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Verified RealEstate™
3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai 600 097, India

hello@verified.realestate
+91 9996 12 9996
verified.realestate

DIGITALLY VERIFIED RECORD

PROPOSED CONSTRUCTION OF "RESIDENTIAL APARTMENT BUILDING" IN S.NO :307/1B2A, 1B2B2 AT NILAYUR BIT -1 VILLAGE/PANCHAYAT, THIRUPARANKUNDRAM TALUK, MADURAI DISTRICT.

STRUCTURAL DESIGN CALCULATION

S.DHILIPARAJAN, M.E.,
CMDA Regn. No. SE/GR-I/19/02/11
GCC Regn. No. RSE100042024
Jehovahking Engineering Consultants Pvt Ltd.,
Second Floor, Plot No. 49/A, New No. 3/1,
6th Cross Street, Lakshmi Nagar, Porur, Chennai-600116.
Mob: 9444624764, Mail: jke_chennai@yahoo.co.in.

ARCHITECT: CHERALATHAN ASSOCIATES, CHENNAI.

STRUCTURAL CONSULTANTS: JEHOVAHKING ENGINEERING CONSULTANTS PVT.LTD PORUR, CHENNAI.

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INDEX

1. Introduction
2. Grade of Materials
3. Design Standards
4. Design Data
5. Analysis of Structure
6. Design Concept
7. Load cases & Load combinations
8. Wind Load
9. Seismic Load
10. Cover for Reinforcement
11. Foundation System
12. Expansion Joint
13. Floor Loading
14. Serviceability Check
15. Design calculation
16. Etabs Model Output

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1. INTRODUCTION

The proposed Residential building consists of Basement floor + Stilt floor + 13 upper floors. The structure is designed as a Reinforced concrete framed structure supported on R.C.C raft foundation. The columns, beams and slabs are considered and designed as reinforced concrete members.

Building size

Width (X-direction) – 21.34m
Length (Y-direction) – 74.30m

Height

Basement floor – 3.0m
Stilt floor – 3.0m
Typical floor – 3.0m

2. GRADE OF MATERIALS

i) Concrete

Characteristic concrete strength (concrete grade) for the project shall be based on exposure condition and forces to be supported by specified structural elements. The minimum cement content and maximum water–cement ratio shall be as per IS code 456:2000. The minimum 28-day compressive strength of concrete for specified structural elements shall be as follows:

Grade of Concrete for columns is M40.
Grade of Concrete for all other Structural elements is M30.

Concrete Properties

Young's Modulus of Elasticity of Concrete	$5000\sqrt{fck}$
Poisson Ratio's Ratio ν =	0.2

ii) Reinforcement

Grade of Steel reinforcement for all Structural elements is Fe500D.

The characteristictensile properties of steel in design shall be as follows.

Reinforcement Characteristic yield strength fy (N/mm^2)	Fe500D
Young's Modulus E (kN/mm^2)	$200kN/mm^2$
Poisson's ratio	0.3
Coefficient of Thermal expansion, α ($^oC^{-1}$)	$12x10^{-6}$
Density	$78.5\ kN/m^3$
Diameters [in mm]: 8, 10, 12, 16, 20, 25 & 32	

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iii) Structural steel

All structural steel, if used, shall conform to Indian standard IS: 2062-2011.

Structural steel	Grade E=250	Grade E-350
Tensile strength	410 N/mm^2	490 N/mm^2
Yield stress t<20mm	250 N/mm^2	350 N/mm^2
Yield stress t = 20mm to 40mm	240 N/mm^2	330 N/mm^2
Yield stress t> 40mm	230 N/mm^2	320 N/mm^2
Young's Modulus (E)	200,000 N/mm^2	200,000 N/mm^2
Density	78.5 kN/m^3	78.5 kN/m^3

Self-weights are calculated on the basis of unit weights of materials given in IS 875 (Part 1) the data provided by consultant and other service consultants will be used for the specific materials.

Materials	Unit weight kN/m^3
Steel	78.50
Plain Cement Concrete	24.00
Reinforced Cement Concrete	25.00
Soil Fill	16.00
Water	10.00
Cement Concrete screed	24.00
Solid block wall (Concrete)	22.00

Normal weight aggregates shall be considered for arriving at self-weight of all Concrete works.

3. DESIGN STANDARDS

The relevant Indian Standard Codes, as given below, shall be followed for structural design:

Sl.No.	Code	Description
1.	IS-875 (Part 1) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Unit weights of buildings materials and stored material.
2.	IS-875 (Part 2) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Imposed loads.

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3.	IS-875 (Part 3) – 2015	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Wind loads.
4.	IS-875 (Part 4) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Snow loads.
5.	IS-875 (Part 5) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Special loads and load combinations.
6.	IS: 456 – 2000	Code of Practice for Plain and Reinforced Concrete.
7.	IS: 1786 – 2008	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement - Specification.
8.	IS: 13920 – 2016	Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice
9	IS: 800 – 1984/2007	Code of Practice for General Construction in Steel.
10.	IS: 1893 (Part 1) – 2016	Criteria for Earthquake resistant design of structures.
11.	IS3370-(PART I & II)-2009	Code of Practice for Concrete structures for the storage of liquids – Reinforced concrete structures
12.	IS 2950 (Part I) -1981	Code of Practice for Design and construction of Raft foundation

4. DESIGN DATA

1. No. of floors = Basement+Stilt+13upper floors
2. Total height of building = 42.0m above FGL (approximately)
3. Safe Bearing Capacity at 3.0m depth = 330 kN/m^2(as per soil report)
4. Density of Concrete = 25 kN/m^3
5. D.L. due to partitions (Light Partition as per IS 875) = 1.50 kN/m^2
6. D.L. due to flooring = 0.040x24=0.96 say 1.0 kN/m^2
7. D.L. due to filling in toilet sunken = 0.1x16=1.60 kN/m^2
8. D.L. due to solar panel = 0.15 kN/m^2
9. Wall Load (200mm thick brick wall): Typical Floor = 3.0m-0.45m=2.55m x 0.2m x22 = 11.22 kN/m
10. Live Load in Stairs, corridor & lobby = 3.00 kN/m^2
11. Live Load in balcony = 3.00 kN/m^2
12. Live Load in Rooms = 2.00 kN/m^2

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13. Live Load in Terrace = 1.50 kN/m2
14. Live Load in toilets = 2.00 kN/m^2
15. L.L in Lift Machine Room = 10.00 kN/m^2
16. Basic wind speed = 39 m/sec
17. Design wind pressure (Max.) = 0.978 kN/m^2
18. Seismic Zone = Zone II
19. Design mix = M40 for columns,
    M30 for all other RC members.

