

(By facsimile)

Ref. No. : GSIDC/Engg/Works/877/5461

6th December 2017

To
✓ **The Executive Engineer,**
Mormugao Port Trust
Headland, Sada,
Goa- 403804

मर्मुगाओ पोर्ट ट्रस्ट
Mormugao Port Trust
मुख्य अभियंता का कार्यालय
Office of the Chief Engineer
दिनांक
Reg. No. 4611 8/12/17

[Handwritten signature]
11/12

Sir,

Sub.: Demolition of old existing jetty & Reconstruction of New Captain of Ports Jetty at Old Goa & Panaji. Reg. Soil Investigation data.

**Ref.: 1. Letter no. CE/Works/IWAI/2017/5172 dated 15/11/2017.
2. Letter no. CP/HSO/245/5266 dated 22/11/2017.**

With reference to above cited letter, please find enclosed herewith soil investigation data for Captain of Ports jetty at Panaji and Captain of Ports Jetty at Old Goa was submitted by Consultant, M/s. Daftary Descon Engineering Pvt. Ltd. for your further needful.

Thanking you,

Yours faithfully,

[Handwritten signature: S. Sangodkar]
(Sudesh Sangodkar)
Dy. Manager (Civil)

Encl.: As above.

Copy to :

- The Captain,**
Captain of Ports Department,
Dayanand Bandodkar Road,
Panaji, Goa.



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JOB NO.G4.026: S.I. PROPOSED JETTIES AT PANAJI, BRITONA, OLD GOA. JAN. '07

REPORT

**SOIL INVESTIGATION
FOR PROPOSED
EXPANSION OF
CAPTAIN OF PORT JETTIES
AT
OLD GOA, BRITONA & PANAJI
GOA.**

CLIENT

**M/S. CONSTRUMA CONSULTANCY PVT. LTD.
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KHAR (WEST), MUMBAI – 400052.**

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OLD GOA

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(A) CHEMICAL ANALYSIS RESULTS OF SOIL SAMPLE

Sr. No.	BH No.	Sample No.	Depth below BL (m)		Chemical analysis results		
			From	To	pH	Chloride as Cl (%)	Sulphate as SO ₃ (%)
1	1	1	1.60	2.20	6.80	0.23	0.85

(B) CHEMICAL ANALYSIS RESULTS OF WATER SAMPLE

Sr. No.	BH No.	Sample No.	Depth below water surface (m)	Chemical analysis results		
				pH	Chloride as Cl (mg/l)	Sulphate as SO ₄ (mg/l)
1	River water	--	1.00	7.75	18410	2925

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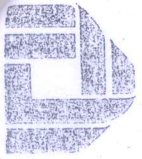
(A) CHEMICAL ANALYSIS RESULTS OF SOIL SAMPLE

Sr. No.	BH No.	Sample No.	Depth below BL (m)		Chemical analysis results		
			From	To	pH	Chloride as Cl (%)	Sulphate as SO ₃ (%)
1	1	1	1.60	2.20	6.80	0.23	0.85

(B) CHEMICAL ANALYSIS RESULTS OF WATER SAMPLE

Sr. No.	BH No.	Sample No.	Depth below water surface (m)	Chemical analysis results		
				pH	Chloride as Cl (mg/l)	Sulphate as SO ₄ (mg/l)
1	River water	--	1.00	7.75	18410	2925

FIG. NO. : CHEMICAL ANALYSIS RESULTS OF SOIL & WATER SAMPLES



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REPORT

1. SCOPE OF WORK

Captain of Port had built jetties at Old Goa, Britona & Panaji long back which have gone weak due to time & use and are not adequate for today's demand. Hence, Captain of Ports have proposed for expansion of jetties at these locations. This expansion is being done by GSIDC. GSIDC has appointed Construma Consultancy Pvt. Ltd. as Consultants for this expansion work of jetties. Hence, it was decided to do the soil investigation to know the founding strata for foundation design of COP jetty at Old Goa, Britona & Panaji.

