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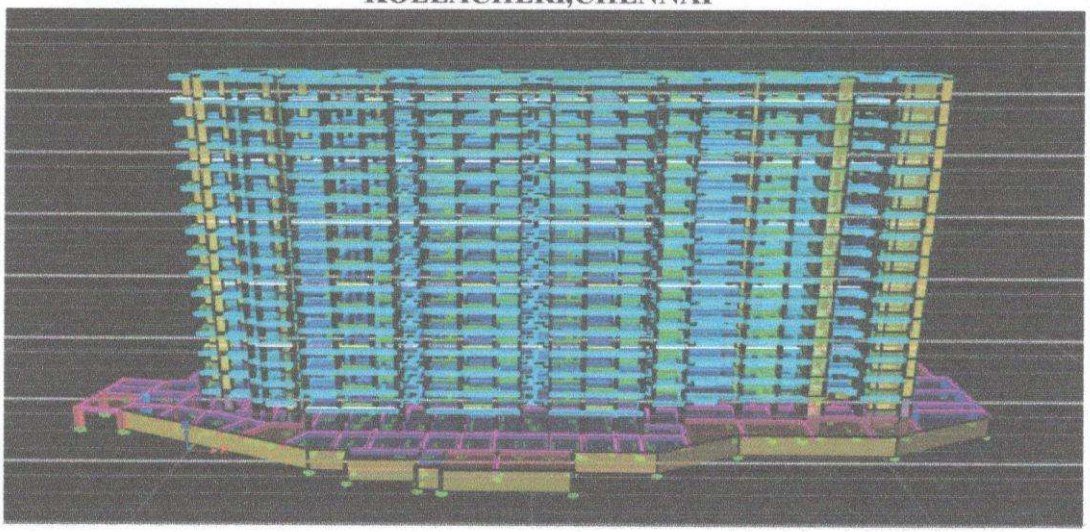
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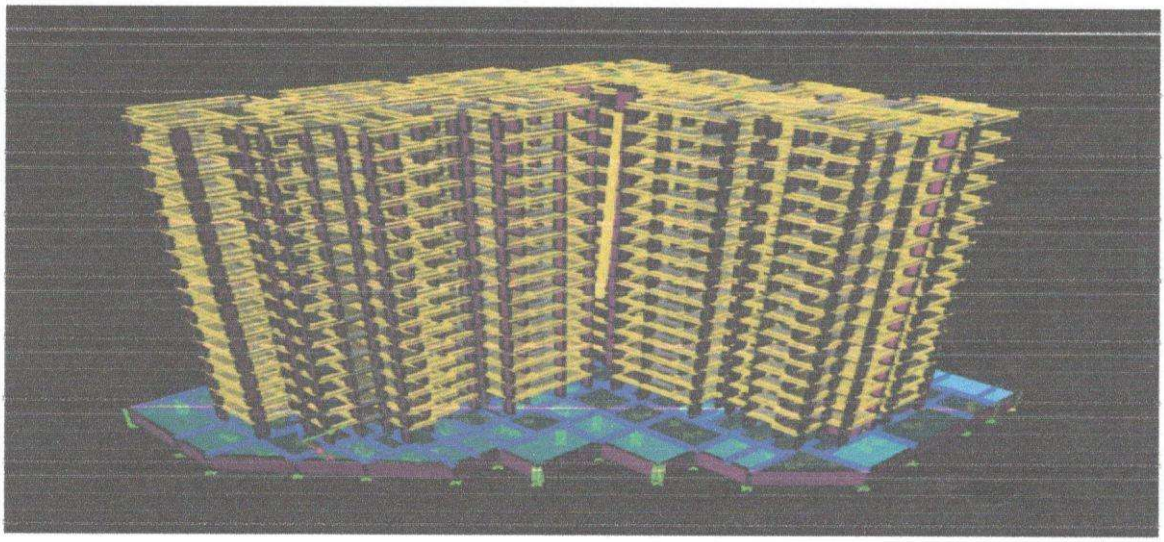
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# STRUCTURAL DESIGN BRIEF REPORT

**M/s CASAGRAND FRESH PVT.LTD.**
**RESIDENTIAL BUILDING AT**
**KOLLACHERI,CHENNAI**





QUADOMETRY
ENGINEERING


**#610,17th B CROSS, INDIRANAGAR II STAGE,**
**HOYSALA NAGAR, INDIRANAGAR,**
**BENGALURU-560038**

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## 1. INTRODUCTION

**Quadometry Engineering Pvt. Ltd.** has been appointed as Structural Consultants by **Casagrand Fresh Pvt. Ltd.** to develop structural schemes and design for proposed low rise residential development at Kollacheri Village, Kundrathur Taluk, Kancheepuram District The objectives of these reports are stated as follows:

