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THE PROPOSED CONSTRUCTION OF RESIDENTIAL NON-HIGH-RISE GROUP DEVELOPMENT BUILDING CONSISTS OF 2 BLOCKS WITH COMBINED BASEMENT, BLOCK 1: GROUND FLOOR + 5 UPPER FLOORS, (87 D/U) BLOCK 2: GROUND FLOOR (PART) + 5 UPPER FLOORS, (136 D/U) CLUB HOUSE (PART) GROUND FLOOR + 4 UPPER FLOORS WITH SWIMMING POOL ON THE GROUND LEVEL, TOTALLY 223 D/U COMPRISED IN S.NO. 524/2A & 524/2B OF SULUR VILLAGE, SULUR TALUK, COIMBATORE DISTRICT.

STRUCTURAL DESIGN BASIS REPORT

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THE PROPOSED RESIDENTIAL NON-HIGH-RISE GROUP DEVELOPMENT BUILDING AT SULUR TALUK, COIMBATORE DISTRICT.

PROJECT BRIEF

This report sets out the basic parameters used for the proposed construction of residential non-high-rise group development building consists of 2 blocks with combined basement, block 1: ground floor + 5 upper floors, (87 d/u) block 2: ground floor (part) + 5 upper floors, (136 d/u) club house (part) ground floor + 4 upper floors with swimming pool on the ground level, totally 223 d/u comprised in s.no. 524/2a & 524/2b of sulur village, sulur taluk, coimbatore district. This has been updated to incorporate the current information on the structure.

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

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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
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. STRUCTURAL SYSTEM

The structural system adopted is as below, based on preliminary analysis and design, which have been elucidated later in this report.

- The structure shall be analyzed as 3D frame using Analysis software and the structure design would be based on limit state design complying with Indian codes of practices
- The foundation system will be designed as Isolated foundation as per soil test report, and for safe load capacities refer soil test report.
- Concrete mix (grade) shall generally be M30 for column and RC wall giving a minimum cube crushing strength of 30 N/mm^2.

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- All water retaining structures shall be designed as 'un-cracked section' of concrete as per IS 3370
- Period of fire resistance considered is 1.5 hrs. Cover for fire resistance will be as per Table 16-A of IS: 456 – 2000.
- Grade of steel Fe 550

GRADE OF CONCRETE FOR ALL MEMBERS

- Isolated footing with conRaft Foundation – M25
- Retaining wall – M25
- Columns & Shear wall – M30
- Basement roof – M25
- Basement roof PT area – refer PT vendor dwg
- Typical floor Beam, slab & Staircase – M25
- Water retaining structures – M30

D. LOAD DATA

(I) DEAD LOAD

Self-weight of the materials shall be calculated on the basis of unit weights given in IS: **875 (PART I)**

- Unit weight of reinforced cement concrete = 25 KN/m^3
- Unit weight of plain cement concrete = 24 KN/m^3
- Floor finishes considered = 2 KN/m^2
- Unit weight of AAC block = 7 KN/m^3
- Unit weight of steel = 78.5 KN/m^3
- Filling material of sunken floors = 7 KN/m^3

(II) LIVE LOAD

1. Car Parking : 500 Kg / Sqm
2. Kitchen : 200 Kg / Sqm
3. Balcony : 300 Kg / Sqm

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4. Utility	:	200 Kg / Sqm
5. Toilets	:	200 Kg / Sqm
6.Living Room, Bed Room	:	200kg/Sqm
7. Terraces	:	200 Kg / Sqm
8. Corridors, passages, lobbies and staircases including fire escapes	:	300 Kg / Sqm
9. Gym Area	:	500 Kg / Sqm
10. Billiards Room	:	500 Kg / Sqm
11. Swimming Pool	:	200 Kg / Sqm
12. Sauna Room	:	300 Kg / Sqm
13. Table Tennis Section	:	500 Kg / Sqm
14. Fire tender Load	:	1500kg/Sqm
15. Yoga, Aerobics	:	300Kg / Sqm
16.Association room/FMS room	:	300Kg / Sqm
17.Squash	:	300Kg / Sqm
18.Indoor kids play area	:	300Kg / Sqm
19.Creche	:	300Kg / Sqm
20.Multipurpose hall	:	500Kg / Sqm
21.Board games room	:	300Kg / Sqm
22.Video games room	:	300Kg / Sqm
23.Change room	:	200Kg / Sqm
24.Art, painting, music deck	:	300Kg / Sqm
25.Business center	:	400Kg / Sqm
26.Learning center	:	300 Kg / Sqm
27.AV room	:	500 Kg / Sqm
28.VR games	:	300 Kg / Sqm
29.Carom, Foosball, Air Hockey	:	300Kg / Sqm
30.Terrace floor (Access provided)	:	200 Kg / Sqm
31.Lift Machine Room slab	:	1000Kg / Sqm

Details of Dead Loads & Live Loads Considered for Residential Apartment.

