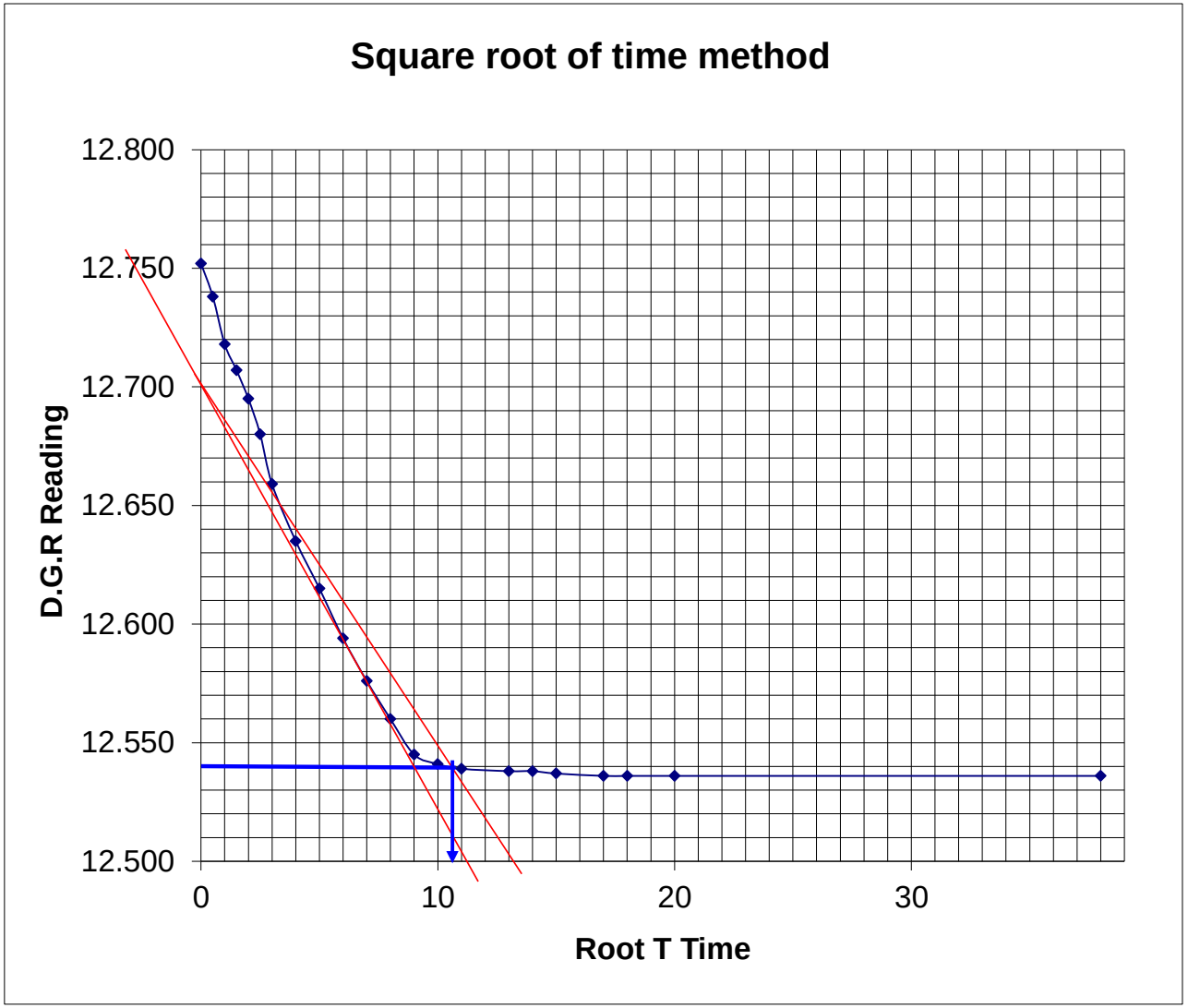
PRESSURE INTENSITY (kg/cm2) = **1.00**

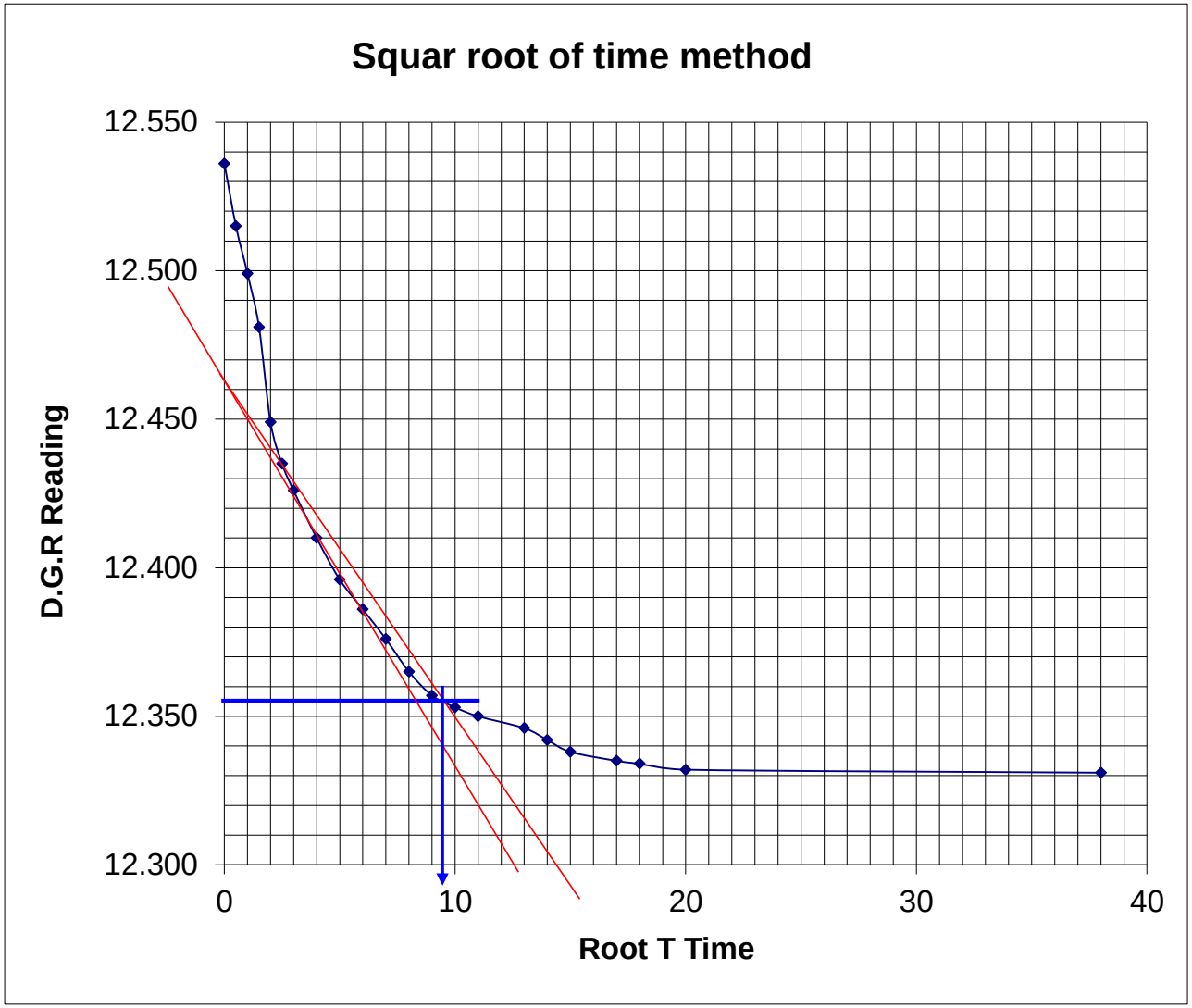
ROOT t	D.G.R
0	12.752
0.5	12.738
1	12.718
1.5	12.707
2	12.695
2.5	12.680
3	12.659
4	12.635
5	12.615
6	12.594
7	12.576
8	12.560
9	12.545
10	12.541
11	12.539
13	12.538
14	12.538
15	12.537
17	12.536
18	12.536
20	12.536
38	12.536



t_{90} = 114 min C_v = 1.21E-04 cm^2/sec

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

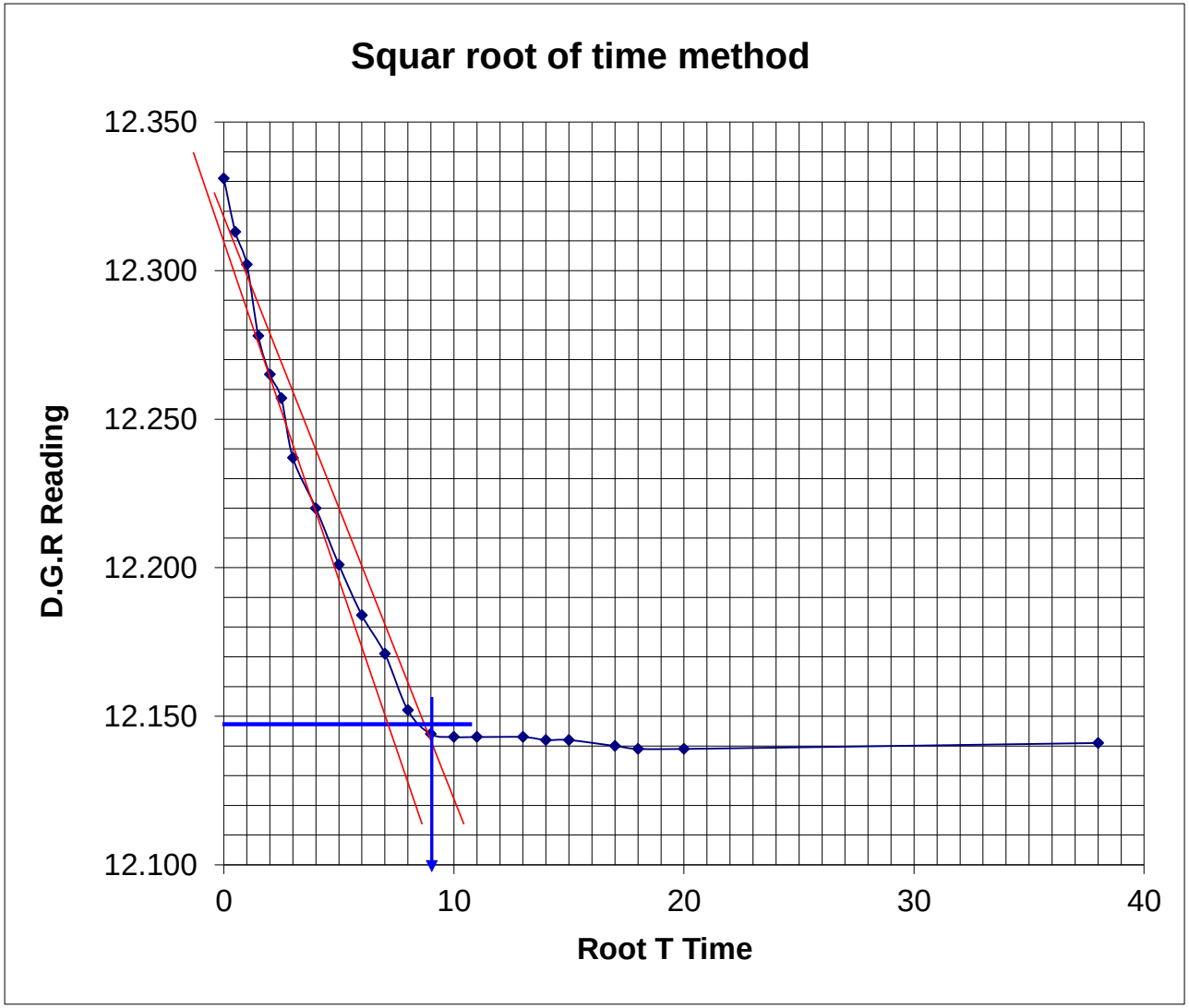
ROOT t	D.G.R
0	12.536
0.5	12.515
1	12.499
1.5	12.481
2	12.449
2.5	12.435
3	12.426
4	12.410
5	12.396
6	12.386
7	12.376
8	12.365
9	12.357
10	12.353
11	12.350
13	12.346
14	12.342
15	12.338
17	12.335
18	12.334
20	12.332
38	12.331



t_{90} = **90 min** C_v = **1.50E-04 cm^2/sec**

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

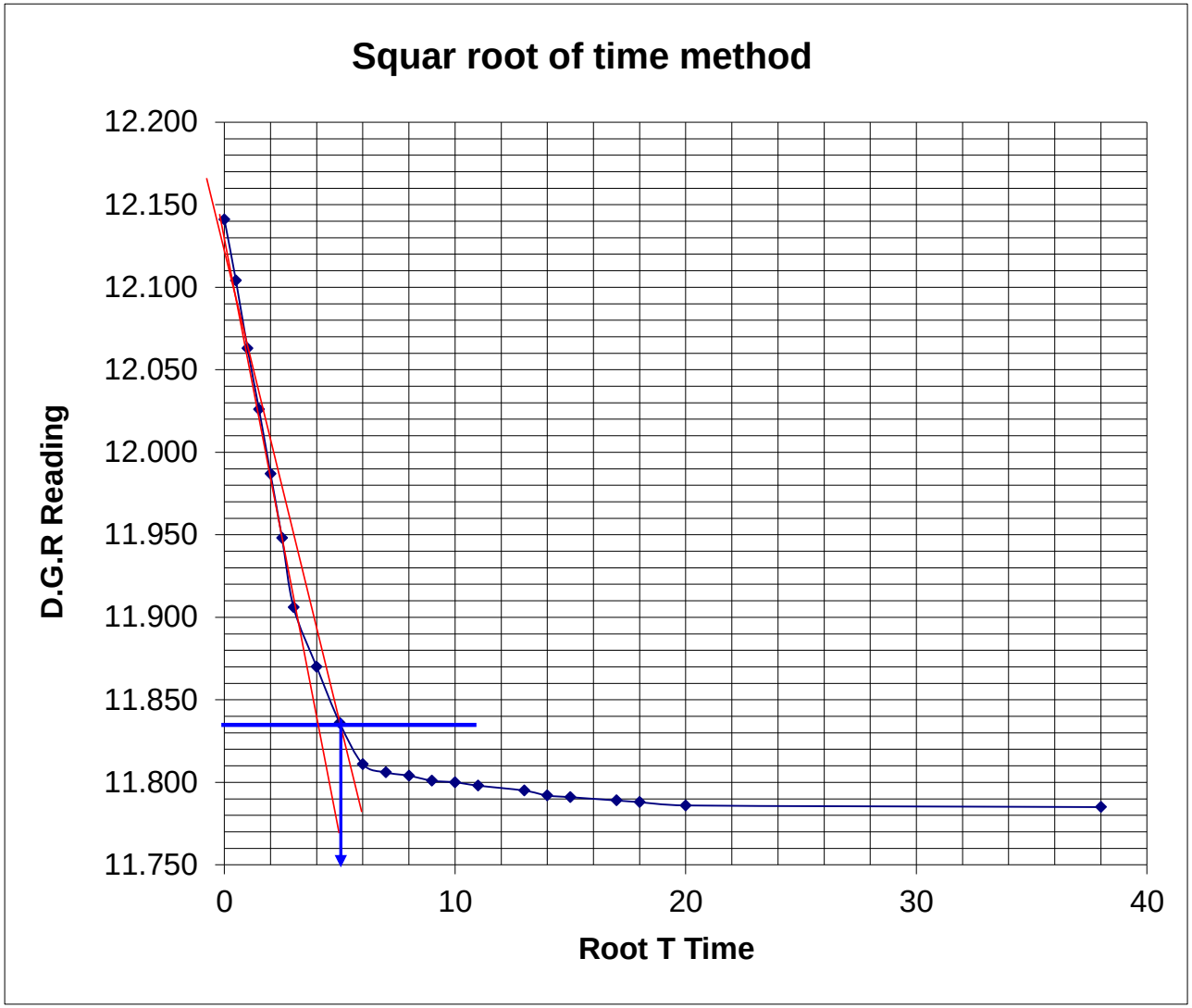
ROOT t	D.G.R
0	12.331
0.5	12.313
1	12.302
1.5	12.278
2	12.265
2.5	12.257
3	12.237
4	12.220
5	12.201
6	12.184
7	12.171
8	12.152
9	12.144
10	12.143
11	12.143
13	12.143
14	12.142
15	12.142
17	12.140
18	12.139
20	12.139
38	12.141



t_{90} = **81 min** C_v = **1.64E-04 cm^2/sec**

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

ROOT t	D.G.R
0	12.141
0.5	12.104
1	12.063
1.5	12.026
2	11.987
2.5	11.948
3	11.906
4	11.870
5	11.836
6	11.811
7	11.806
8	11.804
9	11.801
10	11.800
11	11.798
13	11.795
14	11.792
15	11.791
17	11.789
18	11.788
20	11.786
38	11.785

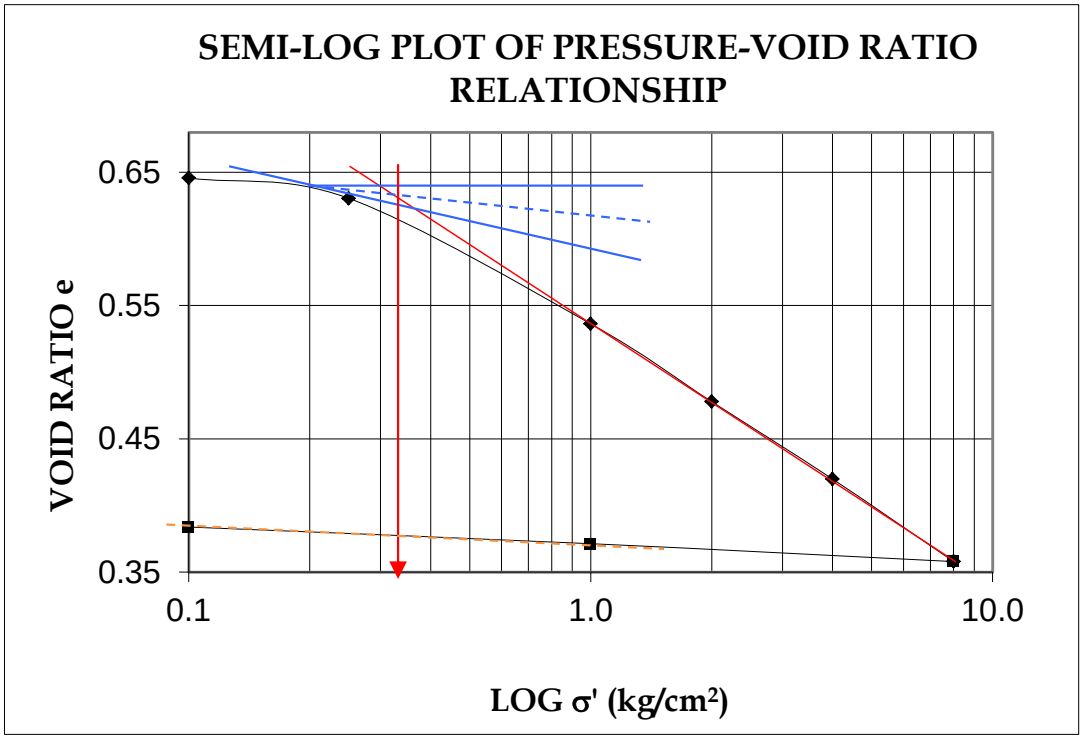


t_{90} = **49 min** C_v = **2.64E-04 cm^2/sec**

Consolidation Test (IS:2720-Part-15)

Location : BH-4

Depth : 2.5m



Cr = 0.013

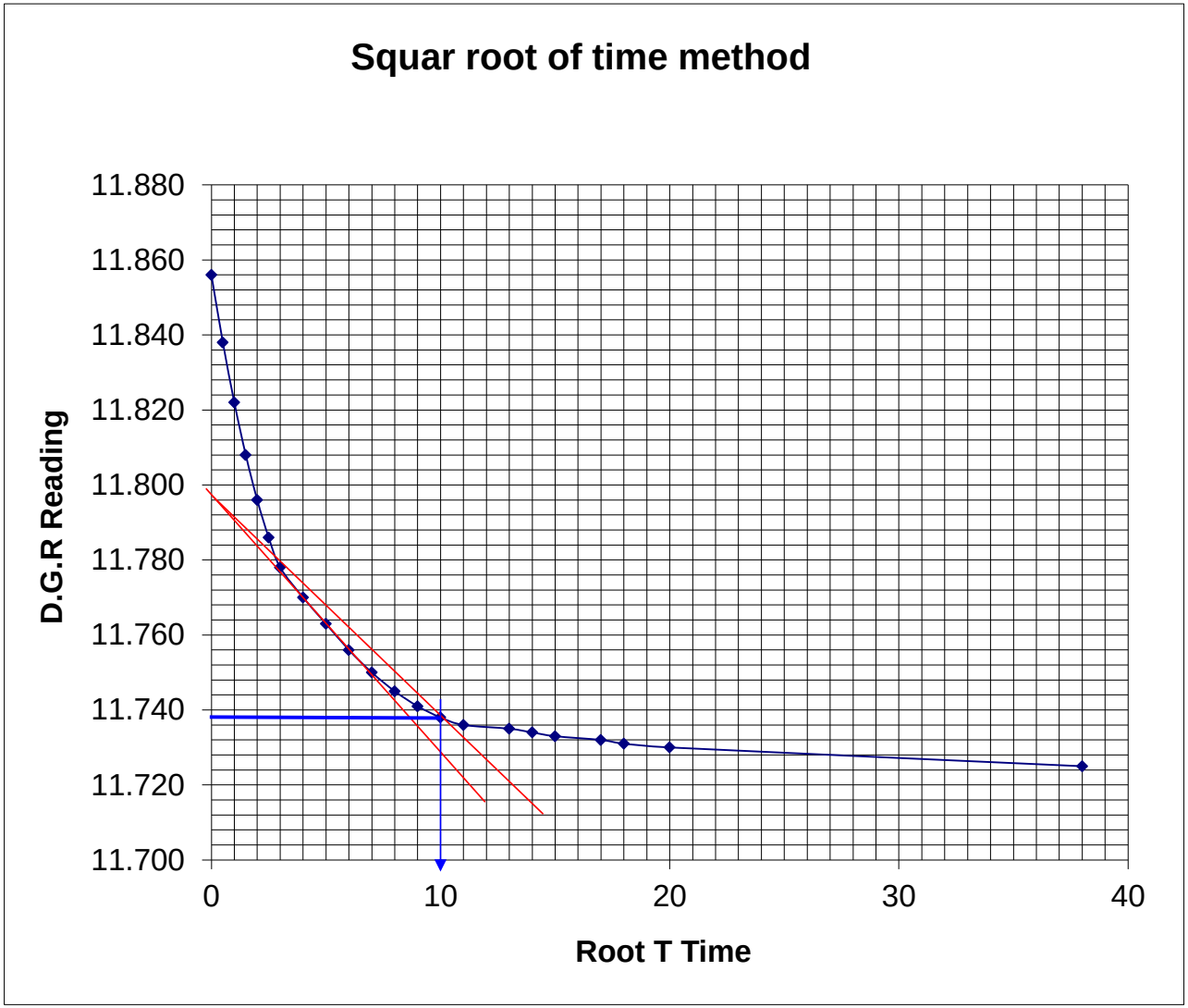
Cc = 0.21

Pc = 0.32 kg/cm2

m_v = 0.038 cm2/kg

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

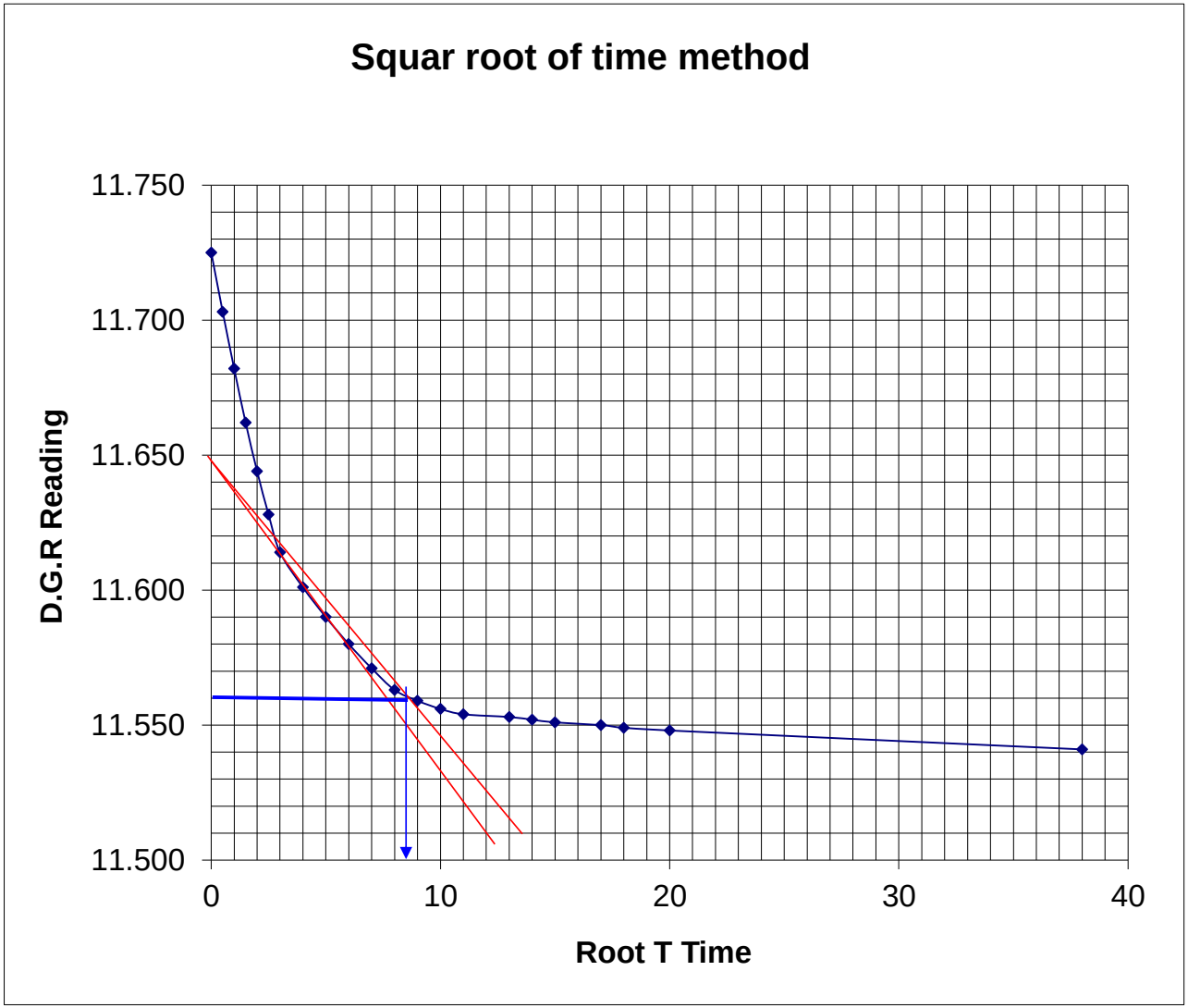
ROOT t	D.G.R
0	11.856
0.5	11.838
1	11.822
1.5	11.808
2	11.796
2.5	11.786
3	11.778
4	11.770
5	11.763
6	11.756
7	11.750
8	11.745
9	11.741
10	11.738
11	11.736
13	11.735
14	11.734
15	11.733
17	11.732
18	11.731
20	11.730
38	11.725



t_{90} = 100 min C_v = 1.40E-04 cm^2/sec

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

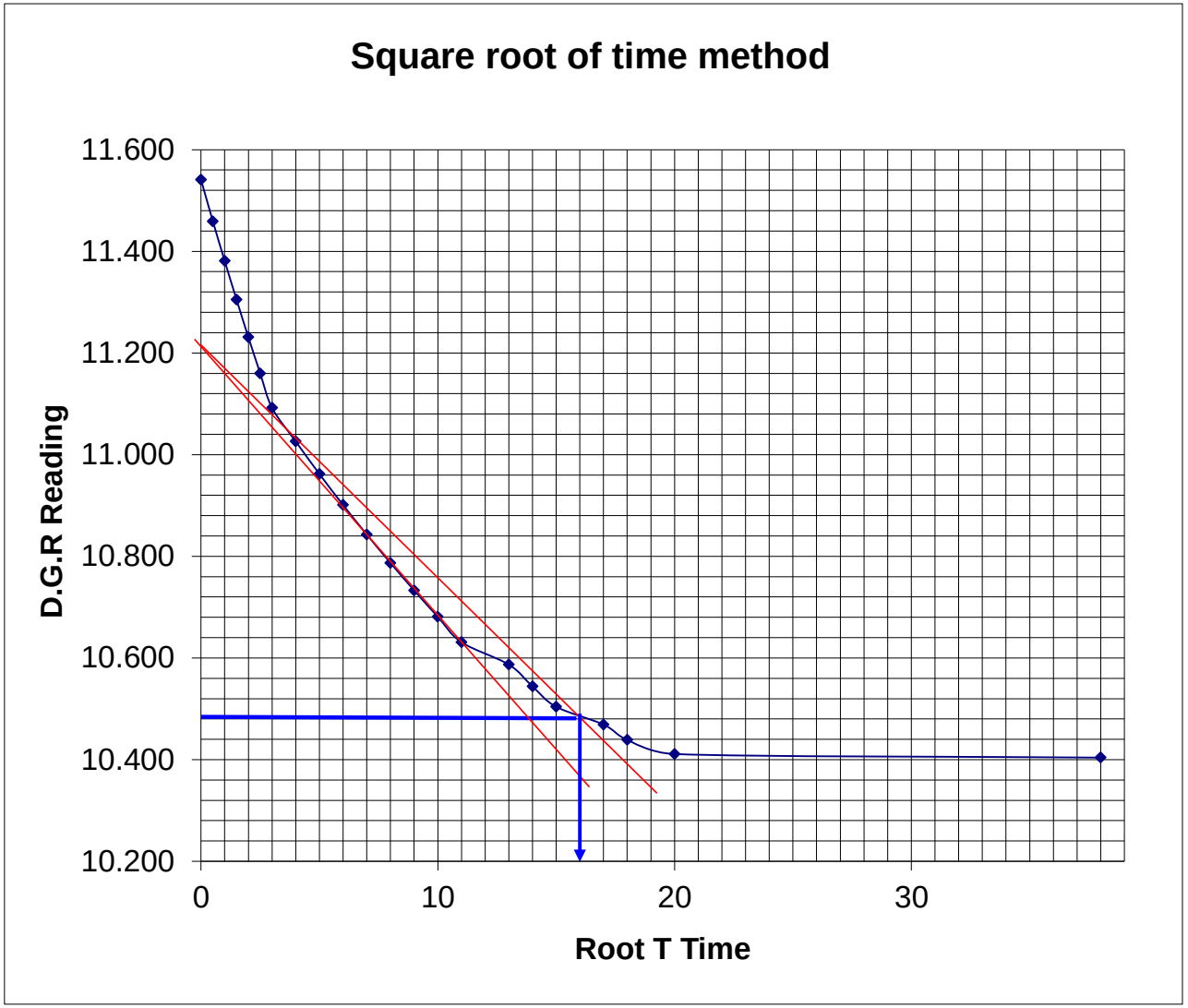
ROOT t	D.G.R
0	11.725
0.5	11.703
1	11.682
1.5	11.662
2	11.644
2.5	11.628
3	11.614
4	11.601
5	11.590
6	11.580
7	11.571
8	11.563
9	11.559
10	11.556
11	11.554
13	11.553
14	11.552
15	11.551
17	11.550
18	11.549
20	11.548
38	11.541



t_{90} = 0 min C_v = 1.91E-04 cm^2/sec

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

ROOT t	D.G.R
0	11.541
0.5	11.459
1	11.381
1.5	11.305
2	11.231
2.5	11.160
3	11.092
4	11.026
5	10.962
6	10.901
7	10.843
8	10.787
9	10.733
10	10.681
11	10.631
13	10.587
14	10.544
15	10.504
17	10.469
18	10.439
20	10.411
38	10.404

