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STRUCTURAL DESIGN BASIS REPORT

FOR

PROPOSED CONSTRUCTION OF COMMERCIAL OFFICE BUILDING OF BASEMENT + STILT FLOOR + 3 FLOORS AT S.NO.14/2C1B2 AT EGATTUR VILLAGE, THIRUPORUR TALUK, CHENGALPATTU DISTRICT, CHENNAI.

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R0– 28 FEBRUARY. 2025

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SE Grade-I DTCP (R.No:CGLRGN/SE/Gr-I/2019/06/15)
36, Suppa Colony, Guindy, Ch-32. 9952046424

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1. INTRODUCTION

The proposed development consists of **1 Basement +Stilt + 3 Floors + Terrace**. Tower is mean for use as commercial apartments. The Basement Floor to be used as Parking Area & for Services. The 1st to 3th floors are to be used for office purposes. Lift machine rooms are above the terrace level.
The Structural system for building consists of column, shear walls, PT/RC beams & PT/RC slabs. Shear walls are the part of Lateral Load Resistance system.

The floor to floor height of respective floors is as shown below.

Floor level	Floor to Floor Ht (m)
Basement	3.80
Ground Floor	4.20
1st Floor to 3rd Floor	4.00

The total height of building up to Terrace level is 16.2 meter (excluding parapet) from Ground Floor level.

2. DESIGN LOADS

2.1 Material Dead Loads as per IS875 (part-1) :

The self-weight of the various elements are computed based on the built weight of materials as given below.
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 Saturated Soil = 20 kN/m^3
Density of Water = 10 kN/m^3
Density of light weight Masonry = 10 kN/m^3
Density of Plum Concrete = 24 kN/m^3

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2.2 Weight of Walls:

External Light weight Wall with 200 thk = 2.51 kN/m^2

Internal Light weight Wall with 100 thk = 1.41 kN/m^2

Typical calculations for wall load:

External Wall with 200 thick Light Weight wall

Light wall Density = 10 kN/ cu. meter

Plaster Density = 20.4 kN/ cu. meter

Plaster thickness = 25mm (Internal + External)

Wall Load = (0.20x10+0.025x20.4) = 2.51 KN/m^2

Internal Wall with 100 thick Light Weight wall

Light wall Density = 10 kN/ cu. meter

Plaster Density = 20.4 kN/ cu. meter

Plaster thickness = 20mm (Internal + External)

Wall Load = (0.10x10+0.020x20.4) = 1.41 KN/m^2

Note: For localized design of slabs, wall loading shall be applied as per actual layout.

2.3 DEAD& LIVE LOADS:

The construction load, super imposed dead load that are envisaged to act permanently (wherever applicable) as per IS:875(part-1)–1987 & Live loads for each occupancy category as per IS:875(part-2)–1987 and Live load reduction is considered as per IS:875(part-2) CL.3.2.

2.3.1 PARKING AREA

Description		KN/m^2
Dead Load	Slab & beam	Self-weight
Superimposed Dead Load	Floor Finishes including screed (50mm Thk Tremix)	1.0
Live Load	Parking Area	4.0

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2.3.2 1ST TO 3RD TYPICAL COMMERCIAL FLOORS

Description		KN/m^2
Dead Load	Slab & Beam	Self-weight
Superimposed Dead Load	Floor Finishes	1
	Toilet Sunk 200 mm (Including Finish)	2
	Partition Wall	1
Live Load	Offices	4
	Toilet	2
	Corridors, Passages, Staircase including fire escapes, Lift lobbies,	4

2.3.3 TERRACE LEVEL

Description		
Dead Load	Slab & Beam	Self-weight
	Water proofing & Floor Finishes including screed (150mm)	3.00 KN/m^2
Live Load	Live	1.50 KN/m^2

Description		
	Lift Machine Room	400KN per lift (as per architectural drawings)
	Head Room	800KN (Including Self Weight)

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2.4 WIND LOADS

The wind pressure is calculated on the basis of data furnished below and other provisions laid in IS875 (Part-3) – 2015

Basic Wind Speed	V_b	=	39 m/sec
Risk Coefficient	K_1	=	1 (Based on 50 years return period)
Terrain, Height Factor	K_2	=	1 (as per Table 2 of IS: 875 (Part 3) – 2015)
Terrain Category		=	II
	K_3	=	1
	K_4	=	1

Design Wind Speed (V_z)

$V_z=V_b \times K_1 \times K_2 \times K_3 \times K_4$

Where,
V_b =Basic Wind Speed
K_1 = Risk Co-efficient for different classes of structures in different wind speed zones.
K_2 = Terrain roughness & height factor.
K_3 = Topography factor.
K_4 = Importance factor for cyclonic region.

