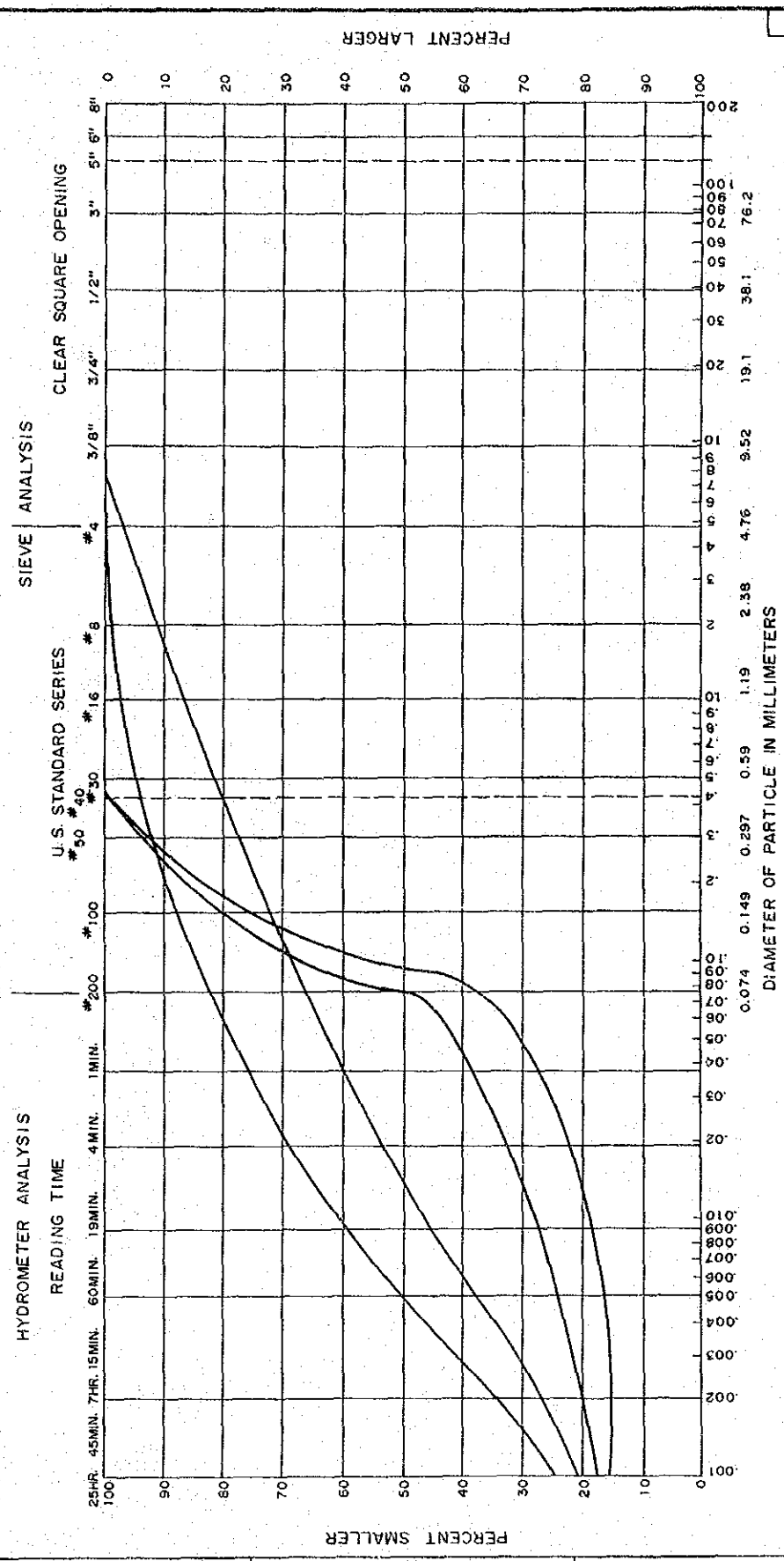
FIGURES

FIG NO.



THE REPUBLIC OF TURKEY
ELEKTRİK İŞLERİ ETÜD İDARESİ
GENEL MÜDÜRLÜĞÜ

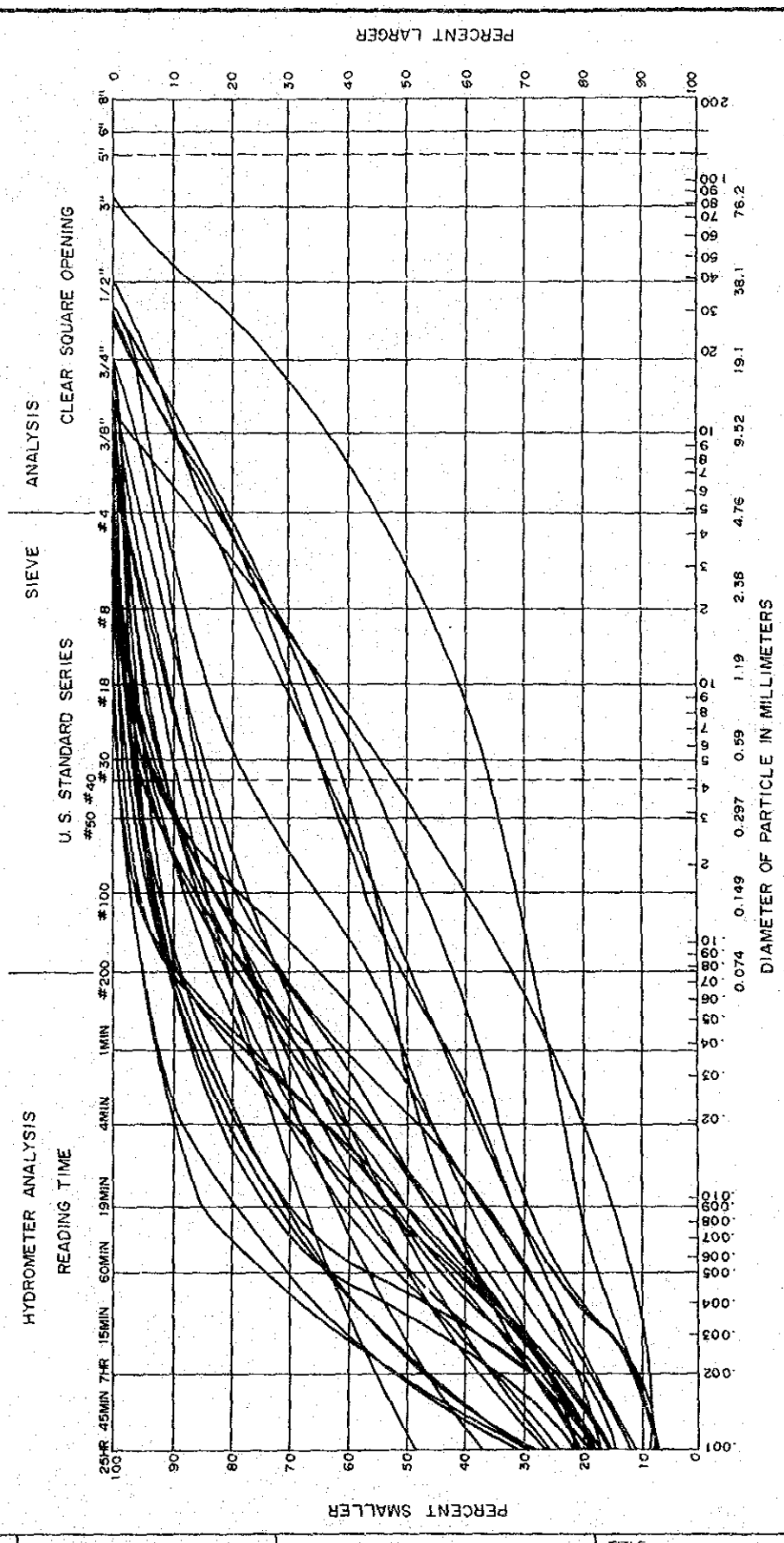
ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE

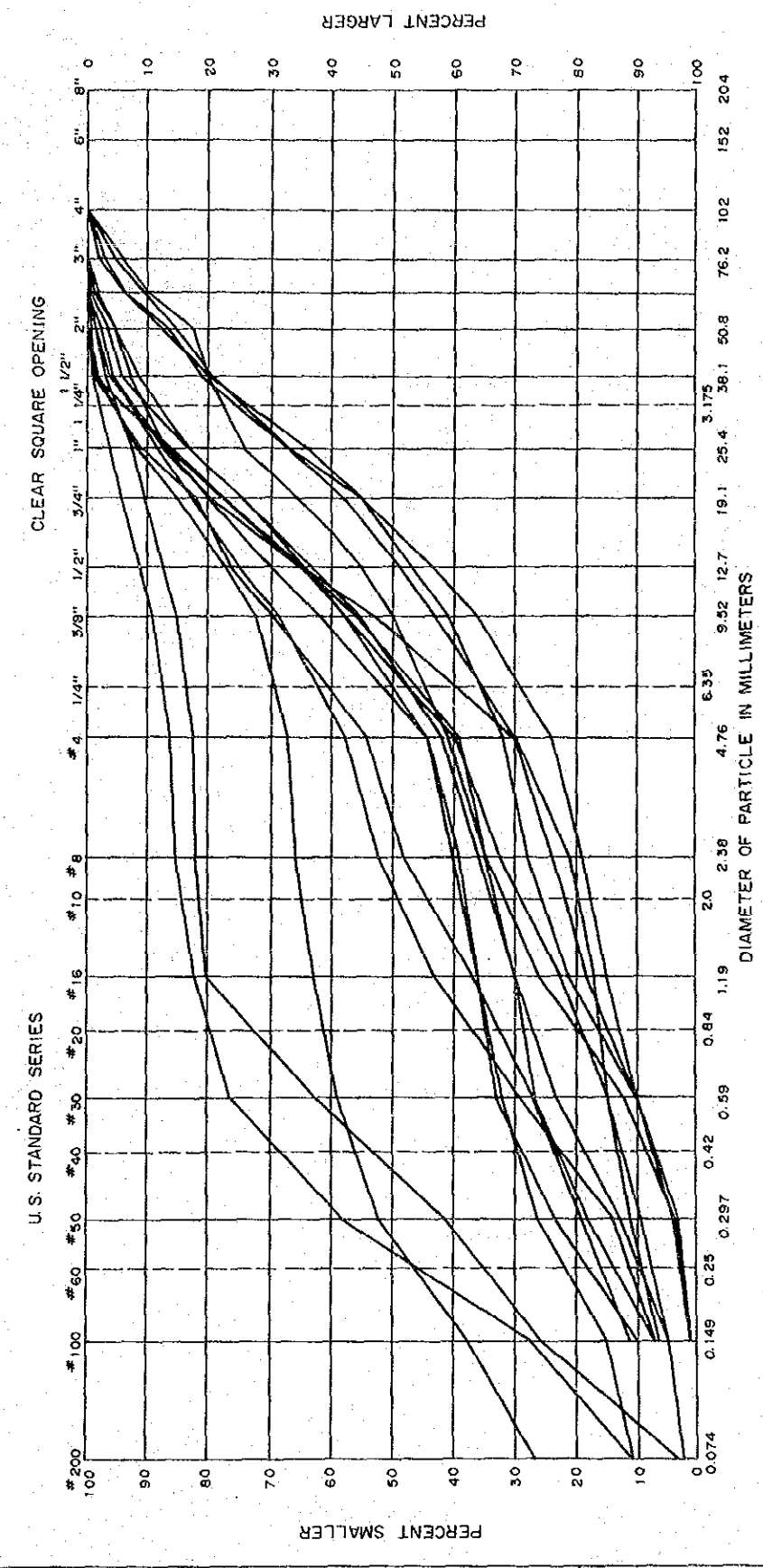
Fig. B1
Gradation Curves (1/3)
Impervious Core Materials
Borrow Area A

FIG NO.



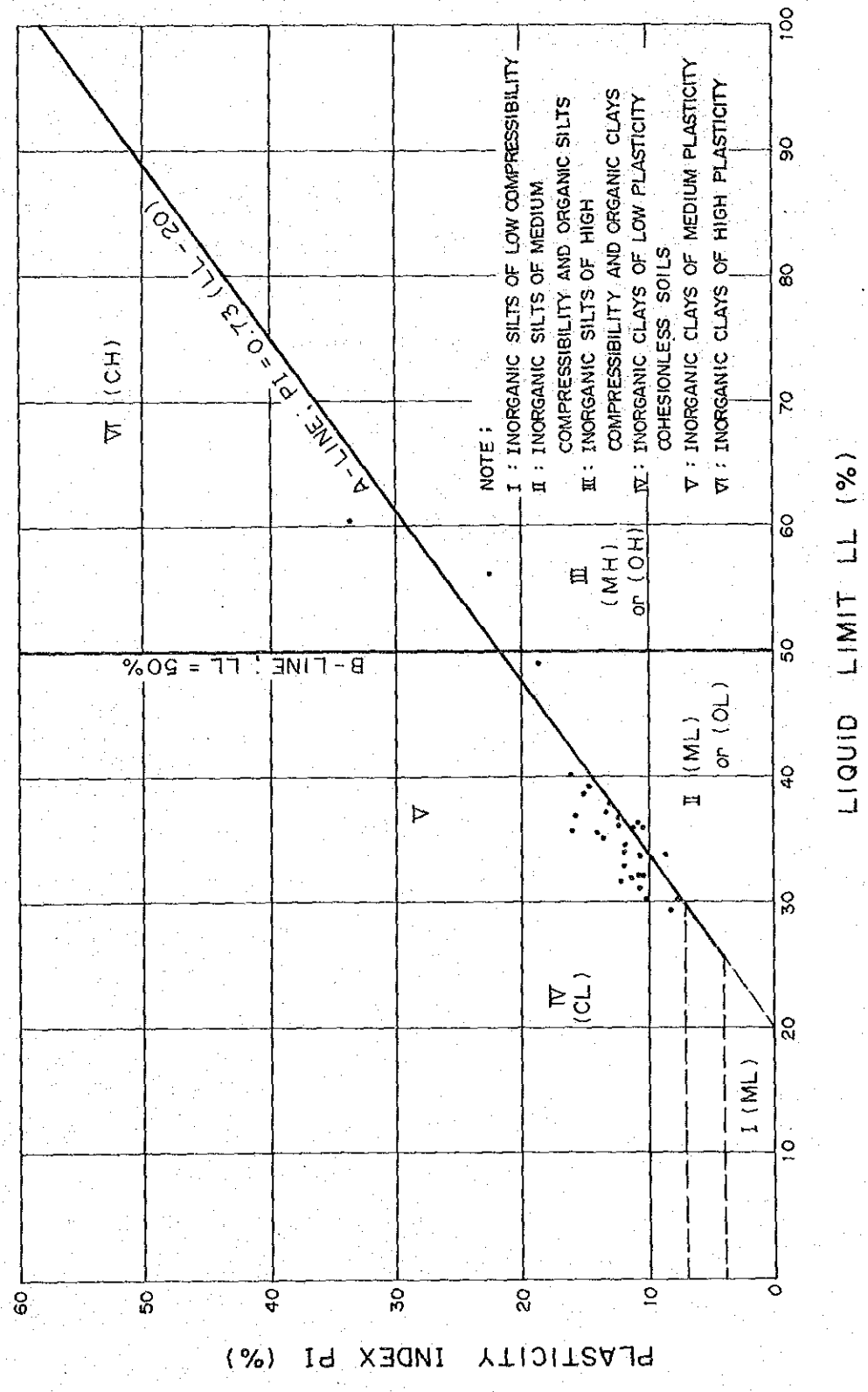
THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	**Fig. B1** **Gradation Curves (2/3)** **Impervious Core Materials** **Borrow Area F,C,D,B,I & E**

