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PROJECT

PROPOSED RESIDENTIAL BUILDING AT GOPALAPURAM IN CHENNAI, TAMILNADU

CLIENT

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TITLE

DESIGN BASIS REPORT

REPORT NO.: JC-2023-STR-1074

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1.0 Design Philosophy

The structure is proposed for Construction of residential building at Gopalapuram, Chennai. This report covers minimum design specifications, which will form the overall Design Philosophy to be adopted in the Structural Design of the project.

The Structural Design Basis Report is prepared in reference with the relevant IS Codes and Architectural drawings. This report provides design basis report for residential building. It consists of Basement floor + Ground floor + 8 Upper floors + Terrace. Basement and ground floor accommodates for parking facility and other service rooms. 1st floor to 8th floor accommodates home units and its amenities. In 2nd floor consists of gym and indoors games and then 5th to 8th floors are typical floors. Terrace floor consists of LMR, staircase headroom, Barbeque corner, swimming pool etc.

The foundation system is adopted as per the soil consultant's report and recommendations.

This report will cover information on Codes of practice, Design loading, Material strength considered for design and analysis of the building. All designs shall strictly conform to the standards specified in clause **10.0**

2.0 Design Loads

2.1 Imposed loads

The imposed loads that are envisaged to act permanently (wherever applicable) are as following: -

Load component	Load Intensity kN/m2	Occupancy classification
Floor finish – 50mm screed	1.2	Parking floors, Livings rooms, bed rooms, Store room, Ramps, Lobby. Balconies
Floor finish – 150mm screed	3.2	Terrace
Floor finish – 75mm screed	1.8	Staircases
Floor finish – 115mm screed	2.5	Balcony
50 mm sunken + 65 mm floor finish	2.5	Toilet
Services, false ceiling	0.5	All floors

The superimposed load or otherwise live load assessed based on the occupancy classifications as per IS: 875 (Part 2) – 1987 is listed as follows: -

Sl.No	Occupancy classification	Reducible LL KN/m^2	Non-Reducible LL KN/m^2
1.	Living rooms and Bed rooms	2	--
2.	Kitchens and laundries	3	--
3.	Terrace	3	--
4.	Passages, Staircases, Corridors and Ramps, Balconies	4	--
5.	Baths and Toilets	2	--
6.	Public lounges and Billiards room, indoor games	3	--
7.	Store rooms	5	--
8.	Rooms for indoor games	3	--
9.	Electrical and storage	2.5	5
10.	LMR	2	13

2.2 Self-Weight of Structural Member

Materials	**Unit Weight in kN/m^3**
Steel	78.50
Plain Concrete	24.00
Reinforced Concrete	25.00
Soil -Dry	18.00
Soil -Moist	20.00
Water	10
Solid block masonry	19.00
Aerated block masonry	8.7

2.3 Wind Load

Wind Loads for structure and elements shall be calculated in accordance with provisions laid in IS: 875-2015(part-3) & basic data as follows.

Description	**Data**	**Remarks**
Basic Wind Speed, V_b	50 m/s	Chennai
Probability factor (Risk co-efficient), k_1	1.00	General buildings & Structures (for return period of 50 years)
Terrain Category	2	Open terrain with well scattered Obstruction
Terrain, height and structure size factor, k_2	k2= 1.123 for height of 50m	As per Structure class & height of structure
Topography factor, k_3	1.00	Upwind slope is lesser than 3°
Importance factor for cyclonic region k_4	1.00	Clause 6.3.4, IS 875-2015

Design Wind Speed at the height Z	V_z	$= V_b * k_1 * k_2 * k_3 * k_4$
Design Wind pressure at the height Z	P_z	$= 0.6 * V_z^2$
Wind Directionality Factor	Kd	=1.0 (Clause 7.2.1)
Area Averaging Factor	Ka	=0.8 (Clause 7.2.2)
Combination Factor	Kc	=1.0(Clause7.3.3.13)
Design Wind pressure, Pd		= Max **(**(K_d * K_a * K_c * P_z) or 0.7P_z**)**

Calculated Wind loads are applied over structure in 0°, 90°,180° and 270° Wind Directions.

Application of Wind load shall be as per IS 875-2015.

2.4 Earthquake Load

Structure and foundation shall be designed to resist the effects of earthquakes in accordance with IS: 1893 (Part-1) – 2016.

Structure shall be designed for Design Basis Earthquake (DBE). Response spectrum method will be used to carry out seismic analysis. Horizontal acceleration values of the spectra are obtained from IS: 1893(Part 1) - 2016.

The horizontal seismic co-efficient (A_h) = (Z / 2) x (I / R) x (S_a / g)

Seismic parameters Z, I, R and (S_a/g) are obtained as per table below.

Total horizontal design base shear shall be calculated (V_B) = (A_h x W)

Where: W- Total seismic weight of the building

Vertical acceleration values of the spectra are obtained from IS: 1893(Part 1) - 2016.

The Vertical seismic co-efficient (Av) = ((2 /3) x (Z / 2)) x 2.5 x (I / R)

Seismic parameters Z, I and R are obtained as per table below.

Total Vertical design base shear shall be calculated (VB) = (Av x W)

Where: W- Total seismic weight of the building

2.4.1 Seismic Parameters

Item	Value	Reference
Seismic Zone	Zone – III	Annex–E IS: 1893(Part 1)-2016
Zone Factor (z)	0.16	Table 3 Clause 6.4.2 IS: 1893(Part 1)-2016
Importance Factor (I)	1.0	Table 8 IS: 1893(Part 1)-2016
Damping	5 %	Clause 7.2.4 IS: 1893(Part 1)-2016
Design acceleration coefficient	1+15T, T < 0.10 s 2.5, 0.10 s < T < 0.40 s 1.0 /T, 0.40 s < T < 4.00 s 0.25, T > 4.00 s	Clause 6.4.2 For hard/rocky soil sites IS: 1893(Part 1)-2016
Response reduction factor (R)	4	Table 9 Clause 7.2.6 IS: 1893(Part 1)-2016

Fundamental natural time period shall be based on clause 7.6.2(b) of IS 1893(Part 1)2016.

$T_a = 0.075h^{0.75}/\sqrt{A_w} \geq 0.09h/\sqrt{d}$

A_w - Total effective area of walls in the first story of the building.

h – Height of the building as per Cl 7.6.2(a)

d – Basic dimension of the building at the plinth level along the considered direction of earthquake

As building is located in Zone-III, Ductile detailing is carried out according to IS: 13920-2016. For Structural detailing other than specified in IS: 13920-2016, shall be referred to IS: 456-2000.

The foundation to be supported on hard soil and as per clause 6.3.5.2 and Table 1 of IS:1893 (Part 1)- 2016 the increase in Net bearing pressure by 50% for seismic load combination.

In accordance with Cl.6.3.3 of IS:1896-2016: The structure has plan and vertical irregularities. Hence vertical earthquake effects are taken into consideration.

2.5 Load Combinations

The various loads shall be combined in accordance with the stipulations in IS: 875 (Part 5) – 1987. Whichever combination produces the most unfavorable effect in the building, foundation or structural member concerned shall be adopted.

Values of Partial Safety Factor for Loads

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. Wind load and earthquake load shall be considered for both x & y directions.

DL - Dead load

LL - Live load

WL - Wind load

EL - Earthquake load

3.0 Serviceability Consideration

3.1 Deflection and Sway

For RCC Structure/Elements:

Type	Description	Limit
Vertical Deflection of building elements	Due to all loads including the effects of temperature, creep and shrinkage and measured from as-cast level of the supports of the floors, roofs and all other horizontal members	Span/250
Vertical Deflection of building elements	Due to all loads including the effects of temperature, creep and shrinkage occurring after erection of partition and application of finishes	Span/350 or 20mm whichever is less
Lateral Sway of building	Under transient Wind Load sway at top of building (H= Total height of the building)	H /500
Drift	Earthquake force with scale safety factor 1.0	0.004*Storey height

3.2 Crack Width

In general, RCC Superstructure Structures, width of surface crack shall be limited to 0.3mm. For RCC Structural elements which are in contact with Soil and for Water tanks, width of surface crack shall be limited to 0.2mm.

4.0 Analysis Methods

3D analysis of the structures is carried out using the ETABS 22.2.0 and appropriate loads and its combinations, as per relevant clauses in IS codes, for most unfavorable effects are chosen for design. For earthquake, response spectrum dynamic analysis is considered. The floor slabs will be modeled as rigid diaphragms to transfer the lateral forces to the supporting column as per Cl 7.6.4 IS:1893-2016. Stiffness modifiers for beams and columns are considered as 0.35 and 0.7 respectively as per IS:1893-2016. Torsional Design eccentricity shall be applied as per Cl.7.8.2 IS:1893-2016. The openings in diaphragms are checked as per Fig 3C, IS:1893-2016 and found to be within limits.

5.0 Design Life

The design life of the structure is assumed as 50 years. This requirement is not applicable to replaceable materials.

6.0 Design Methodology

Individual members shall be designed for worst combination of forces such as Axial force, Shear Force, Bending Moment, torsion etc.

RCC structural elements shall be designed using Limit State Method as specified in IS: 456-2000. Ductile detailing shall be as per IS:13920-2016.

All columns shall be designed for minimum eccentricity, equal to the unsupported length of column/500 plus lateral dimension/30, subject to a minimum of 20mm. For design of columns and foundations, live load shall be reduced as per Table 10 of IS:1893-2016.

Slabs shall be designed as per loading considerations mentioned in the above table. Beams shall be designed for worst envelope combinations.

All post tensioning structural elements shall be designed as specified in IS:1343-2012. Class of members shall be Type 3 as per cl.19.3.2 as per IS:1343-2012

Post-Tensioned Steel Reinforcement specification as follows,

The strand shall be Class II type and its specification shall be as follows as per IS:14268-1995(Reaffirmed 2003),

Nominal Diameter	12.7 mm
Nominal Area	98.7 mm^2
Nominal weight	0.775 kg/m

Min. Ultimate strength	1860 kN/mm^2
Modulus of elasticity	195 kN/mm^2
Min. Braking load per strand	183.7 kN
Low Relaxation Strands after 1000h	Max. 2.5% relaxation losses at load of at 70% UTS
Max jacking load	140kN (75% of UTS)

7.0 Foundation

Foundation system adopted is pile foundation as per soil report. The various diameter piles and load bearing capacity are as follows:

TABLE:- 4.1 RECOMMENDED SAFE LOAD CARRYING CAPACITIES OF BORED CAST-IN SITU PILES

SI.NO	REFERENCE BORE HOLE NO.	LENGTH OF PILE BELOW E.G.L	ASSUMED LENGTH OF CUT-OFF BELOW E.G.L	LENGTH OF PILE BELOW CUT-OFF	DIA.OF PILE IN (mm)	SAFE LOAD CARRYING CAPACITY (kN)		
						VERTICAL LOAD CARRYING CAPACITY	PULL OUT CAPACITY	LATERAL LOAD CARRYING CAPACITY
1.0	BH-03	22.0	8.0	14.00	500	1200	300	20
2.0					600	1700	350	25
3.0					750	2300	450	35
4.0					800	2800	500	40
5.0					900	3500	550	50
6.0					1000	4000	600	60

8.0 Materials

8.1 Concrete

Concrete item	Grade	Max. Size of Aggregate (mm)	Type of cement
Raft Foundation	M40	20	OPC/PPC
Column, Shear wall	M40	20	OPC/PPC
Beams	M30	20	OPC/PPC
Conventional Slab	M30	20	OPC/PPC
PT slab	M30	20	OPC/PPC
Lintels, mullions & nonstructural elements	M25	20	OPC/PPC

Normal weight aggregates shall be considered for all concrete works.