Design Wind Pressure

$Pz = 0.6Vz^2$

2.4.1 GUST FACTOR

Gust factor method shall be used as per clause No. 10.0 IS 875 (part 3) - 2015. (If required.)

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2.5 EARTHQUAKE LOAD

The loading due to earthquake is assessed as per the provisions of IS: 1893 (Part-1):2016

Seismic Zone		=	III
Soil type		=	I
Table-2	Zone factor (Z)	=	0.16
Table-6	Importance Factor (I)	=	1.0
Table-7	Response Reduction Factor (R)	=	5.0
	Height of buildings (H)	=	16.2 m

Height of building considered from footing level for time period calculation.

Fundamental natural time period (Ta)

Ta(x) = 0.09H / √ d from CL.7.6.1– IS1893 (part – I):2016

Ta(y) = 0.09H / √ d from CL.7.6.1 – IS1893 (part – I):2016

Sa/g from FIG-2 IS 1893 (part I):2016.

Horizontal Seismic Co-Efficient

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

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

Dynamic analysis is performed using response reduction as per IS-1893(2016) Clause 7.7.

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3. CHECK FOR LATERAL SWAY AS PER IS 456-2000 & IS 1893-2016

It is generally recognized that absolute sway is not a perceivable parameter; however, limiting sway is used to provide a reasonable level of stiffness and in order to limit damage to non-structural elements as well as limit size of curtain wall joints, etc.

Generally tall building lateral load resisting systems are sized on the basis of limiting overall lateral sways to limits of approximately Overall Height/500 under the 50 year return period wind loads, Overall Height/400 under the 20 year return period wind loads and Overall Height/250 under seismic loads.

4. CHECK FOR LATERAL SWAY (STOREY DRIFT) AS PER IS- 1893-2016

The allowable lateral sway (storey drift) due to earthquake force should not exceed L/250, Where L is the storey height

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5. BASIC LOAD CASES

The various loads are combined in accordance with the stipulations in IS: 875 (Part 5)-1987. Wherever imposed load is combined with earthquake load the appropriate part of the imposed

Load as specified in IS: 1893-2016 is adopted both for evaluating earthquake effect and for combined load effects, used in such combination.

5.1 Basic Load Cases

Load Case Type	Mark	Description
Primary	DL	SELF WEIGHT OF STRUCTURAL MEMBER
Primary	SDL	SUPERIMPOSED DEAD LOAD
Primary	LL1	LIVE LOAD =<3 kN/m^2 (Live 1)
Primary	LL2	LIVE LOAD > 3 kN/m^2 (Live 2)
Primary	LL3	NON REDUCIBLE LIVE LOAD
Primary	EQX	SEISMIC LOAD IN X DIRECTION
Primary	EQY	SEISMIC LOAD IN Y DIRECTION
Primary	WLX	WIND LOAD IN X DIRECTION
Primary	WLY	WIND LOAD IN Y DIRECTION
Primary	SLX	SEISMIC LOAD IN X DIRECTION
Primary	SLY	SEISMIC LOAD IN Y DIRECTION

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6. BASIC LOADS AND LOAD COMBINATIONS

The various loads are combined in accordance with the stipulations in IS: 875 (Part 5)-1987. Wherever imposed load is combined with earthquake load the appropriate part of the imposed load as specified in IS: 1893-2016 is adopted both for evaluating earthquake effect and for combined load effects, used in such combination.

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

7. ANALYSIS METHOD

The structure is analyzed for Static loads (both dead and live loads) and Lateral loads due to Earthquake/Wind loads and its combinations. Software used is E-Tabs version 21.0.0 & for foundation safe version 16.0.2.
The structure will be modeled as 3D space frame. Floor slabs shall be modeled as membrane elements for diaphragm effect only.

8. DESIGN METHODOLOGY

All structural members will be 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.
Limit state method is adopted for design of overhead water tanks by using IS-3370(2009)

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Proportionate	Total Area (sq.m)	UDS land Area	Car Parking		
			Covered	Open	

LIMITED

24

9. CONSTRUCTION DETAILS

1. Raft foundation -M: 30
2. Water Tanks -M: 30
3. Columns/Walls -M: 30
4. Beams & Slabs -M: 30

10. REINFORCEMENT

Steel reinforcement shall be of Grade Fe 500 conforming to IS: 1786-1985.

11. EXPOSURE CONDITION

Structural elements below ground level and Exterior External faces of walls are designed for severe exposure condition and internal faces of walls, floor beams and slabs are designed for Mild exposure conditions per Table 16 of IS 456-2000.

12. COVER TO REINFORCEMENT

As per Table 16A- IS 456-2000.

