


ISLAMIC REPUBLIC OF PAKISTAN
SUBSOIL INVESTIGATION REPORT
ON
THE CONSTRUCTION PROJECT OF
A MINI-PORT IN GWADAR

MARCH, 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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INTRODUCTION

This report details the content and findings of the soil investigation done for the "STUDY REPORT ON THE CONSTRUCTION PROJECT OF A MINI-PORT IN GWADAR".

Kisojiban Consultants Co., Ltd. performed the soil investigation during Phase II of the Gwadar Mini-Port Construction Project Study from August 24 to December 2, 1979.

Subsoil investigations were performed in the East Bay twice in the past.

- 1) 11 drilling holes were made by Messrs. Boremaster Ltd. under the supervision of NESPAC from November, 1974 to April, 1975.
- 2) 8 drilling holes were dug by Messrs. Incorporated Consulting Engineers, in association with Sir William Halcrow and Partners, in 1976.

The former included a considerable number of standard Penetration tests, sampling and laboratory tests.

The results are very useful to understand the general engineering properties of the soil at Gwadar.

However, as no detailed description of the drilling and sampling methods was provided, and as the drilling locations were along the headland, approximately 1.2 Km

south of the Proposed Mini-Port, it is difficult to apply the results directly to engineering study.

The latter investigation covered only soil classification, so that it can hardly be indicative of the soil strength.

This report presents the results of soil studies undertaken as a part of the study of the Gwadar Mini-Port.

The proposed major structures are landing facilities, groin, revetment, channel and basin.

Primary purposes of these investigations were:

1. To explore the subsurface ground conditions at the site.
2. To compile the engineering properties of the soil for the study.

The standard used for this investigation was the Japanese Industrial Standard (JIS).

The location of Gwadar is shown on the map on the following page.

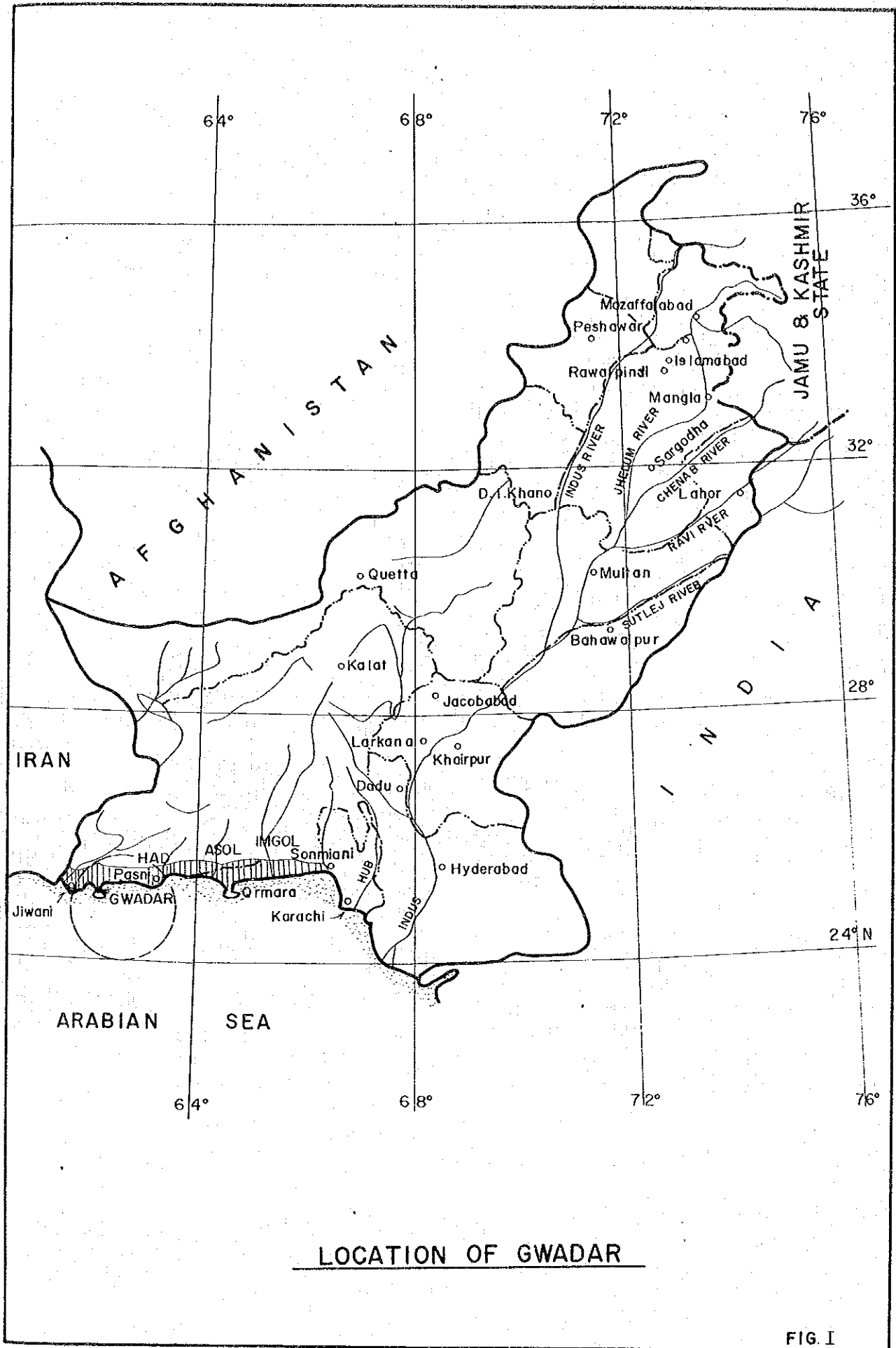


FIG. I

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SECTION I

OUTLINE OF WORKS PERFORMED

The field investigation was started on 6th September, 1979 and completed on 10th November, 1979.

This soil investigation consisted of:

1. Exploratory drilling with Standard Penetration Tests and undisturbed sampling.
2. Laboratory soil tests on soil samples obtained from the site.

Eighty percent of the unconfined compression tests were conducted at the Gwadar temporary laboratory to avoid any disturbance of the samples due to transportation.

The tests of natural water content and of unit weight were also carried out at the laboratory. Triaxial compression tests, consolidation tests, remaining unconfined compression tests and other physical properties tests were performed in the laboratory of KISO-JIBAN CONSULTANTS CO., LTD. in Singapore.

Elevations referred to in this report were based on the datum obtained by the survey works performed in association with the study.

Investigation works performed are listed in Table I.

TABLE I INVESTIGATION WORKS PERFORMED

BORE HOLE NO.	Drilling Length (m)	In-Situ Test Standard Penetration Test	UD Sampling		Natural Water Content	Specific Gravity	Atterberg Limits LL & PL	Unit weight		Grain Size Analysis *	Unconfined Compression Test		Triaxial Compression Test	Consolidation Test		
			by SPS	by DS				GWD	S'pore		GWD	S'pore			GWD	S'pore
1	14.45	9	4	-	4	3	2	4	3	2	4	-	2	3		
2	15.36	10	2	2	3	4	4	3	4	4	3	-	3	2		
3	30.45	26	3	-	3	3	3	3	2	3	3	-	2	2		
3'	(4.85)	-	3	-	4	3	2	4	3	2	4	1	2	2		
4	19.45	12	6	-	1	6	6	1	6	6	1	4	4	3		
5	13.45	10	2	-	-	2	2	-	2	2	-	1	2	1		
6	16.40	11	4	-	4	4	3	4	4	3	4	-	4	2		
7	20.45	13	5	-	2	4	4	2	4	4	2	2	3	3		
8	30.45	22	3	4	7	5	4	7	5	5	7	-	3	3		
9	22.25	18	3	-	4	2	1	4	2	1	4	-	1	2		
10	30.30	23	6	1	3	6	6	3	6	6	3	4	4	3		
To- tal	213.01 ^m (217.86 ^m)	154	41	7	35	42	40 NOS.	35	41	48 NOS.	35	47 NOS.	30 NOS.	26 NOS.		
			48 NOS.		77 NOS.		37	76 NOS.								

(Notes) UD Sampling: Undisturbed Sampling GWD: in Gwadar LL: Liquid Limit
 SPS: by Stationary Piston Sampler S'pore: in Singapore PL: Plastic Limit
 DS: by Densison Sampler * ... Grain Size Analysis with Hydrometer Test

SECTION II

FIELD INVESTIGATION

The alignment of major structures of the proposed Mini-port from the Set-Out Point (S.O.P.) is 70 degrees east of magnetic north.

The drilling holes are located along the alignment, the most distant hole from land being about 1450 m from S.O.P., as shown in Fig. II, "Location of Drilling Holes".

a) Exploratory Drilling

Eleven (11) exploratory drilling holes were performed on the fixed steel pipe stagings. One of them was for only undisturbed sampling.

All these holes were drilled by a rotary boring rig. The deepest hole was 30.45 m and the shallowest hole was 4.85 m below the surface of the seabed, and the diameter of holes was 90 mm for undisturbed sampling and 65 mm for normal drilling with Standard Penetration Tests. Location of drill holes were determined using a boat and two transits located on land with communication by means of walkie-talkies.

b) Sampling and Standard Penetration Tests

Undisturbed samplings were performed using a stationary piston sampler or a Denison sampler.

The thin-wall sampling tube of the samplers was made

GWADAR CITY

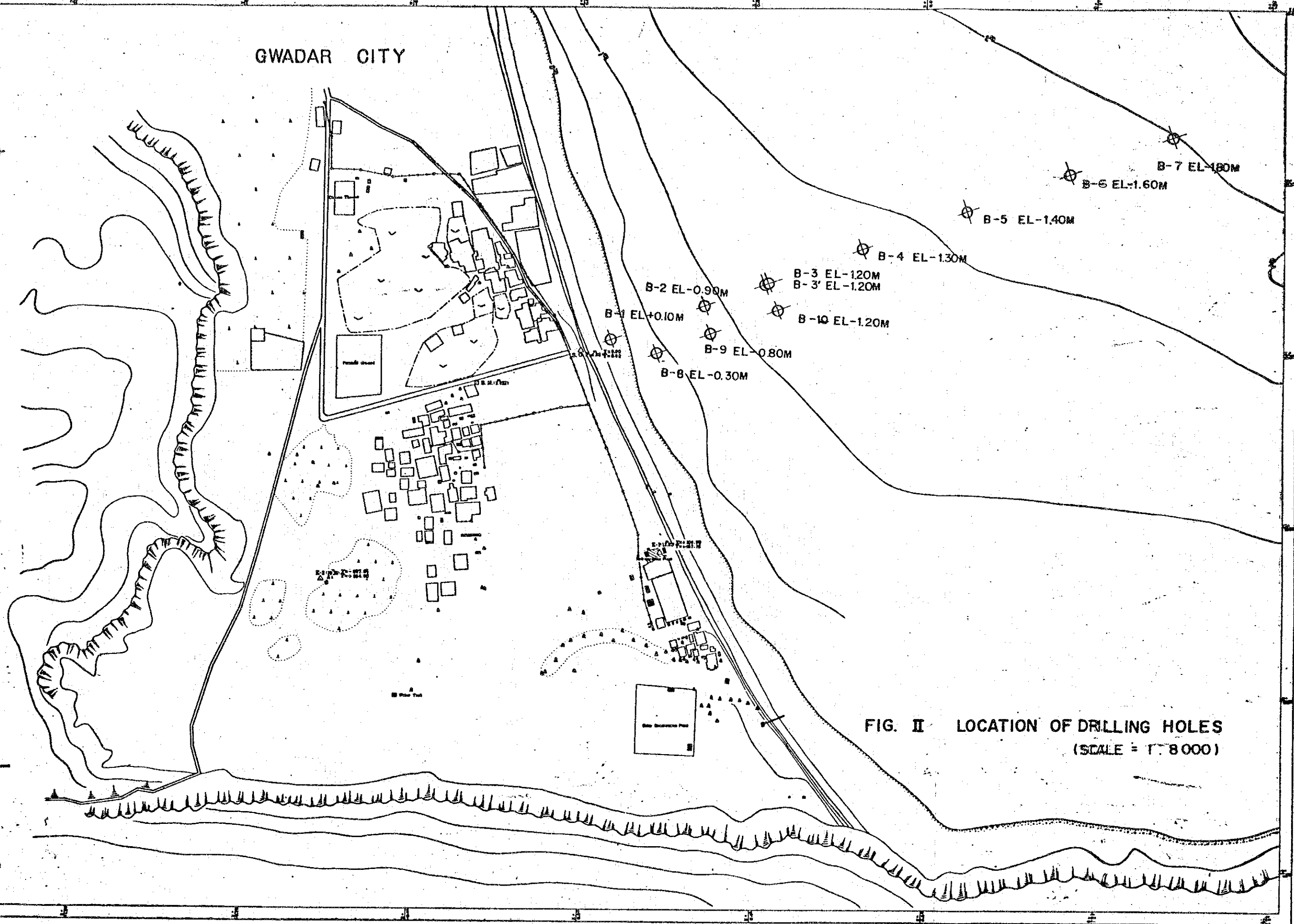


FIG. II LOCATION OF DRILLING HOLES
(SCALE = 1:8000)

of brass and had an inner diameter of 75 mm and a length of 1.0 m.

Many shell fragments were included in the soil at shallow depths and apt to remain on bore hole bottom. These fragments on hole bottom were flushed away before sampling in order to recover sufficient lengths of undisturbed samples.

After undisturbed samples were sealed with paraffin at both ends of the thin-wall tubes, they were carefully brought to the Gwadar temporary laboratory, where the tests of natural water content and unit weight of soil, and unconfined compression tests, were performed.

The remaining undisturbed samples were re-sealed with paraffin, well-packed in thick foam rubber cushion to avoid any disturbance due to transportation, and sent to Singapore by air.

Standard Penetration Tests were conducted at 1.0-m intervals in each drilling hole except at depths where undisturbed samples were taken.

Disturbed samples taken from split tube samplers of Standard Penetration Tests were packed in plastic jars as observational samples and submitted in Gwadar to the Assistant Executive Engineer of the Gwadar Fishery Port Project. The results of drilling are summarized in Fig. III-1 to 10, Drilling Logs and shown in Fig. IV-1 to 2, Soil Profiles.

