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JW Consultants LLP

Design Basis Report

PREPARED FOR:

ASHIANA BUILDERS

ASHIANA VATSALYA, CHENNAI

March 25

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Content

- INTRODUCTION
- SCOPE
- FUNCTIONAL REQUIREMENTS
- TYPICAL FLOOR LAYOUT
- ARCHITECTURAL LAYOUT
- ARCHITECTURAL BUILDING SECTION
- DESIGN CRITERIA
- STRUCTURAL SYSTEM
- ANALYTICAL APPROACH
- LOADS
- SERVICEABILITY CONSIDERATIONS
- CODES & STANDARDS

1. INTRODUCTION

Proposed development is situated at RESIDENTIAL COMPLEX FOR ASHIANA BUILDERS ASHIANA VATSALYA AT CHENNAI.

This design basis report outlines basis of structural analysis and design for the proposed residential building having stacking as

Ground floor + 1st to 14th typical floors.

Total height of proposed residential building above ground is 44.25m

2. SCOPE

The scope of design basis report is to highlight the following.

- Analysis methodology
- Different types of loading on the building.
- Strength and serviceability requirements

3. FUNCTIONAL REQUIREMENTS

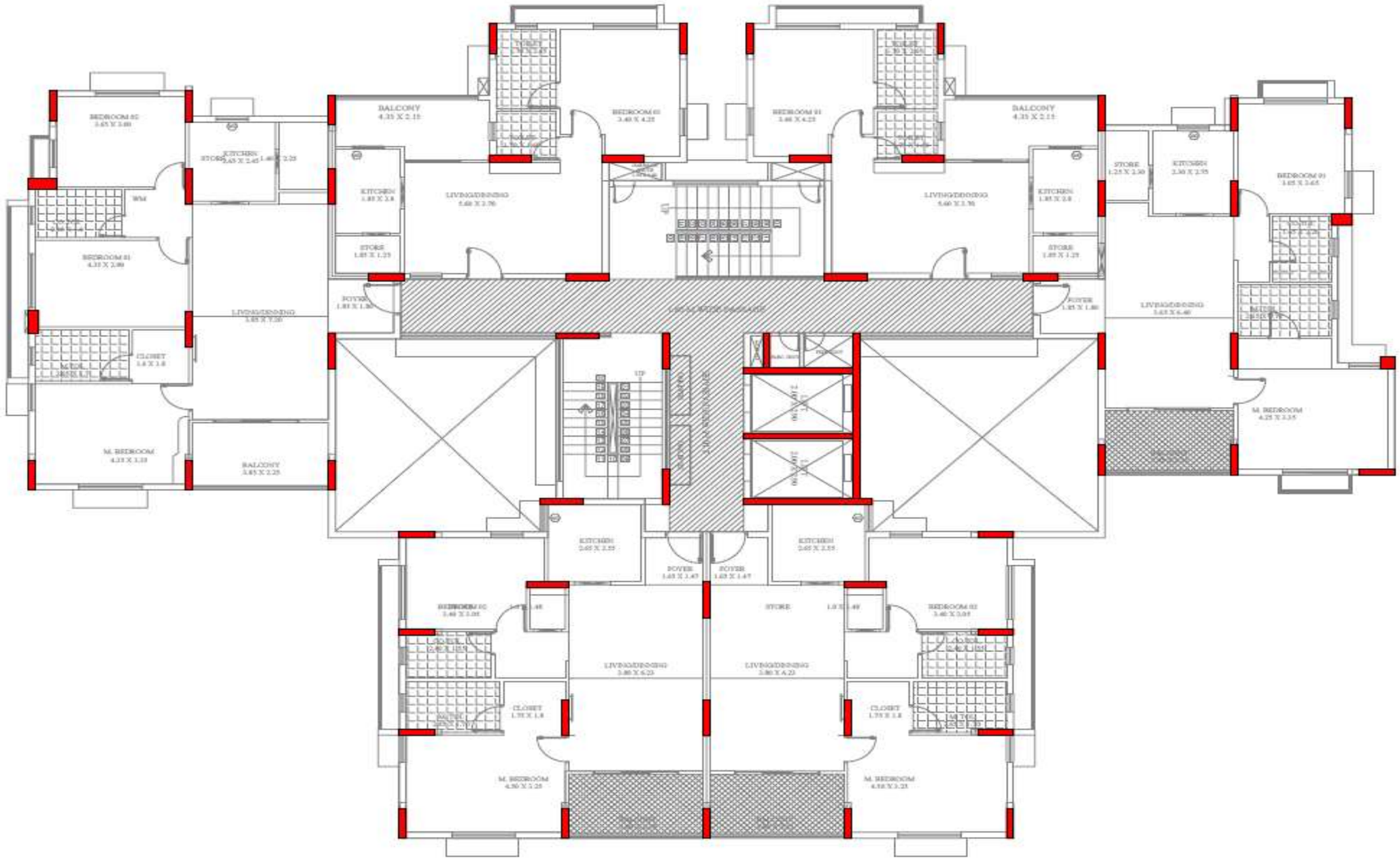
Functional requirement of structure is mainly residential.

The functional requirements of the building are tabulated below:

Floor	No. of Floors	Height (m)	Function Use
Ground Floor	1	2.95	Four-Wheeler / Two-Wheeler Parking
1st to 7th Floor	7	2.95	Residential
8th, 13th floors	2	2.95	Residential+ Part Refuge Floor
9th to 12th Floor	4	2.95	Residential
14th Floor	1	2.95	Residential
Total	**15**	**44.25**	