Member	Clear Cover (mm)
Foundation	75 mm
Column	40 mm
Shear Walls	40 mm
Beams	40 mm
Slabs	20 mm
Staircase waist slab	30 mm
Water Tanks	40 mm

S.No	Block	Floor	Flat No	Type	RERA Carpet Area	NEW RERA Carpet Area	Diff.	Exclusive Balcony	Exclusive Verandah	Proportionate	Total Area (sq.m)	UDS land Area

PROJECT : DRA CLOVER

RERA CARPET AREA STATEMENT - 09-01-2024

DRA AADITHYA SOUTH CITY PROJECTS PRIVATE LIMITED

13. FOUNDATION SYSTEM

The building has been supports on pile foundation. Pile capacities settlements considered as per soil investigation report provided by DR. RAM PRASAD Consultant

14. FIRE RATING

Fire rating of 2 hours is considered for columns and 1.5 hours for beam and slabs.

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15. CODES AND 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)-2015	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 Concrete
IS:1893 (Part-1)-2016	Indian Standard Criteria for Earthquake Resistant Design of Structures
IS:432 (Part-1)-1982	Specification of Mild Steel and Medium Tensile Steel bars and Hard drawn Steel Wire for concrete reinforcement -Mild Steel and Medium Tensile Steel Bars
IS:432 (Part-2)-1982	Specification of Mild Steel and Medium Tensile Steel bars and Hard drawn Steel Wire for concrete reinforcement -Hard drawn Steel Wire.
IS:1786-1985	Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement
IS:13920-2016	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.
IS:3370-2009	Indian Standard Code of practice for Concrete Structures for Storage of Liquids.
IS:1343-1980	Indian Standard Code of practice for Pre-stressed Concrete.

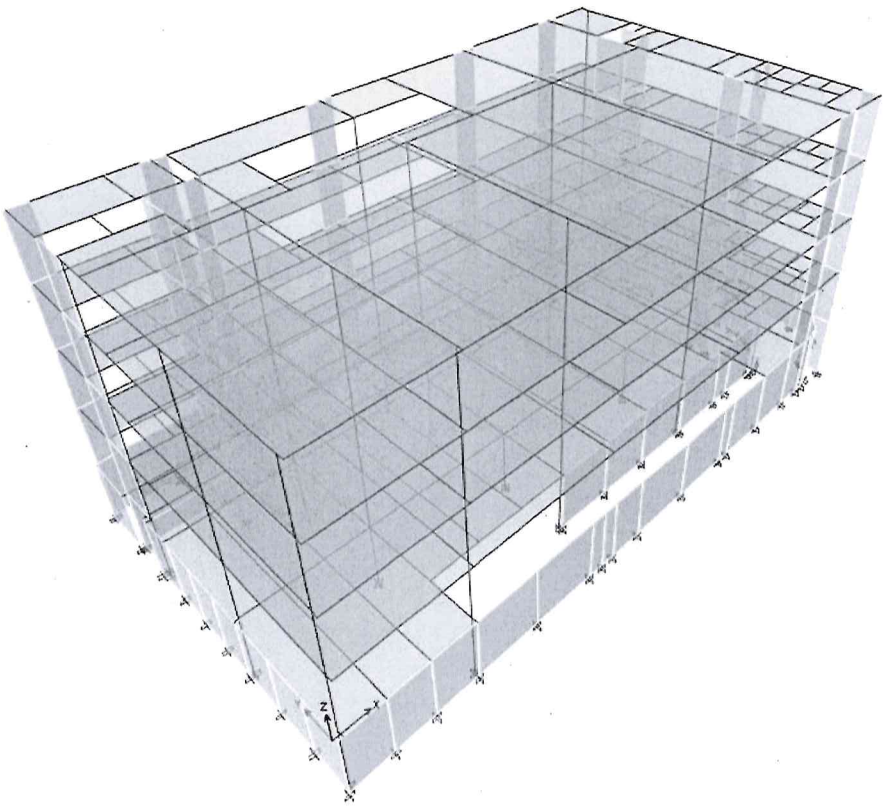
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1 Structure Data

This chapter provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

1.1 Story Data

Table 1.1 - Story Definitions

Tower	Name	Height m	Master Story	Similar To	Splice Story	Splice Height m	Color
T1	TERRACE FLOOR	4	Yes	None	No		Cyan
T1	THIRD FLOOR	4	Yes	None	No		Magenta
T1	SECOND FLOOR	4	No	THIRD FLOOR	No		Gray8Dark
T1	FIRST FLOOR	4	No	THIRD FLOOR	No		Green
T1	GROUND FLOOR	4.2	No	THIRD FLOOR	No		Red

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2 Loads

This chapter provides loading information as applied to the model.

