SECTION-G

DRAWINGS OF EWS HOUSING for 6 LIGHT HOUSE PROJECT SITES

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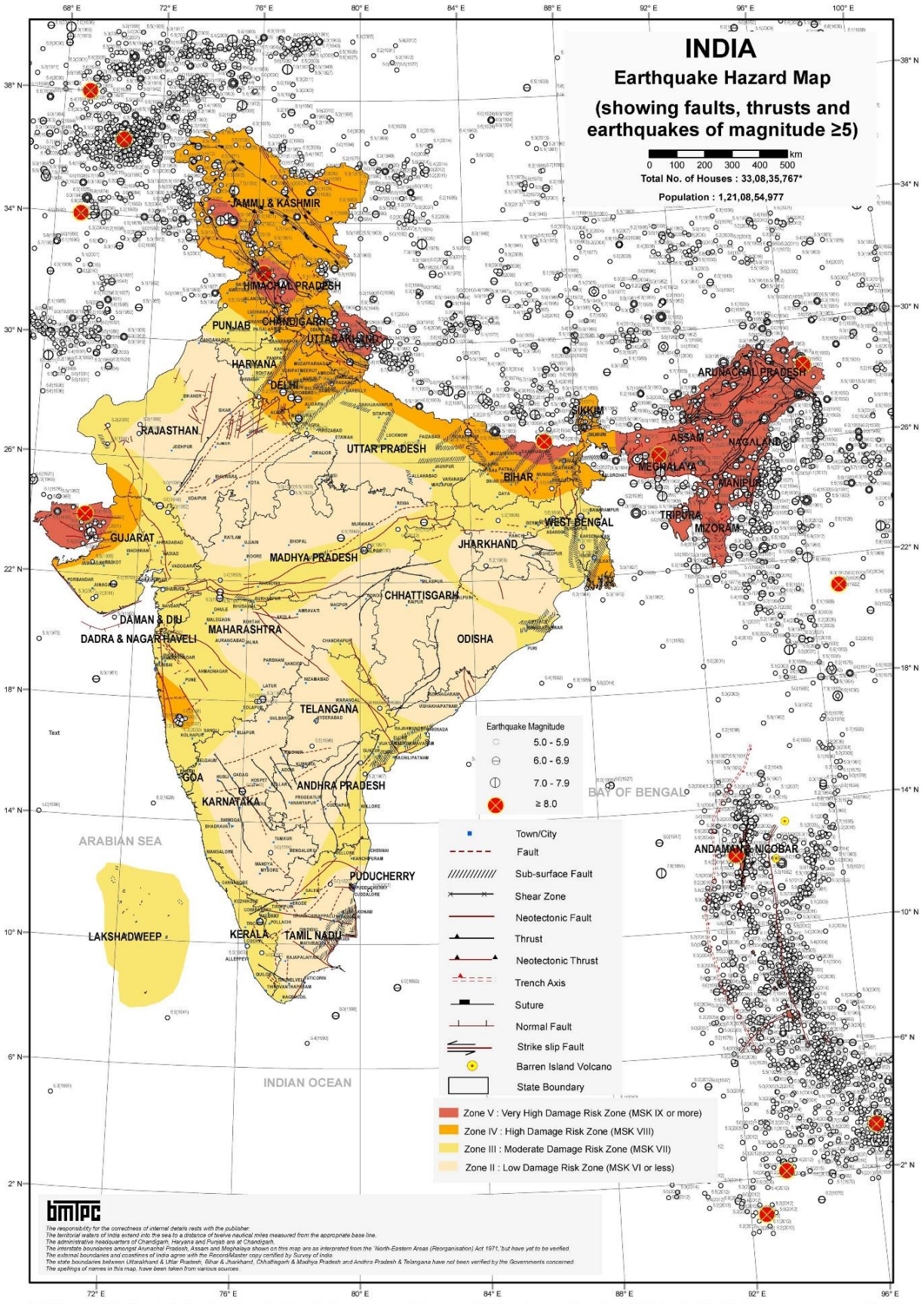
2.6.6 Floor Plans

2.6.7 Physical Infrastructure Drawings

2.6.8 Social Infrastructure Building Drawings

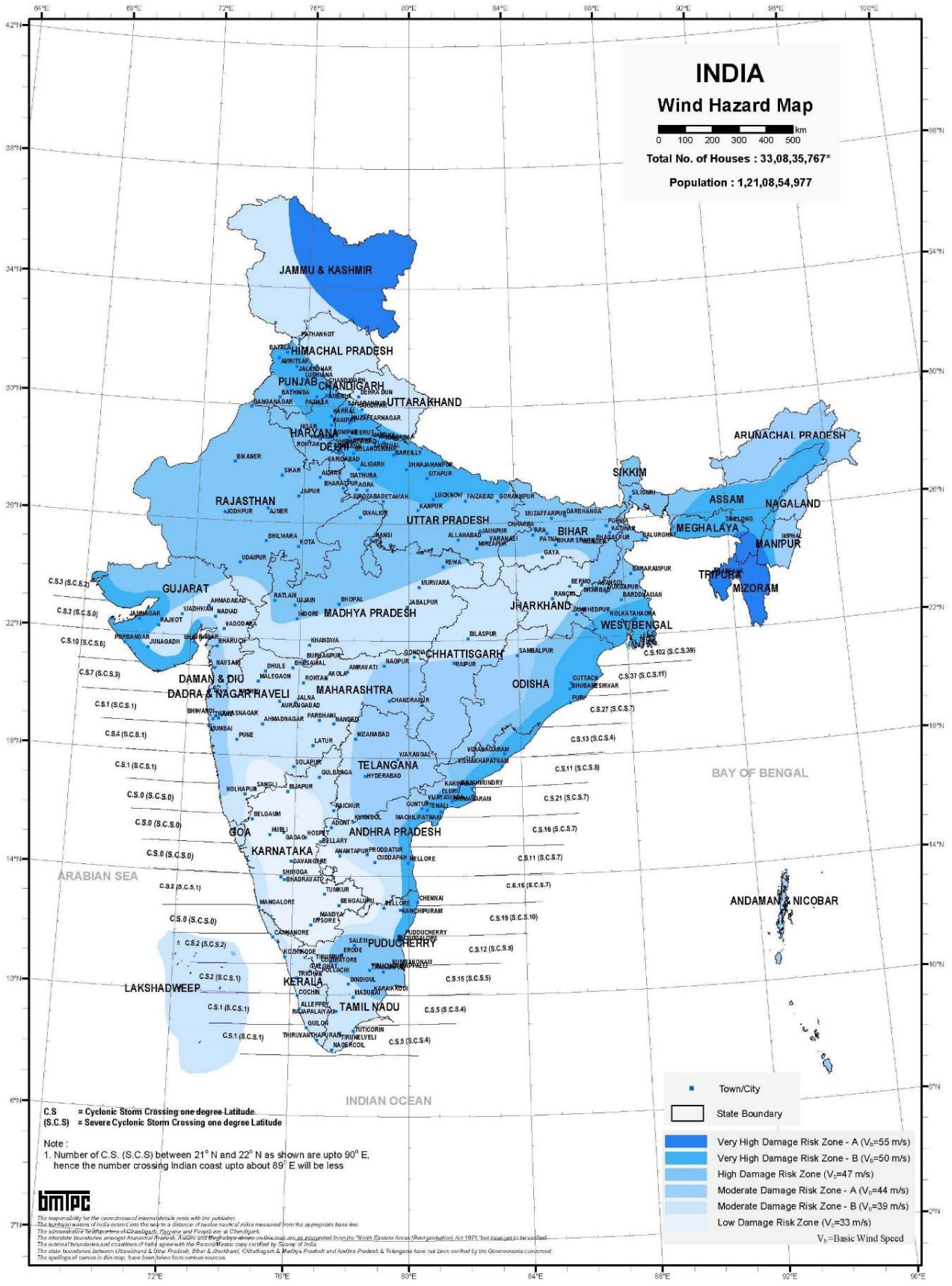
1 Maps as per Vulnerability Atlas of India 2019

1.1 Earthquake Hazard Map



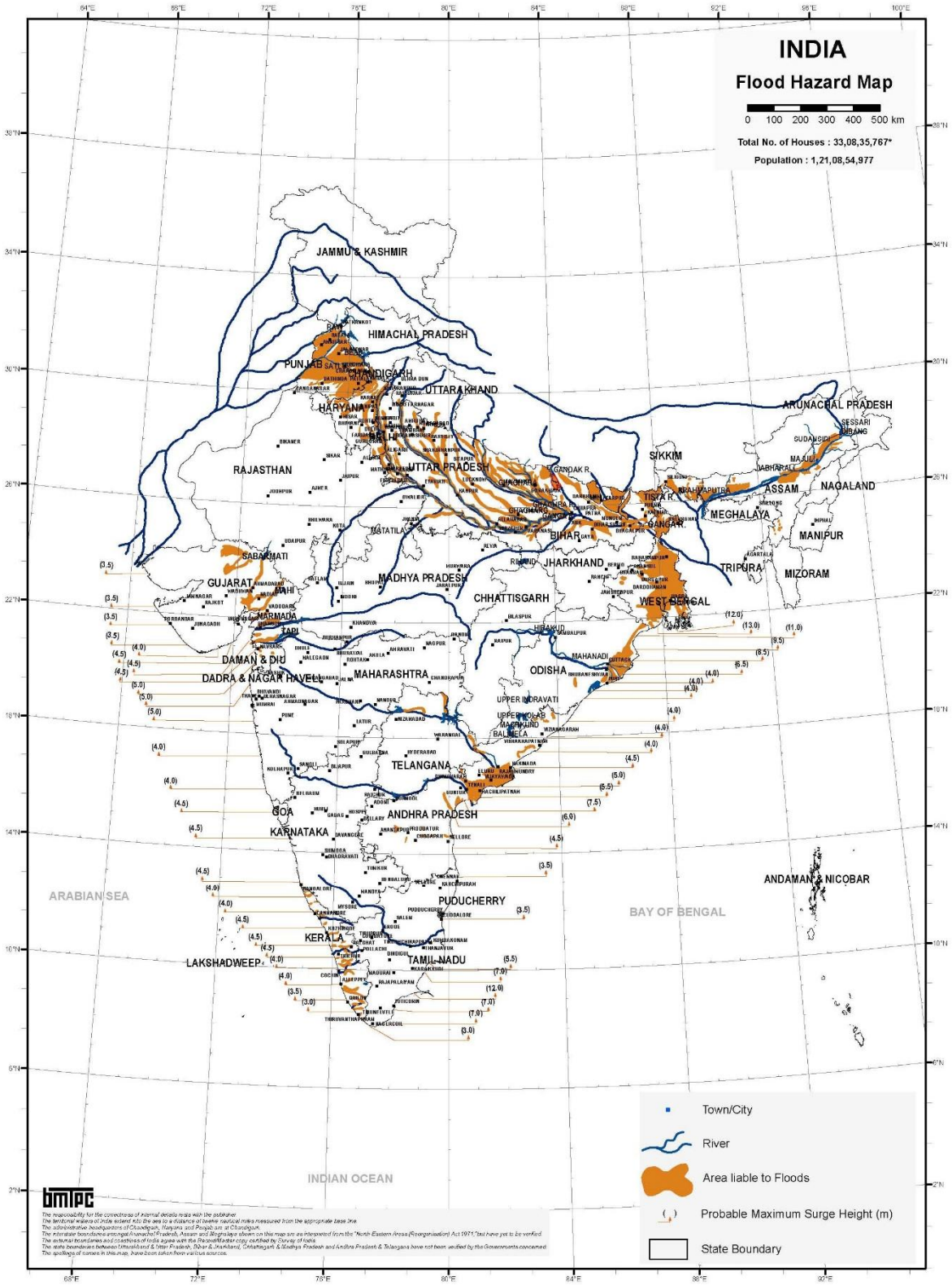
BMTPC : Vulnerability Atlas - 3rd Edition : Peer Group, MoHUA, GOI; Map is Based on digitised data of SOI; Seismic Zones of India Map IS 1893 (Part I): 2002, BIS; Earthquake Epicentre from IMD; Seismotectonic Atlas of India and its Environs, GSI; Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

1.2Wind Hazard Map



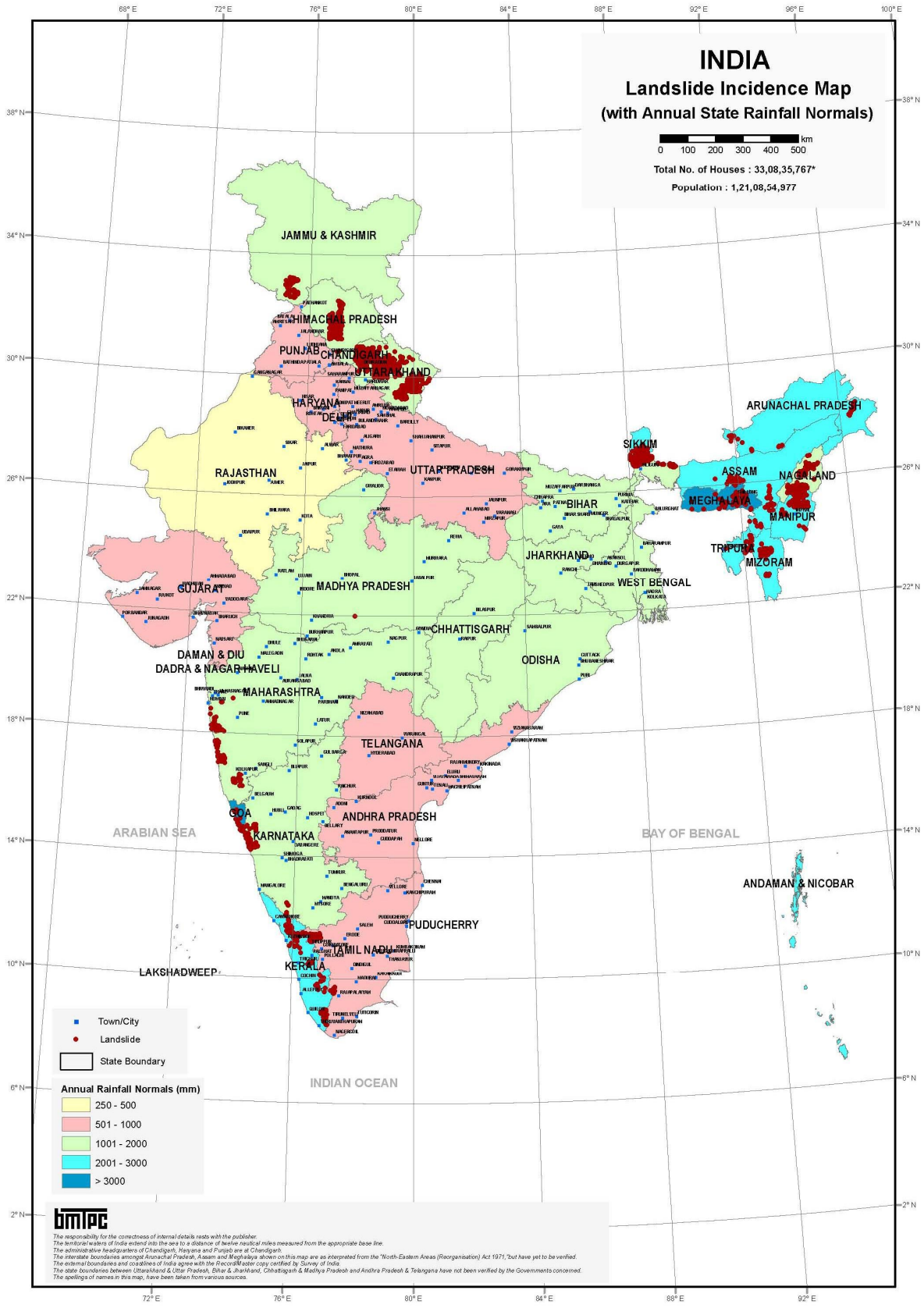
BMTPC : Vulnerability Atlas- 3rd Edition; Peer Group, MoHUA; Map is Based on digitised data of SOI, GOI; Basic Wind Speed Map National Building Code: 2016; Cyclone Data, 1891-2015, IMD, GOI. Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

1.3 Flood Hazard Map



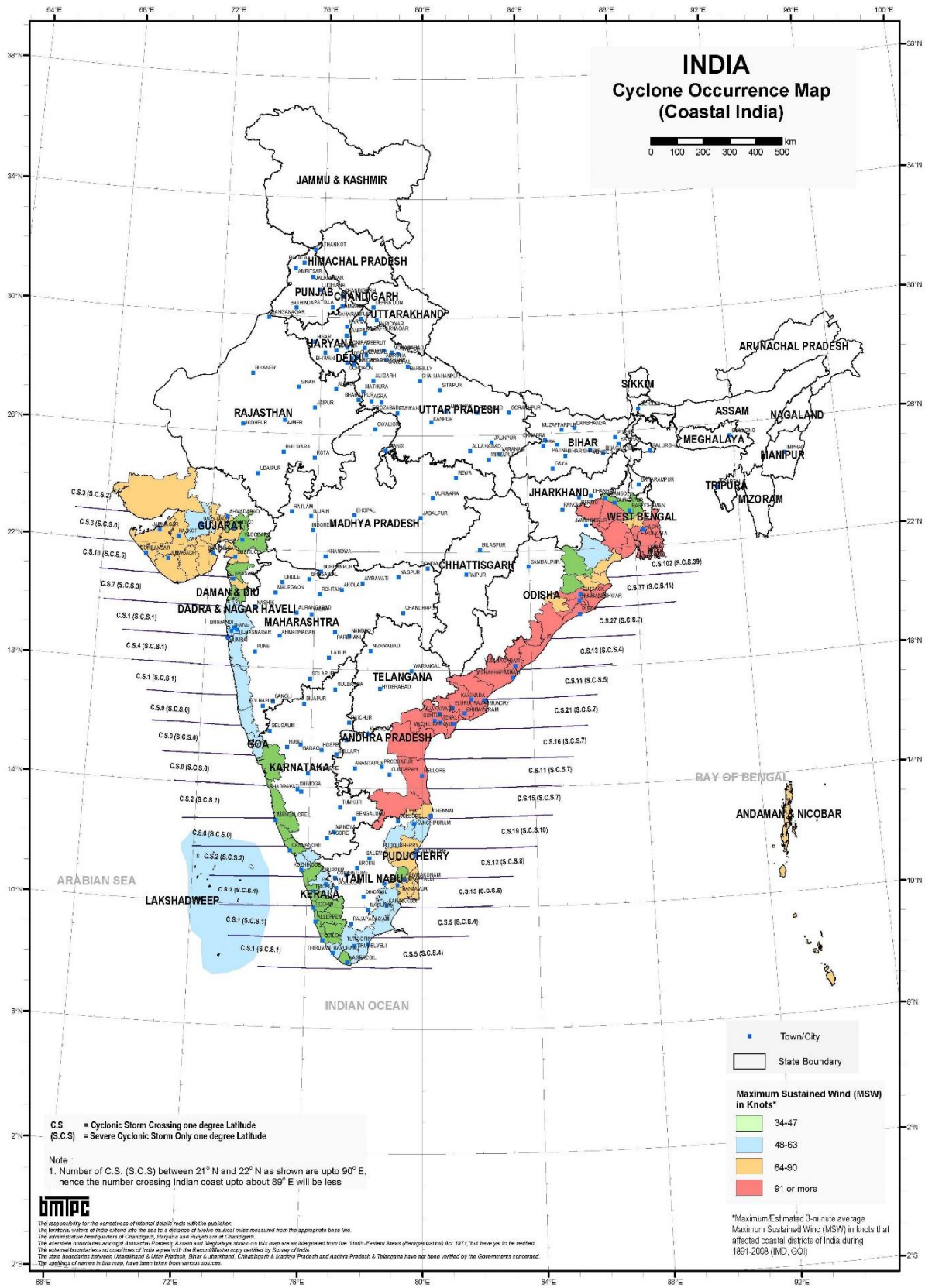
BMTPC : Vulnerability Atlas - 3rd Edition; Peer Group, MoHUA; Map is Based on digitised data of SOI, GOI; Census of India 2011; Flood Atlas (1987),Task Force Report (2004), C.W.C., G.O.I. Houses/Population as per Census 2011; * Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

