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THE PROPOSED CONSTRUCTION OF RESIDENTIAL HIGH RISE BUILDING COMBINED BASEMENT FLOOR (BLOCK - 1,TOWER - 1 STILT +11 FLOORS + 12TH FLOOR PART) COMBINED STILT FLOOR (BLOCK – 2: TOWER 2, 3 & 4) AND COMBINED (PODIUM) FIRST FLOOR (BLOCK – 2: TOWER 2, 3 & 4) TOWER -2 - STILT + FIRST FLOOR + 41 FLOORS, TOWER - 3 STILT + FIRST FLOOR + 41 FLOORS, TOWER-4 - STILT + FIRST FLOOR + 13 FLOORS, AND CLUB HOUSE - GROUND + 5 FLOORS WITH SWIMMING POOL @ GROUND LEVEL COMPRISED IN S.NOS.18/1, 2, 3, 8A, 8B,10, 19/1, 2, 3, 4, 6B,23/1A, 23/1C, 23/3A1C, 24/1, 25/1A,1B,1C,1D, 2, 3, 4, 5, 6, 7, 8, 9A, 9B, 9C, 10, 29/12C1, 12C2, 12C3B, 30/5C1A, 6B, 7A, 8, 9,10,12C1A, 12C1B, 12C2, 12C3, 13A1, 13B, 31/1C1A1, 11,13 OF KANATHUR REDDYKUPPAM VILLAGE, THIRUPORUR TALUK, CHENGALPATTU DISTRICT.

- Structural Design Report

August 2024

STRUCTURAL CONSULTANT

Somadev Nagesh
New No: 15 3rd cross street,
Karpagam gardens, Adyar.
Chennai-600020.
Telefax: 24464410, 43504060

ARCHITECT

M/S Vernekar Associates
Pvt.Ltd.
Bengaluru.

S. NAGESH, B.E. (CIVIL), M.A.Sc., F.I.E.
STRUCTURAL ENGINEER GRADE I (SE)
DTCP REG No. CGLDIST/ENGR-I/2019/05/004 (MLPA)
New No. 15, 3rd Cross Street,
Karpagam Gardens, Adyar, Chennai - 600 020
Email : nagesh.somadev@gmail.com
Mobile : 98402 31666

S. NAGENDRA, BE (CIVIL), MCP., PTP.
STRUCTURAL ENGINEERING CONSULTANT
DTCP/CMDA No. CHLDISTRICT-1700/97/2000 (SLP)
New No. 15, 3rd Cross Street,
Kanagam Gardens, Adyar, Chennai - 600 020
Email : nagesh.nandu@gmail.com
Mobile : 98402 31666

1.1 FOREWORD

1.1.1 - Description of Project

M/S Voora Developers, Chennai, proposing a RESIDENTIAL HIGH RISE BUILDING COMBINED BASEMENT FLOOR (BLOCK - 1,TOWER - 1 STILT +11 FLOORS + 12TH FLOOR PART) COMBINED STILT FLOOR (BLOCK – 2: TOWER 2, 3 & 4) AND COMBINED (PODIUM) FIRST FLOOR (BLOCK – 2: TOWER 2, 3 & 4) TOWER -2 - STILT + FIRST FLOOR + 41 FLOORS, TOWER - 3 STILT + FIRST FLOOR + 41 FLOORS, TOWER-4 - STILT + FIRST FLOOR + 13 FLOORS, AND CLUB HOUSE - GROUND + 5 FLOORS WITH SWIMMING POOL @ GROUND LEVEL COMPRISED IN S.NOS.18/1, 2, 3, 8A, 8B,10, 19/1, 2, 3, 4, 6B,23/1A, 23/1C, 23/3A1C, 24/1, 25/1A,1B,1C,1D, 2, 3, 4, 5, 6, 7, 8, 9A, 9B, 9C, 10, 29/12C1, 12C2, 12C3B, 30/5C1A, 6B, 7A, 8, 9,10,12C1A, 12C1B, 12C2, 12C3, 13A1, 13B, 31/1C1A1, 11,13 OF KANATHUR REDDYKUPPAM VILLAGE, THIRUPORUR TALUK, CHENGALPATTU DISTRICT project is architecture **by M/s Vernekar Associates Pvt. Ltd, Bengaluru**.

