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JAPAN INTERNATIONAL COOPERATION AGENCY
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GEOTECHNICAL INVESTIGATION
FOR
DEVELOPMENT OF SCIENCE AND
MATHEMATICS TEACHING FOR
PRIMARY AND SECONDARY EDUCATION PROJECT
IKIP - BANDUNG

FINAL REPORT

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CONSULTANT :

PACIFIC CONSULTANTS INTERNATIONAL
Consulting Engineers and Architects
7-5, Sekido 1-chome, Tama-shi, Tokyo-206 JAPAN, Ph. 81-423-72-0111

SURVEY CONSULTANT :

PT BITA ENARCONENGINEERING
ENGINEERS • ARCHITECTS • CONSULTANTS
JL. PAHLAWAN NO. 74 - BANDUNG 40124; PHONE (022) 702748 (HUNTING); FAX. (022) 702749
JL. RINI NO.61 AMPERA RAYA-RAGUNAN, JAKARTA SELATAN 12560; PHONE (021) 78833354; FAX (021) 7804137

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1. INTRODUCTION

Under the aid funded by **Japan International Cooperation Agency (JICA)**, a new building units for the purpose of Development of Science and Mathematics Teaching For Primary and Secondary Education are to be constructed in the allocated lot inside IKIP compounds in Bandung, Indonesia.

Pacific Consultants International (PCI) being the main consultant for this project requires geotechnical parameters to be used as the basis for designing the substructure of the new building referred above.

PT. BITA Enarcon Engineering (BITA) is retained by **PCI** to provide the services to carry out the Geotechnical Investigation for the above purpose. The Geotechnical Investigation was carried out in line with the Topographical Survey and Mapping so that location of the investigated points can be plotted in the Topographical Map. (see separate report)

This report serves as Final Report on the above assignment and consists of methodology, field activities, bore log and record of Dutch Cone Penetration test as well as recommendation on the allowable load for the foundation design.

2. SCOPE OF WORK

The scope of work of the Geotechnical Investigation for this project under the contract is as follows :

Field works :

a. Boring and sampling at four (4) points with 25 m depth each.
b. Dutch Cone Penetration Test at four (4) points using 2.5 ton capacity DCPT apparatus.
c. Standard Penetration Test at 1m interval.
d. Ground Water Level Observation.
e. Hand auger boring at three (3) locations with 8 m depth.

Laboratory works :

Using undisturbed soil samples collected from the bore holes, the laboratory tests shall analyse and evaluate the following soil properties:

a. Index Properties
b. Engineering Properties

3. FIELD ACTIVITIES

The field activities were carried out from September 21, 1998 up to October 4,1998. In general, there were not any problems encountered. All tasks were carried out in accordance with the plan.

The whether in general were fine. Rainfalls during the period of the field activities were relatively moderate. No heavy rainfalls occurred during the said period.

Log of boring taken on site, were maintained by the field team under supervision of the Geologist. The boring activities were stopped at 25 m depth, while the Dutch Cone penetration tests were terminated when the cone resistance reach : qc > 200 kg/cm2.

4. METHODOLOGY

4.1. General

Prior to the execution of the work, a draft block plan was studied to determine the approximate location of the investigated points. The designated points were then explored in accordance with the plan, ie: deep boring using bore machine, hand augering, dutch cone penetration testing.

Core samples were taken continuously and collected into core boxes. Soil collected during the SPT observation were also stored in the core boxes at appropriate depth of the bore holes. The core boxes were then stored in the vicinity of the project office in IKIP Bandung.

All activities were recorded on site by the field team and verified by our Geologist. In case of any doubts or peculiarities then our Geologist checked the core samples in the core boxes and discussed with the field team. Reading of the Dutch Cone Penetration apparatus were also carried out by the field team under supervision of the Geologist. References from the geological map and previous experiences were taken into consideration in observing and analysing the findings from the field activities.

4.2 Core Drilling

For the core drilling work, a tungsten bit capable of producing core of 76 mm diameter size was utilized. This drilling bit was attached to the core barrel, then to the drilling rod and afterwards pressed and rotated vertically into the ground.

Hydraulic boring machines, YBM - 01, made in Japan was used to drive the drilling machine and facilitate the coring process. The coring process involves filling the core shell with materials and lifted to the ground, to be sampled and megascopically analyzed. Only small amount of water was used to facilitate the boring process.

Boring were done at four (4) points, progressed down to 25-m depth and alongside the boring SPT is also carried out at 1 m intervals.

During the boring process undisturbed soil samples were obtained from the borehole. Sampling was carried out using Shelby tube sampler. This tool can be pushed to the ground using drop hammer or hydraulic spindle. The undisturbed sample collected is immediately retrieved from the tube and sealed inside plastic bags to avoid moisture loss.

Ground water level measurements were carried out for each borehole the next day. Log and sample description and groundwater level were all noted down and presented in comprehensive table form.

4.3 Standard Penetration Test

The standard penetration test (SPT), an empirical dynamic penetration test, was carried out in the borehole. The test consists of driving into the ground a standard split spoon sampler by a 63.6 kg weight falling 762 mm. The spoon sampler has a 50-mm outside diameter, a 35-mm inside diameter and a length of 800-mm. After proper cleaning of the hole, the penetrometer on the end of the drilling rods is lowered to the bottom of the hole and driven an initial 150-mm and the blow count recorded. The penetrometer is then driven a further 300-mm and the blow count for this latter drive ,called the SPT N value,were recorded.

If the soil consists of very fine or silty sand below the water table, a correction is made when the measured N is greater than 15, because excess pore water pressure set up during driving cannot dissipate. The results are affected as follows:

$$N_{corrected} = 15 + 0.5(N_{measured} - 15)$$

Test is defined as counting the blows required to drive split spoon sampler to penetrate soil by 30 cm. For this particular test, the constants 63.5 kg for weight of the free falling hammer and 75 cm. for falling heights are used.

The results of the test may be used to describe granular soil density and clayey soil consistency as shown in the following table:

Granular Soil		**Clayey Soil**	
Blows	Density	Blows	Consistency
0 - 4	Very Loose	0 – 1	Very Soft
5 - 10	Loose	2 – 4	Soft
11 - 24	Medium Dense	5 – 8	Medium Stiff
25 - 50	Dense	9 – 15	Stiff
Over 50	Very Dense	16 – 30	Very Stiff
		31 – 60	Hard
		Over 60	Very Hard

4.4. Dutch Cone Penetration Test

In this test, a 60 degree cone with a cross sectional area of 10 cm^2 is forced into the ground at reasonably constant rate of strain, and provision is made to measure independently the point resistance, qc, and the resistance due to the side friction, fs.

The test utilizes the biconus type Begemann and equipment with 2.5 ton capacity. Cone resistance and friction reading can be directly read from the manometer gauge. Readings and observations are noted every 20 cm. depth interval. The rate of penetration is around 1.0 to 2.0 cm/sec and adhering to the ASTM D 3341 standard. A reading of more than 250 kg/cm^2 ends the testing process.

4.5 Hand Auger Boring

Instead of using manual way in doing hand auger boring, boring machine was employed to carry out the work. Boring progressed down to 8-m depth and alongside the boring SPT is also carried at 1-m depth intervals.

4.6 Laboratory Test

The undisturbed and soil samples are taken to the laboratory for the following tests and analysis : (the result is presented in **Table 1a, 1b,** and **1c**)

4.6.1 Index Property Test

- **Moisture Content (ASTM D-2216)**
  Moisture content is defined as the ratio of the weight of water in soil mass to the weight of the soil solids, expressed in percent

- **Unit Weight (ASTM D-2937)**
  Unit weight is defined as the ratio of the total weight of water and soil per unit volume.

- **Specific Gravity (ASTM D-854)**
  Specific gravity may be defined as the ratio of the weight of the soil particles, exclusive of the voids in the soil, to the weight of an equal volume of water at 4° C.

- **Atterberg Limit (ASTM D-4318)**
  In fine-grained soils, the amount of water present in the voids has a pronounced effect on the soil properties. Three indications or indexes of the effect of moisture, recognized as "Atterberg Limits", are the liquid limit (LL), plastic limit (PL), and plasticity index (PI). The liquid limit is defined as that moisture content at which a soil just ceases to act as a plastic and begins to act as a liquid. The plastic limit is that moisture content at which

a soil just ceases to act as a solid material and begins to act as a plastic. The range of moisture contents or rather the difference between the liquid limit and the plastic limit is the plasticity index.

- **Grainsize Analysis (ASTM D-422)**
  Grain size and gradation are established by sieve analysis and hydrometer analysis. Sieve analysis is used to determine the gradation of sand and gravel, while hydrometer analysis is used for silt and clay.

4.6.2 Engineering Property Test

- **Unconfined Compression test ASTM D-2166**
  The unconfined compression test of a soil is a uniaxial compression test in which the test specimen is provided with no lateral support while undergoing vertical compression. The test measures the unconfined compressive strength of a cylinder of cohesive or semi-cohesive soil, which indirectly, may be the indicative of the shearing strength.
  The test is usually performed upon an undisturbed sample of soil at its natural moisture content. It may also be performed upon a remolded sample to evaluate the consequences of disturbances and remolding upon the shearing strength.

- **UU Triaxial test(ASTM D-2850)**
  The triaxial test of a soil is a compression test in which the test specimen is provided with lateral support while undergoing vertical compression. The test indirectly measures the shear strength parameters of a cohesive or non-cohesive soil, which are expressed in soil parameters as cohesion (C)and internal friction angle (f).
  The test is usually performed upon an undisturbed sample of soil at its natural moisture content.
  UU denote unconsolidated undrained, which explain that the soil sample subjected to shearing stress is unconsolidated prior to the test and undrained during the test.

- **Direct Shear test (ASTM D-3080)**
  Direct shear test of a soil is a shearing test in which the test specimen is provided with normal stress while subjected to shearing stress. The failure line in the direct shear test is imposed by the method of testing.

- **Consolidation test (ASTM D-2435)**
  Consolidation test is used to determine the compressibility of a soil, the test is carried out by subjecting a soil specimen with progressively increasing compression test. The settlement and time required to complete the consolidation process for each stress were recorded and a graph of final settlement log-time versus stress is established. From the graph consolidation parameters can be obtained.

Tabel 1a.

SUMMARY OF LABORATORY TEST RESULTS

Project : FMIPA IKIP Development
Location : IKIP Bandung
Date : October 1998

Bore hole/Test pit no.		BH-1	BH-1	BH-1	BH-2	BH-2	BH-2
Depth	(m)	2.00-2.50	7.00-7.50	8.00-8.50	3.00-3.50	6.00-6.50	9.00-9.50
Color		dark brown	greyish brown	yell. brown	dark brown	yell. brown	light brown
USCS Classification		MH	ML	MH	MH	MH	CL
Natural water content	(%)	52.62	65.72	68.87	74.46	60.09	52.26
Unit weight	(t/m^3)	1.601	1.518	1.473	1.472	1.662	1.576
Specific gravity		2.623	2.714	2.671	2.668	2.677	2.714
Atterberg test							
Liquid limit	(%)	68	48	85	100	61	48
Plastic limit	(%)	42	44	49	67	35	26
Pasticity index	(%)	26	4	36	33	26	22
Grainsize analysis							
Gravel	(%)	-	22.90	-	-	-	3.70
Sand	(%)	9.50	25.00	8.90	9.30	12.90	27.20
Silt	(%)	53.20	42.90	55.70	58.00	56.40	45.80
Clay	(%)	37.30	9.20	35.40	32.70	30.70	23.30
% Finer #200 sieve	(%)	90.50	52.10	91.10	90.70	87.10	69.10
Triaxial test UU							
C	(kPa)	46.30	-	26.6	-	21.20	5.70
Ø	(degree)	3.10	-	3.40	-	11.70	11.40
Unconfined Compression test							
qu undisturbed	(kPa)	-	15.14	-	84.60	-	-
qu remoulded	(kPa)	-	8.90	-	41.30	-	-
Direct Shear test							
C	(kPa)	-	-	32.80	-	40.20	-
Ø	(degree)	-	-	19.50	-	19.40	-
Consolidation Test							
eo		-	2.22	1.99	2.37	-	1.50
Cc		-	0.69	0.86	0.89	-	0.24
Po	(kg/cm^2)	-	4.67	2.56	4.56	-	2.90
Cv avg.	(cm/min)	-	1.50	1.20	1.70	-	2.00

Tabel 1b.

SUMMARY OF LABORATORY TEST RESULTS

Project : FMIPA IKIP Development Date : October 1998
Location : IKIP Bandung

Bore hole/Test pit no.		BH-3	BH-3	BH-3	BH-4	BH-4	BH-4
Depth	(m)	3.00-3.50	6.00-6.50	9.00-9.50	2.00-2.50	5.00-5.50	10.00-10.50
Color		dark brown	greyish brown	greyish brown	dark brown	greyish brown	greyish brown
USCS Classification		MH	MH	MH	MH	MH	MH
Natural water content	(%)	66.78	71.19	63.72	72.68	91.48	66.60
Unit weight	(t/m^3)	1.375	1.431	1.456	1.506	1.304	1.491
Specific gravity		2.629	2.656	2.641	2.633	2.615	2.622
Atterberg test							
Liquid limit	(%)	100	93	78	82	95	77
Plastic limit	(%)	57	66	44	66	54	49
Pasticity index	(%)	43	27	34	16	41	28
Grainsize analysis							
Gravel	(%)	-	-	1.90	-	-	4.90
Sand	(%)	3.20	6.50	1.70	7.60	4.50	26.20
Silt	(%)	52.30	39.50	69.70	47.30	47.20	49.70
Clay	(%)	44.50	54.00	26.70	45.10	48.30	19.20
% Finer #200 sieve	(%)	96.80	93.50	96.40	92.40	95.50	68.90
Triaxial test UU							
C	(kPa)	41.60	25.30	-	56.20	-	12.80
Ø	(degree)	7.40	5.90	-	4.20	-	6.20
Unconfined Compression test							
qu undisturbed	(kPa)	87.70	-	21.17	-	-	22.53
qu remoulded	(kPa)	74.00	-	14.63	-	-	13.62
Direct Shear test							
C	(kPa)	-	-	20.50	-	-	25.10
Ø	(degree)	-	-	13.10	-	-	19.50
Consolidation Test							
eo		1.87	-	2.16	1.96	3.08	-
Cc		0.41	-	0.86	0.44	1.17	-
Po	(kg/cm^2)	0.74	-	2.64	2.68	2.28	-
Cv avg.	(cm/min)	1.00	-	1.00	1.25	1.00	-

Tabel 1c.

SUMMARY OF LABORATORY TEST RESULTS

Project : FMIPA IKIP Development Date : October 1998
Location : IKIP Bandung

Bore hole/Test pit no.		HB-1	HB-2	HB-3			
Depth	(m)	3.00-3.50	5.00-5.50	7.00-7.50			
Color		dark brown	brown	yell. brown			
USCS Classification		MH	MH	MH			
Natural water content	(%)	61.21	65.44	65.18			
Unit weight	(t/m^3)	1.373	1.521	1.536			
Specific gravity		2.606	2.619	2.630			
Atterberg test							
Liquid limit	(%)	99	92	71			
Plastic limit	(%)	63	51	38			
Pasticity index	(%)	36	41	33			
Grainsize analysis							
Gravel	(%)	-	-	-			
Sand	(%)	8.60	4.10	4.60			
Silt	(%)	48.40	34.30	52.90			
Clay	(%)	43.00	61.60	42.50			
% Finer #200 sieve	(%)	91.40	95.90	95.40			
Triaxial test UU							
C	(kPa)	33.00	47.90	46.60			
Ø	(degree)	9.10	7.70	4.30			
Unconfined Compression test							
qu undisturbed	(kPa)	-	-	-			
qu remoulded	(kPa)	-	-	-			
Direct Shear test							
C	(kPa)	-	-	-			
Ø	(degree)	-	-	-			
Consolidation Test							
eo		2.53	2.06	2.14			
Cc		0.71	0.51	0.65			
Po	(kg/cm^2)	4.44	2.04	1.77			
Cv avg.	(cm/min)	1.70	1.50	1.40			

5 RESULT OF THE INVESTIGATION

5.1 Regional Geology

Based on the regional geology map of Bandung area, with scale 1:250.000 (Directorate Geology, 1973), the engineering geological units that can be found at the IKIP area are;

- **QyD**, Sandy Tuff : Sandy tuff from G. Dano and G. Tangkuban Perahu (Van Bemmelen, 1934). Brownish sandy tuffs, very porous, containing very coarse hornblende crystals. Also red, weathered lahar, lapilli layers, and breccia.

