REPUBLIC OF INDONESIA
PERUSAHAAN UMUM LISTRIK NEGARA

CIPASANG HYDROELECTRIC POWER
DEVELOPMENT PROJECT

TECHNICAL SPECIFICATIONS FOR FIELD INVESTIGATION

August 1985

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO, JAPAN

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT

TECHNICAL SPECIFICATIONS

FOR

No. 1 TOPOGRAPHICAL SURVEY AND MAPPING

No. 2 CONSTRUCTION MATERAIL AND LABORATORY TEST

No. 3 GEOLOGICAL INVESTIGATION

No. 4 METEORO-HYDROLOGICAL SURVEY

AND

COPY OF TERMS OF REFERENCE FOR PRE-FEASIBILITY STUDY

SPEC. No. 1

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT

TECHNICAL SPECIFICATIONS

FOR

TOPOGRAPHICAL SURVEY AND MAPPING

CONTENTS

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT

TOPOGRAPHICAL SURVEY AND MAPPING

TECHNICAL SPECIFICATIONS

I. Scope of the Works

The following are maps and topographical data to be newly produced by this survey and mapping work in the Main Investigation Stage.

		Scale	Total area or length	Remarks
(i)	Maps	: 1/5,000	5.0 km^2	for the quarry site
(ii)	"	: 1/1,000	7.5 km^2	for the dam site
(iii)	Dam longitudinal section	: 1/500	1 km	for the dam axis
(iv)	Dam cross section	: 1/500	8 km	for 10 sections at the dam foundation
(v)	River cross section	: 1/200	4 km	for 20 sections at the tailrace outlet site.

Figs T-1 and T-2 show the areas of the maps and the locations of the river cross sections. The maps of 1/5,000 scale for the quarry are photogrammetric ones to be produced from the existing aerial photographs on 1/50,000 scale of BAKOSURTANAL. The Contractor shall execute the survey and mapping works to prepare the aforesaid maps and topographical data in accordance with the technical specifications prescribed in the following sections.

II. Technical Guidance and Supervision

All the Contractor's works including the following work items shall be carried out under the supervision and technical guidance of the Engineer, for the purposes of producing the maps and data with the accuracies specified in this technical specification on schedule.

(1) Work plan and schedule.
(2) Actual field and home works.
(3) Check of work results including maps newly produced and data prepared by the Contractor.

III. Ground Control Survey and Mapping

3.1 General

1) Area

The area to be mapped is to be approximately 5 km^2 in total as outline in Fig. T-2. The mapping area will however be fixed by the Engineering by the end of May 1986, but total mapping area of 5.0 km^2 not be changed. A quarry site will be selected at a place(s) of almost the same topographical conditions as shown on this map, through it has not been settled yet.

2) Outline of works

The works to be carried out are composed of ground control survey for aerial triangulation and mapping by photogrammetric methods.

3) Plan of survey

A plan with a time schedule of surveying shall be submitted to the Engineer by the Contractor before commencement of the works and be authorized by the Engineer.

4) Standard of mapping

Legends and marks of maps shall be fundamentally followed to those of Indonesia. Special legends and marks will be prepared for the maps of this project, if any.

5) Coordinate system

The coordinate system prescribed in Indonesia shall be applied to mapping. Furthermore, the coordinate of the Cipasang shall coincide with the coordinate of the Jatigede project.

3.2 Ground Control Survey

1) Existing basic control and closing

Survey routes to be carried out shall be closed and at least one existing basic control shall be contained in closed net.

2) Accuracy

Closing error of horizontal control shall not exceed $15'' \sqrt{N}$ (N ; the number of stations) for azimuth and 1:10,000 for coordinates.

Closing error of vertical control shall not exceed $30\ mm\sqrt{K}$ (K in kilometer) for frame routes and $50\ mm\sqrt{K}$ for supplemental routes.

3) Distrubution of control points

Horizontal control points for aerial triangulation shall be placed at the each ends of strip and further control points shall be distributed by one each approximately four models for strip adjustment.

For vertical control, several leveling routes shall pass through a strip.

4) Aerial triangulation

Aerial traingulation shall be carried out for plottong by using data of the ground control survey.

4) Aerial triangulation

Aerial triangulation shall be carried out for plotting by using data of the ground control survey.

3.3 Mapping

1) Grid line and map size

Coordinate grid lines shall be drawn at each 10 centimeters and be based on the UTM projection. Map size shall be 70 cm x 100 cm.

2) Map scale and contour interval

The scale of map shall be at 1 : 5,000 and the contour interval at 5 meters, but 2,5 meters as a sub-contour line for flat areas.

3) Planimetry

The map shall be contained all planemetric features which are visible or identifiable or interpratable from photos. The features shall be drawn on maps according to symbol indicated by the Engineer.

4) Spot height

Spot height determined by plotting machine shall be shown at every 5 cm intervals and at significant points such as road intersections, bridges, summits, depressions, changes of slope, ditch, or banks. The height shall be indecated on maps in meter.

Spot height determined by ground control survey shall be indicated in decimeter.

5) Accuracy

In height accuracy, the error of a spot elevation shall be less than two-thirds (2/3) of the contour interval.

In planimetric accuracy, the error of horizontal position shall be less than two-tenths milimeter.

Plotted position of control points shall not be more than two-tenths milimeter for grid lines.

Grid line shall not be more than two-tenths milimeter from the true value.

6) Materials to be used

The map manuscript and the fine traced map shall be drawn on polyester type of plastic or materials of equivalent or higher quality in dimentional stability.

7) Materials to be delivered

Following materials shall be delivered to PLN by the end of October 1986

(1) One set of original traced map of 1/5,000 scale for the quarry site
(2) One set of copied map of polyester type of the above item (1)
(3) Ten sets of ozalid paper of the above item (1).

3.4 Time limit

The ground control survey shall be completed by the end of July 1986 and also the Contractor shall submit data necessary for mapping by the middle of August 1986. The mapping work shall be completed by the end of September 1986 and all documents shall submitted by the end of October 1986. In this time limit, the ground control survey is scheduled to be commenced at the beginning of June 1986.

IV. Ground Survey

4.1 General

1) The area to be surveyed is approximately 7.5 km^2 as shown in Fig. T-1 The mapping area will be fixed on the basis of the result of comperative study on three (3) alternative damsites by the end of May 1986, but total mapping area of 7.5 km^2 will not be changed. Therefore (A) site is tentatively shown in this figure.

2) The works to be carried out consists of topographic survey, longitudinal and cross sectional survey (dam and river).

3) A plan with time schedule of surveying shall be submitted by the Contractor to the Engineer before commencement of the works and be authorized by the Engineer.

4) All survey results shall be properly checked and authorized by the Engineer.

4.2 *Topographic Survey*

1) Topographic survey shall be carried out at the proposed damsite as follows :

   i) Survey and mapping area for the proposed damsite of 7.5 km^2

   ii) Mapping scale of 1/1,000 with 1 m (one meter) contour as far as possible (2 or 5 m contour for steep slope).

2) Mapping method shall be used by detailed survey and, cross-leveling.

3) Concrete posts (20 cm x 20 cm x 30 cm) have to be used for base-line of each area.

4) Angle measurement of traversing shall be carried out by two (2) series.

5) Allowable error of traversing

   (1) Observation error : 40"

   (2) Double angle error : 50"

6) Distance measurement shall be carried out with an EDM (electronic distance meter) or a steel tape by reading of 3 times per set and vice versa.

7) Cross-leveling and detailed survey shall be carried out according to an ordinary method.

4.3 Dam longitudinal and cross sectional survey

1) Dam longitudinal survey shall be carried out along the proposed dam axis.

Length : about 1 km

2) Dam cross sectional survey shall be carried out at a right angle for the proposed dam axis at about 50 m intervals

Number of cross section : approx. 10 lines

3) The cross sectional line shall satisfactorily be extended for dam design.

4) The line shall be connected to the nearby Bench Mark established for ground control survey.

5) Measuring interval has to be less than 10 m for surveying under water.

6) Clossing error of leveling shall not exceed 20 mm$\sqrt{D}$ (D : distance in km).

4.4 River cross sectional survey

1) River cross sectional survey shall be carried out along the river from 500 m downstream to 500 m upstream of the proposed site of the tailrace outlet.

Distance : 1 km
Number of cross section : 20 lines at 50 m intervals

2) The line shall be extended up to relative height of 20 m above the water surface.

3) The line shall be connected to the nearby Bench Mark established for ground control survey.

4) River water depth shall be surveyed by rope with a weight or measuring rod.

5) Measuring interval has to be less than 10 m for surveying under water.

6) Closing error of leveling shall not exceed $20\ mm\sqrt{D}$ (D : distance in km).

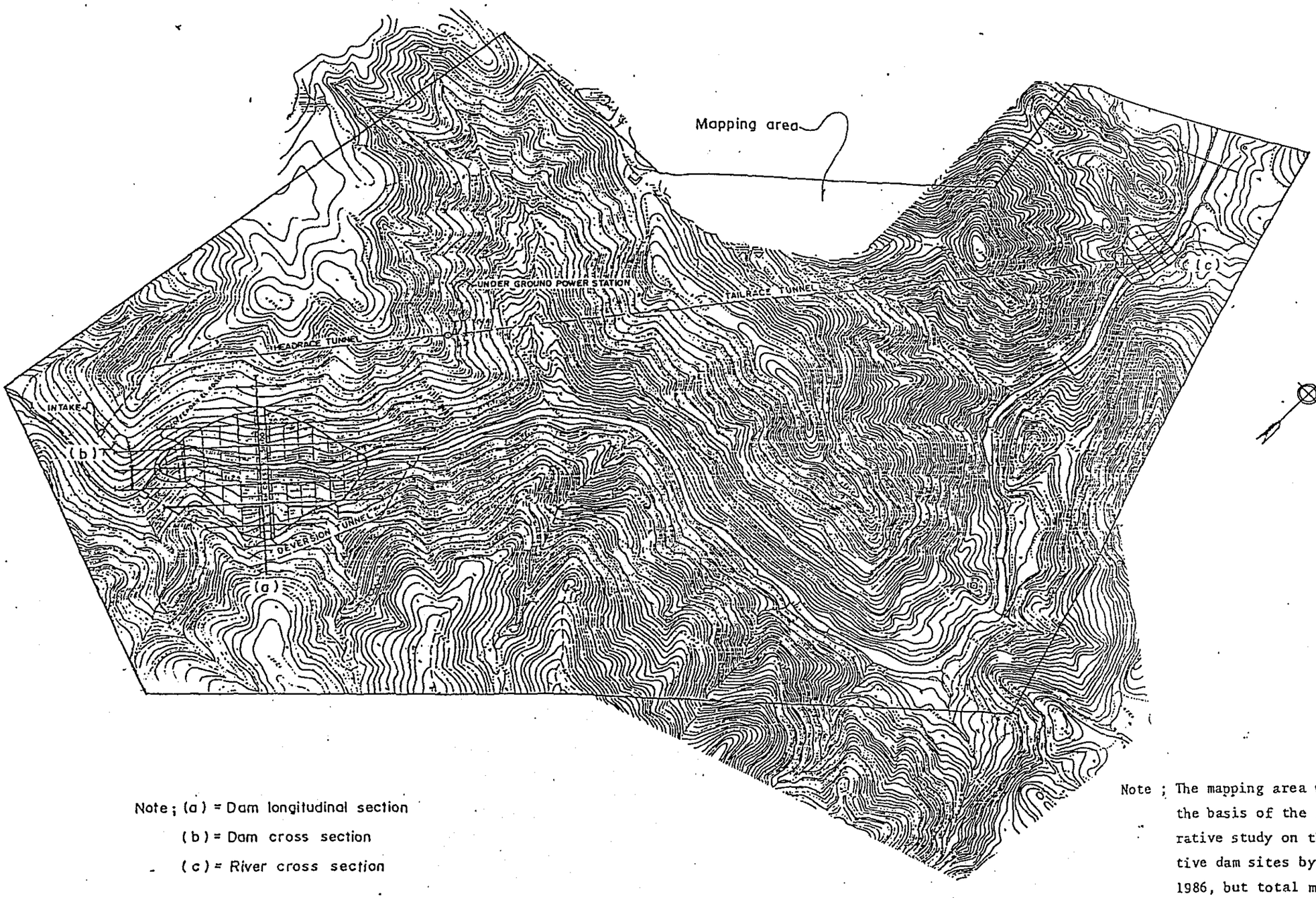
4.5 Materials to be delivered

Following materials shall be delivered to PLN by the end of September 1986.

(1) One set of original traced maps of 1/1,000 scale for the dam site.
(2) One set of copied map of polyester type on the above item (1).
(3) Ten set of ozalid paper on the above item (1).
(4) One set of original traced drawings of the dam longitudinal section (1/500 scale), dam cross sections (1/500 scale) and river cross sections (1/200 scale).
(5) One set of copied drawing of polyester type on the above item (4)
(6) Ten set of ozalid paper on the above item (4).

4.6 Time limit

All the survey works consisting of field and home works shall be completed by the end of September 1986 on the condition of the field work commencement at the beginning of June 1986.



Note ; (a) = Dam longitudinal section
(b) = Dam cross section
(c) = River cross section

Scale 0 500m

Fig. T-1 Mapping Area and Cross Sections of Dam Site

Note ; The mapping area will be fixed on the basis of the result of comperative study on three (3) alternative dam sites by the end of May 1986, but total mapping area of 7.5 km^2 will not be changed.

Therefore (A) site is tentatively shown in this figure.

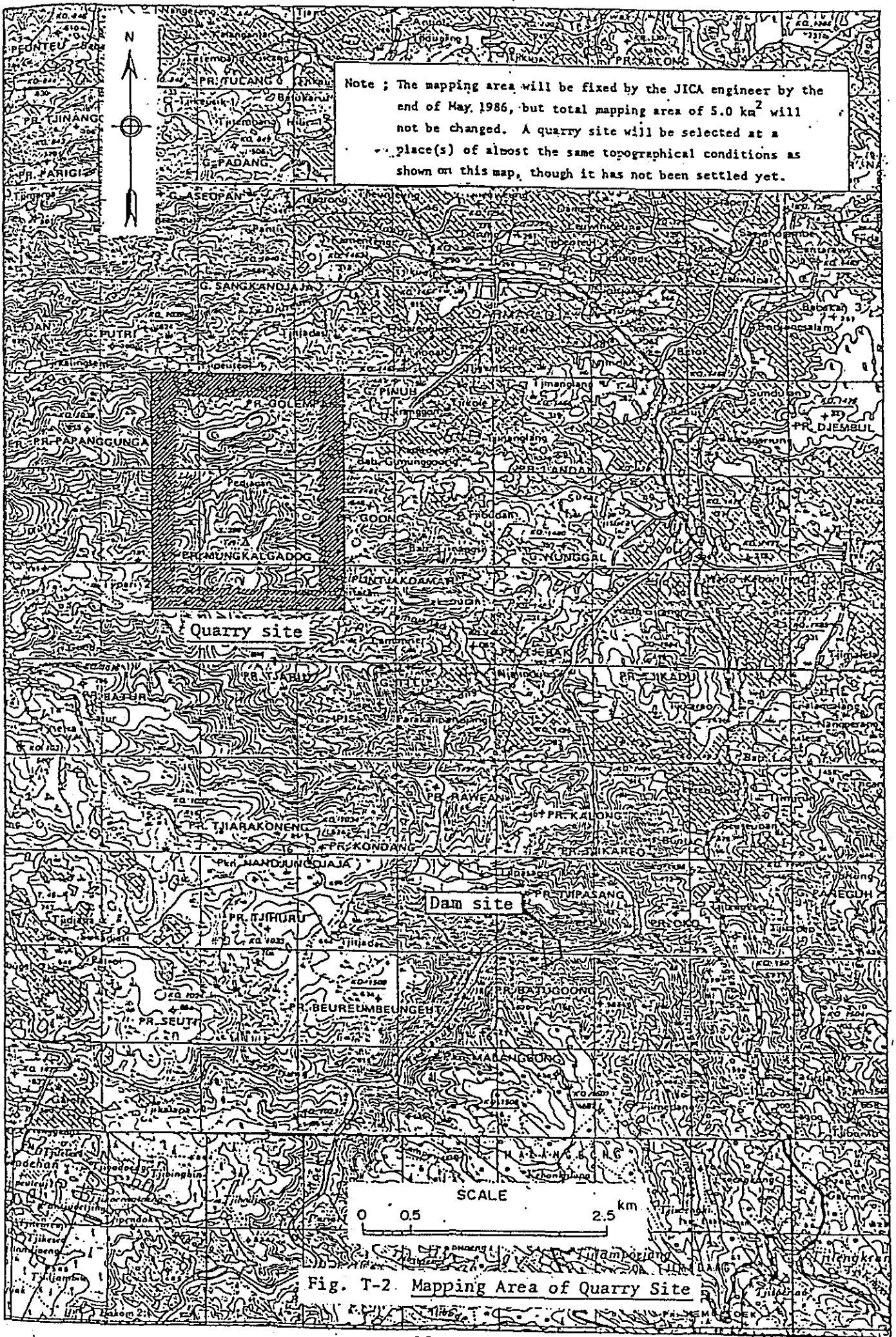


Fig. T-2 Mapping Area of Quarry Site

WORK ITEMS AND QUANTITIES

Unit : Rp.

Item No.	Work	Unit	Quantity	Unit Price	Amount	Reference No. in Specification
T-1	Maps of 1/5,000 scale for quarry site	km^2	5.0			III
T-2	Maps of 1/1,000 scale for dam site	km^2	7.5			4.1, 4.2, 45
T-3	Dam longitudinal section	km	1.0			4.1, 4.3, 45
T-4	Dam cross sectionc (10 sections)	km	8.0			4.1, 43, 45
T-5	River cross sections (20 sections) at tailrace	km	4.0			4.1, 44, 45

SPEC. No. 2

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT

TECHNICAL SPECIFICATIONS

FOR

CONSTRUCTION MATERIAL SURVEY AND LABORATORY TEST

CONTENTS

CONSTRUCTION MATERIAL SURVEY AND LABORATORY TEST

TECHNICAL SPECIFICATIONS

1. SCOPE OF WORKS

The construction material survey and laboratory test shall aim to clarify physical properties, obtainable quantities and design values of those for the proposed dam embankment and concrete works.

For this purpose, the Contractor shall carry out the materials survey of :

1) a borrow area(s) for impervious core material.

2) a borrow area(s) for filter materials and concrete aggregates.

The Contractor shall execute the material sampling for test from the above borrow area(s), and shall conduct the laboratory test within the specified work period in close contact with the Engineer in accordance with the technical specifications prescribed in the following sections. Besides drilled core samples from the quarry to be supplied by another contractor shall be tested in the Contractor's laborotory.

Fig. M-1 shows approximate locations of the borrow area(s). Exact locations will be indicated at the field by the Engineer. The quantity of site works and the laboratory tests to be done are shown in Table M-1 and M-2 respectively.

2. TECHNICAL GUIDANCE AND SUPERVISION

All the Contractor's works including for the following item shall be carried out under the supervision and technical guidance of the Engineer.

(1) work plan and schedule
(2) excavation and sampling
(3) laboratory test
(4) check of the test results and reporting.

3 MATERIALS SURVEY

3.1 A Quarry(s) of Rockfill Material and Concrete Aggregates

To clarify the rock characteristic and the overburden thickness, the following investigations are executed by a contractor for geological investigation (hereinafter called as "Geo-contractor").

(1) core boring, and
(2) seismic exploration.
(3) test pit and trench-cut

For the purpose of the laboratory rock test, the Contractor shall collect, pack and carry speciment from the core samples drilled and stored by the Geo-contractor. The hole number and depth of rock core to be sampled and tested will be designated by the Engineer after the completion of core boring.

The collected samples shall be packed for each source attaching a label in which the name of the Project, the number of the borehole, the depth and date of sampling shall be written clearly and indelibly. The core samples shall be transported from the Geo-contractor's store house at the site to the Contractor's laboratory by the Contractor.

3.2 Borrow Area for Impervious Core

For the purpose of confirming the soil layer thickness and sampling the laboratory test materials, the following investigations shall be executed by the Contractor as specified below in the areas C-1 and C-2 as shown in FIG.M-1. The investigation shall be done for two soil layers; that is, upper soil layer and lower (hereinafter, called as "upper soil and lower soil" respectively) which are defined as follows :

- upper soil :
  The soil layer, which is distributed in the shallower portion of the proposed borrow area, consists mainly of fine particles and contains little coarser particles.
- lower soil :
  The soil layer, which is distributed in the deeper portion of the proposed borrow areas, contains some gravels and cobbles.

1) Auger boring

Hand auger boring shall be carried out at the spots designated by the Engineer, with an auger of the approved design to ASTM D1452 (1972) "Soil Investigation and Sampling by Auger Boring" or the equivalent.

Auger borings shall be made to the depth at the upper boundary of lower soil layer or otherwise directed by the Engineer. However, it is not expected to bore more than 7.5 m depth.

Where auger boring is obstructed with 1.5 m depth from the ground surface due to roots, rock boulder or any other obstruction, a new hole shall be sunk at approximately 5 m offset from the previous boring location. Auger boring at the offset shall be terminated at the specific depth or at the shallower depth if obstructions are again encountered.

For the purpose of the moisture content test and the record sample, the material samples of about 1 kg each shall be taken at every 1 m depth interval from each auger boring hole.

The specifications concerning to logging and sample preservation are refered to hereinafter.

2) Test pit

Test pitting shall be made at the spots, designated by the Engineer, by man-power. The test pit shall have at least 1.0 m x 3.0 m cross-sectional area at the bottom as shown in FIG. M-2, unless otherwise approved by the Engineer.

Test pitting shall be made to 5 m deep. However, when test pitting is obstructed due to the hard rock block, test pitting shall be terminated in accordance with the approval of the Engineer.

For the purpose of sampling laboratory test material, samples shall be taken as explained below :

Samples of about 1 kg for moisture content test and the record samples :	At every 1 m deep interval from the ground surface or otherwise directed by the Engineer.

Samples of about 2 kg each for index properties test :	At every 1.5 m deep from the ground surface or otherwise directed by the Engineer.
Upper soil samples of about 60 kg each for lower soil sample of about 120 kg each for engineering properties test and index properties test :	At every 3.0 m deep from the ground surface or otherwise directed by the Engineer.

All the test pits shall be color-photographed so as to show the status of subsurface.

Backfillings with the excavated materials or provision of the safety guard, so as to satisfy the Engineer, shall be made to all the test pits.

3) Trench Cutting

Trench cutting shall be made at the spots designated by the Engineer. The shape and dimensions shall be the same as shown in Fig. M-2 or otherwise approved by the Engineer.

Trench shall be excavated to the depth or length downward where the lower soil is revealed at least 3 m deep and 1.5 m wide at the bottom, or otherwise directed by the Engineer.

For the purpose of sampling laboratory test materials, the material samples shall be taken from 1 m deep below the surface of the lower soil as explained below :

Samples of about 1 kg each for moisture content test and the record samples :	At every 1 m deep interval from the top of lower soil.
Samples of about 2 kg each for index properties test :	At the spot of 3 m below the top of the lower soil or otherwise as directed by the Engineer.
Samples of about 120 kg each for engineering properties test and index properties test :	At the spot of 2 m below the top of the lower soil or as directed by the Engineer.

The bottom surface of all trench-cuts shall be color photographed so as to show the status of subsurface.

3.3 Borrow Area for Filter Material and Concrete Aggregates

The purpose of the sand and gravel survey is to confirm the thickness of sand and gravel deposits and to take samples for laboratory test in the areas F-1 and F-2 in FIG. M-1.

