(4) Materials and Equipment Procurement Plan

1) Construction materials and equipment

Construction materials and equipment to be used should, with the exception of the following, be local products or those procured from a third country.

① Special piles and jacks to be used in reinforcing the building foundations, except those which are available locally or from a third country.

② Japanese construction materials and equipment of the same grade as the local products' should be adopted if procurement from Japan (including packing, transportation and insurance) costs less than local procurement,

With the above exceptions, the materials and equipment planned for use in this project are as shown in Table 17.

Table 17 Construction Materials and Equipment

Work	Item	Local product	Japanese product	Remarks
Concrete	Portland cement	o		
	Coarse sand	o		
	Fine sand	o		
	Gravel	o		
	Crushed stones	o		
Foundation reinforcement	Piles		o	High accuracy required.
Stone laying on slope	Local stone	o		
Reinforcing bars	Deformed bars		o	Procurement of Japanese product costs less, even when packing, transportation and insurance are included.
Masonry	Bricks	o		
	Concrete blocks	o		
Plastering	Mortar	o		
	Plaster	o		
Aluminum fittings	Windows		o	For repair of fittings only.
	Doors		o	Ditto
Steel fittings	Doors	o		
Paint	All items	o		

2) Equipment

Equipment to be procured in this project should be of Japenese manufacture since there are no suitable local products and procurement from a third country is expensive.

In transporting and installing the equipment and materials, the following factors should also be taken into consideration:

① Proper packing should be used, since temperatures in the hold may reach up to 70°C during shipping.

② Precision equipment should be vacuum packed or similar.

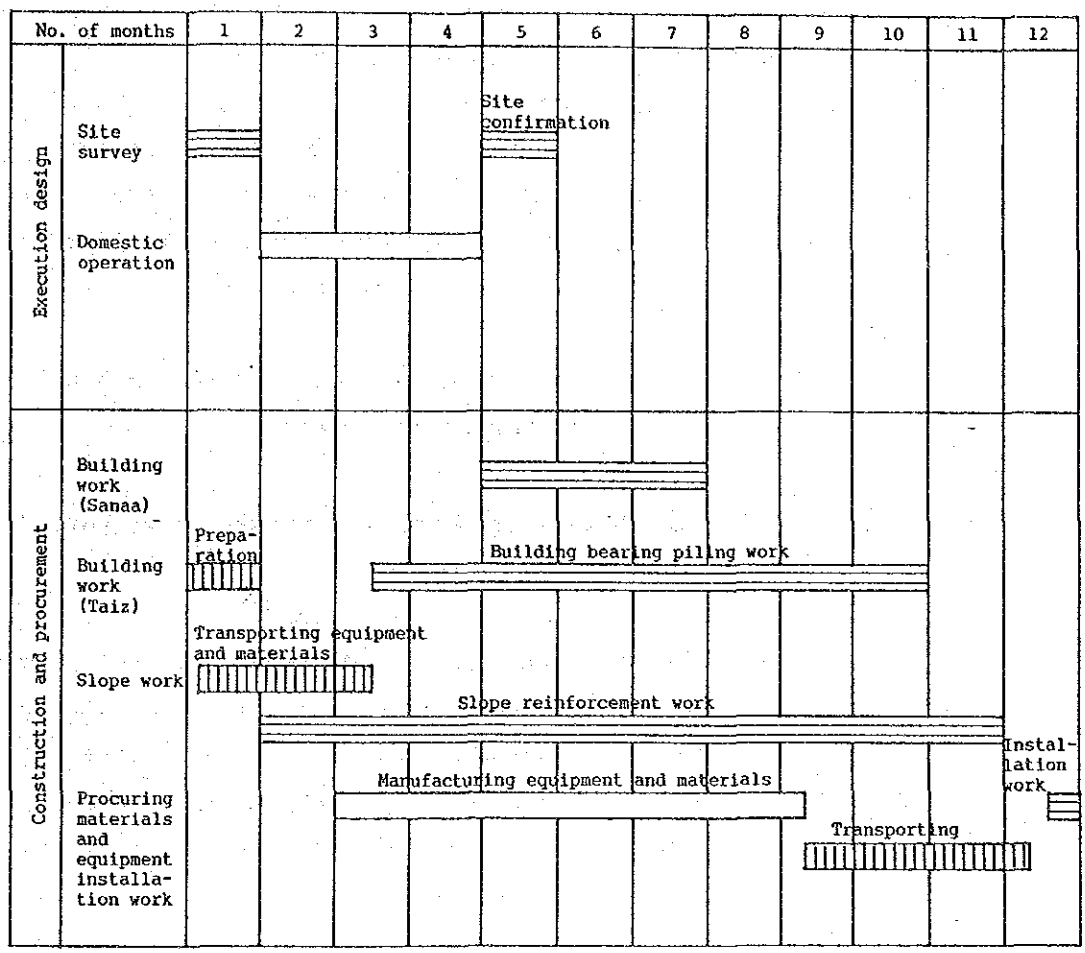
③ Items requiring special protection, such as microscopes, coating of the lenses or other measures should be taken as appropriate.

④ A minimum of training an operation of the equipment should be given and instruction manuals for all equipment should be prepared and submitted in English.

(5) Work Schedule

The work of renovating the Taiz subcenter entails 12 months of construction work and half a month to procure and install the medical equipment. The schedule is shown in Table 18.

Table 18 Work Schedule



(6) Estimated Cost of the Project

1) Costs Borne by the Yemeni side

Certain costs pursuant to or in advance of the construction work by the Japanese side, are to be borne by the Yemeni side. The work involved is important to the smooth execution of this project.

① Certain fees to a Japanese foreign exchange bank under a banking arrangement

1) Fee for issuing the authority of payment (A/P)
2) Fee for payment

② Costs of certifying the exemptions from payments for freight forwarding, customs clearance at the port of Hodeida, and rapid domestic transportation of the equipment and materials to be imported for the purposes of this project under the Grant Aid Program of the Government of Japan.

③ Costs of exempting from customs duties, taxes, and other charges made by the Republic of Yemen the Japanese contributions of equipment, materials, and services supplied under approved contracts for the purposes of this project under the Grant Aid Program of the Government of Japan.

④ The costs of processing all applications to enter and stay in the Republic of Yemen by Japanese nationals engaged in the provision of equipment, materials and services under approved contracts for the purposes of this project under the Grant Aid Program of the Government of Japan.

⑤ The costs of all items other than those provided under the Grant Aid Program of the Government of Japan, such as facility construction, transportation, and the installation of equipment and materials.

⑥ The Republic of Yemen shall correctly and effectively use, maintain and manage all the constructed facilities and all the equipment and materials provided under the Grant Aid Program of the Government of Japan.

⑦ The costs of providing sufficient land for a site office, work space, storage, and a yard for equipment and materials, all of which are necessary for the construction work.

⑧ The costs of temporary electricity and water supplies and telephones, etc. required for the construction work.

None of the costs for slope reinforcement or building supporting work for Taiz Subcenter are to be borne by the Yemeni side.

2) Others

It is assumed that this project will be executed in accordance with the system of Japanese Government Grant Aid.

CHAPTER 5 EXPECTED EFFECTS OF THE PROJECT AND CONCLUSION

CHAPTER 5 EXPECTED EFFECTS OF THE PROJECT AND CONCLUSION

JICA started Project-type Technical Cooperation in 1983, and subsequently, in 1986, the "National Tuberculosis Institute (NTI)" was constructed in the capital Sanaa under a Grant Aid Program of JICA. During the following year, 1987, subcenters were constructed in Taiz and Hodeida, where measures against tuberculosis had been difficult to implement. The Technical Cooperation covered mainly (1) assistance in improving the organization and fostering skills, (2) assistance in developing preventive, diagnostic, and therapeutic technology both in the NTI and at the two subcenters, and (3) assistance in research for the Tuberculosis Control Programme.