- Define the engineering strategy and parameters in relation to the building structure and Architectural concept.
- Identify and record all input requirements, Analysis and design criteria.
- Develop structural scheme 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.
- Fast-track construction and cost effectiveness

## 2. PROJECT DESCRIPTION

The proposed residential development consists of three Blocks 1 & 2 along with one Basement as parking, Stilt floor. Blocks 3 ground floor no parking. This design basis caters for the Structural Design of Block 1, Block 2 and Block 3 buildings. Ground floor of Block 3 will have Club house & Swimming pool having depth of 1200 mm. Fire tender movement area is planned over driveway outside the ground floor to access each Blocks on mother earth.

Block-1, Block-2 will have one basement + stilt +15 stories above. Height of the Blocks is approx. 48 m above ground level.

Block-3 will have one ground +2 stories above. Height of the Block is approx. 10.95m above ground level.

Dimensions of Block-1 are approx. 42.42m x 51.3m x20.03m with following floor heights

| | | |
|---|---|---|
| Basement | : | 3.15 m |
| Stilt Floor | : | 3.3 m |
| Typical Floor Second Floor to Terrace | : | 2.95m |

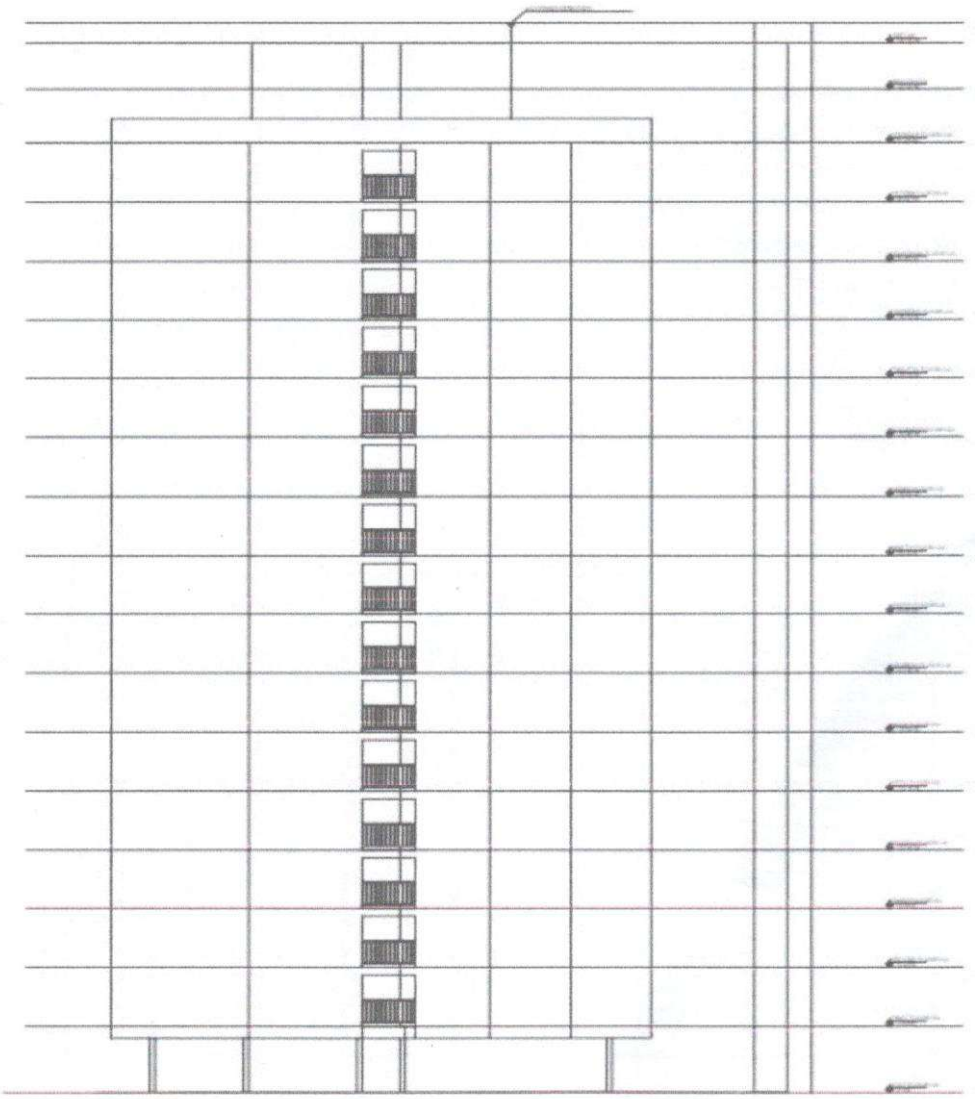
Dimensions of Block-2 are approx. 80.95m x 21.2 m with following floor heights