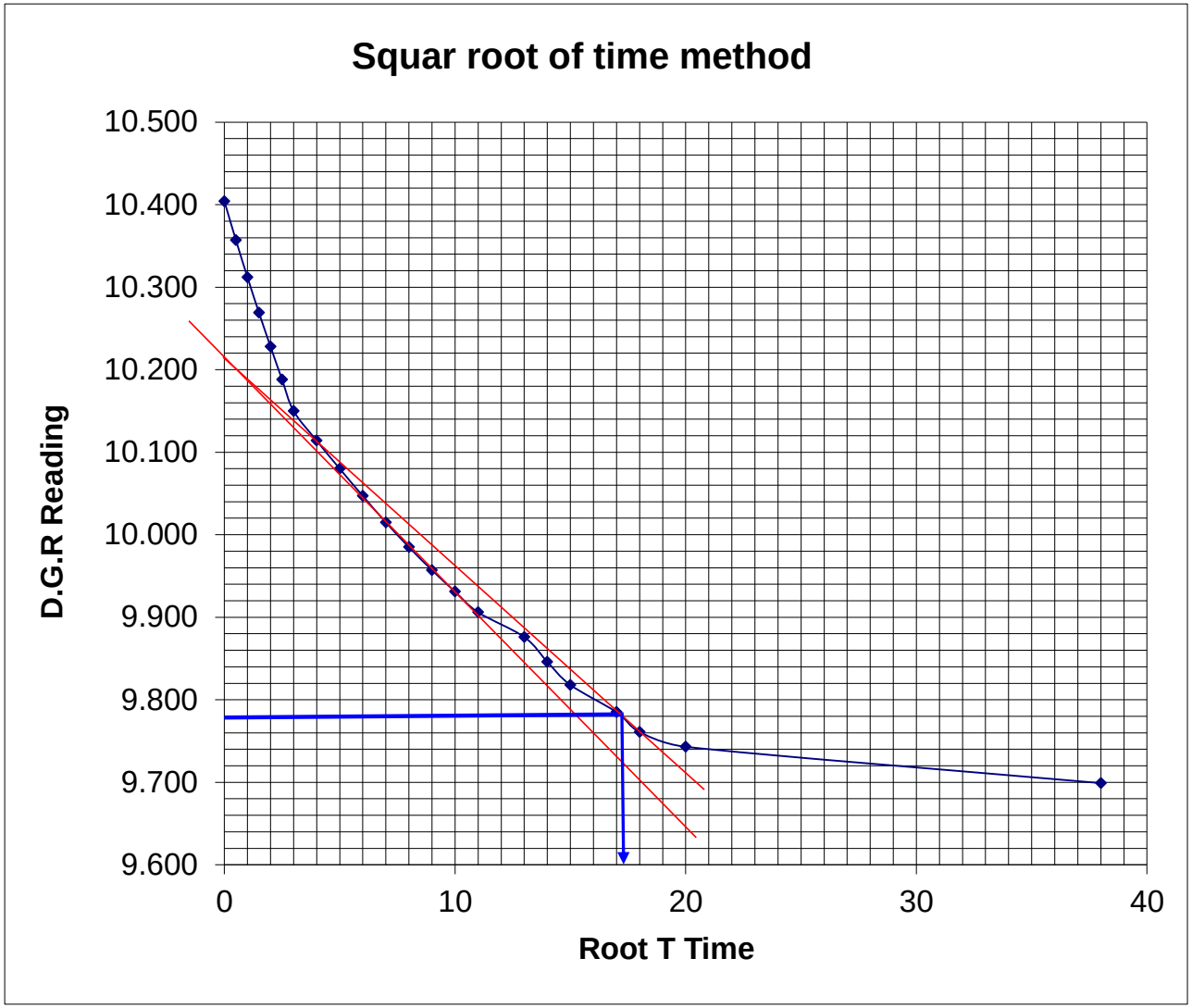


t_{90} = 0 min

C_v = 5.04E-05 cm^2/sec

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

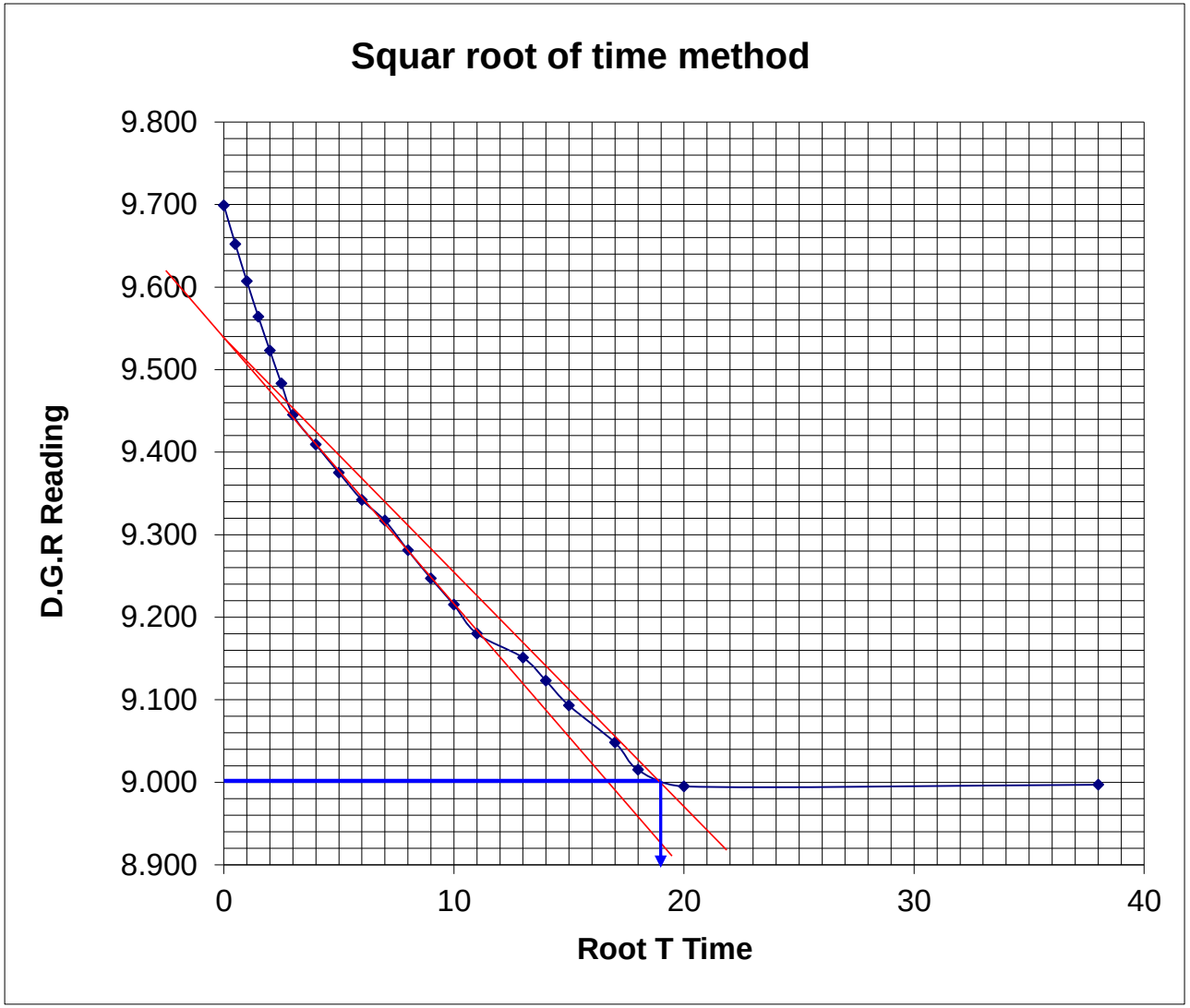
ROOT t	D.G.R
0	10.404
0.5	10.357
1	10.312
1.5	10.269
2	10.228
2.5	10.188
3	10.150
4	10.114
5	10.080
6	10.047
7	10.015
8	9.985
9	9.957
10	9.931
11	9.906
13	9.876
14	9.846
15	9.818
17	9.785
18	9.761
20	9.743
38	9.699



t_{90} = **292 min** C_v = **4.00E-05 cm^2/sec**

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

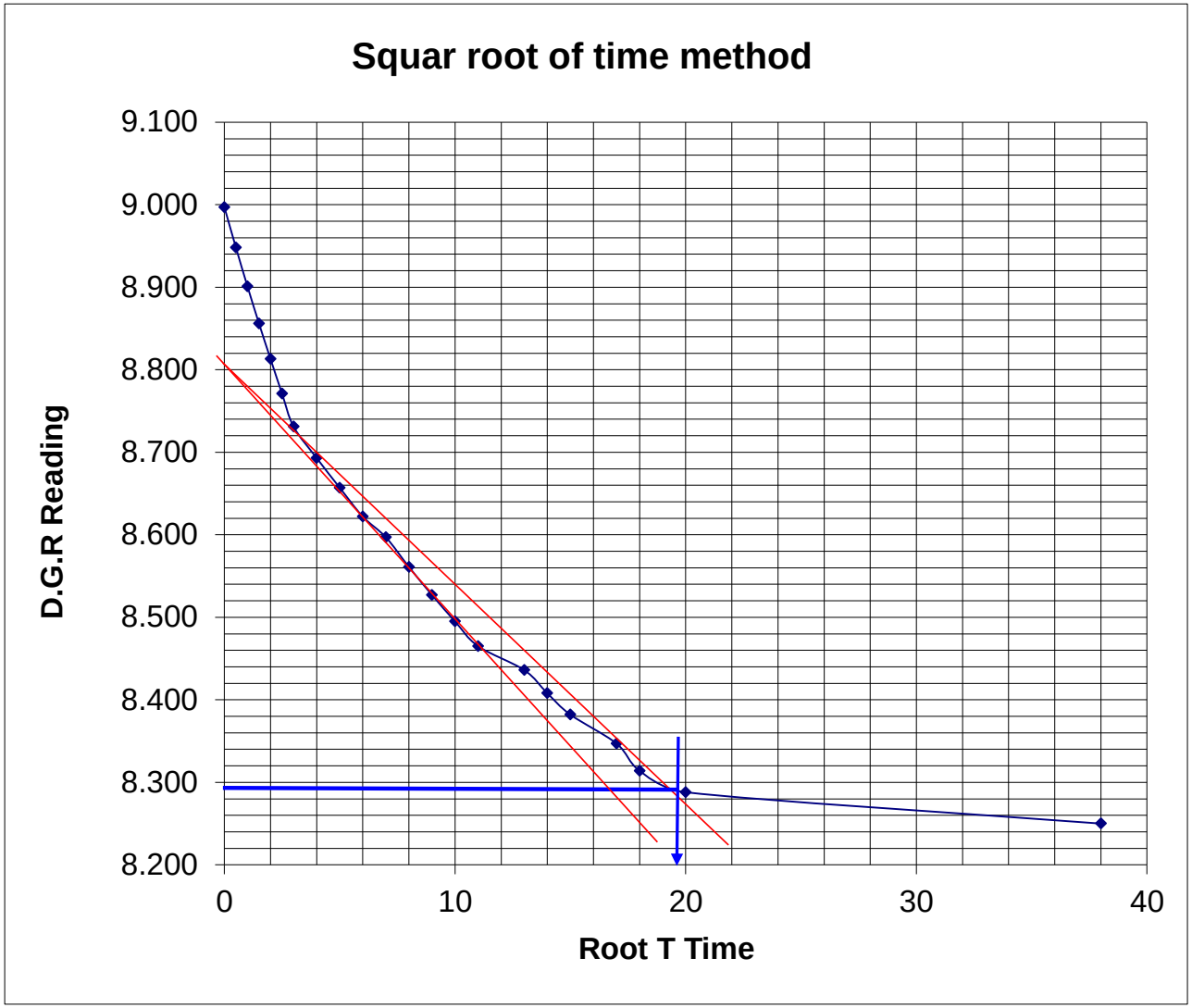
ROOT t	D.G.R
0	9.699
0.5	9.652
1	9.607
1.5	9.564
2	9.523
2.5	9.483
3	9.445
4	9.409
5	9.375
6	9.342
7	9.317
8	9.281
9	9.247
10	9.215
11	9.180
13	9.151
14	9.123
15	9.093
17	9.048
18	9.015
20	8.995
38	8.997



t_{90} = 361 min **C_v = 2.99E-05 cm^2/sec**

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

ROOT t	D.G.R
0	8.997
0.5	8.948
1	8.901
1.5	8.856
2	8.813
2.5	8.771
3	8.731
4	8.693
5	8.657
6	8.622
7	8.597
8	8.561
9	8.527
10	8.495
11	8.465
13	8.436
14	8.408
15	8.382
17	8.347
18	8.314
20	8.288
38	8.250

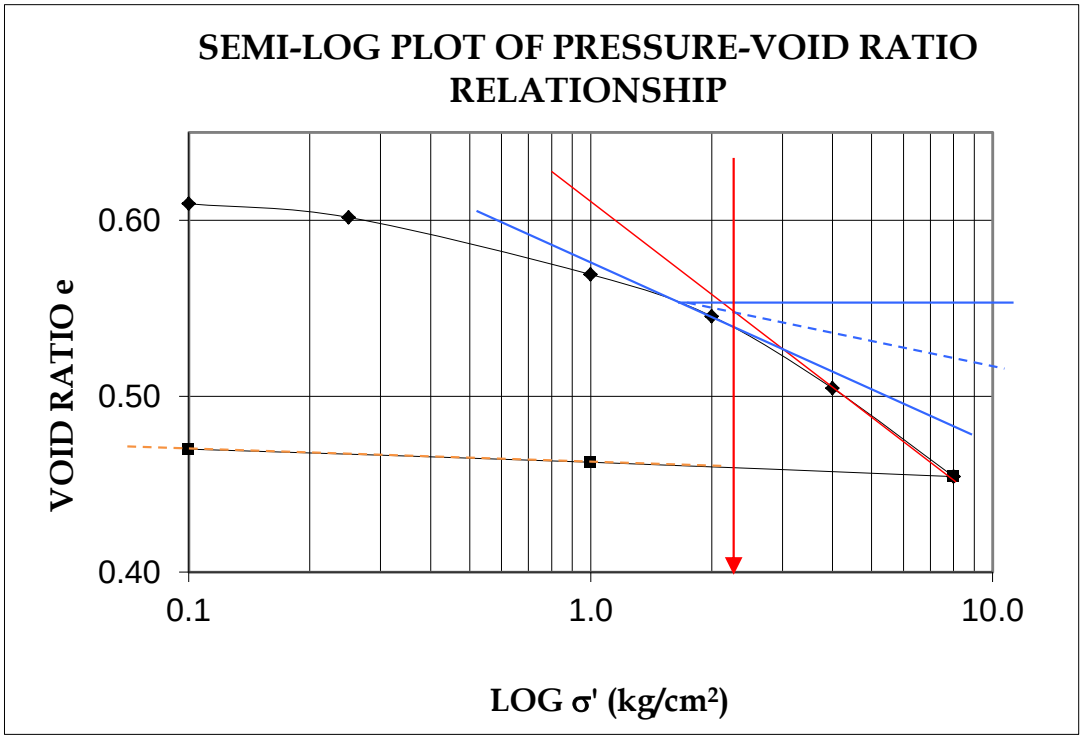


t_{90} = 392 min C_v = 2.53E-05 cm^2/sec

Consolidation Test (IS:2720-Part-15)

Location : BH-5

Depth : 8.5m



Cr = 0.007

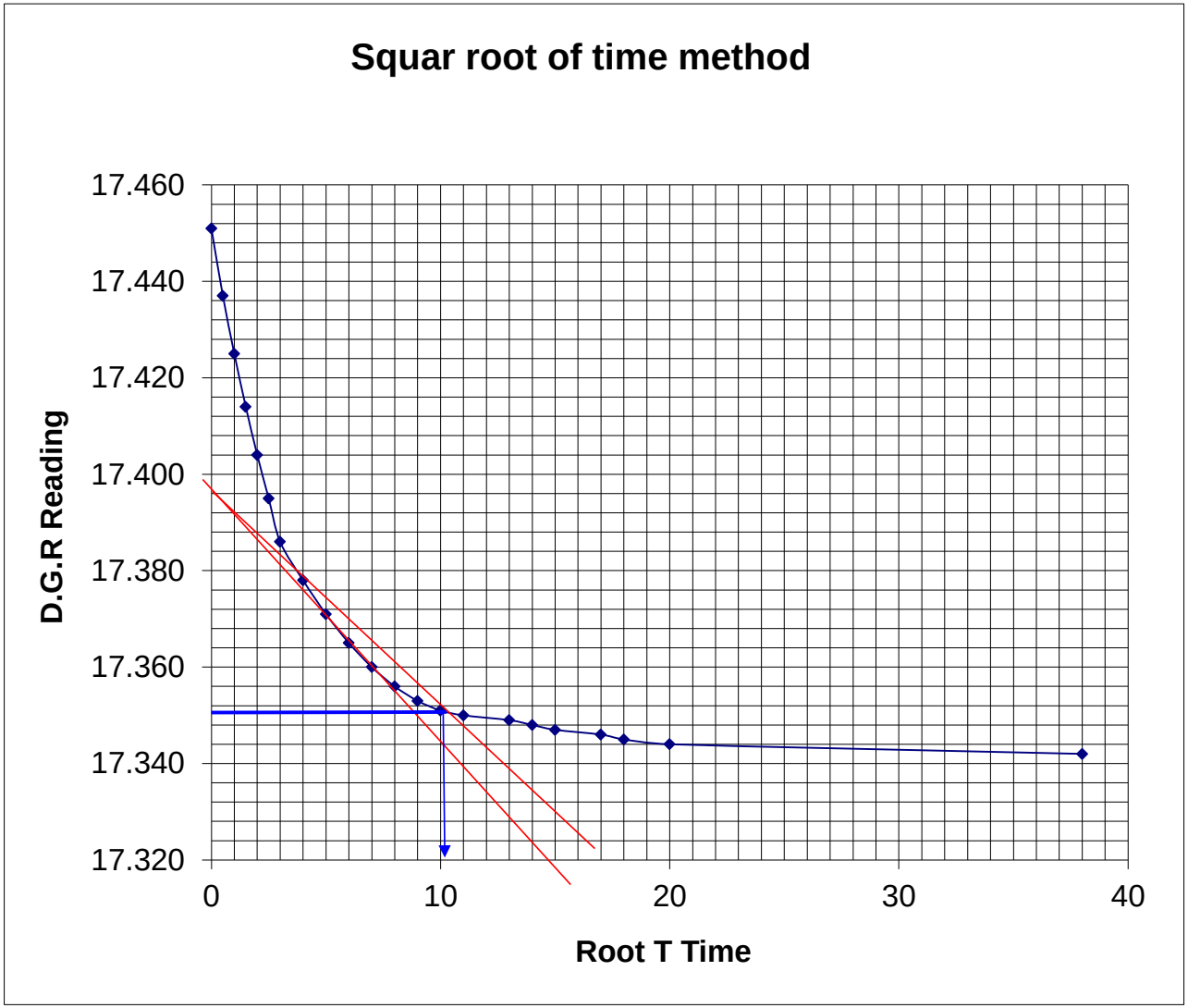
Cc = 0.17

Pc = 2.30 kg/cm2

m_v = 0.015 cm2/kg

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

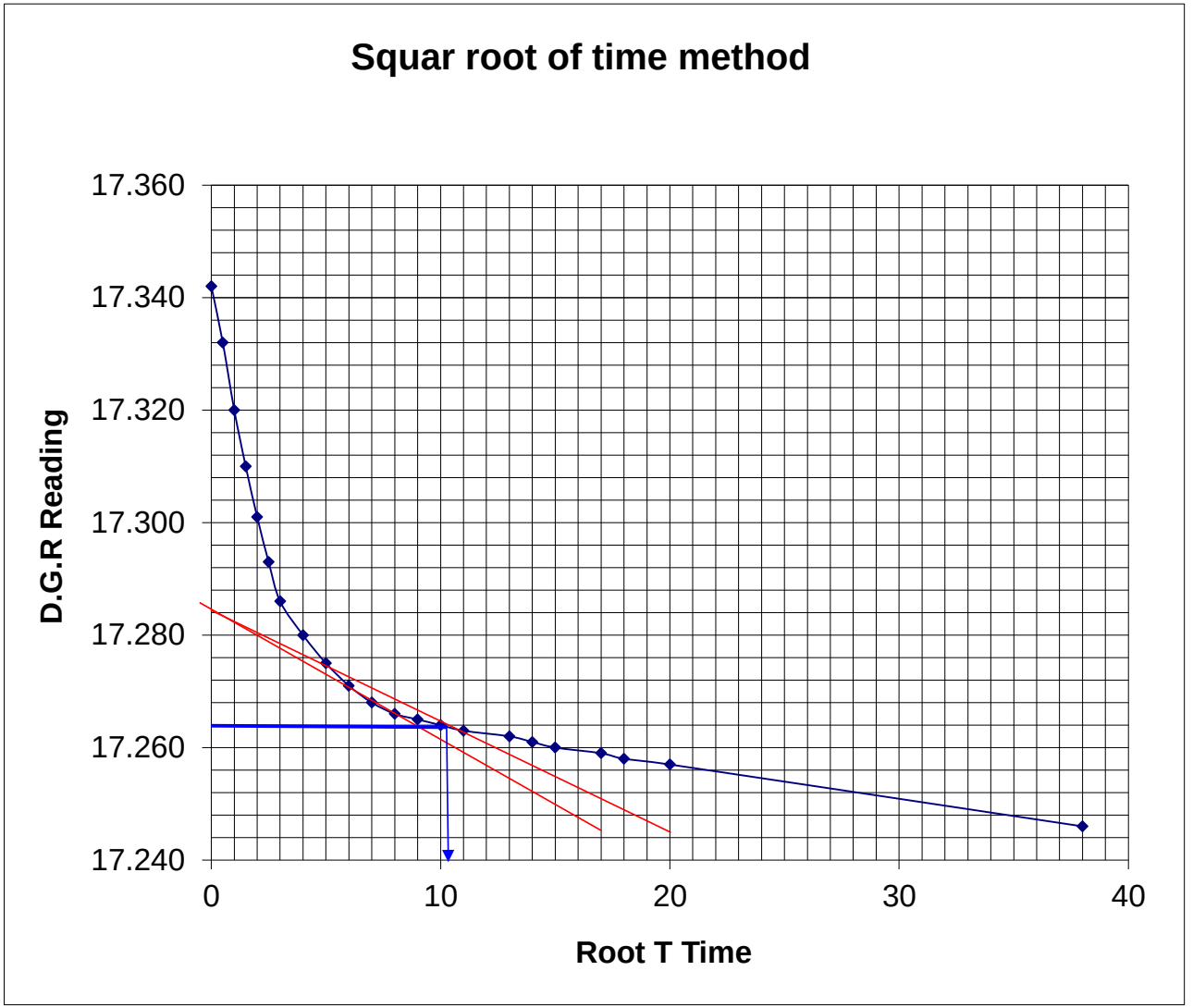
ROOT t	D.G.R
0	17.451
0.5	17.437
1	17.425
1.5	17.414
2	17.404
2.5	17.395
3	17.386
4	17.378
5	17.371
6	17.365
7	17.360
8	17.356
9	17.353
10	17.351
11	17.350
13	17.349
14	17.348
15	17.347
17	17.346
18	17.345
20	17.344
38	17.342



t_{90} = 102 min C_v = 1.38E-04 cm^2/sec

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

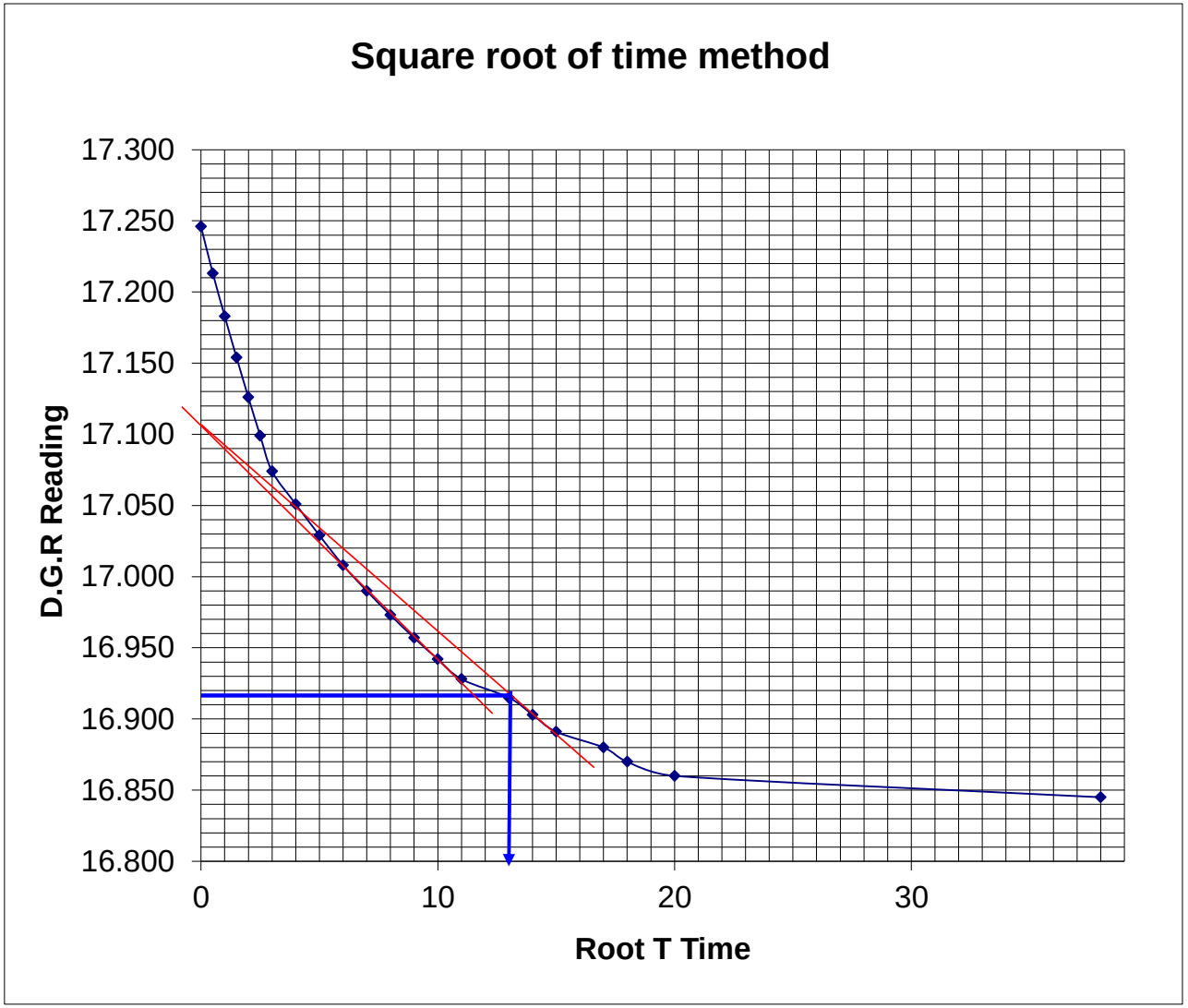
ROOT t	D.G.R
0	17.342
0.5	17.332
1	17.320
1.5	17.310
2	17.301
2.5	17.293
3	17.286
4	17.280
5	17.275
6	17.271
7	17.268
8	17.266
9	17.265
10	17.264
11	17.263
13	17.262
14	17.261
15	17.260
17	17.259
18	17.258
20	17.257
38	17.246



t_{90} = 0 min C_v = 1.34E-04 cm^2/sec

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

ROOT t	D.G.R
0	17.246
0.5	17.213
1	17.183
1.5	17.154
2	17.126
2.5	17.099
3	17.074
4	17.051
5	17.029
6	17.008
7	16.990
8	16.973
9	16.957
10	16.942
11	16.928
13	16.915
14	16.903
15	16.891
17	16.880
18	16.870
20	16.860
38	16.845