Through the assistance from September 1983 to August 1990, a patient registration system was established, and starting from the unification of the country, recording style, clinical examination techniques, and X-ray photography techniques were enhanced to promote the early discovery of tuberculosis, effective medication methods were introduced and a small-scale preparatory survey of the current state of the spread of tuberculosis was carried out.

Japanese Grant Aid Program and Technical Cooperation have thus contributed to attaining a certain result in forming the foundation of tuberculosis control and educating personnel to play a pivotal role in it. However, the aid and assistance have aimed at improving so-called "spot-type" symptomatic treatment (diagnosis and medical techniques of NTI and the subcenters). So in the next stage, the aim should be to develop more "expansive" preventive medicine (nationwide tuberculosis control).

From this viewpoint, JICA's Project-type Technical Cooperation has been extended in its term for another two years, with the main purposes of carrying out (1) a fact-finding survey on tuberculosis; (2) advice, guidance, and education of personnel for establishing a tuberculosis control program based on the results of (1); (3) an increase in the

technical level for the promotion of national tuberculosis control all over the country; (4) an improvement in tuberculosis control at local health care facilities; and (5) an expansion of NTI's function.

After north-south unification, the new Republic of Yemen has begun expanding the anti-TB measures of the former Yemen to cover the whole nation. Basically, the government has divided the country into 18 areas, made up of 17 provinces and the Sanaa City region, made the largest health center in each area the central health center, and appointed provincial governorate tuberculosis controllers (GTCs). The current request for Grant Aid can be regarded as essential in efficiently and effectively providing the above Technical Cooperation and promoting nationwide anti-TB control in the post unification era. It can be expected that the project will give direct and indirect support to the Technical Cooperation.

Now that the three centers (NTI, Hodeida, and Taiz), which were established in a project under Grant Aid from Japan, play a pivotal role in tuberculosis control, it is expected that further encouragement of GTCs-centered activities will lead to the formation of a nationwide network to promote tuberculosis control activities. Accordingly, the more accurate data obtained through investigation and study will be used for anti-TB activities by the NTI, Taiz and Hodeida Subcenters, while the skills of each provincial health center will be enhanced and the techniques of tuberculosis prevention, diagnosis and medical treatment will be improved. Since it hoped that this project will greatly contribute to post-unification health and medical care in the country, rapid implementation of the project is desirable.

APPENDIX

1 Members of the Study Team

2 Site Survey Schedule

3 List of Persons Interviewed

4 Minutes of Discussions

5 Boring Data

6 Results of Swedish-Type Sounding Test

7 Stability of Slope in Its Existing Condition

1. Members of Study Team

Tadashi Isobe	Team leader	Deputy Director Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs
Noriaki Nishimiya	Project Coordinator	Staff Planning Division, Grant Aid Project Management Dept., Japan International Cooperation Agency (JICA)
Matashi Kojima	Architectural Planner	Chief Architect Design and Engineering Dept., AXS Satow Inc.
Yoshiteru Miyamoto	Structural Planner	Senior Structural Engineer Design and Engineering Dept., AXS Satow Inc.
Shoichi Miyake	Equipment Planner	Senior Engineer Central Laboratory, Institute of Health Systems Development

2. Site Survey Schedule

Days	Date	Morning	Afternoon
1	October 30 (Tue.)	Survey Team Depart Narita (Private Companies)	
2	October 31 (Wed.)	Survey Team arrives at Bahrain Bahrain	Survey Team depart Bahrain
3	November 1 (Thu.)	Survey Team arrives at Sanaa (Private companies) Protocol visit to Japanese Embassy Meeting with NTI	Meeting within the survey team
4	November 2 (Fri.)	Meeting within the survey team	Meeting with NTI
5	November 3 (Sat.)	Meeting with Japanese Embassy Meeting with Ministry of Health Protocol visit to Ministry of Planning and Development	Move to Hodeida
6	November 4 (Sun.)	Hodeida Tuberculosis Subcenter (Visit to Hodeida)	Moves to Taiz
7	November 5 (Mon.)	Visit to Taiz Subcenter Inspection of Taiz Subcenter	Investigation of slope
8	November 6 (Tue.)	Protocol visit to Taiz PHC Meeting with Ministry of Health and Planning and Development	Investigation of slope Mr. Miyake moves to Sanaa
9	November 7 (Wed.)	Meeting with Health Ministry and Planning and Development (Engineers) at Taiz Subcenter Mr. Miyake meeting with Damar GTC	Investigation of building and slope Same as left
10	November 8 (Thu.)	Investigation of building and slope of Taiz Subcenter Mr. Miyake meeting with NTI	Same as left Same as left
11	November 9 (Fri.)	Investigation of building and slope of Taiz Subcenter	Same as left
12	November 10 (Sat.)	Investigation of building and slope of Taiz Subcenter Mr. Miyake meeting with Hajja GTC	Same as left Moves to Hodeida

Days	Date	Morning	Afternoon
13	November 11 (Sun.)	Investigation of building and slope of Taiz Subcenter Mr. Miyake visits to Harad Hospital	Same as left Moves to Hodeida
14	November 12 (Mon.)	Investigation of building and slope Mr. Miyake meeting with Hodeida Subcenter	Same as left Moves to Sanaa
15	November 13 (Tue.)	Investigation of building and slope Mr. Miyake meeting with NTI	Same as left Arrangement of data
16	November 14 (Wed.)	Investigation of building and slope Mr. Miyake meeting with Ministry of Health	Same as left Arrangement of data
17	November 15 (Thu.)	Investigation of building and slope of Taiz Subcenter Mr. Miyake meeting with NTI	Same as left Arrangement of data
18	November 16 (Fri.)	Investigation of building and slope of Taiz Subcenter	Messrs. Kojima and Miyamoto move to Sanaa
19	November 17 (Sat.)	Meeting with Japanese Embassy Meeting with NTI Meeting with Ministry of Health	Meeting within Study Team
20	November 18 (Sun.)	Survey Team (Government side) arrives at Sanaa Protocol visit to Japanese Embassy Protocol visit to Ministry of Health Protocol visit to Ministry of Planning and Development	Meeting within Study Team
21	November 19 (Mon.)	Mr. Miyamoto departs Sanaa Survey Team moves to Taiz Investigation of building and slope of Taiz Subcenter Meeting with Taiz Subcenter	Protocol visit to Governor of Taiz Move to Aden
22	November 20 (Tue.)	Survey of building and slope of Taiz Subcenter Meeting with Taiz Subcenter	Move to Aden

Days	Date	Morning	Afternoon
23	November 21 (Wed.)	Protocol visit to Consulate of Japanese Embassy Meeting with Bureau of Health in Aden Visit to Poly Clinic Visit to Republic Hospital	
24	November 22 (Thu.)	Move to Sanaa	
25	November 23 (Fri.)	Meeting within Study Team	
26	November 24 (Sat.)	Meeting with Ministry of Health	Arrangement of data Mr. Nishimiya departs Sanaa
27	November 25 (Sun.)	Meeting with Ministry of Health Signing of Minutes	Arrangement of data
28	November 26 (Mon.)	Supplementary investigation for Taiz Subcenter	Same as left
29	November 27 (Tue.)	Supplementary investigation for Taiz Subcenter	Arrangement of data
30	November 28 (Wed.)	Survey Team departs Sanaa	
31	November 29 (Thu.)		Survey Team (Consultant side) arrives at Narita
32	November 30 (Fri.)		Survey Team (Government side) arrives at Narita

3. List of Persons Interviewed

Ministry of Health

Dr. Mohamed Ali Mukbil	Minister of Public Health
Dr. Abdullah Assaedi	Undersecretary, Health & Development sector
Dr. Ahamed Mohamed Makki	Undersecretary, Services & Health Care sector
Dr. Ahamed Abdul Latif	Director General, Public Health
Dr. Mohammed Gharama Al-Raie	Director General, Planning, Statistics & Follow-Up
Eng. Hussain Abdullah Jubran	Director General Maintenance & Running
Dr. Abdul Halim Hashim	Deputy D.G., Public Health
Dr. Abdullah Moharam	Director, Communicable Disease
Dr. Omar Mohammed Thabet	Director, National TB Control Programme
Mr. Abdul Elah Shahari	Director, Public Relation
Eng. Mansor Thabet	Engineer