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| | | |
|---|---|---|
| Basement | : | 3.15 m |
| Stilt Floor | : | 3.3 m |
| Typical Floor First Floor to Terrace | : | 2.95 m |

Dimensions of Block-3 are approx. 16.50 m x 18.20 m with following floor heights

| | | |
|---|---|---|
| Ground Floor | : | 3.5 m |
| First Floor to second floor | : | 3.5 m |
| Second Floor to terrace floor | : | 3.5 m |



TYPICAL ELEVATION -1

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## CONSTRUCTION TYPE

### SUBSTRUCTURE

There will not be any basement. The Buildings will be supported on set of Isolated and combined foundations. A grade slab will be provided at the lowest level along with vapour barrier to ensure water tightness on a murum filling compacted to 95% proctor density.

### SUPERSTRUCTURE

The superstructure will be constructed in conventional RCC slab system with beams, columns and shear walls. Concrete will be poured in a RCC slab on erection of formwork and fabrication of reinforcement.

## 3. STRUCTURAL SYSTEM

### 3.1 FOUNDATION

Based on the proposed structure and sub soil conditions, Geotechnical investigations report recommends pile foundation system. With Below recommendations.

### 4.2 Foundation System

For the kind of proposed structure and the sub soil conditions, it is not possible to adopt any kind of open foundation system from both shear and settlement considerations. Hence, it is advisable to adopt deep pile foundation system. The piles can be installed by drilling with direct mud circulation technique **(Bored Cast In-situ Piles)** and the recommended safe load carrying capacity of bored cast in-situ piles in compression, tension and lateral for different diameters is worked out as per IS 2911-Part-I-Section-2 and are presented in Table 4.1.

Typical computations are presented in Annexure.

**Table:- 4.1 Recommended Safe Load Carrying Capacities of Bored Cast-in Situ Piles**

| Sl.No | Reference Bore hole No. | Length of Pile below E.G.L | Assumed Length of Cut-Off Below E.G.L | Length of Pile below Cut-off | Dia.of Pile in (mm) | SAFE LOAD CARRYING CAPACITY (kN) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Vertical Load Carrying Capacity | Pull Out Capacity | Lateral Load Carrying Capacity |
| 1 | BH-01 | 10.0 | 1.0 | 9.00 | 450 | 650 | 220 | 34 |
| 2 | | | | | 500 | 850 | 225 | 38 |
| 3 | | | | | 550 | 1000 | 250 | 41 |
| 4 | | | | | 600 | 1250 | 275 | 45 |
| 5 | | | | | 650 | 1450 | 300 | 48 |
| 6 | | | | | 750 | 1750 | 350 | 55 |

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### 3.2 SUPERSTRUCTURE

Structural form should contribute to the building character and identity, while being efficient, cost effective and simple to construct. Shear walls are placed in such a way that minimum obstructions are developed to space utility and architect vision.

The building is primarily conventional R.C.C Beam and Slab system supported by beams, columns and shear walls. Floor slabs are considered to act as a rigid diaphragm to transfer the lateral forces to the lateral load resisting elements. Provision is done in design in such a way that services can be laid without any major obstructions and maximum head room is achieved. Kollacheri is located in Zone-III as classified by IS: 1893-2016. Seismic forces on the structure will be moderate. Hence RCC Beam - Slab system is considered more suitable structuralsystem as it offers more clear height, provides ease and speed of construction.

## 4. STRUCTURAL DESIGN STANDARDS AND CODES CONSIDERED

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(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 4): 1987: | Snow Loads |
| IS 875(Part 5): 1987: | Special loads and load combinations |
| IS 1893:2016: | Criteria for earthquake resistance design of structures. |
| IS: 13920-2016: | Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces |

**Foundations:**

| | |
|---|---|
| IS 1080:1985(2016): | Code of Practice for design and construction of shallow foundations on soils (other than raft, ring and shell). |
| IS 1904:1986(2015): | Code of Practice for design and construction of foundation in soils general requirements. |
| IS 2950:1981(2013): | Code of Practice for design and construction of raft foundations |
| IS 2974:1998(2015/13): | Code of Practice for design and construction of machine foundations (All parts). |
| IS 8009:1976/1980(2013/15): | Code of Practice for calculations of foundations (All parts). |

