VOLUME-III

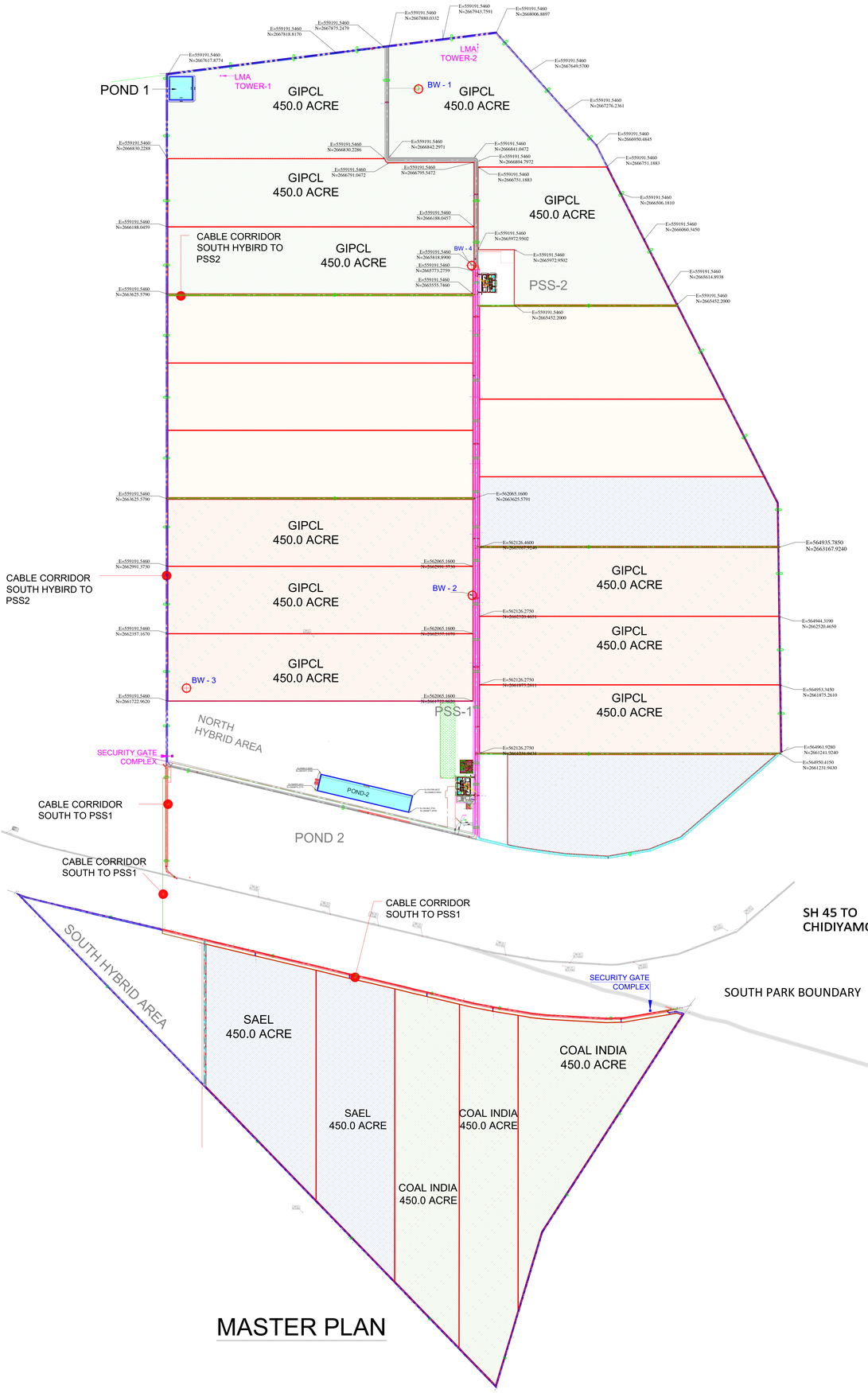
PART - 1

TENDER DRAWINGS & ANNEXURES - CIVIL

Tender Drawings

1. Layout of Raw water pipe alignment
2. Longitudinal section from bore wells to desalination plant at RE park
3. Typical road cross section
4. 1 MLD Desalination plant layout
5. Water Storage Tank
6. Ultrafiltration water tank
7. ASCF Ultrafiltration wash & Reject water sump
8. CIP tank
9. Water supply network
10. Typical PVC coated chain link peripheral Fence Details
11. Typical cable tray precast support

TRUE NORTH
PLANT NORTH



MASTER PLAN

BOREWELL CO-ORDINATES			
S.NO	BW NO	EASTING	NORTHING
1	B1	561552.63	2667485.84
2	B2	562059.64	2662718.59
3	B3	559368.35	2661844.77
4	B4	562052.35	2665823.87

NOTES :

1. ALL DIMENSIONS AREA IN METERS UNLESS OTHERWISE SPECIFIED.
2. FOR ROAD LAYOUT AND CROSSING TYPES REFER ROAD ANNEXURE-2&3 DRAWINGS.
3. FOR DRAINS, CULVERTS AND HUME PIPE DETAILS REFER DRAIN ANNEXURE – 4&5 DRAWINGS.

LEGEND :

- TYPE-I ROAD
- TYPE-II ROAD
- TYPE-III ROAD
- TYPE-IV ROAD
- TYPE-V ROAD
- CABLE
- WATER SUPPLY LINE
- HUME PIPE (PC1)
- DRAIN CULVERT (DC1)
- CO-ORDINATE MARKING POINT
- SGC — SECURITY GATE COMPLEX
- SPC — SECURITY PORTA CABIN
- LMAT — LMA TOWER 2NO'S

LEGEND :

- GIPCL PLANT AREA (600MW)
- GIPCL PLANT AREA (500MW)
- SJVN GREEN PLANT AREA (500MW)
- SAEL PLANT AREA (400MW)
- COAL INDIA PLANT AREA (300MW)

FOR TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
R4	10.10.2025	REVISED AS PER COMMENMTS	VU				
R3	09.07.2025	REVISED AS PER COMMENMTS	RK	MAP			
R2	20.12.2024	REVISED AS PER COMMENMTS	RK	MAP			
R1	14.05.2024	REVISED AS PER COMMENMTS	RK	MAP			
R0	02.04.2024	ISSUED FOR TENDER PURPOSE	RK	MAP			

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangaluru

GUJARAT INDUSTRIES POWER CO. LTD
2375 MW CAPACITY SOLAR/WIND/HYBRID RENEWABLE ENERGY PARK AT GREAT RANN OF KUTCH AREA, GUJARAT

	SIGNATURE	DATE
DRAWN	RK	09.07.2025
DESIGNED	MAP	09.07.2025
CHECKED	MAP	09.07.2025
DEPT.HEAD	SK	09.07.2025
PROJ.MGR.	RP	09.07.2025

RELEASED FOR

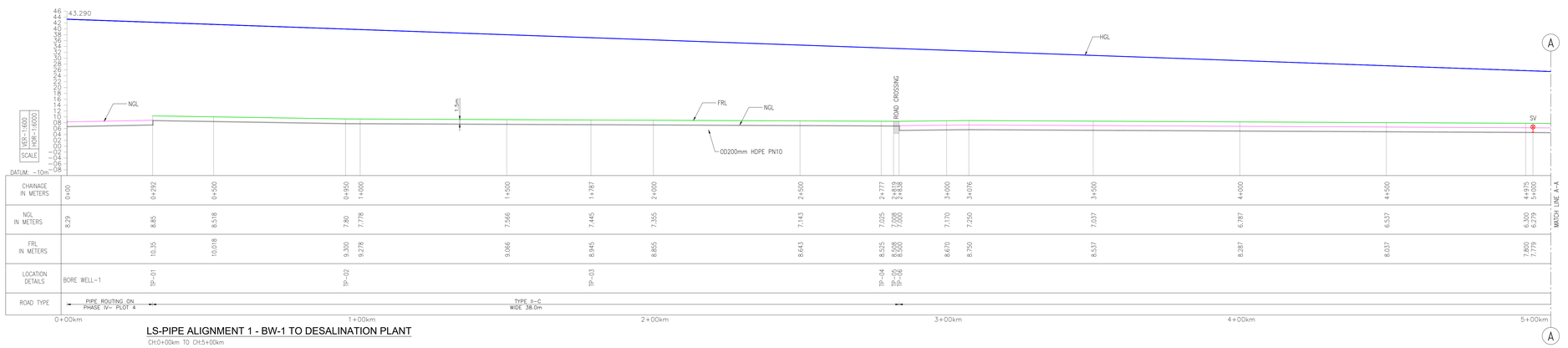
PRELIMINARY	
TENDER	✓
ENGINEERING	
CONSTRUCTION	

LAYOUT-BOREWELL LOCATIONS

DEPT. RENEWABLE | JOB NO. 1721125 A | SCALE: AS SHOWN | REV.

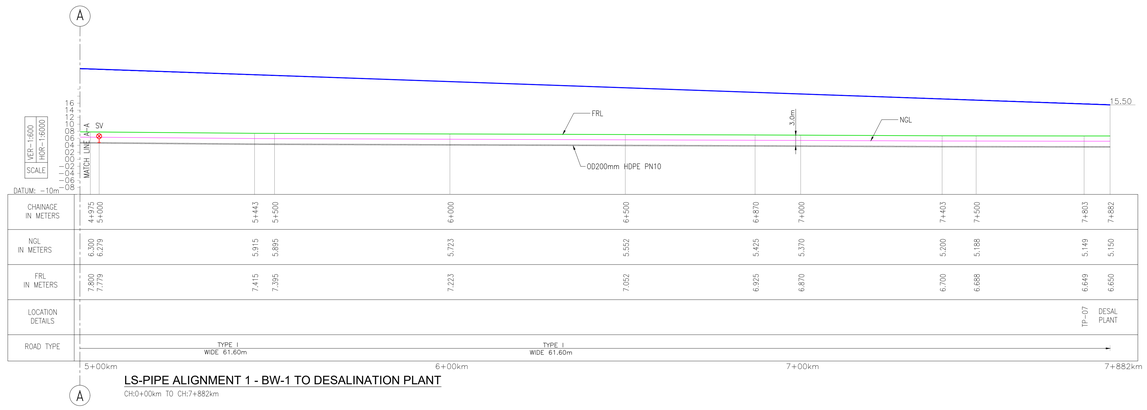
DWG.NO. FCE-1721125-IWE-DWG-LAY-9100-001 | R4

SIZE-A0



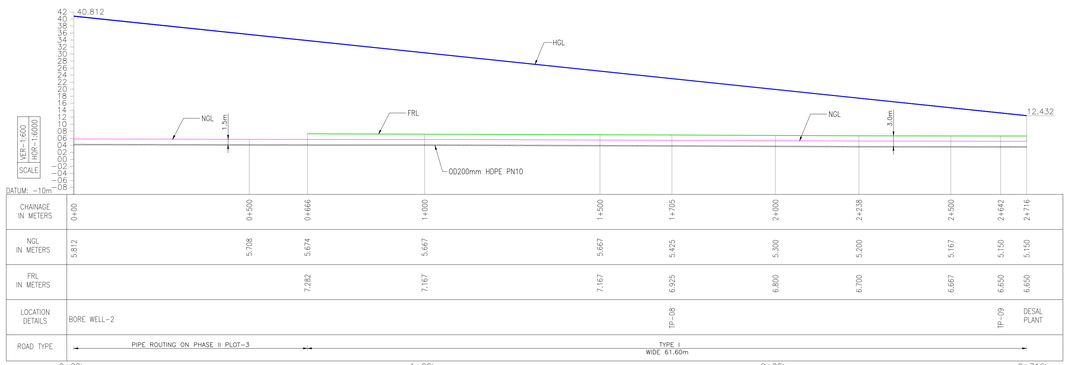
LS-PIPE ALIGNMENT 1 - BW-1 TO DESALINATION PLANT

CH:0+00km TO CH:5+00km



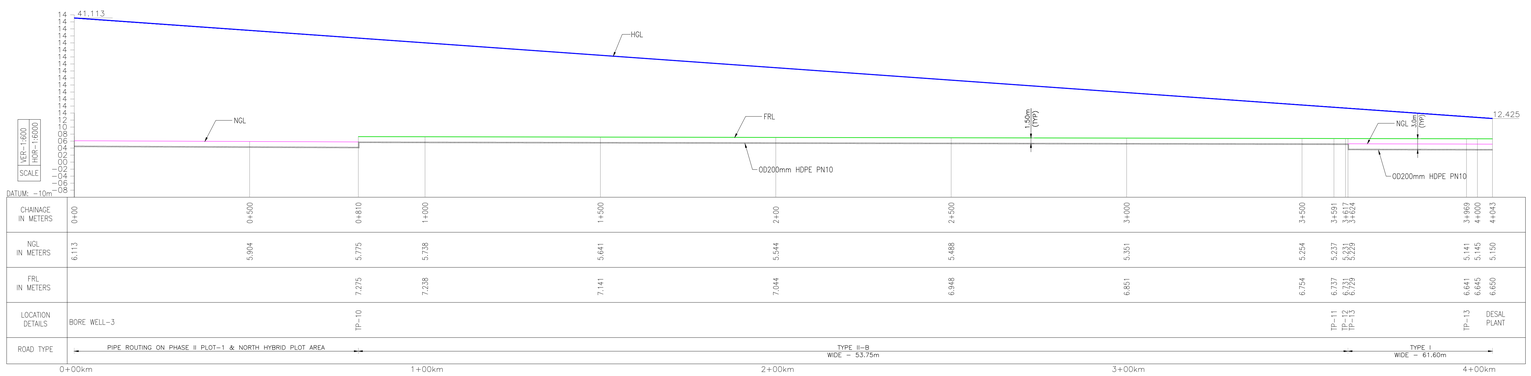
LS-PIPE ALIGNMENT 1 - BW-1 TO DESALINATION PLANT

CH:0+00km TO CH:7+882km



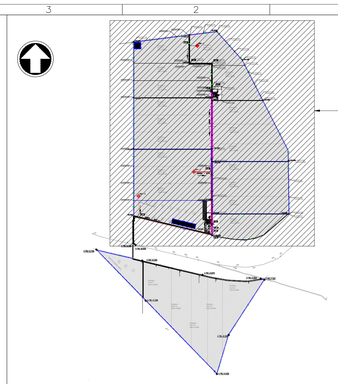
LS-PIPE ALIGNMENT 2 - BW-2 TO DESALINATION PLANT

CH:0+00km TO CH:2+716km



LS-PIPE ALIGNMENT 3 - BW-3 TO DESALINATION PLANT

CH:0+00km TO CH:4+043km



KEYPLAN:

NOTES :

1. ALL LEVELS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. PIPES ARE TO BE LAID 1.5m BELOW GL.

LEGEND

NGL	NATURAL GROUND LEVEL
FRL	FINISHED ROAD LEVEL
HGL	HYDRAULIC GRADIENT LINE
	SLUICE VALVE (SV)
	FINISHED ROAD LEVEL
	NATURAL GROUND LEVEL
	PIPE LINE

TENDER PURPOSE ONLY

SCALE	VER-1:600
	HOR-1:6000

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
0	28-09-2024	ISSUED FOR DETAILED PROJECT REPORT	GCY				

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangaluru

GUJARAT INDUSTRIES POWER CO. LTD

DETAILED PROJECT REPORT TO SUPPLY CLEAN WATER BY INSTALLATION OF DESALINATION PLANT AT RE PARK, FOR 2375 MW CAPACITY SOLAR/WIND/ HYBRID/RENEWABLE ENERGY PARK AT GREAT RAN OF KUTCH AREA, GUJARAT

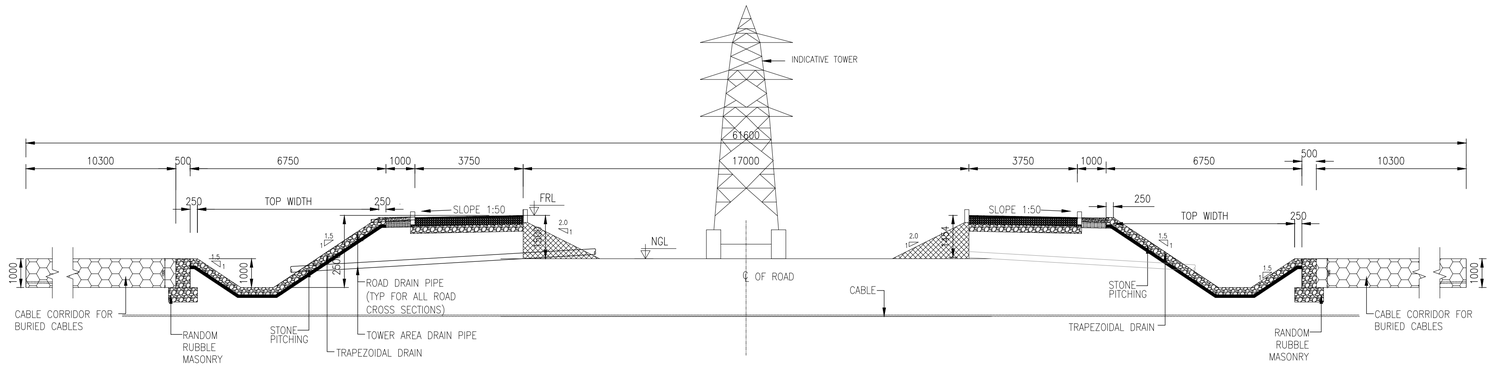
	SIGNATURE	DATE
DRAWN	GCY	10-09-24
DESIGNED	SKS	06-09-24
CHECKED	RJB	16-09-24
DEPT.HEAD	BRL	16-09-24
TEAM LEADER	RJB	16-09-24

DETAILED PROJECT REPORT
LONGITUDINAL SECTION
FROM BORE WELLS TO DESALINATION PLNAT AT RE PARK

RELEASED FOR: PRELIMINARY | TENDER | ENGINEERING ✓ | CONSTRUCTION

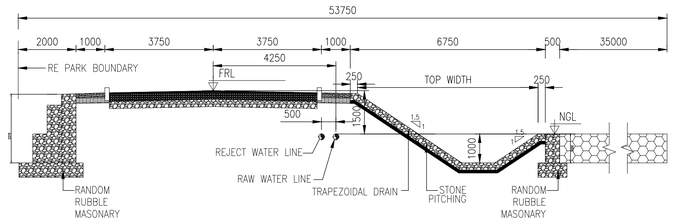
DEPT.	IWE	JOB NO. 20723196	SCALE: AS SHOWN	REV.
DWG.NO.	FCE-20723196-IWE-DWG-DP-6101-002			0

18



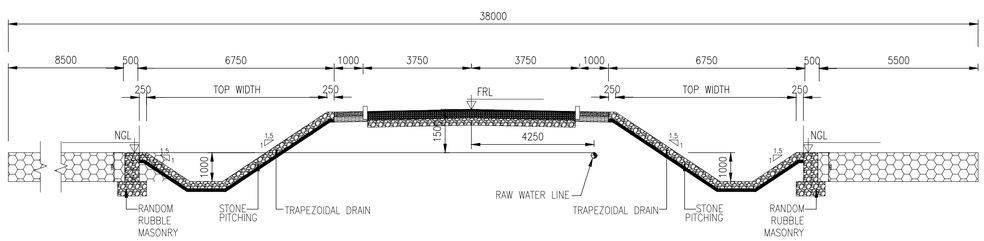
TYPE - I BITUMEN ROAD CROSS SECTION

SCALE 1:100



TYPE - II-B BITUMEN ROAD CROSS SECTION - NORTH

SCALE 1:100



TYPE - II-C BITUMEN ROAD CROSS SECTION

SCALE 1:100

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS AND COORDINATES ARE IN METERS UNLESS OTHERWISE NOTED.
2. DRAINS SHOWN IN ROAD CROSS SECTIONS ARE INDICATIVE. REFER DRAINS LAYOUT FOR DETAILS.
3. COORDINATES PROVIDED SHALL BE CHECKED AT SITE.
4. FOR CULVERTS DETAILS REFER DRAIN ANNEXURE–5
5. THIS DRAWING IS ONLY AN INDICATIVE GENERAL ARRANGEMENT DRAWING AND THE SIZE AND DIMENSIONS OF VARIOUS COMPONENTS & MEMBERS NEED TO BE ARRIVED BASED ON THE DESIGN OUTCOME AND TO BE GOT APPROVED BY 'OWNER'S ENGINEER' BEFORE START EXECUTION

CAPILLARY CUT OFF ARRANGEMENT:

ALL BITUMINOUS ROADS ARE TO BE DESIGNED WITH CAPILLARY CUT OFF ARRANGEMENT AS PER IRC: 34–2011. FOR THIS PURPOSE THE HIGH FLOOD LEVEL (HFL) SHALL BE CONSIDERED AS 0.45M AND THE FINISHED ROAD LEVELS SHALL BE CONSIDERED AS 1.5M ABOVE NATURAL GROUND LEVEL. NECESSARY SAND / GRANULAR MATERIAL CUSHION WITH CAPILLARY CUTOFF WITH NON–WOVEN GEOTEXTILE SHEET OF WEIGHT NOT LESS THAN 200 GSM (GRAM PER SQUARE METER) SHALL BE PROVIDED AS PER IRC:34–2011.

LEGEND :

℄	–	CENTER LINE
FGL	–	FINISHED GROUND LEVEL
FRL	–	FINISHED ROAD LEVEL

REFERENCE DWG

1. FCE–20723196–IWE–DWG–DP–6101–001	–	ALIGNMENT PLAN
2. ANNEXURE–3	–	ROAD SECTION AND DETAILS REV–07 (DATED 19.12.2022)

TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
1	05–02–2025	REVISED AS PER CLIENT COMMENTS	GCY				
0	28–09–2024	ISSUED FOR APPROVAL	GCY				

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangaluru

GUJARAT INDUSTRIES POWER CO. LTD

DETAILED PROJECT REPORT TO SUPPLY CLEAN WATER BY INSTALLATION OF DESALINATION PLANT AT RE PARK, FOR 2375 MW CAPACITY SOLAR/WIND/ HYBRID/RENEWABLE ENERGY PARK AT GREAT RAN OF KUTCH AREA, GUJARAT

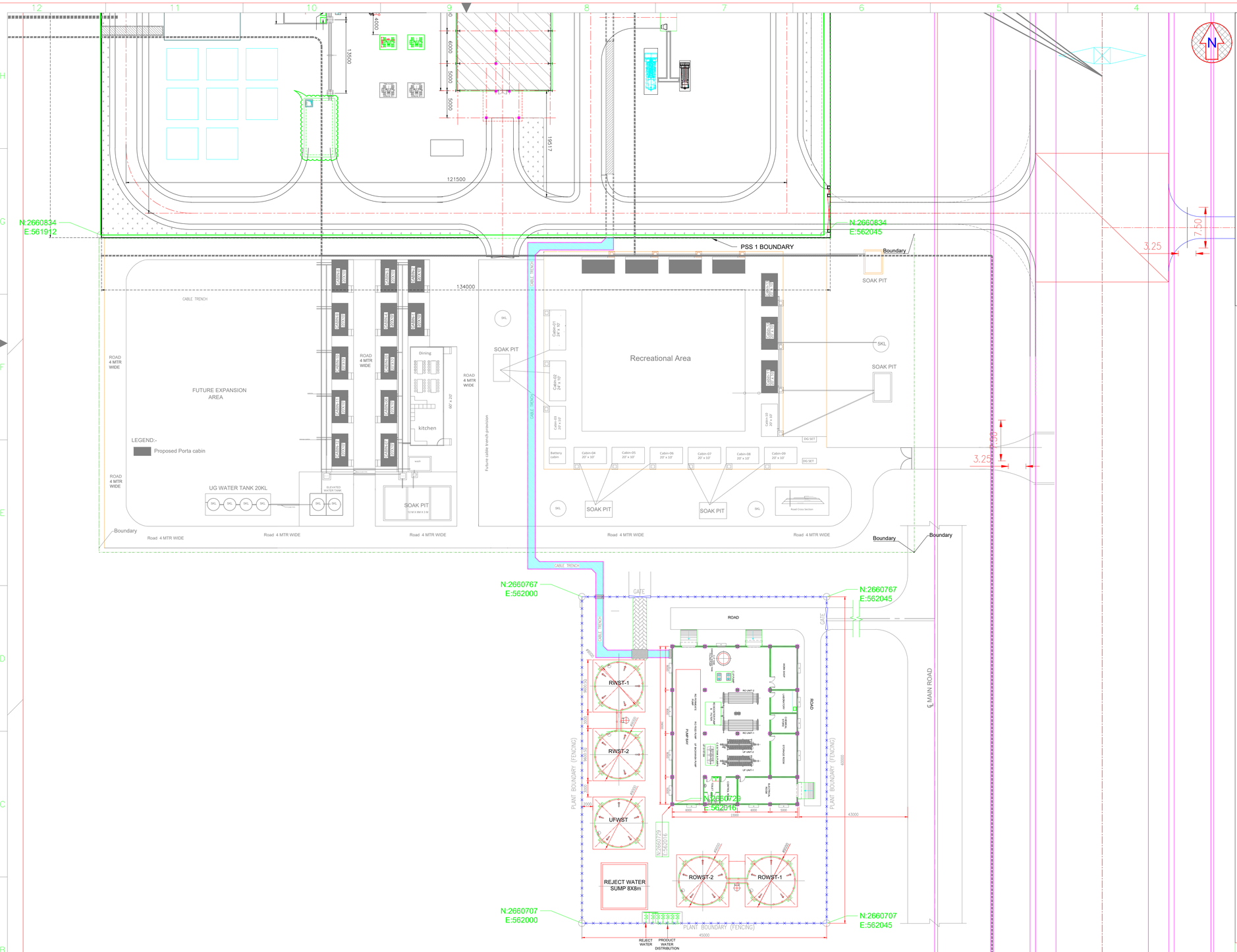
	SIGNATURE	DATE
DRAWN	GCY	13.09.2024
DESIGNED	SKS	10.09.2024
CHECKED	RJB	16.09.2024
DEPT.HEAD	BRL	16.09.2024
TEAM.LEADER	RJB	16.09.2024

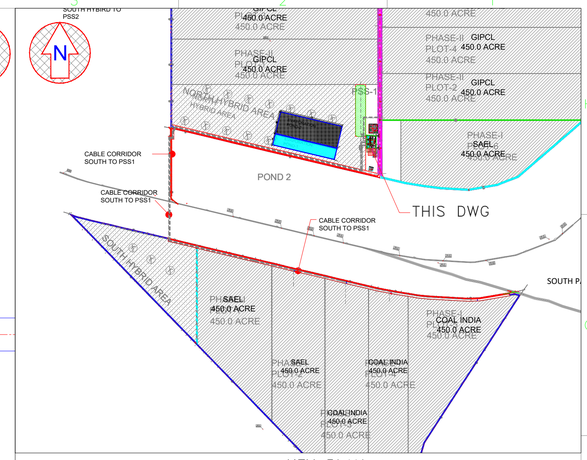
DETAILED PROJECT REPORT

TYPICAL ROAD CROSS SECTION

RELEASED FOR			DEPT. IWE	JOB NO. 20723196	SCALE: NTS	REV.
	PRELIMINARY					
	TENDER	✓	DWG.NO. FCE–20723196–IWE–DWG–FS–6101–003			1
	ENGINEERING					
	CONSTRUCTION					

M:\Industrial Water Infrastructure Engineering\Projects\20723196 - GIPCL - 1 MLD\4. FI Deliverables\7.6. Water & Infrastructure\DPR\Dwg\Conveyance\05-02-25\FCE-20723196-IWE-DWG-DP-6101-003.dwg





KEY PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS & COORDINATES ARE IN METERS,UNLESS NOTED OTHERWISE.

TENDER PURPOSE ONLY

TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
2	02.06.2025	REVISED AS PER COMMENTS	RK				
1	20.03.2025	REVISED AS PER COMMENTS	RK				
0	28.09.2024	ISSUED FOR DETAILED PROJECT REPORT	GCY				

APPROVED BY

FICHTNER
Consulting Engineers
(India) Private Limited
Chennai, Bangaluru

GUJARAT INDUSTRIES POWER CO. LTD

DETAILED PROJECT REPORT TO SUPPLY CLEAN WATER BY INSTALLATION OF DESALINATION PLANT AT RE PARK, FOR 2375 MW CAPACITY SOLAR/WIND/ HYBRID/RENEWABLE ENERGY PARK AT GREAT RAN OF KUTCH AREA, GUJARAT

	SIGNATURE	DATE
DRAWN	GCY	13.09.2024
DESIGNED	BM	10.09.2024
CHECKED	MKS	19.09.2024
DEPT.HEAD	BRL	19.09.2024
PROJ.MGR.	MKS	19.09.2024

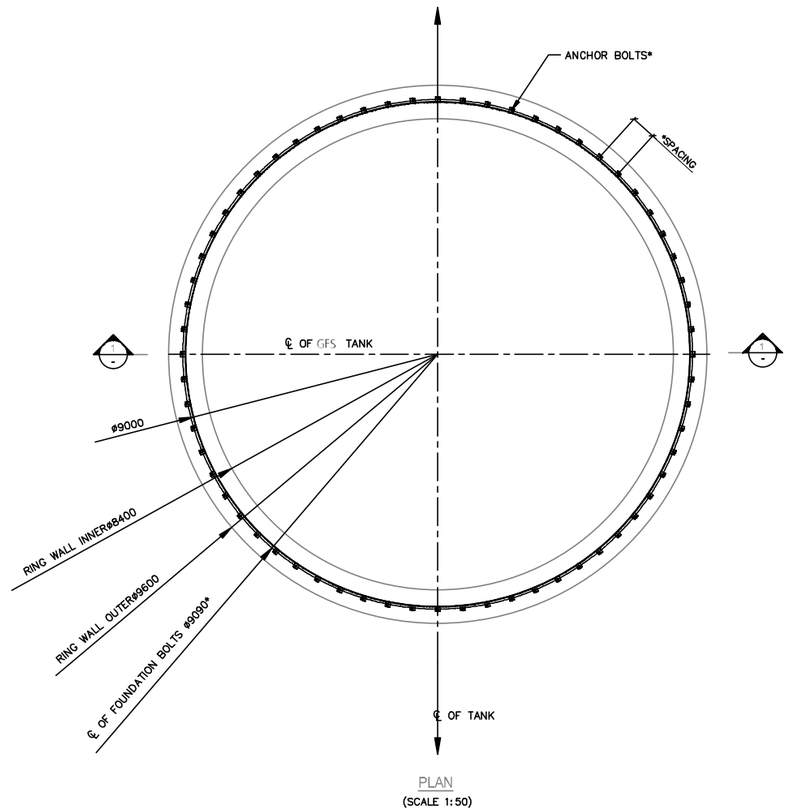
1 MLD DESALINATION PLANT LAYOUT

RELEASED FOR: PRELIMINARY; TENDER; ENGINEERING ✓; CONSTRUCTION

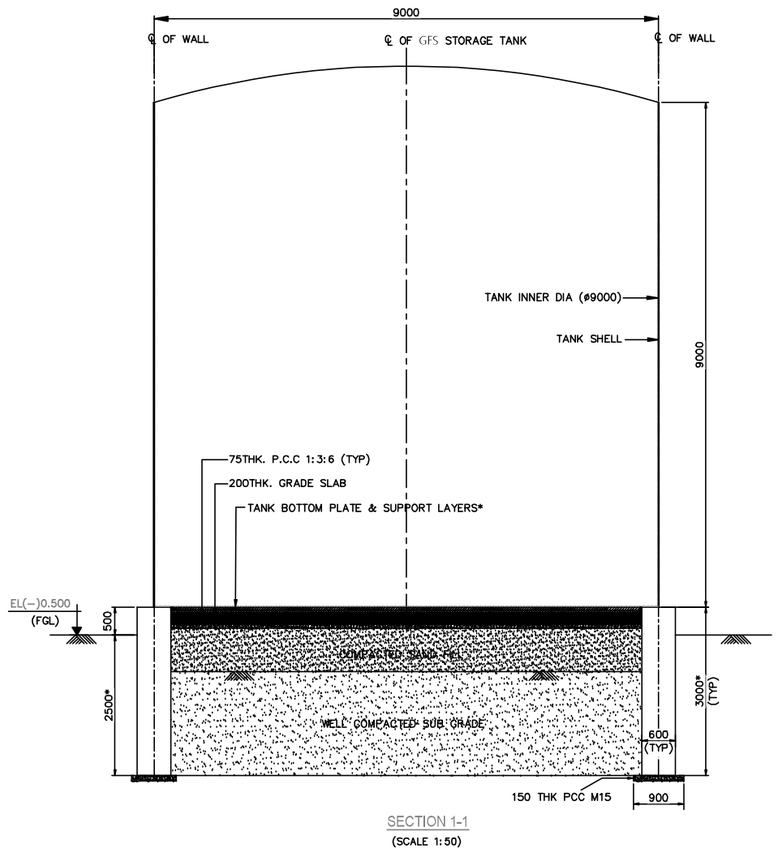
DEPT. IWE | JOB NO. 20723196 | SCALE: 1:175 | REV.

DWG.NO. FCE-20723196-IWE-DWG-DP-6101-004 | 2

D:\RAJASEKAR\PROJECT\031 200325109 GIPCL HYBRID PROJECT\02 WORK\02 LAYOUT\02-06-25\FCE-20723196-IWE-DWG-FS-6101-004_R2_03-06-25 1.dwg



PLAN
(SCALE 1:50)



SECTION 1-1
(SCALE 1:50)

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH CONTRACT TERMS & CONDITIONS SPECIFICATION & SCHEDULE OF ITEMS.
2. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
3. ALL RCC CONCRETE WORKS SHALL BE WITH GRADE M25 CONCRETE.
4. REINFORCEMENT STEEL SHALL BE OF Fe500 GRADE, CONFORMING TO IS:1786 & SHALL BE PROVIDED WITH FUSION BONDED EPOXY COATING COFORMING TO IS:13620.
5. CLEAR COVER TO CONCRETE SHALL BE AS FOLLOWS:

DESCRIPTION	TOP	BOTTOM	SIDES
RING FOUNDATION	45	45	45

6. THE CONTRACTOR SHALL BRING TO THE ATTENTION OF THE ENGINEER ANY DISCREPANCIES BETWEEN THESE DOCUMENTS DRAWINGS & SEEK CLARIFICATION BEFORE PROCEEDING WITH THE WORK.

LEGEND:

℄ - CENTER LINE
EL - ELEVATION
FGL - FINISHED GROUND LEVEL
PCC - PLAIN CEMENT CONCRETE

- CONCRETE
- PCC
- FINISHED GROUND LVL
- EL. X.XXX (TOC) - TOP OF CONCRETE

* DETAILS AS PER VENDOR

REFERENCE DWG:

1. FCE-20723196-IWE-DWG-DP-6101-004 – 1 MLD DESALINATION PLANT LAYOUT

1. RAW WATER STORAGE TANK	2 Nos
2. RO WATER STORAGE TANK	2 Nos

TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
0	28.09.2024	ISSUED FOR APROVAL	GCY				

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Consulting Engineers (India) Private Limited
Chennai, Bangalkuru

GUJARAT INDUSTRIES POWER CO. LTD
DETAILED PROJECT REPORT TO SUPPLY CLEAN WATER BY INSTALLATION OF DESALINATION PLANT AT RE PARK, FOR 2375 MW CAPACITY SOLAR/WIND/ HYBRID RENEWABLE ENERGY PARK AT GREAT RAN OF KUTCH AREA, GUJARAT

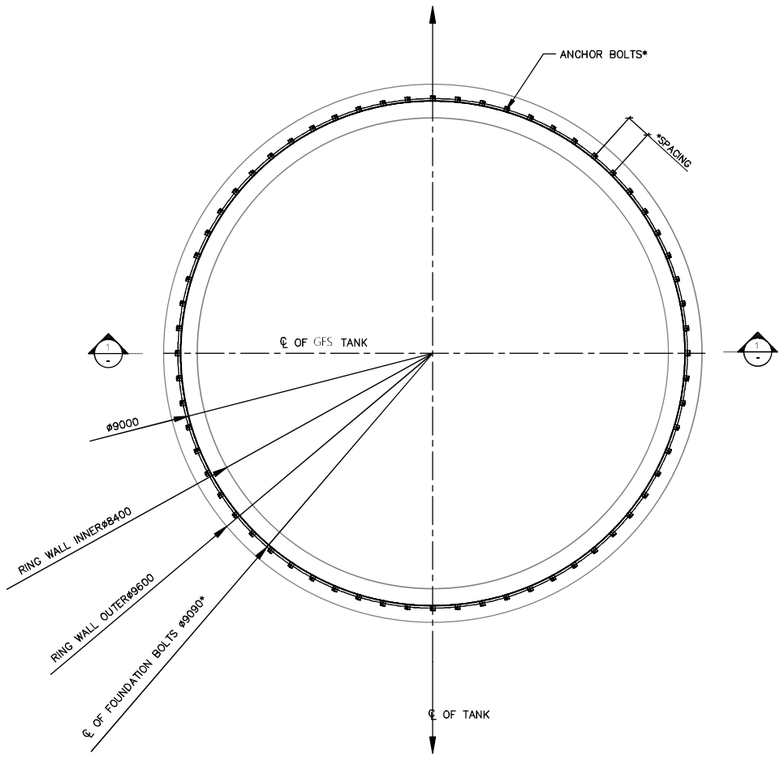
	SIGNATURE	DATE
DRAWN	GCY	28.09.2024
DESIGNED	SH	28.09.2024
CHECKED	RB	28.09.2024
DEPT.HEAD	BRL	28.09.2024
PROJ.MGR.	MKS	28.09.2024

TITLE
GENERAL ARRANGEMENT DWG OF WATER STORAGE TANK

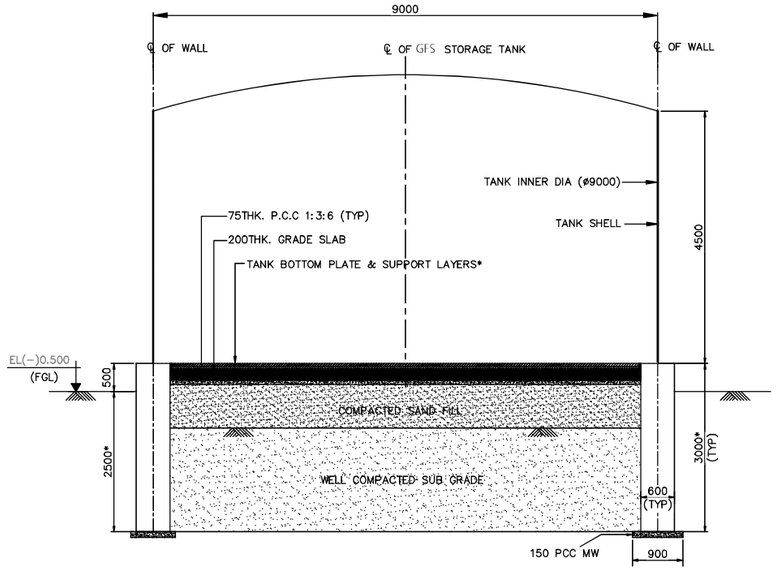
RELEASED FOR: PRELIMINARY / TENDER / ENGINEERING / CONSTRUCTION

DEPT. IWE | JOB NO. 20723196 | SCALE: AS SHOWN | REV.

DWG.NO. FCE-20723196-IWE-DWG-DP-6101-005 | SHEET | RO



PLAN
(SCALE 1:50)



SECTION 1-1
(SCALE 1:50)

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH CONTRACT TERMS & CONDITIONS SPECIFICATION & SCHEDULE OF ITEMS.
2. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
3. ALL RCC CONCRETE WORKS SHALL BE WITH GRADE M25 CONCRETE.
4. REINFORCEMENT STEEL SHALL BE OF Fe500 GRADE, CONFORMING TO IS:1786 & SHALL BE PROVIDED WITH FUSION BONDED EPOXY COATING COFORMING TO IS:13620.
5. CLEAR COVER TO CONCRETE SHALL BE AS FOLLOWS:

DESCRIPTION	TOP	BOTTOM	SIDES
RING FOUNDATION	45	45	45

6. THE CONTRACTOR SHALL BRING TO THE ATTENTION OF THE ENGINEER ANY DISCREPANCIES BETWEEN THESE DOCUMENTS DRAWINGS & SEEK CLARIFICATION BEFORE PROCEEDING WITH THE WORK.

LEGEND:

℄ - CENTER LINE
EL - ELEVATION
FGL - FINISHED GROUND LEVEL
PCC - PLAIN CEMENT CONCRETE

- CONCRETE
- PCC
- FINISHED GROUND LVL
- EL. X.XXX (TOC) - TOP OF CONCRETE

* DETAILS AS PER VENDOR

TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
0	28.09.2024	ISSUED FOR APPROVAL	GCY				

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangaluru

GUJARAT INDUSTRIES POWER CO. LTD
DETAILED PROJECT REPORT TO SUPPLY CLEAN WATER BY INSTALLATION OF DESALINATION PLANT AT RE PARK, FOR 2375 MW CAPACITY SOLAR/WIND/ HYBRID RENEWABLE ENERGY PARK AT GREAT RAN OF KUTCH AREA, GUJARAT

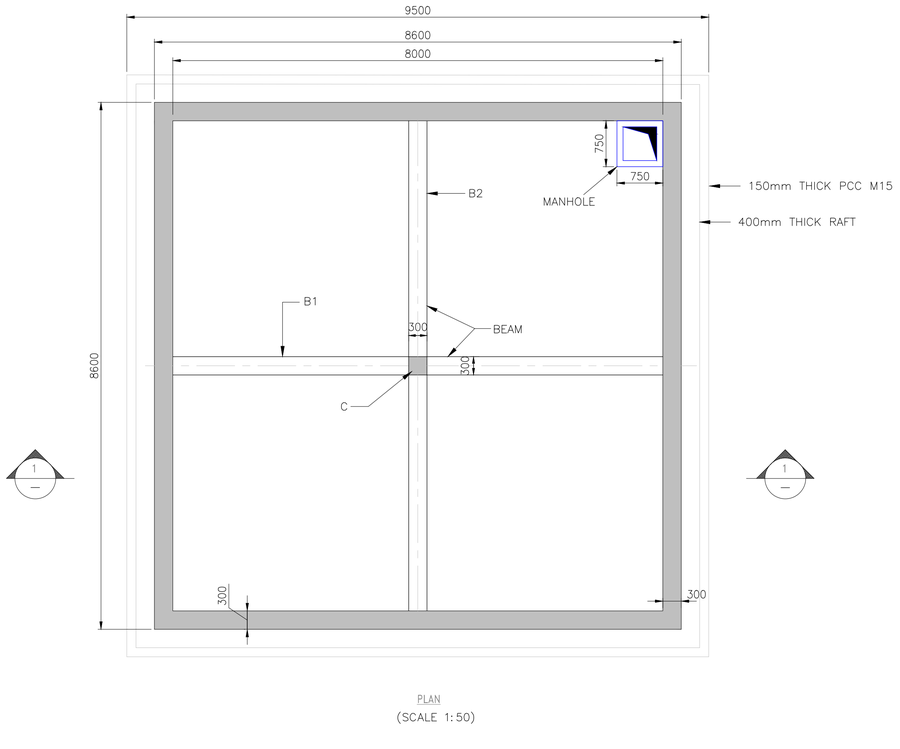
	SIGNATURE	DATE
DRAWN	GCY	28.09.2024
DESIGNED	SH	28.09.2024
CHECKED	RB	28.09.2024
DEPT.HEAD	BRL	28.09.2024
PROJ.MGR.	MKS	28.09.2024

TITLE
GENERAL ARRANGEMENT DWG OF ULTRAFILTARATION WATER TANK 200CUM. CAPACITY

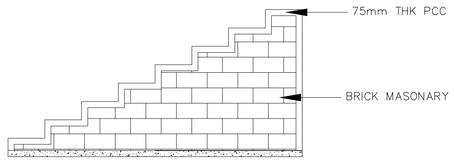
RELEASED FOR: PRELIMINARY, TENDER, ENGINEERING, CONSTRUCTION

DEPT. IWE | JOB NO. 20723196 | SCALE: AS SHOWN | REV.

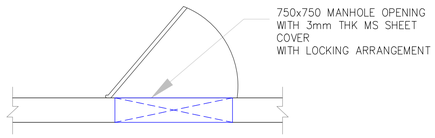
DWG.NO. FCE-20723196-IWE-DWG-DP-6101-006 | SHEET | RO



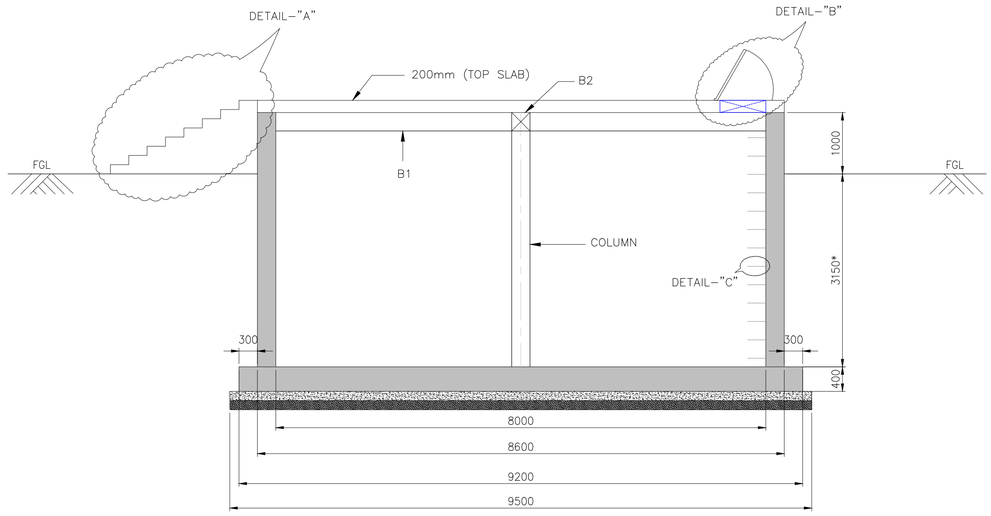
PLAN
(SCALE 1:50)



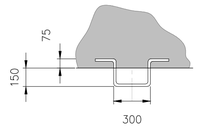
DETAIL – A
(SCALE 1:25)



DETAIL – B
(SCALE 1:25)



SECTION 1–1
(SCALE 1:50)



DETAIL – C
(SCALE 1:25)

NOTES:–

1. ALL LEVELS ARE IN BASED ON THE RL.
2. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNO.
3. GRADE OF CONCRETE SHALL BE M25 WITH 20mm DOWN GRADED AGGREGATES.
4. REINFORCEMENT STEEL SHALL BE OF Fe500 GRADE, CONFIRMING TO IS:1786.
5. CLEAR COVER TO CONCRETE SHALL BE AS FOLLOWS:

DESCRIPTION	TOP	BOTTOM	SIDES
RAFT	50	50	50
SIDE WALL	40	–	40
COLUMN	40	–	40
TOP SLAB	30	30	50
BEAM	30	30	50

6. LAP LENGTH(Ld) FOR REINFORCEMENT SHALL BE 50 DIA OF SMALLEST BAR BEING LAPPED AS STAGGERED.
7. FOR LIQUID RETAINING STRUCTURES IN CONTACT WITH EARTH AND WATER, 150mm WIDE x 8mm THK PVC WATER STOP SHALL BE PROVIDED AT ALL CONSTRUCTION, EXPANSION / ISOLATION JOINTS RESPECTIVELY UNLESS NOTED OTHERWISE.
8. PROPER CARE SHALL BE TAKEN TO KEEP THE WATER STOPER IN POSITION AND TO PROTECT IT FROM DAMAGE WHILE COMPACTING.

LEGEND:–

℄ – CENTER LINE
FGL – FORMED GROUND LEVEL
RL – REDUCED LEVEL
WS – WATER STOPPER
TYP – TYPICAL
UNO – UNLESS NOTED OTHERWISE
THK. – THICKNESS

B1 – 300x300mm
B2 – 300x300mm
C – 300x300mm
TOP SLAB – 200mm
RAFT – 400mm

TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
0	28.09.2024	ISSUED FOR APPROVAL	GCY				

FICHTNER
Consulting Engineers
(India) Private Limited
Chennai, Bangaluru

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DETAILED PROJECT REPORT TO SUPPLY CLEAN WATER BY INSTALLATION OF DESALINATION PLANT AT RE PARK, FOR 2375 MW CAPACITY SOLAR/WIND/ HYBRID RENEWABLE ENERGY PARK AT GREAT RAN OF KUTCH AREA, GUJARAT

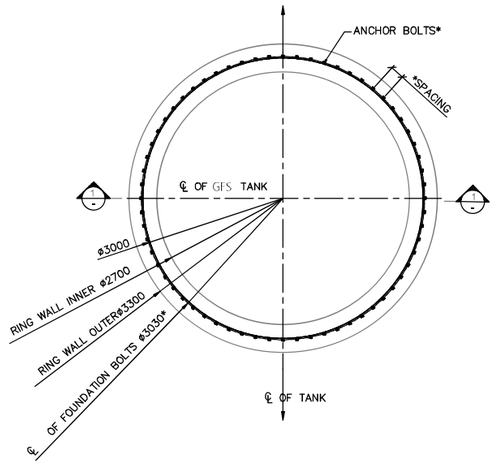
	SIGNATURE	DATE
DRAWN	GCY	28.09.2024
DESIGNED	SH	28.09.2024
CHECKED	RB	28.09.2024
DEPT.HEAD	BRL	28.09.2024
PROJ.MGR.	MKS	28.09.2024

TITLE
GENERAL ARRANGEMENT DWG OF ASCF ULTRAFILTRATION BACK WASH & REJECT WATER SUMP 150 CUM. CAPACITY

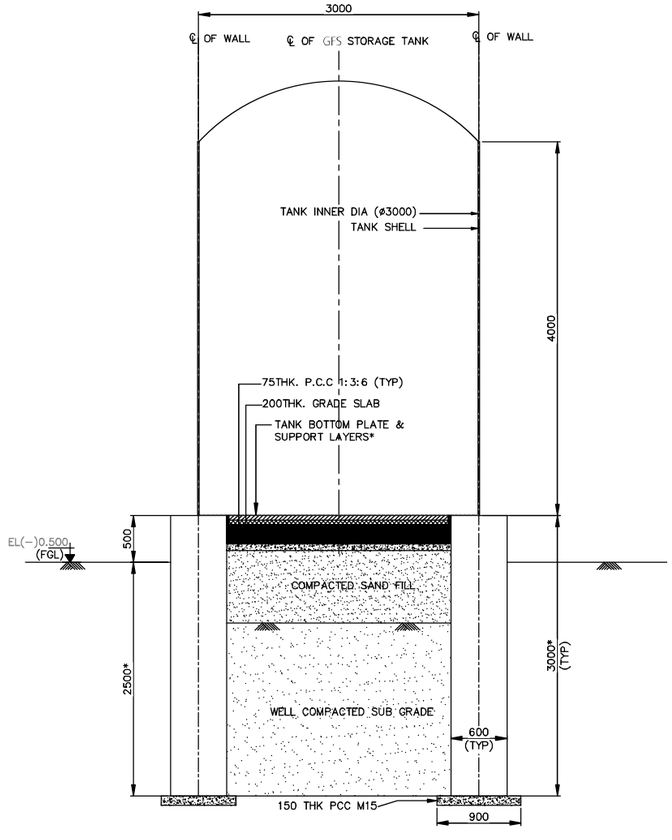
RELEASED FOR: PRELIMINARY, TENDER, ENGINEERING, CONSTRUCTION

DEPT. IWE | JOB NO. 20723196 | SCALE: AS SHOWN | REV.

DWG.NO. FCE–20723196–IWE–DWG–DP–6101–007 | SHEET | R0



PLAN
(SCALE 1:30)



SECTION 1-1
(SCALE 1:30)

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH CONTRACT TERMS & CONDITIONS SPECIFICATION & SCHEDULE OF ITEMS.
2. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
3. ALL RCC CONCRETE WORKS SHALL BE WITH GRADE M25 CONCRETE.
4. REINFORCEMENT STEEL SHALL BE OF Fe500 GRADE, CONFORMING TO IS:1786 & SHALL BE PROVIDED WITH FUSION BONDED EPOXY COATING COFORMING TO IS:13620.
5. CLEAR COVER TO CONCRETE SHALL BE AS FOLLOWS:

DESCRIPTION	TOP	BOTTOM	SIDES
RING FOUNDATION	45	45	45

6. THE CONTRACTOR SHALL BRING TO THE ATTENTION OF THE ENGINEER ANY DISCREPANCIES BETWEEN THESE DOCUMENTS DRAWINGS & SEEK CLARIFICATION BEFORE PROCEEDING WITH THE WORK.

LEGEND:

℄ - CENTER LINE
EL - ELEVATION
FGL - FINISHED GROUND LEVEL
PCC - PLAIN CEMENT CONCRETE

- CONCRETE
- PCC
- FINISHED GROUND LVL
- EL. X.XXX (TOC) - TOP OF CONCRETE

* DETAILS AS PER VENDOR

TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
				APPROVED BY			
0	28.09.2024	ISSUED FOR APPROVAL	GCY				

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangaluru

GUJARAT INDUSTRIES POWER CO. LTD
DETAILED PROJECT REPORT TO SUPPLY CLEAN WATER BY INSTALLATION OF DESALINATION PLANT AT RE PARK, FOR 2375 MW CAPACITY SOLAR/WIND/ HYBRID RENEWABLE ENERGY PARK AT GREAT RAN OF KUTCH AREA, GUJARAT

	SIGNATURE	DATE
DRAWN	GCY	28.9.2024
DESIGNED	SH	28.9.2024
CHECKED	RB	28.9.2024
DEPT.HEAD	BRL	28.9.2024
PROJ.MGR.	MKS	28.9.2024

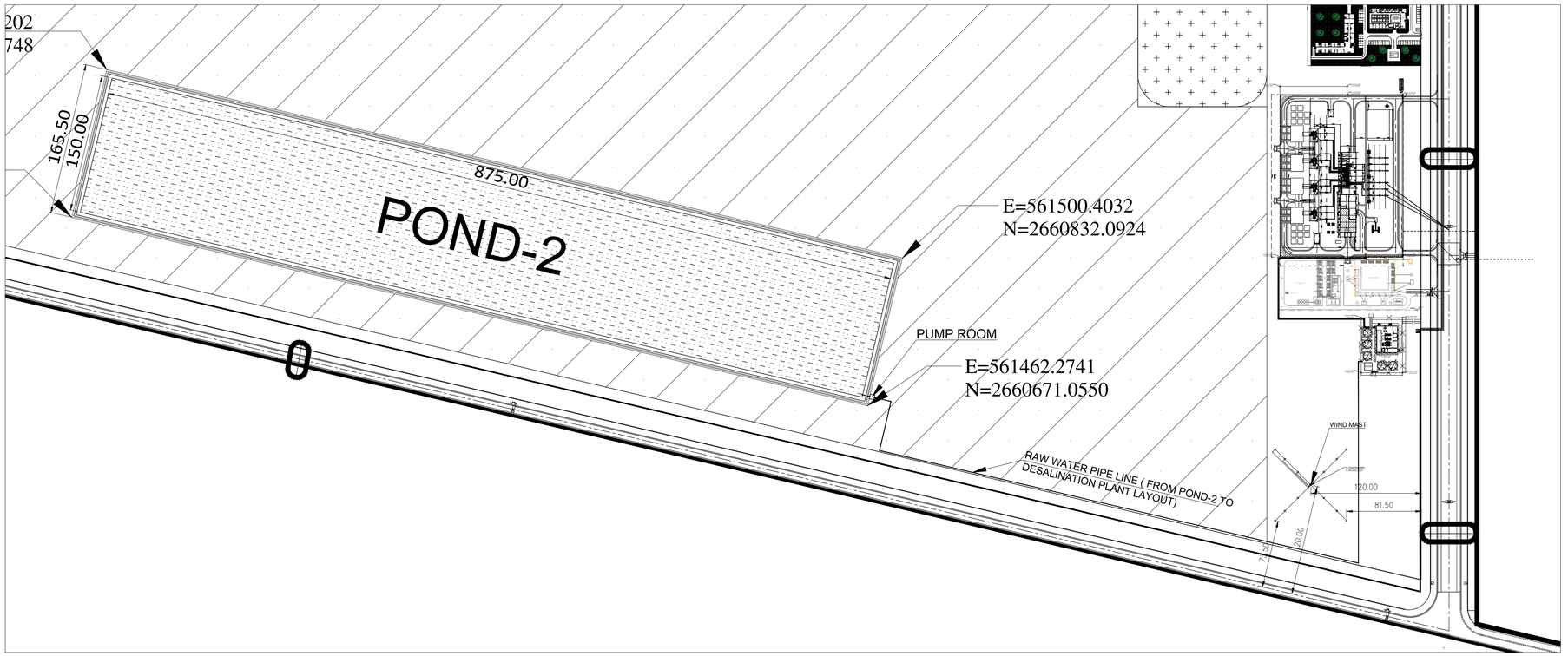
TITLE
GENERAL ARRANGEMENT DWG OF CIP TANK 20 CUM. CAPACITY

RELEASED FOR: PRELIMINARY, TENDER, ENGINEERING, CONSTRUCTION

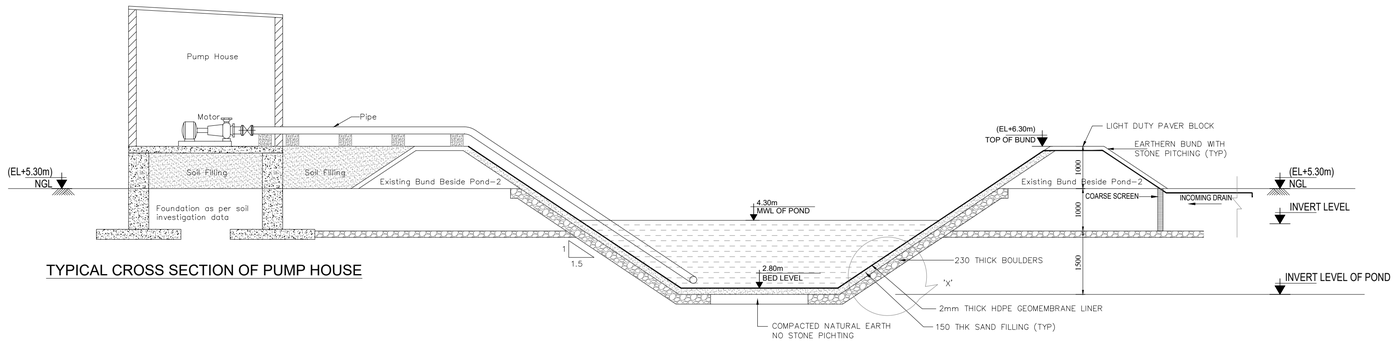
DEPT. IWE | JOB NO. 20723196 | SCALE: AS SHOWN | REV.

