DESIGN BASIS REPORT

FOR ACME OZONE

Proposed Sale Buildings
Tower EUCALYPTIA & FENELIA

At
Manpada, Thane

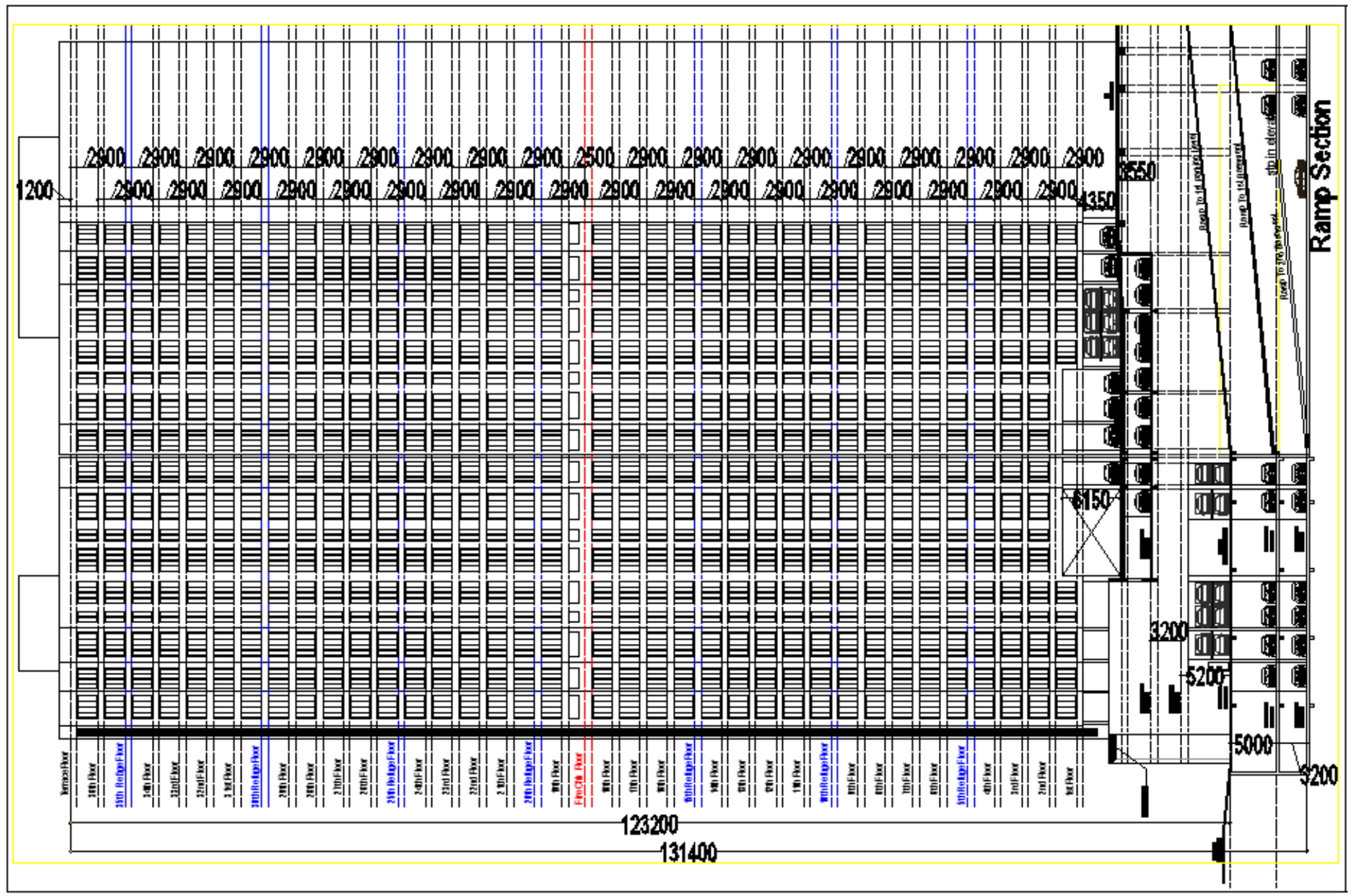
SUMMARY OF INFORMATION
APPENDIX – A
PROJECT PERSONNEL ON RECORD AND CONTACT INFORMATION

1	Project Reference No. (HRC Folio No)	HRB –
2	Municipal Reference No. (Building Proposal Ref. / File No.)	V.P. No. 88/142 TMC/TDD
3	Project Name	**ACME OZONE**
4	Project Address	PROPOSED BUILDINGS ON LAND BEARING GUT.NO. 61/1/1,2,3,4, 61/2/1,2,3 VILLAGE CHITALSAR - MANPADA, TALUKA DIST. THANE.
5	Project Proponent / Developer's Name	ACME HOUSING INDIA PVT. LTD.
6	Project Proponent / Developer's Address	5th Floor, Building No. 10., Solitaire Corporate Park, Chakala, Andheri (E) Mumbai 400093
7	Project Proponent / Developer's Telephone / Mobile / email address	022-67570000 & 28258345
8	Architect's Name, qualifications & License No.	Ar. Subhash Gupte, SCAPES
9	Architect's Address	Gupte Cottage, Opposite Bhakti Mandir, Panchapakhadi, Thane (W). Mumbai - 400602
10	Architect's Telephone / Mobile / email address	Tel. - 2538 5855 / Fax - 2534 5014. Email: mails@scapesarth.com
11	Structural Engineer's Name, Qualifications & License No	Mr. A. N. Watve B.E. F.I.E. Structural Engineer M.C.G.B. Reg.No.Str/W/10
12	Structural Engineer's Address	M/S JW Consultants LLP Sai Radhe, Office No 201.2nd Fl,100 Kennedy Road, Behind Hotel Sheraton Grand, Pune 411001
13	Structural Engineer's Telephone/ Mobile / Email address	Tel: 020 – 66449100 Email: watve@jwconsultant.in
14	Geotechnical Consultant's Name and qualifications	Mr. Jaideep Wagh B.E,M.S, P.E (Geotechnical)
15	Geotechnical Consultant's Address	45, Casa Luna Building, 1st floor, L.J.Road No.1, Mahim (W) Mumbai – 400 016.
16	Geotechnical Consultant's Telephone / Mobile / Email address	Tel : - 24448985 Mobile : - 9820094574 Email : - geocon6@hotmail.com
17	M.E.P. Consultant's Name, Address, License No & Signature	Pankaj Dharkar & Associates 302, Trade Avenue 260 Suren Road Andheri (E) Mumbai - 400093
18	M.E.P. Consultant's Telephone / Mobile / Email address	Off- 2683 7283, mumbai@pdamepconsultants.com

DESIGN DATA

STRUCTURAL INFORMATION

BUILDING SECTION



1) STRUCTURAL RELATED GENERAL INFORMATION

Total No. of floors	43 floor slabs Basement 2 + Basement 1 + Ground + Podium 1 + Podium 2 + Stilt + 36 Typical Residential floors (including refuge) + 1 Fire Check + Terrace.
• No of basements floors with height	2 Basement 2 = 3.5m, Basement 1 = 5.0m.
• Ground floor	Height of floor - 5.20m
• Number of podium Floors along with height of floor	2 1st floor = 3.20 m 2nd floor = 3.55 m
• Number of Residential Floors	36 1st to 36th Typical floors = 2.9 m
• Number of Refuge Floors	7 5th, 10th, 15th , 20th , 25th , 30th & 35th Part refuge floors Height of Floor = 2.9 m.

2) LIST OF CODES

I. IS 456 – 2000 - Plain and reinforced concrete- code of practice

II. IS 1893 – (Part I) – 2016 Criteria for earthquake resistant design of structures.

Part 1 General Provisions and buildings.

III. IS 875 – (Part –I) – 1987 edition 3.1(1997-12) Code of practice for design loads (other than earthquake) for buildings and structures- Dead loads

IV. IS 875 – (Part- II) – 1987 - reaffirmed 1997) Code of practice for design loads (other than earthquake) for buildings and structures.- Imposed loads

V. IS 875 – (Part – III) –2015 - reaffirmed 1997) Code of practice for design loads (other than earthquake) for buildings and structures.- Wind loads

VI. IS 875 – (Part – V) -1987- reaffirmed 1997) Code of practice for design loads (other than earthquake) for buildings and structures.- special loads and load combinations.

VII. IS 13920 – 2016 - Ductile detailing of reinforced concrete structures subjected to seismic forces- code of practice.

VIII. IS 16700 – 2017 – Criteria for Structural Safety of Tall Concrete Buildings.

3) LOADING PARAMETERS

3.1 MATERIAL DENSITY

No.	Material	Density (kN/m^3)
1	Reinforced Concrete	25
2	Steel	78.5
3	Mortar below Floor Finishes	20
4	Flooring	26.5
5	Glass	25
6	Brick bat water proofing	20
7	AAC Block work	8

3.2 DEAD LOADS AND LIVE LOADS ON DIFFERENT UNITS OF STRUCTURE AS FOLLOWS

a) Typical Residential Floors
Self-Weight - slab = 25x slab thickness KN/m^2
Superimposed Dead Load
Floor Finishes = 1.00 KN/m^2
Live Load = 2.00 KN/m^2

b) Core Area / Corridors / Lobby
Self-Weight - slab = 25x slab thickness
Superimposed Dead Load
Floor Finishes = 1.50 KN/m^2
Total Superimposed Dead Load = 1.5 KN/m^2
Live Load = 3.00 KN/m^2

c) Staircase
Self-Weight - slab = 25x slab thickness
Superimposed Dead Load
Floor Finishes = 3.375KN/m^2
Live Load = 3.00 KN/m^2

d) Wet Area / Toilets
Self-Weight - slab = 25x slab thickness
Superimposed Dead Load
200 mm Sunk
Filling load = 4.00 KN/m^2
Total Superimposed Dead Load =2.35 KN/m^2
Live Load = 2.00 KN/m^2

e) For Part Refuge Floors
Self-Weight - slab = 25x slab thickness
Superimposed Dead Load
Floor Finishes = 1.00 KN/m^2
Total Superimposed Dead Load = 1.00 KN/m^2
Live Load = 3.0 KN/m^2

f) For Terrace Floors
Self-Weight - slab = 25x slab thickness
Superimposed Dead Load
Floor Finishes with water proofing = 3.0 KN/m^2
Total Superimposed Dead Load = 3.0 KN/m^2
Live Load = 3.00 KN/m^2

3.3 NOMINAL COVER
Fire rating considered: - 2 Hours

No.	Concrete Element	Nominal Cover as per Environmental Exposure Conditions		
		Mild	Moderate	Severe
1	Footings	50	50	50
2	Columns & walls >200mm width (to links of column)	40	40	45
3	Columns & walls with width 200mm & below having reinf. of dia. 16mm and above(to links of column)	40	40	45
4	Columns & walls with width 200mm & below having reinf. of dia. 12mm (to links of columns)	25	30	45
5	Slabs	20	30	45
6	Beams (to stirrups of beams)	20	30	45
7	Lift walls	40	40	45

3.4. GRADE OF CONCRETE AND STEEL FOR STRUCTURAL MEMBERS

i) Grade of concrete

Foundation = M40

SL.NO	LEVELS	WALL	COLUMN	BEAMS/SLABS
1	Foundation to 3rd Typical floor	M60	M60	M40
2	3rd to 10th Typical floor	M50	M50	M40
2	10th to Terrace floor	M40	M40	M30

ii) Grade of Steel = Fe500 High Strength deformed Steel bars produced by thermo-mechanical treatment process having elongation more than 14.5 % and conforming to IS 1786. (As per Clause 5.3.1.b, Page No. 4, IS 13920:2016)

3.5. ENVIRONMENTAL EXPOSURE CONDITIONS

As per exposure conditions given in IS 456:2000

Sub Structure:

All Substructure elements — Moderate

Super Structure:

All external columns and peripheral beams- Moderate

All internal columns, beams and floor slabs- Moderate

3.6. CONSTRUCTION SEQUENCE AND LOADING PARAMETERS

Construction to be done in single phase

3.7. PROPOSED APPROACH TO STRUCTURAL ANALYSIS

I. ETABs – 17.0 -software is used for analysis.
II. SAFE – 16.0 - software is used for raft foundation.

3.8. LIST OF DESIGN LOAD COMBINATIONS AS PER IS: 875(PART-5)

FOR EUCALYPTIA:-

Ref.No.	Analysis No.	Load Case
1	(0.9DL+1.5SPEC1+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +1.5 (SPEC1) +0.45 (SPEC3)
2	(0.9DL-1.5SPEC1-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -1.5 (SPEC1) -0.45 (SPEC3)
3	(0.9DL+1.5SPEC1-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +1.5 (SPEC1) -0.45 (SPEC3)
4	(0.9DL-1.5SPEC1+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -1.5 (SPEC1) +0.45 (SPEC3)
5	(0.9DL+1.5SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +0.45 (SPEC3) +1.5 (SPEC2)
6	(0.9DL-1.5SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -0.45 (SPEC3) -1.5 (SPEC2)
7	(0.9DL+1.5SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -0.45 (SPEC3) +1.5 (SPEC2)
8	(0.9DL-1.5SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +0.45 (SPEC3) -1.5 (SPEC2)
9	(0.9DL+1.5SPEC1+0.45SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +1.5 (SPEC1) +0.45 (SPEC3) +0.45 (SPEC2)
10	(0.9DL+1.5SPEC1-0.45SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +1.5 (SPEC1) +0.45 (SPEC3) -0.45 (SPEC2)
11	(0.9DL+1.5SPEC1+0.45SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +1.5 (SPEC1) -0.45 (SPEC3) +0.45 (SPEC2)
12	(0.9DL+1.5SPEC1-0.45SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +1.5 (SPEC1) -0.45 (SPEC3) -0.45 (SPEC2)
13	(0.9DL-1.5SPEC1+0.45SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -1.5 (SPEC1) +0.45 (SPEC3) +0.45 (SPEC2)
14	(0.9DL-1.5SPEC1-0.45SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -1.5 (SPEC1) +0.45 (SPEC3) -0.45 (SPEC2)
15	(0.9DL-1.5SPEC1+0.45SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -1.5 (SPEC1) -0.45 (SPEC3) +0.45 (SPEC2)
16	(0.9DL-1.5SPEC1-0.45SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -1.5 (SPEC1) -0.45 (SPEC3) -0.45 (SPEC2)
17	(0.9DL+0..45SPEC1+1.5SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +0.45 (SPEC1) +0.45 (SPEC3) +1.5 (SPEC2)
18	(0.9DL+0.45SPEC1-1.5SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +0.45 (SPEC1) +0.45 (SPEC3) -1.5 (SPEC2)
19	(0.9DL+0.45SPEC1+1.5SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +0.45 (SPEC1) -0.45 (SPEC3) +1.5 (SPEC2)
20	(0.9DL+0.45SPEC1-1.5SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +0.45 (SPEC1) -0.45 (SPEC3) -1.5 (SPEC2)
21	(0.9DL-0.45SPEC1+1.5SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -0.45 (SPEC1) +0.45 (SPEC3) +1.5 (SPEC2)
22	(0.9DL-0.45SPEC1-1.5SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -0.45 (SPEC1) +0.45 (SPEC3) -1.5 (SPEC2)
23	(0.9DL-0.45SPEC1+1.5SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -0.45 (SPEC1) -0.45 (SPEC3) +1.5 (SPEC2)
24	(0.9DL-0..45SPEC1-1.5SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -0.45 (SPEC1) -0.45 (SPEC3) -1.5 (SPEC2)
25	(0.9DL+1.5WX)	0.9 (DEAD) +0.9 (SDL) +1.5 (WX)
26	(0.9DL-1.5WX)	0.9 (DEAD) +0.9 (SDL) -1.5 (WX)
27	(0.9DL+1.5WY)	0.9 (DEAD) +0.9 (SDL) +1.5 (WY)
28	(0.9DL-1.5WY)	0.9 (DEAD) +0.9 (SDL) -1.5 (WY)
29	(1.2DL+1.2LL+1.2SPEC1+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (SPEC1) +0.36 (SPEC3)
30	(1.2DL+1.2LL-1.2SPEC1-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) -0.36 (SPEC3)
31	(1.2DL+1.2LL+1.2SPEC1-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (SPEC1) -0.36 (SPEC3)
32	(1.2DL+1.2LL-1.2SPEC1+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) +0.36 (SPEC3)
33	(1.2DL+1.2LL+1.2SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC3) +1.2 (SPEC2)
34	(1.2DL+1.2LL-1.2SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -0.36 (SPEC3) -1.2 (SPEC2)
35	(1.2DL+1.2LL+1.2SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -0.36 (SPEC3) +1.2 (SPEC2)
36	(1.2DL+1.2LL-1.2SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC3) -1.2 (SPEC2)
37	(1.2DL+1.2LL+1.2SPEC1+0.36SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (SPEC1) +0.36 (SPEC3) +0.36 (SPEC2)
38	(1.2DL+1.2LL+1.2SPEC1-0.36SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (SPEC1) +0.36 (SPEC3) -0.36 (SPEC2)
39	(1.2DL+1.2LL+1.2SPEC1+0.36SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (SPEC1) -0.36 (SPEC3) +0.36 (SPEC2)
40	(1.2DL+1.2LL+1.2SPEC1-0.36SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (SPEC1) -0.36 (SPEC3) -0.36 (SPEC2)
41	(1.2DL+1.2LL-1.2SPEC1+0.36SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) +0.36 (SPEC3) +0.36 (SPEC2)
42	(1.2DL+1.2LL-1.2SPEC1-0.36SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) +0.36 (SPEC3) -0.36 (SPEC2)

43	(1.2DL+1.2LL-1.2SPEC1+0.36SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) -0.36 (SPEC3) +0.36 (SPEC2)
44	(1.2DL+1.2LL-1.2SPEC1-0.36SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) -0.36 (SPEC3) -0.36 (SPEC2)
45	(1.2DL+1.2LL+0.36SPEC1+1.2SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC1) +0.36 (SPEC3) +1.2 (SPEC2)
46	(1.2DL+1.2LL+0.36SPEC1-1.2SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC1) +0.36 (SPEC3) -1.2 (SPEC2)
47	(1.2DL+1.2LL+0.36SPEC1+1.2SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC1) -0.36 (SPEC3) +1.2 (SPEC2)
48	(1.2DL+1.2LL+0.36SPEC1-1.2SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC1) -0.36 (SPEC3) -1.2 (SPEC2)
49	(1.2DL+1.2LL-0.36SPEC1+1.2SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -0.36 (SPEC1) +0.36 (SPEC3) +1.2 (SPEC2)
50	(1.2DL+1.2LL-0.36SPEC1-1.2SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC1) +0.36 (SPEC3) +1.2 (SPEC2)
51	(1.2DL+1.2LL-0.36SPEC1+1.2SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC1) +0.36 (SPEC3) -1.2 (SPEC2)
52	(1.2DL+1.2LL-0.36SPEC1-1.2SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC1) -0.36 (SPEC3) +1.2 (SPEC2)
53	(1.2DL+1.2LL+1.2WX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (WX)
54	(1.2DL+1.2LL-1.2WX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (WX)
55	(1.2DL+1.2LL+1.2WY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (WY)
56	(1.2DL+1.2LL-1.2WY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (WY)
57	(1.2DL+1.2LL+1.2GWX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (GWX)
58	(1.2DL+1.2LL-1.2GWX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (GWX)
59	(1.2DL+1.2LL+1.2GWY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (GWY)
60	(1.2DL+1.2LL-1.2GWY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (GWY)
61	(1.5DL+1.5SPEC1+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) +0.45 (SPEC3)
62	(1.5DL-1.5SPEC1-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -1.5 (SPEC1) -0.45 (SPEC3)
63	(1.5DL+1.5SPEC1-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) -0.45 (SPEC3)
64	(1.5DL-1.5SPEC1+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -1.5 (SPEC1) +0.45 (SPEC3)
65	(1.5DL+1.5SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC3) +1.5 (SPEC2)
66	(1.5DL-1.5SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -0.45 (SPEC3) -1.5 (SPEC2)
67	(1.5DL+1.5SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -0.45 (SPEC3) +1.5 (SPEC2)
68	(1.5DL-1.5SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC3) -1.5 (SPEC2)
69	(1.5DL+1.5SPEC1+0.45SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) +0.45 (SPEC3) +0.45 (SPEC2)
70	(1.5DL+1.5SPEC1-0.45SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) +0.45 (SPEC3) -0.45 (SPEC2)
71	(1.5DL+1.5SPEC1+0.45SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) -0.45 (SPEC3) +0.45 (SPEC2)
72	(1.5DL+1.5SPEC1-0.45SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) -0.45 (SPEC3) -0.45 (SPEC2)
73	(1.5DL-1.5SPEC1+0.45SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -1.5 (SPEC1) +0.45 (SPEC3) +0.45 (SPEC2)
74	(1.5DL-1.5SPEC1-0.45SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -1.5 (SPEC1) +0.45 (SPEC3) -0.45 (SPEC2)
75	(1.5DL-1.5SPEC1+0.45SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -1.5 (SPEC1) -0.45 (SPEC3) +0.45 (SPEC2)
76	(1.5DL-1.5SPEC1-0.45SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -1.5 (SPEC1) -0.45 (SPEC3) -0.45 (SPEC2)
77	(1.5DL+0.45SPEC1+1.5SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC1) +0.45 (SPEC3) +1.5 (SPEC2)
78	(1.5DL+0.45SPEC1-1.5SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC1) +0.45 (SPEC3) -1.5 (SPEC2)
79	(1.5DL+0.45SPEC1+1.5SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC1) -0.45 (SPEC3) +1.5 (SPEC2)
80	(1.5DL+0.45SPEC1-1.5SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC1) -0.45 (SPEC3) -1.5 (SPEC2)
81	(1.5DL-0.45SPEC1+1.5SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -0.45 (SPEC1) +0.45 (SPEC3) +1.5 (SPEC2)
82	(1.5DL-0.45SPEC1-1.5SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -0.45 (SPEC1) +0.45 (SPEC3) -1.5 (SPEC2)
83	(1.5DL-0.45SPEC1+1.5SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -0.45 (SPEC1) -0.45 (SPEC3) +1.5 (SPEC2)
84	(1.5DL-0.45SPEC1-1.5SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -0.45 (SPEC1) -0.45 (SPEC3) -1.5 (SPEC2)
85	(1.5DL+1.5WX)	1.5 (DEAD) +1.5 (SDL) +1.5 (WX)
86	(1.5DL-1.5WX)	1.5 (DEAD) +1.5 (SDL) -1.5 (WX)
87	(1.5DL+1.5WY)	1.5 (DEAD) +1.5 (SDL) +1.5 (WY)
88	(1.5DL-1.5WY)	1.5 (DEAD) +1.5 (SDL) -1.5 (WY)
89	(1.5DL+1.5GWX)	1.5 (DEAD) +1.5 (SDL) +1.5 (GWX)
90	(1.5DL-1.5GWX)	1.5 (DEAD) +1.5 (SDL) -1.5 (GWX)
91	(1.5DL+1.5GWY)	1.5 (DEAD) +1.5 (SDL) +1.5 (GWY)

92	(1.5DL-1.5GWY)	1.5 (DEAD) +1.5 (SDL) -1.5 (GWY)
93	(1.5DL+1.5LL)	1.5 (DEAD) +1.5 (SDL) +1.5 (LIVE) +1.5 (LIVE1) +1.5 (LIVE2)

FOR FENELIA:-

Ref.No.	Analysis No.	Load Case
1	(0.9DL+1.5SPEC1+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +1.5 (SPEC1) +0.45 (SPEC3)
2	(0.9DL-1.5SPEC1-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -1.5 (SPEC1) -0.45 (SPEC3)
3	(0.9DL+1.5SPEC1-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +1.5 (SPEC1) -0.45 (SPEC3)
4	(0.9DL-1.5SPEC1+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -1.5 (SPEC1) +0.45 (SPEC3)
5	(0.9DL+1.5SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +0.45 (SPEC3) +1.5 (SPEC2)
6	(0.9DL-1.5SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -0.45 (SPEC3) -1.5 (SPEC2)
7	(0.9DL+1.5SPEC2-0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) -0.45 (SPEC3) +1.5 (SPEC2)
8	(0.9DL-1.5SPEC2+0.45SPEC3)	0.9 (DEAD) +0.9 (SDL) +0.45 (SPEC3) -1.5 (SPEC2)
9	(0.9DL+1.5WX)	0.9 (DEAD) +0.9 (SDL) +1.5 (WX)
10	(0.9DL-1.5WX)	0.9 (DEAD) +0.9 (SDL) -1.5 (WX)
11	(0.9DL+1.5WY)	0.9 (DEAD) +0.9 (SDL) +1.5 (WY)
12	(0.9DL-1.5WY)	0.9 (DEAD) +0.9 (SDL) -1.5 (WY)
13	(0.9DL+1.5WX+1.5AWXY)	0.9 (DEAD) +0.9 (SDL) +1.5 (AWXY) +1.5 (WX)
14	(0.9DL-1.5WX-1.5AWXY)	0.9 (DEAD) +0.9 (SDL) -1.5 (AWXY) -1.5 (WX)
15	(0.9DL+1.5WX-1.AWXY)	0.9 (DEAD) +0.9 (SDL) -1.5 (AWXY) +1.5 (WX)
16	(0.9DL-1.5WX+1.5AWXY)	0.9 (DEAD) +0.9 (SDL) +1.5 (AWXY) -1.5 (WX)
17	(0.9DL+1.5WY+1.5AWYX)	0.9 (DEAD) +0.9 (SDL) +1.5 (AWYX) +1.5 (WY)
18	(0.9DL-1.5WY-1.5AWYX)	0.9 (DEAD) +0.9 (SDL) -1.5 (AWYX) -1.5 (WY)
19	(0.9DL+1.5WY-1.5AWYX)	0.9 (DEAD) +0.9 (SDL) -1.5 (AWYX) +1.5 (WY)
20	(0.9DL-1.5WY+1.5AWYX)	0.9 (DEAD) +0.9 (SDL) +1.5 (AWYX) -1.5 (WY)
21	(1.2DL+1.2LL+1.2SPEC1+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (SPEC1) +0.36 (SPEC3)
22	(1.2DL+1.2LL-1.2SPEC1-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) -0.36 (SPEC3)
23	(1.2DL+1.2LL+1.2SPEC1-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (SPEC1) -0.36 (SPEC3)
24	(1.2DL+1.2LL-1.2SPEC1+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) +0.36 (SPEC3)
25	(1.2DL+1.2LL+1.2SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC3) +1.2 (SPEC2)
26	(1.2DL+1.2LL-1.2SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -0.36 (SPEC3) -1.2 (SPEC2)
27	(1.2DL+1.2LL+1.2SPEC2-0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -0.36 (SPEC3) +1.2 (SPEC2)
28	(1.2DL+1.2LL-1.2SPEC2+0.36SPEC3)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +0.36 (SPEC3) -1.2 (SPEC2)
29	(1.2DL+1.2LL+1.2WX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (WX)
30	(1.2DL+1.2LL-1.2WX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (WX)
31	(1.2DL+1.2LL+1.2WY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (WY)
32	(1.2DL+1.2LL-1.2WY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (WY)
33	(1.2DL+1.2LL+1.2WX+1.2AWXY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (AWXY) +1.2 (WX)
34	(1.2DL+1.2LL-1.2WX-1.2AWXY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (AWXY) -1.2 (WX)
35	(1.2DL+1.2LL+1.2WX-1.2AWXY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (AWXY) +1.2 (WX)
36	(1.2DL+1.2LL-1.2WX+1.2AWXY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (AWXY) -1.2 (WX)
37	(1.2DL+1.2LL+1.2WY+1.2AWYX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (AWYX) +1.2 (WY)
38	(1.2DL+1.2LL-1.2WY-1.2AWYX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (AWYX) -1.2 (WY)
39	(1.2DL+1.2LL+1.2WY-1.2AWYX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (AWYX) +1.2 (WY)
40	(1.2DL+1.2LL-1.2WY+1.2AWYX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (AWYX) -1.2 (WY)
41	(1.2DL+1.2LL+1.2GWX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (GWX)
42	(1.2DL+1.2LL-1.2GWX)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (GWX)
43	(1.2DL+1.2LL+1.2GWY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) +1.2 (GWY)
44	(1.2DL+1.2LL-1.2GWY)	1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (GWY)
45	(1.5DL+1.5SPEC1+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) +0.45 (SPEC3)
46	(1.5DL-1.5SPEC1-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -1.5 (SPEC1) -0.45 (SPEC3)
47	(1.5DL+1.5SPEC1-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) -0.45 (SPEC3)
48	(1.5DL-1.5SPEC1+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -1.5 (SPEC1) +0.45 (SPEC3)
49	(1.5DL+1.5SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC3) +1.5 (SPEC2)
50	(1.5DL-1.5SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -0.45 (SPEC3) -1.5 (SPEC2)
51	(1.5DL+1.5SPEC2-0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) -0.45 (SPEC3) +1.5 (SPEC2)
52	(1.5DL-1.5SPEC2+0.45SPEC3)	1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC3) -1.5 (SPEC2)
53	(1.5DL+1.5WX)	1.5 (DEAD) +1.5 (SDL) +1.5 (WX)
54	(1.5DL-1.5WX)	1.5 (DEAD) +1.5 (SDL) -1.5 (WX)
55	(1.5DL+1.5WY)	1.5 (DEAD) +1.5 (SDL) +1.5 (WY)
56	(1.5DL-1.5WY)	1.5 (DEAD) +1.5 (SDL) -1.5 (WY)
57	(1.5DL+1.5WX+1.5AWXY)	1.5 (DEAD) +1.5 (SDL) +1.5 (AWXY) +1.5 (WX)
58	(1.5DL-1.5WX-1.5AWXY)	1.5 (DEAD) +1.5 (SDL) -1.5 (AWXY) -1.5 (WX)
59	(1.5DL+1.5WX-1.5AWXY)	1.5 (DEAD) +1.5 (SDL) -1.5 (AWXY) +1.5 (WX)
60	(1.5DL-1.5WX+1.5AWXY)	1.5 (DEAD) +1.5 (SDL) +1.5 (AWXY) -1.5 (WX)
61	(1.5DL+1.5WY+1.5AWYX)	1.5 (DEAD) +1.5 (SDL) +1.5 (AWYX) +1.5 (WY)
62	(1.5DL-1.5WY-1.5AWYX)	1.5 (DEAD) +1.5 (SDL) -1.5 (AWYX) -1.5 (WY)
63	(1.5DL+1.5WY-1.5AWYX)	1.5 (DEAD) +1.5 (SDL) -1.5 (AWYX) +1.5 (WY)
64	(1.5DL-1.5WY+1.5AWYX)	1.5 (DEAD) +1.5 (SDL) +1.5 (AWYX) -1.5 (WY)
65	(1.5DL+1.5GWX)	1.5 (DEAD) +1.5 (SDL) +1.5 (GWX)
66	(1.5DL-1.5GWX)	1.5 (DEAD) +1.5 (SDL) -1.5 (GWX)
67	(1.5DL+1.5GWY)	1.5 (DEAD) +1.5 (SDL) +1.5 (GWY)

68	(1.5DL-1.5GWY)	1.5 (DEAD) +1.5 (SDL) -1.5 (GWY)
69	(1.5DL+1.5LL)	1.5 (DEAD) +1.5 (SDL) +1.5 (LIVE) +1.5 (LIVE1) +1.5 (LIVE2)

3.9. SOIL PROFILE IN BRIEF

Geo technical investigation report is attached herewith.