Ministry of Planning and Development

Mr. Abdul Wali Al-Agel	Deputy Minister for Economic & Technical Affair
Mr. Abdul Malik Iriyani	Director General, Technical Cooperation
Mr. Hamud Hamdani	Director, Bilateral Cooperation of Japan
Eng. Amin Derhem	Engineer

Taiz

Col. Mohel Al-Yusefi	Governor of Taiz
Mr. Yahia Rasea	Deputy Director, Taiz Health
Dr. Mohamed Ba-Alawi	General Director, Taiz Health Office
Dr. Abdul Waheb Al-Gorbani	General Director, Taiz Primary Health Care
Dr. Amin Noman	Director, Taiz Tuberculosis Subcenter

Aden

Dr. Ahamed Nagi	Deputy Minister, Aden Health Office
Dr. Mohamed Bahwel	Governorate Tuberculosis Coordinator Aden

MINUTES OF DISCUSSIONS
ON
THE BASIC DESIGN STUDY
ON
THE PROJECT FOR EXPANSION OF NATIONAL TUBERCULOSIS CONTROL PROGRAMME
IN
THE REPUBLIC OF YEMEN

In response to the request made by the Government of the Republic of Yemen, the Government of Japan decided to conduct a Basic Design Study on the Project for Expansion of National Tuberculosis Control Programme (hereinafter referred to as "the Project") and Japan International Cooperation Agency (JICA) has sent the Basic Design Team headed by Mr.Tadashi Isobe, Assistant Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, from November 1 to November 28, 1990.

The Team had a series of discussions with the authorities concerned of the Government of the Republic of Yemen and conducted a field survey.

As the result of the study, both parties have agreed to recommend to their respective Governments that the major point of understanding reached between them as attached herewith should be examined towards the realization of the project.

Sana'a, November 25, 1990

T. Isobe

Tadashi Isobe
Leader,
Basic Design Study Team
Japan International Cooperation Agency

25/11/90.

Abdullah Assa'edi M. D.
Undersecretary for Health Development
Ministry of Public Health
Government of the Republic of Yemen

Hamoud Al-Hamdani
Bilateral Cooperation Department
Ministry of Planning & Development
Government of the Republic of Yemen

MINUTES OF DISCUSSIONS
ON
THE BASIC DESIGN STUDY
ON
THE PROJECT FOR EXPANSION OF NATIONAL TUBERCULOSIS CONTROL PROGRAMME
IN
THE REPUBLIC OF YEMEN

In response to the request made by the Government of the Republic of Yemen, the Government of Japan decided to conduct a Basic Design Study on the Project for Expansion of National Tuberculosis Control Programme (hereinafter referred to as "the Project") and Japan International Cooperation Agency (JICA) has sent the Basic Design Team headed by Mr.Tadashi Isobe, Assistant Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, from November 1 to November 28, 1990.

The Team had a series of discussions with the authorities concerned of the Government of the Republic of Yemen and conducted a field survey.

As the result of the study, both parties have agreed to recommend to their respective Governments that the major point of understanding reached between them as attached herewith should be examined towards the realization of the project.

Sana'a, November 25, 1990

T. Isobe

Tadashi Isobe
Leader,
Basic Design Study Team
Japan International Cooperation Agency

Abdullah Assa'edi M. D.
Undersecretary for Health Development
Ministry of Public Health
Government of the Republic of Yemen

Hamoud Al-Hamdani
Bilateral Cooperation Department
Ministry of Planning & Development
Government of the Republic of Yemen

ATTACHMENT

1. Objective of the Project

The objective of the project is to assist to execute the National Tuberculosis Control Programme (NTP) activities integrated into the frame work of Primary Health Care (PHC), through procuring medical equipment, construction a storage for drugs and garage for the mobile X-ray vehicle, and repairing the land slope and the building of Taiz Tuberculosis Subcenter, thus to contribute to promotion of the health of inhabitants in the Republic of Yemen.

2. Executing Agency

The project will be executed by the Ministry of Public Health.

3. Items Requested

The study Team will convey to the Japanese Government the desire of the Government of the Republic of Yemen that the former takes necessary measures to cooperate by providing the equipment and other items listed in Annex I under the Grant Aid.

4. Grant Aid Programme

The authorities concernd of the Government of the Republic of Yemen have understood the Japanese Grant Aid System explained by the Team including the principle of use of a Japanese Consultant Firm and a Japanese Contractor for the implementation of the Project.

5. Technical Views on Taiz Subcenter

The engineers of the both parties had a series of discussions on the repair of the land slope and the building of Taiz Tuberculosis Subcenter, and reached mutual understandings summarized in Annex II.

6. Necessary Measures taken by the Yemeni Side

The authorities concerned of the Government of the Republic of Yemen have confirmed that the Government of the Republic of Yemen will take necessary measures as listed in Annex III on condition that the Grant Aid by the Japanese Government would be extended to the Project.

Annex I.

1. Equipment

(1) Microscope	106 units
(2) Automatic X-ray Film Processor	2 units
(3) Water Softner	3 units
(4) First-Aid Box	102 units
(5) Resuscitator	19 units
(6) Suction Pump	10 units
(7) Personal Computer	2 units
(8) Administration Equipment (contents: Copy machine, Typewriter, White board and Facsimile)	18 units
(9) Ambulance	4 units
(10) Vehicle, 4WD	18 units

2. National Tuberculosis Institute (NTI)

(1) Re-arrange a storage for drugs.

(2) Conservation of a garage for the mobile X-ray vehicle.

3. Taiz Tuberculosis Subcenter

Repairing the land slope and the building.

1. The main purpose should be not only to repair the slope, but also to strengthen of the building foundation.

2. Regarding the foundation of the building, it is necessary to make suitable treatment for protecting the building against ground subsidence. In this connection, piling is considered as a method and its applicability should be examined. If this method is selected, the rusting should be considered.

3. Regarding the land slope, the repairing treatment should be made for protecting the slope against rainfalls and land sliding to insure the stability of the slope.
   The recomendable method should contain the followings :

   (1) Enough compacting the surface of the slope
   (2) Covering the surface with suitable materials
   (3) Reducing the angle of the slope
   (4) Strengthening the existing retaining wall

Annex III.

1. To carry out site preparation such as clearing, leveling and reclaiming the site prior the commencement of the construction.

2. To undertake incidental out-door works such as making parks and constructing fence and gate in and around the site.

3. To provide facilities for distribution of electricity, water supply, drainage telephone line and other incidental facilities to the proposed site before the commencement of the Project.

   (1) Electricity distributing line to the site
   (2) City water distribution main to the site
   (3) Drainage city main to the site
   (4) Telephone trunk line to main distribution panel of building

4. To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.

   (1) Advising commission of authorization to pay
   (2) Payment commission

5. To ensure prompt unloading, tax exemption, customs clearance at port of disembarkation and prompt internal transportation of the equipment purchased under the Grant Aid.

6. To exempt Japanese Nationals involved in the Project from custom duties, internal taxes and other fiscal levies which may be imposed in the Republic of Yemen with respect to the supply of the products and services under the Verified Contracts.

7. To accord Japanese Nationals mentioned in the item 6 under the Verified Contracts to enter into the Republic of Yemen and stay therein for the performance of their work.

8. To maintain and use property and effectively the facilities constructed and equipment procured under the Japanese Grant Aid.

