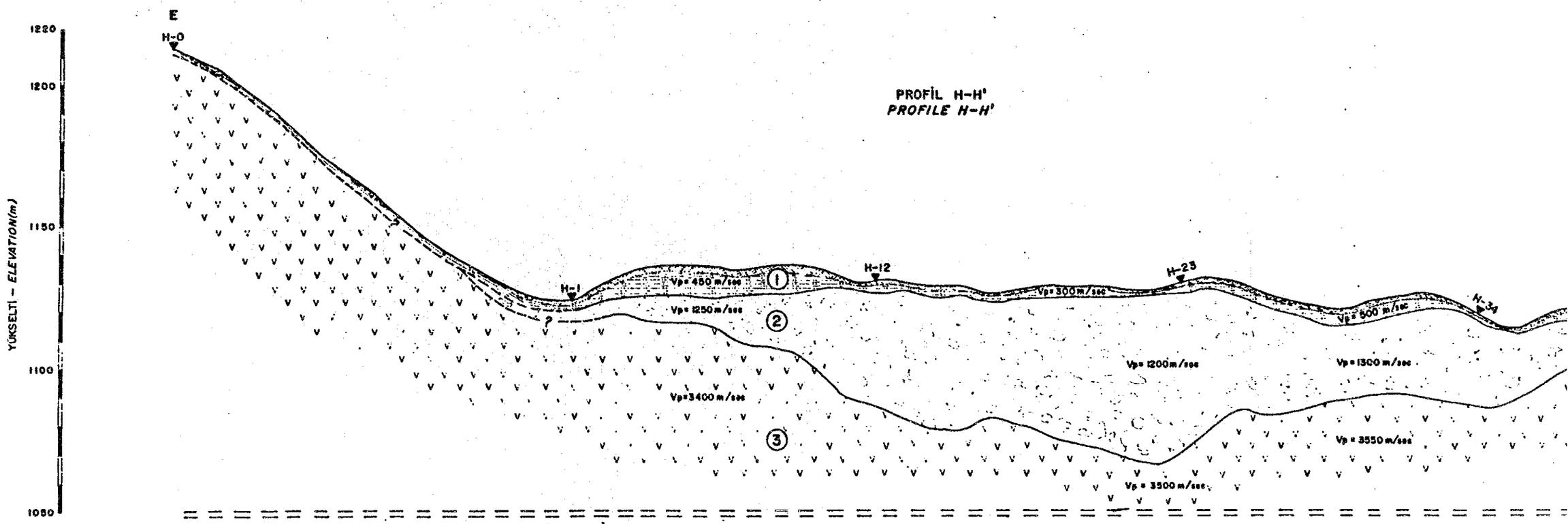
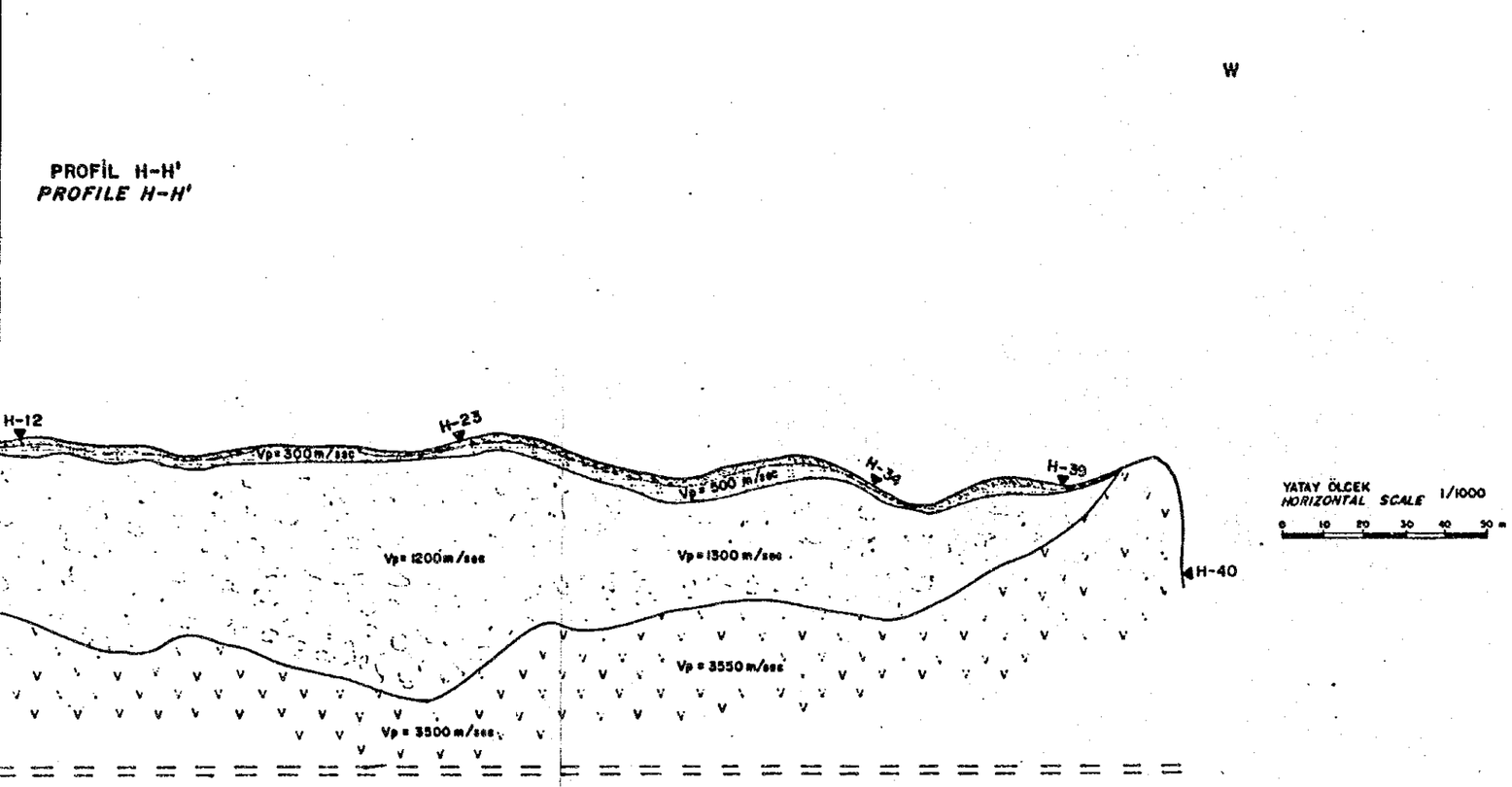

PROFIL H-H'
PROFILE H-H'
E
H-0
H-1
H-12
H-23
H-34
YÜKSELTİ – ELEVATION(m)
1220
1200
1150
1100
1050
Vp=450 m/sec
Vp=1250 m/sec
Vp=3400 m/sec
Vp=300 m/sec
Vp=1200 m/sec
Vp=3500 m/sec
Vp=500 m/sec
Vp=1300 m/sec
Vp=3550 m/sec
1
2
3

PROFİL H-H'
*PROFILE H-H'*




YATAY ÖLÇEK
*HORIZONTAL SCALE* 1/1000

0 10 20 30 40 50 m

## AÇIKLAMA—*EXPLANATION*

H-23 — SİSMİK ATIŞ NOKTASI
*SHOT POINT*

Vp=1200 m/sec — BOYUNA DALGA HIZI
*LONGITUDINAL WAVE VELOCITY*

OLASI TABAKA SINIRI
*PROBABLE CONTACT*

① HEYELAN MALZEMESİ
*LANDSLIDE MATERIAL*

② HEYELAN MALZEMESİ
*LANDSLIDE MATERIAL*

③ TABANKAYA (AYVALI VOLKANİTLERİ)
*BEDROCK (AYVALI VOLCANICS)*

OLASI ENERJİ TÜNELİ
*PROBABLE ENERGY TUNNEL*

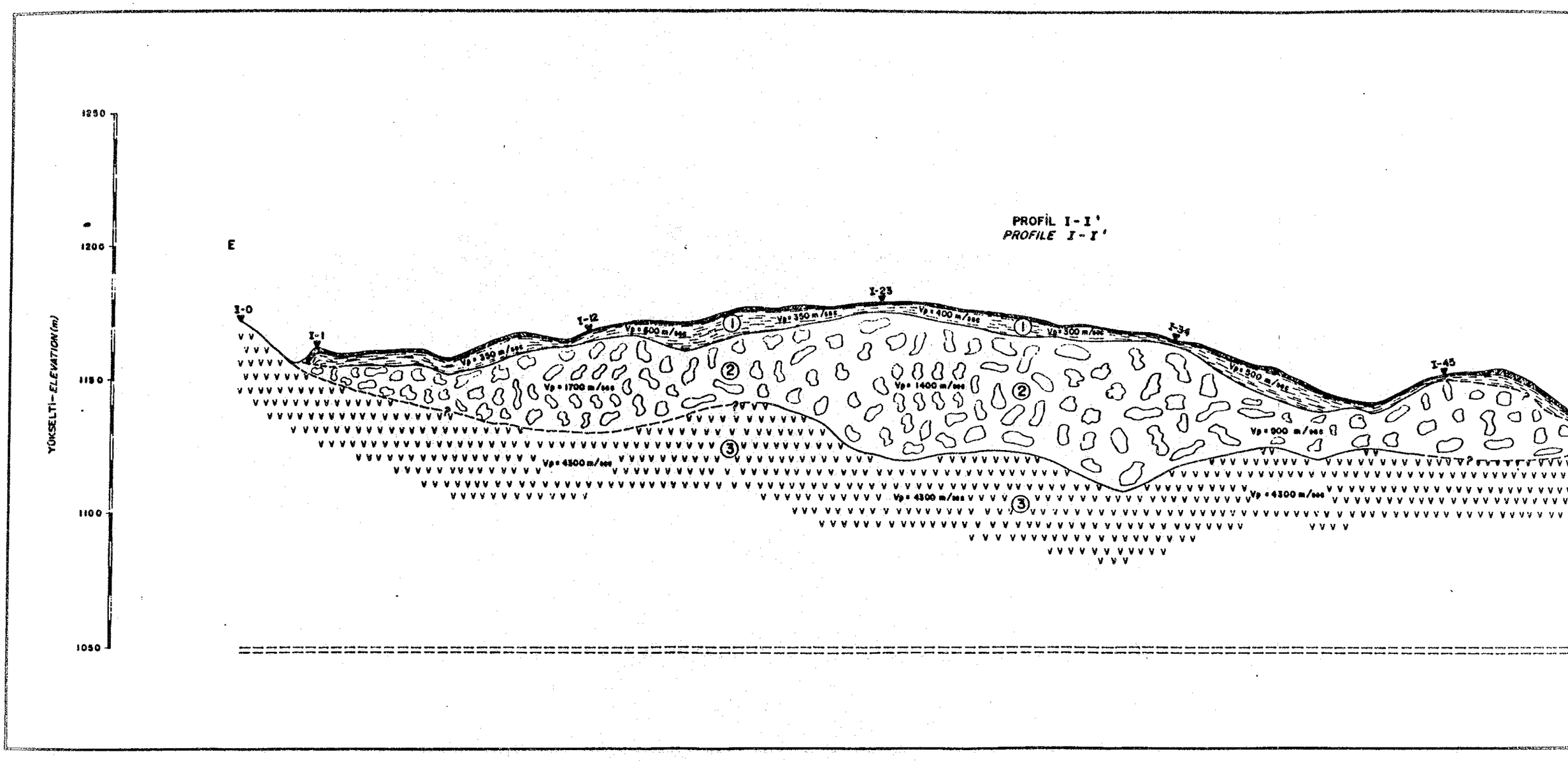
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

ÇORUH-OLTU KOLU OLUR BARAJ VE HES PROJESİ
BAHÇECİK HEYELANI JEOFİZİK KESİTİ
*GEOPHYSICAL SECTION OF BAHÇECİK LANDSLIDE*

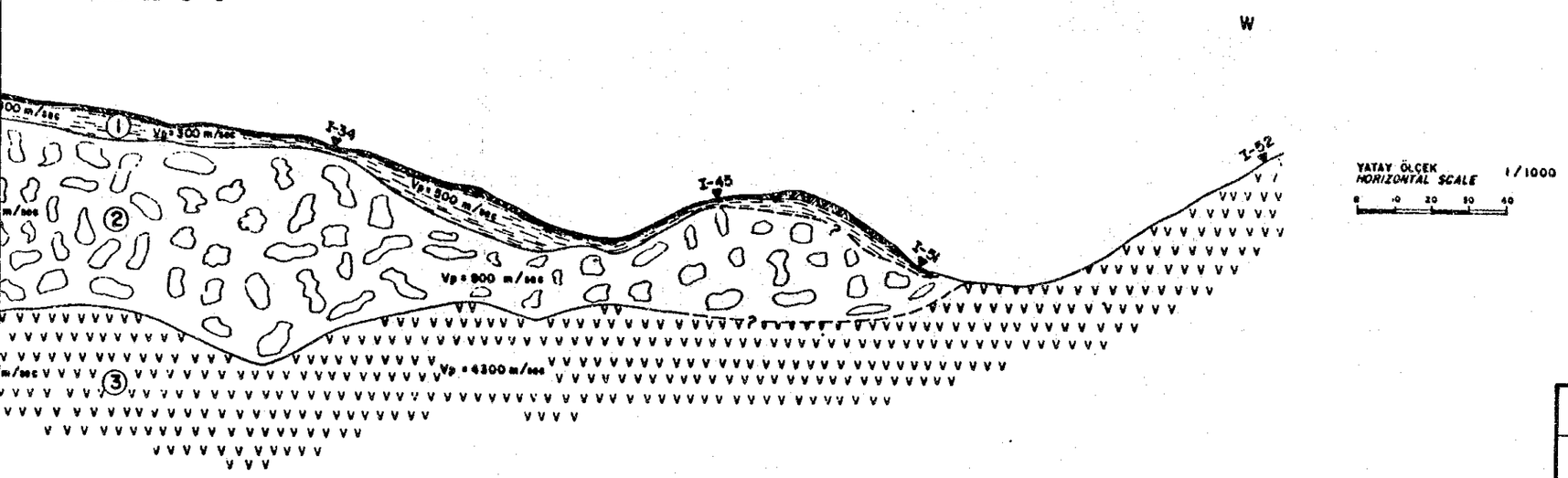
| | |
|---|---|
| YAPAN *DESIGNED BY* : N. SARAÇ Ö.TEKELİ | DAİRE BAŞKANI *HEAD OF DEPART.* |
| ÇİZEN *DRAWN BY* : Sibel GÖÇER | |
| KONTROL *CHECKED* : | GENEL MÜDÜR *GENERAL DIRECTOR* |
| ŞUBE MÜ. *CHIEF OF DIVISION* : | |

| | | | | |
|---|---|---|---|---|
| No. *No* | ÖLÇEK *SCALE* | | | Ek *App* 2 |
| Tarih *Date* 27.8.1991 | 1/1000 | | | |

AP-3-152


PROFİL I-I'
PROFILE I-I'
E
YÜKSELTİ-ELEVATION (m)
1250
1200
1150
1100
1050
I-0
I-1
I-12
I-23
I-34
I-45
Vp = 350 m/sec
Vp = 500 m/sec
Vp = 400 m/sec
Vp = 1700 m/sec
Vp = 1400 m/sec
Vp = 4300 m/sec
Vp = 900 m/sec

PROFİL I-I'
*PROFILE I-I'*




## AÇIKLAMA – *EXPLANATION*

| | |
|---|---|
| I-34 | SİSMİK ATIŞ NOKTASI<br>*SHOT POINT* |
| Vp = 1400 m/sec | BOYUNA DALGA HIZI<br>*LONGITUDINAL WAVE VELOCITY* |
| | OLASI TABAKA SINIRI<br>*PROBABLE CONTACT* |
| 1 | HEYELAN MALZEMESİ<br>*LANSLIDE MATERIAL* |
| 2 | HEYELAN MALZEMESİ<br>*LANDSLIDE MATERIAL* |
| 3 | TABANKAYA (AYVALI VOLKANİTLERİ)<br>*BEDROCK (AYVALI VOLCANICS)* |
| ===== | OLASI ENERJİ TÜNELİ<br>*PROBABLE ENERGY TUNNEL* |

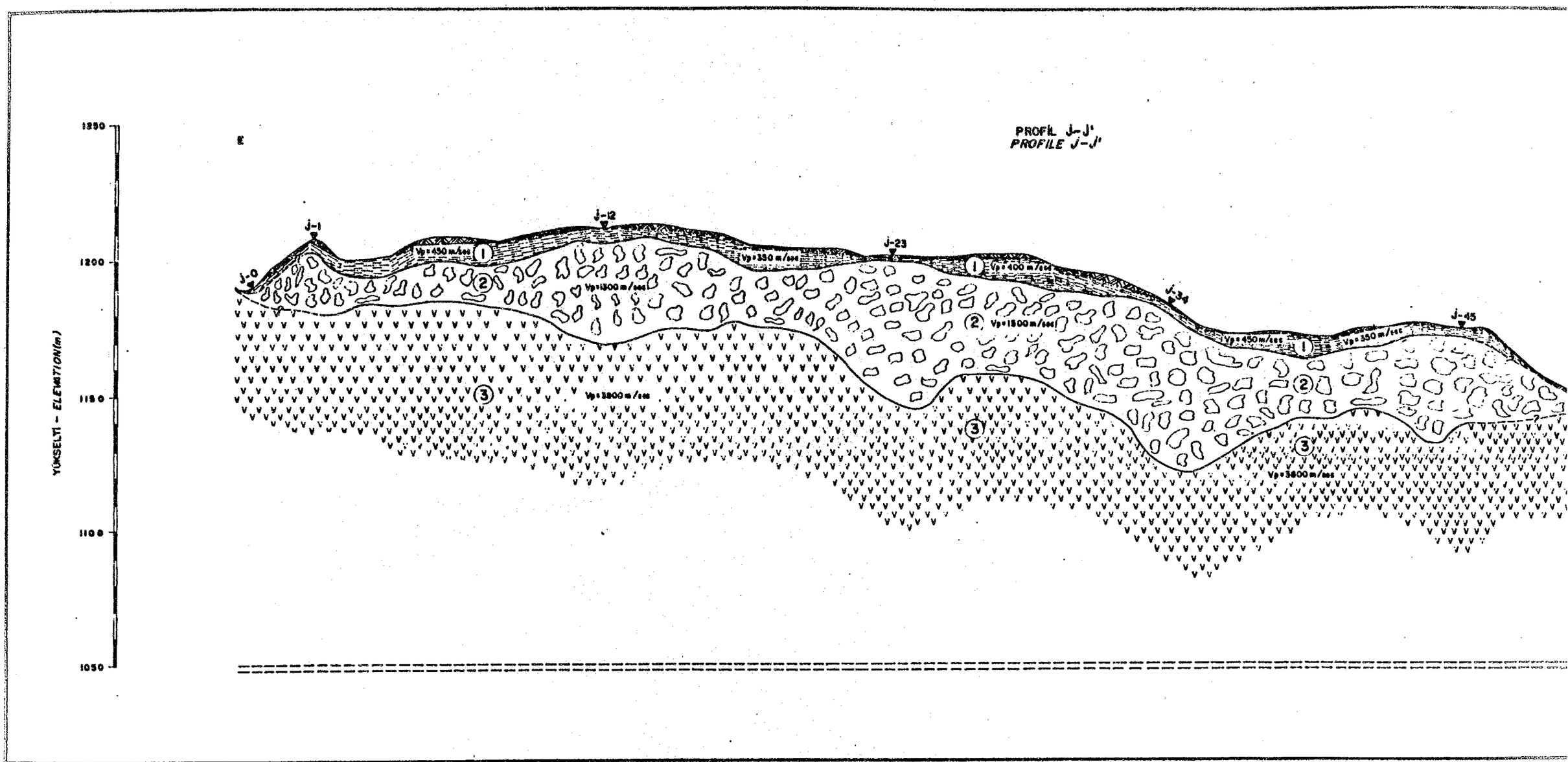
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

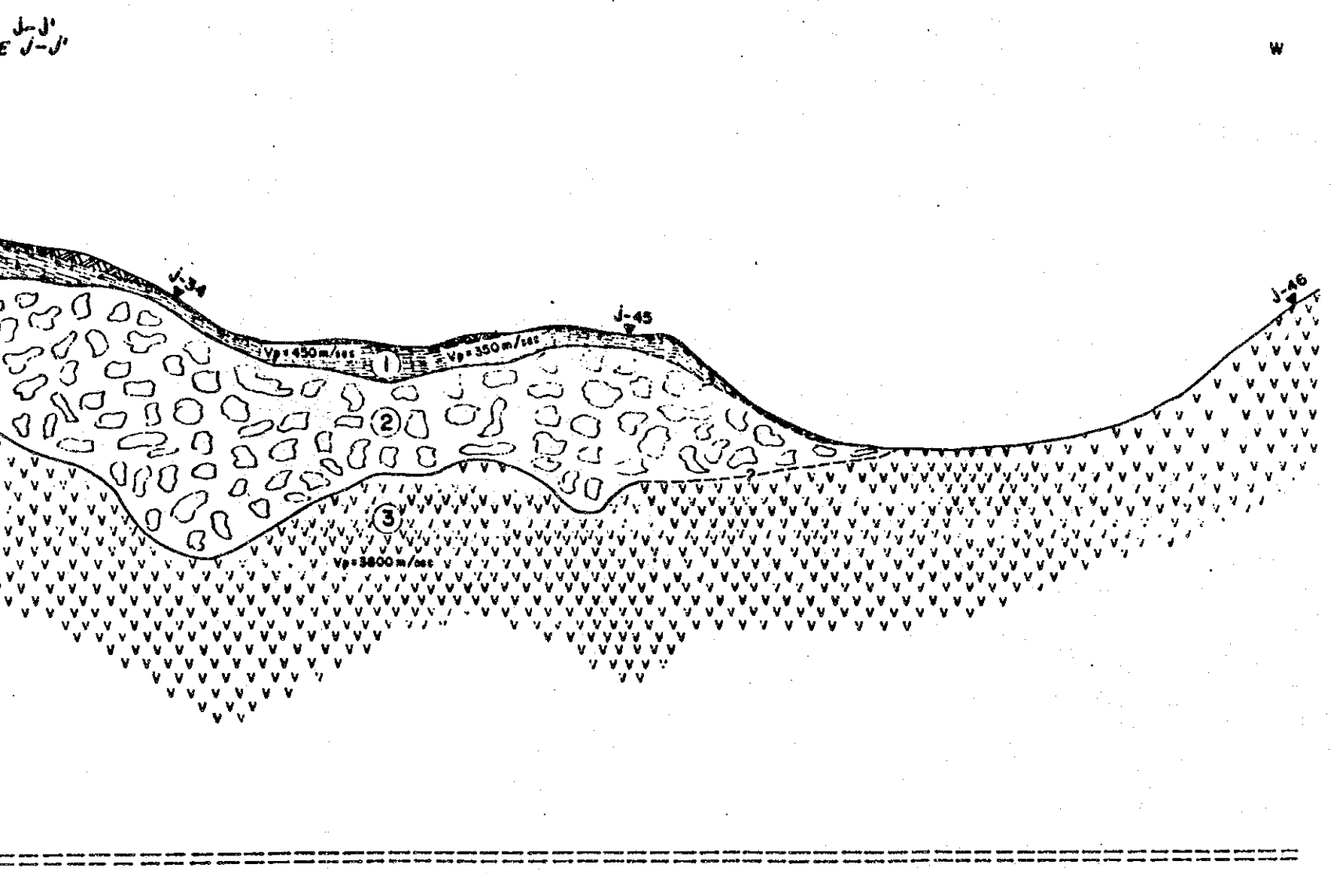
ÇORUH-OLTU KOLU OLUR BARAJ ve HES PROJESİ
BAHÇECİK HEYELANI JEOFİZİK KESİTİ
*GEOPHYSICAL SECTION OF BAHÇECİK LANDSLIDE*

| | |
|---|---|
| YAPAN / *DESIGNED BY* : N. SARAÇ H. GÖRMÜŞ | DAİRE BAŞKANI / *HEAD OF DEPART.* |
| ÇİZEN / *DRAWN BY* : Sibel GÖÇER | |
| KONTROL / *CHECKED* : | GENEL MÜDÜR / *GENERAL DIRECTOR* |
| ŞUBE MÜ / *CHIEF OF DIVISION* | |

| | | | | |
|---|---|---|---|---|
| No. / *No.* | ÖLÇEK / *SCALE* | | | Ek / *App.* : 3 |
| Tarih / *Date* 26.6.1992 | 1/1000 | | | |

AP-3-153


PROFIL J–J'
PROFILE J–J'
E
YÜKSELTİ – ELEVATION (m)
1250
1200
1150
1100
1050
J-0
J-1
J-12
J-23
J-34
J-45
Vp=450 m/sec
Vp=350 m/sec
Vp=400 m/sec
Vp=1500 m/sec
Vp=3800 m/sec
1
2
3




YATAY ÖLÇEK
*HORIZONTAL SCALE* 1 / 1000

0 10 20 30 40

## AÇIKLAMA—*EXPLANATION*

J-23 — SİSMİK ATIŞ NOKTASI
*SHOT POINT*

Vp=3800 m/sec — BOYUNA DALGA HIZI
*LONGITUDINAL WAVE VELOCITY*

OLASI TABAKA SINIRI
*PROBABLE CONTACT*

1 — HEYELAN MALZEMESİ
*LANSLIDE MATERIAL*

2 — HEYELAN MALZEMESİ
*LANDSLIDE MATERIAL*

3 — TABANKAYA (AYVALI VOLKANİTLERİ)
*BEDROCK (AYVALI VOLCANICS)*

OLASI ENERJİ TÜNELİ
*PROBABLE ENERGY TUNNEL*

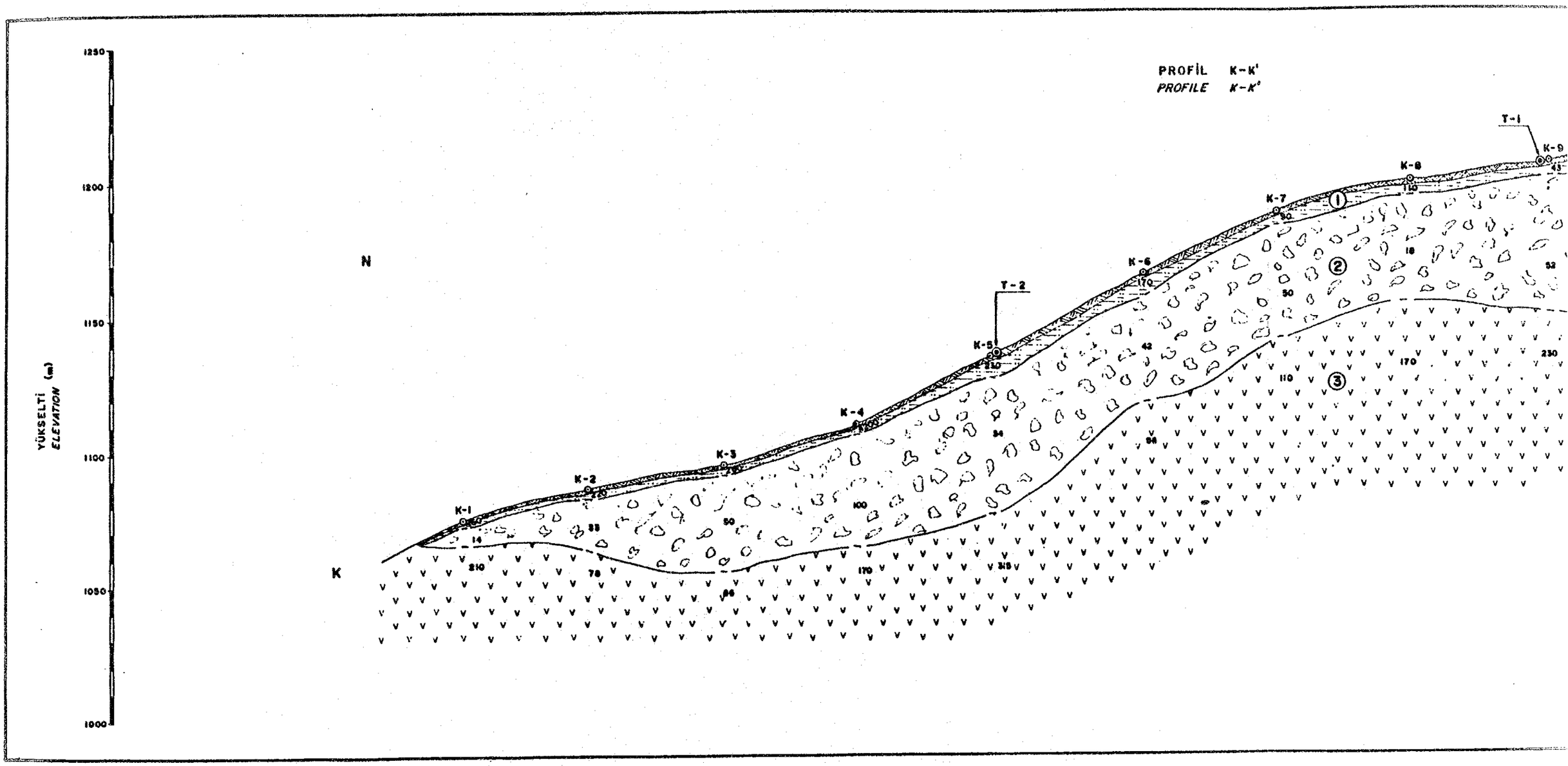
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

