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CIN : U45201TN2005PTC055334

STRUCTURAL STABILITY REPORT

THIS IS TO CERTIFY THAT THE PROPOSED CONSTRUCTION OF STILT +5 FLOORS RESIDENTIAL BUILDING (HEIGHT-18.30M) WITH 91 DWELLING UNITS (AFFORDABLE HOUSING)(GYM, KINDERGARTEN ROOM AT 4TH FLOOR & INDOOR GAMES ROOM AT 5TH FLOOR) POTHERI, COMPRISED IN S.NO.41/4, 41/5, POTHERI VILLAGE, CHENGALPATTU TALUK, CHENGALPATTU DISTRICT, WITHIN THE LIMIT OF MARAIMALAI NAGAR MUNICIPALITY.

1. Foundation & its vertical elements is designed for Residential apartment building with Stilt + 5 storey meant for residential purpose.
2. The minimum grade of concrete used in the structural design is M30.
3. The design and Analysis using the code of practice for loading standards as per IS 875 – part 1 - V and seismic force as per code IS 1893, is carried out.
4. The building will be sound and stable when used for the purpose for which it is designed.

Date: 25.11.2023

Place: Chennai

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Signature of the Certified Engineer

PROPOSED RESIDENTIAL DEVELOPMENT

DESIGN BRIEF REPORT FOR STRUCTURAL SERVICES

Client:	DAC DREAM ASCEND CONQUER	DAC Developers No: Plot No. A, Thiruvalluvar Street, RV Garden,Tambaram West, Kadaperi, Chennai - 600 045
Structural Consultant:		BURO ENGINNERS (I) PVT LTD Civil & Structural Consultants New No.31, (old No. 14), Besant Avenue, Adyar, Chennai 600 020.

DOCUMENT NO : STR - DBR/Rev-R0

DATE	ISSUE	PREPARED	CHECKED	REVISION
20-11-2023		Yoga	P. Jegatheesan	R0

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1.0 PROJECT INFORMATION

1.1 Introduction:

This Design Brief Report (DBR) is for the Proposed Residential Development.

The proposed residential building consist of Stilt floor + 5 Story + Terrace.

This report provides the information on Codes of Practice, Design loading, Material Strength considered for the Design and Analysis of the building. In addition this report includes Structural system, Foundation system, Method statement of structural analysis which will be adopted for design and analysis for the building.

1.2 Facilities:

The proposed building, is primarily a residential building housing apartments consisting of Bedrooms, Kitchen, Toilets, Living Area, and Lobby & Balcony.

1.3 Floor to Floor Height:

STILT Floor	3.0m
1st to 5th	3.0m

2.0 CODES OF PRACTICE

The relevant Indian Standard codes below are followed.

2.1 Code, Standards and References:

All design of structures shall comply with the requirements specified in the following.

a. Relevant Indian Standard Codes of Practice
b. National Building Code.
c. Local Building regulations.
d. Other relevant International codes where required.

All applicable latest edition of codes and standards will be referred and adopted in the analysis of structures and the design and detailing of structural members. All structural elements design shall be carried out primarily based on. Indian Standards and Codes with latest revision, with amendments if any, as on date.In addition, other international codes and standards shall also be referred when required and relevant.

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In the analysis, design and detailing of the building, the following Indian Standard codes of latest amendment will be used.

CODE	DESCRIPTION
IS 875(Part 1) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures – Unit weights of buildings materials and stored material
IS 875 (Part 2) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures – Imposed Loads
IS 875 (Part 3) 2015	Code of practice for Design Loads (other than earthquake) for buildings and structures – Wind Loads
IS 875 (Part 5) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures – Special Loads and load combinations
IS 456 – 2000	Code of Practice for Plain and Reinforced Concrete
IS 16700 – 2017	Criteria for Structural Safety of Tall Concrete Buildings
IS 1343 – 2012	Code of Practice for Prestressed Concrete
IS 1893 – 2016	Criteria for earthquake resistant design of structures
IS 4326 –1993	Code of practice for Earthquake Resistant Design and Construction of Buildings
IS 3370 – 2009	Code of Practice for Concrete structures for the storage of liquids
IS 1904-1995	Code of Practice for design and construction of Foundation
IS 1080 – 1997	Code of Practice for design and construction of shallow Foundation
IS 2950 - 1998	Code of Practice for design and construction of