FIG. III - 1 DRILLING LOG

Name of Project : GWADAR MINI-PORT PROJECT Type of Drilling : ROTARY
 Hole Number No. B-1 Elevation + 0.10 m. Date : OCT. 30 TO 31. 1979
 Water Table — m. Driller : K. SUGAYA (—)

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Standard Penetration Test or Core Recovery				
									Depth in m.	Sampling for Lab.	N-Value	Blows Per Each 10cm	(N-Value)
1	-0.30 - 0.40	0.40	0.40	⊖	Silty sand	Dark grey V. Loose	Including many shells						
2				⊖		Dark grey	With great quantities of shell fragments at 0.40 to 1.00m.						
3				⊖			Very soft						
4				⊖			to soft						
5				⊖	Silty clay	Bluish grey	Very highly cohesive soil.						
6	-5.40 - 5.50	5.10	5.10	⊖	Alternate layers of sandy silt and silt	Bluish grey to dark bluish grey	Sand is very fine.						
7				⊖									
8	-7.90 - 8.00	8.00	2.50	⊖	Silt	Dark grey	Loose						
9	-9.10 - 9.20	9.20	1.20	⊖	Silt	Dark grey	Stiff	Including some decomposed organic matter.					
10				⊖									
11				⊖									
12	-11.70 - 11.80	11.80	2.60	⊖	Sandy silt	Dark grey	Stiff	With occasional shell fragments.					
13				⊖									
14	-14.35 - 14.45	14.45	2.65	⊖	Silty fine sand	Dark grey	Very dense	Sand is homogeneous and very fine.					
15				⊖									
16				⊖									

FIG. III -2 DRILLING LOG

Name of Project GWADAR MINI-PORT PROJECT Type of Drilling ROTARY
 Hole Number No. B-2 Elevation -0.90 m. Date SEP. 22 TO 23, 1979
 Water Table — m. Driller K. SUGAYA (—)

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Standard Penetration Test or Core Recovery					
									Depth in m.	Sampling for Lab.	N-Value	Blows Per Each 10cm		
1	1.30 - 0.40	0.40	0.40		Fine sand	Bluish grey	Very loose	Containing many shell fragments.	2.50					
2								Containing many shell fragments up to 2.4 m deep.	3.20	S2-1				
3					Silty clay	Bluish grey	Very soft	Cohesive.	3.35	P-1	12/30	1/13		
4	4.70 - 3.80	3.80	3.40		Sandy silt	Dark bluish grey	Soft	Sand is fine.	3.65					
5	5.60 - 4.70	4.70	0.90		Silty fine sand	Dark, bluish grey	Loose	Sand is extremely fine. Containing alternate silty seams.	4.00	S2-2				
6									6.15	P-2	12/30	3	4	5
7	7.50 - 6.60	6.60	1.90					Well consolidated.	6.45	P-3	10/30	3	3	4
8									7.00	S2-30				
9									7.00					
10	10.50 - 9.60	9.60	3.00		Sandy silt	Dark, bluish grey	Stiff to very stiff		8.15	P-4	25/30	0	0	9
11									8.45					
12									9.15	P-5	20/30	7	9	12
13									9.95					
14									10.00	S2-40				
15									10.60					
16									11.15	P-6	30/30	7	12	17
17									11.45					
18									12.15	P-7	37/30	10	11	16
19									12.45					
20									13.15	P-8	50/22	10	24	16
21									13.37					
22									14.15	P-9	30/10	21	10	8
23									14.33					
24									15.15	P-10	30/21	20	27	9
25	16.26 - 15.36	15.36	5.76		Silty fine sand	Dark bluish grey	Dense to very dense	Sand is extremely fine. Generally homogeneous, though consolidated, clayey or silty seams are found in some parts.	15.36					
26					End of Drilling									
27														

FIG. III - 3 DRILLING LOG

Name of Project GWADAR MINI-PORT PROJECT Type of Drilling ROTARY
 Hole Number No. B-3 Elevation -1.20 m. Date SEP. 26 TO 30, 1979
 Water Table — m. Driller K. SUGAYA (—)

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Standard Penetration Test or Core Recovery		
									Depth in m.	Blows Per Each 10cm	(N-Value)
1	1.65 - 0.95	0.95 - 0.45		⊙	Fine sand	Bluish grey	Very loose	Containing shell fragments in the lower part			
2								Dotted with shell fragments and small blocks of medium sand up to 3.0m deep.			
3											
4								Very cohesive or sticky			
5											
6	7.20 - 6.00	6.00 - 5.55			Silty clay	Bluish grey	Very soft				
7								Cohesive. Dotted with shell fragments.			
8	8.00 - 7.60	7.60 - 1.60			Sandy silt	Dark bluish grey	Stiff to very stiff				
9								Sand is fine.			
10								Sand is extremely fine.			
11								Containing thin, alternate, consolidated silt layers.			
12	13.10 - 12.10	12.10 - 4.50			Silty fine sand	Dark bluish grey	Very dense				
13											
14											
15											
16								Containing fine sand.			
17								Well consolidated but cohesive or sticky.			
18											
19								Containing fossiliferous organic matter.			
20								Core recovery is 50 to 60% generally.			
21											
22											
23											
24											
25								Resembles soft mud stone in the lower part of the stratum, though still sticky when taken as core.			
26											
27											
28											
29											
30					Clayey silt	Dark bluish grey	Hard				
31	31.65 - 30.45	30.45 - 10.35									
32											

FIG. III-4 DRILLING LOG

Name of Project : GWADAR MINI-PORT PROJECT Type of Drilling : ROTARY
 Hole Number : B-4 Elevation : -1.90 m. Date : OCT. 17 TO 19. 1979
 Water Table : — m. Driller : K. SUGAYA ()

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Depth in m.	Sampling for Lab.	N-Value Blows/30 cm	Standard Penetration Test or Core Recovery	
												Blows Per Each 10cm	(N-Value)
1	1.90 - 0.60	0.60			Fine sand	Dark grey	V. loose	With many shell fragments	2.00				
2						Dark grey		With great quantities of shell fragments and fine sand up to 2.00m.	2.70	S4-1			
3									3.00				
4									3.07	S4-2			
5									4.00	S4-3			
6									4.05	S4-4			
7									5.00				
8									5.07	P-1	2/30	1/4	1/6
9	14.30 - 9.00	9.00	3.40		Silty clay	Bluish grey	Very soft to soft	With occasional shell fragments.	6.75				
10									6.95	P-2	3	1	1
11									7.15				
12									7.45				
13									8.00				
14									8.00	S4-5			
15									9.15	P-3	5	2 1/4	1 1/8
16									9.45				
17									10.15	P-4	7	2	2
18									10.45				
19									11.00				
20	20.75 - 19.45	19.45	10.45		Clayey silt	Bluish grey	Medium to stiff	High cohesion	10.15	S4-6			
21									11.07				
									12.15	P-5	7	2	3 1/4
									12.45				
									13.75	P-6	9	3	3
									13.95				
									14.15	P-7	6	2	2
									14.45				
									15.15	P-8	8	2	3
									15.45				
									16.15	P-9	24	7	8
									16.45				
									17.15	P-10	32	7	10
									17.45				
									18.15	P-11	30	7	10
									18.45				
									19.15	P-12	32	10	10
									19.45				

FIG. III-5 DRILLING LOG

Name of Project : QWADAR MIN - PORT PROJECT Type of Drilling : ROTARY
 Hole Number : No. B-5 Elevation : - 1.4 m. Date : SEP. 14 TO 15, 1979
 Water Table : — m. Driller : K. SUGAYA (—)

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Standard Penetration Test or Core Recovery			
									Depth in m.	Sampling for Lab.	N-Value	Blows Per Each 10cm
1	1.00 - 0.40	0.40 - 0.90		2:6 2:0	Fine sand	Dark grey	Very loose	With many shell fragments.	2.15	P-1	1/32	
2				2:6 2:0				Many shell fragments and much sandare including from 0.4m to 1.6m	2.47			
3									3.00	SS-1		
4									3.74			
5	6.50 - 5.10	5.10 - 4.60		2:6 2:0	Silty clay	Bluish grey	Very soft	Highly cohesive	4.15	P-2	1/30	
6									4.45			
7				2:6 2:0					5.00	SS-2		
8	9.40 - 8.00	8.00 - 2.90		2:6 2:0	Sandy silt	Greenish bluish grey	Medium	Block of shell fragments is included.	5.69	P-3	5/80	2 1/2
9									6.15			1 1/2
10									6.45			2
11									7.15	P-4	7	2
12									7.45			2
13									8.15	P-5	13	3
14									8.45			4
15									9.15	P-6	19	5
									9.45			6
									10.15			6
									10.45	P-7	24	7
									11.15			7
									11.45	P-8	36	10
									12.15			11
									12.45	P-9	40	12
									13.15			14
	14.05 - 13.45	13.45 - 5.45			Clayey silt	Brownish bluish grey	Hard	Fine sand layers (40 ~ 15cm) are included occasionally	13.45	P-10	30	10
					End of Drilling				13.45			13
												15

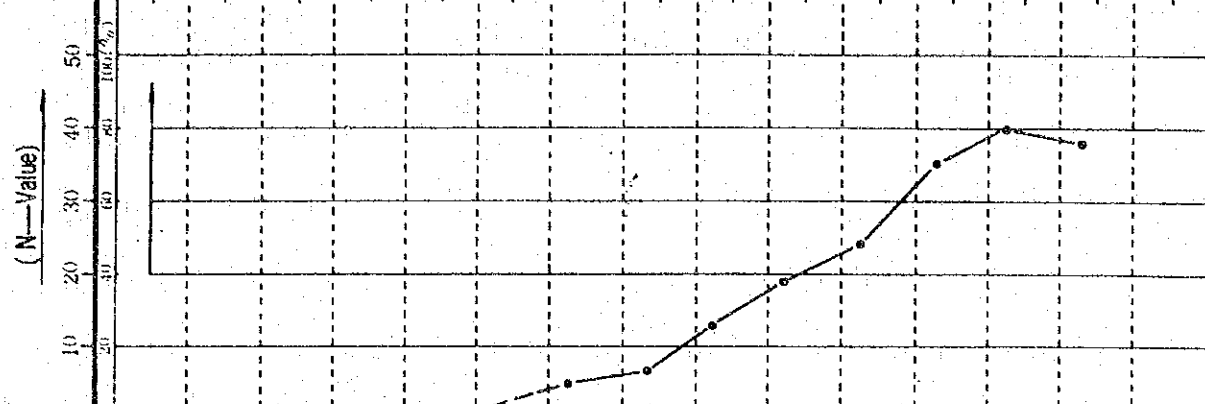


FIG. III-6 DRILLING LOG

Name of Project : GWADAR MINI-PORT PROJECT Type of Drilling : ROTARY
 Hole Number : B-6 Elevation : -1.60 m. Date : Oct. 24 TO 25 1979
 Water Table : — m. Driller : K. SUBAYA (—)

Remarks _____

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Standard Penetration Test or Core Recovery				
									Depth in m.	Sampling for Lab.	N-Value	Blows Per Each 10cm	(N-Value)
1	2.00 - 2.40	0.40	0.40		Silty sand	Dark grey	Very loose	With much shell.	2.00				
2						Dark grey		Including great quantities of shell fragments up to 1.00.	2.87	Sb-1			
3						to	Very soft	With some sand	3.75	P-1	1	1/10	
4							to	Very corecive soil	4.00	Sb-2			
5						Bluish grey	soft		4.70	P-2	4	1 2/5	
6	7.40 - 5.00	5.40	5.40		Silty clay	grey	soft		5.45				
7						Dark bluish grey	Medium	With medium size sand occasionally	6.00	Sb-3			
8	8.90 - 7.30	1.50	1.50		Silt		Medium		6.06	P-3	6	2 2 2	
9							Medium	Including occasional shell fragments.	7.25				
10							to		7.45	P-4	7	2 2 3	
11								Sand is homogeneous and fine.	8.75				
12						Dark grey	stiff		9.00	Sb-4			
13	14.10 - 12.50	5.20	5.20		Sandy silt				9.07	P-5	6	2 2 2	
14								Sand is very fine.	10.75				
15	16.40 - 14.80	2.30	2.30		Silty sand	Brownish grey	Stiff		10.45	P-6	10	3 3 4	
16								Low water content.	11.75				
17	18.00 - 16.40	1.60	1.60		Silt	grey	Hard		11.45	P-7	11	3 4 4	
18									12.15	P-8	9	3 3 3	
									12.45	P-9	10	3 3 4	
									13.15	P-10	40	10 12 24	
									13.45				
									14.15	P-11	50	12 24 1/5	
									14.45				
									15.15				
									15.45				
									16.15				
									16.40				

FIG. III-7 DRILLING LOG

Name of Project GWADAR MINI PORT PROJECT Type of Drilling ROTARY
 Hole Number No. B-7 Elevation -1.00 m. Date OCT. 20 TO 22, 1979
 Water Table --- m. Driller T. SUGAYA (---)

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Depth in m.	Sampling for Lab.	Blows Per 10cm	Standard Penetration Test or Core Recovery	
												(N-Value)	(N-Value)
1	2.10	0.30	0.30	0.0	Fine sand	Dark grey	Very loose		3.00	S7-1			
2		3.79			Dark grey	Dark grey	Very soft	Including great quantities of shell fragments.	3.79	S7-1			
3		4.15			to	to			4.15	P-1	2/85	1/20	1/15
4		4.50			Dark, brownish grey			With high water content.	4.50				
5		5.02						Highly cohesive soil.	5.02	S7-2			
6		6.15							6.15	P-2	3	1	1
7		6.45							6.45				
8		7.00							7.00	S7-3			
9		7.82							7.82	P-3	3	1/4	1/16
10		8.45						With much sand between 8.00 and 9.00 m.	8.45				
11		9.15							9.15	P-4	2	1/4	1/16
12		9.45							9.45				
13		10.00							10.00				
14		10.97			Silty clay	Brownish grey	Soft		10.97	S7-4			
15		11.15							11.15	P-5	4	1/15	1/5
16		11.45						With high water content.	11.45				
17		12.15							12.15	P-6	3	1	1
18		12.45							12.45				
19		13.15							13.15	P-7	3	1/12	1/10
20		13.45							13.45				
21		14.15							14.15	P-8	4	1	2/10
22		14.45						Very cohesive	14.45				
23		15.00							15.00				
24		15.72						With hard block of silt.	15.72	S7-5			
25		16.15							16.15	P-9	6	2/12	2/8
26		16.45						Including occasional fine sand.	16.45				
27		17.15			Silt	Dark grey	Medium		17.15	P-10	8	2	3
28		17.45							17.45				
29		18.15			Sandy silt	Brownish grey	Stiff	With fine sand seams	18.15	P-11	16	4	5
30		18.45							18.45				
31		19.15						Sand is homogeneous and very fine.	19.15	P-12	36	7	10
32		19.45							19.45				
33		20.15							20.15	P-13	42	10	12
34		20.45			Silty sand	Brownish grey	Very stiff		20.45				