4. TYPICAL FLOOR LAYOUT

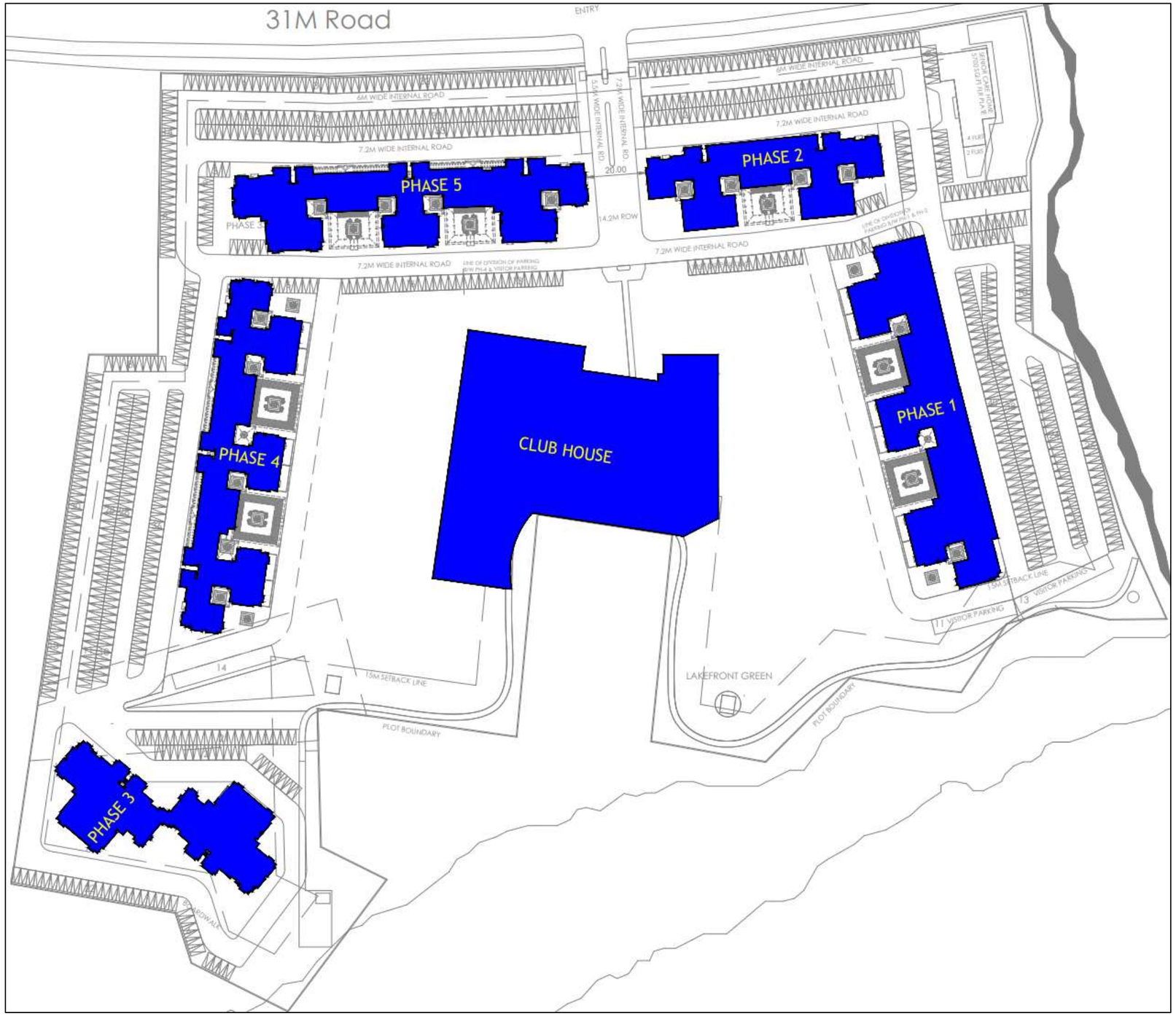
The framing layout for typical floor is shown below



INDEX PLAN FOR RCC TYPICAL FLOOR COLUMN MARKING

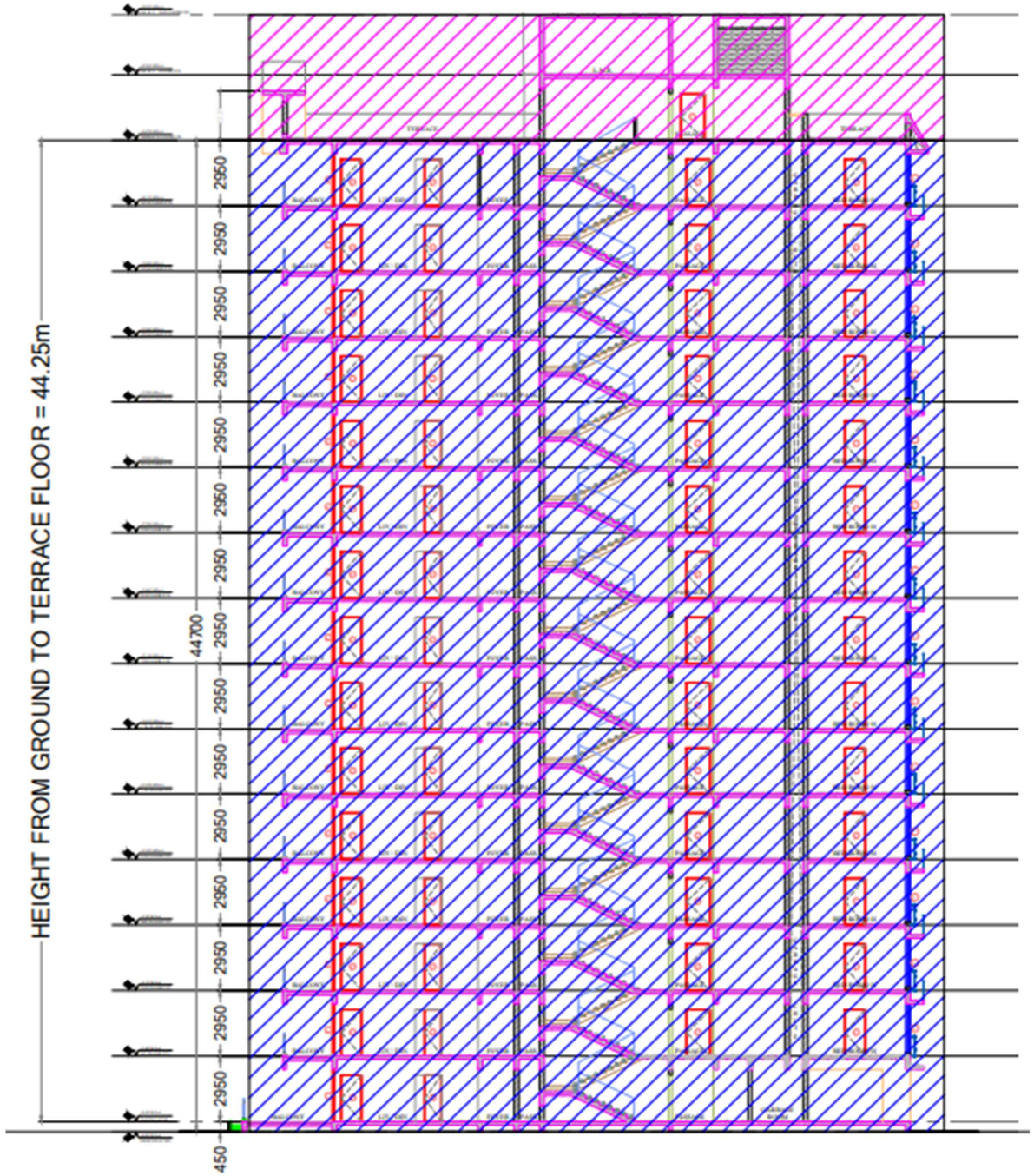
5. ARCHITECTURAL LAYOUT

The architectural layout for the building :



6. ARCHITECTURAL BUILDING SECTION

The building section Showing proposed Floors of sale building.



7. DESIGN CRITERIA

- **MATERIALS**

1. CEMENT: - Ordinary Portland Cement (OPC) of Grade 43, Grade 53 or higher confirming to IS 8112 and IS 12269 and Portland Pozzolana cement confirming to IS 1489 – 1991 Part 1 is specified for concrete grades ranging from M 20 to M 60.
   Fly ash confirming to relevant requirement of IS 3812-2013 may be used as part replacement of ordinary Portland cement.
   Ground granulated blast furnace slag obtained by grinding granulated blast furnace slag confirming to IS 12089-1987 may be used as part replacement of ordinary Portland cement.

2. AGGREGATES: - The sizes of coarse aggregates confirm to IS 383. Nominal size of coarse aggregate shall be 20mm & 12 mm, suitably graded as per the requirement of mix design. (It should pass through 20mm & 12.5 mm sieve). The fine aggregates confirming to the specifications of IS 383, Table 4 shall be used.

