PROPOSED RESISDENTIAL GROUP HOUSING PUDUPAKKAM VILLAGE, CHENGALPET TALUK CHENNAI.

STRUCTURAL DESIGN BASIS REPORT

CLIENT ***: PACIFICA COMPANIES***

PROJECT ***: PROPOSED RESISDENTIAL GROUP HOUSING***

ARCHITECT ***: M/s PACIFICA COMPANIES***

STRUCTURAL: CONSULTANT'S

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JOB NO. : **VISDA-STR-2213**

ISSUE RECORD

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CONTENTS

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A.0 INTRODUCTION

M/s. PACIFICA, have proposed the construction of a Residential Group housing at pudupakkam village chengalpet taluk kanchipuram district Chennai.

M/s Pacifica Companies are the Architects for the project and the Structural Engineering service is provided by M/s VISION STRUCTURAL DESIGN AID, Bangalore.

The proposed Residential group housing,

31 types of villas

Ground + 2 upper floors + Terrace = 3 Structural slabs

Ground + 1 upper floors + Terrace = 2 Structural slabs

The criteria furnished in this document shall govern the design of civil and structural works of the proposed project. This document covers the general description of the applicable design codes and standards, characteristics of the building, specific building materials, design criteria, design loads and combination, design methodology adopted for the structures.

A.1 STATUTORY REQUIREMENTS:

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

- National Building Code
- The Building Regulations Act
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.
- ASHRAE.
- Any other applicable laws as advised by the client.
- Bureau of Indian Standard Codes.

B.0 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 in designs. All design work shall be based on Indian Standards and Codes with latest revision, with amendments if any, as on date.

Loads:

IS: 875-1987	Code of Practice for design loads (other than earthquake) for Buildings and structure (part 1, 2, 3, 4&5)
IS: 1911	Schedule of unit weights of building materials

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Foundations:

IS: 1080	Code of Practice for design and construction of shallow foundations on soils (other than raft, ring and shell)
IS: 1904	Code of Practice for design and construction of foundations in soils general requirement
IS: 2950	Code of Practice for design and construction of raft foundations
IS: 2974	Code of Practice for design and construction of machine foundations (All parts)
IS: 8009	Code of Practice for calculation of settlement of foundations (All parts)
IS: 11089	Code of Practice for design and construction of ring foundation

RCC:

IS: 456	Code of Practice for plain and reinforced concrete
IS: 458	Specification for precast concrete pipes
IS: 3370	Code of Practice for concrete structures for the storage of liquids: (All parts)
IS: 3414	Code of Practice for design and installation of joints in buildings
IS: 3935	Code of Practice for composite construction
IS: 4326	Code of Practice for earthquake resistant design and construction of buildings
IS: 5525	Recommendation for detailing of reinforced concrete works
IS: 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS: 10262	recommended guidelines for concrete mix design
IS: 11384	Code of Practice for composite construction in structural steel and concrete
IS: 1893 (Part-1)	Criteria for earthquake resistant design of structures (General provisions and building).
IS: 1893 (Part-4)	Criteria for earthquake resistant design of structures (Industrial structures including stack-like structures).
IS: 13920	Ductile Detailing of reinforced concrete structures subjected to seismic forces

Structural steel:

IS: 800	Code of Practice for general construction in steel
IS: 806	Code of Practice for use of steel tubes in general building construction
IS: 808	Dimensions for hot rolled steel beam, column channel and angle section
IS: 813	Scheme of symbols for welding
IS: 816	Code of Practice for use of metal arc welding for general construction in mild steel
IS: 1161	Steel tubes for structural purposes
IS: 2062	Structural steel (fusion welding quality)
IS: 4000	High Strength bolts in steel structures – Code of Practice
IS: 7215	Tolerances for fabrication of steel structures
IS: 9595	Recommendation for Metal arc welding of carbon and carbon manganese steel
IS: 12843	Tolerances for erection of steel structures.

