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STRUCTURAL DESIGN CALCULATION REPORT

**PROPOSED CONSTRUCTION OF STILT+5 FLOORS (HEIGHT-18.3m)
RESIDENTIAL BUILDING AT SURVEY NO: 29/5 JOTHI NAGAR MAIN ROAD,
MOULIVAKKAM VILLAGE, KUNDRATHUR TALUK,
KANCHIPURAM DISTRICT.**

CLIENT:

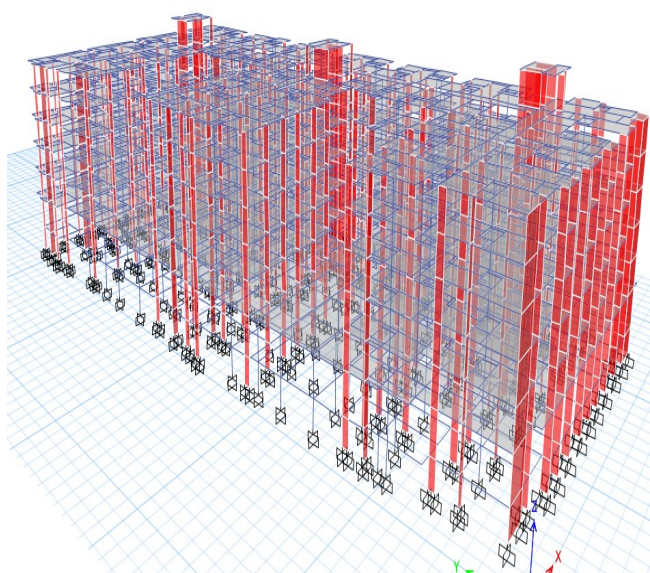
M/s. LIFESTYLE VIN HOMES LLP

ARCHITECT:

**LIFE STYLE HOUSING &
INFRASTRUCTURE**

NO:61, 1st floor, Ormes Road,
Kilpauk, Chennai-600010.

**STRUCTURAL
CONSULTANT:**



BURO ENGINEER (I) PVT LTD.

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R0	13-03-2024	Design Basis Report	OK	SATHISHKUMAR M	PERAM	PERAM
REV	DATE	DESCRIPTION	STATUS	PREPARED BY	REVIEWED BY	APPRVD. BY



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- Design Information and Criteria
- 3D Model & Analysis summary report
- Design of Pile foundation
- Design of Columns
- Design of Beams
- Design of Slabs



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DESIGN INFORMATION AND CRITERIA



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1. INTRODUCTION

M/s.Lifestyle Vin homes LLP has proposed to construct Residential Building comprises Stilt +5 Floors +Roof at survey No:29/5 Jothi nagar main road,moulivakkam village, kundrathur taluk, kanchipuram district .Architecturally, it is designed with a Stilt + 5 Floors + Roof structure. In which, the stilt floor is designed to facilitate parking where as the 1st floor to 5th floor are designed for residential use.

This report covers the design basis of residential development, comprises a residential building having stilt+1st Floor to 5th Floor+Roof. In the residential building, the stilt floors accommodate car/two-wheeler parking and the 1st floor five floors are designed for residential use. Architecturally, the building is designed to be a linear & rectangular in shape. Structurally the building is designed to be a framed structure with Columns,RC Walls, Beams and slabs, are directly connected to the columns/Rc walls which are together forms a lateral load resisting system. Foundation is designed to be pile with a depth of around 22m below existing ground level.

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

2. CODES OF PRACTICE

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

2.1 Design Loads (Other Than Earthquake Loads)

IS Code	Description
IS 875 (Part 1): 1987	Dead Loads (Unit Weight of Building Material and Stored Material)
IS 875 (Part 2): 1987	Imposed Load
IS 875 (Part 3): 2015	Wind Load
IS 875 (Part 5): 1987	Special Loads and Combinations



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2.2 Design for Earthquake Resistance

IS Code	Description
IS 1893(Part-1):2016	Criteria for Earthquake Resistance design of structures.
IS 4326: 1993	Earthquake Resistant Design and Construction of Buildings – Code of Practice
IS 13920: 2016	Ductile Detailing of Reinforced Concrete Structures subject to Seismic Forces - Code of Practice.

2.3 Design of Steel Structural Elements

IS Code	Description
IS 800: 2007	Code of Practice for General Construction in Steel
IS 2062: 1999	Steel for general structural purposes

2.4 Design of Concrete Elements

IS Code	Description
IS 456: 2000	Plain and Reinforced Concrete - Code of practice
IS 6403 -1981	Code of practice for determination of bearing capacities of shallow foundations.
IS 8009 -1976 (Part I):	Code of practice for calculation of settlement of foundations – Shallow foundation
IS 1904	Indian Standard Code of practice for design & construction of foundations in Soil : General Requirements
IS 2950 (Part 1):1981 (Reaff. Nov 2013)	Code of practice for design and construction of raft foundations : Part 1 Design (second revision).
IS 2911-(Part1-Sec2)	Indian Standard Code of Practice for Design and Construction of Pile Foundation-Bored Cast In situ Piles
IS 2911-(Part-4)	Load Tests on Pile
IS 2974	Code of practice for design & construction of machine foundation
SP 16	Structural use of concrete, Design charts for singly reinforced beams, doubly reinforced beams and columns.
SP 34	Handbook on Concrete Reinforcement & Detailing



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SP 7(Part IV)-2015	National Building code of India
IS 1786-2007	Specification for high strength deformed bars and wires for concrete Reinforcement.
IS 432 (Part 2) 1982	Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete reinforcement – Hard Drawn Steel Wire
IS 3370 (part I)	Code of practice for concrete structure for the storage of liquids

3. DESIGN PARAMETERS

3.1 Materials of Construction

The building comprises of columns connected with a frame/slab. The lateral load resisting system of Columns is well connected in orthogonal direction. All vertical elements comprise Columns are connected by a floor slab which acts as a diaphragm in redistribution of lateral forces.

3.1.1 Concrete Grade

Concrete grade should be M30 for R.C Wall & Columns, M30 for beams pile, pile cap & underground sump etc., with a minimum 28-day strength of 30 MPa & 30MPa.

Concrete Mix M10 has been used in filling, plum concrete, leveling courses (PCC) and other non-structural items.

