GEOFABRICS FOR EROSION CONTROL & FOUNDATIONS

By:

Dr. Mahesh D. Desai

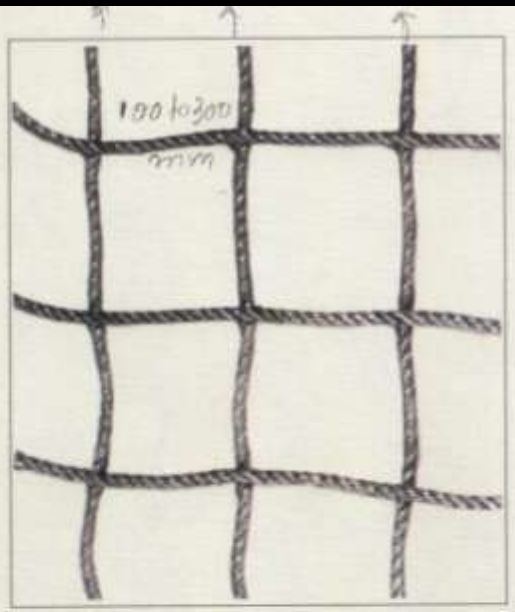
Ph.D. (Civil Engg), Visiting Prof. SVNIT, Surat.

Consulting Engineer, EFGE Consultant, Surat.

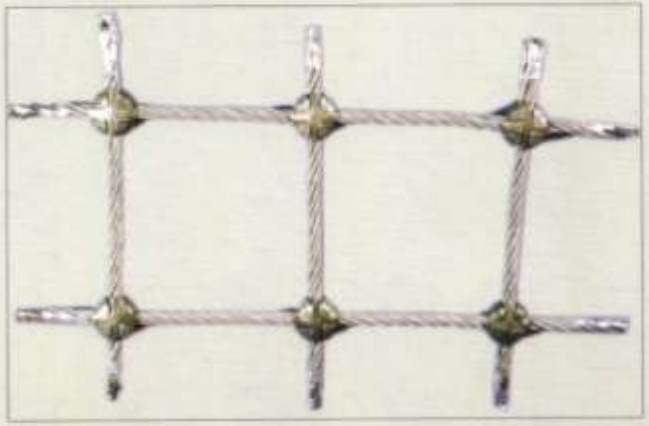
Product Information

Polymer Ropenet

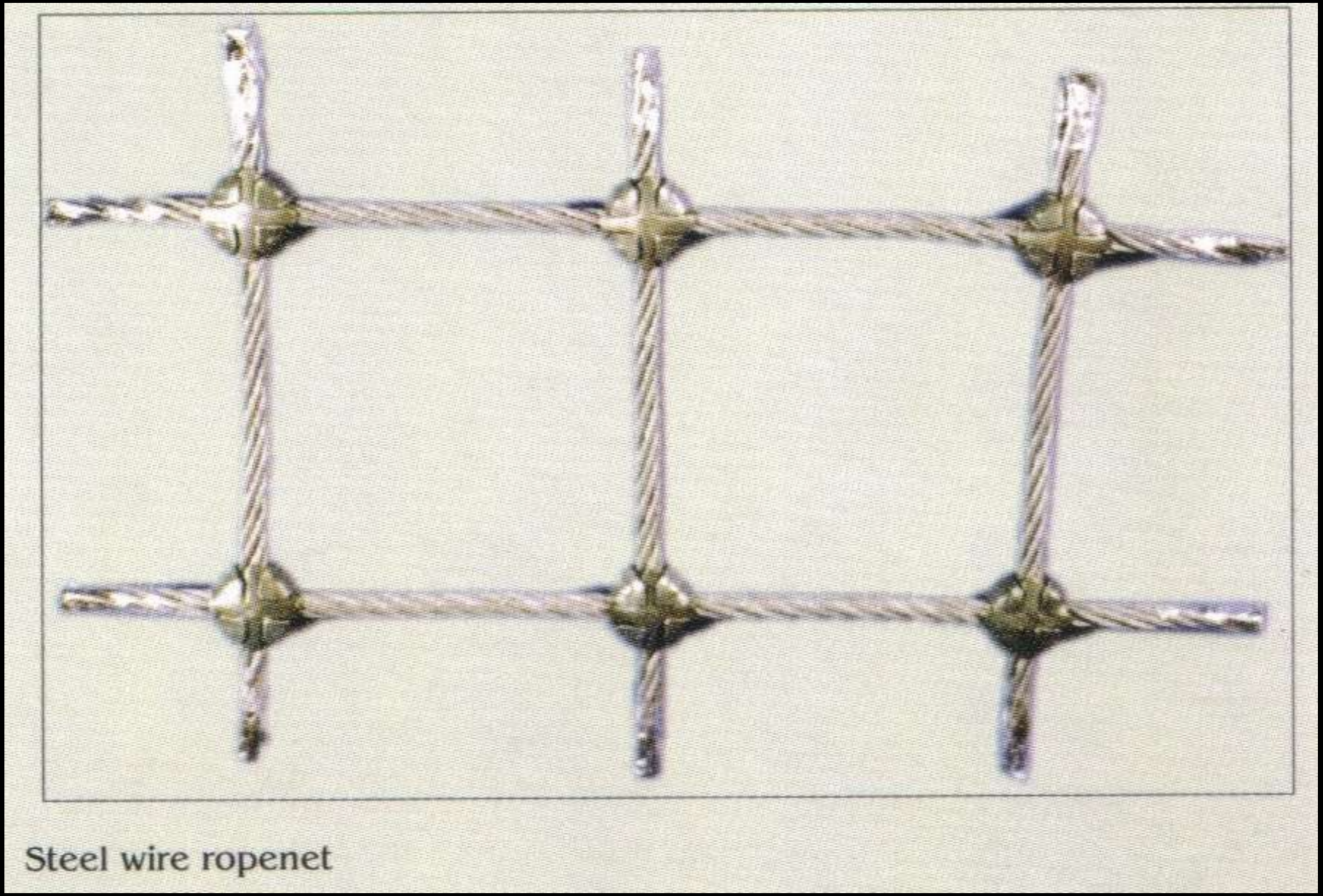
They are made of polypropylene ropes of 10 mm to 16 mm dia. having very high thermal, abrasion & U.V. resistance. The mesh size can be varied from 100 mm to 300 mm depending upon the sizes of the fractured rock and the strength required. They are appropriate where medium tensile strengths of approximately 6 to 8 Ton/m are required - say to retain small to medium size boulders.



Polymer ropenet mattress



Steel wire ropenet



Steel wire ropenet


MH 14
1954

Akshardam, Swaminarayan Temple, Delhi (2000)

Case study of Swaminarayan Temple, Delhi.

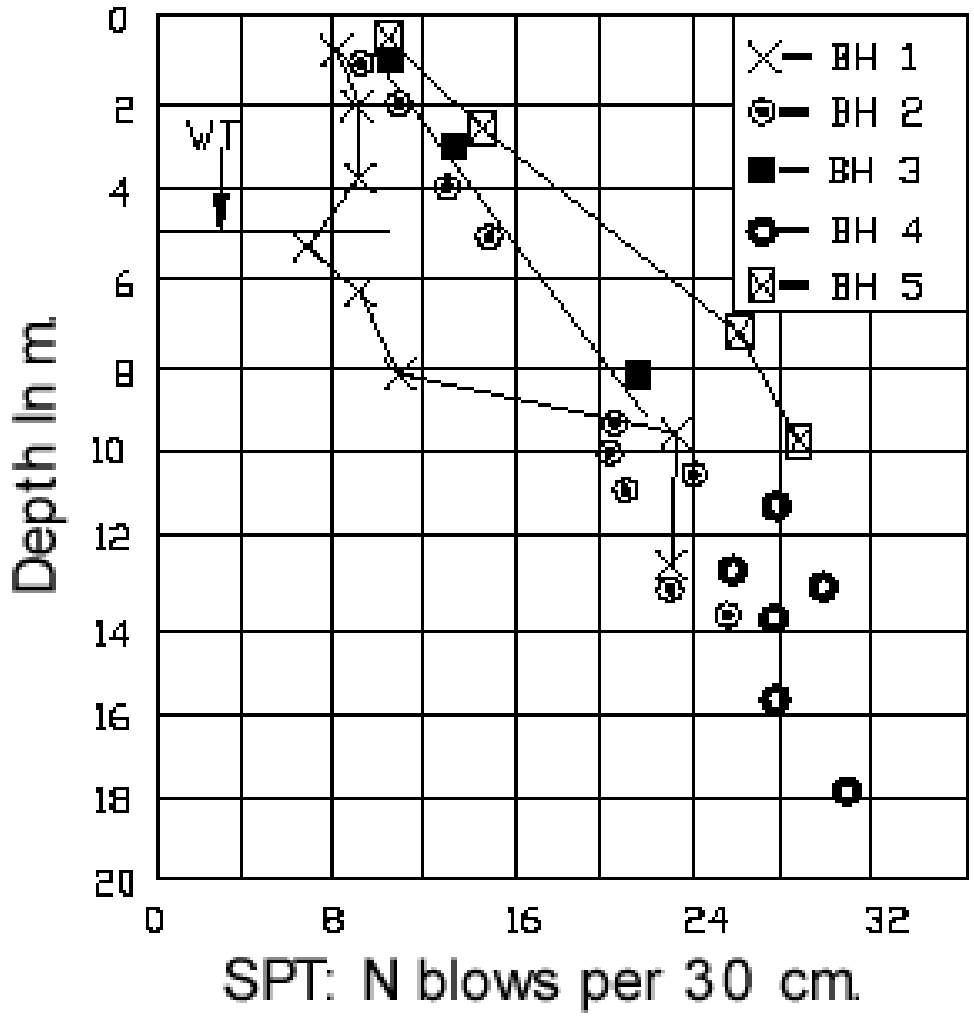


Fig.1. Variation Of SPT N Value with depth at site (GEOTECH 2000)

SOIL PROFILE

The overall plot was explored by Geotech Consultants. The generalized soil profile was :

0-2 m	Low cohesive, Non Plastic siltyfine sand (SM group) with average S.P.T. resistance of 10 blows/30 centimeters.
2-18 m	SM-SP group, siltyfine sand, medium to dense with SPT resistance, N increasing from 10 to 30 blows / 30 centimeters. Sand below 10 m is very dense, Ground water was at 6.0 m below Ground level.
18-25 m	Fine grained soils (CL/CI group)

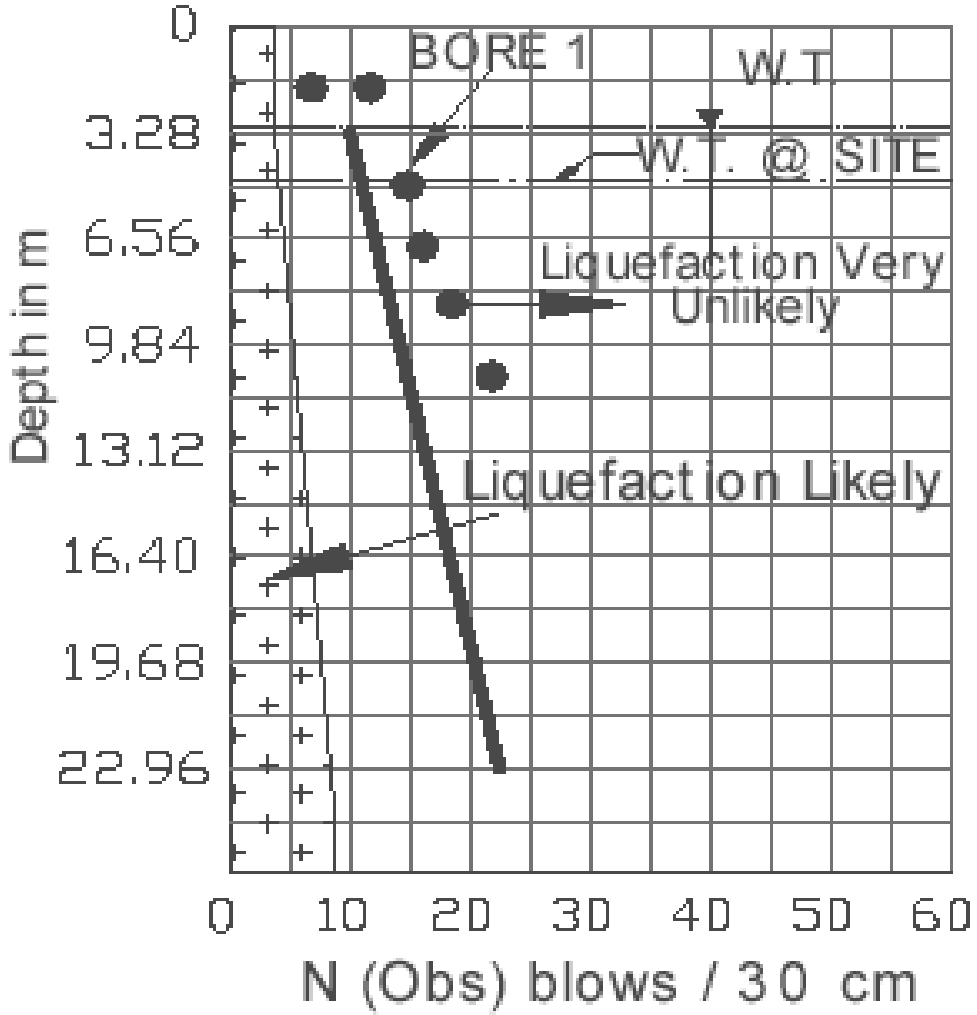


Fig. 2. Probability of liquefaction for the site using Seed & Idriss approach (1971) for 0.15g acceleration.

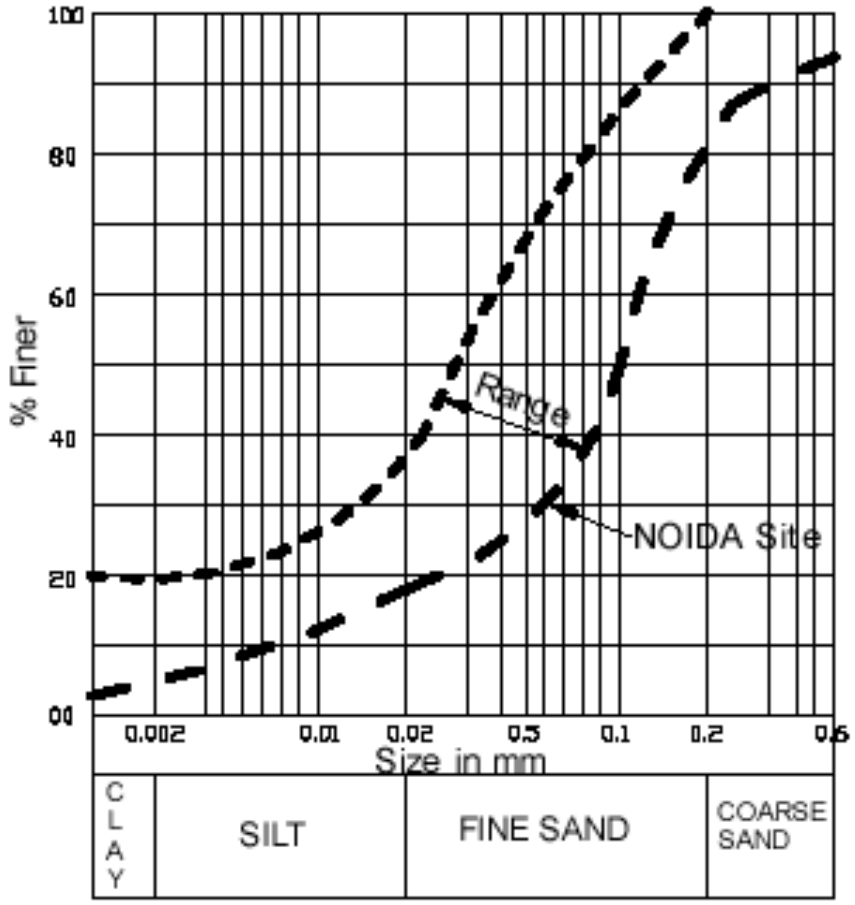


Fig.3. Grading range for top 5.0 m soils around Delhi and Noida Site. (Desai M.D., 1969)

Table 1. Specifications of Geofilter fabric (GWF 40-220 Polypropylene Multifilament woven fabric)

Property :	
Mechanical Breaking Strength (IS 1969)	
Warp (kN/m)	62
Weft (kN/m)	46
Elongation at break (%)	26-31
Grab strength (ASTM D5034) kN	1.845(min.)
Mullen Burst (ASTM D 3786) KPa	4632 (min.)
Hydraulic Pore (ASTM D4751)	<0.075 mm
Permiability (ASTM D 4491) Lit./m^2/sec.	6.35

Table 2. Specifications for Rope net

Size of body & border rope	8.0 mm
Weight	30 gms / m ± 10%
Material	Polypropylene with UV stabilization
Mesh opening	100 mm x 100 mm
Breaking strength of rope-net m/width	10,000 Kg. (min.)
Structure	3 Strand Houser laid, tucked joint at intersection

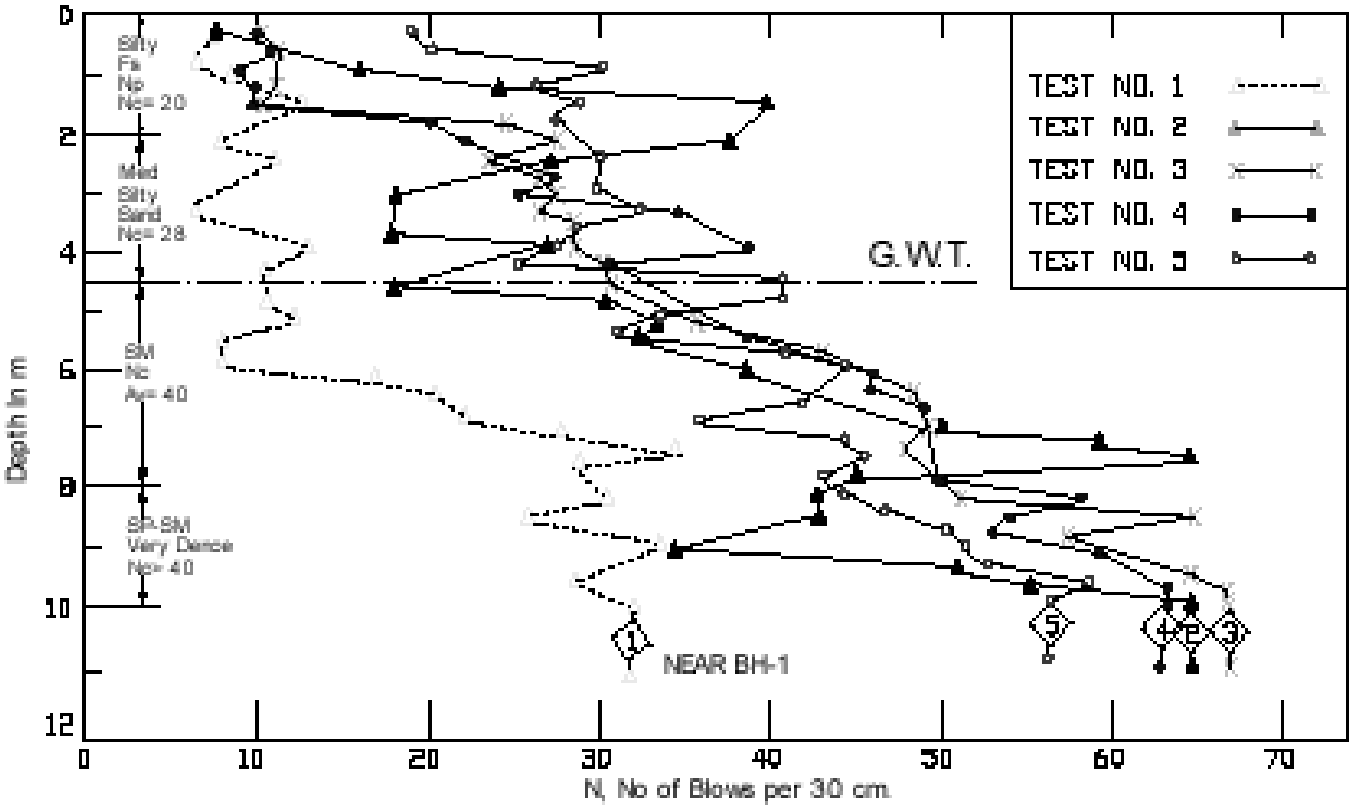
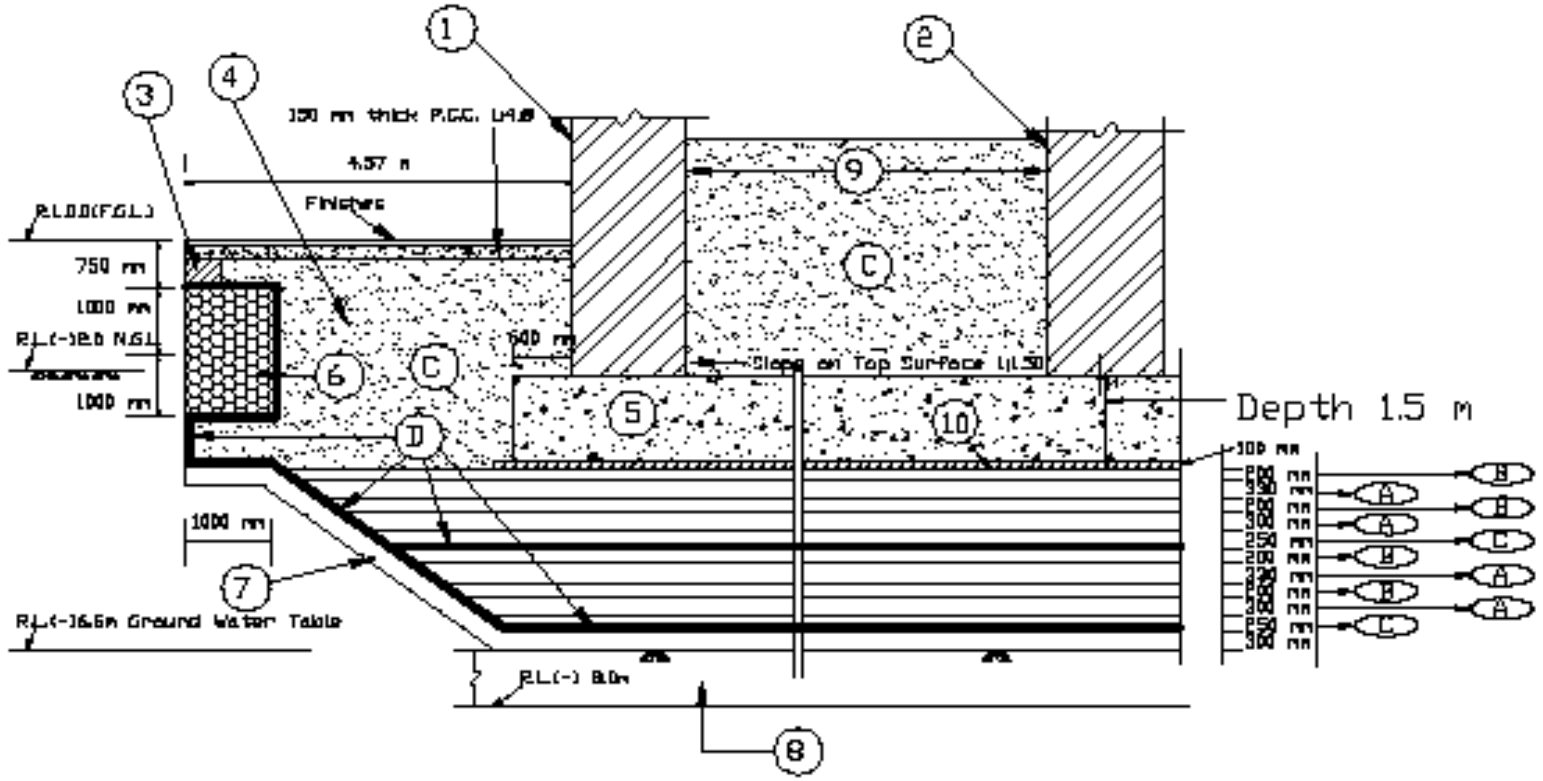


Fig.4. Nc blows per 30 cm by dynamic cone penetration test, soil profile at "Noida" site. (ATES 2000)



(A) Boulders (size not less than 175mm) with smaller in filling stones and quarry spoil/stone screening rolled with 10 T roller eight times. (B)Boulders (size 90mm – 40mm) with smaller in filling stones and quarry spoil/stone screening rolled with 10 T roller eight times,(C) Compacted sand,(D) Geocomposite comprising of rope mattress and geofilter

Legends:

(1) Face of outer plinth wall (2) Outer face of inner plinth wall (3) 345 mm thick brick wall (4) Compacted sand on either side of gabion wall (5) Fiber reinforced PCC 1:2:4 grade (6) Gabion wall 2m high (7) Compacted thick stone soiling (8) Insitu sand compacted by 10 T pneumatic tyred roller to density 1580 Kg/ Cu.m. (9) Hexagonal cell of brick masonry (Bricks of 120 Kg/Sq.cm. strength) (10) 100 mm thick P.C.C. 1:4:8

Fig .5. Foundation system for temple at "Noida"- A typical section.

Fig.6(a). *Sequential construction of the foundation system shown in fig 5 in a typical cross section*

Fig.6(b). Photo plate showing the geo fabric, overlaying rope mattress and stone

15:Bottom most layer of 300 thk (45-90mm)

14: a) Boulder soling / Roling

b) Voids

13: Boulder soling at the edge before rolling

BUILDING ON REFILLED SOIL (2003)

ABRAR COMPLEX, 10 STOREY BUILDING, SURAT.

- Excavation – Refilling - Compacted
- Geofilter as Separator & Improve Stiffness
- $\phi = 16°$ increase to $30°$
- SBC = 15 t / sq.mt increase to 30 t / sq.mt
- Settlement reduce to 25 mm

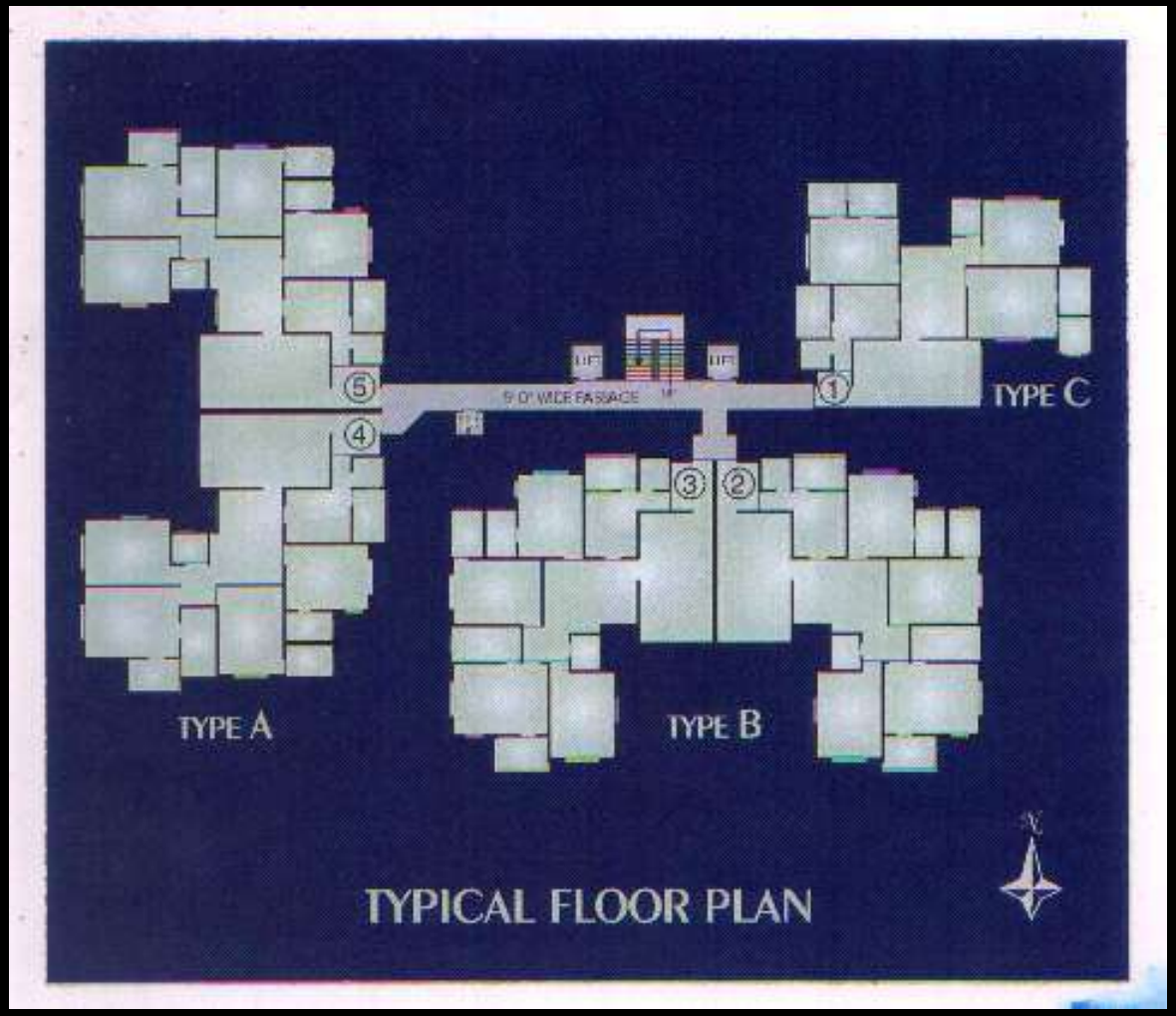
Excavation Of Creek Zone

Compaction of Bottom of Excavation by 10 T Vibratory Roller

Providing Geofilter for Separation or as Reinforcement

Spreading Next Layer of Same Soil to be Compacted over Filter.

Spreading Layer of Same Soil to be Compacted over Filter.



Typical Plan

Elevation

SWAMINARAYAN TEMPLE, VALSAD.

(2000)

- 20-30 M Erosion on Swaminarayan Temple Plot by Tide(1999-2000)

- Eroded sandy slope 4m to 5m high.

- Conventional Stone Riprap Protection Stones. Eroded by Tides.

- Excavated for Toe wall Trench

- Excavated sand used as barrier for Tidal water

- Toe Wall Trench & Filter Laying.

- Erection of Gabion on Geo-filter for Toe

- Erection of Gabbian Mat in Position for Stone Filling.

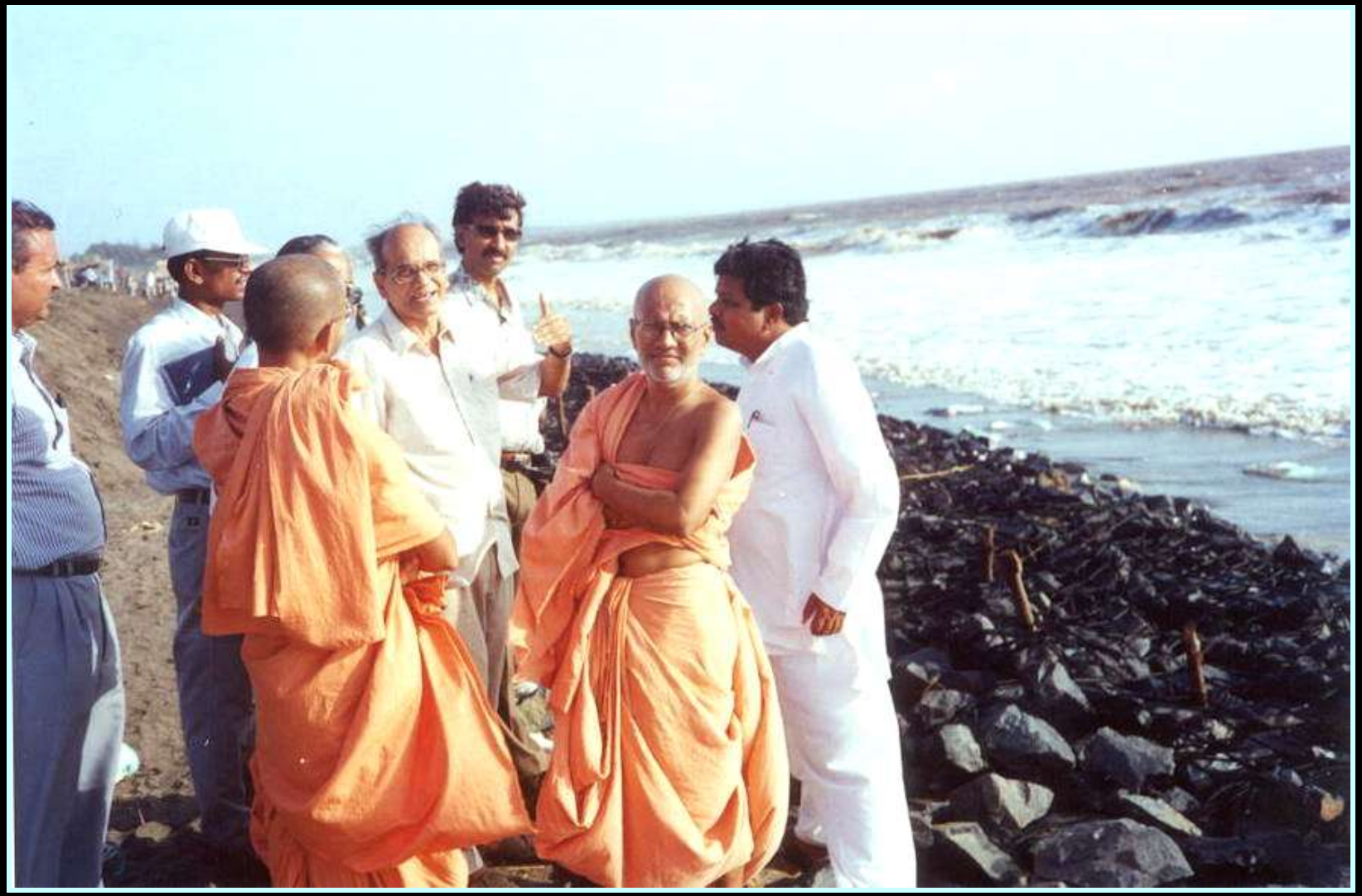
- Completed Toe , Sluiced by Tide Sand.

