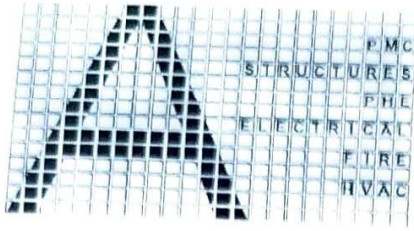


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DESIGN BASIS REPORT

PROPOSED RESIDENTIAL DEVELOPMENT
AT VEERAPANDI PIRIVU,CBE


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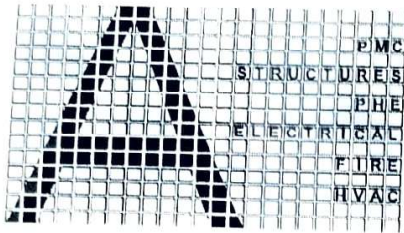
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PROJECT NAME: PROPOSED RESIDENTIAL DEVELOPMENT AT VEERAPANDI PIRIVU,CBE

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1. INTRODUCTION

CASAGRAN COVAAN PVT LTD has appointed CASAGRAN ARCHITECTS to Architect the building and AREN MATRIX ENGG Pvt. Ltd. to develop structural schemes and design for proposed residential development at Veerapandi Pirivu, Coimbatore.

The objectives of these reports are stated as follows:

- Identify and record all input requirements, Analysis and design criteria.
- Develop safe and stable structural scheme pertaining to Indian Standards compatible with Architectural vision, services requirements and client's needs.
- Prepare structural design that will aim to actual structural durability and integrity.
- Desirable structural performance under characteristic services load.

2. PROJECT DESCRIPTION

Project : RESIDENTIAL DEVELOPMENT
Location : VEERAPANDI PIRIVU, COIMBATORE

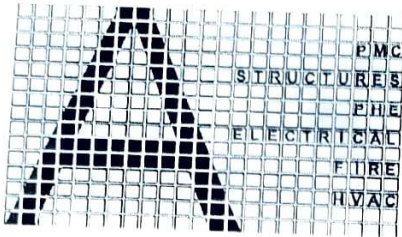
2.1 AGENCIES

Client : CASAGRAN COVAAN PVT LTD
Design Architects : CASAGRAN ARCHITECTS
Structural Consultants : AREN MATRIX ENGG PVT LTD

2.2 PROJECT

The Proposed Construction of Residential Non-High Rise Group Development consists of 57 Blocks, Block 1 To 55: Ground Floor+First Floor (55D/u), Block 56: Stilt Floor+ 5 Upper Floors (55D/u), Block 57:(Amenity Block) - Ground Floor + First Floor + Second Floor, with Swimming Pool on the Ground level, Totally 110 D/u, Comprised in S.Nos. 446/2A4A3 & 446/2B3 Of Veerapandi Village, Tiruppur South Taluk, Tiruppur City Municipal Corporation, Tiruppur District.

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2.2.0 BUILDING DIMENSION

2.2.1 Plan dimensions (Typical Floors) : (Refer Relevant Architectural Plans)

East Facing 4BHK Villas (No.s 1-17,31-43) : 1851 Sq.Ft

West Facing 4BHK Villas (No.s 18-30) : 2200 Sq.Ft

West Facing 4BHK Villas (No.s 44-55) : 2526 Sq.Ft

Block 56 (total area) : 87126 Sq.Ft

Block 57 (total area) : 5472 Sq.Ft

Swimming Pool (total area) : 2386 Sq.Ft

2.2.2 Floor Heights

All Villas : 11'4" (Typical height for all floors)

Block 56 : 79'3" (From FGL to Top)

Block 56 : 9'8" (Typical height for all floors)

Block 57 : 11'4" (Typical height for all floors)

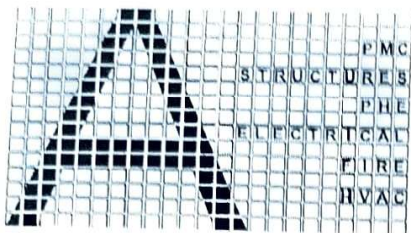
2.3 Design Philosophy

The proposed Structure is to develop residential development; in cast in-situ concrete construction with slab options like Conventional Slab system.