1) Test pit

Test pitting shall be made at the spots designated by the Engineer. The test pit shall have 1.5 m x 1.5 m sectional dimension and 3 m in depth. The pit shall be protected by wooden frame and plate for protecting from collapse of the excavated pit wall. A ladder shall also be installed from the top to bottom for inspection and sampling.

Two (2) numbers of sample with 75 kg each shall be taken from a test pit as directed by the Engineer and stored in an appropriate container.

3.4 Logs of Auger Boring, Test Pits and Trench-cuts

Carefull observation shall be done on the materials from auger boring holes, the side walls of the test pits, and the bottom of the trench-cuts. The representative materials shall be selected and classified by the visual and manual procedure in accordance with the ASTM-D2488-69 (1975) "Description of Soil (visual-manual procedure)". Based upon the above mentioned classification, the logs of the auger boring and test pit shall be made respectively in such a form as approved by the Engineer.

3.5 Preservation of Samples

All samples for the laboratory test shall be preserved, immediately after being recovered or excavated, in bags made of polyethylene sheeting or the equivalent materials approved by the Engineer. Each sample shall be placed in two layers of such sheeting each layer sealed to form an air-tight bag. The air inside the bag shall be expelled as much as possible, before the bag containing sample will be sealed.

The record samples of about 200 g each shall be taken simultaneously with the moisture content test sample or from the moisture content test materials preserved before testing. Each record sample shall be preserved

in a wide-mouth, air-tigh, clear plastic of glass jar with a air-tight cap or in an other container approved by the Engineer. The void at the upper end shall be filled with unabsorbent materials such as polyethylene sheet block, etc.

A label clearly and indelibly marked with the name of project, the number of sample, the number of borrow area, the number of auger boring, test pit or trench, depth of sampling, and date taken shall be attached to each sample of the laboratory test and record so as not to be lost during transportation.

3.6 Quantity of Site Works

The number of auger borings, test pits and trenches shall be approximately as indicated in Table M-1. However, the Engineer is to reserve the right to decrease or increase the number as conditions may require without increase in applicable unit costs.

4. LABORATORY TEST

To claryfy the materials characteristics and determine the design values of materials for the proposed dam embankments and concrete works, the laboratory test mentioned hereinafter shall be carried out by the Contractor.

4.1 Rock Test for Rockfill Materials and Concrete Aggregates

On the rock samples taken for the rockfill materials and concrete aggregate, the following rock test shall be carried out in accordance with the following testing standards or the equivalent.

1) Specific gravity and absorption test : ASTM C127
2) Soundness test : ASTM C88
3) Compressive strength test : ASTM D2938
4) Measurement of "P" and "S" waves velocities : ASTM D2845
5) Triaxial compression :

Triaxial compression test on rock samples shall be carried out as follows :

Specimen (test piece) : about 5 cm diameter and 10 cm height, taken from the drilling core designated by the Engineer

Condition of test pieces : saturated or as directed otherwise by the Engineer

Confirming pressure : at least three kinds of 50 kg/cm^2, 100 kg/cm^2 and 150 kg/cm^2 or as directed by the Engineer.

4.2 Soil Test for Filter Materials

On the sand and gravel samples taken from the borrow areas, No.F-1 and No. F-2, the following soil test shall be carried out in accordance with the following testing standard and/or the testing procedures explained hereinafter.

1) Specific gravity and absorption test :

The specific gravity test shall be carried out ;

for Sand : ASTM C128,
and for Gravel : ASTM C127

2) Particle size analysis (Sieve Analysis) : ASTM C136

3) Relative density test : ASTM D2049 (Material passing No.4 sieve)

4) Constant head permeability test : : ASTM D2434 (Material passing No.4 sieve, and its relative density of about 70%)

5) Consolidated and drained triaxial Compression test :

The consolidated and drained triaxial compression test shall be carried out as follows :

Maximum particle size of test-piece	: 5 mm (passing No.4 sieve)
Size of test-piece	: 5 cm (in diameter) x more than 10 cm (in height)
Relative density of test-piece	: 70%
Condition of test-piece	: Saturated before consolidation
Confining pressure ($\sigma 3$)	: At least three kinds of 1 kg/cm^2, 2 kg/cm^2 and 3 kg/cm^2
Loading method	: Strain control with the rate of 0.5%/minute in strain.

4.3 Soil Test for Impervious Core

On the upper soil samples and lower soil samples taken from the borrow areas, No. C-1, and No. C-2, and the mixed materials of them, the following soil tests shall be carried out in accordance with the following testing standards and/or the testing procedures explained hereinafter.

1) Moisture content test : ASTM D2216
2) Specific gravity test : ASTM D854
3) Particle size analysis : ASTM D422

4) Liquid and plastic limit test : ASTM D423 and ASTM D424

5) Compaction test : ASTM D698

The materials shall not be dried before the start of testing. On such compacted materials, the cone penetration test shall be carried out at the depth of 2.5 cm, 5.0 cm and 7.5 cm, by using of portable cone penetrometer having the area of 3.24 cm^2 at the bottom of cone and the angle of 30° at the top of cone.

6) Variable head permeability test : ASTM D2434

Densities and moisture contents of test pieces shall be designated by the Engineer.

The material of test-piece shall be of 5 mm at the maximum size.

7) Unconsolidated and undrained triaxial compression test :

The unconsolidated and undrained triaxial compression test shall be carried out as follows :

Maximum paricle size of test-piece	: 5 mm (pasiing No.4 sieve)
Size of test-piece	: 5 cm (in diameter) x more than 10 cm (in height)
Moisture content of test-piece	: as designated by the Engineer
Confining pressure	: at least three kinds of 1 kg/cm^2 2 kg/cm^2, and 3 kg/cm^2
Load method	: strain control with the rate of 1% per minute in strain.

8) Consolidated and undrained triaxial compression test :

The consolidated and undrained triaxial test shall be carried out in accordance with the designation E-17 of "Earth Manual". The test shall be carried out on at least three test pieces applied with different confining pressure of 1 kg/cm^2, 2 kg/cm^2 and 3 kg/cm^2 for each. Densities and moisture contents of the test pieces shall be designated by the Engineer.

9) Consolidation test : ASTM D2435

4.4 Sand and Gravel Test for Concrete Aggregate

The following test shall be carried out in accordance with the ASTM testing standard for concrete aggregate or the equivalent.

1)	Washing	: ASTM C177
2)	Organic impurities	: ASTM C 40
3)	Soundness	: ASTM C 88
4)	Abrasion	: ASTM C1131 and C535

4.5 Quantities of Tests

The test items specified above and the number of tests are listed in Table M-2. However, the Engineer is to reserve the right to decrease or increase the number as conditions may required without increse in applicable unit costs.

5. REPORT

On completion of the field exploration work and laboratory tests, the Contractor shall submit the comprehensive report which shall include the logs of auger boring, the test pit and trench. The report shall describe about the results of laboratory tests compiling the obtained values into tables or diamgrams for the asy interpretation. The form which shall be put to use only under the Engineer's approval.

6. TIME LIMIT

The field survey and sampling shall be carried out for one and a half (1.5) months from the beginning of June 1986. The laboratory test shall be completed by the middle of September 1986 and the Contractor shall submit the report including all the information of the field exploration and the results of the laboratory tests by the middle of October 1986, on the condition of the aforesaid date of the field survey commencement.

Table M-1 QUANTITY OF SITE WORKS

1) Auger boring (5 m deep) 10 nos x 2 areas = 20 nos (100 m)

2) Test pit for impervious
Core material (5 m deep) : 5 nos x 2 areas = 10 nos (50 m)

3) Trench excavation for impervious
Core material (12 m long) : 3 nos x 2 areas = 6 nos (72 m)

4) Test pit for filter material and
concrete aggregates (3 m deep) : 5 nos x 2 areas = 10 nos (30 m)

5) Sampling from borrow areas

5.1) Earth material sample for moisture content & record sample (about 1 kg) = 72 samples

5.2) Earth material sample for moisture content & record sample and index properties test (about 2 kg) = 76 samples

5.3) Earth material sample for moisture content & record sample, index properties test and engineering properties test (60 kg or 120 kg)= 26 samples

5.4) Sand and gravel material sample for filter material and concrete aggregate test (75 kg) = 10 samples

6) Sampling from quarry and foundation rock for rock test (about 5 cm dia. and 10 cm high each) = 45 test pieces

Table M-2 QUANTITY OF LABORATORY TESTS (1)

1)	Rock samples	
1.1)	Uniaxial compression (2 test pieces/each sample)	15 samples
1.2)	Triaxial compression (3 test pieces/each sample at least)	15 "
1.3)	Specific gravity and absorption	45 tests
1.4)	Soundness	15 samples
1.5)	P-wave and S-wave velocities	15 "
2)	Sand and gravel samples	
2.1)	Specific gravity and absorption of gravel	10 samples
2.2)	- do - of sand	10 "
2.3)	Gradation (Particle size analysis)	20 "
2.4)	Washing test of sand	10 "
2.5)	Organic impuritis of sand	10 "
2.6)	Soundness of gravel	10 "
2.7)	Soundness of sand	10 "
2.8)	Abrasion of gravel	10 "
2.9)	Relative density	10 "
2.10)	Constant head permeability test	6 "
2.11)	Consolidated drained test	6 "
3)	Earth material sample	
3.1)	Moisture content	120 samples
3.2)	Specific gravity	76 "
3.3)	Gradation (Particle size analysis)	76 "
3.4)	Liquid and plastic limits	76 "
3.5)	Compaction	26 "

Table M-2 QUANTITY OF LABORATORY TESTS (2)

3.6)	Variable head permeability	33 samples
3.7)	Unconsolidated undrained triaxial compression	33 "
3.8)	Consolidated undrained triaxial compression	33 "
3.9)	Consolidation	33 "

Table M-3 WORK ITEMS AND QUANTITIES (1)

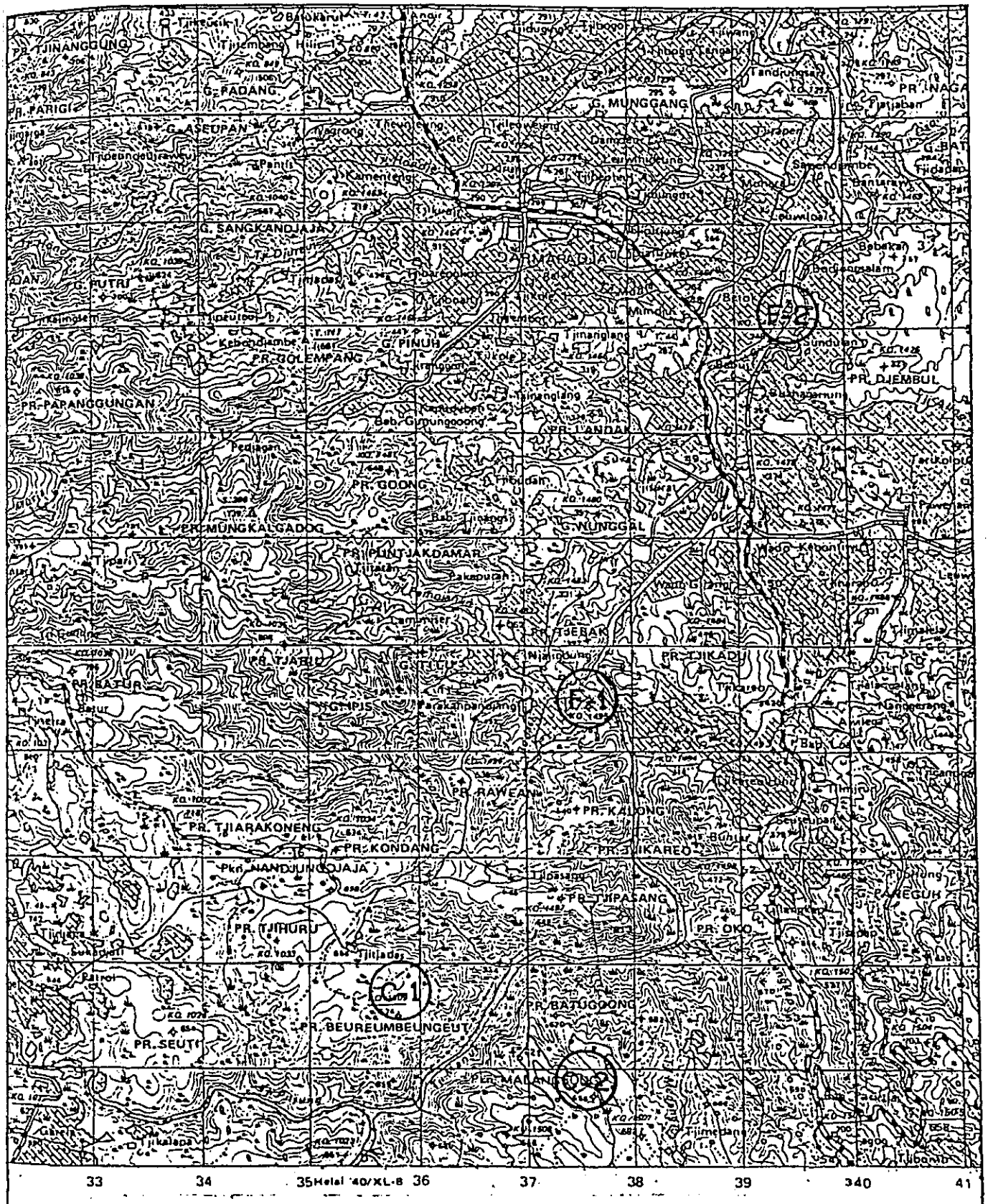
Unit : Rp.

Item No.	Work	Unit	Quantity	Unit Price	Amount	Reference No. in Specification
	Site work					
	1) Auger boring (20 spots x 5 m)	m	100			3.2, 1)
	2) Test pit for impervious core material (10 spots x 5 m)	m	50			3.2, 2)
	3) Trench excavation for impervious core material (12 m x 6 spots)	m	72			3.2, 3)
	4) Test pit for filter material and concrete aggregates (10 spots x 3 m)	m	30			3.3, 1)
	5) *Sampling from borrow area*					
	5.1) Earth material for moisture content, record sample (1 kg)	nos.	72			3.2, 1), 2), 3)
	5.2) Earth material for moisture content, record sample and index properties test (2 kg)	"	76			3.2, 1), 2), 3)
	5.3) Earth material for moisture content, record sample index properties and engineering properties test (60 kg or 120 kg)	"	26			3.2, 1), 2), 3)
	5.4) Sand/gravel material for filter material and concrete aggregates (75 kg)	"	20			3.3, 1)
	6) Sampling from quarry and foundation rock for rock test	L.S	1			3.1
	Laboratory test					
	1) Rock sample					
	1.1) Uniaxial compression (2 test pieces/each sample)	sample	15			4.1
	1.2) Triaxial Compression (3 test pieces/each sample at least)	"	5			4.1
	1.3) Specific gravity and absorption	test	45			4.1
	1.4) Soundness	"	15			4.1
	1.5) P-wave and S-wave velocities	"	15			4.1

Table M-3 WORK ITEMS AND QUANTITIES (2)

Unit : Rp.

Item No.	Work	Unit	Quantity	Unit Price	Amount	Reference No. in Specification
	2) Sand and gravel sample					
	2.1) Specific gravity and absorption of gravel	test	10			4.2, 1)
	2.2) Specific gravity and absorption of sand	"	10			4.2, 1)
	2.3) Gradation (Particle size analysis)	"	20			4.2, 2)
	2.4) Washing test of sand	"	10			4.4, 1)
	2.5) Organic impurities of sand	"	10			4.4, 2)
	2.6) Soundness of gravel	"	10			4.4, 3)
	2.7) Soundness of sand	"	10			4.4, 3)
	2.8) Abrasion of gravel	"	10			4.4, 4)
	2.9) Relative density	sample	10			4.2, 3)
	2.10) Constant head permeability	"	6			4.2, 4)
	2.11) Consolidated drained triaxial compression	"	6			4.2, 5)
	3) Earth					
	3.1) Moisture content	sample	120			4.3, 1)
	3.2) Specific gravity	"	76			4.3, 2)
	3.3) Gradation (Particle size analysis)	"	76			4.3, 3)
	3.4) Liquid and plastic limits	"	76			4.3, 4)
	3.5) Compaction	"	26			4.3, 5)
	3.6) Variable head permeability	"	33			4.3, 6)
	3.7) Unconsolidated undrained triaxial compression	"	33			4.3, 7)
	3.8) Consolidated undrained triaxial compression	"	33			4.3, 8)
	3.9) Consolidation	"	33			4.3, 9)



SCALE 1 : 50,000

Notes :

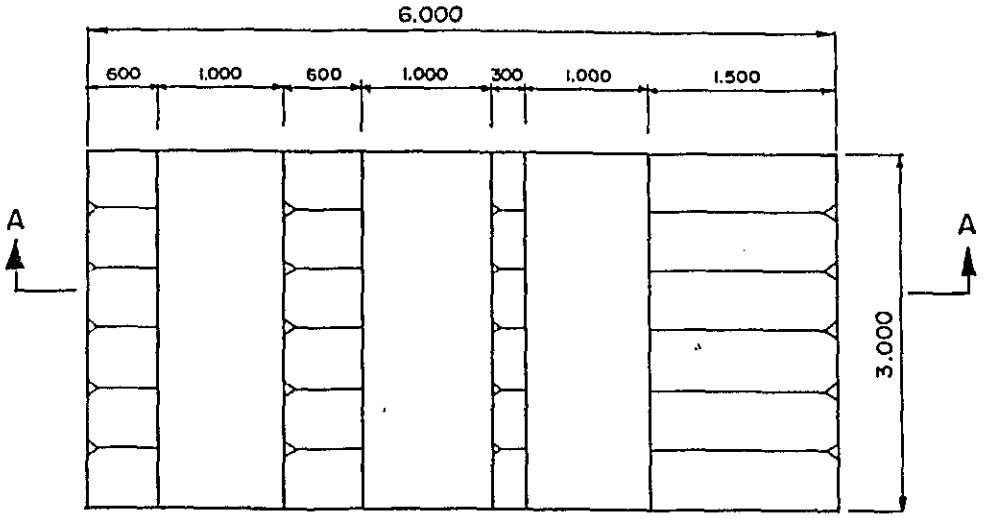
C-1, C-2 : Borrow area for impervious core

F-1, F-2 : Borrow area for filter

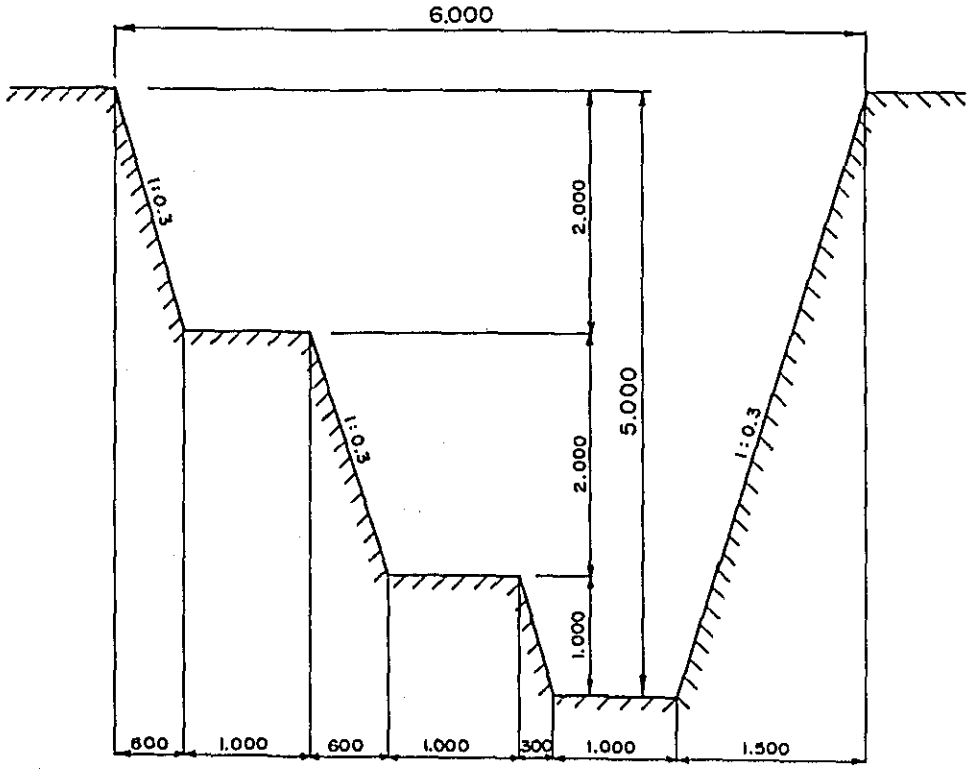
CIPASANG PROJECT

LOCATION OF EXPLORATION BORROW AREAS

FIG. M-1

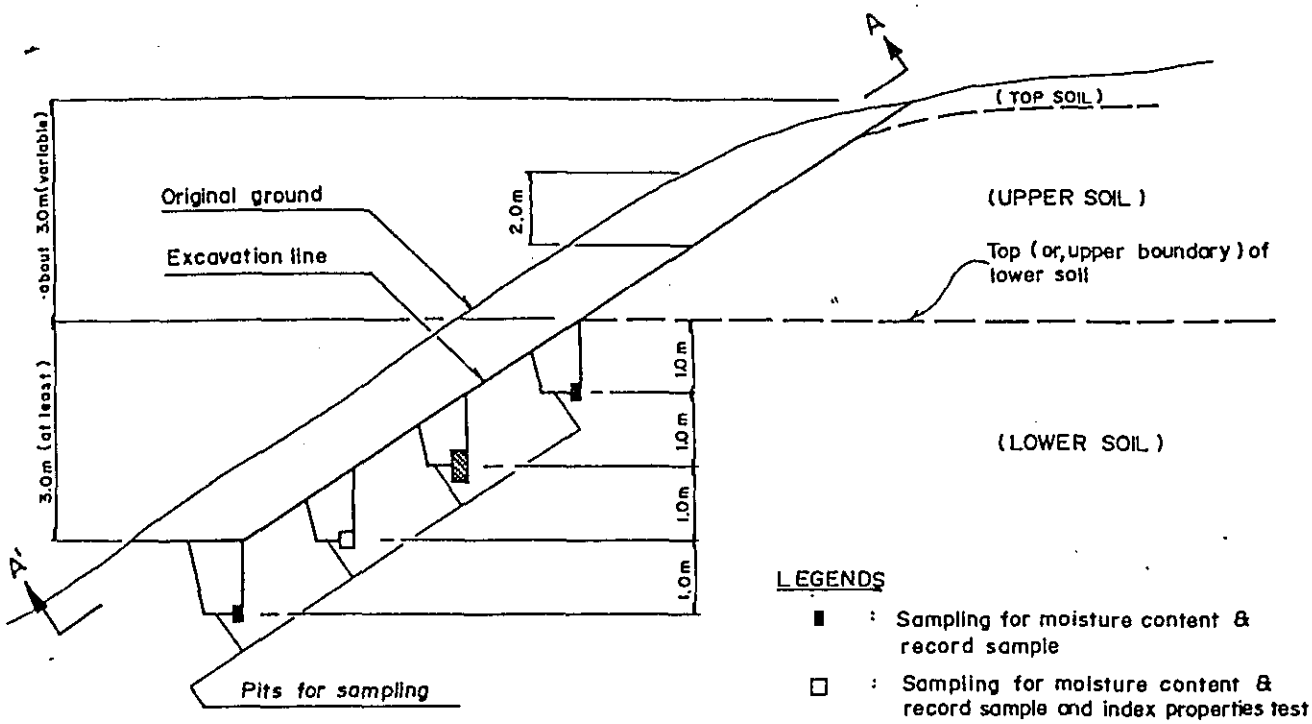


PLAN

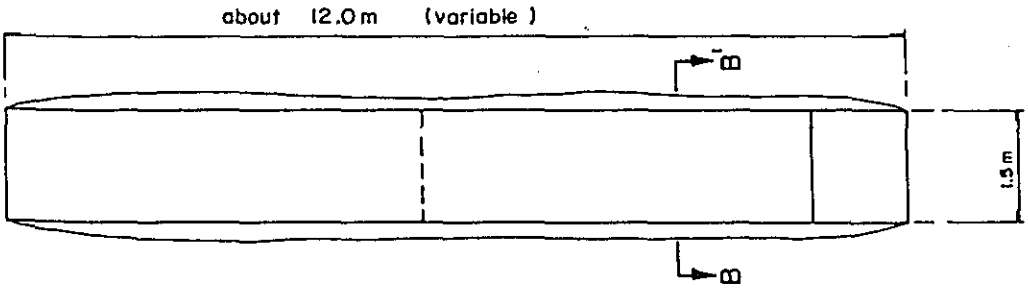


SECTION A-A

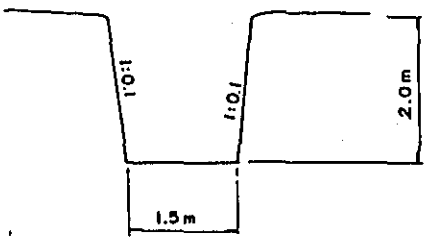
CIPASANG PROJECT
RECOMMENDED TEST PIT
FIG. M-2



PROFILE



PLAN (SECTION A-A')



CROSS-SECTION B-B'

CIPASANG PROJECT
SCHEMATIC REPRESENTATION
OF
TRENCH - CUT

FIG. M-3

Table M-3 WORK ITEMS AND QUANTITIES (1)

Unit : Rp.

