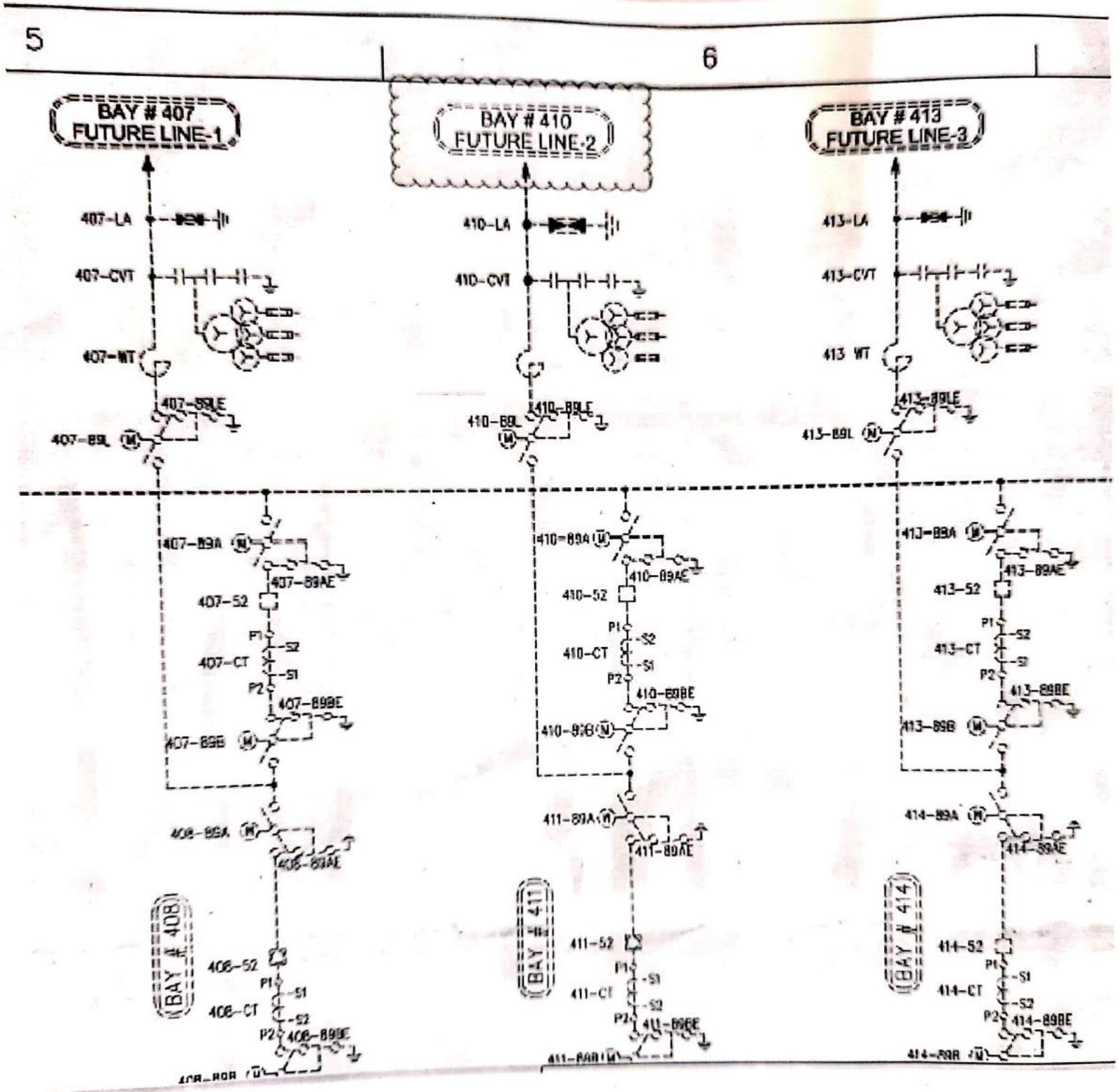
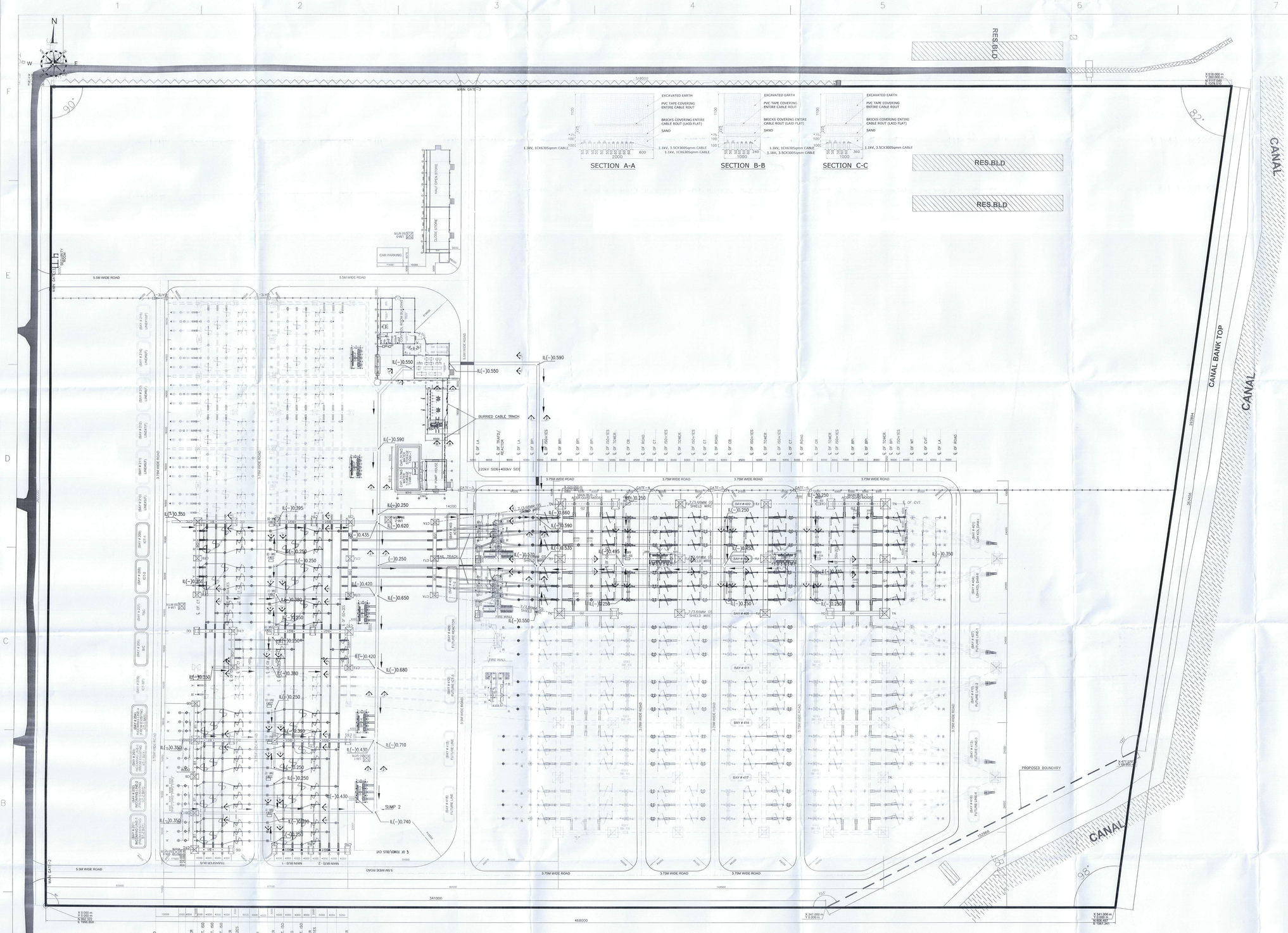


Bay No. 401

Bay No. 404

Bay No. 407

Bay No. 410 for line reactor

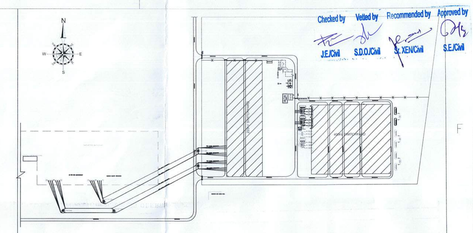


SECTION A-A

SECTION B-B

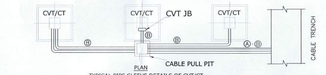
SECTION C-C

KEY PLAN



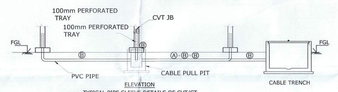
LEGEND:

- PRESENT SCOPE
- FUTURE / NOT IN SCOPE
- BOUNDARY
- FENCE
- CABLE TRENCH
- BURRIED CABLE TRENCH
- DUCT BANK
- JUNCTION BOX
- PULL PIT



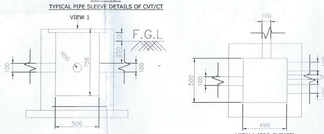
PLAN

TYPICAL PIPE SLEEVE DETAILS OF CVT/CT



ELEVATION

TYPICAL PIPE SLEEVE DETAILS OF CVT/CT



TYPICAL PIPE SLEEVE DETAILS OF EQUIPMENTS:-

	DESCRIPTION	QUANTITY
A	1 x 50mm Ø PVC PIPE	750
B	1 x 100mm Ø PVC PIPE	2000
C	1 x 200mm Ø PVC PIPE	100
	100mm WIDE PERFORATED TRAY	100

NOTES:-

1. ALL DIMENSION ARE IN mm, UNLESS OTHERWISE SPECIFIED.
2. CABLE TRENCH SECTIONS AND ROAD CROSSING SHALL BE AS PSTCL STANDARD DRAWING DWG NO.– PSTCL/TS(D)/D-005(D)/R0, PSTCL/TS(D)/D-006(D)/R0 AND PSTCL/TS(D)/D-007(D)/R0.
3. POWER & CONTROL CABLES SHALL BE LAID IN SEPARATE TIERS. POWER CABLES SHALL BE LAID ON THE TOP TIER AND CONTROL CABLES ON BOTTOM TIER.
4. THIS DRG. SHALL BE READ IN CONJUNCTION WITH APPROVED GA LAYOUT DRAWING & FOUNDATION LAYOUT DRAWING.
5. TRENCH SHALL CLEAR THE EQUIMENT FOUNDATIONS BY PREFERABLY MINIMUM 100MM GAP. AS PER SITE CONDITION THE SAME SHALL BE PROVIDED.
6. AFTER LAYING OF CABLES, THE END OF PIPES SHALL BE SUIABLY SEALED AT SITE TO PREVENT WATER INGRESS INTO PIPES.
7. THE SIZE OF THE CONDUIT/PIPE SHALL BE SELECTED ON THE BASIS OF 40% FILL CRITERION & 60% VOID. ACCORDINGLY IF ADDITIONAL PIPES ARE REQUIRED IN BURRIED TRENCHES IN ABSENCE OF TRENCHES.
8. THE CABLES TO LT TRAFO, DG SET, ITPH FROM CRB SHALL BE LAID IN THE BURRIED CABLE TRENCHES. LIGHTING CABLES ALSO SHALL BE LAID
9. ALL CABLES FROM BAY CABLE TRENCH TO EQUIPMENTS INCLUDING AND ALL INTERPOLE CABLES (BOTH POWER AND CONTROL) FOR ALL EQUIPMENT, SHALL BE LAID IN PVC PIPES OF CLASS 4 AS PER IS 4985 WHICH SHALL BE BURIED IN THE GROUND AT A DEPTH OF 250MM BELOW FINISH FORMATION LEVEL.
10. WHERE CABLES CROSS ROADS, DRAINS AND RAIL TRACKS, THESE SHALL BE LAID IN REINFORCED SPUN CONCRETE OR STEEL PIPES BURIED AT NOT LESS THAN ONE METRE DEPTH. THE SIZE OF HUME/STEEL PIPE SHALL BE SUCH THAT APPROXIMATELY 70% AREA IS ONLY OCCUPIED.
11. THE LOCATION OF PULL PIT SHOWN HERE IS TENTATIVE, HOWEVER THAT CAN BE MODIFIED AT SITE TO SUIT ACTUAL SITE CONDITION.
12. THE ROUTING FOR BURRIED CABLE TRENCH FOR LT TRANSFORMERS & DG SET SHALL BE FINALIZED AFTER THE FINALIZATION OF LOCATIONOF LT TR & DG SET.
13. FOR BUILDING CABLE TRENCHES DETAILS INDIVIDUAL APPROVED CABLE TRENCH DRAWINGS SHALL BE REFERRED.
14. SUITABLE OPENINGS SHALL BE PROVIDED IN THE BUILDINGS AT APPROPRIATE LOCATIONS FOR CABLE ENTRY INTO THE TRENCH.

REFERANCE DRAWING NO.:

1.400/220/kV AIS SUBSTATION OVERALL LAYOUT – PLAN : DWG NO. SVP010092–PSTCL–ROP–E–GA–003
2.DETAILS OF CABLE TRENCHES & CABLE TRENCH ROAD CROSSING : DWG NO.– PSTCL/TS(D)/D-005(D), 006(D), 007(D)

CLIENT:

PUNJAB STATE TRANSMISSION CO. LTD
TRANSMISSION SYSTEM DESIGN, PSTCL, PATIALA

PROJECT:

CONSTRUCTION OF 400/220kV AIS SUB-STATION AT ROPAR, (PUNJAB)

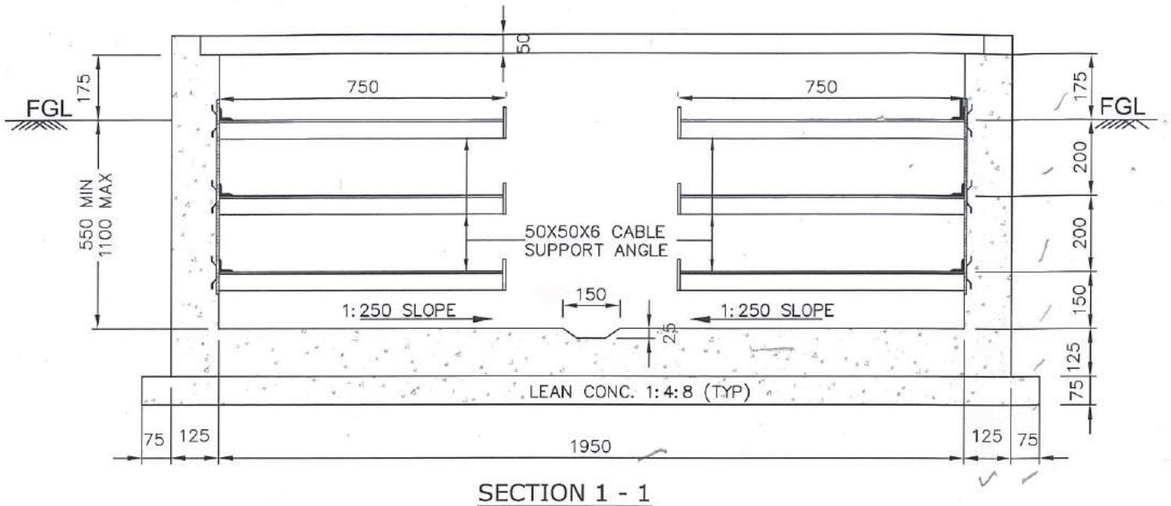
EPC CONTRACTOR GODREJ & BOYCE MFG. CO. LTD.
PIROJSHANAGAR, VIKHROLI WEST, MUMBAI MAHARASTRA (INDIA).

NOA No.: 1060/STQ–3063, DATED–06/09/2021

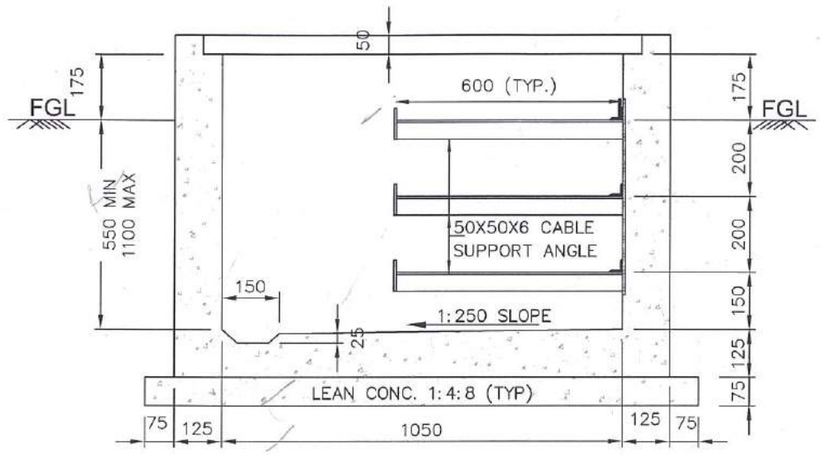
400/220kV AIS SUBSTATION - OUTDOOR AREA CABLE TRENCH LAYOUT

REV.	DESCRIPTION	DRAWN	SIGN	CHECKED	SIGN	APPROVED	SIGN	STATUS
R1	REVISED TO ADD LEVELS AND SECTIONAL DETAILS	Name YGB Date 15.07.22		Name AM Date 15.07.22		Name GJ Date 15.07.22		FOR APPROVAL
R0	FIRST ISSUE	Name YGB Date 16.02.22		Name AM Date 16.02.22		Name GJ Date 16.02.22		FOR APPROVAL

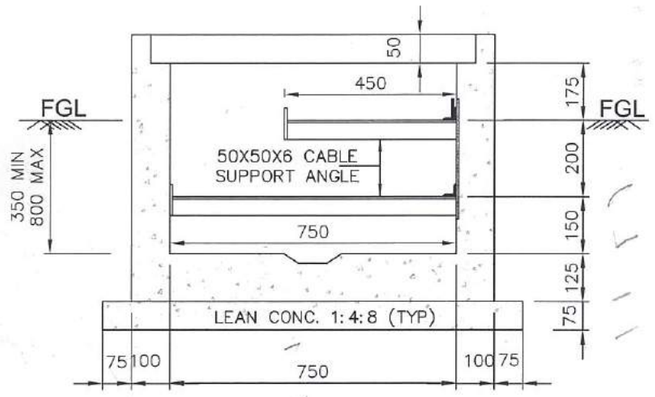
A0	DRAWING No.	TOTAL SH. 01	SH.No.	REV.
	SVP010092-PSTCL-ROP-E-CAB-001	SCALE NTS	01of 01	R1



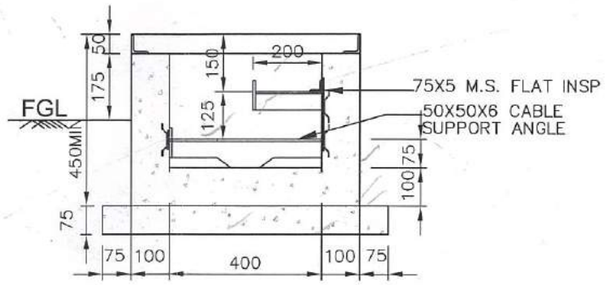
SECTION 1 - 1



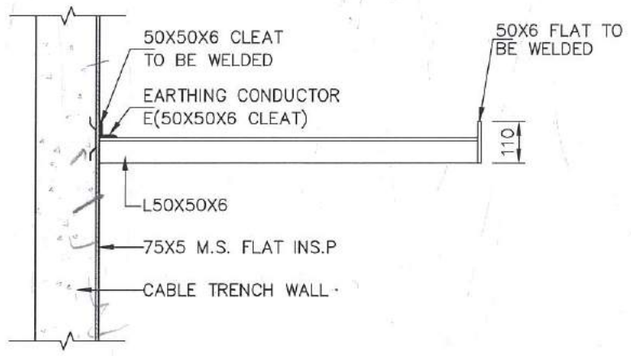
SECTION 2 - 2



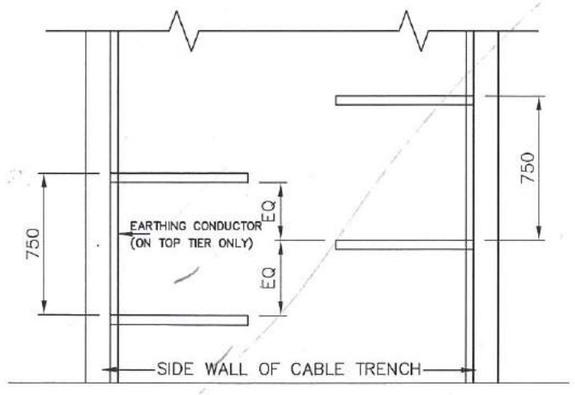
SECTION 3 - 3



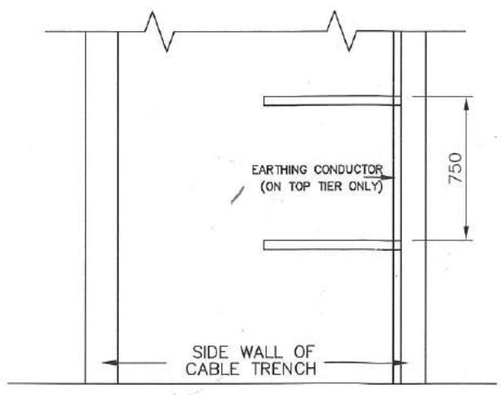
SECTION 4-4



TYPICAL CABLE SUPPORT



PLAN
CABLE TRAY SUPPORT FOR SECTION 1-1



PLAN
CABLE TRAY SUPPORT FOR
SECTION 2-2 & 3-3

NOTES:-

1. ALL DIMENSION ARE IN mm. UNLESS OTHERWISE SPECIFIED.
2. INCASE EXPANSIVE SOIL IS ENCOUNTERED AT FLOOR SLAB LEVEL OF TRENCH, SAME SHALL BE REMOVED AND TO BE REPLACED BY GOOD EARTH/SAND TO A MINIMUM DEPTH OF 300MM.
3. IF EXCAVATED EARTH IS EXPANSIVE IN NATURE, IT SHALL NOT BE USED FOR BACKFILLING.
4. WEIGHT OF EARTHING CONDUCTOR IS NOT BE CONSIDERED AS EMBEDMENT AS THE SAME IS COVERED UNDER EARTHING SCOPE.