Density of reinforced concrete is assumed as 25 kN/cu.m.

Minimum cement content, water cement ratio etc. shall conform to IS 456:2000 code provisions for durability and strength criteria. The approved design mix shall be used for producing concrete.

Grade of Concrete for various structural elements:

Pile and pile cap	M30
R.C Columns & Wall	M30
Beams and Slabs	M30
Underground sump	M30
Parapet Wall & any other	M25



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Structural members

3.1.2 Cement

Ordinary Portland cement of grade 43 or higher confirming to IS 8112 and IS 12269 is specified for concrete M30 for pile and pile cap, M30 for RC Wall and Column. Beam, slab. with cement content appropriate to the grade. The design mix using the intended brand of cement together with a material test report including test report on other raw materials shall be submitted to the consultant's review and obtain the consent before the construction.

3.1.3 Aggregates

The size of coarse aggregates was confirmed to IS 383. Nominal maximum size of coarse aggregate to be 20 mm, suitably graded as per the requirements of mix design. The fine aggregates confirm the specifications of IS 383.

3.1.4 Water

Water used for construction shall comply with stipulations given in IS 456: 2000.

3.1.5 Reinforcement

High yield strength deformed bars conforming to IS 1786 with $f_y = 500$ N/ sq.mm has been used with elongation of not less than 14.5 %.

3.1.6 Structural Steel

MS steel with yield strength $f_y = 250$ N/ sq.mm has been used for structural steel work shall conform to IS 226 and IS 2062 for Indian steel sections.

3.1.7 Concrete Cover

Cover to reinforcement considered for various elements with fire rating considered - 2hrs. are as follows.

- | | |
|--------------------|--------|
| a. Pile | = 75mm |
| b. Pile cap | = 75mm |
| c. RCC Wall&Column | = 40mm |



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- d. Beam = 30mm (Bottom and sides)
- e. Slab = 25mm (Top and Bottom)
- f. Water tanks / Sump tank
 - On water face = 40mm (Top and Bottom)
 - On other face = 40mm (Top and Bottom)

3.1.8 Development Length

Unless otherwise specified in the good for construction drawing, the Development length of 50 times diameter of bar is to be considered in the BBS & Fabrication..

3.1.9 Soil Parameters

Based on the soil test report no: TJE/002968/2023, 4 no of bore holes were done at different locations of the plot spreaded across the building foot print. All the bore holes are terminated in the range of 22m to 23m at very dense layer with N value more than 100. Based on the soil test report, it is concluding that soil strata is not similar in BH-01, BH-02, BH-03, & BH-4 location. Here we list out the Bore Hole No:1 sub soil Profile.

As per the bore log data the top layer up to 0.5m is filled up soil, 0.5m to 1.1m is silty sandy clay, followed by 1.1m to 3.8m is loose to medium dense silty sand (N=9-12), 3.8m to 10m is soft to medium stiff sand silty clay (N=4-7), and 10m to 11.6m loose clayey silty sand (N=9), 11.6m to 17.7m medium stiff silty clay (N=5-7), 17.7m to 18.3m dense silty clayey sandy gravel (N=>100), 18.3m to 20m very dense sandy gravel (N=>100).

3.2 Loading Standards

Table: Structural Configuration and Floor heights:

Residential building	Basement+Stilt + 5 Floors + Roof
Stilt Floor height	3.3m
1 st to 5 th Floor height	3.0m
Roof	3.0m
Head Room	2.5m
OHT	2.5m
Type of Foundation	Pile
Grade of concrete Pile & pile cap	M30
Grade of concrete for Columns & RC Walls	M30
Grade of concrete for RC beams	M30
Grade of concrete for RC slabs	M30
Grade of Steel	Fe 500



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Table: Unit Weight of Materials:

Material	Density
Reinforced Cement Concrete	25.00 kN/m ³
Plain Cement Concrete	24.00 kN/m ³
Screed Concrete	24.00 kN/m ³
Cement Mortar	20.00 kN/m ³
Structural Steel	78.50 kN/m ³
Brickwork(AAC block)	7.5 kN/m ³
Dry soil	18.00 kN/m ³
Wet Soil	22.00 kN/m ³
Landscape soil	16.00 kN/m ³
Glass	28.00 kN/m ³
water	10.00 kN/m ³

Table: Gravity Load Calculations:

Floor Slab:	
Self weight of 125 mm thick Slab	$0.125 \times 25 = 3.125$ kN/Sq.mt.
Self weight of 150 mm thick Slab	$0.150 \times 25 = 3.750$ kN/Sq.mt.
Self weight of 175 mm thick Slab	$0.175 \times 25 = 4.375$ kN/Sq.mt.
Self weight of 200 mm thick Slab	$0.200 \times 25 = 5.000$ kN/Sq.mt.
Self weight of 250 mm thick Slab	$0.250 \times 25 = 6.250$ kN/Sq.mt.

Residential building External/Internal Wall Line Load:	
Stilt Floor	$= (0.20 \times 2.85 \times 7.5) + (0.03 \times 2.85 \times 20) = 6$ kN/m
Stilt Floor	$= (0.10 \times 2.85 \times 7.5) + (0.03 \times 2.85 \times 20) = 3.9$ kN/m
1st Floor to 5 th floor	$= (0.20 \times 2.55 \times 7.5) + (0.03 \times 2.55 \times 20) = 5.5$ kN/m
1st Floor to 5 th floor	$= (0.10 \times 2.55 \times 7.5) + (0.03 \times 2.55 \times 20) = 3.5$ kN/m
Terrace Parapet Wall	$= (0.20 \times 1.5 \times 7.5) + (0.03 \times 1.5 \times 20) = 3.15$ kN/m



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3.2.1 Imposed Loads on Slab

The following are the imposed loads in the structural slabs, in addition to the self-weight and the floor finishes. *(Self-weight of slab will be as per the thickness mentioned in the respective drawings. Floor finishes of 50/75/100 mm thickness have been considered on all floors).*

Table: Superimposed Dead Load (SDL) & Live Load (LL)