DWG.NO. FCE-20723196-IWE-DWG-DP-6101-008 | SHEET | R0

TRUE NORTH
PLANT NORTH

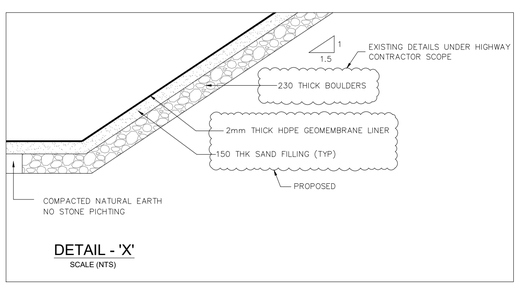


PLAN
SCALE 1:2000



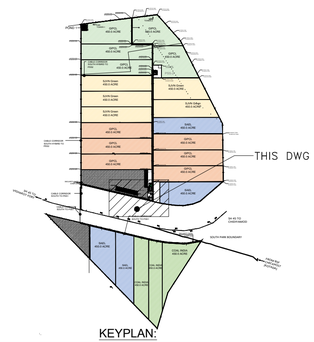
TYPICAL CROSS SECTION OF PUMP HOUSE

TYPICAL CROSS SECTION OF POND
SCALE (NTS)



DETAIL - 'X'
SCALE (NTS)

TRUE NORTH
PLANT NORTH



KEYPLAN:

NOTES :

1. ALL LEVELS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. PIPES ARE TO BE LAID 1.5m BELOW GL.

FOR TENDER

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH	ELEC.	INST.
R0	04.09.2025	ISSUED FOR TENDER PURPOSE	RK			SK	

APPROVED BY

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangaluru

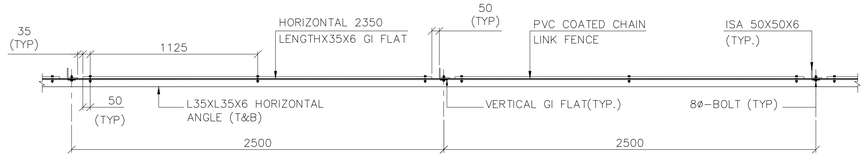
GUJARAT INDUSTRIES POWER CO. LTD
2375 MW CAPACITY SOLAR/WIND/HYBRID
RENEWABLE ENERGY PARK AT GREAT RANN OF KUTCH AREA, GUJARAT

	SIGNATURE	DATE
DRAWN	RK	04.09.2025
DESIGNED	–	04.09.2025
CHECKED	–	04.09.2025
DEPT.HEAD	SK	04.09.2025
PROJ.MGR.	RP	04.09.2025

POND-2 PUMP HOUSE ARRANGEMENT

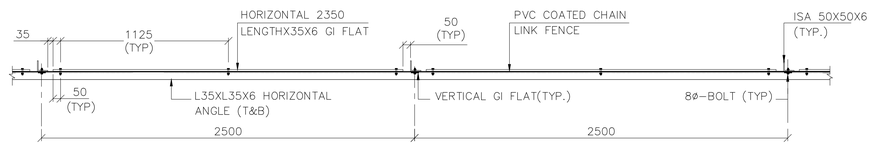
RELEASED FOR:			DEPT. RENEWABLE	JOB NO. 172112 5 A	SCALE: AS SHOWN	REV.
	PRELIMINARY					
	TENDER	✓	DWG.NO.	FCE-171125-ST-DWG-LAY-1300-009		R0
	ENGINEERING					
	CONSTRUCTION					

SIZE-A0



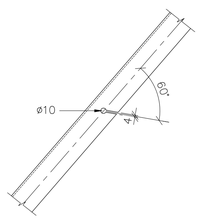
PLAN OF FENCE POST

(SCALE 1:20)



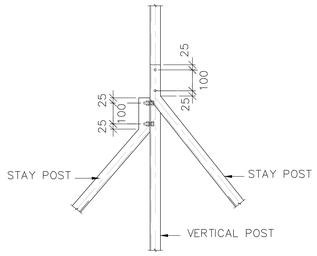
HORIZONTAL ANGLE DETAILS

FABRICATION DETAILS
(SCALE 1:20



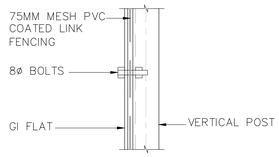
DETAIL-A

(SCALE 1:20)



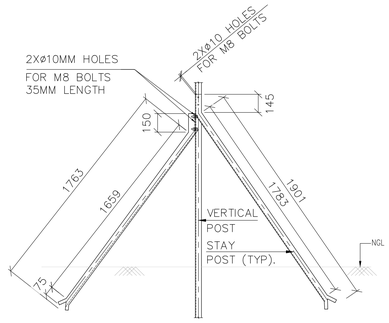
DETAIL-B

(SCALE 1:20)



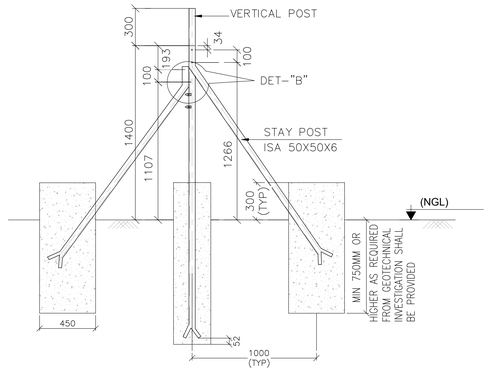
DETAIL-C

(SCALE 1:20)



STAY POST DETAIL

(SCALE 1:20)



STAY POST DETAIL

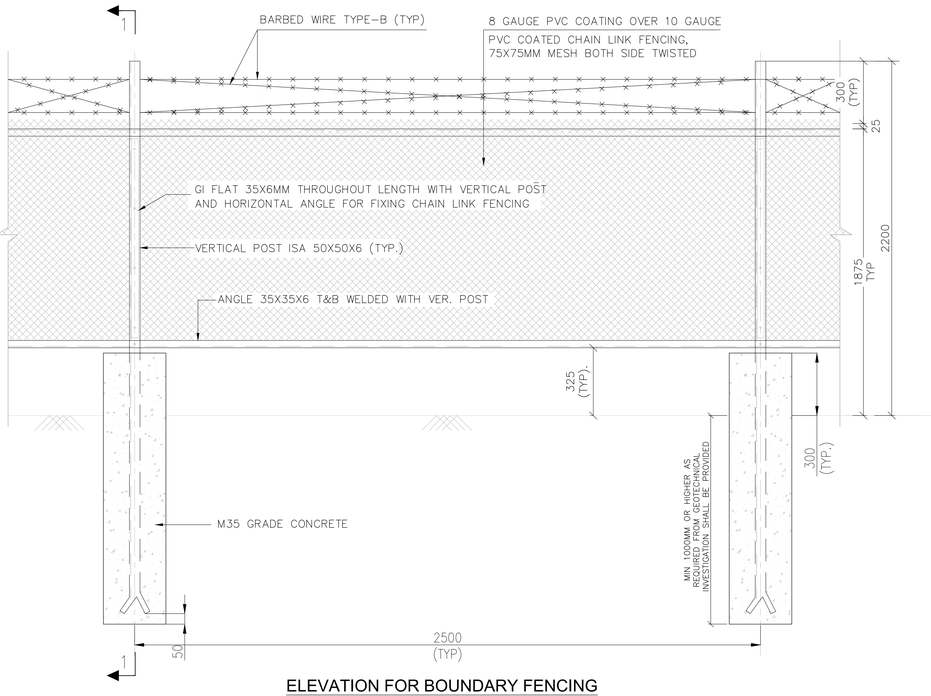
(SCALE 1:20)

LEGEND:

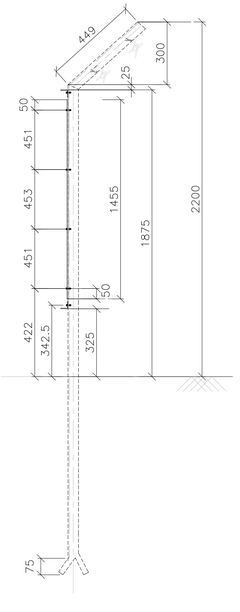
PCC–PLAIN CEMENT CONCRETE	T&B–TOP&BOTTOM
NGL–NATURAL GROUND LEVEL	ø–DIAMETER
NTS–NOT TO SCALE	GI–GALVANIZED IRON
DET–DETAIL	THK–THICKNESS
TYP–TYPICAL	PVC–POLY VINYL CHLORIDE
Eq–EQUAL	ISA–INDIAN STANDARD ANGLE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETER AND ELEVATIONS ARE IN METER
2. ALL STRUCTURAL STEEL WORK SHALL CONFORM TO IS:2062 GRADE–A
3. ALL DIMENSIONS TO BE CHECKED BEFORE FABRICATION OF STEEL WORK
4. GALVANIZATION ON WIRES SHALL CONFORM TO IS:4826
5. HOT DIP GALVANIZATION MINIMUM THICKNESS SHALL BE 90 MICRONS FOR ALL THE STRUCTURAL MEMBERS, 300MM ABOVE GROUND AND 110 MICRON FOR BELOW GROUND AND UPTO 300MM ABOVE GROUND.
6. FENCING HEIGHT SHALL FOLLOW THE NATURAL CONTOUR OF LAND.
7. PVC COATED CHAIN LINK FENCE AND BARBED WIRE SHALL BE ERECTED ONLY AFTER ERECTION OF EACH SEGMENTS OF FENCE POSTS AND STAY POSTS, SEGMENTS IS SHOWN IN THE PLAN.
8. BARBED WIRE (TYPE–B) FENCING SHALL MINIMUM 12–14 GAUGE APPROVED MAKE TATA OR EQUIVALENT. IT SHALL BE CONFORM TO IS 278.
9. THE BARBED WIRES SHALL BE INSERTED IN THE SLOTTED HOLE AND BINDED WITH BINDING WIRES.
10. TWO COLUMN POST SHALL BE PROVIDED AT EVERY CORNER AND WHEREVER CHANGE IN ELEVATION/LEVEL.
11. CLEAR COVER SHALL BE 50MM STEEL POST.
12. GRADE OF CONCRETE SHALL BE M35 WITH 20MM NOMINAL SIZE GRADED AGGREGATES AS PER IS:456
13. MINIMUM YIELD STRENGTH OF STRUCTURAL STEEL SHALL BE FY250.
14. ALL THE BOLTS GRADE IS 4.6 AND IT SHALL BE HOT DIP GALVANIZED
15. IF SOIL INVESTIGATIONS INDICATE SOFT CLAYEY/SLUSHY SOILS OR WATER TABLE AT FOUNDING LEVEL, MINIMUM 150MM THK DRY RUBBLE (SOLING) PACKING FOR FOUNDATION WITH APPROVED HARD STONE SET IN REGULAR LINES, HAND PACKED, FILLING THE INTERSTICES WITH SMALL STONE CHIPS AND SAND, RAMMING, WATERING AND COMPACTING.
16. ANTI CORROSIVE PAINT SHALL BE APPLIED OVER PILE CAP WHICH IS PROJECTING ABOVE GROUND LEVEL.

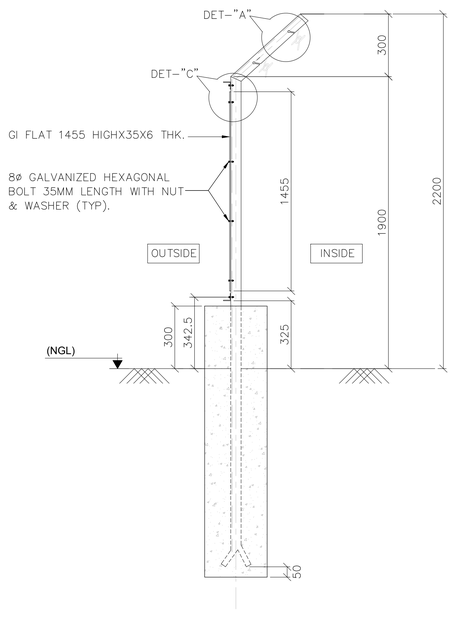


ELEVATION FOR BOUNDARY FENCING

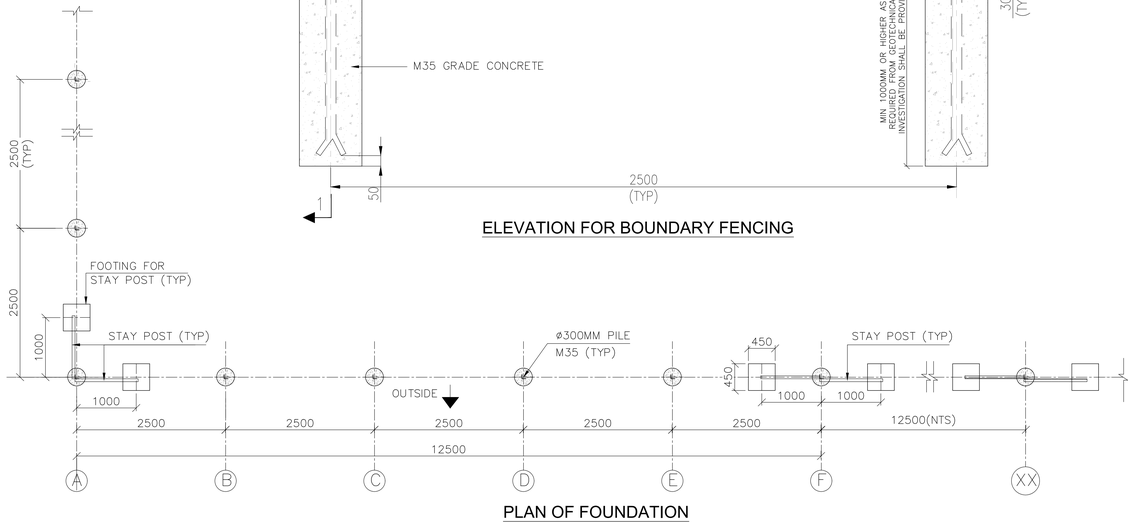


SECTION 1-1

(FABRICATION DETAILS)



SECTION 1-1



PLAN OF FOUNDATION

TENDER PURPOSE ONLY

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
0	01.10.2024	ISSUED FOR APPROVAL	MR				

APPROVED BY

FICHTNER
Consulting Engineers
(India) Private Limited
Chennai, Bangaluru

GUJARAT INDUSTRIES POWER CO. LTD
PREPARATION OF FEASIBILITY STUDY OF VARIOUS OPTIONS TO SUPPLY CLEAN WATER AT RE PARK FOR 2375 MW CAPACITY SOLAR/WIND/HYBRID RENEWABLE ENERGY PARK AT GREAT RANN OF KUTCH AREA, GUJARAT

	SIGNATURE	DATE
DRAWN	MR	01.10.2024
DESIGNED	SV	01.10.2024
CHECKED	SV	01.10.2024
DEPT.HEAD	LVP	01.10.2024
TEAM LEADER	RJB	01.10.2024

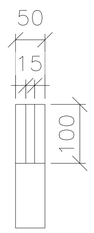
TYPICAL CABLE TRAY PRECAST SUPPORT

RELEASED FOR: PRELIMINARY ✓ | TENDER | ENGINEERING | CONSTRUCTION

DEPT. IWE | JOB NO. 20723196 | SCALE: NTS | SHEET 3 OF 8 | REV.

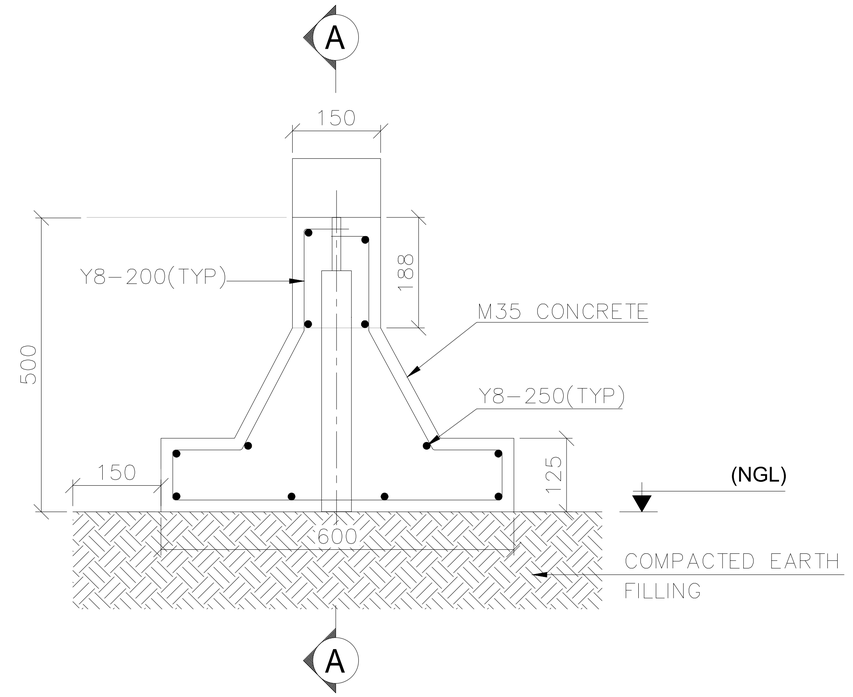
DWG.NO. FCE–20723196–IWE–DWG–IC–6101–002 | 0

M:\Industrial Water Infrastructure Engineering\Projects\20723196 - GIPCL - 1 MLD\WIP Spec R2 R3\SPEC R4\OCT 2025_FINAL_R4\CIVIL\Tender Dwg\ANNEXURE 6 - TYPICAL CABLE TRAY PRECAST SUPPORT.dwg



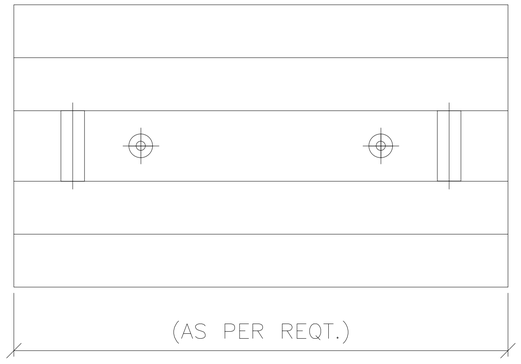
DETAIL-A

NTS



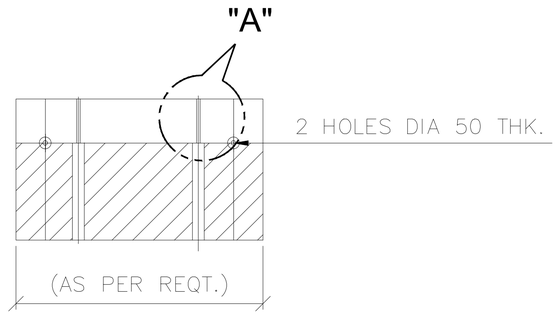
TYPICAL CROSS SECTION

NTS



TOP VIEW

NTS



SECTION A-A

NTS

LEGEND:

PCC–PLAIN CEMENT CONCRETE	T&B–TOP&BOTTOM
NGL–NATURAL GROUND LEVEL	ø–DIAMETER
NTS–NOT TO SCALE	GI–GALVANIZED IRON
DET–DETAIL	THK–THICKNESS
TYP–TYPICAL	PVC–POLY VINYL CHLORIDE
Eq–EQUAL	ISA–INDIAN STANDARD ANGLE

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER AND ELEVATIONS ARE IN METER
2. GRADE OF CONCRETE SHALL BE M35 WITH 20MM NOMINAL SIZE GRADED AGGREGATES AS PER IS: 456
3. MINIMUM YIELD STRENGTH OF STRUCTURAL STEEL SHALL BE FY250.
4. ALL REINFORCEMENT SHALL BE HIGH YIELD STRENGTH DEFORMED BAR OF GRADE TMT FE550D CORROSION RESISTANT STEEL (CRS) CONFORMING TO IS:1786.
5. THIS IS INDICATIVE DRAWING AND BIDDER TO SUBMIT THE DRAWINGS INLINE WITH THE REQUIREMENTS FOR REVIEW AND APPROVAL.

FOR TENDER PURPOSE

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST.
0	12.05.2025	ISSUED FOR TENDER PURPOSE	GCY	APPROVED BY			

FICHTNER
Consulting Engineers (India) Private Limited
Chennai, Bangaluru

GUJARAT INDUSTRIES POWER CO. LTD
PREPARATION OF FEASIBILITY STUDY OF VARIOUS OPTIONS TO SUPPLY CLEAN WATER AT RE PARK FOR 2375 MW CAPACITY SOLAR/WIND/HYBRID RENEWABLE ENERGY PARK AT GREAT RANN OF KUTCH AREA, GUJARAT

	SIGNATURE	DATE
DRAWN	GCY	03.10.2024
DESIGNED	CM	01.10.2024
CHECKED	RJB	04.10.2024
DEPT.HEAD	BRL	04.10.2024
TEAM LEADER	RJB	04.10.2024

TYPICAL CABLE TRAY PRECAST SUPPORT

RELEASED FOR		DEPT. IWE	JOB NO. 20723196	SCALE: NTS	REV.
	PRELIMINARY				
	TENDER	✓	DWG.NO. FCE-20723196-IWE-DWG-IC-6101-013		0
	ENGINEERING				
	CONSTRUCTION				

C:\Users\ydeesh\kumargv\AppData\Local\Microsoft\Windows\INetCache\Content.Outlook\7SH96WIM\ANNEXTURE-6 TYPICAL CABLE TRAY PRECAST SUPPORT.dwg

VOLUME-III

PART - 1

ANNEXURES - CIVIL

Geotechnical Investigation Report

Consulting Engineers (India) Private Limited

- ☐ Action - 1 Approved
- ☐ Action - 2 Approved except as noted. Revise and resubmit for final approval
- ☐ Action - 3 Returned with Comments. Revise and resubmit for review/ approval
- ☐ Action - 4 Not approved. Revise and resubmit for review
- ☑ Action - 5 Retained for Information, Reference & Records
- ☐ Action - 6 Returned without review
- ☐ Action - 7 Documents reviewed only against our previous comments and other revisions highlighted and identified by the Contractor/Vendor
- ☐ Action - 8 Reviewed

Review/Approval of documents for the general compliance with the Contract does not constitute a blanket approval of the content of document.The Vendor / Contractor is responsible for correctness of design and details. Approval of document does not relieve the Vendor / Contractor of his responsibility in carrying out the work correctly and fulfilling the complete requirements of the contract, stated or implied, nor does it limit the Purchaser's rights under the Contract.

FI Letter Ref. No.: 1731125/TL/ST/VDT/1000154 Date: 15-07-2024

Signature Initials: RP

Name of Project

Geotechnical Investigation Work at 400 kV Transmission Line Work of M/S. GIPCL at Khavda, Bhuj, Kachchh, Gujarat.

AP-(5/1)

UNIQUE ENGINEERING SERVICES

Plot No. 52, Ward-6 (Industrial), B/H Emergency Response Center, Gandhidham, Kachchh Gujarat- 370201.
Web site: www.uniquelab.co.in; Email: pro@uniquelab.co.in
Contact no.: 02836- 258110/ 7069042725

PROJECT NAME	Geotechnical Investigation Work at 400 kV Transmission Line Work of M/S. GIPCL at Khavda, Bhuj, Kachchh, Gujarat.		
CLIENT NAME			
GEOTECHNICAL CONSULTANT	UNIQUE ENGINEERING SERVICES		
REFERENCE NO.	APS/GIP-92/RE Park/TL/SOIL INVST./01, DATE:-01/11/2023		
DOCUMENT NO.	UES/2023-24/231212-101/129/26		
REVISION NO.	R-0		
REPORTING DATE	21-06-2024		
TOTAL PAGES	31		
LOCATION	AP-(5/1), GIPCL Plot, Khavda Kachchh		
REPORT	NAME	DESIGNATION	
PREPARED BY	PUJA GOSWAMI	Sr. ENGINEER	
CHECKED BY	DR. KALPANA MAHESHWARI	TECHNICAL DIRECTOR	

TABLE OF CONTENT

1. INTRODUCTION

1.1. GENERAL

Associated Power Structures Private Limited has engaged **Unique Engineering Services** to provide their Service vide their letter No: APS/GIP-92/R E Park/TL/SOIL INVST. /01; Date – 01-11-2023 to carry out detailed Geotechnical Investigation including laboratory testing works, technical report, etc for 400 kV Transmission Line Work of M/s GIPCL at Khavda, Bhuj. The field testing was carried out from the 24th of May 2024 to the 26th of May 2024. This report includes 1 borehole of 50.00 m depth from respective ground levels, as per specification for a Transmission Tower.

1.2. PURPOSE

The objective of the geotechnical investigation was to explore the subsoil profile up to a predetermined depth and to work out the bearing capacity/allowable pressure on the soil beneath at a required foundation depth for the proposed type of foundation.

Complete geotechnical investigation work was undertaken to obtain the required subsurface information to study and define the nature and behavior of soil, under the application of loads of proposed structures. Such information was obtained through the following steps:

- Drilling boreholes and collecting disturbed and undisturbed soil samples.
- Performing in-situ tests (e.g. SPT,) and conducting laboratory tests to classify and determine the physical and engineering properties of soils.

2. SCOPE OF THE WORK

2.1. Exploration at AP 5/1 (Transmission Tower Structure) of the proposed site and conduct requisite in-situ tests.

2.2. Laboratory testing of representative samples obtained during the field investigation to evaluate relevant engineering parameters of the subsurface soils.

2.3. Preparation of this report includes:

- Bore logs
- Results of laboratory tests and field tests
- Recommendation of foundation types and depths

Table 1: Scope of work

Sr. No.	Description	Quantity
1	Boreholes	1 Nos. of 50.00 m depth
2	Laboratory Tests, Analysis, and Submission of report.	

3. SITE CONDITIONS

3.1 Introduction:

The project location is located in eastern part of Great Rann of Kachchh. It is in Kachchh district of Gujarat State. The district is situated in the western part of Gujarat State and forms a part of the wester Gujarat region with the city Bhuj as its administrative headquarters. It lies between 23° 18'51" and 23°29'24" north and 68°27'35" and 41°01'40" east longitudes. It has totaled an area of 45674 sq.km and is bounded in the north by the Pakistan, towards west and south west by Arabian Sea and Gulf of Kachchh respectively.

3.2 Climate:

The district has semi-arid climate. Climate in the district is characterized by the hot summer and dryness in the non-rainy seasons. The year is marked by four distinct seasons i.e. cold from December to February followed by the hot season from March to May/(mid-June). The south-west monsoon season is from mid-June to mid-September and Post monsoon season is from mid-September to end of October. May is the hottest month with mean daily maximum

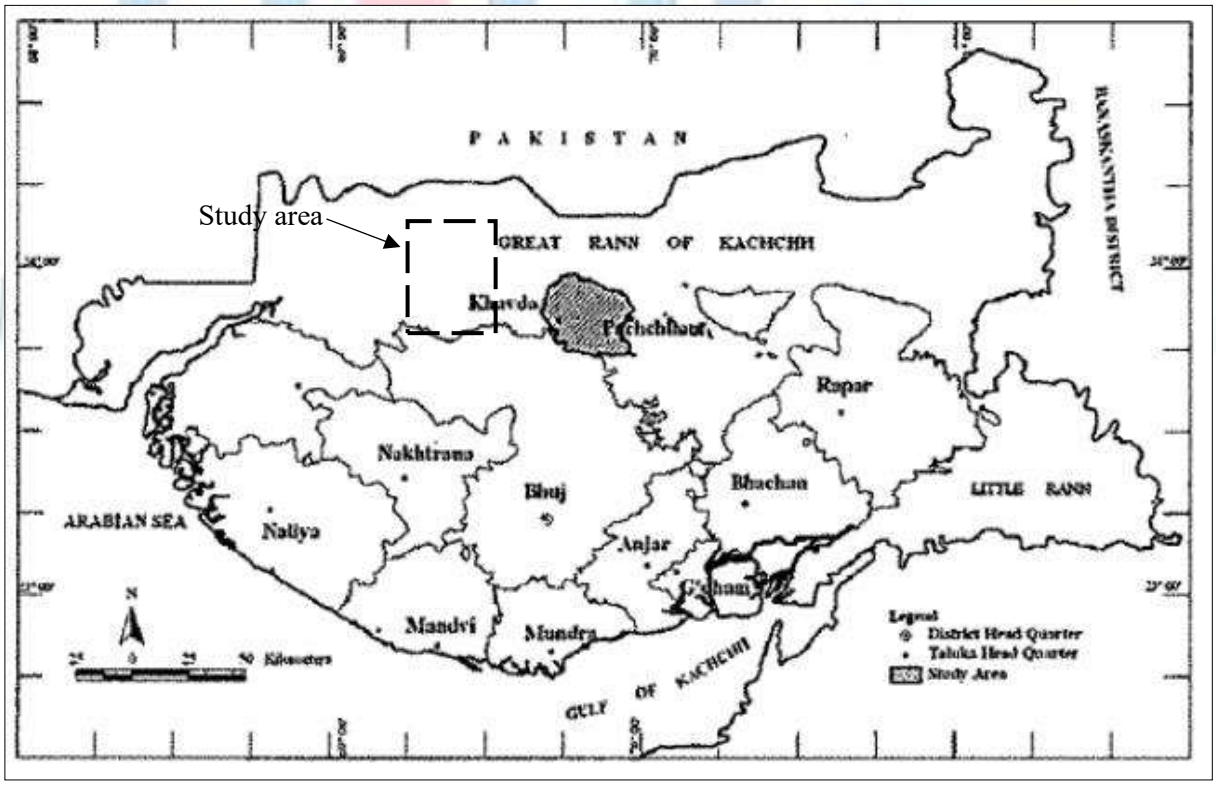


Figure 1 Administrative map of Kachchh District.

temperature of 41^0 C. January is the coldest month in which the mean daily minimum temperature of 9.8^0 C recorded in 1998. Annual rainfall of the district is 456 mm and is mostly received during the south-west monsoon season from June to September.

3.3 Rainfall:

Rainfall data in respect of 7 rain gauge station representing Kachchh district have been collected from Water Resources Investigation (WRI), State Data Centre, Govt. of Gujarat, Gandhinagar. Data has been analysed for the year of 1992 to 2021 (29 years). The average annual rainfall of the area is 456 mm (year 1992-2021), although there is a considerable variation from year to year.

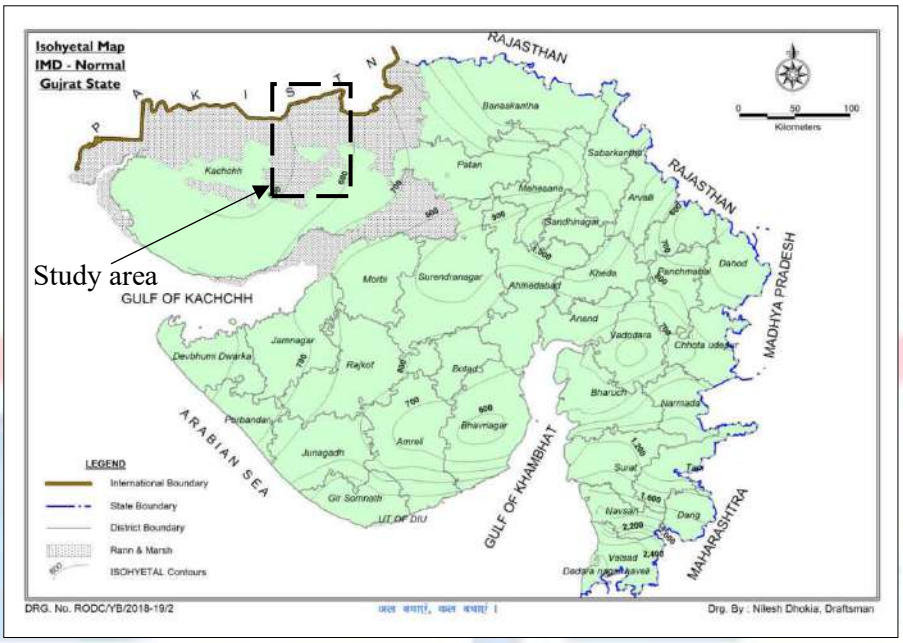


Figure 2 Isohyetal map year 2021, Gujarat.

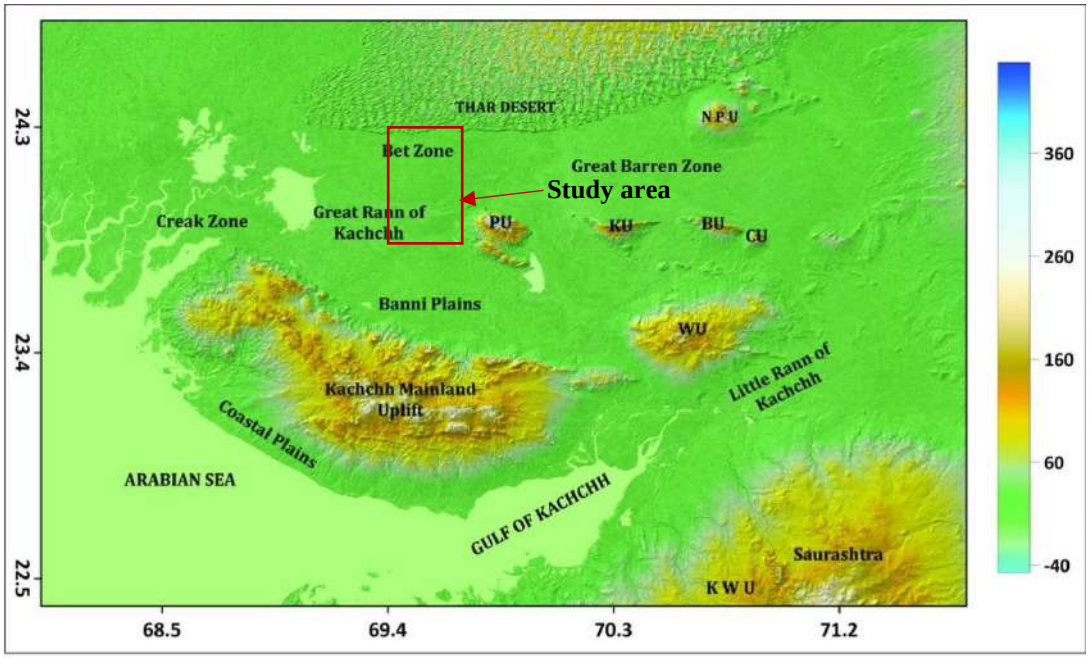
3.4 Topography

The Rann of Kachchh is a unique landscape located in the western part of Gujarat state with unusual geomorphic terrain and is the only saline and marshy desert of the world (Maurya et al; 2002) and is characterized by flat topography with average height up to 4m above MSL. Cubitt and Mountfort (1991) defined Rann of Kachchh as "a desolate area of unrelieved, sunbaked saline clay desert, shimmering with the images of a perpetual mirage". The monotonous flatness, salinity, and the unusual inundation have rendered the Rann as a place of mysterious ground. In spite of its unusual position and character, Rann has hardly been studied. Though the mainland of Kachchh has drawn the attention of many scientists and researchers, regrettably various aspects of Rann continued to be only feebly understood.

3.5 Physiographic Divisions of Kachchh

Kachchh region can be divided into four major physiographic divisions, which are

- The Island Belt
- The Mainland Kachchh
- The Coastal Zone of Kachchh
- The Great Rann of Kachchh and Banni Plains



Uplifts: NPU- Nagar Parker Uplift, PU- Pachcham Uplift, KU- Khadir Uplift, BU- Bela Uplift, CU- Chorar Uplift WU- Wagad Uplift, KWU- Kathiyawar Uplift,

Figure 3 Map showing major geomorphic division of Kachchh (Modified after Kar et al., 2001)

3.5.1 The Island Belt

The Island belt comprises four highlands viz. Pachham, Khadir, Bela and Chorar from west to east. These highlands are commonly described as "Islands" as they stand out amidst the Ranns, which are submerged during the monsoon. These four islands occur in east-west line to the south of the Great Rann. Northern boundaries of all the islands are steeper while the gradient is very low towards south. A large upland region towards northeast of the Mainland, and south of Khadir, Bela and Chorar islands is known as Wagad Highland. This table like region has very low dip due south or southwest.

3.5.2 The Great Rann of Kachchh

The flat terrain of the Great Rann and Banni plain together comprise a vast barren landscape that is hostile and almost non-navigable (Glennie and Evans, 1976). These continuous; terrains occur a few meters above sea level and are believed to be part of a former gulf occupying an E-W

trending tectonic depression (Fig. 4). The Ranns, which constitute flat terrain with no surface exposures, are the product of marine deposition (Biswas, 1974; Glennie and Evans, 1976). The evolution of the Great Rann of Kachchh has been linked to tectonic activity in late Quaternary period. The basin was filled up by sediments supplied from the Indus drainage basin while the surface has been suffered by the frequent earthquakes. The Ranns are therefore the most promising areas of the Kachchh for neotectonic and paleo seismic investigations. These unique geomorphic features occupy eastern and northern parts and have a total area of 22,000 sq km.

The Great Rann of Kachchh has been the site of the 1819 AD earthquake which produced surface rupture known as the 'Allah Bund' resulting in the uplift of the northern part of the Rann. This vast wasteland is about 4 m above high water line. The Ranns are geomorphologically divisible into four units (Merh and Patel, 1988) - Bet Zone (BTZ), Linear Trench Zone (LTZ), Great Barren Zone (GBZ) and Little Rann of Kachchh (LRK).

The Bet zone forms a slightly uplifted area towards the north of Allah Bund, and represents an old mouth of a great Himalayan river system. The southern limit of this complex network of bets and inlet channels is marked by the Allah Bund while to the north it merges into the sand ridges of Sindh-Pakistan.

The Linear Trench Zone, a narrow E–W trending tract, is a depression extending from the Kori Creek eastward up to Kuar Bet. This depressed terrain lying between the Banni and the Allah Bund, gets inundated by tidal waters of the Arabian Sea through the Kori Creek. Its western portion in the proximity of the Kori Creek is a region of regular marine inundation; the central portion comes under the influence of high tides only during monsoon months.

The Great Barren Zone, the eastern most portions, is an extensive barren area, free from sea water ingression creating a vast shallow saucer shaped depression which to the north merges into the sand dunes of Thar Desert, to the south a buts against the mainland, to the east rises into the alluvial plains of Banaskantha and to the south blocked by the rocky islands of Pachham, Khadir, Bela and Chorar.

3.6 Tectonic setup of Great Rann of Kachchh:

The evolution of the Kachchh basin is related to the breakup of Gondwanaland in the Late Triassic/Early Jurassic and the subsequent spreading history of the Eastern Indian Ocean (Biswas, 1982, 1987). The basin is traverse by several E-W trending faults namely Nagar Parkar Fault (NPF), Island Belt Fault (IBF), Gora Dongar Fault (GDF), Kachchh Mainland Fault (KMF), South Wagad Fault (SWF), Katrol Hill Fault (KHF) and North Kathiyawad Fault (NKF). The Kachchh Basin comprises of three main uplifted regions as Kachchh Mainland Uplift,

Wagad uplift and Island Belt Uplift. In between Nagar Parkar Fault (NPF) and Island Belt Fault (IBF) graben, system lies the salt flats known as the Rann of Kachchh. The Great Rann of Kachchh characterized by recent sediments comprising of sand, silt and clay ranging up to hundreds of meters.

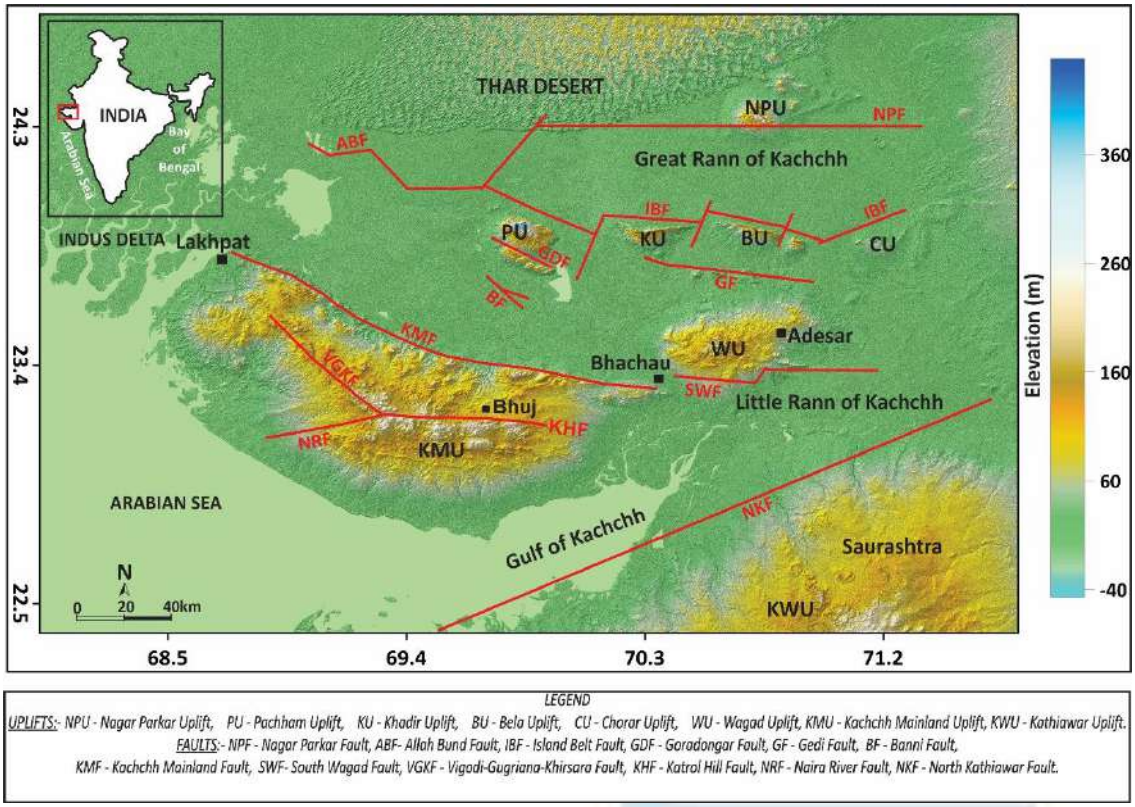


Figure 4 Structural and tectonic map of Kachchh (after Biswas and Khattri, 2002)

3.6.1 Tectonic setup of study

- ***Island Belt Fault (IBF):***

IBF is not well exposed along the island chain of uplifts being concealed under Rann sediments. The faulting is indicated by steeply dipping beds of the forelimbs of drape – folds and the imposing escarpments facing north. At the foot of the northern scarp of Pachham (Kaladongar hills), hard sandstone beds dipping 600-800 to the north into the Rann sediments indicate the fault. High and erratic dips along the margin of the uplifts bordering Rann indicate faults. The fault appears to have been dislocated by left lateral NE-SW strike-slip faults, which separated Island Belt Uplift (IBU) into four discrete blocks [Pachham Uplift (PU), Khadir Uplift (KU), Bela Uplift (BU), and Chorar Uplift (CU)]. These blocks were rotated anticlockwise and shifted progressively westward as indicated by their axial orientation

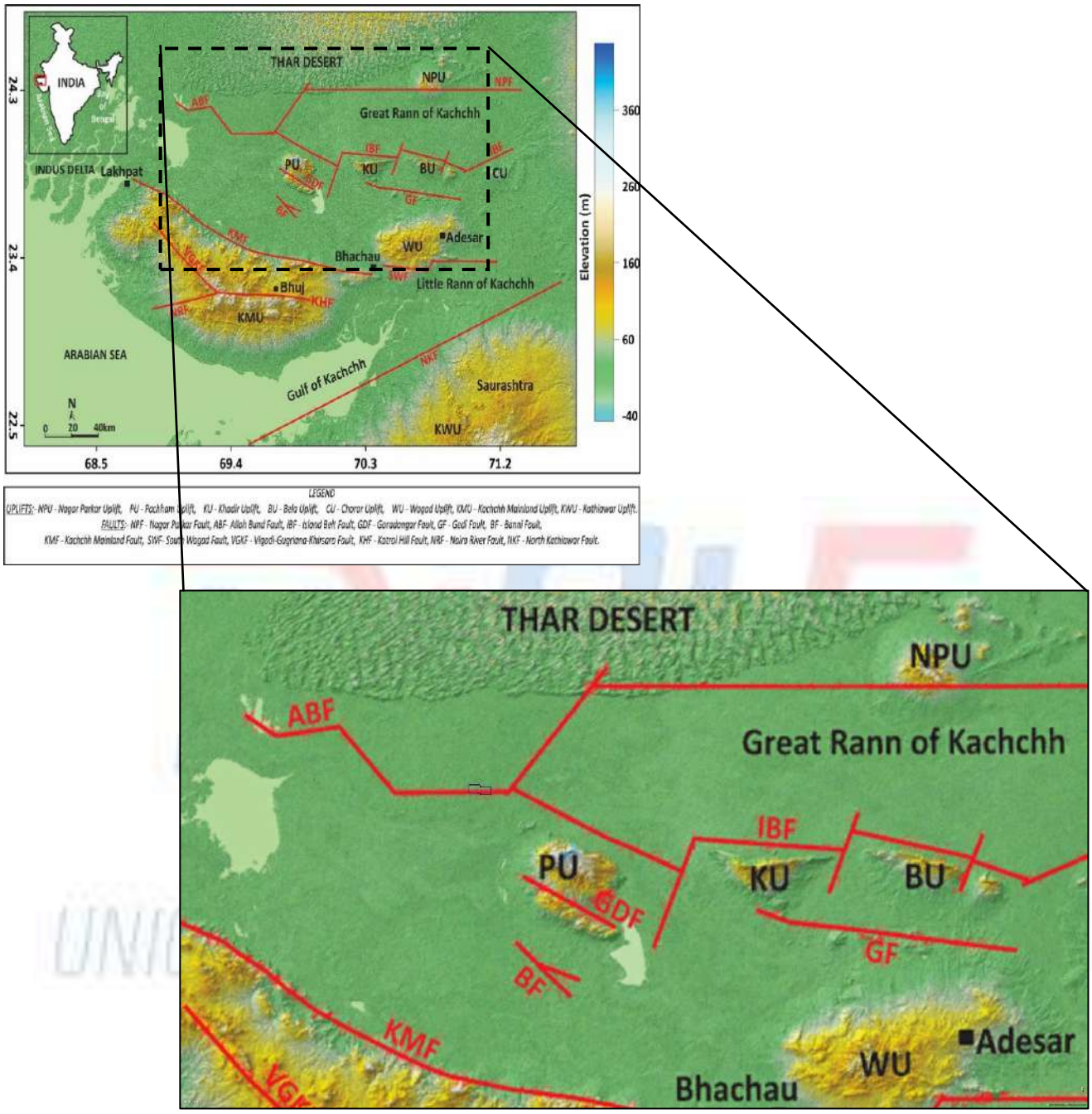


Figure 5 Structural and tectonic map of study area shown in blue colour boundary (after Biswas and Khattri, 2002)

3.7 Geology of study area

3.7.1 Quaternary sediment

The region of Kachchh falls in an arid zone, which is the southwestern continuation of the arid belt of north western India that includes the Thar Desert in Rajasthan. There are three principal areas in Kachchh, which have witnessed significant Quaternary sedimentation. One is the flat saline wasteland of the Ranns which includes the Great Rann of Kachchh and the Little Rann of Kachchh. The Ranns, which constitute a flat terrain made up of silt and clay sediments rich with salt and occasionally sands with no surface exposures of any hard rocks, are the product of marine deposition (Platt, 1962; Biswas, 1974; Glennie and Evans, 1976; Roy and Merh, 1981). The second area is the narrow E-W trending coastal plains of southern Mainland Kachchh along the Gulf of Kachchh coastline. The third area is the hinterland Quaternary deposits along the river valleys as terraces and fluvial sand bars and also along the major fault scarps in the form of colluvial fans, alluvial fan, and valley fill milliolitesandy biomicrites and aeolian milliolite. Significant work has been produced in last couple of years regarding the Quaternary sediments of Kachchh, which has great relevance in understanding the seismic phenomena and the climatic changes in western India. The present description of Quaternary deposits of Kachchh comprise the following titles: The Rann sediments, the coastal plain deposits and the inland Quaternary deposits that includes colluvial fans, the alluvial fans, the fluvio-aeolian and valley fill milliolites

4. FIELD INVESTIGATION

4.1. DRILLING WORK

The rotary drilling machine was mobilised at the site. The safety mechanisms were developed for the technical team and workers.

1 borehole of 4” diameter was drilled to determine the sub-soil stratification and to test the samples of various depths for the physical and the engineering properties. The undisturbed samples were collected as per IS 1892:2021 Subsurface investigation for foundations Code of practice second revision of IS 1892. The boreholes were terminated at the termination criteria given in the specifications.

4.2. GROUNDWATER CONDITION

The groundwater level was checked in the test boreholes after 24 hours of completion of drilling work. Ground water was encountered at 2.30 m depth below EGL during subsurface investigation work carried out in the month of May’24. It may differ depending on the period of year and climatic conditions.

Table 2: Borehole Details

BH. No.	Depth below EGL, m	Groundwater below EGL, m	42 R, Co-ordinates, m	
			N	E
AP-5/1	50.00	2.30	2660607	562093

4.3. SAMPLING DESCRIPTION

The disturbed samples were collected from the borehole and the undisturbed samples were collected using a Shelby tube. The soil samples were visually identified and described in accordance with relevant IS codes and thereafter packed, labeled, sealed, and dispatched to our laboratory. The soil samples were transported to our laboratory in Gandhidham for testing.

4.3.1. DISTURBED SOIL SAMPLES

The disturbed soil samples were collected during the boring and also from the split spoon sampler. The samples recovered were labeled and placed in polythene bags and transported to the laboratory for testing.

4.3.2. UNDISTURBED SOIL SAMPLES

The undisturbed soil samples were collected in accordance with IS 2132:1986 (Reaffirmed-2021) Code of Practice for Thin-walled Tubed Sampling of Soil. The sampler used for sampling had a smooth surface, appropriate area ratio, and cutting edge angle thereby minimizing disturbance of the soil during sampling. The samples were collected starting from 3.0m depth at every 1.50m depth from EGL and at every 3.00 m after 30.0 m till hard strata have been recovered. The coating of oil was applied on both sides of the sampler to obtain undisturbed samples in the best possible manner. The sampler was then lowered into the borehole on a string of drill rods at a pre-determined level. The disturbed material in the upper end of the sampler, if any, was completely removed. The soil at the lower end of the sampler was trimmed to about 10 to 15 mm. The samples were sealed using the wax, labeled, and transported to our laboratory at Gandhidham for testing.

4.4. STANDARD PENETRATION TEST (SPT)

The SPT has been conducted in accordance with IS 2131:1981 (Reaffirmed-2021) Method for Standard Penetration Test for Soils, in boreholes starting from 0.5 m depth from EGL at every change in strata or an interval of 1.50 m depth upto 30.0 m and at 3.00 m depth after that in uniform strata. The split spoon sampler has been seated 15 cm with the blows of the hammer weighing 63.5 kg, falling freely through the height of 75 cm. Thereafter the split spoon sampler

was further driven by 30 cm. The number of blows required to drive each 15 cm penetration has been recorded. The number of blows for the first 15 cm penetration is termed as a seating drive. The last 30 cm penetration is termed as penetration resistance N-Value.

Table 3: Co-relation of SPT value for cohesionless soil

SPT (N) value	0 – 4	4 – 10	10 – 30	30 – 50	>50
Consistency of soil	Very Loose	Loose	Medium	Dense	Very Dense

Table 4: Co-relation of SPT value for cohesive soil

SPT (N) value	0 – 2	2 – 4	4 – 8	8 – 15	15 – 30	>30
Consistency of soil	Very Soft	Soft	Medium	Stiff	Very Stiff	Hard

5. LABORATORY TESTING

The laboratory tests were performed in accordance with relevant IS codes along with the technical specification of the project, at our laboratory in Gandhidham. The summary of the laboratory test results of all boreholes is presented in Annexure.

Table 5: Laboratory Tests

Laboratory Test	IS Code
Moisture Content	IS 2720 Part 2:1973, RA-2020
Specific Gravity	IS 2720 Part 3:1980, RA-2021
Grain Size Analysis	IS 2720 Part 4:1985, RA-2020
Hydrometer	IS 2720 Part 4:1985, RA-2020
Atterberg's Limits	IS 2720 Part 5:1985, RA-2020
Unconfined Compressive Strength	IS 2720 Part 10:1991, RA-2020
Shear Parameters i.e. c – ϕ	IS 2720 Part 11:1981, RA-2021 IS 2720 Part 13:1986, RA-2021
Free Swell Index	IS 2720 Part 40, RA-2021
pH	IS 2720 Part 26: 1987, RA-2021
Chlorides	IS 3025 Part 32: 1988, RA-2019
Sulphate	IS 2720 Part 27: 1977, RA-2020

5.1. SUB-SOIL PROFILE

Table 6: Sub-Soil Profile

BH. No.	Depth, m		Soil description	Type of Soil
	From	To		
AP-5/1	0.00	3.60	Brownish Clay of Low Plasticity mixed with Little Fine Grained Sand Particles	CL
	3.60	10.95	Greyish Non-Plastic Silt mixed with Fine Grained Sand Particles	ML
	10.95	24.60	Greyish Clay of Low Plasticity mixed with Little Fine Grained Sand Particles	CL
	24.60	34.05	Greyish Clay of Intermediate Plasticity mixed with Little Fine Grained Sand Particles	CI
	34.05	40.05	Greyish Non-Plastic Silt mixed with Fine Grained Sand Particles	ML
	40.05	50.05	Greyish Medium to Fine Grained Sand Particles mixed with Fines	SM

5.2. RESULTS OF CHEMICAL ANALYSIS

Table 7: Chemical Test Results of Soil

Sr. No.	Bore Hole	Depth from EGL, m	pH	Chloride, mg/L	Sulphate, %
1	AP-5/1	3.00	8.71	965	0.1421
Reference			As per IS 456 Table – 4 Class I		

Table 8: Chemical Test Results of Water

Sr. No.	Bore Hole	pH	Chloride, mg/L	Sulphate, mg/L
1	AP-5/1	6.85	744	883
IS 456 – 2000 RA:2021		> 6.00	500 mg/L Max (for RCC Work)	400 mg/L Max
Reference			As per IS 456 Table – 4 Class IV	

6. ASSESSMENT OF LIQUEFACTION

Liquefaction of soils is phenomenon which occurs in saturated cohesionless soil (i.e., sand stratum) during dynamic conditions in earthquakes.

According to IS-1893, Part-1, Cl. 3.16 "Liquefaction is a state in saturated cohesionless soil" and Cl. 6.3.5.2 states "In soil deposits consisting of submerged loose sands and soils falling under classification SP with standard penetration N-values less than 15 in seismic Zones III, IV, V and less than 10 in seismic Zone II, the vibration caused by earthquake may cause liquefaction or excessive total and differential settlements. Such sites should preferably be avoided while locating new settlements or important projects. Otherwise, this aspect of the problem needs to be investigated and appropriate methods of compaction or stabilization adopted to achieve suitable N-values as indicated below". The seismic zone factor (Z) 0.36 and maximum earthquake magnitude (Mw) 7.5 has been considered for Bhuj city. The evaluation of the liquefaction potential in case of cohesionless soils shall be computed based on Annex-F from IS1893 (Part-1) : 2016. The same in case of clayey soils is given by Seed and Idriss (1982) who stated that clayey soils (i.e. plots above the A-line on the plasticity chart) could be susceptible to liquefaction only if all three of the following conditions are met: (1) Percent less than 5 mm < 15%, (2) LL < 35, and (3) wc/LL > 0.9. Due to its origin, this standard is known in the literature as the "Chinese Criteria".

4 The desirable minimum corrected field values of *N* shall be as specified below:

Seismic Zone	*Depth* (m) *below Ground Level*	*N Values*	*Remarks*
III, IV and V	≤ 5 ≥10	15 25	For values of depths between 5 m and 10 m, linear interpolation is recommended
II	≤ 5 ≥10	10 20	

7. FOUNDATION RECOMMENDATIONS

7.1. DESIGN OF PILE:

Bored Cast *In-Situ* Pile design as per IS: 2911 (Part 1/Sec II)

For Non-Cohesive Soils (Clause No. 6.3.1.1 – Appendix B 1)

$$Q_u = A_p\left(0.5\, D\, \gamma\, N_\gamma + P_d\, N_q\right) + K\, P_D \tan\delta\; A_s$$

For Cohesive Soils (Clause No. 6.3.1.1 – Appendix B 2)

$$Q_u = (A_p\, N_c\, C_p + \alpha\, C_s\, A_s)$$

Where,

A_p = Cross-sectional area of pile toe, m^2

D = Diameter of the stem, m

γ = Effective unit weight of soil at pile toe, kN/m^3

P_d = Effective overburden pressure at pile toe, kN/m^2

P_D = Effective overburden pressure at around stem, kN/m^2

N_q & N_γ = Bearing capacity factors

K = Coefficient of earth pressure

δ = Angle of wall friction between pile & soil

A_s = Surface area of pile stem, m^2

C_p = Average cohesion around pile toe, kN/m^2

α = Reduction factor

C_s = Average cohesion around pile stem, kN/m^2

7.2. Summary of the load-carrying capacity of the pile: Looking to the characteristics and behavior of soil, the capacity of the pile foundation is tabulated in the table below. The size and depth of the pile foundation may be selected as per the site feasibility.

