Annexure – I

STRUCTURAL DESIGN BASIS REPORT

PROJECT : PROPOSED DEVELOPMENT OF HIGHRISE BUILDINGS AT AHMEDABAD, GUJARAT.

CLEINT : JEWEL RESIDENCY (BLOCK-A)

ARCHITECT: PANDYA ASSOCIATES.

STRUCTURAL CONSULTANTS: SETU INFRASTRUCTURE

1. INTRODUCTION

The proposed Building consists of 3 Basement + 1 Ground floor +19 stories and Overhead water two water tanks with 25000 lit as per AMC Submission plan however As consideration of future expansion & with consideration to Use of Extra chargeable FSI & or TDR bases development plan we have structurally design this building for 3 Basement + 1 Ground floor +20 stories and Overhead water two water tanks with 25000 lit.

Brick bat coba waterproofing on terrace including floor finish (150mm thk) is considered as 0.15x20 kN/m^3 =3.0 kN/m^2. (As In Tabulated)

2. DESIGN LOADS

a) Dead Loads

The self-weight of the various elements are computed based on size and density of Materials as given below:-

Density of Reinforced Cement Concrete =25 kN/m^3

Density of Plain Cement Concrete = 24 kN/m^3

Density of Steel = 78.5 kN/m^3

Density of Soil = 18 kN/m^3

Density of Brick with plaster = 20 kN/m^3

Floor finish = 1.5kN/m^2

SiporexWall : Density : =8.0 kN/m^3

b) Floor Loads

Floor	SIDL Siporex Wall load Kn/m^2	LL Kn/m^2	FF including Screed + Ducting Kn/m^2	Remarks
First Basement	Nil	3	1.5	
Second Basement	Nil	3	1.5	
Third Basement	Nil	6	1.5	
GF	2.5	3	1.5	Shops 3.0kn/m^2, Access Road outside building design for (Fire Engine) 50 tn or 15kn/m^2
TypFlr ($1^{st}$to 20 stories floor)	2	2	1.5	Stair case foyer – 3kn/m^2
RF		1.5	3	

c) Loads as per IS 875(part 2) -1987

Area	Live Load (KN/m2)	Floor Finish including Screed + ducting (KN/m^2)	Siporex Wall Load Kn/m^2
Show Room detail	3.0	1.5	2.5
Toilets & Bath Rooms	2.0	3 (if Sunk)/1.5 without sunk	2
Staircase , Corridors,Ramp,Fire escape	3.0	1	Nil
Fire Engine (outside building at GF)	15.0kn/m^2	1.5	Nil

FOS against uplift due to ground water table considered 1.0

d) Wind Load

The wind pressure has been calculated based on the data furnished below and other provision laid in IS875 (Part-3) – 1987.

Basic Wind Speed (pg53)	Vb	=	39 m/sec
Risk Coefficient Factor (pg 11)	K1	=	1.0
Terrain Category (Pg 8)		=	3
Structure Class (pg 11)		=	C (Ht More than 50m)
Terrain, Height & Structure Size Factor	K2	=	1
Topography Factor	K3	=	1

e) Earthquake Load

The loading due to earthquake is assessed based on the provisions of IS: 1893 (Part-1):2002

Seismic Zone (pg 36)		= III
Table-2	Zone factor (Z)	= 0.16.
Table-6	Importance Factor (I)	= 1
Table-7	Response Reduction Factor (R)	= 5

Soil type As per geotechnical report and in accordance with Cl. No. 6.4.5 IS 1893-2002

Height of building (h) =3B+GF+20Storey

= (4.7+3.4+3.4) + (3.5) + (3.2x20)

= 84.2 Approx.

Fundamental Natural Time Period (Ts) with brick infill walls

Block A

X- dir.

$$T=\frac{0.09xh}{\sqrt{d}}$$

$$=\frac{0.09x83.2}{\sqrt{46.20}}$$

= 1.11 Sec

Y – dir.

$$T=\frac{0.09xh}{\sqrt{d}}$$

$$=\frac{0.09x83.2}{\sqrt{18.1}}$$

= 1.78 Sec

Horizontal seismic coefficient

$$Ah = \frac{Z \times I \times Sa}{2 \times R \times g}$$

3. CHECK FOR LATERAL SWAY AS PER IS Codes

The allowable lateral sway at top should not exceed H/500(For wind Forces).Stories Drift shall not exceed 0.004 i.e (1/250) H(For Seismic forces).Where, H is total height of Building.

4. BASIC LOADS AND LOAD COMBINATIONS

The various loads are combined in accordance with the stipulations in IS:875 (Part5) 1987. Wherever imposed load is combined with earthquake load the appropriate part of the imposed load as specified in IS:1893-2002 is adopted both for evaluating earthquake effect and for combined load effects, used in such combination.

BASIC LOAD CASES

Load case	Mark	Description
1	EQX	SEISMIC LOAD IN X DIR.
2	EQY	SEISMIC LOAD IN Y DIR.
3	DL+FF	FLOOR SLAB & FINISH LOAD
4	WL	WALL LOAD
5	LIVE1	LIVE LOAD =<3 kN/m^2
6	LIVE2	LIVE LOAD > 3 kN/m^2

5. LOAD FACTORS FOR DESIGN

Description of Load Combination	Load Factor for Primary Load Cases			
	Dead Load	**Live Load**	**Wind Load**	**Seismic Load**
Dead load + Live load	**1.5**	**1.5**	**0.0**	**0.0**
Dead load + Wind load	**1.5**	**0**	**1.5**	**0.0**
Dead load Seismic load	**1.5**	**0**	**0**	**1.5**
Dead load+Liveload+Wind load	**1.2**	**1.2**	**1.2**	**0.0**
Dead load+Liveload+Seismic load	**1.2**	**1.2**	**0**	**1.2**
Dead + Seismic	**0.9**	**0**	**0**	**1.5**
Dead load+Wind load	**0.9**	**0**	**1.5**	**0**

6. ANALYSIS METHOD

Basic modeling has been generated in our customized Programme along with all primary loadings and the same is exported in ETABS-2015 for analysis. The output of analysis is modified again by customized interface package for in-house design module.

The structure will be analyzed for Static and Dynamic and Lateral loads due to Earthquake/Wind loads and its combinations in ETABS Software.

7. DESIGN METHODOLOGY

All structures have been designed according to the Limit State Method as specified in IS:456-2000. Appropriate loads and its combinations, as per relevant clauses in Code IS 456:2000 Code IS 875 (Part-5) 1987, for the most unfavorable effects are chosen for design.

8. CONSTRUCTION DETAILS

1. Open Foundation	-	Concrete Mix M:25 & Steel Fe 415
2. Columns/Shear wall	-	Concrete Mix M:30 M: 35 M: 40 & Steel Fe 415
3. Beams & Slabs	-	Concrete Mix M:20 M: 25& Steel Fe 415
4. R.C. Retaining Wall	-	Concrete Mix M:20M: 25& Steel Fe 415
5. External Wall	-	150 thk Siporex block wall as per architectural layout.
6. Internal Wall	-	100 thk Siporex block wall as per architectural layout.
7. Typical Floor Height	-	As per Arch Drawing

9. CONCRETE

All the concrete items for the construction have the following characteristics

Grade of Concrete	=	M:25, M30, M:35 , M:40 (Concrete design Mix as per IS 456-2000) M15 (For P.C.C.)
Aggregate	=	20mm and down size, mechanically crushed Aggregate

10. REINFORCEMENT

Steel reinforcement shall be of Grade Fe500 .

11. EXPOSURE CONDITION

Structural elements below Plinth level and External column and beam are designed for Moderate exposure condition and internal column, floor beams and slabs are designed for mild exposure condition as per Table 16 of IS 456-2000.

12. COVER TO REINFORCEMENT

The nominal cover to main reinforcement shall be as follows.

	Cover		Fire resistance (Hours)
Staircase waist slab	=	35mm	2
Slab	=	25mm	1.5
Columns	=	40mm	2
Floor Beams	=	30mm	2
Retaining Wall	=	40mm	2

13. FOUNDATION SYSTEM

The buildings have been supported on columns with shear wall with raft foundation as per recommendation in SIR.

Safe allowable bearing capacity is considered as per soil investigation report.

14. CODES & STANDARDS

All the designs are conforming to the relevant Indian Standards. Some of the relevant Indian Standard Codes, which have been followed for the structural designs, are given below.

Code	**Description**
IS:875 (Part-1)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Unit Weights of Buildings Materials and Stored Material.
IS:875 (Part-2)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Imposed loads

IS:875 (Part-3)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures –Wind Load.
IS:875 (Part-5)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – Special Loads and Load Combinations
IS:456 2000	Code of Practice for Plain and Reinforced ConcreteIS:1893 (Part-1)-2002 Indian Standard Criteria for Earthquake Resistant Design of Structures
IS:13920-1993	Ductile Detailing of reinforced concrete structures subjected to seismic forces – code of practice.
IS:1904	Indian Standard Code of practice for Design &Construction foundations in Soil: General Requirements.
IS:1642-1989	Indian Standard Code of practice for Fire Safety Of Buildings (General) : Details Of Construction.