Miscellaneous:

IS: 432(part 2) Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement

IS: 8112	43 grade Ordinary Portland cement specification.
IS: 6313(part II)	Standards for anti-termite treatment

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IS: 2751	Code of practice for welding of mild steel bars used for reinforced concrete construction
IS: 1346	Code of Practice for water proofing of roofs with bitumen felts
IS: 1742	Code of Practice for building drainage
IS: 1905	Code of Practice for structural use of unreinforced masonry
IS: 2470	Code of Practice for installation of septic tank:
(Part 1)	Design criteria and construction
(Part 2)	Secondary treatment and disposal of septic tank effluent
IS: 3067	Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings
SP: 6	Handbook for structural engineers (all parts)
SP: 7	National Building Code of India
SP: 16	Design Aids for reinforced concrete to IS: 456-1978
SP: 20	Handbook on masonry design and construction
SP: 22	Explanatory handbooks on codes for earthquake engineering (IS: 1983-1975 and IS: 4326-1976)
SP: 24	Explanatory handbook on Indian Standard code of Practice for plain and reinforced concrete
SP: 25	Handbook on causes and prevention of cracks in buildings
SP: 32	Handbook on functional requirements of industrial buildings
SP: 34	Handbook of concrete reinforcement and detailing (SCIP)

C.0 DESIGN DATA

C.1 LOADS

C.1.1 DEAD LOADS

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

Materials	Unit weight KN/m³
Steel	78.50
Plain Concrete	24.00
Reinforced Concrete	25.00
Brickwork	20.00
Solid Block work	20.00
Cement plaster	21.00
Floor finish	20.00
Soil	18.00
Water	10.00
Light weight blocks	10.00

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C.1.2 LIVE LOADS

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

1. All rooms and kitchens	:	200 Kg / Sqm
2. Toilet and bath rooms	:	200 Kg / Sqm
3. Corridors, passages, Staircases including tire escapes and store rooms	:	300 Kg / Sqm
4. Balconies	:	300 Kg / Sqm
5. Terrace	:	150 Kg / Sqm
6. Landscape	:	As per Actuals

C.1.2a. Details of Dead Loads & Live Loads Considered for Aurum Project Phase 3 villa.

The following are the imposed gravity loads adopted in additional to the self-weight (Self Weight of Slab / beam /columns are calculated as per the dimensions adopted in the respective drawings).

1. Ground Floor:
a. Super Imposed Load.

LOAD COMPONENT	THICKNESS(mm)	LOAD INTENSITY
TOWER PORTION		
WALL LOADS (200mmthk wall LIGHT WT BLOCK). Height of the floor is taken as 3.15mts as per Architectural Elevation. (Density = 10KN/m^3)	200 =0.2*10*(3.15-0.45) =5.4kn/m2	5.5 KN/m
WALL LOADS (100mmthk wall LIGHT WT BLOCK). Height of the floor is taken as 3.15mts as per Architectural Elevation. (Density = 10KN/m^3)	100 =0.1*10*(3.15-0.45) =2.7kn/m2	2.7 KN/m

B. LIVE LOAD FOR ALL TOWERS.

LOAD COMPONENT	LOAD INTENSITY (KN/SQMT)
All rooms and kitchens	2
Toilet and bath rooms	2
Corridors, passages, staircases including	3
Balconies	3

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2. TERRACE FLOOR'S

a. Super Imposed Load

LOAD COMPONENT	THICKNESS(mm)	LOAD INTENSITY
Finishes (Density Should not exceed 20KN/CUM)	150	3 KN/SQMT