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
Finishes	100	2 KN/SQMT
Finishes Fire Drive Way.	200(In Podium Area)	5 KN/SQMT
Landscape loading (450mm depth as per architectural sections)	450 (with Wet density of 20 kN/m3)	9 KN/SQMT

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b. Live Load

LOAD COMPONENT	LOAD INTENSITY (KN/SQMT)
CAR PARKING and Inner Drive Way	5
Fire Drive Way	25

2. Typical Floor's

a. Super Imposed Load

LOAD COMPONENT	THICKNESS(mm)	LOAD INTENSITY
Finishes	50	2 KN/SQMT

FLOOR FINISH LOAD BREAK UP

Tile thickness = 12mm
Density = 20kN/m3
Load from tile = 0.24kN/m2

Screed+ Mortar thickness (for levelled surface) = 38mm
Density = 20kN/m3
Load from screed + Mortar = 0.76kN/m2

Due to uncertainty in the surface level and Tile/ Granite, 2 kN/m2 SDL is considered.

b. Live Load

LOAD COMPONENT	LOAD INTENSITY (KN/SQMT)
Bed Room, Kitchen, Dining, Toilet	2
Utility, Balcony, Corridor/Passage and staircase	3

3. Terrace Floor's

a. Super Imposed Load

LOAD COMPONENT	THICKNESS(mm)	LOAD INTENSITY
Finishes	150	3 KN/SQMT

b. Live Load

LOAD COMPONENT	LOAD INTENSITY (KN/SQMT)
Terrace Area	1.5

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(III) WIND LOADS

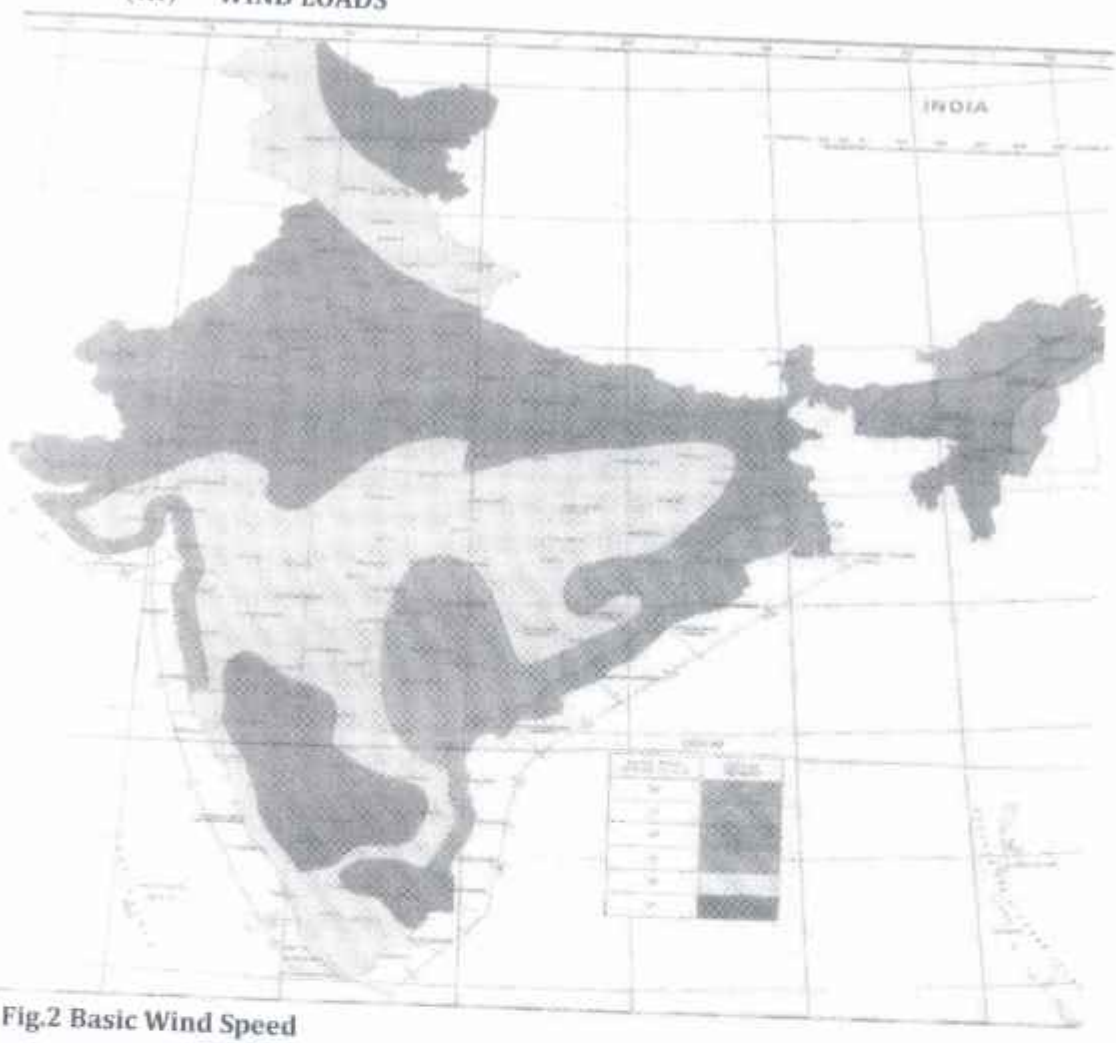


Fig.2 Basic Wind Speed

The following parameters are considered for the calculation of wind pressure for the proposed residential apartment:

Basic Wind Speed (Vb)	: 39 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
Importance factor for Cyclonic Region(k4)	: 1.00
Design wind speed Vz	: $Vb \times k1 \times k2 \times k3 \times k4$
Design wind pressure Pz	: $0.6 \times Vz^2$

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(IV) SEISMIC LOAD

Seismic loads for design of structure shall be considered as per **IS 1893-2016.**

Zone	: III
Zone factor	: 0.16
Importance factor	: 1.2
Response Reduction factor	: 5.0
Damping ratio	: 5%

The ductile detailing of the structure elements would be done as per IS 13920-2016, Confining Reinforcement will be designed as per IS 13920-2016.

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