REFERANCE DRAWING NO.:

1. DETAILS OF CABLE TRENCH SECTION : DWG NO. PSTCL-TS(D)-D-005/R0

Checked by	Vetted by	Recommended by	Approved by
J.E./Civil	S.D.O./Civil	Sr. XEN/Civil	S.E./Civil

REV.	DESCRIPTION	DRAWN	CHECKED	APPROVED	STATUS
R0	FIRST ISSUE	YGR 15.07.22	AM 15.07.22	GJ 15.07.22	FOR APPROVEL

CLIENT:
PUNJAB STATE TRANSMISSION CO. LTD
TRANSMISSION SYSTEM DESIGN, PSTCL, PATIALA

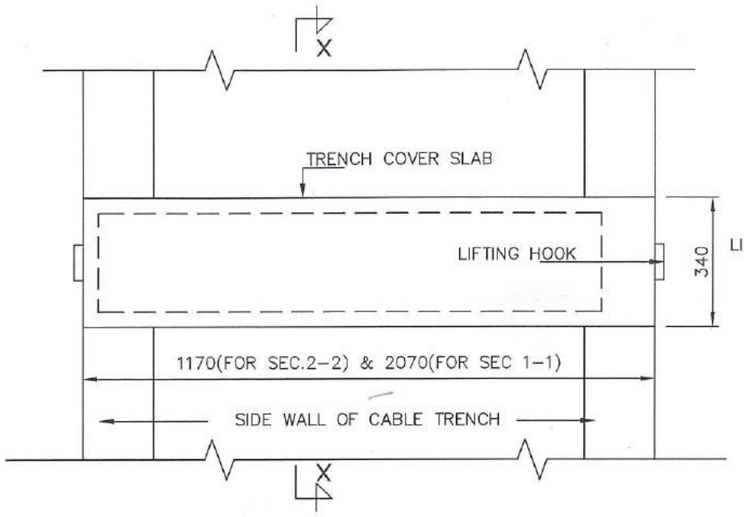
PROJECT:
CONSTRUCTION OF 400/220kV AIS
SUB-STATION AT ROPAR, (PUNJAB)

EPC CONTRACTOR GODREJ & BOYCE MFG. CO. LTD.
PIROJSHANAGAR, VIKHROLI WEST, MUMBAI MAHARASTRA (INDIA).

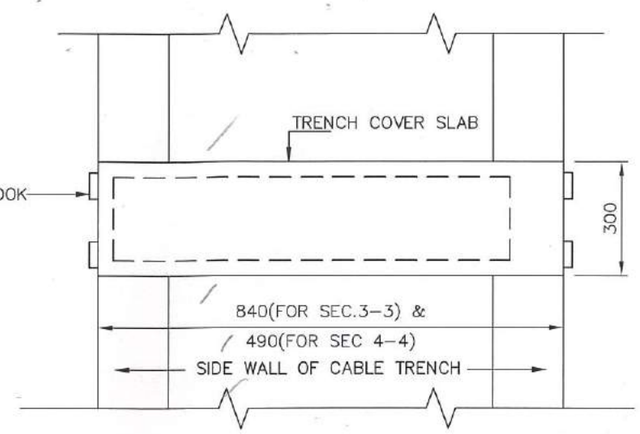
NOA No.: 1060/STQ-3063, DATED-06/09/2021

400/220kV AIS SUBSTATION -
DETAIL FOR CABLE TRENCH SECTIONS

A0 | DRAWING No. SVP010092-PSTCL-ROP-E-CAB-003 | TOTAL SH. 01 | SH.No. 01 of 02 | REV. R0 | SCALE NTS



DETAIL OF TRENCH COVER SLAB
FOR SECTION 1-1 & 2-2



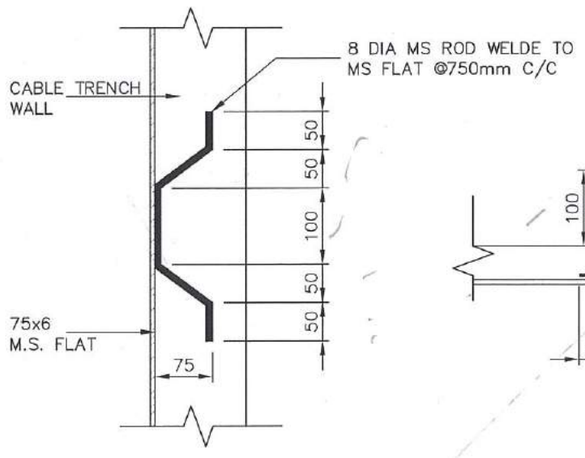
DETAIL OF TRENCH COVER SLAB
FOR SECTION 3-3 & 4-4

NOTES:-

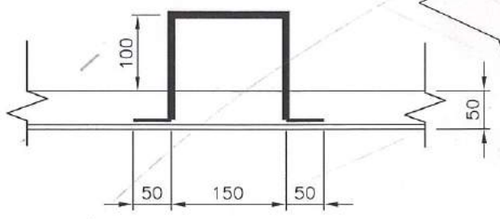
1. ALL DIMENSION ARE IN mm. UNLESS OUTHERWISE SPECIFIED.
2. DO NOT SCALE THE DRG. FOLLOW WRITTEN DIMENSION ONLY.
3. R.C.C. MIX SHALL BE 1:1, 5:3
   (1 CEMENT:1 SCOARSE SAND 3 STONE AGGREGATE)
   20MM NOMINAL SIZE
4. LEAN CONC. SHALL BE 1:4:8
5. CLEAR COVER FOR BOTTOM SLAB REINF. ON TOP SIDE IS 25MM.
6. LIFTING HOOK ARE TO BE PROVIDED IN EVERY TENTH SLAB.
7. NECESSARY OPENING SHALL BE PROVIDED AT APPROPRIATE LOCATION TO TAKE OUT CABLES.
8. FOR ACTUAL DEPTH OF TRENCHES REFER CABLE TRENCH LAYOUT.
9. F.G.L DENOTES FINISHED GRADED LEVEL (FORMATION LEVEL)
11. A SLOP OF 1:250 SHALL BE GIVEN IN THE DIRECTION PERPENDICULAR TO THE RUN OF THE TRENCH FOR ALL SECTIONS.
12. ALL CABLE TRENCHES SHALL BE GIVEN A SLOPE OF 1:1000 IN THE DIRECTION OF MAIN RUN AWAY FROM THE BUILDING.
13. EARTHING CONDUCTOR 'E' 50X6 MS FLAT WOULD BE WELDED ON THE CABLE SUPPORTING STRUCTURES BEFORE INSTALATION OF CABLE.
14. ALL STEEL STRUCTURE PLATES WOULD BE PAINTED WITH NON CORROSIVE PAINT ON A SUITABLE PRIMER BEFORE INSTALATION OF CABLE EARTHING CONDUCTOR WOULD HAVE RED PAINT.
15. TRENCH WALL SHALL CLEAR THE EQUIPMENT FOUNDATION BY 100MM (MIN)
16. NECESSARY CONSTRUCTION JOINT SHALL BE PROVIDED AT EVERY 30M MIN OR AS PER SITE REQUIRMENT.
17. 40MM CLEAR COVER FOR TOP AND BOTTOM SLAB REINFORCEMENT WHICH IS TOWARDS EARTHSIDE SHALL BE PROVIDED.
18. ALL SUPPORT ANGLE SHALL BE L50X50X6.
19. ANCHORING FLAT (75X6MM) SHALLBE PROVIDED AT EACH SUPPORT ANGLE POINT.
20. EARTHING CONDUCTOR MKD. 'E' SHALL BE PROVIDED ON THE TOP TIER OF EACH CABLE TRENCH SECTIONS.
21. TRENCH WALL SHALL CLEAR THE TOWER FOUNDATION BY 1000MM (MIN).

REFERANCE DRAWING NO.:

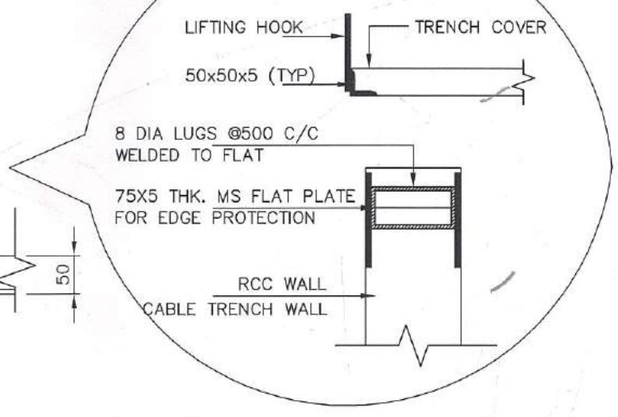
1. DETAILS OF CABLE TRENCH SECTION : DWG NO. PSTCL–TS(D)–D–005/R0



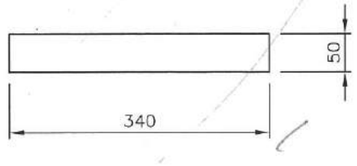
TYPICAL DETAIL OF ANCHORING
75X6 M.S. FLAT



DETAIL OF LIFTING HOOK
FOR SECTION 1-1 & 2-2



TYPICAL DETAIL OF
SLAB SUPPOT



SECTION X-X

Checked by — J.E./Civil
Vetted by — S.D.O./Civil
Recommended by — Sr. XEN/Civil
Approved by — S.E./Civil

CLIENT:
PUNJAB STATE TRANSMISSION CO. LTD
TRANSMISSION SYSTEM DESIGN, PSTCL, PATIALA

PROJECT:
CONSTRUCTION OF 400/220kV AIS
SUB-STATION AT ROPAR, (PUNJAB)

EPC CONTRACTOR: GODREJ & BOYCE MFG. CO. LTD.
PIROJSHANAGAR, VIKHROLI WEST, MUMBAI MAHARASTRA (INDIA).

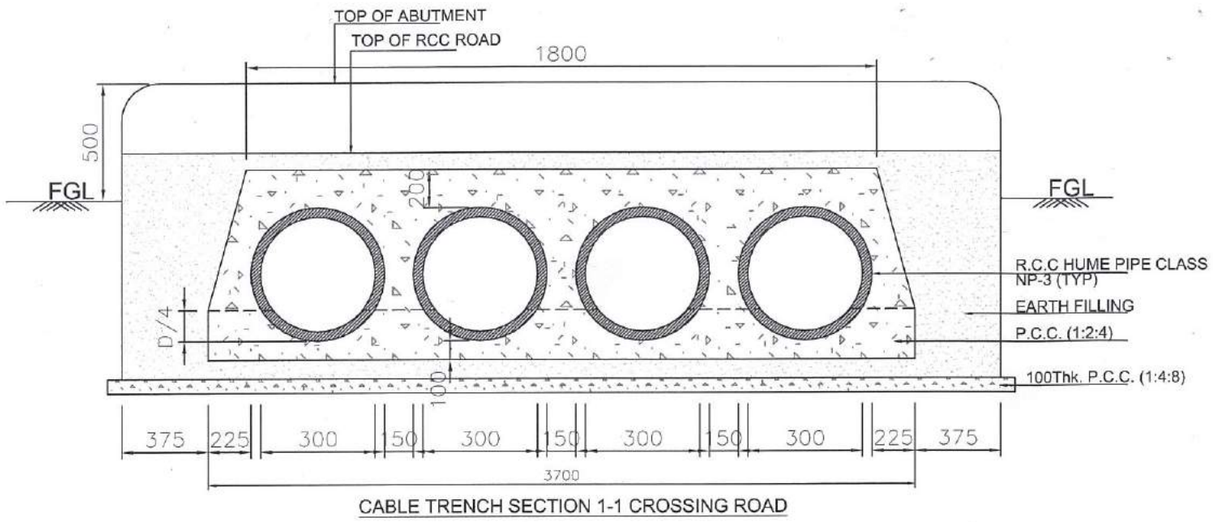
NOA No.: 1060/STC–3083, DATED–06/09/2021

400/220kV AIS SUBSTATION -
DETAIL FOR CABLE TRENCH SECTIONS

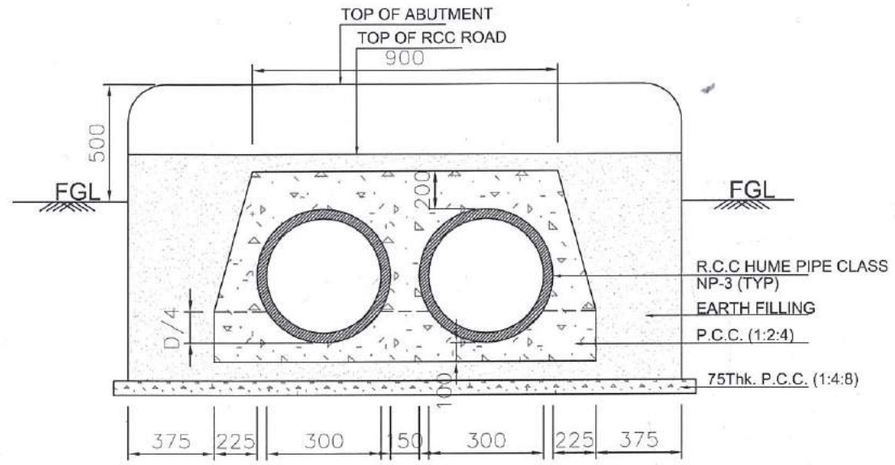
REV.	DESCRIPTION	DRAWN	CHECKED	APPROVED	STATUS
R0	FIRST ISSUE	YGB 15.07.22	AM 15.07.22	GJ 15.07.22	FOR APPROVEL

DRAWING No.	TOTAL SH.	SH.No.	REV.
SVP010092-PSTCL-ROP-E-CAB-003	02	02 of 02	R0

SCALE NTS

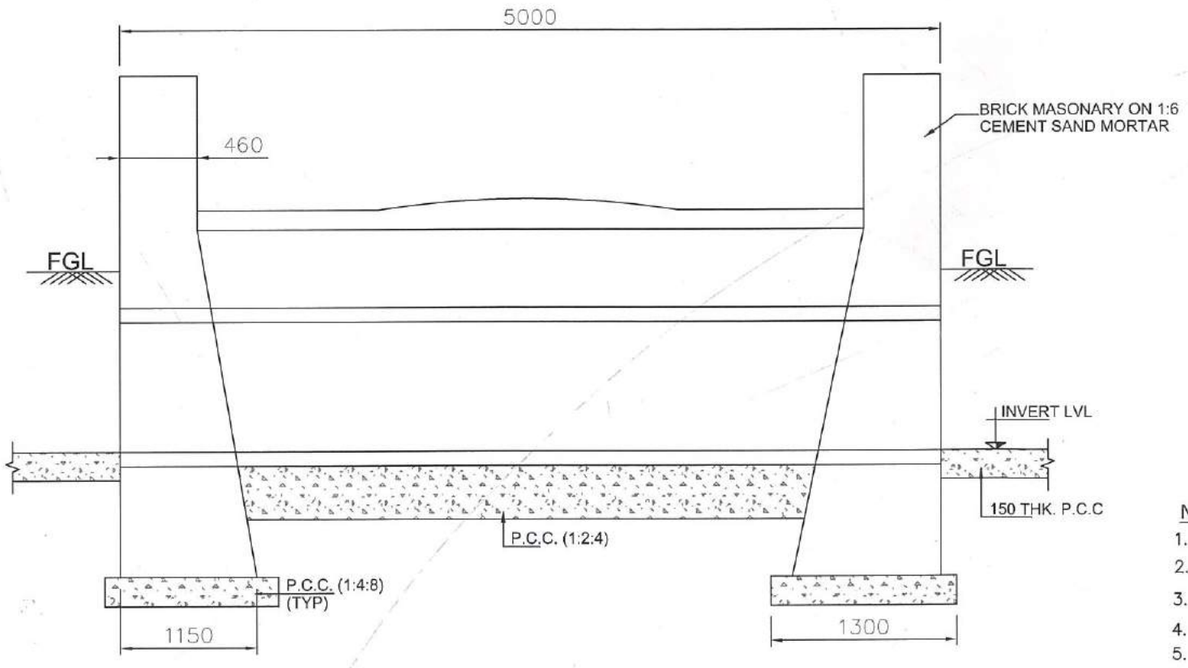


CABLE TRENCH SECTION 1-1 CROSSING ROAD

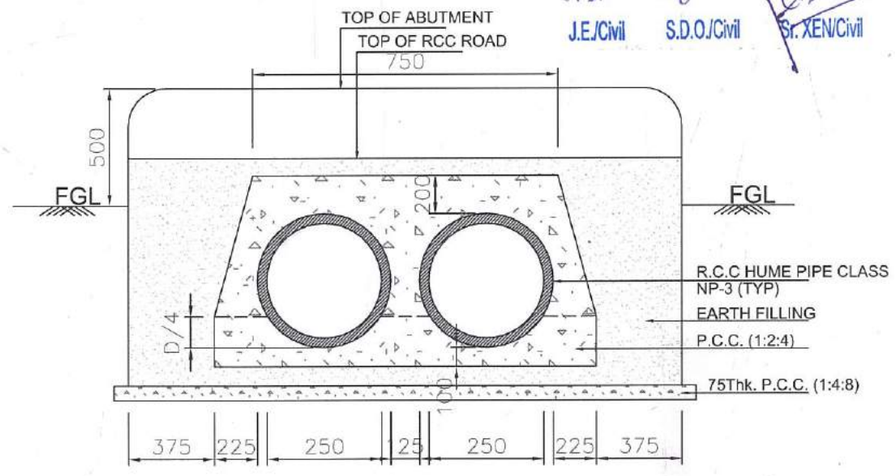


CABLE TRENCH SECTION 2-2 CROSSING ROAD

Checked by	Vetted by	Recommended by	Approved by
J.E./Civil	S.D.O./Civil	Sr. XEN/Civil	S.E./Civil



LONGITUDINAL SECTION THROUGH CABLE TRENCH CROSSING ROAD



CABLE TRENCH SECTION 3-3 CROSSING ROAD

NOTES:-

1. ALL DIMENSION ARE IN mm.
2. DO NOT SCALE THE DRG. FOLLOW WRITTEN DIMENSION ONLY.
3. R.C.C. HUME PIPE SHALL BE OF GRADE NP3.
4. CLASS 75 BRICKS SHALL BE USED.
5. CONCRETE MIX USE FOR COVRING RCC PIPE SHALL BE 1: 2: 4 (1 CEMENT 4COURSE SAND 8STONE AGGREGATE OF 40MM NORMINAL SIZE)
6. BRICK MASONARY SHALL BE DONE USING CEMENT MORTAR (1 CEMENT: 6 FINE SAND)

REFERANCE DRAWING NO.:

1. DETAILS OF CABLE TRENCH CROSSING : DWG NO. PSTCL–TS(D)–D–007/R0

REV.	DESCRIPTION	DRAWN	CHECKED	APPROVED	STATUS
R0	FIRST ISSUE	YGB 11.07.22	AM 11.07.22	CJ 11.07.22	FOR APPROVL

CLIENT:
PUNJAB STATE TRANSMISSION CO. LTD
TRANSMISSION SYSTEM DESIGN, PSTCL, PATIALA

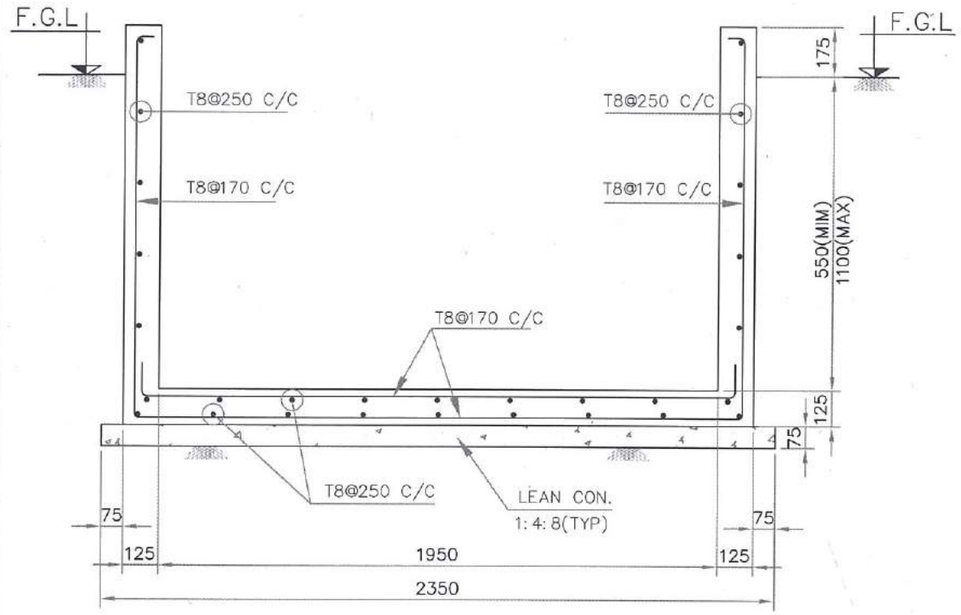
PROJECT:
CONSTRUCTION OF 400/220kV AIS SUB-STATION AT ROPAR, (PUNJAB)

EPC CONTRACTOR GODREJ & BOYCE MFG. CO. LTD.
PIROJSHANAGAR, VIKHROLI WEST, MUMBAI, MAHARASHTRA (INDIA).