1.4 Landslide Incidence Map



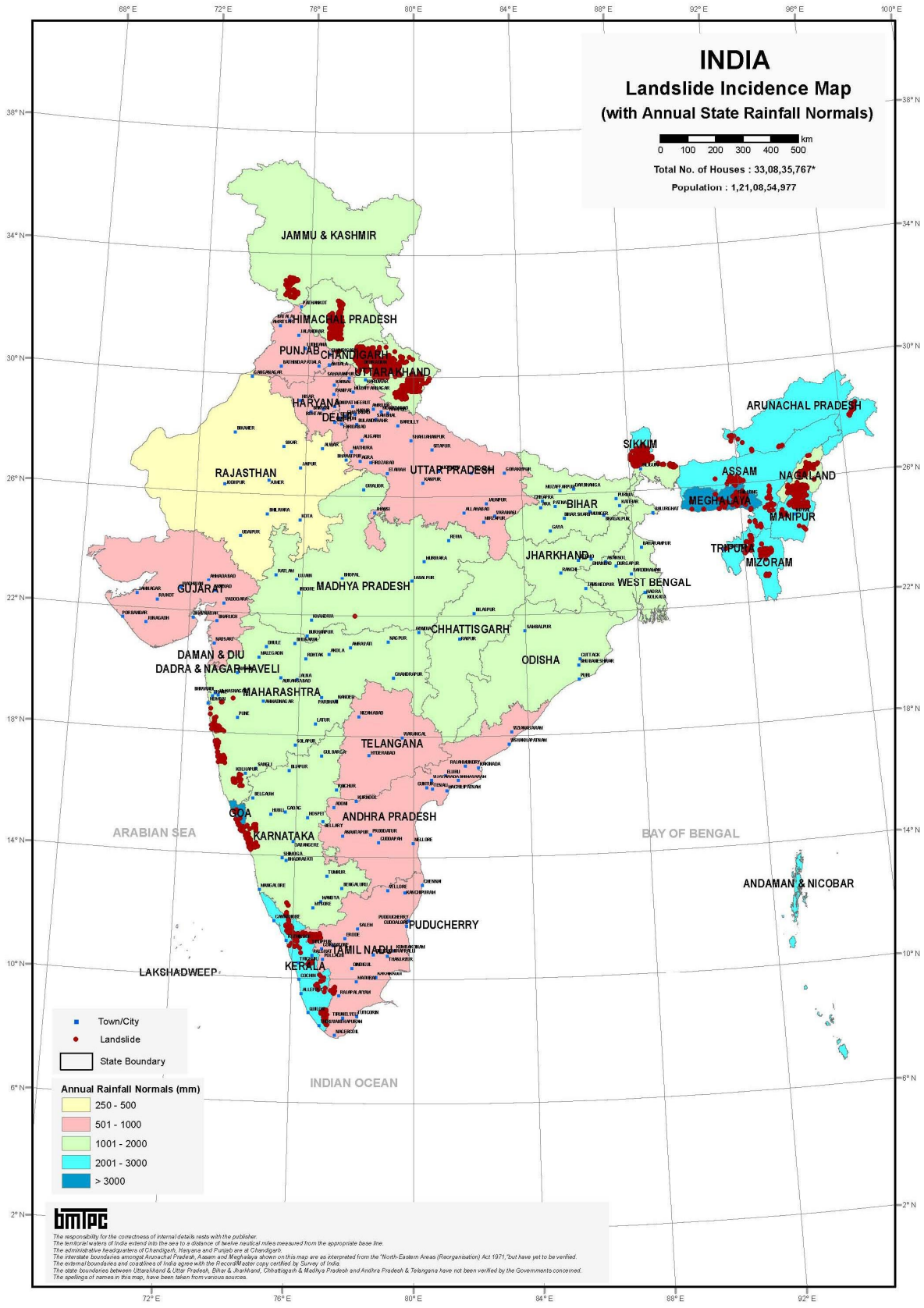
BMTPC: Vulnerability Atlas - 3rd Edition: Peer Group, MoHUA,GOI: Map is Based on digitised data of SOI; Landslide Incidence data GSI; Annual Rainfall data IMD. Houses/Population as per Census 2011;
* Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

1.5 Cyclone Occurrence Map



BMTPC : Vulnerability Atlas- 3rd Edition; Peer Group, MoHUA; Map is Based on digitised data of SOI, GOI; Maximum Sustained Wind (MSW) Data from IMD, GOI. Disclaimer: The maps are solely for thematic presentation.

1.6 Thunderstorm Incidence Map



BMTPC: Vulnerability Atlas - 3rd Edition: Peer Group, MoHUA,GOI: Map is Based on digitised data of SOI; Landslide Incidence data GSI; Annual Rainfall data IMD. Houses/Population as per Census 2011;
* Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

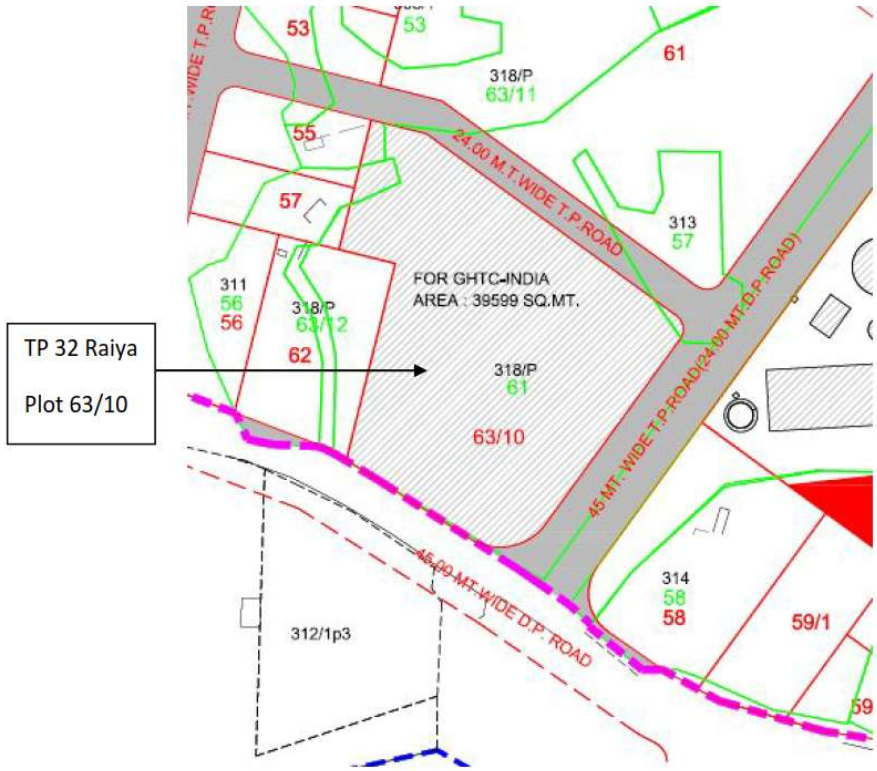
2 Drawings of 6 LHP sites

2.1 LHP1 Gujarat

2.1.1 Location Map

Map of the site showing distance from the city

Proposed Plot Details



DRAFT TOWN PLANNING SCHEME RAJKOT NO. -32(RAIYA)

MAP SHOWING ORIGINAL PLOTS AND FINAL PLOT - MAP NO. 3

LEGEND:-

- R.M.C. BOUNDRY
- BOUNDRY OF T.P. SCHEME
- BOUNDRY OF ORIGINAL PLOT
- BOUNDRY OF FINAL PLOT
- PROPOSED T.P. ROAD
- RESERVATION PLOTS
- 32 R.SURVEY.NO.
- EXIT.LAKE
- 32 ORIGINAL PLOT NO.
- 32 FINAL PLOT NO.

To Jamngar road
45.00 M.T.WIDE EXIT D.P.ROAD
ADJ. VILLAGE BOUNDARY OF GHANTESHWER
ADJ. SURVEYNO OF VILLAGE RAIYA(RMC)
45 MT. WIDE T.P.ROAD(24.00 MT.D.P.ROAD)
40.00 M.T.WIDE T.P.ROAD
24.00 MT. WIDE T.P. ROAD
LAKE NO.1
63/4/A SOCIAL INFRA.
63/4/B SOCIAL INFRA.
63/4/C COMM.SALE
63/4/D COMM.SALE
63/5/A SOCIAL INFRA
63/5/B S.E.W.S.H.
63/5/C RESI SALE
18/A SOCIAL INFRA
63/3/A GARDEN
63/3/B GARDEN
63/2/A SOCIAL INFRA.
63/1/A COMM.SALE
LAKE NO.2
LAKE NO.3
31/A GARDEN
35/A COMM.SALE
44/A GARDEN
34/A SOCIAL INFRA
62/A GARDEN
43/A GARDEN
45/A RESI.SALE
49/A RESI.SALE
50/A RESI.SALE
59/A SOCIAL INFRA
7/A COMM.SALE
29/A COMM.SALE
13/A SALE FOR RESI.
13/B COMM.SALE
17/A S.E.W.S.H.
2/A S.E.W.S.H.
4/A S.E.W.S.H.
4/B S.E.W.S.H.
4/C S.E.W.S.H.
4/D S.E.W.S.H.
4/E OPEN SPACE
R.M.C. S.T.P.
GARDEN-1
GARDEN-2
GARDEN-3
GARDEN-4
GARDEN-5
GARDEN-6
GARDEN-10
GARDEN-11
GARDEN-14
75.00 MT WIDE D.P.ROAD
ADJ. VILLAGE BOUNDARY OF VAJDIGADH
ADJ. VILLAGE BOUNDARY OF VEJAGAM
EXISTING 45 MT.WIDE SECOND RING ROAD
To Kalavad road
To VillageRaiya
ADJ. VILLAGE BOUNDARY OF MUNJKA
45.00 MT.WIDE D.P. ROAD
24.00 MT.WIDE D.P. ROAD
18.00 MT. WIDE T.P. ROAD
36.00 M.T.WIDE T.P.ROAD
60.00 M.T.WIDE T.P.ROAD

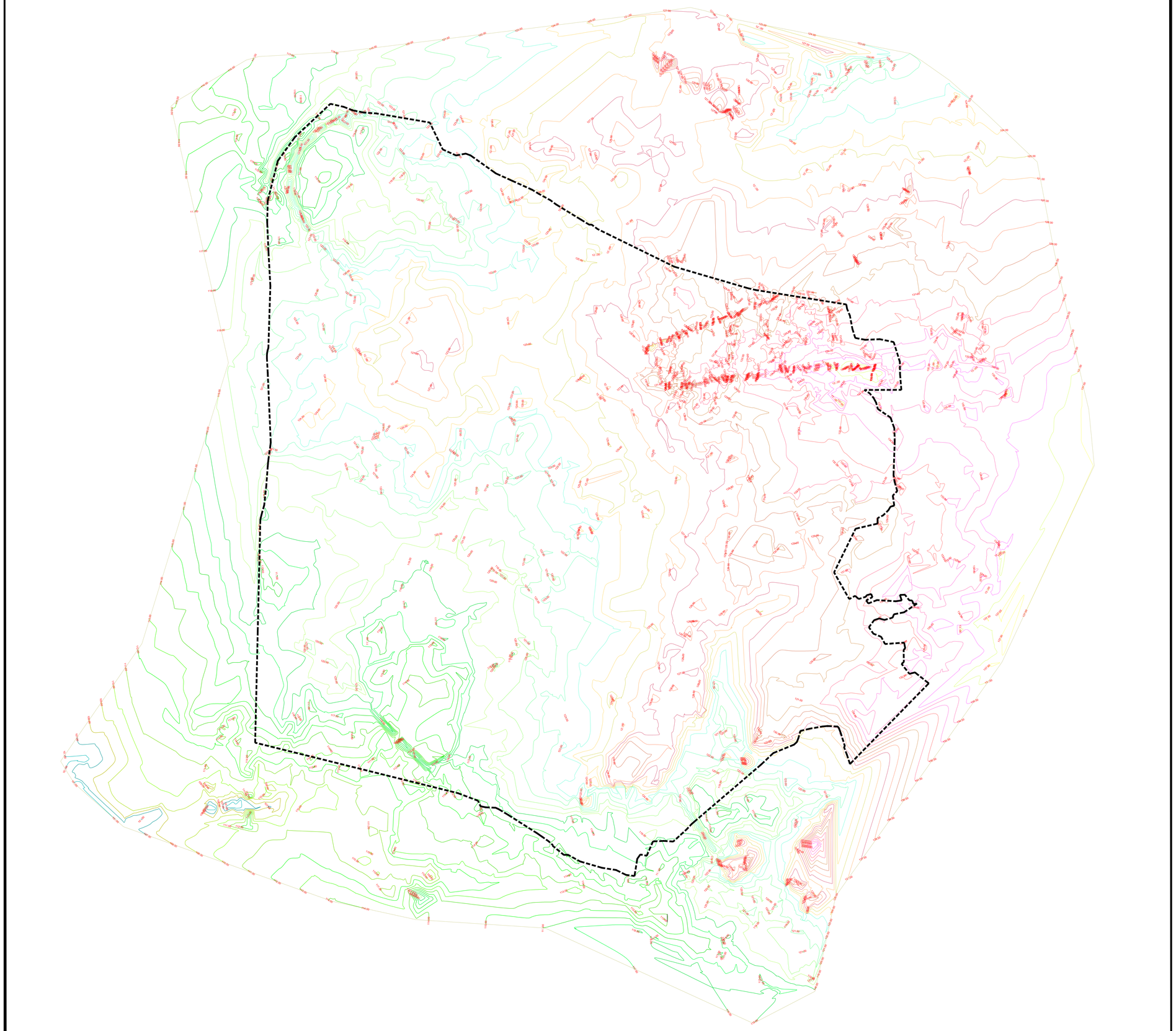
RAJKOT MAHANAGAR SEWA SADAN

Scale : 1cm = 30 mt.

TOWNPLANNING OFFICER
RAJKOT MAHANAGAR SEWA SADAN

COMMISSIONER
RAJKOT MAHANAGAR SEWA SADAN

2.1.2 Total Station Survey Map



RAJKOT MUNICIPAL CORPORATION

N

Scale : 1cm = 30 mt.

2.1.3 Soil Testing Report

GEOTECHNICAL INVESTIGATION REPORT

GREEN FIELD AREA – RAJKOT SMART CITY

CONSULTANTS	**PRIME MERIDIAN SURVEYS PVT. LTD,** New No.68/6, Ground Floor Madhangi Flat, Jones Road, Saidapet, Chennai-15 Ph. No. 044-23813667/68 Mobile: 9444020824/9500057519 Email : meridiansurveys@gmail.com Website: www.primemeridiansurveys.com
CLIENT	**AECOM INDIA PVT LTD,** Gurgaon-122002
PROJECT	**PROPOSED CONSTRUCTION OF INDUSTRIAL DEVELOPMENT AT RAJKOT, GUJARAT**
TITLE	**GEOTECHNICAL INVESTIGATION REPORT**

0	**04-10-2018**	**PMSPL/AECOM INDIA PVT LTD/285/2018-19**	
REV.	**DATE**	**REPORT NUMBER**	**PREP. BY**

CONTENTS

CHAPTER-1

INTRODUCTION

1.0 Preamble

Prime Meridian Surveys Pvt. Ltd., Chennai proposed to construct an **Industrial Development at Rajkot, Gujarat.**

For the purpose of designing the foundations, the responsibility of carrying out suitable soil investigation was entrusted to **M/s. Geo Mines ENGINEERS Pvt. Ltd., Chennai.**

This report contains the field and laboratory test results along with Design computations and recommendations for suitable foundation systems.

1.1 Scope of Work

- Sinking Fifteen Standard Soil investigation bore holes of 150mm diameter up to depth below existing ground level where SPT>100 or as directed by the engineer-in-charge.
- Conducting Standard Penetration Test (SPT) at regular depth intervals.
- Collection of Split Spoon Samples or Disturbed Soil Samples
- Collection of water samples from each bore hole.
- Conducting relevant laboratory test results.

1.2 Structure of the Report

- Contents
- Introduction
- Investigation Methodology & Test Results
- Figures & Tables
- Sub-Surface Stratification
- Foundation Systems
- Recommendations
- Annexure (Design Computations)

CHAPTER-2

INVESTIGATION METHODOLOGY & TEST RESULTS

2.0 Field Testing:

2.1 Preamble:

Fifteen standard soil investigation boreholes were put. The equipment used and the methodology adopted to carry out the fieldwork is described below.

2.2 Equipment Used and Method of Drilling:

2.2.1 Equipment Used

The equipment used for performing the drilling operations is a Calyx Rotary Drill Rig with direct mud circulation technique. The drill mud used was made out of Sodium Bentonite.

2.2.2 Methodology of drilling

In the soil strata, the drilling operations have been carried out using special drill bits and cutters coupled with direct mud circulation.

2.3 In-Situ Strength Tests:

2.3.1 Standard Penetration Test:

Standard penetration tests were conducted at the borehole locations, in accordance with IS: 2131. The tests were conducted at every change of strata up to the depth of termination of the borehole as directed by the engineer-in-charge.

2.4. Collection of Samples:

2.4.1 Disturbed Soil Samples

The SPT-samples collected were used as disturbed soil samples. These samples were used for visual and physical identification and for conducting laboratory classification tests as per I.S.1498-1970.

2.4.2 Ground Water

For conducting suitable chemical tests, the ground water sample was collected from the respective boreholes.

2.5 Summary of Field Work

The locations of the boreholes are shown in site plan given in Fig.2.0. The soil profiles obtained at each location is shown in Fig.2.1 to 2.15.

2.6 Laboratory Testing:

2.6.1 Coarse Grained Samples:

2.6.1.1 Grain size Analysis Tests:

On the coarse grained samples, grain size distribution tests were conducted as per I.S.2720 (Part 4)-1985, to know the gradation characteristics and to classify them. These results are presented in Tables 2.1 to 2.15.

2.6.2 Fine Grained Samples:

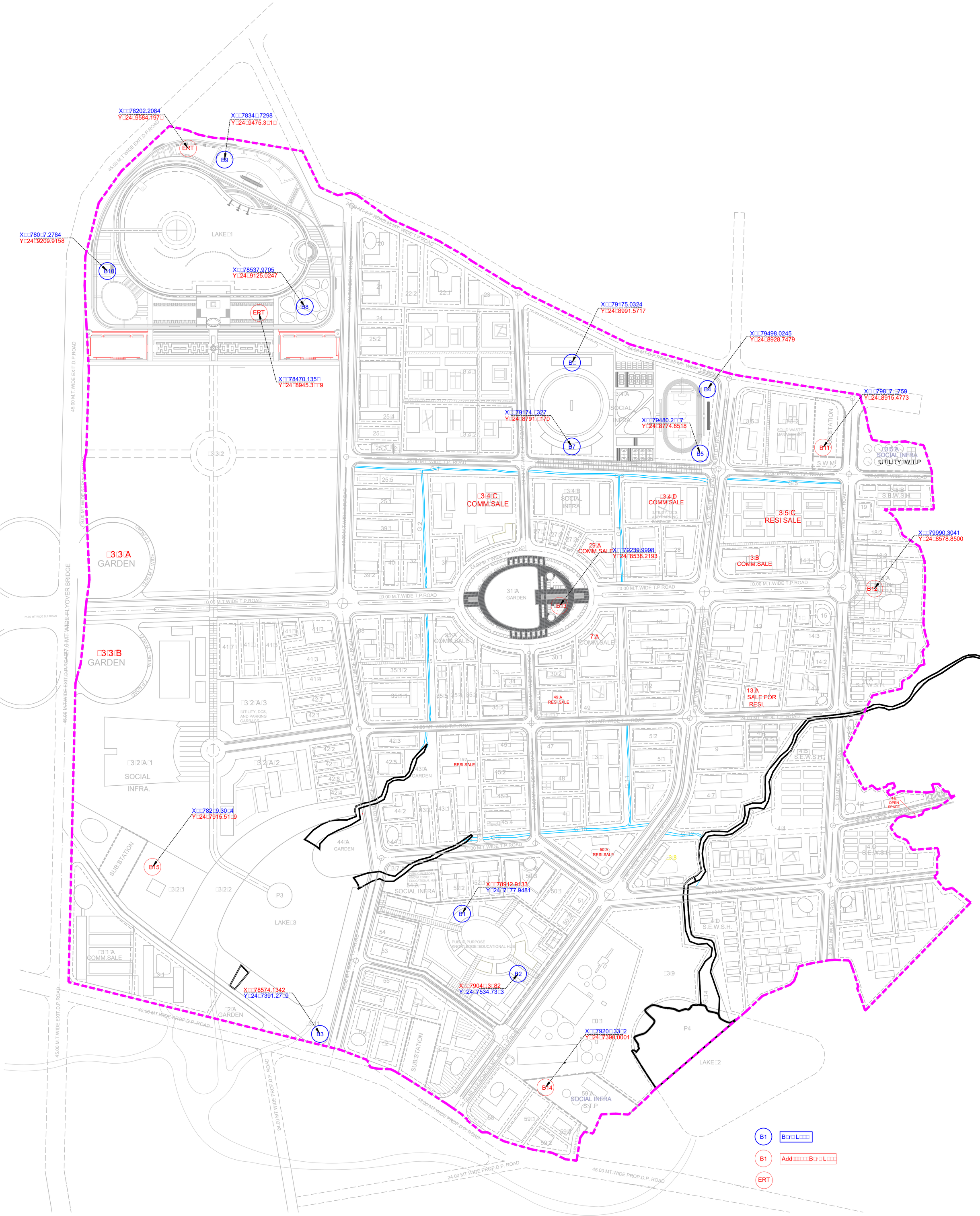
2.6.2.1 Index Property – Free Swell Tests:

Atterberg Limits were carried out on fine grained soil samples to evaluate the limits of different consistency states. Generally Liquid limits, Plastic limits and Shrinkage Limits tests were conducted as per I.S.2720 (Part-5)-1985 and I.S.2720 (Part 6)-1972. On such type of soil strata encountered at the investigation locations, such tests were conducted and the test results are presented in Tables 2.1 to 2.15.