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	Raft Foundation
IS 800 – 2007	Code of practice for General Construction in steel
BS 8110 : 1997	Plain and reinforced concrete-code of practice(British standard)
ACI 318	Plain and reinforced concrete-code of practice (American standard)
IS 13920: 2016	Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces
SP24	Explanatory Hand book on Indian standard code of practice
SP34	Handbook on concrete reinforcement and detailing

3.0 COVER AND FIRE RATING

Cover to reinforcement considered for various elements

Structural element	Exposure condition	Fire rating in hours	Cover
Column		2	40
Shear wall		2	30
Beam (Simply supported)		2	40
Beam (Continuous)		2	30
Slab (Simply supported)		2	35
Slab (Continuous)		2	25

4.0 STRUCTURAL SYSTEM

Floor system: The structural Floor system for the super structure is R.C.C Beam with R.C.C slab. The slab thicknesses are to be 125mm/150mm.

Lateral load resisting system:

Ductile RC structural wall system.

Foundation System:

Isolated Foundation, Combined footing in lift core wall location. With reference to soil investigation report the SBC at 2.10m from EGL is 30.50T/m2.

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5.0 MATERIAL GRADES

Materials specified will confirm to the latest edition of the relevant Indian Standards. Specifications for materials will include for sampling and testing as stipulated in the design standards. Detailed material specifications will be included in the Technical specifications.

5.1 Concrete

Durability provisions for concrete structures shall be as per 'Severe' conditions of environment in accordance with IS 456:2000.

Keeping the durability and structural requirements, the proposed Compressive Strength of structural concrete at 28 days, for various structural elements/members are as indicated in the below table

Structural Elements		Compressive Strength at 28 days	Concrete grade
Minimum grade of concrete for any structural member is considered as		30 N/Sq.mm	M30
All Structural concrete for :			
Columns, Shear walls & Core walls	Foundation to Terrace level	30 N/Sq.mm	M30
Footing		30 N/Sq.mm	M30
Beams and slabs	Ground to Terrace level	30 N/Sq.mm	M30
Overhead Water Tank, UG Water Tank, STP & Pump room		30 N/Sq.mm	M30

5.2 Reinforcement

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

Youngs' Modulus (Es)	200,000N/Sq.mm
Yield Stress (fy)	550 N/Sq.mm
Diameters {in mm} (d)	8, 10, 12, 16, 20, 25 & 32
Density ('ϒ)	78.5 kN/cum

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6.0 DESIGN OF LOADINGS

6.1 Material Density

Unit weight of materials are as per IS: 875 (Part-I) 1987.

Unit weight of concrete	-	25 KN / Cum.
Unit weight of steel	-	78.5 KN / Cum.
Screed concrete	-	24 KN / Cum.
Unit weight of dry soil	-	18 KN / Cum.
Unit weight of saturated soil	-	20 KN / Cum.
Unit weight of Glass	-	27.2 KN / Cum.
Unit weight of water	-	9.81 KN / Cum.
Aerated block masonry	-	8.65 KN / Cum.
Light weight concrete filling	-	16.0 KN / Cum (Supplier - Nuvoco)

6.2 Superimposed Dead Loads and Live Loads

The following are the imposed loads such as SDL and LL to be considered for the design of floor system depending usage floor. In addition to these loads, self-weight of structural elements will be considered depending member sizes shown in the floor plans.

