GASED BASED COMBINED CYCLE POWER PROJECT OF NEEPCO AT SONAMURA, TRIPURA (WEST)

Gravel – G
Sand – S
Silt – M
Clay – C
Organic Silts and clays – O
Peat – Pt
Well-graded Coarse grained soils with little or no fines – W
Poorly graded Coarse grained soils with little or no fines – P
Low Compressibility – L
Medium Compressibility – I
High Compressibility – H

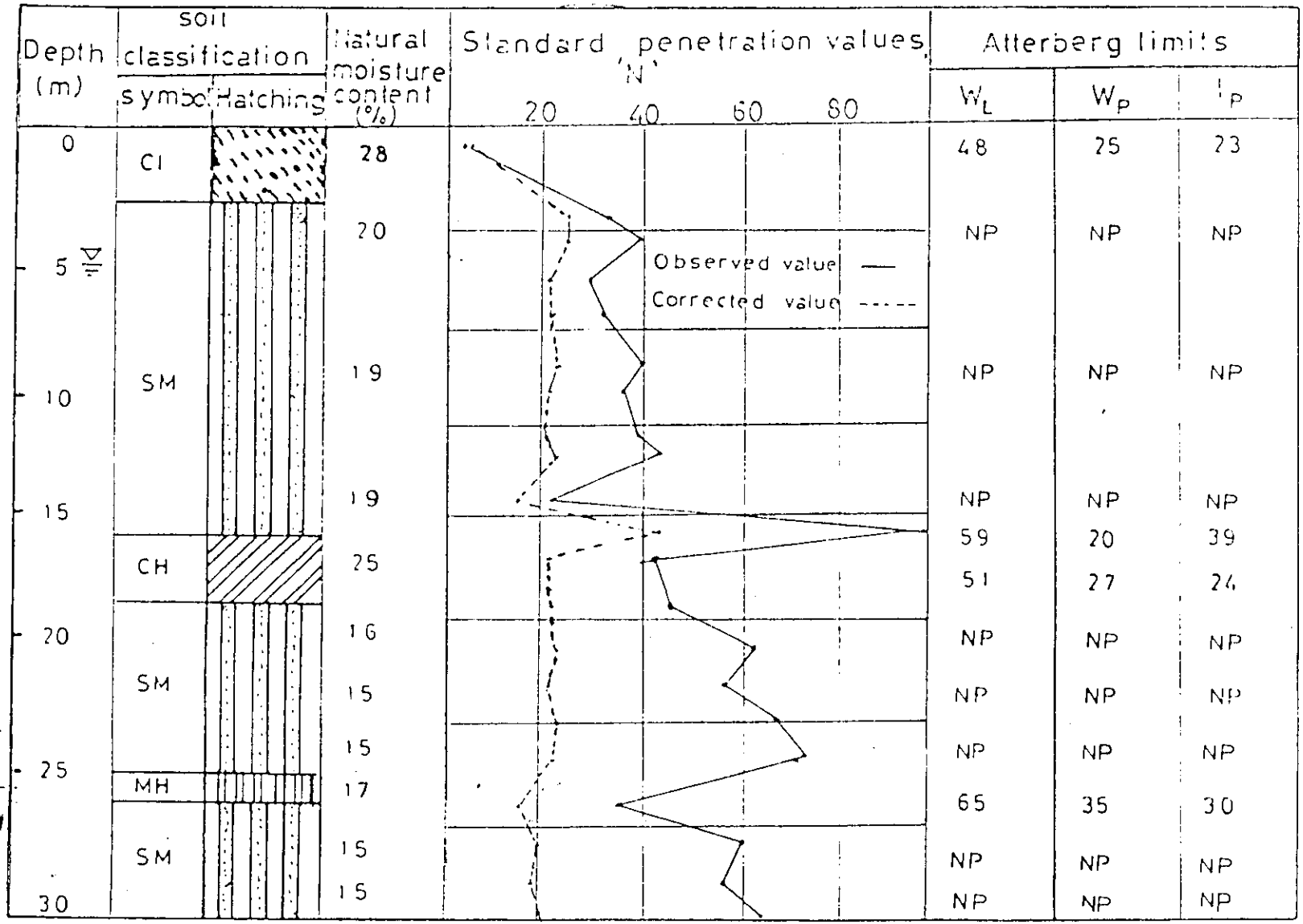


Fig.2 Bore log details of bore hole BH - 1 R.L-170 m

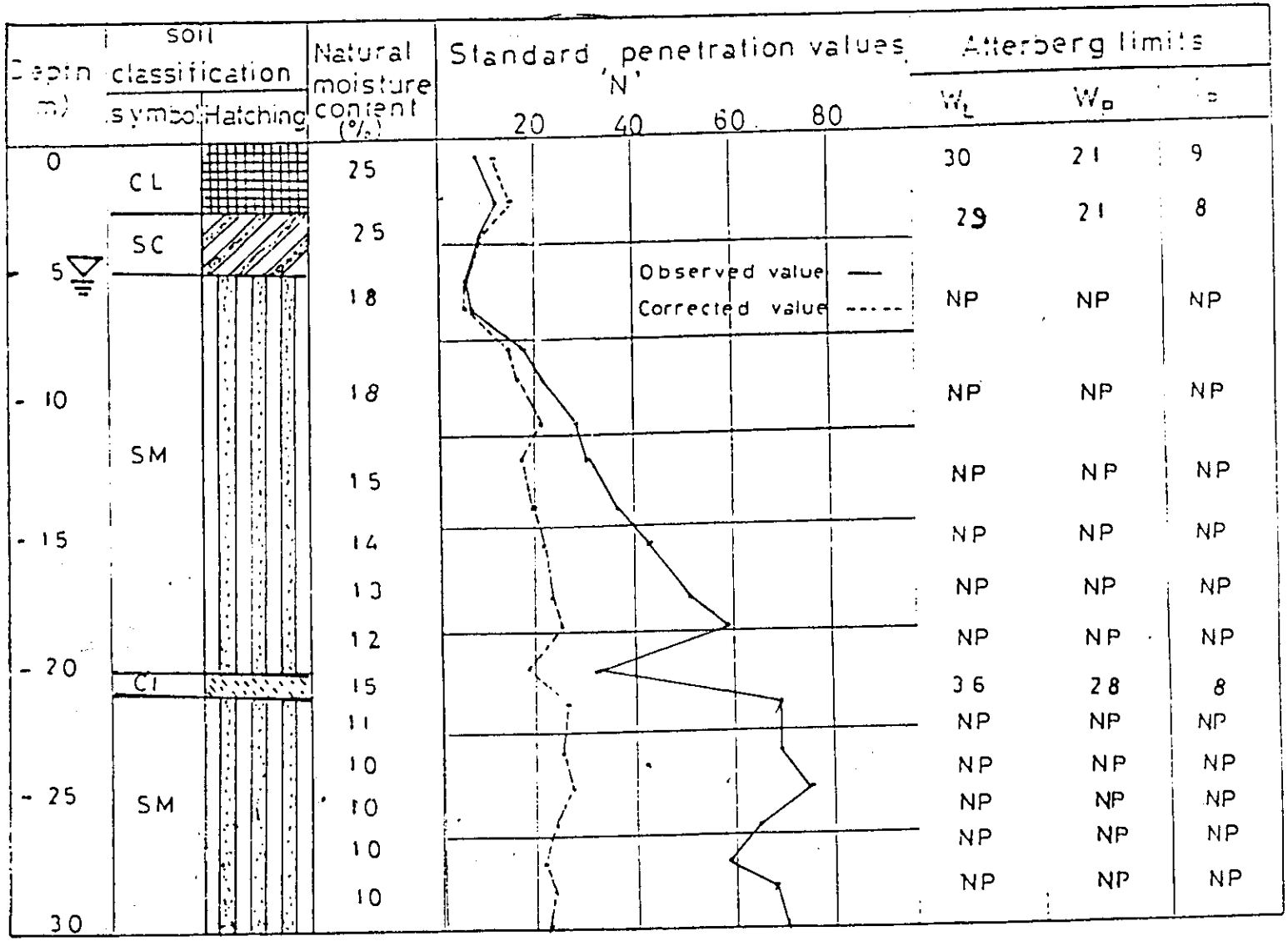


Fig.3 Bore log details of bore hole BH - 2 R.L - 22.0 m.

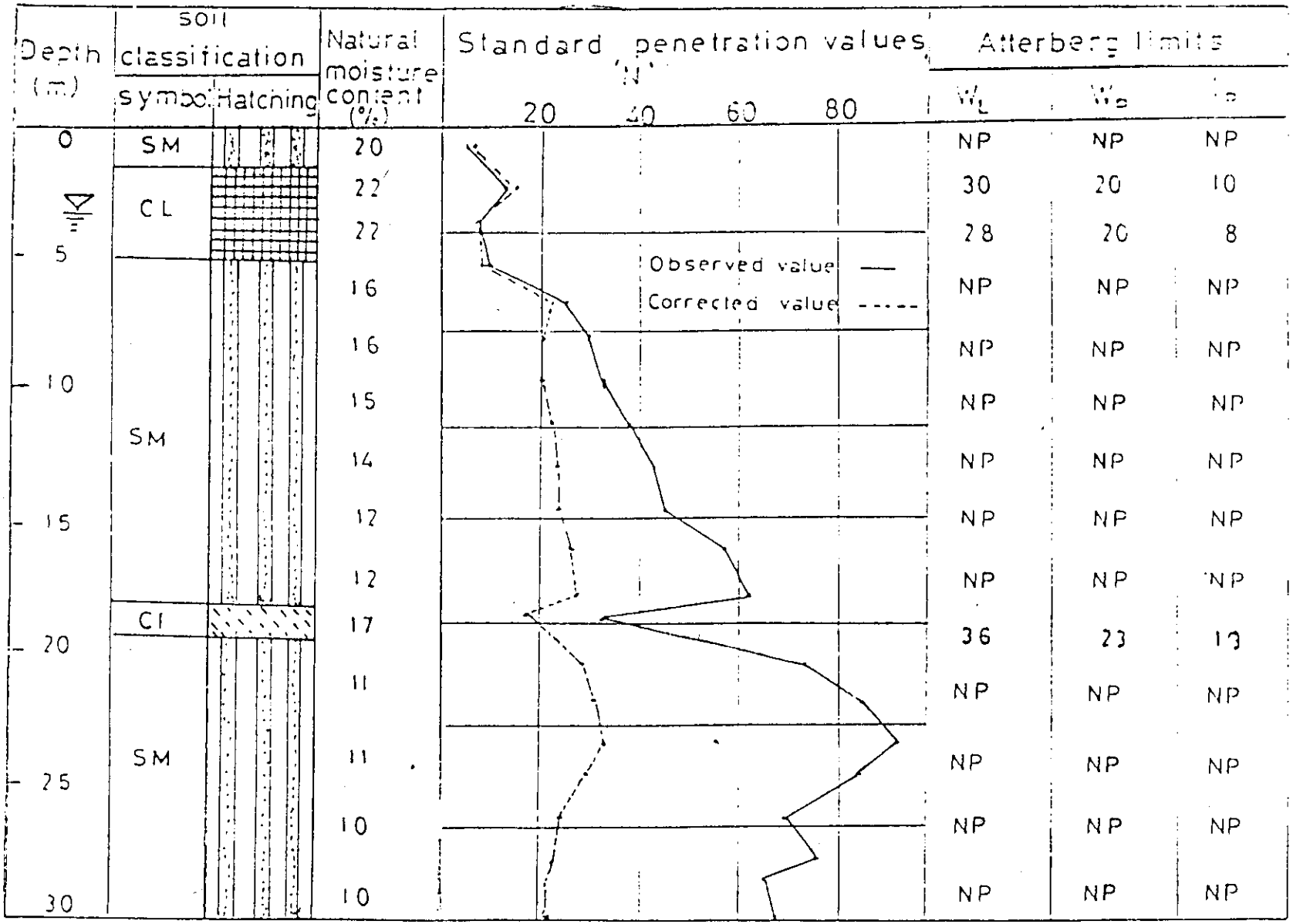


Fig. 4 Bore log details of bore hole BH -3 R.L 22·0 m.

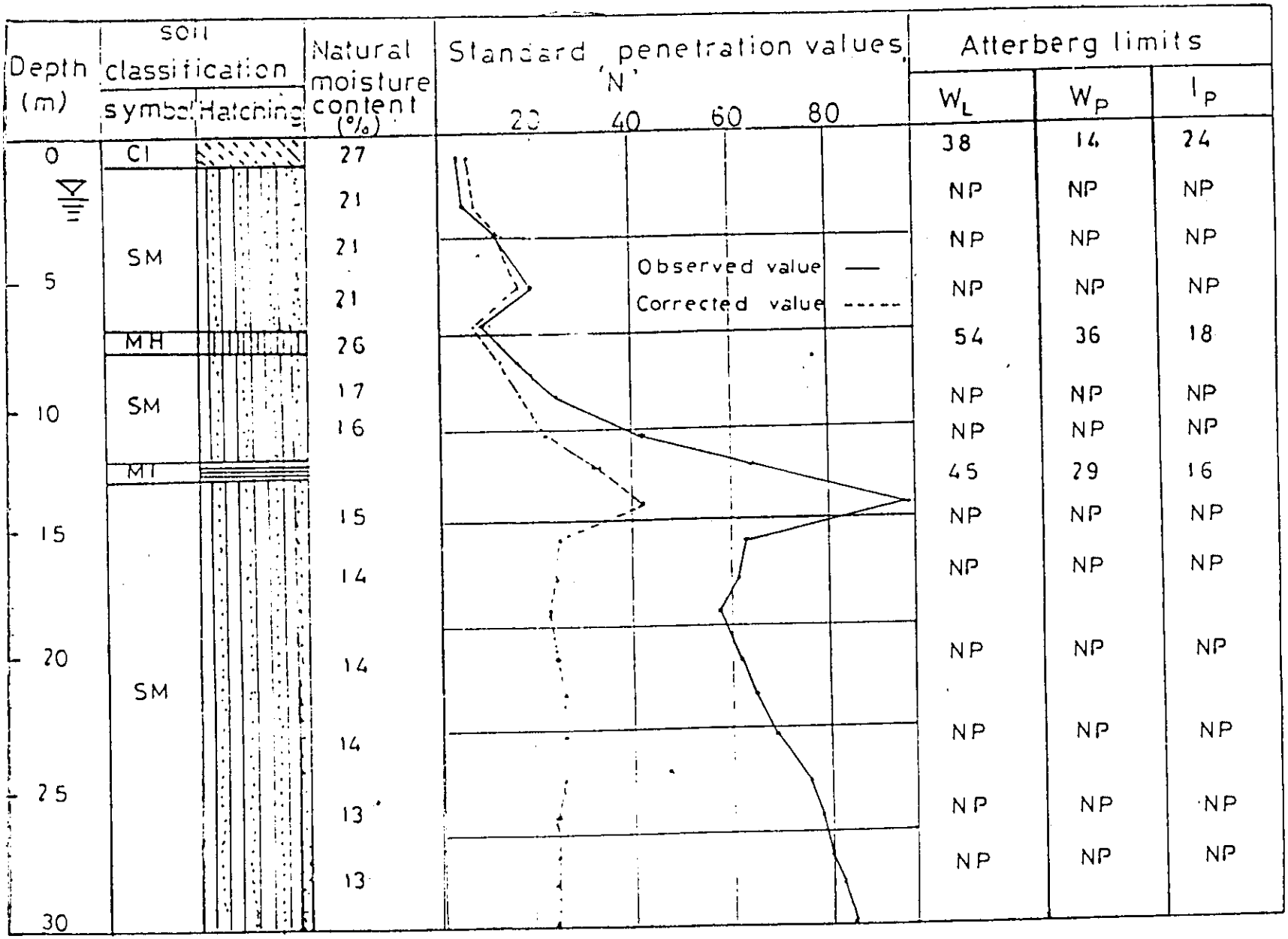


Fig. 5 Bore log details of bore hole BH - 4 R.L- 17·0 m.

