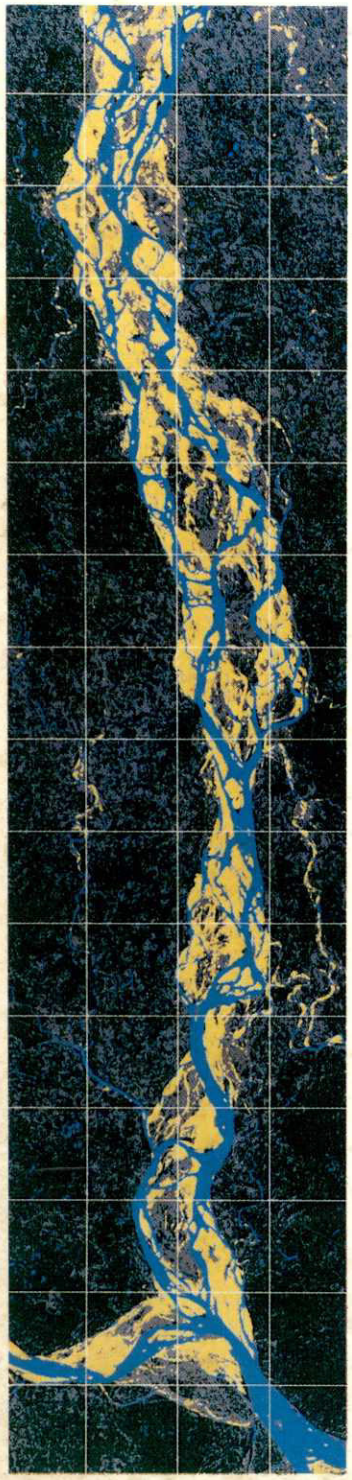
GOVERNMENT OF PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION, WATER DEVELOPMENT AND FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION

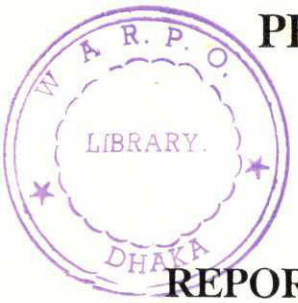
KREDITANSTALT FÜR
WIEDERAUFBAU (KfW)

CAISSE FRANCAISE DE
DEVELOPPEMENT (CFD)



BANK PROTECTION AND RIVER TRAINING (AFPM) PILOT PROJECT FAP 21/22

TEST AND IMPLEMENTATION PHASE



REPORT ON MONITORING AND ADAPTATION AT KAMARJANI TEST SITE

INTERIM REPORT (ANNEXES)

MARCH 1996

CONSULTING CONSORTIUM FAP 21/22

RHEIN-RUHR ING.-GES.MBH, DORTMUND/GERMANY

COMPAGNIE NATIONALE DU RHONE, LYON/FRANCE
PROF.DR. LACKNER&PARTNERS, BREMEN/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS

In association with:

BANGLADESH ENGINEERING &
TECHNOLOGICAL SERVICES LTD.(BETS)
DESH UPODESH LIMITED (DUL)

BANK PROTECTION AND RIVER TRAINING
(AFPM) PILOT PROJECT
FAP 21/22

TEST AND IMPLEMENTATION PHASE

REPORT ON MONITORING AND ADAPTATION AT KAMARJANI TEST SITE

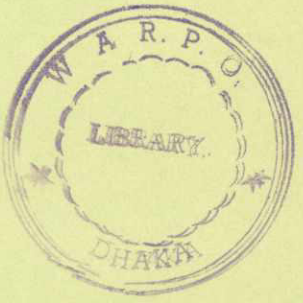
INTERIM REPORT (ANNEXES)

MARCH 1996

BANK PROTECTION AND RIVER TRAINING/AFPM PILOT PROJECT
FAP 21/22

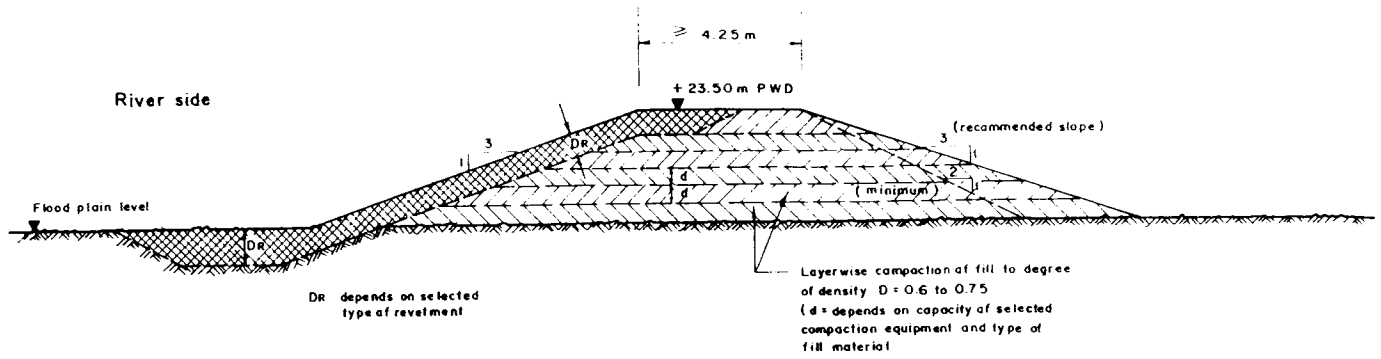
REPORT ON MONITORING AND ADAPTATION AT KAMARJANI TEST SITE

List of Annexes



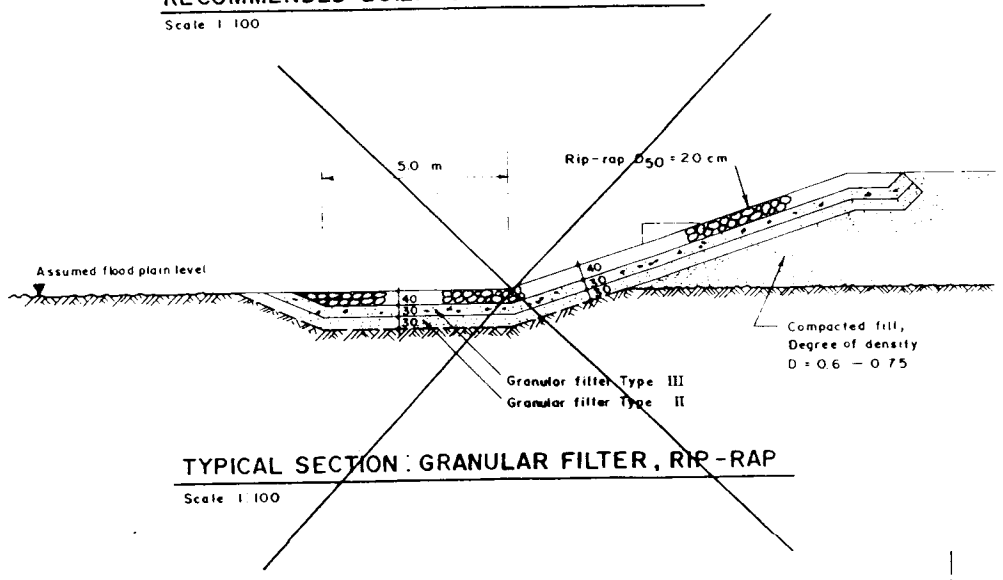
ANNEX A

As Built Drawings



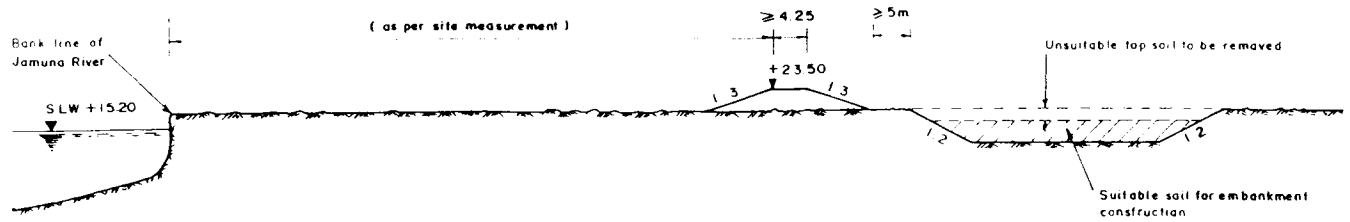
RECOMMENDED BUILT-UP OF EMBANKMENT

Scale 1 100



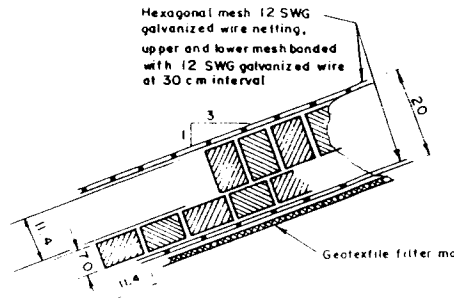
TYPICAL SECTION : GRANULAR FILTER, RIP-RAP

Scale 1 100

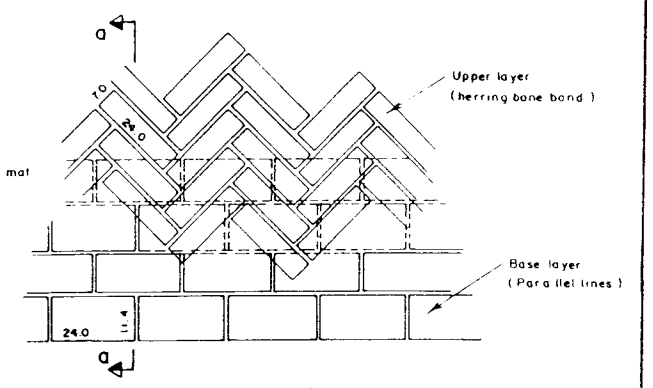


RECOMMENDED CROSS-SECTION OF EMBANKMENT AT TEST SITE I

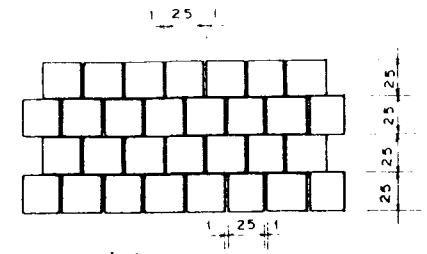
Scale 1 500



SECTION a-a

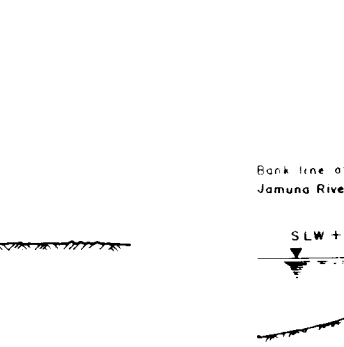


DETAIL 'A' : BRICK MATTRESS, d = 20 cm (measurements in cm)



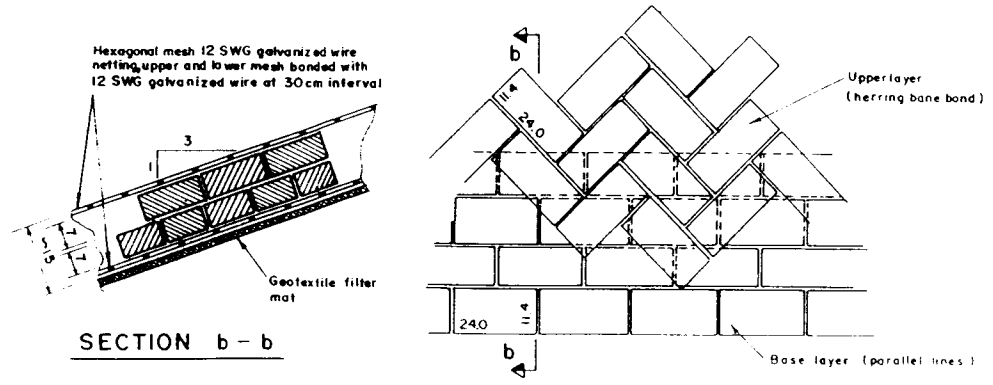
DETAIL 'D'
LAYING PATTERN OF CONCRETE BLOCKS

Scale 1 20 (measurements in cm)



DETAIL OF BRICK BLOCK

Scale 1 10



SECTION b – b

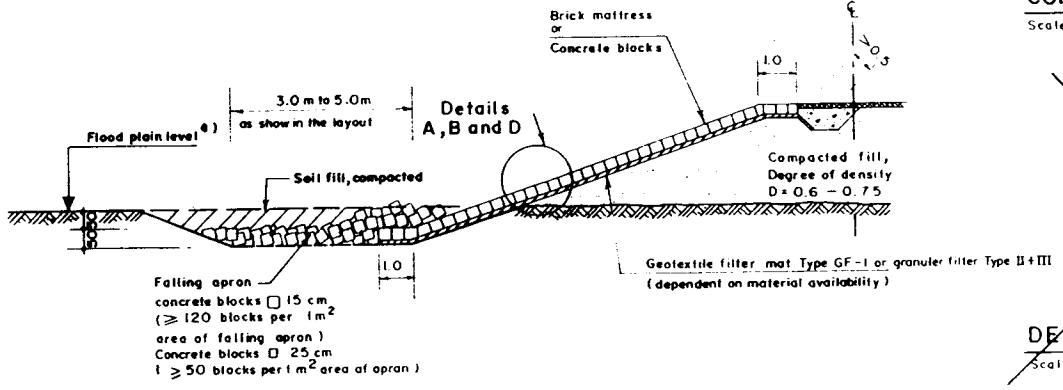
DETAIL 'B' : BRICK MATTRESS, d = 15 cm (measurements in cm)

Ⓐ Brick mattress 20 cm FA 15°/3 m wide

Ⓑ Brick mattress 15 cm FA 15°/3 m wide

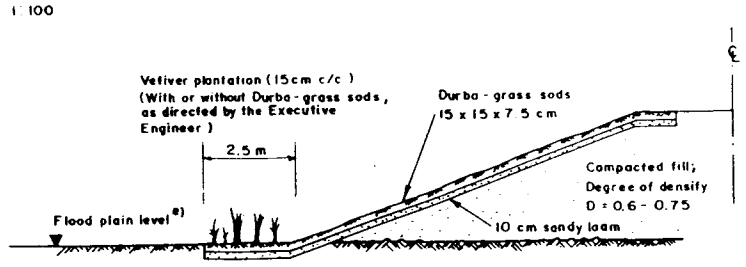
Ⓒ Durba / Vetiver 2.5 m wide

Ⓓ (Provisional works) CC-blocks 25° FA 25°/5 m wide



TYPICAL SECTION Ⓐ Ⓑ Ⓓ : GEOTEXTILE FILTER, CC-BLOCKS or BRICK MATTRESSES

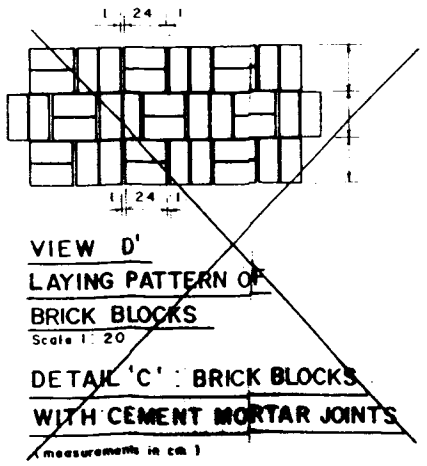
Scale 1 100



TYPICAL SECTION Ⓒ : BIOTECHNICAL REVETMENT

Scale 1 100

*) or as decided at Site by the Employer.



VIEW D'
LAYING PATTERN OF BRICK BLOCKS

Scale 1 20

DETAIL 'C' : BRICK BLOCKS WITH CEMENT MORTAR JOINTS

(measurements in cm)

NOTES

1. Levels refer to ±0.0 m PWD
2. Measurements in meter and centimeter
3. Filter material was Geotextile Type GF-I, and granular filter Type II + III (30 cm thick each), as instructed at Site by the Employer.
4. Reference Drawings :
   - KA-016 General Arrangement of Revetment Protection
   - KA-005 Filter Gradation Curves

DRAWING PHOTOREDUCED BY 50 %

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
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FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

RHEIN-RUHR ING.-GES MBH, DORTMUND/GERMANY — In association with
COMPAGNIE NATIONALE DU RHONE, LYON/FRANCE
PROF. DR. LACKNER & PARTNERS, BREMEN/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD. (BETS)
DESH UPODESH LIMITED (DUL)

TEST SITE I - KAMARJANI

BWDB - EMBANKMENT
REVETMENT DETAILS

REV.	DATE	NAME	DESCRIPTION	APPROVED
2	22-07	ANOWAR	AS BUILT DRAWING	
1	13-12	ANOWAR	REVETMENT DETAILS	

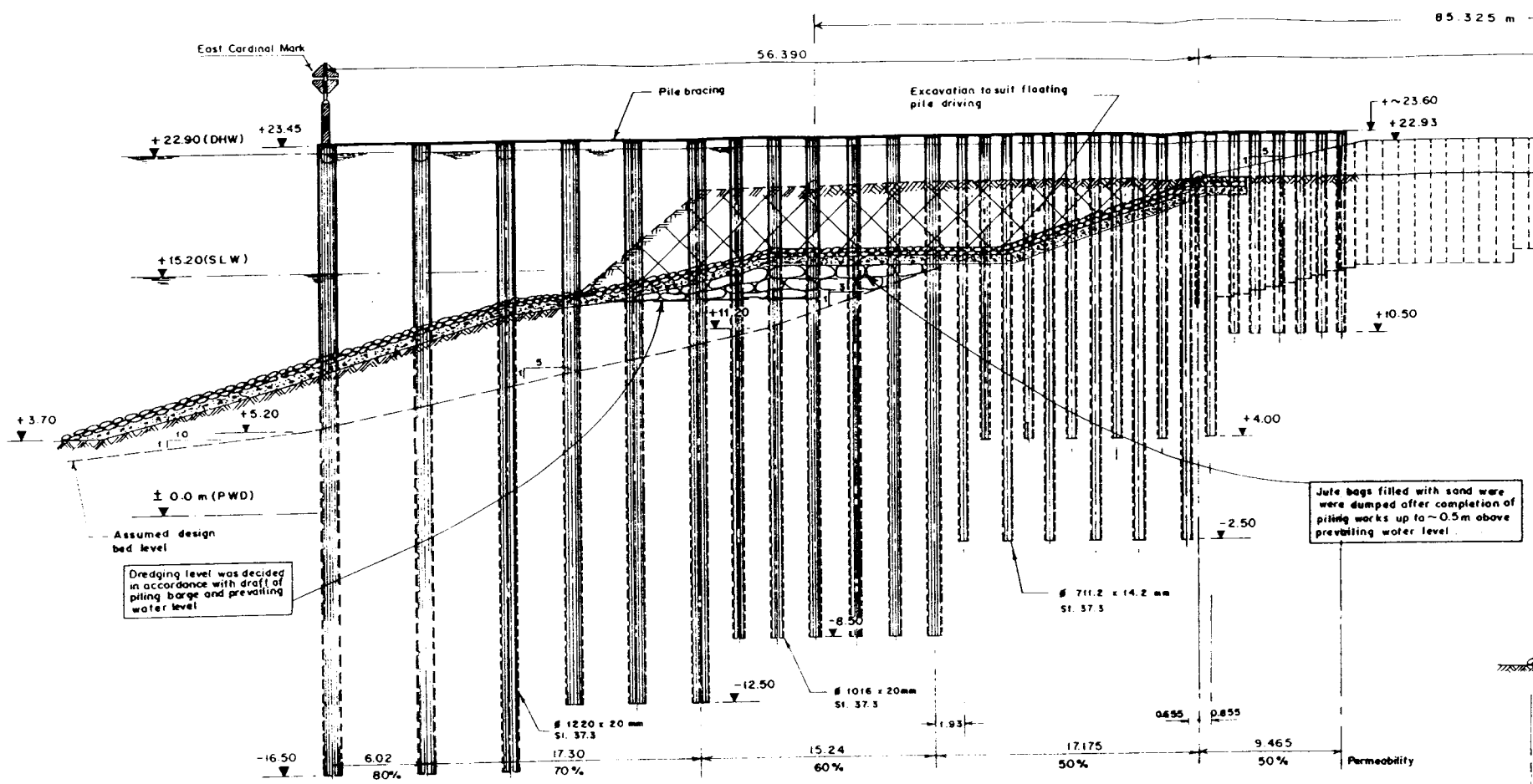
	NAME	DATE
DRAWN	F. HOSSAIN	06-02-94
CHECKED		08-02-94
APPROVED		10-02-94

SCALE 1:100, 1:20, 1:10

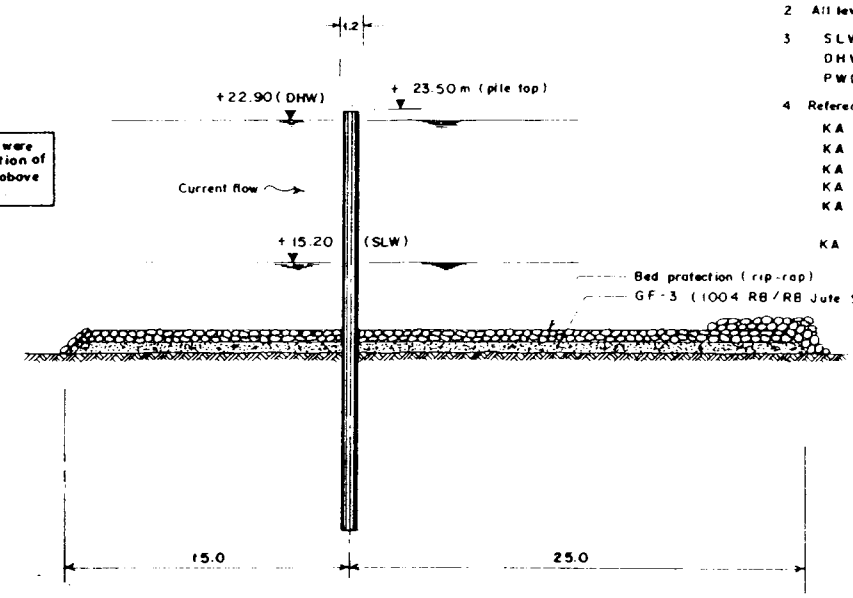
DRAWING NO. KA-014

REVISION 2

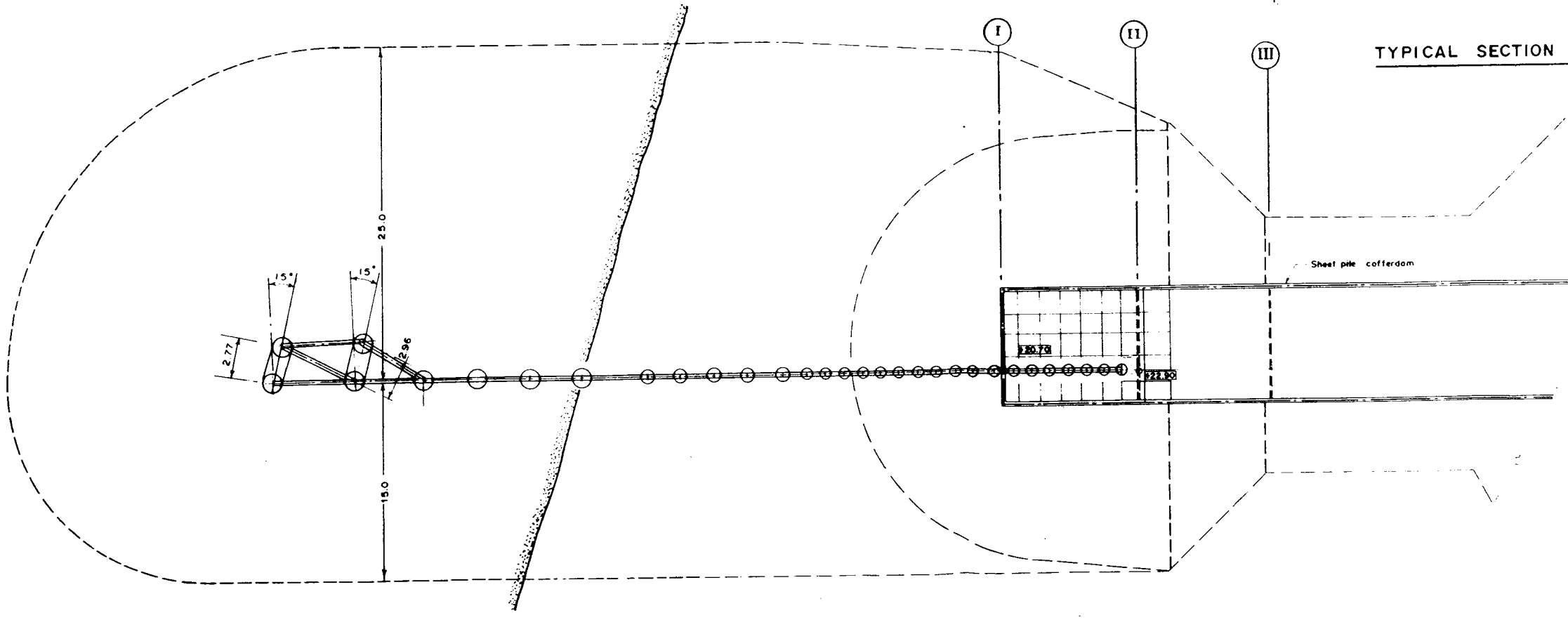
ELEVATION



TYPICAL SECTION



PLAN



Notes

1. All measurements in meters.
2. All levels refer to ±0.0m PWD
3. SLW = Standard Low Water.
   DHW = Design High Water
   PWD = Public Works Datum
4. Reference Drawings:
   - KA - 003 Layout of Groynes
   - KA - 105 Pile Installation Plan
   - KA - 106 Sheet Pile Cofferdam
   - KA - 109 Revetment and Bed Protection
   - KA - 111/1 Pile Frame and bracing
   - KA - 113 Navigation Aids "East Cardinal Mark"

DRAWING PHOTOREDUCED BY 50

REV.	DATE	NAME	DESCRIPTION	APPROVED
3	23/5/95	ANOWAR	AS BUILT DRAWING	
2	15/7/94	ANOWAR	RIVER BED LEVEL	
1	3/10/94	ANOWAR	PILE LAYOUT, GANGWAY, PLATFORM	

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
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FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