Usage	SDL (kN/m2)				LL (kN/m2)
	Partition Wall	Services	Finishes	Total	
Parking - Cars	0.00	0.50	2.40	2.90	3.00
Staircase	0.00	0.00	3.00	3.00	3.00
Toilet	0.00	0.00	3.36	3.36	2.00
Bed, Living, Dinning & Kitchen	0.00	0.00	1.20	1.20	2.00
Balcony	0.00	0.00	2.40	2.40	3.00
Lobby & Corridor	0.00	0.00	1.20	1.20	3.00

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Terrace	0.00	0.00	3.60	3.60	5.00
LMR	0.00	0.00	3.60	3.60	10.00
OHT	0.00	10xWater Height	1.80	0.00	0.00

Permissible reduction in imposed load on each floor is considered for design of columns and footings as per IS 875 Part (2).

a) SUPER IMPOSED DEAD LOADS (kN/m^2)

Floor Finishes of 50 mm thickness have been considered on all the typical floors, , toilet 100+40=140mm, balcony-100mm.

TERRACES (Load in kN/m2)

Waterproofing + Screed 3.60 (0.15(average floor finish.) x 24=3.60)

b) SELF-WEIGHT OF LIGHT WEIGHT WALLS (kN/m^2)

Infill walls (20mm for External wall & internal wall 15mm plastering on Either side)

(i) 200mm thick light weight block wall 2.60kN/m^2
(ii) 100mm thick light weight block wall 1.60kN/m^2

Water Tank Water height x 10

6.3 Seismic Design Parameters:

Design of lateral force under seismic condition shall be as per IS1893 – 2016. Total lateral force (base shear) of the building shall be estimated at ground floor level as per clause 7.2.1 of IS1893 – 2016 which provides by

Base shear Vb = Ah W

Ah is horizontal seismic coefficient and W is seismic weight of the building, Horizontal seismic coefficient depends on location of the building (Zone factor Z), usage of the building (Importance factor, I), building lateral resisting system (Response reduction factor, R) and design acceleration coefficient (Sa /g) which is based on subsoil condition and fundamental natural period (Ta).

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For the proposed development is for Residential use. Considering it, the seismic weight is summation of total dead load and 25% of live load where live load is equal and less than 3 kN/sq.m and 50% of live load greater that 3 kN/sq.m

1) The lateral load resisting system of the buildings is ductile shear wall with Gravity Columns. The Walls are detailed as per IS: 13920-2016, Clause- 11, Confirming to this all the RC Ductile Walls are designed for 100% Lateral Loads, also the Columns are independently designed in according to their stiffness.
2) As per IS 1893:2016 code, Chennai lies in Zone III with Zone factor Z = 0.16
3) The Design Base Shear is given by V_b = Ah x W, Where Ah = Z / 2 x I/R x S_a/g

   I = Importance Factor = 1.2

   Soil Type 1 (Rock or Dense soil)

   R (Response reduction factor) = 4.0.

   Sa/g = Average Response acceleration coefficient

   For the building height with reference to IS: 1893-2016, since the buildings are well connected with basement walls so for the time period calculation the heights are considered ground floor to roof.

   With reference to IS 1893 - 2016 clause 7.6.2 (b) the time period for building each directions are as follows,

The fundamental natural period (Ta) for building,

c) **All other buildings:**

$$T_a = \frac{0.09h}{\sqrt{d}}$$

where

h = height of building, as defined in **7.6.2**(a), in m; and

d = base dimension of the building at the plinth level along the considered direction of earthquake shaking, in m.

Where,

Base Dimension along X Direction, dx = 43.22m (Longer length)