8.2 Reinforcement

Steel reinforcement shall be of Grade Fe 500D conforming to IS: 1786-2008.

8.3 Fire resistance

Structural Elements shall be designed for two hours of fire resistance.

9.0 Nominal Cover

From Durability requirement, exposure condition is assumed as moderate for Structural elements above and below ground level. The Nominal cover to reinforcement to meet Durability requirement for two – hour fire resistance shall be as follows:

Element	Exposure condition	Cover as per exposure condition	Cover as per 2hrs fire rating	Actual cover
Foundation	Moderate	45	--	45
Column	Moderate	30	40	40
Shear wall	Moderate	30	30	30
Retaining wall (soil side)	Severe	50	--	50
Retaining wall (inside side)	Moderate	30	--	30
Slab simply supported	Moderate	30	35	35
Slab continuous	Moderate	30	25	30
Beam simply supported	Moderate	30	40	40
Beam continuous	Moderate	30	30	30
Water tank/UG sump	Severe	30	--	30

For any other elements not specified above, clear cover shall be as per the clause 26.4 of IS: 456-2000

10.0 Design Standards

The relevant Standards/codes used for the design of various element and components of the building are given below:

SL.No	Code	Description
1.	IS:875(Part-1)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 1 – Dead Loads)
2.	IS:875(Part-2)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 2 – Imposed Loads)
3.	IS:875(Part-3)-2015	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Part 3 – Wind Loads)
4.	IS:875(Part-5)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – (Part-5 Special Loads and Load Combinations).

5.	IS:1893(Part-1)-2016	Criteria for Earthquake Resistant Design of Structures (Part 1 - General Provisions and Buildings)
6.	IS:1893(Part-2)-2015	Criteria for Earthquake Resistant Design of Structures (Part 2 – General Provisions for Liquid retaining structures)
7.	IS:4326-2013	Earthquake Resistance Design and Construction of Buildings-Code of practice
8.	IS:456- 2000	Code of Practice for Plain and Reinforced Concrete.
9.	IS:13920-2016	Ductile detailing of reinforced concrete structures subjected to seismic forces – Code of practice
10.	IS:3370(Part-1)-2009	Concrete Structures for Storage of Liquids-Code of practice-General Requirements
11.	IS:1905-1907	Code of practice for Structural use of Unreinforced masonry
12.	IS:1904-1986	Code of Practice for Design and Construction of Foundation in Soils-General Requirements
13.	SP:7 - 2016	National Building Code of India 2016 (NBC 2016)
14.	SP:16 - 1980	Design Aids for Reinforced Concrete to IS 456
15.	SP:24 (S&T) :1983	Explanatory Handbook on Indian standard code of practice for Plain and Reinforced concrete (IS:456-1978)
16.	SP:34 - 1987	Hand Book of Concrete Reinforcement and Detailing
17.	SP - Others	Special Publications of Bureau of Indian Standards
18.	IS:1343-2012	Code of practice for pre-stressed concrete
19.	IS:1786-2008	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement-Specification
20.	IS:800-2007	Code of practice for General construction in Steel
21.	IS:2062-2011	Specifications for Hot Rolled medium and high tensile structural steel

For Geomarine Consultants (P) Ltd., Chennai

M.BALAGANESH M.E (Struct.), CMDA & DTCP SE-GRADE(I), C.Eng , MIE

12.0 Analysis Report

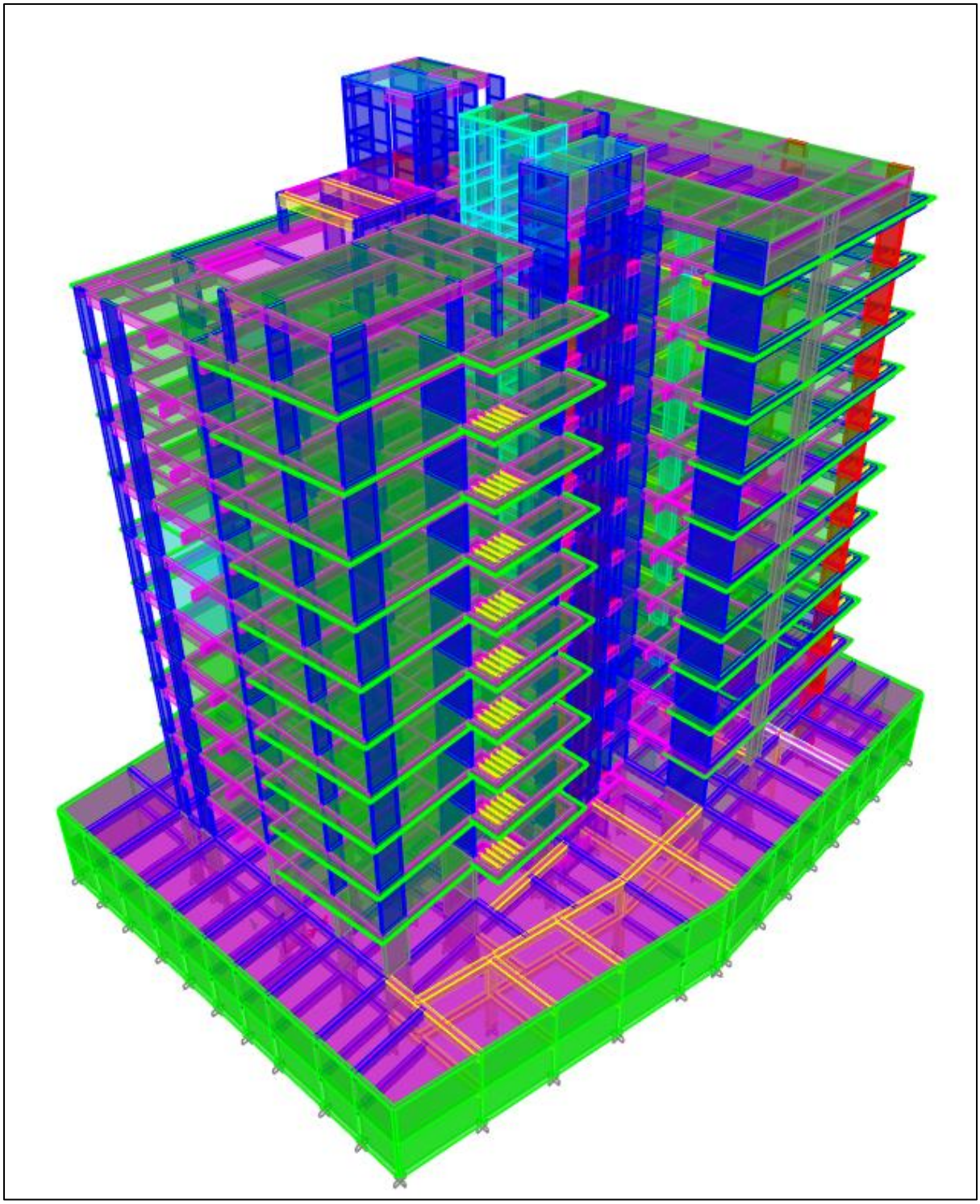
12.1.1 Permissible Drift Limit (Inter-Storey) – X- Direction

Story	Load Case/Combo	Direction	Drift	Drift Limit ratio	Status
TERRACE	SPECX-DRIFT	X	0.00052	0.004	SAFE
9TH	SPECX-DRIFT	X	0.000635	0.004	SAFE
8TH	SPECX-DRIFT	X	0.000711	0.004	SAFE
7TH	SPECX-DRIFT	X	0.000758	0.004	SAFE
6TH	SPECX-DRIFT	X	0.000794	0.004	SAFE
5TH	SPECX-DRIFT	X	0.000808	0.004	SAFE
4TH	SPECX-DRIFT	X	0.000793	0.004	SAFE
3RD	SPECX-DRIFT	X	0.000749	0.004	SAFE
2ND	SPECX-DRIFT	X	0.00067	0.004	SAFE
1ST	SPECX-DRIFT	X	0.00045	0.004	SAFE
STILT	SPECX-DRIFT	X	9.9E-05	0.004	SAFE

12.1.2 Permissible Drift Limit (Inter-Storey) – Y- Direction

Story	Load Case/Combo	Direction	Drift	Drift Limit ratio	Status
TERRACE	SPECY-DRIFT	Y	0.000741	0.004	SAFE
9TH	SPECY-DRIFT	Y	0.000787	0.004	SAFE
8TH	SPECY-DRIFT	Y	0.000824	0.004	SAFE
7TH	SPECY-DRIFT	Y	0.000849	0.004	SAFE
6TH	SPECY-DRIFT	Y	0.00086	0.004	SAFE
5TH	SPECY-DRIFT	Y	0.000852	0.004	SAFE
4TH	SPECY-DRIFT	Y	0.000818	0.004	SAFE
3RD	SPECY-DRIFT	Y	0.000739	0.004	SAFE
2ND	SPECY-DRIFT	Y	0.000592	0.004	SAFE
1ST	SPECY-DRIFT	Y	0.000429	0.004	SAFE
STILT	SPECY-DRIFT	Y	0.00012	0.004	SAFE

12.2 3D IMAGE OF ETABS



12.3 Permissible Drift limit Check (Overall Drift) – X-Direction

Lateral sway due to wind load should not exceel H/500 (H – height of structure)

Story	Load Case/Combo	Direction	Drift	Building height	H/500	Status
TERRACE	S2	X	0.000607	45.5	0.091	SAFE
TERRACE	S3	X	0.000229	45.5	0.091	SAFE
TERRACE	S4	X	0.000719	45.5	0.091	SAFE
TERRACE	S5	X	0.000503	45.5	0.091	SAFE
TERRACE	S6	X	0.000558	45.5	0.091	SAFE
TERRACE	S7	X	0.00031	45.5	0.091	SAFE
TERRACE	S8	X	0.000702	45.5	0.091	SAFE
TERRACE	S9	X	0.000528	45.5	0.091	SAFE
9TH	S2	X	0.000702	45.5	0.091	SAFE
9TH	S3	X	0.000285	45.5	0.091	SAFE
9TH	S4	X	0.000832	45.5	0.091	SAFE
9TH	S5	X	0.000467	45.5	0.091	SAFE
9TH	S6	X	0.00062	45.5	0.091	SAFE
9TH	S7	X	0.000362	45.5	0.091	SAFE
9TH	S8	X	0.0008	45.5	0.091	SAFE
9TH	S9	X	0.000508	45.5	0.091	SAFE
8TH	S2	X	0.000796	45.5	0.091	SAFE
8TH	S3	X	0.000326	45.5	0.091	SAFE
8TH	S4	X	0.00094	45.5	0.091	SAFE
8TH	S5	X	0.000436	45.5	0.091	SAFE
8TH	S6	X	0.000686	45.5	0.091	SAFE
8TH	S7	X	0.000399	45.5	0.091	SAFE
8TH	S8	X	0.00089	45.5	0.091	SAFE
8TH	S9	X	0.000487	45.5	0.091	SAFE
7TH	S2	X	0.0009	45.5	0.091	SAFE
7TH	S3	X	0.000355	45.5	0.091	SAFE
7TH	S4	X	0.001036	45.5	0.091	SAFE
7TH	S5	X	0.000403	45.5	0.091	SAFE
7TH	S6	X	0.000767	45.5	0.091	SAFE
7TH	S7	X	0.000423	45.5	0.091	SAFE
7TH	S8	X	0.000967	45.5	0.091	SAFE
7TH	S9	X	0.000462	45.5	0.091	SAFE
6TH	S2	X	0.000997	45.5	0.091	SAFE
6TH	S3	X	0.00037	45.5	0.091	SAFE
6TH	S4	X	0.001108	45.5	0.091	SAFE
6TH	S5	X	0.000362	45.5	0.091	SAFE
6TH	S6	X	0.000845	45.5	0.091	SAFE
6TH	S7	X	0.000431	45.5	0.091	SAFE
6TH	S8	X	0.001021	45.5	0.091	SAFE
6TH	S9	X	0.000425	45.5	0.091	SAFE
5TH	S2	X	0.001056	45.5	0.091	SAFE
5TH	S3	X	0.000375	45.5	0.091	SAFE
5TH	S4	X	0.001148	45.5	0.091	SAFE