- **QyT**, Pumiceous Tuff : Tuffaceous sand, lapilli, bombs, scoriaceous lava, angular fragments of dense andesite-basalts, many pumice fragments, mostly from G. Tangkuban Perahu (Van Bemmelen, 1934) and G. Tampomas.

5.2 Site Investigation Results

The distribution of site investigation points at the proposed FMIPA Building location was indicated in **Appendix 1**. Soil profiles were also prepared across the site through (BH-2,BH-4,HB3) and (BH-1,BH-3,HB-1), presented in **Appendix 2.**

The boring reach up to limited depth of 25 m and the soil profiles define four (4) distinct soil layers as described below:

- The topsoil represented by soft **CLAYEY SILT**, dark brown in colour, high plasticity, the thickness is about 4 to 6 m.

  SPT N value = 3 to 4
  Cone resistance, qc = 3 to 12 kg/cm^2

- Underlying this topsoil is **TUFFACEOUS SANDY SILT**, yellowish brown, mottled grey, soft to firm, medium to high plasticity, the thickness is about 6 to 10 m.

  SPT N value = 3 to 10
  Cone resistance, qc = 5 to 15 kg/cm^2

- The next layer is **TUFFACAOUS SAND**, yellowish brown, fine to medium grain size, medium to very dense, poorly cemented, the thickness is about 3 to 6 m.

  SPT N value = 30 to > 50
  Cone resistance, qc = > 250 kg/cm^2

- The last layer is **TUFFACEOUS GRAVELLY SAND**, greyish brown mottled yellow, coarse to very coarse grains, very dense, poorly cemented, the thickness is unknown.

  SPT N value > 50
  Cone resistance, qc > 250 kg/cm^2.

Results of Standard Penetration Test (SPT) and Dutch Cone Penetration test indicate that hard soil layer was found at the depth of 13 to 18 meter from the existing ground level.

Groundwater was encountered at the depth of 7.00 m to 11.20 m, below the ground level.

5.3 Laboratory Test Results

As indicated in the Table 1-a, 1-b, and 1-c ,the results of the laboratory analysis shows the following soil parameters :

Representing the *top soil* layer from 0 to about 6 m depth;

USCS Classification	: MH
Color	: dark brown
Water Content	: 53 - 81 %
Unit Weight	: 1.37 - 1.60 ton/m^3
Cohesion	: 33 – 48 kPa
Friction Angle	: 3.10 – 9.10 degrees

And the *tuffaceous sandy silt* soil layer from 6 to 10 m depth is represented by the following soil parameters;

USCS Classification	: MH
Color	: yellowish, greyish brown
Water Content	: 52 - 91 %
Unit Weight	: 1.43 - 1.66 ton/m^3
Cohesion	: 13 – 26 kPa
Friction Angle	: 3.4 – 11.70 degrees

6 FOUNDATION RECOMMENDATIONS

The results of Soil boring and Dutch Cone Penetration test indicate that the soil layer from 0 to about 10 meter depth are clayey silt and sandy silt of high plasticity with soft to firm grades.

Compression ratio of this soil layer is ranging from 0.21 to as high as 0.89, indicate that this soil layer will settle significantly when subjected to high pressure.

To avoid excessive settlement, deep foundation sitting on the stratum having higher bearing capacity, is recommended.

Our recommendations for foundation alternatives are described in the following section:

6.1 Shallow Foundation

A shallow foundation of continuous or square footing made of stone masonry or reinforced concrete can be applied for light to medium load structures. The depth of the foundation's base should be at least one (1) meter from the ground level, the deeper the foundation's base the higher bearing capacity will be obtained.

By limiting the amount of settlement to a maximum of 25 mm, the recommended allowable bearing capacity for shallow foundation is 2.5 ton/m^2.

6.2 Deep Foundation

For the heavier structure such as the FMIPA buildings, which will be of about five (5) stories, deep foundation is recommended.

Considering the load imposed by the building and the depth of the hard layer at the proposed building area, it is most likely that deep foundation, in the range of 15 m to 18 m depth, will be required.

We prefer to utilize driven pile rather than bored pile due to the following reasons:

- High possibility of caving-in during construction of bored pile.
- Bored pile will usually rely on the end bearing, which make the required section area of the pile is bigger, resulting more concrete required, compared to driven pile.
- While distance from the existing structure is still permissible, driven pile will be easier to construct compared to bored pile.

Hence, precast concrete driven pile of square and circular shape will be evaluated, for example of driven pile application.

Pile allowable load capacity analysis is made based on standard penetration test, Dutch cone penetration test and soil property data.

6.2.1. Based on Standard Penetration Test

Meyerhof (1956), Decourt (1982) has correlated the shaft and base resistance of a pile with the results of a standard penetration test. For displacement pile the ultimate load is given by :

$$Qu = Qp + Qs$$
$$Qp = K.\ Np.\ Ap$$
$$Qs = fs.\ As$$
$$fs = 1 + N_{av}/3$$

Where:

Qu	: ultimate load capacity of a pile, ton
Qp	: end-bearing ultimate load capacity, ton
Qs	: skin friction ultimate load capacity, ton
K	: soil coefficient, based on the soil type For gravelly sand, K = 40 t/m²
Np	: SPT N value at pile base
Ap	: net sectional area of pile, m²
As	: surface area of pile shaft, m²
N_{av}	: average SPT N value along pile shaft

6.2.2. Based on Dutch Cone Penetration Test

The modern cone penetration test was originally developed in the Netherlands during the 1930s. Because the process of conducting a cone penetration test is so similar to driving piles, analysis methods based on this data should be good in predicting a pile load capacity.

$$Qu = qc.Ap + \Sigma fs.\ As$$

Where:

qc	: average cone resistance at the pile base, determined according to Dutch method *(Heijnen,DeRuiter and Beringen, 1979).*
Ap	: net sectional area of pile
As	: surface area of pile shaft
fs	: unit friction resistance
fs	: α'. fsc, *Nottingham and Schmertmann (1975)* have correlated the skin resistance with the local side friction, fsc.
α'	: correlation factor between fs and fsc

6.2.3. Based on Soil Properties

The following formula uses basic soil parameters such as the friction angle, ϕ, or undrained shear strength, Su. These parameters may be obtained from the laboratory and/or in-situ tests.

$$Qu = Qp + Qs$$

For cohesive soil;

$Qp = Su.Nc.Ap$

$Qs = \alpha.Su.As$

For non-cohesive soil;

$Qp = q.Nq.Ap$

$Qs = 0.5\ q.Ks.As.\tan\delta$

Where:

Qu	: ultimate load capacity of a pile
Qp	: end-bearing ultimate load capacity
Qs	: skin friction ultimate load capacity
q	: effective overburden pressure
Nc,Nq	: bearing capacity factor
Ap	: net sectional area of pile
As	: surface area of pile shaft
Su	: average undrained shear strength along pile shaft
α	: adhesion factor
Ks	: coefficient of earth pressures which depends on the volume displacement of the pile, the material of the pile and its shape.
δ	: the angle of friction between pile and soil, equal to 0.75 ϕ for concrete pile.

6.3. Settlement of the Pile

Settlement of the pile sitting on stiffer stratum may be predicted by the following formula :

$\rho = P.I / Es.D$

$I = Io.Rk.Rb.R\nu$

Where:

ρ	: settlement of pile head
P	: applied axial load
Io	: settlement influence factor for incompressible pile in semi-infinite mass, for $\nu_s = 0.5$
Rk	: correction factor for pile compressibility
Rb	: correction factor for finite depth of layer on a rigid base
$R\nu$	: correction factor for soil Poisson's ratio ν_s
D	: pile diameter
Es	: soil elastic modulus

Poulos & Davis (1980)

A safety factor of three (3) is used to calculate the allowable pile capacity. The results of allowable pile bearing capacity and its settlement prediction are tabulated in the following page (**Table 2**).

Table 2. Allowable load capacity and estimated immediate settlement for precast concrete pile

Pile Dimension (cm)	Area (cm^2)	All.Load based on SPT (ton)	CPT (ton)	Soil Prop. (ton)	Recommended Allowable Load (ton)	Estimated Immediate Settlement (cm)
30 x 30	900	47	44	40	40	0.39
35 x 35	1225	60	57	52	50	0.43
40 x 40	1600	75	72	65	65	0.47
45 x 45	2025	91	89	80	80	0.52
50 x 50	2500	108	107	96	95	0.55
dia. 30	707	37	35	32	30	0.30
dia. 35	963	47	45	41	40	0.34
dia. 40	1257	59	57	51	50	0.37
dia. 45	1591	71	70	63	60	0.41
dia. 50	1964	85	84	75	75	0.43

Note :Safety factor of 3 is used.

7. CONCLUSION AND RECOMMENDATION

The results of site drilling up the depth of 25 m reveal that the soil profile at the proposed FMIPA building site from top to bottom is as follows:

- The topsoil is represented by **CLAYEY SILT** which is dark brown in colour, soft (N=3-4), with high plasticity and with thickness of about 4 to 6 m.
- **TUFFACEOUS SANDY SILT**, yellowish brown mottled grey, soft to firm (N=3-10), medium to high plasticity, as weathered tuff, the thickness is about 6 to 10 m.

- **TUFFACEOUS SAND**, yellowish brown, fine to medium grain size, medium to very dense (N=10-50), poorly cemented, the thickness is about 3 to 6 m.
- **TUFFACEOUS GRAVELLY SAND**, greyish brown mottled yellow, coarse to very coarse grains, very dense (N>50), poorly cemented, the thickness is unknown.

Groundwater was encountered at the depth of 7.00 m to 11.20 m, below the ground level.

Dutch cone penetration tests carried out on-site were terminated at 15 m to 18 m depth, at the sandy tuff layer (SPT N = 30-50).

For the proposed FMIPA building, it is recommended to use deep foundation to support the structure. Various dimension of square and circular precast concrete pile have been calculated for their load capacity and estimated settlement, as presented in **Table 2**.

The bearing layer ,represented by the tuffaceous sand, based on borehole data, is getting deeper southward. Its depth varies from 15 m at the northern part to 18 m at the southern part.

It is recommended that, to further validate the design load capacity, **loading test** need to be carried out. Standards and procedures of this loading test shall follow the applicable codes.

8. PERSONNEL AND EQUIPMENT

8.1. Personnel

Geologist	: Cindarto
Assistant Geologist	: Tahal Mangunsong
Bore Master	: Hendra, Tatang
DCPT Operator	: Herman

8.2. Equipment

Bore Machine	: YBM - 01 capacity of 100 m	1 unit
DCPT	: Gouda type capacity of 2.5 ton	1 unit
Hand Auger		1 unit

REFERENCES

TERZAGHI, C., PECK, R.B., *"Soil Mechanics in Engineering Practice"*, John Wiley, New York, 1974

SIMONS, N.E., MENZIES, B.K., *"A Short Course in Foundation Engineering"*, ELBS, Butterworth & Co. LTD., 1977.

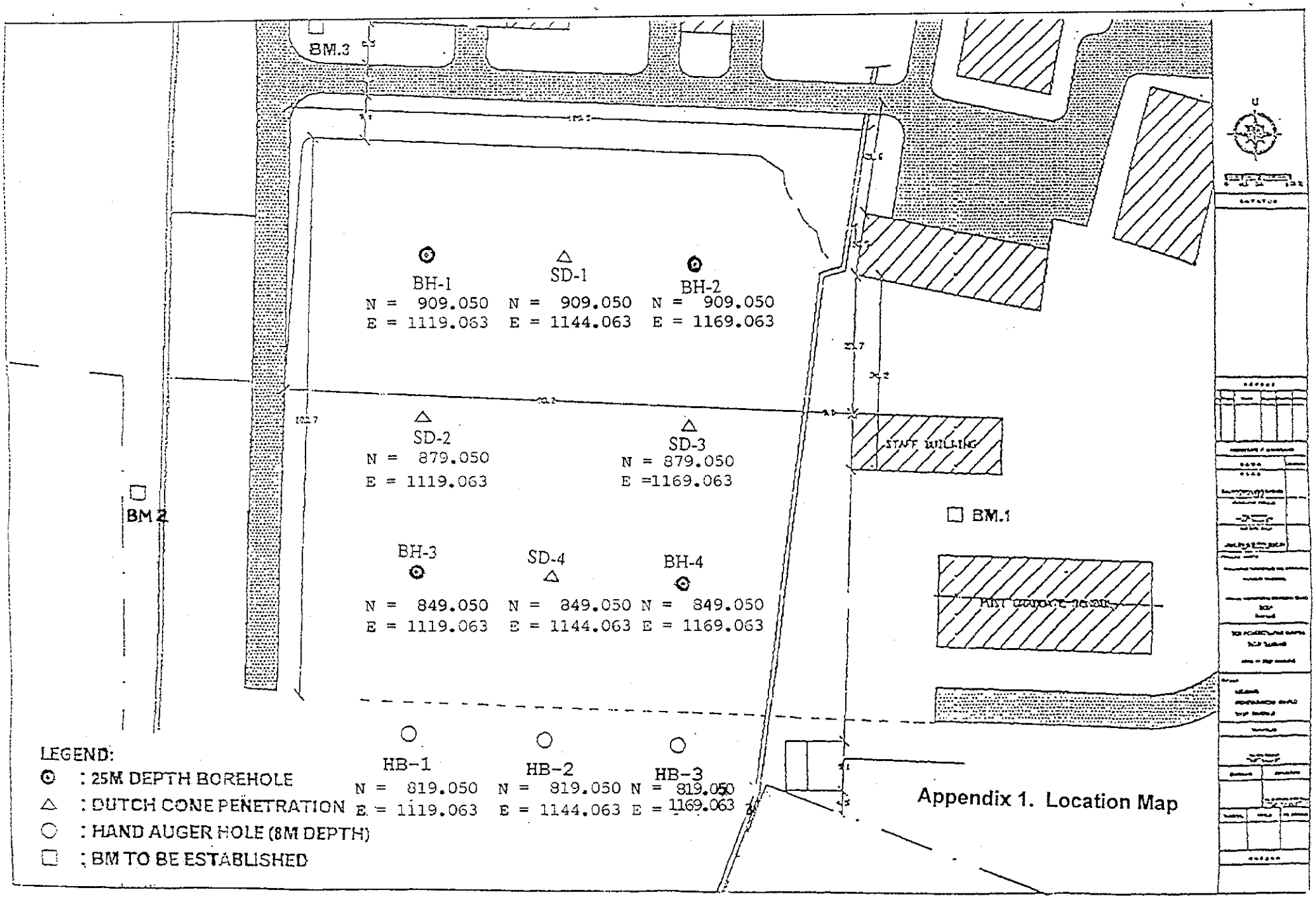
TOMLINSON M.J., *"Pile Design and Construction Practice"*, Viewpoint, London, 1977.

POULOS, H.G., DAVIS, E.H., *"Pile Foundation Analysis and Design"*, John Wiley, New York, 1980.

CODUTO D.P., *"Foundation Design: Principles and Practices"*, Prentice Hall, New Jersey, 1994.