The Structural design of the proposed project is based on Indian Standard Codes and is analyzed for Dead, Live, Wind and Seismic Load conditions taking into relevant load combinations recommended by the codes & structural elements are designed in limit state design as per IS Code.

Lateral loads due to wind and seismic forces are transferred to the soil through proposed Reinforced Concrete, columns and footings. Footings/Foundations are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants as the case may be.


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3. STRUCTURAL DESIGN STANDARDS AND CODES

Following Indian codes shall here to be used for detailed design.

3.1 INDIAN CODES

3.1.1 LOADS

IS 875(Part 1):1987	-	Dead Loads - Unit Weight of Building Material and Stored Material
IS 875(Part 2):1987	-	Imposed Loads
IS 875(Part 3):2015	-	Wind Loads
IS 875(Part 5):1987	-	Special loads and load combinations
IS 1893(Part 1):2016	-	Criteria for earthquake resistance design of structure
NBC:2016	-	National building code of India

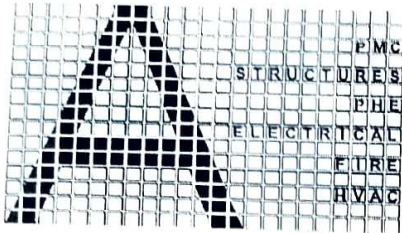
3.1.2 CONCRETE DESIGN

IS 456:2000	-	Plain and Reinforced Concrete - Code of practice
SP16	-	Structural use of concrete. Design charts for singly reinforced beams, doubly reinforced beams and columns
SP 34	-	Handbook on Concrete Reinforcement & Detailing
IS 1904	-	Indian Standard Code of practice for design & construction of foundations in Soil: General Requirements
IS 13920:2016	-	Ductile design and detailing of Reinforced Concrete Structures subjected to Seismic Forces
IS 3370:2009	-	Code of practice for concrete structure for storage of liquid

3.1.3 STEEL DESIGN

IS: 800-2007	-	Code of practice for general construction in steel
IS: 2062-2011	-	Hot rolled medium & high tensile structural steel specification
IS: 806-1968	-	Code of practice for use of steel tubes in general building Construction
IS: 4000-1992	-	Code of practice for high strength bolt in steel structure
IS: 816-1969	-	Code of practice for use of metal arc welding for general Construction in mild steel

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3.1.4 DESIGN PARAMETERS

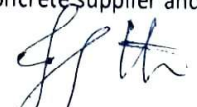
Material of Construction

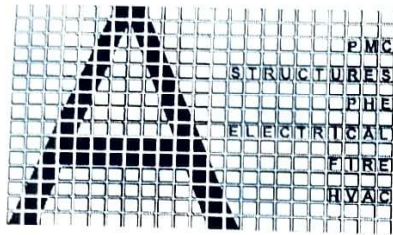
3.1.5 RCC WORKS

The building will primarily be RCC frame structure, slabs and beams. Floor slabs of this structure are being used as diaphragms in distribution of lateral forces.

Structural Elements	Design grade of concrete	Use of Cement
Concrete mix for Columns and Shear wall from foundation	M30	OPC
Concrete mix for Slabs and Beams	M25	OPC
Concrete mix for U.G.W.T / STP	M30	OPC
Concrete mix for Retaining walls	M30	OPC
Concrete mix for footing	M25	OPC

- Grade of Concrete M: 10 will be used in filling, plum concrete, leveling courses and other non-structural items. Density of reinforced concrete is assumed as 25 kN/m³.
- Minimum cement content, water cement ratio etc. will conform to IS 456:2000 provisions for durability and strength criteria. (As per approved mix design from concrete supplier and contractor)


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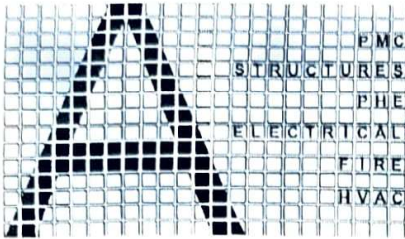
3.1.6 Ordinary Portland cement of grade 43 or higher conforming to *IS 8112* and *IS 12269* are specified for concrete grades.