- Gabbian Raised . Tide Spills & Silts Back Side.

- Toe wall construction with tidal water

- Toe Gabbian Burried.Shape of Filled Gabbian.

- Sand Filling Voids & Silting Behind Gabbian Filter.



- Tide Invades Construction Two Times – Work Completed in 100 Days

- Final Layout . Backfill With Sand.

- **Clipping**


14:01
17. 9.2001


14:01
17. 9. 2001


14:02
17. 9.2001

Year 2003 Visit

- Silting towards sea creating island infront of Temple

- Garden development in eroded portion after the treatment.

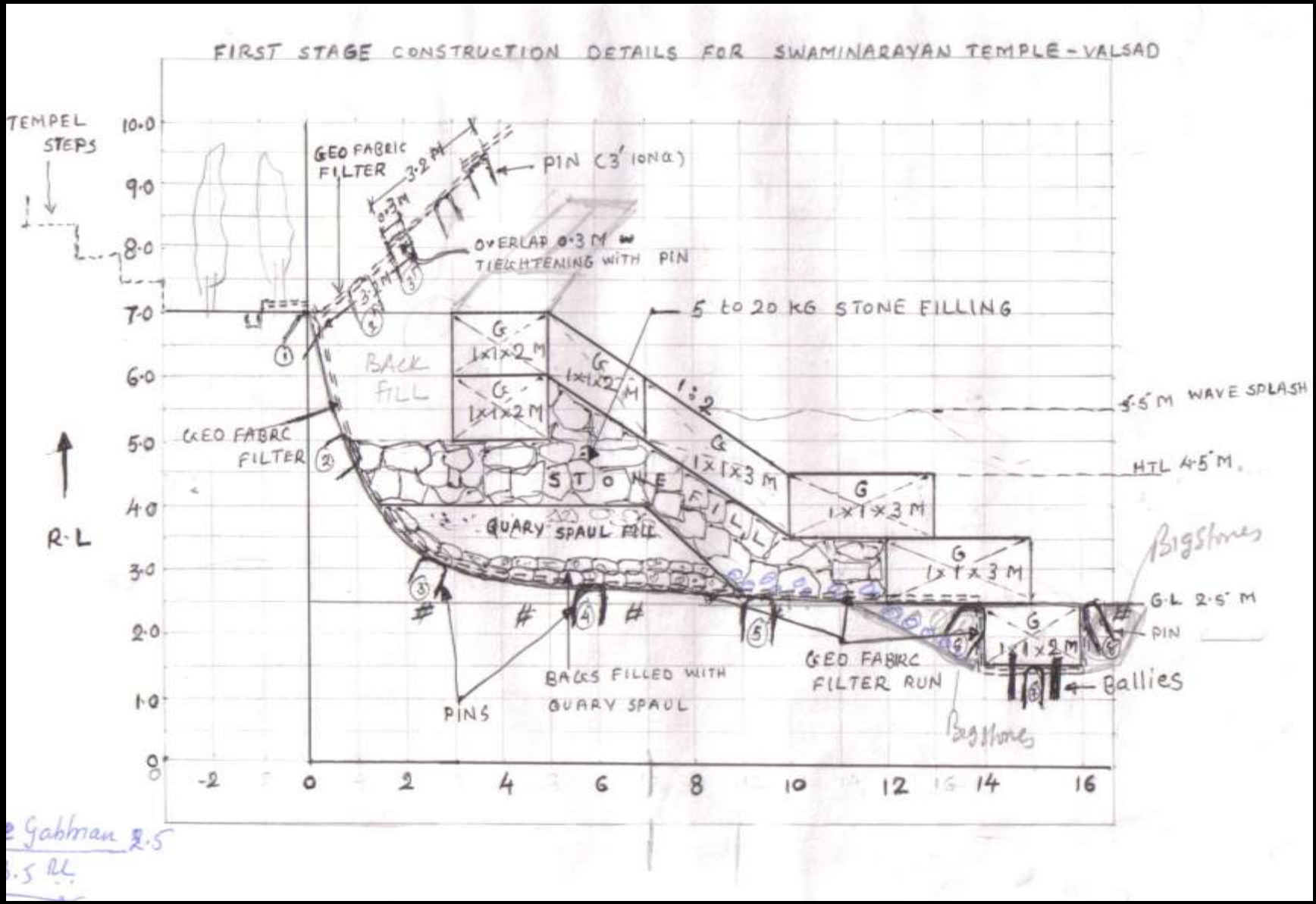
Year 2008 Visit

- Silting beach formation in front of Temple

- Typical sectional view showing Compound wall above the Gabion Wall.

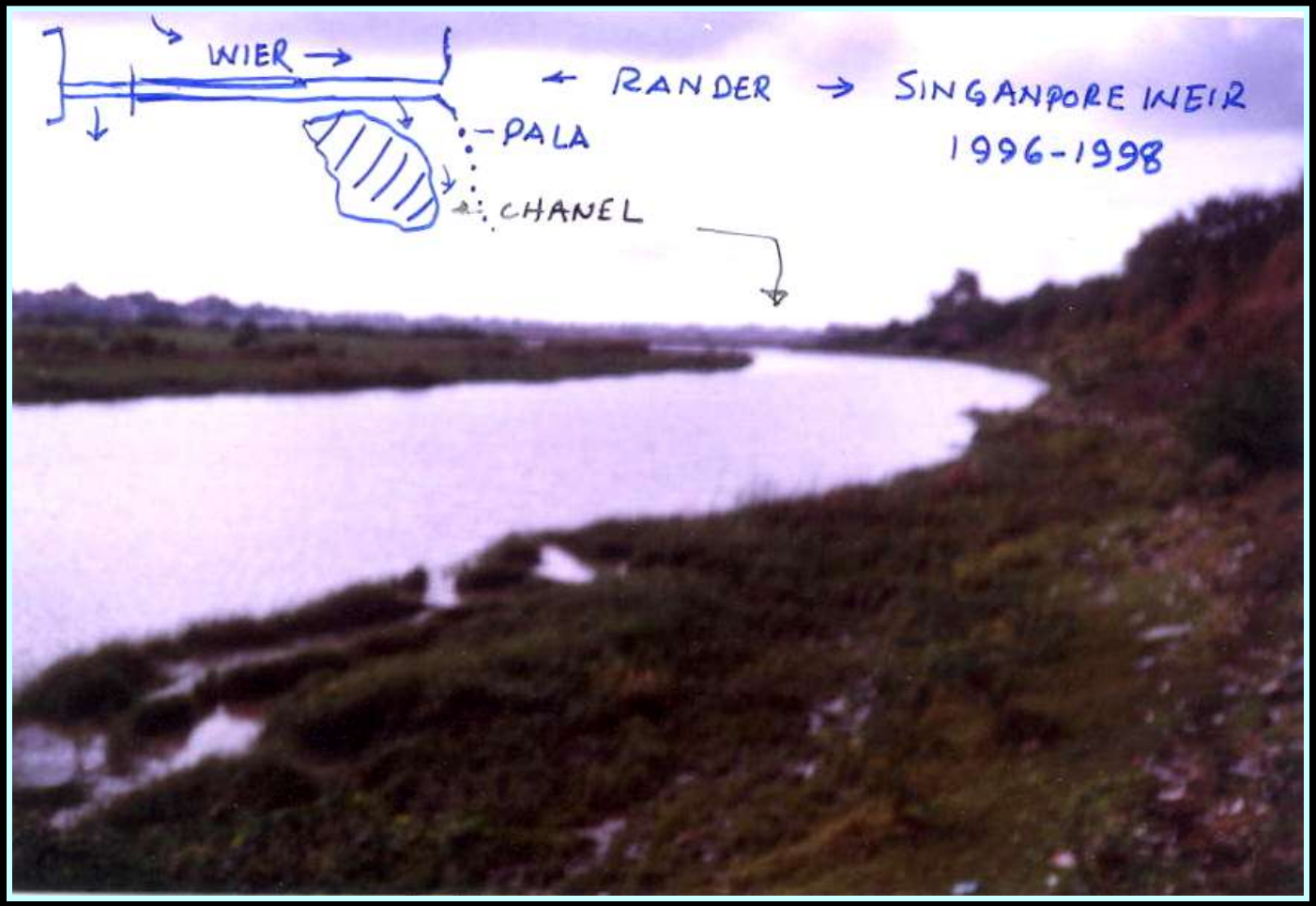
- Developed garden on the filled soil.

- Development on filled soil.

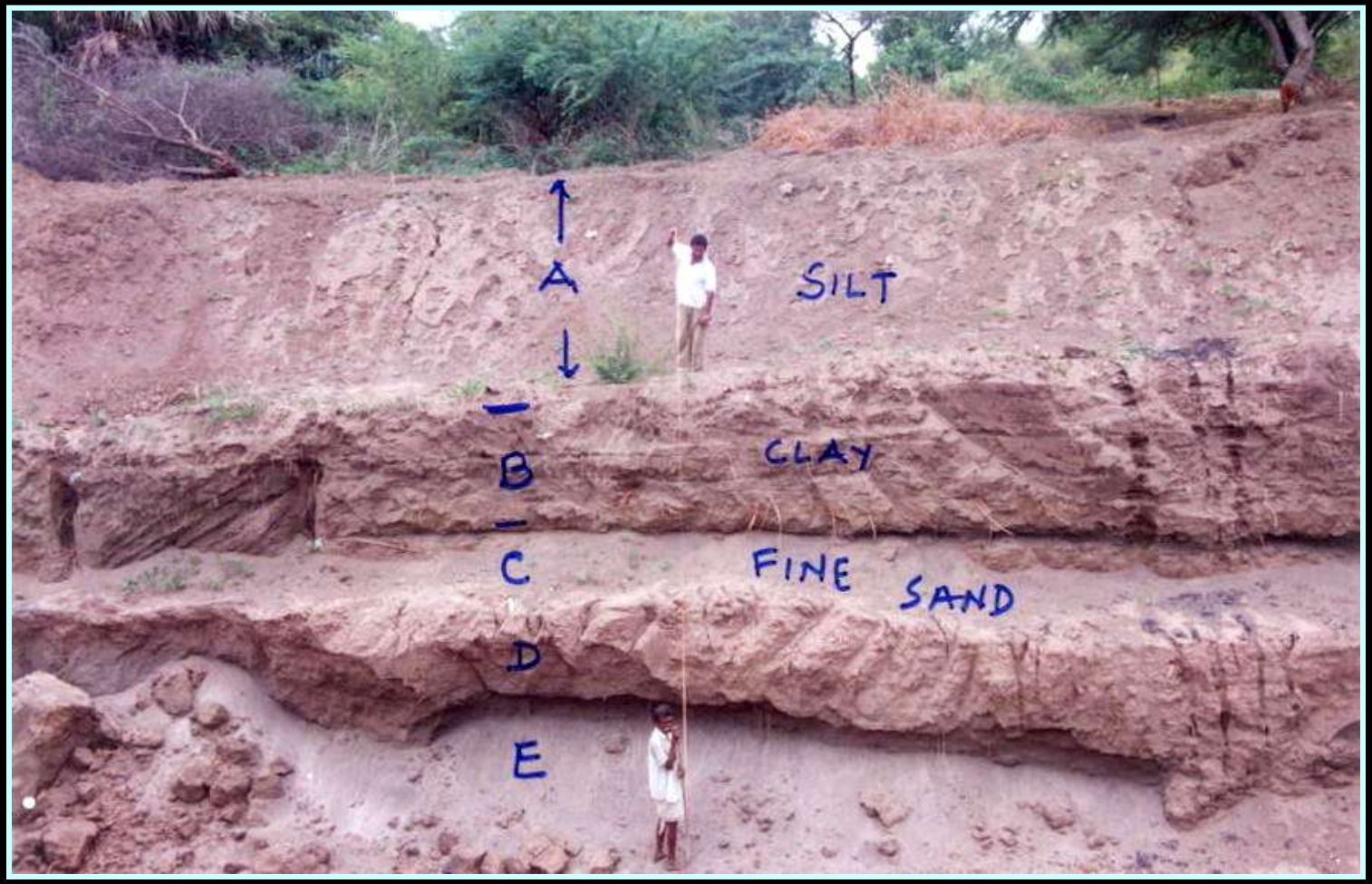

FIRST STAGE CONSTRUCTION DETAILS FOR SWAMINARAYAN TEMPLE - VALSAD
TEMPEL STEPS
R.L
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-2
0
2
4
6
8
10
12
14
16
GEO FABRIC FILTER
3.2 M
0.3M
PIN (3' long)
OVERLAP 0.3 M TIGHTENING WITH PIN
5 to 20 KG STONE FILLING
BACK FILL
G 1x1x2 M
1:2
5.5 M WAVE SPLASH
HTL 4.5 M.
G 1x1x3 M
STONE FILL
QUARY SPAUL FILL
Bigstones
G.L 2.5 M
PIN
GEO FABRIC FILTER RUN
Ballies
PINS
BACKS FILLED WITH QUARY SPAUL
Bagstones
2 Gabbman 2.5
3.5 RL

Cross section of erosion control bund at Moti Danti, Vaisad

BREAK WATER, SURAT. (1998)



- 1996-98 Flood-Scoured deep cut on left Bank D/S of weir.Island,Channel,Bank with flood embankments. (Danger for Pala at Bharimata, piping under Pala.)



- Soil stratification of left Bank. Base of Embankment. Layer C,E caused cavity by Sand flow in return tides. Collapse of Bank – Piping Perpendicular to Profile.

- Construction of Break Water to silt channel near Pala (Alt. to Spurs) from Ved end

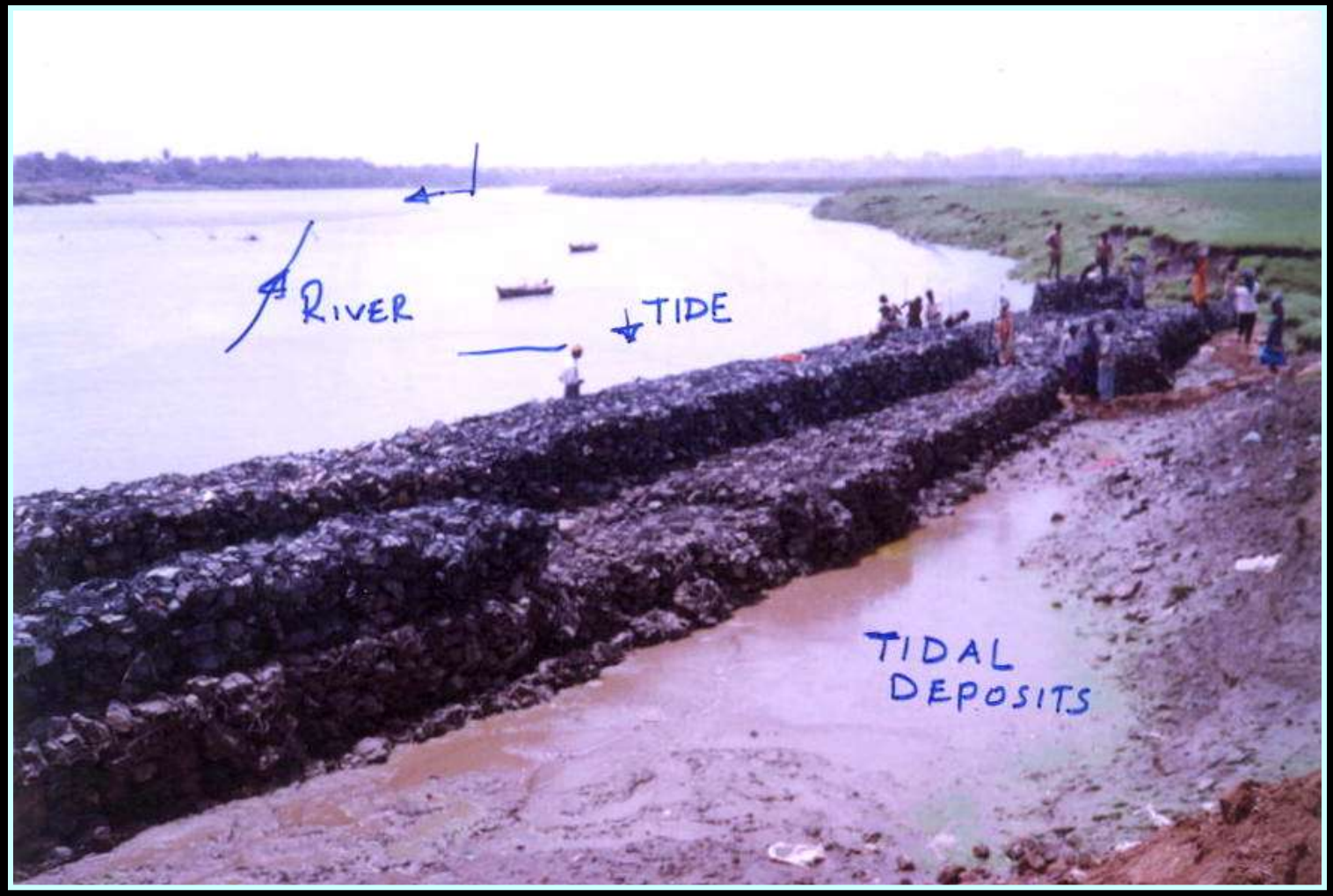
- Laying of Gabbians, Filter in stages in tidal zone.

➢ Break Water Under construction

- Stepped Break water finished to RL +4.0 (1m sunk into mud)

- Rope Gabbians in place.

- Closer of Break Water to island with tide water.



- Return tide silting during construction.

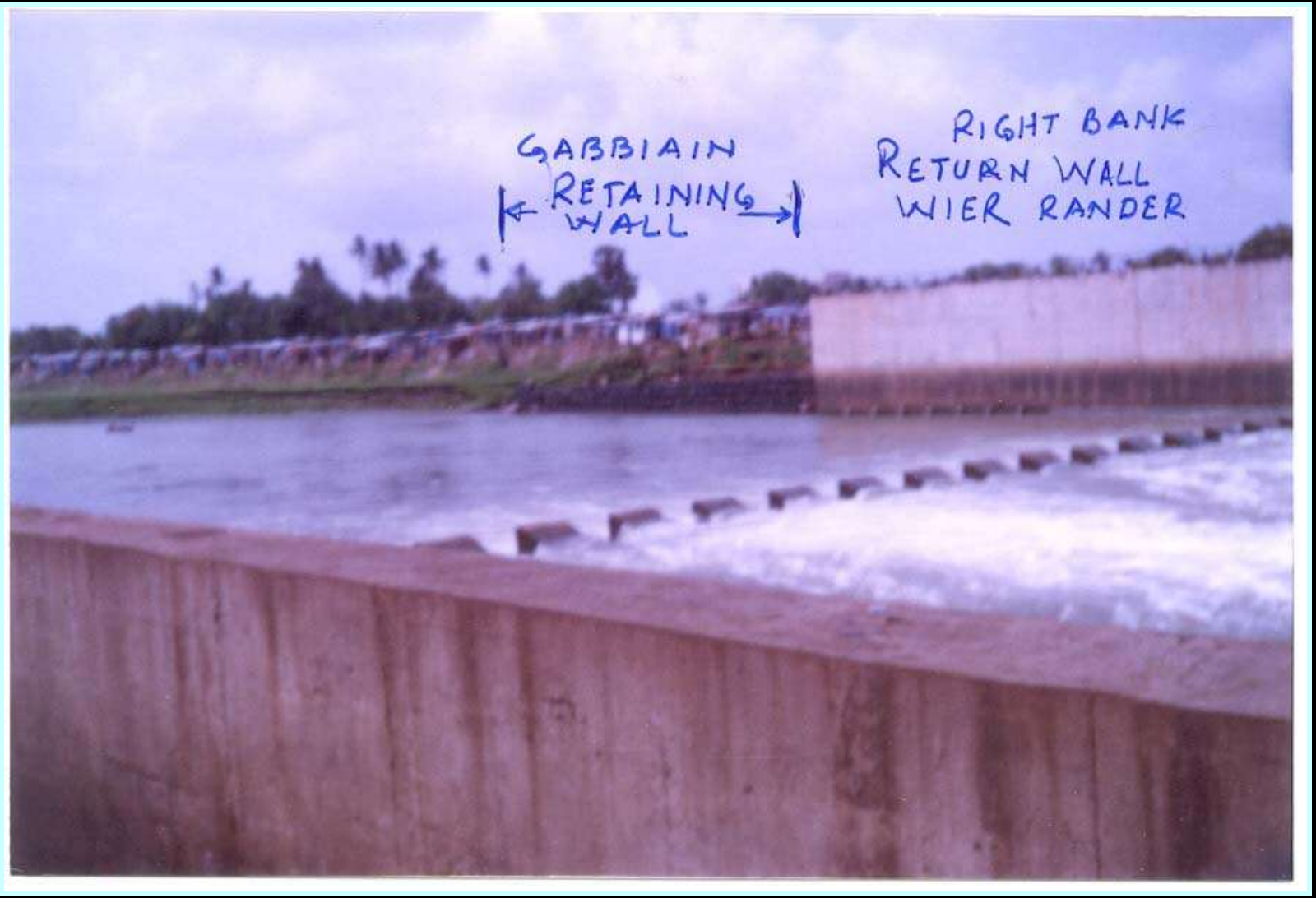
- Top showing filter and Gabbions, River flow , Tide.

- Silting on Weir & Island side (2000).

- Silting on Weir & Island side (2002).

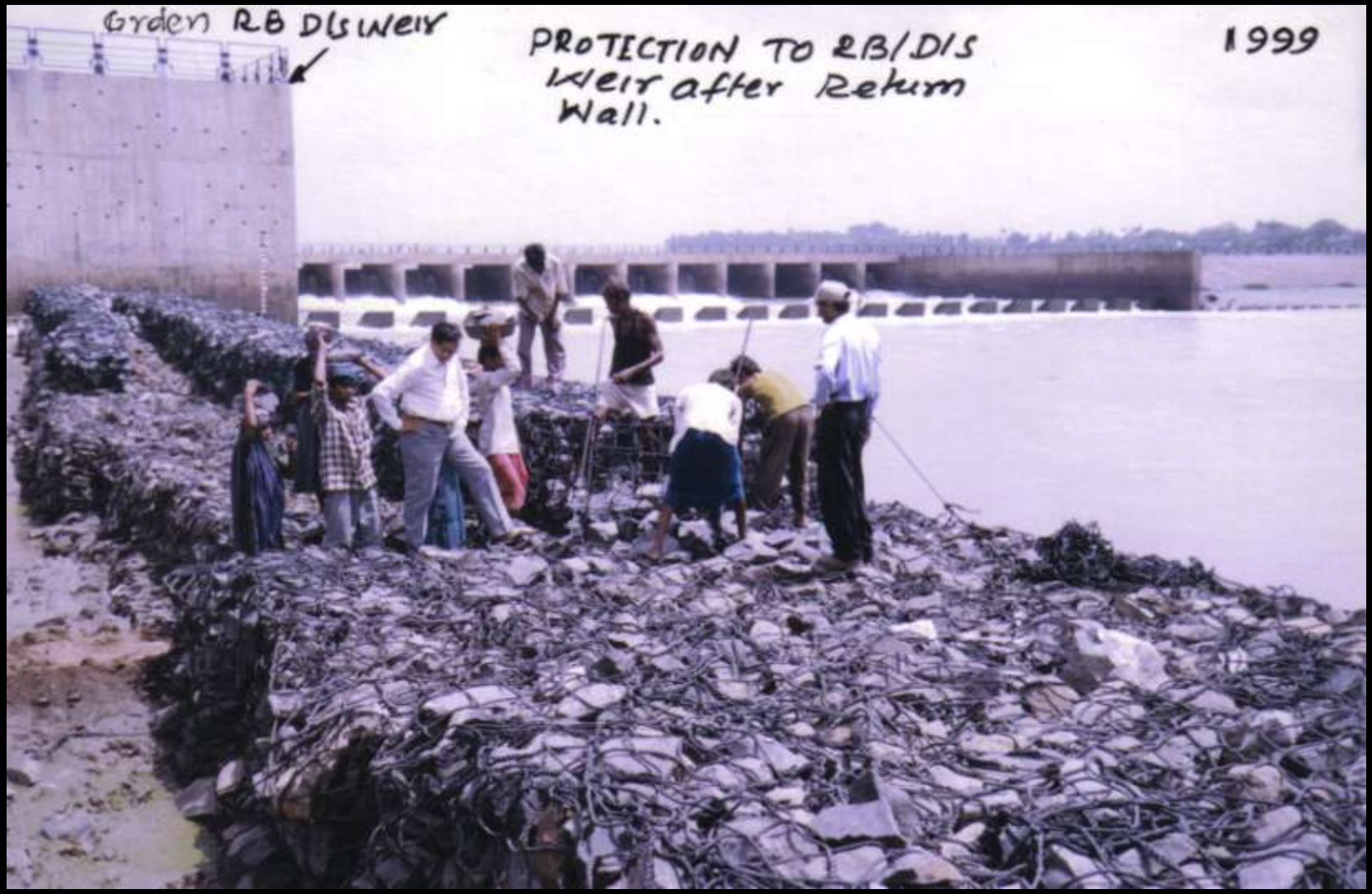
- Final Silted Stilling Basin D/S of Weir near Ved June 2002.

RETAINING WALL D/S OF WEIR, RANDER END, SURAT. (1999)



- Weir Return Wall, Weir Under Sluice & Protection Gabbian Wall Protection-view (1998).

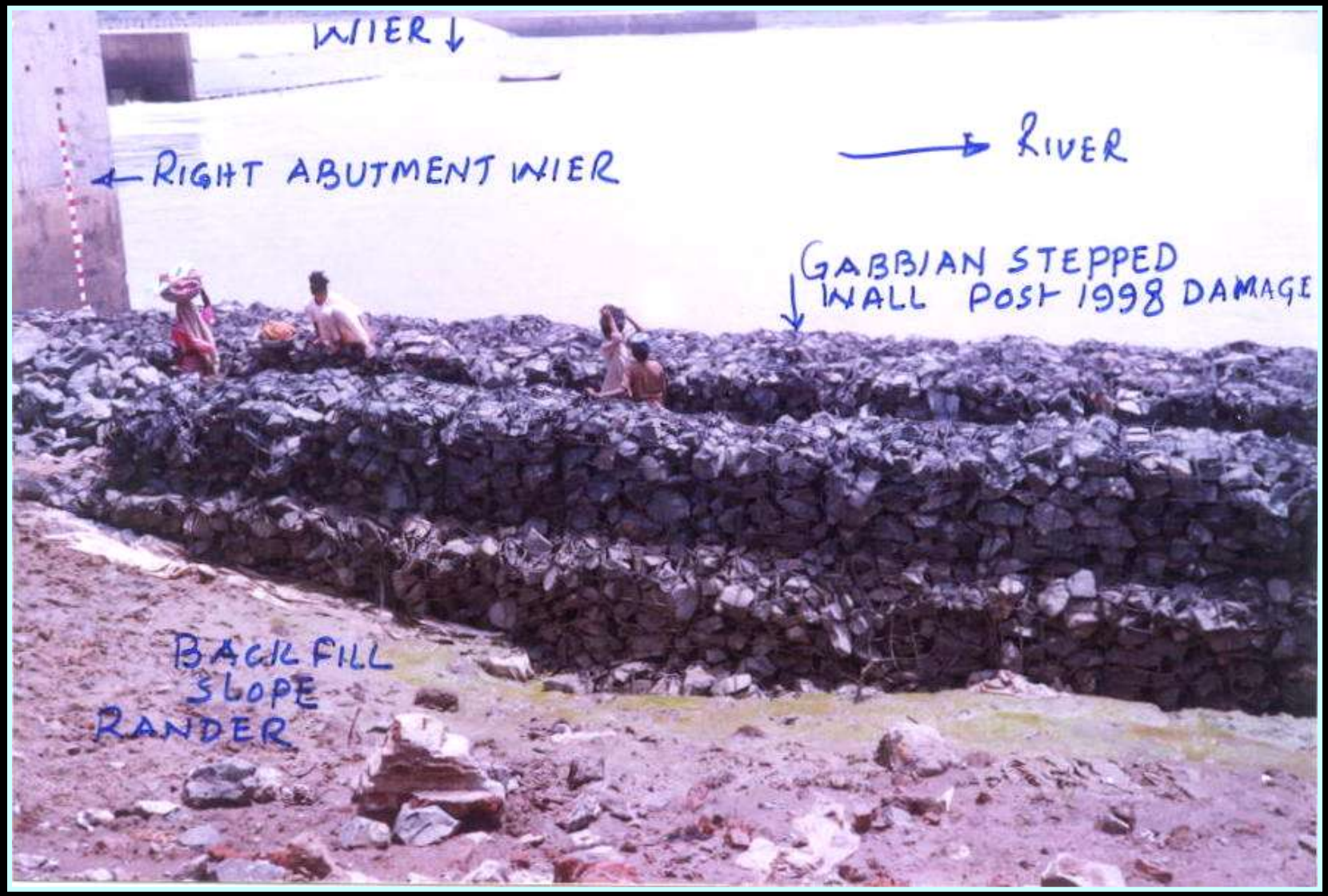
- Laying of Gabbian on Soft Slush in Stages.



- Right bank protection work under construction

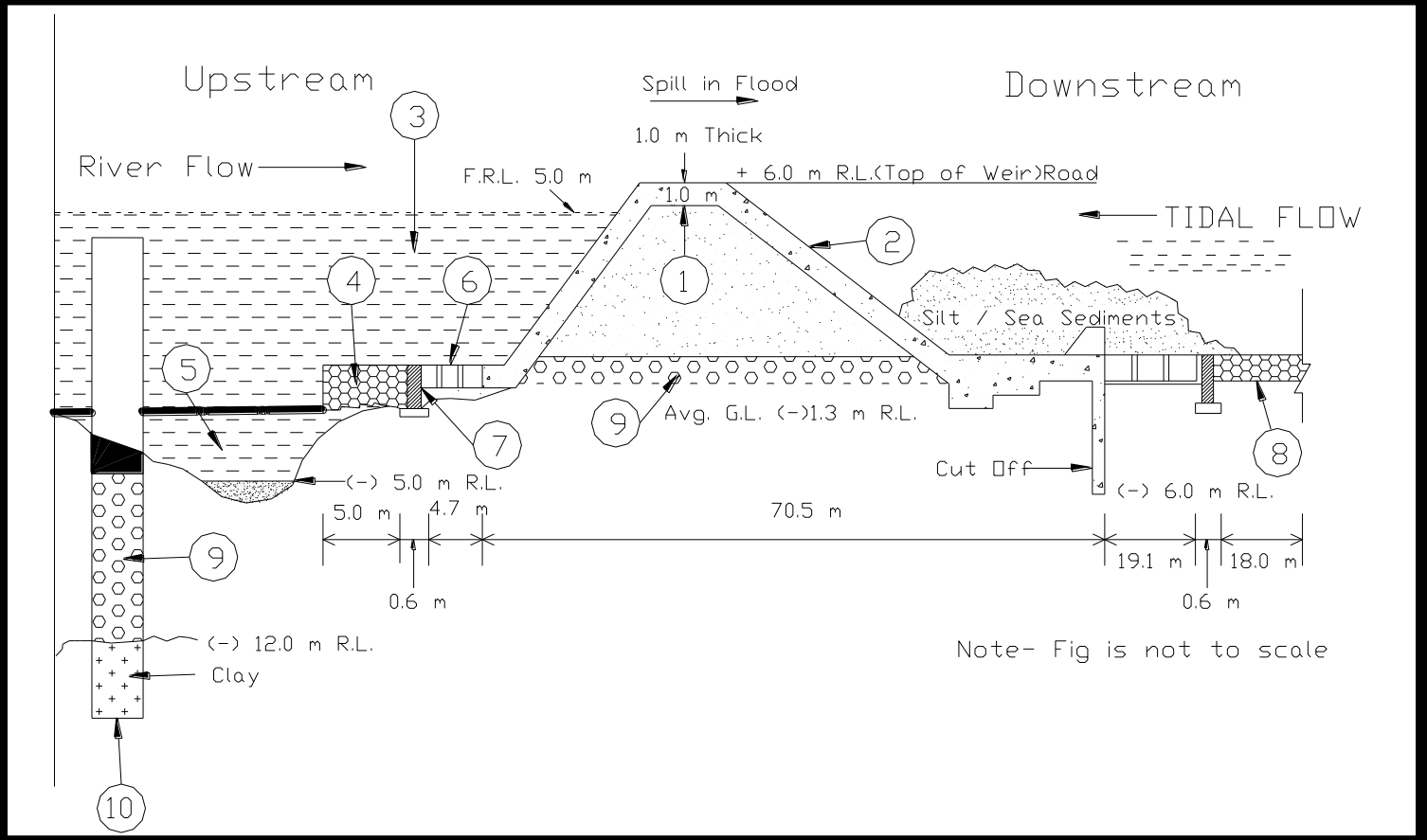
- Right bank protection work partially completed

➢ Stepped Gabbians With Backfill, Slope Above.

