STRUCTURAL DESIGN BASIS REPORT

PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING AT RATHINAPURI, COIMBATORE

SUBMITTED BY

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1. GENERAL PROJECT DETAILS

Structural Design Introduction

The proposed structure is Stilt + 5residential building situated at Rathinapuri, Coimbatore, India. In this brief report we are presenting the data and assumptions related to the project, which has lead to the conceptual design at this preliminary stage. The document attempts to record all inputs assumed in design and will form the basis for all future detailed structural work.

The report most importantly clarifies the load criteria assumed in the design and it is therefore expected that all related consultants, including the architects, would go through the document and refer to it at every stage of detailed design. Recommendations or revisions on assumed parameters are requested at this stage.

Besides this the report will also form the outline of the design criteria and methods of both analysis and design to be adopted in this project with the aim of achieving a design that satisfies all sorts of seismic, and serviceability requirements.

2. List of References

IS 456-2000	Plain and reinforced concrete-code of practice
IS 875	Code Of practice for design loads for buildings and structures
Part 1: 1987	dead loads- unit weights of building material and stored material
Part 2: 1987	Imposed loads
Part 3: 1987	Wind loads
IS 1893: 2016	Criteria for earthquake resistant design of structures
IS1904-1986 (Reaffirmed 2006)	Code of practice for design & construction of foundation in soils
IS 4326:1993	Code of practice for earthquake resistant design and construction of buildings
IS 13920: 1993	Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces
BS 8110: 1997	Plain and reinforced concrete-code of practice(British standard)
ACI 318	Plain and reinforced concrete-code of practice (American standard)
CP65	Plain and reinforced concrete-code of practice (Singapore standard)
IS 800:1984 & 2007	Code of practice for general construction in steel
IS 1343:2012	Code of practice for pre-stressed concrete (First Revision)

Reynolds Handbook	
IS 3414	Code of practice for joints in the buildings
IS 3370 Part 1 TO 4	Code of practice for liquid retaining structures
BS-8007	Code of practice for liquid retaining structures for crack width calculation
Soil Report	

3. Material, Workmanship, Inspection and Testing.

The proposed RCC structure will consist of concrete and steel reinforcement as the two main materials used for construction of the structure. The specifications for these materials are discussed in this chapter

3.1 Concrete:

The concrete shall be in grades designated as per Table 2 IS 456-2000.
Recommended grades for the different members is as follows:

Footing/column M25
Shear wall M25
Beams/Slabs M25
Water Tanks M25

Any other structural member will be in general designed in M25.

3.2 Durability of concrete

The structure is located in Chennai, where the climatic conditions are considered as moderate. Concrete grade of submerged structural elements will be a minimum of M25. Nominal covers shall not be less than 30 mm from a durability point of view.

The cover to the various structural elements is to be as follows,

Structural Element	Clear Cover in mm
Slabs	25
Beams	30
Shear walls/Shear wall	40
Footings	50
Structural elements under ground	50

3.3 Reinforcement:

The reinforcement shall be high strength deformed steel bars with yield strength of 550 N/mm^2 confirming to IS: 1786.

3.4 Structural Steel:

The structural steel to be used shall confirm to IS 800.

3.5 Expansion Joint:

As per IS456 Expansion joint is required for lateral dimension of the buildingmorethan45m.consideringserviceandmaintenancecriterianowherepossi bletoprovideexpansionjoint,sincethestructuredimensionmarginallyhigh.Howeve r, we have done thermal analysis for all floor periphery beam and shear wall andentireterraceelements.

3.6 Construction Joint:

Construction joints and shrinkage strips will be planned with the contractor and only be used in locations pre-approved by consultants.

1) No construction joint is allowed in the sunken portion
2) Preferred at l/3 from support.
3) Construction joint shall be placed at accessible location for maintenance purpose.
4) Joints are common source of weakness;therefore it is desirable to avoid or at least minimize them.