3.10. SOIL RETENTION SYSTEM

RCC Retaining Wall

3.11. EXPANSION JOINT/SEPARATION JOINT

300 mm Separation Joint

CHECK LIST

EUCALYPTIA

LIST FOR THE MAIN STRUCTURAL CONSULTANT

1.	Design Basis Report as per the document HRC/DBR/V1.0.	
2.	Description of Sub-structure and Super-structure as per the format given in the Appendix enclosed.	43 floor slabs Basement 2 + Basement 1 + Ground + Podium 1 + Podium 2 + Stilt + 36 Typical Residential floors (including refuge) + 1 Fire Check + Terrace.
3.	Brief Description of structural system with sketches, image of drg. Etc. with specific focus on 'Lateral load resisting system'	Ductile RCC Shear walls with Non-Ductile Beam Structure
4.	Brief note on modeling, software used etc. Clearly mentioned whether infill/ partition wall is idealized as part of lateral load system?	Building is modeled in ETAB 17.0 version infill and partition walls are not modeled. Entire structure in 3 Dimensions provides lateral load resisting system.
5.	Method of Analysis	Analysis is done by Response Spectrum Method.
6.	Earthquake parameter	
a)	Zone Factor	Z = 0.16
b)	Importance factor	I = 1.2
c)	Response Reduction factor	R = 4.0 (IS 1893:2016)
d)	Soil Type	Hard
e)	% LL considered in seismic	25% up to 3 kN/m2 & 50% above 3 kN/m2

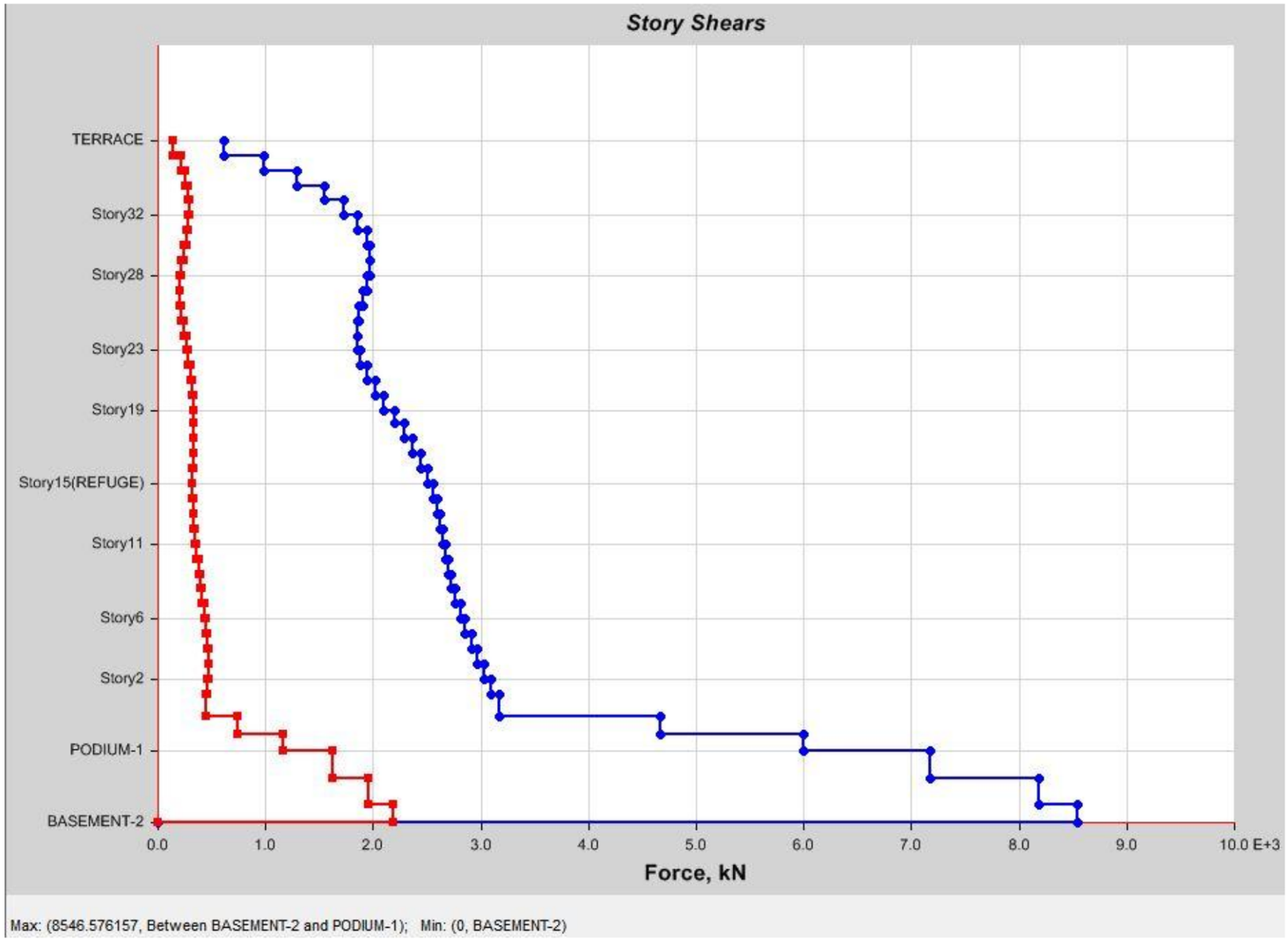
f)	Time Period in the horizontal X-direction as per code IS: 1893 (Part 1)-2016	Tx = $\frac{0.09\,h}{\sqrt{d\,x}}$ h= Height of Building = $\frac{0.09\,X\,137.70}{\sqrt{41.9}}$ **Tx = 1.831 Sec.** Tx = $\frac{0.075\,h\text{^}0.75}{\sqrt{Aw}}$ h= Height of Building = $\frac{0.075\,x131.70\text{^}0.75}{\sqrt{2.063}}$ **Tx = 2.030 Sec** **Final Time Period = 2.030 Sec (Maximum of Above)**
g)	Time Period in the horizontal Y-direction as per code IS: 1893 (Part 1)-2016	Ty = $\frac{0.09\,h}{\sqrt{d\,y}}$ h= Height of Building = $\frac{0.09\,X\,131.70}{\sqrt{26.85}}$ = 2.287 Sec. Ty = $\frac{0.075\,h\text{^}0.75}{\sqrt{Aw}}$ h= Height of Building = $\frac{0.075\,x131.70\text{^}0.75}{\sqrt{1.33}}$ **Ty = 2.530 Sec** **Final Time Period = 2.530 Sec (Maximum of Above)**
h)	seismic weight KN	722895.6143 KN
i)	Static base shear in X direction in KN	$= \frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g} \times seismicweight$ $= \frac{0.16}{2} \times \frac{1.2}{4.0} \times 0.493 \times 722895.61$ = 8546.5491 KN ----------1.18% of total seismic wt.

j)	Static base shear in Y direction in KN	$= \frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g} \times seismicweight$ $= \frac{0.16}{2} \times \frac{1.2}{4.0} \times 0.395 \times 722895.61$ = 6857.5078 KN ----------0.948 % of total seismic wt.
k)	Dynamic base shear X direction in KN	8030.2192 KN ----------1.11 % of total seismic wt.
l)	Dynamic base shear Y direction in KN	6013.0443 KN ----------0.83 % of total seismic wt.
m)	Scale Factor X- direction $\frac{static\ base\ shear}{Dynamic\ base\ shear}$	=1.56
n)	Scale Factor Y- direction $\frac{static\ base\ shear}{Dynamic\ base\ shear}$	=1.85
o)	Maximum Deflection at roof level	34.253 mm or H/3844.92---------- in X direction 58.22 mm or H/2262.1---------- in Y direction
p)	Maximum inter storey drift	1.479 mm (0.051%) (Earthquake in X direction - 18TH Floor) 2.784 mm (0.096%) (Earthquake in Y direction- 29th Floor)

q) Table of distribution for base shear: For Dynamic base shear

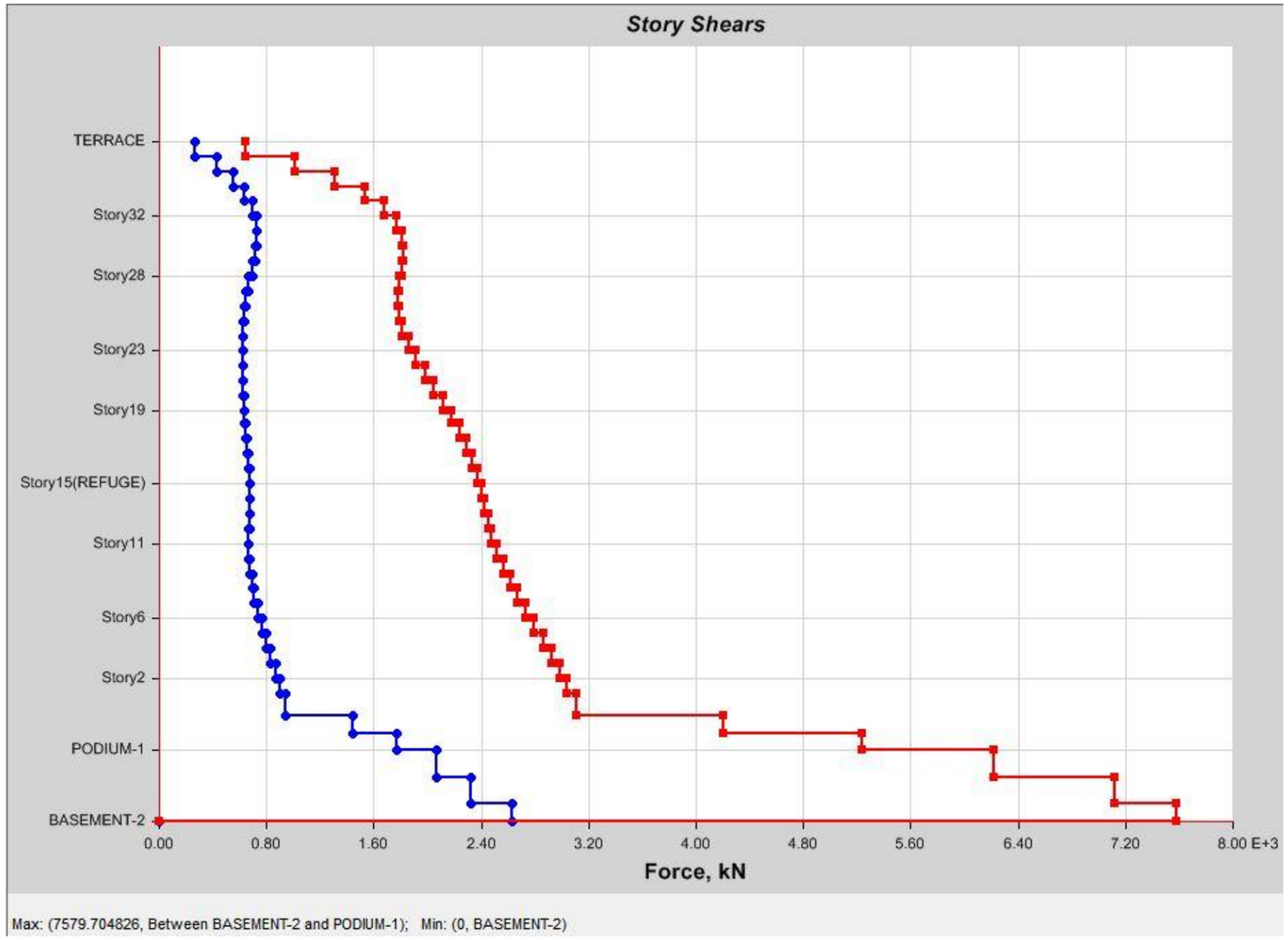
Story	Load	VX	Load	VY
TERRACE	SPEC1 Max	618.3262	SPEC2 Max	640.9273
Story36	SPEC1 Max	986.1722	SPEC2 Max	1012.2616
Story35(REFUGE)	SPEC1 Max	1294.5172	SPEC2 Max	1308.2766
Story34	SPEC1 Max	1541.6106	SPEC2 Max	1529.5822
Story33	SPEC1 Max	1728.9827	SPEC2 Max	1681.4773
Story32	SPEC1 Max	1859.5057	SPEC2 Max	1772.4887
Story31	SPEC1 Max	1938.1086	SPEC2 Max	1814.2815
Story30(REFUGE)	SPEC1 Max	1971.8177	SPEC2 Max	1821.0148
Story29	SPEC1 Max	1970.1489	SPEC2 Max	1808.0694
Story28	SPEC1 Max	1944.2925	SPEC2 Max	1790.5096
Story27	SPEC1 Max	1907.05	SPEC2 Max	1780.9011
Story26	SPEC1 Max	1871.7505	SPEC2 Max	1787.4941
Story25(REFUGE)	SPEC1 Max	1850.6283	SPEC2 Max	1813.3892
Story24	SPEC1 Max	1852.9099	SPEC2 Max	1857.0608
Story23	SPEC1 Max	1882.6565	SPEC2 Max	1914.227
Story22	SPEC1 Max	1938.5138	SPEC2 Max	1979.6269
Story21	SPEC1 Max	2014.6756	SPEC2 Max	2048.3392
Story20(REFUGE)	SPEC1 Max	2103.1244	SPEC2 Max	2116.2647
Story19	SPEC1 Max	2193.1103	SPEC2 Max	2178.5929
FIRE CHECK	SPEC1 Max	2284.7315	SPEC2 Max	2240.1064
Story18	SPEC1 Max	2368.5167	SPEC2 Max	2293.0586
Story17	SPEC1 Max	2440.1095	SPEC2 Max	2335.5749
Story16	SPEC1 Max	2505.8161	SPEC2 Max	2373.2203
Story15(REFUGE)	SPEC1 Max	2553.626	SPEC2 Max	2401.2723
Story14	SPEC1 Max	2590.7188	SPEC2 Max	2425.3999
Story13	SPEC1 Max	2619.9936	SPEC2 Max	2450.4122
Story12	SPEC1 Max	2644.924	SPEC2 Max	2480.5132
Story11	SPEC1 Max	2668.9894	SPEC2 Max	2518.0941
Story10(REFUGE)	SPEC1 Max	2695.2352	SPEC2 Max	2563.454
Story9	SPEC1 Max	2726.5152	SPEC2 Max	2615.424
Story8	SPEC1 Max	2764.0143	SPEC2 Max	2672.3432
Story7	SPEC1 Max	2808.0272	SPEC2 Max	2732.8601
Story6	SPEC1 Max	2857.914	SPEC2 Max	2795.9314
Story5(REFUGE)	SPEC1 Max	2912.5314	SPEC2 Max	2860.3382
Story4	SPEC1 Max	2970.3893	SPEC2 Max	2924.0604
Story3	SPEC1 Max	3030.784	SPEC2 Max	2985.203
Story2	SPEC1 Max	3093.7499	SPEC2 Max	3042.6823
Story1	SPEC1 Max	3169.6771	SPEC2 Max	3105.2885
STILT	SPEC1 Max	4670.7902	SPEC2 Max	4200.1481
PODIUM2	SPEC1 Max	5994.4399	SPEC2 Max	5235.462
PODIUM1	SPEC1 Max	7177.5841	SPEC2 Max	6218.5195
GR	SPEC1 Max	8185.8498	SPEC2 Max	7124.3337
BASEMENT 1	SPEC1 Max	8546.5762	SPEC2 Max	7579.7048