b. Live Load

LOAD COMPONENT	LOAD INTENSITY (KN/SQMT)
Terrace Area (accessible)	2

C.1.4 WIND LOADS

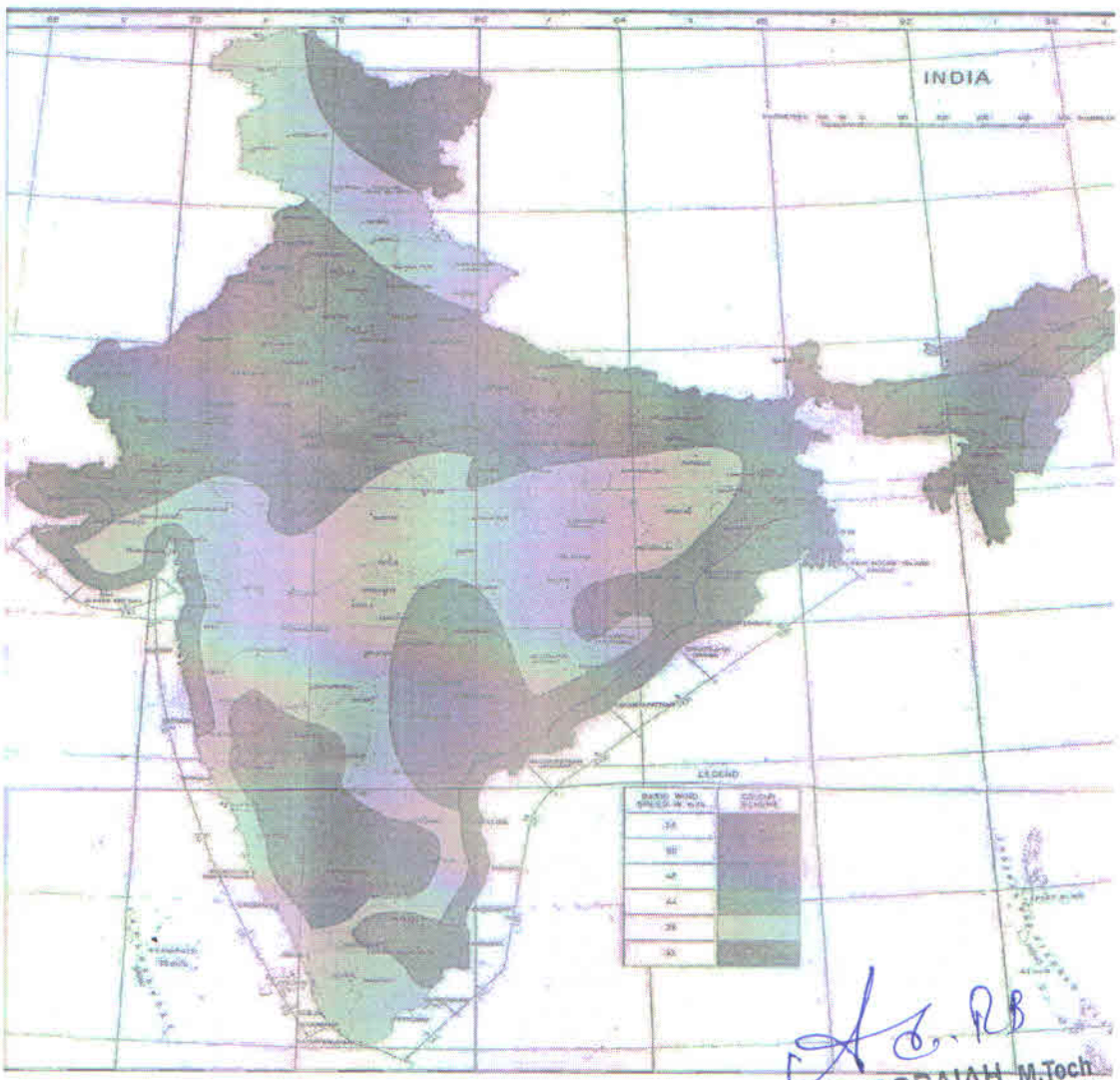

Fig.2 Basic Wind Speed

The proposed project is located in Chennai and the wind loads as per IS 875 part III has been considered. The following parameters are considered for the calculation of wind pressure for the proposed Residential group housing development at chengalpet taluk village, Chennai.

Basic Wind Speed (Vb): 55 m/sec
Risk Coefficient (k1) : 1.0
Terrain, category and class : Category 2 & Class C.
Size factor (k2) : 1(Calculated by considering the actual height of the Structure)
Topography factor (k3) : 1.00
Design wind speed Vz : $Vb \times k1 \times k2 \times k3$
Design wind pressure Pz : $0.6 \times Vz^2$

The external and internal pressure co-efficient shall be as per respective clause of IS: 875 (Part 3) and is calculated as shown below:

Data:

H = 6.5 m, L = 11.7m, And B = 8.1m.