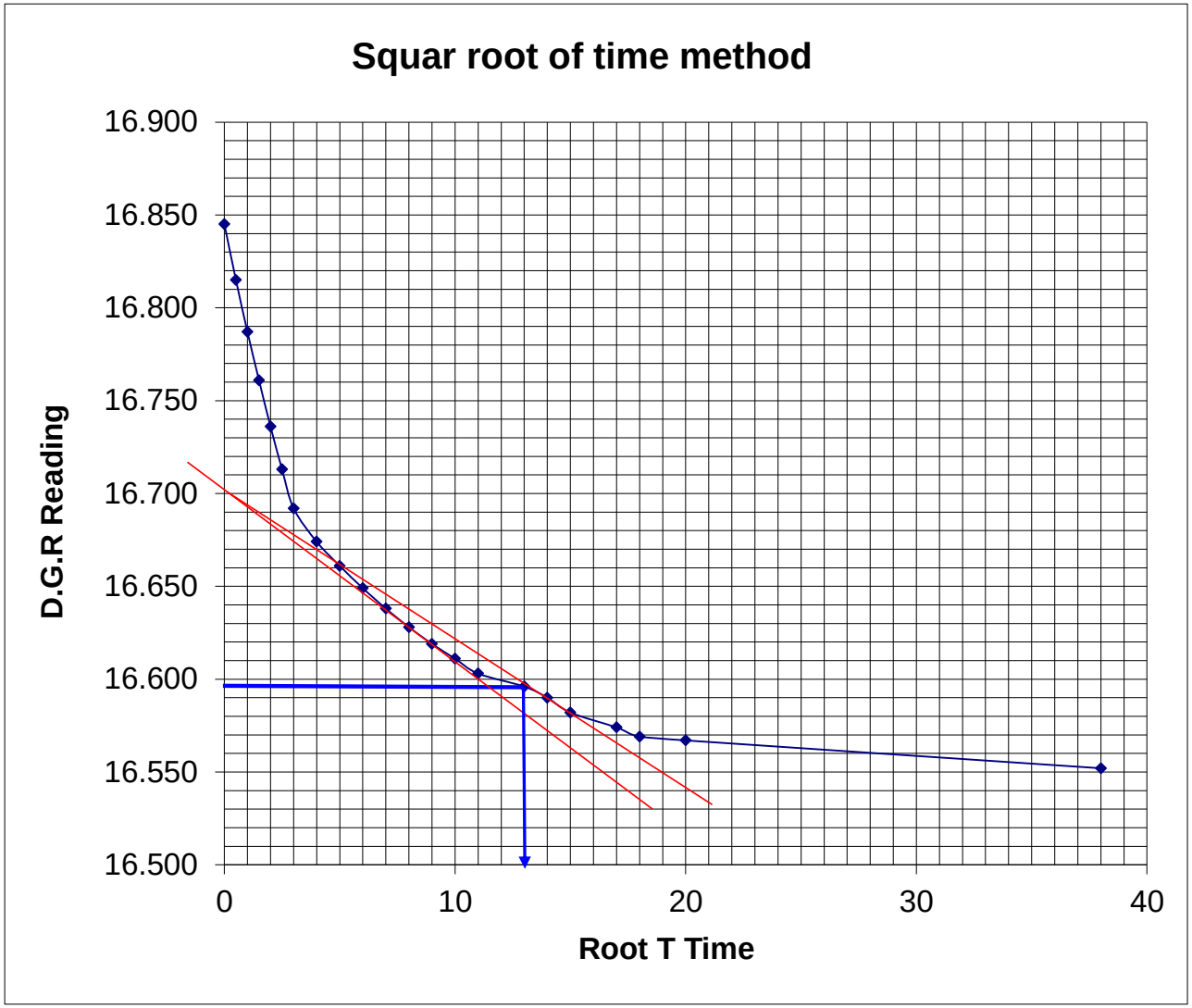


t_{90} = 0 min

C_v = 8.03E-05 cm^2/sec

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

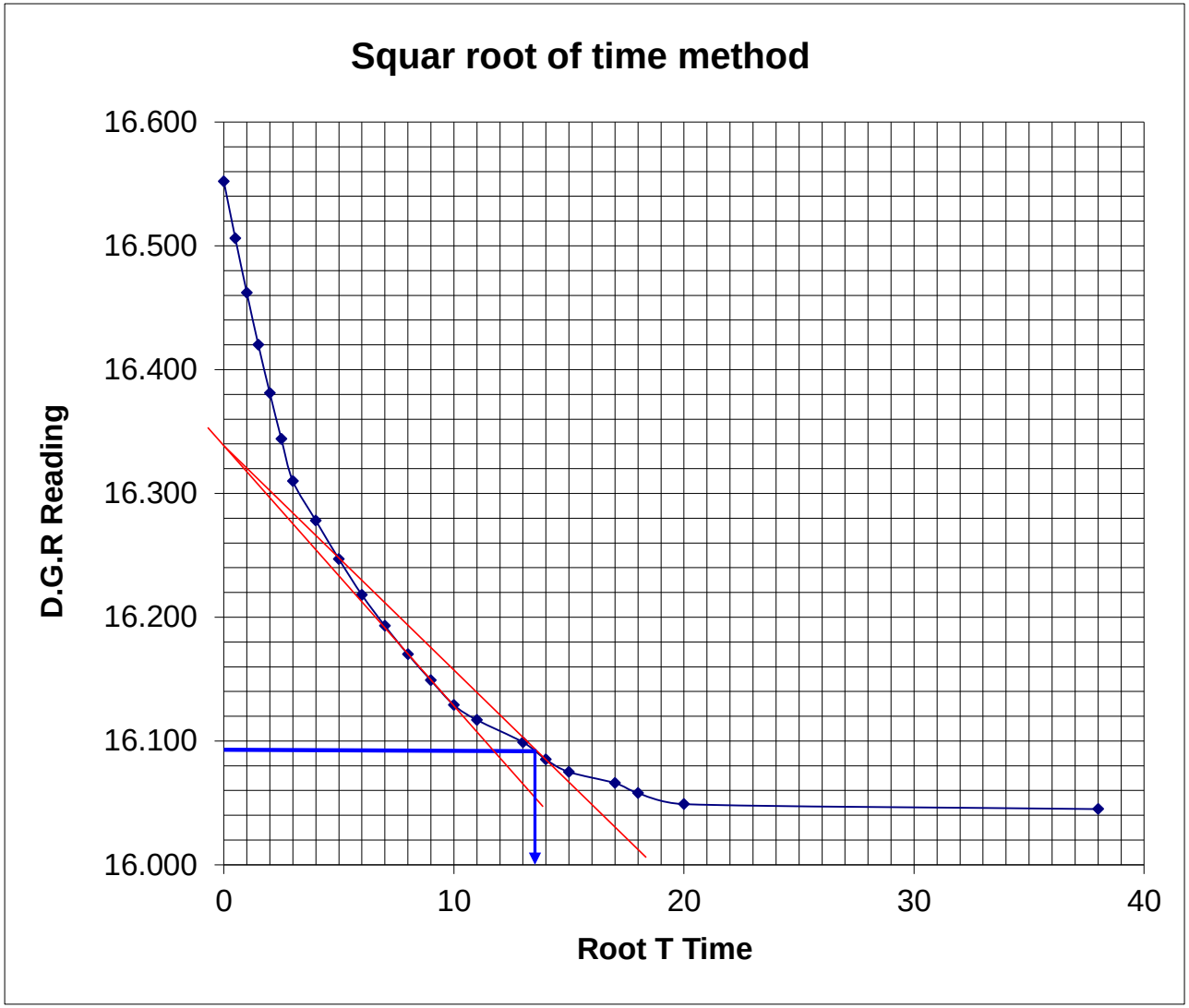
ROOT t	D.G.R
0	16.845
0.5	16.815
1	16.787
1.5	16.761
2	16.736
2.5	16.713
3	16.692
4	16.674
5	16.661
6	16.649
7	16.638
8	16.628
9	16.619
10	16.611
11	16.603
13	16.596
14	16.590
15	16.582
17	16.574
18	16.569
20	16.567
38	16.552



t_{90} = 169 min **C_v = 7.75E-05 cm^2/sec**

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

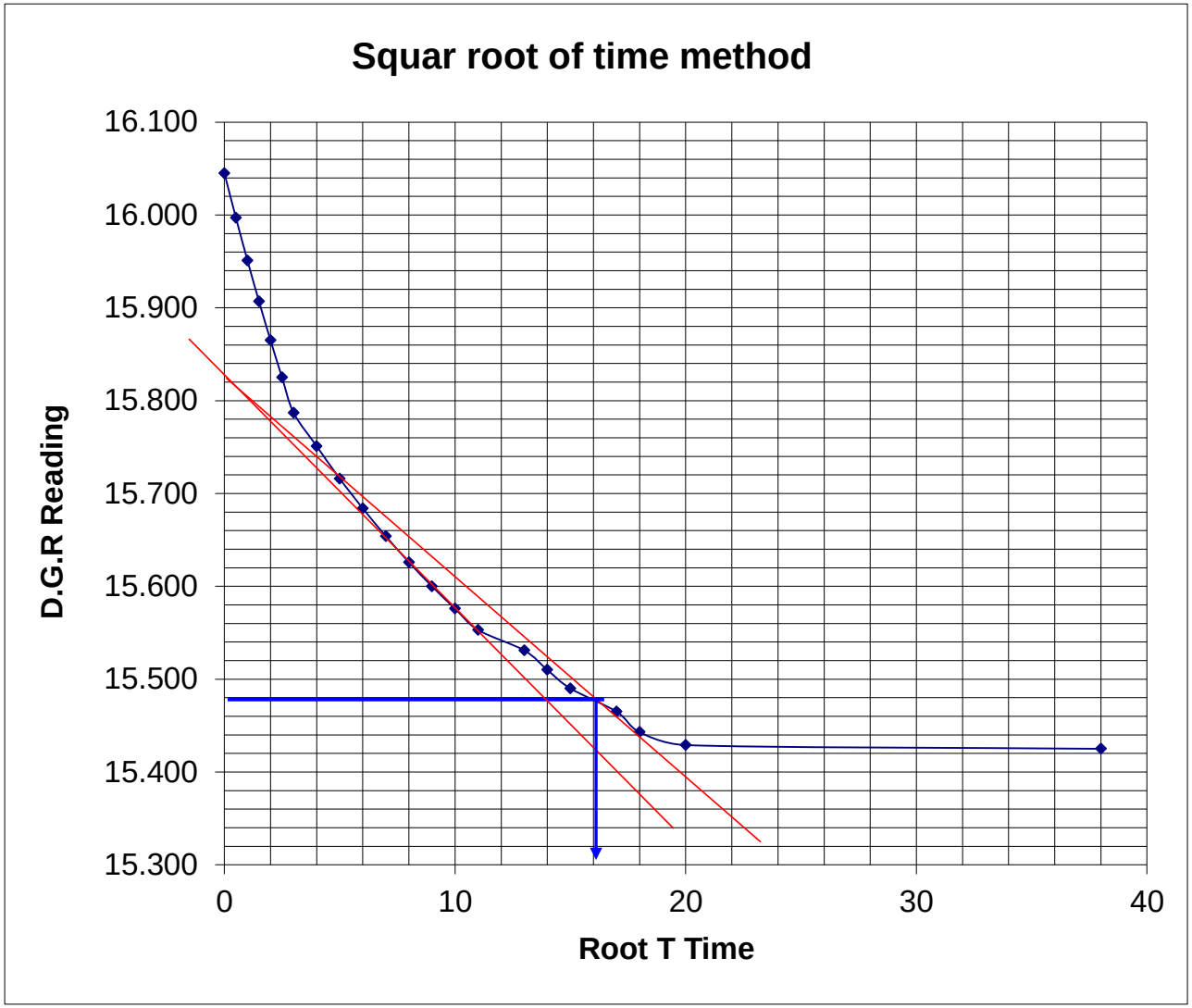
ROOT t	D.G.R
0	16.552
0.5	16.506
1	16.462
1.5	16.420
2	16.381
2.5	16.344
3	16.310
4	16.278
5	16.247
6	16.218
7	16.193
8	16.170
9	16.149
10	16.129
11	16.117
13	16.099
14	16.085
15	16.075
17	16.066
18	16.058
20	16.049
38	16.045



t_{90} = 185 min C_v = 6.79E-05 cm^2/sec

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

ROOT t	D.G.R
0	16.045
0.5	15.997
1	15.951
1.5	15.907
2	15.865
2.5	15.825
3	15.787
4	15.751
5	15.716
6	15.684
7	15.654
8	15.626
9	15.600
10	15.576
11	15.553
13	15.531
14	15.510
15	15.490
17	15.465
18	15.443
20	15.429
38	15.425

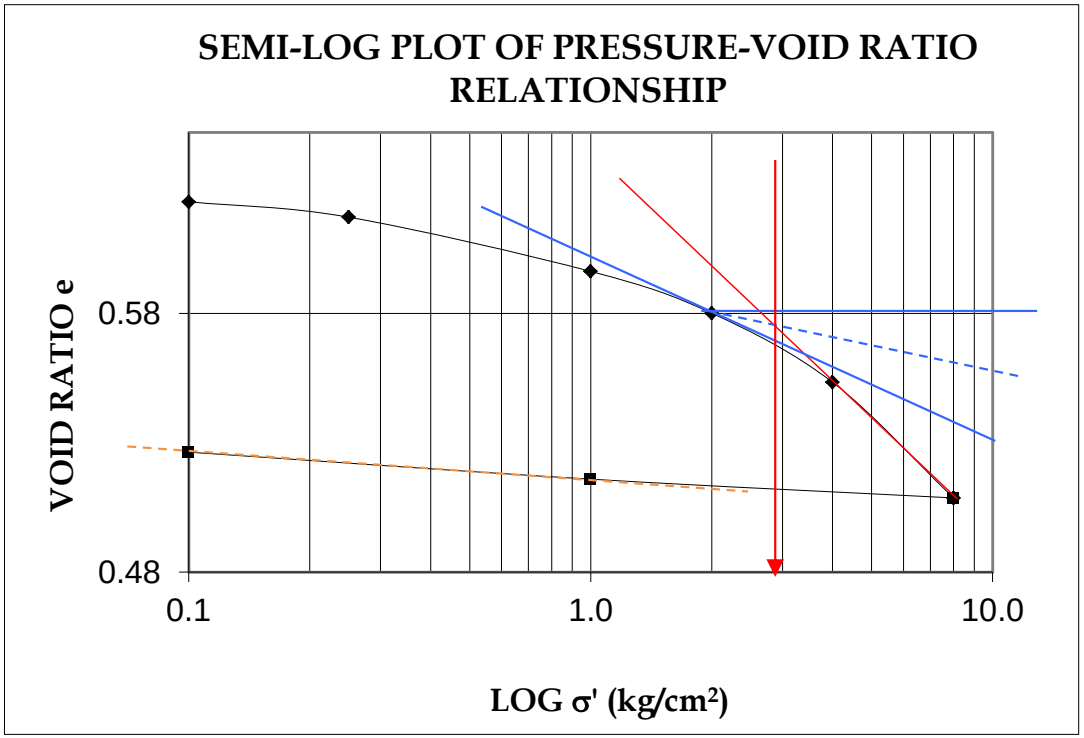


t_{90} = 256 min C_v = 4.61E-05 cm^2/sec

Consolidation Test (IS:2720-Part-15)

Location : BH-5

Depth : 11.5m



Cr = 0.010

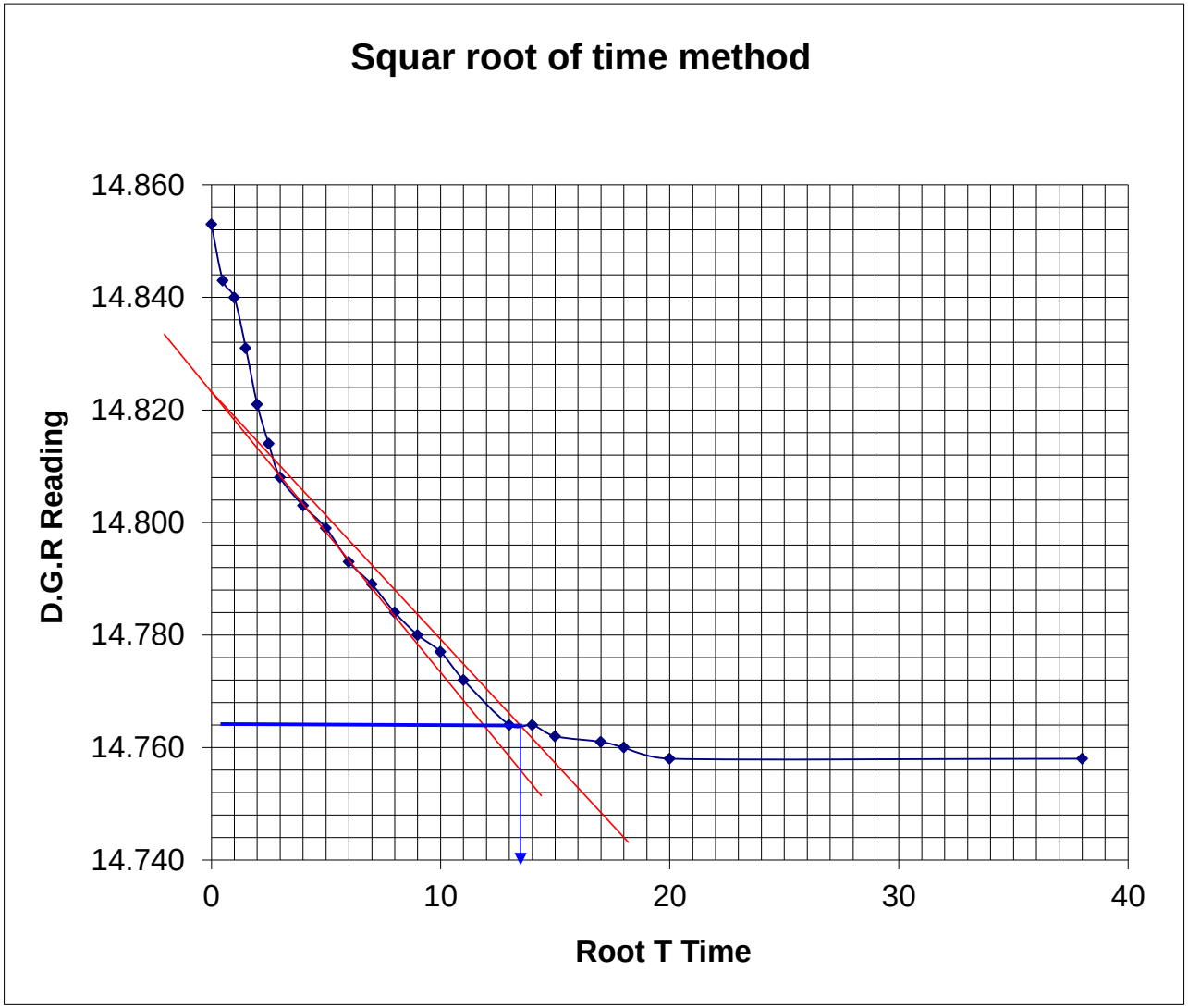
Cc = 0.15

Pc = 2.90 kg/cm2

m_v = 0.010 cm2/kg

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

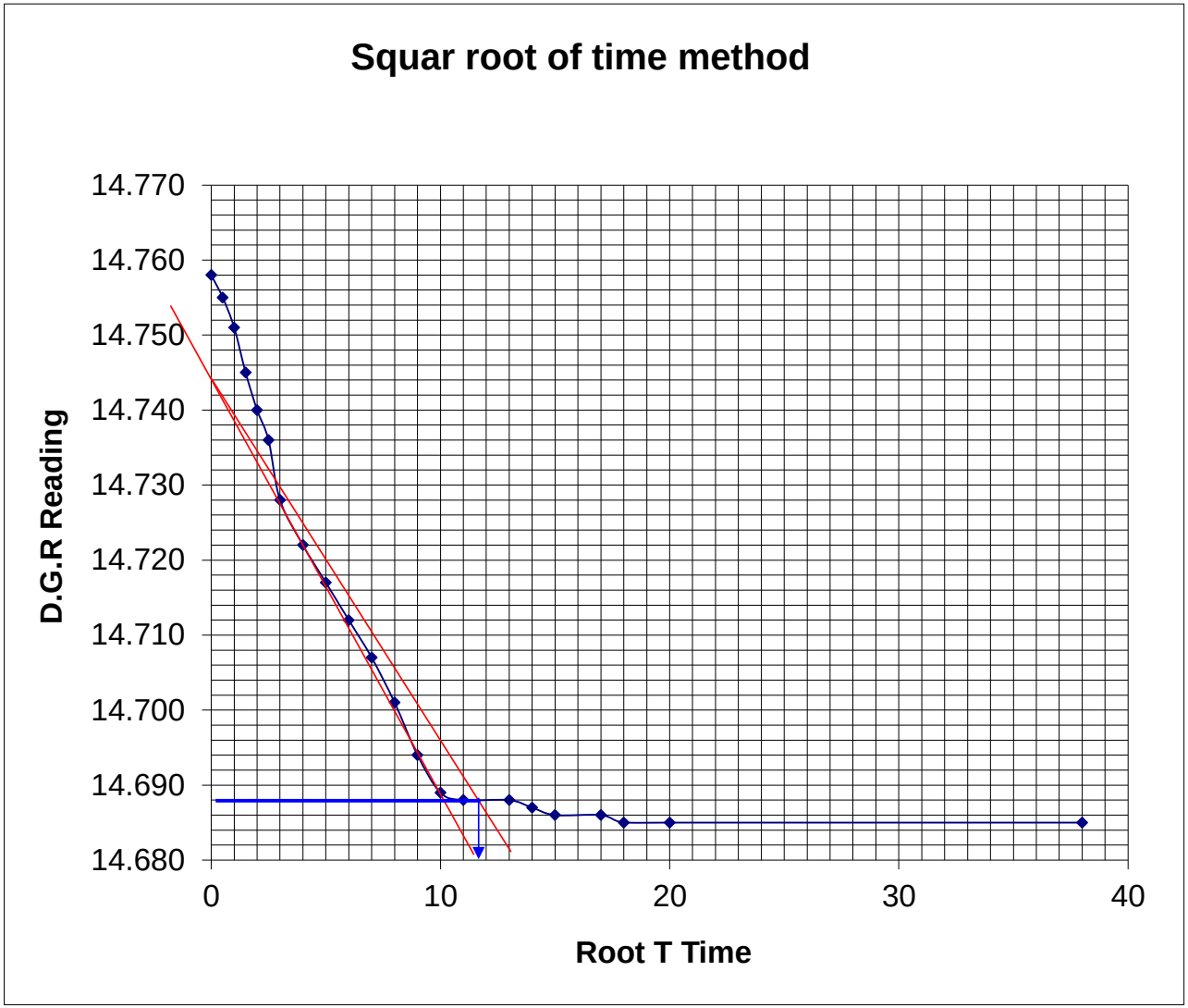
ROOT t	D.G.R
0	14.853
0.5	14.843
1	14.840
1.5	14.831
2	14.821
2.5	14.814
3	14.808
4	14.803
5	14.799
6	14.793
7	14.789
8	14.784
9	14.780
10	14.777
11	14.772
13	14.764
14	14.764
15	14.762
17	14.761
18	14.760
20	14.758
38	14.758