2.6.3 Chemical Analysis Tests:

2.6.3.1 Water/Soil Samples:

On representative water/soil samples, chemical analysis tests were conducted to estimate pH, Chlorides and Sulphates. These results are presented in Table-2.16.


X□□78202.2084
Y□24□9584.197□
ERT
X□□7834□7298
Y□24□9475.3□1□
B9
45.00 M.T.WIDE EXIT D.P.ROAD
X□□780□7.2784
Y□24□9209.9158
B10
LAKE□1
X□□78537.9705
Y□24□9125.0247
B8
ERT
X□□78470.135□
Y□24□8945.3□□9
□3□3□A
GARDEN
□3□3□B
GARDEN
□3□2□A□3
UTILITY, DCS, AND PARKING GARRAGE
□3□2□A□1
SOCIAL INFRA.
□3□2□A□2
X□□782□9.30□4
Y□24□7915.51□9
B15
SUB STATION
□3□2□1
□3□2□2
P3
LAKE□3
□3□1□A
COMM.SALE
□3□1
X□□78574.1342
Y□24□7391.27□9
B3
□2□A
GARDEN
□2□1
45.00 MT.WIDE PROP.D.P. ROAD
24.00 MT.WIDE PROP.D.P. ROAD
X□□79175.0324
Y□24□8991.5717
B6
X□□79498.0245
Y□24□8928.7479
B4
X□□798□7.□759
Y□24□8915.4773
X□□79174.□327
Y□24□8791.□170
B7
X□□79480.2□□7
Y□24□8774.8518
B5
24.00 MT. WIDE T.P.ROAD
40.00 M.T.WIDE T.P.ROAD
45 MT. WIDE T.P.ROAD
□3□4□A
SOCIAL INFRA.
□3□4□B
SOCIAL INFRA.
□3□4□C
COMM.SALE
□3□4□D
COMM.SALE
UTILITY, DCS, AND PARKING GARRAGE
□3□5□C
RESI SALE
□3□5□A
SOCIAL INFRA
UTILITY□W.T.P
□3□5□B
S.B.W.S.H.
SOLID WASTE MANAGEMENT
S.T.P STATION
S.W.M
X□□79990.3041
Y□24□8578.8500
B12
29□A
COMM.SALE
X□□79239.9998
Y□24□8538.2193
B13
31□A
GARDEN
13□B
COMM.SALE
7□A
COMM.SALE
49□A
RESI.SALE
13□A
SALE FOR RESI.
45□A
RESI.SALE
43□A
GARDEN
50□A
RESI.SALE
54□A
SOCIAL INFRA
PUBLIC PURPOSE KNOWLEDGE□EDUCATIONAL HUB
X□□78912.9133
Y□24□7□77.9481
B1
X□□7904□3□82
Y□24□7534.73□3
B2
X□□7920□33□2
Y□24□7390.0001
B14
59□A
SOCIAL INFRA
S.T.P
54□E
OPEN SPACE
4□A
S.E.W.S.H.
4□B
S.E.W.S.H.
4□C
S.E.W.S.H.
4□D
S.E.W.S.H.
P4
LAKE□2
B1
B□r□L□□□
B1
Add□□□□□B□r□L□□□
ERT

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-01

Co-ordinates: X-678912.9133, Y-2467677.9481

Started On : 10/09/2018; Ended On : 10/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details				Graphical Representation of SPT		Relative Density/Consistency	Type of Sample
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	0 10 20 30 40 50 60 70 80 90		
0.50			Soft Disintegrated Rock							V.Dense	DS
				1.00	10cms Penetration for 50 Blows					V.Dense	SS
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
3.00				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 3.00m below the existing ground level

Fig. 2.1 Soil Profile at BH-01 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-02

Co-ordinates: X-679046.3682, Y-2467534.7363

Started On : 10/09/2018; Ended On : 10/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details					Graphical Representation of SPT												Relative Density/Consistency	Type of Sample
									0	10	20	30	40	50	60	70	80	90				
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value														
			Soft Disintegrated																		V.Dense	DS
0.70			Rock																			
				1.00	09cms Penetration for 50 Blows																V.Dense	SS
			Weathered	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded																V.Dense	SS
			Rock																			
				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded																V.Dense	SS
3.50				3.50	Nil Penetration for 50 Blows, SPT Hammer Rebounded																V.Dense	SS

Bore Hole Terminated at a depth of 3.50m below the existing ground level

Fig. 2.2 Soil Profile at BH-02 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-03

Co-ordinates: X-678574.1342, Y-2467391.2769

Started On : 13/09/2018; Ended On : 13/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details					Graphical Representation of SPT											Relative Density/Consistency	Type of Sample
									0	10	20	30	40	50	60	70	80	90			
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value													
0.50			Brownish Soft Silty Sandy Clay																	Soft	DS
0.90			Greyish to Whitish Medium Dense Silty Clayey Fine Sand mixed with lime																	M.Dense	DS
				1.00	03cms Penetration for 50 Blows															V.Dense	SS
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS
				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS
3.50				3.50	SPT Hammer Rebounded															V.Dense	SS
			Soft		Rock Core Recovery: 20cm															V.Dense	CS
4.50			Rock	4.50																	

Bore Hole Terminated at a depth of 4.50m below the existing ground level

Fig. 2.3 Soil Profile at BH-03 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-04

Co-ordinates: X-679498.0245, Y-2468928.7479

Started On : 15/09/2018; Ended On : 15/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details					Graphical Representation of SPT												Relative Density/Consistency	Type of Sample
									0	10	20	30	40	50	60	70	80	90				
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value														
0.30			Brownish to Reddish Dense Silty Sandy Gravels																		Dense	DS
				1.00	05cms Penetration for 50 Blows																V.Dense	SS
			Weathered Rock																			
2.00				2.00	SPT Hammer Rebounded																V.Dense	SS
			Soft		Rock Core Recovery: 25cm																V.Dense	CS
3.00			Rock	3.00																		

Bore Hole Terminated at a depth of 3.00m below the existing ground level

Fig. 2.4 Soil Profile at BH-04 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-05

Co-ordinates: X-679480.2667, Y-2468774.8518

Started On : 08/09/2018; Ended On : 09/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details					Graphical Representation of SPT											Relative Density/Consistency	Type of Sample
									0	10	20	30	40	50	60	70	80	90			
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value													
0.50			Soft Disintegrated Rock																	V.Dense	DS
				1.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS
2.50				2.50	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS

Bore Hole Terminated at a depth of 2.50m below the existing ground level

Fig. 2.5 Soil Profile at BH-05 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-06

Co-ordinates: X-679175.0324, Y-2468991.5717

Started On : 09/09/2018; Ended On : 09/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details				Graphical Representation of SPT		Relative Density/Consistency	Type of Sample
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	0 10 20 30 40 50 60 70 80 90		
0.40			Soft Disintegrated Rock							V.Dense	DS
				1.00	04cms Penetration for 50 Blows					V.Dense	SS
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
3.00				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 3.00m below the existing ground level

Fig. 2.6 Soil Profile at BH-06 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-07

Co-ordinates: X-679174.6327, Y-2468791.6170

Started On : 09/09/2018; Ended On : 09/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details				Graphical Representation of SPT		Relative Density/Consistency	Type of Sample
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	0 10 20 30 40 50 60 70 80 90		
0.50			Soft Disintegrated Rock							V.Dense	DS
				1.00	02cms Penetration for 50 Blows					V.Dense	SS
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
2.50				2.50	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 2.50m below the existing ground level

Fig. 2.7 Soil Profile at BH-07 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-08

Co-ordinates: X-678537.9705, Y-2469125.0247

Started On : 11/09/2018; Ended On : 11/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details				Graphical Representation of SPT		Relative Density/Consistency	Type of Sample
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	0 10 20 30 40 50 60 70 80 90		
0.70			Brownish Dense Silty Sandy Gravels							Dense	DS
			Weathered Rock	1.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
				2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
2.50				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 3.00m below the existing ground level

Fig. 2.8 Soil Profile at BH-08 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-09

Co-ordinates: X-678346.7298, Y-2469475.3616

Started On : 14/09/2018; Ended On : 14/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details					Graphical Representation of SPT											Relative Density/Consistency	Type of Sample
									0	10	20	30	40	50	60	70	80	90			
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value													
0.60			Brownish to Greyish Soft Silty Clay																	Soft	DS
0.90			Greyish to Whitish Dense Silty Clayey Fine Sand mixed with kankars																	Dense	DS
				1.00	06cms Penetration for 50 Blows															V.Dense	SS
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS
3.00				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS

Bore Hole Terminated at a depth of 3.00m below the existing ground level

Fig. 2.9 Soil Profile at BH-09 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-10

Co-ordinates: X-678067.2784, Y-2469209.9158

Started On : 11/09/2018; Ended On : 11/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details				Graphical Representation of SPT		Relative Density/Consistency	Type of Sample
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	0 10 20 30 40 50 60 70 80 90		
0.80			Brownish to Reddish Dense Silty Sandy Gravels							Dense	DS
			Weathered Rock	1.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
				2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
3.60				3.60	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 3.60m below the existing ground level

Fig. 2.10 Soil Profile at BH-10 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-11

Co-ordinates: X-679867.6759, Y-2468915.4773

Started On : 12/09/2018; Ended On : 12/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details: Depth of SPT below E.G.L (m)	SPT - Details: 0-15 cm	SPT - Details: 15-30 cm	SPT - Details: 30-45 cm	Graphical Representation of SPT: N-Value	Graphical Representation of SPT: 0 10 20 30 40 50 60 70 80 90	Relative Density/Consistency	Type of Sample
0.50			Brownish to Reddish Dense Silty Sandy Gravels							Dense	DS
			Weathered Rock	1.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
				2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS
3.00				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 3.00m below the existing ground level

Fig. 2.11 Soil Profile at BH-11 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-12

Co-ordinates: X-679990.3041, Y-2468578.8500

Started On : 12/09/2018; Ended On : 12/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details					Graphical Representation of SPT											Relative Density/Consistency	Type of Sample
									0	10	20	30	40	50	60	70	80	90			
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value													
0.60			Brownish Soft Silty Clay																	Soft	DS
			Brownish to Greyish Very Dense Silty Clayey Fine Sand mixed with lime nodules	1.00	12	17	40	57												V.Dense	SS
1.60																					
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS
3.00				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS

Bore Hole Terminated at a depth of 3.00m below the existing ground level

Fig. 2.12 Soil Profile at BH-12 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-13

Co-ordinates: X-679239.9998, Y-2468538.2193

Started On : 13/09/2018; Ended On : 14/09/2018 G.W.T: 1.40m below existing ground level

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details: Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value	Graphical Representation of SPT (0 10 20 30 40 50 60 70 80 90)	Relative Density/Consistency	Type of Sample
			Brownish to Greyish Stiff Silty Clay	1.00	4	3	6	9		Stiff	SS
1.40											
			Greyish to Whitish Very Dense Silty Fine Sand mixed with kankars	2.00	26	33	40	73		V.Dense	SS
2.80											
			Weathered Rock	3.00	11cms Penetration for 50 Blows					V.Dense	SS
4.00				4.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded					V.Dense	SS

Bore Hole Terminated at a depth of 4.00m below the existing ground level

Fig. 2.13 Soil Profile at BH-13 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-14

Co-ordinates: X-679206.3362, Y-2467390.0001

Started On : 12/09/2018; Ended On : 12/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details: Depth of SPT below E.G.L (m)	SPT - Details: 0-15 cm	SPT - Details: 15-30 cm	SPT - Details: 30-45 cm	Graphical Representation of SPT: N-Value	Relative Density/Consistency	Type of Sample
								0 10 20 30 40 50 60 70 80 90		
0.40			Filled Up Soil						-	DS
0.90			Brownish to Greyish Soft Silty Clay mixed with lime						Soft	DS
				1.00	07cms Penetration for 50 Blows				V.Dense	SS
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded				V.Dense	SS
				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded				V.Dense	SS
3.50				3.50	Nil Penetration for 50 Blows, SPT Hammer Rebounded				V.Dense	SS

Bore Hole Terminated at a depth of 3.50m below the existing ground level

Fig. 2.14 Soil Profile at BH-14 Location

Project : Proposed Construction of Industrial Development at Rajkot, Gujarat

Location: BH-15

Co-ordinates: X-678269.3064, Y-2467915.5169

Started On : 14/09/2018; Ended On : 15/09/2018 G.W.T: Not met within investigation depth

R.L of Layer (m)	G.W.T. (m)	Soil Profile	Engineering Description of Soil	SPT - Details					Graphical Representation of SPT											Relative Density/Consistency	Type of Sample
									0	10	20	30	40	50	60	70	80	90			
				Depth of SPT below E.G.L (m)	0-15 cm	15-30 cm	30-45 cm	N-Value													
0.30			Brownish to Reddish Dense Silty Sandy Gravels																	Dense	DS
				1.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS
			Weathered Rock	2.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS
3.00				3.00	Nil Penetration for 50 Blows, SPT Hammer Rebounded															V.Dense	SS

Bore Hole Terminated at a depth of 3.00m below the existing ground level

Fig. 2.15 Soil Profile at BH-15 Location

Table 2.1: Laboratory Test Result on the Soil Sample Collected from BH-01

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.50	-	DS	Soft Disintegrated Rock	-	-	-	-	-	2.66	-	19.3	-	-	-	Dense	33	12	15	31	9	0	-	-	SDR
0.50 to 3.00	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.6	-	-	-	V.Dense	41	9	21	16	13	0	5.20	42.30	SDR

Table 2.2: Laboratory Test Result on the Soil Sample Collected from BH-02

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.70	-	DS	Soft Disintegrated Rock	-	-	-	-	-	2.66	-	19.3	-	-	-	Dense	27	19	10	33	11	0	-	-	SDR
0.70 to 3.50	>100	SS	Weathered Rock	-	-	-	-	-	2.63	-	21.1	-	-	-	V.Dense	44	11	8	21	16	0	6.40	42.10	SDR

Table 2.3: Laboratory Test Result on the Soil Sample Collected from BH-03

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.50	-	DS	Silty Sandy Clay	33	85	16	69	0.8	2.68	0.9	14	-	70	-	Soft	0	0	0	11	11	78	-	-	CH
0.50 to 0.90	-	DS	Silty Clayey Fine Sand mixed with lime	-	-	-	-	-	2.67	-	16	-	-	-	M.Dense	21	0	0	55	10	14	-	-	SM
0.90 to 3.50	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	19.9	-	-	-	V.Dense	41	15	26	12	6	0	2.40	41.90	SDR
3.50 to 4.50	>100	SS	Soft Rock	-	-	-	-	-	2.63	-	20.4	-	-	-	V.Dense	100	0	0	0	0	0	-	42.50	-

Table 2.4: Laboratory Test Result on the Soil Sample Collected from BH-04

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.30	-	DS	Silty Sandy Gravels	-	-	-	-	-	2.66	-	19	-	-	-	Dense	53	0	11	26	10	0	-	-	GP
0.30 to 2.00	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.3	-	-	-	V.Dense	37	18	13	19	13	0	5.20	41.80	SDR
2.00 to 3.00	>100	SS	Soft Rock	-	-	-	-	-	2.63	-	21.1	-	-	-	V.Dense	100	0	0	0	0	0	-	42.20	SR

Table 2.5: Laboratory Test Result on the Soil Sample Collected from BH-05

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.50	-	DS	Soft Disintegrated Rock	-	-	-	-	-	2.66	-	19.3	-	-	-	Dense	31	24	9	21	15	0	-	-	SDR
0.50 to 2.50	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.4	-	-	-	V.Dense	47	19	18	13	3	0	1.20	42.20	SDR

Table 2.6: Laboratory Test Result on the Soil Sample Collected from BH-06

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.40	-	DS	Soft Disintegrated Rock	-	-	-	-	-	2.66	-	19.6	-	-	-	Dense	24	21	18	28	9	0	-	-	SDR
0.40 to 3.00	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.4	-	-	-	V.Dense	48	12	13	19	8	0	3.20	42.30	SDR

Table 2.7: Laboratory Test Result on the Soil Sample Collected from BH-07

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.50	-	DS	Soft Disintegrated Rock	-	-	-	-	-	2.66	-	19.4	-	-	-	Dense	30	14	11	39	6	0	-	-	SDR
0.50 to 2.50	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.6	-	-	-	V.Dense	47	13	20	16	4	0	1.60	42.20	SDR

Table 2.8: Laboratory Test Result on the Soil Sample Collected from BH-08

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.70	-	DS	Silty Sandy Gravels	-	-	-	-	-	2.66	-	19.6	-	-	-	Dense	61	0	10	22	7	0	-	-	GP
0.70 to 3.00	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	21.3	-	-	-	V.Dense	41	16	16	21	6	0	2.40	42.50	SDR

Table 2.9: Laboratory Test Result on the Soil Sample Collected from BH-09

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.60	-	DS	Silty Clay	37	88	21	67	0.8	2.68	1.0	14	-	80	-	Soft	0	0	0	0	14	86	-	-	CH
0.60 to 0.90	-	DS	Silty Clayey Fine Sand mixed with Kankars	-	-	-	-	-	2.66	-	19.5	-	-	-	Dense	22	0	0	51	12	15	-	-	SM
0.90 to 3.00	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.4	-	-	-	V.Dense	37	13	19	22	9	0	3.60	42.10	SDR

Table 2.10: Laboratory Test Result on the Soil Sample Collected from BH-10

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.80	-	DS	Silty Sandy Gravels	-	-	-	-	-	2.66	-	19.1	-	-	-	Dense	59	0	11	25	5	0	-	-	GP
0.80 to 3.60	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.4	-	-	-	V.Dense	42	12	15	23	8	0	3.20	42.30	SDR

Table 2.11: Laboratory Test Result on the Soil Sample Collected from BH-11

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.50	-	DS	Silty Sandy Gravels	-	-	-	-	-	2.66	-	19.7	-	-	-	Dense	56	0	13	22	9	0	-	-	GP
0.50 to 3.00	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.4	-	-	-	V.Dense	44	17	16	21	2	0	0.80	42.20	SDR

Table 2.12: Laboratory Test Result on the Soil Sample Collected from BH-12

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.60	-	DS	Silty Clay	48	89	21	68	0.6	2.68	1.3	14	-	80	-	Soft	0	0	0	0	15	85	-	-	CH
0.60 to 1.60	57	SS	Silty Clayey Fine Sand mixed with Lime Nodules	-	-	-	-	-	2.65	-	20.3	-	-	-	Dense	19	0	0	56	10	15	10.00	42.05	SM
1.60 to 3.00	>100	SS	Weathered Rock	-	-	-	-	-	2.64	-	21.1	-	-	-	V.Dense	34	14	21	20	11	0	4.40	42.20	SDR

Table 2.13: Laboratory Test Result on the Soil Sample Collected from BH-13

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 1.40	9	SS	Silty Clay	29	80	16	64	0.8	2.67	0.8	17	-	80	-	Stiff	0	0	0	0	20	80	60.00	8.00	CH
1.40 to 2.80	73	SS	Silty Fine Sand mixed with kankars	-	-	-	-	-	2.65	-	20.3	-	-	-	V.Dense	28	0	0	58	14	0	5.60	42.00	SM
2.80 to 4.00	>100	SS	Weathered Rock	-	-	-	-	-	2.63	-	21.1	-	-	-	V.Dense	39	11	16	28	6	0	2.40	42.30	SDR

Table 2.14: Laboratory Test Result on the Soil Sample Collected from BH-14

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.40	-	DS	Filled Up Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.40 to 0.90	-	DS	Silty Clay mixed with lime	41	90	16	74	0.7	2.68	1.1	13	-	85	-	Soft	22	0	0	0	11	67	-	-	CH
0.90 to 3.50	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	21.1	-	-	-	V.Dense	45	19	11	17	8	0	3.20	42.50	SDR

Table 2.15: Laboratory Test Result on the Soil Sample Collected from BH-15

Depth of Sample below E.G.L. (m)	SPT of Sample	Type of Sample	Engineering Description of Soil	NMC(%)	Clay				Specific Gravity, G	Void Ratio, e	Bulk Density, kN/m^3	Dry Density, kN/m^3	Free Swell (%)	Swelling Pressure (kPa)	Relative Density/ Consistency	Sieve Analysis						Direct Shear		IS-Classification
					LL (%)	PL (%)	PI	Consistency, I_C								Gravel (%)	Coarse (%)	Medium (%)	Fine (%)	Silt (%)	Clay (%)	c (kN/m^2)	ϕ (Deg.)	
0.00 to 0.30	-	DS	Silty Sandy Gravels	-	-	-	-	-	2.66	-	19.1	-	-	-	Dense	61	0	10	25	4	0	-	-	GP
0.30 to 2.50	>100	SS	Weathered Rock	-	-	-	-	-	2.65	-	20.5	-	-	-	V.Dense	41	15	17	24	3	0	1.20	42.50	SDR

Table 2.16: Chemical Analysis Results conducted on Water/Soil Samples collected from BH-01 to BH-15				
Location	**Depth of Sample below E.G.L. (m)**	**pH**	**Chlorides (ppm)**	**Sulphates (ppm)**
BH-01	3.00	7.71	299.19	336.58
BH-02	3.00	7.71	303.64	341.59
BH-03	3.00	7.71	308.41	346.96
BH-04	3.00	7.71	305.47	343.65
BH-05	3.00	7.71	299.11	336.49
BH-06	3.00	7.71	296.18	333.20
BH-07	3.00	7.71	301.24	338.89
BH-08	3.00	7.71	295.33	332.24
BH-09	3.00	7.71	286.44	322.24
BH-10	3.00	7.71	285.61	321.31
BH-11	3.00	7.71	291.55	327.99
BH-12	3.00	7.71	311.28	350.19
BH-13	1.40	7.71	296.18	333.20
BH-14	3.00	7.71	311.47	350.40
BH-15	3.00	7.71	315.68	355.14

CHAPTER-3

SUB-SURFACE STRATIFICATION

3.0 Preamble

The sub surface stratification at borehole locations, with respect to foundation/geotechnical engineering application are derived based on the visual identification, laboratory classification tests and field in-situ strength tests. Further, the strength parameters are estimated based on the in-situ strength test results as per the following correlation.