TEST SITE I - KAMARJANI

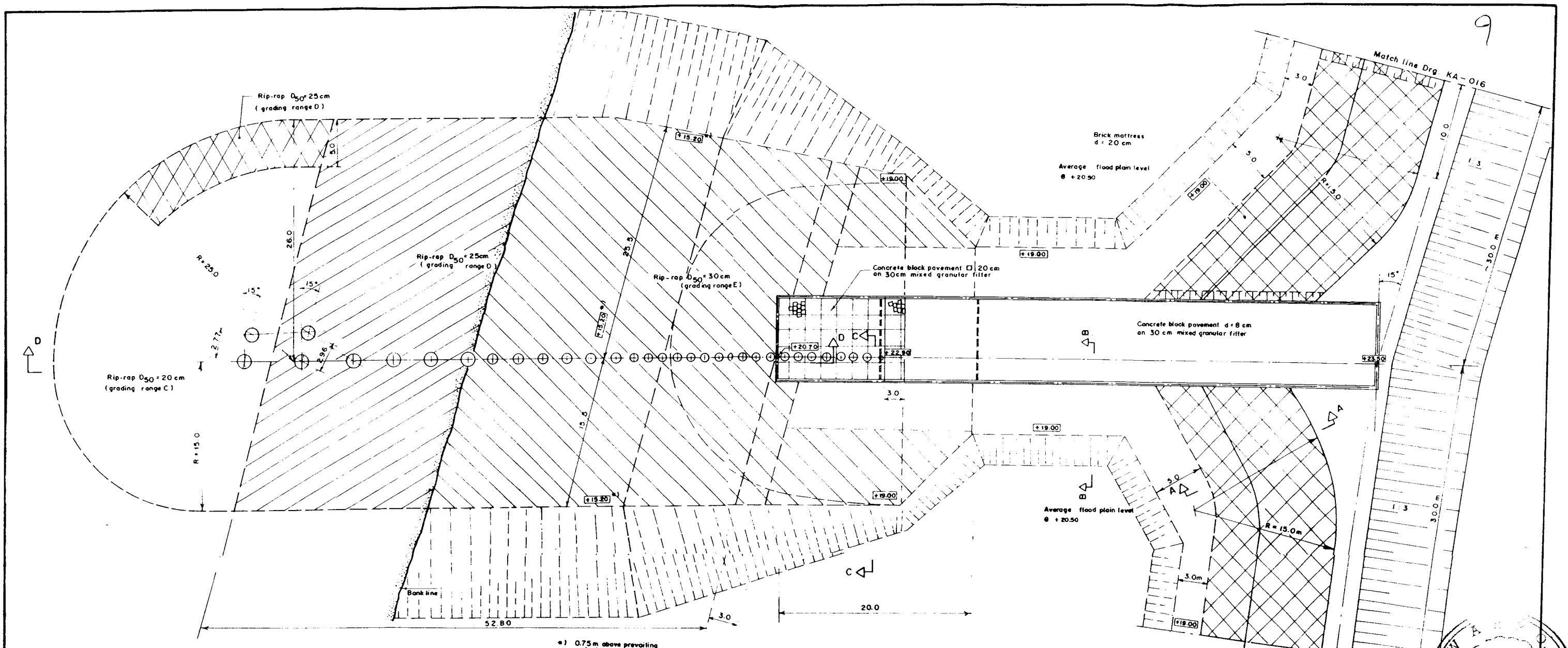
GROYNE G-1
GENERAL ARRANGEMENT
ELEVATION, PLAN, SECTION

	NAME	DATE
DRAWN	ANOWAR	07-12-93
CHECKED		19-01-94
APPROVED		10-02-94

SCALE : 1 : 200

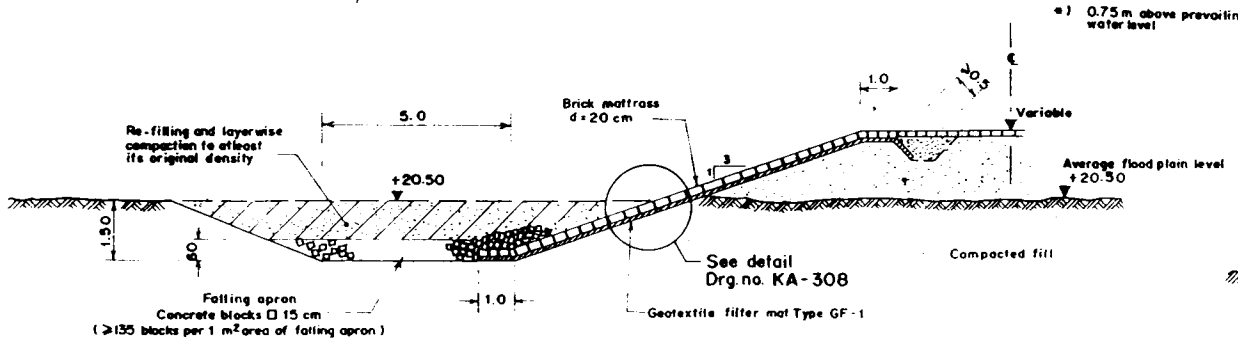
DRAWING NO. KA - 101

REVISION 3

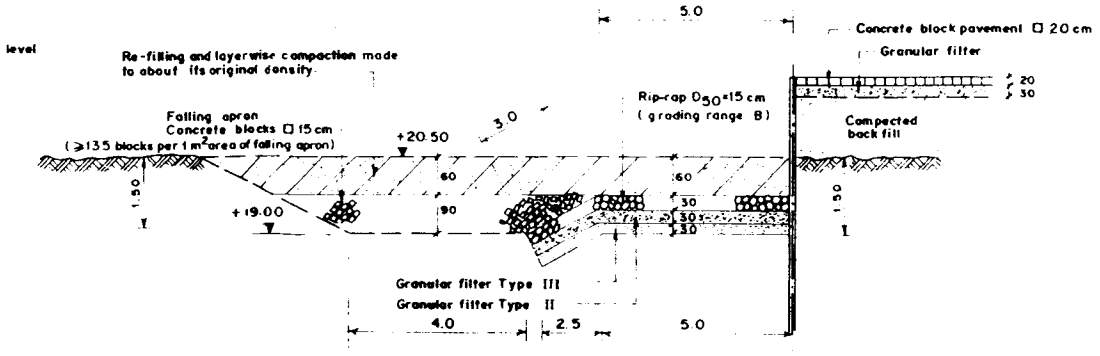


a) 0.75 m above prevailing water level

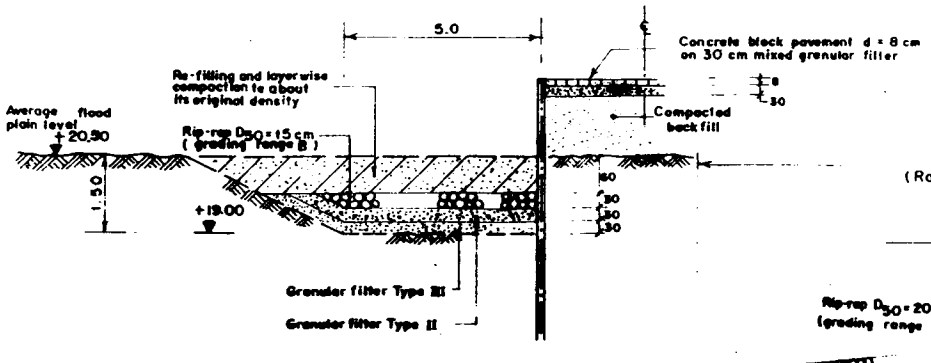
PLAN
Scale : 1 : 200



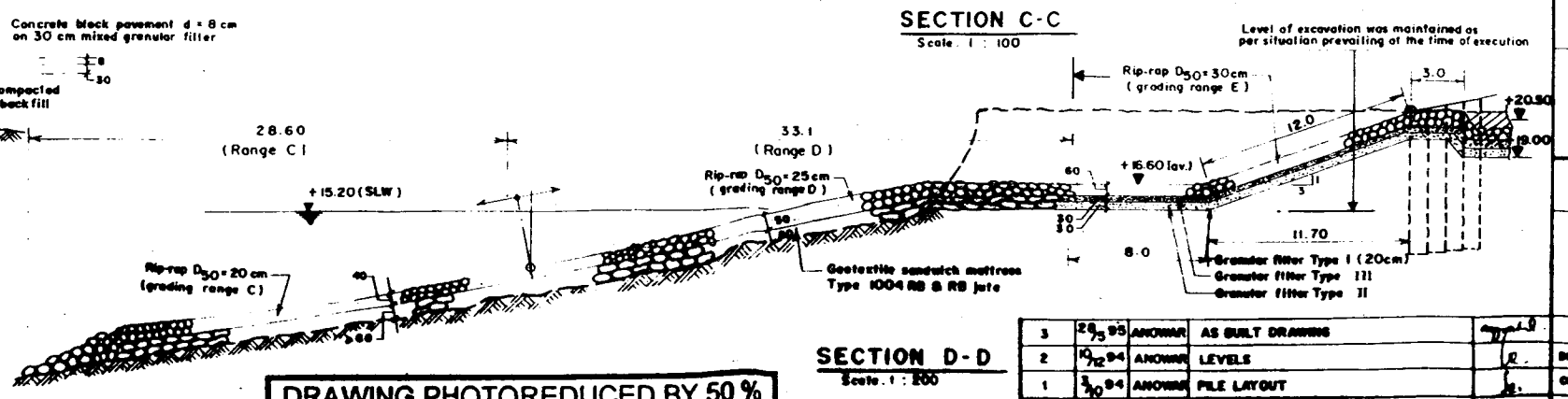
SECTION A-A
Scale : 1 : 100



SECTION C-C
Scale : 1 : 100



SECTION B-B
Scale : 1 : 100



SECTION D-D
Scale : 1 : 200

DRAWING PHOTOREDUCED BY 50 %

Notes :

1. All measurements in meters.
2. Levels refer to ± 0.0 m PWD
3. Assumed levels are subject to confirmation as per actual site conditions and prevailing water level
4. Reference Drawings :
   - KA - 003 Layout of Groynes
   - KA - 005 Filter Gradation Curves
   - KA - 006 Stone Gradations and Layer Thicknesses.
   - KA - 308 Revetments and Falling Aprons, Detailed Sections
   - KA - 010 General Installation Method; Geotextile Filter Materials.

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
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BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

In association with:

TEST SITE I - KAMARJANI

GROYNE G-1
REVETMENT AND BED PROTECTION
PLAN, DETAILED SECTIONS

REV.	DATE	NAME	DESCRIPTION	APPROVED
3	26/5/95	ANOWAR	AS BUILT DRAWING	
2	10/12/94	ANOWAR	LEVELS	
1	3/10/94	ANOWAR	PILE LAYOUT	

	NAME	DATE
DRAWN	ANOWAR	07-12-93
CHECKED		19-01-94
APPROVED		10-02-94

SCALE : 1 : 100, 1 : 200

DRAWING NO. KA - 109

REVISION 3

East Cardinal Mark

64.91

Gangway Unit 1

Gangway Unit 2

Monitoring gangway (Standard units)

Excavation to suit floating pile driving

60.0

M.F.S

+23.50

4.25

Driving level +23.45

+22.90 (DHW)

+23.10

+22.90

+23.60

Test Pile

Impermeable groyne

New embankment constructed under contract of BWDB

±15.20 (SLW)

+11.20

Falling apron

+5.20

Assumed design bed level

±0.0m(PWD)

+4.0

-2.50

Jute bags filled with sand dumped after completion of piling works up to ~0.5 m above prevailing water level

ϕ 711.2x14.2mm St 37-3

-8.50

0.755

0.755

16.50

50%

9.465

50%

Permeability

ϕ1220x20mm St.37-3

-12.50

ϕ 1016 x 20mm St.37-3

85

ϕ 1220 x 14.2mm St 37-3

ϕ1220 x 20mm St 37-3

-16.50

16.91

70%

2.68

14.65

60%

16.11

80%

ELEVATION

15°

15.0

Falling apron (concrete blocks)

300

1.20

Monitoring equipment

+22.90

Monitoring gangway

15.0

1:3

Stone revetment on granular filter layer

Stone revetment on granular filter layer

Brick mattress on geotextile filter mat

+23.50

M.F.S.

8.0

Stone revetment on granular filter layer

Brick mattress on geotextile filter mat

PLAN

Notes

1. All measurements in meters.
2. All levels refer to ± 0.0m PWD.
3. SLW - Standard Low Water
   DHW - Design High Water
4. Reference Drawings:
   KA - 003/I Layout of Groynes
   KA - 205 Pile Installation Plan
   KA - 206 Revetments, Falling Aprons, Plan
   KA - 207 Revetments, Falling Aprons, Details
   KA - 208/I Monitoring Gangway (Standard Unit)
   KA - 208/II Monitoring Gangway (Units 1 + 2)
   KA - 208/III Supplementary Drawing for Gangway Unit-2
   KA - 113 Navigation Aids " East Cardinal Mark ".

DRAWING PHOTOREDUCED BY 50 %

REV.	DATE	NAME	DESCRIPTION	APPROVED
3	15-3-95	EHOSSAIN	AS BUILT DRAWING	
2	14-11	ANOWAR	RIVER BED PROFILE, PILE LENGTHS	
1	26-9	ANOWAR	PILE LAYOUT, NOTES.	

	NAME	DATE
DRAWN	ANOWAR	07-12-93
CHECKED		20-01-94
APPROVED		10-02-94

SCALE 1 : 200

DRAWING NO. KA - 201

REVISION 3

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION, WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

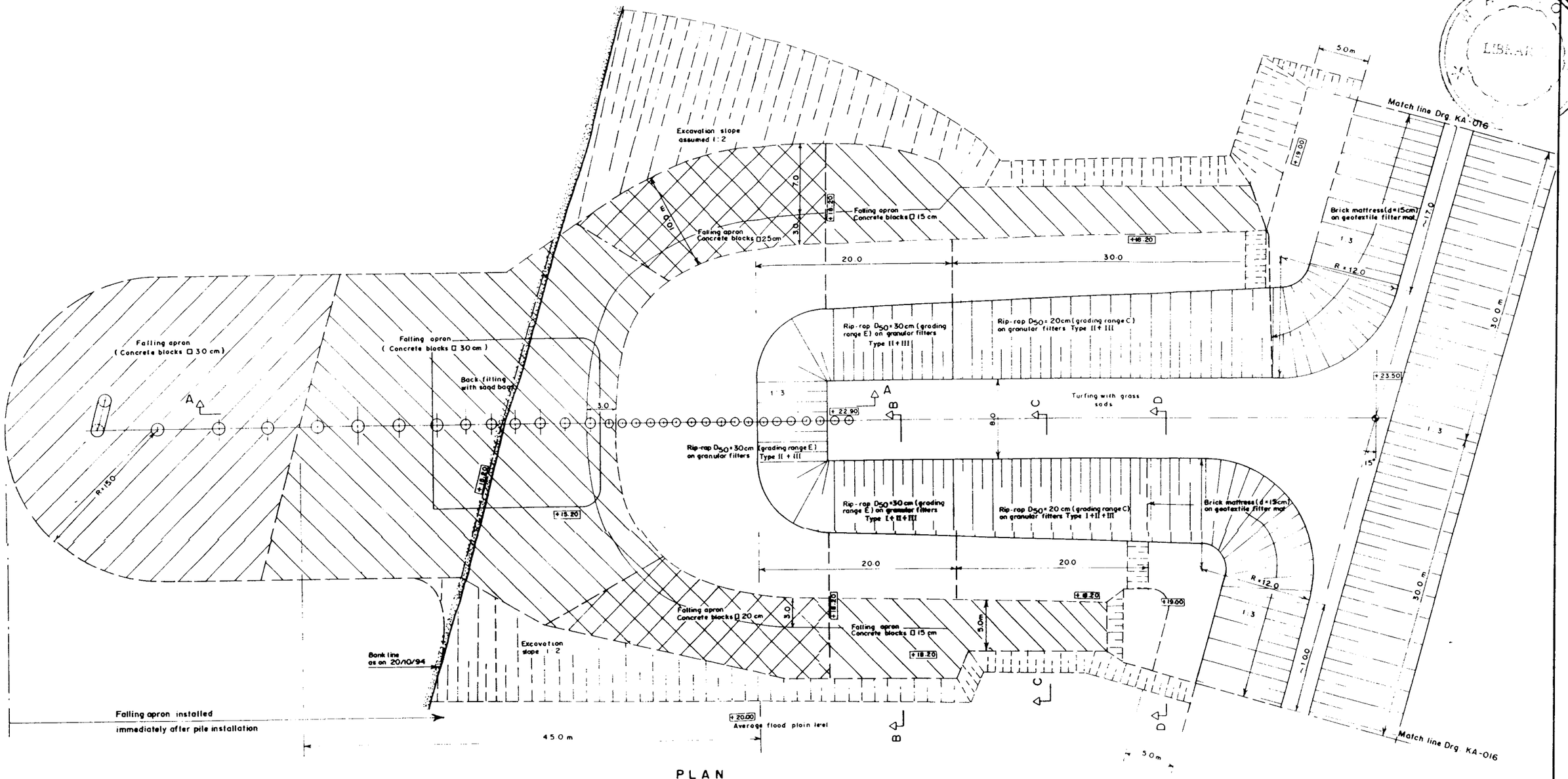
CONSULTING CONSORTIUM

In association with

BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD. (BETS)

TEST SITE I - KAMARJANI

GROYNE G-2
GENERAL ARRANGEMENT
ELEVATION, PLAN



PLAN

DRAWING PHOTOREDUCED BY 50 %

General Falling Apron Data

Block Size (cm)	Layer Thickness (cm)	No. of Blocks per 1 m^2	Single Block Weight (kg)
15	≥ 50	≥120	~ 6.7
20	≥ 70	≥ 70	~ 15.8
25	≥ 90	≥ 50	~ 31.0
30	≥105	≥ 35	~ 53.5
35	≥125	≥ 25	~ 85.0
40	≥140	≥ 20	~ 126.7

Notes :

1. All measurements in meter.
2. Levels refer to ± 0.0 m PWD.
3. Reference Drawings
   - KA - 003/1 Layout of Groynes
   - KA - 006 Stone Gradation and Layer Thickness
   - KA - 207 Revetments and Falling Aprons, Detailed Sections.

REV.	DATE	NAME	DESCRIPTION	APPROVED
3	07-06	ANOWAR	AS BUILT DRAWING	
2	11-12	ANOWAR	BANKLINE, ELEVATIONS	
1	28-9	ANOWAR	PILE LAYOUT, FALLING APRONS	

	NAME	DATE
DRAWN	ANOWAR	08-12-93
CHECKED		24-01-94
APPROVED		10-02-94

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
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BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

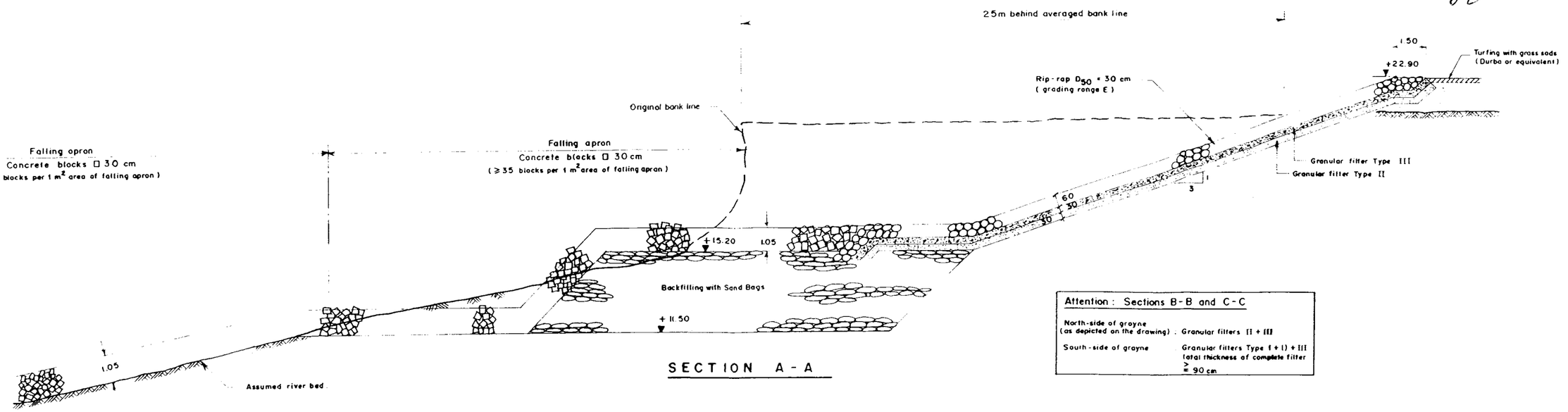
TEST SITE I - KAMARJANI

GROYNE G-2
REVETMENTS, FALLING APRONS
PLAN

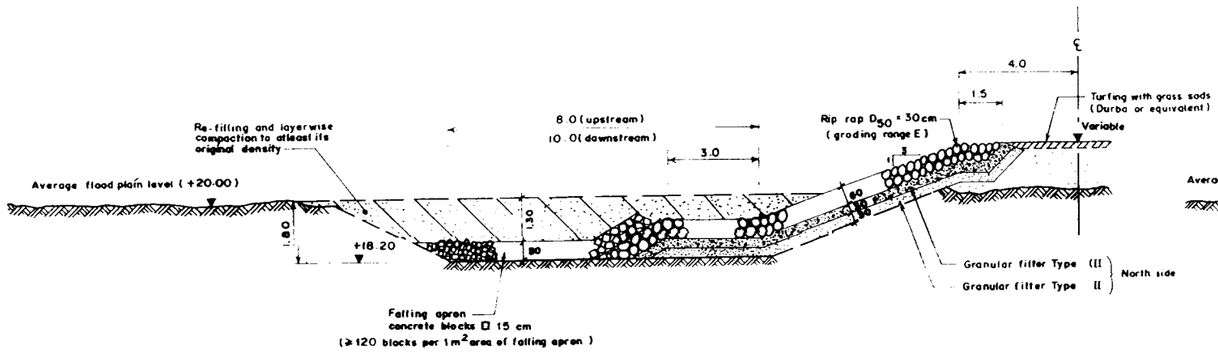
SCALE: 1 : 200

DRAWING NO. KA-206

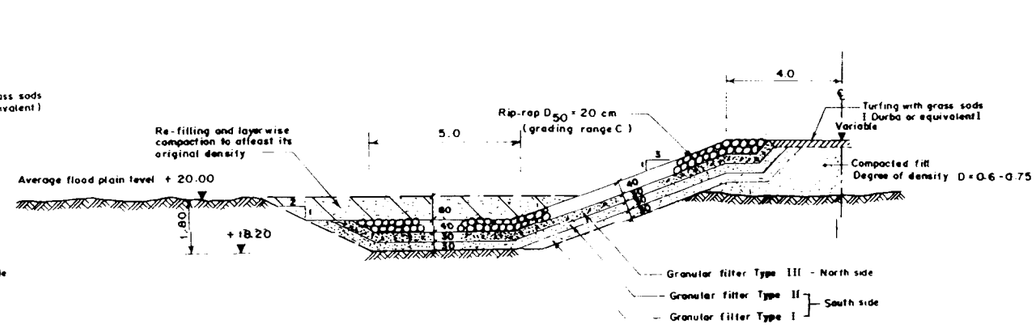
REVISION 3



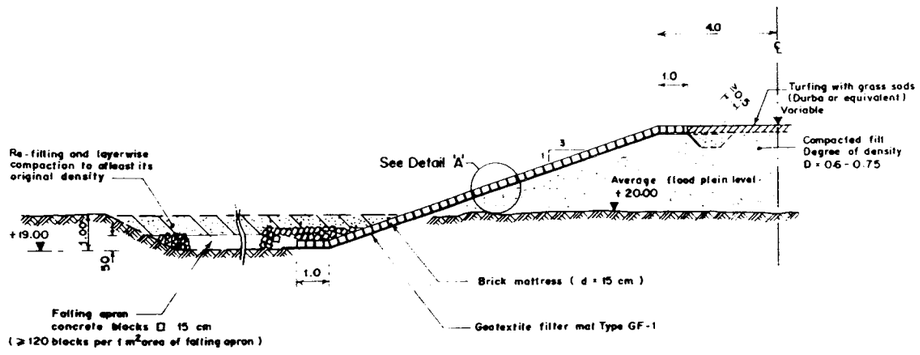
SECTION A - A



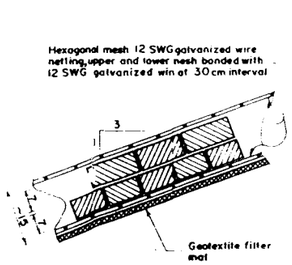
SECTION B-B

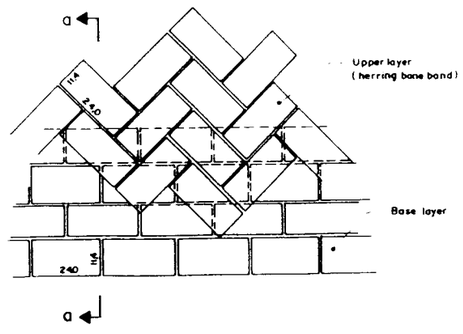


SECTION C-C



SECTION D-D





SECTION a - a

DETAIL 'A'
BRICK MATTRESS (15 cm)

Notes :

1. Measurements are in meter and centimeter.
2. Levels refer to ±0.0 m PWD
3. Reference Drawings :
   - KA - 206 Revetments, Falling Aprons, Plan
   - KA - 005 Filter Gradation Curves.
   - KA - 006 Stone Gradation and Layer Thicknesses.

DRAWING PHOTOREDUCED BY 50 %

REV	DATE	NAME	DESCRIPTION	APPROVED
3	26.95	ANOWAR	AS BUILT DRAWING	
2	13-12	ANOWAR	LEVELS, MEASUREMENTS	
1	26-9	ANOWAR	SECTION A-A, BRICK MATTRESS	

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
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CONSULTING CONSORTIUM

TEST SITE I - KAMARJANI

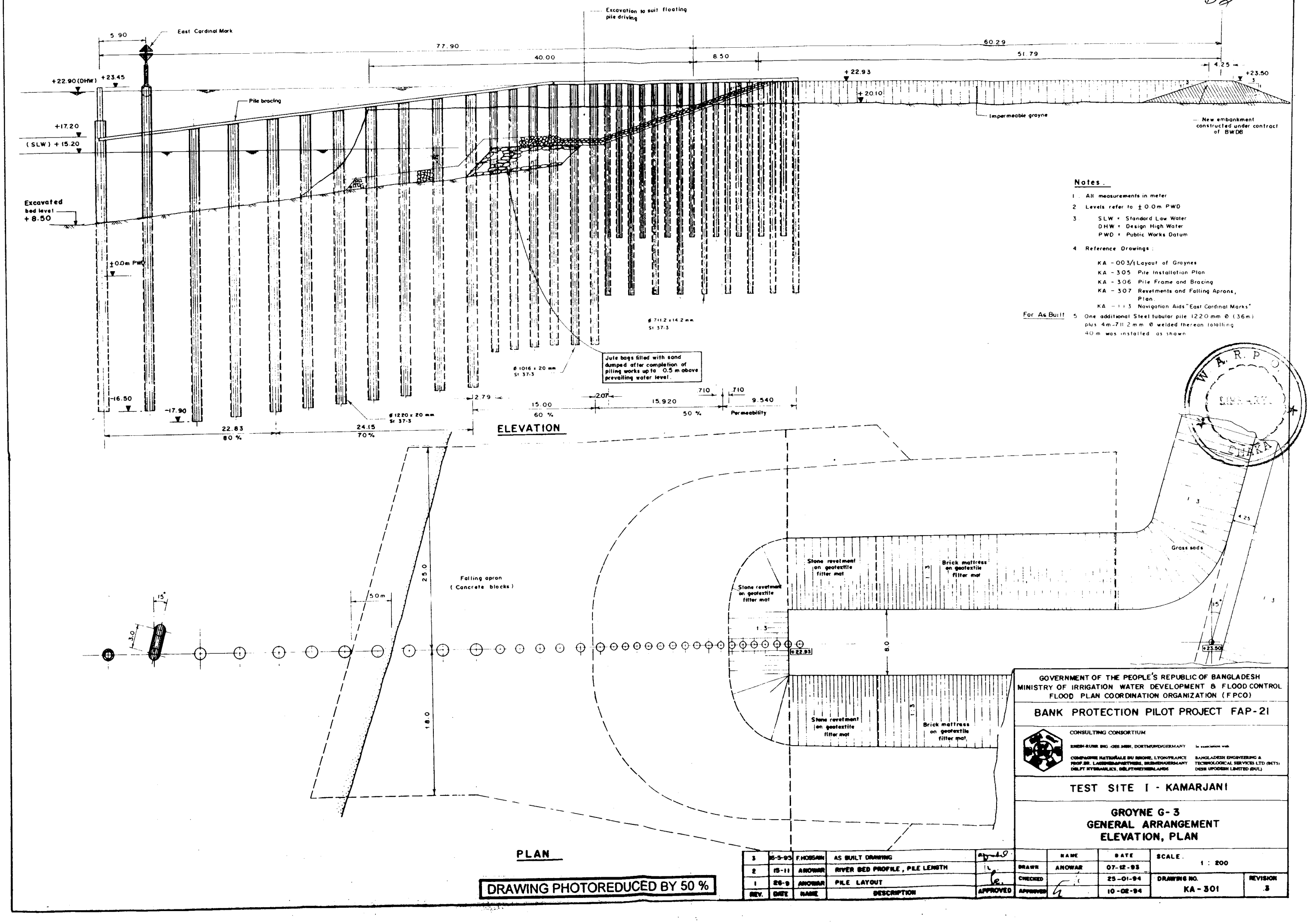
GROYNE G-2
REVETMENTS FALLING APRONS
DETAILED SECTIONS

	NAME	DATE
DRAWN	ANOWAR	07-12-93
CHECKED		24-01-94
APPROVED		10-02-94

SCALE : 1 : 100

DRAWING NO. KA-207

REVISION 3



Notes.

1. All measurements in meter
2. Levels refer to ± 0.0m PWD
3. SLW = Standard Law Water
   DHW = Design High Water
   PWD = Public Works Datum
4. Reference Drawings :
   - KA - 003/1 Layout of Groynes
   - KA - 305 Pile Installation Plan
   - KA - 306 Pile Frame and Bracing
   - KA - 307 Revetments and Falling Aprons, Plan.
   - KA - 113 Navigation Aids "East Cardinal Marks"

For As Built 5. One additional Steel tubular pile 1220 mm Ø (36m) plus 4m-711.2 mm Ø welded thereon totalling 40 m was installed as shown

DRAWING PHOTOREDUCED BY 50 %

REV.	DATE	NAME	DESCRIPTION	APPROVED
3	05-5-95	F.HOSSAIN	AS BUILT DRAWING	
2	15-11	ANOWAR	RIVER BED PROFILE, PILE LENGTH	
1	26-9	ANOWAR	PILE LAYOUT	

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

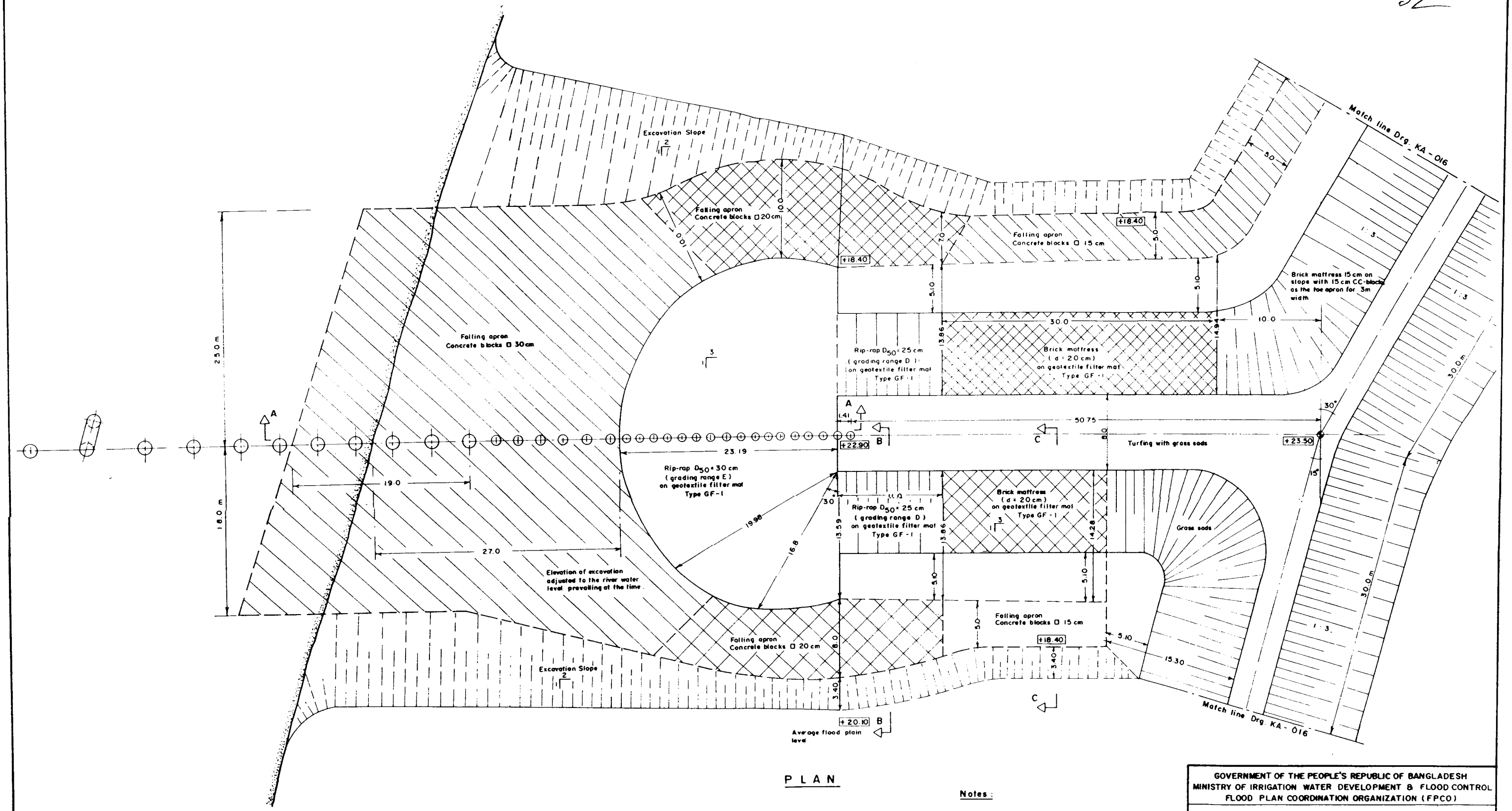
EMSH-RUHR ING -GBS MBH, DORTMUND/GERMANY — In association with
COMPAGNIE NATIONALE DU RHONE, LYON/FRANCE
PROF.DR. LARSEN&PARTNERS, HILDESHEIM/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD (BETS)
DESH UPODESH LIMITED (DUL)

TEST SITE I - KAMARJANI

GROYNE G-3
GENERAL ARRANGEMENT
ELEVATION, PLAN

	NAME	DATE
DRAWN	ANOWAR	07-12-93
CHECKED		25-01-94
APPROVED		10-02-94

SCALE. 1 : 200
DRAWING NO. KA - 301
REVISION 3



PLAN

Notes :

1. All measurements in meter.
2. Levels refer to ± 0.0 m PWD
3. Reference Drawing :
   - KA - 003/I Layout of Groynes
   - KA - 308 Revetments and falling aprons; Detailed Sections.