The soil investigation consisted of drilling two boreholes at each site from existing jetty top upto and into the rock including conducting necessary field standard penetration test, laboratory tests and submitting report alongwith foundation recommendations

2. DRILLING AND FIELD TESTS

Drilling rig was erected on top of existing jetty at Old Goa & Panaji. However, timber ballies temporary platform was done at Britona.

Drilling was done by power operated rotary drilling rig with tungsten carbide and diamond bits. Depth of borehole at different sites is as under:

Site	BH no.	Depth below BL (m)
Old Goa	BH1	23.88
	BH2	21.70
Britona	BH3	24.04
	BH4	24.08
Panaji	BH5	22.88
	BH6	25.66

Water was circulated by pressure pump. Drilling was done by NX tungsten carbide core bit in overburden and by diamond bit in rock. 100mm / NX size casing was used in the drill hole to prevent collapse.

Standard penetration tests and undisturbed sampling were conducted at regular intervals. Soil samples from the split spoon sampler were collected in plastic bags as representative disturbed samples for visual classification. Site layout plan showing location of borehole is placed at fig. No.2, 10 & 17 respectively for Old Goa, Britona & Panaji jetty site. Borehole log in standard proforma giving different soil strata metwith, SPT - N values, details of sampling done etc. are placed sitewise.

Standard penetration test results and rock core recovery details are tabulated separately in standard tabular proforma and placed sitewise.



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3. LABORATORY TESTS

Laboratory tests were conducted on the samples collected depending upon the nature of the soil. These include field density and natural moisture content, Atterberg's limits, mechanical analysis, specific gravity, box shear and their results are placed sitewise.

Rock crushing strength test was done on soaked rock core samples and results are placed sitewise

Chemical analysis was also done on one soil and one water sample from Old Goa site for pH, sulphate and chloride contents and their results are placed at fig no.9.

4. SOIL / ROCK STRATA

The soil & rock profile as revealed by boreholes drilled is generally as below:

Strata	Site					
	Old Goa		Britona		Panaji	
	Thickness (m)	Av. SPT-N	Thickness (m)	Av. SPT-N	Thickness (m)	Av. SPT-N
a) Alluvial deposits Very soft, grey, marine clayey silt	4.10	<1	2.30 to 3.60	01 to 07	9.0 to 12.0	<1 to 18
b) Insitu strata: Red, brown, lateritic clayey silt with gravels & fragments.	3.4 to 4.9	9 to 21	11.0 to 12.90	17 to >50	4.50 to 6.0	10 to >50
c) Stiff to very stiff yellow, brown, grey, phyllitic clayey silt.	3.0	13 to 34	Nil	--	Nil	--
d) Brown, grey clayey silt (derived from highly weathered rock)	8.08 to 8.77	24 to >50	3.55 to 6.70	24 to >50	2.50 to 5	>50
e) Weathered soft rock.	Nil	--	0.87	>50	0.70 to 4.60	>50
f) Hard rock	18.58 to 20.77 below bed	--	20.10 to 20.87 below bed	--	20.70 to 22.60 below bed	--

Details of strata is given in borehole logs of each site placed in annexure.



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5. FOUNDATION RECOMMENDATIONS

Since rock is available at reasonable depth, it is feasible to adopt R.C. cast insitu pile foundations for the jetty extension. The piles can be bored and socketed in the hard rock. Chiselling can be done to socket the piles in rock.

The vertical load carrying capacity of the pile can be limited to crushing strength of concrete with adequate factor of safety.

For a typical case of 1000mm dia., M-30 concrete pile socketed in rock, the safe load in pile can be taken as 470 MT. For other dias; safe load can be estimated accordingly.

The piles will of course have to be designed for other lateral and berthing loads.

For DAFTARY – DESCON ENGINEERING PVT. LTD.