APPENDIX 1

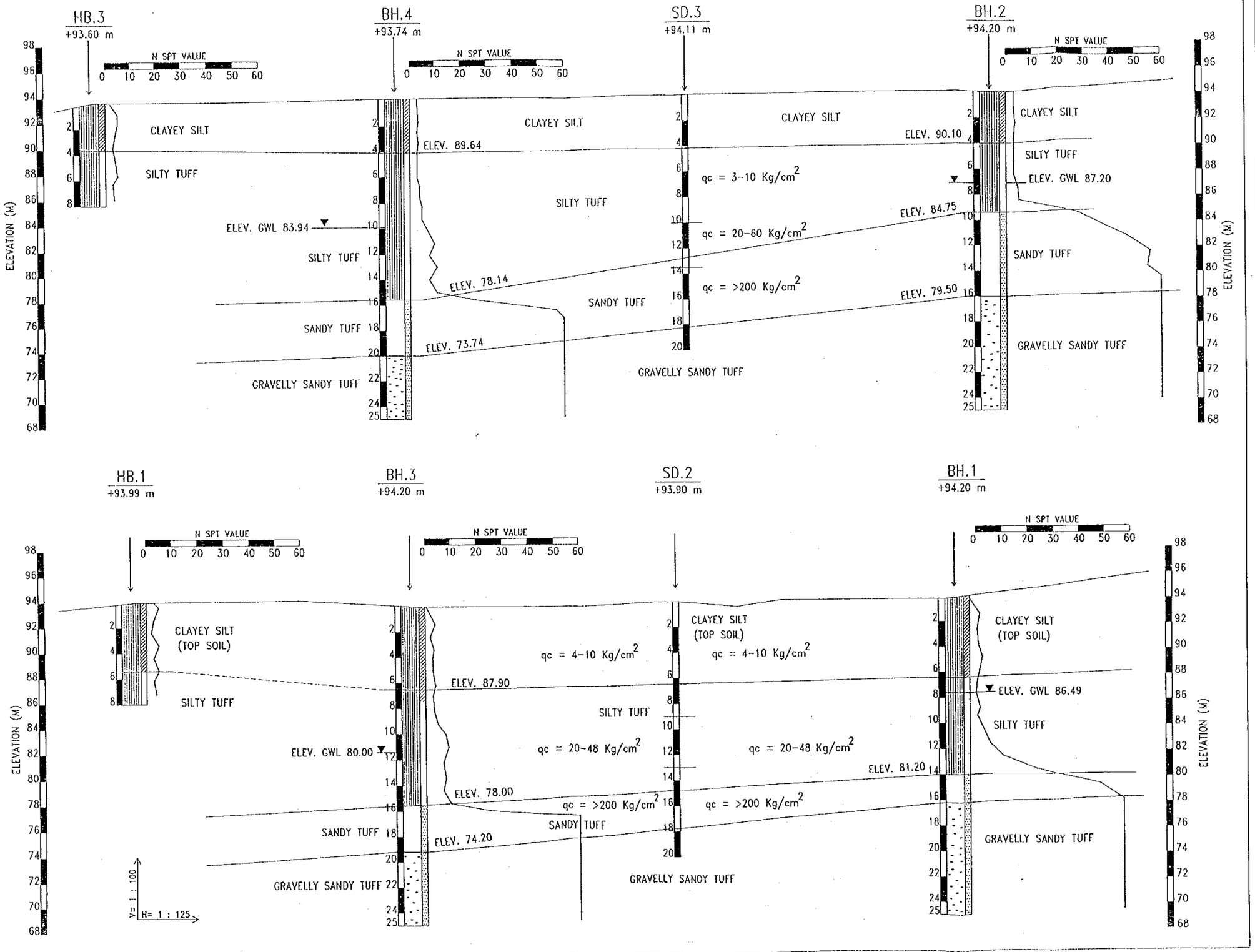
LOCATION MAP



Appendix 1. Location Map

APPENDIX 2

GEOLOGICAL CROSS SECTION PROFILE



NOTES

LITOLOGY UNIT :

- CLAYEY SILT (TOP SOIL)
- SILTY TUFF
- SANDY TUFF
- GRAVELLY SANDY TUFF
- N SPT VALUE
- GROUND WATER LEVEL
- THICKNES LAYERS

REVISION

NO	CHECKED	APPROVED	DESCRIPTION	DATE
0	TM	SGH	FOR APPROVAL	30-09-98

OWNER

JAPAN INTERNATIONAL COOPERATION AGENCY (J I C A)

CONSULTANT

PACIFIC CONSULTANTS INTERNATIONAL
CONSULTING ENGINEERS AND ARCHITECTS
2-5, SEIJOO 1-CHOME, TAMA-SHI, TOKYO-206 JAPAN, PH. 81-423-72-0111

SURVEY-CONSULTANT

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DESIGN	-		
CHECKED	TM		
APPROVED			
DESIGN MNG.	SGH		
PROJECT DIR.	AP		
PCI			

DISCIPLINE	ARC	CIV/STR	ELECT	MECH/PIP
INITIAL	-	-	-	-
DATE				

PROJECT

FMIPA IKIP BANDUNG DEVELOPMENT PROJECT

DRAWING TITLE

GEOLOGYCAL CROSSECTION PROFIL

SCALE	FILE	
PROJECT NO.	BEE CONTRACT NO.	DISCIPLINE
98 910		CIVIL
CONTRACT NO.	DRAWING NUMBER	
REVISION NO.	APPENDIX-2	
0		

APPENDIX 3

BORING LOGS

BORING LOG

Borehole No. : BH-1

Project	: FMIPA IKIP Bandung	Date started	: 29 September 1998
Location	: IKIP Bandung	Date finished	: 30 September 1998
Northing	: 909.050	Bor master	: Hendra
Easting	: 1.119.063	Logged by	: Tahal
Elevation	: + 94.20 m	Total depth	: 25.00 m
GWL	: - 7.50 m	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Description	Litology Unit	Standard Penetration Test: No. of blows (15 cm)			value N	N Graph
29 Sept. 1998	1		CLAYEY SILT, dark brown, soft, medium to high plasticity	TOP SOIL					
	2	SPT			1	2	2	4	
		UDS							
	3	SPT			1	1	2	3	
	4	SPT			1	1	2	3	
	5	SPT			1	2	2	4	
	6	SPT			1	2	2	4	
	7	SPT	SANDY SILT, tuffaceous, yellowish brown mottled grey, soft to firm, low to medium plasticity. Weathered tuff.	SILTY TUFF	1	2	2	4	
	GWL	UDS							
	8	SPT			1	1	2	3	
		UDS							
	9	SPT			1	2	1	3	
	10	SPT			1	2	2	4	
30 Sept. 1998	11	SPT			2	2	4	6	
	12	SPT			2	3	5	8	
	13	SPT			4	6	7	13	
	14	SPT	SAND, tuffaceous, yellowish brown, fine to medium grain size, medium to very dense, poorly cemented, sub-rounded to rounded grain shape, containing	SANDY TUFF	6	10	17	27	
	15	SPT			9	16	35	>50	

N Graph scale: 10 20 30 40 50

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BORING LOG

Borehole No. : BH-1

Project	: FMIPA IKIP Bandung	Date started	: 29 September 1998
Location	: IKIP Bandung	Date finished	: 30 September 1998
Northing	: 909.050	Bor master	: Hendra
Easting	: 1.119.063	Logged by	: Tahal
Elevation	: + 94.20 m	Total depth	: 25.00 m
GWL	: - 7.50 m	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Symbol	Description	Litology Unit	Standard Penetration Test				
						No. of blows (15 cm)			value N	N Graph
	16			breccia fragmen with angular shape at 12.10 to 12.30 m depth.	SANDY TUFF	13	19	38	>50	
	17	SPT				18	25	38	>50	
30 Sept. 1998	18	SPT		GRAVELLY SAND, tuffaceous, greyish browns mottled yellow, coarse to very coarse grain size, sub-angular to sub-rounded grain shape, very den poorly cemented.	GRAVELLY SANDY TUFF	16	27	39	>50	
	19	SPT				35	56	60	>50	
	20	SPT				53	60		>50	
	21	SPT				47	60		>50	
	22	SPT				60			>50	
	23	SPT				60			>50	
	24	SPT				60			>50	
	25	SPT				60			>50	
	26									
	27									
	28									
	29									
	30									

BORING LOG

Borehole No. : BH-2

Project	: FMIPA IKIP Bandung	Date started	: 26 September 1998
Location	: IKIP Bandung	Date finished	: 28 September 1998
Northing	: 909.050	Bor master	: Hendra
Easting	: 1.169.063	Logged by	: Tahal
Elevation	: + 94.20 m	Total depth	: 25.00 m
GWL	: - 7.00 m	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Symbol	Description	Litology Unit	Standard Penetration Test: No. of blows 15 cm			value N	N Graph
	1									
	2	SPT				1	2	2	4	
26 Sept. 1998	3	SPT		CLAYEY SILT, dark brown, soft, medium to high plasticity	TOP SOIL	1	2	2	4	
		UDS								
	4	SPT				1	1	2	3	
	5	SPT				1	1	2	3	
	6	SPT		SANDY SILT, tuffaceous, yellowish brown	SILTY	1	1	2	3	
		UDS		mottled grey, soft to firm, low to medium plasticity.	TUFF					
GWL	7	SPT		Weathered tuff.		1	1	2	3	
	8	SPT				1	2	2	4	
	9	SPT				1	2	3	5	
		UDS								
	10	SPT				5	10	18	28	
	11	SPT		SAND, tuffaceous, yellowish brown, fine to mediu	SANDY	9	16	28	44	
				grain size, medium to very dense, poorly cemente	TUFF					
	12	SPT		sub-rounded to rounded grain shape, containing		10	18	29	47	
				breccia fragmen with angular shape at 14.00 to						
27 Sept. 1998	13	SPT		14.20 m and 14.50 to 14.60 m depth.		13	21	36	>50	
	14	SPT				9	25	30	>50	
	15	SPT				15	24	36	>50	

BORING LOG

Borehole No. : BH-2

Project	: FMIPA IKIP Bandung	Date started	: 26 September 1998
Location	: IKIP Bandung	Date finished	: 28 September 1998
Northing	: 909.050	Bor master	: Hendra
Easting	: 1.169.063	Logged by	: Tahal
Elevation	: + 94.20 m	Total depth	: 25.00 m
GWL	: - 7.00 m	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Symbol	Description	Litology Unit	Standard Penetration Test: No. of blows (15 cm)			value N	N Graph (10 20 30 40 50)
27 Sept. 1998	16			GRAVELLY SAND, tuffaceous, greyish browns mottled yellow, coarse to very coarse grain size, sub-angular to sub-rounded grain shape, very den poorly cemented.	GRAVELLY SANDY TUFF	13	25	37	>50	
	17	SPT				25	48	50	>50	
	18	SPT				38	60		>50	
	19	SPT				29	48	60	>50	
	20	SPT				51	60		>50	
28 Sept. 1998	21	SPT				47	60		>50	
	22	SPT				60			>50	
	23	SPT				60			>50	
	24	SPT				60			>50	
	25	SPT				60			>50	
	26									
	27									
	28									
	29									
	30									

BORING LOG

Borehole No. : BH-3

Project	: FMIPA IKIP Bandung	Date started	: 21 September 1998
Location	: IKIP Bandung	Date finished	: 23 September 1998
Northing	: 849.050	Bor master	: Hendra
Easting	: 1.119.063	Logged by	: Tahat
Elevation	: +93.69 m	Total depth	: 25.00 m
GWL	: - 11.20 m	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Description	Litology Unit	Standard Penetration Test: No. of blows (15 cm)			value N	N Graph
21 Sept. 1998	1		CLAYEY SILT, dark brown, soft, medium to high plasticity	TOP SOIL					
	2	SPT			1	1	2	3	
	3	SPT			1	1	1	2	
		UDS							
	4	SPT			1	1	2	3	
	5	SPT			1	2	2	4	
	6	SPT			1	2	2	4	
		UDS							
	7	SPT	SANDY SILT, tuffaceous, yellowish brown mottled grey, soft to firm, low to medium plasticity. Weathered tuff.	SILTY TUFF	1	1	2	3	
	8	SPT			1	1	2	3	
	9	SPT			1	2	2	4	
		UDS							
	10	SPT			1	2	4	6	
GWL	11	SPT			4	4	6	10	
	12	SPT			4	6	6	12	
22 Sept. 1998	13	SPT			3	4	5	9	
	14	SPT			2	4	4	8	
	15	SPT			2	3	5	8	

N Graph scale: 10 20 30 40 50

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BORING LOG

Borehole No. : BH-3

Project	: FMIPA IKIP Bandung	Date started	: 21 September 1998
Location	: IKIP Bandung	Date finished	: 23 September 1998
Northing	: 849.050	Bor master	: Hendra
Easting	: 1.119.063	Logged by	: Tahal
Elevation	: +93.69 m	Total depth	: 25.00 m
GWL	: - 11.20 m	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Symbol	Description	Litology Unit	Standard Penetration Test: No. of blows (15 cm)			value N	N Graph (10 20 30 40 50)
22 Sept. 1998	16	SPT		SANDY SILT, tuffaceous, yellowish brown mottled grey, soft to firm, low to medium plasticity.	SILTY TUFF	3	5	6	11	
	17	SPT		SAND, tuffaceous, fine to medium grain size, yellowish brown, medium to dense, poorly cemented, sub-rounded to rounded grain shape, containing brecccia fragmen with angular shape at 12.10 to 12.40 m depth.	SANDY TUFF	6	15	20	35	
	18	SPT				15	30	35	>50	
	19	SPT				18	29	37	>50	
	20	SPT				18	60		>50	
23 Sept. 1998	21	SPT				20	60		>50	
	22	SPT		GRAVELLY SAND, tuffaceous, greyish brown, medium to very coarse grain size, sub-rounded to rounded grain shape, very dense, poorly cemente	GRAVELLY SANDY TUFF	60			>50	
	23	SPT				60			>50	
	24	SPT				60			>50	
	25	SPT				60			>50	
	26									
	27									
	28									
	29									
	30									

BORING LOG

Borehole No. : BH-4

Project	: FMIPA IKIP Bandung	Date started	: 24 September 1998
Location	: IKIP Bandung	Date finished	: 25 September 1998
Northing	: 849.050	Bor master	: Hendra
Easting	: 1.169.063	Logged by	: Tahal
Elevation	: +93.74 m	Total depth	: 25.00 m
GWL	: - 9.80 m	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Symbol	Description	Litology Unit	Standard Penetration Test: No. of blows 15 cm			N value	N Graph 10 20 30 40 50
	1									
	2	SPT		CLAYEY SILT, dark brown, soft, medium to high plasticity	TOP SOIL	1	2	2	4	
24 Sept. 1998		UDS								
	3	SPT				1	1	2	3	
	4	SPT				1	2	2	4	
	5	SPT				1	1	2	3	
		UDS								
	6	SPT				1	1	2	3	
	7	SPT				1	1	2	3	
	8	SPT		SANDY SILT, tuffaceous, yellowish brown mottled grey, soft to firm, low to medium plasticity. Weathered tuff.	SILTY TUFF	1	2	2	4	
	9	SPT				1	2	2	4	
GWL	10	SPT				1	2	3	5	
		UDS								
	11	SPT				2	3	5	8	
	12	SPT				2	3	6	9	
25 Sept. 1998	13	SPT				2	2	5	7	
	14	SPT				3	3	5	8	
	15	SPT				2	3	4	7	

BORING LOG

Borehole No. : BH-4

Project	: FMIPA IKIP Bandung	Date started	: 24 September 1998
Location	: IKIP Bandung	Date finished	: 25 September 1998
Northing	: 849.050	Bor master	: Hendra
Easting	: 1.169.063	Logged by	: Tahal
Elevation	: +93.74 m	Total depth	: 25.00 m
GWL	: - 9.80 m	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Symbol	Description	Litology Unit	Standard Penetration Test: No. of blows 15 cm			value N	N Graph 10 20 30 40 50
25 Sept. 1998	16	SPT		SAND, tuffaceous, fine to medium grain size, yellowish brown, medium to very dense, poorly cemented, angular to sub-rounded grain shape, containing brecccia fragmen with angular shape.	SANDY TUFF	3	4	6	10	
	17	SPT				8	11	15	26	
	18	SPT				11	28	23	>50	
	19	SPT				17	30	36	>50	
	20	SPT				15	25	36	>50	
	21	SPT		GRAVELLY SAND, tuffaceous, greyish brown, medium to very coarse grain size, angular to sub-rounded grain shape, very dense, poorly cemente At depth 24.50 to 24.80 andesitic boulder was found.	GRAVELLY SANDY TUFF	40	60		>50	
	22	SPT				60			>50	
	23	SPT				60			>50	
	24	SPT				60			>50	
	25	SPT				60			>50	
	26									
	27									
	28									
	29									
	30									

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BITA

HAND AUGER LOG

Borehole No. : HB-1

Project	: FMIPA IKIP Development	Date started	: 2 October 1998
Location	: IKIP Bandung	Date finished	: 2 October 1998
Northing	: 819.050	Bor master	: Hendra
Easting	: 1.119.063	Logged by	: Tahal
Elevation	: + 93.99 m	Total depth	: 8.00 m
GWL	: -	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Description	Litology Unit	Standard Penetration Test: No. of blows (15 cm)			value N
2 Oct. 1998	1	SPT	CLAYEY SILT, dark brown, soft, medium to high plasticity	FILL MAT'L or TOP SOIL	1	2	3	5
	2	SPT			1	2	2	4
	3	SPT			1	2	2	4
		UDS						
	4	SPT			1	1	2	3
	5	SPT			1	1	2	3
	6	SPT	SANDY SILT, tuffaceous, yellowish brown mottled grey, soft, low to medium plasticity.	SILTY TUFF	1	2	3	5
	7	SPT			1	1	3	4
	8	SPT			1	2	2	4
22 Sept. 1998	9							
	10							
	11							
	12							
	13							
	14							
	15							