r) Graph of distribution for SPEC-X of base shear (Dynamic)



Graph for SPEC-X

r) Graph of distribution for SPEC-Y of base shear (Dynamic)



Graph for SPEC Y

7. WIND LOADING PARAMETER AND RESULTS:

Wind loading Parameters		
a)	Category of building	3
b)	Basic wind speed in m/sec	44
c)	Wind speed parameter	
	K1	1
	K2 for height 123.20 m	**0.813**
	K3	1
	K4 (Importance factor for cyclonic region)	1.00
	Design wind speed at terrace level Vz in m/s	= K1 x k2 x k3 x k4 x Vb = 1 x**0.813** x 1x1.00 x 44 = 35.772 m/s
	Wind pressure at terrace level	= 0.6 x Vz^2 = 0.6 x 35.772^2 = 767.78
d)	Shape factor (force coefficient) Cf As per IS875-Part-3-Fig no. 4A	h/b = 2.94 a/b = 0.641 Cf = 1.3
e)	Gust factor calculations	Calculations Attached
f)	Wind tunnel test	Not Applicable

h) Base shear and Maximum Deflection due to wind loads

No.	Loading Type	Wind Base Shear (KN)		Deflection (MM)		Story Drift (%)	
		X	Y	X	Y	X	Y
1	Static	7683.446	10913.9863	78.355	202.82	0.115	0.2466
				H/1572.33	H/607.44	Stilt floor	15th floor
2	Gust	7208.982	11600.3723	84.905	235.814	0.0842	0.2949
				H/1451.03	H/522.44	15th floor	16th floor

7. E.1). **GUST WIND LOAD CALCULATIONS – in X direction:-**

H	=	Total height of main structure of the building in meters above Ground level	=	123.2	m
B	=	Breadth of a structure in the horizontal plane normal to wind direction	=	26.85	m
D	=	Maximum base dimension of building in meters In a direction parallel to the applied wind force.	=	41.9	m
Tx	=	Time period of building /structure in along wind direction (coresponding dispalced Mode)	=	3.511	Sec
fax	=	I/T	=	0.285	Cyc/Sec
gR	=	Peak factor for resonant response √[2ln(3600Xfa)]	=	3.724	
β	=	Damping Coefficient Bolted Steel/RCC Structure	=	0.02	
k1	=	probability factor(risk coefficient)	=	1	
k2	=	terrain roughness and height factor	=	0.813	
k3	=	topography factor	=	1	
k4	=	importance factor for cyclonic region All other structures	=	1	
Vb	=	Regional wind basic speed, for Mumbai	=	44	m/s
Vhd	=	Design Hourly mean wind speed at height z		35.781	
	=	Vhd = Vb k1 k2 k3 k4	=		m/s
pz	=	wind pressure at height z	=	768.159	N/m2
	=	0.60 Vhd2			
Kd	=	Wind directionality factor	=	0.9	
Ka	=	Area Averaging Factor	=	1	
Kc	=	Combination Factor	=	1	
pd	=	Design Wind Pressure	=	691.343	N/m2
	=	Kd Ka Kc pz			
Lh	=	Measure of effective turbulence length scale at height h	=	159.247	
		Category 3			
N	=	Effective reduced frequency	=	1.268	

E	=	Spectrum of turbulence in the approaching wind stream	=	0.076	
b0h	=	Average breadth of buiding between 0 to h	=	26.850	m
S	=	Size reduction factor	=	0.122	
Hs	=	Height Factor for resonance response	=	2	
gv	=	Peak factor for upwind velocity fluctuation	=	4	
zoi	=		=	0.2	
Ih,i	=	Turbulence intensity at height h in terrain category i	=	0.150	
r	=	roughness factor	=	0.299	
Bs	=	Background Factor	=	0.897	
ϕ	=	factor to account for second order turbulence intensity	=	0.283	
Gx	=	Gust Factor $1+r\sqrt{([g_v^2.B_s(1+\phi^2)]+[H_s g_r^2 SE/\beta])}$	=	2.808	

7. E.2). **GUST WIND LOAD CALCULATIONS – in Y direction:-**

H	=	Total height of main structure of the building in meters above Ground level	=	123.2	m
B	=	Breadth of a structure in the horizontal plane normal to wind direction	=	41.9	m
D	=	Maximum base dimension of building in meters In a direction parallel to the applied wind force.	=	26.85	m
Ty	=	Time period of building /structure in along wind direction (coresponding dispalced Mode)	=	4.833	Sec
fay	=	l/T	=	0.207	Cyc/Sec
gR	=	Peak factor for resonant response √[2ln(3600Xfa)]	=	3.637	
β	=	Damping Coefficient Bolted Steel/RCC Structure	=	0.02	
k1	=	probability factor(risk coefficient)	=	1	
k2	=	terrain roughness and height factor	=	0.813	
k3	=	topography factor	=	1	
k4	=	importance factor for cyclonic region All other structures	=	1	
Vb	=	Regional wind basic speed, for Mumbai	=	44	m/s
Vhd	=	Design Hourly mean wind speed at height z		35.781	
	=	Vhd = Vb k1 k2 k3 k4	=		m/s
pz	=	wind pressure at height z	=	768.159	N/m2
	=	0.60 Vhd2			
Kd	=	Wind directionality factor	=	0.9	
Ka	=	Area Averaging Factor	=	1	
Kc	=	Combination Factor	=	1	
pd	=	Design Wind Pressure	=	691.343	N/m2
	=	Kd Ka Kc pz			
Lh	=	Measure of effective turbulence length scale at height h	=	159.247	
		Category 3			
N	=	Effective reduced frequency	=	0.921	
E	=	Spectrum of turbulence in the approaching wind stream	=	0.094	

b0h	=	Average breadth of buiding between 0 to h	=	41.9	m
S	=	Size reduction factor	=	0.145	
Hs	=	Height Factor for resonance response	=	2	
gv	=	Peak factor for upwind velocity fluctuation	=	4	
zoi	=		=	0.2	
Ih,i	=	Turbulence intensity at height h in terrain category i	=	0.150	
r	=	roughness factor	=	0.299	
Bs	=	Background Factor	=	0.849	
ϕ	=	factor to account for second order turbulence intensity	=	0.275	
Gx	=	Gust Factor	=	2.896	
		$1+r\sqrt{([g_v^2.B_s(1+\phi^2)]+[H_s g_r^2 SE/\beta])}$			

8) Data from Dynamic Analysis

TABLE: Modal Participating Mass Ratios

Mode	Period	Frequency	X-Participation	Y-Participation	RZ-Participation	Sum UX (%)	Sum UY (%)	Sum RZ (%)
	sec		X-Translation	Y -Translation	Rotation			
1	4.833	0.206911	0.71	17.4	5.49	0.71	17.4	5.49
2	4.547	0.219925	0.03	25.12	14.84	0.74	42.52	20.33
3	3.511	0.284819	42.7	0.28	0.43	43.44	42.8	20.76
4	1.391	0.718907	0.23	8.7	15.1	43.67	51.5	35.85
5	1.294	0.772798	0.01	10.68	8.28	43.68	62.18	44.14
6	1.041	0.960615	17.9	2.33	16.22	61.59	64.5	60.36
7	0.951	1.051525	3.56	3.78	19.19	65.14	68.28	79.54
8	0.691	1.447178	0	13.08	3.28	65.14	81.36	82.82
9	0.607	1.647446	2.74	0.1	0.65	67.88	81.46	83.47
10	0.6	1.666667	0.003679	0	0.000552	67.89	81.46	83.47
11	0.534	1.872659	15.87	1.37	1.16	83.76	82.82	84.64
12	0.469	2.132196	0.2	5.55	1.29	83.96	88.37	85.93
13	0.444	2.252252	0.001634	0.000338	0.000699	83.96	88.37	85.93
14	0.391	2.557545	0.001321	0.000302	0.001563	83.96	88.37	85.93
15	0.387	2.583979	1.03	0.000432	0.26	84.99	88.37	86.19
16	0.37	2.702703	4.14	0.52	0.36	89.13	88.89	86.56
17	0.363	2.754821	0.02	0.002011	0.000491	89.15	88.89	86.56
18	0.327	3.058104	0.13	1.67	0.07	89.28	90.56	86.63
19	0.304	3.289474	0.01	0.004091	0.03	89.29	90.57	86.66
20	0.283	3.533569	0.64	0.25	2.63	89.93	90.82	89.29
21	0.279	3.584229	0.16	0.33	1.5	90.09	91.15	90.78
22	0.26	3.846154	0.52	0.26	0.000523	90.61	91.41	90.78
23	0.226	4.424779	0.58	0.0029	0.06	91.19	91.41	90.84
24	0.21	4.761905	0.000452	1.41	0.3	91.19	92.82	91.14
25	0.202	4.950495	0.89	0.48	0.05	92.08	93.3	91.19
26	0.164	6.097561	2.22	0.18	0.21	94.3	93.49	91.4
27	0.157	6.369427	0.67	2.31	0.06	94.97	95.79	91.47
28	0.139	7.194245	0.22	0.05	0.001732	95.19	95.84	91.47
29	0.08	12.5	2.58	0.98	0.01	97.77	96.82	91.48
30	0.074	13.51351	0.51	2.43	0.004465	98.28	99.25	91.48
31	0.071	14.08451	0.49	0.000444	0.00063	98.77	99.25	91.49

9) Table for diaphragm displacement at Terrace Level

Load Case	Dx-Max (MM)	H/Dx	Drift-X %	Dy-Max (MM)	H/Dy	Drift-Y %
DL	7.37	H/17869.74	0.0251	30.665	H/4294.8	0.068
DL+LL	11.01	H/11961.85	0.0347	39.724	H/3315.37	0.0882
SPEC 1	34.253	H/3844.92	0.0432	4.516	H/29162.97	0.0344
SPEC 2	8.02	H/16421.44	0.0376	58.22	H/2262.11	0.0829
WX	78.355	H/1572.33	0.0543	5.621	H/21917.81	0.0141
WY	5.623	H/21910.01	0.0409	202.82	H/607.44	0.1747

10) Table for Torsion irregularity

a) (along X-direction)

Load case	Corner -1	Corner -2	Corner -3	Corner -4	Avg-X	% = Max/Avg	Max/Min
SPEC 1	48.726	39.823	40.28	42.504	42.833	1.137	1.223
WX	75.747	77.123	80.521	77.077	77.617	1.037	-

b) (along Y-direction)

Load case	Corner -1	Corner -2	Corner -3	Corner -4	Avg-X	% = Max/Avg	Max/Min
SPEC 2	76.93	90.726	86.115	85.075	84.7115	1.071	1.179
WY	235.19	250.76	167.32	168.78	205.51	1.22	-

11) Data regarding Vertical Elements.

a)	Maximum loaded column/shear wall no.	P51
b)	size column/shear wall in mm	300 X 3300
c)	Factored Gravity load on col./wall in KN	28423.6358 kN
d)	Factored Axial stress in max. loaded column	28.71 N/mm2
e)	Grade of max. loaded column at base	M60
f)	Unfactored Axial settlement in max. loaded column/wall	$\delta = \frac{PL}{AE} = \frac{28423\ .64 \times 10^3 \times 3500}{1.5x0.99 \times 10^6 \times 38729\ .83}$ = 1.73 mm
g)	Minimum loaded column/Shear wall no.	P90 (450X1000)
h)	Unfactored Axial settlement in Minimum loaded column/wall	$\delta = \frac{PL}{AE} = \frac{2160\ .40 \times 10^3 \times 3500}{1.5x0.45 \times 10^6 \times 38729\ .83}$ = 0.289 mm
i)	% Base-shear resisted by all walls along X (static)	100%
j)	% Base-shear resisted by all walls along Y (static)	100%

12) Data for each cantilever.-

Buildings	
Cantilever span in meter	1.98 M
Beam Size	200 X 700
Nature of class	Supporting Bedroom slab
Maximum elastic deflection under gravity load in mm	1.507 mm

13)	Provide stability calculations for uplift and overturning (model extract in case of model)	No Columns/walls is in tension.
14)	Typical design calculations for footings	Attached below.
15)	Typical design calculations for RCC Column	Attached below.
16)	Typical design calculations for RCC beams	Attached below.
17)	Typical design calculations for Steel Bracings	N.A

18)	Wind tunnel studies shall be conducted for any HRB with total height beyond normal ground level exceeding 250 mt. Wind tunnel studies shall include modeling of all surrounding obstacles in the area. The report from study should be submitted.	N.A
19)	Provide a note on special provisions suggested for the building (like dampers etc.)	N.A
20)	Soft copy of model including input and output.	Yes
21)	Soft copy of Power point presentation including all above points.	Yes
22)	Items 1 to 21 on CD.	Yes