Item No.	Work	Unit	Quantity	Unit Price	Amount	Reference No. in Specification
	Site work					
	1) Auger boring (20 spots x 5 m)	m	100			3.2, 1)
	2) Test pit for impervious core material (10 spots x 5 m)	m	50			3.2, 2)
	3) Trench excavation for impervious core material (12 m x 6 spots)	m	72			3.2, 3)
	4) Test pit for filter material and concrete aggregates (10 spots x 3 m)	m	30			3.3, 1)
	5) Sampling from borrow area					
	5.1) Earth material for moisture content, record sample (1 kg)	nos.	72			3.2, 1), 2), 3)
	5.2) Earth material for moisture content, record sample and index properties test (2 kg)	"	76			3.2, 1), 2), 3)
	5.3) Earth material for moisture content, record sample index properties and engineering properties test (60 kg or 120 kg)	"	26			3.2, 1), 2), 3)
	5.4) Sand/gravel material for filter material and concrete aggregates (75 kg)	"	20			3.3, 1)
	6) Sampling from quarry and foundation rock for rock test	L.S	1			3.1
	Laboratory test					
	1) Rock sample					
	1.1) Uniaxial compression (2 test pieces/each sample)	sample	15			4.1
	1.2) Triaxial Compression (3 test pieces/each sample at least)	"	5			4.1
	1.3) Specific gravity and absorption	test	45			4.1
	1.4) Soundness	"	15			4.1
	1.5) P-wave and S-wave velocities	"	15			4.1

Table M-3 WORK ITEMS AND QUANTITIES (2)

Unit : Rp.

Item No.	Work	Unit	Quantity	Unit Price	Amount	Reference No. in Specification
	2) Sand and gravel sample					
	2.1) Specific gravity and absorption of gravel	test	10			4.2, 1)
	2.2) Specific gravity and absorption of sand	"	10			4.2, 1)
	2.3) Gradation (Particle size analysis)	"	20			4.2, 2)
	2.4) Washing test of sand	"	10			4.4, 1)
	2.5) Organic impurities of sand	"	10			4.4, 2)
	2.6) Soundness of gravel	"	10			4.4, 3)
	2.7) Soundness of sand	"	10			4.4, 3)
	2.8) Abrasion of gravel	"	10			4.4, 4)
	2.9) Relative density	sample	10			4.2, 3)
	2.10) Constant head permeability	"	6			4.2, 4)
	2.11) Consolidated drained triaxial compression	"	6			4.2, 5)
	3) Earth					
	3.1) Moisture content	sample	120			4.3, 1)
	3.2) Specific gravity	"	76			4.3, 2)
	3.3) Gradation (Particle size analysis)	"	76			4.3, 3)
	3.4) Liquid and plastic limits	"	76			4.3, 4)
	3.5) Compaction	"	26			4.3, 5)
	3.6) Variable head permeability	"	33			4.3, 6)
	3.7) Unconsolidated undrained triaxial compression	"	33			4.3, 7)
	3.8) Consolidated undrained triaxial compression	"	33			4.3, 8)
	3.9) Consolidation -	"	33			4.3, 9)

SPEC. No. 3

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT

TECHNICAL SPECIFICATIONS
FOR
GEOLOGICAL INVESTIGATION

GENERAL SPECIFICATIONS

DETAILED SPECIFICATIONS

SURFACE GEOLOGICAL SURVEY

CORE DRILLING

SEISMIC REFRACTION PROSPECTING

CONTENTS

GENERAL SPECIFICATIONS

DETAILED SPECIFICATIONS

I SURFACE GEOLOGICAL SURVEY

III SEISMIC REFRACTION PROSPECTING

FIGURES

GENERAL SPECIFICATIONS

0.1 DESCRIPTION OF PROJECT

0.1.1 LOCATION

The project area is situated in the middle reaches of the Cimanuk river in West Jawa. The damsite is planned in the gorge near Desa Cipasang about 50 Km east of Bandung. A quarry site (or sites) will be settled in hills or mountain within the area of 20 Km in radius from the damsite prior to the start of the work.

0.1.2 PROJECT

The Project is schemed to create a reservoir of 700 to 800 million cubic meters by constructing a 170 to 200 meter hight dam for hydroelectric power development.

0.2 SCOPE OF THE WORK

0.2.1 SCOPE

The followings are the main work items in this investigation.

1) surface geological survey,
2) core drilling with the field permeability test and the standard penetration test in boreholes,
3) seismic refraction prospecting.

The work covered by the Specifications includes furnishing all technical staff, labours, materials, equipment, and supplies required to perform geological investigation for the feasibility study of the Project.

0.2.2 PURPOSE

The feasibility study of the Project is planned to be carried out in stepwised two stages called the preliminary stage and the main stage.

The work covered by this Specifications is the geological investigation of the main stage for the purpose of obtaining subsurface information necessary for the feasibility study.

0.2.3 PERIOD

The Contractor shall complete the work and submit the final report within six and a half (6.5) months from the middle of May 1986 by which the Contract will have been signed.

0.2.4 WORK BY OTHER CONTRACT

The works to be performed by the Contractor or other contractors in accordance with the other specifications will be as follows :

1) topographic survey,

2) construction material investigation,

3) laboratory test.

0.3 INVESTIGATION PROGRAMME AND REPORT

0.3.1 INVESTIGATION PROGRAMME

The investigation schedule shown in the Figures is solely attached to assist the Tenderers. The Contractor shall submit his detailed investigation programme and schedule to the Engineer for approval prior to the start of the work. The Contractor's investigation schedule shall be provided for the overall investigation as well as for the investigation of the specific survey items. The operations under each of the schedule submitted by the Contractor shall be broken down in greater detail than that shown in the Figures attached in Specifications. Approved construction schedule shall be monitored and kept updated by the Contractor throughout the work. All revisions shall be accompanied by a detailed explanation of the reasons for changes.

0.3.2 FIELD PROGRESS REPORT

The Contractor, on the fifth day of each month or at any time designated by the Engineer, submit three copies of the written report in a form furnished by the Engineer on the progress of the work during the preceding month. The report shall show the percentage of each survey item completed during the month and the total percentage of completion as of the date of the report. The report shall include the following matters ;

1) progress of the work,
2) number and classification of technical staff and labours engaged in the work in daily basis,
3) equipments and apparatus used for the investigation work,
4) findings,
5) accident,
6) other data required by the Engineer.

0.3.3 DRAFT FINAL REPORT

The Contractor shall submit the draft of the final report within six months after the commencement of the work.

0.3.4 FINAL REPORT

The Contractor shall prepare the final report of the geological investigation which shall include but not limited to the following items :

1) outline of the Project and the purpose of the geological investigation,
2) results of the surface geological survey,
3) results of the core drilling with the field permeability test and the standard penetration test,
4) results of the seismic refraction prospecting,

5) regional geology and geomorphology,

6) geology of the project area,

7) engineering geology of the main structures sites and quarry sites,

8) conclusion,

9) references

The final report shall contain all result and item specified in the Detailed Specification. The results of all survey item including the results of preceding investigation shall be taken into account and explained concordantly in each other. Photographs and samples stipulated in the Detailed Specification shall be sumbitted together with the final report. Original sheets of the drawings and negatives of the photographs to be attached and submitted shall be the property of PLN.

The expense for the reports shall be included in the unit prices of various items as stipulated in the Detailed Specifications so that no separate payment for the reporting will be made.

0.4 MATERIALS AND EQUIPMENT

All materials and equipmnet required for the investigation and completion of the work shall be furnished by the Contractor as soon as practicable after the signing of the Contract. The Contractor shall submit for the approval of the Engineer, drawings, catalogs, diagrams and other descriptive data for all equipment and testing apparatus designated by the Engineer. The equipment shall have such sufficient performance capacity and durability as to secure the completion of the work within the investigation period stipulated under the Contract. All materials and equipment will be subject to inspection or test by the Engineer at any time and in any state of completion both off-site and on-site as he deems necessary. The Contractor shall furnish promptly without additional charge, all facilities, labour, and materials reasonably needed for performing such inspection and test as may be required by the Engineer.

All expenses, such as the costs of fuel, lubricant, operator, and consumption goods, etc., entailed by use of the equipment during the investigation period shall be borne by the Contractor.

0.5 VARIATIONS

The programme shown on the Figures and described herein is tentative and is presented for the purpose of obtaining comparative tenders. The amount of surface geological survey, core drilling, testing in boreholes and seismic refraction prospecting which actually will be required is unknown, and will be governed not only by the findings of the preliminary stage investigation but also by conditions encountered as the work progress.

The decreasing and/or increasing of the quantity shown in the Bill of Quantities will be made without the decrease and increase of the unit prices as stipulated in the Clauses for Measurement and Payment.

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT
DETAILED SPECIFICATION

I SURFACE GEOLOGICAL SURVEY

1.1 SCOPE

These specifications cover the preparation of the geological maps and the performance of all the works necessary to prepare the geological maps in connection with the entire Contract. The work includes but not limitted to the following items;

1) review and study of existing geological data and references,
2) field reconnaissance including observation and recording of outcrops,
3) geomorphological study,
4) stratigraphical, lithological and structural study,
5) geohydrological study,
6) engineering geological study,
7) preparation of geological maps,
8) preparation of geological profiles,
9) reporting

1.2 GENERAL

Surface geological survey shall be covered the future reservoir area, main structure sites and/or quarry sites. The works shall reveal the geology of the reservoir area, main structure sites and/or quaryy sites thoroughly as well as to obtain engineering geological data necessary for the project assessment, design of the project and establishment of the further detailed investigation plan.

1.3 MAPPING AREA AND SCALE

The geological maps shall cover the area of 5 sq.km wide for the main structure sites in the scale 1:1,000 and the area of 5 sq.km wide for the other area to be designated prior to the start of the work in the scale of 1:5,000.

1.4 METHODS OF SURVEY

1) Existing geological references and data shall be collected as many as possible and carefully studied. Aerophotographes shall be studied and interpreted.

2) Surface geological survey shall be performed in the area wide enough in order to reveal the geology of the whole area stipulated in the Clause 1.3 with sufficient accuracy.

3) In the field, top soil shall be removed in order to observe rocks and/or structues, if necessary to reveal and/or confirm the geology. The observation shall be done from the aspects not only of geology but also of engineering geology.

4) Field observation and measurement shall be recorded in field notebooks and route maps.

5) Photographs which well show the geomorphology and/or geology of the project area shall be taken in color at places.

6) Specimens of rocks shall be sampled for each stratigraphic unit. Specimens shall be examined with a microscope, if necessary and/or ordered by the Engineer.

1.5 GEOLOGICAL MAP AND PROFILE

Geological maps and profiles shall be drawn based on the field data obtained through the field geological survey and recorded on the route maps and field notebooks, according to the geological theory and mapping. The location and number of profiles shall be of sufficient to explain the geology of the mapping area throughly and be approved by the Engineer.

The boundary of stratigraphic units and the trend of structure shall be reasonably deduced not only from field observation but also taking other references such as previous studies and aerophoto interpretation into account. Confirmed and/or observed geological phenomina shall be clearly shown on geological maps and profiles and/or mentioned in the report distinguished from inferred geology. Regarding inferred geology, degrees of probability and/or certainty of inference shall be explained.

1.6 SUBMISSION OF RECORD AND SPECIMENS

Route maps and specimens stipulated in the Clause 1.4 shall be submitted to the Engineer together with the final report. In the route maps, the location of outcrops, water springs, land-slides and other phenomena related to the project shall be clearly shown together with necessary notes on geomorphology, geology, engineering geology and geohydrology.

1.7 REPORT

The report shall include but not limitted to the following items :

1) the purpose of the geological investigation,
2) the procedure and methodology applied for the geological investigation,
3) location, geomorphology and regional geology,
4) geology of the site including stratigraphy and lithology of each stratigraphic unit,
5) geological structure,
6) geological history,
7) engineering geology regarding not only on rocks but also on soil including the studies on groundwater and land sliding both of the present and of the future,
8) conclusion on the construction of the main structures, inudation of the reservoir area and possibility of construction materials from the geological aspect,

9) recommendation for future geological investigation,

10) references,

11) color photographs which represent geomorphology and geology of the site,

12) geological maps and profiles.

1.8 SUBMISSION OF ORIGINAL SHEET

Original sheets of geological maps and profiles and negatives of color photographs stipulated in the Clause 1.7 shall be submitted to the Engineer together with the final report.

1.9 MEASUREMENT AND PAYMENT

Measurement will be made of the number of square kilometers of geological maps acceptably drawn based on surface geological survey in conformity with this specification except the work of surface soil stripping.

Payment will be made for the number of square kilometers of geological maps as provided above at the respective Contract unit prices per square kilometer for the Item "Surface Geological Survey", and shall constitute full compensation for the surface geological survey and all other works related to this item except the work of surface soil stripping.

Measurement for the surface soil stripping will be made of the number of cubic meters of soil and fragments removed from the surface of bedrock and accepted by the Engineer. Payment for the surface soil stripping will be made for the number of cubic meters as provided above at the Contract unit price per cubic meters for the Item "Surface Soil Stripping", and shall constitute full compensation for the surface soil stripping and all other works related to this item.

II CORE DRILLING AND TESTING IN BOREHOLES

2.1 SCOPE

These specifications cover the performance of the core drilling and the in-situ tests in the boreholes which are necessary to investigate the geological conditions of the Project in connection with the entire Contract. The work includes but not limited to the following items :

1) to establish the detailed working plan including a list of personnel and a table of schedule,
2) mobilization and site preparation including to get right of way and to make foot passes, if necessary,
3) transportation, setting and dismantling of equipments, tools and materials,
4) core drilling with the standard penetration test and the field permeability test,
5) arrangement of drilling core samples in core boxes, taking photographs of core samples and recording of the tests in boreholes,
6) setting a mark at the neck of a borehole as an indication of hole location,
7) logging of core drilling, determination of penetration resistivity by the standard penetration test and determination of in-place permeability,
8) sampling of specimens from drilling core and sending to a laboratory according to the instruction of the Engineer,

9) storing of core-boxes in a warehouse to be indicated by the Engineer,

10) demobilization and site clearing,

11) reporting

.2.2 CLASSIFICATION

The terms "rock" and "soil" are hereby defined when used for the purpose of classifying drilled materials for payment under the Item "Core Drilling" in the Bill of Quantity.

Rock : Rock shall mean all in-place igneous and sedimentary rock and their metamorphosed products such as schists and quartzites in whatever degree of weathering as so classified by the Engineer. A boulder larger than one meter in diameter so as to be cored like in-place rocks will be classified in rock, when authorized by the Engineer.

Soil : Soil shall mean all materials except rock as defined above. Soil shall include, but not necessarily be limitted to, all geological recent material overlying bedrock such as allivium, talus and top soil. Unconsolidated recent pysoclastic products such as deposits of volcanic ash, pumice and scoria shall be considered as soil.

2.3 GENERAL

The works shall be performed for the purpose of obtaining geological and engineering geological data about sub-surface conditions of the proposed sites such as for main structures, construction materials and others related to the Project. Therefore every efforts shall be made to recover core samples fully and any remarkable phenomina and abnormal conditions encountered during performance of the works shall be reported to the Engineer immediately.

The Contractor shall send a resident engineer or geologist who has sufficient knowledge and experience regarding geological investigation of dam foundation and to be approved by the Engineer. The resident engineer shall stay in the site fully through the investigation period.

2.4 PROGRAMME

The programme shown on the Figures and described herein is tentative and is presented for the purpose of obtaining comparative tenders. The amount of drilling and testing in boreholes which actually will be required is unknown, and will be governed by conditions encoutered as the work progress. The location, arrangement, inclination and depth of boreholes shown on the Figures will be subject to the Engineer's revision as necessary to reveal the site geology according to the conditions encountered.

Drilling points will be located in the damsite, other main structure sites, reservoir area, quarry sites and other places related to the project. Exact drilling location will be instructed in the site and/or shown in a map to be furnished prior to the start of the work, though will still be subject to the Engineer's revision according to the conditions encountered.

The total drilling length will be 3,000 linear-meters of boreholes which will be deployed to the various sites as follows :

S i t e	Drilling length in total of a site
Main Dam	670 m
Diversion Tunnel	80 m
Spillway	140 m
Waterway	550 m
Powerhouse	1,170 m
Quarry	390 m
T o t a l	3,000 m

The geological investigation plan of the preliminary stage shown in Fig. 2 will be completed prior to the commencement of the work to be covered by this Contract. Fig. 3 shows a possible geological investigation plan of the dam and power-station sites other than quarry based on the assumption that the alternative damsite-A would be selected in the preliminary study stage. A quarry site (or Quarry sites) to be investigated will be selected in hills or mountains within the area of 20 km in radius from the damsite, prior to the start of the main stage investigation.

The field permeability test shall be performed in boreholes at the stage to be described hereinafter and/or to be instructed in the field by the Engineer. Tentatively, the number of test stages is assumed as 400 for tendering purpose.

The standard penetration test shall be performed at each 2 meter intervals of the drilling depth in soil from the ground surface in the boreholes to be directed by the Engineer. The total number of testing points will be various depending upon the actual thickness of soil underline by the bedrock. For the tendering, the number of SPT points to be tested is assumed as 50.

2.5 CORE DRILLING

2.5.1 DIAMETER

Rock coring shall be accomplished using double tube coring equipment and diamond bits to permit maximum recovery of all core. Diamond bits shall be not smaller than 47 mm of inside diameter and not smaller than 64 mm of outside diameter.

2.5.2 DEPTH AND INCLINATION

Drilling depth of a hole will be not deeper than 200 m except at an underground powerhouse alternative site (or sites). The length of the

hole (holes) deeper than 200 m will be measured separately from the ground surface to 200 m and from 200 m to the bottom of the hole for payment.

Holes shall be dilled exactly in vertical except inclined holes. The Contractor shall drill a hole (or holes) with certain inclination as directed by the Engineer. Measurement of the length of boreholes will be made as stipulated in the Clause 2.9 for payment, regardless the inclination of holes.

The actual depth of each boreholes may be varied, shortened or extended, according to the geological conditions encountered as judged and directed by the Engineer. The depth of each completed borehole shall be measured by inserting rod pipes until the bottom of the hole at the presence of the Engineer, unless otherwise directed by the Engineer.

2.5.3 CORE RECOVERY

The Contractor shall make every efforts to realize the core recovery in 100 percent. The Contractor shall follow the replacement order of personnel, equipment and/or tools, if directed by the Engineer due to unsatisfactory recovery of core samples. Drilling without flushing water for the purpose of obtaining better core recovery will be admitted in soft materials such as clay soil, unless otherwise directed by the Engineer.

2.5.4 GROUND WATER LEVEL

Water level in each bore hole shall be recorded daily during the days of drilling that hole. Observation of the water level shall be made every morning before starting the day's drilling work. The water level shall be recorded in terms of depth from the top of the borehole.

2.5.5 SPRING WATER

If groundwater springs up from a drilling hole, it shall be reported to the Engineer immediately. The depth where the spring water is encountered shall be recorded.

The head of the artesian water and the discharge rate at a certain hight shall be measured by means of setting a packer immediately above the aquifer or incerting a pipe casing sufficiently deep in order to avoid the artesian water could dissipate from upper pervious layers. Relating information such as the devise adopted for this measurement, the diameter of pipes, etc., shall be recorded in detail.

2.5.6 CORE SAMPLES

The Contractor shall provide wooden core boxes as directed by the Engineer. Core samples taken from each borehole shall be placed in order in core boxes showing the depth of coring clearly. After placement in core boxes, the cores shall be photographed by the Contractor as directed by the Engineer.

Core samples of moistened soft rock shall be wrapped airtightly with transparent vinyl sheet before placed in a core box.

Necessary notes including borehole number and coring depth shall be attached on each core box. These core boxes shall finally be stored in the warehouse which will be indicated by the Engineer.

2.5.7 MARK OF DRILLED HOLE

After the completion of drilling of a hole, the hole shall be marked by means of furnishing a post above the hole as approved by the Engineer. The post shall be settled with concrete and/or mortar.

2.5.8 DAILY REPORT

The Contractor shall submit a daily report written in a form approved by the Engineer, regarding work progress and all findings for each drilling unit every day. The daily report shall include but not limited to the following items :

- Date,
- Location and the hole number,
- Diameter of the hole,
- Depth of pipe casing inserted,
- Water level in the hole and the time observed,
- Drilling time of each operation,
- Drilled depth of each operation and daily progress,
- Rate of water flow applied for drilling as well as return or loss of the injected water. Water loss and spring shall be recorded as detailed as possible together with the depth, if any.
- Color of water returned,
- Description of subsurface rock conditions and all findings obtained during the drilling
- Model of the drill used
- Name of the operator and recorder, and the number of workers.

The form of the daily report shall be prepared as approved by the Engineer in the expense of the Contractor.

If encountered any abnormality during the drilling work, the Contractor shall report to the Engineer as immediately as possible.

2.5.9 DRILL LOG

Drill logs shall be prepared for each hole by the Contractor in a logging form approved by the Engineer. The drill log shall contain, but not limited to the following items :

- Notes on the hole : name of the site and hole, coordinates, ground height, etc.
- Operational records : drilling date, hole depth and diameter, model of drill, kinds of bit, color of return water, water loss, water spring, drilling speed etc.
- Records of coring : core loss (or recovered percentage of core) RQD (or Rock Quality Designation), etc.
- Geological description : rock name, columnar section, conditions of weathering, fracturing and discontinuities, hardness and all other geological and engineering geological information obtained by careful observation of core samples.
- Personal names of the geologist who prepared the drill log and of in charge of the drilling operation.
- Other records : water table, permeability, resistivity of penetration test, etc.