* **For Coarse Grained Samples, Ref. Fig.1, IS: 6403 to estimate Angle of Shearing Resistance.**
* **For Fine Grained Samples, Ref. Terzaghi & Peck, 1948, to estimate Unconfined Compressive Strength.**

3.1 Sub Surface Stratification:

3.1.1 Soil Profile at BH-01 Location

(At BH-01 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.50m depth)**

Type of Strata	Soft Disintegrated Rock
Colour	-
Thickness of Layer	0.50m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-2 (from 0.50m to 3.00m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	2.50m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance,	42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.2 Soil Profile at BH-02 Location
(At BH-02 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 1.95m depth)**

Type of Strata	Soft Disintegrated Rock
Colour	-
Thickness of Layer	0.70m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-2 (from 0.70m to 3.50m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	2.80m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance,	42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.3 Soil Profile at BH-03 Location
(At BH-03 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.50m depth)**

Type of Strata	Silty Sandy Clay
Colour	Brownish
Thickness of Layer	0.50m
SPT of the layer	-
Consistency	Soft
Un-drained Cohesion, Cu	-

* **Layer-2 (from 0.50m to 0.90m depth)**

Type of Strata	Silty Clayey Fine Sand mixed with lime
Colour	Greyish to Whitish
Thickness of Layer	0.40m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-3 (from 0.90m to 3.50m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	2.60m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance,	42.50^0

* **Layer-4 (from 3.50m to 4.50m depth)**

Type of Strata	Soft Rock
Colour	-
Thickness of Layer	1.00m
SPT of the layer	>100

Relative Density Very Dense
Angle of Shearing Resistance, 42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.4 Soil Profile at BH-04 Location
(At BH-04 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.30m depth)**

Type of Strata Silty Sandy Gravels
Colour Brownish to Reddish
Thickness of Layer 0.30m
SPT of the layer -
Relative Density Dense
Angle of Shearing Resistance, -

* **Layer-2 (from 0.30m to 2.00m depth)**

Type of Strata Weathered Rock
Colour -
Thickness of Layer 1.70m
SPT of the layer >100
Relative Density Very Dense
Angle of Shearing Resistance, 42.50^0

* **Layer-3 (from 2.00m to 3.00m depth)**

Type of Strata Soft Rock
Colour -
Thickness of Layer 1.00m
SPT of the layer >100
Relative Density Very Dense
Angle of Shearing Resistance, 42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.5 Soil Profile at BH-05 Location
(At BH-05 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.50m depth)**

Type of Strata Soft Disintegrated Rock
Colour -
Thickness of Layer 0.50m
SPT of the layer -
Relative Density Dense
Angle of Shearing Resistance, -

* **Layer-2 (from 0.50m to 2.50m depth)**

Type of Strata Weathered Rock
Colour -
Thickness of Layer 2.00m
SPT of the layer >100

Relative Density Very Dense
Angle of Shearing Resistance, 42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the first week of September 2018.

3.1.6 Soil Profile at BH-06 Location
(At BH-06 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.40m depth)**

Type of Strata Soft Disintegrated Rock
Colour -
Thickness of Layer 0.40m
SPT of the layer -
Relative Density Dense
Angle of Shearing Resistance, -

* **Layer-2 (from 0.40m to 2.80m depth)**

Type of Strata Weathered Rock
Colour -
Thickness of Layer 2.40m
SPT of the layer >100
Relative Density Very Dense
Angle of Shearing Resistance, 42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the first week of September 2018.

3.1.7 Soil Profile at BH-07 Location
(At BH-07 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.50m depth)**

Type of Strata Soft Disintegrated Rock
Colour -
Thickness of Layer 0.50m
SPT of the layer -
Relative Density Dense
Angle of Shearing Resistance, -

* **Layer-2 (from 0.50m to 2.50m depth)**

Type of Strata Weathered Rock
Colour -
Thickness of Layer 2.00m
SPT of the layer >100
Relative Density Very Dense
Angle of Shearing Resistance, 42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the first week of September 2018.

3.1.8 Soil Profile at BH-08 Location
(At BH-08 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.70m depth)**

Type of Strata	Silty Sandy Gravels
Colour	Brownish
Thickness of Layer	0.70m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-2 (from 0.70m to 3.00m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	2.30m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance,	42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.9 Soil Profile at BH-09 Location
(At BH-09 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.60m depth)**

Type of Strata	Silty Clay
Colour	Brownish to Greyish
Thickness of Layer	0.60m
SPT of the layer	-
Consistency	Soft
Un-drained Cohesion, Cu	-

* **Layer-2 (from 0.60m to 0.90m depth)**

Type of Strata	Silty Clayey Fine Sand mixed with kankars
Colour	Greyish to Whitish
Thickness of Layer	0.30m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-3 (from 0.90m to 3.00m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	2.10m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance,	42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.10 Soil Profile at BH-10 Location
(At BH-10 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.80m depth)**

Type of Strata	Silty Sandy Gravels
Colour	Brownish to Reddish
Thickness of Layer	0.80m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-2 (from 0.80m to 3.60m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	2.80m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance,	42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.11 Soil Profile at BH-11 Location
(At BH-11 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.50m depth)**

Type of Strata	Silty Sandy Gravels
Colour	Brownish to Reddish
Thickness of Layer	0.50m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-2 (from 0.50m to 3.00m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	2.50m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance,	42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.12 Soil Profile at BH-12 Location
(At BH-12 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.60m depth)**

Type of Strata	Silty Clay
Colour	Brownish
Thickness of Layer	0.60m
SPT of the layer	-
Consistency	Soft
Un-drained Cohesion, Cu	-

* **Layer-2 (from 0.60m to 1.60m depth)**

Type of Strata	Silty Clayey Fine Sand mixed with lime nodules
Colour	Brownish to Greyish
Thickness of Layer	1.00m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-3 (from 1.60m to 3.00m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	1.40m
SPT of the layer	>100
Relative Density	Very Dense
Angle of Shearing Resistance,	42.50^0

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.13 Soil Profile at BH-13 Location
(At BH-13 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 1.40m depth)**

Type of Strata	Silty Clay
Colour	Brownish to Greyish
Thickness of Layer	1.40m
SPT of the layer	09
Consistency	Stiff
Un-drained Cohesion, Cu	60.00kPa

* **Layer-2 (from 1.40m to 2.80m depth)**

Type of Strata	Silty Fine Sand mixed with Kankars
Colour	Greyish to Whitish
Thickness of Layer	1.40m
SPT of the layer	-
Relative Density	Dense
Angle of Shearing Resistance,	-

* **Layer-3 (from 2.80m to 4.00m depth)**

Type of Strata	Weathered Rock
Colour	-
Thickness of Layer	1.20m

SPT of the layer >100
Relative Density Very Dense
Angle of Shearing Resistance, 42.50

Ground Water

Ground water table was encountered at a depth of 1.40m below the existing ground level during the second week of September 2018.

3.1.14 Soil Profile at BH-14 Location
(At BH-14 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.40m depth)**
  Type of Strata Filled Up Soil
  Colour -
  Thickness of Layer 0.40m
* **Layer-2 (from 0.40m to 0.90m depth)**
  Type of Strata Silty Clay mixed with lime
  Colour Brownish to Greyish
  Thickness of Layer 0.50m
  SPT of the layer -
  Consistency Soft
  Un-drained Cohesion, Cu -
* **Layer-3 (from 0.90m to 3.50m depth)**
  Type of Strata Weathered Rock
  Colour -
  Thickness of Layer 2.60m
  SPT of the layer >100
  Relative Density Very Dense
  Angle of Shearing Resistance, 42.50

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

3.1.15 Soil Profile at BH-15 Location
(At BH-15 Location, as presented in Site plan)

* **Layer-1 (from E.G.L to 0.30m depth)**
  Type of Strata Silty Sandy Gravels
  Colour Brownish to Reddish
  Thickness of Layer 0.30m
  SPT of the layer -
  Relative Density Dense
  Angle of Shearing Resistance, -
* **Layer-2 (from 0.30m to 2.50m depth)**
  Type of Strata Weathered Rock
  Colour -
  Thickness of Layer 2.20m
  SPT of the layer >100
  Relative Density Very Dense
  Angle of Shearing Resistance, 42.50

Ground Water

No ground water table was encountered within the explored depth of investigation in the second week of September 2018.

Table 4.0-Safe Bearing Capacities of Open Foundation System located at different depths below present existing ground level at different investigation Locations						
Borehole No	Type of Bearing Strata	Depth of Open Excavations below Existing Ground Level (m)	Recommended Thickness of CNS Back-Fill (m)	Depth of Isolated Column Footing below Existing Ground Level (m)	Safe Bearing Capacity (t/m^2)	Elastic Settlements (mm)
BH-01	Weathered Rock	2.00	0.00	2.00	30	15
BH-02	Weathered Rock	2.00	0.00	2.00	30	15
BH-03	Weathered Rock	2.00	0.00	2.00	30	15
BH-04	Soft Rock	2.00	0.00	2.00	40	15
BH-05	Weathered Rock	2.00	0.00	2.00	30	15
BH-06	Weathered Rock	2.00	0.00	2.00	30	15
BH-07	Weathered Rock	2.00	0.00	2.00	30	15
BH-08	Weathered Rock	2.00	0.00	2.00	30	15
BH-09	Weathered Rock	2.00	0.00	2.00	30	15
BH-10	Weathered Rock	2.00	0.00	2.00	30	15
BH-11	Weathered Rock	2.00	0.00	2.00	30	15
BH-12	Weathered Rock	2.00	0.00	2.00	30	15
BH-13	Silty Fine Sand	2.00	0.00	2.00	30	15
BH-14	Weathered Rock	2.00	0.00	2.00	30	25
BH-15	Weathered Rock	2.00	0.00	2.00	30	25

Notes

1.Settlements are restricted to a maximum of 25mm for Isolated Column Footings.

2. Excavated highly plastic fine-grained soil encountered at shallow depths shall be in no case used for back filling purposes (Ref. BH-13 & BH-14).

3. It is recommended to connect the grade beams for the entire structure to act as a single unit against any differential settlements in between the individual footings.

4. No structural units can be in direct contact of highly plastic fine-grained soil encountered at isolated borehole locations. A 0.30m thick well compacted CNS (cohesive non-swelling) soil cushion is recommended to be sand-witched in between.

5. CNS can be clean river sand or M-Sand or Sand-Gravels mix of 1:2.

CHAPTER-5

CONCLUSIONS & RECOMMENDATIONS

1. Open Foundation system presented in Table 4.0, Page No. 45 & 46 can be adopted for foundation design purposes.

Open Foundation System

2. Safe bearing capacity of open foundation system is computed considering any rise in the ground water table up to or above the level of footing.
3. In case, ground water table is encountered within recommended depth of foundation system, provision shall be made to continuously bail the water out of the foundation pits to keep the surfaces of pit consolidated dry.

Usage of Excavated Earth

4. **Excavated highly plastic fine-grained soil encountered at shallow depths shall be in no case used for back filling purposes (Ref. BH-13 & BH-14).**
5. **No structural units can be in direct contact of medium plastic fine-grained soil strata encountered at shallow depths. A 0.30m thick well compacted CNS (cohesive non-swelling) soil cushion is recommended to be sand-witched in between.**

Type of CNS to Use

6. **CNS can be well graded coarse-grained M-Sand or quarry dust or clean river sand or sand: gravels mix (1:2) or fly-ash.**

Other Recommendations

7. It is recommended to connect the grade beams for the entire structure to act as a single unit against any differential settlements in between the individual footings.
8. As the chlorides and sulphates present in water/soil samples are within the permissible limits, no special steel or cement is recommended to be used for foundation construction purposes.

2.1.4 Layout Plan

PROPOSED E.W.S -II TYPE HOUSING AT F.P.- 63 /10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

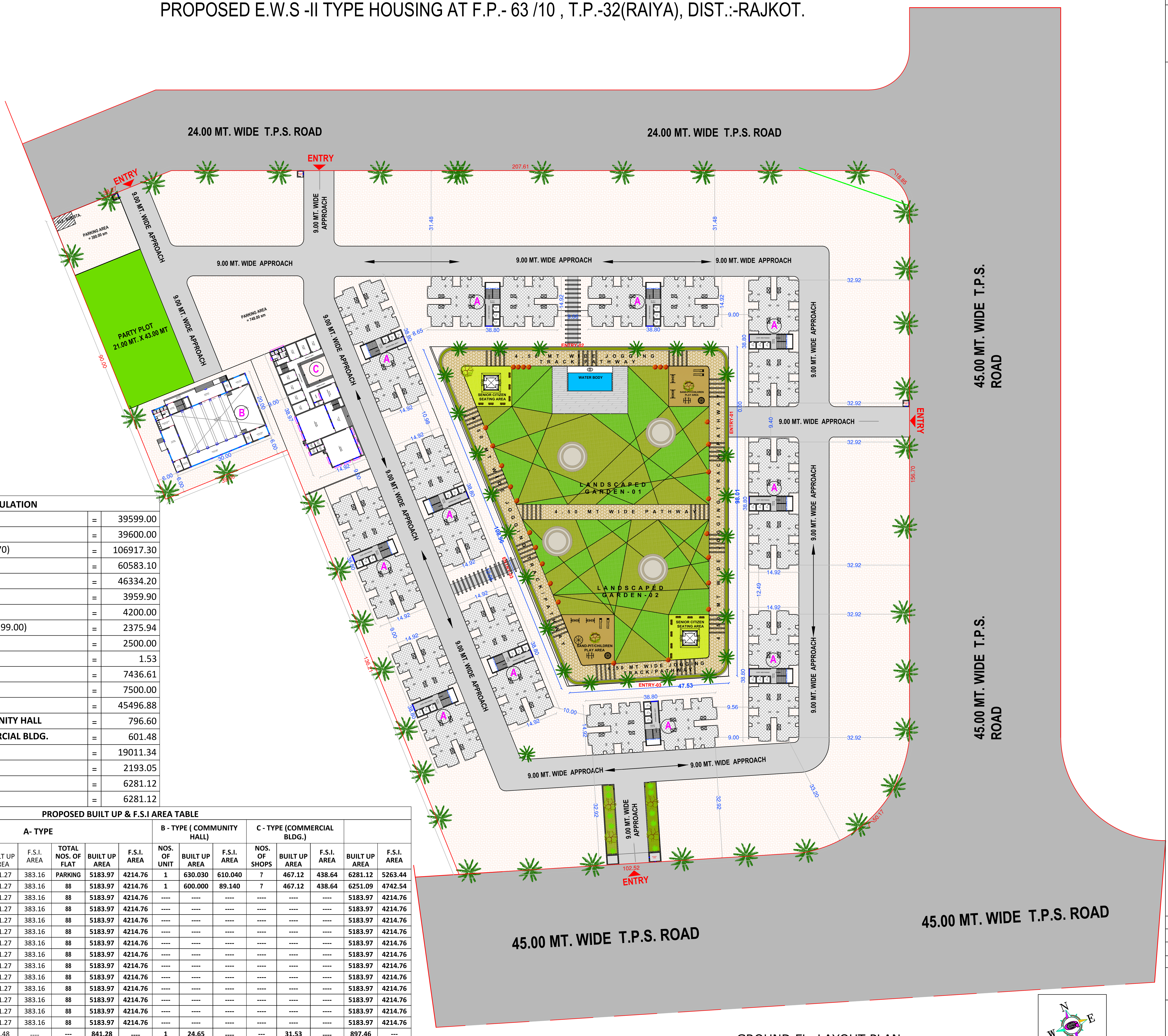
FOR DPR PURPOSE

LAYOUT PLAN

A - TYPE .....11.BLDG......PARKING + 13FL.

TOTAL NO. OF UNIT'S = 1144

CARPET AREA = 39.77 SM.



GROUND FL. LAYOUT PLAN

AREA CALCULATION		
PLOT AREA	=	39599.00
NET PLOT AREA	=	39600.00
PERMISSIBLE F.S.I. AREA (39599.00 X 2.70)	=	106917.30
PROPOSED F.S.I. AREA	=	60583.10
BLANCE F.S.I. AREA	=	46334.20
REQUIRED C.P. AREA (10 % X39599.00)	=	3959.90
PROPOSED C.P. AREA	=	4200.00
REQUIRED GREEN BELT AREA (6 % X 39599.00)	=	2375.94
PROPOSED GREEN BELT AREA	=	2500.00
F.S.I. CONSUME	=	1.53
REQUIRED PARKING AREA	=	7436.61
PROPOSED PARKING AREA	=	7500.00
TOTAL CARRET AREA (A-TYPE)	=	45496.88
TOTAL CARRET AREA (B-TYPE) COMMUNITY HALL	=	796.60
TOTAL CARRET AREA (C-TYPE) COMMERCIAL BLDG.	=	601.48
TOTAL OPEN AREA	=	19011.34
TOTAL BALCONY AREA (A-TYPE)	=	2193.05
TOTAL COVERED AREA	=	6281.12
TOTAL GROUND COVERED AREA	=	6281.12

PROPOSED BUILT UP & F.S.I AREA TABLE

FLOOR		A- TYPE							B - TYPE (COMMUNITY HALL)			C - TYPE (COMMERCIAL BLDG.)				
	USE	NOS. OF UNIT	NOS. OF FLAT	BUILT UP AREA	F.S.I. AREA	TOTAL NOS. OF FLAT	BUILT UP AREA	F.S.I. AREA	NOS. OF UNIT	BUILT UP AREA	F.S.I. AREA	NOS. OF SHOPS	BUILT UP AREA	F.S.I. AREA	BUILT UP AREA	F.S.I. AREA
GR. FL.	RESI.	11	PARKING	471.27	383.16	PARKING	5183.97	4214.76	1	630.030	610.040	7	467.12	438.64	6281.12	5263.44
1ST FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	1	600.000	89.140	7	467.12	438.64	6251.09	4742.54
2nd FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
3rd FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
4th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
5th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
6th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
7th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
8th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
9th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
10th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
11th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
12th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
13th FL.	RESI.	11	8	471.27	383.16	88	5183.97	4214.76	----	----	----	----	----	----	5183.97	4214.76
STAIRCABIN		11	---	76.48	----	---	841.28	----	1	24.65	----	---	31.53	----	897.46	---
LMR & O.H.WT.		11	---	71.91	----	---	791.01	----	1	16.12	----	---	20.98	----	828.11	---
TOTAL			104	6746.170	5364.240	1144	74207.87	59006.64	1	1270.800	699.18	14 SHOPS	986.75	877.28	76465.42	60583.10

2 9

REVISION :	DATE :
SCALE : N.T.S	TYPE :