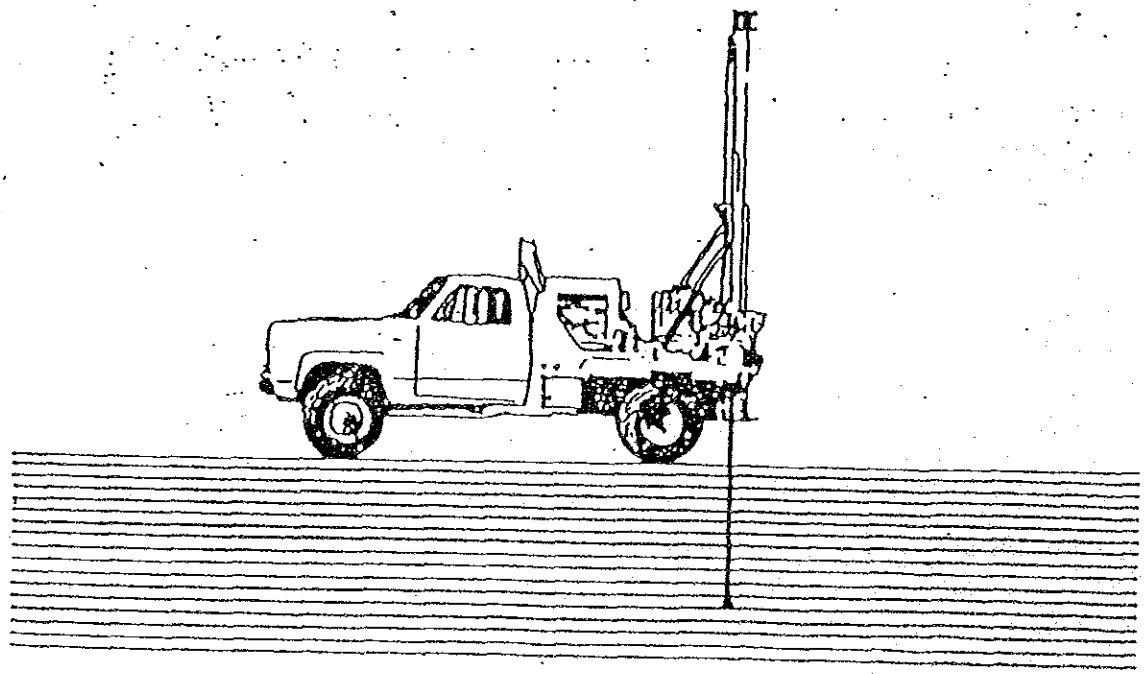
9. To bear all the expenses other than those to be born by the Japanese Grant Aid, necessary for execution of the Project.

5. Boring Data

مركز الاستشارات الهندسية
CONSULTING ENGINEERING CENTER

تقرير استطلاع موقع

SITE INVESTIGATION REPORT



PROJECT No. : 90 - 23 رقم المشروع :

PROJECT : SITE INVESTIGATION FOR TAIZ I.B CENTER المشروع :

DATE : JUNE 1990 التاريخ :

C.E.C.

Consulting Engineering Center

مركز الإستشارات الهندسية

Republic of Yemen
Ministry of Public Health
Sana'a

Ref : 90/56
Date: 12 July 1990

Dear Sirs ,

The Consulting Engineering Center / Laboratories Department / has carried out upon your request a site investigation for the site of the T.B center in Taiz .

The site investigation ended up with conclusions , recommendations and interpretations relevant to the findings . Those, in addition to field , laboratory and geotechnical analyses are included in the attached report .

We thank you for your confidence and looking forward for further cooperation .

We remain .

Sincerely yours

مركز الإستشارات الهندسية
CONSULTING ENGINEERING CENTER
SANA'A - Y.A.R.

Sami A. Hijjawi, Ph.D
Laboratories Department
Head

S.H / H.H

I . INTRODUCTION

This report presents the outcome of the site investigation and soil testing for the site of T.B center in Taiz .

The location of the T.B building with all dimensions are shown in Fig. 1 presented by the client .

II. PURPOSE OF INVESTIGATION

Since there have been some cracks appearing in columns and beams of the T.B center , it was necessary to carry out this cpmprehensive investigation .

The principal objectives of the investigation are :

(1) to determine the sequence,thickness,lateral extent of the soil strata and the level of bedrock ;

(2) to obtain representative samples of the soils for identification and classification and then for use in laboratory tests to determine relevant soil parameters ;

(3) to identify the ground water conditions .

To accomplish this , we performed the drilling of six boreholes in the different sides of the structure .

These holes are numbered as in Fig.1 . The depth of each hole is evident in the geological cross section (Fig.2) and the attached borehole logs (see appendix).

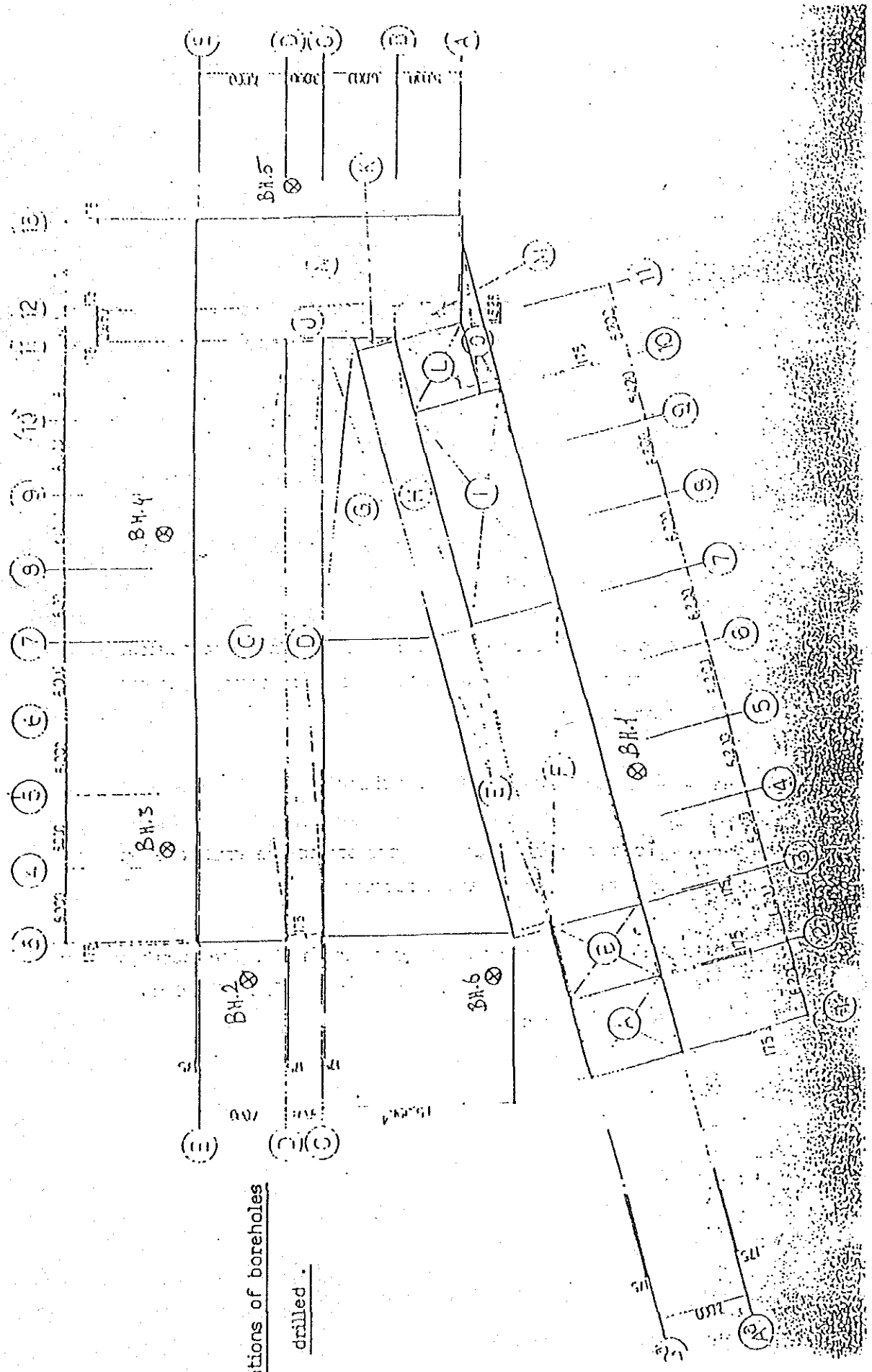


Fig.1- Locations of boreholes drilled .