1. Structure height to minimum lateral dimensions ratio: 6.5/8.1=0.802
2. Length of the structure to width ratio: 11.7/8.1= 1.44
3. The Above values are obtained from Shuttering Layout.

The Co-efficient of Pressure for Windward and Lee ward side is found using the above ratios by referring to IS 875-part (III). The Co-efficient of Pressure for Windward and Lee ward side is found to be:

1. X-Direction: Angle = 0^0
   Windward (Cp) = 0.7
   Lee ward (Cp) = 0.25

2. In Y- Direction Angle = 90^0
   Windward (Cp) = 0.7
   Lee ward (Cp) = 0.25

A.R.B
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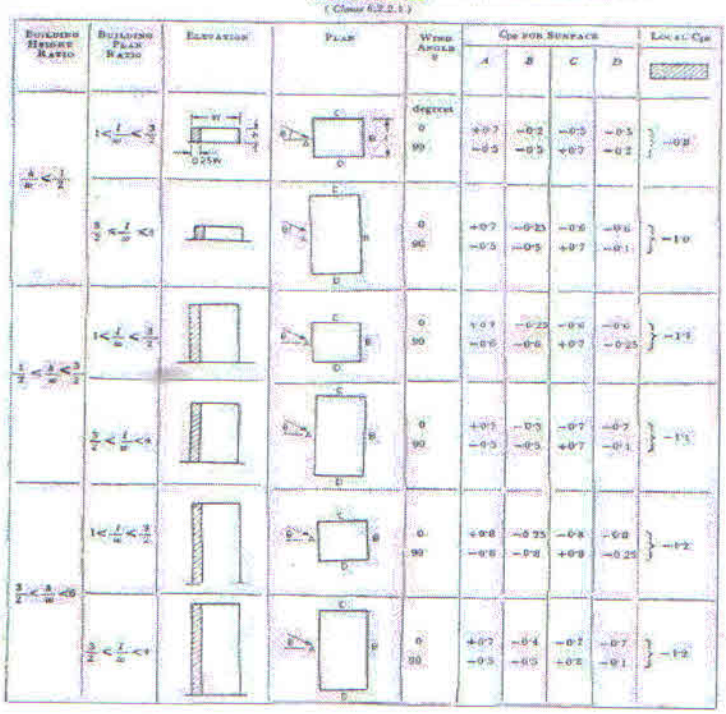
TABLE 4 EXTERNAL PRESSURE COEFFICIENTS (C_{pe}) FOR WALLS OF RECTANGULAR CLAD BUILDINGS

(*Clause* 6.2.2.1)



The above table shows varies ratios and their co-efficient of pressures as per IS 875

PART III

C.1.5 SEISMIC FORCES

The proposed Residential located at Chennai, Comes under **Seismic zone III** as per **IS 1893-2016** (Part 1) and has the following factors to be considered for designs:

Seismic Zone	: III
Seismic Zone factor, Z	: 0.16
I -Importance factor	: 1.2
Response reduction Factor	: 3 (ordinary Moment Resisting Frame OMRF)
Sa/g, Clause 6.4.2 (b) - IS 1893-2016	: for Type I soil, Sa/g value is taken for (1/T) times
the Time Period	

Time Period is being calculated by considering with Infill effect. I.e as Per Clause 7.6.2 of I S 1893 2016.

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Time Period Calculation considering Without Infill effect in Both X & Y Directions:

for all villas.