APPENDIX – II

DESCRIPTION OF SUB-STRUCTURE

No. of basements		3
Minimum clearance between outermost basement retaining wall and compound wall		2.66 m
Has a Shoring system been installed? Submit sectional detail of the shoring system		NO
Give details of methodology used to resist uplift pressure due to ground water for tower portion as well as the portion outside the tower.	Bottom Level of Raft w.r.t. ground level in mts. Total downward load of self-weight of raft + Counterweight over raft + Rock Anchors if any (for raft spanning between columns) Whether pressure release pipes have been used? Water level assumed for uplift calculation	15.0 m
Description of the foundation for the tower block		
Nature of Foundation	Piles, Spread Footings, Combined Raft, Piled Raft, etc.	Combined Raft ,Spread Footing
SBC assumed T/sq.mt.		31 T/m^2
Sub-grade Elastic Modulus		6000 Kn/m^3
Flooring system of the Basements	VDF or IPS	
Retaining wall types & Sequence of backfilling	Whether Proposed cantilever, Cantilever Supported between Buttresses/Counter forts, etc.	Proposed Cantilever
Intended Use of basements		Parking
If rock anchors are used, are they grouted after installation and stressing?		Not Applicable
Is structural steel used in the construction of the sub-structure?		NO
If yes. What are the measures taken for its fire proofing and corrosion resistance?		Not Applicable

Whether Expansion/Separation joints provided? Whether expansion joint/separation joint continues through basement? If yes, detail at Basement level & retaining wall junction		NO

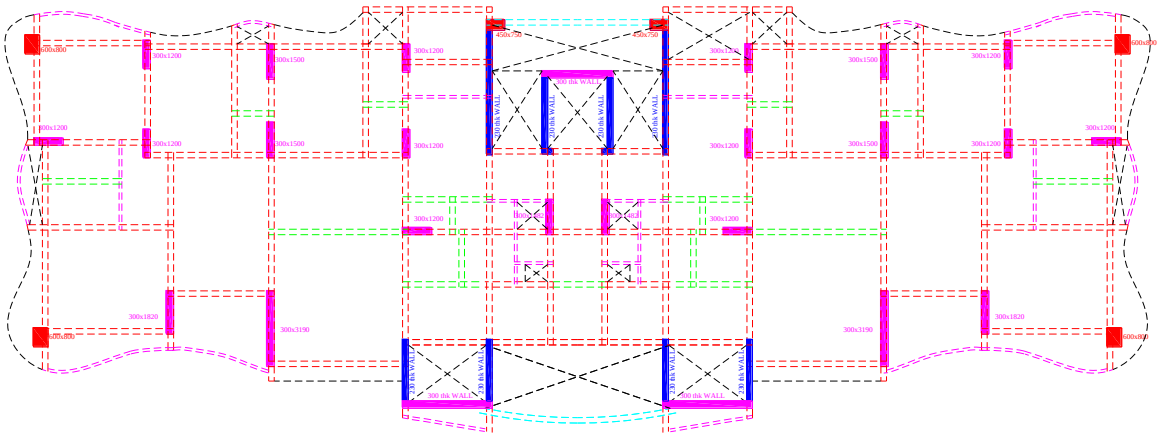
APPENDIX – III

DESCRIPTION OF SUPER STRUCTURE

No. of Floors & height of building in mt.	{[3rd B + 2nd B + 1st B]+ [Plinth + GF + FF] + [2nd to 15th floor] + [16th to 19th floor] + [20th Floor]+ [SC + LMR + OHWT + Air Antenna] = Total Height
	{[4.650 mt + 3.45 mt + 4.05 mt] + [0.45 mt +4.50 mt +3.45 mt]+ [44.01 mt (3.15 mt x 14 floor)] + [13.80 mt (3.45 mt x 4 floor] [3.45 mt] + [8.41 mt]} = 90.00 mt
Shape of Building, Plan, Elevation, whether Symmetric in Elevation	Rectangular
Maximum plan dimension in either direction in mt.	46.2 m
Ratio of plan dimension	2.55
Typical floor to floor height in mt. Maximum floor to floor height in entire height of building in mt.	3.2 m 4.7 m
Aspect ratio (Height of Building till Terrace / Minimum Dimension of Building)	80.5/18.1 = 4.44
Type of floor slab	One Way, Two Way
Average thickness of floor slab in mm.	150 mm
Whether column are RCC, Composite or in structural steel	RCC
Lateral System Whether the Geometry of Building is Symmetric Whether the lateral load resisting system is symmetrically placed in Geometry	Ductile Shear Wall with SMRF Yes Yes
Use of floor at different levels (Residential / Commercial / industrial)	3rd Basement floor and G.F used for Commercial , 1st to 19th floor used for Residential
Use of floor at different levels (Resident / Commercial / industrial)	Resident / Commercial
Is there any Transfer level? If yes, depth of Transfer Girder	NO
Whether expansion joint is provided? If yes, what is the maximum plan dimension in mt.	Not Require
Whether separation gap at the joint is sufficiently	Not Require

provided?	
Maximum cantilever projection in mt.	2 m

3) Provide brief Description of Structural System with sketches, images of dwg. etc. with specific focus on _Lateral load resisting system.
   - Shear wall provide for lateral resisting system.



4) Provide brief note on modeling, software used etc. Clearly mention whether infill / partition wall is idealized as part of lateral load system?

- Model has been generated in ETABS-2015 by the architectural grid.
- Material properties, section properties and loading parameters input in ETABS.
- For Earthquake load Time period input as per IS 1893-2002 for brick infill wall.
- The output of analysis is modified by the customized interface for in house design module.

5) Provide the height of building in mt.

- Height of building is 90.00 m

5A) Provide plan dimensions of the building (mt x mt)

- L X B = 46.20 X 18.1

6)	Provide following EQ loading details.		
a)	Zone Factor		= III
b)	Importance factor		= 1
c)	Response Reduction factor		= 5
d)	Soil type		=Medium Soil
e)	% LL considered in seismic		= 0.25 ,0.5 %
f)	Time Period in the horizontal X-direction (sec) (from Formula in code)		= 1.11 sec
g)	Time Period in the horizontal Y-direction (sec) (from Formula in code)		= 1.78 sec
h)	Total Seismic weight (Sw) of building (kN)		= 207794
i)	Static Base-shear in X-direction	(as % of Sw)	=1.56%
j)	Static Base-shear in Y-direction	(as % of Sw)	=0.97%

k) Table of distribution for static base shear

Story	Load Case	Shear X	Load Case	Shear Y
		kN		kN
Story25	EQX 1	191.7924	EQY 1	119.6009
Story24	EQX 1	589.5833	EQY 1	367.6615
Story23	EQX 1	961.4759	EQY 1	599.572
Story22	EQX 1	1295.7826	EQY 1	808.0442
Story21	EQX 1	1594.6208	EQY 1	994.3984
Story20	EQX 1	1858.4633	EQY 1	1158.9294
Story19	EQX 1	2090.7519	EQY 1	1303.7835
Story18	EQX 1	2295.7375	EQY 1	1431.6116
Story17	EQX 1	2475.1266	EQY 1	1543.4778
Story16	EQX 1	2630.6256	EQY 1	1640.4463
Story15	EQX 1	2763.9409	EQY 1	1723.5811
Story14	EQX 1	2876.7789	EQY 1	1793.9465
Story13	EQX 1	2970.8462	EQY 1	1852.6064
Story12	EQX 1	3047.8491	EQY 1	1900.6251
Story11	EQX 1	3109.4941	EQY 1	1939.0666
Story10	EQX 1	3157.4876	EQY 1	1968.9952
Story9	EQX 1	3193.942	EQY 1	1991.7279
Story8	EQX 1	3220.3331	EQY 1	2008.1853
Story7	EQX 1	3237.9999	EQY 1	2019.2022
Story6	EQX 1	3248.6872	EQY 1	2025.8668
Story5	EQX 1	3255.0458	EQY 1	2029.832
Story4	EQX 1	3257.2198	EQY 1	2031.1877
Story3	EQX 1	3257.2198	EQY 1	2031.1877
Story2	EQX 1	3257.2198	EQY 1	2031.1877
Story1	EQX 1	3257.2198	EQY 1	2031.1877

l) Max. Deflection at roof level. (mm) = 122.5mm < (H/500= 166 CL 20.5 IS 456:2000) OK

m) Max. Inter stories drift. / Height = 5.7mm < (CL 7.11.1 IS 1893:2002 PART 1 not exceed 0.004 times stories height) OK

7) Provide following Wind loading details.

a) Category of building = 3

b) Class of building = C

c) Basic wind speed in m/sec. = 39m/sec

d) Maximum wind pressure(kN/m2) = NA

e) Force coefficient =0.7 ,0.5

f) Wind Base-shear in the horizontal X-direction(kN) =1560KN

g) Wind Base-shear in the horizontal Y-direction (kN) =3869 KN

h) Gust factor calculations (if Gust-wind applied) = NA

i) Details of wind tunnel force data (if applicable) = NA

j) Estimated magnitude of wind induced vibrations = NA

k) Max. deflection at roof level (mm) =66 mm

l) Max. Inter stories drift. =3.2 mm

8) Provide following data from Dynamic Analysis.