1.1.2 – Objective of the Report.

The objective of this report is to provide and furnish complete details related to Project and structuralanalysis and design considerations.

1.1.2 – Scope of the Report.

The Structural Report covers the complete Structural Elements design considerations for analysis of lateralloads & gravity loads.

1.2 CODES, STANDARDS AND

REFERENCESStatutory Requirements:

The design of structural and other building services will comply with the following requirements:

- National Building Code
- Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.Fire
- prevention and detection in compliance with the local Fire Regulation.

DESIGN STANDARDS:

Specific applicable codes and standards will be identified and adopted in the design philosophies as appropriate to the structural elements. The latest editions of the Codes and Standards will be used indesigns. All design work shall be based on Indian Standards and Codes with latest revision, with amendments if any, as on date.

Loads:

IS:875 -2015	Code of Practice for design loads (other than earthquake) for Buildings andstructure (All parts)
IS:1893-2016	Criteria for earthquake resistant design of structure

Foundations:

IS:1080-1985(2016)	Code of Practice for design and construction of shallow foundations on soils(other than raft, ring and shell)
IS:1904-1986(2015)	Code of Practice for design and construction of foundations in soils general requirement
IS:2911-1980(2013)	Code of Practice for design and construction of pile foundations (All parts)
IS:2950-1981(2013)	Code of Practice for design and construction of raft foundations
IS:2974-1998(2013/2015)	Code of Practice for design and construction of machine foundations(All parts)

IS:8009-1976/1980(2013/2015) Code of Practice for calculation of settlement of foundations(All parts)

RCC

:	IS:456 -2000(2016)	Code of Practice for plain and reinforced concreteIS:458
	-1988	Specification for precast concrete pipes
	IS:3370-2009	Code of Practice for concrete structures for the storage of liquids:(All parts)
	IS:4326-2013	Code of Practice for earthquake resistant design and construction ofbuildings
	IS:5525-1969(2013)	Recommendation for detailing of reinforced concrete works
	IS:1786-2008	Specification for high strength deformed steel bars and wires for concrete reinforcement
	IS:10262-2009	Recommended guidelines for concrete mix design
	IS: 1893 (Part-1)-2016	Criteria for earthquake resistant design of structures (General provisionsand building).
	IS:16700 – 2017	Criteria for structural safety of Tall Concrete buildings
	IS:13920 – 2016	Ductile design and Detailing of Reinforced concrete structures subjected toSeismic forces – Code of practice
	IS:1343 – 1980	Code of practice for Prestressed concrete

Structural steel:

IS:800 -2007(2012)	Code of Practice for general construction in steel
IS:802 -1995	Code of Practice for use of structural steel in overhead transmission linetowers: (All parts)
IS:806 -1968(2013)	Code of Practice for use of steel tubes in general building construction IS:808 -
1989	Dimensions for hot rolled steel beam, column channel and angle sectionIS:816 -
1998	Code of Practice for use of metal arc welding for general construction in mild steel
IS:1161-1998	Steel tubes for structural purposes
IS:4000-1998	High Strength bolts in steel structures – Code of Practice
IS:7215 -1995	Tolerances for fabrication of steel structures

Miscellaneous:

IS: 432(part 2)-1995	Specification for mild steel and medium tensile steel bars and hard-drawnsteel wire for concrete reinforcement
IS: 6313(part II)-2001	Standards for anti-termite treatment
IS:1905-1998	Code of Practice for structural use of unreinforced masonry
IS:3067-1995	Code of Practice for general design details and preparatory works for dampproofing and water proofing of buildings
SP:6 -1998	Handbook for structural engineers (all parts)SP:7
-2005	National Building Code of India
SP:16-1999	Design Aids for reinforced concrete to IS:456-1978
SP:22-1982	Explanatory handbook on codes for earthquake engineering (IS:1982-1975and IS:4326-1976)
SP:24-1983	Explanatory handbook on Indian Standard code of Practice for plain and reinforced concrete
SP:34-1987	Handbook of concrete reinforcement and detailing (SCIP)

Material :

IS: 269 -2015	Specification for Ordinary, rapid hardening and low heat Portland cement.IS: 455 -
1995	Specification for Portland blast furnace slag cement.
IS: 1489-1991	Specification for Portland pozzolana cement IS:
4031-1991	Method of physical tests for Portland cement.
IS: 383 - 2016	Specification for coarse and fine aggregates from natural sources forconcrete.

IS: 516 – 1999	Method of test for strength of concrete.
IS: 1199-1999	Method of sampling and analysis of concrete.
IS: 1566-2000	Specification for plain hard drawn steel wire fabric for concrete reinforcement.
IS: 4990-1998	Specification for plywood for concrete shuttering works.
IS: 2645-1999	Specification for integral cement water proofing compounds.

1.3– DESCRIPTION OF STRUCTURE

1.3.1 – Location – Vandalur Chennai.

1.3.2 Building Description.

The Development consists of the following:

1. Hostel building floor covered with RCC roofing.

The usages of individual floors are as given below:

Floors	Details
Hostel building	Space for Hostel Purpose

1.3.3 – Structural Arrangement:

- The Structural System for the residential buildings comprises of rcc column and beam.

	Description	Main Building
a)	Column grids	6 m x 4 m (Varies for some grids)
b)	Structural system	RCC Shear wall & column
c)	Slab thickness	Minimum 130mm Variesdepends on span
e)	Foundation	Pile cum Raft Foundation
f)	Column size	As per design
g)	Beams	As per design.

1.4 DESIGN APPROACH

1.4.1 – Design Life.

The design life of the building is assumed as 50 years. This requirement is applicable only for concrete works and not applicable to replaceable finishing materials, water proofing membrane and thermal insulations (if any). Hence periodic maintenance / refurbishment are required for all replaceable material for longer life.

1.4.2 – Material Properties.

Materials specified will conform to the latest edition of the relevant Indian Standard or other accepted standard. Specifications for materials will include sampling and testing as stipulated in the design standards. Detailed material specifications will be included in the Technical Specification.

Concrete:

- All structural concrete shall have cube crushing strength of 25 N/sq.mm (M25) at 28 days.Plain
- cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

Concrete Mix:

Concrete item	Grade
Foundation	M30
Columns	M45-M30
Slab, beams	M30

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 – 1985 having minimum yield strength of 500 N/sq.mm.Corrosion resistant steel is not required

Structural Steel

- All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm

1.4.3 – Design loads.

Loads:

Dead loads:

Dead load shall include weight of all structural and Architectural components. Self-weight of the materialsshall be calculated on the basis of unit weights given in IS: 875.

- Floor finish of 75 mm thickness: 175 kg/sqm

- Self-weight of Plain concrete : 2400 kg/cum (24 kN/cum)
- Self-weight of RCC : 2500 kg/cum (25 kN/cum)
- AAC block masonry : 800 kg/cum (8 kN/cum) [For walls]
- block masonry : 800 kg/cum (8 kN/cum)
  (With additional 15mm thick plastering on external surface and 12mm plastering on internal wallsurfaces)
- Soil (Dry) : 1800 kg/cum (18 kN/cum)
- Soil (Wet) : 2000 kg/cum (20 kN/cum)
- Water : 1000 kg/cum (10 kN/cum)
- Masonry with plastering : 2200 kg/cum (22 kN/cum)
- Wall loads : As per actuals

Live loads:

The superimposed loads shall be calculated in accordance with IS: 875(Part-2) based on Occupancy Classification. For multiple occupancies of use in the building shall be referred with the other appropriate comparable occupancy classification as per Table.1 of IS 875(Part-2)-1987.