FIG. III-8 DRILLING LOG

Name of Project : GWADAR MINI-PORT PROJECT Type of Drilling : ROTARY
 Hole Number : No. B-8 Elevation : 2.30 m. Date : SEP 15 TO 19, 1979
 Water Table : — m. Driller : K. SUBAYYA (—)

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Standard Penetration Test or Core Recovery		
									Blows Per Each 10cm	Blows (N-Value)	Blows (N-Value)
1	0.60	0.30	0.30	6	Medium sand	Bluish grey	Very loose	Containing shell fragments			
2				6				With many fragments			
3				6							
4				6							
5				6							
6				6							
7				6							
8				6							
9				6							
10				6	Silty clay	Bluish grey	Very soft to soft				
11	10.00	10.50	0.20	6	Silty fine sand	Ditto	Loose	Containing shell fragments. Sand is uniform and very fine.			
12	12.10	11.00	1.30	V							
13				V							
14				V	Silty clay	Blue grey to dark blue grey	Medium	Homogeneous and cohesive.			
15	14.90	14.60	2.00	V							
16				V	Silt	Brownish grey	Medium to stiff	Cohesive. Partly sandy seams are observed.			
17	16.00	16.50	1.90	V							
18				V							
19				V							
20				V							
21				V				Well consolidated.			
22				V				Fine sand is contained, especially in the upper part of the stratum.			
23				V							
24				V							
25				V							
26				V							
27				V							
28				V							
29				V							
30				V	Clayey silt	Dark, brownish grey	Very stiff to Hard				
31	30.75	30.45	13.95	V	End of Drilling						
32				V							

FIG. III - 9 DRILLING LOG

Name of Project : GWADAR MINI-PORT PROJECT Type of Drilling : ROTARY
 Hole Number : No. B-9 Elevation : - 0.00 m. Date : OCT. 26 TO 28 1979
 Water Table : --- m. Driller : K. SUGAYA (---)

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Depth in m.	Sampling for Lab.	Blows (N-Value)	Blows Per Each 10cm (N-Value)	Standard Penetration Test or Core Recovery	
													(N-Value)	(N-Value)
1	1.20 - 0.40	0.40 - 0.40	0.40	h	Silty sand	Dark grey		With many shells	2.00	SP-1	2/30	1/10		
2				h		Dark grey		Including much shell fragments at 0.4 to 1.6 m.	2.02					
3									3.15	P-1	1/10	1/17		
4									3.50					
5				v		to	Very soft to soft	With decomposed timber.	4.00	SP-2				
6	6.00 - 6.00	6.00 - 5.60	5.60		Silty clay	Bluish grey	soft		4.02	P-2	4/30	2/10	1/6	
7								Very highly cohesive soil.	5.15					
8	3.10 - 7.30	7.30 - 1.30	1.30		Silt	Dark blue grey	Soft		5.45	P-3	6/30	2/2	2/2	
9				h				With shell fragments generally.	6.45	SP-3				
10							Medium		7.70	P-4	7/30	2/2	2/3	
11								Size of shell is about 7 to 15 mm.	8.15					
12				h					9.15	P-5	14/30	6/5	3/3	
13									9.45					
14	14.00 - 14.00	14.00 - 6.70	6.70		Sandy Silt	Dark grey	stiff		10.15	P-6	7/30	2/2	2/3	
15								Very high cohesion	10.45					
16									11.15	P-7	8/30	2/3	3/3	
17									11.45					
18	18.65 - 17.05	17.05 - 3.85	3.85		Silt	Dark blue grey	stiff		12.15	P-8	10/30	2/3	5/5	
19									12.45					
20	20.60 - 19.00	19.00 - 1.95	1.95		Sandy silt	Dark grey	stiff		13.15	P-9	10/30	3/3	4/4	
21								Sand is very fine and homogeneous.	13.45					
22	23.05 - 22.25	22.25 - 2.45	2.45		Silty fine sand	Dark grey	dense		14.15	P-10	9/30	3/3	3/3	
23									14.45					
24									15.15	P-11	8/30	2/12	3/8	
									15.45					
									16.15	P-12	10/30	3/3	4/4	
									16.45					
									17.15	P-13	12/30	3/4	5/5	
									17.45					
									18.15	P-14	11/30	3/4	4/4	
									18.45					
									19.15	P-15	10/30	4/5	9/9	
									19.45					
									20.15	P-16	30/30	8/10	14/14	
									20.45					
									21.15	P-17	50/15	26/5	24/5	
									21.30					
									22.15	P-18	50/10	50/50		
									22.25					

FIG. III-10 DRILLING LOG

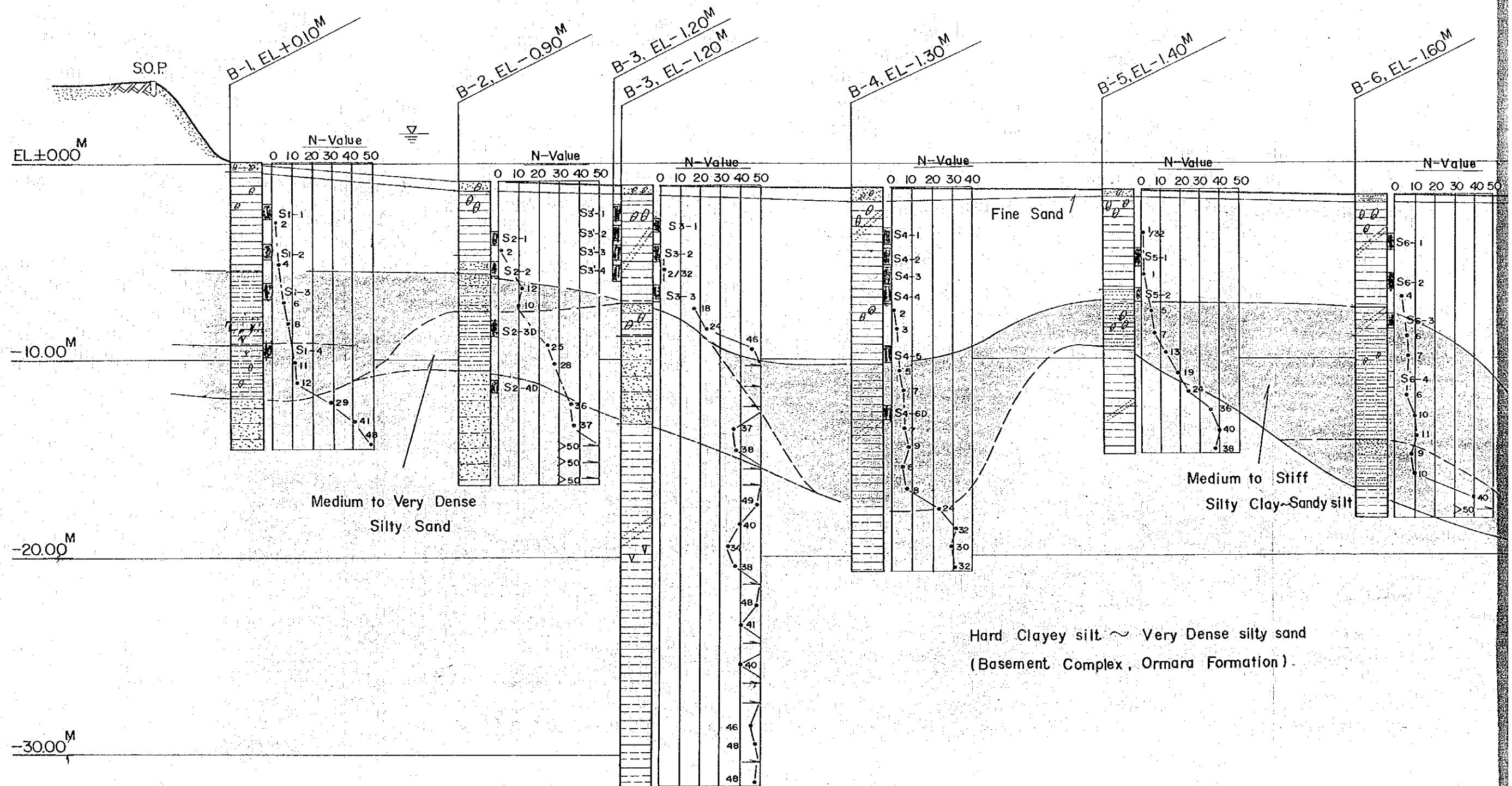
Name of Project : G WADAR MINI-PORT PROJECT Type of Drilling : ROTARY
 Hole Number : No. B-10 Elevation : 120 m. Date : Oct. 4 TO 7, 1979
 Water Table : --- m. Driller : K. SUGAYA (---)

Remarks

Scale in m.	Elevation in m.	Depth in m.	Thickness	Legend	Type of Soil	Colour	Relative Density or Consistency	General Remarks	Depth in m.	Sampling for Lab.	N-Value Blows/10cm	Blows Per Each 10cm 10cm/10cm	Standard Penetration Test or Core Recovery	
													(N-Value)	100(%)
1	1.50 - 2.30	0.80	0.30	0.30	Silty fine sand	Dark grey	Very loose	With fine sand up to 1.50m.	1.20	S10-1				
2									1.70					
3							Very soft	With many shell fragments	2.50	S10-2				
4									3.31					
5									3.50	S10-3				
6									4.34					
7									4.80	S10-4				
8									5.61					
9									5.70	S10-5				
10									6.20					
11									6.30	S10-6				
12									6.80					
13									7.15	P-1	5	2 1/4	1/6	3/10
14									7.45					
15									8.00	S10-7				
16									8.35					
17									8.75	P-2	7	2	2	3
18									9.25					
19									10.15	P-3	11	3	4	4
20									10.45					
21									11.15	P-4	20	5	7	8
22									11.45					
23									12.15	P-5	27	6	8	13
24									12.45					
25									13.15	P-6	50/12	26	24	24
26									13.35					
27									14.15	P-7	30/13	22	24	24
28									14.35					
29									15.15	P-8	30/17	24	24	24
30									15.35					
31									16.15	P-9	50/20	19	31	31
32									16.35					
33									17.15	P-10	47	10	12	19
34									17.35					
35									18.15	P-11	26	6	7	13
36									18.35					
37									19.15	P-12	32	7	10	13
38									19.35					
39									20.15	P-13	47	10	12	19
40									20.35					
41									21.15	P-14	50/20	18	19	19
42									21.35					
43									22.15	P-15	50/22	13	18	18
44									22.37					
45									23.15	P-16	32	7	10	15
46									23.35					
47									24.15	P-17	20	6	8	14
48									24.35					
49									25.15	P-18	43	11	12	20
50									25.35					
51									26.15	P-19	50/14	25	25	24
52									26.37					
53									27.15	P-20	50/18	20	30	30
54									27.37					
55									28.15	P-21	36	10	12	14
56									28.35					
57									29.15	P-22	40	10	14	16
58									29.35					
59									30.15	P-23	50/25	21	29	29
60									30.37					

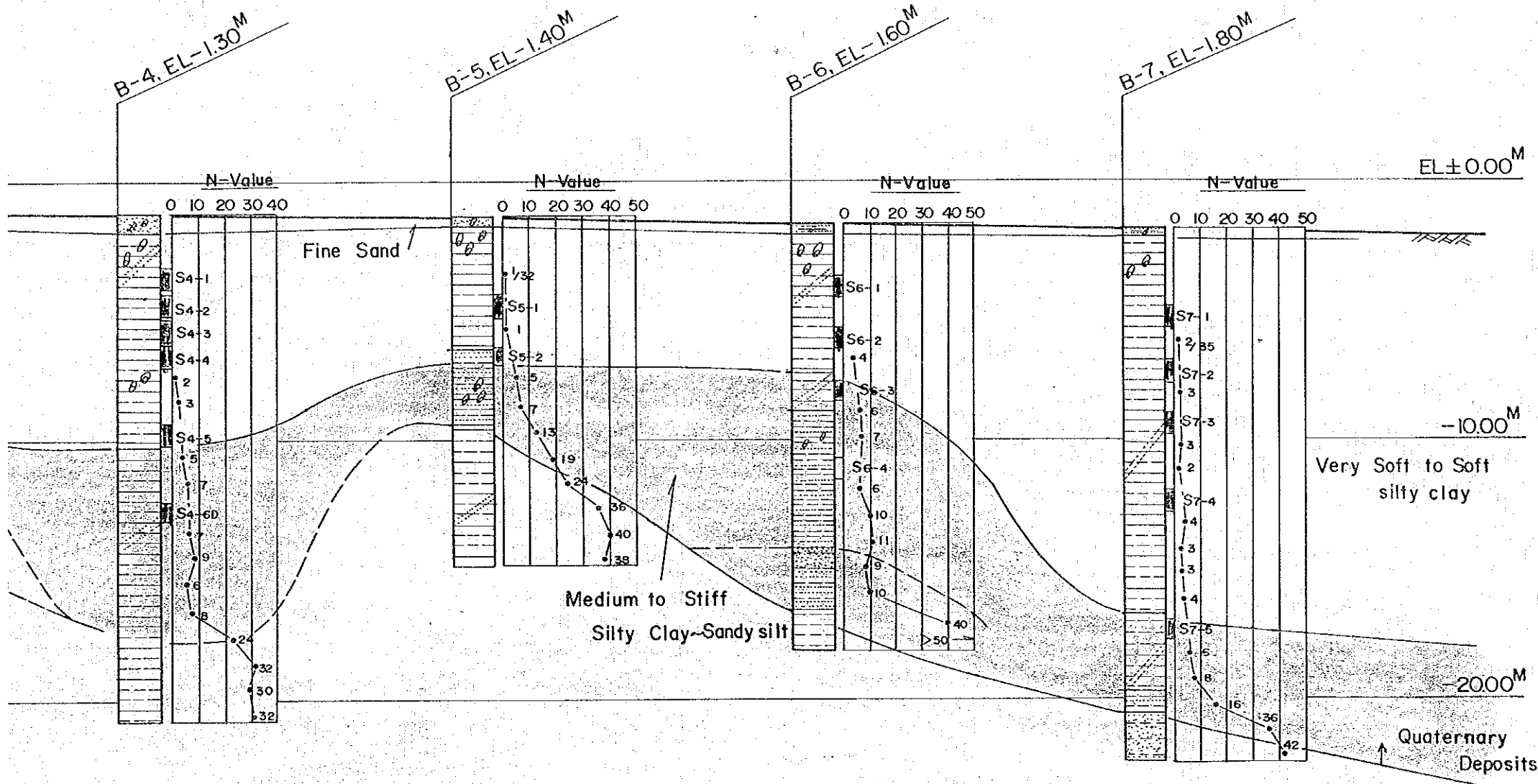
FIG. IV -1 SOIL PROFILE, CROSS SECTION, B-1 TO B-7