- The sizes of aggregates conform to *IS 383*. Nominal maximum size of coarse aggregate is 20 mm, suitably graded as per the requirement of mix design.
- Mixing Water will conform to *IS 456: 2000*.
- High yield strength deformed TMT bars Fe 500D conforming to *IS 1786 : 2008* with $F_y = 500$ N/mm² will be used as Reinforcing-bars in concrete elements.
- Elongation of reinforcement should not be less than 16% as per *IS 1786 : 2008*.
- All mix design of concrete should be got approved prior to execution of work.
- Take out 6 cubes from every batch of concrete and report of the same of 7 days and 28 days must be submitted to us.
- For reinforcement, test report should be carried out at every 30 ton for each category.

3.1.7 STRUCTURAL STEEL

- All structural steel shall conform to *IS -2062-2011*.
- Grade of Structural steel for different Built-up members shall be as follows: Steel beams - S345 (i.e. $f_y=345$ N/mm²)
- Grade of Structural steel for Hot rolled members shall be S345 (i.e. $f_y=345$ N/mm²)
- Grade of Structural steel for MS plates & MS bars shall be S345 (i.e. $f_y=345$ N/mm²)
- Grade of profiled metal deck TR60 or Equivalent shall be S345 (i.e. $f_y=345$ N/mm²)
- Grade of shear stud shall be S345 (i.e. $f_y=345$ N/mm²)
- High strength structural bolts, nuts and washers shall confirm to *IS 3757, IS 6623, IS 6649* & *IS 4000*.
- All weld shall confirm to *IS 816*.


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LOADING PARAMETERS

3.1.8 SELF WEIGHTS

Self-weight of the structural members shall to be considered based on the following properties.

- Density of Reinforced Concrete : 25.0 kN/m³
- Density of Plain Concrete : 24.0 kN/m³
- Density of Steel : 78.5 kN/m³
- Density of Floor Finishes / Plasters : 20.0 kN/m³
- Density of Soil (Unsaturated) : 18.0 kN/m³
- Density of Soil (Saturated) : 21.0 kN/m³
- Density of Light Weight Cinder Filling Material : 9.0 kN/m³
- Density of Light weight aerated concrete block : 8.0 kN/m³
- Density of glass : 27.3 kN/m³
- Density of water : 10 kN/m³

3.1.9 IMPOSED GRAVITY LOADS

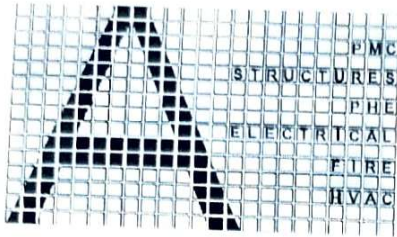
The following imposed gravity loads shall be adopted in addition to the self-weight of the structure. (Self-weight of slab / beam / columns and wall will be as per the dimensions adopted in the respective drawings).

3.1.9.1 LIVE LOAD

4BHK VILLAS & APARTMENT

General Rooms	= 2 kN/m ²
Staircase	= 3 kN/m ²
Balcony	= 2.5 kN/m ²
Toilet	= 2 kN/m ²
Terrace	= 2 kN/m ²
Lift Maintenance Room	= 2 kN/m ²
OHT	= 0.75 kN/m ²

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AMENITY BLOCK

Multipurpose room	= 4 kN/m ²
Staircase	= 3 kN/m ²
Lobby	= 3 kN/m ²
Gym	= 5 kN/m ²
Game Room	= 4 kN/m ²
Toilet	= 2 kN/m ²
Terrace	= 2 kN/m ²

3.1.9.2 FLOOR FINISH

4BHK VILLAS & APARTMENT

General Rooms	= 1.5 kN/m ²
Staircase	= 2 kN/m ²
Balcony	= 1.5 kN/m ²
Toilet	
= 2.5 kN/m ²	
Terrace	= 2.5 kN/m ²

AMENITY BLOCK

Multipurpose room	= 2 kN/m ²
Staircase	= 2.5 kN/m ²
Lobby	= 2 kN/m ²
Gym	= 2 kN/m ²
Game Room	= 2 kN/m ²
Toilet	= 2.5 kN/m ²
Terrace	= 2.5 kN/m ²

4.0 SELF - WEIGHT OF DIFFERENT WALLS

APARTMENT BUILDING:

Floor height mm: 2950 mm

200mm thick Block wall= (2.95-0.45) X 0.2 X 1 X 20 = 10 kN/m

100mm thick block wall= (2.95-0.45) x 0.1 X 1 X 20 = 5 kN/m

VILLAS & AMENITY BLOCK:

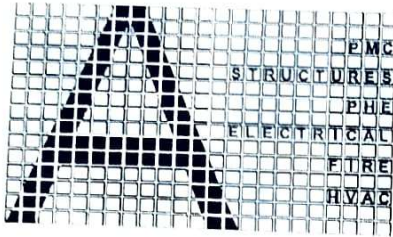
Floor height mm: 3450 mm

200mm thick Block wall= (3.45-0.45) X 0.2 X 1 X 20 = 12 kN/m

100mm thick block wall= (3.45-0.45) x 0.1 X 1 X 20 = 6 kN/m

Wall loads are considered as per architectural plans at respective levels.

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5.0 SEISMIC LOADS

The seismic load calculations will be carried out in accordance with IS 1893(Part 1): 2016. As per the code, Coimbatore lies in Zone III, zone factor $Z = 0.16$.

The Design of Base Shear is given by $V_b = (Z/2) \times (I/R) \times (S_a/g) \times W$ where, Importance factor, I will be taken as 1 as it is a building with occupancy less than 200 person as per IS 1893 : 2016 and response reduction factor R will be taken as '3',

S_a / g is the normalized Response Spectrum value for the structure which is the function of the fundamental time period of vibration of the structure and the type of the founding soil. W is the Seismic Weight of the building, which will be calculated in accordance with the relevant clause in, IS 1893(Part 1):2016.

The design vertical earthquake effects is considered as per IS-1893-2016 cl. 6.3.3.1 and the parameters to be consider in the analysis of model are as follows.

The design seismic acceleration spectral value A_v for vertical motions of the building as per IS 1893-2016 cl.6.4.6 is given by

$$A_v = \frac{\frac{2}{3} \times \frac{Z}{3} \times 2.5}{\frac{R}{T}} \text{ For buildings governed by IS 1893}$$

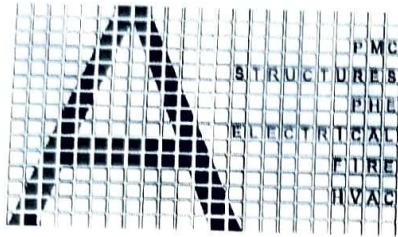
Percentage of imposed load to be considered in seismic weight calculation as per IS-1893-2002 (cl. 7.3.1)

Impose uniformity distributed floor loads(kN/m2)(Live Load)	Percentage of imposed loads
Up to and including 3.0	25
Above 3.0	50

5.1 TIME PERIOD CALCULATION

Time period in both directions will be evaluated for following three conditions and appropriate time period will be chosen for building design, with infill wall equation $= 0.09 \times (h)/\text{root}(d)$ in both directions

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WIND LOADS

IS 875-Part.III-2015 is used to find wind force.

Basic wind speed (V_b) = 39 m/s

The Design Wind Speed is given by $V_z = k_1 \times k_2 \times k_3 \times k_4 \times V_b$

Where, k_1 = Probability factor = 1;

k_2 = Terrain, height and structure size factor; k_3 = Topography factor,

k_4 = Important factor for cyclonic region,

The structure falls under Category-2

Hence,

$$k_2 = 1.04$$

$$V_z = V_b \times k_1 \times k_2 \times k_3 \times k_4 = 39 \times 1 \times 1.04 \times 1 \times 1 = 40.56 \text{ m/s}$$

$$p_z = 0.6 \times (V_z)^2 = 0.6 \times (41)^2 = 987 \text{ N/m}^2$$

The Design Wind Pressure is given by $P_d = k_a \times k_d \times k_c \times p_z$ Where, k_a = Area averaging factor = 0.9;

k_d = Wind directionality factor = 0.9; k_c = Combination factor = 0.9;

$$\begin{aligned} \text{The Design Wind Pressure is given by } P_d &= k_a \times k_d \times k_c \times p_z \\ &= 0.9 \times 0.9 \times 0.9 \times 987 \\ &= 720 \text{ N/m}^2 \end{aligned}$$

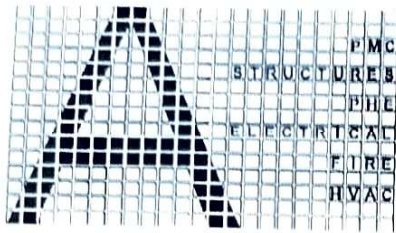
However, value of P_d shall not be taken less than $0.7 \times p_z$, 691 N/m²

The Design Wind Pressure, $P_d = 720 \text{ N/m}^2$

STRUCTURAL ANALYSIS

The structure is modeled for concrete frames and analyzed. Structure will be checked for earthquake forces by using minimum column section at floors. Structure will be analyzed using ETABS 18.1.1. The analysis results generated by software will be cross verified by hand calculations for critical members.