APPENDIX
DESCRIPTION OF SUB-STRUCTURE

Number of Basements		2
Minimum clearance between outermost basement retaining wall and compound wall		As per soil investigation report
Has a shoring system been installed? Submit section detail of the shoring system		As per soil investigation report
For Tower Area Dead Weight of tower Structure is much more than Hydrostatic Uplift		
Give details of methodology used to resist uplift pressure due to ground water for tower portion.	Bottom Level of Raft w.r.t. ground level in mts.	10.50m
	Total downward load of self-weight of raft + Counter weight over raft	48.25 kN/m2
	Water level assumed for uplift calculation for Non Tower Area	2 m below ground level

DESCRIPTION OF THE FOUNDATION FOR THE TOWER BLOCK		
Rock Anchors		NA
Nature of Foundation		RAFT FOUNDATION
SBC assumed T/sq.mt.		300 T/M2
Sub-grade Elastic Modulus		25000 T/m3
Pile dia with capacity		-
Flooring system of the Basements		Tremix Concrete Floor
Retaining wall types , Diaphragm Wall & Sequence of backfilling	Propped cantilever Back Filling should be done after casting of respective basement slabs.	Propped cantilever Back Filling should be done after casting of respective basement slabs.
Intended Use of basements		Parking and Services
If rock anchors are used, are they grouted after installation and stressing?		NA
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?		N.A.
Whether Expansion/Separation joints provide?		YES. Provided in Non-Tower Area.
Whether expansion joint/separation joint continues through basement?		YES

DESCRIPTION OF STRUCTURE

No. of Floors	43 Floor slabs
Shape Of Building, Plan, Elevation whether Symmetric in Elevation	Not Symmetric in elevation.
Maximum plan dimension in M	41.9 M
Ratio of Plan dimension	1.56
Typical Floor to floor height in mt. Maximum floor to floor height in entire height of building in mt.	1st Residential floor – 4.35 m 2^{nd} to 36^{th} -Typical floors – 2.90 m
Aspect Ratio (Ht. of building till terrace/Minimum dimension of building	131.70 / 26.85 = 4.905
Type of floor slab	Conventional Slab and Beam
Average slab thickness	150mm
Whether Wall are RCC, Composite or In structural steel	RCC shear walls
Lateral System Whether the Geometry of Building is Symmetric	NO
Whether the lateral load resisting system is symmetrically placed in Geometry	NO
Use of floor at different levels (Residential / Commercial / industrial)	Residential and Parking as per Architectural plan
Is there any Transfer level If yes, depth of Transfer Girder	NA
Whether Expansion joint is provided? If yes, what is the maximum plan dimension in mt.	NA
Whether separation gap is sufficient joint is provide?	NA
Maximum cantilever projection in mt. (Chajja)	0.75 m

SAMPLE ELEMENT CALCULATIONS

EUCALYPTIA

SAMPLE BEAM CALCULATION

Group	: **G3**		
Beam No	: **B3**		
Analysis Reference (Member)	Story7 : B1389		
Beam Length	: 3400	mm	
Breadth (B)	: 200	mm	
Depth (D)	: 700	mm	
Effective Depth (d)	: 640	mm	
Design Code	: IS 456		
Beam Type	: Regular Beam		
Grade Of Concrete (Fck)	: M40	N/sqmm	
Grade Of Steel	: Fe500	N/sqmm	
Clear Cover (Cmin)	: 30	mm	
Es	: 2x10^5	N/sqmm	

Flexure Design

	Beam Bottom			Beam Top		
	Left	**Mid**	**Right**	**Left**	**Mid**	**Right**
Critical L/C - Analysis	117.(1.5DL+1.5LL)	117.(1.5DL+1.5LL)	117.(1.5DL+1.5LL)	60.(1.2DL+1.2LL+0.36SPEC1-1.2SPEC2+0.36SPEC3) MAX	80.(1.5DL-1.5SPEC1+0.45SPEC3)	80.(1.5DL-1.5SPEC1+0.45SPEC3)
Critical L/C - RCDC	45	45	45	35	1	1
Mu (kNm)	21.904	44.193	23.69	-	-	-
Tu (kNm)	0	0	0	0	0	0
M_{Tu} (kNm)	0	0	0	0	0	0
Mud (kNm)	21.9	44.19	23.69	0	0	0
MuLim (kNm)	436	436	436	436	436	436
R	0.267	0.539	0.289	0	0	0
Ptmin (%)	0.17	0.17	0.17	0.1	0.1	0.1
Ptclc (%)	0.17	0.17	0.17	0.1	0.1	0.1
Pcclc (%)	0	0	0	0	0	0
PtPrv (%)	0.177	0.177	0.177	0.177	0.177	0.177
AstCalc (sqmm)	217.6	217.6	217.6	128	128	128
AstPrv (sqmm)	226.2	226.2	226.2	226.2	226.2	226.2
Reinforcement	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12

Shear Design

	Left	**Mid**	**Right**
Critical L/C - Analysis	117.(1.5DL+1.5LL)	117.(1.5DL+1.5LL)	117.(1.5DL+1.5LL)
Critical L/C - RCDC	45	45	45
PtPrv (%)	0.177	0.177	0.177
Vu (kN)	43.59	32.418	46.734
Tu (kNm)	0	0	0
V_{Tu} (kN)	0	0	0
Vut (kN)	43.59	32.42	46.73
Tv (N/sqmm)	0.34	0.25	0.37
Tc (N/sqmm)	0.32	0.32	0.32
Vc (kN)	41.01	41.01	41.01
Vus=Vut-Vc (kN)	2.58	0	5.72
Legs	2	2	2
Stirrup Rebar	8	8	8
Asv Torsion (sqmm)	-	-	-
Asv Torsion Prv (sqmm)	-	-	-
Asv Reqd (sqmm)	221.576	221.576	221.576
SvCalc (mm)	300	300	300
SvPrv (mm)	300	300	300
Asv Total Prv (sqmm)	335.13	335.13	335.13

Maximum Spacing Criteria

Basic

Spc1 =0.75d	= 480	mm
Spc2	= 300	mm

SFR Design

Beam Width	= 200	mm

Beam Depth	= 700	mm
Web Depth	= 700 <= 750	mm
Side Face Reinforcement Not Required.		

SAMPLE COLUMN/SHEAR WALL CALCULATION

General Data

Wall No.	:	P14	
Level	:	BASEMENT-2 To BASEMENT-1	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel	=	Fe500	N/sqmm
Wall B	=	300	mm
Wall D	=	2000	mm
Clear Cover	=	50	mm
Clear Floor Height @ B	=	3500	mm
Clear Floor Height @ D	=	2800	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	UnBraced	
Minimum eccentricity check	:	One Axis at a Time	

Load Data

Analysis Reference No.	=	P14	
Critical Analysis Load Combination	:	117.(1.5DL+1.5LL)	
Load Combination	=	[44] : 1.5 (DEAD) +1.5 (SDL) +1.5 (LIVE) +1.5 (LIVE1) +1.5 (LIVE2)	
Critical Location	=	Top Joint	
Pu	=	14462.8	kN
Mux	=	12.11	kNm
Muy	=	12.76	kNm
Vux	=	-6.92	kN
Vuy	=	50.28	kN

Check For Requirement Of Boundary Element

Check For Maximum Compressive Stress

Having maxstress in between level's (BASEMENT-1 - Story1)

At level (BASEMENT-1)

Load Combination	=	[51] : 1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC1) -0.45 (SPEC3) +1.5 (SPEC2)
Maximum Stress	=	24.03
0.2 x Fck	=	12

Maximum Stress in Wall > 0.2 x Fck

Hence Boundary Element is applicable

At level (BASEMENT-1)

Load Combination	=	[51] : 1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC1) -0.45 (SPEC3) +1.5 (SPEC2)
Maximum Stress	=	24.03
0.15 x Fck	=	9

Maximum Stress in Wall > 0.15 x Fck

Hence Boundary Element is applicable

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N/m	mm	mm	N/m	N/m	
Bottom	8852.533	No Beam	No Beam	-	-	1
Top	8852.533	993.41 x 300 x 700	4586.62 x 300 x 700	1337.246	289.632	0.902

Sway Condition (as per Stability Index)	=	Non Sway
Effective Length Factor along Major Axis	=	1

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N/m	mm	mm	N/m	N/m	
Bottom	199.182	No Beam	No Beam	-	-	1
Top	199.182	No Beam	No Beam	-	-	1

Sway Condition (as per Stability Index)	=	NONSWAY
Effective Length Factor along Minor axis	=	1

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
	=	17	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	289.26	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	11.67	
	<	60	(Hence Ok)
Column Is Unbraced Along D			
Slenderness Check Along D:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	1.4, Wall not Slender Along D	
Column Is Unbraced Along B			
Slenderness Check Along B:			
Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	11.67, Wall not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	12.11	---	12.11	0	12.11
Minor Axis - Muy	12.76	289.26	289.26	0	289.26

Where

A = Moments directly from analysis
B = Moments due to minimum eccentricity
C = Maximum of analysis moment and min. eccentricity = Max (A,B)
E = Moment due to slenderness effect
F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	14462.8	kN
Mux	=	12.11	kNm
Muy	=	289.26	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.01	
Reinforcement Provided	=	24-T16 + 6-T16	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	87.6	deg
MRes	=	289.51	kNm
MCap	=	406.09	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.71 <= 1	

Check For Boundary Element

Length of boundary element	=	500	mm
Proportioned length of BE	=	0.25	

Muv = Moment Contribution Of Web

Most Unfavouring Pu	=	0.8 x P(DL + LL) - 1.2 x Abs(P(EQ)	
		7032.4851	
Pu on web	=	3516.2425	kN
Lambda	=	0.1953	
Phi	=	0.0006	
Alpha-1	=	0.3599	
Alpha-2	=	0.15	
Alpha-3	=	-0.0002	
Alpha-4	=	-0.1944	
Alpha-5	=	-0.0005	
First root of Alpha-1, 4 and 5	=	0.5425	
Second root of Alpha-1, 4 and 5	=	-0.0024	
Correct root of Aplha-1, 4 and 5	=	0.5425	
Xu/Lw	=	0.5425	
Xu*/Lw	=	0.6167	
Phi	=	Condition1	
Muv/(Fck*Tw*Lw^2)	=	0.0537	
Moment carried by web, Muv	=	966.5494	kNm
Moment carried by BE	=	Mu-max - Muv	
	=	75.5626	kNm
Lever arm between Boundary elements	=	L - Length of BE/2	
	=	1500	mm

Additional force in BE	=	Moment carried by BE / Lever arm between BE	
	=	50.3751	kN

Check for Compression Capacity of BE

Compressive force in wall	=	1.2 x P(DL+LL) + 1.2 x Abs(P(EQ))	
(Favouring combination)	=	12356.2468	kN
Compressive force in BE	=	Compressive force in wall x Length proportion	
	=	3089.0617	kN
Total compressive force in BE	=	Force due to combination + Force due to moment component	
	=	3139.4368	kN
Ast provided in BE	=	2412.7432	mm2
Capacity of BE in compression	=	0.4 x Fck x Aconcrete + 0.67 x Fy x Ast	
	=	4350.3631	kN
	>	Max. compressive force, Hence OK	

Check for Tension Capacity of BE

Compressive force in wall	=	0.8 x P(DL+LL) - 1.2 x Abs(P(EQ))	
Unfavouring Combination	=	7032.4851	kN
Compressive force in BE	=	Compressive force in wall x Length proportion	
	=	1758.1213	kN
Total tensile force in BE	=	Force due to moment component - Force due to combination	kN
	=	No Tension In BE	kN
Ast provided in BE	=	2412.7432	mm2
Capacity of BE in tension	=	0.87 x Fy x Ast	
	=	1049.5433	kN
	>	Max. tensile force, Hence OK	

Wall Configuration

	Boundary Element	Mid	Boundary Element
Length (mm)	500	1000	500
Reinforcement	12-T16	6-T16	12-T16
Ast provided	2412.74	1206.37	2412.74
Pt as % of entire wall	0.4 %	0.2 %	0.4 %
Pt as % of zone	1.61 %	0.4 %	1.61 %

Design Of Shear

Design for shear along D

Critical Analysis Load Combination	:	97.(1.5DL-0.45SPEC1+1.5SPEC2+0.45SPEC3) MAX	
Critical Load Combination	=	[35] : 1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC1) +0.45 (SPEC3) +1.5 (SPEC2)	
Design shear force, Vuy	=	220.824	kN
Pu	=	10946.33	
	=	0.46	N/sqmm
Pt	=	0.503	%
Design shear strength, Tc	=	0.5229	N/sqmm
Shear Strength Enhancement Factor	=	1 + 3 x Pu / (B x D x Fck)	
	=	1.9122	
Shear Strength Enhancement Factor (max)	=	1.5	
Shear Strength Enhancement Factor	=	1.5	
Enhanced shear strength, Tc-e	=	0.7844	N/sqmm
Design shear check	=	Tvy < Tc x Enhancement factor	

Link for Shear Design along D are not required

Design for shear along B

Critical Analysis Load Combination	:	45.(1.2DL+1.2LL+1.2SPEC1+0.36SPEC2+0.36SPEC3) MIN	
Critical Load Combination	=	[9] : 1.2 (DEAD) +1.2 (SDL) +1.2 (LIVE) +1.2 (LIVE1) +1.2 (LIVE2) -1.2 (SPEC1) -0.36 (SPEC3) -0.36 (SPEC2)	
Design shear force, Vux	=	-9.0063	kN
Pu	=	12006.08	
Design shear stress, Tvx	=	Vux / (B x 0.8 xD)	kN
	=	0.0188	N/sqmm
Pt	=	0.503	%
Design shear strength, Tc	=	0.5229	N/sqmm
Shear Strength Enhancement Factor	=	1 + 3 x Pu / (B x D x Fck)	
	=	2.0005	
Shear Strength Enhancement Factor (max)	=	1.5	
Shear Strength Enhancement Factor	=	1.5	
Enhanced shear strength, Tc-e	=	0.7844	N/sqmm
Design shear check	=	Tvx < Tc x Enhancement factor	

Link for Shear Design along B are not required

Design Of Links

Main Links

Links in the zone where special confining links are not required

Normal Links

Min. Horizontal Reinforcement	= 0.25% of cross sectional area	
	= 750	sqmm
Diameter of main horizontal steel	= 8	mm
Thus, Spacing	= 125	mm
Spacing of horizontal reinforcement is minimum of following		
D / 5	= 400	mm
3 x B	= 900	mm
Maximum	= 450	mm
Spacing considered	= 125	mm

Special confining reinforcement

as per IS 13920 - 2016

Min. Lateral dimension of column, B	= 300	mm
B/4	= 75	mm
Hence Link spacing, S	= 75	mm
Hoop dimension, h	158.5	
Gross area of column, Ag	= B x(Z1 + cover + Dia Z1 / 2)	
	= 167400	sqmm
Core area of column, Ak	= (B - 2 x cover to Link) x (Z1 - cover + Dia Z1 / 2 + Link)	
	= 113680	sqmm
Area of special confining link, Ash	= 0.18 x S x h x (Fck/Fy) x (Ag/Ak-1)	
	= 121.34	sqmm
Diameter of special confining link	= 16	mm
	= > Max. longitudinal bar dia / 4	
	= 4	mm
Area of horizontal steel provided	= Area of bar provided x 1000 x 2 / spacing	
	= 5361.6	(sqmm)/ m height
	= 1.7872	%
	= > min. steel required 0.2%	

Special confining links to be provided along full height in BE.