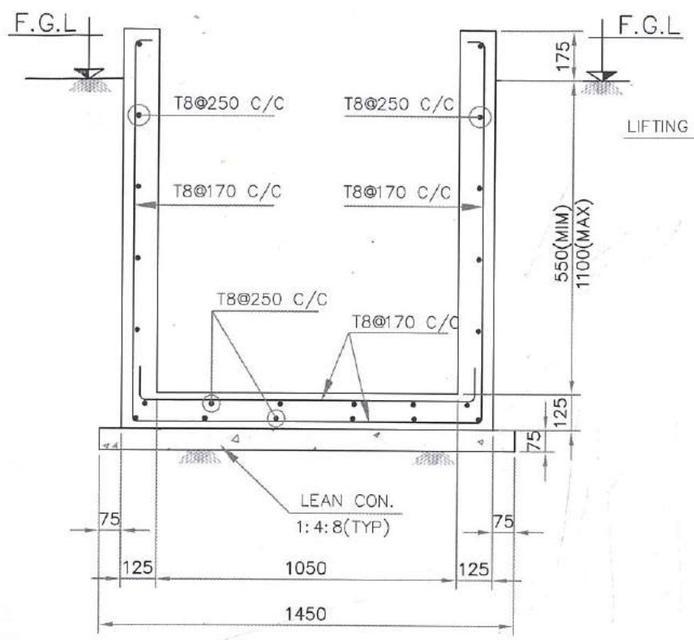
NOA No.: 1060/STC–3083, DATED–06/09/2021

400/220kV AIS SUBSTATION -
DETAIL OF CABLE TRENCH CROSSING

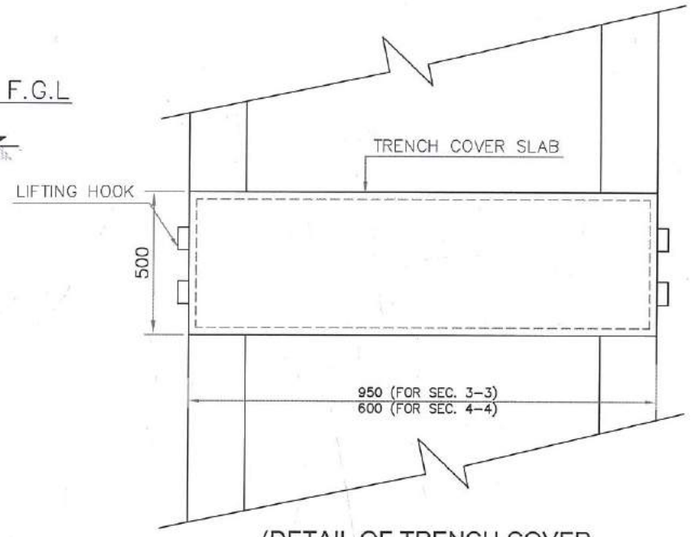
A0	DRAWING No.	TOTAL SH. 01	SH.No.	REV.
	SVP010092-PSTCL-ROP-E-CAB-004	SCALE NTS	01 of 01	R0



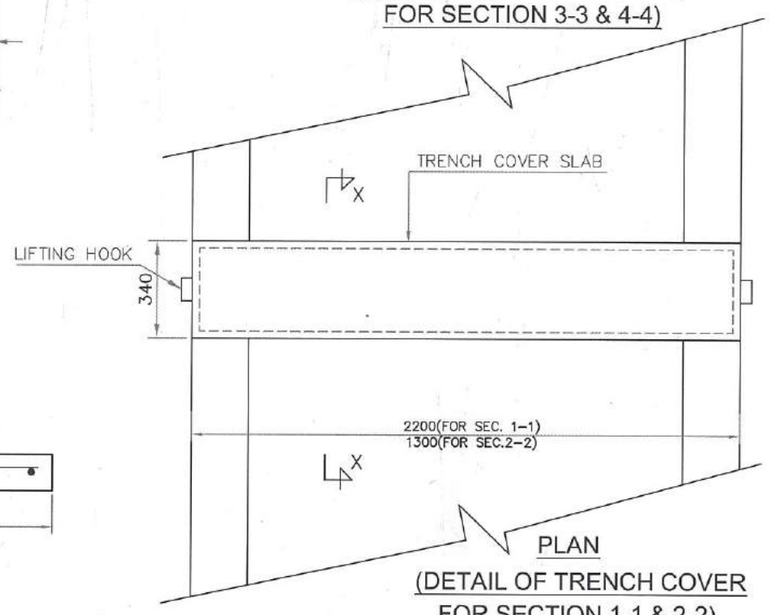
SECTION 1-1



SECTION 2-2

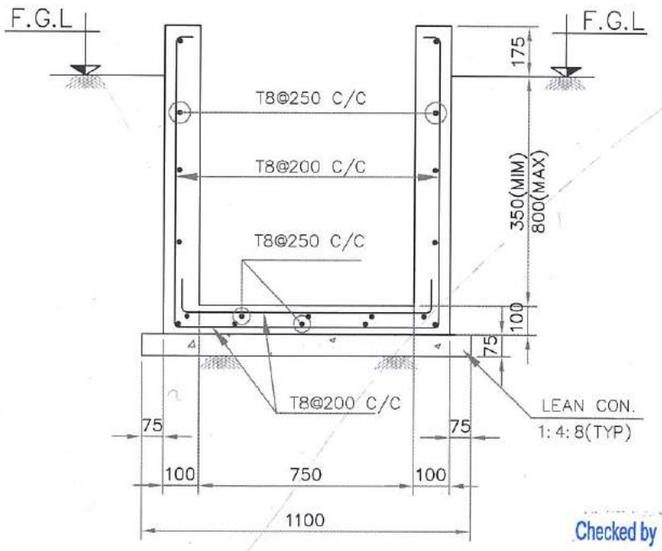


(DETAIL OF TRENCH COVER FOR SECTION 3-3 & 4-4)

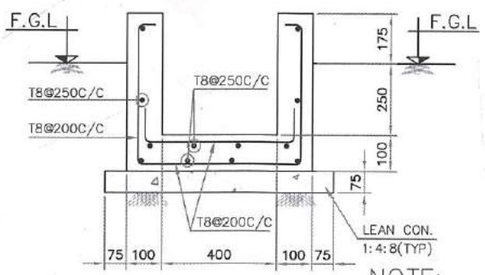


PLAN

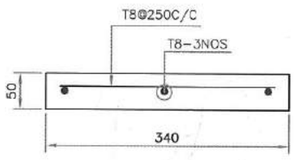
(DETAIL OF TRENCH COVER FOR SECTION 1-1 & 2-2)



SECTION 3-3



SECTION 4-4



SECTION X-X

NOTE:

1: ALL DIMENSION ARE IN mm UNLESS OTHERWISE SPECIFIED.

2: R.C.C. MIX. SHOULD BE 1:1.5:3 (1 CEMENT:1.5 COARSE SAND:3 STONE AGGREGATE 20mm NOMINAL SIZE.)

3: LEAN CONC.SHALL BE IN THE RATIO.1:4:8

4: 400/220kV AIS SUBSTATION: BURIED CABLE TRENCH LAYOUT DWG. SVP010092-PSTCL-ROP-E-CAB-001

REFERANCE DRAWING NO.:

1. RCC DETAILS FOR CABLE TRENCH SECTIONS : DWG NO. PSTCL-TS(D)-D-006/R0

Checked by	Vetted by	Recommended by	Approved by
J.E./Civil	S.D.O./Civil	Sr. XEN/Civil	S.E./Civil

REV.	DESCRIPTION	DRAWN	SIGN	CHECKED	SIGN	APPROVED	SIGN	STATUS
R0	FIRST ISSUE	Name: SSS Date: 11.07.22		Name: NMP Date: 11.07.22		Name: MMP Date: 11.07.22		FOR APPROVEL

CLIENT:
PUNJAB STATE TRANSMISSION CO. LTD
TRANSMISSION SYSTEM DESIGN, PSTCL, PATIALA

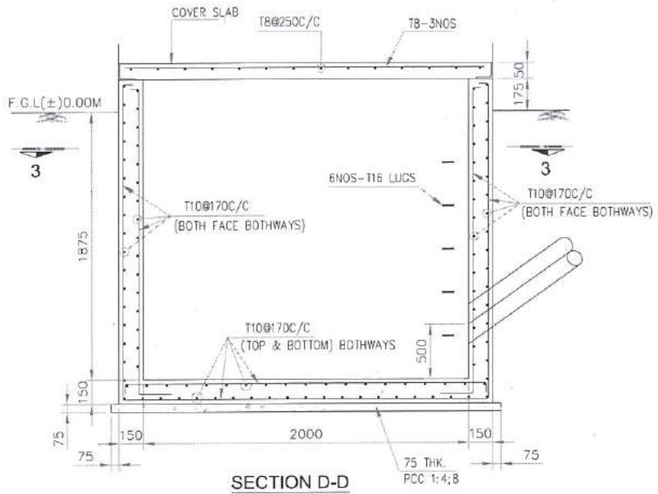
PROJECT:
CONSTRUCTION OF 400/220kV AIS SUB-STATION AT ROPAR, (PUNJAB)

EPC CONTRACTOR: GODREJ & BOYCE MFG. CO. LTD.
PIROJSHANAGAR, VIKHROLI WEST, MUMBAI MAHARASTRA (INDIA).

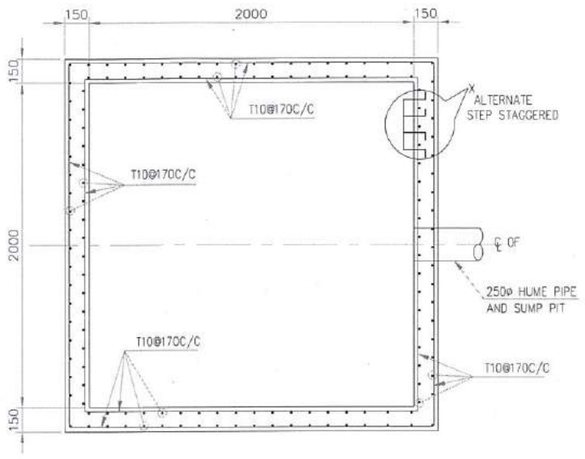
NOA No.: 1060/STQ-3063, DATED-06/09/2021

400/220kV AIS SUBSTATION - R.C.C DETAIL FOR CABLE TRENCH SECTIONS

A0	DRAWING No.	TOTAL SH. 01	SH.No.	REV.
	SVP010092-PSTCL-ROP-E-CAB-005	SCALE: NTS	01 of 01	R0



SECTION D-D
SCALE-1:40



SECTION 3-3
SCALE-1:40

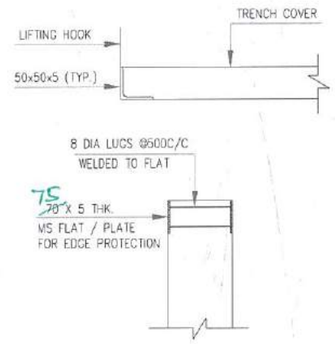
NOTE:

1: ALL DIMENSION ARE IN mm UNLESS OTHERWISE SPECIFIED.

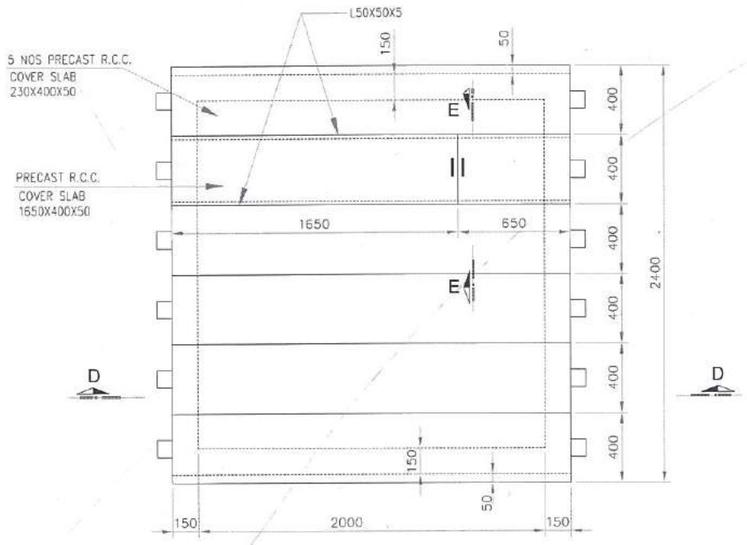
2: R.C.C. MIX. SHOULD BE 1:1.5:3 (1 CEMENT:1.5 COARSE SAND:3 STONE AGGREGATE 20mm NOMINAL SIZE.)

3: LEAN CONC.SHALL BE IN THE RATIO.1:4;8 (1 CEMENT : 4 COURSE SAND: 8STONE AGGREGATE 40MM NOMINAL SIZE)

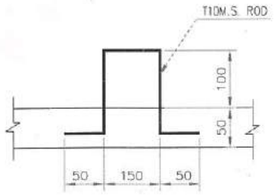
4: 400/220kV AIS SUBSTATION: OUTDOOR LAYOUT CABLE TRENCH/ SUMP PIT LOCATION DWG. NO:SVP010092-PSTCL-ROP-E-CAB-001



TYPICAL DETAIL OF SLAB SUPPORT
SCALE-1:10



TOP PLAN OF SUMP PIT
SCALE-1:25



DETAIL OF LIFTING HOOK
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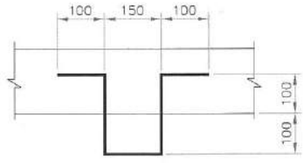
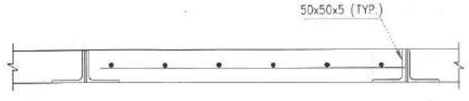


DETAIL 'X'
SCALE-1:15



SECTION E-E
SCALE-1:20

Checked by	Vetted by	Recommended by	Approved by
J.E./Civil	S.D.O./Civil	Sr.XEN/Civil	S.E./Civil

REV	DESCRIPTION		DRAWN		CHECKED		APPROVED		STATUS
R0	FIRST ISSUE	Name	SSS	Name	NMP	Name	NMP		FOR APPROVEL
		Date	15.07.22	Date	15.07.22	Date	15.07.22		

CLIENT:
PUNJAB STATE TRANSMISSION CO. LTD
TRANSMISSION SYSTEM DESIGN, PSTCL, PATIALA

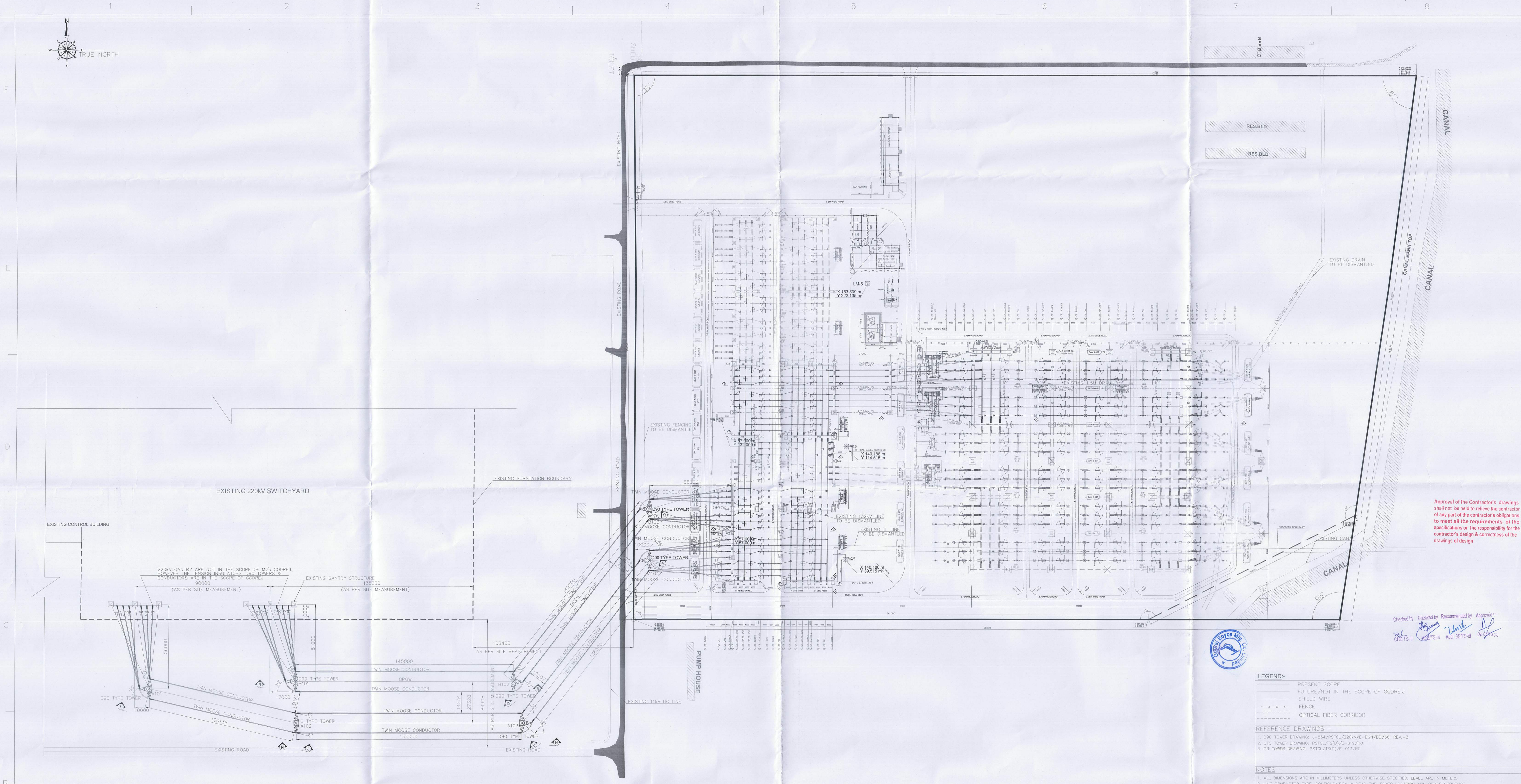
PROJECT:
CONSTRUCTION OF 400/220kV AIS SUB-STATION AT ROPAR, (PUNJAB)

EPC CONTRACTOR: GODREJ & BOYCE MFG. CO. LTD.
PIROJSHANAGAR, VIKHROLI WEST, MUMBAI MAHARASTRA (INDIA)

NOA No.: 1050/STC-3063, DATED-06/09/2021

400/220kV AIS SUBSTATION - R.C.C DETAILS OF SUMP PIT

A2	DRAWING No.	TOTAL SH. 01	SH.No.	REV.
	SVP010092-PSTCL-ROP-E-CAB-006	SCALE NTS	01 of 01	R0



LEGEND:-

- PRESENT SCOPE
- FUTURE/NOT IN THE SCOPE OF GODREIJ
- SHIELD WIRE
- FENCE
- OPTICAL FIBER CORRIDOR

REFERENCE DRAWINGS: –

1. D90 TOWER DRAWING: J-854/PSTCL/220kV/E-DGN/DD/66. REV.-3
2. CTC TOWER DRAWING: PSTCL/TS(D)/E-019/R0
3. CB TOWER DRAWING: PSTCL/TS(D)/E-013/R0

NOTES: –

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED. LEVEL ARE IN METERS
2. LINE CONDUCTOR TYPE, CONFIGURATION & DEAD END TOWER LOCATION AND PHASE SEQUENCE BE CONFIRMED BY CLIENT.
3. LOCATION AND NUMBER OF LIGHTNING MASTS SHALL BE FINALIZED AFTER DSLP DETAIL DESIGN.
4. OPTICAL FIBER CONNECTION SHALL BE CARRIED OUT USING OPGW CONNECTION.

CLIENT:

PUNJAB STATE TRANSMISSION CO. LTD
TRANSMISSION SYSTEM DESIGN, PSTCL, PATIALA

PROJECT:

CONSTRUCTION OF 400/220kV AIS SUB-STATION AT ROPAR, (PUNJAB)

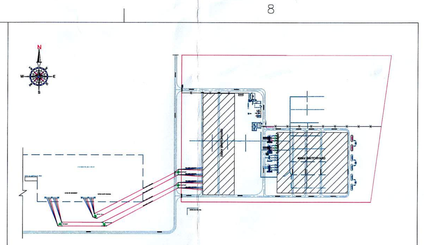
EPC CONTRACTOR: **GODREJ & BOYCE MFG. CO. LTD.**
PIROJSHANAGAR, VIKHROLI WEST, MUMBAI MAHARASTRA (INDIA).

NOA No.: 1060/STQ-3063, DATED-06/09/2021

400/220kV AIS SUBSTATION - OVERALL PLOT - PLAN & SECTION

REV.	DESCRIPTION	DRAWN	CHECKED	APPROVED	STATUS
R0	FIRST ISSUE	Name YGB, Date 27.01.22	Name AM, Date 27.01.22	Name GJ, Date 27.01.22	FOR APPROVEL

	DRAWING No.	TOTAL SH.	SCALE	SH.No.	REV.
A0	SVP010092-PSTCL-ROP-E-GA-010	02	1:900	01of 02	R0



EARTHING BILL OF MATERIALS

SYMBOL	DESCRIPTION	QTY.
———	40mm M.S. ROD (MAIN EARTHING CONDUCTOR)	8200mtrs.
- - - -	40mm M.S. ROD (AUXILIARY MAT & RISER)	6850mtrs.
- - - -	75x12mm G.S. FLAT (RISERS)	3750mtrs.
- - - -	50x6mm M.S. FLAT (For Cable trench)	1650mtrs.
- · - · -	50x6mm G.S. FLAT (JB & MBs)	850mtrs.
(E)	40mm DIA 3M LONG MS ROD ELECTRODE	115 Nos.
(P)	40mm DIA 3M LONG GS PIPE ELECTRODE WITH TEST LINK	10 Nos.