2.6 FIELD PERMEABILITY TEST

2.6.1 GENERAL

In-situ permeability in the bedrock shall be determined in boreholes to be drilled by means of the water pressure test (or Lugeon test) stipulated below. In-situ permeability in soil (including sand and gravel deposits) and rock masses which are too soft or loose to set a sealing packer for the water pressure test shall be determined in boreholes by means of the open-end pipe test, if required by the Engineer.

2.6.2 WATER PRESSURE TEST

1) General Procedure

For the water pressure test (or Lugeon test) a plug seal (rubber packer) shall be inserted at about 5 m from the base of the hole and then water be applied under pressure through a pipe extending through the plug to the base of the hole. The flow of water shall be measured, at various pressure to be stipulated in the following Clause 2.6.2,2). The permeability of the

rock shall be assessed in both terms of Lugoen units and permeability coefficient.

2) Test Pressure and Observation

The test pressure for each section shall be changed at seven steps, namely 1 kg/cm^2, 4 kg/cm^2, 7 kg/cm^2, 10 kg/cm^2, 7 kg/cm^2, 4 kg/cm^2 and 1 kg/cm^2 in order ; the pressure as observed at the top of the injection pipe. In case that pressure does not rise high even under the pumping rate of more than 60 lit/min, because of much leakage, the test in the high pressure will be omitted, if approved by the Engineer.

Flow rate of injecting water shall be observed under each step of the pressure for 10 minutes after the flow rate becomes stable, and be recorded by every one minute.

Pressure gauge should be attached at the top of the injection pipe and below the manifold of the supply and return line. Height from the nech of the borehole to the pressure gauge shall be recorded.

3) Rejection of Foreign Material

The injection pipes shall be inspected before each use in order to confirm not clogged by soil, dust or other foreign materials. Water for the test shall be sufficiently clean. Use of turbid water shall be prohibited.

4) Experiment of Friction Loss in the Injection Pipe

The pressure applied at the neck of a hole is not entirely effective at the test section due to the loss of energy in flow through the injection pipe. Magnitude of the friction loss varies depending on the diameter, length and quality of the pipe. It should be determined for correction of the test result.

In advance to the commencement of all the water pressure test, an experiment for the friction loss shall be conducted. The injection pipes which are actually to be used shall be laid on the horizontal ground surface and jointed. Water shall be pumped from one end and discharged to the other end.

The water flow rate shall be controlled by the use of a side outlet valve, at 5 steps so that the pressure read at the pumping side changes at the same steps. This pressure may be regarded as the friction loss for each step of the flow rate. The pressure and the corresponding flow rates shall be recorded and plotted on a graph.

The above procedure shall be repeated for the lengths of jointed injection pipes of 12 m; 18 m; 24 m; 30 m and 36 m. Since the test length may not be exactly these values because of the odds in actual length of the pipes, the actual test length shall be measured and recorded.

The results of the experiment shall be plotted on a pressure-flow rate relation curve and be submitted to the Engineer together with the test record.

5) Calculation of Permeability

Results of the water pressure test shall be presented in Lugoen unit and Permeability Coefficient.

Lugoen Units (Lu)

$$Lu = \frac{Q}{L.P} \times 10$$

where, Lu : the Lugoen units,
Q : the constant rate of flow into the hole (lit/min),
L : the length of test section (m), and
P : the pumping pressure applied (kg/cm^2).

Permeability Coefficient

(from the packer test in "Earth Manual" USBR)

$$k = \frac{Q}{2\pi.L.H} \times \log_e \frac{L}{r}$$

where, k : the permeability coefficient (cm/sec),

Q : the constant rate of flow into the hole (cm^3/sec),

L : the length of test section (cm),

r : the radius of hole tested (cm), and

H : the differential head of water (cm)

$$H = H_p + H_o - H_f$$

H_p : the pumping pressure presented in height or water head (cm)

H_o : the static head from the middle part of the test section to the level of the pressure gauge (cm).
If groundwater table is higher than the middle part of the test section, H_o is the height from the groundwater table to the pressure gauge.

H_f : the friction loss corresponding to the length of the injection pipe and the injection rate (cm).

2.6.3 OPEN-END PIPE TEST

The test shall be made through the open-end of a pipe casing sunk to the depth to be tested. Before commencement of test, the inside of casing pipe shall be cleared of sand and fragments deep to the bottom and then the test be begun by adding clear water into the hole to maintain a constant head. Measurement of constant head, constant rate of flow into the hole, size of casing pipe, and elevation of top and bottom of casing shall be recorded. Test shall be continued until the rate of injecting flow into the hole becomes constant. The permeability shall be obtained from the following equation quoted from "Earth Manual" by USBR.

$$k = \frac{Q}{5.5.r.H}$$

where, k : the permeability coefficient (cm/sec),
Q : the constant rate of flow into the hole (cm^3/sec),
r : the internal radius of casing (cm), and
H : the differential head of water (cm).

2.6.4 DAILY REPORT

The Contractor shall submit the daily report of the field permeability test for each test stage in a form approved by the Engineer. The report shall include, but not limited to, the following information.

- Date
- Groundwater level in the hole measured before starting the day's work as well as before testing
- Height of the pressure gauge measured from the neck of the borehole,
- Depth of the packer setting and the bottom of the borehole as measured from the neck of the hole. Diameter of the borehole,
- Pumping pressures and flow rate of injecting water as observed every minute in the duration of test for 10 minutes,
- Lugoen and permeability coefficient determined
- Name of the personnel in charge.

2.7 STANDARD PENETRATION TEST (SPT)

2.7.1 PROCEDURE

Standard penetration test using the Raymond sampler and drive hammer shall be performed at 2 m interval of depth in a drilling hole, following the progress of the core drilling work. In advance of each test, slime and sediment in the bottom of the hole shall be removed. The sampler shoe with broken or worn edge shall not be allowed to use.

The Raymond sampler connected with drill rod shall be inserted to the bottom of the hole, and driven as a pre-knocking by 15 cm by blow of the hammer on the knocking block attached to the rod. After the above preminary penetration of 15 cm, the test shall be started.

The sampler shall be driven by 30 cm by the blow of the drive hammer freely dropped from 75 cm of height, and the number of blows shall be recorded for every 10 cm of penetration.

In case that the penetration is less than 30 cm at 50 times of blow, the depth of penetration at 50 blows shall be recorded and the test will be finished, unless otherwise directed by the Engineer.

2.7.2 DAILY REPORT

The results of the standard penetration test shall be recorded on the daily report of the core drilling. The record shall include, but not limited to, the following information.

- Depth of the test
- Number of blows for every 10 cm penetration
- N-value, or the number of blow for 30 cm penetration.

2.8 EQUIPMENT

All drilling and testing equipment used shall be of a type, capacity and mechanical condition suitable for doing the work as determined by the Engineer. The power and equipment and the layout and transportation thereof shall meet all applicable requirements of local and government regulations and codes both safety and otherwise. The Contractor shall submit for approval of the Engineer an equipment list and operation plan including water supply and transportation route prior to the commencement of the work.

1) Drilling machine. Hydraulic feed, rotary type core-drills with

sufficient capacity shall be used. A wire-line type core drill shall be used for a hole (or holes) deeper than 300 m.

2) Drilling pump. Reciprocating piston type, with capacity not less than 100 liters per minute in discharge and 15 kg/cm^2 in pumping pressure shall be provided. For the water pressure test, the Contractor shall used a pump with sufficient capacity to obtain the maximum pressure planned, unless otherwise approved by the Engineer.

3) Core barrels. Core barrels shall be double tube coring type. The inside diameter of core barrels shall be not less than 47 mm and the outside diameter of bits fit for core used shall be not less than 64 mm. Double tube core barrels with a devise for protecting drilling core by extensive plastic-cover (such as GI-type core barrel) shall be used for drilling in rock, if required by the Engineer.

4) Packer for the water pressure test. Packer shall be pneumatic or mechanical expansion rubber type fit for the drilled hole in order to seal a testing section even under the maximum pumping pressure specified.

5) Standard penetration testing. All tools need for the standard test shall be of a make and device that meets the standard of ASTM or JIS. The Raymond sumpler shall have the outside diameter 51 mm, the inside diameter 35 mm and the length 810 mm. The drive hammer shall be 63.5 kg in weight, with a hole in the center for drill rod to pass.

All equipments, inlcuding the above, shall be put to use only under the Engineer's approval. The Contractor shall replace any equipments which is not appropriately functioning to meet the purpose of the work as judged by the Engineer, even if the equipment had once been approved.

2.9 MEASUREMENT AND PAYMENT

2.9.1 MOBILIZATION AND DEMOBILIZATION

Measurement will be made of the lump sum.

Payment will be made for the lump sum at the Contract price for the Item "Mobilization and Demobilization" and shall constitute full compensation for mobilization, transportation, preparation and withdrawal of all man-power, equipment, tool, material and accomodation necessary for the execution of the work prior to, during and after the field operation inlcuding to get right of way and necessary expense to meet all applicable requirements of local and governmental regulations and codes.

Payment will be made half after sufficient man-power, equipment, tools, materials and accomodation for the execution of the work have been mobilized in the site as judget by the Engineer. Payment of the remaining half will be made after the completion of the work including clearing the site, withdrawal and submission of all field data, sample and report.

2.9.2 SETUP AND DISMANTLE

Measurement will be made of the number of holes actually drilled in confirmity with this specification regardless the diameter, depth and inclination of hole.

Payment will be made for the number of holes as provided above at the Contract unit price per hole for the Item "Setup and Dismantle of Drilling Equipment", and shall constitute full compensation for setup and dismantle of drilling equipment including transportation from hole to hole and all other related work such as laying a water supply system.

2.9.3 CORE DRILLING

Measurement will be made of the number of linear meters of boreholes actually drilled by rotary coring methods and accepted in soil and rock from surface for each of the classifications for the various Items in the Bill of Quantities. The classifications for the various Items in the Bill of Quantities are of the drilled materials, i.e. soil or rock, and of the drilled depth, i.e. not deeper than 200 m or deeper than 200 m : and the linear meter to be considered under an Item shall be the linear meter within the classified material and/or depth section. The diameter larger than specified and inclination of holes will not be taken into account.

Payment will be made for the number of linear meters measured as provided above at the respective Contract unit prices per linear meter for "Core Drilling : Soil" "Core Drilling : Rock : Not Deeper than 200 m" and "Core Drilling : Rock : Deeper than 200 m" ; and shall constitute full compensation for drilling and all other work related to the Item inlcuding furnishing and storing of core sample boxes, taking and submitting photographs of core samples and reporting.

2.9.4 FIELD PERMEABILITY TEST

Measurement will be made of the number of test stages actually performed, recorded and reported in accordance with this Specification.

Payment will be made for the number of test stages as provided above at the Contract unit price per stage for the Item "Field Permeability Test", and shall constitute full compensation for field permeability testing and all other work related to the Item.

2.9.5 STANDARD PENETRATION TEST

Measurement will be made of the number of test points actually performed, recorded and reported in accordance with this Specification.

Payment will be made for the number of test points as provided above at the Contract unit price per point for the Item "Standard Penetration Test", and shall constitute full compensation for standard penetration testing and all other work related to the Item.

III SEISMIC REFRACTION PROSPECTING

3.1 SCOPE

These specifications cover the performance of the seismic refraction prospecting which is necessary to investigate the geological conditions of the Project in connection with the entire Contract. The work includes but not limitted to the following items :

1) establishing the detailed working plan including list of equipment and personnel, and a table of schedule,

2) mobilization and site preparation including to get right of way and to make foot passes, if necessary,

3) procurement of tools and materials including explosives,

4) field operation of seismic refraction prospecting including profile survey of prospecting lines,

5) producing time distance curves and interpretation,

6) demobilization and site clearing,

7) reporting.

3.2 GENERAL

The work shall be performed for the purpose of obtaining geological and engineering geological data about subsurface conditions of the proposed sites such as for main structures, construction material sources and other related to the Project. Prospecting shall be made by the seismic refraction method.

3.3 PROGRAMME

The programme shown on the Figures and described herein is tentative and is presented for the purpose of obtaining comparative tenders. The location,

arrangement and length of prospecting lines shown on the Figures will be subject to the Engineer's revision as necessary to reveal the site subsurface conditions according to the progress of the investigation.

Seismic refraction prospecting lines will be located in the damsite, other main structures sites, quarry sites and other related to the Project. Exact prospecting location will be instructed in the site and/or shown on a map to be furnished prior to the start of the work.

The total prospecting length will be 9,600 m; out of which 6,600 m will deployed in the damsite and other main structures sites, and the remains will be in alternative sites for quarry.

The geological investigation plan shown in Fig. 2 is of the preliminary stage which will be carried out within the year of 1985 prior to the main stage investigation to be covered by this Contract. Fig. 3 shows a possible geological investigation plan of the dam and power station sites for the main stage based on the assumption that the alternative damsite-A would be selected in the preliminary stage study. A quaryy site (or Quarry sites) to be investigated will be determined in hills or mountains within the area of 20 km in radius from the damsite, before the start of the main stage investigation.

3.4 WORKING PLAN

The Contractor shall submit a working plan prior to the start of the field operation for the approval of the Engineer. Field operation shall meet all applicable requirements of local and government regulations and codes of safety and otherwise.

3.5 EQUIPMENT

All prospecting equipment used such as detector, aplifier and oscillograph shall be of a type, sensitivity and mechanical condition suitable for doing the work as determined by the Engineer. An amplifier and an oscillograph with 24 channels will be acceptable.

3.6 FIELD OPERATION

3.6.1 GENERAL

The arrangement of shots and detectors shall be planned to be laid out on a line (profile shooting). Before the field recording begins, ground surface profiles shall be surveyed and shot and detector stations shall be marked by stakes.

In a cycle of operation, the distance range shall be arranged in such a manner that five or six shots of 50 m or 100 m intervals are picked up by detectors being spread at regular intervals of 5 m in the main structure sites, and of 10 m in the quarry sites.
The shot locations and detector spreads of one operation cycle shall be moved progressively to give complete coverage over the refraction prospecting lines.

3.6.2 HANDLING OF EXPLOSIVE

Shooting shall be effectively and safely made with subsurface explosion in hand-dug pits or auger holes by using dynamite and electric instantaneous detonators. Prior to the shooting, adequate warning shall be given to the personnel working at the site, and to the residents or passers-by at and arround the site.

The Contractor shall always maintain the qualified personnel in the field to secure the safety of the explosion. Any accident caused on the explosion or the related procedures shall be due to the responsibility of the Constractor.

3.6.3 INTERVAL OF DETECTORS

Detectors shall be spread on a line at regular intervals of 5 m for the prospecting of the main structures sites, and at regular intervals 10 m for the prospecting of the quarry site (or sites).

3.6.4 PROFILE SURVEY

The elevation of each receiving point shall be surveyed by leveling or stadia survey, and the topographic profile along the prospecting line shall be drawn in the scale of 1:500.

3.6.5 SHOT POINTS

Shots shall be done on a line at every 50 m or 100 m interval, unless otherwise approved by the Engineer. Shots shall be made at five points in one "spread" of operation at least. The number of shots shall be more, if necessary for the prospecting as directed by the Engineer. At both the ends of each spread, shooting points shall always be located. Remoted or offset shooting shall be made, unless otherwise approved by the Engineer.

3.6.6 FIELD OBSERVATION

A cycle of spreading, shooting and recording of a spread shall be continued until the whole prospecting line is covered throughly. When the record of a spread is not clear, shooting and recording shall be repeated. Each end of a spread shall be overlapped by the adjoining spread so as to obtain the complete coverage of a prospecting line.

3.7 INTERPRETATION

The results obtained through the field operation shall be plotted on the time-distance curve and shall be interpreted in stratified seismic wave speed layers by an authorized method approved by the Engineer.

The procedure and auxiliary lines used to deduce stratified seismic wave speed layers from time-distance curves shall be clearly shown on the time-distance curves and explained in the report, such as T' curve of the

differecial method. Abnormal and/or conspicuous phenomina, if any, shall be reported to the Engineer, such as discotinuous time-distance curve and reversed speed layers.

The deduced seismic wave speed layers shall be explained on the profiles. Topographic profiles shall be drawn from the survey results of the receiving points.

The profiles of seismic speed layers shall be interpreted from geological and engineering geological aspects correspondingly with the results of other geological investigation items such as the surface geological survey, core drilling and laboratory rock testing.

3.8 REPORT

The report shall include but not limited to the following items :

1) purpose of the work including outline of the Project and topography and geology of the site,
2) location and arrangement of seismic refraction prospecting lines,
3) work volume and period,
4) list of equipment used, materials consumed, and personnel engaged,
5) methodology adopted for interpretation,
6) time-distance curves,
7) speed layer profiles,
8) discussion on the deducted speed layers and corresponding geological and engineering geological conditions of the site,
9) conclusion.

Records of oscillograph shall be submitted to the Engineer with necessary explanation such as the rolling speed, shot point and first arrival of seismic wave.

3.9 MEASUREMENT AND PAYMENT

Measurement will be made of the number of kilometers of the length of seismic refraction prospecting lines actually spreaded, shooted, recorded. interpreted and accepted for each of the classifications of the intervals of detectors for the items in the Bill of Quantities. The classifications are the intervals of detectors in a spread, i.e., "5 m intervals" and "10 m inetervals"

Payment will be made for the number of kilometers measured as provided above at the respective Contract unit prices per meter for "Seismic Refraction Prospecting : 5 m intervals" and "Seismic Refraction Prospecting : 10 m intervals", and shall constitute full compensation for the seismic refraction prospecting and all other work related to the Items such as preparation, procurement, field operation, interpretation and reporting.

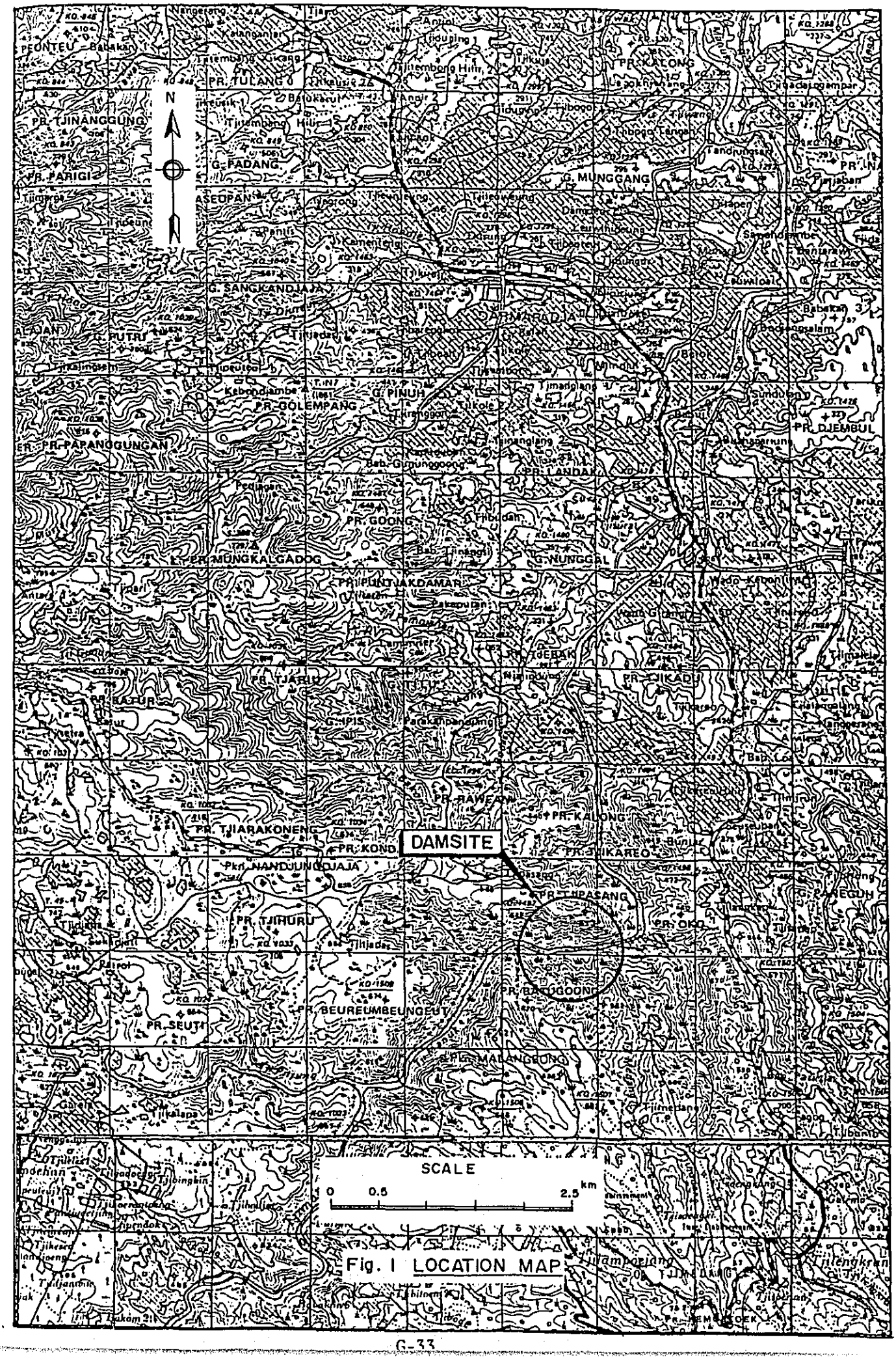
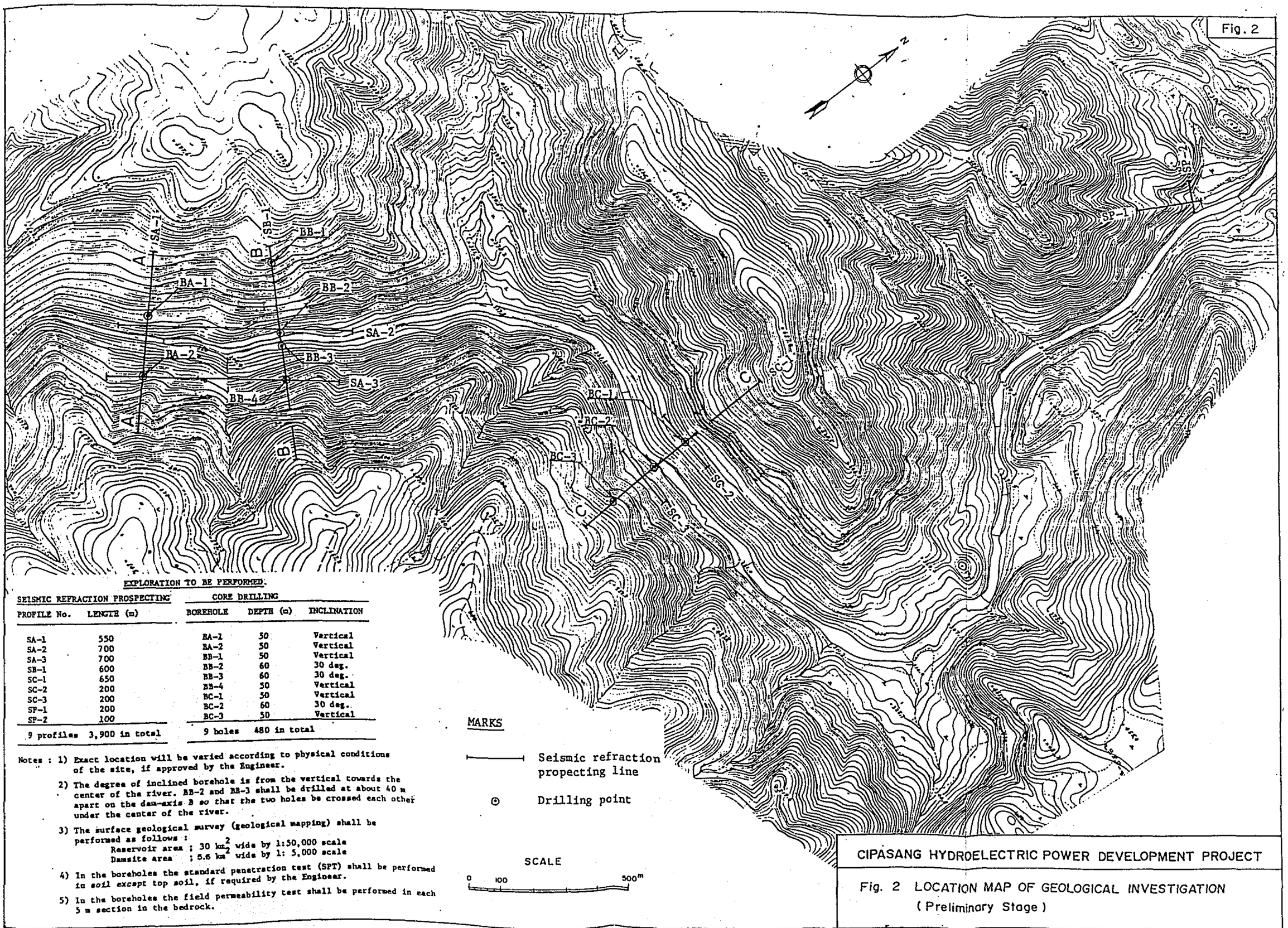


Fig. 1 LOCATION MAP

Fig. 2



EXPLORATION TO BE PERFORMED.