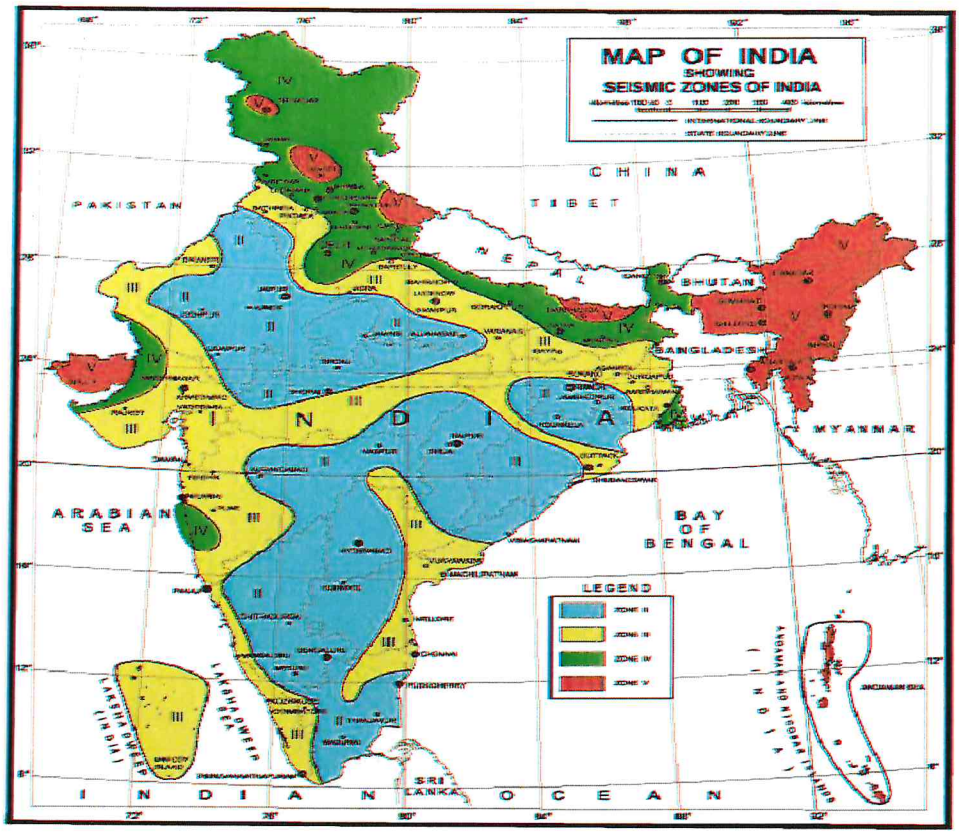
Base Dimension along Y Direction, dy = 60.05m (Longer length)

H = 20m

T_a = 0.273 (along X direction)

T_a = 0.232 (along Y direction)

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SEISMIC ZONE CLASSIFICATION FROM IS 1893: 2016

Dynamic Analysis

Response spectrum method of Dynamic Analysis carried out with following parameters pertaining to dynamic analysis.

Number of modes Considered : 10 Numbers (Min)
Modal Combination Method Used : Complete Quadratic combination (CQC).
Directional Combination Method used : Square root of the sum of Square (SRSS).
Modal case type : Ritz vector Method
Cut off frequency in case response spectrum method of analysis - 33 Hz.
Mass participation is 90% as per our analysis
Damping 5%is used for seismic analysis
Dynamic analysis of building is carried out. The members are designed accordingly.

6.4 Wind Loads

The wind pressure shall be calculated based on the basic wind speed and other provisions laid in IS 875 Part (3) - 2015

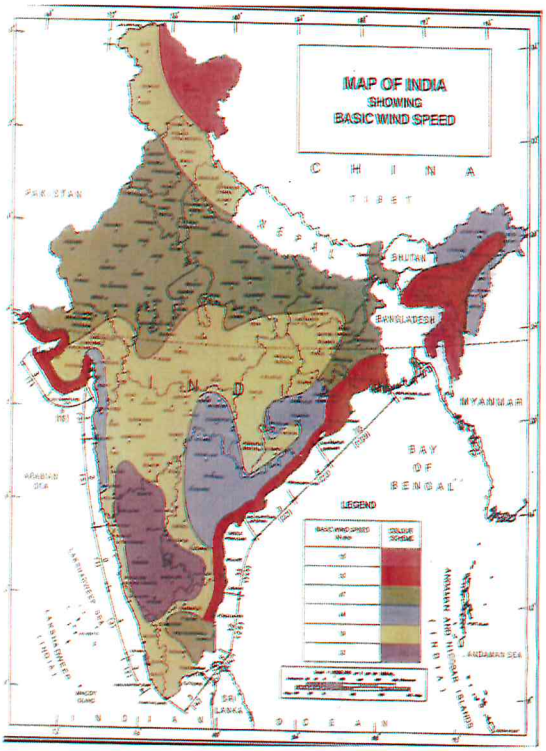
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Design Wind Speed, VZ			= Vbxk1x k2x k3x k4
Vb	→	Basic Wind velocity for Chennai	= 50m/s
K1	→	Risk coefficient for all general buildings	= 1.00
k2	→	Terrain category 2	= To suit the height of the structure for terrain
k2		(H=20m -GF to Roof)	= 1.07
k3	→	Topography factor	= 1.00
k4	→	Importance Factor for cyclonic Region	= 1.00

