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**PROJECT: PROPOSED RESIDENTIAL APARTMENTS
AT KOVILANCHERI, CHENNAI.
DESIGN BASIS REPORT
DOCUMENT NUMBER: ID-CG/KC-STR-DB-1001-001**

SUBMITTED TO:



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Table of Contents

1. THE PROJECT	3
1.1. Location	3
2. SCOPE OF THE WORK.....	3
3. PURPOSE OF THIS DESIGN BASIS REPORT	3
4. DESIGN STANDARDS	4
4.1. General	4
4.2. Loads	4
4.3. Nominal cover to Reinforcement	9
4.4. Reinforced Concrete.....	10
4.5. Reinforcement bar.....	11
4.6. Structural Steel	11
4.7. Deflection limits	11
4.8. Joints	11
5. Analysis and design parameters	11
5.1. Method of Analysis	11
5.2. Design of Beams, Columns and Foundations:	12
5.3. Continuous Loading on Beams	12
5.4. Method of design.....	12
5.5. Load Combinations Considered in the Design.	13
5.6. Design Criteria.....	14
5.7. Foundations.....	14

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1. THE PROJECT

1.1. Location

The Proposed Site location is at KOVILANCHERI VILLAGE OF TAMBARAM TALUK, CHENGALPET DISTRICT. (GOOGLE COORDINATES 12.877196662205638, 80.16929850836888)



2. SCOPE OF THE WORK

Scope of work consists the Structural Design of PROPOSED RESIDENTIAL BLOCKS. Apartments comprises of total 3 Blocks of B+G+5 FLOORS.

Basement is meant for the car parking's & MEP services, whereas Ground & upper floors are meant for residential occupancy. Floor to Floor height for Basement is 3.15m under driveways & 3.60 m under residential blocks & in Residential floors it is 2.95m. (slab top to slab top)

3. PURPOSE OF THIS DESIGN BASIS REPORT

The purpose of this Design Basis is to formulate a comprehensive document outlining the design standards to be adopted and formulating the improvement proposals for the project. Further this Design Basis shall also serve as a platform for discussing the merits and de-merits of the improvement proposed residential structure

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In case of any specific requirements which are not covered in the Design Basis, a technical note shall be prepared and discussed on a case to case basis before finalizing the construction drawings.

The structural design of **B+G+5 FLOORS RESIDENTIAL** are based on Relevant applicable standards and codes. This chapter summarizes design parameters of various aspects of structural design.

4. DESIGN STANDARDS

4.1. General

This report meant to serve as a guide for design of Residential Block in the Project. The provisions herein shall use with discretion and care shall be taken to ensure that the stability and soundness of the structures designed are as per the provisions of the relevant codes and sound engineering practice.

This report presents a summary of the various tasks foreseen, primarily covering the major issues regarding the codes of practices & good engineering practices followed with respect to standard detailing, design philosophy & methodology etc.

This document aims at standardizing the procedure of designs to be performed. The need for the hour is to avoid any duplication at various setups. It, however prima fascia is an effort to streamline the design effort. Suggestions at any stage are invited to achieve optimization in ease of construction and overall costs without compromising on safety.

The report divided into different sections, which give the details of the Geometric Standards aimed at during the design of the Structures and proposed Column beam framing and details of the structures to be constructed. This report also gives the details of list of standards and codes, which adhered to during the design exercise, includes notes on various materials used and highlights the proposed Structure, the selection of the type of superstructure, substructure and the foundations for structure. This report provides details of the design philosophy and methodology and includes information on the structural designs being performed.

4.2. Loads

Design Loads will be in accordance with the more stringent as set forth by governing national codes. Structural design will be coordinated with architectural, mechanical and electrical drawings to ensure all loads impacting structural elements are adequately considered. Wind and seismic loads shall be as required by governing National codes.

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4.2.1. Dead Load

Table 1: Dead load

Item	Load
Slabs	Load in kN/m ² (As per Thickness)
Floor finishes Load on working floors	1.5 kN/m ²
Floor finishes on Terrace	1.5 kN/m ²
Staircase Imposed DL+ floor finish	3.3 kN/m ²
VDF Floor Finish (100mm thk)	2.4 kN/m ²
Landscape Soil filling	Soil Density x Depth of Filling.
Beams	Load in kN/m
Self-Weight	Weight density x width x Total depth
Masonry	Load in kN/m
Brick Masonry	Wall Density x wall thickness (Including plastering) x wall Height

Notes: *Openings (Doors, Windows Ventilators etc.) in the masonry are ignored.