N Graph: 10 20 30 40 50

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HAND AUGER LOG

Borehole No. : HB-2

Project	: FMIPA IKIP Development	Date started	: 1 October 1998
Location	: IKIP Bandung	Date finished	: 2 October 1998
Northing	: 1.144.630	Bor master	: Hendra
Easting	: 819.082	Logged by	: Tahal
Elevation	: +94.20 m	Total depth	: 8.00 m
GWL	: -	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Description	Litology Unit	Standard Penetration Test: No. of blows (15 cm)			value N	N Graph
1 Oct. 1998	1	SPT	CLAYEY SILT, dark brown, soft, medium to high plasticity	FILL MAT'L or TOP SOIL	1	2	3	4	
	2	SPT			1	2	2	5	
	3	SPT			1	2	2	3	
	4	SPT			1	1	2	4	
	5	SPT			1	1	2	5	
		UDS							
	6	SPT			1	2	3	6	
	7	SPT			1	1	3	5	
2 Oct.	8	SPT	SANDY SILT, tuffaceous, yellowish brown mottled grey, soft, low to medium plasticity.	SILTY TUFF	1	2	2	4	
	9								
	10								
	11								
	12								
	13								
	14								
	15								

N Graph: 10 20 30 40 50

HAND AUGER LOG

Borehole No. : HB-3

Project	: FMIPA IKIP Development	Date started	: 3 October 1998
Location	: IKIP Bandung	Date finished	: 3 October 1998
Northing	: 819.050	Bor master	: Hendra
Easting	: 1.169.063	Logged by	: Tahal
Elevation	: +93.60 m	Total depth	: 8.00 m
GWL	: -	Borehole diameter	: 76 mm

Date	Depth (m)	Test	Description	Litology Unit	Standard Penetration Test: No. of blows 15 cm			value N	N Graph
3 Oct. 1998	1	SPT	CLAYEY SILT, dark brown, soft, medium to high plasticity	FILL MAT'L or TOP SOIL	2	2	3	5	
	2	SPT			1	2	3	5	
	3	SPT			1	2	2	4	
	4	SPT			1	1	2	3	
	5	SPT	SANDY SILT, tuffaceous, yellowish brown mottled grey, soft, low to medium plasticity.	SILTY TUFF	2	2	2	4	
	6	SPT			2	2	3	5	
	7	SPT			1	2	2	4	
	8	UDS SPT			1	2	2	4	
	9								
	10								
	11								
	12								
	13								
	14								
	15								

N Graph scale: 10 20 30 40 50

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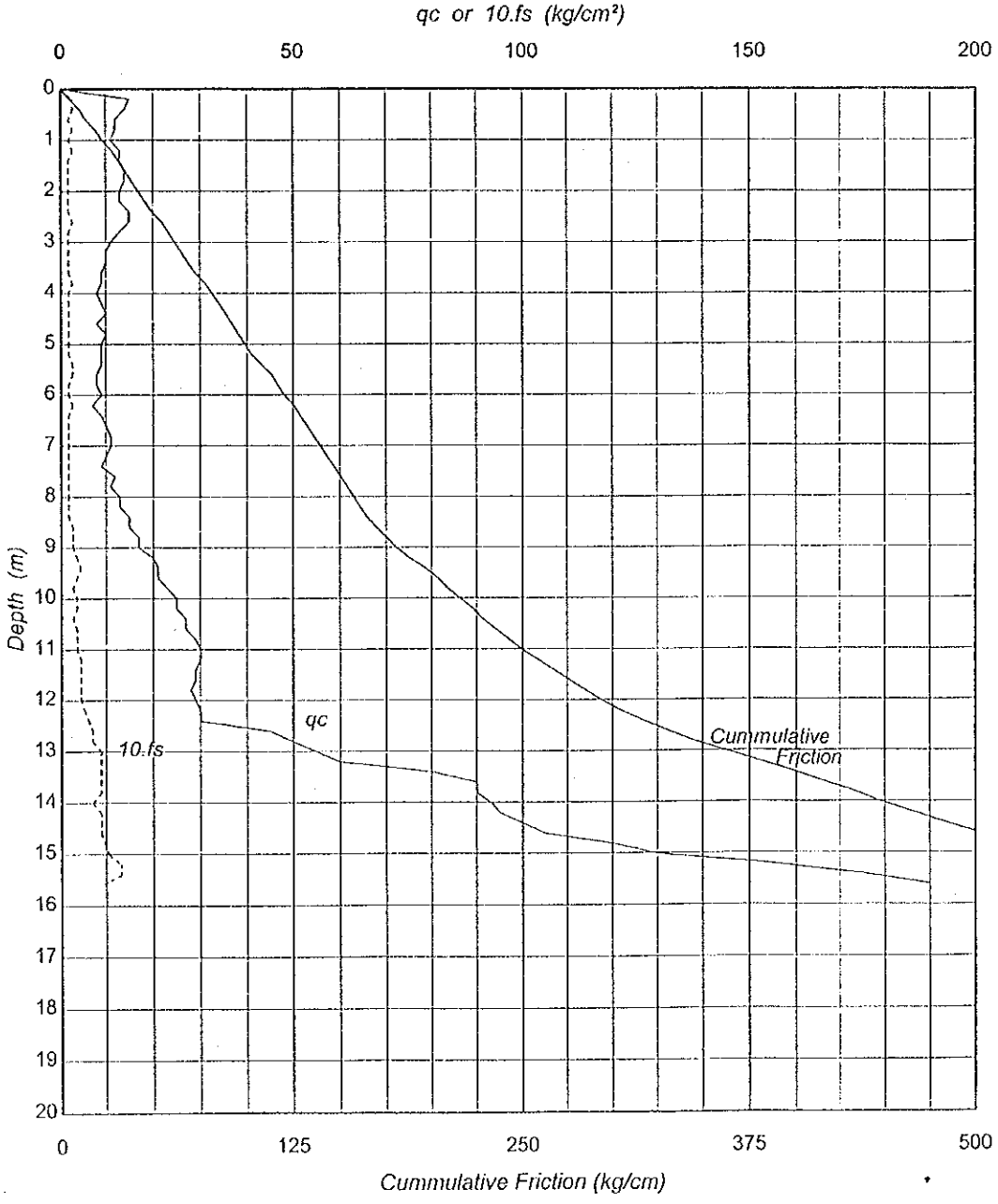
APPENDIX 4

DUTCH CONE PENETRATION TEST GRAPHS

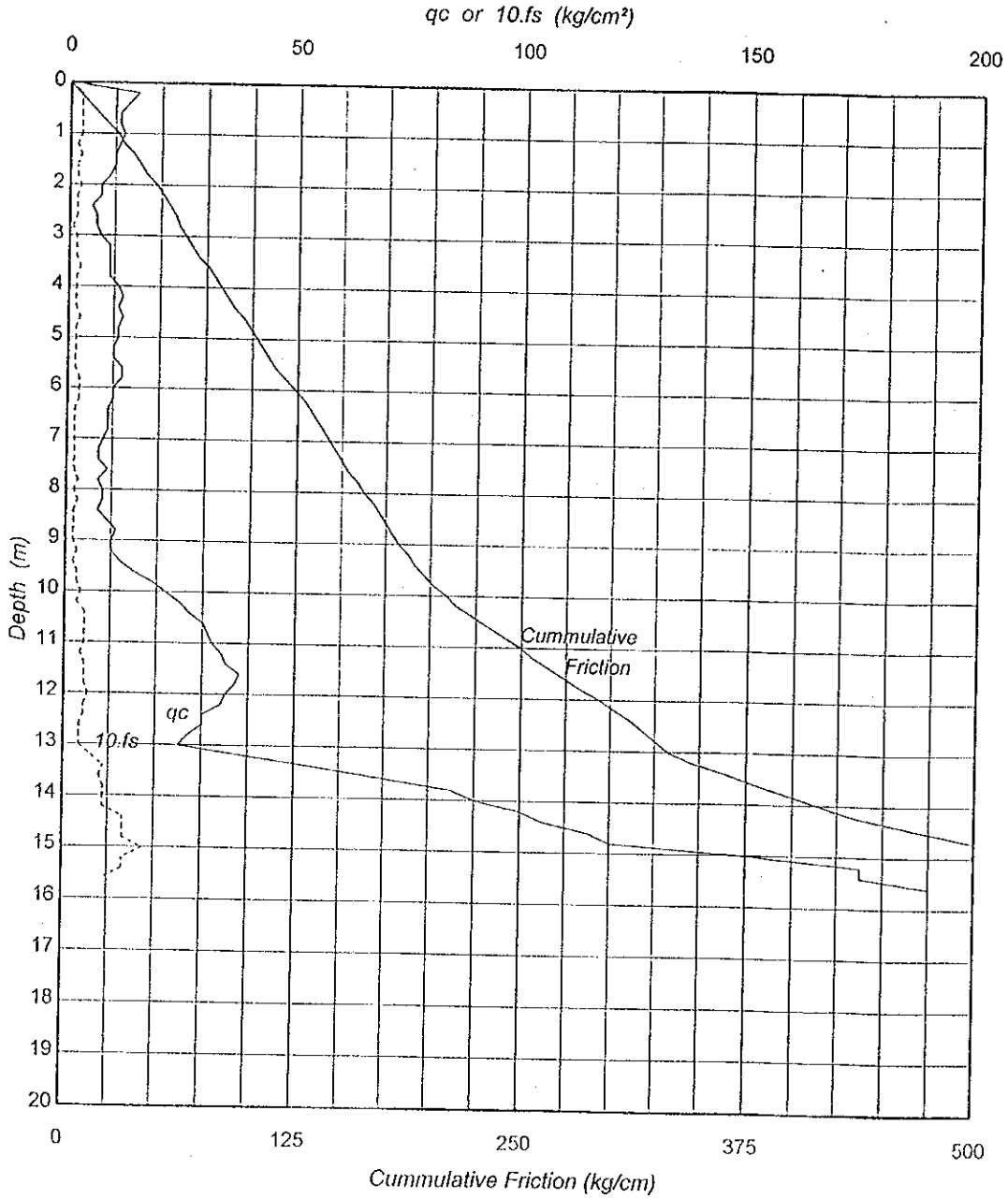
DUTCH CONE PENETRATION TEST

Project	: FMIPA IKIP Development	Date	: Okt '98
Test No.	: SD-1	Tested by	: Herman
Location	: IKIP Bandung	North	: 909.050
Elevation	: +94.25	East	: 1144.063



DUTCH CONE PENETRATION TEST

Project	: FMIPA IKIP Development	Date	: Okt '98
Test No.	: SD-2	Tested by	: Herman
Location	: IKIP Bandung	North	: 879.050
Elevation	: +93.90	East	: 1119.063



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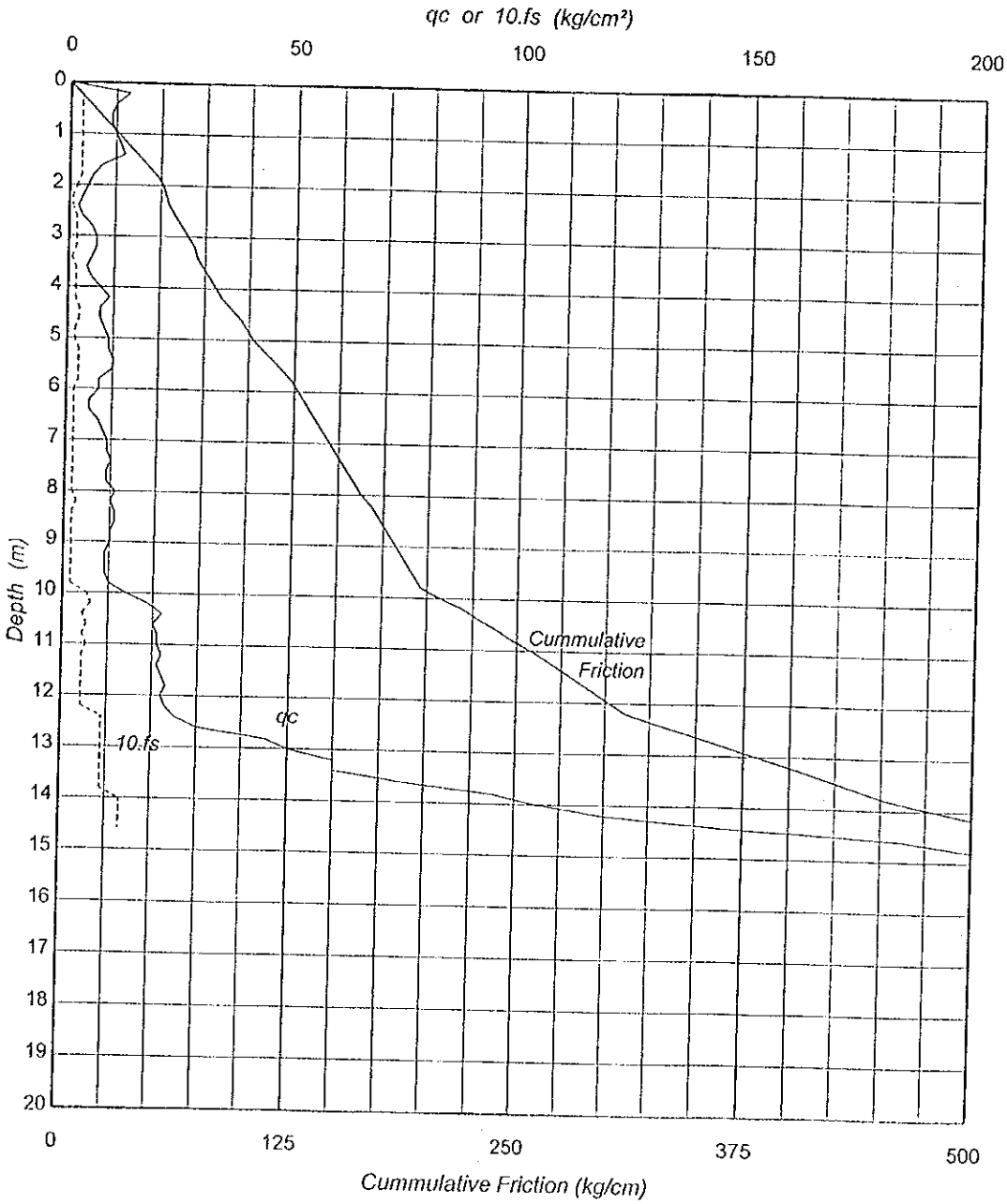
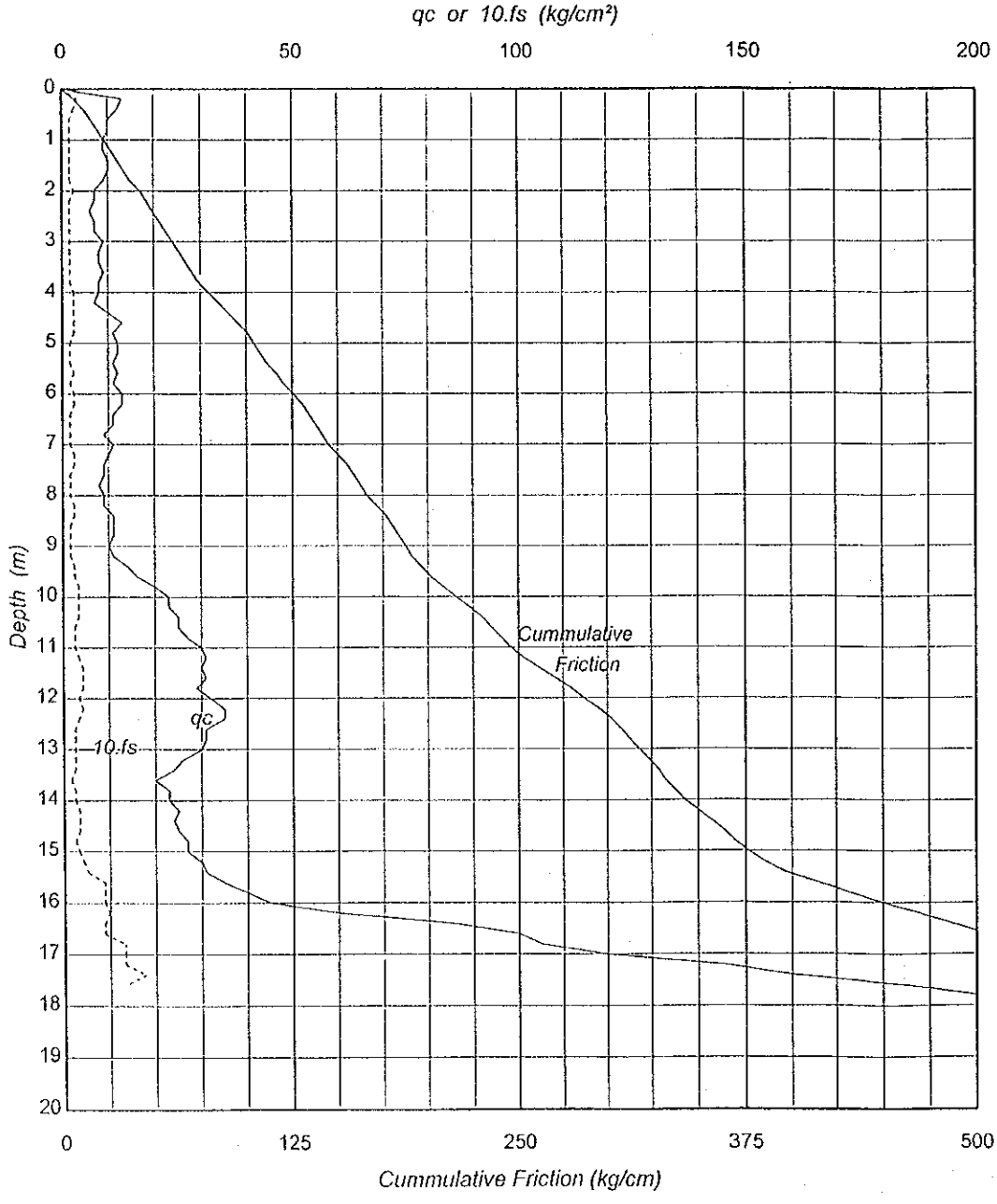
DUTCH CONE PENETRATION TEST