III . FIELD EXPLORATION AND LABORATORY TESTING

A. Drilling and sampling :

The drilling was executed using rotary air flush drilling method , four inches bit hammer , with a MobileDrill , Model B-34 drilling rig .

A total of six boreholes were drilled under the supervision of the CEC's soil engineer , who examined and classified all collected samples and kept a log of the drilling operations .

Graphical presentation of the soil layers encountered (borehole logs) are shown in the appendix of test results attached to this report .

Because of the gravelly nature of soils , it was difficult to obtain satisfactory undisturbed samples for laboratory testing . Disturbed soil samples required for classification and determination of main soil properties were obtained at each lithological change of the strata .

B. Field testing :

The field Standard Penetration Test (SPT) was carried out in some of the drilled boreholes according to the known standards , and the number of blows required to produce 300mm of penetration is reported (see borehole logs) .

C. Laboratory testing :

In order to evaluate the engineering properties of the soils encountered , the following tests were performed according to the standards mentianed beside :

(1) Natural moisture content (ASTM D-2216) ,

(2) Grain size distribution (BS 1377:1975)

(3) Specific gravity (BS 1377:1975)

(4) Atterberg Limits (ASTM D-423 and D-424)

(5) Bulk density (BS 1377:1975) .

IV . THE SUBSURFACE CONDITIONS

A. Material description and properties

The top soil layer encountered in the drilled boreholes consisted mostly of loose artificial fill materials composed of basalt pebbles mixed with silty clay material . The moisture content of this layer ranges from 4.0 to 10.0 %.

Materials beneath this layer consisted mostly of gravel-sand mixture with fines (silt and clay) .

It should be noted that a soil layer with high moisture content was encountered in borehole No 2 (from 3.0- 10.0m , W=34.5%) , this borehole is located near a septic tank . TO examine wether the dampness is caused by mean of leakage from the tank , borehole No 6 was drilled in the same side . It was found that the same soil appeared but with a normal moisture content (W= 11.5%) . So it is recommended to give a special care for this phenomenon .

Care should be also given to study the zone of the subsurface where the slope is located : Two boreholes (3 and 4) were drilled in this zone . Materials encountered in these holes are of similar nature,but they are in a loose state in BH.3 (especially the second layer) while they are more dense in BH.4 . Soils in this zone are mixed with trash .

The hard rock formation in this side is reached at a depth of 15.0 meters in BH.3 and 12.0 meters in BH.4 .

Detailed geological section through BH.3 and BH.4 is shown in Figure 2 .

B. Ground water and cavities

No free ground water or cavities were encountered in any of the boreholes to the drilled depths .

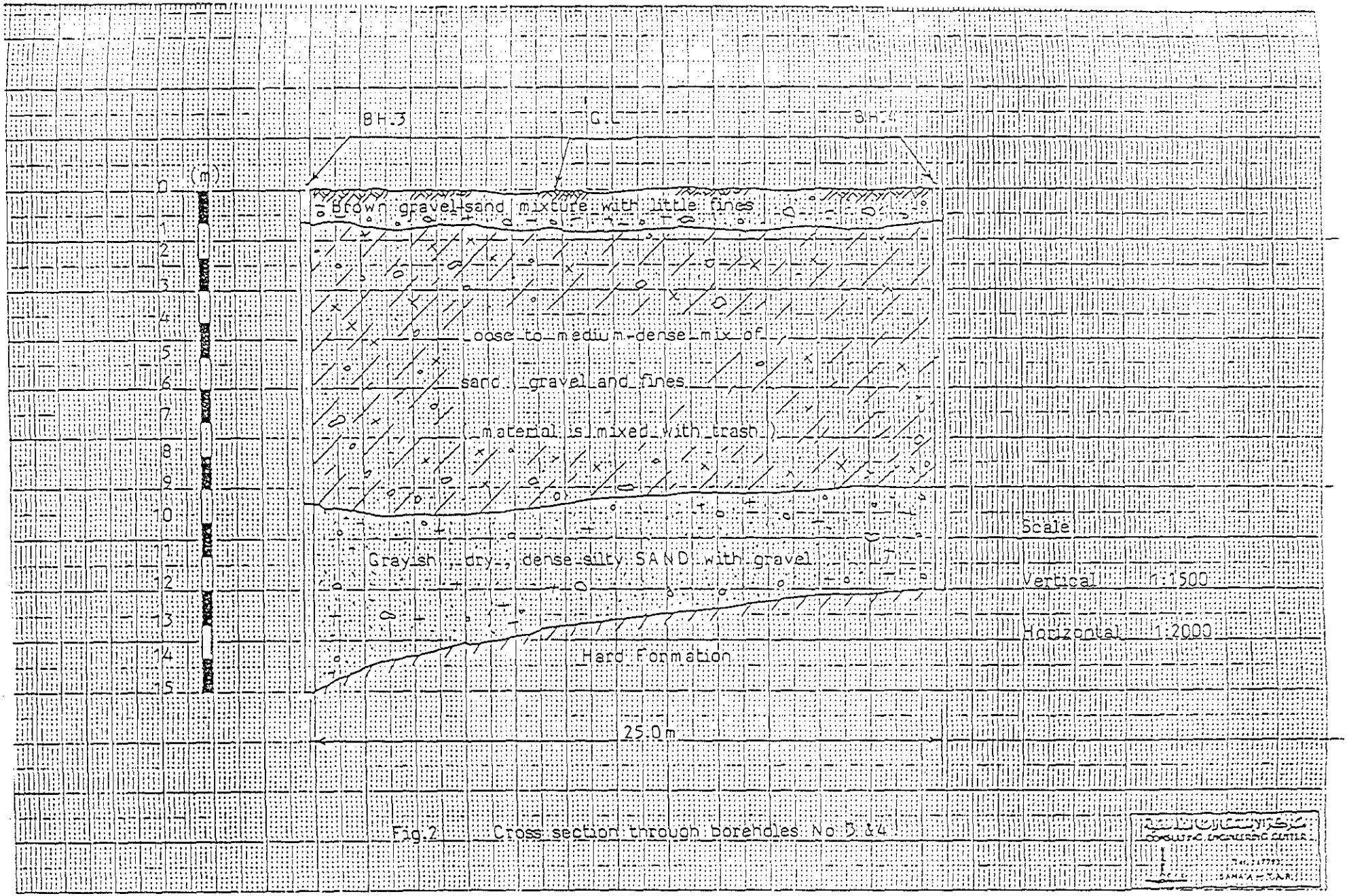


Fig.2 Cross section through boreholes No 3 &4

V . CONCLUSIONS

(1) It was evident that the soil was not compacted before constructing the foundations , especially in the zone where the slope is located.

(2) Soils in the above mentioned zone are in loose state especially where borehole No 3 is located (from 1.0-9.5m) and it is mixed with trash.

(3) There is a possible leakage from the septic tank located in the garden (The zone where BH.2 is located).

(4) The visual examination of the slope surface indicated a clear zones of buckling in it . This could have been caused by a horizontal soil displacement .

(5) The gravelly loose nature of soils encountered in the zone of slope made it difficult to obtain undisturbed samples for studying the shear parameters needed for slope stability analysis . The angle of internal friction of the second layer shown in Fig.2 , according to the soil state and classification , estimated to be about 35° (Ref.1, p.541 , Table 12.3) .

REFERENCES

(1) Head K.H. Manual of Soil Laboratory Testing . Volume 2 . Pentech Press , London , 1982 .

(2) BS 5930 : 1981. Code of Practice for Site Investigations .

(3) BS 1377 : 1975 . Methods of Test For Soils for Civil Engineering Purposes .