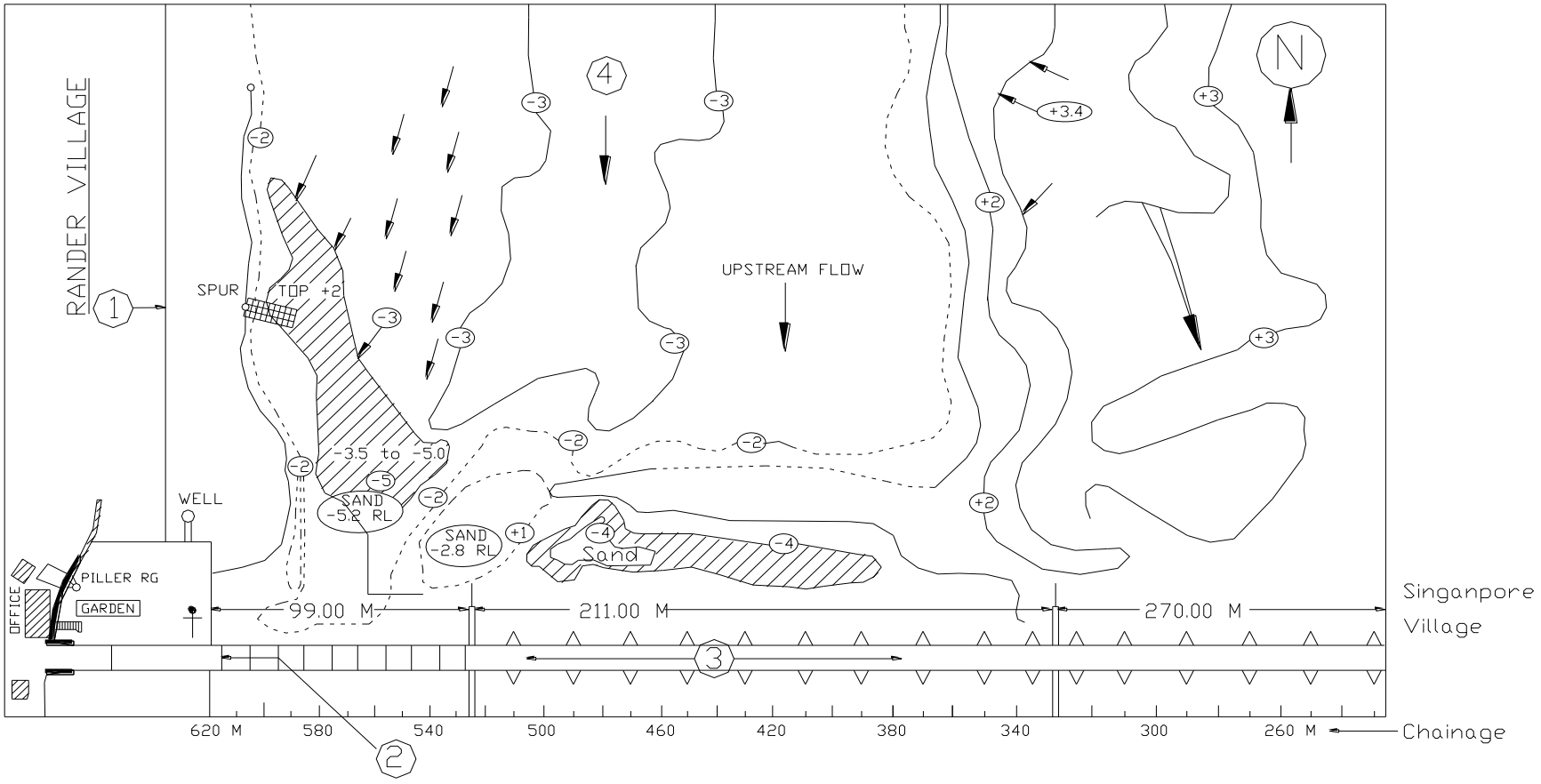


➢ Construction Phase With Free Tide Movement.

SCOURING PROTECTION U/S OF WEIR, RANDER END, SURAT. (1999)

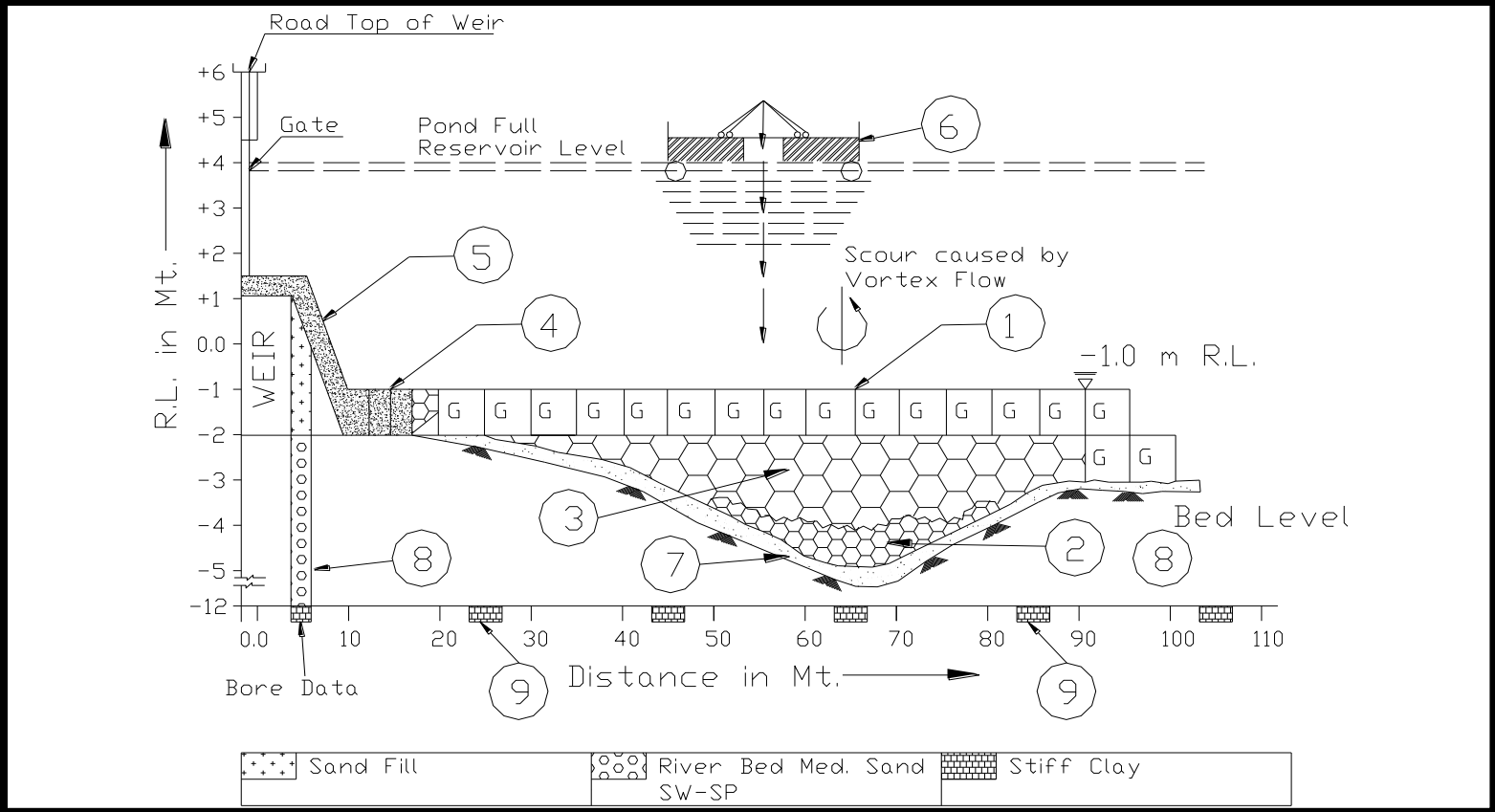


- FIG – Cross Section of Weir Bays-Showing probability of Piping (weir Surat)
- Legends: (1) Sand fill, (2) C.C. weir floor & glacis, (3) Sweet water Pond, (4) Original loose stone Apron of stones weighing min. 40 Kg & size 300 mm upstream, (5) June ‘2000 Scour Pocket, (6) P.C.C. block, (7) R.C.C. toe wall, (8) Loose stone Apron, (9) Sand & Gravel (Bed Material), (10) Bore.



➢ FIG – Scour Pockets – Channel Formed At Upstream Of Weir, Surat.

Legends: (1) Flood protection wall / Embankment, (2) Sluice Gate,
(3) Weir Top, (4) Channel Formed by sand Mining in Upstream



- FIG – Typical Cross-Section of Upstream Scour Hole Indicating,(A) Upstream concrete Top & Apron, (2) Proposed repairs

  Legends: (1) Proposed Rope Gabions (G), (2) Stitched Geotextile filter bags filled with sand laid under water, (3) Dumped stone fill dropped from Pontoon, (4) Launching Apron (C.C. blocks & stone riprap),(5) C.C. weir Floor, (6) Pontoon, (7) Silt (1.0 to 2.0 m deep), (8) Medium sand, (9) Stiff clay.

Gas Pipeline Erosion, Pal, Surat (2005)

- Gas Pipeline Bed Erosion, Pal, Surat. → Requires safety measures.

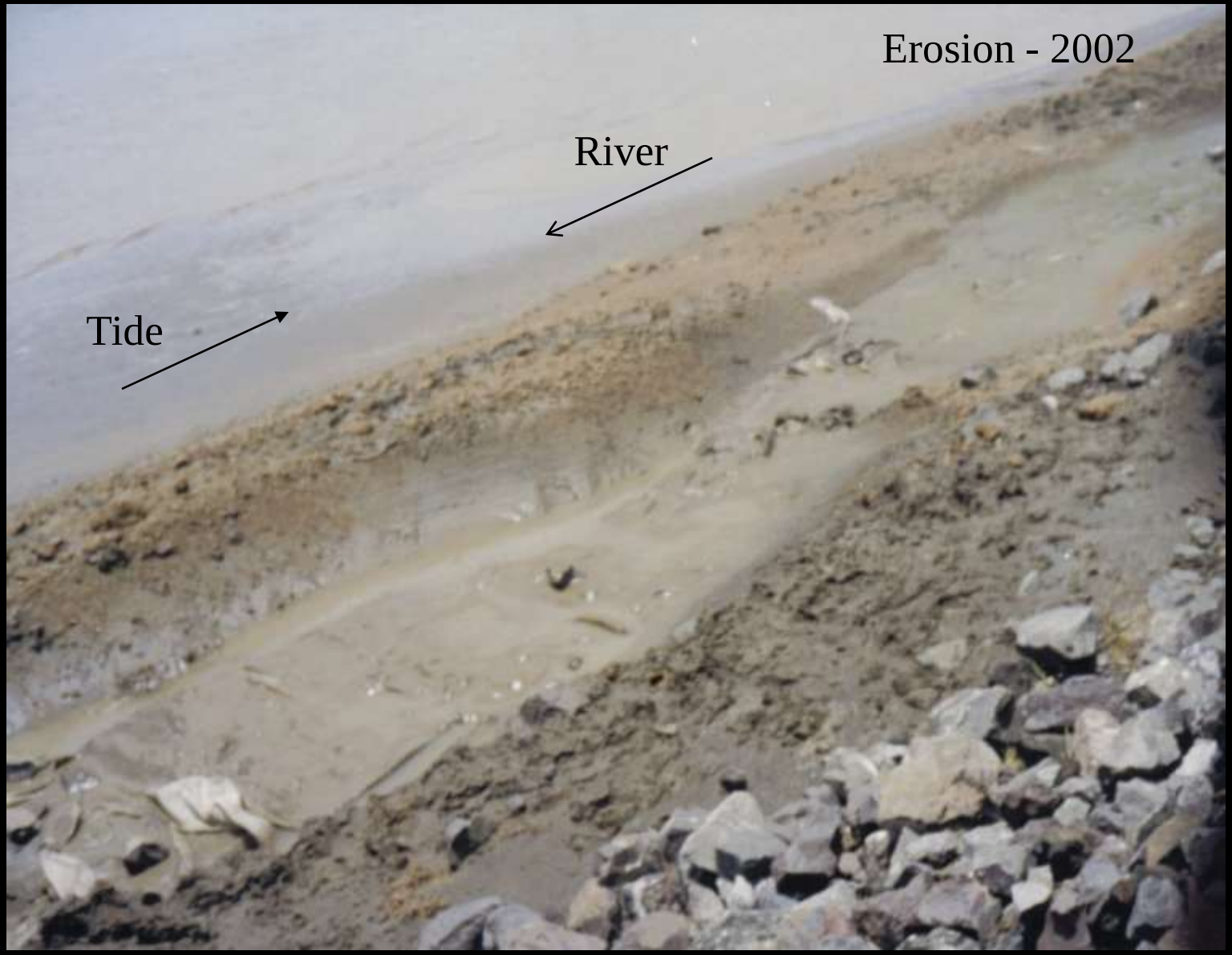
- Cause for bed erosion – Strom drain kotar

- Erosion protection treatment by Gabion & Geo-filer: Geo-synthetics.

- Protection work in progress.

- Finalized profile protection against erosion. (floods 2005, 2006)

Bank Erosion, Goverdhan Construction, Dumas Road (2002)



- Tapi bank erosion, Dumas Road

- Protection work with Netlon Gabion base at Dumas Road.

Bank Erosion Protection, Dumas Road, Surat.

- Eroded bank at Dumas Road, Surat

- Bank protection with Geo-filter & Gabion wall base.

- Gabion filled outside to be laid under water.

- Gabion laying from crane on bank.

- Gabion laying from crane on bank.

- Gabion laying above the geo-filter.

- Second layer of Gabion filling above water level.

- Base preparation for Wall above the Gabion wall.

- Base preparation for Wall above the Gabion wall.

- Final finished Base for Wall.

Anandima Ashram, Nikora, Bharuch (2005)

- Eroded bank of River Narmda, near Nikora, Bharuch

- Eroded bank of River Narmda, near Nikora, Bharuch

- Bank protection work at River Narmda, near Nikora, Bharuch

- Bank protection work at River Narmda, near Nikora, Bharuch

SWAMINARAYAN TEMPLE AT KOLKATTA (2005)

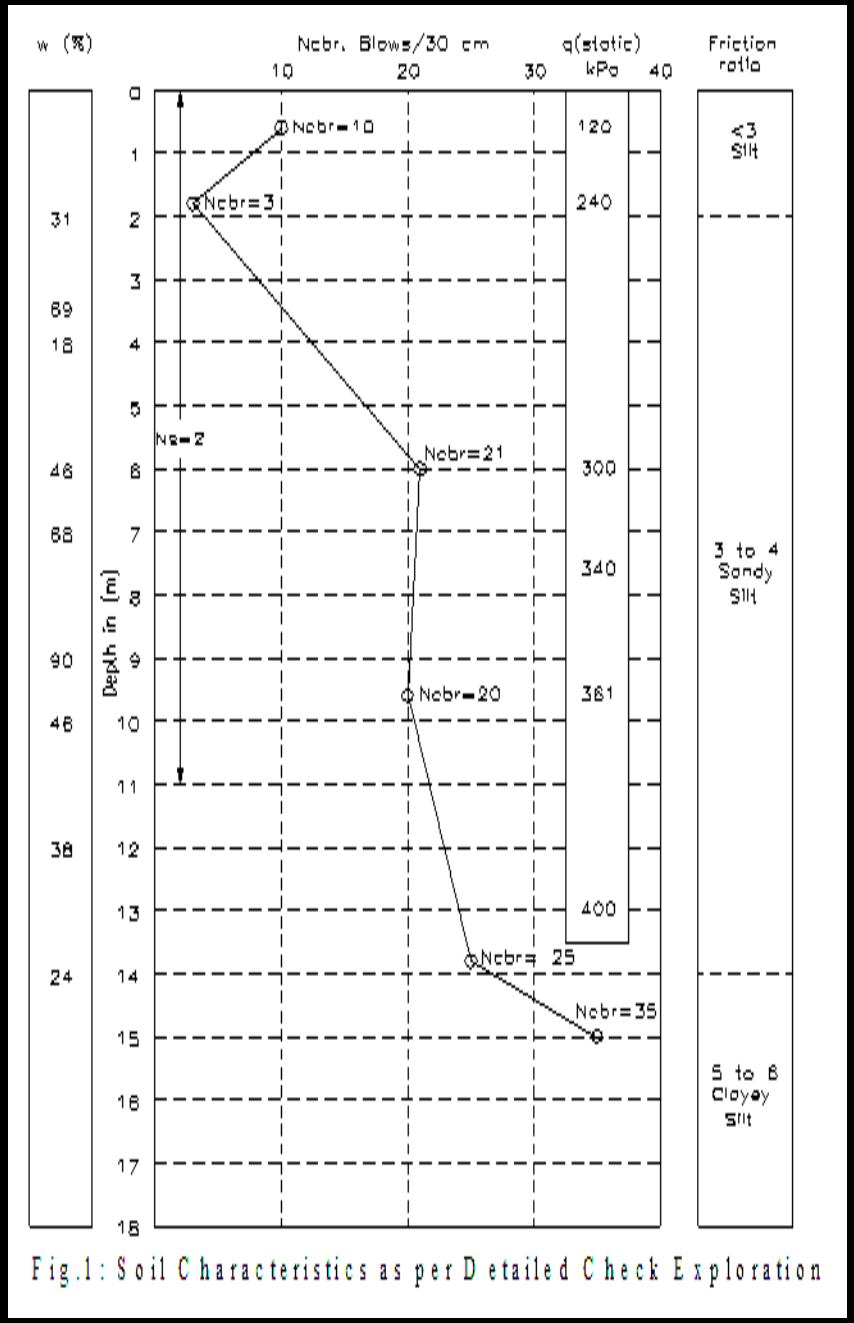


Fig.1: Soil Characteristics as per Detailed Check Exploration

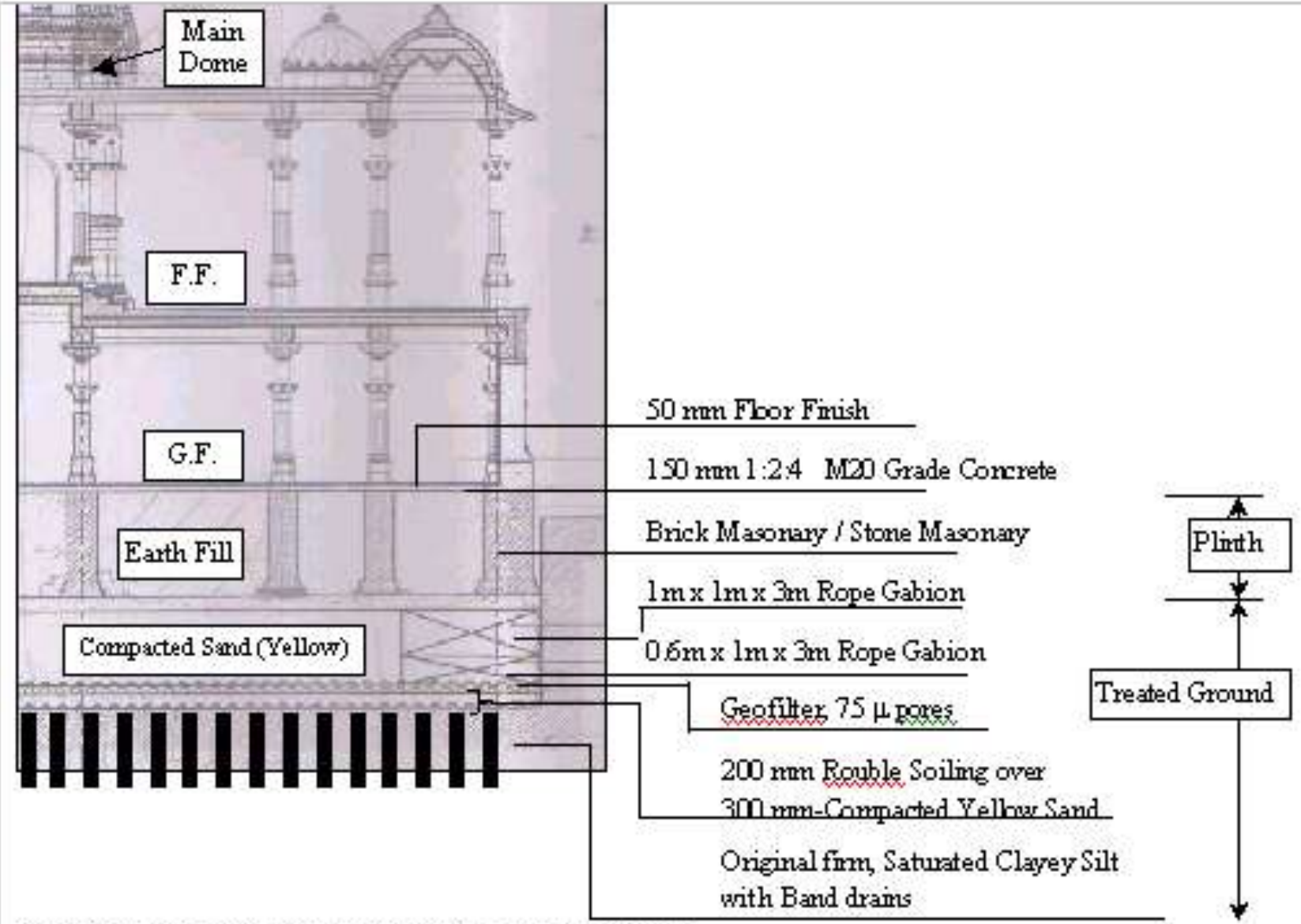
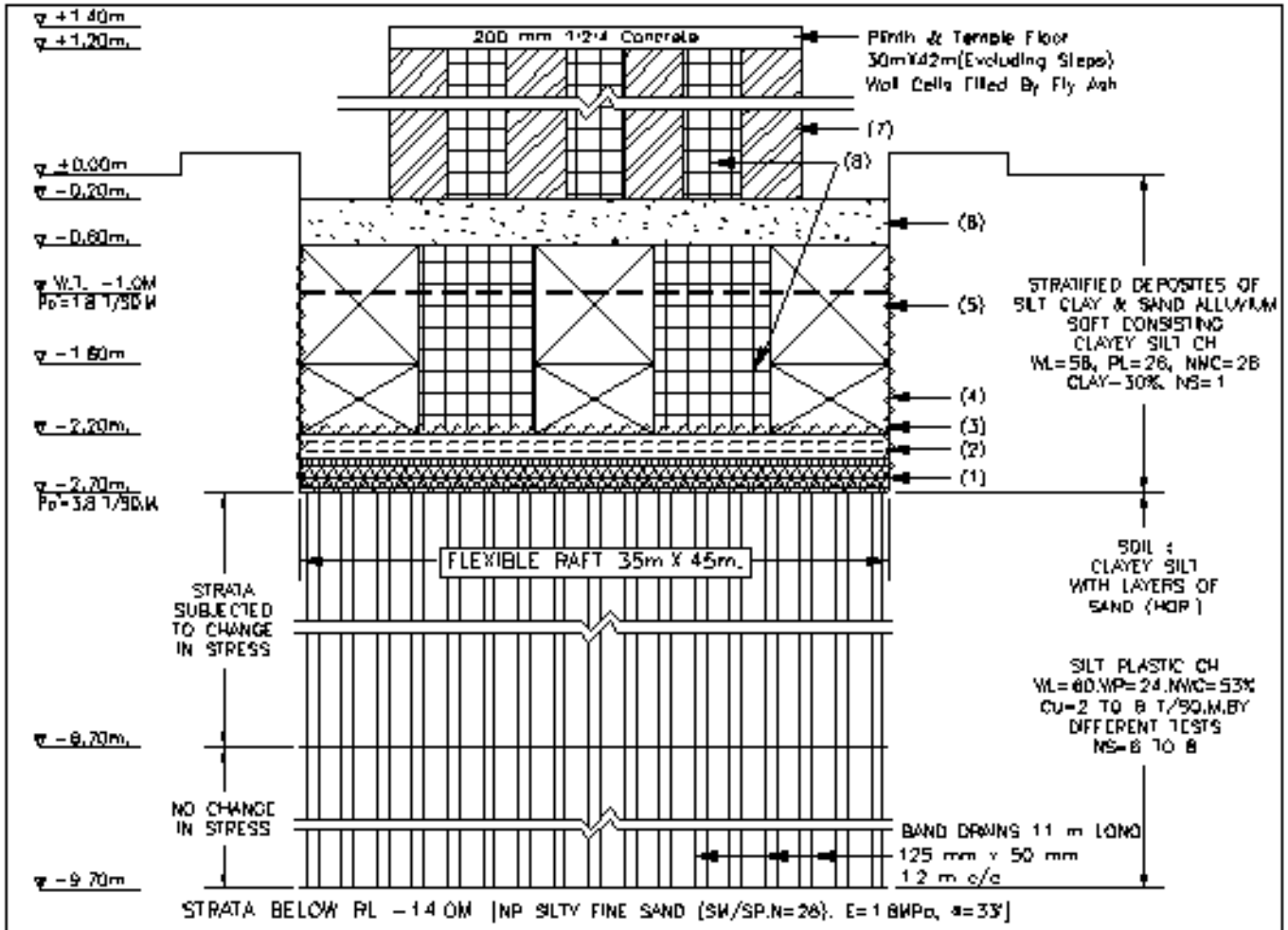


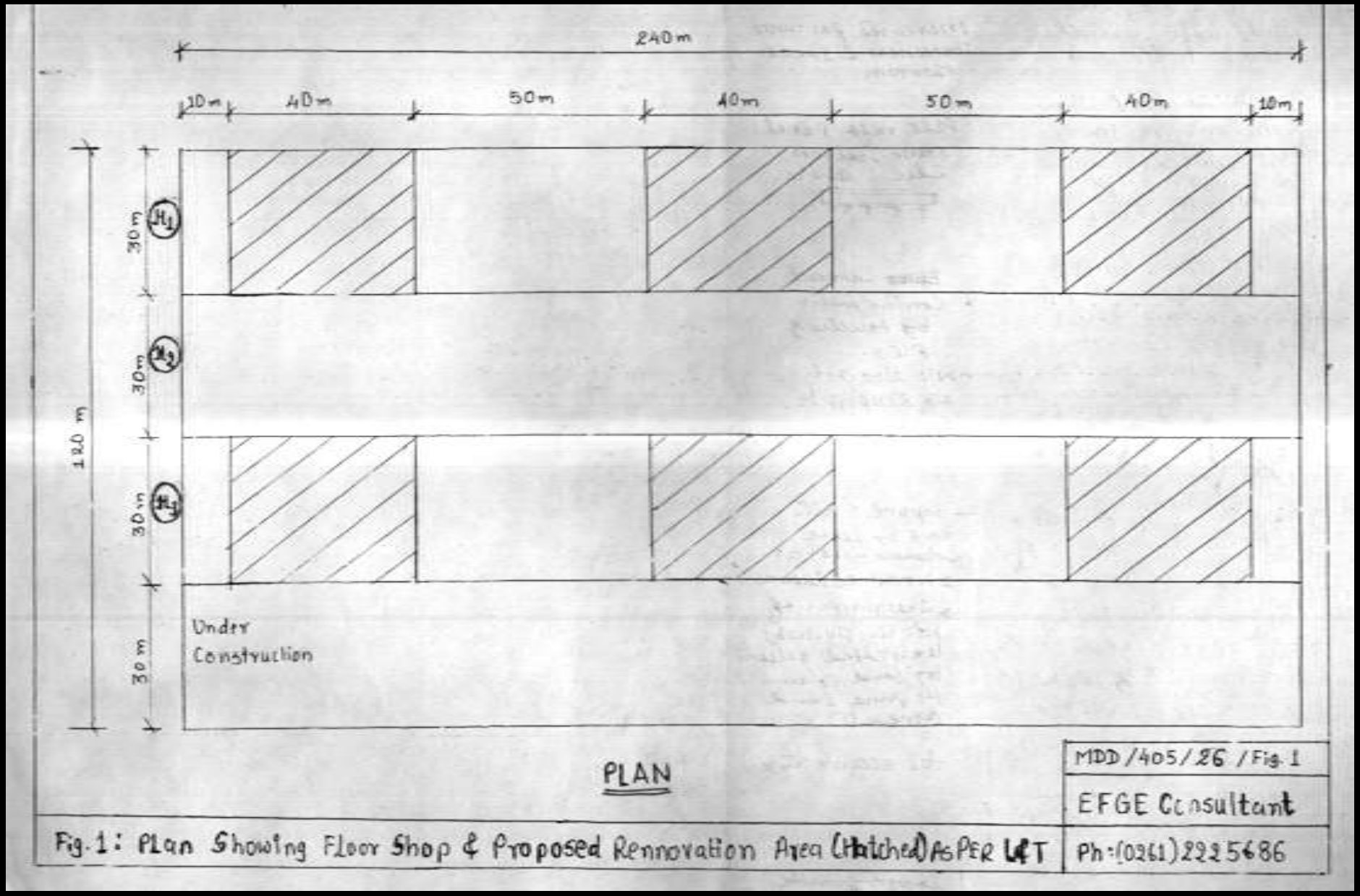
Fig. 2: Typical Foundation System for Flexible Stone Temple.



(1) 300mm thick. Sand Cushion on Geofilter
(2) 200mm thick. Rouble Soling. Lightly Compacted
(3) Filter Geofabric. Carvore 250 to 250 gm/sqm, 75 micron pores, 5m Wide, 400 mm overlap
(4) Gabion 0.60m high X 3m X 1m, 8mm Rope, 150mm mesh Joints Broken, 1600 to 1700kg/cum Stone Fill Manual
(5) Gabion 1.00m high X 3m X 1m, 8mm rope, 150mm mesh, Stones 250mm size, 1600±50kg/cum,
(6) 400mm 1:2:4 Concrete with 30% cement replaced By Fly Ash(Flexible)
(7) Brick Masonary grid of Plinth
(8) Compacted Sandfill

Fig.3: Details of Ground Treatment

L & T FLOOR IMPROVEMENT (2005)



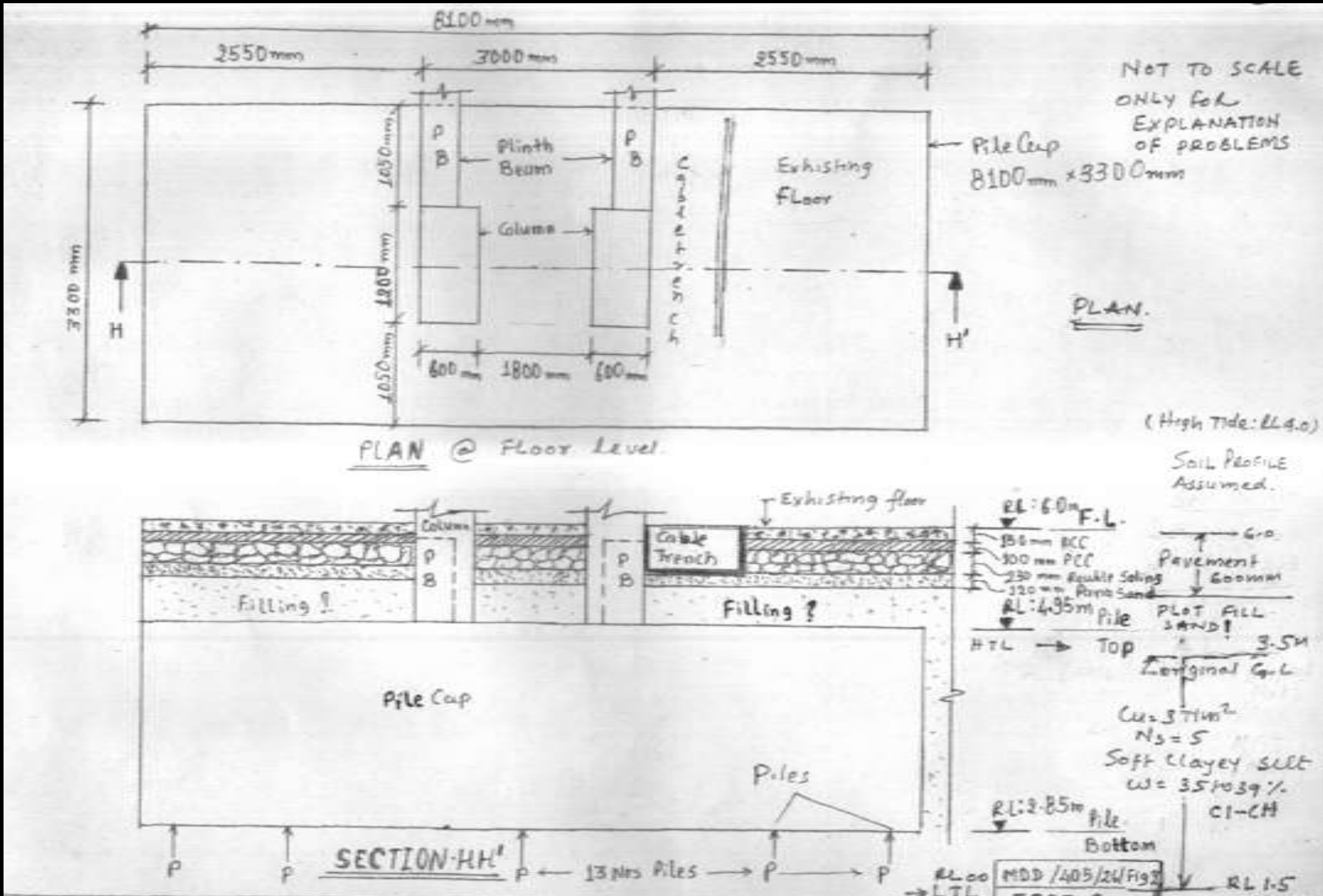
PLAN

MDD/405/26/Fig. 1

EFGE Consultant

Ph:(0261)2225686

Fig. 1: Plan Showing Floor Shop & Proposed Rennovation Area (Hatched) As PER LAY


8100 mm
2550 mm
3000 mm
2550 mm
NOT TO SCALE
ONLY FOR EXPLANATION OF PROBLEMS
Pile Cap
8100 mm × 3300 mm
P B
Plinth Beam
Existing Floor
Column
3300 mm
1050 mm
1200 mm
600 mm
1800 mm
600 mm
H
H'
PLAN.
PLAN @ Floor Level
(High Tide: RL 4.0)
SOIL PROFILE Assumed.
Existing floor
Column
Cable Trench
RL: 6.0 m F.L.
150 mm RCC
100 mm PCC
230 mm Rubble Soling
120 mm Panna Sand
Pavement 600 mm
Filling ?
RL: 4.95 m Pile Top
HTL
PLOT FILL SAND!
3.5 M
Original G.L
Pile Cap
Cu = 3 T/m²
Ns = 5
Soft Clayey silt
ω = 35 to 39 %
CI–CH
Piles
RL: 2.85 m Pile Bottom
SECTION-HH'
P
13 Nos Piles
RL 0.0 LTL
RL 1.5
MDD /405/24 Fig 3

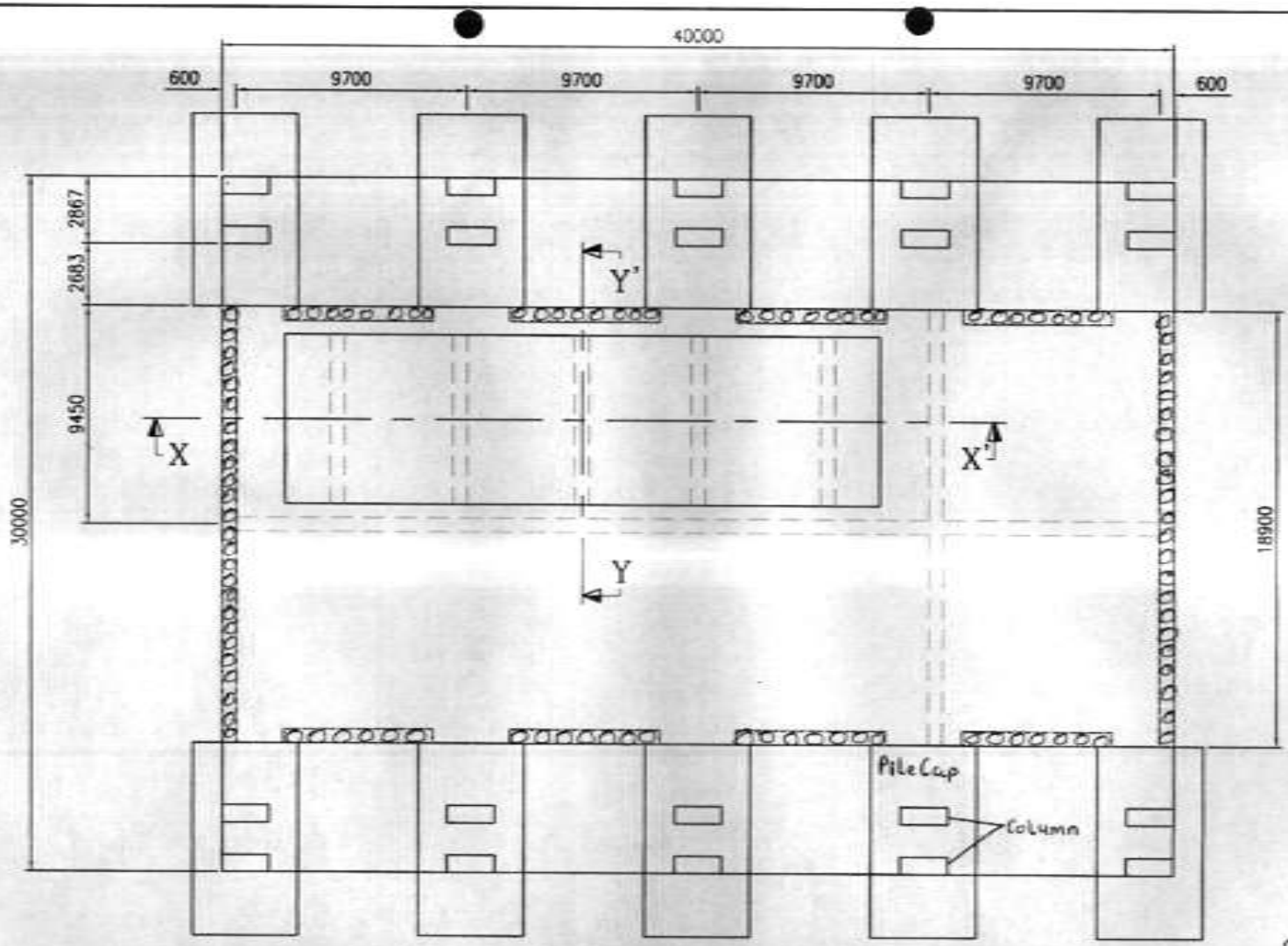


Fig 3 : PLAN OF FLOOR showing Location of touching piles enclosed between pile caps.