NOTES:-

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. MAIN EARTH GRID CONDUCTOR SIZE IS 40mm DIA M.S. ROD.
3. FOR MAIN EQUIPMENT AND STRUCTURE EARTHING DETAILS REFER POWER GRID STANDARD EARTHING DETAILS DRAWING NO C/ENGG/STD/EARTHINGS/09 ENCLOSED WITH THE TECHNICAL SPECIFICATION, SECTION–SWITCHYARD ERECTION –Rev. 10.
4. EARTHING CONDUCTOR SHALL BE LAID AT A MINIMUM DEPTH OF 300mm BELOW THE CABLE TRENCHES, DRAINS, ROADS & RAIL.
5. THIS DRAWING IS ONLY SYMBOLIC REPRESENTATION OF EARTHING CONDUCTOR LAYOUT. AT ACTUAL SITE CONDITION CONDUCTOR WILL BE ROUTED IN SUCH MANNER SO THAT IT DOES NOT FOUL WITH ANY FOUNDATION.
6. EARTHMAT WILL BE LAID 2000mm BEYOND THE FENCE. IN CASE OF BOUNDARY WALL IT WILL BE LAID UPTO 500mm INSIDE THE BOUNDARY WALL.
7. CABLE TRENCH EARTHING WILL BE DONE WITH 50x6mm MS FLAT AND RUN ALONG THE CABLE SUPPORTING STRUCTURE. EARTH FLAT OF CABLE TRENCH WILL BE CONNECTED TO THE MAIN EARTHING GRID AT 30m INTERVAL AND AT BOTH ENDS.
8. ROD ELECTRODE FOR CVT & LA LOCATIONS INDIACTIVE ONLY. IF REQUIRED SAME SHALL BE MODIFIED AS PER SITE CONDITION.
9. EARTHING CONDUCTORS OR LEADS ALONG THE RUN OR CABLE TRENCH LOADER, WALL, ETC SHALL BE SUPPORTED BY SUITABLE WELDING/CLEATING AT INTERVAL OF 750MM.
10. ALL THE GATE'S AND EVERY ALTERNATE POST OF THE FENCE SHALL BE CONNECTED TO EARTHING GRID.

Checked by — Checked by — Recommended by — Approved by

REFERANCE DRAWING NO.:

1.400/220/33KV AIS SUBSTATION OVERALL LAYOUT – PLAN : DWG NO. SVP010053–JAK–E–ARR–001

CLIENT:

PUNJAB STATE TRANSMISSION CO. LTD

TRANSMISSION SYSTEM DESIGN, PSTCL, PATIALA

PROJECT:

CONSTRUCTION OF 400/220kV AIS SUB-STATION AT ROPAR, (PUNJAB)

EPC CONTRACTOR: **GODREJ & BOYCE MFG. CO. LTD.**

PIROJSHANAGAR, VIKHROLI WEST, MUMBAI MAHARASTRA (INDIA).

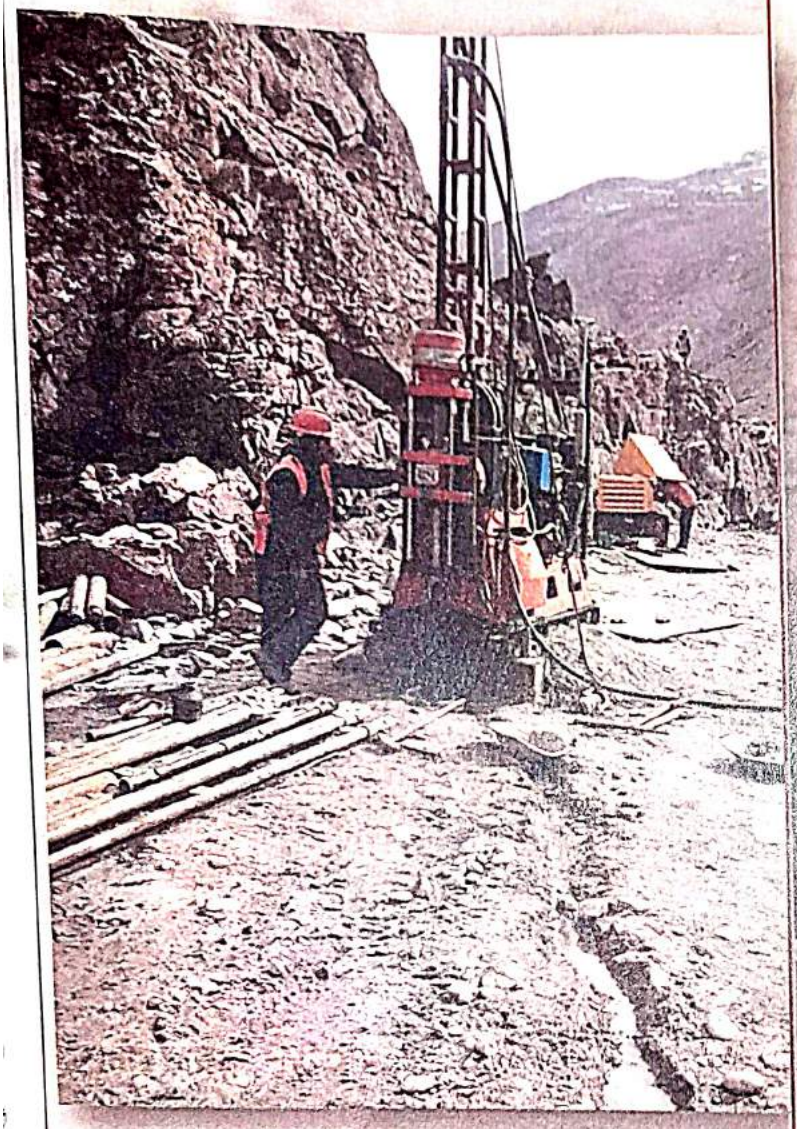
NOA No.: 1060/STQ–3063, DATED–06/09/2021

400/220kV AIS SUBSTATION - MAIN EARTHING GRID LAYOUT- PLAN

REV.	DESCRIPTION	DRAWN	CHECKED	APPROVED	STATUS
R1	REVISED AS PER PSTCL COMMENT	YGB 31.05.22	AM 31.05.22	GJ 31.05.22	FOR APPROVEL
R0	FIRST ISSUE	YGB 04.04.22	AM 04.04.22	GJ 04.04.22	

A0 | DRAWING No. SVP010092-PSTCL-ROP-E-GND-002 | TOTAL SH. 01 | SH.No. 01 of 01 | REV. R1 | SCALE NTS

GEOTECHNICAL INVESTIGATION REPORT



PROJECT NAME : CONSTRUCTION OF 400/220 KV SUB STATION ROPAR (PUNJAB)

NAME :- PSTCL

CONTRCTOR :-GODREJ

Checked by	Vetted by	Recommended by	Approved by
J.E./Civil	S.D.O./Civil	Sr. XEN/Civil	S.E./Civil

REPORT BY:-

GEO GLOBE CONSULTANT

ISO: 9001-2015

BRIEFDESCRIPTION

CLIENT	PSTCL
NAME OF WORK	CONSTRUCTION OF 400/220KV PSTCL ROPAR SUBSTATION
LOCATION	ROPAR(PUNJAB)
TESTING AGENCY	**GEO GLOBE CONSULTANTS (ISO : 9001-2015)** **PlotNo.777, JLPL Industrial Area,** **Sector 82, Mohali, Punjab-160062.** **Contact: 9888608424** **Gmail:ggconsultants2010@gmail.com** **Website:www.geoglobeconsultant.com**
TESTING	GEO-TECHNICAL INVESTIGATION

SOIL INVESTIGATION

GEO GLOBE CONSULTANTS
Plot No. 777, Sector 82, JLPL, S.A.S.Nagar, Mohali

TABLE OF CONTENTS

1 INTRODUCTION

1.01 The report presented herein deals with result of field and laboratory investigation carried out to assess the nature of sub-soil strata and to evaluate the bearing capacity and other parameter sat 400 KV Substation Ropar, Ropar Punjab.

1.02 The work of soil investigations was assigned to M/s Geo Globe Consultants, Mohali. (Pb)

2 SCOPE OF WORK

The soil investigation covers the following: -

2.01 Conducting Standard Penetration Test (SPT) in 14 No. bore hole up to a depth of 15 m.

2.02 Collecting soil samples at various depths as per requirement of the Client from the bore holes as feasible, for laboratory tests.

2.03 Analyzing the field and laboratory observations.

2.04 Submitting four copies of the soil investigations report and recommending safe Bearing capacity of soil.

3 SITE

3.01 The Site of Investigation is at Thermal Plant -Ropar . There is no special features which affected the explorations.

3.02 The location of bore holes was given by the client's representative who was with the investigating team till the investigations were over.

4GROUND WATER TABLE

Sr.No.	LOCATION	Water Table Depth From NGL (m)
1	B.H 1	1.3
2	BH 2	1.4
3	BH 3	1.45
4	BH 4	1.39
5	BH 5	1.45
6	BH 6	1.45
7	BH 7	1.34
8	BH 8	1.2
9	BH 9	1.37
10	BH 10	1.36
11	BH 11	1.15
12	BH 12	1.0
13	BH 13	1.2
14	BH 14	1.2

5 FIELD INVESTIGATIONS

The field investigations were conducted to cover the entire scope of the job.

Boring – operations (IS 1892-1979)

The exploratory bore holes were made by shell and auger by pushing the casing pipe and removing material within the casing. To avoid excessive disturbance to the in-situ deposits, the casing was not driven but was rotated frequently with slow motion. The samples were taken from below the bottom of the casing after completely cleaning the bore holes of any loose material at all depths wherever the samples had to be taken. The undisturbed soil samples were taken by pushing thin walled tubes into the bore holes. Immediately after taking these, they were logged, labeled, sealed in polythene bag and sent to the laboratory for testing.

5.02 Standard Penetration Test (DCPT)(IS: 2131)

The Standard Penetration Tests were conducted at various depths in the bore holes. These tests were conducted by driving into the soil a standard split spoon sampler. This sampler was driven with the help of a hammer weighing 63.5 kg. Which was vertically guided to fall through a free height of 75cm on the driving head. This driving head was attached to a drill rod, to the other end of which the sampler was fitted. The number of blows required to penetrate the first, second and third 15 cm lengths of the sampler were noted. The number of blow (i.e.N value), as given in the data sheets of bore holes, is the numerical value for the number of blows counted during the second and third stages i.e. for a depth of 30 cms. The procedure adopted for conducting this test was as per IS: 2131. The observed N values for all the boreholes have been noted down in tables.

6 LABORATORY INVESTIGATIONS

6.01 The laboratory tests were conducted on selected soil samples recovered from the test bore holes. The results obtained have been given in the various tables at the end of the report.

6.02: Grain Size Analysis: (IS 2720 part 4)

Grain Size analysis was carried out on Disturbed and undisturbed Samples obtained during boring operation. Percentage of sand and combined Silt and Clay were determined from this analysis. The test was carried out as per IS: 2720 (Part IV)

6.03: Liquid Limits and Plastic Limits (IS 2720 part 5)

To obtain an idea about the consistency characteristics of materials met with at various elevations, the liquid limits and plastic limits of fine fractions were evaluated as per procedure laid down in IS : 2720 (Part-V). These values have been recorded only in the case of plastic samples (cohesive soils), on the bore hole data.

6.04:

To obtain an idea about the consistency characteristics of materials met with at various elevations, the liquid limits and plastic limits of fine fractions were evaluated as per procedure laid down in IS : 2720 (Part-V). These values have been recorded only in the case of plastic samples (cohesive soils), on the bore hole data.

6.05 The wet density and grain size analysis was done for the samples taken as per IS: 2720 (Part IV)

6.06 Direct Shear Test(IS 2720 part 13):1986

This test was performed in a shear-box apparatus. The apparatus consisted of two-piece shear box of square cross-section. The lower half of the box was rigidly held in positions in a container which rested over rollers and which was pushed forward at a constant rate by a geared jack, driven by an electric motor. The upper half of the box

butted against a proving ring. The soil sample was compacted in the shear box and was

held between metal grids and porous stones. Normal load was applied on the pressure pad. The shearing strain was made to increase at constant rate. The shear force at failure corresponding to the applied normal load was measured with the help of the proving ring. A number of identical specimens were tested under increasing normal loads and the required maximum shear force was recorded and a graph was plotted between shear force as the ordinate and normal load as the abscissa to get the failure envelops and the value of c&ϕ.

6.07 Unconfined Compression Test :**(IS: 2720 Part 10)** is carried out on cylindrical sample of cohesive soil of dia 3.8 cm as per guidelines given in code.

6.08Triaxial Compression Test (IS 2720 part 11)

A triaxial compression test is the most versatile test available for the shear testing of soil. In this test a soil specimen , cylindrical in shape was subjected to direct stresses acting in three mutually perpendicular directions by means of triaxial apparatus comprises of triaxial cell and loading frame. The major principal stress was applied in the vertical direction and the other two principal stresses were applied in the horizontal directions by the fluid pressure all around the specimen the test was performed on cylindrical specimen of dia 38 mm. The height of the specimen was twice the dia. Shearing processes were started immediately without any consolidation and without allowing any drainage of water. In this way no drainage or dissipation of pore water pressure from soil specimen took place during the entire testing time.

7 CONSOLIDATION TESTS (IS 2720 PART 15)

The consolidation tests were carried out on undisturbed soil specimen in order to determine the settlement characteristics of soil at different depths. The tests is conducted in accordance to IS: 2720 (Pt-XV).

An undisturbed soil specimen was extruded to the consolidation ring of 60mm dia. The edge was trimmed carefully such that the sample was flushed with the top and bottom edges of the ring. The thickness of the specimen was measured and the weight was recorded. The bottom porous stone was then centered on the base of the

consolidation cell. The specimen was then placed centrally between the bottom porous stone and the upper porous stone. A filter paper was provided in between specimen and porous stones. Then the loading cap was placed on the top. The consolidometer was placed in position in the loading device and suitably adjusted. The dial gauge is then clamped into position for recording the relative movement between the base of the cell and the loading cap. A seating pressure of 0.05 kg/cm2 was applied to the specimen. The cell was kept filled with water. After 24 hr. the test was continued further using a loading sequence on the soil specimen of 0.25, 0.5, 1.0, 2.0, 4.0, & 8.0 kg/cm2. For each loading increment after application of load, readings of the dial gauge was taken using time sequence 0, 0.25, 1, 2.25, 2, 6.25, 9, 16, 25, 36, 49 ... up to 24 hrs. From the observations of all incremental pressures, void ratio versus log (pressure) curve was obtained. The slope of the straight line portion was designated as compression index cc.

7.1 Swelling Index Procedure

Dry about 50 g of soil in an oven at 100-110°C, sieve the soil through 425-micron IS sieve.

Take two specimen of this soil each weighing 10 g. Fill one cylinder with Kerosene oil and the other with distilled water each up to about 80-90 ml. capacity. Pour gently one soil specimen in the first cylinder containing Kerosene

and the other specimen in the second cylinder containing distilled water. Remove the entrapped air by gentle shaking or by stirring with clean glass rods Leave the soils in both the cylinders to settle for 24 hours or more. Read the final (constant) volume of soil specimen (not that of liquid) in both the cylinders. Kerosene is a non-polar liquid causing no swelling of the soil. The level of the soil specimen in the graduated cylinder containing Kerosene oil, therefore, is read as the original volume of the soil sample. The level of the soil specimen in the second cylinder containing distilled water is taken as the free swell level.

7.2 TRIAL PIT

Trial pits were excavated at the locations as given in the layout for visual observation of the strata and undisturbed samples were collected at every meter depth and same were tested in the laboratory as tested for samples from bore hole. The stratification as available from trail pit inspection are tabulated in a separatetable along with details of density and classification of soil .

8.0 Interpretation of Soil Strata

i) On perusal of the strata chart (Table-1) indicates the sub-soil strata at the site is heterogeneous in nature

ii) Bore hole all 14 locations the majority of soil strata from NGL to 1.5 m Gravel ,boulder & silty Sand. From 1.5 m to 8 m Boulder sand. A patch of clay gravel, boulder was encountered between 8 to 9 m however in some bores extended to 10m. Beyond which boulder sand layer was encountered up to 15 m.

NOTATIONS USED

NSL	-	Natural Surface Level
SSWL	-	Sub-soil Water Level
B	-	Width of Footing
L	-	Length of Footing
D	-	Depth of Footing
P	-	Effective Pressure
P_0	-	Initial Effective Pressure at mid height of layer
ΔP	-	Pressure Increment
q	-	Effective Surcharge at Base Level of foundation
P_n	-	Net Loading Intensity
q_{nf}	-	Net Ultimate Bearing capacity
q_a	-	Allowable b.c.
q_{ns}	-	Net safe b.c. against Shear Failure
N	-	SPT Value
N_n	-	Normalized SPT Value
C_N	-	Correction Factor for N-Value
N_C	-	Corrected SPT Value
CL	-	Clay of low plasticity
ML	-	Silt of low plasticity
SP	-	Poorly Graded Sand with no fines
SM	-	Silty Sand, Poorly Graded Sand-Silt Mixture
SW	-	Well Graded Sand with no fines
GW	-	Well Graded Gravels
GP	-	Poorly Graded Gravels
GM	-	Silty Gravels
GSF	-	General Shear Failure
LSF	-	Local Shear Failure
GC	-	Clayey Gravels
SC	-	Clayey Sands
MI	-	Silt of Medium Plasticity
CI	-	Clay of Medium Plasticity
MH	-	Silt of High Plasticity

CH	-	Clay of High Plasticity
$M_{(NP)}$	-	Non Plastic Silt
ML-CL	-	Mixture of ML and CL
ϕ	-	Angle of Internal Friction
ϕ'	-	Effective Angle of Internal Friction
ϕ_m	-	Mobilized Angle of Internal Friction
N_c, N_q, N_γ	-	Bearing Capacity Factors
S_c, S_q, S_γ	-	Shape Factors
d_c, d_q, d_γ	-	Depth Factors
w’	-	Moisture Content
γ	-	Bulk Unit Weight
γ_{sat}	-	Saturated Bulk Unit Weight
γ_d	-	Dry Bulk Density
γ'	-	Submerged Unit Weight
q_u	-	Unconfined Compressive Strength
C_u	-	Undrained Shear Strength
C’	-	Effective Cohesion
G	-	Specific Gravity
H	-	Thickness of Soil Layer
H_t	-	Thickness of sandy layer
B_t	-	Top width of sandy layer
ΔP_t	-	Stress increment at top of sandy layer
D_f	-	Depth factor
L_{yf}	-	Lateral yield factor
R_f	-	Rigidity factor
S_o	-	Settlement due to net unit foundation loading intensity (1 Kg/Cm^2)
S_{ob}	-	Settlement due to net unit foundation loading intensity under submerged conditions (1Kg/Cm^2)
S_t	-	Total settlement
e_0	-	Void Ratio
FOS	-	Factor of Safety
LL	-	Liquid Limit

PL - Plastic Limit

C_C - Compression Index

PI - Plasticity Index

BORE HOLE 1(BH-1)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.91	-
3.0	>100	>100	5.56	-
4.5	>100	>100	8.60	-
7.5	>100	>100	13.13	-
9.0	>100	>100	15.89	-
11.5	>100	>100	20.08	-
13.0	>100	>100	22.34	-
15.0	>100	>100	25.97	-

BORE HOLE 2(BH-2)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.77	-
3.0	>100	>100	5.47	-
4.5	>100	>100	8.35	-
7.5	>100	>100	12.66	-
9.0	>100	>100	15.90	-
11.5	>100	>100	20.25	-
13.0	>100	>100	22.92	-

BORE HOLE 3(BH-3)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.72	-
3.0	>100	>100	5.33	-
4.5	>100	>100	8.35	-
7.5	>100	>100	13.66	-
9.0	>100	>100	15.83	-
11.5	>100	>100	20.17	-
13.0	>100	>100	22.88	-

BORE HOLE 4(BH-4)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.80	2.80
3.0	>100	>100	5.50	5.50
4.5	>100	>100	7.86	7.86
7.5	>100	>100	13.64	13.64
9.0	>100	>100	14.76	14.76
11.5	>100	>100	18.11	18.11
13.0	>100	>100	21.02	21.02

BORE HOLE 5(BH-5)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.80	-
3.0	>100	>100	5.61	-
4.5	>100	>100	8.17	-
7.5	>100	>100	12.60	-
9.0	>100	>100	15.28	-
11.5	>100	>100	19.60	-
13.0	>100	>100	23.25	-

BORE HOLE 6(BH-6)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.821	-
3.0	>100	>100	5.507	-
4.5	>100	>100	8.100	-
7.5	>100	>100	12.309	-
9.0	>100	>100	15.373	-
11.5	>100	>100	19.212	-
13.0	>100	>100	22.627	-

BORE HOLE 7(BH-7)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.821	-
3.0	>100	>100	5.507	-
4.5	>100	>100	8.100	-
7.5	>100	>100	12.309	-
9.0	>100	>100	15.373	-
11.5	>100	>100	19.212	-
13.0	>100	>100	22.627	-

BORE HOLE 8(BH-8)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.821	-
3.0	>100	>100	5.507	-
4.5	>100	>100	8.100	-
7.5	>100	>100	12.309	-
9.0	>100	>100	15.373	-
11.5	>100	>100	19.212	-
13.0	>100	>100	22.627	-

BORE HOLE 9(BH-9)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	5.364	-
3.0	>100	>100	7.918	-
4.5	>100	>100	12.135	-
7.5	>100	>100	14.514	-
9.0	>100	>100	19.495	-
11.5	>100	>100	22.160	-
13.0	>100	>100	26.117	-

BORE HOLE 10(BH-10)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.757	-
3.0	>100	>100	5.463	-
4.5	>100	>100	7.918	-
7.5	>100	>100	11.921	-
9.0	>100	>100	15.084	-
11.5	>100	>100	19.439	-
13.0	>100	>100	21.922	-

BORE HOLE 11(BH-11)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.757	-
3.0	>100	>100	5.463	-
4.5	>100	>100	7.918	-
7.5	>100	>100	11.921	-
9.0	>100	>100	15.084	-
11.5	>100	>100	19.439	-
13.0	>100	>100	21.922	-

BORE HOLE 12(BH-12)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.689	-
3.0	>100	>100	5.324	-
4.5	>100	>100	8.722	-
7.5	>100	>100	13.362	-
9.0	>100	>100	15.579	-
11.5	>100	>100	21.586	-
13.0	>100	>100	23.088	-

BORE HOLE 13(BH-13)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.763	-
3.0	>100	>100	5.463	-
4.5	>100	>100	7.823	-
7.5	>100	>100	13.232	-
9.0	>100	>100	14.735	-
11.5	>100	>100	19.426	-
13.0	>100	>100	21.251	-

BORE HOLE 14(BH-14)

Depth m	Observed SPT	Corrected	Overburden pressure t/m^2	Correction Factor
1.5	>100	>100	2.685	-
3.0	>100	>100	5.418	-
4.5	>100	>100	7.910	-
7.5	>100	>100	13.423	-
9.0	>100	>100	14.952	-
11.5	>100	>100	20.295	-
13.0	>100	>100	23.371	-

FOUNDATION ANALYSIS:-

Case No I BH 1 : - Shear Failure Analysis:-

The shear value determined in the laboratory with the help of Shear Test on the collected samples from the location the actual lowest shear value determined in the laboratory worked out to C-value 0 Kg/cm2 and φ value as between 34°-38°.Using these values the net bearing capacity is calculated from the following formula as per IS 6403-1981 for local shear failure.