DRAWING PHOTOREDUCED BY 50 %

REV.	DATE	NAME	DESCRIPTION	APPROVED
3	16-05	Anowar	As Built Drawing (New Sheet)	
2	12-12	Anowar	Bank Line, Levels	
1	26-9	Anowar	Pile Layer!	

	NAME	DATE
DRAWN	ANOWAR	06-12-93
CHECKED		25-01-94
APPROVED		10-02-94

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
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BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

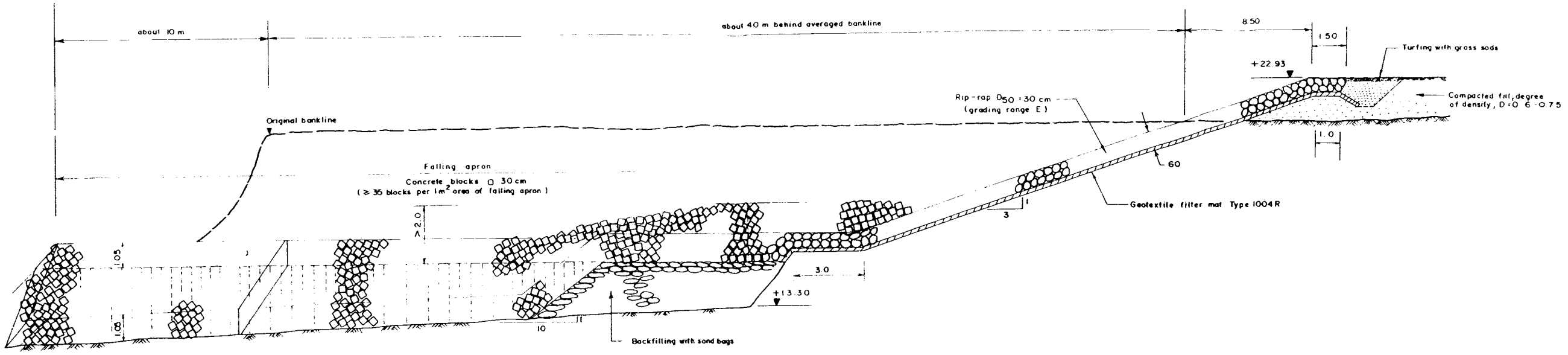
TEST SITE I - KAMARJANI

GROYNE G-3
REVETMENTS AND FALLING APRONS
PLAN

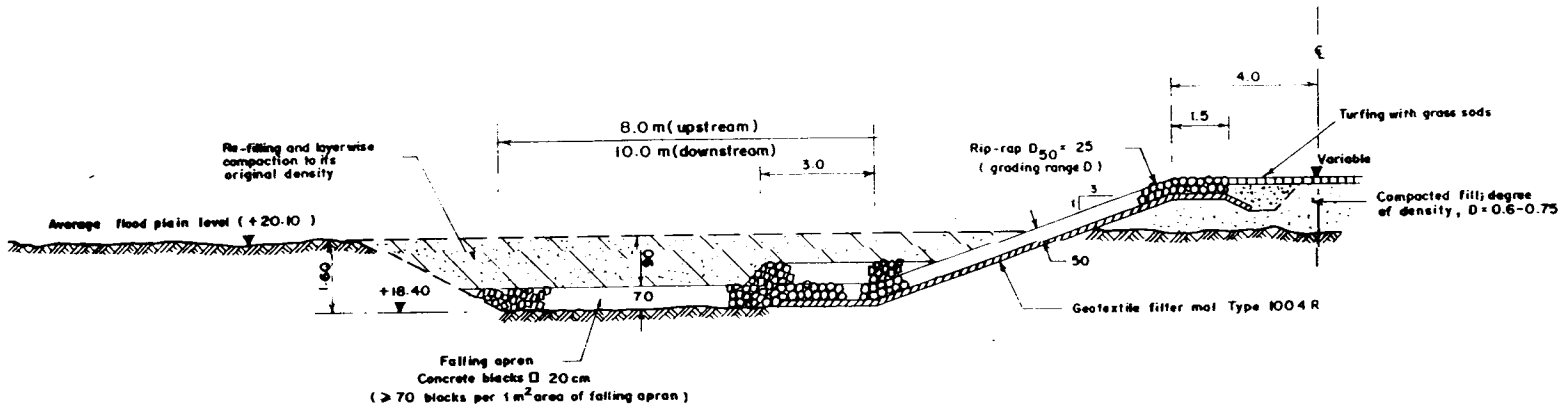
SCALE. 1 : 200

DRAWING NO. KA - 307

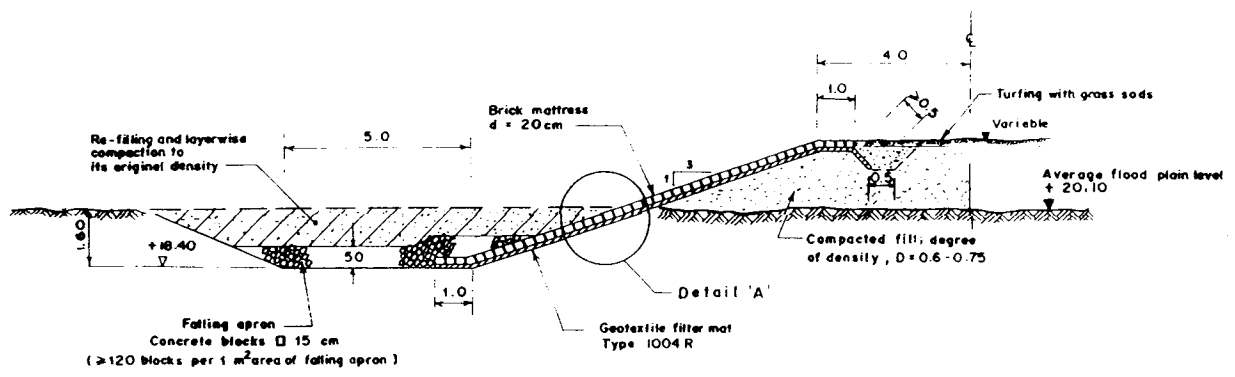
REVISION 3



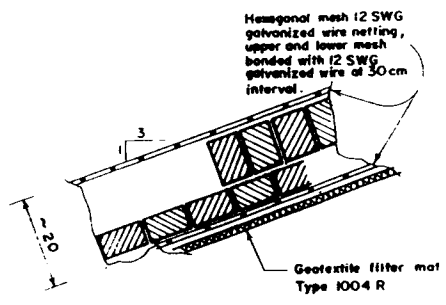
SECTION A-A



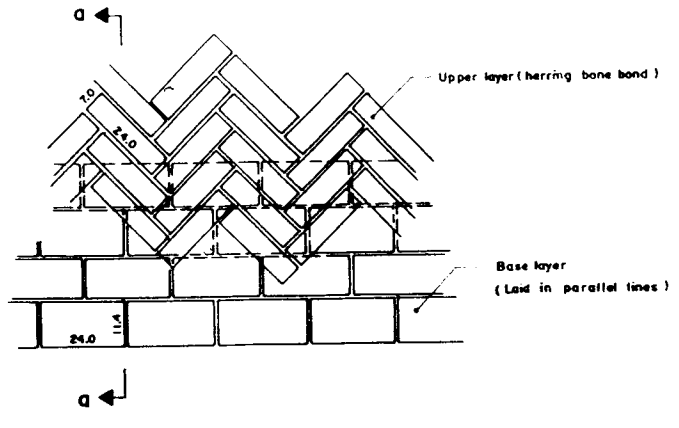
SECTION B-B



SECTION C-C

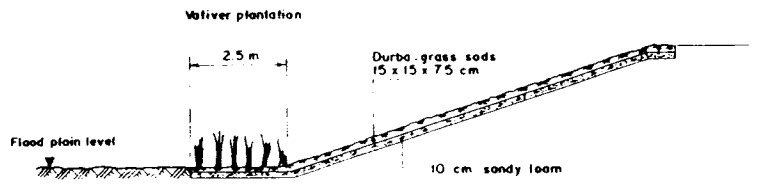


SECTION G-G



DETAIL 'A'
BRICK MATTRESS (d = 20 cm)

SCALE : 1 : 10



TYPICAL SECTION WITH BIOTECHNICAL REVETMENT

SCALE 1 : 100

Notes.

1. All measurements in meter and centimeter
2. Levels refer to ±0.0 m PWD
3. Reference Drawings:
   - KA-005 Filter Gradation Curves.
   - KA-006 Stone Gradation and Layer Thickness.
   - KA-307 Revetments and Falling Aprons, Plan.
4. All the geotextile sheets are pegged (bottom & top)

REV.	DATE	NAME	DESCRIPTION	APPROVED
3	27-4-95	FHOSSAIN	AS BUILT DRAWING	
2	15-12-94	ANOWAR	LEVELS, MEASUREMENTS	

DRAWING PHOTOREDUCED BY 50 %

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FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

in association with

BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD. (BETS)
DESH UPODESH LIMITED (DUL)

TEST SITE I - KAMARJANI

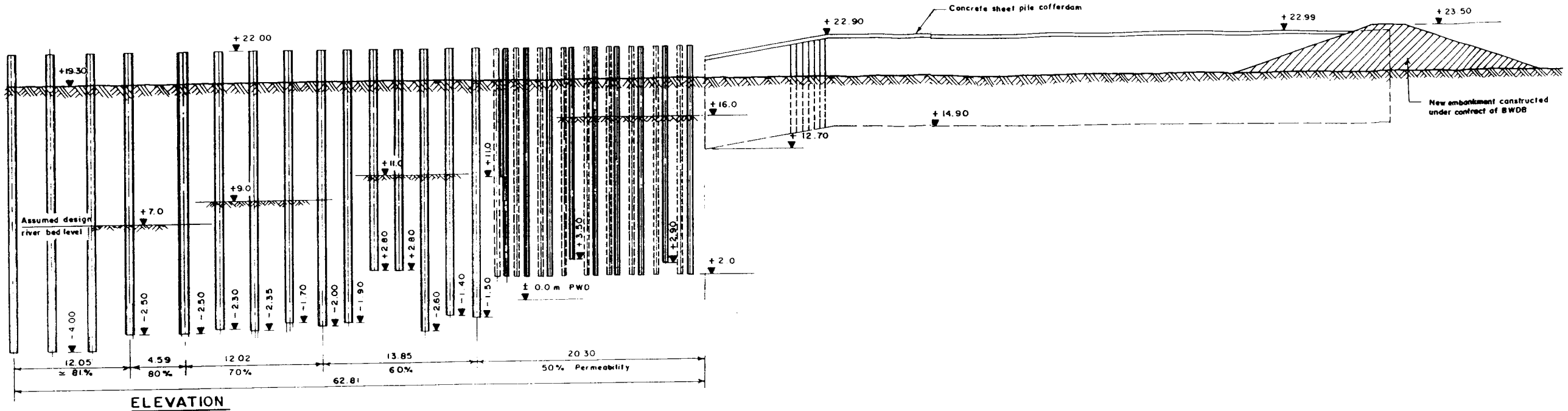
GROYNE G-3
REVETMENTS AND FALLING APRONS
DETAILED SECTIONS

	NAME	DATE
DRAWN	ANOWAR	07-12-93
CHECKED		25-01-94
APPROVED		10-02-94

SCALE : 1 : 10, 1 : 100

DRAWING NO. KA - 308

REVISION 3



ELEVATION
Scale 1:200

PLAN
Scale 1:200

NOTES

1. All measurements in meter.
2. All levels refer to ± 0.0 m PWD
3. Reference Drawings:
   KA - 404 Pile Installation Plan
   KA - 406 Concrete Sheet Pile Cofferdam
   KA - 003/1 Layout of Groynes
   KA - 414 Details of Scour Protection

For as built Drawing

4. Bored pile No. 9 abandoned due to collapse of bore hole during installation.
5. Two additional spun pile installed.
6. Three additional steel tubular pile installed.
7. Two spun piles could not be driven to design depth. Undriven part was cut off and repaired

DRAWING PHOTOREDUCED BY 50 %

REV.	DATE	NAME	DESCRIPTION	APPROVED
3	23-04-96	Anwar	As built Drawing	
2	18-12-94	Anwar	Scour protection	
1	6-11-94	Anwar	Orientation of embankment, cofferdam	

	NAME	DATE
DRAWN	F. HOSSAIN	06-12-93
CHECKED		20-01-94
APPROVED		10-02-94

SCALE : 1 : 200
DRAWING NO. KA - 401
REVISION 3

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
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FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

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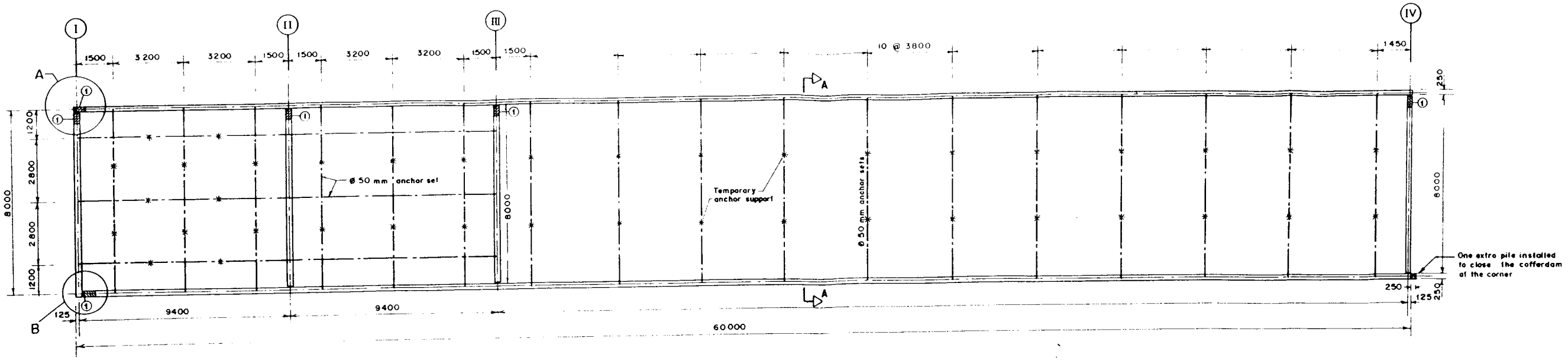
DHV WOODSIDE LIMITED (DUL)

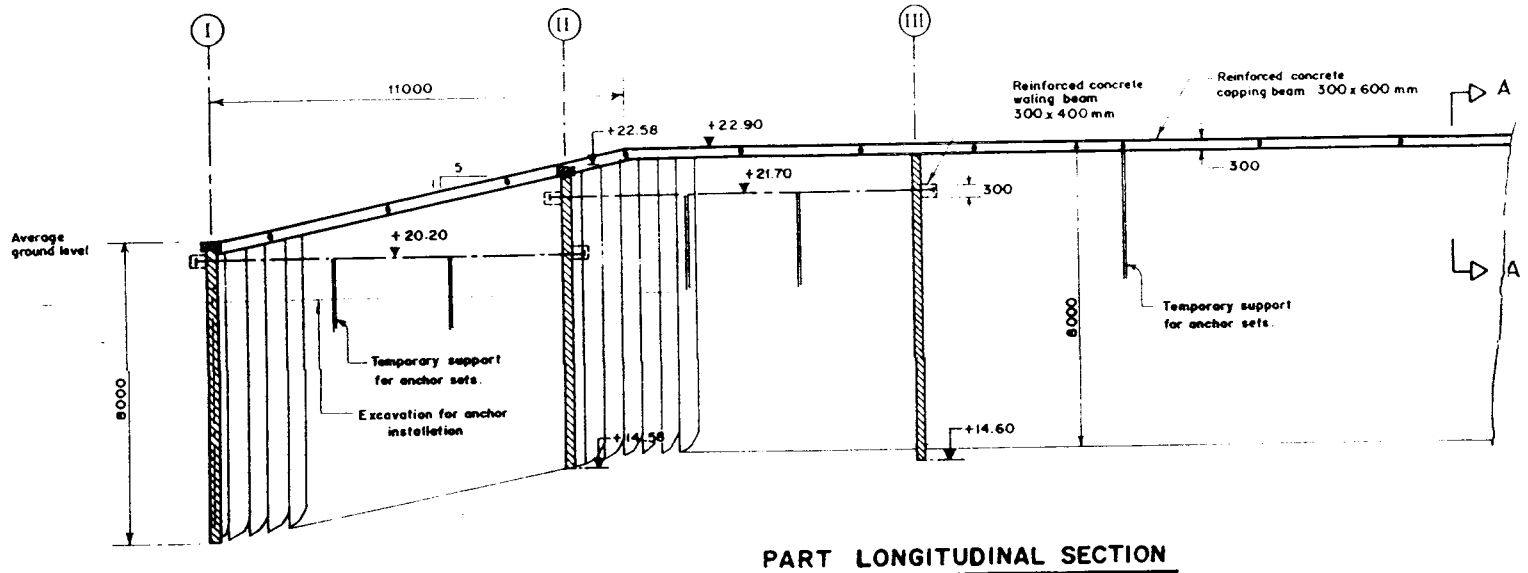
TEST SITE I - KAMARJANI

GROYNE G-A
GENERAL ARRANGEMENT
PLAN AND ELEVATION



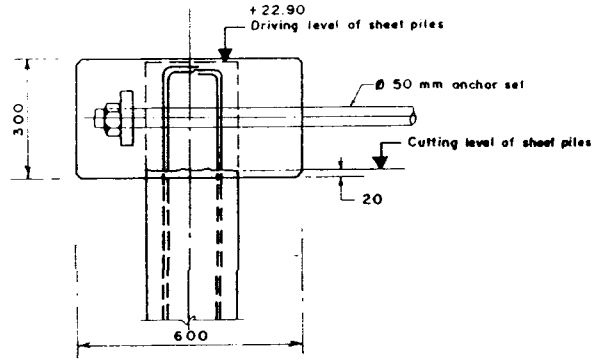
GENERAL LAYOUT PLAN

Scale 1:100



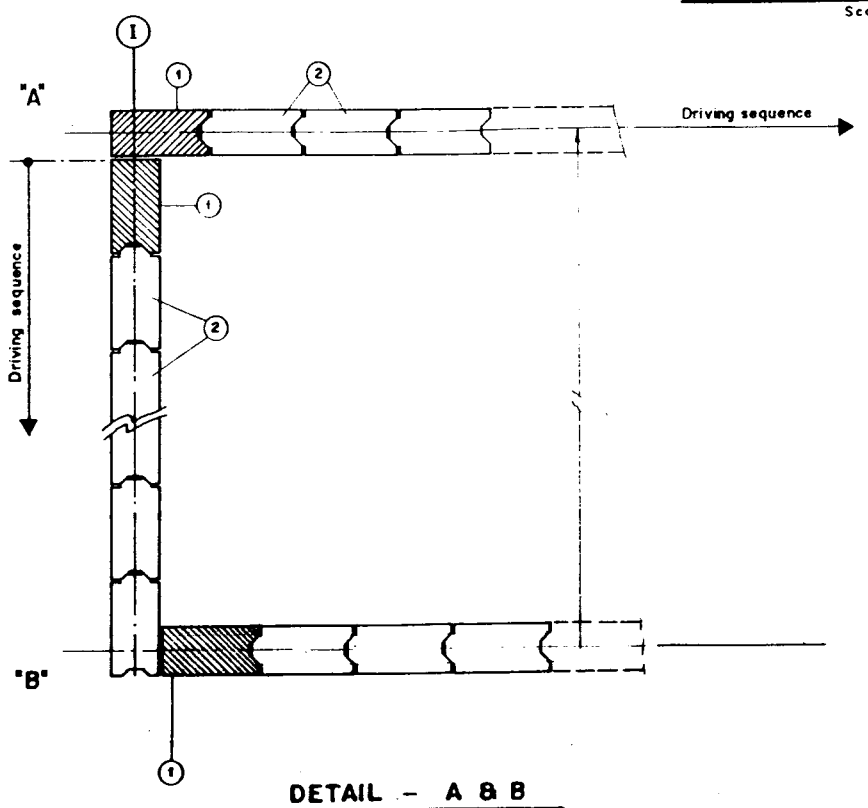
PART LONGITUDINAL SECTION

Scale 1:100



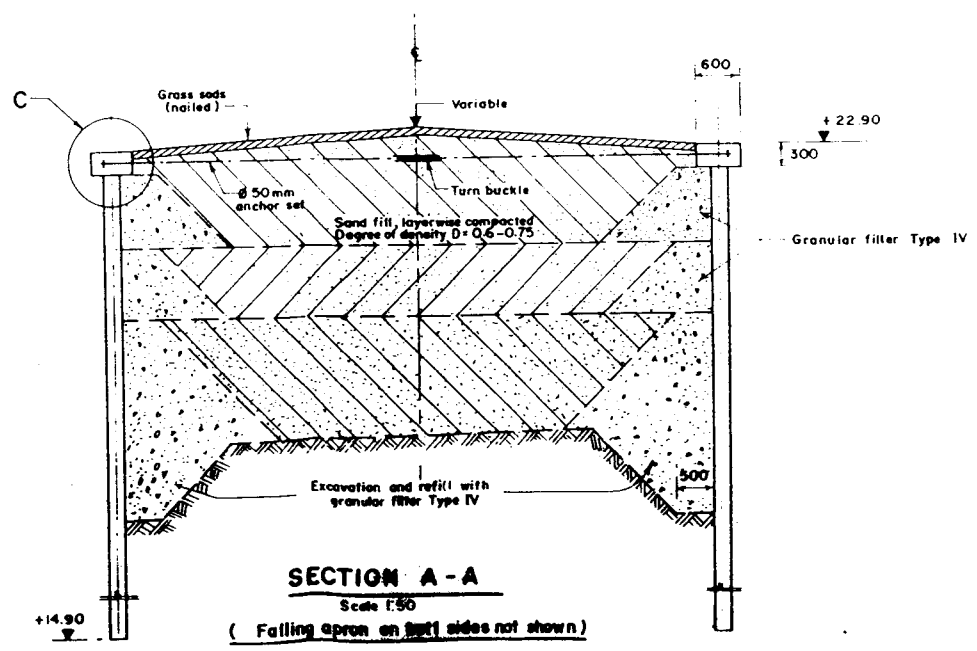
DETAIL - C

Scale 1:10



DETAIL - A & B

Scale 1:20



SECTION A-A

Scale 1:50

(Falling apron on both sides not shown)

Notes

1. All measurements in millimeters.
2. Levels refer to ± 0.0 m PWD
3. Sheet pile capping beam and waling beams:
   - Reinforcing steel grade 60, ASTM A-615
   - Concrete class B 25, DIN 1045
   - Cement Type I (Ruby brand, Bangladesh)
   - Concrete cover to reinforcing steel 30 mm
4. ① – Starter pile
   ② – Standard pile
5. Reference Drawings:

KA - 003	Layout of Groynes
KA - 405	Reinforced Concrete Sheet Piling
KA - 407	Details of Anchoring
KA - 408	Capping Beams, Waling Beams
KA - 414	Details of Scour Protection

DRAWING PHOTOREDUCED BY 50 %

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

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GEOTEC. LABS HERMANSBURG, HERMANSBURG/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS

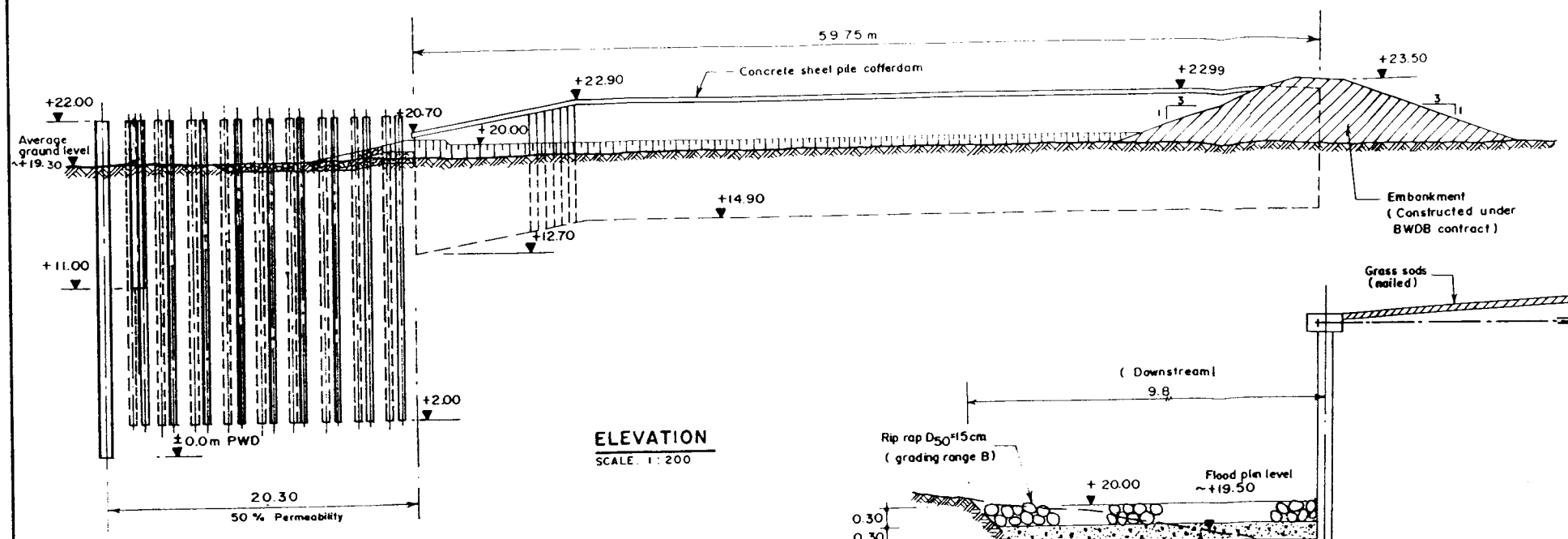
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD. (BETS)
DHAN HYDRAULICS LIMITED (DHL)