5TH	S6	X	0.000891	45.5	0.091	SAFE
5TH	S7	X	0.000427	45.5	0.091	SAFE
5TH	S8	X	0.001045	45.5	0.091	SAFE
5TH	S9	X	0.000378	45.5	0.091	SAFE
4TH	S2	X	0.001051	45.5	0.091	SAFE
4TH	S3	X	0.000371	45.5	0.091	SAFE
4TH	S4	X	0.001143	45.5	0.091	SAFE
4TH	S6	X	0.000879	45.5	0.091	SAFE
4TH	S7	X	0.000412	45.5	0.091	SAFE
4TH	S8	X	0.00103	45.5	0.091	SAFE
4TH	S9	X	0.000321	45.5	0.091	SAFE
3RD	S2	X	0.000973	45.5	0.091	SAFE
3RD	S3	X	0.00035	45.5	0.091	SAFE
3RD	S4	X	0.001072	45.5	0.091	SAFE
3RD	S6	X	0.000806	45.5	0.091	SAFE
3RD	S7	X	0.000379	45.5	0.091	SAFE
3RD	S8	X	0.000957	45.5	0.091	SAFE
3RD	S9	X	0.000254	45.5	0.091	SAFE
2ND	S2	X	0.000798	45.5	0.091	SAFE
2ND	S3	X	0.000459	45.5	0.091	SAFE
2ND	S4	X	0.001154	45.5	0.091	SAFE
2ND	S5	X	0.000327	45.5	0.091	SAFE
2ND	S6	X	0.000654	45.5	0.091	SAFE
2ND	S7	X	0.0005	45.5	0.091	SAFE
2ND	S8	X	0.001055	45.5	0.091	SAFE
2ND	S9	X	0.000394	45.5	0.091	SAFE
1ST	S2	X	0.000633	45.5	0.091	SAFE
1ST	S3	X	0.000354	45.5	0.091	SAFE
1ST	S4	X	0.000779	45.5	0.091	SAFE
1ST	S6	X	0.000561	45.5	0.091	SAFE
1ST	S7	X	0.000386	45.5	0.091	SAFE
1ST	S8	X	0.000726	45.5	0.091	SAFE
SF	S2	X	0.000228	45.5	0.091	SAFE
SF	S3	X	0.000245	45.5	0.091	SAFE
SF	S4	X	0.000267	45.5	0.091	SAFE
SF	S5	X	0.000264	45.5	0.091	SAFE
SF	S6	X	0.000258	45.5	0.091	SAFE
SF	S7	X	0.000271	45.5	0.091	SAFE
SF	S8	X	0.000288	45.5	0.091	SAFE
SF	S9	X	0.000286	45.5	0.091	SAFE
B1	S2	X	0.000119	45.5	0.091	SAFE
B1	S3	X	0.000105	45.5	0.091	SAFE
B1	S4	X	0.000072	45.5	0.091	SAFE
B1	S5	X	0.000092	45.5	0.091	SAFE
B1	S6	X	0.000126	45.5	0.091	SAFE
B1	S7	X	0.000114	45.5	0.091	SAFE
B1	S8	X	0.000088	45.5	0.091	SAFE
B1	S9	X	0.000102	45.5	0.091	SAFE

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12.4 Permissible Drift limit Check (Overall Drift)- Y-Direction

Story	Load Case/Combo	Direction	Drift	Building height	H/500	Status
TERRACE	S2	Y	0.000608	45.5	0.091	SAFE
TERRACE	S3	Y	0.000502	45.5	0.091	SAFE
TERRACE	S4	Y	0.000589	45.5	0.091	SAFE
TERRACE	S5	Y	0.001158	45.5	0.091	SAFE
TERRACE	S6	Y	0.000677	45.5	0.091	SAFE
TERRACE	S7	Y	0.000522	45.5	0.091	SAFE
TERRACE	S8	Y	0.000662	45.5	0.091	SAFE
TERRACE	S9	Y	0.001117	45.5	0.091	SAFE
9TH	S2	Y	0.000597	45.5	0.091	SAFE
9TH	S3	Y	0.000645	45.5	0.091	SAFE
9TH	S4	Y	0.000515	45.5	0.091	SAFE
9TH	S5	Y	0.001155	45.5	0.091	SAFE
9TH	S6	Y	0.000658	45.5	0.091	SAFE
9TH	S7	Y	0.000638	45.5	0.091	SAFE
9TH	S8	Y	0.000592	45.5	0.091	SAFE
9TH	S9	Y	0.001104	45.5	0.091	SAFE
8TH	S2	Y	0.000587	45.5	0.091	SAFE
8TH	S3	Y	0.000778	45.5	0.091	SAFE
8TH	S4	Y	0.000461	45.5	0.091	SAFE
8TH	S5	Y	0.001172	45.5	0.091	SAFE
8TH	S6	Y	0.000641	45.5	0.091	SAFE
8TH	S7	Y	0.000744	45.5	0.091	SAFE
8TH	S8	Y	0.00054	45.5	0.091	SAFE
8TH	S9	Y	0.001109	45.5	0.091	SAFE
7TH	S2	Y	0.000578	45.5	0.091	SAFE
7TH	S3	Y	0.00091	45.5	0.091	SAFE
7TH	S4	Y	0.001196	45.5	0.091	SAFE
7TH	S5	Y	0.000626	45.5	0.091	SAFE
7TH	S6	Y	0.000854	45.5	0.091	SAFE
7TH	S7	Y	0.000503	45.5	0.091	SAFE
7TH	S8	Y	0.001121	45.5	0.091	SAFE
7TH	S9	Y	0.000568	45.5	0.091	SAFE
6TH	S2	Y	0.001035	45.5	0.091	SAFE
6TH	S3	Y	0.00121	45.5	0.091	SAFE
6TH	S4	Y	0.000612	45.5	0.091	SAFE
6TH	S5	Y	0.000962	45.5	0.091	SAFE
6TH	S6	Y	0.001126	45.5	0.091	SAFE
6TH	S7	Y	0.001107	45.5	0.091	SAFE
6TH	S8	Y	0.00119	45.5	0.091	SAFE
6TH	S9	Y	0.00058	45.5	0.091	SAFE
5TH	S2	Y	0.001015	45.5	0.091	SAFE
5TH	S3	Y	0.001099	45.5	0.091	SAFE
5TH	S4	Y	0.001106	45.5	0.091	SAFE
5TH	S6	Y	0.001117	45.5	0.091	SAFE

5TH	S7	Y	0.000521	45.5	0.091	SAFE
5TH	S8	Y	0.000995	45.5	0.091	SAFE
5TH	S9	Y	0.001023	45.5	0.091	SAFE
4TH	S2	Y	0.001049	45.5	0.091	SAFE
4TH	S3	Y	0.000982	45.5	0.091	SAFE
4TH	S4	Y	0.000437	45.5	0.091	SAFE
4TH	S6	Y	0.00093	45.5	0.091	SAFE
4TH	S7	Y	0.000893	45.5	0.091	SAFE
4TH	S8	Y	0.000986	45.5	0.091	SAFE
4TH	S9	Y	0.000764	45.5	0.091	SAFE
3RD	S2	Y	0.00087	45.5	0.091	SAFE
3RD	S3	Y	0.00069	45.5	0.091	SAFE
3RD	S4	Y	0.000171	45.5	0.091	SAFE
3RD	S6	Y	0.000585	45.5	0.091	SAFE
3RD	S7	Y	0.000132	45.5	0.091	SAFE
3RD	S8	Y	0.000622	45.5	0.091	SAFE
3RD	S9	Y	0.000181	45.5	0.091	SAFE
2ND	S2	Y	0.000483	45.5	0.091	SAFE
2ND	S3	Y	0.000152	45.5	0.091	SAFE
2ND	S4	Y	0.000514	45.5	0.091	SAFE
2ND	S5	Y	0.000051	45.5	0.091	SAFE
2ND	S6	Y	0.000154	45.5	0.091	SAFE
2ND	S7	Y	0.000062	45.5	0.091	SAFE
2ND	S8	Y	0.000208	45.5	0.091	SAFE
2ND	S9	Y	0.000057	45.5	0.091	SAFE
1ST	S2	Y	0.000121	45.5	0.091	SAFE
1ST	S3	Y	0.000066	45.5	0.091	SAFE
1ST	S4	Y	0.000178	45.5	0.091	SAFE
1ST	S6	Y	0.000042	45.5	0.091	SAFE
1ST	S7	Y	0.000029	45.5	0.091	SAFE
1ST	S8	Y	0.000051	45.5	0.091	SAFE
SF	S2	Y	0.000036	45.5	0.091	SAFE
SF	S3	Y	0.000029	45.5	0.091	SAFE
SF	S4	Y	0.000046	45.5	0.091	SAFE
SF	S5	Y	0.000608	45.5	0.091	SAFE
SF	S6	Y	0.000502	45.5	0.091	SAFE
SF	S7	Y	0.000589	45.5	0.091	SAFE
SF	S8	Y	0.001158	45.5	0.091	SAFE
SF	S9	Y	0.000677	45.5	0.091	SAFE
B1	S2	Y	0.000522	45.5	0.091	SAFE
B1	S3	Y	0.000662	45.5	0.091	SAFE
B1	S4	Y	0.001117	45.5	0.091	SAFE
B1	S5	Y	0.000597	45.5	0.091	SAFE
B1	S6	Y	0.000645	45.5	0.091	SAFE
B1	S7	Y	0.000515	45.5	0.091	SAFE
B1	S8	Y	0.001155	45.5	0.091	SAFE
B1	S9	Y	0.000658	45.5	0.091	SAFE

12.5 Torsional Irregularity Check

As per IS:1893-2016, In Torsionally irregular buildings, when the raio of maximum horizontal displacement at one end the minimum horizontal displacement at the other end is,
Δ Max < 1.2 Δ avg

X DIRECTION	
Δ MAX	24.476
Δ MIN	24.347
Δ AVE	24.411
1.2 *Δ AVE	29.293
1.4 *Δ AVE	34.175
Δ MAX < 1.2 Δ AVG / 1.4Δ AVG	

Y DIRECTION	
Δ MAX	27.399
Δ MIN	18.898
Δ AVE	23.148
1.2 *Δ AVE	27.777
1.4 *Δ AVE	32.407
Δ MAX < 1.2 Δ AVG / 1.4Δ AVG	

12.6 Modal Participating Mass Ratio

As per IS:1893 (Part1) -2016, In Buildings located in seismic Zone III, it should be ensured that the first three modes together contribute at least 65 percent mass participation factor in each principal plan direction.