3. ADMIXTURES: - Suitable admixture may be used only if approved by an Engineer. An admixture shall comply with one of the IS 9103-1999 as appropriate. Admixtures should not impair the durability of the concrete nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of the reinforcement.
   Both the proposed dosage and method of use shall be submitted to the Engineer together

4. WATER: - Mixing water shall confirm to IS 456: 2000

5. REINFORCEMENT: - High yield strength deformed bars confirming to IS 1786 with fy = 500 N/mm2 shall be used.

6. STRUCTURAL STEEL MEMBER: - All the structural steel member used in construction are of grade E350 & shall confirm to IS 2062

• DENSITY

The following parameters are considered as per IS 875 Part I

No.	Material	Density (kN/m3)
1	Reinforced Concrete	25
2	Steel	78.5
3	Mortar below Floor Finishes / Plaster	20.4
4	Marble flooring	26.5
5	AAC Light Weight Block	8
6	Glass	25
7	Brick bat water proofing	20
8	Water	10
9	Soil	19

• CONCRETE STRENGTH

No	Grade	Strength (N/mm2)	Minimum Modulus of Elasticity (N/mm2)
1	M30	30	27386
2	M40	40	31622

The following list shows 28-day cube strength (min) to be achieved by the concrete for some main structural members.

No.	Material	Grade of Concrete
1	Foundation	M30
2	Column and Shear Walls	Base to 5^{th} floor = M40 5^{th} to terrace floor = M30
3	Typical floors slab	M30

- Column / shear wall at beam Junction shall have grade of concrete as specified for columns/shear wall.

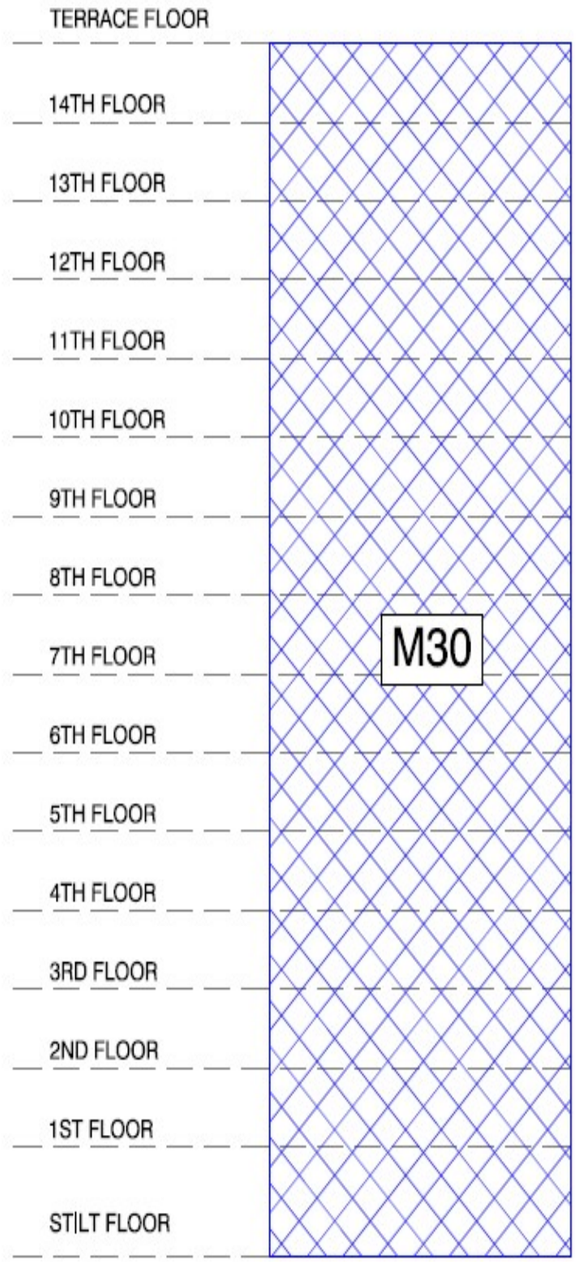
• REINFORCEMENT

No.	Description	Yield Strength (N/mm2)
1	Fe 500TMT	500

- **FLOOR WISE DISTRIBUTION OF CONCRETE GRADE**



COLUMN / WALL



SLAB / BEAM

- ## NOMINAL COVER

Nominal required as per exposure conditions given in IS 456:2000.

Substructure & Super structure	Exposure
Sub Structure:	
All Substructure elements	Severe
Super Structure:	
All external columns and peripheral beams	Moderate
All internal columns, beams and floor slabs	Mild

1.3. MINIMUM PERCENTAGE FOR STRUCTURAL ELEMENTS

Structural Walls:

As per Table 1 of IS 13920: 2016 (all walls are to be detailed ductile)

Other elements:

No.	Element	Min %
1	Footings & rafts	0.12
2	Columns	0.80
3	Ordinary Beams	As per clause 26.5.1.1. of IS 456: 2000
4	Ductile Beams	(0.24√fck)/(fy) As per clause 6.2.1 b) of IS 13920: 2016 (on any face at any section)
5	Slabs & Retaining wall	0.12
6	Shear walls	As per Table 1 Clause 10.1.6 IS 13920: 2016

- ## STRUCTURAL SYSTEM

The stability of structure can be achieved by providing suitable structural system to resist the different loads acting on the structure.
The structural system consisting of below listed systems,

a) Lateral Load Resisting System (shear wall system)

b) Floor System

c) Gravity Column

- ## Lateral Load Resisting System-

In the life of the structure in addition to the vertical load the structure also must resist the external horizontal forces acting on it. The external horizontal forces are generated due to,

- Wind pressure acting on the external face of the structure
- Forces developed during response to earthquake of the structure.

To resist these external forces an appropriate lateral stability system is required. To achieve this lateral stability the strong core of RCC walls are required and the required area of these **RCC wall as per IS 1893**

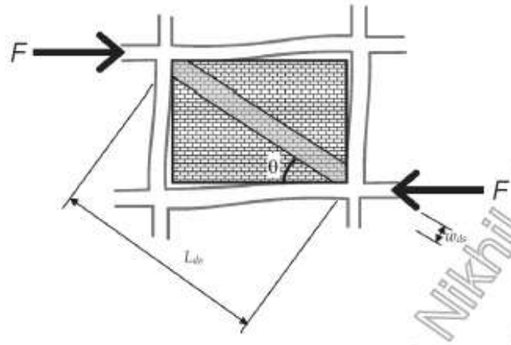
part 1 (2016) is 2% of the floor area in each direction i.e. in 'X' and 'Y' direction of the structure. Refer the clause no. 7.10.3 of IS 1893

(refer screen shot).

where E_m and E_f are the modulii of elasticity of the materials of the URM infill and RC MRF, I_c the moment of inertia of the adjoining column, t the thickness of the infill wall, and θ the angle of the diagonal strut with the horizontal;

c) For URM infill walls with openings, no reduction in strut width is required; and

d) Thickness of the equivalent diagonal strut shall be taken as thickness t of original URM infill wall, provided $h/t < 12$ and $l/t < 12$, where h is clear height of URM infill wall between the top beam and bottom floor slab, and l clear length of the URM infill wall between the vertical RC elements (columns, walls or a combination thereof) between which it spans.



c) connected preferably to the moment resisting frame of the building.

7.10.3 When the RC structural walls are provided, they shall be designed such that the building does NOT have:

a) Additional torsional irregularity in plan than that already present in the building. In assessing this, lateral stiffness shall be included of all elements that resist lateral actions at all levels of the building;

b) Lateral stiffness in the open storey(s) is less than 80 percent of that in the storey above; and

c) Lateral strength in the open storey(s) is less than 90 percent of that in the storey above.