Project	: FMIPA IKIP Development	Date	: Okt '98
Test No.	: SD-3	Tested by	: Herman
Location	: IKIP Bandung	North	: 879.050
Elevation	: + 94.11 m	East	: 1169.063



DUTCH CONE PENETRATION TEST

Project	: FMIPA IKIP Development	Date	: Okt '98
Test No.	: SD-4	Tested by	: Herman
Location	: IKIP Bandung	North	: 849.050
Elevation	: +93.70	East	: 1144.063



APPENDIX 5

RESULTS OF LABORATORY TEST

WATER CONTENT DETERMINATIONS

PROJECT : DEPLOPMENT IKIP BANDUNG .
LOCATION : IKIP BANDUNG.

D A T E : 06 - 10 - 1998
TESTED BY : TRIADI CS.
CHECKED B : SUDIRMAN.

SAMPLE NUMBER / DEPTH.	BH.1 2.00 - 2.50 M.		BH.1 7.00 - 7.50 M.		BH.1 8.00 - 8.50 M	
CONTAINER NO.	82	96	22	67	32	295
WT TARE+SAMPLE WET (g)	44.10	45.60	40.69	44.00	43.23	39.57
WT TARE+SAMPLE DRY (g)	32.30	33.41	28.37	30.58	29.80	27.59
WT OF WATER	11.80	12.19	12.32	13.42	13.43	11.98
T A R E (g)	9.99	10.12	9.56	10.23	10.33	10.17
WT DRY SOIL (g)	22.31	23.29	18.81	20.35	19.47	17.42
WATER CONTENT (%)	52.89	52.34	65.50	65.95	68.98	68.77
AVERAGE MOIST.CONT.(%)		52.62		65.72		68.87

SAMPLE NUMBER / DEPTH.	BH.2 3.00 - 3.50 M.		BH.2 6.00 - 6.50 M.		BH.2 9.00 - 9.50 M.	
CONTAINER NO.	35	42	68	79	99	44
WT TARE+SAMPLE WET (g)	38.79	38.97	42.73	57.57	36.71	29.34
WT TARE+SAMPLE DRY (g)	26.53	26.74	30.46	39.99	27.75	23.08
WT OF WATER	12.26	12.23	12.27	17.58	8.96	6.26
T A R E (g)	10.10	10.28	10.34	10.29	10.52	11.16
WT DRY SOIL (g)	16.43	16.46	20.12	29.70	17.23	11.92
WATER CONTENT (%)	74.62	74.30	60.98	59.19	52.00	52.52
AVERAGE MOIST.CONT.(%)		74.46		60.09		52.26

WATER CONTENT DETERMINATIONS

PROJECT : DEPLOPMENT IKIP BANDUNG .
LOCATION : IKIP BANDUNG.

D A T E : 28 - 09 - 1998
TESTED BY : TRIADI CS.
CHECKED B : SUDIRMAN.

SAMPLE NUMBER DEPTH.	BH.3 3.00 - 3.50 M.		BH.3 6.00 - 6.50 M.		BH.3 9.00 - 9.50 M	
CONTAINER NO.	59	51	299	37	35	106
WT TARE+SAMPLE WET (g)	29.05	30.20	32.49	29.48	29.05	38.70
WT TARE+SAMPLE DRY (g)	21.49	22.18	23.01	21.25	21.65	27.94
WT OF WATER	7.56	8.02	9.48	8.23	7.40	10.76
T A R E (g)	10.18	10.16	10.25	10.14	10.10	10.96
WT DRY SOIL (g)	11.31	12.02	12.76	11.11	11.55	16.98
WATER CONTENT (%)	66.84	66.72	74.29	74.08	64.07	63.37
AVERAGE MOIST.CONT.(%)		66.78		74.19		63.72

SAMPLE NUMBER DEPTH.	BH.4 2.00 - 2.50 M.		BH.4 5.00 - 5.50 M.		BH.4 10.00 - 10.50	
CONTAINER NO.	35	109	10	96	74	31
WT TARE+SAMPLE WET (g)	49.65	49.38	27.92	32.94	53.72	53.92
WT TARE+SAMPLE DRY (g)	33.30	32.82	19.57	22.10	36.30	36.05
WT OF WATER	16.35	16.56	8.35	10.84	17.42	17.87
T A R E (g)	10.85	9.99	10.54	10.12	10.09	9.27
WT DRY SOIL (g)	22.45	22.83	9.03	11.98	26.21	26.78
WATER CONTENT (%)	72.83	72.54	92.47	90.48	66.46	66.73
AVERAGE MOIST.CONT.(%)		72.68		91.48		66.60

WATER CONTENT DETERMINATIONS

PROJECT : DEPLOPMENT IKIP BANDUNG .
LOCATION : IKIP BANDUNG.

D A T E : 21 - 09 - 1998
TESTED BY : TRIADI CS.
CHECKED B : SUDIRMAN.

SAMPLE NUMBER DEPTH.	HB.1 3.00 - 3.50 M.		HB.2 5.00 - 5.50 M.		HB.3 7.00 - 7.50 M	
CONTAINER NO.	70	1	20	32	96	18
WT TARE+SAMPLE WET (g)	55.12	53.75	62.34	62.32	46.70	44.91
WT TARE+SAMPLE DRY (g)	34.90	34.00	41.80	41.85	32.25	31.20
WT OF WATER	20.22	19.75	20.54	20.47	14.45	13.71
T A R E (g)	10.00	9.68	10.38	10.60	10.12	10.13
WT DRY SOIL (g)	24.90	24.32	31.42	31.25	22.13	21.07
WATER CONTENT (%)	81.20	81.21	65.37	65.50	65.30	65.07
AVERAGE MOIST.CONT.(%)		81.21		65.44		65.18

UNIT WEIGHT TEST

PROJECT : DEPLOPMENT IKIP BANDUNG (JICA). TESTED BY : TRIADI I. CS.
D A T E : 06 - 10 - 1998 CHECKED BY : SUDIRMAN

HOLE NO. / DEPTH.		BH.1 2.00 - 2.50 M.		BH.1 7.00 - 7.50 M.		BH.1 8.00 - 8.50 M.	
DIAMETER OF SAMPLE.	*mm*	38.00	38.00	38.00	50.00	38.00	38.00
HEIGHT OF SAMPLE.	*mm*	76.00	76.00	76.00	20.00	76.00	76.00
AREA OF SAMPLE.	*Cm2*	11.34	11.34	11.34	19.63	11.34	11.34
VOLUME OF SAMPLE.	*Cm3*	86.15	86.15	86.15	39.25	86.15	86.15
WEIGHT OF SAMPLE.	*gr*	136.89	138.90	131.00	59.47	126.76	127.10
UNIT WEIGHT	*t/m3*	1.589	1.612	1.521	1.515	1.471	1.475
AVERAGE UNIT WEIGHT	*t/m3*		1.601		1.518		1.473

HOLE NO. / DEPTH.		BH.2 3.00 - 3.50 M.		BH.2 6.00 - 6.50 M.		BH.2 9.00 - 9.50 M.	
DIAMETER OF SAMPLE.	*mm*	38.00	50.00	38.00	38.00	38.00	38.00
HEIGHT OF SAMPLE.	*mm*	76.00	20.00	76.00	76.00	76.00	76.00
AREA OF SAMPLE.	*Cm2*	11.34	19.63	11.34	11.34	11.34	11.34
VOLUME OF SAMPLE.	*Cm3*	86.15	39.25	86.15	86.15	86.15	86.15
WEIGHT OF SAMPLE.	*gr*	127.80	57.34	137.41	148.96	133.77	137.83
UNIT WEIGHT	*t/m3*	1.483	1.461	1.595	1.729	1.553	1.600
AVERAGE UNIT WEIGHT	*t/m3*		1.472		1.662		1.576

UNIT WEIGHT TEST

PROJECT : DEPLOPMENT IKIP BANDUNG (JICA). TESTED BY : TRIADI I. CS.
D A T E : 26 - 09 - 1998 CHECKED BY : SUDIRMAN

HOLE NO. / DEPTH.		BH.3 8.00 - 8.50 M.		BH.3 6.00 - 6.50 M.		BH.3 9.00 - 9.50 M.	
DIAMETER OF SAMPLE.	*mm*	38.00	38.00	38.00	38.00	38.00	50.00
HEIGHT OF SAMPLE.	*mm*	76.00	76.00	76.00	76.00	76.00	20.00
AREA OF SAMPLE.	*Cm2*	11.34	11.34	11.34	11.34	11.34	19.63
VOLUME OF SAMPLE.	*Cm3*	86.15	86.15	86.15	86.15	86.15	39.25
WEIGHT OF SAMPLE.	*gr*	118.89	117.95	122.19	124.42	125.92	56.89
UNIT WEIGHT	*t/m3*	1.380	1.369	1.418	1.444	1.462	1.449
AVERAGE UNIT WEIGHT	*t/m3*		1.375		1.431		1.456

HOLE NO. / DEPTH.		BH.4 2.00 - 2.50 M.		BH.4 5.00 - 5.50 M.		BH.4 10.00 - 10.50 M.	
DIAMETER OF SAMPLE.	*mm*	38.00	38.00	50.00	50.00	38.00	38.00
HEIGHT OF SAMPLE.	*mm*	76.00	76.00	20.00	20.00	76.00	76.00
AREA OF SAMPLE.	*Cm2*	11.34	11.34	19.63	19.63	11.34	11.34
VOLUME OF SAMPLE.	*Cm3*	86.15	86.15	39.25	39.25	86.15	86.15
WEIGHT OF SAMPLE.	*gr*	127.22	132.21	51.08	51.29	127.95	129.03
UNIT WEIGHT	*t/m3*	1.477	1.536	1.301	1.307	1.485	1.498
AVERAGE UNIT WEIGHT	*t/m3*		1.506		1.304		1.491

UNIT WEIGHT TEST

PROJECT : DEPLOPMENT IKIP BANDUNG (JICA). TESTED BY : TRIADI I. CS.
D A T E : 13 - 10 - 1998 CHECKED BY : SUDIRMAN

HOLE NO. / DEPTH.		HB.1 3.00 - 3.50 M.		HB.2 5.00 - 5.50 M.		HB.3 7.00 - 7.50 M.	
DIAMETER OF SAMPLE.	*mm*	38.00	38.00	38.00	38.00	38.00	38.00
HEIGHT OF SAMPLE.	*mm*	76.00	76.00	76.00	76.00	76.00	76.00
AREA OF SAMPLE.	*Cm2*	11.34	11.34	11.34	11.34	11.34	11.34
VOLUME OF SAMPLE.	*Cm3*	86.15	86.15	86.15	86.15	86.15	86.15
WEIGHT OF SAMPLE.	*gr*	117.98	118.53	129.60	132.41	131.99	132.60
UNIT WEIGHT	*t/m3*	1.369	1.376	1.504	1.537	1.532	1.539
AVERAGE UNIT WEIGHT	*t/m3*	1.373		1.521		1.536	

SPECIFIC GRAVITY TEST

PROJECT : DEPLOPMENT IKIP BANDUNG .
LOCATION : IKIP BANDUNG.

D A T E : 06 - 10 - 1996
TESTED BY : TRIADI CS.
CHECKED BY : SUDIRMAN.

SAMPLE NUMBER	BH.1		BH.1		BH.1	
DEPTH	2.00 - 2.50 M.		7.00 - 7.50 M.		8.00 - 8.50 M.	
PICN. NO.	C	E	K	H	42	45
WT OF PICN.+ SAMPLE W1	38.49	41.01	42.67	41.30	26.01	24.78
WT OF PICN. W2	32.47	34.86	36.42	35.20	19.77	18.89
WT OF SAMPLE WT=W1-W2	6.02	6.15	6.25	6.10	6.24	5.89
WT OF PICN.+ WATER						
TEMP. T1 DEG.C						
WT PICN+WATER+SAMPLE W3	129.85	136.36	134.10	134.18	73.29	72.80
TEMP. TX DEG C	26.50	26.50	26.50	26.50	26.30	26.30
WT OF PICN.+WATER TX DEG.C	126.13	132.55	130.15	130.33	69.37	69.13
W5=W1-W2+W4	132.15	138.70	136.40	136.43	75.61	75.02
VOL. OF SAMPLE W5-W3	2.30	2.34	2.30	2.25	2.32	2.22
SPEC.GRAV WT/(W5-W3)	2.617	2.628	2.717	2.711	2.690	2.653
AVERAGE		2.623		2.714		2.671

SAMPLE NUMBER	BH.2		BH.2		BH.2	
DEPTH	3.00 - 3.50 M.		5.00 - 5.50 M.		10.00 - 10.50 M.	
PICN. NO.	27	11	32	45	D	E
WT OF PICN.+ SAMPLE W1	25.88	24.83	25.02	24.78	51.39	40.19
WT OF PICN. W2	19.30	19.24	19.32	18.86	46.19	34.86
WT OF SAMPLE WT=W1-W2	6.58	5.59	5.70	5.92	5.20	5.33
WT OF PICN.+ WATER						
TEMP. T1 DEG.C						
WT PICN+WATER+SAMPLE W3	73.59	72.63	73.17	72.79	143.37	135.92
TEMP. TX DEG C	26.30	26.30	26.50	26.50	26.40	26.40
WT OF PICN.+WATER TX DEG.C	69.47	69.14	69.60	69.08	140.09	132.55
W5=W1-W2+W4	76.05	74.73	75.30	75.00	145.29	137.88
VOL. OF SAMPLE W5-W3	2.46	2.10	2.13	2.21	1.92	1.96
SPEC.GRAV WT/(W5-W3)	2.675	2.662	2.676	2.679	2.708	2.719
AVERAGE		2.668		2.677		2.714

SPECIFIC GRAVITY TEST

PROJECT : DEPLOPMENT IKIP BANDUNG.
LOCATION : IKIP BANDUNG.

DATE : 28 - 09 - 1998
TESTED BY : TRIADI CS.
CHECKED BY : SUDIRMAN.