Table 9: Parameters for the Load Carrying Capacity of a Pile

Borehole No.	Depth from EGL, m		Type of soil	Bulk density, g/cc	Cohesion, kg/cm^2	Angle of internal friction, φ	Remark
	From	To					
AP-5/1	0.00	3.60	CL	1.848	0.29	15	Borelog
	3.60	10.95	ML	1.866	0.00	23	Borelog
	10.95	24.60	CL	1.896	0.35	13.6	Borelog
	24.60	34.05	CI	1.988	0.45	11.4	Borelog
	34.05	40.00	ML	2.024	0.00	30	Borelog

Table 10: Load Carrying Capacity of a Pile

Pile Type	Bore Hole No.	Length of pile Below EGL, m	Pile Dia.,mm	Pile Capacity, MT					
				Safe Capacity		Ultimate Capacity		Lateral	
				Vertical	Uplift	Vertical	Uplift	Fixed Head	Free Head
Bored Cast In-Situ Pile	BH-AP - 5/1	36.0	750	221.3	178.5	553.3	535.4	19.3	7.5
		38.0		237.1	192.9	592.8	578.7		
		40.0		252.9	207.3	632.3	621.9		
		36.0	900	296.8	229.8	741.9	689.3	31.3	12.1
		38.0		319.7	250.6	799.1	751.9		
		40.0		342.6	271.5	856.4	814.5		
		36.0	1000	354.9	266.8	887.4	800.5	41.1	16.0
		38.0		383.3	292.7	958.3	878.1		
		40.0		411.7	318.5	1029.3	955.6		

8. DISCUSSION & RECOMMENDATIONS: -

- The water table is considered at 0.0 m, i.e. at EGL, for the calculation purpose.
- The factor of safety for vertical and uplift capacity is considered as 2.5 and 3.0 respectively.
- The cut-off level for pile has been not considered below EGL, in the computation of pile capacity.
- Adequacy of pile capacity shall be checked by a static pile load test at 2.5 times of design load.

- The working pile shall be checked at 1.5 times the design load for the permissible settlement as per IS 2911 Part-4, 2013.
- Lateral capacity is evaluated for permissible deflection 1.0 % pile diameter (Ref. IRC 78,2014) and considering M35 grade of concrete.
- The liquefaction potential for borehole, have been shown at Annexure-3.
- The magnitude of the earthquake 7.5 and zone factor 0.36 for computation of liquefaction potential.
- The groundwater table was encountered 2.30 m depth from EGL at the time of field investigation in the month of May 2024. It should be noted; that the groundwater levels are subject to variation caused by seasonal variations or local drainage/pumping conditions and so may be significantly different from those measured during the investigation.
- From Table 7 & 8, based on chemical test results, due to high chloride and sulphate content in soil and ground water, it is recommended to use OPC cement with C_3A content from 5% to 8% shall be used in concrete. Alternatively, Portland Slag Cement confirming to IS 455 having more than 50% slag or a blend of OPC and slag may be used. Alternatively, Sulphate resisting Portland cement or Super sulphated cement with protective coatings can be used with maximum water-cement ratio of 0.45 and minimum cement content shall be 370 kg/m^3 as per IS: 456 Table 4.
- The report presented is representative of the bore locations and does not represent the entire area of construction as a whole.

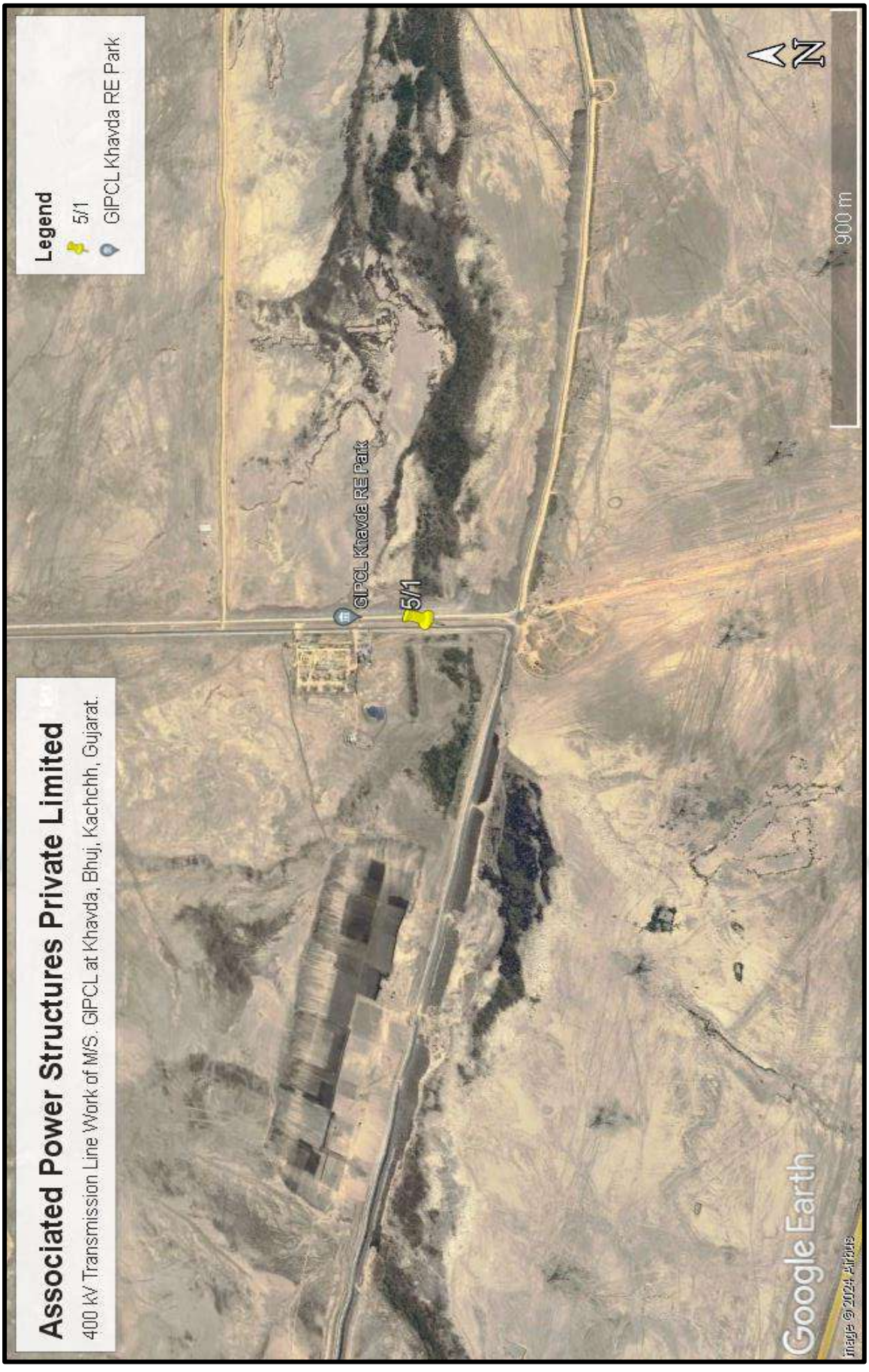
General Remarks: -

1. During excavation for the foundation, it is suggested to verify the subsoil stratum for any variation and the same shall be reported for any further recommendations or amendments.
2. The comments are given in this report and the opinion expressed is based on the ground conditions encountered during the site work and based on the results of tests made on-site and in the laboratory. There may, however, special conditions prevailing at the site which may not have been disclosed by the investigation and which may not have been taken in to account in the report. Any variation in stratification in any of the foundation location shall be studied thoroughly before executing the foundation work.

For **Unique Engineering Services, Gandhidham**

Authorized Signatory

ANNEXURE 1: SATELLITE IMAGE OF LOCATIONS



ANNEXURE 2: BORELOG

AP-5/1

Name of Owner	: Associated Power Structures Private Limited	Date Started	: 24-05-2024	Type of Bit used	: TC Bit
Name of Project	: Geotechnical Investigation Work at 400 kV Transmission Line Work of M/S. GIPCL at Khavda, Bhuj, Kachchh, Gujarat.	Date Completed	: 26-05-2024	Bearing of Hole	: 90^0 with Horizontal Plane
Bore Hole No.	: AP-5/1	Diameter of Boring	: 150 mm	Type of Boring	: Rotary Drilling
Top of Water Level Below EGL	: 2.30 m	Depth of Boring	: 50.00 m	Co-ordinates, m	: 42 R, N 2660607.483, E 562093.525

Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling: Type	Sampling: Lab.No.	Sampling: Depth (m) From	Sampling: Depth (m) To	SPT N-Value	Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Grain Size Analysis: % Gravel > 4.75 mm	Grain Size Analysis: % Sand 4.75-0.075 mm	Grain Size Analysis: % Silt & Clay < 0.075 mm	Hydrometer: % Silt	Hydrometer: % Clay	Atterberg's Limit: Liquid Limit, %	Atterberg's Limit: Plastic Limit, %	Atterberg's Limit: Plasticity Index, %	Specific Gravity	Type of Test	Cohesion, C, kg/cm^2	Angle of Internal friction Ø	Free Swell Index, %	Consolidation: Cc	Consolidation: Pc kg/cm^2	CLASSIFICATION
0.00				DS	129-AP-5/1-01	0.00	0.50	--	--	--	--	0	4	96	--		33.6	18.6	15.0	--	--	--	--	--	--	--	CL
0.50				SPT	129-AP-5/1-02	0.50	0.95	3	--	--	--	0	0	100	--		34.1	19.7	14.4	--	--	--	--	--	--	--	CL
1.00																											
1.50	Brownish Clay of Low Plasticity mixed with Little Fine Grained Sand Particles	CL	3.60	SPT	129-AP-5/1-03	1.50	1.95	4	--	--	--	0	1	99	--		33.8	19.3	14.5	--	--	--	--	--	--	--	CL
2.00																											
2.50																											
3.00				UDS	129-AP-5/1-04	3.00	3.60	--	1.848	1.522	21.4	0	2	98	79	19	32.5	18.5	14.0	2.659	TUU	0.29	15	10	--	--	CL
3.50																											
4.00																											
4.50				SPT	129-AP-5/1-05	4.50	4.95	32	--	--	--	0	26	74	--		29.2	NP		--	--	--	--	--	--	--	ML
5.00																											
5.50																											
6.00				UDS	129-AP-5/1-06	6.00	6.60	--	1.915	1.568	22.1	0	18	82	77	5	30.4	NP		--	--	--	--	--	--	--	ML
6.50																											
7.00																											
7.50	Greyish Non-Plastic Silt mixed with Fine Grained Sand Particles	ML	7.35	SPT	129-AP-5/1-07	7.50	7.95	50	--	--	--	0	19	81	--		31.1	NP		--	--	--	--	--	--	--	ML
8.00																											
8.50																											
9.00				UDS	129-AP-5/1-08	9.00	9.60	--	1.818	1.495	21.6	0	22	78	72	6	32.5	NP		2.719	DUU	0	23	Nil	--	--	ML
9.50																											
10.00																											
10.50				SPT	129-AP-5/1-09	10.50	10.95	27	--	--	--	0	24	76	--		30.9	NP		--	--	--	--	--	--	--	ML
11.00																											
11.50																											
12.00				UDS	129-AP-5/1-10	12.00	12.60	--	1.873	1.528	22.6	0	19	81	62	19	33.9	21.9	12.0	--	--	--	--	--	--	--	CL
12.50																											
13.00																											
13.50				SPT	129-AP-5/1-11	13.50	13.95	44	--	--	--	0	11	89	--		33.4	20.1	13.3	--	--	--	--	--	--	--	CL
14.00																											
14.50																											
15.00				UDS	129-AP-5/1-12	15.00	15.60	--	1.886	1.547	21.9	0	14	86	68	18	32.8	19.4	13.4	2.667	--	--	--	10	--	--	CL
15.50																											
16.00																											
16.50				SPT	129-AP-5/1-13	16.50	16.95	19	--	--	--	0	10	90	--		33.9	20.2	13.7	--	--	--	--	--	--	--	CL
17.00																											
17.50																											
18.00	Greyish Clay of Low Plasticity mixed with Little Fine Grained Sand Particles	CL	13.65	UDS	129-AP-5/1-14	18.00	18.60	--	1.886	1.532	23.1	0	16	84	65	19	33.8	20.0	13.8	--	--	--	--	--	--	--	CL
18.50																											
19.00																											
19.50				SPT	129-AP-5/1-15	19.50	19.95	34	--	--	--	0	22	78	--		31.7	18.6	13.1	--	--	--	--	--	--	--	CL
20.00																											
20.50																											
21.00				UDS	129-AP-5/1-16	21.00	21.60	--	1.908	1.556	22.6	0	12	88	72	16	32.6	19.1	13.5	2.662	TUU	0.35	13.6	10	--	--	CL
21.50																											
22.00																											
22.50				SPT	129-AP-5/1-17	22.50	22.95	37	--	--	--	0	10	90	--		33.4	19.6	13.8	--	--	--	--	--	--	--	CL
23.00																											
23.50																											
24.00				UDS	129-AP-5/1-18	24.00	24.60	--	1.928	1.546	24.7	0	13	87	69	18	33.9	20.1	13.8	--	--	--	--	--	--	--	CL
24.50																											

UNIQUE ENGINEERING SERVICES

AP-5/1

Name of Owner	: Associated Power Structures Private Limited	Date Started	: 24-05-2024
Name of Project	: Geotechnical Investigation Work at 400 kV Transmission Line Work of M/S. GIPCL at Khavda. Bhui. Kachchh. Guiarat.	Date Completed	: 26-05-2024
Bore Hole No.	: AP-5/1	Diameter of Boring	: 150 mm
Top of Water Level Below EGL	: 2.30 m	Depth of Boring	: 50.00 m

Type of Bit used	: TC Bit
Bearing of Hole	: 90^0 with Horizontal Plane
Type of Boring	: Rotary Drilling
Co-ordinates, m	: 42 R, N 2660607.483, E 562093.525

Depth (m)	Description of Strata	Legend	Stratum Thickness (m)	Sampling: Type	Sampling: Lab.No.	Sampling: Depth (m) From	Sampling: Depth (m) To	SPT N-Value	Bulk Density, g/cc	Field Dry Density, g/cc	Field Moisture Content, %	Grain Size Analysis: % Gravel > 4.75 mm	Grain Size Analysis: % Sand 4.75-0.075 mm	Grain Size Analysis: % Silt & Clay < 0.075 mm	Hydrometer: % Silt	Hydrometer: % Clay	Atterberg's Limit: Liquid Limit, %	Atterberg's Limit: Plastic Limit, %	Atterberg's Limit: Plasticity Index, %	Specific Gravity	Type of Test	Cohesion, C, kg/cm²	Angle of internal friction Ø	Free Swell Index, %	Consolidation: Cc	Consolidation: Pc kg/cm²	CLASSIFICATION
25.00																											
25.50				SPT	129-AP-5/1-19	25.50	25.95	39	--	--	--	0	3	97	--		39.4	22.9	16.5	--	--	--	--	--	--	--	CI
26.00																											
26.50																											
27.00				UDS	129-AP-5/1-20	27.00	27.60	--	1.972	1.576	25.1	4	6	90	65	25	43.6	23.9	19.7	--	--	--	--	--	--	--	CI
27.50																											
28.00																											
28.50				SPT	129-AP-5/1-21	28.50	28.95	42	--	--	--	0	2	98	--		38.8	21.6	17.2	--	--	--	--	--	--	--	CI
29.00																											
29.50	Greyish Clay of Intermediate Plasticity mixed with Little Fine Grained Sand Particles	CI	9.45																								
30.00				UDS	129-AP-5/1-22	30.00	30.45	--	2.003	1.585	26.4	0	1	99	76	23	38.0	23.8	14.2	2.649	TUU	0.45	11.4	27	--	--	CI
30.50																											
31.00																											
31.50																											
32.00																											
32.50																											
33.00				UDS-S+ SPT	129-AP-5/1-23	33.00	34.05	66	--	--	--	0	5	95	--		39.7	24.0	15.7	--	--	--	--	--	--	--	CI
33.50																											
34.00																											
34.50																											
35.00																											
35.50																											
36.00				UDS+ SPT	129-AP-5/1-24	36.00	37.05	46	2.012	1.628	23.6	0	36	64	58	6	30.9	NP		2.699	DUU	0	30	Nil	--	--	ML
36.50																											
37.00	Greyish Non-Plastic Silt mixed with Fine Grained Sand Particles	ML	6.00																								
37.50																											
38.00																											
38.50																											
39.00				UDS + SPT	129-AP-5/1-25	39.00	40.05	>100 (6 cm)	2.036	1.663	22.4	0	34	66	--		31.8	NP		--	--	--	--	--	--	--	ML
39.50																											
40.00																											
40.50																											
41.00																											
41.50																											
42.00																											
42.50																											
43.00				UDS-F + SPT	129-AP-5/1-26	43.00	44.05	>100 (9 cm)	--	--	--	10	55	35	--		21.6	NP		--	--	--	--	--	--	--	SM
43.50																											
44.00																											
44.50																											
45.00	Greyish Medium to Fine Grained Sand Particles mixed with Fines	SM	10.00																								
45.50																											
46.00				UDS-F + SPT	129-AP-5/1-27	46.00	47.05	>100 (3 cm)	--	--	--	4	60	36	--		22.8	NP		--	--	--	--	--	--	--	SM
46.50																											
47.00																											
47.50																											
48.00																											
48.50				UDS-F + SPT	129-AP-5/1-28	49.00	50.05	>100 (5 cm)	--	--	--	7	61	32	--		21.4	NP		--	--	--	--	--	--	--	SM
49.00																											
49.50																											
50.00																											

DS : Disturbed Sample **SPT :** Standard Penetration Test **UDS :** Undisturbed Sample

ANNEXURE 3: LIQUEFACTION CALCULATION

Evaluation of Liquefaction Potential (IS 1893 - Part 1 : 2016, RA-2021) for BH AP-5/1

Project Name: Geotechnical Investigation Work at 400 kV Transmission Line Work of M/S. GIPCL at Khavda, Bhuj, Kachchh, Gujarat.

Actual Water Table Depth : 2.30 m **Zone Factor :** 0.36

Borehole No.: AP-5/1 **Water Table Considered :** 0.00 m **Location :** Khavda

Hammer Fall: 0.75 m **Hammer Weight:** 63.5 kg **Earthquake Magnitude (M_W) :** 7.5

INPUT PARAMETERS						COHESIVE SOILS						COHESIONLESS SOILS																			CONCLUSIONS	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	α	β	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.50	CL	3	1.85	0.85	100	21.40	19	34.10	NO	NO	YES	1.00	0.92	0.42	0.51	1.70	0.75	0.984	1.05	0.75	1.10	1.92	3.26	5.00	1.20	8.91	0.10	1.000	0.10	0.20	Non-Liquefiable	
1.50	CL	4	1.85	0.85	99	21.40	19	33.80	NO	NO	YES	0.99	2.77	1.27	0.50	1.70	0.75	0.984	1.05	0.75	1.10	2.56	4.35	5.00	1.20	10.22	0.12	1.000	0.12	0.23	Non-Liquefiable	
4.50	ML	32	1.92	0.92	74							0.97	8.52	4.02	0.48	1.59	0.75	0.984	1.05	0.85	1.10	23.19	36.95	5.00	1.20	49.35	NA	1.000	NA	>1		Non Liquefiable
7.50	ML	50	1.82	0.82	81							0.94	13.96	6.46	0.48	1.26	0.75	0.984	1.05	0.95	1.10	40.50	50.88	5.00	1.20	66.06	NA	1.000	NA	>1		Non Liquefiable
10.50	ML	27	1.82	0.82	76							0.89	19.42	8.92	0.46	1.07	0.75	0.984	1.05	1	1.10	23.02	24.62	5.00	1.20	34.55	NA	1.000	NA	>1		Non Liquefiable
13.50	CL	44	1.87	0.87	89	22.60	19	33.90	NO	NO	YES	0.81	25.04	11.54	0.41	0.94	0.75	0.984	1.05	1	1.10	37.51	35.28	5.00	1.20	47.33	NA	1.000	NA	>1	Non-Liquefiable	
16.50	CL	19	1.89	0.89	90	21.90	18	33.90	NO	NO	YES	0.73	30.69	14.19	0.37	0.85	0.75	0.984	1.05	1	1.10	16.20	13.73	5.00	1.20	21.48	0.23	1.000	0.23	0.63	Non-Liquefiable	
19.50	CL	34	1.89	0.89	78	23.10	19	31.70	NO	NO	YES	0.65	36.35	16.85	0.33	0.78	0.75	0.984	1.05	1	1.10	28.99	22.55	5.00	1.20	32.06	NA	1.000	NA	>1	Non-Liquefiable	
22.50	CL	37	1.91	0.91	90	22.60	19	33.40	NO	NO	YES	0.57	42.08	19.58	0.29	0.72	0.75	0.984	1.05	1	1.10	31.55	22.77	5.00	1.20	32.33	NA	1.000	NA	>1	Non-Liquefiable	

1) The project site falls in Zone - V. A maximum earthquake intensity of 7.5 has been considered in the analysis.
2) C_{HT} & C_{HW}= Correction for hammer energy ratio, C_{HT} = 0.75, Energy Ratio for Rope and Pully System = 80 %, C_{HW} = Height x Weight / 48387
3) Borehole diameter = 150 mm , Hence C_{BD} = 1.05
4) C_{SS} = Correction for Standard sampler = 1.1
5) $C_{60} = C_{HT}C_{HW}C_{BD}C_{RL}C_{SS}$

REMARK

The FOS belongs to only COHESIONLESS soils because the liquefaction potential for COHESIVE soil is based on Seed & Idriss Criteria

[illegible] Seed, H. Bolton; Idriss, I. M.; Arango, Ignacio (1983). "Evaluation of Liquefaction Potential Using Field Performance Data", Journal of Geotechnical Engineering, 109(3), 458–482.

Bored Cast in-situ Piles

Sample Calculation of 36m Deep Pile with 0.75m Diameter for BH-AP - 5/1

DESIGN PARAMETERS

1	Diameter	D	m	0.75	6	Critical Depth	D_c	m	11.25
2	Length with CUTOFF below EGL, m - 0.00	L	m	36.00	7	Water Table below EGL	GWT	m	0.00
3	Angle of Internal Friction at Toe	Ø	degree	30.0	8	Cross Sectional Area of Pile tip	A_p	m^2	0.442
4	Cohesion at Toe	C	kN/m^2	0.0	9	Factor of Safety for Uplift Capacity	F_{su}	IS 2911 P1 S2 Cl: 6.3.2	3.0
5	L/D Ratio	L/D	---	15.00	10	Factor of Safety for Vertical Capacity	F_{sv}		2.5

PILE CAPACITY COMPUTATION

Layer below EGL	Depth, m	Type of Soil	Bulk Density	Effective Unit Weight of soil at pile tip	Average Cohesion at pile tip	Angle of Internal Friction	Shear Strength (Cu)	Angle of Wall Friction between Pile and Soil	Bearing Capacity Factors			Adhesion Factor	Coefficient of Earth Pressure	'-ve' Skin Friction Factor
	L		γ_b	γ	C	Ø	$= C + \sigma \tan Ø$	δ	N_c	N_q	N_γ	α	K	β
	m		kN/m^3	kN/m^3	kN/m^2	degree	kN/m^2	degree	--	--	--	--	--	--
1	0.00	CL	0.00	0.00	0.0	0.0	0.0	0.0	9.0	1.00	0.00	0.00	0.00	0.00
2	3.60	CL	18.48	8.48	29.0	15.0	37.2	15.0	9.0	3.94	2.65	1.00	1.00	0.00
3	10.95	ML	18.66	8.66	0.0	23.0	40.0	23.0	9.0	8.66	8.21	0.00	1.50	0.00
4	24.60	CL	18.96	8.96	35.0	13.6	58.4	13.6	9.0	3.45	2.16	1.00	1.00	0.00
5	34.05	CI	19.88	9.88	45.0	11.4	64.5	11.4	9.0	2.81	1.54	0.98	1.00	0.00
6	36.00	ML	20.24	10.24	0.0	30.0	55.9	30.0	9.0	20.00	22.41	0.00	1.50	0.00
7	38.00	ML	20.24	10.24	0.0	30.0	55.9	30.0	9.0	20.00	22.41	0.00	1.50	0.00
8	40.00	ML	20.24	10.24	0.0	30.0	55.9	30.0	9.0	20.00	22.41	0.00	1.50	0.00

Effective Overburden Pressure at Tip	Effective Overburden Pressure at CG	Surface Area of Pile Shaft	Skin Friction, P_{su}			End Bearing, P_{pu}				Self Weight of Pile (P_{self})	Negative Skin Friction (Psd)	Ultimate Vertical Downward Capacity (Q_u)	Safe Vertical Downward Capacity (Q_{us})	Uplift Capacity (Q_p)
σ	P_d	A_s	$\alpha * C * A_s$	$K * P_d * Tan\delta * A_s$	P_{su}	$N_c * C$	$q * N_q$	$0.5 * D * \gamma * N_\gamma$	P_{pu}	$\gamma_c = 24\ kN/m^3$	$= \beta * \sigma$	$= P_{pu} + P_{su}$	$= (Q_u/F_{sv}) - P_{sd}$	$= (P_{su}/F_{su}) + P_{self}$
kN/m^2	kN/m^2	m^2	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.53	15.26	8.48	245.92	34.68	280.60	261.00	120.28	8.43	172.25	38.18	0.00	452.85	181.14	131.71
94.18	62.35	17.31	0.00	687.23	967.83	0.00	815.59	26.66	372.28	83.64	0.00	1340.11	536.04	406.25
96.87	95.48	32.16	1125.60	742.85	2836.28	315.00	334.19	7.26	290.15	168.07	0.00	3126.43	1250.57	1113.50
96.87	96.87	22.26	982.48	434.78	4253.54	405.00	272.20	5.71	301.84	226.52	0.00	4555.39	1822.15	1644.37
96.87	96.87	4.59	0.00	385.05	4638.60	0.00	1937.34	86.05	894.34	238.59	0.00	5532.94	2213.18	1784.79
96.87	96.87	4.71	0.00	395.12	5033.72	0.00	1937.34	86.05	894.34	250.97	0.00	5928.06	2371.22	1928.88
96.87	96.87	4.71	0.00	395.12	5428.84	0.00	1937.34	86.05	894.34	263.35	0.00	6323.18	2529.27	2072.96

Sample Calculation of 36m Deep Pile with 0.75m Diameter for BH-AP - 5/1

DESIGN PARAMETERS :

Diameter of Pile	D	=	0.75	m	
Length of Pile	L	=	36.00	m	CUTOFF below EGL, m - 0.00
Angle of Internal Friction at Toe	Ø	=	30	degree	
Cohesion at Toe	C	=	0	kN/m^2	
L/D Ratio	L/D	=	15.00	---	
Critical Depth	Dc	=	11.25	m	
Water Table below EGL	GWT	=	0.00	m	
Cross Sectional Area of Pile-tip	Ap	=	0.442	m^2	
Factor of Safety (Uplift Capacity)	Fsu	=	3.00	(Ref.: IS 2911 Part 1 Sec 2 CL.: 6.3.2)	
Factor of Safety (Vertical Capacity)	Fsv	=	2.50	(Ref.: IS 2911 Part 1 Sec 2 CL.: 6.8.2)	

Vertical Capacity, Qu = End Bearing (Ppu) + Skin Friction (Psu)

Ppu = Ap x ((0.5 x D x γ x Nγ + q x Nq) + (Nc x Cp))

= 0.442 x (((0.5 x 0.75 x 10.24 x 22.41) + (96.87 x 20)) + (9 x 0))

= 894.37 kN

Psu = (Skin friction for 34.05m to 36m Depth) + Total skin friction upto 34.05m Depth

Psu = ((K x Pd x tan(di) x Asi) + (ai x ci x Asi)) + 4253.544

= ((1.5 x 96.867 x tan30 x 4.59) + (0 x 0 x 4.59)) + 4253.544

= 4638.60 kN

Vertical Capacity, Qu = Ppu + Psu

= 894.37 + 4638.6

Qu = 5532.97 kN

Safe Vertical Capacity, Qus = (Qu / Fsv) - ('-ve' skin friction)

= (5532.97 / 2.5) - 0

Qus = 2213.188 kN

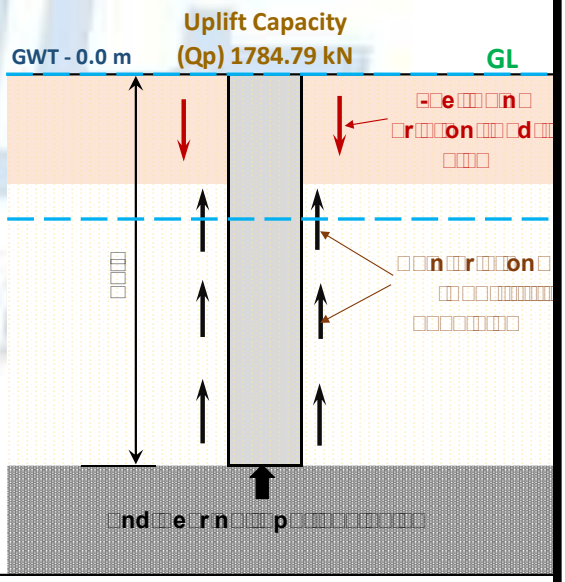
Qus = 221.32 MT

Uplift Capacity, Qp = (Psu / FoS) + Self Weight of Pile (Pself)

= (4638.6 / 3) + 238.59

Qp = 1784.79 kN

Qp = 178.48 MT



Note: The above figure is just for illustration purpose, so it is not to scale and not as per actual borelog.

PILE LATERAL CAPACITY FOR BH-AP - 5/1

PILE DESIGN - Bored Cast *in-situ* Piles - (IS 2911 Part I/Sec2)

*	**Diameter, D (cm)** ◆——→	**75**	**90**	**100**	
	LATERAL CAPACITY OF PILE FOR SAND & NORMALY LOADED CLAYS				
1	**Permissible Deflection of top, Y (mm)**	**7.5**	**9.0**	**10.0**	
2	**Grade of Concrete** **M**	**35**			
3	**Young's Modulus of Concrete, E (kN/m^2)**	**29580399**			
	= 5000 X 35 X 10 ^ 3 = 29580399				
4	**Moment Inertia of Pile, I (m^4)**	**0.015532**	**0.032206**	**0.049087**	
	= (π / 64) X (D/100) ^ 4 = (π / 64) X (75/100) ^ 4 = 0.015532				
5	**Free Length, e (m)**	**0**			
	FIXED HEAD CONDITION - LATERAL CAPACITY (H_{fx})				
6	**Modulus of Subgrade reaction, ηh (kN/m^3)**	**3128**	**(For N - 22 from IS 2911 Part 1 Sec 2)**		
7	**Stiffness Factor, T (m)**	**2.7**	**3.1**	**3.4**	
	= ((E x I) / ηh) ^ 0.2 = ((29580399 X 0.015532) / 3128) ^ 0.2 = 2.7				
8	**Ratio Lf / T**	**2.2**			
9	**Cantilever Length, Zf (m)**	**6.0**	**6.9**	**7.5**	
	= (Lf / T) X T = 2.2 X 2.72 = 6.0	**(Depth of Fixity)**			
10	**Lateral Capacity, H_{fx} (kN)**	**193.0**	**312.5**	**411.0**	
	= (12 x E I Y) / ((e + Zf) ^ 3) x 1000) = (12 x 29580399 x 0.015532 x 7.5) / ((0 + 5.984) ^ 3 x 1000) = 193.0				
	Lateral Capacity, H_{fx} (MT)	**19.3**	**31.3**	**41.1**	
11	**Reduction Factor, RF**	**0.83**			
12	**Maximum Moment in Pile, M (kN-m)**	**479.2**	**895.6**	**1281.4**	
	= ((Hfx (e + Zf))/2) x RF = ((192.98(0 + 5.984)/2)*0.83 = 479.2*				
	FREE HEAD CONDITION - LATERAL CAPACITY (H_{fr})				
13	**Ratio Lf / R**	**1.9**			
14	**Cantilever Length, Lf, m**	**5.2**	**6.0**	**6.5**	
	= (Lf / R) X T = 1.9 X 2.72 = 5.2	**(Depth of Fixity)**			
15	**Lateral Capacity, H_{fr} (kN)**	**74.9**	**121.3**	**159.5**	
	= (3 x E I Y) / ((e + Lf) ^ 3) x 1000) = (3 x 29580399 x 0.015532 x 7.5) / ((0 + 5.168) ^ 3 x 1000) = 74.9				
	Lateral Capacity, H_{fr} (MT)	**7.5**	**12.1**	**16.0**	
16	**Reduction Factor, RF**	**0.40**			
17	**Maximum Moment in Pile, M (kN-m)**	**154.82**	**289.33**	**413.97**	
	= ((Hfr (e + Lf)) x RF = (74.9(0 + 5.168))*0.4 = 154.8*				

ANNEXURE 5: SAMPLE PHOTOGRAPHS

ANNEXURE 6: LABORATORY TESTING PHOTOGRAPHS

WET SIEVE ANALYSIS

LIQUID LIMIT TEST BY CONE PENETROMETER METHOD

SPECIFIC GRAVITY TEST

FREE SWELL INDEX

DIRECT SHEAR TEST

TRIAXIAL TEST

HYDROMETER TEST

ABBREVIATIONS

G	Gravel
S	Sand
M	Silt
C	Clay
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
NP	Non-Plastic
FDD	Field Dry Density
FMC	Field Moisture Content
C	Unit Cohesion
Ø	Angle of Internal Friction
Cc	Compression Index
Pc	Pre-Consolidation Pressure
UCS	Unconfined Compressive Strength
CH	Clay of High Plasticity
CI	Clay of Intermediate Plasticity
CL	Clay of Low Plasticity
MH	Silt of High Plasticity
MI	Silt of Intermediate Plasticity
ML	Silt of Low Plasticity
SP	Poorly Graded Sand
SM	Silty Sand
DS	Disturbed Sample
UDS	Undisturbed Sample
WR	Weathered Rock
HWR	Highly Weathered Rock
EGL	Existing ground Level

APPENDIX

Table 4 Requirements for Concrete Exposed to Sulphate Attack

(Clauses 8.2.2.4 and 9.1.2)

Sl No.	Class	Concentration of Sulphates, Expressed as SO_3			Type of Cement	Dense, Fully Compacted Concrete, Made with 20 mm Nominal Maximum Size Aggregates Complying with IS 383	
		In Soil		In Ground Water		Minimum Cement Content kg/m³	Maximum Face Water-Cement Ratio
		Total SO_3	SO_3 in 2:1 Water: Soil Extract				
		Percent	g/l	g/l			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	1	Traces (< 0.2)	Less than 1.0	Less than 0.3	Ordinary Portland cement or Portland slag cement or Portland pozzolana cement	280	0.55
ii)	2	0.2 to 0.5	1.0 to 1.9	0.3 to 1.2	Ordinary Portland cement or Portland slag cement or Portland pozzolana cement	330	0.50
					Supersulphated cement or sulphate resisting Portland cement	310	0.50
iii)	3	0.5 to 1.0	1.9 to 3.1	1.2 to 2.5	Supersulphated cement or sulphate resisting Portland cement	330	0.50
					Portland pozzolana cement or Portland slag cement	350	0.45
iv)	4	1.0 to 2.0	3.1 to 5.0	2.5 to 5.0	Supersulphated or sulphate resisting Portland cement	370	0.45
v)	5	More than 2.0	More than 5.0	More than 5.0	Sulphate resisting Portland cement or supersulphated cement with protective coatings	400	0.40

NOTES

1 Cement content given in this table is irrespective of grades of cement.

2 Use of supersulphated cement is generally restricted where the prevailing temperature is above 40 °C.

3 Supersulphated cement gives an acceptable life provided that the concrete is dense and prepared with a water-cement ratio of 0.4 or less, in mineral acids, down to pH 3.5.

4 The cement contents given in col 6 of this table are the minimum recommended. For SO_3 contents near the upper limit of any class, cement contents above these minimum are advised.

5 For severe conditions, such as thin sections under hydrostatic pressure on one side only and sections partly immersed, considerations should be given to a further reduction of water-cement ratio.

6 Portland slag cement conforming to IS 455 with slag content more than 50 percent exhibits better sulphate resisting properties.

7 Where chloride is encountered along with sulphates in soil or ground water, ordinary Portland cement with C,A content from 5 to 8 percent shall be desirable to be used in concrete, instead of sulphate resisting cement. Alternatively, Portland slag cement conforming to IS 455 having more than 50 percent slag or a blend of ordinary Portland cement and slag may be used provided sufficient information is available on performance of such blended cements in these conditions.

REFERENCES

(A) INDIAN STANDARD CODES

IS 1498:1970	*Classification and Identification of Soils for General Engineering Purposes*
IS 1892:1979	*Code of Practice for Subsurface Investigation for Foundation*
IS 1904:1986	*Code of Practice for Design and Construction of Foundations in Soils: General Requirements*
IS 2131:1981	*Method for Standard Penetration Test for Soils*
IS 2132:1986	*Code of Practice for Thin-Walled Tube Sampling of Soils*
IS 2911(P1-S1):2010	*Design and Construction of Pile Foundations - Code of Practice Concrete Piles: Driven Cast In-situ Concrete Piles*
IS 2911(P1-S2):2010	*Design and Construction of Pile Foundations - Code of Practice Concrete Piles: Bored Cast In-situ Concrete Piles*
IS 2720	*Various parts. Methods for testing of soils*

(B) BIBLIOGRAPHY

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Terzaghi, Peck & Mesri	*Soil Mechanics in Engineering Practice*
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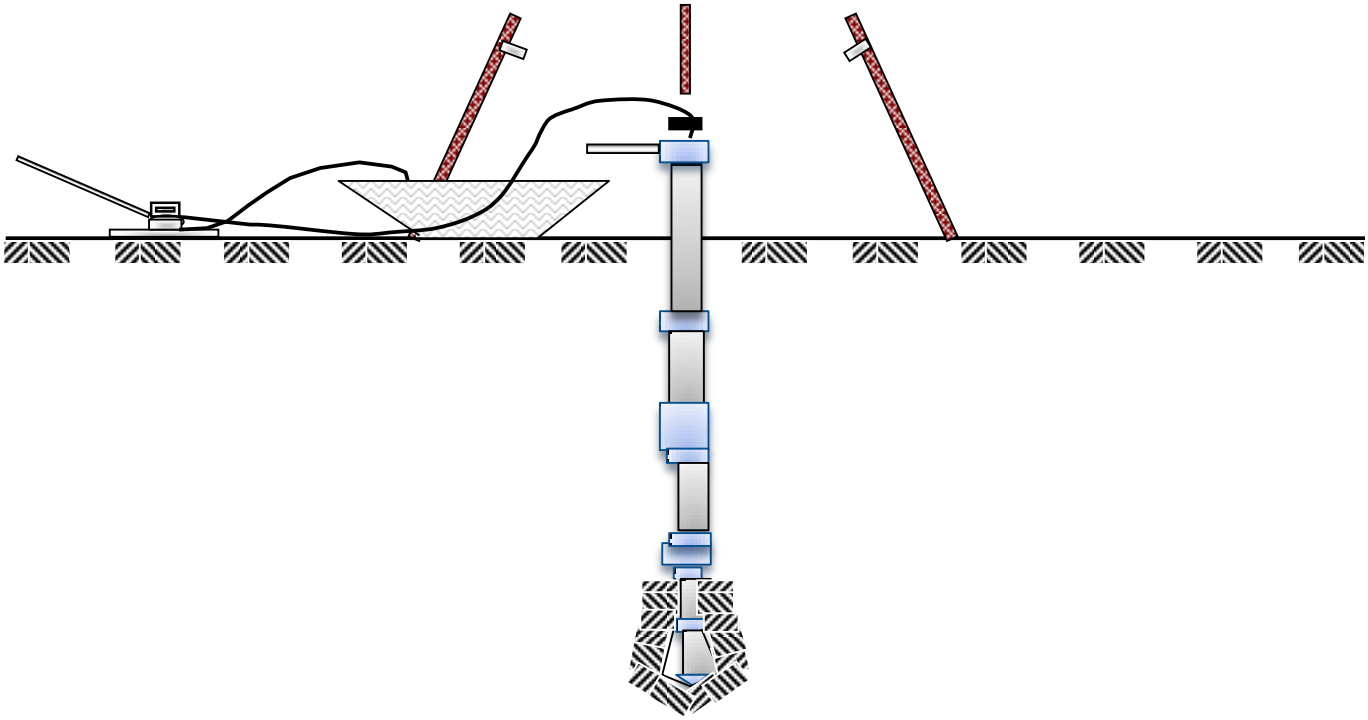
Look, B.	*Handbook of Geotechnical Investigation and Design Tables*
Punamia, B. C.	*Soil Mechanics & Foundations*

R2	REVISED AS PER COMMENTS	23.01.2023	GTH	SK/GC	VV
R1	REVISED AS PER COMMENTS	05.01.2023	GTH	SK/GC	VV
R0	ISSUED FOR APPROVAL	22.12.2022	GTH	SK	VV
REV.	DESCRIPTION	DATE	PRP. BY	CHK. BY	APPD. BY

CONTRACTOR :		**KEC INTERNATIONAL LIMITED.**	
CONSULTANT :		**FICHTNER INDIA LTD**	
END USER:		**M/S GUJARAT INDUSTRIES POWER CO. LTD**	
PROJECT :	**400/33kV PSS-1 OF SOLAR/WIND/HYBRID REPARK OF 2375 MW CAPACITY AT GREAT RANN OF KUTCH AREA, GUJARAT**		
TITLE :	**GEOTECHNICAL INVESTIGATION REPORT**		
DOC NO. :	**KEC-GIPCL1180-ST-DOC-RPT-2100-103**		REV.02

GEOTECHNICAL INVESTIGATION REPORT

(IS : 1892 - 2021)



CLIENT

Gujarat Industries Power Co. Ltd.

LOCATION

Great Rann of Kutch Area, Gujarat

NAME OF WORK

Geotechnical Investigation Work at Pooling Substation 400/33 kv, 1200 MW (PSS-1, Phase-I & Phasr-II of 600 MW each) of solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat

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CONTENT

BRIEF DETAIL OF PROJECT SITE

CLIENT	: Gujarat Industries Power Co. Ltd.		
CONTRACTOR	: KEC International Limited		
AGENCY	: -		
NAME OF WORK	: Geotechnical Investigation Work at Pooling Substation 400/33 kv, 1200 MW (PSS-1, Phase-I & Phasr-II of 600 MW each) of solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat		
REF.No.	: Ref: KEC/GIPCL/PSS-1/SB-312/003 Letter Dt: 05/11/2022		
PROJECT No.	: BRD/GIR/90/226001/1 - 5	**REPORT DT.**	: 09/12/2022
JOB No.	: 90/226001	**SAMPLE NO.**	: 1 - 5
REF. Code	: IS : 2720, IS : 1892 - 2021		
LOCATION	: Great Rann of Kutch Area, Gujarat	**BORE HOLE DEPTH**	: 30 m
BOREHOLE ID	: BH-1 to BH-5	**BORE HOLE IN**	: Existing Ground
BOREHOLE DIA	: 150mm	**WATER TABLE**	: Encountered
TYPE OF BORING	: Manual/Machine Boring		
FIELD WORK STARTING DATE	: 19/11/2022		
FIELD WORK COMP. DATE	: 26/11/2022		
NO. OF BORE HOLE	: Five		

1.0 INTRODUCTION

Sub surface investigation and laboratory tests for Geotechnical Investigation Work at Pooling Substation 400/33 kv, 1200 MW (PSS-1, Phase-I & Phasr-II of 600 MW each) of solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat was reffered us by KEC International Limited.

The objective of the exploration work was to determine the probable sub surface conditions such as stratification, denseness or hardness of the strata, position of ground water table etc. and to evaluate probable range of safe bearing capacity and Safe bearing pressure.

- Five borehole executed up to the depth of 30 m below Existing Ground in order to know the sub surface stratification, conducting necessary field tests and to collect disturb and undisturbed soil samples for laboratory testing.
- Testing soil / rock samples in the laboratory to determine its physical and engineering properties of the soil / rock samples, and
- Analyzing all field and laboratory data to evaluate safe bearing capacity and safe bearing pressure of the soil for given foundation sizes and necessary recommendations for foundation design and construction.

The site is located near Great Rann of Kutch Area, Gujarat

The actual field investigation work was started on 19/11/2022 and Completed on Dated 26/11/2022.

2.0 SUMMARY OF BOREHOLE :

Field work of executed boreoles is summarised as follows,

Sr.no.	At Site	Location ID	Field work started on	Field work completed on	Co-ordinates		Water table (below EGL)	Depth of investigation
					Northing	Easting		
1	Great Rann of Kutch Area, Gujarat	BH-1	25/11/2022	26/11/2022	2660899	561987	3.0 mt	30 m
2		BH-2	19/11/2022	20/11/2022	2660920	561947	3.0 mt	30 m
3		BH-3	20/11/2022	22/11/2022	2660936	561932	3.0 mt	33 m
4		BH-4	22/11/2022	23/11/2022	2660936	561932	3.0 mt	30 m
5		BH-5	22/11/2022	23/11/2022	2660955	561966	3.0 m	30 m

Note: Depth of termination of borehole and nos. of boreholes are investigated as directed by Client/site incharge.

3.0 SUB SURFACE EXPLORATION

3.1 DRILLING:

Five borehole of 150mm diameter are drill up to the depth of 30 m Where caving of the borehole occurred, casing was used to keep the borehole stable. The work was in general accordance with IS: 1892 – 2021.

3.1.1 DISTURBED SAMPLES:

Disturbed representative samples were collected, logged, labelled and placed in polythene bags.

3.1.2 UNDISTURBED SAMPLES:

Undisturbed soil samples are collected in 100 mm diameter thin walled sampler (Shelby tube) from the borehole. The sampler used for the sampling had smooth surface and appropriate area ratio and cutting edge angle thereby minimizing disturbance of soil during sampling. Samples are logged and labelled properly and transfer to the laboratory for further testing.

3.1.3 WATER TABLE:

Water table was encountered during the sub soil exploration work carried out in the month of November - 22

Water level fluctuations due to seasonal variations, amount of rainfall, runoff and other factors were not evident at the time of filed work. Trapped or "Perched" water could occur within low permeable strata.

3.1.4 METHOD OF SAMPLING:

Sampler is coupled together with a sampler head to form a sampling assembly. The sampler head provide a non-flexible connection between the sampling tube and the drill rods. Vent holes are provided in the sampler head to allow escape of water from the top of sampler tube during penetration. The sampling tubes are made free from dust and rust. Coating of oil is applied on both sides to obtain the undisturbed samples in best possible manner.

The sampler is then lowered inside the bore hole on a string of rods and driven to a pre-determined level. On completion of driving the sampler is first rotated within the borehole to shear the soil sample at bottom and then pulled out. Upon removal of the sampling tubes, the length of sample in the tube is recorded. The disturbed material in the upper end of the tube, if any, is completely removed before sealing.

The soil at the lower end of the tube is trimmed to a distance of about 10 to 20 mm. After cleaning and inserting an impervious disc at each end, both ends are sealed. The empty space in the sampler, if any, is filled with the moist soil, and the ends covered with tight wrapper. The identification mark is then made on each sample.

3.2 STANDARD PENETRATION TEST:

The standard penetration tests are conducted in each bore as per IS: 2131: 1981 (Reaffirmed 2002). The split spoon sampler resting on the bottom of bore hole is allowed to sink under its own weight, then the split spoon sampler is seated 15 cm with the blows of hammer falling through 750mm. The driving assembly consists of a driving head and a 63.5 kg weight.

It is ensured that the energy of the falling weight is not reduced by friction between the drive weight and the guides or between ropes. The rods to which the sampler is attached for driving are straight, tightly coupled and straight in alignment. Thereafter the split spoon sampler is further driven by 30cm. The number of blows required to drive each 15cm penetration is recorded. The first 15cm of drive considered as seating drive. The total blows required for the second and third 15cm penetration is termed as a penetration resistance - N value. The N- values for each bore hole are given in borelogs

4.0 LABORATORY TEST

A. Laboratory Test for Soil

1. Natural Moisture Content Test (IS: 2720, 1992 Part 2)
2. Grain Size Analysis (IS: 2720, 1992 Part 4)
3. Atterberg's Limits Test (IS: 2720, Part 5 1992)
4. Specific Gravity Test (IS: 2720, Part 3 1992)
5. Free Swell Value Test (IS: 2720, Part 40 1977)
6. Swell Pressure Test (IS: 2720, Part 41, 1977)
7. Triaxial Shear Test (UU) (IS: 2720 Part 11, 1992)
8. Direct Shear Test (IS: 2720, Part 13, 1992)
9. One Dimensional Consolidation Test (IS: 2720 Part 15, 1992)

4.A.1 Natural Moisture Content Test (IS: 2720, 1992 Part 2)

Test procedure conforms to IS: 2720 - Part - 2. A moisture cup is loosely filled with soil sample and weighed with lid. It is then kept in oven with lid removed and maintained at temperature of oven at 110oC for 24 hours. The lid of the container is then replaced and the dry weight found out. The percentage of water content is calculated using the formula.

$W = ((W2 – W3) / (W3 – W1)) \times 100$

Where,

W1 = weight of container with lid, in g.

W2 = weight of container with wet soil, in g.

W3 = weight of container with dry soil, in g.

W = moisture content (%)

4.A.2 Grain Size Analysis (IS: 2720, 1992 Part 4)

Testing procedure generally conforms to IS: 2720 Part 4. Both sieve and hydrometer analysis has been carried out.

Sieve Analysis: Sieve analysis is done by wet sieving method. Oven dried soil is washed through 75m IS sieve. Fraction retained was oven dried and particle size analysis carried out using sieve shaker by passing through the IS sieve.

Hydrometer Analysis : 50 g of soil 75µ passing IS sieve was mixed with 33 g passing sodium hexa-meta-phosphate and 7g sodium carbonate and soil suspension prepared. Suspension was made up to 1000 ml distilled water and then shaken thoroughly. Hydrometer is immersed to a depth slightly below its floating position and then allowed to float freely. Hydrometer readings are taken at 10, 20, 30 and 45 sec, subsequently at 1, 2, 4, 8,15 and 30 minutes and finally at 1, 2, 4, 8 and 24 hour interval. Diameter of the particle in suspension at any sampling time‘t’ is calculated using “Stokes” formula and the percentage finer was calculated. In the semi log graph, silt and clay fractions are indicated along with coarser fractions.

4.A.3 Atterberg's Limits Test (IS: 2720, Part 5 1992)

Liquid limit and plastic limit test on cohesive and semi cohesive samples has been done as per procedure in IS 2720 (Part 5).

Liquid Limit: Liquid limit and plastic limit test on cohesive has been done as per procedure in IS 2720 (Part 5) using the more reliable "cone penetrometer", method where errors of grove cutting involved in Casagrande's device are minimized. In cone penetrometer test about 200 g of passing 425µ sieve is taken mixed with requisite water, placed in cup and compacted lightly in 3layers. The tip of penetrometer is adjusted such that it just touches soil surface. The needle is allowed to plunge slowly under its own weight for 5 seconds and penetration in mm is recorded. The water content is adjusted such that penetration is between 16-26mm. The following relationship is used to evaluate liquid limit.

Plastic Limit: About 20g of oven dried soil passing through 425µ sieve is mixed with sufficient quantity of water to become plastic enough to be easily shaped into a ball. A portion of this ball is rolled on a glass plate with the palm into a thread of uniform diameter of 3mm. The corresponding water content represents the plastic limit of the soil.

Plastic Index: PI = Liquid limit – Plastic limit.

Shrinkage Limit (IS : 2720, Part 6, 1992): It is the maximum water content expressed as percentage of oven-dry weight at which any further reduction in water content will not cause a decrease in volume of the soil mass is calculated as follows:

$SL = W - ((V - V_0) / W_0) \times 100$

Where,

SL = Shrinkage limit in %.

W = Moisture content of wet soil pat in %.

V = Volume of wet soil pat in ml.

V_0 = Volume of dry soil pat in ml.

W_0 = Weight of oven-dried soil pat in gm.

4.A.4 Specific Gravity Test (IS: 2720, Part 3 1992)

The specific gravity of soil solids is determined by a 50 ml density bottle. The weight (W1) of the empty dry bottle is taken first. A sample of oven-dried soil about 10-20 g cooled in a desiccators, is put in the bottle, and weight (W2) of the bottle and the soil taken. The bottle is then filled with distilled water gradually removing the entrapped air either by applying Veccume of 20mmhg & weighted as (W3) of the bottle, soil and water (full up to the top) is then taken. Finally the bottle is emptied completely and thoroughly washed and clean water is filled to the top and the weight (W4) is taken.

$G = (W2 – W1) / [(W4 – W1) – (W3 – W2)]$

4.A.5 Free Swell Value Test (IS: 2720, Part 40 1977)

Free Swell Index Test was conformed as per IS: 2720 – Part – 40 - 1977. In this test 10 gm of soil passing IS sieve 425 μ is taken. Two graduated cylinders of 100 ml capacity are taken. One cylinder is filled with Kerosene oil and the other with distilled water and soil. Remove entrapped air by shaking well and stirring using a glass rod. Allow the soil in both the jars to settle for a sufficient time (not less than 24 hours) for the soil sample to attain equilibrium state of volume without any further changes. Free swell index is calculated as follows:

$F.S.I (\%) = [(Vd – Vk) / Vk] \times 100$

Where,

Vd = The volume of soil sample read from the graduated cylinder containing distilled water.

Vk = The volume of soil sample read from the graduated cylinder containing Kerosene.

4.A.6 Swell Pressure Test (IS: 2720, Part 41, 1977)

The swell pressure tests are carried out at field dry density with zero percent moisture content and by constant and volume method. An oven dry soil specimen is compacted into the specimen ring with the specimen kept in between two porous stone saturated in boiling water providing a filter paper between the soil specimen and the porous stones. The loading block is then positioned centrally on the top of the porous stone. The assembly is then placed on the platen of loading unit. The load measuring proving ring is attached to the load frame and placed in contact with the consolidation cell without any eccentricity. A direct strain measuring dial gauge is fitted to the cell. The specimen is then inundated with distilled water and allowed to swell. The initial reading of the proving ring s noted. The swelling of the specimen with increasing volume is obtained in the strain measuring load gauge. The specimen is kept at constant volume by adjusting the strain dial gauge always at original reading. This adjustment is done at every 0.1mm of swell or earlier. The swell pressure is then calculated frm the difference between the final and initial dial readings of the proving ring. Swell pressure (Kg/cm2) is calculated as follows: SP = ((Final Dial Gauge reading - Initial Dial Gauge reading) / Area of specimen) x Calibration factor of the proving ring.

4.A.7 Triaxial Shear Test (UU) (IS: 2720 Part 11, 1992)

The extracted specimen is then placed in triaxial cell pedestal. The cell is assembled and placed on loading machine. A cell pressure through an operating fluid (oil) was applied. The plunger was made to have proper contact with specimen. A compressive force at a constant strain rate of 1.25 mm/min is applied, till the failure occurred within a period of 5-15 minutes or rill the failure of 20% strain was removed, cell chamber cleaned and test continued on a new specimen.
The test was repeated on three different specimens at three different cell pressures as per standard practice. Mohr-Coulomb envelopes were drawn for three stress values recorded and total stress parameters interpreted from the Mohr-Coulomb graph.

4.A.8 Direct Shear Test (IS: 2720, Part 13, 1992)

Direct shear test is carried out using shear box with the specimens (60mm x 60mm). Specimen with plain grid plate at the bottom of the specimen and plain grid plate at the top of the specimen is fitted into position in the shear box housing and assembly placed on the load frame. The serrations of the grid plates are kept at right angle to the direction of shear. The loading pad is kept on the top grid plate. The required normal stress is applied and the rate of longitudinal displacement shear stress application so adjusted that no drainage can occur in the sample during the test (1.25mm/min.). The upper part of the shear box is raised such that a gap of about 1mm is left between the two parts of the box. The test is conducted by applying horizontal shear load to failure or to 20 percent longitudinal displacement whichever occurs first. The test is repeated on identical specimens.

4.A.9 One Dimensional Consolidation Test (IS: 2720 Part 15, 1992)

Consolidation test was done to evaluate compressibility behavior of stiff / hard clayey silt. Procedure is described below. The empty consolidation ring W1 is weighed. Representative sample for testing is extruded and cut off, care being taken to ensure that the two plane faces of the resulting soil disc are parallel to each other. The soil sample thus obtained is trimmed flush with the top and bottom edges of the ring. A sample of soil similar to that in the ring taken from the trimmings is used for determining moisture content. The thickness of the specimen (Ho) is measured and it is weighed immediately (W2). The bottom porous stone is centered on the base of the consolidation cell. The ring and specimen is placed centrally on the bottom porous stone and then the loading cap is placed on top. The consolidometer is 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 consolidation cell and the loading cap. A seating pressure of 0.05 kg/cm2 is applied to the specimen. The consolidation cell is filled with distilled water. The specimen is then allowed to reach equilibrium for 24 hrs. The test is continued using a loading sequence, which would successively apply stress of 0.25, 0.5, 1.0, 2.0 , 4.0, 8.0 kg/cm2 etc on the soil specimen For each loading increment, after application of load, readings of the dial gauge are taken using a time sequence such as 0, 0.25, 4, 6.25, 9, 12.25, 16, 20.25, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225 min etc. up to 24 hr or 1. 1/4, 1/2, 1, 2, 4, 8, 15, 30, 60min, 2, 4, 8 and 24hr. These time sequences facilitate plotting of thickness or change of thickness of specimen against square root of time or against log time. The loading increment is left until readings become more or less constant. On completion of the final loading stage the specimen is unloaded by suitable pressure decrements. Dial gauge readings are taken as necessary during each stage of unloading. On completion of the decrement, the water is siphoned out of the cell and the consolidometer is rapidly dismantled after release of the final load. The specimen, preferably within the ring, is wiped free of water, weighed (W3) and thereafter placed in the oven for drying. Following drying, the specimen plus ring is reweighed (W4). E-log P curve is drawn and consolidation parameters deduced.

5.1 SAFE BEARING CAPACITY (for Open Foundation) for Zone-I :
(Roads, Diesel Generator, Switchyard Tower Foundations, Switchyard Misc Equipment Foundations, PSS Control Room, Bus duct support foundation, Capacitor Bank, , Cable Trenches & Misc lightly loaded foundations)

For BH-1, BH-4 & BH-5, open foundation is not recommended as in BH-1, BH-4 & BH-5, top layer of 6.0m depth is having SPT value of zero at intermediate level and strata may prone to liquiefy upto depth of 7.5 mt. However, open foundation can be adopted at these locations after improving the strata by appropriate ground improvement technique such as stone column upto sufficient depth which shall be designed and verified seperately.