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7.2 P-DELTA ANALYSIS

P-Delta Analysis shall be carried out for accurate results.

Iterative -- Based on Load Cases: The load is computed from a specified nonlinear analysis load cases created by combining load patterns as required for initial P-Delta analysis. This is called the P-Delta load combinations. This is an iterative method which considers P-Delta on an element-by-element basis. Local buckling is captured more effectively.

Scale factors of 1.2 for D. L. and 1.2 for L. L. is used for gravity load analysis case used for initial P-Delta analysis.

As per clause 7.2 (d) of IS 16700, scale factor of 1.5 for Earthquake/Wind shall be used and another load cases shall be created as specified in the clause for initial P-Delta analysis.

7.2 Crack width 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 and element in contact with soil / water, crack width is limited to 0.2mm.

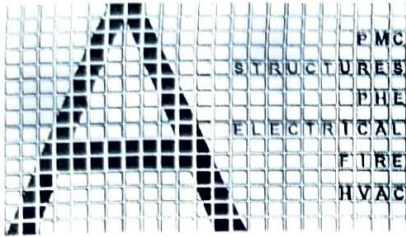
8. LOAD COMBINATIONS

The results obtained from the computer analysis in the form of member forces and reactions will be used for designing the structural members. Following are the load combinations and the member forces will be considered for arriving at the design forces.

LIMIT STATE LOAD COMBINATIONS:

1.5 (Dead Load + Live Load)


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LIMIT STATE LOAD COMBINATIONS: (STATIC)

1.2(DL+LL+EQX)

1.2(DL+LL-EQX)

1.2(DL+LL+EQY)

1.2(DL+LL-EQY)

1.5(DL+EQX)

1.5(DL-EQX)

1.5(DL+EQY)

1.5(DL-EQY)

0.9DL+1.5EQX

0.9DL-1.5EQX

0.9DL+1.5EQY

0.9DL-1.5EQY

1.5(DL+W LX)

1.5(DL-W LX)

1.5(DL+W LZ)

1.5(DL-W LZ)

1.2(DL+LL+W LX)

1.2(DL+LL-W LX)

1.2(DL+LL+W LZ)

1.2(DL+LL-W LZ)

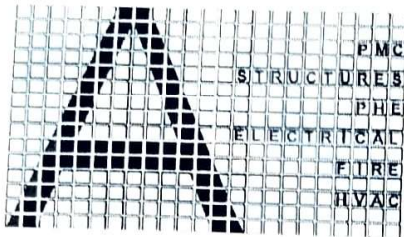
0.9DL+1.5W LX

0.9DL-1.5W LX

0.9DL+1.5W LZ

0.9DL-1.5W LZ


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DEFLECTION

Serviceability Limit State (SLS)

As per IS 1893: 2016 (part-1) the story drift due to minimum specified lateral force with partial load factor of 1.0 shall not exceed $0.004 h_s$, where h_s is the story height under consideration

The vertical deflection under imposed load should be limited as follows:

$L/250$ taking into accounts all imposed loading, including temperature and creep/shrinkage.

$L/350$ taking into accounts all imposed loading, including temperature and creep/shrinkage after erecting the finishes. Or 20mm whichever is less.

$L/500$ taking into account wind load sway at top.