SAMPLE NUMBER	BH.3		BH.3		BH.3	
DEPTH.	3.00 - 3.50 M.		6.00 - 6.50 M.		9.00 - 9.50 M.	
PICN. NO.	H	K	45	T	2	29
WT OF PICN. + SAMPLE W1	40.17	41.52	26.73	32.85	26.62	31.25
WT OF PICN. W2	35.20	36.42	19.91	25.73	20.05	24.51
WT OF SAMPLE WT=W1-W2	4.97	5.10	6.82	7.12	6.57	6.74
WT OF PICN. + WATER						
TEMP. T1 DEG.C						
WT PICN+WATER+SAMPLE W3	133.41	133.31	73.54	81.67	73.78	77.96
TEMP. TX DEG C	27.30	27.30	26.30	26.30	26.60	26.60
WT OF PICN. +WATER TX DEG.C	130.33	130.15	69.29	77.23	69.70	73.77
W5=W1-W2+W4	135.30	135.25	76.11	84.35	76.27	80.61
VOL. OF SAMPLE W5-W3	1.89	1.94	2.57	2.68	2.49	2.55
SPEC.GRAV WT/(W5-W3)	2.630	2.629	2.654	2.659	2.639	2.643
AVERAGE		2.629		2.656		2.641

SAMPLE NUMBER	BH.4		BH.4		BH.4	
DEPTH.	2.00 - 2.50 M.		5.00 - 5.50 M.		10.00 - 10.50 M.	
PICN. NO.	40	45	H	45	E	I
WT OF PICN. + SAMPLE W1	23.20	22.57	40.44	24.29	39.84	40.31
WT OF PICN. W2	19.46	18.86	35.20	18.86	34.86	35.30
WT OF SAMPLE WT=W1-W2	3.74	3.71	5.24	5.43	4.98	5.01
WT OF PICN. + WATER						
TEMP. T1 DEG.C						
WT PICN+WATER+SAMPLE W3	72.22	71.38	133.57	72.43	135.63	133.43
TEMP. TX DEG C	25.80	25.80	26.70	26.70	26.20	26.20
WT OF PICN. +WATER TX DEG.C	69.90	69.08	130.33	69.08	132.55	130.33
W5=W1-W2+W4	73.64	72.79	135.57	74.51	137.53	135.34
VOL. OF SAMPLE W5-W3	1.42	1.41	2.00	2.08	1.90	1.91
SPEC.GRAV WT/(W5-W3)	2.634	2.631	2.620	2.611	2.621	2.623
AVERAGE		2.633		2.615		2.622

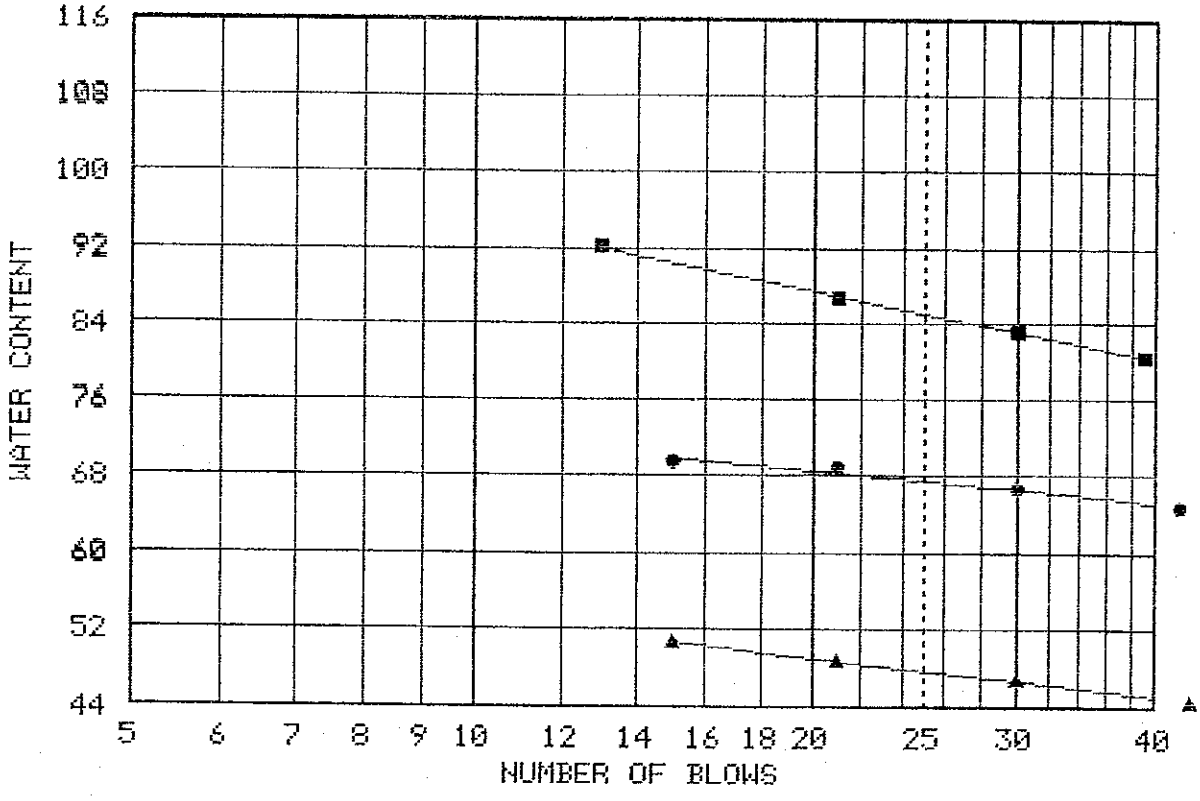
SPECIFIC GRAVITY TEST

PROJECT : DEPLOPMENT IKIP BANDUNG .
LOCATION : IKIP BANDUNG.

DATE : 13 - 10 - 1998
TESTED BY : TRIADI CS.
CHECKED BY : SUDIRMAN.

SAMPLE NUMBER	HB.1		HB.2		HB.3	
DEPTH.	3.00 - 3.50 M.		5.00 - 5.50 M.		7.00 - 7.50 M.	
PICN. NO.	J	I	K	T	C	E
WT OF PICN.+ SAMPLE W1	40.69	39.99	38.81	29.30	37.06	39.45
WT OF PICN. W2	35.92	35.30	34.88	25.40	32.47	34.86
WT OF SAMPLE WT=W1-W2	4.77	4.69	3.93	3.90	4.59	4.59
WT OF PICN.+ WATER						
TEMP. T1 DEG.C						
WT PICN+WATER+SAMPLE W3	134.93	133.22	132.58	79.50	128.98	135.39
TEMP. TX DEG C	26.00	26.00	26.10	26.10	26.20	26.20
WT OF PICN.+WATER TX DEG.C	131.99	130.33	130.15	77.09	126.13	132.55
W5=W1-W2+W4	136.76	135.02	134.08	80.99	130.72	137.14
VOL. OF SAMPLE W5-W3	1.83	1.80	1.50	1.49	1.74	1.75
SPEC.GRAV WT/(W5-W3)	2.607	2.606	2.620	2.617	2.638	2.623
AVERAGE		2.606		2.619		2.630

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	BH.1 DEPTH: 2.00 - 2.50 M YELLOWISH BROWN. ELASTIC SILT.	68	42	26	90.50	MH	A-7-5(31)
▲	BH.1 DEPTH: 7.00 - 7.50 M GREYISH BROWN. SANDY SILT WITH GRAVEL.	48	44	4	52.10	ML	A-5(1)
■	BH.1 DEPTH: 0.00 - 0.50 M LIGHT BROWN. ELASTIC SILT.	85	49	36	91.10	MH	A-7-5(44)

Project No.: JICA.09/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)

Client:
Location: BH.1

Date: 06 - 10 - 1998

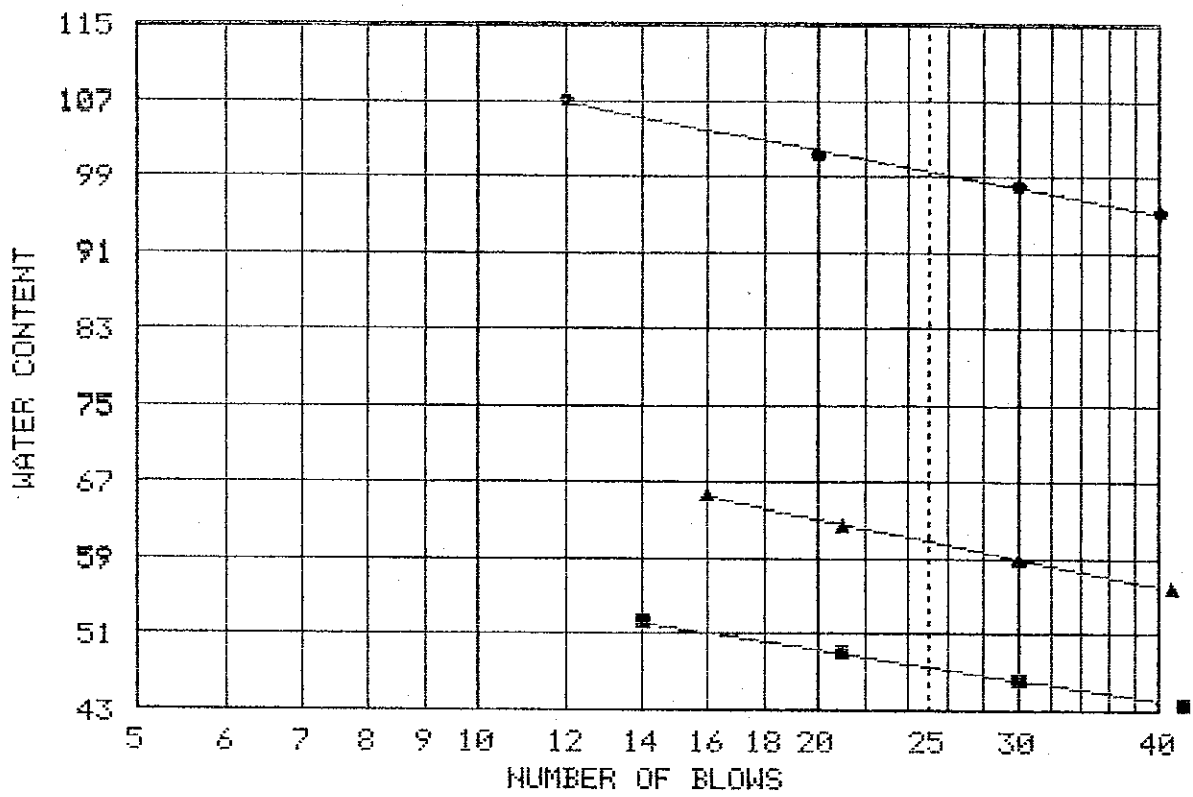
LIQUID AND PLASTIC LIMITS TEST REPORT

PT KONAS TUNNGAL, JLN GAJAHLUMANTUNG 7, BANDUNG

Remarks:
TESTED BY : SUDIONO.
: BEN'S.
CHECKED BY : SUDIRMAN.

Fig. No.

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	BH.2 DEPTH: 3.00 - 3.50 M LIGHT BROWN. ELASTIC SILT.	100	67	33	90.70	MH	A-7-5(45)
▲	BH.2 DEPTH: 6.00 - 6.50 M BROWN. ELASTIC SILT.	61	35	26	87.10	MH	A-7-5(27)
■	BH.2 DEPTH: 9.00 - 9.50 M LIGHT BROWN. SANDY LEAN CLAY.	48	26	22	69.10	CL	A-7-6(15)

Project No.: JICA.09/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)

Client:
Location: BH.2

Date: 06 - 10 - 1998

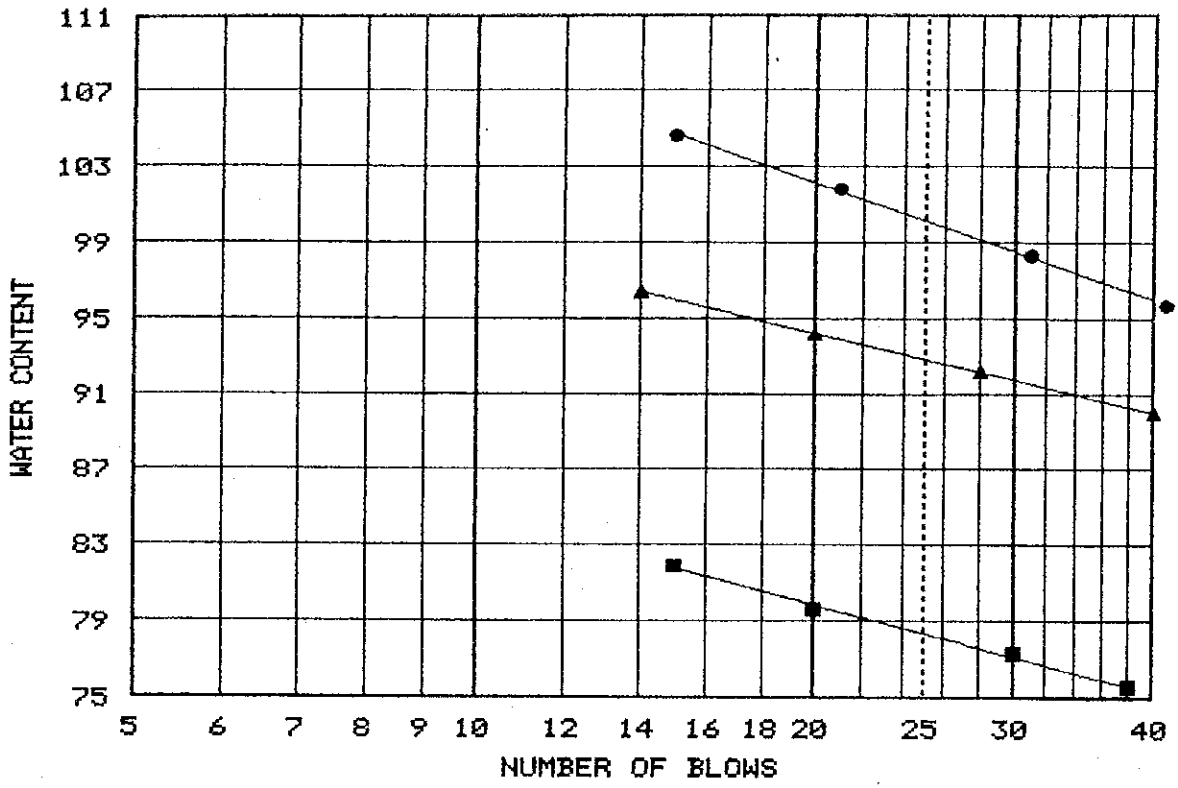
LIQUID AND PLASTIC LIMITS TEST REPORT

PT KONAS TUNNGAL, JLN GAJAHLUMANTUNG 7, BANDUNG

Remarks:
TESTED BY : BEN'S.
: ASEP.
: DEDI.
CHECKED BY : SUDIRMAN.

Fig. No.

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	BH.3 DEPTH: 3.00 - 3.50 M DARK BROWN. ELASTIC SILT.	100	57	43	96.80	MH	A-7-5(58)
▲	BH.3 DEPTH: 6.00 - 6.50 M BROWN, ELASTIC SILT	93	66	27	93.5	MH	A-7-5(41)
■	BH.3 DEPTH: 9.00 - 9.50 M BROWN, ELASTIC SILT	78	44	34	96.5	MH	A-7-5(44)

Project No.: JICA.09/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)

Client:
Location: BH.3

Date: 29 - 09 - 1998

LIQUID AND PLASTIC LIMITS TEST REPORT

PT KONAS TUNNGAL, JLN GAJAHLUMANTUNG 7, BANDUNG

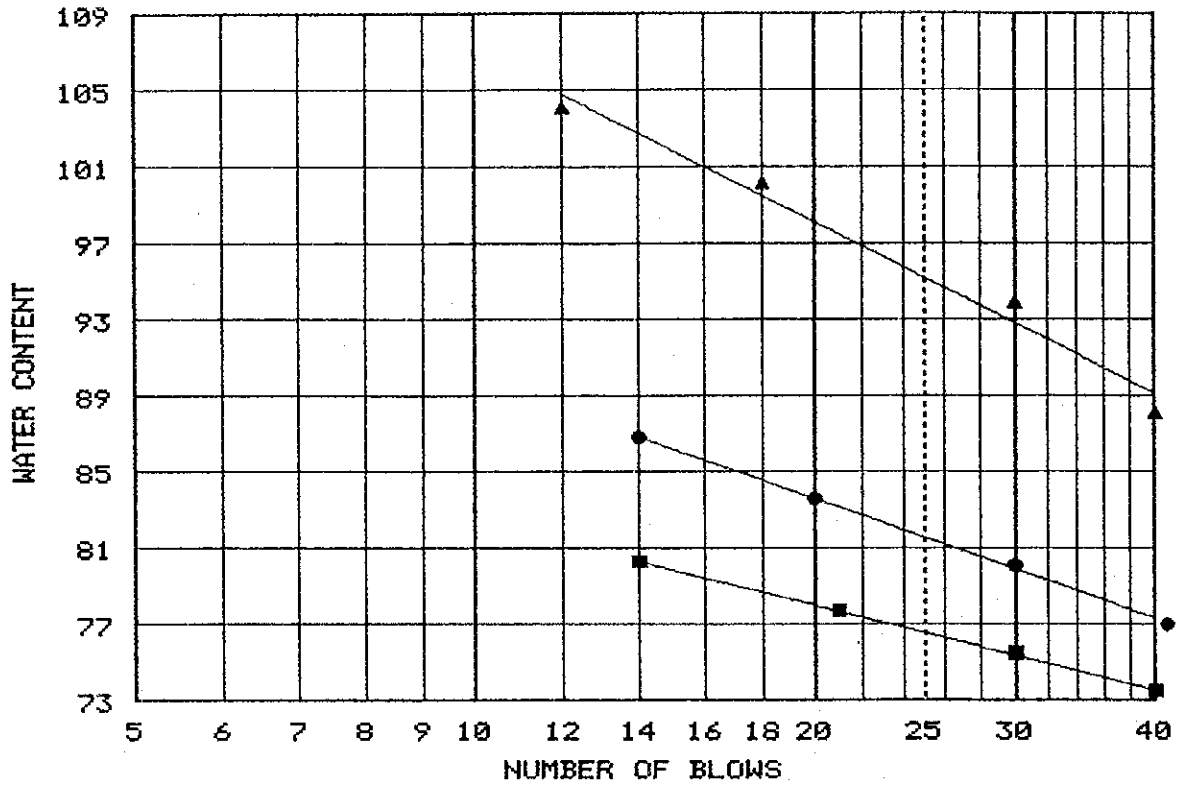
Remarks:

TESTED BY : I W A N.
: A L A N

CHECKED BY : SUDIRMAN.