5.2 SAFE BEARING CAPACITY (for Pile Foundation) for Zone-I :
(Roads, Diesel Generator, Switchyard Tower Foundations, Switchyard Misc Equipment Foundations, PSS Control Room, Bus duct support foundation, Capacitor Bank, , Cable Trenches & Misc lightly loaded foundations)

Looking to the proposed type of project, site conditions Pile Foundation is recommended along with safe capacity for different dia of pile.

$$(Rf)ult = \Sigma K \times Pdi \times \tan d \times As + a \times C \times As$$

$$Ru = Ap(1/2\ D \times \gamma \times N\gamma + Pd \times Nq) + (Ap \times Nc \times Cp)$$

Table-1 of Safe Capacity of Pile Foundation

TYPE OF PILE	LOCATION	LENGTH OF PILE (below EGL)	PILE DIA	SAFE LOAD IN COMPRESSION	SAFE LOAD IN UPLIFT
		m	cm	MT	MT
Bored Cast in-situ Pile	BH-1, BH-4 & BH-5 (Zone-I)	26.5	50	**43.4**	**33.5**
		22.5	60	**43.8**	**32.2**
		20.0	75	**49.3**	**33.5**
		17.5	90	**43.2**	**27.2**

Note:

1) Total safe capacity of the pile calculated above is as per IS:2911, part 1, sec -2. It may be used as guideline for initial pile design. However the working load on the pile should not exceed its structural capacity.

2) The safe load of pile shown in above table are subjected to initial pile load test as per I.S.Codal provision.

3) Effect of liquefaction is considered up to 7.5m depth for BH-1,BH-4 & BH-5.

Table-2 for Safe Lateral Capacity of Pile Foundation						
TYPE OF PILE	Location	Pile Dia	for Free Head		for Fixed Head	
			Depth of Fixity	Lateral Capacity	Depth of Fixity	Lateral Capacity
		cm	m	MT	m	MT
Bored Cast in-situ Pile	BH-1, BH-4 & BH-5 (Zone-I)	50	9.59	0.15	9.81	0.58
		60	10.19	0.32	10.50	1.17
		75	11.22	0.73	11.51	2.71
		90	11.98	1.50	12.66	5.07

Note:

1) Lateral capacity of the pile calculated above is as per IS:2911, part 1, sec -2.It may be used as guideline for initial pile design. However the working load on the pile should not exceed its structural capacity.

2) The safe load of pile shown in above table are subjected to initial pile load test as per I.S.Codal Provision.

3) Allowable displacement of pile at head is considered as 1% of pile dia as per IRC-78-2014.

4) Above capacity is based on M35 grade of concrete.

5) Effect of liquefaction is considered up to 7.5m depth for BH-1,BH-4 & BH-5. Also cut-off level is considered as 0.9m in the analysis.

5.3 SAFE BEARING CAPACITY (For Open Foundation) for Zone-II: Transformer Foundations, Pooling Switchgear Building , Transformer rail foundations

Looking to the proposed type of project, site conditions and sub soil stratification, RCC Open Foundation is recommended along with safe bearing capacity and safe bearing pressure at different depths. Intensity of bearable load determined as soil bearing capacity (SBC) and soil bearing pressure (SBP) on soil.

SBC BASED ON SHEAR :- The ultimate net bearing capacity is evaluated after taking into consideration of shape factor and depth factor of the foundation in accordance with I.S. 6403-2021. The net bearing capacity worked out using the following equation.

$$Q = C\,N_c\,S_c\,d_c + q\,(N_q - 1)\,S_q\,d_q + 0.5\,B\,\gamma\,N_\gamma\,S_\gamma\,d_\gamma$$

Where,

c	=	*Cohesion*
q	=	*Overburden Pressure*
γ	=	*Density*
B	=	*Width of the Footing*
N_c, N_q, N_γ	=	*Bearing capacity Factor*
S_c, S_q, S_γ	=	*Shape Factor*
d_c, d_q, d_γ	=	*Depth Factor*

Properties	
Cohesion (kg/cm^2)	0.43
Angle of Internal Friction (Degree)	4
Dry Density (in gm/cc)	1.512
Specific Gravity	2.58
Factor of Safety	2.50
Void ratio, e (Computed)	0.7063
Type of Shear Failure Considered	Intermediate Shear Failure

Thus,Intermediate Shear Failure was considered for safe bearing capacity computation. The net safe bearing capacity for various sizes of individual footings having vertical static load intensity is evaluated as in TABLE- 2, SAFE BEARING CAPACITY AND SAFE BEARING PRESSURE
(For BH-2 & BH-3 in Zone-II) .

TABLE- 3, SAFE BEARING CAPACITY AND SAFE BEARING PRESSURE (For BH-2 & BH-3 in Zone-II)					
Foundation Details			Safe Bearing Capacity (SBC) in t/m²	Permissible Settlement of 50mm for RCC Open footing in t/m^2	Recommended Safe Bearing Capacity in t/m^2
Type	Depth Below EGL (m)	Size in (m)			
RCC Open Foundation	1.50	1.5 x 1.5	12.22	+13	12.2
		2.0 x 2.0	11.71		11.7
		2.5 x 2.5	11.42		11.4
		3.0 x 3.0	11.23		11.2
		3.5 x 3.5	11.10		11.1
		4.0 x 4.0	11.00		11.0
		4.5 x 4.5	10.94		10.9
		5.0 x 5.0	10.89	+11	10.9
		5.5 x 5.5	10.85		10.9
		6.0 x 6.0	10.82		10.8
	2.00	1.5 x 1.5	13.00	+14	13.0
		2.0 x 2.0	12.31		12.3
		2.5 x 2.5	11.91		11.9
		3.0 x 3.0	11.65		11.7
		3.5 x 3.5	11.47		11.5
		4.0 x 4.0	11.34		11.3
		4.5 x 4.5	11.25		11.3
		5.0 x 5.0	11.17	+12	11.2
		5.5 x 5.5	11.12	11.47	11.1
		6.0 x 6.0	11.07	+12	11.1

Note :

1) Minimum value of SBC & SBP shall be considered in design of foundation.

2) If structural loading is more than above mentioned SBC then same can be improved by appropriate ground improvement technique such as stone column which shall be designed and verified seperately.

5.4 SAFE BEARING CAPACITY (for Pile Foundation) for Zone-II : Transformer Foundations, Pooling Switchgear Building , Transformer rail foundations

Looking to the proposed type of project, site conditions Pile Foundation is recommended along with safe capacity for different dia of pile.

$$(Rf)ult = \Sigma K \times Pdi \times \tan d \times As + a \times C \times As$$

$$Ru = Ap(1/2\ D \times \gamma \times N\gamma + Pd \times Nq) + (Ap \times Nc \times Cp)$$

Table-4 of Safe Capacity of Pile Foundation

TYPE OF PILE	LOCATION	LENGTH OF PILE (below EGL)	Pile Dia	SAFE LOAD IN COMPRESSION	SAFE LOAD IN UPLIFT
		m	cm	MT	MT
Single Under-reamed Pile	BH-2 & BH-3 (Zone-II)	3.0	30	**11.7**	**8.9**
			35	**15.1**	**11.3**
			40	**18.8**	**14.1**
		4.5	30	**14.7**	**11.4**
			35	**18.6**	**14.3**
			40	**22.9**	**17.4**
Bored Cast in-situ Pile		12.5	50	**45.5**	**31.1**
		10.5	60	**44.1**	**31.9**
		8.5	75	**45.8**	**30.6**
		7.0	90	**47.0**	**28.9**

Note:

1) Total safe capacity of the pile calculated above is as per IS:2911, part 1, sec -2 (for bored cast in-situ pile) & IS:2911, part 3 (for single under-reamed pile). It may be used as guideline for initial pile design. However the working load on the pile should not exceed its structural capacity.

2) The safe load of pile shown in above table are subjected to initial pile load test as per I.S.Codal provision.

4) Proper care should be taken for formation of bulb of single under reamed pile.

Table-5 for Safe Lateral Capacity of Pile Foundation						
TYPE OF PILE	Location	Pile Dia	for Free Head		for Fixed Head	
			Depth of Fixity	Lateral Capacity	Depth of Fixity	Lateral Capacity
		cm	m	MT	m	MT
Bored Cast in-situ Pile	BH-2 & BH-3 (Zone-II)	50	4.03	2.08	4.99	4.38
		60	4.84	2.99	5.99	6.31
		75	6.05	4.67	7.48	9.86
		90	7.26	6.73	8.98	14.20
		Pile Dia	Lateral Capacity			
			MT			
Single Under-reamed Pile	BH-2 & BH-3 (Zone-II)	30	2.0			
		35	2.67			
		40	3.4			

Note:

1) Lateral capacity of the pile calculated above is as per IS:2911, part 1, sec -2.It may be used as guideline for initial pile design. However the working load on the pile should not exceed its structural capacity.

2) The safe load of pile shown in above table are subjected to initial pile load test as per I.S.Codal Provision.

3) Allowable displacement of pile at head is considered as 1% of pile dia as per IRC-78-2014.

4) Above capacity is based on M35 grade of concrete.

5) Lateral Capacity of Under-reamed Pile (short pile) are derived from Table-1 of IS-2911-P-3, verifiying of the same by actual lateral load test is mandatoy.

6. CONCLUSION & RECOMMENDATION

1. The present report covers the Geotechnical investigation carried out of Five borehole location at Great Rann of Kutch Area, Gujarat

2. Based on the proposed type of project, bore log data, Laboratory test results, presence of ground water table and liquefiable strata, Safe capacity of Open as well as Pile foundation is suggested as shown in table 1 to table-5.

3 Settlement computed from as per I.S.8009, Part I considering permissible settlement of 50mm for Open Founadation.

4. Effect of Water table was considered in the analysis of SBC.

5. Suitability of Soil for back filling: The top soil is of Non to Low Swelling characteristic, which is is suitable for structural back filling and the same shall be compated at 95% MDD.

6. Adjoing superstructure shall be adequately protected against structural failure during excavation work specially for foundation trenches.

7. Care to be taken that "Gentle Slope" should be maintained for the deposited excavated material which should be far away from excavated Foundation trench/pit and necessary shoring arrangement may be done if required.

8. The above report is based on the soil strata encountered at site upto depth of Investigation i.e.30 m.

9. Scope of work does not cover detailed design of foundation or visits by soil testing agency before or after execution of work. If the same is required, it shall be arranged separately.

10. The above recommendations are based on the collected field data, laboratory tests results conducted on soil samples recovered from the test locations. However if the actual subsoil condition during execution vary from what has been represented in this report, the client/agency may be referred to us for suggestions.

Note : Use of Supersulphated or sulphate resisting Portland cement with minimum cement content of 370 kg/m^3 & maximum free water cement ratio of 0.45 is recommended.

Where chloride is encountered along with sulphates in soil or ground water, ordinary Portland cement with C,A content from 5 to 8 percent shall be desirable to be used in concrete, instead of sulphate resisting cement. Alternatively, Portland slag cement conforming to IS 455 having more than 50 percent slag or a blend of ordinary Portland cement and slag may be used provided sufficient information is available on performance of such blended cements in these conditions.

For GEO TEST HOUSE

(Authorized Signatory)

BORE LOG

(As per IS : 1892-2021, 4453-1980 & 4464-1967)

Job No 90/226001
Date

Project	:	Geotechnical Investigation Work at Pooling Substation 400/33 kv, 1200 MW (PSS-1, Phase-I & Phasr-II of 600 MW each) of solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat	Borehole	:	BH-1
Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	Co-ordinates	Depth of casing	: Not Applicable
Dia of Borehole	:	150mm	N 2660899	Date of Starting	: 25/11/2022
Depth of GWT	:	3.0 mt	E 561987	Date of Completion	: 26/11/2022

Depth m	Thickness m	Log	Description	Sample No.	Type	Depth (m) From	Depth (m) To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
1	2.5		Yellowish Brown Clayey Silt of Intermediate Plasticity	1/1	DS	0.0	0.50						
2				1/2	SPT	1.5	1.95	0	0	2	2	2	
3	2.0		Brownish Silty Clay of Low Plasticity	1/3	UDS	2.5	2.95						
4				1/4	SPT	3.0	3.45	0	1	4	5	5	
5	1.0		Brownish Silty Clay of Plasticity	1/5	SPT	4.5	4.95	0	0	0	0	0	
6	2.0		Greyish Sandy Silt of Non Plasticity	1/6	UDS	5.5	5.95						
7				1/7	SPT	6.0	6.45	2	3	10	13	13	
8	1.0		Greyish Clayey Silt of Plasticity	1/8	SPT	7.5	7.95	2	2	6	8	8	
9	2.0		Greyish Clayey Silt of Non to Intermediate Plasticity	1/9	UDS	8.5	8.95						
10				1/10	SPT	9.0	9.45	1	5	8	13	13	
11	1.0		Greyish Clayey Silt of Plasticity	1/11	SPT	10.5	10.95	0	3	4	7	7	
12	2.0		Greyish Silty Clay of Low Plasticity	1/12	UDS	11.5	11.95						
13				1/13	SPT	12.0	12.45	2	7	8	15	15	
14	1.5		Greyish Clayey Silt of Plasticity	1/14	SPT	13.5	13.95	0	1	3	4	4	
15				1/15	UDS	14.5	14.95						

UDS : Undisturb Sample
DS : Disturbed sample
N : Penetration Resistance Value
N' :Corrected Penetration Resistance Value

CR : Core Recovery
RQD : Rock Quality Designation
PR : Rate of Penetration in Rock

GWT : Ground Water Table
SPT : Standard Penetration Test
WS :Wash Sample

Prepared By	Checked / Approved By	GEO TEST HOUSE
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BORE LOG

(As per IS : 1892-2021, 4453-1980 & 4464-1967)

Job No	90/226001
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Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	Depth of casing	:	Not Applicable
Dia of Borehole	:	150mm	Date of Starting	:	25/11/2022
Depth of GWT	:	3.0 mt	Date of Completion	:	26/11/2022

Co-ordinates

N **2660899**

E **561987**

Depth m	Thickness m	Log	Description	Sample No.	Type	Depth (m) From	Depth (m) To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
16	2.5		Greyish Clayey Silt of Plasticity	1/16	SPT	15.0	15.45	0	0	4	4	4	
17													
18	3.0		Greyish Sandy Silt of Non plasticity	1/17	UDS	17.5	17.95						
				1/18	SPT	18.0	18.45	0	0	8	8	8	
19													
20													
21	0.5		Greyish Silty Clay of Low Plasticity	1/19	UDS	20.5	20.95						
22	2.5		Greyish Sandy Silt of Non plasticity	1/20	SPT	21.0	21.45	12	16	25	41	41	
23													
24	3.0		Greyish Silty Clay of Plasticity	1/21	UDS	23.5	23.95						
				1/22	SPT	24.0	24.45	0	0	3	3	3	
25													
26													
27	2.5		Greyish Silty Clay of Intetmediate Plasticity	1/23	UDS	26.5	26.95						
				1/24	SPT	27.0	27.45	0	2	8	10	10	
28													
29													
30	1.0		Reddish Over Consoildated Soil	1/25	Core	29.0	30.00	CR - 11 %		RQD - Nil			

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BORE LOG

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Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	Co-ordinates	Depth of casing	: Not Applicable
Dia of Borehole	:	150mm	N 2660920	Date of Starting	: 25/11/2022
Depth of GWT	:	3.0 mt	E 561947	Date of Completion	: 26/11/2022

Depth (m)	Thickness (m)	Log	Description	Sample No.	Type	Depth (m) From	Depth (m) To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
1	2.5		Brownish Silty Clay of High Plasticity	2/1	DS	0.0	0.50						
2				2/2	SPT	1.5	1.95	3	3	4	7	7	
3	2.0		Brownish Silty Clay of Low Plasticity	2/3	UDS	2.5	2.95						
4				2/4	SPT	3.0	3.45	6	9	11	20	20	
5	1.0		Greyish Silty Clay of Intermediate Plasticity	2/5	SPT	4.5	4.95	7	9	9	18	18	
6	3.0		Greyish Silty Clay of plasticity	2/6	UDS	5.5	5.95						Slip
7				2/7	SPT	6.0	6.45	8	10	12	22	22	
8				2/8	SPT	7.5	7.95	6	8	10	18	18	
9	5.0		Greyish Sandy Silt of Non Plasticity	2/9	UDS	8.5	8.95						
10				2/10	SPT	9.0	9.45	5	11	14	25	25	
11				2/11	SPT	10.5	10.95	4	12	18	30	30	
12				2/12	UDS	11.5	11.95						
13				2/13	SPT	12.0	12.45	7	12	24	36	36	
14	1.5		Greyish Sandy Silt of Non Plasticity	2/14	SPT	13.5	13.95	4	6	9	15	15	
15				2/15	UDS	14.5	14.95						Slip

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BORE LOG

(As per IS : 1892-2021, 4453-1980 & 4464-1967)

Job No 90/226001
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Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	Co-ordinates	Depth of casing	: Not Applicable
Dia of Borehole	:	150mm	N 2660920	Date of Starting	: 25/11/2022
Depth of GWT	:	3.0 mt	E 561947	Date of Completion	: 26/11/2022

Depth m	Thickness m	Log	Description	Sample No.	Type	Depth (m) From	Depth (m) To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
16				2/16	SPT	15.0	15.45	10	15	22	37	37	
17													
18	5.5		Greyish Sandy Silt Non Plasticity	2/17	UDS	17.5	17.95						
				2/18	SPT	18.0	18.45	22	48	50	98	98	
19													
20													
21				2/19	UDS	20.5	20.95						
				2/20	SPT	21.0	21.45	25	33	40	73	73	
22	3.0		Greyish Silty Clay of Low Plasticity										
23													
24				2/21	UDS	23.5	23.95						
				2/22	SPT	24.0	24.45	29	35	45	80	80	
25													
26	5.5		Greyish Silty Clay of Intermediate Plasticty										
27				2/23	UDS	26.5	26.95						
				2/24	SPT	27.0	27.45	3	12	14	26	26	
28													
29													
30	1.0		Reddish Rock	2/25	Core	29.0	30.00	CR - 18 %		RQD - Nil			

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Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	Co-ordinates	Depth of casing	: Not Applicable
Dia of Borehole	:	150mm	N 2660936	Date of Starting	: 20/11/2022
Depth of GWT	:	3.0 mt	E 561932	Date of Completion	: 22/11/2022

Depth m	Thickness m	Log	Description	Sample No.	Type	Depth (m) From	Depth (m) To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
1	2.5		Greyish Clayey Silt of Intermediate Plasticity	3/1	DS	0.0	0.50						
2				3/2	SPT	1.5	1.95	2	2	3	5	5	
3	2.0		Brownish Silty Clay of Intermediate Plasticity	3/3	UDS	2.5	2.95						
4				3/4	SPT	3.0	3.45	5	7	14	21	21	
5	1.0		Greyish Sandy Silt / Silty Clay	3/5	SPT	4.5	4.95	2	3	3	6	6	
6	2.0		Greyish Silty Clay of Low Plasticity	3/6	UDS	5.5	5.95						
7				3/7	SPT	6.0	6.45	4	8	9	17	17	
8	1.0		Greyish Sandy Silt / Silty Clay	3/8	SPT	7.5	7.95	10	10	25	35	35	
9	2.0		Greyish Sandy Silt of Non Plasticity	3/9	UDS	8.5	8.95						
10				3/10	SPT	9.0	9.45	11	22	44	66	66	
11	1.0		Greyish Sandy Silt / Silty Clay	3/11	SPT	10.5	10.95	6	12	21	33	33	
12	2.0		Greyish Sandy Silt of Non Plasticity	3/12	UDS	11.5	11.95						
13				3/13	SPT	12.0	12.45	11	20	27	47	47	
14	1.5		Greyish Sandy Silt / Silty Clay	3/14	SPT	13.5	13.95	4	7	11	18	18	
15				3/15	UDS	14.5	14.95						

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Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	Co-ordinates	Depth of casing	: Not Applicable
Dia of Borehole	:	150mm	N 2660936	Date of Starting	: 20/11/2022
Depth of GWT	:	3.0 mt	E 561932	Date of Completion	: 22/11/2022

Depth (m)	Thickness (m)	Log	Description	Sample No.	Type	Depth (m) From	Depth (m) To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
16	2.5		Greyish Sandy Silt / Silty Clay	3/16	SPT	15.0	15.45	11	23	40	63	63	
17													
18	3.0		Greyish Silty Sand of Non Plasticity	3/17	UDS	17.5	17.95						
				3/18	SPT	18.0	18.45	18	33	41	74	74	
19													
20													
21	3.0		Greyish Sandy Silt / Silty Clay	3/19	UDS	20.5	20.95						
				3/20	SPT	21.0	21.45	15	29	41	70	70	
22													
23													
24	3.0		Greyish Clayey Silt of Intermediate Plasticity	3/21	UDS	23.5	23.95						
				3/22	SPT	24.0	24.45	21	32	43	75	75	
25													
26													
27	2.0		Greyish Clayey Silt of Intermediate Plasticity	3/23	UDS	26.5	26.95						Slip
				3/24	SPT	27.0	27.45	6	10	13	23	23	
28													
29	1.5		Reddish Over Consoildated Soil										
30				3/25	Core	28.5	30.00	CR - 30 %		RQD - 17 %			

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Client	:	Gujarat Industries Power Co. Ltd.			Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	**Co-ordinates**		Depth of casing	:	Not Applicable
Dia of Borehole	:	150mm	**N**	**2660936**	Date of Starting	:	20/11/2022
Depth of GWT	:	3.0 mt	**E**	**561932**	Date of Completion	:	22/11/2022

Depth	Thickness	Log	Description	Sample	Type	Depth (m)		SPT 'N' Value				SPT V/s Depth	Remarks
m	m			No.		From	To	15	15	15	N	Graph	
31													
				3/26	Core	30.0	31.50	CR - 53 %		RQD - 46 %			
32	3.0		Reddish Over Consoildated Soil										
33				3/27	Core	31.5	33.00	CR - 42 %		RQD - 21 %			
34													
35													
36													
37													
38													
39													
40													
41													
42													
43													
44													
45													

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Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	Co-ordinates	Depth of casing	: Not Applicable
Dia of Borehole	:	150mm	N 2660936	Date of Starting	: 22/11/2022
Depth of GWT	:	3.0 mt	E 561932	Date of Completion	: 23/11/2022

Depth m	Thickness m	Log	Description	Sample No.	Type	Depth (m) From	Depth (m) To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
1	2.5		Yellowish Brown Silty Clay of Intermediate Plasticity	4/1	DS	0.0	0.50						
2				4/2	SPT	1.5	1.95	1	3	3	6	6	
3	2.0		Yellowish Brown Clayey Silt of Intermediate Plasticity	4/3	UDS	2.5	2.95						
4				4/4	SPT	3.0	3.45	1	1	2	3	3	
5	1.0		Yellowish Brown Sandy Silt of Non Plasticity	4/5	SPT	4.5	4.95	1	1	1	2	2	
6	2.0		Greyish Sandy silt of Non Plasticity	4/6	UDS	5.5	5.95						
7				4/7	SPT	6.0	6.45	3	6	10	16	16	
8	1.5		Greyish Sandy silt of Non Plasticity	4/8	SPT	7.5	7.95	3	5	5	10	10	
9				4/9	UDS	8.5	8.95						Slip
10	1.5		Greyish Sandy Silt of Non Plasticity	4/10	SPT	9.0	9.45	4	6	12	18	18	
11	1.0		Greyish Sandy Silt of Non Plasticity	4/11	SPT	10.5	10.95	5	8	14	22	22	
12	2.0		Greyish Sandy Silt of Non Plasticity	4/12	UDS	11.5	11.95						
13				4/13	SPT	12.0	12.45	6	13	19	32	32	
14	1.0		Greyish Silty Clay of Plasticity	4/14	SPT	13.5	13.95	4	4	11	15	15	
15	0.5		Greyish Silty Clay of Low plasticity	4/15	UDS	14.5	14.95						

UDS : Undisturb Sample
DS : Disturbed sample
N : Penetration Resistance Value
N' :Corrected Penetration Resistance Value

CR : Core Recovery
RQD : Rock Quality Designation
PR : Rate of Penetration in Rock

GWT : Ground Water Table
SPT : Standard Penetration Test
WS :Wash Sample

Prepared By	Checked / Approved By	GEO TEST HOUSE
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BORE LOG

(As per IS : 1892-2021, 4453-1980 & 4464-1967)

Job No 90/226001
Date

Project	:	Geotechnical Investigation Work at Pooling Substation 400/33 kv, 1200 MW (PSS-1, Phase-I & Phasr-II of 600 MW each) of solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat	Borehole	:	BH-4
Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	**Co-ordinates**		
Dia of Borehole	:	150mm	**N** **2660936**	Date of Starting	: 22/11/2022
Depth of GWT	:	3.0 mt	**E** **561932**	Date of Completion	: 23/11/2022

Depth	Thickness	Log	Description	Sample	Type	Depth (m)		SPT 'N' Value				SPT V/s Depth	Remarks
m	m			No.		From	To	15	15	15	N	Graph	
16	2.5		Greyish Silty Clay of Plasticity	4/16	SPT	15.0	15.45	5	8	14	22	22	
17													
18	6.0		Greyish Sandy Silt of Non Plasticity	4/17	UDS	17.5	17.95						
				4/18	SPT	18.0	18.45	10	20	30	50	50	
19													
20													
21				4/19	UDS	20.5	20.95						
				4/20	SPT	21.0	21.45	13	23	33	56	56	
22													
23													
24	3.0		Greyish Silty Clay of Intermediate Plasticity	4/21	UDS	23.5	23.95						
				4/22	SPT	24.0	24.45	1	7	9	16	16	
25													
26													
27	2.5		Greyish Clayey Silt of Plasticity	4/23	UDS	26.5	26.95						Slip
				4/24	SPT	27.0	27.45	0	5	9	14	14	
28													
29													
30	1.0		Reddish Rock	4/25	SPT	29.3	30.00	23	6 cm / 50 Blows				Refusal

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BORE LOG

(As per IS : 1892-2021, 4453-1980 & 4464-1967)

Job No 90/226001
Date

Project	:	Geotechnical Investigation Work at Pooling Substation 400/33 kv, 1200 MW (PSS-1, Phase-I & Phasr-II of 600 MW each) of solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat	Borehole	:	BH-5
Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	**Co-ordinates**		
Dia of Borehole	:	150mm	**N** **2660955**	Date of Starting	: 22/11/2022
Depth of GWT	:	3.0 m	**E** **561966**	Date of Completion	: 23/11/2022

Depth m	Thickness m	Log	Description	Sample No.	Type	Depth (m) From	Depth (m) To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
1	2.5		Brownish Clayey Silt of Intermediate Plasticity	5/1	DS	0.0	0.50						
2				5/2	SPT	1.5	1.95	1	1	0	1	1	
3	3.0		Brownish Grey Clayey Silt of Plasticity	5/3	UDS	2.5	2.95						Slip
4				5/4	SPT	3.0	3.45	3	8	15	23	23	
5				5/5	SPT	4.5	4.95	0	0	0	0	0	
6	2.0		Greyish Silty Clay of Low Plasticity	5/6	UDS	5.5	5.95						Slip
7				5/7	SPT	6.0	6.45	1	4	12	16	16	
8	1.0		Greyish Sandy Silt of Non Plasticity	5/8	SPT	7.5	7.95	5	5	10	15	15	
9	2.0		Gryish Sandy Silt of Non Plasticity	5/9	UDS	8.5	8.95						
10				5/10	SPT	9.0	9.45	3	8	14	22	22	
11	1.0		Greyish Sandy Silt of Non Plasticity	5/11	SPT	10.5	10.95	6	3	7	10	10	
12	2.0		Gryish Sandy Silt of Non Plasticity	5/12	UDS	11.5	11.95						
13				5/13	SPT	12.0	12.45	7	10	15	25	25	
14	1.5		Greyish Sandy Silt of Non Plasticity	5/14	SPT	13.5	13.95	4	7	10	17	17	
15				5/15	UDS	14.5	14.95						

UDS : Undisturb Sample
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BORE LOG

(As per IS : 1892-2021, 4453-1980 & 4464-1967)

Job No 90/226001
Date

Project	:	Geotechnical Investigation Work at Pooling Substation 400/33 kv, 1200 MW (PSS-1, Phase-I & Phasr-II of 600 MW each) of solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat	Borehole	:	BH-5
Client	:	Gujarat Industries Power Co. Ltd.	Depth of Borehole	:	30 m
Location	:	Great Rann of Kutch Area, Gujarat	**Co-ordinates**		
Dia of Borehole	:	150mm	**N** **2660955**	Date of Starting	: 22/11/2022
Depth of GWT	:	3.0 m	**E** **561966**	Date of Completion	: 23/11/2022

Depth (m)	Thickness (m)	Log	Description	Sample No.	Type	Depth From	Depth To	SPT 'N' Value 15	15	15	N	SPT V/s Depth Graph	Remarks
16	2.5		Greyish Sandy Silt of Non Plasticity	5/16	SPT	15.0	15.45	8	12	14	26	26	
17													
18	3.0		Gryish Silty Sand of Non Plasticity	5/17	UDS	17.5	17.95						
				5/18	SPT	18.0	18.45	17	30	43	73	73	
19													
20													
21	3.0		Greyish Sandy Silt of Non Plasticity	5/19	UDS	20.5	20.95						
				5/20	SPT	21.0	21.45	18	27	45	72	72	
22													
23													
24	6.5		Greyish Clayey Silt of Intermediate Plasticity	5/21	UDS	23.5	23.95						
				5/22	SPT	24.0	24.45	0	0	0	0	0	
25													
26													
27				5/23	UDS	26.5	26.95						
				5/24	SPT	27.0	27.45	0	5	9	14	14	
28													
29													
30				5/25	SPT	30.0	_	22	40	55	95	95	

UDS : Undisturb Sample
DS : Disturbed sample
N : Penetration Resistance Value
N' :Corrected Penetration Resistance Value

CR : Core Recovery
RQD : Rock Quality Designation
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GWT : Ground Water Table
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GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION at Great Rann of Kutch Area, Gujarat

BH-1

Sr. No.	Sample No.	I.S Classification	Depth in mt	Atterberg's Limit			Grain Size Analysis				Shear Parameter		Settlement parameter (mv)	Compression Index (Cc)	Preconsoilidation Pressure (Pc)	Shrinkage Limit	UCS	Swelling Parameter		Sp. Gravity	B.D	F.D.D./R.D	F.M.C.
				L.L.	P.L.	P.I.	G	S	M	C	C	ϕ						F.S.	S.P.				
				%	%	%	%	%	%	%	Kg/cm^2	Degree	cm^2/kg	–	Kg/cm^2	%	Kg/cm^2	%	Kg/cm^2		-	gm/cc	%
1	1/2	MI	1.5	36.3	26.3	10.0	0	1	98	1	_	_	_	_	_	_	_	Nil	_	2.52	_	_	_
2	1/3	CL	2.5	34.0	23.3	10.7	0	1	94	5	0.18	14	0.050	0.22	0.35	_	0.35	_	0.08	2.56	1.762	1.502	17.3
3	1/6	ML	5.5	31.4	NP	NP	0	8	88	4	_	_	0.025	0.21	1.60	_	0.41	_	_	2.59	1.811	1.528	18.5
4	1/9	MI	8.5	36.6	NP	NP	0	1	95	4	0.08	22	0.019	0.19	2.50	_	0.55	_	_	2.56	1.832	1.538	19.1
5	1/12	CL	11.5	30.8	21.5	9.3	0	1	92	7	0.20	15	_	_	_	_	0.60	_	_	2.58	1.864	1.551	20.2
6	1/17	SM	17.5	_	NP	NP	0	80	20		0	28	_	_	_	_	_	_	_	_	1.766	1.571	12.4
7	1/19	CL	20.5	32.5	20.4	12.1	0	1	96	3	0.24	16	_	_	_	_	0.38	_	_	2.57	1.888	1.595	18.4
8	1/23	CI	26.5	40.9	23.3	17.6	0	1	91	8	0.28	18	_	_	_	_	_	_	_	2.59	1.786	1.496	19.4
9	1/25	Overconsoildated	29.0	30.9	20.4	10.5	0	21	79		_	_	_	_	_	_	5.40	_	_	_	1.855	1.650*	12.4

Abbreviation:

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)	F.M.C	Field Moisutre Content (%)	F.S.	Free Swell Index (%)
PI	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)	UCS	Unconfined Comp. Strength (Kg/Sq.cm)	S.P.	Swelling Pressure (Kg/Sq.cm.)
PI	Plasticity Index (%)	F.D.D	Field Dry Density (gm/cc)	mv	Coeff. of Volume Change (Sq.cm/kg)	G	Gravel
NP	Non Plastic	*R.D	Remould Density(gm/cc)			M	Silt
						S	Sand
						C	Clay

Tested By :- DJ

Checked By :-J.S

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION at Great Rann of Kutch Area, Gujarat

BH-2

Sr. No.	Sample No.	I.S Classification	Depth in mt	Atterberg's Limit			Grain Size Analysis				Shear Parameter		Settlement parameter (mv)	Compression Index (Cc)	Preconsolidation Pressure (Pc)	Shrinkage Limit	UCS	Swelling Parameter		Sp. Gravity	B.D	F.D.D./R.D	F.M.C.
				L.L.	P.L.	P.I.	G	S	M	C	C	ϕ						F.S.	S.P.				
				%	%	%	%	%	%	%	Kg/cm^2	Degree	cm^2/kg	-	Kg/cm^2	%	Kg/cm^2	%	Kg/cm^2		-	gm/cc	%
1	2/2	CH	1.5	55.4	24.2	31.2	0	0	100		_	_	_	_	_	_	_	_	_	_	_	_	_
2	2/3	CL	2.5	25.6	18.5	7.1	0	0	85	15	0.43	4	0.014	0.11	1.80	12.5	0.67	10	0.02	2.58	1.761	1.512	16.5
3	2/5	CI	4.5	40.2	21.3	18.9	0	0	100		_	_	_	_	_	_	_	_	_	_	_	_	_
4	2/9	ML	8.5	28.3	NP	NP	0	4	92	4	0.27	35	0.012	0.17	2.30	26.5	_	_	_	2.60	1.804	1.539	17.2
5	2/12	ML	11.5	32.0	NP	NP	0	3	94	3	0.28	36	_	_	_	_	0.80	_	_	2.59	1.772	1.552	14.2
6	2/18	ML	18.0	33.3	NP	NP	0	18	82		_	_	_	_	_	_	_	_	_	_	_	_	_
7	2/20	CL	21.0	32.4	20.4	12.0	0	12	88		_	_	_	_	_	_	_	_	_	_	_	_	_
8	2/21	CI	23.5	39.4	26.2	13.2	0	1	70	29	_	_	_	_	_	_	_	_	_	2.61	1.925	1.586	21.4
9	2/23	CI	26.5	45.3	25.8	19.5	0	1	67	32	0.89	4	_	_	_	_	0.96	_	_	2.60	1.992	1.612	23.6
10	2/25	Rock	29.0	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	2.70	_	_	_

Abbreviation:

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)	F.M.C	Field Moisutre Content (%)	F.S.	Free Swell Index (%)
PI	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)	UCS	Unconfined Comp. Strength (Kg/Sq.cm)	S.P.	Swelling Pressure (Kg/Sq.cm.)
PI	Plasticity Index (%)	F.D.D	Field Dry Density (gm/cc)	mv	Coeff. of Volume Change (Sq.cm/kg)	G	Gravel S Sand
NP	Non Plastic	*R.D	Remould Density(gm/cc)			M	Silt C Clay

Tested By :- DJ

Checked By :-J.S

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION at Great Rann of Kutch Area, Gujarat

BH-3

Sr. No.	Sample No.	I.S Classification	Depth in mt	Atterberg's Limit			Grain Size Analysis				Shear Parameter		Settlement parameter (mv)	Compression Index (Cc)	Preconsolidation Pressure (Pc)	Shrinkage Limit	UCS	Swelling Parameter		Sp. Gravity	B.D	F.D.D./R.D	F.M.C.
				L.L.	P.L.	P.I.	G	S	M	C	C	ϕ						F.S.	S.P.				
				%	%	%	%	%	%	%	Kg/cm^2	Degree	cm^2/kg	–	Kg/cm^2	%	Kg/cm^2	%	Kg/cm^2		-	gm/cc	%
1	3/2	MI	1.5	41.2	26.8	14.4	0	0	98	2	_	_	_	_	_	_	_	10	_	2.57	_	_	_
2	3/3	CI	2.5	39.5	24.6	14.9	0	1	92	7	0.43	6	0.016	0.25	1.60	23.4	1.94	_	0.10	2.58	1.832	1.509	21.4
3	3/6	CL	5.5	34.0	22.7	11.3	0	0	90	10	0.38	14	_	_	_	21.8	_	_	_	2.62	1.863	1.521	22.5
4	3/9	ML	8.5	32.4	NP	NP	0	9	85	6	_	_	0.010	0.10	2.20	_	_	_	_	2.57	1.919	1.559	23.1
5	3/12	ML	11.5	31.1	NP	NP	0	1	97	2	0.15	26	_	_	_	_	_	_	_	2.53	1.900	1.581	20.2
6	3/17	SM	17.5	32.3	NP	NP	0	77	23	3	_	_	_	_	_	_	_	_	_	2.61	1.966	1.621	21.3
7	3/21	MI	23.5	39.2	26.5	12.7	0	1	99		0.50	12	_	_	_	_	_	_	_	_	1.981	1.645	20.4
8	3/25	Overconsoildated	28.5	32.1	19.5	12.6	0	11	89		_	_	_	_	_	_	5.62	_	_	_	1.906	1.650 *	15.5

Abbreviation:

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)	F.M.C	Field Moisutre Content (%)	F.S.	Free Swell Index (%)
PI	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)	UCS	Unconfined Comp. Strength (Kg/Sq.cm)	S.P.	Swelling Pressure (Kg/Sq.cm.)
PI	Plasticity Index (%)	F.D.D	Field Dry Density (gm/cc)	mv	Coeff. of Volume Change (Sq.cm/kg)	G	Gravel
NP	Non Plastic	*R.D	Remould Density(gm/cc)			M	Silt
						S	Sand
						C	Clay

Tested By :- DJ

Checked By :-J.S

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION at Great Rann of Kutch Area, Gujarat

BH-4

Sr. No.	Sample No.	I.S Classification	Depth in mt	Atterberg's Limit			Grain Size Analysis				Shear Parameter		Settlement parameter (mv)	Compression Index (Cc)	Preconsolidation Pressure (Pc)	Shrinkage Limit	UCS	Swelling Parameter		Sp. Gravity	B.D	F.D.D./R.D	F.M.C.
				L.L.	P.L.	P.I.	G	S	M	C	C	ϕ						F.S.	S.P.				
				%	%	%	%	%	%	%	Kg/cm^2	Degree	cm^2/kg	-	Kg/cm^2	%	Kg/cm^2	%	Kg/cm^2		-	gm/cc	%
1	4/2	CI	1.5	42.9	25.5	17.4	0	6	94	0	_	_	_	_	_	_	_	20	_	2.61	_	_	_
2	4/3	MI	2.5	39.7	25.6	14.1	0	3	97	3	0.31	2	0.038	0.21	0.32	19.2	0.41	_	0.32	2.58	1.773	1.485	19.4
3	4/6	ML	5.5	34.9	NP	NP	0	15	82	3	0.08	26	_	_	_	25.5	0.82	_	_	2.56	1.729	1.510	14.5
4	4/10	MI	9.0	36.3	NP	NP	0	4	96		_	_	_	_	_	_	_	_	_	_	_	_	_
5	4/12	MI	11.5	35.1	NP	NP	0	5	95	2	0.10	28	_	_	_	_	_	_	_	2.59	1.814	1.560	16.3
6	4/15	CL	14.5	33.3	20.4	12.9	0	6	89	5	_	_	_	_	_	_	_	_	_	2.57	_	_	_
7	4/17	ML	17.5	32.9	NP	NP	0	21	79	2	0.12	30	_	_	_	_	_	_	_	2.66	1.841	1.572	17.1
8	4/19	ML	20.5	32.8	NP	NP	0	42	57	1	_	_	_	_	_	_	_	_	_	2.52	_	_	_
9	4/22	CI	24.0	35.5	22.9	12.6	0	1	99		_	_	_	_	_	_	1.86	_	_	_	_	_	_
10	4/25	Rock	29.0	_	_	_	_	_	_		_	_	_	_	_	_	_	_	_	2.72	_	_	_

Abbreviation:

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)	F.M.C	Field Moisutre Content (%)	F.S.	Free Swell Index (%)
PI	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)	UCS	Unconfined Comp. Strength (Kg/Sq.cm)	S.P.	Swelling Pressure (Kg/Sq.cm.)
PI	Plasticity Index (%)	F.D.D	Field Dry Density (gm/cc)	mv	Coeff. of Volume Change (Sq.cm/kg)	G	Gravel S Sand
NP	Non Plastic	*R.D	Remould Density(gm/cc)			M	Silt C Clay

Tested By :- DJ

Checked By :-J.S

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION at Great Rann of Kutch Area, Gujarat

BH-5

Sr. No.	Sample No.	I.S Classification	Depth in mt	Atterberg's Limit			Grain Size Analysis				Shear Parameter		Settlement parameter (mv)	Compression Index (Cc)	Preconsolidation Pressure (Pc)	Shrinkage Limit	UCS	Swelling Parameter		Sp. Gravity	B.D	F.D.D./R.D	F.M.C.
				L.L.	P.L.	P.I.	G	S	M	C	C	ϕ						F.S.	S.P.				
				%	%	%	%	%	%	%	Kg/cm^2	Degree	cm^2/kg	-	Kg/cm^2	%	Kg/cm^2	%	Kg/cm^2		-	gm/cc	%
1	5/2	MI	1.5	41.8	26.1	15.7	0	0	94	6	_	_	_	_	_	_	_	_	0.45	_	_	_	_
2	5/6	CL	5.5	34.1	22.3	11.8	0	1	99		_	_	_	_	_	_	_	Nil	_	_	_	_	_
3	5/9	ML	8.5	33.2	NP	NP	0	1	97	2	0.10	29	0.013	0.17	2.30	25.5	0.85	_	_	2.55	2.012	1.578	18.5
4	5/10	ML	9.0	34.7	NP	NP	0	4	96	0	_	_	_	_	_	_	_	_	_	2.59	_	_	_
5	5/12	ML	11.5	29.1	NP	NP	0	16	80	4	0.23	31	0.010	0.15	2.90	_	0.91	_	_	2.57	2.039	1.586	19.6
6	5/17	SM	17.5	29.5	NP	NP	0	55	43	2	_	_	_	_	_	_	_	_	_	2.60	2.082	1.716	21.4
7	5/19	ML	20.5	30.3	NP	NP	10	37	53	0	0.26	33	_	_	_	_	_	_	_	_	2.059	1.741	18.3
8	5/21	MI	23.5	41.3	31.5	9.8	0	1	97	2	_	_	_	_	_	_	0.42	_	_	_	1.816	1.498	17.3
9	5/24	MI	27.0	43.3	27.1	16.2	0	1	96	3	_	_	_	_	_	_	0.50	_	_	_	_	1.525 *	14.2
9	5/25	MI	30.0	31.4	20.3	11.1	0	39	61		_	_	_	_	_	_	5.89	_	_	_	_	1.650 *	15.4

Abbreviation:

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)	F.M.C	Field Moisutre Content (%)	F.S.	Free Swell Index (%)
PI	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)	UCS	Unconfined Comp. Strength (Kg/Sq.cm)	S.P.	Swelling Pressure (Kg/Sq.cm.)
PI	Plasticity Index (%)	F.D.D	Field Dry Density (gm/cc)	mv	Coeff. of Volume Change (Sq.cm/kg)	G	Gravel S Sand
NP	Non Plastic	*R.D	Remould Density(gm/cc)			M	Silt C Clay

Tested By :- DJ

Checked By :-J.S

CHEMICAL ANALYSIS OF SOIL						
Location ID.	**BH- No.**	**Depth in mt.**	**pH**	**2:1 Water:Soil Extract of SO_3 (g/l)**	**Total Sulphate as SO_3 (%)**	**Chloride in (%)**
Great Rann of Kutch Area, Gujarat	BH-1	5.5	8.57	0.3512	0.7212	4.2156
	BH-2	2.5	8.51	0.3053	0.7501	3.9592
	BH-3	3.0	8.77	0.5035	1.2394	6.1967
	BH-4	2.5	8.66	0.4021	1.0951	5.3214

Note : Use of Supersulphated or sulphate resisting Portland cement with minimum cement content of 370 kg/m3 & maximum free water cement ratio of 0.45 is recommended.

Where chloride is encountered along with sulphates in soil or ground water, ordinary Portland cement with C_3A content from 5 to 8 percent shall be desirable to be used inconcrete, instead of sulphate resisting cement. Alternatively, Portland slag cement conforming to IS 455 having more than 50 percent slag or a blend of ordinary Portland cement and slag may be used provided sufficient information is available on performance of such blended cements in these conditions.

CHEMICAL ANALYSIS OF WATER				
BH- No.	**Depth in mt.**	**pH**	**Sulphate (mg/l)**	**Chloride (mg/l)**
BH-1	3.00	6.63	2317.16	72488.16
BH-2	3.00	7.22	1078.13	17165.60
BH-3	3.00	6.61	1767.80	78025.45
BH-4	3.00	6.46	3401.05	44801.71
BH-5	3.00	6.54	3388.70	91113.59

Note: As per Is-456, ground water is not suitable for the purpose of construction.

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION OF PROJECT SITE

TP-1

Sr. No.	Location ID	Depth in (mtr)	I.S Classification of Soil	Type	Atterberg's Limit			Grain Size Analysis			Free Swell	Sp. Gravity	FDD	F.M.C
					L.L.	P.L.	P.I.	G	S	M & C				
					%	%	%	%	%	%	%		gm/cc	%
1	TP-1	1.0	Yellowish Brown Silty Clay of Intermediate Plasticity (CI)	UDS	38.1	23.9	14.2	0	0	100	10	2.47	1.485	16.1
2		2.0	Yellowish Grey Clayey Silt of Low Plasticity (ML)	UDS	32.3	23.7	8.6	0	1	99	Nil	2.52	1.491	16.5
3		2.5	Yellowish Grey Clayey Silt of Low Plasticity (ML)	UDS	30.6	23.2	7.4	0	2	98	Nil	2.55	1.498	17.1
4		3.3	Yellowish Grey Clayey Silt of Low Plasticity (ML)	UDS	28.3	22.8	5.5	0	0	100	Nil	2.61	-	-

Abbrivation :

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)				
PL	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)				
PI	Plasticity Index (%)	R.D.	Remoulded Density (gm/cc)	G	Gravel	S	Sand
NP	Non Plastic	F.M.C	Field Moisutre Content (%)	M	Silt	C	Clay

Tested By :- MV

Checked By :- JS

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION OF PROJECT SITE

TP-2

Sr. No.	Location ID	Depth in (mtr)	I.S Classification of Soil	Type	Atterberg's Limit			Grain Size Analysis			Free Swell	Sp. Gravity	FDD	F.M.C
					L.L.	P.L.	P.I.	G	S	M & C				
					%	%	%	%	%	%	%		gm/cc	%
1	TP-2	1.0	Yellowish Brown Silty Clay of Low Plasticity (CL)	UDS	33.8	23.3	10.5	0	0	100	Nil	-	1.471	14.5
2		2.0	Yellowish Grey Silty Clay of Intermediate Plasticity (CI)	UDS	40.9	23.4	17.5	0	0	100	Nil	2.48	1.501	15.8
3		2.5	Yellowish Grey Silty Clay of Low Plasticity (CL)	UDS	24.2	19.6	4.6	0	0	100	Nil	2.51	1.508	16.6
4		3.1	Yellowish Grey Silty Clay of Low Plasticity (CL)	UDS	33.7	23.5	10.2	0	0	100	10	2.54	-	-

Abbrivation :

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)				
PL	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)				
PI	Plasticity Index (%)	R.D.	Remoulded Density (gm/cc)	G	Gravel	S	Sand
NP	Non Plastic	F.M.C	Field Moisutre Content (%)	M	Silt	C	Clay

Tested By :- MV

Checked By :- JS

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION OF PROJECT SITE

TP-3

Sr. No.	Location ID	Depth in (mtr)	I.S Classification of Soil	Type	Atterberg's Limit			Grain Size Analysis			Free Swell	Sp. Gravity	FDD	F.M.C
					L.L.	P.L.	P.I.	G	S	M & C				
					%	%	%	%	%	%	%		gm/cc	%
1	TP-3	1.0	Yellowish Brown Silty Clay of Intermediate Plasticity (CI)	UDS	35.8	23.7	12.1	0	0	100	Nil	2.48	1.495	19.3
2		2.0	Yellowish Grey Clayey Silt of Low Plasticity (ML)	UDS	26.1	23.3	2.8	0	0	100	Nil	2.53	1.501	20.6
3		2.5	Yellowish Grey Clayey Silt of Low Plasticity (ML)	UDS	29.2	23.6	5.6	0	2	98	Nil	2.58	1.512	22.3
4		3.0	Yellowish Grey Silty Clay of Intermediate Plasticity (CI)	UDS	35.7	23.8	11.9	0	0	100	Nil	2.57	-	-

Abbrivation :

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)				
PL	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)				
PI	Plasticity Index (%)	R.D.	Remoulded Density (gm/cc)	G	Gravel	S	Sand
NP	Non Plastic	F.M.C	Field Moisutre Content (%)	M	Silt	C	Clay

Tested By :- MV

Checked By :- JS

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION OF PROJECT SITE

TP-4

Sr. No.	Location ID	Depth in (mtr)	I.S Classification of Soil	Type	Atterberg's Limit			Grain Size Analysis			Free Swell	Sp. Gravity	FDD	F.M.C
					L.L.	P.L.	P.I.	G	S	M & C				
					%	%	%	%	%	%	%		gm/cc	%
1	TP-4	1.0	Yellowish Clayey Silt of Low Plasticity (ML)	UDS	29.7	24.3	5.4	0	1	99	Nil	2.55	1.488	13.9
2		2.0	Yellowish Clayey Silt of Low Plasticity (ML)	UDS	27.3	23.9	3.4	0	0	100	Nil	2.57	1.491	14.5
3		2.5	Yellowish Silty Clay of Low Plasticity (CL)	UDS	31.1	22.2	8.9	0	1	99	Nil	2.48	1.501	16.3
4		3.0	Yellowish Clayey Silt of Low Plasticity (ML)	UDS	26.6	22.9	3.7	0	1	99	Nil	2.56	-	-

Abbrivation :

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)				
PL	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)				
PI	Plasticity Index (%)	R.D.	Remoulded Density (gm/cc)	G	Gravel	S	Sand
NP	Non Plastic	F.M.C	Field Moisutre Content (%)	M	Silt	C	Clay

Tested By :- MV

Checked By :- JS

GENERAL SUMMARY OF GEO-TECHNICAL INVESTIGATION OF PROJECT SITE

TP-5

Sr. No.	Location ID	Depth in (mtr)	I.S Classification of Soil	Type	Atterberg's Limit			Grain Size Analysis			Free Swell	Sp. Gravity	FDD	F.M.C
					L.L.	P.L.	P.I.	G	S	M & C				
					%	%	%	%	%	%	%		gm/cc	%
1	TP-5	1.0	Yellowish Brown Silty Clay of Low Plasticity (CL)	UDS	26.7	20.5	6.2	0	0	100	15	2.49	1.501	12.5
2		2.0	Yellowish Grey Silty Clay of Low Plasticity (CL)	UDS	32.0	22.2	9.8	0	0	100	Nil	2.51	1.512	13.3
3		2.5	Yellowish Grey Silty Clay of Low Plasticity (CL)	UDS	27.1	21.2	5.9	0	1	99	Nil	2.47	1.522	14.3
4		3.0	Yellowish Grey Clay Silt of Non Plasticity (ML)	UDS	32.2	NP	NP	0	1	99	Nil	2.58	-	-

Abbrivation :

LL	Liquid Limit (%)	C	Cohession (Kg/Sq.cm)				
PL	Plastic Limit (%)	ϕ	Angle of Internal Friction (Degree)				
PI	Plasticity Index (%)	R.D.	Remoulded Density (gm/cc)	G	Gravel	S	Sand
NP	Non Plastic	F.M.C	Field Moisutre Content (%)	M	Silt	C	Clay

Tested By :- MV

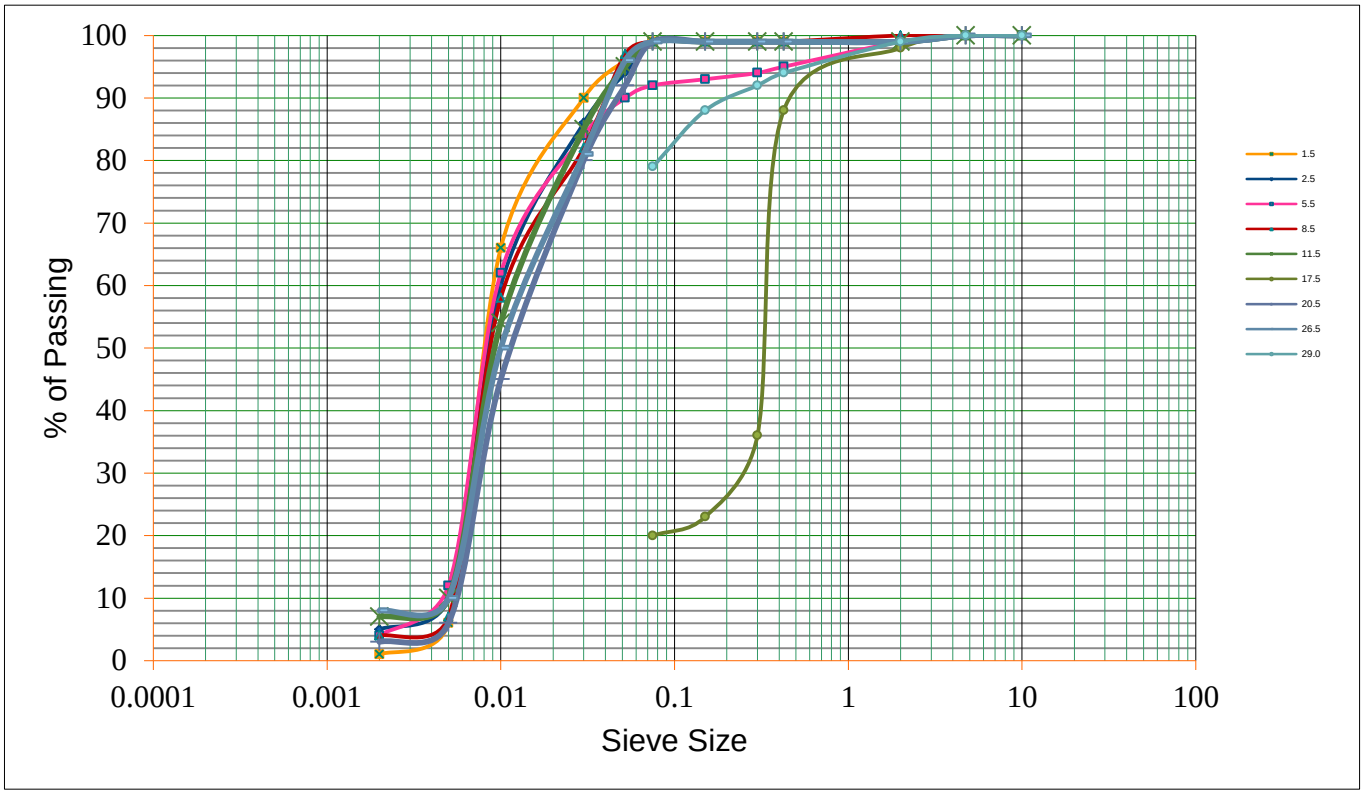
Checked By :- JS

Grain Size Analysis (IS: 2720 (Part-4)

Location :- **Great Rann of Kutch Area, Gujarat**

BH ID :- **BH-1**

Depth in meter	Grain Size Analysis				Depth in meter	Grain Size Analysis			
	Gravel	Sand	Silt	Clay		Gravel	Sand	Silt	Clay
	%	%	%	%		%	%	%	%
1.5	0	1	98	1	17.5	0	80	20	
2.5	0	1	94	5	20.5	0	1	96	3
5.5	0	8	88	4	26.5	0	1	91	8
8.5	0	1	95	4	29.0	0	21	79	
11.5	0	1	92	7					



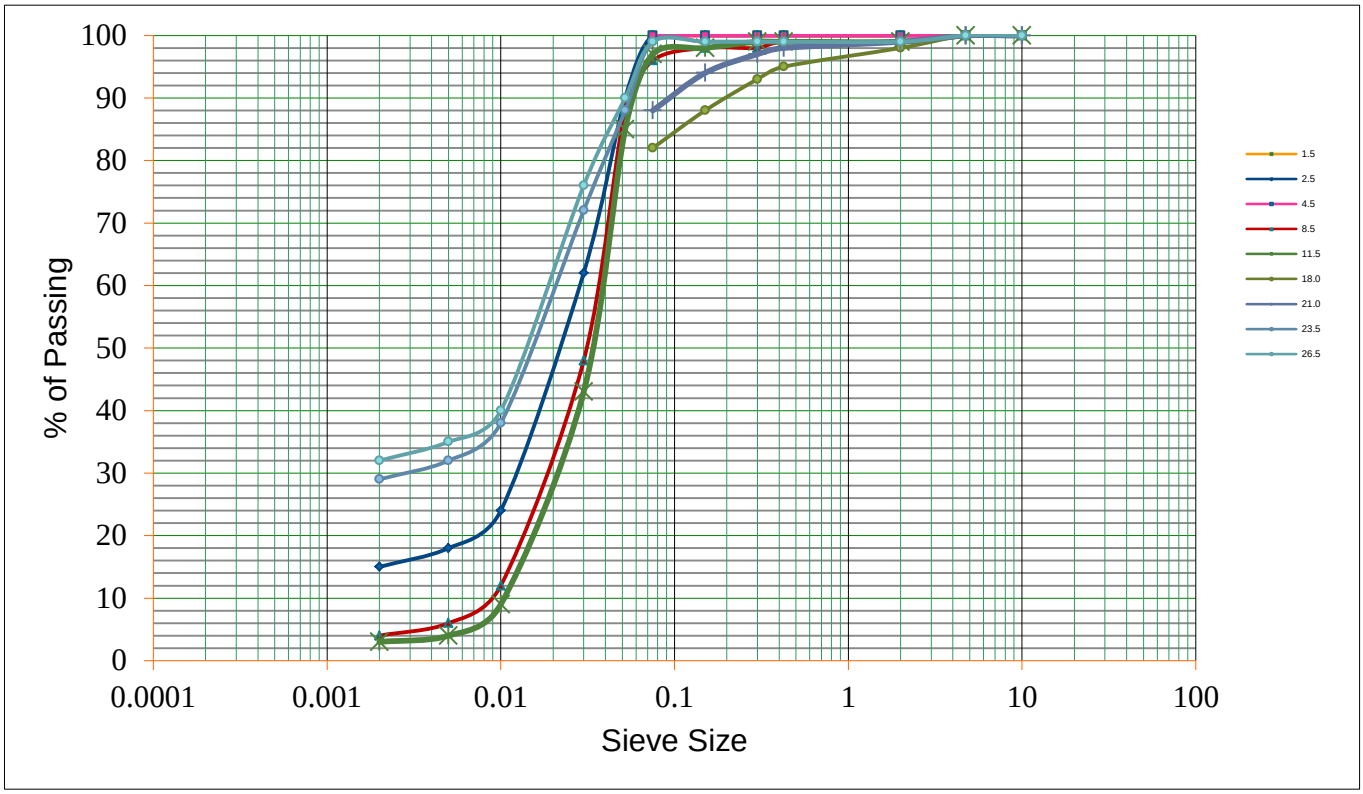
Clay	Silt	fine sand	medium sand	coarse sand	fine gravel	coarse gravel	
0.002mm		0.075mm	0.425mm	2mm	4.75mm	20mm	80mm