7.10.4 When the RC structural walls are provided, the RC structural wall plan density ρ_{sw} of the building shall be at least 2 percent along each principal direction in Seismic Zones III, IV and V. These walls shall be well distributed in the plan of the building along each plan direction. RC structural walls of this measure can be adopted even in regular buildings that do not have open storey(s).

7.10.5 RC structural walls in buildings located in Seismic Zones III, IV and V shall be designed and detailed to comply with all requirements of IS 13920.

• ANALYTICAL APPROACH

- A comprehensive 3-dimensional analysis of the superstructure will be carried out with the help of ETABS.
- Foundation- Isolated/combined/raft foundation depending upon loads and encountered stratum. Geotechnical Consultant is appointed conduct soil investigation and SBC shall be adopted as per the geotechnical report.
- Buildings will be assessed for a combination of gravity and lateral loads, detailed separately.
- Two separate numerical models will be made use of; serviceability limit state (SLS) model with un-factored loads to establish serviceability checks and ultimate limit state (ULS) model with factored loads to arrive at design forces. Following stiffness modifiers will be considered

i. Slabs: 0.35 for both out-of-plane & in-plane stiffness for SLS model; 0.01 for out-of-plane stiffness & 0.25 for in-plane stiffness for ULS model (modelled as shell in ETABS)

ii. Beams – 0.70 for SLS model; 0.35 for ULS model (flexural property modifier)

iii. Walls & columns – 0.90 for SLS model; 0.70 for ULS model (flexural property modifier); should any of the lateral load resisting walls / columns exhibit net tension for a seismic load combination under factored loads, that particular wall(s) / column(s) shall be assigned flexural property modifier of 0.35)

iv. All beams will be assigned a torsional modifier 0.01; the exception would be the beam (if such a case exists) from which cantilever slab/another beam is taken out and where top of beam is completely unrestrained by means of considerable sunk.

v. All secondary beams shall be considered decoupled (introduction of internal hinge at the secondary support in the model).

vi. Semi-Rigid diaphragm will be considered in the analysis. Floor panels at different levels (within the same floor system) will be de-assigned from the global diaphragm definition if those are not connected with lateral load resisting elements. Stair slabs will also not be part of diaphragm definition.

vii. Accidental eccentricity of 5% will be considered in the model.

- All liquid retaining structures will be detailed as per requirements of IS 3370:2009. Reynolds' Handbook may be referred to for computing design moments and shears.
- P delta Analysis based load factors considered for design.
  Dead load – 1.0
  Live load – 0.50
  Superimposed dead load -1.0

- # LOADS

This structural loading criterion of the project is for general information only and does not modify, alter or overrule the specifications, or the drawings. Annexure B showing detailed information about Loadings to be used for design.

6.1. GRAVITY AND LIVE LOADS

Plasters are taken at a unit weight of 20.4 kN/m3.
The following are dead, superimposed dead and live loads taken for each occupancy category:

i. TYPICAL FLOORS

Self-Weight - slab = 25x slab thickness

Superimposed Dead Load

Floor Finishes = 1.5 KN/m2

Live Load = 2.00 KN/m2

ii. LIFT LOBBIES, ENTRANCE LOBBIES

Self-Weight - slab = 25x slab thickness

Superimposed Dead Load

Floor Finishes = 1.5 KN/m2

Live Load = 3 KN/m2

iii. STAIRS

Self-Weight - slab = 25x slab thickness

Superimposed Dead Load including steps self wt= 3.50 KN/m2

Live Load = 3.00 KN/m2

iv. TOILETS/WET AREAS

Self-Weight - slab = 25x slab thickness

Superimposed Dead Load

200 mm sunk filling load = 4.00 KN/m2

Floor Finishes = 1.50 KN/m2

Total superimposed Dead load = 5.5 KN/m2

Live Load = 2.00 KN/m2

v. BALCONY

Self-Weight - slab = 25x slab thickness

Superimposed Dead Load

50 mm sunk filling load = 1.00 KN/m2

Floor Finishes = 1.50 KN/m2

Total superimposed Dead load = 2.5 KN/m2

Live Load = 3.00 KN/m2

vi. TERRACE FLOOR

Self-Weight - slab = 25 x slab thickness

Superimposed Dead Load

150mm filling with water proofing = 3.0kN/m2

Total Superimposed Dead Load = 3.0 kN/m2

Live Load = 3.00 kN/m2

vii. Inaccessible Chajja

Self-Weight - slab = 25 x slab thickness

Floor Finishes = 1 KN/m2

Live Load = 0.75 KN/m2

- ## WALL LOADS

NON STRUCTURAL WALL LOAD (EXTERNAL WALLS - AT PERIPHERY)

1. 200mm thick NS wall full wall load

   Wall load density = 25 kN/m2

   Below Beam = (2.95 – 0.60) x 0.20 x 25 = 11.75 kN /m

   Approx. = 11.75 kN/m

2. 200mm thick NS wall with 30% opening

   Wall load density = 25 kN/m2

   Below Beam = (2.95 – 0.60) x 0.20 x 25 x 0.70 = 8.23 kN /m

   Approx. = 8.25 kN/m

LIGHT WEIGHT WALL LOAD (ALL INTERNAL WALLS)