Table 2: Material densities

Material	Weight Density-kN/m ³
AAC Block Masonry	10
Reinforced Cement Concrete With normal aggregates	25
Light weight Concrete	18
Roof Screed	24
Unsaturated Soil	18
Plain Cement Concrete	24

Saturated Soil	20
Light weight Sunken filling (Light weight brick bat)	10
Standard Red Soil Brick	19

4.2.2. Live loads

Considering the functional utilities of each units applicable live loads will be consider as follow : Table 3: Live load

Generally as per I.S.875 (Part II) or as Load specified by Requirement/clients. Occupancy Classification	Uniformly Distributed (UDL) in kN/m ²
Podium Subjected to fire fighting vehicle movement	20
Slabs for car parking	2.5+0.5(Impact Load)
Ramps & Driveways	5
Services Collateral loads (Basements)	0.5
Electrical panel Rooms	10
Residential rooms	2.0
Water	Height of water X 10
Corridors & Balconies.	3.0
Terrace (in-accessible)	0.75
Terrace (Accessible)	1.5
Lift Head Room	10
Club House	3

Live Load Reduction on Floors will be done as per Clause 3.2 of IS 875 part 2.

4.2.3. Seismic Design Forces:

Our Structure(Moment Resisting Frame) falls under earthquake zone III. Earthquake Loads to be considered as per IS:1893(Part1) : 2002 & IS:1893(Part1) : 2016.

Zone	=	Zone III (Chennai)
Zone factor 'Z'	=	0.16
Time Period 'Ta'	=	$0.075 \cdot h^{(0.75)}$ (for MRF)
Height of Building h	=	(6*2.95) (17.7 m)
Importance factor	=	1.2 (occupancy more than 200)
Seismic Weight	=	1.0 DL + 0.25 LL

Soil Type shall be Classified as **Hard Soil Type 1**(As per table 4 of IS 1893 part 1) based on N value(As per Soil report)

Modelling of Slabs will be done considering as slabs as membrane and Diaphragm will be given.

Table 4: Response Reduction Factor for Earth Quake Loading

Considering Response Reduction factor 5(SMRF) as per below table.

S. No.	Lateral Load Resisting System ¹	R
Building Frame Systems		
1.	RC Buildings With Ordinary Moment Resisting Frame (OMRF)	3
	RC Buildings With Special Moment Resisting Frame (SMRF)	5
2.	Steel Frame With Concentric Braces	4
	Eccentric Braces	5
Building With Shear Walls³		
3.	Load Bearing Masonry Wall Buildings	
	Unreinforced	1.5
	Reinforced with horizontal RC Bands	2.5
	Reinforced with horizontal RC bands and vertical bars at corners of rooms and jambs of openings	3
4.	Ordinary reinforced concrete shear walls	3
Building with dual systems⁴		
5.	Ordinary shear wall with OMRF	3
6.	Ductile shear wall with OMRF	4.5

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: The above values of response reduction factors are to be used for buildings with lateral load resisting elements, and not just for the lateral load resisting elements built in isolation.
: OMRF are those designed and detailed as per IS: 456-2000 or IS: 800- 1984.
Note 3: Buildings with shear walls also include buildings having shear walls and frames, but where frames are not designed to carry lateral loads, or frames are designed to carry lateral loads but do not fulfill the requirements of “dual systems”.
Note 4: Buildings with dual systems consist of shear walls (or braced frames) and moment resisting frames such that the two systems are designed to resist the total design force in proportion to their lateral stiffness considering the interaction of dual system at all floor levels; and the moment resisting frames are designed to independently resist at least 25% of the design seismic base shear.

Detailing of structures shall be conforming to IS-13920 & SP34. Ductile detailing of Reinforced concrete structures subjected to seismic forces shall be as per IS 13920. This is applicable for structures as specified in code.

Minimum Design Earthquake horizontal force as per table 7 of IS 1893 part 1 2016(Clause 7.2.2) will be followed in the Seismic Design of Structure.

Moment of Inertia Modifiers Considered as per Clause 6.4.3.1 of IS 1893 part1 2016 are as follows

Element	Modifier(%)
Columns	70
Beams	35

4.2.4. Wind Loading

Wind load will be considered as per IS-875, Part III, 2015. Following parameters will be considered in design.