FIG NO.



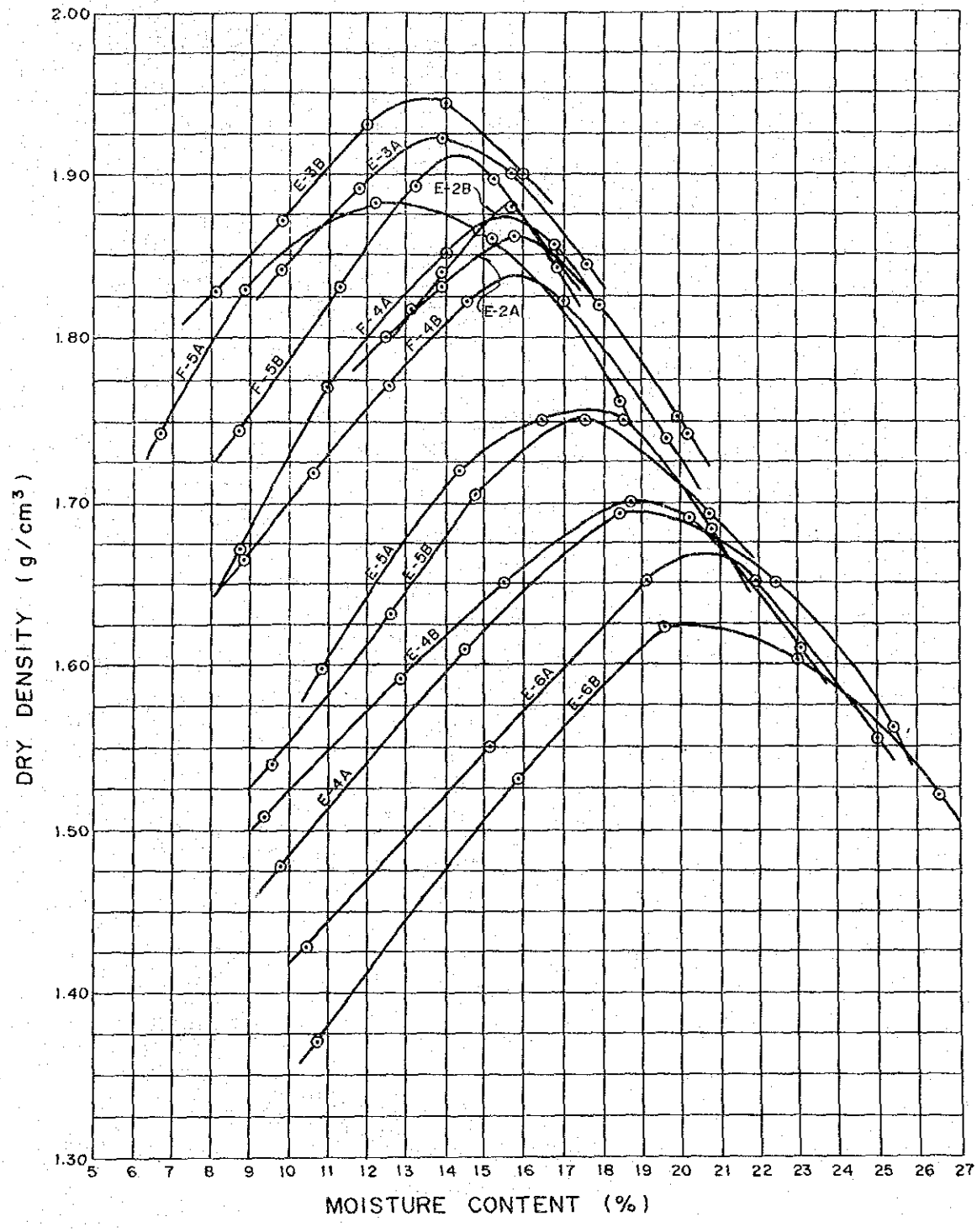
THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **Fig. B1** **Gradation Curves (3/3)** **Sand and Gravel Materials**

FIG NO.