SEISMIC REFRACTION PROSPECTING		CORE DRILLING		
PROFILE No.	LENGTH (m)	BOREHOLE	DEPTH (m)	INCLINATION
SA-1	550	BA-1	50	Vertical
SA-2	700	BA-2	50	Vertical
SA-3	700	BB-1	50	Vertical
SB-1	600	BB-2	60	30 deg.
SC-1	650	BB-3	60	30 deg.
SC-2	200	BB-4	50	Vertical
SC-3	200	BC-1	50	Vertical
SP-1	200	BC-2	60	30 deg.
SP-2	100	BC-3	50	Vertical
9 profiles	3,900 in total	9 holes	480 in total	

Notes : 1) Exact location will be varied according to physical conditions of the site, if approved by the Engineer.

2) The degree of inclined borehole is from the vertical towards the center of the river. BB-2 and BB-3 shall be drilled at about 40 m apart on the dam-axis B so that the two holes be crossed each other under the center of the river.

3) The surface geological survey (geological mapping) shall be performed as follows :
Reservoir area ; 30 km^2 wide by 1:50,000 scale
Damsite area ; 5.6 km^2 wide by 1: 5,000 scale

4) In the boreholes the standard penetration test (SPT) shall be performed in soil except top soil, if required by the Engineer.

5) In the boreholes the field permeability test shall be performed in each 5 m section in the bedrock.

MARKS

Seismic refraction propecting line

Drilling point

SCALE

0 100 500m

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT

Fig. 2 LOCATION MAP OF GEOLOGICAL INVESTIGATION
(Preliminary Stage)

Fig. 3

LEGEND

Seismic Refraction Profile:
to be performed in the preliminary stage

Seismic Refraction Profile:
proposed for the main stage

Core Drilling:
to be performed in the preliminary stage

Core Drilling:
proposed for the main stage

N

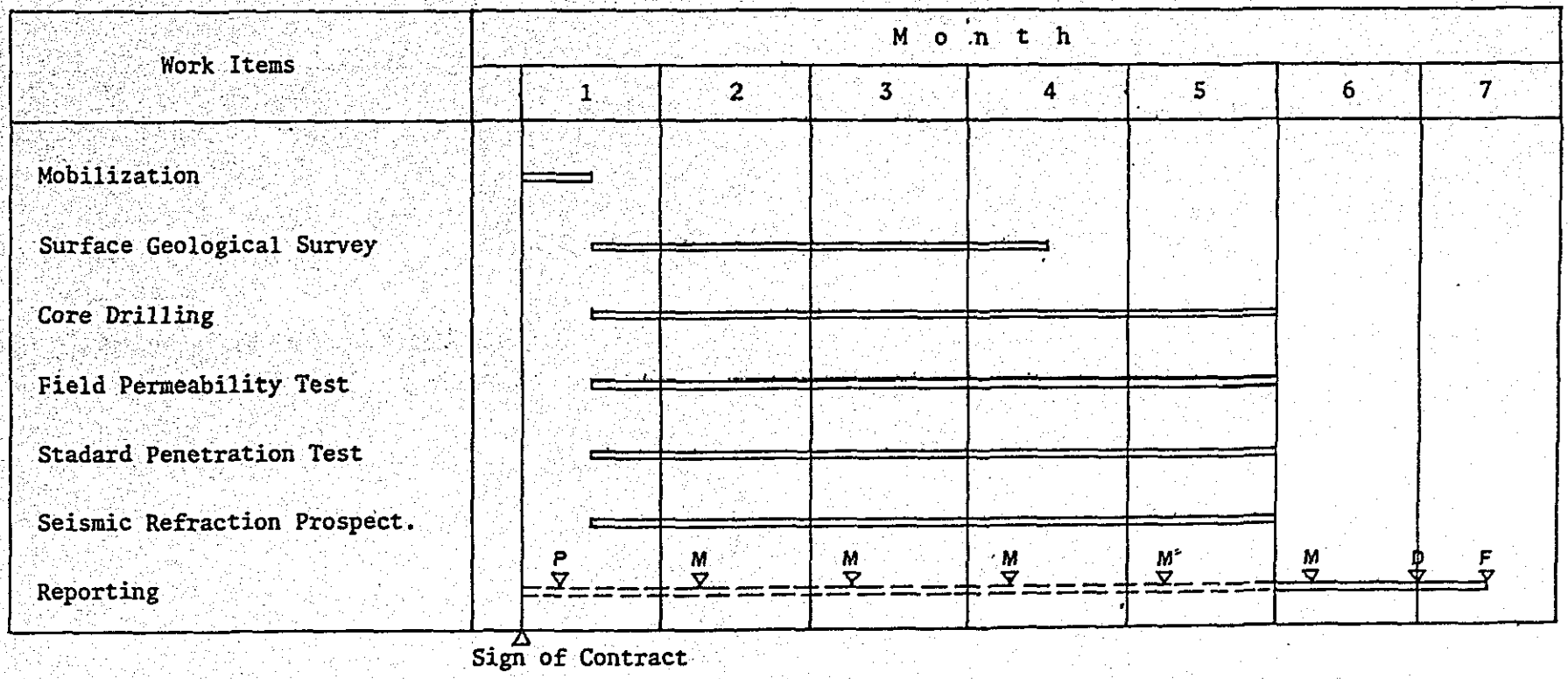
SCALE
0 100 500m

Note : This investigation plan has been made tentatively based on the assumption that the alternative damsite-A would be selected so as to be varied according to the results of the preliminary stage study.

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT

Fig. 3 GEOLOGICAL INVESTIGATION PLAN FOR THE MAIN STAGE

Fig. 4 SCHEDULE OF GEOLOGICAL INVESTIGATION



Reports ; P : Investigation Programme Report
M : Monthly Report
D : Draft Final Report
F : Final Report

Table-1 BILL OF QUANTITIES

I t e m s	Unit	Quantity	Unit Price (Rp.)	Amount (Rp.)
I Surface Geological Survey				
I-1 Map Scale 1:5,000	km^2	5.0		
I-2 Map Scale 1:1,000	km^2	5.0		
I-3 Surface Soil Stripping	m^3	20		
II Core Drilling				
II-1 Mobilization and Demobilization	Lot	1		
II-2 Setup and Dismantle of Drilling Equipment	hole	34		
II-3 Core Drilling : Soil	m	250		
II-4 Core Drilling : Rock:Not deeper than 200 m	m	2,250		
II-5 Core Drilling : Rock Deeper than 200 m	m	500		
II-6 Field Permeability Test	stage	400		
II-7 Standard Penetration Test	point	50		
III Seismic Refraction Prospecting				
III-1 Seismic Refraction Prospect : 5 m intervals	km	6.6		
III-2 Seismic Refraction Prospect :10 m intervals	km	3.0		

SPEC. No. 4

CIPASANG HYDROELECTRIC POWER DEVELOPMENT PROJECT

TECHNICAL SPECIFICATIONS

FOR

METEORO-HYDROLOGICAL SURVEY

RUNOFF MEASUREMENT
SEDIMENT LOAD MEASUREMENT
WATER QUALITY TEST
METEOROLOGICAL OBSERVATION
CONSTRUCTION OF CABLEWAY

CONTENTS

1. SCOPE OF WORKS

The following table shows the work items of the meteoro-hydrological survey in the Main Investigation Stage.

Table H-1 Summary of meteoro-hydrological survey

Work item	Quantity	Remarks
(1) Discharge measurement		by currenmeter
- Low water stage	14 times	(Apr.'86 - Mar.'87)
- Intermediate water stage	14 "	
(2) Flood discharge measurement	7 "	by float basically
(3) Sediment load measurement		
- Water sampling in low water stage	10 "	(Apr.'86 - Mar.'87)
- " in intermediate water stage	10 "	
- " of flood discharge	10 "	
- Analysis of the water taken	90 samples	suspended load concentration
(4) Water quality test		
- Water sampling in low water stage	3 samples	(Apr.'86 - Sep.'86)
- " in intermediate water stage	3 "	
- Laboratory tests for the water taken	6 "	chemical analysis
(5) Meteorological observation		
- Evaporation	one per day	1 year (Apr.'86-Mar.'87)
- Rainfall	"	
- Temperature	"	
- Relative Humidity	"	
(6) Construction of Cableway		at gauging station

2. DISCHARGE MEASUREMENT

2.1 GENERAL

Current-meter measurements shall be made by the Contractor using the cableway in principle, to establsih the water discharge rating curve at the runoff gauging station installed by the local office concerned immediately downstream of the planned tailrace outlet of the Cipasang power station as shown on Fig. H-1. If the current-meter measurement can not be done due to many flowing obstacles, a float method shall be applied so as to meet the numbers of measurement times as shown in Table H-1 for the respective river water stages. The method of the runoff measurements specified in this Specifications is therefore, based on the gauging facilities as referred to Fig. H-4.

2.2 CURRENT-METER MEASUREMENT

Velocity measurement by a current meter will be made at every 2.5 m horizontal interval and at 0.2 and 0.8 of the water depth of vertical sections. In water depth less than 70 cm deep, the velocity shall be measured at 0.6 of the total depth from the water surface. The current-meter measurements shall be recorded on standard form similar to that shown in table H-2.

Using the OTT-75 kg single drum winch or equivalent, on OTT-C31 current-meter or equivalent and 50 kg middle piece (sinker weight) with groundfeeler, the sequence of operations at a measurement section is as follows :

1) to record the distance of the vertical section from a reference point using a tape, a tag line or cableway counter.

2) to lower a meter using winch untill groundfeeler just touches surface of water.

3) to set zero OTT winch counter.

4) to lower the curremt mater until grounfeeler just touches river bed.

5) to read and record depth of flow from winch counter.

6) to calculate and record 0.2 and 0.8 (or 0.6) depth.

7) to raise current mater to 0.8 (or 0.6) depth from surface (allowing for the distance between base of groundfeeler and centre line of current meter).

8) to count revolution pulses over a 50 sec. period (usually) and record it.

9) to raise current meter to 0.2 depth from surface (allowing for the distance between base of groundfeeler and centre line of current meter).

10) to count revolution pulses over a 50 sec. period and record it.

The example given in Table H-2 illustrates this method. The section to the left of the $\frac{N}{s}$ column is completed in the field and the remainder computed in the office as follows :

(1) The point velocity is obtained from $\frac{N}{s}$ and the current meter calibration formula for the current meter and propellor concerned.

(2) The mean velocity in the vertical is found by computing the average of the point velocities at depths 0.2 and 0.8 (or by repeating the 0.6 value in the case of single point measurement).

(3) The mean velocity in the area of the section between adjacent verticals is found by computing the average of the mean velocities in the adjacent verticals.

(4) The area of the section is computed by multiplying the section width by the mean section depth.

(5) The discharge through the section is then found by multiplying the sectional area (from (d) by the mean velocity in the section (from (c)).

(6) The total discharge is then found by totalling the discharge in the individual sections.

(7) The total discharge is normally plotted against the mean of the staff gauge heights at the beginning and end of the current meter measurement. In some cases zero flow corrections are made to the staff gauge heights by plotting the rating curve.

2.3 FLOAT MEASUREMENT

The sequence of the float measurement is as follows :

(1) To set the two measuring cross-sections,

(2) To measure the time required for the float to run from the upsteam section to the downstream section,

(3) To estimate the mean velocity by use of the observed velocity,

(4) To take the river cross-section by surveying after flood.

(5) To calculate the discharge by the following equation :

$$Q = \frac{AI + AII}{2} \times Vm \times F$$

Where, Q : Discharge (m^3/sec.)
AI : Sectional area of the upstream section (m^2)
AII : Sectional area of the downstream section (m^2)
Vm : Average travelling time of the floats between the the upstream and the downstream section (m/sec.)
F : Adjustment factor of float used

Surface float and vertical float (bamboo made) shall be used for the measurement of the velocity. The float applied in this Specification have, as a rule, a size specified in the following table. If, the specified float cannot be used due to flowing trees, plants and other obstacles, such flowing materials may be used as a surface float.

Float No.	Water Depth (m)	Stem of Float (m)
1	Shallower than 0.7	Surface Float
2	0.7 to 1.3	0.5
3	1.3 to 2.6	1.0
4	2.6 to 5.2	2.0
5	over 5.2	4.0

The stream width shall be divided into some sections to observe velocity. The size of a float is selected depending on the depth at each section. Then the time for the float to run from the upstream section to the downstream section is measured using a stopwatch.

In velocity measurement, the following manner shall be kept.

(1) The staff-gage must be read before and after every performance of observation.

(2) Velocity shall be read up to 0.1 second.

(3) If a float does not flow along the planned passage, it is tried again

Calculation of the discharge shall be made regarding the following matters:

(1) In calculating the average sectional area of the segments of the upper and lower sections, the segments of each section that are located just opposed to each other shall be taken, and an average shall be obtained.

(2) In this case, the average of the water level measured at the beginning and ending of the observation shall be used. The sectional area shall be obtained by trapezoid method.

(3) The above average sectional area shall be obtained separately on the basis of each cross-sectional survey performed before and after flood.

(4) The velocity, which is measured with floats and multiplied by coefficient of variation, is to be taken as the revised value of the velocity. These coefficients of variation for the floats are as shown below.

No. of Float	Float (m)	Adjustment factor
1	Surface float	0.85
2	0.5	0.88
3	1.0	0.91
4	2.0	0.94
5	4.0 and over	0.96

(5) Discharge is the total of revised velocity multiplied by the sectional area of the segments.

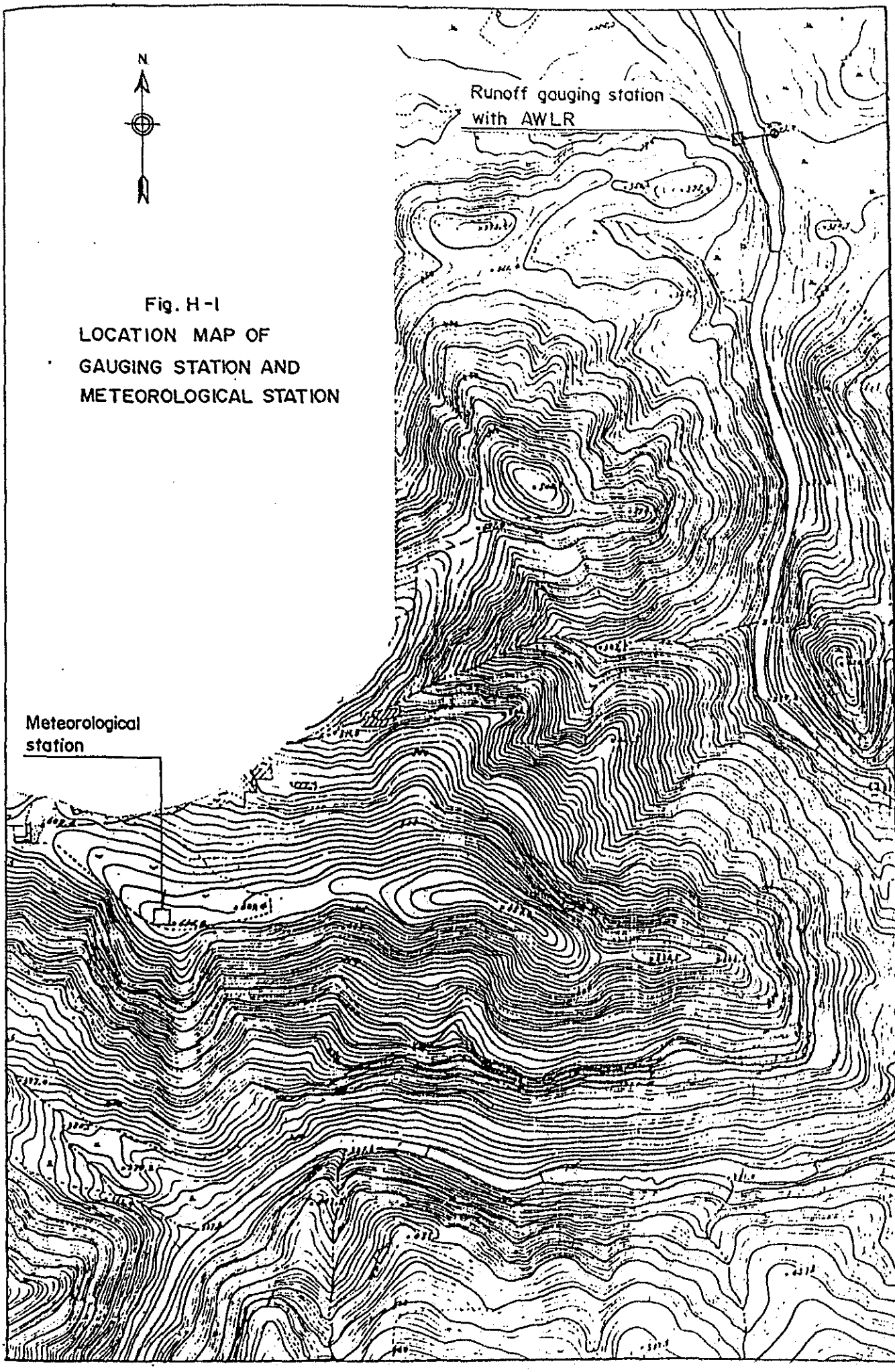


Fig. H-1
LOCATION MAP OF
GAUGING STATION AND
METEOROLOGICAL STATION

TABLE H-2

CURRENT METER DISCHARGE MEASUREMENT

RIVER CIMANUK STATION NO..... STATION NAME .....

MEASUREMENT NO..... LOCATION ..... METHOD OF MEASUREMENT .....
at 0.2 & 0.8 of total depth
or at 0.6 of total depth

STAFF GAUGE HEIGHT mm

	River	Canal	Time & Date
Start	.....	.....	.....
Finish	.....	.....	.....

INSTRUMENT TYPE OTTC 31

INSTRUMENT NO. .....

GATE OPENINGS PROPELLOR NO.....

Spendle Height 1.... cm 2....cm 3....cm TEAM CIPASANG HYDROPOWER - JICA

DIST FROM INITIAL POINT	DEPTH TOTAL d	DEPTH OBSERVATION	NO OF REVS N	TIME Sec. s	N/s	VELOCITY AT POINT	VELOCITY MEAN IN VERTICAL	MEAN IN SECTION	AREA m²	MEAN DEPTH m	WIDTH m	Q m³/s	REMARKS
	0	0	-	VELOCITY 80%		0.255	0.255						
								0.287	0.38	0.15	2.5	0.11	
2.5	0.30	0.18	60	50	1.20	0.319	0.319						
								0.296	0.94	0.375	2.5	0.28	
5.0	0.45	0.27	51	50	1.02	0.272	0.272						
								0.301	1.06	0.425	2.5	0.32	
7.5	0.40	0.24	62	50	1.24	0.329	0.329						
								0.327	0.99	0.395	2.5	0.32	
10.0	0.39	0.24	61	50	1.22	0.324	0.324						
								0.304	0.99	0.395	2.5	0.30	
12.5	0.40	0.24	53	50	1.06	0.283	0.283						
								0.299	1.01	0.405	2.5	0.30	
15.0	0.41	0.24	59	50	1.18	0.314	0.314						
								0.319	1.03	0.41	2.5	0.38	
17.5	0.41	0.24	61	50	1.22	0.324	0.324						
								0.324	1.01	0.405	2.5	0.33	
20.0	0.40	0.24	61	50	1.22	0.324	0.324						
								0.322	1.00	0.40	2.5	0.32	
22.5	0.40	0.24	60	50	1.20	0.319	0.319						
								0.324	1.00	0.40	2.5	0.32	
25.0	0.40	0.24	62	50	1.24	0.329	0.329						
								0.322	1.00	0.40	2.5	0.32	
27.5	0.40	0.24	59	50	1.18	0.314	0.314						
								0.299	1.00	0.40	2.5	0.30	
30.0	0.40	0.24	53	50	1.06	0.283	0.283						
								0.312	0.81	0.325	2.5	0.25	
32.5	0.25	0.15	64	50	1.28	0.340	0.340						
								0.306	0.50	0.125	4.0	0.15	
36.5	0	0	-	VELOCITY 80%		0.272	0.272						
								TOTAL	12.72		TOTAL	3.95	

3. SEDIMENT LOAD MEASUREMENT

The technique described in this Specifications is the Equal Transit Rate Integrated Depth method of obtaining a suspended sediment sample along a vertical line between the water surface and the river bed. The sampler, which is streamlined to present a nozzle intake to the flow, is lowered to the bed and raised again to the surface at a constant rate (the transit rate). This rate is selected such that the water sediment sample flows continuosly into the sampling bottle throughout both the downward and upward movements of the sampler equipment. If a single transit rate is used on all selected verticals of a cross section, the samples collected from each vertical may be composited to form a representative sample of the entire cross section at the station.

3.1 FIELD EQUIPMENT

The following equipment is required in the field :

(1) Standard current matering equipment

(2) US D 49 cable suspension sampler, for boat derrick or cableway measurements.

(3) Sampler nozzles -1/8", 3/16" and 1/4" diameter.

(4) Sampling bottles to fit sampler - 1 U.S. pint size (473 ml).

(5) Plastic sample containers and carrying crate.

(6) Stopwatch.

3.2 SAMPLING PROCEDURE

The Equal Transit Rate (ETR) method shall be applied for the suspended load sampling at the discharge gauging station. The sampling Procedure is as follows :

(1) Sampling positions shall be selected at least 3 points on a cross-sectional direction ($\frac{1}{4}$ 1, $\frac{1}{2}$ 1 and $\frac{3}{4}$ 1).

(2) Velocity measurement by using the current-meter shall be made at the selected positions, which is the same method described in the previous section.