Determination of Bearing Capacity

Mode of computation

As per shear failure consideration,

Type of foundation = Raft Footing

Size of foundation be considered as 2 m,

Depth of foundation = 2 m,

Governing Soil Parameters, From Direct Shear Test

$C = 0 kg/cm^2$, $\phi = 35°$, $\phi' = 25°$

Shear failure Considerations:

Local Shear failure

N_q = 10.66,

S_q = 1.2,

d_q = 1.16

$N\gamma$ = 10.88, $S\gamma$ = 0.8,

$d\gamma$ = 1.16

$d_q = d_\gamma = 1 + 0.1 \frac{D_f}{B} \tan(45 + \phi/2) = 1.15$

γ_d = 1.88 ,

γ_b = 2.26

Net Ultimate b.c:

q_{nf} = $q (N_q-1) S_q d_q + 0.5 B\gamma N_\gamma S_\gamma d_\gamma W'$

= $62.39 t/m^2$

Net Safe b.c

'q_{ns}' = $24.95 t/m^2$(f.o.s = 2.5)

Where:

q_{nf} = Net ultimate bearing capacity

q_{ns} = Net Safe bearing capacity

ϕ = angle of shear resistance

q = Effective surcharge

B = Width of footing

γ = density

$S_c S_q S_\gamma$ = Bearing capacity factors, Shape factors

$d_c d_q d_\gamma$ = Depth factors

$i_c i_q i_\gamma$ = inclination factors

pressure has been calculated as code IS: 8009 (Part 1)1976

Nav =50

Corresponding settlement =4.8 mm

Applying water correction settlement shall be =4.8/2=9.6

Permissible settlement chosen as 25 mm

Allowable Bearing pressure works out to be ==26.04 t/m2

From among both calculations, least value is adopted

Therefore, Allowable Safe Bearing Capacity = 26.04 t/m2

CONCLUSIONS AND RECOMMENDATIONS

- On the basis of field & laboratory investigation & calculation forbearing capacity values following reference have been drawn.
- The value of allowable B.C to be adopted for design consideration at different depths are as follows
- This is the general recommendation. The designer may change the recommendation & he may decide the depth of the foundation & type of foundation as per the structural details of structure.

SUMMARY BH 1-BH 14

S. No.	size of fdn(B) m	Depth from NGL m	Type of Foundation	(qa)Net t/m2 Shear	(qa)Net t/m2 settlement (25 mm)
1	2 X 2square	0.5 m	Isolated Foundation	10.9	25.1
2	4 x 4square			17.6	20.63
3	2x5 rectangular			10.5	25.1
4	4 x7.5 rectangular		Raft Foundation	16.9	22.72
5	5x10 rectangular		Raft Foundation	20.16	21.9
6	6 x 6square		Raft Foundation	24.4	20.68
7	2 X 2square	1.0m	Isolated Foundation	15.4	25.1
8	4 x 4square			21.9	20.56
9	2 x 5 rectangular			11.9	25.51
10	6 x 6square		Raft Foundation	28.6	20.83
11	2 X 2square		Isolated Foundation	20.16	25.51

12	4 x 4square	1.5 m		26.3	22.7
13	2 x 5 rectangular			16.76	25.1
14	6 x 6square			32.88	20.53
15	2 X 2square	2.0 m	Isolated Foundation	24.95	26.04
16	4 x 4square		Isolated Foundation	30.83	22.75
17	2 x 5 rectangular			16.7	25.51
17	6 x 6square		Raft Foundation	37.24	20.63
18	2 X 2square	2.5 m	Isolated Foundation	27.28	25.51
19	4 x 4 square			28.63	22.72
20	6 x 6 square			31.2	20.63
21	2 x 5 rectangular			24.94	25.51
22	2 X2square	3 m	Isolated Foundation	**33.63**	**25.0**
23	4 x 4square			34.44	22.7
24	2 x 5 rectangular			30.10	25.51
25	6 x 6square		Raft Foundation	37.12	20.22
26	2 X 2square	4.0m	Isolated Foundation	49.8	25.1
27	4 x 4square			**43.55**	**22.72**
28	6 x 6square		Raft Foundation	45.21	20.23
29	2x 5 rectangular			30.19	25.51

BORE LOG CHART

BH-1

GEO GLOBE CONSULTANTS (GGC)

PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL

LOCATION:- Ropar Thermal Plant | DATE OF BORING :-

BH NO.:- 3 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C Kg/Cm^2	Φ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX C_c	SWELL INDEX	REMARKS
1.0	>100	>100		Silty, Sand	GM	1.3 M	15.7	22.0	58.0	20.0	NIL	NIL	N	P	2.25	1.93	2.34	0.21	-	-	35	-		Boulder Gravel, Silty Sand
1.5	>100	>100		BOULDER	GW		19.0	92.0	5.6	2.4	33.0%	NIL	N	P	2.26	1.88	2.33	0.24	-	-	36	-		Boulder ,partial core recovery
3.0	>100	>100		BOULDER	GW		20.4	95.0	4.5	0.5	32.0%	NIL	N	P	2.25	1.85	2.25	0.21	-	-	37	-		Boulder ,partial core recovery
4.5	>100	>100		BOULDER	GW		20.4	96.5	3.2	0.3	34.0%	NIL	N	P	2.32	1.91	2.32	0.21	-	-	37	-		Boulder ,partial core recovery
7.5	>100	>100		BOULDE	GW		20.1	94.5	2.8	2.7	35.0%	NIL	N	P	2.12	1.75	2.55	0.46	-	-	36	-		Boulder ,partial core recovery
9.0	>100	>100		Clayey gravel	GC		19.6	33.2	1.0	65.8	16.0%	NIL	31	11	2.13	1.77	2.50	0.42	-	2.6	12	0.18	<20 low	Boulder ,partial core recovery
11.5	>100	>100		BOULDER	GC		19.9	29.0	4.5	66.5	23.0%	NIL	N	P	2.11	1.75	2.55	0.46	-	-	36	-		Boulder ,partial core recovery
13.0	>100	>100		BOULDER	GW		22.3	28.0	4.5	67.5	35.0%	NIL	N	P	2.12	1.72	2.64	0.54			36			Boulder ,partial core recovery
15.0	>100	>100		BOULDER	GW		21.5	94.2	4.5	1.3	68.0%	NIL	N	P	2.12	1.73	2.64	0.52			37			Boulder ,partial core recovery
GGC																								

BORE LOG CHART

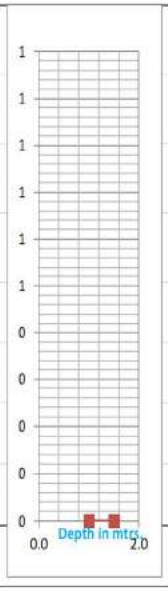
BH-2

GEO GLOBE CONSULTANTS (GGC)
PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

PROJECT:-Soil Investigation for Construction of proposed structure.
REFERENCE POINT (RL) :- NGL
LOCATION:- Ropar Thermal Plant
DATE OF BORING :-
BH NO.:- 2
DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm. FIELD Density gm/cc	DENSITY (gm. DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm² (C_u)	C' Kg/Cm²	COMPRESSION TEST	SWELL INDEX	COMPRESSION INDEX C_c	REMARKS
1.0	>100	>100		Silty, Sand	GM	1.4 M	14.7	23.0	56.0	21.0	NIL	NIL	N	P	1.99	1.72	2.63	0.53	-	-	34	Nil	-	Boulder Gravel, Silty Sand
1.5	>100	>100		Boulder	GW		21.3	53.0	42.1	4.9	42.0%	NIL	N	P	2.26	1.85	2.26	0.22	-	-	34	Nil	-	Boulder , sand ,partial core recovery
3.0	>100	>100		Boulder	GW		22.4	55.0	41.1	3.9	43.0%	NIL	N	P	2.25	1.82	2.25	0.23	-	-	36	Nil	-	Boulder , sand ,partial core recovery
4.5	>100	>100		Boulder	GW		23.5	59.0	1.9	39.1	48.0%	NIL	N	P	2.31	1.86	2.31	0.25	-	-	37	Nil	-	Boulder , sand ,partial core recovery
7.5	>100	>100		Clayey gravel	GC		24.6	37.0	1.5	61.5	47.0%	NIL	30	10	2.12	1.69	2.55	0.51	-	2.6	15	<20% low	0.19	Clayey Boulder ,partial core recovery
9.0	>100	>100		Clayey gravel	GC		22.4	36.0	2.5	61.5	22.0%	NIL	33	12	2.18	1.77	2.50	0.41	-	2.5	16	<20% low	0.19	Clayey Boulder ,partial core recovery
11.5	>100	>100		Boulder	GW		23.4	67.0	28.6	4.4	23.0%	NIL	N	P	2.19	1.76	2.55	0.45	-	-	36	Nil	-	Boulder , sand ,partial core recovery
13.0	>100	>100		Boulder	GW		24.4	68.2	27.5	4.3	35.0%	NIL	N	P	2.21	1.76	2.64	0.5		-	36	Nil		Boulder , sand ,partial core recovery
15.0	>100	>100		Boulder	GW		22.3	67.3	31.6	1.1	68.0%	NIL	N	P	2.31	1.87	2.64	0.41		-	37	Nil		Boulder , sand ,partial core recovery



GGC

BORE LOG CHART

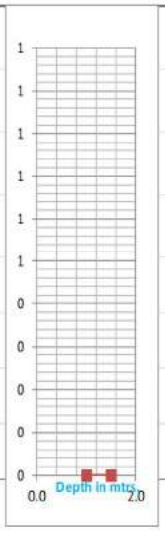
BH-3

GEO GLOBE CONSULTANTS (GGC)
PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL
LOCATION:- Ropar Thermal Plant | DATE OF BORING :-
BH NO.:- 3 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C' Kg/Cm^2	COMPRESSION TEST	COMPRESSION INDEX C_c	SWELL INDEX	REMARKS
1.0	>100	>100		Silty, Sand	GM	1.45 M	16.3	24.4	60.3	15.3	NIL	NIL	N	P	1.98	1.69	2.63	0.56	-	-	35	-		Boulder Gravel, Silty Sand
1.5	>100	>100		BOULDER	GW		23.3	63.0	3.8	33.2	40.0%	NIL	N	P	2.25	1.81	2.25	0.24	-	-	37	-		Boulder Gravel, Sand
3.0	>100	>100		BOULDER	GW		24.6	94.0	3.9	2.1	42.0%	NIL	N	P	2.23	1.78	2.23	0.26	-	-	38	-		Boulder Gravel, Sand
4.5	>100	>100		BOULDER	GW		24.5	93.0	2.5	4.5	68.0%	NIL	N	P	2.33	1.86	2.33	0.26	-	-	37	-		Boulder Gravel, Sand
7.5	>100	>100		Clayey ravel	GC		22.6	34.0	3.2	62.8	22.0%	NIL	29.6	9.5	2.25	1.82	2.55	0.4	-	2.6	15	0.2	<20 low	Boulder Gravel, Silty Clay
9.0	>100	>100		Clayey ravel	GC		23.5	35.0	2.5	62.5	23.6%	NIL	32.6	10.5	2.19	1.76	2.50	0.42	-	-	16	-		Boulder Gravel, Silty Clay
11.5	>100	>100		BOULDER	GW		25.6	26.9	3.5	69.6	20.3%	NIL	N	P	2.22	1.75	2.55	0.45	-	-	37	-		Boulder Gravel, Sand
13.0	>100	>100		BOULDER	GW		26.3	27.9	3.8	68.3	32.0%	NIL	N	P	2.24	1.76	2.64	0.5			37			Boulder Gravel, Sand
15.0	>100	>100		BOULDER	GW		24.6	59.0	37.4	3.6	33.0%	NIL	N	P	2.21	1.76	2.64	0.5			37			Boulder Gravel, Sand



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BORE LOG CHART

BH-4

GEO GLOBE CONSULTANTS (GGC)

PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

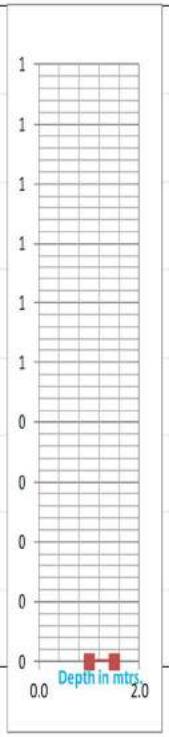
PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL

LOCATION:- Ropar Thermal Plant | DATE OF BORING :-

BH NO.:- 4 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm² (C_u)	C' Kg/Cm²	COMPRESSION TEST COMPRESSION INDEX Cc	SWELL INDEX	REMARKS
1.0	>100	>100		Silty, Sand	GM	1.39M	14.6	24.5	60.3	15.2	NIL	NIL	N	P	2.00	1.73	2.63	0.52	-	-	35	-		Boulder Gravel, Silty Sand
1.5	>100	>100		BOULDER	GW		23.6	89.0	10.2	0.8	41.0%	NIL	N	P	2.33	1.87	2.33	0.25	-	-	36	-		Boulder Gravel, Silty Sand
3.0	>100	>100		BOULDER	GW		25.6	94.3	2.3	3.4	43.0%	NIL	N	P	2.32	1.83	2.32	0.27	-	-	37	-		Boulder Gravel, Silty Sand
4.5	>100	>100		BOULDER	GW		27.8	95.3	3.1	1.6	67.0%	NIL	N	P	2.25	1.75	2.25	0.29	-	-	.	-		Boulder Gravel, Silty Sand
7.5	>100	>100		BOULDER	GW		26.6	36.1	3.4	60.5	75.0%	NIL	33.6	10.3	2.32	1.82	2.60	0.43	-	-	15	-		Boulder Gravel, Silty Sand
9.0	>100	>100		Clayey ravel	GC		24.6	27.4	3.6	69.0	25.0%	NIL	34	9.8	2.06	1.64	2.66	0.62	-	2.3	16	0.19	<20 low	Boulder Gravel, Silty Clay
11.5	>100	>100		Clayey ravel	GC		27.9	26.9	3.2	69.9	36.0%	NIL	32.6	8.1	2.03	1.57	2.65	0.68	-	2.3	9	0.19	<20 low	Boulder Gravel, Silty Clay
13.0	>100	>100		BOULDER	GW		24.6	26.9	4.0	69.1	32.0%	NIL	33.5	7.6	2.03	1.62	2.66	0.65			15			Boulder Gravel, Silty Sand
15.0	>100	>100		BOULDE	GW		25.6	95.3	3.4	1.3	55.0%	NIL	N	P	2.32	1.83	2.67	0.46			37			Boulder Gravel, Silty Sand



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BORE LOG CHART

BH-5

GEO GLOBE CONSULTANTS (GGC)

PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

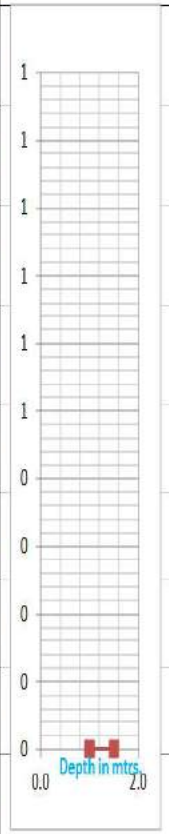
PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL

LOCATION:- Ropar Thermal Plant | DATE OF BORING :-

BH NO.:- 5 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (Cu)	C Kg/Cm^2	Φ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX Cc	swell index	REMARKS
1.0	>100	>100		Silty, Sand	GM	1.45 M	15.6	23.7	60.3	16.1	NIL	NIL	N	P	1.99	1.71	2.63	0.54	-	-	34	-		Boulder Gravel, Silty Sand
1.5	>100	>100		BOULDER	GW		22.6	58.0	30.8	11.2	28.0%	NIL	N	P	2.31	1.87	2.31	0.24	-	-	35	-		Boulder Cobble ,partial core recovery
3.0	>100	>100		BOULDER	GW		23.6	67.0	29.1	3.9	25.0%	NIL	N	P	2.33	1.87	2.33	0.25	-	-	36	-		Boulder , sand, partial core recovery
4.5	>100	>100		BOULDER	GW		26.3	77.4	20.1	2.5	26.0%	NIL	N	P	2.31	1.81	2.31	0.27	-	-	37	-		Boulder ,partial core recovery
7.5	>100	>100		Clayey gravel	GW		24.6	35.6	3.2	61.2	18.0%	NIL	30.2	10.2	2.11	1.68	2.55	0.52	-	3.3	15	0.19	<20 low	Boulder ,clayey soil
9.0	>100	>100		Clayey gravel	GC		23.9	27.4	2.5	70.1	16.0%	NIL	31.2	9.8	2.12	1.70	2.50	0.47	-	3.1	16	0.19	<20 low	Boulder ,clayey soil
11.5	>100	>100		BOULDER	GW		24.6	69.6	3.5	26.9	25.0%	NIL	N	P	2.14	1.70	2.55	0.5	-	-	33	-		Boulder , sand, partial core recovery
13.0	>100	>100		BOULDER	GW		23.7	69.3	3.8	26.9	26.0%	NIL	N	P	2.23	1.79	2.64	0.48			36			Boulder , sand, partial core recovery
15.0	>100	>100		BOULDER	GW		24.9	60.4	3.6	36.0	24.0%	NIL	N	P	2.32	1.84	2.64	0.43			37			Boulder , sand, partial core recovery



GGC

BORE LOG CHART

BH-6

GEO GLOBE CONSULTANTS (GGC)
PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

PROJECT:-Soil Investigation for Construction of proposed structure.
LOCATION:- Ropar Thermal Plant
BH NO.:- 6

REFERENCE POINT (RL) :- NGL
DATE OF BORING :-
DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE		I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C' Kg/Cm^2	ϕ^0 DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX C_c	swell index	REMARKS
1.0	>100	>100	1		Silty, Sand	GM	1.45 M	17.4	22.0	60.3	17.7	NIL	NIL	N	P	1.98	1.67	2.63	0.57	-	-	34	-		Boulder Gravel, Silty Sand
1.5	>100	>100	1		Boulder	GW		22.4	65.0	26.5	8.5	23.0%	NIL	N	P	2.32	1.88	2.32	0.23	-	-	35	-		Boulder sand, partial core recovery
3.0	>100	>100	1		Boulder	GW		24.9	85.0	11.1	3.9	24.0%	NIL	N	P	2.31	1.84	2.31	0.26	-	-	36	-		Boulder sand, partial core recovery
4.5	>100	>100	1		Boulder	GW		27.9	86.3	11.2	2.5	25.3%	NIL	N	P	2.32	1.80	2.32	0.29	-	-	37	-		Boulder sand, partial core recovery
7.5	>100	>100	1		Clayey ravel	GW		27.0	38.0	3.6	58.4	17.3%	NIL	28.5	11.2	2.10	1.64	2.55	0.55	-	3.6	15	0.21	<20 low	clayey gravel
9.0	>100	>100	0		Clayey ravel	GC		27.8	27.4	3.6	69.0	16.0%	NIL	30.2	10.3	2.20	1.71	2.50	0.46	-	-	16	0.22	<20 low	clayey gravel
11.5	>100	>100	0		Boulder	GC		26.5	69.9	26.9	3.2	25.0%	NIL	N	P	2.13	1.67	2.13	0.28	-	-	33	-		Boulder sand, partial core recovery
13.0	>100	>100	0		Boulder	GC		27.1	56.6	39.6	3.8	26.0%	NIL	N	P	2.23	1.74	2.23	0.28			38			Boulder sand, partial core recovery
15.0	>100	>100	0		Boulder			24.8	58.7	38.2	3.1	28.0%	NIL	N	P	2.32	1.84	2.32	0.26			38			Boulder sand, partial core recovery