2.1 Load Patterns

Table 2.1 - Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
Dead	No	Dead	1	
EQX	No	Seismic	0	IS 1893:2016
EQX(1/3)	Yes	Seismic	0	IS 1893:2016
EQX(2/3)	Yes	Seismic	0	IS 1893:2016
EQX(3/3)	Yes	Seismic	0	IS 1893:2016
EQY	No	Seismic	0	IS 1893:2016
EQY(1/3)	Yes	Seismic	0	IS 1893:2016
EQY(2/3)	Yes	Seismic	0	IS 1893:2016
EQY(3/3)	Yes	Seismic	0	IS 1893:2016
Finish	No	Super Dead	0	
Live<3	No	Reducible Live	0	
Live>3	No	Reducible Live	0	
LMROHWT	No	Super Dead	0	
Roof Live	No	Live	0	
Service load	No	Dead	1	
Sunk	No	Super Dead	0	
Wall	No	Super Dead	0	
WindX	No	Wind	0	Indian IS 875:2015
WindY	No	Wind	0	Indian IS 875:2015

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IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQX according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = User Specified

User Period — T = 0.23 sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] — Z = 0.16

Response Reduction Factor, R [IS Table 9] — R = 5

Importance Factor, I [IS Table 8] — I = 1

Site Type [IS Table 1] = I

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] $\frac{S_a}{g} = 2.5$ — $\frac{S_a}{g} = 2.5$

Equivalent Lateral Forces

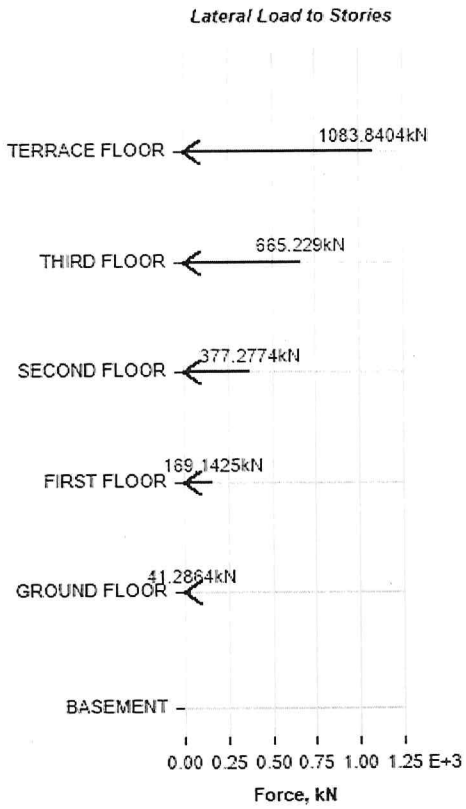
Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X	0.23	58419.3933	2336.7757
X + Ecc. Y	0.23	58419.3933	2336.7757
X - Ecc. Y	0.23	58419.3933	2336.7757

Applied Story Forces

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Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
TERRACE FLOOR	16.2	1083.8404	0
THIRD FLOOR	12.2	665.229	0
SECOND FLOOR	8.2	377.2774	0
FIRST FLOOR	4.2	169.1425	0
GROUND FLOOR	0.2	41.2864	0
BASEMENT	-4	0	0

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IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQY according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = Multiple

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = User Specified

User Period — $T = 0.306$ sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] — $Z = 0.16$

Response Reduction Factor, R [IS Table 9] — $R = 5$

Importance Factor, I [IS Table 8] — $I = 1$

Site Type [IS Table 1] = I

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] — $\frac{S_a}{g} = 2.5$ — $\frac{S_a}{g} = 2.5$

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2]

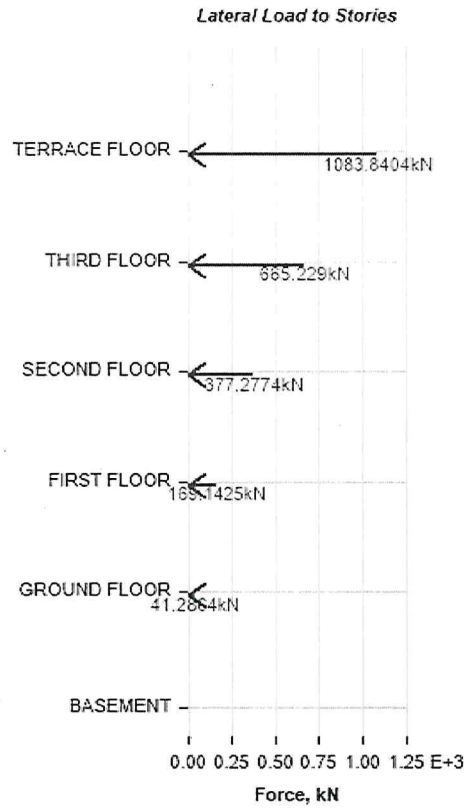
$$A_h = \frac{ZI\frac{S_a}{g}}{2R}$$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
Y	0.306	58419.3933	2336.7757
Y + Ecc. X	0.306	58419.3933	2336.7757
Y - Ecc. X	0.306	58419.3933	2336.7757