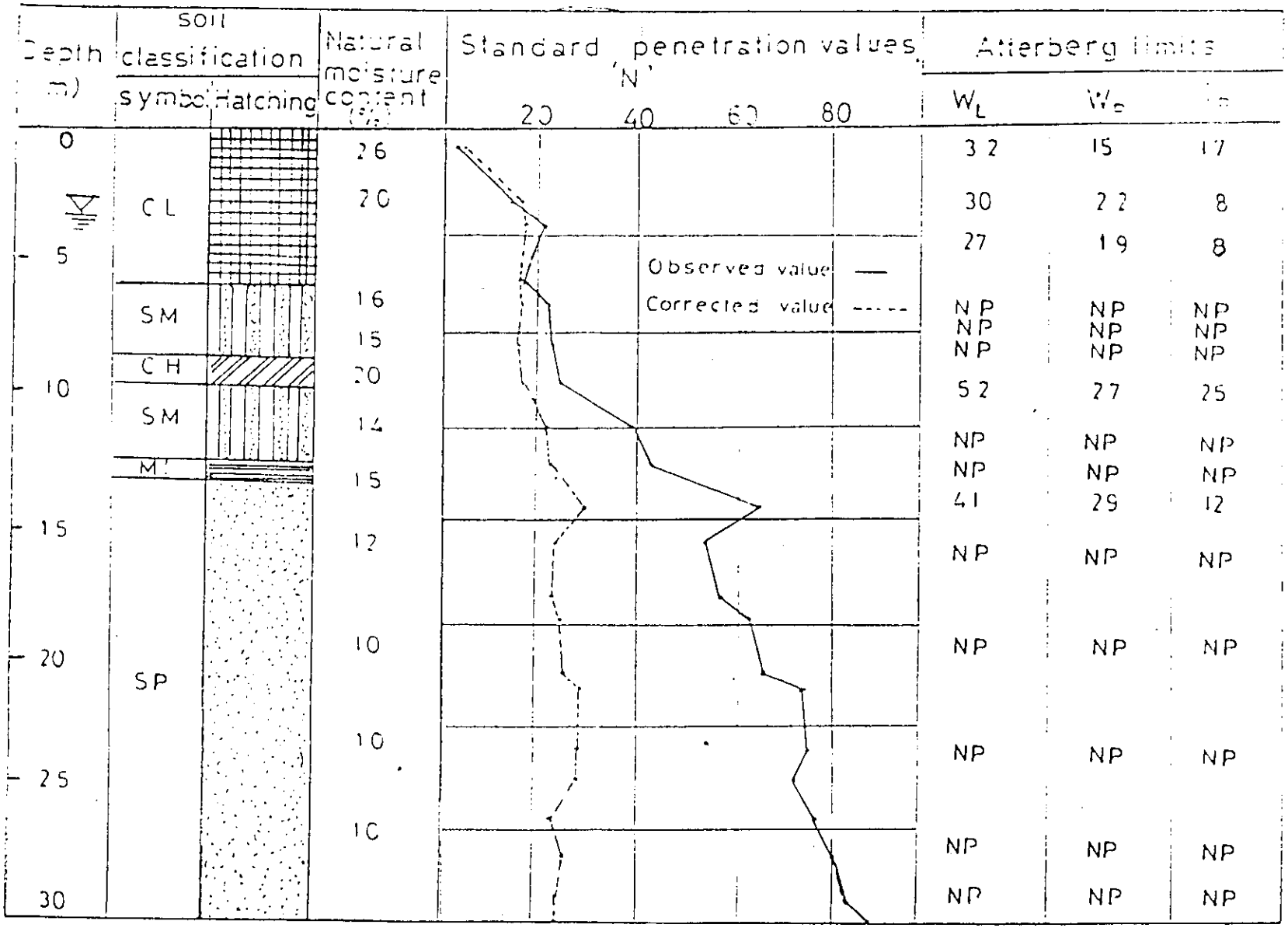


Fig. 6 Bore log details of bore hole BH - 5 R.L - 19.0 m

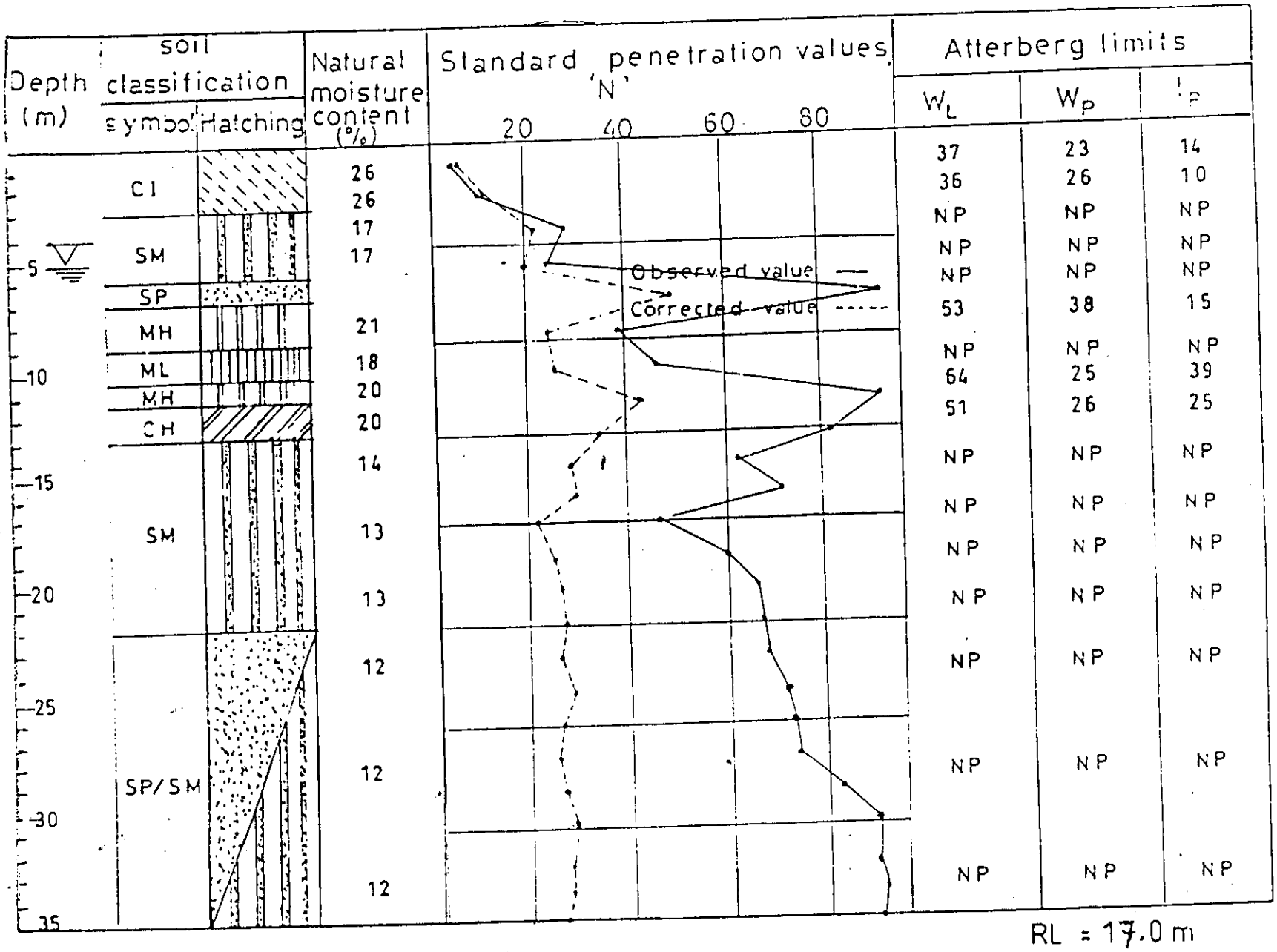


Fig. 7 Bore log details of bore hole BH -6

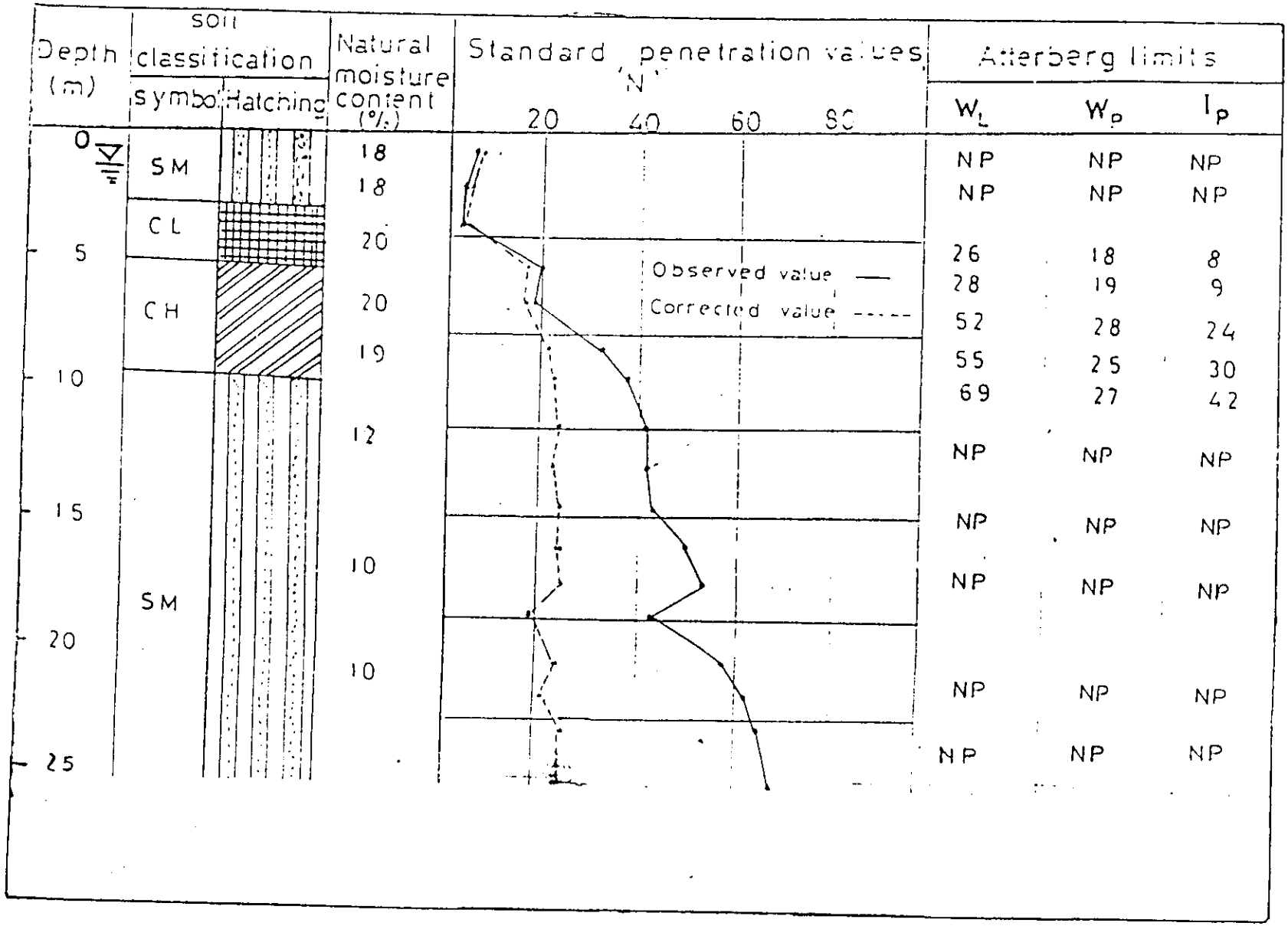


Fig.8 Bore log details of bore hole BH -7 R.L -15·00 m

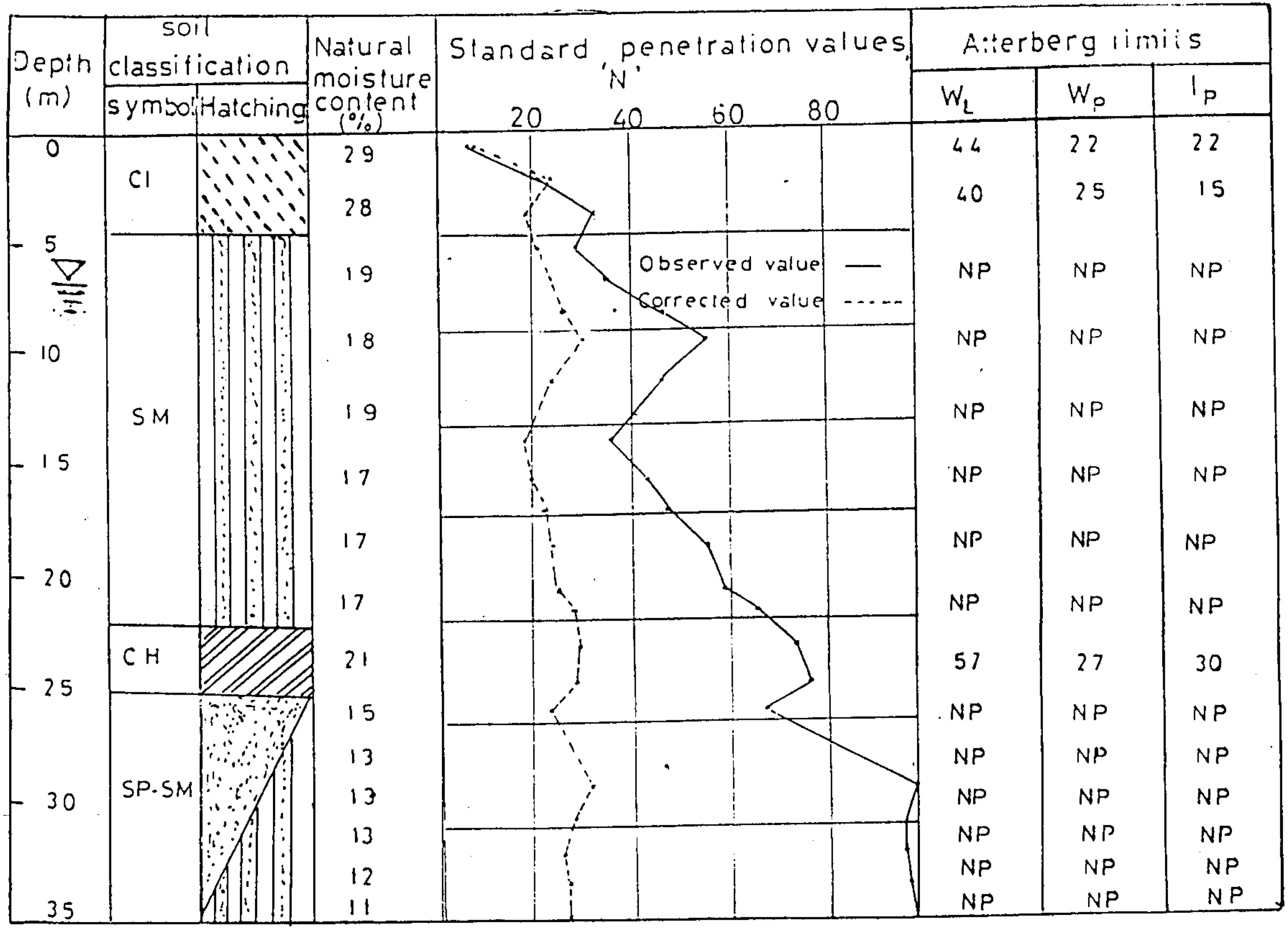


Fig. 9 Bore log details of bore hole BH -8 RL-19·0 m

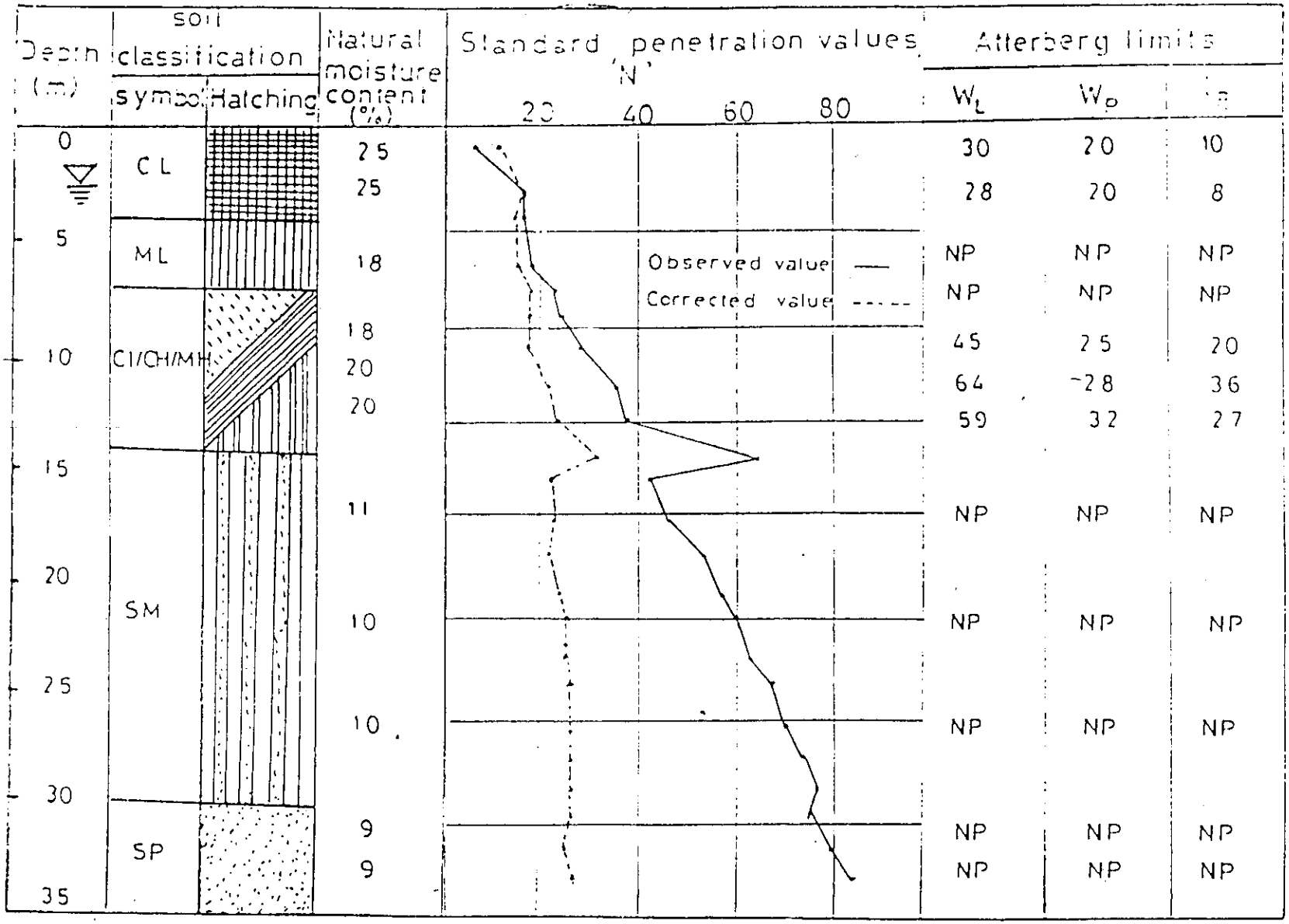


Fig.10 Bore log details of bore hole BH - 9 R.L - 180 m.