Manager



SARVESTI SINGH



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ANNEXURES



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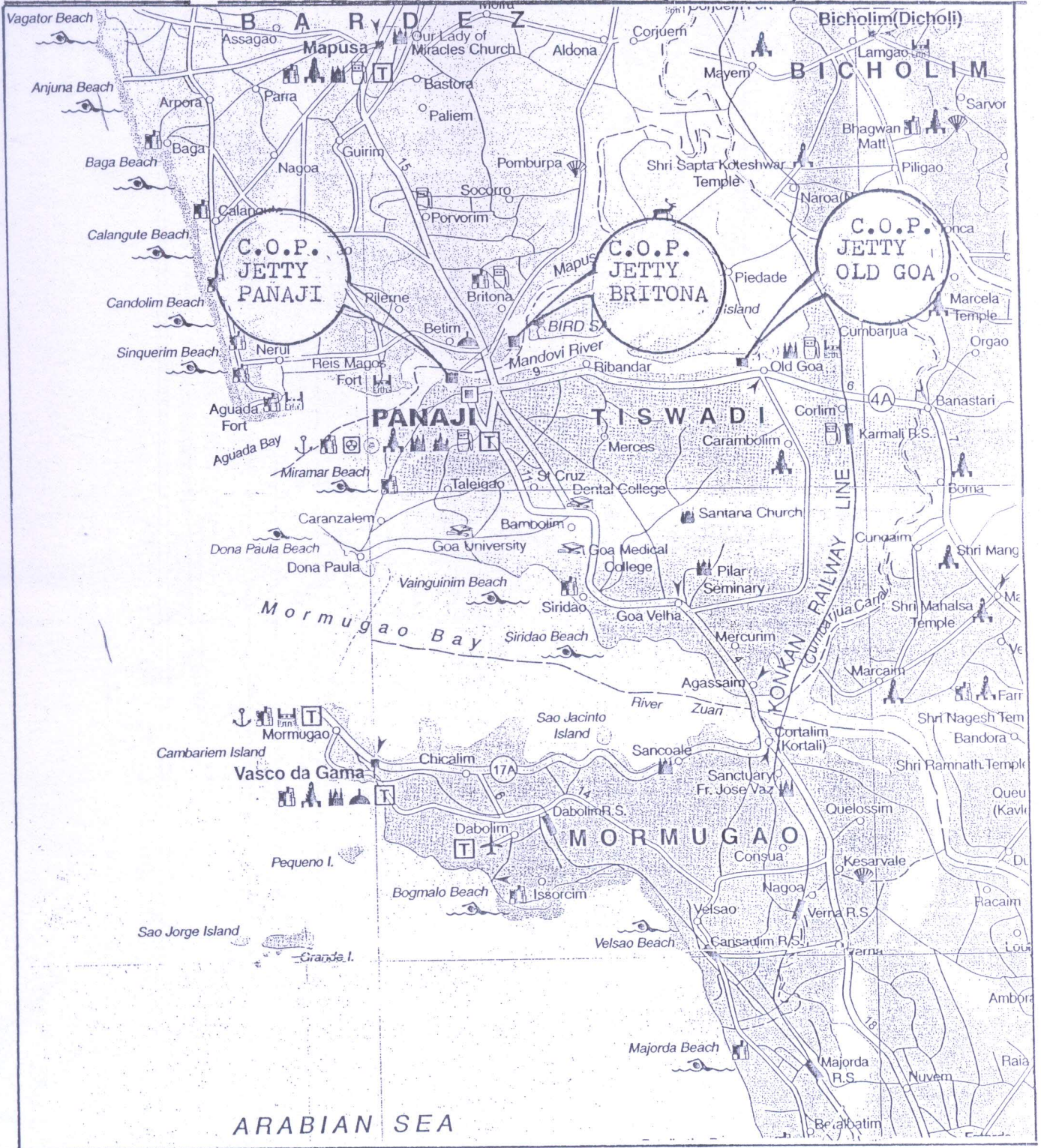


FIG. NO. 1 : GENERAL SITE LOCATIONS PLAN (NTS)