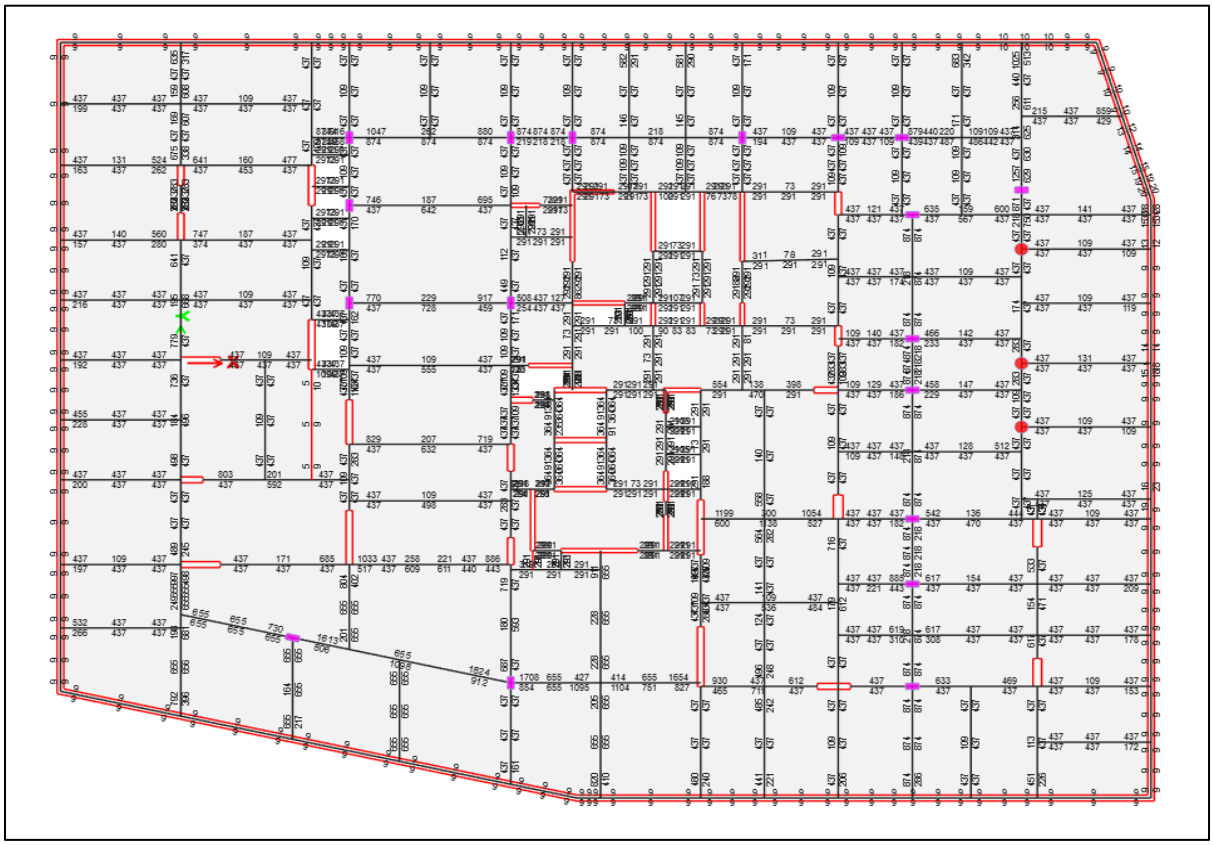
Case	Mode	Period	UX	UY	RZ
		sec			
Modal	1	2.615	0.5056	0.0012	0.0004
Modal	2	2.447	0.0005	0.0158	0.3771
Modal	3	2.054	0.001	0.497	0.0063
Modal	4	0.672	0.0889	0.0002	0.0026
Modal	5	0.605	0.0056	0.0007	0.0582
Modal	6	0.518	0.0002	0.1075	0.002
Modal	7	0.319	0.0162	0.0003	0.00002051
Modal	8	0.301	0.0248	0.0004	0.0005
Modal	9	0.244	0.0001	0.0556	0.0004
Modal	10	0.172	0.0101	0.0074	0.0002
Modal	11	0.125	0.1938	0.0162	0.000036
Modal	12	0.118	0.0083	0.2014	0.0011
			61.07%	66.01%	

Note : Since the second mode contributes to Z-direction, we have considered vertical earthquake effects and corresponding load combinations are incorporated in design.