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**RCC:**

| | |
|---|---|
| IS 456:2000: | Code of Practice for plain and reinforced concrete |
| IS 458:1988: | Specification for precast concrete pipes |
| IS 3370:2009: | Code of Practice for concrete structures for the storage of liquids |
| IS 4326:2013: | Code of Practice for earthquake resistant design and construction of buildings. |
| IS 5525:1969(2013): | Recommendation for detailing of reinforced concrete works. |
| IS 1786:2008: | Specification for high strength deformed steel bars and wires for concrete reinforcement. |
| IS 10262:2009: | Recommended guidelines for concrete mix design. |
| IS 1786:2008: | Specification for high strength deformed steel bars and wires for concrete reinforcement. |
| IS 1893(Part-1) 2016: | Criteria for earthquake resistant design of structures (General provision and buildings). |
| IS 13920:2016: | Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces. |
| IS 1343:2012: | Prestressed Concrete |

**Structural steel:**

| | |
|---|---|
| IS 800:2007 | Code of Practice for general construction in steel. |
| IS 806:1968(2013): | Code of Practice for use of steel tubes in general building construction |
| IS 808:1989: | Dimension for Hot rolled steel beam, column channel and angle section. |
| IS 816:1998: | Code of Practice for use of metal arc welding for general construction in mild steel. |
| IS 1161:1998: | Steel tubes for Structural Purpose. |
| IS 4000:1998: | High strength bolts in Steel Structures- Code of Practice |
| IS:7215 -1995 | Tolerances for fabrication of steel structures. |

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DESIGN LOADS

**4.1 Dead Loads**

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

Floor finish of 50 to 75 mm thickness

| | | |
|---|---|---|
| for Parking | : | 165 kg/sq.m (1.65 kN/sq.m) |
| and 50mm for Residential floors | : | 110 kg/sq.m (1.1 kN/sq.m) |
| False ceiling / ducting + Sprinklers | : | 50 kg/sq.m (0.5 kN/sq.m) |
| Self-weight of Plain concrete | : | 2400 kg/cu.m (24 kN/cu.m) |
| Self-weight of RCC | : | 2500 kg/cu.m (25 kN/cu.m) |
| Solid block masonry | : | 2000 kg/cu.m (20 kN/cu.m) |
| Light weight block masonry | : | 800 kg/cu.m (8 kN/cu.m) |

(with additional 20mm thick plastering on external surface and 14mm plastering on internal) wall surfaces

| | | |
|---|---|---|
| Soil (Dry) | : | 1800 kg/cu.m (18 kN/cu.m) |
| Soil (Wet) | : | 2000 kg/cu.m (20 kN/cu.m) |
| Water | : | 1000 kg/cu.m (10 kN/cu.m) |
| Glass | : | 2800 kg/cu.m (28 kN/cu.m) |
| Masonry with plastering solid block | : | 2000 kg/cu.m (22 kN/cu.m) |
| Masonry with plastering light block | : | 1000 kg/cu.m (10 kN/cu.m) |
| Filling for sunken portion | : | 1200 kg/cu.m (12 kN/cu.m) (Wherever filling is required) |
| Waterproofing | : | As per actuals |
| Landscape loads | : | 300/450/600 soil filling/finishes as per landscape details |
| OHT loads above the terraces | : | As per actuals (Shall be referred from MEP dwgs). |
| Electrical rooms | : | 750 kg/sq.m (7.5 kN/sq.m = 5.0 kN/sq.m + 2.5 finishes) |
| Wall loads | : | As per actuals |
| Storage rooms | : | 750 kg/sq.m (7.5 kN/sq.m) |
| AHU Rooms if any in club house | : | 750 kg/sq.m (7.5 kN/sq.m = 5.0 kN/sq.m + 2.5 finishes) |
| Lift Machine room | : | 1000 kg/ sq.m or as per actual. |

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### 4.2 Live Loads

Loads for the building shall be taken as follows as per IS: 875 (Part II),

| | | |
|---|---|---|
| Corridors, passages, lobbies and Staircases including fire escape | : | 3.0 kN/sq.m |
| Pantry, cafeterias/food courts and Club house floor | : | 4.0 kN/sq.m |
| Living | : | 2.0 kN/sq.m |
| Bedroom | : | 2.0 kN/sq.m |
| Bath and toilet rooms | : | 2.0 kN/sq.m |
| AHU /HUB/Electrical Room | : | 7.5 kN/sq.m |
| Storage | : | 5.0 kN/sq.m |
| Terrace / Balcony | : | 3.0 kN/sq.m |
| Roof (Inaccessible) | : | 0.75 kN/sq.m |
| Single Parking, Ramp | : | 5.0 kN/sq.m |
| Lift machine room | : | 10.0 kN/sq.m |

Live load reduction is done as per Clause 3.2, IS 875 (Part 2) for the design of columns and footings of the structure.