Applied Story Forces

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Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
TERRACE FLOOR	16.2	0	1083.8404
THIRD FLOOR	12.2	0	665.229
SECOND FLOOR	8.2	0	377.2774
FIRST FLOOR	4.2	0	169.1425
GROUND FLOOR	0.2	0	41.2864
BASEMENT	-4	0	0

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2.4 Load Cases

Table 2.4 - Load Case Definitions - Summary

Name	Type	Notes
Modal	Modal - Eigen	
Dead	Linear Static	
Live<3	Linear Static	
Live>3	Linear Static	
Roof Live1	Linear Static	
Finish	Linear Static	
Sunk	Linear Static	
Wall	Linear Static	
LMROHWT	Linear Static	
EQX	Linear Static	
EQY	Linear Static	
SPECX	Response Spectrum	
SPECY	Response Spectrum	
WindX	Linear Static	
WindY	Linear Static	
Service load	Linear Static	

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3 Analysis Results

This chapter provides analysis results.

3.1 Structure Results

Table 3.1 - Base Reactions (Part 1 of 2)

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m
Dead	LinStatic		-2.022E-06	-1.326E-06	38672.9458	422888.7467	-777135.0459	-8.371E-07	0
Live<3	LinStatic		-6.078E-07	0	952.027	14832.5545	-20286.2234	9.07E-06	0
Live>3	LinStatic		0	0	11409.9629	114036.7119	-229633.4751	-8.383E-06	0
Roof Live1	LinStatic		0	0	1214.9886	12548.9883	-25068.4204	0	0
Finish	LinStatic		0	0	5959.4351	63826.8324	-122523.2567	2.315E-06	0
Sunk	LinStatic		0	0	240.1605	1144.2922	-9265.5636	1.39E-06	0
Wall	LinStatic		-7.915E-07	-5.341E-07	8079.9371	89073.5109	-179393.0069	-1.983E-06	0
LMROHWT	LinStatic		0	0	2400	39668.1276	-50346.5332	-2.29E-06	0
EQX	LinStatic	Max	-2336.7758	8.257E-07	-3.551E-06	-0.0001	-38833.4431	27756.4612	0
EQX	LinStatic	Min	-2336.7758	6.548E-07	-3.703E-06	-0.0001	-38833.4431	25436.0762	0
EQY	LinStatic	Max	1.508E-06	-2336.7757	2.81E-06	38833.442	2.906E-05	-45564.1187	0
EQY	LinStatic	Min	1.273E-06	-2336.7757	2.542E-06	38833.442	2.359E-05	-49677.5197	0
SPECX	LinRespSpec	Max	2336.7769	633.8109	2.964E-06	9667.7379	30218.5695	23154.296	0
SPECY	LinRespSpec	Max	554.0756	2336.7815	2.405E-06	30413.4129	8637.9151	61341.0812	0
WindX	LinStatic		-775.7045	0	-7.999E-07	-1.901E-05	-9976.4375	8519.8903	0
WindY	LinStatic		5.557E-07	-1386.525	1.063E-06	17710.8	8.254E-06	-28419.3688	0
Service load	LinStatic		-2.022E-06	-1.326E-06	38672.9458	422888.7467	-777135.0459	-8.371E-07	0

Table 3.1 - Base Reactions (Part 2 of 2)

Y m	Z m
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4
0	-4

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3.2 Story Results

Table 3.2 - Story Max Over Avg Displacements

Story	Output Case	Case Type	Step Type	Direction	Maximum m	Average m	Ratio
TERRACE FLOOR	WindX	LinStatic		X	0.007881	0.007088	1.112
THIRD FLOOR	WindX	LinStatic		X	0.006051	0.005487	1.103
SECOND FLOOR	WindX	LinStatic		X	0.003818	0.003492	1.093
FIRST FLOOR	WindX	LinStatic		X	0.001471	0.001362	1.08
GROUND FLOOR	WindX	LinStatic		X	9.2E-05	8.7E-05	1.063
GROUND FLOOR	WindX	LinStatic		Y	2.1E-05	1E-05	2.028
TERRACE FLOOR	WindY	LinStatic		Y	0.010996	0.008677	1.267
THIRD FLOOR	WindY	LinStatic		Y	0.008395	0.006679	1.257
SECOND FLOOR	WindY	LinStatic		Y	0.005475	0.00442	1.239
FIRST FLOOR	WindY	LinStatic		Y	0.002543	0.002128	1.195
GROUND FLOOR	WindY	LinStatic		Y	0.00053	0.000493	1.076