Modes	Frequency in Hz	Time Period in sec	X-participation	Y-participation
Mode 1	0.297	3.371	62.44	0.02
Mode 2	0.31	3.225	3.32	0.15
Mode 3	0.339	2.947	0.0008748	63.07
Mode 4	0.979	1.021	10.12	0.0006694
Mode 5	1.053	0.95	4.49	0.001675
Mode 6	1.293	0.774	0	16.35
Mode 7	1.925	0.52	3.16	0.01
Mode 8	2.138	0.468	3.63	0.01
Mode 9	2.841	0.352	0.003436	7.35
Mode 10	3.061	0.327	1.91	0.003196
Mode 11	3.558	0.281	2.38	0.001285
Mode 12	4.385	0.228	1.52	0.01
Mode 13	4.887	0.205	0.01	4.45
	Summation		92.98	91.426

(Note: Fundamental mode should not be a torsional mode)

9) Provide Table for lateral deflections (mm) at Terrace Level in the following format.

Load Case	Dx-max	H/Dx	Drift-x	Dy-max	H/Dy	Drift-y
DL	0.6	5833	0.000006	8.5	411	0.00018
DL+LL	0.77	4545	0.000007	12.7	275	0.00026
EQx	119.3	29.33	0.0009	14.5	241	0.000054
EQY	7.6	460.52	0.000142	76	46	1.00077
Wx	32.5	107.69	0.00029	2.3	1521	0.00004
WY	0.51	6862	0.000002	66.5	52.63	0.000747

10) Provide corner displacements (mm) for Torsional Irregularity (along X-direction) in the following format.

Load Case	Corner-1	Corner-2	Corner-3	Corner-4	Avg-x	%Max./Avg.
Eq-x	119.3	119.3	109.6	109.6	114.45	1.04 %
Wl-x	32.4	32.4	30.9	30.9	31.65	1.02 %

11) Provide Corner displacements (mm) for Torsional Irregularity (along Y-direction) in the following format.

Load Case	Corner-1	Corner-2	Corner-3	Corner-4	Avg-Y	%Max./Avg.
Eq-Y	76	76	38.2	38.2	57.1	1.33 %
Wl-Y	66	66	64	64	65	1.01%

12) Provide acceleration (mg) values in the following format.

Eq-X	Eq-Y	WL-X	WL-Y
100%	100%	100%	100%

13) Provide following data regarding Vertical Elements.

a) Size of maximum loaded column = 600 x 800 mm

b) Gravity load on max. loaded column = 6500 KN

c)	Axial stress in max. loaded column (Gravity loads)	= 13.54 N/mm2
d)	Grade of max. loaded column	= 35 Mpa
e)	Axial settlement in max. loaded column	= 2.6mm
f)	Axial settlement in min. loaded column	= 0.8 mm
g)	%Base-shear resisted by all columns along X (static)	= 3.16 %
h)	%Base-shear resisted by all columns along Z (static)	= 1.77 %

14) Provide, if applicable, following data regarding Floating Columns.

a)	Total gravity load on floating column (provide table if there are multiple floating columns)	=NA
b)	Size and span of girders supporting floating columns	=NA
c)	Number of floors supported by floating columns	=NA
d)	Deflection of girder under column (from model)	=NA
e)	Deflection of girder under column (from s/s action)	=NA
f)	Specific details about floating columns on cantilever girders (Refer Table below)	

15) Provide, if applicable, following data regarding soft Story effect.

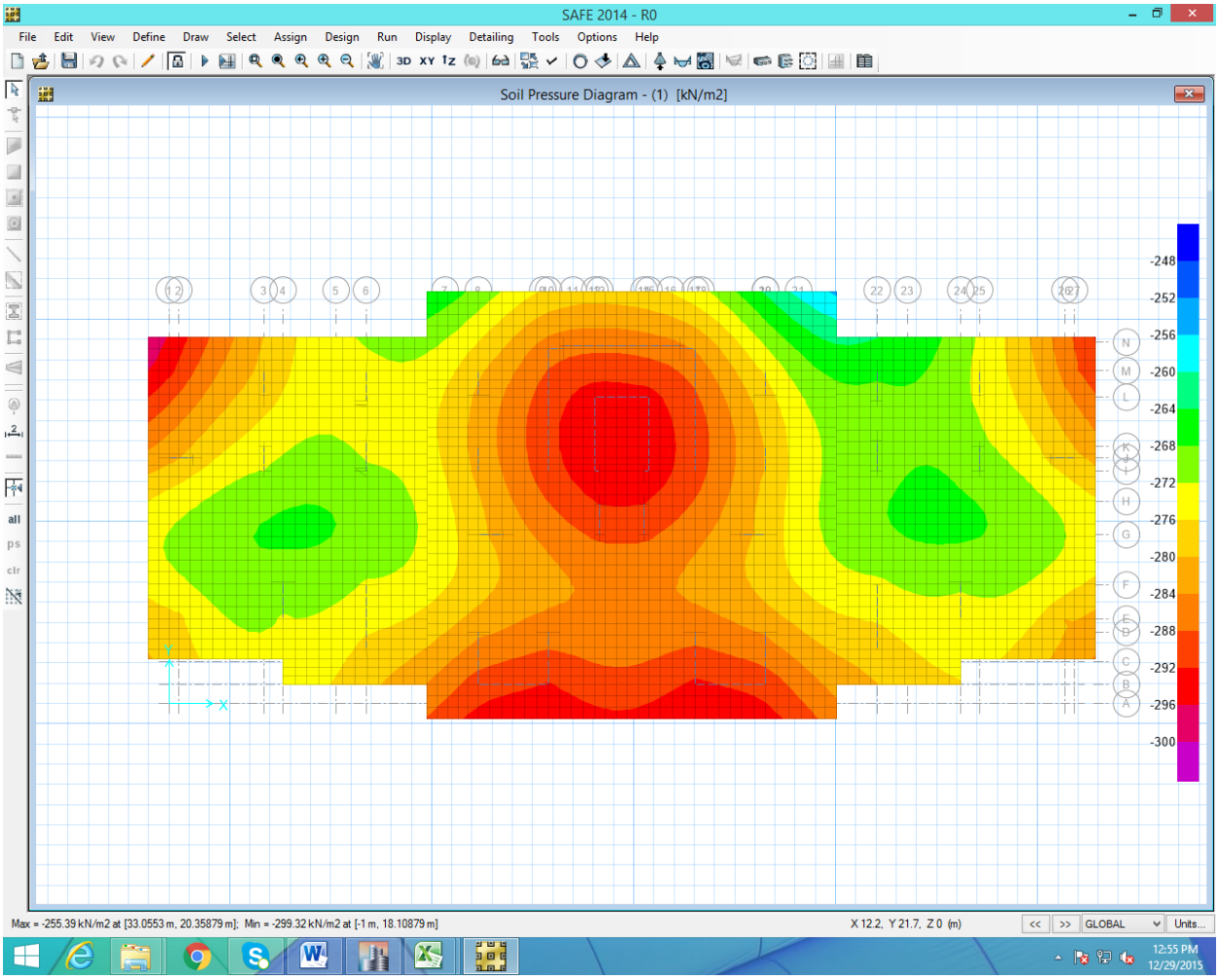
a)	Stiffness of lower floor (in deflection/KN)	=NA
b)	Stiffness of lower floor (in deflection/KN)	=NA
c)	Relative stiffness ratio (upper/lower)	=NA
d)	Level of soft story	=NA
e)	Number of floors above soft story	=NA

16) Provide, if applicable, following data for each cantilever.

a)	Cantilever span	=NA
b)	Structural system	=NA
c)	Nature of usage	=NA
d)	Maximum elastic deflection under gravity loads	=NA

17) Provide stability calculations for uplift and overturning (model extract in case of model) =NA

18) Typical design calculations for footing



Soil pressure diagram

19) Typical design calculations for RCC columns

ETABS 2015 Concrete Frame Design

IS 456:2000 Column Section Design(Envelope)

Column Element Details

Level	Element	Section ID	Length (mm)	LLRF
Story5	C3	CL 600X800 M35	3400	0.4

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	600	75	45

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	500	500

Design Code Parameters

ɣc	ɣs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	3840	0.8
Bottom	3970	0.83

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
	kN	kN-m	kN-m	mm	
Top	2351.6604	-309.093	-296.4585	2800	DWal32
Bottom	5105.3317	-589.5943	-445.1179	0	DWal29

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	0	2800	DWal32
Bottom	886.75	0	0	DWal32

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	665.06	20.0313	2800	DWal32
Bottom	665.06	20.0313	0	DWal32

20) Typical design calculations for RCC walls

ETABS 2015 Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
Story4	P25	5638.7	5093.1	1825	300	0.4

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	500	500

Design Code Parameters

γ_s	γ_c	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	5638.7	4180.6	5638.7	6005.6	1825	300
Bottom	Leg 1	5638.7	4180.6	5638.7	6005.6	1825	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	9648	0.0176	0.0023	DWal29	7892.0123	373.1611	-552.7039	547500
Bottom	9926	0.0181	0.0023	DWal29	7986.456	376.4918	-559.3181	547500

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	DWal29	7399.1702	193.5632	-109.1591	269.9795	665.1317
Bottom	Leg 1	750	DWal29	7493.614	209.3064	-109.1591	269.9795	665.1317

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	600	DWal29	7892.0123	-36.0973	14.63	7
Top–Right	Leg 1	600	DWal29	8355.2581	91.2148	15.81	7
Bottom–Left	Leg 1	600	DWal2	8449.7019	-126.3679	16.19	7
Botttom–Right	Leg 1	600	DWal2	7986.456	209.3064	15.84	7

21) Typical design calculations for RCC Beams

ETABS 2015 Concrete Frame Design

IS 456:2000 Beam Section Design (Envelope)