GGC

BORE LOG CHART

BH-7

GEO GLOBE CONSULTANTS (GGC)
PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL
LOCATION:- Ropar Thermal Plant | DATE OF BORING :-
BH NO.:- 7 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE		I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C Kg/Cm^2	COMPRESSION TEST	COMPRESSION INDEX C_c	swell index	REMARKS
1.0	>100	>100			Silty, Sand	GM	1.34M	17.4	22.0	60.3	17.7	NIL	NIL	N	P	1.98	1.67	2.63	0.57	-	-	34	-		Boulder Gravel, Silty Sand
1.5	>100	>100			Boulder	GW		22.4	59.0	32.5	8.5	23.0%	NIL	N	P	2.32	1.88	2.32	0.23	-	-	35	-		Boulder Sand ,partial core recovery
3.0	>100	>100			Boulder	GW		24.9	62.0	34.1	3.9	26.0%	NIL	N	P	2.31	1.84	2.31	0.26	-	-	36	-		Boulder Sand ,partial core recovery
4.5	>100	>100			Boulder	GW		27.9	65.3	32.3	2.4	25.0%	NIL	N	P	2.32	1.80	2.32	0.29	-	-	37			Boulder Sand ,partial core recovery
7.5	>100	>100			Clayey gravel	GC		27.0	38.0	3.6	58.4	28.0%	NIL	28.5	11.2	2.10	1.64	2.55	0.55	-	2.8	15	0.22	<20 LOW	clayey gravel
9.0	>100	>100			Clayey gravel	GC		27.8	27.4	3.6	69.0	21.0%	NIL	30.2	10.3	2.20	1.71	2.50	0.46	-	2.6	16	0.23	<20 LOW	clayey gravel
11.5	>100	>100			Boulder	GW		26.5	69.5	27.3	3.2	40.0%	NIL	N	P	2.13	1.67	2.13	0.28	-	-	33	-		Boulder Sand ,partial core recovery
13.0	>100	>100			Boulder	GW		27.1	57.6	38.6	3.8	42.0%	NIL	N	P	2.23	1.74	2.23	0.28			38			Boulder Sand ,partial core recovery
15.0	>100	>100			Boulder	GW		24.8	74.0	22.9	3.1	43.0%	NIL	N	P	2.32	1.84	2.32	0.26			38			Boulder Sand ,partial core recovery
GGC																									

BORE LOG CHART

BH-8

GEO GLOBE CONSULTANTS (GGC)

PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

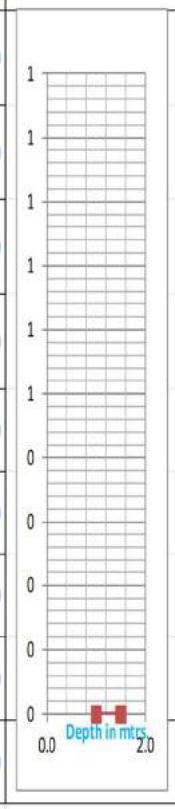
PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL

LOCATION:- Ropar Thermal Plant | DATE OF BORING :-

BH NO.:- 8 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm/cc) FIELD Density gm/cc	DENSITY (gm/cc) DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C Kg/Cm^2	ϕ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX C_c	swell index	REMARKS
1.0	>100	>100		Silty, Sand	GM	1.2 M	17.4	22.0	60.3	17.7	NIL	NIL	N	P	1.98	1.67	2.63	0.57	-	-	34	-		Boulder Gravel, Silty Sand
1.5	>100	>100		Boulder	GW		22.4	56.0	8.5	35.5	36.0%	NIL	N	P	2.32	1.88	2.32	0.23	-	-	35	-		Boulder Gravel, sand partial core recovery
3.0	>100	>100		Boulder	GW		24.9	52.3	3.9	43.8	38.0%	NIL	N	P	2.31	1.84	2.31	0.26	-	-	36	-		Boulder Gravel, sand partial core recovery
4.5	>100	>100		Boulder	GW		27.9	55.6	2.5	41.9	35.0%	NIL	N	P	2.32	1.80	2.32	0.29	-	-	37	-		Boulder Gravel, sand partial core recovery
7.5	>100	>100		Clayey ravel	GW		27.0	38.0	3.6	58.4	52.0%	NIL	28.5	11.2	2.10	1.64	2.55	0.55	-	2.45	15	0.15	< 20 low	Clayey Gravel
9.0	>100	>100		Clayey ravel	GC		27.8	27.4	3.6	69.0	26.0%	NIL	30.2	10.3	2.20	1.71	2.50	0.46	-	2.63	16	0.16	< 20 low	Clayey Gravel
11.5	>100	>100		Boulder	GW		26.5	26.9	69.2	3.9	36.0%	NIL	N	P	2.13	1.67	2.13	0.28	-	-	33	-		Boulder Gravel, sand partial core recovery
13.0	>100	>100		Boulder	GW		27.1	26.5	69.8	3.7	38.0%	NIL	N	P	2.23	1.74	2.23	0.28			38			Boulder Gravel, sand partial core recovery
15.0	>100	>100		Boulder	GW		24.8	32.0	58.6	9.4	35.0%	NIL	N	P	2.32	1.84	2.32	0.26			38			Boulder Gravel, sand partial core recovery



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BORE LOG CHART

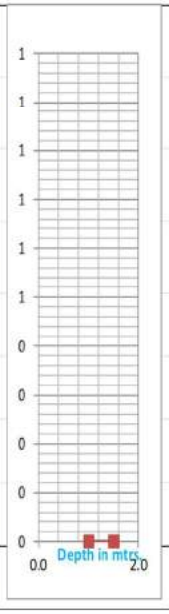
BH-9

GEO GLOBE CONSULTANTS (GGC)
PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL
LOCATION:- Ropar Thermal Plant | DATE OF BORING :-
BH NO.:- 9 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm² (C_u)	C' Kg/Cm²	COMPRESSION TEST	COMPRESSION INDEX C_c	swell index	REMARKS
1.0	>100	>100		Silty, Sand	GM	1.37 M	14.5	24.4	61.2	14.4	NIL	NIL	N	P	1.99	1.72	2.63	0.53	-	-	35	-		Boulder Gravel, Silty Sand
1.5	>100	>100		Boulder	GW		23.6	59.3	31.5	9.2	35.6%	NIL	N	P	2.25	1.81	2.25	0.25	-	-	35	-		Boulder Gravel, Silty Sand
3.0	>100	>100		Boulder	GW		25.4	55.4	7.6	37.0	33.0%	NIL	N	P	2.26	1.79	2.26	0.26	-	-	36	-		Boulder Gravel, Silty Sand
4.5	>100	>100		Boulder	GW		26.3	55.7	11.4	33.0	32.0%	NIL	N	P	2.24	1.76	2.24	0.27	-	-	37	-		Boulder Gravel, Silty Sand
7.5	>100	>100		Clayey gravel	GW		25.7	25.4	5.8	68.8	36.0%	NIL	31	10.9	2.05	1.62	2.63	0.63	-	1.9	17	0.16	<20 LOW	Clayey Gravel,
9.0	>100	>100		Clayey gravel	GC		28.6	26.9	4.3	68.8	33.0%	NIL	29.7	9.4	2.09	1.61	2.63	0.63	-	2.5	16	0.18	<20 LOW	Clayey Gravel,
11.5	>100	>100		Boulder	GW		27.6	52.4	36.3	11.3	32.0%	NIL	N	P	2.18	1.70	2.18	0.29	-	-	34	-		Boulder Gravel, Silty Sand
13.0	>100	>100		Boulder	GW		26.3	53.6	30.2	16.2	33.0%	NIL	N	P	2.17	1.70	2.17	0.27			37			Boulder Gravel, Silty Sand
15.0	>100	>100		Boulder	GW		24.8	55.4	1.2	43.4	33.0%	NIL	N	P	2.19	1.74	2.19	0.26			37			Boulder Gravel, Silty Sand



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BORE LOG CHART

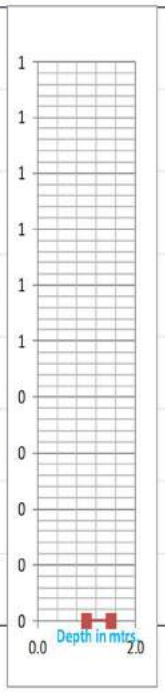
BH-10

GEO GLOBE CONSULTANTS (GGC)
PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL
LOCATION:- Ropar Thermal Plant | DATE OF BORING :-
BH NO.:- 10 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C' Kg/C m^2	Φ^0 DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX C_c	swell index	REMARKS
1.0	>100	>100		Silty. Sand	GM	1.36	13.6	23.5	59.3	17.3	NIL	NIL	N	P	1.98	1.73	2.63	0.52	-	-	34	-		Boulder Gravel, Silty Sand
1.5	>100	>100		Boulder	GW		26.3	56.0	30.3	13.7	36.0%	NIL	N	P	2.34	1.84	2.34	0.27	-	-	35	-		Boulder Gravel, Sand
3.0	>100	>100		Boulder	GW		28.6	45.0	47.4	7.6	38.0%	NIL	N	P	2.36	1.82	2.36	0.3	-	-	37	-		Boulder Gravel, Sand
4.5	>100	>100		Boulder	GW		26.3	40.0	49.4	10.6	41.0%	NIL	N	P	2.24	1.76	2.24	0.27	-	-	37	-		Boulder Gravel, Sand
7.5	>100	>100		Clayey gravel	GC		28.6	36.3	12.6	51.1	20.0%	NIL	29.3	11.23	2.06	1.59	2.63	0.65	-	2.2	18	0.15	<20 LOW	Clayey Gravel,
9.0	>100	>100		Clayey gravel	GC		24.3	25.3	4.3	70.4	21.4%	NIL	32	9.5	2.10	1.68	2.63	0.57	-	2.3	18	0.15	<20 LOW	Clayey Gravel,
11.5	>100	>100		Boulder	GW		25.6	56.3	36.3	7.4	36.0%	NIL	N	P	2.14	1.69	2.14	0.27	-	-	35	-		Boulder Gravel, Sand
13.0	>100	>100		Boulder	GW		26.5	56.0	30.2	13.8	40.0%	NIL	N	P	2.15	1.69	2.15	0.28			36			Boulder Gravel, Sand
15.0	>100	>100		Boulder	GW		24.8	45.0	53.5	1.5	43.0%	NIL	N	P	2.16	1.72	2.16	0.26			37			Boulder Gravel, Sand



BORE LOG CHART

BH-11

GEO GLOBE CONSULTANTS (GGC)

PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

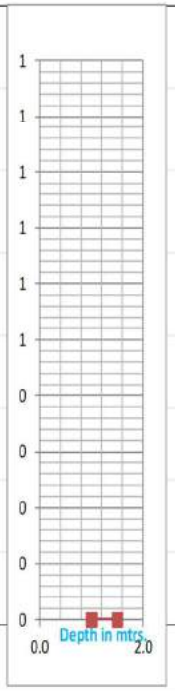
PROJECT:-Soil Investigation for Construction of proposed structure. REFERENCE POINT (RL) :- NGL

LOCATION:- Ropar Thermal Plant DATE OF BORING :-

BH NO.:- 11 DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE		I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm, FIELD Density gm/cc	DENSITY (gm, DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C Kg/Cm^2	ϕ DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX C_c	REMARKS
1.0	>100	>100			Silty, Sand	GM	1.15	13.6	23.5	59.3	17.3	NIL	NIL	N	P	1.98	1.73	2.63	0.52	-	-	36	-	Boulder Gravel, Silty Sand
1.5	>100	>100			Boulder	GW		26.3	56.0	30.3	13.7	36.0%	NIL	N	P	2.34	1.84	2.34	0.27	-	-	37	-	Boulder Gravel, Silty Sand
3.0	>100	>100			Boulder	GW		28.6	82.3	7.6	10.1	38.0%	NIL	N	P	2.36	1.82	2.36	0.3	-	-	37	-	Boulder Gravel, Silty Sand
4.5	>100	>100			Boulder	GW		26.3	81.2	10.6	8.2	41.0%	NIL	N	P	2.24	1.76	2.24	0.27	-	-	37	-	Boulder Gravel, Silty Sand
7.5	>100	>100			Clayey ravel	GW		28.6	36.3	12.6	51.1	20.0%	NIL	29.3	11.23	2.06	1.59	2.63	0.65	-	2.3	18	0.15	Clayey Gravel,
9.0	>100	>100			Clayey ravel	GC		24.3	25.3	4.3	70.4	21.4%	NIL	32	9.5	2.10	1.68	2.63	0.57	-	2.2	18	0.16	Clayey Gravel,
11.5	>100	>100			Boulder	GC		25.6	56.3	36.3	7.4	36.0%	NIL	N	P	2.14	1.69	2.14	0.27	-	-	35	-	Boulder Gravel, Silty Sand
13.0	>100	>100			Boulder	GC		26.5	78.0	15.0	7.0	43.0%	NIL	N	P	2.15	1.69	2.15	0.28			36		Boulder Gravel, Silty Sand
15.0	>100	>100			Boulder			24.8	96.3	1.5	2.2	41.0%	NIL	N	P	2.16	1.72	2.16	0.26			37		Boulder Gravel, Silty Sand



GGC

BORE LOG CHART

BH-12

GEO GLOBE CONSULTANTS (GGC)

PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

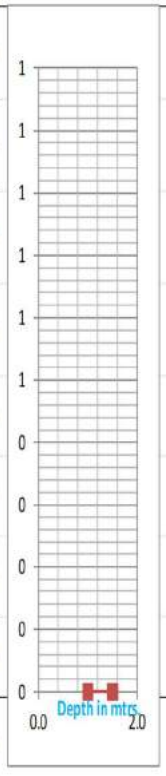
PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL

LOCATION:- Ropar Thermal Plant | DATE OF BORING :-

BH NO.:- 12 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE	I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm² (C_u)	C' Kg/Cm²	COMPRESSION TEST COMPRESSION INDEX Cc	swell index	REMARKS
1.0	>100	>100		Silty, Sand	GM	1 M	18.6	20.6	53.6	25.8	NIL	NIL	N	P	2.13	1.78	2.63	0.48	-	-	34	-	-	Boulder Gravel, Silty Sand
1.5	>100	>100		Boulder	GW		22.3	58.0	32.6	9.4	32.0%	NIL	N	P	2.21	1.79	2.21	0.23	-	-	36	-	-	Boulder Gravel, Silty Sand
3.0	>100	>100		Boulder	GW		28.6	55.0	16.4	28.6	36.0%	NIL	N	P	2.30	1.77	2.30	0.3	-	-	37	-	-	Boulder Gravel, Silty Sand
4.5	>100	>100		Boulder	GW		25.4	64.0	31.2	4.8	42.0%	NIL	N	P	2.45	1.94	2.45	0.26	-	-	38	-	-	Boulder Gravel, Silty Sand
7.5	>100	>100		Boulder	GW		21.4	68.0	29.6	2.4	45.0%	NIL	N	P	2.18	1.78	2.63	0.48	-	-	37	-	-	Boulder Gravel, Silty Sand
9.0	>100	>100		Clayey ravel	GC		22.6	23.0	5.3	71.7	10.0%	NIL	30.2	9.5	2.14	1.73	2.63	0.52	-	1.8	14	0.18	< 20 low	Clayey Gravel,
11.5	>100	>100		Boulder	GW		22.6	55.0	25.3	19.7	35.0%	NIL	N	P	2.32	1.88	2.32	0.24	-	-	36	-	-	Boulder Gravel, Silty Sand
13.0	>100	>100		Boulder	GW		25.7	56.0	21.4	22.6	46.0%	NIL	N	P	2.25	1.78	2.25	0.27			38	-	-	Boulder Gravel, Silty Sand
15.0	>100	>100		Boulder	GW		23.6	71.3	27.3	1.4	48.0%	NIL	N	P	2.36	1.89	2.36	0.25			37	-	-	Boulder Gravel, Silty Sand



GGC

BORE LOG CHART

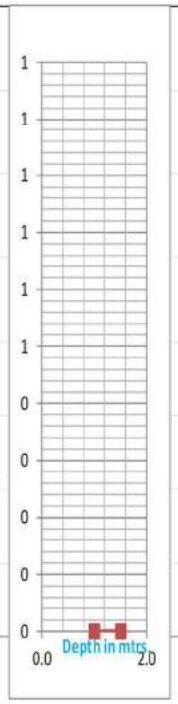
BH-13

GEO GLOBE CONSULTANTS (GGC)
PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL
LOCATION:- Ropar Thermal Plant | DATE OF BORING :-
BH NO.:- 13 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE		I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm/cc) FIELD Density gm/cc	DENSITY (gm/cc) DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C' Kg/Cm^2	COMPRESSION TEST COMPRESSION INDEX C_c		REMARKS
1.0	>100	>100		Silty, Sand	GM		1.2 M	21.6	20.6	54.3	25.1	NIL	NIL	N	P	2.12	1.73	2.63	0.52	-	-	34	-	Boulder Gravel, Silty Sand
1.5	>100	>100		COBBLE	GW			22.8	55.6	36.0	8.4	32.0%	NIL	N	P	2.28	1.84	2.28	0.24	-	-	36	-	Boulder Gravel, Silty Sand
3.0	>100	>100		COBBLE	GW			28.6	78.6	11.2	10.2	36.0%	NIL	N	P	2.36	1.82	2.36	0.3	-	-	37	-	Boulder Gravel, Silty Sand
4.5	>100	>100		COBBLE	GW			33.6	75.3	12.3	12.4	42.0%	NIL	N	P	2.34	1.74	2.34	0.35	-	-	38	-	Boulder Gravel, Silty Sand
7.5	>100	>100		COBBLE	GW			22.6	68.4	19.3	12.3	45.0%	NIL	N	P	2.18	1.76	2.63	0.49	-	-	37	-	Boulder Gravel, Silty Sand
9.0	>100	>100		Clayey ravel	GC			23.6	31.0	5.3	63.7	10.0%	NIL	31.2	9.23	2.04	1.64	2.63	0.61	-	1.9	14	0.2	Clayey Gravel,
11.5	>100	>100		COBBLE	GC			24.5	68.6	26.3	5.1	35.0%	NIL	N	P	2.12	1.69	2.12	0.26	-	-	36	-	Boulder Gravel, Silty Sand
13.0	>100	>100		COBBLE	GC			32.4	78.6	16.3	5.1	46.0%	NIL	N	P	2.18	1.63	2.18	0.33			38		Boulder Gravel, Silty Sand
15.0	>100	>100		COBBLE				20.4	85.0	2.3	12.7	48.0%	NIL	N	P	2.36	1.94	2.36	0.21			37		Boulder Gravel, Silty Sand



GGC

BORE LOG CHART

BH-14

GEO GLOBE CONSULTANTS (GGC)

PLOT NO. 777, INDUSTRIAL AREA, Sector 82, MOHALI (pb)

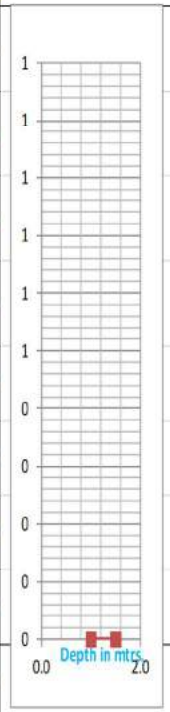
PROJECT:-Soil Investigation for Construction of proposed structure. | REFERENCE POINT (RL) :- NGL

LOCATION:- Ropar Thermal Plant | DATE OF BORING :-

BH NO.:- 14 | DIA OF CASING=150 mm

LABORATORY TEST RESULTS

DEPTH FROM NGL (m)	SPT (N) BLOWS 30cm OBSERVED	SPT (N) BLOWS 30cm CORRECTED	STANDARD PENETRATION RESISTANCE CURVE		I.S.C. GROUP		Level Of Water Table	% MOISTURE	% GRAVEL MODULES (-80 MM FRACTION)	% SAND	% SILT + CLAY (-75 MICRON)	Core Recovery	RQD	LL	PI	DENSITY (gm FIELD Density gm/cc	DENSITY (gm DRY Density gm/cc	SP. GRAVITY	VOID RATIO	UNCONFINED COMP. STRN Kg/Cm^2 (C_u)	C' Kg/Cm^2	φ° DIRECT SHEAR TRIAXIAL COMPRESSION TEST	COMPRESSION INDEX Cc	swell index	REMARKS
1.0	>100	>100			Silty, Sand	GM	1.2 M	22.6	31.2	54.3	14.5	NIL	NIL	N	P	2.13	1.72	2.63	0.53	-	-	33	-	-	Boulder Gravel, Silty Sand
1.5	>100	>100			COBBLE	GW		23.6	56.3	32.2	11.5	32.0%	NIL	N	P	2.23	1.79	2.23	0.25	-	-	35	-	-	Boulder Gravel, Silty Sand
3.0	>100	>100			COBBLE	GW		26.9	36.0	38.7	25.3	33.0%	NIL	N	P	2.31	1.81	2.31	0.28	-	-	37	-	-	Boulder Gravel, Silty Sand
4.5	>100	>100			COBBLE	GW		31.6	39.0	40.2	20.8	41.0%	NIL	N	P	2.33	1.76	2.33	0.33	-	-	38	-	-	Boulder Gravel, Silty Sand
7.5	>100	>100			COBBLE	GW		23.6	36.0	26.3	37.7	25.0%	NIL	N	P	2.23	1.79	2.63	0.47	-	-	37	-	-	Boulder Gravel, Silty Sand
9.0	>100	>100			Clayey ravel	GC		24.2	25.0	3.6	71.4	11.0%	NIL	30	8	2.08	1.66	2.63	0.58	-	2.2	12	0.18	<20 low	Clayey Gravel,
11.5	>100	>100			COBBLE	GW		25.4	35.0	26.3	38.7	35.0%	NIL	N	P	2.23	1.76	2.23	0.26	-	-	37	-	-	Boulder Gravel, Silty Sand
13.0	>100	>100			COBBLE	GW		23.6	75.6	18.3	6.1	45.0%	NIL	N	P	2.24	1.80	2.24	0.25			36	-	-	Boulder Gravel, Silty Sand
15.0	>100	>100			COBBLE	GW		22.3	86.5	8.9	4.6	42.0%	NIL	N	P	2.36	1.91	2.36	0.23			37	-	-	Boulder Gravel, Silty Sand



GGC

TRIAL PITS

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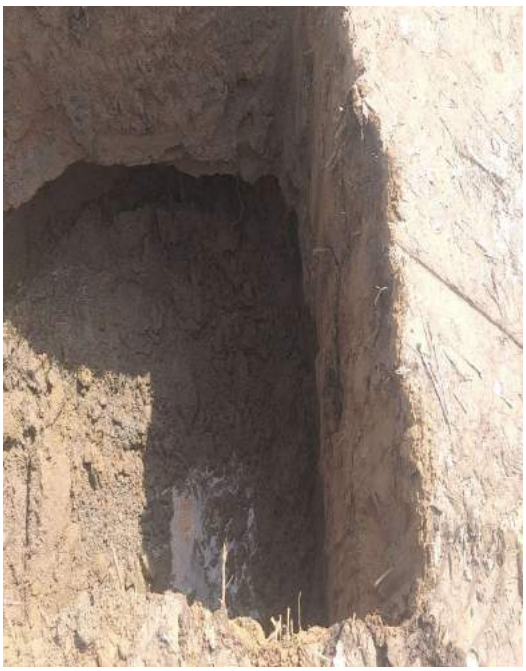

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CHEMICAL TEST RESULT

S.NO	Description Of solids	Tested as per IS code	Result (ppm)	Permissible Limit max (ppm)
1	**Sulphate**	**IS 3025(Part 24)**	**72.5-100.2**	**400**
2	**Chloride**	**IS 3025 (Part 32)**	**26.4-45.6**	**2000**
3	**Carbonates**	**IS 3025 (Part 21**	**16.3-25.4**	**200**
4	**Nitrates**	IS 3025 (Part 34)	**1.06-2.2**	**45**
5	**Ph**	**IS 3025 (Part 7)**	**7-7.6**	**8.5**
6	**Organic matter**	**IS 3025 (Part 32)**	**23.9-60.2**	**200**

BIBLIOGRAPHY:-

1) (IS 1892-1979): Code of practice for subsurface investigation for foundations

2) (IS: 2131) : Code of practice for Standard Penetration test

3) (IS 2720 part 4): Methods of test for soils part 4, grain size analysis

4) (IS 2720 part 5): Methods of test for soils part 5 Determination of liquid and plastic limits

5) (IS 2720 part 10): Methods of test for soils part 10, determination of unconfined compression test.