ÇORUH-OLTU KOLU OLUR BARAJ ve HES PROJESİ
BAHÇECİK HEYELANI JEOFİZİK KESİTİ
*GEOPHYSICAL SECTION OF BAHÇECİK LANDSLIDE*

| | |
|---|---|
| YAPAN *DESIGNED BY* : N. BARAÇ H.GÖRMUŞ | DAİRE BAŞKANI *HEAD OF DEPART.* |
| ÇİZEN *DRAWN BY* : Sibel GÖÇER | |
| KONTROL *CHECKED* : | GENEL MÜDÜR *GENERAL DIRECTOR* |
| ŞUBE MD *CHEF OF DIVISION* : | |

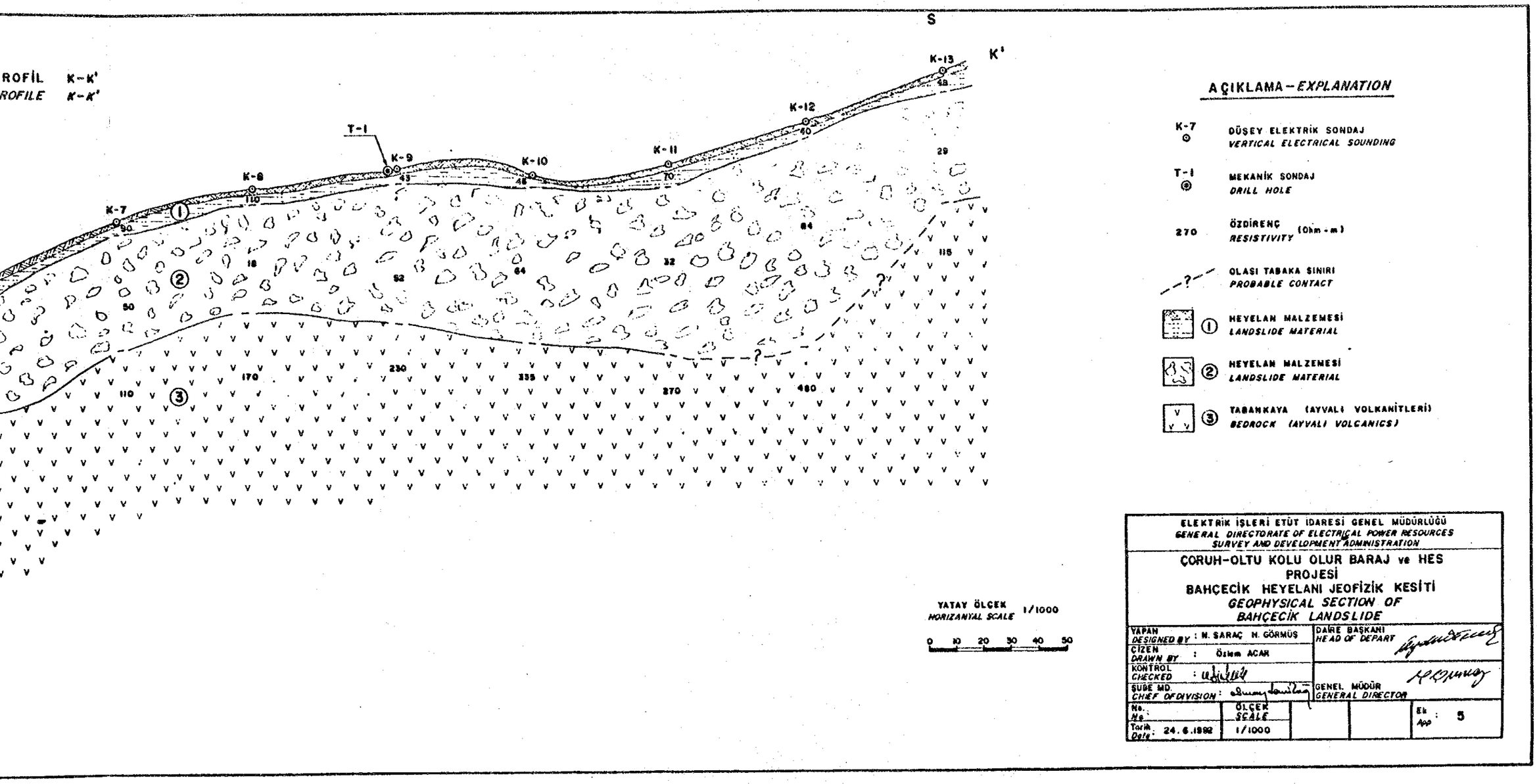
| | | | | |
|---|---|---|---|---|
| No. : *No* | ÖLÇEK *SCALE* | | | Ek *App* 4 |
| Tarih: *Date* 24.6.1992 | 1/ 1000 | | | |

AP-3-154


PROFİL K-K'
PROFILE K-K'
YÜKSELTİ
ELEVATION (m)
1250
1200
1150
1100
1050
1000
N
K
K-1
K-2
K-3
K-4
K-5
K-6
K-7
K-8
K-9
T-1
T-2
1
2
3

アポンディクス.

ROFİL K-K'
ROFILE K-K'

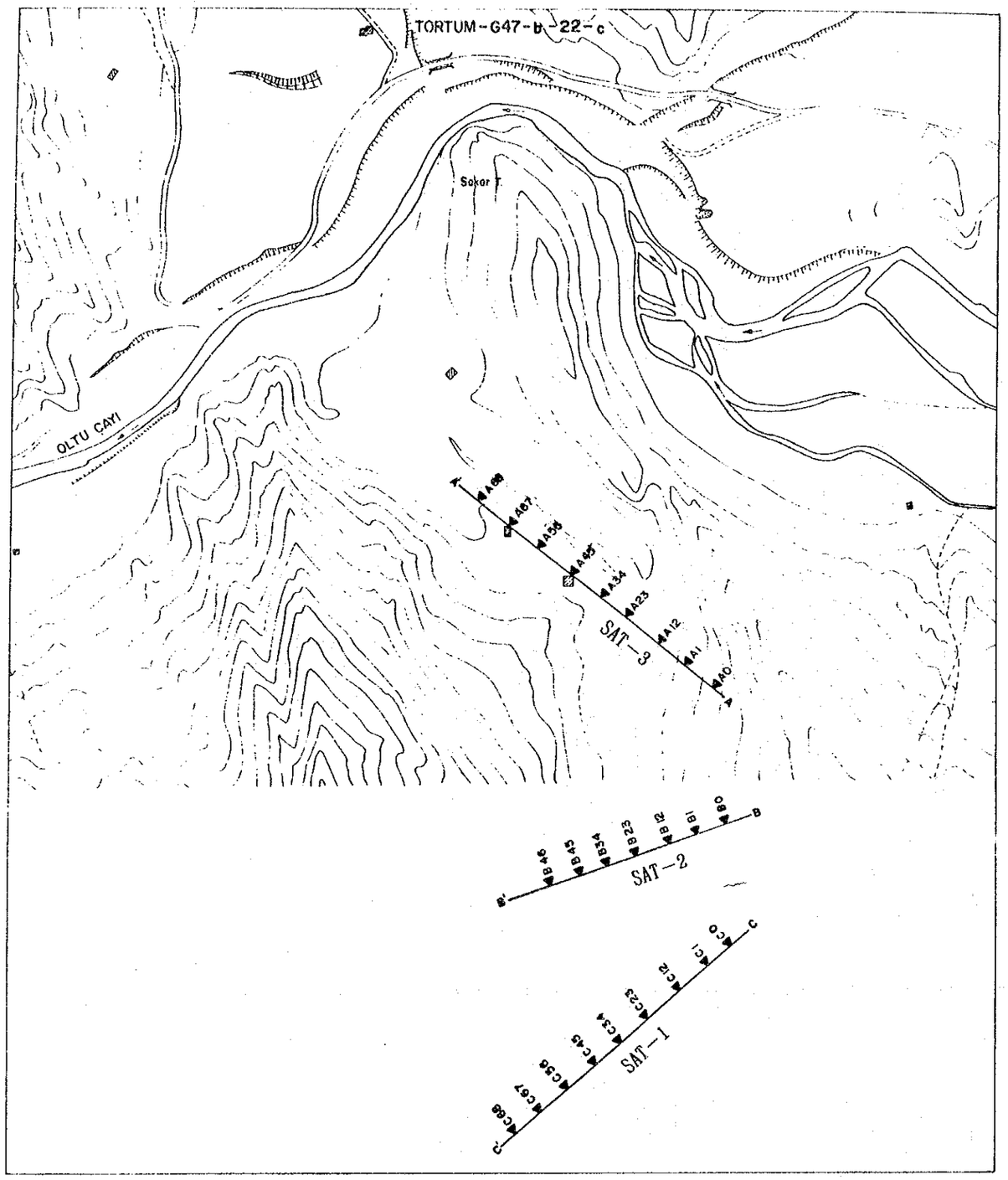



ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION

ÇORUH-OLTU KOLU OLUR BARAJ ve HES PROJESİ
BAHÇECİK HEYELANI JEOFİZİK KESİTİ
GEOPHYSICAL SECTION OF BAHÇECİK LANDSLIDE

| | | |
|---|---|---|
| YAPAN / DESIGNED BY : H. SARAÇ H. GÖRMÜŞ | | DAİRE BAŞKANI / HEAD OF DEPART |
| ÇİZEN / DRAWN BY : Özlem ACAR | | |
| KONTROL / CHECKED : | | |
| ŞUBE MD. / CHIEF OF DIVISION : | | GENEL MÜDÜR / GENERAL DIRECTOR |
| No. / No : | ÖLÇEK / SCALE | Ek / App : 5 |
| Tarih / Date : 24.6.1992 | 1/1000 | |

AP-3-155




N

## AÇIKLAMA – *EXPLANATION*

A——A' SİSMİK PROFİL
*SEISMIC PROFILE*

A12 SİSMİK ATIŞ NOKTASI
*SHOT POINT*

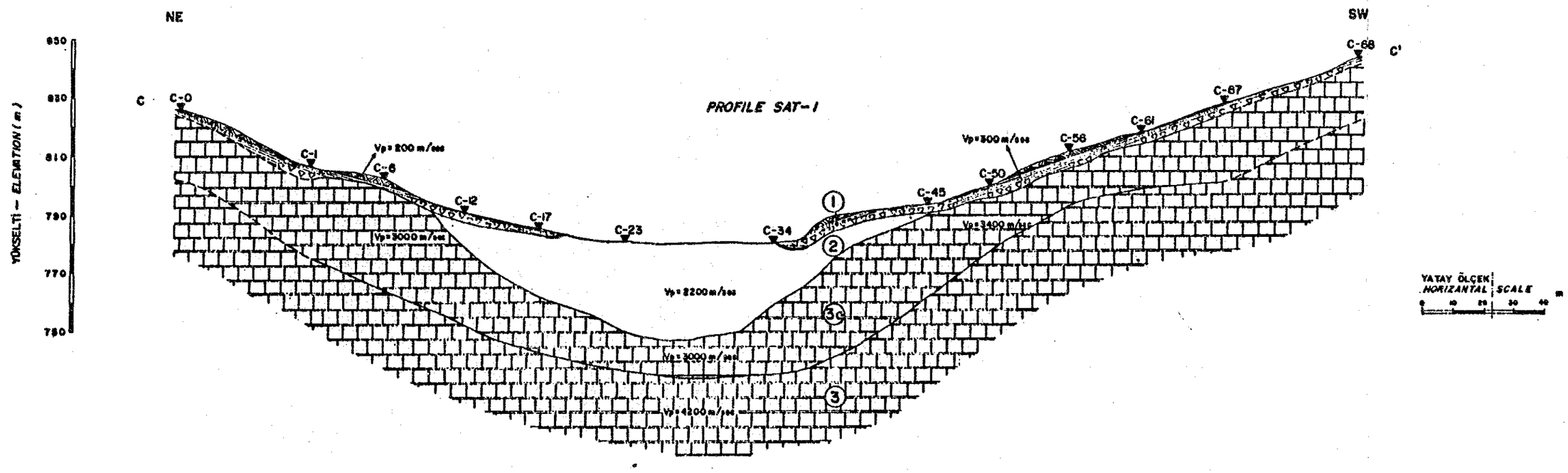
NOT = TORTUM-G47-c-02-b numaralı 1/5000 ölçekli harita EIE arşivlerinde olmadığı için BB' ve CC' sismik profilleri harita üzerine çizilememiştir.

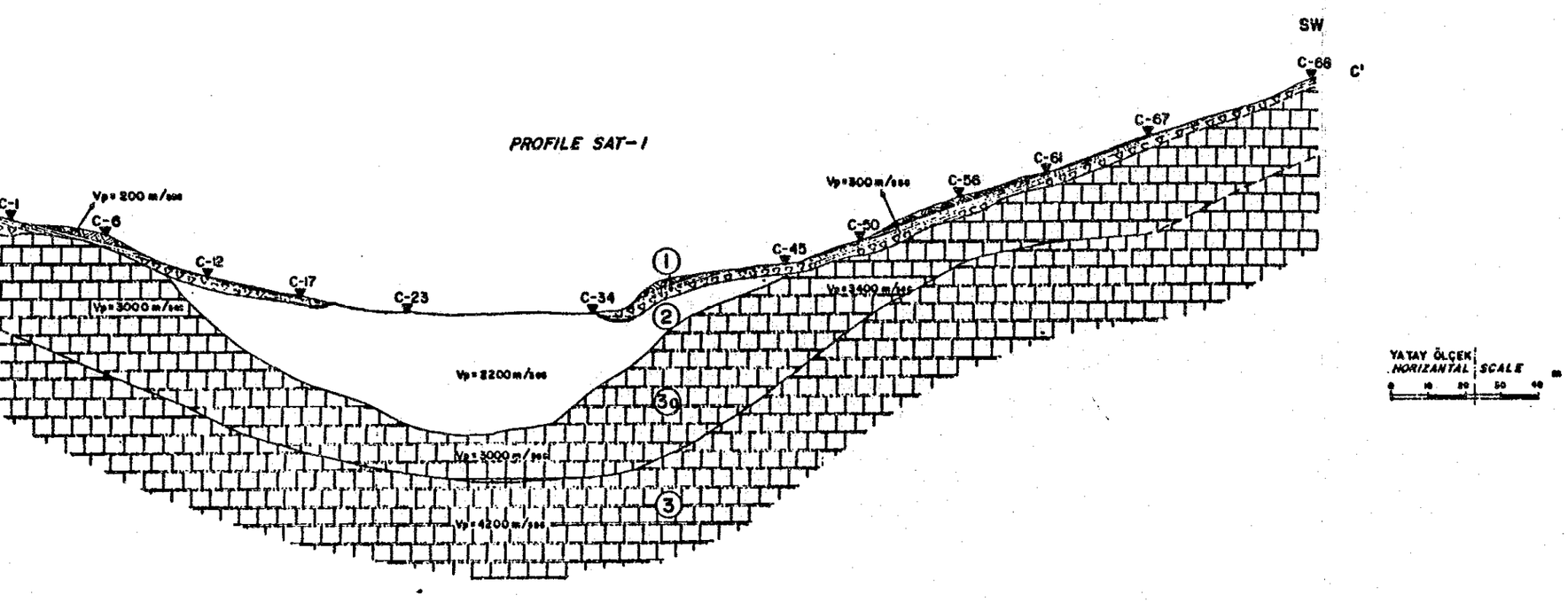
*NOTE = TORTUM-G47-c-02-b (scale 1/5000) is not available at EIE therefore BB' and CC' profiles could not be placed on the map.*

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

ÇORUH-OLTU KOLU AYVALI BARAJ VE HES PROJESİ
TÜNEL GÜZERGAHI
JEOFİZİK ÇALIŞMA LOKASYON HARİTASI
*OLTU-AYVALI HPP PROJECT GEOPHYSICAL SURVEY LOCATION MAP FOR TUNNEL ROUTE*

| | | |
|---|---|---|
| YAPAN *DESIGNED BY* : N.SARAÇ Ö.TEKELİ S.ERTAN | | DAIRE BAŞKANI *HEAD OF DEPART.* |
| ÇİZEN *DRAWN BY* : Sibel GÖÇER | | |
| KONTROL *CHECKED* : | | GENEL MÜDÜR *GENERAL DIRECTOR* |
| ŞUBE MD. *CHIEF OF DIVISION* : | | |
| No. : *No* | ÖLÇEK *SCALE* | Ek *App* : 1 |
| Tarih : 19.9.1991 *Date* | 1/5000 | |


NE
SW
C
C'
PROFILE SAT-1
YÜKSELTİ - ELEVATION (m)
850
830
810
790
770
750
C-0
C-1
C-6
C-12
C-17
C-23
C-34
C-45
C-50
C-56
C-61
C-67
C-68
Vp = 200 m/sec
Vp = 300 m/sec
Vp = 3000 m/sec
Vp = 2200 m/sec
Vp = 3400 m/sec
Vp = 3000 m/sec
Vp = 4200 m/sec
1
2
3c
3
YATAY ÖLÇEK
HORIZANTAL SCALE
0
10
20
30
40
m




## AÇIKLAMA – EXPLANATION

| | |
|---|---|
| C-1 | SİSMİK ATIŞ NOKTASI<br>*SHOT POINT* |
| Vp=2200 m/sec | BOYUNA DALGA HIZI<br>*LONGITUDINAL WAVE VELOCITY* |
| | OLASI TABAKA SINIRI<br>*PROBABLE CONTACT* |
| 1 | BİTKİSEL TOPRAK + ALÜVYON<br>*AGRICULTURAL SOIL + ALLUVIUM* |
| 2 | ALÜVYON<br>*ALLUVIUM* |
| 3a | TABANKAYA (Püşey Formasyonu)<br>*BEDROCK (Puşey Formation)* |
| 3 | TABANKAYA (Püşey Formasyonu)<br>*BEDROCK (Puşey Formation)* |

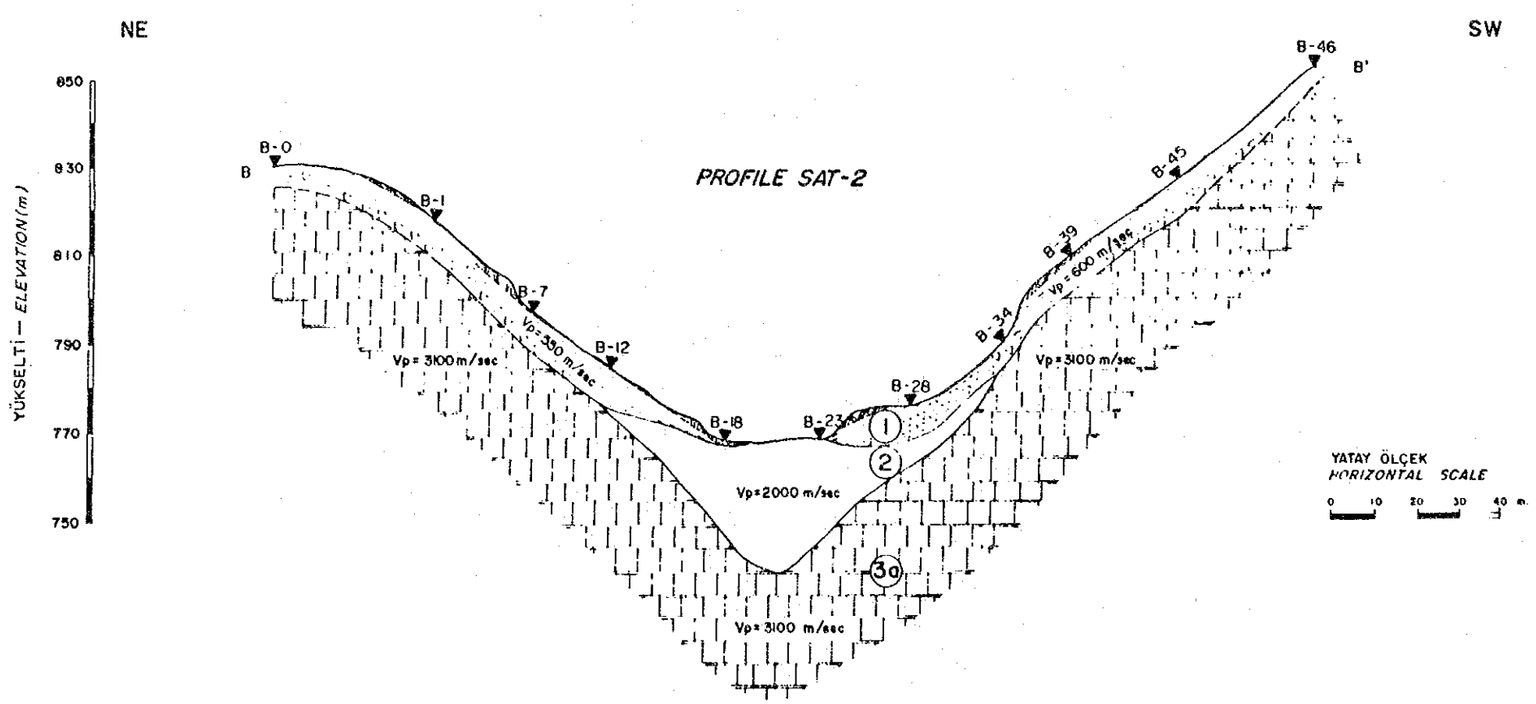
YATAY ÖLÇEK
*HORIZANTAL SCALE*
0 10 20 30 40 m

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

ÇORUH–OLTU KOLU AYVALI BARAJ VE HES PROJESİ
TÜNEL GÜZERGAHI JEOFİZİK KESİTİ
*ÇORUH–OLTU–AYVALI HPP PROJECT*
*GEOPHYSICAL SECTIONS AT TUNNEL ROUTE*

| | |
|---|---|
| YAPAN *DESIGNED BY* : N. SARAÇ Ö. TEKELİ S. ERTAN | DAİRE BAŞKANI *HEAD OF DEPART.* |
| ÇİZEN *DRAWN BY* : Sibel GÖÇER | |
| KONTROL *CHECKED BY* : | GENEL MÜDÜR V. *GENERAL DIRECTOR* |
| ŞUBE MÜ. *CHI OF DIVIS* : | |
| No. *No.* : | ÖLÇEK *SCALE* : 1/1000 |
| Tarih *Date* : 4.9.1991 | Ek *App* : 4 |

AP-3-157




## AÇIKLAMA – *EXPLANATION*

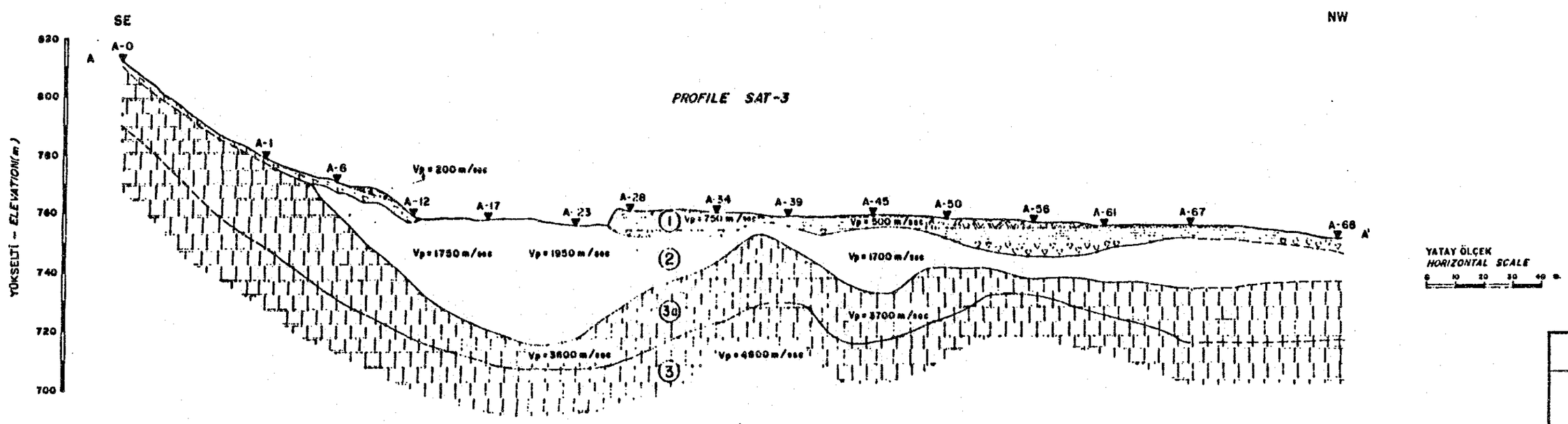
| | |
|---|---|
| B-12 ▼ | SİSMİK ATIŞ NOKTASI<br>*SHOT POINT* |
| Vp= 2000 m/sec | BOYUNA DALGA HIZI<br>*LONGITUDINAL WAVE VELOCITY* |
| | OLASI TABAKA SINIRI<br>*PROBABLE CONTACT* |
| 1 | BİTKİSEL TOPRAK + ALÜVYON<br>*AGRICULTURAL SOIL + ALLUVIUM* |
| 2 | ALÜVYON<br>*ALLUVIUM* |
| 3a | TABANKAYA (Püğey Formasyonu)<br>*BEDROCK (Pugey Formation)* |

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

ÇORUH–OLTU KOLU AYVALI BARAJ VE HES PROJESİ
TÜNEL GÜZERGAHI JEOFİZİK KESİTİ
*ÇORUH–OLTU–AYVALI HES PROJECT*
*GEOPHYSICAL SECTIONS AT TUNNEL ROUTE*

| | | |
|---|---|---|
| YAPAN *DESIGNED BY* N. SARAÇ Ö. TEKELİ S. ERTAN | | DAİRE BAŞKANI *HEAD OF DEPART.* |
| ÇİZEN *DRAWN BY* Sibel GÖÇER | | |
| KONTROL *CHECKED* | | |
| ŞUBE MD. *CHIEF OF DIVISION* | | GENEL MÜDÜR *GENERAL DIRECTOR* |
| No. *No* | ÖLÇEK *SCALE* | Ek *App* 3 |
| Tarih. *Date* 26.8.1991 | 1/1000 | |