Following live loads are considered while designing the structural elements apart from the dead loads asper codes.

Floor Live loads:

- Living, kitchen, Dining : 200 kg/sqm (2.0 kN/sqm)
- Car Parking : 325 kg/sqm (3.25 kN/sqm)
- Stairs : 300 kg/sqm (3.0 kN/sqm)
- Corridors / Balcony : 300 kg/sqm (3.0 kN/sqm)
- Toilets : 200 kg/sqm (2.0 kN/sqm)
- Terrace with Access : 150 kg/sqm (1.5 kN/sqm)
- Electrical rooms : 400 kg/sqm (4.0 kN/sqm)
- Ramps : 300 kg/sqm (3.0 kN/sqm)

Sunken Details:

- Toilet : 75mm
- Balcony : 150mm
- Corridor : 50mm

Wind Loads

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3):2015.Chennai

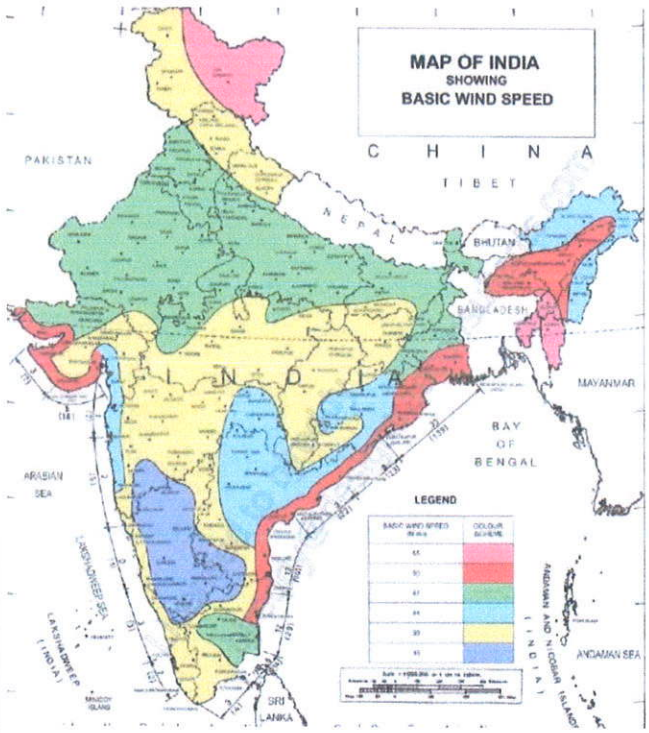
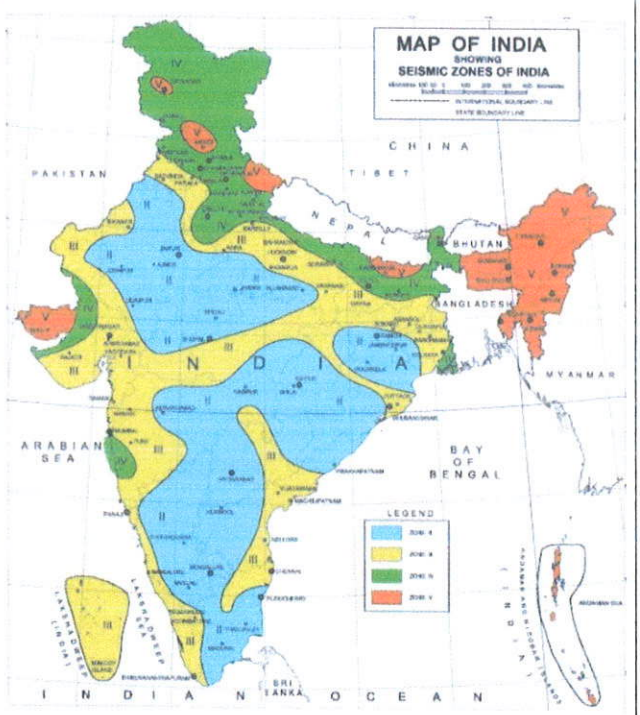
has a high wind speed of 50m/s.