Grain Size Analysis (IS: 2720 (Part-4)

Location :- **Great Rann of Kutch Area, Gujarat**

BH ID :- **BH-2**

Depth in meter	Grain Size Analysis				Depth in meter	Grain Size Analysis			
	Gravel	Sand	Silt	Clay		Gravel	Sand	Silt	Clay
	%	%	%	%		%	%	%	%
1.5	0	0	100		18.0	0	18	82	
2.5	0	0	85	15	21.0	0	12	88	
4.5	0	0	100		23.5	0	1	70	29
8.5	0	4	92	4	26.5	0	1	67	32
11.5	0	3	94	3					



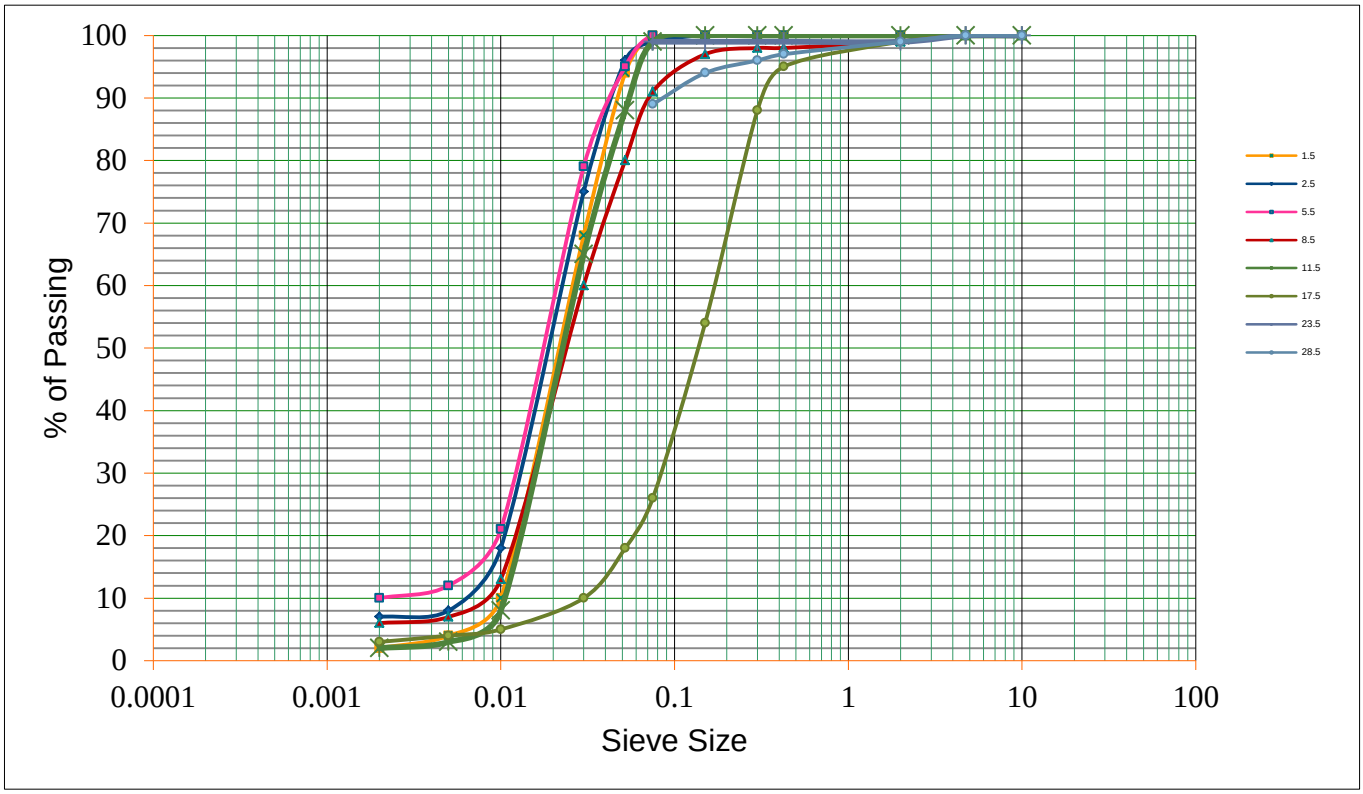
Clay	Silt	fine sand	medium sand	coarse sand	fine gravel	coarse gravel	
0.002mm		0.075mm	0.425mm	2mm	4.75mm	20mm	80mm

Grain Size Analysis (IS: 2720 (Part-4)

Location :- **Great Rann of Kutch Area, Gujarat**

BH ID :- **BH-3**

Depth in meter	Grain Size Analysis				Depth in meter	Grain Size Analysis			
	Gravel	Sand	Silt	Clay		Gravel	Sand	Silt	Clay
	%	%	%	%		%	%	%	%
1.5	0	0	98	2	17.5	0	74	23	3
2.5	0	1	92	7	23.5	0	1	99	
5.5	0	0	90	10	28.5	0	11	89	
8.5	0	9	85	6					
11.5	0	1	97	2					



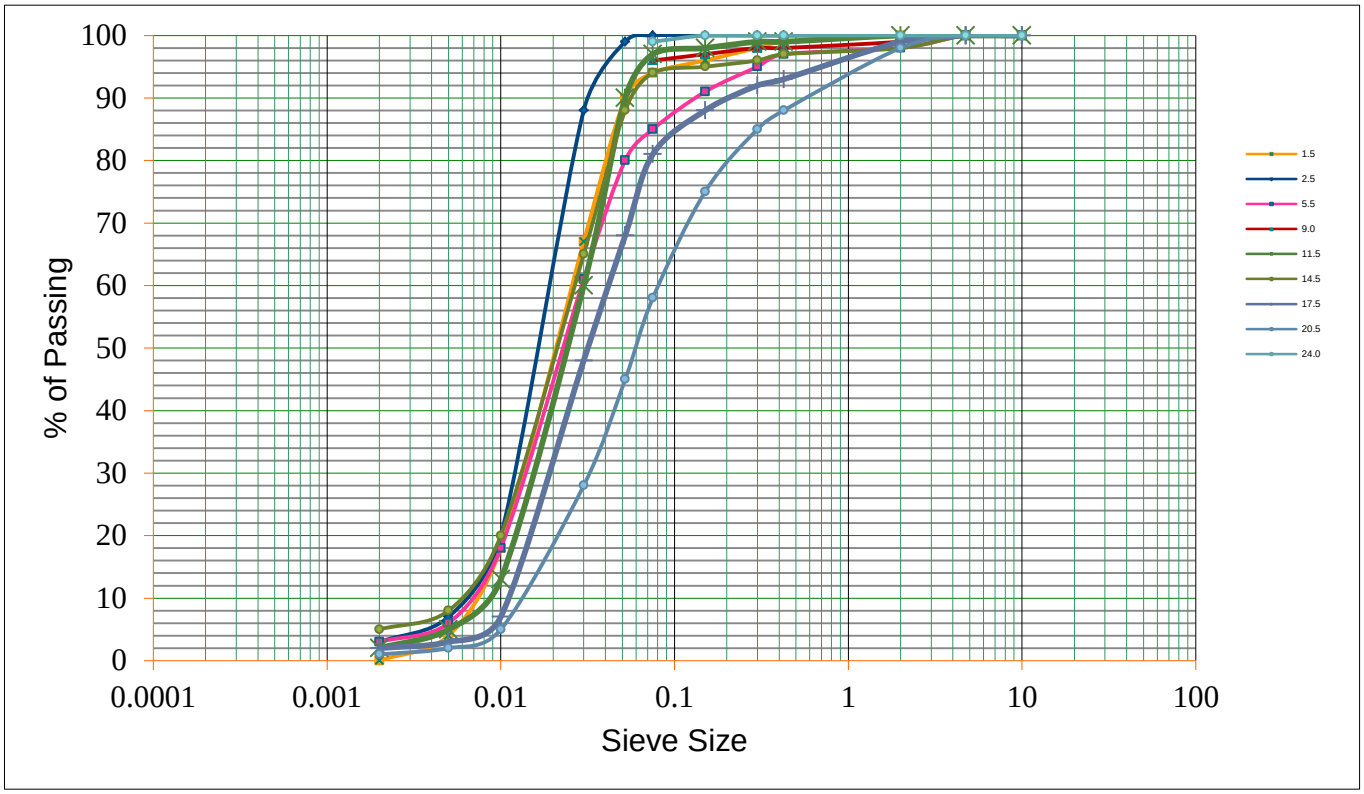
Clay	Silt	fine sand	medium sand	coarse sand	fine gravel	coarse gravel	
0.002mm		0.075mm	0.425mm	2mm	4.75mm	20mm	80mm

Grain Size Analysis (IS: 2720 (Part-4)

Location :- **Great Rann of Kutch Area, Gujarat**

BH ID :- **BH-4**

Depth in meter	Grain Size Analysis				Depth in meter	Grain Size Analysis			
	Gravel	Sand	Silt	Clay		Gravel	Sand	Silt	Clay
	%	%	%	%		%	%	%	%
1.5	0	6	94	0	**14.5**	0	6	89	5
2.5	0	0	97	3	**17.5**	0	19	79	2
5.5	0	15	82	3	**20.5**	0	42	57	1
9.0	0	4	96		**24.0**	0	1	99	
11.5	0	3	95	2					



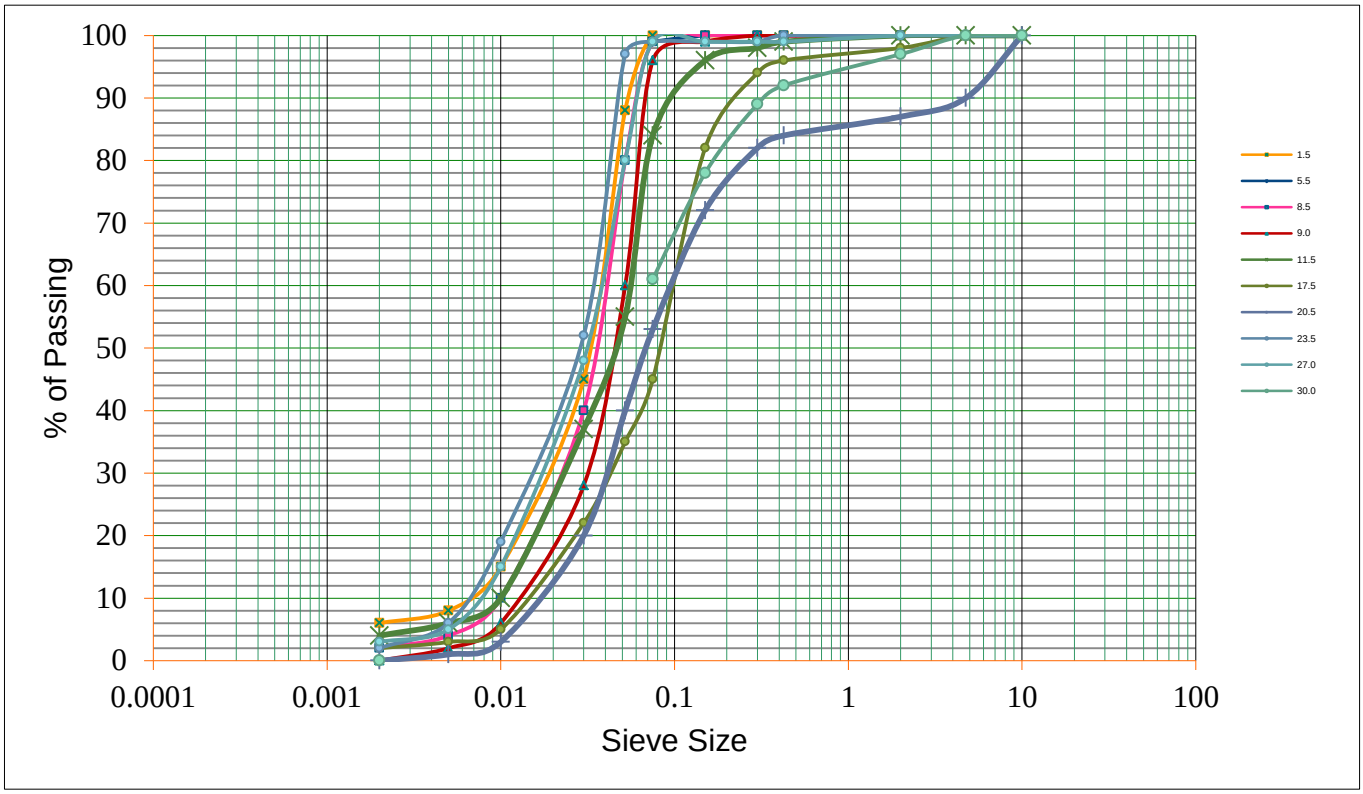
Clay	Silt	fine sand	medium sand	coarse sand	fine gravel	coarse gravel	
0.002mm		0.075mm	0.425mm	2mm	4.75mm	20mm	80mm

Grain Size Analysis (IS: 2720 (Part-4)

Location :- **Great Rann of Kutch Area, Gujarat**

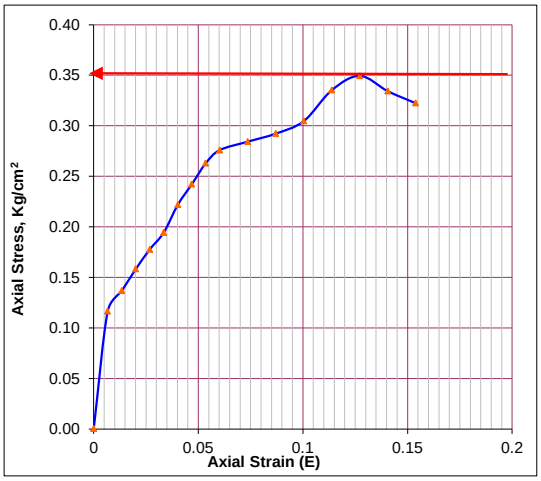
BH ID :- **BH-5**

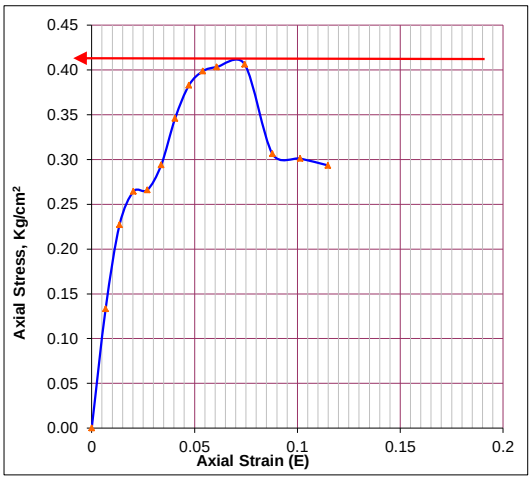
Depth in meter	Grain Size Analysis				Depth in meter	Grain Size Analysis			
	Gravel	Sand	Silt	Clay		Gravel	Sand	Silt	Clay
	%	%	%	%		%	%	%	%
1.5	0	0	94	6	17.5	0	55	43	2
5.5	0	1	99		20.5	10	37	53	0
8.5	0	1	97	2	23.5	0	1	97	2
9.0	0	4	96	0	27.0	0	1	96	3
11.5	0	16	80	4	30.0	0	39	61	



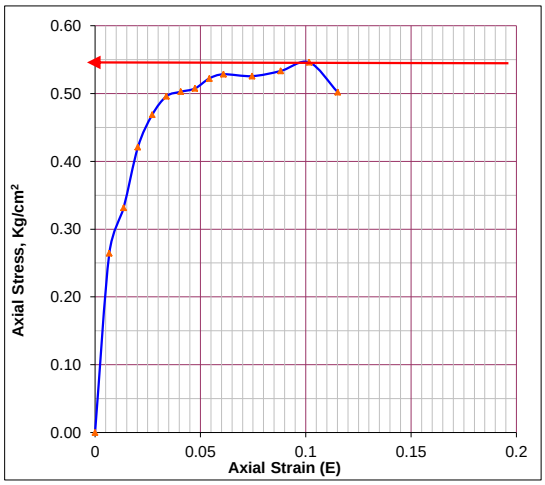
Clay	Silt	fine sand	medium sand	coarse sand	fine gravel	coarse gravel	
0.002mm		0.075mm	0.425mm	2mm	4.75mm	20mm	80mm

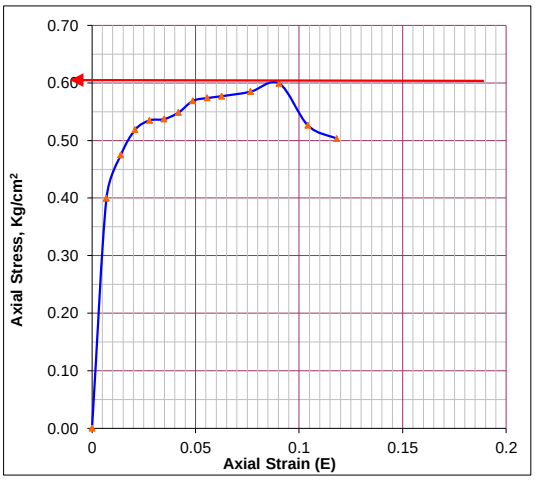
UCS Test Results



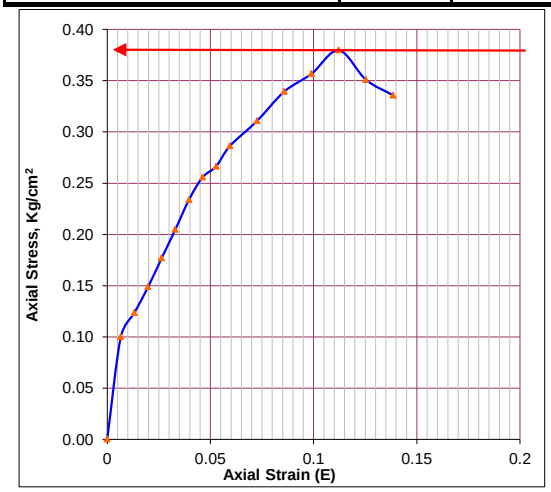


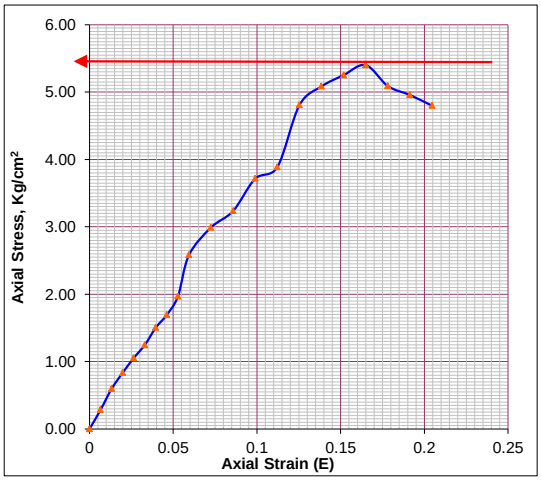
Result				Result			
BH ID	**1**	**Depth(m)**	**2.5**	**BH ID**	**1**	**Depth(m)**	**5.5**
UCS		Kg/cm^2	0.35	UCS		Kg/cm^2	0.41





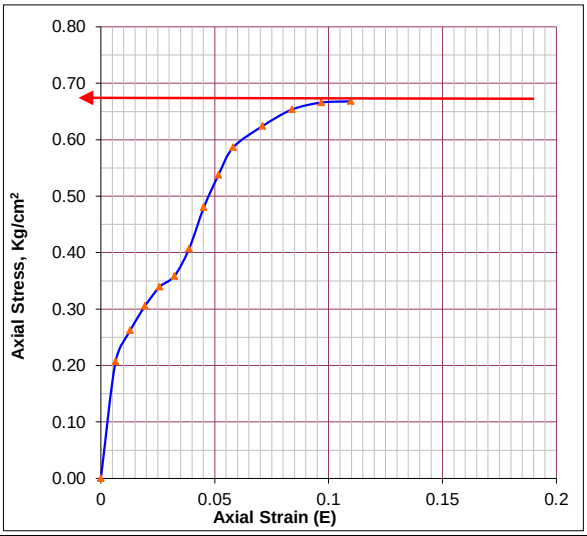
Result				Result			
BH ID	**1**	**Depth(m)**	**8.5**	**BH ID**	**1**	**Depth(m)**	**11.5**
UCS		Kg/cm^2	0.55	UCS		Kg/cm^2	0.60

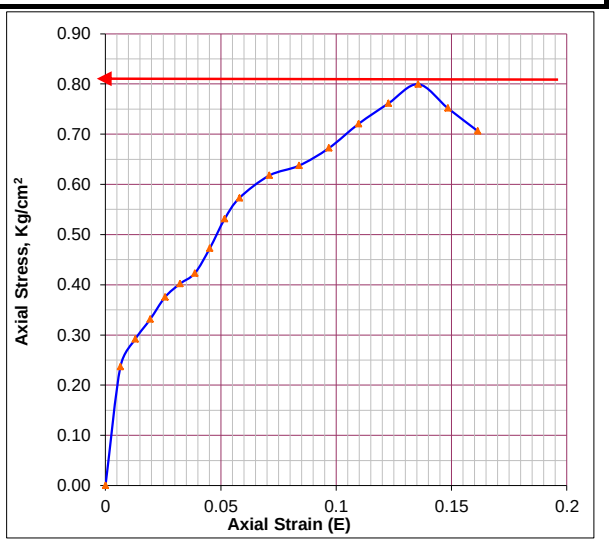




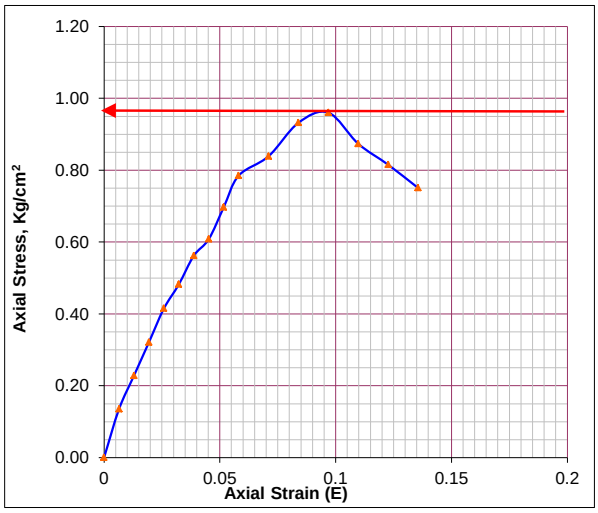
Result				Result			
BH ID	**1**	**Depth(m)**	**20.5**	**BH ID**	**1**	**Depth(m)**	**29.0**
UCS		Kg/cm^2	0.38	UCS		Kg/cm^2	5.40

UCS Test Results



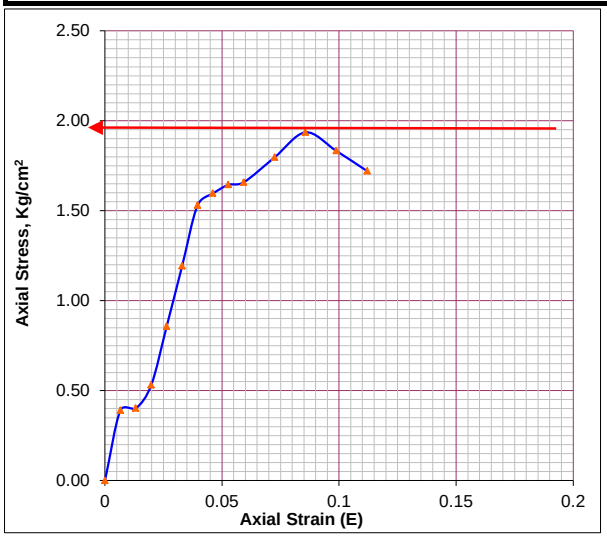


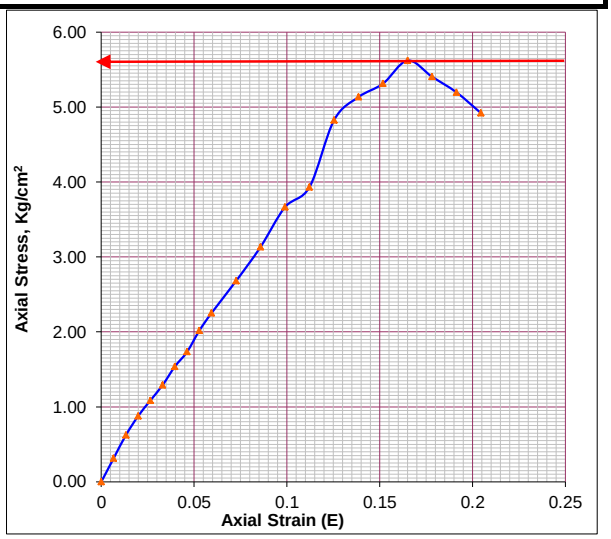
Result				Result			
BH ID	**2**	**Depth(m)**	**2.5**	**BH ID**	**2**	**Depth(m)**	**11.5**
UCS		Kg/cm^2	0.67	UCS		Kg/cm^2	0.80



Result							
BH ID	**2**	**Depth(m)**	**26.5**				
UCS		Kg/cm^2	0.96				

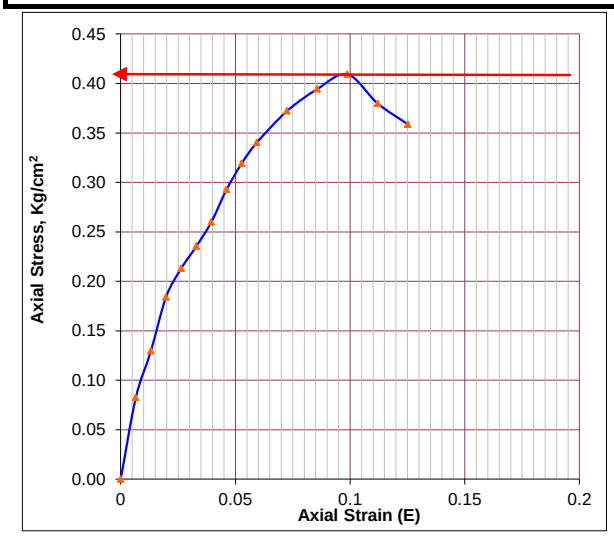
UCS Test Results

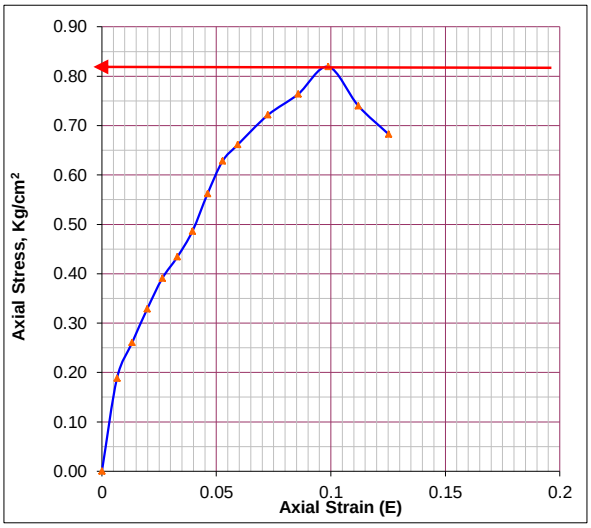




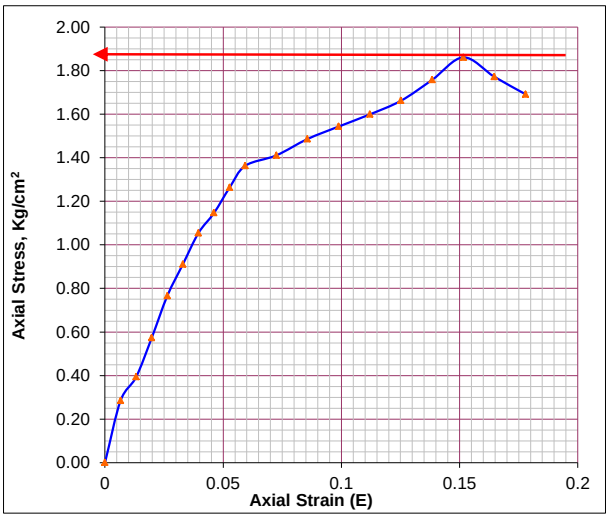
Result				Result			
BH ID	**3**	**Depth(m)**	**2.5**	**BH ID**	**3**	**Depth(m)**	**28.5**
UCS		Kg/cm^2	1.94	UCS		Kg/cm^2	5.62

UCS Test Results



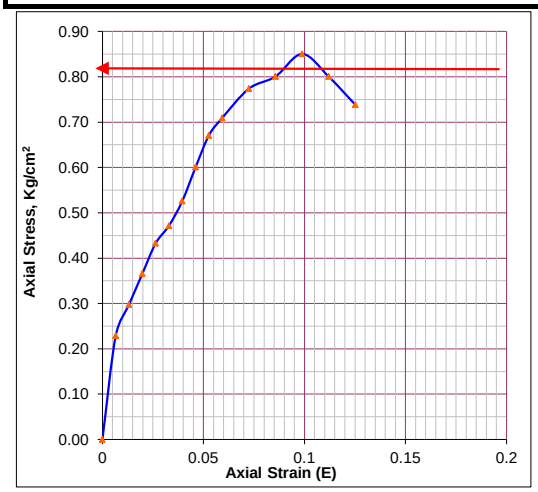


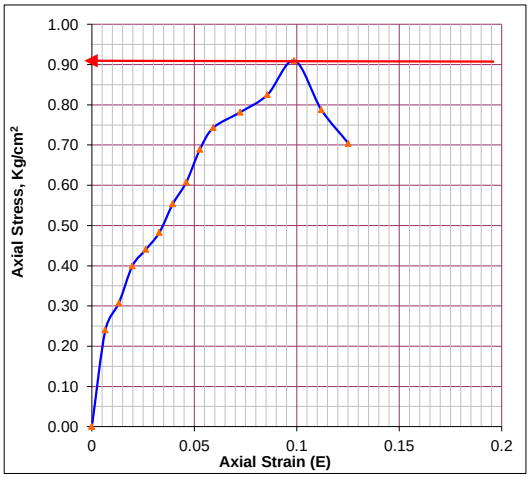
Result				Result			
BH ID	**4**	**Depth(m)**	**2.5**	**BH ID**	**4**	**Depth(m)**	**5.5**
UCS		Kg/cm^2	0.41	UCS		Kg/cm^2	0.82



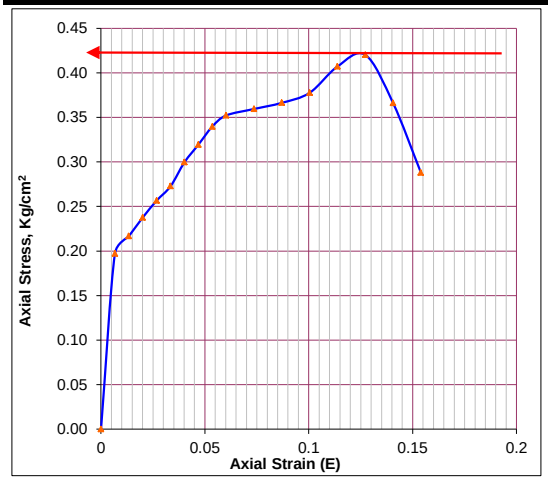
Result							
BH ID	**4**	**Depth(m)**	**24.0**				
UCS		Kg/cm^2	1.86				

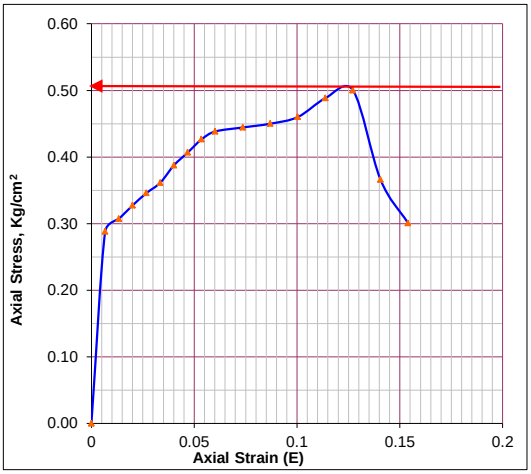
UCS Test Results



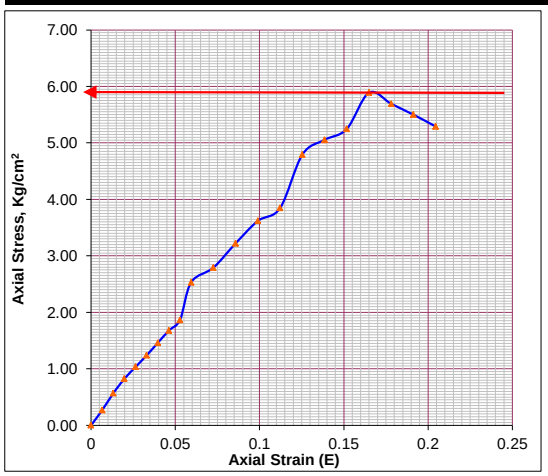


Result				Result			
BH ID	**5**	**Depth(m)**	**8.5**	**BH ID**	**5**	**Depth(m)**	**11.5**
UCS		Kg/cm^2	0.85	UCS		Kg/cm^2	0.91



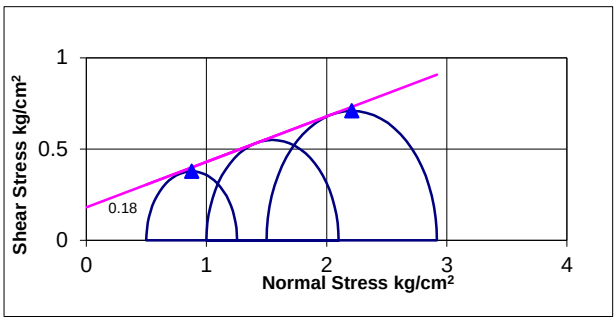


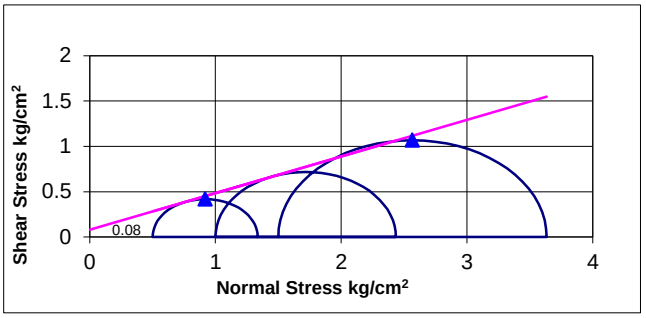
Result				Result			
BH ID	**5**	**Depth(m)**	**23.5**	**BH ID**		**Depth(m)**	**27.0**
UCS		Kg/cm^2	0.42	UCS		Kg/cm^2	0.50



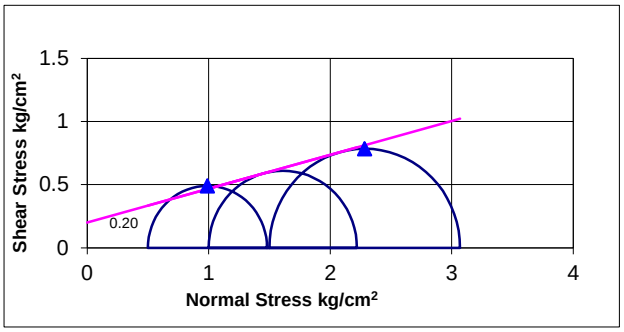
Result							
BH ID	**1**	**Depth(m)**	**30.0**				
UCS		Kg/cm^2	5.89				

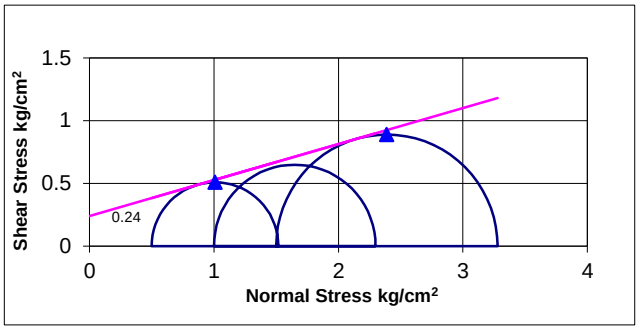
Triaxial Test Results



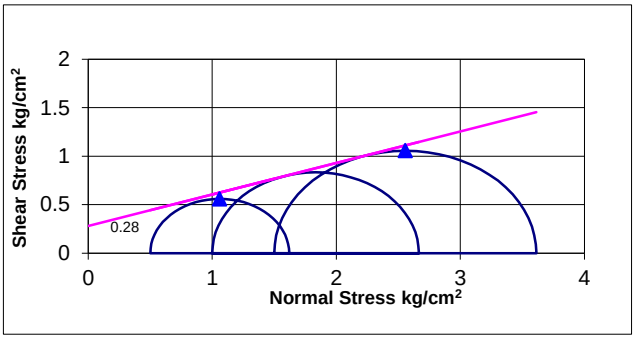


Result				Result			
BH ID	**1**	**Depth(m)**	**2.5**	**BH ID**	**1**	**Depth(m)**	**8.5**
Cohesion in Kg/cm^2		C	0.18	Cohesion in Kg/cm^2		C	0.08
Angle of Internal Friction		ϕ	14.0	Angle of Internal Friction		ϕ	22.0



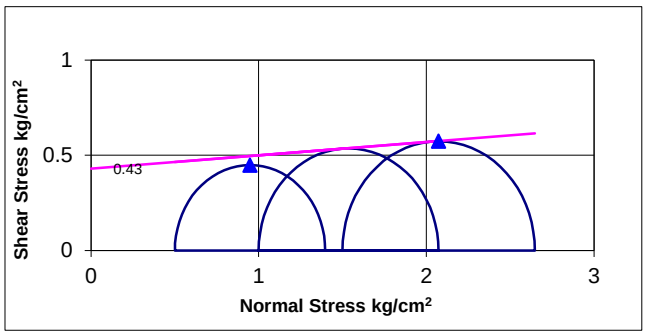


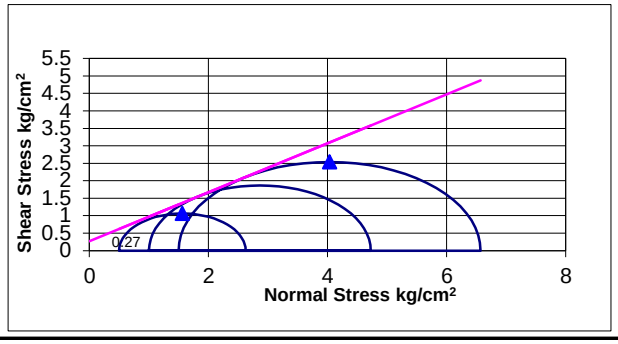
Result				Result			
BH ID	**1**	**Depth(m)**	**11.5**	**BH ID**	**1**	**Depth(m)**	**20.5**
Cohesion in Kg/cm^2		C	0.20	Cohesion in Kg/cm^2		C	0.24
Angle of Internal Friction		ϕ	15.0	Angle of Internal Friction		ϕ	16.0



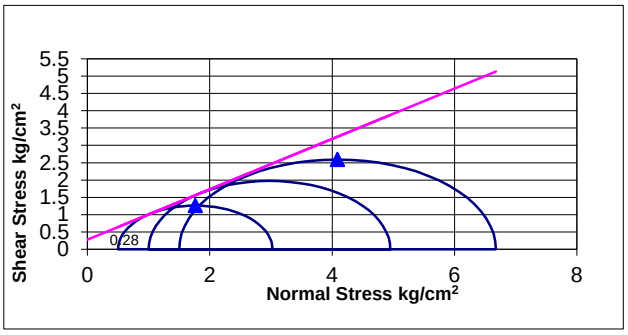
Result			
BH ID	**1**	**Depth(m)**	**26.5**
Cohesion in Kg/cm^2		C	0.28
Angle of Internal Friction		ϕ	18.0

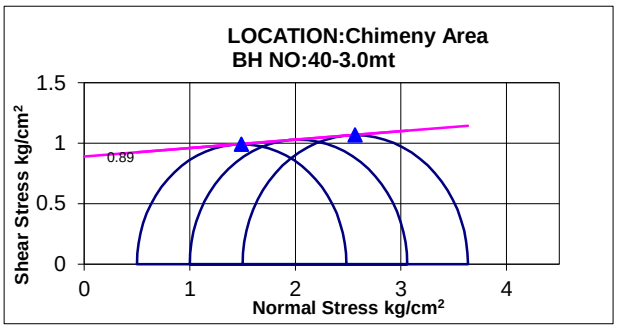
Triaxial Test Results





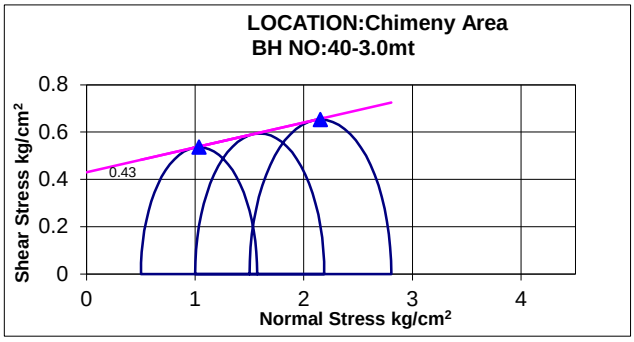
Result				Result			
BH ID	**2**	**Depth(m)**	**2.5**	**BH ID**	**2**	**Depth(m)**	**8.5**
Cohesion in Kg/cm^2		C	0.43	Cohesion in Kg/cm^2		C	0.27
Angle of Internal Friction		ϕ	4.0	Angle of Internal Friction		ϕ	35.0

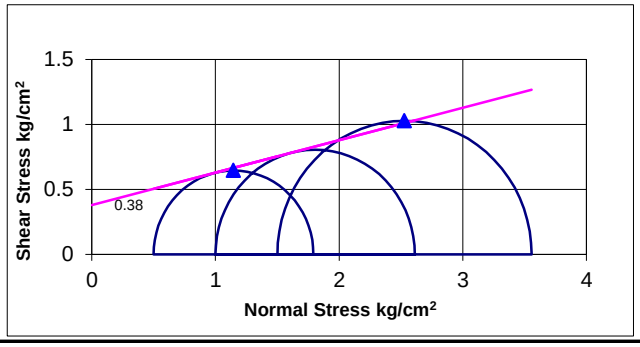




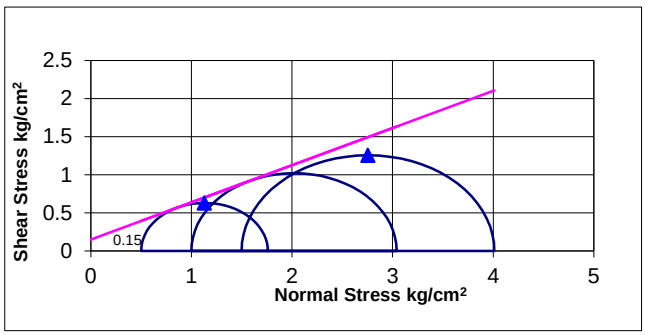
Result				Result			
BH ID	**2**	**Depth(m)**	**11.5**	**BH ID**	**2**	**Depth(m)**	**26.5**
Cohesion in Kg/cm^2		C	0.28	Cohesion in Kg/cm^2		C	0.89
Angle of Internal Friction		ϕ	36.0	Angle of Internal Friction		ϕ	4.0

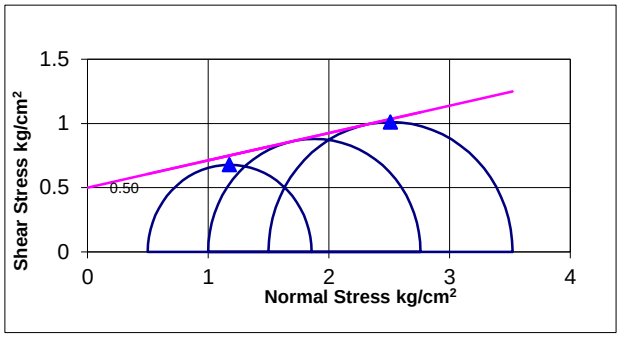
Triaxial Test Results





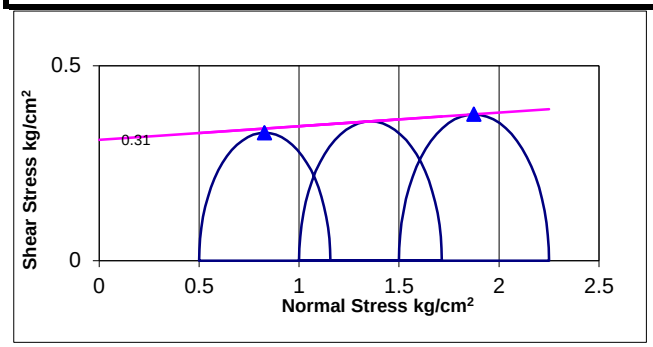
Result				Result			
BH ID	**3**	**Depth(m)**	**2.5**	**BH ID**	**3**	**Depth(m)**	**5.5**
Cohesion in Kg/cm^2		C	0.43	Cohesion in Kg/cm^2		C	0.38
Angle of Internal Friction		ϕ	6.0	Angle of Internal Friction		ϕ	14.0

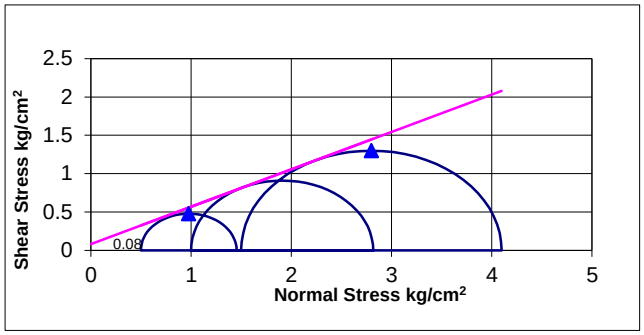




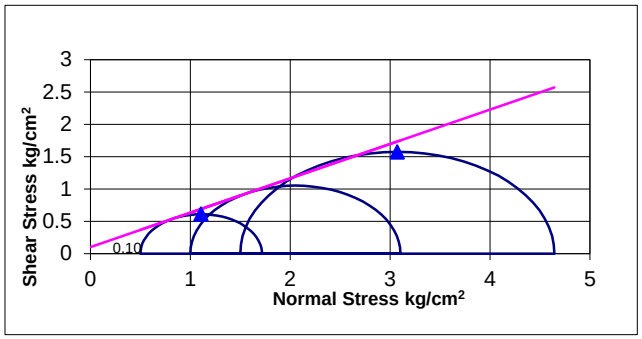
Result				Result			
BH ID	**3**	**Depth(m)**	**11.5**	**BH ID**	**3**	**Depth(m)**	**23.5**
Cohesion in Kg/cm^2		C	0.15	Cohesion in Kg/cm^2		C	0.50
Angle of Internal Friction		ϕ	26.0	Angle of Internal Friction		ϕ	12.0

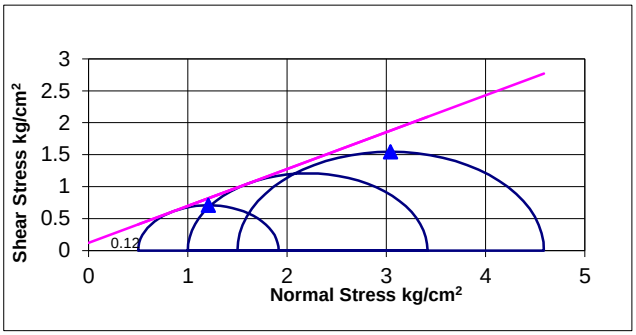
Triaxial Test Results





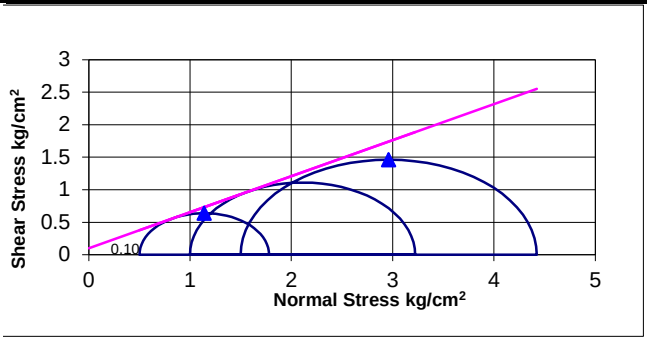
Result				Result			
BH ID	**4**	**Depth(m)**	**2.5**	**BH ID**	**4**	**Depth(m)**	**5.5**
Cohesion in Kg/cm^2		C	0.31	Cohesion in Kg/cm^2		C	0.08
Angle of Internal Friction		ϕ	2.0	Angle of Internal Friction		ϕ	26.0

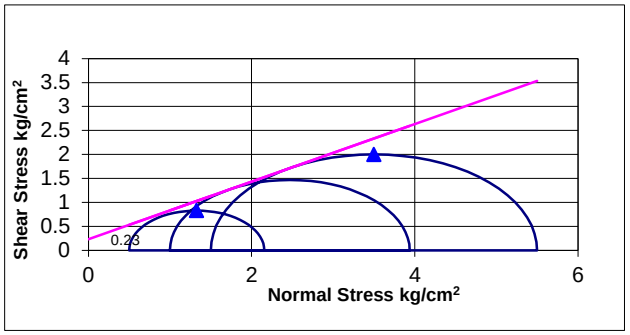




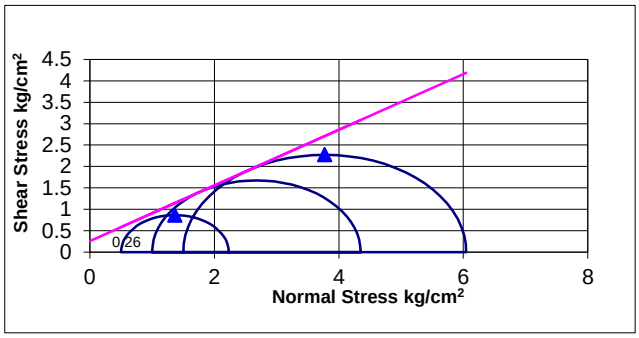
Result				Result			
BH ID	**4**	**Depth(m)**	**11.5**	**BH ID**	**4**	**Depth(m)**	**17.5**
Cohesion in Kg/cm^2		C	0.10	Cohesion in Kg/cm^2		C	0.12
Angle of Internal Friction		ϕ	28.0	Angle of Internal Friction		ϕ	30.0

Triaxial Test Results



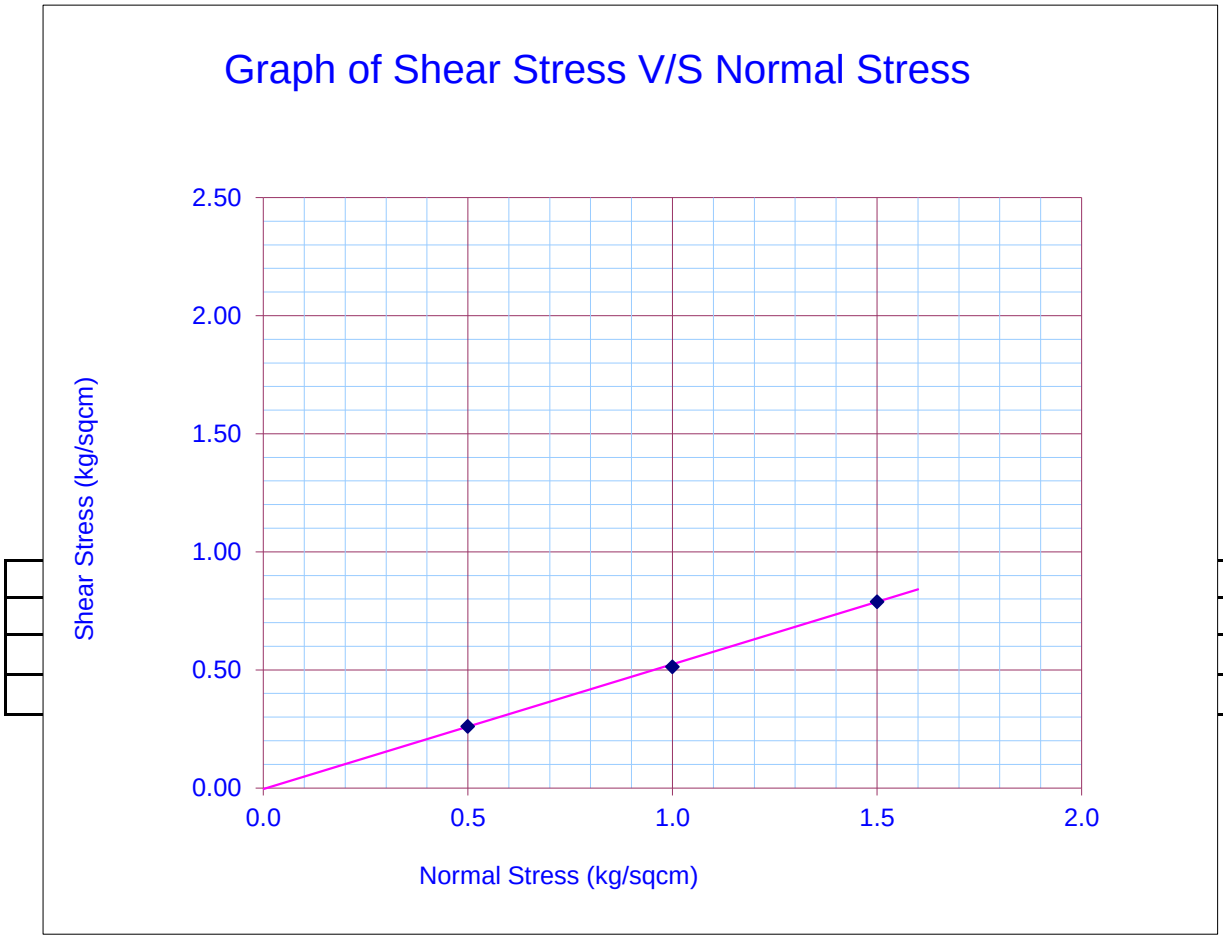


Result				Result			
BH ID	**5**	**Depth(m)**	**8.5**	**BH ID**	**5**	**Depth(m)**	**11.5**
Cohesion in Kg/cm^2		C	0.10	Cohesion in Kg/cm^2		C	0.23
Angle of Internal Friction		ϕ	29.0	Angle of Internal Friction		ϕ	31.0



Result							
BH ID	**5**	**Depth(m)**	**20.5**				
Cohesion in Kg/cm^2		C	0.26				
Angle of Internal Friction		ϕ	33.0				

Direct Shear Test Results

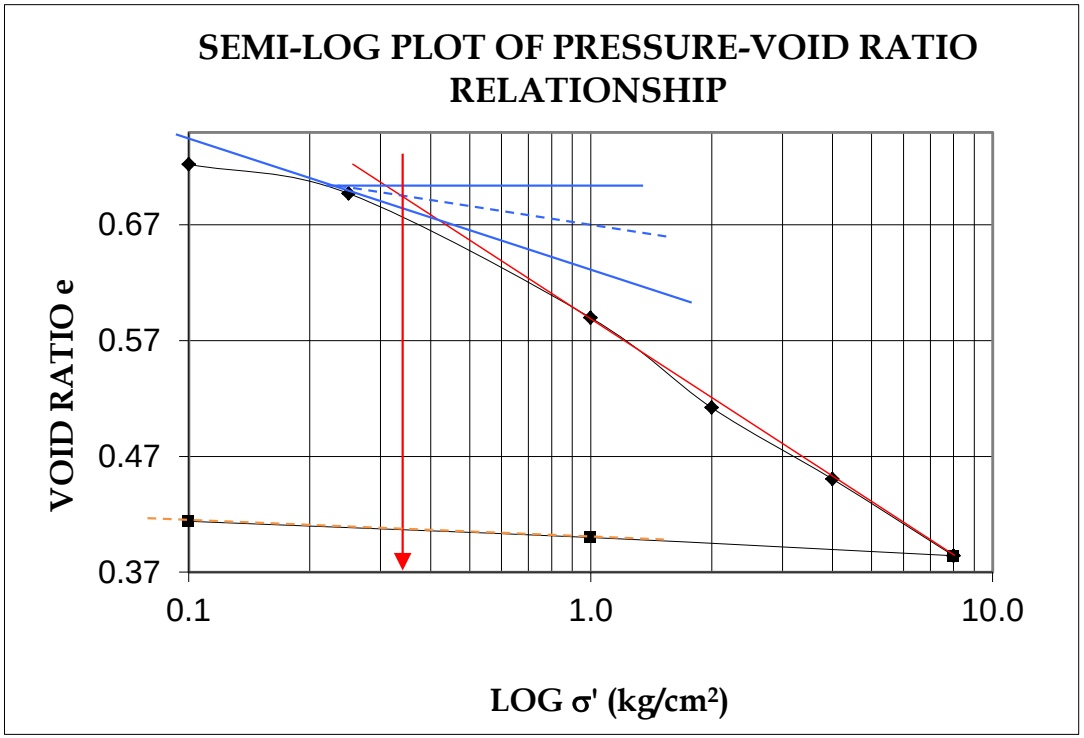


Result			
BH ID	**1**	**Depth(m)**	**17.5**
Cohesion in Kg/cm^2		C	0
Angle of Internal Friction		ϕ	28

Consolidation Test (IS:2720-Part-15)