### 4.1 Wind Loads

Wind loads have been derived on basis of IS: 875 (Part 3) 2015

| | | |
|---|---|---|
| Basic wind speed considered Vb | : | 50 m/s (for Kollacheri) |
| Building classification/ topography data | | |
| Risk coefficient, k1 | : | 1 Table 1, IS 875 (Part 3) |
| Topography factor, k3 | : | 1 |
| Terrain Category | : | 1 Cl 6.3.2.1, IS 875 (Part 3) |

Terrain and Height Multiplier (k2) will be calculated separately for the building as per Table 2 of IS 875 (Part 3):2015

| | | |
|---|---|---|
| Importance factor for cyclonic region(k4) | : | 1 Cl 6.3.4, IS 875 (Part 3) |

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**Wind pressure calculation (Cl. 7.2, IS 875 (Part 3) 2015)**

Pz : 0.6Vz2

Vz : k1 x k2 x k3 x k4 x Vb

Pd : Kd x Ka x Kc x Pz

Where Kd : wind directionality factor

Ka : area averaging factor

Kc : combination factor

**4.2 Seismic Loads**

Seismic design and detailing shall be in accordance with IS 1893 (Part 1):2016 and IS 13920:2016 respectively. Kollacheri falls under Zone III (moderate) as categorized in IS: 1893-2016, and according to IS 13920, Table 9 Flat Slab with ductile shear wall system is to be provided. All shear walls will be provided with ductile detailing to resist 100% of lateral shear. All beams which are framing into shear walls will be provided with ductile detailing.

Seismic Force is considered in all three directions in accordance with IS 1893 (Part 1):2016.

The seismic design parameters are as follows:

Z : 0.16 (as per Table 3 IS 1893:2016)

I : 1.2 (Building as per Table 8 of IS 1893:2016)

Damping : 5% (as per Cl 7.2.4 of IS 1893:2016)

Soil type I : (for Rock or Hard soils as per Cl 6.4.2 of IS 1893:2016)

R : 5.0 (Refer Table 9; RC building with special moment resisting frame systems (SMRF)

Design Lateral Force: (as per Cl.7.2, IS 1893:2016)

Base shear ($V_B$) = Ah x W

Where W : Seismic weight of structure as per Cl. 7.4

Ah : Design Horizontal Seismic Coefficient as per Cl. 6.4.2 Time period calculation for Static Base Shear:

T : $0.075*h^{0.75}$

Where h : Height of building above footing level

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**Minimum design Lateral Force**

Building will be designed for minimum lateral force for 1.1 % of total seismic weight as per Cl.7.2.2 of IS 1893:2016 (Table 7 for Seismic Zone III). For isolated and combined footings with tie beams, SBC will be increased by 50% in earthquake condition for Rock or Hard soils, in accordance with Table 1, Sl. No. (i) of IS 1893 Part 1.

### 4.3 Temperature Loads on Terrace

As per IS: 875 (Part 5) & IRC: 6-2010 for expansion and contraction due to changes in the temperature of the material of the structure due to daily or seasonal fluctuations in the temperature:

For Kollacheri, as per IS 875 (Part5)

Maximum air shed temperature 45° C

Minimum air shed temperature 15° C

Mean temperature = ((45) + (15))/2 = 30° C

Temperature at which the structure is effectively restrained = Mean of maximum and minimum temperature i.e. at 30° C Variation in temperature:

Maximum = 45-30 = 15° C (TL max)

Minimum = 15- 30 = -15° C (TL min)

This temperature variation shall be applied to terrace.

### 4.4 Primary Loads and Load Combination

| | | |
|---|---|---|
| DL | : | Dead Load |
| LL | : | Live Load |
| WLX | : | Wind Load in + ve X-Direction |
| WLY | : | Wind Load in + ve Y-Direction |
| EQx | : | Seismic Load in X-Direction |
| EQy | : | Seismic Load in y-Direction |
| TL max | : | Maximum Temperature load |
| TL min | : | Minimum Temperature load |