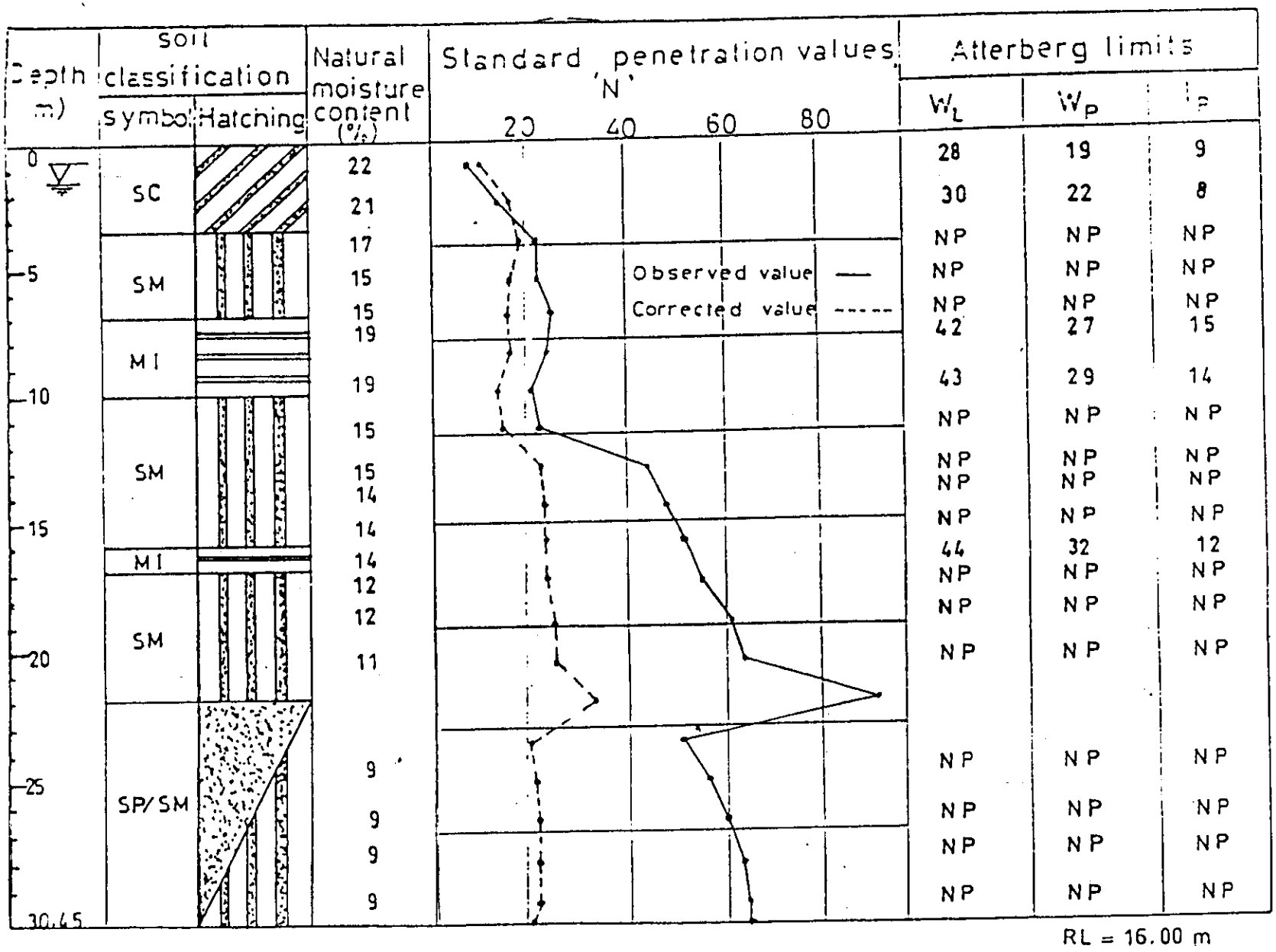


Fig. 11 Bore log details of bore hole BH -10

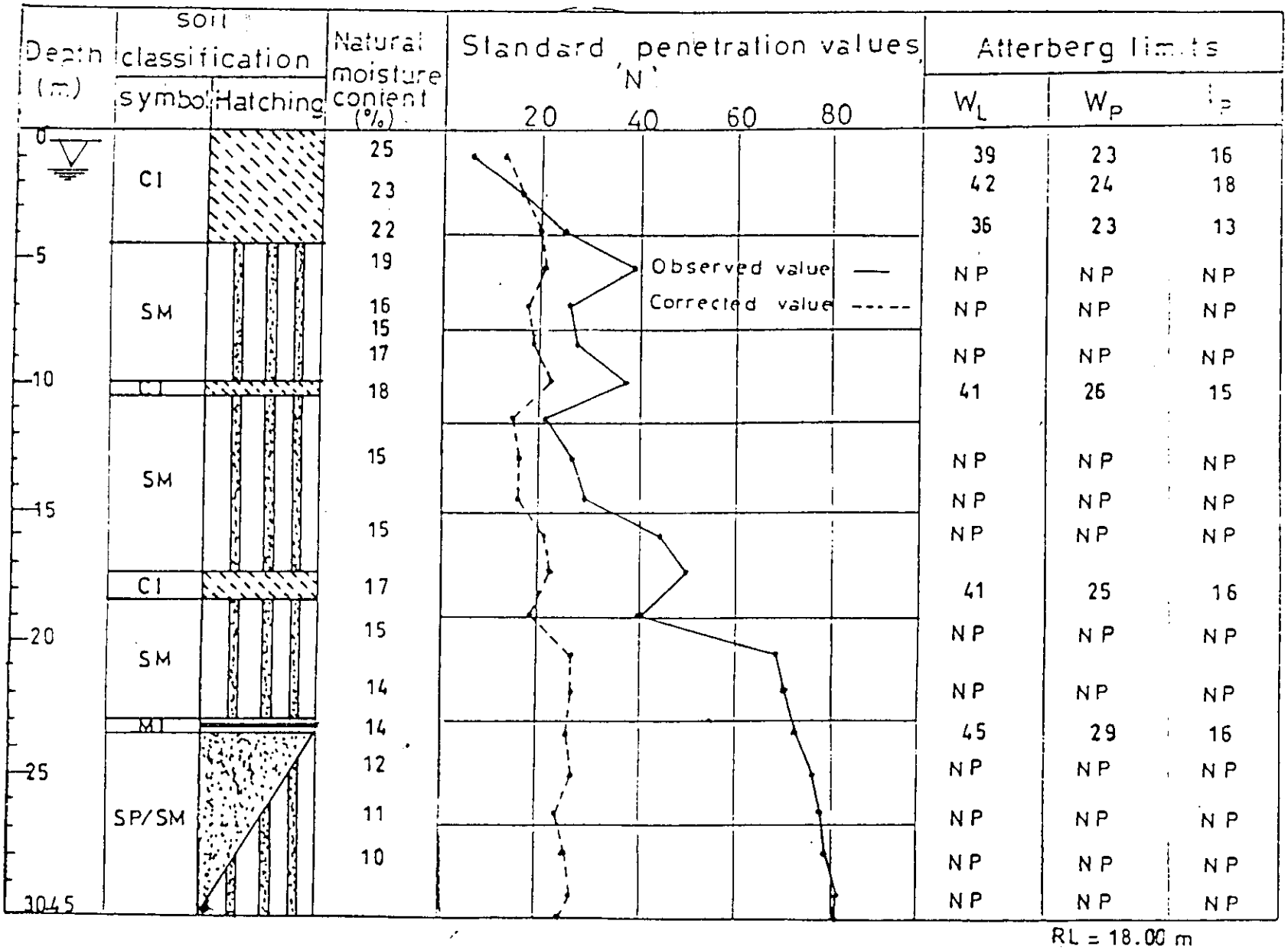


Fig. 12 Bore log details of bore hole BH -11

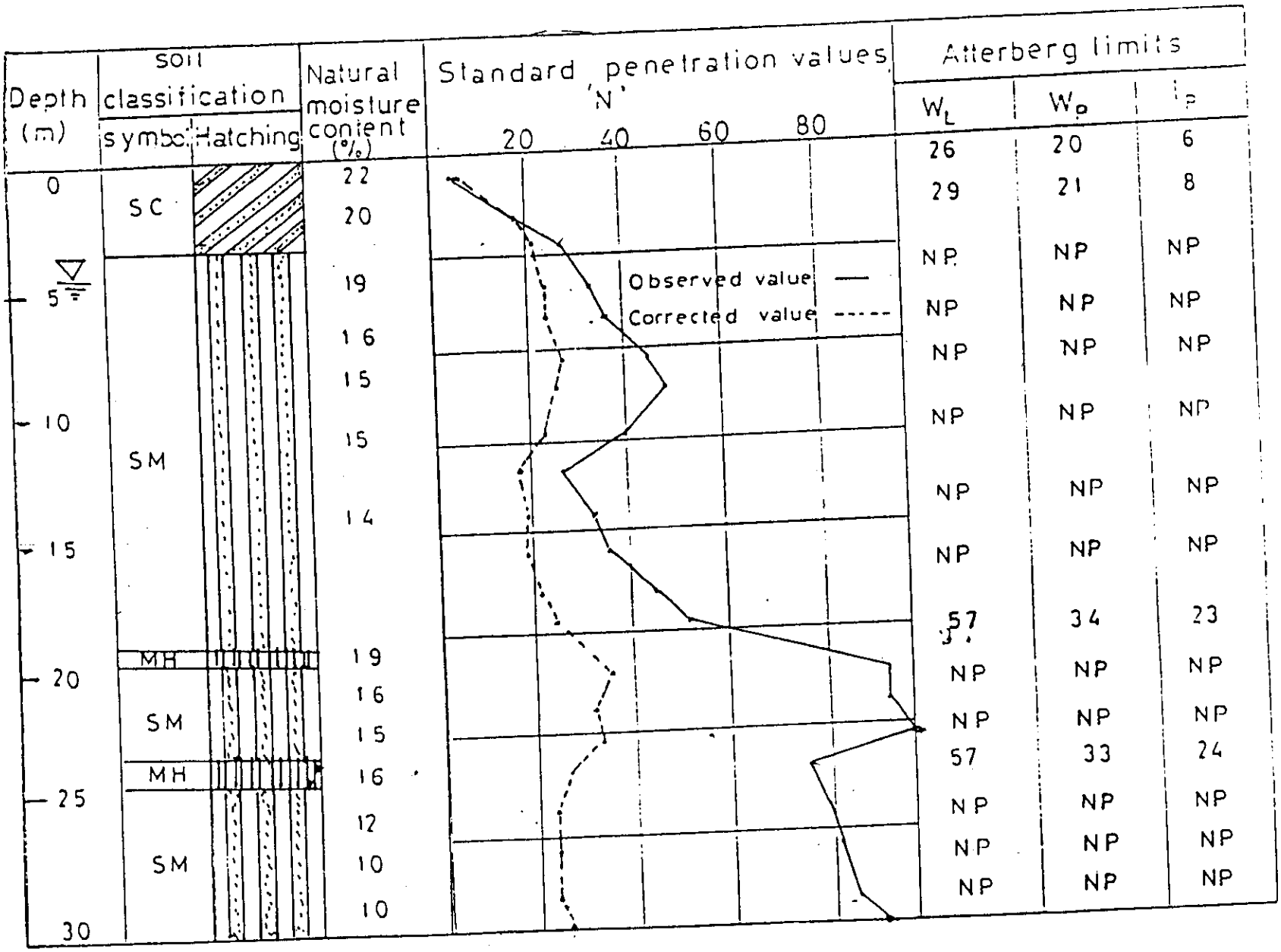


Fig. 13 Bore log details of bore hole BH - 12 R.L-18·00

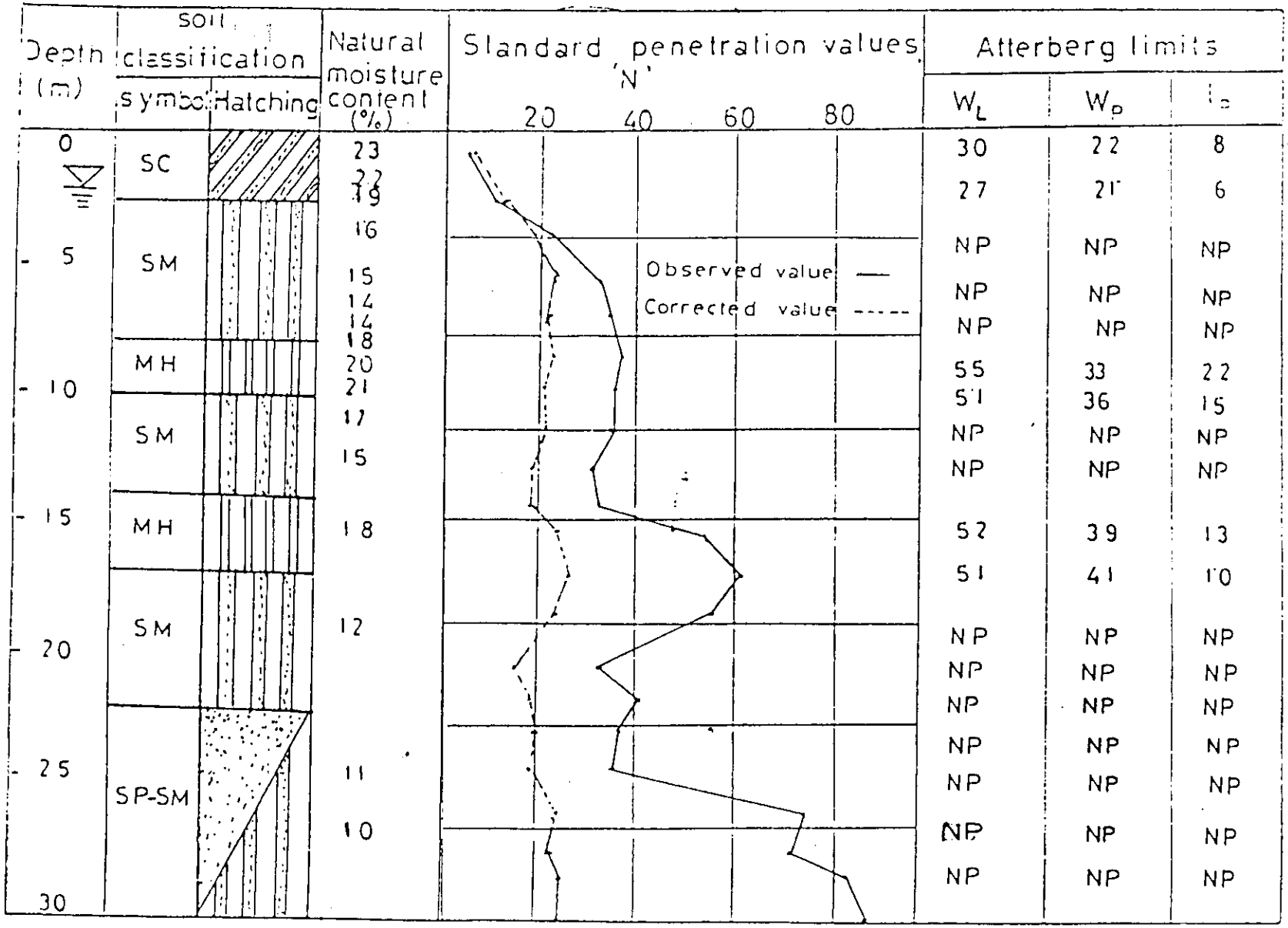


Fig.14 Bore log details of bore hole BH - 13 R.L - 18·00

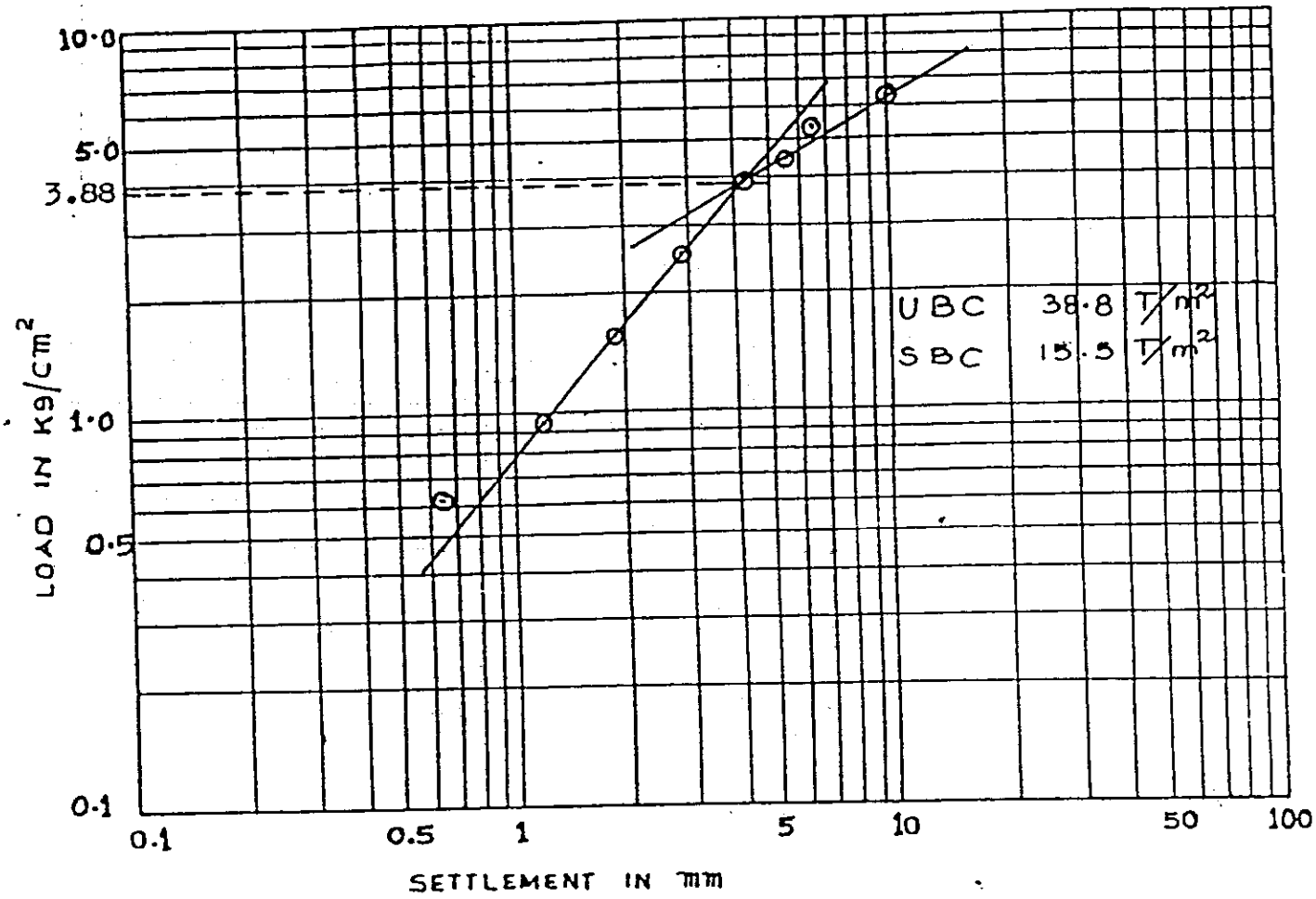


FIG -15 LOAD SETTLEMENT CURVE FOR PLT - 1

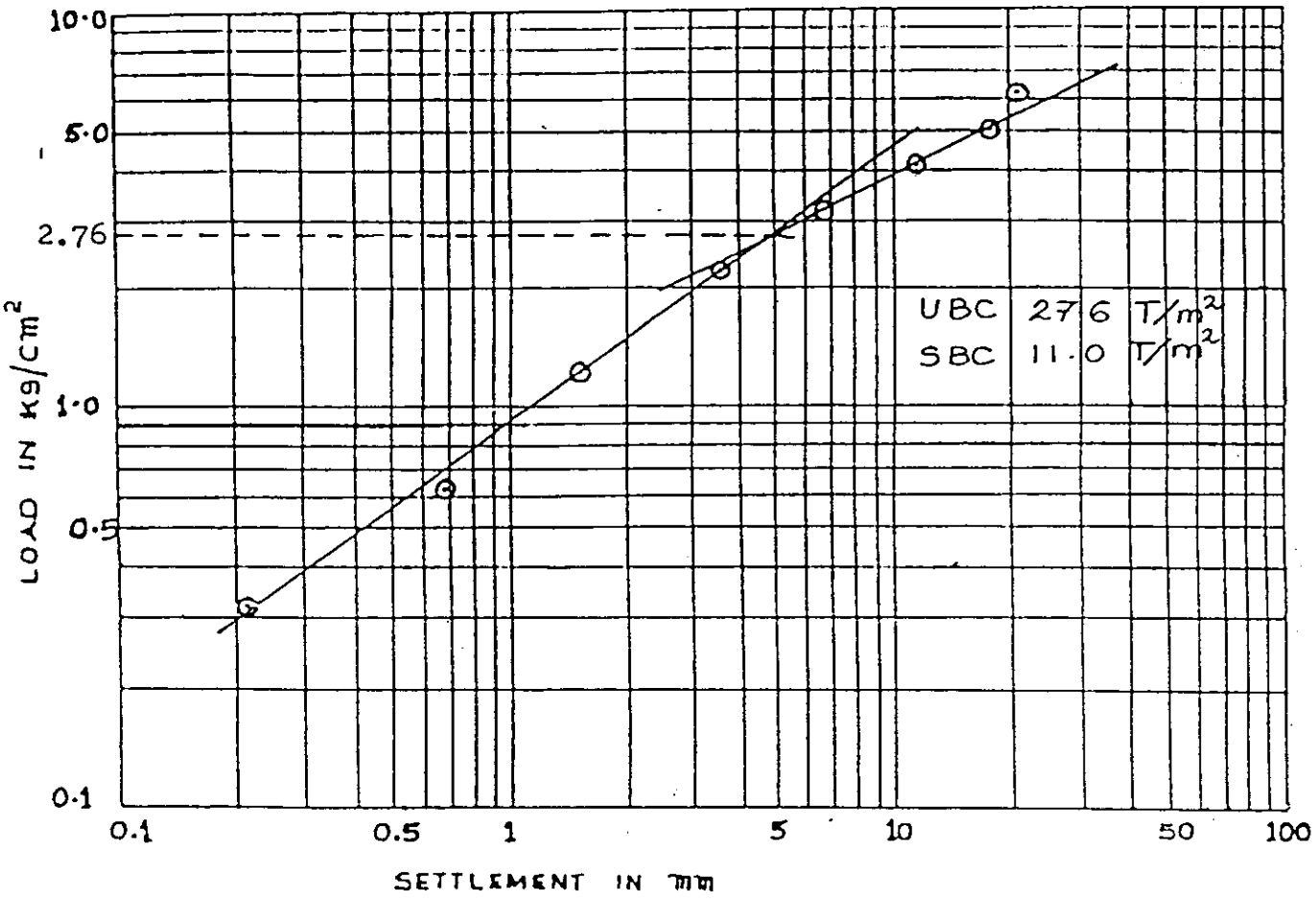


FIG - 16 LOAD SETTLEMENT CURVE FOR PLT-2

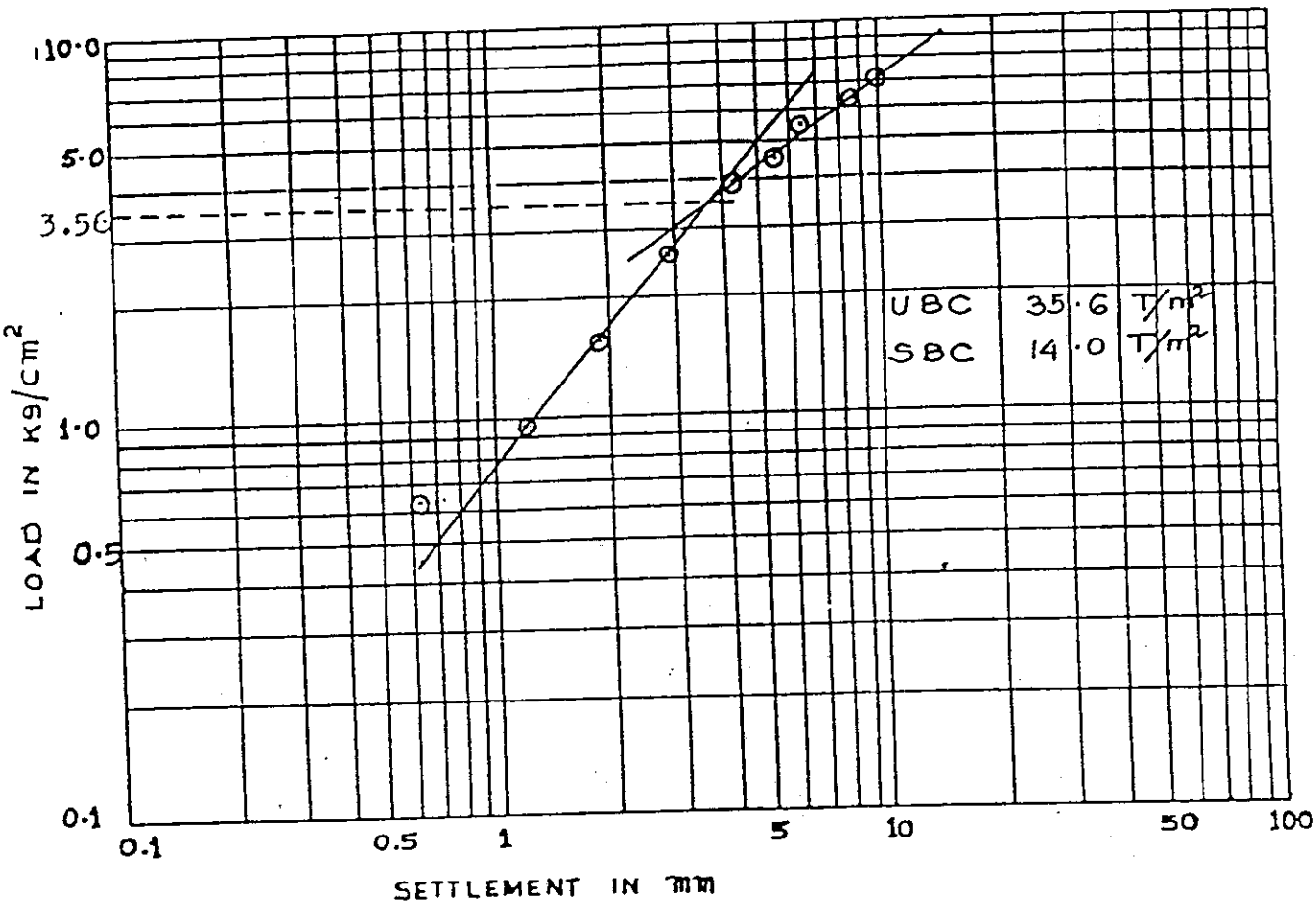


FIG -17 LOAD SETTLEMENT CURVE FOR PLT-3

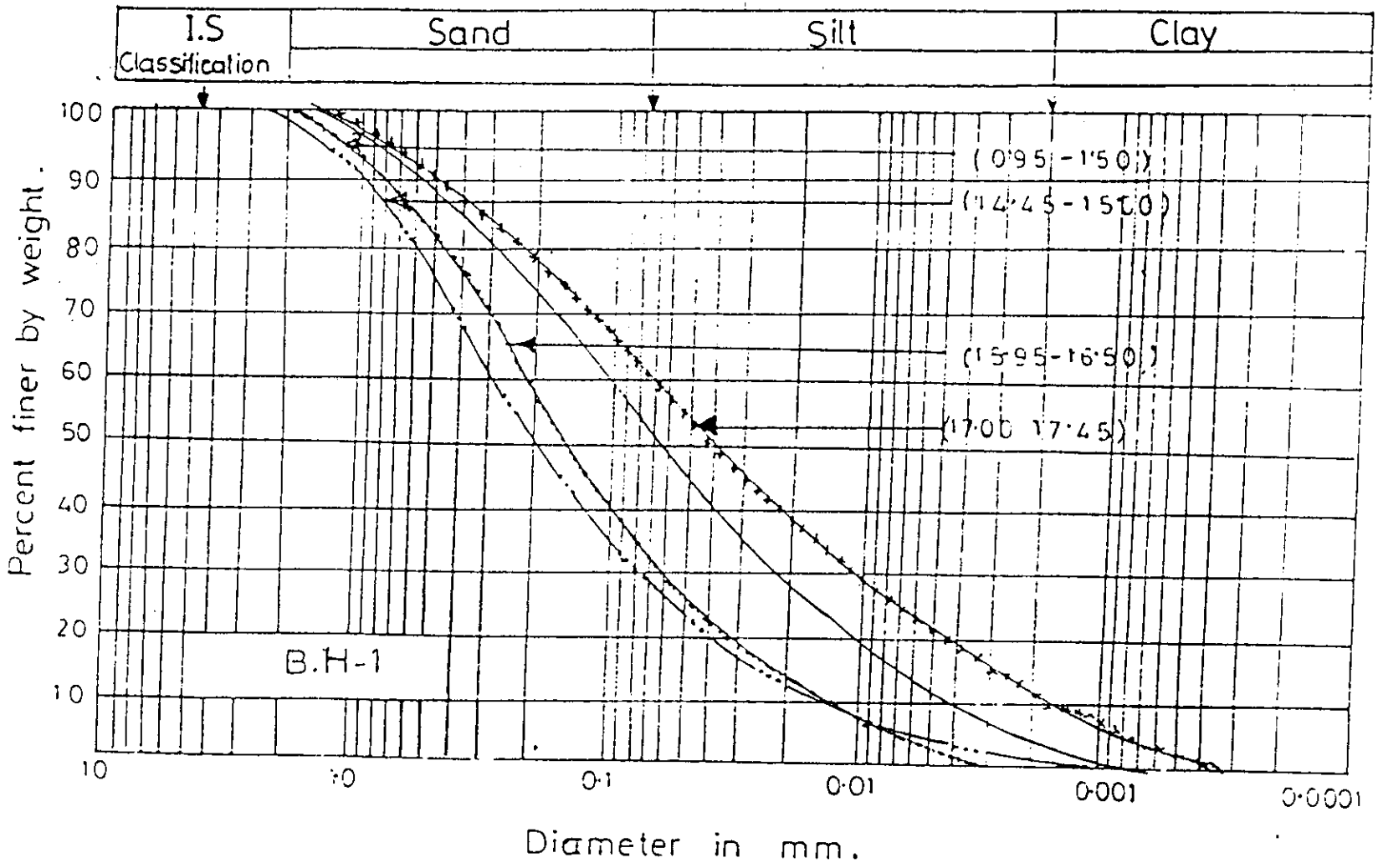


Fig. 18 Grain Size Distribution Curve

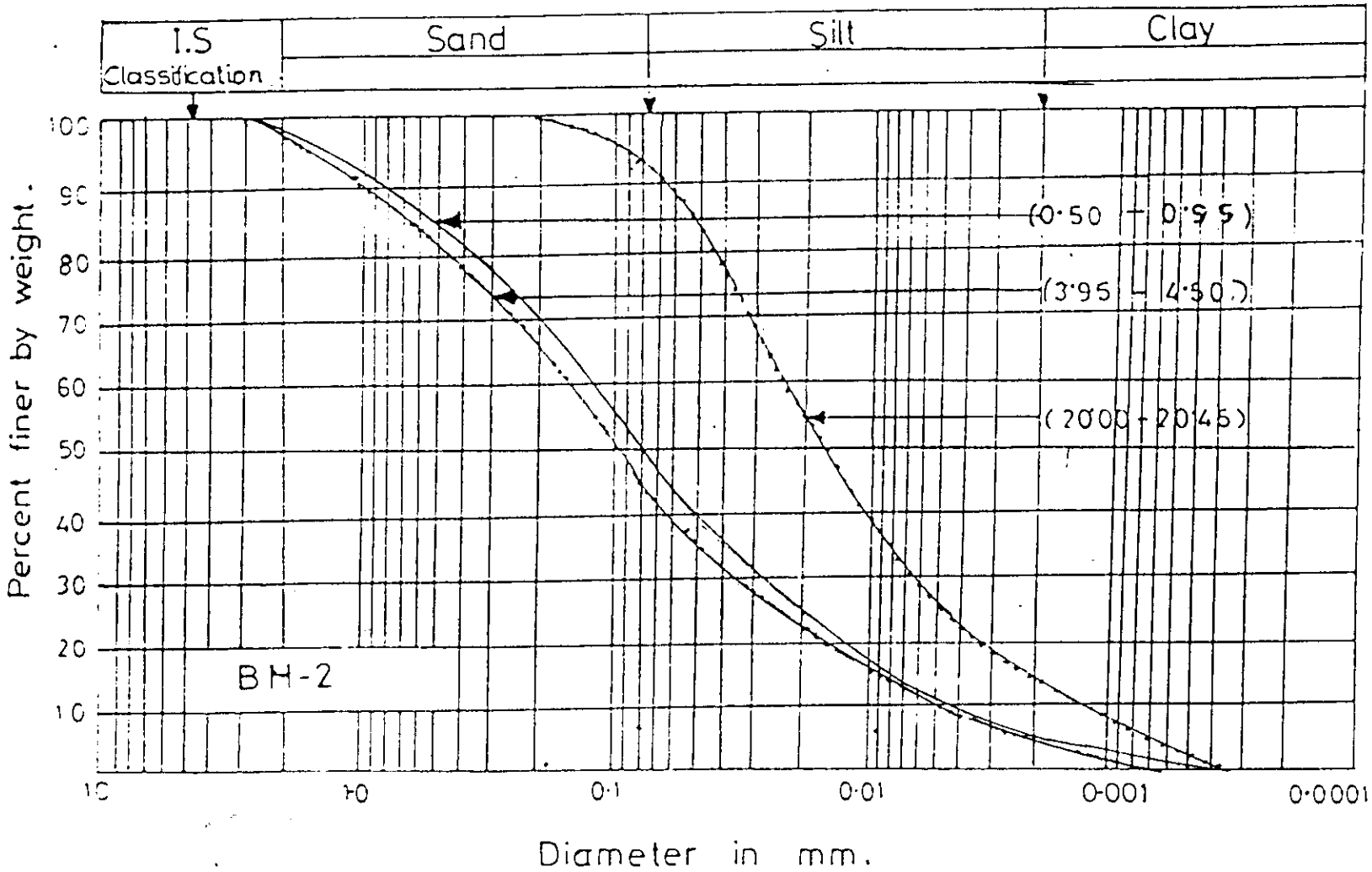


Fig. 19 Grain Size Distribution Curve

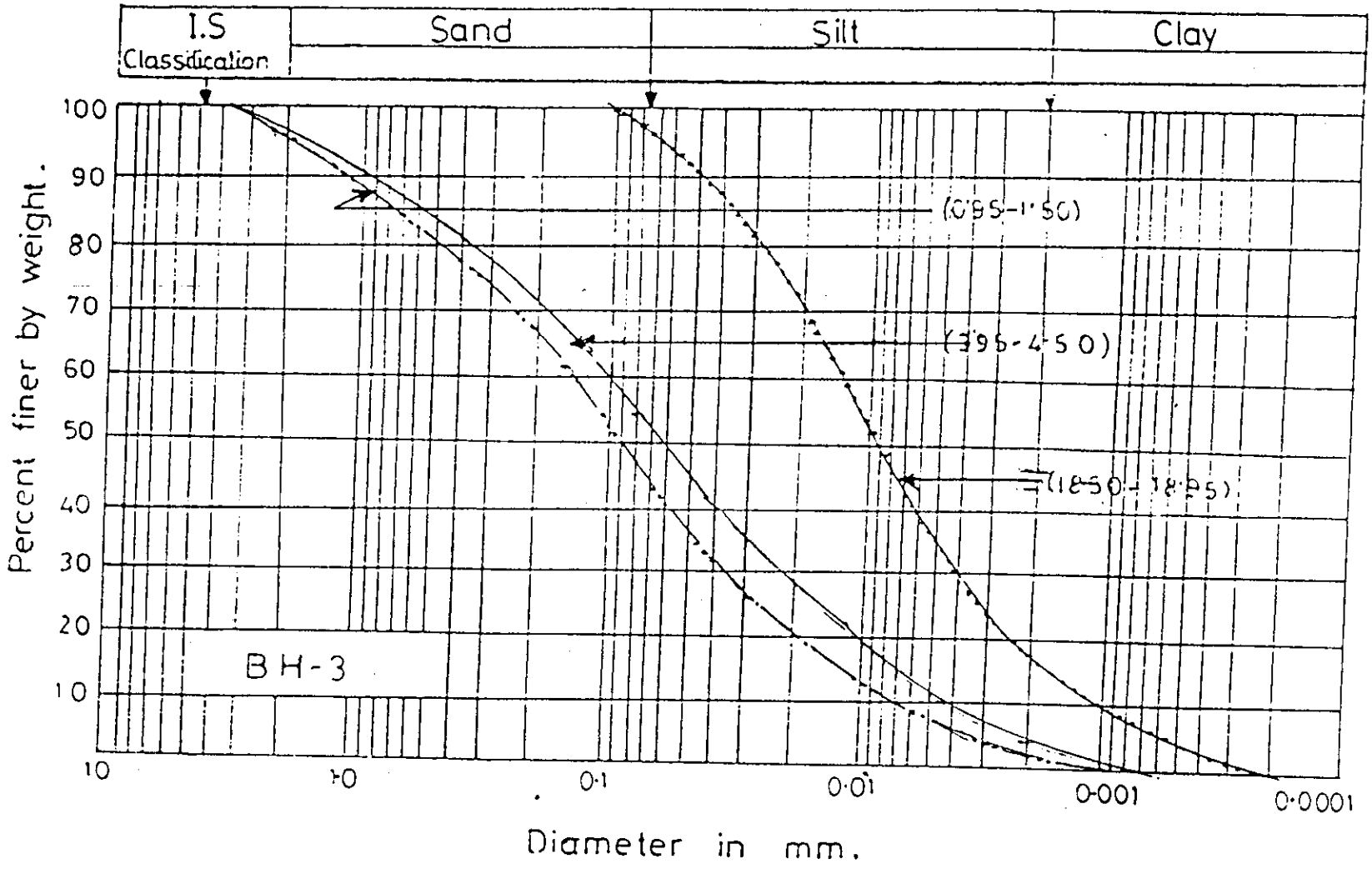


Fig. 20 Grain Size Distribution Curve

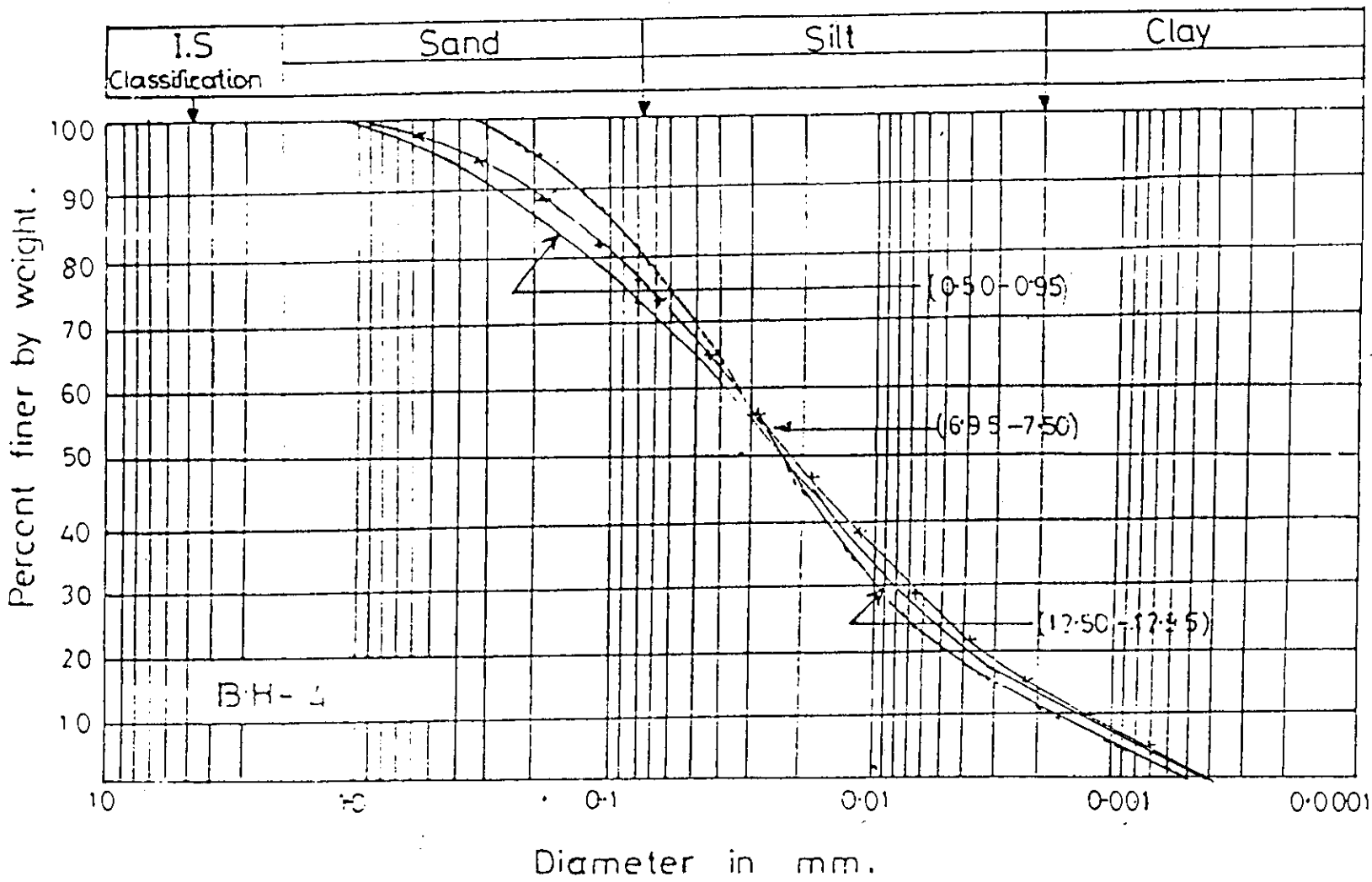


Fig. 21 Grain Size Distribution Curve.