FIRST FLOOR (BADMINTON COURT/KIDS PLAY/JOGGING TRACK)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	5.0
Filling	6.0	0.0
Total	7.25	5.0
(Gym/Indoor games/Yoga/Theatre)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	4	0.0
Live Load	0.0	5.0
Partition Load	-	0.0
Total	4	5.0
(Toilet)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	2.0
Filling	2.0	0.0
Total	3.25	2.0
(Corridors)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	3.0
Partition Load	-	0.0
Total	1.25	3.0
(Store Room)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	5.0
Partition Load	-	0.0
Total	1.25	5.0
(Balcony)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	3.0
Filling	3.0	0.0
Total	4.25	3.0



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(Utility)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	2.0
Filling	3.0	0.0
Total	4.25	2.0
(Open terrace)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	3.0	0.0
Live Load	0.0	3.0
Filling	0.0	0.0
Total	3.0	3.0
(Living/Dining/Kitchen/Sit out/Bed room)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	2.0
Filling	0.0	0.0
Total	1.25	2.0

FIRST FLOOR TO 5TH FLOOR		
(Toilet)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	2.0
Filling	2.0	0.0
Total	3.25	2.0
(Corridors)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	3.0
Partition Load	-	0.0
Total	1.25	3.0
(Balcony)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	3.0
Filling	3.0	0.0
Total	4.25	3.0



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(Utility)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	2.0
Filling	3.0	0.0
Total	4.25	2.0
(Living/Dining/Kitchen/Sit out/Bed room)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.25	0.0
Live Load	0.0	2.0
Filling	0.0	0.0
Total	1.25	2.0
(Terrace)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	3.0	0.0
Live Load	0.0	3.0
Filling	0.0	0.0
Total	3.0	3.0
(LMR/OHT)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	3.0	0.0
Live Load	0.0	20.0
Filling	0.0	0.0
Total	3.0	20.0

Permissible reduction in imposed load on each floor is considered for design of columns and foundation as per IS 875 Part (2), clause.3.2.

The proposed structure is a RCC framed structure, with columns and shear walls forming vertical components. In which, the vertical structural systems are formed such that the RC columns are transfers its base shear in proportion to its stiffness in their loading direction of wind & seismic.

4. PROPOSED APPROACH OF STRUCTURAL ANALYSIS

The building comprises of R.C.C columns and walls connected by beams as framed structure. Slabs acting as rigid in-plane diaphragms have been considered. After preliminary sizing of various structural members, a computer model of the structural frame of the building is generated for carrying out computer analysis for the effects of vertical and lateral loads that are likely to be imposed on the structure.



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The building structure has been analyzed using the ETABS V21 software for the following computer models of the building floor analysis of all floors - for vertical loads with the entire building space frame. ETABS V21 have been thoroughly tested, validated and recognized internationally by several organizations and are well suited for the analysis of building systems.

Geometrical dimensions, member properties and member-node connectivity, including eccentricities will be modeled in the analysis problem. Variations in material grades, if present, will also be considered. The permissible values of the load factors and stresses will be utilized within the purview of the Indian Standards.

The computer analysis will produce accurate individual member forces, reactions at foundation level and deflection pattern of the entire structure as well as individual members. This data will then be used to confirm/review the member sizes and arrive at the most appropriate design of the structural members. Some re-runs of the analysis program might be required for arriving at the optimum structural space frame characteristics that satisfy the strength and stability criteria in all respects.

Design of different structural elements will be carried out using In-house developed spreadsheets and packages.

The following model assumptions used in E-TABS 3D modeling and the load applications are done as listed below,

Column	: Frame Element
Beam Element	: Frame Element
RC Wall & Slab	: Shell Element

- Modulus of Elasticity of Concrete $= 5000\sqrt{f_{ck}}$
- Consideration of Diaphragm - Rigid Diaphragm.
- Slab element is considered as Shell element

The structural model and its behavior have been checked for the following

- a) Storey Drift.
- b) Storey Weight/Column Loading.
- c) Soft Storey Effect.

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d) Deformation.

e) Design Forces.

The following methods of modeling are adopted in creating ETABS 3D model,

- The 3D ETABS model generated based on the shuttering drawing prepared using preliminary sizes.
- Sectional properties are assigned to all the structural elements as per the preliminary shuttering drawing.
- Mesh size assigned in size of 1m x 1m appx.
- External & Internal filler wall loads are assigned as uniformly distributed line load on beams and as area load if the wall is intended to distribute on slab directly. These loads are assigned under SDL type load case.
- Slabs are modeled as shell element in Flat slab area and the same has been modeled as shell in Beam-slab system which 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/SIDL 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 875-2015.
- Temperature loads are applied on to the terraces which are directly exposed to sun .
- 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 0.01 to torsional constant "J". Hence no specific design for Torsion is required for these beams.
- **Chennai is Zone-III.** Hence ductile detailing is followed in the design and detailing of structural elements.
- Concrete cover to reinforcement complied accordance with IS 456-2000, Table 16 & 16A.
- All vertical wall elements are assigned with auto meshing/manual meshing appropriately in order to achieve accuracy in results.
- UG Sump is designed for 0.2mm and STP is designed for the crack width of 0.1mm.
- Secondary beams are not designed for ductile detailing.
- Long term deflections are checked by manual calculation using excel spread sheet wherever necessary. Crack width calculation will be done using spread sheet wherever necessary.

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: Filler wall loads are calculated appropriately considering AAC Blocks and Applied as uniformly distributed line load.



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Lateral Load Resisting Systems: The vertical structural systems are formed by both RC wall & columns which are responsible in transferring its base shear in proportion to its stiffness in their loading direction for both wind & seismic forces.

5.0. LATERAL LOADS

5.1 Wind Loads

The wind pressure shall be calculated based on the basic wind speed and other provisions laid in IS 875 (part 3) – 2015. The basis wind speed considered in the analysis for **Chennai, TN** is 50 m/sec. The design parameters for wind load calculation are as follows,

Design Wind Pressure $V_z = 0.6 V_z^2$

But $V_z = V_b * k_1 * k_2 * k_3 * k_4$

Where V_z - Design Wind Speed

k_1 – 1.0 probability factor or risk coefficient

k_2 – 1.07, Terrain height (18.3m), structure size factor

(measured from Basement floor) with terrain Category-2

k_3 – 1.0, Topography factor

k_4 – 1.0, Importance factor for the cyclonic region, for all other

Structure as per IS 875-Part3, clause 6.3.4.