Location : BH-1

Depth : 2.5m



Cr = 0.014

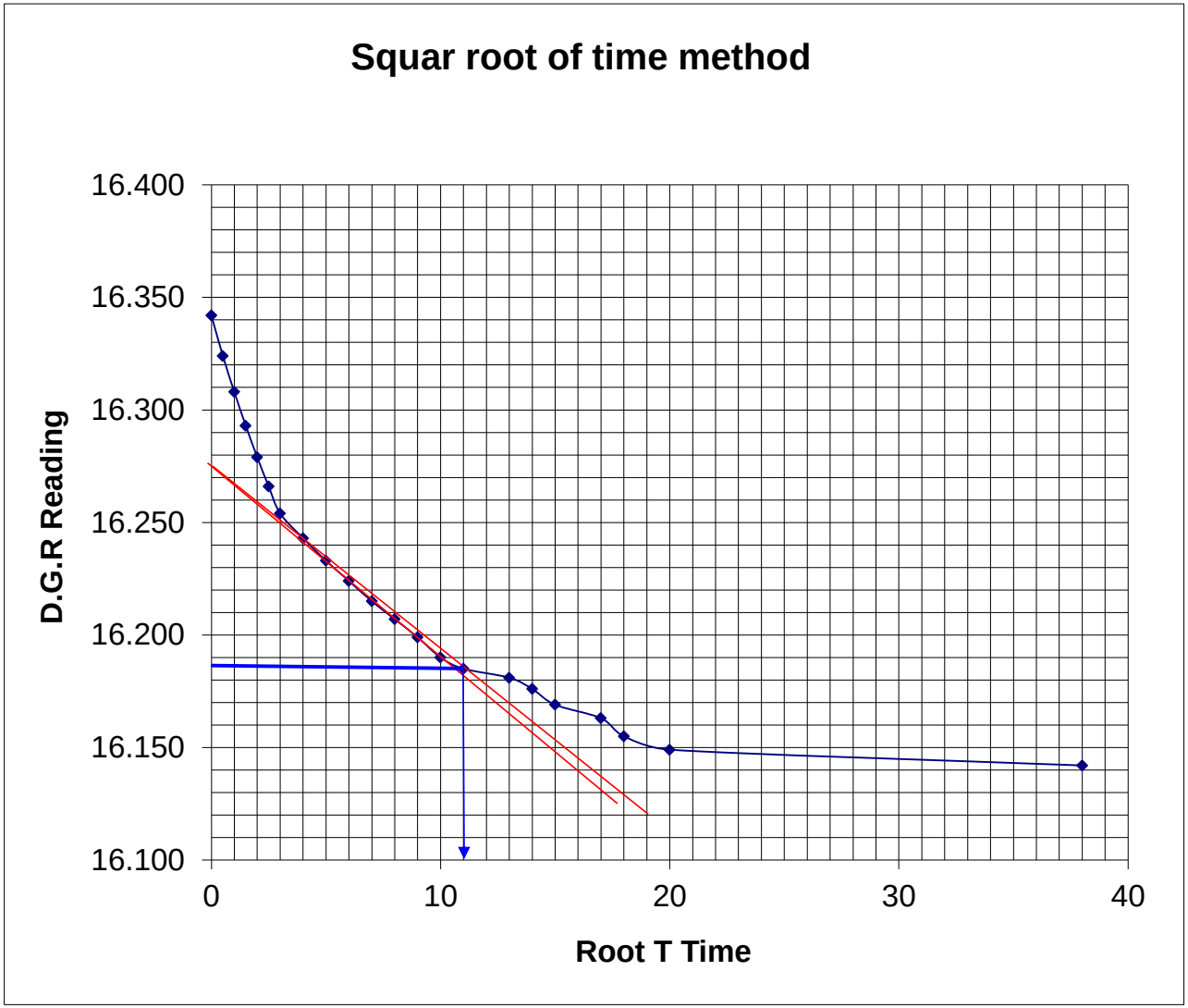
Cc = 0.22

Pc = 0.35 kg/cm2

m_v = 0.049 cm2/kg

PRESSURE INTENSITY (kg/cm2) = **0.10**

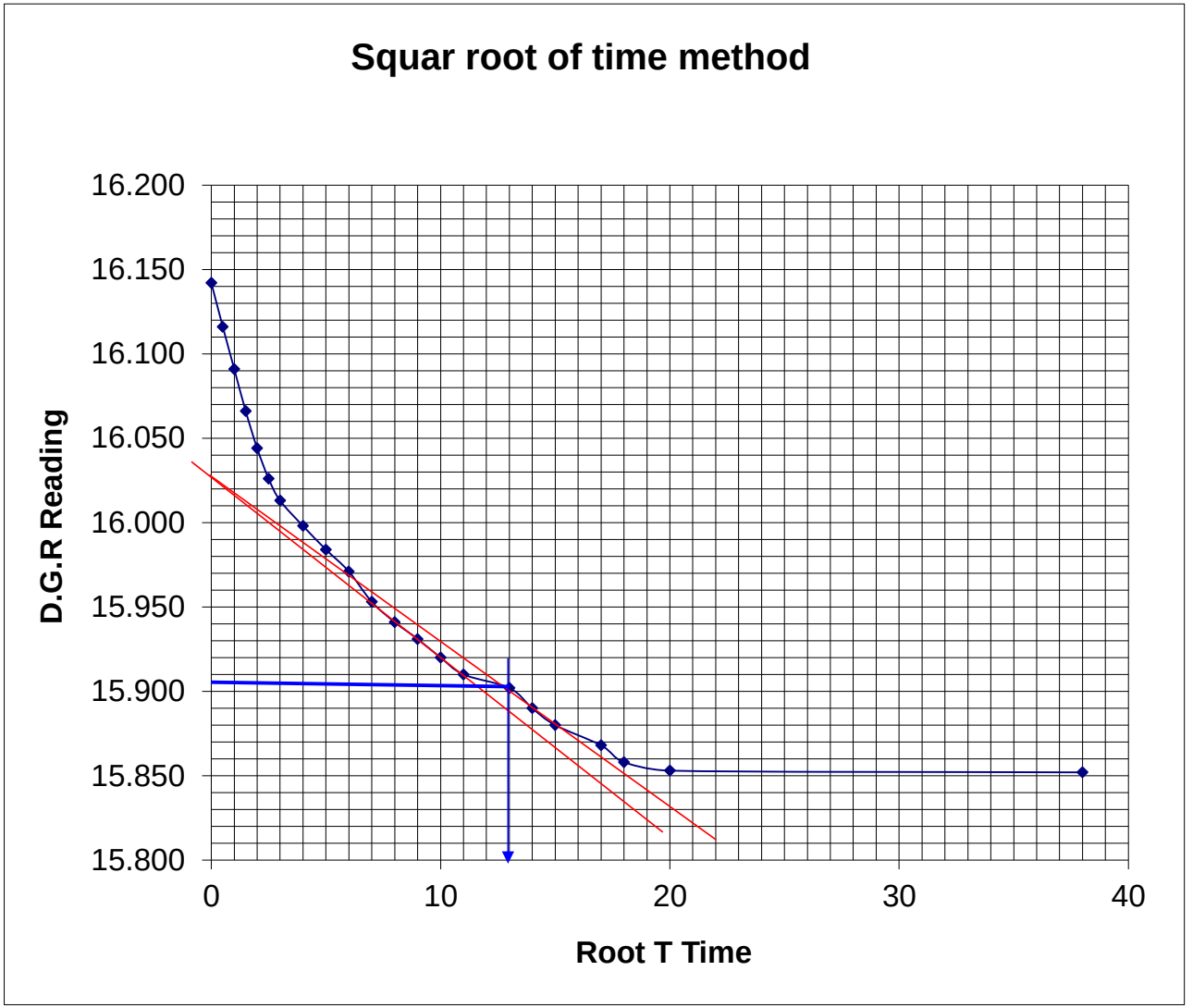
ROOT t	D.G.R
0	16.342
0.5	16.324
1	16.308
1.5	16.293
2	16.279
2.5	16.266
3	16.254
4	16.243
5	16.233
6	16.224
7	16.215
8	16.207
9	16.199
10	16.190
11	16.185
13	16.181
14	16.176
15	16.169
17	16.163
18	16.155
20	16.149
38	16.142



t_{90} = **121 min** C_v = **1.16E-04 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **0.25**

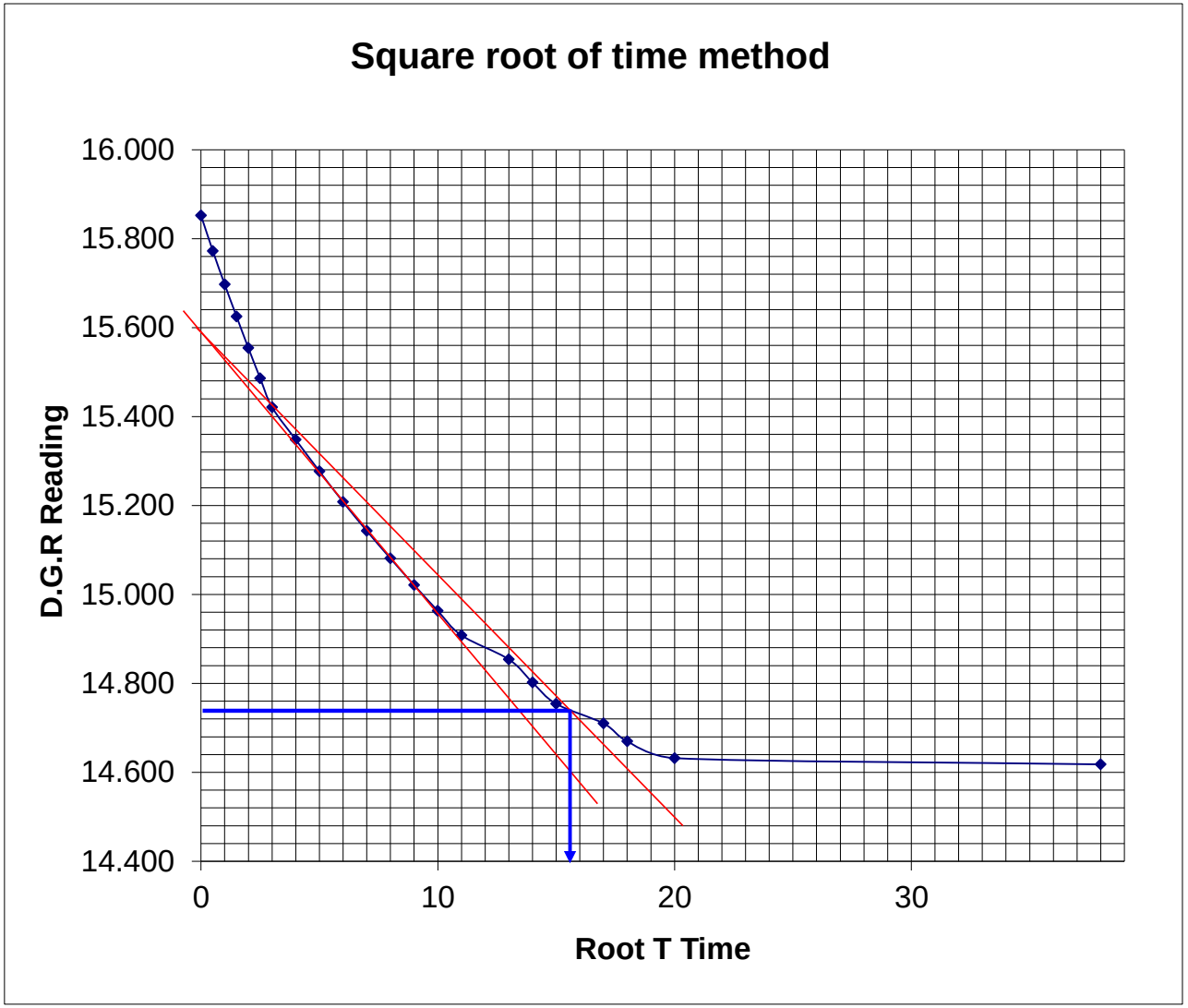
ROOT t	D.G.R
0	16.142
0.5	16.116
1	16.091
1.5	16.066
2	16.044
2.5	16.026
3	16.013
4	15.998
5	15.984
6	15.971
7	15.953
8	15.941
9	15.931
10	15.920
11	15.910
13	15.902
14	15.890
15	15.880
17	15.868
18	15.858
20	15.853
38	15.852



t_{90} = 0 min C_v = 8.08E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **1.00**

ROOT t	D.G.R
0	15.852
0.5	15.772
1	15.697
1.5	15.625
2	15.554
2.5	15.486
3	15.421
4	15.348
5	15.277
6	15.208
7	15.143
8	15.081
9	15.021
10	14.963
11	14.908
13	14.854
14	14.802
15	14.754
17	14.710
18	14.670
20	14.632
38	14.618

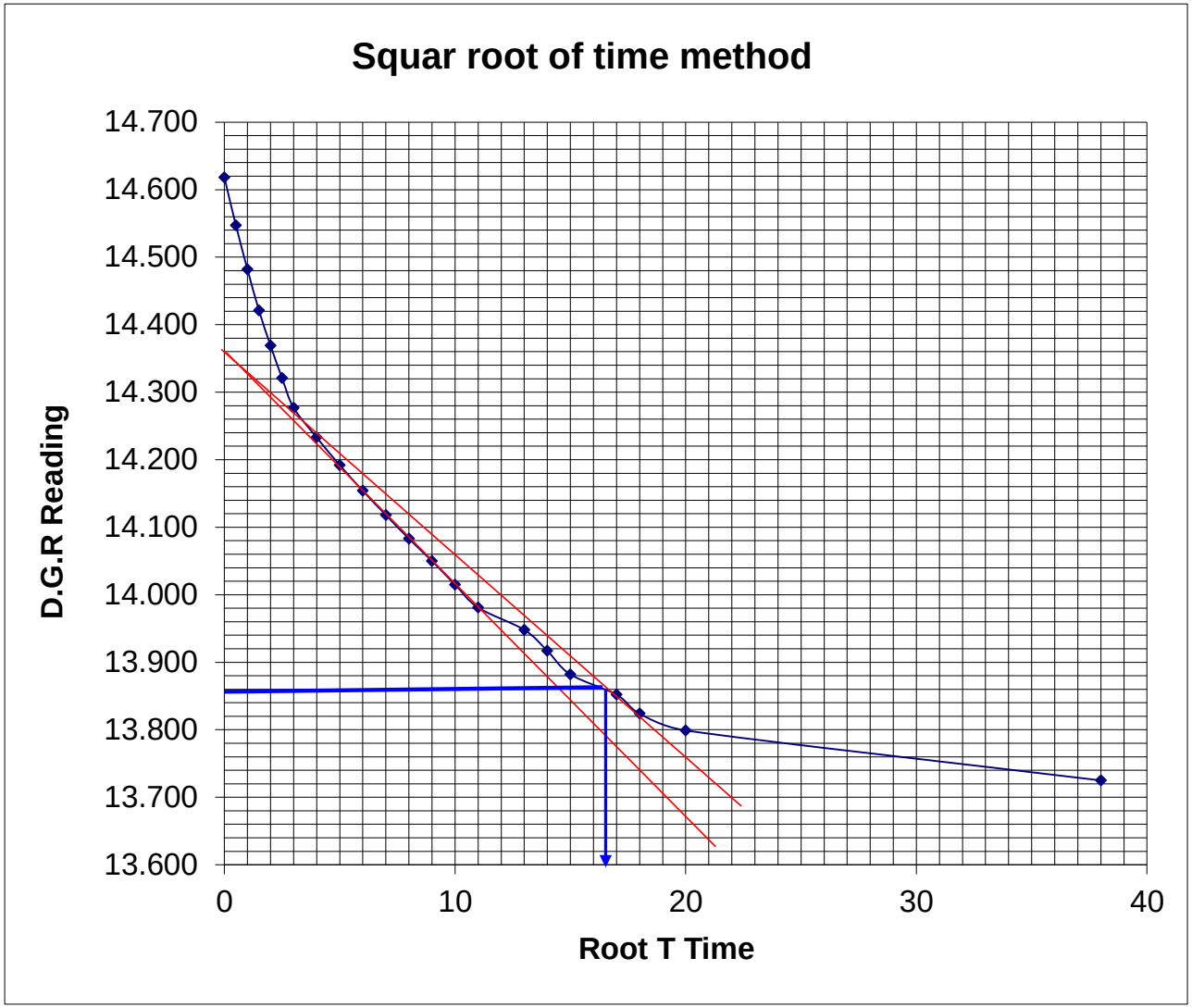


t_{90} = 0 min

C_v = 5.12E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **2.00**

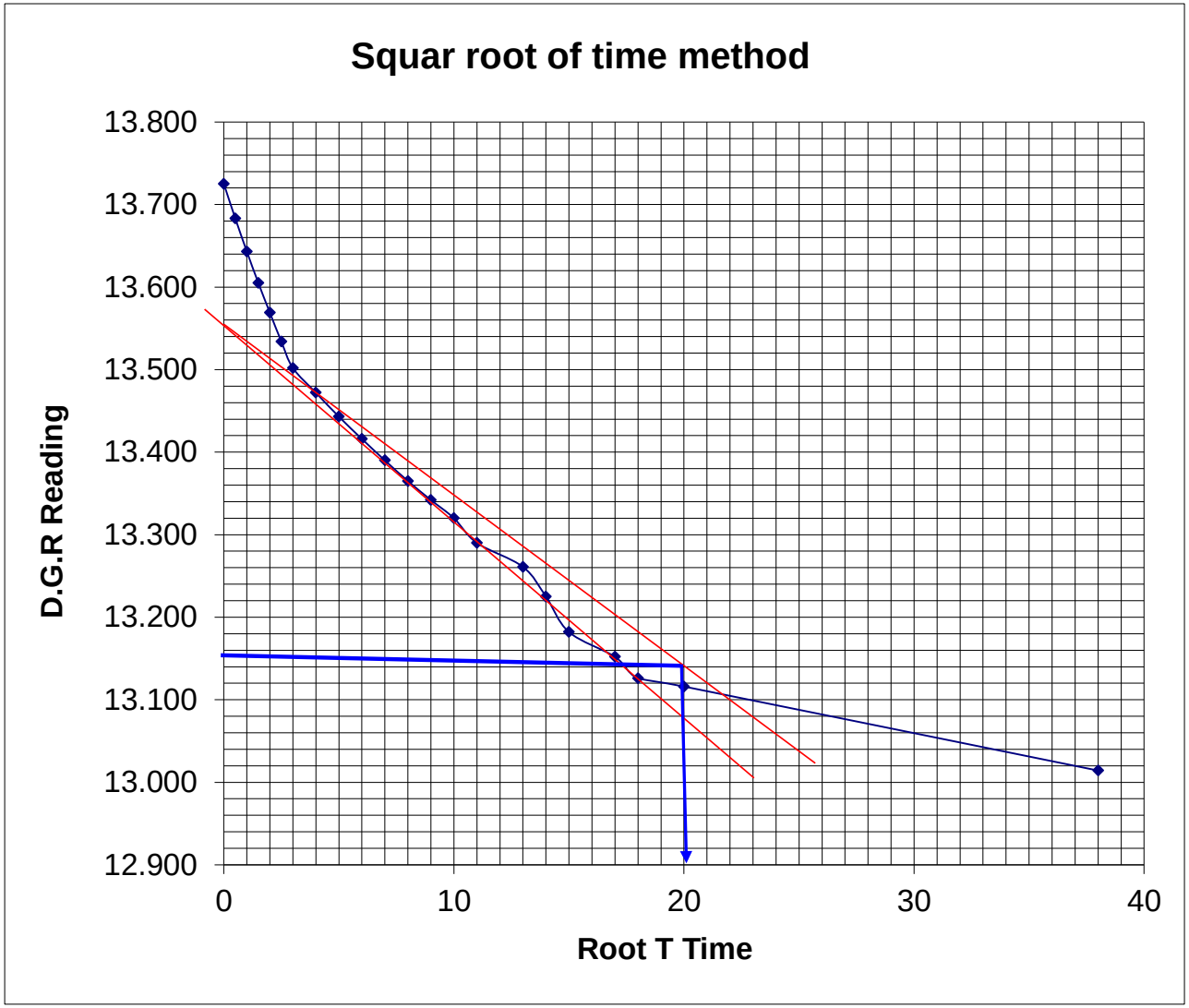
ROOT t	D.G.R
0	14.618
0.5	14.547
1	14.482
1.5	14.421
2	14.369
2.5	14.321
3	14.277
4	14.233
5	14.192
6	14.154
7	14.118
8	14.083
9	14.050
10	14.015
11	13.981
13	13.948
14	13.917
15	13.882
17	13.852
18	13.824
20	13.799
38	13.725



t_{90} = 272 min C_v = 4.13E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **4.00**

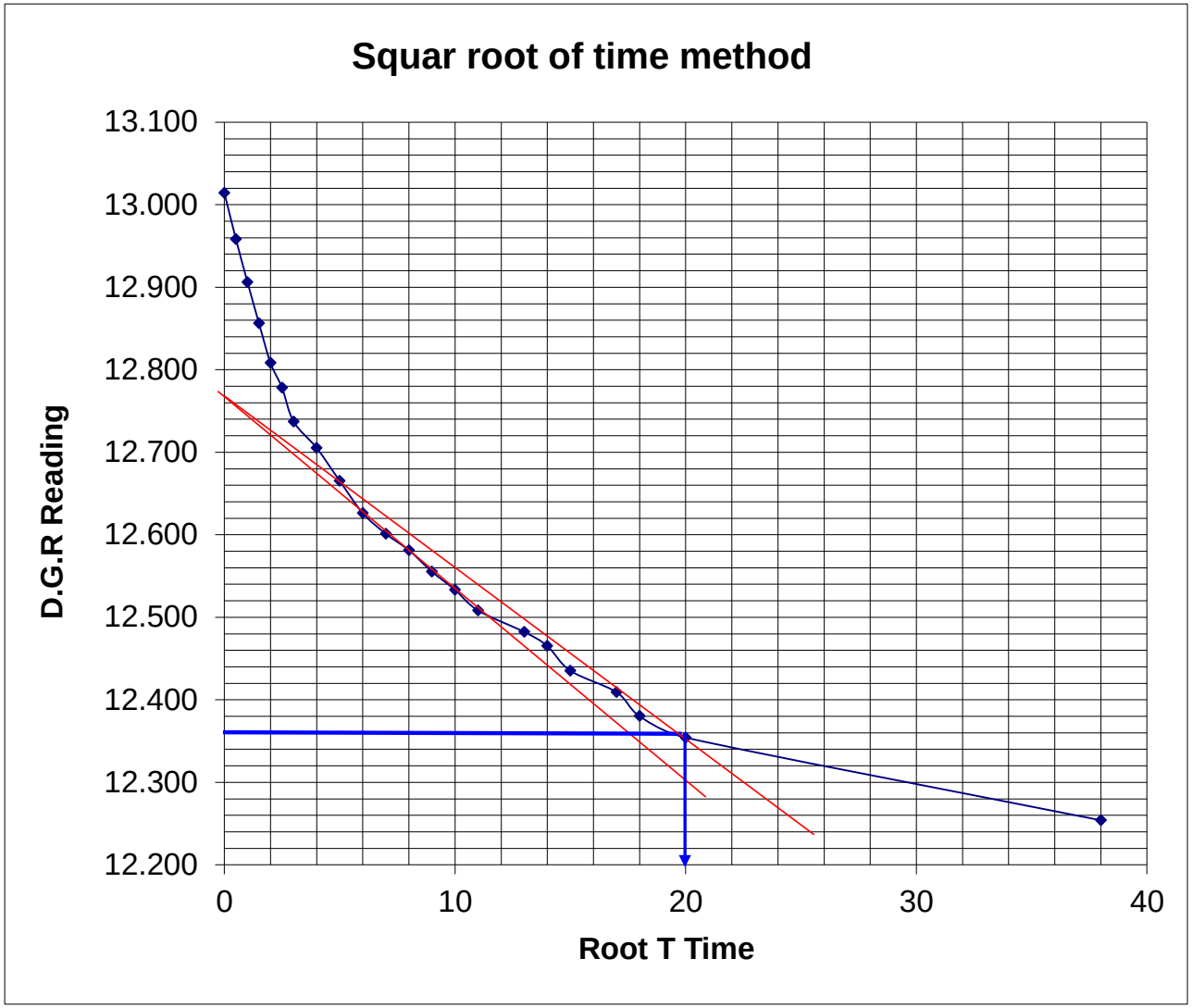
ROOT t	D.G.R
0	13.725
0.5	13.683
1	13.643
1.5	13.605
2	13.569
2.5	13.534
3	13.502
4	13.472
5	13.443
6	13.416
7	13.390
8	13.365
9	13.342
10	13.320
11	13.290
13	13.261
14	13.225
15	13.182
17	13.152
18	13.126
20	13.116
38	13.014



t_{90} = 400 min C_v = 2.56E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **8.00**

ROOT t	D.G.R
0	13.014
0.5	12.958
1	12.906
1.5	12.856
2	12.808
2.5	12.778
3	12.737
4	12.705
5	12.665
6	12.626
7	12.601
8	12.581
9	12.555
10	12.533
11	12.508
13	12.482
14	12.465
15	12.435
17	12.409
18	12.380
20	12.354
38	12.254

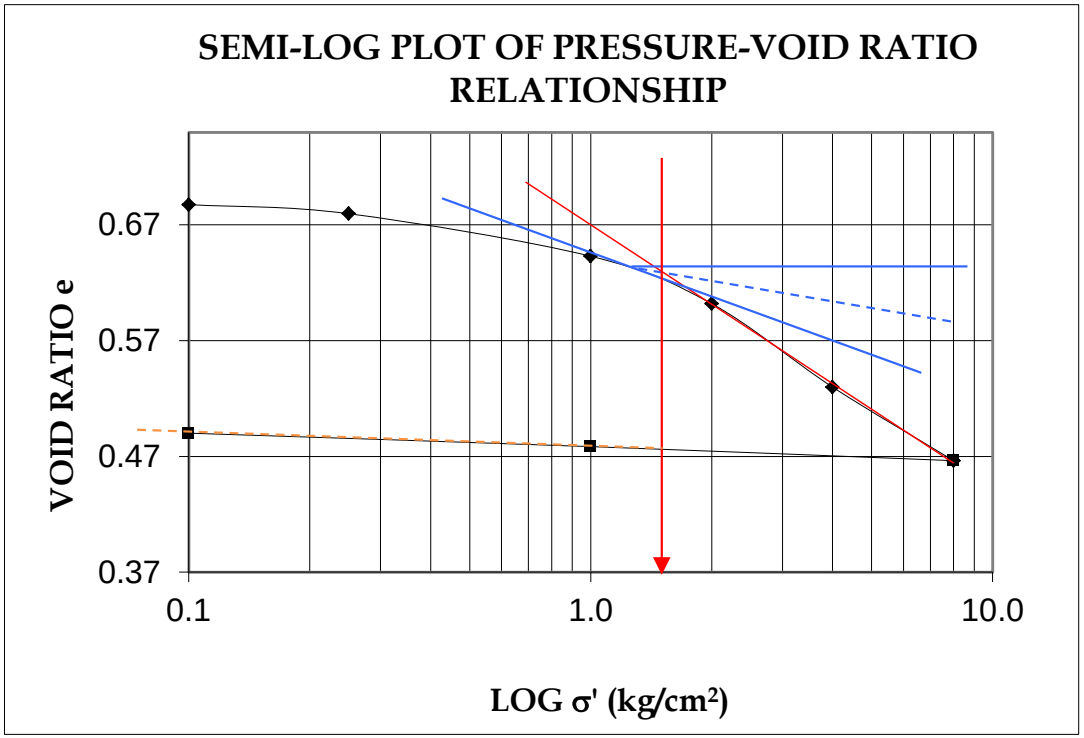


t_{90} = 400 min C_v = 2.34E-05 cm^2/sec

Consolidation Test (IS:2720-Part-15)

Location : BH-1

Depth : 5.5m



Cr = 0.012

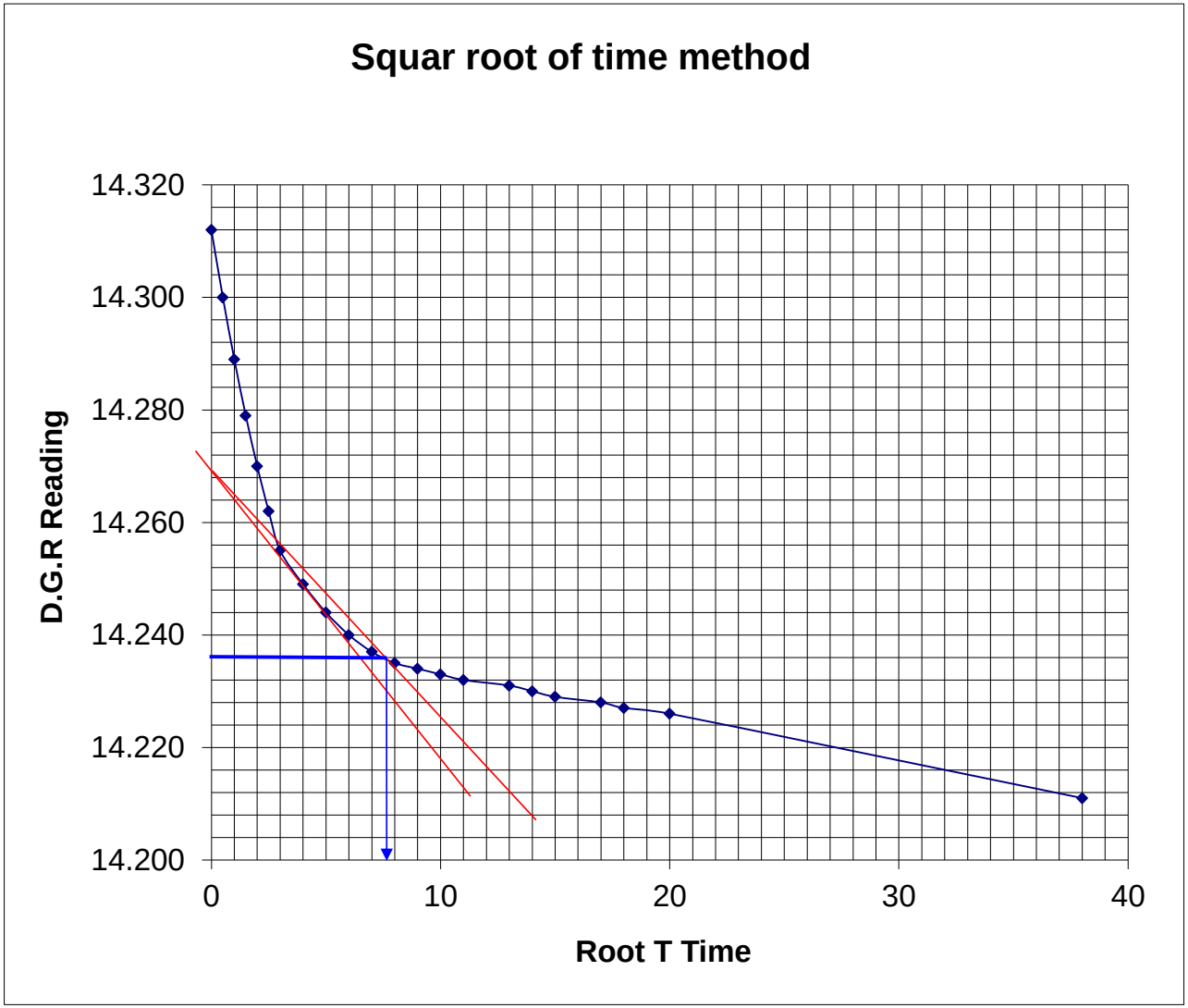
Cc = 0.21

Pc = 1.60 kg/cm2

m_v = 0.025 cm2/kg

PRESSURE INTENSITY (kg/cm2) = **0.10**

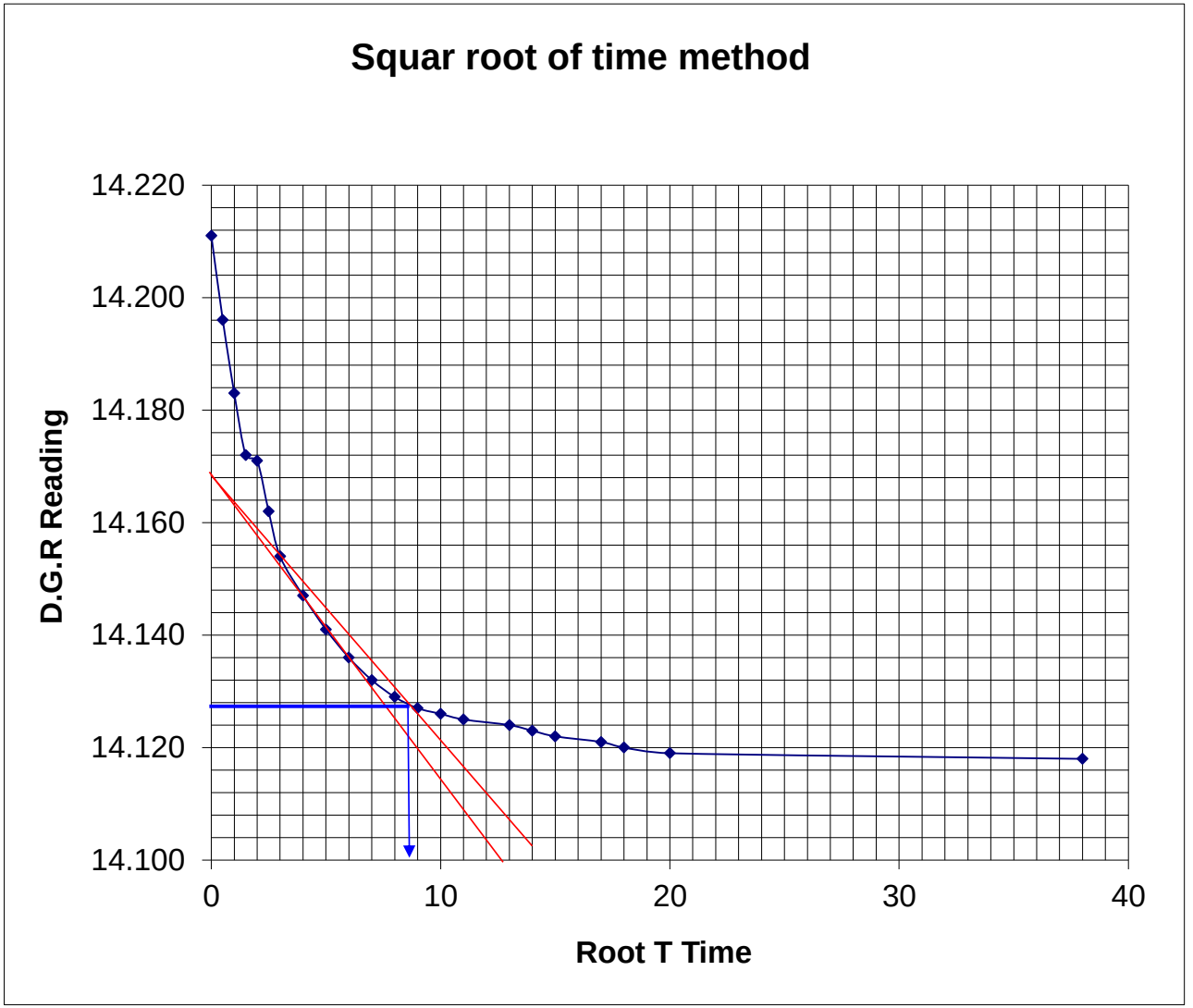
ROOT t	D.G.R
0	14.312
0.5	14.300
1	14.289
1.5	14.279
2	14.270
2.5	14.262
3	14.255
4	14.249
5	14.244
6	14.240
7	14.237
8	14.235
9	14.234
10	14.233
11	14.232
13	14.231
14	14.230
15	14.229
17	14.228
18	14.227
20	14.226
38	14.211



t_{90} = **61 min** C_v = **2.31E-04 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **0.25**

ROOT t	D.G.R
0	14.211
0.5	14.196
1	14.183
1.5	14.172
2	14.171
2.5	14.162
3	14.154
4	14.147
5	14.141
6	14.136
7	14.132
8	14.129
9	14.127
10	14.126
11	14.125
13	14.124
14	14.123
15	14.122
17	14.121
18	14.120
20	14.119
38	14.118

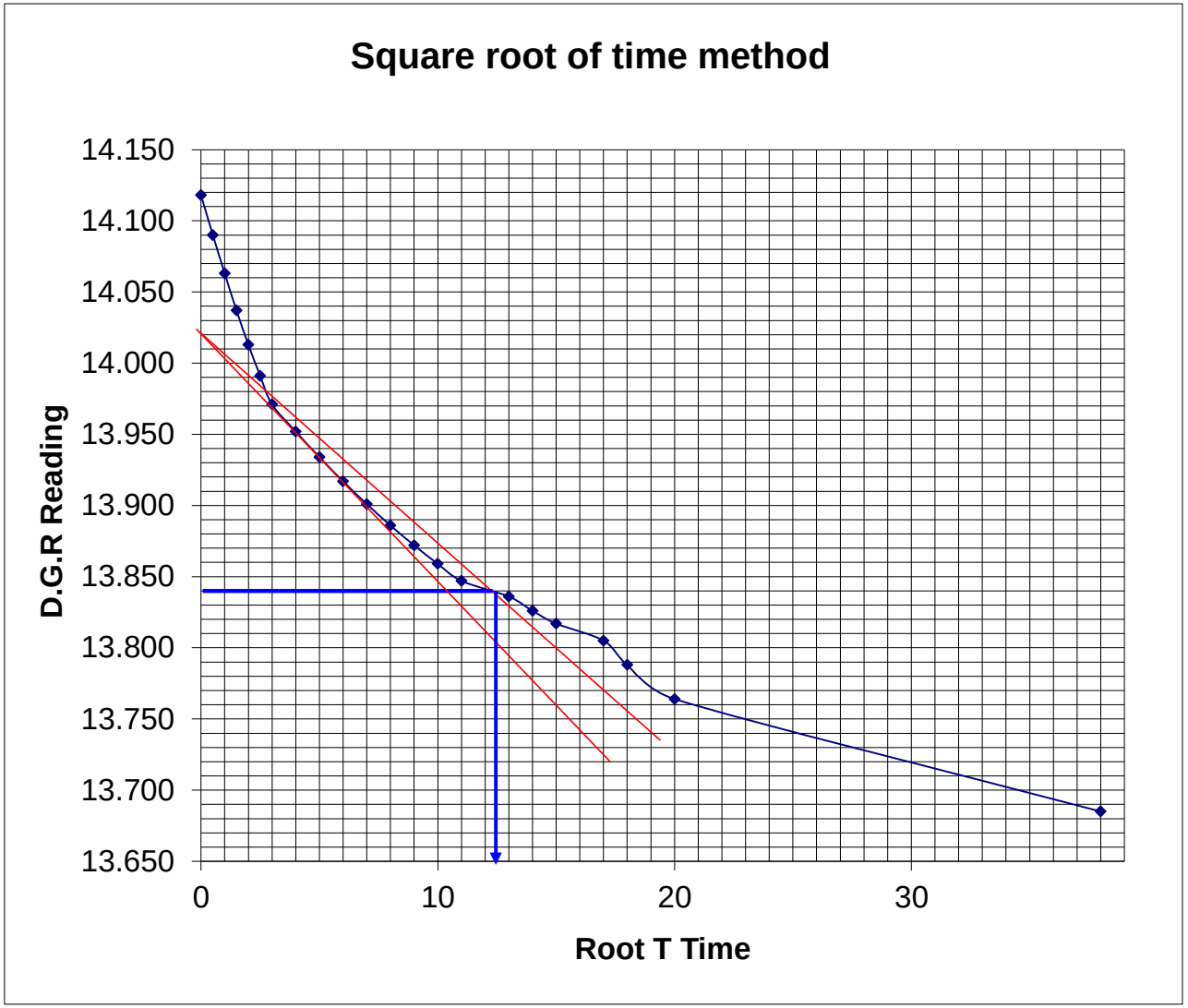


t_{90} = 0 min

C_v = 1.84E-04 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **1.00**

ROOT t	D.G.R
0	14.118
0.5	14.090
1	14.063
1.5	14.037
2	14.013
2.5	13.991
3	13.971
4	13.952
5	13.934
6	13.917
7	13.901
8	13.886
9	13.872
10	13.859
11	13.847
13	13.836
14	13.826
15	13.817
17	13.805
18	13.788
20	13.764
38	13.685

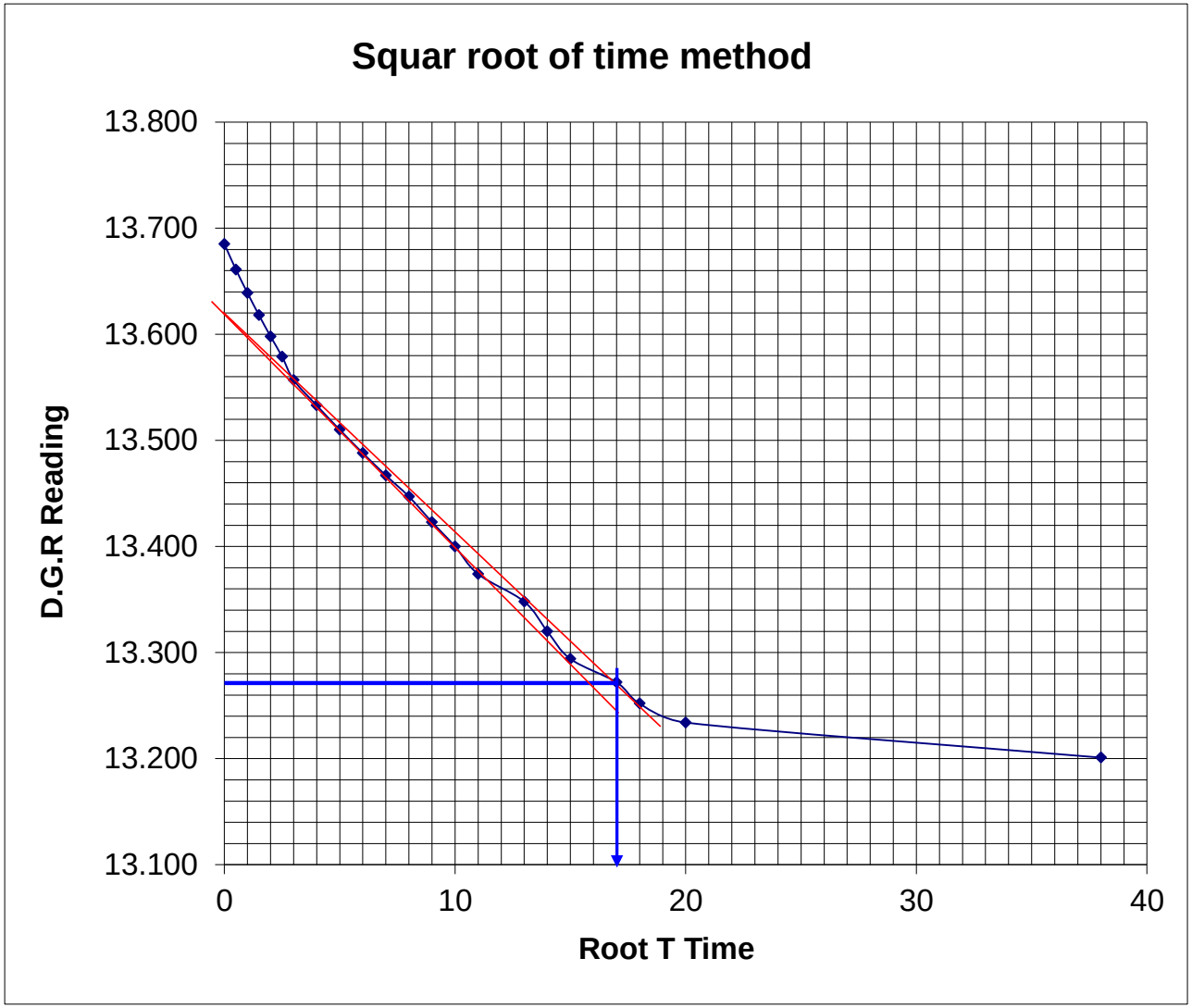


t_{90} = 0 min

C_v = 8.68E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **2.00**

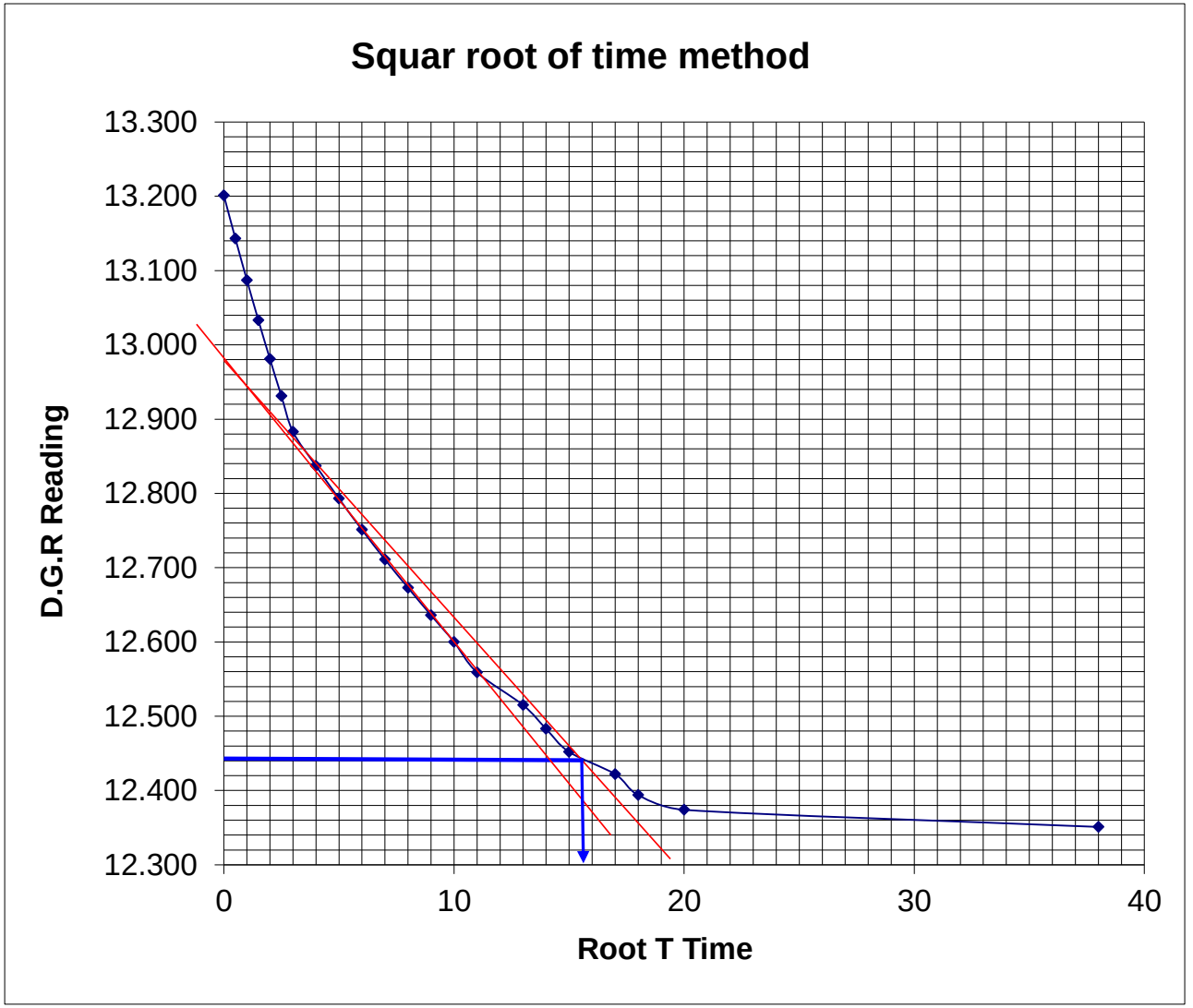
ROOT t	D.G.R
0	13.685
0.5	13.661
1	13.639
1.5	13.618
2	13.598
2.5	13.579
3	13.557
4	13.533
5	13.510
6	13.488
7	13.467
8	13.447
9	13.423
10	13.400
11	13.374
13	13.348
14	13.320
15	13.294
17	13.272
18	13.252
20	13.234
38	13.201



t_{90} = **289 min** C_v = **4.47E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **4.00**

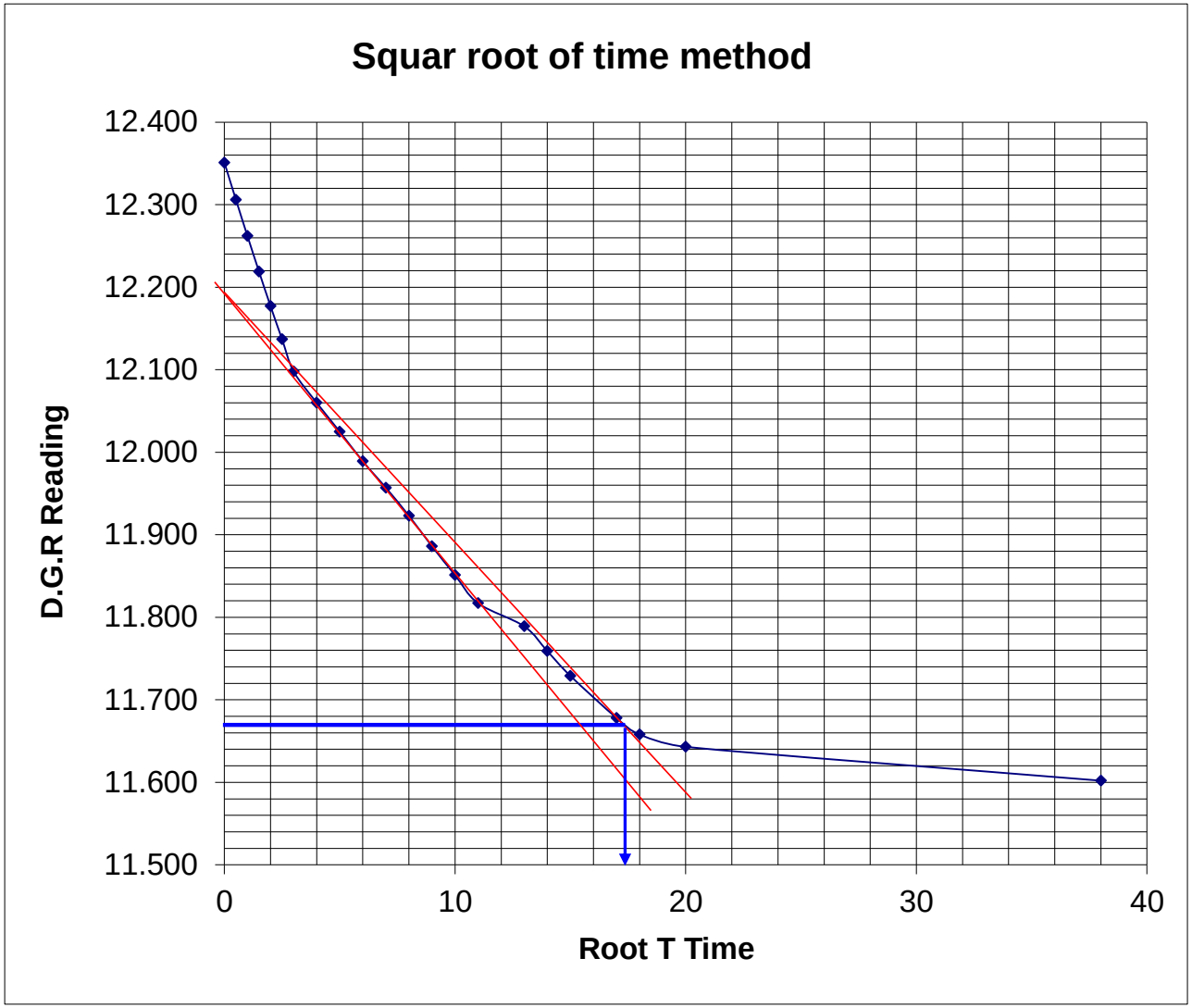
ROOT t	D.G.R
0	13.201
0.5	13.143
1	13.087
1.5	13.033
2	12.981
2.5	12.931
3	12.883
4	12.837
5	12.793
6	12.751
7	12.711
8	12.673
9	12.636
10	12.600
11	12.559
13	12.515
14	12.483
15	12.452
17	12.422
18	12.394
20	12.374
38	12.351



t_{90} = **246 min** C_v = **4.89E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **8.00**

ROOT t	D.G.R
0	12.351
0.5	12.306
1	12.262
1.5	12.219
2	12.177
2.5	12.137
3	12.098
4	12.060
5	12.025
6	11.989
7	11.957
8	11.923
9	11.886
10	11.851
11	11.817
13	11.789
14	11.759
15	11.729
17	11.678
18	11.658
20	11.643
38	11.602

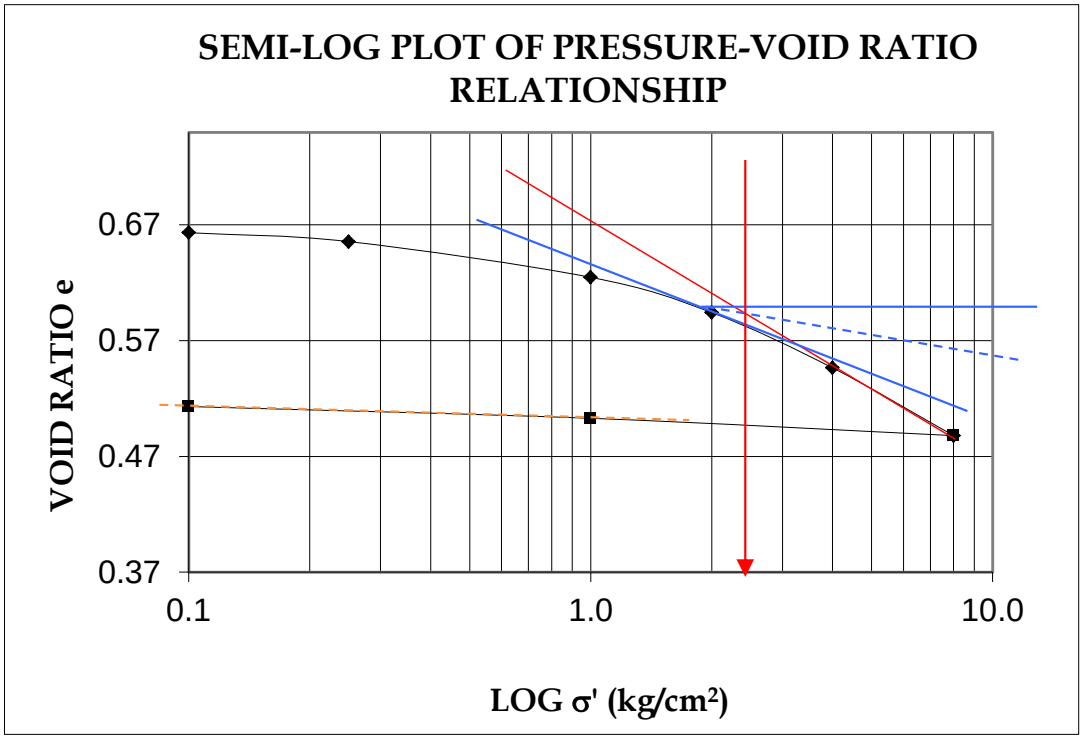


t_{90} = 306 min C_v = 3.60E-05 cm^2/sec

Consolidation Test (IS:2720-Part-15)