SCALE $\left\{ \begin{array}{l} H=1:4000 \\ V=1:200 \end{array} \right.$



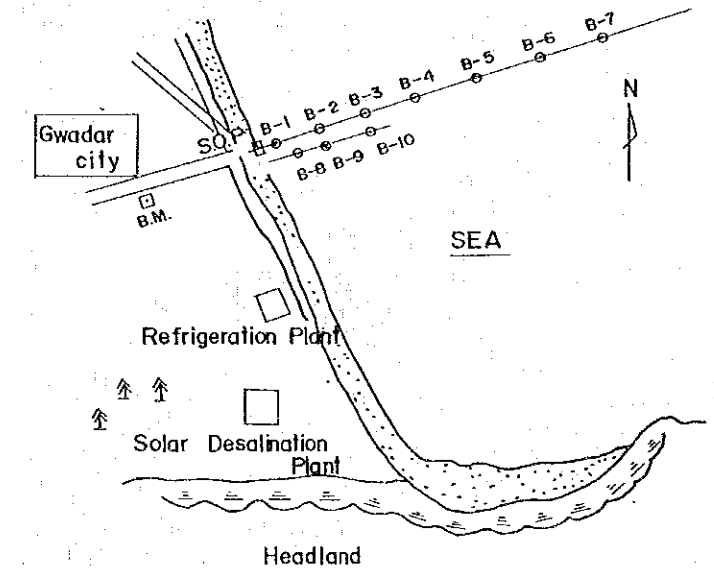
IV-1 SOIL PROFILE, CROSS SECTION, B-1 TO B-7

SCALE $\left\{ \begin{array}{l} H=1:4000 \\ V=1:200 \end{array} \right.$



Hard Clayey silt ~ Very Dense silty sand
(Basement Complex, Ormara Formation)

LOCATION OF DRILLING HOLES (S=1/30000)

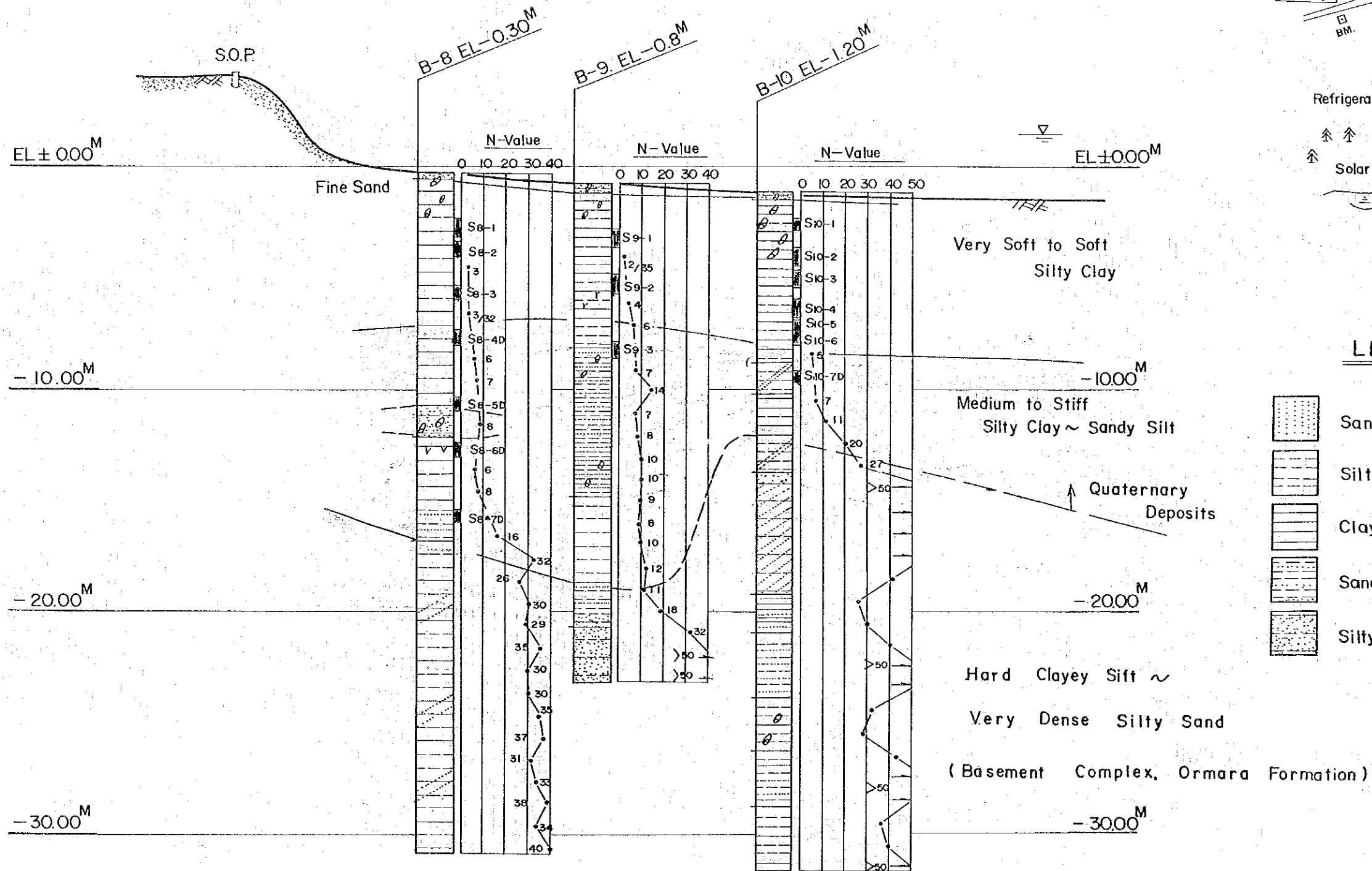


LEGEND

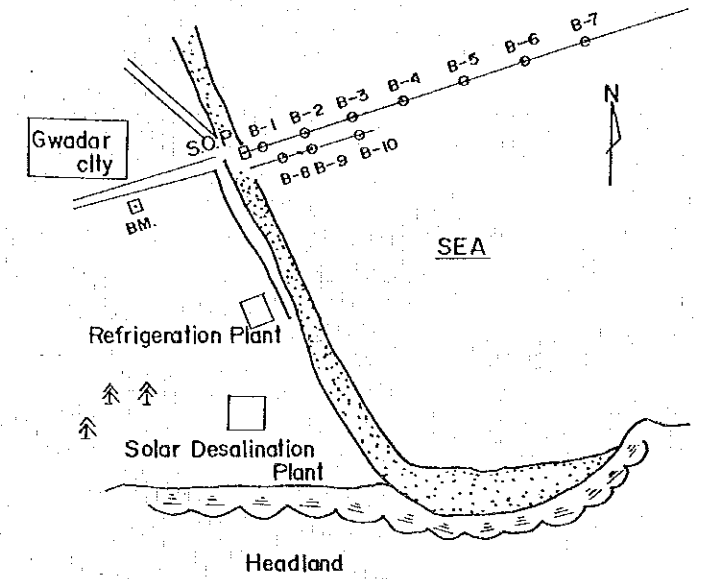
	Sand		Silty Clay
	Silt		Clayey Silt
	Clay		With Shell Fragments
	Sandy Silt		With Sand
	Silty Sand		With Organic Matter

FIG. IV-2 SOIL PROFILE, CROSS SECTION, B-8 TO B-10

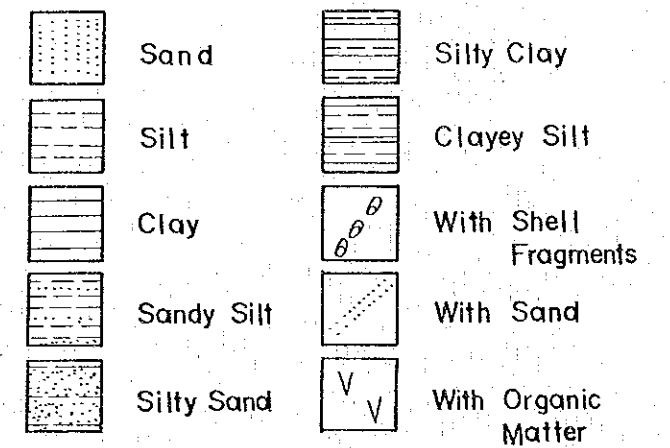
SCALE $\left\{ \begin{array}{l} H=1:4000 \\ V=1:200 \end{array} \right.$



LOCATION OF DRILLING HOLES
(S=1/30000)



LEGEND



SECTION III

LABORATORY SOIL TESTS

Laboratory soil tests were performed at the Gwadar temporary laboratory and in Singapore on undisturbed samples obtained from bore holes. Except for sample no. S2-3D, samples of hard clayey silt and very dense silty sand (Basement Complex - Ormara Formation) were not tested in the laboratory because these layers are very stable and pose no difficult technical problems for design. The physical and mechanical properties of soil samples were tested according to JIS.

The types and numbers of laboratory soil tests performed are listed in Table I, Investigation Works Performed.

Results of laboratory soil tests are summarized in Tables II-1 to 12, "Summary of Soil Test", and discussed in this section. Detailed results of laboratory soil tests are shown in Appendices A to G.

III-1) Physical Property Tests

a) Natural Water Content and Atterberg Limits (LL, PL)

Results of natural water content and Atterberg Limits tests are shown in Fig. V, Engineering Properties of Soil vs Depth, and are summarized in Table III, Natural Water Contents and Atterberg Limits.

Table II-1. SUMMARY OF SOIL TEST

Project: GMPPStandard: JIS

Borehole No.		B-1							
Sample No.		S1-2	S1-3	S1-4					
Sample depth		4.00 m 4.83 m	6.00 m 6.79 m	9.00 m 9.84 m	m				m
Condition of sample		Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed XXXXXX	Disturbed XXXXXX	Disturbed XXXXXX	Disturbed Undisturbed
Natural water content, %		26.7	21.8	31.8					
Specific gravity		2.742	2.734	2.699					
Wet density, g/cm ³		2.01	2.10	1.91					
Dry density, g/cm ³		1.59	1.72	1.45					
Natural void ratio		0.728	0.586	0.858					
Degree of saturation, %		100	100	100					
Atterberg limits	Liquid limit, %	32.6	27.6	-					
	Plastic limit, %	16.3	14.0	-					
	Plasticity index	16.3	13.6	-					
Grain size analysis	Gravel, %	0	0	-					
	Sand, %	0	1	-					
	Silt, %	50	64	-					
	Clay & colloid, %	50	35	-					
	Max. diameter, mm	0.105	0.105	-					
	Diam. at 60%	0.0077	0.018	-					
	Diam. at 10%	-	-	-					
Visual soil description		Silty Clay	Clayey Silt	Silty Clay					
Unified soil classification		CL	CL	-					
Unconfined compression test	Undisturbed sample, kg/cm ²	-	-	-					
	Remoulded sample, kg/cm ²	-	-	-					
	Sensitivity ratio	-	-	-					
	Strain at failure, %	-	-	-					
Triaxial compression test	Angle of internal friction	0°	0°	-					
	Cohesion, kg/cm ²	0.26	0.34	-					
	Condition of drainage	U-U	U-U	-					
Consolidation test	Preconsolidation pressure, kg/cm ²	1.7	2.4	2.3					
	Compression index	0.21	0.17	0.30					
Remarks:									

Table II-2. SUMMARY OF SOIL TEST

Project: GMPP Standard: JIS

Borehole No.		B-2					B-3			
Sample No.		S2-1	S2-2	S2-3D Top	S2-3D Bottom		S3-1	S3-2	S3-3	
Sample depth		2.50 ^m 3.20 ^m	4.00 ^m 4.70 ^m	7.00 ^m 7.40 ^m	7.40 ^m 7.80 ^m		1.60 ^m 2.30 ^m	3.00 ^m 3.80 ^m	5.00 ^m 5.82 ^m	
Condition of sample		XXXX Undisturbed	XXXX Undisturbed	XXXX Undisturbed	XXXX Undisturbed	Disturbed Undisturbed	Disturbed XXXX	XXXX Undisturbed	XXXX Undisturbed	Disturbed Undisturbed
Natural water content, %		29.5	21.4	22.1	19.0		27.4	29.4	28.3	
Specific gravity		2.719	2.705	2.706	2.728		2.728	2.723	2.717	
Wet density, g/cm ³		1.96	2.09	2.07	2.14		-	1.96	1.99	
Dry density, g/cm ³		1.51	1.72	1.70	1.80		-	1.51	1.55	
Natural void ratio		0.796	0.570	0.596	0.517		-	0.809	0.752	
Degree of saturation, %		100	100	100	100		-	100	100	
Atterberg limits	Liquid limit, %	34.7	24.4	22.0	27.0		27.4	35.9	33.0	
	Plastic limit, %	15.2	12.5	16.6	15.0		15.4	14.8	13.7	
	Plasticity index	19.5	11.9	5.4	12.0		12.0	21.1	19.3	
Grain size analysis	Gravel, %	0	1	0	0		3	0	0	
	Sand, %	1	7	11	3		7	1	1	
	Silt, %	48	63	75	65		42	49	46	
	Clay & colloid, %	51	29	14	32		48	50	53	
	Max. diameter, mm	0.84	4.76	4.76	0.42		19.1	0.105	0.105	
	Diam. at 60%	0.0069	0.027	0.039	0.017		0.0084	0.0078	0.0070	
	Diam. at 10%	-	-	0.0044	-		-	-	-	
Visual soil description		Silty Clay	Clayey Silt	Sandy Clayey Silt	Clayey Silt		Silty Clay with Sand	Silty Clay	Silty Clay	
Unified soil classification		CL	CL	ML-CL	CL		CL	CL	CL	
Unconfined compression test	Undisturbed sample, kg/cm ²	-	-	-	-		-	-	-	
	Remoulded sample, kg/cm ²	-	-	-	-		-	-	-	
	Sensitivity ratio	-	-	-	-		-	-	-	
	Strain at failure, %	-	-	-	-		-	-	-	
Triaxial compression test	Angle of internal friction	0°	0°	-	0°		-	0°	0°	
	Cohesion, kg/cm ²	0.17	(0.77 ~1.45)	-	(0.77 ~1.90)		-	0.17	0.19	
	Condition of drainage	U-U	U-U	-	U-U		-	U-U	U-U	
Consolidation test	Preconsolidation pressure, kg/cm ²	1.0	-	-	-		-	-	1.0	
	Compression index	0.23	0.10	-	-		-	0.23	0.23	
Remarks:										