(4) ASTM . Volume 04.08 / Soil and Rock ; Building Stones .

APPENDIX

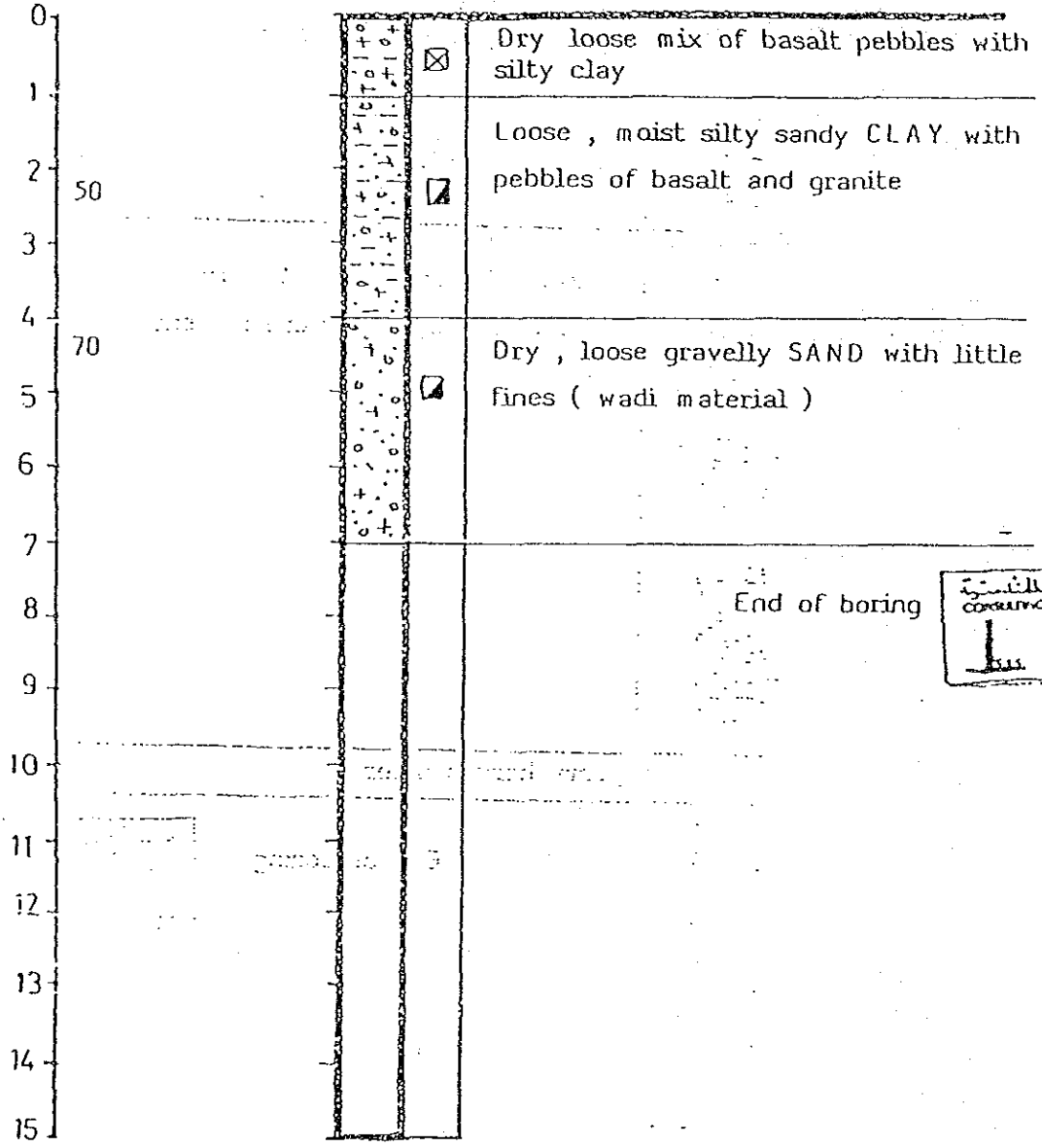
NOTE : Borehole logs presented earlier to the client were depended on visual description of soils encountered . Revised logs depending on soil classification tests included hereto .

CONSULTING ENGINEERING CENTER
LABORATORY

C.E.C

P.O.BOX 8180
AMMAN - JORDAN
P.O.Box 19066
Sana'a - Y.R.

BORING Nº 1



KEY :

- = UNDISTURBED' SAMPLE
- = STANDARD PENETRATION TEST PERFORMED AND DISTURBED SOIL SAMPLE OBTAINED
- = DISTURBED SOIL SAMPLE OBTAINED ONLY WITHOUT PERFORMING STANDARD PENETRATION TEST

LOG OF BORING

H.No	Depth(m)	Clay and silt(%)	Sand(%)	Gravel(%)	Average moisture co.(%
1	0.0-1.0	10.0	31.0	59.0	4.3
	1.0-4.0	38.0	32.0	30.0	10.4
	4.0-7.0	12.7	57.3	30.0	3.3
2	0.0-3.0	30.0	45.0	25.0	10.2
	3.0-10.0	54.0	34.0	12.0	34.5
3	0.0-1.0	24.0	39.0	37.0	9.6
	2.5-9.5	33.5	56.5	10.0	3.8
	9.5-15.0	20.0	60.0	20.0	3.9
4	0.0-1.0	19.0	20.0	61.0	6.9
	1.0-9.0	33.0	32.0	32.0	8.0
	9.0-12.0	30.0	63.0	7.0	2.1
5	0.0-2.5	29.0	33.0	38.0	12.2
	2.5-6.5	57.0	38.0	5.0	14.2
6	0.0-2.5	35.0	40.0	25.0	8.3
	2.5-3.5	33.0	42.0	25.0	8.1
	3.5-6.0	55.0	40.0	5.0	11.5

Table 1 — Grain size analysis and moisture content of soil samples collected in the drilled boreholes .

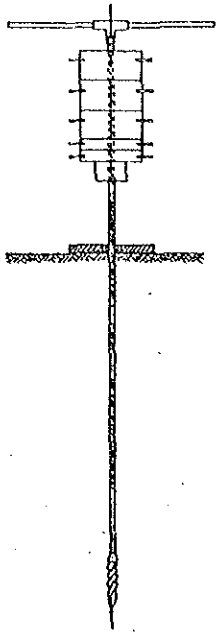
BH.No	Depth (m)	Specific gravity
1	1.0-4.0	2.67
	4.0-7.0	2.66
2	0.0-2.5	2.58
	3.0-10.0	2.72
3	1.0-2.5	2.70
	9.5-15.0	2.69
4	1.0-9.0	2.56
	9.0-12.0	2.64
5	0.0-2.5	2.69
	6.5-10.0	2.66
6	0.0-2.5	2.60
	2.5-3.5	2.58

Table 2 — Specific gravity of some soil sample collected in the drilled boreholes .

BH.No	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity index
2	3.0-10.0	46	26.3	19.7
5	2.5-6.5	52	31.5	20.5
6	3.5-6.0	47.9	29.7	18.2

Table 3 — Atterberg Limits for clay samples collected in BHs 2.5 & 6.

6. Results of Swedish Type Sounding Test



Swedish type sounding tester

Screw point

Testing method

A screw point is installed on the tip of a rod with 0.8 m in length, loading clamp is fixed joining the bottom of the clamp at 50 cm from the lower end of the screw point and is supported vertically through the bottom plate on the point to be surveyed.

Confirm whether the rod penetrates into ground as it is. If it does the amount of penetration is obtained measuring the length from the datum plane to the next next division line on the rod when the penetration stops and recorded as the amount of penetration against the load of 5 kg.

Next, the weight of 10 kg is placed on the loading clamp and repeat the operation in 3.2 and recorded as the amount of penetration against the load of 15 kg.

The load is increased successively repeating the operation of 3.3. The steps of the loading shall be 5, 15, 25, 50, 75 and 100 kg.