TEST SITE I - KAMARJANI

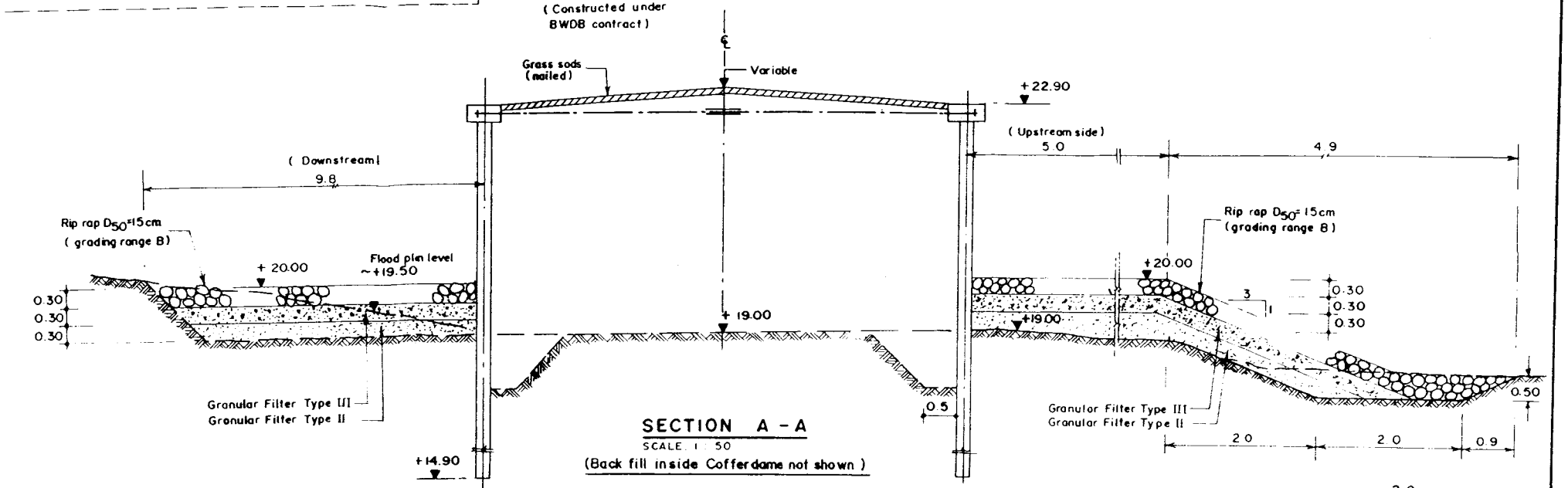
GROYNE G-A
CONCRETE SHEET PILE COFFERDAM
PILE INSTALLATION PLAN, DETAILS

	NAME	DATE	SCALE
DRAWN	ANOWAR	30-11-93	1:100, 1:50, 1:10
CHECKED		26-01-94	DRAWING NO. KA-406
APPROVED		10-02-94	REVISION 2

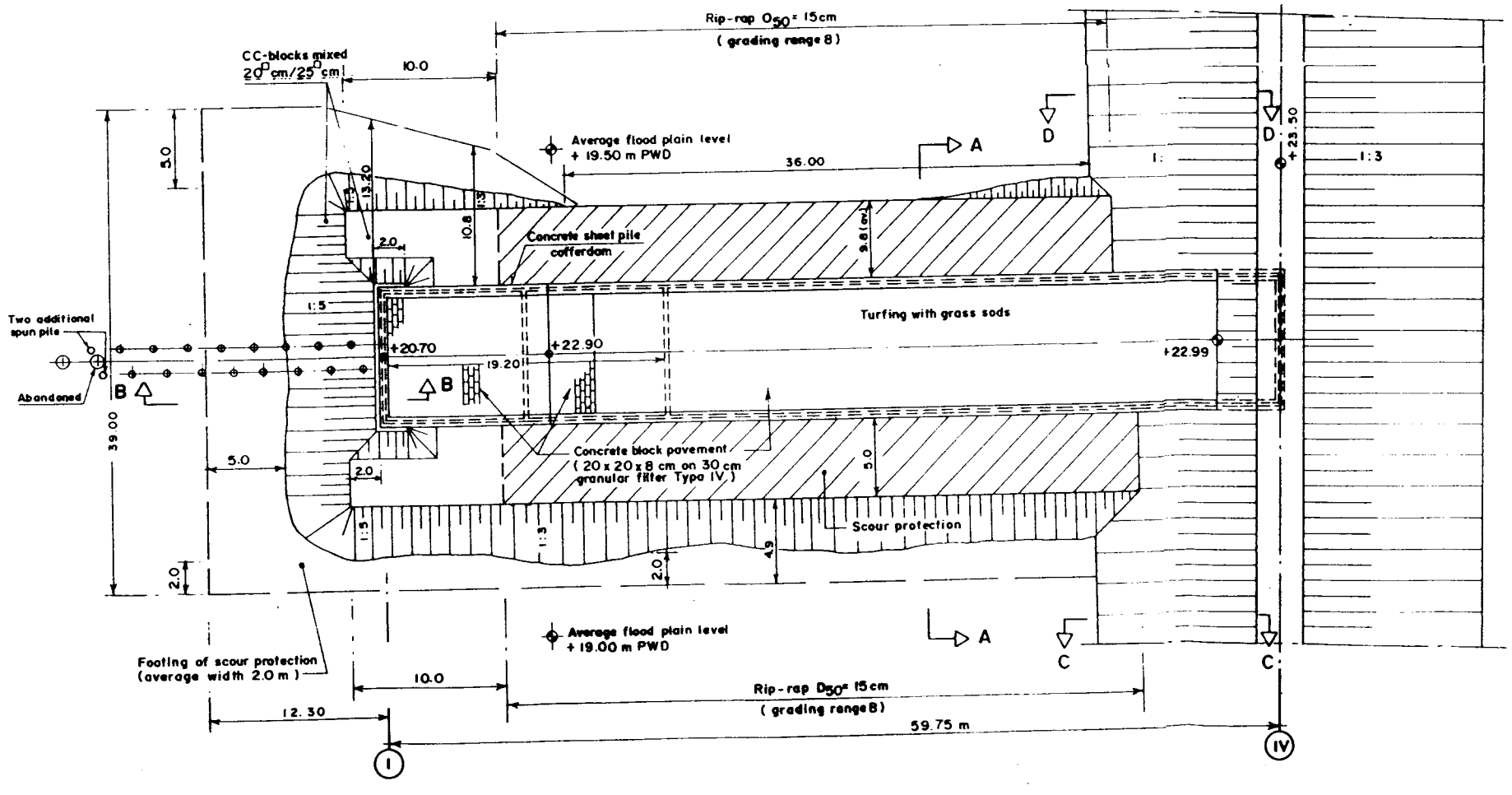
REV.	DATE	NAME	DESCRIPTION	APPROVED
2	2-5-94	Anowar	As built drawing	
1	8-11-94	Anowar	Section A-A, Actual ground level	



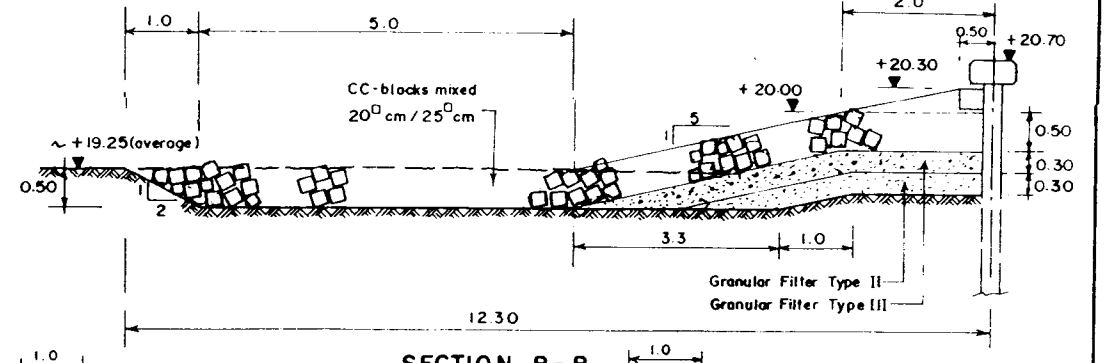
ELEVATION
SCALE 1 : 200



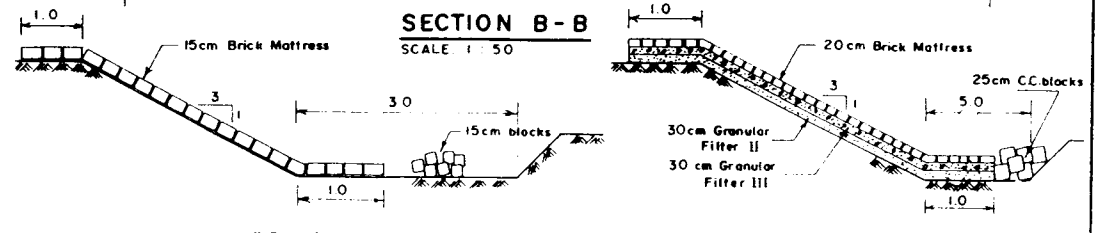
SECTION A - A
SCALE 1 : 50
(Back fill inside Cofferdame not shown)



PLAN
SCALE. 1 : 200



SECTION B - B
SCALE 1 : 50



SECTION C - C
SCALE 1 : 50

SECTION D - D
NOT TO SCALE

NOTES:
1. In case Rip-rap, grading range B, is not available in adequate quantity, CC-blocks of mixed size 15° cm and 20° cm can be used instead.
2. All measurements in meter
3. All levels refer to ± 0.0 m PWD
4. Length of slopes adapted to existing ground levels around the cofferdam.
5. Reference Drawings:
   KA – 401 Groyne G - A
   General Arrangement Plan and Elevation

DRAWING PHOTOREDUCED BY 50 %

REV.	DATE	NAME	DESCRIPTION	APPROVED
1	3-5-95	Anowar	As Built Drawing	

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MINISTRY OF IRRIGATION, WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

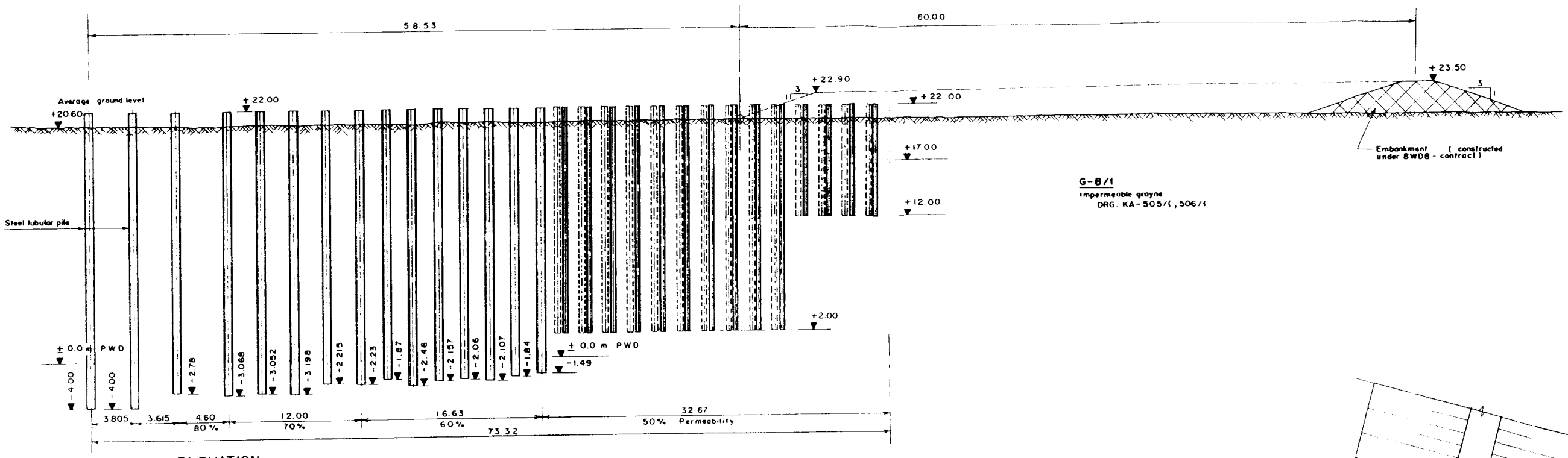
[illegible] In association with

[illegible] BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD. (BETS)
DELFT HYDRAULICS, DELFT/NETHERLANDS DESH UPODESH LIMITED (DUL)

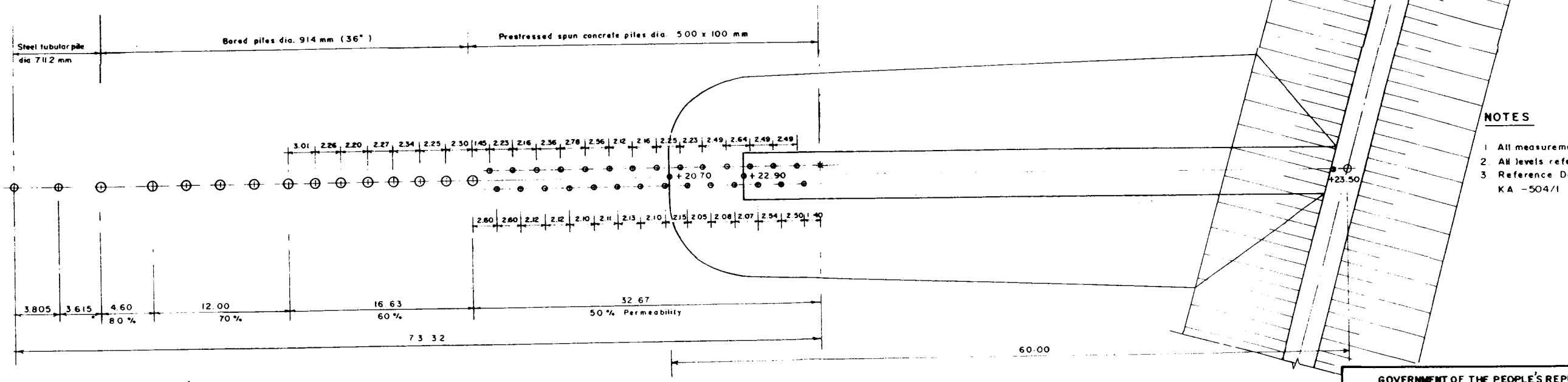
TEST SITE I - KAMARJANI

GROYNE G - A
CONCRETE SHEET PILE COFFERDAM
DETAILS OF SCOUR PROTECTION

	NAME	DATE	SCALE:
DRAWN	ANOWAR	17-12-94	1:50, 1:200
CHECKED		18-12-94	DRAWING NO. KA - 414
APPROVED			REVISION 1



ELEVATION
Scale 1 200



PLAN
Scale 1:200

NOTES

1. All measurements in meter
2. All levels refer to ±00m PWD
3. Reference Drawings
   KA -504/1 Pile Installation Plan

DRAWING PHOTOREDUCED BY 50 %

REV.	DATE	NAME	DESCRIPTION	APPROVED
2	18-05	ANOWAR	AS BUILT DRAWING	
1	14-12	ANOWAR	GROUND LEVELS, PILES AXES & TOB,IB,	

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CONSULTING CONSORTIUM
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PROF.DR. LACOMBE&PARTNERS, BREMEN/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD (BETS)
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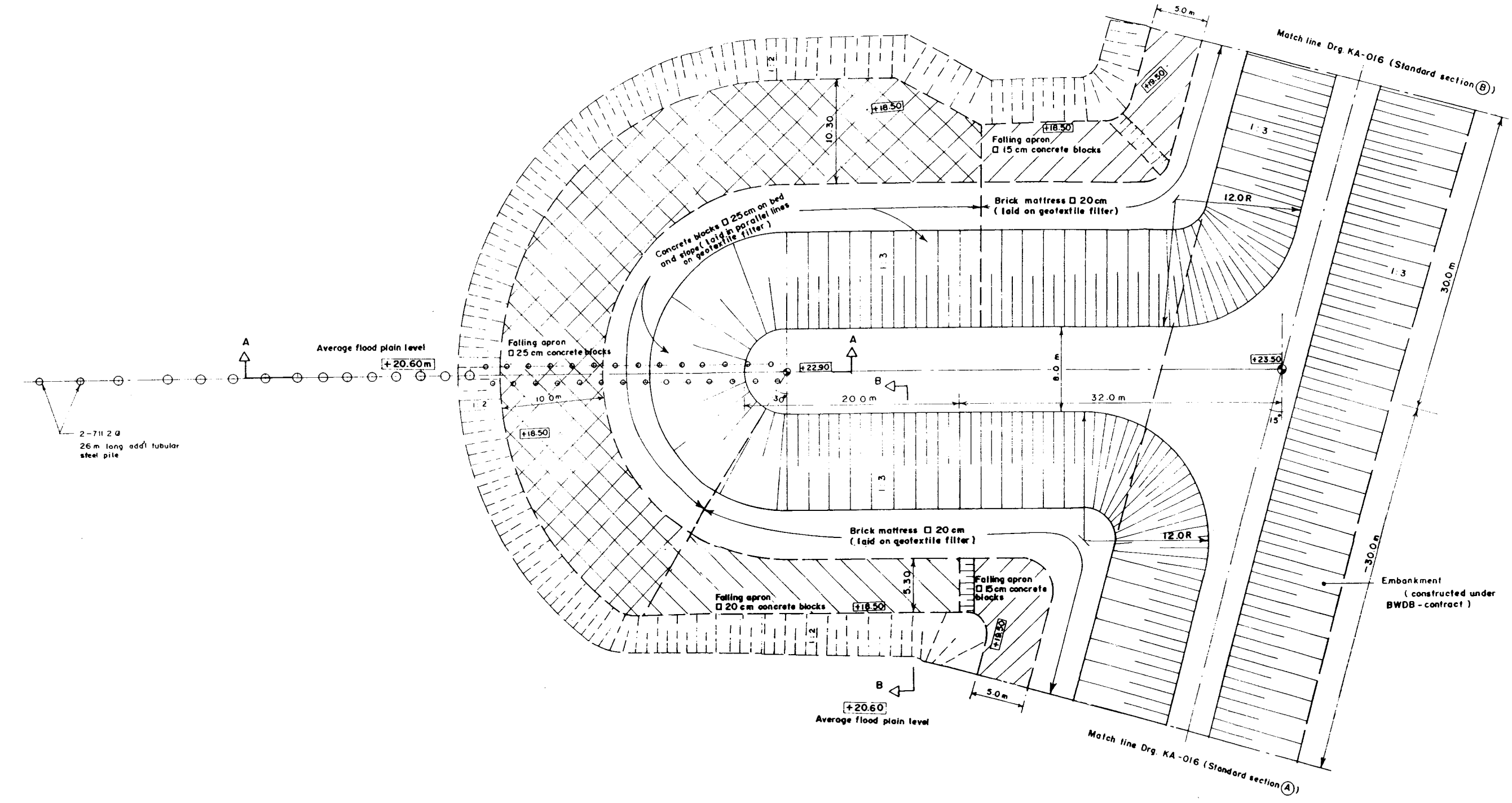
TEST SITE I - KAMARJANI

GROYNE G-B/1;
GENERAL ARRANGEMENT
PLAN, ELEVATION

	NAME	DATE	SCALE: 1 : 200
DRAWN	F.HOSSAIN	06-12-93	
CHECKED		26-01-94	DRAWING NO. KA-501/1
APPROVED		10-02-94	REVISION 2



PLAN

DRAWING PHOTOREDUCED BY 50 %

NOTES

1. Measurements in meter, unless shown otherwise.
2. Levels refer to ± 0.0 m PWD.
3. Reference Drawings :
   KA - 003/1 LAYOUT OF GROYNES
   KA - 506/1 DETAIL SECTIONS

REV.	DATE	NAME	DESCRIPTION	APPROVED
1	23.05	ANOWAR	AS BUILT DRAWING	

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BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

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PROF.DR. LAUSEN&PARTNERS, ESSEN/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD.(BETS)
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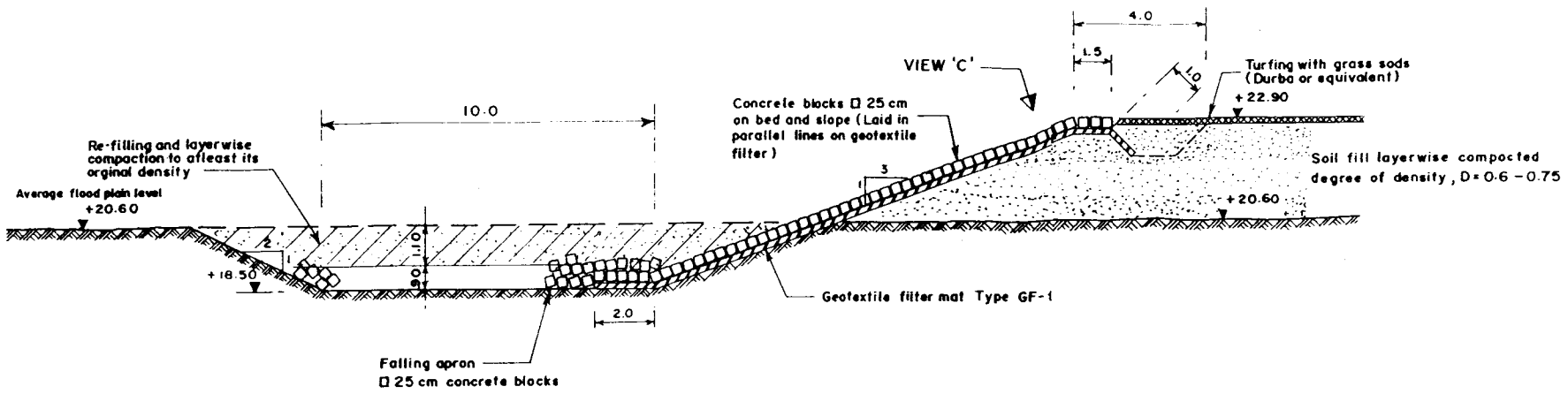
TEST SITE I - KAMARJANI

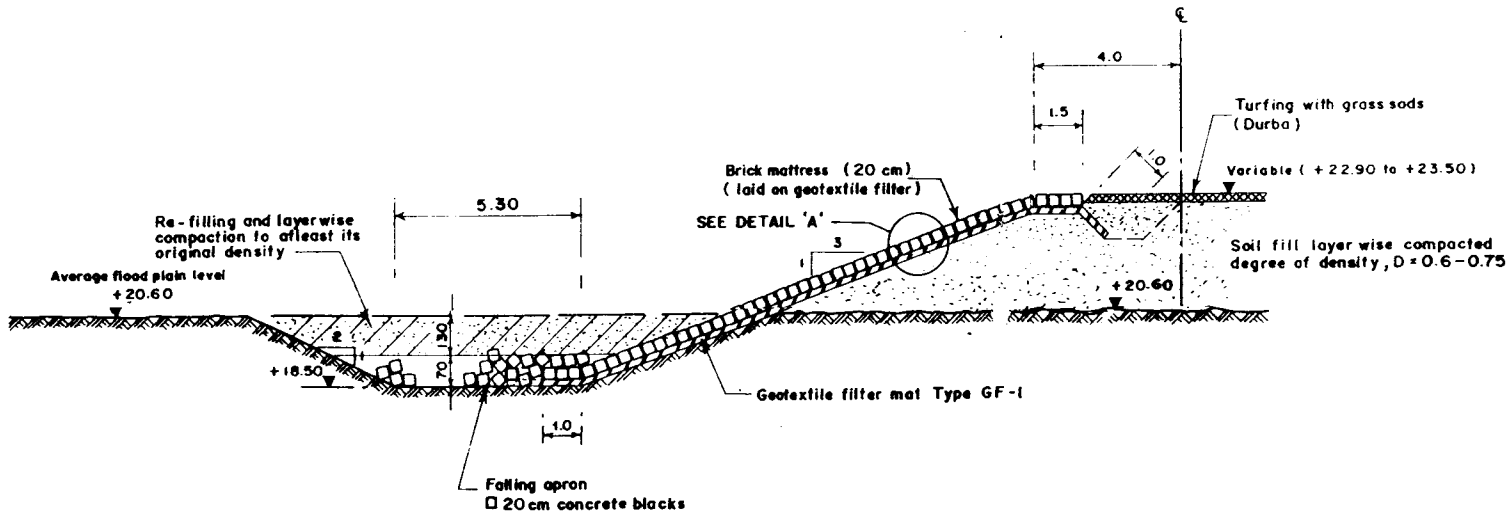
GROYNE G-B/1
REVETMENTS, FALLING APRONS
PLAN

	NAME	DATE	SCALE
DRAWN	ANOWAR	08-12-94	1 : 200
CHECKED		13-12-94	DRAWING NO. KA - 505/1
APPROVED			REVISION 0



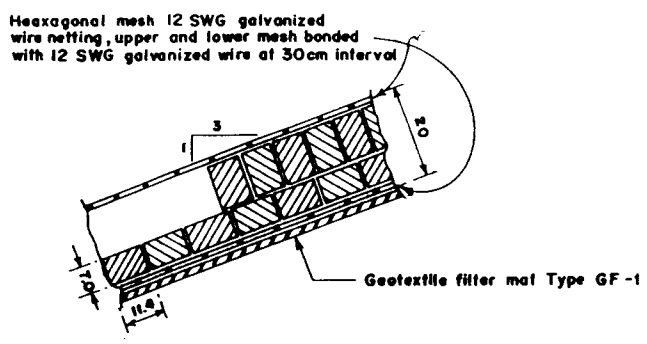
SECTION A-A

SCALE 1 : 100

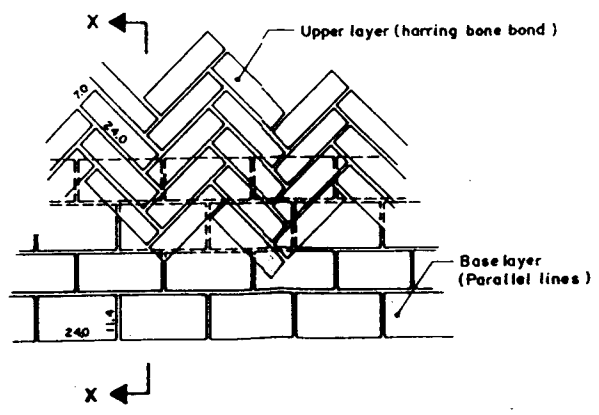


SECTION B-B

SCALE 1 : 100

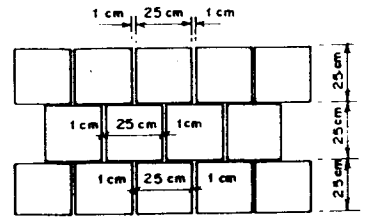


SECTION X-X



DETAIL 'A'
BRICK MATTRESS (d = 20 cm)

SCALE. 1 : 10



VIEW 'C'
CONCRETE BLOCKS

SCALE. 1 : 20

NOTES :

1. Measurements in meter, unless shown other wise.
2. Levels refer to ± 0.0 m PWD.
3. Reference Drawings :

   KA - 005 Filter Gradation Curves.
   KA - 505/1 Groyne G-B/1
   Revetments, Falling Aprons
   Plan.