3. 200mm thick light weight wall below beam

   Wall load density = 11.825 kN/m2

   Below Beam = (2.95 – 0.60) x 0.20 x 11.825 = 5.55 kN /m

   Approx. = 5.55 kN/m

4. 100mm thick light weight wall below beam

   Wall load density = 13.10 kN/m2

   Below Beam = (2.95 – 0.60) x 0.10 x 13.10 = 3.078 kN /m

   Approx. = 3.08 kN/m

5. 100mm thick light weight wall below slab

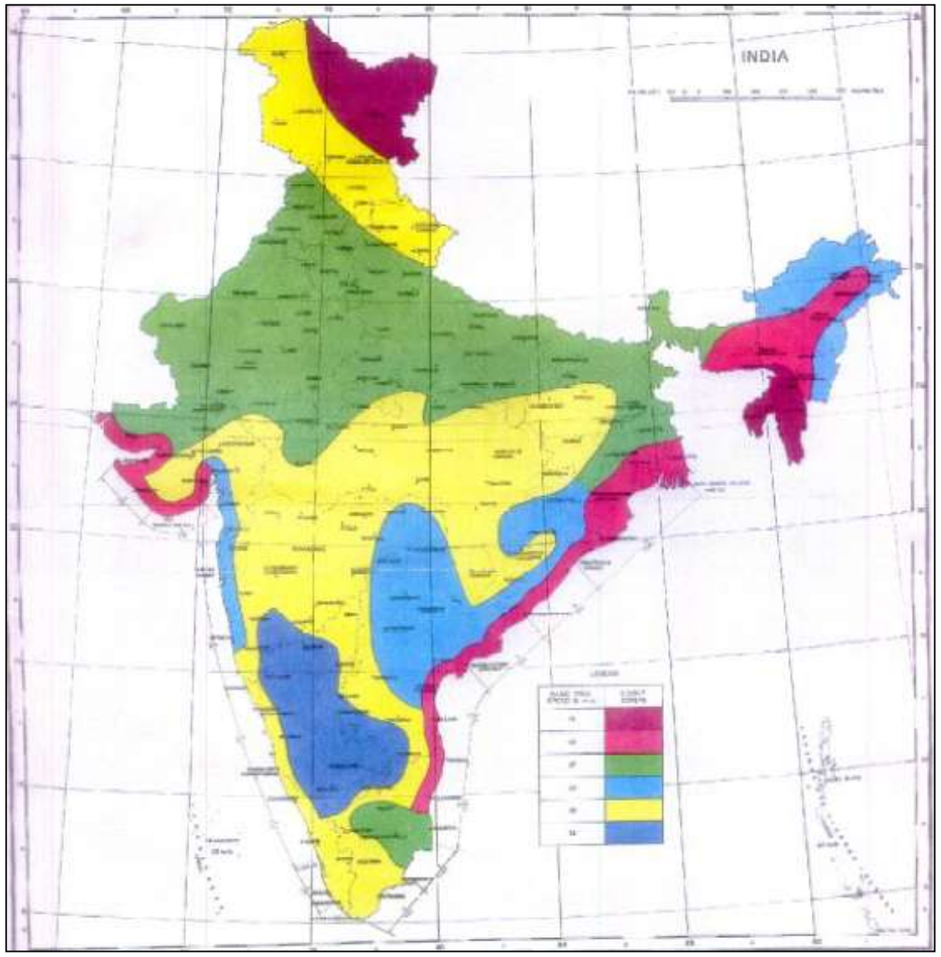
   Wall load density = 13.10 kN/m2

   Below Beam = (2.95 – 0.125) x 0.10 x 13.10 = 3.70 kN /m

   Approx. = 3.70 kN/m

- **WIND LOAD**

In Accordance with IS 875 – Part 3 – 2015, the basic wind speed Vb for the site obtained from Fig 1.0 and as stated in Appendix A is 50m/s.



ANNEX A

(*Clause* 6.2)

BASIC WIND SPEED AT 10 m HEIGHT FOR SOME IMPORTANT CITIES / TOWNS

City/Town	Basic wind Speed m/s	City/Town	Basic wind Speed m/s
Agra	47	Kanpur	47
Ahmedabad	39	Kohima	44
Ajmer	47	Kolkata	50
Almora	47	Kozhikode	39
Amritsar	47	Kurnool	39
Asansol	47	Lakshadweep	39
Aurangabad	39	Lucknow	47
Bahraich	47	Ludhiana	47
Bengaluru	33	Madurai	39
Barauni	47	Mandi	39
Bareilly	47	Mangalore	39
Bhatinda	47	Moradabad	47
Bhilai	39	Mumbai	44
Bhopal	39	Mysore	33
Bhubaneshwar	50	Nagpur	44
Bhuj	50	Nainital	47
Bikaner	47	Nasik	39
Bokaro	47	Nellore	50
Chandigarh	47	Panjim	39
Chennai	50	Patiala	47
Coimbatore	39	Patna	47
Cuttack	50	Puducherry	50
Darbhanga	55	Port Blair	44
Darjeeling	47	Pune	39
Dehradun	47	Raipur	39
Delhi	47	Rajkot	39
Durgapur	47	Ranchi	39
Gangtok	47	Roorkee	39
Guwahati	50	Rourkela	39
Gaya	39	Shimla	39
Gorakhpur	47	Srinagar	39
Hyderabad	44	Surat	44
Imphal	47	Tiruchirappalli	47
Jabalpur	47	Trivandrum	39
Jaipur	47	Udaipur	47
Jamshedpur	47	Vadodara	44
Jhansi	47	Varanasi	47
Jodhpur	47	Vijayawada	50
		Vishakapatnam	50

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The basic parameters of wind load as per IS 875 – Part 3 – 2015 for design of structure as summarized below:

No	Description	Value	Reference
1	Basic Wind Velocity - Vb	50m/sec	Clause 6.2 , page 51, Appendix – A
2	Terrain Category	3	Clause 6.3.2.2 Page 8 Table 2
3	Probability factor k1	1.0	Clause 6.3.1 Page 11, Table 1
4	Terrain roughness and height factor k2	Varies	Clause 6.3.2
5	Topography factor k3	1.0	Clause 6.3.3
6	Importance factor for cyclonic region k4	1.0	Clause 6.3.4
7	Return Period for Serviceability	20 Yrs	Clause 6.2
8	Return Period for Design	50 Yrs	Clause 6.2
9	Interference Factor	1.25	Clause 8.3

Max. Design wind speed (Vz – Vb x K1 x K2 x K3 x k4)

Wind pressure (Pz = 0.6 x Vz2)

Max. Design wind pressure (Pd = Kd x Ka x Kc x Pz)

Where,

Kd = wind directionality factor

Ka = area averaging factor

Kc = combination factor.

The above data is basic information only.

Further on, dynamic wind response shall be considered based on Clause 10 of IS 875 (Part 3).

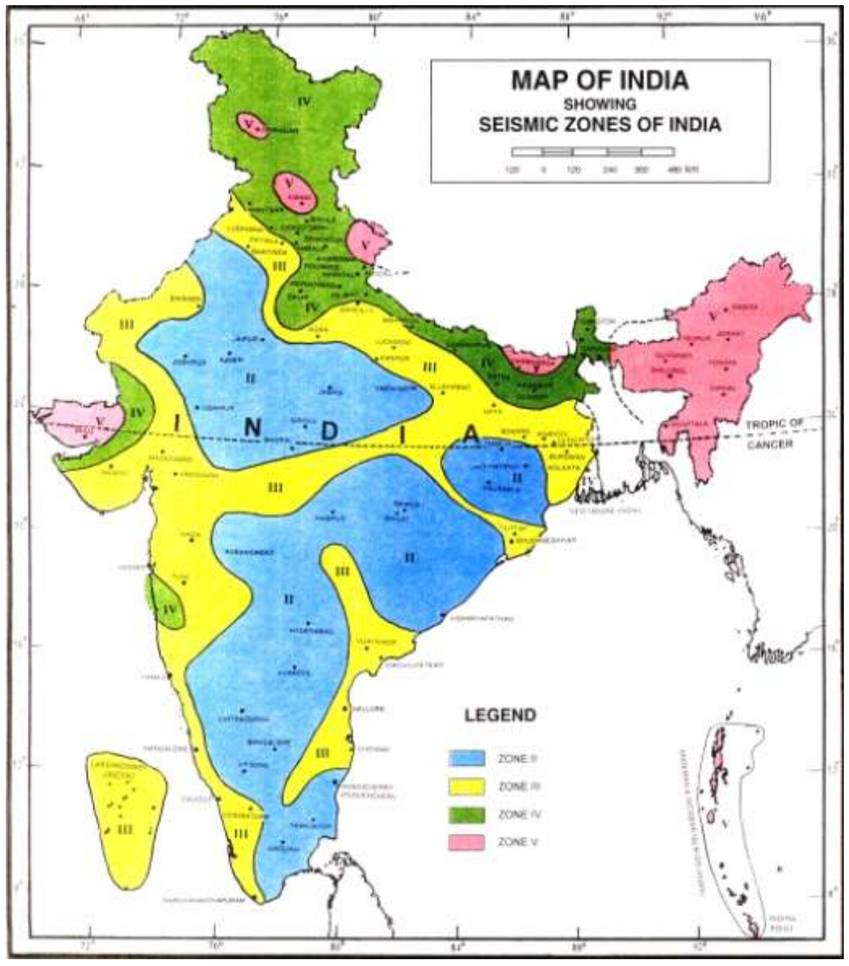
Across wind response (to determine equivalent static wind load and base overturning moment) included in the code is exclusively for rectangular cross sections of given h: b: d ratios and as such is not applicable for the building under consideration.