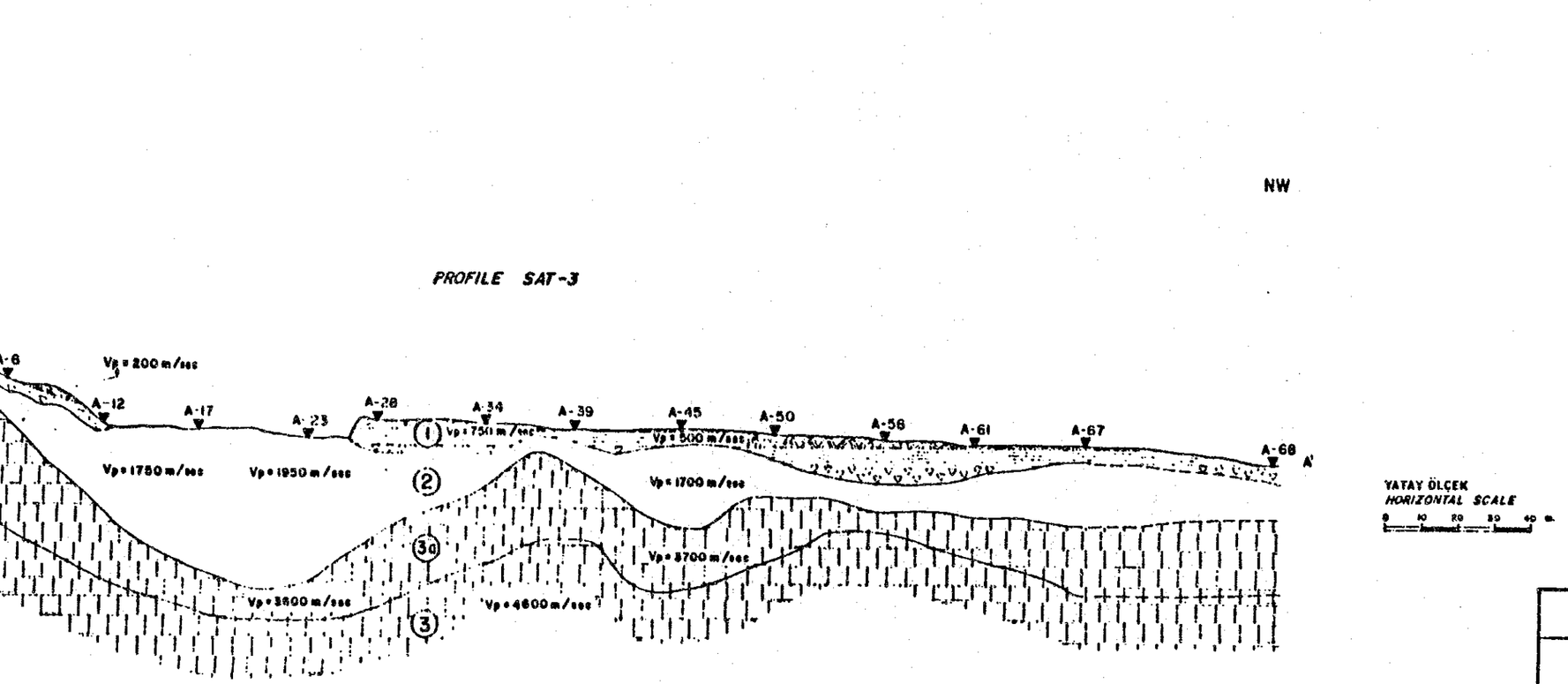
AP-3-158




ÇOR

GEO

YAPAN DESIGNED BY :
ÇİZEN DRAWN BY :
KONTROL CHECKED BY :
ŞUBE NO CHK OF DIVIS :
No :
No :
Tarih Date : 83. 8. 19




YATAY ÖLÇEK
*HORIZONTAL SCALE*

0 10 20 30 40 m

## AÇIKLAMA – *EXPLANATION*

A-6 — SİSMİK ATIŞ NOKTASI / *SHOT POINT*

Vp=4600 m/sec — BOYUNA DALGA HIZI / *LONGITUDINAL WAVE VELOCITY*

OLASI TABAKA SINIRI / *PROBABLE CONTACT*

1 — BİTKİSEL TOPRAK + ALÜVYON / *AGRICULTURAL SOIL + ALLUVIUM*

2 — ALÜVYON / *ALLUVIUM*

3a — TABANKAYA (Pügey Formasyonu) / *BEDROCK (Pugey Formation)*

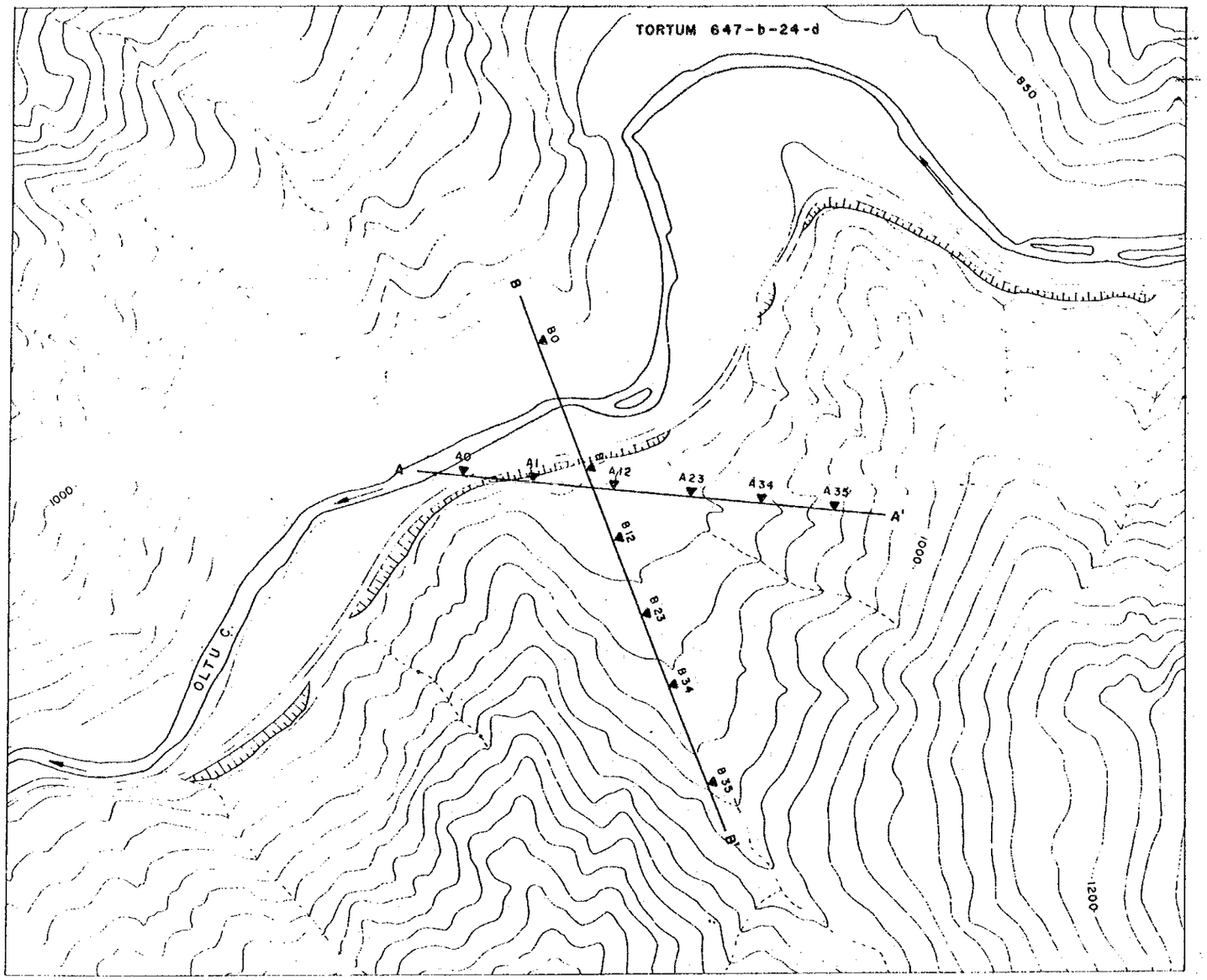
3 — TABANKAYA (Pügey Formasyonu) / *BEDROCK (Pugey Formation)*

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

ÇORUH–OLTU KOLU AYVALI BARAJ VE HES PROJESİ
TÜNEL GÜZERGAHI JEOFİZİK KESİTI
*ÇORUH–OLTU–AYVALI HES PROJECT*
*GEOPHYSICAL SECTIONS AT TUNNEL ROUTE*

| | |
|---|---|
| YAPAN / *DESIGNED BY* : H. SARAÇ Ö. TEKELİ B. ERTAN | DAİRE BAŞKANI / *HEAD OF DEPART.* |
| ÇİZEN / *DRAWN BY* : Sibel GÖÇER | |
| KONTROL / *CHECKED BY* : | |
| ŞUBE MÜ / *CHF. OF DIVIS* : | GENEL MÜDÜR Y. / *GENERAL DIRECTOR* |

| | | | | |
|---|---|---|---|---|
| No / *No* : | ÖLÇEK / *SCALE* | | | EK / *App* : 2 |
| Tarih / *Date* : 23.8.1991 | 1/1000 | | | |




N

## AÇIKLAMA — *EXPLANATION*

A ——— A' SİSMİK PROFİL
*SEISMIC PROFILE*

B1 ▼ SİSMİK ATIŞ NOKTASI
*SEISMIC SHOT POINT*

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

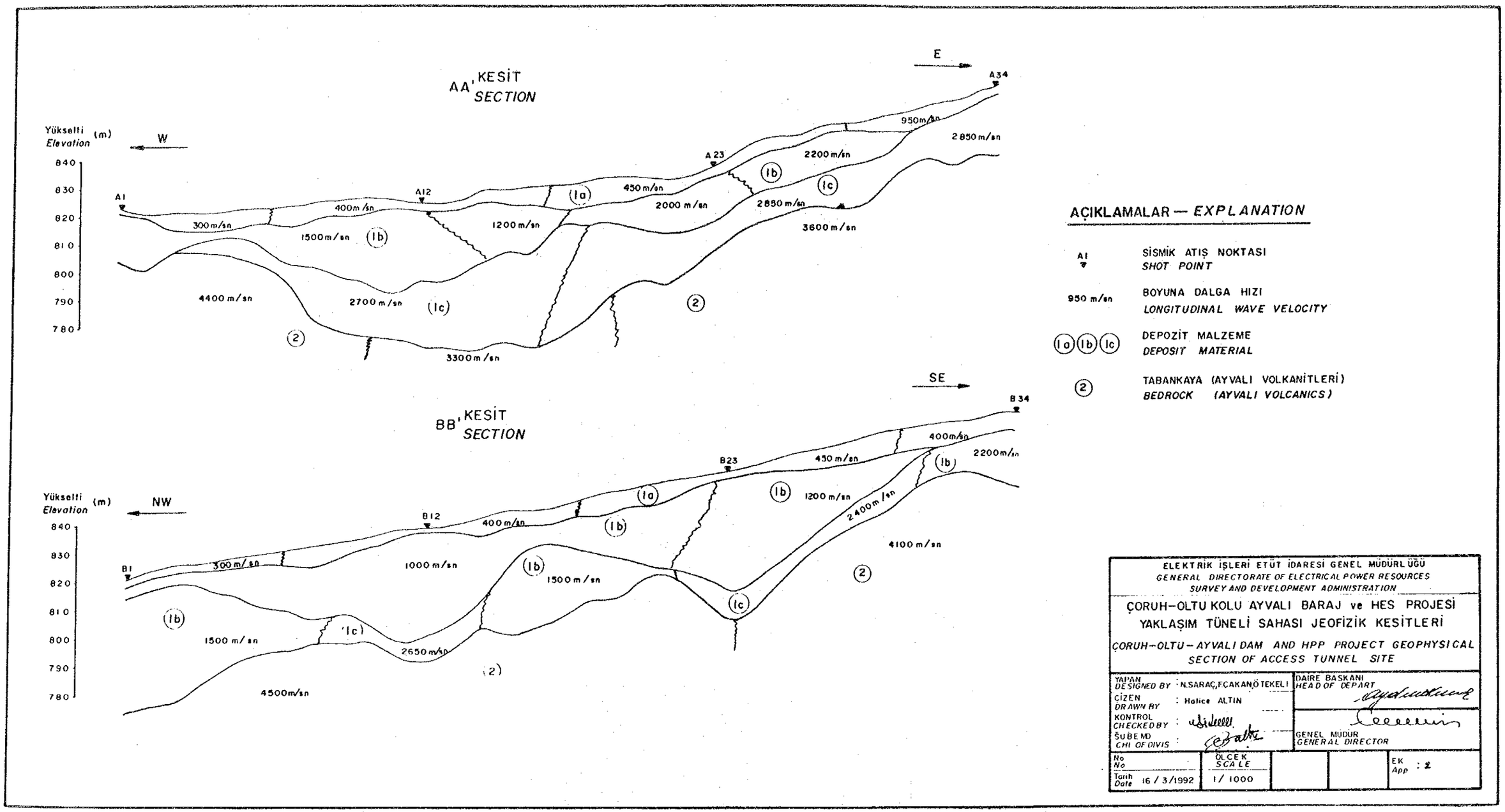
ÇORUH - OLTU KOLU AYVALI BARAJ VE HES PROJESİ
YAKLAŞIM TÜNELİ SAHASI JEOFİZİK ÇALIŞMA LOKASYON HARİTASI

*CORUH-OLTU-AYVALI DAM AND HPP PROJECT*
*GEOPHYSICAL SURVEY LOCATION MAP OF*
*ACCESS TUNNEL SITE*

| | | |
|---|---|---|
| YAPAN / *DESIGNED BY* | : N. SARAÇ, F. ÇAKAN Ö. TEKELİ | DAİRE BAŞKANI / *HEAD OF DEPART* |
| ÇİZEN / *DRAWN BY* | : Birsen DÜNDAR | |
| KONTROL / *CHECKED* | : | |
| ŞUBE MD. / *CHI OF DIVIS* | : | GENEL MÜDÜR / *GENERAL DIRECTOR* |

| | | | | |
|---|---|---|---|---|
| NO : | ÖLÇEK / *SCALE* | | | EK / *App* : 1 |
| Tarih / *Date* : 17/3/1992 | 1/5000 | | | |

AP-3-160



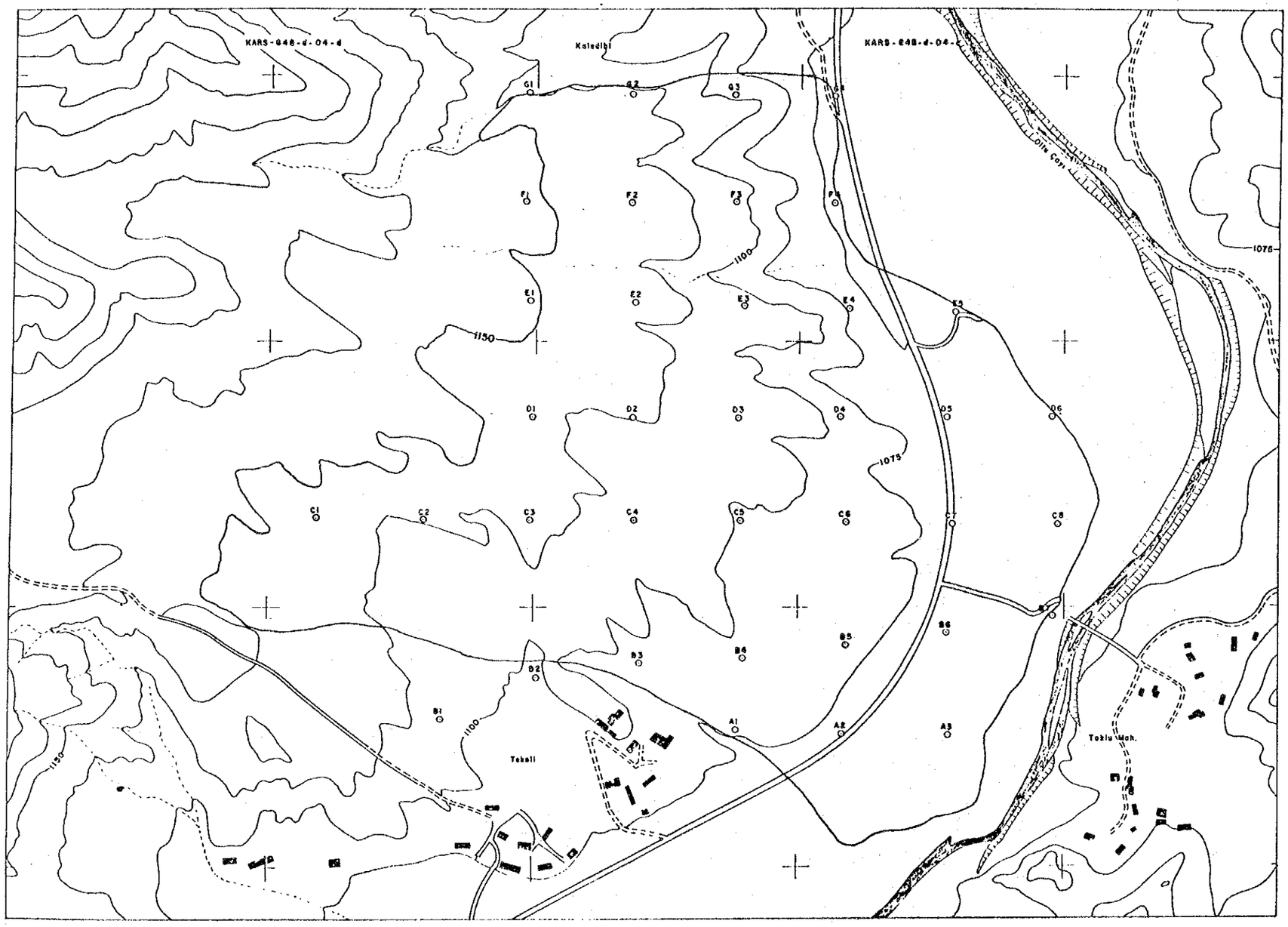

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION

ÇORUH-OLTU KOLU AYVALI BARAJ ve HES PROJESİ
YAKLAŞIM TÜNELİ SAHASI JEOFİZİK KESİTLERİ

ÇORUH-OLTU-AYVALI DAM AND HPP PROJECT GEOPHYSICAL SECTION OF ACCESS TUNNEL SITE

| | | |
|---|---|---|
| YAPAN / DESIGNED BY | N.SARAÇ, F.CAKAN, Ö.TEKELİ | DAİRE BAŞKANI / HEAD OF DEPART |
| ÇİZEN / DRAWN BY | Halice ALTIN | |
| KONTROL / CHECKED BY | | GENEL MÜDÜR / GENERAL DIRECTOR |
| ŞUBE MD / CHIEF DIVIS | | |
| No / No | ÖLÇEK / SCALE | EK / App : 2 |
| Tarih / Date 16 / 3 / 1992 | 1 / 1000 | |

AP-3-161




N

## AÇIKLAMA - *EXPLANATION*

A1 ⊙ DÜŞEY ELEKTRİK SONDAJ
*VERTICAL ELECTRICAL SOUNDING*

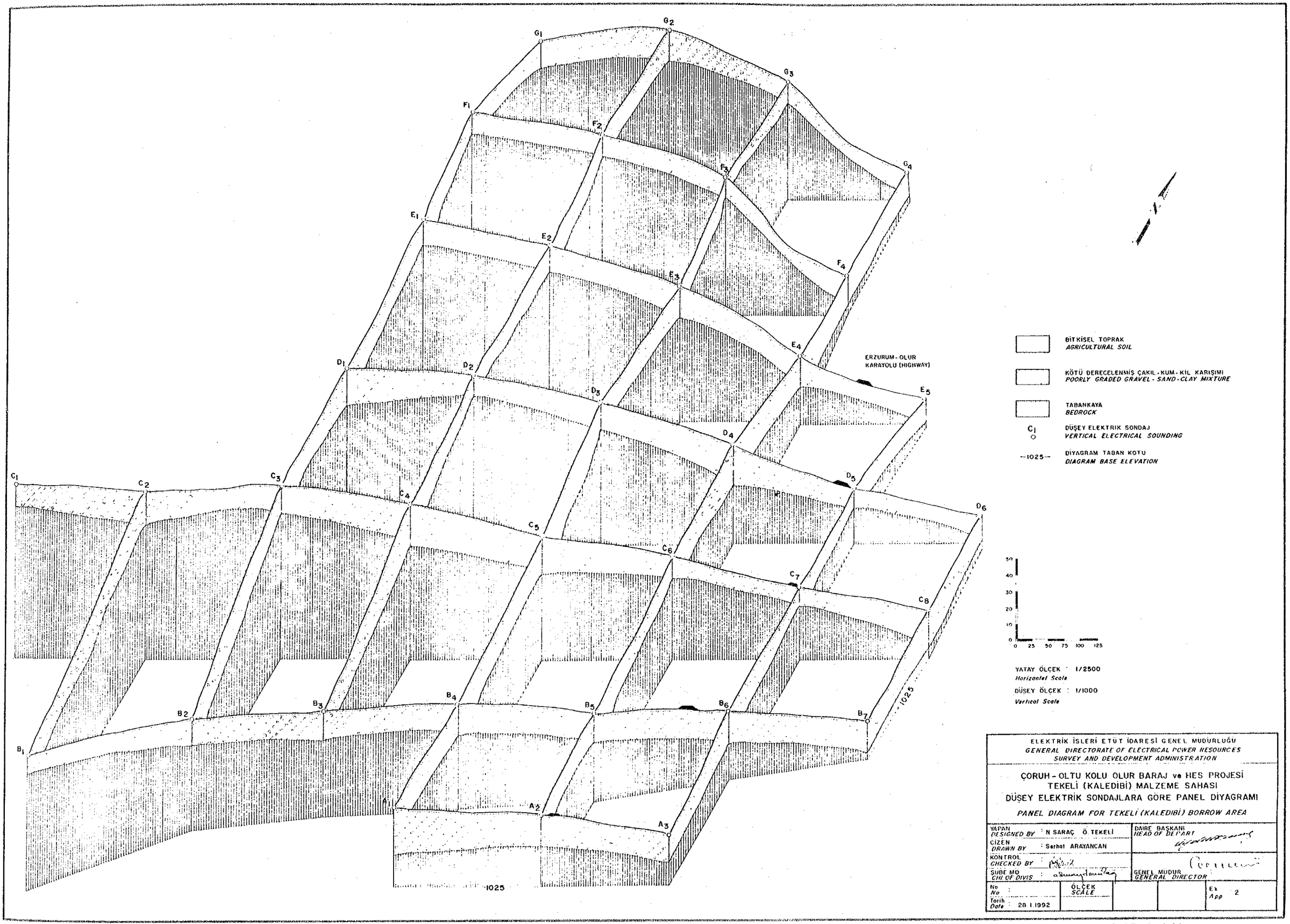
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

ÇORUH-OLTU KOLU OLUR BARAJ VE HES PROJESİ
TEKELİ (KALEDİBİ) MALZEME SAHASI
JEOFİZİK ÇALISMA LOKASYON HARİTASI
*OLTU-OLUR HPP PROJECT GEOPHYSICAL SURVEY*
*LOCATION MAP FOR TEKELİ (KALEDİBİ) BORROW AREA*

| | |
|---|---|
| YAPAN / *DESIGNED BY* : Necati SARAÇ, Onder TEKELİ | DAİRE BAŞKANI / *HEAD OF DEPART.* |
| ÇİZEN / *DRAWN BY* : Birsen DÜNDAR | |
| KONTROL / *CHECKED BY* | GENEL MÜDÜR / *GENERAL DIRECTOR* |
| ŞUBE MÜ. / *CHI OF DIVIS.* | |

| | | | | |
|---|---|---|---|---|
| No / *No* : | ÖLÇEK / *SCALE* | | | Ek / *App* : 1 |
| Tarih / *Date* : 28/1/1992 | 1/5000 | | | |

AP-3-162


G1
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C1
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C4
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C6
C7
C8
B1
B2
B3
B4
B5
B6
B7
A1
A2
A3
ERZURUM - OLUR
KARAYOLU (HIGHWAY)
1025
BİTKİSEL TOPRAK
AGRICULTURAL SOIL
KÖTÜ DERECELENMİŞ ÇAKIL - KUM - KIL KARIŞIMI
POORLY GRADED GRAVEL - SAND - CLAY MIXTURE
TABANKAYA
BEDROCK
DÜŞEY ELEKTRİK SONDAJ
VERTICAL ELECTRICAL SOUNDING
DİYAGRAM TABAN KOTU
DIAGRAM BASE ELEVATION
50
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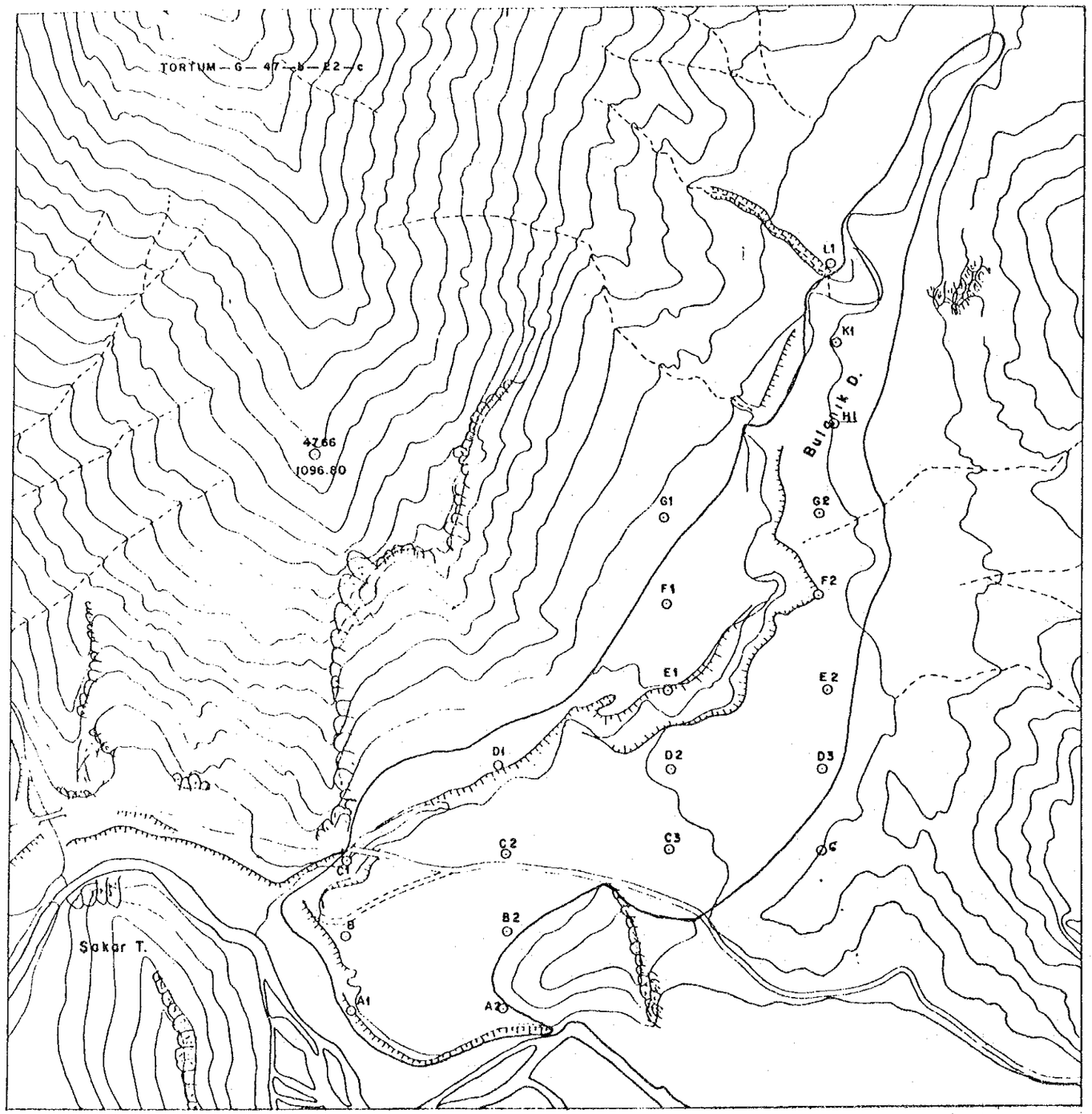
30
20
10
0
0 25 50 75 100 125
YATAY ÖLÇEK : 1/2500
Horizontal Scale
DÜŞEY ÖLÇEK : 1/1000
Vertical Scale
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES
SURVEY AND DEVELOPMENT ADMINISTRATION
ÇORUH - OLTU KOLU OLUR BARAJ ve HES PROJESİ
TEKELİ (KALEDİBİ) MALZEME SAHASI
DÜŞEY ELEKTRİK SONDAJLARA GÖRE PANEL DİYAGRAMI
PANEL DIAGRAM FOR TEKELİ (KALEDİBİ) BORROW AREA
YAPAN
DESIGNED BY : N SARAÇ Ö. TEKELİ
CİZEN
DRAWN BY : Serhat ARAYANCAN
KONTROL
CHECKED BY :
ŞUBE MD
CHI OF DIVIS :
DAİRE BAŞKANI
HEAD OF DEPART
GENEL MÜDÜR
GENERAL DIRECTOR
No :
No :
Tarih
Date : 28.1.1992
ÖLÇEK
SCALE
Ek
App 2