In Wind Exposure Height of Structure Including parapet is $6 \times 2.95 = 17.7\text{m}$

Table 5: Wind Loadings

Design Parameter	Symbol	Value	Remarks
Basic Wind speed	Vb	50 m/sec	As per IS 875 part III
Probability Factor	K1	1.00	Design life :100 years
Terrain height and structure size factor	K2	1.07	Based on Terrain category and height
Topography factor	K3	1.0	Plane topography
Importance factor for Cyclonic region	K4	1.15	Based on cyclonic region
Design Wind Pressure	Pz	2.27 kN/m ²	Based on Clause:7.2, Pg:9

Design Wind pressure Pd will be Calculated as per IS 875 part 3 Clause 7.2.

4.2.5. Load Effect due to Impact and Vibration

The structural design will be consider due to impact Allowance on account of Lifts and Cranes (if any) shall be taken as per Clause6 of IS 875 Part -2.

4.3. Nominal cover to Reinforcement

Based on I.S.456, **DURABILITY AND FIRE REQUIREMENTS**

Reinforcement shall have cover and the thickness of such cover (exclusive of plaster or other decorative finish) shall be as follows:

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Table 6: Cover to any bar including links/Stirrups

RCC Element	Clear Cover in mm
<u>General Building under Moderate Exposure condition</u>	
Footing	50 mm
Column	40 mm or not less than dia. of vertical Bars
Beams	30 mm
Slabs	20 mm
Retaining wall	40 mm
Water Retaining Structures	45 mm

4.4. Reinforced Concrete

Minimum grade of structural concrete for different structures shall be as given below (As per Contract agreement)

Table 7: Minimum Grade of Concrete

Building/Structure	Concrete Grade
Liquid Retaining Structures, Severe exposure condition	M30
Columns	M30
Beams	M25
Slabs	M25
Shear walls (if any)	M30
Footings	M25
Retaining wall	M25

4.5. Reinforcement bar

Reinforcement bars shall be of high yield strength deformed bars (Fe-550) conforming to IS 1786:1985.

4.6. Structural Steel

- Grade of structural steel Fe 410W A, Yield strength = 250N/mm², conforming to IS2062:2006.
- Cold Formed Members, Yield strength = 350N/mm², conforming to IS Code.
- Dimensions for Hot Rolled steel Beam , Column, Channel and Angle section will follow as per section IS808:1989.
- Design of steel structures will follow as per IS800:2007.

4.7. Deflection limits

Contents	Limit
Beams vertical Deflection (As per IS 456)	Span/250 or 20mm
Global Lateral Displacements(1893 part 1)	H/500

4.8. Joints

The Construction, Contraction and Expansion joint will follow as per IS Code

5. Analysis and design parameters

5.1. Method of Analysis

Analysis of different structure shall be carried out in the following manner.

- For building frame structures, it shall be generated as space frame and shall be analyzed for different combination of load cases as per IS-456-2000 by ETABS/STAAD.
- For Liquid retaining structures, STP and water Tanks shall be analyzed by STAAD FEM.
- Excel working Sheets for the member design are used.

5.2. Design of Beams, Columns and Foundations:

Incorporating the results (forces) obtained from the Space Frame Analysis for various load combinations, the beams at each floor levels are designed for flexure and shear at critical sections. The main frame beams are designed and detailed as per IS: 456, IS: 13920 with the help of Handbooks like SP: 16, SP: 24 and SP: 34. Secondary beams can be designed and detailed as per IS:456 & IS13920.

Similarly, the RCC columns and Foundations are designed, detailed, and checked for the forces obtained from the analysis for different load combinations.

5.3. Continuous Loading on Beams

The beams in floors, platforms & walkways shall be designed for a point load or uniformly distributed load, which is to be applied in the worst position on the member under consideration for bending and for end reactions.

Liquid retaining structure

Plane frame/finite element analysis shall be carried out to find out the forces in different structural element and design shall be carried out as per IS-3370, Limit State Method of Design with limiting crack width to 0.1 mm for severe exposure condition and 0.1mm for water retaining structures.

5.4. Method of design

In general, design shall be done in as per limit state method of design as per IS 456.