Beam Element Details

Level	Element	Section ID	Length (mm)	LLRF
Story6	B339	B 230X600 M20	5609.9	0.991

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
230	600	230	0	35	60

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
22360.68	20	1	500	500

Design Code Parameters

ɣc	ɣs
1.5	1.15

Flexural Reinforcement for Major Axis Moment, M_{u3}

	End-I Rebar Area mm²	End-I Rebar %	Middle Rebar Area mm²	Middle Rebar %	End-J Rebar Area mm²	End-J Rebar %
Top (+2 Axis)	1553	1.13	408	0.3	1164	0.84
Bot (-2 Axis)	777	0.56	562	0.41	682	0.49

Flexural Design Moment, M_{u3}

	End-I Design M_u kN-m	End-I Station Loc mm	Middle Design M_u kN-m	Middle Station Loc mm	End-J Design M_u kN-m	End-J Station Loc mm
Top (+2 Axis)	-320.4224	0	-92.1879	1402.5	-234.9135	5609.9
Combo	DWal10		DWal10		DWal9	
Bot (-2 Axis)	0	0	116.8018	4207.4	137.7697	5609.9
Combo	DWal14		DWal14		DWal14	

Shear Reinforcement for Major Shear, V_{u2}

End-I Rebar A_{sv} /s mm²/m	Middle Rebar A_{sv} /s mm²/m	End-J Rebar A_{sv} /s mm²/m
860.54	844.41	757.9

Design Shear Force for Major Shear, V_{u2}

End-I Design V_u kN	End-I Station Loc mm	Middle Design V_u kN	Middle Station Loc mm	End-J Design V_u kN	End-J Station Loc mm
209.71	935	0.1878	1402.5	182.0125	5142.4
DWal28		DWal29		DWal29	

Torsion Reinforcement

Shear Rebar A_{svt} /s mm²/m
565.43

Design Torsion Force

Design T_u kN-m	Station Loc mm	Design T_u kN-m	Station Loc mm
0.9458	0	3.6846	5609.9
DWal10		DWal29	

PROJECT DATA SHEET

UNIT NO._____

DESIGNS (R & B), GANDHINAGAR

Sr. No.	Description			
1.	Name of Project	Jewel Residency (Block A)		
2.	Project file No. (To be filled by Design Circle).			
3.	Project Team (To be filled by Design Circle).	EE	DEE	AE
4.	Project Referred By:			
		Name of Office	Contact Person	Telephone Nos.
(a)	Circle			
(b)	Division			
(c)	Sub-Division			
5.	Consultants of the project:			
(a)	Nature of Consultancy		Architect	Structural Consultant
(b)	Nature of the firm		Pandya Associates	Setu Infrastructure
(c)	Address		Architects and Engineers, 64, sharda Nagar, Paldi, Ahmedabad – 380007	308,Abhishilp Complex, B/h. Puja Party Plot, Judges Bungalow Road, off. 132 ft. Ring Road, Vastrapur, Ahmedabad - 380015.
(d)	Authorized Representative			
(e)	Telephone, Fax, E-mail		079 26633666	07940037661/26751800 Email: setuinf@gmail.com
6. (a)	Nature of Project		New Construction -Residential	
7. (a)	Work order office letter outward No. with date		01 August 2015	
(b)	Stipulated date of starting work as per agreement		01 September 2015	
(c)	Stipulated date of completion of work as per agreement.		29 February 2016	

8.	**Details of Building**	
(a)	**Type**	Load Frame
(b) i	**[1]As per AMC Submission Plan* Total floor area in m^2**	14012.49 m^2
ii	**As per Structural Design** - Total floor area in m^2 for**	14634.86 m^2 (Additional 622.87 Sq. Mt Built up added for 20th Floor)
(c) i	**Total height from Basement to Top in m [2]As per AMC Plan***	{[3rd B + 2nd B + 1st B]+ [Plinth + GF + FF] + [2nd to 15th floor] + [16th to 19th floor] + + [SC + LMR + OHWT + Air Antenna] = Total Height
		{[4.650 mt + 3.45 mt + 4.05 mt] + [0.45 mt +4.50 mt +3.45 mt]+ [44.10 mt (3.15 mt x 14 floor)] + [13.80 mt (3.45 mt x 4 floor] + [8.42 mt]} = 86.87mt
ii	**Total height from Basement to Top in m As per structural Design****	{[3rd B + 2nd B + 1st B]+ [Plinth + GF + FF] + [2nd to 16th floor] + [17th to 20th floor] + [SC + LMR + OHWT + Air Antenna] = Total Height
		{[4.650 mt + 3.45 mt + 4.05 mt] + [0.45 mt +4.50 mt +3.45 mt]+ [47.25 mt (3.15 mt x 15 floor)] + [13.80 mt (3.45 mt x 4 floor] + [8.42 mt]} = 90.02
iii	**Total height from GL in m As per AMC Plan***	[Plinth + GF + FF] + [2nd to 15th floor] + [16th to 19th floor] + + [SC + LMR + OHWT + Air Antenna] = Total Height
		[0.45 mt +4.50 mt +3.45 mt]+ [44.10 mt (3.15 mt x 14 floor)] + [13.80 mt (3.45 mt x 4 floor] + [8.42 mt]} = 74.72mt

*As per AMC Submission plan there is 3B+G+19 stories building.

** As consideration of future expansion & with consideration to Use of Extra chargeable FSI & or TDR bases development plan we have structurally design this building for 3B+G+20 stories

iv.	**Total height from GL in m** **As per structural Design**[3]**	[Plinth + GF + FF] + [2nd to 16th floor] + [17th to 20th floor] + [SC + LMR + OHWT + Air Antenna] = Total Height
		[0.45 mt +4.50 mt +3.45 mt]+ [47.25 mt (3.15 mt x 15 floor)] + [13.80 mt (3.45 mt x 4 floor]+ [8.42 mt]} = 77.87m
(d)	**No. of stories ; As per AMC Plan***	3B+G+19
	As per Structural Design **	3B+G+20
(e)	**Base dimension bx in m**	46.20
(f)	**Base dimension bz in m**	18.1
9.	**Exposure condition:**	
(a)	**Type**	Moderates
(b)	**Minimum Grade of RCC**	M20
(c)	**Minimum Grade of PCC**	M15
10.	**Fire Resistance Rating in Hours.**	
(a)	**Building height Up to 15 m.**	1 Hour
(b)	**Building height more than 15 m.**	2 Hour
11.	**Nominal Cover (Clear cover) in mm (To main reinforcement considering exposure condition & fire resistance**	
(a)	**Footing**	50
(b)	**Column**	40
(c)	**Beam below Ground level**	20
(d)	**Beam above Ground level**	30
(e)	**Slab**	25
12.	**Dead Loads:**	
(a)	**Earth**	18.00 KN/m^3
(b)	**Water**	10.00 KN/m^3
Brick masonry with plaster/finish on both faces		
(c)	**115 Thk.**	2.90 KN/m^3
(d)	**230 mm Thk.**	5.30 KN/m^3
(e)	**350 mm Thk.**	7.70 KN/m^3
(f)	**PCC**	24.0 KN/m^3
(g)	**RCC**	25.0 KN/m^3
13.	**Imposed loads (As per IS:875-1987)**	
(a)	**Occupancy**	Imposed load (in KN/m^2)
	Basement Parking Area	3 KN/m^2
	Shops Area	3 KN/m^2
	Typical Storey	2 KN/m^2
	Staircase + Foyer	3 KN/m^2
(b)	**Roof load:-** **Accessible**	1.5 KN/m^2

[3] *As per AMC Submission plan there is 3B+G+19 stories building .

** As consideration of future expansion & with consideration to Use of Extra chargeable FSI & or TDR bases development plan we have structurally design this building for 3B+G+20 stories

(c)	**Roof load:-** **Not accessible** **Slope Angle.**	KN/m^2
(d)	**Water Tank:**	
	(i) Type	PVC/RCC
	(ii) Capacity in Liters	25000 Liters
	(iii) Height in m	4048.76mm
	(iv) Diameter in m	2999.74mm
	(v) Nos. & position	2 tanks
14.	**Earthquake Load Date:**	
(a)	**Earthquake Zone**	III
(b)	**Zone Factor 'Z'**	0.16
(c)	**Importance Factor 'I'**	1.0
(d)	**Response Reduction Factor 'R'**	5
(e)	**Natural Period:** **Tx (Sec.)**	1.78
(f)	**Natural Period:** **Tz (Sec.)**	1.11
(g)	**Live Load Reduction Factor**	0.25,0.5
(h)	**Ductility detailing as per IS:13920-1993**	Yes
15	**Soil Data:**	
(a)	**Soil Report No. & Date**	ST/14/09/6663
(b)	**Depth of foundation below GL**	12 m
(c)	**SBC**	31 T / m^2
(d)	**Type of soil**	Medium
(e)	**N-value**	60

CERTIFICATE

It is hereby certified that the building Structure of Project Jewel Residency has been designed for following:

(A) Latest revision/amendments of following IS Codes considered in the design:

(1) IS:456-2000	…	Yes
(2) IS:1893-2002	…	Yes
(3) IS:13920-1993	…	Yes
(4) IS:4326-1993	…	No
(5) IS:875-1987	…	Yes

(B) SBC, N-Value and foundation depth are taken as per the Soil Report No. ST/14/09/6663 Dt. Sept. - 2014 prepared by K.C.T. Consultancy Services.