Hence the Wind Pressure $= 0.6 \times (50 \times 1.0 \times 1.07 \times 1.0 \times 1.0)^2$
 $= 2862.25 \text{ N/m}^2 \approx 2.87 \text{ kN/m}^2$

Design Wind Pressure (P_d) = $K_d * K_a * K_c * P_z$

Where K_d - 0.9, wind directionality factor

K_a - 0.8, area averaging factor

K_c - 0.9, combination factor

Design Wind Pressure (P_d) = $0.9 \times 0.8 \times 0.9 \times 1.9$
 $= 1.86 \text{ kN/m}^2$

The design wind load will be calculated based on the surface area with the calculated design wind pressure and it shall be applied on surface area of the building in both the orthogonal direction.



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5.2 Earthquake Loads

Chennai is classified under Earthquake **Zone III** (Moderate) as per the latest classification. The loading due to earthquake shall be assessed based on the provisions of IS 1893 – 2016. The design parameters adopted are as follows:

Seismic Zone III with seismic zone factor $Z = 0.16$ (Moderate) and Response reduction factor is to be 5.0 considering RC Building with SMRF as per IS: 1893-2016, Table-7 and Soil considered as Type-I Hard soil.

Base Shear Calculation for Static Analysis

As per IS 1893:2016, the total design lateral force or design seismic base shear (V_b) is determined by the following expression.

$$V_b = A_h W$$

Where A_h is Design horizontal acceleration spectrum value using fundamental natural period and W is Seismic weight of the building.

The Seismic weight is estimated based on Full dead load + 25 % Live load for Residential building i.e. for Live Load < 3 kN/Sq.mt. the reduction considered is 25%.

The Fundamental natural period of vibration (T_a) in seconds of a RC building is estimated by using the following formula, $T_a = 0.09 \cdot h / (d)^{0.5}$.

Where h is the height of the building in meters. d is the base dimension of the building at the plinth level, in m along the considered direction of the lateral force.

Height of the building	= 18.3 m (measured from stilt floor)
d (along-y, length of the building)	= 44.24 m
b (along-x breadth of the building)	= 36.14 m
T_a (along x)	= $0.09 \times 18.3 / (42.05)^{0.5}$
	= 0.25 Sec.
T_a (along y)	= $0.09 \times 18.3 / (90.2)^{0.5}$
	= 0.18 Sec.

From IS 1893: 2002, Clause 6.4.2, Design horizontal seismic coefficient

$$A_h = \frac{Z I S_a}{2 R g}$$

Where,

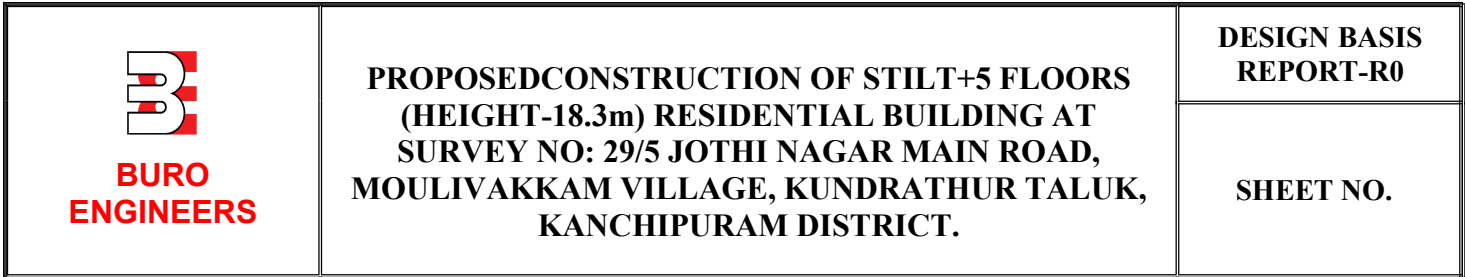
Z for Zone III = 0.16

I for Important buildings = 1.2 (Refer to IS 1893-2016, Table.8)

R for RC Building with Special Moment resisting Frame i.e. SMRF = 5.0 as per (Table 9).

S_a/g (Hard soil) X-Dir. = 2.5 (Refer to IS 1893-2016, page 13, Fig 1)

S_a/g (Hard soil) Y-Dir. = 2.5 (Refer to IS 1893-2016, page 13, Fig 1)



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Design horizontal seismic coefficient A_{hx} = 0.06
Base Shear V_{bx} = 0.06W

Design horizontal seismic coefficient A_{hy} = 0.06
Base Shear V_{bv} = 0.06W

5. LOAD COMBINATIONS

The various loads shall be combined in accordance with the stipulations in IS 875 (Part 5) 1987 and IS 456: 2000. The structural elements shall be designed for the combination that produces most unfavorable effect out of the following combinations.

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

Load Combination		LOAD FACTORS								
		D.L.	I.L.	T.L	EQX	EQY	SPECX	SPECY	WX	WY
	Limit State Of Serviceability (LSS) Combinations									
	LC1	1.0	-	1.0	-	-	-	-	-	-
	LC2	1.0	1.0	1.0	-	-	-	-	-	-
	LC3	1.0	-	1.0	1.0	-	-	-	-	-
	LC4	1.0	-	1.0	-1.0	-	-	-	-	-
	LC5	1.0	-	1.0	-	1.0	-	-	-	-
	LC6	1.0	-	1.0	-	-1.0	-	-	-	-
	LC7	1.0	-	1.0	-	-	-	-	1.0	-
	LC8	1.0	-	1.0	-	-	-	-	-1.0	-
	LC9	1.0	-	1.0	-	-	-	-	-	1.0
	LC10	1.0	-	1.0	-	-	-	-	-	-1.0
	LC11	1.0	-	1.0	-	-	1.0	-	-	-
	LC12	1.0	-	1.0	-	-	-1.0	-	-	-
	LC13	1.0	-	1.0	-	-	-	1.0	-	-
	LC14	1.0	-	1.0	-	-	-	-1.0	-	-
	LC15	1.0	0.8	1.0	0.8	-	-	-	-	-
	LC16	1.0	0.8	1.0	-0.8	-	-	-	-	-
	LC17	1.0	0.8	1.0	-	0.8	-	-	-	-
	LC18	1.0	0.8	1.0	-	-0.8	-	-	-	-
	LC19	1.0	0.8	1.0	-	-	-	-	0.8	-
	LC20	1.0	0.8	1.0	-	-	-	-	-0.8	-
	LC21	1.0	0.8	1.0	-	-	-	-	-	0.8
	LC22	1.0	0.8	1.0	-	-	-	-	-	-0.8
	LC23	1.0	0.8	1.0	-	-	0.8	-	-	-
	LC24	1.0	0.8	1.0	-	-	-0.8	-	-	-
	LC25	1.0	0.8	1.0	-	-	-	0.8	-	-
	LC26	1.0	0.8	1.0	-	-	-	-0.8	-	-
	Limit State Of Collapse (LSC) Combinations									