6) (IS 2720 part 11) : Methods of test for soils part 10, determination of unconfined compression test, determination of shear strength parameters of soil specimen tested in unconsolidated un drained triaxial compression without the measurement of pore water pressure (amendment 3) Reaffirmed 1990 CED 23

7) (IS 2720 part 15): Methods os test for soils part 15, Determination of consolidation properties.

8) (IS 2720 part 13): Methods of test for soils part 13, Direct Shear Test.

9) (IS 6403 -1981): Code of practice for determination of bearing capacity of shallow foundations.

10) Settlement Consideration :(IS: 8009 (Part-I)-1976 Reaffirmed 2003)

CBR TESTING

AT 400 KV

SUBSTATION

ROPAR

GEO GLOBE CONSULTANTS
Plot No. 777, Sector 82, JLPL, S.A.S.Nagar, Mohali

1. INTRODUCTION:-

The job of collection of soil samples from site, testing of field density, field moisture content and testing of various other soil parameters in laboratory to determine the CBR value of subgrade soil for the preparation of Roads for Petrol pump unit as titled.

2. PURPOSE OF TESTING:-

These Pavements are to be improved to cater for the increased provide the required crust. The Properties of sub grade soil play an important role in road design. Sub grade soil is an integral part of the road pavement structure as it supports the pavement from beneath. The main function of sub grade is to give adequate support to the pavement and for this the sub grade should possess sufficient stability under adverse climatic and load conditions.

The failure of pavement is generally attributed to the poor sub grade stability caused due to various reasons.

As per provision in IRC:SP:20-2002 Chapter-5.3.1, for pavement design, the sub grade strength should be determined in terms of CBR at the most critical moisture conditions likely to occur. The CBR test should be conducted on remolded samples prepared at optimum moisture content & dry density corresponding to standard proctor compaction. (lS:2720 (Part 7)-1980] and soaked in water for four days prior to testing. If annual rainfall is 500 mm or less & the water table is too deep, soaking for 4 days may not be necessary. One or two CBR tests should be done per kilometer depending on the variation of soil type. If there is no variation in soil type, mean CBR value should be adopted for the design of pavements. In case of existing roads requiring strengthening, the soil should be moulded at the existing moisture content & Field density, and soaked for four days prior to testing for CBR.

3. COLLECTION OF SAMPLES:-

The samples were collected from the shoulders of the site at Dhariwal the pre-determined locations.

The top soil about 30cm was removed to avoid vegetation and loose materials. The samples in this case were collected in plastic bags & brought to laboratory for testing.

4. TESTS PERFORMED:-

The following tests were performed in the field.

1. Field Density (IS 2720 PART - XXVIII)
2. Field Moisture Content (IS 2720 PART - II)

The following tests were performed in the lab.

1. Soil gradation (IS 2720 PART - IV)
2. Plasticity Index (IS 2720 PART - V)
3. Un Soaked & Soaked CBR values (1S2720 PART - XVI)

Brief requirement of test & methodology followed IS as Under

4.1 Field Density & Field Moisture Content:-

4.1(a) This test is conducted to determine the field density at sub grade level. In case of existing roads requiring strengthening, the soil should be moulded at the existing moisture content & Field density, and soaked for four days prior to testing of CBR.

4.1(b) Procedure:-The Field density is determined by core cutter method. The top earth up to the existing subgrade level is removed. The dolly & the cutter is placed & rammed gently in to the soil till about one cm. of the dolly protrudes above the surface. Dig out the cutter containing the soil extruding from the ground. Remove the dolly & trim off any soil extruding from the ends. Weigh the cutter full of soil & keep a representative sample for water content determination. Measure the inside dimensions of the cutter & calculate its volume. Weigh the cutter without Dolly. Calculate the dry density of the soil by knowing its weight, volume and water content.

4.3(b) Procedure:-the water content at which the soil will begin to crumble when rolled into a The liquid limit test is conducted on the standard instrument with soil specimens at various moisture contents. The liquid limit is taken as that moisture content where the standard groove will close under an impact of 25 blows. The plastic limit is thread of 3mm in diameter. The plasticity index is taken as the difference between liquid limit and plastic limit.

4.4 MOISTURE DENSITY RELATIONSHIP: (IS: 2720 PART-VII)

4.4(a)Purpose:-Soil changes by varying the moisture content under the standard compaction The sub grade soil is to be rolled and compacted at optimum moisture content to achieve the max density. The MDD varies from soil to soil. The density of so.

4.4(b)Procedure:-Two degrees of compaction, light compaction (IS: 2720, Part VII) and heavy compaction (IS: 2720, Part VIII) are usually specified. The former compaction also goes by the term Proctor compaction and latter by the term modified proctor.

light compaction. The wet soil is compacted in three equal layers by the rammer of weight 2.6 kg and free fall 31 cm with 25 evenly distributed blows on each layer. In heavy compaction, rammer weights 4.89 kg and the free fall is 45cm. Compaction is done in 5 equal layers, each being given 56 blows.

The procedure is to compact the soil with different moisture content and drawing a moisture density curve to find out the maximum dry density and the corresponding moisture content (OMC).

4.5 Laboratory CBR (IS 2720 Part XVI)

4.5(a)Purpose:-This is the penetration test used for evaluation of the stability of the soil sub grade& other flexible pavement materials. The test results are correlated with flexible pavement thickness requirement for highways.

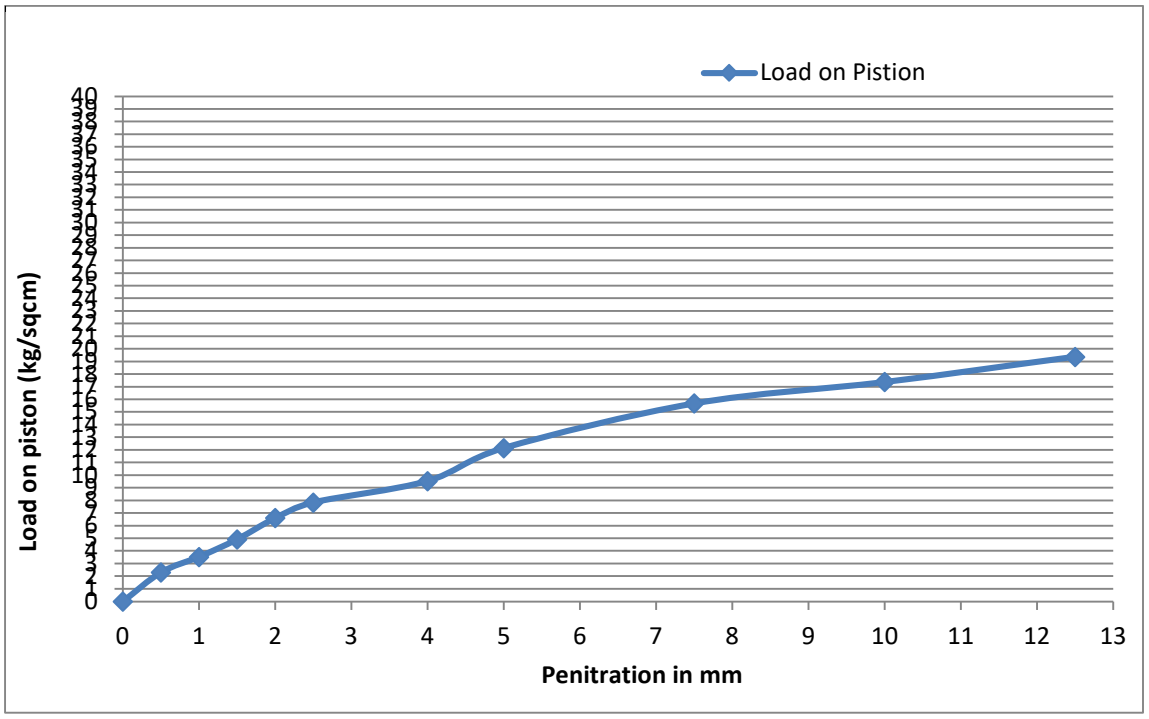
4.5(b)Procedure:-The CBR test is performed on remolded soil samples in the laboratory. The moulds are prepared in laboratory compacted at OMC to modify proctor density as worked out in laboratory (for heavy compaction).

The CBR test is conducted at 100 % of MDD at Optimum moisture content which is taken from the results of the test conducted in the lab.

The apparatus consists of a mould 15 cm diameter with a base plate and collar, a loading frame with cylindrical plunger of 5 cm collar and diameter gauges for measuring the expansion on soaking and be penetration values. Briefly, the test consists of causing the plunger to penetrate the compacted specimen with specified surcharge in the mould at 1.25 mm/minute under 4 days soaked or unsoaked condition. A load v/s penetration curve is plotted, correction is applied and the load corresponding to 2.5 and 5 mm penetration value are found. This load is expressed as a percentage of the standard load at the respective deformation level to obtain the CBR value. The standard loads for 2.5 mm and 5 mm penetrations are 1,370 kg and 2,055 kg respectively. The CBR usually selected is at 2.5 mm penetration. For this test,only the material passing 20 mm sieve is used.

Location 1

Penetration	soaked CBR Value			CBR value at 98 % MDD
	Dial Gauge	Load	Load on piston	
(mm)	reading(Div)	(Kg)	(kg/sqcm)	
0	0	0	0	11.2
0.5	1.5	45.3	2.31	
1.0	2.3	69.5	3.54	
1.5	3.2	96.6	4.92	
2.0	4.3	129.9	6.62	
2.5	5.1	154.0	7.85	
4.0	6.2	187.2	9.54	11.6
5.0	7.9	238.6	12.15	
7.5	10.2	308.0	15.69	
10.0	11.3	341.3	17.38	
12.5	12.6	380.5	19.38	

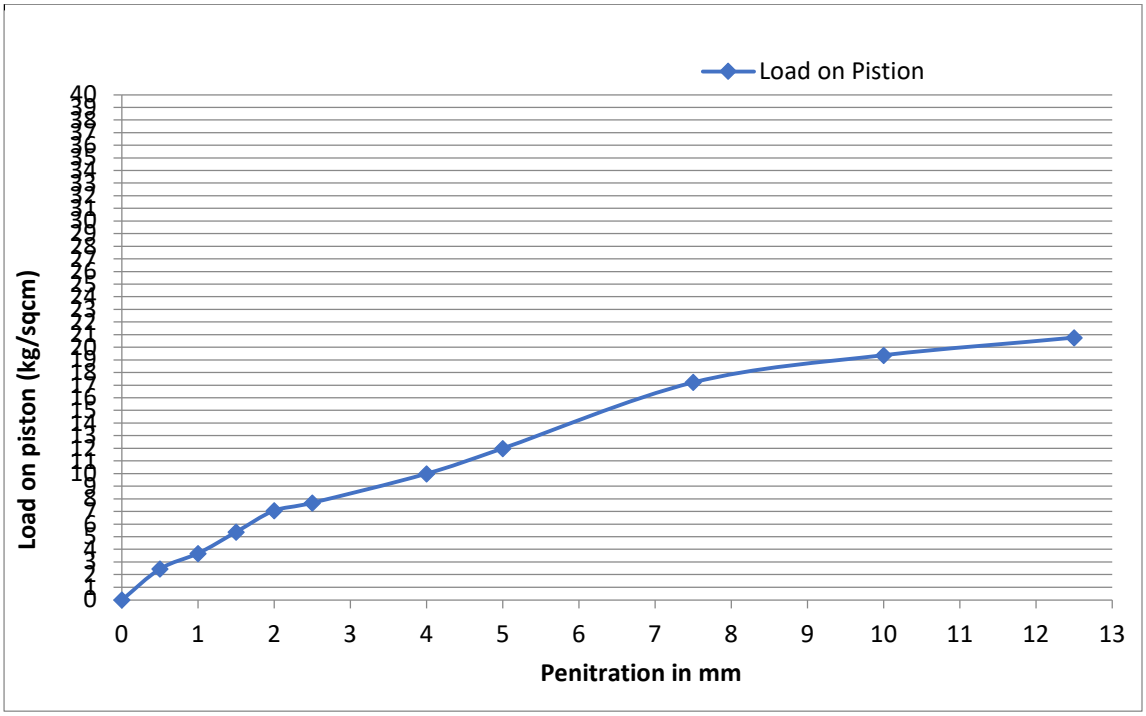


Location 2

Penetration	soaked CBR Value	CBR value at 98 % MDD

	Dial Gauge	Load	Load on piston	
(mm)	reading(Div)	(Kg)	(kg/sqcm)	
0	0	0	0	11.0
0.5	1.6	48.3	2.46	
1.0	2.4	72.5	3.69	
1.5	3.5	105.7	5.38	
2.0	4.6	138.9	7.08	
2.5	5.0	151.0	7.69	
4.0	6.5	196.3	10.00	11.4
5.0	7.8	235.6	12.00	
7.5	11.2	338.2	17.23	
10.0	12.6	380.5	19.38	
12.5	13.5	407.7	20.77	

Location 2



Location 3

Penetration	soaked CBR Value			CBR value at 98 % MDD
	Dial Gauge	Load	Load on piston	
(mm)	reading(Div)	(Kg)	(kg/sqcm)	
0	0	0	0	12.7
0.5	1.8	54.4	2.77	
1.0	2.8	84.6	4.31	
1.5	3.6	108.7	5.54	
2.0	4.6	138.9	7.08	
2.5	5.8	175.2	8.92	
4.0	7.5	226.5	11.54	13.0
5.0	8.9	268.8	13.69	
7.5	11.2	338.2	17.23	
10.0	12.6	380.5	19.38	
12.5	13.6	410.7	20.92	

Location 3

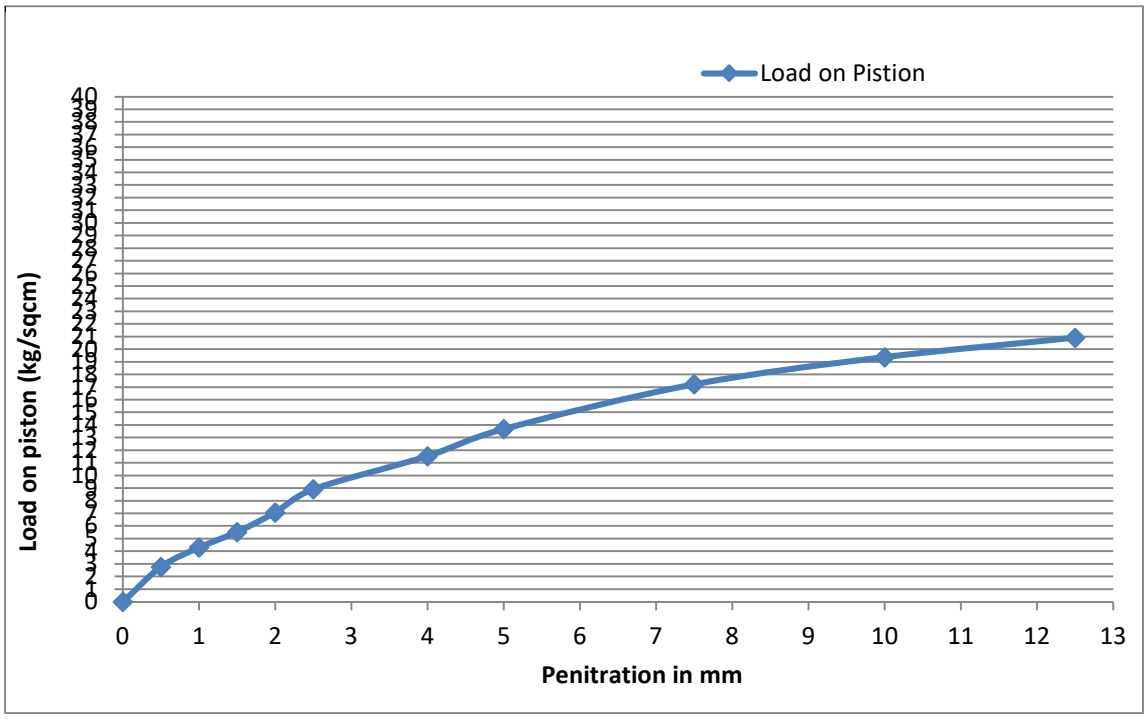


PLATE LOAD TEST

GEO GLOBE CONSULTANTS
Plot No. 777, Sector 82, JLPL, S.A.S.Nagar, Mohali

1.0 Introduction

The report presented herein deals with result of field investigation carried out by conducting the plate load test to assess settlement criteria with the increments of load and to evaluate the bearing capacity of the soil at 400 KV Subsation Ropar

The work of soil investigations was assigned to M/s Geo-Globe Consultants, Mohali(Punjab)

2.0 Scope of work

1. The work was carried out as per the standards laid down for conducting the plate load test and estimation of bearing capacity of soils and its settlement.
2. For the purpose of this standard, the definitions given in IS: 1888-1982 shall apply.

3.0 Apparatus used

1). Hydraulic jack of capacity (60) tones with properly calibrated load measuring device, proving ring .

2) Proving ring with least count 1 divs =.125ton

3) Dial gauges with 50mm (max), having least count .01mm 3 nos.

4) Magnetic base: for holding dial gauges

5) Datum Bar: An iron rod about 1-1.5 m long to be fitted on two separate supports.

6) Other apparatus: loading columns of different lengths, wooden blocks, collar, stop watch, spirit level, plumb bob betc.

4.0 Field Investigations

The field investigations were conducted as per IS 1888, to cover the entire scope of the job.

5.0 Plate Load Test Arrangement

Firstly a test pit of size 3 m x 3m was excavated up to the level of foundation of the proposed structure. The minimum dia. of the plate was kept 75 cm, and (taken overall size of the plate) .The loading platform was supported by suitable means. A suitable working space was provided at least 2.5m from the test area with a height of 1.15 m from the bottom of the pit to provide sufficient working space a fine sand layer of maximum thickness 5mm was poured in the small pocket made on the test level, the Centre of plate made coincides with the Centre of reaction girder/beam, with the help of a plumb and bob and horizontally leveled by a spirit level to avoid eccentric loading. The hydraulic jack was centrally placed over the plate with the loading column in between the jack and reaction beam so as to transfer load to the plate. A ball and socket arrangement was inserted to keep the direction of the load vertical throughout thetest.

The two supports of the reference beam or datum rod were placed over firm ground, fixed with minimum four dial gauges resting at diametrically opposite ends of the plates. The dial gauges were so arranged that settlement is measured continuously without any resting in between.

6.0 Application of Load

A minimum seating pressure of 70 kg/cm^2 to 140 kg/cm^2 shall be applied and removed before staring the load test. Load increments were applied t to soil in cumulative equal increment up to 0.4 kg/cm^{2}0.7 kg/cm^2. The load was applied without impact, fluctuation or eccentricity.

7.0 Dial Gauge Observations:

Settlement and observation-settlements were observed for each increment of load after an

interval of 1, 2.25, 4, 6.25, 9, 16 and 25 min and thereafter at hourly intervals to the nearest 0.02mm. The next increment of load was then applied and the observations repeated. The test was continued till, a settlement of 3.35 mm. The final settlement corresponding to each loading intensity by taking average of settlements of all the two final dial gauge readings were calculated. The experimental observations are tabulated in table 1.