(C) The design is based on the sound engineering practice and undersigned are solely responsible for the correctness of design and soundness, durability & strength of the structure.

Contractor	Consultant	signed in my presence (Executive Engineer) Div._____
Name: _____	Name: _____	Name: _____
Sign: _____	Sign: _____	Sign: _____

Annexure – I

STRUCTURAL DESIGN BASIS REPORT

PROJECT : PROPOSED DEVELOPMENT OF HIGHRISE BUILDINGS AT AHMEDABAD, GUJARAT.

CLEINT : JEWEL RESIDENCY (BLOCK-B)

ARCHITECT: PANDYA ASSOCIATES.

STRUCTURAL CONSULTANTS: SETU INFRASTRUCTURE

1. INTRODUCTION

The proposed Building consists of 3 Basement + 1 Ground floor +19 stories and Overhead water two water tanks with 25000 lit as per AMC Submission plan however As consideration of future expansion & with consideration to Use of Extra chargeable FSI & or TDR bases development plan we have structurally design this building for 3 Basement + 1 Ground floor +20 stories and Overhead water two water tanks with 25000 lit

The building is meant for use Residential, Three Basement and ground floor partial area are used as car parking area .The Structural system for the Building consists of Slab with Beam, R.C. Columns/Shear Walls.

Brick bat coba waterproofing on terrace including floor finish (150mm thk) is considered as 0.15x20 kN/m^3 =3.0 kN/m^2. (As In Tabulated)

2. DESIGN LOADS

a) Dead Loads

The self-weight of the various elements are computed based on size and density of materials as given below:-

Density of Reinforced Cement Concrete =25 kN/m^3

Density of Plain Cement Concrete = 24 kN/m^3

Density of Steel = 78.5 kN/m^3

Density of Soil = 18 kN/m^3

Density of Brick with plaster = 20 kN/m^3

Floor finish = 1.5kN/m^2

SiporexWall : Density : =8.0 kN/m^3

b) Floor Loads

Floor	SIDL Siporex Wall load Kn/m^2	LL Kn/m^2	FF including Screed + Ducting Kn/m^2	Remarks
First Basement	Nil	3	1.5	
Second Basement	Nil	3	1.5	
Third Basement	Nil	6	1.5	
GF	2.5	3	1.5	Shops 3.0kn/m^2, Access Road outside building design for (Fire Engine) 50 tn or 15kn/m^2
TypFlr ($1^{st}$to 20 stories floor)	2	2	1.5	Stair case foyer – 3kn/m^2
RF		1.5	3	

c) Loads as per IS 875(part 2) -1987

Area	Live Load (KN/m2)	Floor Finish including Screed + ducting (KN/m^2)	Siporex Wall Load Kn/m^2
Show Room detail	3.0	1.5	2.5
Toilets & Bath Rooms	2.0	3 (if Sunk)/1.5 without sunk	2
Staircase , Corridors,Ramp,Fire escape	3.0	1	Nil
Fire Engine (outside building at GF)	15.0kn/m^2	1.5	Nil

FOS against uplift due to ground water table considered 1.0

d) Wind Load

The wind pressure has been calculated based on the data furnished below and other provision laid in IS875 (Part-3) – 1987.

Basic Wind Speed (pg53)	Vb	=	39 m/sec
Risk Coefficient Factor (pg 11)	K1	=	1.0
Terrain Category (Pg 8)		=	3
Structure Class (pg 11)		=	C (Ht More than 50m)
Terrain, Height & Structure Size Factor	K2	=	1
Topography Factor	K3	=	1

e) Earthquake Load

The loading due to earthquake is assessed based on the provisions of IS: 1893 (Part-1):2002

Seismic Zone (pg 36) = III

Table-2 Zone factor (Z) = 0.16.

Table-6 Importance Factor (I) = 1

Table-7 Response Reduction Factor (R) = 5

Soil type As per geotechnical report and in accordance with Cl. No. 6.4.5 IS 1893-2002

Height of building (h) =3B+GF+20Storey

= (4.7+3.4+3.4) + (4.6) + (3.2x20)

= 84.2 Approx.

Fundamental Natural Time Period (Ts) with brick infill walls

Block B

X- dir

$$T=\frac{0.09xh}{\sqrt{d}}$$

$$=\frac{0.09x83.2}{\sqrt{38}}$$

= 1.23 Sec

Y – dir.

$$T=\frac{0.09xh}{\sqrt{d}}$$

$$=\frac{0.09x83.2}{\sqrt{21.4}}$$

= 1.64 Sec

Horizontal seismic coefficient

$$Ah = \frac{Z \times I \times Sa}{2 \times R \times g}$$

3. CHECK FOR LATERAL SWAY AS PER IS Codes

The allowable lateral sway at top should not exceed H/500(For wind Forces).Storey Drift shall not exceed 0.004 i.e (1/250) H(For Seismic forces).Where, H is total height of Building.

4. BASIC LOADS AND LOAD COMBINATIONS

The various loads are combined in accordance with the stipulations in IS:875 (Part5) 1987. Wherever imposed load is combined with earthquake load the appropriate part of the imposed load as specified in IS:1893-2002 is adopted both for evaluating earthquake effect and for combined load effects, used in such combination.

BASIC LOAD CASES

Load case	Mark	Description
1	EQX	SEISMIC LOAD IN X DIR.
2	EQY	SEISMIC LOAD IN Y DIR.
3	DL+FF	FLOOR SLAB & FINISH LOAD
4	WL	WALL LOAD
5	LIVE1	LIVE LOAD =<3 kN/m^2
6	LIVE2	LIVE LOAD > 3 kN/m^2

5. LOAD FACTORS FOR DESIGN

Description of Load Combination	Load Factor for Primary Load Cases			
	Dead Load	**Live Load**	**Wind Load**	**Seismic Load**
Dead load + Live load	**1.5**	**1.5**	**0.0**	**0.0**
Dead load + Wind load	**1.5**	**0**	**1.5**	**0.0**
Dead load+Seismic load	**1.5**	**0**	**0**	**1.5**
Dead load+Liveload+Wind load	**1.2**	**1.2**	**1.2**	**0.0**
Dead load+Liveload+Seismic load	**1.2**	**1.2**	**0**	**1.2**
Dead + Seismic	**0.9**	**0**	**0**	**1.5**
Dead load+Wind load	**0.9**	**0**	**1.5**	**0**

6. ANALYSIS METHOD

Basic modeling has been generated in our customized Programme along with all primary loadings and the same is exported in ETAB for analysis. The output of analysis is modified again by customized interface package for in-house design module.

The structure will be analyzed for Static and Dynamic and Lateral loads due to Earthquake/Wind loads and its combinations in ETAB Software.

7. DESIGN METHODOLOGY

All structures have been designed according to the Limit State Method as specified in IS:456-2000. Appropriate loads and its combinations, as per relevant clauses in Code IS 456:2000 Code IS 875 (Part-5) 1987, for the most unfavorable effects are chosen for design.

8. CONSTRUCTION DETAILS

1. Open Foundation	-	Concrete Mix M:25 & Steel Fe 415
2. Columns/Shear wall	-	Concrete Mix M:30 M: 35 M: 40 & Steel Fe 415
3. Beams & Slabs	-	Concrete Mix M:20 M: 25& Steel Fe 415
4. R.C. Retaining Wall	-	Concrete Mix M:20M: 25& Steel Fe 415
5. External Wall	-	150 thk Siporex block wall as per architectural layout.
6. Internal Wall	-	100 thk Siporex block wall as per architectural layout.
7. Typical Floor Height	-	As per Arch Drawing

9. CONCRETE

All the concrete items for the construction have the following characteristics

Grade of Concrete	=	M:25, M30, M:35 , M:40 (Concrete design Mix as per IS 456-2000) M15 (For P.C.C.)
Aggregate	=	20mm and down size, mechanically crushed Aggregate

10. REINFORCEMENT

Steel reinforcement shall be of Grade Fe500 .

11. EXPOSURE CONDITION

Structural elements below Plinth level and External column and beam are designed for Moderate exposure condition and internal column, floor beams and slabs are designed for mild exposure condition as per Table 16 of IS 456-2000.

12. COVER TO REINFORCEMENT

The nominal cover to main reinforcement shall be as follows.

	Cover		Fire resistance (Hours)
Staircase waist slab	=	35mm	2
Slab	=	25mm	1.5
Columns	=	40mm	2
Floor Beams	=	30mm	2
Retaining Wall	=	40mm	2

13. FOUNDATION SYSTEM

The building has been supported on columns with shear wall with raft foundation as per recommendation in SIR.

Safe allowable bearing capacity is considered as per soil investigation report.

14. CODES & STANDARDS

All the designs are conforming to the relevant Indian Standards. Some of the relevant Indian Standard Codes, which have been followed for the structural designs, are given below.

Code	Description
IS:875 (Part-1)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Unit Weights of Buildings Materials and Stored Material.
IS:875 (Part-2)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Imposed loads
IS:875 (Part-3)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures –Wind Load.
IS:875 (Part-5)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – Special Loads and Load Combinations
IS:456 2000	Code of Practice for Plain and Reinforced ConcreteIS:1893 (Part-1)-2002 Indian Standard Criteria for Earthquake Resistant Design of Structures
IS:13920-1993	Ductile Detailing of reinforced concrete structures subjected to seismic forces – code of practice.
IS:1904	Indian Standard Code of practice for

	Design &Construction foundations in Soil: General Requirements.
IS:1642-1989	Indian Standard Code of practice for Fire Safety Of Buildings (General) : Details Of Construction.