N

## AÇIKLAMA– *EXPLANATION*

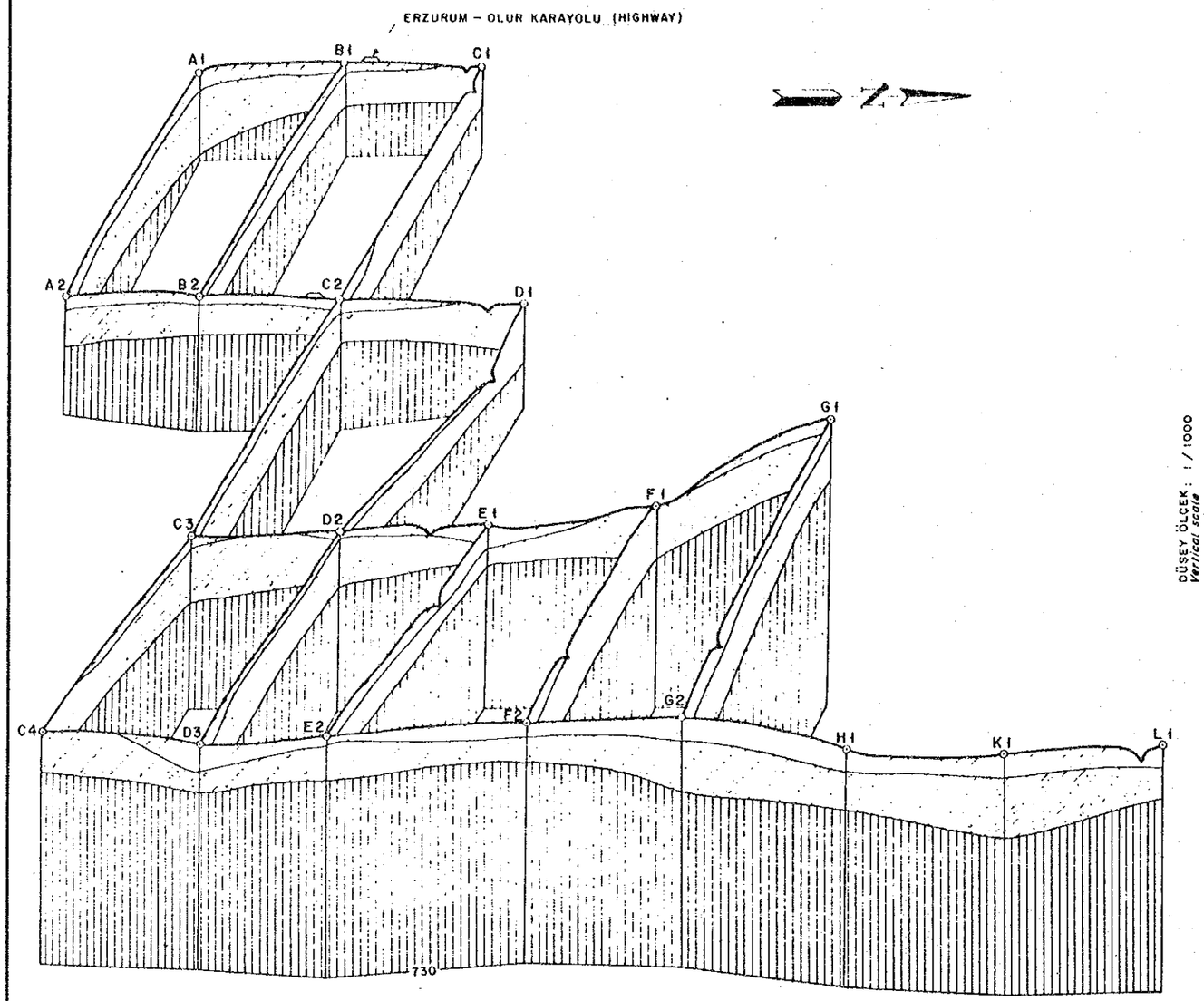
A1 ⊙ DÜŞEY ELEKTRİK SONDAJ
*VERTICAL ELECTRICAL SOUNDING*

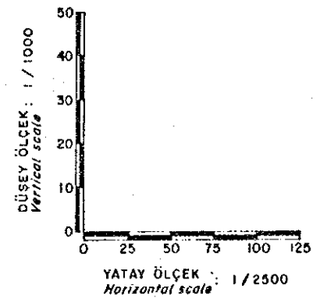
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY AND DEVELOPMENT ADMINISTRATION*

**ÇORUH–OLTU KOLU AYVALI BARAJ VE HES PROJESİ**
**BULANIKDERE MALZEME SAHASI**
**JEOFİZİK ÇALIŞMA LOKASYON HARİTASI**
*OLTU AYVALI HPP PROJECT GEOPHYSICAL SURVEY*
*LOCATION MAP FOR BULANIK VALLEY BORROW AREA*

| | |
|---|---|
| YAPAN *DESIGNED BY* : N. SARAÇ Ö. TEKELİ | DAIRE BAŞKANI *HEAD OF DEPART.* : |
| ÇİZEN *DRAWN BY* : Hatice ALTIN | |
| KONTROL *CHECKED BY* : | GENEL MÜDÜR *GENERAL DIRECTOR* : |
| ŞUBE MD. *CHI OF DIVIS.* : | |

| No. *No* | ÖLÇEK *SCALE* | | | EK *APP* I |
|---|---|---|---|---|
| Tarih *Date* 27/1/1992 | 1/5000 | | | |




## AÇIKLAMA – *EXPLANATION*

DÜŞÜK – ORTA PLASTİSİTELİ ÇAKILLI KİL (İNORGANİK)
*GRAVELLY CLAY (INORGANIC) WITH LOW – MEDIUM PLASTICITY*

KÖTÜ DERECELENMİŞ ÇAKIL – KUM – KİL KARIŞIMI
*POORLY GRADED GRAVEL- SAND – CLAY MIXTURE*

TABANKAYA
*BEDROCK*

A2 ⊙ DÜŞEY ELEKTRİK SONDAJ
*VERTICAL ELECTRICAL SOUNDING*

—730— DİYAGRAM TABAN KOTU
*DIAGRAM BASE ELEVATION*

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL MÜDÜRLÜĞÜ
*GENERAL DIRECTORATE OF ELECTRICAL POWER RESOURCES SURVEY and DEVELOPMENT ADMINISTRATION*

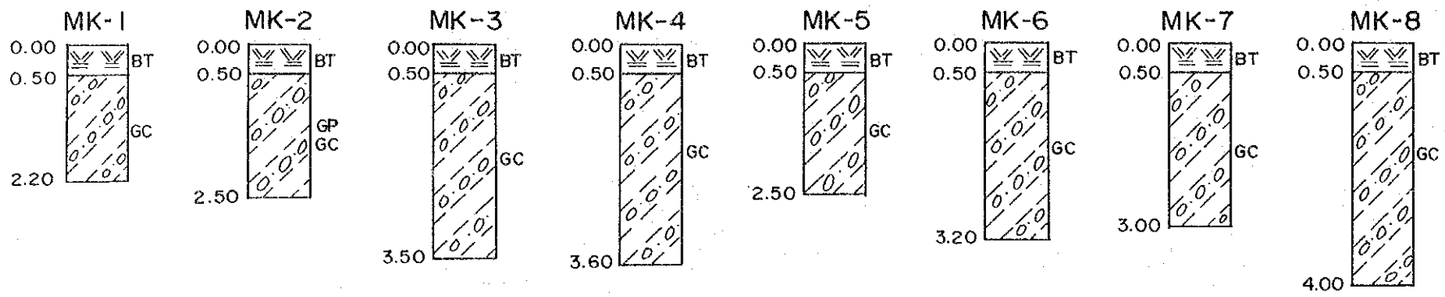
ÇORUH – OLTU KOLU AYVALI BARAJ ve HES PROJESİ
BULANIKDERE MALZEME SAHASI
DÜŞEY ELEKTRİK SONDAJLARA GÖRE PANEL DİYAGRAMI
*PANEL DIAGRAM FOR BULANIKDERE BORROW AREA*

| | |
|---|---|
| YAPAN / *DESIGNED BY* : N. SARAÇ, O. TEKELİ | DAİRE BAŞKANI / *HEAD OF DEPART.* : |
| ÇİZEN / *DRAWN BY* : Sinan USER | |
| KONTROL / *CHECKED BY* : | GENEL MÜDÜR / *GENERAL DIRECTOR* : |
| ŞUBE MD. / *CHI. OF DIVIS.* : | |

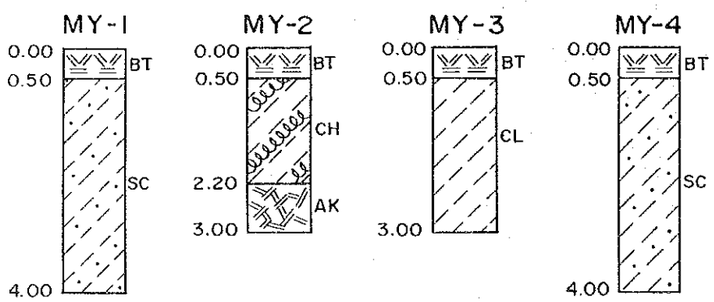
| | | | | |
|---|---|---|---|---|
| No. / *No.* : | ÖLÇEK / *SCALE* | | | EK / *App* : 2 |
| Tarih / *Date* : 28. I. 1992 | | | | |

# TEST PIT LOGS OF IMPERVIOUS CORE MATERIAL FOR OLUR DAM AND HPP

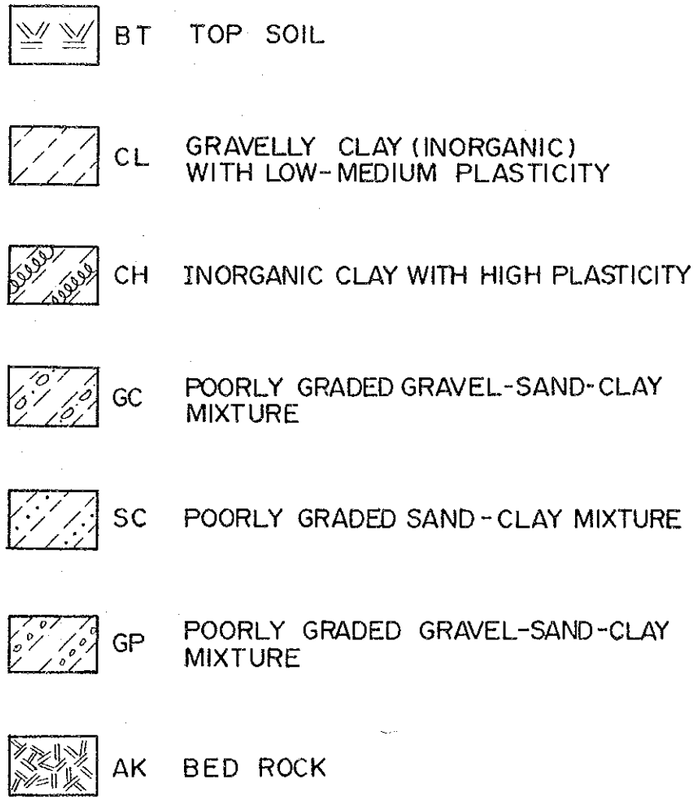
## KALEDİBİ BORROW AREA




## YOLBOYU BORROW AREA




## LEGEND



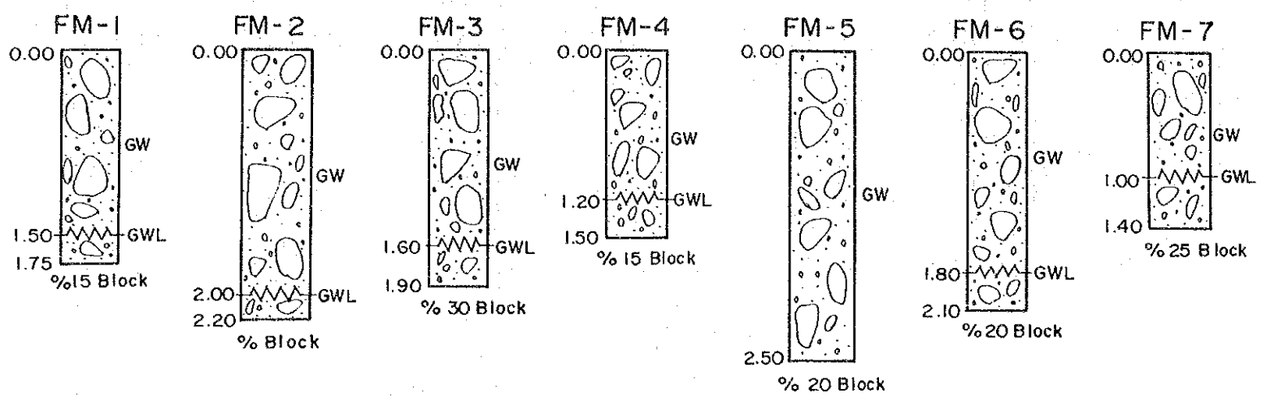

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

Geological Investigation Work

OLUR BORROW AREA-PIT

Kaledibi and Yolboyu

# PROFILES OF PERVIOUS MATERIAL TEST PITS




## LEGEND

WELL GRADED GRAVEL - SAND MIXTURES

GROUND WATER LEVEL

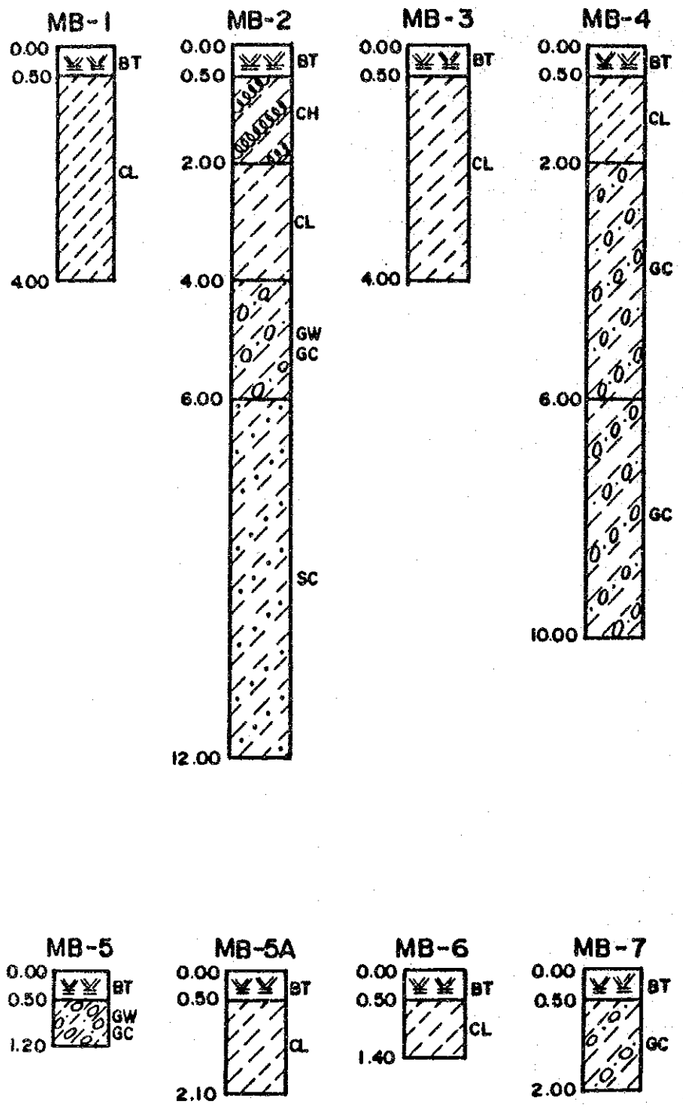
OLTU RIVER HYDROELECTRIC
POWER DEVELOPMENT PROJECT

Geological Investigation Work

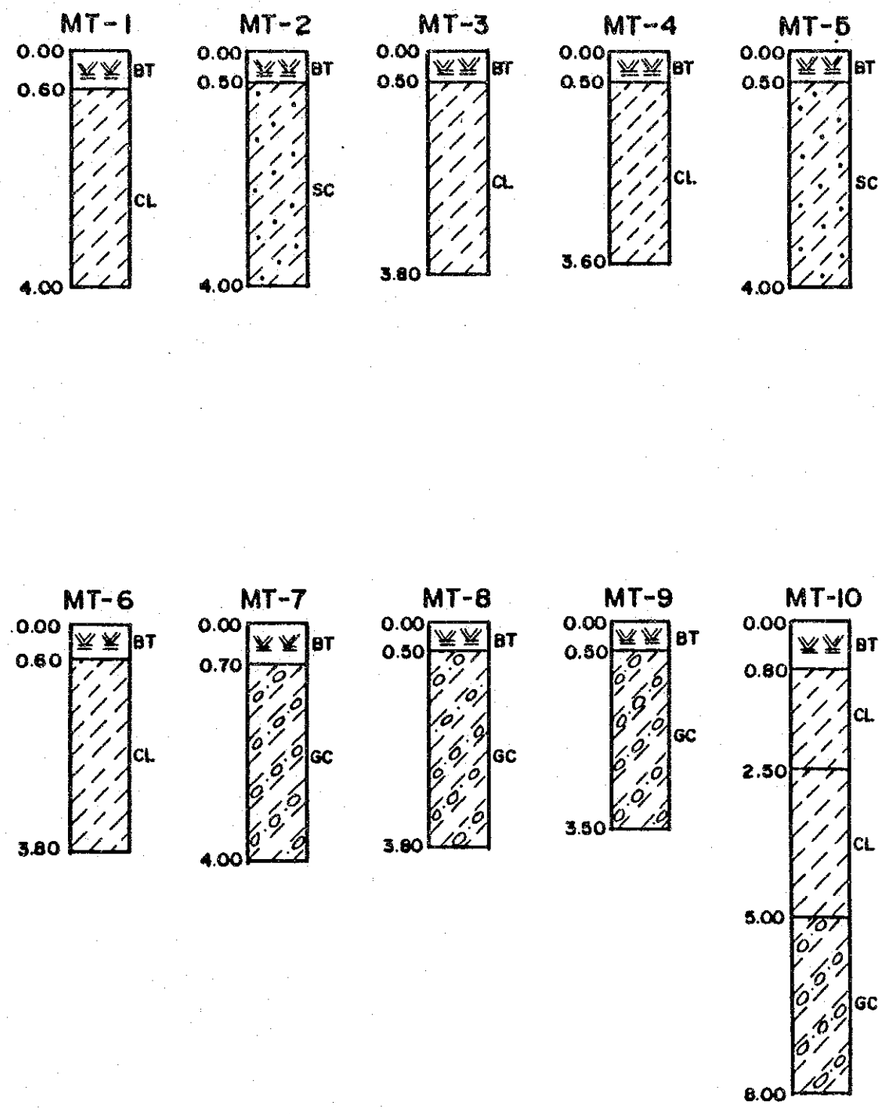
OLUR AGGREGATE - PIT

# TEST PIT LOGS OF IMPERVIOUS CORE MATERIAL FOR AYVALI DAM and HPP

## BULANIK DERE BORROW AREA




## TAVUSKER BORROW AREA

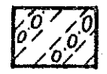


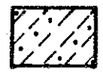

## LEGEND

BT TOP SOIL

CL GRAVELLY CLAY (I
WITH LOW-MEDIUM

CH INORGANIC CLAY W


GC POORLY GRADED G


SC POORLY GRADED SA

GW WELL GRADED GRA

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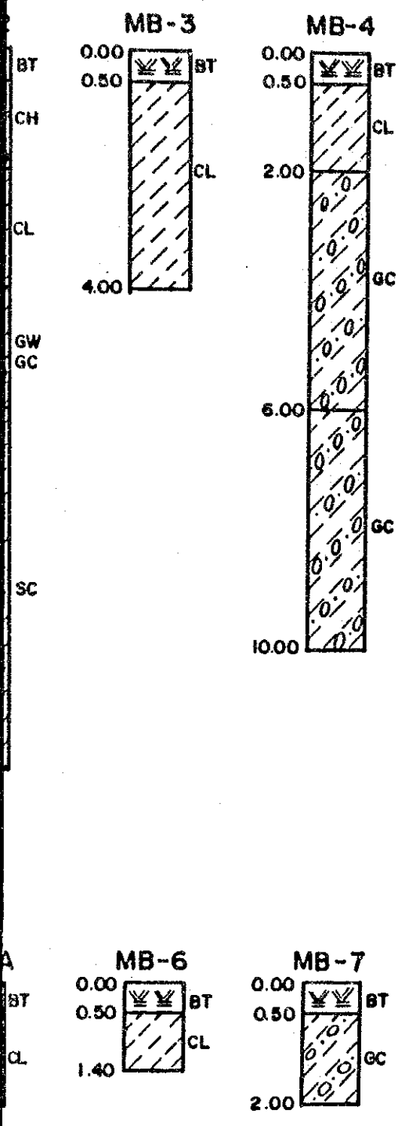
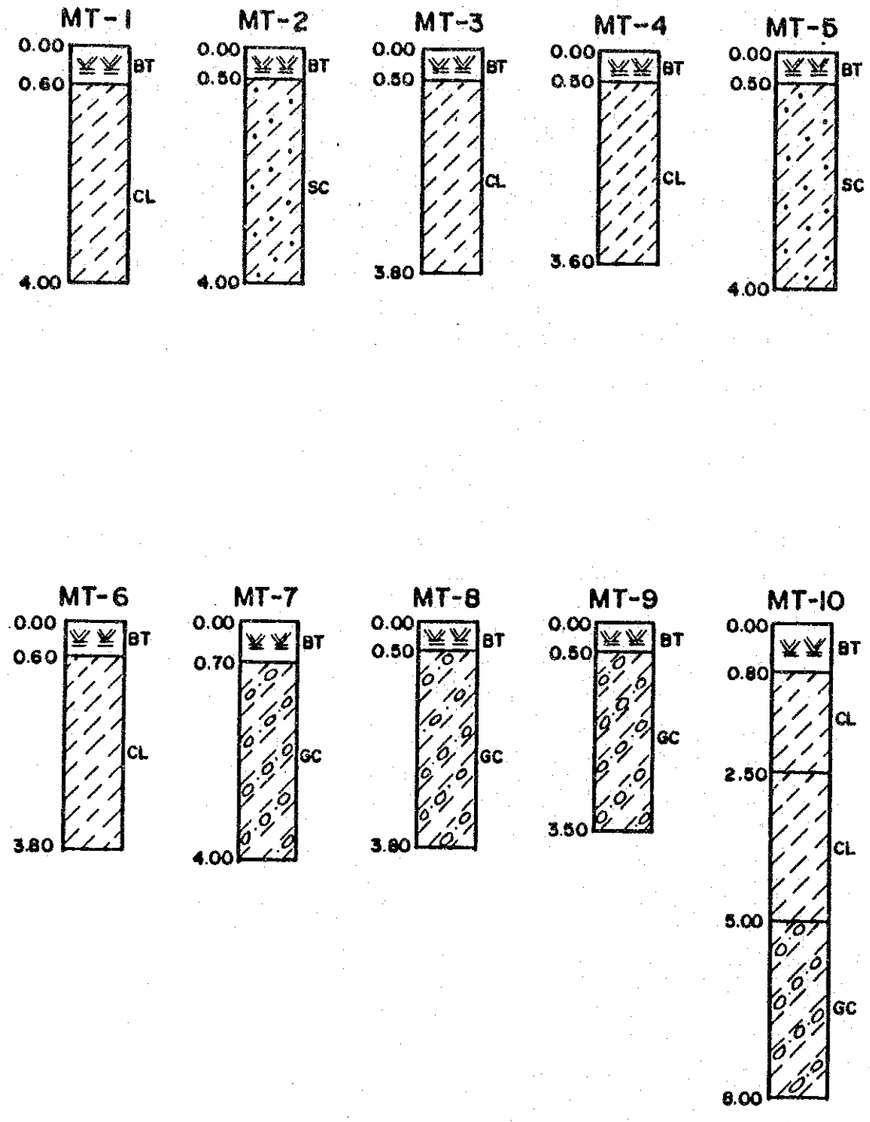
# OGS OF IMPERVIOUS CORE MATERIAL FOR AYVALI DAM and HPP

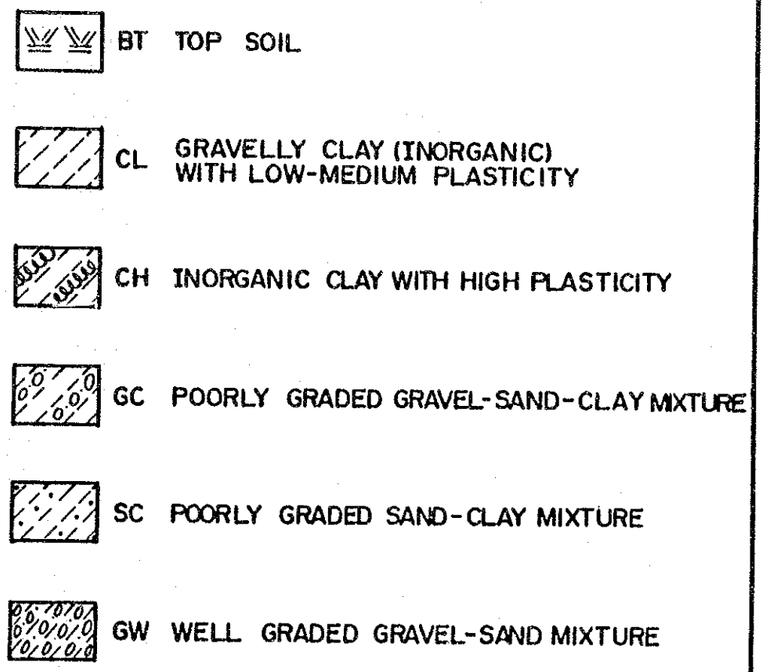
## ERE BORROW AREA




## TAVUSKER BORROW AREA




## LEGEND



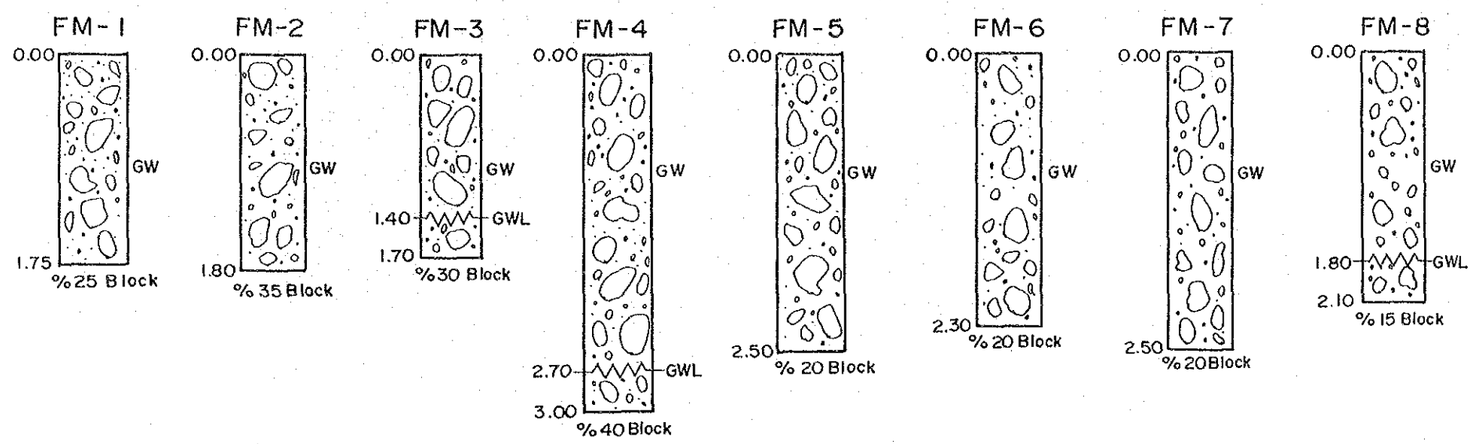

OLTU RIVER HYDOROELECTRIC POWER DEVELOPMENT PROJECT

Geological Investigation Work

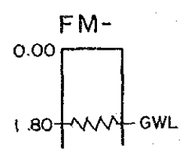
AYVALI BORROW AREA-PIT

Bulanik and Tavusker

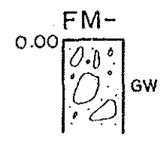
# PROFILES OF PERVIOUS MATERIAL TEST PITS




## LEGEND




GROUND WATER LEVEL




WELL GRADED GRAVEL-SAND MIXTURES

OLTU RIVER HYDOROELECTRIC
POWER DEVELOPMENT PROJECT

Geological Investigation Work

AYVALI AGGREGATE - PIT

AP-3-169

# A-4 Feasibility Design

## A-4-1 Capacity of Spillway

### 1. General

Number and dimensions of spillway gate are determined so as to be able to divert the design flood discharge (P.M.F.; 4,750 $m^3/s$ for Olur, 5,270 $m^3/s$ for Ayvali) at H.W.L. (1,105 m for Olur, 930 m for Ayvali) with all three gates open. Further, water level rise are calculated at P.M.F. with one of the gates out of order.