Basic Wind Speed V_b	: 50 m/s
Risk Coefficient k_1	: 1.00 (k_1 corresponds to 50 years Mean Probable Design Life of Structure)
Terrain, height, structure size factor k_2	: To suit the height of the structure for terrain category 2
Topography factor k_3	: 1.00
Importance factor for cyclonic region k_4	: 1.00

The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3):2015Design

wind speed V_z : $V_b \times k_1 \times k_2 \times k_3 \times k_4$

Design wind pressure p_z : $0.6 \times V_z^2$

Map showing basic wind speed	Map showing seismic zones
	
Basic wind speed in m/s (based on 50-year return period)	Seismic zones of India

Seismic Forces:

Chennai falls under seismic zone III as per IS 1893-2016 (Part 1) (Sixth Revision) and has the followingfactors to be considered for designs. Ductile detailing is required. (Please refer attached map above)

Seismic Zone	: III
Seismic Zone factor, Z	: 0.16 (As per Table 3; IS: 1893-2016)
Design horizontal seismic coefficient (Ah)	: $(Z/2)*(S_a/g)*(I/R)$
I -Importance factor	: 1.2 (Ref Table 8; IS: 1893-2016)
Response reduction Factor	: 5
Soil type	: Type -1 with N>100 at the founding levels of about 9m
Damping Ratio for RCC	: 5 %

Sa/g – Average response acceleration coefficient for soil sites as per Fig.2 of IS: 1893-2016 and it is arrivedbased on appropriate fundamental natural period of structure as per Cl 7.6.2 (b)

Design horizontal seismic coefficient (A_h) : $(Z/2)*(S_a/g)*(I/R)$

: $(0.16/2)*(1.2/5) * (S_a/g)$

A_h : $0.0192 * (S_a/g)$

Design seismic base shear, V_b : $A_h * w$ where, w - seismic weight of building

Effect of infill panels : Not considered in the analysis

Table No : 03

Seismic Zone Factor Z

(Clause 6.4.2)

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

Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. Minimum & maximum temperatures considered are as shown in the table below. Same will be used

for the analysis & design. The coefficient for thermal expansion and contraction will be in accordance withIS: 456 and IS: 800 for concrete and steel respectively.

Station Name	Month	Period	No. of Years	Mean Temperature in Degree C		Mean rainfall in mm
				Maximum	Minimum	
Chennai (Minambakkam)	January	1901-2000	100	28.8	20.4	35.3
Chennai (Minambakkam)	February	1901-2000	100	30.5	21.1	13.0
Chennai (Minambakkam)	March	1901-2000	100	32.6	23.0	14.5
Chennai (Minambakkam)	April	1901-2000	100	34.7	25.8	15.9
Chennai (Minambakkam)	May	1901-2000	100	37.4	27.6	42.4
Chennai (Minambakkam)	June	1901-2000	100	37.3	27.4	53.9
Chennai (Minambakkam)	July	1901-2000	100	35.3	26.1	99.6
Chennai (Minambakkam)	August	1901-2000	100	34.5	25.5	129.9
Chennai (Minambakkam)	September	1901-2000	100	33.9	25.2	123.5
Chennai (Minambakkam)	October	1901-2000	100	31.8	24.2	284.6
Chennai (Minambakkam)	November	1901-2000	100	29.4	22.6	353.0
Chennai (Minambakkam)	December	1901-2000	100	28.4	21.2	146.3

[Source: National Data Centre : ndc@imdpune.gov.in
DGM (Sectt.) : dgm.hq@imd.gov.in]

Considering the average **daily** maximum temperature as 34 degrees and minimum as 24 degrees, the variation in temperature for analysis is considered as **10 degrees**.