5. ANALYSIS OF STRUCTURE

Computer-aided analysis using finite element method (FEM) shall be carried out for the Analysis of structure.

Assumptions:

- The structure is idealized as 3D space frame and analyzed using Etabs software package for both vertical and lateral loads.
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and for the load combinations as given in the relevant codes.
- Temperature load is applied on the terrace floor of the buildings.

Column	:	Frame Element
RC Wall	:	Wall (Shell) Element
Beam element:		Frame Element
Slab element	:	Membrane Element

For 3D or 2D structural frame analysis ETABS or SAFE software shall be used, verified in-house spreadsheets will be used for the design of reinforced concrete (RC) and steel elements in consideration of flexure, shear and axial forces.
The following are general parameters adopted in the analysis and design,
Consideration of Diaphragm – Semi Rigid Diaphragm.

6. DESIGN CONCEPT

Limit State concept of design will be used as per IS: 456-2000 & SP - 16. The detailing of reinforcement shall be done satisfying the requirements of IS: 456, SP-16, IS: 13920, IS: 4326 and SP-34.

The Slabs and beams are checked for deflection as per IS 456. Cover for Reinforcement is considered as per Table 16A of NBC, for a Fire resistance of **2 hrs.**

7. LOAD CASE

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7.1 Primary Load

- Dead Load (DL)
- Live Load (LL)
- Earthquake Load (EL)
- Wind Load (WL)
- Temperature Load (TL)

7.2 Load Combinations:

The following combinations of Loads as per IS 1893 is considered in the STAAD Analysis.

1. 1.5(DL +LL)
2. 1.2(DL + LL ± WL)
3. 1.2(DL +LL ± EL)
4. 1.5(DL ± EL)
5. 1.5(DL ± WL)
6. 0.9DL ± 1.5EL
7. 0.9DL ± 1.5WL

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	WL/EL	DL	LL	WL/EL
DL + LL	1.5	1.5	--	1.0	1.0	--
DL +/- WL	1.5 or 0.9$	--	1.5	1.0	--	1.0
DL + LL +/- WL	1.2	1.2	1.2	1.0	0.8	0.8
DL +/- EL	1.5 or 0.9$	--	1.5	1.0	--	1.0
DL + LL +/- EL	1.2	1.2	1.2	1.0	0.8	0.8

$This value is to be considered when stability against overturning or stress reversal is critical

DL - Dead load
LL - Live load
WL - Wind load
EL - Earthquake load
TL - Temperature Load

Wind load and earthquake load shall be considered for both X & Y directions.

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The above load combinations will be considered and effect of worst combinations will be taken for design of various building elements.
Whenever imposed load is combined with earthquake load the appropriate part of imposed load as specified in IS: 1893 – 2016 will be used both for evaluating earthquake effect and for combined load effects used in such combination.

General Load Combinations considered in the analysis are as follows:

Combinations considered for the design of the various building elements:					
COMB 1	1.5 DL	+	1.5 LL		
COMB 2	1.2 DL	+	1.2 LL	+	1.2 SPECX
COMB03	1.2 DL	+	1.2 LL	+	1.2 SPECY
COMB04	1.5 DL			+	1.5 SPECX
COMB05	1.5 DL			+	1.5 SPECY
COMB06	0.9 DL			+	1.5 SPECX
COMB07	0.9 DL			+	1.5 SPECY
COMB08	1.2 DL	+	1.2 LL	+	1.2 WLX
COMB09	1.2 DL	+	1.2 LL	-	1.2 WLX
COMB10	1.2 DL	+	1.2 LL	+	1.2 WLY
COMB11	1.2 DL	+	1.2 LL	-	1.2 WLY
COMB12	1.5 DL			+	1.5 WLX
COMB13	1.5 DL			-	1.5 WLX
COMB14	1.5 DL			+	1.5 WLY
COMB15	1.5 DL			-	1.5 WLY
COMB16	0.9 DL			+	1.5 WLX
COMB17	0.9 DL			-	1.5 WLX
COMB18	0.9 DL			+	1.5 WLY
COMB19	0.9 DL			-	1.5 WLY
COMB21	0.9 DL			+	1.5 TL
COMB22	1.5 DL			+	1.5 TL
COMB23	1.5 DL	+	1.5 LL	+	1.5 TL
COMB24	1.2 DL			+	1.2 TL
Un-factored Loads to be taken for foundation design:					
FOUN01	1.0 DL	+	1.0 LL		

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FOUN02	1.0 DL	+	0.8 LL	+	0.8 SPECX
FOUN03	1.0 DL	+	0.8 LL	+	0.8 SPECY
FOUN04	1.0 DL			+	1.0 SPECX
FOUN05	1.0 DL			+	1.0 SPECY
FOUN06	1.0 DL	+	0.8 LL	+	0.8 WLX
FOUN07	1.0 DL	+	0.8 LL	-	0.8 WLX
FOUN08	1.0 DL	+	0.8 LL	+	0.8 WLY
FOUN09	1.0 DL	+	0.8 LL	-	0.8 WLY
FOUN10	1.0 DL			+	1.0 WLX
FOUN11	1.0 DL			-	1.0 WLX
FOUN12	1.0 DL			+	1.0 WLY
FOUN13	1.0 DL			-	1.0 WLY
FOUN14	1.0 DL			+	1.0 TL
FOUN15	1.0 DL	+	1.0 LL	+	1.0 TL
DL - Dead Load					
LL - Live Load					
EL - Earthquake Load					
WL - Wind Load					
* Note - Seismic Load Cases have both "MAX" and "MIN" Load Cases for +ve & -ve Directions respectively.					

8. WIND LOAD

Wind loads and pressures are calculated based on the static design wind pressure. This pressure has been considered for the load analysis and applied to the model. The wind pressure shall be calculated based on the data furnished below and other provisions laid in IS: 875 (Part 3) – 2015.