DRAWING PHOTOREDUCED BY 50 %

REV.	DATE	NAME	DESCRIPTION	APPROVED
1	22-5-95	ANOWAR	AS BUILT DRAWING	

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

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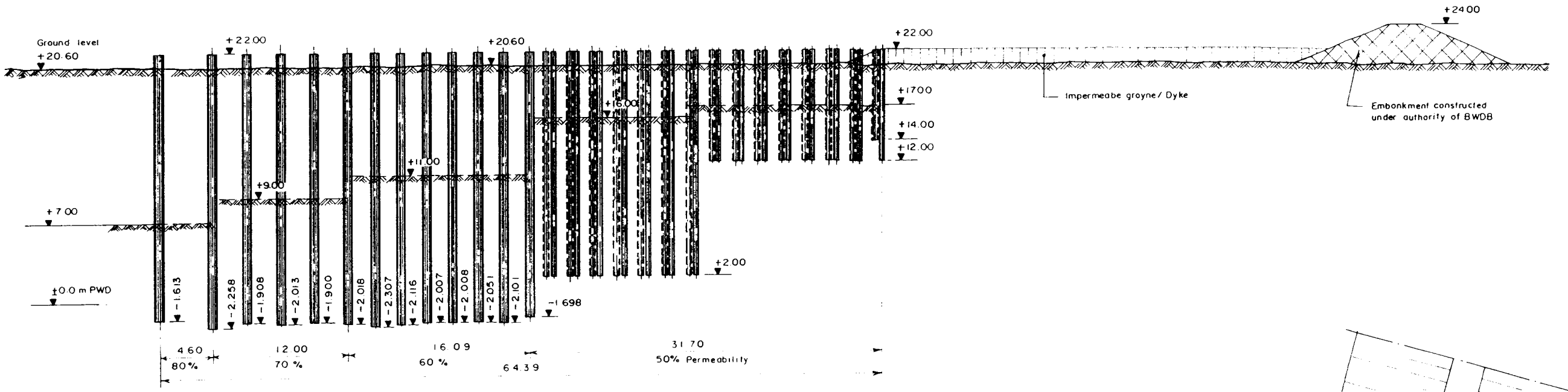
GEOMARINE NATIONALE DU BATIMENT, LYON/FRANCE
PROF.DR. LACKERAPARTNER, ESSEN/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD.(BETS)
DESH UPODESH LIMITED (DUL)

TEST SITE I - KAMARJANI

GROYNE G-B/1
DETAIL SECTIONS

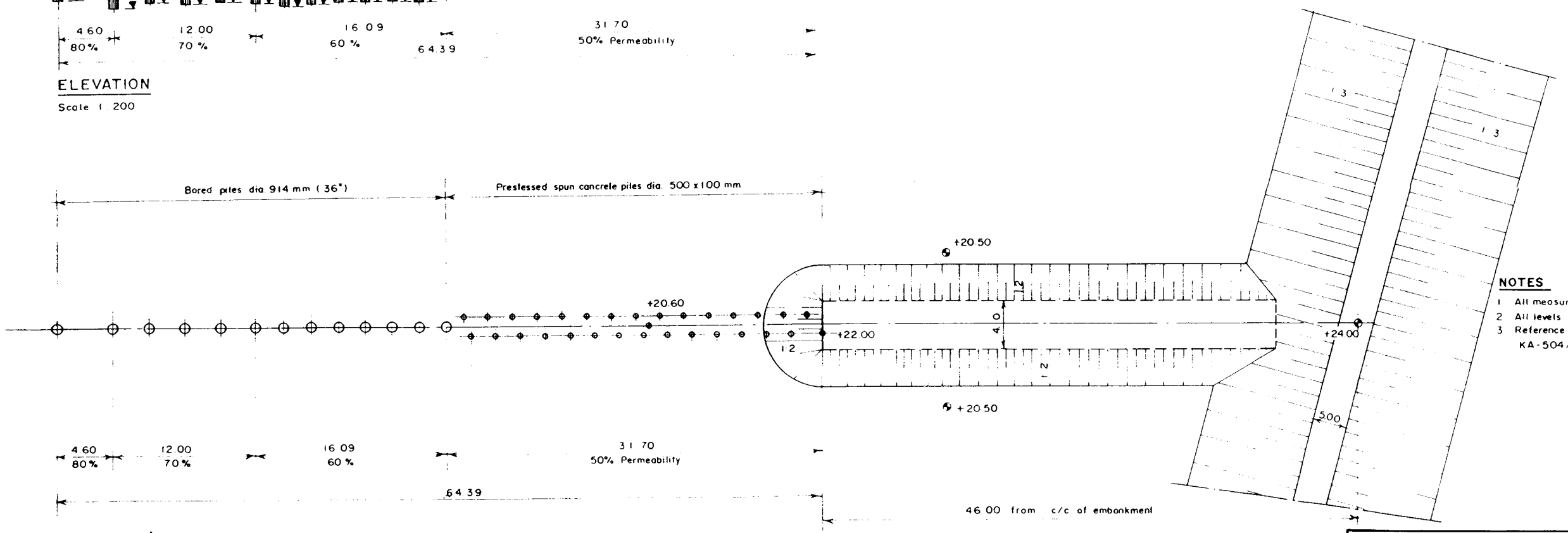
	NAME	DATE	SCALE
DRAWN	ANOWAR	06-12-94	1:100, 1:20, 1:10
CHECKED		13-12-94	DRAWING NO. KA-506/1
APPROVED			REVISION 1

2.D



ELEVATION

Scale 1 200



PLAN

Scale. 1 : 200

NOTES

1. All meosurements in meter
2. All levels refer to ±0.0m PWD
3. Reference Drawings
   KA-504/2 Pile Installation Plan

DRAWING PHOTOREDUCED BY 50 %

REV.	DATE	NAME	DESCRIPTION	APPROVED
1	8.6.95	ANOWAR	AS BUILT DRAWING (NEW SHEET)	

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

CONSULTING CONSORTIUM

RHEIN-RUHR ING. GES. MBH. DORTMUND/GERMANY — In association with

COMPAGNIE NATIONALE DU RHONE, LYON/FRANCE
PROF DR. LACOMBE & PARTNERS, BRUHEM/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD (BETS)
DESH UPODESH LIMITED (DUL)

TEST SITE 1 - KAMARJANI

GROYNE G-B/2
GENERAL ARRANGEMENT
PLAN, ELEVATION

	NAME	DATE	SCALE:
DRAWN	ANOWAR	06-12-93	1 : 200
CHECKED		26-01-94	
APPROVED		10-02-94	

DRAWING NO. KA - 501/2 | REVISION 1

ANNEX B

(Reserved for Final Report)

ANNEX C

(Reserved for Final Report)

ANNEX D

(Reserved for Final Report)

ANNEX E

Model Tests

- Photographs

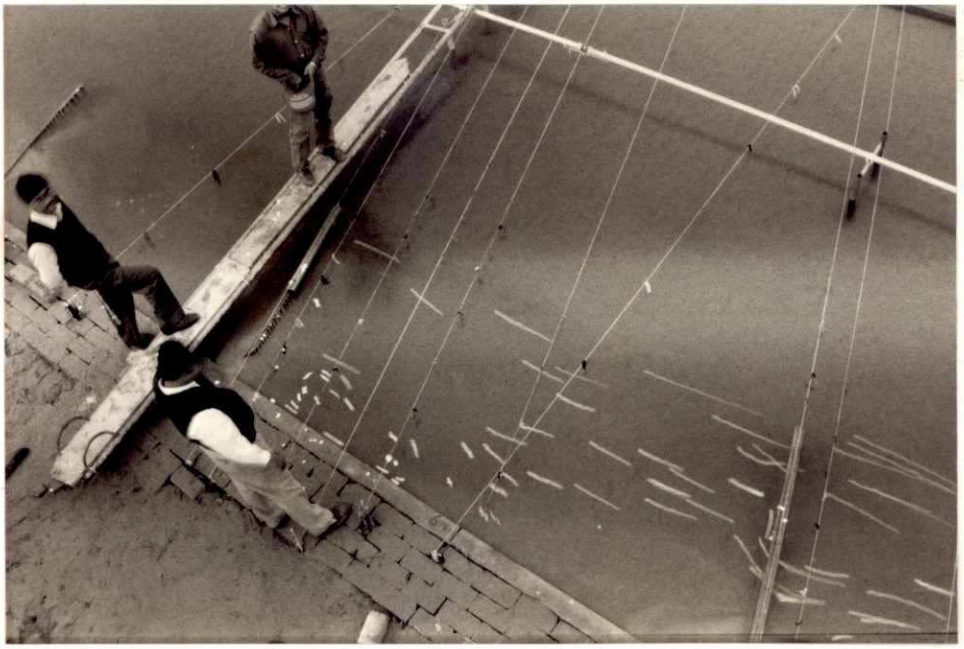


Photo 1: Return flow reduced by adaptation of pile spacing and impermeable head; T1, flow from G-2 to G-3

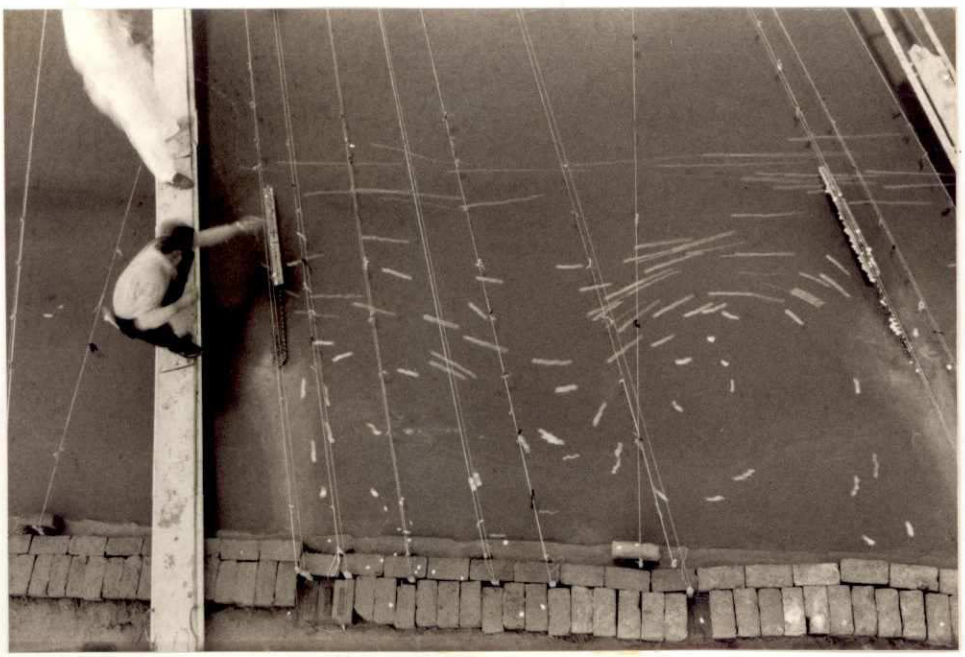


Photo 2: Return flow becomes unstable pattern of two eddies after retreating the bank. No further reduction of bank flow velocities; T2, flow from G-2 to G-3

Photo 3 and 4: Local scour holes downstream from G-2 and G-3 in T2

ANNEX F

Detailed Description of Works

DETAILED DESCRIPTION OF WORKS

1 INITIAL MEASURES FOR ADAPTATION OF PILE STRUCTURES AT GROYNES G-A AND G-3

Utilizing steel pile material available at Site the following works shall be carried out:

Groyne G-A (Drawing No. AD-KA-040/-041)

- Welding at the pile yard of three piles dia. 1016 x 20 mm, lengths 32.0 m Nos.) and 31.5 m (pile axes 25-26-27);
- Extension of groyne piles at axes 22-23-24 by 4.5 m, after cutting about 10 cm from the present pile heads;
- Welding at the pile yard of four piles dia. 711.2 x 14.2 mm, length 32 m each (pile axes 18-19-20-21);
- Installation of piles No. 25-26-27 as well as No. 18-19-20-21, re-driving of piles No. 22-23-24. Appropriate pile installation records are to be maintained as per Specifications, Subsection 1560.
- Cutting of all steel piles to the level shown on the drawing, subsequent welding of steel cover plates and horizontal steel beam bracings;
- Pile No. 27 shall be extended after installation by an about 7 m long steel pile section dia. 711.2 x 14.2 mm and finally be topped with a "Danger Point Mark", whose conical shaped top is to be painted "RED", using durable, preferably epoxy-resin based paint, after proper derusting and primer coating.
- In a 2nd Phase, i.e. after arrival at Site of the newly imported steel pile material, 5 Nos. additional piles dia. 711.2 x 14.2 mm, length 32 m each, shall be prepared and installed at locations No. 17-16-15-14-13 as supplementary piles.

Groyne G-3 (Drawing No. AD-KA-031)

- Preparation of 8 Nos. pile extension pieces dia. 711.2 x 14.2 mm, individual lengths of 12 m to 13.5 m, utilizing selected material available at Site;
- Cutting the horizontal pile bracing of the groyne structure between piles No. 2 and 18; material to be stored for re-use;
- Cutting the pile top plates from piles No. 3-5-7-9-11-13-15 and 17; material to be stored for re-use;
- Piles No. 3-5-7-9-11-13-15-17 to be bevelled for welding, pile extension sections to be placed as per drawing, well aligned, secured in place and connected to the pile finally by full penetration butt welding;
- Re-driving of the extended piles to approximately top level +23.00 m PWD. Appropriate pile installation records are to be kept as per Specifications, Subsection 1560;
- Cutting of all redriven piles to finishing level, subsequent welding of steel cover plates and horizontal bracings, utilizing the interim stored materials.
- In a 2nd Phase, i.e. after arrival of the newly imported steel pile material, the groyne will be further extended and modified as detailed under Chapter 4.

2 RELOCATION AND IMPROVEMENT OF MAIN EMBANKMENT (Drawing Nos. AD-KA-010/-020/-030/-002/-003)

(1) Between groynes G-3 and G-2 the present embankment shall be relocated by 50 m towards Hinterland and between groynes G-2 and G-1 by 20 m.

Transitions from the existent embankment terminate 150 m downstream the G-3 and 30 m downstream G-1.

In the area of groynes G-3 and G-2 a gap of about 30 m width each shall be kept open, to facilitate pile installation works within the future groyne head area.

Earth works and subsequent revetment works shall commence 150 m downstream from groyne G-3 and shall progress section-wise towards upstream, following the directions of para (3).

As soon as the bored concrete piles No. 1 to 6 for the new groyne G-A/2 have been completed, the improvement of the existent embankment within ±50 m up- and downstream from the new groyne shall be taken up. The toe level is to be extended at the river-side to +17.50 m PWD and the trench for the toe protection as well as the launching apron area are likewise to be excavated to level +17.50 m PWD. The excavated soil shall be used for final profiling of the BWDB-embankment in this area, otherwise transported and stock-piled for use in other working sections.

Provided time permits and with the Consultants approval the improvement of the BWDB-embankment from 50 m downstream from G-A/2 towards Manos River may be taken up (OPTIONAL WORK). The toe level of the existent embankment is likewise to be extended to level +17.50 m PWD.

Simultaneously with progressing embankment works, adequate soil material stock piles shall be arranged as close as possible to the future groyne heads G-3 and G-2. This is important to facilitate construction of these parts in the shortest possible period of time after completion of the respective piling works. This work is on the critical path.

(3) It is essential for the strategy of work implementation that individual embankment sections are built-up and compacted in layers and finally profiled to receive immediately filter and revetment layers. The length of such working sections shall not exceed about 60 m. The toe level of the river-sided slopes are designed at +17.50 m PWD, except between groynes G-2 and G-1, where the excavation level is fixed at +18.50 m PWD.

(4) The existent borrow pits within the area of the realigned embankment are to be cleaned within the areas to be backfilled from any undesirable matter and filled in well compacted layers, following the design profiles shown on the Drawings.

(5) Soil from the present embankment which is to be relocated and all soil from cuttings for the slope extensions along the river-sided slopes shall be re-used for construction of the new embankment. Material shortage are to be covered from borrow pits to be arranged by the Contractor.

(6) The river-sided slope revetment comprises of 15 cm thick brick mattresses as per Specifications, Subsection 1078 and in accordance with the details shown on the Drawings. The mattresses are to be laid on a geotextile filter mat Type GF-1, which will be supplied by the Consultant to the Contractor free of cost at Site.

Between the groynes G-3 and G-1 the top of mattressing is designed at level +21.0 m PWD, which is 30 cm above the Standard High Water level. Above, the earthen slope shall be covered

with Durba-grass sods in accordance with Specifications, Subsection 1079. Due to delivery constraints Geo-Jute soil saver shall not be provided, but the individual grass sods must be properly nailed with bamboo sticks and thoroughly watered daily.

Downstream of groyne G-3, up to and beyond the new groyne G-A/2, the top of brick mattressing is designed at +23.50 m PWD, which is the design top level of the embankment.

It is to be noted that a toe protection along the main embankment by cc-blocks will not be provided, although shown in the Drawings. The reason being to limit constraints in timely production of these blocks, but mainly due to the experience that a toe protection of limited width will not substantially improve the stability of the mattresses in case of severe erosion/scouring along the slopes toe. CC-block toe protection will only be placed within ±30 m upstream/downstream from the center of groynes G-3 and G-2 and within ±50 m of groyne G-A/2.

It is further to be noted that (for time constraint reasons) the land-sided slopes of the embankment shall not receive Durba-grass sod coverage in this season, although indicated on the Drawings.

(7) The toe of the brick mattresses shall be placed against a single row of cc-blocks size 25/25/25 cm. The bottom wire mesh is to be placed around the cc-block row and to be overlapped with the top wire mesh for at least 75 cm. Top and bottom wire mesh are to be tightly bonded with 12 SWG wire at 30 cm interval. Any wire used in brick mattressing shall be galvanized wire.

At the upper end the brick mattressing shall be specially anchored in a trench. The top and bottom wire mesh are to be tight together as anchor flap for at least 60 cm width, using 12 SWG binders. At the end a continuous 12 SWG wire is to be drawn-in (i.e. along the upper end of the wire mesh). Hard wood pegs of size 50 x 50 mm, and at least 60 cm long, shall be driven through the wire mesh at 60 cm intervall along the upper end of the anchor flap. The anchor trench is subsequently to be filled with sandy soil in well compacted layers.

3 CONSTRUCTION OF SUPPLEMENTARY GROYNE G-A/2
(Drawings No. AD-KA-050/-051)

(1) Severe bankline erosion is expected downstream of groyne G-A during the next monsoon season, threatening the main embankment near the Manos River estuary. For this reason a new groyne shall be constructed 200 m downstream from the present groyne G-A. Its direction is pointing at 15° against the projects' main base line, i.e. is planned parallel to groyne G-A. The total length of the groyne is designed at 81.35 m and the structure is composed of 14 Nos. in-situ concrete bored piles dia. 914 mm (36") and 20 Nos. tubular steel piles, dia. 711.2 x 14.2 mm. The steel pile material will be delivered by the Consultant to the Contractor at the Port of Chittagong.

(2) In-situ concrete bored piles are to be constructed in accordance with the Specifications, Section 1200. The length of tubular steel lining shall be 8.4 m for all piles.

Appropriate bored pile production reports are to be prepared by the Contractor for each pile in accordance with Subsection 1270 of the Specifications.

(3) Construction of bored piles shall start from the toe of the present embankment, progressing towards river-side. As soon as the first six piles are completed, the improvement of the existent BWDB-embankment shall start within 50 m upstream and downstream from the center line of the new groyne, including connecting the new revetment to the existent one, which terminates about 150 m downstream from groyne G-A. Details are described in Chapter 2, para (2), (6) and (7) of this Description of Works. Toe protection and launching apron of cc-blocks are to be placed subsequently.

(4) The start of installation of tubular steel piles depends on the timely arrival at Site of the material, which is expected by 15.03.96. In case of a major delay in the arrival of steel pile material, it may have to be optioned to continue construction of the new groyne by in-situ concrete bored piles as follows:

Axis 14 to 18: 4 bored piles dia. 914 mm, length 30 m, at 2.3 m spacing,
Axis 18 to 25: 7 bored piles dia. 914 mm, length 34 m, at 3.0 m spacing.
All such additional piles shall likewise receive a permanent steel tube lining of 8.4 m length.

Respective decision is to made by the Consultant in consultation with the Contractor at the appropriate time.

(5) Tubular steel piles are to be installed with piling equipment operating on the flood plain, but the last 3 or 4 (river-sided) piles will have to be installed by Consultant's floating piling equipment.

Due to limited leader length of bank-sided piling equipment, it will be required to install the piles in two to three sections:

Initially 12 m long sections shall be installed at the designed locations. Subsequently the pile heads are to be cut about 10 m below pile top (or below deformation, if any) and bevelled. The second pile section of 12 m is to be placed and to be well aligned with the pile axis of the installed first pile section. To ease the installation the pile extension sections should be provided with 3 to 4 guide brackets welded to the piles' interior. A full penetration butt weld is to be carried out, meeting the requirements as per Subsection 1531 of the Specifications.

Ceramic backing rings will be utilized to ensure proper root welding. The ceramic backing rings are supplied by the Consultant free of cost to the Contractor.

After inspection/testing of the completed butt welds the piles are to be driven to a level suitable to receive the last extension section. Dependent on the location, the section lengths vary from about 2 m to 8 m. The butt joint for the third extension is to be carried out as described above. Finally, the piles are to be driven to the designed head level. No further cutting of the pile heads to design level is required.

Finally, the completely installed piles shall be filled with soil to the top, as shown on the Drawings.

(6) The tubular steel piles to be installed by the floating pile installation equipment shall be installed in full length, provided the site/bankline conditions permit to do so at the time of work execution. As

the case may be, some dredging/ excavation into the flood plain may be required to carry out the pile installation.

(7) Records are to be prepared for the complete pile installation process in accordance with Subsection 1560, Specifications. All piles have to reach the designed toe levels. In case of non-reaching the design depth, Subsection 1553 of the Specifications applies. All such measures are to be coordinated with the Consultant.

(8) The most river-sided pile (No. 34) shall be topped with a "Danger Point Mark", which conical shaped top is to be painted "RED", using durable, preferably epoxy-resin based paint, after proper derusting and primer coating.

4 EXTENSION AND MODIFICATION OF GROYNES G-3 AND G-2

(1) During the forthcoming monsoon season 1996 severer attack is expected at groyne G-3, wherefore modification and extension of this groyne shall be given priority over groyne G-2.

All works related to the extension and modification of groynes G-3 and G-2 are on the critical path due to relatively late arrival at Site of the newly supplied tubular steel pile material.

(2) As stated under Chapter 2, para (1) a gap of about 30 m width shall be kept in the main embankment at the location of groynes G-3 and G-2, to facilitate pile installation works. The area of future pile installation works is to be levelled at a suitable elevation.

Stock-piles of soil for construction of the future groyne heads are to be prepared at the nearest point, refer to Chapter 2, para (2), last paragraph.

In addition all protection material, such as wire mesh, bricks for mattresses, the individual cc-block sizes and boulders are likewise to be kept ready at stock-piles, facilitating easy and speedy transport to the final location.

Should the newly imported steel piles arrive too late to facilitate completion of groynes G-3 and/or G-2, the gap in the embankment shall be closed and the river-sided slopes protected, utilizing the stock-piled materials. The deadline for this measure is to be coordinated with the Consultant.

(3) Immediately after arrival of tubular steel pile material at Site and provided the remaining period of the construction window is considered adequate to complete these works, the on-shore piling shall commence at groyne G-3.

Dependent on the bankline condition at the time, it is expected that 10 Nos. of piles (location No. A18 to A9) dia. 711.2 x 14.2 mm (L = 24 m and 28 m) can be installed, commencing with the most river-sided one. Due to limited leader length of the piling equipment, it will be required to install the piles in two respectively three sections each, analogously to the procedures described under Chapter 3, para (5).

Subsequently the land-sided piling equipment is to be shifted to groyne G-2, were only about 4 piles, dia. 711.2 x 14.2 mm (L = 28 m) can be installed analogously to the above.

(4) After the first few piles dia. 711.2 x 14.2 mm have been welded at the yard to designed length the nearest pile location which can be reached with the leader of the floating piling equipment at groyne G-3 shall be installed. It is expected that this may be pile No. 25 (dependent on riverbed situation at the time of construction).

After its installation, horizontal pile guide beams shall be arranged between pile Nos. A18 and A25, to facilitate installation of piles A19 to A24 (L=28 m to 32 m) without using the leader. These guides may be tubular steel piles dia. 711.2 mm supported near the heads of the said piles. The piles in the transition between the last land-sided one (A18) and the first river-sided driven one (A25) may have to be installed in sections analogously to the procedures described under Chapter 3, para (5). Initially by PTC-vibrator, but finally driving will have to be done using the Menck piling hammer. Respective measures are to be coordinated with the Consultant and the pile welding schedule for works at the yard is to be drawn up accordingly.

After completing the transition at groyne G-3, the floating pile driver has to move to groyne G-2, where the transition between the last land-sided pile and the first new one driven in the river shall be executed analogously to above procedures.

Only after completing the transition at groyne G-2, the floating pile driver shall complete the remaining pile installation works in the sequence G-3, G-2, G-A and G-A/2.

(5) After completing the pile installation works at groynes G-3 and G-2, the pile head plates and bracings (G-3), respectively the original gangways (G-2) are to be installed. The gangway sections recovered from G-2 will not be adequate to cover the extended groyne length, but need to be supplemented by additional gangway sections, which will be of a simple design.

(6) Immediately after completion of land-sided piling at groynes G-3 and G-2 the river bed profile in front of the future impermeable groyne heads has to be surveyed and the prevailing condition be compared with the profiles shown on the Drawings. If with the prevailing situation the groyne heads cannot be constructed with the designed slopes and toe levels, the length of the impermeable groyne is to be reduced and/or the excavation/ finishing level of the slopes to be adjusted, however, the slope inclination shall not be altered. The respective measures and decisions are to be coordinated with the Consultant.

(7) The built-up of the impermeable groyne heads must start accordingly to the results of para (6) above, utilizing material stock-piled for that purpose. Note must be taken that during piling works for the transition to the river-sided pile structure slides are likely to occur near the bank, wherefore final shaping of groyne heads should be done only thereafter.

The slope of the groyne heads has to be shaped smoothly from 1:3 at the main embankment to 1:5 along the main axis of the groyne. Along the groynes' 1:5 slope a 1 m high step has to be integrated by shifting the center of the upstream and downstream slopes 5 m apart. The step itself is to be constructed by cc-blocks, size 50/50/50 cm, laid on well compacted surface and geotextile filter mat, in block masonry pattern.

At groyne G-3 the step is located just upstream from the groynes' pile structure, but at groyne G-2 the axis of the impermeable groyne is designed 5 m upstream from the axis of the pile structure.

The head of impermeable groynes is to be protected by cc-blocks, size 30/30/30 cm, hand-laid in block pattern on geotextile filter mat. Along the horizontal rows a 10 mm wide gap has to be arranged between the blocks to permit seepage. The transitions to the main embankment are to be protected by 20 cm thick brick mattressing, likewise to be laid on geotextile filter materials.

The launching aprons around these groyne heads are to be laid at the designed levels, refer to para (6) above.

(8) Should for any reason (e.g. late arrival of piles or severely progressing changes of bankline and river bed) the construction of the impermeable groyne heads be impossible within the remaining period of time, the gaps left in the main embankment at groynes G-3 and G-2 are to be closed and the river-sided slopes be protected with 15 cm thick brick mattressing, to be laid on geotextile filter mats. The respective deadlines and measures are to be coordinated and agreed upon with the Consultant.

5 PROVISION OF FALLING APRONS AROUND THE PILE STRUCTURE OF GROYNES G-A AND G-2

(Drawings AD-KA-020, -040)

(1) Based on the assumption that groyne G-A will be subjected to severe river attack, it is important to complete the falling apron around the pile structure as early as possible.
Material shall be cc-blocks D_n = 35 cm and/or boulders of size D_{50} = 35 cm, which depends on the timely availability.

Dumping of protection material shall start from the river-side moving towards bank and from downstream towards upstream. It is to be ensured that the designated quantity of material is reasonably uniformly distributed within the defined area. Dependent on the river flow situation at the time of placing, special consideration must be given to the fact that dumped material will considerably be displaced by the current flow wherefore dumping locations are to be decided accordingly.

Material dumping can fully be completed on the downstream side of the groyne, but on the upstream side only after complete installation of all supplementary piles.

(2) Upon completion of all pile installation works for modification and extension of groyne G-2, the falling apron is to be installed around the newly driven piles, as shown on the Drawings.

Material shall be cc-blocks D_n = 35 cm and/or boulders of size D_{50} = 35 cm, which depends on the timely availability of the one or the other. Placing shall follow the procedures stipulated under above para (1).

It is to be noted that the installation of the supplementory falling apron at groyne G-2 has a relative low priority. In case of material shortage at the time, it may be optioned to postphone or cancel this measure. Respective decision is to be arrived at in consultation with the Consultant.

6 PROTECTION MEASURES TO THE SHEET-PILE COFFERDAMS AT GROYNES G-A AND G-1

(See Drawings AD-KA-040, -010)

(1) With the increasing river attack at groyne G-A, where the bank has reached practically the river-sided wall of the reinforced concrete sheet pile cofferdam (January 1996), additional measures where initiated early January 1996 by dumping cc-blocks and boulders of size 30 cm and above around the cofferdam head, covering an area with a radius of about 20 m. Due to insufficient quantity of material the work could not be completed, wherefore additional protection material (cc-blocks or boulders of size 30 cm and above) are to be placed to achieve the full coverage of 2,500 Nos. per 100 m² of protection area.

In addition, the scour protection at the downstream side of the cofferdam shall be extended to 20 m width by dumping cc-blocks and/or boulders of size 30 cm and above, at a cover rate of 2,500 Nos. per 100 m² area.

The choice of material depends on its timely availability and is to be decided at Site.

(2) The steel sheet pile cofferdam of groyne G-1 is exposed at its downstream edge. With the situation January 1996 there is no immediate threat to the structure, the more since no severe attack to this groyne is expected during the coming monsoon season as per latest morphological developments in the test site area.

Should time permit and surplus protection material, either cc-blocks or boulders of size 30 cm and above, be available at the time, additional protection material is to be dumped, covering an area with a radius of about 15 m around the downstream edge of the cofferdam.

The respective measures are to be coordinated with the Consultant, based on up to date soundings in the respective area.

Areas within the bed protection around the pile structure where the filter layer (geo-jute sand mat) is presently exposed, shall adequately be covered by boulders of size 30 cm or above.