LAY OUT PLAN

CLIENT: RAJKOT MUNICIPAL CORPORATION

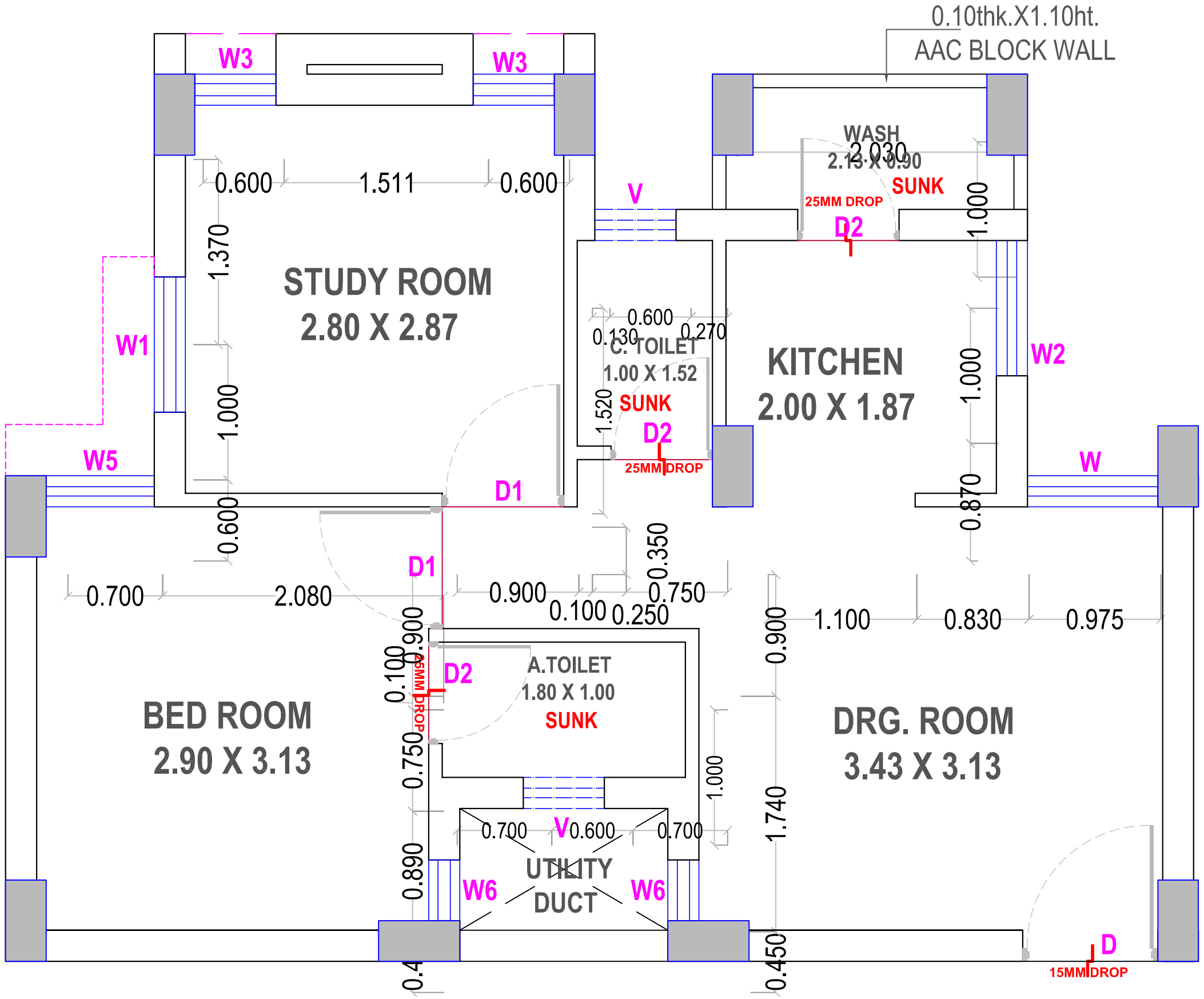
PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
"JALARAM SHAKTI", BESIDE DHAWALGIRI APARTMENT, NR.LOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO	28Y 19
			A-001	

2.1.5 Unit Plan

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



FOR DPR PURPOSE

UNIT PLAN

CARPET AREA = 39.36 SQ.MTS

BUILT UP AREA = 47.72 SQ.MTS

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REVISION :	DATE :
SCALE : N.T.S	TYPE : A - TYPE

WORKING DRAWING

CLIENT: RAJKOT MUNICIPAL CORPORATION

PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

JAYESSH A DALAL
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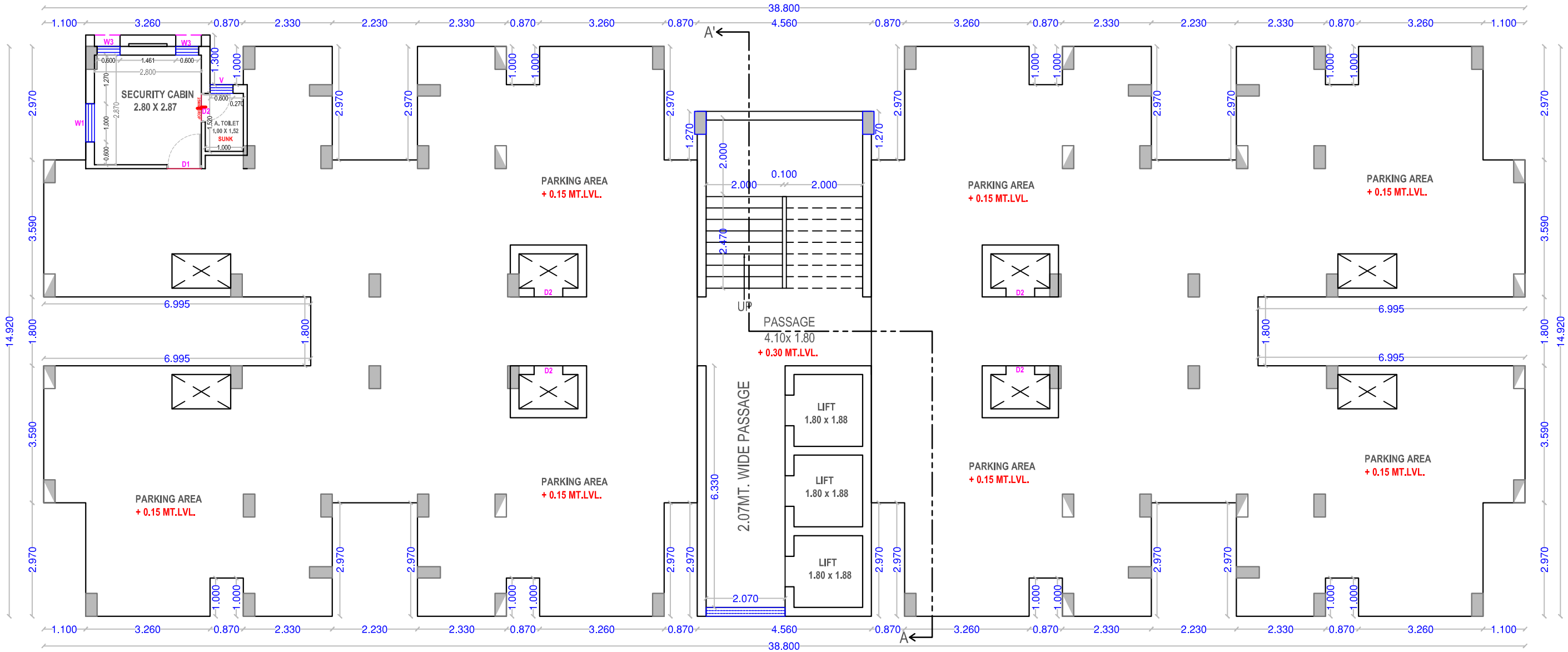
DRAWN BY	CHECK BY		SHEET NO	
SAGUNA				28Y 19

2.1.6 Floor Plans

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



GROUND FLOOR PLAN

(PARKING + 13th.FL.)

FOR DPR PURPOSE

WORKING DRAWING

BLDG.PLAN GR+13FL.

A -TYPE ...(11.BLDG.)

GROUND FLOOR PLAN

SCHEDULE OF DOORS

SR.NO.	NAME	SIZE (OPENING)	POSITION	GR. FL	TY. FL x 13TH FL.	TERR.FL	SILL.	LINTEL.	TOTAL GR.+TYP+TER.=
1.	D	1.000 X 2.425	DRG.RM.	0	8 x 13	2	-	2.425	0 + 104 + 2 = 106
2.	D1	0.900 X 2.425	BED ROOM	1	16 x 13	-	-	2.425	1 + 208 + 0 = 209
3.	D2	0.750 X 2.425	C.TOILET,A.TOILET WASH,	5	24 x 13	-	-	2.425	5 + 312 + 0= 317

SCHEDULE OF WINDOW

SR.NO.	NAME	SIZE (OPENING)	POSITION	GR. FL	TY. FL x 13TH FL.	TERR.FL	SILL.	LINTEL.	TOTAL GR.+TYP+TER.=
1.	W	0.965 X 1.525	DRG. ROOM	0	8 x 13	-	0.900	2.425	0 + 104 + 0 = 104
2.	W1	1.000 X 1.525	STUDY ROOM	1	8 x 13	-	0.900	2.425	1 + 104 + 0 = 105
3.	W2	1.000 X 1.225	KITCHEN	0	8 x 13	-	1.200	2.425	0 + 104 + 0 = 104
4.	W3	0.600 X 1.525	STUDY ROOM	2	16 x 13	-	0.900	2.425	2 + 208 + 0 = 210
5.	W4	0.870 X 1.525	BEDROOM	0	4 x 13	-	0.900	2.425	0 + 52 + 0 = 52
6.	W5	0.800 X 1.525	BEDROOM	0	4 x 13	-	0.900	2.425	0 + 52 + 0 = 52
7.	W6	0.450 X 1.525	BEDROOM	0	16 x 13	-	0.900	2.425	0 + 208 + 0 = 208

SCHEDULE OF VENTILATION

SR.NO.	NAME	SIZE (OPENING)	POSITION	GR. FL	TY. FL x 13TH FL.	TERR.FL	SILL.	LINTEL.	TOTAL GR.+TYP+TER.=
1.	V	0.600 X 0.600	C.TOILET,A.TOILET	1	16 x 13	-	-	2.425	1 + 208 + 0 = 209

REVISION :	DATE :
SCALE : N.T.S	TYPE : A - TYPE

WORKING DRAWING

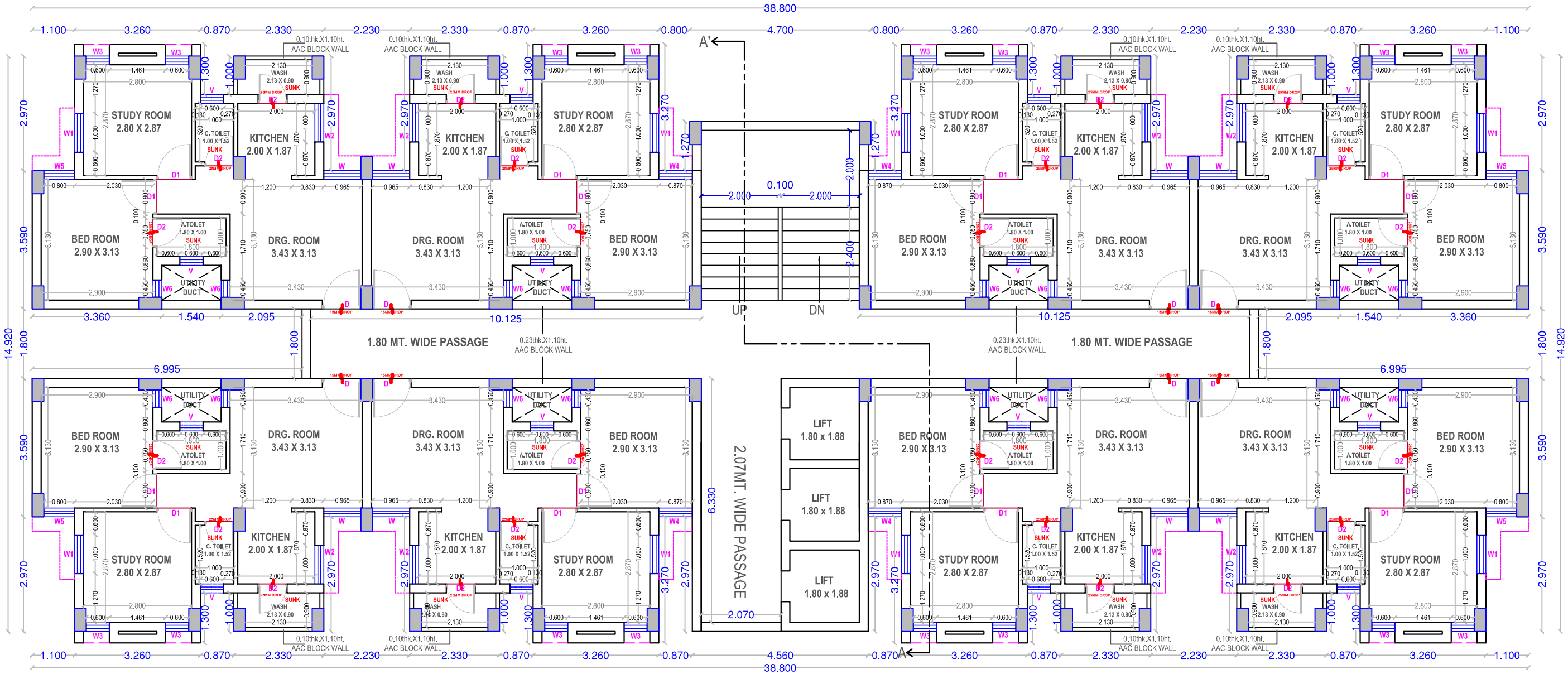
CLIENT: RAJKOT MUNICIPAL CORPORATION

PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
"JALARAM SHAKTI", BESIDE DHAWALGIRI APARTMENT, NR.LOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO
SAGUNA			28Y 19

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



TYPICAL FLOOR PLAN

(1ST TO 13TH.FL.)

FOR DPR PURPOSE

WORKING DRAWING

BLDG.PLAN GR+13FL.

A -TYPE ...(11.BLDG.)

TYPICAL FLOOR PLAN

SCHEDULE OF DOORS

SR.NO.	NAME	SIZE (OPENING)	POSITION	GR. FL	TY. FL x 13TH FL.	TERR.FL	SILL.	LINTEL.	TOTAL GR.+TYP+TER.=
1.	D	1.000 X 2.425	DRG.RM.	0	8 x 13	2	-	2.425	0 + 104 + 2 = 106
2.	D1	0.900 X 2.425	BED ROOM	1	16 x 13	-	-	2.425	1 + 208 + 0 = 209
3.	D2	0.750 X 2.425	C.TOILET,A.TOILET WASH,	5	24 x 13	-	-	2.425	5 + 312 + 0= 317

SCHEDULE OF WINDOW

1.	W	0.965 X 1.525	DRG. ROOM	0	8 x 13	-	0.900	2.425	0 + 104 + 0 = 104
2.	W1	1.000 X 1.525	STUDY ROOM	1	8 x 13	-	0.900	2.425	1 + 104 + 0 = 105
3.	W2	1.000 X 1.225	KITCHEN	0	8 x 13	-	1.200	2.425	0 + 104 + 0 = 104
4.	W3	0.600 X 1.525	STUDY ROOM	2	16 x 13	-	0.900	2.425	2 + 208 + 0 = 210
5.	W4	0.870 X 1.525	BEDROOM	0	4 x 13	-	0.900	2.425	0 + 52 + 0 = 52
6.	W5	0.800 X 1.525	BEDROOM	0	4 x 13	-	0.900	2.425	0 + 52 + 0 = 52
7.	W6	0.450 X 1.525	BEDROOM	0	16 x 13	-	0.900	2.425	0 + 208 + 0 = 208

SCHEDULE OF VENTILATION

1.	V	0.600 X 0.600	C.TOILET,A.TOILET	1	16 x 13	-	-	2.425	1 + 208 + 0 = 209

REVISION :	DATE :
SCALE : N.T.S	TYPE : A - TYPE

WORKING DRAWING

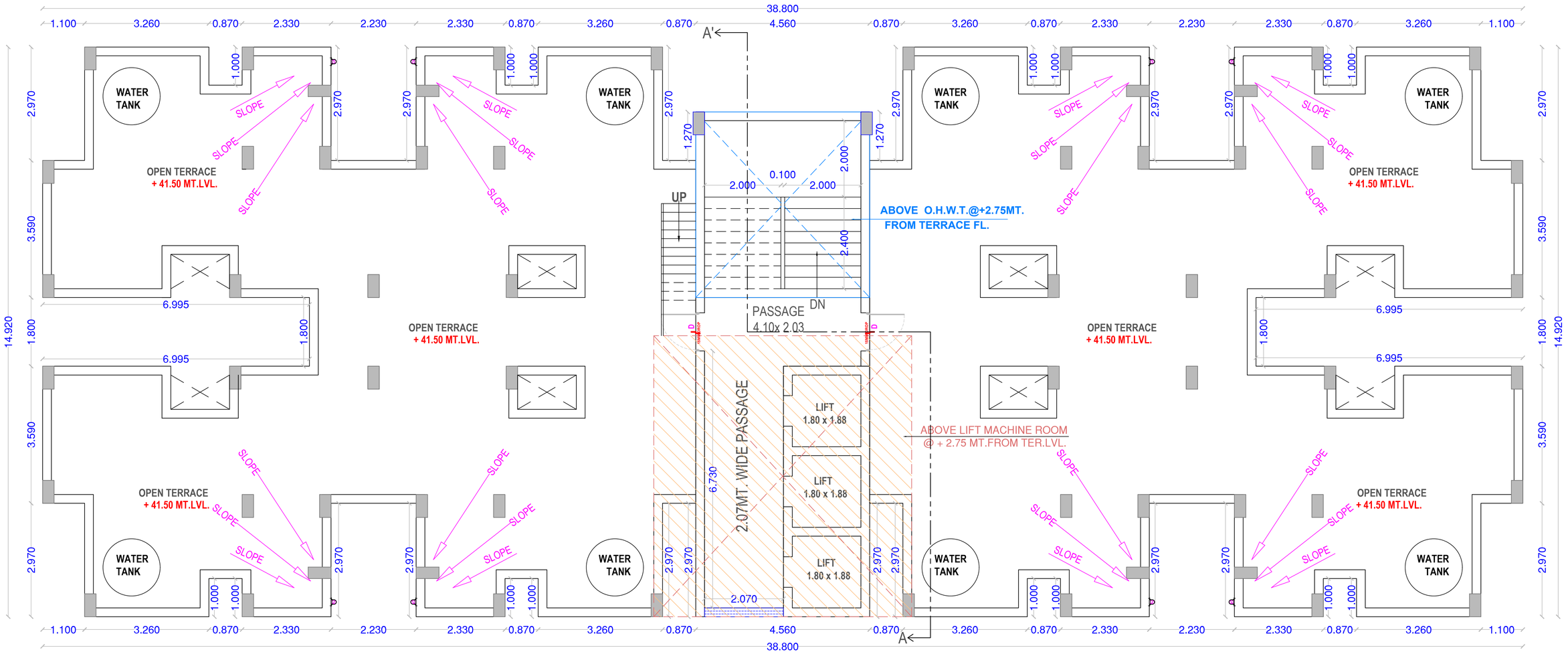
CLIENT: RAJKOT MUNICIPAL CORPORATION

PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
"JALARAM SHAKTI", BESIDE DHAWALGIRI APARTMENT, NR.LOURD'S CONVENT SCHOOL,.ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO
SAGUNA			28Y 19

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



TERRACE FLOOR PLAN

FOR DPR PURPOSE

WORKING DRAWING

BLDG.PLAN GR+13FL.

A -TYPE ...(11.BLDG.)

TERRACE FLOOR PLAN

SCHEDULE OF DOORS

SR.NO.	NAME	SIZE (OPENING)	POSITION	GR. FL	TY. FL x 13TH FL.	TERR.FL	SILL.	LINTEL.	TOTAL GR.+TYP+TER.=
1.	D	1.000 X 2.425	DRG.RM.	0	8 x 13	2	-	2.425	0 + 104 + 2 = 106
2.	D1	0.900 X 2.425	BED ROOM	1	16 x 13	-	-	2.425	1 + 208 + 0 = 209
3.	D2	0.750 X 2.425	C.TOILET,A.TOILET WASH,	5	24 x 13	-	-	2.425	5 + 312 + 0= 317

SCHEDULE OF WINDOW

1.	W	0.965 X 1.525	DRG. ROOM	0	8 x 13	-	0.900	2.425	0 + 104 + 0 = 104
2.	W1	1.000 X 1.525	STUDY ROOM	1	8 x 13	-	0.900	2.425	1 + 104 + 0 = 105
3.	W2	1.000 X 1.225	KITCHEN	0	8 x 13	-	1.200	2.425	0 + 104 + 0 = 104
4.	W3	0.600 X 1.525	STUDY ROOM	2	16 x 13	-	0.900	2.425	2 + 208 + 0 = 210
5.	W4	0.870 X 1.525	BEDROOM	0	4 x 13	-	0.900	2.425	0 + 52 + 0 = 52
6.	W5	0.800 X 1.525	BEDROOM	0	4 x 13	-	0.900	2.425	0 + 52 + 0 = 52
7.	W6	0.450 X 1.525	BEDROOM	0	16 x 13	-	0.900	2.425	0 + 208 + 0 = 208

SCHEDULE OF VENTILATION

1.	V	0.600 X 0.600	C.TOILET,A.TOILET	1	16 x 13	-	-	2.425	1 + 208 + 0 = 209

275

REVISION :	DATE :
SCALE : N.T.S	TYPE : A - TYPE

WORKING DRAWING

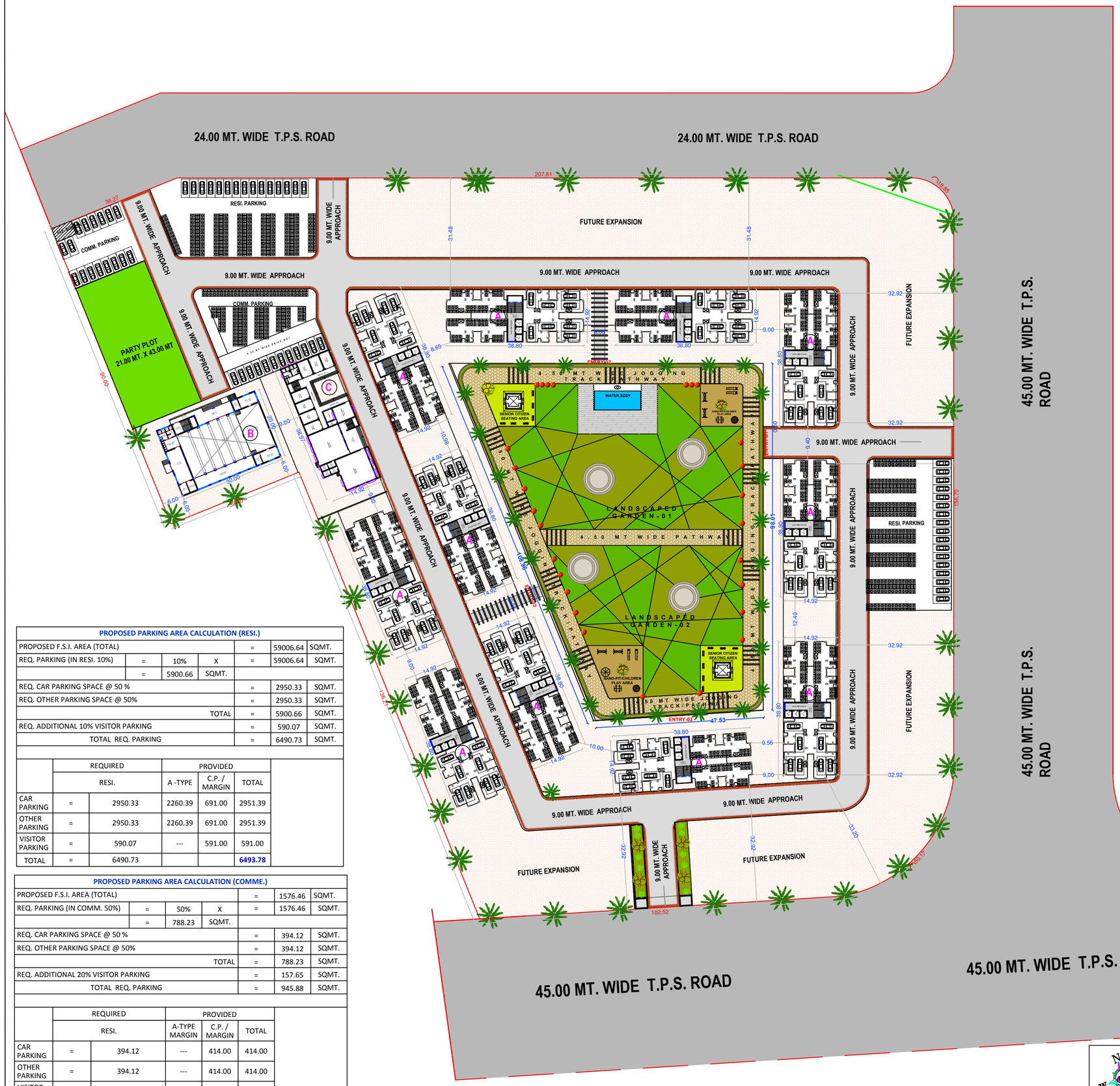
CLIENT: RAJKOT MUNICIPAL CORPORATION

PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
"JALARAM SHAKTI", BESIDE DHAWALGIRI APARTMENT, NR.LOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO
SAGUNA			28Y 19

PROPOSED E.W.S -II TYPE HOUSING AT F.P.- 63 /10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



PROPOSED PARKING AREA CALCULATION (RESI.)