1. Time Period in X- Direction is calculated, $Ta = 0.075(h)^{0.75}$, where d= width in X-direction in plan

$$Ta = 0.075\ (6.5)^{0.75}$$

$$Ta = 0.305 \text{ sec}$$

2. Time Period in y- Direction is calculated, $Ta = 0.075(h)^{0.75}$, where d= width in Y-direction in plan

$$Ta = 0.075\ (6.5)^{0.75}$$

$$Ta = 0.305 \text{ sec}$$

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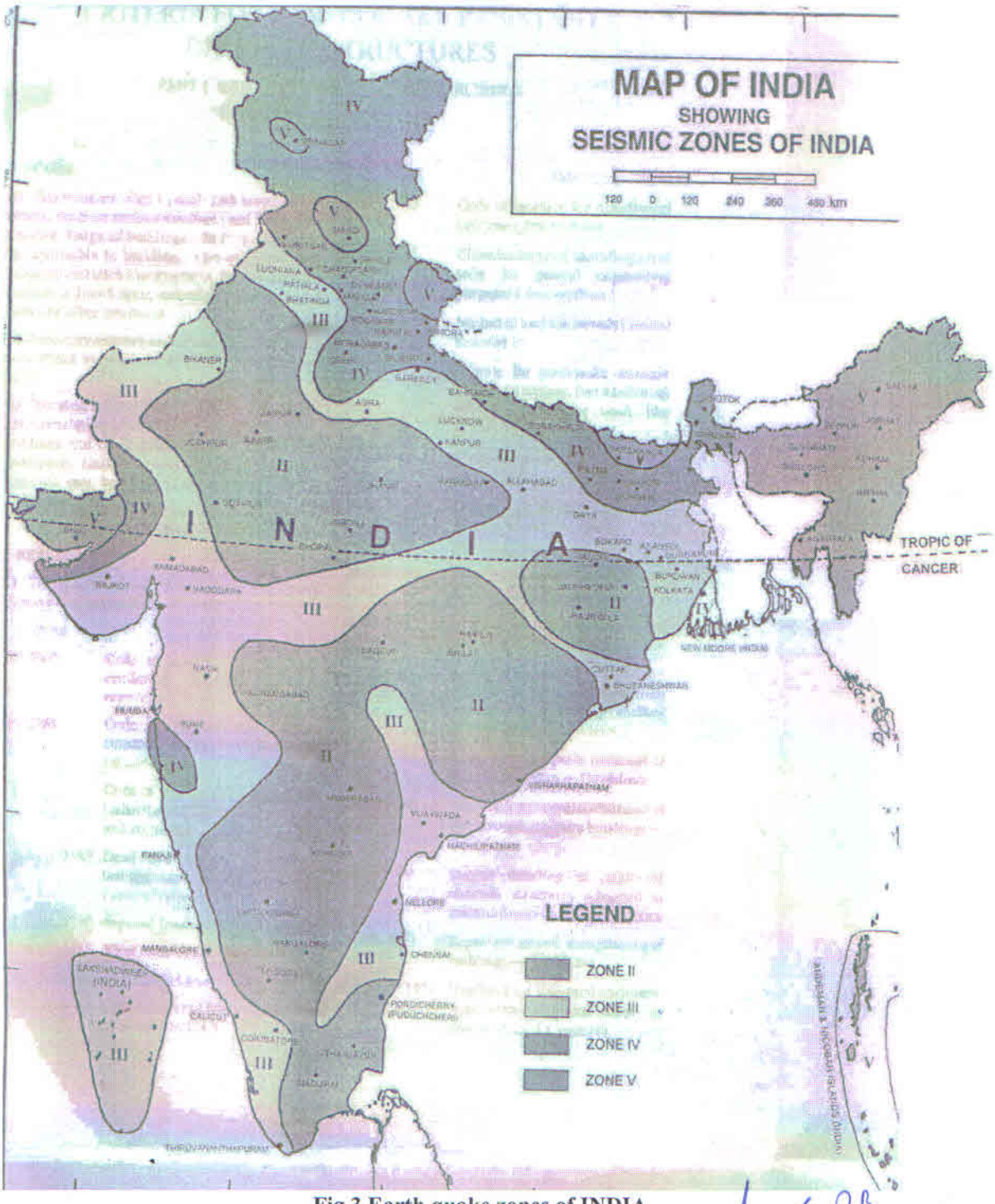

Fig.3 Earth quake zones of INDIA

C.2 ENVIRONMENTAL CONDITIONS, CORROSION AND FIRE PROTECTION FOR CONCRETE AND STRUCTURAL STEEL

C.2.1

- **Environment** : Moderate for all structures other than water retaining structure
- **Exposure conditions** : Concrete surfaces protected against weather or aggressive condition except those situated in coastal area.
- **Fire protection** : Thickness of the structural elements as per cl.21.0 of IS456:2000

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

- **Minimum grade of concrete** : Moderate exposure – M25
- **Nominal cover to reinforcement** : For Moderate Exposure Nominal cover should not be less than 30 mm.