E461|400 E461|600 E461|800 E462|000 E462|200 E462|400

N804|600 N804|400 N804|200 N804|000 N803|800 N803|600 N803|400 N803|200 N803|000 N802|800

DHUTICHARA PRY. SCHOOL

FAP 21.03

MADRASHA

Borrow pit

24.20 24.22 24.24 24.26 24.29 24.31 24.33

G-B/2 G-B/1 G-1 G-2 G-3 G-A G-A/2

253.87 m 252.10 m 250.33 m 300.36 m 310.33 m 584.28 m

15° 15° 15° 15° 15° 15°

110 m 119.82 m 116.39 m R=120m 30m 100m 50m 150m 138.19 m 87.44 30.75 76.52 47.67 124.19 m 22.58 137.86m 214.93 m 200 m

Supplementary slope protection (Optional works, 1996)

E-1 E-2 E-3 E-4

Re-location of main embankment under FAP-21 adaptation works (1996)
(Cross-sections see Drg AD-KA-002)

R=50m

Impermeable groyne head

Pile structure

5m

Groyne modification and extension (1996)

Original BWDB-embankment (soil to be re used for construction of retired embankment)

Groyne extension (1996)

Supplementary groyne (1996)

Vetiver plantation at 15cm C/C 2.5 m wide along embankment toe. (planting January'96)

Existing slope protection

Bankline 22.12.95

Supplementary pile row (1996)

Supplementary slope protection (January, 1996)

Main Base Line

Slope revetment (~130m) (Optional work)

Manos River

JTWC Camp

FAP 21.05

DAKATIA PRY SCHOOL

15.736m

G-A

G-A/2

JAMUNA RIVER

E461|600 E461|800 E462|000 E462|200 E462|400

N804|600 N804|400 N804|200 N804|000 N803|800 N803|600 N803|400 N803|200 N803|000 N802|800

CONTROL POINT SCHEDULE

Location	ID-No of Control Point	Co-ordinates BTM (FAP 24) Easting	Co-ordinates BTM (FAP 24) Northing	Elevation (m PWD)
Near Camp	FAP 21.05	461,479.517	802,817.795	+21.920
G-A/2	No. 24.33	(to be established)		
G-A	No. 24.31	461,763.470	803,328.440	+23.335
G-3	No. 24.29	461, 922.160	803, 595.130	+23.258
G-2	No. 24.26	462,003.780	803,884.190	+23.446
G-1	No. 24.24	462, 071.690	804,125.130	+23.390
G-B/1	No. 24.22	462,106.970	804,374.750	+23.404
G-B/2	No. 24.20	462,142.470	804,626.130	+23.954

LEGEND

Homestead
Borrow pit
Bankline
Control points

NOTES

1. All measurements in meters.
2. Levels refer to ±0.00 m PWD
3. Reference Drawings

AD-KA-002 Cross-Sections of Main Embankment
AD-KA-003 Main Embankment, Details of Revetment
AD-KA-010 Groyne G-1, General Layout Plan
AD-KA-020 Groyne G-2, General Layout Plan
AD-KA-030 Groyne G-3, General Layout Plan
AD-KA-040 Groyne G-A, General Layout Plan
AD-KA-050 Groyne G-A/2, General Layout Plan

0 50 100 200 m
Scale 1:2000

E461|800 E462|000 E462|200 E462|400

REVISION	DATE	NAME	DESCRIPTION	APPROVED
1	28.01.96	ANOWAR	Revetment near G-A/2	

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

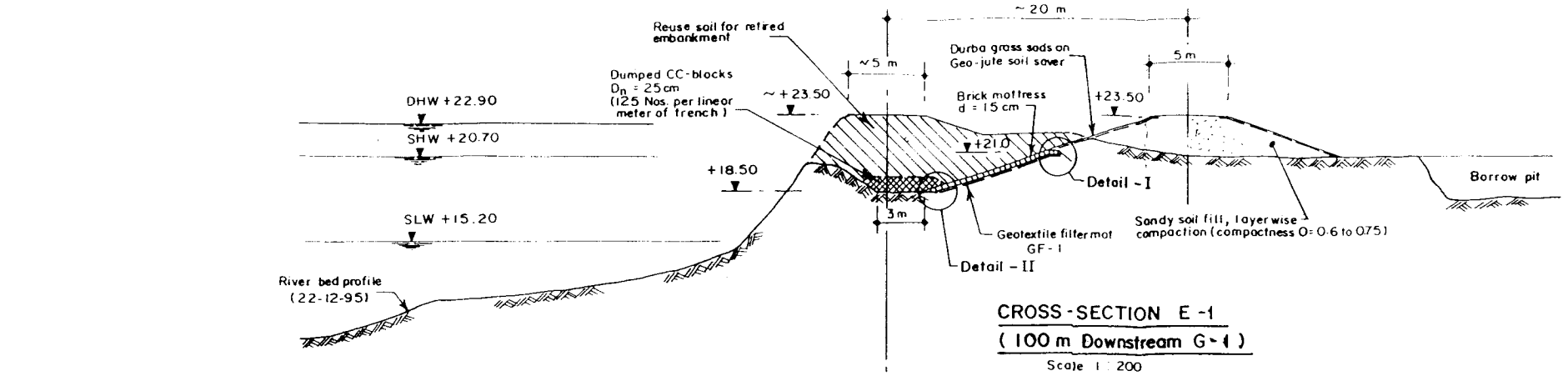
BANK PROTECTION PILOT PROJECT FAP-21

JAMUNA TEST WORKS CONSULTANTS, JOINT VENTURE

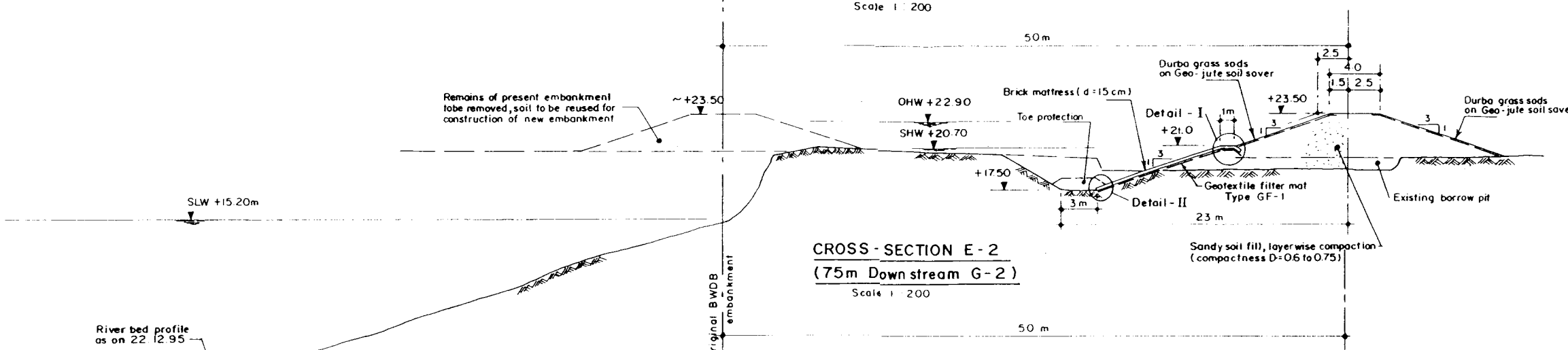
CONSULTING CONSORTIUM FAP 21/22

TEST SITE I - KAMARJANI
-ADAPTATION WORKS-
ADAPTATION OF TEST STRUCTURES
GENERAL PROJECT LAYOUT

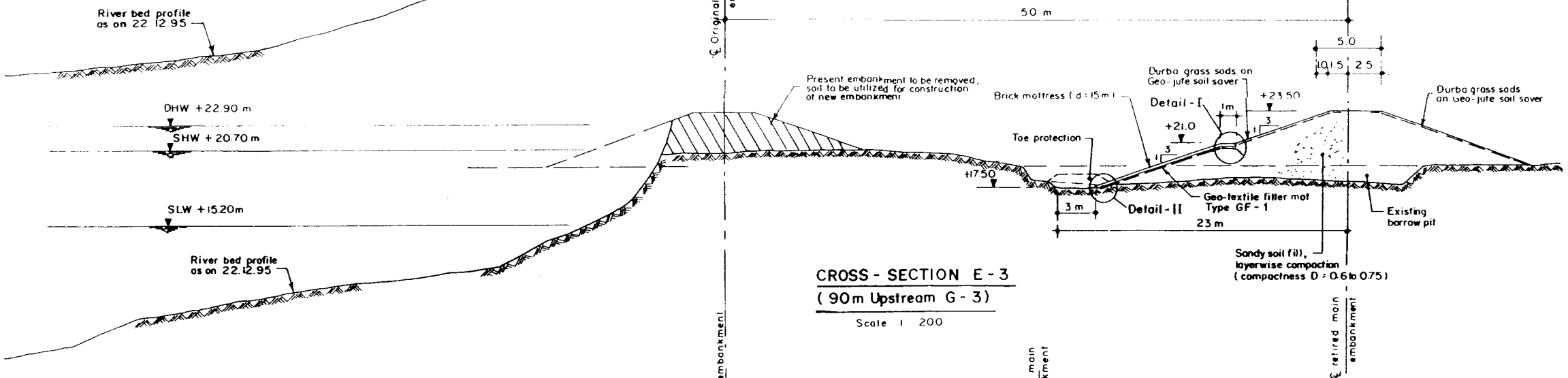
	NAME	DATE	SCALE:
DRAWN	ANOWAR	10-01-96	1:2000
CHECKED		16-01-96	DRAWING NO. AD-KA-001
APPROVED			REVISION 1



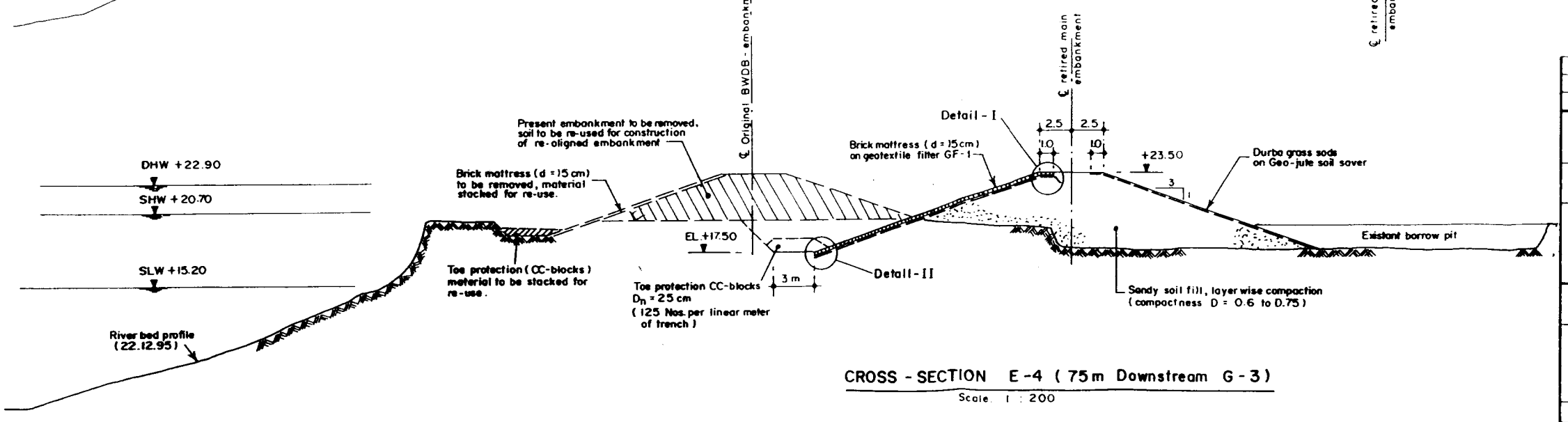
CROSS-SECTION E-1
(100 m Downstream G-1)
Scale 1 : 200



CROSS-SECTION E-2
(75m Down stream G-2)
Scale 1 : 200



CROSS-SECTION E-3
(90m Upstream G-3)
Scale 1 : 200



CROSS-SECTION E-4 (75m Downstream G-3)
Scale 1 : 200

DRAWING PHOTOREDUCED BY 50%

0 5 10 20 m
Scale. 1 : 200

NOTES

1. All measurements in meter.
2. Levels refer to ± 0.0m PWD.
3. S.L.W = Standard Low Water
   S.H.W = Standard High Water
   D.H.W = Design High Water
4. Details of revetment see Drg. AO-KA-003
5. Reference Drawings:

AO-KA-001	Adoptation of Test Structures General Project Layout
AO-KA-003	Main Embankment, Details of Revetment
AD-KA-020	Groyne G-2 General Layout Plan
AD-KA-030	Groyne G-3 General Layout Plan
AD-KA-040	Groyne G-4 General Layout Plan

REV.	DATED	NAME	DESCRIPTION	APPROVED

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

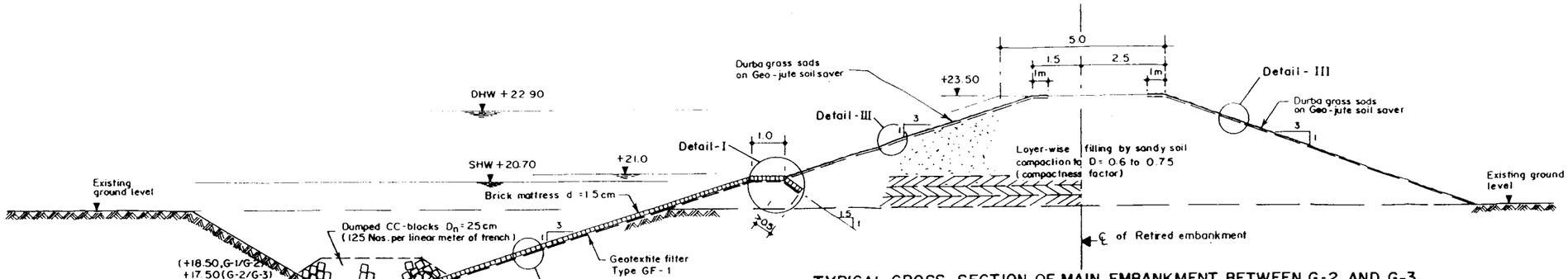
JAMUNA TEST WORKS CONSULTANTS, JOINT VENTURE
CONSULTING CONSORTIUM FAP 21/22
ARGE-21/22 BPP, AACHEN, BERGISCH GLADBACH/GERMANY
COMPAGNIE INGENIERIE BTP SECHE, LYON/FRANCE
PROF.DR. LACHER & PARTNERS, BERGISCH GLADBACH/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS
In association with:
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES (PRIVATE) LTD. (BETS)
DORSCH CONSULT LIMITED (DCL)

TEST SITE I - KAMARJANI
- ADAPTATION WORKS -

CROSS-SECTION OF MAIN EMBANKMENT
(E-1 to E-4)

	NAME	DATE	SCALE:
DRAWN	ANOWAR	17-01-96	1 : 200
CHECKED		22-01-96	
APPROVED			

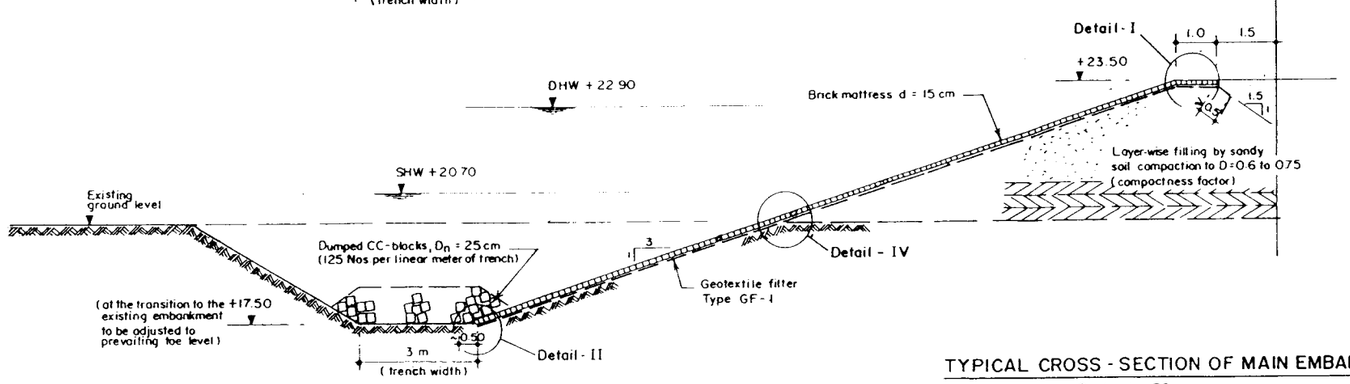
DRAWING NO. AD-KA-002 | REVISION 0



TYPICAL CROSS-SECTION OF MAIN EMBANKMENT BETWEEN G-2 AND G-3

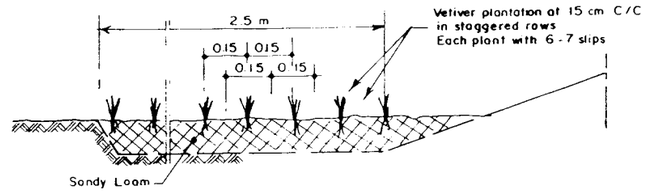
(Cross-Section upstream G-2 identical for Details I, II, III, IV)

Scale 1:75



TYPICAL CROSS-SECTION OF MAIN EMBANKMENT DOWN STREAM G-3

Scale 1:75

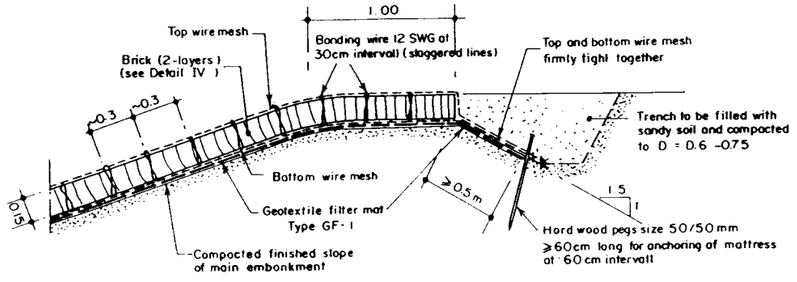


DETAIL OF VETIVER PLANTATION AS BIOTECHNICAL TOE PROTECTION

Scale 1:10

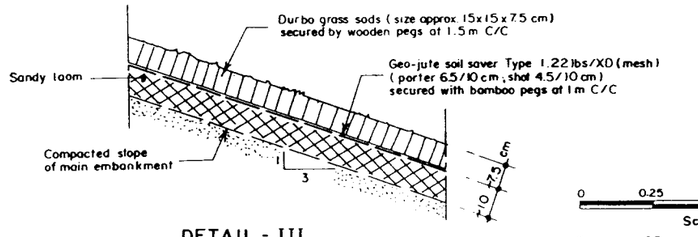
NOTES

1. Measurements in meters unless shown different
2. Levels refer to ± 0.0 m PWD.
3. Filling and compaction of sandy soil as per Specifications, Section 900.
4. Filter materials and protection materials and their installation as per Specification Section 1000.
5. Reference Drawings:
   AD-KA-002 Cross-Sections of Main Embankment.



DETAIL - I

Scale 1:20



DETAIL - III

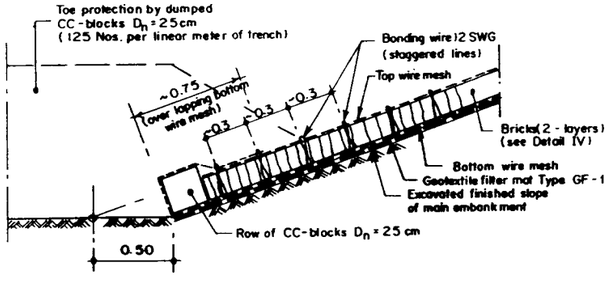
Biotechnical Revetment by Durba Grass

Scale 1:10

0 0.25 0.50 1.0 m
Scale. 1:10

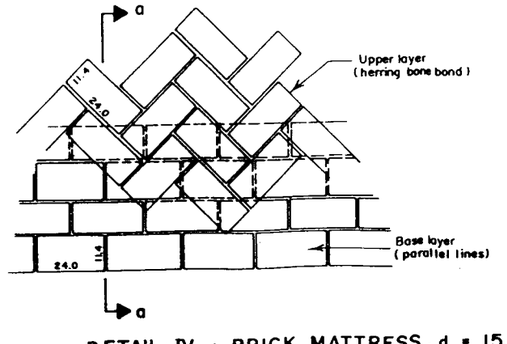
0 0.5 1.0 2.0 m
Scale. 1:20

0 2.5 5.0 7.5 m
Scale. 1:75



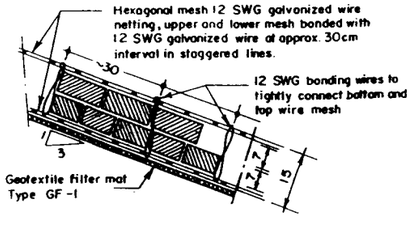
DETAIL - II

Scale 1:20



DETAIL-IV : BRICK MATTRESS, d = 15 cm (measurements in cm)

Scale 1:10



SECTION a-a

DRAWING PHOTOREDUCED BY 50%

REV.	DATED	NAME	DESCRIPTION	APPROVED

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

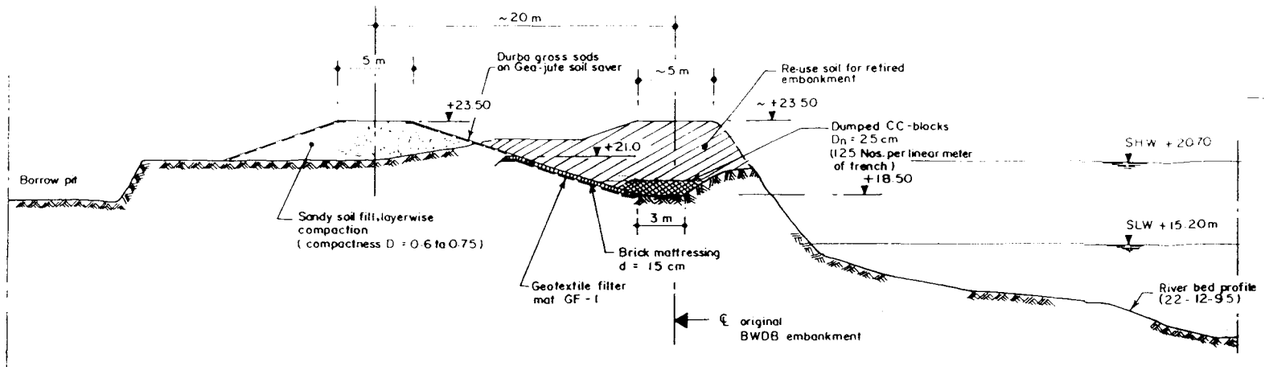
JAMUNA TEST WORKS CONSULTANTS, JOINT VENTURE

CONSULTING CONSORTIUM FAP 21

TEST SITE 1 - KAMARJANI
- ADAPTATION WORKS -

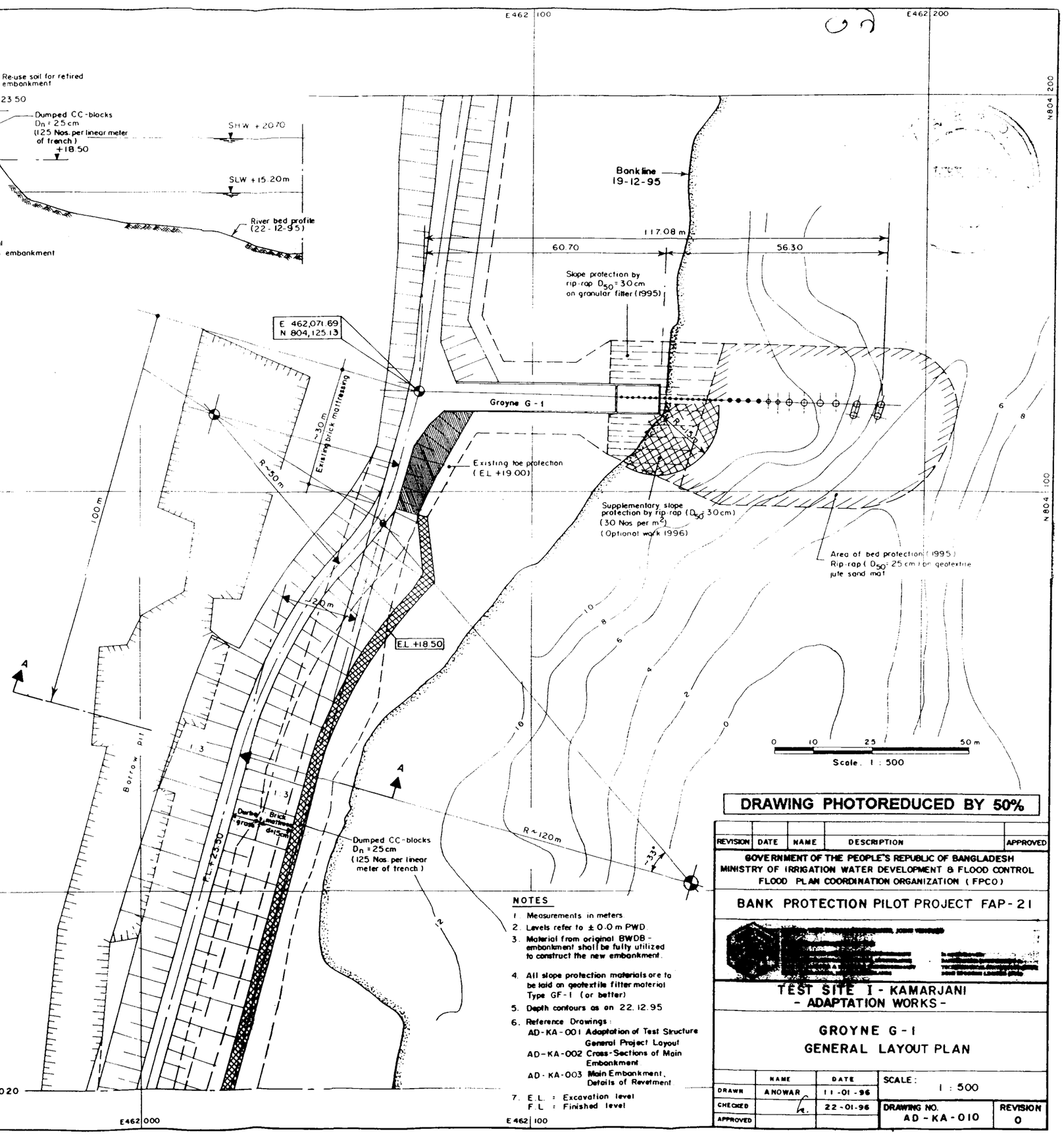
MAIN EMBANKMENT
DETAILS OF REVETMENT

	NAME	DATE	SCALE:
DRAWN	ANOWAR	18-01-96	1:10, 1:20, 1:75
CHECKED		23-01-96	DRAWING NO. AD-KA-003 / REVISION 0
APPROVED			



CROSS-SECTION A-A

SCALE 1 : 200



Match Line Drawing No. AD-KA-020

DRAWING PHOTOREDUCED BY 50%

NOTES

1. Measurements in meters
2. Levels refer to ± 0.0 m PWD.
3. Material from original BWDB embankment shall be fully utilized to construct the new embankment.
4. All slope protection materials are to be laid on geotextile filter material Type GF-1 (or better)
5. Depth contours as on 22.12.95
6. Reference Drawings :
   - AD-KA-001 Adaptation of Test Structure General Project Layout
   - AD-KA-002 Cross-Sections of Main Embankment
   - AD-KA-003 Main Embankment, Details of Revetment
7. E.L. : Excavation level
   F.L. : Finished level

REVISION	DATE	NAME	DESCRIPTION	APPROVED

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

TEST SITE I - KAMARJANI
- ADAPTATION WORKS -

GROYNE G-1
GENERAL LAYOUT PLAN

	NAME	DATE	SCALE: 1 : 500
DRAWN	ANOWAR	11-01-96	
CHECKED		22-01-96	DRAWING NO. AD-KA-010
APPROVED			REVISION 0

80

E461|900 E462|000 E462|100

Match line Drawing No. AD-KA-010

N803|900

Borrow pit

E 462,003.78
N 803,084.19

Durbo grass
Durbo grass
Brick mattress (d=15cm)

F.L.+23.50
F.L.+18.50
1:3
2.5
3.5

124.19 m
⑲ Pile axis
76.52 m
Modified and extended pile structure
47.67 m
Original groyne pile structure

Toe protection
CC-blocks D_n=25cm
(125 Nos per linear meter of trench)

30 m
30 m
R=20 m
49.40
45°

Brick mattress (d=20cm)
F.L.+2.50
E.L.+1.50

M.F.S to be demolished

Toe protection
CC-blocks D_n=25 cm
(125 Nos. per linear meter of trench)

Slope/toe protection of groyne head see Drg. AD-KA-023

Additional falling apron (1996)
CC-blocks D_n=35 cm / boulders
(35 blocks / 1 m²)

Area of falling apron (1995)
CC-blocks D_n=30 cm
(35 blocks /1 m²)

~1.5 m
~1.5 m
~2.5 m

R~50 m

E-2

Cofferdam (temporary)

F.L.+21.00
F.L.+23.50

Borrow pit

Bank line
19.12.95

E-2
(see Drg. AD-KA-002)

Match line Drawing No. AD-KA-030

N803|800

N803|700

0 10 25 50 m
Scale 1:500

NOTES

1. Measurements in meters.
2. Levels refer to ± 0.0 m PWD.
3. Material from original BWDB embankment shall be fully utilized to construct the new embankment and groyne head.
4. All slope protection materials are to be laid on geotextile filter material Type GF-1 (or Better)
5. Depth contours as on 22.12.95
6. Reference Drawings:
   - AD-KA-001 Adoptation of Test Structures General Project Layout
   - AD-KA-002 Cross Sections of Main Embankment
   - AD-KA-021 Pile Layout Plan Pile Schedule, Pile Bracing
   - AD-KA-023 Detailed Layout of Modified Groyne
7. E.L. = Excavation level
   F.L. = Finished level.