Fig. No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	BH.4 DEPTH: 2.00 - 2.50 M DARK BROWN. ELASTIC SILT.	82	66	16	92.40	MH	A-7-5(28)
▲	BH.4 DEPTH: 5.00 - 5.50 M BROWN. ELASTIC SILT.	95	54	41	95.50	MH	A-7-5(55)
■	BH.4 DEPTH: 10.00-10.50 M GREYISH BROWN. SANDY ELASTIC SILT	77	49	28	68.9	MH	A-7-5(23)

Project No.: JICA.09/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)

Client:
Location: BH.4

Date: 29 - 09 - 1998

LIQUID AND PLASTIC LIMITS TEST REPORT

PT KONAS TUNNGAL, JLN GAJAHLUMANTUNG 7, BANDUNG

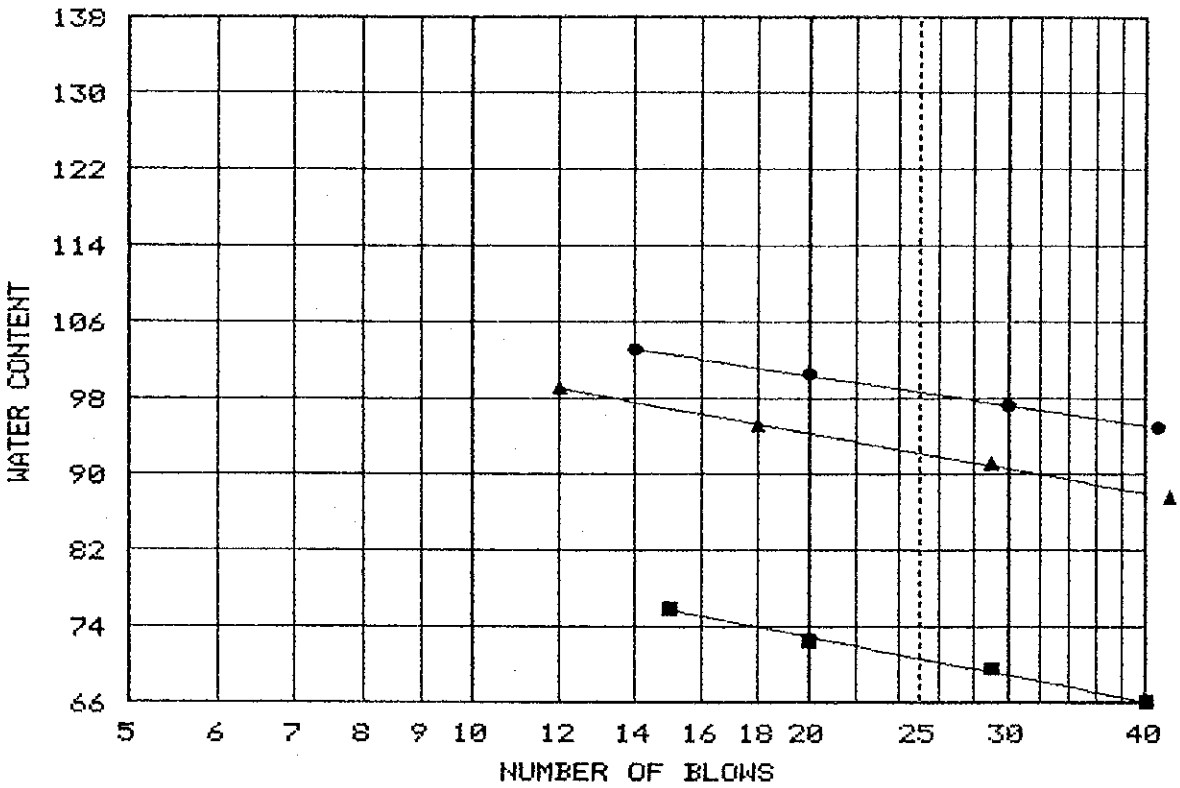
Remarks:

TESTED BY : Y U D I.
: A D E RS.
: A M I R.

CHECKED BY : SUDIRMAN.

Fig. No._____

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	USCS	AASHTO
●	HB.1 DEPTH: 3.00 - 3.50 M DARK BROWN. ELASTIC SILT.	99	63	36	91.40	MH	A-7-5(47)
▲	HB.2 DEPTH: 5.00 - 5.50 M BROWN. ELASTIC SILT.	92	51	41	95.90	MH	A-7-5(53)
■	HB.3 DEPTH: 7.00 - 7.50 M BROWN. ELASTIC SILT.	71	38	33	95.40	MH	A-7-5(40)

Project No.: JICA.10/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)

Client:
Location: HB.

Date: 10 - 10 - 1998

LIQUID AND PLASTIC LIMITS TEST REPORT

PT KONAS TUNNGAL, JLN GAJAHLUMANTUNG 7, BANDUNG

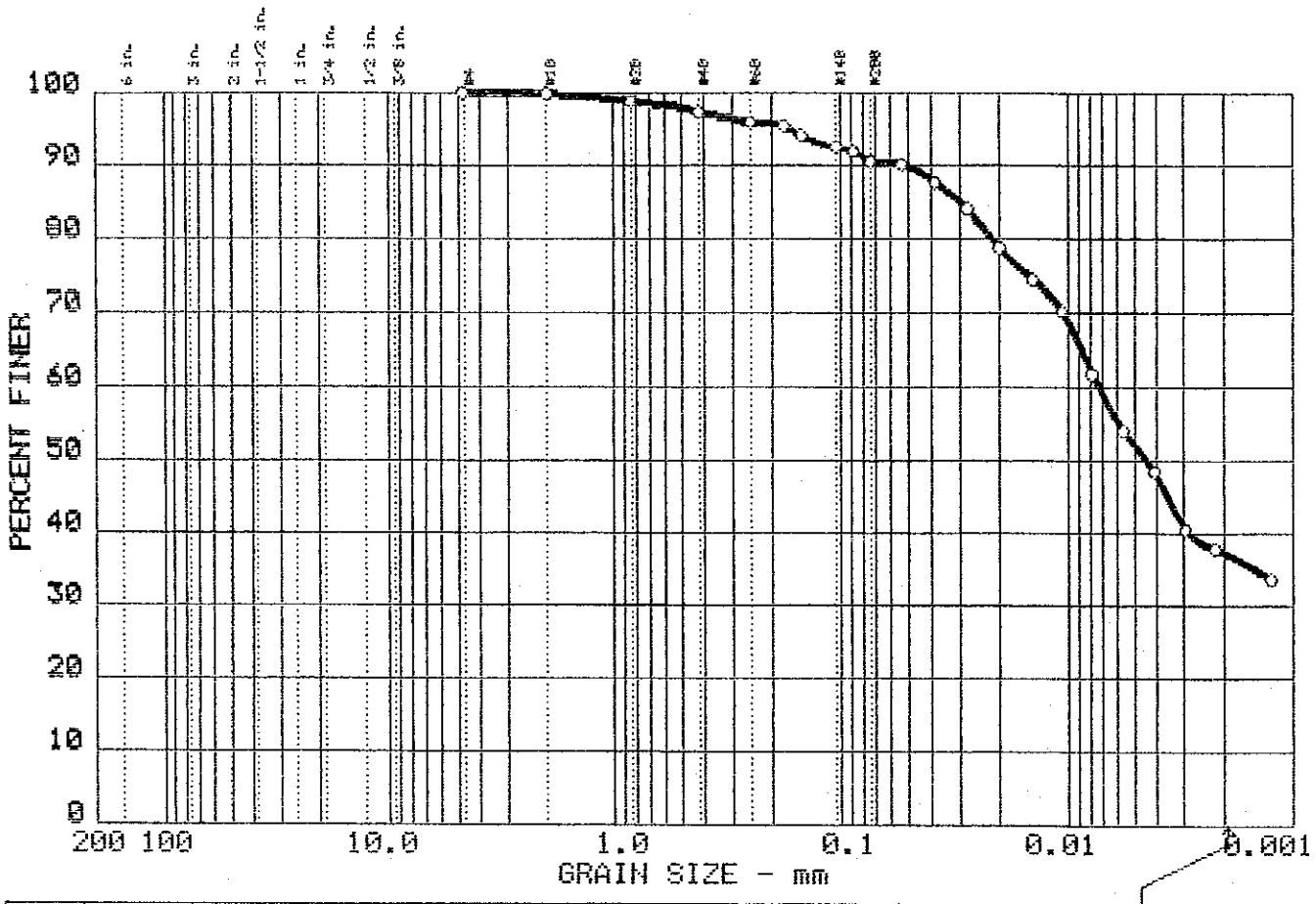
Remarks:

TESTED BY : MIRUL.
: YUDI
: IWAN.

CHECKED BY : SUDIRMAN.

Fig. No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	16	0.0	0.0	9.5	53.2	37.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	68.00	26.00			0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
○ GREYISH BROWN / ELASTIC SILT.	MH	A-7-5(31.2)

Project No.: JICA.10/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)
○ Location: BH.1 DEPTH : 2.00 - 2.50 m

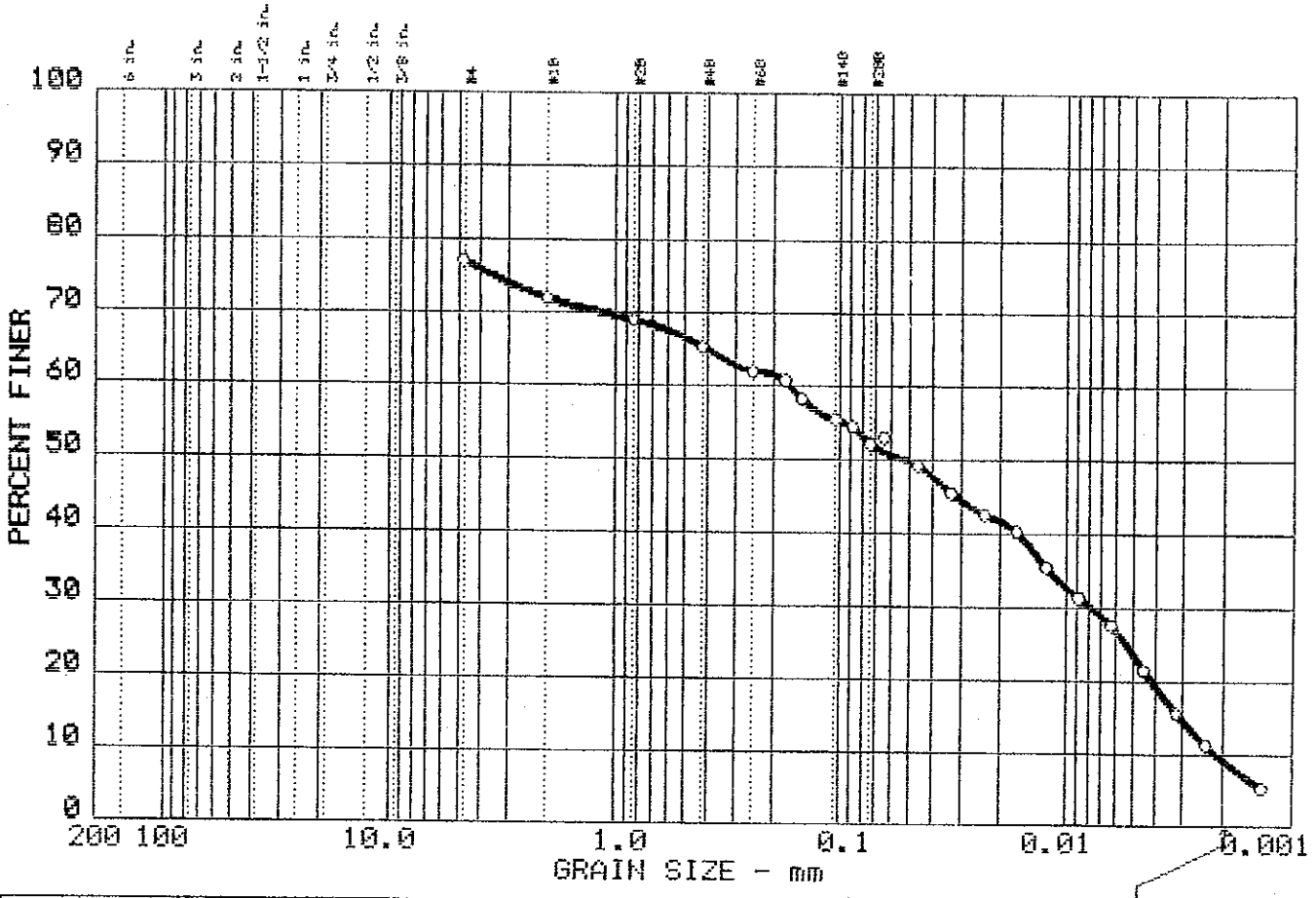
Date: 05 - 10 - 1998

Remarks:
TESTED BY : SUDIONO.
CHECKED BY : SUDIRMAN.