The design wind velocity at any given height and at a given site is given by,

$Vz = V_b\ k_1 k_2\ k_3\ k_4$

where,

V_b- basic wind speed in m/s at 42m height

k_1 - probability or risk factor

k_2 - terrain, height and structure size factor

k_3 - local topography factor

Basic wind speed = 39 m/sec

Risk coefficient, k_1 = 1.0

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Terrain category = 2

Height factor- k_2 = Varies with height

Terrain, size height & structure factor, k_2 up to 42 m height = 1.15
(as per Cl. 6.3.2 of IS 875 Part 3 - 2015)

Topography factor k_3 = 1.0

as per Cl. 6.3.3 of IS 875 Part 3 - 2015)

k_4 – Importance factor = 1.0 (Other buildings)
(As per cl.6.3.4 of IS875 part 3 - 2015)

Design wind speed at any height z, V_z = 39×1×1.15×1×1

= 44.85m/sec

The design wind pressure, Pz in MPa at any height above mean ground level is given by,

p_z = $0.6\ V_z^2$

= 0.6×44.85^2

= 1206.9 N/m^2

p_z = 1.207 kN/m^2

$p_d = K_d \times K_a \times K_c \times p_z$ where, as per IS875 PART 3 - 2015

K_d - wind directionality factor = 1.0

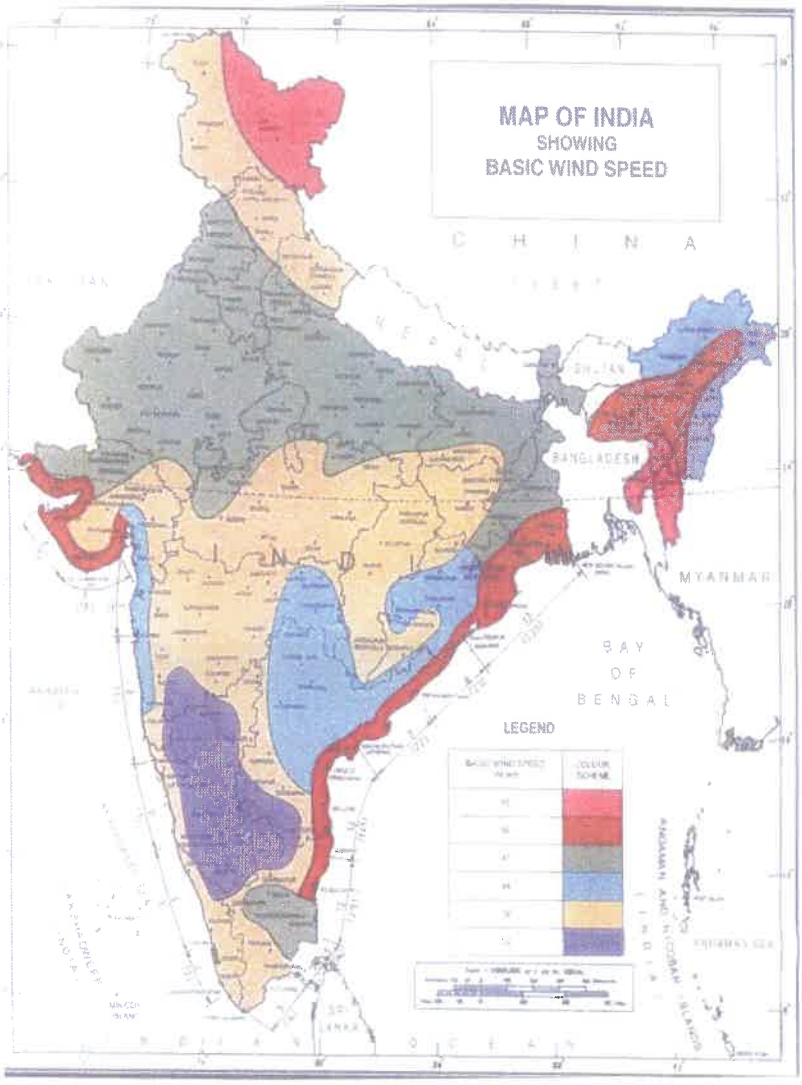
K_a - area averaging factor = 0.9

K_c - combination factor = 0.9

Therefore, p_d= 1.0 x 0.9 x 0.9 x 1.207 = 0.978 kN/m^2 >0.7 p_z

The wind pressure of 0.93 kN/m^2 is applied along the height of the column.

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9. SEISMIC LOAD

The Proposed Residential building at Madurai falls under Zone II as per the IS Code. Response spectrum method shall be used, for seismic analysis of R.C. Frames as recommended by IS: 1893-2016

Seismic Zone	=Zone II
Zone Factor 'Z'	=0.10
Response Reduction Factor 'R' (for SMRF)	=5.00
Importance Factor 'I'	=1.20
Type of Structure	=1.00
Type of Soil	= II (medium)

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SEISMIC ANALYSIS:

9.1. STATIC ANALYSIS:

Design of lateral force under seismic condition shall be as per IS1893 – 2016. Total lateral force (base shear) of the building shall be estimated as per clause 7.2.1 of IS1893 – 2016 which provides by

$$V_b = A_h W$$

Ah is horizontal seismic coefficient and W is seismic weight of the building, Horizontal seismic coefficient depends on location of the building (Zone factor Z), usage of the building (Importance factor, I), building lateral resisting system (Response reduction factor, R) and design acceleration coefficient (Sa /g) which is based on subsoil condition and fundamental natural period (Ta).

For the proposed building is for residential use. Considering it, the seismic weight is summation of total dead load and 50% of live load where live load is greater than 3 KN/sq.m, 25% for live load equal or lesser than 3 KN/sq.m.

From IS 1893:2016 clause 6.4.2, Design horizontal seismic coefficient

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

Where, Z for Zone II = 0.10
Importance factor = 1.2
R for SMRF = 5.0

i. $T = 0.09\ h / \sqrt{d}$ (Refer IS 1893 - 2016 clause 7.6.2c),
ii. $T = (0.075\ h0.75) / (\sqrt{Aw})$ (Refer IS 1893 - 2016 clause 7.6.2b) ,
iii. $T = (0.075\ h0.75)$ (Refer IS 1893 - 2016 clause 7.6.2a);

The time period has been calculated for all above specified cases and it ensured that the case (ii) time period is not greater than case (iii) and not lesser than case-(i).

Where,

T is Fundamental natural period

For the building height with reference to IS: 1893-2016 the building is well connected with basement wall in all four sides, so for the time period calculation the heights are considered as follows,

h = Height of the structure from Stilt Floor to Roof.
d = Width of the building along the direction of lateral force.
Aw = Total effective wall area in square meter

9.2. DYNAMIC ANALYSIS:

Response spectrum method of Dynamic Analysis carried out with following parameters pertaining to dynamic analysis.