Table For Links

Note: Ductile Design Of Links Is Applicable Only For Boundary Elements

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	16	8	16
Spacing	125	---	75	125	75

Secondary Links:

In Boundary element	T8@75c/c
In Mid-zone	T8@125c/c

CHECK LIST

FENELIA

LIST FOR THE MAIN STRUCTURAL CONSULTANT

1.	Design Basis Report as per the document HRC/DBR/V1.0.	
2.	Description of Sub-structure and Super-structure as per the format given in the Appendix enclosed.	43 floor slabs Basement 2 + Basement 1 + Ground + Podium 1 + Podium 2 + Stilt + 36 Typical Residential floors (including refuge) + 1 Fire Check + Terrace.
3.	Brief Description of structural system with sketches, image of drg. Etc. with specific focus on 'Lateral load resisting system'	Ductile RCC Shear walls with Non-Ductile Beam Structure
4.	Brief note on modeling, software used etc. Clearly mentioned whether infill/ partition wall is idealized as part of lateral load system?	Building is modeled in ETAB 17.0 version infill and partition walls are not modeled. Entire structure in 3 Dimensions provides lateral load resisting system.
5.	Method of Analysis	Analysis is done by Response Spectrum Method.
6.	Earthquake parameter	
i)	Zone Factor	Z = 0.16
j)	Importance factor	I = 1.2
k)	Response Reduction factor	R = 4.0 (IS 1893:2016)
l)	Soil Type	Hard
m)	% LL considered in seismic	25% up to 3 kN/m2 & 50% above 3 kN/m2

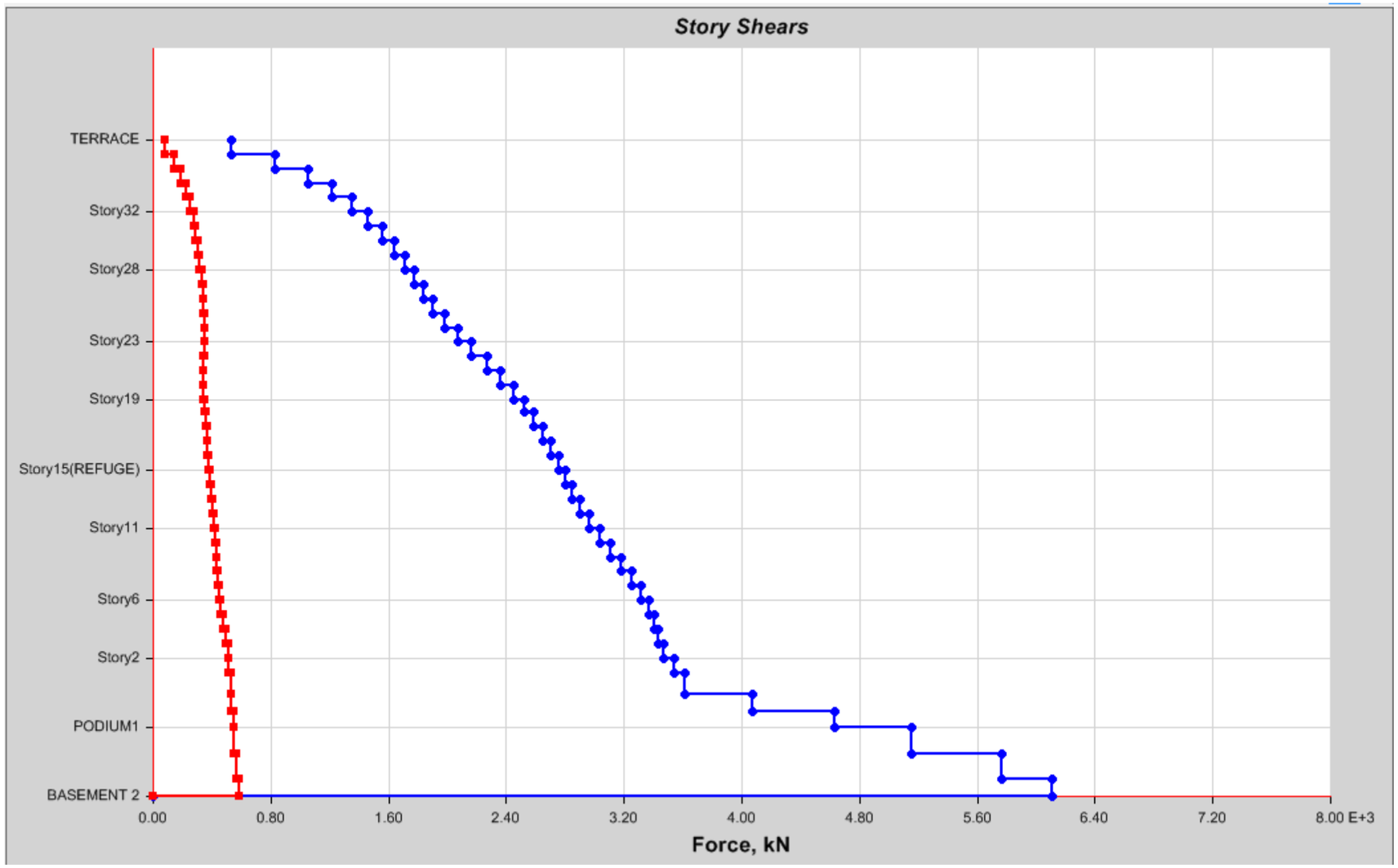
n)	Time Period in the horizontal X-direction as per code IS: 1893 (Part 1)-2016	Tx = $\frac{0.09\,h}{\sqrt{d\,x}}$ h= Height of Building = $\frac{0.09\,X\,131.70}{\sqrt{29.80}}$ **Tx = 2.171 Sec.** Tx = $\frac{0.075\,h\text{^}0.75}{\sqrt{Aw}}$ h= Height of Building = $\frac{0.075\,x131.70\text{^}0.75}{\sqrt{1.311}}$ **Tx = 2.547 Sec** **Final Time Period = 2.547 Sec (Maximum of Above)**
o)	Time Period in the horizontal Y-direction as per code IS: 1893 (Part 1)-2016	Ty = $\frac{0.09\,h}{\sqrt{d\,y}}$ h= Height of Building = $\frac{0.09\,X\,131.70}{\sqrt{35.15}}$ = 1.999 Sec. Ty = $\frac{0.075\,h\text{^}0.75}{\sqrt{Aw}}$ h= Height of Building = $\frac{0.075\,x131.70\text{^}0.75}{\sqrt{1.7096}}$ **Ty = 2.230 Sec** **Final Time Period = 2.230 Sec (Maximum of Above)**
h)	Seismic Weight KN	522096.36 KN
i)	Static base shear in X direction in KN	$= \frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g} \times seismicweight$ $= \frac{0.16}{2} \times \frac{1.2}{4.0} \times 0.393 \times 522096$ = 4919.636 KN ----------0.9423% of total seismic wt.

j)	Static base shear in Y direction in KN	$= \frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g} \times seismicweight$ $= \frac{0.16}{2} \times \frac{1.2}{4.0} \times 0.448 \times 522096$ = 5618.974 KN ----------1.0762 % of total seismic wt.
k)	Dynamic base shear X direction in KN	3450.741 KN ----------0.661 % of total seismic wt.
l)	Dynamic base shear Y direction in KN	4245.527 KN ----------0.813 % of total seismic wt.
m)	Scale Factor X- direction $\frac{static\ base\ shear}{Dynamic\ base\ shear}$	=1.426
n)	Scale Factor Y- direction $\frac{static\ base\ shear}{Dynamic\ base\ shear}$	=1.323
o)	Maximum Deflection at roof level	110.34 mm or H/1194---------- in X direction 60.545 mm or H/2175---------- in Y direction
p)	Maximum inter storey drift	4.602 mm (0.1587 %) (Earthquake in X direction - 15th Floor) 2.946 mm (0.1016 %) (Earthquake in Y direction- 23rd Floor)

s) Table of distribution for base shear: For Dynamic base shear

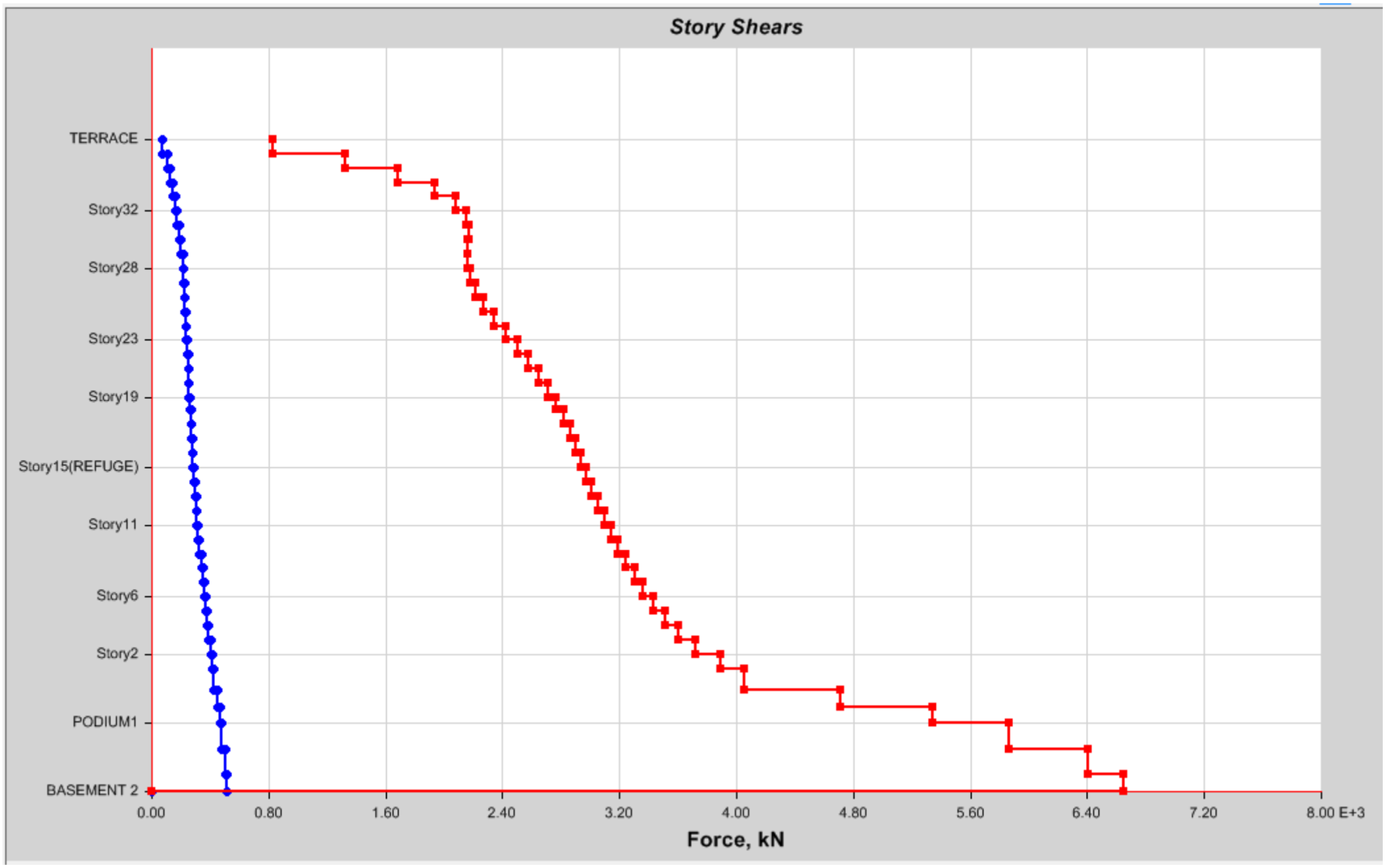
Story	Load	VX	Load	VY
TERRACE	SPEC1	527.2105	SPEC2	826.0246
Story36	SPEC1	824.4546	SPEC2	1320.8849
Story35(REFUGE)	SPEC1	1049.6616	SPEC2	1686.7964
Story34	SPEC1	1219.2392	SPEC2	1934.3351
Story33	SPEC1	1351.3249	SPEC2	2081.6329
Story32	SPEC1	1460.1808	SPEC2	2150.8523
Story31	SPEC1	1554.8433	SPEC2	2169.0903
Story30(REFUGE)	SPEC1	1639.5406	SPEC2	2164.8537
Story29	SPEC1	1713.5305	SPEC2	2162.3966
Story28	SPEC1	1778.7494	SPEC2	2177.1322
Story27	SPEC1	1839.9654	SPEC2	2214.4204
Story26	SPEC1	1904.6036	SPEC2	2271.5301
Story25(REFUGE)	SPEC1	1980.2071	SPEC2	2342.9019
Story24	SPEC1	2068.271	SPEC2	2420.8818
Story23	SPEC1	2166.0032	SPEC2	2500.7122
Story22	SPEC1	2266.3289	SPEC2	2578.4846
Story21	SPEC1	2361.7478	SPEC2	2650.7256
Story20(REFUGE)	SPEC1	2447.9723	SPEC2	2715.1065
Story19	SPEC1	2520.6726	SPEC2	2767.0949
FIRE CHECK	SPEC1	2588.5253	SPEC2	2818.1862
Story18	SPEC1	2648.859	SPEC2	2860.625
Story17	SPEC1	2703.2664	SPEC2	2898.0249
Story16	SPEC1	2753.579	SPEC2	2934.298
Story15(REFUGE)	SPEC1	2802.2213	SPEC2	2972.5245
Story14	SPEC1	2851.2781	SPEC2	3012.535
Story13	SPEC1	2904.337	SPEC2	3053.9983
Story12	SPEC1	2964.4618	SPEC2	3097.0125
Story11	SPEC1	3032.7113	SPEC2	3142.5749
Story10(REFUGE)	SPEC1	3107.5507	SPEC2	3192.2416
Story9	SPEC1	3183.3121	SPEC2	3245.6796
Story8	SPEC1	3254.4172	SPEC2	3302.3267
Story7	SPEC1	3315.758	SPEC2	3362.6463
Story6	SPEC1	3364.8725	SPEC2	3429.636
Story5(REFUGE)	SPEC1	3403.4822	SPEC2	3509.0282
Story4	SPEC1	3435.8033	SPEC2	3604.3193
Story3	SPEC1	3468.9325	SPEC2	3716.9005
Story2	SPEC1	3537.1234	SPEC2	3890.1881
Story1	SPEC1	3612.7341	SPEC2	4052.7079
STILT	SPEC1	4075.6836	SPEC2	4713.5992
PODIUM2	SPEC1	4634.3113	SPEC2	5341.9901
PODIUM1	SPEC1	5157.227	SPEC2	5866.9786
GR	SPEC1	5770.0984	SPEC2	6404.4529
BASEMENT 1	SPEC1	**6103.7188**	SPEC2	**6647.6611**

t) Graph of distribution for SPEC-X of base shear (Dynamic)