### 2. Basic Formulas

$$Q = C*L*He^{3/2}$$
$$L = L'-2*(n*Kp-Ka)*He$$
$$L' = n*B$$
$$C/C0 = 0.784+0.22*(He/H0)^{0.77}$$

where, Q : discharge ($m^3/s$)
He: water depth from reservoir level to weir crest (m)
H0: water depth from design reservoir level to weir crest (m)
L : effective width of chute (m)
L': total width of chute (m)
B : width of a chute (m)
n : number of gate
C0: coefficient of discharge at H0. (2.050 for Olur, 2.040 for Ayvali)
P : height of crest (m)
C : coefficient of discharge at He

### 3. Design Condition

Main features of spillway gate

| | | Olur | Ayvali |
|---|---|---|---|
| Number (with full gates ordered) | n = | 3 | 3 |
| (with one of the gates out of order) | | 2 | 2 |
| Dimensions | B = | 13.50 | 13.50 m |
| | H0= | 16.00 | 17.00 m |
| | P = | 5.00 | 5.00 m |
| Design Discharge | Q = | 4,750 | 5,270 $m^3/s$ |

### 4. Calculations

Spillway capacity has been calculated at various reservoir level as shown in Table A-*-*. Consequently, it is obvious that the spillway has enough capacity for the design flood, and water level rise from H.W.L. for Olur and Ayvali are 3.00 m and 3.30 m respectively in case only two gates are under operation.

Table A -4-1

| Olur | | | | Ayvali | | | |
|---|---|---|---|---|---|---|---|
| Reservoir W.L. (EL.) | He (m) | Q ($m^3/s$) n = 3 | Q ($m^3/s$) n = 2 | Reservoir W.L. (EL.) | He (m) | Q ($m^3/s$) n = 3 | Q ($m^3/s$) n = 2 |
| 1,089.0 | 0.0 | 0 | 0 | 913.0 | 0.0 | 0 | 0 |
| 1,090.0 | 1.0 | 67 | 45 | 915.0 | 2.0 | 193 | 129 |
| 1,095.0 | 6.0 | 1,076 | 719 | 920.0 | 7.0 | 1,360 | 908 |
| 1,100.0 | 11.0 | 2,843 | 1,900 | 925.0 | 12.0 | 3,232 | 2,161 |
| 1,105.0 | 16.0 | 5,250 | 3,514 | 930.0 | 17.0 | 5,716 | 3,827 |
| 1,110.0 | 21.0 | 8,255 | 5,842 | 935.0 | 22.0 | 8,778 | 6,194 |

Fig. A-4-1 Spillway Capacity Curve, Olur

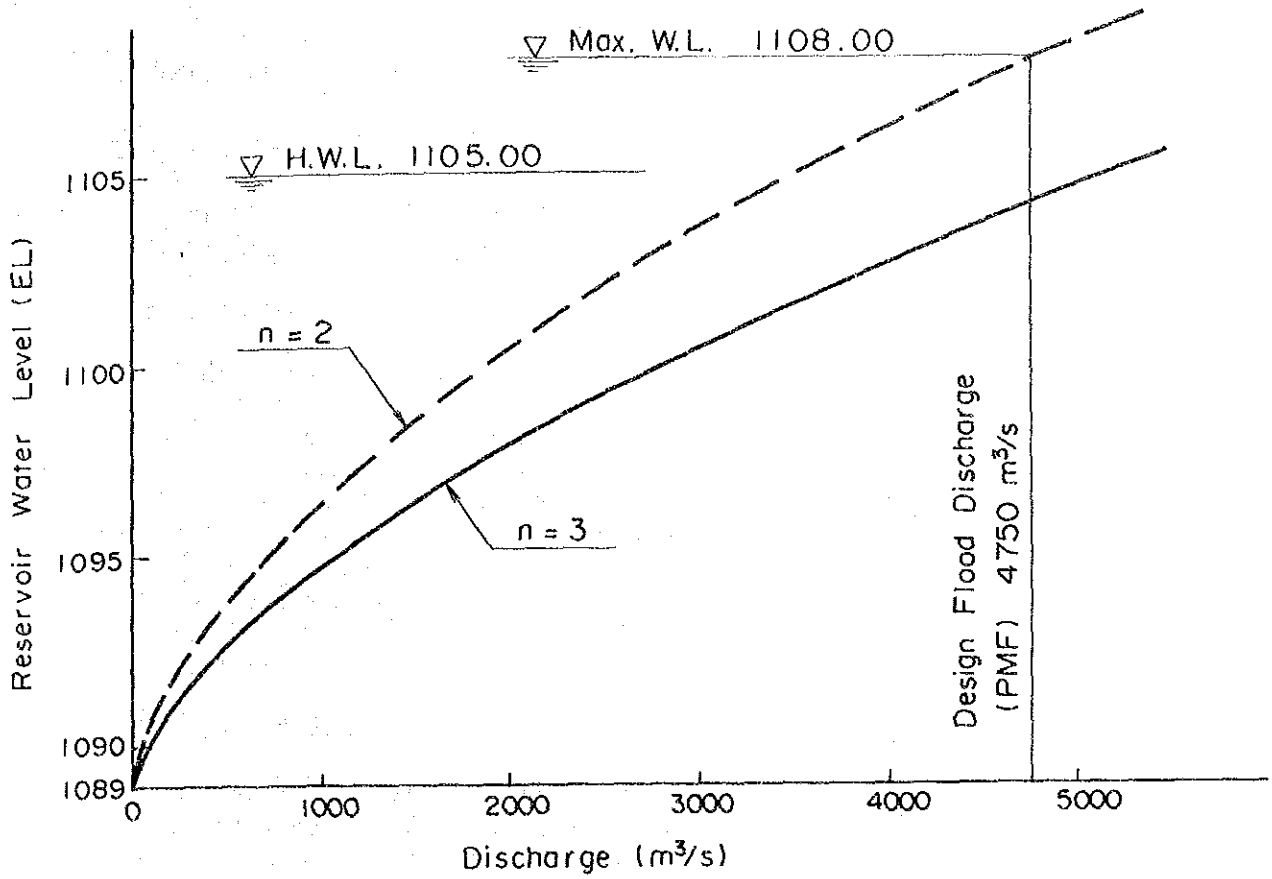
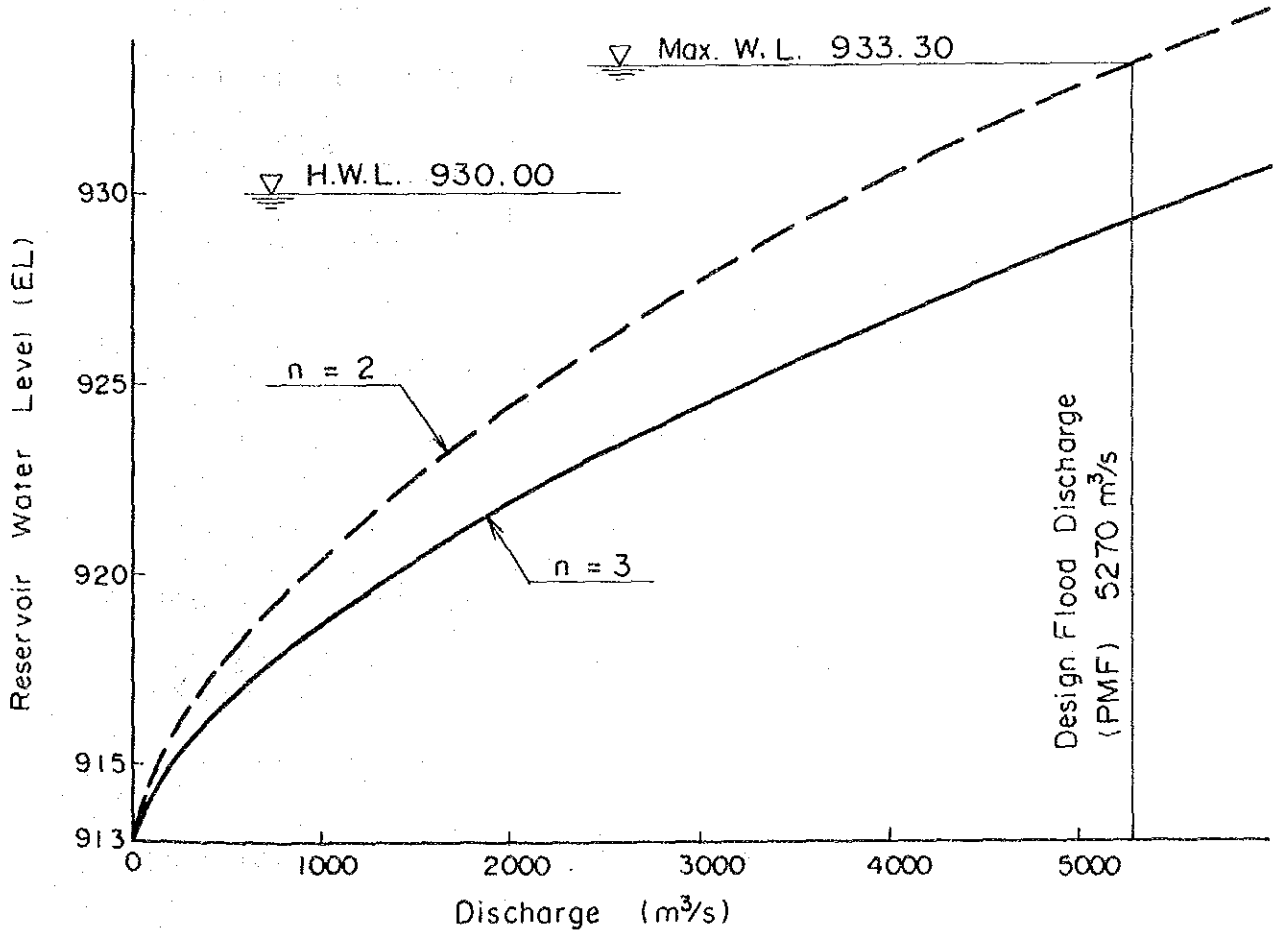



Fig. A-4-2 Spillway Capacity Curve, Ayvali



## A-4-2 Determination of Freeboad

1. General

The elevation of dam crest is determined enough high not to be lower than reservoir water level adding wave height and allowances.

2. Basic Formula

$$H_t \geqq \max.(\ H.W.L. + h_w + h_e + h_a + h_i\ ,\ \max.W.L. + h_w\ )$$

where, $H_t$ = elevation of dam crest (m)
$h_w$ = height of wave due to wind (m)
$h_e$ = height of wave due to earthquake (m)
$h_a$ = allowance considering delayed gate operation (m)
$h_i$ = additional amount according to type and importance of dam (m)
max.W.L. = water level in case only two gates are under operation (m)

3. Calculation

i ) Height of Wave due to Wind

Although there are various formulae available regarding the relations of wind speed and fetch with wave height, the uprush height obtained by the combination of the S.M.B. method and Saville's method is used here.

| | Olur | Ayvali |
|---|---|---|
| Fetch | 4,000 m | 4,000 m |
| Average wind speed for 10 minutes | 30 m/sec | 30 m/sec |
| Height of Wave | 1.20 m | 1.20 m |

ii ) Height of Wave due to Earthquake

With regard to earthquake wave height the formula of Seiichi Sato which gives a comparatively large wave height is used.

$$h_e = k\tau/2\pi * \sqrt{gH_0}$$

where, $h_e$ = height of wave due to earthquake at the front of the dam (m)
$k$ = horizontal seismic coefficient (= 0.15)
$\tau$ = earthquake period (= 1 sec)
$H_0$ = reservoir water depth from normal water level (= 85 m; Olur, 120 m; Ayvali)
$g$ = acceleration of gravity (= 9.8 m/sec$^2$)

Height of Wave Olur; 0.69 m, Ayvali; 0.82 m

iii ) Extra Height According to Dam Type and Importance

Being a fill dam, 1.00 m is additionally considered for the sake of safety.

iv ) Water Level in case only Two Gates are under Operation
(Refer A-4-1,4-2 )

max.W.L. Olur; 1,108.00 m Ayvali; 933.30 m

v) Calculation of Elevation of Dam Crest

[Olur] $H.W.L. + h_w + h_e + h_a + h_i = 1,105.00 + 1.20 + 0.69 + 0.50 + 1.00$
$= 1,108.39$ m

$max.W.L. + h_w = 1,108.00 + 1.20$
$= 1,109.20$ m

$H_t \geqq max.(H.W.L. + h_w + h_e + h_a + h_i,\ max.W.L. + h_w)$
$= 1,109.20$ m $\longrightarrow$ 1,110.00 m

[Ayvali] $H.W.L. + h_w + h_e + h_a + h_i = 930.00 + 1.20 + 0.82 + 0.50 + 1.00$
$= 933.52$ m

$max.W.L. + h_w = 933.30 + 1.20$
$= 934.50$ m

$H_t \geqq max.(H.W.L. + h_w + h_e + h_a + h_i,\ max.W.L. + h_w)$
$= 934.50$ m $\longrightarrow$ 935.00 m

therefore, elevation of dam crest for Olur and Ayvali were decided 1,110.00 m and 935.00 m respectively, i.e. 5.0 m of freeboard is to be taken for the dam.

**Fig. A-4-3** Surging Curve in Olur Surge Tank
in case the Turbine is Suddenly stopped (Q = 48→ 0 m³/s)

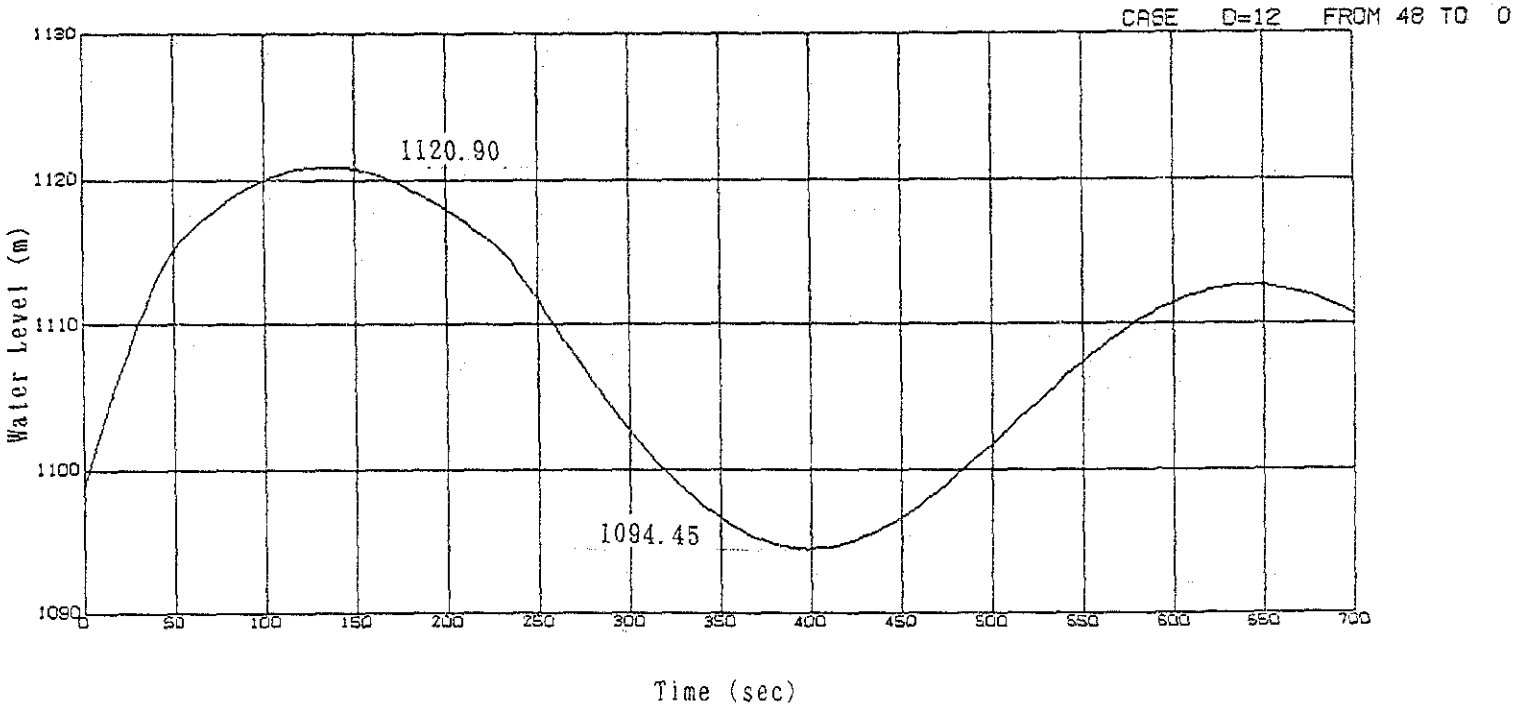


**Fig. A-4-4** Surging Curve in Olur Surge Tank
in case of Increase of Load (Q = 24→ 48 m³/s)

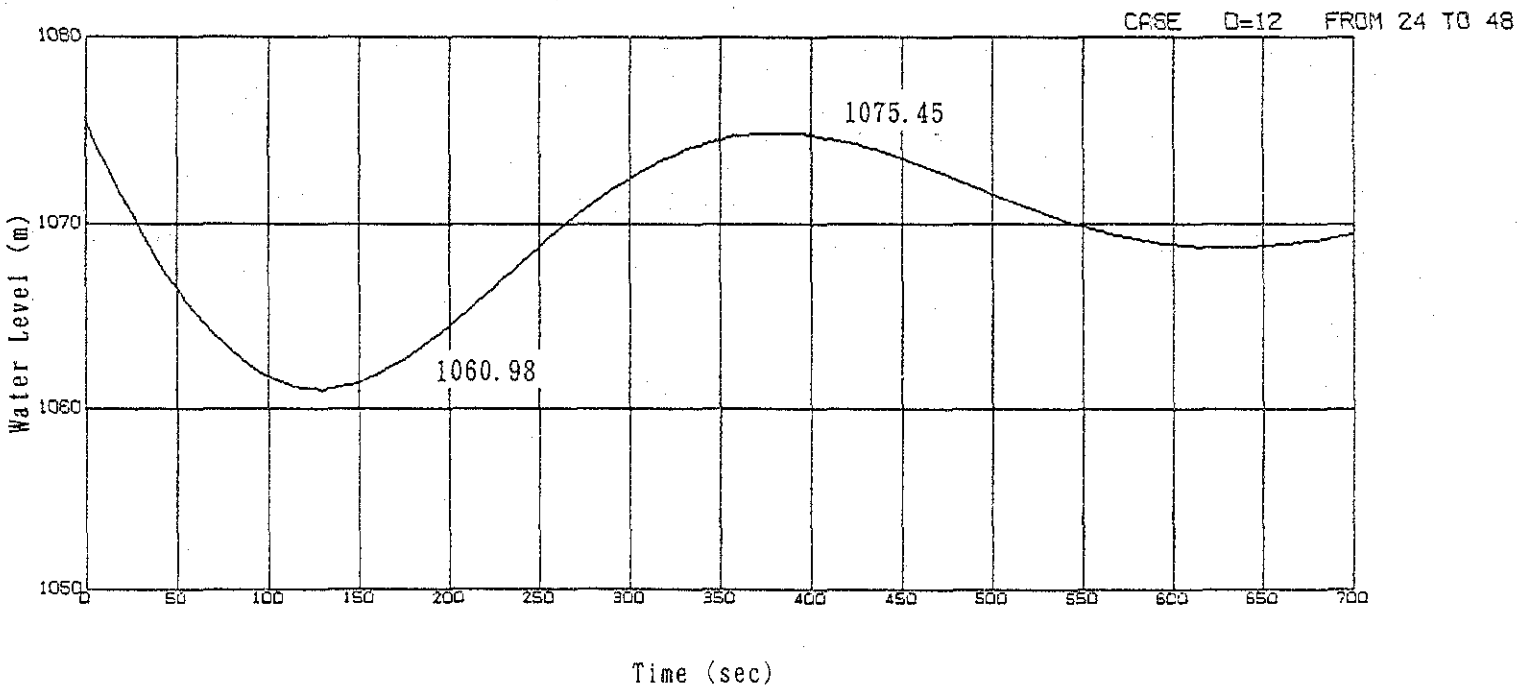


**Fig. A-4-5** Surging Curve in Ayvali Surge Chamber in case the Turbine is Suddenly stopped (Q = 67→ 0 $m^3/s$)

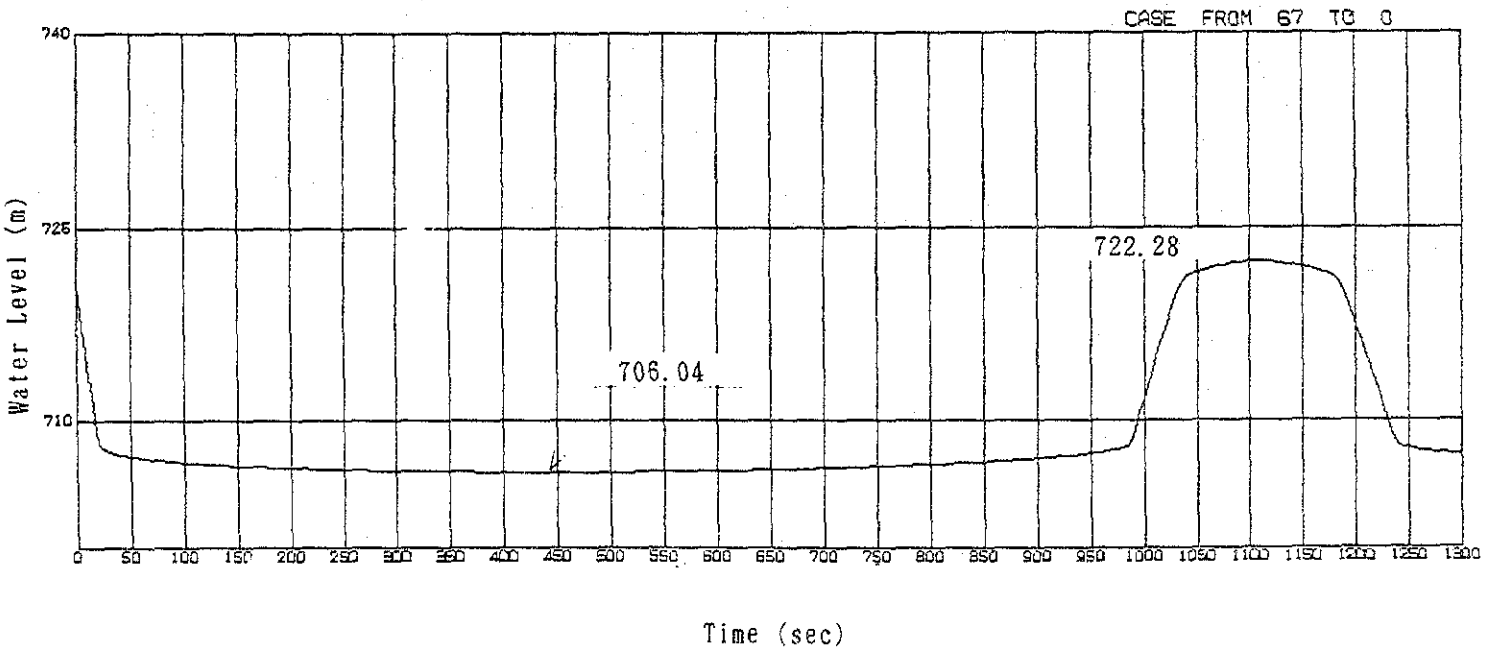


**Fig. A-4-6** Surging Curve in Ayvali Surge Chamber in case of Increase of Load (Q = 33.5→ 67 $m^3/s$)

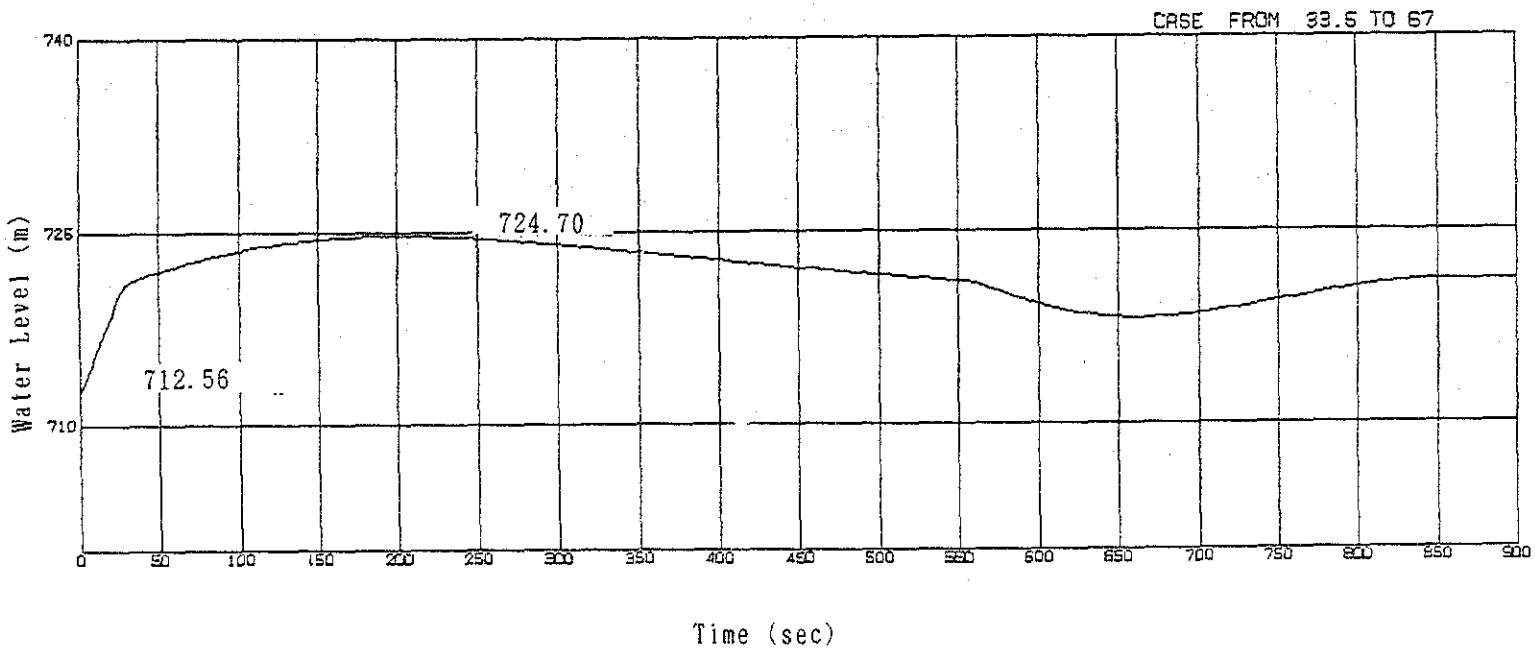
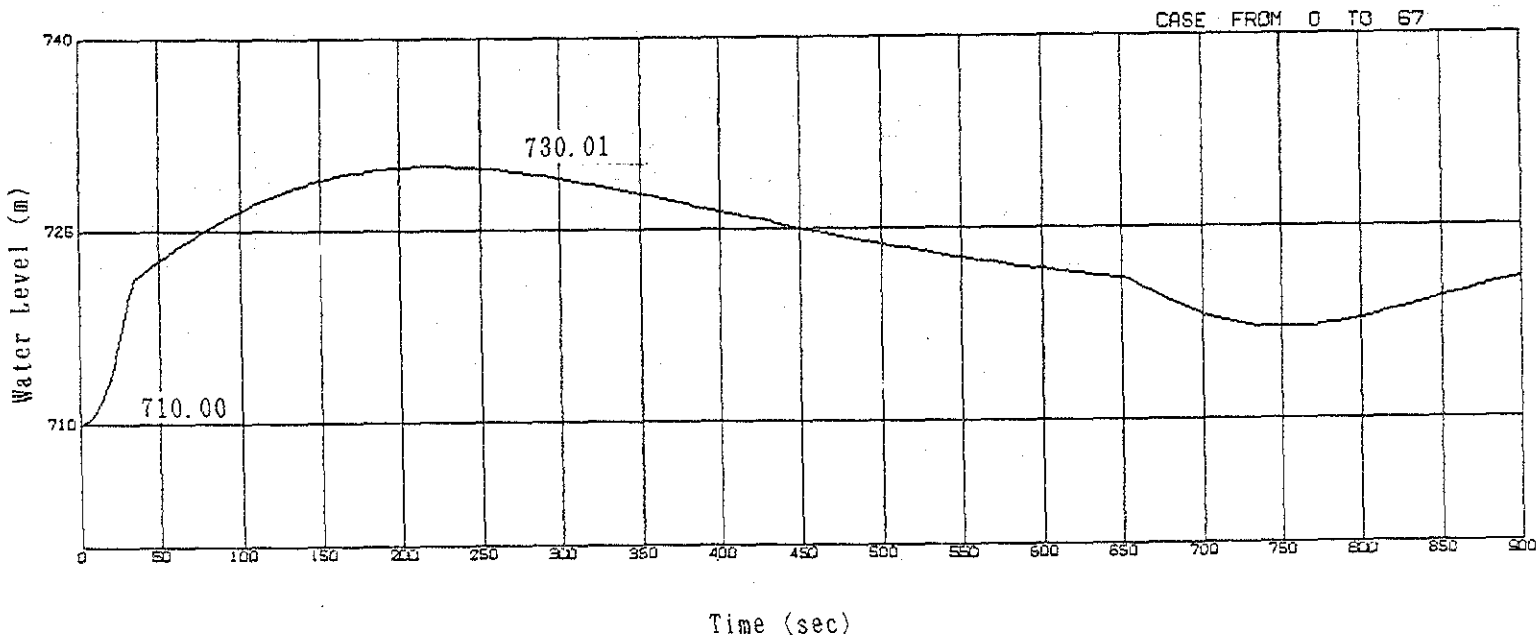