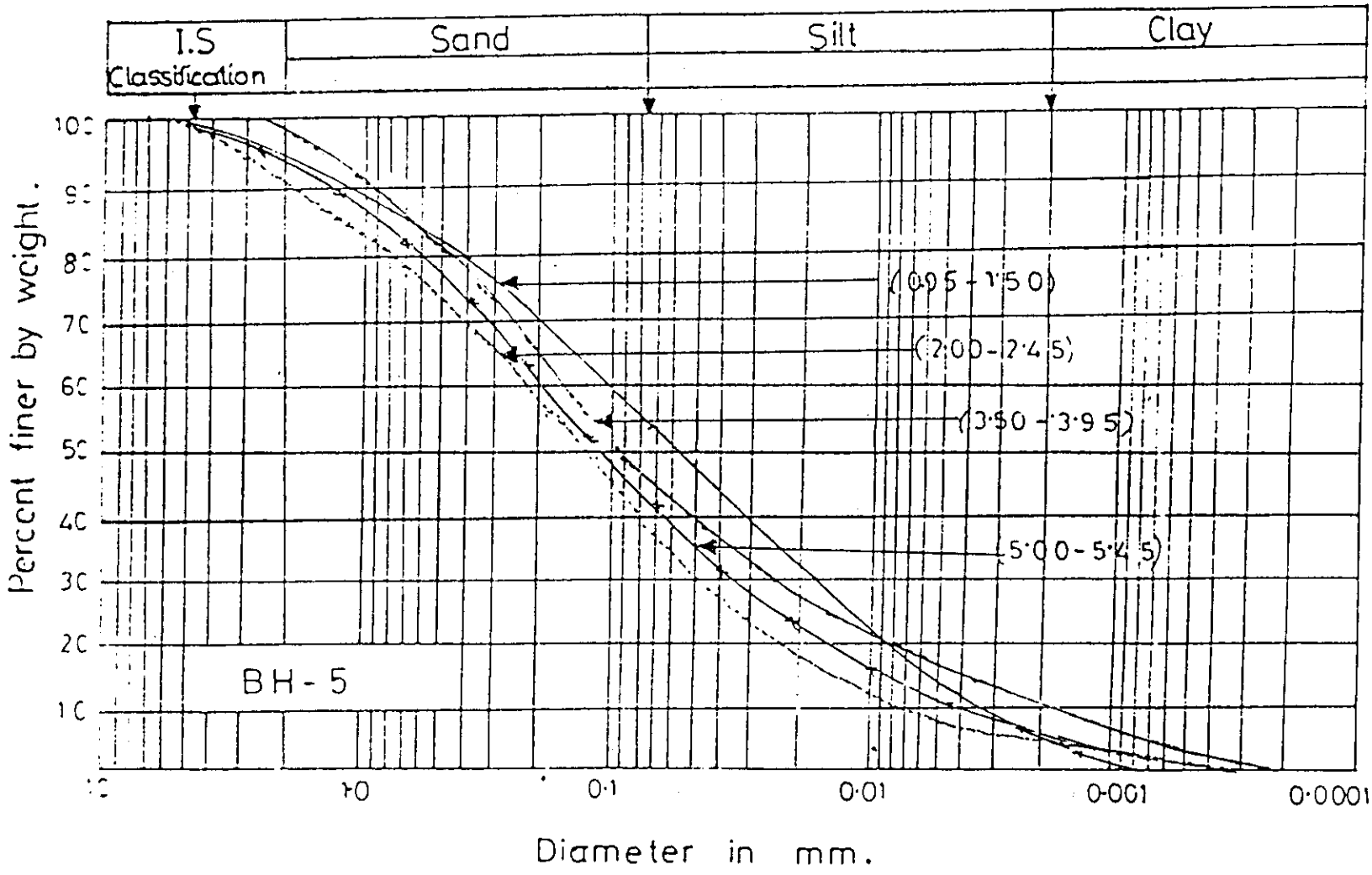


Fig. 22 Grain Size Distribution Curve

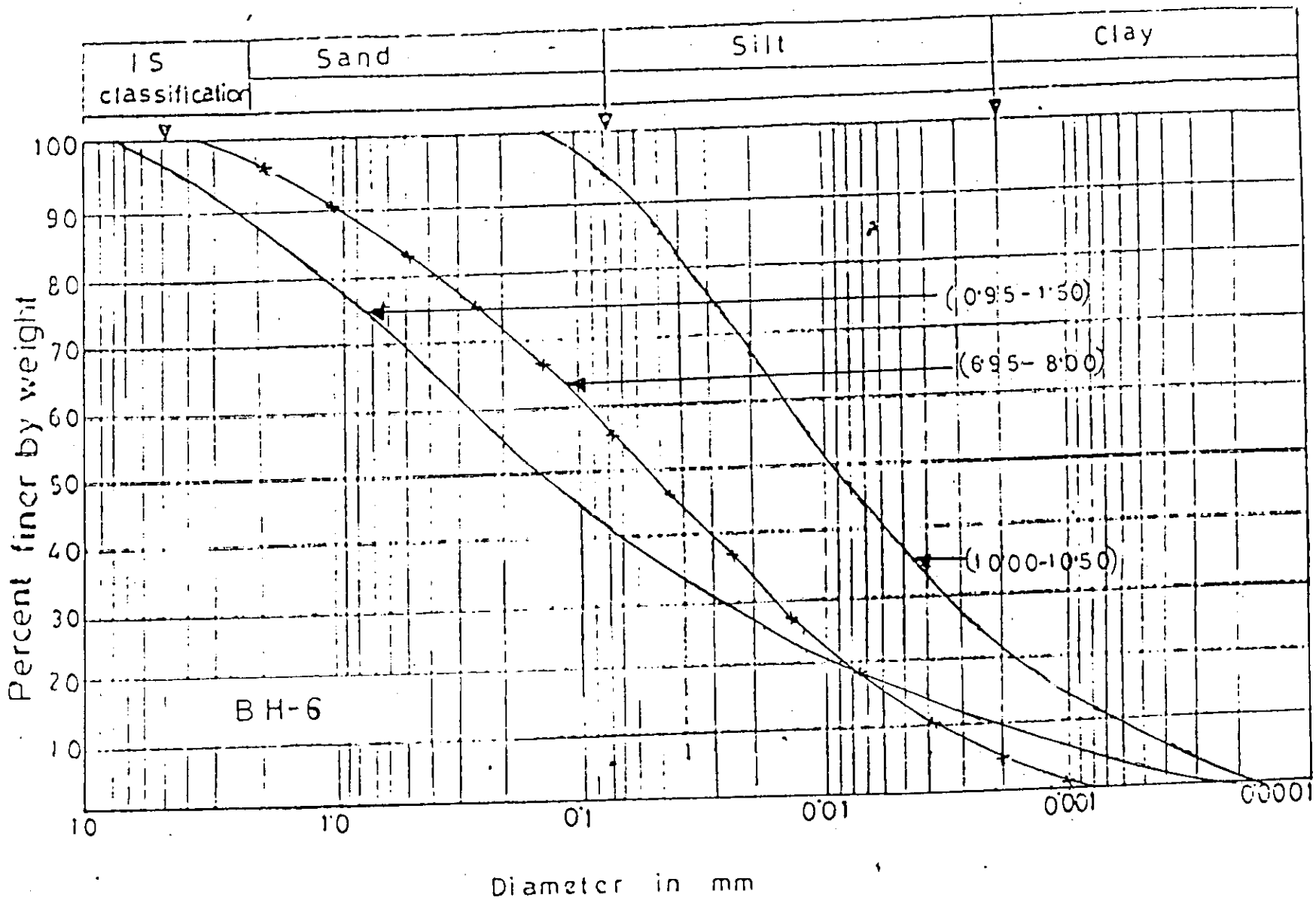


Fig. 23 GRAIN SIZE DISTRIBUTION

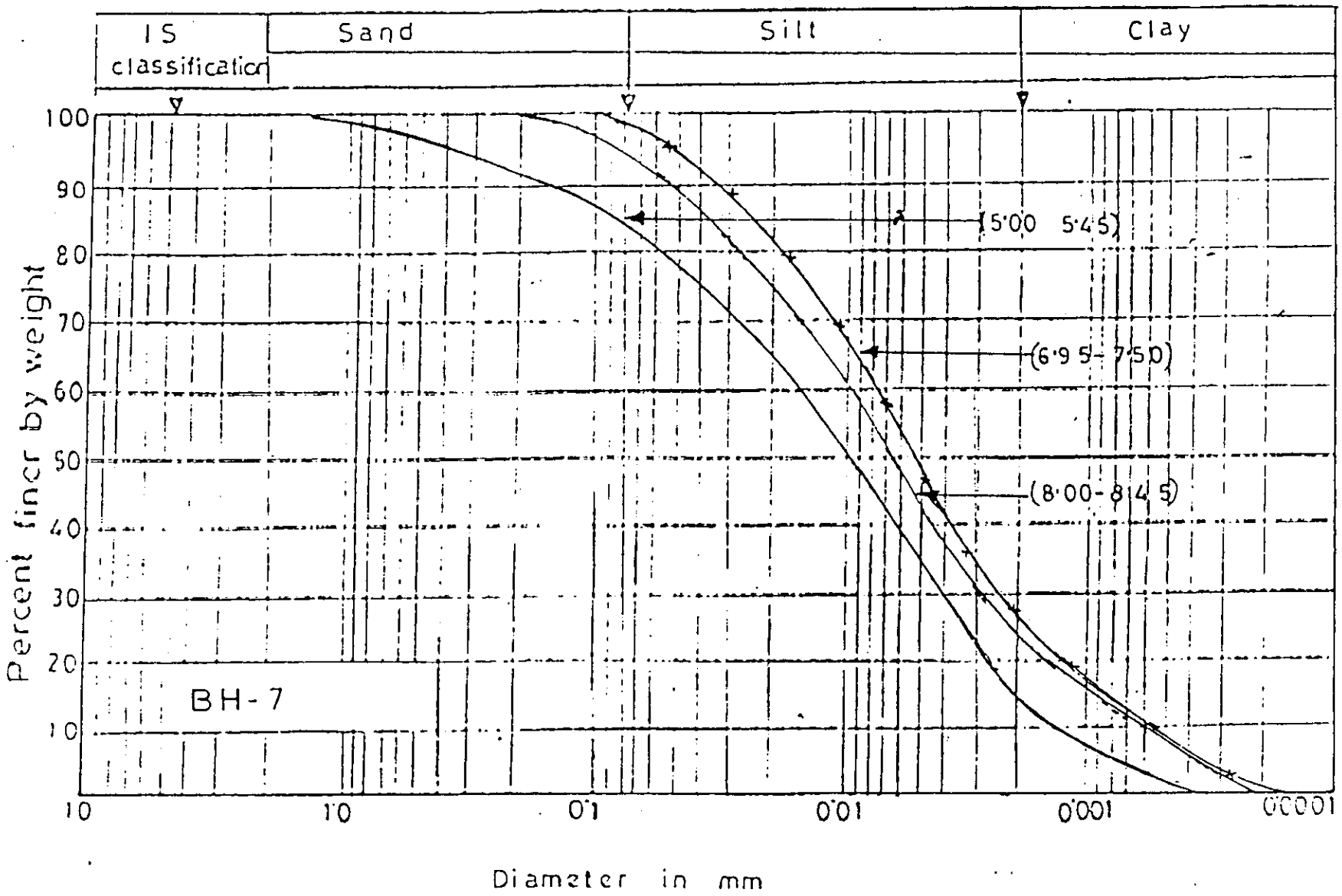


Fig. 24

GRAIN SIZE DISTRIBUTION

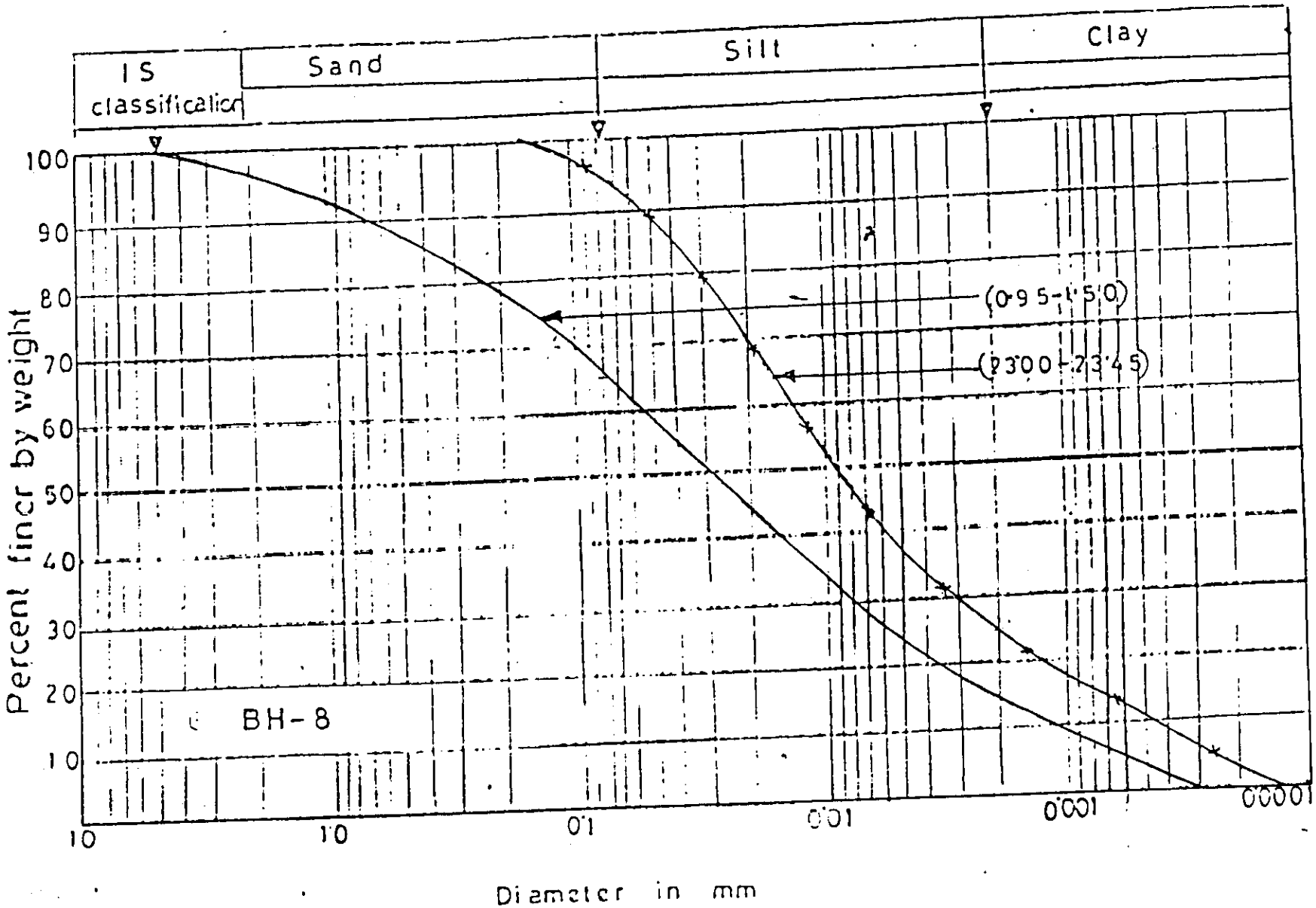


Fig. 25. GRAIN SIZE DISTRIBUTION

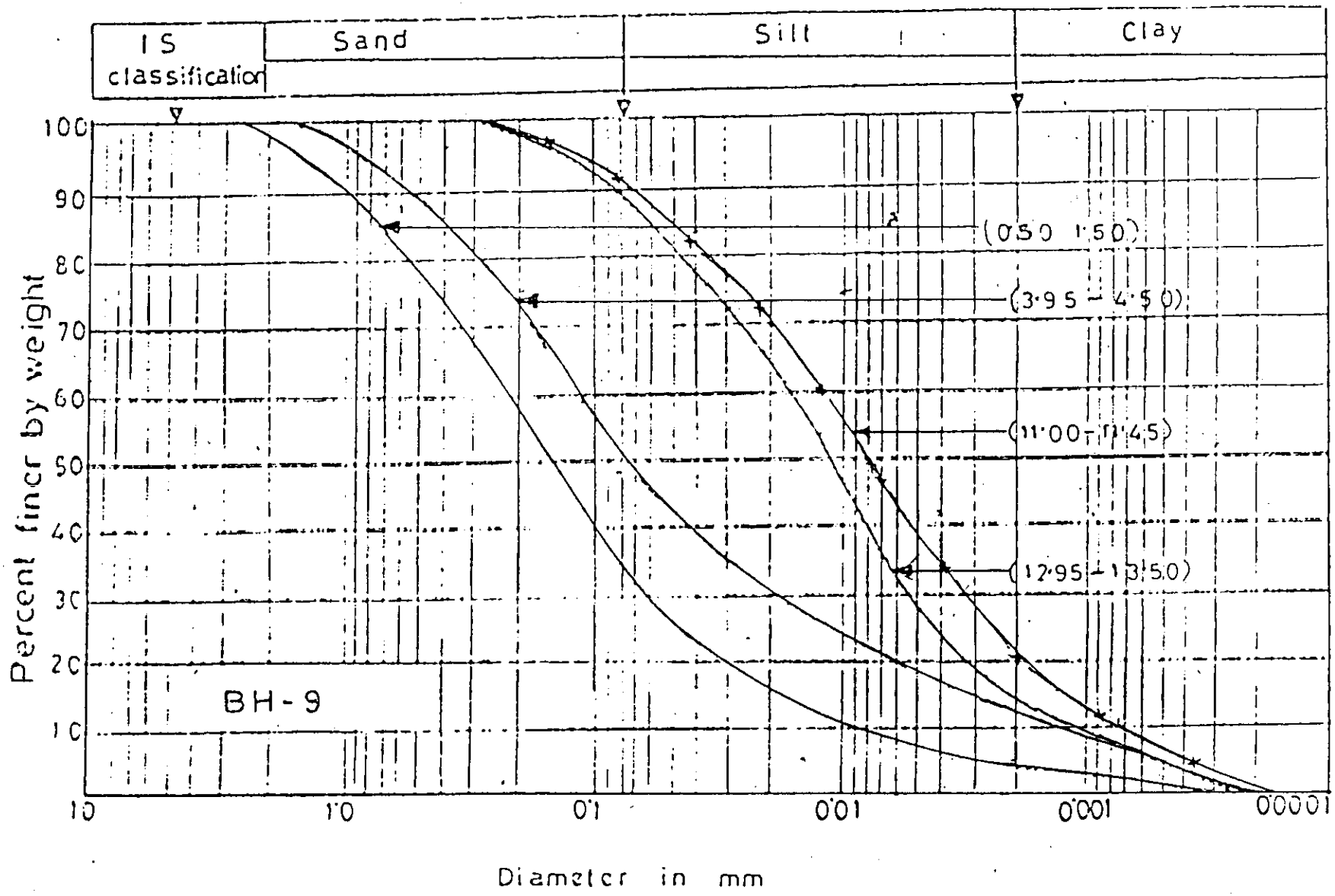


Fig. 26

GRAIN SIZE DISTRIBUTION

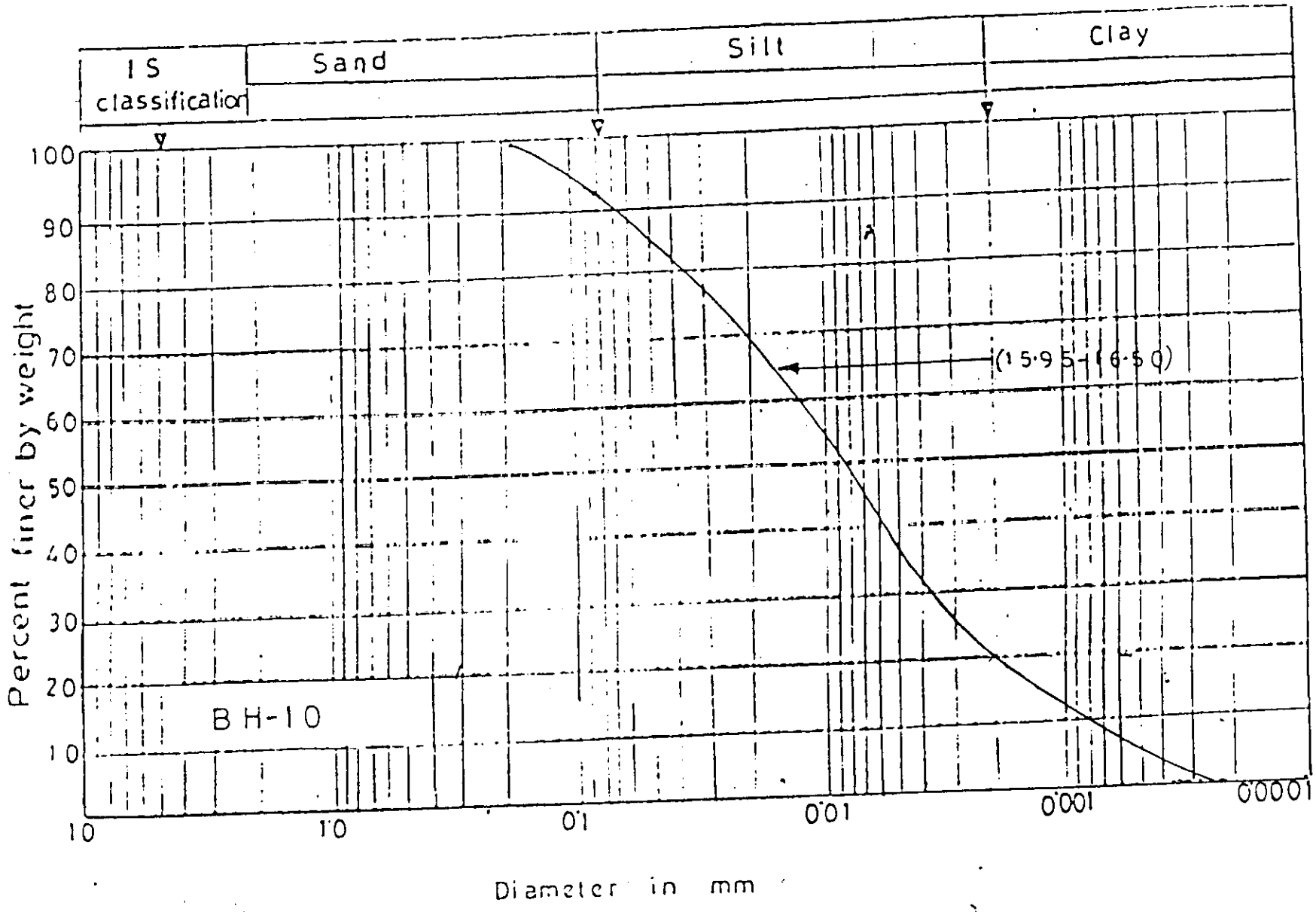


Fig. 27. GRAIN SIZE DISTRIBUTION

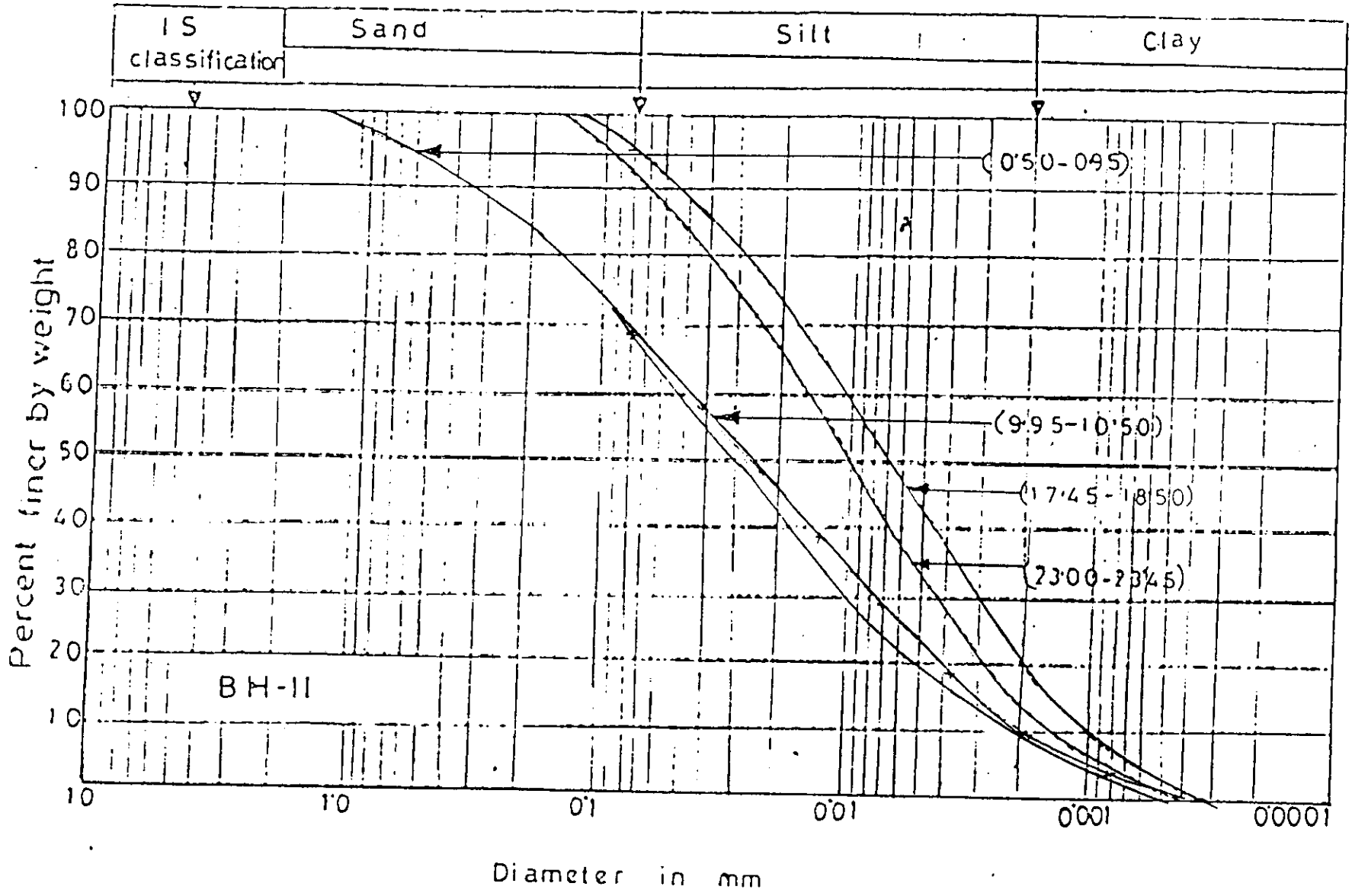


Fig. 28

GRAIN SIZE DISTRIBUTION

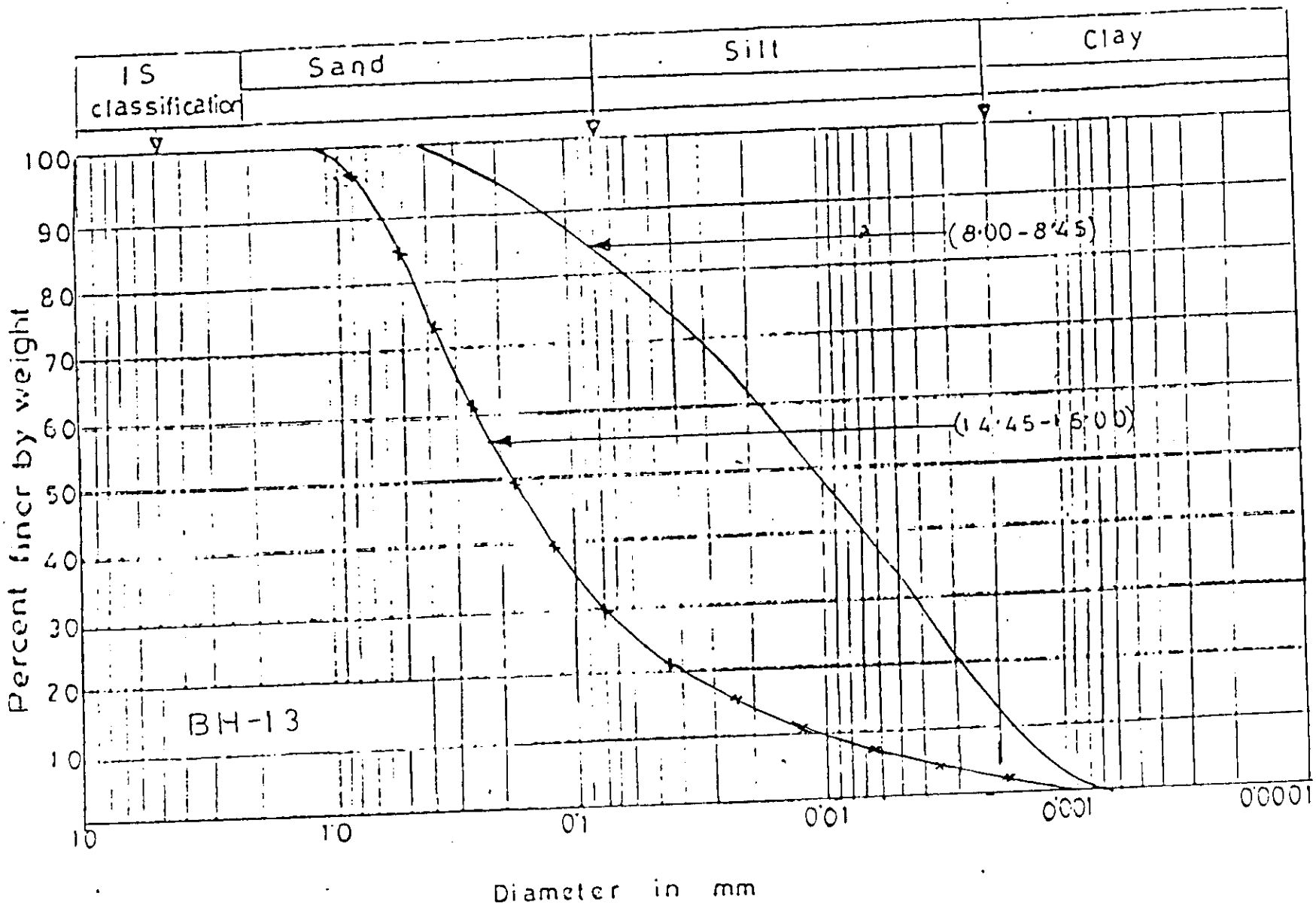


Fig. 29 GRAIN SIZE DISTRIBUTION

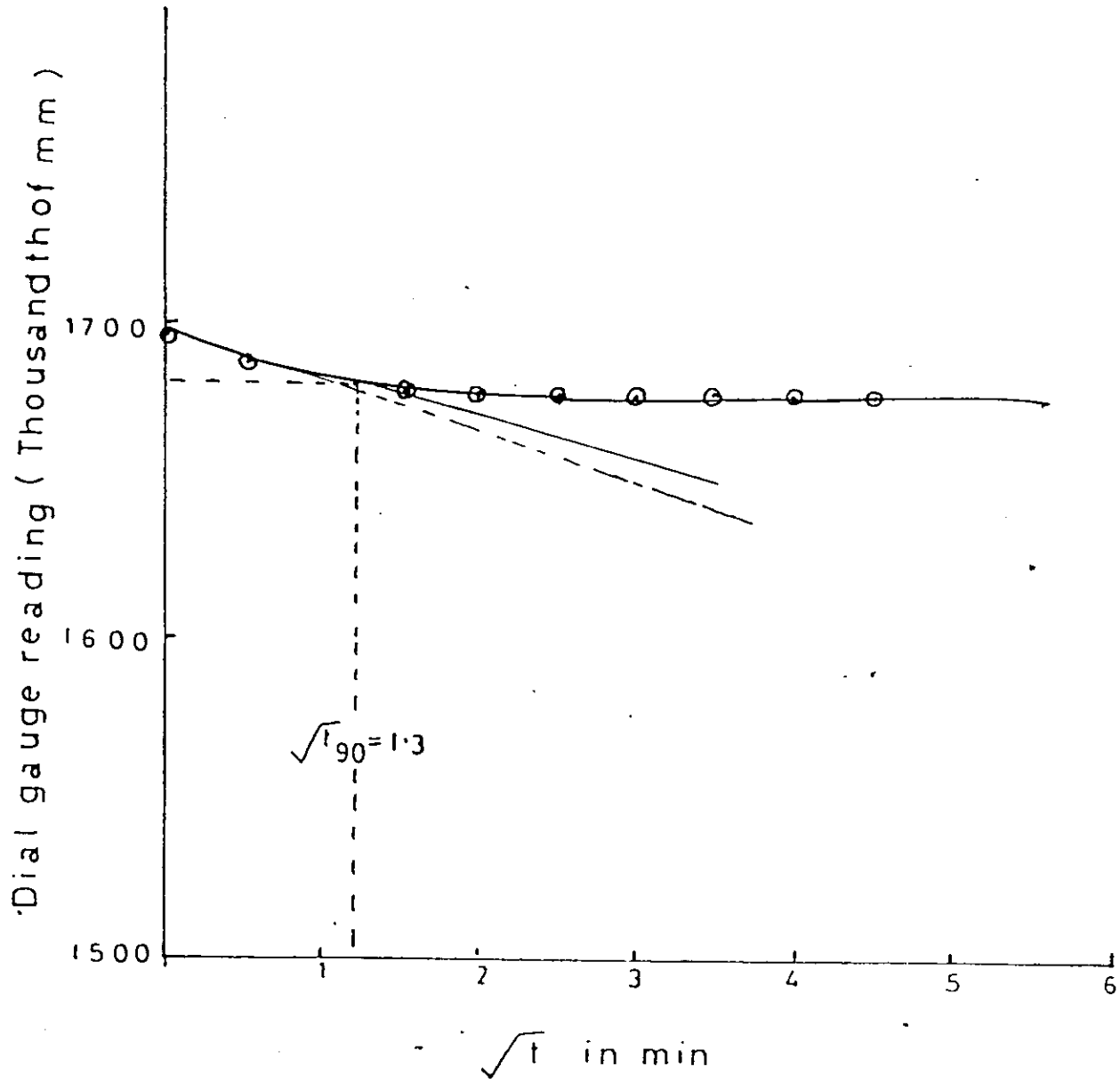


Fig. 30 Time settlement graph from SRTF method for BH-2 (1·5 - 1·9 m)

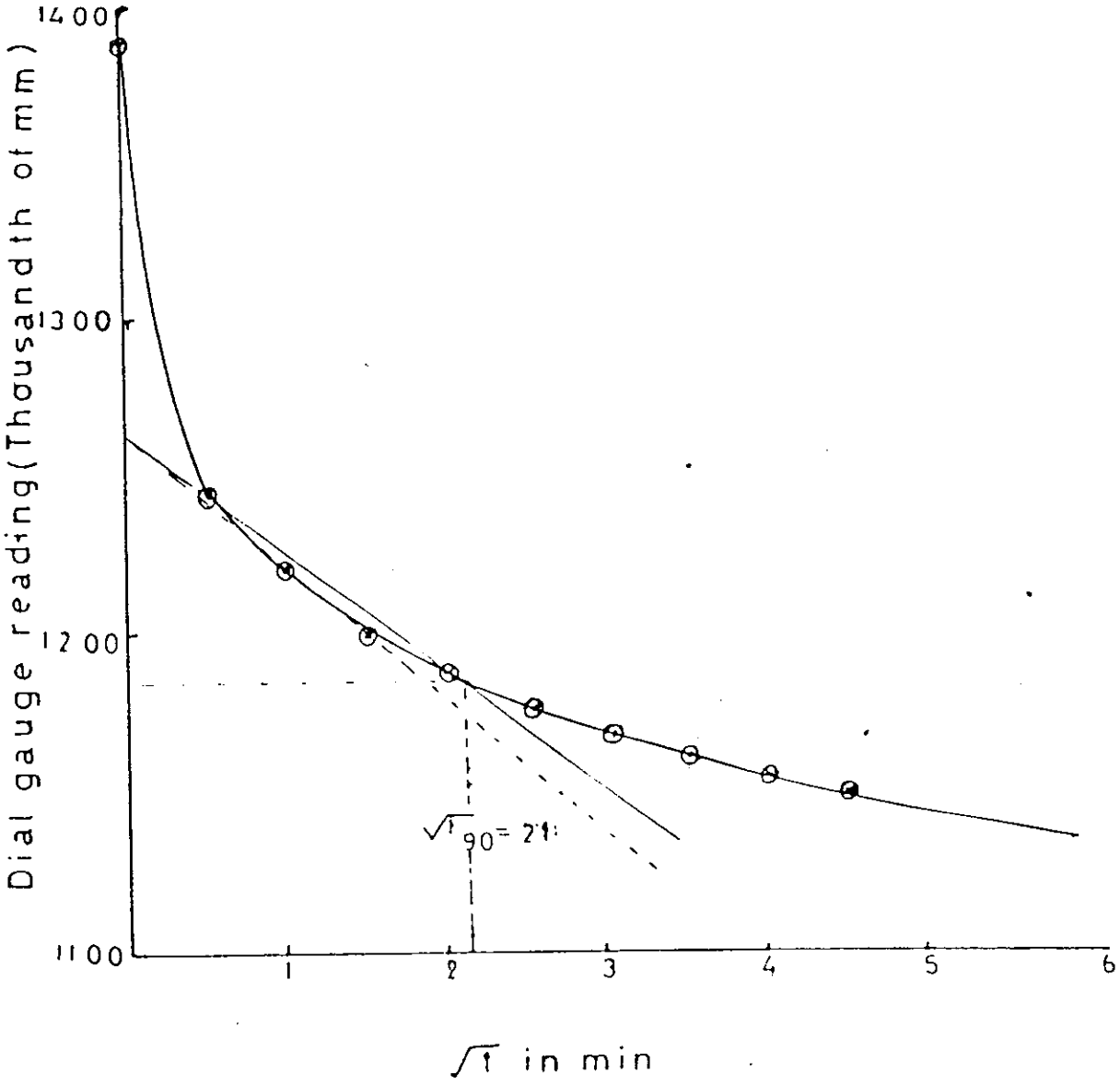


Fig.31 Time settlement graph from SRTF method for BH 3 (1·5 - 1·9 m)

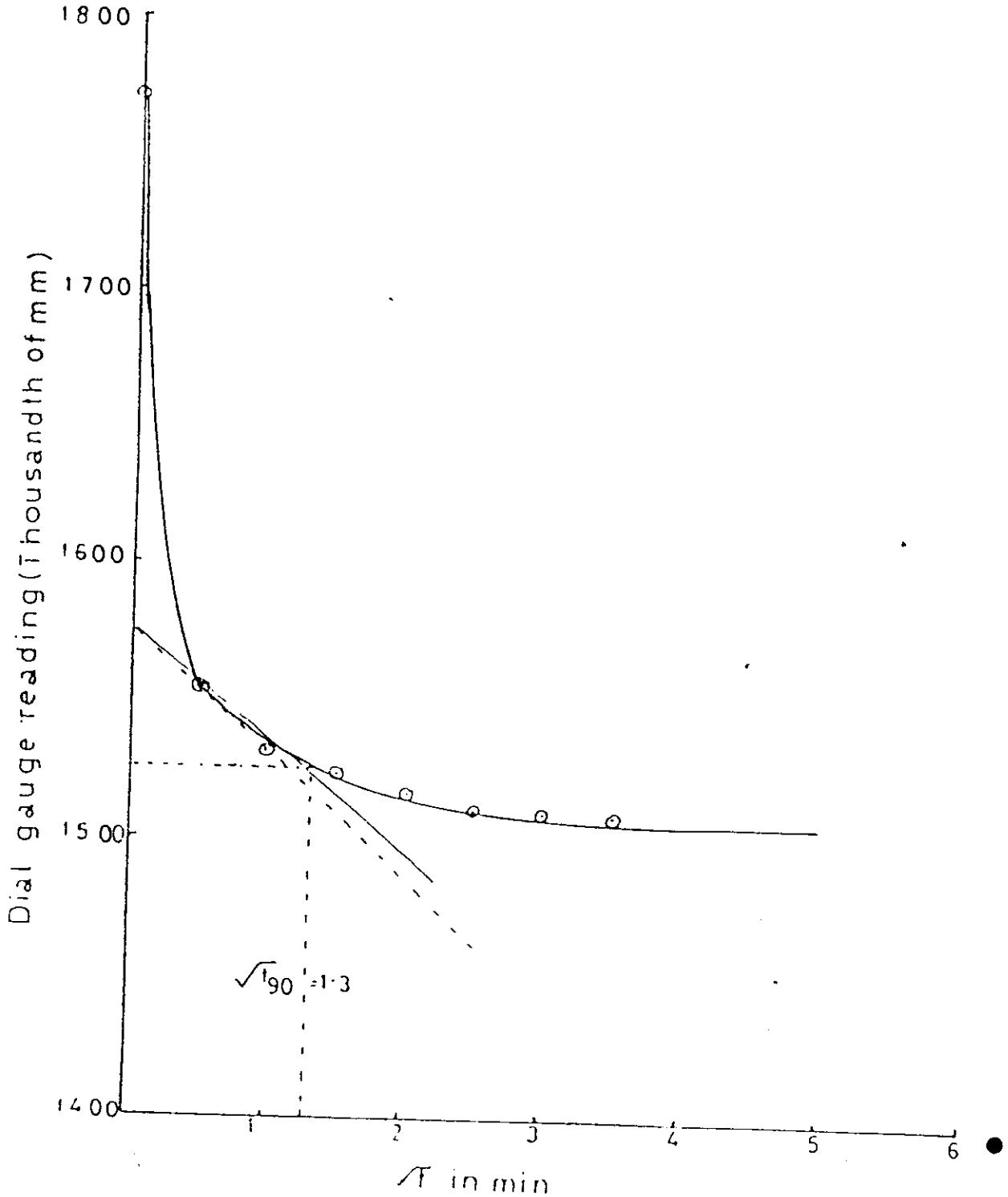


Fig.32 Time settlement graph from SRTF method for BH - 3 (4·5 - 4·9 m)