Number of modes Considered : 12 Numbers (Minimum)

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Modal Combination Method Used : Complete Quadratic combination (CQC).
Directional Combination Method used : Square root of the sum of Square (SRSS).
Modal case type : Eigen vector Method

10. COVER FOR REINFORCEMENT:

Cover for Reinforcement is considered as per Table 16A of NBC, for a Fire resistance of **2 hrs.**

Footing	= 50 mm
Columns	= 40 mm
Beams	= 30 mm
Slabs	= 25 mm
Retaining wall	= 40 mm for earth side and 25mm for inner side
Shear wall	= 25 mm

11. FOUNDATION SYSTEM:

As per GEO TECHNICAL recommendations

9. Abstract OF SBC Calculations

The summary of safe bearing capacity calculated is presented as follows:

Table-A

Sl. No.	Depth Below NGL	SBC in T/sq.m				Recommended SBC in T/sq.m
		BH 1	BH 2	BH 3	BH 4	
1	1.50 m	16.95	17.02	17.10	16.98	16.00
2	*2.00 m	*22.59	*22.65	*22.72	*22.62	*22.00
3	3.00 m	33.88	33.92	33.96	33.90	33.00

DRAFT Report

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Depth from GL (m)	Graphic Log	Visual soil Description	Type	15	30	45	N	correction factor in Cn	Due to overburden pressure in N'	Due to dilatancy pressure in N"	Graphical Representation of SPT N Values	Type of Samples
1.00		Red Soil	SPT	30	55/R 9cm Penetration		>50	1.58	79	44		D
2.00		Soft Disintegrated Rock	SPT	55/R 5cm Penetration			>50	1.35	70	44		D
3.00		Soft Disintegrated Rock	SPT	SPT Hammer Rebound			>50	1.21	61	44		D
4.00		Soft Disintegrated Rock	SPT	SPT Hammer Rebound			>50	1.12	56	44		D
5.00		Soft Disintegrated Rock	SPT	SPT Hammer Rebound			>50	1.04	52	44		D
6.00		Soft Disintegrated Rock	SPT	SPT Hammer Rebound			>50	0.98	49	44		D
7.00		Soft Rock	SPT	6 Small Pieces Recovered			>50	0.92	46	44		D
8.00		Soft Rock	SPT	5 Small Pieces Recovered			>50	0.87	44	44		D
9.00		Weathered Rock	SPT	5 Small Pieces Recovered			>50	0.83	41	44		D
10.00		Weathered Rock	SPT	4 Small Pieces Recovered			>50	0.79	40	44		D

DRAFT Report

We have taken Safe Bearing Capacity as 33 T/Sq.m (330 kN/sqm) at (-) 3.0m depth from EGL as per the above soil report. It is proposed to have isolated /strip raft footing to resist floor loads from Columns.

The support condition for columns in ETABS model is considered as fixed support.

12. EXPANSION JOINT:

We have provided the Expansion joint, since the length of the building exceeds the IS code Limit.

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13 FLOOR LOADING

a) FLOOR SLABS LOAD

The floor slab and beams are designed as conventional slab members for floor loads as mentioned below.

RC Conventional Slab:

Self-Weight of 150 thk. slab	= 3.75 kN/m ^{2}
Load due to Floor Finish	= 1.00 kN/m ^{2}
Load due to Partition load	= 1.50 kN/m ^{2}
Live load	= 2.00 kN/m^2
	8.25 kN/m^2

14. SERVICEABILITY CHECK

a. For Deflections:

The final deflection due to all loads including the effect of temperature, creep and shrinkage and measured from the as-cast level of the supports of floors, roofs and all other horizontal members should not normally exceed span / 250.

The deflection including the effect of temperature, creep and shrinkage occurring after the erection of partitions and the application of finishes should not normally exceed Span / 350 or 20 mm whichever is less.

b. Lateral drift :

Under transient wind load the lateral sway at the top should not exceed H/500, where H is the total height of the building.

The storey drift in any storey due to the minimum specified design lateral force, with partial load factor of 1, shall not exceed 0.004 times the storey height.

c. For Cracking

Surface crack width shall not exceed 0.3 mm in general and for water retaining structure it is limited to 0.2 mm.

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15. Design Calculation:

Typical Design of Column:

C1 - columns:

Total load on column = 9000 kN
Moment in Z-Direction = 180 kNm
Moment in Y-Direction = 180 kNm

A_{st} = 14040 mm^2
pt = 3.9%
p/f_{ck} = 0.1
$P_u / f_{ck} bd$ = 0.63
$M_u / f_{ck} bd^2$ = 0.062
$M_u / f_{ck} bd^2$ = 0.076
Muy_1 = 266 KN.m
Muz_1 = 1310 KN.m
Puz/Ag = 25 N/mm^2
Muy/Muy_1 = 0.678
Muz/Muz_1 = 0.317
∝n = 1.00
$(Muy/Muy_1)^{\propto n} + (Muz/Muz_1)^{\propto n}$ = 0.995 Hence safe.

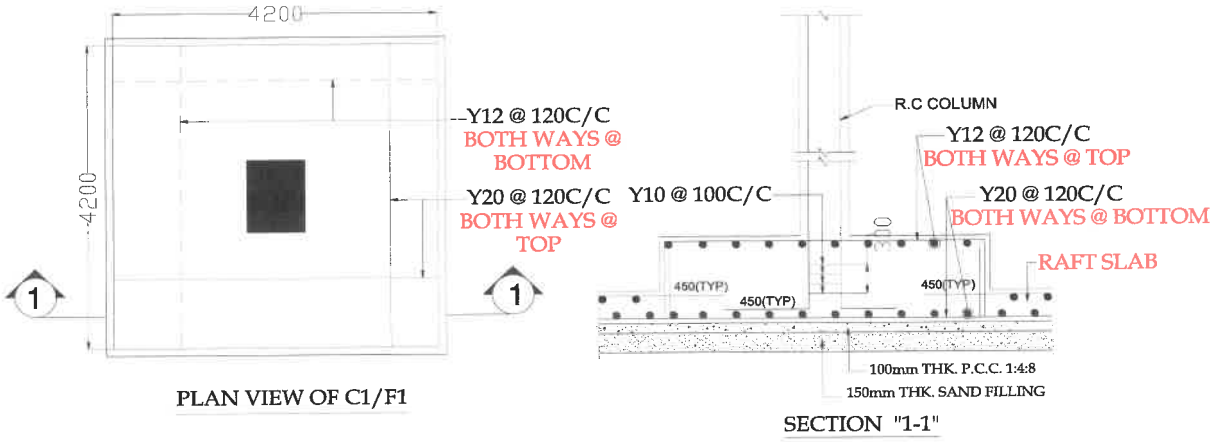
Provide 300 x 1200 columns with 16 Nos Y32 + 4Nos Y25 with Y8 rings @ 180 c/c up to Stilt floor roof.