t_{90} = **182 min** C_v = **7.72E-05 cm^2/sec**

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

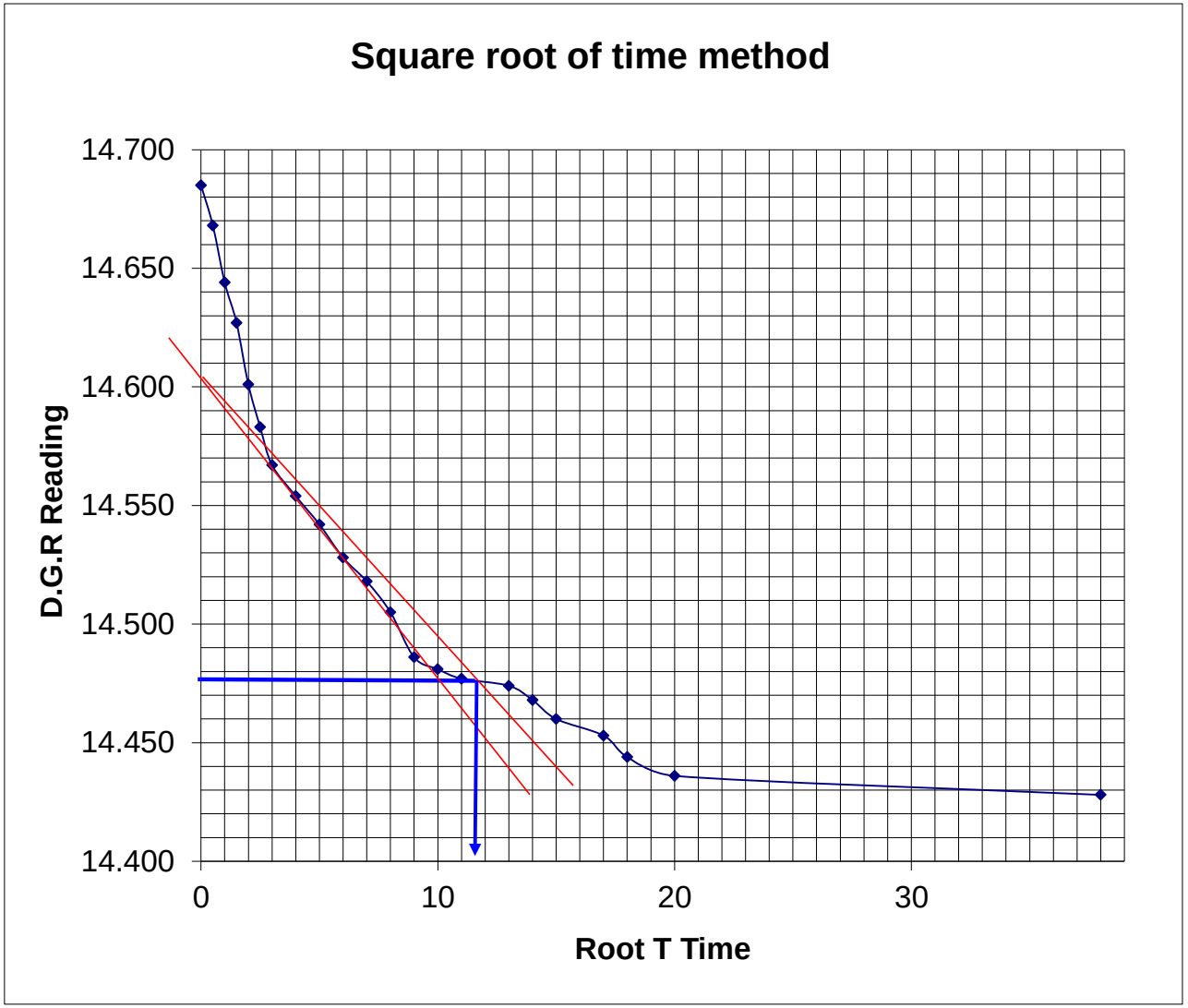
ROOT t	D.G.R
0	14.758
0.5	14.755
1	14.751
1.5	14.745
2	14.740
2.5	14.736
3	14.728
4	14.722
5	14.717
6	14.712
7	14.707
8	14.701
9	14.694
10	14.689
11	14.688
13	14.688
14	14.687
15	14.686
17	14.686
18	14.685
20	14.685
38	14.685



t_{90} = 139 min C_v = 1.00E-04 cm^2/sec

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

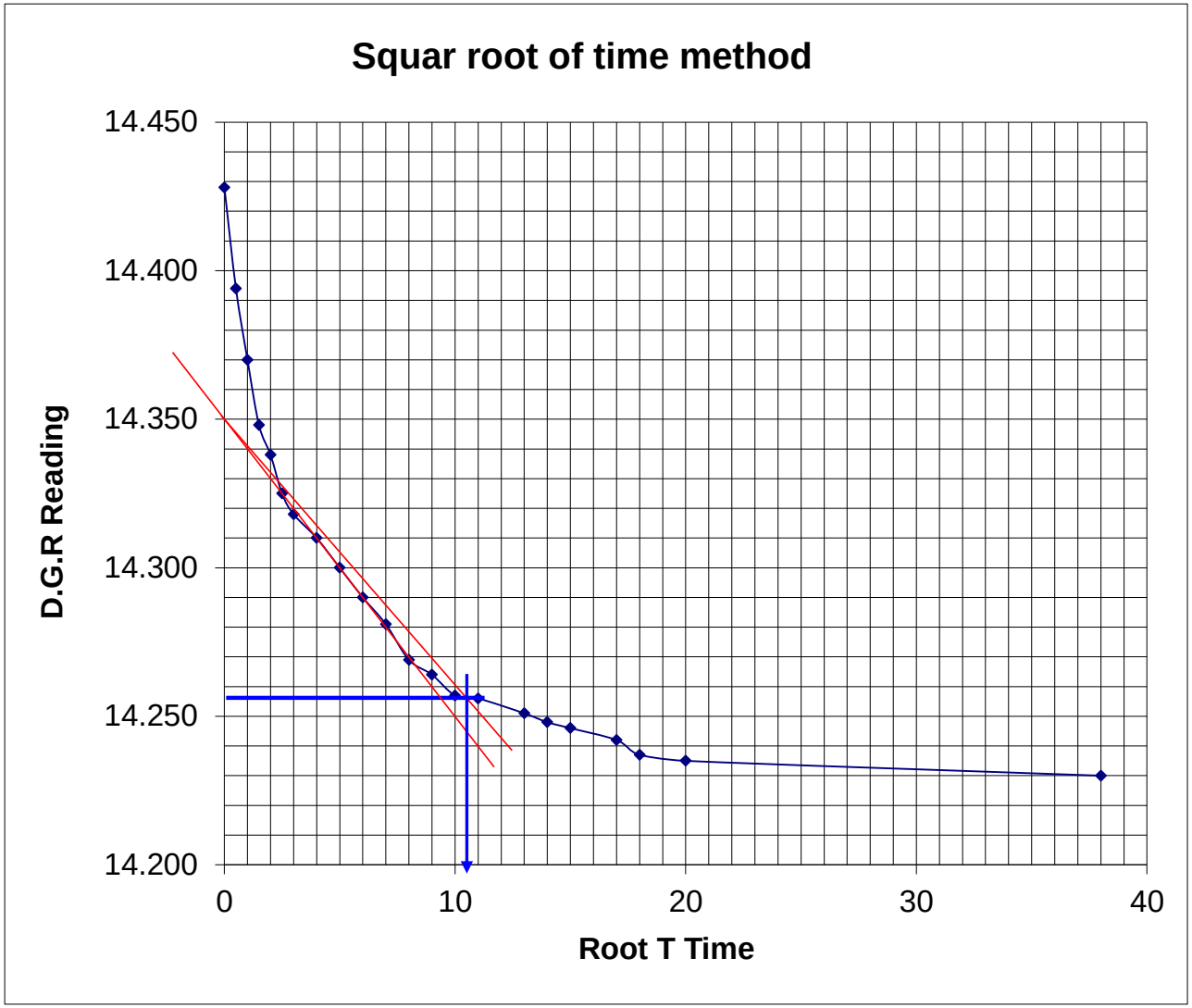
ROOT t	D.G.R
0	14.685
0.5	14.668
1	14.644
1.5	14.627
2	14.601
2.5	14.583
3	14.567
4	14.554
5	14.542
6	14.528
7	14.518
8	14.505
9	14.486
10	14.481
11	14.477
13	14.474
14	14.468
15	14.460
17	14.453
18	14.444
20	14.436
38	14.428



t_{90} = 132 min C_v = 1.04E-04 cm^2/sec

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

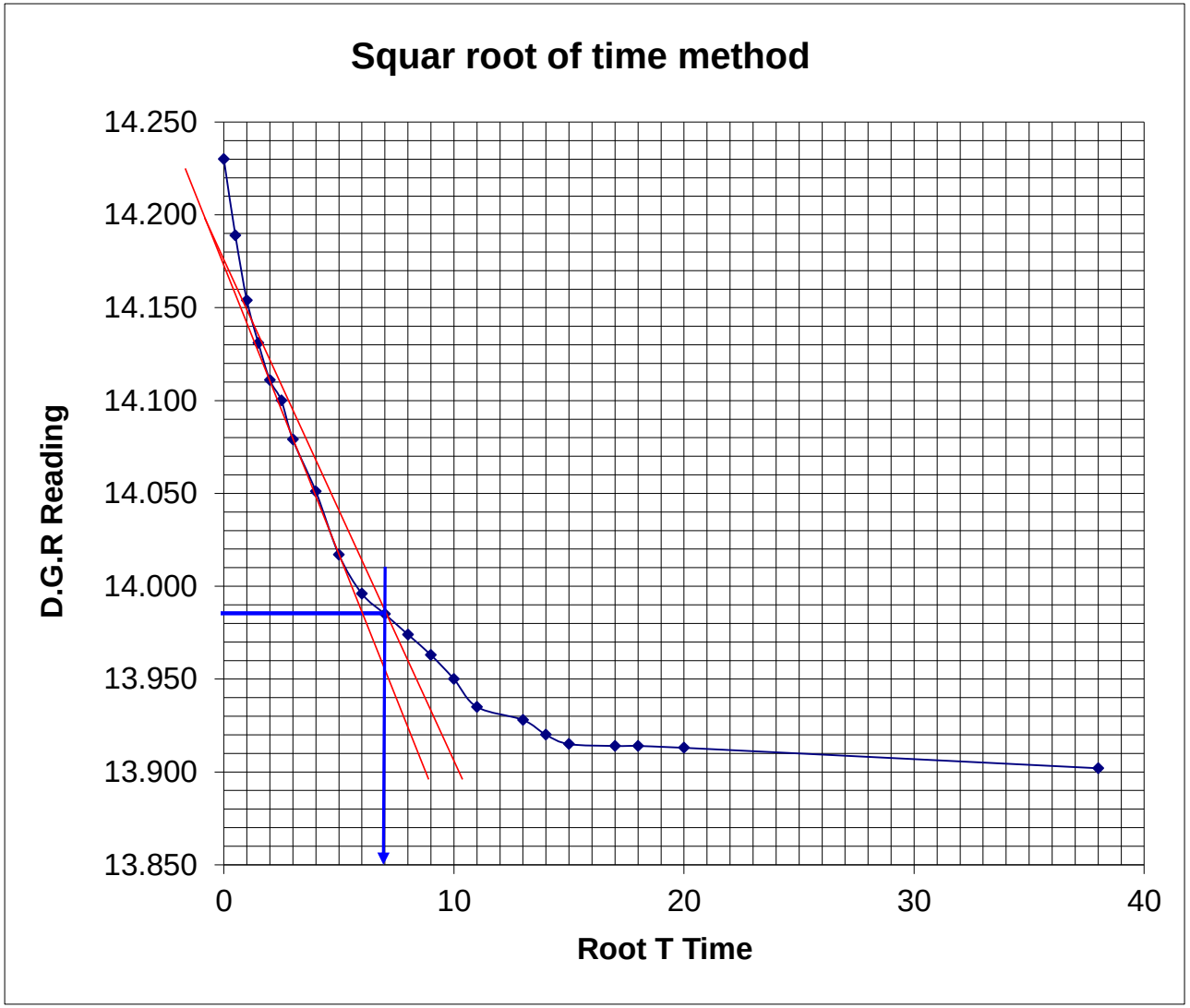
ROOT t	D.G.R
0	14.428
0.5	14.394
1	14.370
1.5	14.348
2	14.338
2.5	14.325
3	14.318
4	14.310
5	14.300
6	14.290
7	14.281
8	14.269
9	14.264
10	14.257
11	14.256
13	14.251
14	14.248
15	14.246
17	14.242
18	14.237
20	14.235
38	14.230



t_{90} = 110 min **C_v = 2.27E-04 cm^2/sec**

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

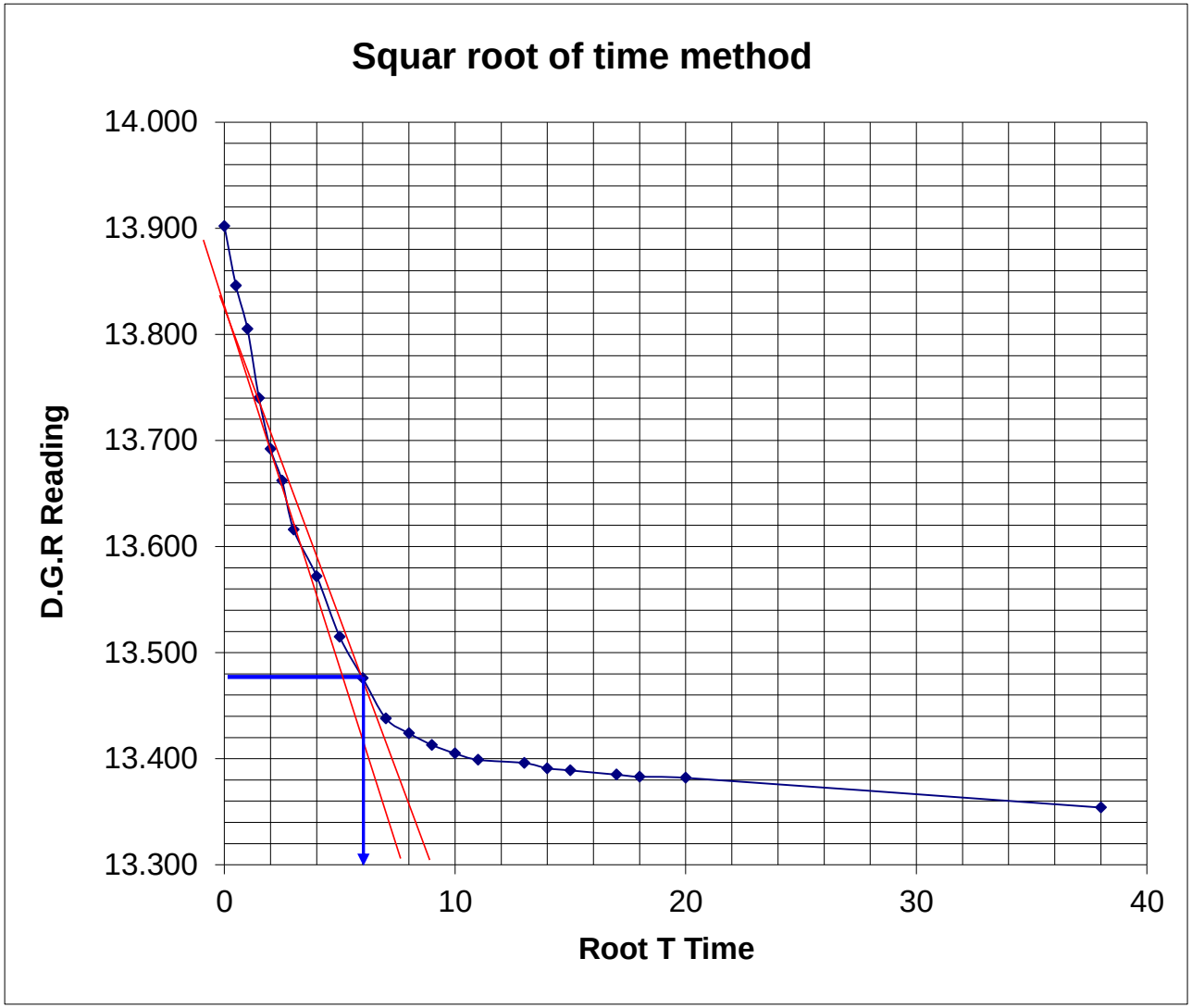
ROOT t	D.G.R
0	14.230
0.5	14.189
1	14.154
1.5	14.131
2	14.111
2.5	14.100
3	14.079
4	14.051
5	14.017
6	13.996
7	13.985
8	13.974
9	13.963
10	13.950
11	13.935
13	13.928
14	13.920
15	13.915
17	13.914
18	13.914
20	13.913
38	13.902



t_{90} = **49 min** C_v = **2.66E-04 cm^2/sec**

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

ROOT t	D.G.R
0	13.902
0.5	13.846
1	13.805
1.5	13.740
2	13.692
2.5	13.662
3	13.616
4	13.572
5	13.515
6	13.476
7	13.438
8	13.424
9	13.413
10	13.405
11	13.399
13	13.396
14	13.391
15	13.389
17	13.385
18	13.383
20	13.382
38	13.354



t_{90} = 36 min C_v = 3.46E-04 cm^2/sec

Calculation of SBC of soil as per IS: 6403(Part I) - 1981

SAFE BEARING CAPACITY OF SOIL

Plate - 3

Sample Calculation

Location : Great Rann of Kutch Area, Gujarat (BH-2 & BH-3)

Shape of footing =	Square		
Depth of footing D =	***2.00***	*m*	
Width of footing B =	***6.00***	*m*	
Length of footing L =	***6.00***	*m*	
Cohesion C =	***0.43***	*kg/cm²*	
Angle of Int.Fric ϕ =	***4***	*degrees*	
Specific Gravity G =	***2.58***		
Inclination Angle α =	***0***	*degrees*	
Correction Factor for Water Table =	***0.5***		
Dry Density Yd =	***1.512***	gm/cc	
Sat.density Ysat =	**1.926**	gm/cc	
Submerged density=	**0.926**	gm/cc	
Factor of Safety =	***2.5***		
Void Ratio eo =	***G x Yw / Yd***	***-1***	
=	*0.7063*	***it is >= 0.55 & <= 0.75***	***hence it is an intermediate shear failure***

d, s, i	***depth factor***	***shape factor***	***inclination factor***
dc, sc, ic	*1.071*	*1.300*	*1.000*
dq, sq, iq	*1.000*	*1.200*	*1.000*
d γ,s γ,i γ	*1.000*	*0.800*	*1.000*

(General Shear Failure e_o < 0.55) Φ= 4

(Local Shear Failure e_o > 0.75) Φ' = ***Tan^{-1} (0.67 tan Φ)***

Φ' = 2.68

c= ***0.430*** if e_o < 0.55, it is general shear failure

c'= ***0.287*** if e_o > 0.75, it is local shear failure

c''= ***0.318*** if e_o => 0.55 & <= 0.75, it is an intermediate shear failure

for Intermediate Shear Failure		**for Local Shear Failure**		**for General Shear Failure**	
Nc'' =	5.94	*Nc' =*	5.86	*Nc =*	6.22
Nq'' =	1.34	*Nq' =*	1.31	*Nq =*	1.46
N γ'' =	0.27	*N γ' =*	0.24	*N γ =*	0.36

Note:

Bearing capacity factors are considered in SBC analysis for Intermediate Shear Failure. These values are derived by interpolation of bearing capacity factor of local and general shear failure.

q_{un} = *cNcScdcic + q(Nq-1) Sqdqiq + 0.5 B γN γS γd γi γ W'*

for general shear failure

= ***0.00*** q_{ns} = ***0.00*** ***t/m²***

q_{un} = *c'N'cScdcic + q(N'q-1) Sqdqiq + 0.5 B γN' γS γd γi γ W'*

for local shear failure

= ***0.00*** q_{ns} = ***0.00*** ***t/m²***

q_{un} = *c''N''cScdcic + q(N''q-1) Sqdqiq + 0.5 B γN'' γS γd γi γ W'*

for intermediate shear failure

= ***27.69*** ***t/m²*** q_{ns} = ***11.07*** ***t/m²***

Safe Bearing pressure calculated for 50mm permissible as per I.S.8009 Part I for consolidated soil as shown in Plate - 4

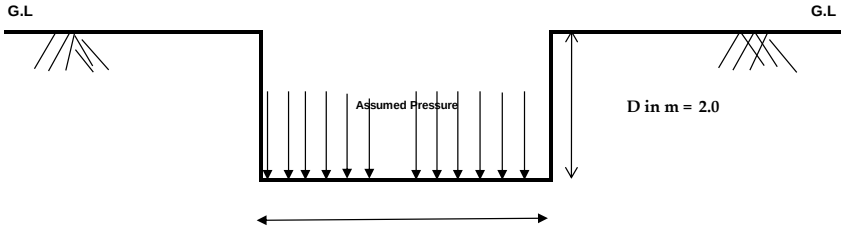


Plate - 4

Location:- **Great Rann of Kutch Area, Gujarat (BH-2 & BH-3)**

Allowable Settlement = **50mm**

Sample Calculation

B =	6.0	mtr	Width of Foundation
H =	12.0	mtr	Total Thickness of compressible strata
L=	6.0	mtr	Length of foundation
L/B =	1.0		
$D/\sqrt{LB}$ =	0.333		
$\sqrt{LB}/D$ =	3.000		

Assume pressure p = 12.77 t/m^2

1.28 kg/cm^2

Immediate Settlement $S_i = [(pxB(1-\mu^2)x\ (Iw)/(E_s)]$

where,

p = Intensity of pressure	=	1.277	in kg/cm^2
B = Least lateral dimension	=	600	in cm
μ = Poisson' ratio	=	0.500	
E_s = Modulus of elasticity of soil	=	365	in kg/cm^2
I_w =Influence factor	=	1.12	
Si = Immediate Settlement	=	17.630	in mm

Zi in m	B/2 / Zi	L/2 / Zi	I_B	Total I_B	Δ P Kg/cm²	H cm	mv cm^2/kg	Settlement, mv x **Δp x H mm**	Pore Pressure Correction factor	consolidation settlement, Sc in mm	Rigidity factor	Depth factor
6.0	0.500	0.500	0.085	0.34	0.434	1200	0.014	72.930	0.7	51.051	0.8	0.91

Total Settlement = 50.00 mm

Hence the asssumed foundation pressure of 12.77t/sq.mt is safe for the allowable settlement of 50mm

Liquefaction Assessment by Simplified Seed & Idrees method (IS 1893-P-1 : 2016)

Location **BH-1**

M =	7.5	**CRR7.5**
$(N1)_{60CS}$ =	104	0.50

Depth in m	I.S Classification	SAT g/cc	SUB g/cc	rd	6o t/m2	t av for amax/g = 0.36	6o' t/m2	**CSR** = tav/6o'	N	C_N	Hammer eff correction C_E	Hammer Correction C_H	Drill rod length correction C_R	Sampler correction Cs	Bore hole dia correction C_B	(N1)60	α	β	% fines	(N1)60CS	CRR7.5	Km [Fig A-1]	**Corrected CRR**	**FOS**	liquefaction possibility
1.50	MI	1.91	0.91	0.99	2.9	0.66	1.4	0.49	2	1.70	1.33	0.986	0.80	1.00	1.05	4	5.00	1.20	99	9	0.10	1.00	0.10	0.21	N.A (Plastic Soil)
3.00	CL	1.92	0.92	0.98	5.7	1.31	2.7	0.48	5	1.70	1.33	0.986	0.85	1.00	1.05	10	5.00	1.20	99	17	0.18	1.00	0.18	0.38	N.A (Plastic Soil)
4.50	CL	1.92	0.92	0.97	8.6	1.94	4.1	0.47	0	1.58	1.33	0.986	0.85	1.00	1.05	0	5.00	1.20	99	5	0.07	1.00	0.07	0.15	N.A (Plastic Soil)
6.00	ML	1.94	0.94	0.95	11.5	2.57	5.5	0.47	13	1.36	1.33	0.986	0.95	1.00	1.05	23	5.00	1.20	92	33	0.50	1.00	0.50	1.07	No
7.50	ML	1.94	0.94	0.94	14.4	3.18	6.9	0.46	8	1.21	1.33	0.986	0.95	1.00	1.05	13	5.00	1.20	92	20	0.21	1.00	0.21	0.46	Yes
9.00	MI	1.94	0.94	0.93	17.3	3.77	8.3	0.45	13	1.11	1.33	0.986	1.00	1.00	1.05	20	5.00	1.20	99	29	0.41	1.00	0.41	0.90	N.A (Plastic Soil)
10.50	CL	1.94	0.94	0.89	20.2	4.23	9.7	0.43	7	1.02	1.33	0.986	1.00	1.00	1.05	10	5.00	1.20	99	17	0.18	1.00	0.18	0.41	N.A (Plastic Soil)
12.00	CL	1.95	0.95	0.85	23.2	4.63	11.2	0.41	15	0.96	1.33	0.986	1.00	1.00	1.05	20	5.00	1.20	99	29	0.41	1.00	0.41	0.99	N.A (Plastic Soil)
13.50	CL	1.95	0.95	0.81	26.1	4.96	12.6	0.39	4	0.90	1.33	0.986	1.00	1.00	1.05	5	5.00	1.20	99	11	0.12	1.00	0.12	0.30	N.A (Plastic Soil)
15.00	CL	1.95	0.95	0.77	29.0	5.25	14.0	0.37	4	0.85	1.33	0.986	1.00	1.00	1.05	5	5.00	1.20	99	11	0.12	1.00	0.12	0.32	N.A (Plastic Soil)
18.00	SM	1.96	0.96	0.69	34.9	5.66	16.9	0.34	8	0.78	1.33	0.986	1.00	1.00	1.05	9	3.61	1.08	20	13	0.14	1.00	0.14	0.42	Yes
21.00	ML	1.97	0.97	0.61	40.8	5.86	19.8	0.30	41	0.72	1.33	0.986	1.00	1.00	1.05	40	5.00	1.20	99	54	0.50	1.00	0.50	1.69	No
24.00	CL	1.97	0.97	0.55	46.7	6.03	22.7	0.27	3	0.67	1.33	0.986	1.00	1.00	1.05	3	5.00	1.20	99	8	0.09	1.00	0.09	0.34	N.A (Plastic Soil)
27.00	CI	1.97	0.97	0.53	52.6	6.50	25.6	0.25	10	0.63	1.33	0.986	1.00	1.00	1.05	9	5.00	1.20	99	15	0.16	1.00	0.16	0.63	N.A (Plastic Soil)
30.00	CL	1.97	0.97	0.50	58.5	6.90	28.5	0.24	100	0.60	1.33	0.986	1.00	1.00	1.05	82	5.00	1.20	79	104	0.50	1.00	0.50	2.07	N.A (Plastic Soil)

Note: A maximum earthquake intensity of 7.5 has been considered in the analysis.

In BH-1, SPT at 4.5m is 0 which indicates very soft soil. Hence, there may be chances of excessive differencial settlement/liquefaction. The method adopted above is for cohesionless soil as per IS-1893 (P-1) but for fine soils, there are different criteria as mentioned below:

1. As per *Chinese criteria* , soil up to 7.5m which is of Non plastic characteristics having W_L >35% & W_n < 0.9W_L may not prone to liquefy.
2. As per *Modified Chinese criteria* , soils having clay particles (<0.002mm) <10% and W_L <32% is succeptible to liquefaction and soils having clay particles (<0.002mm) <10% and W_L>32% requires further studies for succeptibility to liquefaction.
3. As per *Fondation Design Manual by N.V.Nayak* , fine soils with clay & silts can also be prone to liquefaction and fine soils with I_P<7% may be analysed as cohesionless soils.

Looking to the all of the above criteria, we can conclude that soil may prone to liquefy up to 7.5m depth at BH-1.