Based on the above,

Max. design wind speed (VZ)	(Vbxk1x k2x k3x k4)	= 53.5m/s
Max. design wind pressure (Pz)	= 0.6 x Vz2	= 1717.35 N/m2
Design wind pressure: pd	= Pz x Kax Kd x Kc	= 1251.94N/m2

Kd	→ Wind directionality factor	= 0.90
ka	→ Area averaging factor	= 0.90
Kc	→ Combination factor	= 0.90



INDIAN WIND SPEED CLASSIFICATION FROM IS 875 PART (III)

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6.5 Temperature Loads:

The building is completely covered with block work on the sides. So there will be no appreciable differential temperature during the service life of building. The roof slab and the podium of building is to be analysed for ± 15°C difference in temperature is applied to Etabs model and necessary load combinations are considered in analysis & Design of the building. The roof slab is assign as semi rigid diaphragm for ultimate load combination.

7.0 LOAD COMBINATION

The various loads combinations used for design in accordance with IS 1893-2016 are as follows:

1. 1.5 (DL + LL)
2. 1.2 (DL + LL + SPECX)
3. 1.2 (DL + LL + SPECY)
4. 1.2 (DL + LL ± WindX)
5. 1.2 (DL + LL ± WindY)
6. 1.5 (DL + SPECX)
7. 1.5 (DL + SPECY)
8. 1.5 (DL ± WindX)
9. 1.5 (DL ± WindY)
10. 0.9DL + 1.5SPECX
11. 0.9DL + 1.5SPECY
12. 0.9DL ± 1.5WindX
13. 0.9DL ± 1.5WindY

Load Combination for foundation sizing

14. DL+LL
15. DL+LL+SPECX
16. DL+LL+SPECY
17. DL+SPECX
18. DL+SPECY
19. DL+LL±WX
20. DL+LL±WY
21. DL±WX
22. DL±WY

The various service loads combinations of structure as per IS 456 are as follows

23. 1.0DL +1.0 LL
24. 1.0DL + 1.0SPECX
25. 1.0DL + 1.0SPECY
26. 1.0DL ± 1.0WindX
27. 1.0DL ± 1.0WindY

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28. 1.0DL ± 1.0TEMP
29. 1.0DL + 0.8LL + 0.8SPECX
30. 1.0DL + 0.8LL + 0.8SPECY
31. 1.0DL + 0.8LL ± 0.8WindX
32. 1.0DL + 0.8LL ± 0.8WindY

Where,
DL - Dead load,
LL - Live load
Wind X- Wind load in x - direction
Wind Y- Wind load in y-direction
SPECX- Earthquake load in x-direction
SPECY - Earthquake load in y-direction
TEMP - Temperature load
AL -Accidental Load (such as fire tender load)

8.0 SERVICIBILITY LIMITS

11.1 Lateral Deflection (Wind)

Overall Deflection	<	Height/500
Storey Deflection	<	Storey height/500

11.2 Lateral Deflection (Seismic)

Overall Drift	<	H / 250
Storey Drift	<	0.004 times storey height

11.3 Vertical Deflection of Beams and Slabs due to Gravity Loads

Total Deflection (DL + LL) < Span/250
Deflection including the effects of Temperature, Creep and Shrinkage Occurring after erection of partitions and the application of finishes < Span/350 or 20mm whichever is less.

9.0 STRUCTURAL ANALYSIS AND DESIGN APPROACH

Computer-aided analysis using finite element method (FEM) shall be carried out for the design of structural elements. For 3D or 2D structural frame analysis latest version of software ETABS or SAFE shall be used, Prokon, RCDC calculations for manual design of elements and verified in-house spreadsheets will be used for the design of reinforced concrete (RC) and steel elements in consideration of flexure, shear and axial forces.