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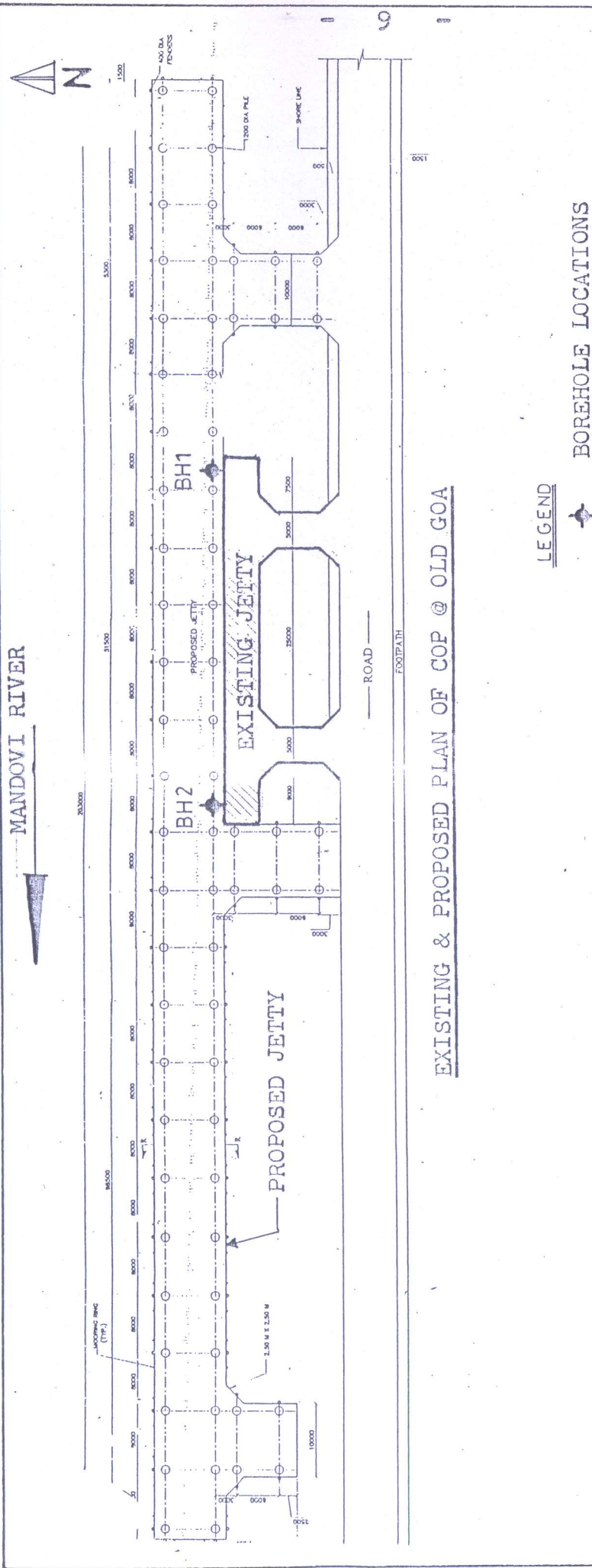


FIG.NO. 2 : SITE LAYOUT PLAN SHOWING BOREHOLE LOCATIONS (NTS)

FIG NO.4 : BOREHOLE LOG NO.2 (RIBANDER SIDE)

Date Of Start : 18/11/2006 Rotary Drilling : TC / diamond bit
Date Of Completion : 25/11/2006 Dia. Of Casing : 100mm / NX
Borehole Coords : Refer site layout plan Dia. Of Core : NX
Bed level : (-) 3.44m w.r.t. jetty top RL (+) 3.21m