DRAWING PHOTOREDUCED BY 50%

REF.	DATED	NAME	DESCRIPTION	APPROVED

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

HYDRAULIC WORKS CONSULTANTS, JOINT VENTURE

TEST SITE I - KAMARJANI
- ADAPTATION WORKS -

GROYNE G-2
GENERAL LAYOUT PLAN

	NAME	DATE	SCALE: 1:500
DRAWN	ANOWAR	11-01-96	
CHECKED		22-01-96	DRAWING NO. AD-KA-020 / REVISION 0
APPROVED			

E2

E461 700 | E461 800 | E461 900 | E462 000

N803 700 | N803 600 | N803 500

Match line Drawing No. AD-KA-020

50m

℄ original BWDB - embankment

E-3

Durbo grass

Brick mattress (d = 15cm)

Toe protection CC-blocks D_n = 25cm (125 Nos per linear meter of trench)

3m

FL +21.0

FL +17.50

FL +23.50

1 : 3

Bank line 19.12.95

E-3 (See Drg AD-KA-002)

138.19m

50.75

87.44 m

Existing pile structure

62.35m

Groyne extension

40m

see SPECIAL NOTE on Drg. AD-KA-033

0.16

40% 70% 75% 65% 60% 50% 60% 70% 80%

Permeability of groyne structure

E 461,922.16
N 803,595.13

Pile axis (35) (2)

FL +22.50

30m

Borrow pit

Brick mattress (d = 20cm)

Slope/toe protection of groyne head see Drg. AD-KA-033

150m

Brick mattress (d = 25 cm)

Falling apron

10m

25m

35°

0 10 25 50m

Scale : 1 : 500

E-4 (see Drg. AD-KA-002)

Borrow pit

Durbo grass

Brick mattress (d = 15cm)

Toe protection CC-blocks D_n = 25cm (125 Nos per linear meter of trench)

E-4

R=30m

Existing brick mattress (d = 15cm)

Match line Drawing AD-KA-040

DRAWING PHOTOREDUCED BY 50%

REV	DATED	NAME	DESCRIPTION	APPROVED

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

MOTT MACDONALD HALCROW DELFT HYDRAULICS JOINT VENTURE

In association with: BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD., DESH UPODESH LIMITED (DUL)

TEST SITE I - KAMARJANI
- ADAPTATION WORKS -

GROYNE G-3
GENERAL LAYOUT PLAN

	NAME	DATE
DRAWN	ANOWAR	13-01-96
CHECKED		22-01-96
APPROVED		

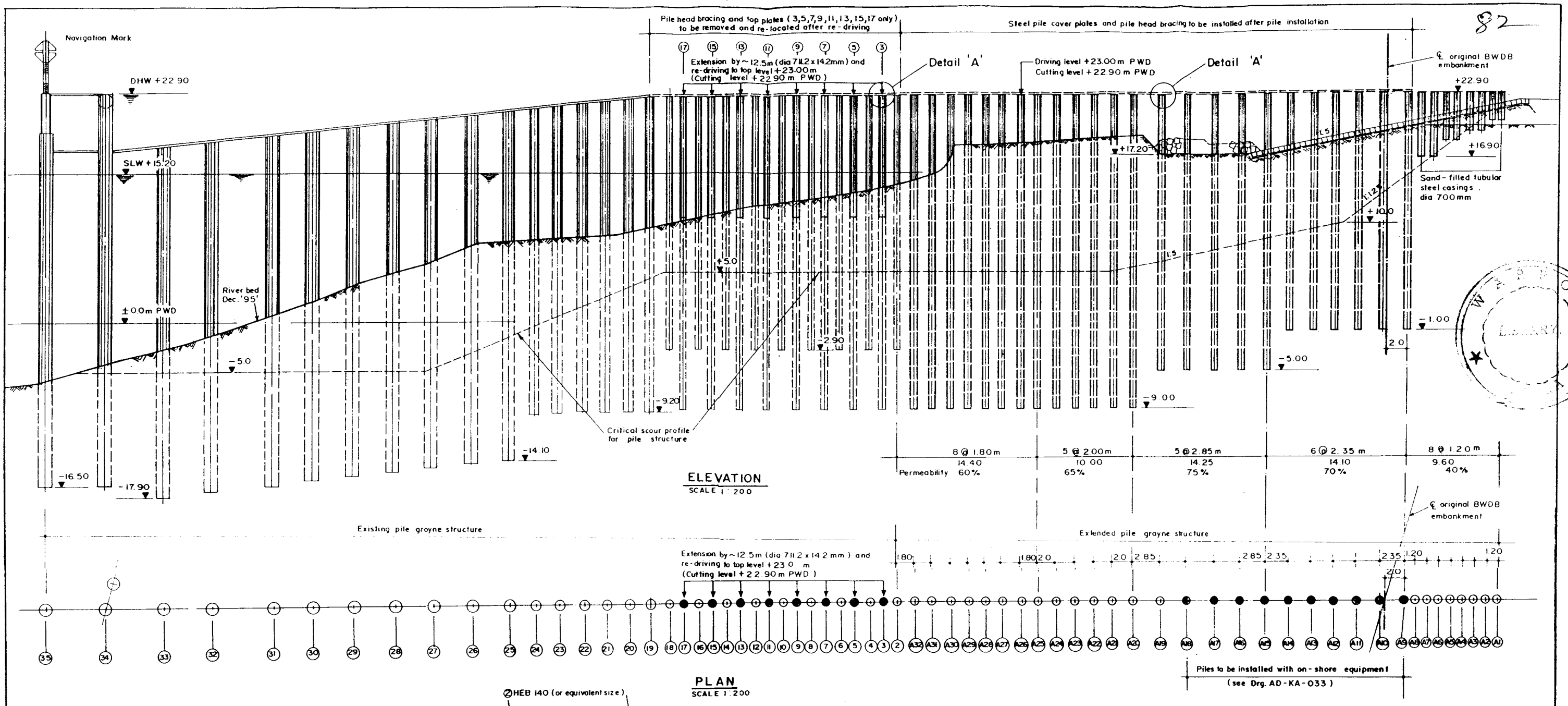
SCALE : 1 : 500

DRAWING NO. AD-KA-030

REVISION 0

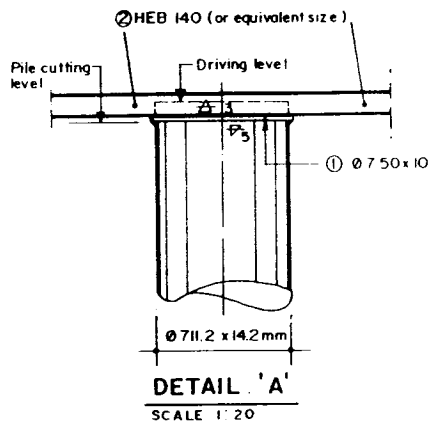
NOTES

1. Measurements in meters
2. Levels refer to ±0.0 m PWO.
3. Material from original BWDB - embankment shall be fully utilized to construct the new embankment and groyne head.
4. All slope protection materials are to be laid on geotextile filter material Type GF-1 (or better)
5. Depth contours as on 22.12.95
6. Reference Drawings :
   - AD-KA-001 Adaptation of Test Structures General Project Layout
   - AD-KA-031 Pile Layout Plan Pile Schedule, Pile Bracing
   - AD-KA-033 Detailed Layout of Modified Groyne
7. E.L. = Excavation level
   F.L. = Finished level



ELEVATION
SCALE 1:200

PLAN
SCALE 1:200



DETAIL 'A'
SCALE 1:20

PILE INSTALLATION SCHEDULE

PILE TYPE STEEL-GRADE	LOCATION NO.	NOS	PILE HEAD: TOP LEVEL AFTER INSTALLATION m PWD	PILE HEAD: CUTTING LEVEL m PWD	PILE POINT LEVEL m PWD	TOTAL PILE LENGTH (m)
Ø711.2 x 14.2mm St. 37-3	A-9 to A-14	6	+23.00	+22.90	-1.00	24.00
	A-15 to A-19	5	+23.00	+22.90	-5.00	28.00
	A-20 to A-32	13	+23.00	+22.90	-9.00	32.00
	EXTENSION OF EXISTING PILES					
	LOC. NO.	NOS.	LENGTH OF EXTENSION			
	17	1	13.50	+23.00	+22.90	-10.00	33.00
	15	1	13.00	+23.00	+22.90	-9.50	32.50
	13,11,9, 7,5	5	12.50	+23.00	+22.90	-9.00	32.00
	3	1	12.00	+23.00	+22.90	-8.50	31.50

MATERIAL SCHEDULE FOR PILE HEAD BRACINGS
Axes (A9) to (2)

ITEM NO.	QUANTITY	SECTION / DIMENSIONS	SINGLE WEIGHT (kg)	TOTAL WEIGHT (kg)	REMARKS
1	24 Nos.	Ø750 x 10	44.16	1,060	
2	65 m	HEB 140	33.7 kg/m	2,190	
		TOTAL		3,250	

NOTES :

1. All measurements in meters
2. All levels refer to ±0.0m PWD
3. S.L.W : Standard Low Water
   D.H.W : Design High Water
4. Reference Drawings
   KA-305/3 Pile Installation Plan (as built)
   AD-KA-032 Steel Pile Dia 711.2 x 14.2 mm Pile Schedule, Detail
   AD-KA-033 Detailed Layout of Modified Groyne

0 1 2 m
SCALE 1:20

0 5 10 15 20m
SCALE 1:200

DRAWING PHOTOREDUCED BY 50%

REV.	DATE	NAME	DESCRIPTION	APPROVED

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

JAMUNA BRIDGE WORKS CONSULTANTS, JOINT VENTURE

TEST SITE 1 - KAMARJANI
— ADAPTATION WORKS —

GROYNE - G3
PILE LAYOUT PLAN
PILE SCHEDULE - PILE BRACING

	NAME	DATE
DRAWN	F. Hossain	16-01-96
CHECKED		18-01-96
APPROVED		

SCALE : 1:200, 1:20

DRAWING NO. AD-KA-031

REVISION 0

E461 700 | E461 800 | E461 900 | E462 000

N803 400

N803 300

N803 200

Match line Drg. AD-KA-030

Borrow pit

Bank line 19.12.95

Concrete sheet pile cofferdam

Scour protection (1994/95)

+22.99

+22.90

+20.70

20.30

50%

FL. +23.50

200 m (to center line Groyne G-A/2)

59.75

20m

R-20m

13.85 60%

12.02 70%

16.64 80%

Supplementary pile row (1996)

Permeability

15m

122.56

62.81

137.86

118.30

Groyne extension (1996)

G-A

15m

25m

Supplementary scour protection by boulders / CC-blocks, $D_n \geq 30$ cm (25 Nos / 1 m^2)

~150 m

Existing slope revetment with toe protection

Falling apron by CC-blocks $D_n = 35$ cm and boulders $D_{50} = 35$ cm (35 Nos./1m^2)

Existing soil embankment

FL. +23.50

Extension of embankment slope to EL. +17.50

Match line Drg. AD-KA-050

0 10 25 50 m

Scale. 1 : 500

DRAWING PHOTOREDUCED BY 50%

NOTES

1. Measurements in meters.
2. Levels refer to ±0.0 m PWO.
3. Material from earth cut shall be fully utilized to construct the new embankment and groyne heads upstream of G-A.
4. All slope protection materials are to be laid on geotextile filter material Type GF-1 (or better).
5. Depth contours as on 22.12.95
6. Reference Drawings:

   AO-KA-001 Adaptation of Test Structures General Project Layout

REV.	DATED	NAME	DESCRIPTION	APPROVED

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN CO ORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

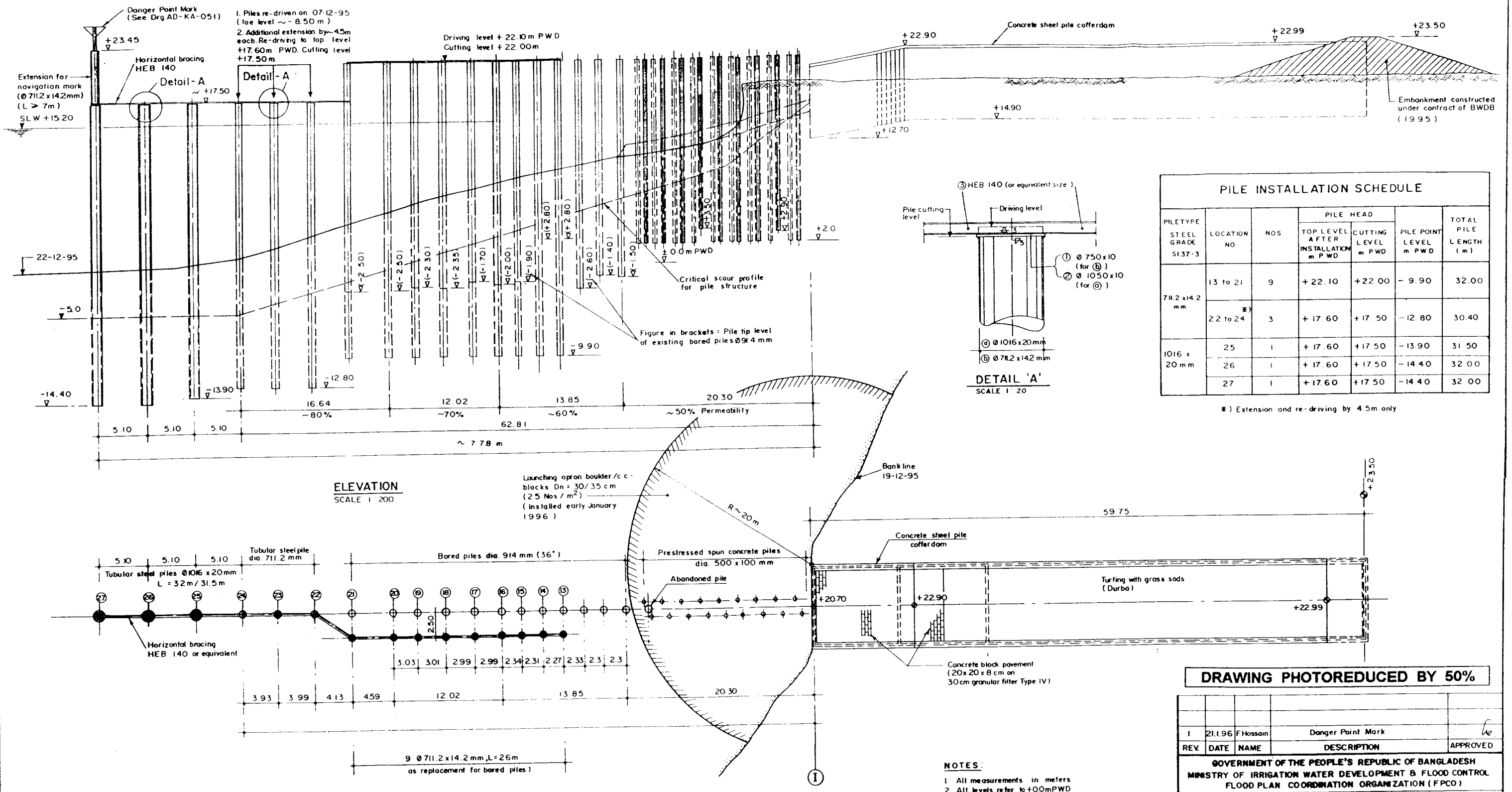
JAMUNA TEST WORKS CONSULTANTS, JOINT VENTURE
CONSULTING CONSORTIUM FAP 21/22
RENDEL VISER INC., ENGLAND, NORTHWATER GROUP
GEOSCIENCE NATIONALE DE BRONIE, LYON FRANCE
WEST DR. LACROIX & PARTNERS, ENGINEERING
DELFT HYDRAULICS, DELFT NETHERLANDS
In association with:
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD. (BETS)
DESH WOODEN LIMITED (DWL)

TEST SITE I - KAMARJANI
- ADAPTATION WORKS -

GROYNE G-A
GENERAL LAYOUT PLAN

	NAME	DATE	SCALE: 1 : 500
DRAWN	ANOWAR	15-01-96	
CHECKED		21-01-96	DRAWING NO. AD-KA-040
APPROVED			REVISION 0

8c



DETAIL 'A'
SCALE 1:20

PILE INSTALLATION SCHEDULE

PILE TYPE STEEL GRADE SI 37-3	LOCATION NO	NOS.	PILE HEAD: TOP LEVEL AFTER INSTALLATION m PWD	PILE HEAD: CUTTING LEVEL m PWD	PILE POINT LEVEL m PWD	TOTAL PILE LENGTH (m)
711.2 x14.2 mm	13 to 21	9	+22.10	+22.00	- 9.90	32.00
	22 to 24 *)	3	+17.60	+17.50	-12.80	30.40
1016 x 20 mm	25	1	+17.60	+17.50	-13.90	31.50
	26	1	+17.60	+17.50	-14.40	32.00
	27	1	+17.60	+17.50	-14.40	32.00

*) Extension and re-driving by 4.5m only

ELEVATION
SCALE 1:200

PLAN
SCALE 1:200

MATERIAL SCHEDULE FOR PILE HEAD BRACING

ITEM NO.	QUANTITY	SECTION / DIMENSIONS	SINGLE WEIGHT	TOTAL WEIGHT (kg)	REMARKS
1	12 Nos.	Ø 750 x 10	44.16 kg/No	529.92	
2	3 Nos	Ø 1050 x 10	86.54 kg/No	259.63	
3	55 m	HEB 140 (or equivalent size)	33.70 kg/m	1853.50	
			TOTAL	2,643.05	

NOTES:

1. All measurements in meters
2. All levels refer to +0.0mPWD
3. Reference Drawings.
   - KA-401/3 (as-built)
   - AD-KA-042 Steel pile dia 711.2x14.2mm Pile Schedule, Details
   - AD-KA-043 Steel pile dia 1016x20mm Pile Schedule, Details
   - AD-KA-051 Grayne G-A/2 Pile Layout Plan, Danger Point Mark

0 1 2m
SCALE 1:20

0 5 10 15 20m
SCALE 1:200

DRAWING PHOTOREDUCED BY 50%

REV.	DATE	NAME	DESCRIPTION	APPROVED
1	21.1.96	F Hossain	Danger Point Mark	fe

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

JAMUNA TEST WORKS CONSULTANTS, JOINT VENTURE

In association with: BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD. (BETS) HALCROW LIMITED (UK)

TEST SITE I - KAMARJANI
- ADAPTATION WORKS -

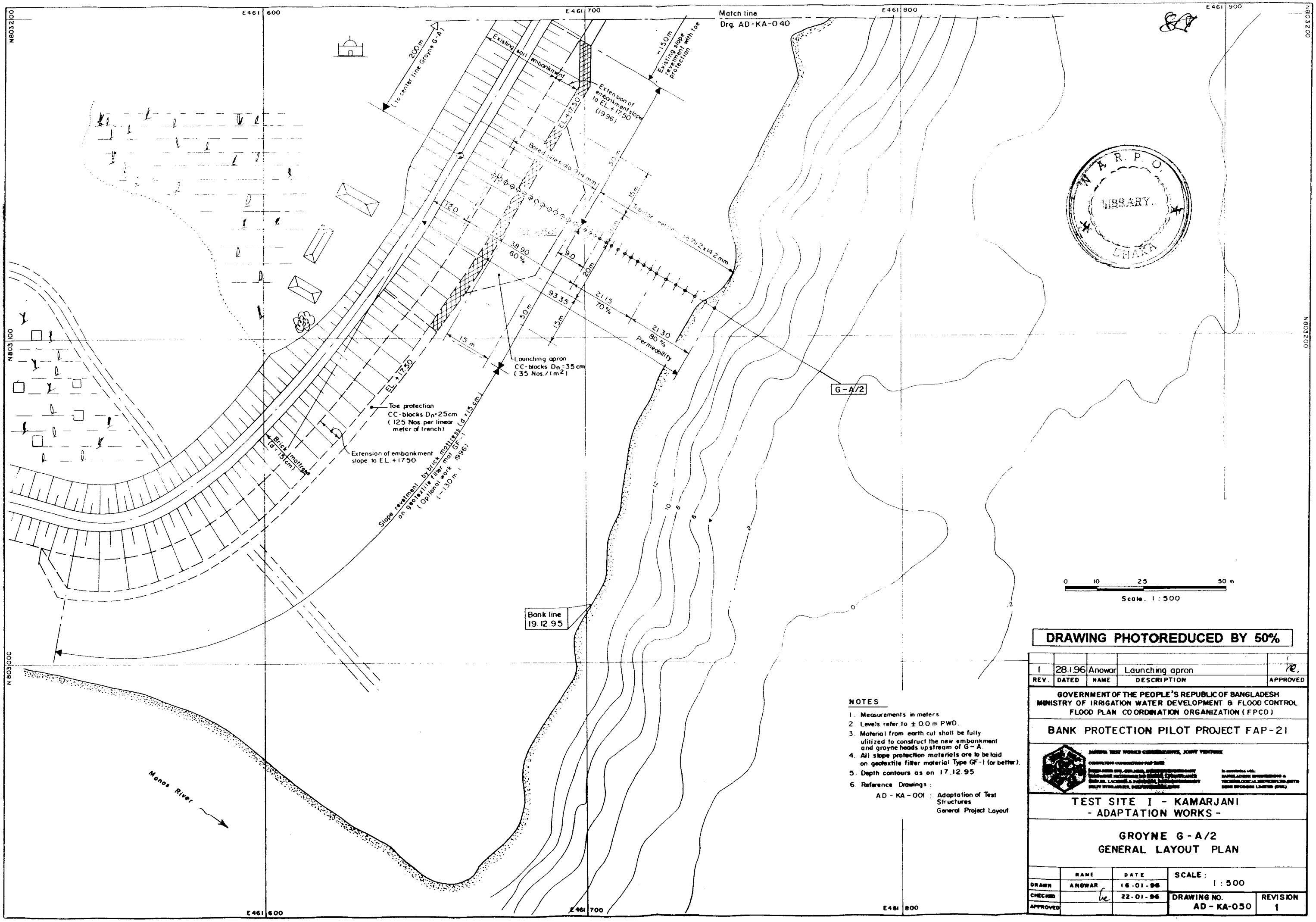
GROYNE G-A
PILE LAYOUT PLAN
PILE SCHEDULE, PILE BRACING

	NAME	DATE
DRAWN	ANOWAR	15-01-96
CHECKED		16-01-96
APPROVED		

SCALE: 1:200, 1:20

DRAWING NO. AD-KA-041

REVISION 0



0 10 25 50 m

Scale. 1 : 500

DRAWING PHOTOREDUCED BY 50%

REV.	DATED	NAME	DESCRIPTION	APPROVED
1	28.1.96	Anowar	Launching apron	

NOTES

1. Measurements in meters.
2. Levels refer to ± 0.0 m PWD.
3. Material from earth cut shall be fully utilized to construct the new embankment and groyne heads upstream of G – A.
4. All slope protection materials are to be laid on geotextile filter material Type GF-1 (or better).
5. Depth contours as on 17.12.95
6. Reference Drawings :
   AD - KA - 001 : Adaptation of Test Structures General Project Layout

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCD)

BANK PROTECTION PILOT PROJECT FAP-21

In association with:

TEST SITE I - KAMARJANI
- ADAPTATION WORKS -

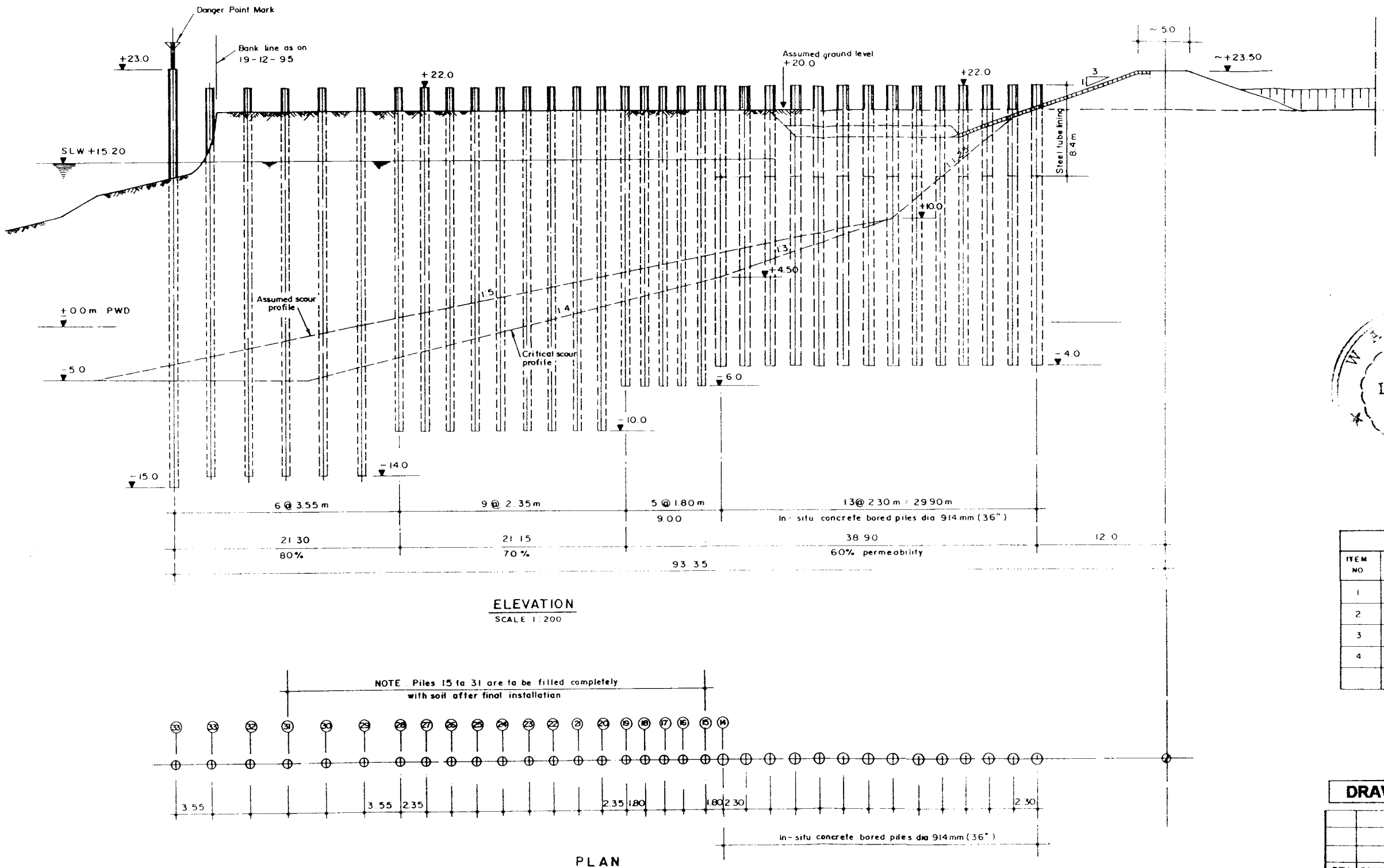
GROYNE G-A/2
GENERAL LAYOUT PLAN

	NAME	DATE
DRAWN	ANOWAR	16-01-96
CHECKED		22-01-96
APPROVED		

SCALE : 1 : 500

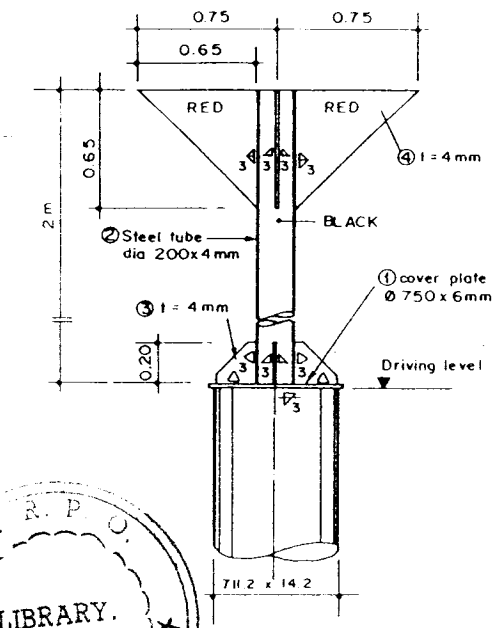
DRAWING NO. AD - KA-050

REVISION 1



ELEVATION
SCALE 1:200

PLAN
SCALE 1:200



PILE HEAD COVER ①
(only axes 32,33,34)
SCALE 1:20

DANGER POINT MARK
(Axis 34 only)

MATERIAL SCHEDULE

ITEM NO	NOS	SECTION / SIZE	UNIT WEIGHT (kg)	WEIGHT (kg)
1	3	▱ 750 x 6	26.5/No	79.5
2	1	Ø 200 x 4 2000	19.3/m	38.6
3	4	▱ 200 x 4 200	1.25/No	5.0
4	4	▽ 650 x 4 650	6.63/No	26.5
		TOTAL		149.6

PILE INSTALLATION SCHEDULE

PILE TYPE	LOCATION NO.	NOS.	PILE HEAD LEVEL m PWD	PILE POINT LEVEL m PWD	PILE LENGTH m
Bored pile dia 914 mm	1 to 14	14	+ 22.0	- 4.00	26.0
Tubular Steel pile dia. 711.2 x 14.2 mm St 37-3	15 to 19	5	+ 22.0	- 6.00	28.0
	20 to 28	9	+ 22.0	- 10.00	32.0
	29 to 33	5	+22.0	- 14.00	36.0
	34	1	+ 23.0	- 15.00	38.0

NOTES:
1. All measurements in meters
2. Levels refer to ±0.0m PWD
3. SLW = Standard Low Water
4. Reference Drawings
   - AD-KA-001 Adaptation of Test Structures General Project Layout
   - AD-KA-050 General Layout Plan
   - AD-KA-052 Steel Pile Dia 711.2x14.2mm Pile Schedule

0 1.0 2.0 m
SCALE 1:20

0 5 10 15 20m
SCALE 1:200

DRAWING PHOTOREDUCED BY 50%

REV.	DATE	NAME	DESCRIPTION	APPROVED

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION, WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