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Load combinations Used for Strength, Serviceability are tabulated below:

| Load Combination | Limit State of Collapse | | | Limit State of Serviceability | | |
|---|---|---|---|---|---|---|
| | *DL+SDL* | *LL* | *WL/EL/TL* | *DL+SDL* | *LL* | *WL/EL/TL* |
| DL + LL | 1.5 | 1.5 | — | 1 | 1 | — |
| DL + WL | 1.5 or 0.9* | — | 1.5 | 1 | — | 1 |
| DL + EL | 1.5 or 0.9* | — | 1.5 | 1 | — | 1 |
| DL + TL | 1.5 | — | 1.5 | 1 | — | 1 |
| DL+LL+WL | 1.2 | 1.2 | 1.2 | 1 | 1 | 1 |
| DL+LL+EL | 1.2 | 1.2 | 1.2 | 1 | 1 | 1 |
| DL+LL+TL | 1.2 | 1.2 | 1.2 | 1 | 1 | 1 |
| DL+WL+TL | 1.2 | — | 1.2 | 1 | — | 1 |
| DL+EL+TL | 1.2 | — | 1.2 | 1 | — | 1 |
| DL+LL+EL+TL | 1.2 | 1.2 | 1.2 | 1 | 1 | 1 |

DL - Dead Load; LL - Live Load; TL - Temperature Load; WL - Wind Load; EL - Earthquake Load

Vertical earthquake effect is not considered for the design of structural elements. 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: 18932016 / Clause 7.3.3 of seismic code will be used both for evaluating earthquake effect and for combined load effects used in such combination. Serviceability loads combinations with suitable live load reduction factor as per IS: 875(Part-2) will be used for foundation design.

## 5. FIRE RESISITANCE OF ELEMENTS

All structural members will be designed for two-hour fire rating. The requirements for fire resistance will be met by adopting the minimum structural dimensions and clear cover to reinforcement. Minimum dimension of structural element and Nominal cover to reinforcements will be provided as given IS: 456-2000.

## 6. ENVIRONMENTAL EXPOSURE

The site is situated in Kollacheri, Chennai which receives moderate rainfall. However, "Severe" exposure is considered for the Substructure in view of the fluctuating ground water table. The minimum nominal cover to the reinforcement will be 45 mm & 50mm for the structural elements like Retaining wall and Footing respectively which are in contact with soil. Also for UG tank and STP walls which are in contact with water, minimum cover shall be

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45mm. The members in the Superstructure exposed to weather will be designed for "Moderate" exposure condition. All members in the Super structure within the building will be designed for 'Mild' exposure condition as defined in IS 456-2000, Table 16.

## 7. COVER TO REINFORCEMENT

Minimum clear cover to any reinforcement shall be provided based on the fire requirements and exposure condition whichever is more.

## 8. MATERIALS

### 8.1 Concrete

Minimum grade for structural concrete shall be of grade M25. The minimum cement content in concrete for substructure as well as superstructure shall be 300kg/m3 and the maximum free water-cement ratio shall be 0.50. Grade of Concrete for columns and shear walls shall be gradually reduced from M40 at lower floors to M30 at upper levels.

### 8.2 Reinforcements

High strength deformed steel bar, produced by the thermo-mechanical treatment (TMT) process, of grades Fe 500(D) having elongation more than 14.5 percent as per IS 13920:2016 and conforming to other requirements of IS 1786: 2008 will be used for the reinforcement.

### 10.3 Structural Steel

All structural steel used for construction shall conform to IS: 2062 with fy= 310 Mpa.

## 9. ANALYSIS OF STRUCTURE

The analysis will be based on Stiffness matrix method and using the engineering software ETABS 19 version. This is a tried and time tested 3D Structural analysis tool, which includes analysis of plane frames, space frames using truss, beam and shell elements. Generally, all the structures will be idealized as 3D – frames, using line element for column & beams and Shell elements for slabs, shear walls. The structures shall be analysed for individual load cases as described in 6.6 above. Analysis for governing load combinations shall be performed and the performance of the structures in various states of Collapse and Serviceability will be checked accordingly. Manual analysis shall be done for retaining walls, slabs, staircases, water tank etc. The raft and combined footings will be modelled and analysed using software SAFE.

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## 10. DESIGN OF STRUCTURE

The design of the RC and steel structures will be based on the Limit State Method as per IS: 456-2000 and IS: 800-2007 respectively. For liquid retaining concrete structures, the design is based on the Limit State Method, conforming to IS 3370-2009.

The design of RC Columns and beams, footings, slab, staircases and junctions of the structures shall be made using spread sheets developed in-house and/or manual calculations and/or using ETABS software.

## 11. ACCEPTANCE OF CRITERIA

**Deflection Limits:**

For Reinforced concrete works: Limiting values of deflection (Short and Long term) as per clause 35.3 of IS: 456-2000 is followed in the design. Limiting value for long term deflection is considered as span/250 and for the long-term deflection after erection of partitions & finishes is considered as span/350 or 20mm whichever less as per IS 456 – 2000.