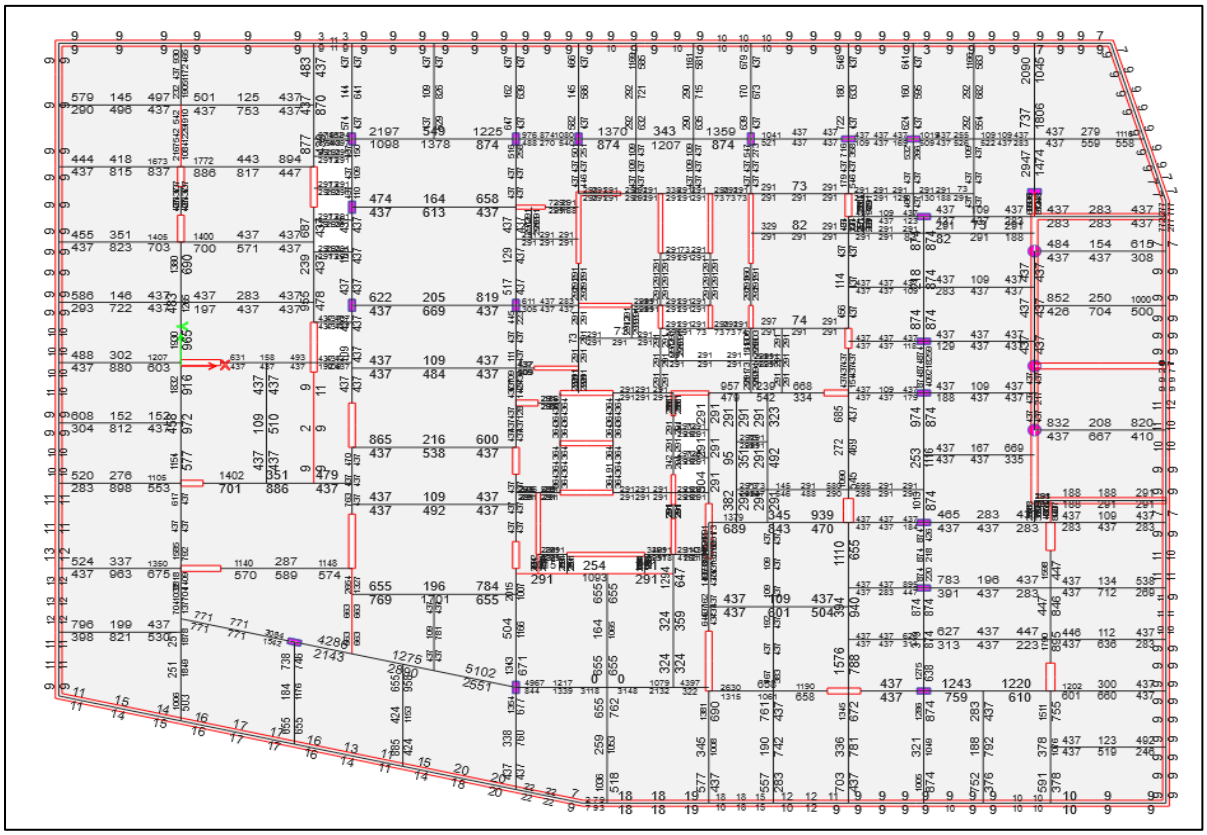
13.0 Member Design

13.1 BEAM DESIGN

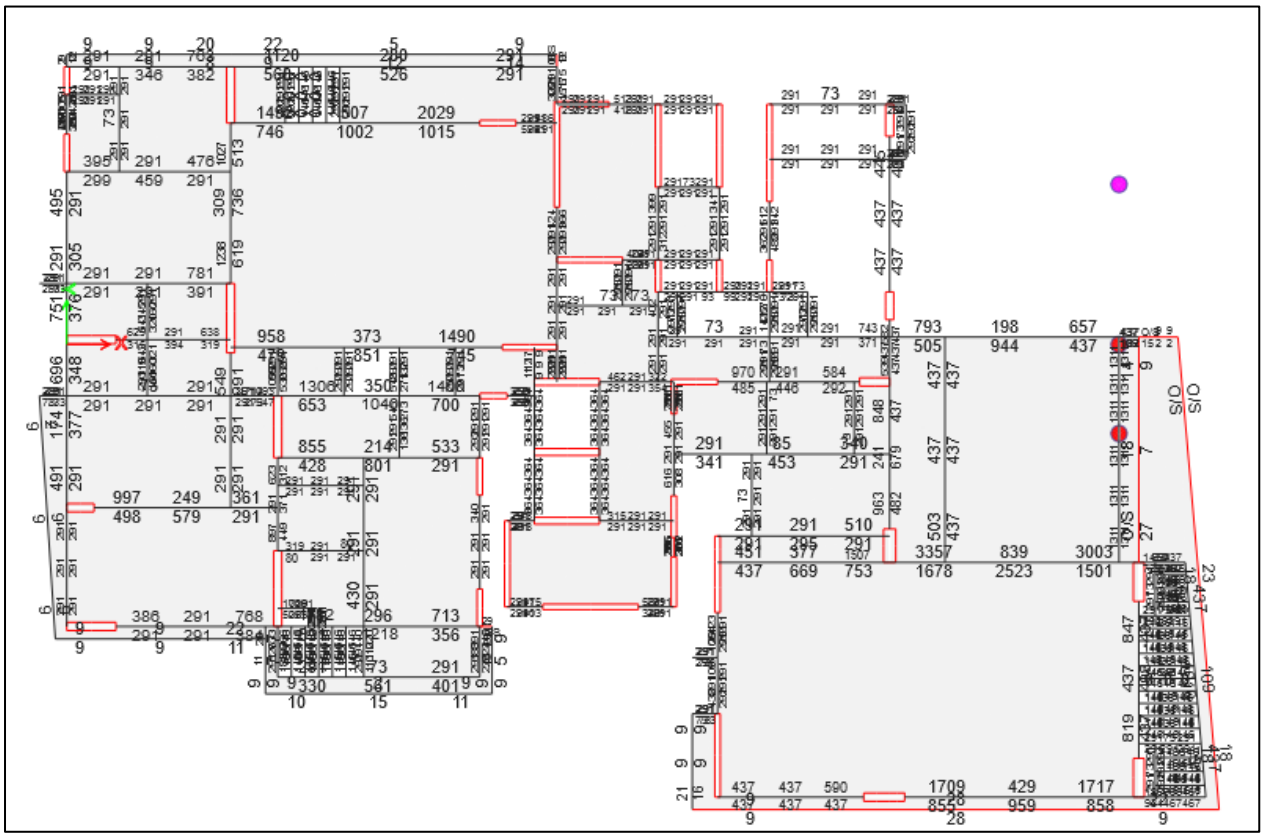
13.1.1 BASEMENT FLOOR BEAM DESIGN



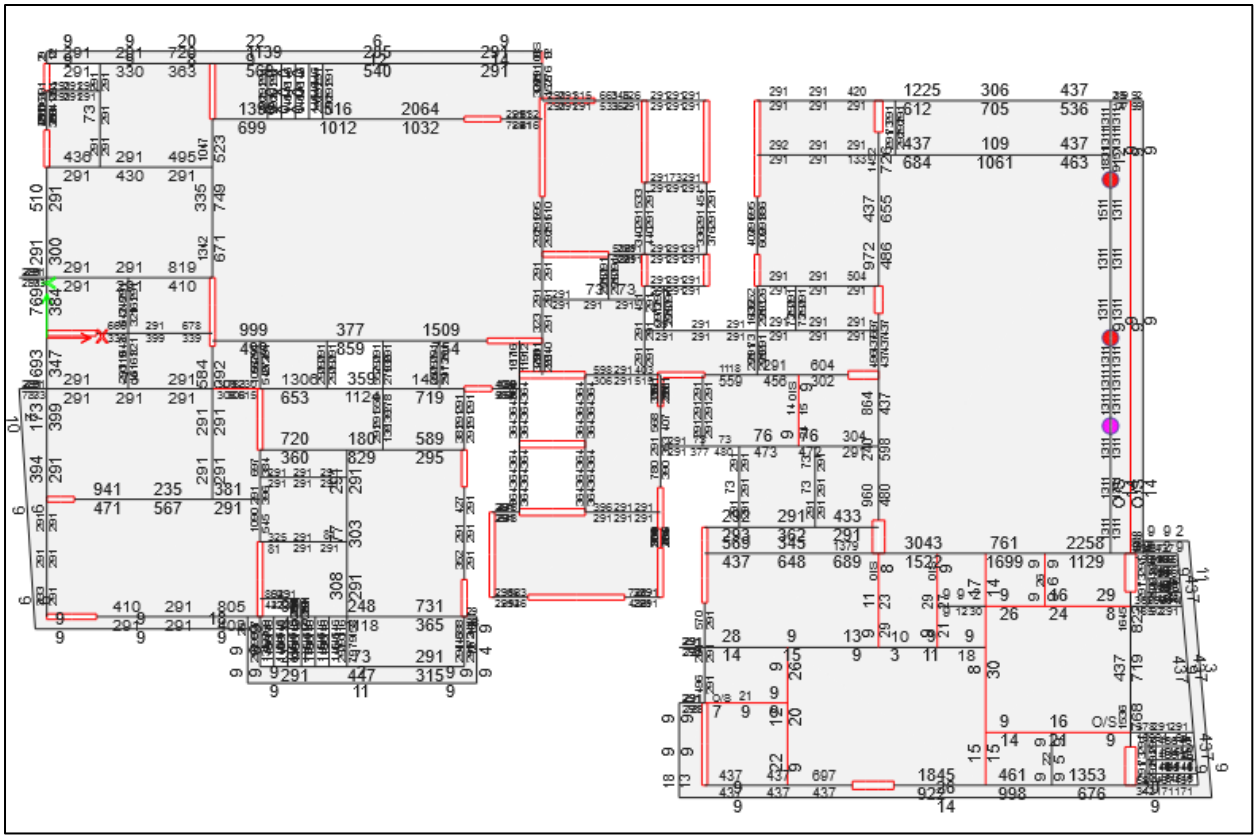
13.1.2 STILT FLOOR BEAM DESIGN



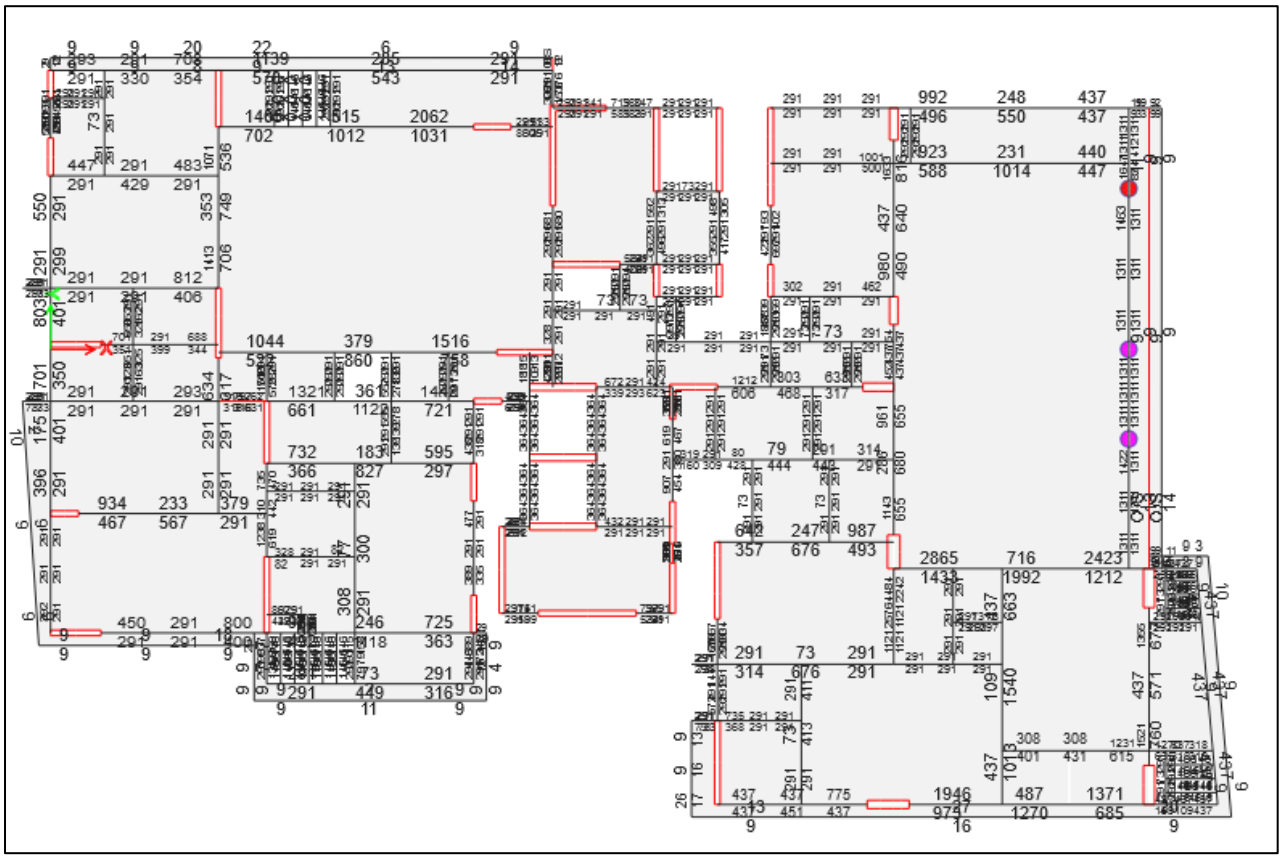
13.1.3 FIRST FLOOR BEAM DESIGN



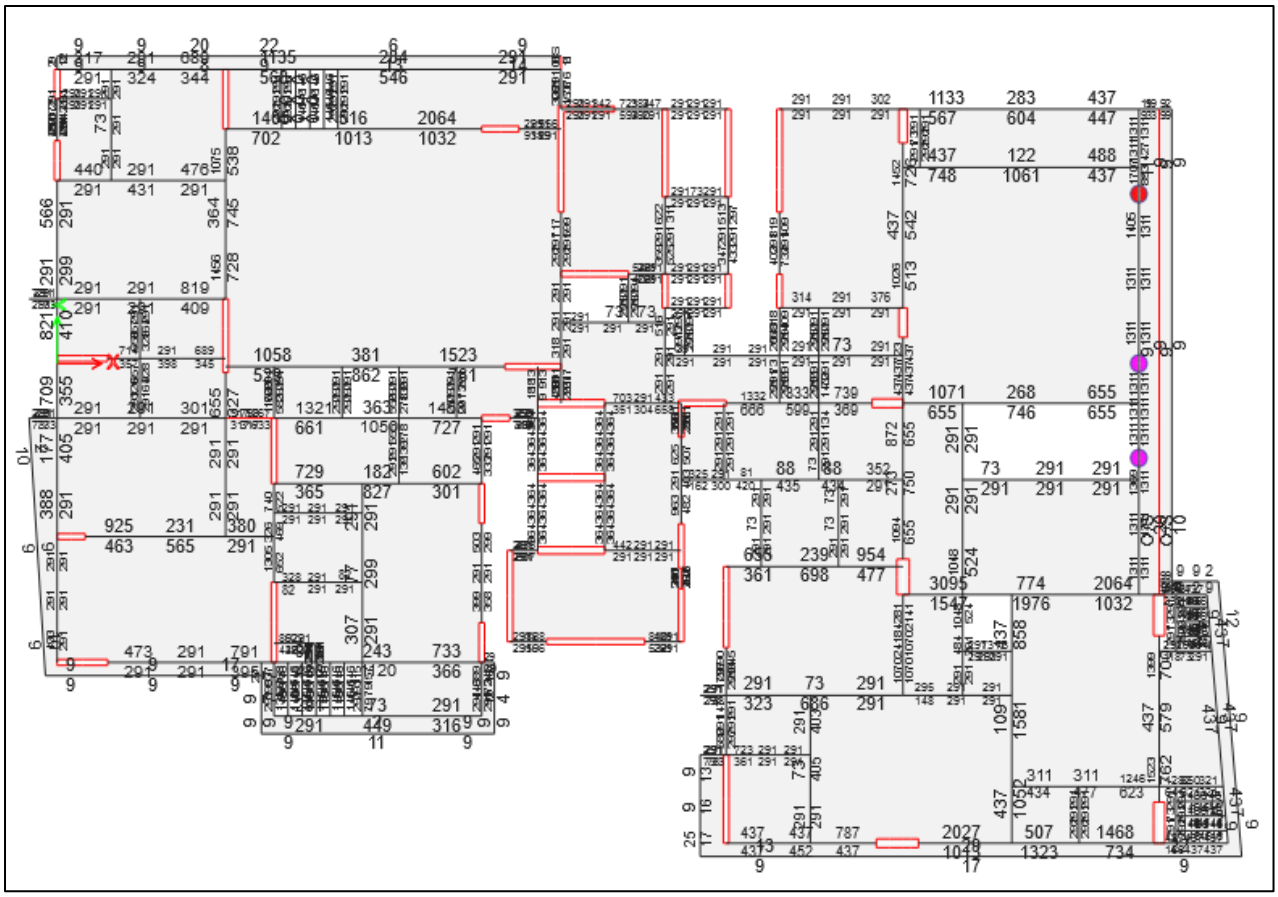
13.1.4 SECOND FLOOR BEAM DESIGN



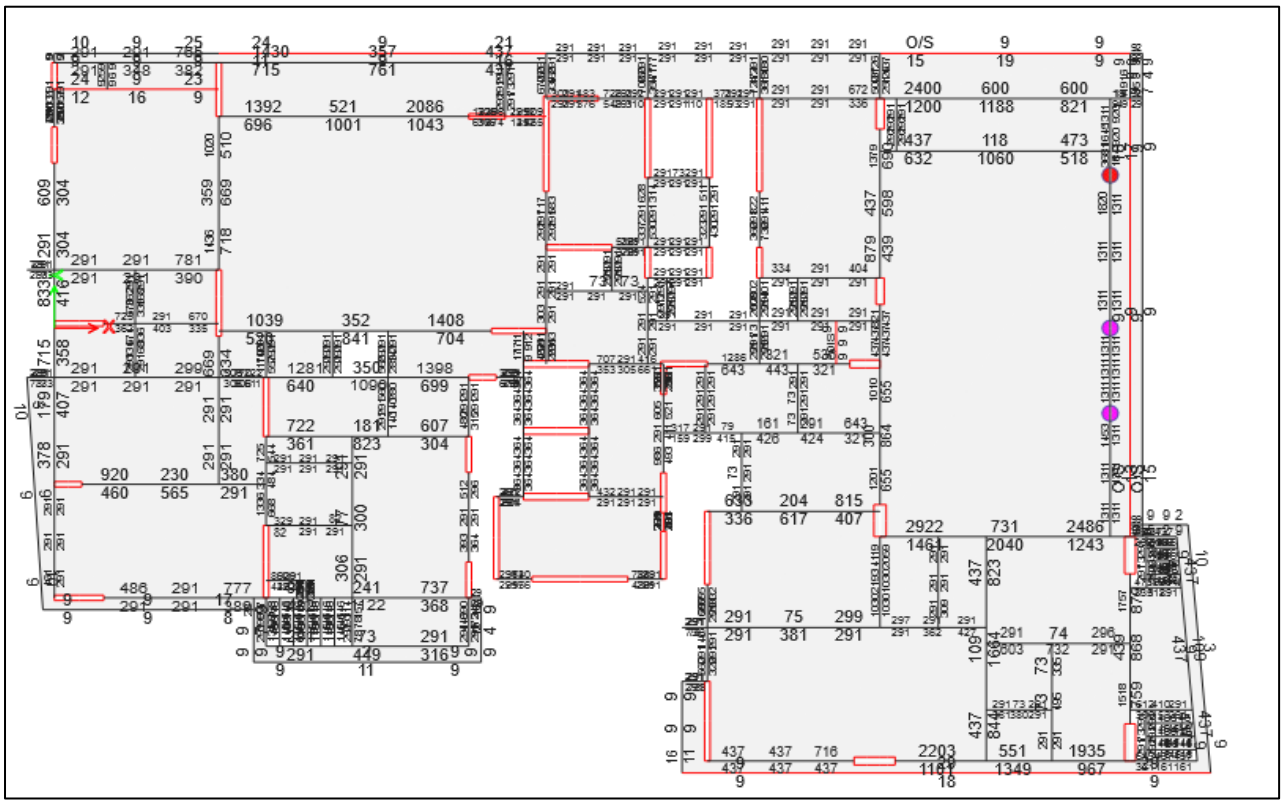
13.1.5 THIRD FLOOR BEAM DESIGN



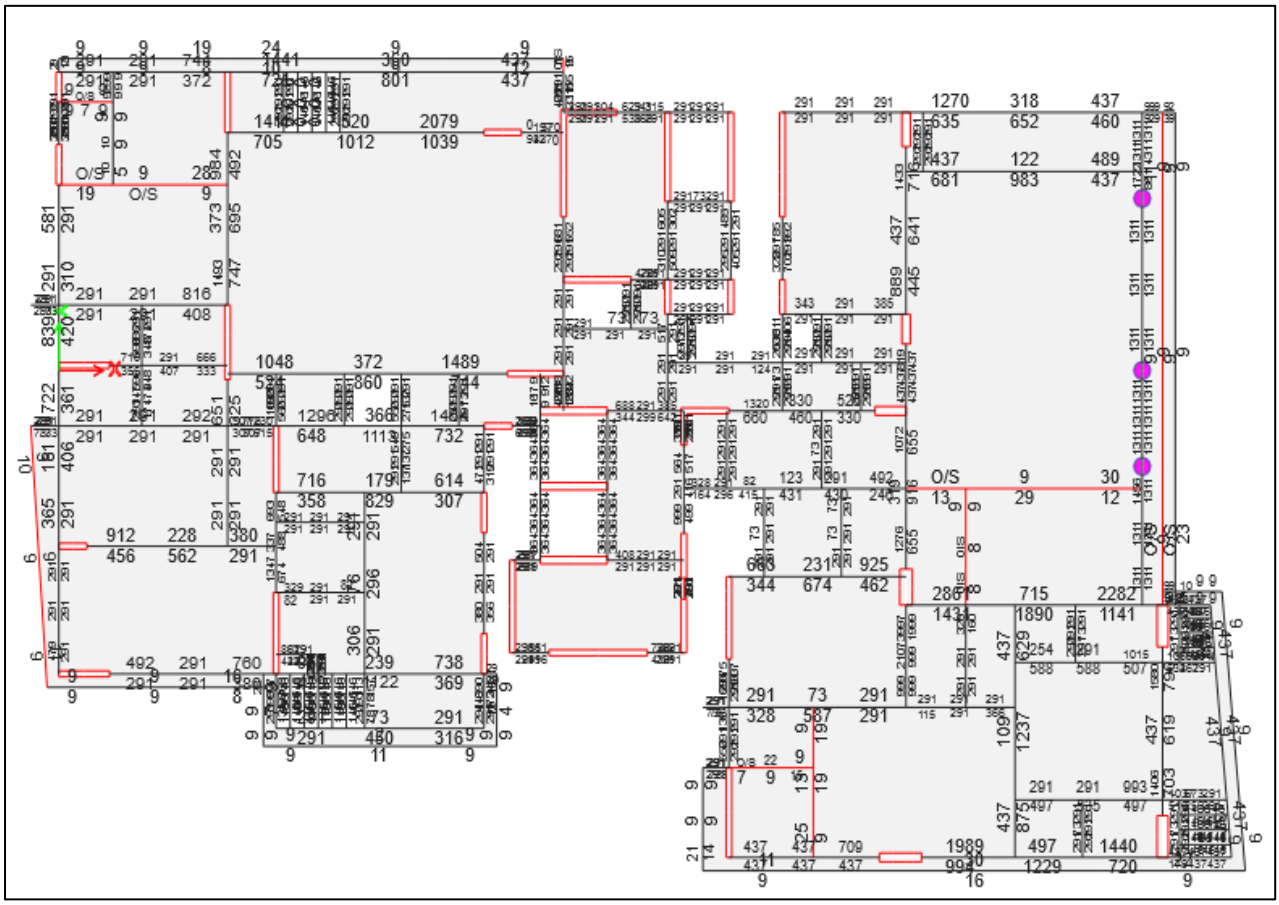
13.1.6 FOURTH FLOOR BEAM DESIGN



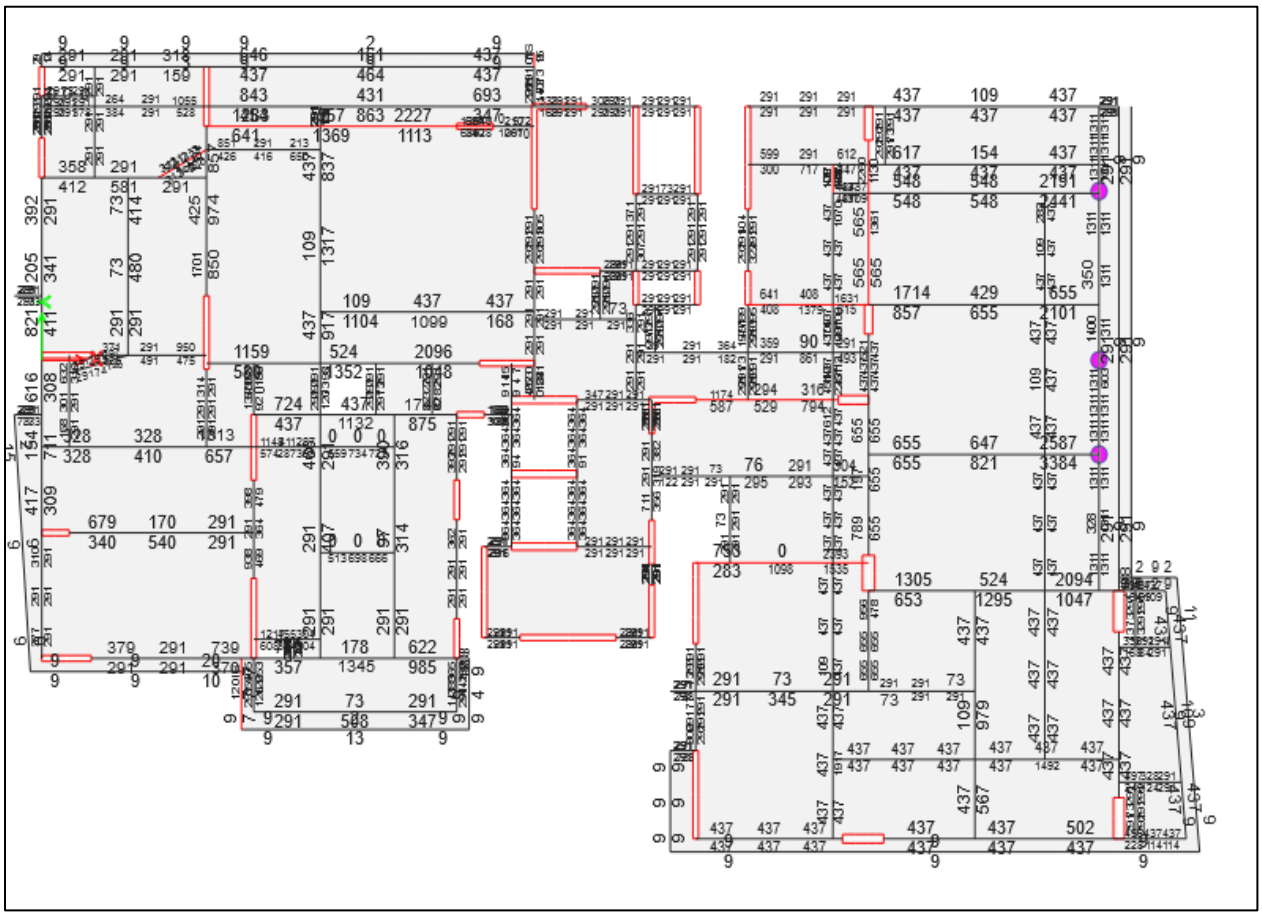
13.1.7 FIFTH FLOOR BEAM DESIGN



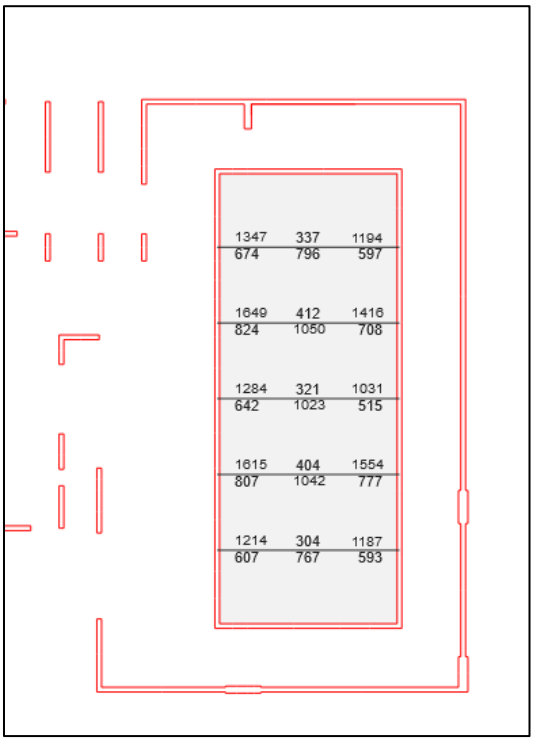
13.1.8 SIXTH TO NINTH FLOOR BEAM DESIGN



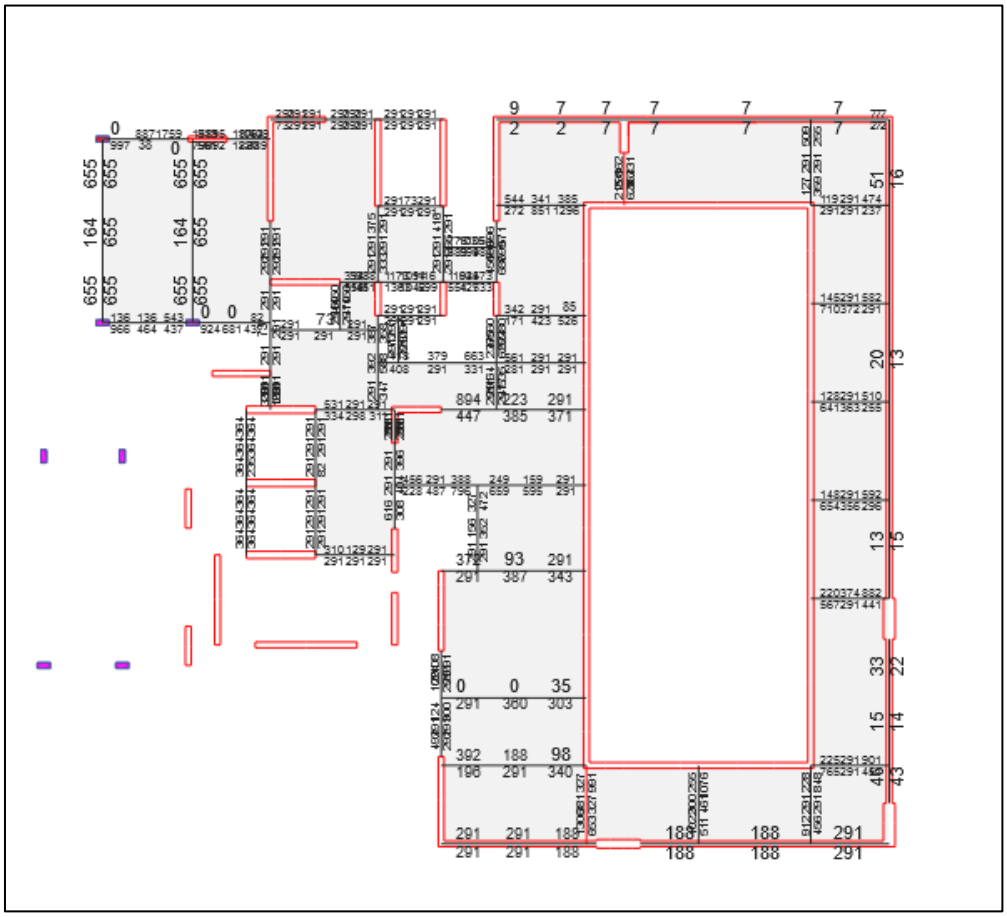
13.1.9 TERRACE FLOOR BEAM DESIGN



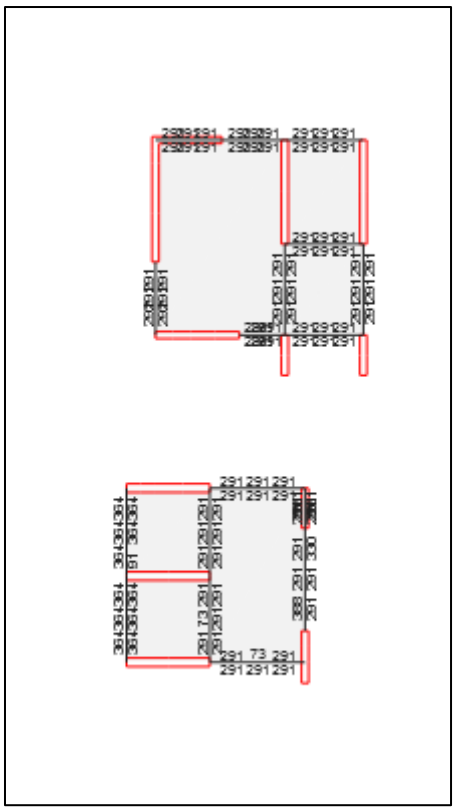
13.1.10 POOL BASE SLAB



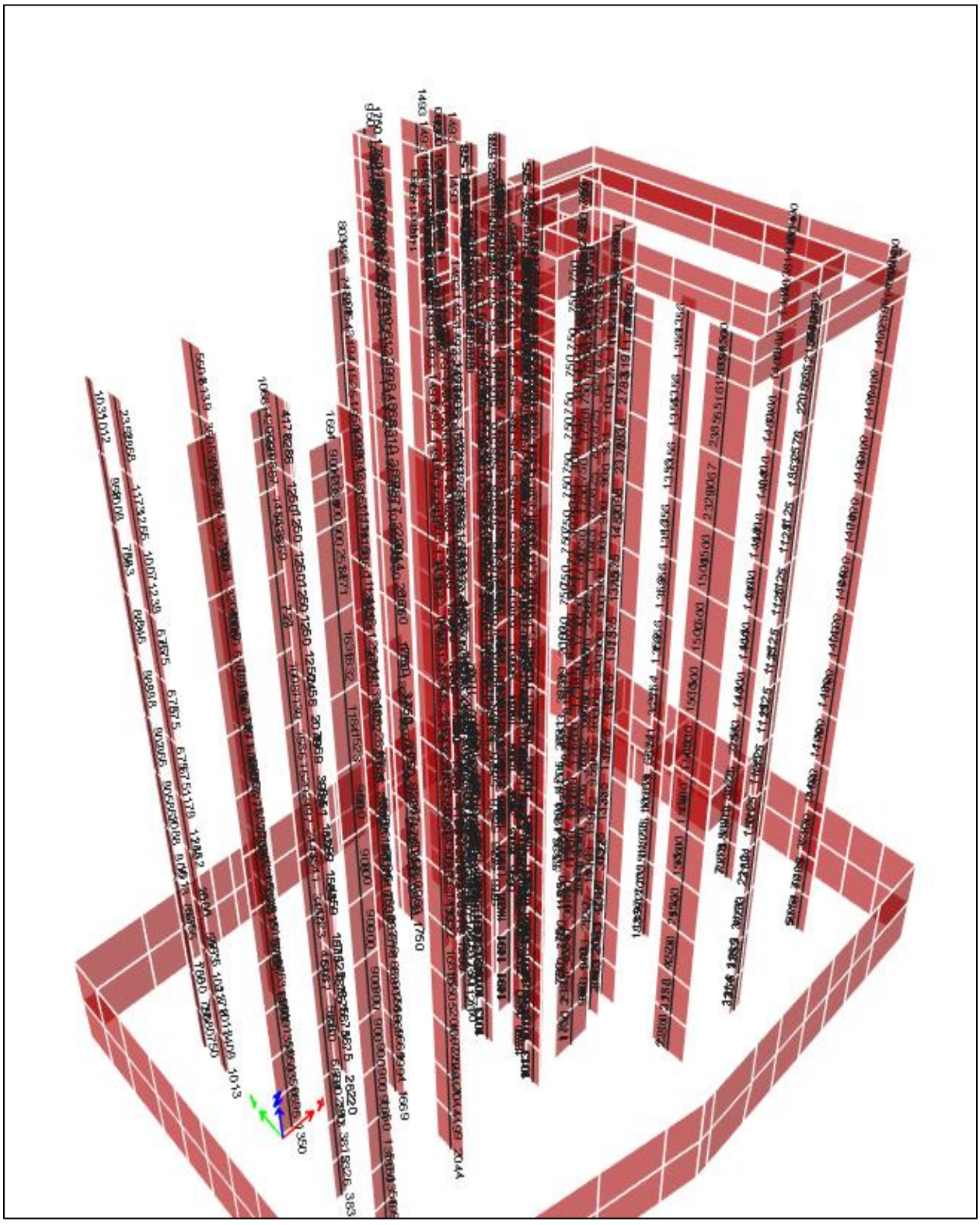
13.1.11 DECK LEVEL SLAB



13.1.12 LIFT MACHINE ROOM LEVEL



13.2 COLUMN DESIGN



13.3 COLUMN DESIGN REPORT

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
4TH	P43	39257	-15595	1400	400	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	39257	-16295	39257	-14895	1400	400
Bottom	Leg 1	39257	-16295	39257	-14895	1400	400

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1400	0.0025	0.0053	COMB19-1	6091.0265	127.5055	151.3282	560000
Bottom	1400	0.0025	0.0053	COMB19-1	6174.2201	-134.5736	-233.6957	560000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	1000	COMB19	4994.7184	469.1323	-164.9681	201.6	605.7739
Bottom	Leg 1	1000	COMB19	5073.1529	88.6154	-164.9681	201.6	605.7739

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	COMB15	3986.2179	-67.2112	7.63	8
Top–Right	Leg 1	400	COMB19	6231.4519	469.1323	14.72	8