[Source:https://www.wunderground.com/history/airport/VOMM/2016/1/4/CustomHistory.html?dayend=5&monthend=2&yearend=2017&req_city=&req_state=&req_statename=&reqdb.zip=&reqdb.magic=&reqdb.wmo=]

Temperature and shrinkage effect:

Horizontal floor displacement due to differential temperatures and shrinkage is of importance in long concrete buildings. It can be taken care of by either providing expansion joints at an appropriate spacing ordesigning structural members for the additional moments caused by the temperature and shrinkage effects.Pour strips at suitable locations shall also be considered where required.

Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design:Exceptional

- loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building) Accidental
- collision of vehicles on the façade of the building

1.4.4 Durability Considerations:

Environmental conditions, Corrosion and Fire protection for concrete and structural steel

- Environment : moderate

Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size

(Clauses 6.1.2, 8.2.4.1 *and* 9.1.2*)*

Sl No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	–	300	0.55	M 20
iii)	Moderate	240	0.60	M 15	300	0.50	M 25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40

NOTES

1 Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.

2 Minimum grade for plain concrete under mild exposure condition is not specified.

- Exposure conditions : Concrete surfaces exposed to moderate environment
- Minimum grade of concrete : Moderate exposure – M25

S. NAGESH, B.E. (CIVIL). M.A.Sc., F.I.E.
STRUCTURAL ENGINEER GRADE I (SE)
DTCP REG No. CGLDIST/SE/GR-I/2019/05/004 (MLPA)
New No. 15, 3rd Cross Street,
Karpagam Gardens, Adyar, Chennai - 600 020.
Email : nagesh.somadev@gmail.com
Mobile : 98402 31666

1.4.5 Fire Rating:

- Thickness of the structural elements as per table 15, 16 & 16A clause 26.4 of IS 456-2000.

Fire Resistance h	Minimum Beam Width b	Rib Width of Slabs b_w	Minimum Thickness of Floors D	Column Dimension (b or D)			Minimum Wall Thickness		
				Fully Exposed	50% Exposed	One Face Exposed	$p<0.4\%$	$0.4\% \le p \le 1\%$	$p>1\%$
	mm	mm	mm	mm	mm	mm	mm	mm	mm
0.5	200	125	75	150	125	100	150	100	100
1	200	125	95	200	160	120	150	120	100
1.5	200	125	110	250	200	140	175	140	100
2	200	125	125	300	200	160	–	160	100
3	240	150	150	400	300	200	–	200	150
4	280	175	170	450	350	240	–	240	180

NOTES

1 These minimum dimensions relate specifically to the covers given in Table 16A.

2 p is the percentage of steel reinforcement.

FIG. 1 MINIMUM DIMENSIONS OF REINFORCED CONCRETE MEMBERS FOR FIRE RESISTANCE

Nominal covers for 2 hr. fire resistance :

Nominal Cover						
Beams		Slabs		Ribs		Columns
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous	
mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40

1.5 ANALYSIS METHODOLOGY:

This structure has physical interface with almost all the disciplines like geotechnical works, MEP services, etc. The structure proposed is of cast in-situ concrete construction with columns suitably placed.

The Vertical Loads including the dead and super imposed loads are transferred to the soil through columns,pedestal and Pile caps. Pile caps are sized with consideration to the safe carrying capacity of pile at the levelof transfer of load recommended by specialist soil investigation consultants.

1.5.1 Assumptions:

- The structure is idealized as 3D space frame and analyzed using Etabs software package for bothvertical and lateral loads.
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and forthe load combinations as given in the relevant codes.
- The foundation is represented in analysis model using fixed end conditions.

1.5.2 Mathematical model

Mass Modelling:

Mass Source as per IS: 1893_2016 is considered as follows.