**Fig. A-4-7** Surging Curve in Ayvali Surge Chamber in case of Rapid Increase of load (Q = 0→67 m³/s)



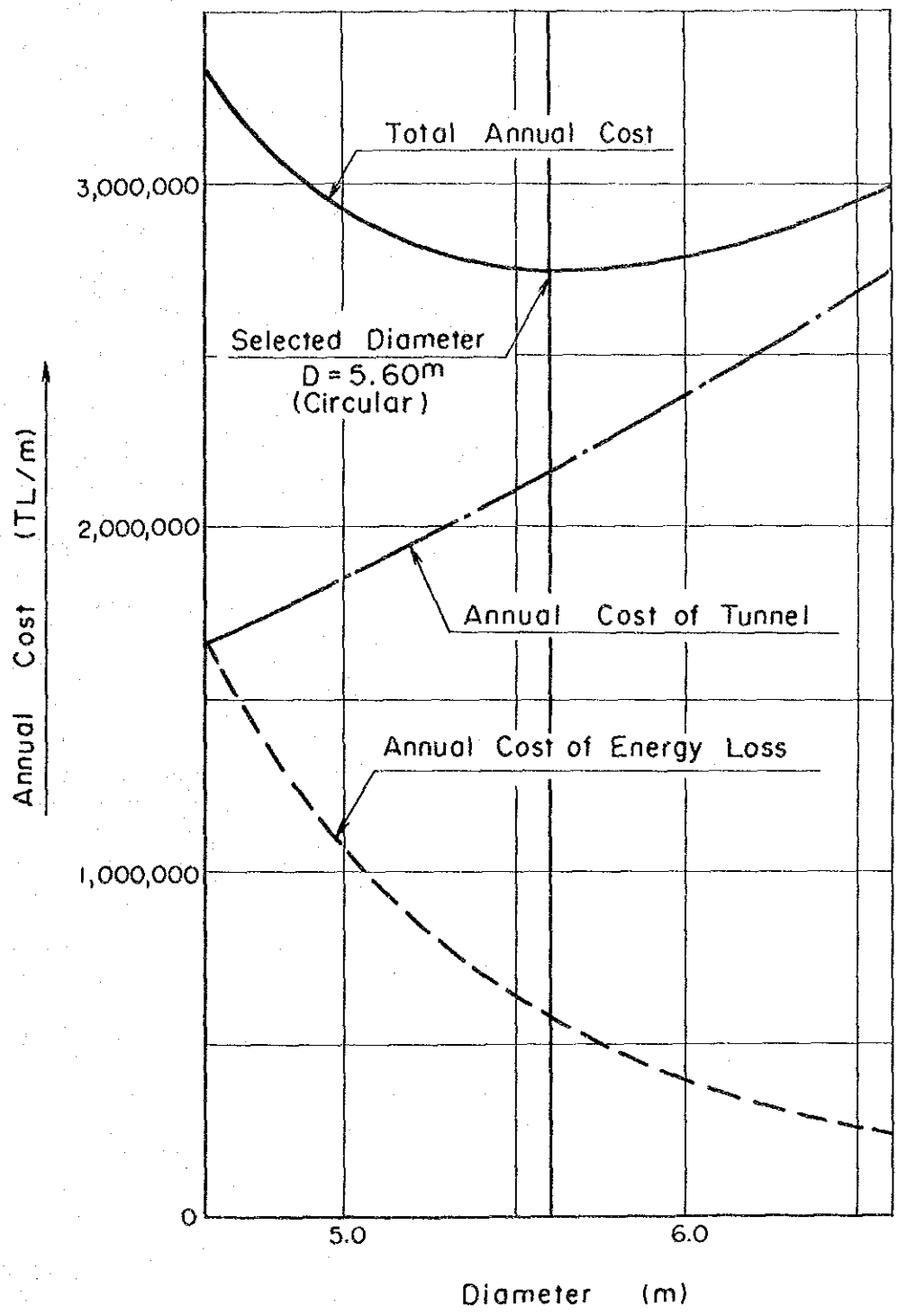



Fig. A-4-8 Estimation of Optimum Diameter of Headrace Tunnel, Ayvali (Alternative)

## A-4-3 Calculation of Loss

1. Intake
   1) Screen

Basic formula : $hr = fr * V^2/2g$

$\theta = 56° 58' 34''$ ( 56.97613° ) ←1:0.65
$fr = \beta * \sin\theta * (t/b)^{4/3}$, $\beta = 1.6$ Screen bar
$t$ = 1cm, $b$= 9cm, $V = Q/A$

| | OPK | Loss | APU | (Loss) |
|---|---|---|---|---|
| n×B (m)<br>H (m²) | 1 * 6.0<br>11.0 | | 1 * 7.0<br>13.0 | |
| A (m²)<br>fr | 66.0<br>$7.1659*10^{-2}$ | | 91.0<br>$7.1659*10^{-2}$ | |
| Total | $8.3932*10^{-7}$ | 0.002 | $4.4150*10^{-7}$ | 0.002 |

   2) Inflow

Basic formula : $he = fe * V^2/2g$ $V = Q/A$ $A = \pi D^2/4$
For Bellmouth $fe = 0.01 \sim 0.05 \rightarrow 0.05$

| | OPK | (Loss) | APU | (Loss) |
|---|---|---|---|---|
| D (m)<br>A (m²) | 4.9<br>18.857 | | 4.1<br>13.203 | |
| Total | $7.1738*10^{-6}$ | 0.017 | $1.4635*10^{-5}$ | 0.066 |

2. Headrace
   1) Curve

Basic formula : $hb = fb_1 * fb_2 * V^2/2g$ $fb_1 = 0.131 + 0.1632(D/\rho)^{7/2}$, $fb_2 = (\theta/90)^{1/2}$
D: Diameter, $\rho$: Radius, $\theta°$ : Angle

| | OPK | (Loss) | APU | (Loss) |
|---|---|---|---|---|
| D (m)<br>A (m²) | 4.9<br>18.857 | | ——— | |
| ①Vertical $\theta$ (°)<br>$\rho$ (m)<br>Coefficient | 32.96657<br>30.00<br>$1.1400*10^{-5}$ | | ——— | |
| ②Horizontal $\theta$ (°)<br>$\rho$ (m)<br>Coefficient | 43.65028<br>80.00<br>$1.3090*10^{-5}$ | | ——— | |
| ③Horizontal $\theta$ (°)<br>$\rho$ (m)<br>Coefficien | ——— | | ——— | |
| Total | $2.4490*10^{-5}$ | 0.056 | ——— | ——— |

2) Friction

Basic formula : $hf=124.5n^2/D^{4/3}*L*V^2/2g$ n=0.013 Concrete
D: Diameter, L:Length

| | OPK | (Loss) | APU | (Loss) |
|---|---|---|---|---|
| D (m)<br>L (m) | 4.9<br>9,661.17 * | | ——— | |
| Total | $3.5043*10^{-3}$ | 8.074 | ——— | ——— |

*Including intake portion

3. Friction in Vsurge tank

Basic formula : $hf=124.5n^2/D^{4/3}*L*V^2/2g$ n=0.012 Lower part of
D: Diameter, L=30.00m :Length

| | OPK | (Loss) | APU | (Loss) |
|---|---|---|---|---|
| D (m) | 4.9 | | ——— | |
| Total | $9.2720*10^{-6}$ | 0.021 | ——— | ——— |

4. Penstock
1) Gradual reduction

Basic formula : $hgc=fgc*V^2/2g$ V:Velocity after reduction

| | OPK | (Loss) | APU | (Loss) |
|---|---|---|---|---|
| ① D (m)<br>L (m)<br>$\theta$ (°)<br>fgc<br>Coefficient | 4.9 ~ 4.1<br>0.70, 6.00<br>15.19<br>0.0035<br>$1.0245*10^{-6}$ | | 4.1 ~ 3.8<br>0.86, 11.78<br>2.92<br>0.0010<br>$3.9667*10^{-7}$ | |
| ② D (m)<br>L (m)<br>$\theta$ (°)<br>fgc<br>Coefficient | 4.1 ~ 3.6<br>0.77, 6.00<br>9.53<br>0.0020<br>$9.8488*10^{-7}$ | | ——— | |
| ③ D (m)<br>L (m)<br>$\theta$ (°)<br>fgc<br>Coefficient | 3.6 ~ 3.2<br>0.79, 5.91<br>7.74<br>0.0010<br>$7.8880*10^{-7}$ | | ——— | |
| Total | $2.7982*10^{-6}$ | 0.006 | $3.9667*10^{-7}$ | 0.002 |

2) Bending

Basic formula : $hb=fb_1*fb_2*V^2/2g$ $fb_1=0.131+0.1632(D/\rho)^{7/2}$, $fb_2=(\theta/90)^{1/2}$

D: Diameter, $\rho$: Redius, $\theta°$ : Angle

| | OPK | (Loss) | APU | (Loss) |
|---|---|---|---|---|
| ①Horizontal $\theta$ (°)<br>D, $\rho$ (m)<br>Coefficient | 15.38086<br>4.10, 40.00<br>$1.5858*10^{-5}$ | | ——— | |
| ②Vertical $\theta$ (°)<br>Dm, $\rho$ (m)<br>Coefficient | 22.91965<br>3.85, 15.00<br>$2.5153*10^{-5}$ | | ——— | |
| ③Vertical $\theta$ (°)<br>Dm, $\rho$ (m)<br>Coefficient | 13.89295<br>3.60, 20.00<br>$2.5424*10^{-5}$ | | ——— | |
| ④Vertical $\theta$ (°)<br>Dm, $\rho$ (m)<br>Coefficient | 16.93690<br>3.40, 20.00<br>$3.5262*10^{-5}$ | | ——— | |
| ⑤Vertical $\theta$ (°)<br>Dm, $\rho$ (m)<br>Coefficient | 53.80679<br>3.20, 7.00<br>$8.6327*10^{-5}$ | | 45.000<br>3.95, 15.00<br>$3.1840*10^{-5}$ | |
| Toral | $1.8802*10^{-4}$ | 0.433 | $3.1840*10^{-5}$ | 0.143 |

3) Friction

Basic formula : $hf=124.5n^2/D^{4/3}*L*V^2/2g$ n=0.012 Penstook

D: Diameter, L:Length

| | OPK | (Loss) | APU | (Loss) |
|---|---|---|---|---|
| ① Dm (m)<br>L (m)<br>Coefficient | 4.50<br>6.00<br>$2.9204*10^{-6}$ | | ——— | |
| ② Dm (m)<br>L (m)<br>Coefficient | 4.10<br>215.90<br>$1.7265*10^{-4}$ | | ——— | |
| ③ Dm (m)<br>L (m)<br>Coefficient | 3.85<br>6.00<br>$6.7110*10^{-6}$ | | ———<br>*Incl. intake part (2m) | |
| ④ Dm (m)<br>L (m)<br>Coefficient | 3.60<br>148.26<br>$2.3723*10^{-4}$ | | 4.10<br>265.46 *<br>$2.1228*10^{-4}$ | |
| ⑤ Dm (m)<br>L (m)<br>Coefficient | 3.40<br>5.91<br>$1.2827*10^{-5}$ | | 3.95<br>11.78<br>$1.1492*10^{-5}$ | |
| ⑥ Dm (m)<br>L (m)<br>Coefficient | 3.20<br>54.29<br>$1.6281*10^{-4}$ | | 3.80<br>12.69<br>$1.5219*10^{-5}$ | |

| | OPK | Loss (m) | APU | Loss (m) |
|---|---|---|---|---|
| Total | $5.9515*10^{-4}$ | 1.371 | $2.3899*10^{-4}$ | 1.073 |

5. Out let (Draft Tunnel
   1) Gradual expansion

Basic formula : $hge=fge*fse*V^2/2g$ V:漸拡前の流速

$fse=[1-(A_1/A_2)]^2$ fse:coefficent of sudden expansion

| | OPK | Loss (m) | APU | Loss (m) |
|---|---|---|---|---|
| ①Before expansion H(m)<br>After expansion H(m)<br>Section , $\sqrt{(A_1/A_2)}$<br>$\theta$ (°), $\sqrt{(A_2/A_1)}$<br>fse, fge<br>Coefficient | 4.0*1.8<br>6.0*2.2<br>5.4 , 0.74<br>19.95, 1.35<br>0.21, 0.40<br>$8.1338*10^{-5}$ | | 6.2*2.0<br>8.0*2.5<br>4.5 , 0.79<br>23.86, 1.27<br>0.14, 0.55<br>$2.6353*10^{-5}$ | |
| ②Before expansion H(m)<br>After expansion H(m)<br>Section , $\sqrt{(A_1/A_2)}$<br>$\theta$ (°), $\sqrt{(A_2/A_1)}$<br>fse, fge<br>Coefficient | 6.0*2.2<br>6.0*3.0<br>6.5 , 0.86<br>10.71, 1.17<br>0.07, 0.19<br>$3.9563*10^{-6}$ | | 8.0*2.5<br>8.0*4.0<br>10.0 , 0.79<br>13.51, 1.26<br>0.14, 0.23<br>$4.1255*10^{-6}$ | |
| Total | $8.5294*10^{-5}$ | 0.197 | $3.0479*10^{-5}$ | 0.137 |

2)

Basic formula : $hgc=fgc*V^2/2g$ V:Gradual reduction

| | OPK | Loss (m) | APU | Loss (m) |
|---|---|---|---|---|
| ①Before expansion H(m)<br>After expansion H(m)<br>$A_2/A_1$, Length (m)<br>$\theta$ (°)<br>fgc | ——— | | 8.0*4.0<br>5.4*2.5<br>0.42, 17.00<br>13.30<br>0.005 | |
| $Q^2$ friction | ——— | ——— | $1.3997*10^{-8}$ | 0.006 |

3) Fricition

Basic formula : $hf=f'*(L/R)*V^2/2g$

$f'=2gn^2/R^{1/3}$

L: Length , R=A/S , S:
n: Penstock concrete

| | OPK | Loss (m) | APU | Loss (m) |
|---|---|---|---|---|
| ①Length Area A<br>R, n<br>f'<br>$Q^2$ Coefficient | 5.4, 10.2<br>0.729, 0.012<br>$3.1360*10^{-3}$<br>$1.1392*10^{-5}$ | | 4.5, 26.2<br>1.401, 0.012<br>$2.5224*10^{-3}$<br>$6.0217*10^{-7}$ | |
| ①Length Area A<br>S, R (m)<br>n, f'<br>$Q^2$ Coefficient | 6.5, 15.6<br>0.907, 0.013<br>$3.4220*10^{-3}$<br>$5.1413*10^{-6}$ | | 10.0, 26.0<br>1.156, 0.013<br>$3.1561*10^{-3}$<br>$2.0606*10^{-6}$ | |
| ①Length Area A<br>S, R (m)<br>n, f'<br>$Q^2$ Coefficient | ——— | | 17.0, 22.75<br>1.143, 0.013<br>$3.1681*10^{-3}$<br>$4.6449*10^{-6}$ | |
| Total | $1.6533*10^{-5}$ | 0.038 | $7.3077*10^{-6}$ | 0.033 |

4) Outflow

Basic formula : $hse=fse*V^2/2g$

fse=1 Sudden expansion $D_1/D_2=0$
V : V before outflow

| | OPK | Loss (m) | APU | Loss (m) |
|---|---|---|---|---|
| Area before outflow | 18.0 | | 13.5 | |
| $Q^2$ friction | $1.5747*10^{-4}$ | 0.363 | $2.7995*10^{-4}$ | 1.257 |

6. Total loss

| | OPK | Loss (m) | APU | Loss (m) |
|---|---|---|---|---|
| Discharge $m^3/s$ | | 48.0 | | 67.0 |
| Intake : Screen | $8.3932*10^{-7}$ | 0.002 | $4.4150*10^{-7}$ | 0.002 |
| : Inflow | $7.1738*10^{-6}$ | 0.017 | $1.4635*10^{-5}$ | 0.066 |
| Sut-tota | $8.0131*10^{-6}$ | 0.019 | $1.5077*10^{-5}$ | 0.068 |
| Headrace : Bend | $2.4490*10^{-5}$ | 0.056 | | |
| : Friction | $3.5043*10^{-3}$ | 8.074 | | |
| Sut-tota | $3.5288*10^{-3}$ | 8.130 | ——— | ——— |
| Surge tank friction | $9.2720*10^{-6}$ | 0.021 | ——— | ——— |
| Penstock : Reduction | $2.7982*10^{-6}$ | 0.006 | $3.9667*10^{-7}$ | 0.002 |
| : Bend | $1.8802*10^{-4}$ | 0.433 | $3.1840*10^{-5}$ | 0.143 |
| : Frilction | $5.9515*10^{-4}$ | 1.371 | $2.3899*10^{-4}$ | 1.073 |
| Sut-tota | $7.8597*10^{-1}$ | 1.810 | $2.7123*10^{-4}$ | 1.218 |
| Outlet : Expansion | $8.5294*10^{-5}$ | 0.197 | $3.0479*10^{-5}$ | 0.137 |
| : Reduction | ——— | ——— | $1.3997*10^{-6}$ | 0.006 |
| : Friction | $1.6533*10^{-5}$ | 0.038 | $7.3077*10^{-6}$ | 0.033 |
| : Outflow | $1.5747*10^{-4}$ | 0.363 | $2.7995*10^{-4}$ | 1.257 |
| Sut-tota | $2.5930*10^{-4}$ | 0.598 | $3.1914*10^{-4}$ | 1.433 |
| Total | $4.5914*10^{-3}$ | 10.578 | $6.0545*10^{-4}$ | 2.719 |
| Other : 10% | (10.6%) | 1.122 | (10.3%) | 0.281 |
| Grand Total | | 11.70 m | | 3.00 m |

| | | |
|---|---|---|
| Intak Water Level | 1,095.7 m | 922.7 m |
| Tail Water Level | 929.0 m | 707.90 m |
| (Reservoir) | | ( 700.00 m) |
| Gross Head | 166.7 m | 214.8 m |
| | | ( 222.7 m) |
| Loss of Head | 12.0 m | 3.00 m |
| (by tunnel gradient) | | ( 7.90 m) |
| Effective Head | 154.7 m | 211.8 m |

### A-4-4 Alternative Design

As described in Chapter 9 Development Plans, various studies were made regarding the Oltu Project with comparison studies carried out upon setting up alternatives layouts for the respective Projects, and from among these the most economically advantageous alternatives were selected as the layouts for the Project and preliminary designing was done. This preliminary design is described in Chapters 9 and 11. The project alternative layouts which had ranked second in the comparison studies will be described herein.

(1) Olur Project

Regarding the location of the dam in the Olur Project, two sites, upstream and downstream, were compared and studied, and as a result, the upstream dam site was selected as described in Chapter 11.

Regarding the comparison study on the powerhouse location including the waterway route, the four alternatives of OPM, OPJ, OPT, and OPK were formulated and compared as described in Chapter 9. The OPK alternative was selected from among these as being the most advantageous, and this has been discussed up to and including the preceding chapter. The difference with the OPT alternative which was second best in the economic comparisons was small so that detailed investigations were made of topography and geology regarding the OPT alternative, and a comparison study was made in fairly great detail. The OPT alternative is described below.

In the OPT alternative, the greater part of the head race tunnel route was the same as in the OPK alternative, but diverged from the route of the basic proposal downstream of the Bacelik Dere to be connected to the powerhouse in the OPT alternative by a surge tank and penstock.

(a) Outline of Geology

The geologies of the headrace and powerhouse are practically the same as in the OPK alternative with there being distributions of Ayvali Volcanic Rocks, terrace deposits, and talus deposits, and the deposits at the powerhouse site are of considerable thickness. Further, concerning this powerhouse site, geological investigation works consisting of seismic prospecting and boring were carried out. According to these, the thickness of the deposits at the powerhouse location is about 15 m.

(b) Design

Since the headrace tunnel route as far as the downstream side of the Bacelik Dere is in common with the OPK alternative, upstream of this point will not be discussed. Downstream of the Bacelik Dere, as shown in Fig. A-4-9, the route would be changed toward the powerhouse in the OPT alternative. Next, the waterway would go by the surge tank and penstock to reach the powerhouse, and water used for power generation would be discharged into the Oltu River via a tailrace.

The diameter of the headrace tunnel would be 4.9 m, the same as in the OPK alternative, and this would be a circular cross section pressure tunnel 9,358 m in length.

The surge tank would be an orifice type similarly to the OPK alternative, the dimensions and specifications being almost the same as in the OPK alternative. The penstock would also be the same as in the OPK alternative, with a steel penstock of ring girder-supported type installed at the surface. The diameter

would range between 4.9 m and 3.2 m, while the length would be 403 m.

The power generation water leaving the powerhouse would be discharged into the Oltu River by a concrete culvert 181 m in length.

The powerhouse would be provided on a rock foundation approximately 400 m upstream of the OPK alternative. The construction of the powerhouse would be practically the same as in the OPK alternative.

The specifications of power generating equipment would be almost the same as in the basic plan. That is, the power discharge would be 48 $m^3/s$, the same as in the OPK alternative, with output reduced by the amount of reduction in effective head. The output would be 64.5 MW.

An outline of the OPT proposal is shown in Fig. A-4-9, A-4-10, A-4-15 and A-4-16.

The construction cost is given in Table A-4-2

(2) Ayvali Project

With regard to the dam location for the Ayvali Project, there is no prospective site other than the presently projected one.

Regarding comparison studies of powerhouse sites including waterway routes, including the site given in the Master Plan, the four alternative of APM, APU (basic proposal), APL, and the Ayvali Project plus the Sakartepe Project were formulated and comparison studies made as described in Chapter 9. The APU alternative was selected from among these as being the most economically advantageous and has

been discussed in detail up to and including the preceding chapter. The APL alternative which was second best in the economic comparison is considerably higher in construction cost compared with the APU alternative, but will be described in detail herein.

In the APL alternative the dam would be the same as in the APU alternative, but the waterway system from the intake and beyond would be different from that in the APU alternative. The APL alternative is for the head from Ayvali Reservoir to be utilized providing a headrace tunnel and a tailrace tunnel. The powerhouse would be an underground type to be provided in the Pugey Formation (sedimentary rock) at the right-bank side of the Anzav Dere.

(a) Outline of Geology

The geology of the headrace tunnel route consists of Ayvali Volcanic Rocks of lava, rhyolite, tuff, volcanic breccia, etc. and the Pugey Formation composed of alternations of limestone and marl bounding the former at the downstream side by a fault. Both formations are sound excluding the fault portion.

The powerhouse and its appurtenant facilities would be provided in the Pugey Formation. The route of the tailrace tunnel at the downstream side of the powerhouse would pass through the Pugey Formation consisting of alternations of limestone and marl.

The engineering geological evaluation of the geology is as described in Chapter 7.

(b) Design

The headrace tunnel would pass through the

mountainland at the left-bank side of the Oltu River in the form of a circular pressure tunnel of inside diameter 4.8 m and length of 7,669 m. Two or three work adits and access roads would be required to carry out the headrace tunnel work.

The surge tank would be an orifice type, the dimensions being diameter of 20 m and height of 64 m.

The penstock would be an embedded steel pipe type, the diameter ranging from 4.1 m to 3.8 m with the length being 309 m.

Power generation water leaving the powerhouse would be led to Yusufeli Reservoir by a horseshoe-shaped tunnel of diameter 5.4 m and length 2,141 m which will pass through the foundation rock under the Anzav Dere at an ample depth.

The powerhouse would be 19 m in width, 44.5 m in height, and 42 m in length same as to the APU alternative and would be provided as an underground type in the mountain body consisting of the Pugey Formation.

The specifications of electrical equipment would be practically the same as of the APU alternative. That is, the power discharge would be 67 $m^3/s$, the same as the APU alternative, the output being different due to the change in the effective head. The output would be 124.7 MW.

An outline of the APL alternative is shown in Figs. A-4-17, A-4-18 and A-4-21.