Bottom–Left	Leg 1	400	COMB19	6312.5702	-348.2658	13.94	8
Botttom–Right	Leg 1	400	COMB19	6312.5702	88.6154	11.95	8

13.4 TYPICAL BEAM DESIGN REPORT

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design (Summary)



Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
B1	B388	1394	B300X600M30	COMB1	3945.7	7400	1	Ductile Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{cr} (mm)	d_{cb} (mm)
300	600	300	0	46	46

Material Properties

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

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
128.4107	0.0004	1.8621	-0.5968

Design Moments, M_{u3} & M_r

Factored Moment kN-m	Factored M_r kN-m	Positive Moment kN-m	Negative Moment kN-m
128.4107	0.0006	128.4114	0

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

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	0		109	0	0	109
Bottom (-2 Axis)		128.4114	555	555	0	437

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

Shear V_s kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm²/m
1.8621	68.7282	66.48	38.6435	332.53

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
0.0004	1.8621	228	528	0

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design (Summary)



Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
7TH	B44	1080	B200X600M30	COMB1	9950	9950	1	Ductile Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{cc} (mm)	d_{cb} (mm)
200	600	200	0	46	46

Material Properties

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

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
-305.413	0.0031	140.1136	0

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-305.413	0.0073	0	-305.4203

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

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-305.4203		1531	0	1531	383
Bottom (-2 Axis)		0	766	0	283	766

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

Shear V_s kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm²/m
140.1136	81.5955	58.5429	60.4475	292.83

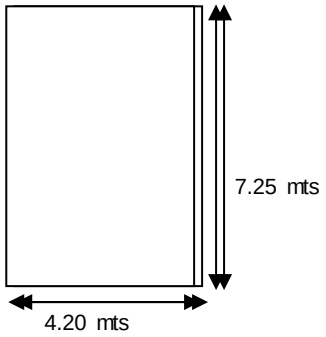
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{vt}/s mm²/m
0.0031	132.7033	128	528	0

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13.5 DESIGN OF TWO- WAY SLAB

DESIGN OF TWO WAY SLAB				SLAB ID:	S1
				Clear dimensions:	
Short span	S=	4.20	mts	4.08	
Long span	L=	7.25	mts	7.13	
Assumed slab thickness	t=	0.150	mts	greater than 'min. eff depth reqd'. Hence ok	
Grade of concrete	fck=	30	N/mm^2		
Grade of reinforcement	fy=	500	N/mm^2		



Type of panel One long edge continuous

Loads

Self weight of slab	w 1=	3.75	kN/m^2	
Floor finish	w 2=	1.70	kN/m^2	
Live load	w 3=	2.00	kN/m^2	
Wall load	w 4=		kN/m^2	
Filling Load	w 5=		kN/m^2	TOTAL
Miscellaneous	w 6=		kN/m^2	7.45 kN/m^2

Ratio of long span to short span	R=	1.75	
Design Load with load factor of 1.5	Wu=	11.18	kN/m^2

Design

	Coeff	BM	k	pt	Ast	Dia	Spacing	d
Short span direction								
Negative moment at continuous edge	0.091	17.90	1.33	0.32	375	8	134	116
Positive moment at midspan	0.069	13.57	1.01	0.24	280	8	179	116
Long span direction								
Negative moment at continuous edge	0	0.00	0.00	0.00	180	8	279	108
Positive moment at midspan	0.043	8.46	0.72	0.17	185	8	271	108

Minimum effective depth reqd	dre=	65.75	mm	
Clear cover to top reinforcement	c=	30	mm	
Clear cover to bottom reinforcement	c=	30	mm	
Minimum effective depth provided	dpr=	108	mm	greater than 'min. eff depth reqd'. Hence ok
Minimum reinforcement	Amin=	180	mm^2	