4. Foundation system:

RAFT FOUNDATION: Raft Foundation at 3 m from the existing ground level with 15 Ton/m^2 KN safe bearing capacity.

5. General design considerations:

5.1 Method of Design

The aim of design is the achievement of an acceptable probability that structures being designed will perform satisfactorily during their intended life. With an appropriate degree of safety, they should sustain all the loads and deformations of normal construction and use and have adequate durability and adequate resistance to the effects of earthquake, wind and fire.

Structures and structural elements will be designed by Limit State Method. Due consideration will give to the accepted theories, experience and modern philosophy of design.

Retaining walls will be designed to resist backfill loads as per the section at the wall. Saturated soil density is 20 KN/m3. The angle of shear resistance is assumed to be 30^{o}. The water pressure due to the static water between the clay and the wall is also considered in design.

5.2 Loads and Forces

In structural design, account is taken of the dead, imposed and wind loads and forces such as those caused by earthquake etc., where applicable.

5.2(a) Dead Loads

The dead loads are calculated on the basis of unit weights of materials given in IS 875 (Part 1) the data provided by consultant and other service consultants will be used for the specific materials/equipment.

Unless otherwise specified the unit weight of materials will be used as follows.

Reinforced Concrete	25 kN/cum
Plain concrete	24 kN/cum
Brickwork	20 kN/cum
Autoclaved aerated concrete (AAC) Blocks	8 kN/cum
Soil dry	16 kN/cum
Floor finishes	20 kN/cum
Structural steel	78.5 kN/cum
Water	9.81 kN/cum

5.2 b Load Combinations considered:

1. 1.5D+1.5L
2. 1.2D+1.2L+1.2WX
3. 1.2D+1.2L-1.2WX
4. 1.2D+1.2L+1.2WZ
5. 1.2D+1.2L-1.2WZ
6. 0.9D+1.5WX
7. 0.9D-1.5WX
8. 0.9D+1.5WZ
9. 0.9D-1.5WZ
10. 1.5D+1.5WX
11. 1.5D-1.5WX
12. 1.5D+1.5WZ
13. 1.5D-1.5WZ
14. 1.2D+1.2L+1.2SX
15. 1.2D+1.2L-1.2SX
16. 1.2D+1.2L+1.2SZ

17. 1.2D+1.2L-1.2SZ
18. 0.9D+1.5SX
19. 0.9D-1.5SX
20. 0.9D+1.5SZ
21. 0.9D-1.5SZ
22. 1.5D+1.5SX
23. 1.5D-1.5SX
24. 1.5D+1.5SZ
25. 1.5D-1.5SZ
26. 1.2DL+1.2TL
27. 1.2DL+1.2LL+1.2TL
28. 1.2DL+1.2LL+1.2WX+1.2TL
29. 1.2DL+1.2LL +1.2WY+1.2TL
30. 1.2DL+1.2LL +1.2SX+1.2TL
31. 1.2DL+1.2LL +1.2SY+1.2TL

Following **Service load** combinations will be considered for the analysis of the structure.

1. DL+ LL
2. DL + 0.8 LL ± 0.8WX
3. DL + 0.8 LL ± 0.8WY
4. DL ± WX
5. DL ± WY
6. DL + 0.8 LL ± 0.8SX
7. DL + 0.8 LL ± 0.8SY
8. DL± SX
9. DL± SY

Software's for the analysis & design:

a. ETABS
b. Adapt / Safe
c. Excel program sheet
d. RCDC

6. Residentialbuilding

6.1 Residential building:

The special features for this building are listed as below.

The proposed building is residentialbuilding. Stiltfloor is intended for parking, Toilets, Storages, & Rooms.Allother floors are intended for residential purpose which includes first, second, third, fourth, fifth, and terrace, LMR floor above it.

6.1a Imposed Loads:

Imposed loads are assumed in accordance with IS 875 part 2, as follows. The table listed below is a summary of these loads.