Profile	Depth below BL (m)	Description	SPT N	Samples			Remarks	
				No.	Type	Depth (m)		
						From		To
		ALLUVIAL DEPOSITS						
X								
X		Dark grey, very soft marine clayey silt with some broken shells	<1	01	DP	01.60	02.20	
X	2.5	(CHICOL)	<1	02	DW	03.05	03.55	
							DP sample slipped.	
		INSITU STRATA						
X	5.0	Red, yellow, brown, grey, stiff to very stiff lateritic clayey silt with gravels & fragments.	18	03	DP	04.50	04.95	
X			16	04	DP	06.05	06.50	
X				05	UD	06.55	06.90	
X	7.5		13	06	DP	07.50	07.95	
X		Yellow, brown, grey, very stiff phyllitic clayey silt with some quartzitic fragments.	31	07	DP	09.00	09.45	
X	10.0			08	CB	09.45	10.50	
X			26	09	CB	10.50	10.95	
X								
X	12.5	Brown, grey, very stiff clayey silt (derived from highly weathered rock).	24	10	DP	12.05	12.50	
X			47	11	DP	13.50	13.95	
X				12	UD	14.00	14.35	
X	15.0							
X								
X								

LEGEND

DP : Sample From SPT Tube
DW : Wash Sample

UD : Undisturbed Sample
CB : Core Barrel Sample

FIG NO.5: STANDARD PENETRATION TEST RESULTS

SR. NO.	BH. NO.	DEPTH (M) BELOW GL		PENETRATION (CM)	CORRESPONDING NO. OF BLOWS	SPT N	REMARKS
		FROM	TO				
01	1	01.50	02.10	60	01	<1	
02	1	03.05	03.55	50	01	<1	
03	1	04.63	05.08	15	07		
				15	05		
				15	04	09	
04	1	06.00	06.45	15	11		
				15	09		
				15	10	19	
05	1	07.50	07.95	15	13		
				15	11		
				15	10	21	
06	1	09.05	09.50	15	05		
				15	06		
				15	12	18	
07	1	10.50	10.95	15	09		
				15	12		
				15	22	34	
08	1	13.50	13.95	15	08		
				15	14		
				15	27	41	
09	1	15.00	15.45	15	12		
				15	22		
				15	32	>50	
10	1	16.50	16.78	15	19		
				13	50	>50	Rebound from 32 nd blow.
11	1	18.00	18.29	15	22		
				14	50	>50	Rebound from 31 st blow.
12	1	20.05	20.12	07	50	>50	Rebound after 6 th blow.
13	2	01.60	02.20	60	1	<1	
14	2	03.05	03.55	15	01		
				35	01	<1	
15	2	04.50	04.95	15	04		
				15	07		
				15	11	18	

FIG NO.5: STANDARD PENETRATION TEST RESULTS

SR. NO.	BH. NO.	DEPTH (M) BELOW GL		PENETRATION (CM)	CORRESPONDING NO. OF BLOWS	SPT N	REMARKS
		FROM	TO				
01	1	01.50	02.10	60	01	<1	
02	1	03.05	03.55	50	01	<1	
03	1	04.63	05.08	15	07		
				15	05		
				15	04	09	
04	1	06.00	06.45	15	11		
				15	09		
				15	10	19	
05	1	07.50	07.95	15	13		
				15	11		
				15	10	21	
06	1	09.05	09.50	15	05		
				15	06		
				15	12	18	
07	1	10.50	10.95	15	09		
				15	12		
				15	22	34	
08	1	13.50	13.95	15	08		
				15	14		
				15	27	41	
09	1	15.00	15.45	15	12		
				15	22		
				15	32	>50	
10	1	16.50	16.78	15	19		
				13	50	>50	Rebound from 32 nd blow.
11	1	18.00	18.29	15	22		
				14	50	>50	Rebound from 31 st blow.
12	1	20.05	20.12	07	50	>50	Rebound after 6 th blow.
13	2	01.60	02.20	60	1	<1	
14	2	03.05	03.55	15	01		
				35	01	<1	
15	2	04.50	04.95	15	04		
				15	07		
				15	11	18	

FIG NO.5: STANDARD PENETRATION TEST RESULTS (CONTD.)