Table 3.3 - Story Drifts

Story	Output Case	Case Type	Step Type	Direction	Drift	Drift/	Label	X m	Y m	Z m
TERRACE FLOOR	EQX	LinStatic	Max	X	0.002399		215	40.3812	-0.3615	16.2
TERRACE FLOOR	EQX	LinStatic	Min	X	0.00232		215	40.3812	-0.3615	16.2
TERRACE FLOOR	EQY	LinStatic	Max	Y	0.001957		215	40.3812	-0.3615	16.2
TERRACE FLOOR	EQY	LinStatic	Min	Y	0.001755		53	40.3812	7.9889	16.2
TERRACE FLOOR	SPECX	LinRespSpec	Max	X	0.00207		215	40.3812	-0.3615	16.2
TERRACE FLOOR	SPECX	LinRespSpec	Max	Y	0.001008		62	40.3812	6.8889	16.2
TERRACE FLOOR	SPECY	LinRespSpec	Max	X	0.000624		252	40.3812	22.3379	16.2
TERRACE FLOOR	SPECY	LinRespSpec	Max	Y	0.001749		53	40.3812	7.9889	16.2
THIRD FLOOR	EQX	LinStatic	Max	X	0.002699		215	40.3812	-0.3615	12.2
THIRD FLOOR	EQX	LinStatic	Min	X	0.002618		215	40.3812	-0.3615	12.2
THIRD FLOOR	EQY	LinStatic	Max	Y	0.002064		62	40.3812	6.8889	12.2
THIRD FLOOR	EQY	LinStatic	Min	Y	0.001855		62	40.3812	6.8889	12.2
THIRD FLOOR	SPECX	LinRespSpec	Max	X	0.002225		215	40.3812	-0.3615	12.2
THIRD FLOOR	SPECX	LinRespSpec	Max	Y	0.00103		62	40.3812	6.8889	12.2
THIRD FLOOR	SPECY	LinRespSpec	Max	X	0.000699		252	40.3812	22.3379	12.2
THIRD FLOOR	SPECY	LinRespSpec	Max	Y	0.001806		62	40.3812	6.8889	12.2
SECOND FLOOR	EQX	LinStatic	Max	X	0.002547		215	40.3812	-0.3615	8.2
SECOND FLOOR	EQX	LinStatic	Min	X	0.002477		215	40.3812	-0.3615	8.2
SECOND FLOOR	EQY	LinStatic	Max	Y	0.001891		53	40.3812	7.9889	8.2
SECOND FLOOR	EQY	LinStatic	Min	Y	0.001707		53	40.3812	7.9889	8.2
SECOND FLOOR	SPECX	LinRespSpec	Max	X	0.002096		215	40.3812	-0.3615	8.2
SECOND FLOOR	SPECX	LinRespSpec	Max	Y	0.000916		62	40.3812	6.8889	8.2
SECOND	SPECY	LinRespSpec	Max	X	0.000671		252	40.3812	22.3379	8.2

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Story	Output Case	Case Type	Step Type	Direction	Drift	Drift/	Label	X m	Y m	Z m
FLOOR										
SECOND FLOOR	SPECY	LinRespSpec	Max	Y	0.00165		53	40.3812	7.9889	8.2
FIRST FLOOR	EQX	LinStatic	Max	X	0.001379		215	40.3812	-0.3615	4.2
FIRST FLOOR	EQX	LinStatic	Min	X	0.001341		215	40.3812	-0.3615	4.2
FIRST FLOOR	EQY	LinStatic	Max	Y	0.001183		62	40.3812	6.8889	4.2
FIRST FLOOR	EQY	LinStatic	Min	Y	0.001078		62	40.3812	6.8889	4.2
FIRST FLOOR	SPECX	LinRespSpec	Max	X	0.001183		215	40.3812	-0.3615	4.2
FIRST FLOOR	SPECX	LinRespSpec	Max	Y	0.00053		62	40.3812	6.8889	4.2
FIRST FLOOR	SPECY	LinRespSpec	Max	X	0.000394		322	37.5552	22.2389	4.2
FIRST FLOOR	SPECY	LinRespSpec	Max	Y	0.001052		62	40.3812	6.8889	4.2
GROUND FLOOR	EQX	LinStatic	Max	X	7.7E-05		14	32.6312	22.2389	0.2
GROUND FLOOR	EQX	LinStatic	Max	Y	2.2E-05		82	0.1022	22.2389	0.2
GROUND FLOOR	EQX	LinStatic	Min	X	7.3E-05		14	32.6312	22.2389	0.2
GROUND FLOOR	EQX	LinStatic	Min	Y	1.7E-05		82	0.1022	22.2389	0.2
GROUND FLOOR	EQY	LinStatic	Max	Y	0.000263		48	43.7133	15.6941	0.2
GROUND FLOOR	EQY	LinStatic	Min	Y	0.000246		48	43.7133	15.6941	0.2
GROUND FLOOR	SPECX	LinRespSpec	Max	X	6.6E-05		215	40.3812	-0.3615	0.2
GROUND FLOOR	SPECX	LinRespSpec	Max	Y	8.4E-05		48	43.7133	15.6941	0.2
GROUND FLOOR	SPECY	LinRespSpec	Max	Y	0.000991		180	24.7802	22.2389	0.2