(3) The sampling of the water shall be made by using D49 cable suspention sampler with suitable nozzle to be selected on the basis of Fig. H-2 and H-3.

(4) The gauge height of the discharge gauging station shall be recorded before and after the sampling.

(5) The river water temperature shall be measured.

(6) The following informations shall be written on the plastic sample bottle after collecting the water :

Bottle No. (in order of sampling)
Station Name
Date
Time
Gauge Height
Distance from initial point (bank, etc.)
Water Temperature

These details shall also be entered on the field sheet along with the depth and velocity at the section.

(7) Sample bottles shall be sealed, replaced in the crate and kept in the shade until they reach the laboratory.

3.3 SUSPENDED LOAD ANALYSIS

The samples of sediment laden water collected shall be sent to authorized laboratory for analysis to quantity the total sediment content of the sample, so that ultimately, a relationship between flow suspended sediment transport over the full range of discharge could be produced as specified in Table H-1.

Resulting the laboratory analysis, the concentration of the suspended load shall be arranged using the following table.

Sample No.	Date Time	Gauge height (m)	Discharge (m^3/sec.)	Concentration of Suspended load (mg/l)	Sediment discharge (kg/sec)
1					
2					
.					
.					
.					
.					
30					

4. WATER QUALTITY TEST

To clarify the content of chemical elements in the river water, water samples shall be collected from the gauging station of the Cipasang damsite. In order to find seasonal fluctuation of the chemical elements, if any, the water sampling shall be made for 3 times at low water in the dry season and 3 times at high water stage in the rainy season.

The laboratory tests for water quality analysis shall be carried out regarding the following chemical elements and characteristics.

- PH, Alkalinity and Acidity
- Sulfate (SO_4)
- Silica (SiO_2)
- Borron (B)
- Sodium (Na)
- Magnesium (Mg)
- Pottasium (K)
- Calsium (Ca)
- Maganese (Mn)
- Iron (Fe)
- Bicarbonat (HCO_3)
- Nitrate Nitrogen (NO_2, NO_3)
- Anmonia Nitrogen

5. METEOROLOGICAL OBSERVATION

5.1 CONSTRUCTION OF METEOROLOGICAL STATION

The meteorological station shall be constructed by the Contractor at the Cipasang damsite as shown on Fig. H-1.

The following conditions shall be satisfied on the construction of the meteorological station :

(1) Right of way for the station shall be fenced by wire net (8 m x 5 m) including 1 m gate as suggested in page IV of "Guidance Book of Climatology" issued by DPMA in September 1983.

(2) Surrounding of the station shall be freed from threes and buildings.

(3) Weeds in/around the station shall be cut so as not to give harmful effects for the observation.

5.2 DAILY RAINFALL

To adjust the evaporation data obtained from observation of daily evaporation, the daily rainfall shall be measured by the Contractor using automatic rain gauge (weekly recording tipping backet type-LAMBRECHT HELLMAN Type No. 1507) and manual type rain gauge (No. 1500).

The daily rainfall shall be recorded at 7:00 AM every day and be processed using Table H-4.

5.3 PAN EVAPORATION

Class A evaporation pan shall be installed at the specified meteorological station, while a micrometer hook gauge is to be supplied by PLN to the Contractor. The evaporation shall be observed at 7:00 AM daily and be recorded in Table H-4. The observation method of the evaporation in detail is referred to the "Guidance of Climatology".

5.4 TEMPERATURE

The air temperature shall be measured at the specified meteorological station using a thermohygrograph (THIES Type) with supporitng maximum, minimum and ordinary (dry bulb) thermometers. Detailed methods for recording and computing the temperature are referred to the "Guidance Book of Climatology". The daily maximum minimum and mean temperatures are summarized onto a form as shown in Table H-4.

5.5 RELATIVE HUMIDITY

The relative humidity of the Cipasang damsite shall be measured at the specified meteorological station using the thermohygrograph as mentioned in 5.4. Instantaneous values of the relative humidity can also be obtained using the wet and dry bulb readings. The daily mean, maximum and minimum relative humidities are summarized in Table H-4.

6. CONSTRUCTION OF CABLEWAY

In order to carry out the current-meter measurement and the sediment load sampling at the runoff gauging station, the cableway shall be constructed by the Contractor in accordance with Fig. H-4, H-5 and H-6.

For current meter measurements, an OTT 75 kg single drum winch shall be brought to the site and mounted on the table made on the winch frame as shown on Fig. H-4. The suspension/conductor cable shall be passed over the wooden pulley on the traveller and the current meter connected to the cable ready for use.

Table H-3 SEDIMENT SAMPLING FIELD SHEET

RIVER : ..... DATE : .....

STATION : .....

NUMBER : ..... OBSERVERS : .....

DISTANCE FROM Ip	DEPTH	VELOCITY	VELOCITY x DEPTH	FOR LARGEST VELOCITY x DEPTH CALCULATE TRANSIT RATES			SELECTED NOZZLE	SELECTED TRANSIT RATE	TRANSIT TIME FOR EACH VERTICAL	BOTTLE NO	TIME	TEMP	REMARKS
				1/8"	3/16"	1/4"							
m	m	m/s						m/s	s		hr. min.	°C	

TABLE H-4

CLIMATOLOGICAL DATA - DAILY VALUES

STATION NO.: STATION NAME: MONTH: YEAR:

ALTITUDE: m LATITUDE: E LONGITUDE: S

DAY	TEMPERATURE °C			RELATIVE HUMIDITY %			SUN. HRS.	RADIATION Cal/cm²/ day	WIND		PAN mm	PRECIP-ITATION mm
	Max.	Min.	Mean	Max.	Min.	Mean			Run km/day	Dir.		
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
Mean 10 - day												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
Mean 10 - day												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Mean 10 - day												
Mean Monthly												

Fig. H-2

SUSPENDED SEDIMENT SAMPLING EQUAL TRANSIT RATE METHOD NOMOGRAPH FOR ESTIMATING TRANSIT TIME AND RATE

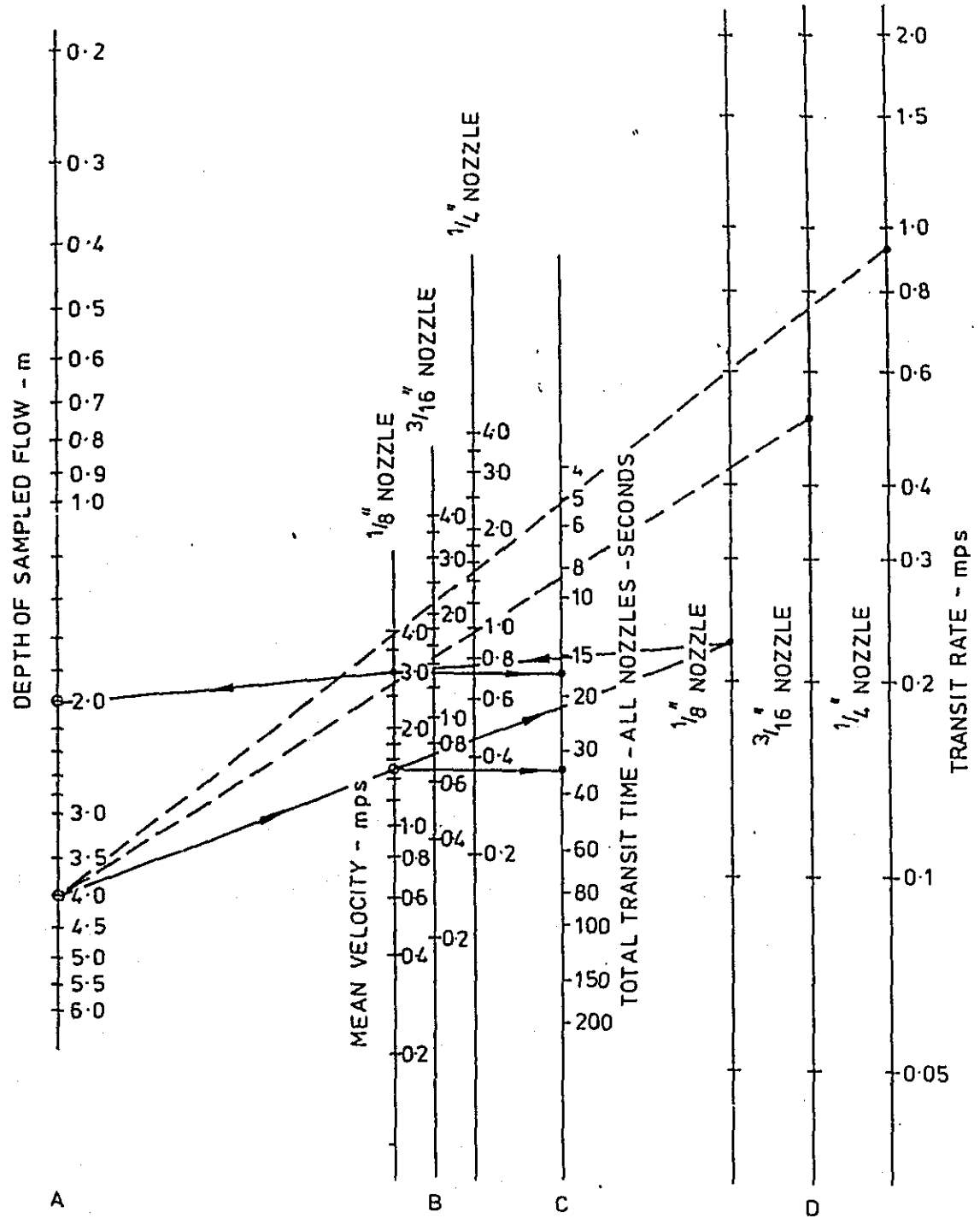
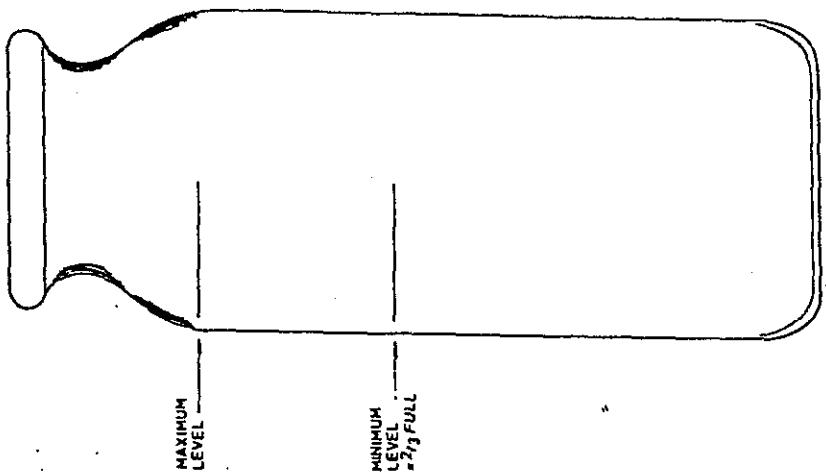


Fig. H-3



SEDIMENT SAMPLING BOTTLE
CAPACITY 1 U.S. PINT OR 473 ml

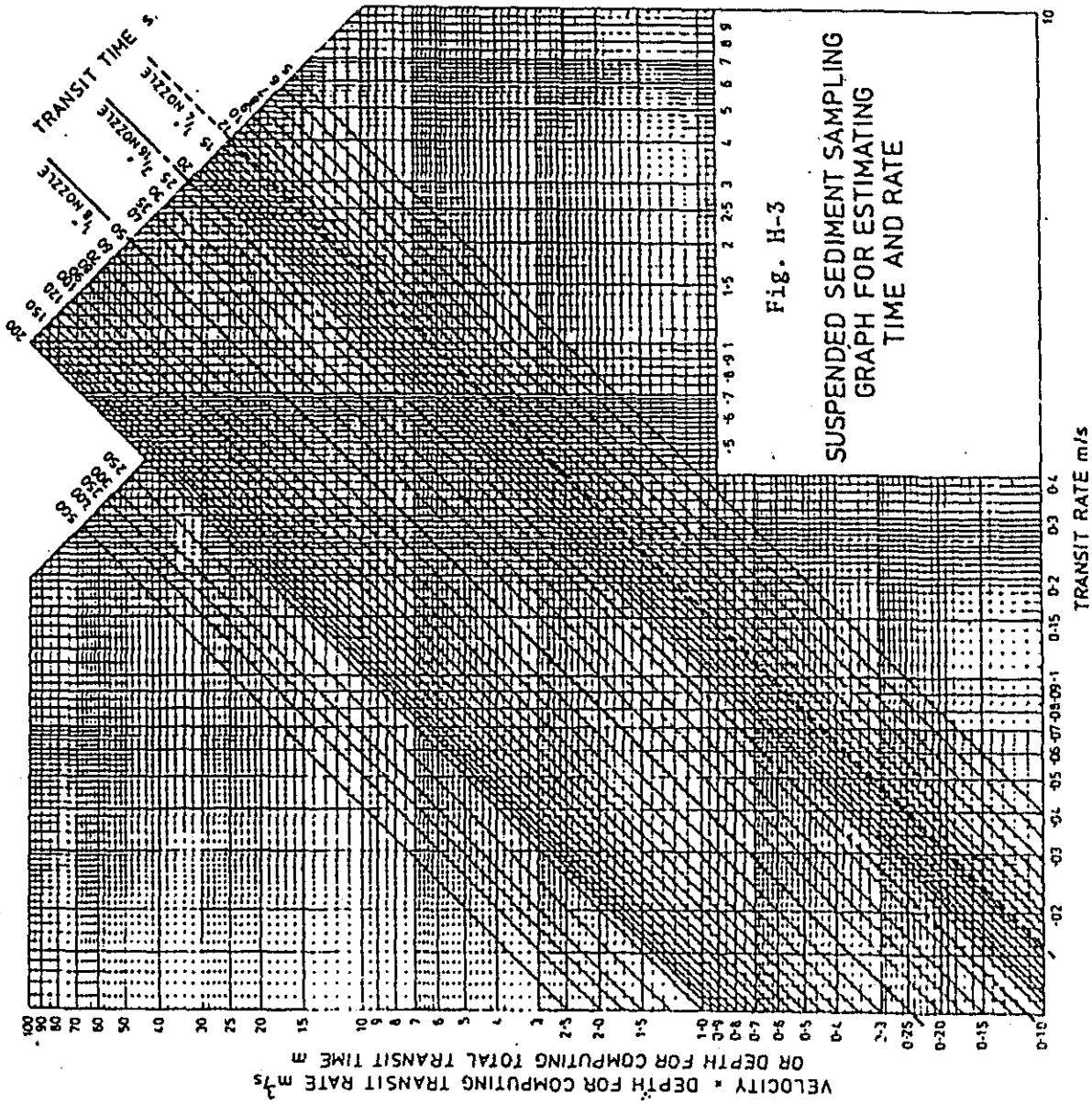
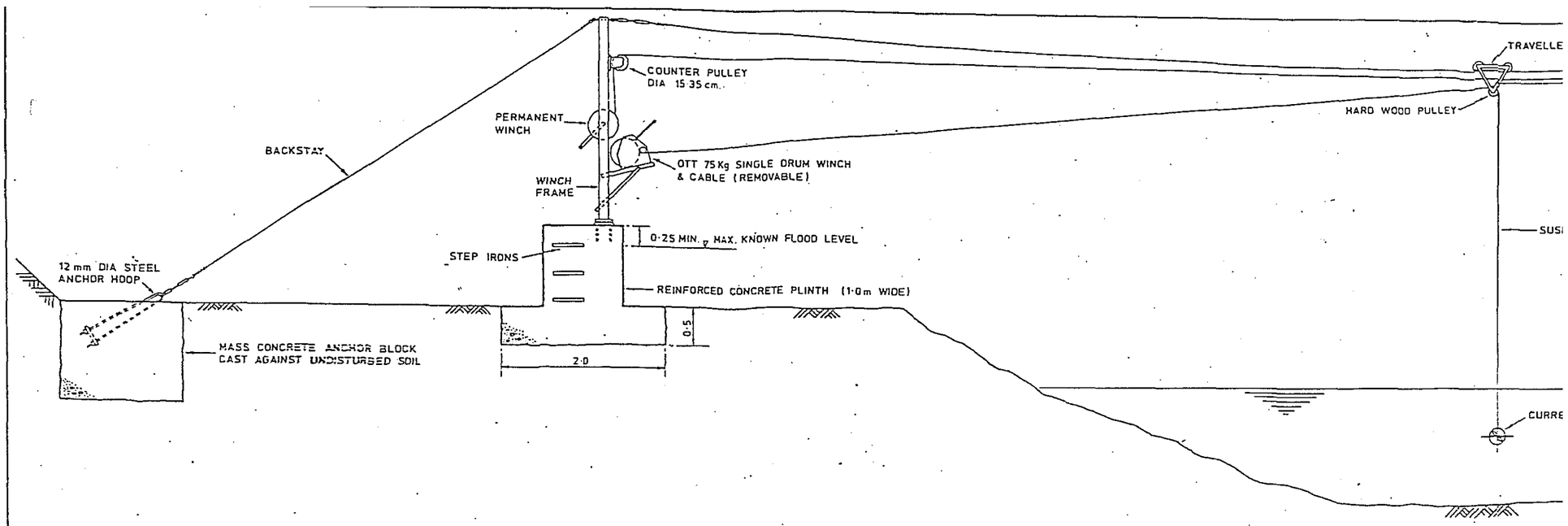


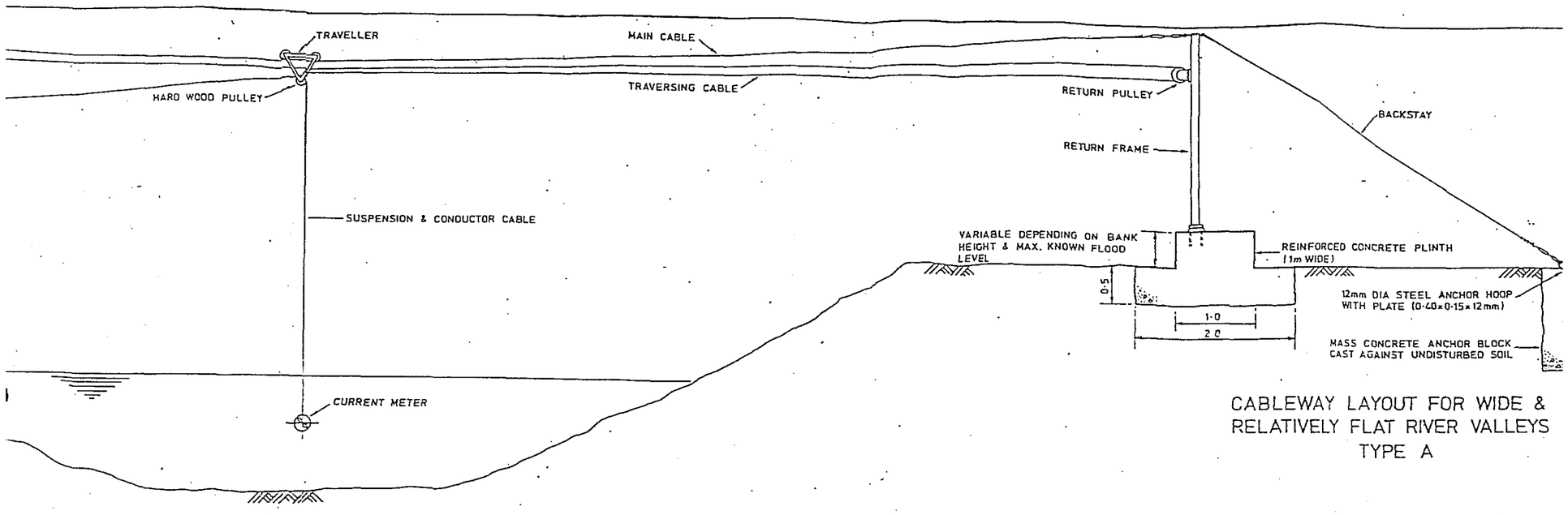
Fig. H-3

SUSPENDED SEDIMENT SAMPLING
GRAPH FOR ESTIMATING
TIME AND RATE



DESIGN DETAILS

DESCRIPTION	CLEAR SPAN BETWEEN FRAMES	
	LESS THAN 50m	50 - 100m
MAIN CABLE DIA. (GALVANISED STEEL WIRE)	16mm, ($^5/_8$)	16mm ($^5/_8$)
MAIN CABLE MAX. TENSION	2100 Kg	2700 - 3400 Kg
MAX. SAG AT MID SPAN	1m	2m
MAX. LIVE LOAD (METER, SINKER & TRAVELLER)	70 Kg	70 Kg
BACK STAY ANGLE (TO HORIZONTAL)	30°	30° - 45°
TRAVERSING CABLE (GALVANISED STEEL WIRE)	3mm ($^1/_8$)	3mm ($^1/_8$)
ANCHOR BLOCK (MASS CONCRETE) WIDTH DEPTH LENGTH	1·25 m 1·25 m 1·25 m	1·25 m 1·25 m 1·50 m
STEEL ANCHOR HOOP LENGTH (CABLEWAY TYPE A)	1·00m	1·20m



CABLEWAY LAYOUT FOR WIDE & RELATIVELY FLAT RIVER VALLEYS TYPE A

BETWEEN FRAMES	
50m	50 ~ 100m
	16mm (5/8")
	2700 - 3400 Kg
	2m
	70 Kg
	30° ~ 45°
	3mm (1/8")
	1·25m 1·25m 1·50m
	1·20m

SCHEDULE OF FITTINGS

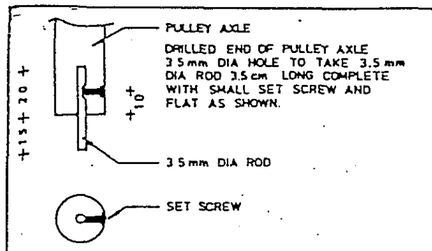
ITEM	LOCATION			
	WINCH FRAME END	RETURN FRAME END	DEADMAN END	TRAVELLER
3/4" TURNBUCKLE	2	2	1	-
3/4" SHACKLE	3	3	1	-
5/8" LOOP SHOE	3	3	1	-
5/8" CABLE CLAMPS	9	9	3	-
1/2" SHACKLE	2	-	-	1
1/2" LOOP SHOE	2	-	-	1
1/2" CABLE CLAMPS	5	-	-	2

NOTE:

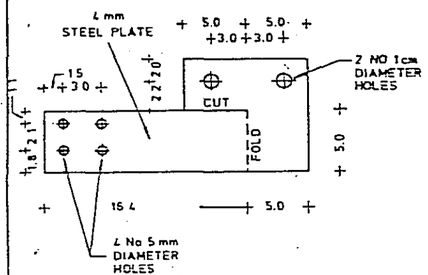
1. ALL DIMENSIONS IN METRES UNLESS OTHERWIS
2. ONE REVOLUTION OF THE COUNTER PULLEY IS TO A MOVEMENT OF THE TRAVELLER OF APPRO