HASKONING TEST WORKS CONSULTANTS, JOINT VENTURE

TEST SITE 1 - KAMARJANI
- ADAPTATION WORKS -

GROYNE G-A/2
PILE LAYOUT PLAN
PILE INSTALLATION SCHEDULE
DANGER POINT MARK

	NAME	DATE	SCALE: 1:200, 1:20
DRAWN	F. HOSSAIN	20-01-96	
CHECKED		20-01-96	DRAWING NO. AD-KA-051
APPROVED			REVISION 0

ANNEX G

Detailed Construction Time Schedule

ADAJUMAC.MPP

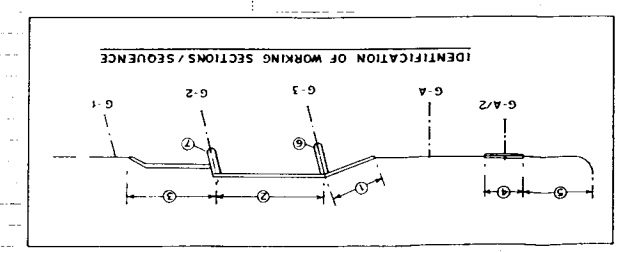
ID	Description	Activity	Duration	Scheduled Start	Scheduled Finish
1	Prepare commencement at Site		0d	22 Jan '96	22 Jan '96
2	CONTRACTOR: MATERIAL SUPPLIES		38d	22 Jan '96	8 Mar '96
3	Bricks for CC-blocks production	2.75 million	30d	22 Jan '96	20 Feb '96
4	Cement for CC-blocks production	2 000 t	30d	24 Jan '96	28 Feb '96
5	Wet mesh for brick masonry	25,000 m²	21d	31 Jan '96	21 Feb '96
6	Wet mesh for brick masonry (OPTIONAL)	3,800 m²	7d	28 Feb '96	6 Mar '96
7	Bricks for reinforcing	1 million	22d	30 Jan '96	21 Feb '96
8	Bricks for reinforcing (OPTIONAL)	0.3 million	5d	28 Feb '96	1 Mar '96
9	Steel casings dia. 700 mm	531	16d	15 Feb '96	8 Mar '96
10	Bored pile casings	161	21d	25 Jan '96	14 Feb '96
11	Reinforcing steel	461 t	7d	1 Feb '96	7 Feb '96
12	READY cemmed for bored piles	128 t	0d	15 Feb '96	15 Feb '96
13	Concrete aggregates for bored piles	m³	10d	2 Feb '96	11 Feb '96
14	Dutra grass sods	4,150 m²	12d	7 Feb '96	19 Feb '96
15	Veneer plants	33,500 Nos.	16d	25 Jan '96	7 Feb '96
16	EMPLOYER: MATERIAL SUPPLIES		66d	25 Jan '96	15 Feb '96
17	Construction fiber materials	22,800 m²	0d	31 Jan '96	31 Jan '96
18	Bricklaying (site Storm)	8,000 m²	25d	25 Jan '96	19 Feb '96
19	Tubular steel poles dia. 711 x 16 mm	2,660 m	0d	15 Mar '96	15 Feb '96
20	Veneer partitions u/s and d/s of C-A	750 m²	21d	28 Feb '96	15 Feb '96
21	CC - block production		66d	25 Jan '96	6 Apr '96
22	Size 25/25/25 cm	100,000 Nos.	56d	29 Jan '96	24 Mar '96
23	Size 9/10/20cm	50,000 Nos.	60d	1 Feb '96	4 Apr '96
24	Size 35/25/35 cm	120,000 Nos.	45d	27 Jan '96	26 Mar '96
25	Size 50/50/50 cm	560 Nos.	12d	1 Mar '96	12 Mar '96
26	Size 25/25/25 cm (OPTIONAL)	22,500 Nos.	13d	25 Mar '96	6 Apr '96
27	Size 35/35/35 cm (OPTIONAL)	28,250 Nos.	5d	15 Feb '96	28 Feb '96
28	Earth works main embankment		45d	22 Jan '96	26 Mar '96
29	Section C-A to C-3	7,800 m³	7d	22 Jan '96	28 Jan '96
30	Section C-3 to C-2	24,000 m³	16d	25 Jan '96	8 Feb '96
31	Section C-2 to C-1	11,800 m³	6d	10 Feb '96	17 Feb '96
32	Section at C-A2	4,700 m³	4d	8 Feb '96	6 Mar '96
33	Section downstream C-A2 (OPTIONAL)	3,800 m³	4d	7 Feb '96	10 Feb '96
34	Soil stockpiling at C-B/C-2	15,000 m³	10d	17 Feb '96	1 Mar '96
35	Brick masonry (15 cm) foundation and filter mat		47d	6 Feb '96	12 Mar '96
36	Section C-A to C-3	2,300 m³	8d	5 Feb '96	12 Feb '96
37	Section C-3 to C-2	2,150 m³	10d	11 Feb '96	20 Feb '96
38	Section C-2 to C-1	1,800 m³	6d	25 Feb '96	1 Mar '96
39	Section at C-A2	2,800 m³	6d	8 Feb '96	14 Mar '96
40	Section downstream C-A2 (OPTIONAL)	3,800 m³	12d	15 Feb '96	28 Mar '96
41	Dutra grass protection between C-3 and C-1	4,150 m²	14d	15 Feb '96	8 Mar '96
42	Toe protection along main embankment (size 25 cm		66d	8 Feb '96	12 Mar '96
43	Section C-A to C-3	14,375 Nos.	5d	8 Feb '96	15 Feb '96
44	Section C-3 to C-2	22,500 Nos.	11d	17 Feb '96	2 Mar '96
45	Section C-2 to C-1	24,500 Nos.	13d	9 Mar '96	21 Mar '96
46	Section at C-A2 (site 25 cm)	12,500 Nos.	6d	18 Mar '96	19 Mar '96
47	Section at C-A2 (site 35 cm)	28,825 Nos.	12d	19 Mar '96	30 Mar '96
48	Section downstream C-A2 (OPTIONAL)	22,500 Nos.	13d	1 Apr '96	12 Apr '96
49	Bored pile foundation	14 Nos.	21d	15 Feb '96	90 Mar '96
50	Tubular steel pile works		41d	18 Mar '96	25 Apr '96
51	Ball joint welding of piles	155 Nos.	23d	18 Mar '96	7 Apr '96
52	Land-sided piling at C-B	10 Nos.	5d	19 Mar '96	22 Mar '96
53	Land-sided piling at C-2	6 Nos.	2d	24 Mar '96	25 Mar '96
54	Land-sided piling at C-A2	17 Nos.	10d	26Mar '96	4 Apr '96
55	River-sided piling at C-3 (transition only)	7 Nos.	7d	23 Mar '96	29 Mar '96
56	River-sided piling at C-2 (transition only)	7 Nos.	7d	31 Mar '96	6 Apr '96
57	River-sided piling at C-3 (pre cleaning)	7 Nos.	3d	8 Apr '96	10 Apr '96
58	River-sided piling at C-2 (pre cleaning)	23 Nos.	7d	12 Apr '96	18 Apr '96
59	River-sided piling at C-A	5 Nos.	2d	20 Apr '96	21 Apr '96
60	River-sided piling at C-A2	3 Nos.	3d	23 Apr '96	25 Apr '96
61	Steel works at the heads / transings / gangway C-2	25 t	37d	25 Mar '96	30 Apr '96
62	Section at the heads (Option)		23d	30 Mar '96	27 Apr '96
63	Earth works	8,000 m³	6d	30 Mar '96	6 Apr '96
64	Brick mattress (20 cm), hvdc filter mats	1,800 m²	7d	8 Apr '96	8 Apr '96
65	CC-block pavement at slopes, bird mats	15,130 Nos.	10d	8 Apr '96	12 Apr '96
66	Toe protection (co-blocks 25cm)	5,800 Nos.	2d	6 Apr '96	7 Apr '96
67	Laundring apron (co-blocks 30cm)	27,500 Nos.	14d	8 Apr '96	21 Apr '96
68	Filling apron (OPTIONAL dumping by boats	28,250 Nos.	13d	15 Apr '96	27 Apr '96
69	Groyne head C-2 ⑦		38d	7 Apr '96	6 May '96
70	Earth works	8,000 m³	4d	7 Apr '96	10 Apr '96
71	Brick mattress (20 cm), hvdc filter mats	1,250 m²	5d	11 Apr '96	15 Apr '96
72	CC-blocks pavement of slopes, bird mats	7,860 Nos.	6d	11 Apr '96	16 Apr '96
73	Toe protection (co-blocks 25cm)	8,000 Nos.	2d	13 Apr '96	14 Apr '96
74	Laundring apron (co-blocks 30cm)	25,250 Nos.	12d	16 Apr '96	27 Apr '96
75	Filling apron pipe sources (CCblks 35 cm)	42,750 Nos.	16d	18 Apr '96	28 Apr '96
76	Filling apron pipe sources (boulders, size 35 c	31,250 Nos.	6d	29 Apr '96	6 May '96
77	Groyne C-A		66d	7 May '96	11 May '96
78	Scour protection cellurains (CCblks 30 cm)	16,750 Nos.	5d	7 May '96	11 May '96
79	Filling apron pipe sources (boulders, size 35 c	112,000 Nos.	20d	22 Apr '96	11 May '96
80	Groyne C-1		5d	5 Apr '96	9 Apr '96
81	Scour protection cellurains (CCblks 30 cm)	12,250 Nos.	5d	5 Apr '96	9 Apr '96

Date: 28 Jan '96

Jamuna Test Works Consultans. Consulting Consortium FAP 21/22

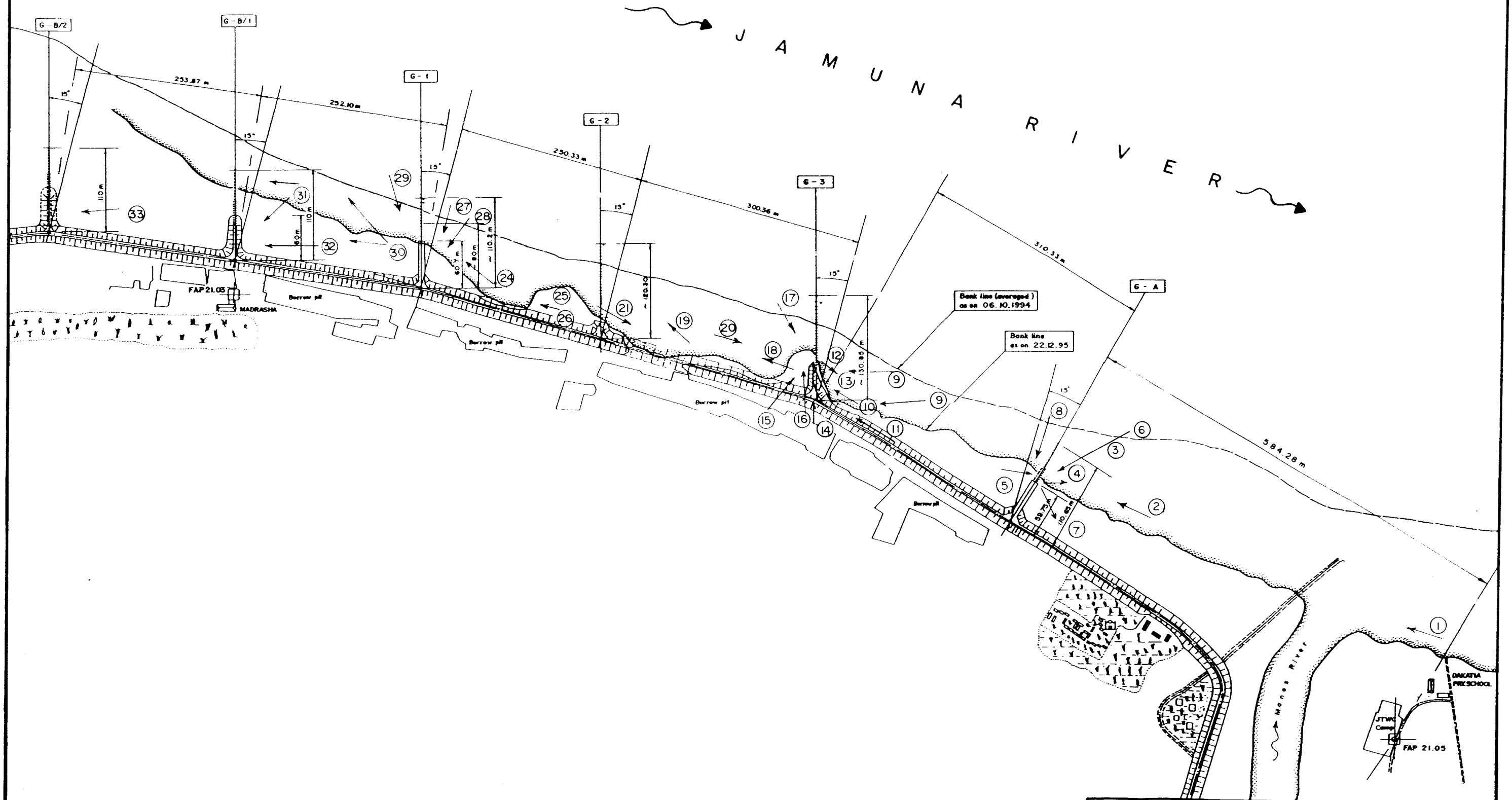
TEST SITE I . KAMARJANI
ADAPTATION OF TEST STRUCTURES (1996)
Detailed Construction Time Schedule

IDENTIFICATION OF WORKING SECTIONS / SEQUENCE



ANNEX H

Photographs



TEST SITE I - KAMARJANI
SITUATION AFTER MONSOON 1995
Scale 1: 5,000

Photo 1: Manos river estuary on 02.12.1995
(water level at 15.79 m PWD)

Photo 2: Groyne G-A; view from downstream on 02.12.1995
(water level at 15.79 m PWD)

Photo 3: Groyne G-A on 02.12.1995; bank erosion reached d/s edge of cofferdam (water level at 15.79 m PWD)

Photo 4: Groyne G-A on 02.12.1995; Falling apron near d/s edge of cofferdam (water level at 15.79 m PWD)

Photo 5: Groyne G-A on 02.12.1995; erosion process around spun cc-piles (water level at 15.79 m PWD)

Photo 6: Groyne G-A on 03.02.1996; eroding bank reached d/s edge of cofferdam. Falling apron around cofferdam head completely unfunctional (water level at 14.48 m PWD)

Photo 7: Groyne G-A on 02.12.1995; view towards d/s main embankment (water level at 15.79 m PWD)

Photo 8: Groyne G-A on 02.12.1995; view along u/s side of cofferdam, no damages (water level at 15.79 m PWD)

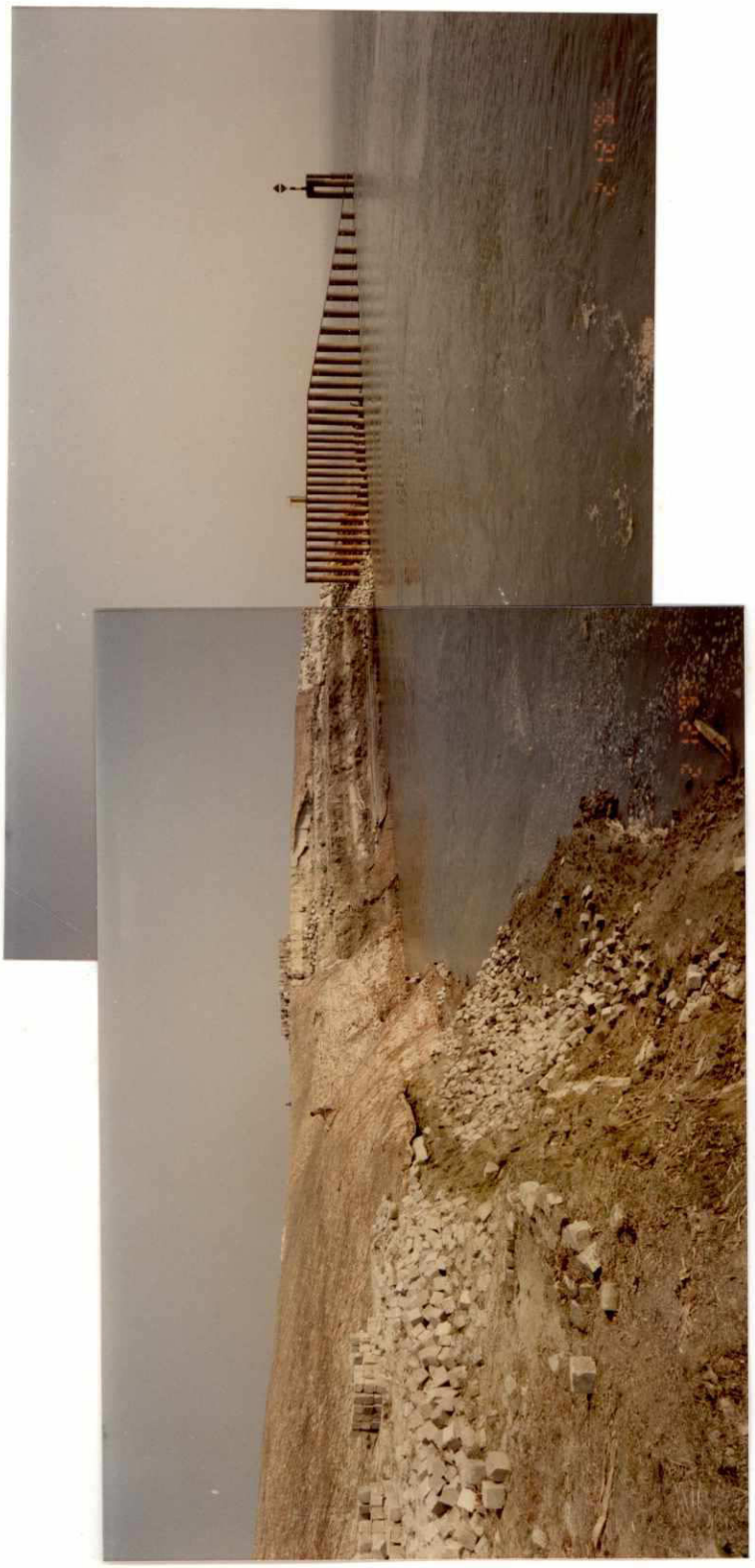


Photo 9: Groyne G-3 on 02.12.1995; view from d/s into damaged part of the groyne (water level at 15.79 m PWD)

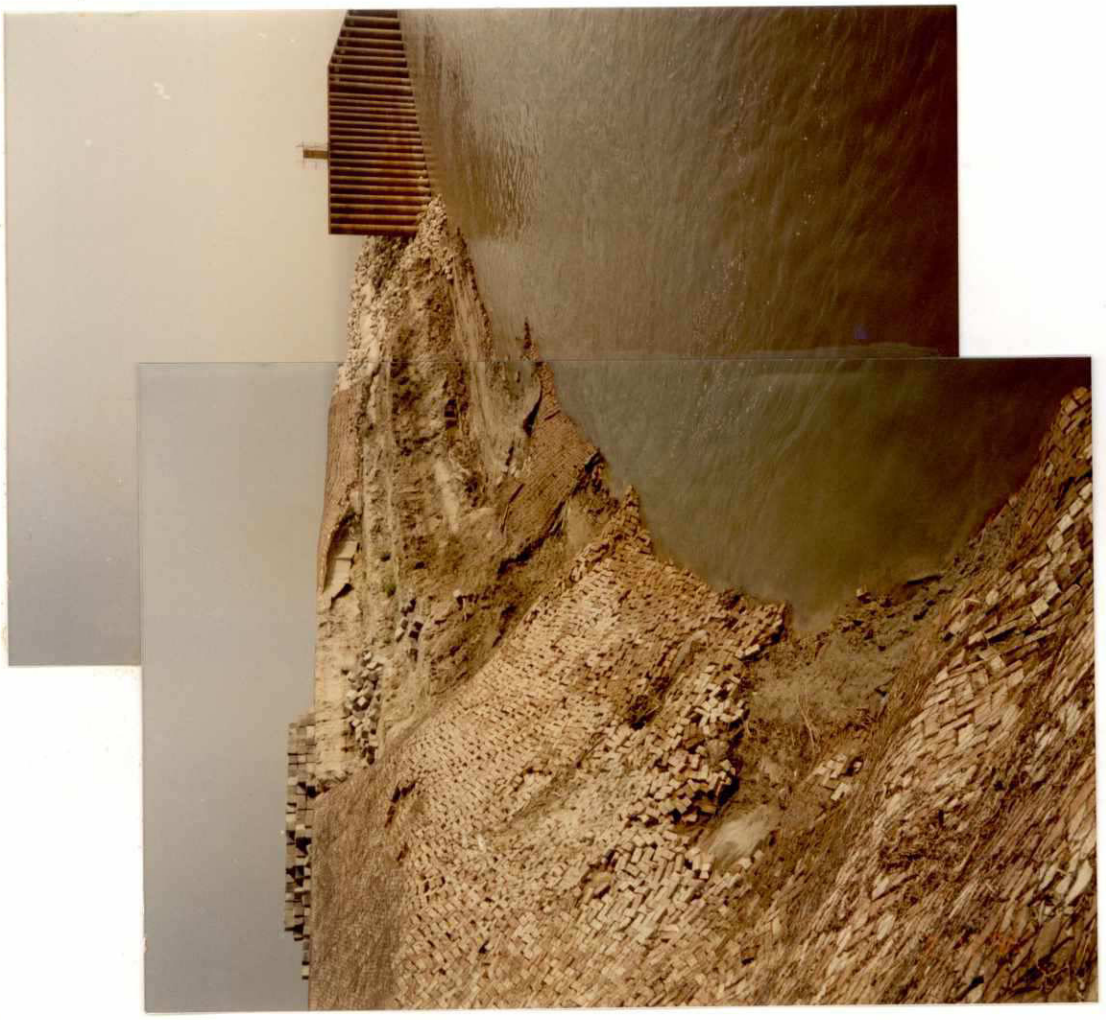


Photo 10: Groyne G-3 on 02.12.1995; view from d/s to damaged part of the groyne (water level at 15.79 m PWD)

Photo 11: Groyne G-3 on 02.12.95; Anchorage of brick mattress effected by major slide but yet functional (water level at 15.79 m PWD)

Photo 12: Groyne G-3 on 02.12.1995; view from groyne head towards downstream (water level at 15.79 m PWD)

Photo 13: Groyne G-3 on 02.12.1995; Damaged main embankment d/s from G-3 (water level at 15.79 m PWD)

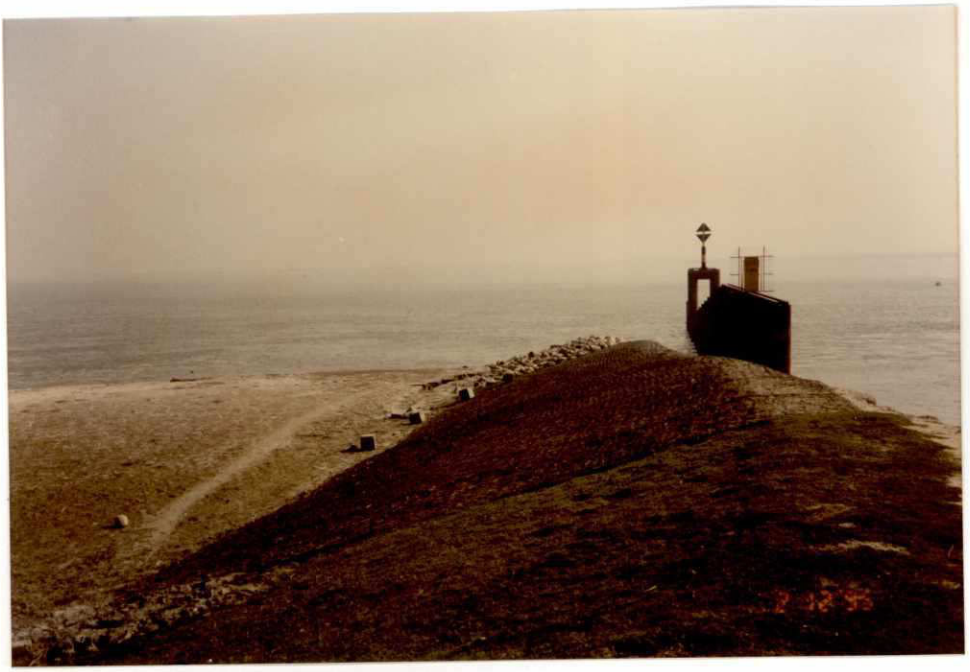


Photo 14: Groyne G-3 on 02.12.1995; View along impermeable part of G-3; upstream portion yet fully in tact (water level at 15.79 m PWD)

Photo 15: Groyne G-3 on 02.12.1995; falling apron of u/s impermeable groyne head; stone dumping along piles likely to be excessive dumping during construction (water level at 15.79 m PWD)

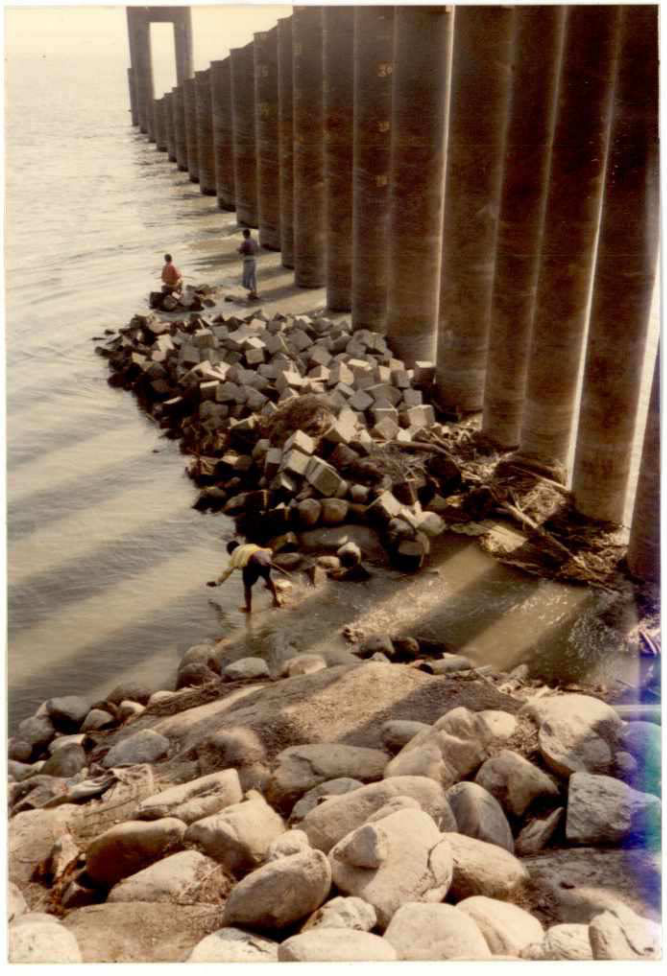


Photo 16: Groyne G-3 on 02.12.1995; view along pile structure (u/s side) (water level at 15.79 m PWD)

Photo 17: Groyne G-3 on 02.12.1995; (u/s side) scattered cc-blocks of falling apron (protection to impermeable groyne head) (water level at 15.79 m PWD)

Photo 18: Groyne G-2 on 02.12.1995; view from G-3 towards G-2 (water level at 15.79 m PWD)

Photo 19: Groyne G-2 on 02.12.1995; Damaged main embankment (water level at 15.79 m PWD)

Photo 20: Groyne G-2 on 02.12.1995; Temporary cofferdam approx. 80 m downstream from G-2 as closure for breached main embankment (water level at 15.79 m PWD)

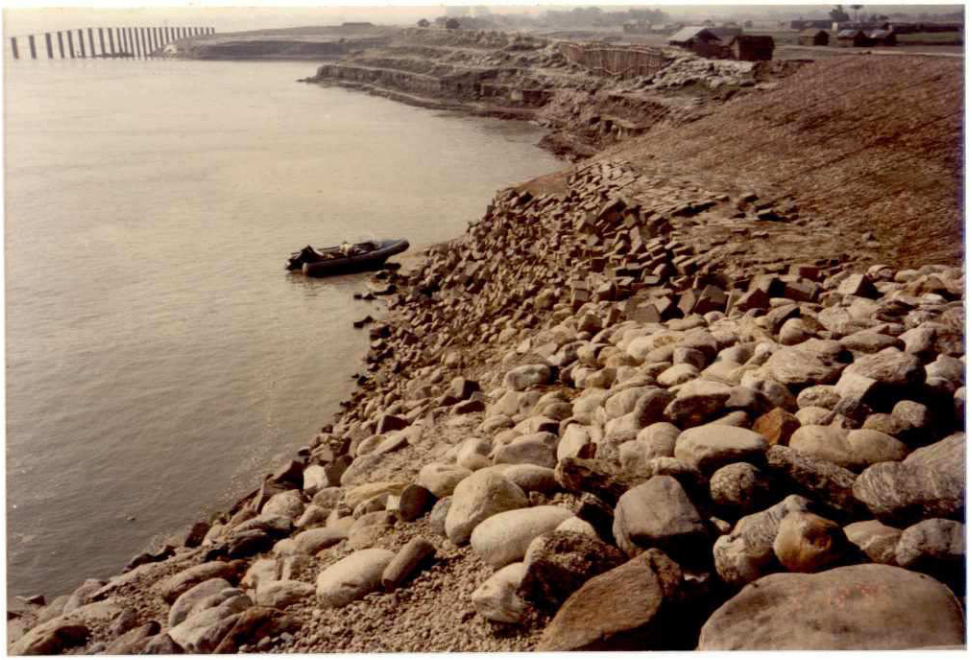


Photo 21: Groyne G-2 on 02.12.1995; view from groyne toward (d/s) main damage to embankment (water level at 15.79 m PWD)

Photo 22: Groyne G-2; Tubular steel piles dia. 711.2x14.2 mm recovered from damaged part of groyne

Photo 23: Groyne G-2; Tubular steel pile dia. 711.2x14.2 mm; material failure at max. deformation point about 6 m from pile tip

Photo 24: Groyne G-1 on 03.12.1996; view from downstream (water level at 15.75 m PWD)

Photo 25: Groyne G-1on 03.12.1995; main embankment eroded by waves (Durba grass planted too late to develop proper rooting) (water level at 15.75 m PWD)

Photo 26: Groyne G-1 on 03.12.1995; main embankment eroded by waves and return current (water level at 15.75 m PWD)

Photo 27: Groyne G-1 on 03.02.1996; view from d/s side; slope protection functional (water level at 14.48 m PWD)

Photo 28: Groyne G-1 on 03.12.1995; slope deformation, rip-rap on granular filter layer (water level at 15.75 m PWD)

Photo 29: Groyne G-1 on 03.02.1996; View from u/s side; slope protection in tact; Geo-jute-sand mat partly exposed within bed protection around the piles (water level at 14.48 m PWD)

Photo 30: View from G-1 toward groyne G-B/1 on 03.12.1995
(water level at 15.75 m PWD)

Photo 31: Groyne G-B/1 on 03.12.1995; pile structure partly exposed by on-going erosion (water level at 15.75 m PWD)

Photo 32: Groyne G-B/1 on 03.12.1995; Impermeable groyne without any damage

Photo 33: Groyne G-B/2 on 03.12.1995; Impermeable groyne; earthdam and Durba grass cover; downstream side eroded (Durba grass sods planted too late)