3.3 Modal Results

Table 3.4 - Modal Periods And Frequencies

Case	Mode	Period sec	Frequency cyc/sec	CircFreq rad/sec	Eigenvalue rad2/sec2
Modal	1	1.281	0.781	4.9067	24.0755
Modal	2	1.071	0.934	5.8691	34.4467
Modal	3	0.758	1.319	8.286	68.658
Modal	4	0.321	3.117	19.5839	383.5288
Modal	5	0.314	3.186	20.0194	400.7746
Modal	6	0.279	3.59	22.5555	508.7487
Modal	7	0.253	3.955	24.8491	617.4802
Modal	8	0.189	5.292	33.2517	1105.6729
Modal	9	0.176	5.679	35.6853	1273.4434
Modal	10	0.165	6.06	38.074	1449.631
Modal	11	0.151	6.633	41.6736	1736.6889
Modal	12	0.138	7.245	45.5189	2071.972
Modal	13	0.126	7.909	49.6952	2469.6168
Modal	14	0.113	8.84	55.5415	3084.86
Modal	15	0.104	9.596	60.2903	3634.9246
Modal	16	0.09	11.07	69.5522	4837.514
Modal	17	0.074	13.51	84.8839	7205.2791
Modal	18	0.069	14.502	91.1195	8302.7666
Modal	19	0.067	15.019	94.3691	8905.5309
Modal	20	0.058	17.197	108.0534	11675.543
Modal	21	0.043	23.12	145.2677	21102.6954

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Case	Mode	Period sec	Frequency cyc/sec	CircFreq rad/sec	Eigenvalue rad2/sec2
Modal	22	0.041	24.206	152.0903	23131.4601
Modal	23	0.04	25.266	158.7503	25201.6647
Modal	24	0.027	36.687	230.5091	53134.4526

Table 3.5 - Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX
Modal	1	1.281	0.5825	0.0215	0	0.5825	0.0215	0	0.0135	0.4103	0.0331	0.0135
Modal	2	1.071	0.0422	0.5647	0	0.6247	0.5862	0	0.3452	0.03	0.0657	0.3586
Modal	3	0.758	0.0187	0.0982	0	0.6434	0.6844	0	0.0539	0.0137	0.5452	0.4125
Modal	4	0.321	3.545E-05	0.0018	0	0.6434	0.6862	0	0.0036	4.379E-05	0.0001	0.4161
Modal	5	0.314	0.1285	0.0013	0	0.7719	0.6875	0	0.0021	0.1596	0.0052	0.4183
Modal	6	0.279	1.068E-05	0.0026	0	0.7719	0.6902	0	0.0052	1.179E-05	0.0002	0.4234
Modal	7	0.253	0.0025	0.1535	0	0.7745	0.8437	0	0.2443	0.0034	0.0127	0.6678
Modal	8	0.189	5.446E-07	0.0036	0	0.7745	0.8473	0	0.0067	9.263E-07	4.23E-05	0.6745
Modal	9	0.176	0.0026	0.0176	0	0.7771	0.8649	0	0.0294	0.0047	0.1501	0.7038
Modal	10	0.165	0	5.575E-07	0	0.7771	0.8649	0	9.133E-07	0	2.257E-06	0.7038
Modal	11	0.151	0	3.415E-05	0	0.7771	0.8649	0	0.0001	0	0.0004	0.7039
Modal	12	0.138	0	0	0	0.7771	0.8649	0	0	0	7.654E-06	0.7039
Modal	13	0.126	0.0637	0.0003	0	0.8408	0.8651	0	0.0004	0.0713	0.0014	0.7044
Modal	14	0.113	8.984E-06	0.002	0	0.8408	0.8671	0	0.004	1.107E-05	6.915E-06	0.7084
Modal	15	0.104	0.0005	0.0698	0	0.8413	0.937	0	0.1288	0.0007	0.0039	0.8372
Modal	16	0.09	0	0	0	0.8413	0.937	0	0	0	0.0002	0.8372
Modal	17	0.074	0.004	0.0031	0	0.8453	0.9401	0	0.0068	0.0069	0.076	0.844
Modal	18	0.069	1.197E-06	4.476E-05	0	0.8453	0.9401	0	0.0001	2.108E-06	1.804E-05	0.8442
Modal	19	0.067	0.046	7.87E-06	0	0.8914	0.9401	0	1.956E-05	0.0757	0.0029	0.8442
Modal	20	0.058	0.0001	0.0369	0	0.8915	0.9771	0	0.0927	0.0002	0.001	0.9369
Modal	21	0.043	0.0455	1.231E-06	0	0.937	0.9771	0	1.517E-05	0.0954	0.0231	0.9369
Modal	22	0.041	0.0437	0.0054	0	0.9807	0.9825	0	0.0156	0.0885	0.032	0.9524
Modal	23	0.04	0.0155	0.0154	0	0.9961	0.998	0	0.0422	0.0323	0.0038	0.9947
Modal	24	0.027	0	0.0042	0	0.9961	1.0021	0	0.011	2.102E-05	0.0371	1.0057