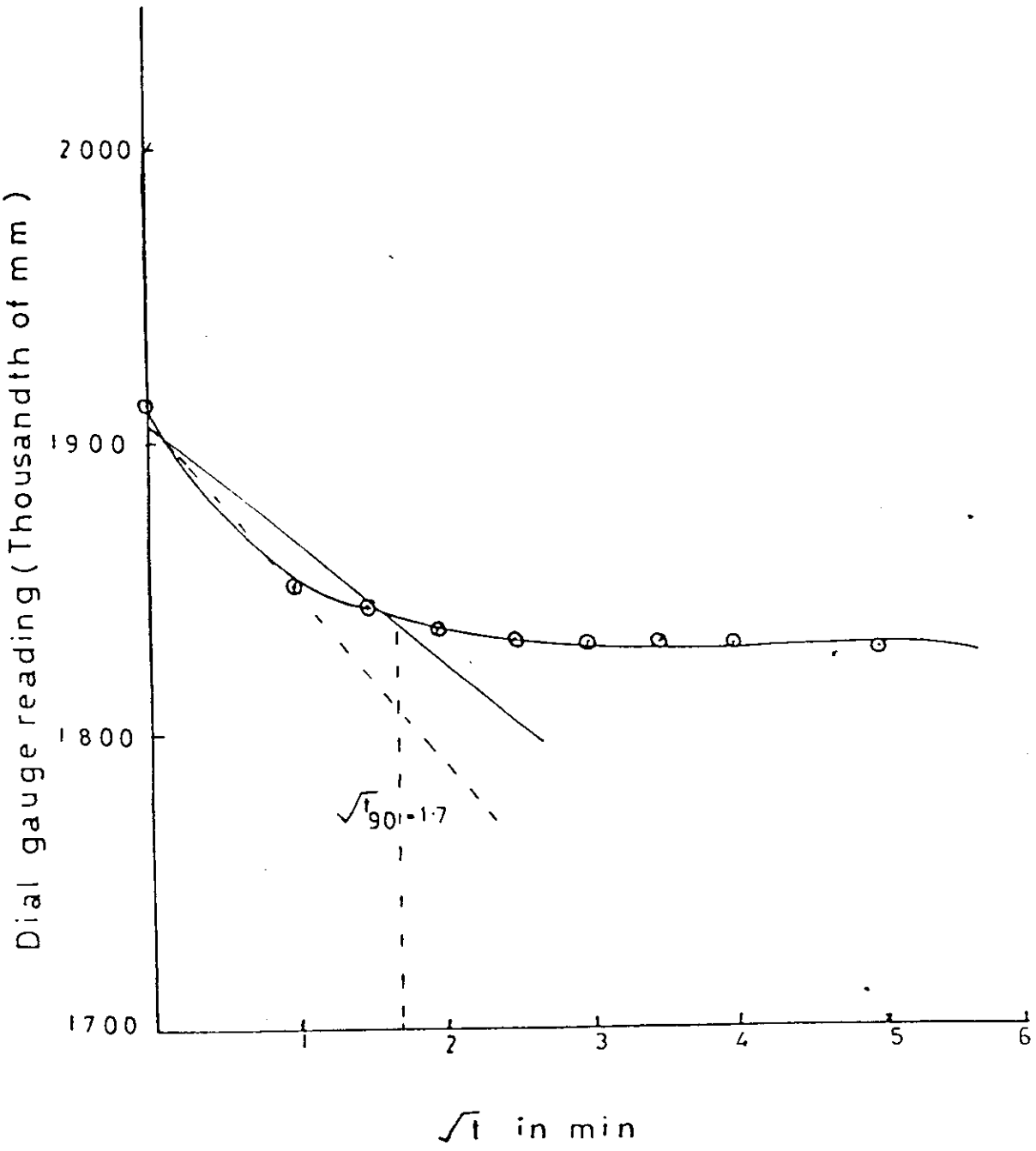


Fig.33 Time settlement graph from SRTF method for bore hole BH-4 (1·5-1·9 m.)

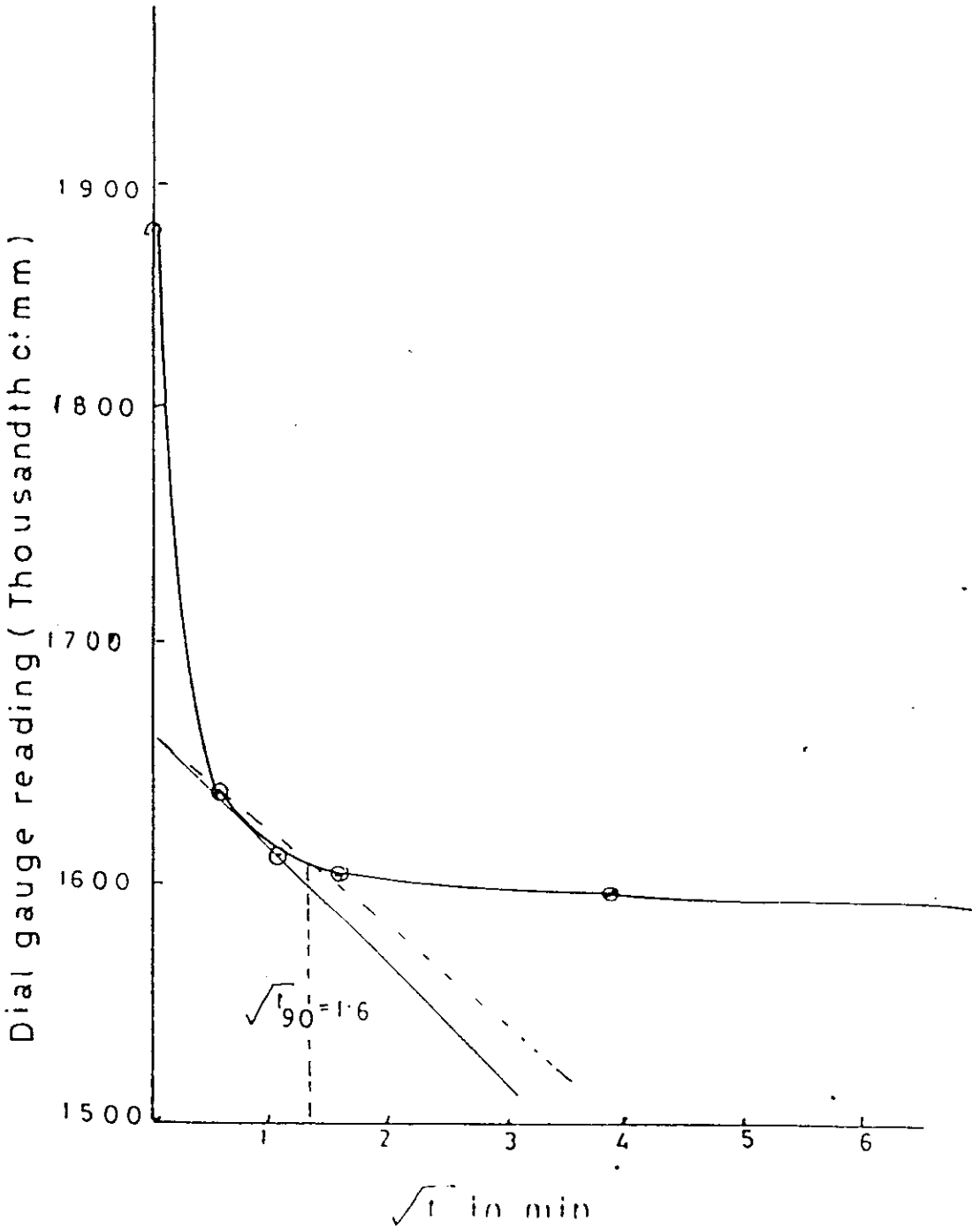


Fig 34 Time settlement graph from S.R.T.F method for B.H - 5 (3·00 3·40 m)

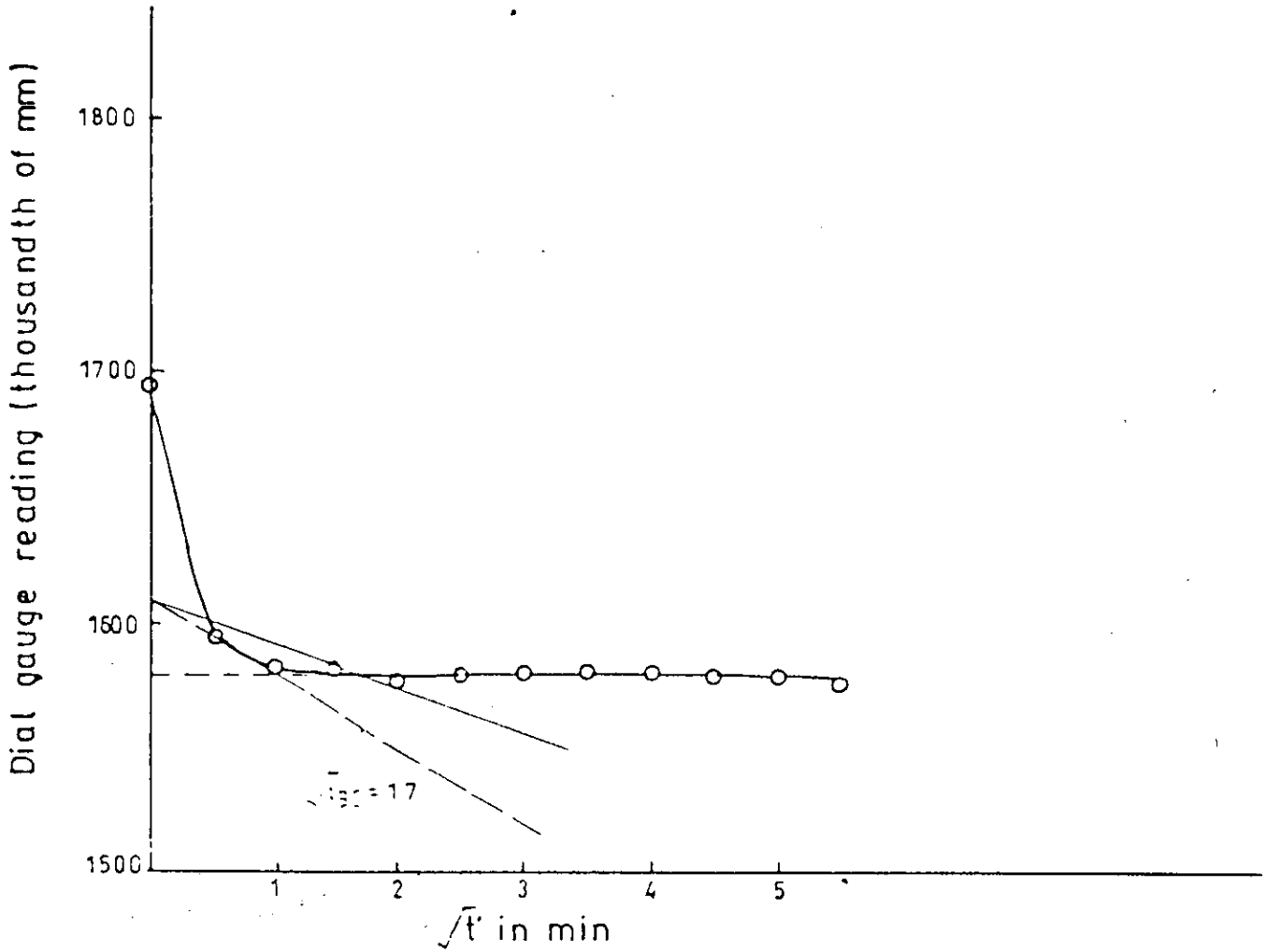


Fig. 35 Time settlement Curves SRTF method for borehole 5 (4.50 – 4.90m)

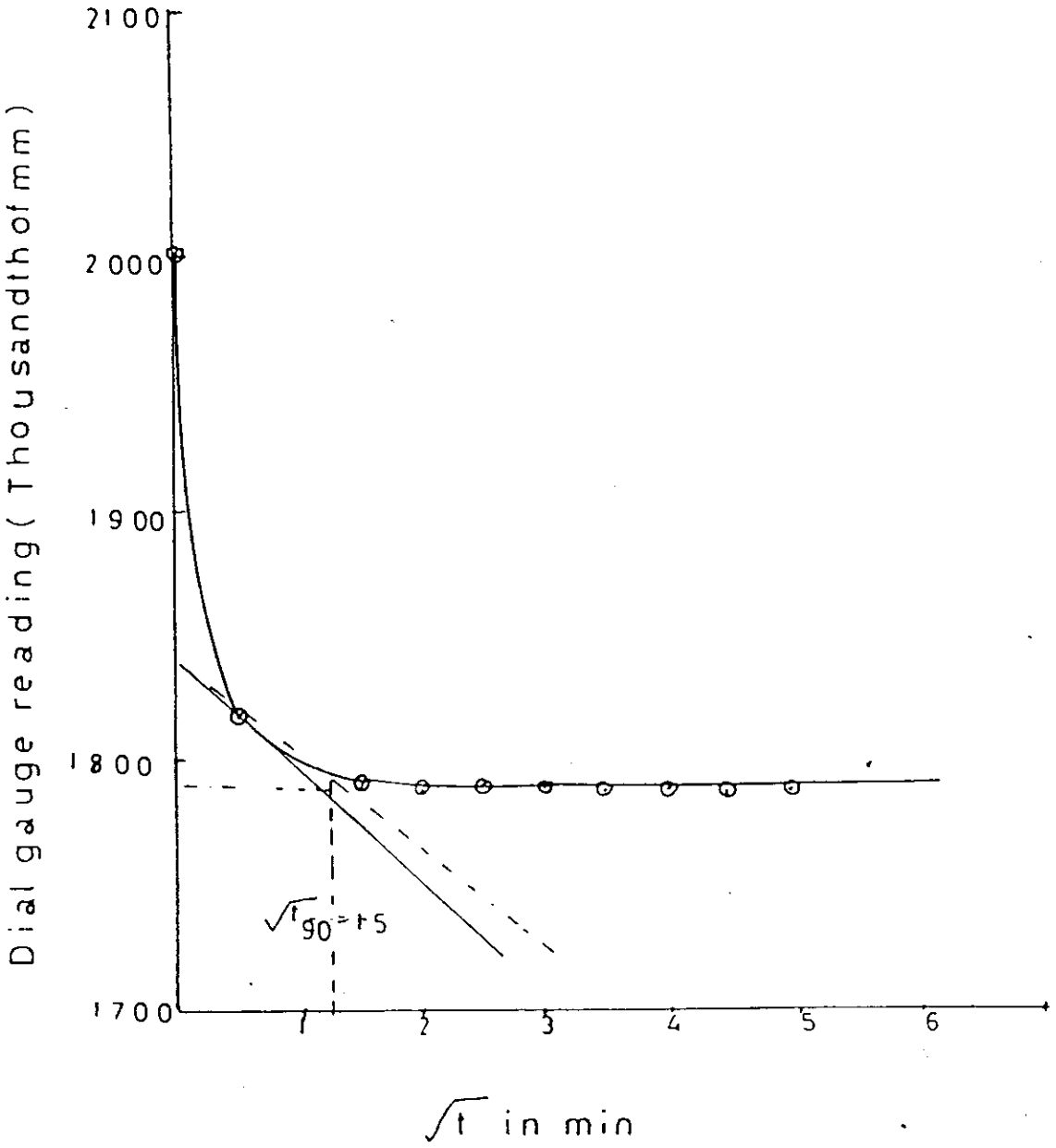


Fig.36 Time settlement graph from S.R.T.F method for B.H-6 (1·5-1·9)

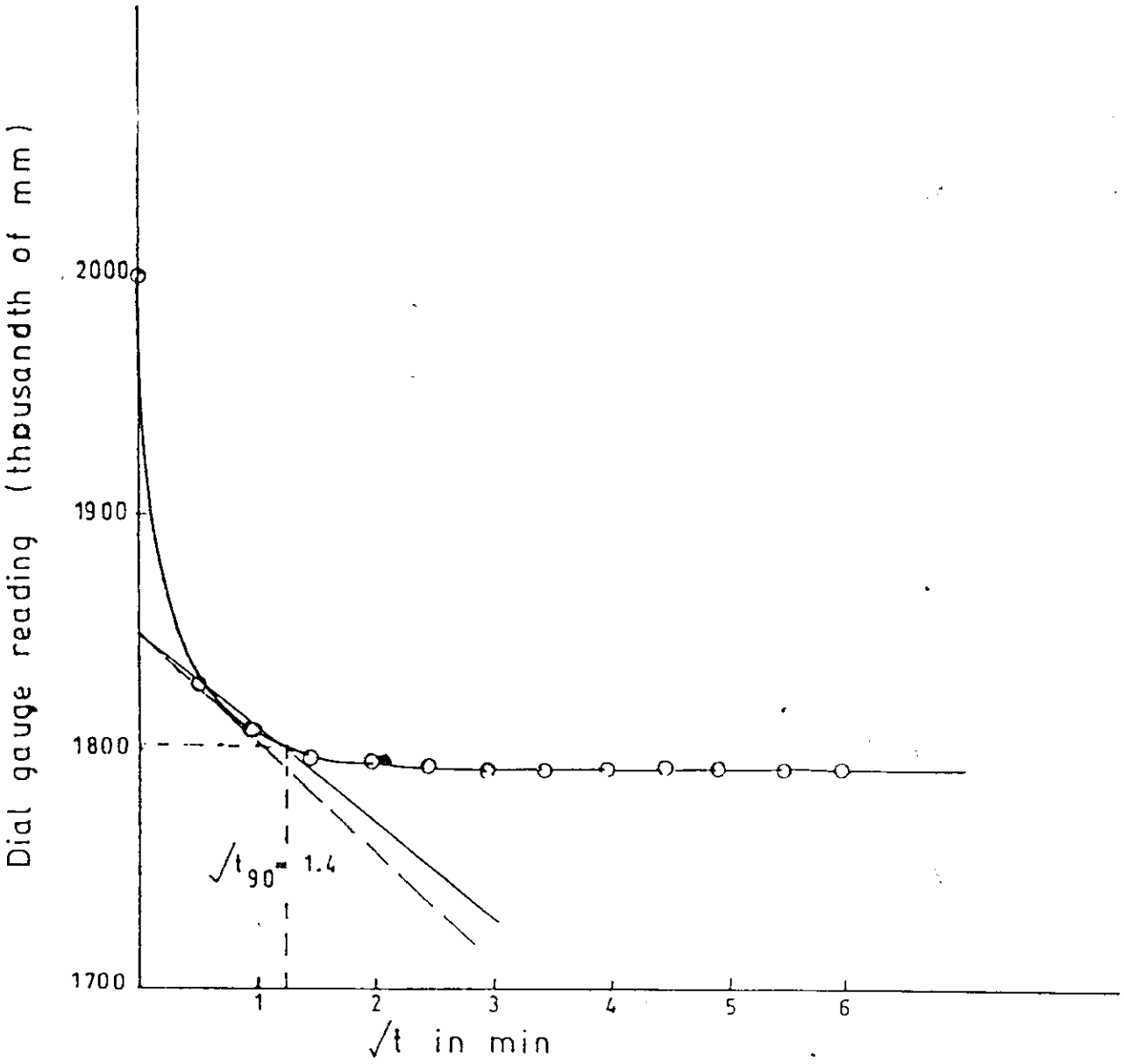


Fig. 37 Time Settlement Curves SRTF method for bore hole 6 (3.00 – 3.40 m).

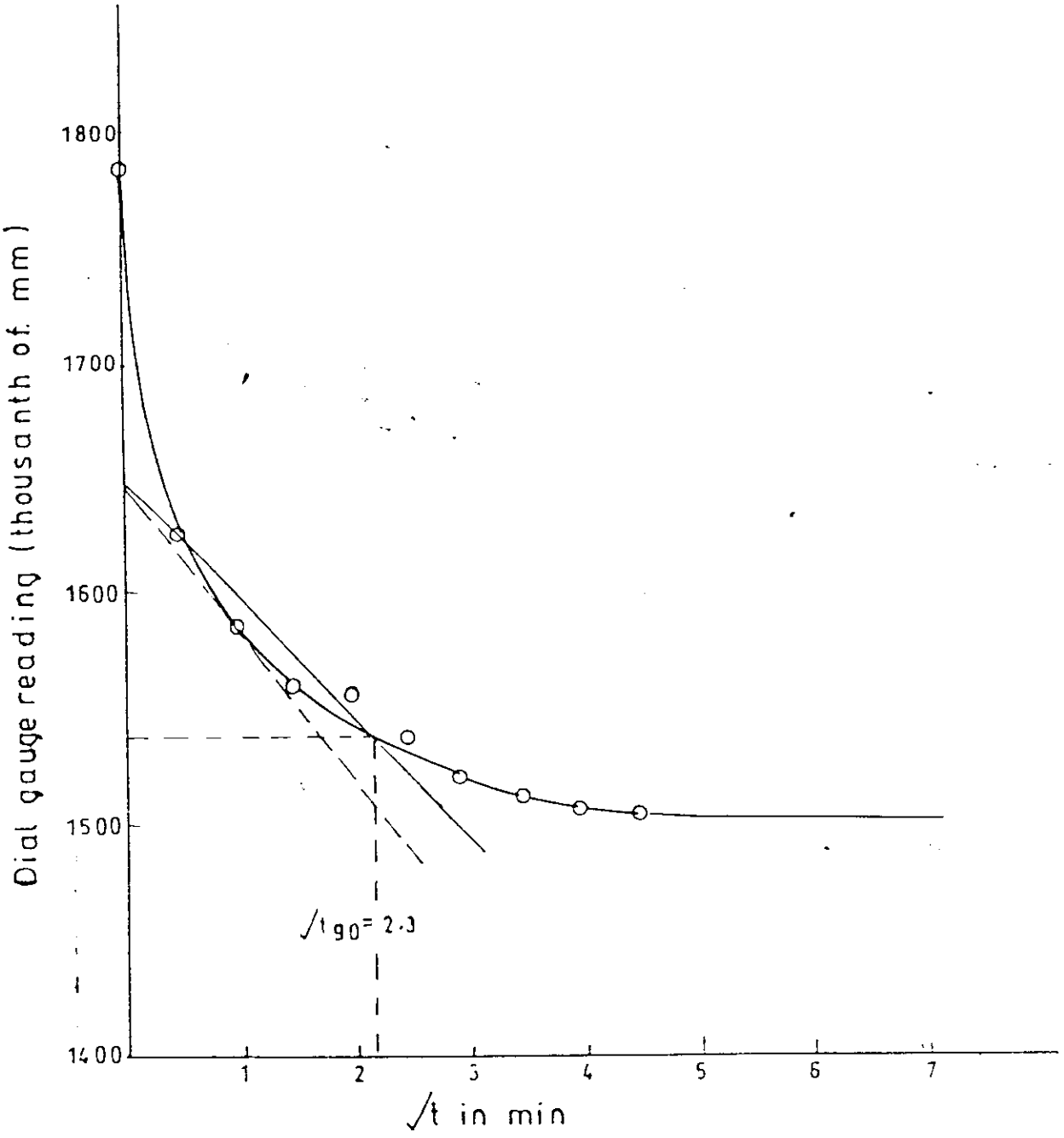


Fig 38 Time Settlement curve SRTF method for borehole No. 7 (7.50 - 7.90 m).

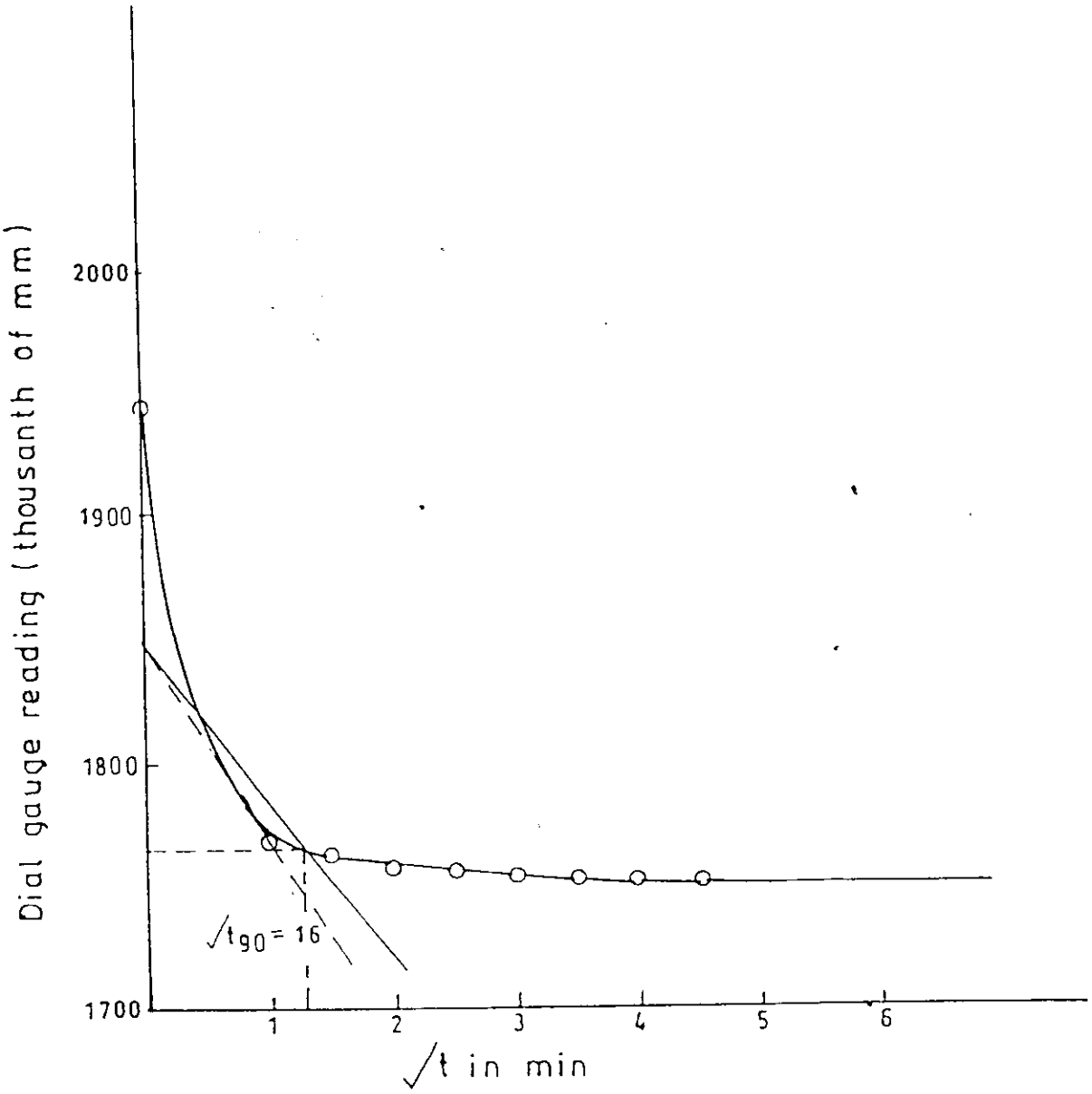


Fig. 39 Time Settlement Curves SRTF method for borehole 10 (1.50 – 1.90 m).