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COMB1	1.5	-	1.0	-	-	-	-	-	-
COMB2	1.5	1.5	1.0	-	-	-	-	-	-
COMB3	1.2	1.2	1.0	1.2	-	-	-	-	-
COMB4	1.2	1.2	1.0	-1.2	-	-	-	-	-
COMB5	1.2	1.2	1.0	-	1.2	-	-	-	-
COMB6	1.2	1.2	1.0	-	-1.2	-	-	-	-
COMB7	1.2	1.2	1.0	-	-	-	-	1.2	-
COMB8	1.2	1.2	1.0	-	-	-	-	-1.2	-
COMB9	1.2	1.2	1.0	-	-	-	-	-	1.2
COMB10	1.2	1.2	1.0	-	-	-	-	-	-1.2
COMB11	1.2	1.2	1.0	-	-	1.2	-	-	-
COMB12	1.2	1.2	1.0	-	-	-1.2	-	-	-
COMB13	1.2	1.2	1.0	-	-	-	1.2	-	-
COMB14	1.2	1.2	1.0	-	-	-	-1.2	-	-
COMB15	1.5	-	1.0	1.5	-	-	-	-	-
COMB16	1.5	-	1.0	-1.5	-	-	-	-	-
COMB17	1.5	-	1.0	-	1.5	-	-	-	-
COMB18	1.5	-	1.0	-	-1.5	-	-	-	-
COMB19	1.5	-	1.0	-	-	-	-	1.5	-
COMB20	1.5	-	1.0	-	-	-	-	-1.5	-
COMB21	1.5	-	1.0	-	-	-	-	-	1.5
COMB22	1.5	-	1.0	-	-	-	-	-	-1.5
COMB23	1.5	-	1.0	-	-	1.5	-	-	-
COMB24	1.5	-	1.0	-	-	-1.5	-	-	-
COMB25	1.5	-	1.0	-	-	-	1.5	-	-
COMB26	1.5	-	1.0	-	-	-	-1.5	-	-
COMB27	0.9	-	1.0	1.5	-	-	-	-	-
COMB28	0.9	-	1.0	-1.5	-	-	-	-	-
COMB29	0.9	-	1.0	-	1.5	-	-	-	-
COMB30	0.9	-	1.0	-	-1.5	-	-	-	-
COMB31	0.9	-	1.0	-	-	-	-	1.5	-
COMB32	0.9	-	1.0	-	-	-	-	-1.5	-
COMB33	0.9	-	1.0	-	-	-	-	-	1.5
COMB34	0.9	-	1.0	-	-	-	-	-	-1.5
COMB35	0.9	-	1.0	-	-	1.5	-	-	-
COMB36	0.9	-	1.0	-	-	-1.5	-	-	-
COMB37	0.9	-	1.0	-	-	-	1.5	-	-
COMB38	0.9	-	1.0	-	-	-	-1.5	-	-

DL: Dead Load **EQX** : Earthquake Load in X-dir. **WX:** Wind Load in X-dir.

IL: Imposed Load **EQY** : Earthquake Load in Y-dir. **WY:** Wind Load in Y-dir. **TL:** Temperature Load

6. COVER AND FIRE RATING

Fire rating considered - 2hrs. Cover to reinforcement considered for various elements are as follows.

Pile & pile cap	75 mm
Columns	40 mm
RC Wall	40 mm
Beams	30 mm
Slabs	30 mm



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7. DEFLECTION CRITERIA

7.1 Lateral Deflection (Wind)

Overall Deflection < Height/500

Storey Deflection < Storey height/500

7.2 Lateral Deflection (Seismic)

Overall Drift < H / 250

Storey Drift < 0.004 times storey height

7.3 Vertical Deflection of Beams and Slabs due to Gravity Loads

Total Deflection (DL + LL) < Span/250 up to 20 maximum

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

8. DESIGN OF STRUCTURAL ELEMENTS

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 with consideration for strength and durability. The grade of concrete adopted in the Analysis and Design is M30 for Columns and RC wall, M30 For Beam, slab, Pile & Pile cap, underground sump etc., considering the level of stresses to be borne by the members both in compression as well as flexural.

High Yield Strength Deformed bars conforming to IS: 1786 with $F_y = 500$ MPa will be used as reinforcement. Structural steel, if any with $F_y = 250$ Grade shall be used.

Covers to reinforcement shall be in accordance with IS: 456:2000 corresponding to **moderate exposure conditions** for the super-structure or severe exposure conditions for the sub-structure and to satisfy a fire rating of 2 hrs as per National building code of India- SP7 (part IV).



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8. FOUNDATION

As per the column load intensity and the Soil consultant recommendation laid down in the report, the building is designed with Pile Foundation. The foundation is designed to be a pile with the depth of 22m from EGL over weathered Rock stratum with the "N" value more than 100 at a depth of 22m & below from existing ground level.

9. STABILITY OF STRUCTURES

1. For the purpose of stability of the structure as a whole against overturning, the restoring moment shall not be less than 1.2 times the maximum overturning moments due to dead load plus 1.4 times the maximum overturning moments due to imposed loads. In case where dead load provides the restoring moments only 0.9 times in dead load shall be considered. The restoring moments due to imposed loads shall be ignored.
2. The factor of safety against sliding shall not be less than 1.40.
3. Factor of safety against buoyancy shall be not less than 1.20 ignoring the superimposed loading.

12.0 OTHER DATA

Specific requirements of floor and wall cutouts for services, sinking (extent & depth) of floors in services, kitchen, utility and toilet areas, external architectural features, and entrance canopies are provided as required by Architects and Service Consultants. The relevant information is obtained from them in the form of drawings.