In Design of Retaining Wall Active Earth will be considered $K_o = (1 - \sin \phi) / (1 + \sin \phi)$, where ϕ is Angle of Internal friction of backfilling Soil. In addition to it Surcharge Load of 10 kN/Sqm will be Considered.

Table 9: Details for method of design

RCC Element Method of Design	
Footings, Pile Cap and Piles	Limit State
Columns,	Limit State
Beams and Slabs, Shear walls	Limit State
Retaining Walls	Limit State
Water Retaining Structure	Limit state - limiting crack width to 0.1mm

5.5. Load Combinations Considered in the Design.

DL- DEAD LOAD

LL- LIVE LOAD

WL- WIND LOAD

EL- EARTHQUAKE LOAD

*****INDIVIDUAL LOAD CASES*****

1 .EL +X DRN

2 .EL -X DRN

3. EL +Z DRN

4 .EL -Z DRN

5 .WL+X

6 .WL-X

7 .WL +Z

8. WL -Z

9. DL

10. LL

***** FACTORED LOAD COMBINATIONS*****

11 .1.5DL+1.5LL

12. 1.5DL+1.5WL(+X)

13 .1.5DL+1.5WL(-X)

14. 1.5DL+1.5WL(+Z)

15. 1.5DL+1.5WL(-Z)

16 .1.5DL+1.5EL(+X)

17. 1.5DL+1.5EL(-X)

18 .1.5DL+1.5EL(+Z)

19. 1.5DL+1.5EL(-Z)

20 .1.2DL+1.2LL+1.2WL(+X)

21. 1.2DL+1.2LL+1.2WL(-X)

22 .1.2DL+1.2LL+1.2WL(+Z)

23 .1.2DL+1.2LL+1.2WL(-Z)

24 .1.2DL+1.2LL+1.2EL(+X)

25. 1.2DL+1.2LL+1.2EL(-X)

26. 1.2DL+1.2LL+1.2EL(+Z)

27. 1.2DL+1.2LL+1.2EL(-Z)

28 .0.9DL+1.5EL(+X)

29. 0.9DL+1.5EL(-X)

30. 0.9DL+1.5EL(+Z)

31. 0.9DL+1.5EL(-Z)

32 .0.9DL+1.5WL(+X)

33 .0.9DL+1.5WL(-X)

34 .0.9DL+1.5WL(+Z)

35. 0.9DL+1.5WL(-Z)

***** SERVICE LOAD COMBINATIONS*****

36 .DL+LL

37. DL+WL(+X)

38. DL+WL(-X)

39. DL+WL(+Z)

40. DL+WL(-Z)

41. DL+EL(+X)

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42. DL+EL(-X)
43. DL+EL(+Z)
44. DL+EL(-Z)
45. DL+0.8LL+0.8WL(+X)
46. DL+0.8LL+0.8WL(-X)
47. DL+0.8LL+0.8WL(+Z)
48. DL+0.8LL+0.8WL(-Z)
49. DL+0.8LL+0.8EL(+X)
50. DL+0.8LL+0.8EL(-X)
51. DL+0.8LL+0.8EL(+Z)
52. DL+0.8LL+0.8EL(-Z)

5.6. Design Criteria

5.7.1. Foundations

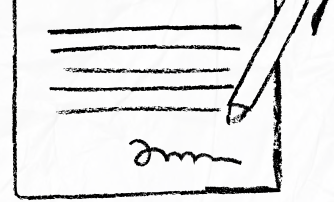
Foundation shall be designed to carry all the loads from Super- structure, which they support in accordance with the relevant codes.

- Net safe bearing capacity of soil: As per Geo-technical Report.
- Minimum Depth of Foundation will be as per Geo-technical report but not less than as specified in IS 1904, IS12070 and IS 2911.
- Type of Foundation: As per Geo-technical Report.
- Allowable increase in soil bearing capacity as per IS 1893 Part I is give as below,

Table 10 Details for Factor of Safety (Enhancement of Soil bearing capacity)

Percentage Increase in Net Bearing Pressure and Skin Friction of soils	
Soil Type	%age Increase Allowable as per 1893
Type A: Rock or Hard soil	50
Type B: Medium or stiff soil	25
Type C: Soft soil	0

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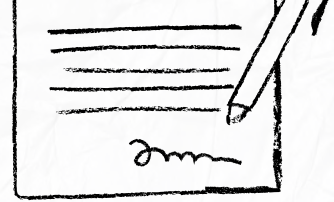
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