- **SEISMIC LOAD**

As per the seismic zoning map given in the Indian Standards

IS 1893:2016 (fig 3.6) and as stated in Annex E,

the building lies in seismic Zone – III



ANNEX E

(Foreword)

LIST OF SOME TOWNS WITH POPULATION MORE THAN 3 LAKHS (as per CENSUS 2011) AND THEIR SEISMIC ZONE FACTOR Z

Town	Zone	Z	Town	Zone	Z
Agra	III	0.16	Calicut (Kozhikode)	III	0.16
Ahmedabad	III	0.16	Chandigarh	IV	0.24
Ajmer	II	0.10	Chennai	III	0.16
Allahabad	II	0.10	Chitradurga	II	0.10
Almora	IV	0.24	Coimbatore	III	0.16
Ambala	IV	0.24	Cuddalore	II	0.10
Amritsar	IV	0.24	Cuttack	III	0.16
Asansol	III	0.16	Darbhanga	V	0.36
Aurangabad	II	0.10	Darjeeling	IV	0.24
Bahraich	IV	0.24	Dharwad	III	0.16
Bangalore (Bengaluru)	II	0.10	Dehra Dun	IV	0.24
Barauni	IV	0.24	Dharampuri	III	0.16
Bareilly	III	0.16	Delhi	IV	0.24
Belgaum	III	0.16	Durgapur	III	0.16
Bhatinda	III	0.16	Gangtok	IV	0.24
Bhilai	II	0.10	Guwahati	V	0.36
Bhopal	II	0.10	Gulbarga	II	0.10
Bhubaneswar	III	0.16	Gaya	III	0.16
Bhuj	V	0.36	Gorakhpur	IV	0.24
Bijapur	III	0.16	Hyderabad	II	0.10
Bikaner	III	0.16	Imphal	V	0.36
Bokaro	III	0.16	Jabalpur	III	0.16
Bulandshahr	IV	0.24	Jaipur	II	0.10
Burdwan	III	0.16	Jamshedpur	II	0.10

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Table 2 of the Indian Standard IS 1893: (Part 1) 2016 classifies the seismic intensity of Zone III as moderate and the corresponding seismic acceleration is 0.16 as shown below:

Seismic Zone	II	III	IV	V
Seismic Intensity	Low	Moderate	Severe	Very Severe
Z	0.10	0.16	0.24	0.36

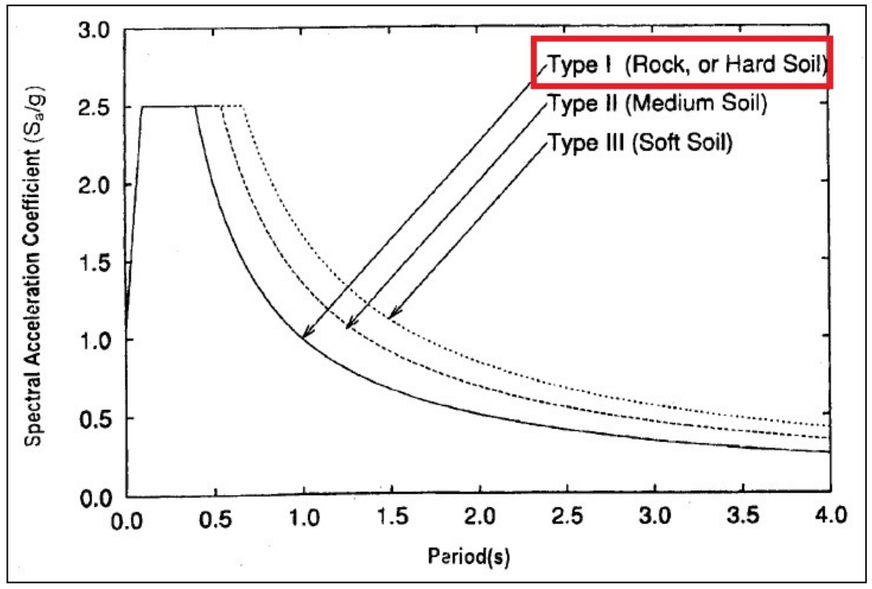
The geotechnical investigation indicates that the base strata are hard rock. Hard rock is classified as soil type I as per IS 1893 Part 1 – 2016

Seismic loads on the building are calculated based on IS 1893 Part 1 – 2016. Since the building lateral force resisting system is ductile shear walls, the formula used for calculating the seismic periods for the purpose of design is

Ta = (0.075*h^0.75) / (Aw) ^0.5 >= 0.09 x H/√D

Where Aw = total effective area of walls in 1st storey of the building.

As outlined in page 24 of IS 1893 – Part I. response spectrum method is used for building design. The response spectrum function used in the analysis is the function corresponding to type I soil (rock) as shown in the figure below:



The design base shear Vb for each direction is scaled to match the base shear calculated using the fundamental period Ta defined in equation 4.1 above. A damping ratio of 5% of critical (typical concrete buildings) is used for the building analysis.

Basic input parameters for the seismic load are shown on the table below:

No	Description	Value	Reference
1	Seismic zone factor Z	0.16 (III)	IS 1893 Clause 6.4.2, Page 10, Table 3
2	Structure importance coefficient – I	1.2	IS 1893 Clause 7.2.3, Page 19, Table 8
3	Site Soil Classification	I (HARD)	The site strata need to be confirmed from Geotech Report
4	Response reduction factor R Ductile Shear Walls	4	IS 1893 Clause 7.2.6, Page 20, Table 9
5	% of live load considered in seismic	25% for loads ≤ 3 KN.m2	IS 1893 Clause 7.3.1 Page 20, Table 10
		50% for loads > 3 KN.m2	

In the limit state design of reinforced concrete structures, the following primary load combinations have been accounted for:

Primary Loads		
1	Dead Load	DL
2	Live Load	LL
3	Earthquake in X direction	SPEC 1
4	Earthquake in Y direction	SPEC 2
5	Earthquake in Z direction	SPEC 3
6	Wind in X direction	WLX
7	Wind in Y direction	WLY
8	Gust in X direction	GWX
9	Gust in Y direction	GWY

- ## LOAD COMBINATIONS

6.1.1. SERVICEABILITY LOAD COMBINATION

1. 1.0 **(DL)** + 1.0 **(LL)**
2. 1.0 **(DL)** +/- 1.0 **(SPEC 1)** +/- 0.3 **(SPEC 3)**
3. 1.0 **(DL)** +/- 1.0 **(SPEC 2)** +/- 0.3 **(SPEC 3)**
4. 1.0 **(DL)** +/- 1.0 **(WLX)**
5. 1.0 **(DL)** +/- 1.0 **(WLY)**
6. 1.0 **(DL)** +/- 1.0 **(GWX)**
7. 1.0 **(DL)** +/- 1.0 **(GWY)**
8. 1.0 **(DL)** + 1.0 **(LL)** +/- 1.0 **(SPEC 1)** +/- 0.3 **(SPEC 3)**
9. 1.0 **(DL)** + 1.0 **(LL)** +/- 1.0 **(SPEC 2)** +/- 0.3 **(SPEC 3)**
10. 1.0 **(DL)** + 1.0 **(LL)** +/- 1.0 **(WLX)**
11. 1.0 **(DL)** + 1.0 **(LL)** +/- 1.0 **(WLY)**
12. 1.0 **(DL)** + 1.0 **(LL)** +/- 1.0 **(GWX)**
13. 1.0 **(DL)** + 1.0 **(LL)** +/- 1.0 **(GWY)**
14. 0.9 **(DL)** +/- 1.0 **(SPEC 1)** +/- 0.3 **(SPEC 3)**
15. 0.9 **(DL)** +/- 1.0 **(SPEC 2)** +/- 0.3 **(SPEC 3**)
16. 0.9 **(DL)** +/- 1.0 **(WLX)**
17. 0.9 **(DL)** +/- 1.0 **(WLY)**
18. 1.0 **(DL)** + 1.0 **(LL)** +/- 1.0 **(WLX)** +/- 0.35 **(WLY)**
19. 1.0 **(DL)** + 1.0 **(LL)** +/- 1.0 **(WLY)** +/- 0.35 **(WLX)**
20. 1.0 **(DL)** +/- 1.0 **(WLX)** +/- 0.35 **(WLY)**
21. 1.0 **(DL)** +/- 1.0 **(WLY)** +/- 0.35 **(WLX)**