Liquefaction Assessment by Simplified Seed & Idrees method (IS 1893-P-1 : 2016)

Location **BH-2**

M =	7.5	**CRR7.5**
$(N1)_{60CS}$ =	27	0.33

Depth in m	I.S Classification	SAT g/cc	SUB g/cc	rd	6o t/m2	t av for amax/g = 0.36	6o' t/m2	**CSR** = tav/6o'	N	C_N	Hammer eff correction C_E	Hammer Correction C_H	Drill rod length correction C_R	Sampler correction Cs	Bore hole dia correction C_B	(N1)60	**α**	**β**	% fines	(N1)60CS	CRR7.5	Km [Fig A-1]	**Corrected CRR**	**FOS**	liquefaction possibility
1.50	CH	1.93	0.93	0.99	2.9	0.67	1.4	0.48	7	1.70	1.33	0.986	0.80	1.00	1.05	13	5.00	1.20	100	21	0.22	1.00	0.22	0.46	N.A (Plastic Soil)
3.00	CL	1.93	0.93	0.98	5.8	1.32	2.8	0.48	20	1.70	1.33	0.986	0.85	1.00	1.05	40	5.00	1.20	100	53	0.50	1.00	0.50	1.05	N.A (Plastic Soil)
4.50	CI	1.93	0.93	0.97	8.7	1.96	4.2	0.47	18	1.56	1.33	0.986	0.85	1.00	1.05	33	5.00	1.20	100	45	0.50	1.00	0.50	1.06	N.A (Plastic Soil)
6.00	CI	1.92	0.92	0.95	11.6	2.58	5.6	0.46	22	1.36	1.33	0.986	0.95	1.00	1.05	39	5.00	1.20	100	52	0.50	1.00	0.50	1.08	N.A (Plastic Soil)
7.50	CI	1.92	0.92	0.94	14.4	3.19	6.9	0.46	18	1.21	1.33	0.986	0.95	1.00	1.05	29	5.00	1.20	100	39	0.50	1.00	0.50	1.09	N.A (Plastic Soil)
9.00	ML	1.95	0.95	0.93	17.4	3.78	8.4	0.45	25	1.10	1.33	0.986	1.00	1.00	1.05	38	5.00	1.20	96	51	0.50	1.00	0.50	1.11	No
10.50	ML	1.95	0.95	0.89	20.3	4.24	9.8	0.43	30	1.02	1.33	0.986	1.00	1.00	1.05	42	5.00	1.20	96	56	0.50	1.00	0.50	1.15	No
12.00	ML	1.95	0.95	0.85	23.2	4.64	11.2	0.41	36	0.95	1.33	0.986	1.00	1.00	1.05	47	5.00	1.20	97	62	0.50	1.00	0.50	1.21	No
13.50	ML	1.95	0.95	0.81	26.1	4.98	12.6	0.39	15	0.90	1.33	0.986	1.00	1.00	1.05	19	5.00	1.20	97	27	0.33	1.00	0.33	0.84	Yes
15.00	ML	1.95	0.95	0.77	29.1	5.26	14.1	0.37	37	0.85	1.33	0.986	1.00	1.00	1.05	43	5.00	1.20	97	57	0.50	1.00	0.50	1.34	No
18.00	ML	1.95	0.95	0.69	34.9	5.67	16.9	0.33	98	0.78	1.33	0.986	1.00	1.00	1.05	105	5.00	1.20	82	131	0.50	1.00	0.50	1.49	No
21.00	CL	1.95	0.95	0.61	40.8	5.85	19.8	0.30	73	0.72	1.33	0.986	1.00	1.00	1.05	72	5.00	1.20	88	92	0.50	1.00	0.50	1.69	N.A (Plastic Soil)
24.00	CI	1.97	0.97	0.55	46.7	6.03	22.7	0.27	80	0.67	1.33	0.986	1.00	1.00	1.05	74	5.00	1.20	99	94	0.50	1.00	0.50	1.88	N.A (Plastic Soil)
27.00	CI	1.97	0.97	0.53	52.6	6.50	25.6	0.25	26	0.63	1.33	0.986	1.00	1.00	1.05	23	5.00	1.20	99	32	0.50	1.00	0.50	1.97	N.A (Plastic Soil)
30.00	Rock	_	_	_	_	_	_	_	R	_	_	_	_	_	_	R	_	_	_	Refusal	_	_	_	_	N.A (Rock)

Note: A maximum earthquake intensity of 7.5 has been considered in the analysis.

The method adopted above is for cohesionless soil as per IS-1893 (P-1) but for fine soils, there are different criteria as mentioned below:

1. As per *Chinese criteria* , soil having W_L >35% & W_n < 0.9W_L may not prone to liquefy.
2. As per *Modified Chinese criteria* , soils having clay particles (<0.002mm) <10% and W_L <32% is succeptible to liquefaction and soils having clay particles (<0.002mm) <10% and W_L>32% requires further studies for succeptibility to liquefaction.
3. As per *Fondation Design Manual by N.V.Nayak* , fine soils with clay & silts can also be prone to liquefaction and fine soils with I_P<7% may be analysed as cohesionless soils.

Looking to the all of the above criteria, we can conclude that soil may not prone to liquefy at BH-2.

Liquefaction Assessment by Simplified Seed & Idrees method (IS 1893-P-1 : 2016)

Location **BH-3**

M =	7.5	**CRR7.5**
$(N1)_{60CS}$ =	16	0.17

Depth in m	I.S Classification	SAT g/cc	SUB g/cc	rd	6o t/m2	t av for amax/g = 0.36	6o' t/m2	**CSR** = tav/6o'	N	C_N	Hammer eff correction C_E	Hammer Correction C_H	Drill rod length correction C_R	Sampler correction Cs	Bore hole dia correction C_B	(N1)60	**α**	**β**	% fines	(N1)60CS	CRR7.5	Km [Fig A-1]	**Corrected CRR**	**FOS**	liquefaction possibility
1.50	MI	1.92	0.92	0.99	2.9	0.67	1.4	0.48	5	1.70	1.33	0.986	0.80	1.00	1.05	9	5.00	1.20	100	16	0.17	1.00	0.17	0.35	N.A (Plastic Soil)
3.00	CI	1.92	0.92	0.98	5.8	1.32	2.8	0.48	21	1.70	1.33	0.986	0.85	1.00	1.05	42	5.00	1.20	99	55	0.50	1.00	0.50	1.05	N.A (Plastic Soil)
4.50	CI	1.92	0.92	0.97	8.7	1.96	4.2	0.47	6	1.57	1.33	0.986	0.85	1.00	1.05	11	5.00	1.20	99	18	0.19	1.00	0.19	0.40	N.A (Plastic Soil)
6.00	CL	1.94	0.94	0.95	11.6	2.58	5.6	0.46	17	1.35	1.33	0.986	0.95	1.00	1.05	30	5.00	1.20	100	41	0.50	1.00	0.50	1.08	N.A (Plastic Soil)
7.50	CL-ML	1.94	0.94	0.94	14.5	3.19	7.0	0.46	35	1.21	1.33	0.986	0.95	1.00	1.05	55	5.00	1.20	100	71	0.50	1.00	0.50	1.09	No
9.00	ML	1.95	0.95	0.93	17.4	3.79	8.4	0.45	66	1.10	1.33	0.986	1.00	1.00	1.05	100	5.00	1.20	91	125	0.50	1.00	0.50	1.11	No
10.50	ML	1.95	0.95	0.89	20.3	4.25	9.8	0.43	33	1.02	1.33	0.986	1.00	1.00	1.05	46	5.00	1.20	91	61	0.50	1.00	0.50	1.16	No
12.00	ML	1.96	0.96	0.85	23.3	4.65	11.3	0.41	47	0.95	1.33	0.986	1.00	1.00	1.05	62	5.00	1.20	99	79	0.50	1.00	0.50	1.21	No
13.50	CL-ML	1.96	0.96	0.81	26.2	4.99	12.7	0.39	18	0.90	1.33	0.986	1.00	1.00	1.05	22	5.00	1.20	99	32	0.50	1.00	0.50	1.27	No
15.00	CL-ML	1.96	0.96	0.77	29.1	5.27	14.1	0.37	63	0.85	1.33	0.986	1.00	1.00	1.05	74	5.00	1.20	99	93	0.50	1.00	0.50	1.34	No
18.00	SM	2.00	1.00	0.69	35.1	5.70	17.1	0.33	74	0.77	1.33	0.986	1.00	1.00	1.05	79	4.39	1.12	26	93	0.50	1.00	0.50	1.50	No
21.00	CL-ML	2.00	1.00	0.61	41.1	5.90	20.1	0.29	70	0.71	1.33	0.986	1.00	1.00	1.05	69	5.00	1.20	99	87	0.50	1.00	0.50	1.71	No
24.00	MI	1.97	0.97	0.55	47.0	6.08	23.0	0.26	75	0.67	1.33	0.986	1.00	1.00	1.05	69	5.00	1.20	99	87	0.50	1.00	0.50	1.90	N.A (Plastic Soil)
27.00	MI	1.97	0.97	0.53	52.9	6.54	25.9	0.25	23	0.63	1.33	0.986	1.00	1.00	1.05	20	5.00	1.20	99	29	0.41	1.00	0.41	1.63	N.A (Plastic Soil)
30.00	Overconsolidated Soil	1.97	0.97	0.50	58.8	6.94	28.8	0.24	–	–	–	–	–	–	–	–	–	–	89	–	–	–	–	–	N.A (Overconsolidated Soil)

1) A maximum earthquake intensity of 7.5 has been considered in the analysis.

The method adopted above is for cohesionless soil as per IS-1893 (P-1) but for fine soils, there are different criteria as mentioned below:

1. As per *Chinese criteria* , soil having W_L >35% & W_n < 0.9W_L may not prone to liquefy.
2. As per *Modified Chinese criteria* , soils having clay particles (<0.002mm) <10% and W_L <32% is susceptible to liquefaction and soils having clay particles (<0.002mm) <10% and W_L>32% requires further studies for succeptibility to liquefaction.
3. As per *Fondation Design Manual by N.V.Nayak* , fine soils with clay & silts can also be prone to liquefaction and fine soils with I_P<7% may be analysed as cohesionless soils.

Looking to the all of the above criteria, we can conclude that soil may not prone to liquefy at BH-3.

Liquefaction Assessment by Simplified Seed & Idrees method (IS 1893-P-1 : 2016)

Location **BH-4**

M =	7.5	**CRR7.5**
$(N1)_{60CS}$ =	20	0.21

Depth in m	I.S Classification	SAT g/cc	SUB g/cc	rd	6o t/m2	t av for amax/g = 0.36	6o' t/m2	**CSR** = tav/6o'	N	C_N	Hammer eff correction C_E	Hammer Correction C_H	Drill rod length correction C_R	Sampler correction Cs	Bore hole dia correction C_B	(N1)60	**α**	**β**	% fines	(N1)60CS	CRR7.5	Km [Fig A-1]	**Corrected CRR**	**FOS**	liquefaction possibility
1.50	CI	1.92	0.92	0.99	2.9	0.66	1.4	0.48	6	1.70	1.33	0.986	0.80	1.00	1.05	11	5.00	1.20	94	18	0.19	1.00	0.19	0.39	N.A (Plastic Soil)
3.00	MI	1.91	0.91	0.98	5.7	1.31	2.7	0.48	3	1.70	1.33	0.986	0.85	1.00	1.05	6	5.00	1.20	100	12	0.13	1.00	0.13	0.27	N.A (Plastic Soil)
4.50	ML	1.91	0.91	0.97	8.6	1.94	4.1	0.47	2	1.58	1.33	0.986	0.85	1.00	1.05	4	5.00	1.20	85	9	0.10	1.00	0.10	0.21	Yes
6.00	ML	1.92	0.92	0.95	11.5	2.56	5.5	0.47	16	1.36	1.33	0.986	0.95	1.00	1.05	29	5.00	1.20	85	39	0.50	1.00	0.50	1.07	No
7.50	ML	1.92	0.92	0.94	14.4	3.17	6.9	0.46	10	1.22	1.33	0.986	0.95	1.00	1.05	16	5.00	1.20	85	24	0.27	1.00	0.27	0.58	Yes
9.00	MI	1.92	0.92	0.93	17.2	3.76	8.2	0.46	18	1.11	1.33	0.986	1.00	1.00	1.05	28	5.00	1.20	96	38	0.50	1.00	0.50	1.10	No
10.50	MI	1.92	0.92	0.89	20.1	4.21	9.6	0.44	22	1.03	1.33	0.986	1.00	1.00	1.05	31	5.00	1.20	96	42	0.50	1.00	0.50	1.14	No
12.00	MI	1.96	0.96	0.85	23.1	4.61	11.1	0.42	32	0.96	1.33	0.986	1.00	1.00	1.05	42	5.00	1.20	97	56	0.50	1.00	0.50	1.20	No
13.50	CL	1.96	0.96	0.81	26.0	4.95	12.5	0.40	15	0.90	1.33	0.986	1.00	1.00	1.05	19	5.00	1.20	94	27	0.33	1.00	0.33	0.83	N.A (Plastic Soil)
15.00	CL	1.95	0.95	0.77	28.9	5.24	13.9	0.38	22	0.86	1.33	0.986	1.00	1.00	1.05	26	5.00	1.20	94	36	0.50	1.00	0.50	1.33	N.A (Plastic Soil)
18.00	ML	1.98	0.98	0.69	34.9	5.66	16.9	0.34	50	0.78	1.33	0.986	1.00	1.00	1.05	54	5.00	1.20	81	69	0.50	1.00	0.50	1.49	No
21.00	ML	1.95	0.95	0.61	40.7	5.84	19.7	0.30	56	0.72	1.33	0.986	1.00	1.00	1.05	55	5.00	1.20	58	72	0.50	1.00	0.50	1.69	No
24.00	CI	1.97	0.97	0.55	46.6	6.02	22.6	0.27	16	0.67	1.33	0.986	1.00	1.00	1.05	15	5.00	1.20	99	23	0.25	1.00	0.25	0.94	N.A (Plastic Soil)
27.00	MI	1.97	0.97	0.53	52.5	6.49	25.5	0.25	14	0.63	1.33	0.986	1.00	1.00	1.05	12	5.00	1.20	99	20	0.21	1.00	0.21	0.83	N.A (Plastic Soil)
30.00	Rock	–	–	–	–	–	–	–	R	–	–	–	–	–	–	R	–	–	–	Refusal	–	–	–	–	N.A (Rock)

1) A maximum earthquake intensity of 7.5 has been considered in the analysis.

In BH-4, SPT at 4.5m is 2 which indicates very soft soil. Hence, there may be chances of excessive differencial settlement/liquefaction. The method adopted above is for cohesionless soil as per IS-1893 (P-1) but for fine soils, there are different criteria as mentioned below:

1. As per *Chinese criteria* , soil up to 7.5m which is of Non plastic characteristics having W_L >35% & W_n < 0.9W_L may not prone to liquefy.
2. As per *Modified Chinese criteria* , soils having clay particles (<0.002mm) <10% and W_L <32% is succeptible to liquefaction and soils having clay particles (<0.002mm) <10% and W_L>32% requires further studies for succeptibility to liquefaction.
3. As per *Fondation Design Manual by N.V.Nayak* , fine soils with clay & silts can also be prone to liquefaction and fine soils with I_P<7% may be analysed as cohesionless soils.

Looking to the all of the above criteria, we can conclude that soil may prone to liquefy up to 7.5m depth at BH-4.

Liquefaction Assessment by Simplified Seed & Idrees method (IS 1893-P-1 : 2016)

Location **BH-5**

M =	7.5	**CRR7.5**
$(N1)_{60CS}$ =	19	0.20

Depth in m	I.S Classification	SAT g/cc	SUB g/cc	rd	6o t/m2	t av for amax/g = 0.36	6o' t/m2	**CSR** = tav/6o'	N	C_N	Hammer eff correction C_E	Hammer Correction C_H	Drill rod length correction C_R	Sampler correction Cs	Bore hole dia correction C_B	(N1)60	**α**	**β**	% fines	(N1)60CS	CRR7.5	Km [Fig A-1]	**Corrected CRR**	**FOS**	liquefaction possibility
1.50	MI	1.91	0.91	0.99	2.9	0.66	1.4	0.48	1	1.70	1.33	0.986	0.80	1.00	1.05	2	5.00	1.20	100	7	0.08	1.00	0.08	0.17	N.A (Plastic Soil)
3.00	MI	1.91	0.91	0.98	5.7	1.31	2.7	0.48	23	1.70	1.33	0.986	0.85	1.00	1.05	46	5.00	1.20	100	60	0.50	1.00	0.50	1.04	N.A (Plastic Soil)
4.50	MI	1.91	0.91	0.97	8.6	1.95	4.1	0.47	0	1.58	1.33	0.986	0.85	1.00	1.05	0	5.00	1.20	100	5	0.07	1.00	0.07	0.15	N.A (Plastic Soil)
6.00	CL	1.93	0.93	0.95	11.5	2.57	5.5	0.47	16	1.36	1.33	0.986	0.95	1.00	1.05	28	5.00	1.20	99	39	0.50	1.00	0.50	1.07	N.A (Plastic Soil)
7.50	ML	1.93	0.93	0.94	14.4	3.18	6.9	0.46	15	1.22	1.33	0.986	0.95	1.00	1.05	24	5.00	1.20	99	34	0.50	1.00	0.50	1.09	No
9.00	ML	1.97	0.97	0.93	17.3	3.78	8.3	0.45	22	1.11	1.33	0.986	1.00	1.00	1.05	33	5.00	1.20	96	45	0.50	1.00	0.50	1.10	No
10.50	ML	1.97	0.97	0.89	20.3	4.25	9.8	0.43	10	1.02	1.33	0.986	1.00	1.00	1.05	14	5.00	1.20	96	22	0.24	1.00	0.24	0.55	Yes
12.00	ML	1.97	0.97	0.85	23.3	4.64	11.3	0.41	25	0.95	1.33	0.986	1.00	1.00	1.05	33	5.00	1.20	84	44	0.50	1.00	0.50	1.21	No
13.50	ML	1.97	0.97	0.81	26.2	4.99	12.7	0.39	17	0.90	1.33	0.986	1.00	1.00	1.05	21	5.00	1.20	84	30	0.46	1.00	0.46	1.17	No
15.00	ML	1.97	0.97	0.77	29.2	5.28	14.2	0.37	26	0.85	1.33	0.986	1.00	1.00	1.05	30	5.00	1.20	84	41	0.50	1.00	0.50	1.34	No
18.00	SM	2.06	1.06	0.69	35.3	5.73	17.3	0.33	73	0.77	1.33	0.986	1.00	1.00	1.05	77	5.00	1.20	45	98	0.50	1.00	0.50	1.51	No
21.00	ML	2.07	1.07	0.61	41.5	5.96	20.5	0.29	72	0.70	1.33	0.986	1.00	1.00	1.05	70	5.00	1.20	53	89	0.50	1.00	0.50	1.72	No
24.00	MI	1.97	0.97	0.55	47.4	6.13	23.4	0.26	0	0.66	1.33	0.986	1.00	1.00	1.05	0	5.00	1.20	99	5	0.07	1.00	0.07	0.27	N.A (Plastic Soil)
27.00	MI	1.97	0.97	0.53	53.3	6.59	26.3	0.25	14	0.62	1.33	0.986	1.00	1.00	1.05	12	5.00	1.20	99	19	0.20	1.00	0.20	0.80	N.A (Plastic Soil)
30.00	MI	1.97	0.97	0.50	59.2	6.99	29.2	0.24	95	0.59	1.33	0.986	1.00	1.00	1.05	77	5.00	1.20	61	98	0.50	1.00	0.50	2.09	N.A (Plastic Soil)

1) A maximum earthquake intensity of 7.5 has been considered in the analysis.

In BH-5, SPT at 4.5m is 0 which indicates very soft soil. Hence, there may be chances of excessive differencial settlement/liquefaction. The method adopted above is for cohesionless soil as per IS-1893 (P-1) but for fine soils, there are different criteria as mentioned below:

1. As per *Chinese criteria* , soil having W_L >35% & W_n < 0.9W_L may not prone to liquefy.
2. As per *Modified Chinese criteria* , soils having clay particles (<0.002mm) <10% and W_L <32% is succeptible to liquefaction and soils having clay particles (<0.002mm) <10% and W_L>32% requires further studies for succeptibility to liquefaction.
3. As per *Fondation Design Manual by N.V.Nayak* , fine soils with clay & silts can also be prone to liquefaction and fine soils with I_P<7% may be analysed as cohesionless soils.

Looking to the all of the above criteria, we can conclude that soil may not prone to liquefy at BH-5.

Pile Capacity Calculation for Bored Cast in-situ Pile

Layer 1	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult}$ = Σ K x Pdi x tan δ x As+ α x C x A_s		Location
			Zone-I
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	750
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0
		Bottom overburden pressure, kg/cm^2	0.000
		Effective overburden pressure , kg/cm^2	0.000
6	γ	Unit weight in kg/cm^3	0.00000
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0.18
9	δ (Φ)	Angle of wall friction between pile and soil, degree	24
10		Depth of liquefiable strata in cm	750
11	As=Asi	Surface area of pile shaft in cm^2	0
12		Unit ultimate side resistance ,kg/cm^2	0.180
13	$(Rf)_{ult}$	Ultimate side resistance, MT	0.00
14		Factor of safety	2.5
15	**Rf**	Safe side resistance in MT	0.00

Layer 2	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult}$ = Σ K x Pdi x tan δ x As+ α x C x A_s		Location
			Zone-I
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	400
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0.000
		Bottom overburden pressure, kg/cm^2	0.375
		Effective overburden pressure , kg/cm^2	0.187
6	γ	Unit weight in kg/cm^3	0.001
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0.08
9	δ (Φ)	Angle of wall friction between pile and soil, degree	22
10	As=Asi	Surface area of pile shaft in cm^2	62832
11		Unit ultimate side resistance ,kg/cm^2	0.2
12	$(Rf)_{ult}$	Ultimate side resistance, MT	9.78
13		Factor of safety	2.5
14	**Rf**	Safe side resistance in MT	3.9

Layer 3	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult} = \Sigma K \times Pdi \times \tan\delta \times As + \alpha \times C \times A_s$		Location
			Zone-I
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	350
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0.375
		Bottom overburden pressure, kg/cm^2	0.707
		Effective overburden pressure , kg/cm^2	0.541
6	γ	Unit weight in kg/cm^3	0.001
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0.2
9	δ (Φ)	Angle of wall friction between pile and soil, degree	15
10	As=Asi	Surface area of pile shaft in cm^2	54978
11		Unit ultimate side resistance ,kg/cm^2	0.3
12	$(Rf)_{ult}$	Ultimate side resistance, MT	18.97
13		Factor of safety	2.5
14	**Rf**	Safe side resistance in MT	7.6

Layer 4	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult} = \Sigma K \times Pdi \times \tan\delta \times As + \alpha \times C \times A_s$		Location
			Zone-I
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	250
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0.707
		Bottom overburden pressure, kg/cm^2	0.707
		Effective overburden pressure , kg/cm^2	0.707
6	γ	Unit weight in kg/cm^3	0.001
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0.2
9	δ (Φ)	Angle of wall friction between pile and soil, degree	15
10	As=Asi	Surface area of pile shaft in cm^2	39270
11		Unit ultimate side resistance ,kg/cm^2	0.4
12	$(Rf)_{ult}$	Ultimate side resistance, MT	15.30
13		Factor of safety	2.5
14	**Rf**	Safe side resistance in MT	6.1

Layer 5	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult}$ = Σ K x Pdi x tan δ x As+ α x C x A_s		Location
			Zone-I
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	600
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0.707
		Bottom overburden pressure, kg/cm^2	0.707
		Effective overburden pressure , kg/cm^2	0.707
6	γ	Unit weight in kg/cm^3	0.00097
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0
9	δ (Φ)	Angle of wall friction between pile and soil, degree	28
10	As=Asi	Surface area of pile shaft in cm^2	94248
11		Unit ultimate side resistance ,kg/cm^2	0.4
12	$(Rf)_{ult}$	Ultimate side resistance, MT	35.45
13		Factor of safety	2.5
14	**Rf**	Safe side resistance in MT	14.2

Layer 6	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult}$ = Σ K x Pdi x tan δ x As+ α x C x A_s		Location
			Zone-I
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	300
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0.707
		Bottom overburden pressure, kg/cm^2	0.707
		Effective overburden pressure , kg/cm^2	0.707
6	γ	Unit weight in kg/cm^3	0.00098
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0.24
9	δ (Φ)	Angle of wall friction between pile and soil, degree	16
10	As=Asi	Surface area of pile shaft in cm^2	47124
11		Unit ultimate side resistance ,kg/cm^2	0.4
12	$(Rf)_{ult}$	Ultimate side resistance, MT	20.87
13		Factor of safety	2.5
14	**Rf**	Safe side resistance in MT	8.3

BASE RESISTANCE IN SOIL AS PER IS:2911 $Ru = Ap(1/2\ D \times \gamma \times N_\gamma + P_d \times N_q) + (A_p \times N_c \times C_p)$			
1	D	Pile Dia in cms	50
2	Ap	Cross Section area of base of pile in cm^2	1963
3	γ	Effective unit weight of soil at pile tip in kg/cm^3	0.00091
4	ø	Angle of internal friction around pile tip in degree	16.00
5	N_γ	Bearing capacity factor based on angle of internal friction at pile tip	3.06
6	Pd	Effective overburden pressure at pile tip kg/cm^2	0.707
7	N_q	Bearing capacity factor based on angle of internal friction at pile tip	2.72
8	N_c	Bearing capacity factor usually taken as 9	9
9	C_p	Average cohesion at pile tip,kg/cm^2	0.24
10		Ultimate base resistance,kg/cm^2	4.2
11	Ru	Ultimate base resistance, MT	8.16
12		Factor of safety	2.5
13	(Qb)s	Safe base resistance in MT	3.26

Sr No	CAPACITY OF BORED CAST IN SITU PILE		
1	**D**	STEM DIA IN CM	50.0
2	**L**	TOTAL LENGTH OF PILE BELOW CUT-OFF LEVEL, IN M	26.50
3	**Qs**	**TOTAL SAFE CAPACITY OF PILE IN MT**	**43.4**
4	$(Q_{uplift})_s$	**SAFE UPLIFT CAPACITY IN MT**	**33.5**

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 if considered up to 7.5m depth.

4) Maximum overburden pressure at bottom of pile for calculation of Skin resistance and bearing resistance is limited to overburden pressure at depth equal to 15 times diameter of pile considered EGL.

Pile Capacity Calculation for Bored Cast in-situ Pile

Layer 1	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult} = \Sigma K \times Pdi \times \tan\delta \times As + \alpha \times C \times A_s$		Location
			Zone-II
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	550
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0
		Bottom overburden pressure, kg/cm^2	0.508
		Effective overburden pressure , kg/cm^2	0.254
6	γ	Unit weight in kg/cm^3	0.00092
7	α	Reduction factor	0.9
8	C	Average cohesion ,kg/cm^2	0.43
9	δ (Φ)	Angle of wall friction between pile and soil, degree	6
10		Cut-off length in cm	0
11	As=Asi	Surface area of pile shaft in cm^2	86394
12		Unit ultimate side resistance ,kg/cm^2	0.414
13	$(Rf)_{ult}$	Ultimate side resistance, MT	35.74
14		Factor of safety	2.5
15	**Rf**	Safe side resistance in MT	14.30

Layer 2	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult} = \Sigma K \times Pdi \times \tan\delta \times As + \alpha \times C \times A_s$		Location
			Zone-II
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	200
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0.508
		Bottom overburden pressure, kg/cm^2	0.696
		Effective overburden pressure , kg/cm^2	0.602
6	γ	Unit weight in kg/cm^3	0.00094
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0.38
9	δ (Φ)	Angle of wall friction between pile and soil, degree	14
10	As=Asi	Surface area of pile shaft in cm^2	31416
11		Unit ultimate side resistance ,kg/cm^2	0.5
12	$(Rf)_{ult}$	Ultimate side resistance, MT	16.66
13		Factor of safety	2.5
14	**Rf**	Safe side resistance in MT	6.7

Layer 3	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult} = \Sigma K \times Pdi \times \tan\delta \times As + \alpha \times C \times A_s$		Location
			Zone-II
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	400
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0.696
		Bottom overburden pressure, kg/cm^2	0.696
		Effective overburden pressure , kg/cm^2	0.696
6	γ	Unit weight in kg/cm^3	0.00095
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0.38
9	$\delta(\Phi)$	Angle of wall friction between pile and soil, degree	14
10	As=Asi	Surface area of pile shaft in cm^2	62832
11		Unit ultimate side resistance ,kg/cm^2	0.6
12	$(Rf)_{ult}$	Ultimate side resistance, MT	34.79
13		Factor of safety	2.5
14	**Rf**	Safe side resistance in MT	13.9

Layer 4	SIDE RESISTANCE IN SOIL AS PER IS:2911		
	LOAD CARRYING CAPACITY-FOR ULTIMATE SIDE RESITANCE $(R_f)_{ult} = \Sigma K \times Pdi \times \tan\delta \times As + \alpha \times C \times A_s$		Location
			Zone-II
1	D	Stem dia , cm	50
2	L	Total length of pile , cm	100
3	Ap	C/S area of base of pile , cm^2	1963.5
4	K	Coefficient of earth pressure	1
5	Pdi	Top overburden pressure, kg/cm^2	0.696
		Bottom overburden pressure, kg/cm^2	0.696
		Effective overburden pressure , kg/cm^2	0.696
6	γ	Unit weight in kg/cm^3	0.00096
7	α	Reduction factor	1
8	C	Average cohesion ,kg/cm^2	0.15
9	$\delta(\Phi)$	Angle of wall friction between pile and soil, degree	26
10	As=Asi	Surface area of pile shaft in cm^2	15708
11		Unit ultimate side resistance ,kg/cm^2	0.5
12	$(Rf)_{ult}$	Ultimate side resistance, MT	7.69
13		Factor of safety	2.5
14	**Rf**	Safe side resistance in MT	3.1

BASE RESISTANCE IN SOIL AS PER IS:2911 $Ru = Ap(1/2\ D \times \gamma \times N_\gamma + P_d \times N_q) + (A_p \times N_c \times C_p)$			
1	D	Pile Dia in cms	50
2	Ap	Cross Section area of base of pile in cm^2	1963
3	γ	Effective unit weight of soil at pile tip in kg/cm^3	0.00096
4	ø	Angle of internal friction around pile tip in degree	26.00
5	N_γ	Bearing capacity factor based on angle of internal friction at pile tip	12.54
6	Pd	Effective overburden pressure at pile tip kg/cm^2	0.696
7	N_q	Bearing capacity factor based on angle of internal friction at pile tip	11.50
8	N_c	Bearing capacity factor usually taken as 9	9
9	C_p	Average cohesion at pile tip,kg/cm^2	0.15
10		Ultimate base resistance,kg/cm^2	9.7
11	Ru	Ultimate base resistance, MT	18.96
12		Factor of safety	2.5
13	(Qb)s	Safe base resistance in MT	7.59

Sr No	CAPACITY OF BORED CAST IN SITU PILE		
1	**D**	STEM DIA IN CM	50.0
2	**L**	TOTAL LENGTH OF PILE BELOW CUT-OFF LEVEL, IN M	12.50
3	**Qs**	**TOTAL SAFE CAPACITY OF PILE IN MT**	**45.5**
4	$(Q_{uplift})_s$	**SAFE UPLIFT CAPACITY IN MT**	**31.6**

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.