Deflection check

Reinf provided at midspan along short direction		402.12	mm^2		Dia	8	at	125 mm
Stress in reinforcement	fs=	202.11	N/mm^2					
Percentage of reinforcement provided	pt=	0.35	%					
Modification factor as per fig 4 of IS:456-2000	MF=	1.700						
Basic span to effective depth ratio		23.125					1	
Minimum effective depth reqd from deflection criteria		106.71	mm					
Effective depth provided		116	mm	greater than 'min. eff depth reqd'. Hence ok				

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13.6 PILE DESIGN CALCULATION

1 Levels

Depth of pile below EGL	=	22	m
Pile Cutoff Level	=	0.6	m

2 Loading Data

Pile Load Carrying Capacities 0f 500mm diameter pile

Vertical Compressive Load Capacity (Pp)	=	1700	kN
Pull out capacity (Pt)	=	350	kN
Lateral Load Carrying Capacity (Pl)	=	25	kN

3 Structural Design of Piles

3.1 Geometrical Data

Dia. Of pile (D)	=	600.00	mm
Clear cover to pile reinforcement	=	50.00	mm
Area of pile (A)	=	0.28	m^2
Length of pile (Lp)	=	22.00	m

3.2 Material Properties

Characteristic Compressive Strength of Concrete (f_{ck})	=	40.00	Mpa
Characteristic Yield Strength of Steel (f_y)	=	500.00	N/mm^2

4 Structural Design

4.1 Pile Member (Compression Bending)

Ultimate Vertical Load (P_u)	=	2550.00	kN
Allowable maximum eccentricity on pile	=	75.00	mm
Mom. Due to eccentricity (M_u)	=	191.25	kN-m
Ultimate Design moment (Mu)	=	191.25	kN-m
$(P_u/f_{ck}D^2)$	=	0.18	
$(Mu/f_{ck}D^{2)}$	=	0.02	
d'/D	=	0.10	
Pt/f_{ck} from SP-16 Chart-60	=	0.02	
Percentage of steel required	=	0.60	%
Minimum % steel as per clause:5.11.1 IS:2911-Part-I/Sec.2	=	0.40	%
Required steel (Ast)	=	1696.46	mm^2
Dia. Of main reinforcement (d)	=	16.00	mm
No of main reinforcement (n)	=	9	
Provide the nos of main reinforcement (n)	=	10	
Provided Ast	=	2011	
Percentage of steel provided	=	0.71	%

PROVIDED REINFORCEMENT DETAIL = Y 16 - 10 NOS.

16# 10 Nos. with 8# ties @ 150c/c Helical Links and Master Link of 16# @ 1.5mc/c

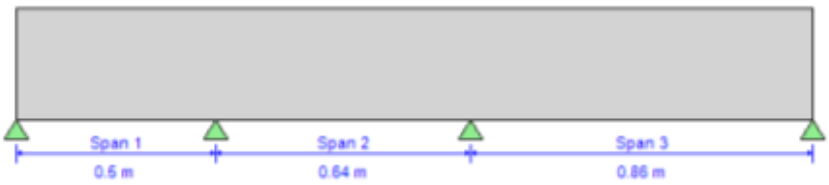
13.7 PILE CAP CALCULATION –

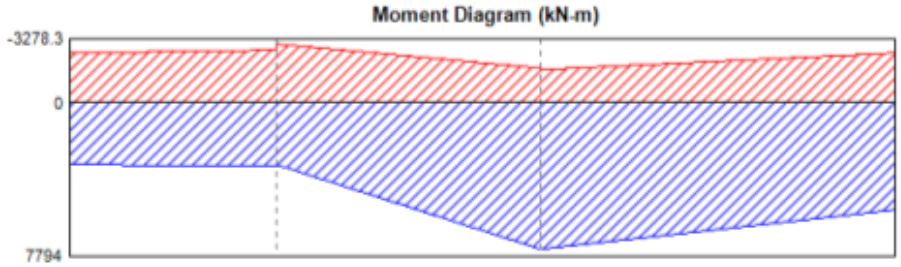
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IS 456:2000 Concrete Strip Design

Geometric Properties
Combination = Overall Envelope
Strip Label = CSA8
Length = 4 m
Distance to Top Rebar Center = 24 mm
Distance to Bot Rebar Center = 24 mm

Material Properties
Concrete Comp. Strength = 40 MPa
Concrete Modulus = 31622.78 MPa
Longitudinal Rebar Yield = 500 MPa

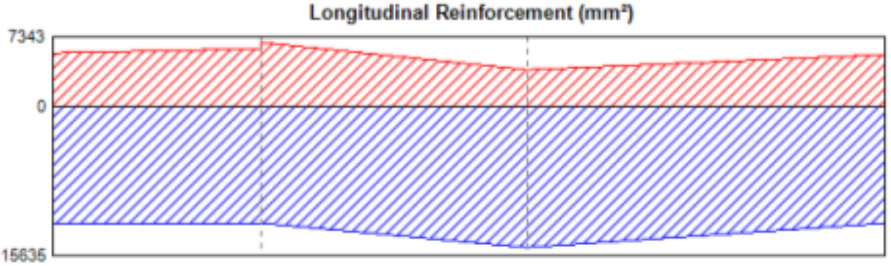




(-)Moment	-2541.9927	0	-2973.4909	-2973.4909	0	-1736.2716	-1736.2716	0	-2533.3443
(+)Moment	3164.9121	0	3154.9573	3154.9573	0	7421.4052	7421.4052	0	5492.16

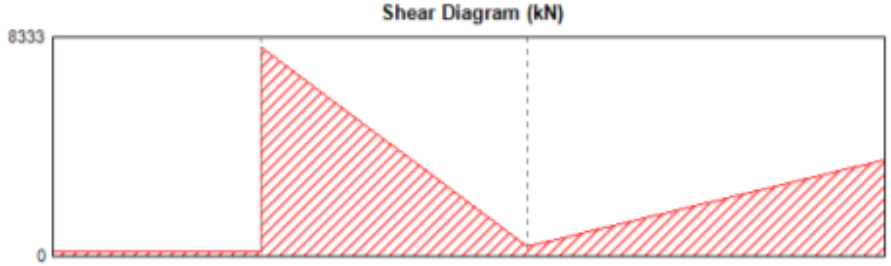
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Longitudinal Reinforcement (mm²)



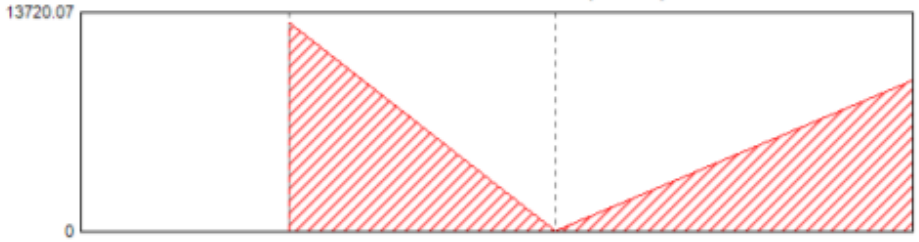
As (top)	5577	0	6693	6693	0	3894	3894	0	5488
As (bot)	COMB19		COMB19	COMB19		COMB19	COMB19		COMB19
	6267	0	7053	7053	0	14890	14890	0	11063
	COMB1		COMB19	COMB19		COMB1	COMB1		COMB1

Shear Diagram (kN)



Shear	0	0	7936.1935	7936.1935	0	340.1357	340.1357	0	3626.5918

Transverse Reinforcement (mm²/m)

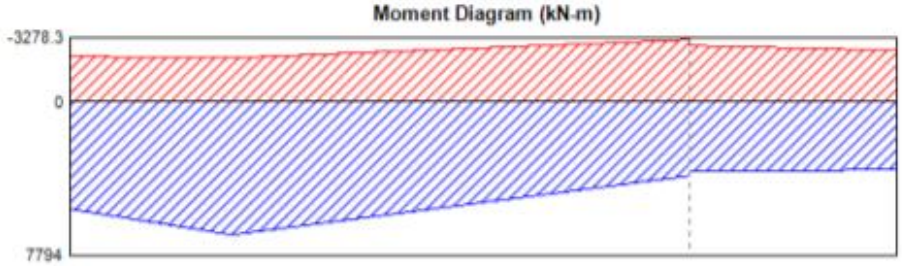


Asv/s reqd	0	0	13066.73	13066.73	0	0	0	0	9421.69

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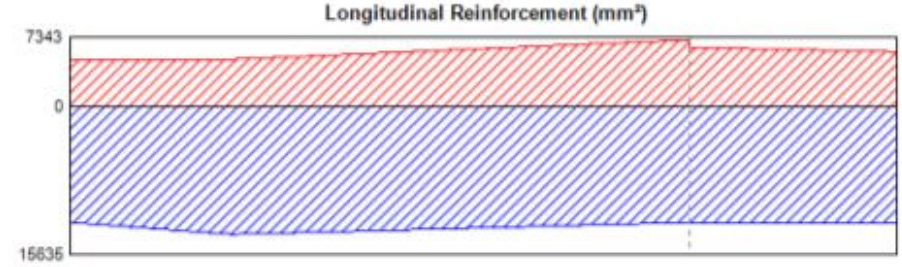


Moment Diagram (kN-m)



(-)Moment	-2533.3443	-2257.2472	-3122.1952	-3122.1952	0	-2630.7894
(+)Moment	5492.16	6780.6781	3800.6403	3800.6403	0	3496.9654

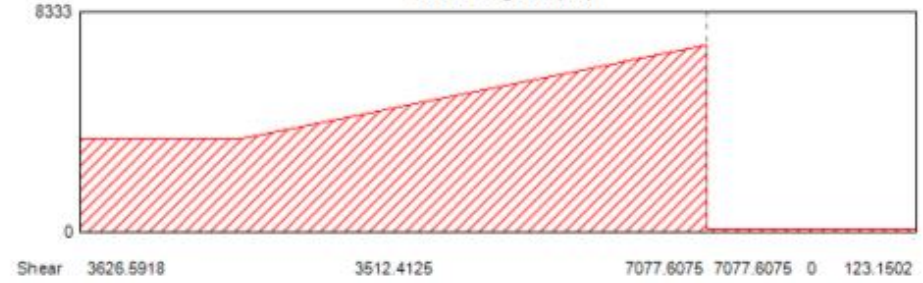
Longitudinal Reinforcement (mm²)



As (top)	5488	4911	6993	6993	0	5741
As (bot)	COMB19	COMB19	COMB19	COMB19		COMB19
	11063	13636	7775	7775	0	6951
	COMB1	COMB1	COMB1	COMB1		COMB1

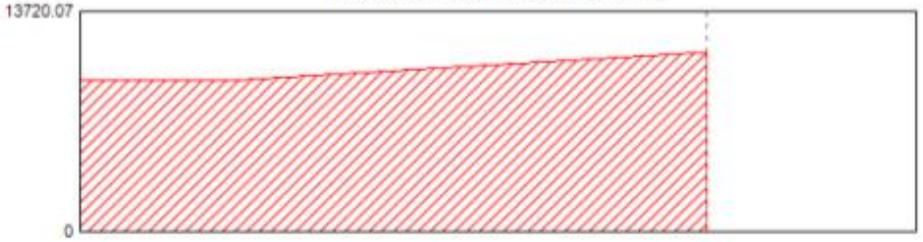
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Shear Diagram (kN)



Shear	3626.5918	3512.4125	7077.6075	7077.6075	0	123.1502

Transverse Reinforcement (mm²/m)



Asv/s reqd	9421.69	9421.69	11191.7	11191.7	0	0

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

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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.