Location : BH-1

Depth : 8.5m



Cr = 0.010

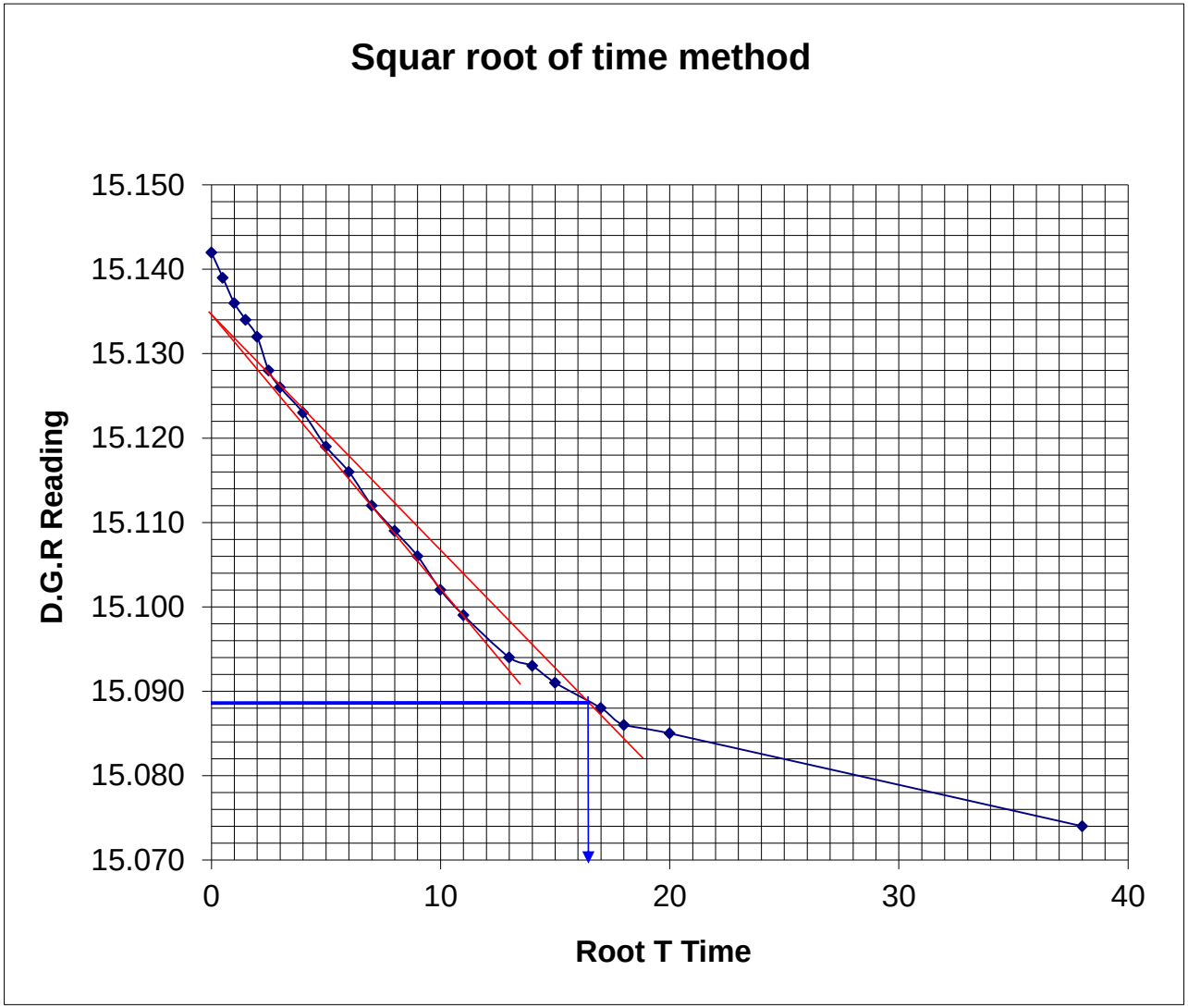
Cc = 0.19

Pc = 2.50 kg/cm2

m_v = 0.019 cm2/kg

PRESSURE INTENSITY (kg/cm2) = **0.10**

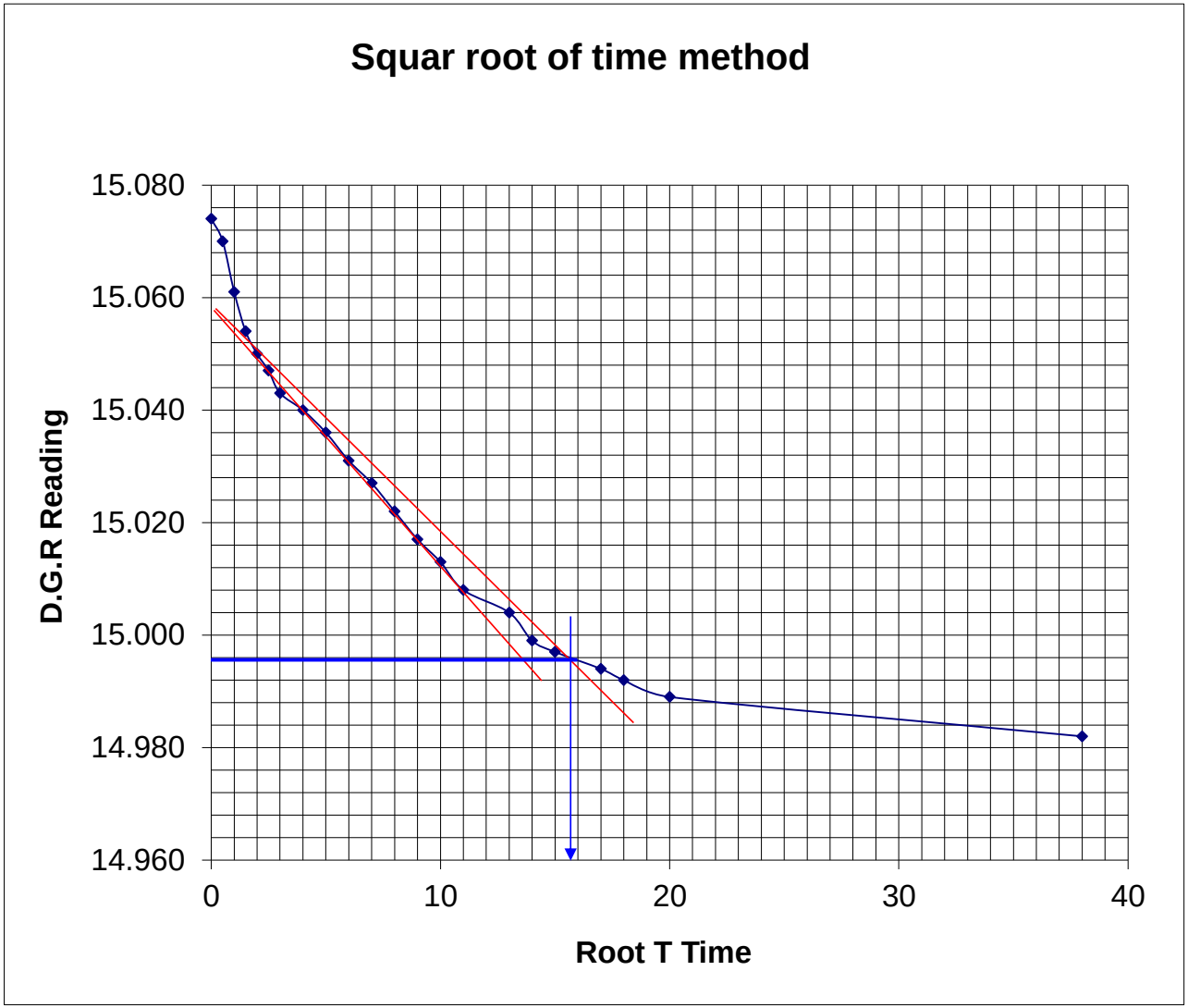
ROOT t	D.G.R
0	15.142
0.5	15.139
1	15.136
1.5	15.134
2	15.132
2.5	15.128
3	15.126
4	15.123
5	15.119
6	15.116
7	15.112
8	15.109
9	15.106
10	15.102
11	15.099
13	15.094
14	15.093
15	15.091
17	15.088
18	15.086
20	15.085
38	15.074



t_{90} = **272 min** C_v = **5.2E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **0.25**

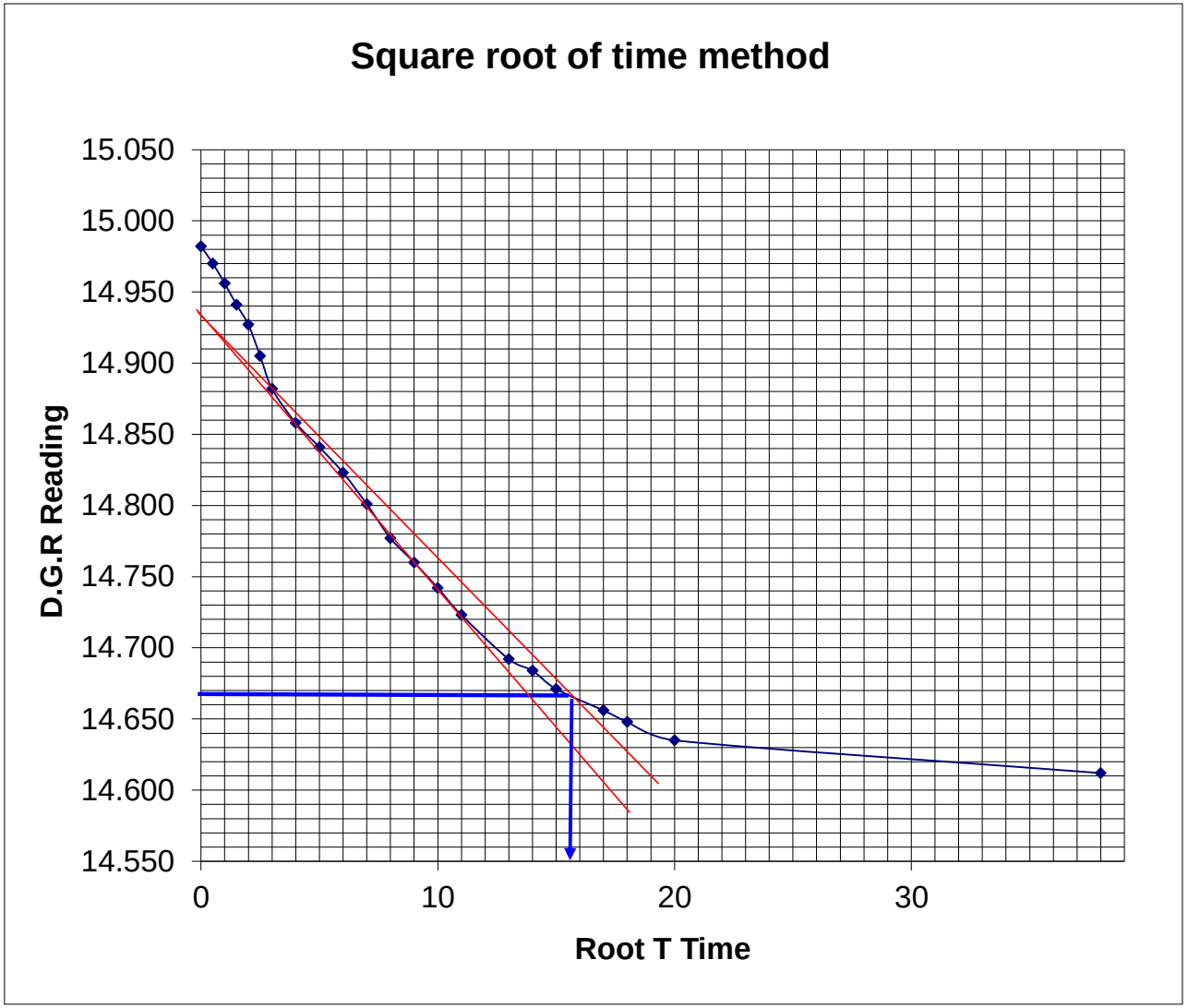
ROOT t	D.G.R
0	15.074
0.5	15.070
1	15.061
1.5	15.054
2	15.050
2.5	15.047
3	15.043
4	15.040
5	15.036
6	15.031
7	15.027
8	15.022
9	15.017
10	15.013
11	15.008
13	15.004
14	14.999
15	14.997
17	14.994
18	14.992
20	14.989
38	14.982



t_{90} = **250 min** C_v = **5.6E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **1.00**

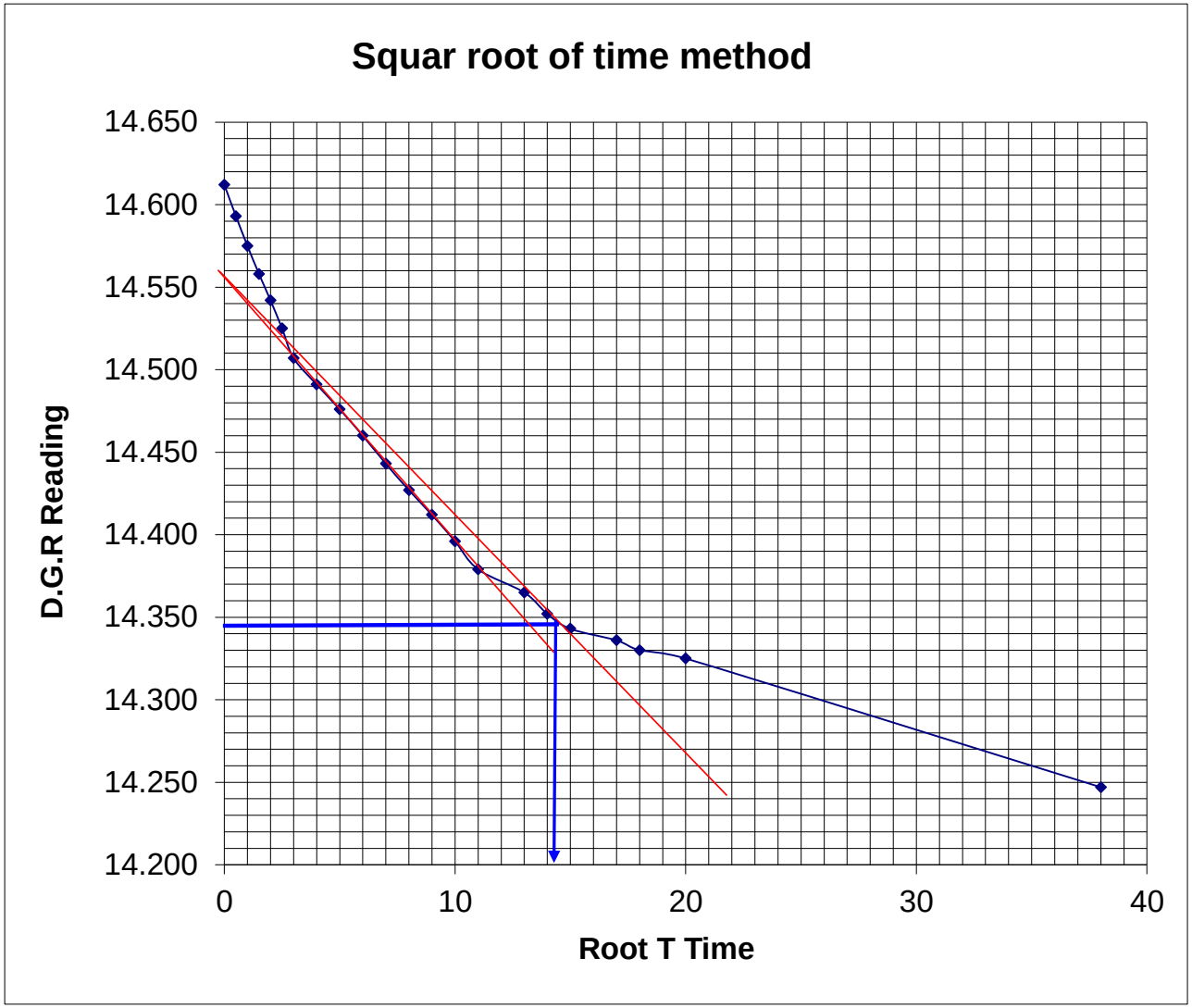
ROOT t	D.G.R
0	14.982
0.5	14.970
1	14.956
1.5	14.941
2	14.927
2.5	14.905
3	14.882
4	14.858
5	14.841
6	14.823
7	14.801
8	14.777
9	14.760
10	14.742
11	14.723
13	14.692
14	14.684
15	14.671
17	14.656
18	14.648
20	14.635
38	14.612



t_{90} = **243 min** C_v = **5.6E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **2.00**

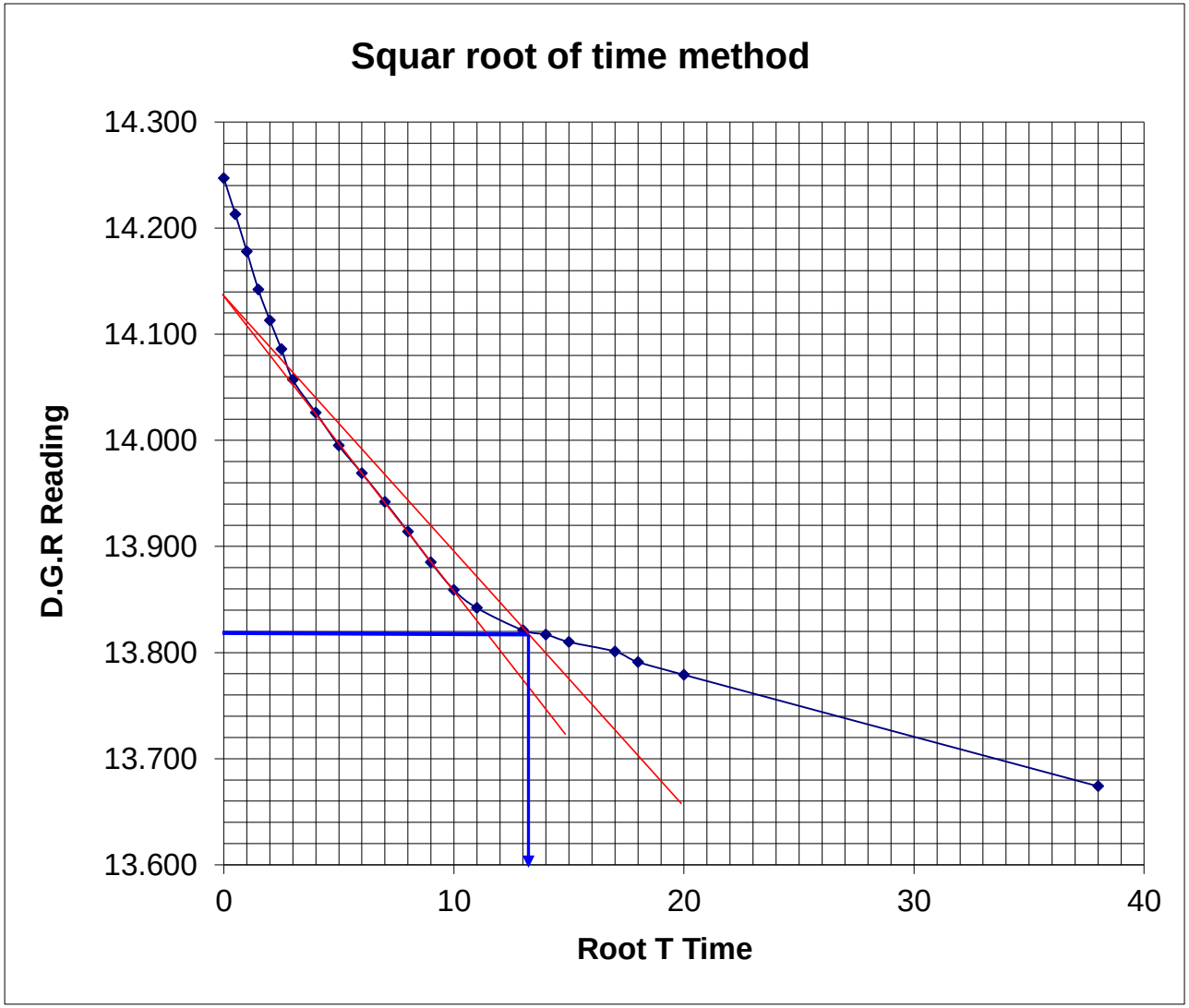
ROOT t	D.G.R
0	14.612
0.5	14.593
1	14.575
1.5	14.558
2	14.542
2.5	14.525
3	14.507
4	14.491
5	14.476
6	14.460
7	14.443
8	14.427
9	14.412
10	14.396
11	14.379
13	14.365
14	14.352
15	14.343
17	14.336
18	14.330
20	14.325
38	14.247



t_{90} = 202 min **C_v = 6.5E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **4.00**

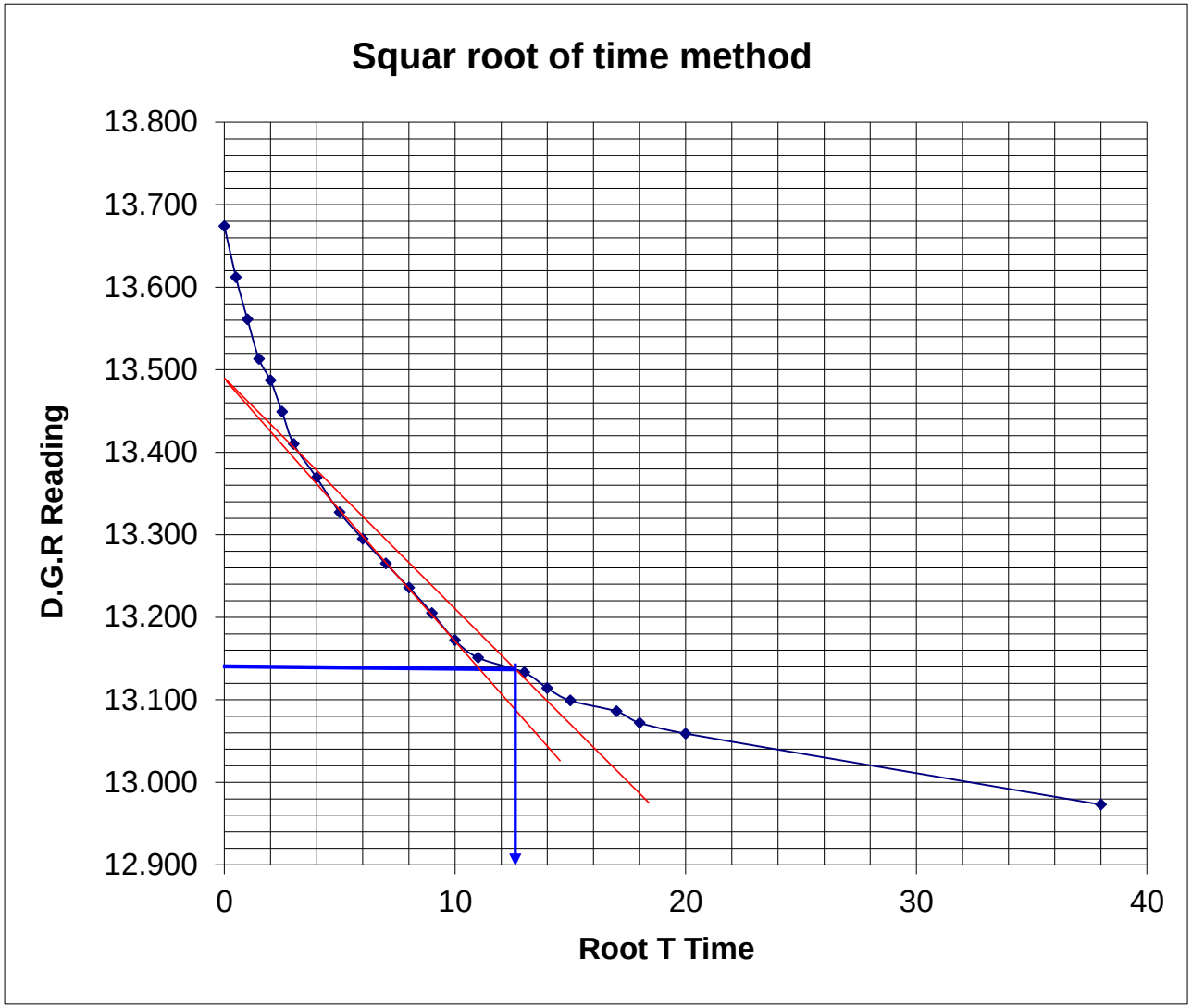
ROOT t	D.G.R
0	14.247
0.5	14.213
1	14.178
1.5	14.142
2	14.113
2.5	14.086
3	14.057
4	14.026
5	13.995
6	13.969
7	13.942
8	13.914
9	13.885
10	13.859
11	13.842
13	13.821
14	13.817
15	13.810
17	13.801
18	13.791
20	13.779
38	13.674



t_{90} = 174 min **C_v = 7.2E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **8.00**

ROOT t	D.G.R
0	13.674
0.5	13.612
1	13.561
1.5	13.513
2	13.487
2.5	13.449
3	13.410
4	13.369
5	13.327
6	13.295
7	13.265
8	13.236
9	13.205
10	13.172
11	13.151
13	13.133
14	13.114
15	13.099
17	13.086
18	13.072
20	13.059
38	12.973

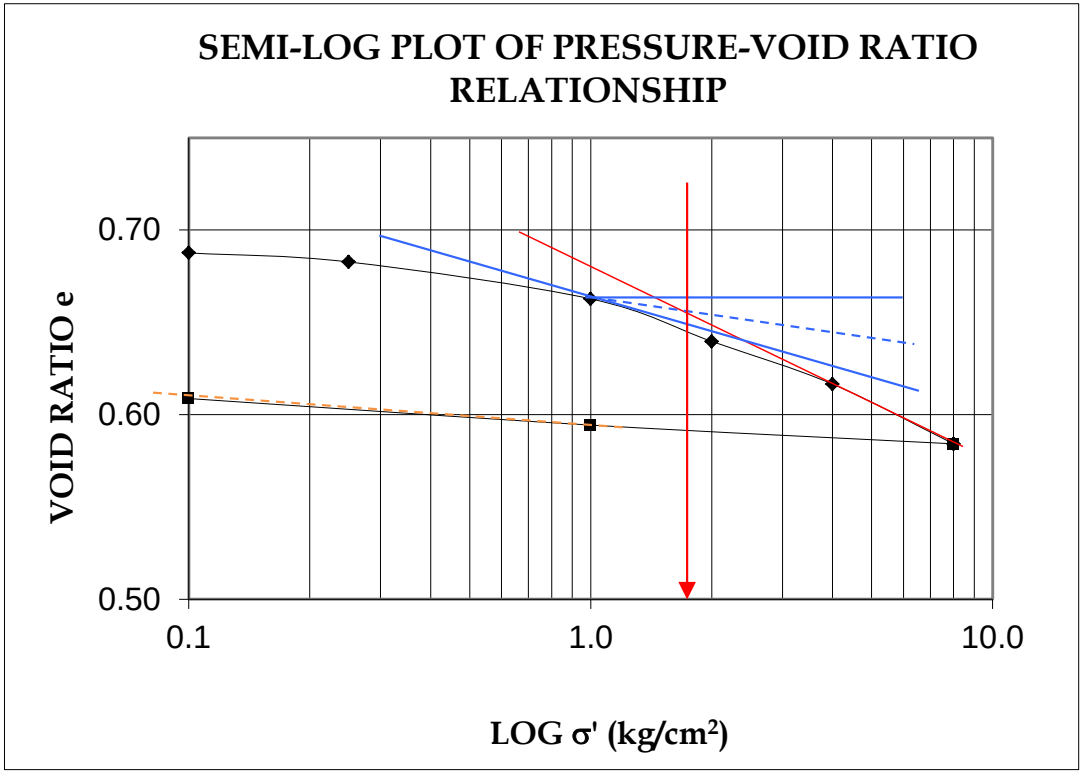


t_{90} = 156 min C_v = 7.5E-05 cm^2/sec

Consolidation Test (IS:2720-Part-15)

Location : BH-02

Depth : 2.5 mt



Cr = 0.014

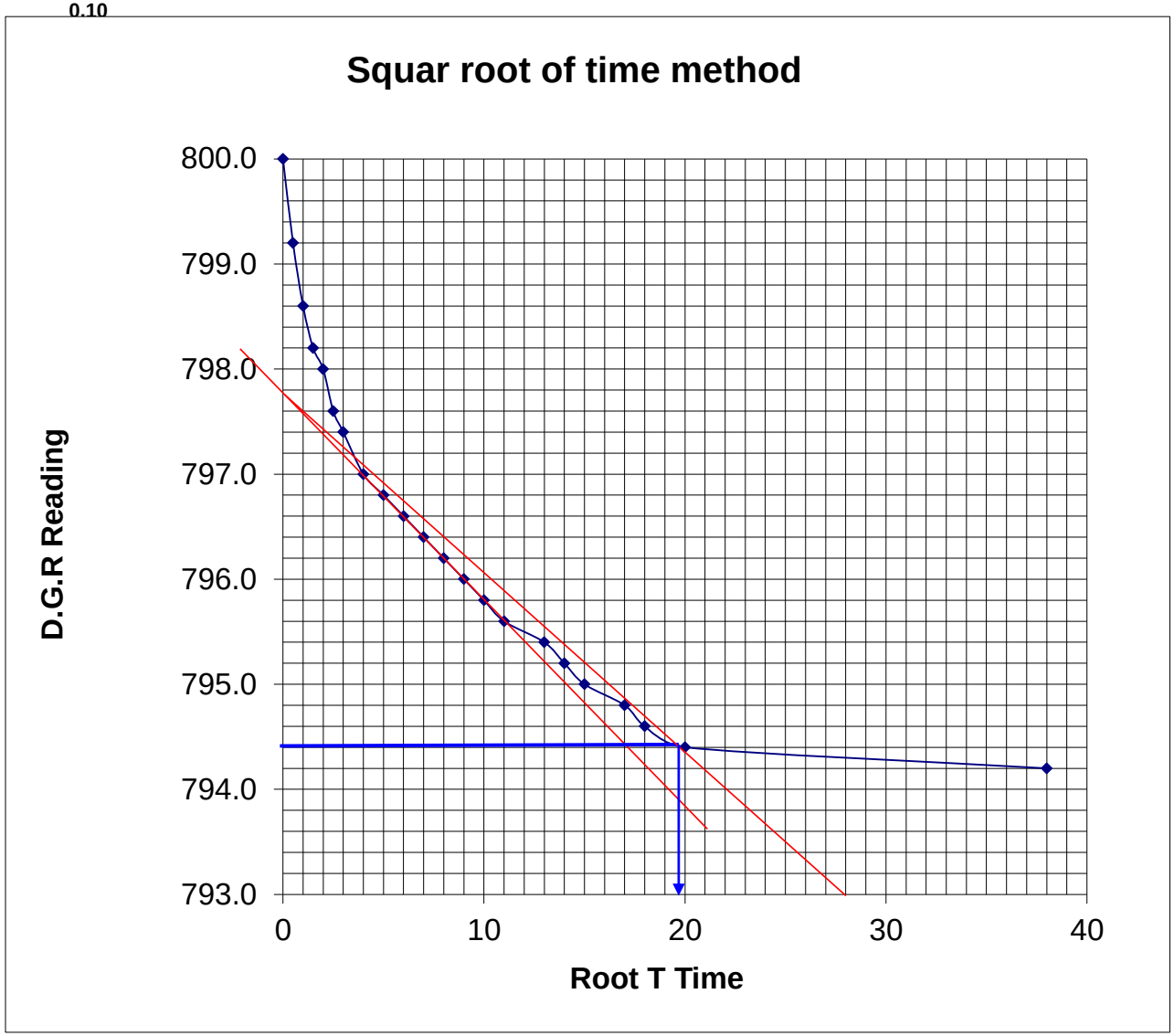
Cc = 0.11

Pc = 1.8 kg/cm2

m_v = 0.014 cm2/kg

PRESSURE INTENSITY (kg/cm2) = **0.10**

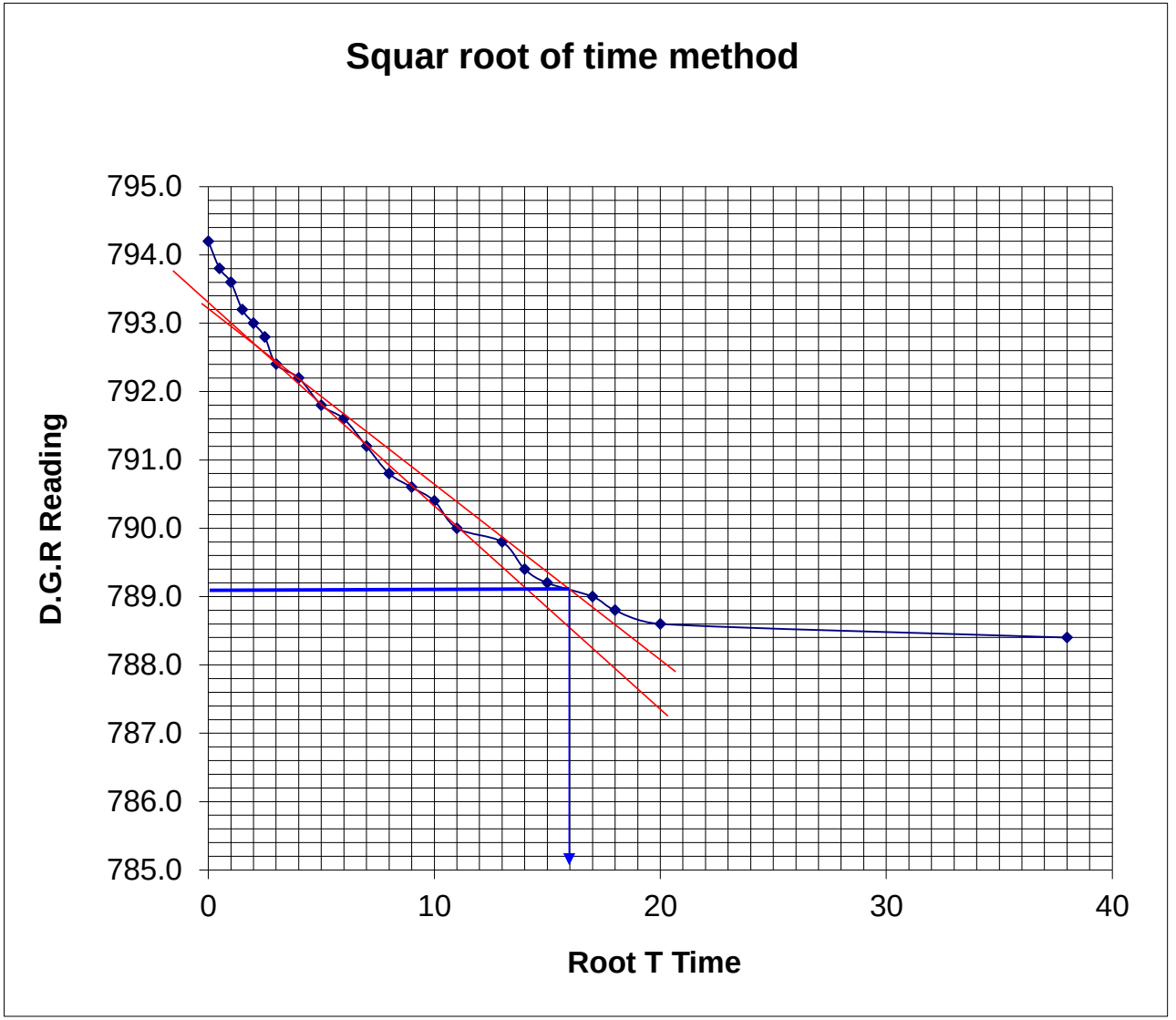
ROOT t	D.G.R
0	800.0
0.5	799.2
1	798.6
1.5	798.2
2	798.0
2.5	797.6
3	797.4
4	797.0
5	796.8
6	796.6
7	796.4
8	796.2
9	796.0
10	795.8
11	795.6
13	795.4
14	795.2
15	795.0
17	794.8
18	794.6
20	794.4
38	794.2



12.65

PRESSURE INTENSITY (kg/cm2) = **0.25**

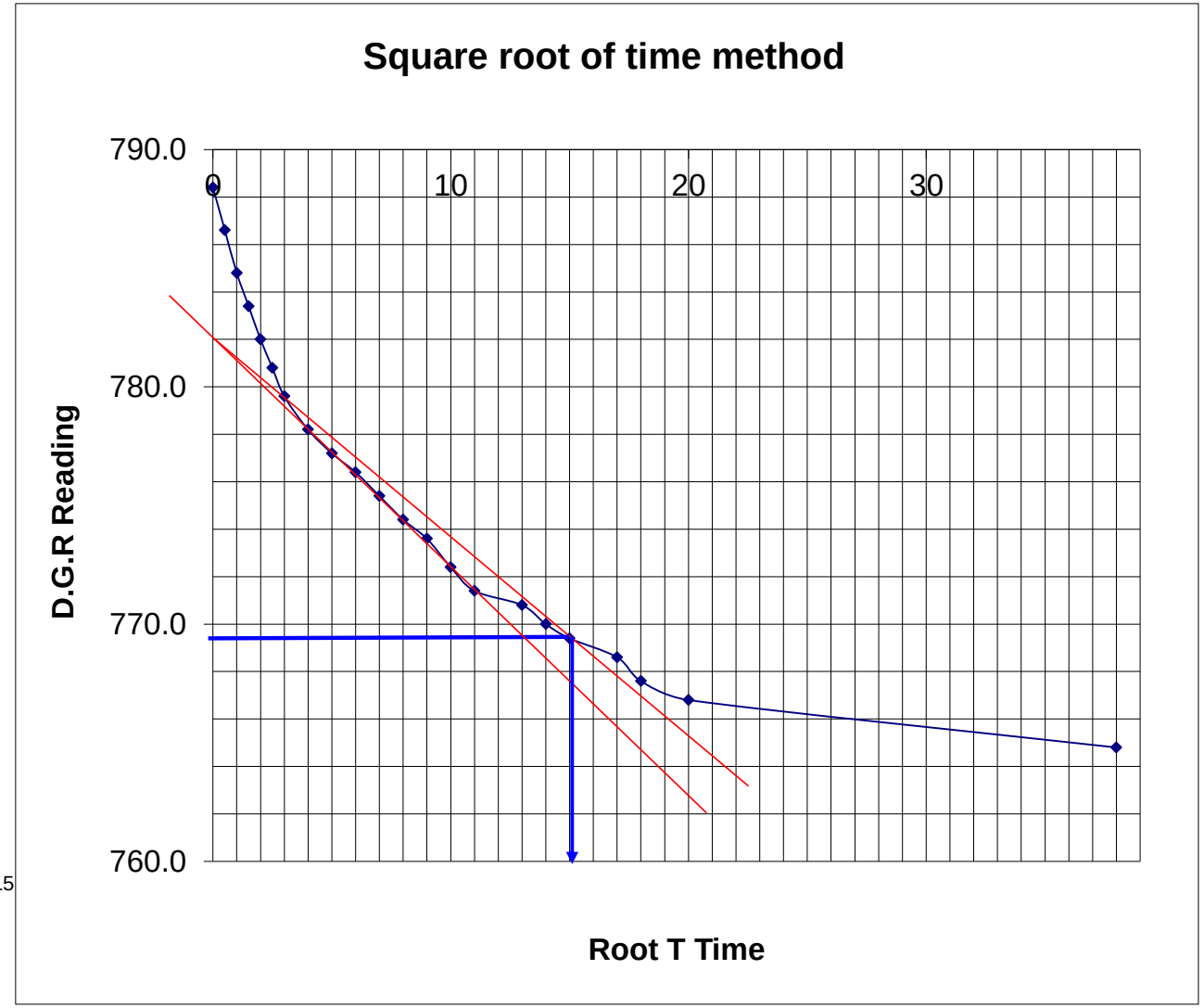
ROOT t	D.G.R
0	794.2
0.5	793.8
1	793.6
1.5	793.2
2	793.0
2.5	792.8
3	792.4
4	792.2
5	791.8
6	791.6
7	791.2
8	790.8
9	790.6
10	790.4
11	790.0
13	789.8
14	789.4
15	789.2
17	789.0
18	788.8
20	788.6
38	788.4



12.65

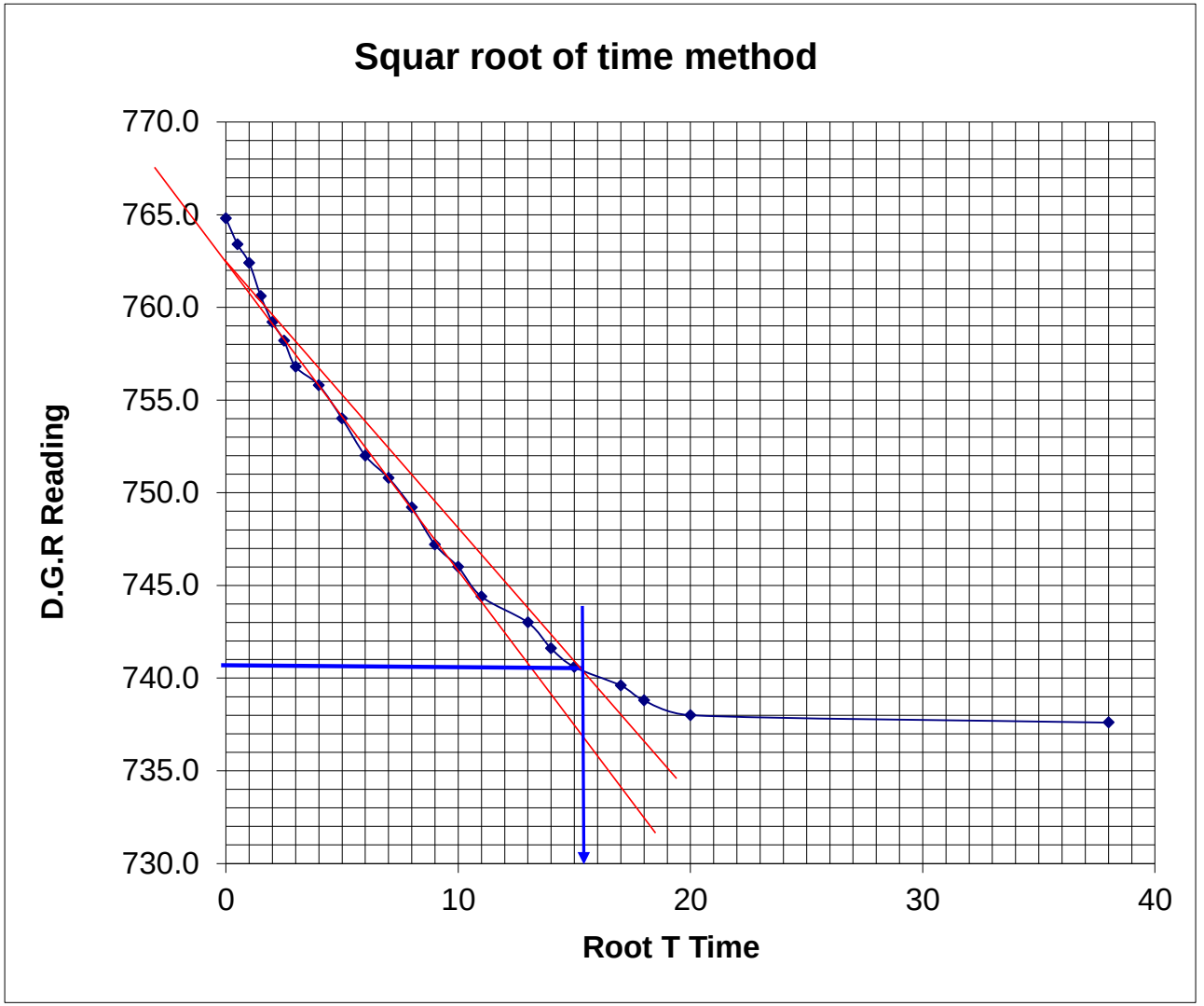
PRESSURE INTENSITY (kg/cm2) = **1.00**

ROOT t	D.G.R
0	788.4
0.5	786.6
1	784.8
1.5	783.4
2	782.0
2.5	780.8
3	779.6
4	778.2
5	777.2
6	776.4
7	775.4
8	774.4
9	773.6
10	772.4
11	771.4
13	770.8
14	770.0
15	769.4
17	768.6
18	767.6
20	766.8
38	764.8



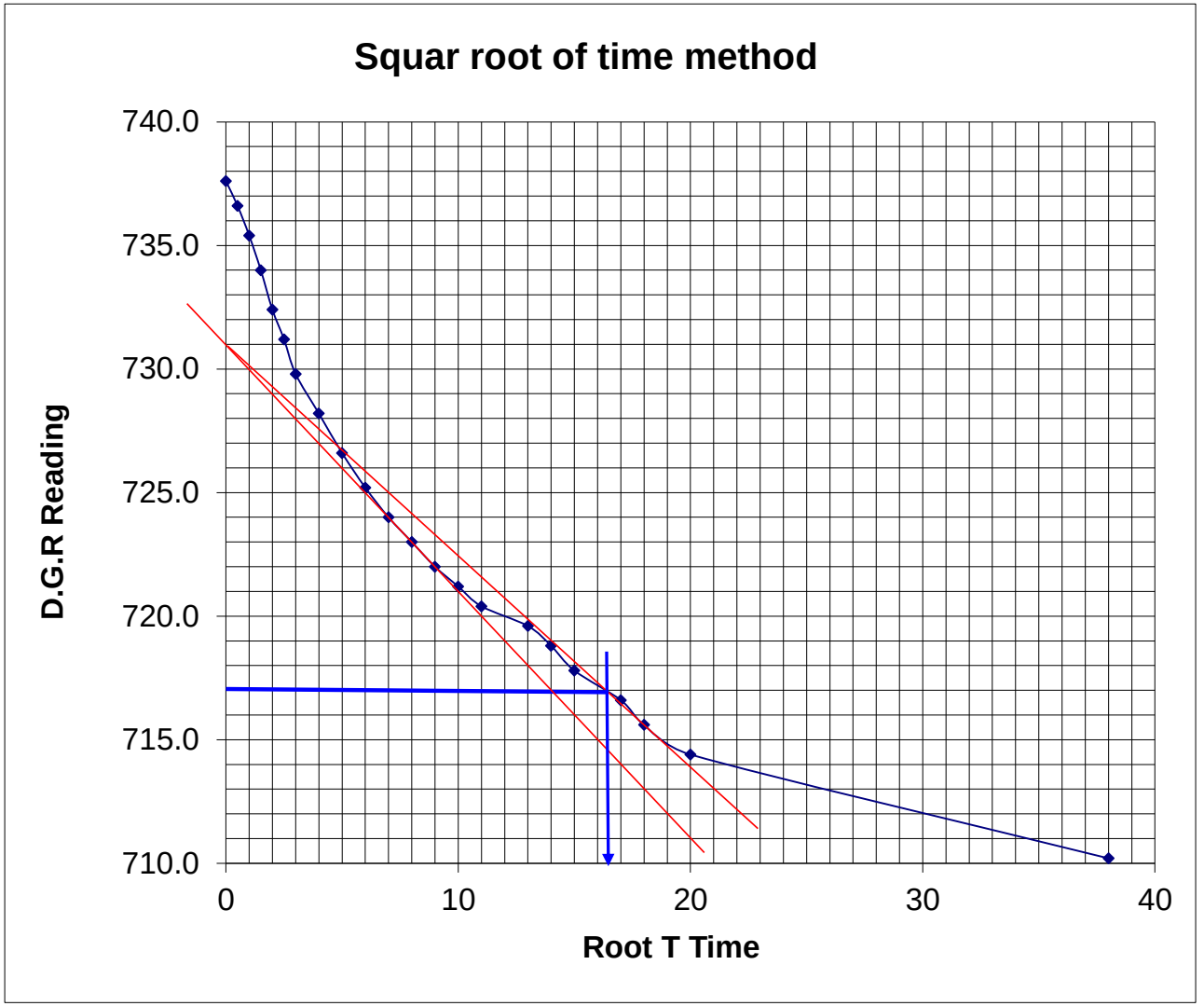
PRESSURE INTENSITY (kg/cm2) = **2.00**

ROOT t	D.G.R
0	764.8
0.5	763.4
1	762.4
1.5	760.6
2	759.2
2.5	758.2
3	756.8
4	755.8
5	754.0
6	752.0
7	750.8
8	749.2
9	747.2
10	746.0
11	744.4
13	743.0
14	741.6
15	740.6
17	739.6
18	738.8
20	738.0
38	737.6



PRESSURE INTENSITY (kg/cm2) = **4.00**

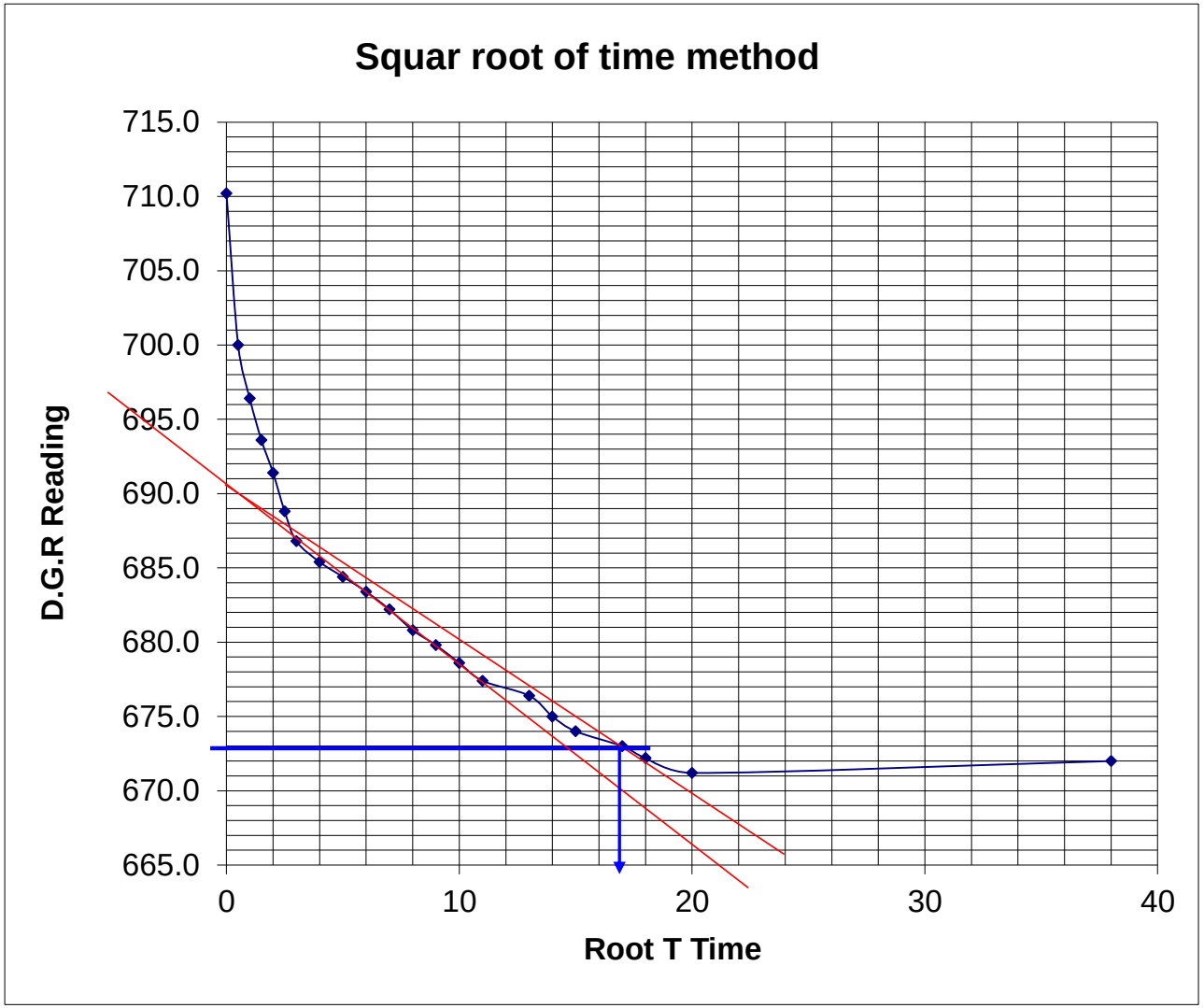
ROOT t	D.G.R
0	737.6
0.5	736.6
1	735.4
1.5	734.0
2	732.4
2.5	731.2
3	729.8
4	728.2
5	726.6
6	725.2
7	724.0
8	723.0
9	722.0
10	721.2
11	720.4
13	719.6
14	718.8
15	717.8
17	716.6
18	715.6
20	714.4
38	710.2



9.43

PRESSURE INTENSITY (kg/cm2) = **8.00**

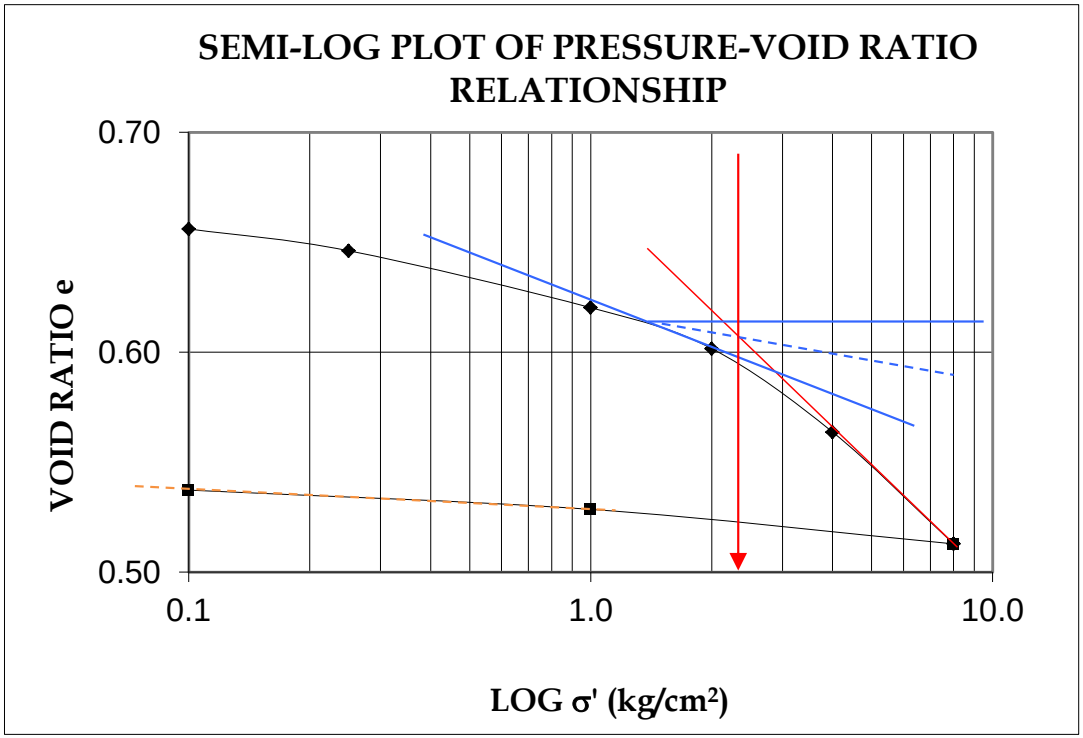
ROOT t	D.G.R
0	710.2
0.5	700.0
1	696.4
1.5	693.6
2	691.4
2.5	688.8
3	686.8
4	685.4
5	684.4
6	683.4
7	682.2
8	680.8
9	679.8
10	678.6
11	677.4
13	676.4
14	675.0
15	674.0
17	673.0
18	672.2
20	671.2
38	672.0



Consolidation Test (IS:2720-Part-15)

Location : BH-2

Depth : 8.5m



Cr = 0.009

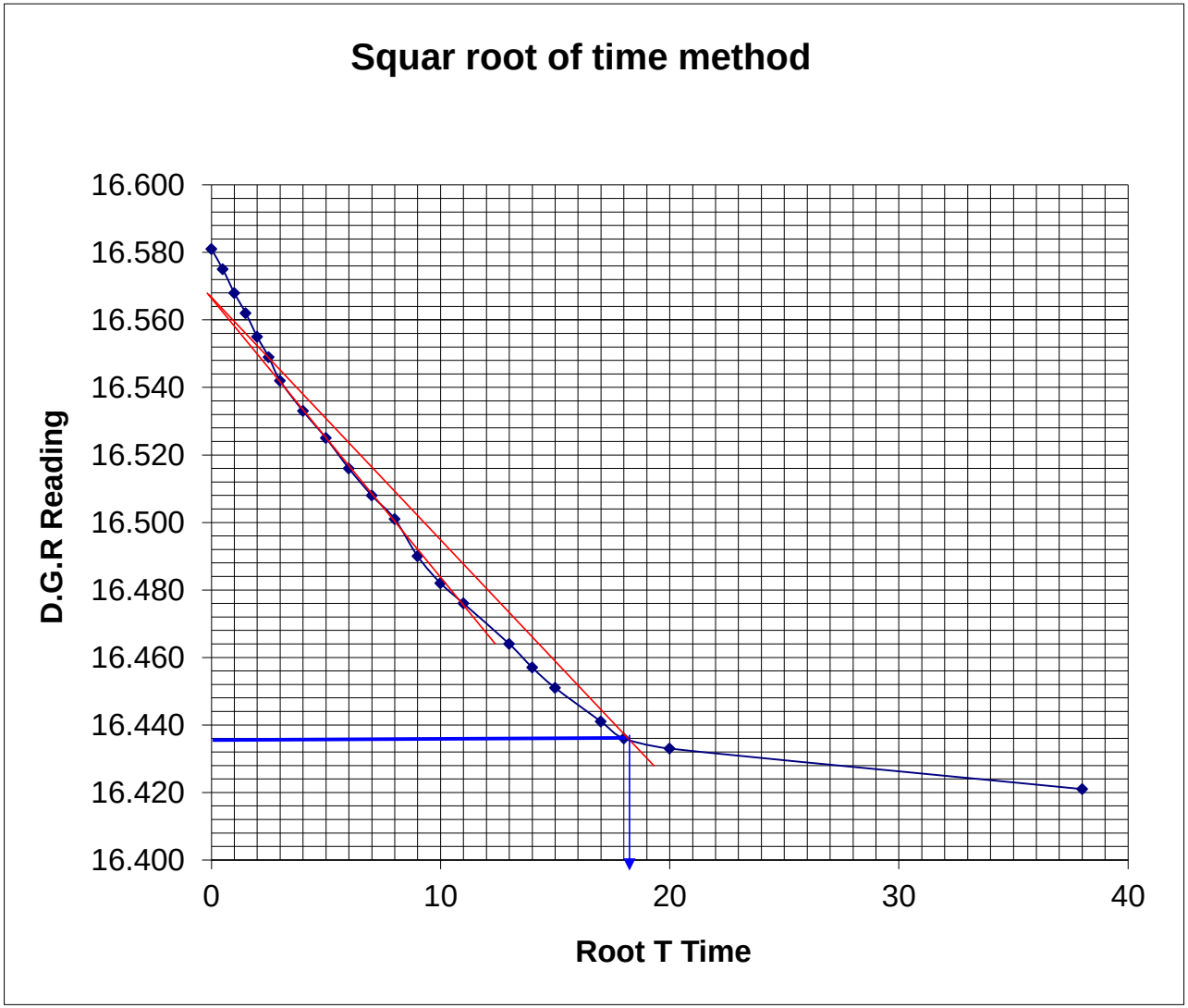
Cc = 0.17

Pc = 2.30 kg/cm2

m_v = 0.011 cm2/kg

PRESSURE INTENSITY (kg/cm2) = **0.10**

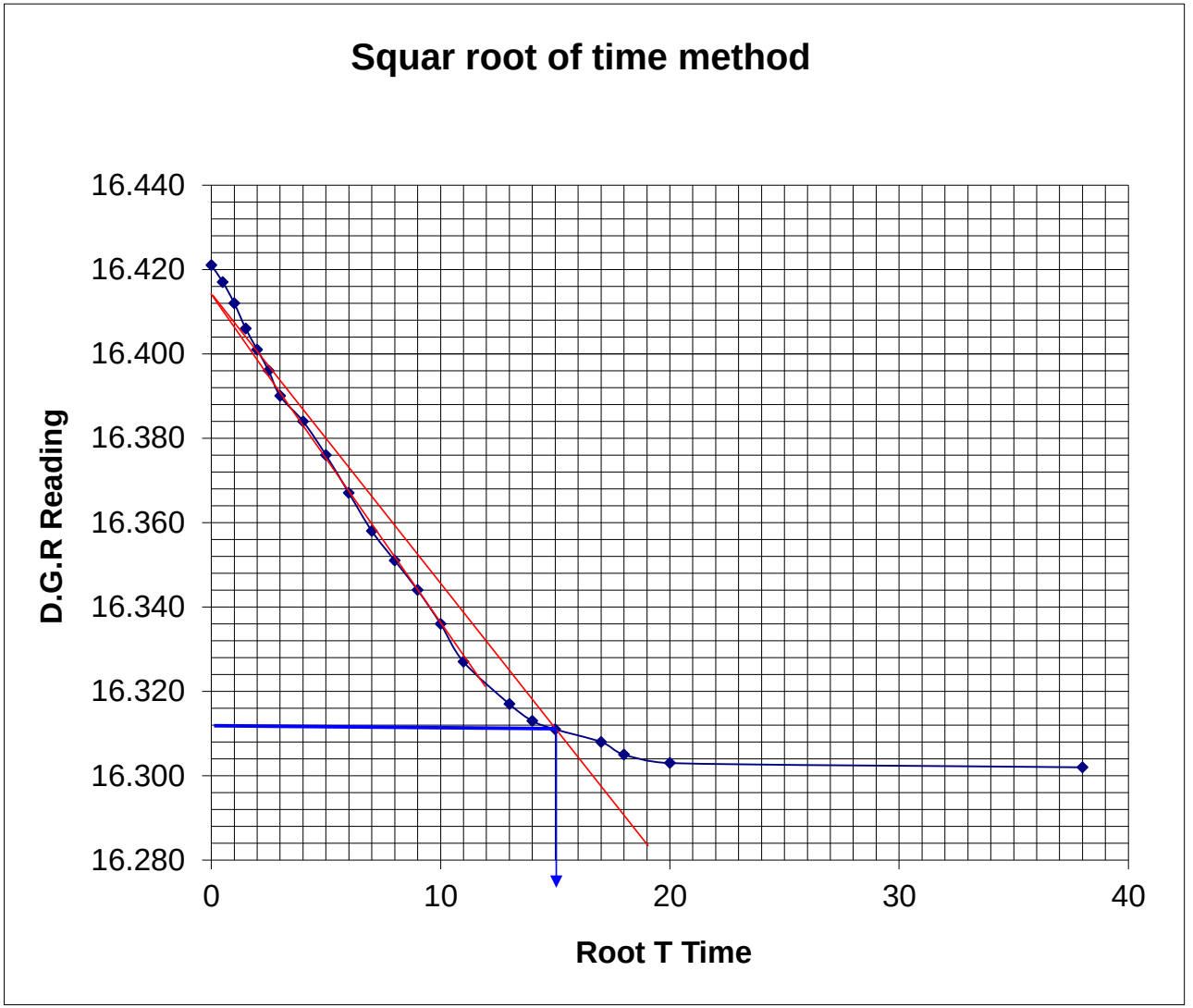
ROOT t	D.G.R
0	16.581
0.5	16.575
1	16.568
1.5	16.562
2	16.555
2.5	16.549
3	16.542
4	16.533
5	16.525
6	16.516
7	16.508
8	16.501
9	16.490
10	16.482
11	16.476
13	16.464
14	16.457
15	16.451
17	16.441
18	16.436
20	16.433
38	16.421



t_{90} = 331 min **C_v = 4.23E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **0.25**