SR. NO.	BH. NO.	DEPTH (M) BELOW GL		PENETRATION (CM)	CORRESPONDING NO. OF BLOWS	SPT N	REMARKS
		FROM	TO				
16	2	06.05	06.50	15	05		
				15	12		
				15	04	16	
17	2	07.50	07.95	15	05		
				15	05		
				15	08	13	
18	2	09.00	09.45	15	04		
				15	12		
				15	19	31	
19	2	10.50	10.95	15	08		
				15	10		
				15	16	26	
20	2	12.05	12.50	15	12		
				15	10		
				15	14	24	
21	2	13.50	13.95	15	06		
				15	18		
				15	29	47	
22	2	15.05	15.50	15	03		
				15	06		
				15	14	20	
23	2	16.50	16.78	15	14		
				13	50	>50	Rebound after 33 rd blow.
24	2	18.10	18.22	12	50	>50	Rebound after 13 th blow.

FIG NO.6 : ROCK CORE RECOVERY DETAILS

BH. NO.	SAMPLE NO.		DEPTH (M)		DRILLING RUN (M)	CORE RECOVERED (M)	CORE RECOVERED (%)	R.Q.D.
	FROM	TO	FROM	TO				
1	15	20	20.77	22.10	1.33	1.33	100.00	74.43
1	21	23	22.10	23.35	1.25	1.25	100.00	93.60
1	24	28	23.35	23.82	0.47	0.37	78.72	Nil
2	17	27	18.58	19.80	1.22	1.15	94.26	23.77
2	28	35	19.80	21.44	1.64	1.63	99.39	80.50
2	36	38	21.44	21.70	0.26	0.26	100.00	57.69



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FIG.7: TABLE OF LABORATORY TEST RESULTS

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Sr. No.	Bore	From	To	Bulk	Dry	Moisture	L.L	P.L	P.I	Gravel	Sand	Silt	Clay	Gravity	Specific	Mechanical Analysis	Atterberg Limits	Field Density & Moisture Content	Depth	BOX SHEAR	REMARKS
1	1	5.08	5.43	1.82	1.49	21.8	33.0	26.2	6.8	2.0	28.5	69.5	2.68	1800	19.5						
2	1	12.05	12.40	1.91	1.61	18.8				6.5	21.5	72.0	2.73	2400	22.5						
3	2	6.55	6.90	1.86	1.51	23.4	36.5	28.4	8.1	0.0	26.5	73.5	2.70	2050	21.5						
4	2	14.00	14.35	1.88	1.61	16.5				5.0	18.5	76.5	2.71	2250	22.0						

--- Combined ---

Note: Shear tests are done on remoulded samples.

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Sr. No.	BH. No.	Sample No.	Depth Below GL		Dia. (D) (cm)	Length (L) (cm)	Rock Crushing Results (Soaked)			
			From (m)	To (m)			Load Applied (Kg.)	Actual Crushing Strength (Kg/cm ²)	$\frac{L}{D}$	Corrected Crushing Strength (Kg/cm ²)
1	1	16	20.77	22.10	5.4	10.8	16000	698.97	2.0	698.97
2	2	32	19.80	21.44	5.4	10.8	17500	764.50	2.0	764.50

FIG. NO.8 : ROCK CRUSHING STRENGTH TEST RESULTS (SOAKED)

(A) CHEMICAL ANALYSIS RESULTS OF SOIL SAMPLE

Sr. No.	BH No.	Sample No.	Depth below BL (m)		Chemical analysis results		
			From	To	pH	Chloride as Cl (%)	Sulphate as SO ₃ (%)
1	1	1	1.60	2.20	6.80	0.23	0.85

(B) CHEMICAL ANALYSIS RESULTS OF WATER SAMPLE

Sr. No.	BH No.	Sample No.	Depth below water surface (m)	Chemical analysis results		
				pH	Chloride as Cl (mg/l)	Sulphate as SO ₄ (mg/l)
1	River water	--	1.00	7.75	18410	2925

FIG. NO.9 : CHEMICAL ANALYSIS RESULTS OF SOIL & WATER SAMPLES