Table II-3. SUMMARY OF SOIL TEST

Project: GMPP Standard: JIS

Borehole No.		B-3'							
Sample No.		S3'-2	S3'-3	S3'-4					
Sample depth		3.00 ^m 3.84 ^m	4.00 ^m 4.88 ^m	5.00 ^m 5.85 ^m	^m ^m	^m ^m	^m ^m	^m ^m	^m ^m
Condition of sample		Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed
Natural water content, %		26.0	26.5	24.4					
Specific gravity		2.716	-	2.721					
Wet density, g/cm ³		2.02	2.02	2.04					
Dry density, g/cm ³		1.60	1.60	1.64					
Natural void ratio		0.694	-	0.659					
Degree of saturation, %		100	-	100					
Atterberg limits	Liquid limit, %	31.7	-	27.7					
	Plastic limit, %	15.1	-	13.6					
	Plasticity index	16.6	-	14.1					
Grain size analysis	Gravel, %	0	-	0					
	Sand, %	0	-	1					
	Silt, %	54	-	61					
	Clay & colloid, %	46	-	38					
	Max. diameter, mm	0.105	-	0.105					
	Diam. at 60%	0.0095	-	0.016					
	Diam. at 10%	-	-	-					
Visual soil description		Clayey Silt	Silty Clay	Clayey Silt					
Unified soil classification		CL	-	CL					
Unconfined compression test	Undisturbed sample, kg/cm ²	-	0.469*	-					
	Remoulded sample, kg/cm ²	-	-	-					
	Sensitivity ratio	-	-	-					
	Strain at failure, %	-	(15)	-					
Triaxial compression test	Angle of internal friction	0°	-	0°					
	Cohesion, kg/cm ²	0.22	-	0.24					
	Condition of drainage	U-U	-	U-U					
Consolidation test	Preconsolidation pressure, kg/cm ²	1.2	-	(1.5)					
	Compression index	0.21	-	0.17					

Remarks: * Mean value

Table II-4. SUMMARY OF SOIL TEST

Project: GMP Standard: JIS

Borehole No.		B-4							
Sample No.	S4-1	S4-3	S4-4 Top	S4-4 Bottom	S4-5 Top	S4-5 Bottom	S4-6D		
Sample depth	2.00 ^m 2.78 ^m	4.00 ^m 4.85 ^m	5.00 ^m 5.50 ^m	5.50 ^m 5.87 ^m	8.00 ^m 8.35 ^m	8.35 ^m 8.80 ^m	11.00 ^m 11.67 ^m		
Condition of sample	XXXX Undisturbed	XXXX Undisturbed	XXXX Undisturbed	XXXX Undisturbed	XXXX Undisturbed	XXXX Undisturbed	XXXX Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed
Natural water content, %	-	28.1	26.3	22.9	25.3	23.4	30.4		
Specific gravity	-	2.754	2.716	2.709	2.742	2.722	2.758		
Wet density, g/cm ³	-	1.99	2.02	2.06	2.04	2.07	1.98		
Dry density, g/cm ³	-	1.55	1.60	1.68	1.63	1.68	1.52		
Natural void ratio	-	0.773	0.698	0.616	0.684	0.623	0.816		
Degree of saturation, %	-	100	100	100	100	100	100		
Atterberg limits	Liquid limit, %	-	33.2	31.8	27.7	31.0	27.0	36.0	
	Plastic limit, %	-	17.7	15.4	15.4	17.2	16.4	19.1	
	Plasticity index	-	15.5	16.4	12.3	13.8	10.6	16.9	
Grain size analysis	Gravel, %	-	0	0	0	0	0		
	Sand, %	-	1	0	4	1	0	1	
	Silt, %	-	43	49	58	54	65	41	
	Clay & colloid, %	-	56	51	38	45	35	58	
	Max. diameter, mm	-	0.105	0.105	0.25	0.105	0.105	0.105	
	Diam. at 60%	-	0.0061	0.0075	0.013	0.010	0.019	0.0056	
	Diam. at 10%	-	-	-	-	-	-	-	
Visual soil description	-	Silty Clay	Silty Clay	Clayey Silt	Clayey Silt	Clayey Silt	Silty Clay		
Unified soil classification	-	CL	CL	CL	CL	CL	CL		
Unconfined compression test	Undisturbed sample, kg/cm ²	-	0.358 ~0.386	0.485 ~0.567	-	0.602*	0.566*	-	
	Remoulded sample, kg/cm ²	-	-	-	-	-	-	-	
	Sensitivity ratio	-	-	-	-	-	-	-	
	Strain at failure, %	-	8 ~ 14	13 ~ 14	-	15	11 ~ 14	-	
Triaxial compression test	Angle of internal friction	-	0°	0°	0°	-	-	0°	
	Cohesion, kg/cm ²	-	(0.19)	0.26	0.23	-	-	0.23	
	Condition of drainage	-	U-U	U-U	U-U	-	-	U-U	
Consolidation test	Preconsolidation pressure, kg/cm ²	-	1.4	1.7	-	-	-	1.8	
	Compression index	-	0.22	0.20	-	-	-	0.29	

Remarks: * Mean value

Table II-5. SUMMARY OF SOIL TEST

Project: GMPP Standard: J.I.S.

Borehole No.		B-5			B-6					
Sample No.		S5-1	S5-2		S6-1	S6-2	S6-3	S6-4		
Sample depth		3.00 m 3.74 m	5.00 m 5.69 m		2.00 m 2.87 m	4.00 m 4.78 m	6.00 m 6.86 m	9.00 m 9.87 m		
Condition of sample		Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed
Natural water content, %		(30.5)	(20.4)		30.2	31.8	31.3	23.4		
Specific gravity		2.759	2.722		2.732	-	2.740	2.699		
Wet density, g/cm ³		1.97	2.11		1.98	1.96	1.97	2.06		
Dry density, g/cm ³		1.51	1.75		1.52	1.49	1.50	1.67		
Natural void ratio		0.828	0.553		0.796	-	0.829	0.617		
Degree of saturation, %		100	100		100	-	100	100		
Atterberg limits	Liquid limit, %	36.1	24.0		36.7	-	39.1	23.3		
	Plastic limit, %	17.0	15.1		17.0	-	16.9	16.1		
	Plasticity index	19.1	8.9		19.7	-	22.2	7.2		
Grain size analysis	Gravel, %	0	0		0	-	0	0		
	Sand, %	0	5		0	-	1	3		
	Silt, %	40	68		42	-	36	76		
	Clay & colloid, %	60	27		58	-	63	21		
	Max. diameter, mm	0.105	4.76		0.105	-	0.105	0.84		
	Diam. at 60%	0.0050	0.021		0.0055	-	0.0045	0.036		
	Diam. at 10%	-	-		-	-	-	-		
Visual soil description		Silty Clay	Clayey Silt		Silty Clay	Silty Clay	Silty Clay	Clayey Silt		
Unified soil classification		CL	CL		CL	-	CL	CL		
Unconfined compression test	Undisturbed sample, kg/cm ²	0.291 ~0.340	-		-	-	-	-		
	Remoulded sample, kg/cm ²	-	-		-	-	-	-		
	Sensitivity ratio	-	-		-	-	-	-		
	Strain at failure, %	12 ~ 15	-		-	-	-	-		
Triaxial compression test	Angle of internal friction	0°	23° (0°)		0°	0°	0°	(10°)		
	Cohesion, kg/cm ²	0.17	0.24 (1.3)		0.19	0.19	0.23	(0.26)		
	Condition of drainage	U-U	U-U		U-U	U-U	U-U	U-U		
Consolidation test	Preconsolidation pressure, kg/cm ²	1.2	-		1.1	-	(1.0)	-		
	Compression index	0.24	-		0.23	-	0.22	-		
Remarks:										

Table II-6. SUMMARY OF SOIL TEST

Project: GMPPStandard: J.I.S.

Borehole No.		B-7							
Sample No.		S7-1	S7-2	S7-3	S7-4	S7-5			
Sample depth		3.00 m 3.78 m	5.00 m 5.83 m	7.00 m 7.82 m	10.00 m 10.87 m	15.00 m 15.72 m	m m	m m	m m
Condition of sample		Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed
Natural water content, %		30.2	-	30.5	27.0	26.5			
Specific gravity		2.756	-	2.750	2.734	2.748			
Wet density, g/cm ³		1.96	-	1.96	2.00	2.01			
Dry density, g/cm ³		1.51	-	1.50	1.58	1.59			
Natural void ratio		0.831	-	0.831	0.736	0.729			
Degree of saturation, %		100	-	100	100	100			
Atterberg limits	Liquid limit, %	35.0	-	36.3	30.0	29.5			
	Plastic limit, %	16.4	-	17.1	15.7	15.0			
	Plasticity index	18.6	-	19.2	14.3	14.5			
Grain size analysis	Gravel, %	0	-	0	0	0			
	Sand, %	1	-	0	0	0			
	Silt, %	44	-	38	54	53			
	Clay & colloid, %	55	-	62	46	47			
	Max. diameter, mm	0.105	-	0.105	0.105	0.105			
	Diam. at 60%	0.0060	-	0.0046	0.011	0.011			
	Diam. at 10%	-	-	-	-	-			
Visual soil description		Silty Clay	-	Silty Clay	Clayey Silt	Clayey Silt			
Unified soil classification		CL	-	CL	CL	CL			
Unconfined compression test	Undisturbed sample, kg/cm ²	0.283 ~0.376	-	0.466 ~0.599	-	-			
	Remoulded sample, kg/cm ²	-	-	-	-	-			
	Sensitivity ratio	-	-	-	-	-			
	Strain at failure, %	11 ~ 15	-	10 ~ 15	-	-			
Triaxial compression test	Angle of internal friction	0°	-	0°	-	0°			
	Cohesion, kg/cm ²	0.18	-	0.26	-	0.32			
	Condition of drainage	U-U	-	U-U	-	U-U			
Consolidation test	Preconsolidation pressure, kg/cm ²	1.2	-	-	1.7	2.3			
	Compression index	0.25	-	-	0.21	0.21			
Remarks:									

Table II-7. SUMMARY OF SOIL TEST

Project: GMPP Standard: J.I.S.

Borehole No.		B-8									
Sample No.		S8-2	S8-3	S8-4D	S8-5D	S8-6D	S8-7D				
Sample depth		3.00 ^m 3.74 ^m	5.00 ^m 5.62 ^m	7.00 ^m 7.65 ^m	10.00 ^m 10.58 ^m	12.00 ^m 12.62 ^m	15.00 ^m 15.60 ^m				
Condition of sample		Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	
Natural water content, %		34.2	30.5	20.7	-	30.6	20.2				
Specific gravity		2.728	2.727	2.705	-	2.717	2.700				
Wet density, g/cm ³		1.91	1.98	2.09	-	1.96	2.07				
Dry density, g/cm ³		1.42	1.52	1.73	-	1.50	1.72				
Natural void ratio		0.917	0.797	0.562	-	0.797	0.568				
Degree of saturation, %		100	100	100	-	100	97				
Atterberg limits	Liquid limit, %	41.2	39.8	29.3	-	40.2	NP				
	Plastic limit, %	18.3	16.4	14.0	-	16.2	NP				
	Plasticity index	22.9	23.4	15.3	-	24.0	NP				
Grain size analysis	Gravel, %	0	0	0	-	0	3				
	Sand, %	0	0	2	-	1	18				
	Silt, %	35	45	55	-	43	67				
	Clay & colloid, %	65	55	43	-	56	12				
	Max. diameter, mm	0.105	0.074	0.42	-	0.105	9.52				
	Diam. at 60%	0.0043	0.0059	0.014	-	0.0060	0.052				
	Diam. at 10%	-	-	-	-	-	0.0013				
Visual soil description		Silty Clay	Silty Clay	Clayey Silt	-	Silty Clay	Sandy Silt				
Unified soil classification		CL	CL	CL	-	CL	ML				
Unconfined compression test	Undisturbed sample, kg/cm ²	-	-	-	-	-	-				
	Remoulded sample, kg/cm ²	-	-	-	-	-	-				
	Sensitivity ratio	-	-	-	-	-	-				
	Strain at failure, %	-	-	-	-	-	-				
Triaxial compression test	Angle of internal friction	0°	-	0°	-	-	22° (0°)				
	Cohesion, kg/cm ²	0.21	-	0.33	-	-	0.78 (3.2)				
	Condition of drainage	U-U	-	U-U	-	-	U-U				
Consolidation test	Preconsolidation pressure, kg/cm ²	-	1.2	-	-	-	-				
	Compression index	-	0.26	0.14	-	0.24	-				
Remarks:											

Table II-8. SUMMARY OF SOIL TEST

Project: GMPP Standard: J.I.S.

Borehole No.		B-9							
Sample No.		S9-1	S9-2	S9-3					
Sample depth		2.00 m 2.82	4.00 m 4.82	7.00 m 7.78	m	m	m	m	m
Condition of sample		Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed
Natural water content, %		33.4	-	21.6					
Specific gravity		2.734	-	2.733					
Wet density, g/cm ³		1.90	-	2.09					
Dry density, g/cm ³		1.42	-	1.72					
Natural void ratio		0.899	-	0.509					
Degree of saturation, %		100	-	100					
Atterberg limits	Liquid limit, %	-	-	25.5					
	Plastic limit, %	-	-	14.2					
	Plasticity index	-	-	11.3					
Grain size analysis	Gravel, %	-	-	0					
	Sand, %	-	-	0					
	Silt, %	-	-	70					
	Clay & colloid, %	-	-	30					
	Max. diameter, mm	-	-	0.105					
	Diam. at 60%	-	-	0.021					
	Diam. at 10%	-	-	-					
Visual soil description		Silty Clay	-	Clayey Silt					
Unified soil classification		-	-	CL					
Unconfined compression test	Undisturbed sample, kg/cm ²	-	-	-					
	Remoulded sample, kg/cm ²	-	-	-					
	Sensitivity ratio	-	-	-					
	Strain at failure, %	-	-	-					
Triaxial compression test	Angle of internal friction	-	-	0°					
	Cohesion, kg/cm ²	-	-	0.42					
	Condition of drainage	-	-	U-U					
Consolidation test	Preconsolidation pressure, kg/cm ²	0.93	-	1.6					
	Compression index	0.27	-	0.15					
Remarks:									

Table II-9. SUMMARY OF SOIL TEST

Project: GMPP Standard: J.I.S.