PROPOSED F.S.I. AREA (TOTAL)				=	59006.64	SQMT.
REQ. PARKING (IN RESI. 10%)	=	10%	X	=	59006.64	SQMT.
	=	5900.66	SQMT.			
REQ. CAR PARKING SPACE @ 50 %				=	2950.33	SQMT.
REQ. OTHER PARKING SPACE @ 50%				=	2950.33	SQMT.
TOTAL				=	5900.66	SQMT.
REQ. ADDITIONAL 10% VISITOR PARKING				=	590.07	SQMT.
TOTAL REQ. PARKING				=	6490.73	SQMT.

	REQUIRED		PROVIDED			
	RESI.		A -TYPE	C.P. / MARGIN	TOTAL	
CAR PARKING	=	2950.33	2260.39	691.00	2951.39	
OTHER PARKING	=	2950.33	2260.39	691.00	2951.39	
VISITOR PARKING	=	590.07	---	591.00	591.00	
TOTAL	=	6490.73			**6493.78**	

PROPOSED PARKING AREA CALCULATION (COMME.)

PROPOSED F.S.I. AREA (TOTAL)				=	1576.46	SQMT.
REQ. PARKING (IN COMM. 50%)	=	50%	X	=	1576.46	SQMT.
	=	788.23	SQMT.			
REQ. CAR PARKING SPACE @ 50 %				=	394.12	SQMT.
REQ. OTHER PARKING SPACE @ 50%				=	394.12	SQMT.
TOTAL				=	788.23	SQMT.
REQ. ADDITIONAL 20% VISITOR PARKING				=	157.65	SQMT.
TOTAL REQ. PARKING				=	945.88	SQMT.

	REQUIRED		PROVIDED			
	RESI.		A-TYPE MARGIN	C.P. / MARGIN	TOTAL	
CAR PARKING	=	394.12	---	414.00	414.00	
OTHER PARKING	=	394.12	---	414.00	414.00	
VISITOR PARKING	=	157.65	---	178.22	178.22	
TOTAL	=	945.88			**1006.22**	

GROUND FL. LAYOUT PLAN

27

FOR DPR PURPOSE

PARKING LAYOUT PLAN

A - TYPE .....11.BLDG.....PARKING + 13FL.

TOTAL NO. OF UNIT'S = 1144

CARPET AREA = 39.77 SM.

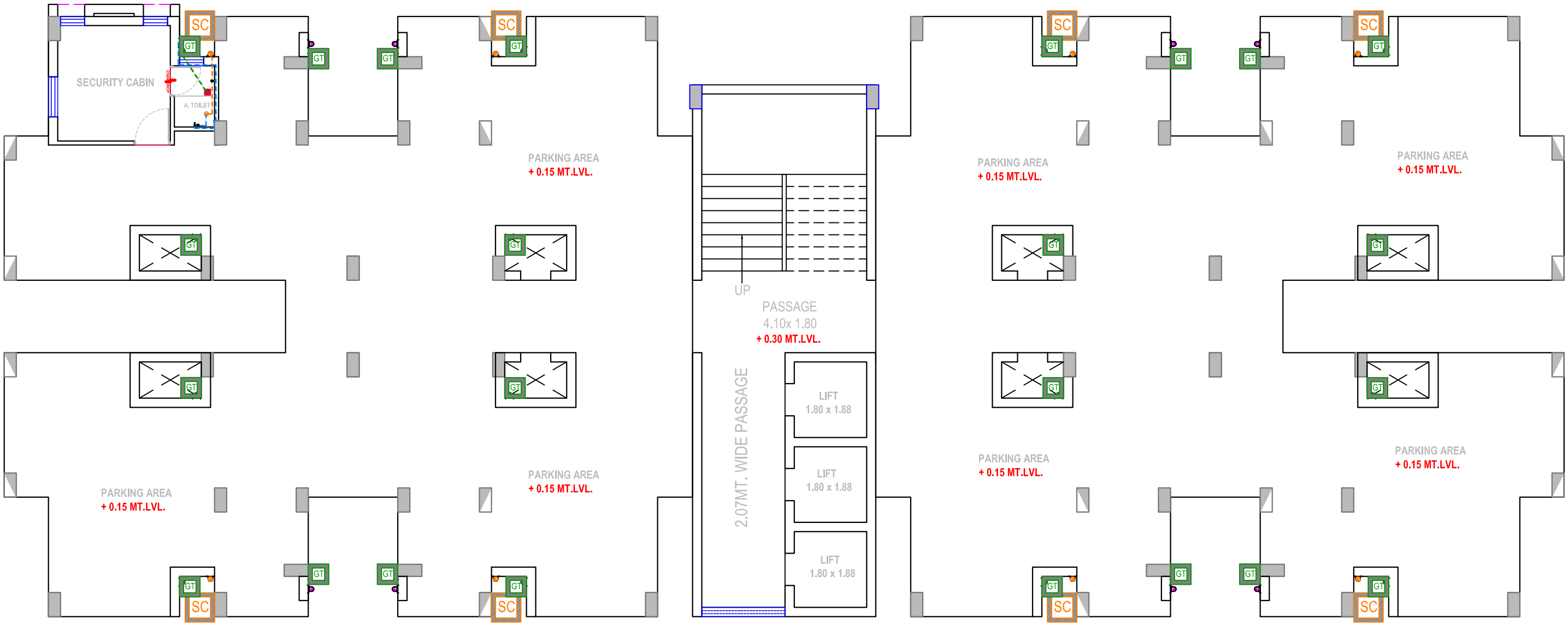
REVISION :	DATE :
SCALE : N.T.S	TYPE :
PARKING LAY OUT PLAN	
CLIENT: RAJKOT MUNICIPAL CORPORATION	
PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.	

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
"JALARAM SHAKTI", BESIDE DHANVANTARI APARTMENT, NR.LOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO	
			A - 07	28Y 19

2.1.7 Physical Infrastructure Drawings

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



278

FOR DPR PURPOSE

PLUMBING DRAWING

BLDG.PLAN GR+13FL.

A -TYPE ...(11.BLDG.)

GRUND FLOOR PLAN

Plumbing legends:-

SR.NO:	SYMBOL	DESCRIPTION
01		EUROPEAN TYPE W.C. PAN
02		WASH BASIN
03		A.C. - Angular cock
04		B.C. - Bib cock
05		2 way (B.C.) Bib cock with H.F.(health fauset)
06		S.C. - Sink cock
07		C.V. - Controlled Valve
08		Soil Water down take
09		Rain Water down take
10		Waste Water down take
11		Domestic Water down take
12		Soil Water Pipe
13		Waste Water Pipe
14		Domestic water supply pipe
15		F.D. - Floor drain " or " N.T. - nahni trap M.F.T. - Multi floor trap

REVISION :	DATE :
SCALE : N.T.S	TYPE : A - TYPE

PLUMBING DRAWING

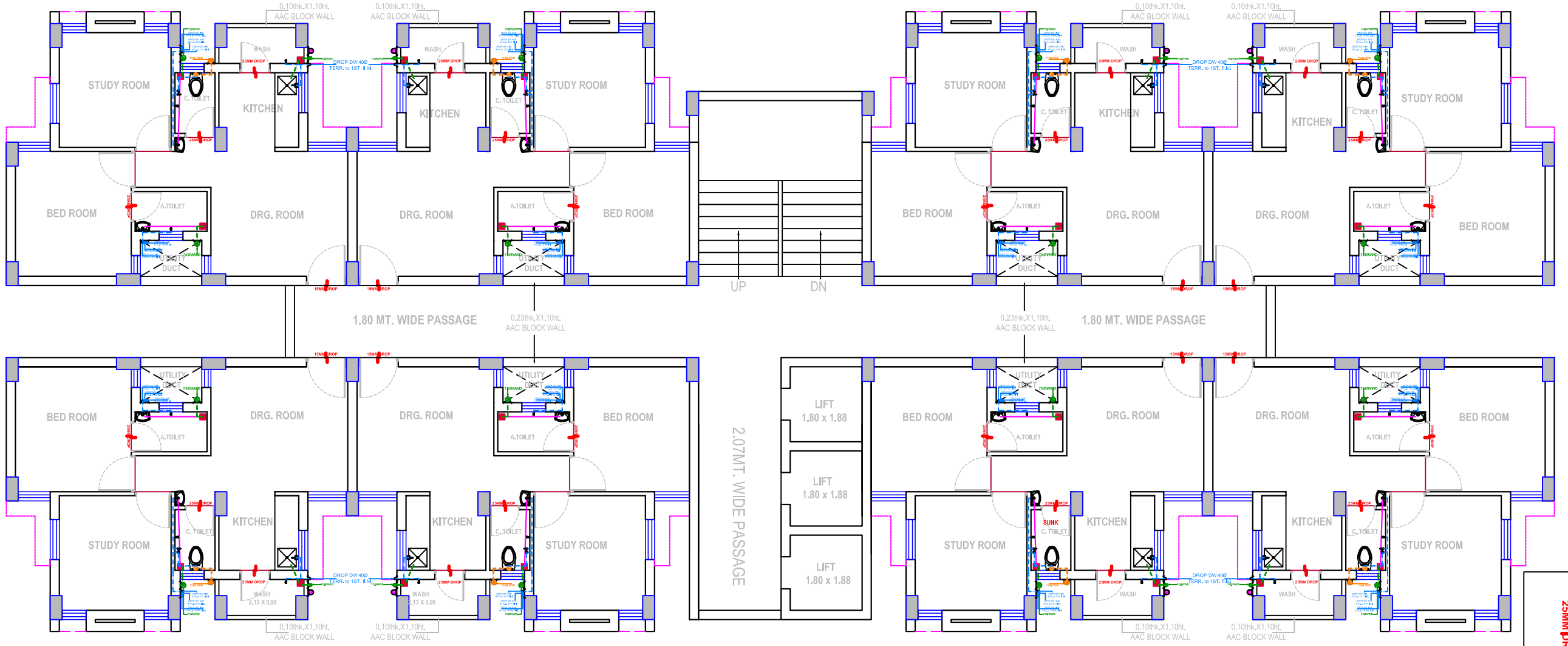
CLIENT: RAJKOT MUNICIPAL CORPORATION

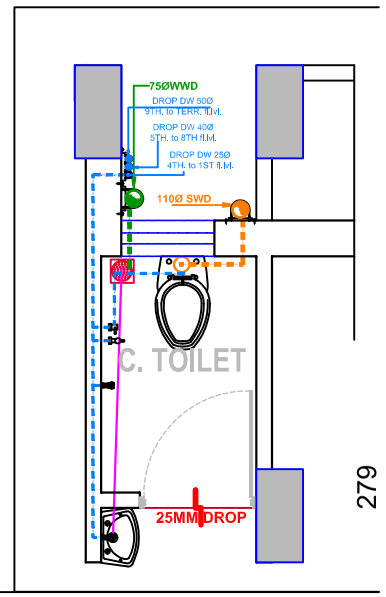
PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

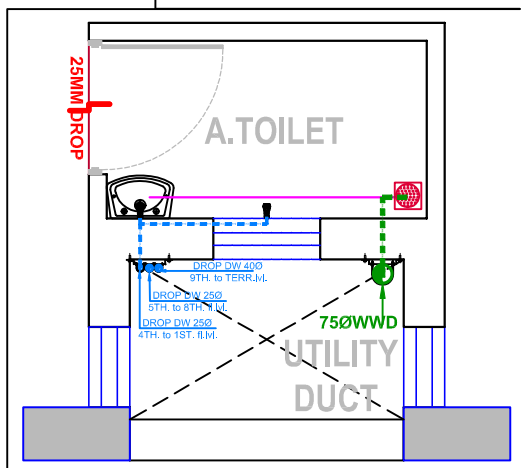
JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
"JALARAM SHAKTI", BESIDE DHAWALGIRI APARTMENT, NR.LOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO	
SAGUNA			A-PL-02	28Y 19

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.







TYPICAL FLOOR PLAN

(1ST TO 13TH.FL.)

FOR DPR PURPOSE

PLUMBING DRAWING

BLDG.PLAN GR+13FL.

A -TYPE ...(11.BLDG.)

TYPICAL FLOOR PLAN

Plumbing legends:-

SR.NO:	SYMBOL	DESCRIPTION
01		EUROPEAN TYPE W.C. PAN
02		WASH BASIN
03		A.C. - Angular cock
04		B.C. - Bib cock
05		2 way (B.C.) Bib cock with H.F.(health fauset)
06		S.C. - Sink cock
07		C.V. - Controlled Valve
08		Soil Water down take
09		Rain Water down take
10		Waste Water down take
11		Domestic Water down take
12		Soil Water Pipe
13		Waste Water Pipe
14		Domestic water supply pipe
15		F.D. - Floor drain " or " N.T. - nahni trap M.F.T. - Multi floor trap

REVISION :	DATE :
SCALE : N.T.S	TYPE : A - TYPE

PLUMBING DRAWING

CLIENT: RAJKOT MUNICIPAL CORPORATION

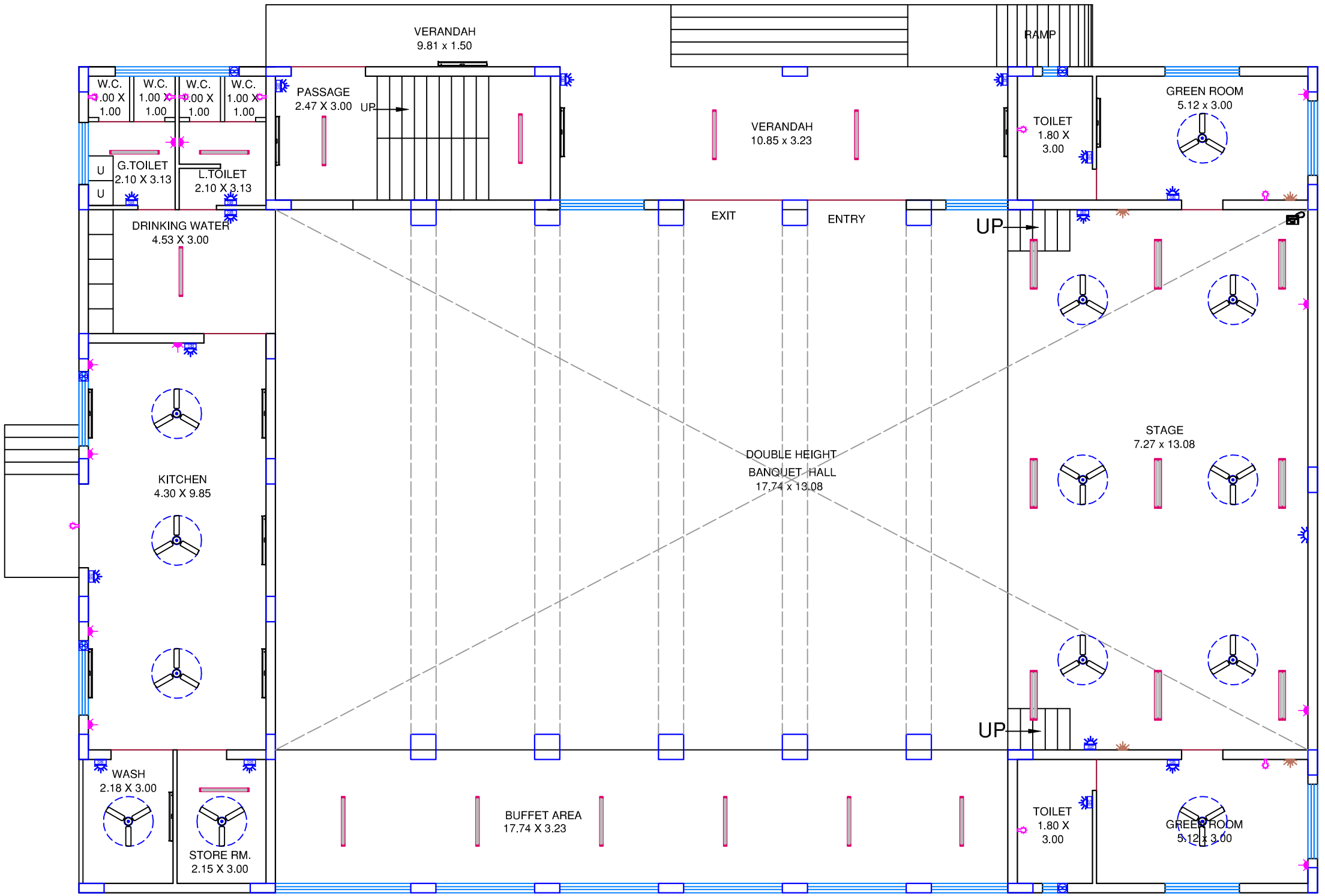
PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
"JALARAM SHAKTI", BESIDE DHAWALGIRI APARTMENT, NR.LOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO	
SAGUNA			A-PL-03	28Y 19

2.1.8 Social Infrastructure Building Drawings

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



GROUND FLOOR PLAN

FOR DPR PURPOSE

ELECTRICAL DRAWING

BLDG.PLAN GR+1 FL.

COMMERCIAL BLDG.