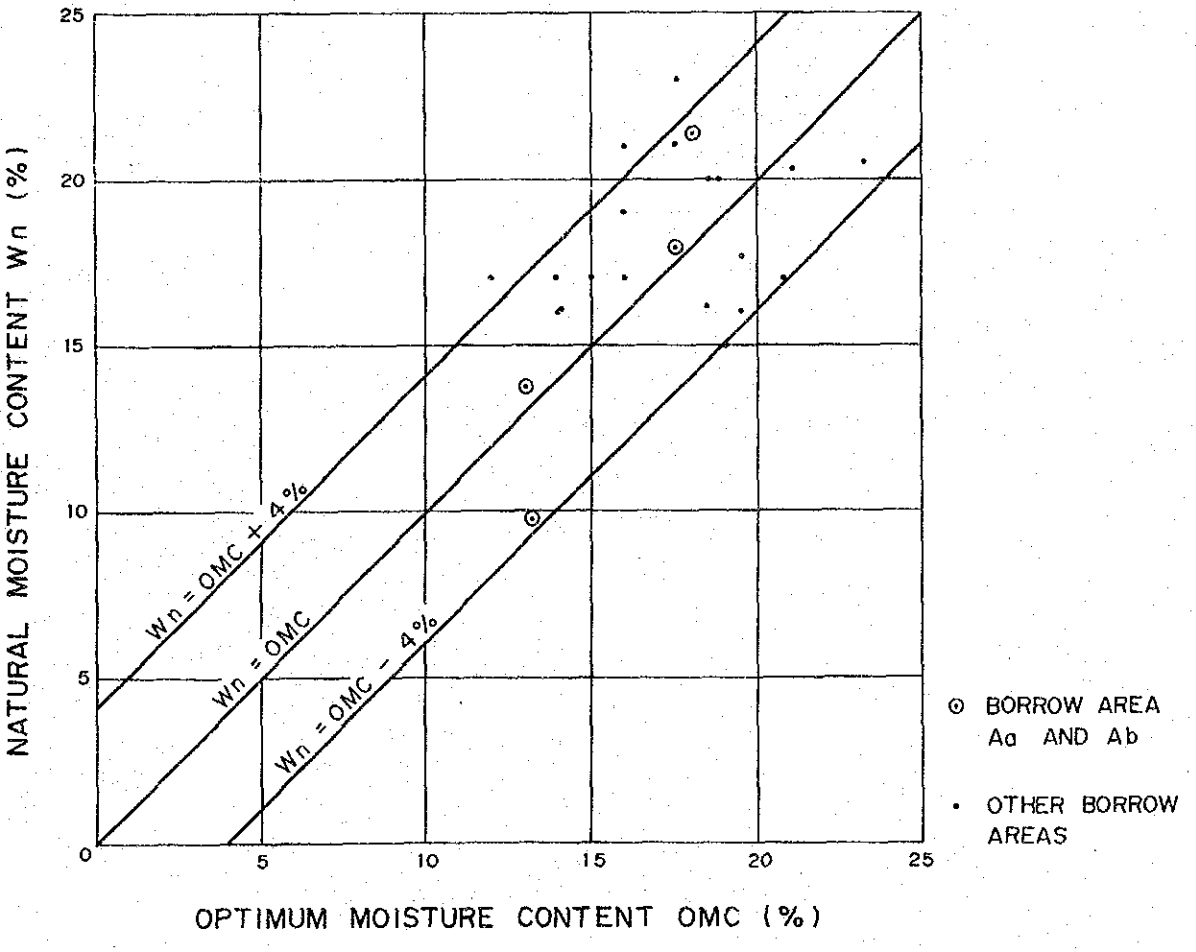
THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **Fig. B2** **Plasticity Chart**	

FIG NO.



THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **Fig. B3** **Moisture-Density Relations (Compaction curves)**

FIG NO.



	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **Fig. B4** **Relation between Natural Moisture Content and Optimum Moisture Content**