Borehole No.		B-10							
Sample No.	S10-2	S10-3	S10-4	S10-6	S10-7D Top	S10-7D Middle	S10-7D Bottom		
Sample depth	2.50 m 3.31 m	3.50 m 4.30 m	4.80 m 5.61 m	6.30 m 6.80 m	8.00 m 8.25 m	8.25 m 8.45 m	8.45 m 8.55 m	m	m
Condition of sample	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed	Disturbed Undisturbed
Natural water content, %	31.5	-	27.2	25.1	25.5	23.2	54.2		
Specific gravity	2.731	-	2.723	2.718	2.713	2.691	2.631		
Wet density, g/cm ³	1.95	-	2.01	2.02	2.03	2.05	1.69		
Dry density, g/cm ³	1.48	-	1.58	1.60	1.62	1.66	1.10		
Natural void ratio	0.842	-	0.723	0.695	0.677	0.617	1.40		
Degree of saturation, %	100	-	100	100	100	100	100		
Atterberg limits	Liquid limit, %	38.4	-	35.1	32.0	33.0	27.3	66.0	
	Plastic limit, %	16.7	-	13.5	14.2	15.4	17.6	28.6	
	Plasticity index	21.7	-	21.6	17.8	17.6	9.7	37.4	
Grain size analysis	Gravel, %	0	-	0	0	0	0	0	
	Sand, %	1	-	0	1	2	11	4	
	Silt, %	42	-	47	50	49	67	38	
	Clay & colloid, %	57	-	53	49	49	22	58	
	Max. diameter, mm	0.25	-	0.074	0.105	0.105	2.00	0.84	
	Diam. at 60%	0.0056	-	0.0067	0.0078	0.0087	0.037	0.0055	
	Diam. at 10%	-	-	-	-	-	-	-	
Visual soil description	Silty Clay	-	Silty Clay	Silty Clay	Silty Clay	Sandy Clayey Silt	Silty Clay		
Unified soil classification	CL	-	CL	CL	CL	CL	CH		
Unconfined compression test	Undisturbed sample, kg/cm ²	0.345 ~0.353	-	0.460 ~0.562	-	-	0.519	0.304 ~0.311	
	Remoulded sample, kg/cm ²	-	-	-	-	-	-	-	
	Sensitivity ratio	-	-	-	-	-	-	-	
	Strain at failure, %	11 ~ 15	-	11 ~ 15	-	-	5	9	
Triaxial compression test	Angle of internal friction	0°	-	0°	0°	0°	-	-	
	Cohesion, kg/cm ²	0.17	-	0.24	0.22	0.18	-	-	
	Condition of drainage	U-U	-	U-U	U-U	U-U	-	-	
Consolidation test	Preconsolidation pressure, kg/cm ²	1.2	-	1.4	-	-	-	-	
	Compression index	0.25	-	0.22	-	-	0.13	-	
Remarks:									

Table II-10.
SUMMARY OF SOIL TEST

Performed at Gwadar, Pakistan

Project GWADAR MINI-PORT

Standard JIS.

Borehole No.	B-1				B-2	
Sample No.	S1-1	S1-2	S1-3	S1-4	S2-1	S2-2
Sample depth in meter	2.0-2.8	4.0-4.8	6.0-6.8	9.0-9.8	2.5-3.2	4.0-4.7
Natural water content, %	30.8	28.1	20.7	27.9	30.4	27.2
Wet density, g/cm ³	1.92	2.00	2.11	1.96	1.96 -2.00	1.96 -2.00
Dry density, g/cm ³	-	-	-	-	-	-
<u>Unconfined Compression Test</u>						
Undisturbed Sample, kg/cm ²	0.39	0.49	0.66	0.67	0.37	0.26
Remolded Sample, kg/cm ²	-	-	-	-	0.12	-
Sensitivity ratio	-	-	-	-	3.00	-
Strain at failure, %	6-11	6-11(15)	9-11	7-14	9-13	(16)

(Notes)

Borehole No.	B-2	B-3			B-3'	
Sample No.	S2-3D	S3-1	S3-2	S3-3	S3'-1	S3'-2
Sample depth in meter	7.0-7.8	1.6-2.3	3.0-3.8	5.0-5.8	3.0-3.8	4.0-4.9
Natural water content, %	22.0	30.9	30.4	25.7	30.8	29.6
Wet density, g/cm ³	2.04 -2.07	1.97	1.94 -1.96	2.00	1.93 -1.95	1.94 -1.97
Dry density, g/cm ³	-	-	-	-	-	-
<u>Unconfined Compression Test</u>						
Undisturbed Sample, kg/cm ²	0.27	0.16	0.25	0.34	0.19 -0.31	0.36
Remolded Sample, kg/cm ²	-	-	-	-	-	-
Sensitivity ratio	-	-	-	-	-	-
Strain at failure, %	10-14	(15)	13	7-10	10-(15)	5-8

(Notes)

Table II-11.
SUMMARY OF SOIL TEST

Performed at Gwadar, Pakistan

Project GWADAR MINI-PORT

Standard JIS.

Borehole No.	B-3'		B-4	B-6		
Sample No.	S3'-3	S3'-4	S4-2	S6-1	S6-2	S6-3
Sample depth in meter	4.0-4.9	5.0-5.9	3.0-3.9	2.0-2.9	4.0-4.8	6.0-6.9
Natural water content, %	26.7	25.7	28.3	31.2	33.1	30.0
Wet density, g/cm ³	2.02	1.99 -2.04	1.95	1.98	1.94	1.94 -1.97
Dry density, g/cm ³	-	-	-	-	-	-
<u>Unconfined Compression Test</u>						
Undisturbed Sample, kg/cm ²	0.38 -0.49	0.32 -0.51	0.41	0.33	0.37	0.49
Remolded Sample, kg/cm ²	-	-	-	0.13	-	-
Sensitivity ratio	-	-	-	2.4 -2.8	-	-
Strain at failure, %	6-10	5.5-11	6.5-8	5-8	9-(15)	6-10

(Notes)

Borehole No.	B-6	B-7		B-8		
Sample No.	S6-4	S7-2	S7-4	S8-1	S8-2	S8-3
Sample depth in meter	9.0-9.9	5.0-5.8	10.0 -10.9	2.0-2.9	3.0-3.7	5.0-5.6
Natural water content, %	25.7	32.3	26.5	34.8	32.3	32.3
Wet density, g/cm ³	2.02	1.94	2.01	1.90	1.91	1.92
Dry density, g/cm ³	-	-	-	-	-	-
<u>Unconfined Compression Test</u>						
Undisturbed Sample, kg/cm ²	0.54	0.35	0.55	0.45	0.46	0.44
Remolded Sample, kg/cm ²	-	-	-	-	-	-
Sensitivity ratio	-	-	-	-	-	-
Strain at failure, %	8-14	8-10	9-10.5	6.5-9.0	12-13	10

(Notes)

Table II-12.
SUMMARY OF SOIL TEST

Performed at Gwadar, Pakistan

Project GWADAR MINI-PORT

Standard JIS.

Borehole No.	B-8				B-9	
Sample No.	S8-4D	S8-5D	S8-6D	S8-7D	S9-1	S9-2
Sample depth in meter	7.0-7.7	10.0 -10.6	12.0 -12.6	15.0 -15.6	2.0-2.8	4.0-4.8
Natural water content, %	22.2	21.0	27.8	21.4	33.6	29.5
Wet density, g/cm ³	2.08	2.08	1.91 -1.98	2.03	1.90	1.96
Dry density, g/cm ³	-	-	-	-		
<u>Unconfined Compression Test</u>						
Undisturbed Sample, kg/cm ²	0.66	0.67	0.55	0.59	0.26 -0.40	0.39
Remolded Sample, kg/cm ²	-	-	-	-	-	-
Sensitivity ratio	-	-	-	-	-	-
Strain at failure, %	10-(15)	7-13	12-13	5-7	10-(15)	5-9

(Notes)

Borehole No.	B-9		B-10		
Sample No.	S9-3	S9-3	S10-1	S10-3	S10-5
Sample depth in meter	7.0 -7.28	7.28-35	1.2-1.7	3.5-4.3	5.7-6.2
Natural water content, %	22.5	20.3	32.9	28.8	25.7
Wet density, g/cm ³	2.08	2.12	1.95	1.99	2.03
Dry density, g/cm ³	-	-			
<u>Unconfined Compression Test</u>					
Undisturbed Sample, kg/cm ²	0.49	0.69 -1.21	0.27 -0.31	0.32 -0.43	0.41
Remolded Sample, kg/cm ²	-	-	-	-	0.15
Sensitivity ratio	-	-	-	-	2.7
Strain at failure, %	8-(15)	10-12	(15)	7-9	7-8

(Notes)

FIG. V ENGINEERING PROPERTIES OF SOIL VS. DEPTH

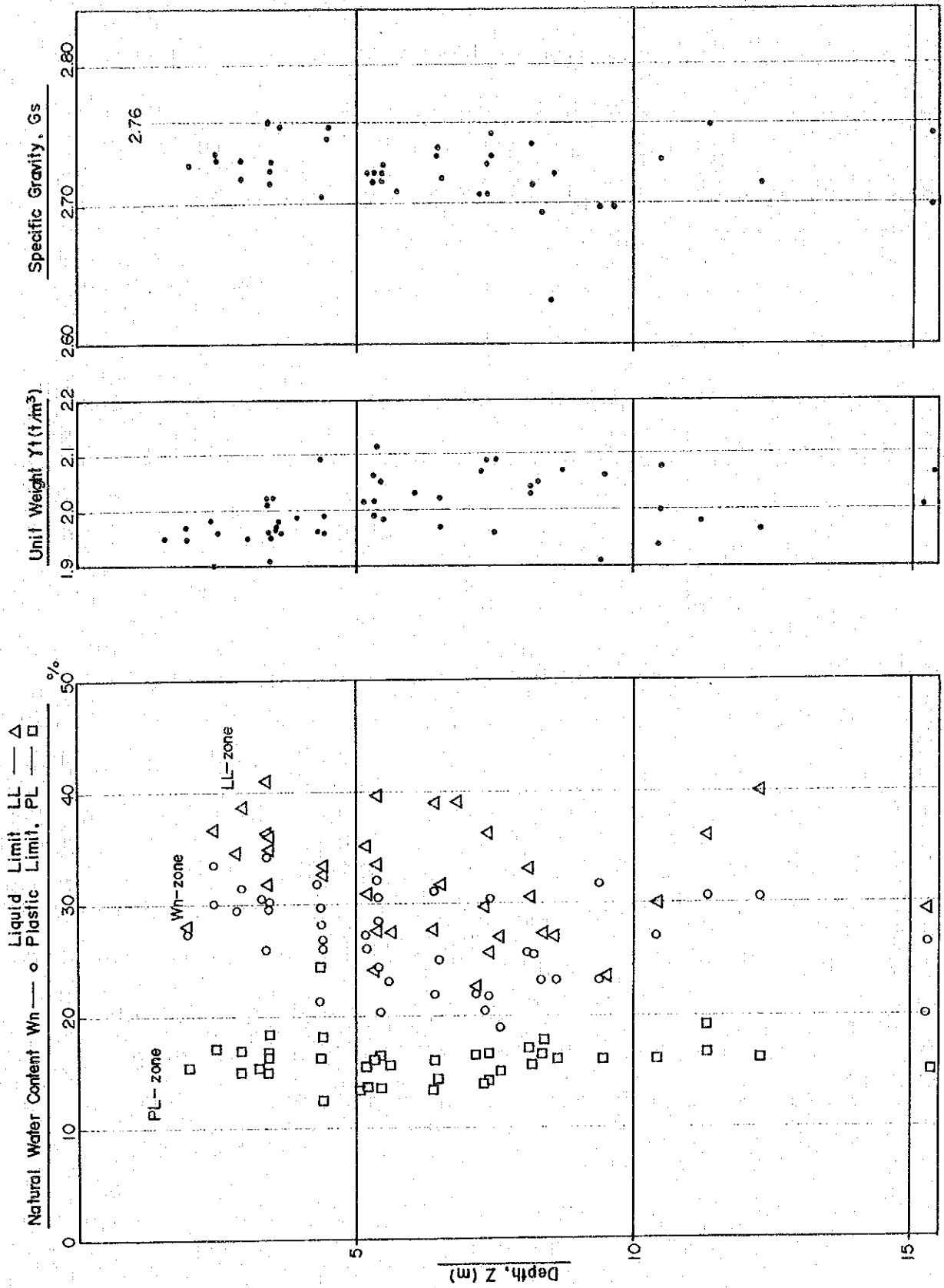


Table III

Natural Water Contents and Atterberg Limits

	Layer	Natural Water Content	Atterberg Limits		
			Liquid Limit	Plastic Limit	Plasticity Index
Quaternary Deposits	Very Soft to Soft Silty Clay	21-34%	24-41%	13-18%	9-23
	Medium to Stiff Silty Clay and Sandy Silt	20-31.8%	23-40% (66)	14-19% (29)	10-24 (37)
Basement Complex (Ormara Formation)	Medium to Very Dense Silty Sand	19-22%	22-27%	15-17%	5-12%

b) Specific Gravity, Unit Weight and Void Ratio

Specific gravity and unit weight at natural water content vs. depth are shown in Fig. V, Engineering Properties of Soil vs Depth. Specific Gravity (Gs) is generally in the range of 2.70 to 2.75 for any layer of Quaternary deposits and basement complex. Gs at the depth of 8.50 m in borehole B-10 is 2.631, lower than others because of the presence of organic matter.

The unit weight of very soft to soft silty clay varies from 1.90 to 2.1 t/m³ and the average is approximately 2.0 t/m³.

The unit weight of medium to stiff silty clay and sandy silt is in the range of 2.03 to 2.12 t/m³ and that of medium to very dense silty sand of the basement complex is 2.14 t/m³.

The void ratio of all Quaternary deposits is in the range of 0.55 to 0.90, less than the value of normal Quaternary cohesive soil.

The void ratio of medium to very dense silty sand of the basement complex is 0.52.