GRAIN SIZE DISTRIBUTION TEST REPORT
PT KONAS TUNGGAL SOIL LABORATORY

Figure No.____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	17	0.0	22.9	25.0	42.9	9.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	48.00	4.00	4.76	0.17	0.05	0.008	0.0031	0.0021	0.16	78.5

MATERIAL DESCRIPTION	USCS	AASHTO
○ GREYISH BROWN / SANDY SILT WITH GRAVEL.	ML.	A-5(1.9)

Project No.: JICA.10/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)
○ Location: BH.1 DEPTH : 7.00 - 7.50 m

Date: 05 - 10 - 1998

GRAIN SIZE DISTRIBUTION TEST REPORT

PT KONAS TUNGGAL SOIL LABORATORY

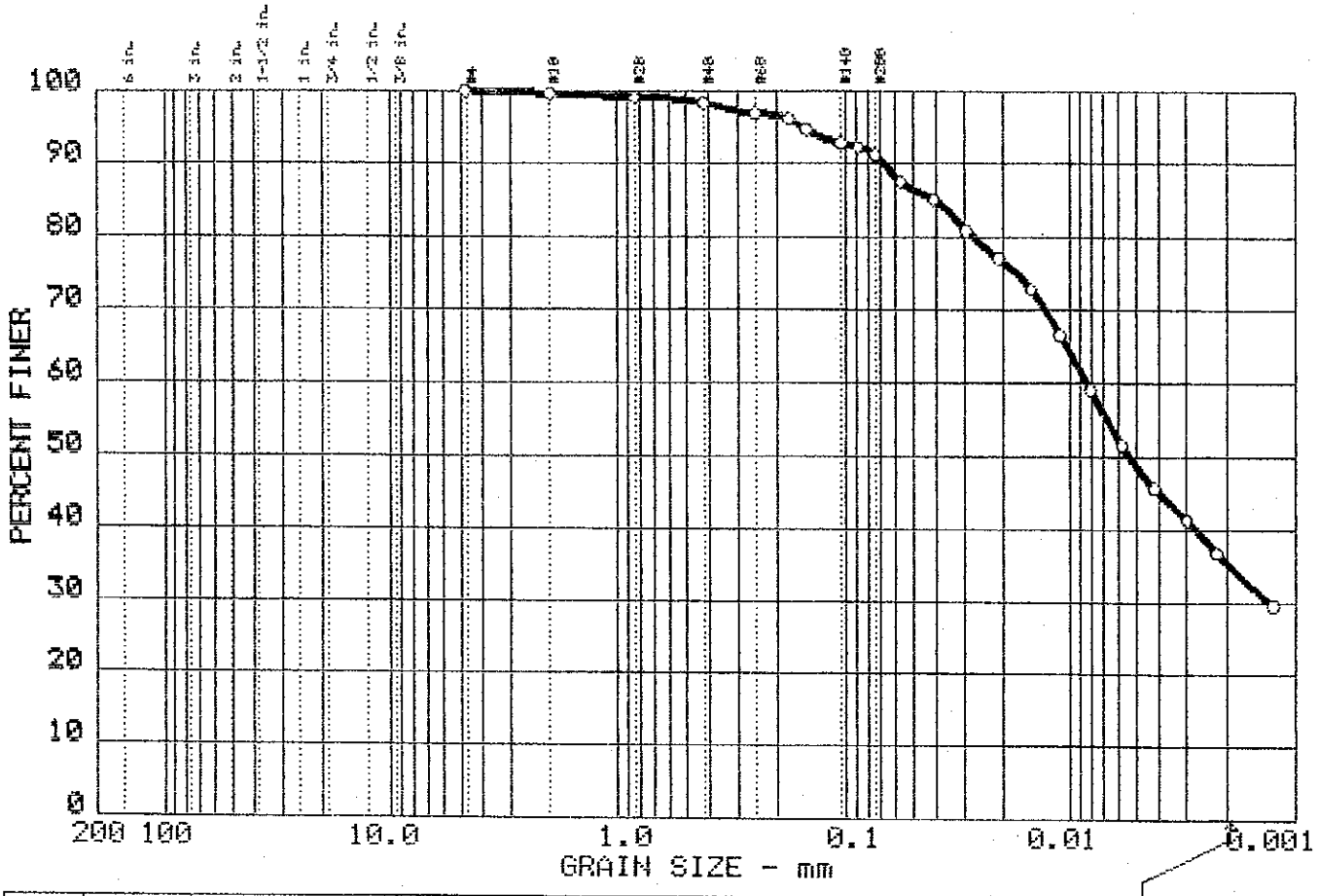
Remarks:

TESTED BY : SUDIONO.

CHECKED BY : SUDIRMAN.

Figure No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	18	0.0	0.0	8.9	55.7	35.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	85.00	36.00			0.01	0.001				

MATERIAL DESCRIPTION	USCS	AASHTO
○ LIGHT BROWN / ELASTIC SILT.	MH.	A-7-5(43.6)

Project No.: JICA.10/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)
○ Location: BH.1 DEPTH : 8.00 - 8.50 m

Date: 05 - 10 - 1998

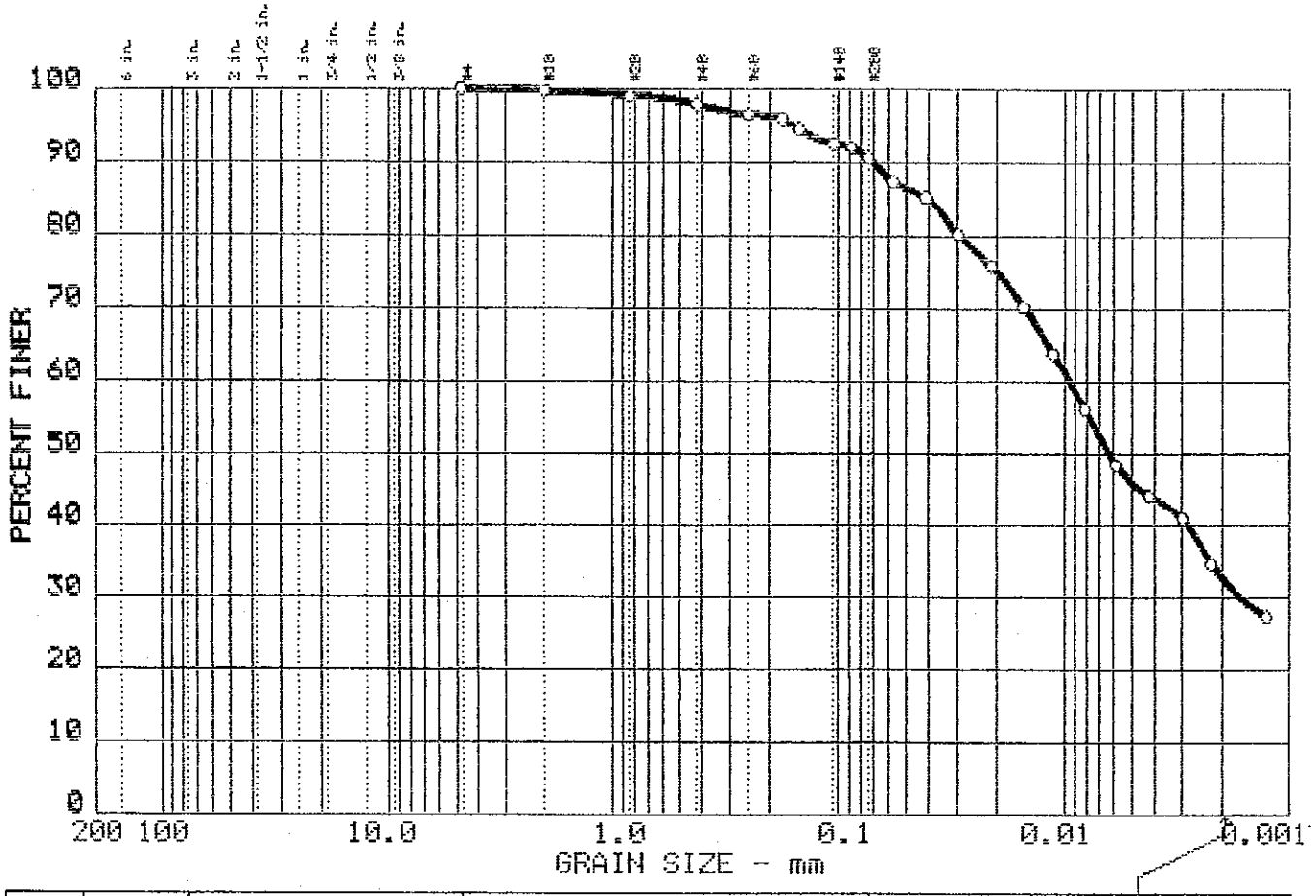
Remarks:
TESTED BY : BEN'S.
CHECKED BY : SUDIRMAN.

GRAIN SIZE DISTRIBUTION TEST REPORT

PT KONAS TUNGGAL SOIL LABORATORY

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	19	0.0	0.0	9.3	58.0	32.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	100.0	33.00			0.01	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
o LIGHT BROWN / ELASTIC SILT.	MH.	A-7-5(45.5)

Project No.: JICA.10/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)
o Location: BH.2 DEPTH : 3.00 - 3.50 m

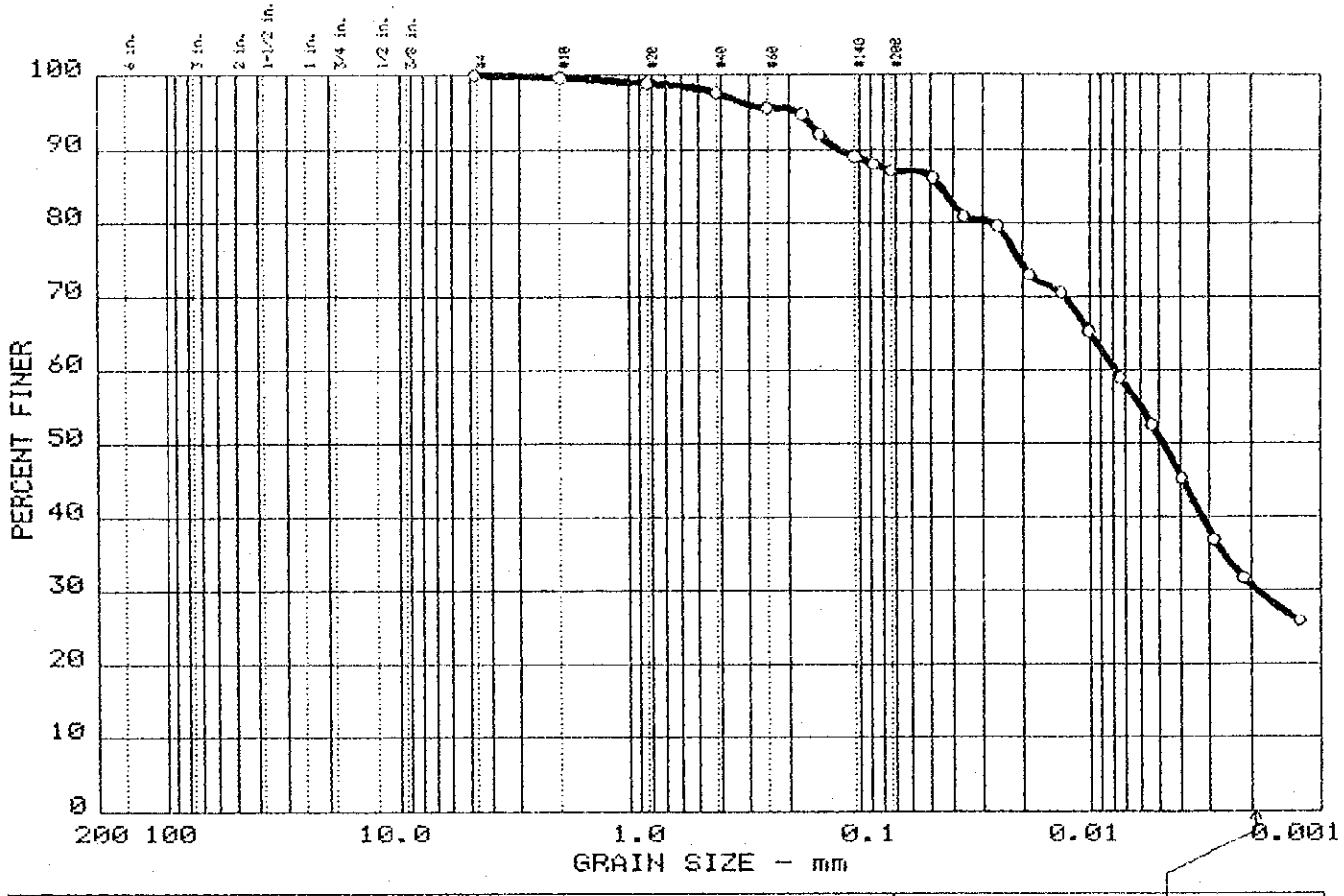
Date: 05 - 10 - 1998

Remarks:
TESTED BY : BEN'S.
CHECKED BY : SUDIRMAN.

GRAIN SIZE DISTRIBUTION TEST REPORT
PT KONAS TUNGGAL SOIL LABORATORY

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
○	20	0.0	0.0	12.9	56.4	30.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	61.00	26.00			0.00	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN / ELASTIC SILT.	MH.	A-7-5(27.4)

Project No.: JICA.10/98
Project: DEPLOPMENT IKIP BANDUNG (JICA)
○ Location: BH.2 DEPTH : 6.00 - 6.50 m

Date: 05 - 10 - 1998

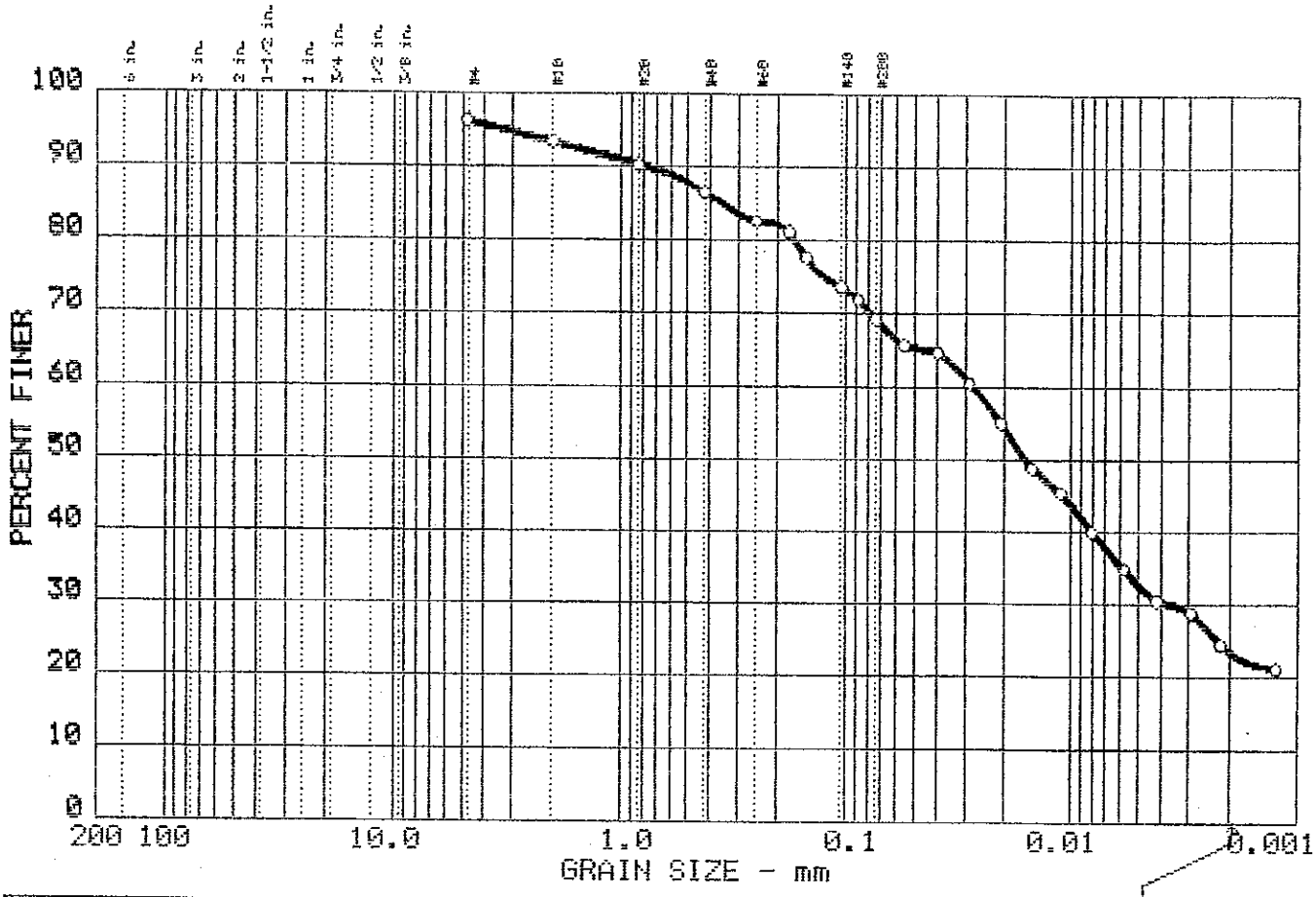
Remarks:
TESTED BY : ASEP.
CHECKED BY : SUDIRMAN.

GRAIN SIZE DISTRIBUTION TEST REPORT

PT KONAS TUNGGAL SOIL LABORATORY

Figure No._____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	1	0.0	3.7	27.2	45.8	23.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	48.00	22.00	0.35		0.02	0.004				

MATERIAL DESCRIPTION	USCS	AASHTO
o BROWN / ELASTIC SILT.	CL	A-7-6(14.6)

Project No.: JICA.10/98
Project: DEPLOPMENT IKIP BANDUNG (JICA).
o Location: BH.2 DEPTH : 9.00 - 9.50 M.

Date: 06 - 10 - 1998

Remarks:
TESTED BY : DEDY.
CHECKED BY : SUDIRMAN.

GRAIN SIZE DISTRIBUTION TEST REPORT

PT KONAS TUNGGAL SOIL LABORATORY

Figure No.