TYPICAL DESIGN OF FOOTINGS:

Footing"C1/F1":

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JKECPL	PROPOSED CONSTRUCTION OF "RESIDENTIAL APARTMENT BUILDING" IN S.NO :307/1B2A, 1B2B2 AT NILAYUR BIT -1 VILLAGE/PANCHAYAT, THIRUPARANKUNDRAM TALUK, MADURAI DISTRICT.	DESIGN CALCULATION
		DATE 27.05.2026



SBC of the Soil =	300	KN/m²	TOTAL VOLUME	34.02	
Garede of Concrete =	30	KN/m³	CONCRETE VOLUME	29.052	
Garede of Steel =	500	KN/m³	FILLING VOLUME	4.968	
Axial Load on Column =	6000	KN	CONCRETE WEIGHT	726.3	
SW of footing+Load due to filling=	805.8	KN	FILLING WEIGHT	79.488	
Total Axial Load on soil=	6805.8	KN			
Size of the column =	300 | 1200	mm			
Footing Area Required =	22.69	m²	AREA PROVIDED	22.68	
Provided size of the Footing =	4.20 | 5.40				
Net Upward Pressure(with filling) =	300.1				
Net Upward Pressure(without filling) =	264.5502646				
Moment along longer length (M1)=	583.4	KN.m			
Moment along longer length (M2)=	503	KN.m			
Depth of footing at Free End (D1)=	1200	mm			
Depth of footing at cantilever End (D2)=	1200	mm			
Mu1/bd² =	0.67				
Mu2/bd² =	0.58				
Pt1 =	0.16				
Pt2 =	0.14			req	prov
Ast1 =	1840	mm²	20	171	120
Ast2 =	1610	mm²	20	195	120
Provide :	Y20 @ 120mm C/C				2618
	Y20 @ 120mm				2618

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	C/C			
Check for Oneway Shear(Along Longer direction)				
V =	1056	KN		d @ critical
τv =	0.328	N/mm²		1150.00
100Ast/bd =	0.23			
β =	15.30			
τc =	0.354			
	tc>tv			
	Hence safe			
Check for Twoway Shear				
V =	5098.544974	KN		d @ critical
τv =	0.88	<	1.369	1150.00
	Hence Safe			
Check for Oneway Shear(Along Shorter direction)				
V =	1143	KN		d @ critical
τv =	0.276	N/mm²		1150.00
100Ast/bd =	0.23			
β =	15.30			
τc =	0.354			
	tc>tv			
	Hence safe			

Provide Footing of size 4.2 x 5.4 m

Provide 1200mm depth

Provide Y20 @ 120 c/c in both ways @ bottom

Provide Y12 @ 120 c/c in both ways @ top

However, provide full raft of 1000mm thick since full excavation will be done.

DESIGN OF TYPICAL FLOOR BEAM:

Design of beam "B1":

Results from model

Mu (+)	= 64 kN.m
Mu (-)	= 127 kN.m
Shear	= 203kN
Beam size	= 230 X 450mm
bf	= 500 mm
Effective depth	= 410mm

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Grade of Concrete = M30
Grade of Steel = Fe500

Tension Reinforcement Details:

Mu (+) / (bf * d^2) = (64 x 10 ^ 6) / (500 * 410 * 410)
= 0.76 N/mm^2
For 0.76 N/mm^2; p_t = 0.181%
Then Ast = 0.181 * 500 * 410/100
= 372mm^2
No of bars = 372 / ((π * 16^2) / 4)
= 1.0 No.

Provide 2-Y16 (throughout) @ bottom

Mu (-) / (B * d^2) = (127 * 10 ^ 6) / (230 * 410 * 410)
= 3.78 N/mm^2

For 3.78 N/mm^2; p_t = 1.06%;
Then Ast = 1.06 * 230 * 410/100
=870 mm^2
= 870 / ((π * 16^2) / 4)
No of bars = 4.3 Nos.

Provide 2-Y16 throughout + 2-Y20 extra over longer span and 2-Y16 extra at other end supports in top.

Shear Reinforcement Details:

τv = Vu / (B*d)
τv = 203*10^3 / (200 * 410)
= 2.48
τc = 0.69

Here, $\tau v > \tau c$
Providing 8mm dia stirrup

Vus = ($\tau v - \tau c$) * B *d
Sv = (0.87 *fy* d * Asv) / (Vus)
Sv = 103mm

Reinforcement Details:

Provide 8mm dia rod with 4" C/C at supports and 8mm with 6" at mid span

Provide 2-Y16 (throughout) @ bottom

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Provide 2-Y16 throughout + 2-Y20 extra over mid spans and 2-Y16 extra at other end supports in top.

Typical Design of Roof slab:

Typical Floor Slab:

Size of the Slab	=	3.0m X 4.0m
Thickness of Slab	=	150mm
Dead load on the Slab		
Due to Self Weight (0.15x25)	**=**	**3.75 kN/m^2**
Due to Partitions	=	1.5 kN/m^2
Due to Floor Finish	=	1.0 kN/m^2
Live load on Slab	=	2.0 kN/m^2
TOTAL LOAD ON THE SLAB	**=**	**8 .25kN/m^2**
l_y / l_x = 1.0		
- ve B.M 0.065 x 3.0^2 x 8.25 kN/m^2	=	4.83 kN.m
+ ve B.M 0.05x 3.0^2 x 8.25kN/m^2	=	3.70 kN.m

Provide 150 mm thick slab.