GROUND FLOOR PLAN

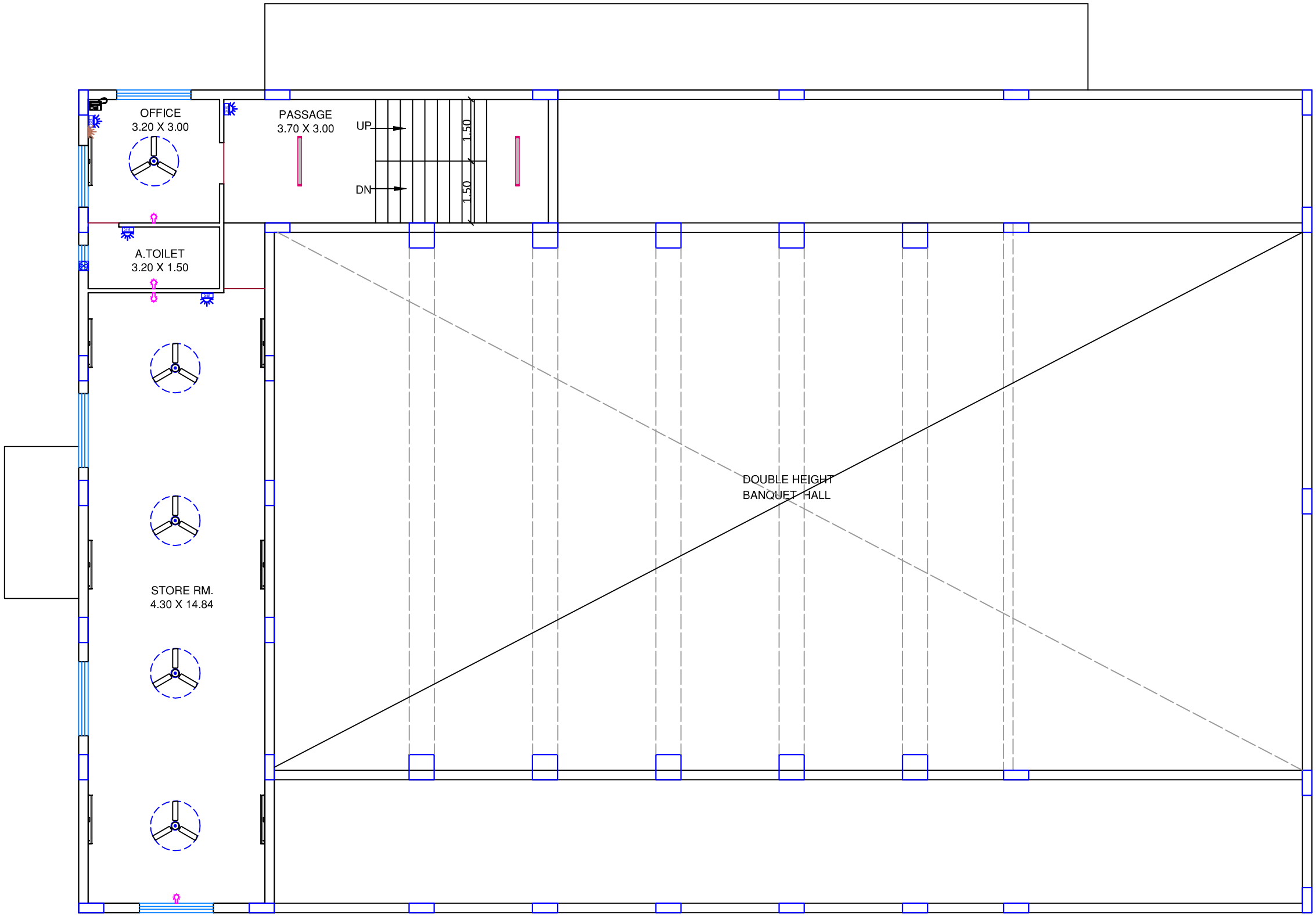
SYMBOL	DESCRIPTION	MOUNTING HEIGHT
	LIGHTING DISTRIBUTION BOARD(LDB) [I/C-25A DP , O/G-20A ,SP-1,16A SP-2,10A SP-3]	1800mm
	6 A /16 A LOOPED PLUG POINT	1200mm
	6A SWITCH SOCKET OUTLET	ON BOARD
	20A PP AC POINT	1200mm
	15A PP SWITCH SOCKET OUTLET	1200mm
	36 Watt Tube Light	2100mm
	36 Watt Tube Light	CEILING
	36 Watt Tube Light	CEILING
	Ceiling Fan	CEILING
	1X18W BRAKET LIGHT	2100mm

REVISION :	DATE :
SCALE : N.T.S	TYPE :
ELECTRICAL DRAWING	
CLIENT: RAJKOT MUNICIPAL CORPORATION	
PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.	

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
JALARAM SHAKTI, BESIDE DHAWALGIRI APARTMENT, NR.LOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO	
SAGUNA			A-EL-26	28Y 19

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



MEZZ. FLOOR PLAN

FOR DPR PURPOSE

ELECTRICAL DRAWING

BLDG.PLAN GR+1 FL.

COMMERCIAL BLDG.

MEZZANINE FLOOR PLAN

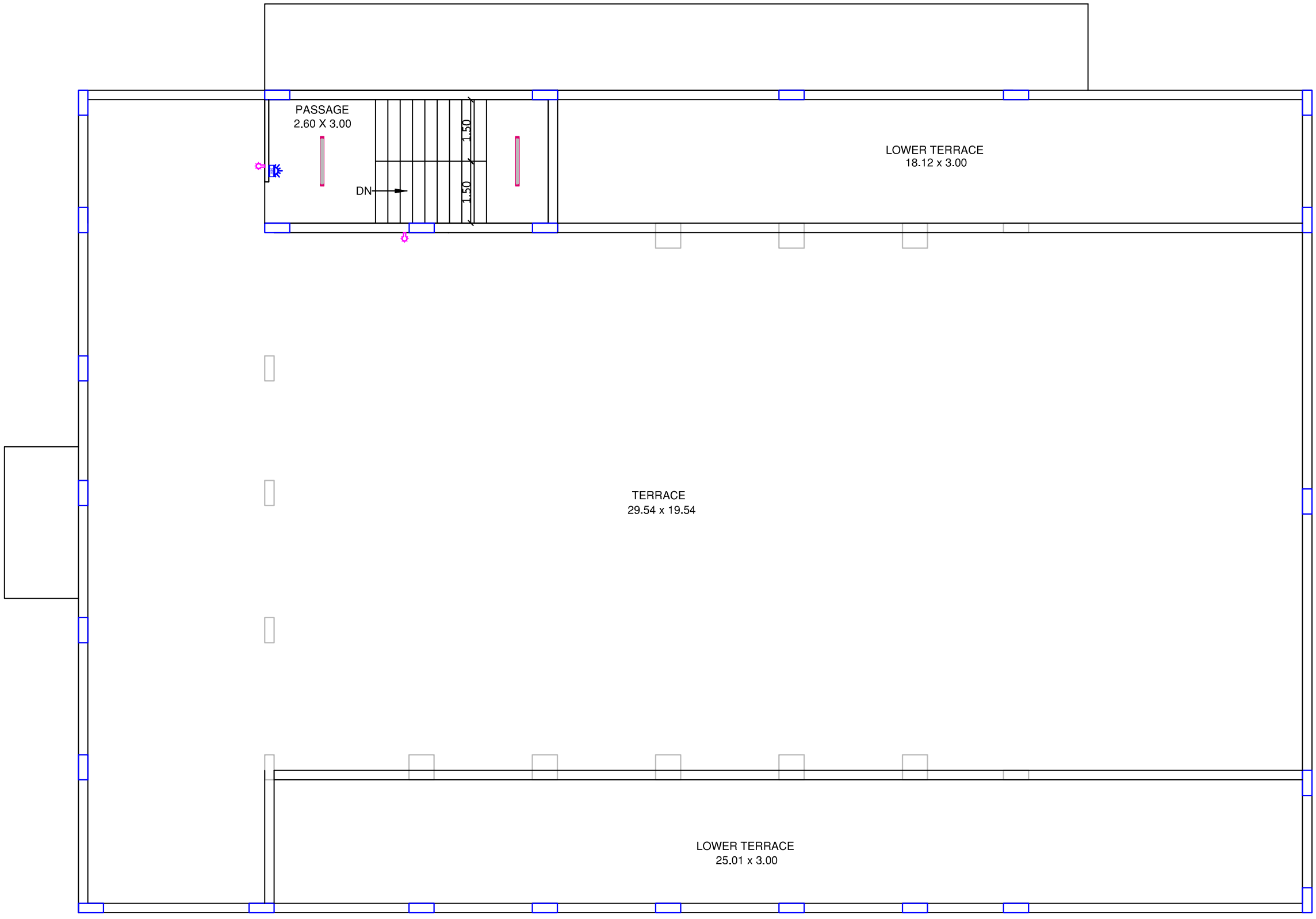
SYMBOL	DESCRIPTION	MOUNTING HEIGHT
	LIGHTING DISTRIBUTION BOARD(LDB) [I/C-25A DP , O/G-20A ,SP-1,16A SP-2,10A SP-3]	1800mm
	6 A /16 A LOOPED PLUG POINT	1200mm
	6A SWITCH SOCKET OUTLET	ON BOARD
	20A PP AC POINT	1200mm
	15A PP SWITCH SOCKET OUTLET	1200mm
	36 Watt Tube Light	2100mm
	36 Watt Tube Light	CEILING
	36 Watt Tube Light	CEILING
	Ceiling Fan	CEILING
	1X18W BRAKET LIGHT	2100mm

REVISION :	DATE :
SCALE : N.T.S	TYPE :
ELECTRICAL DRAWING	
CLIENT: RAJKOT MUNICIPAL CORPORATION	
PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.	

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
*JALARAM SHAKTI', BESIDE DHAWALGIRI APARTMENT, NR.LOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO	
SAGUNA			A-EL-27	28Y 19

PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.



TERRACE FLOOR PLAN

FOR DPR PURPOSE

ELECTRICAL DRAWING

BLDG.PLAN GR+1 FL.

COMMERCIAL BLDG.

TERRACE FLOOR PLAN

SYMBOL	DESCRIPTION	MOUNTING HEIGHT
	LIGHTING DISTRIBUTION BOARD(LDB) [I/C-25A DP , O/G-20A ,SP-1,16A SP-2,10A SP-3]	1800mm
	6 A /16 A LOOPED PLUG POINT	1200mm
	6A SWITCH SOCKET OUTLET	ON BOARD
	20A PP AC POINT	1200mm
	15A PP SWITCH SOCKET OUTLET	1200mm
	36 Watt Tube Light	2100mm
	36 Watt Tube Light	CEILING
	36 Watt Tube Light	CEILING
	Ceiling Fan	CEILING
	1X18W BRAKET LIGHT	2100mm

REVISION :	DATE :
SCALE : N.T.S	TYPE :

ELECTRICAL DRAWING

CLIENT: RAJKOT MUNICIPAL CORPORATION

PROJECT: PROPOSED E.W.S -II TYPE HOUSING AT F.P.-63/10 , T.P.-32(RAIYA), DIST.:-RAJKOT.

JAYESSH A DALAL
PROJECT MANAGEMENT CONSULTANT
"JALARAM SHAKTI", BESIDE DHAWALGIRI APARTMENT, INFLOURD'S CONVENT SCHOOL,ATHWALINES,SURAT.

DRAWN BY	CHECK BY		SHEET NO	
SAGUNA			A-EL-28	28Y 19

283

2.2 LHP 2 Jharkhand

2.2.1 Location Map

Site Name	Land Details	Area in Acres
Bajra 485	Mauja – Bajra , Khata 103, Thana No. 140 ,Plot 485	7.13

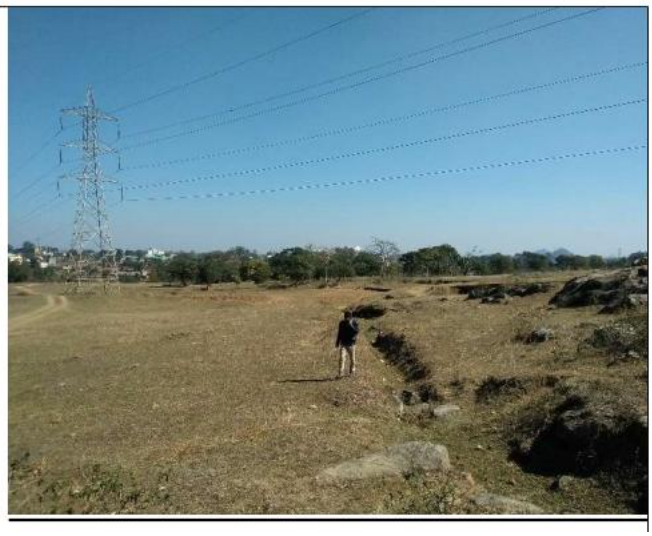
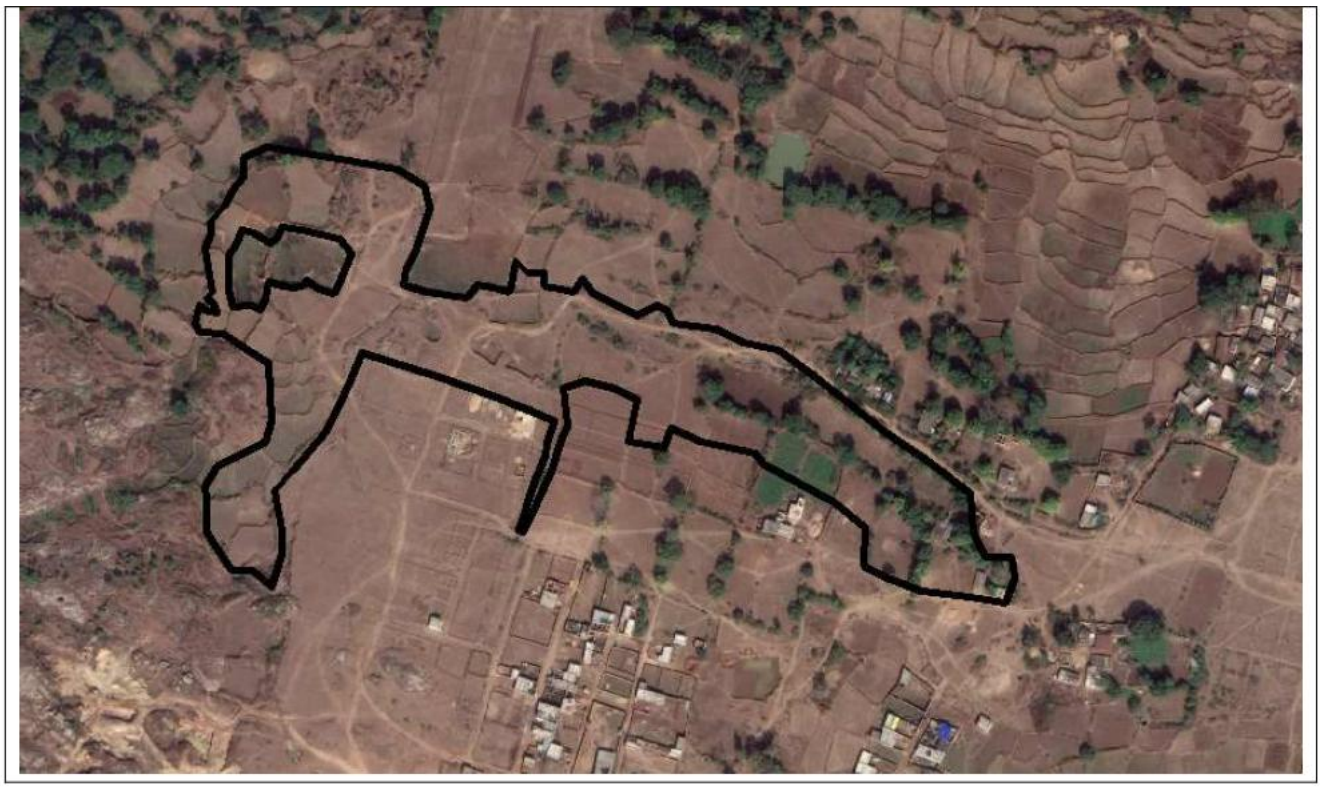
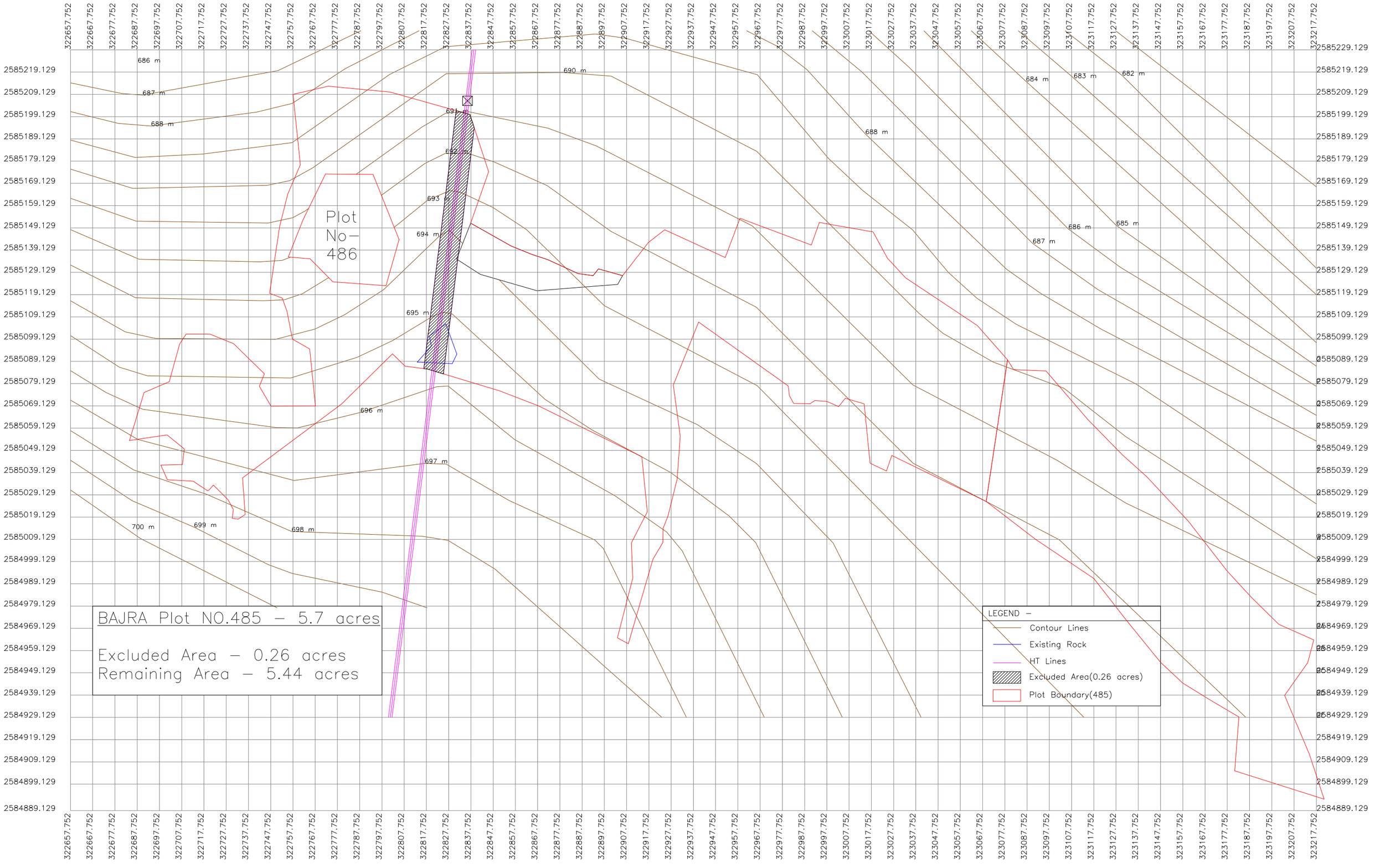


Figure 17: Google Earth Image of the Site



2.2.2 Total Station Survey Map


Plot
No–
486
BAJRA Plot NO.485 – 5.7 acres
Excluded Area – 0.26 acres
Remaining Area – 5.44 acres
LEGEND –
Contour Lines
Existing Rock
HT Lines
Excluded Area(0.26 acres)
Plot Boundary(485)

2.2.3 Soil Testing Report

A

REPORT ON
GEOTECHNICAL INVESTIGATION
FOR PREPARATION OF DETAILED PROJECT REPORT
AND PROJECT MANAGEMENT CONSULTANCY
UNDER PRADHAN MANTRI AWAS YOJNA
FOR "CLUSTER I" OF JHARKHAND
PROJECT : PLOT 485 BAJRA (RANCHI)

CONSULTANT / TECHNICAL ADVISOR

DARASHAW ENGINEERING COMPANY PVT. LTD.

SUBMITTED TO:

JHARKHAND URBAN INFRASTRUCTURE DEVELOPMENT COMPANY LTD. (JUIDCO)

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Executed By:

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1. INTRODUCTION :

Soil exploration, investigation and testing of soil and rock samples for the construction of proposed Plot-485 Bajra under Ranchi ULB, was entrusted to SPARSH ENGINEERING CO. (P) LTD. The objective was to ascertain the subsoil characteristics, stratification and other necessary data of underlying subsoil stratum at the site for the construction of proposed building. The sub soil investigation work consisted of the following operations:

(i) Sinking 16 nos. Bore holes varying in depths upto a maximum depth of 4.50m below the existing ground level at various locations including collection of undisturbed / disturbed soil samples and conducting Standard Penetration Tests at specified depths.

(ii) Drilling Sx & Nx size borehole in refusal strata (N > 100) in continuation of, including visual identification, collection and preservation of rock (including boulder) core samples in core boxes and determination of core recovery and RQD.

(iii) Reporting of formation at the site for various layers present at their respective depths along with their thickness including location of ground water table.

(iv) Conducting Laboratory Tests on Soil & Rock Samples collected during Boring/Drilling Operation and recommending type of foundation, depth of foundation, bearing capacity for open foundation and pile capacity for pile foundation.

During sinking of bore holes soil samples in disturbed and undisturbed conditions and rock core samples were collected for laboratory tests. The disturbed samples were subjected to tests to obtain soil index properties. The undisturbed soil samples, however, were used mainly for conducting tests to obtain shear strength parameters as well as consolidation characteristics of the soil representing the strata.