Lift loads and lift machine room equipment and cut out layouts will be obtained from the lift manufacturers. An impact factor of 100% will be considered in the lift supporting structures.

13.0 R.C Design

The structures are analyzed for the various load combinations as per IS: 456-2000. The design of structural elements are carried out by ETABS/RCDC Connect V11 for all structural elements for the worst forces extracted from the ETABS analysis output whereas the slab design is being done using in house spread sheet. For the design of R.C.C structural elements carried out, the recommendations stipulated in IS: 456-2000 is followed. Limit State method of design is adopted with appropriate load factors with the various load combinations for the different structural elements appropriately.



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13.1. Foundation

The building is designed with Pile Foundation. The foundation is designed to be a pile depth of 22m from EGL over weathered Rock stratum with the “N” value more than 100 at a depth of 22m from existing ground level. pile Foundation has been designed using vertical load carrying Capacity of 1000 kN for 500 dia pile and 1450 kN for 600 dia pile .The foundation is designed considering the load intensity of the columns and the load carrying capacity recommended in the soil Investigation Report No:TJE/002968/2023. Soil Investigation carried out by T.J.Engineers.

13.2. Column/Wall

Vertical elements carry both gravity and lateral loads like Columns are designed for the worst combination results using ETABS/RCDC/in house spread sheet.

13.3. Beam

Beams are designed for the worst combination results using ETABS/RCDC/in house spread sheet.

13.4. Slab

Slabs are designed using in house spread sheet as per IS-456 Annex-D, Table-26.

14.0 COMPUTER PROGRAMS USED

The following Software / spreadsheet are used to carry out Structural design.

- | | | |
|------|--|--|
| 14.1 | PROKON Ver 3.0 | - Basement Wall & STP design |
| 14.2 | ETABS V21 | - Three-Dimensional FEM analysis and Design Programs |
| 14.3 | SAFE Ver 20.3.0 | - Raft Slab Analysis & Design |
| 14.4 | In-House Spreadsheet | - One way/ Two-way slab design |
| 14.5 | RCDC Connect Edition V11 - Design Software for all Structural Elements except Raft | |



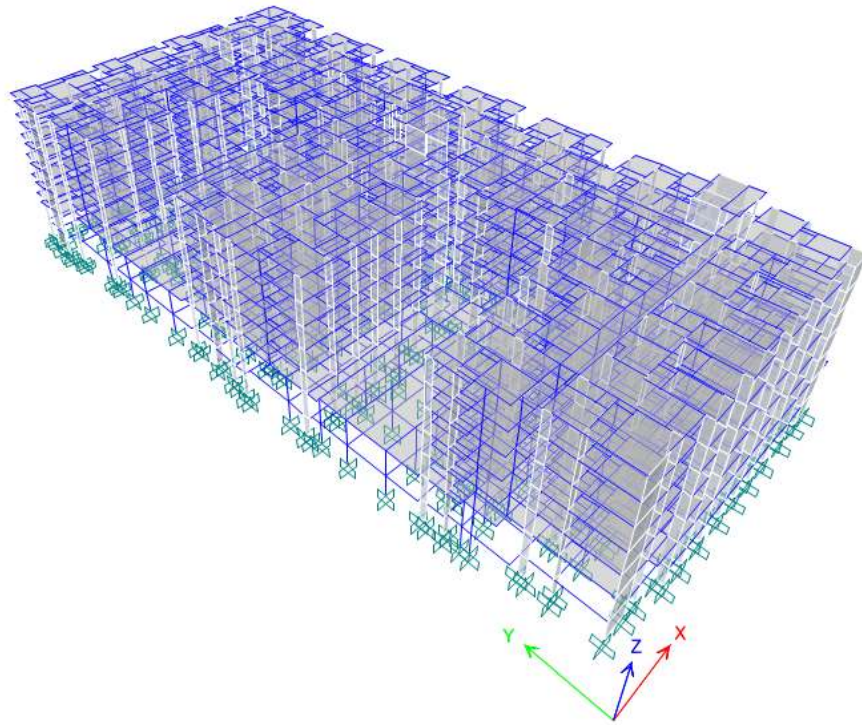
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**3D MODEL
&
ANALYSIS SUMMARY REPORT**



User Report

13-03-2024

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1 Structure Data

This chapter provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

1.1 Story Data

Table 1.1 - Story Definitions

Tower	Name	Height m	Master Story	Similar To	Splice Story	Color
T1	HAEAD ROOM	3	No	None	No	Red
T1	TERRACE	3	No	None	No	Red
T1	5TH	3	No	None	No	Red
T1	4TH	3	No	None	No	Red
T1	3RD	3	No	None	No	Red
T1	2ND	3	Yes	None	No	Red
T1	1ST	3.6	No	2ND	No	Red
T1	STILT	2.5	No	None	No	Red

2 Properties

This chapter provides property information for materials, frame sections, shell sections, and links.

2.1 Materials

Table 2.1 - Material Properties - Concrete Data

Material	Fc MPa	LtWtConc	IsUserFr	SSCurveOpt	SSHysType	SFf mm/mm	SCap mm/mm	FinalSlope	FAngle deg	DAngle deg
M30	30	No	No	Mander	Concrete	0.002191	0.005	-0.1	0	0
M40	40	No	No	Mander	Concrete	0.00253	0.005	-0.1	0	0

Table 2.2 - Material Properties - Rebar Data

Material	Fy MPa	Fu MPa	Fye MPa	Fue MPa	SSCurveOpt	SSHysType	SHard mm/mm	SCap mm/mm	FinalSlope
HYSD415	415	485	456.5	533.5	Simple	Kinematic	0.02	0.12	-0.1
HYSD500	500	545	550	599.5	Simple	Kinematic	0.02	0.12	-0.1

Table 2.3 - Material Properties - Tendon Data

Material	Fy MPa	Fu MPa	SSCurveOpt	SSHysType	FinalSlope
Tendon	1720	1890	270 ksi	Kinematic	-0.1

Table 2.4 - Material Properties - Other Data

Material	SSHysType	FAngle deg	DAngle deg
DUMMY	Elastic	0	0

3 Loads

This chapter provides loading information as applied to the model.