**Cracking 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 basement retaining wall and water retaining structures, crack width is limited to 0.2mm.

**Permissible Drift Limits:**

Lateral drift = Height/500(For Wind Loads)

Lateral drift = Height/1000 (at Roof) (For Seismic loads as per Note 4 of Table 9 of IS 1893:2016)

Inter Storey drift = 0.004 x storey height (as per IS 1893:2016)

## 12. SEPERATION AND EXPANSION JOINTS

Expansion joints will be provided within the building foot print. Pour strips will be provided to allow for initial shrinkage in the concrete. As building dimensions exceed 45m in length (Clause 27.2, IS 456 2000), structure is designed to carry additional stresses as per Clause 2.1, IS 875 (Part 5). The width of expansion joint is calculated on the basis of maximum displacements found for lateral loads between adjoining buildings (Block-1 and Block-2) at podium floors.

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## 13. WATERPROOFING

The following Water-Proofing methodology is adopted for various members,

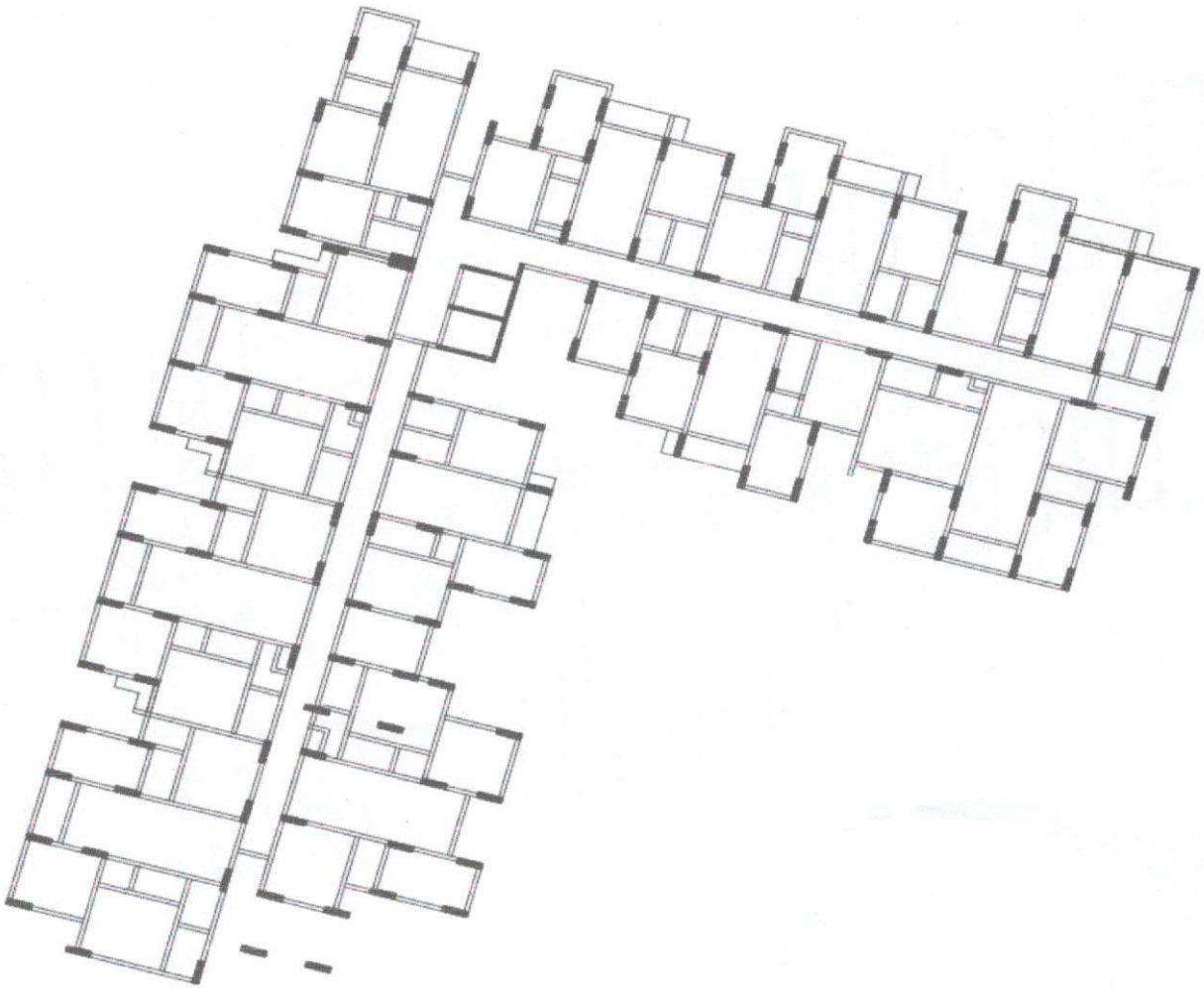
1. Bottom of Foundation, Rafts, Lift pits and Tanks: Self Adhesive HDPE membrane or equivalent.
2. Retaining walls: Sam-Shield XL with protection boards.
3. Podium w/o landscape: Brush bond/Spray apply Polyurethane.
4. Planters/STP/UG (Internal): Brush bond/Spray apply Polyurea.
5. Toilets/Balconies: Dr. fixit - fast flex.
6. Terrace: Brickbat Coba with crystalline mortar or Polyurethane.