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Assumptions for 3D model analysis using ETABS

Column: Frame Element
RC Wall: Wall (Shell) Element
Beam Element: Frame Element
Slab: Shell Element

The following are general parameters adopted in the analysis and design,
Modulus of Elasticity of Concrete -5000$\sqrt{}$fck
Consideration of Diaphragm - Semi Rigid Diaphragm.
Slab/Wall element considered as Shell element
Stiffness modification factors are adopted in the analysis as per IS -16700-2017, Table.6.

Table 6 Cracked RC Section Properties

(Clause 7.2)

Sl No.	Structural Element	Un-factored Loads		Factored Loads	
		Area	Moment of Inertia	Area	Moment of Inertia
(1)	(2)	(3)	(4)	(5)	(6)
i)	Slabs	1.0 A_g	0.35 I_g	1.00 A_g	0.25 I_g
ii)	Beams	1.0 A_g	0.7 I_g	1.00 A_g	0.35 I_g
iii)	Columns	1.0 A_g	0.9 I_g	1.00 A_g	0.70 I_g
iv)	Walls	1.0 A_g	0.9 I_g	1.00 A_g	0.70 I_g

The following parameters and methods are adopted in creating ETABS 3D model for the buildings and design of structural elements.

- ✓ The 3D ETABS model generated based on the preliminary floor plans (shuttering drawings) prepared using preliminary sizes.
- ✓ Sectional properties are assigned to all the structural elements as per the preliminary floor plans (shuttering drawings).
- ✓ External & Internal in fill wall loads are assigned as uniformly distributed line load on beams and as area load if the wall is intending to distribute on slab directly.
- ✓ Slabs are modelled as shell element if floor system and slabs are assigned with horizontal diaphragms.
- ✓ Live Load reduction is considered in the design of Foundation and Column as per the Code: IS 875-1987 (Part-II), clause.3.2.1.
- ✓ Area design load i.e. Live load/SDL or any other load is applied at floor relevant to its usage.
- ✓ All lateral loads & parameters are assigned as per Codes IS 1893-2016 & IS 875-Part-3, 2015.
- ✓ Temperature loads are applied on to the terraces and to areas directly exposed to atmosphere.

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- ✓ Beams under Torsion is required to maintain Equilibrium will be designed for Torsion in accordance with IS 456-2000, clause 41.1 to 41.4 and for all other beams torsional stiffness is neglected in the analysis by applying stiffness modifier as 0.000001 to torsional constant "J". Hence no specific design for Torsion is required for these beams.
- ✓ Concrete cover to reinforcement complied accordance with IS 456-2000, Table.16 & 16A.
- ✓ All vertical wall elements are assigned with auto meshing/manual messing appropriately in order to achieve accuracy in results.

Design approach of structural elements

Shear wall/Column:
RC Structural Walls & Columns which are supporting both vertical loads and lateral forces are designed for the most adverse load conditions and envelope of the forces which will be the maximum for that structural element from the load combinations considered in the 3D Etabs Model.
RCDC a design software will be used to design the element for the maximum forces obtained from the Etabs model analysis results.

Beams: Each Beam will be designed for maximum forces from the 3D analysis using Etabs and RCDC Softwares.

Area Load & Application: Applied as uniformly distributed area load with intensity proportionate to its usage as mentioned in the Loading items in the DBR.

Line (Wall) Load & Application: Non load bearing or infill wall loads are calculated aappropriately and Applied as uniformly distributed line load.

10.0 COMPUTER PROGRAMS

The following Software / spreadsheet to be used to carry out Structural analysis and design.

1.	PROKON Ver 2.3	- Wall & Beam design
2.	ETABS Ver 19.1	- Three Dimensional Program
3.	SAFE Ver 20.0	- Raft Analysis / Strip Analysis
4.	In-House Spreadsheet	- one way/ two way slab design
5.	Rapt-6	- Post Tensioning Analysis & Design
6.	RCDC	- Beam Design, Isolated footing design, Column design and Wall design
STAAD PRO & ETABS		- Structural Steel Design.

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