3.1 Auto Wind Loading

Table 3.1 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 1 of 3)

Name	Exposure Set	Is Auto Load	Exposure Source	Top Story	Bottom Story	Include Parapet	Parapet Height m	Cp Windward	Cp Leeward	Wind Speed meter/sec
WI X	1	No	Diaphragms	TERRACE	STILT	Yes	1.5	0.8	0.5	50
WI X	1	No								
WI X	1	No								
WI X	1	No								
WI X	1	No								
WI X	1	No								
WI Y	1	No	Diaphragms	TERRACE	STILT	Yes	1.5	0.8	0.5	50
WI Y	1	No								
WI Y	1	No								
WI Y	1	No								
WI Y	1	No								
WI Y	1	No								

Table 3.1 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 2 of 3)

Name	Exposure Set	Terrain Category	Importance Factor	Risk Coefficient	Topography	Width Type	Direction Angle deg	Story	Diaphragm
WI X	1	2	1.00	1	1	Auto	0	TERRACE	D1
WI X	1							5TH	D1
WI X	1							4TH	D1
WI X	1							3RD	D1
WI X	1							2ND	D1
WI X	1							1ST	D1
WI Y	1	2	1.00	1	1	Auto	90	TERRACE	D1
WI Y	1							5TH	D1
WI Y	1							4TH	D1
WI Y	1							3RD	D1
WI Y	1							2ND	D1
WI Y	1							1ST	D1

Table 3.1 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 3 of 3)

Name	Exposure Set	Depth m	X m	Y m
WI X	1	43.9	22.5	48.4
WI X	1	43.9	22.5	48.4
WI X	1	43.9	22.5	48.4
WI X	1	43.9	22.5	48.4
WI X	1	43.9	22.5	48.4
WI X	1	43.9	22.5	48.4
WI Y	1	90.3	22.5	48.4

Table 3.1 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 3 of 3, continued)

Name	Exposure Set	Depth m	X m	Y m
WI Y	1	90.3	22.5	48.4
WI Y	1	90.3	22.5	48.4
WI Y	1	90.3	22.5	48.4
WI Y	1	90.3	22.5	48.4
WI Y	1	90.3	22.5	48.4

3.2 Auto Seismic Loading

Table 3.2 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 1 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Is Auto Load	X Dir?	X Dir Plus Ecc?	X Dir Minus Ecc?	Y Dir?	Y Dir Plus Ecc?	Y Dir Minus Ecc?
EQ X	0.25	0.048	208343.4205	10000.4842	No	Yes	No	No	No	No	No
EQ Y	0.18	0.048	208343.4205	10000.4842	No	No	No	No	Yes	No	No

Table 3.2 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 2 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Ecc Ratio	Top Story	Bottom Story	Period Type	User T sec	Z
EQ X	0.25	0.048	208343.4205	10000.4842	0.05	TERRACE	STILT	User Defined	0.25	0.16
EQ Y	0.18	0.048	208343.4205	10000.4842	0.05	TERRACE	STILT	User Defined	0.18	0.16

Table 3.2 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 3 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	I	R
EQ X	0.25	0.048	208343.4205	10000.4842	1.2	5
EQ Y	0.18	0.048	208343.4205	10000.4842	1.2	5

IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ X according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = X

Structural Period

Period Calculation Method = User Specified

User Period

$$T = 0.25 \text{ sec}$$

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3]

$$Z = 0.16$$

Response Reduction Factor, R [IS Table 9]

$$R = 5$$

Importance Factor, I [IS Table 8]

$$I = 1.2$$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2]

$$\frac{S_a}{g} = 2.5$$

$$\frac{S_a}{g} = 2.5$$

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2]

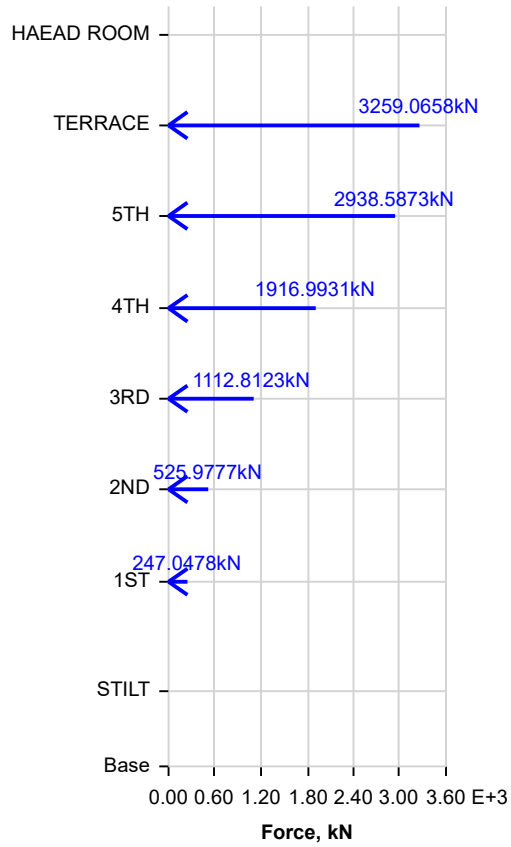
$$A_h = \frac{Z I \frac{S_a}{g}}{2 R}$$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V _b (kN)
X	0.25	208343.4205	10000.4842

Applied Story Forces

Lateral Load to Stories - X



Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
HAEAD ROOM	24.1	0	0
TERRACE	21.1	3259.0658	0
5TH	18.1	2938.5873	0
4TH	15.1	1916.9931	0
3RD	12.1	1112.8123	0
2ND	9.1	525.9777	0
1ST	6.1	247.0478	0
STILT	2.5	0	0
Base	0	0	0

IS 1893:2016 Auto Seismic Load Calculation

This calculation presents the automatically generated lateral seismic loads for load pattern EQ Y according to IS 1893:2016, as calculated by ETABS.