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# ANNEXURE

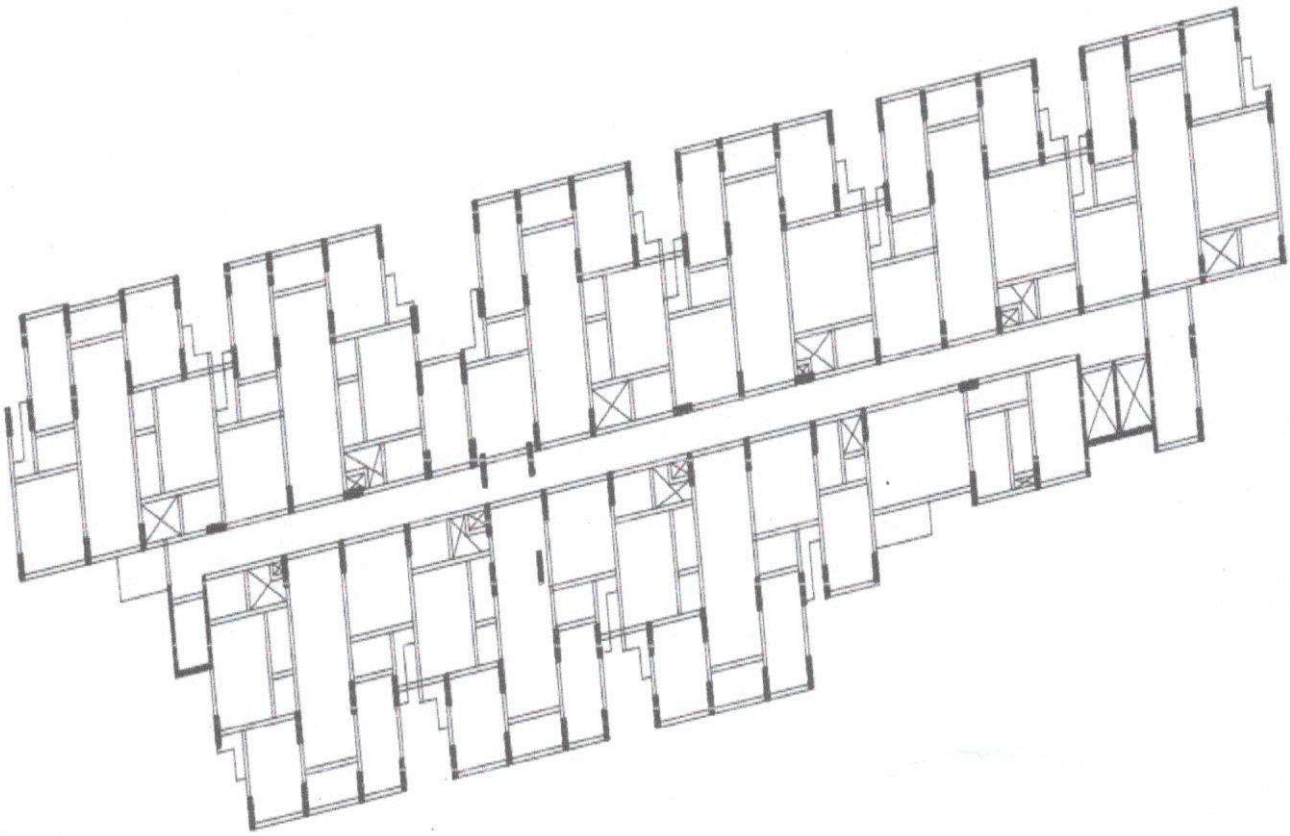
# FRAMING PLANS

## BLOCK-01



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# BLOCK-02



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