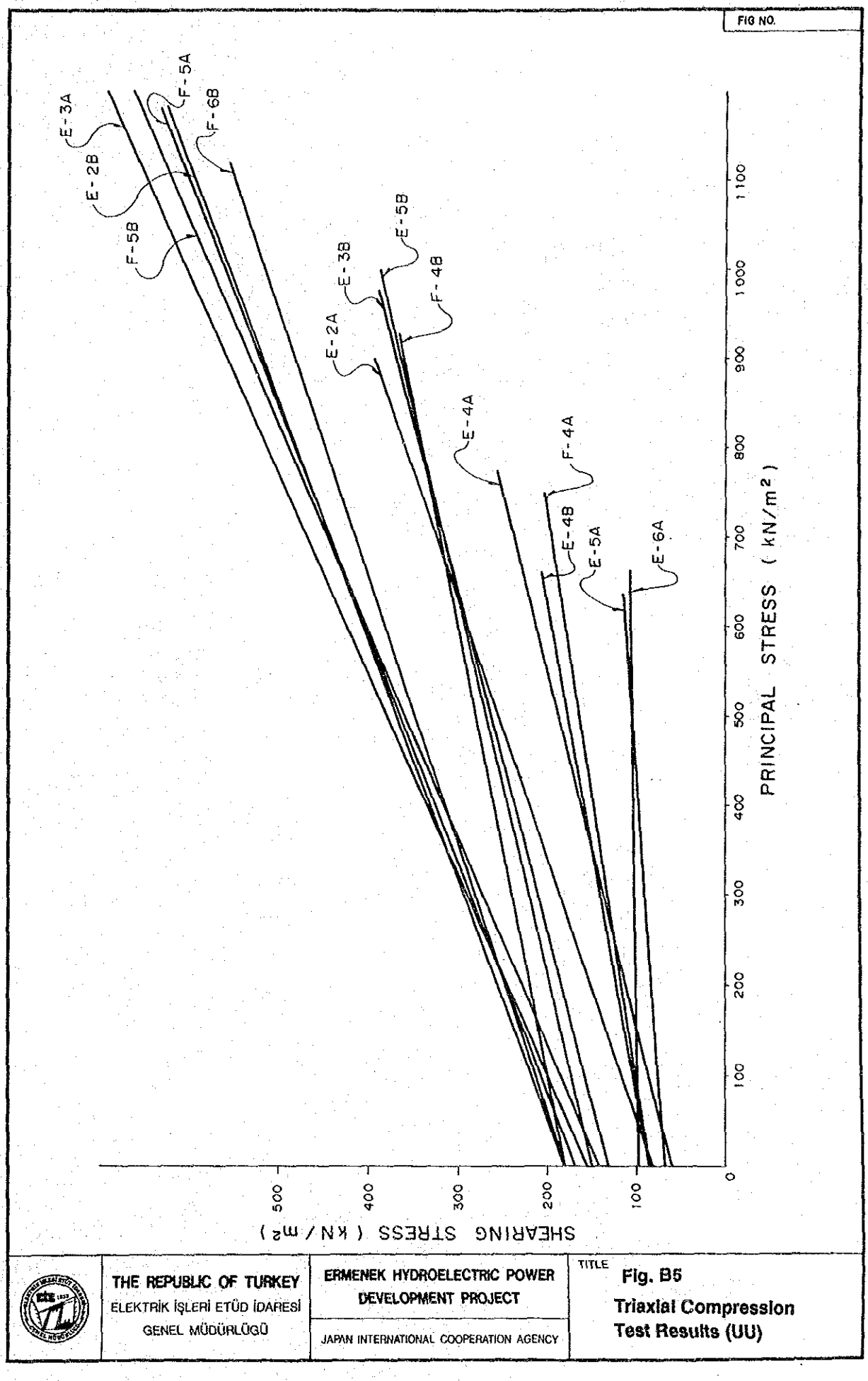


FIG NO.
E-3A
E-2B
F-5B
F-5A
F-6B
E-2A
E-3B
E-5B
F-4B
E-4A
F-4A
E-4B
E-5A
E-6A
PRINCIPAL STRESS (kN/m²)
0
100
200
300
400
500
600
700
800
900
1000
1100
SHEARING STRESS (kN/m²)
100
200
300
400
500
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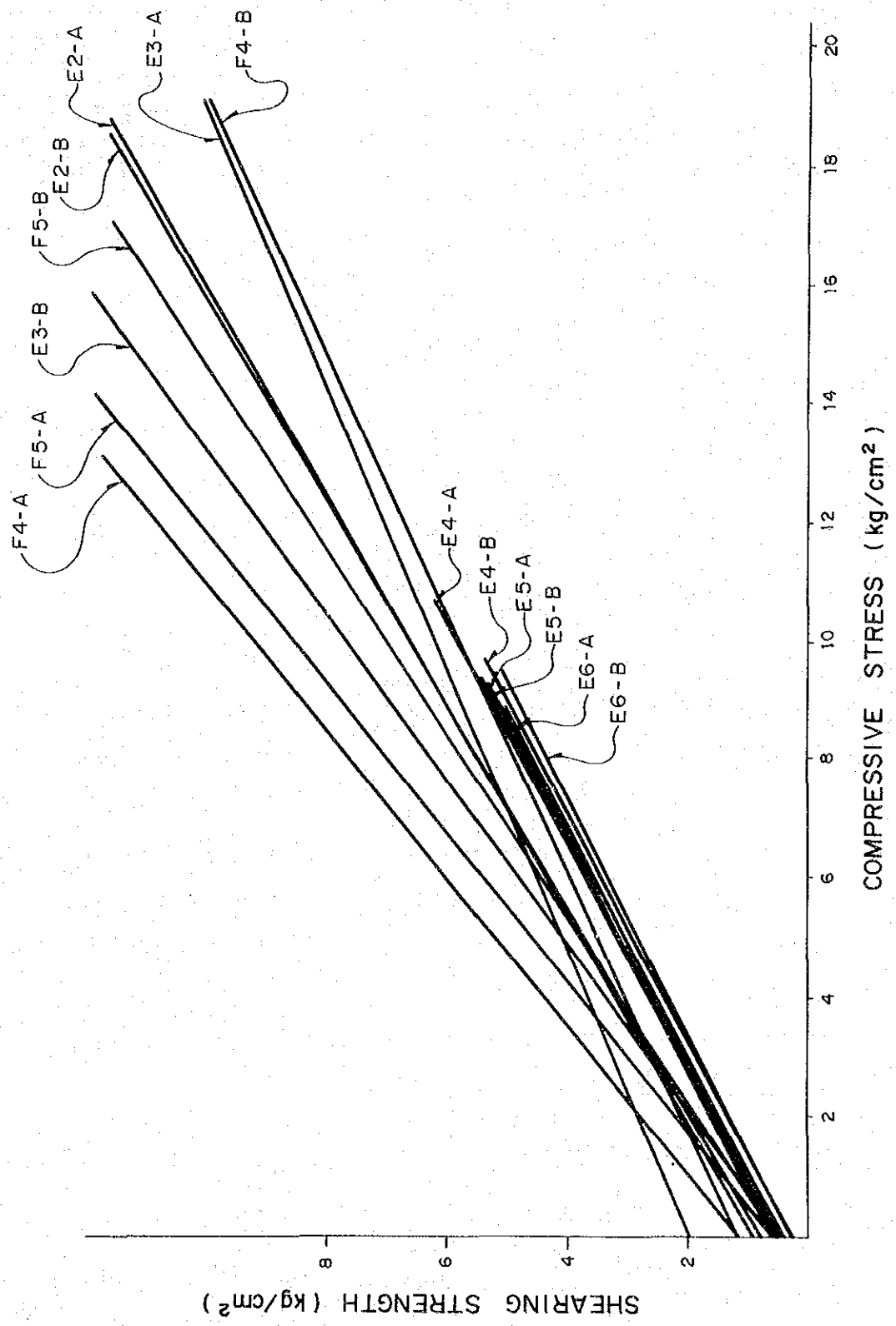
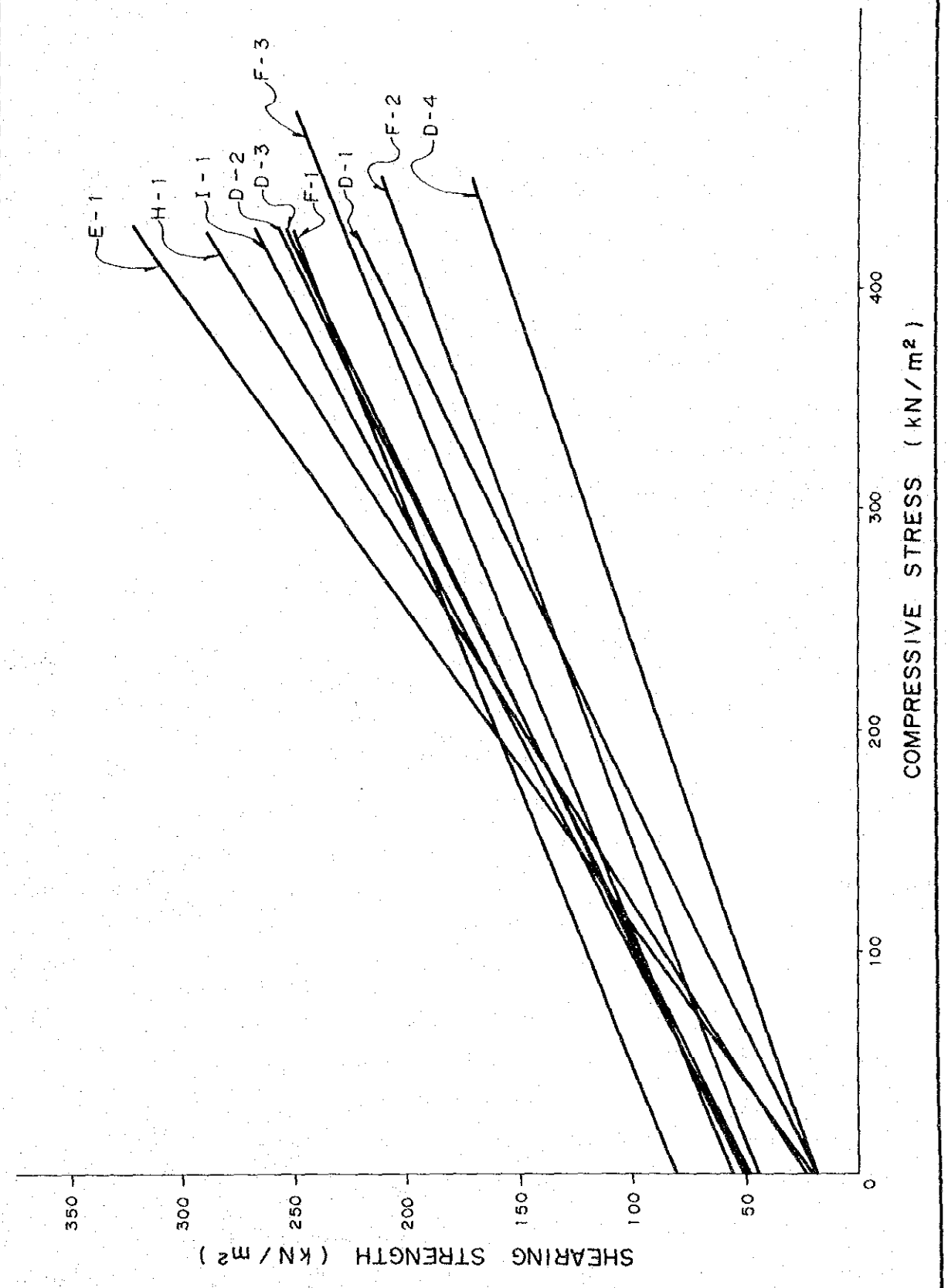
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE
Fig. B5
Triaxial Compression Test Results (UU)

FIG NO.



	THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜĞÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Fig. B6 Triaxial Compression Test Results (CU)

FIG NO



THE REPUBLIC OF TURKEY ELEKTRİK İŞLERİ ETÜD İDARESİ GENEL MÜDÜRLÜGÜ	ERMENEK HYDROELECTRIC POWER DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE **Fig. B7** **Shear Test Results**	

Attachment B1

Geological Condition of Test Pits

GEOLOGICAL CONDITION OF TEST PITS

1 BORROW AREAS FOR CORE MATERIALS

(1) BORROW AREA Aa

A-1	Depth (m)	
	0.00 - 0.20	Surface soil, dry.
	0.20 - 1.50	Silty clay, light brown, dry.
	1.50 - 2.50	Silty clay, with gravels (10 %), brown. Slightly wet.
	2.50 - 5.00	Sandy-silty clay, brown. Moderatly wet

A-3	Depth (m)	
	0.00 - 0.30	Surface soil.
	0.30 - 5.00	Silty clay. Dry; 0.00 - 1.00 m. Slightly wet; 1.00 - 2.00 m. Moderately wet; 2.00 - 5.00 m.

(2) BORROW AREA Ab

A-2	Depth (m)	
	0.00 - 0.40	Surface soil.
	0.40 - 3.20	Silty sand, moderately wet.
	3.20 - 4.00	Gravels and limestone boulders. Moderately wet.

A-4	Depth (m)	
	0.00 - 0.15	Surface soil.
	0.15 - 1.80	Silty clay, moderately wet.
	1.80 - 3.00	Gravel, moderately wet.

(3) BORROW AREA B

B-1	Depth (m)	
	0.00 - 0.20	Surface soil.
	0.20 - 1.50	Clayey silt, light brown-greenish brown, with a little sand.
	1.50 - 2.00	Clayey-silty sand.
	2.00 - 2.50	Gravel.

(4) BORROW AREA C

C-1	Depth (m)	
	0.00 - 0.30	Surface soil.
	0.30 - 1.10	Silty clay, reddish-light brown, with some gravels (5-10%).
	1.10 - 2.50	Clay, reddish brown.
	2.50 - 3.80	Silty clay, light brown.
	3.80 - 4.50	Slity clay, with lime lump, light brown.
	4.50 - 5.00	Sandy-silty clay, light brown.
C-2	Depth (m)	
	0.00 - 0.20	Surface soil.
	0.20 - 1.50	Clay, reddish brown.
	1.50 - 2.00	Silty clay, light brown.
	2.00 - 2.60	Silty clay, with lime lump, light brown.
	2.60 - 3.10	Sandy-silty clay, light brown.
C-3	Depth (m)	
	0.00 - 0.30	Surface soil.
	0.30 - 3.10	Clayer-sandy silt, with a little gravels (10-15%).
	3.10 - 3.40	Clayey-sandy silt, with gravels.
	3.40 - 4.40	Clayer-sandy silt, with a little gravels (10-15%).
	4.40 - 5.00	Gravels. Slightly wet; 0.30-5.00 m.
C-4	Depth (m)	
	0.00 - 0.30	Surface soil.
	0.30 - 0.60	Silty clay, with a little sand, brown.
	0.60 - 1.00	Silty clay, with a little sand, brown, with gravels and boulders (max.15cm).
	1.00 - 2.00	Sandy-clayey silt, light brown, with gravels and boulders (max 15cm).

(5) BORROW AREA D

D-1	Depth (m)	
	0.00 - 0.50	Surface soil, dry.
	0.50 - 2.00	Sandy-clayey silt, light brown, with a little gravel and one bouldre(15cm), slightly wet.
	2.00 - 5.00	Sandy-clayey silt, light brown. Moderately wet.

D-2	Depth (m)	
	0.00 - 0.40	Surface soil.
	0.40 - 5.00	Sandy-clayey silt, light brown. Slightly wet.

D-3	Depth (m)	
	0.00 - 0.50	Surface soil.
	0.50 - 1.50	Sandy-clayer silt, with a little gravel.
	1.50 - 5.00	Sandy-clayer silt, slightly wet.

D-4	Depth (m)	
	0.00 - 0.30	Surface soil.
	0.30 - 5.00	Clay and silit clay, light brown. Slightly wet.

(6) BORROW AREA E

E-1	Depth (m)	
	0.00 - 0.30	Surface soil.
	0.30 - 3.50	Sandy silt and clayey-silty sand, with gravels(10-15%).

(7) BORROW AREA Ea

E-4	Depth (m)	
	0.00 - 0.50	Surface soil, clay with gravels(10-15%), dark brown.
	0.50 - 1.10	Clay-silty clay, dark brown.
	1.10 - 3.50	Silty clay, light brown.

E-5 Depth (m)

0.00 - 0.80	Surface soil.
0.80 - 4.00	Silty clay.
	Moderately wet; 1.00 - 4.00 m.

(8) BORROW AREA Eb

E-6 Depth (m)

0.00 - 0.40	Surface soil.
0.40 - 1.60	Sandy-silty clay, light brown.
	Below 1.6m, sand and gravels.

(9) BORROW AREA Ec

E-2 Depth (m)

0.00 - 0.70	Surface soil, light brown, dry.
0.70 - 2.30	Sandy-clayey silt, with gravels(10%) and boulders (max.20x20x40cm) in 1.80-2.30m.
2.30 - 3.20	Sandy-clayey silt, with small gravels (10-15%).
3.20 - 3.50	Sandy-clayey silt, with boulders (40-50%).
3.50 - 4.00	Sandy-clayey silt, with coarse gravels (15%).
4.00 - 4.50	Gravels and boulders (max.20x30x50cm).

E-3 Depth (m)

0.00 - 1.00	Surface soil, light brown, with gravels (max.5cm).
1.00 - 1.60	Sandy-silty clay, with gravels(50%, max.5cm).
1.60 - 2.15	Sandy-silty clay, light brown.
2.15 - 2.35	Sand and gravels layer.
2.35 - 3.20	Sandy-silty clay, light brown.
	Slightly-moderately wet; 1.20 - 3.20 m.

(10) BORROW AREA Fa

F-4 Depth (m)

0.00 - 0.30	Surface soil, with coarse gravels, dark brown.
0.30 - 2.10	Silth clay, with lime lump (1-2cm, 5%), light brown.
2.10 - 2.90	Silth clay, with gravels(25-30%), light brown.
2.90 - 3.50	Many boulders(70%), light brown.
	Slightly wet; 0.30 - 3.50 m.

F-5 Depth (m)

0.00 - 0.60	Surface soil.
0.60 - 1.90	Clayey silt, with small gravels (5-10%).
1.90 - 3.20	Clayey silt, light brown.
3.20 - 3.50	Sand and small gravels.
3.50 - 5.00	Clayey silt, light brown.
	Slightly wet; 0.60 - 5.00 m.

(11) BORROW AREA Fb

F-1 Depth (m)

0.00 - 1.00	Surface soil, silty clay, brown.
1.00 - 3.20	Clayey silt, Brown-light brown.
3.20 - 5.00	clayey silt, with sand layer (5-15cm thick) at interval of 25-30cm.
	Slightly wet; 1.20 - 5.00 m.