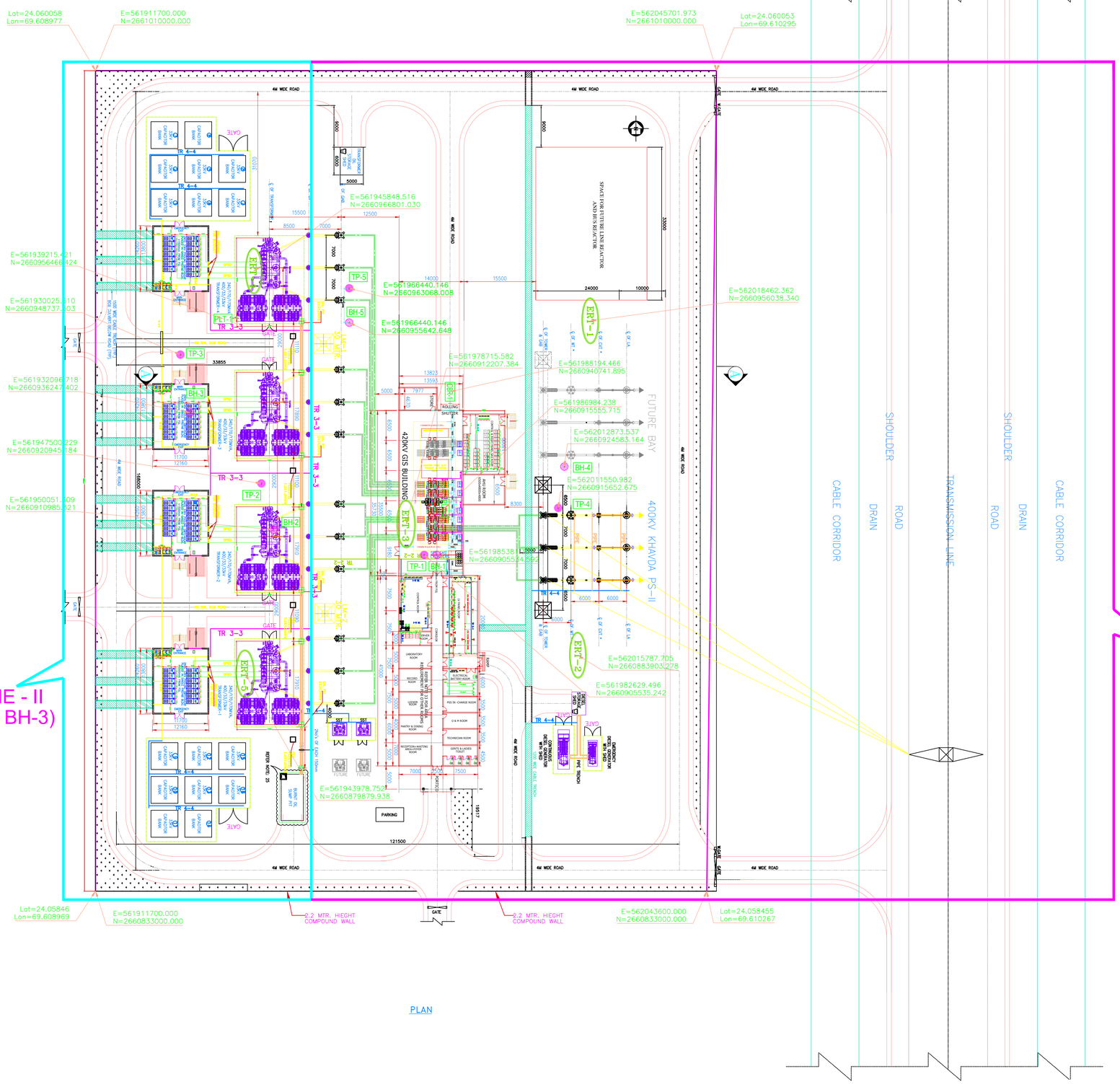
2) The safe load of pile shown in above table are subjected to initial pile load test as per I.S.Codal provision.

3) Maximum overburden pressure at bottom of pile for calculation of Skin resistance and bearing resistance is limited to overburden pressure at depth equal to 15 times diameter of pile considered EGL.

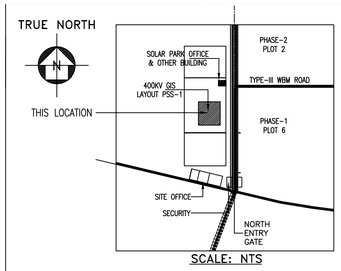
CAPACITY OF SINGLE UR PILE (IS-2911, P- III) :

LOCATION : ZONE-II

			30	35	40
D	=	stem diameter in cm	707	962	1257
A_p	=	cross-sectional area of pile stem at toe in cm^2	9	9	9
N_c	=	bearing capacity factor	0.38	0.38	0.38
C_p	=	cohesion around toe in kg/cm^2	75	87.5	100
D_u	=	underreamed bulb dia in cm	3711	5051	6597
A_a	=	$\{ \pi (D_u^2 - D^2) / 4 \}$ in cm^2	0.41	0.41	0.41
C_a'	=	average cohesion around the bulbs in kg/cm^2	0.0008	0.0008	0.0008
γ	=	average unit weight of soil in kg/cm^3	10	10	10
ϕ	=	angle of internal friction in degree	1.22	1.22	1.22
N_γ	=	bearing capacity factor	1.15	1.15	1.15
N_q	=	bearing capacity factor	300	300	300
d_f	=	total depth of pile provided below ground level in cm	0	0	0
l_c	=	depth of cut-off below ground level in cm	300	300	300
d_{eff}	=	effective total depth of pile provided below ground level in cm	229	226	223
d_{ur}	=	depth of the centre of first underreamed bulb in cm	17.30	23.57	30.82
Q_b	=	ultimate bearing component of pile capacity in MT	0.90	0.90	0.90
α	=	reduction factor	0.43	0.43	0.43
C_a	=	average cohesion of the soil along the pile stem in kg/cm^2	28274	32987	37699
A_s	=	surface area of stem in cm^2	1.75	1.75	1.75
K	=	earth pressure coefficient	10	10	10
δ	=	angle of wall friction	12.05	14.06	16.07
Q_f	=	ultimate friction in MT	29.36	37.63	46.89
Q_u	=	ultimate capacity in MT	**11.74**	**15.05**	**18.76**
Q_{safe}	=	safe capacity in comp in MT	**8.91**	**11.35**	**14.07**
Q_{safe}	=	safe capacity in uplift in MT			



PLAN



SCALE: NTS

KEY PLAN

NOTES:

1. ALL E,N COORDINATES ARE IN MM.
2. BORE HOLE & TRIAL PITS SHALL BE CARRIED OUT AT ONE LOCATION PER HECTARE
3. THIS DRAWING SHALL BE REFERRED FOR BORE HOLE (BH), TRAIL PIT (TP), EARTH RESISTIVITY TEST (ERT) PLATE LOAD TEST (PLT) & CALIFORNIA BEARING RATIO TEST (CBR) LOCATION ONLY.

BOQ.

S.NO.	DESCRIPTION	SYMBOL	NO. OF POINTS
1	BORE HOLE POINTS	⊙	05
2	TRIAL PIT POINTS	⊙	05
3	EARTH RESISTIVITY TEST	ERT-1	05
4	PLATE LOAD TEST	PLT	02
5	CALIFORNIA BEARING RATIO TEST	CBR	01

BH POINT	COORDINATE 'E'	COORDINATE 'N'
BH -01	E=561985381.327	N=2660905534.592
BH -02	E=561950051.309	N=2660910985.521
BH -03	E=561932096.718	N=2660936247.402
BH -04	E=562012873.537	N=2660924583.164
BH -05	E=561966440.146	N=2660955642.648
TP POINT	**COORDINATE 'E'**	**COORDINATE 'N'**
TP -01	E=561982629.496	N=2660905535.242
TP -02	E=561947500.229	N=2660920945.184
TP -03	E=561930025.610	N=2660948737.503
TP -04	E=562011550.982	N=2660915652.675
TP -05	E=561966440.146	N=2660963068.008
ERT POINT	**COORDINATE 'E'**	**COORDINATE 'N'**
ERT-1	E=562018462.362	N=2660956038.340
ERT-2	E=562015787.705	N=2660883903.278
ERT-3	E=561978715.582	N=2660912207.384
ERT-4	E=561945848.516	N=2660966801.030
ERT-5	E=561943978.752	N=2660879879.938
PLT POINT	**COORDINATE 'E'**	**COORDINATE 'N'**
PLT-1 AT 1.2M FROM NGL	E=561939215.421	N=2660956466.424
PLT-2 AT 3.0M FROM NGL	E=561986984.238	N=2660915555.715
CBR POINT	**COORDINATE 'E'**	**COORDINATE 'N'**
CBR-1	E=561988194.466	N=2660940741.895

LEGENDS:-

PRESENT SCOPE

FUTURE SCOPE

CLIENT: GUJARAT INDUSTRIES POWER CO. LTD.
2375MW CAPACITY SOLAR/WIND/HYBRID

EPC CONTRACTOR
KEC INTERNATIONAL LIMITED

SUBSTATION:
400/33KV GIS SUBSTATION PSS-1

TITLE: LOCATION OF BORE HOLE & TRAIL PIT, FOR SOIL INVESTIGATION AND ERT POINTS

DIVISION: ELECTRICAL SUBSTATION
DATE:- 20.10.2022

DWG.NO. KEC/GUJARAT/GIS /LAYOUT-001
SCALE: 1 : 320

CLIENT DRG. NO. KEC-GIPCL1100-ST-DOC-RPT-2100-103
REV. R2
SHEET 1 OF 1

REV	DATE	DESCRIPTION	DRN	CHD	APP
R3	07.11.22	REVISED AS PER CLIENT'S COMMENT	KV	JY	SB
R2	20.10.22	REVISED AS PER CLIENT'S COMMENT	KV	JY	SB
R1	18.10.22	REVISED AS PER CLIENT'S COMMENT	KV	JY	SB
R0	11.10.22	FIRST ISSUE FOR APPROVAL	KV	JY	SB

SIZE: A0

TEST REPORT

Job No	: 90/226001	Report No :	BRD/LIMS/90/226001/1
Sample No.	: 1	Report Dt :	05-Dec-22

Client	: Gujarat Industries Power Co. Ltd.
Contractor	: KEC International Limited
Project Name	: 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
Reference No.	: Ref: KEC/GIPCL/PSS-1/SB-312/003 Letter Dt: 05/11/2022

Material Description	: Soil Sample	Sample Size (Kg) :	50
Date Sample received	: 24-Nov-22	Sample Brought by :	Contractor
Location/Source	: Great Rann of Kutch Area, Gujarat	Date Test Started :	24-Nov-22
Sample Id	: _	Date Test Completed :	05-Dec-22

Test Result

Item No.	Test Name		Unit	Results	Method of Testing
1	Modified Proctor Test	Maximum Dry Density	gm/cc	1.678	I.S.2720-Part-8-1983
		Optimum Moisture Content	%	13.8	
2	CBR Value (Soaked)		%	2.5	I.S.2720-Part-16-1987

Tested by : DJ

Authorised Signatory

NOTE:

1.This certificate or report may not be published for commercial purpose except in full unless permission for the publication of an approved abstract has been obtained from the GEO TEST HOUSE,Vadodara.

2.This test certificate applies only to the samples received in the laboratory.

TEST REPORT

Job No	: 90/226001	Report No :	BRD/LIMS/90/226001/2
Sample No.	: 2	Report Dt :	05-Dec-22

Client	: Gujarat Industries Power Co. Ltd.
Contractor	: KEC International Limited
Project Name	: 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
Reference No.	: Ref: KEC/GIPCL/PSS-1/SB-312/003 Letter Dt: 05/11/2022

Material Description	: Soil Sample	Sample Size (Kg) :	50
Date Sample received	: 24-Nov-22	Sample Brought by :	Contractor
Location/Source	: Great Rann of Kutch Area, Gujarat	Date Test Started :	24-Nov-22
Sample Id	: _	Date Test Completed :	05-Dec-22

Test Result

Item No.	Test Name		Unit	Results	Method of Testing
1	Modified Proctor Test	Maximum Dry Density	gm/cc	1.692	I.S.2720-Part-8-1983
		Optimum Moisture Content	%	13.1	
2	CBR Value (Soaked)		%	2.7	I.S.2720-Part-16-1987

Tested by : DJ

Authorised Signatory

NOTE:

1.This certificate or report may not be published for commercial purpose except in full unless permission for the publication of an approved abstract has been obtained from the GEO TEST HOUSE,Vadodara.

2.This test certificate applies only to the samples received in the laboratory.

PLATE LOAD TEST REPORT
Kentledge Loading Method (IS : 1888-1982)

CLIENT

Gujarat Industries Power Co. Ltd.

LOCATION

Great Rann of Kutch

NAME OF WORK

Conducting Plate Load Test at Pooling Substation 400/33kv, 1200 M W (PSS-1, Phase - II of 600 MW each) of Solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat.

GEO TEST HOUSE

(A Division of Geo Designs & Research Pvt Ltd.)

B-10, Krishna Industrial Estate, Opp, B.I.D.C., Estate,

Gorwa Estate, Gorwa, Vadodara - 390023

Ph.No. 0265 - 2283081, 2290222

E-Mail - lab@geogroup.in,

BRIEF DETAIL OF PLATE LOAD TEST

Name of Work	:	Conducting Plate Load Test at Pooling Substation 400/33kv, 1200 M W (PSS-1, Phase - II of 600 MW each) of Solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat.
Client	:	Gujarat Industries Power Co. Ltd.
Contractor	:	KEC International Limited
Consultant	:	--
PMC	:	--
Ref. No	:	KEC/GIPCL/PSS-1/SB-312/003, Dtd:- 05-11-2022
Testing Agency	:	Geo Test House (A Division of Geo Designs & Research Pvt Ltd.) B-10, Krishna Industrial Estate, Opp. B.I.D.C., Gorwa Estate, Vadodara - 390 016. Ph : 91-265-2290222. Telefax : 91-265-2282014.
Report No	:	BRD/90/226001
Ref.Code	:	IS :1888-1982
Nos of PLT	:	One
Plate Size	:	450 X 450 mm
Shape of Plate	:	Square
Test Depth	:	1.2 m
Fine Sand Layer	:	5 mm thick.
Location I.D	:	Great Rann of Kutch

Test Date	:	18/11/2022
Test Load	:	12.15 MT
Load Increment	:	20 % of Ultimate Bearing Capacity / 1Kg/cm^2
Type of Load	:	Maintained Load (Reaction Method)
Hyadraulic Jack Req	:	1 Nos.
Capacity	:	30 MT
Pressure Gauge	:	1 No.
Resolution	:	1 kg/cm^2
Capacity	:	600 Kg/cm^2

INTRODUCTION

Conducting Plate Load Test at Pooling Substation 400/33kv, 1200 M W (PSS-1, Phase - II of 600 MW each) of Solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat. was referred to us by Gujarat Industries Power Co. Ltd.

With reference to above we were deputed our engineering team for the purpose of testing on Great Rann of Kutch under the supervision of Client and Consultantat project site.

`

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.

- One Plate load test was carried out at existing ground level to know the bearing capacity of soil
- Analyzing all field and laboratory data to evaluate safe bearing capacity of the soil for given foundation sizes and necessary recommendations for foundation design and construction.

The site is located at Great Rann of Kutch

OBJECTIVE

The main objective of carrying out the Plate Load Test is to check the settlement for the ultimate bearing capacity of soil in place and its settlement. The Testing was carried out as per I.S. code 1888-1982.

METHODOLOGY (IS : 1888-1982)

PLATE SIZE AND THICKNESS :

The plate of 450 X 450 mmSquare with at least 2.5 cm thick was used for plate load test

Test plate was placed at the center of the test pit

PLACING OF TEST PLATE :

The test plate shall be placed over a test layer of maximum thickness of 5 mm so that the centre of plate coincides with the centre of reaction girder / beam, with the help of a plumb and bob and horizontally leveled by a spirit level to avoid eccentric loading. The hydraulic jack was centrally placed over the plate with the loading column in between the jack and reaction beam so as to transfer load to the plate. A minimum seating pressure of 70-g/sq.cm was applied and removed before starting the load test.

METHOD OF LOADING:

The methodology adopted for Plate Load Test by Anchor Reaction method is in such a way that the full test (Compression) load be supplied in the form of dead weight stacked above the foundation on framework.

The test load was then applied through hydraulic jack and other Anchor Reaction assembly. The framework was capable of supporting the entire load at a single location where a hydraulic ram or jack could progressively transfer the load to the top of the pile. The center of gravity of the reaction load was generally be on the axis of the contanct area of soil and the load applied by the jack was coaxial with contact area of plate and suitably positioned dial gauges record the settlement.

SETTLEMENT AND OBSERVATION :

Settlement was observed for each increment cycle, the readings had been taken at regular intervals at 1.0, 2.25, 4.0, 6.25, 9.0, 16, 25, and 60 min until the rate of settlement is less than 0.02 mm/min. The next increment of load was then applied and the observations repeated. The test was to be continued till a settlement of 25 mm under normal circumstances and 50 mm in case of special cases such as dense gravel, gravel and sand mixture is obtained, till failure occurs, or up to design ultimate safe bearing pressure, whichever was earlier.

OBSERVATION TABLE- PLT-1

Type of Test : Static Plate Load Test

Client : : Gujarat Industries Power Co. Ltd.

Name of work : Conducting Plate Load Test at Pooling Substation 400/33kv, 1200 M W (PSS-1, Phase - II of 600 MW each) of Solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat.

Location : : Great Rann of Kutch

Size of Plate : 450 X 450 mm

Date of Testing: 18/11/2022

Sr. No.	*Date*	*Time in Min.*	*Pressure in Kg/Sq.cm (On Ram)*	*Pressure in T/Sq.m (on Plate)*	*Dial Gauge Readings (L.C - 0.01 mm)*				*Average Reading*	*Settlement in mm*
					A	*B*	*C*	*D*		
LOADING										
1	Date : 18/11/2022	11:45:00 AM	0	0	2000	2000	2000	2000	2000.00	0.000
2		1:00	40.0	9.2	1790	1750	1786	1737	1765.75	2.343
		2.25			1788	1747	1785	1735	1763.75	2.363
		4.00			1786	1746	1784	1734	1762.50	2.375
		6.25			1773	1738	1775	1722	1752.00	2.480
		9.00			1768	1735	1765	1714	1745.50	2.545
		16.00			1765	1733	1763	1710	1742.75	2.573
		25.00			1764	1731	1761	1708	1741.00	2.590
		60.00			1763	1729	1759	1705	1739.00	2.610
3		12:45:00 PM	90.0	20.7						
		1:00			1225	1202	1270	1212	1227.25	7.728
		2.25			1196	1172	1244	1190	1200.50	7.995
		4.00			1167	1140	1213	1162	1170.50	8.295
		6.25			1148	1121	1193	1142	1151.00	8.490
		9.00			1123	1092	1163	1113	1122.75	8.773
		16.00			1089	1045	1129	1015	1069.50	9.305
		25.00			1062	1027	1100	1049	1059.50	9.405
		60.00			1060	1025	1094	1047	1056.50	9.435

Sr. No.	Date	Time in Min.	Pressure in Kg/Sq.cm (On Ram)	Pressure in T/Sq.m (on Plate)	Dial Gauge Readings (L.C - 0.01 mm)				Average Reading	Settlement in mm
					A	B	C	D		
LOADING										
3	Date : 18/11/2022	1:45:00 PM	130.0	29.9						
		1:00			896	880	840	838	863.50	11.365
		2.25			874	863	818	822	844.25	11.558
		4.00			850	841	799	800	822.50	11.775
		6.25			822	817	780	783	800.50	11.995
		9.00			801	798	763	759	780.25	12.198
		16.00			783	772	727	734	754.00	12.460
		25.00			756	755	701	709	730.25	12.698
		60.00			741	722	669	677	702.25	12.978
4		2:45:00 PM	140.0	32.2						
		1:00			156	132	102	105	123.75	18.763
					Dial Gauge Reset					
					2000	2000	2000	2000	2000.00	18.763
		15:00			1009	1039	1517	1549	1278.50	25.978

Note:- The test was terminated as the settlement was exceed 25 mm (As per IS 1888)

Calculation :-

Pressure on ram : 40 Kg/cm^2 (Observed Pressure)

Load on Test Plate : Pressure on ram X C/S area of ram Jack Ram Area :- 46.6 cm^2

: 40 X 46.6

: 1864 Kg

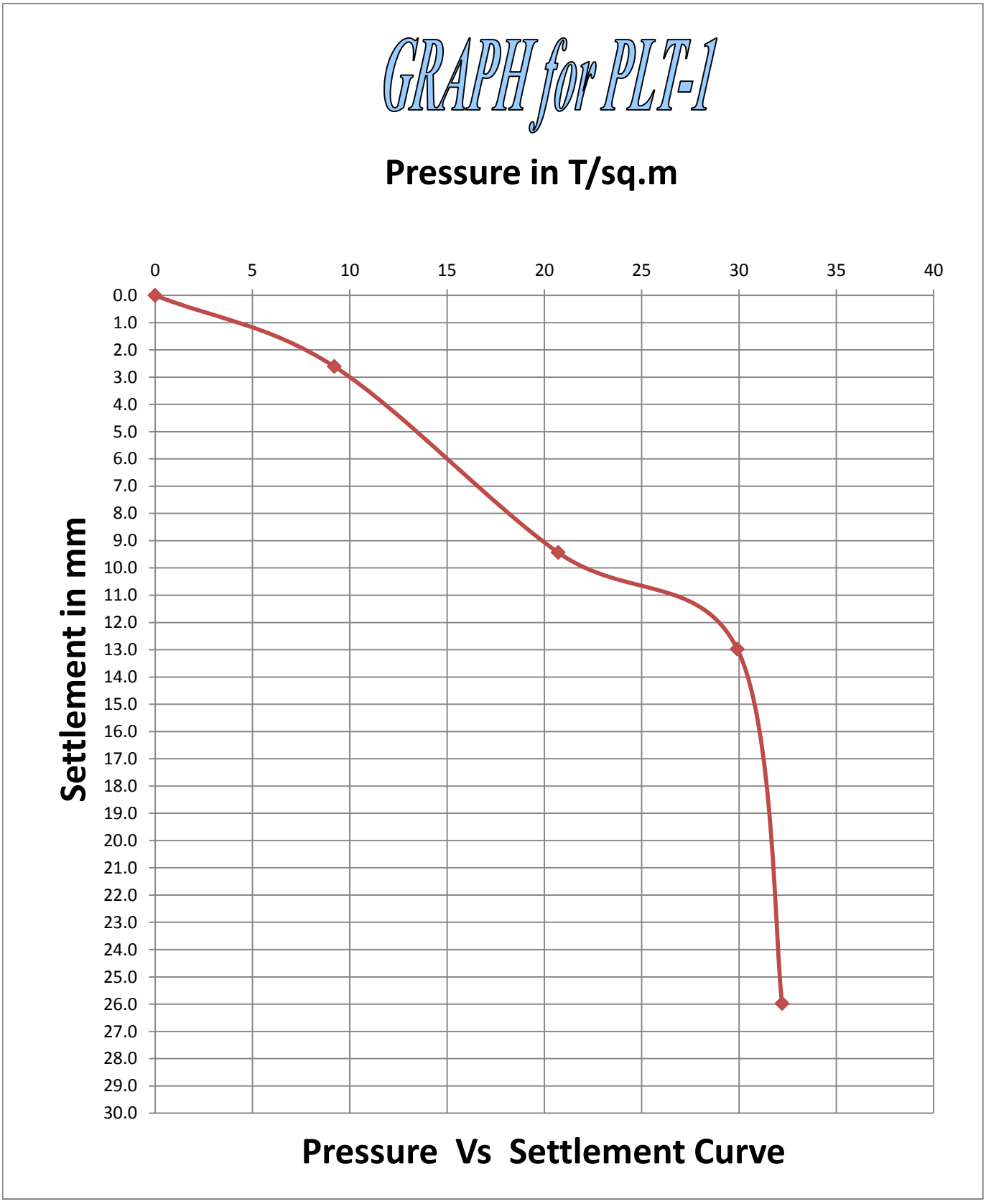
: 1.864 T

Presssure on test Plate : Load on Test Plate/Bearing area of Plate

: (1.864/ (0.45 X 0.45))

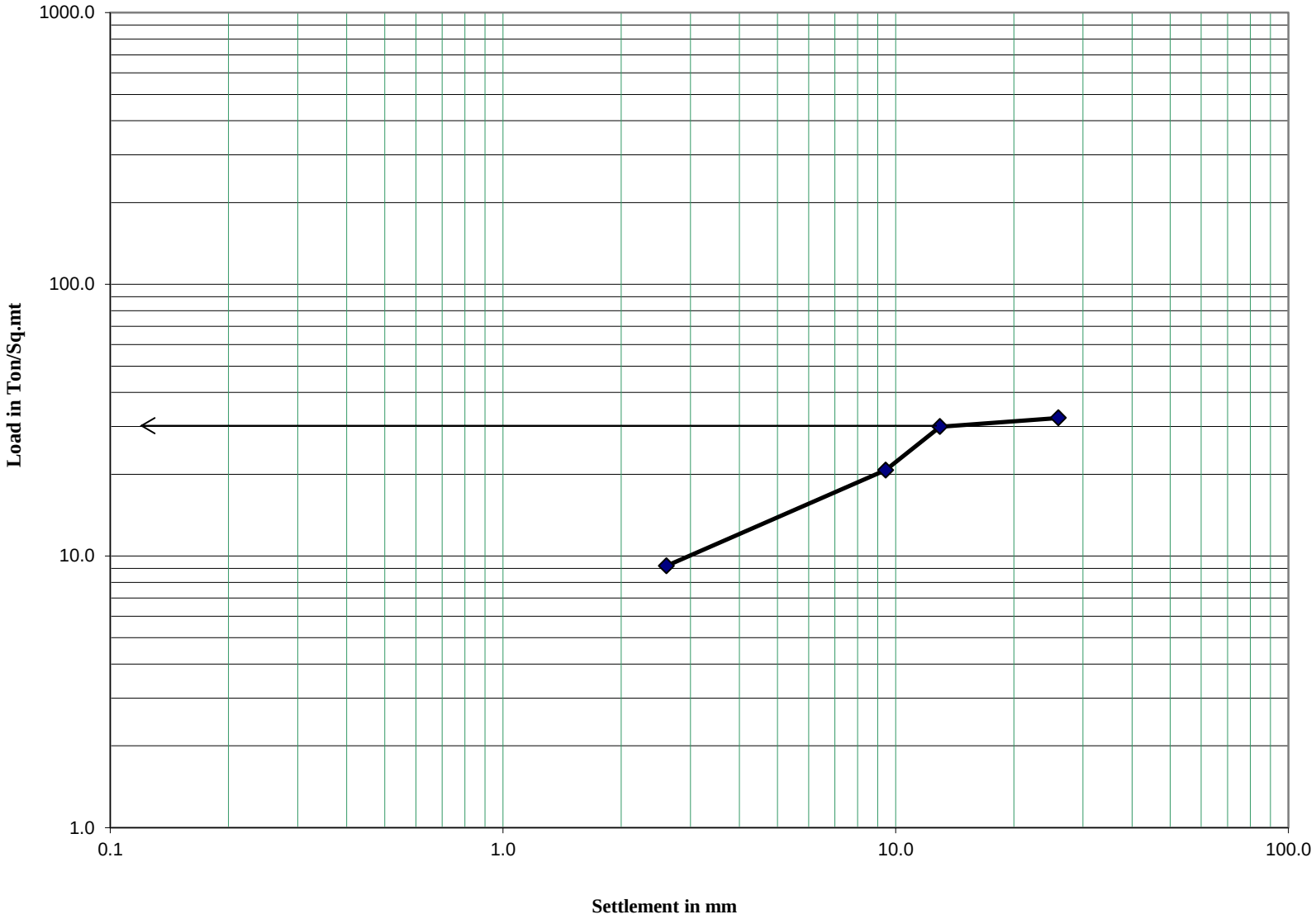
: 9.20 T/M^2

GRAPH for PLT-1



LOG-LOG GRAPH

Load vs Settlement Curve



ANALYSIS FOR PLATE LOAD TEST :-

i) For Safe Bearing Capacity & Safe Bearing Pressure Calculation.