MDD/405/26/Fig 3
EFGE Consultant
Ph:(0261)2225686

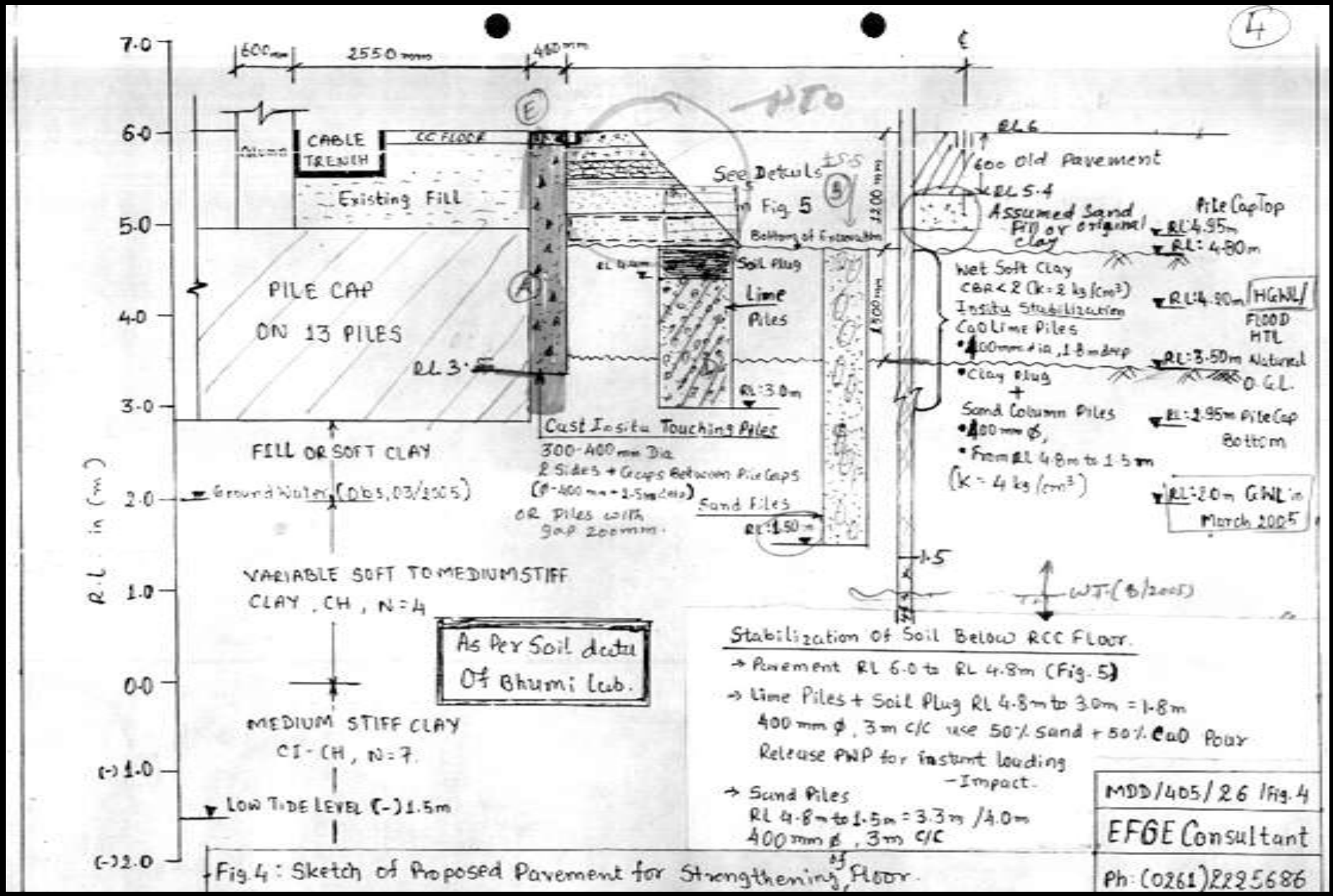
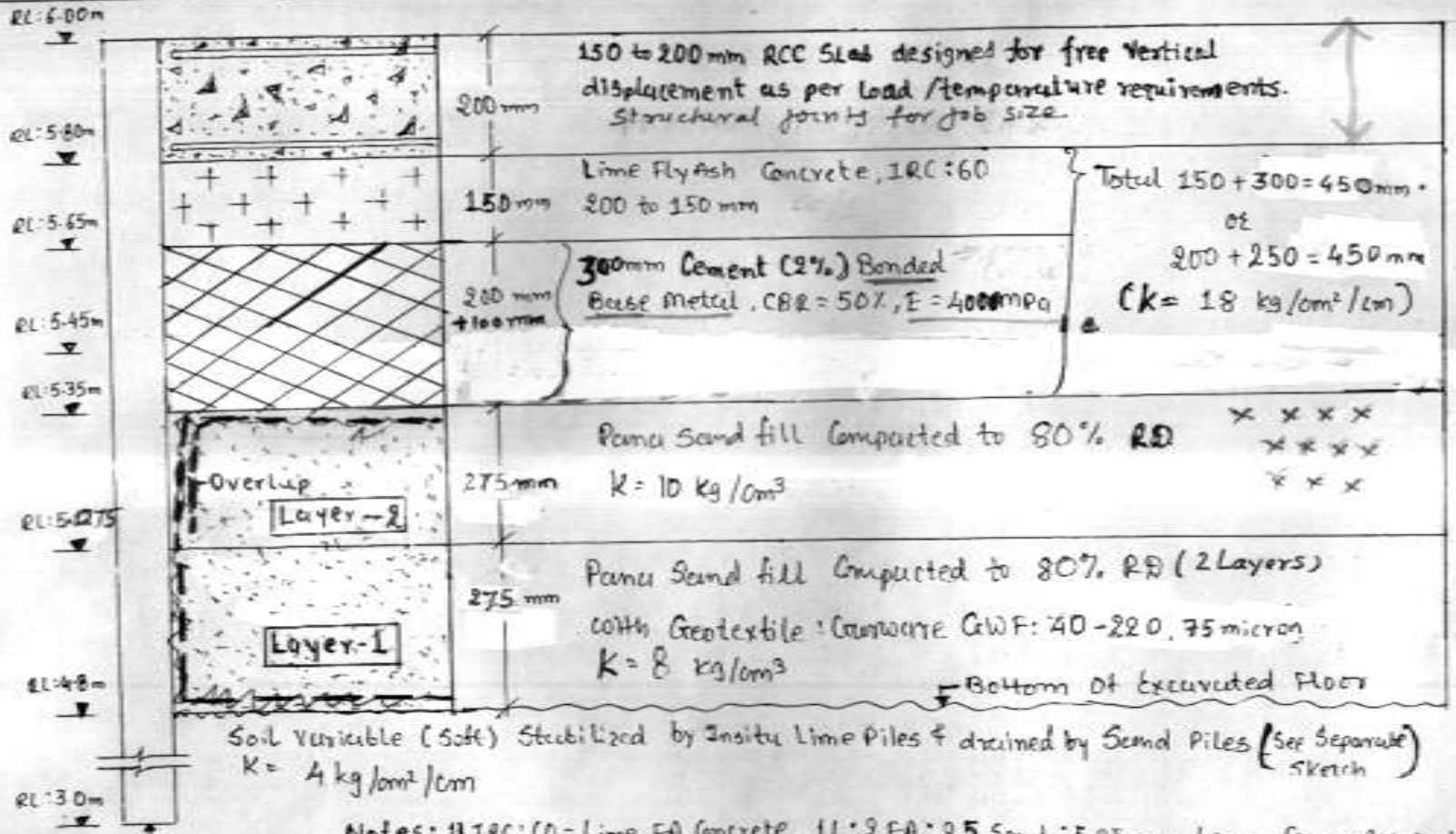


Fig. 4 : Sketch of Proposed Pavement for Strengthening of Floor.

Fig.5: Design Subbase, Base and Subgrade for the Raft @ L&T, Heavy Engg. Shop, Hajira.



Notes: 1) IRC: 60 - Lime FA Concrete, 1L: 2 FA: 2.5 Sand: 5.25 max. 40mm Coarse Aggregates Compacted by Plate Compactor. Thickness 150mm

2) Pavers Block 80mm thick interlocking (1:2:4 grade M20 Concrete) (Now Dropped)

3) The Composite Behaviour of the Subgrade, Subbase (Pavu sand) and Pavers, Base of Bonded metal & Lime FA in Confined Conditions will give k = 15 kg/cm²/cm

Rev. 5/5/2005 after meeting with Dr. Bhangale. (Str. Eng's representative)

MDD/605/26/Fig.5
EFGE Consultant
PH: (0261) 2225686

RIVER TAPTI, SURAT.

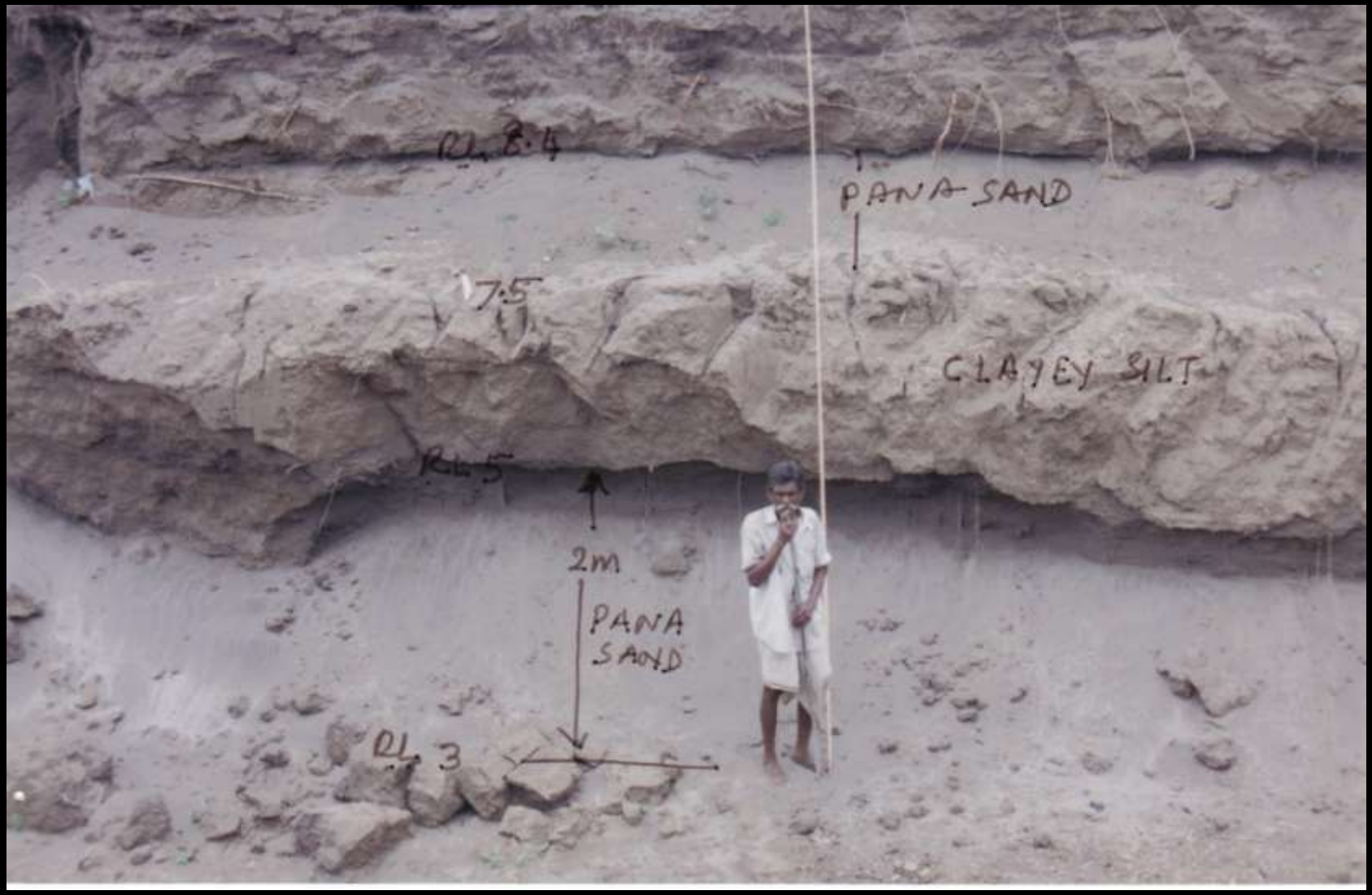
- Erosion on Left Bank at Umra Tapti - HT line.Soil Cohesive.Tidal Depth 4m (After 1998 Floods)

- Vertical Sinking of Left bank. Bridge – Island 1 km D/S Tapti Tidal Estuary.

- Eroded Bank of Tapti at Vesu – Slope Dressing for Laying Mattress.

- Eroded Bank of Tapti in upstream in Weir

- Tapi bank erosion showing different soil strata.



- Tapi bank erosion showing different soil strata.

- Flood Damage to Pala and Fencing – Note. 2m exposed pile foundations Ved.

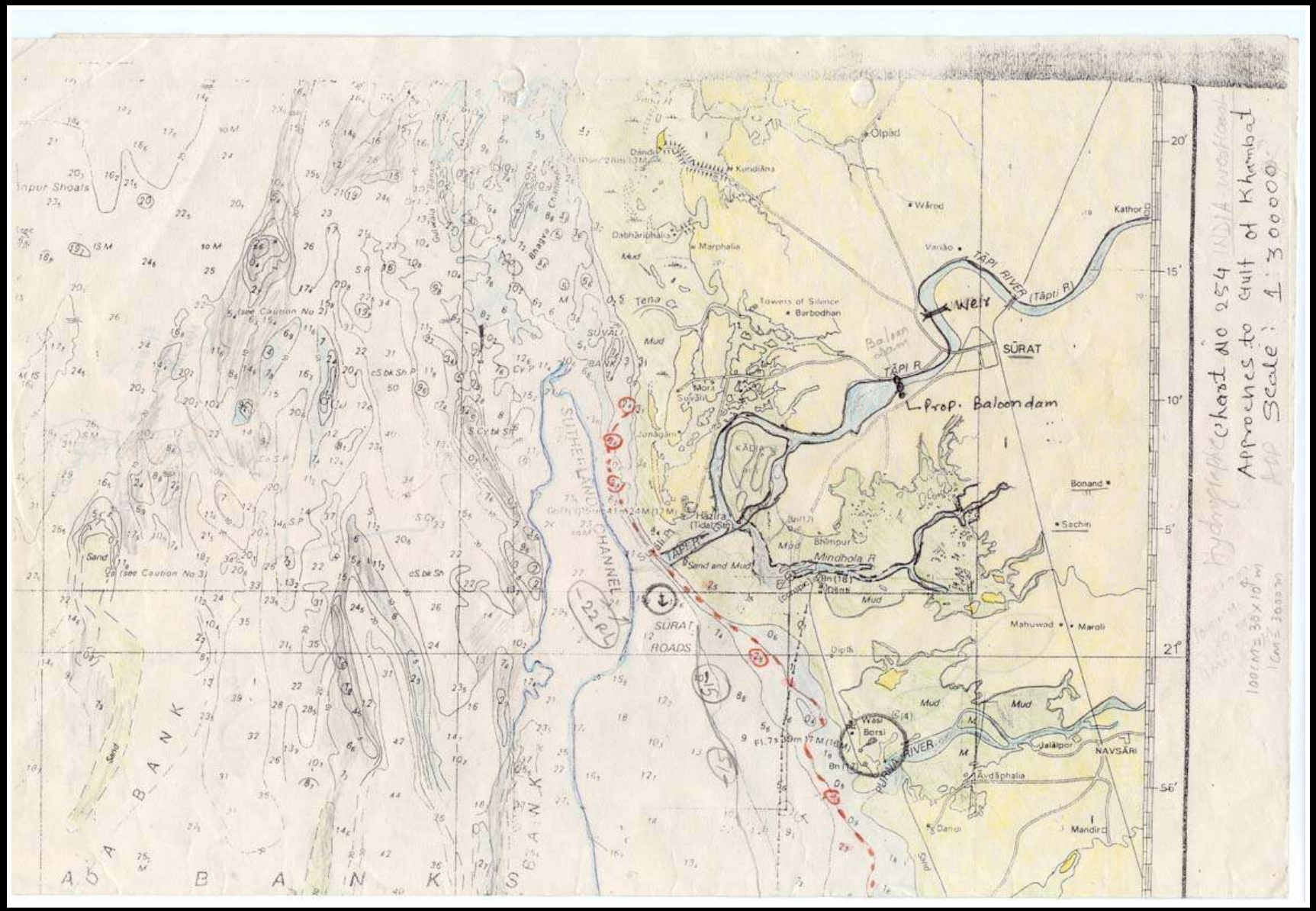
- Gabbian Retaining Wall for the extension of Samhan Ashwanikumar and Flood Control.(1999) The precast concrete facing. Height 4.0m.

- Soil Strata on Which Gabbion Break Water Was Constructed at Bharimata (Left Bank Tapti).

- Typical Gabbian Before Rock Fill.

- Typical 1m Cube Gabbian Lifted by Crane and Lowered to Bed Under Water(Umra)

- Gabbian Laid in Position to Form Erosion Protection and Base for Foundation of Wall (Umra).



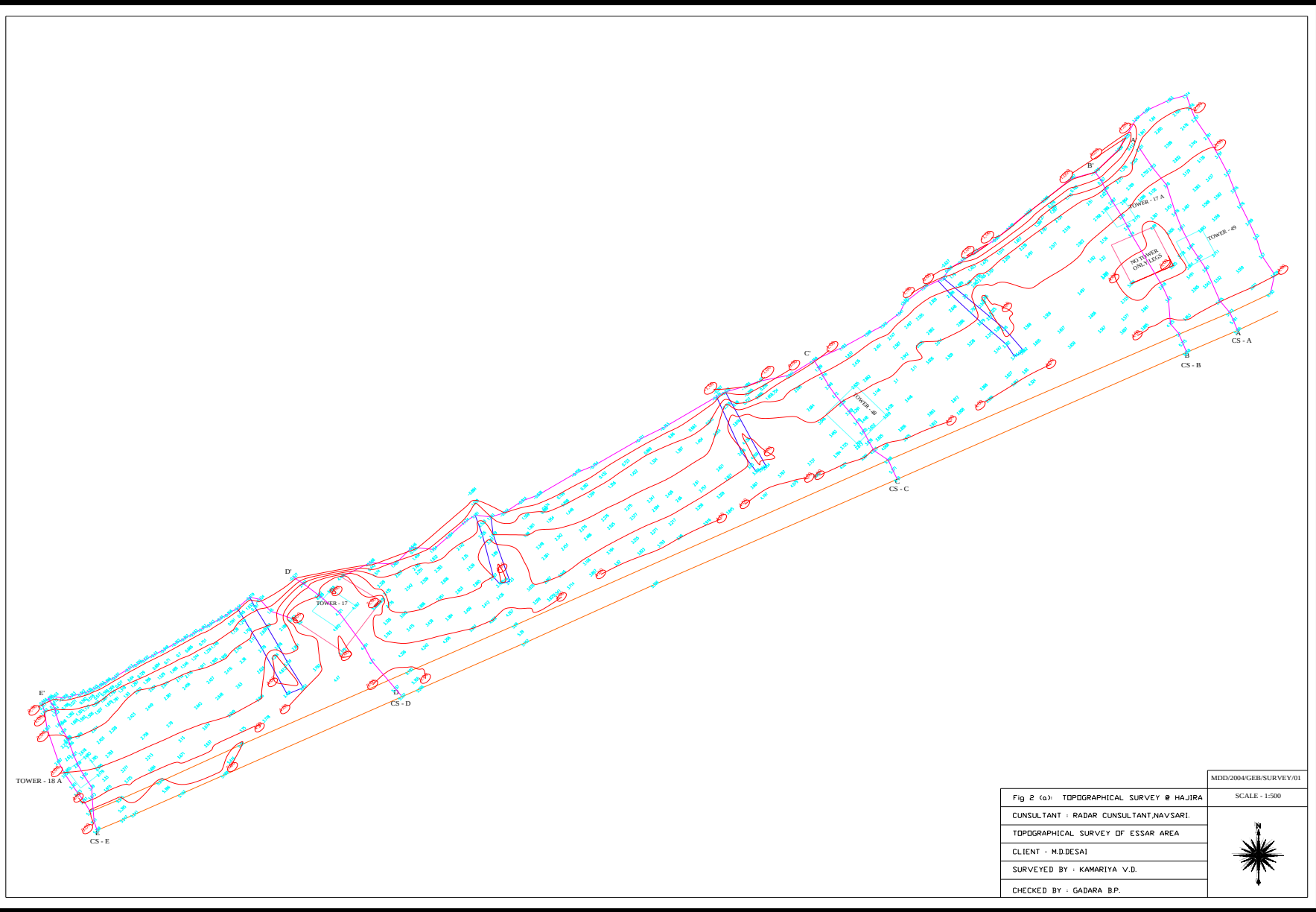
- Erosion On Arabian Sea Coast at Tapti Estuary.

- Impact Test of Gabbian. The Shape of 1 M^3 Gabbian on Lifting.

GEB Tower, ESSAR Road, Erosion Control (2003)


More...
More...
Map
More...
Map
More...
Map
More...
Map
More...
Map
Satellite


More...
Map
More...
Map
Satellite
More...
Map
More...
Map


TOWER - 18 A
TOWER - 17
TOWER - 17 A
TOWER - 49
TOWER - 48
NO TOWER ONLY LEGS
CS - A
CS - B
CS - C
CS - D
CS - E
A
B
C
D
E
A'
B'
C'
D'
E'
MDD/2004/GEB/SURVEY/01
SCALE - 1:500
Fig 2 (a): TOPOGRAPHICAL SURVEY @ HAJIRA
CUNSULTANT : RADAR CUNSULTANT,NAVSARI.
TOPOGRAPHICAL SURVEY OF ESSAR AREA
CLIENT : M.D.DESAI
SURVEYED BY : KAMARIYA V.D.
CHECKED BY : GADARA B.P.
N

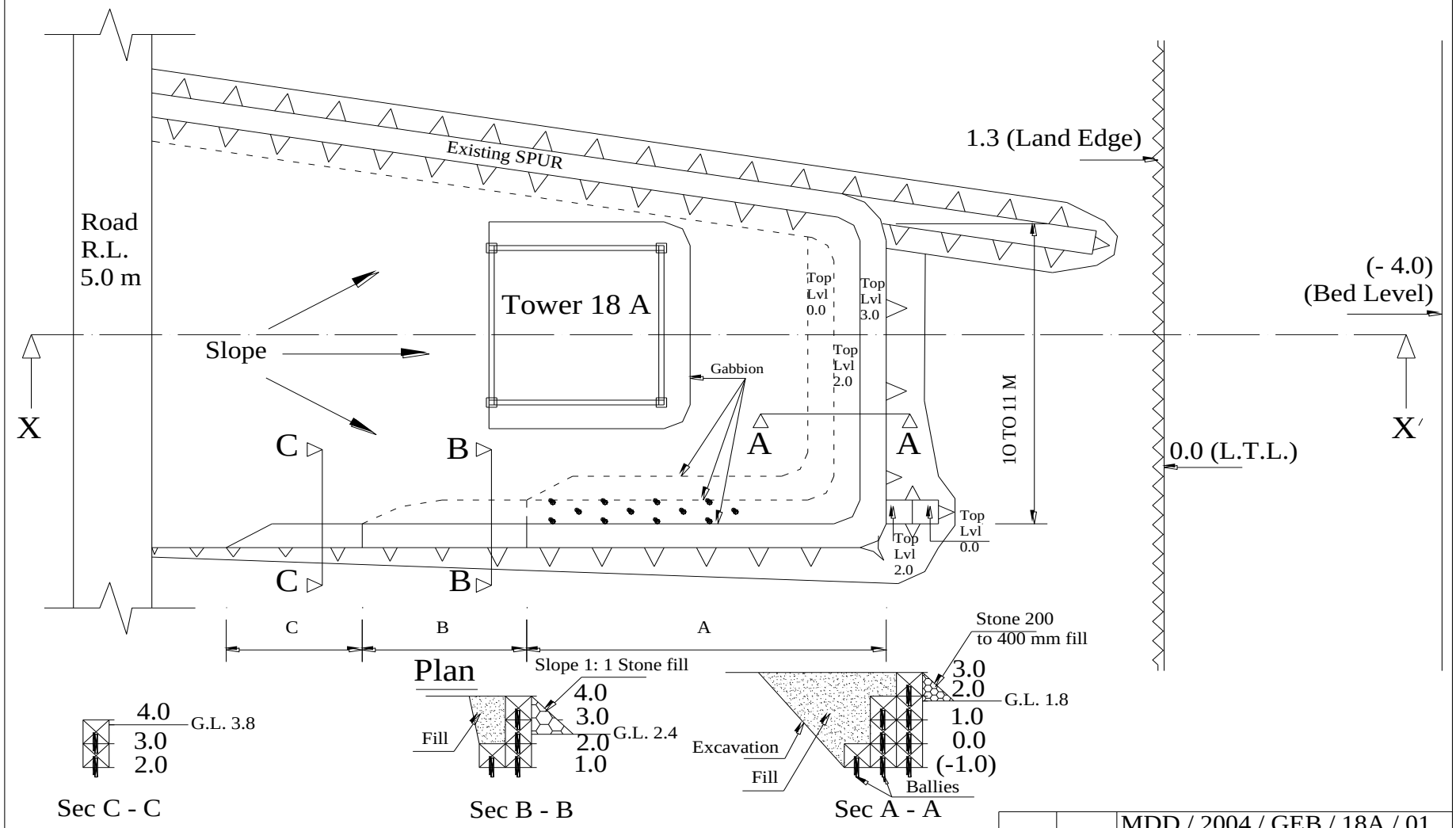
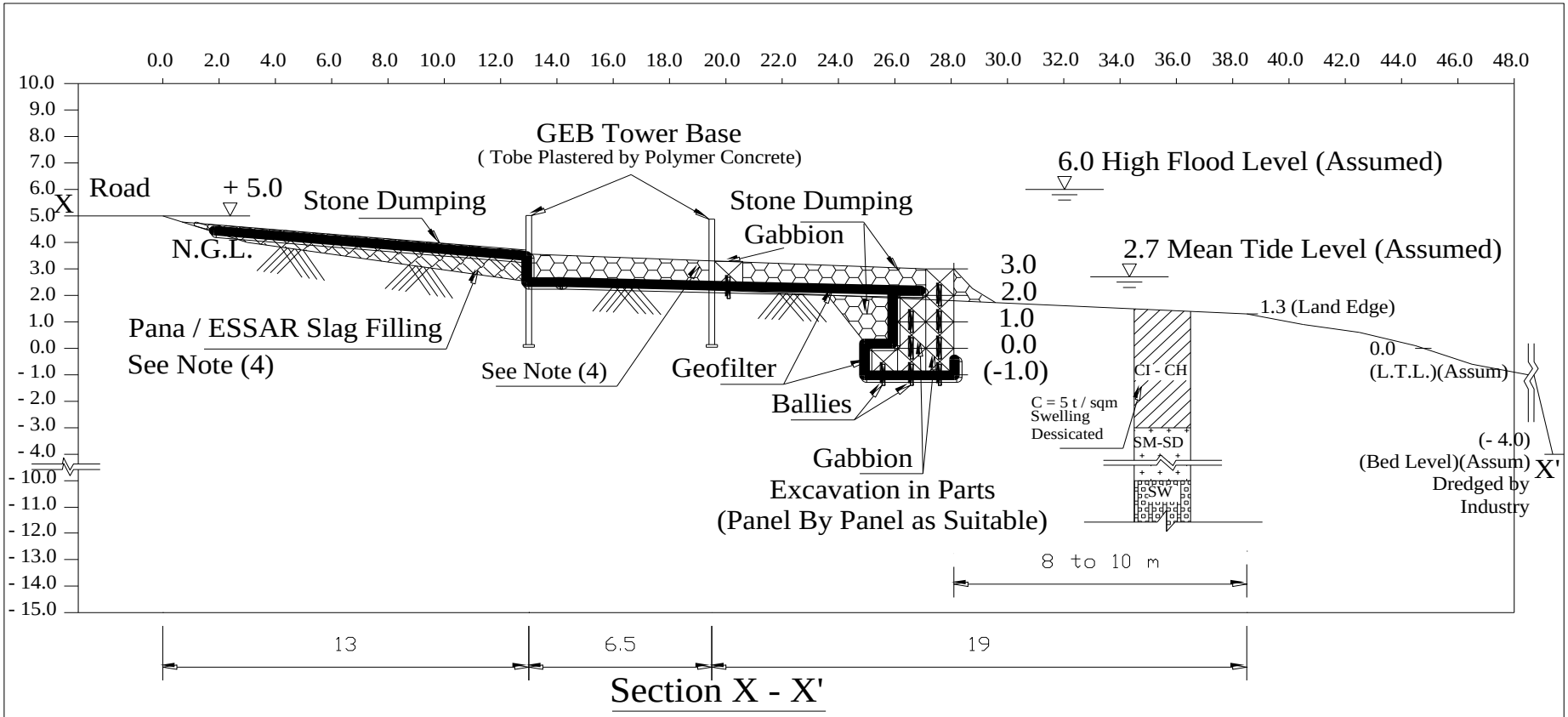


Fig 1 (a): Plan for Tower No: 18 A (Foundation Protection)

		MDD / 2004 / GEB / 18A / 01
		EFGE Consultant
01	20/04	Dr.M.D.Desai
Rev.	Date	Ph: (0261) 2225686



Section X - X'

Notes:
1) Deepest Level (R.L. -4.0) is beyound 48 m.
2) Levels are w.r.t. GTS Road level assumed R.L. +5.0 m
3) Survey Data By GEB.
4) Filling of ESSAR Slag / Pana sand over filter will be covered by 500 mm thick stone packed pitching with interlock(stones > 200 mm)
5) Ballies 2 per Gabbion 1.5 m at G.L. and 1.0 m between Gabbions 2" Dia.
6) Soil Profile is assumed from data base.
7) Geo filter thicker than 40 g / sqm Joined by 75 mm overlap e pins.
8) Projected C.C. Legs of tower will be cleaned & covered by 40 mm polymer plaster with binder coat.
9) Width of work shall be 10 + 5 m to be planned as per site conditions.
10) Existing Spur will be strengthens using Ballies, Stones / Gabbions to R.L. + 3.0.