Mass source = DL+SDL+ 0.

3LLWhere DL - Dead

Load;

SDL – Super Imposed Dead Load;

LL - Live Load

1.5.3 Static Analysis:

Following Static loads cases are considered in the analysis

DL - Dead Load which includes self-weight of the structure.

SDL – Super Imposed Dead Load, including load due to finishes, wall Loads, Soil filling loads etc.LL - Live Load

1.6 LOAD COMBINATIONS:

Load combinations Used for Strength, Serviceability are tabulated below:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL+SDL	*LL*	*WL/EL/TL*	*DL+SDL*	*LL*	*WL/EL/TL*
DL + LL	1.5	1.5	—	1	1	—
DL + WL	1.5 or 0.9*	—	1.5	1	—	1
DL + EL	1.5 or 0.9*	—	1.5	1	—	1
DL + TL	1.5	—	1.5	1	—	1
DL+LL+WL	1.2	1.2	1.2	1	0.8	0.8
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8
DL+LL+TL	1.2	1.2	1.2	1	1	1
DL+WL+TL	1.2	—	1.2	1	—	1
DL+EL+TL	1.2	—	1.2	1	—	1
DL+LL+EL+ TL	1.2	1.2	1.2	1	1	1

The various loads are 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 may be adopted.

*This value is to be considered when stability against overturning and stress reversal is critical where DL/LL/WL/EL denotes,

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

Wind load and earthquake loads are considered for both x & y directions. Whenever imposed load is combined with earthquake load, the appropriate part of imposed load as specified in IS: 1893-2016 / Clause 7.3.3 of seismic code will be used both for evaluating earthquake effect and for combined load effects usedin such combination. Serviceability loads combinations with suitable live load reduction factor as per IS: 875(Part-2) will be used for foundation design.

1.7 DESIGN METHODOLOGY:

- All R.C.C structures shall be designed according to the Limit State Method as specified in IS: 456 –2000.
- Forces and moments from the 3D analysis output for the worst combinations are used for the designof the structure.
- The foundations are designed for critical load combination.
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and forthe load combinations as given in the relevant codes.
- The slab is analyzed as two-way and one way slabs.
- Design of special members like retaining wall, water tanks will be done in accordance with therelevant IS Codes.
- Design of structural steel members are done using elastic method as per IS: 800 with relevantallowable stresses.

1.8 ACCEPTANCE CRITERIA:

1.8.1 Deflection Limits:

For Reinforced concrete works:

- Limiting values of deflection (Short and Long term) as per clause 35.3 of IS: 456-2000 is followed in the design.
- Limiting value for long term deflection is considered as span/250 and for the long term deflection after erection of partitions & finishes is considered as span/350 or 20mm whichever less as per IS 456 – 2000.

1.8.2 Cracking Limits:

- Limiting values of crack width as per clause 35.3 of IS: 456-2000 is followed in the design.In general
- for slabs and beams, the crack width is limited to 0.3mm.
- For water retaining structures, crack width is limited to 0.2mm.

1.8.3 Soil data:

Foundations are designed based on Geo Technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. The soil investigation report recommends Pile foundation system and raftslab to resist water pressure.

1.9 DETAILING REQUIREMENTS:

- RC walls, which are considered as lateral load resisting elements are detailed as ductile RC walls along with perimeter SMRFs (both columns and beams). Rest of the columns and beams are detailedas per normal detailing requirement.
- Detailing for all structural members shall be in accordance with IS: 456 & SP: 34.

S. NAGESH, B.E. (CIVIL). M.A.Sc., F.I.E.
STRUCTURAL ENGINEER GRADE I (SE)
DTCP REG No. CGLDIST/SE/GR-1/2019/05/004 (MLPA)
New No. 15, 3rd Cross Street,
Karpagam Gardens, Adyar, Chennai - 600 020.
Email : nagesh.somadev@gmail.com
Mobile : 98402 31666



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Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

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