$(q_u)_p$= Ultimate Bearing Capacity of Plate in t/m^2	**30**
$(q_u)_f$ = Ultimate Bearing Capacity of Footing in t/m^2	30.0
FOS = factor of safety	**3**
$(q_s)_f$ = Safe Bearing Capacity (SBC) of footing in t/m^2	**10.0**

Bp =	**0.45 m**

Table -1 for Safe Bearing Capacity, Safe Bearing Pressure & Recommended SBC

Permissible settlement of footing in mm	Width of footing in m	Permissible settlement of plate in mm	Safe bearing pressure in t/m^2(SBP) (from graph)	Recommended SBC in t/m^2
Sf	Bf	Sp =Sf x [Bp/Bf]		
50	2.0	11.3	27.5	10.0
50	3.0	7.5	17.5	
50	4.0	5.6	14.0	

1) Allowable settlement of Plate for different width of foundation is calculated in Table-1.

CONCLUSION

1. IS :1888-1982 Plate Load Test was carried out at Great Rann of Kutch

2. Safe Bearing Capacity, Safe Bearing Pressure are determined as per as per I.S : 1888-1982 Clause No. 5.0

3. Ultimate bearing capacity is derived from the Pressure / Settlement curve, and Safe bearing capacity is determined by considering factor of safety of 3.0. Minimum value from SBC and SBP shall be considered in design of foundation as mentioned in Table-1 .

Limitations of Plate load tests are as follows :

1) Plate bearing test is of short duration test and hence consolidation settlement does not fully occur during this test. As such this test cannot be used to predict consolidation settlement. Hence from settlement considerations, its use is restricted to sandy soils and to partially saturated or rather slightly unsaturated clayey soils.

2) The test results reflect only the character of the soil located within a depth of less than twice the width of the bearing plate. Thus the results of the tests are likely to be misleading, if the character of the soil changes at shallow depth which is not uncommon.

3) For clayey soils the bearing capacity (from shear consideration) for a larger foundation is almost the same as that for the smaller test plate. But in dense sandy soils the bearing capacity increases with the size of the foundation. Thus test with smaller size plate tend to give conservative values in dense sandy soils.

There are inaccuracies introduced in extrapolating the results from small size plates to large size foundations. Hence, it is stressed here that plate bearing test alone is not to be used in predicting the allowable bearing pressure for foundation.

For **GEO TEST HOUSE, Vadodara.**

Authorized Signatory

PLATE LOAD TEST REPORT
Kentledge Loading Method (IS : 1888-1982)

CLIENT

Gujarat Industries Power Co. Ltd.

LOCATION

Great Rann of Kutch

NAME OF WORK

Conducting Plate Load Test at Pooling Substation 400/33kv, 1200 M W (PSS-1, Phase - II of 600 MW each) of Solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat.

GEO TEST HOUSE

(A Division of Geo Designs & Research Pvt Ltd.)

B-10, Krishna Industrial Estate, Opp, B.I.D.C., Estate,

Gorwa Estate, Gorwa, Vadodara - 390023

Ph.No. 0265 - 2283081, 2290222

E-Mail - lab@geogroup.in,

BRIEF DETAIL OF PLATE LOAD TEST

Name of Work	:	Conducting Plate Load Test at Pooling Substation 400/33kv, 1200 M W (PSS-1, Phase - II of 600 MW each) of Solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat.
Client	:	Gujarat Industries Power Co. Ltd.
Contractor	:	KEC International Limited
Consultant	:	--
PMC	:	--
Ref. No	:	KEC/GIPCL/PSS-1/SB-312/003, Dtd:- 05-11-2022
Testing Agency	:	Geo Test House (A Division of Geo Designs & Research Pvt Ltd.) B-10, Krishna Industrial Estate, Opp. B.I.D.C., Gorwa Estate, Vadodara - 390 016. Ph : 91-265-2290222. Telefax : 91-265-2282014.
Report No	:	BRD/90/226001
Ref.Code	:	IS :1888-1982
Nos of PLT	:	Two
Plate Size	:	450 X 450 mm
Shape of Plate	:	Square
Test Depth	:	2.0 m
Fine Sand Layer	:	5 mm thick.
Location I.D	:	Great Rann of Kutch

Test Date	:	20/11/2022
Test Load	:	9.11 MT
Load Increment	:	20 % of Ultimate Bearing Capacity / 1Kg/cm^2
Type of Load	:	Maintained Load (Reaction Method)
Hyadraulic Jack Req	:	1 Nos.
Capacity	:	30 MT
Pressure Gauge	:	1 No.
Resolution	:	1 kg/cm^2
Capacity	:	600 Kg/cm^2

INTRODUCTION

Conducting Plate Load Test at Pooling Substation 400/33kv, 1200 M W (PSS-1, Phase - II of 600 MW each) of Solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat. was referred to us by Gujarat Industries Power Co. Ltd.

With reference to above we were deputed our engineering team for the purpose of testing on Great Rann of Kutch under the supervision of Client and Consultantat project site.

`

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.

- Two Plate load test was carried out at existing ground level to know the bearing capacity of soil
- Analyzing all field and laboratory data to evaluate safe bearing capacity of the soil for given foundation sizes and necessary recommendations for foundation design and construction.

The site is located at Great Rann of Kutch

OBJECTIVE

The main objective of carrying out the Plate Load Test is to check the settlement for the ultimate bearing capacity of soil in place and its settlement. The Testing was carried out as per I.S. code 1888-1982.

METHODOLOGY (IS : 1888-1982)

PLATE SIZE AND THICKNESS :

The plate of 450 X 450 mmSquare with at least 2.5 cm thick was used for plate load test

Test plate was placed at the center of the test pit

PLACING OF TEST PLATE :

The test plate shall be placed over a test layer of maximum thickness of 5 mm so that the centre of plate coincides with the centre of reaction girder / beam, with the help of a plumb and bob and horizontally leveled by a spirit level to avoid eccentric loading. The hydraulic jack was centrally placed over the plate with the loading column in between the jack and reaction beam so as to transfer load to the plate. A minimum seating pressure of 70-g/sq.cm was applied and removed before starting the load test.

METHOD OF LOADING:

The methodology adopted for Plate Load Test by Anchor Reaction method is in such a way that the full test (Compression) load be supplied in the form of dead weight stacked above the foundation on framework.

The test load was then applied through hydraulic jack and other Anchor Reaction assembly. The framework was capable of supporting the entire load at a single location where a hydraulic ram or jack could progressively transfer the load to the top of the pile. The center of gravity of the reaction load was generally be on the axis of the contanct area of soil and the load applied by the jack was coaxial with contact area of plate and suitably positioned dial gauges record the settlement.

SETTLEMENT AND OBSERVATION :

Settlement was observed for each increment cycle, the readings had been taken at regular intervals at 1.0, 2.25, 4.0, 6.25, 9.0, 16, 25, and 60 min until the rate of settlement is less than 0.02 mm/min. The next increment of load was then applied and the observations repeated. The test was to be continued till a settlement of 25 mm under normal circumstances and 50 mm in case of special cases such as dense gravel, gravel and sand mixture is obtained, till failure occurs, or up to design ultimate safe bearing pressure, whichever was earlier.

OBSERVATION TABLE- PLT-1

Type of Test : Static Plate Load Test

Client : : Gujarat Industries Power Co. Ltd.

Name of work : Conducting Plate Load Test at Pooling Substation 400/33kv, 1200 M W (PSS-1, Phase - II of 600 MW each) of Solar/wind/Hybrid RE Park of 2375 MW Capacity at Great Rann of Kutch Area, Gujarat.

Location : : Great Rann of Kutch

Depth of Pit : 2.0 m

Size of Plate : 450 X 450 mm

Date of Testing: 20/11/2022

Sr. No.	*Date*	*Time in Min.*	*Pressure in Kg/Sq.cm (On Ram)*	*Pressure in T/Sq.m (on Plate)*	*Dial Gauge Readings (L.C - 0.01 mm)*				*Average Reading*	*Settlement in mm*
					A	*B*	*C*	*D*		
LOADING										
1	Date : 20/11/2022	12:50:00 PM	0	0	2000	2000	2000	2000	2000.00	0.000
2		1:00	40.0	9.2	1566	1585	1637	1637	1606.25	3.938
		2.25			1565	1583	1635	1626	1602.25	3.978
		4.00			1563	1581	1633	1625	1600.50	3.995
		6.25			1561	1579	1631	1624	1598.75	4.013
		9.00			1560	1577	1630	1622	1597.25	4.028
		16.00			1558	1575	1628	1620	1595.25	4.048
		25.00			1552	1570	1625	1618	1591.25	4.088
		60.00			1550	1566	1623	1615	1588.50	4.115
3		1:50:00 PM	80.0	18.4						
		1:00			1100	1105	1138	1180	1130.75	8.693
		2.25			1082	1095	1135	1073	1096.25	9.038
		4.00			966	991	935	980	968.00	10.320
		6.25			956	986	930	796	917.00	10.830
		9.00			950	981	925	971	956.75	10.433
		16.00			946	979	920	966	952.75	10.473
		25.00			939	973	920	960	948.00	10.520
		60.00			918	963	900	951	933.00	10.670
			110.0	18.4	35	40	99	50	56.00	19.440

Sr. No.	*Date*	*Time in Min.*	*Pressure in Kg/Sq.cm (On Ram)*	*Pressure in T/Sq.m (on Plate)*	*Dial Gauge Readings (L.C - 0.01 mm)*				*Average Reading*	*Settlement in mm*
					A	*B*	*C*	*D*		
LOADING										
					Dial Gauge Reset					
					2000	2000	2000	2000	2000.00	19.440
	Date : 20/11/2022	3:00:00 PM								
		1:00			1750	1760	1763	1709	1745.50	21.985
		2.25			1675	1698	1703	1670	1686.50	22.575
4		4.00	120.0	27.6	1613	1640	1645	1633	1632.75	23.113
		6.25			1555	1570	1580	1583	1572.00	23.720
		9.00			1480	1514	1530	1555	1519.75	24.243
		16.00			1385	1425	1441	1489	1435.00	25.090

Note:- The test was terminated as the settlement was exceed 25 mm (As per IS 1888)

Calculation :-

Pressure on ram : 40 Kg/cm^2 (Observed Pressure)

Load on Test Plate : Pressure on ram X C/S area of ram Jack Ram Area :- 46.6 cm^2

: 40 X 46.6

: 1864 Kg

: 1.864 T

Presssure on test Plate : Load on Test Plate/Bearing area of Plate

: (1.864/ (0.45 X 0.45))

: 9.20 T/M^2

GRAPH for PLT-1

ANALYSIS FOR PLATE LOAD TEST :-

i) For Safe Bearing Capacity & Safe Bearing Pressure Calculation.

$(q_u)_p$= Ultimate Bearing Capacity of Plate in t/m^2 — **No Shear Failuer observed**

$(q_u)_f$ = Ultimate Bearing Capacity of Footing in t/m^2

FOS = factor of safety — **3**

$(q_s)_f$ = Safe Bearing Capacity (SBC) of footing in t/m^2

Bp =	**0.45 m**

Table -1 for Safe Bearing Capacity, Safe Bearing Pressure & Recommended SBC

Permissible settlement of footing in mm	Width of footing in m	Permissible settlement of plate in mm	Safe bearing pressure in t/m^2(SBP) (from graph)	Recommended SBC in t/m^2
Sf	Bf	Sp =Sf x [Bp/Bf]		
40	2.0	9.0	16.9	10.0
40	3.0	6.0	12.8	
40	4.0	4.5	10.0	

1) Allowable settlement of Plate for different width of foundation is calculated in Table-1.

CONCLUSION

1. IS :1888-1982 Plate Load Test was carried out at Great Rann of Kutch

2. Safe Bearing Capacity, Safe Bearing Pressure are determined as per as per I.S : 1888-1982 Clause No. 5.0

3. Ultimate bearing capacity is derived from the Pressure / Settlement curve, and Safe bearing capacity is determined by considering factor of safety of 3.0. Minimum value from SBC and SBP shall be considered in design of foundation as mentioned in Table-1 .

Limitations of Plate load tests are as follows :

1) Plate bearing test is of short duration test and hence consolidation settlement does not fully occur during this test. As such this test cannot be used to predict consolidation settlement. Hence from settlement considerations, its use is restricted to sandy soils and to partially saturated or rather slightly unsaturated clayey soils.

2) The test results reflect only the character of the soil located within a depth of less than twice the width of the bearing plate. Thus the results of the tests are likely to be misleading, if the character of the soil changes at shallow depth which is not uncommon.

3) For clayey soils the bearing capacity (from shear consideration) for a larger foundation is almost the same as that for the smaller test plate. But in dense sandy soils the bearing capacity increases with the size of the foundation. Thus test with smaller size plate tend to give conservative values in dense sandy soils.

There are inaccuracies introduced in extrapolating the results from small size plates to large size foundations. Hence, it is stressed here that plate bearing test alone is not to be used in predicting the allowable bearing pressure for foundation.

For **GEO TEST HOUSE, Vadodara.**

Authorized Signatory

VOLUME-III

PART - 2

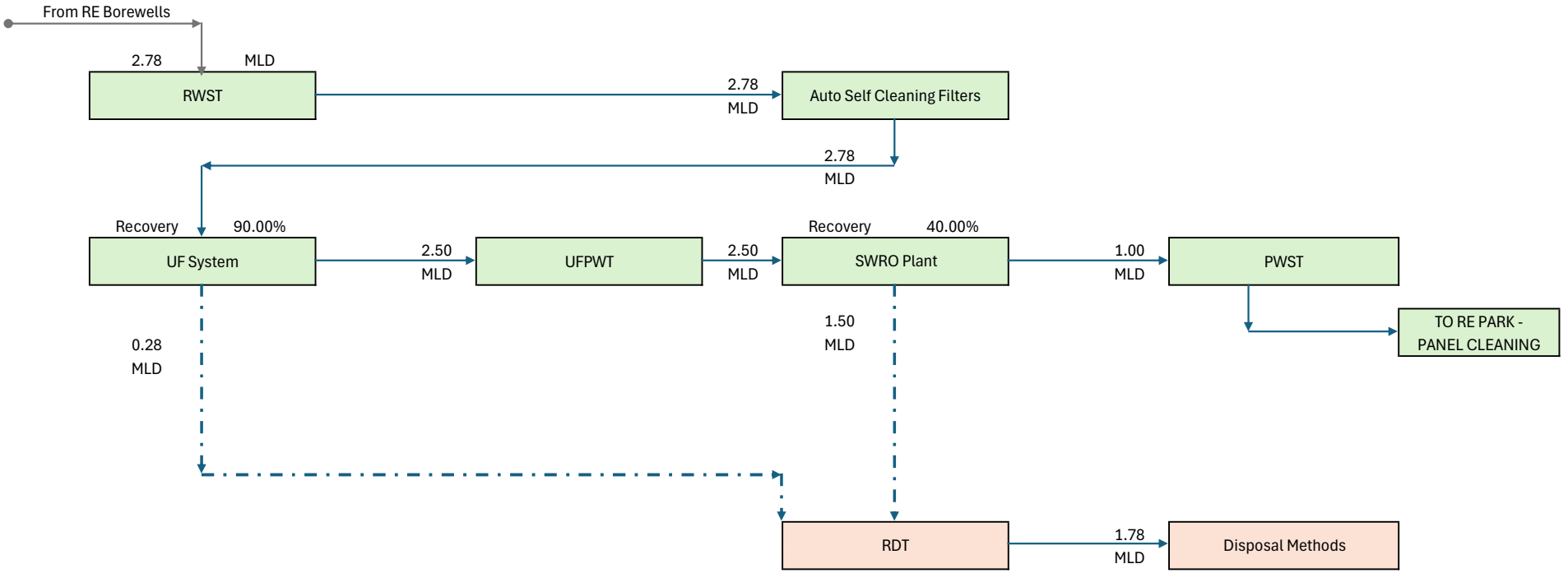
ANNEXURES

(TENDER DRAWINGS AND ATTACHMENTS)
MECHANICAL, ELECTRICAL, AND C&I

Table of Contents

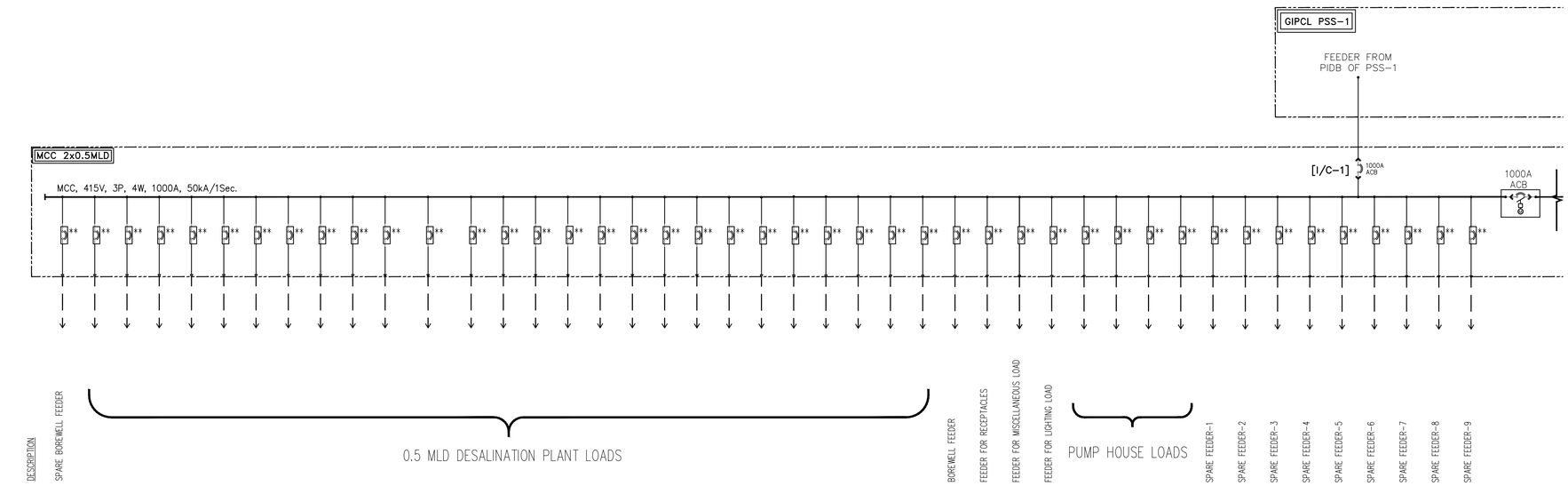
Volume III ,Part 2

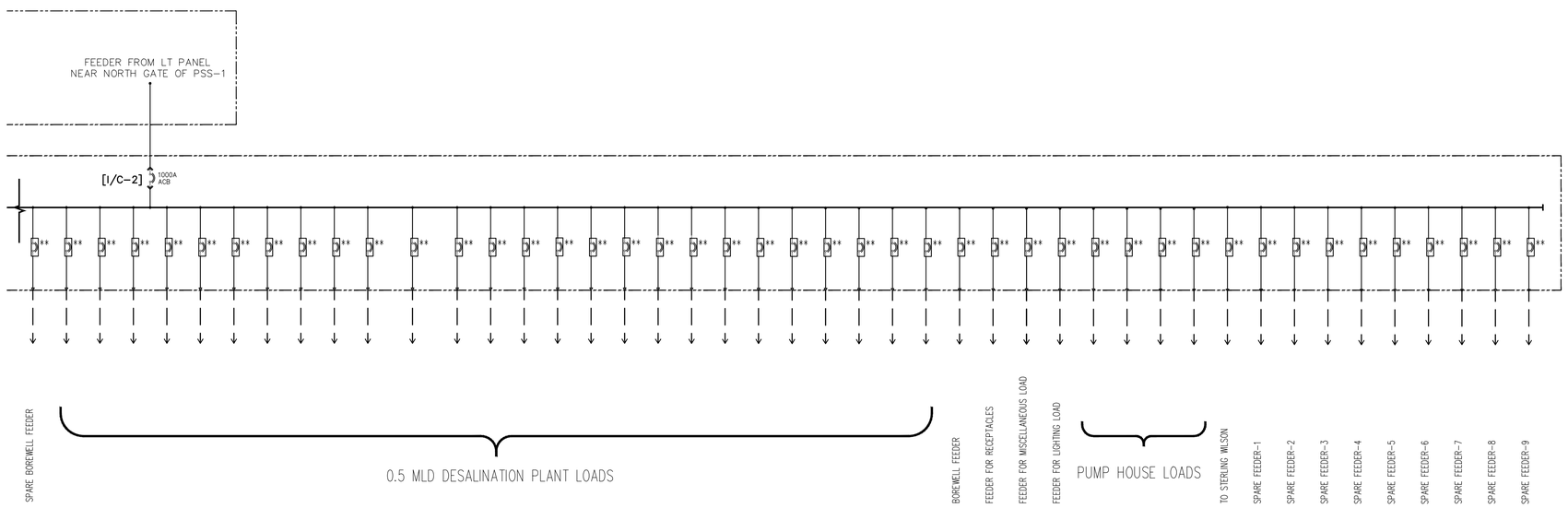
WATER BALANCE DIAGRAM FOR 1 MLD DESALINATION PLANT AT RE PARK (Renewable Park)



Legends & Symbols

RWST	Raw Water Storage Tank	SWRO	Sea Water Reverse Osmosis	→	Process flow Lines
UF	Ultra Filtration	PWST	Product Water Stoarge Tank		
UFPWT	UF Product Water Tank	RDT	Reject Disposal Tank	⇢	Backwash/Reject





NOTES:–

1. ALL ELECTRICAL EQUIPMENTS ARE DESIGNED FOR THE AMBIENT TEMPERATURE OF 50°C
2. ALL EQUIPMENTS RATING INDICATED ARE PRELIMINARY, IT WILL BE FIRMED UP DURING DETAILED ENGINEERING.
3. THE OUTGOING FEEDER TYPE OF THE MCCs SHALL BE AS FOLLOWS:

SL.NO.	DESCRIPTION	BREAKER CONTROL
A	INCOMERS RATED UP TO 400A	MCCB CONTROLLED
B	MOTORS RATED UP TO 7.5kW	MPCB CONTROLLED WITH ELECTRONIC OVERLOAD RELAY
C	MOTORS RATED FROM 7.5kW TO 30kW	MCCB WITH CONTACTOR AND COMMUNICABLE MOTOR PROTECTION RELAY (OVERCURRENT RELAY & ELR SHALL BE PART OF DMPR)

LEGEND:–

MCCB — MOULDED CASE CIRCUIT BREAKER (MCCB)

MPCB — MOTOR PROTECTION CIRCUIT BREAKER. (MPCB)

DRAW OUT

VCB — VACUUM CIRCUIT BREAKER (VCB)

SPECIAL NOTES:–

1.** FEEDER RATING SHALL BE PROVIDED BY BIDDER

REV./ISSUE	DATE	DESCRIPTION	DRN.	STR	MECH.	ELEC.	INST.
				APPROVED BY			
R4	22.09.2025	REVISED AS PER CLIENTS COMMENTS	RK	–	–	MC	–
R3	07.04.2025	REVISED AS PER CLIENTS COMMENTS	USP	–	–	MC	–
R2	04.02.2025	REVISED AS PER CLIENTS COMMENTS DATED ON 16/01/2025	USP	–	–	MC	–
R1	05.11.2024	REVISED AS PER CLIENTS COMMENTS DATED ON 23/10/2024	VS	–	–	MC	–
R0	20.09.2024	PRELIMINARY ISSUE	VS	–	–	MC	–

PROJECT TITLE:– TENDER ENQUIRY DOCUMENT FOR 2X0.5MLD DESALINATION PLANTS AT SOLAR/WIND/HYBRID RE PARK OF 2375MW CAPACITY AT GREAT RANN OF KUTCH AREA

OWNER:– GUJARAT INDUSTRIES POWER CO. LTD

OWNER'S CONSULTANT:– FICHTNER CONSULTING ENGINEERS (INDIA) PRIVATE LIMITED, CHENNAI

	SIGNATURE	DATE
DRAWN	RK	22.09.2025
DESIGNED	CS/SD	20.09.2024
CHECKED	MC	20.09.2024
DEPT.HEAD	AV	20.09.2024
PROJ.MGR.	MKS	20.09.2024

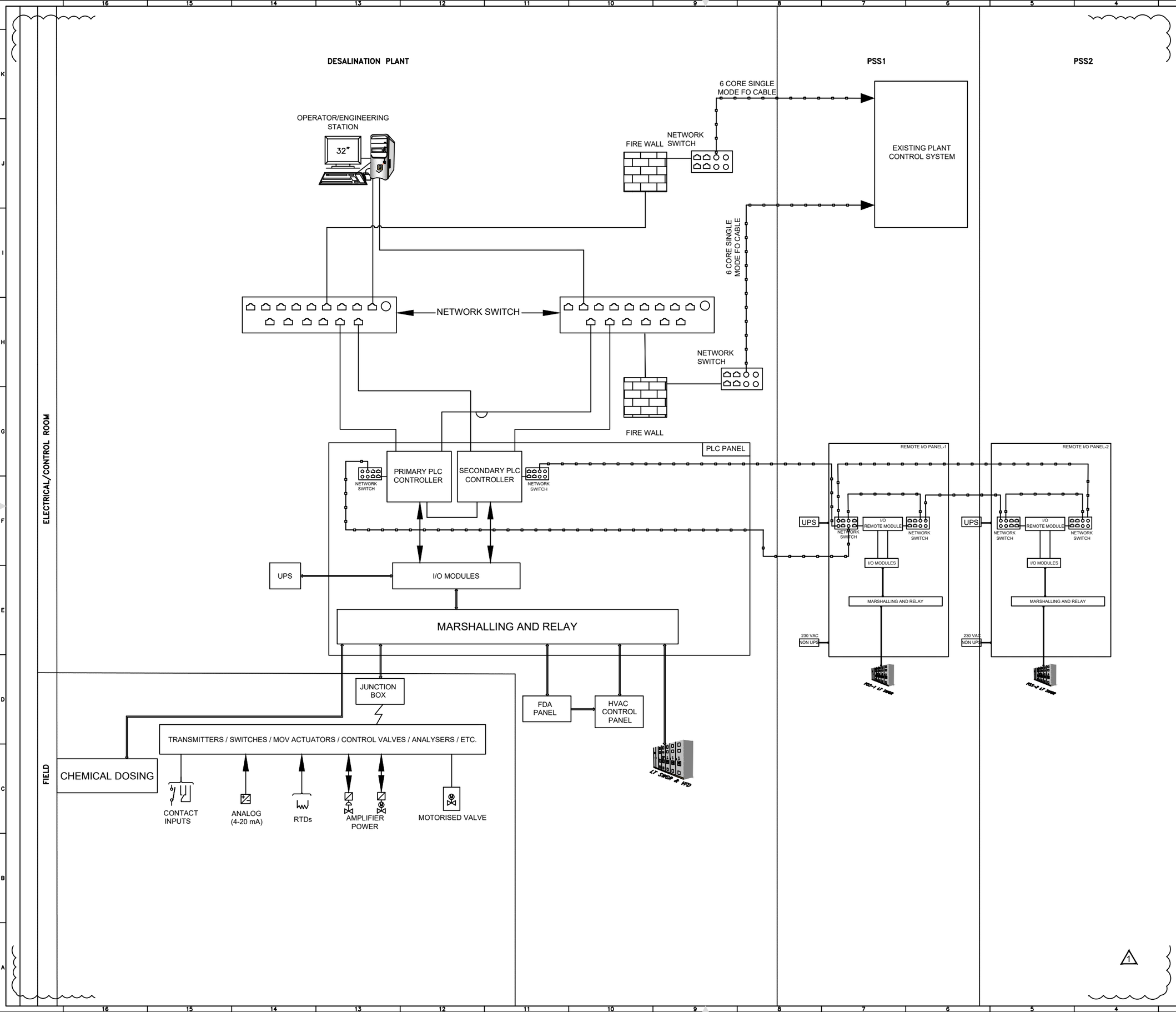
DWG. TITLE:– TENTATIVE SINGLE LINE DIAGRAM

RELEASED FOR: PRELIMINARY; TENDER ✓; ENGINEERING; CONSTRUCTION

DEPT. ELEC JOB NO. 1721125 | SCALE: NTS | SHEET: 01 OF 01 | SIZE : A1

DWG.NO. FCE-1721125-IW-ELE-DWG-SLD-6510-001 | REV./ISSUE R4

SIZE–A1



LEGEND:

1. PLC - PROGRAMMABLE LOGIC CONTROLLER
2. I/O - INPUT / OUTPUT
3. ENGG. - ENGINEERING
4. LV - LOW VOLTAGE
5. ⟷ - HARDWIRED SIGNALS
6. ——— - SYSTEM CABLE
7. -o-o-o- - SINGLE MODE CABLE
8. ⌂⌂⌂ - ETHERNET CABLE PORT
9. ○○○○ - FIBRE OPTIC CABLE PORT

NOTES:

1. THE EXISTING PLANT CONTROL SYSTEM SHALL BE INTEGRATED TO DESAL PLC SYSTEM.
2. ALL POWER SUPPLY AND COMMUNICATION SHALL BE REDUNDANT.
3. GPS MASTER CLOCK SIGNAL SHALL BE TRANSFERRED FROM EXISTING PLANT TO THE PLC IN THE DESALINATION THROUGH THE NETWORK ITSELF.
4. ALL FO CABLE SHALL BE TERMINATED IN THE FO PATCH PANEL SUPPLIED AS A PART OF PLC NETWORK PANEL AND CONNECTION FROM THE PATCH PANEL WILL BE MADE THROUGH FO PATCH CORD.
5. FO CABLE BETWEEN THE PSS-1& PSS-2 IS IN ALREADY EXISTING ONLY THE CONNECTION FROM THE EXISTING SPLICE BOX AT THE PSS-1 and PSS-2 SHALL BE EXTENDED TO THE BIDDERS RIO PANEL. BIDDER SHALL UTILIZE THE EXISTING CABLE SPARE CORES. ALL NECESSARY REQUIREMENTS FOR THE EXTENDING THE FO CABLE FROM THE EXISTING PSS-1 & PSS-2 COMMUNICATION PANEL TO RESPECTIVE RIO SHALL BE IN BIDDER SCOPE.