C) Grain Size Analysis

c-1) Quaternary Deposits

Quaternary deposits, except for a top layer of fine sand, consist of mainly silt and clay (including colloid) and include a small quantity of fine sand and shell fragments.

1 Very Soft to Soft Silty Clay

0 to 3 % gravel

0 to 11 % sand (generally less than 5 %)

35 to 68 % silt

27 to 65 % clay

2 Medium to Stiff Silty Clay and Sandy Silt

0 to 3% gravel

0 to 18% sand

36 to 76 % silt

12 to 63 % clay

c-2) Basement Complex - Ormara Formation

Medium to Very Dense Silty Sand

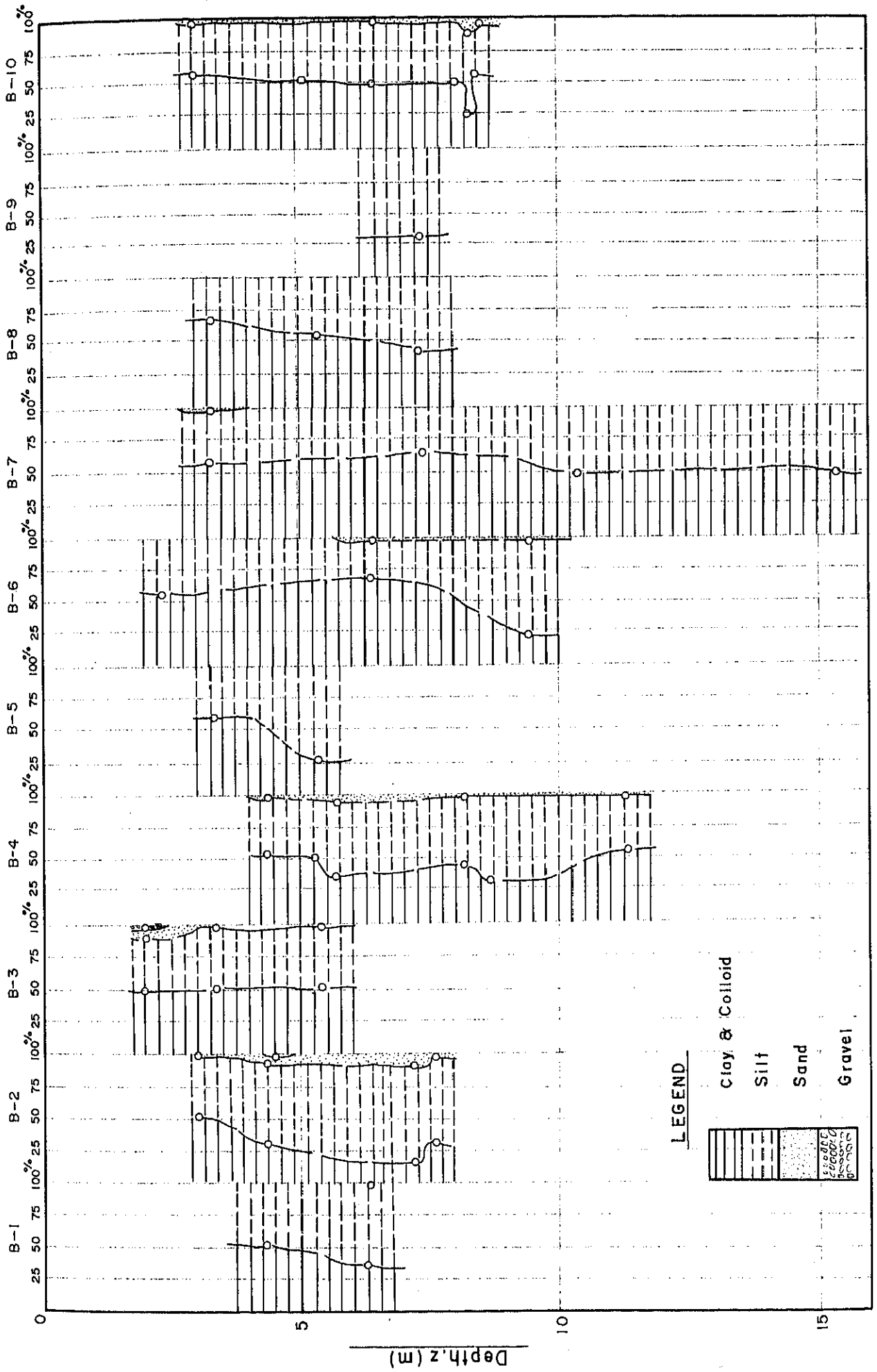
3 to 11 % sand

65 to 75 % silt

14 to 32 % clay

Results of grading analysis are summarized in Fig. VI. Grading Texture vs Depth, and the details are shown in Appendix A.

FIG. VI GRADING TEXTURE VS DEPTH



III-2 Unconfined and Triaxial Compression Tests

Unconfined compression tests were performed on almost all undisturbed samples, and triaxial compression tests were performed on selected undisturbed samples under unconsolidated undrained (U.U.) condition.

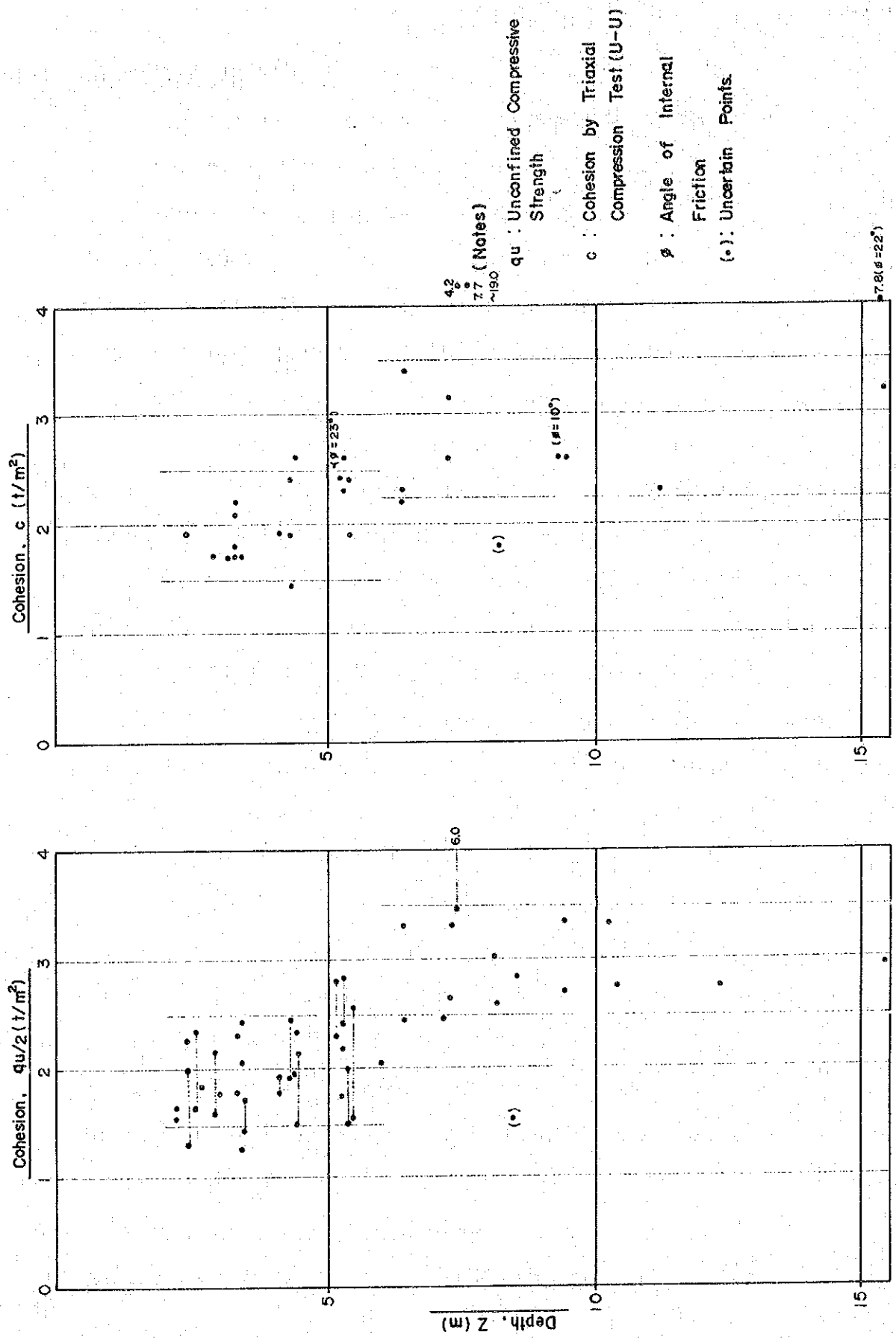
Results of the tests are summarized in Tables II-1 to II-12 and the details are shown in Appendices C, D and E.

Cohesion values obtained from these tests are listed in Fig. VII, Cohesion VS Depth.

Cohesion values ($c=qu/2$) obtained from unconfined compression tests are generally in the range of 1.5 to 2.5 t/m^2 at depths of 2.0 to 6.0 m below the surface of the seabed and vary from 2.5 to 3.5 t/m^2 at depths of 6.0 to 15.5 m, which include Quaternary deposits and basement complex.

Cohesion values obtained from triaxial compression tests are in the range of 1.5 to 2.5 t/m^2 at depths of 2.0 to 6.0 m and almost same to $c=qu/2$, and generally vary from 2.25 to 3.50 t/m^2 at depths of 6.0 to 15.5 m for Quaternary deposits. That for the medium to very dense silty sand of the basement complex is 7.7 to 19 t/m^2 .

FIG. VII COHESION VS. DEPTH



III-3 Consolidation Tests

Consolidation tests were performed in Singapore on selected undisturbed samples.

Test results are indicated in Tables II-1 to II-12, "Summary of Test". Details of each test are shown in Appendix F, "Consolidation Test (e-log p curves)" and Appendix G, "Consolidation Test (log \bar{p} -cv, mv, k curves)".

Preconsolidation pressure is higher than the effective vertical stress of soil, and Quaternary deposits are overconsolidated by about 10 t/m².

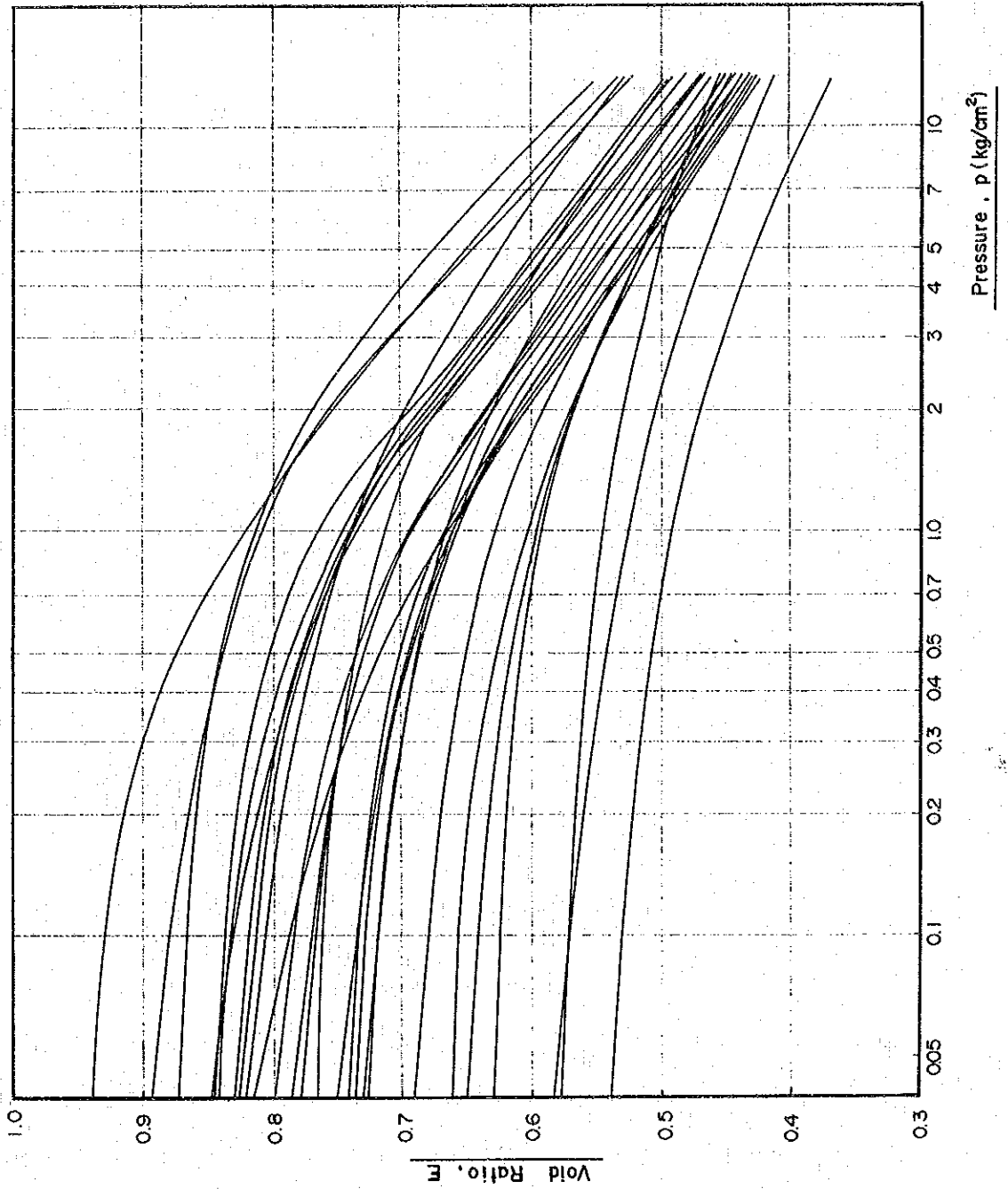
The compression index, C_c, is approximately 0.10 to 0.30, and calculations using the empirical equation proposed by SKEMPTON to estimate C_c after liquid limits for unsensitive clayey soil agree well with the test results obtained. Preconsolidation pressure and compression index versus depth are plotted in Fig. VIII.

All e-log p curves obtained are plotted in Fig. IX.

The coefficient of consolidation, C_v, at a pressure of 10 t/m² is in the range of 5.0 x 10⁻² to 4.0 x 10⁻¹ cm²/min. The coefficient of volume compressibility, mv, is in the range of 1.0 to 5.0 x 10⁻² cm²/kg at a pressure of 10 t/m². The coefficient of permeability, k, varies from 2 to 5 x 10⁻⁶ cm/min at a pressure of 10 t/m².