APPENDIX – II

DESCRIPTION OF SUB-STRUCTURE

No. of basements		3
Minimum clearance between outermost basement retaining wall and compound wall		0.87 m
Has a Shoring system been installed? Submit sectional detail of the shoring system		NO
Give details of methodology used to resist uplift pressure due to ground water for tower portion as well as the portion outside the tower.	Bottom Level of Raft w.r.t. ground level in mts. Total downward load of self-weight of raft + Counterweight over raft + Rock Anchors if any (for raft spanning between columns) Whether pressure release pipes have been used? Water level assumed for uplift calculation	15.0 m
Description of the foundation for the tower block		
Nature of Foundation	Piles, Spread Footings, Combined Raft, Piled Raft, etc.	Combined Raft ,Spread Footing
SBC assumed T/sq.mt.		31 T/m^2
Sub-grade Elastic Modulus		6000Kn/m^3
Flooring system of the Basements	VDF or IPS	
Retaining wall types & Sequence of backfilling	Whether Proposed cantilever, Cantilever Supported between Buttresses/Counter forts, etc.	Proposed Cantilever
Intended Use of basements		Parking
If rock anchors are used, are they grouted after installation and stressing?		Not Applicable
Is structural steel used in the construction of the sub-structure?		NO
If yes. What are the measures taken for its fire proofing and corrosion resistance?		Not Applicable

Whether Expansion/Separation joints provided? Whether expansion joint/separation joint continues through basement? If yes, detail at Basement level & retaining wall junction		NO

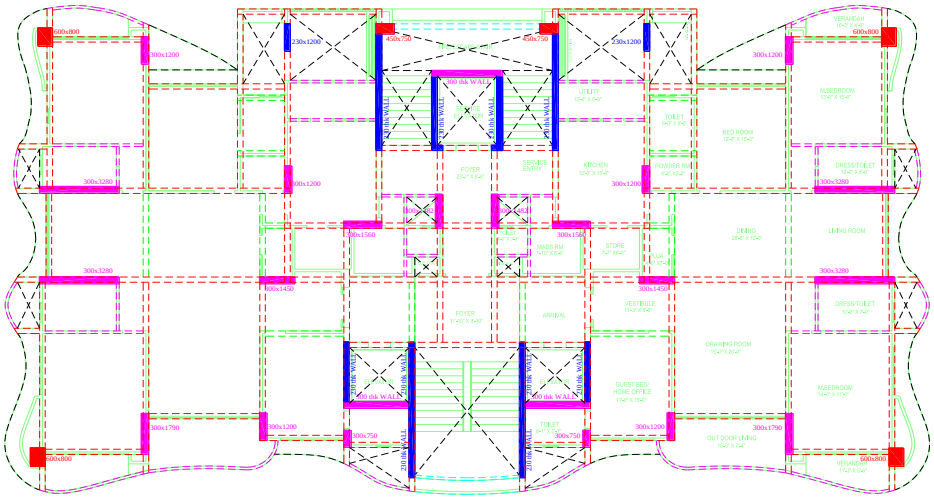
APPENDIX – III

DESCRIPTION OF SUPER STRUCTURE

No. of Floors & height of building in mt.	{[3^{rd} B + 2^{nd} B + 1^{st} B]+ [Plinth + GF + FF] + [2^{nd} to 15^{th} floor] + [16^{th} to 19^{th} floor] + [20^{th} Floor]+ [SC + LMR + OHWT + Air Antenna] = Total Height
	{[4.650 mt + 3.45 mt + 4.05 mt] + [0.45 mt +4.50 mt +3.45 mt]+ [44.01 mt (3.15 mt x 14 floor)] + [13.80 mt (3.45 mt x 4 floor] [3.45 mt] + [8.41 mt]} = 90.00 mt
Shape of Building, Plan, Elevation, whether Symmetric in Elevation	Rectangular
Maximum plan dimension in either direction in mt.	38.0m
Ratio of plan dimension	1.77
Typical floor to floor height in mt. Maximum floor to floor height in entire height of building in mt.	3.2 m 4.7 m
Aspect ratio (Height of Building till Terrace / Minimum Dimension of Building)	80.5/21.4 = 3.76
Type of floor slab	One Way, Two Way
Average thickness of floor slab in mm.	150 mm
Whether column are RCC, Composite or in structural steel	RCC
Lateral System Whether the Geometry of Building is Symmetric Whether the lateral load resisting system is symmetrically placed in Geometry	Ductile Shear Wall with SMRF Yes Yes
Use of floor at different levels (Residential / Commercial / industrial)	3^{rd} Basement floor and G.F. used for Commercial , 1^{st} to 19^{th} floor used for Residential
Use of floor at different levels (Resident / Commercial / industrial)	Resident / Commercial
Is there any Transfer level? If yes, depth of Transfer Girder	NO

Whether expansion joint is provided? If yes, what is the maximum plan dimension in mt.	Not Require
Whether separation gap at the joint is sufficiently provided?	Not Require
Maximum cantilever projection in mt.	2 m

3) Provide brief Description of Structural System with sketches, images of dwg. etc. with specific focus on _Lateral load resisting system.
   - Shear wall provide for lateral resisting system.



4) Provide brief note on modeling, software used etc. Clearly mention whether infill / partition wall is idealized as part of lateral load system?

- Model has been generated in ETABS-2015 by the architectural grid.
- Material properties, section properties and loading parameters input in ETABS.
- For Earthquake load Time period input as per IS 1893-2002 for brick infill wall.
- The output of analysis is modified by the customized interface for in house design module.

5) Provide the height of building in mt.

- Height of building is 90.00 m

5A) Provide plan dimensions of the building (mt x mt)

- L X B = 38 X 21.4

6) Provide following EQ loading details.

a)	Zone Factor	= III
b)	Importance factor	= 1
c)	Response Reduction factor	= 5
d)	Soil type	=Medium Soil
e)	% LL considered in seismic	=0.25,0.5
f)	Time Period in the horizontal X-direction (sec) (from Formula in code)	=1.23 sec
g)	Time Period in the horizontal Y-direction (sec) (from Formula in code)	=1.64 sec
h)	Total Seismic weight (Sw) of building (kN)	=214635
i)	Static Base-shear in X-direction (as % of Sw)	=1.33%
j)	Static Base-shear in Y-direction (as % of Sw)	=0.99%

k) Table of distribution for static base shear

Story	Load Case	Shear X	Load Case	Shear Y
		kN		kN
Story25	EQX 1	137.1002	EQY 1	102.8252
Story24	EQX 1	498.089	EQY 1	373.5674
Story23	EQX 1	827.7208	EQY 1	620.7912
Story22	EQX 1	1123.9429	EQY 1	842.9585
Story21	EQX 1	1389.3948	EQY 1	1042.0474
Story20	EQX 1	1622.8068	EQY 1	1217.1064
Story19	EQX 1	1828.0481	EQY 1	1371.0374
Story18	EQX 1	2009.1656	EQY 1	1506.8755
Story17	EQX 1	2167.667	EQY 1	1625.7515
Story16	EQX 1	2305.0599	EQY 1	1728.7962
Story15	EQX 1	2422.8522	EQY 1	1817.1405
Story14	EQX 1	2522.5516	EQY 1	1891.915
Story13	EQX 1	2605.6659	EQY 1	1954.2507
Story12	EQX 1	2673.7027	EQY 1	2005.2784
Story11	EQX 1	2728.1699	EQY 1	2046.1287
Story10	EQX 1	2770.5977	EQY 1	2077.9496
Story9	EQX 1	2802.8435	EQY 1	2102.1339
Story8	EQX 1	2826.1883	EQY 1	2119.6425
Story7	EQX 1	2841.8158	EQY 1	2131.3631
Story6	EQX 1	2851.2695	EQY 1	2138.4534
Story5	EQX 1	2856.4658	EQY 1	2142.3506
Story4	EQX 1	2858.2855	EQY 1	2143.7154
Story3	EQX 1	2858.2855	EQY 1	2143.7154
Story2	EQX 1	2858.2855	EQY 1	2143.7154
Story1	EQX 1	2858.2855	EQY 1	2143.7154

l) Max. Deflection at roof level. (mm) = 82mm < (H/500= 166 CL 20.5 IS 456:2000) OK

m) Max. Inter stories drift. / Height = 3.4mm < (CL 7.11.1 IS 1893:2002 PART 1 not exceed 0.004 times stories height) OK

7) Provide following Wind loading details.

a)	Category of building	= 3
b)	Class of building	= C
c)	Basic wind speed in m/sec.	= 39m/sec
d)	Maximum wind pressure(kN/m2)	= NA
e)	Force coefficient	= 0.7,0.5
f)	Wind Base-shear in the horizontal X-direction(kN)	= 1366 KN
g)	Wind Base-shear in the horizontal Y-direction (kN)	= 2396 KN
h)	Gust factor calculations (if Gust-wind applied)	= NA
i)	Details of wind tunnel force data (if applicable)	= NA
j)	Estimated magnitude of wind induced vibrations	= NA
k)	Max. deflection at roof level (mm)	= 45 mm
l)	Max. Inter stories drift	= 2.28 mm

8) Provide following data from Dynamic Analysis.