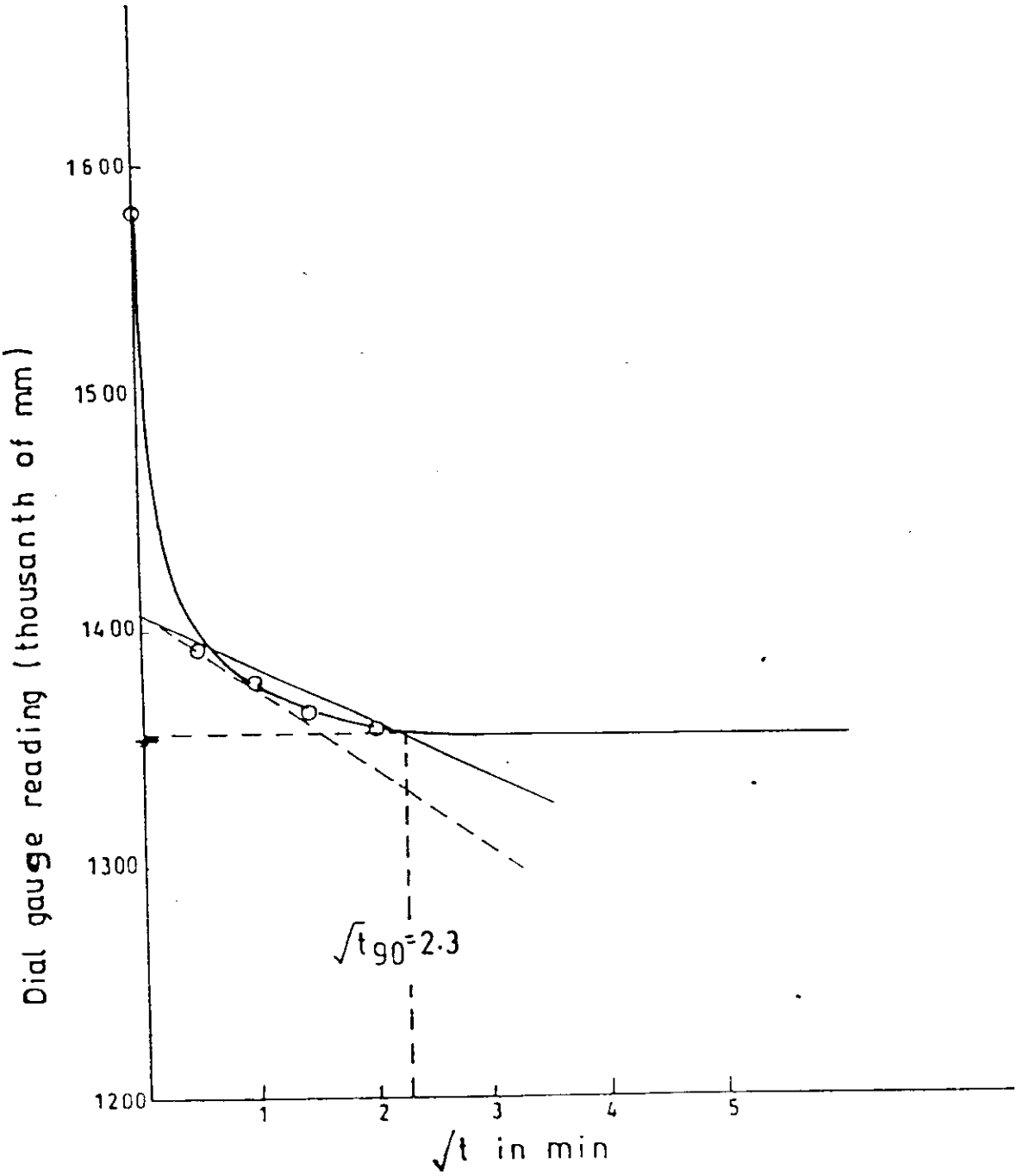


Fig. 40 Time settlement curve SR TF method for borehole 10 (7.50 - 7.90 m).

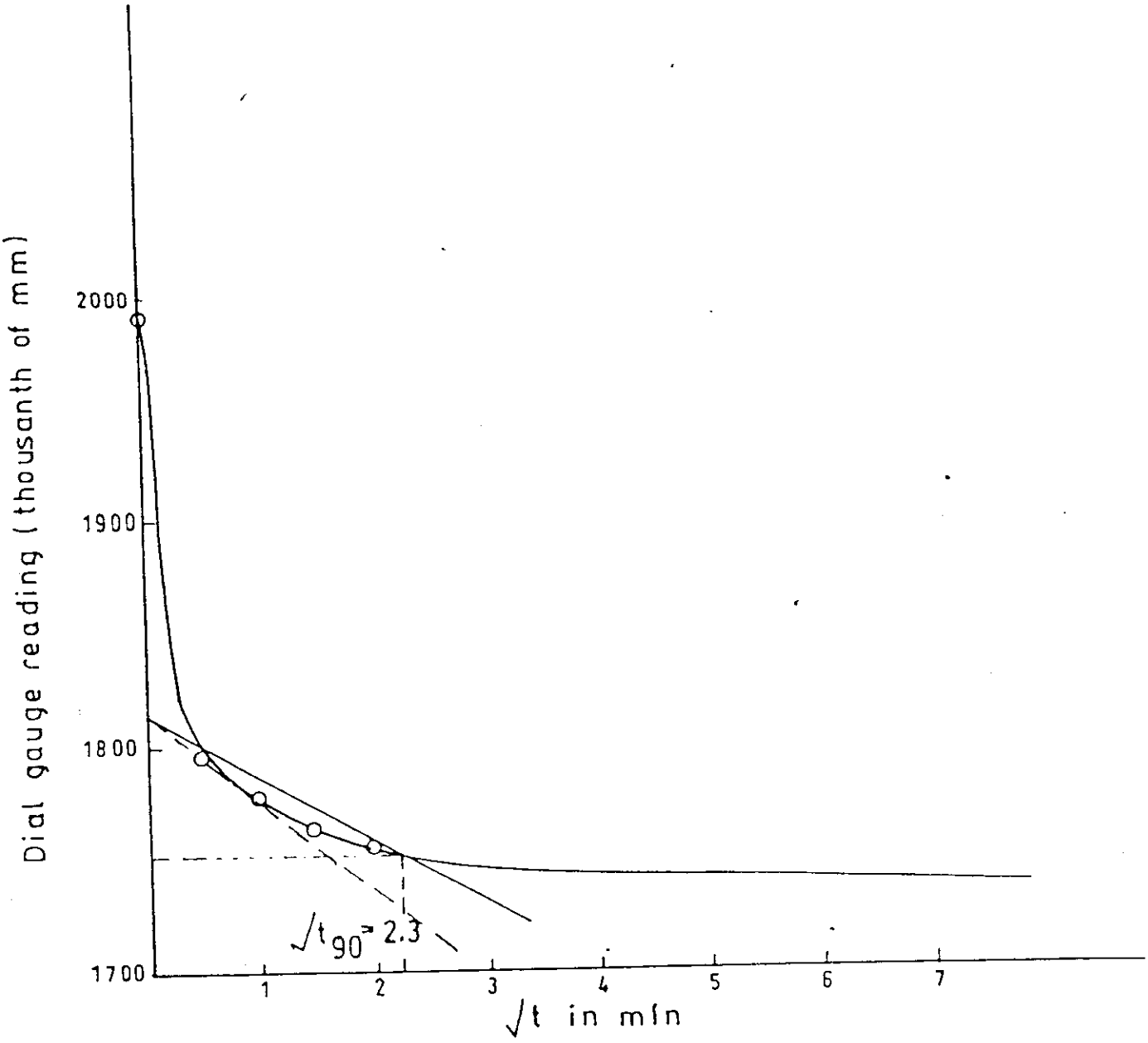


Fig. 41 Time Settlement curves SRTF : method for bore hole 11 (1.50 - 1.90 m).

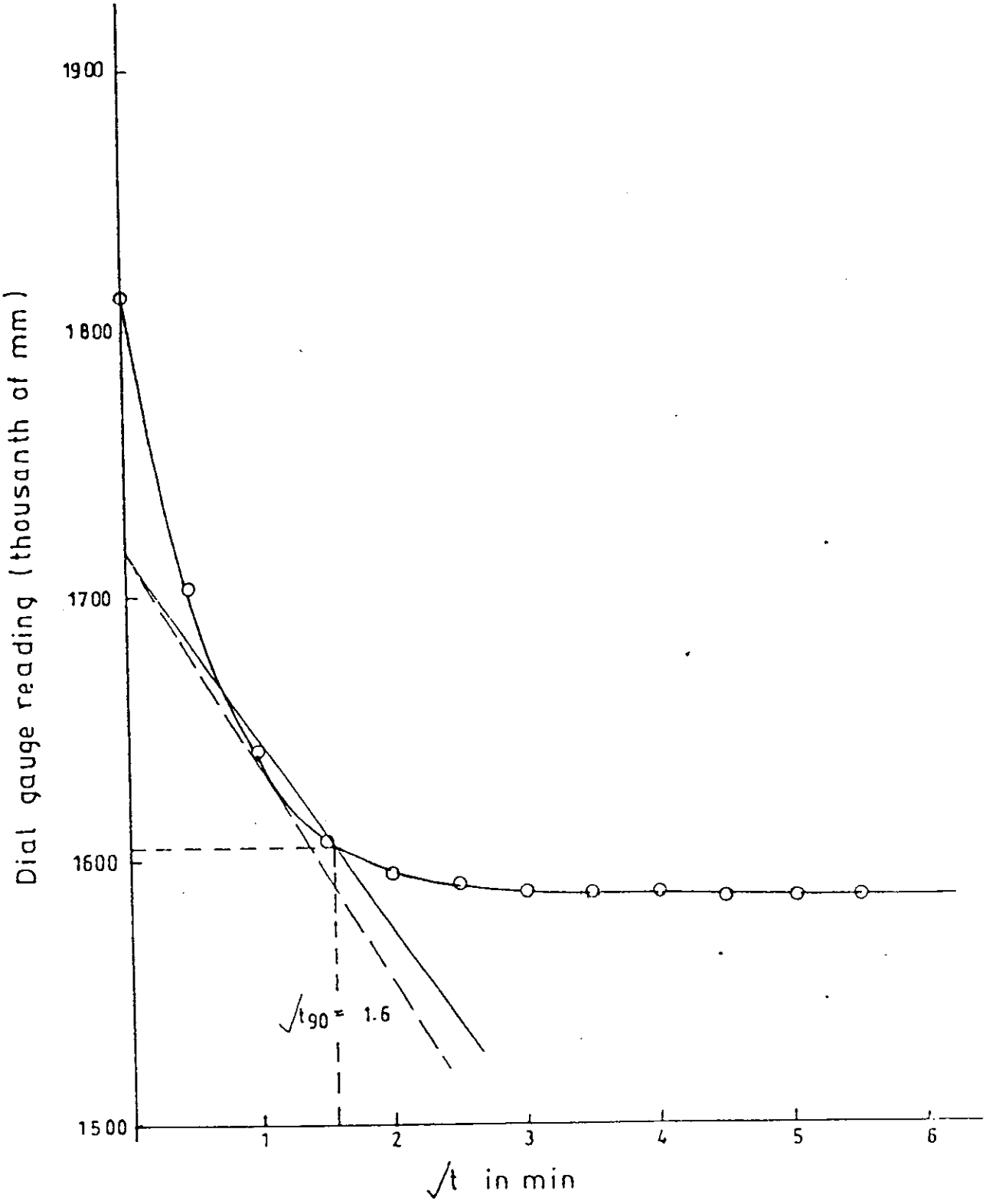


Fig 42 Time Settlement Curves SRTF method for borehole 11 (3.00 - 3.40 m').

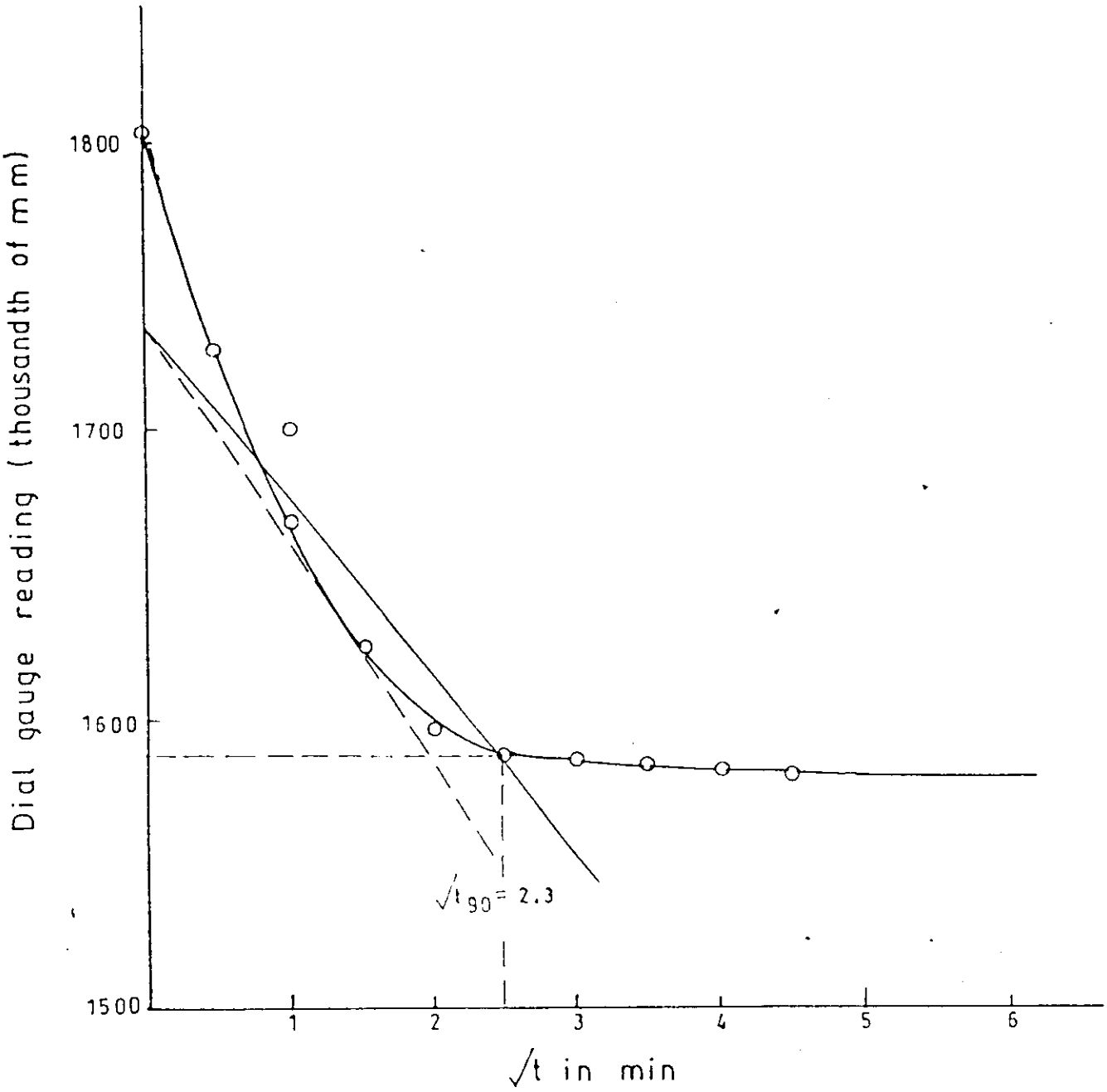


Fig. 43 Time Settlement Curves SRTF method for bore hole 13 (15.00 - 15.40 m).

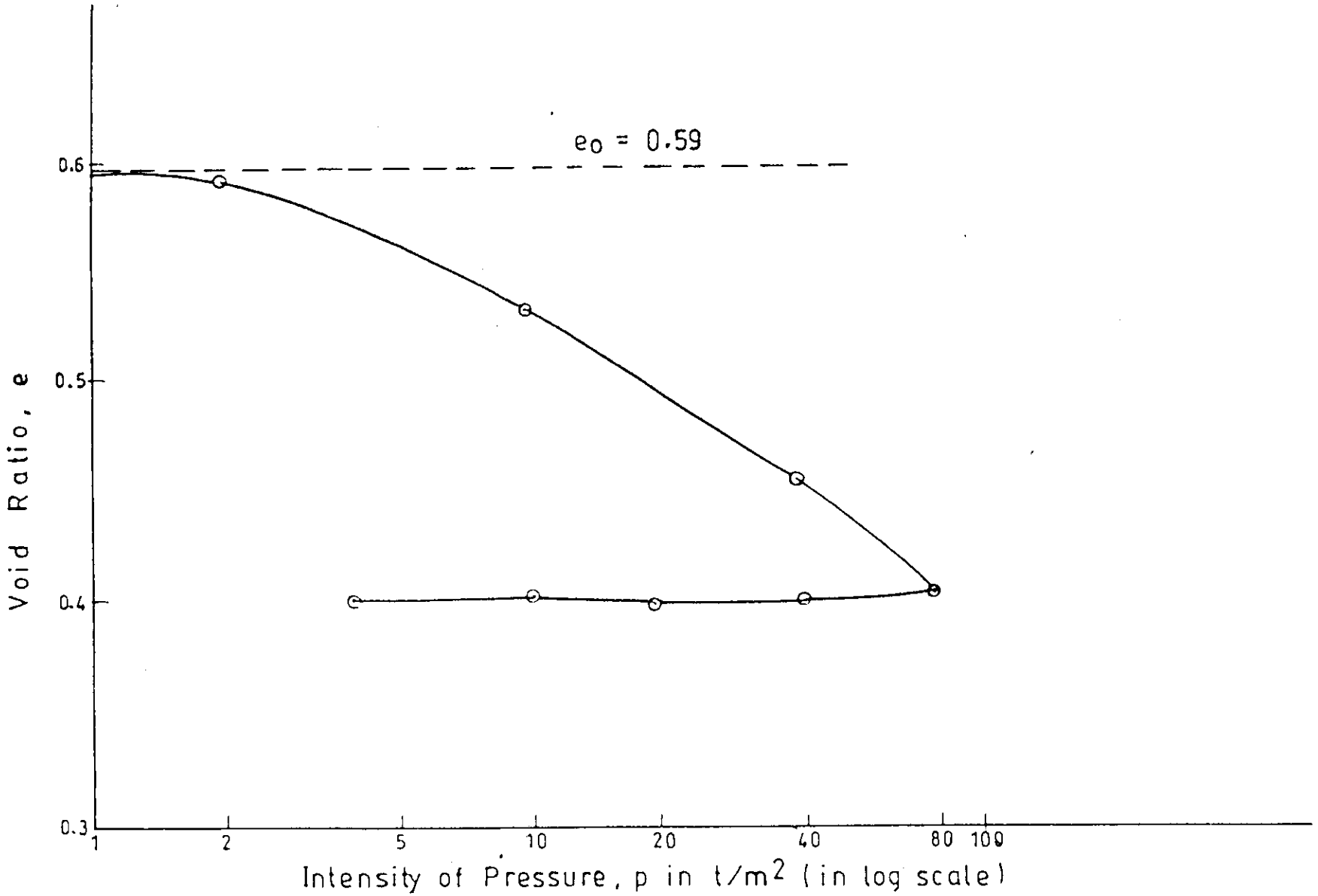


Fig. 44 e log p Curves for Bore hole No. 2. (1.50 m 1.90 m).

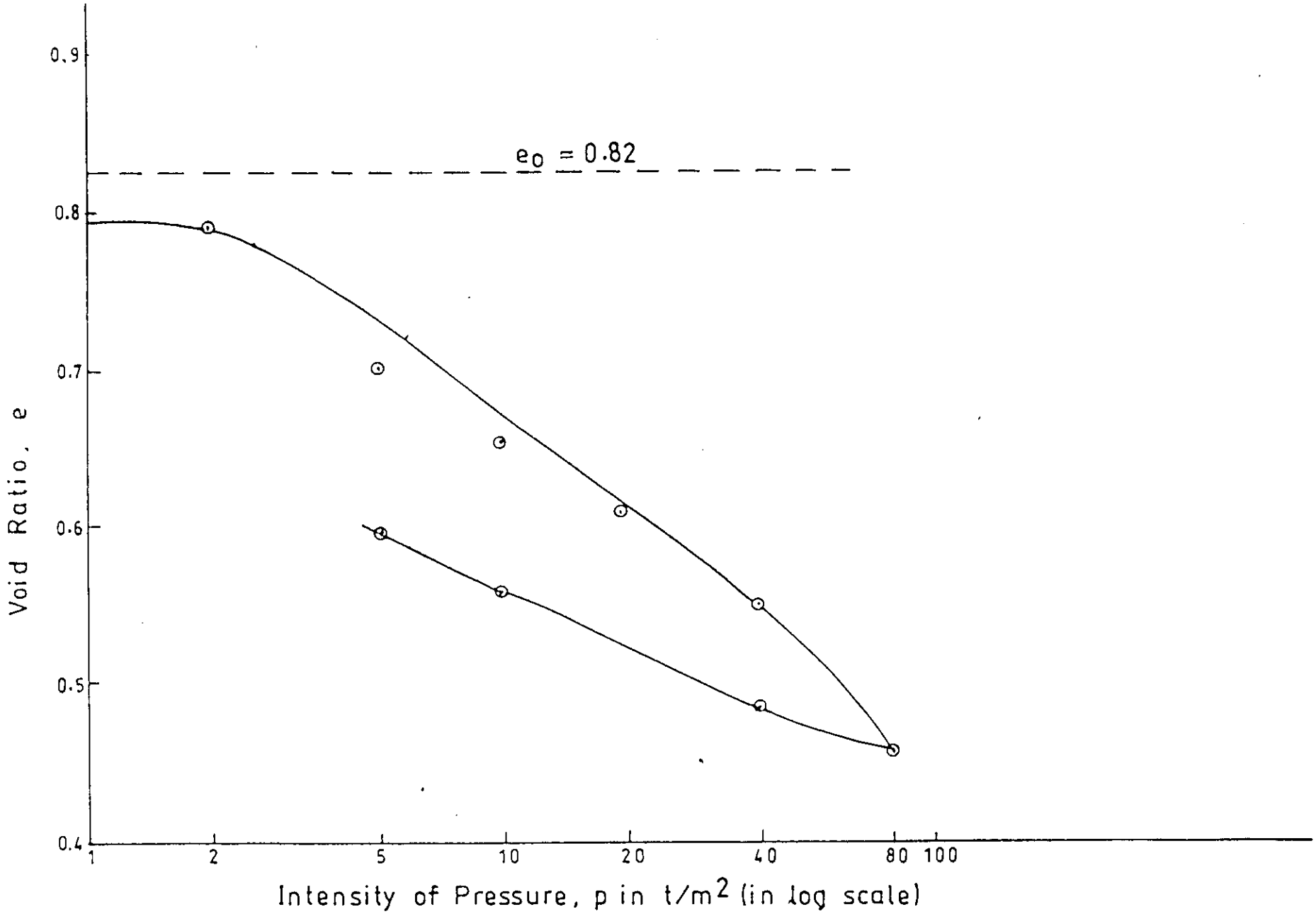


Fig. 45 e log p Curves for Bore hole No. 3. (1.50 m - 1.90 m).

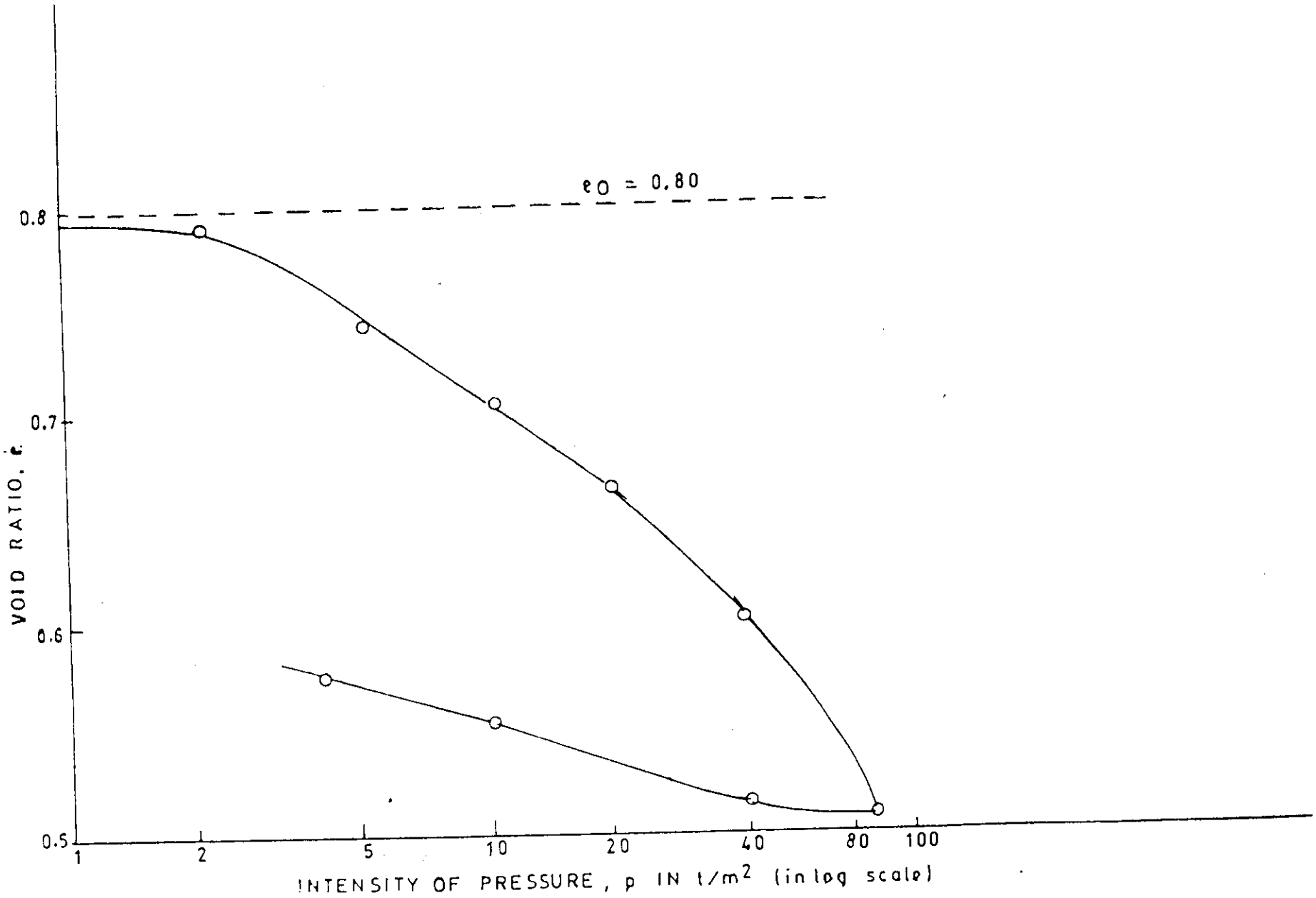


FIG. 46 e log p CURVES FOR BORE HOLE No. 3. (4.50m – 4.90m).

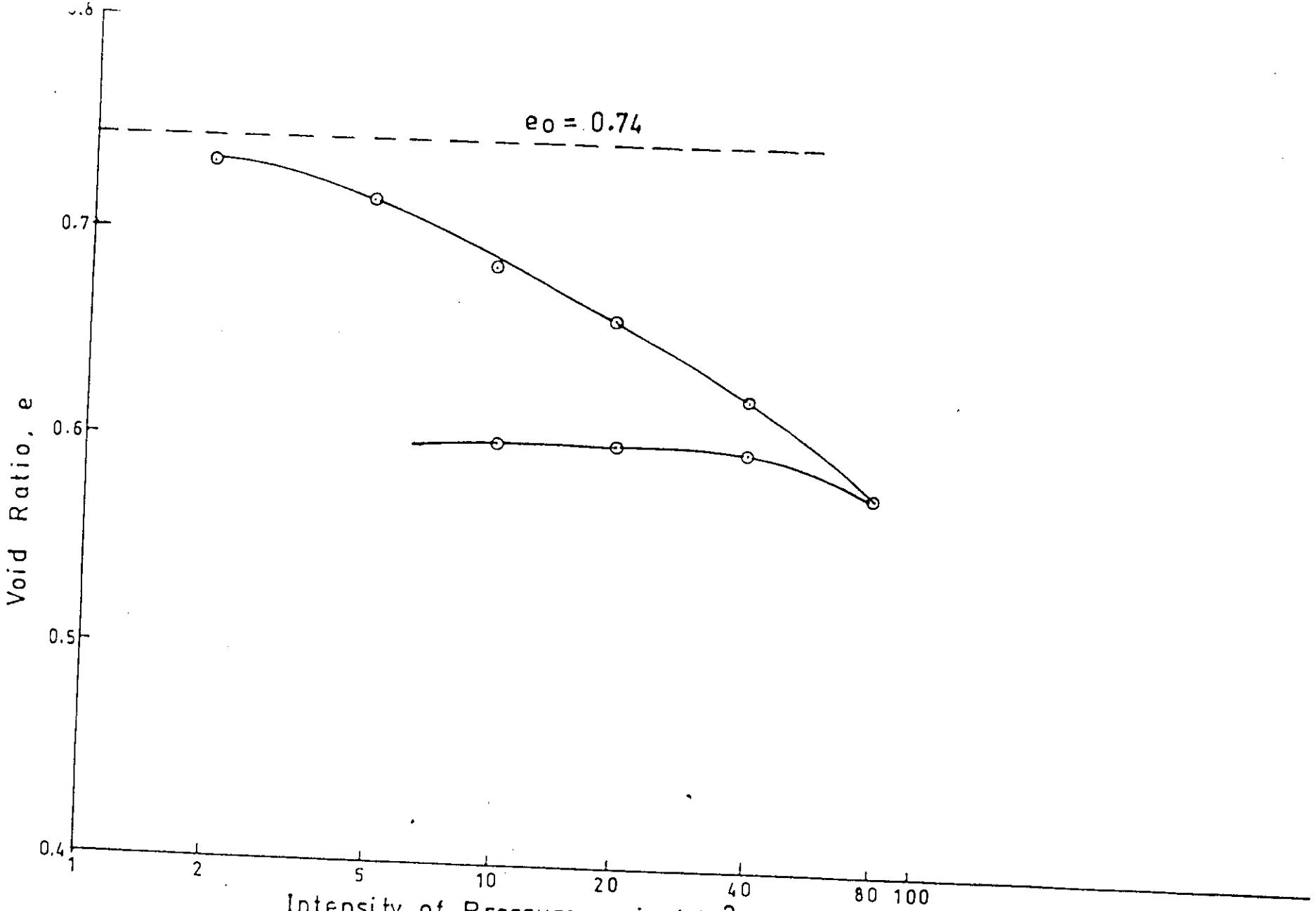


Fig. 47 e log p Curves for Bore hole No. 4. (1.50 m - 1.90 m).