As the loading clamp reaches the bottom plate, remove the weight and add the rod if short, fix it by pulling up the clamp by 50 cm and the operation of 3.4 is performed.

In the case where the penetration speed increases abruptly in the loading process, let it penetrate and record the observation of penetration in detail.

If the penetration should stop with the loading of 100 kg, measure the amount of penetration, install a handle, rotate it so as not to apply the force in the vertical direction to the handle and record the number of half turns that is required to penetrate to the next division line. The measurement thereafter shall be taken every 25 cm (division line). The direction of turn of the handle shall be in a clockwise direction using the method in which the turn is stopped temporarily by every half turn, counting it as one.

Swedish Type Sounding Test

JIS A 1221 スウェーデン式サウンディング試験 報告用紙

調査名・調査地点 ..... 試験年月日 ..... 年 ..... 月 ..... 日

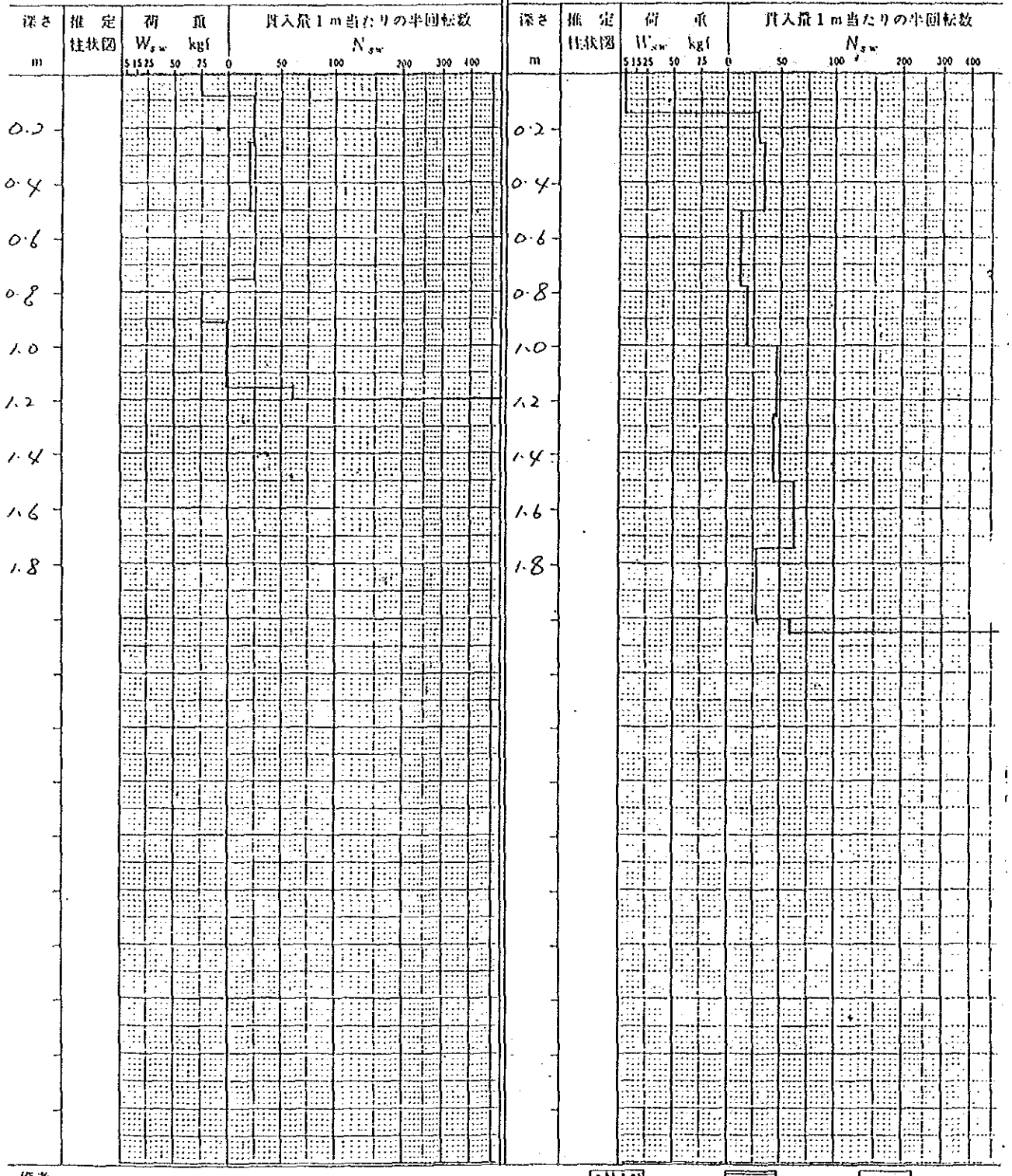
天　候 ..... 試 験 者 .....

測点番号：No. 3 ..... 標　高 ..... m

最終貫入深さ ..... m 作業時間 ..... ~ .....

測点番号：No. 4 ..... 標　高 ..... m

最終貫入深さ ..... m 作業時間 ..... ~ .....



備考

土質記号凡例：礫 / 粘土 / 砂 / ピート

Swedish Type Sounding Test

JIS A 1221	スウェーデン式サウンディング試験	記録用紙

調査名・調査地点 ..... 試験年月日 ..... 年 ..... 月 ..... 日

天候 ..... 試験者 .....

測点番号：No. 3 標高 ..... m

最終貫入深さ ..... m 作業時間 ..... ～

荷重 W_{sw} kgf	半回転数 N_a	貫入深さ D m	貫入量 L cm	1m当たりの半回転数 N_{sw}	記事
75			0.09		
100			—		
〃	4	0.25	0.16	25	
	5	0.50	0.25	20	
	6	0.75	0.25	24	
	—	0.80	0.05		自沈
75		0.91	0.11		
100		1.15	0.24		
〃	3	1.20	0.05		ねじる

測点番号：No. 4 標高 ..... m

最終貫入深さ ..... m 作業時間 ..... ～

荷重 W_{sw} kgf	半回転数 N_a	貫入深さ D m	貫入量 L cm	1m当たりの半回転数 N_{sw}	記事
5		0.21	0.21		
15		0.25	0.04		
100		—	—		
〃	5	0.50	0.25	20	
	5	0.75	0.25	20	ジリジリ
		0.90	0.15		自沈
	3	1.15	0.25	12	ジリジリ
	3	1.20	0.05	12	ねじる
5		0.15	0.15		ガリガリ
100	3	0.25	0.10	30	〃
	8.5	0.50	0.25	34	〃
	3	0.78	0.28	11	〃
	4	1.00	0.22	18	〃
	12	1.25	0.25	48	〃
	10	1.50	0.25	40	〃
	16	1.75	0.25	64	〃
	7	2.00	0.25	28	ジリジリ
	3	2.05	0.05	60	ねじる

備考

7. Stability of Slope in Its Existing Condition

As a result of investigation of the slope on the site of Taiz Subcenter, it was judged that the collapse occurred due to surface slip of the surface of stone pitching and banking (about 50 cm). Although it is somewhat settled at present, it is judged that the possibility of the slip becoming active again due to rainfall in the future, deterioration of joint concrete, creeping of banking material, etc., is high.