The construction cost is given in Table A-4-3

**Table A-4-2 Construction Cost of Alternative Design of Olur Project**

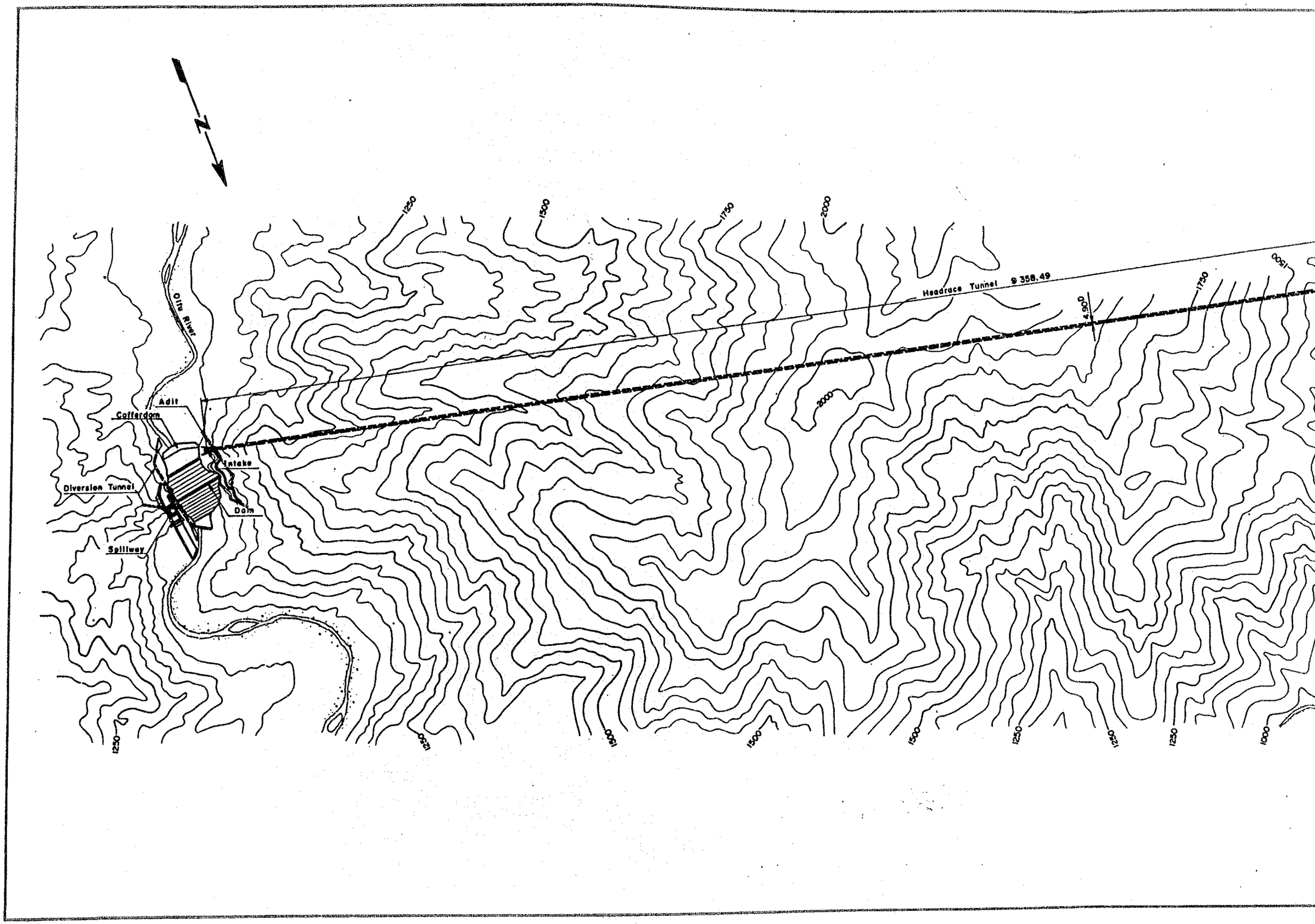
Unit: $10^6$ TL

| Item | OPK | OPT |
|---|---|---|
| Intake | 4,959 | 4,959 |
| Headrace Tunnel | 115,001 | 111,469 |
| Surge Tank | 6,670 | 6,670 |
| Penstock | 2,568 | 7,344 |
| Powerhouse | 7,031 | 13,099 |
| Tailrace | 0 | 4,577 |
| Switchyard | 770 | 770 |
| Hydraulic Equipment | 15,230 | 14,088 |
| Total | 152,229 | 162,976 |

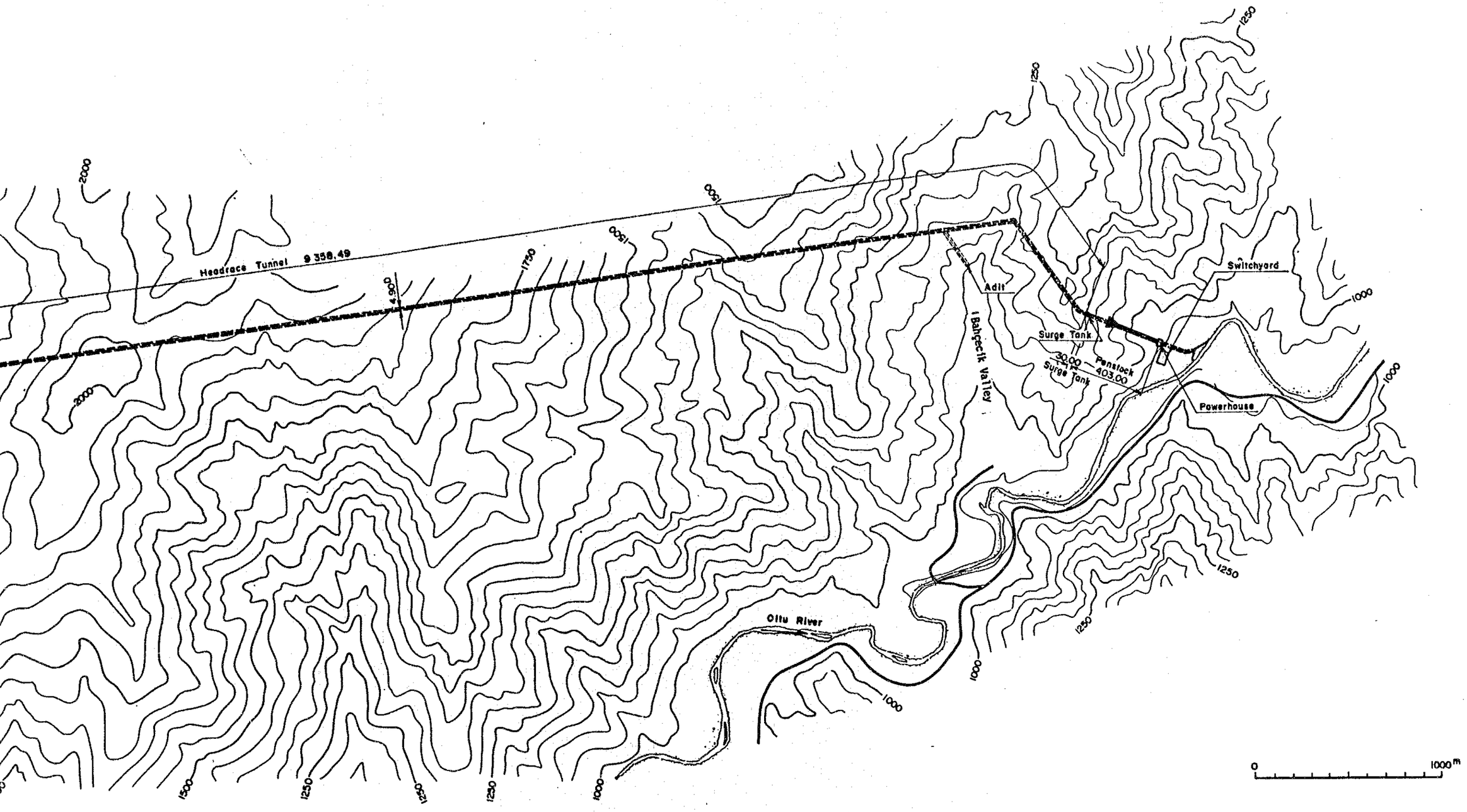
**Table A-4-3 Construction Cost of Alternative Design of Ayvali Project**

Unit: $10^6$ TL

| Item | APU | APL |
|---|---|---|
| Intake | 5,510 | 5,510 |
| Headrace Tunnel | 0 | 112,385 |
| Surge Tank | 0 | 6,412 |
| Penstock | 2,334 | 2,286 |
| Powerhouse | 20,484 | 16,511 |
| Tailrace | 121,260 | 34,062 |
| Hydraulic Equipment | 10,337 | 20,822 |
| Total | 159,925 | 197,988 |


N
Headrace Tunnel @ 358.49
Olta River
Adit
Cofferdam
Intake
Diversion Tunnel
Dam
Spillway
1250
1500
1750
2000
1000

ANNEXURE X




OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

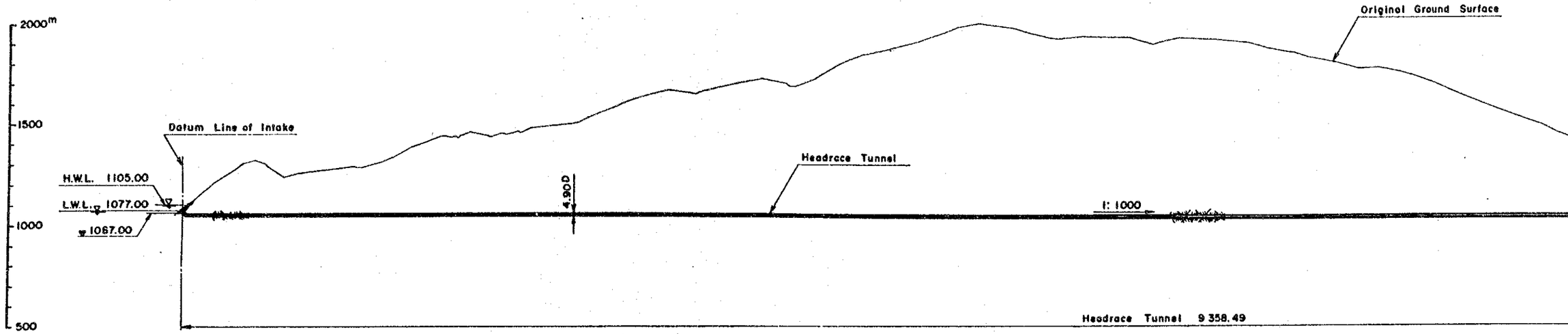
OLUR PROJECT

GENERAL PLAN

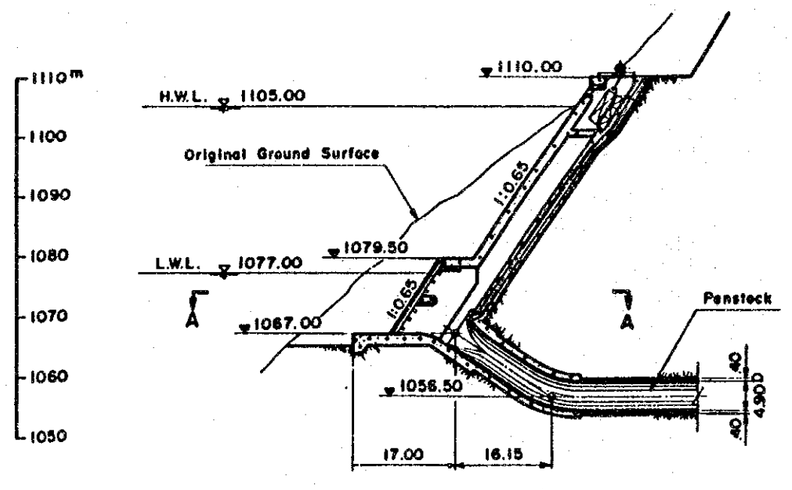
(ALTERNATIVE)

Fig. A-4-9

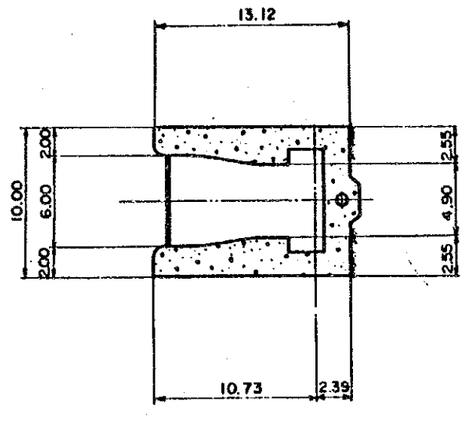
## PROFILE



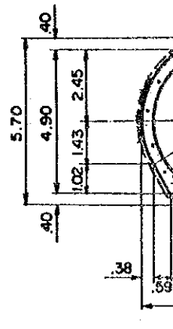

## TYPICAL SECTION OF INTAKE



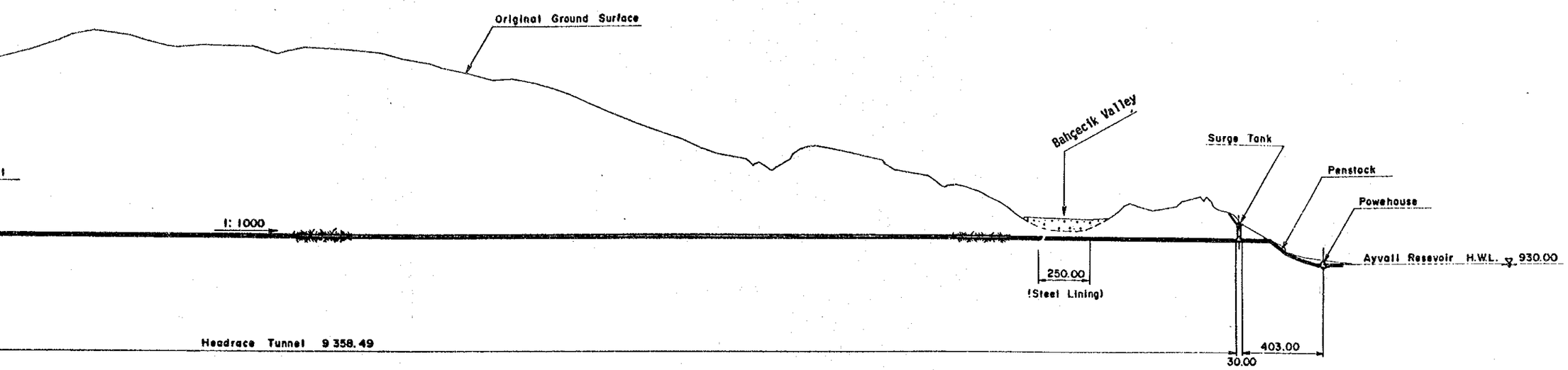

## SECTION A-A



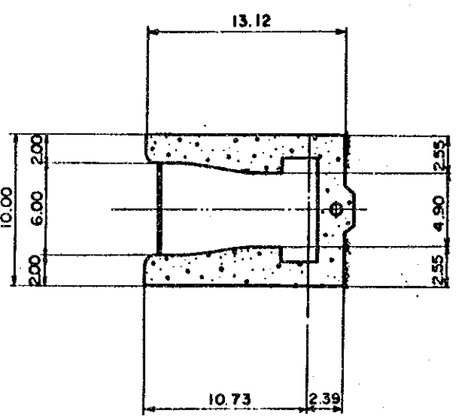

## TYPICAL SECTIO



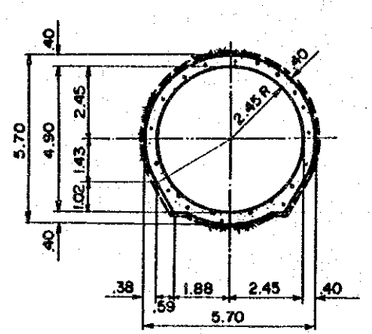
## PROFILE

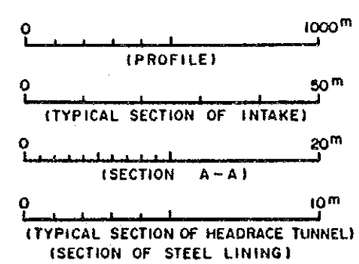



## SECTION A – A




## TYPICAL SECTION OF HEADRACE TUNNEL

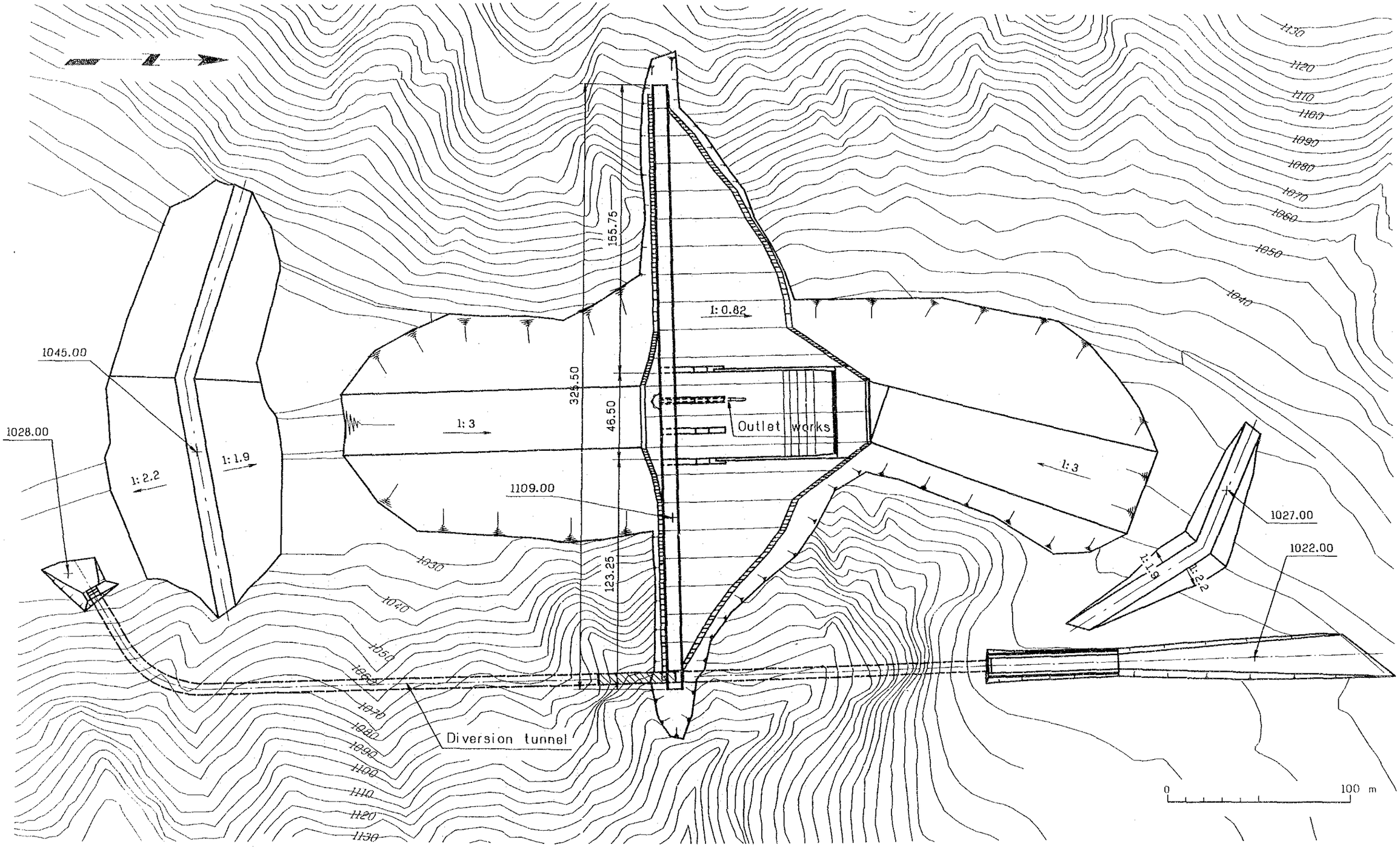



OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

**OLUR PROJECT**
**WATERWAY**
**PROFILE AND SECTIONS**
**(ALTERNATIVE)**

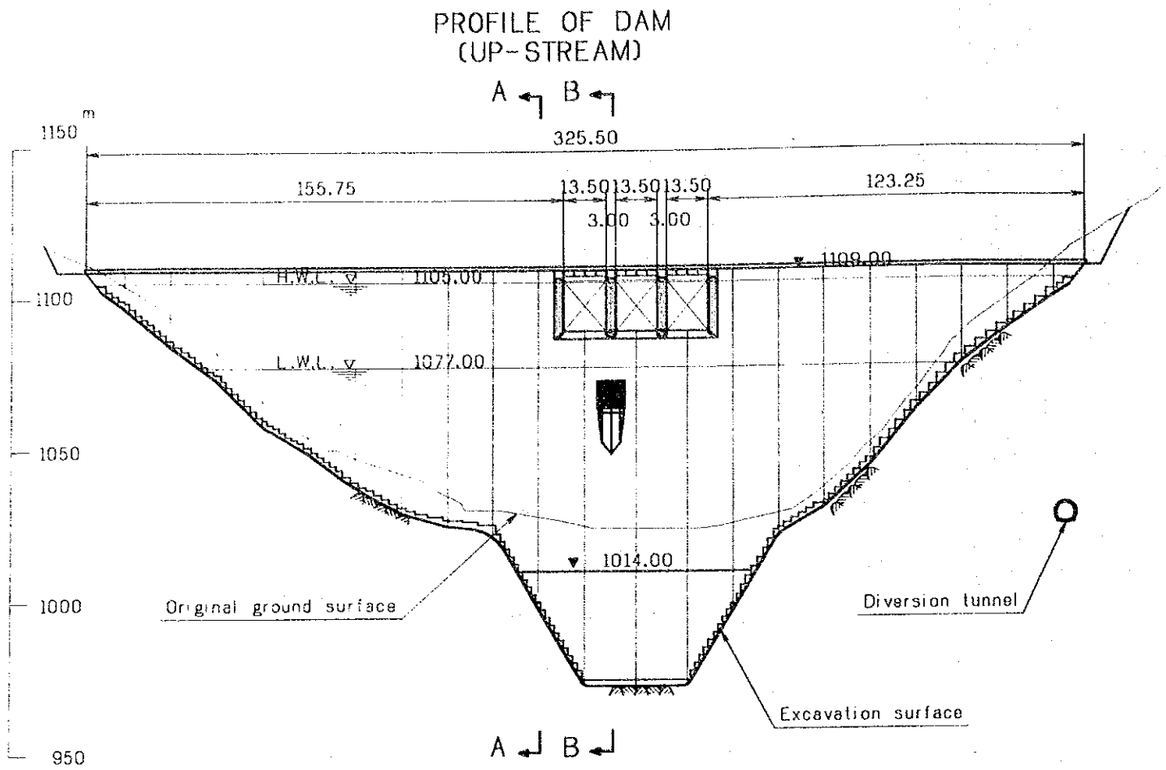
Fig. A-4-10

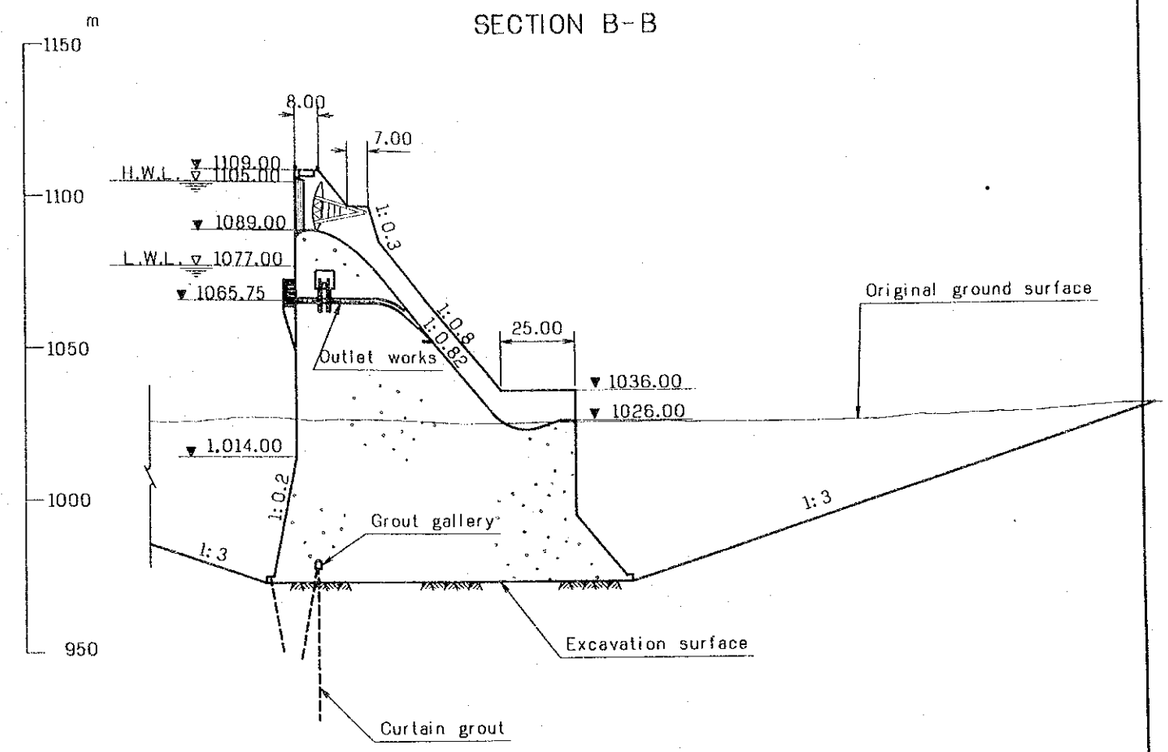


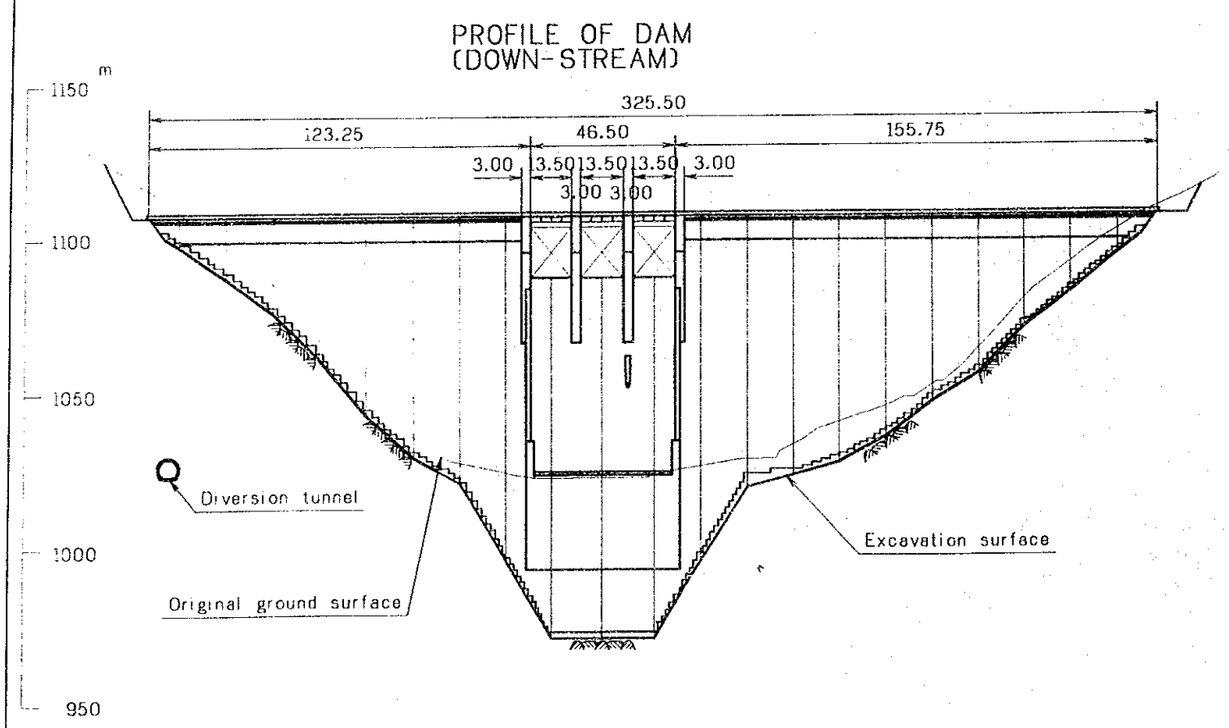

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

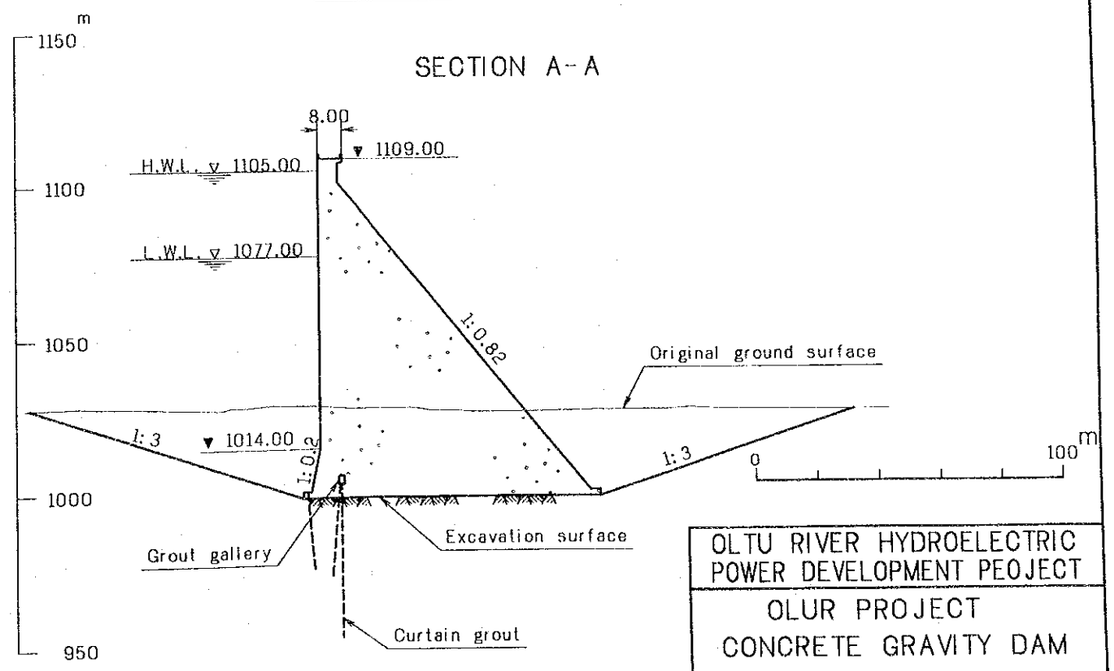
OLUR PROJECT
CONCRETE GRAVITY DAM
GENERAL PLAN
(ALTERNATIVE)