- **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

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- **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
Retaining wall	30 mm
Isolated / Raft Foundation	50 mm

For 1.5 hr Fire Resistance Beams , Slabs and Columns Shall have the min Cover as Specified below: Ref: (Table 16A of IS456:2000)

Type of Structural element	Min. Cover to reinforcement
Beams	30 mm
Slabs	25 mm
Columns	40 mm

F. 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.

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.

G. 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

G. DESIGN LOAD COMBINATION

The proposed building is designed using the limit state method with appropriate factors as per **IS: 456.** The load combinations are as follows

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Load Combination

1.5(DL+LL)

1.2(DL+LL+SLX1)

1.2(DL+LL+SLX2)

1.2(DL+LL+SLZ1)

1.2(DL+LL+SLZ2)

1.2(DL+LL+WLX1)

1.2(DL+LL+WLX2)

1.2(DL+LL+WLZ1)

1.2(DL+LL+WLZ2)

1.5(DL+SLX1)

1.5(DL+SLX2)

1.5(DL+SLZ1)

1.5(DL+SLZ2)

1.5(DL+WLX1)

1.5(DL+WLX2)

1.5(DL+WLZ1)

1.5(DL+WLZ2)

0.9DL+1.5SLX1

0.9DL+1.5SLX2

0.9DL+1.5SLZ1

0.9DL+1.5SLZ2

0.9DL+1.5WLX1

0.9DL+1.5WLX2

0.9DL+1.5WLZ1

0.9DL+1.5WLZ2

Where

DL	- Dead load
LL	- Live load
WLX, WLZ	- Wind load in X and Z direction
SLX, SLZ	- Seismic load in X and Z direction.

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H. REINFORCEMENT STEEL:

- All reinforcement shall confirm to IS: 1786 – 2008 having minimum yield strength of 550 N/sq-mm.(Fe550)

I. STRUCTURAL STEEL

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

J. 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.

K. 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.

F. FOUNDATION SYSTEM:

Foundation system of the structure is designed considering the recommendation from the Geotechnical report.

- The foundation System shall be Isolated Foundation as per soil test report.
- The basement floor slab shall be designed for the uplift pressure corresponding to ground water level based on site conditions.

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