Sr.No.	AreaDescription	FloorFinish	Liveload	Superimposeddead load	Remark/comment
		kN/sq.m	kN/sq.m		
1	Rooms for general use with separate storage	1.5	2.0	-	
2	Staircase	1.5	3	3	-
3	Lobby/corridor/passage	1.5	3	3	-
4	Toilet	1.5	2	3	-
5	Balconies	1.5	3	-	-
6	Terrace	3	2	0	150mmwaterproofing considered.
7	WaterTank	1.5	15	-	1.5mdepthoftank is considered.

6.1b Analysis Approach

StructuralGeometry:

Thestructureconsistsof5 Roofslabs.Theslabswiththeirdescription,levels,heightsandapproximateareasaregivenintableb elow:

Floor	Height
Head room &Lmr	3
Terrace	3
Fifth	3
Fourth	3
Third	3
Second	3
First	3
Total	21

Structural Frames

The proposed building is RCC frame structure, with shear walls & RCC beam framing is proposed for the typical floor system. After taking into considerations the feasibility of particular system, clear height available for particular floor, mobility of the services below slab, cost estimation, provision of openings in the slab, approval of architects, other consultants and client, the final framing system has been arrived.

6.1c Seismic Analysis:

6.1c (i) General Principles and design criteria

The structure is located in the seismic zone III. The design lateral force will ad calculate as per the method described in the following paragraphs. The structure is primarily shear wall and beam framing system although due considerations will be given to the major suggestions/clauses from IS:13920, the basic frame is assumed to be as column structure, as per Table 7.

6.1c (ii) Design Spectrum

SeismicAnalysis(Initialanalysisforpreliminaryshearwallsizing)The designHorizontalseismiccoefficientforastructure

Ah= Z*I*Sa IS:1893-2016Clause 6.4.2

2*R*g

Where,

Z= Zonefactor0.16forZoneIII Table2

I= ImportanceFactor(1.5) Table6

R= Responsereductionfactor5 ForShearwallbuildingfromTable7

Sa/g=AverageResponseaccelerationcoefficient

$T=0.075h^{0.75}$

ForRCframebuildingClause7.

6Where,

TisFundamentalnaturalperi

odh=Heightofthestructure

$T=0.075x12.45^{0.75}$

=0.5

Sa/g=2.5

DesignSeismicBaseshe

ar$V_b=A_hW$

Where,

W=seismicweigh

tAh=0.06

6.1(d) Wind Loads

Wind load for design of structures shall be based on the design wind speed arrived from IS: 875 (Part3)-1987.

The parameters for calculation of design wind speed as per IS: 875 (Part 3)-1987.

Basic wind speed, V_b :50 m/ sec.

Risk Coefficient, K1 : 1.08

(If design life of structure taken as 50 yrs.)

Terrain, Height, Structure size factor, K2 : To suit the height of the structure for Terrain category-2 & class c is 1.11

Topography factor, K3. : 1.0.

K4 factor value :1.0

Design Wind Speed Vz :50 m/s.

Design Wind Pressure Pz :0.6x $(55.5)^2$= 1848 N/m^2

7. Conclusions.

7.1 Other loads: Any other loads like those of services; storage etc. will be obtained from time to time from the relevant consultants and incorporated. The top slab of the lift shaft will be designed for lift loads as obtained from the manufacturer.

7.2 Shear wall locations: The location of the shear walls has been retained as per conceptual drawings received. Although additional shear walls and shear walls are added wherever required, final orientation of the shear walls and their sizing has been decided after discussion with the architects and mutually agreed upon. The frame model will be developed after this process. Any changes with regards to shear wall sizes or locations requested would have to be studied on a case-to-case basis with possible effects on other shear walls.

This DBR attempts to briefly cover all design related methods and assumptions at this stage of the project. As the project progresses certain revisions to the DBR might be warranted and such timely revisions of this report will be promptly provided by us.

8. ETAB Layout.