F-2 Depth (m)

0.00 - 1.00	Surface soil, silty clay, brown.
1.00 - 5.00	Silty clay, light brown, slightly wet.

F-3 Depth (m)

0.00 - 1.00	Surface soil, brown.
1.00 - 5.00	Silty clay-clayey silt, light greenish brown, slightly wet.

(12) BORROW AREA I

I-1 Depth (m)

0.00 - 0.30	Surface soil, clay, reddish brown.
0.30 - 1.50	Clayey silt, with lime lump(5-10%), white-greenish brown.
1.50 - 3.00	Sandy-clayey silt, greenish brown.

(13) OTHERS FOR CORE MATERIALS

H-1 Depth (m)

0.00 - 0.30	Surface soil, with gravels.
0.30 - 3.00	Silty clay, with sand, gravel and bouldre layer (max.18cm, 5-10cm thick) at interval of 15-20cm, slightly wet.

2 BORROW AREAS FOR SAND AND GRAVEL MATERIALS

(1) BORROW AREA Ga

G-1 Depth (m)

0.00 - 0.80	Sand
0.80 - 2.00	Sand and gravels, with blocks(max.15cm).

G-2 Depth (m)

0.00 - 0.60	Sand(80%) and gravels(20%).
0.60 - 2.10	Gravels, with sand.

G-6 Depth (m)

0.00 - 0.80	Sand.
0.80 - 2.20	Gravels, with sand.

(2) BORROW AREA Gb

G-5 Depth (m)

0.00 - 0.80	Silty sand.
0.80 - 2.10	Sand(70%) and gravels(30%).

(3) BORROW AREA Gc

G-7	Depth (m)	
	0.00 - 0.50	Sand.
	0.50 - 2.00	Gravels, with sand.
G-12	Depth (m)	
	0.00 - 0.50	Gravels (80%) and sand (20%).
	0.50 - 2.90	Gravels (60-70%), sand (20-30%) and boulders (5-10%, max.20x10x10cm).

(4) BORROW AREA Gd

G-3	Depth (m)	
	0.00 - 0.80	Sand.
	0.80 - 2.60	Gravels, with sand.
G-4	Depth (m)	
	0.00 - 1.70	Gravels, with sand.
G-10	Depth (m)	
	0.00 - 2.40	Gravels, with sand and boulders (20%).
G-11	Depth (m)	
	0.00 - 1.80	Gravels, with sand and boulders(10-15%).

(5) BORROW AREA Ge

G-8	Depth (m)	
	0.00 - 2.00	Sand(80-90%) and gravels (10-20%).
	2.00 - 3.60	Gravels, with sand.
G-9	Depth (m)	
	0.00 - 2.50	Silty sand.
	2.50 - 4.50	Gravels, with sand.
G-13	Depth (m)	
	0.00 - 0.90	Gravels.
	0.90 - 1.30	Sand.
	1.30 - 2.00	Gravels, with boulders (5%, max.15x20x30cm).

Attachment B2

Drilling Log

DRILL LOG

SITE	Quarry Site	HOLE NO.	311
LATITUDE	9703.04	LONGITUDE	6566.96
DATE	Aug.17 - Sep.11, 1989	ELEVATION	079.2/m
ANGLE	0.00°	DEPTH	59.00m
DIRECTION	0.00°	SLOPE	0.00°

DATE	DEPTH	ELEVATION	GEOLOGICAL AGE	ROCK TYPE	ROCK CLASS	DESCRIPTION	BIT & DIAMETER
	0.50	878.77	Quaternary	Top soil			NC.101
17/8 (2.00)	2.00	877.27	Quaternary	Talus deposit			
	3.00	875.27	Nadire formation	Limestone	Ac-d	Highly weathered rock.	08.101
18/8 (5.00)	5.00	874.27			Ac-d	Weathered rock, Joint: 30 deg. & vertical, with thick green to brown clay (5-10cm).	
	6.60	872.67			Ac-d	Weathered rock. Vertical joint, with 1-2cm greenish gray clay.	
19/8 (8.00)	8.00	871.27			Ac-dIII	Weathered rock,	
	8.50	870.77			Ee	8.50-8.70m: Vertical joint with green clay (1-2cm).	
	9.40	869.87			Ad	8.70-9.20m: Brown clay (5-10cm).	
21/8 (10.00)	10.50	868.77			Ac	11.10m: 30deg. joint with brown clay.	
	11.30	868.02			Ad		
	12.70	866.57			AcIII	Weathered rock.	
22/8 (13.00)	13.00	866.27			EeIII	12.80-13.50m: brown clay.	
	13.50	865.77			Ee	13.50-14.70m: 10-30deg. joints, with clay (1-3cm).	
	14.70	864.57			Ac-d	14.70-15.00m: brown clay. 15.30-15.60m: gray clay.	
	15.15	864.12			Ee		
	15.30	863.97			Ee		
23/8 (15.60)	15.60	863.67			Ee		
	16.20	863.07			Ac-d	Weathered rock.	
	16.4?	862.87			Ee	15.60-17.25m: Vertical joint with green clay. Cores are mostly fragments.	
24/8 (17.00)	17.00	862.27			Ac-dIV		
	17.25	862.02			Ac-d		
	18.20	861.07			Ee	17.25-18.70m: Mostly brown clay.	
25/8 (18.50)	18.50	860.77			Ac-d		
	18.70	860.57			Ee		
	19.35	859.92			Ac-dIV	Weathered rock. Joints (20-40deg.), with thick green clay.	08.86
26/8 (20.00)	21.10	858.17			Ac-d		
28/8 (21.70)	21.70	857.57			Ac-d	Slightly weathered rock. With many joints (vertical & 30-40deg.). Joint surfaces are stained brown.	
	22.30	856.97			Ac-dII		
	23.60	855.67			Ac-dIII		
29/8 (24.00)	24.00	855.27			Ac-dIV		
	24.50	854.77			Ac-dIII		
31/8 (27.60)	28.50	850.77			Ac-dIV		
	28.85	850.42			EeIV	Mainly sandy clay and rock fragments, greenish colored.	
1/9 (30.00)	30.00	849.27			EeIV		

CORE RECOVERY % (m) 0 50 100 | R.Q.D % (m) 0 50 100

WATER PRESSURE TEST: N Value, Lugeon Value, K Value : cm/sec (0 10 20 30 40 50)

*R.Q.D is Rock Quality Designation. R.Q.D=(Total length of cylindric cores longer than 10 cm)/(Total drill length) x 100%
*LUGEON VALUE is l/min/m under injection water pressure of 10kg/cm2
*DEPTH and ELEVATION are in meter
*DIAMETER is in millimeter

DRILL LOG

SITE	Quarry Site			HOLE NO.	SK-311.
LATITUDE	9783.04	LONGITUDE	6566.96	ELEVATION	879.27m
DATE	Aug.17 - Sep.11, 1989			DEPTH	59.00m
ANGLE	180° UP DOWN 0° 90° 0.00° DIRECTION	270° W 180° N 0° E 90° S 0.00° SLOPE	HORIZON 90° 0° 0.00°		