Fig. H-4

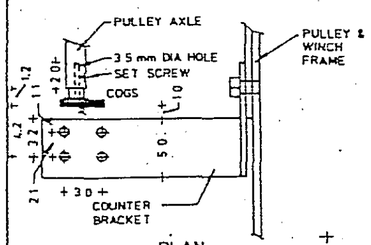
CABLEWAY LAYOU



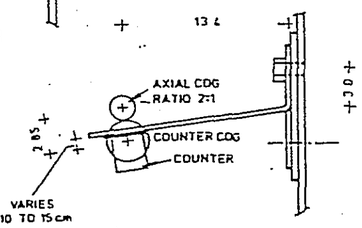
DETAIL OF COG AXLE
SCALE 1:1



DEVELOPMENT OF PLATE
1 NO BRACKET REQUIRED FOR EACH SITE

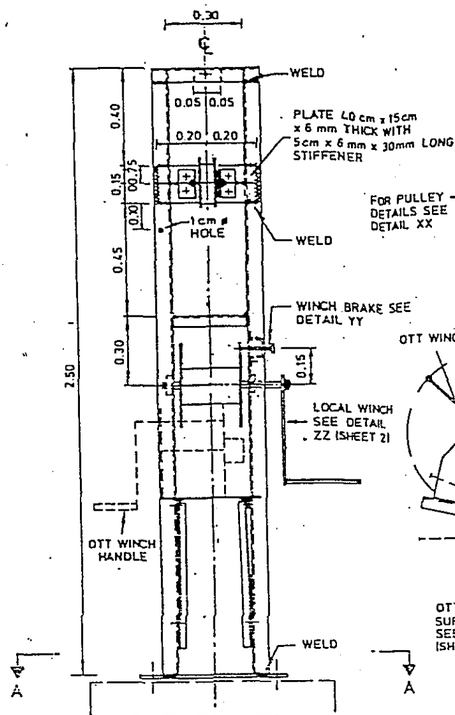


PLAN

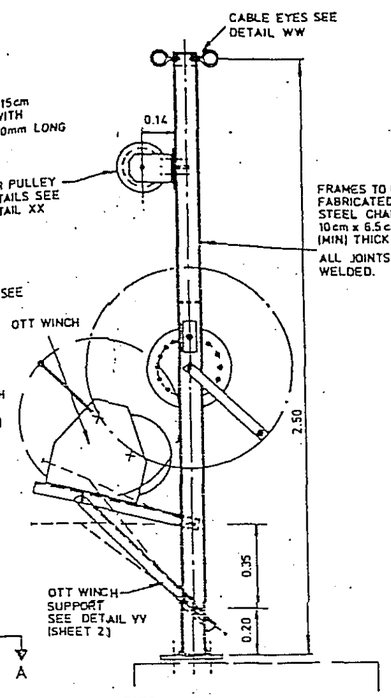


CABLEWAY COUNTER DETAILS
SCALE 1/2
(DIMENSIONS IN cm)

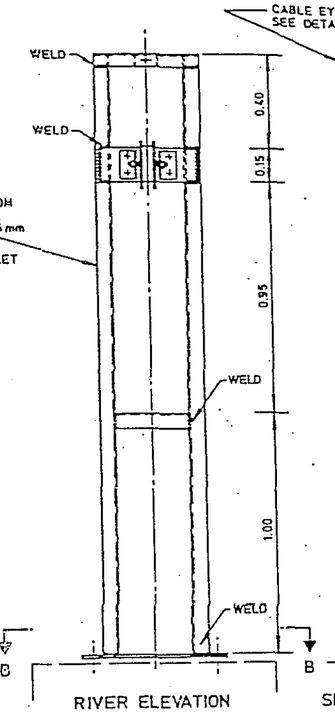
COGS & COUNTER PROVIDED BY L H N P
ELEVATION



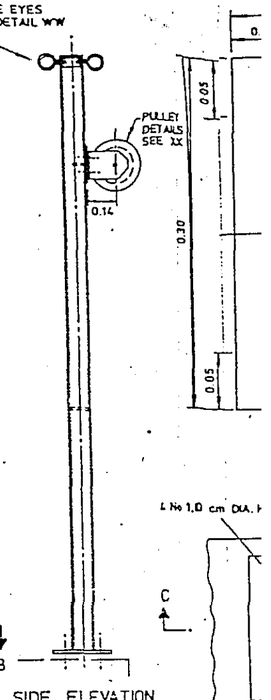
RIVER ELEVATION



SIDE ELEVATION

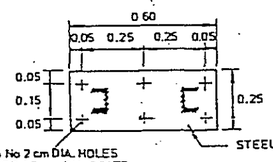


RIVER ELEVATION

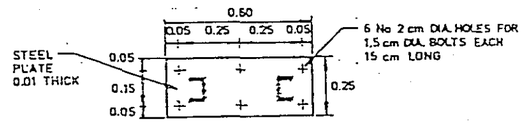


SIDE ELEVATION

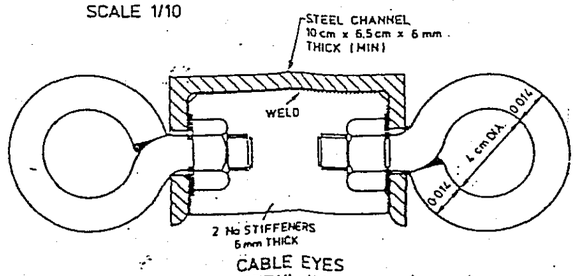
SCALE 1/10



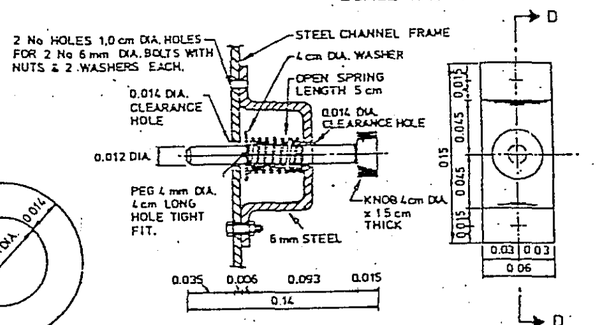
PLAN AA
DETAIL OF WINCH FRAME
SCALE 1/10



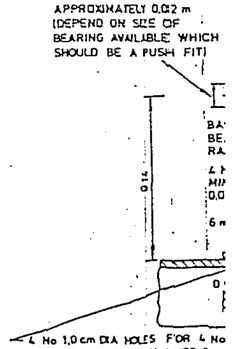
PLAN BB
DETAIL OF CABLE RETURN FRAME
SCALE 1/10



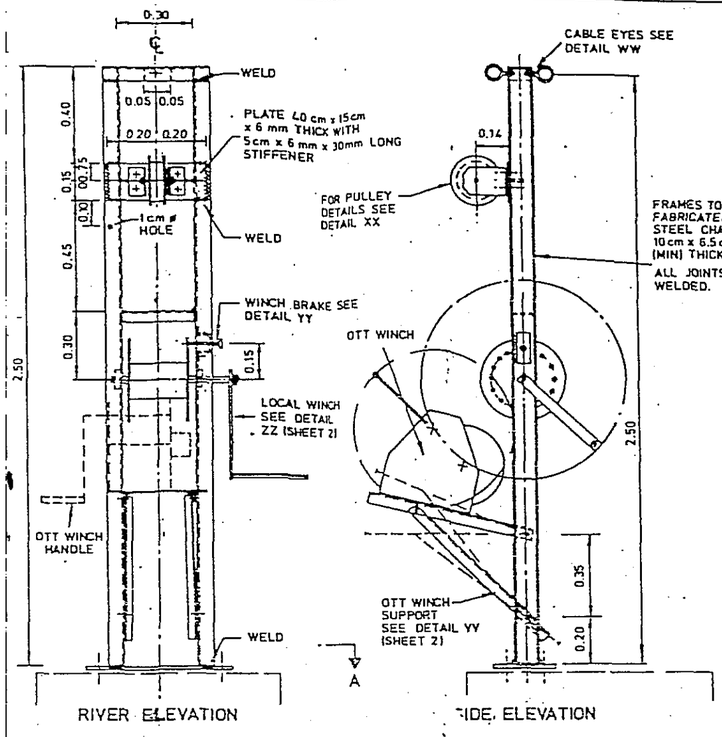
CABLE EYES
DETAIL WW
SCALE 1/1

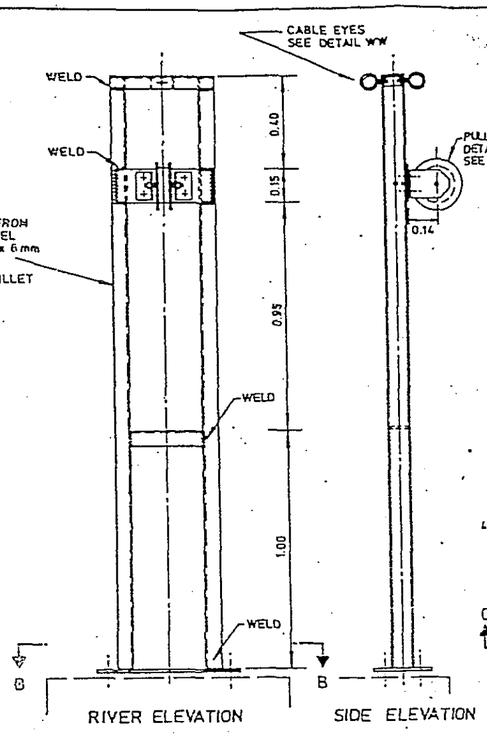


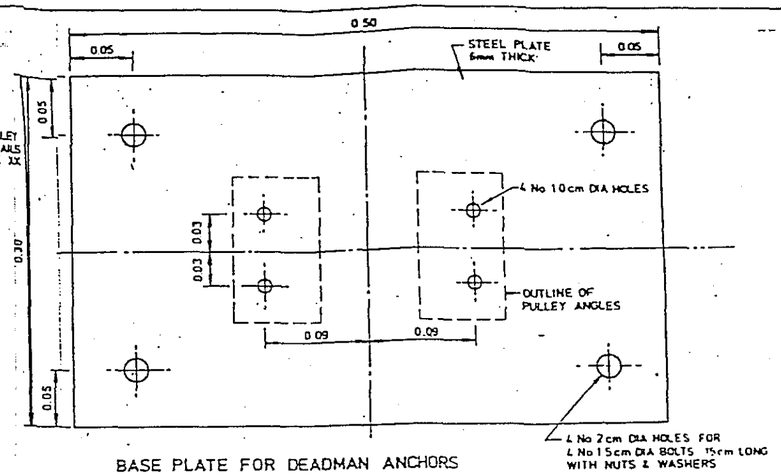
SECTION DD
WINCH BRAKE DETAIL YY
SCALE 1/2



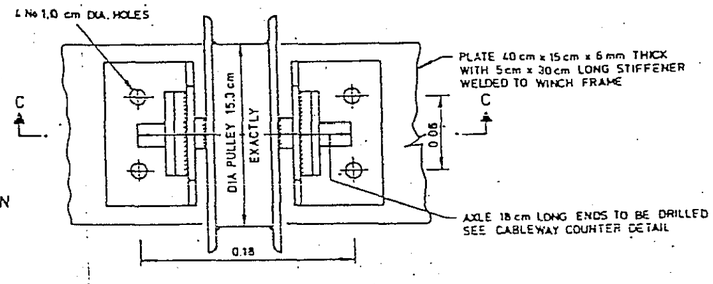
NOTES:-
1) ALL STEELWORK TO BE GIVEN 2 COATS RUST PREVENTIVE PAINT & 1 COAT GREY TOP COAT PRIOR TO ASSEMBLY BUT AFTER WELDING.
2) WELDS SHOWN ~~~~~ OR ———
3) ALL MOVING PART TO BE GREASED PRIOR TO DELIVERY.
4) ALL MATERIAL STEEL UNLESS OTHERWISE STATED.
5) ALL DIMENSIONS METRES UNLESS NOTED

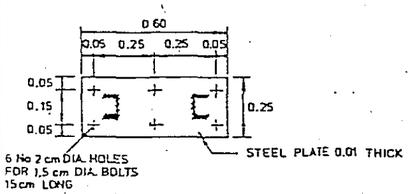




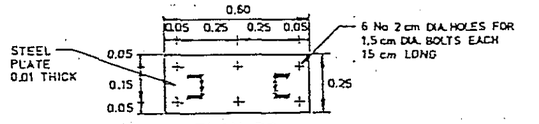


BASE PLATE FOR DEADMAN ANCHORS
SCALE 1/2

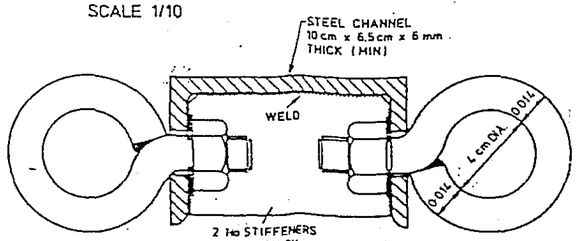




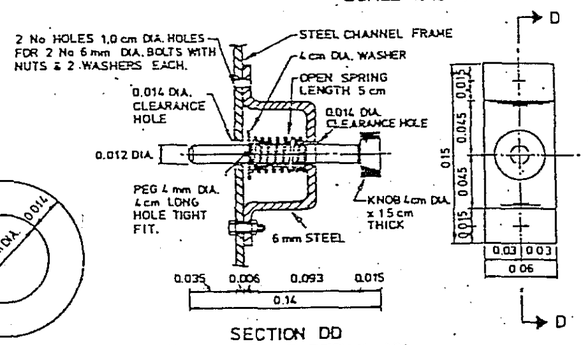
PLAN AA
DETAIL OF WINCH FRAME
SCALE 1/10



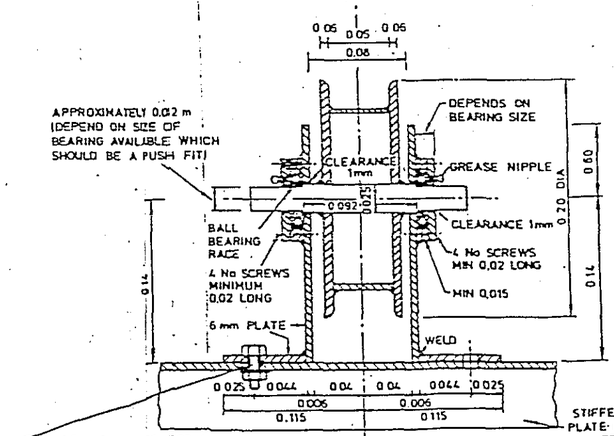
PLAN BB
DETAIL OF CABLE RETURN FRAME
SCALE 1/10



CABLE EYES
DETAIL WW
SCALE 1/1



SECTION DD
WINCH BRAKE DETAIL YY
SCALE 1/2



SECTION CC
PULLEY DETAIL XX
SCALE 1/2

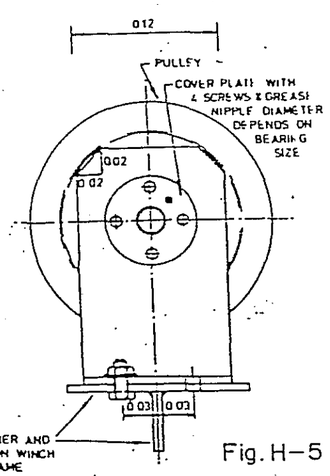
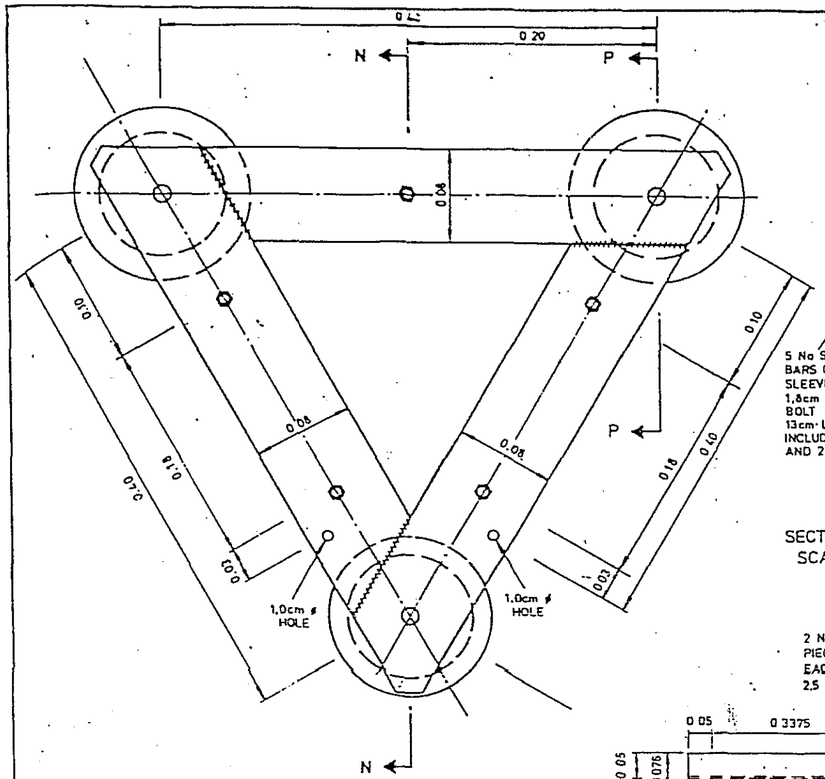


Fig. H–5

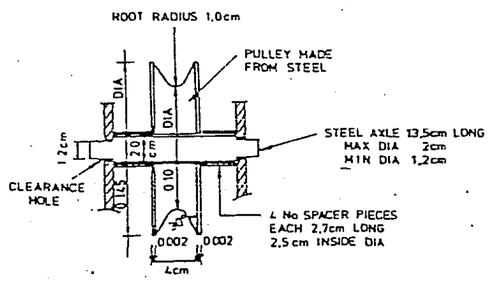
CABLEWAY STEELWORK DETAILS (1)

SHEET 1

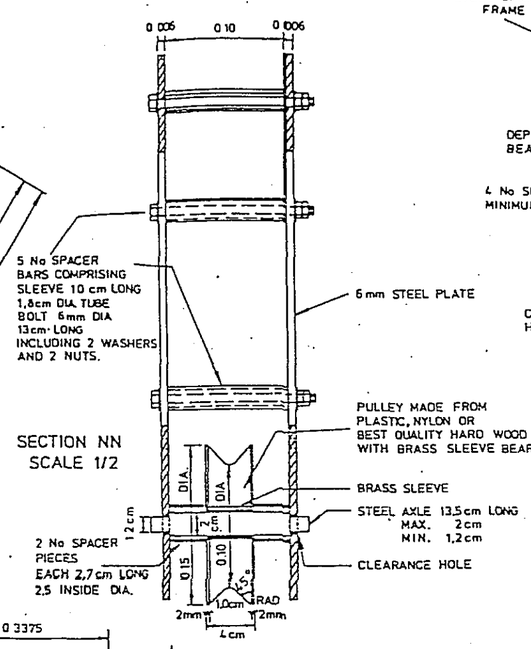
DNS METRES UNLESS NOTED



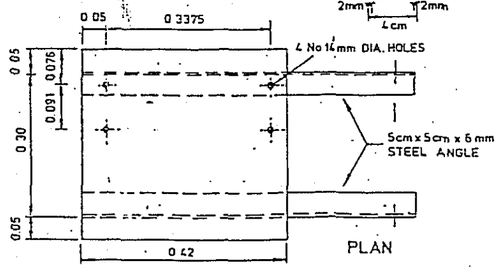
CABLEWAY TRAVELLER DETAILS
ELEVATION
SCALE 1/2