Fig 1 (b): Typical Cross - Section for Tower No: 18 A (Foundation Protection)

		MDD / 2004 / GEB / 18A / 02
		EFGE Consultant
01	20/04	Dr.M.D.Desai
Rev.	Date	Ph: (0261) 2225686

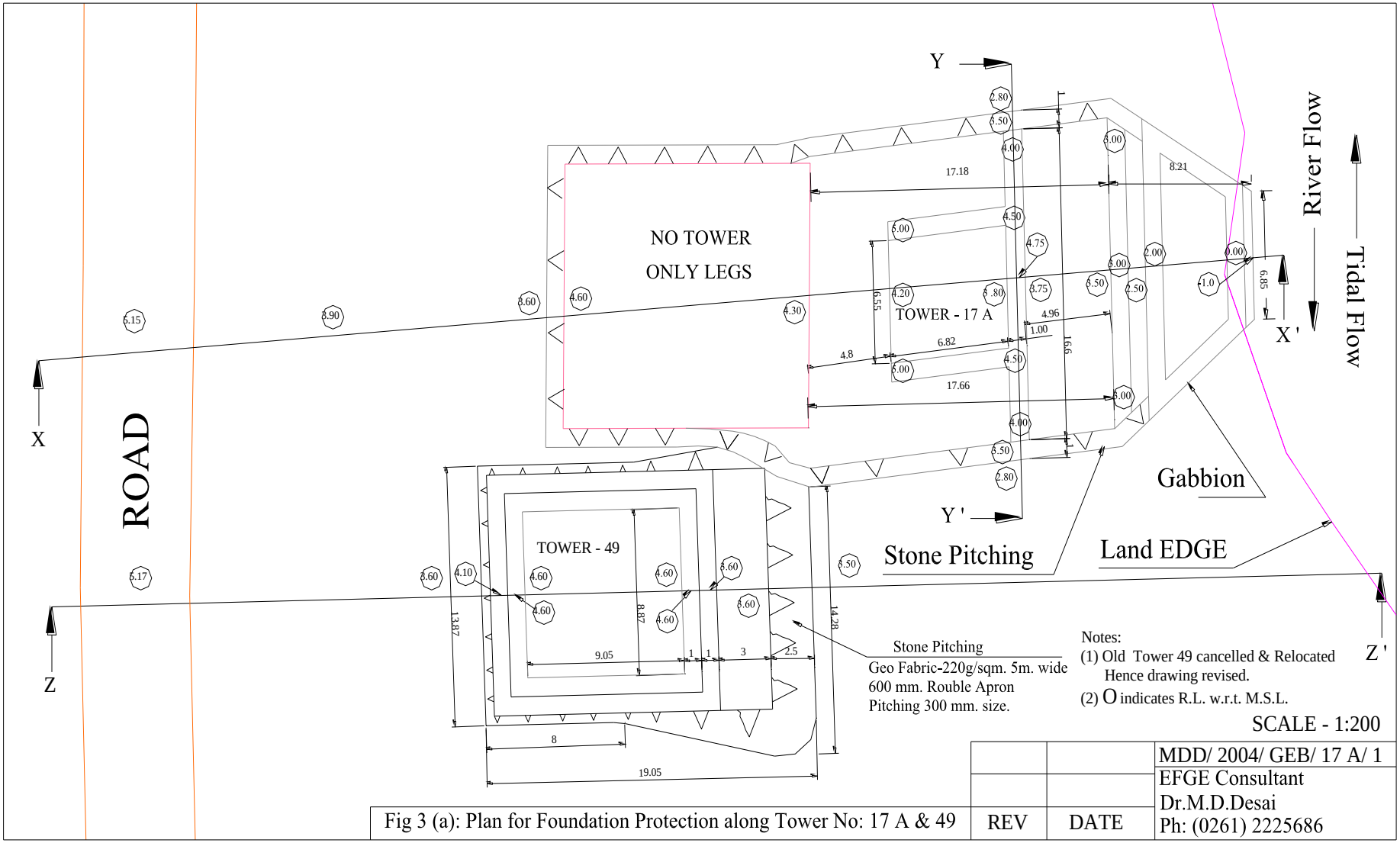
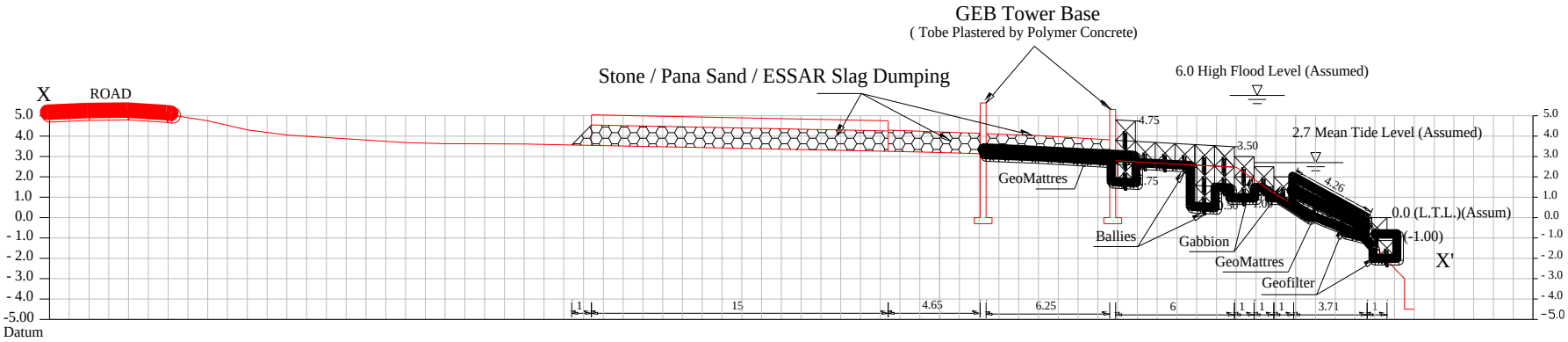


Fig 3 (a): Plan for Foundation Protection along Tower No: 17 A & 49

REV	DATE	MDD/ 2004/ GEB/ 17 A/ 1
		EFGE Consultant
		Dr.M.D.Desai
		Ph: (0261) 2225686



CROSSING	ELEVATION	CHAINAGE
ROAD	5.069	0.000
	5.155	2.000
	5.177	4.000
	5.055	6.000
	4.753	8.000
	4.306	10.000
	4.052	12.000
	3.930	14.000
	3.808	16.000
	3.686	18.000
	3.627	20.000
	3.622	22.000
	3.611	24.000
	3.573	26.000
WALL PROTECTION ONLY LEGS	3.534	28.000
	3.495	30.000
	3.457	32.000
	3.418	34.000
	3.379	36.000
	3.341	38.000
	3.302	40.000
	3.263	42.000
	3.219	44.000
	3.166	46.000
TOWER 17 A	3.096	48.000
	3.023	50.000
	2.907	52.000
	2.791	54.000
LAND EDGE	2.677	56.000
	2.574	58.000
	2.471	60.000
	1.136	62.000
	0.017	64.000
	-0.761	66.000
	-1.018	66.662

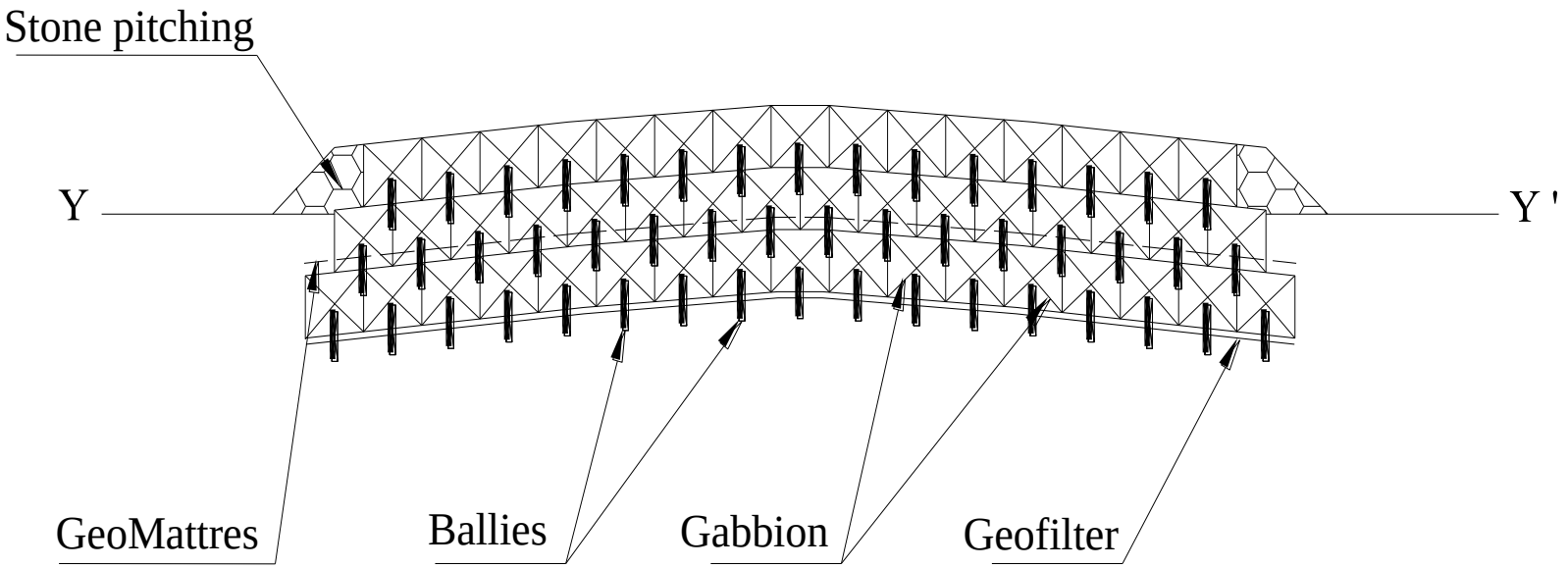
SECTION - X X '

TOWER NO: 17 A

SCALE - 1:200

Fig 3 (b): Cross - Section along Tower No: 17 A

REV	DATE	MDD/ 2004/ GEB/ 17 A/ 2
		EFGE Consultant Dr.M.D.Desai Ph: (0261) 2225686

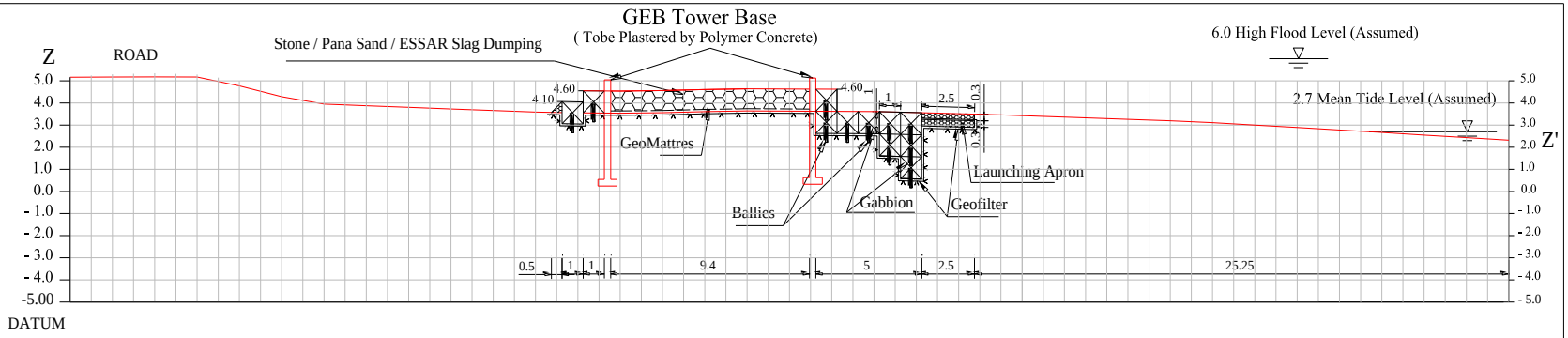


SECTION - Y Y'

TOWER NO: 17 A

SCALE - 1:100

			MDD/ 2004/ GEB/ 17 A/ 3
			EFGE Consultant Dr.M.D.Desai Ph: (0261) 2225686
Fig 3 (C): Section Y Y' along Tower No: 17 A	REV	DATE	



CROSSING	ROAD													TOWER 49																				LAND EDGE
ELEVATION	5.165	5.174	5.179	5.174	4.769	4.286	3.949	3.877	3.804	3.731	3.659	3.586	3.552	3.539	3.560	3.609	3.641	3.631	3.622	3.612	3.566	3.515	3.461	3.394	3.328	3.262	3.195	3.109	2.999	2.890	2.780	2.666	2.549	2.433	2.331
CHAINAGE	0.000	2.000	4.000	6.000	8.000	10.000	12.000	14.000	16.000	18.000	20.000	22.000	24.000	26.000	28.000	30.000	32.000	34.000	36.000	38.000	40.000	42.000	44.000	46.000	48.000	50.000	52.000	54.000	56.000	58.000	60.000	62.000	64.000	66.000	67.761

SECTION - Z Z'

TOWER NO: 49

SCALE - 1:200

Fig 3 (d): Cross - Section along Tower No: 49

REV	DATE	MDD / 2004 / GEB / 49 / 01
		EFGE Consultant Dr.M.D.Desai Ph: (0261) 2225686

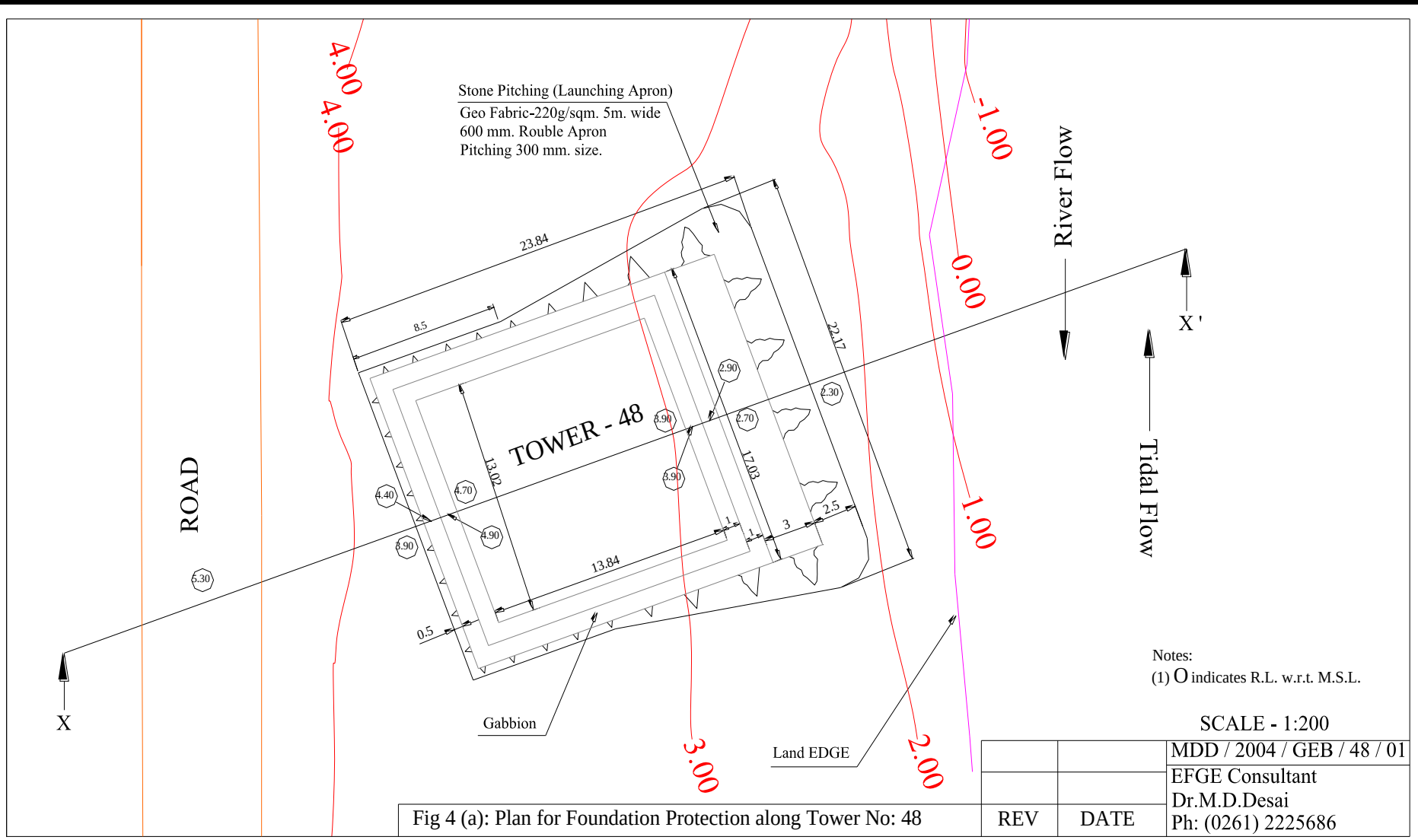
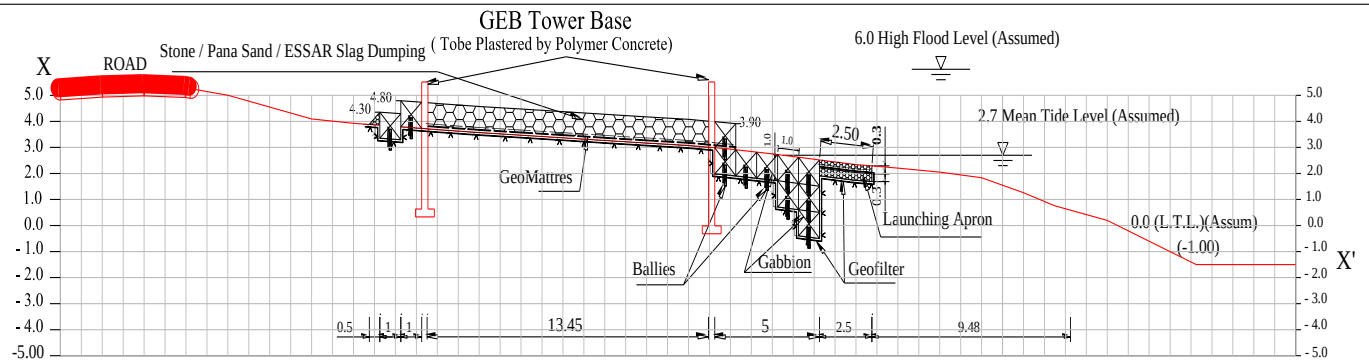


Fig 4 (a): Plan for Foundation Protection along Tower No: 48



CROSSING	ROAD									TOWER 48								LAND EDGE									
ELEVATION	5.190	5.300	5.349	5.286	5.003	4.549	4.095	3.927	3.810	3.687	3.572	3.473	3.373	3.269	3.170	3.075	2.932	2.753	2.545	2.339	2.209	2.054	1.837	1.263	0.759	0.200	-1.00	-1.50
CHAINAGE	0.000	2.000	4.000	6.000	8.000	10.000	12.000	14.000	16.000	18.000	20.000	22.000	24.000	26.000	28.000	30.000	32.000	34.000	36.000	38.000	40.000	42.000	44.000	46.000	47.491	50.000	53.000	56.000

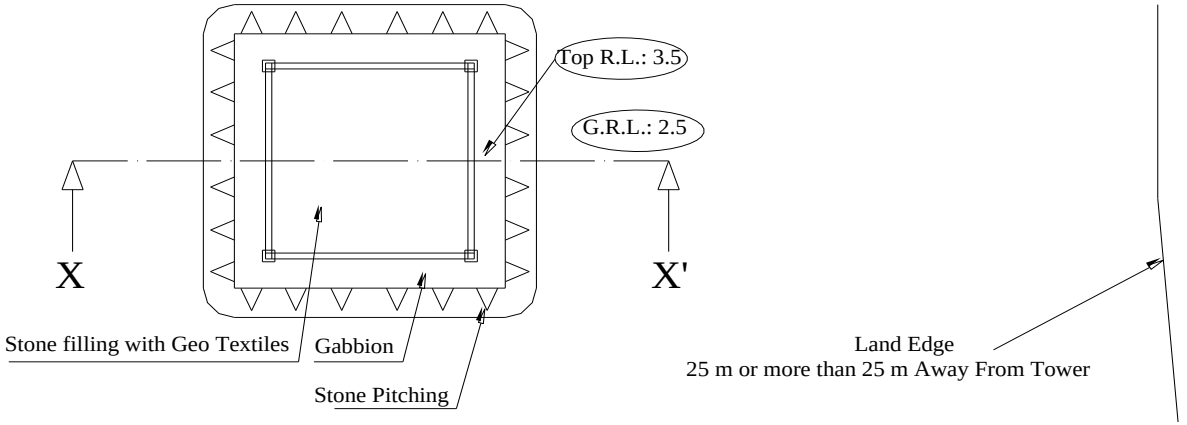
SECTION - X X'

TOWER NO: 48

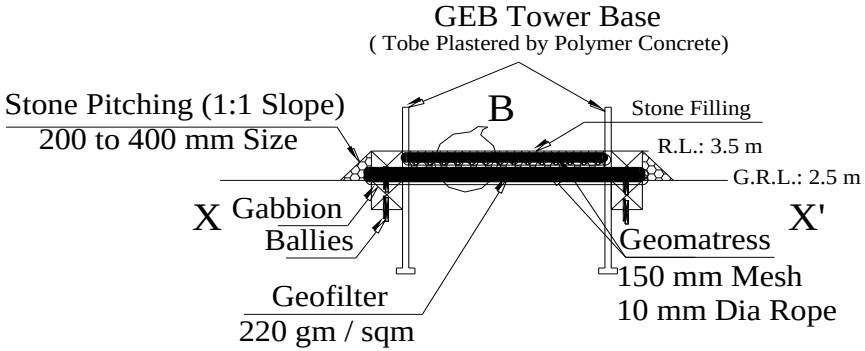
SCALE - 1:200

Fig 4 (b): Cross - Section along Tower No: 48

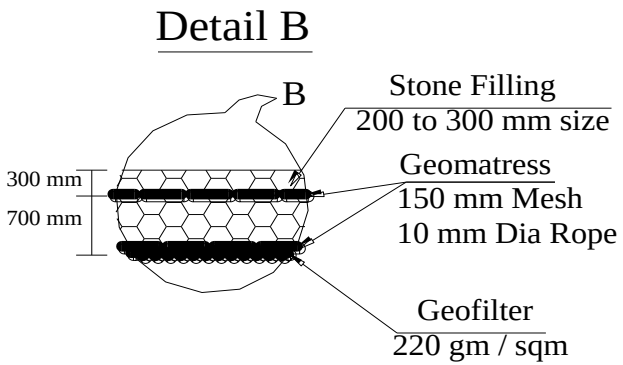
REV	DATE	MDD/ 2004/ GEB/ 48 / 02
		EFGE Consultant Dr.M.D.Desai Ph: (0261) 2225686



Plan



Section X - X'

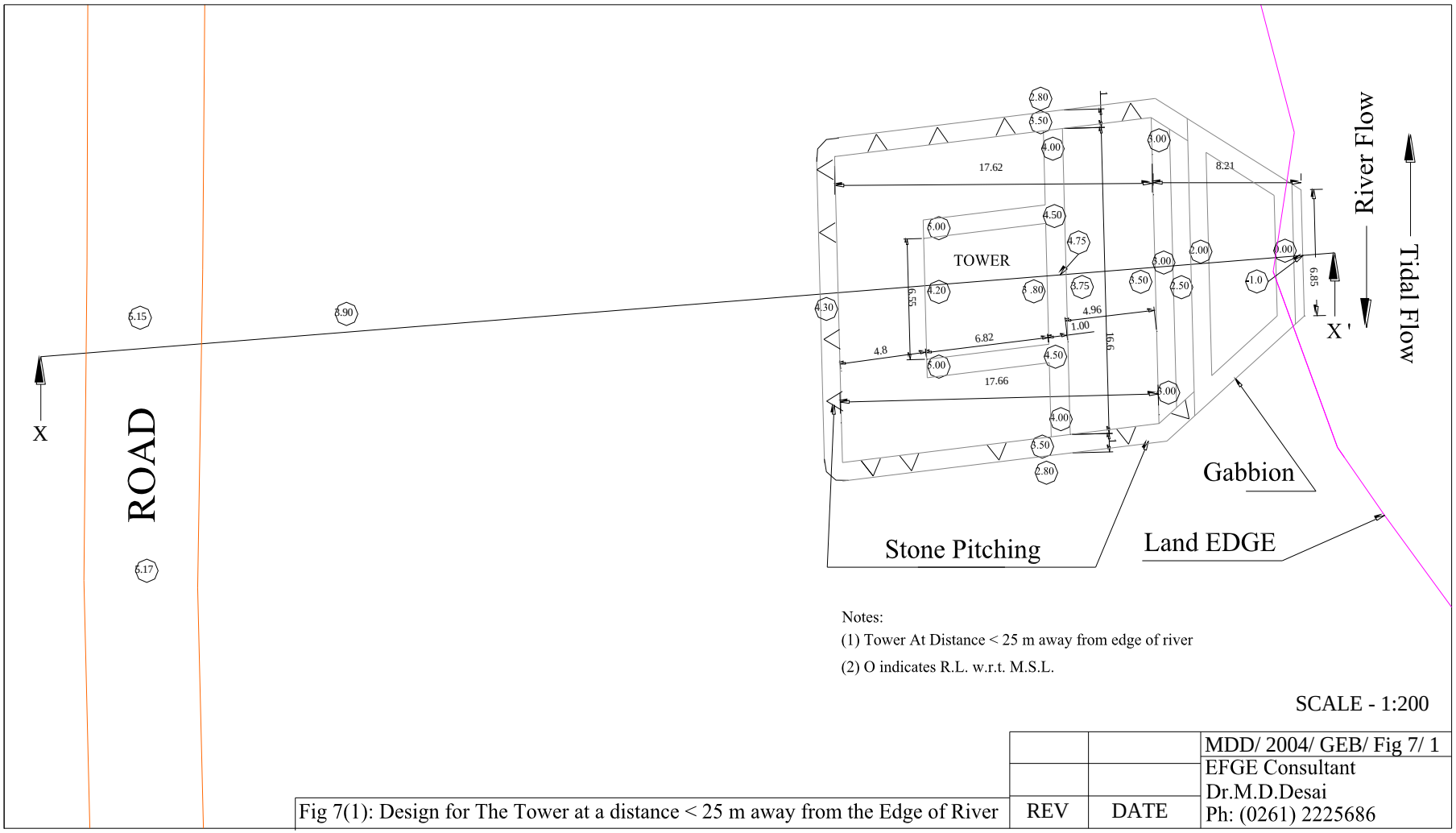


SCALE - 1:200

Note: (1) No. of Gabbion will very with site condition.

Fig:5 - Foundation Protection to Tower having more than 25 m distance from the land edge.

		MDD / 2004 / GEB/ Type C
		EFGE Consultant
01	27/7	Dr.M.D.Desai
Rev.	Date	Ph: (0261) 2225686

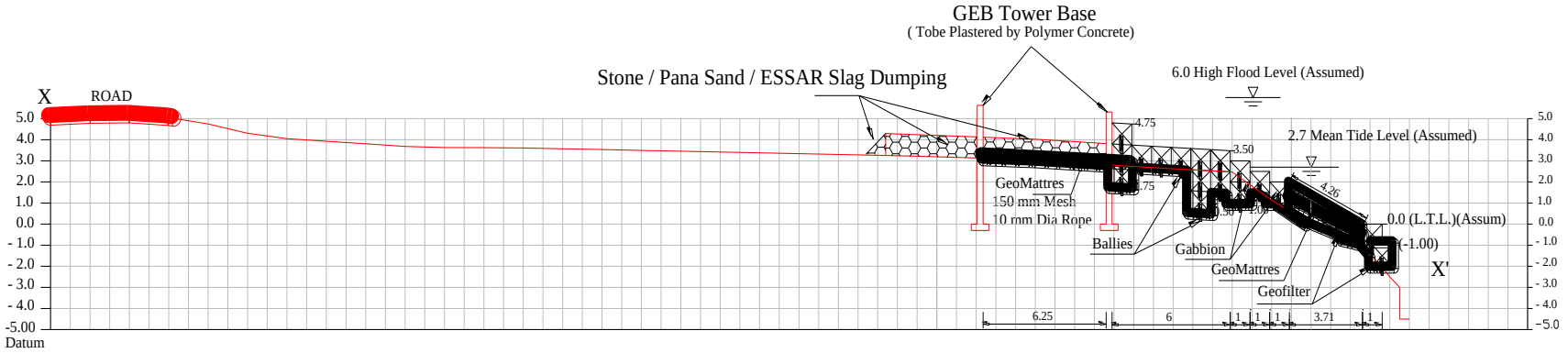


Notes:
(1) Tower At Distance < 25 m away from edge of river
(2) O indicates R.L. w.r.t. M.S.L.