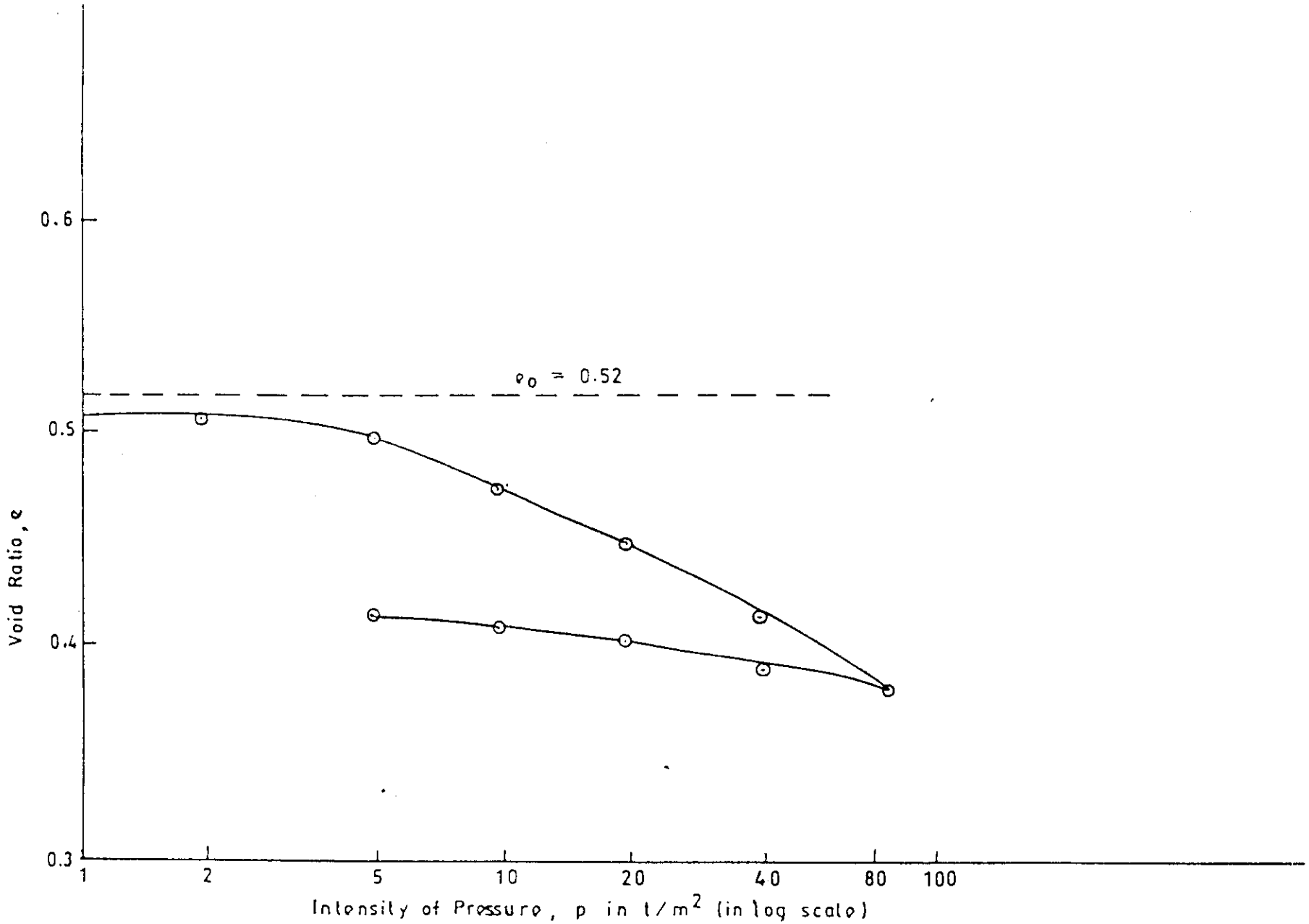


Fig. 49 e log p Curves for Bore hole No. 5. (3.00m - 3.40m).

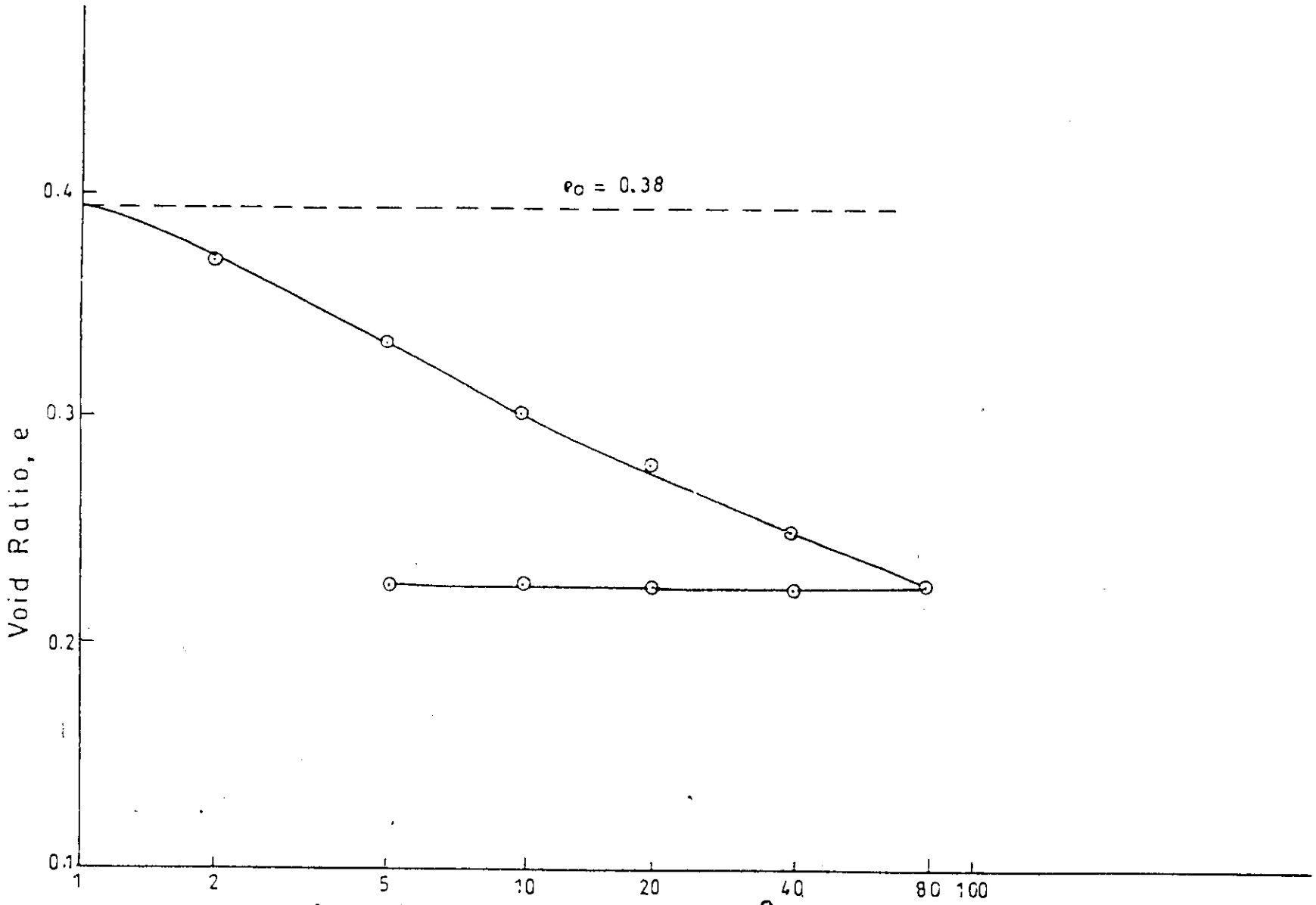


Fig. 50 e log p CURVES FOR BORE HOLE No. 5 (4.50m – 4.90m).

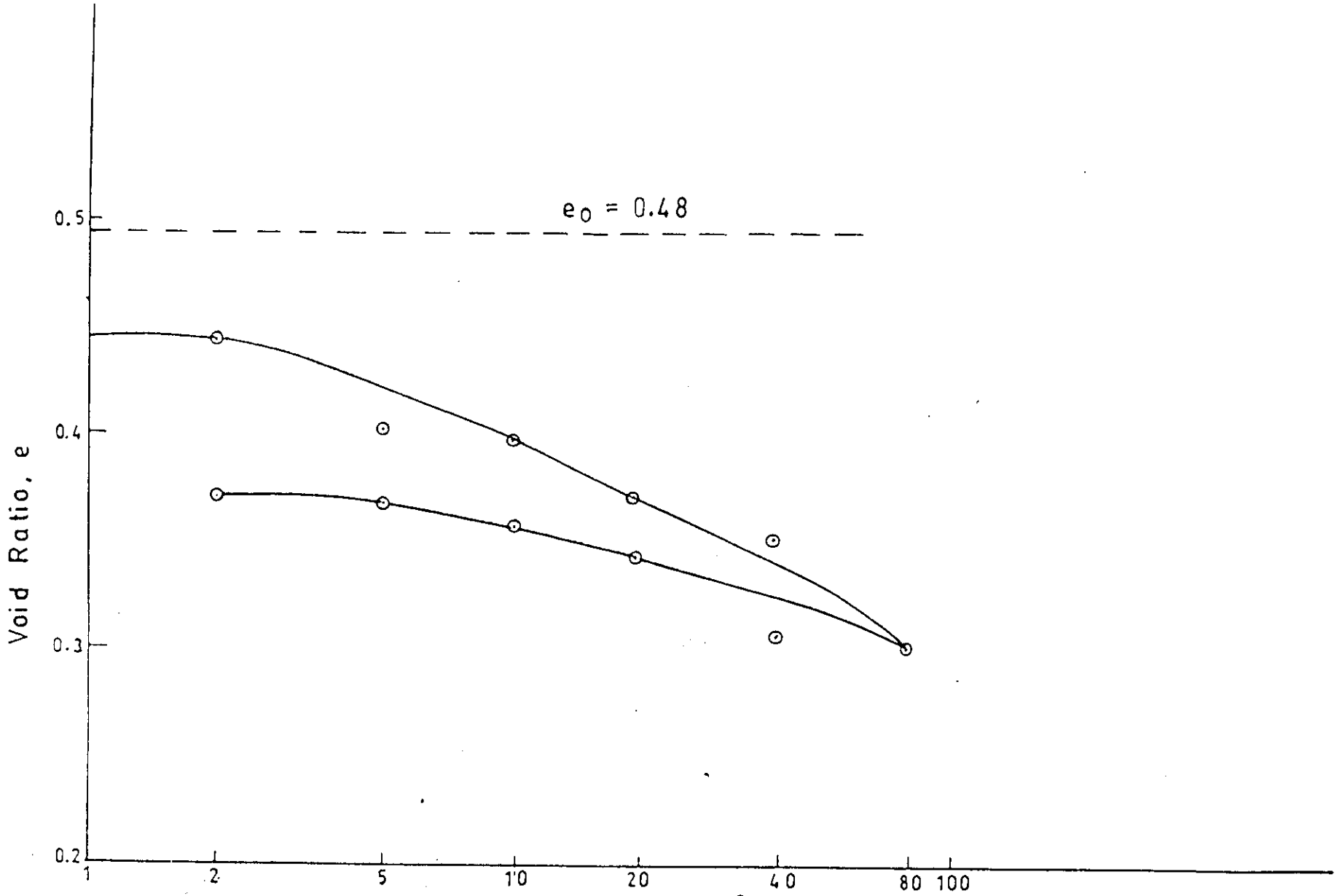


Fig. 51 e log p Curves for Bore hole No. 6 (1.50m – 1.90m).

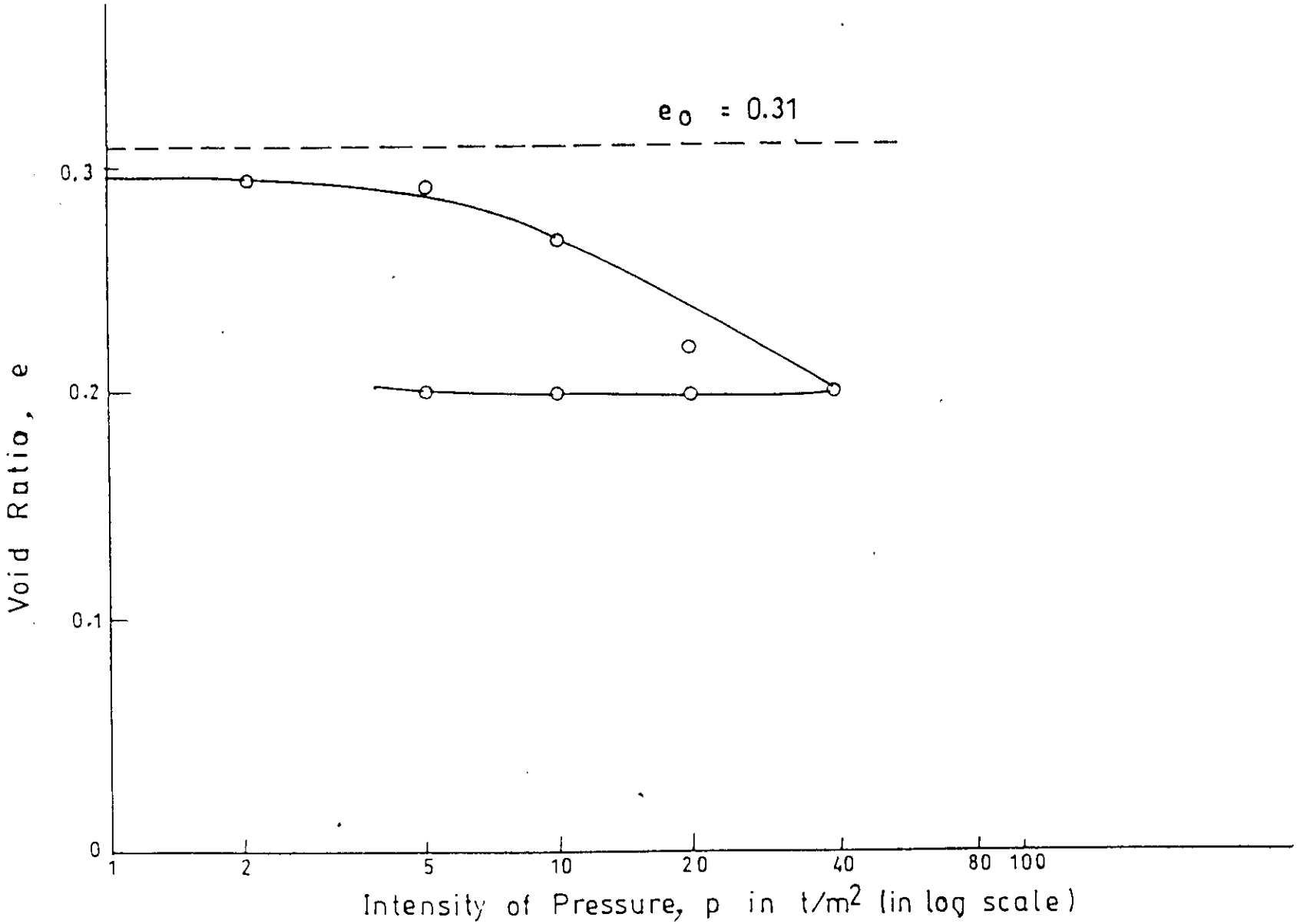


Fig. 52 e log p Curves for Bore hole No. 6 (3.00 – 3.40 m).

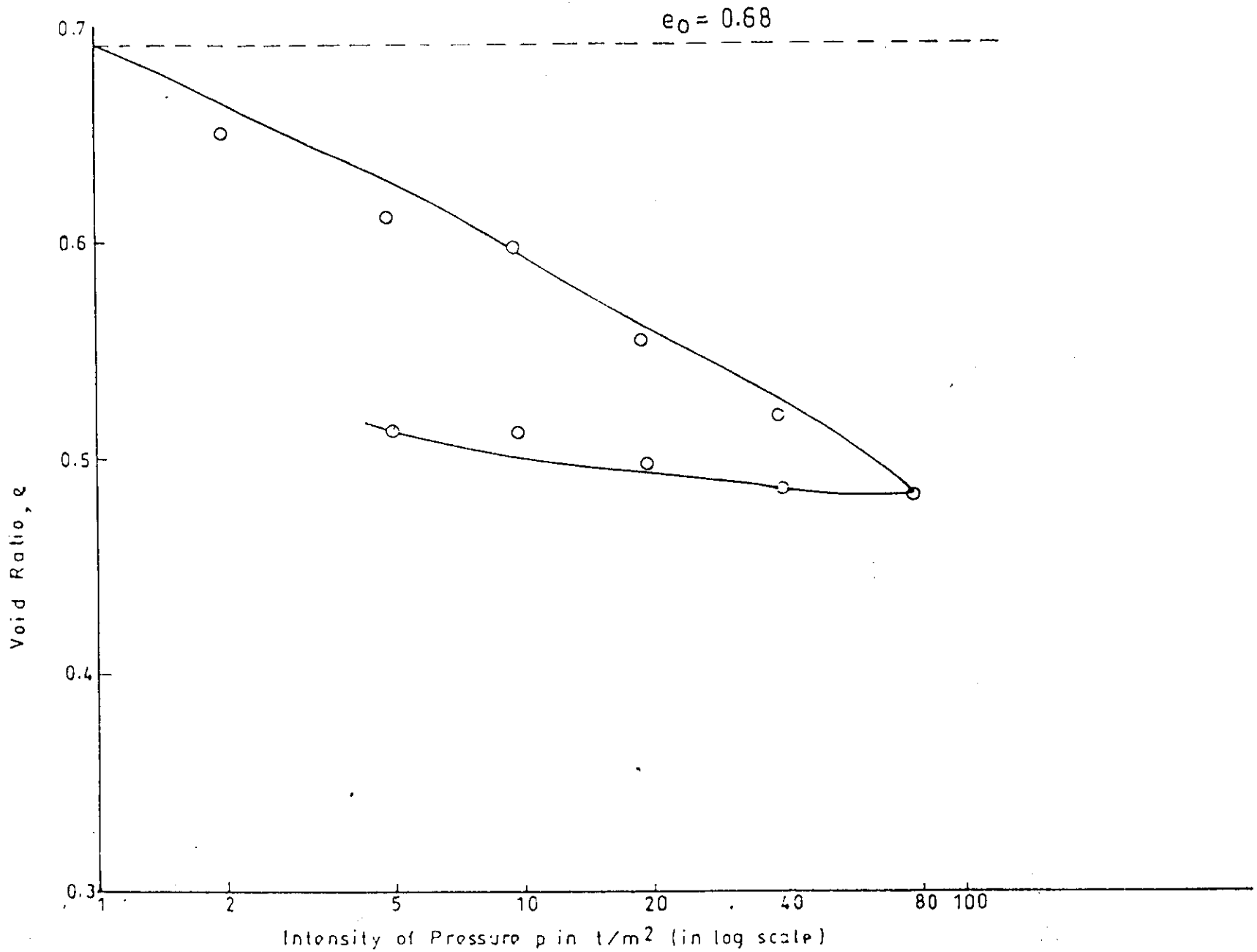


Fig. 53 e log p curves for borehole No. 7 (7.50-7.90 m).

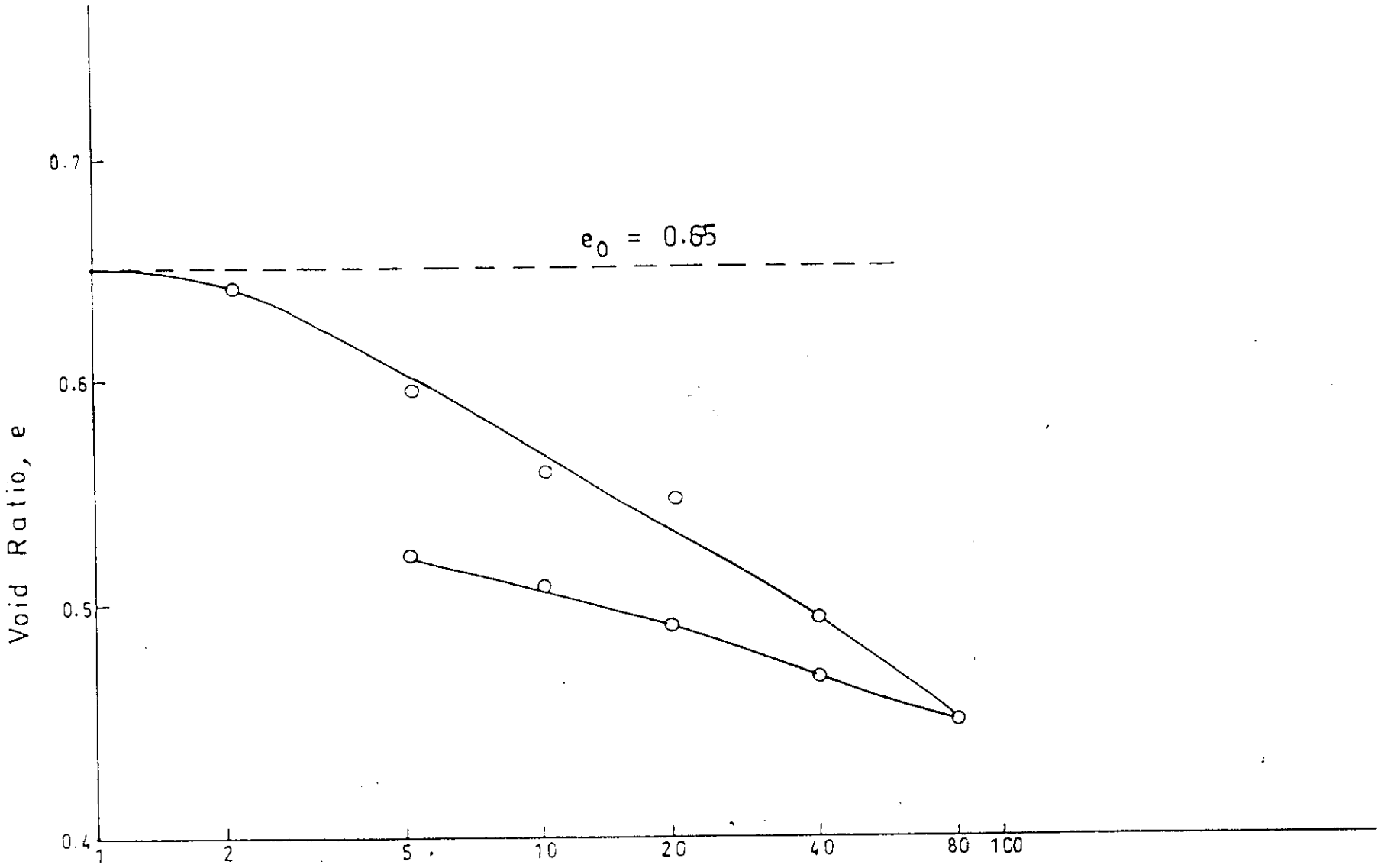


Fig. 54 e log p Curves for borehole No 10 (1.50–1.90 m).

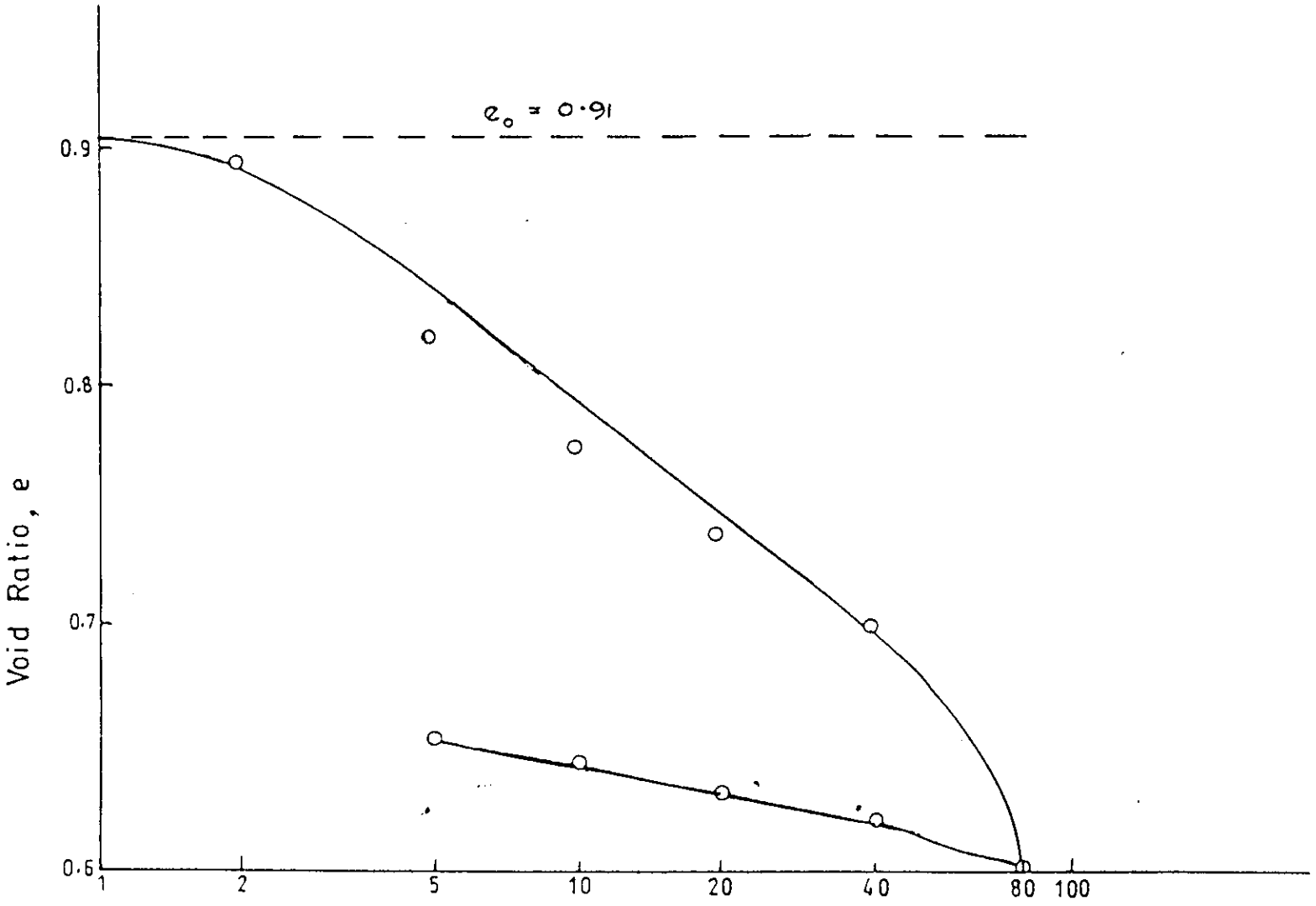


Fig. 55 e log p Curves for borehole No 10 (7.50 – 7.90 m).

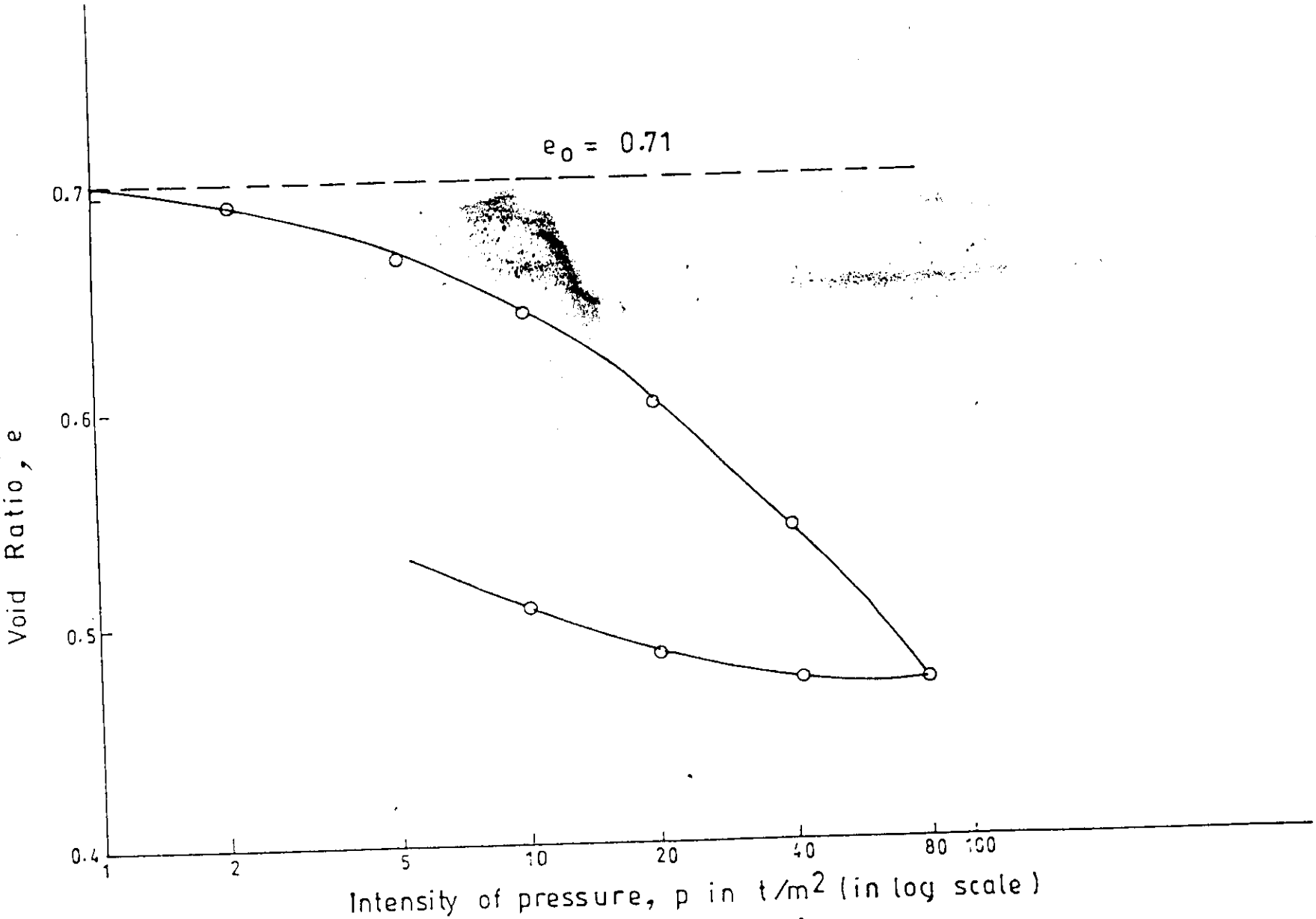


Fig. 56 e log p Curves for borehole 11 (1.50 – 1.90 m).