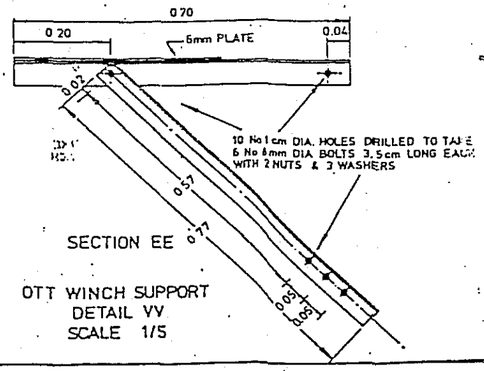
SECTION PP
SCALE 1/2



SECTION NN
SCALE 1/2

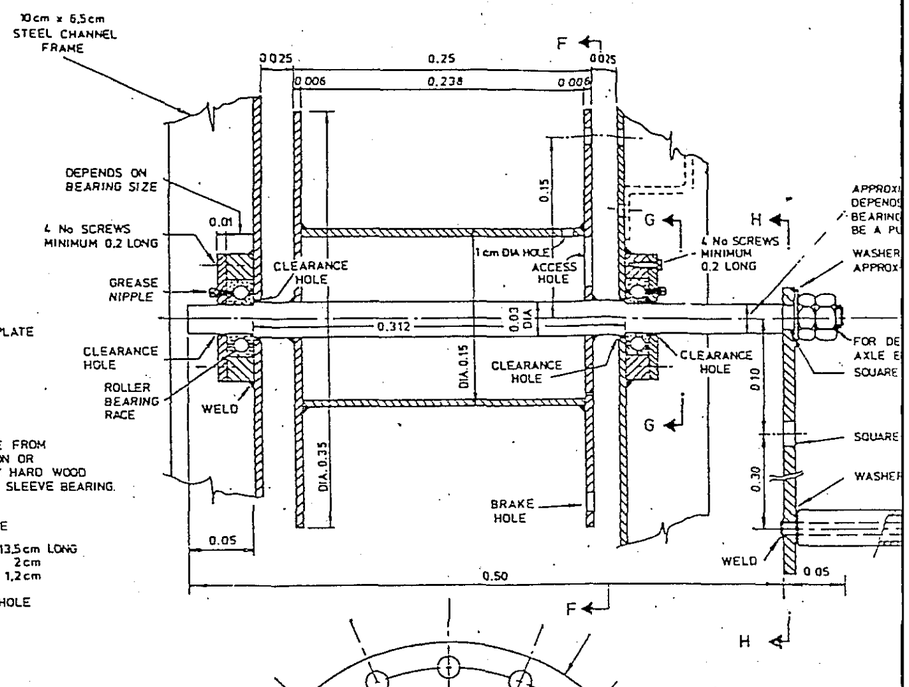


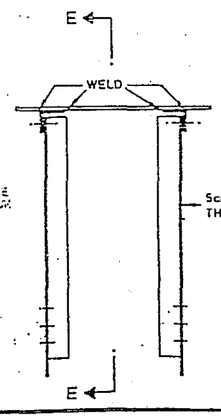
PLAN

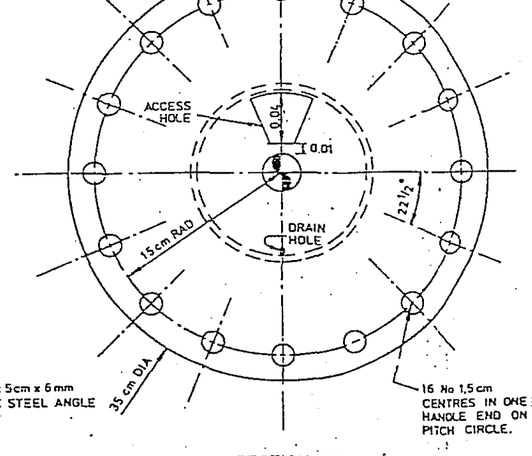


SECTION EE

OTT WINCH SUPPORT
DETAIL VV
SCALE 1/5

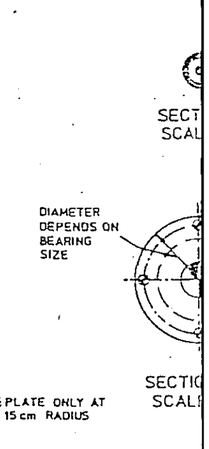




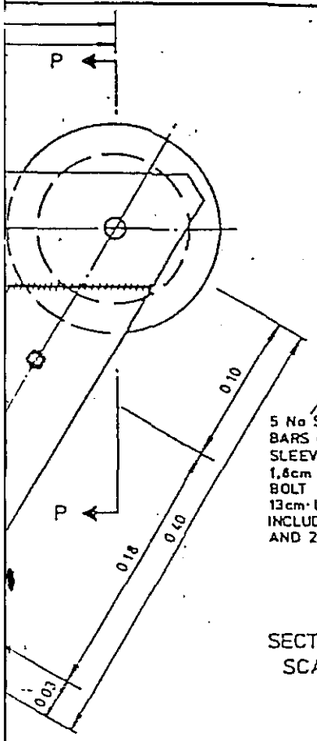


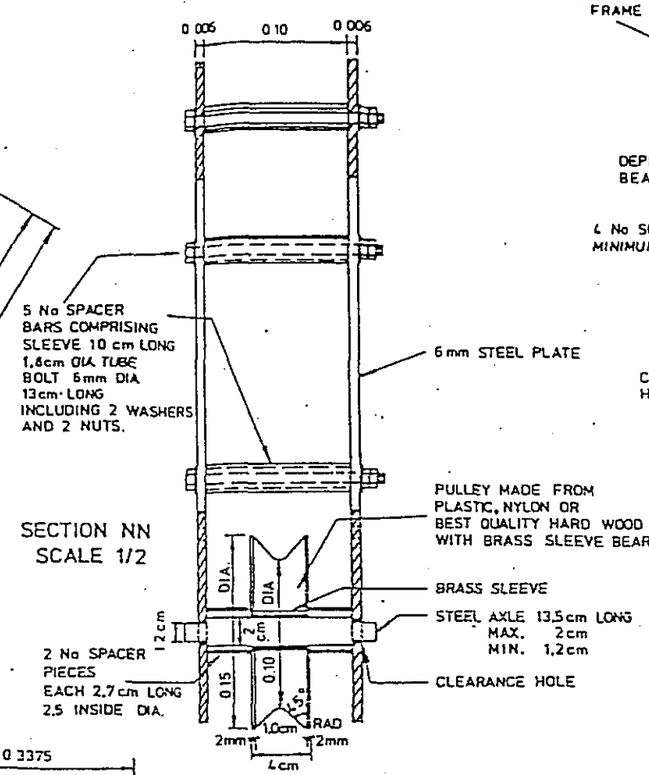
SECTION FF

WINCH DETAIL ZZ
SCALE 1/2

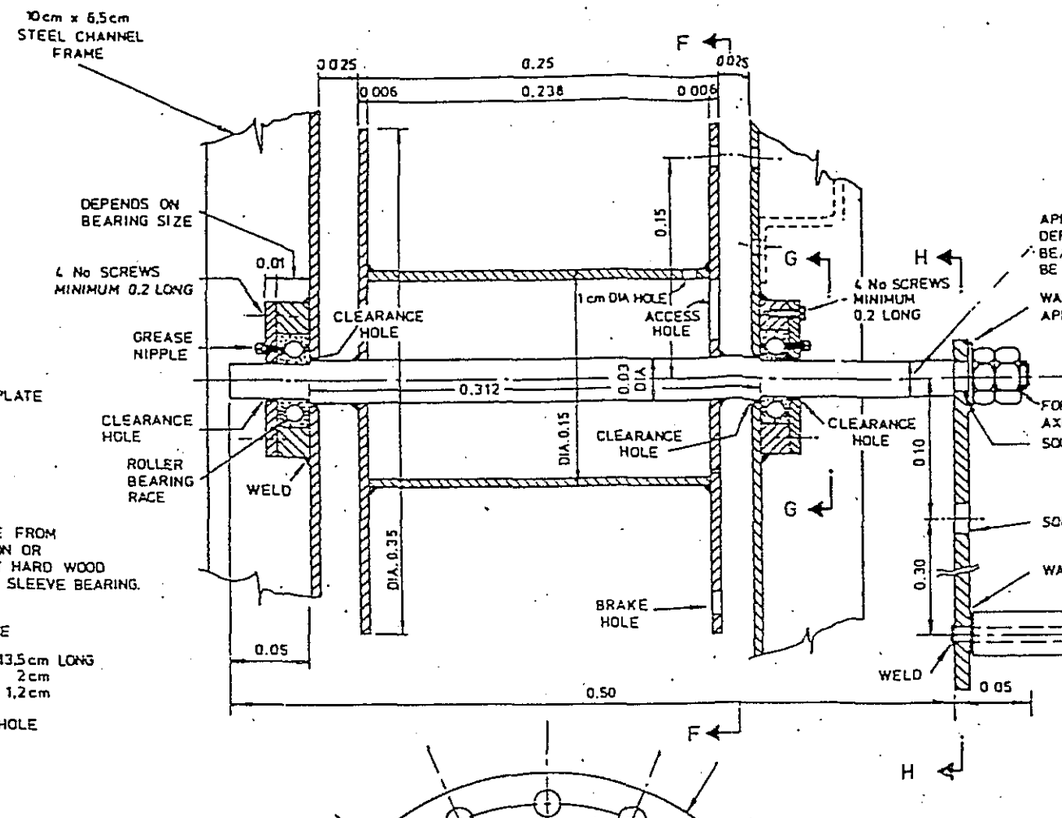


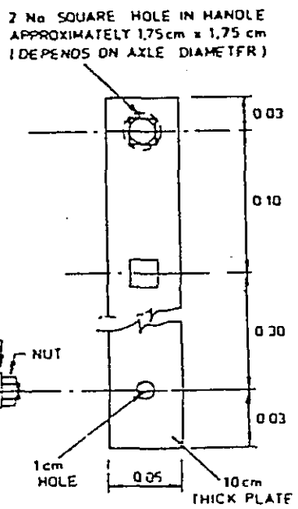
NOTES:-
1 ALL STEEL WORK TO BE GIVEN 2 COATS RUST PREVENTIVE PAINT & 1 COAT GREY TOP COAT ASSEMBLY BUT AFTER WELDING
2 WELDS SHOWN THUS ~~~~ OR
3 ALL MOVING PARTS TO BE GREASED PRIOR T
4 ALL MATERIAL STEEL UNLESS NOTED OTHERW
5 ALL DIMENSIONS IN METRES UNLESS NOTED O



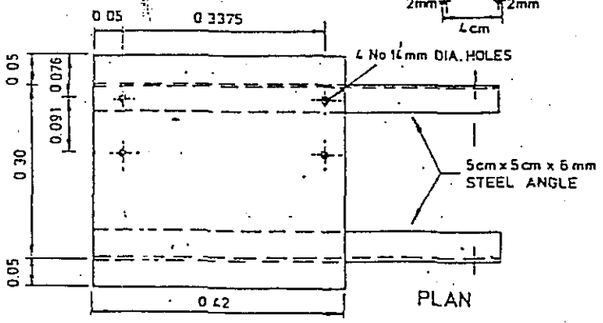


SECTION NN
SCALE 1/2

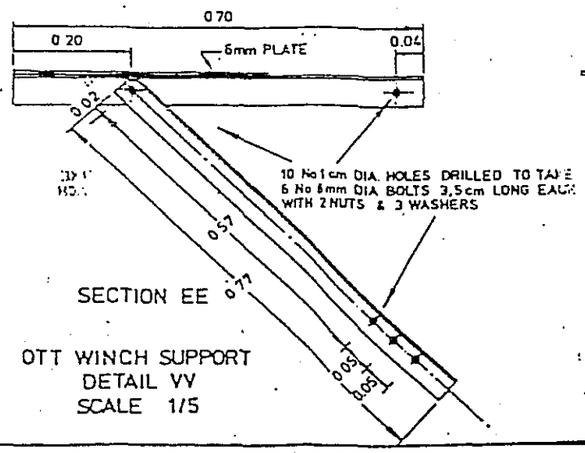




SECTION HH
SCALE 1/2

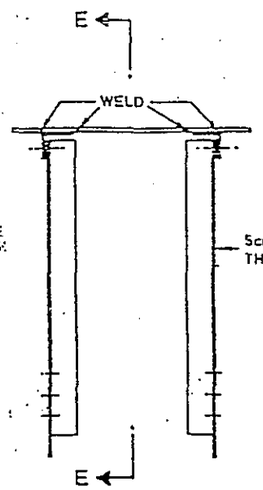


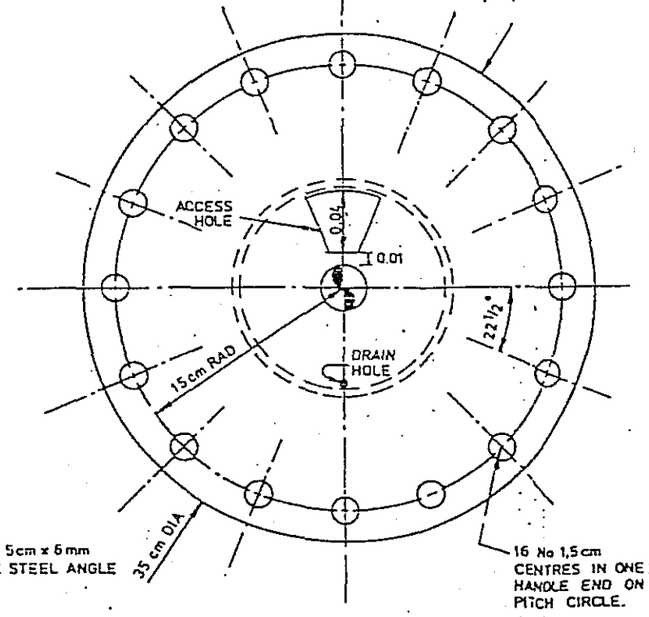
PLAN



SECTION EE

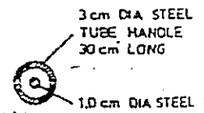
OTT WINCH SUPPORT
DETAIL VV
SCALE 1/5



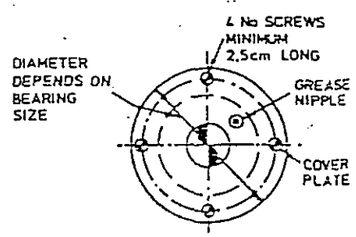


SECTION FF

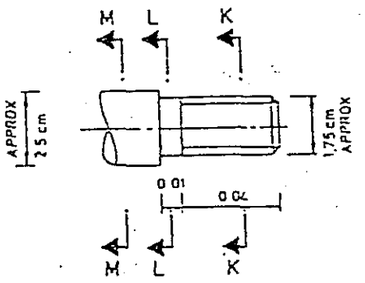
WINCH DETAIL ZZ
SCALE 1/2

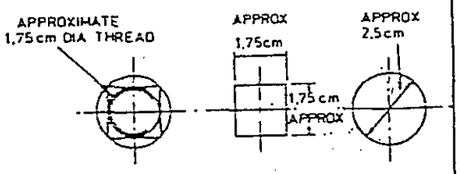


SECTION JJ
SCALE 1/2



SECTION GG
SCALE 1/2





DETAIL UU
SCALE 1/1

NOTES:-
1. ALL STEEL WORK TO BE GIVEN 2 COATS RUST PREVENTIVE PAINT & 1 COAT GREY TOP COAT PRIOR TO ASSEMBLY BUT AFTER WELDING
2. WELDS SHOWN THUS ~~~~ OR ⌊
3. ALL MOVING PARTS TO BE GREASED PRIOR TO DELIVERY
4. ALL MATERIAL STEEL UNLESS NOTED OTHERWISE
5. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.

Fig. H-6

CABLEWAY STEELWORK DETAILS (2)

SHEET 2

Table H-5 BILL OF QUANTITIES

Work Item	Quantity	Remarks
1. Field Works		
(1) Construction of Cableway	1 set	at gauging station
(2) Discharge Measurement		
Current-meter measurement	28 times	using cableway
Float measurement	7 times	for flood discharge
(3) Sediment Load Measurement	30 times	using D49 sampler
(4) Water Sampling for Water Quality Test	6 times	draw up
(5) Meteorological Observation	L.S.	
- Rainfall	(one year)	Automatic, and manual
- Evaporation		Class A Pan
- Temperature		Thermohygrograph
- Relative Humidity		"
(6) Construction of Meteorological Station	L.S.	
2. Meterials		
(1) Plastic bottle, 500 cc suspended load and Water quality	100 pc	
3. Equipment		
(1) Maximum, Minimum thermometers, and Dry and Wet bulb thermometers	1 set	
(2) Rain Gauge (manual)	1 set	No. 1500
(3) Automatic Rain Gauge	1 set	HELLMAN No. 1507
(4) Class A Evaporation Pan	1 set	excluding Hook Gauge
(5) Thermohygrograph	1 set	THIES Type
4. Transportation Cost of Water Samples	L.S.	100 bottles
5. Laboratory Test		
(1) Suspended load analysis	90 samples	
(2) Water quality tests	6 samples	

TERMS OF REFERENCE

PRE - FEASIBILITY STUDY

TERMS OF REFERENCE

PRE - FEASIBILITY STUDY

I. General

In the framework of supporting the Government's program in the development of non-oil energy it is considered neseccary to develop the hydropower energy which potential is big enough to satisfy the energy demand in the future.

One of the potential site to be developed which demands further study, is the catchment area of _____ river in the Province of _____*) which proposed dam site to be studied is at _____*) coordinate North/South latitudes and _____*) East. The site is located at elevation between EL _____*) m, and EL _____*) with annual rainfall mean _____*) mm.

II. Purpose of Study

This pre-feasibility study is conducted for achieving a clear view on the hydro electric power development at selected site with the following conditions, that the study shall be carried out based on existing data (the result of Hydro Power Potentials Study by Nippon Koei and PT Indra Karya) and additional data which is collected during the study period.

III. Scope of Work

The work to be executed covers the below mentioned items :

3.1 To conduct pre-feasibility study.

3.2 To conduct field investigations (including topographical, geological, hydrological, ecological, socio economical, etc.) at the area of dam site, reservoir and catchment area which is related to ad. 3.1 above,

3.3 To prepare recommendation on the Term of Reference for the following work of Feasibility Study accompanied by cost estimate.

---

*) Please refer to attachment.

IV. Job Description

1. The Pre-Feasibility Study should cover (and may not be limited) the below mentioned items :

1.1 Review and the analysis of the reports, data and available informations.

1.2 Study on electric power demand and the plan for the electrical system including the calculation on power out-put.

1.3 Selection of several alternative sites with several altertives on dam axis and the study on the type of site development (such as dam type, material, acces road, etc.) which shall be based on informations obtained during office work as well as field work. (This work shall be supproted by the data of ad. 2) including the optimum confirmation of the development scale from the study results of Hydro Power Potentials.

1.4 Basic design of main structure (dam, spillway, waterway, etc.) of the Hydro Electric Power Generation (PLTA) in general including estimate on transmission route and the switch yard.

1.5 Preparation of "Project Work Schedule", covering the time necessary for Feasibility Study until the construction work period.

1.6 Study of socio economical and ecological effects.

1.7 Hydrological Study/analysis, of the site.

1.8 Estimate fund to be required, domestic as well as foreign, to finance the project in general including maintenance, operation, and other costs.

1.9 Cost and Benefit Analysis in general in the pre-feasibility stage and calculation on the minimum life time of the site to be developed should reach at least 50 years.

2. Field investigation and measurements shall cover :

2.1 Collection of topographical and aerial maps of the site being studied.

2.2 Cross sectional measuring of the whole alternative dam axis and the longitudinal section of the river, covering the

----- area .....

area of the power station, alternative dam axis and part of the reservoir.

2.3 Leveling measurement between the dam site and proposed Power Station.

2.4 Location mapping of the project area being studied on instructions of the PLN/Engineer in case the aerial Photographics were not available.

2.5 Geological investigation of the ground to find the structure condition of the ground as well as the soil and the rock characteristics around the project area (dam site, reservoir, waterway, power station, borrow area, quarry site).

2.6 Investigation of surrounding area to study the probable effects to the localities due to the development of the project including the resettlement possibility of the inhabitants and their social economy.

2.7 Installation Automatic water level recorder, ordinary staff gauge and measurement of Rating Curve for high water (flood) and sedimentation.

3. Cost estimate for the next works

Based on the outgoing study and the results of field survey and investigation cost estimate for the stage of Feasibility Study shall be prepared.

4. Experts :

In this study the experts to be assigned, together with related man-month M/M, shall be as follows :

	Expert	Experience	Classification
4.1	Project Director	15 year or more	A
4.2	Team Leader	10 "	B
4.3	Resident Eng.	7 "	C
4.4	Civil Eng.	5 "	D
4.5	Hydrologist	5 "	D
4.6	Geologist	7 "	C
4.7	Economist	5 "	D
4.8	Electrical Eng.	5 "	D

	Expert	Experience	Classification
4.9	Foreign Expert whose experience is 8 years minimum in the field of Hydro Electric Power Project Study until the Feasibility Study stage (who could prepare the study results based on collected data into compiled report) with 3 M/M.		

5. The reports shall be prepared in both Indonesian and English languages, consisting of :

5.1 Monthly Report (in 25 copies)

5.2 Inception Report, after visiting the site (in 25 copies)

5.3 Interim Report, after field work completes (in 25 copies)

5.4 Draft Final Report (in 25 copies)

5.5 Final Report (50 copies)

5.6 Appendix : Report on Field Works (boring, mapping and others) 10 copies in English.

5.7 For point 5.1 until 5.4 shall be made 15 copies in Indonesian language and 10 copies in English.

5.8 For point 5.5 shall be made 25 copies in Indonesian Language and 25 copies in English.

6. Time Schedule

The Time Schedule shall be prepared in the form of lay out chart covering all the study works in the field until submission of Reports.

7. Completion of Work

All the works shall be completed within 210 days as of the date of issuance of the SPK (Lteer of Intent)

V. Technical Specification

5.1 Photogrammetrical Mapping

The areas to be mapped shall be :

Area	Scale	Contour Level	Contour Slopey
	1:25,000 *)	12.5 m	25 m
1. Resrvoir	1:10,000	5 m	10 m
2. Dam Site	1: 5,000	2.5 m	5 m
3. Waterway	1: 5,000	2.5 m	5 m
4. Power Station	1: 5,000	2.5 m	5 m

The Area of each region could be seen in the Appendix

*) Scale 1:25,000 for the area of reservoir > 100 km²

5.2 Terrestrical Mapping (Ground Survey)

For the areas as mentioned at ad.1. aerial photographs with maximum scale of 1:60,000 will be required.

If such photographs were not available then the terrestrical method of mapping should be done covering the areas of dam site, waterway and the Power Station according guidance of PLN/Engineer.

Other works to be done are leveling and measurement of cross and longitudinal sections of the river. The objects of the measurement works are as follows :

Area	Leveling	Cross Section	Longitudinal Section
1. Dam Site	From nearest bench mark (radius 2 km)	1:1,000 horizontal	1:1,000 horizontal
Closing fault	20 mm $\sqrt{K}$	1:500 vertical total 5 lines	1:500 vertical total 2,5 km from dam site to the direction of the Power Station
Waterway			1:1,000 horizontal 1: 500 vertical

Remarks : K = Distance of 2 measuring points in km

5.3 Accuracy rate for the work at 3.1 and 3.2 shall be as follows :

Work Item	Photogrammetrical Mapping			Terrestrical Mapping
	1:10,000	1:5,000	1:25,000	1:5,000
Main traverse				
- Coordinate fault	1:10,000	1:20,000	1:5,000	1:20,000
- Closing horizontal fault	$15\sqrt{N}$	$10\sqrt{N}$	$20\sqrt{N}$	$10\sqrt{N}$
- Closing vertical fault	$20\sqrt{K}$	$15\sqrt{K}$	$25\sqrt{K}$	$15\sqrt{K}$
Branch traverse :				
- Coordinate fault	1:10,000	1:20,000	1:5,000	1:20,000
- Closing horizontal fault	$20\sqrt{N}$	$15\sqrt{N}$	$25\sqrt{N}$	$15\sqrt{N}$
- Closing vertical fault	$30\sqrt{K}$	$20\sqrt{K}$	$35\sqrt{K}$	$20\sqrt{K}$
- Mapping on map scale	0.5 cm	0.5 cm	0.5 cm	0.5 cm

Remarks : K : Distance of 2 measuring points in km

N : Number of measuring stations

5.4 Permanent Point

Horizontal datum of vertical dam is taken from the datum of the national control net which one point minimum is located at the 2 km radius of the project. Banch Mark should be place the farthest at every 5 km along the Main Traverse. The drawing of the Bench Mark location can be seen in the Appendix.

5.5 Geological Investigation

This investigation consists of :

- Geological mapping
- Seismic investigation
- Boring and permeability test
- Sampling

i. Geological Mapping :

This work prepares detailed geological mapping on the existing map.

Area	Scale
- Reservoir	(See bill of Quantity of the work).
- Dam site	1:5,000
- Waterway	1:5,000
- Power Station	1:5,000

ii. Seismic Exploration

The seismic investigation is necessary to determine the geological structure of the underlaying ground with 50 m minimum depth. Blasting method are to be applied.

Blasting

- Refraction Seismic type
- 12 or 24 channel geo-phone (in line method)
- Dynamite blasted
- In principle the geo-phone interval is 5 m with shooting interval of 50 m.
- 3 shooting points minimum in one spread.

Total of seismic profiles :

Dam site	5 profiles
Waterway (between the surge tank and power station)	1 profile

iii Boring work and Field Test

a. Boring investigation

This work is conducted to understand visually and to make interpretation on the geological structure of the underground soil. Boring location shall be appointed by the Engineer / PLN in charge with .....*) depth. Boring works shall be conducted with the following conditions :

- Minimum diameter of boring hole = 56 mm
- Core recovery shall reach 100 %
- Machnine capacity shall be 150 m fully hydraulic

b. Permeability Test

In dam design it is necessary to make estimation on the probable seepage underneath the dam for which the Lugeon test shall be conducted to determine the permeability coefficient. This test must be done to all the boring holes with interval of 5 m where in every stage the water pressure shall be kept for 10 minutes. The water pressure stages shall 0,10; 3; 7; 3; 1; 0 (in kg/cm^2). In the first stage of the test the water pressure shall be 10 kg/cm^2. The pump capacity must be bigger than 150 liters.minutes when the pressure reaches 10 kg/cm^2.

c. Standard Penetration Test

The standard penetration test shall be applied to each of the boring hole at every 5 m depth for soil foundation.

5.6 Sampling

Sample core shall be kept at the core box as shown in the Appendix and shall be stored at the nearest local PLN Office. Every core sample shall be registered in the bore log and shall be done at the time of the sampling boring.

5.7 Hydrological Survey

The Contractor shall install one Automatic Water Level Recorder (AWLR) and ordinary staff gauge in the proper sub and super structure so as not to be damaged by flood flow.
Type of AWLR is a fllod type recorder of one week winding.
Type of ordinary staff gauges of 1,0 m long each being made of steel covered with enamel and shall fasten to the supporting steel with the concrete base on the firm foundation.
For the purpose of establishing rating curve, stream flow measurement shall be carried out at least 3 times a month and also during the typical flood accurences. Water sampling for the sedimentation study shall be made once a month.

VI. Others

6.1 All the topographical maps, geological maps and the design should follow the terms as below mentioned :

a. Paper sizes : 60 cm x 60 cm (AI)
b. Information column : 10 cm x 80 cm

6.2 The drawings and data to be submitted shall be in the following forms :

- original traced map - 1 set for line map
- drawing copy in polyester - 1 set for line map
- ozarid copy of standard drawing
- field test and laboratory test
- calculation sheet
- topographical measurement data.

6.3 Consumable survey equipments & data (topographical map & geology, hydrology, etc.).