SCALE - 1:200

Fig 7(1): Design for The Tower at a distance < 25 m away from the Edge of River

		MDD/ 2004/ GEB/ Fig 7/ 1
		EFGE Consultant Dr.M.D.Desai Ph: (0261) 2225686
REV	DATE	



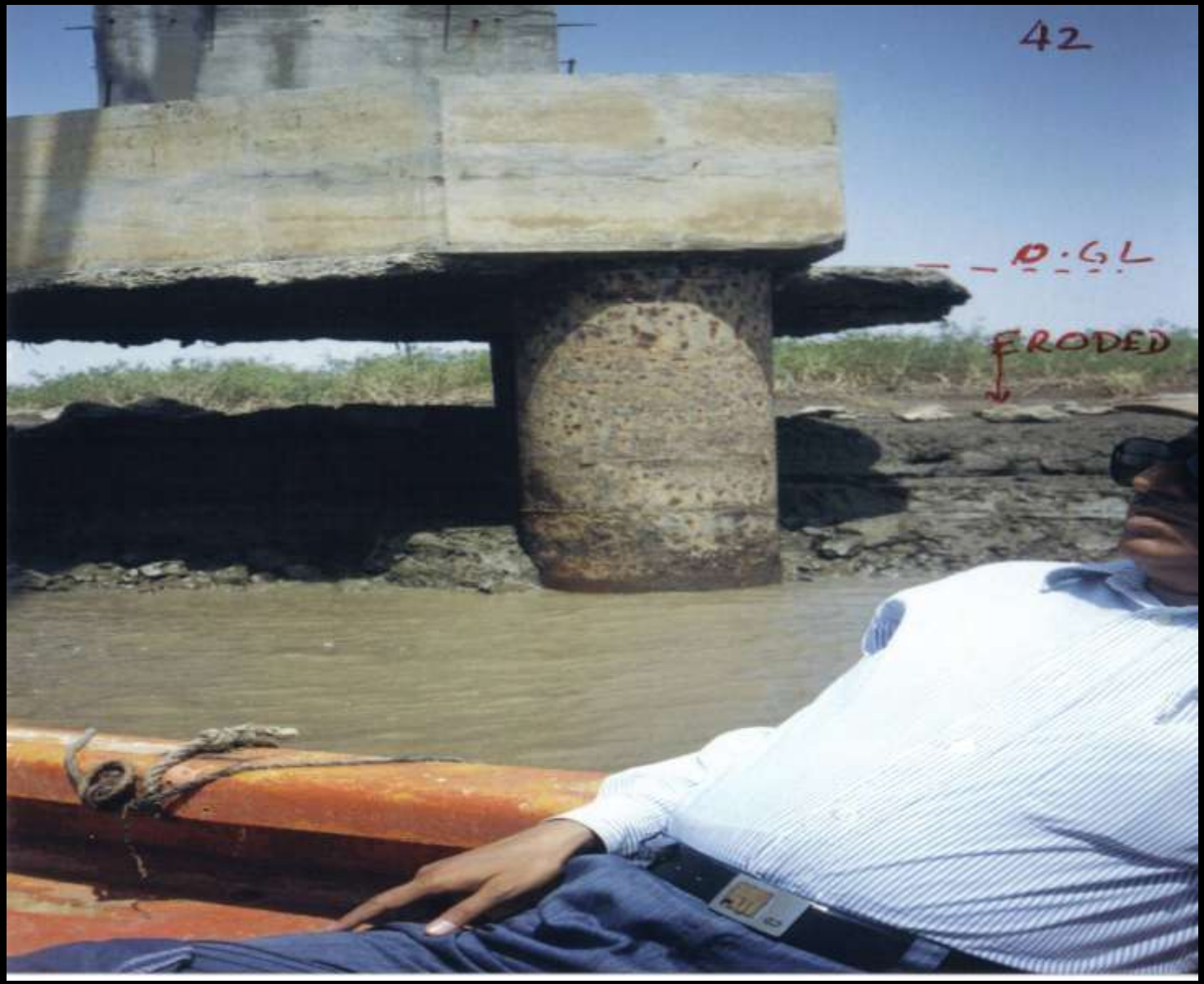
SECTION - X X '

SCALE - 1:200

Fig 7 (2): Cross Section for The Tower at a distance < 25 m away from the Edge of River

REV	DATE	MDD/ 2004/ GEB/ Fig 7/2
		EFGE Consultant
		Dr.M.D.Desai
		Ph: (0261) 2225686


3 PUT GROYANS
NEAR ESSAR
ROAD


42
D.G.L
ERODED


Solid


Tower - 17

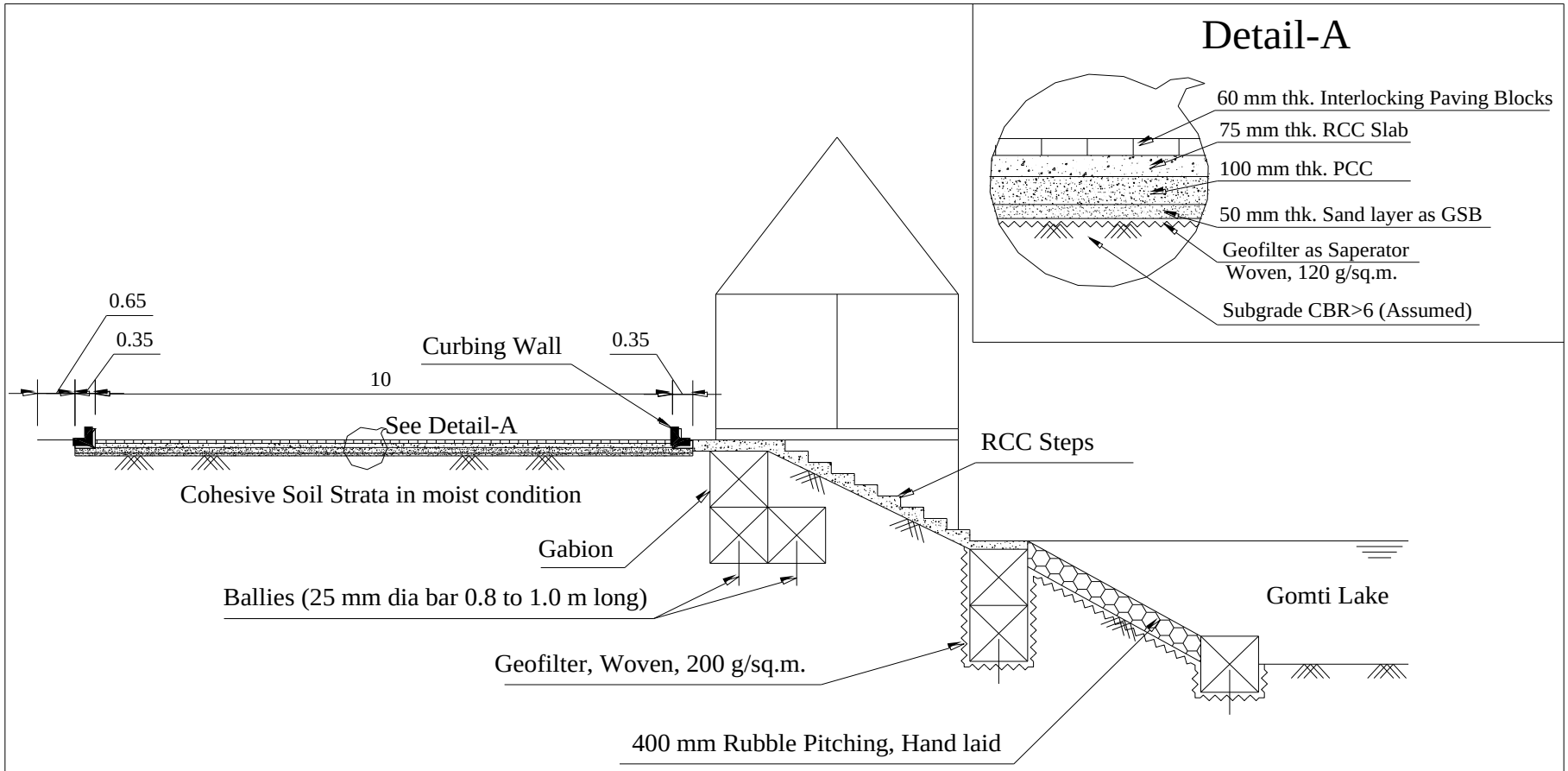
GEB Tower, Kedia Island, Erosion Control (2003)


32
Island
GEB


32
+3
+2
BED +0.5 M


GEB
32

Dwarka Temple, Erosion Control, (2006)

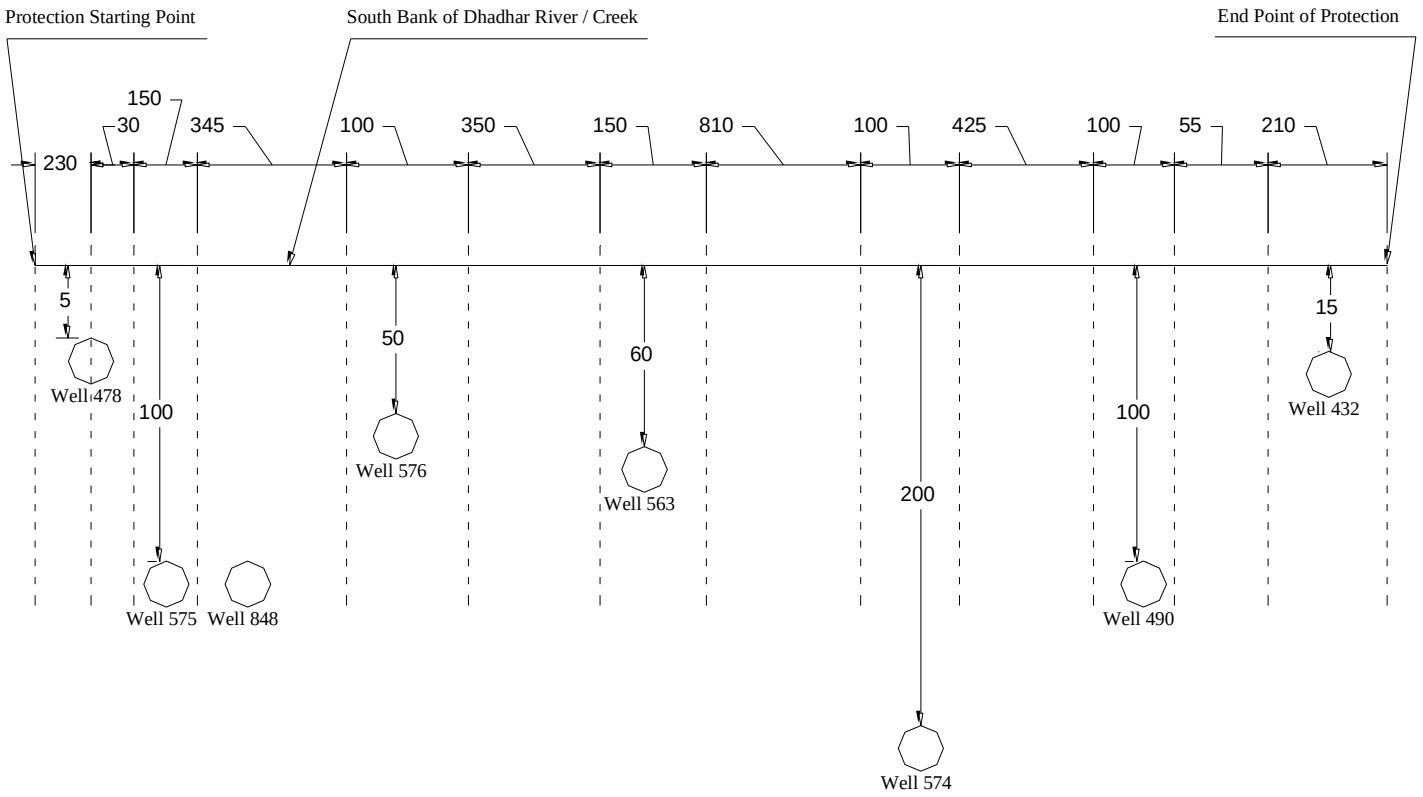


Note:

1. Assumed in working season the Gomti Lake will be in dry condition.
2. SBC of existing soil below the Gabions is assumed as 15 t/sq.m.

Fig. 1: Sketch showing proposed protection works at Gomti Lake.

ONGC Ankleshwar Bank Prot, Erosion Control, (2006)

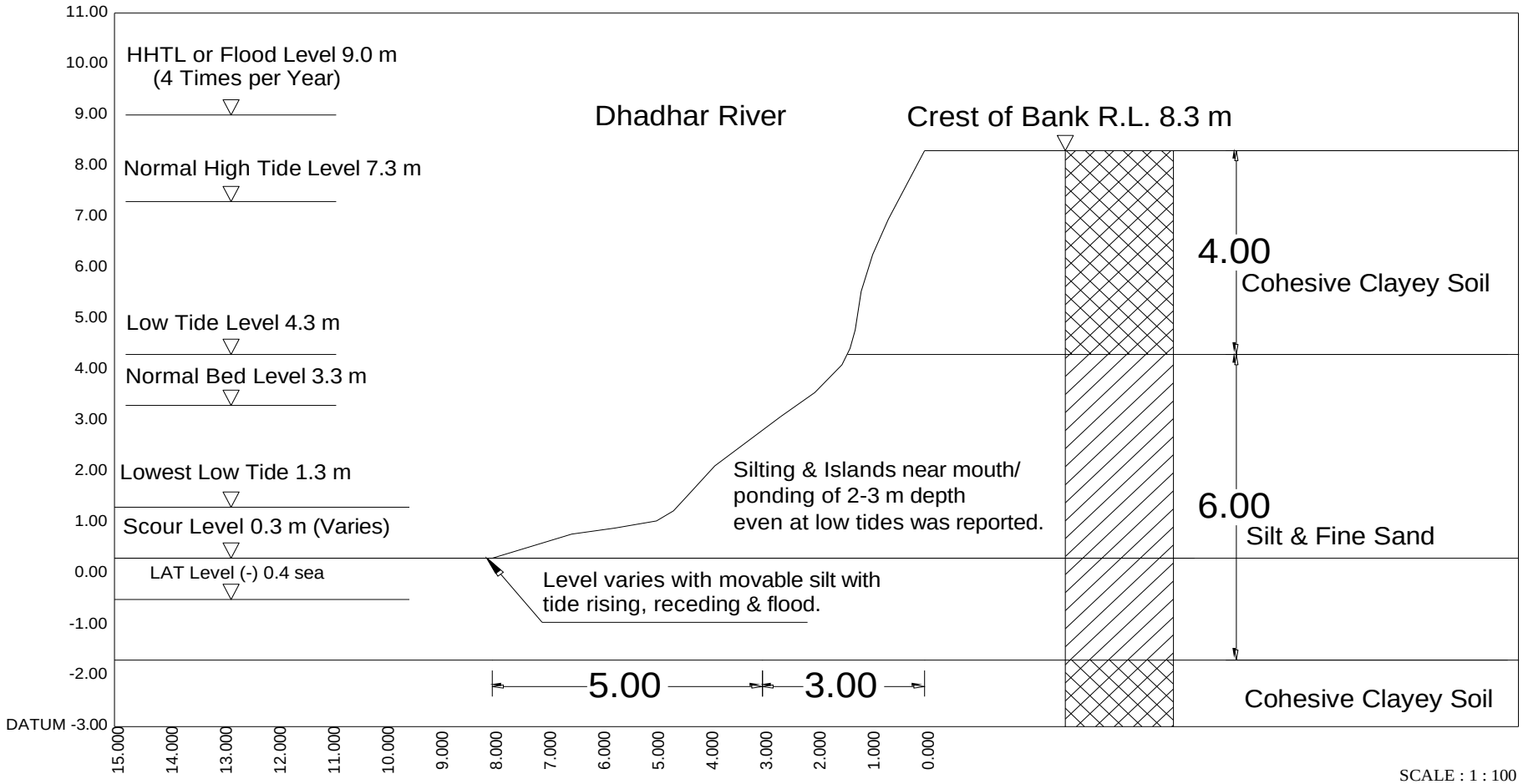


SCALE : NTS

Note: All dimensions are in Mt.

Fig. No: 1 -Location of well & distance from the Water line in River (provided by ONGC)

		Drg No: MDD/ONGC ANK/ 01
		EFGE CONSULTANT
		Dr. M.D. Desai
		West City Light Area, Surat.
		Ph: (0261) 2225686
Rev. No.	Date	

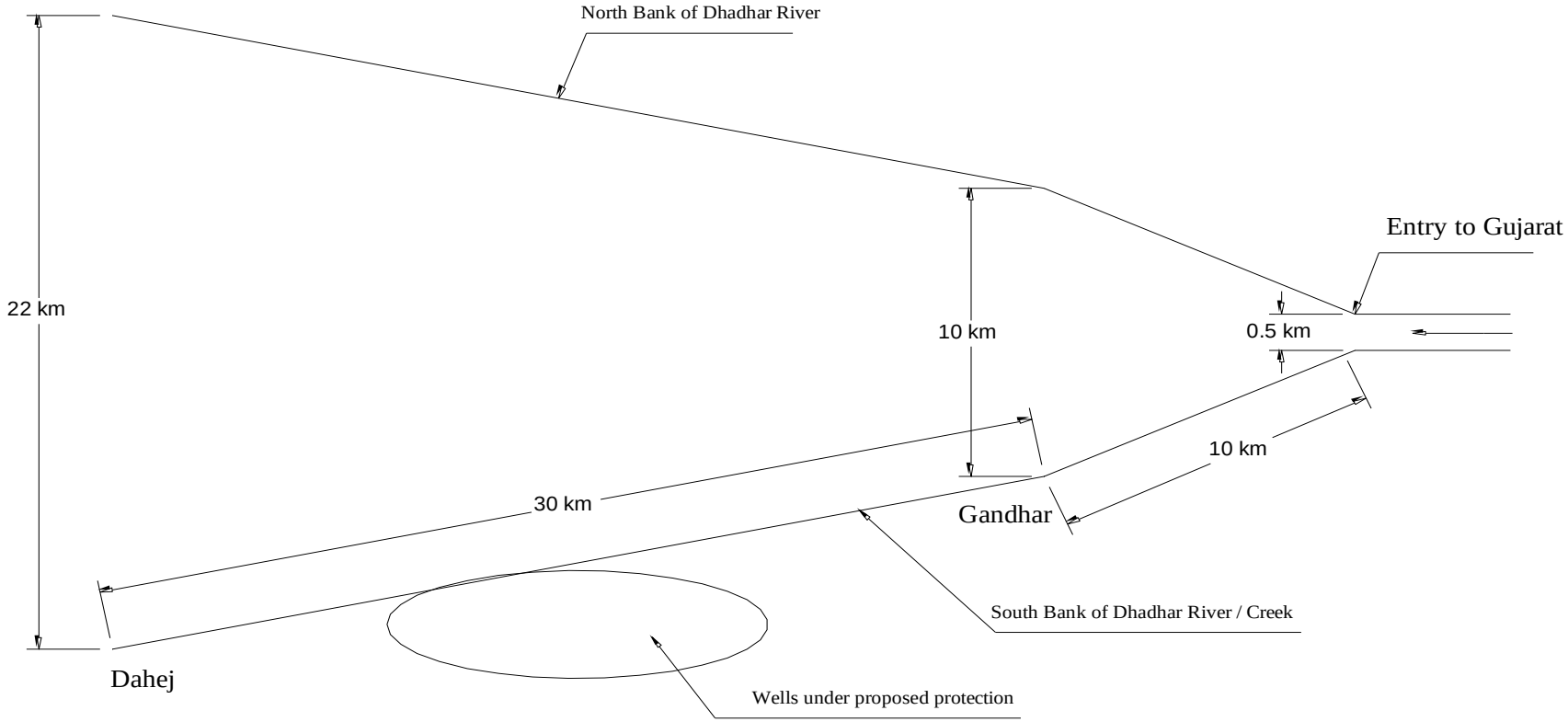


SCALE : 1 : 100

Note: All elevations are Chart Datum Elevation not GTS

		Drg No: MDD/ONGC ANK/ 02
		EFGE CONSULTANT
		Dr. M.D. Desai
		West City Light Area, Surat.
Rev. No.	Date	Ph: (0261) 2225686

Fig. No: 2 - Typical Section of the South bank of River Dhadhar.



SCALE : NTS

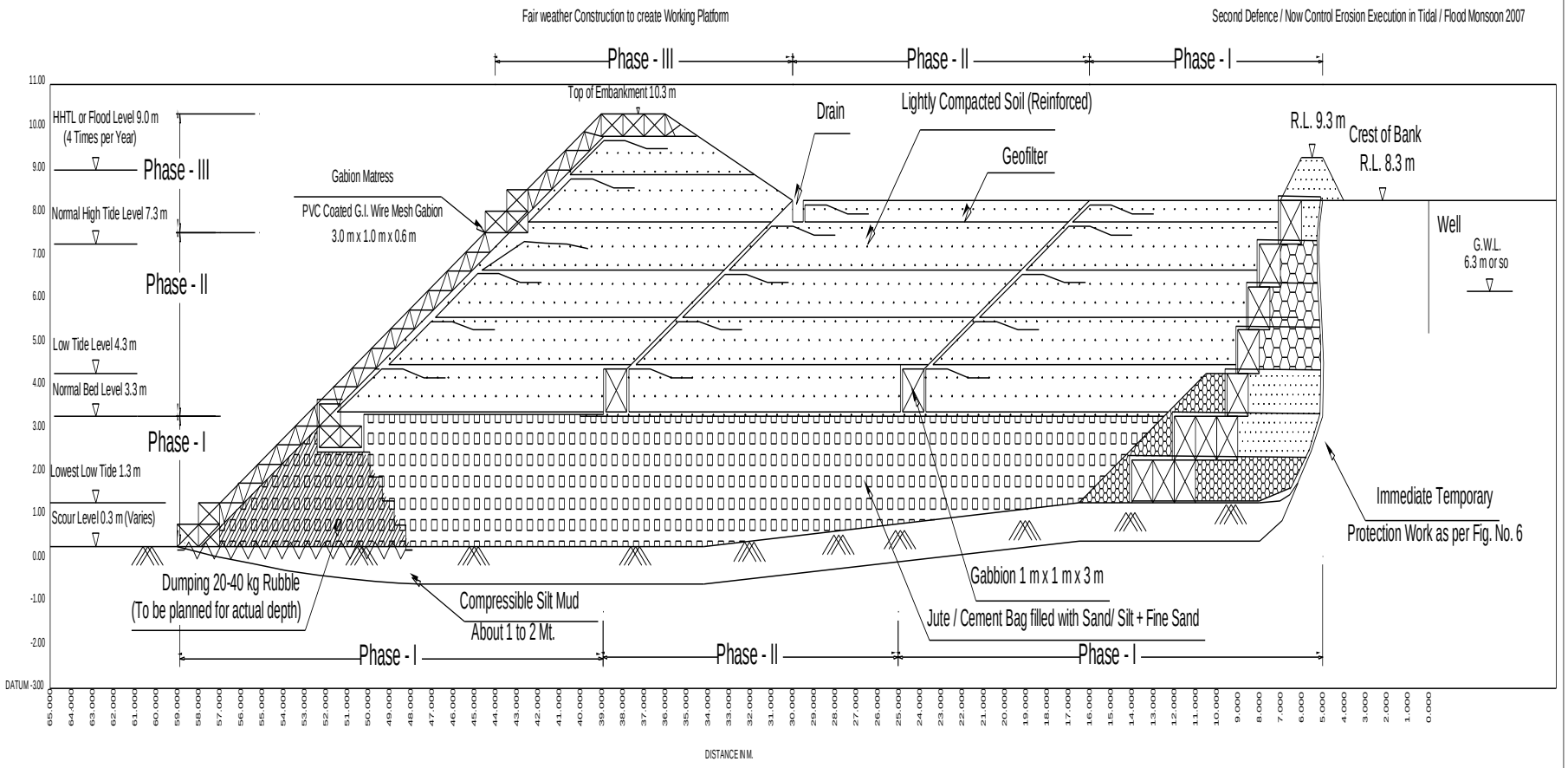
		Drg No: MDD/ONGC ANK/ 03
		EFGE CONSULTANT
		Dr. M.D. Desai
		West City Light Area, Surat.
		Ph: (0261) 2225686
Rev. No.	Date	

Fig. No: 3 - Estuary of Dhadhar River

SCALE : NTS

Fig. No: 4 - Settelite Image of Dhadhar Estuary

		Drg No: MDD/ONGC ANK/ 03
		EFGE CONSULTANT
		Dr. M.D. Desai
		West City Light Area, Surat.
		Ph: (0261) 2225686
Rev. No.	Date	

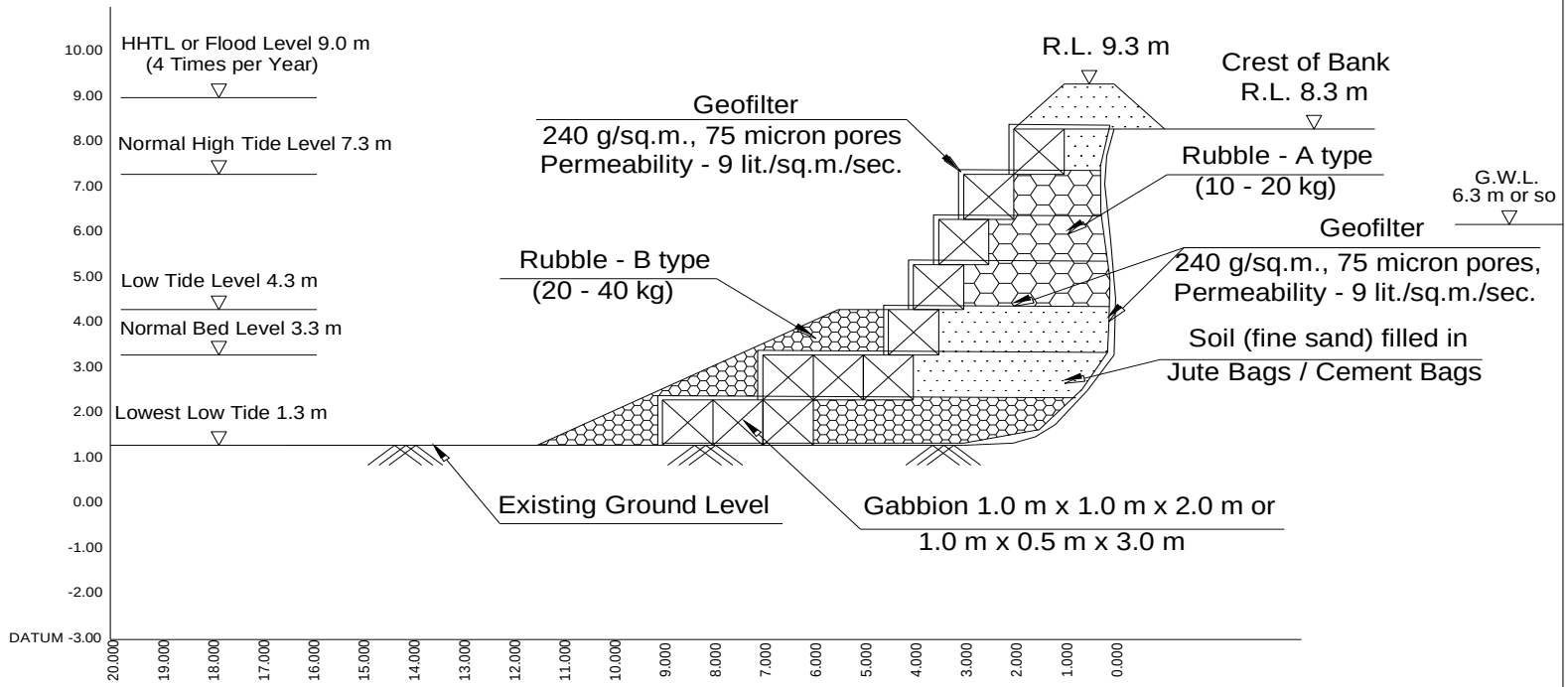


SCALE : 1 : 100

Note: All elevations are Chart Datum Elevation not GTS

Fig. No: 5 - Typical Section showing proposed treatment for well about 5 m away from bank.

Rev. No.	Date	Drg No: MDD/ONGC ANK/ 05
		EFGE CONSULTANT
		Dr. M.D. Desai
		West City Light Area, Surat.
		Ph: (0261) 2225686



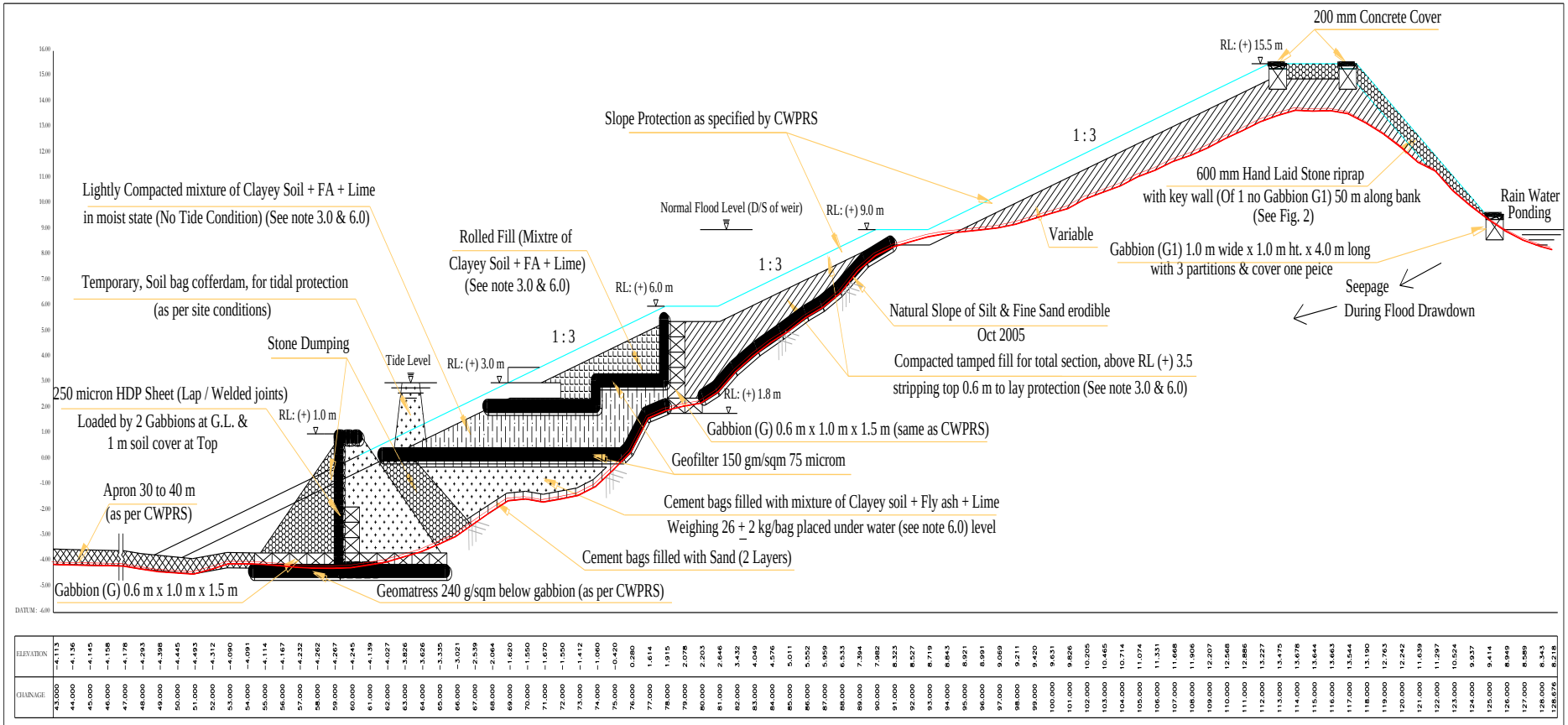
Note: 1. All elevations are Chart Datum Elevation not GTS.
2. Site Geomertry - As supplied by Client.
3. Tide data - Based on CWPRS Report.
4. As discussed on phone on 3/7/07 considering cost, time of construction and short term measures (to be covered by permenant measure) chain link fabricated gabions above R.L. (+) 3.3 m. Wrapover geofilter will be protected by soil bags at gabions end.

SCALE : 1 : 100

		Drg No: MDD/ONGC ANK/ 06
		EFGE CONSULTANT
		Dr. M.D. Desai
		West City Light Area, Surat.
		Ph: (0261) 2225686
Rev. No.	Date	

Fig. No: 6 - Typical Section showing Temporary Protection work for immediate actions.

SMC Bank Prot, Erosion Control, (2006)



CROSS - SECTION (N= 13825)

Notes:

1.0 Soil profile in bed RL (+) 2.0 to 0.0 m clay soil in soft to medium consistency (Nc = 5), RL 0.0 to (-) 6.0 m SM-SW (Ns = 8)
2.0 Construction of rock fill dam at toe under low tide level is followed by fill over exposed left bank
3.0 Finishing cover protection apron as per CWPRS recommendations laid after stripping compacted fill
4.0 Gabbion G- Same as CWPRS Specification
5.0 Gabbion G1- 1 m x 1 m x 4 m, 3 partition, single top cover (1 m x 4 m), mechanically woven GI wire, having 100/120 mm opening (approx. dia of opening 100 mm), wire dia 3 mm or more, lessing wire dia 2.7 mm or more with tensile strength 350 kN/sq.mm. @ 10 % elongation. Top will be covered wih 200 mm thick 1:2:4 coping.
6.0 Mixtuer for fill in cement bags and compacted layers can prepared in 230 mm thick soil layer mixed with Flyash 60 kg/sqm area and Lime 20 kg/sqm area spreaded on soil, placed at 20 to 25 % water content,
7.0 Fill above water level compacted by roller. Compacted soil shall have 95 % compaction (Light). 2 Layers of 230 mm at every 3.0 m height of the filling above RL (+) 3.5 m will be made of soil be same as described in note 6.0.

Scale: N.T.S.

For Detailing See Fig. 2
Pin between Gabbion, Soil Gabbions, Soil
Gabbion 2" Pipe or wood 1 m long

Note:
CWPRS above RL (+) 5 wiremesh Gabbions 0.6 x 1.0 x 1.0
Below RL (+) 5 under water rope Gabbions Same size
Slope 1:4, Change by CWPRS 1:3

Fig 1: Typical Section Showing Construction Plan for Slope Protection (as per CWPRS) at Bharimata (Left Bank) Surat.