Type of Structural element	Min. Cover to reinforcement
Footing	50 mm

Type of Structural element	Min. Cover to reinforcement
Beam	25 mm
Slabs	20mm
Columns	40 mm

C.3 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 or designing structural members for the additional moments caused by the temperature and shrinkage effects.

C.3.1 TEMPERATURE LOADS:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

C.4 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 hitting of vehicle on the facade
- Snow Load

D.0 MATERIALS:

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.

D.1 CONCRETE:

- Structure Concrete M25 Grade is used from Ground to Terrace Floor for Columns.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

D.1.1 CONCRETE MIX

Concrete item	Grade
Columns	M25
BEAMS	M25
SLABS	M25

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D.2 REINFORCEMENT STEEL:

- All reinforcement shall confirm to IS: 1786 – 2008 having minimum yield strength of 500 N/sq-mm.

D.3 STRUCTURAL STEEL

- All structural steel shall confirm to IS: 226 – 1975 with minimum yield strength of 250 N/sq.mm

E.0 STRUCTURAL CONCEPT

The proposed Residential houses consists Ground floor +2 Upper floors + Terrace. Varies on different types of villas.

The proposed building is of the following structural concept:

- RCC Beam Slab system.
- Staircases are provided as per architectural layout.

Analysis and design of the structure have been carried out using commercially available software packages like Etabs.

E.1 STRUCTURAL CONFIGURATION

FRAMING SYSTEM

Framing System: RC Cast-in-situ monolithic structure consisting of:

1. Columns, Beams, Slabs.
2. Detailing is done as per SP 34 for all vertical and frame members.

No.	DESCRIPTION	BUILDING SYSTEM
a)	Structural system	RCC Beam Slab Frame System
b)	Slab thickness	Slab of 125 thk, 150 thk & varies
c)	Beams	200mmx600mm &200mmx450mmm in All Floors & varies
d)	Column size	200mmX450mm & 200mmx600mm in All Floors & Varies
e)	No. of slabs	3 Structural slabs

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E.2 STRUCTURAL ANALYSIS AND DESIGN:

E.2.1. GENERAL

- The structural analysis is carried out by finite element method using the commercially available software tool for the load combinations as per standards.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and for the load combinations as given in the relevant codes.
- The structure shall be designed according to the Limit State Method as specified in IS: 456 – 2000.

E.3 DEFLECTION LIMITS

For Reinforced concrete works:

- Limiting values of deflection (Short and Long term) as per **cl. 35.3and 23.2 of IS: 456-2000** is followed in the design.
- Limiting value for short term deflection is considered as span/250 and for the long term deflection is considered as span/350 or 20mm whichever less as per IS 456 – 2000.
- The vertical deflection limits may generally be assumed to be satisfied provided that the span to depth ratios is not greater than the values obtained as below:

  Continuous..... 26
  Simply Supported..... 20
  Cantilever..... 7
- As per IS1893 (Part1):2002, Story drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height.

E.4 CRACKING LIMITS

- Limiting values of crack width as per cl. 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, the water retaining portion of the structure will be designed as uncracked section.

E.5 LOAD COMBINATIONS

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	LL	WL/EL/TL	DL	LL	WL/EL/TL
DL +/- LL	1.5	1.5	—	1	1	—
DL +/- WL	1.5	—	1.5	1	—	1
DL +/- EL	1.5	—	1.5	1	—	1
DL +/- WL	0.9*	—	1.5	1	—	1
DL +/- EL	0.9*	—	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

(*This value is to be considered when stability against overturning and stress reversal is critical.)

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.

Where DL/LL/WL/EL denotes,

DL- Dead Load

LL- Live 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 / Cl. 7.3.1 of seismic code will be used both for evaluating earthquake effect and for combined load effects used in such combination.

Geotechnical Considerations

As recommended in the Geotechnical report,

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