Table 3.5 - Modal Participating Mass Ratios (Part 2 of 2)

SumRY	SumRZ
0.4103	0.0331
0.4403	0.0988
0.4541	0.6439
0.4541	0.644
0.6137	0.6492
0.6138	0.6495
0.6171	0.6622
0.6171	0.6622
0.6218	0.8123
0.6218	0.8123
0.6218	0.8127
0.6218	0.8127
0.6931	0.8142
0.6931	0.8142
0.6938	0.8181
0.6938	0.8183
0.7007	0.8943
0.7007	0.8943
0.7763	0.8972
0.7765	0.8982
0.8719	0.9213
0.9604	0.9532
0.9927	0.9571
0.9927	0.9942

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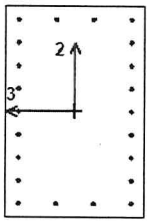
Table 3.6 - Modal Load Participation Ratios

Case	ItemType	Item	Static %	Dynamic %
Modal	Acceleration	UX	100	99.61
Modal	Acceleration	UY	100	100.21
Modal	Acceleration	UZ	0	0

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ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Column Section Design



Column Element Details Type: Ductile Frame (Summary) (Part 1 of 2)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc
SECOND FLOOR	C5	348	C900X600M35	UDConS27	0

Column Element Details Type: Ductile Frame (Summary) (Part 2 of 2)

Length (mm)	LLRF
4000	1

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
600	900	58	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	500	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3} (Part 1 of 2)

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm²
3861.1417	921.6665	711.1676	103.4786	142.09	8140

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3} (Part 2 of 2)

Rebar % %
1.51

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	1.2	3400	284.4671	0	142.09
Minor Bend(M2)	1.2	3400	201.9024	0	103.4786

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Shear Design for V_{u2} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
Major, V_{u2}	383.9788	460.5959	202.0792	383.9788	665.06
Minor, V_{u3}	467.0115	451.4603	195.1188	467.0115	997.59

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm²	Shear Ratio Unitless
Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u3}	N/A	N/A	N/A	N/A	N/A	N/A

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm²	A_{sc} cm²	P_{uz} kN	P_b kN	P_u kN	k Unitless
5400	81.4	11557.6082	4238.5127	3861.1417	1

Additional Moment (IS 39.7.1) (Part 1 of 2)

	Consider M_a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded
Major Bending (M_3)	Yes	0.85	900	4.533	12	No
Minor Bending (M_2)	Yes	0.85	600	6.8	12	No

Additional Moment (IS 39.7.1) (Part 2 of 2)

M_a Moment (kN-m)
0
0

Notes:

N/A: Not Applicable

N/C: Not Calculated

N/N: Not Needed

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ETABS 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
THIRD FLOOR	C7A	367.9	17763.9	2450	300	1

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	415

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	367.9	16538.9	367.9	18988.9	2450	300
Bottom	Leg 1	367.9	16538.9	367.9	18988.9	2450	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	1838	0.0025	0.0023	DWalS32	1112.6492	-55.9113	-601.9087	735009
Bottom	1838	0.0025	0.0023	DWalS32	1244.9118	24.8982	-994.5772	735009

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	DWalS22	953.3651	1075.5717	-541.5858	192.6402	723.1249
Bottom	Leg 1	750	DWalS22	1173.8027	-977.297	-541.5858	197.7543	728.2391

Boundary Element Check

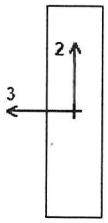
Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	DWalS30	1566.7721	-529.4494	3.9	6
Top–Right	Leg 1	0	DWalS30	1566.7721	891.746	5.1	6
Bottom–Left	Leg 1	300	DWalS30	1787.2097	-1094.0588	6.08	6
Botttom–Right	Leg 1	0	DWalS30	1787.2097	596.6509	4.42	6

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ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary) (Part 1 of 2)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc
FIRST FLOOR	B58	110	B750X200M30	UDConS29	8412.4

Beam Element Details Type: Ductile Frame (Summary) (Part 2 of 2)

Length (mm)	LLRF
8412.4	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
200	750	200	0	75	75

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
-301.3148	0.3489	148.912	-3.1917

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-301.3148	0.9749	0	-302.2898

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

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	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-302.2898		1142	4	1142	355
Bottom (-2 Axis)		0	571	4	0	571

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
193.9931	0	199.1894	74.9381	817.73

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
0.6495	148.912	70	620	307.7

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