MDD/2006/03/Fig. 1

Rev. No.	Rev. Date	Ph: (0261) 2225686
02	09/01/06	EFGE Consultants
01	31/12/05	Dr. M. D. Desai

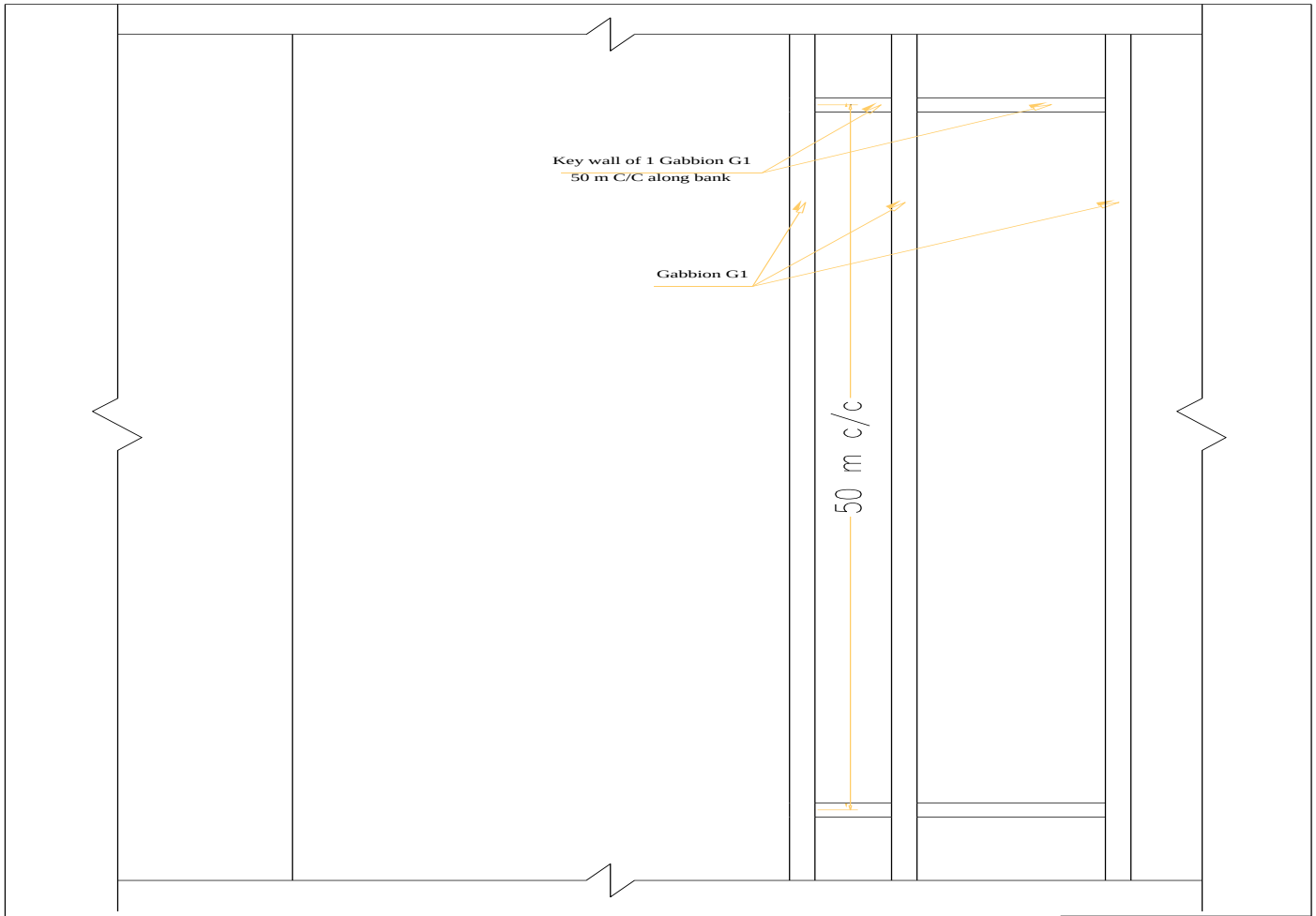
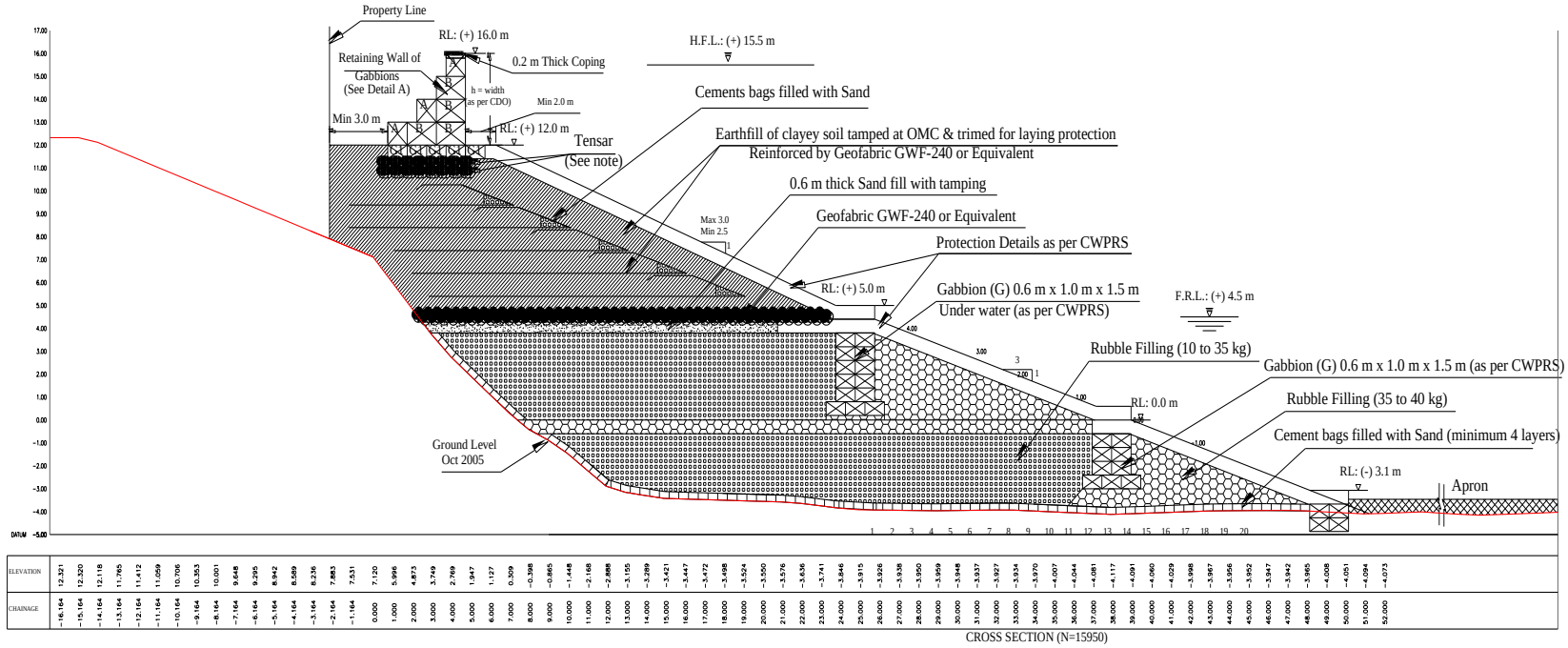


Fig 2: Plan showing arrangement of Key wall with 600 mm Stone Pitching.

MDD/2006/03/Fig. 2
EFGE Consultants
Dr. M. D. Desai
Ph: (0261) 2225686



CROSS SECTION (N=15950)

Notes:

1.0 Design for low probability HFL (+) 15.5 m RL, retaining wall top RL (+) 16.0 m, specified by GOG.

2.0 Stabilised clay in bags of cement were replaced by stone considering cost, time for construction & non availability of borrow pit for soil.

3.0 Fill above water level tamped by plate compactor / frog hammer (it is not practically possible to use static roller). Compacted soil will have 95 % compaction (Light) and will be strengthened by Geofabric.

4.0 The filling will be completed and then excavation for the foundation of wall and protection work will be executed for safety of property nearby.

5.0 Gabbions for retaining wall are mechanically woven GI wire, having 100/120 mm opening (approx. dia of opening 100 mm), wire dia 3 mm or more, lessing wire dia 2.7 mm or more with tensile strength 350 kN/sq.mm. @ 10 % elongation. Top will be covered wih 200 mm thick 1:2:4 coping. Theses gabbions will be staggered in plan & elevation. Filling will be in layers of concrete (1:3:6 concrete in 100 to 200 mm thick layer) & Stones (200 to 250 mm thick layer). Maximum size of aggregate to be used in concrete will be 10 mm.

6.0 As per CDO recommendations, the width of wall will be equal to height of wall and at foundation level Tensar in 2 layers will be provided.

7.0 Tensar Grid will be SS 20, 3.8 m wide, 50 m long, strength 14 kN/m length, mesh opening 39 mm. Width of Tensar Grid will be (width of foundation + 0.5) m. The first Tensar will be placed below 200 mm thick aggreagte (< 40 mm size) layer at founation level, then 400 mm thick rubble layer will provided. Below rubble layer second Tensar will be placed with 100 mm gravel.

8.0 For protection against vandalism exposed mesh will be gunnited, if required.

9.0 Gabbion G- Same as CWPRS Specification.

10.0 Gabbion G1- 0.6 m x 1 m x 3 m, 2 partition, single top cover (1 m x 3 m) filled with layers of a) 100 mm thick 1:3:6 concrete & b) 250 mm rubble.

11.0 Gabbion A- 1 m x 1 m x 3 m, 2 partition, single top cover (1 m x 3 m) filled with layers of a) 100 mm thick 1:3:6 concrete & b) 250 mm rubble, with 200 mm thick concrete layer at top.

12.0 Gabbion B- 1.5 m x 1 m x 3 m, 2 partitions, single top cover (1 m x 3 m) filled with layers of a) 100 mm thick 1:3:6 concrete & b) 250 mm rubble, with 100 mm thick concrete layer at top.

13.0 Design is typical and will be modified by site in-charge to needs of sites, slope, property line keeping overall safety in view.

14.0 The rain water of corridor at back of wall will be planned as there will be no weep holes in wall.

SCALE = N.T.S.

Fig 3: Schematic Diagram for Proposed Bank Protection Works at Payakwad (Wall resting on compacted earth fill)

Rev. No.	Rev. Date	
		MDD/506/40/Fig. 3
02	13/01/06	EFGE Consultants
01	31/12/05	Dr. M. D. Desai
		Ph: (0261) 2225686

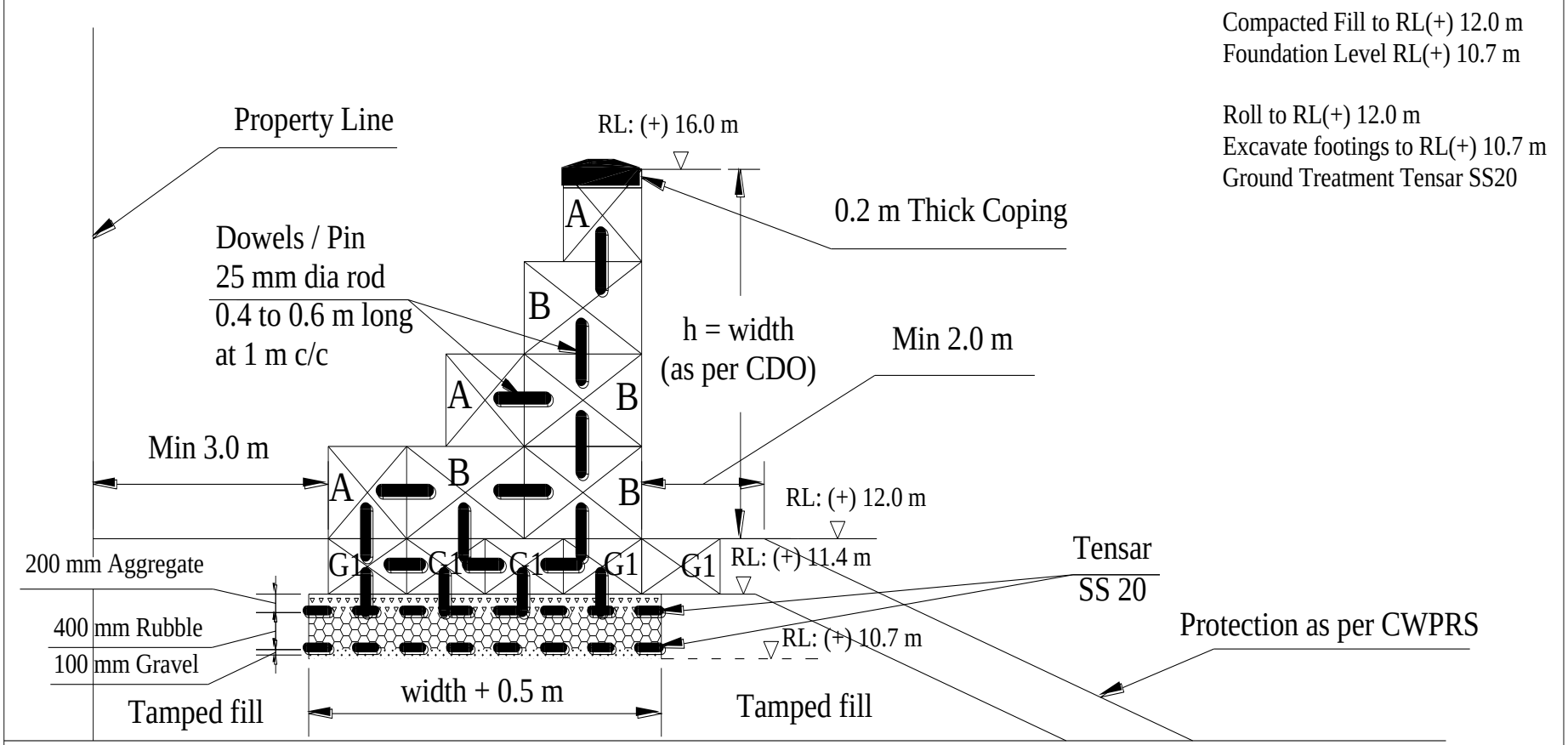


Fig. 3	Detail A	MDD/506/40/Detail A
		EFGE Consultants
		Dr. M. D. Desai
		Ph: (0261) 2225686


17 9:58

L & T RE WALL NH – R, FOUNDATION, (2008)

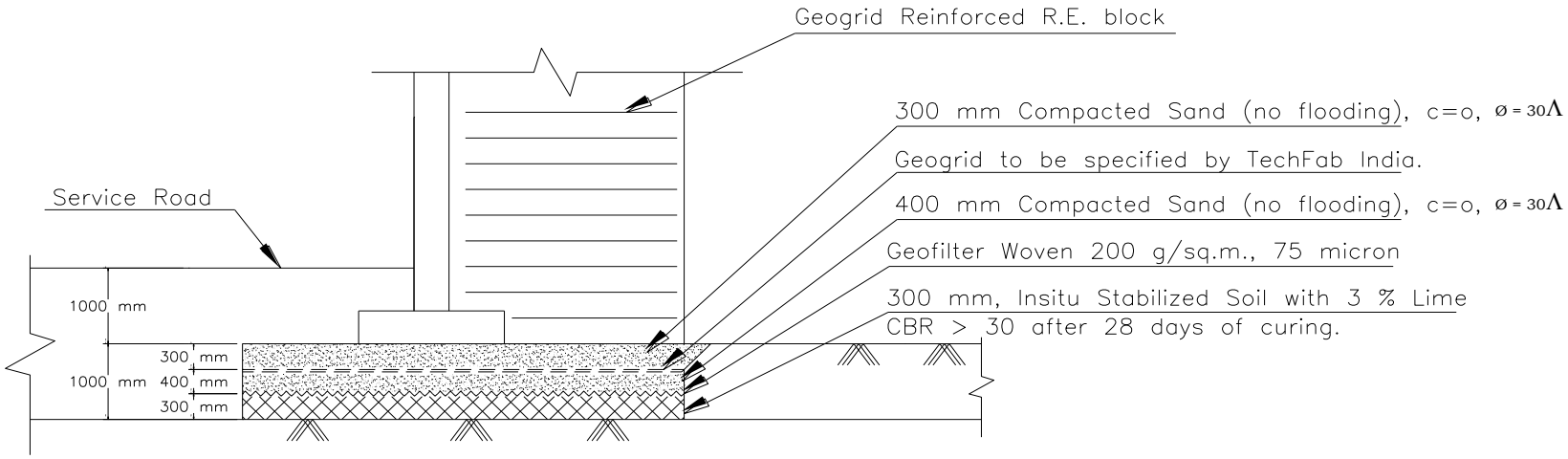


Fig. 1: Sketch showing ground treatment at Kapurai Cross Road.

MDD/L&T–RE WALL/Fig.1

EFGE Consultant
Dr. M.D. Desai
Ph: (0261) 2225686

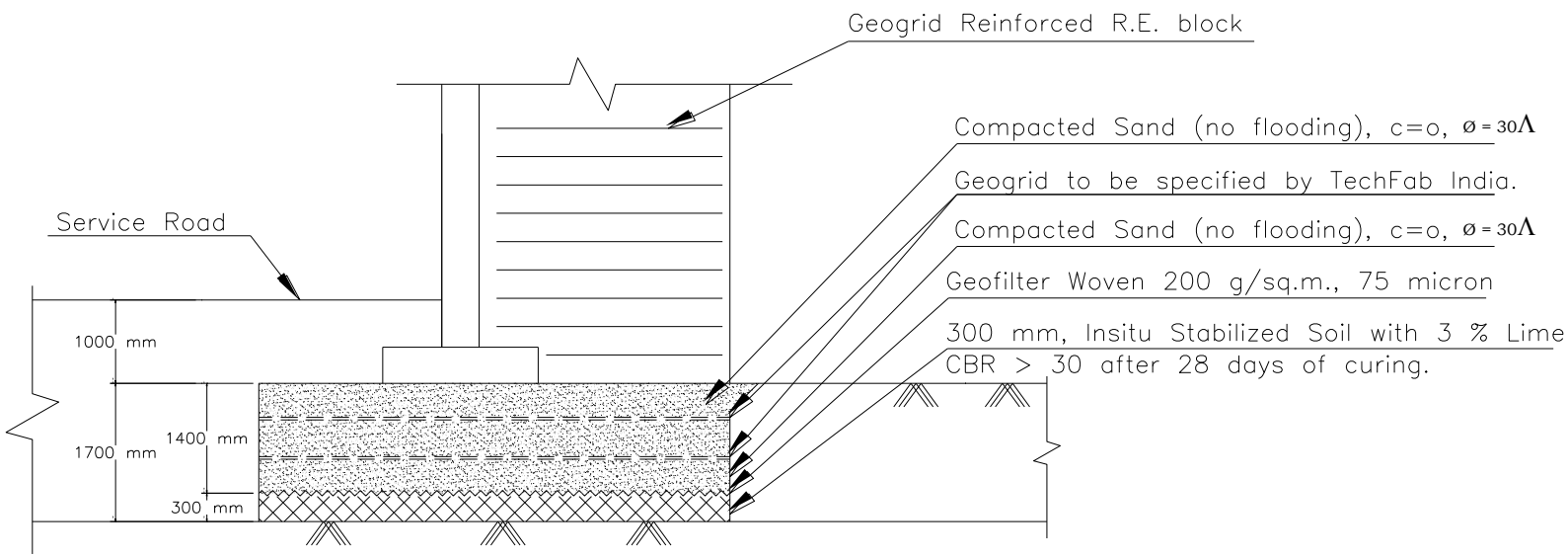
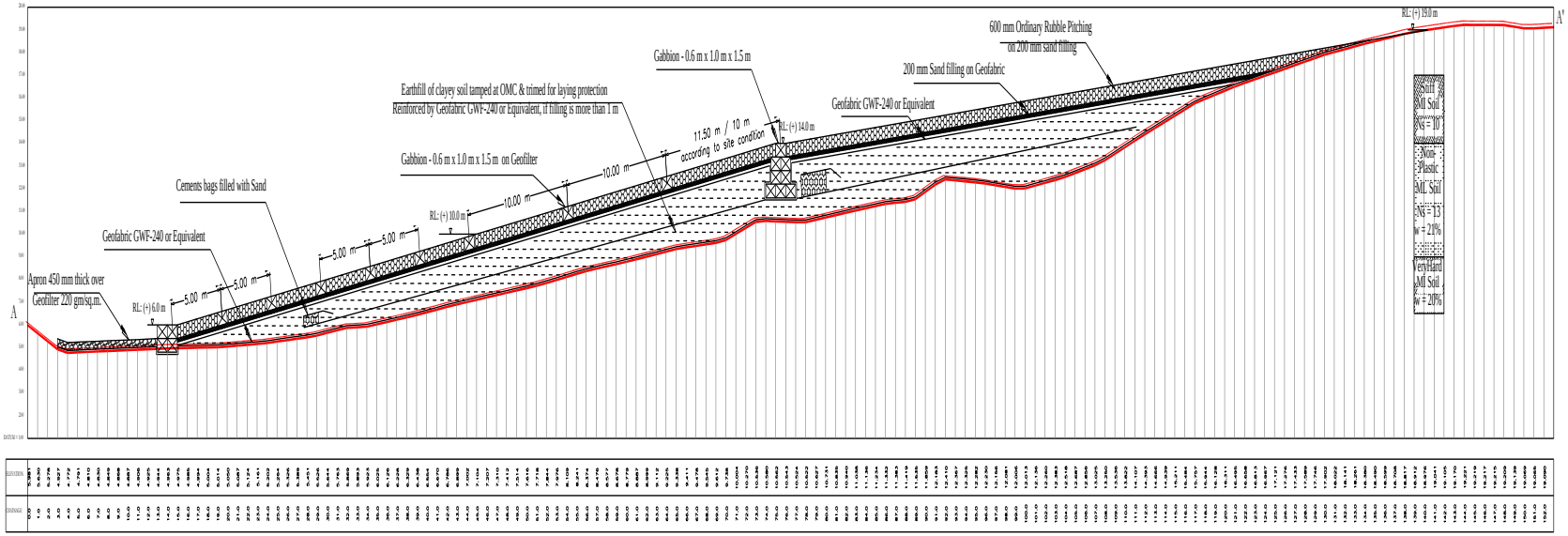


Fig. 2: Sketch showing ground treatment at Por Cross Road.

MDD/L&T–RE WALL/Fig.2

EFGE Consultant
Dr. M.D. Desai
Ph: (0261) 2225686

Reliance Pipeline Bank Protection (2007)



SCALE: 1 C.M. = 1.00 MT

CONSULTANT:	SURVEYED BY:
EFGE Consultant	UNIQUE SURVEYS
Dr. M.D. Desai	216, Bridge Road 6-F, Opp New Water Tank, New Estate Udhyognagar, Udhna, Surat – 394 210. Ph :- (0261) 2278205, 2278310
Ph: (0261) 2225686	SURVEYED BY: PRAVIN SONAR 98241 74683

Fig.2 Typical section A-A' showing proposed bank protection work at River Tapi, South Side, Reliance Pipe line Project

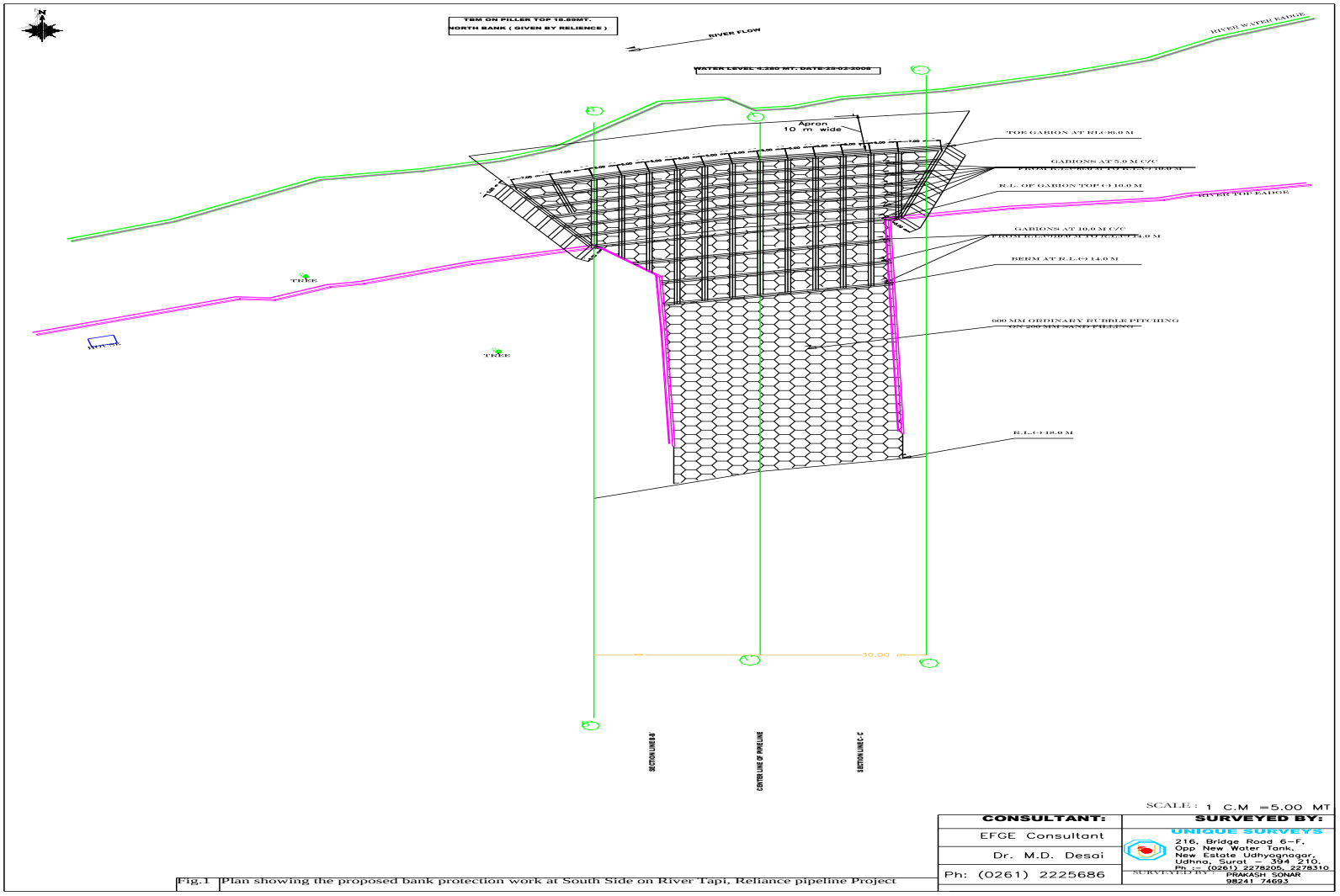


Fig.1 Plan showing the proposed bank protection work at South Side on River Tapi, Reliance pipeline Project

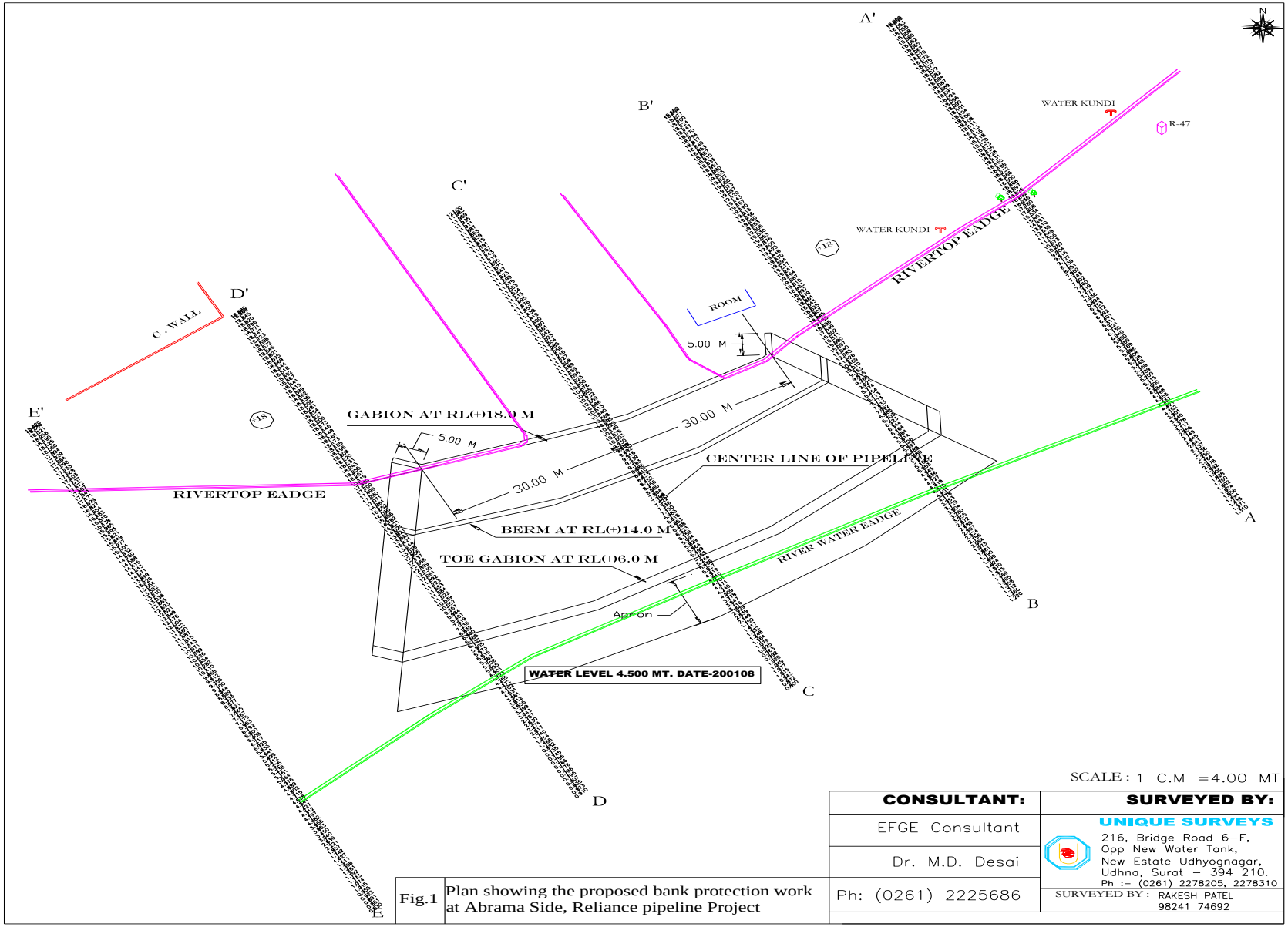
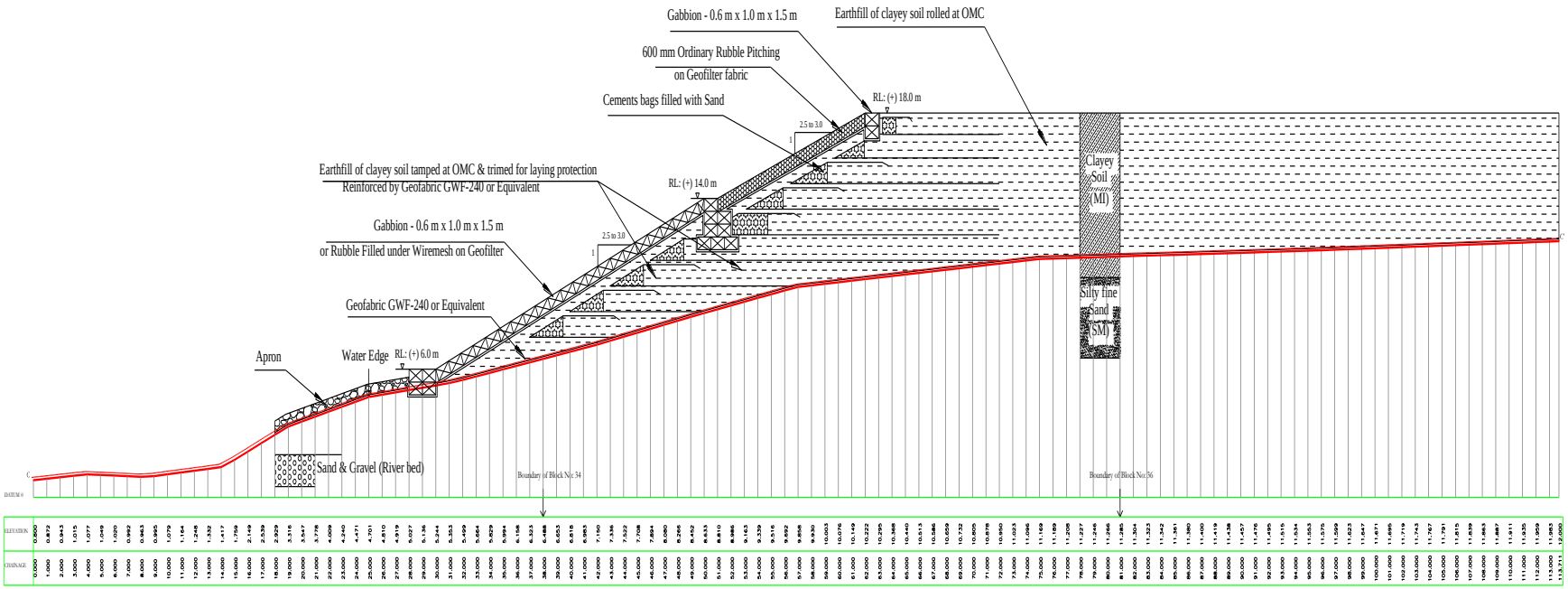


Fig.1 Plan showing the proposed bank protection work at Abrama Side, Reliance pipeline Project

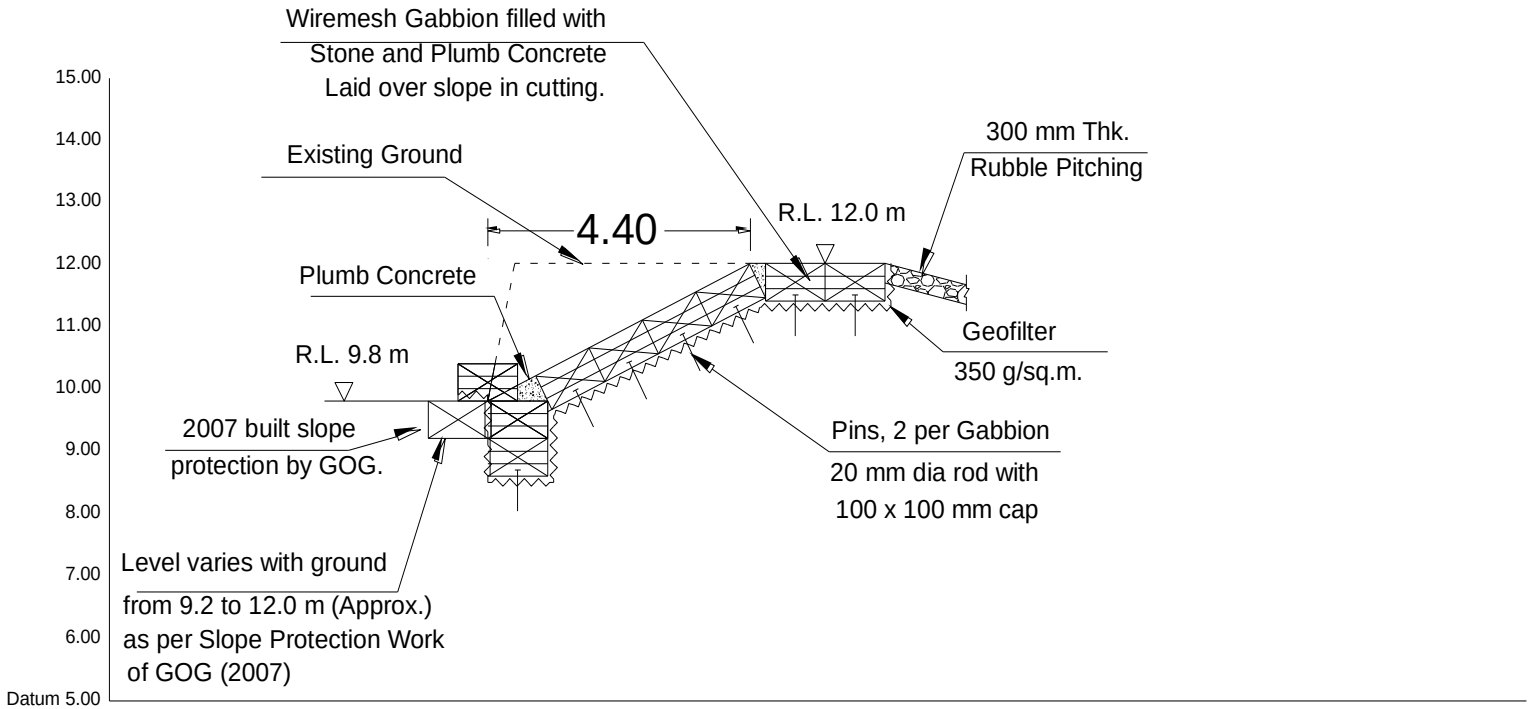


SCALE : 1 C.M =1.00 MT

CONSULTANT:	SURVEYED BY:
EFGE Consultant	UNIQUE SURVEYS 216, Bridge Road 6-F, Opp New Water Tank, New Estate Udhyognagar, Udhna, Surat - 394 210. Ph :- (0261) 2278205, 2278310
Dr. M.D. Desai	SURVEYED BY : RAKESH PATEL 98241 74692
Ph: (0261) 2225686	

Fig.2 Typical section C-C' showing proposed bank protection work at River Tapi, Abrama Side, Reliance Project

Reliance Pipeline Bank Protection (2007)



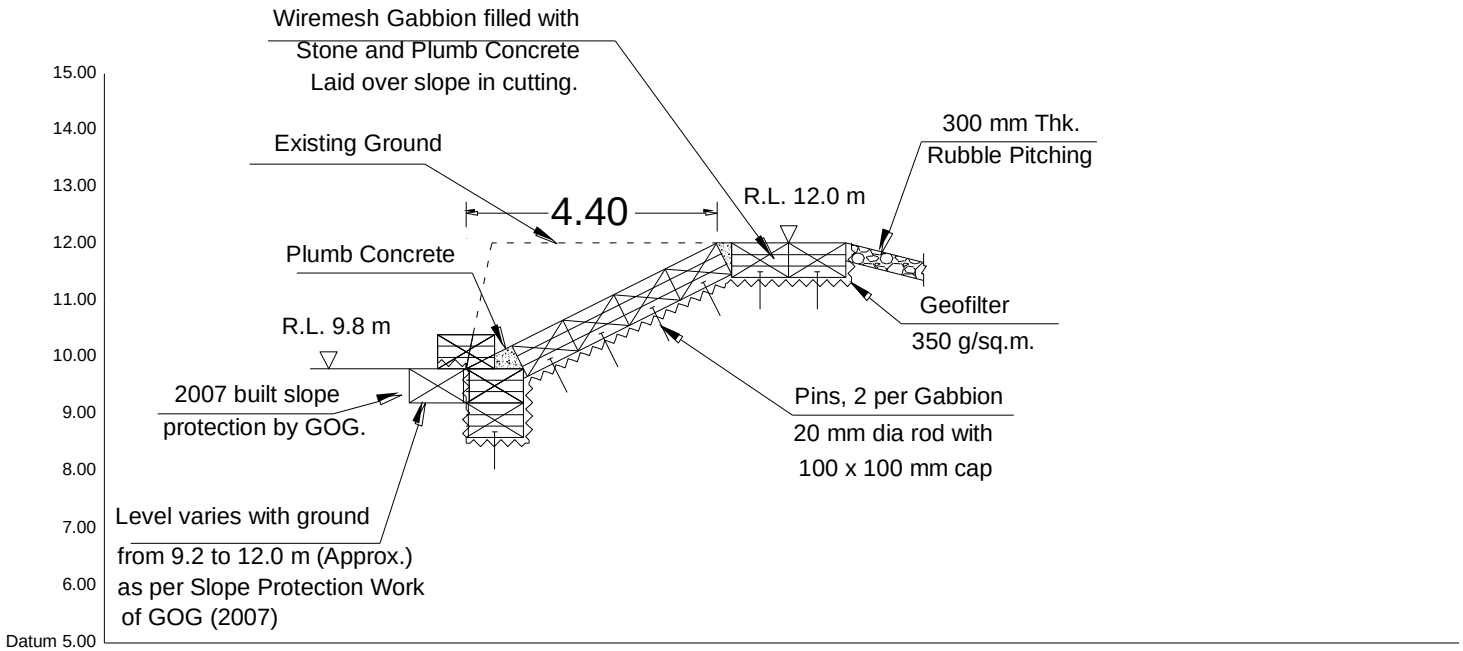
Note: 1. Excavation shall be dumped in adjoining low lying area of garden.
2. All irregular shapes shall be filled with large stones as per site condition.
3. See plan for Overlape & Anchor (Fig. 2)

SCALE : 1 : 100

		Drg No: MDD/Weir Garden/ 03
		EFGE CONSULTANT
		Dr. M.D. Desai
		West City Light Area, Surat.
Rev. No.	Date	Ph: (0261) 2225686

Fig. No: 3 - Typical Section showing Temporary Protection work for Garden in U/S of Weir at Singanpore.