Modes	Frequency in Hz	Time Period in sec	X-participation	Y-participation
Mode 1	0.311	3.213	0.002681	0.001954
Mode 2	0.359	2.789	63.31	0.05
Mode 3	0.362	2.764	0.05	60.86
Mode 4	1.004	0.996	0.01	0.000148
Mode 5	1.207	0.828	14.53	0.000251
Mode 6	1.349	0.741	0.000253	15.84
Mode 7	1.891	0.529	0.05	7.22E-05
Mode 8	2.423	0.413	7.59	0
Mode 9	2.868	0.349	0.001097	0.03
Mode 10	2.926	0.342	0	8.06
Mode 11	3.825	0.261	3.59	0
Mode 12	4.143	0.241	1.73	0.000246
Mode 13	4.995	0.2	0	5.69
	Summation		90.86	90.54

(Note: Fundamental mode should not be a torsional mode)

9) Provide Table for lateral deflections (mm) at Terrace Level in the following format.

Load Case	Dx-max	H/Dx	Drift-x	Dy-max	H/Dy	Drift-Y
DL	0.282	12411	0.000053	11.2	312.5	0.000212
DL+LL	0.25	14000	0.00061	14.34	244	0.000273
EQx	80.2	43.64	0.00088	17.8	196.62	0.000175
EQy	8.2	426.82	0.00013	67.9	51.54	0.00143
Wx	25.6	136.71	0.000241	0.26	13461	0.000006
Wy	0.043	81395	0.000004	45.818	76	0.000503

10) Provide corner displacements (mm) for Torsional Irregularity (along x-direction) in the following format.

Load Case	Corner-1	Corner-2	Corner-3	Corner-4	Avg-x	%Max./Avg.
Eq-x	80.2	80.2	60	60	70.1	1.14 %
Wl-x	25.6	25.6	25.3	25.3	25.45	1.00 %

11) Provide Corner displacements (mm) for Torsional Irregularity (along z-direction) in the following format.

Load Case	Corner-1	Corner-2	Corner-3	Corner-4	Avg-x	%Max./Avg.
Eq-y	67.9	67.9	39.4	39.4	53.65	1.26 %
Wl-y	45.8	45.8	45.8	45.8	45.8	1.00%

12) Provide acceleration (mg) values in the following format.

Eq-X	Eq-Y	WL-X	WL-Y
100%	100%	100%	100%

13) Provide following data regarding Vertical Elements.

a) Size of maximum loaded column = 600 x 800 m

b) Gravity load on max. loaded column = 5357 KN

c) Axial stress in max. loaded column (Gravity loads) = 11.16 N/mm2

d) Grade of max. loaded column = 35 Mpa

e) Axial settlement in max. loaded column = 2.76mm

f) Axial settlement in min. loaded column = 0.7 mm

g) %Base-shear resisted by all columns along X (static) = 2.97 %

h) %Base-shear resisted by all columns along Z (static) = 4.43 %

14) Provide, if applicable, following data regarding Floating Columns.

a) Total gravity load on floating column (provide table if there are multiple floating columns) =NA

b) Size and span of girders supporting floating columns =NA

c) Number of floors supported by floating columns =NA

d) Deflection of girder under column (from model) =NA

e) Deflection of girder under column (from s/s action) =NA

f) Specific details about floating columns on cantilever girders (Refer Table below)

15) Provide, if applicable, following data regarding soft Story effect.

a) Stiffness of lower floor (in deflection/KN) =NA

b) Stiffness of lower floor (in deflection/KN) =NA

c) Relative stiffness ratio (upper/lower) =NA

d) Level of soft story =NA

e) Number of floors above soft story =NA

16) Provide, if applicable, following data for each cantilever.

a) Cantilever span =NA

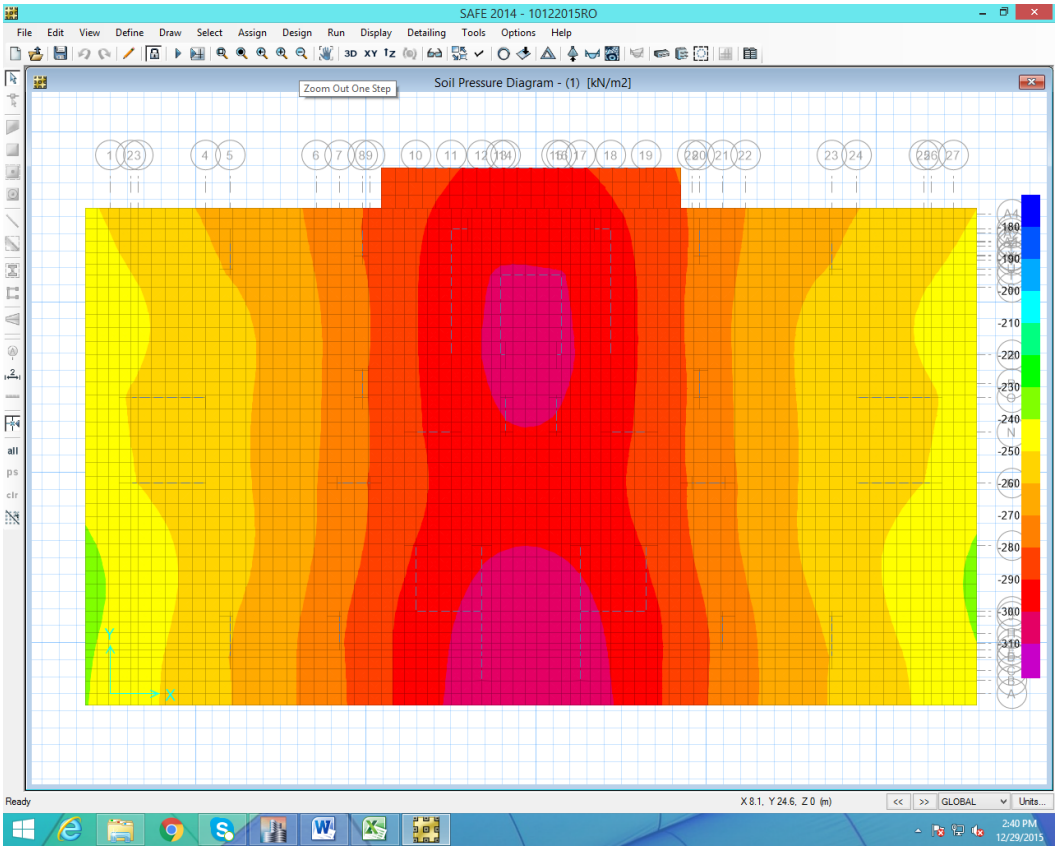
b) Structural system =NA

c) Nature of usage =NA

d) Maximum elastic deflection under gravity loads =NA

17) Provide stability calculations for uplift and overturning (model extract in case of model) =NA

18) Typical design calculations for footings



Soil pressure diagram

19) Typical design calculations for RCC columns

ETABS 2015 Concrete Frame Design

IS 456:2000 Column Section Design(Envelope)

Column Element Details

Level	Element	Section ID	Length (mm)	LLRF
Story4	C3	CL 600X800 M35	4600	0.4

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	600	77.6	45

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	500	500

Design Code Parameters

ɣc	ɣs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	3840	0.8
Bottom	3840	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
	kN	kN-m	kN-m	mm	
Top	3051.6577	-23.9744	85.4464	4000	DWal32
Bottom	3094.8577	103.4623	86.656	0	DWal32

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	0	4000	DWal32
Bottom	886.75	0	0	DWal32

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	665.06	28.9299	4000	DWal32
Bottom	665.06	28.9299	0	DWal32

20) Typical design calculation s for RCC walls

ETABS 2015 Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
Story4	PW11	2552.7	9273	3276.5	300	0.4

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	500	500

Design Code Parameters

γ_S	γ_C	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	914.4	9273	4190.9	9273	3276.5	300
Bottom	Leg 1	914.4	9273	4190.9	9273	3276.5	300

Flexural Design for P_u, M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	5823	0.0059	0.0023	DWal29	11663.4115	-423.2161	1381.1581	982962
Bottom	6572	0.0067	0.0023	DWal29	11832.9724	429.1959	1501.0255	982962

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	DWal29	10129.41	699.1246	-235.3659	464.7595	1174.2017
Bottom	Leg 1	750	DWal29	10298.971	1501.0255	-235.3659	488.13	1197.5723

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	750	DWal29	11663.4115	-532.9768	12.86	7
Top–Right	Leg 1	750	DWal29	11807.7372	107.1924	12.21	7
Bottom–Left	Leg 1	900	DWal29	11832.9724	-1431.6964	14.71	7
Botttom–Right	Leg 1	900	DWal29	11832.9724	1501.0255	14.83	7

21) Typical design calculations for RCC beams

ETABS 2015 Concrete Frame Design

IS 456:2000 Beam Section Design (Envelope)

Beam Element Details

Level	Element	Section ID	Length (mm)	LLRF
Story6	B71	B 230X600 M20	5908.8	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
230	600	230	0	60	60

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
22360.68	20	1	500	500

Design Code Parameters

ɣc	ɣs
1.5	1.15

Flexural Reinforcement for Major Axis Moment, M_{u3}

	End-I Rebar Area mm²	End-I Rebar %	Middle Rebar Area mm²	Middle Rebar %	End-J Rebar Area mm²	End-J Rebar %
Top (+2 Axis)	1460	1.06	365	0.26	1184	0.86
Bot (-2 Axis)	730	0.53	490	0.35	365	0.26