REV.	DATE	DESCRIPTION	DRN.	STR.	MECH.	ELEC.	INST. APPROVED BY
2	03.03.2025	REVISED ASPER CLIENT COMMENT	ANIL				
1	28.11.2024	REVISED ASPER CLIENT COMMENT	SAK				
0	25.09.2024	ISSUED FOR APPROVAL	DRN				

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	SAK	03.03.2025
DESIGNED	SV	03.03.2025
CHECKED	SV	03.03.2025
DEPT.HEAD	LVP	03.03.2025
TEAMLEADER	RJB	03.03.2025

CONTROL SYSTEM ARCHITECTURE

RELEASED FOR: PRELIMINARY | TENDER ✓ | ENGINEERING | CONSTRUCTION

DEPT. C&I | JOB NO. 20723196 | SCALE: NTS | REV.

DWG.NO. FCE-20723196-IWE-DWG-IC-6101-001 | 2

C:\Users\Jaseem\Downloads\FCE-20723196-IWE-DWG-IC-6101-001 4.dwg

DRIVE CONTROL PHILOSOPHY

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

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

DRIVE CONTROL PHILOSOPHY

RELEASED FOR: PRELIMINARY ✓ | TENDER | ENGINEERING | CONSTRUCTION

DEPT. C&I | JOB NO. 20723196 | SCALE:NTS | SHT: 01OF08 | REV.

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

C:\Users\manishn\Desktop\FCE-20123170-IC-DWG-DCP-4200-002.dwg

INDEX

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

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

DRIVE CONTROL PHILOSOPHY

RELEASED FOR: PRELIMINARY ✓ | TENDER | ENGINEERING | CONSTRUCTION

DEPT. C&I | JOB NO. 20723196 | SCALE:NTS | SHT: 02OF08 | REV.

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

C:\Users\manishr\Desktop\FCE-20123170-IC-DWG-DCP-4200-002.dwg

LEGENTS & GENERAL NOTES

PLC — PROGRAMMABLE LOGIC CONTROLLER

PB — PUSHBUTTON

IPR — INTERPOSING RELAY

HT — HIGH TENSION

LT — LOW TENSION

MCC — MOTOR CONTROL CENTER

LS — LIMIT SWITCH

TS — TORQUE SWITCH

SOV — SOLENOID OPERATED VALVE

MCB — MINIATURE CIRCUIT BREAKER

TXR — TRANSMITTER

SWGR — SWITCHGEAR

MPR — MOTOR PROTECTION RELAY

OLR — OVER LOAD RELAY

CMD — COMMAND

COMM — COMMUNICATION

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

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

DRIVE CONTROL PHILOSOPHY

RELEASED FOR: PRELIMINARY ✓ | TENDER | ENGINEERING | CONSTRUCTION

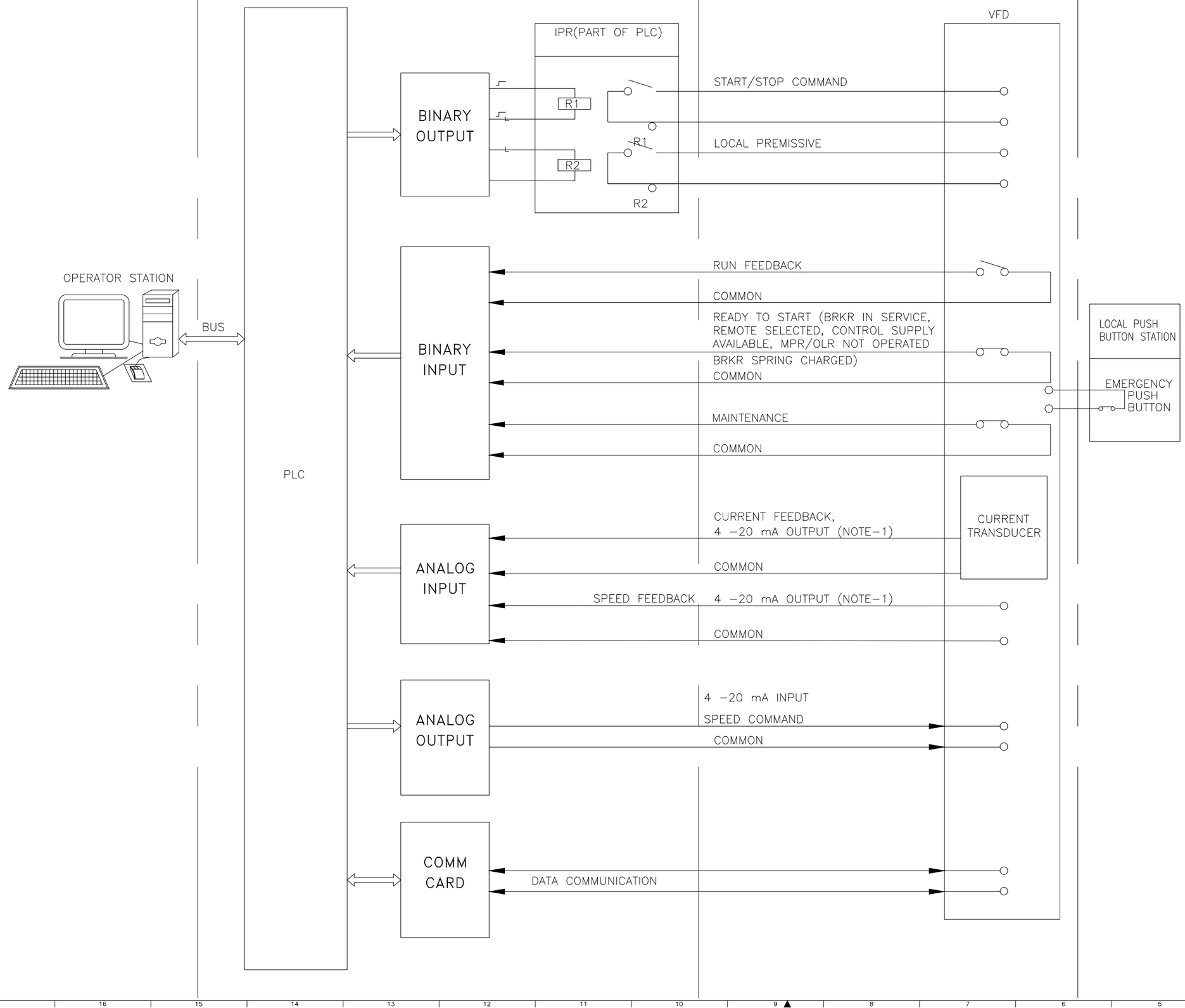
DEPT. C&I | JOB NO. 20723196 | SCALE:NTS | SHT: 030F08 | REV.

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

C:\Users\manishn\Desktop\FCE-20123170-IC-DWG-DCP-4200-002.dwg

LT VFD DRIVES

CONTROL ROOM	PANEL ROOM	SWITCHGEAR ROOM	FIELD



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

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

DRIVE CONTROL PHILOSOPHY

RELEASED FOR: PRELIMINARY ✓ | TENDER | ENGINEERING | CONSTRUCTION

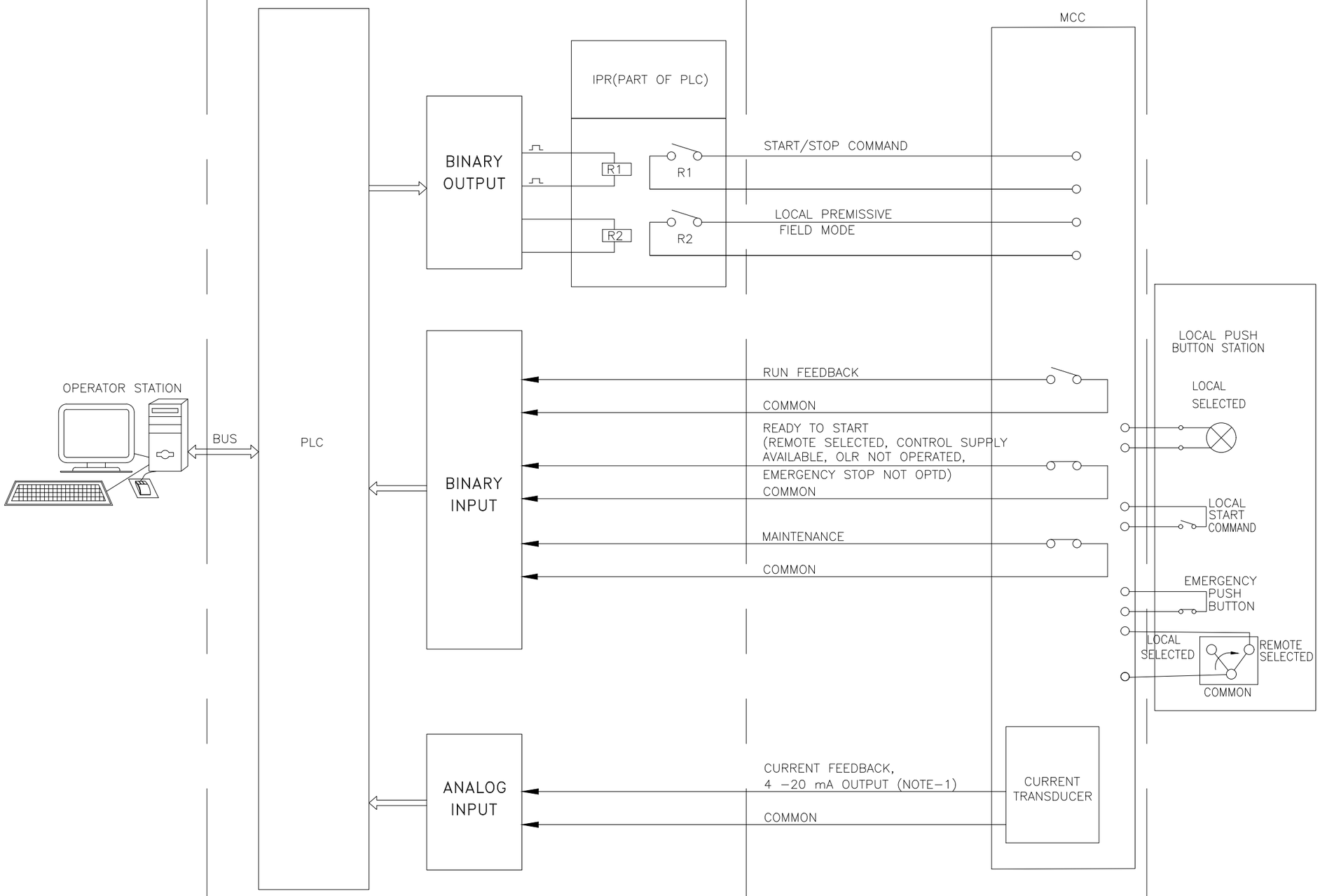
DEPT. C&I | JOB NO. 20723196 | SCALE:NTS | SHT: 04OF08 | REV.

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

C:\Users\manishn\Desktop\FCE-20123170-IC-DWG-DCP-4200-002.dwg

UNI DIRECTIONAL LT DRIVE

CONTROL ROOM	PANEL ROOM	SWITCHGEAR ROOM	FIELD



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

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

DRIVE CONTROL PHILOSOPHY

RELEASED FOR: PRELIMINARY ✓ | TENDER | ENGINEERING | CONSTRUCTION

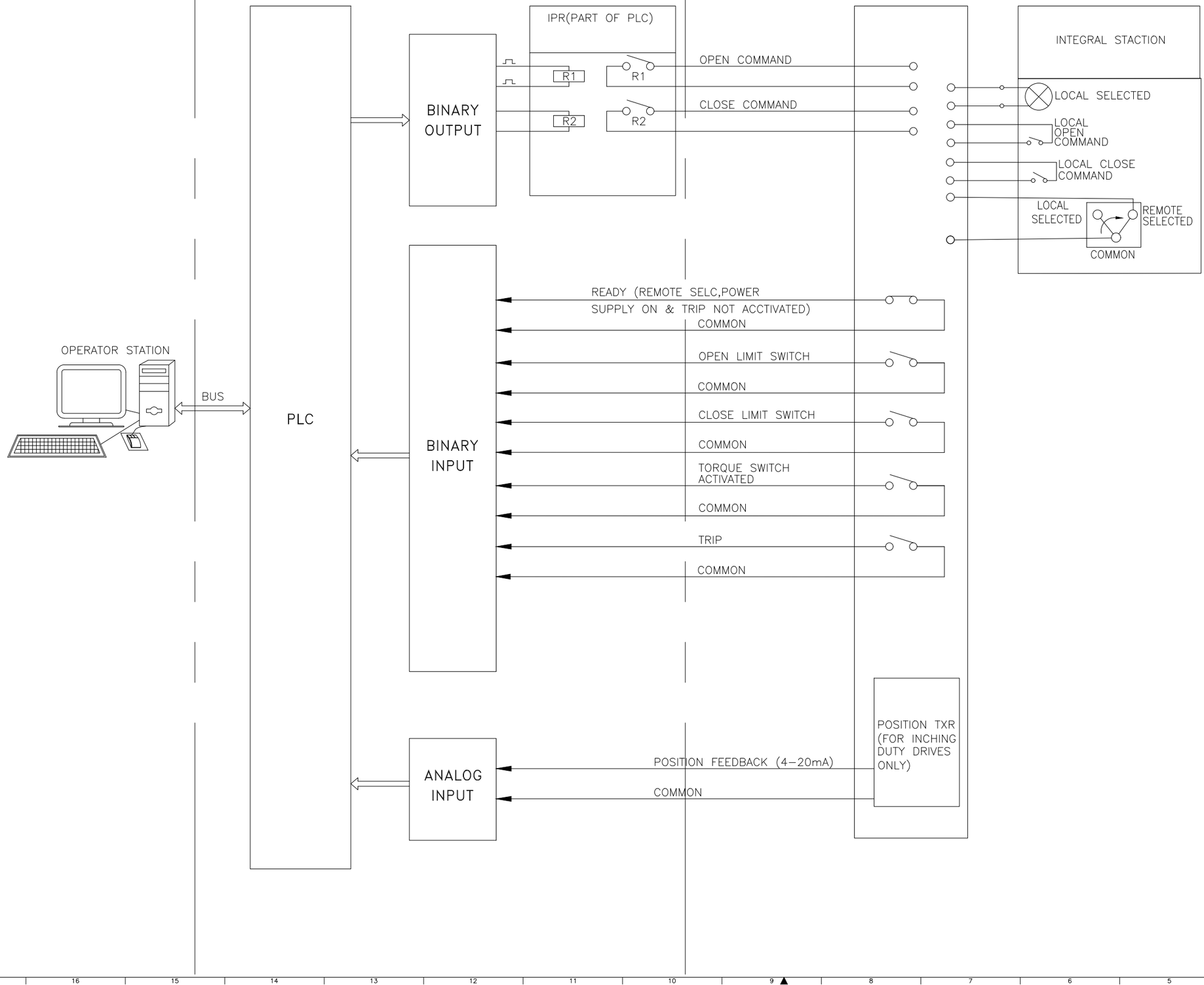
DEPT. C&I | JOB NO. 20723196 | SCALE:NTS | SHT: 050F08 | REV.

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

C:\Users\msnahar\Desktop\FCE-20123170-IC-DWG-DCP-4200-002.dwg

BI-DIRECTIONAL DRIVES (WITH INTEGRAL STARTER)

CONTROL ROOM	PANEL ROOM	FIELD



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

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

DRIVE CONTROL PHILOSOPHY

RELEASED FOR: PRELIMINARY ✓ | TENDER | ENGINEERING | CONSTRUCTION

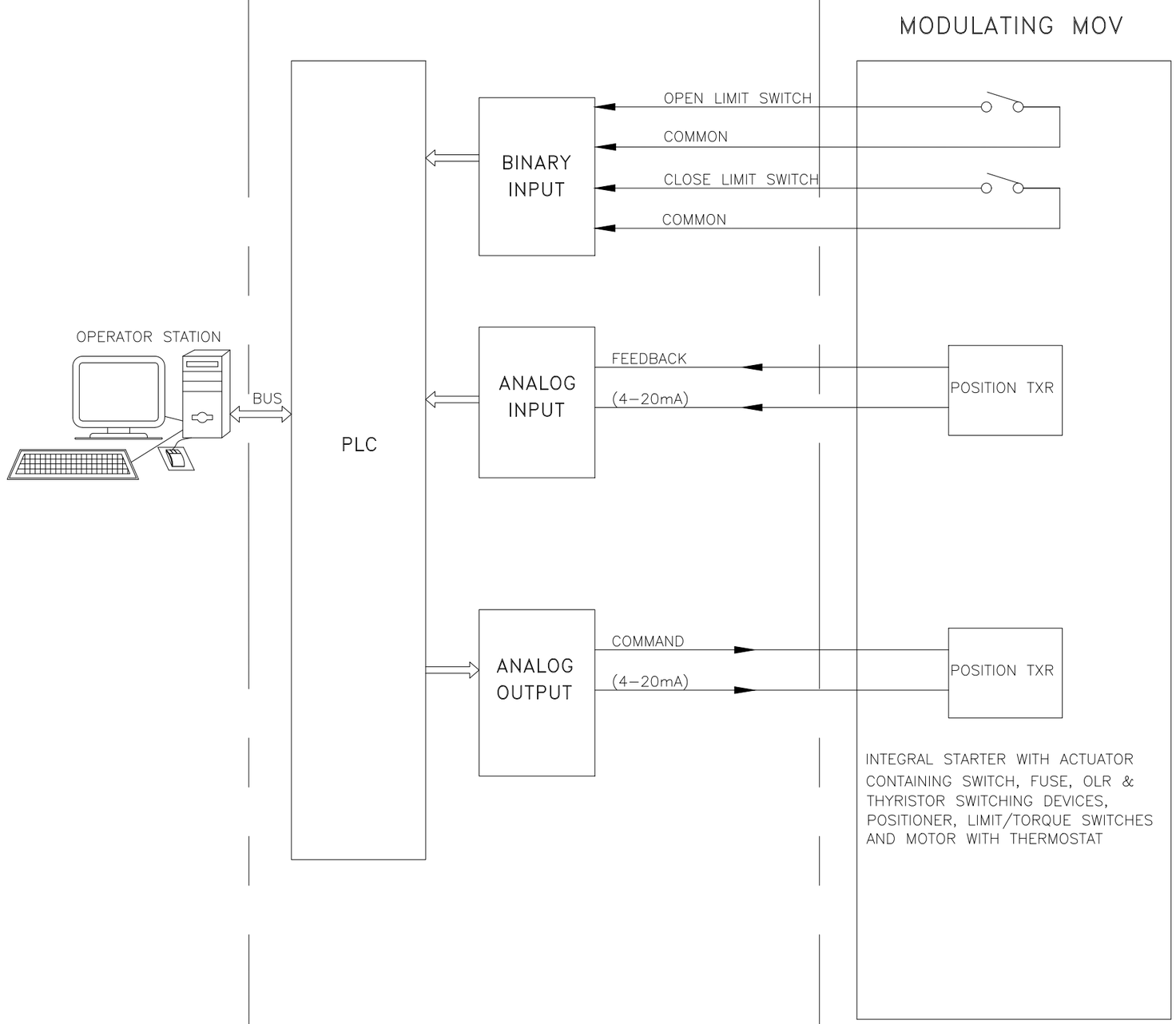
DEPT. C&I | JOB NO. 20723196 | SCALE:NTS | SHT: 060F08 | REV.

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

C:\Users\monishm\Desktop\FCE-20123170-IC-DWG-DCP-4200-002.dwg

MODULATING MOV

CONTROL ROOM	PANEL ROOM	FIELD



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

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

DRIVE CONTROL PHILOSOPHY

RELEASED FOR		
	PRELIMINARY	✓
	TENDER	
	ENGINEERING	
	CONSTRUCTION	

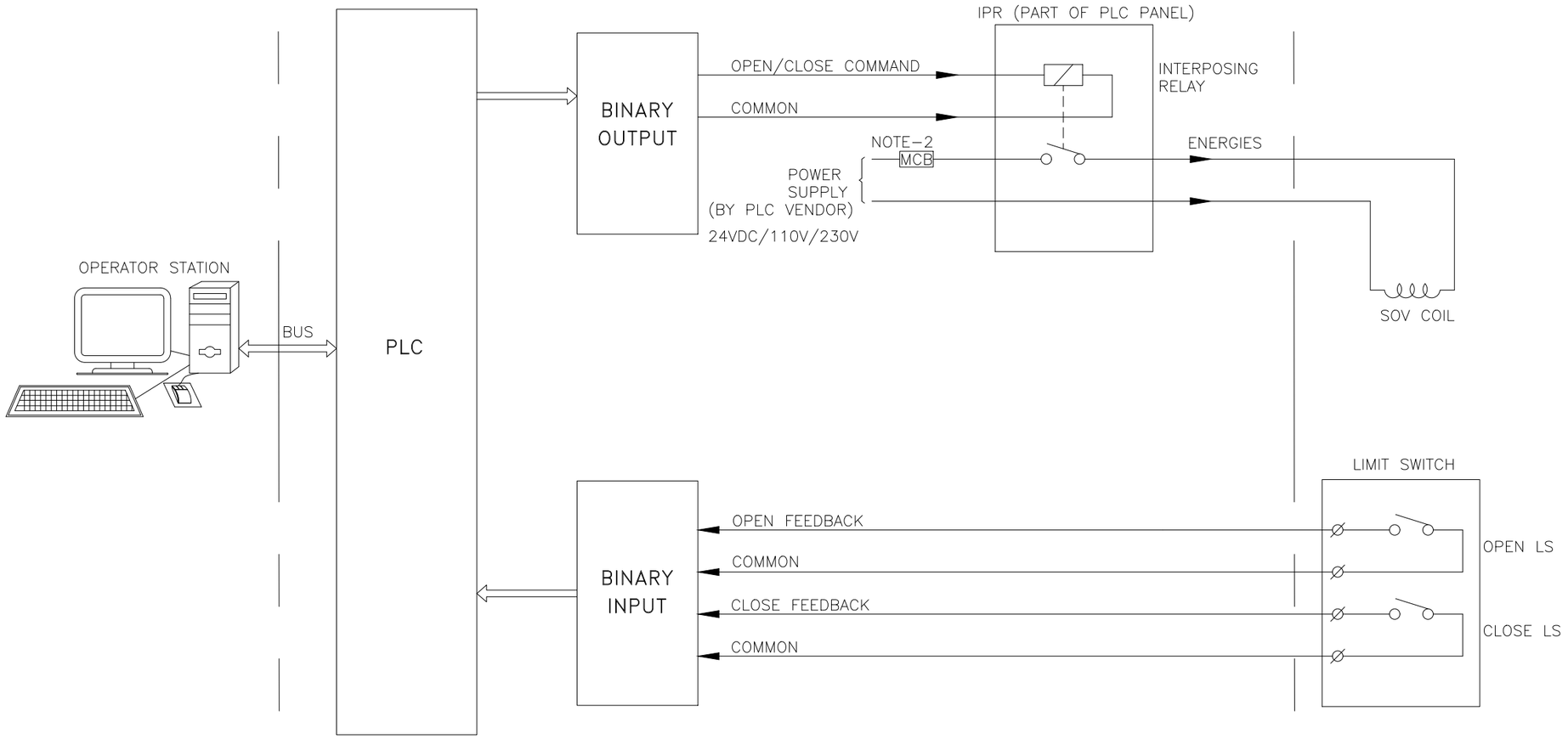
DEPT. C&I | JOB NO. 20723196 | SCALE:NTS | SHT: 07OF08 | REV.

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

C:\Users\manisin\Desktop\FCE-20123170-IC-DWG-DCP-4200-002.dwg

SOLENOID DRIVE

CONTROL ROOM	ELECTRONIC EQUIPMENT ROOM	FIELD



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

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

DRIVE CONTROL PHILOSOPHY

RELEASED FOR			DEPT. C&I	JOB NO. 20723196	SCALE:NTS	SHT: 08OF08	REV.
	PRELIMINARY	✓	DWG.NO. FCE-20723196-IWE-DWG-IC-6101-002				0
	TENDER						
	ENGINEERING						
	CONSTRUCTION						

C:\Users\manishn\Desktop\FCE-20123170-IC-DWG-DCP-4200-002.dwg