6.1.2. ULTIMATE LOAD COMBINATION

1. 1.5 **(DL)** + 1.5 **(LL)**
2. 1.5 **(DL)** +/- 1.5 **(SPEC 1)** +/- 0.45 **(SPEC 3)**
3. 1.5 **(DL)** +/- 1.5 **(SPEC 2)** +/- 0.45 **(SPEC 3)**
4. 1.5 **(DL)** +/- 1.5 **(WLX)**
5. 1.5 **(DL)** +/- 1.5 **(WLY)**
6. 1.5 **(DL)** +/- 1.5 **(GWX)**
7. 1.5 **(DL)** +/- 1.5 **(GWY)**
8. 1.2 **(DL)** + 1.2 **(LL)** +/- 1.2 **(SPEC 1)** +/- 0.36 **(SPEC 3)**
9. 1.2 **(DL)** + 1.2 **(LL)** +/- 1.2 **(SPEC 2)** +/- 0.36 **(SPEC 3)**
10. 1.2 **(DL)** + 1.2 **(LL)** +/- 1.2 **(WLX)**
11. 1.2 **(DL)** + 1.2 **(LL)** +/- 1.2 **(WLY)**
12. 1.2 **(DL)** + 1.2 **(LL)** +/- 1.2 **(GWX)**
13. 1.2 **(DL)** + 1.2 **(LL)** +/- 1.2 **(GWY)**
14. 0.9 **(DL)** +/- 1.5 **(SPEC 1)** +/- 0.45 **(SPEC 3)**
15. 0.9 **(DL)** +/- 1.5 **(SPEC 2)** +/- 0.45 **(SPEC 3**)
16. 0.9 **(DL)** +/- 1.5 **(WLX)**
17. 0.9 **(DL)** +/- 1.5 **(WLY)**
18. 1.2 **(DL)** + 1.2 **(LL)** +/- 1.2 **(WLX)** +/- 0.42 **(WLY)**
19. 1.2 **(DL)** + 1.2 **(LL)** +/- 1.2 **(WLY)** +/- 0.42 **(WLX)**
20. 1.5 **(DL)** +/- 1.5 **(WLX)** +/- 0.525 **(WLY)**
21. 1.5 **(DL)** +/- 1.5 **(WLY)** +/- 0.525 **(WLX)**

• SERVICEABILITY CONSIDERATIONS

- **LIMIT STATE OF SERVICEABILITY**

1. Floor vertical deflection

Maximum permissible short-term deflection due to all loads shall not exceed Span/250.
Maximum permissible long-term deflection due to all loads and including effects of temperature, creep and shrinkage occurring after erection of partitions and application of finishes shall not exceed L/350 OR 20mm whichever is minimum.

2. Lateral Movement under Wind

The maximum lateral movement or drift under service wind loading shall be limited to an inter storey drift ration of h/400, where ‘h’ is the storey height. Total building drift ratio shall be limited to H/500, where ‘H’ is height from Ground to Roof.

3. Lateral Movement under Seismic

The maximum lateral movement or drift under seismic loading shall be limited to an inter storey drift ratio of h/250, where h is storey height.

- **LIMIT STATE OF COLLAPSE**

  Permissible increase in SBC for earthquake shall be 50% and for wind load shall be 25%.

- **CONTROL OF CRACKING**

  Water retaining structures shall be designed for 0.2mm crack width limitation.

CHECK LIST
RESIDENTIAL BUILDING

CHECK LIST FOR THE MAIN STRUCTURAL CONSULTANT

1.	Design Basis Report as per the document HRC/DBR/V1.0.	
2.	Description of Sub-structure and Super-structure as per the format given in the Appendix enclosed.	15 slabs Ground floor + 14 Typical floors (including refuge) + Terrace floor
3.	Brief Description of structural system with sketches, image of drawings etc. with specific focus on 'Lateral load resisting system'	Ductile shear walls
4.	Brief note on modeling, software used etc. Clearly mentioned whether infill/ partition wall is idealized as part of lateral load system?	Building is modelled in ETABs 18.1.1 version infill and partition walls are not modelled. Entire structure in 3 Dimensions provides lateral load resisting system.
5.	Method of Analysis	Analysis is done by Response Spectrum Method.
6.	Earthquake parameter	
a)	Zone Factor	Z = 0.16
b)	Importance factor	I = 1.2
c)	Response Reduction factor	R = 4.0 (IS 1893:2016 for ductile shear walls)
d)	Soil Type	Hard
e)	% LL considered in seismic	25% up to 3 kN/m2 & 50% above 3 kN/m2
f)	Time Period in the horizontal X-direction as per code IS: 1893 (Part 1)-2016	$Tx = \frac{0.09h}{\sqrt{dx}}$ h= Height of Building = 48.70 m, dx = 38.70 m = 0.705 Sec According to Area of Walls, $Tx = \frac{0.075h^{0}.75}{\sqrt{Aw}}$ h= 48.70 m, Aw = 1.516 = 1.155 Sec **Final Time Period = 1.123 Sec** (Max. between two)
g)	Time Period in the horizontal Y-direction as per code IS: 1893 (Part 1)-2016	$Ty = \frac{0.09h}{\sqrt{dy}}$ h= Height of Building = 48.70m, dy = 27.25 m = 0.840 Sec. According to Area of Walls, $Ty = \frac{0.075h^{0}.75}{\sqrt{Aw}}$ h= 48.70 m, Aw= 2.089 = 0.956 Sec **Final Time Period = 0.956 Sec** (Max. between two)
h)	Seismic weight kN	137634.2972 kN
i)	Static base shear in X direction in kN $= \frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g} \times seismicweight$	$= \frac{0.16}{2} \times \frac{1.2}{4.0} \times 0.8905 \times 137634.2972$ = 2941.52 kN (2.137 % of total seismic wt.)
j)	Static base shear in Y direction in kN $= \frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g} \times seismicweight$	$= \frac{0.16}{2} \times \frac{1.2}{4.0} \times 1.046 \times 137634.2972$ = 3455.17 kN (2.510 % of total seismic wt.)
k)	Unscaled Dynamic base shear in X direction	1407.5163 kN (1.018 % of total seismic wt.)
l)	Unscaled Dynamic base shear in Y direction	1659.54 kN (1.23 % of total seismic wt.)
m)	Scale Factor X- direction $= \frac{static\ base\ shear}{Dynamic\ base\ shear}$	= 2941.52 / 1407.5163 = 2.09
n)	Scale Factor Y- direction $= \frac{static\ base\ shear}{Dynamic\ base\ shear}$	= 3455.17 / 1659.54 = 2.082
q)	Maximum diaphragm displacement at roof level	18.569 mm or H/2622.65---------- in X direction 15.50 mm or H/3141.94 ---------- in Y direction
r)	Maximum inter storey drift	0.0595% (Earthquake in X direction)- (6th Floor) 0.0571% (Earthquake in Y direction)- (10^{th} Floor)

u) Table of distribution for base shear: For Dynamic base shear.