Since the investigation could not cover the regional sub-soil features, due weightage for the variations of sub-surface layers in its horizontal and vertical extent is to be given in selecting design basis. The consultant has prepared this report based on the field work and the samples collected from the site by the site in-charge.

2. FIELD WORK :

Geotechnical Investigation was envisaged in an attempt for optimization in the design of foundation for the proposed structures to be constructed at this site. The entire Investigation programmed had been divided mainly into two parts, (I) Field works & (II) Laboratory Tests.

(i) Field works unfold the sub-surface deposit types and their characteristics

(ii) Laboratory tests part would help determining the relevant physical and geotechnical properties of the sub-surface deposits leading to finalization of foundation depths of the structures and the bearing capacity with particular reference to the sub-surface types and their strength parameters and settlement potentials at the site.

2.1. Boring :

Boring was carried out by auger and rotary method as per IS 1892-1979 to sink nominal 150mm diameter boreholes to desired depths and operated by a team of experienced technicians. Flush jointed seamless casings were used to minimize the boreholes and prevent caving of the soil inside the boreholes. The casing pipes were advanced by turning in order to minimize the disturbance. Undisturbed soil samples were collected at suitable intervals or at change of strata whichever is

met earlier by open drive sampling method since it was intended to ascertain the subsoil characteristics. The standing water table in each borehole was determined at least 24 hours after the termination of boring work.

For the boreholes when rock was encountered rotary core drilling technique was adopted down to the explored depth. Drilling was done with standard gravity operated rotary drilling machine as per IS : 6926-1973. In this method the hole was advanced by rotating a system, consisting of series of hollow drill rods to the bottom of which was attached a double tube core barrel with a diamond coring bit, means of a diesel operated engine. When the rod with the coring bit was rotated, downward pressure was applied to the system to obtain penetration in the rocky strata and water under pressure was introduced into the bottom of the hole through the hollow drill rods. Water comes up through the annular space between the drill rods and the bore hole and was collected in the water sump, from where it was re-circulated. Water serves the dual function of cooling the bit as it enters the hole and carrying the cuttings from the bottom of the bore hole on its return journey to the surface.

Seamless flush jointed steel casing of Sx and Nx sizes were used to prevent any caving and water loss from holes and they were inserted simultaneously with the advancement of boring / drilling operations.

2.2. Sampling :

Nominal 100mm diameter undisturbed samples were recovered. The sampling equipment used consists of a two-tier assembly of sample tubes 400mm in length fitted at its lower end. The sampling assembly was driven by means of a jarring link to its full length or as far down as was found practicable. After withdrawal the ends of the tubes were sealed with wax at both ends and capped before transmission to the laboratory. At close intervals in depth, disturbed samples were collected both from split spoon sampler after the standard penetration test and from cutting edge for identification and logging purpose. These were tagged and packed in polythene packets and transported to the laboratory. The depth wise locations of all the undisturbed and disturbed samples were used in the preparation of borehole log data and for general identification and classification purposes.

2.3. Standard Penetration Test :

Standard Penetration Tests were conducted in the boreholes at suitable intervals as per IS: 2131-1963 using a split spoon sampler. The split spoon sampler used is of a standard design having an outer diameter of 50.8 mm and inner diameter of 35mm, driving with a monkey weighing 63.5 kgs, falling freely from a height of 75 cm. A record of the number of blows required to penetrate every 15 cm to a maximum depth of 45 cm was made. The first 15 cm of drive was considered to be seating drive and was neglected. To total blows required to effect each 15 cm of penetration was recorded. The "N" values were obtained by counting the number of blows required to drive the spoon 15 cm to 45 cm. On completion of a test the split spoon sampler was opened and soil specimens were preserved in polythene bags for logging purpose.

All the boreholes were sunk with winch. However, raising of hammer for SPT was done manually. Hence there will not be any inertia loss and the efficiency of hammer blows should be considered as 100%.

2.4. Measurement of Water Table :

Level of water was noted when struck in. This is termed as observed water level. Standing water level was noted during initial stages of boring, intermediate stage of boring and after 24 hours of removal of casing was also noted and shown in the profile.

2.5. Measurement of % Core Recovery and RQD :

The total length of all the cores obtained from the barrel was measured and % core recovery was computed at site, while for measuring RQD, core length of size less than 100 mm in length was not taken into account, as per IS: 11315 (Part-11)-1987 .

The Bore logs has been enclosed as Annexure-A .

3. LABORATORY TESTING :

For proper identification and classification of the sub-soil deposits and for deriving adequate information regarding its relevant physical and geotechnical properties at the site under investigation, the soil samples from the sampling tubes were extracted in the laboratory by pushing out the core by using the extractor frame. The core was jacked out in a direction that corresponded with the soil movement within the tube during sampling. In general, the following laboratory tests were conducted on the soil samples collected from the exploratory bore holes and sampling points :

In general following tests were carried out in soil Samples :

(i) Visual Engineering Classification

(ii) Grain size analysis (Sieve as well as Hydrometer)

(iii) Consistency Limits

(iv) Determination of Natural Moisture Content (Water content)

(v) Determination of Specific Gravity

(vi) Determination of Bulk & Dry Unit Weight

(vii) Determination of Shear Parameters such as c & ϕ value

The following tests were carried out in Rock Samples:

(i) Dry density and Bulk Density.

(ii) Water content

(iii) Porosity

(iv) Specific Gravity

(v) unconfined Compressive Strength

(vi) coefficient of softening

(vii) Point load strength index test

4. CRITERIA FOR CLASSIFICATION OF ROCK.

A.Rock Classification on the basis of Unconfined compressive strength as per Table.2(IRC-78-2014)

Rock Type	Description	Unconfined compressive Strength (Mpa)
Extremely Strong	Can not be scratched with knife or sharp pick. Breaking of specimen could be done by sledge hammer only.	>200
Very Strong	Can not be scratched with knife or sharp pick. Breaking of specimen required several hard blows of geologist's pick.	100 to 200
Strong	Can be scratched with knife or sharp pick with difficult. Hard blow of hammer required to detach hand specimen.	50 to 100
Moderately Strong	Can be scratched with knife or pick 6mm deep gouges or grooves can be made by hand blow of geologist 's pick. Hand specimen can be detached by moderate blow.	12.5 to 50
Moderately Weak	Can be grooved or gouged 1.5 mm deep by firm pressure of knife or pick point. Can be broken into pieces or chips of about 2.5mm max. size by hard blows of the points of geologist's pick.	5 to 12.5
Weak	Can be grooved or gouged easily with point of pick point. Can be break down in chips to pieces several cm's in size by moderate blows of pick point. Small thin pieces can be broken by finger pressure.	1.25 to 5
Very Weak	Can be carved with knife. Can be broken easily with point of pick. Pieces 25mm or more in thickness can be broken by finger pressure. Can be scratched easily by finger nail.	<1.25

B. **Physically** rock can be classified on following basis:

a) Based on color on examination of rock sample.

b) Based on grain of sample

i, Course Grained, ii. Medium grained, iii. Fine Grained

c) Based upon joint/fracture spacing .

i. Very widely, ii. Widely, iii. Medium, iv. Closely

d) Based upon the condition of weathering .

i. Fresh, ii. Slightly weathered, iii. Moderately weathered, iv. Highly weathered, V. Completely weathered, VI. Residual soil.

C. Based on **RQD** of Rock sample.

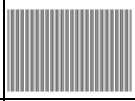
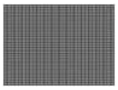
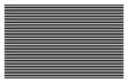
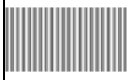
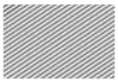
90-100	75-90	50-75	25-50
Excellent	Good	Fair	Very Poor

5. CRITERIA FOR CLASSIFICATION OF SOIL.

Classification and Identification of soil for general engineering Purpose as per IS 1498-1970.

Soil classification including field identification and description.

Division	Sub-Division		Group Letter Symbol	Hatching	Typical Name
COARSE-GRAINED SOIL **More than half material is larger than 75 micron IS sieve Size The smallest partical visiable to the naked eyed.**	**Gravels More than half of coarse fraction is larger than 4.75 mm IS sieve size**	Clean Gravells (Little or no fines)	GW		Well graded gravels, gravels – sand mixture. Little or no fines.
			GP		Poorely graded gravels, gravels –sand mixture. Little or no fines.
		Gravells with fines (Apprectable amount of fines fines)	GM		Silty gravels, poorely graded gravels -sand silt mixture
			GC		Clayey gravels, poorely graded gravels -sand clay mixture
	Sands More than half of coarse fraction is smaller than 4.75 mm IS sieve size	Clean Sands (Little or no fines)	SW		Well graded (sand-gravel and), little or no fines.
			SP		Poorely graded sand-gravely sand, little or no fines.
		Sands with fines (Appreciable amount of fines fines)	SM		Silty sands, poorely graded sand silt mixture
			SC		Clayey sands, poorely graded sand silt mixture

Division	Sub-Division	Group Letter Symbol	Hatching	Typical Name
FINE-GRAINED SOIL More than half material is smaller than 75 micron IS sieve Size The smallest particle visible to the naked eyed.	Silts and clays with low compressibility and liquid limit less than 35.	ML		Inorganic silts and very fined sands, rock flour, silts or clayey fine sands or clayey silt none to low plasticity.
		CL		Inorganic clays ,gravely clays, sandy clays, silty clays, lean clays of low plasticity.
		OL		Organic silt and organics silty clays of low plasticity.
	Silts and clays with medium compressibility and liquid limit greater than 35 & less than 50.	MI		Inorganic silts, silty or clayey fine sands or clayey silt of medium plasticity.
		CI		Inorganic clays, gravely clays, sandy clays, silty clays, lean clays of medium plasticity.
		OI		Organic silt and organics silty clays of medium plasticity.
	Silts and clays with high compressibility and liquid limit greater than 50.	MH		Inorganic silt of high compessibility, micaceous or diatomicaceous fine sandy or silty soil, plastic silt.
		CH		Inorganics clays with high plasticity, clays.
		OH		Organics clays with of medium to high plasticity .
Highly Organic soil		Pt		Peat and other highly organic soil with very high compressibility.

Classification of Coarse-Grained soil based **on laboratory Testing** of soil sample.

Group Symbol	Laboratory Classification Criteria		
GW	Cu greater than 4. Cc Between 1 and 3.	Uniformity Coefficient (Cu)	$Cu=D_{60}/D_{10}$
GP	Not meeting all gradation requirement for GW.	Coefficient of Curvature (Cc)	$(D_{30})^2$
GM	Plastic Index(Ip) less than 4.		$D_{60}XD_{10}$
GC	Plastic Index(Ip) greater than7.	60% finer than size	D_{60}
SW	Cu greater than 6. Cc Between 1 and 3.	30% finer than size	D_{30}
SP	Not meeting all gradation requirement for SW.	10% finer than size	D_{10}
SM	Plastic Index(Ip) less than 4.	plastic Index	Ip
SC	Plastic Index(Ip) greater than7.		

6. COMPUTATION OF BEARING CAPACITY:

6.1.Computation of Bearing Capacity for Rocky Strata

A. Based upon the Clause 6.2 of IS:12070-1987

The computation of bearing capacity has been done as per the provision of clause 6.2 of IS:12070-1987.

The safe bearing pressure should be estimated from the equation:

qs = qc.Nf;

Where,

qs = safe bearing pressure
qc = average uniaxial compressive strength of rock cores,
Nf = empirical coefficient depending on the spacing of discontinuities or as per below table .

= (3+S/Bt)/(10√(1+300§/s)

Where,

§ = Thickness of discontinuities in cm.
S = Spacing of discontinuities in cm.
Bt = Footing width in cm.

Here, the equation included a factor of safety of 3.

The relation given is valid for a rock mass with a spacing of discontinuities greater than 0.3m, aperture (opening) of discontinuities less than 10mm (15mm if filled with soil or rock debris) and foundation width of greater than 0.3m.

Spacing or Discontinuities (cm)	Empirical coefficient (Nf)
300	0 .4
100-300	0.25
30-100	0.1

B. Based upon Clause no. 5.2 of IS:12070-1987

Net safe bearing capacity depending upon the Classification of rock mass is given in clause no.5.2 of IS:12070-1987 is as given below:

NET SAFE BEARING PRESSURE (qns) BASED ON CLASSIFICATION

MATERIAL	**qns(t/sq.m)**
Massive crystalline bedrock including granite, diorite, gneiss, trap rock	1000
Foliated rocks such as schist or slate in sound condition.	400
Bedded limestone in sound condition	400
Sedimentary rock, including hard shales and sandstones	250
Soft or broken bed rock(excluding shale),and soft limestone	100
Soft shale	40

C. Based upon Rock Mass Rating(RMR):

As per provision, clause 5.3 of IS:12070-1987,RMR may also be used to give net allowable pressure as per table given below .This will ensure settlement of raft foundation up to 6m thickness to be less than 12mm.

NET SAFE BEARING PRESSURE BASED ON RMR

Classification No.	I	II	III	IV	V
Description of Rock	Very good	good	Fair	Poor	Very Poor
RMR	100-81	80-61	60-41	40-21	20-0
qns(t/sq.m)	600-448	440-288	280-151	145-90-58	55-45-40

The RMR of Rock mass can be determined as defined by Bieniawski & modified by Wickham, which is as given below:

	A.CLASSIFICATIO PARAMETERS AND THEIR RATINGS								
	Parameter		Range of Values						
1	Strength of intact rock material	Point-load strength index	>10Mpa	4-10Mpa	2-4Mpa	1-2Mpa	For this low range-uniaxial compressive test is preferred.		
		Uniaxial comp. strength	>250 Mpa	100-250 Mpa	50-100 Mpa	25-50 Mpa	5-25 Mpa	1-5 Mpa	<1 Mpa
	Rating		15	12	7	4	2	1	0
2	Drill core Quality RQD		90% -100%	75% -90%	50% -75%	25% -50%	<25%		
	Rating		20	17	13	8	3		
3	Spacing of discontinuities		>2m	0.6-2.0m	200-600mm	60-200mm	<60mm		
	Rating		20	15	10	8	5		
4	Condition of discontinuities (see-E)		Very rough surfaces Not continuous	Slightly rough surfaces Separation<1mm	Slightly rough surfaces Separation<1mm	Slickenside surfaces or Gouge <5mm	Soft gouge >5mm thick or Separation >5mm		

			No separation Untethered wall rock	Slightly weathered walls	Highly weathered walls	thick or Separation 1-5mm continuous	continuous
	Rating		30	25	20	10	0
5		Inflow per10m tunnel length(l/m)	None	<10	10 to 25	25-125	>125
	Ground Water	(Joint water press)/ (Major principal σ)	0	<0.1	0.1-0.2	0.2-0.5	>0.5
		General conditions	Completely dry	Damp	wet	Dripping	Flowing
	Rating		15	10	7	4	0
B.	RATING ADJUSTMENT FOR DISCONTINUITY ORIENTATIONS(See F)						
Strike and dip orientations			Very favorable	Favorable	Fair	Unfavorable	Very Unfavorable
Rating		Tunnels & mines	0	-2	-5	-10	-12
		Foundations	0	-2	-7	-15	-25
		Slopes	0	-5	-25	-50	
C.	ROCK MASS CLASSES DETERMINED FROM TOTAL RATING						
Rating			100 -81	80-61	60-41	40-21	<21
Class number			I	II	III	IV	V
Description			Very good rock	Good rock	Fair rock	Poor Rock	Very Poor Rock
D.	MEANING OF ROCK CLASSES						
Class number			I	II	III	IV	V
Average stand-up time			20 yrs for 15m span	1 yrs for 10m span	1 week for 5m span	10hrs for 2.5m span	30min for 1m span
Cohesion of rock mass(kpa)			>400	300-400	200-300	100-200	<100
Frictional angle of rock mass(deg)			>45	35-45	25-35	15-25	<15
E.	Guidelines for classification of Discontinuity condition						
Discontinuity length(persistence) Rating			<1m 6	1-3m 4	3-10m 2	10-20m 1	>20m 0
Separation (aperture) Rating			None 6	<0.1mm 5	0.1-1.0mm 4	1-5mm 1	>5mm 0
Roughness Rating			Very rough 6	Rough 5	Slightly rough 3	Smooth 1	Slicken sided 0
Infilling(gouge) Rating			None 6	Hard filling<5mm 4	Hard filling>5mm 2	Soft filling<5mm 2	Soft filling>5mm 0
Weathering Ratings			Unweathered 6	Slightly weathered 5	Moderately weathered 3	Highly weathered 1	Decomposed 0

Correction for submergence, cavities etc.

As per provision clause no.9.1 of IS:12070-1987;

For getting the allowable bearing pressure the safe bearing pressure should be multiplied with the correction factor, given below according to the geological condition .These correction are not applicable for the classification of RMR method.

Allowance should be made for submerged conditions, cavities and slope given below.

(i)	Submerged condition Under water table.	
	a) Rock with discontinuous joints with opening less than 1mm wide;	3/4
	b) Rock with continuous joints with opening 1 to 5 mm wide and filled with clay; and	3/4 to 1/2
	c) Limestone/Dolomite deposit with major cavities filled soil	2/3 to 1/2
(ii)	Cavities	
	Major cavities inside limestone (Core recovery less than 70%)	1/2
(iii)	Slope	
	a) Fair orientation of continuous joints in the slope	1 to 1/2
	b) Unfavorable orientation of continuous joints in slope	1/2 to 1/3

6.2. Computation of Bearing Capacity for Sandy & Clayey Strata

The ultimate net bearing capacity is obtained as per clause 5.1.1 of IS:6403-1981.

a) In case of general shear failure (qd)= C.Nc.Sc.Dcic + q(Nq-1)Sq.dq.iq+ 0.5γ.B.Nγ.Sγ.Dγ.iγ.w'.

b) In case of local shear failure (q'd)=2/3 C.N'c.Sc.Dcic+ q(N'q-1)Sq.dq.iq+0.5γ.B.N'γ.Sγ.Dγ.iγ.w'.

Criteria for analysis as per clause 5,2,1.1 of IS:6403-1981 is given below.

Method of analysis base on relative density			
Relative Density	Void Ratio	Condition	Method of Analysis
Greater than 70%	less than 0.55	Dense	General Shear
Less than 20%	Greater than 0.75	Loose	Local Shear(as well as punching shear)
20% to 70%	0.55 to 0.75	Medium	interpolate between (i & ii)

Where;

C=cohesion in kg/sq.cm

Nc, N'c Nq N'q and Nγ N'γ =Bearing capacity factor

Sc, Sq and Sγ =Shape factor

Dc, Dq and Dγ =Depth factor

ic,iγ,&iγ =inclination Factor

γ =bulk unit weight of foundation soil.

q =effective surcharge at the base level of foundation in (kg/sq.cm)

B =Width of footing(cm)

W' =Correction factor for location of water table.

As per clause no. 5.2.2.1 the ultimate net bearing capacity shall be calculated from the following formula.(Based on SPT Value)

(qd)=q(Nq-1)Sq.dq.iq+ 0.5γ.B.Nγ.Sγ.Dγ.iγ.w'

All parameters are same as above, only Φ is read from fig.1 of IS:6403-1981.

The bearing capacity factor ,Depth factor, Shape Factor, inclination factor & effect of water table given below.

Bearing Capacity Factor(IS:6403-1981)			
Φ (deg)	Nc	Nq	Nγ
0	5.14	1	0
5	□.14	1.57	0.45
10	8.35	2.47	1.22
15	10.98	3.94	2.□5
20	14.83	□.4	5.39
25	20.72	10.□□	10.88
30	30.14	18.4	22.4
35	4□.12	33.3	48.03
40	75.31	□4.2	109.41
45	138.88	134.88	271.7□
50	2□□.89	319.07	7□2.89

For obtaining N'c, N'q& N'γ, Φ'=tan-1(0.67tan Φ) and the values are respectively.

Shape Factor(IS:6403-1981)			
Sl.no shape of base	Sc	Sq	Sγ
Continious strip	1	1	1
Rectangle	1+0.2B/L	1+0.2B/L	1-0.4B/L
Square	1.3	1.2	0.8
Circle	1.3	1.2	0.6
where,B the diameter in the bearing capacity formula			

The depth factor shall be as under:

dc=1+ 0.2Dt/B√NΦ

dq=dy=1 for Φ<10deg.

dq=dy=1+0.1Dt/B√NΦ for Φ>10deg.

Here, the correction is to be applied only when back filling is done with proper compaction.
The Inclination Factor shall be under:

ic =iq=(1-a/90)^2

iy =(1-a/ Φ)^2

Where,

a =Inclination of the load to the vertical in deg.

Φ = Angle of shearing resistance of soil in deg.

Effect of Water table :

a) If the water table is likely to permanently remain at or below a depth of (Dt+B) beneath the ground level surrounding the footing then W'=1.
b) If the water table is located at a depth Dt or likely to rise to the base of footing or above the value of W' shall be taken as 0.5
c) If the water table is likely to permanently got located at a depth Dt<Dw<(Dt+B),then the value of W' be obtained by linear interpolation.

In the present case, the foundation has been provided at rocky strata, hence the bearing capacity has been computed for rocky strata and the same has been enclosed.