The following indicates the results of checking of the slope in the existing condition using the soil constant obtained from the laboratory soil test and from the inverse operation using the slope stability calculations:

1) Soil constant

	Natural	Banking ground
Wet unit weight (ρt)	1.7	1.8
Saturated density (ρt sut)	1.9	2.0
Angle of internal friction ϕ^o	23^o	23^o
Cohesion ct/m^2	0.7	1.0

a) Density

$$\rho t = \rho d\ (1 + W/100) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

$$\rho tsut = \rho w\ (\rho s + e)/(1 + e) \quad \ldots\ldots\ldots\ldots\ldots\ (2)$$

$$e = \rho s/\rho d - 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ (3)$$

where,

ρt = wet unit weight gf/cm^3

ρd = dry unit weight gf/cm^3

w = water content in per cent of dry weight %

$\rho tsut$ = saturated density gf/cm^3

ρw = density of water

e = void ratio

Wet unit weight of natural ground

$$\rho t = \rho d\ (1 + W/100)$$
$$= 1{,}479 \times (1 + 14.7/100)$$
$$= 1{,}696 \fallingdotseq 1.70$$

Saturated density of natural ground

$$e = \rho s/\rho d - 1$$
$$= 2.715/1.479 - 1$$
$$= 0.836$$

$$\rho tsut = \rho w\ (\rho s + e)/(1 + e)$$
$$= 1.0 \times (2.715+0.836)/(1 + 0.836)$$
$$= 1.934$$
$$\fallingdotseq 1.9$$

Wet unit weight of banking

$$\rho t = 1.579 \times (1 + 14.7/100)$$
$$= 1.811 \fallingdotseq 1.8$$

Saturated density of banking

Void ratio $e = 2.778/1.579 - 1$
$= 0.759$

$\rho tsut = 1.0 \times (2.778 + 0.759)/(1 + 0.759) = 2.011$
$\fallingdotseq 2.0$

b) Angle of internal friction ϕ, cohesion c

These are established from the results of soil test.

Results of triaxial compression test

ϕ and c with the density at site (natural ground competence)

$\phi = 23^{\circ}$

$c = 0.07 \text{ kgf/cm}^2 = 0.7 \text{ t/m}^2$

ϕ and c of the material with compaction factor of 90% (banking competence)

$\phi = 23^{\circ}$

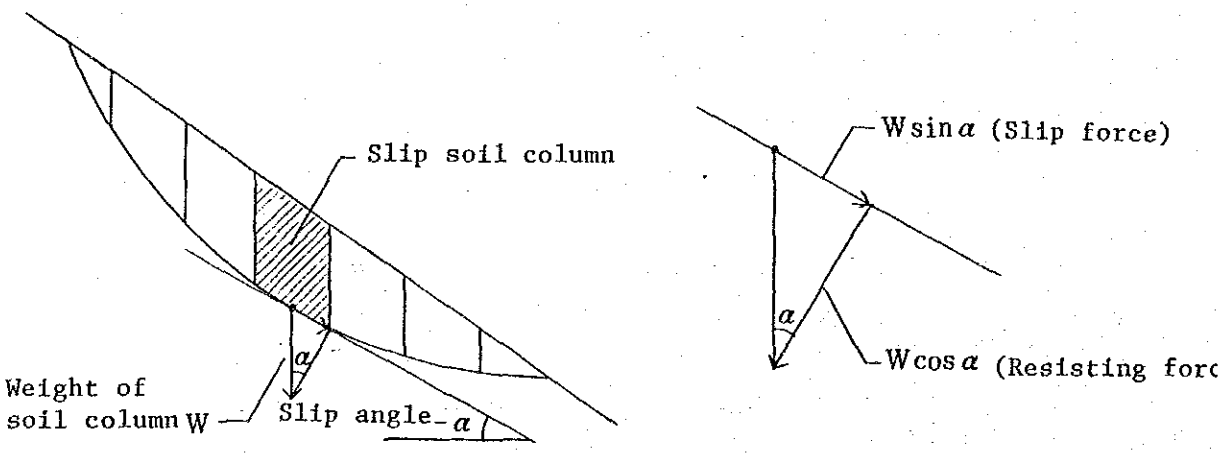
$c = 0.17 \text{ kgf/cm}^2 = 1.7 \text{ t/m}^2$

$\fallingdotseq 1.0 \text{ t/m}^2$

c) Method of stability calculation

The stability calculation of the slope is carried out using a slice method on circular slip surface.

$Fs = \Sigma(C\ell + W\cos\alpha.\tan\phi)/\Sigma W\sin\alpha$

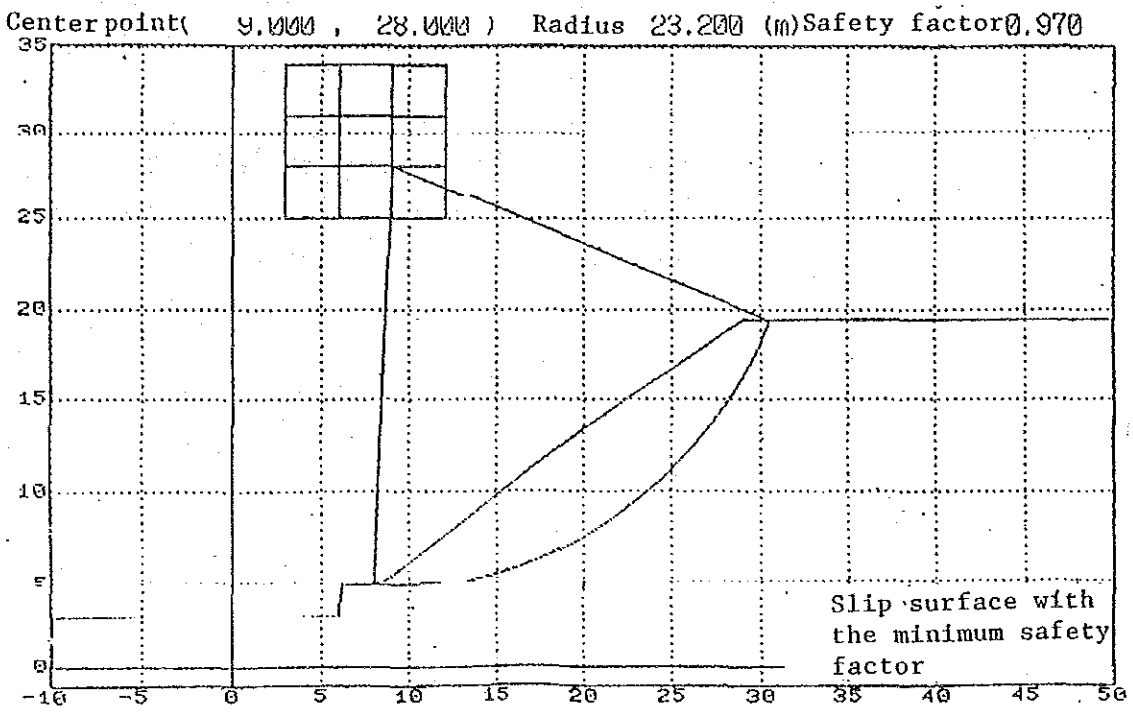


d) Results of stability calculation

The results of calculation are as shown in the table below with the minimum safety factor of existing slope Fs = 0.97.

List of safety factor

Y/X	3.000	6.000	9.000	12.000
34.000	1.908	0.976	1.013	1.088
31.000	1.201	0.991	0.982	1.046
28.000	1.394	1.039	0.970	1.015
25.000	1.866	1.103	0.995	0.999



Since the test results used for establishing the competence of natural ground depended on the samples taken from the surface of banking, it is possible to calculate the increase in strength in the direction of depth from the surface of banking.

$c = 0.2Z$ (Z = depth)

Therefore, assuming that the depth of slip surface is 3 m in average, as the position where the samples are taken

is GL-1.0 m,

$$\Delta C = 0.2 \times (3-1) = 0.4 \text{ t/m}^2$$
$$C = 0.7 + 0.4 = 1.1 \fallingdotseq 1.0 \text{ t/m}^2$$

Considering this increase in strength into the stability calculation,

$$Fs = \Sigma(C\ell + W\cos\alpha.\tan\phi)/\Sigma W\sin\alpha$$

From $C\ell = 20.01$ $\ell = 20.01/0.7 = 28.6$ m

$W\cos\alpha\tan\phi = 61.41$

$W\sin\alpha = 86.39$

$C\ell = 28.6 \times 1.0 = 28.6$

Therefore $Fs = (28.6 + 61.49)/86.39 = 1.04$

(Where the water content in percent of dry weight is extremely high was assumed.)