STORY	OUTPUT LOAD	VX	OUTPUT LOAD	VY
LMR/OHWT-Top	SPEC1	98.9703	SPEC2	126.5845
LMR/OHWT-Bottom	SPEC1	272.9161	SPEC2	339.6315
Terrace	SPEC1	696.2076	SPEC2	675.5607
Story14	SPEC1	1070.522	SPEC2	1036.4327
Story13	SPEC1	1314.562	SPEC2	1329.3713
Story12	SPEC1	1457.067	SPEC2	1551.6304
Story11	SPEC1	1548.941	SPEC2	1710.6941
Story10	SPEC1	1641.471	SPEC2	1822.8038
Story9	SPEC1	1756.977	SPEC2	1912.3815
Story8	SPEC1	1880.731	SPEC2	2008.316
Story7	SPEC1	1986.611	SPEC2	2134.9272
Story6	SPEC1	2070.808	SPEC2	2300.2446
Story5	SPEC1	2162.463	SPEC2	2489.7861
Story4	SPEC1	2295.352	SPEC2	2674.0333
Story3	SPEC1	2462.965	SPEC2	2827.101
Story2	SPEC1	2617.753	SPEC2	2959.1962
Story1	SPEC1	2765.946	SPEC2	3179.2194
Ground	SPEC1	2941.427	SPEC2	3455.2542

7. Wind loading parameter and results:

Wind loading Parameters				
a)	Basic wind speed in m/sec	50		
b)	Category of building	3		
c)	Wind speed parameters			
	K1 (Risk Coefficient)	1		
	K2 (Terrain roughness &height factor) for height 44.25 m	1.1041		
	K3 (Topography factor)	1		
	K4 (importance factor for cyclonic region)	1		
	Design wind speed at terrace level Vz in m/s	= K1 x k2 x k3 x k4 x Vb = 1 x 1.1041 x 1 x 1x 50 = 55.205 m/s		
	Wind pressure at terrace level Pz = kN/m2	= 0.6 x Vz2 = 0.6 x 55.205^2 = 1.8285 kN/m2		
d)	Shape factor (force coefficient) Cf as per IS875-Part-3-Fig no. 4A	H = 44.25 m; a = 38.70 m; b = 27.25 m	h/b = 1.623 a/b = 1.420 Cf x = 1.165	h/b = 1.143 a/b = 0.704 Cf y = 1.306
e)	Gust factor calculations			
f)	Wind tunnel test	NA		

g) Base shear and Maximum Deflection due to wind loads

No.	Loading Type	Wind Base Shear (kN)		Diaphragm Displacement (mm)		Story Drift (%) (mm)	
		X	Y	X	Y	X	Y
1	Static	2162.77 kN	3412.91 kN	30.398 mm H/1455.69	35.044 mm H/1262.70	0.1006 % @ 5th floor	0.1088 % @ 3rd floor

8. Data from Dynamic Analysis :

Mode	Period	Frequency	X-Participation	Y-Participation	RZ-Participation	Sum-X	Sum-Y	Sum- RZ
1	**2.377**	0.421	**61.57**	0.22	14.64	61.57	0.22	14.64
2	**2.247**	0.445	14.25	8.00	**57.19**	75.82	8.22	71.83
3	**1.962**	0.51	0.69	**66.85**	6.79	**76.52**	**75.07**	**78.62**
4	0.717	1.395	0.43	1.59	10.08	76.95	76.66	88.7
5	0.688	1.453	12.35	0.22	0.14	89.3	76.88	88.84
6	0.563	1.776	0.09	12.23	2.18	89.39	89.11	91.02
7	0.431	2.321	0.003	1.81	0.03	89.39	90.92	91.05
8	0.345	2.896	5.02	0.02	0.0005	94.41	90.94	91.05
9	0.245	4.085	0.08	6.66	0.02	94.49	97.6	91.07
10	0.192	5.199	4.10	0.10	0.05	98.59	97.7	91.12
11	0.186	5.381	0.10	0.0003	0.00032	98.69	97.7	91.12
12	0.121	8.257	0.00186	0.00137	0.00321	**98.7**	**97.7**	**91.12**

9. Table for diaphragm displacement at Terrace Level

Load Case	Dx-Max (mm)	H/Dx	Drift-X %	Dy-Max (mm)	H/Dy	Drift-Y %
SPEC1	18.569	H/2622.65	0.0358	1.95	H/24974.36	0.0112
SPEC2	1.833	H/26568.47	0.0137	15.50	H/3141.93	0.0371
WX	30.398	H/1455.69	0.0437	0.182	H/243131.86	0
WY	0.491	H/90122.2	0	35.044	H/1262.70	0.0582

10. Table for Torsion irregularity

(along X-direction & Y-direction) All values are in mm.

Load case	Corner				Avg- X	% = Max/ Avg
	1	**2**	**3**	**4**		
SPEC 1	21.962	21.961	17.165	17.153	19.5575	1.123
SPEC 2	21.036	20.595	14.05	14.047	17.5415	1.199

• GEOTECHNICAL INFORMATION

Geotechnical Investigation Report of site is required to work out the foundation, designing of uplift raft and for designing the retaining wall.

• CONCLUSION

The design basis outlined in this document has been based on currently available data issued by the client and the architect. It will need to be updated if design objectives or assumptions are revised, or if more complete information becomes available in the future. As such, this document should be thoroughly reviewed and verified by the architect and client for accuracy and completeness. Any perceived non-conformance with project standards or expectations should be brought to our attention as early as possible.

• COMPUTER PROGRAMS

- **ETAB 2017**- Software shall be used for analysis
- **SAFE 2016** - Software shall be used for foundation analysis and design.
- **RCDC V8** - Software shall be used for design of structural members.
- **Auto CAD 2019** - software shall be used for drafting.

7. CODES & STANDARDS

- **IS 456: 2000 -** Code of Practice for Plain & reinforced concrete
- **IS 875 (Part-1):1987** -Code of Practice for Design loads – Unit weights.
- **IS 875 (Part-2): 1987** -Code of Practice for Design loads – Imposed loads.
- **IS 875 (Part-3): 2015** - Code of Practice for Design loads – Wind loads.
- **IS 875 (Part-5): 1987** -Code of Practice for Design loads – Special loads.
- **IS 1893 (Part-1): 2016 -**Criteria for Earthquake Resistant Design Structures.
- **IS 13920: 2016** -Ductile Detailing of Reinforced Concrete.
- **IS 1343: 2012** -Code of Practice for Pre-Stressed Concrete.
- **IS 1786: 2008** -Specification for High Strength Deformed Bars
- **SP: 16 -** Design Aids for Reinforced Concrete to IS: 456-1978.
- **SP: 23** -Hand Book on Concrete Mixes
- **SP: 24 -**Explanatory handbook on IS 456: 1973
- **SP: 34** -Hand Book on concrete reinforcement and Detailing

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

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- 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
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