SMC, WEIR LEFT BANK, GARDEN PROTCTION, (2007)



Note: 1. Excavation shall be dumped in adjoining low lying area of garden.
2. All irregular shapes shall be filled with large stones as per site condition.
3. See plan for Overlape & Anchor (Fig. 2)

SCALE : 1 : 100

		Drg No: MDD/Weir Garden/ 03
		EFGE CONSULTANT
		Dr. M.D. Desai
		West City Light Area, Surat.
		Ph: (0261) 2225686
Rev. No.	Date	

Fig. No: 3 - Typical Section showing Temporary Protection work for Garden in U/S of Weir at Singanpore.


17 9:58

THANK YOU

Germany Paper

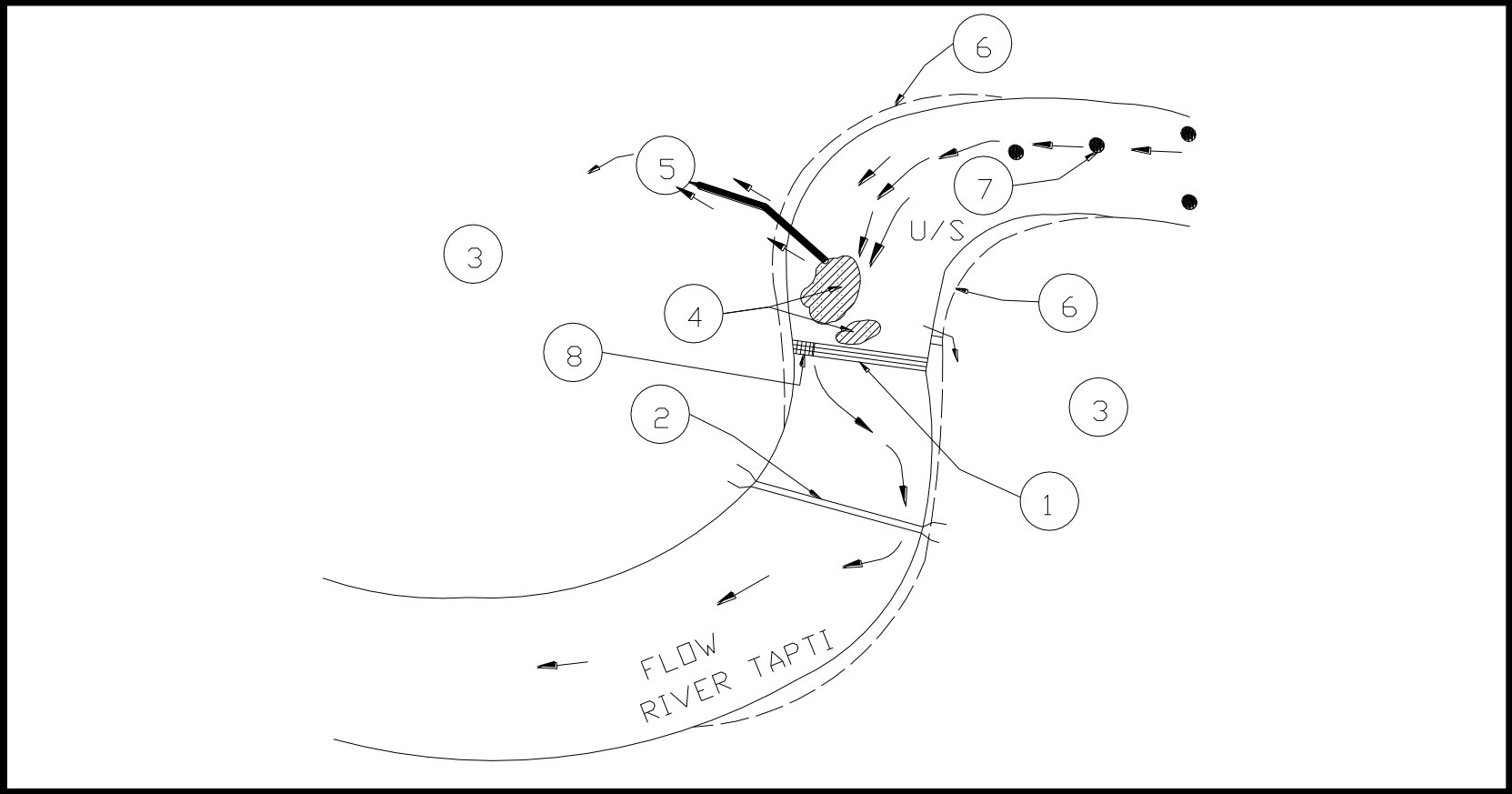


FIG 1: - Upstream of weir on River Tapti – Surat showing location of Typical Scour Pocket.

Legends: (1) Weir cum bridge, (2) Nehru Bridge, (3) City- Surat, (4) Scour Pockets, (5) Flood Breach 1998, (6) Flood Protection Dyke/Wall, (7) Hydraulic mining of sand from riverbed, (8) Auto gate Under sluice.

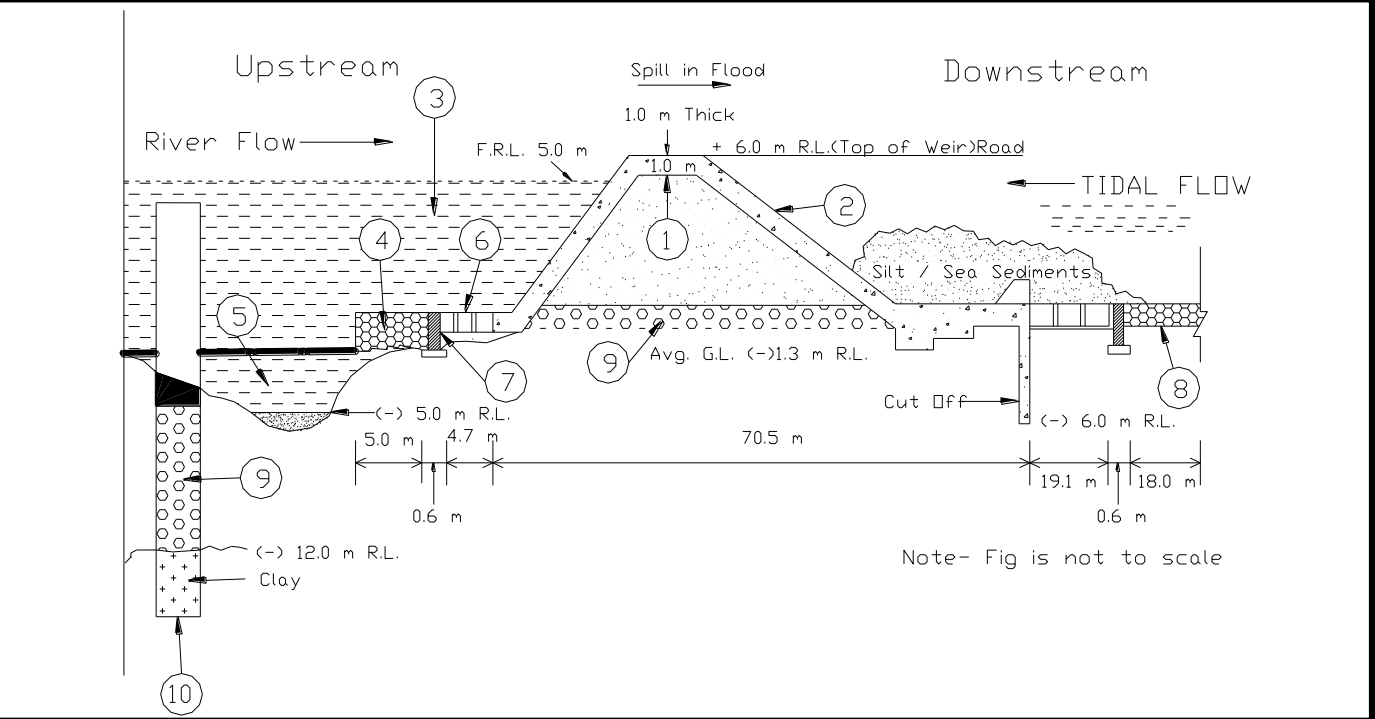


FIG 2: – Cross Section of Weir Bays-Showing probability of Piping (weir Surat)

Legends: (1) Sand fill, (2) C.C. weir floor & glacis, (3) Sweet water Pond, (4) Original loose stone Apron of stones weighing min. 40 Kg & size 300 mm upstream, (5) June ‘2000 Scour Pocket, (6) P.C.C. block, (7) R.C.C. toe wall, (8) Loose stone Apron, (9) Sand & Gravel (Bed Material), (10) Bore.

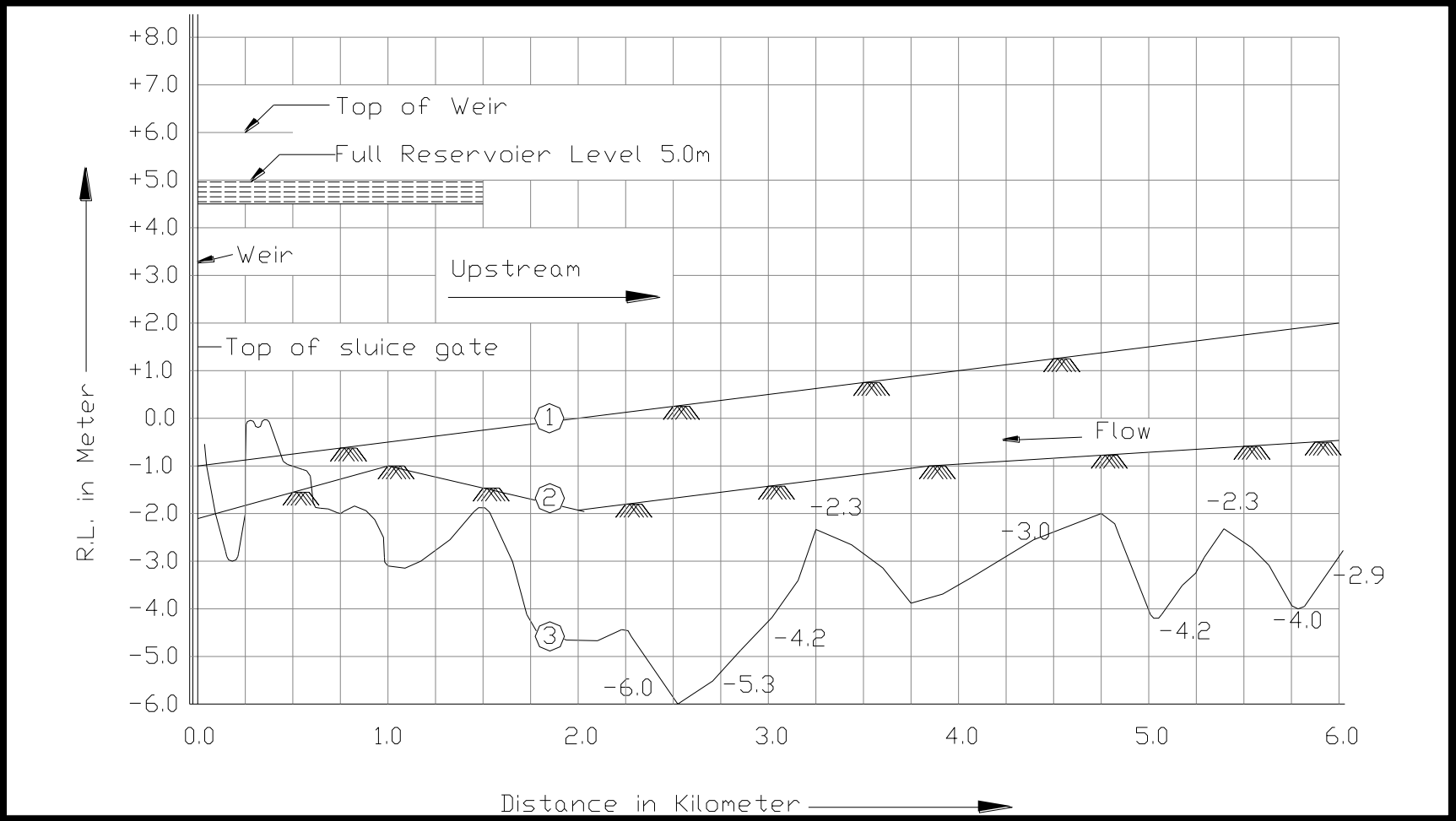


FIG 3: – River Channel Deepest Bed Profile Based On Surveys:
(1) Aprox. For 1990, (2) For year ’98, (3) For year 2000.

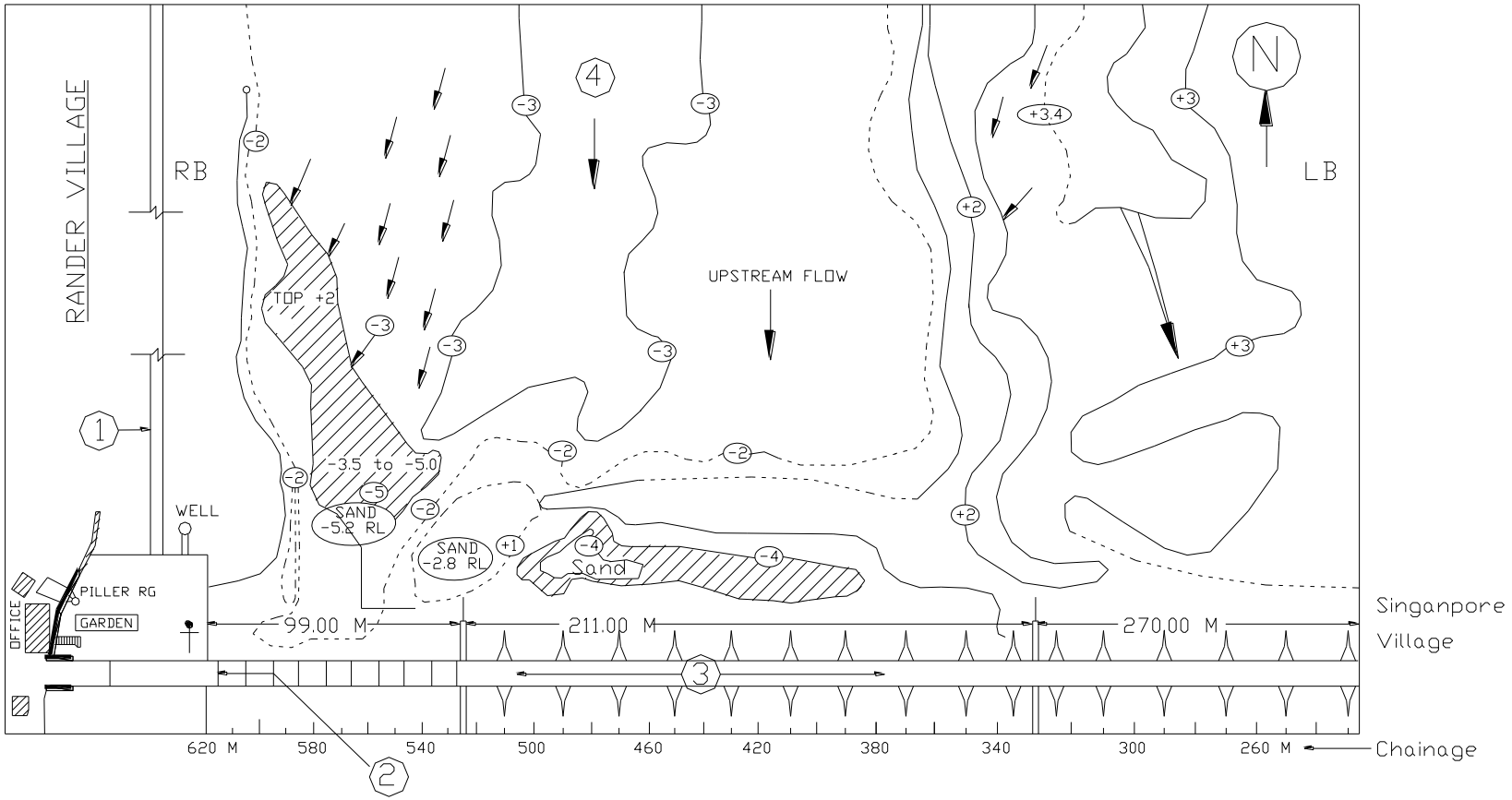


FIG 4: – Scour Pockets – Channel Formed At Upstream Of Weir, Surat.

Legends:

(1) Flood protection wall / Embankment, (2) Sluice Gate, (3) Weir Top, (4) Channel Formed by sand Mining in Upstream

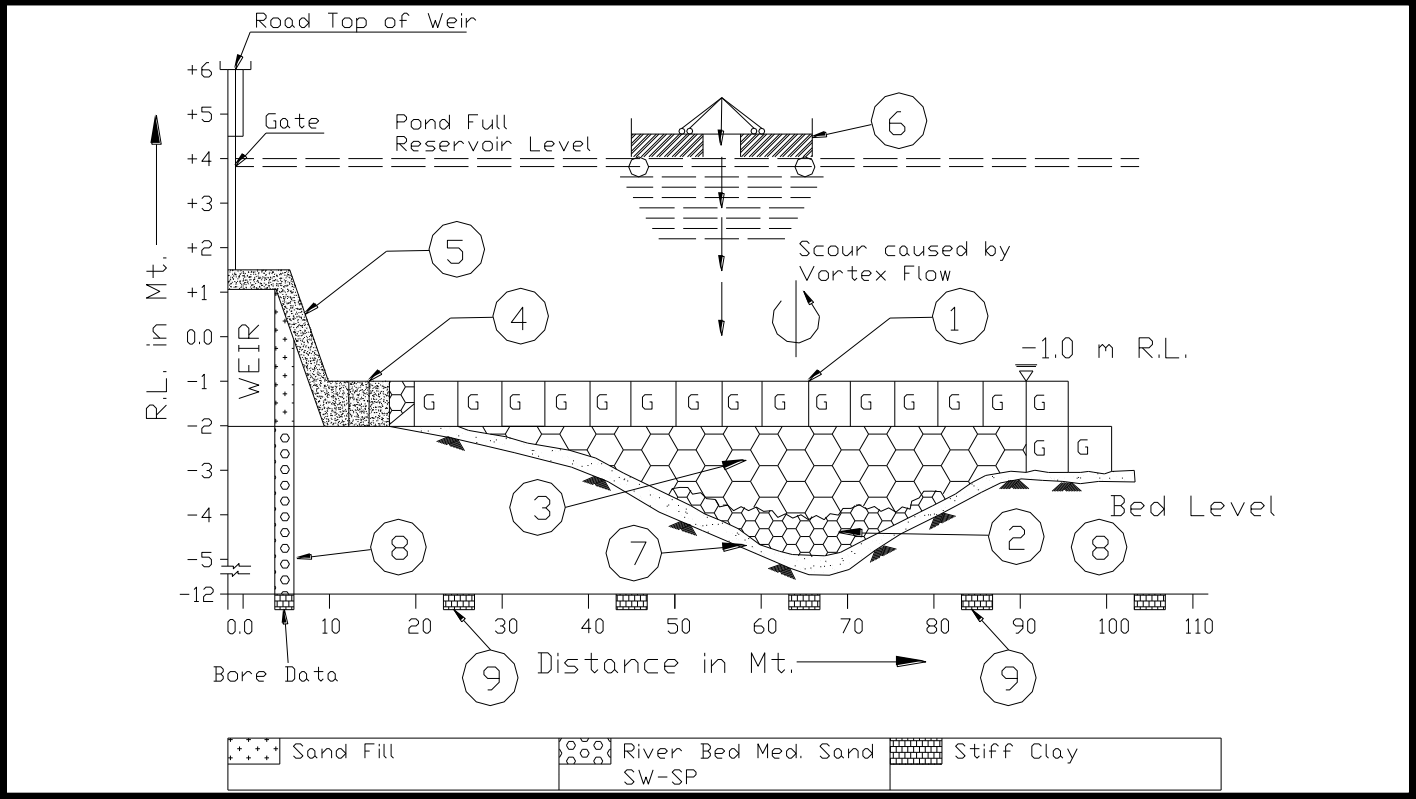


FIG 5: – Typical Cross-Section of Upstream Scour Hole Indicating,(A) Upstream concrete Top & Apron, (2) Proposed repairs

Legends: (1) Proposed Rope Gabions (G), (2) Stitched Geotextile filter bags filled with sand laid under water, (3) Dumped stone fill dropped from Pontoon, (4) Launching Apron (C.C. blocks & stone riprap),
(5) C.C. weir Floor, (6) Pontoon, (7) Silt (1.0 to 2.0 m deep), (8) Medium sand, (9) Stiff clay.

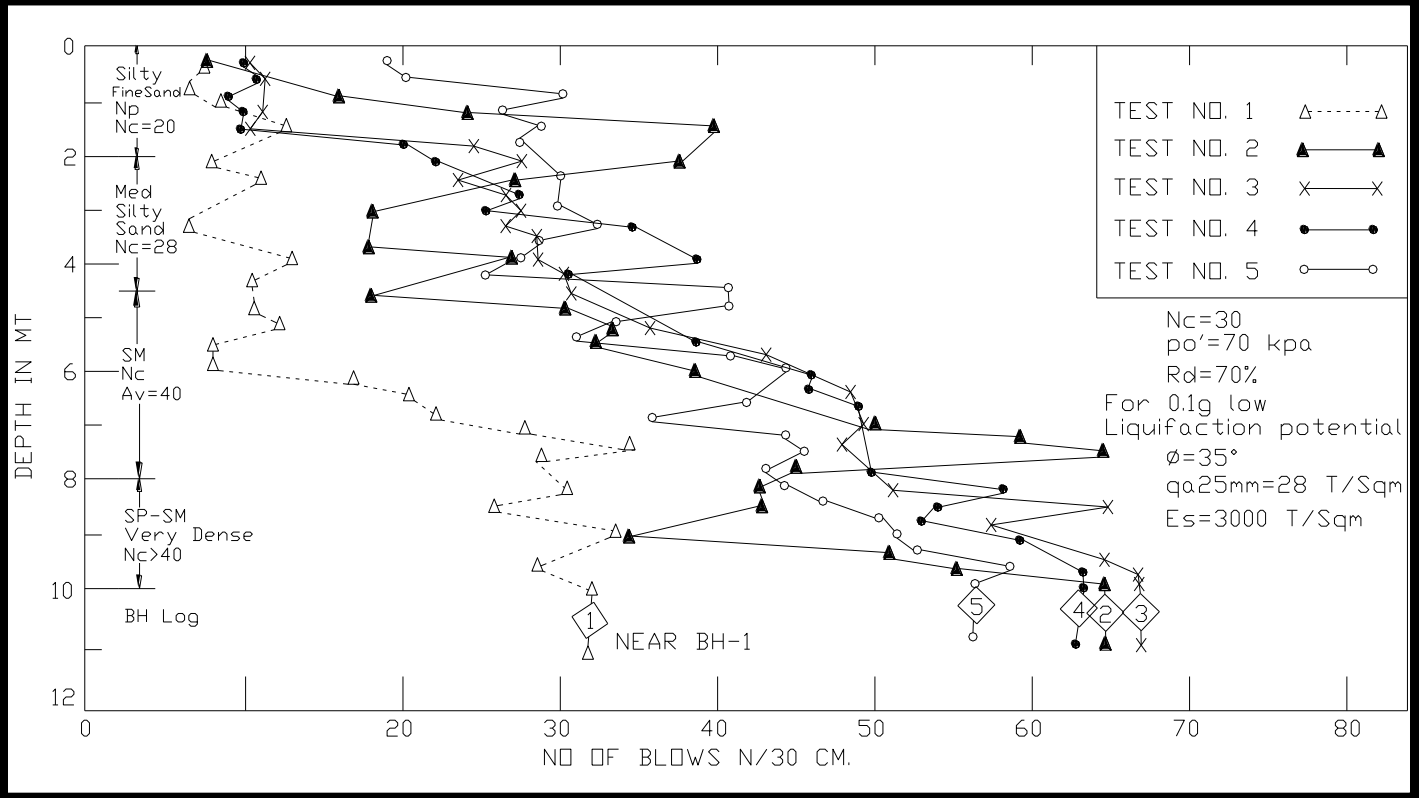
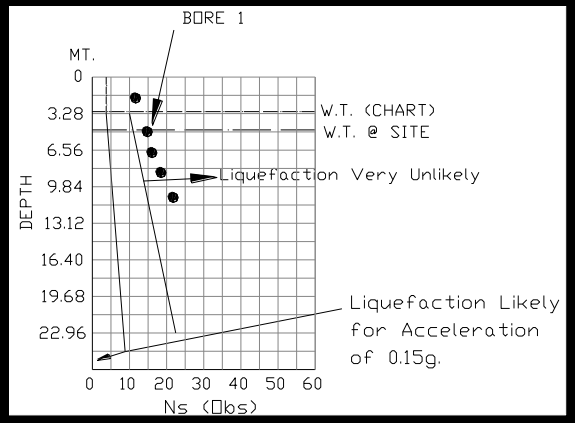


FIG 8 – Dynamic Cone Test Results For BH No 1-5.
(Ref. – DCPT DYN CONE-TEST BY AMIL LTD SEPT.2000)



Standard Penetration Resistance blows / 0.3 M.

	ρa' (KPa)	Obs N	Rd %	ϕ deg	N'	.qa 40 (KPa)	E (KPa)
Ns at 3m	50	12	65%	35°	30		
Ns at 6m	90	16	65%	35°	30	400	42000
Ns at 9m	130	20	68%	35°	35		

Rd – Relative Density (%), ϕ - Friction angle (Deg), N' – Corr. N for surcharge, .qa 40 - permissible stress for 40 mm settlement, E – deformation modulus

Fig 9 – Liquefaction Potential Evaluation Chart For Sand With Water Table At Depth Of About 3.0 M.

(REF. ASCE-M9-PAPER 1269 SEPT.1971, DATA FOR AKSHRDHAM (GEOTECH EXCEPT BORE 1)

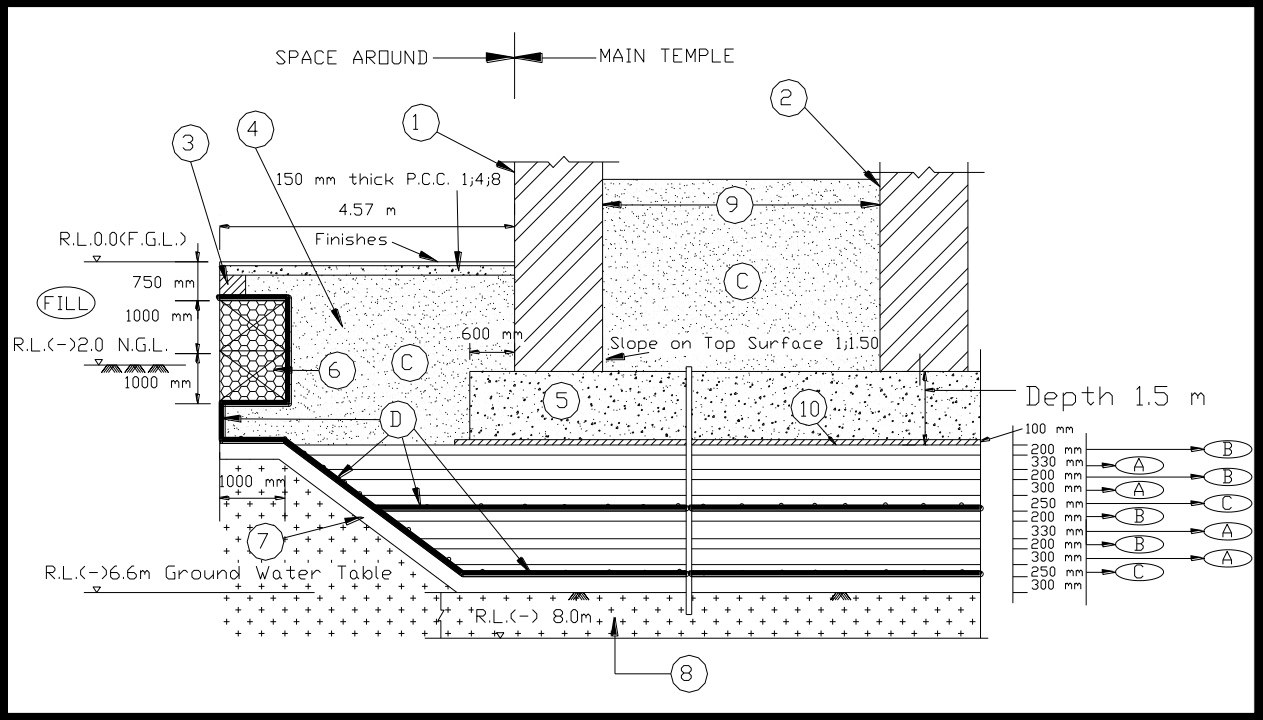


FIG 10: - Flexible Foundation System – Typical Section

Legends:(1) Face of outer plinth wall (2) Outer face of inner plinth wall (3) 345 mm thick brick wall (4) Compaction on either side of gabion wall carried out simultaneously to ensure that gabion does not act as retaining wall (5) Fiber reinforced PCC 1:2:4 (6) Gabion wall 2m High (7) Compacted Thick stone soling (8) Insitu sand compacted by 10 T pneumatic tyred roller to density 1580 Kg/ Cu.m. (9) Monument foundation of hexagonal cell of brick masonry (Special bricks of 120 Kg/Sq.cm. strength) (10) 100 mm thick P.C.C. 1:4:8.

(A) Boulders (size not less than 175mm) with smaller in filling stones and quarry spoil/stone screening rolled with 10 T roller eight times, (B) Boulders (size 90mm – 40mm) with smaller in filling stones and quarry spoil/stone screening rolled with 10 T roller eight times, (C) Compacted sand, (D) Geocomposite (1) Geonet (rope mattress)-(8mm dia @ 150 c/c) (2) Geofilter (40 gm / Sq.m –220)