9.0 STRUCTURAL DESIGN

9.1 DESIGN METHOD

For the design of R.C.C. elements, the Limit State Method will be used as per IS: 456:2000 Materials of construction will be predominantly concrete and steel with consideration for strength and durability. The Reinforcing bars to be used in concrete elements are conforming to IS:1786-2008 with $f_y=500$ N/mm² (Fe500D)

9.2 COVERS TO REINFORCEMENT

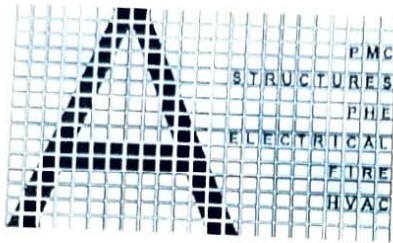
Clear cover for all RCC members shall be in accordance with;

IS: 456:2000 Table 16 corresponding to moderate exposure conditions for the super- structure as well as the sub-structure

IS: 456:2000 Table 16A and NBC: 2016 Table 1 corresponding to Type 2 construction, structural shear wall , columns and beams shall have cover for fire rating of 2 hrs.

Accordingly, minimum clear cover is to be provided to main steel for;


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For Footing	: 75 mm for Sides & Bottom
For Column	: 40mm
For Beam	: 25mm for Sides & Bottom
For Slab	: 25 mm for Continuous
For Retaining wall	: 35 mm for Simply supported : 30 mm
For RCC shear wall	: 40 mm
For tanks	: 40mm

10. SOIL INVESTIGATION & BEARING CAPACITY

As per the Geo-technical data: The recommended depth of foundation is 2m below EGL with an SBC of 180 kN/m².

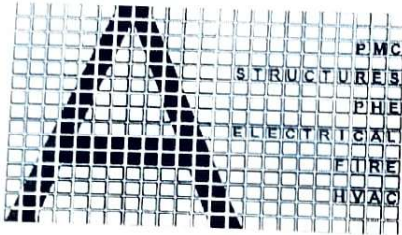
11. ENVIRONMENTAL CONDITIONS, CORROSION AND FIRE PROTECTION FOR CONCRETE

As per clause 8.2.2 IS 456:2000, the general environment to which the concrete will be exposed during its working life is classified into five levels of severity, that is, mild, moderate, severe, very severe and extreme as described in below table.

Cover for steel to protect from fire and corrosion, moderate environment condition is considered.

- As per table 16, IS 456-2000, nominal cover to meet durability requirement is for Moderate condition is 30mm (type of exposure-Concrete surfaces sheltered from saturated salt air in coastal area) is considered for all internal structural element.
- Nominal cover to meet durability requirement is for severe condition is 45mm (type of exposure- Concrete exposed to coastal environment) is considered for all external structural element.


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- Exposure condition "severe" and "very severe", where concrete grade is M30 and above.
- Fire Resistance for slab is considered 1-1/2 hours and Beam, Column and Wall is considered 2 hours.
- Design life of the building is 50 years

12. STRUCTURAL DESIGN

METHOD OF ANALYSIS

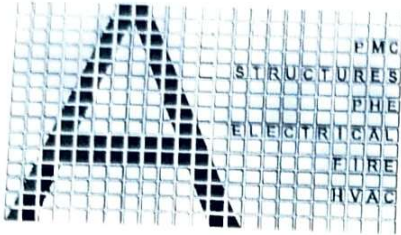
The structural analysis is carried out by finite element method using the commercially available latest software E-tabs / SAFE for the load combinations as per standards. Designs of structural steel members are made using elastic method as per IS: 800 with relevant allowable stresses. All lateral loads & parameters are assigned as per Codes IS 1893-2016 & IS 875-2015. Stiffness modification factors are adopted in the analysis as per IS-1893-2016 (Part-1) Soil and water pressure are not accounted for the structural 3D analysis, however the same shall be considered for individual element analysis and design.

Since Coimbatore in zone III, Ductile detailing norms are adopted to make the building earthquake resistant in accordance with IS: 13920:2016. Secondary beams are not designed for earthquake detailing, slab on grade is not considered for 3D analysis. The modelling of elements is as below and slab is assigned/defined as rigid diaphragm.

Beam:	Frame
Column:	Frame
RC Wall	Shell
Slab	Membrane

Lateral sway for torsional displacement is less than 1.5 times the minimum displacement which satisfies IS1893:2016.


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13. VALUE ENGINEERING

The parameters adopted in this report are going to be the basis of the structural design. Hence it is requested that all team members give their feedback and approval to the parameters, suggestions, recommendations mentioned in this report. Certain additional parametric changes may be adopted due to some conditional changes in plans or requirements. Structural consultant shall have full freedom to add value to any aspect of design parameters mentioned here in this DBR to maintain the sound integrity of the structure.

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