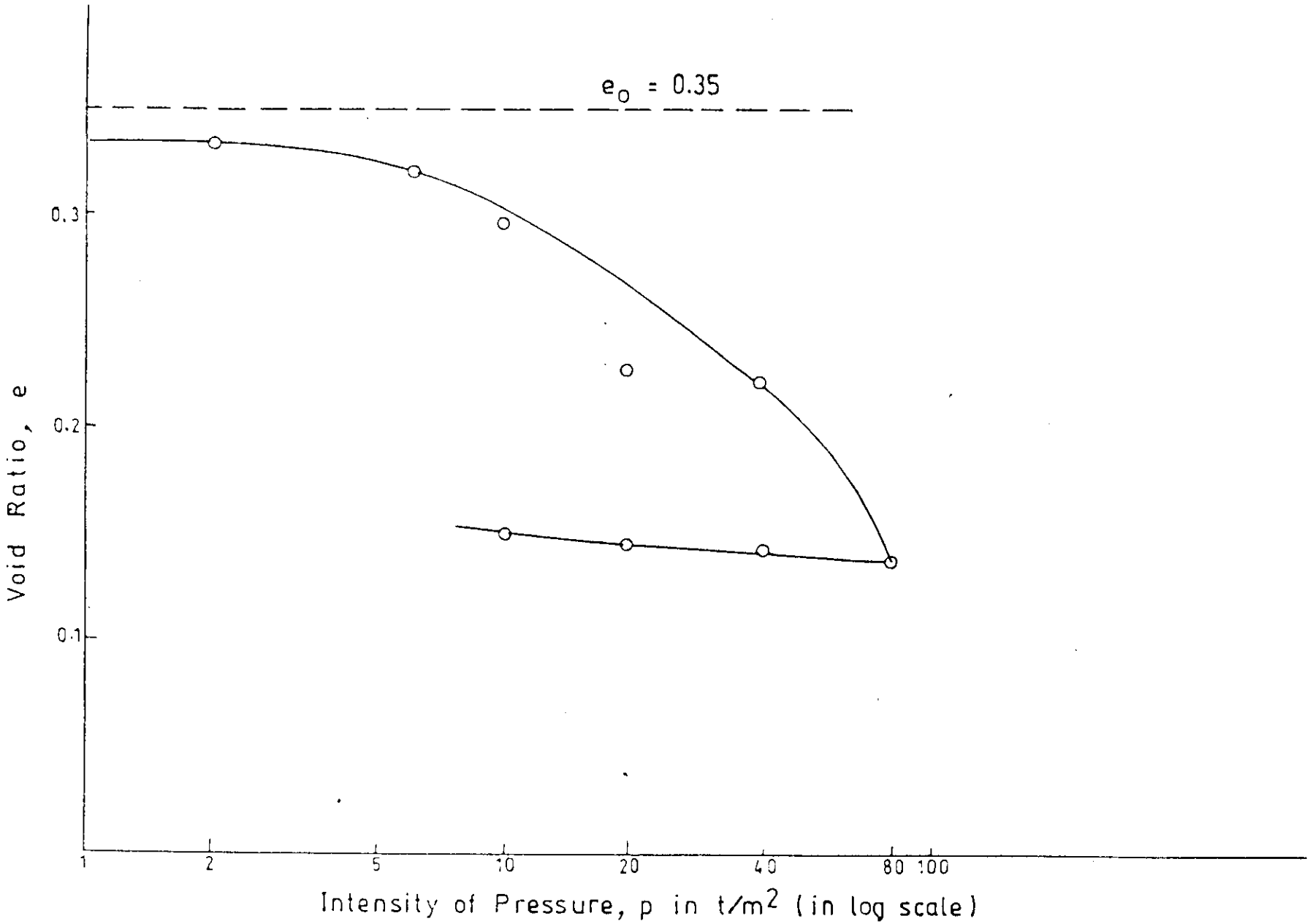


Fig. 57 e log p Curves for Borehole No 11 (3.00 – 3.40 m).

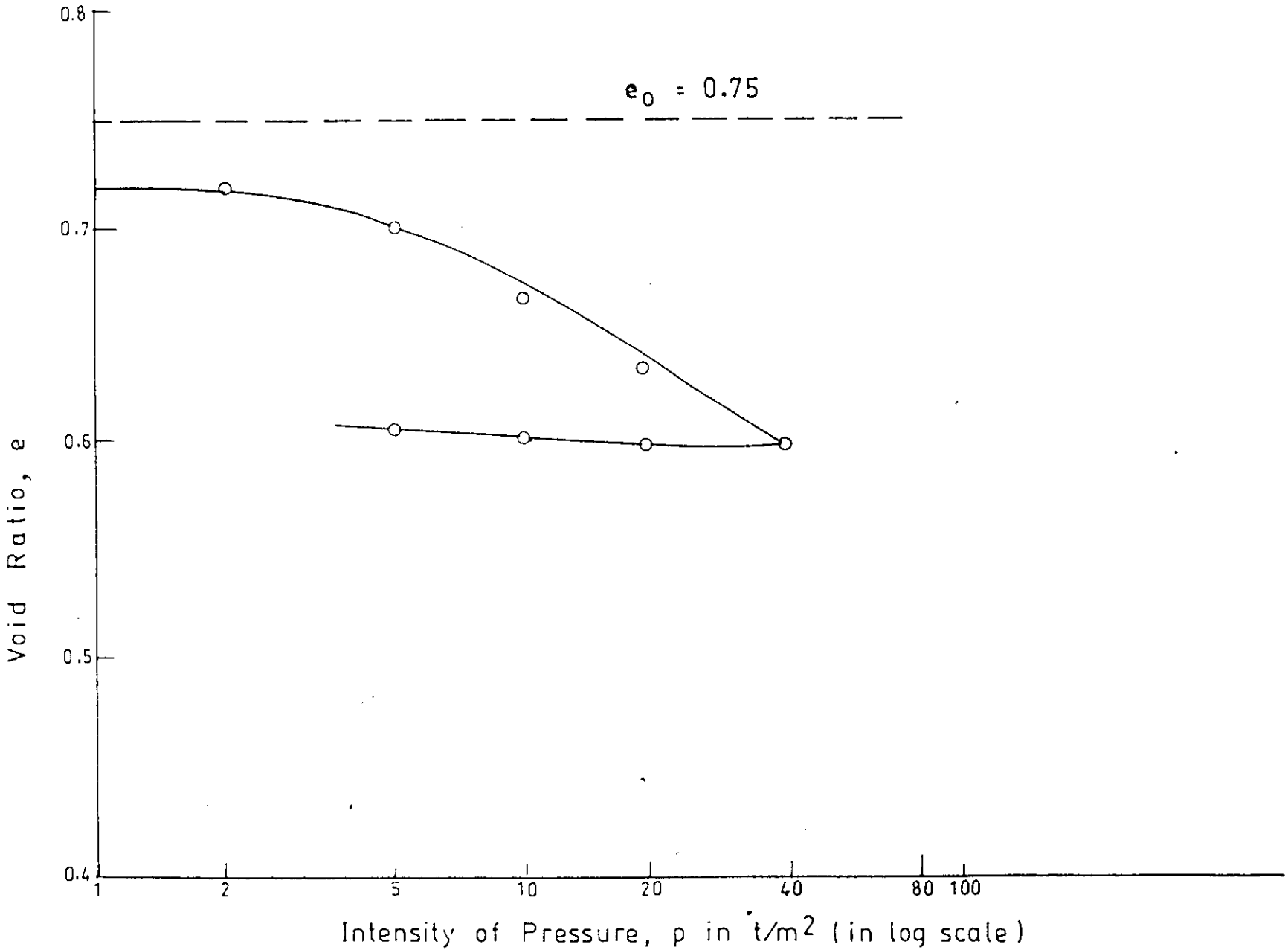
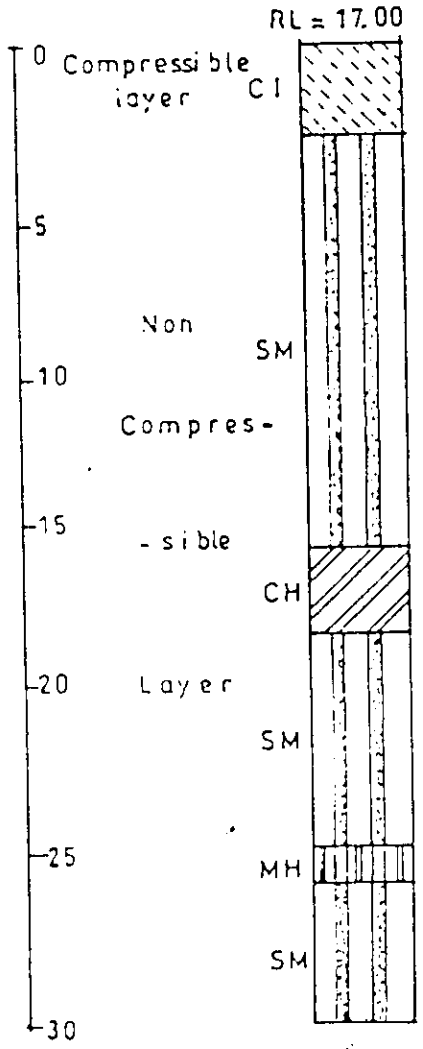


Fig: 58 e log p Curves for Bore hole No. 13 (15.00 - 15.40m).

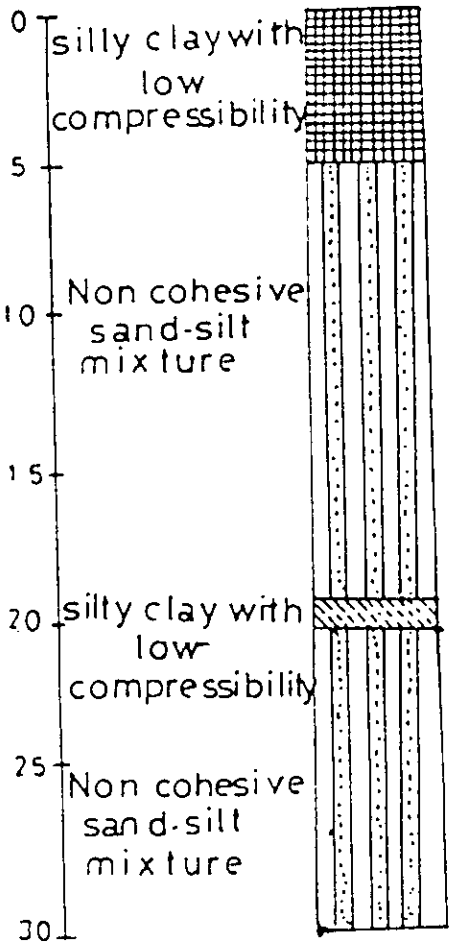
DESIGN PROFILE.



Natural moisture content	Observed N-Value	Corrected N-Value	Atterberg limit w_l	w_p	I_p	γ	ϕ	c
		AVERAGE VALUE						
23	6	10	48	25	23	1·73	21°	·18
20	34	27	NP	NP	NP			
	39	29						
	30	23						
	31	22						
	40	24						
19	37	22	NP	NP	NP			
	99	23						
	43	23						
19	22	15	NP	NP	NP			
	117	45						
25			59	20	39			
	43	21	51	27	24			
	47	22						
16			NP	NP	NP			
	62	25						
15	57	23	NP	NP	NP			
	68	25						
15								
	71	25						
17			65	35	30			
	35	29						
15	60	16	NP	NP	NP			
	57	20						
15								
	64	20						

Fig. 59

MCR/CONTROL ROOM. (BH-1).

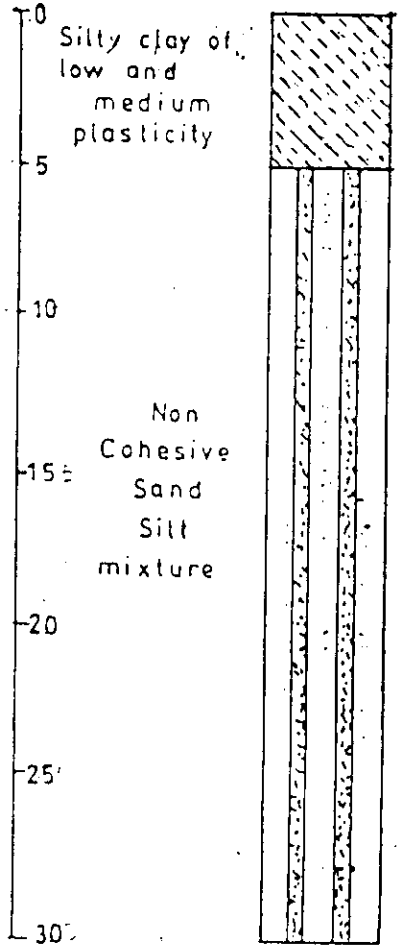


AVERAGE VALUES

N-values

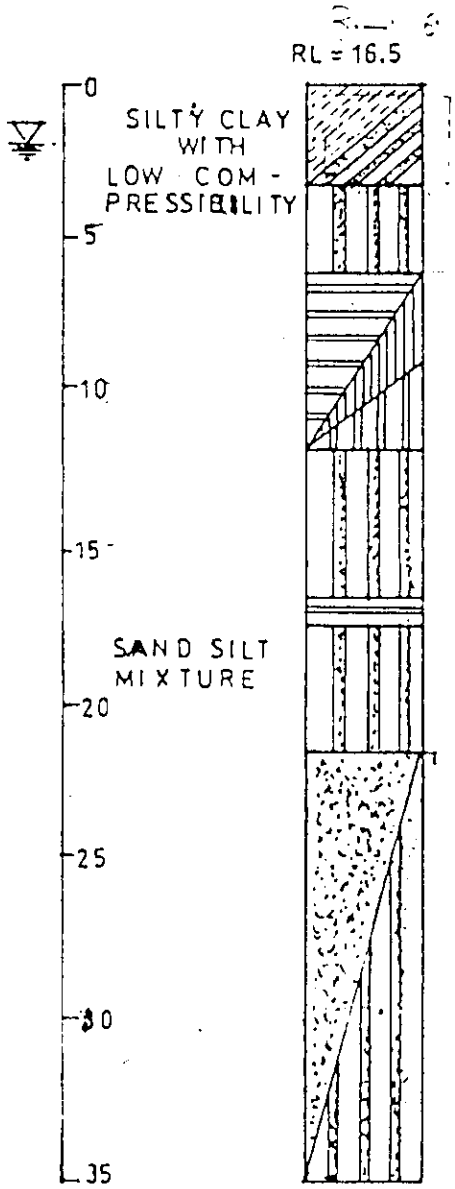
Natural moisture content	Observed	Corrected	W_L	W_p	Ip	C kg/cm²	∅	γ gm/cc
23	7	8	30	21	9			
24	11	13	29	21	8			
23	8	9	28	20	8	·6	5°	1·82
17	8	8	NP	NP	NP			
	12	14	NP	NP	NP			
17	24	18	NP	NP	NP			
17	26	18	NP	NP	NP			
	33	22	NP	NP	NP			
15	36	21	NP	NP	NP			
13	46	22	NP	NP	NP			
	56	24	NP	NP	NP			
12	57	22	NP	NP	NP			
	46	21	NP	NP	NP			
16	53	24	NP	NP	NP			
11	77	28	36	25	11			
	80	29	NP	NP	NP			
11	80	29	NP	NP	NP			
19	68	24	NP	NP	NP			
19	68	23						
	68	23	NP	NP	NP			
19	69	22	NP	NP	NP			

Fig. 60 Design profile for Colony area - BH (2 & 3)



Natural moisture content	AVERAGE VALUES N-Values Observed	Corrected	W_L	W_P	I_P	C kg/cm²	ϕ	γ gm/cc
27	5	7	35	14	21			
21	10	11				0.18	17	1.82
21	16	15	30	22	8			
19	19	17	N P	N P	N P			
21	16	18	N P	N P	N P			
	21	15						
19	26	17	N P	N P	N P			
15	40	23						
	54	28	N P	N P	N P			
15	32	36						
	39	26	N P	N P	N P			
13	39	25						
	60	25	N P	N P	N P			
12	64	26						
	69	27	N P	N P	N P			
12	71	27						
11	76	27	N P	N P	N P			
	77	25						
11								
11	80	26	N P	N P	N P			
	62	25						
	86	25	N P	N P	N P			

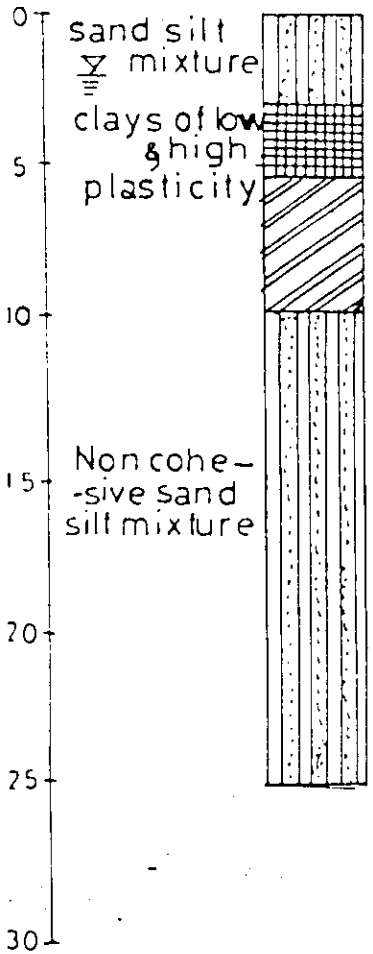
Fig 61 Design Profile for Switch Yard (BH-4 & 5).



Natural moisture content	AVERAGE VALUES N - Values Observed	Corrected	W_L	W_P	I_P	C kg/cm²	Ø	γ gm/cc
	7	8	32	21	11			
24								
23	13	14				0.19	20	1.92
12	25	20	33	24	9			
17	23	19	NP	NP	NP			
19	61	33	NP	NP	NP			
			47	33	14			
18	32	19						
17	35	20	43	29	14			
			64	25	39			
17	70	33	NP	NP	NP			
14	65	30						
	57	27	NP	NP	NP			
18			44	32	12			
	31	22	NP	NP	NP			
	60	29	NP	NP	NP			
12	65	26						
	80	30						
12	60	24	NP	NP	NP			
	65	25	NP	NP	NP			
	67	24						
12	70	23						
			NP	NP	NP			
	73	24						
12								

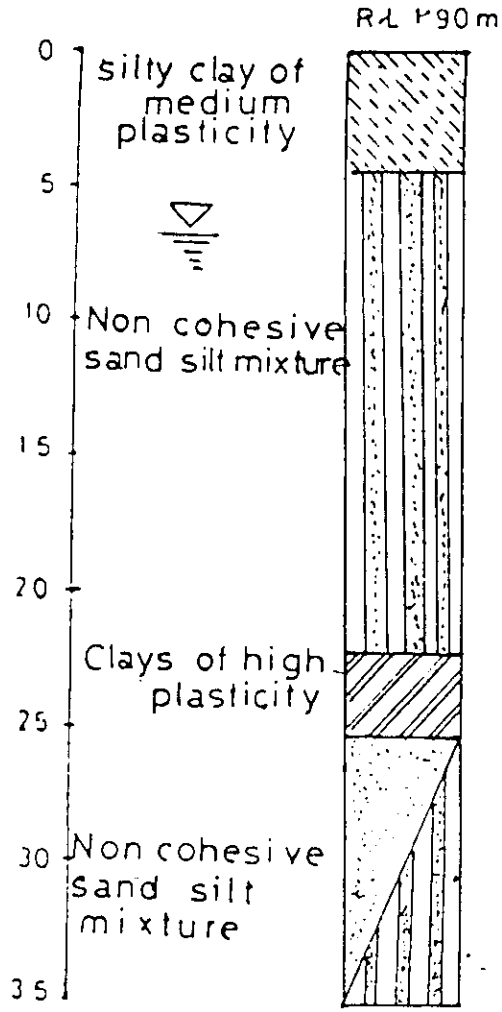
Fig 62 Design Profile for Transformer yard (BH 6 & 10).

AVERAGE VALUES



Natural moisture content	N-Values Observed	N-Values Corrected	W	W_p	I_p	C kg/cm	φ	γ gm/cc
18	6	7	NP	NP	NP			
18	4	5	NP	NP	NP	0·18	18	1·80
20	5	3	26	18	8			
	20	17	28	19	9			
20	19	17	52	28	24			
19	32	22	55	25	30			
	38	23	69	27	42			
12	41	24	NP	NP	NP			
	41	22						
	42	24	NP	NP	NP			
	49	24						
10	53	25	NP	NP	NP			
	42	18						
10	58	25						
	62	21	NP	NP	NP			
	65	25	NP	NP	NP			
10	68	25						

Fig.63 Design profile of Raw water Reservoir BH-7



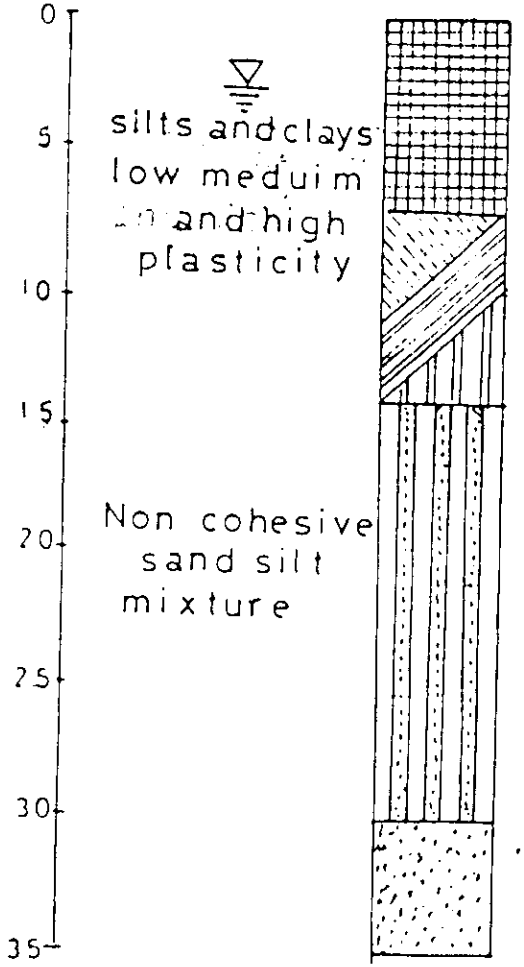
AVERAGE VALUES

N-values

Natural moisture content	Observed	Corrected	W_l	W_p	Ip	C kg/cm²	φ	γ gm/cc
19	7	8	44	22	22			
	21	24						
28	32	19	40	25	15	0·22	17	1·79
19	29	21	NP	NP	NP			
	36	33						
	47	39	NP	NP	NP			
18	56	29						
	46	24						
19	56	27	NP	NP	NP			
	35	19						
17	43	20	NP	NP	NP			
17	48	22	NP	NP	NP			
	55	23						
17	59	24	NP	NP	NP			
	65	26						
21	74	27	57	27	30			
	75	27	NP	NP	NP			
15	68	24	NP	NP	NP			
13	94	29	NP	NP	NP			
13	103	31	NP	NP	NP			
13	98	29	NP	NP	NP			
12	99	28	NP	NP	NP			
11	100	28	NP	NP	NP			

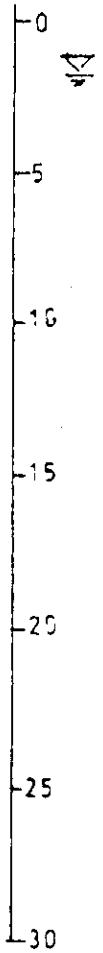
Fig.64 Design profile for Cooling Tower - BH-8

AVERAGE VALUES



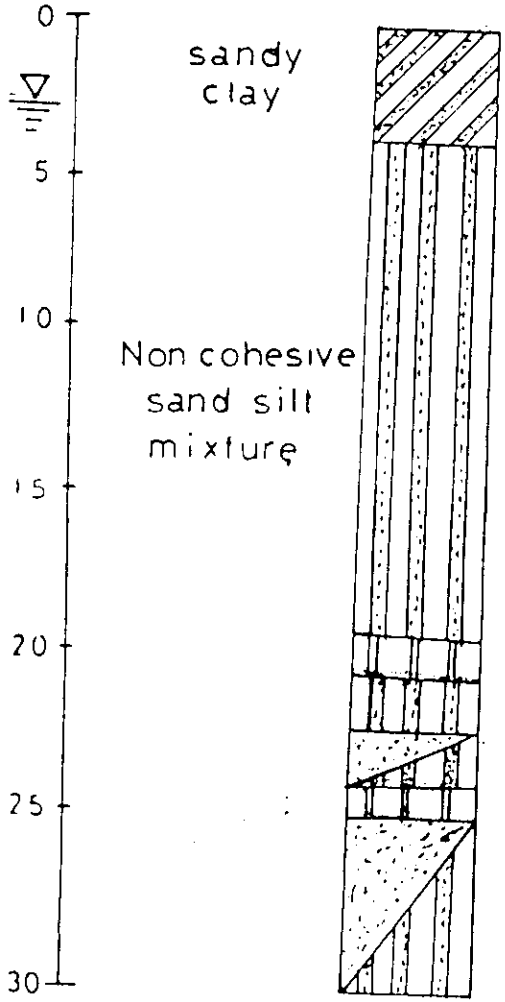
Natural moisture content	N-values Observed	N-values Corrected	W_l	W_p	I_p	C kg/cm²	φ	γ gm/cc
25	8	10	30	20	10			
25	17	17	28	20	8	0.13	21	1.79
	17	16	NP	NP	NP			
18	18	16	NP	NP	NP			
	22	19	NP	NP	NP			
18	22	18	45	25	20			
20	28	18	64	28	36			
20	38	22	59	32	27			
	65	32						
11	42	21	NP	NP	NP			
	48	22	NP	NP	NP			
	53	21						
	57	23	NP	NP	NP			
10	60	24	NP	NP	NP			
	63	24						
10	67	25	NP	NP	NP			
	70	25						
	74	25						
	77	25						
9	75	24	NP	NP	NP			
9	79	24	NP	NP	NP			
	84	25						
	86	25						

Fig. 65 Design profile for S.T area - (BH-9)



	Natural moisture content	AVERAGE VALUES N-Values Observed	Corrected	W_L	W_P	I_P	C kg/cm²	Ø	γ gm/cc
	25	6	7	39	23	16			
	23			42	24	18	c0.22	16	1.90
	22	17	17	36	23	13			
	19	24	20	NP	NP	NP			
	16	39	21						
	15	25	18	NP	NP	NP			
	17	27	19	NP	NP	NP			
	18	38	22	41	26	15			
		21	15						
	15	26	17	NP	NP	NP			
	15	29	17	NP	NP	NP			
		44	21						
	17	49	22	41	25	16			
	15	40	19	NP	NP	NP			
	14	69	27	NP	NP	NP			
	14	70	27	45	29	16			
	12	73	26	NP	NP	NP			
		77	27	NP	NP	NP			
	11	78	26						
	10	79	24	NP	NP	NP			
		81	26						
		81	24	NP	NP	NP			

Fig. 66 Design Profile for WHRB (BH-11).



AVERAGE VALUES

Natural moisture Content	N-values Observed	N-values Corrected	W_l	W_p	I_p	C kg/cm	ϕ	γ gm/cc
23	5	6	28	21	7			
21	13	14	28	21	7	0·15	21	1·81
17	24	20	NP	NP	NP			
	34	21						
15	35	23						
17	42	25	NP	NP	NP			
	42	44						
15	38	22	NP	NP	NP			
14	30	18						
	33	19						
	45	18	NP	NP	NP			
	53	24						
19	53	23	NP	NP	NP			
16	44	23	57	34	23			
15	46	26	NP	NP	NP			
	60	27	NP	NP	NP			
14	60	27	59	33	24			
12	75	23	NP	NP	NP			
10	24	25						
10	90	26	NP	NP	NP			

Fig.67 Design profile for G.T Building BH (12 & 13)