Consolidation tests were performed only on Quaternary deposits (very soft to soft silty clay, and medium to stiff silty clay and sandy silt).

FIG. IX VOID RATIO VS. PRESSURE



SECTION IV

SUBSOIL CONDITIONS AT THE PROPOSED SITE

a) Geological Outline

Geographical features around the proposed site can be grouped into three areas.

1. The Headland
2. Tombolo
3. The Mainland

The Headland is composed of weakly consolidated, argillaceous sedimentary rocks made up mainly of particles of silt and clay. The rocks are mudstone and belong to the Ormara Formation formed during the Pliocene and Pleistocene Epochs. The layer is capped generally by a thin layer of hard limestone or sandstone which consists of shells, sand and coral. The hard limestone layer is of the Jiwani Formation formed during the Pleistocene Epoch.

Tombolo consists of fine-grained particles containing many shell fragments. The fine material is mixed with sand, silt, clay and at some places, with gravel of sandstone and mudstone. However, at the middle portion of the Tombolo are dunes of mainly medium-size sand containing shell fragments. The Tombolo must have been formed gradually by the redeposition of fine-grained particles by the action of the drift paralleling the shore.

On the Mainland, the Makran Coastal range forms the northern border of the Gwadar area. The range essentially consists of mudstone, shale and sandstones formed during the Miocene and Pliocene Epochs. The prominent hillocks on the northeast of Gwadar town, called Koh-e-medi and Koh-e-Sur, consist of mudstone formed during the Tertiary Period.

b) Geological Structure

The formations formed during the Pliocene Epoch are folded and faulted along an east-west axis due to the complex crust movements occurring in the same period with the Himalayan orogenic movements during the Tertiary Period. The Jiwani Formation and recent deposits are not affected by these folds and faults, but they are affected by recent earthquakes which have occurred in Baluchistan.

c) Subsoil Conditions at the proposed Site

Soil conditions at the proposed site, which have been investigated by field explorations and laboratory soil tests, are summarised here.

As shown in the Soil Profiles, Figs. IV-1 and IV-2 the subsurface ground consists of Quaternary deposits (very soft to soft silty clay, and medium to stiff silty clay and sandy silt) and basement complex (medium to very dense silty sand, hard clayey silt and very dense silty sand).

The physical and mechanical properties of soil along the port alignment are indicated in Tables II-1 to II-12 and are summarized in Table IV, Summary of Soil Conditions.

c-1) Quaternary Deposit

1 Fine Sand

Fine sand is deposited at the surface of the seabed. This dark grey, very loose sand layer is 0.30 to 0.60 m thick and includes many shell fragments and some clay.

2 Very Soft to Soft Silty Clay

This layer is deposited below the fine sand to depths of EL -5.5 to -11.0 m. The layer contains shell fragments, especially at depths of 0.5 to 2.50 m below the surface of the seabed, and organic matter, like decomposed wood.

N-values of Standard Penetration Test vary from 1 to 4.

Specific Gravity, $G_s = 2.71-2.76$

Water Content, $w_n = 21-34\%$

Liquid Limit, $LL = 24-41\%$

Plastic Limit, $PL = 13-18\%$

Plastic Index, $PI = 9-23\%$

Grain size distribution: 0-3% Gravel

0-11% sand

35-68% silt

27-65% clay

Unit weight, $\gamma_t = 1.90 - 2.10 \text{ t/m}^3$ (Average; 2.0 t/m^3)

Cohesion, $c = qu/2 = 1.25-3.0 \text{ t/m}^2$ (mainly $1.5-2.5 \text{ t/m}^2$)

$c = 1.5-2.5 \text{ t/m}^2$ (Triaxial compression test)

Compression Index, $C_c = 0.10-0.29$

Coefficient of Consolidation,

$C_v = 6.5 \times 10^{-2} - 3.0 \times 10^{-1} \text{ cm}^2/\text{min.}$

(at a pressure of 10 t/m^2)

Coefficient of Volume Compressibility,

$m_v = 1.2 \text{ to } 4.7 \times 10^{-2} \text{ cm}^2/\text{kg}$

(at a pressure of 10 t/m^2)

Coefficient of Permeability,

$k = 1.5 \text{ to } 5 \times 10^{-6} \text{ cm/min.}$

(at a pressure of 10 t/m^2)

3 Medium to Stiff Silty Clay and Sandy Silt

This layer was encountered below very soft to soft silty clay with the maximum thickness of 12.0 m .

The layer contains shell fragments.

N-values are 4 to 12.

Specific Gravity, $G_s = 2.63-2.76$

Water Content, $w_n = 20-31.8\%$

Liquid Limit, $LL = 23-40\%$

Plastic Limit, $PL = 14.0-19\%$

Plasticity Index, $PI = 10-24$

Grain size distribution: 0-3% gravel

0-18% sand

36-76% silt

12-63% clay

Unit weight, $\gamma_t = 2.03-2.12 \text{ t/m}^3$

Cohesion, $c = 2.5-3.5 \text{ t/m}^2$ (Unconfined Compression Test)

Cohesion, $c = 2.4-4.2 \text{ t/m}^2$

Angle of Internal Friction $\phi = 22^\circ-10^\circ$ } Triaxial compression test

Compression Index, $C_c = 0.13-0.30$

Coefficient of Consolidation,

$$C_v = 8 \times 10^{-2} \text{ to } 3.0 \times 10^{-1} \text{ cm}^2/\text{min}$$

(at a pressure of 10 t/m^2)

Coefficient of Volume Compressibility,

$$m_v = 1.0 \text{ to } 4.0 \times 10^{-2} \text{ cm}^2/\text{kg}$$

(at a pressure of 10 t/m^2)

Coefficient of Permeability,

$$k = 1.3 \text{ to } 5 \times 10^{-6} \text{ cm/min}$$

(at a pressure of 10 t/m^2)

c-2) Basement complex - Ormara Formation

The basement complex consists of medium to very dense silty sand, hard clayey silt and very dense silty sand. The complex is of the Ormara Formation formed during the Pliocene and Pleistocene Epochs. The formation has folds and faults due to complex crustal movements, and there is the possibility of faults between boreholes B-4 and B-5, and between boreholes B-9 and B-10.

1 Medium to Very Dense Silty Sand

This layer was found at boreholes B-2 to B-3 and has a thickness of 3.0 to 5.0 m.

N-values are 25 to more than 50.

Specific Gravity, $G_s = 2.73$

Water Content, $W_n = 19-22\%$

Liquid Limit, $LL = 22-27\%$

Plastic Limit, $PL = 15-17\%$

Plasticity Index, $PI = 5-12$

Grain size distribution: 3% to 11% sand
65% to 75% silt
14% to 32% clay

Unit weight, $\gamma_t = 2.14 \text{ t/m}^3$

Cohesion, $c = (7.7 \text{ to } 19.0) \text{ t/m}^2$

(Triaxial compression test)

2 Hard Clayey Silt and Very Dense Silty Sand

This layer is hard and very dense and is not compressible due to the loads of the proposed Mini-port facilities.

Its N-values are 24 to more than 50. The layer is expected to act as a drainage layer for the Quaternary deposits while a surcharge of reclaimed soil is applied.

Table IV
SUMMARY OF SOIL CONDITIONS

Layer	Grading Analysis				Water Content Wn	Atterberg Limits			Specific Gravity Gs	Unit Weight γt	Standard Penetration Test SPT	Cohesion C	Consolidation Properties					
	Gravel G	Sand S	Silt M	Clay C		Liquid Limit	Plastic Limit	Plasticity Index					Cc	Cv	m _v	K		
Quaternary Deposits	Very Soft to Soft Silty Clay	0-3	0-11	35-68	27-65	21-34	24-41	13-18	9-23	2.71 -2.76	1.90 -2.10	blows/ 0.3m 1-4	1.5-2.5	0.10 -0.29	6.5x10 ⁻² 3.0x10 ⁻¹	1.2 to 4.7 x10 ⁻²	1.5 to 5 x10 ⁻⁶	(at a pressure of 10 t/m ²)
	Medium to Stiff Silty Clay and Sandy Silt	0-3	0-18	36-76	12-63	20-31.8	23-40	14-19	10-24	2.63 -2.76	2.03 -2.12	4-12	2.5-3.5 (Unconfined compression test) c=2.4-4.2 φ=10-22° (Triaxial compression test)	0.13 -0.30	8.0x10 ⁻² 3.0x10 ⁻¹	1.0 to 4.0 x10 ⁻²	1.3 to 5 x10 ⁻⁶	(at a pressure of 10 t/m ²)
Basement Complex (Ormara Formation)	Medium to Very Dense Silty Sand	0	3-11	65-75	14-32	19-22	22-27	15-17	5-12	2.73	2.14	25- >50	(7.7-19.0) (Triaxial compression test)	--	--	--	--	
	Hard Clayey Silt and Very Dense Silty Sand	-	-	-	-	-	-	-	-	-	-	24- >50	--	--	--	--	--	
(Notes)		Cc : Compression Index				m _v : Coefficient of Volume Compressibility				Cv : Coefficient of Consolidation				K : Coefficient of Permeability				

A P P E N D I C E S

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G.	Consolidation Tests (log p- cv, mv, k curves)	G - 1 to 26

GRAIN SIZE DISTRIBUTION

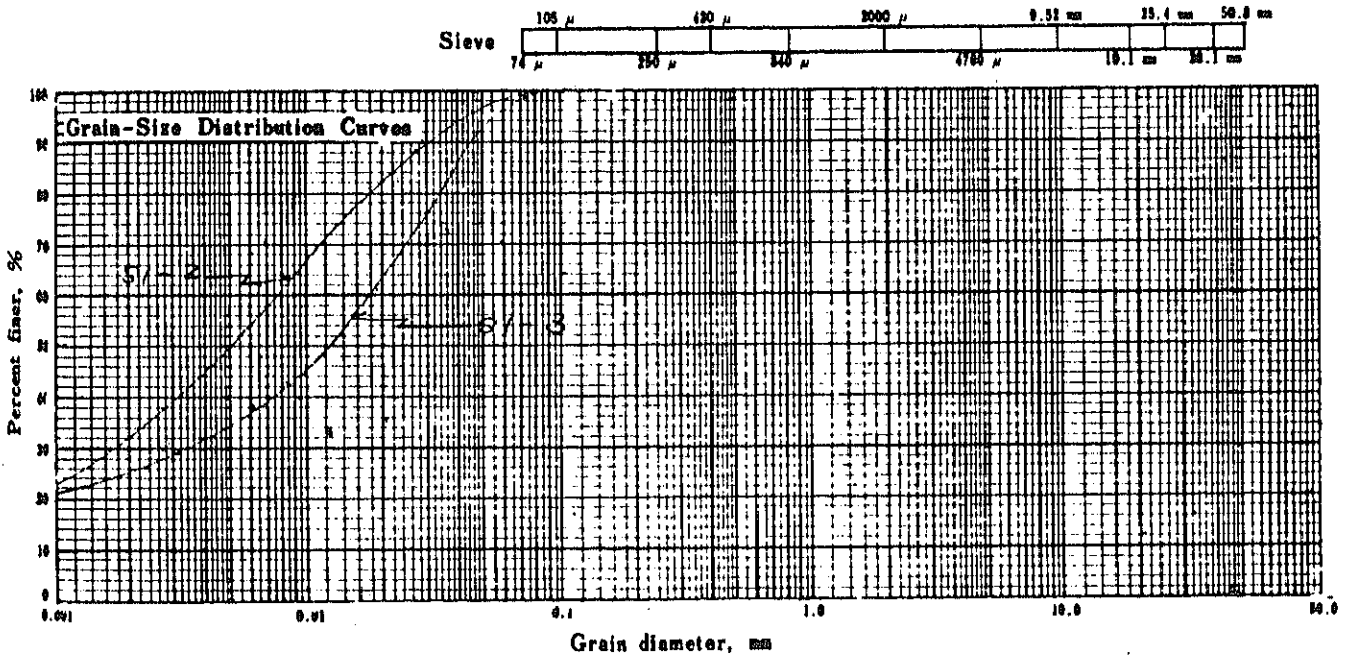
Project GWADAR MINI PORT Job No. _____
 Location of Project GWADAR, PAKISTAN Boring No. B-1
 Tested by T. SAGAE Date of Testing Nov. 16, 1979

Sample No., Depth: No. S1-2 (4.00 m - 4.83 m) Specific Gravity, $G_s =$ 2.742

Diam. mm	50.8	38.1	25.4	19.1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
% Passing											100	99.5
Diam. mm	0.037	0.027	0.018	0.011	0.0079	0.0057	0.0030	0.0013				
% Passing	93.2	88.4	80.5	68.6	58.7	52.7	39.1	26.4				

Sample No., Depth: No. S1-3 (6.00 m - 6.79 m) Specific Gravity, $G_s =$ 2.734

Diam. mm	50.8	38.1	25.4	19.1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
% Passing											100	99.2
Diam. mm	0.038	0.028	0.019	0.012	0.0089	0.0061	0.0031	0.0013				
% Passing	84.3	74.1	60.7	48.2	43.4	37.6	29.2	21.7				



Colloid	Clay	Silt	Sand	Gravel
0.001	0.005	0.075	2.0	

Sample No., Depth	No. <u>S1-2</u> <u>4.00 m - 4.83 m</u>	No. <u>S1-3</u> <u>6.00 m - 6.79 m</u>	Sample No., Depth	No. <u>S1-2</u> <u>4.00 m - 4.83 m</u>	No. <u>S1-3</u> <u>6.00 m - 6.79 m</u>
Larger than 4.76 mm	0 %	0 %	Max. diam.	0.105 mm	0.105 mm
4.76 - 2 mm	0 %	0 %	Diam. at 60%	0.0077 mm	0.018 mm
2 - 0.42 mm	0 %	0 %	Diam. at 30%	0.0017 mm	0.0034 mm
0.42 - 0.074 mm	0 %	1 %	Diam. at 10%	— mm	— mm
0.074 - 0.005 mm	50 %	64 %	Coefficient of uniformity	—	—
Smaller than 0.005 mm	50 %	35 %	Coefficient of curvature	—	—
Smaller than 0.001 mm	23 %	21 %			
2000 μ Sieve Passing	100 %	100 %			
420 μ Sieve Passing	100 %	100 %			
74 μ Sieve Passing	100 %	99 %			