Graph for SPEC-X

u) Graph of distribution for SPEC-Y of base shear (Dynamic)



Graph for SPEC-Y

7. WIND LOADING PARAMETER AND RESULTS:

Wind loading Parameters		
a)	Category of building	3
b)	Basic wind speed in m/sec	44
c)	Wind speed parameter	
	K1	1
	K2 for height 123.20 m	**0.813**
	K3	1
	K4 (Importance factor for cyclonic region)	1.00
	Design wind speed at terrace level Vz in m/s	= K1 x k2 x k3 x k4 x Vb = 1 x**0.813** x 1x1.00 x 44 = 35.772 m/s
	Wind pressure at terrace level	= 0.6 x Vz ^{2} = 0.6 x 35.772^2 = 767.78
d)	Shape factor (force coefficient) Cf As per IS875-Part-3-Fig no. 4A	h/b = 3.50 a/b = 0.851 Cf = 1.3
e)	Gust factor calculations	Calculations Attached
f)	Wind tunnel test	Not Applicable

p) Base shear and Maximum Deflection due to wind loads

No.	Loading Type	Wind Base Shear (KN)		Deflection (MM)		Story Drift (%)	
		X	Y	X	Y	X	Y
1	Static	8378.03	6912.40	215.082	110.255	0.3008	0.1718
				H/573	H/1117	18th floor	16th floor
2	Gust	10182.796	8165.366	283.047	137.001	0.3637	0.1978
				H/435	H/899	18th floor	16th floor

7. E.1). **GUST WIND LOAD CALCULATIONS – in X direction:-**

H	=	Total height of main structure of the building in meters above Ground level	=	**123.20**	m
B	=	Breadth of a structure in the horizontal plane normal to wind direction	=	**35.15**	m
D	=	Maximum base dimension of building in meters In a direction parallel to the applied wind force.	=	**29.80**	m
T_x	=	Time period of building /structure in along wind direction (1st Mode)	=	**5.585**	Sec
f_{ax}	=	I/T	=	**0.179**	Cyc/Sec
g_R	=	Peak factor for resonant response	=	**3.597**	
β	=	Damping Coefficient Bolted Steel/RCC Structure	=	**0.02**	
k_1	=	probability factor(risk coefficient)	=	**1**	
k_2	=	terrain roughness and height factor	=	**0.813**	
k_3	=	topography factor	=	**1**	
k_4	=	importance factor for cyclonic region All other structures	=	**1**	
V_b	=	Regional wind basic speed, for Mumbai	=	**44**	m/s
V_{hd}	=	Design Hourly mean wind speed at height z			
	=	$V_{hd} = V_b\ k_1\ k_2\ k_3\ k_4$	=	**35.781**	m/s
p_z	=	wind pressure at height z			
	=	0.60 V_{hd}^2	=	**768.159**	N/m2
K_d	=	Wind directionality factor	=	**0.9**	
K_a	=	Area Averaging Factor	=	**1**	
K_c	=	Combination Factor	=	**1**	
p_d	=	Design Wind Pressure			
	=	$K_d\ K_a\ K_c\ p_z$	=	**691.343**	N/m2
L_h	=	Measure of effective turbulence length scale at height h	=	**159.247**	
		Category 3			
N	=	Effective reduced frequency	=	**0.797**	
E	=	Spectrum of turbulence in the approaching wind stream	=	**0.103**	
b_{0h}	=	Average breadth of building between 0 to h	=	**35.15**	m
S	=	Size reduction factor	=	**0.186**	
H_s	=	Height Factor for resonance response	=	**2**	

g_v	=	Peak factor for upwind velocity fluctuation	=	**4**	
z_{oi}	=		=	**0.2**	
$I_{h,i}$	=	Turbulence intensity at height h in terrain category i	=	**0.150**	
r	=	roughness factor	=	**0.299**	
B_s	=	Background Factor	=	**0.870**	
ϕ	=	factor to account for second order turbulence intensity	=	**0.279**	
Gx	=	Gust Factor $1+r\sqrt{([g_v^2.B_s(1+\phi^2)]+[H_s g_r^2 SE/\beta])}$	=	**3.062**	

7. E.2). **GUST WIND LOAD CALCULATIONS – in Y direction:-**

H	=	Total height of main structure of the building in meters above Ground level	=	**123.20**	m
B	=	Breadth of a structure in the horizontal plane normal to wind direction	=	**29.80**	m
D	=	Maximum base dimension of building in meters In a direction parallel to the applied wind force.	=	**35.15**	m
T_y	=	Time period of building /structure in along wind direction (2^{nd} Mode)	=	**4.224**	Sec
f_{ax}	=	I/T	=	**0.237**	Cyc/Sec
g_R	=	Peak factor for resonant response	=	**3.674**	
β	=	Damping Coefficient Bolted Steel/RCC Structure	=	**0.02**	
k_1	=	probability factor(risk coefficient)	=	**1**	
k_2	=	terrain roughness and height factor	=	**0.813**	
k_3	=	topography factor	=	**1**	
k_4	=	importance factor for cyclonic region All other structures	=	**1**	
V_b	=	Regional wind basic speed, for Mumbai	=	**44**	m/s
V_{hd}	=	Design Hourly mean wind speed at height z			
	=	$V_{hd} = V_b\ k_1\ k_2\ k_3\ k_4$	=	**35.781**	m/s
p_z	=	wind pressure at height z			
	=	$0.60\ V_{hd}^2$	=	**768.159**	N/m2
K_d	=	Wind directionality factor	=	**0.9**	
K_a	=	Area Averaging Factor	=	**1**	
K_c	=	Combination Factor	=	**1**	
p_d	=	Design Wind Pressure			
	=	$K_d\ K_a\ K_c\ p_z$	=	**691.343**	N/m2
L_h	=	Measure of effective turbulence length scale at height h	=	**159.247**	
		Category 3			
N	=	Effective reduced frequency	=	**1.054**	
E	=	Spectrum of turbulence in the approaching wind stream	=	**0.086**	
b_{0h}	=	Average breadth of building between 0 to h	=	**29.80**	m
S	=	Size reduction factor	=	**0.145**	
H_s	=	Height Factor for resonance response	=	**2**	

g_v	=	Peak factor for upwind velocity fluctuation	=	**4**	
z_{oi}	=		=	**0.2**	
$I_{h,i}$	=	Turbulence intensity at height h in terrain category i	=	**0.150**	
r	=	roughness factor	=	**0.299**	
B_s	=	Background Factor	=	**0.887**	
ϕ	=	factor to account for second order turbulence intensity	=	**0.282**	
Gy	=	Gust Factor $1+rV([g_v^2.B_s(1+\phi^2)]+[H_s g_r^2 SE/\beta])$	=	**2.897**	

8) Data from Dynamic Analysis

TABLE: Modal Participating Mass Ratios

Mode	Period	Frequency	X-Participation	Y-Participation	RZ-Participation	Sum UX (%)	Sum UY (%)	Sum RZ (%)
	sec		X-Translation	Y -Translation	Rotation			
1	5.585	0.179051	45.7	0.04	10.53	45.7	0.04	10.53
2	5.214	0.191791	10.74	3.13	34.17	56.44	3.17	44.7
3	4.224	0.236742	0.53	53.19	1.05	56.97	56.36	45.74
4	1.663	0.601323	8.5	0.04	5.32	65.48	56.41	51.07
5	1.371	0.729395	6.63	0.61	8.19	72.11	57.02	59.26
6	1.132	0.883392	0.11	15.46	0.38	72.21	72.48	59.64
7	0.87	1.149425	4.1	0.04	6.35	76.31	72.53	65.99
8	0.642	1.557632	4.82	0.02	6.55	81.13	72.54	72.54
9	0.57	1.754386	2.55	0.06	4.97	83.68	72.61	77.52
10	0.546	1.831502	0.01	9.05	0.77	83.69	81.66	78.29
11	0.406	2.463054	0.2	0.000536	6.68	83.89	81.66	84.97
12	0.393	2.544529	5.02	0.003004	0.3	88.91	81.66	85.27
13	0.346	2.890173	0.000515	5.81	0.09	88.91	87.48	85.36
14	0.298	3.355705	0.01	0.003726	0.08	88.92	87.48	85.44
15	0.295	3.389831	0.3	0.02	1.61	89.23	87.5	87.05
16	0.287	3.484321	0.01	0.000555	0.001358	89.23	87.5	87.05
17	0.283	3.533569	0.00012	0.04	0.003947	89.23	87.54	87.06
18	0.272	3.676471	0.2	0.01	0.06	89.43	87.55	87.11
19	0.271	3.690037	2.2	0.02	1.1	91.63	87.56	88.21
20	0.245	4.081633	8.73E-05	2.9	0.05	91.63	90.46	88.25
21	0.236	4.237288	0.002945	0.1	0.000201	91.63	90.56	88.25
22	0.227	4.405286	0.31	0.02	0.5	91.95	90.58	88.76
23	0.22	4.545455	0.1	0.02	0.02	92.05	90.6	88.78
24	0.201	4.975124	0.06	0.12	0.03	92.11	90.72	88.8
25	0.191	5.235602	1.22	0.01	0.01	93.33	90.74	88.81
26	0.184	5.434783	0.04	1.34	0	93.37	92.07	88.81
27	0.173	5.780347	0.01	0.21	0.01	93.38	92.28	88.82
28	0.153	6.535948	1.54	0.02	0.56	94.92	92.3	89.39
29	0.137	7.29927	0.000548	1.4	0.01	94.92	93.7	89.4
30	0.128	7.8125	0.000208	0.21	0.003322	94.92	93.91	89.4
31	0.098	10.20408	1.56	0.45	1.33	96.49	94.36	90.73
32	0.096	10.41667	0.21	2.17	0.28	96.7	96.53	91.01
33	0.091	10.98901	0.01	0.25	0.02	96.71	96.78	91.03
34	0.052	19.23077	2.63	0.02	0.01	99.34	96.8	91.04
35	0.051	19.60784	0.03	2.49	0.02	99.37	99.29	91.06
36	0.047	21.2766	0.00134	0.13	0.00021	99.37	99.42	91.06

9) Table for diaphragm displacement at Terrace Level

Load Case	Dx-Max (MM)	H/Dx	Drift-X %	Dy-Max (MM)	H/Dy	Drift-Y %
DL	13.206	H/9973	0.0302	11.609	H/11345	0.037
DL+LL	13.523	H/9739	0.0336	13.96	H/9434	0.0431
SPEC 1	110.34	H/1194	0.1298	12.322	H/10688	0.0652
SPEC 2	9.765	H/13487	0.0592	60.545	H/2175	0.0892
WX	215.082	H/573	0.2447	11.397	H/10810	0
WY	8.207	H/15012	0	110.255	H/1117	0.1214

10) Table for Torsion irregularity

a) (along X-direction)

Load case	Corner - 1	Corner - 2	Corner - 3	Corner - 4	Avg-X	% = Max/Avg	Max/Min
SPEC1	122.932	119.506	142.552	142.582	131.893	1.081	1.193
WX	295.742	285.353	162.94	162.945	226.745	1.304	-

b) (along Y-direction)

Load case	Corner - 1	Corner - 2	Corner - 3	Corner - 4	Avg-Y	% = Max/Avg	Max/Min
SPEC2	64.647	64.908	96.01	67.665	73.307	1.309	1.485
WY	85.266	121.255	168.168	73.925	112.153	1.499	-

11) Data regarding Vertical Elements.

a)	Maximum loaded column/shear wall no.	FP5
b)	size column/shear wall in mm	600 X 6270
c)	Factored Gravity load on col./wall in KN	53457.73 kN
d)	Factored Axial stress in max. loaded column	14.21 N/mm2
e)	Grade of max. loaded column at base	M60
f)	Unfactored Axial settlement in max. loaded column/wall	$\delta = \frac{PL}{AE} = \frac{53457 \times 10^3 \times 3500}{1.5x3.762 \times 10^6 \times 38729 .83}$ = 0.856 mm
g)	Minimum loaded column/Shear wall no.	FP20 (450X710)
h)	Unfactored Axial settlement in Minimum loaded column/wall	$\delta = \frac{PL}{AE} = \frac{4105 \times 10^3 \times 3500}{1.5x0.3195 \times 10^6 \times 38729 .83}$ = 0.774 mm
i)	% Base-shear resisted by all walls along X (static)	100%
j)	% Base-shear resisted by all walls along Y (static)	100%

12) Data for each cantilever.-

Buildings	
Cantilever span in meter	1.33 M
Beam Size	200 X 700
Nature of class	Supporting bedroom
Maximum elastic deflection under gravity load in mm	1.415

13)	Provide stability calculations for uplift and overturning (model extract in case of model)	No Columns/walls is in tension.
14)	Typical design calculations for footings	Attached below.
15)	Typical design calculations for RCC Column	Attached below.
16)	Typical design calculations for RCC beams	Attached below.
17)	Typical design calculations for Steel Bracings	N.A

18)	Wind tunnel studies shall be conducted for any HRB with total height beyond normal ground level exceeding 250 mt. Wind tunnel studies shall include modeling of all surrounding obstacles in the area. The report from study should be submitted.	NA
19)	Provide a note on special provisions suggested for the building (like dampers etc.)	N.A
20)	Soft copy of model including input and output.	Yes
21)	Soft copy of Power point presentation including all above points.	Yes
22)	Items 1 to 21 on CD.	Yes

APPENDIX
DESCRIPTION OF SUB-STRUCTURE

Number of Basements		2
Minimum clearance between outermost basement retaining wall and compound wall		As per soil investigation report
Has a shoring system been installed? Submit section detail of the shoring system		As per soil investigation report
For Tower Area Dead Weight of tower Structure is much more than Hydrostatic Uplift		
Give details of methodology used to resist uplift pressure due to ground water for tower portion.	Bottom Level of Raft w.r.t. ground level in mts.	10.50m
	Total downward load of self-weight of raft + Counter weight over raft	48.25 kN/m2
	Water level assumed for uplift calculation for Non Tower Area	2 m below ground level