SCALE (m)	DATE	DEPTH	ELEVATION	GEOLOGICAL AGE	ROCK TYPE	COLUMN SECTION	ROCK CLASS	DESCRIPTION	BIT Ø DIAMETER	GROUND WATER LEVEL	CORE RECOVERY % (m)	R.Q.D % (m)	WATER PRESSURE TEST N Value Lugeon Value K Value : cm/sec
31								Slightly weathered rock. Joints: 20-40deg., stained brown generally, partly with thin greenish-gray clay.					
32							Ab-cIV						
33	4/9 (33.60)												
34		34.75	845.62										
35							AbIII						
36		35.69	843.67										
37							AbIV						
38	6/9 (38.00)	38.00	841.27										
		38.50	840.77				AbIII						
39		39.00	840.27				Ab-cIV						
40							Ab-cIII						
41		40.65	838.62					Slightly weathered rocks. Many greenish colored thin clay is seen along vertical-irregular, & 10-20deg. joints.					
42	7/9 (41.20)												
43							A-Ba-bIV						
44													
45		44.78	831.57						88.86				
46	8/9 (46.00)	46.00	833.27										
47								Slightly weathered rock. Joints: 70-90deg. & 20-30deg., partly with thin gray clay. Oxidation (brown color) is rare.					
48							Ab-cIV						
49													
50													
51		50.75	828.52										
52							Aa-bIV						
53	9/9 (53.00)	53.00	826.27										
54							Aa-bIII						
55		55.00	824.27										
56													
57							Aa-bIV						
58													
59	11/9 (59.00)	59.00	820.27										
60													

Nadire formation

Limestone

※R.Q.D is Rock Quality Designation, R.Q.D=(Total length of cylindric cores longer than 10 cm)/(Total drill length) x 100%
※LUGEON VALUE is l/min/m under injection water pressure of 10kg/cm2
※DEPTH and ELEVATION are in meter
※DIAMETER is in millimeter

DRILL LOG

SITE	Quarry Site			HOLE NO.	SK-312
LATITUDE	9521.46	LONGITUDE	6600.14	ELEVATION	864.52m
DATE				DEPTH	50.00m
ANGLE	90° / 0.00°	DIRECTION		SLOPE	HORIZON 0° / 90° / 0.00°

SCALE (m)	DATE	DEPTH	ELEVATION	GEOLOGICAL AGE	ROCK TYPE	COLUMN SECTION	ROCK CLASS	DESCRIPTION	BIT & DIAMETER	GROUND WATER LEVEL	CORE RECOVERY % (m)	R.Q.D % (m)	WATER PRESSURE TEST N Value Lugeon Value K Value : cm/sec
1		0.50	864.02		Top soil			Partly looks like matrix of Ophiolithic Melange.					
2													
3				Quaternary	Talus deposit		D-Ed-e						
4	29/9 (4.00)												
5		4.50	859.62					Highly weathered rock.					
6							Bd		NC.101				
7	30/9 (7.69)												
8		7.50	856.92				AcIII	Moderately to slightly weathered rock.- 7.70-7.90m Opening. Joints: 20-30deg. in general.					
9		8.80	855.72										
		9.20	855.32				AdIII	Fragments only; vertical joint with green clay.					
10		9.70	854.82				AdIV						
		10.00	854.52					Moderately to slightly weathered rock.					
11							AcIV	Joints; stained brown, partly with thin green clay, 10-30 & 60-90deg.					
12		12.50	851.52										
13							AcIII	14.50-15.60m Fragments only, with vertical joint. 15.60-17.40m 60deg. joint, stained brown.					
14		14.20	850.32										
		14.40	850.12				AcIV						
15		15.00	849.52					17.40-18.20m Fragments.					
		15.60	848.92				AdIV		08.101				
16				Nabire formation									
							Ab-cIV						
17		17.40	847.12										
18		18.00	846.52										
		18.20	846.32					Moderately to slightly weathered rock.					
19								Joints; 10-20deg., stained brown, partly with thin green clay.					
20													
		20.60	843.92				AbIV	Cores are partly fragments.					
21		21.20	843.32										
22													
23								Moderately to slightly weathered rock. Cores are fragments only. Joint; 60deg., stained brown, partly with thin green clay.					
24		23.80	840.72										
		24.20	840.32				Ac-dIV		08.86				
		24.50	840.02					Moderately to slightly weathered rock.					
25							Ab-cIV	Cores are partly fragments.					
26		25.95	838.57										
		26.50	838.02				Ab-cII	Joints; 60-90deg., stained brown, partly with thin green clay.					
27							Ab-cIV						
28		27.60	836.92				Ab-cIII						
		28.00	836.52										
29							Ab-cIV						
30													

※R.Q.D is Rock Quality Designation, R.Q.D=(Total length of cylindric cores longer than 10 cm)/(Total drill length) x 100%
※LUGEON VALUE is l/min/m under injection water pressure of 10kg/cm2
※DEPTH and ELEVATION are in meter
※DIAMETER is in millimeter

DRILL LOG

SITE	Quarry Site	HOLE NO.	SK-312
LATITUDE	9521.46	LONGITUDE 6600.14	ELEVATION 864.52m
DATE			DEPTH 50.00m
ANGLE	180° UP / DOWN 0°, 90°, 0.00°	DIRECTION 270° W, 0° N, 90° E, 180° S, 0.00°	SLOPE HORIZON 0°, 90°, 0.00°

SCALE (m)	DATE	DEPTH	ELEVATION	GEOLOGICAL AGE	ROCK TYPE	COLUMN SECTION	ROCK CLASS	DESCRIPTION	BIT & DIAMETER	GROUND WATER LEVEL	CORE RECOVERY % (m)	R.Q.D % (m)	WATER PRESSURE TEST N Value / Lugeon Value / K Value : cm/sec
31		30.56	834.62	Nadine formation	Limestone		Ab-cIV		08.86		0 50 100	0 50 100	0 10 20 30 40 50
32		32.00	832.52				Ab-cIII	Moderately to slightly weathered rock. Cores are partly fragments.					
33							Ab-cIV	Joint; 30-60deg., stained brown, partly with thin green clay.					
34		34.20	830.32					34.20-35.00m: Fragments. Vertical joint with thin clay.					
35		34.35	829.82				Ac-dIV						
		35.00	829.52				Ac-d						
36		35.25	829.27				AbIV	Slightly weathered rocks. Joint; stained brown, partly with clay, 10-30deg, rarely 60deg. 39.75-39.95m: Clay(20cm) in 60deg. joint. 47.5m: Green sandy clay in 30deg. joint. 43.35: Green clay(1cm) in 60-90deg. joint.					
37							AbIII						
38		38.75	825.77										
39							AbII						
40		39.75	824.77										
41							AbIII						
42													
43		42.85	821.67				AbIV						
44		43.35	821.17										
45		44.40	820.12										
46							AbIII						
47		47.30	817.22										
48													
49		49.25	815.27										
50		50.00	814.52				AbIV						
51													
52													
53													
54													
55													
56													
57													
58													
59													
60													

※R.Q.D is Rock Quality Designation, R.Q.D=[Total length of cylindric cores longer than 10 cm]/[Total drill length] x 100%
※LUGEON VALUE is l/min/m under injection water pressure of 10kg/cm2
※DEPTH and ELEVATION are in meter
※DIAMETER is in millimeter

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