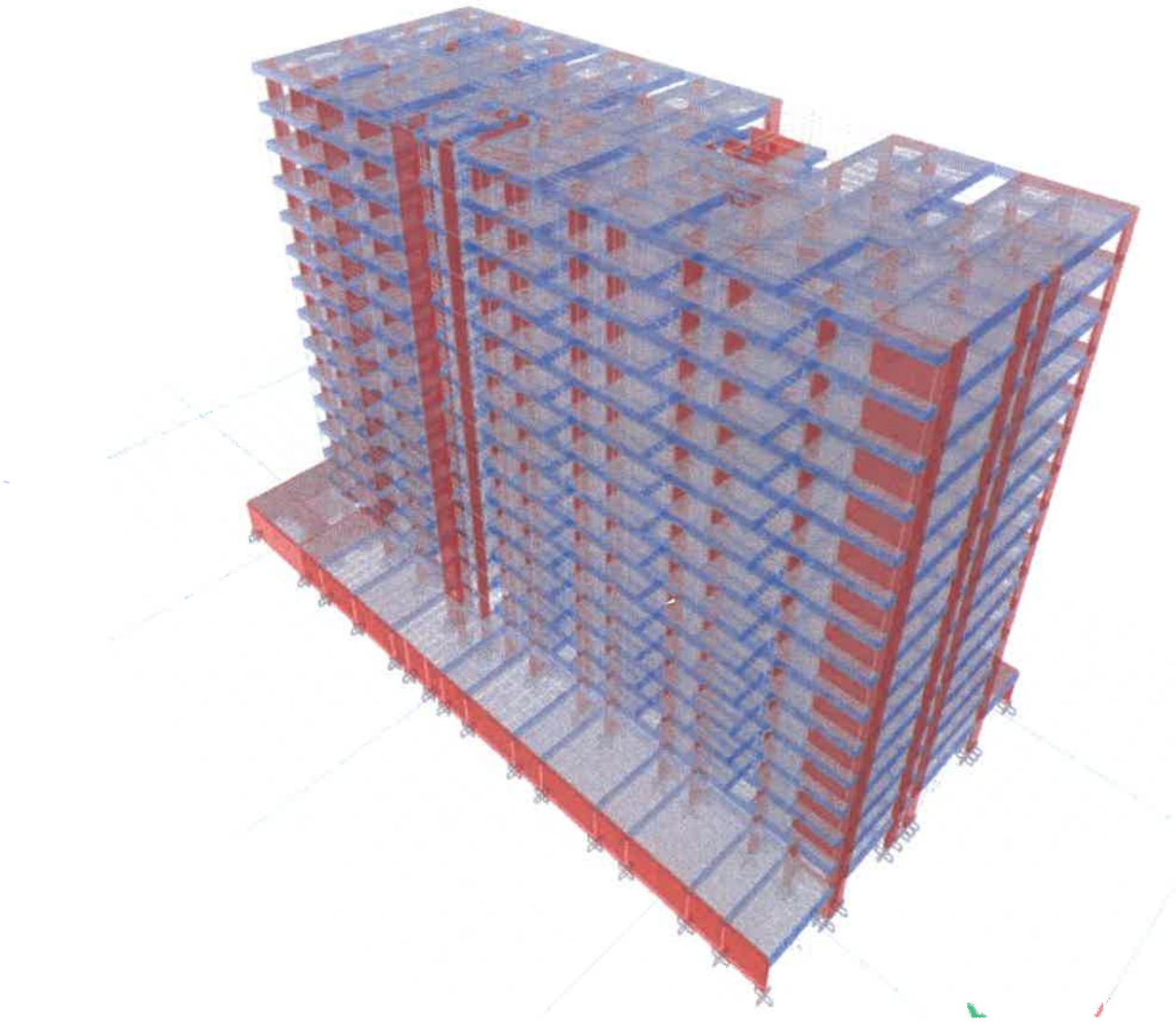
$M_u / bd^2 = 0.52$, $p_t = 0.122$, $A_{st} = 146$ sq.mm^2

PROVIDE:

Y8 @ 150mm c/c @ both ways

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16. E tabs model Output



3D VIEW OF ETABS MODEL

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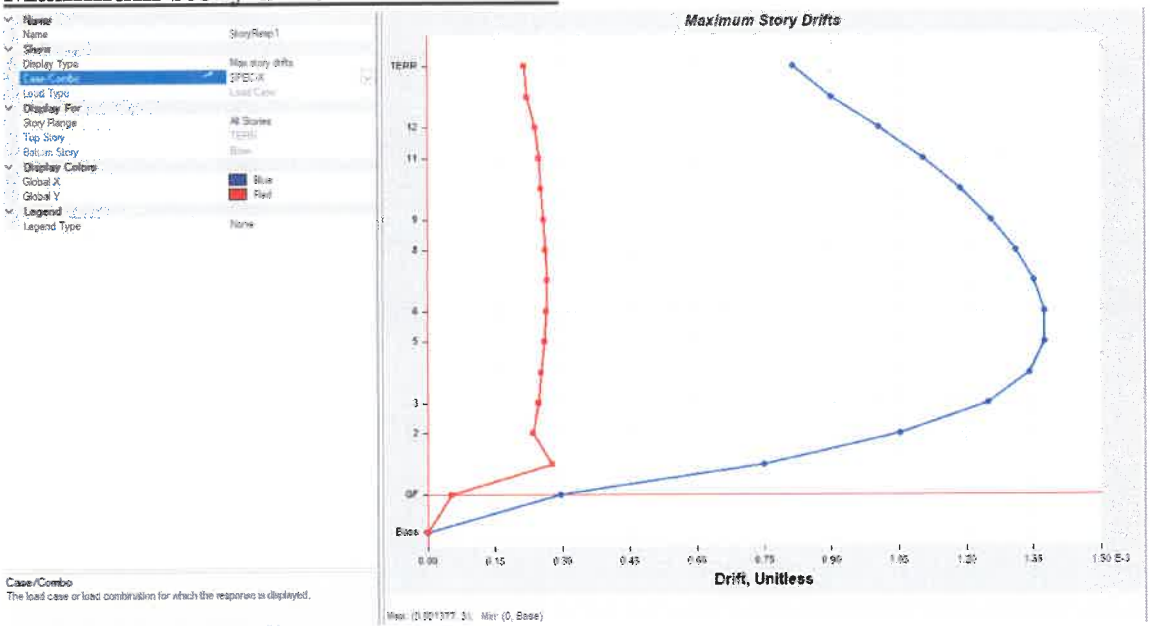
16.1 Mass Participation check:

TABLE: Modal Participating Mass Ratios

Case	Mode	Period (sec)	UX	UY	UZ	Sum UX	Sum UY	Sum UZ	RX	RY	RZ
Modal	1	3.193	0.0006	0.6683	0	0.0006	0.6683	0	0.3519	0.0003	0.0029
Modal	2	2.4	0.6152	0.0015	0	0.6157	0.6698	0	0.001	0.2678	0.0981
Modal	3	2.2	0.094	0.0012	0	0.7097	0.671	0	0.001	0.0452	0.5799
Modal	4	0.836	0.0003	0.1465	0	0.71	0.8175	0	0.264	0.0008	0.0015
Modal	5	0.704	0.1133	0.001	0	0.8233	0.8185	0	0.0019	0.3088	0.0092
Modal	6	0.636	0.0076	0.0029	0	0.8309	0.8214	0	0.0043	0.0189	0.1078
Modal	7	0.469	0.0001	0.00003	0	0.831	0.8214	0	0.0015	0.0001	0.0001
Modal	8	0.404	0.0005	0.0494	0	0.8315	0.8708	0	0.0787	0.0009	0.0026
Modal	9	0.39	0.0001	0.00004	0	0.8316	0.8709	0	0.0002	0.0004	0.0002
Modal	10	0.358	0.0458	0.0013	0	0.8774	0.8722	0	0.0021	0.0683	0.0017
Modal	11	0.314	0.0019	0.0038	0	0.8793	0.876	0	0.0067	0.002	0.0453
Modal	12	0.274	0.0045	0.0004	0	0.8838	0.8763	0	0.0006	0.0063	0.0006

16.2 STORY DRIFT:

Maximum story drift in X-direction:

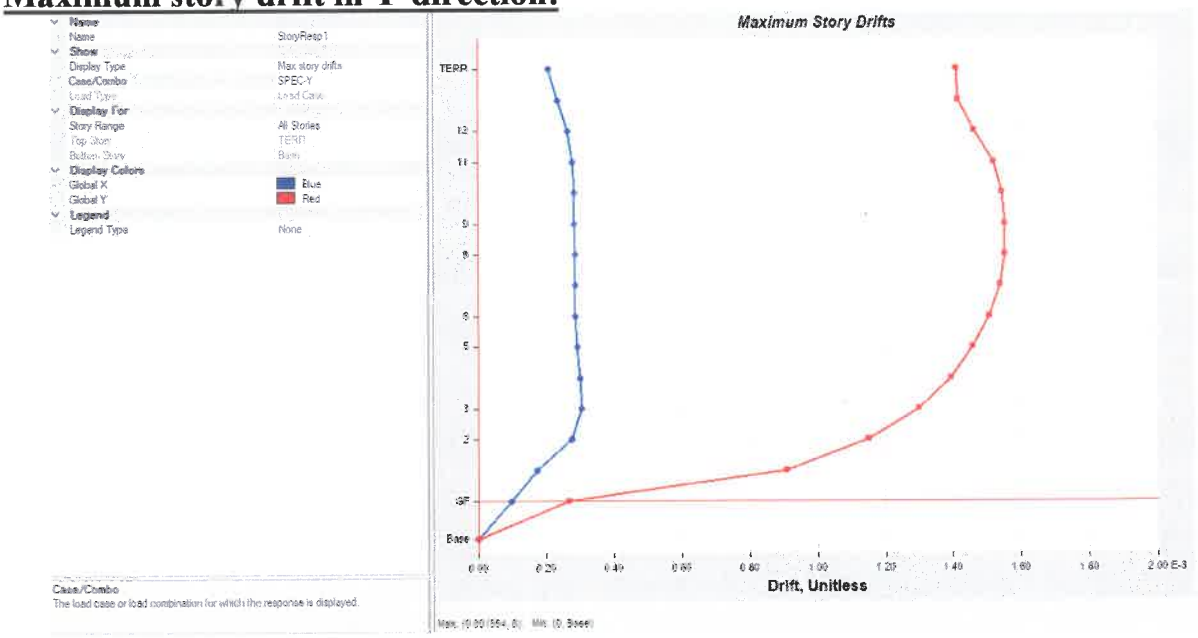


Allowable story Drift = 0.004 x 3.0 = 0.012

Actual story Drift = 0.0013 < 0.012, **Hence safe.**

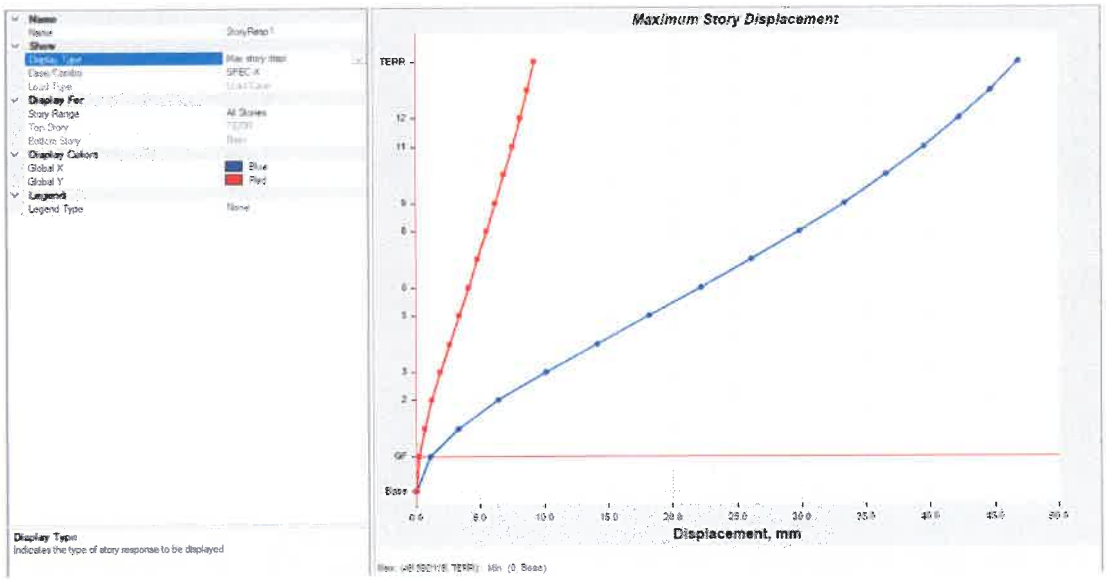
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Maximum story drift in Y-direction:



Allowable story Drift = 0.004 x 3.0 = 0.012
Actual story Drift = 0.0015 < 0.012, **Hence safe.**

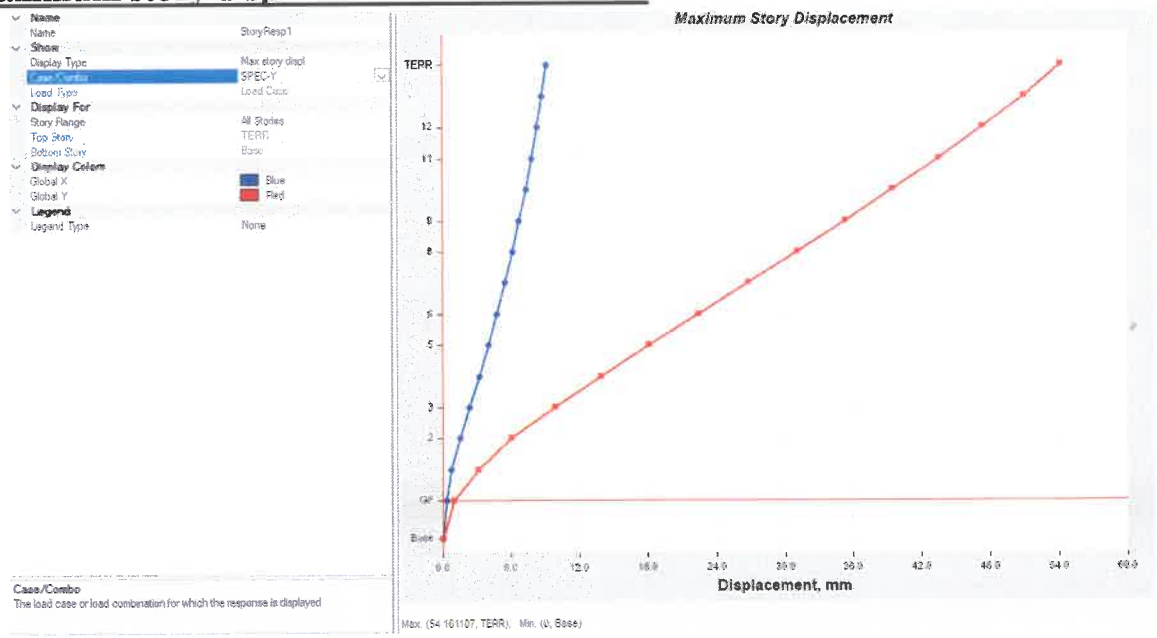
16.3 Maximum story displacement in X-direction:



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Allowable Displacement = 0.004 x 42m = 0.168m = 168mm
Actual Displacement = 47mm < 168mm, **Hence safe.**

Maximum story displacement in Y-direction:



Allowable Displacement = 0.004 x 42m = 0.168m = 168mm
Actual Displacement = 55mm < 168mm, **Hence safe.**

16.4 Seismic Base shear check:

Output Case	Case Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m
Dead	LinStatic	0	0	118375.1	5335315	-1193033	6.04E-07
Live	LinStatic	0	0	35705.32	1598187	-363825	0
SIDL	LinStatic	0	0	133160.7	5956897	-1343515	1.13E-06
EQX	LinStatic	-3376.16	0	2.87E-06	0.0002	-117236	151011.5
EQY	LinStatic	0	-3376.16	9.15E-07	117235.9	-1.4E-05	-34188.4
SPEC-X	LinRespSpec	3380.016	223.6599	2.45E-06	4062.637	89069.47	156571
SPEC-Y	LinRespSpec	261.8032	3333.787	7.02E-07	79955.68	4507.697	39818.98

Mass = **260462.1** kN
Minimum base shear = 0.7 % **1823.234** kN

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ActualBase Shear X	3376.156	>	1823.234	**Okay**
ActualBase Shear Y	3376.156	>	1823.234	**Okay**

S.DHILIPARAJAN, M.E.,
CMDA Regn. No. SE/GR-I/19/02/11
GCC Regn. No. RSE100042024
Jehovahking Engineering Consultants Pvt Ltd.,
Second Floor, Plot No. 49/A, New No. 3/1,
8th Cross Street, Lakshmi Nagar, Porur, Chennai-600116.
Mob: 9444024764, Mail: jkc_chennai@yahoo.co.in

16.5 Story stiffness check:

Story	Output Case	Case Type	Shear X kN	Drift X mm	Stiff X kN/m	Shear Y kN	Drift Y mm	Stiff Y kN/m	Soft Story Check
TERR	EQX	LinRespSpec	444.5458	1.785	249018.4	0	0.109	0	**No Soft Story**
13	EQX	LinRespSpec	1002.467	2.07	484231.1	0	0.092	0	**No Soft Story**
12	EQX	LinRespSpec	1484.677	2.382	623171.4	0	0.084	0	**No Soft Story**
11	EQX	LinRespSpec	1896.695	2.685	706421.3	0	0.085	0	**No Soft Story**
10	EQX	LinRespSpec	2244.038	2.956	759070.4	0	0.087	0	**No Soft Story**
9	EQX	LinRespSpec	2532.226	3.182	795853.8	0	0.086	0	**No Soft Story**
8	EQX	LinRespSpec	2766.776	3.368	821394.9	0	0.084	0	**No Soft Story**
7	EQX	LinRespSpec	2953.206	3.493	845534.7	0	0.081	0	**No Soft Story**
6	EQX	LinRespSpec	3097.036	3.539	875000.1	0	0.081	0	**No Soft Story**
5	EQX	LinRespSpec	3203.783	3.499	915601	0	0.079	0	**No Soft Story**
4	EQX	LinRespSpec	3278.965	3.328	985228.1	0	0.072	0	**No Soft Story**
3	EQX	LinRespSpec	3328.101	2.962	1123640	0	0.079	0	**No Soft Story**
2	EQX	LinRespSpec	3356.707	2.317	1448851	0	0.111	0	**No Soft Story**
1	EQX	LinRespSpec	3370.493	1.395	2416214	0	0.433	0	**No Soft Story**
TERR	EQY	LinStatic	0	0.144	0	444.5458	5.189	85670.72	**No Soft Story**
13	EQY	LinStatic	0	0.11	0	1002.467	5.583	179572.6	**No Soft Story**
12	EQY	LinStatic	0	0.096	0	1484.677	5.823	254953.9	**No Soft Story**
11	EQY	LinStatic	0	0.09	0	1896.695	6.091	311408.4	**No Soft Story**
10	EQY	LinStatic	0	0.102	0	2244.038	6.332	354385.6	**No Soft Story**
9	EQY	LinStatic	0	0.127	0	2532.226	6.49	390180.5	**No Soft Story**
8	EQY	LinStatic	0	0.151	0	2766.776	6.552	422252.2	**No Soft Story**
7	EQY	LinStatic	0	0.17	0	2953.206	6.498	454484.5	**No Soft Story**
6	EQY	LinStatic	0	0.192	0	3097.036	6.315	490446.1	**No Soft Story**
5	EQY	LinStatic	0	0.205	0	3203.783	5.959	537608.9	**No Soft Story**
4	EQY	LinStatic	0	0.219	0	3278.965	5.428	604045.4	**No Soft Story**
3	EQY	LinStatic	0	0.234	0	3328.101	4.676	711763.3	**No Soft Story**
2	EQY	LinStatic	0	0.219	0	3356.707	3.703	906533.5	**No Soft Story**
1	EQY	LinStatic	0	0.104	0	3370.493	2.749	1226084	**No Soft Story**

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THE LANDLENS SUITE

Eight ways to know a piece of land before you pay for it.

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

LandLens One
Ask anything about a property and get an answer grounded in live government records, with the sources shown.
/landlens/one

Verify My Land
Every record check run on one property and returned as a single report.
/landlens/verify-my-land

Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
/landlens

One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
/landlens/one/map

PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
/landlens/pricemap

Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
/landlens/build-scope

Property Tracker
Watch a property and hear about it when something new is registered against it.
/landlens/property-tracker

Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
/landlens/deal-room

FREE TOOLS · NO ACCOUNT NEEDED

Twenty-four checks you can run yourself, at no cost.

Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

Every free tool
/tools

Services we run for you
/services

The LandLens suite
/landlens/one

Verified RealEstate™

Every claim in this document traces back to a government record.

- Legal opinions, due diligence and title verification
- Building plan, layout and sub-division approvals
- Completion and occupancy certificates, regularisation
- Escrow, negotiation and NRI property management
- Land survey, soil testing, architecture and construction

Verified RealEstate
3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai 600 097, India
hello@verified.realestate
+91 9996 12 9996

Prepared from the registers named on the page each finding sits on. Where a register could not be read, this document says so in its place rather than leaving the gap to be read as a clean result.