Flexural Design Moment, M_{u3}

	End-I Design M_u kN-m	End-I Station Loc mm	Middle Design M_u kN-m	Middle Station Loc mm	End-J Design M_u kN-m	End-J Station Loc mm
Top (+2 Axis)	-287.0153	0	0	4385.3	-229.3106	5791.5
Combo	DWal29		DWal32		DWal29	
Bot (-2 Axis)	0	0	103.4389	2979.1	21.4145	5908.8
Combo	DWal32		DWal32		DWal32	

Shear Reinforcement for Major Shear, V_{u2}

End-I Rebar A_{sv} /s mm²/m	Middle Rebar A_{sv} /s mm²/m	End-J Rebar A_{sv} /s mm²/m
1085.26	629.94	816.81

Design Shear Force for Major Shear, V_{u2}

End-I Design V_u kN	End-I Station Loc mm	Middle Design V_u kN	Middle Station Loc mm	End-J Design V_u kN	End-J Station Loc mm
235.8997	368.1	144.932	4385.3	183.5886	5791.5

End-I Design V_u kN	End-I Station Loc mm	Middle Design V_u kN	Middle Station Loc mm	End-J Design V_u kN	End-J Station Loc mm
DWal29		DWal28		DWal29	

Torsion Reinforcement

Shear Rebar A_{svt} /s mm²/m
887.84

Design Torsion Force

Design T_u kN-m	Station Loc mm	Design T_u kN-m	Station Loc mm
3.2938	368.1	17.9314	5908.8
DWal29		DWal2	

PROJECT DATA SHEET

UNIT NO._____

DESIGNS (R & B), GANDHINAGAR

Sr. No.	Description			
1.	Name of Project	Jewel Residency (Block B)		
2.	Project file No. (To be filled by Design Circle).			
3.	Project Team (To be filled by Design Circle).	EE	DEE	AE
4.	Project Referred By:			
		Name of Office	Contact Person	Telephone Nos.
(a)	Circle			
(b)	Division			
(c)	Sub-Division			
5.	Consultants of the project:			
(a)	Nature of Consultancy		Architect	Structural Consultant
(b)	Nature of the firm		Pandya Associates	Setu Infrastructure
(c)	Address		Architects and Engineers, 64, sharda Nagar, Paldi, Ahmedabad – 380007	308,Abhishilp Complex, B/h. Puja Party Plot, Judges Bungalow Road, off. 132 ft. Ring Road, Vastrapur, Ahmedabad - 380015.
(d)	Authorized Representative			
(e)	Telephone, Fax, E-mail		079 26633666	07940037661/26751800 Email: setuinf@gmail.com
6. (a)	Nature of Project		New Construction -Residential	
7. (a)	Work order office letter outward No. with date		01 August 2015	
(b)	Stipulated date of starting work as per agreement		01 September 2015	
(c)	Stipulated date of completion of work as per agreement.		29 February 2016	

8.	**Details of Building**	
(a)	**Type**	Load Frame
(b) i	**[1]As per AMC Submission Plan* Total floor area in m^2 including Basement Built up Area**	23446.24 m^2
ii	**As per Structural Design** Total floor area in m^2 including Basement Built up Area**	24010.87 m^2 (Additional 564.63 Sq. Mt Built up added for 20th Floor)
(c) i	**Total height from Basement to Top in m [2]As per AMC Plan***	{[3rd B + 2nd B + 1st B]+ [Plinth + GF + FF] + [2nd to 15th floor] + [16th to 19th floor] + + [SC + LMR + OHWT + Air Antenna] = Total Height
		{[4.650 mt + 3.45 mt + 4.05 mt] + [0.45 mt +4.50 mt +3.45 mt]+ [44.10 mt (3.15 mt x 14 floor)] + [13.80 mt (3.45 mt x 4 floor] + [8.42 mt]} = 86.87mt
ii	**Total height from Basement to Top in m As per structural Design****	{[3rd B + 2nd B + 1st B]+ [Plinth + GF + FF] + [2nd to 16th floor] + [17th to 20th floor] + [SC + LMR + OHWT + Air Antenna] = Total Height
		{[4.650 mt + 3.45 mt + 4.05 mt] + [0.45 mt +4.50 mt +3.45 mt]+ [47.25 mt (3.15 mt x 15 floor)] + [13.80 mt (3.45 mt x 4 floor] + [8.42 mt]} = 90.02
iii	**Total height from GL in m As per AMC Plan***	[Plinth + GF + FF] + [2nd to 15th floor] + [16th to 19th floor] + + [SC + LMR + OHWT + Air Antenna] = Total Height
		[0.45 mt +4.50 mt +3.45 mt]+ [44.10 mt (3.15 mt x 14 floor)] + [13.80 mt (3.45 mt x 4 floor] + [8.42 mt]} = 74.72mt

*As per AMC Submission plan there is 3B+G+19 stories building.

** As consideration of future expansion & with consideration to Use of Extra chargeable FSI & or TDR bases development plan we have structurally design this building for 3B+G+20 stories

iv.	**Total height from GL in m** **As per structural Design**[3]**	[Plinth + GF + FF] + [2nd to 16th floor] + [17th to 20th floor] + [SC + LMR + OHWT + Air Antenna] = Total Height
		[0.45 mt +4.50 mt +3.45 mt]+ [47.25 mt (3.15 mt x 15 floor)] + [13.80 mt (3.45 mt x 4 floor]+ [8.42 mt]} = 77.87m
(d)	**No. of stories ; As per AMC Plan***	3B+G+19
	As per Structural Design **	3B+G+20
(e)	**Base dimension bx in m**	38
(f)	**Base dimension bz in m**	21.4
9.	**Exposure condition:**	
(a)	**Type**	Moderates
(b)	**Minimum Grade of RCC**	M20
(c)	**Minimum Grade of PCC**	M15
10.	**Fire Resistance Rating in Hours.**	
(a)	**Building height Up to 15 m.**	1 Hour
(b)	**Building height more than 15 m.**	2 Hour
11.	**Nominal Cover (Clear cover) in mm (To main reinforcement considering exposure condition & fire resistance**	
(a)	**Footing**	50
(b)	**Column**	40
(c)	**Beam below Ground level**	20
(d)	**Beam above Ground level**	30
(e)	**Slab**	25
12.	**Dead Loads:**	
(a)	**Earth**	18.00 KN/m^3
(b)	**Water**	10.00 KN/m^3
Brick masonry with plaster/finish on both faces		
(c)	**115 Thk.**	2.90 KN/m^3
(d)	**230 mm Thk.**	5.30 KN/m^3
(e)	**350 mm Thk.**	7.70 KN/m^3
(f)	**PCC**	24.0 KN/m^3
(g)	**RCC**	25.0 KN/m^3
13.	**Imposed loads (As per IS:875-1987)**	
(a)	**Occupancy**	Imposed load (in KN/m^2)
	Basement Parking Area	3 KN/m^2
	Shops Area	3 KN/m^2
	Typical Storey	2 KN/m^2
	Staircase + Foyer	3 KN/m^2
(b)	**Roof load:-** **Accessible**	1.5 KN/m^2

[3] *As per AMC Submission plan there is 3B+G+19 stories building.

** As consideration of future expansion & with consideration to Use of Extra chargeable FSI & or TDR bases development plan we have structurally design this building for 3B+G+20 stories

(c)	**Roof load:-** **Not accessible** **Slope Angle.**	KN/m^2
(d)	**Water Tank:**	
	(i) Type	PVC/RCC
	(ii) Capacity in Liters	25000 Liters
	(iii) Height in m	4048.76mm
	(iv) Diameter in m	2999.74mm
	(v) Nos. & position	2 tanks
14.	**Earthquake Load Date:**	
(a)	**Earthquake Zone**	III
(b)	**Zone Factor 'Z'**	0.16
(c)	**Importance Factor 'I'**	1.0
(d)	**Response Reduction Factor 'R'**	5
(e)	**Natural Period:** **Tx (Sec.)**	1.64
(f)	**Natural Period:** **Ty (Sec.)**	1.23
(g)	**Live Load Reduction Factor**	0.25,0.5
(h)	**Docility detailing as per IS:13920-1993**	Yes
15	**Soil Data:**	
(a)	**Soil Report No. & Date**	ST/14/09/6663
(b)	**Depth of foundation below GL**	12 m
(c)	**SBC**	31 T / m^2
(d)	**Type of soil**	Medium
(e)	**N-value**	60

CERTIFICATE

It is hereby certified that the building Structure of Project Jewel Residency has been designed for following:

(A) Latest revision/amendments of following IS Codes considered in the design:

(1) IS:456-2000	…	Yes
(2) IS:1893-2002	…	Yes
(3) IS:13920-1993	…	Yes
(4) IS:4326-1993	…	No
(5) IS:875-1987	…	Yes

(B) SBC, N-Value and foundation depth are taken as per the Soil Report No. ST/14/09/6663 Dt. Sept. - 2014 prepared by K.C.T. Consultancy Services.

(C) The design is based on the sound engineering practice and undersigned are solely responsible for the correctness of design and soundness, durability & strength of the structure.

Contractor Consultant signed in my presence
(Executive Engineer)
Div._____

Name: _____ Name: _____ Name: _____

Sign: _____ Sign: _____ Sign: _____