❖ Determination of ultimate bearing capacity/safe bearing pressure

Generally the load settlement curve is plotted out between load intensity and settlements to arithmetic scale or Log-log scale as per strata.

As per IS CODE 1888-1982 the yield value is determined from the intersection of two lines.

A factor of safety (2.5) is applied to obtain the safe bearing capacity of sub soil strata at the test level.

TABLE-1, LOCATION 1

Size of plate =30cm x 30cm x 25” Location: Ropar

Size of Pit = 2 m x 3 m Project: 440 kv sub

Station

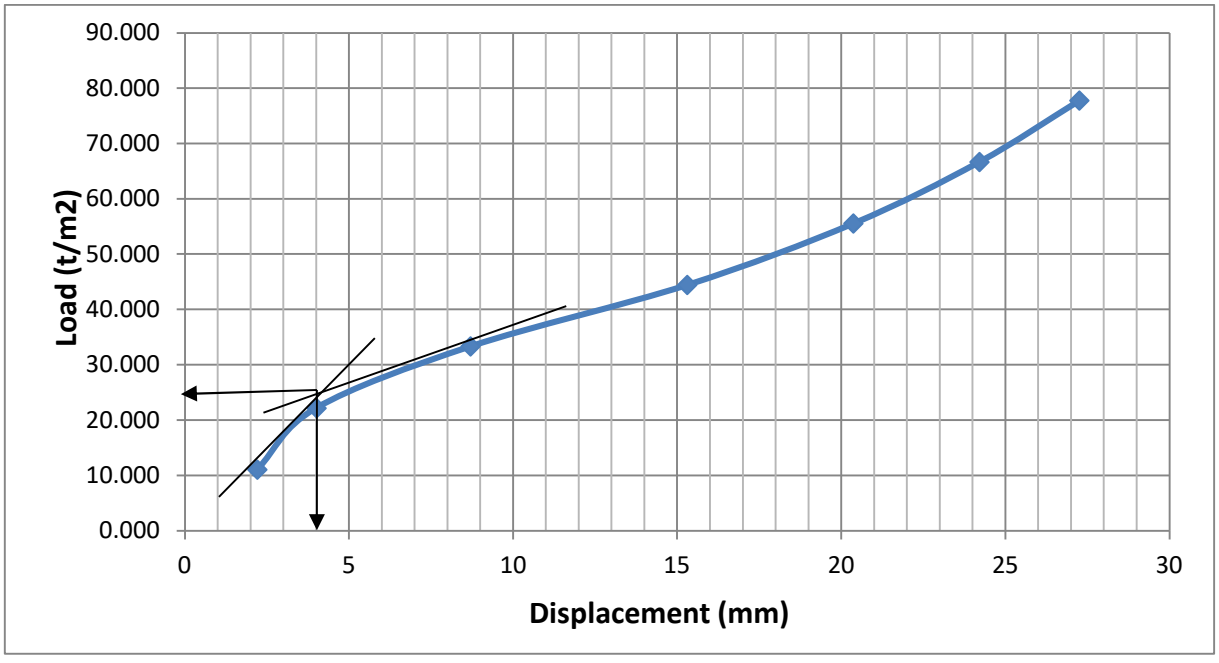
Dial gauge LC =.01

Date of 6.03.20 Date of Completion:6.03.2022

Plate Load Test - 1

S. No	Load (Kg)	Load (t)	Load (t/m^2)	Dial Gauge			Average	Settlement (mm)
				D-1	D-2	D-3		
1	1000	1.000	11.11	2	2.3	2.3	2.2	2
2	2000.00	2.000	22.22	5	3.44	3.56	4.00	5
3	3000.00	3.00	33.33	9.2	8.5	8.36	8.69	9.2
4	4000.00	4.00	44.44	15.15	15.236	15.5	15.30	15.15
5	5000.00	5.00	55.56	20.8	19.27	21	20.36	20.8
6	6000.00	6.00	66.67	24.18	23.5	24.92	24.20	24.18
7	7000.00	7.00	77.78	27.69	27.45	26.6	27.25	27.69

GRAPH 1 FIG 1



Evolution of Bearing Capacity
Point Of contraflexure at =25 t/m2
SBC Qn =25 t/m2
SBC Qu =25/2.5 (F.O.S) =10 T/M^2

TABLE-1, LOCATION 2

Size of plate =30cm x 30cm x 25”

Size of Pit = 2 m x 3 m

Dial gauge LC =.01

Date of Start 7.03.2022

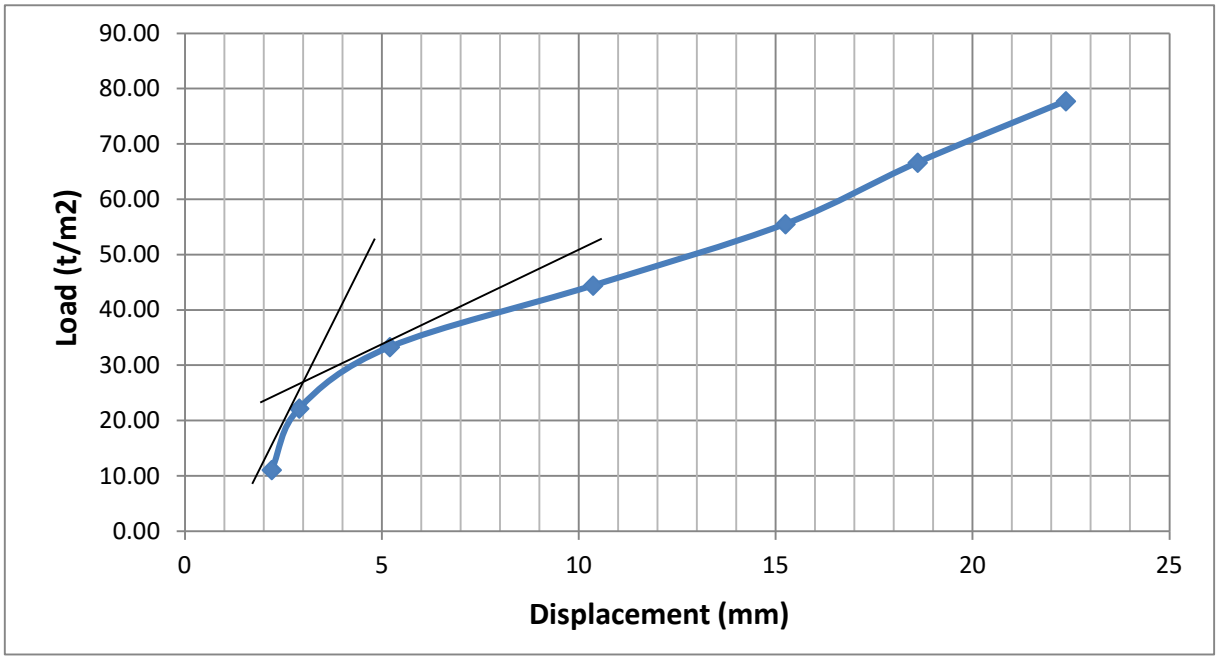
Date of Completion:7.03.2022

Location: Ropar

Project: 440 kv sub Station

Plate Load Test - 2

S. No	Load (Kg)	Load (t)	Load (t/m^2)	Dial Gauge			Average	Settlement (mm)
				D-1	D-2	D-3		
1	1000	1.000	11.11	2.1	2.4	2.7	2.4	2.2
2	2000.00	2.000	22.22	2.91	2.94	2.85	2.90	2.90
3	3000.00	3.00	33.33	4.6	5.8	5.2	5.20	5.20
4	4000.00	4.00	44.44	11.23	10.56	14.25	12.01	10.36
5	5000.00	5.00	55.56	14.6	13.53	17.6	15.24	15.24
6	6000.00	6.00	66.67	18.9	18.5	18.4	18.60	18.60
7	7000.00	7.00	77.78	23.2	22.37	21.5	22.36	22.36
8	8000.00	8.00	88.89	25.5	25.1	24.4	25.00	25.00



Evolution of Bearing Capacity
Point Of contraflexure at =28 t/m2
SBC Qn =28t/m2
SBC Qu =28/2.5 (F.O.S) =11.2 T/M^2

SUMMARY

S.NO	Location	Depth(m)	SBC (T/M^2)	Subgrade Reaction "K" Value Kg/cm^2
1	Location 1	0.5	10	6.6
2	Location 2	0.5	11.2	7.5

Test Report Report For Earth Resistivity Test At 400 kv substation Ropar

GEO GLOBE CONSULTANTS
Plot No. 777, Sector 82, JLPL, S.A.S.Nagar, Mohali

SOIL RESISTIVITY MEASUREMENTS FOR 400 KV SUBSTATION ROPAR

Description of site

The soil resistivity measurements were recorded for proposed substaion . The sub surface strata are composed of unconsolidated sediments and are essentially comprised of silts sands, on the shallow layers. The earth surface at the site was dry at the time of investigation. The resistivity measurements were carried out at 8 points as proposed as per client's requirements.

Method

Measurements of earth resistivity was done as per IS: 3043 – 1987 using a high sensitivity digital resistivity meter employing "Wenner" method as shown on next page. The electrodes were spaced equal.-distance. Measured D.C. current was passed through two outer electrodes (current electrodes C1 and C2) and potential drop across two inner electrodes (potential electrodes P1 and P2) was noted.

Two sets of measurements i.e. in direct and reverse flow of current were taken at each electrodes separation for the purpose of cross checking the megger. The electrodes separation was increased progressively to obtained resistivity value of deeper layers.

The diameter of the electrodes used was 10 mm and the depth of electrodes penetration into the ground was not less than 10 cm (10-15 cm). As depth of penetration of electrodes was small as compared to their separation, the following equation was used for computation of soil resistivity value.

The apparent soil resistivity is then given by $\rho=2\Pi DR$ (Ohm-meter)

Where:-

ρ= ground resistivity in Ohm-meter

$\Pi = 3.142$

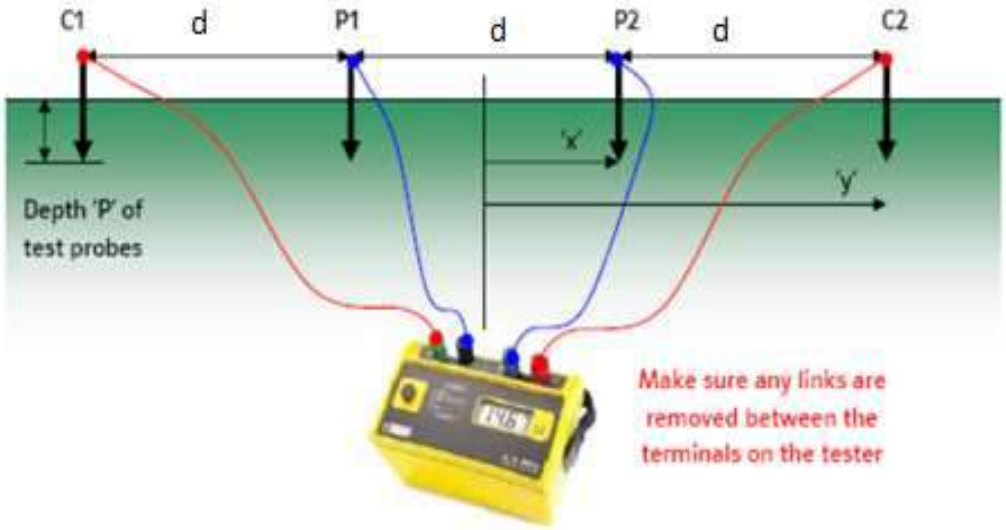
D = electrode spacing in meters

R = measured resistance in Ohms at spacing 'd'

Field Measurements:-

The soil resistivity value obtained at the surveyed point for different electrodes separation are tabulated below:

FIELD MEASUREMENTS AND CALCULATIONS


C1
d
P1
d
P2
d
C2
'x'
'y'
Depth 'P' of
test probes
Make sure any links are
removed between the
terminals on the tester

TEST 1														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 1														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	5.33	33.47	1	2	3.14	4.93	31.0	1	2	3.14	3.8	33.79	1	2	3.14	5.38	33.79
2	2	3.14	2.25	28.26	2	2	3.14	2.49	31.3	2	2	3.14	1.54	24.49	2	2	3.14	1.95	24.49
5	2	3.14	2.70	84.78	5	2	3.14	1.96	61.5	5	2	3.14	1.94	57.46	5	2	3.14	1.83	57.46
				48.84					41.3					38.58					38.58
				Ave. Resistivity in Ω -m =					41.81										

TEST 2														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 2														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	3.27	20.54	1	2	3.14	4.56	28.6	1	2	3.14	4.74	29.77	1	2	3.14	4.74	29.77
2	2	3.14	1.51	18.97	2	2	3.14	1.97	24.7	2	2	3.14	1.83	22.98	2	2	3.14	1.83	22.98
5	2	3.14	0.46	14.44	5	2	3.14	0.83	26.1	5	2	3.14	0.53	16.64	5	2	3.14	0.53	16.64
				17.98					26.5					23.13					23.13
				Ave. Resistivity in Ω -m =					22.68										

TEST 3														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 3														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	3.25	20.41	1	2	3.14	4.56	28.6	1	2	3.14	3.87	24.30	1	2	3.14	4.74	29.77
2	2	3.14	1.35	16.96	2	2	3.14	1.97	24.7	2	2	3.14	1.51	18.97	2	2	3.14	1.83	22.98
5	2	3.14	0.41	12.87	5	2	3.14	0.83	26.1	5	2	3.14	0.46	14.44	5	2	3.14	0.53	16.64
				16.75					26.5					19.24					23.13
				Ave. Resistivity in Ω -m =					21.40										

TEST 4														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 4														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	0.81	6.14	1	2	3.14	4.78	30.0	1	2	3.14	0.33	6.97	1	2	3.14	6.52	40.95
2	2	3.14	0.17	2.39	2	2	3.14	2.2	27.6	2	2	3.14	0.41	2.75	2	2	3.14	3.18	39.94
5	2	3.14	0.64	0.55	5	2	3.14	0.47	14.8	5	2	3.14	0.61	0.59	5	2	3.14	0.68	21.35
				3.03					24.1					3.44					34.08
				Ave. Resistivity in Ω -m =					16.17										

TEST 5														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 5														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	6.11	38.37	1	2	3.14	4.58	28.8	1	2	3.14	5.46	34.29	1	2	3.14	5.79	36.36
2	2	3.14	2.28	28.64	2	2	3.14	2.03	25.5	2	2	3.14	1.99	24.99	2	2	3.14	2.35	29.52
3	2	3.14	0.45	8.48	5	2	3.14	0.47	14.8	5	2	3.14	0.42	13.19	5	2	3.14	0.53	16.64
				25.16					23.0					24.16					27.51
				Ave. Resistivity in Ω -m					24.96										

TEST 6														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 6														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	5.88	36.93	1	2	3.14	4.56	28.6	1	2	3.14	5.98	37.55	1	2	3.14	5.76	36.17
2	2	3.14	2.13	26.75	2	2	3.14	2.01	25.2	2	2	3.14	2.53	31.78	2	2	3.14	2.28	28.64
5	2	3.14	0.64	20.10	5	2	3.14	0.44	13.8	5	2	3.14	0.49	15.39	5	2	3.14	0.49	15.39
				27.93					22.6					28.24					26.73
				Ave. Resistivity in Ω -m					26.37										

TEST 7														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 7														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	2.90	18.21	1	2	3.14	4.15	26.1	1	2	3.14	3.05	19.14	1	2	3.14	3.95	24.81
2	2	3.14	1.18	14.82	2	2	3.14	1.85	23.2	2	2	3.14	1.51	18.97	2	2	3.14	1.60	20.10
5	2	3.14	0.41	12.87	5	2	3.14	0.69	21.7	5	2	3.14	0.30	9.42	5	2	3.14	0.48	15.07
				15.30					23.7					15.84					19.99
				Ave. Resistivity in Ω -m					18.70										

ERT AT THERMAL PLANT ROPAR LOCATION 8														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	2.95	18.53	1	2	3.14	4.95	31.1	1	2	3.14	3.60	22.61	1	2	3.14	3.91	24.55
2	2	3.14	1.26	15.83	2	2	3.14	1.8	22.6	2	2	3.14	1.51	18.97	2	2	3.14	1.65	20.72
5	2	3.14	0.35	10.99	5	2	3.14	0.65	20.4	5	2	3.14	1.89	59.35	5	2	3.14	0.53	16.64
				15.11					24.7					33.64					20.64
				Ave. Resistivity in Ω -m =					23.52										

TEST 9														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 9														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	5.75	36.11	1	2	3.14	4.5	28.3	1	2	3.14	5.84	36.68	1	2	3.14	5.78	36.30
2	2	3.14	2.11	26.50	2	2	3.14	2	25.1	2	2	3.14	2.50	31.40	2	2	3.14	2.21	27.76
5	2	3.14	0.59	18.53	5	2	3.14	0.38	11.9	5	2	3.14	0.45	14.13	5	2	3.14	0.40	12.56
				27.05					21.8					27.40					25.54
				Ave. Resistivity in Ω -m =					25.44										

TEST 10														Inst. Make Waco					
ERT AT THERMAL PLANT ROPAR LOCATION 10														S.no ,		Range 0-10 Ω			
North					**South**					**West**					**East**				
dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD	dist D(m)		Π	R	2 ΠRD
1	2	3.14	6.90	43.33	1	2	3.14	4.48	28.1	1	2	3.14	5.40	33.91	1	2	3.14	5.82	36.55
2	2	3.14	2.27	28.51	2	2	3.14	2.03	25.5	2	2	3.14	1.90	23.86	2	2	3.14	2.38	29.89
5	2	3.14	0.45	14.13	5	2	3.14	0.45	14.1	5	2	3.14	0.40	12.56	5	2	3.14	0.55	17.27
				28.66					22.6					23.45					27.90
				Ave. Resistivity in Ω -m =					25.65										

AVERAGE RESITIVITY =24.67 Ω-m

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The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C/ individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out during detailed engineering along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-C/individual sections for various equipments shall be subject to Employer's approval.

SERVICES TO BE PERFORMED BY THE EQUIPMENT BEINGFURNISHED

The 800kV and 420kV system is being designed to limit the switching surge over voltage of 1.9 p.u. and 2.5 p.u., respectively and the power frequency over voltage of1.4 p.u. and 1.5 p.u., respectively. In case of the 420kV system, the initial value of the temporary over voltages could be 2.0 p.u. for 1-2 cycles. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.

All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.

The equipment shall also comply to the following:

a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

System Parameter

765kV, 400kV & 220kV System

SL No	Description of parameters	765kV System	400kV System	220kV System
1.	System operating voltage	765kV	400kV	220kV
2.	Maximum operating voltage of the system (rms)	800kV	420kV	245kV
3.	Rated frequency	50HZ	50Hz	50Hz
4.	No. of phase	3	3	3
5.	Rated Insulation levels			

Godrej & Boyce Mfg. Co. Limited

Dy. Chief Engineer
Transmission Design
PSTCL, Patiala

SL No	Description of parameters	765kV System	400kV System	220kV System
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	2100kVp	1550kVp	1050 kVp
ii).	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1550kVp	1050kVp	-
iii)	One minute power frequency dry withstand voltage (rms)	830kV	630kV	-
iv)	One minute power frequency dry and wet withstand voltage (rms)	-	-	460kV
6.	Corona extinction voltage -	508 kV	320kV	-
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	2500 µV at 508 kV rms	1000 µV at 266kV rms	1000 µV at 156kV rms
8.	Minimum creepage distance - for Equipment other than Insulator string	20000 mm (24800 mm for coastal area)	10500 mm (13020 mm for coastal area)	6125 mm (7595 mm for coastal area)
	Minimum creepage distance - for Insulator String	As specified in Section-Switchyard Erection		
9.	Min. clearances			
i.	Phase to phase	7600mm (for conductor-conductor configuration) 9400mm (for rod-conductor configuration)	4000mm (forconductor-conductor configuration) 4200mm (for rod -conductor configuration)	2100 mm
ii.	Phase to earth	4900mm (for conductor-structure) 6400mm (for rod- structure)	3500 mm	2100 mm
iii)	Sectional clearances	10300 mm	6500 mm	5000 mm
10.	Rated short circuit current for 1 sec. duration	50kA	50kA	40kA
11.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed

By. Chief Engineer
Transmission Design,
PSTCL, Patiala

132kV, 66kV, 33kV & 11kV System

SL No	Description of parameters	132 kV System	66kV System	33 kV System	11kV System
1.	System operating voltage	132kV	66kV	33kV	11kV
2.	Maximum operating voltage of the system(rms)	145kV	72.5kV	36kV	12kV
3.	Rated frequency	50Hz	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3	3
5.	Rated Insulation levels				
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	650 kVp	325 kVp	170 kVp	75 kVp
ii)	One minute power frequency dry and wet withstand voltage (rms)	275kV	140kV	70kV	28kV
6.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	500 µV at 92kV rms	-	-	-
7.	Minimum creepage distance	3625 mm (4495mm for coastal area)	1813 mm (2248mm for coastal area)	900 mm (1116mm for coastal area)	300 mm (372mm for coastal area)
8.	Min. clearances				
i.	Phase to phase	1300 mm	750 mm	320 mm	280 mm
ii.	Phase to earth	1300 mm	630 mm	320 mm	140 mm
iii.	Sectional clearances	4000 mm	3000 mm	2800 mm	2800 mm
9.	Rated short circuit current	40kA/ 31.5 kA (as applicable) for 1 sec	31.5 kA for 3 sec	25 kA for 3 sec	25 kA for 3 sec
10.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed	Effectively earthed

Notes:

1. The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable as per relevant IEC.
2. The insulation and RIV levels of the equipments shall be as per values given in the Technical Specification of respective equipment.
3. Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure given at **Annexure-A** and **Annexure-B** respectively.

Dy. Chief Engineer