DESCRIPTION OF THE FOUNDATION FOR THE TOWER BLOCK

Rock Anchors		NA
Nature of Foundation		RAFT FOUNDATION
SBC assumed T/sq.mt.		300 T/M2
Sub-grade Elastic Modulus		25000 T/m3
Pile dia with capacity		-
Flooring system of the Basements		Tremix Concrete Floor
Retaining wall types , Diaphragm Wall & Sequence of backfilling	Whether propped cantilever, Cantilever Supported between Buttresses / Counter forts, etc.	Propped cantilever Back Filling should be done after casting of respective basement slabs.
Intended Use of basements		Parking and Services
If rock anchors are used, are they grouted after installation and stressing?		NA
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?		N.A.
Whether Expansion/Separation joints provide?		YES. Provided in Non-Tower Area.
Whether expansion joint/separation joint continues through basement?		YES

DESCRIPTION OF STRUCTURE

No. of Floors	43 Floor slabs
Shape Of Building, Plan, Elevation whether Symmetric in Elevation	Not Symmetric in elevation.
Maximum plan dimension in M	54.19 M
Ratio of Plan dimension	1.55
Typical Floor to floor height in mt. Maximum floor to floor height in entire height of building in mt.	1st Residential floor – 4.35 m 2nd to 36th -Typical floors – 2.90 m
Aspect Ratio (Ht. of building till terrace/Minimum dimension of building	131.70 / 29.93 = 4.400
Type of floor slab	Conventional Slab and Beam
Average slab thickness	150mm
Whether Wall are RCC, Composite or In structural steel	RCC shear walls
Lateral System Whether the Geometry of Building is Symmetric	NO
Whether the lateral load resisting system is symmetrically placed in Geometry	NO
Use of floor at different levels (Residential / Commercial / industrial)	Residential and Parking as per Architectural plan
Is there any Transfer level If yes, depth of Transfer Girder	NA
Whether Expansion joint is provided? If yes, what is the maximum plan dimension in mt.	NA
Whether separation gap is sufficient joint is provide?	NA
Maximum cantilever projection in mt. (Chajja)	0.75 m

SAMPLE ELEMENT CALCULATIONS

FENELIA

SAMPLE BEAM CALCULATION

Group		**: G75**	
Beam No		**: B88**	
Analysis Reference (Member)	Story7	: B165	
Beam Length		: 6610	mm
Breadth (B)		: 200	mm
Depth (D)		: 700	mm
Effective Depth (d)		: 645	mm
Design Code		: IS 456	
Beam Type		: Regular Beam	
Grade Of Concrete (Fck)		: M40	N/sqmm
Grade Of Steel		: Fe500	N/sqmm
Clear Cover (Cmin)		: 25	mm
Es		: 2x10^5	N/sqmm

Flexure Design

	Beam Bottom			Beam Top		
	Left	**Mid**	**Right**	**Left**	**Mid**	**Right**
Critical L/C - Analysis	108.(1.5DL-1.5WX+1.5AWXY)	117.(1.5DL+1.5LL)	107.(1.5DL+1.5WX-1.5AWXY)	114.(1.5DL-1.5GWX)	80.(1.5DL-1.5SPEC1+0.45SPEC3)	80.(1.5DL-1.5SPEC1+0.45SPEC3)
Critical L/C - RCDC	36	61	46	12	1	1
Mu (kNm)	116.961	197.261	110.42	-	-	-
Tu (kNm)	0.682	0.937	0.82	0.736	0.984	0.6
M_{Tu} (kNm)	1.81	2.48	2.16	1.95	2.6	1.59
Mud (kNm)	118.77	199.74	112.58	1.95	2.6	1.59
MuLim (kNm)	443	443	443	443	443	443
R	1.427	2.401	1.353	0.023	0.031	0.019
Ptmin (%)	0.17	0.17	0.17	0.1	0.1	0.1
Ptclc (%)	0.343	0.597	0.324	0.1	0.1	0.1
Pcclc (%)	0	0	0	0.005	0.007	0.004
PtPrv (%)	0.623	0.623	0.623	0.122	0.122	0.122
AstCalc (sqmm)	442.35	769.58	418.3	129	129	129
AstPrv (sqmm)	804.24	804.24	804.24	157.08	157.08	157.08
Reinforcement	2-T16 2-T16	2-T16 2-T16	2-T16 2-T16	2-T10	2-T10	2-T10

Shear Design

	Left	**Mid**	**Right**
Critical L/C - Analysis	108.(1.5DL-1.5WX+1.5AWXY)	108.(1.5DL-1.5WX+1.5AWXY)	107.(1.5DL+1.5WX-1.5AWXY)
Critical L/C - RCDC	36	36	46
PtPrv (%)	0.623	0.623	0.623
Vu (kN)	109.215	66.816	101.677
Tu (kNm)	0.682	0.793	0.606
V_{Tu} (kN)	5.46	6.34	4.85
Vut (kN)	114.67	73.16	106.52
Tv (N/sqmm)	0.89	0.57	0.83
Tc (N/sqmm)	0.56	0.56	0.56
Vc (kN)	71.95	71.95	71.95
Vus=Vut-Vc (kN)	42.72	1.21	34.57
Legs	2	2	2
Stirrup Rebar	8	8	8
Asv Torsion (sqmm)	213.097	142.612	197.42
Asv Torsion Prv (sqmm)	670.27	670.27	670.27
Asv Reqd (sqmm)	221.576	221.576	221.576
SvCalc (mm)	150	150	150
SvPrv (mm)	150	150	150
Asv Total Prv (sqmm)	670.27	670.27	670.27

Maximum Spacing Criteria

Basic

Spc1 =0.75d	= 484	mm
Spc2	= 300	mm

For Torsion

(X1 = 160, Y1 = 660)

Spc3 = X1	= 160	mm
Spc4=(X1+Y1)/4	= 200	mm

SFR Design

Beam Width	= 200	mm
Beam Depth	= 700	mm
Torsion	= 0.79 > 0	kNm
	Beam Depth >750 Or Torsion > 0, Hence SFR Provided	
	= 140	sqmm
SFR Provided	= 3-T8EF	
ASFR Provided	= 301.62	sqmm

Spacing Criteria

Provided Spacing	= 148	mm
1.<= beam Width	= 200	mm
2. Not Greater Than	= 300	mm

SAMPLE COLUMN/SHEAR WALL CALCULATION

General Data

Wall No.	:	P5	
Level	:	BASEMENT 2 To BASEMENT 1	
Design Code	=	IS 456 - 2000 + IS 13920 - 2016	
Grade Of Concrete	=	M60	N/sqmm
Grade Of Steel	=	Fe500	N/sqmm
Wall B	=	600	mm
Wall D	=	5120	mm
Clear Cover	=	50	mm
Clear Floor Height @ B	=	3900	mm
Clear Floor Height @ D	=	4000	mm
No Of Floors	=	1	
No Of Walls In Group	=	1	
Wall Type	:	Braced	
Minimum eccentricity check	:	One Axis at a Time	

Load Data

Analysis Reference No.	=	P5	
Critical Analysis Load Combination	:	116.(1.5DL-1.5GWY)	
Load Combination	=	[23] : 1.5 (DEAD) +1.5 (SDL) -1.5 (GWY)	
Critical Location	=	Bottom Joint	
Put (top joint)	=	38990.28	kN
Muxt (top joint)	=	-38086.7	kNm
Muyt (top joint)	=	-60.95	kNm
Vuxt (top joint)	=	36.23	kN
Vuyt (top joint)	=	-181.41	kN
Pub (bottom joint)	=	39639.22	kN
Muxb (bottom joint)	=	-38921.18	kNm
Muyb (bottom joint)	=	105.73	kNm
Vuxb (bottom joint)	=	36.23	kN
Vuyb (bottom joint)	=	-181.41	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N/m	mm	mm	N/m	N/m	
Bottom	226010.011	No Beam	No Beam	-	-	1
Top	226010.011	No Beam	No Beam	-	-	0.998

Sway Condition (as per Stability Index)	=	Sway
Effective Length Factor along Major Axis	=	1

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N/m	mm	mm	N/m	N/m	
Bottom	3103.775	No Beam	No Beam	-	-	1
Top	3103.775	No Beam	No Beam	-	-	0.874

Sway Condition (as per Stability Index)	=	Non Sway

Effective Length Factor along Minor axis	=	1	

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in X-direction

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
	=	178.67	mm
Minimum Eccentricity	>	20	mm
Mminx (top)	=	Pu x Minimum Eccentricity	
	=	6966.26	kNm
Mminx (bottom)	=	Pu x Minimum Eccentricity	
	=	7082.21	kNm

Slenderness Check

Max Slenderness Ratio(L/B)	=	6.5	
	<	60	(Hence Ok)

Column Is Braced Along D

Slenderness Check Along D:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / D	
	=	0.78, Wall not Slender Along D	

Column Is Braced Along B

Slenderness Check Along B:

Effective Length Factor	=	1	
Slenderness Ratio	=	Effective Length / B	
	=	6.5, Wall not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Minit	Mslndx (Abs)	Mdesign-final
	A	B	C	D	E	F
Major Axis Mux (top)	-38086.7	6966.26	-38086.7	---	0	-38086.7
Major Axis Mux (bottom)	-38921.18	7082.21	-38921.18	---	0	-38921.18
Minor Axis Muy (top)	-60.95	---	-60.95	---	0	-60.95
Minor Axis Muy (bottom)	105.73	---	105.73	---	0	105.73

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

D = Initial moment = 0.4 x Min (top, bottom) ± 0.6 x Max (top, bottom) [As per sign requirement]

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	39639.22	kN
Mux	=	-38921.18	kNm
Muy	=	105.73	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.78	
Reinforcement Provided	=	106-T32	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	1.62	deg
MRes	=	38936.78	kNm
MCap	=	89419.75	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.44 <= 1	

Design Of Shear

Design for shear along D

Critical Analysis Load Combination	:	83.(1.5DL+1.5SPEC2-0.45SPEC3) MAX	
Critical Load Combination	=	[28] : 1.5 (DEAD) +1.5 (SDL) +0.45 (SPEC3) +1.5 (SPEC2)	
Design shear force, Vuy	=	2020.5147	kN
Pu	=	40525.44	
	=	0.8221	N/sqmm
Pt	=	1.388	%
Design shear strength, Tc	=	0.8033	N/sqmm
Shear Strength Enhancement Factor	=	1 + 3 x Pu / (B x D x Fck)	
	=	1.6596	

Shear Strength Enhancement Factor (max)	=	1.5	
Shear Strength Enhancement Factor	=	1.5	
Enhanced shear strength, Tc-e	=	1.2049	N/sqmm
Design shear check	=	Tvy < Tc x Enhancement factor	

Link for Shear Design along D are not required

Design for shear along B

Critical Analysis Load Combination	:	80.(1.5DL-1.5SPEC1+0.45SPEC3) MAX	
Critical Load Combination	=	[3] : 1.5 (DEAD) +1.5 (SDL) +1.5 (SPEC1) +0.45 (SPEC3)	
Design shear force, Vux	=	194.7633	kN
Pu	=	41277.73	
Design shear stress, Tvx	=	Vux / (B x 0.8 xD)	kN
	=	0.0792	N/sqmm
Pt	=	1.388	%
Design shear strength, Tc	=	0.8033	N/sqmm
Shear Strength Enhancement Factor	=	1 + 3 x Pu / (B x D x Fck)	
	=	1.6718	
Shear Strength Enhancement Factor (max)	=	1.5	
Shear Strength Enhancement Factor	=	1.5	
Enhanced shear strength, Tc-e	=	1.2049	N/sqmm
Design shear check	=	Tvx < Tc x Enhancement factor	

Link for Shear Design along B are not required

Design Of Links

Main Links

Links in the zone where special confining links are not required

Normal Links

Min. Horizontal Reinforcement	= 0.25% of cross sectional area	
	= 1500	sqmm
Diameter of main horizontal steel	= 10	mm
Thus, Spacing	= 100	mm
Spacing of horizontal reinforcement is minimum of following		
D / 5	= 1024	mm
3 x B	= 1800	mm
Maximum	= 450	mm
Spacing considered	= 100	mm

Special confining reinforcement as per IS 13920 - 2016

Min. Lateral dimension of column, B	= 600	mm
B/4	= 150	mm
Hence Link spacing, S	= 100	mm
Hoop dimension, h	169	
Gross area of column, Ag	= B x(Z1 + cover + Dia Z1 / 2)	
	= 3072000	sqmm
Core area of column, Ak	= (B - 2 x cover to Link) x (Z1 - cover + Dia Z1 / 2 + Link)	
	= 2620800	sqmm
Area of special confining link, Ash	= 0.18 x S x h x (Fck/Fy) x (Ag/Ak-1)	
	= 62.85	sqmm
Diameter of special confining link	= 10	mm
	= > Max. longitudinal bar dia / 4	
	= 8	mm
Area of horizontal steel provided	= Area of bar provided x 1000 x 2 / spacing	
	= 1570.8	(sqmm)/ m height
	= 0.2618	%
	= > min. steel required 0.2%	

Special confining links to be provided along full height in BE.

Table For Links

Note: Ductile Design Of Links Is Applicable Only For Boundary Elements

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	10	---	10	10	10
Spacing	100	---	100	100	100

Secondary Links:

In Boundary element	T8@100c/c
In Mid-zone	T8@100c/c

SAMPLE RAFT CALCULATION

ANALYSIS DONE BY SOFTWARE.

Max. Positive BM at face of Column in X direction = 3286 KN-m`

D = 2000 mm

d = 1950 mm

$$Ast = \frac{0.5\,X\,40}{500}[1-\sqrt{1-\frac{4.6\,X\,3286\;X\,10^{6}}{40\,X\,1000\;X\,1950^{2}}}]1000\;X\,1950$$

= 3977 mm²

Provided tor 25 @200C/C in 1st layer @ btm

Provided tor 20 @200C/C in 2nd layer @ btm

Max. Positive BM at face of Column in Y direction = 2321 KN-m

D = 2000 mm

d = 1950 mm

$$Ast = \frac{0.5\,X\,40}{500}[1-\sqrt{1-\frac{4.6\,X\,2321\;X\,10^{6}}{40\,X\,1000\;X\,1950^{2}}}]1000\;X\,1950$$

= 2787 mm²

Provided tor 25@175C/C in 1st layer @ btm

Max. Negative BM at face of Column in X direction = 2150 KN-m`

D = 2000 mm

d = 1950 mm

$$Ast = \frac{0.5\,X\,40}{500}[1-\sqrt{1-\frac{4.6\,X\,2150\;X\,10^{6}}{40\,X\,1000\;X\,1950^{2}}}]1000\;X\,1950$$

= 2579 mm²

Provided tor 25@200C/C in 1st layer @ top

Max. Negative BM at face of Column in Y direction = 2026 KN-m`

D = 2000 mm

d = 1950 mm

$$Ast = \frac{0.5\,X\,40}{500}[1-\sqrt{1-\frac{4.6\,X\,2026\;X\,10^{6}}{40\,X\,1000\;X\,1950^{2}}}]1000\;X\,1950$$

= 2440 mm²

Provided tor 25@200C/C in 1st layer @ top