Fig.A-4-11



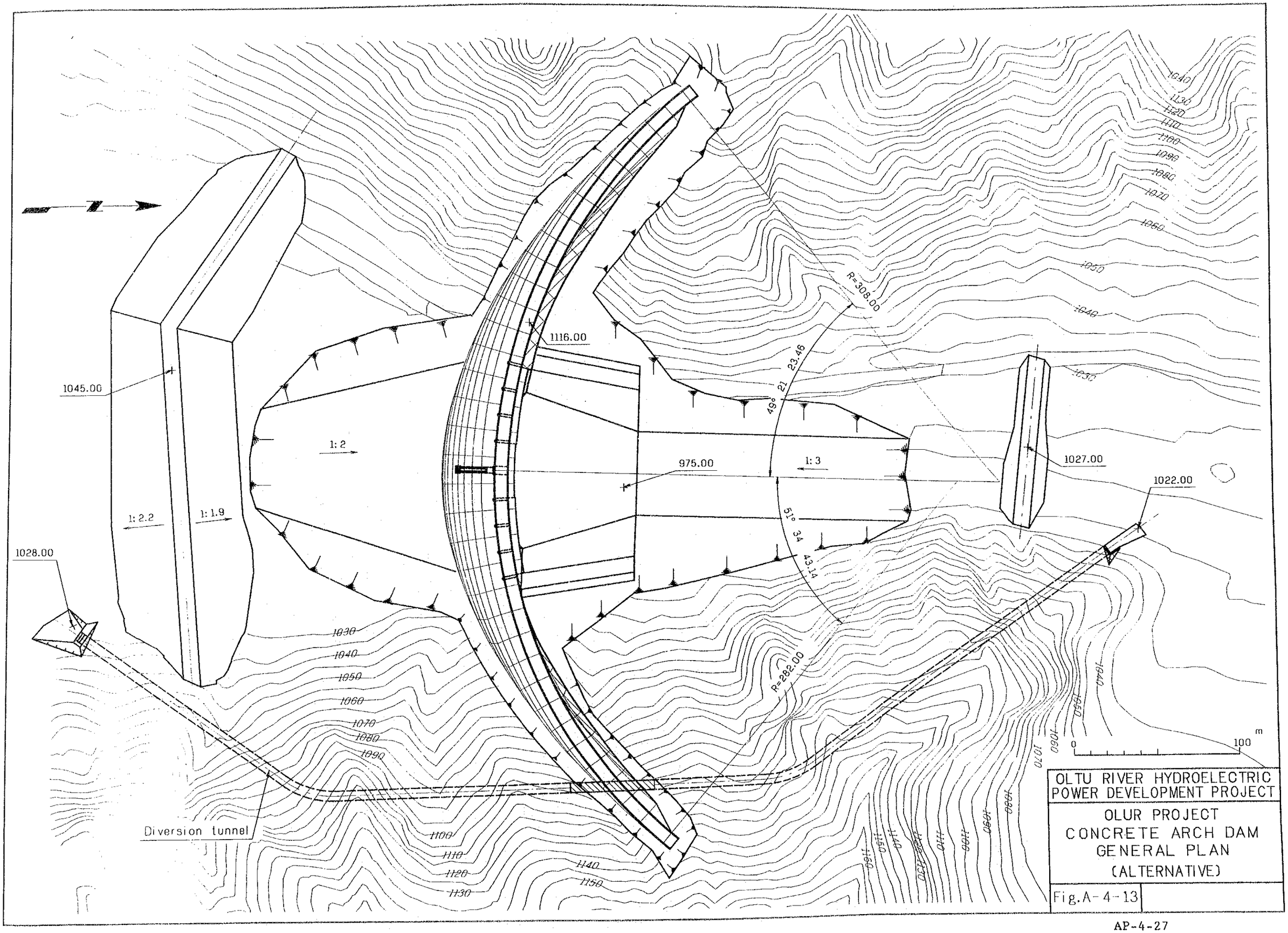



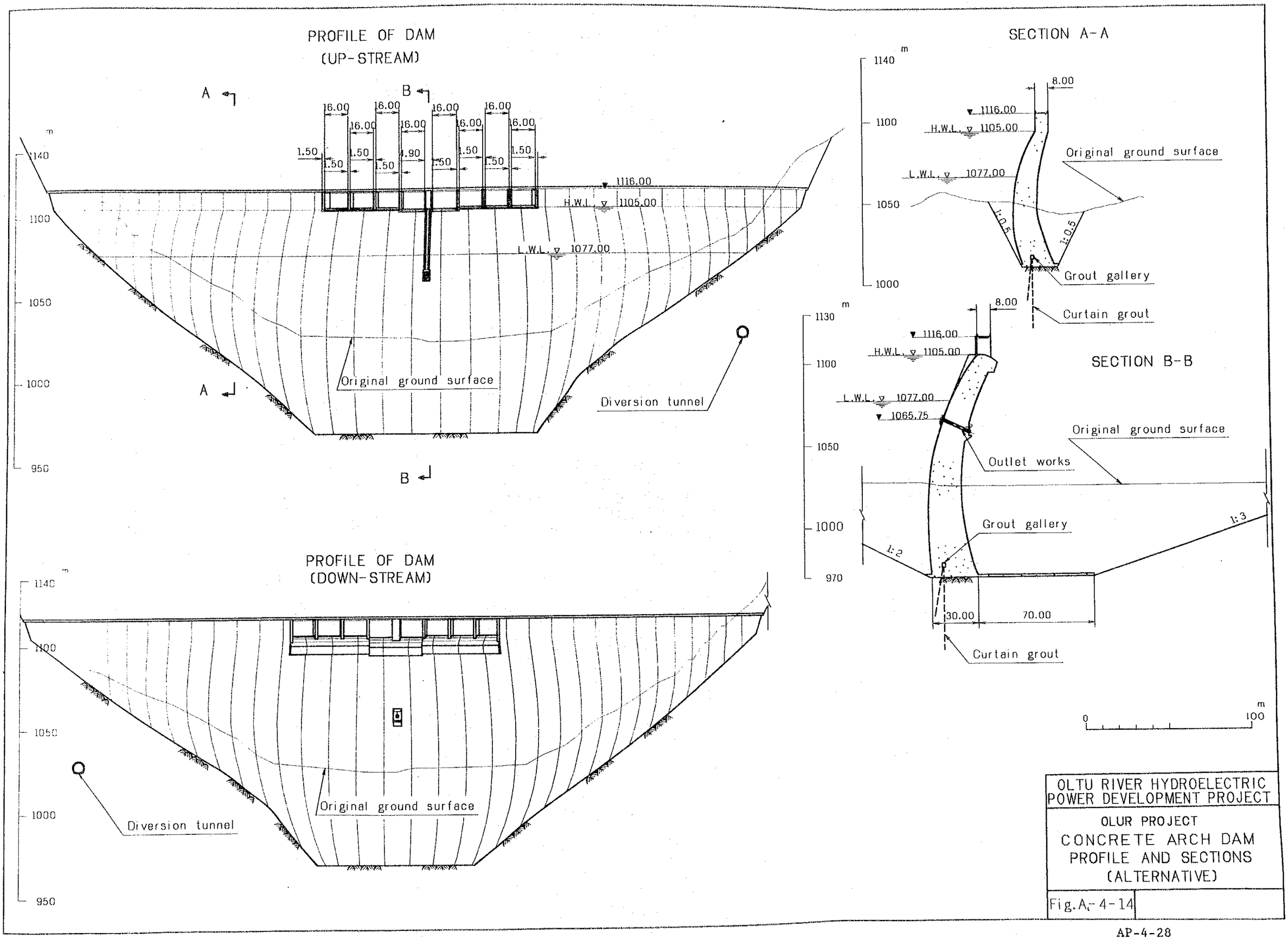



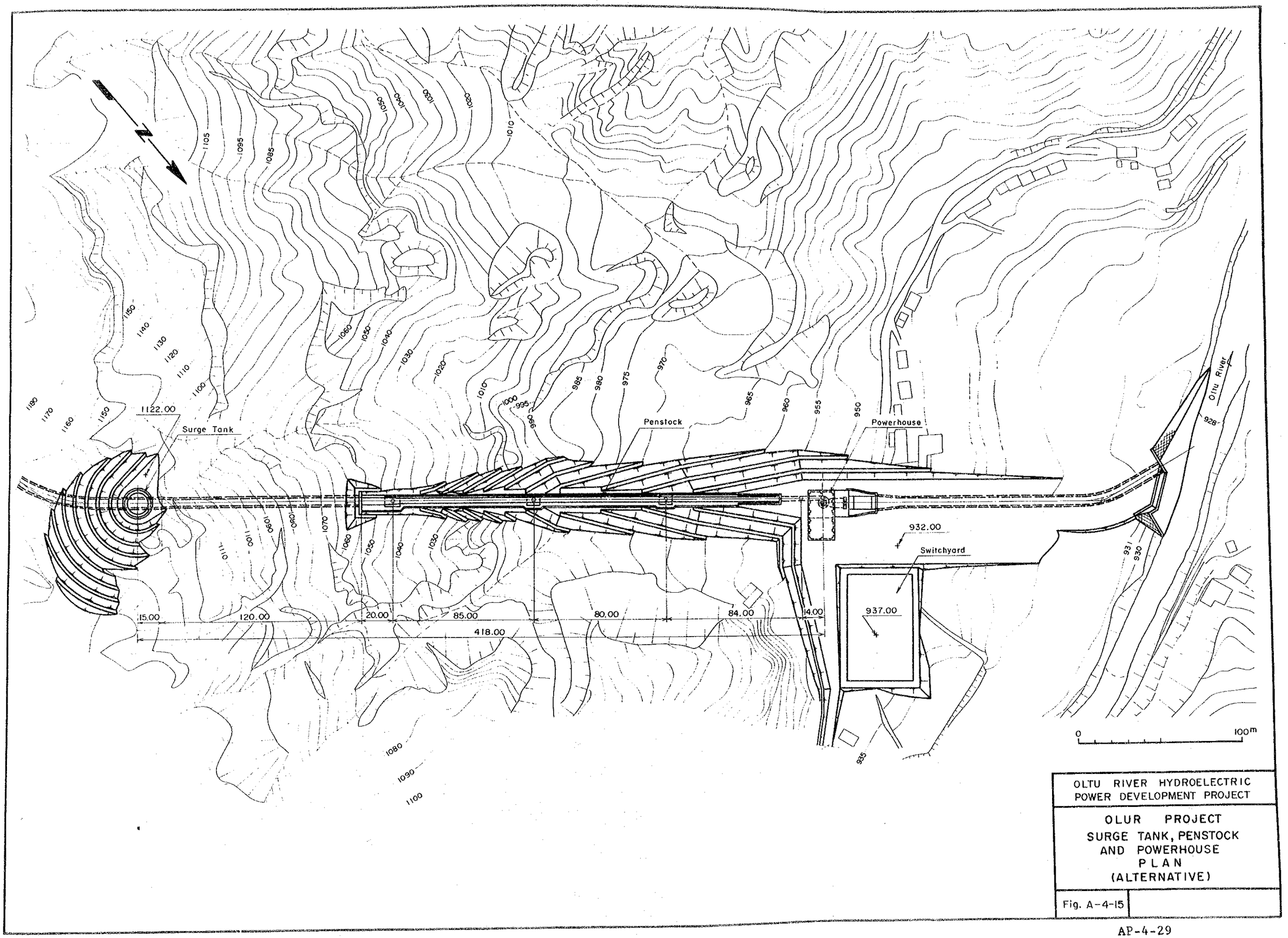

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PEOJECT

OLUR PROJECT
CONCRETE GRAVITY DAM
PROFILE AND SECTIONS
(ALTERNATIVE)

Fig.A-4-12


1045.00
1028.00
1116.00
975.00
1027.00
1022.00
1: 2
1: 2.2
1: 1.9
1: 3
R=308.00
R=282.00
23.46
21
49°
51°
34
43.14
Diversion tunnel
1030
1040
1050
1060
1070
1080
1090
1100
1110
1120
1130
1140
1150
0
100
m
OLTU RIVER HYDROELECTRIC
POWER DEVELOPMENT PROJECT
OLUR PROJECT
CONCRETE ARCH DAM
GENERAL PLAN
(ALTERNATIVE)
Fig.A-4-13

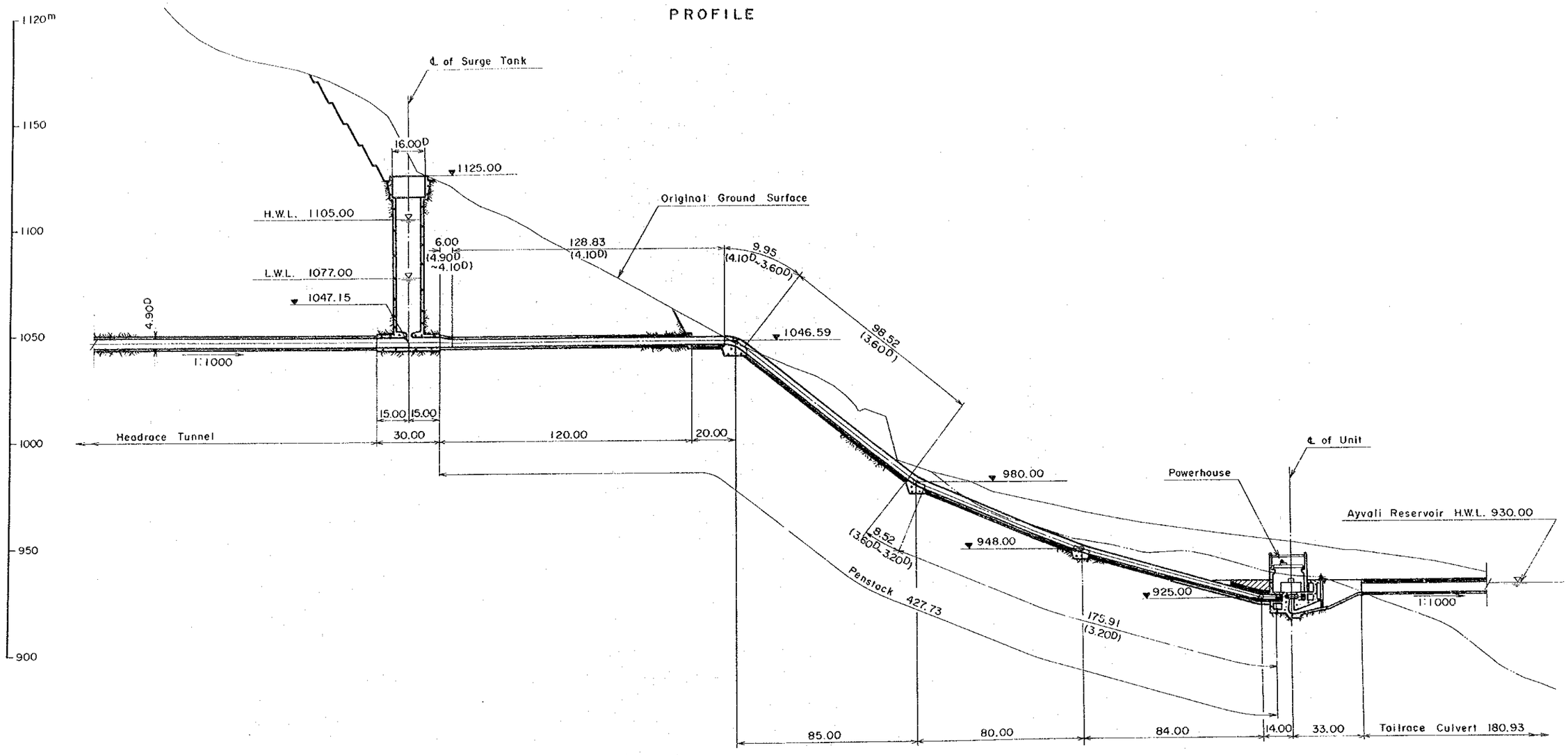

PROFILE OF DAM
(UP-STREAM)
A
B
16.00
1.50
1.90
1116.00
H.W.L. 1105.00
L.W.L. 1077.00
Original ground surface
Diversion tunnel
1140
1100
1050
1000
950
PROFILE OF DAM
(DOWN-STREAM)
Original ground surface
Diversion tunnel
SECTION A-A
8.00
1116.00
H.W.L. 1105.00
L.W.L. 1077.00
Original ground surface
1:0.5
Grout gallery
Curtain grout
1130
SECTION B-B
1065.75
Outlet works
Grout gallery
1:2
1:3
970
30.00
70.00
Curtain grout
0
100
OLTU RIVER HYDROELECTRIC
POWER DEVELOPMENT PROJECT
OLUR PROJECT
CONCRETE ARCH DAM
PROFILE AND SECTIONS
(ALTERNATIVE)
Fig.A-4-14



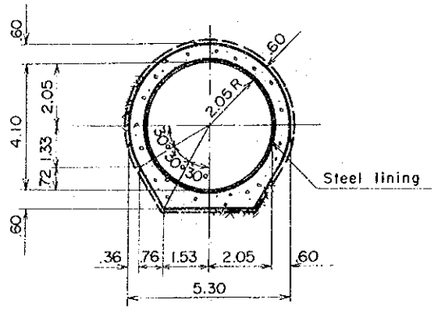

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

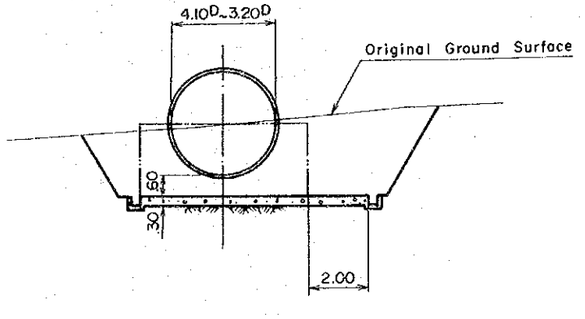
OLUR PROJECT
SURGE TANK, PENSTOCK AND POWERHOUSE PLAN (ALTERNATIVE)

Fig. A-4-15




TYPICAL SECTION OF PENSTOCK



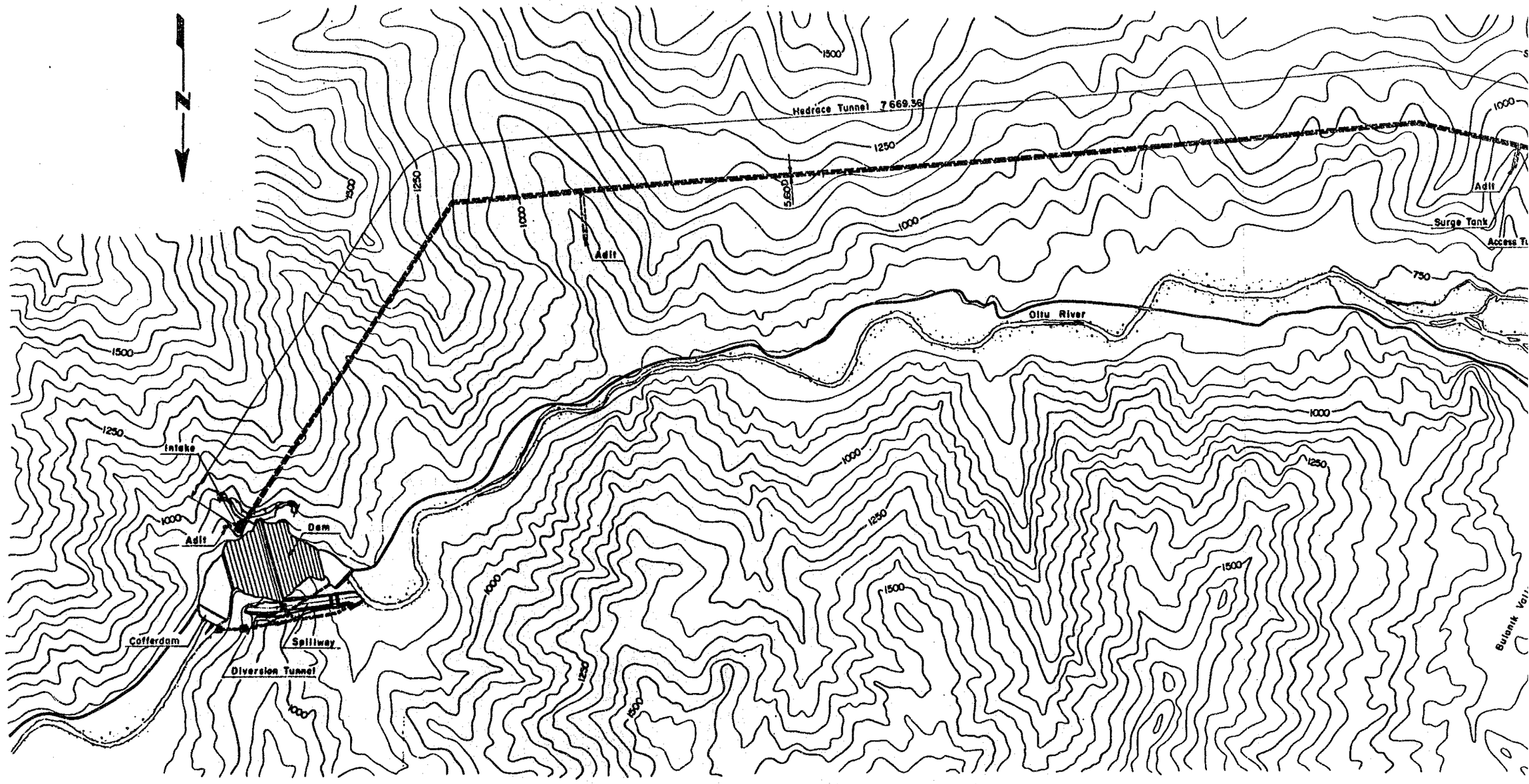

0 100m (PROFILE)

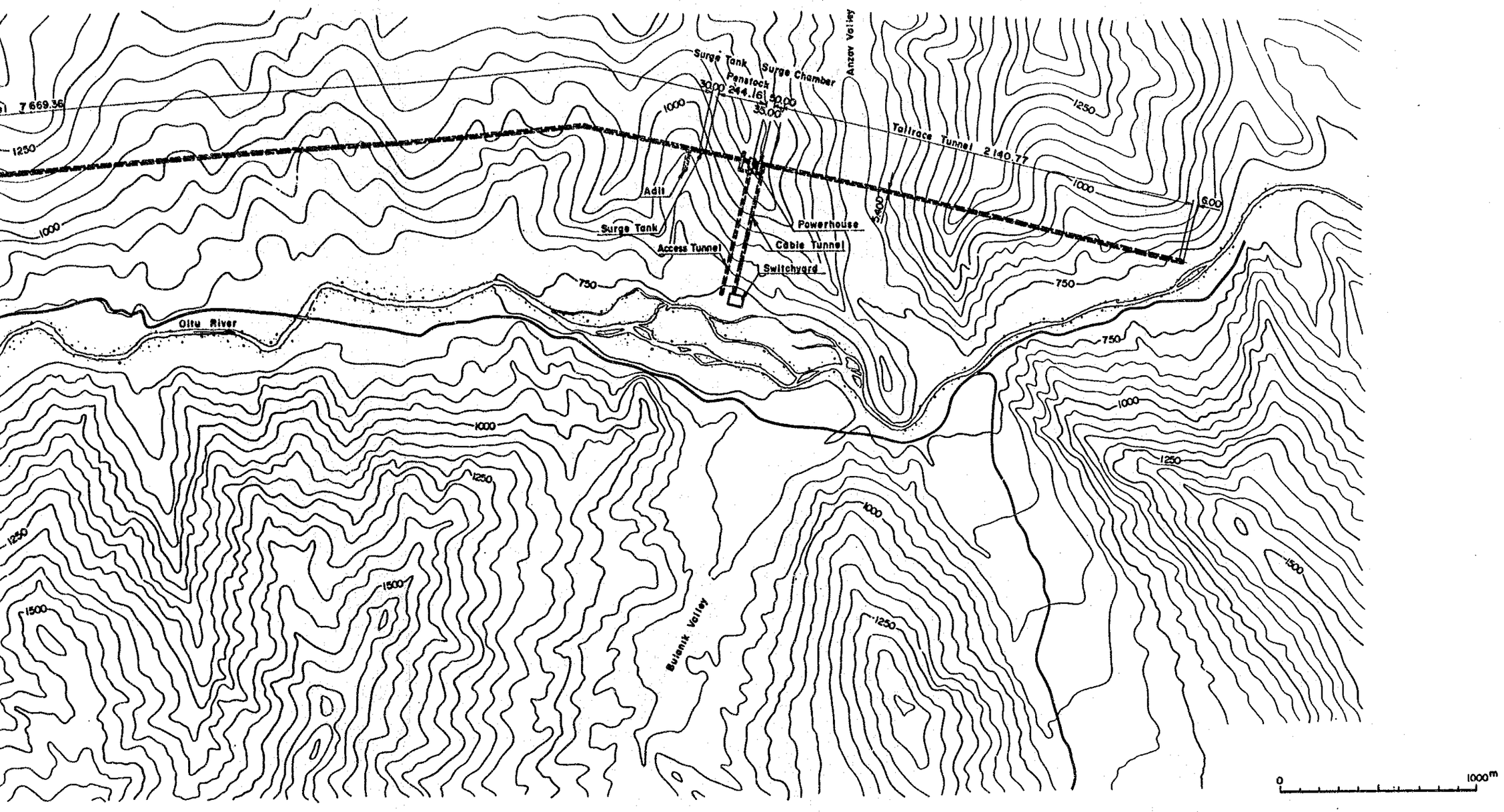
0 10m (TYPICAL SECTION OF PENSTOCK)

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

OLUR PROJECT
SURGE TANK AND PENSTOCK
PROFILE AND SECTIONS
(ALTERNATIVE)

Fig. A-4-16


N
Headrace Tunnel 7,669.36
5,600.0
Adit
Surge Tank
Access Tu
Oltu River
Intake
Adit
Dam
Cofferdam
Spillway
Diversion Tunnel
Bulanik Vall
1500
1250
1000
750



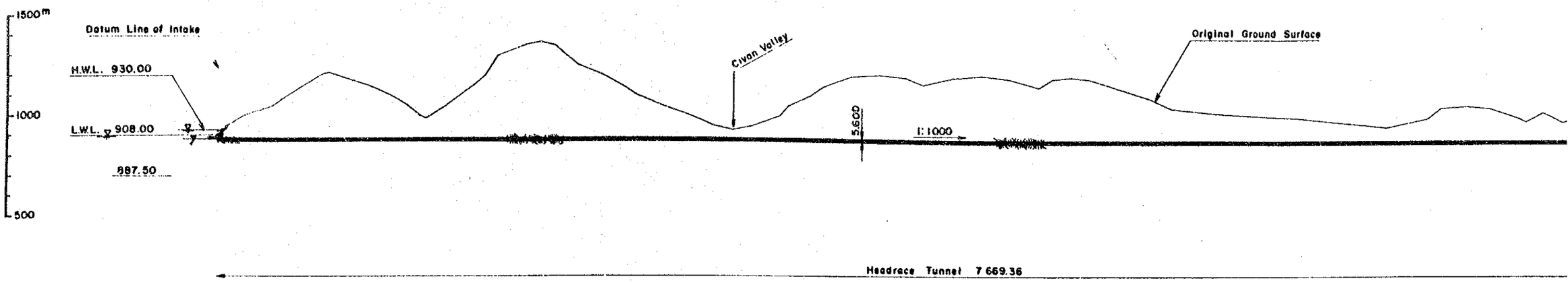

OLTU RIVER HYDROELECTRIC POWER DEVELOPMENT PROJECT

AYVALI PROJECT

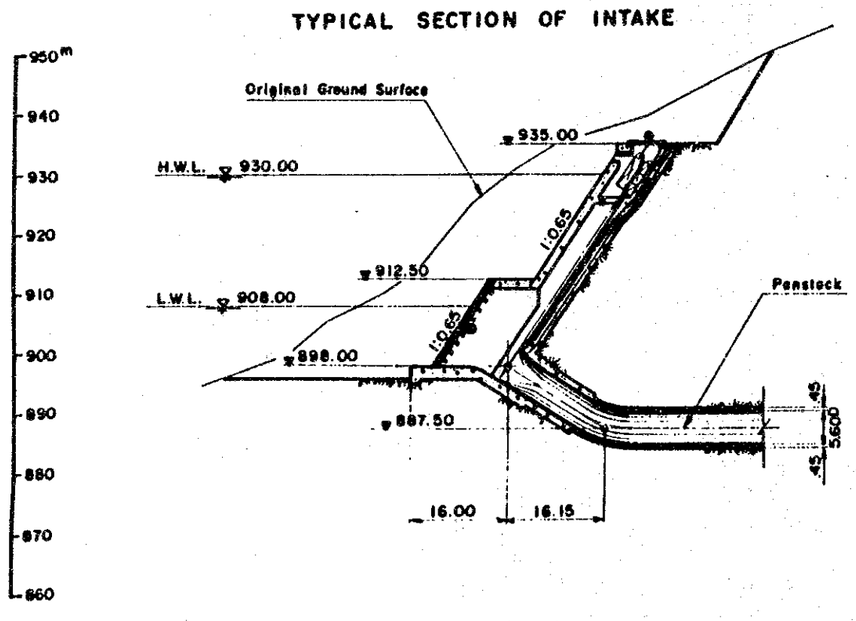
GENERAL PLAN (ALTERNATIVE)

Fig. A-4-17

## PROFILE

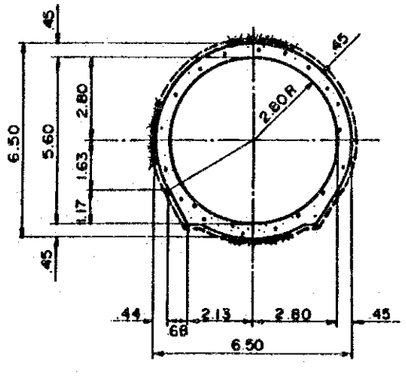


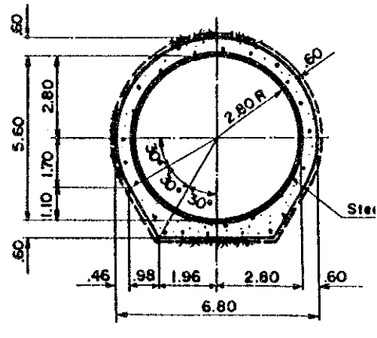

## TYPICAL SECTION OF INTAKE




## TYPICAL SECTION OF TUNNEL

### HEADRACE




### PENSTOCK