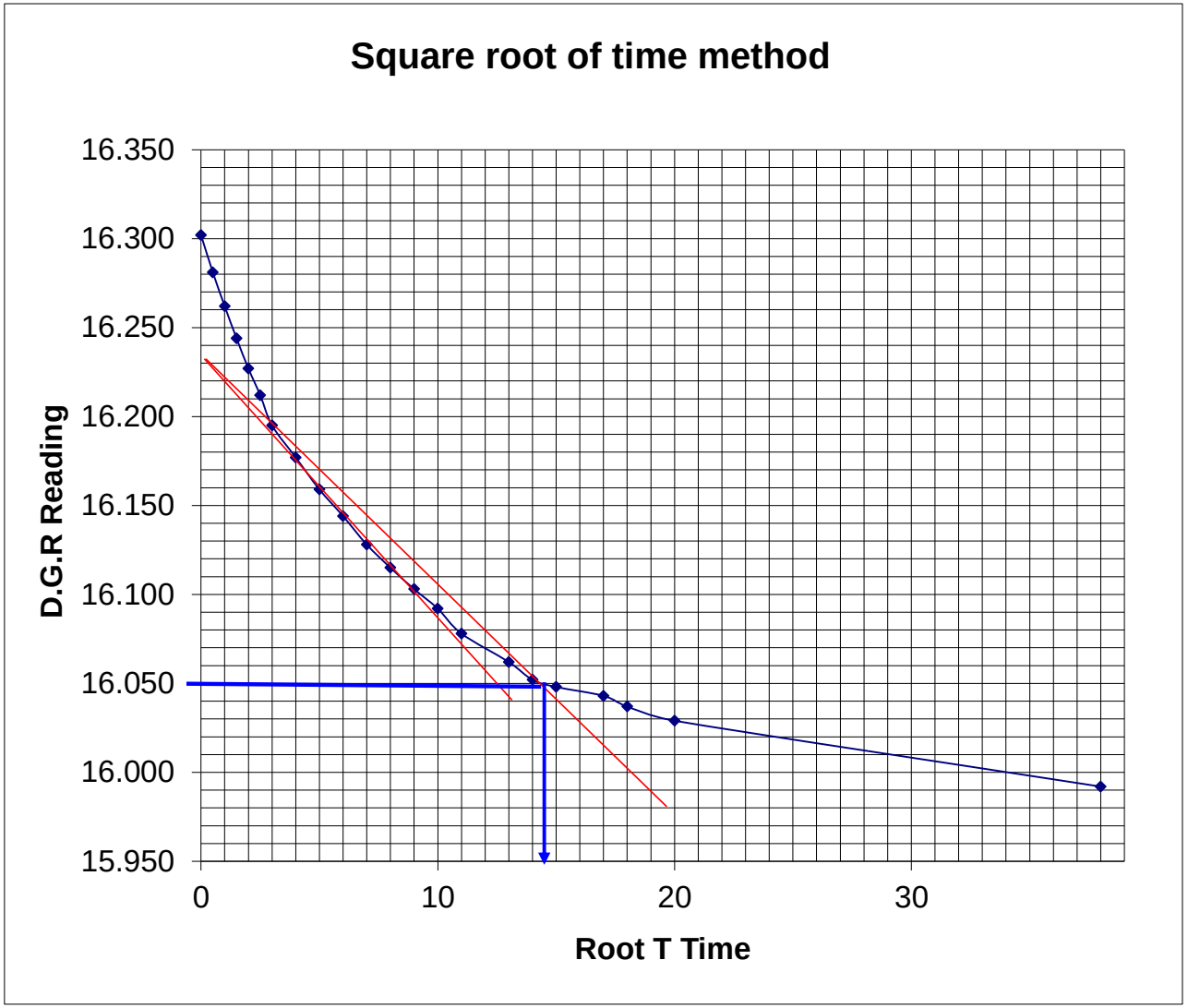
ROOT t	D.G.R
0	16.421
0.5	16.417
1	16.412
1.5	16.406
2	16.401
2.5	16.396
3	16.390
4	16.384
5	16.376
6	16.367
7	16.358
8	16.351
9	16.344
10	16.336
11	16.327
13	16.317
14	16.313
15	16.311
17	16.308
18	16.305
20	16.303
38	16.302



t_{90} = **225 min** C_v = **6.14E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **1.00**

ROOT t	D.G.R
0	16.302
0.5	16.281
1	16.262
1.5	16.244
2	16.227
2.5	16.212
3	16.195
4	16.177
5	16.159
6	16.144
7	16.128
8	16.115
9	16.103
10	16.092
11	16.078
13	16.062
14	16.052
15	16.048
17	16.043
18	16.037
20	16.029
38	15.992

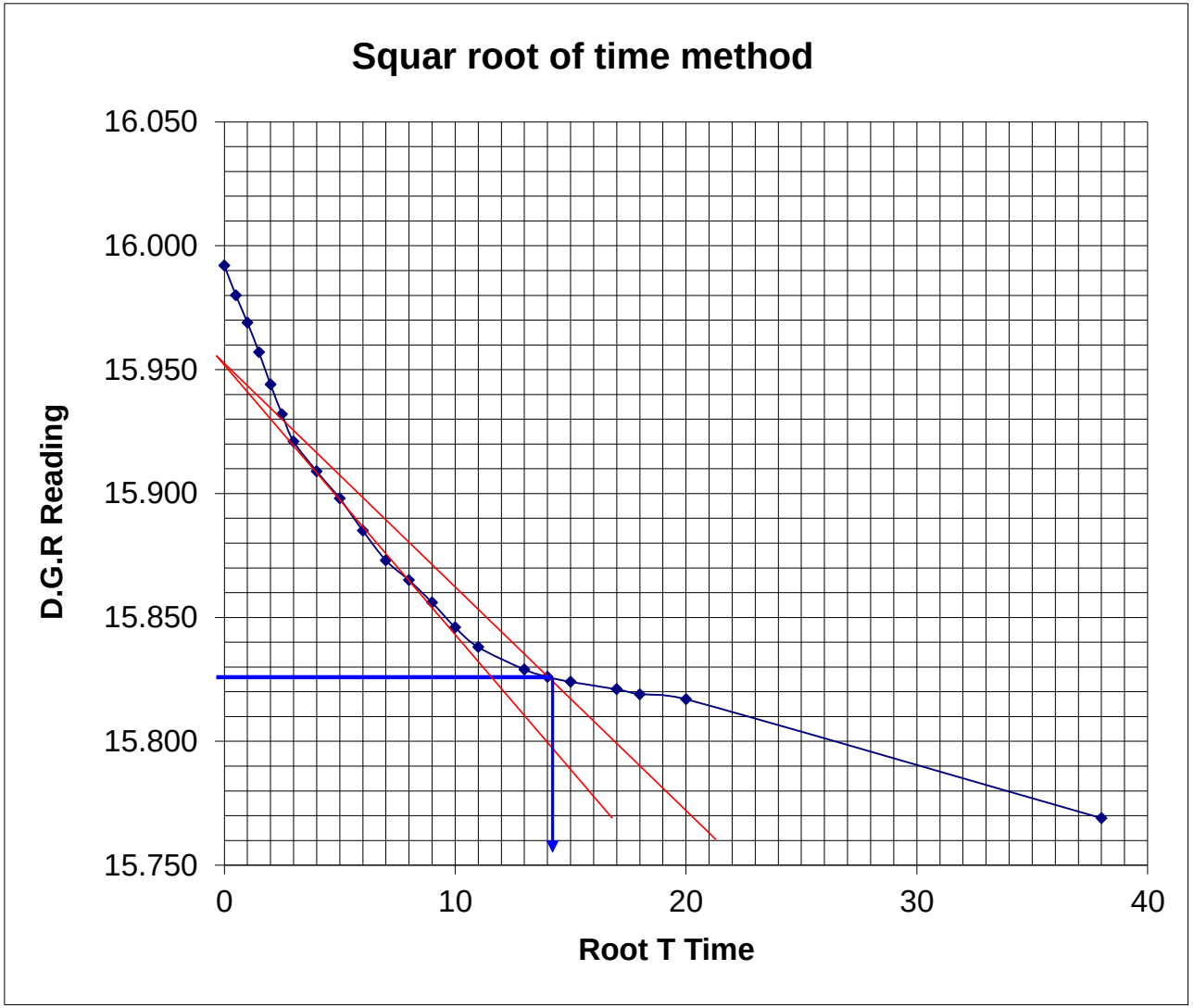


t_{90} = 0 min

C_v = 6.52E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **2.00**

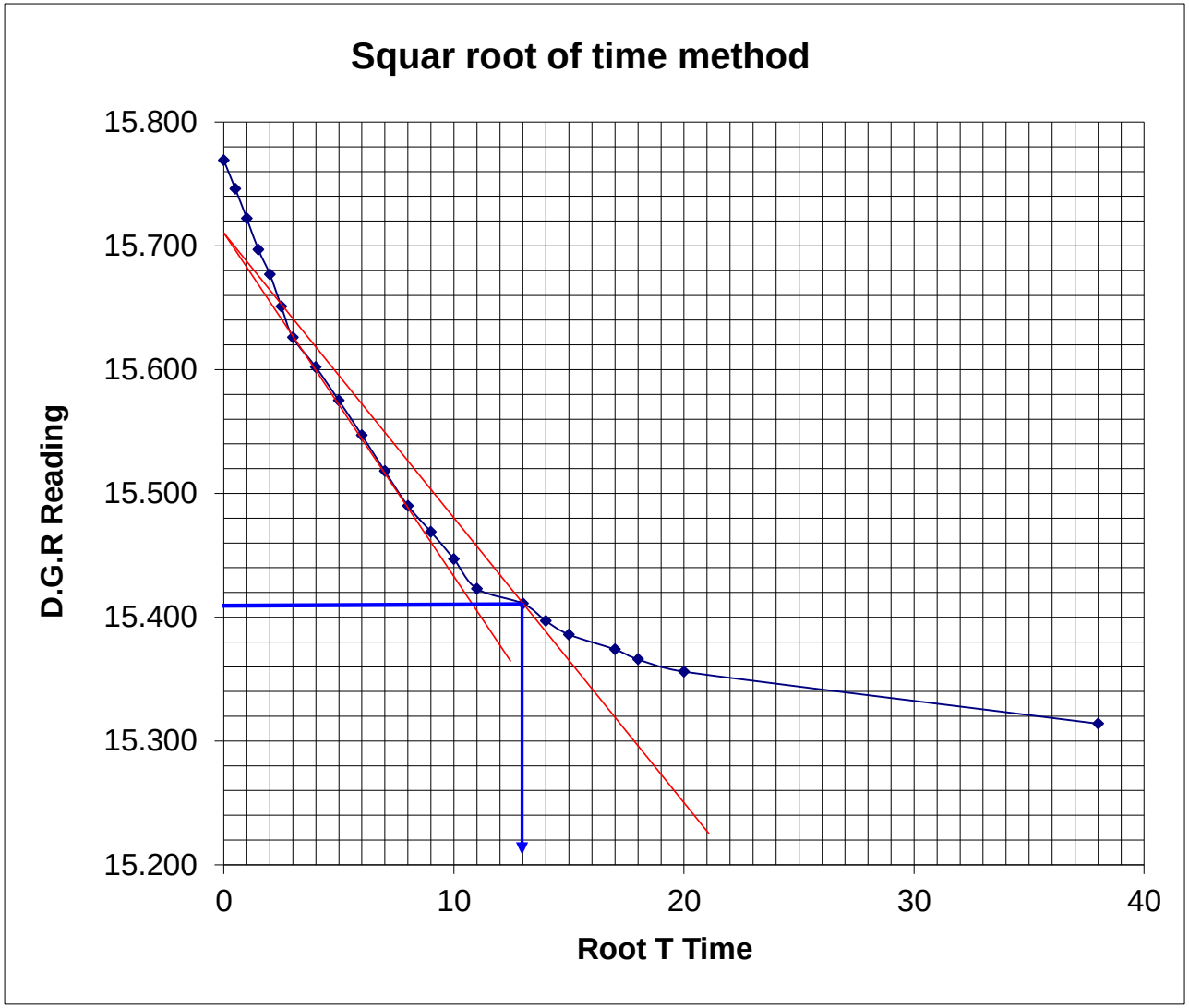
ROOT t	D.G.R
0	15.992
0.5	15.980
1	15.969
1.5	15.957
2	15.944
2.5	15.932
3	15.921
4	15.909
5	15.898
6	15.885
7	15.873
8	15.865
9	15.856
10	15.846
11	15.838
13	15.829
14	15.826
15	15.824
17	15.821
18	15.819
20	15.817
38	15.769



t_{90} = **199 min** C_v = **6.62E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **4.00**

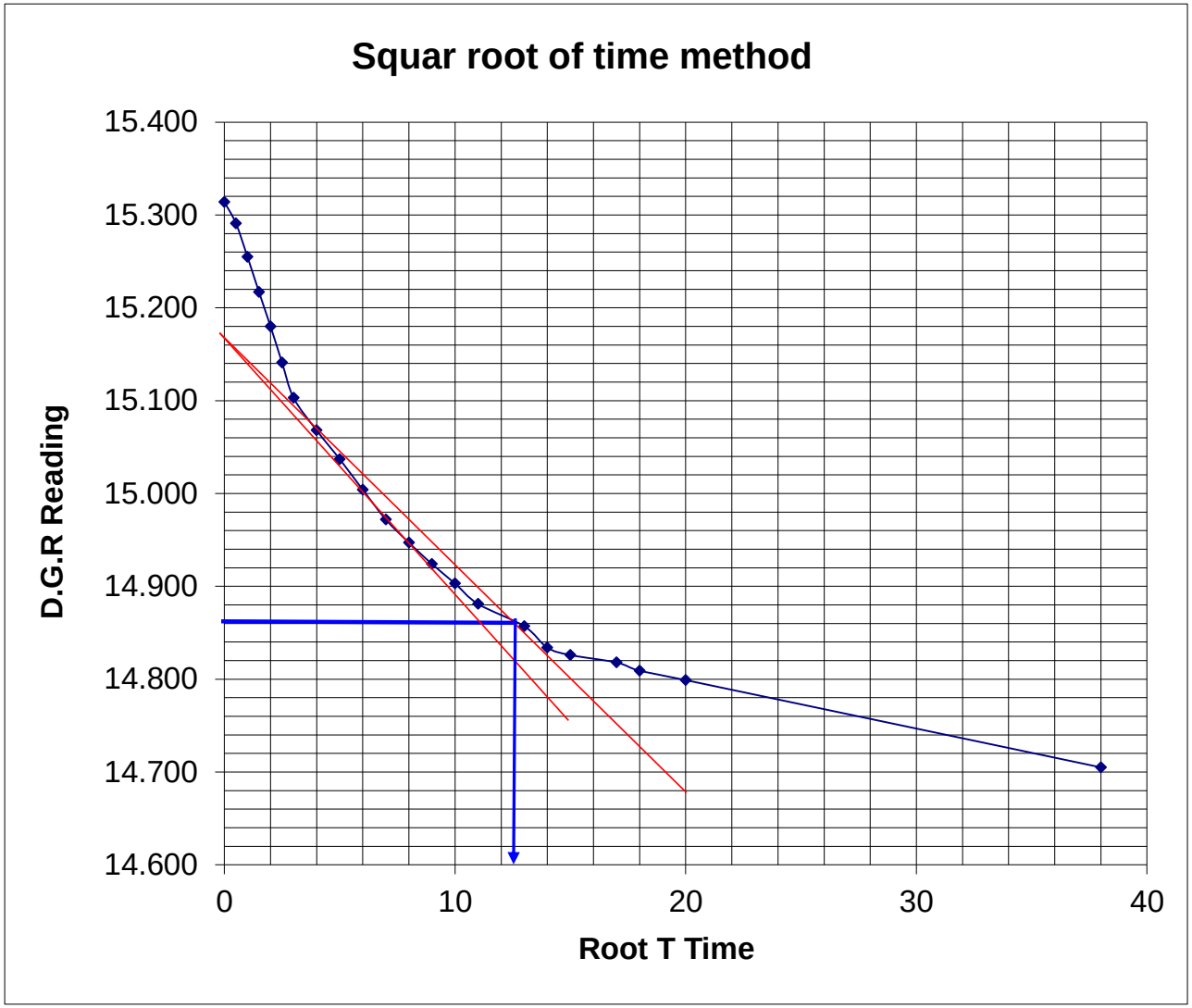
ROOT t	D.G.R
0	15.769
0.5	15.746
1	15.722
1.5	15.697
2	15.677
2.5	15.651
3	15.626
4	15.602
5	15.575
6	15.547
7	15.518
8	15.490
9	15.469
10	15.447
11	15.423
13	15.411
14	15.397
15	15.386
17	15.374
18	15.366
20	15.356
38	15.314



t_{90} = 169 min C_v = 7.52E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **8.00**

ROOT t	D.G.R
0	15.314
0.5	15.291
1	15.255
1.5	15.217
2	15.180
2.5	15.141
3	15.103
4	15.068
5	15.037
6	15.004
7	14.972
8	14.947
9	14.924
10	14.903
11	14.881
13	14.857
14	14.834
15	14.826
17	14.818
18	14.809
20	14.799
38	14.705

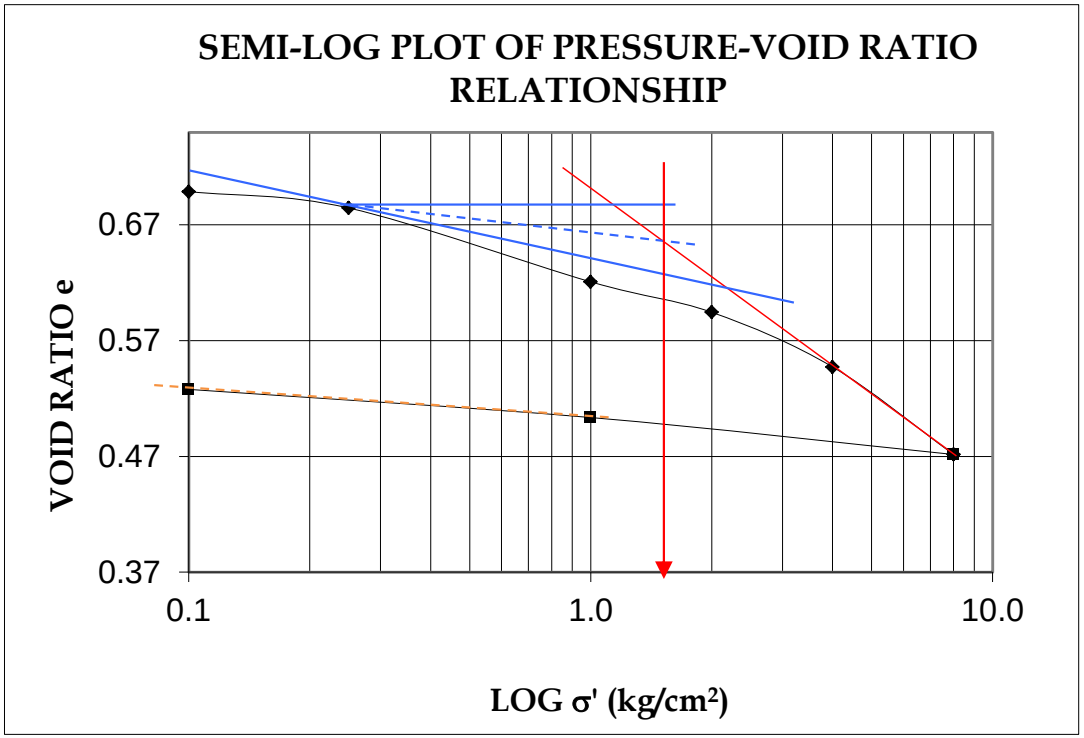


t_{90} = 156 min C_v = 7.68E-05 cm^2/sec

Consolidation Test (IS:2720-Part-15)

Location : BH-3

Depth : 2.5m



Cr = 0.024

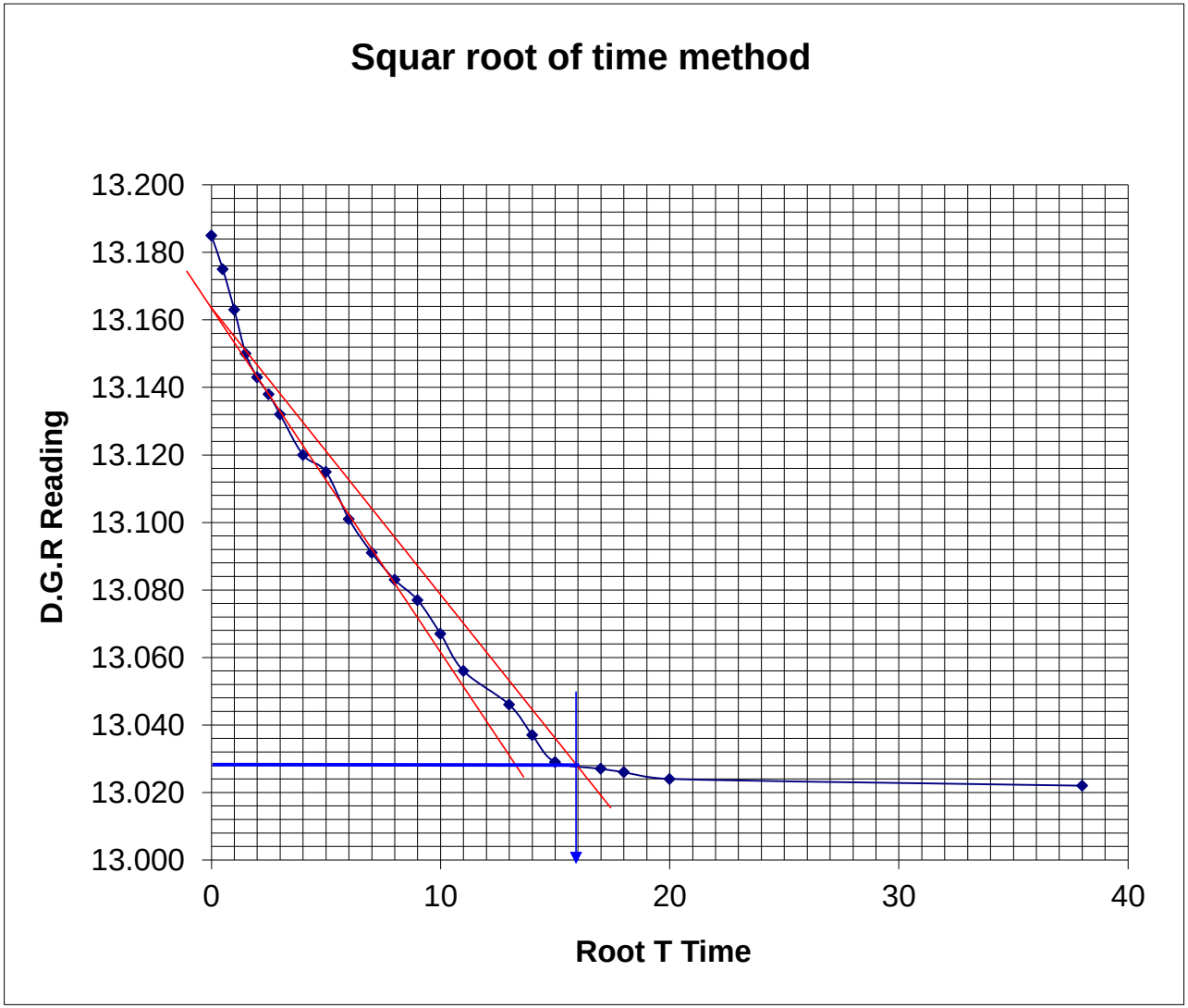
Cc = 0.25

Pc = 1.60 kg/cm2

m_v = 0.016 cm2/kg

PRESSURE INTENSITY (kg/cm2) = **0.10**

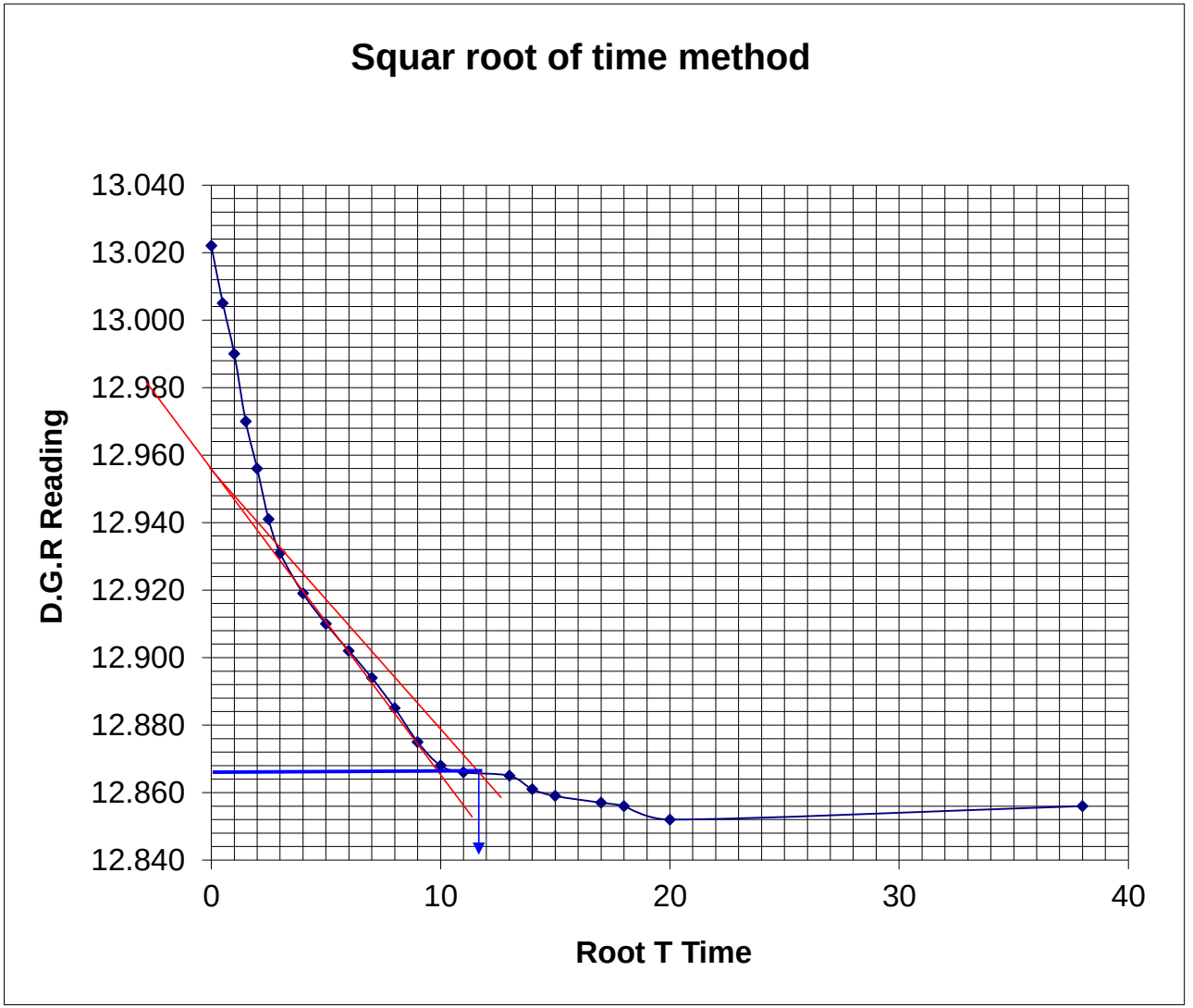
ROOT t	D.G.R
0	13.185
0.5	13.175
1	13.163
1.5	13.150
2	13.143
2.5	13.138
3	13.132
4	13.120
5	13.115
6	13.101
7	13.091
8	13.083
9	13.077
10	13.067
11	13.056
13	13.046
14	13.037
15	13.029
17	13.027
18	13.026
20	13.024
38	13.022



t_{90} = **256 min** C_v = **5.48E-05 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **0.25**

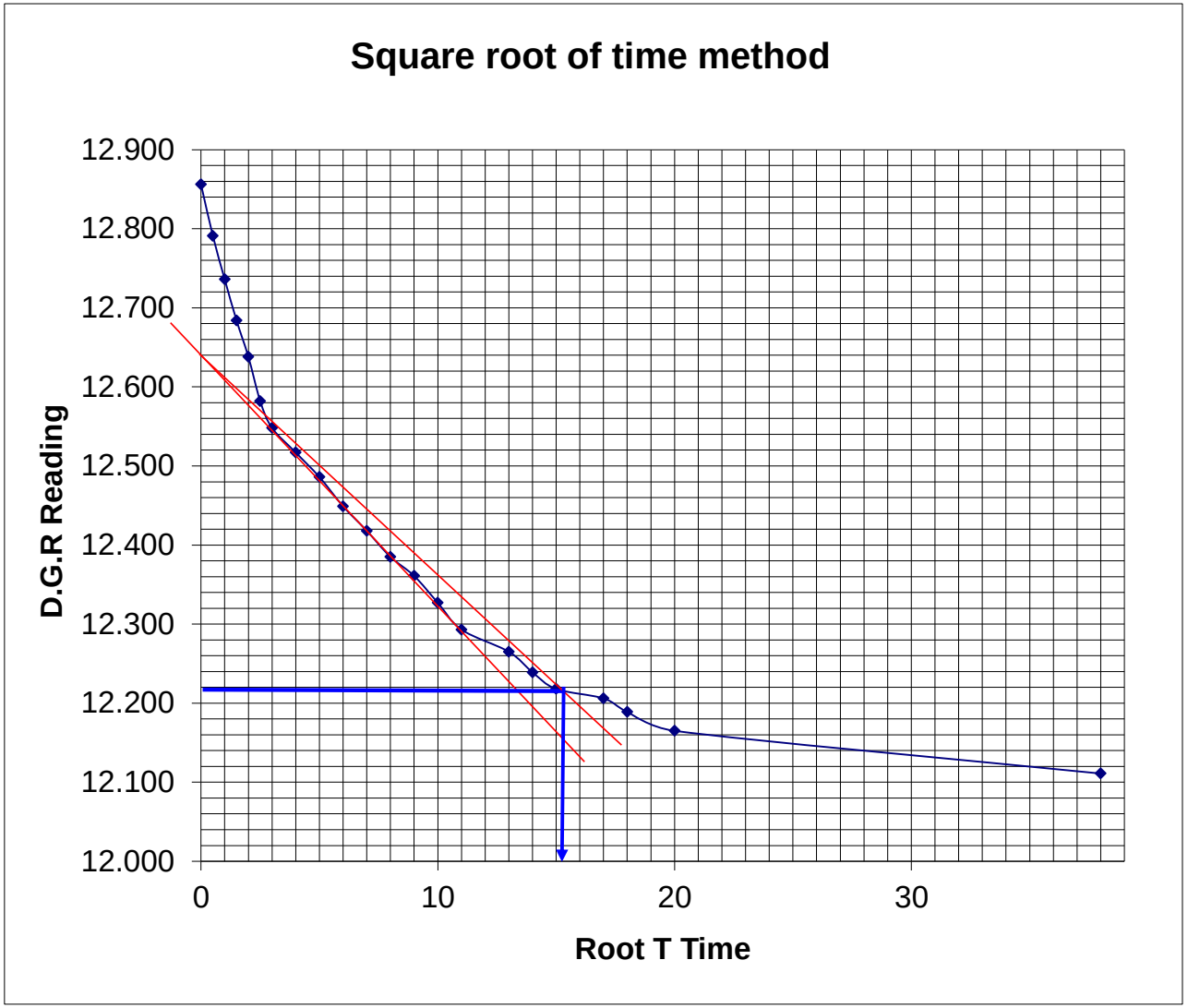
ROOT t	D.G.R
0	13.022
0.5	13.005
1	12.990
1.5	12.970
2	12.956
2.5	12.941
3	12.931
4	12.919
5	12.910
6	12.902
7	12.894
8	12.885
9	12.875
10	12.868
11	12.866
13	12.865
14	12.861
15	12.859
17	12.857
18	12.856
20	12.852
38	12.856



t_{90} = 0 min C_v = 9.90E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **1.00**

ROOT t	D.G.R
0	12.856
0.5	12.791
1	12.736
1.5	12.684
2	12.638
2.5	12.582
3	12.548
4	12.517
5	12.486
6	12.449
7	12.418
8	12.385
9	12.361
10	12.327
11	12.293
13	12.265
14	12.239
15	12.218
17	12.206
18	12.189
20	12.165
38	12.111

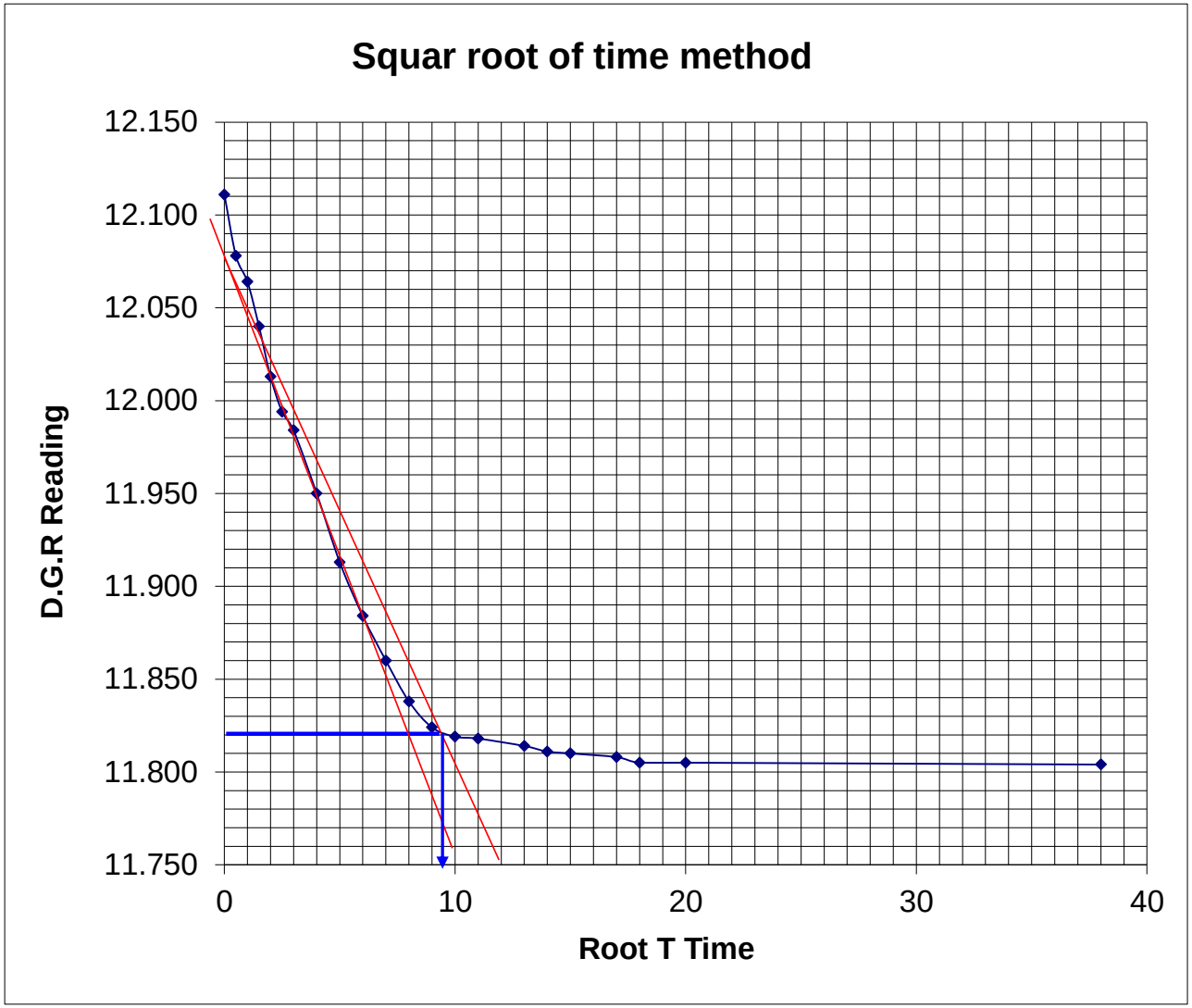


t_{90} = 0 min

C_v = 5.70E-05 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **2.00**

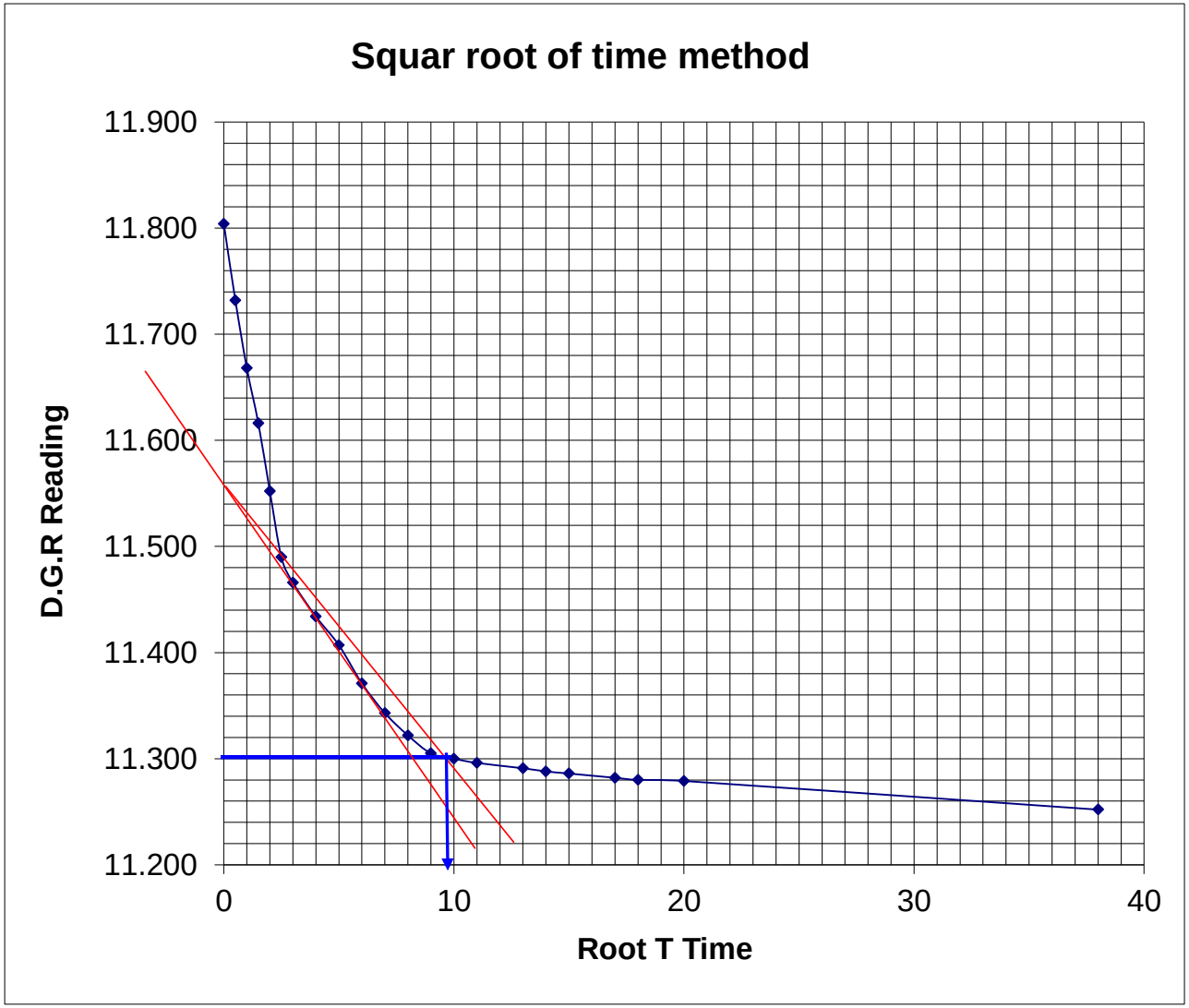
ROOT t	D.G.R
0	12.111
0.5	12.078
1	12.064
1.5	12.040
2	12.013
2.5	11.994
3	11.984
4	11.950
5	11.913
6	11.884
7	11.860
8	11.838
9	11.824
10	11.819
11	11.818
13	11.814
14	11.811
15	11.810
17	11.808
18	11.805
20	11.805
38	11.804



t_{90} = **90 min** C_v = **1.38E-04 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **4.00**

ROOT t	D.G.R
0	11.804
0.5	11.732
1	11.668
1.5	11.616
2	11.552
2.5	11.490
3	11.466
4	11.434
5	11.407
6	11.371
7	11.343
8	11.322
9	11.305
10	11.300
11	11.296
13	11.291
14	11.288
15	11.286
17	11.282
18	11.280
20	11.279
38	11.252

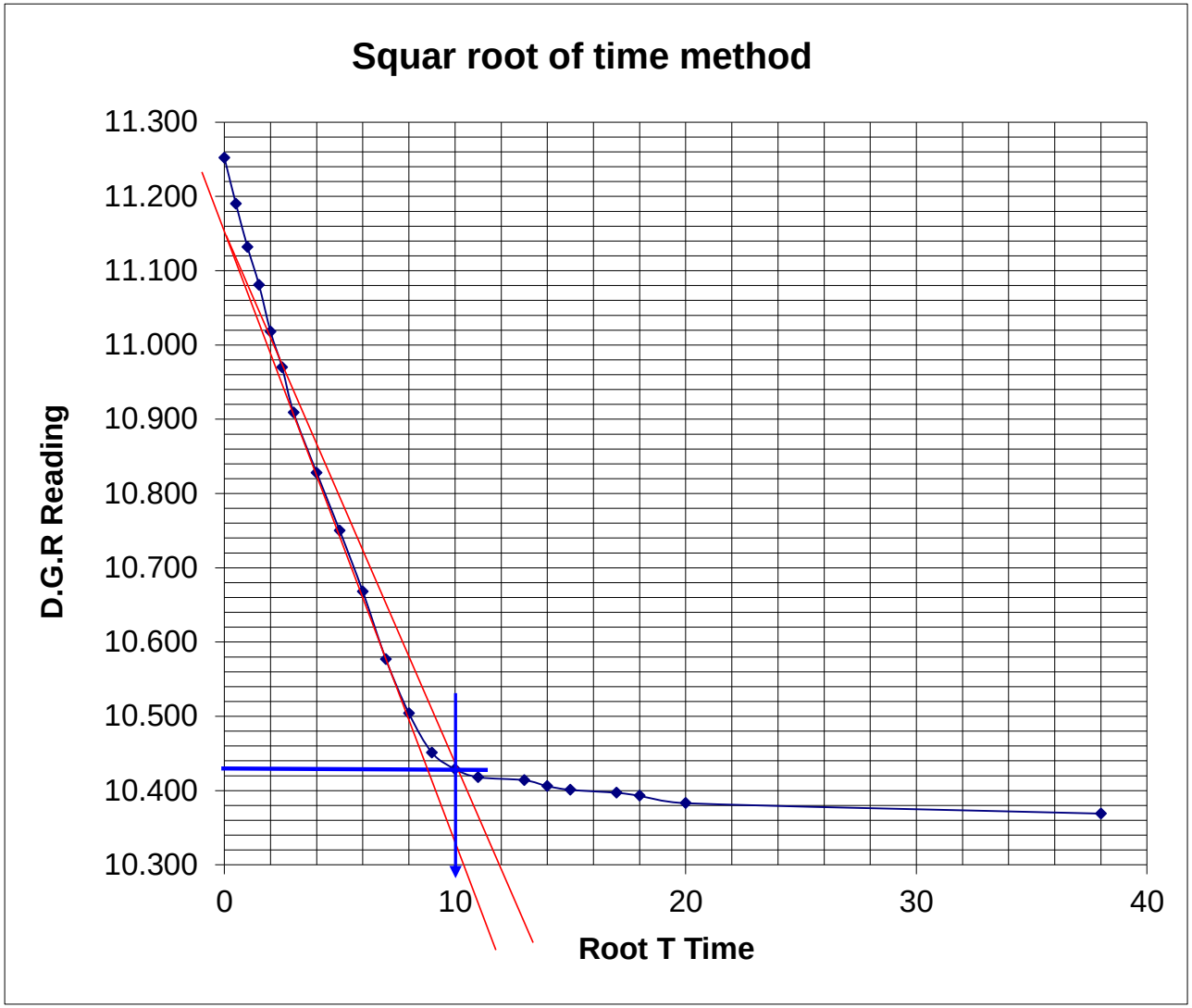


t_{90} = 96 min

C_v = 1.24E-04 cm^2/sec

PRESSURE INTENSITY (kg/cm2) = **8.00**

ROOT t	D.G.R
0	11.252
0.5	11.190
1	11.132
1.5	11.081
2	11.018
2.5	10.970
3	10.909
4	10.828
5	10.750
6	10.668
7	10.577
8	10.504
9	10.451
10	10.429
11	10.418
13	10.414
14	10.406
15	10.401
17	10.397
18	10.393
20	10.383
38	10.369

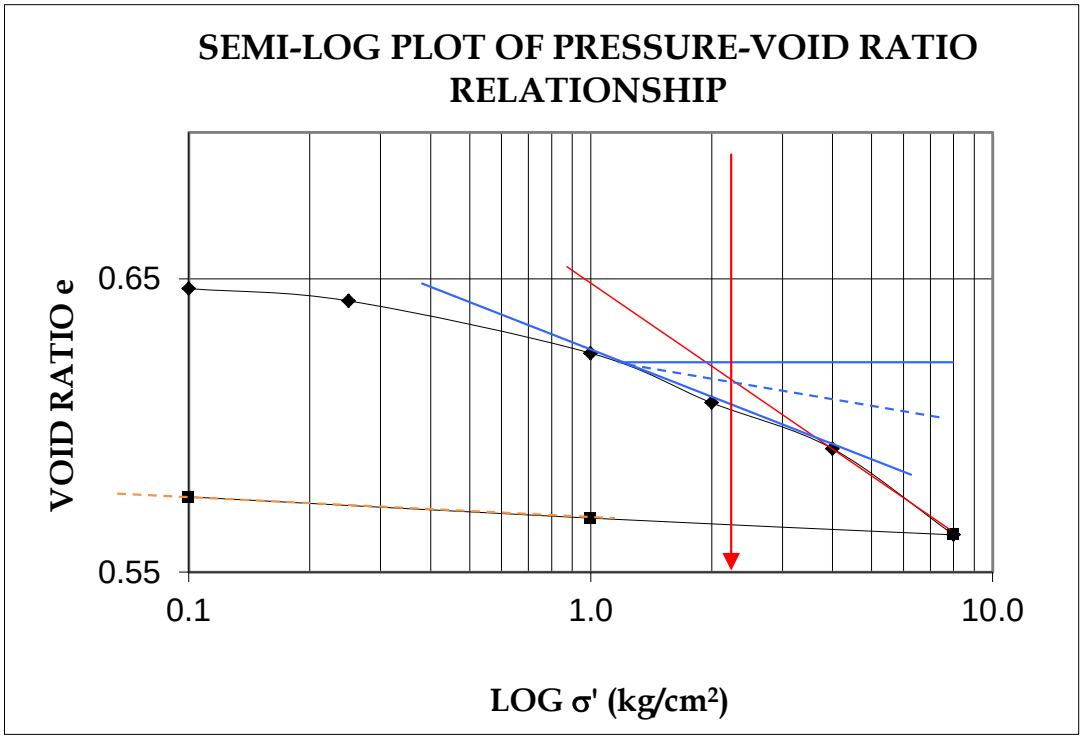


t_{90} = 100 min C_v = 1.10E-04 cm^2/sec

Consolidation Test (IS:2720-Part-15)

Location : BH-3

Depth : 8.5m



Cr = 0.007

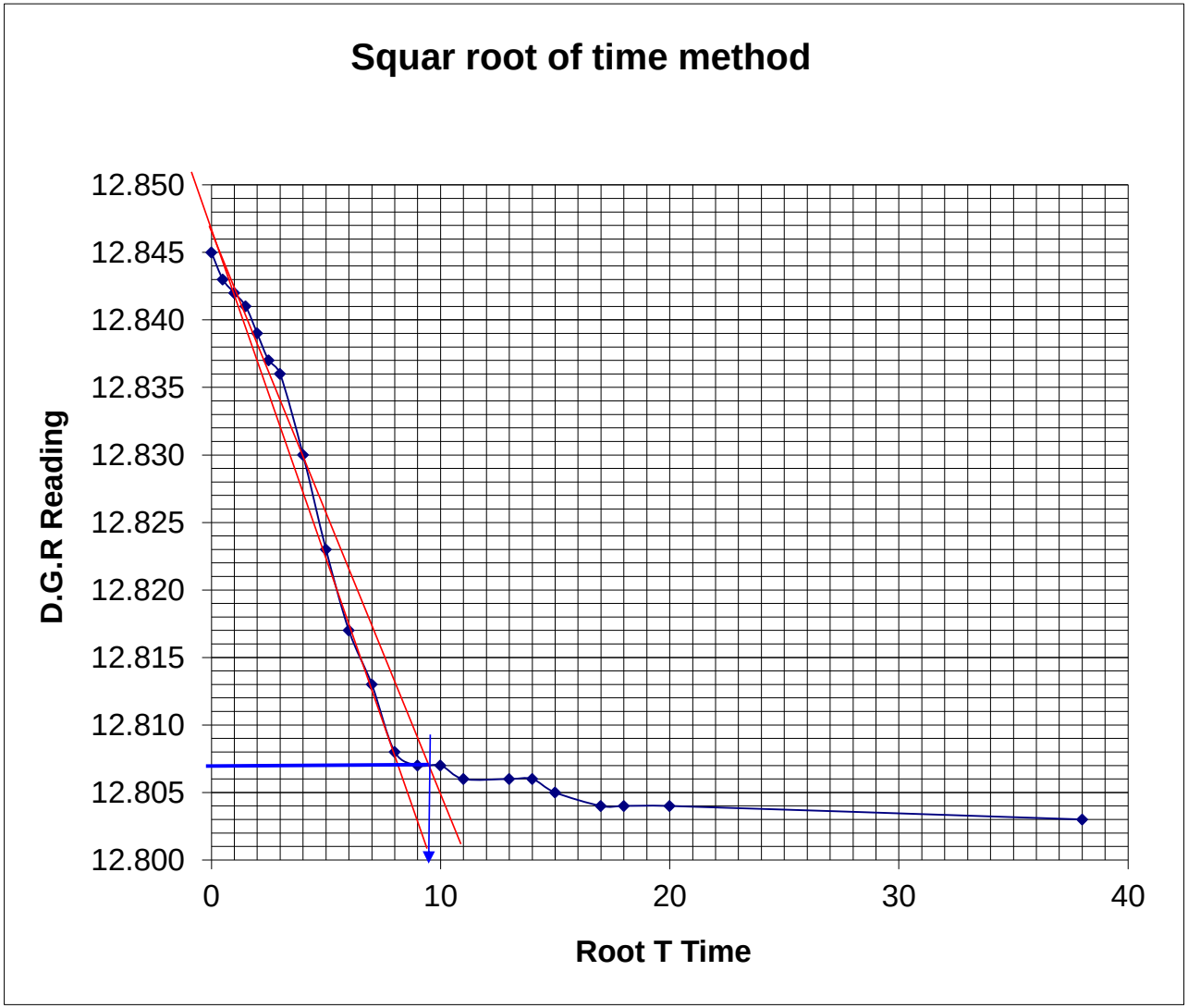
Cc = 0.10

Pc = 2.20 kg/cm2

m_v = 0.010 cm2/kg

PRESSURE INTENSITY (kg/cm2) = **0.10**

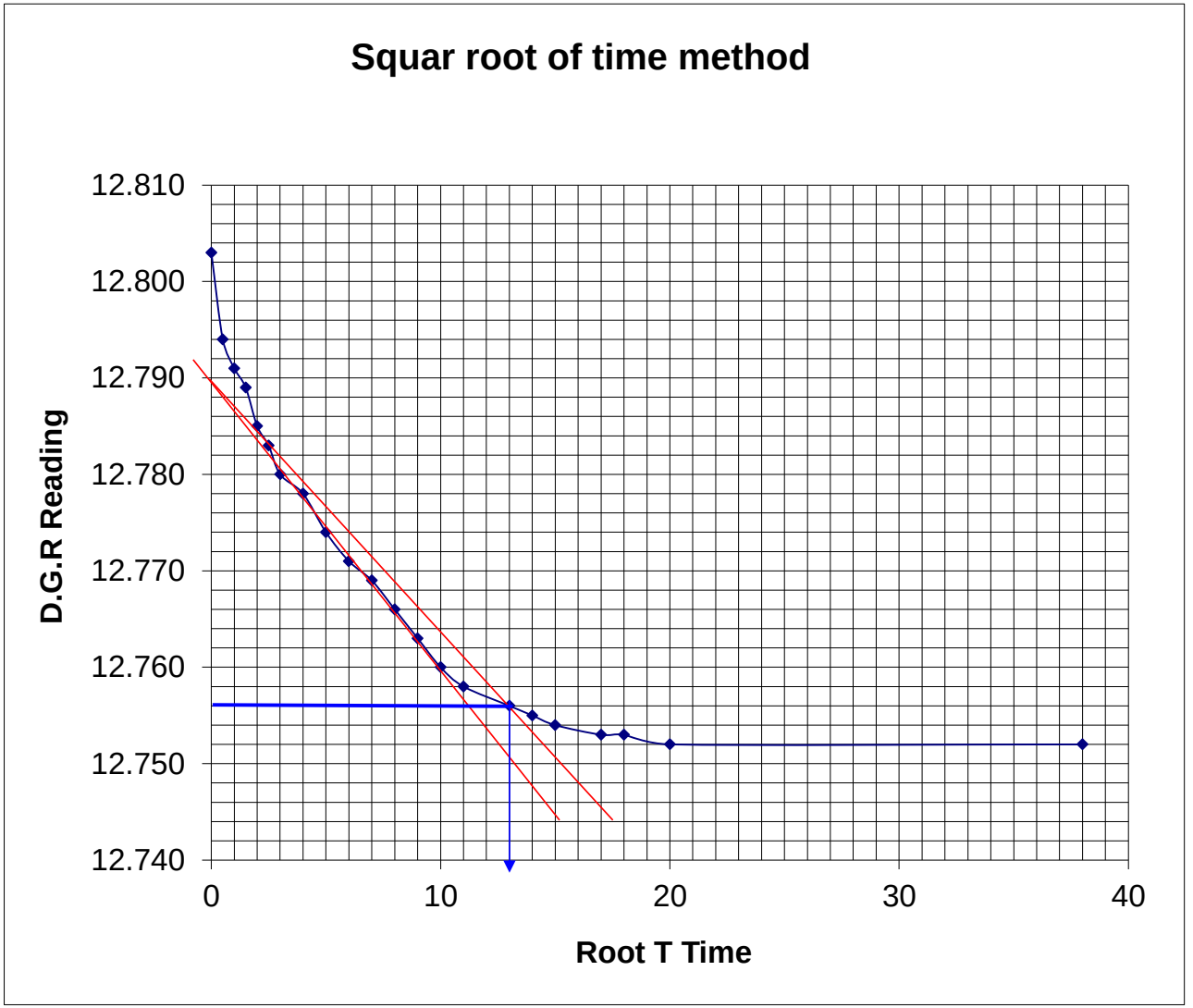
ROOT t	D.G.R
0	12.845
0.5	12.843
1	12.842
1.5	12.841
2	12.839
2.5	12.837
3	12.836
4	12.830
5	12.823
6	12.817
7	12.813
8	12.808
9	12.807
10	12.807
11	12.806
13	12.806
14	12.806
15	12.805
17	12.804
18	12.804
20	12.804
38	12.803



t_{90} = **90 min** C_v = **1.56E-04 cm^2/sec**

PRESSURE INTENSITY (kg/cm2) = **0.25**

ROOT t	D.G.R
0	12.803
0.5	12.794
1	12.791
1.5	12.789
2	12.785
2.5	12.783
3	12.780
4	12.778
5	12.774
6	12.771
7	12.769
8	12.766
9	12.763
10	12.760
11	12.758
13	12.756
14	12.755
15	12.754
17	12.753
18	12.753
20	12.752
38	12.752



t_{90} = 0 min

C_v = 8.31E-05 cm^2/sec