Direction and Eccentricity

Direction = Y

Structural Period

Period Calculation Method = User Specified

User Period

$$T = 0.18 \text{ sec}$$

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3]

$$Z = 0.16$$

Response Reduction Factor, R [IS Table 9]

$$R = 5$$

Importance Factor, I [IS Table 8]

$$I = 1.2$$

Site Type [IS Table 1] = II

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2]

$$\frac{S_a}{g} = 2.5$$

$$\frac{S_a}{g} = 2.5$$

Equivalent Lateral Forces

Seismic Coefficient, A_h [IS 6.4.2]

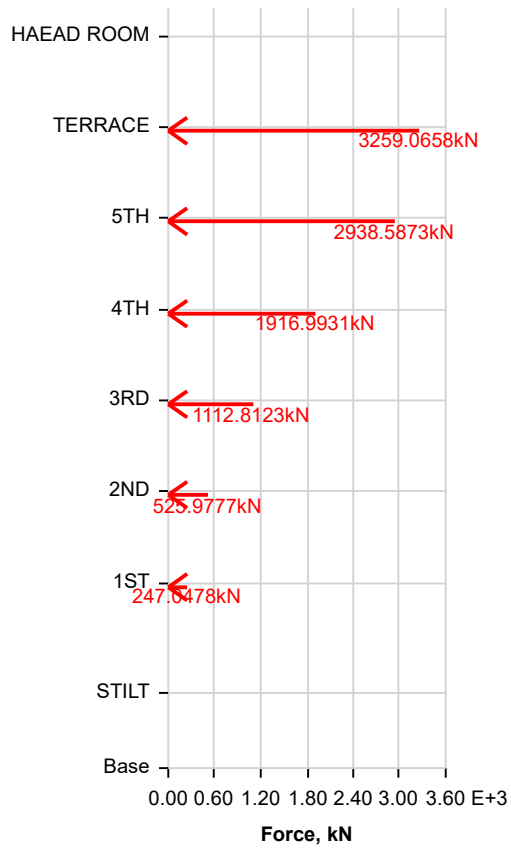
$$A_h = \frac{Z I \frac{S_a}{g}}{2 R}$$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V _b (kN)
Y	0.18	208343.4205	10000.4842

Applied Story Forces

Lateral Load to Stories - Y



Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
HAEAD ROOM	24.1	0	0
TERRACE	21.1	0	3259.0658
5TH	18.1	0	2938.5873
4TH	15.1	0	1916.9931
3RD	12.1	0	1112.8123
2ND	9.1	0	525.9777
1ST	6.1	0	247.0478
STILT	2.5	0	0
Base	0	0	0

3.3 Functions

3.3.1 Response Spectrum Functions

Table 3.5 - Functions - Response Spectrum - IS1893 2016

Name	Period sec	Value	Seismic Zone	I	Soil Type	R	Damping Ratio
Func1	0	0.0192	III	1.2	II	5	0.05
Func1	0.1	0.048					
Func1	0.55	0.048					
Func1	0.8	0.03264					
Func1	1	0.026112					
Func1	1.2	0.02176					
Func1	1.4	0.018651					
Func1	1.6	0.01632					
Func1	1.8	0.014507					
Func1	2	0.013056					
Func1	2.5	0.010445					
Func1	3	0.008704					
Func1	3.5	0.007461					
Func1	4	0.006528					
Func1	4.5	0.006528					
Func1	5	0.006528					
Func1	5.5	0.006528					
Func1	6	0.006528					
Func1	6.5	0.006528					
Func1	7	0.006528					
Func1	7.5	0.006528					
Func1	8	0.006528					
Func1	8.5	0.006528					
Func1	9	0.006528					
Func1	9.5	0.006528					
Func1	10	0.006528					

Table 3.6 - Functions - Response Spectrum - User Defined

Name	Period sec	Value	Damping Ratio
Fun Z	0	0.04	0.05
Fun Z	10	0.04	

4 Analysis Results

This chapter provides analysis results.

4.1 Structure Results

Table 4.1 - Base Reactions (Part 1 of 2)

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
Dead	LinStatic		1.192E-06	0	126192.3337	6191004.14	-3037206
LIVE>3	LinStatic		-6.042E-07	0	5558.1993	273716.7759	-75202.7275
LIVE<3	LinStatic		8.838E-07	0	26932.8885	1316741.5755	-672405.6272
ROOF	LinStatic		0	0	7401.9605	363543.0418	-180910.8258
SDL	LinStatic		0	0	37071.3504	1803407.5461	-840120.6497
WALL	LinStatic		3.025E-06	0	52920.2009	2626672.2323	-1360385
TEMP	LinStatic		-1.902E-06	1.174E-06	8.012E-07	3.715E-05	-0.0001
EQ X	LinStatic		-10000.484	1.263E-05	-1.057E-05	-0.0006	-170659.731
EQ Y	LinStatic		7.186E-07	-10000.4843	1.401E-06	170659.7357	-0.0001
WI X	LinStatic		-3378.5161	0	-2.532E-06	-0.0001	-46358.9272
WI Y	LinStatic		-1.289E-06	-1642.4901	0	22537.7293	-4.242E-05
SPEC X (D)	LinRespSpec	Max	10379.5044	988.7576	5782.881	279572.6715	198141.5375
SPEC Y (D)	LinRespSpec	Max	702.7421	10222.6009	1515.0054	160944.7493	38162.1368
SPEC Z(D)	LinRespSpec	Max	1205.1565	904.7075	26080.4392	1261214.4039	658377.1601
SPEC X(S)	LinRespSpec	Max	3436.4675	327.3599	1914.608	92561.4902	65601.1043
SPEC Y(S)	LinRespSpec	Max	310.43	4515.7418	669.24	71095.8931	16857.7801
1 1DL+1LL	Combination		2.528E-06	0	256076.9334	12575085	-6166231
2 1.5DL+1.5LL	Combination		4.742E-06	-5.272E-07	384115.4002	18862628	-9249346
3 1.2DL+1.2LL+1.2WI X	Combination		-4054.2193	0	307292.3201	15090102	-7455108
4 1.2DL+1.2LL-1.2WI X	Combination		4054.2193	-7.165E-07	307292.3201	15090102	-7343846
5 1.2DL+1.2LL+1.2WI Y	Combination		1.866E-06	-1970.9882	307292.3201	15117148	-7399477
6 1.2DL+1.2LL-1.2WI Y	Combination		4.96E-06	1970.9882	307292.3201	15063057	-7399477
7 1.2DL+1.2LL+1.2SPEC X	Combination	Max	13142.2488	5192.3401	324166.1374	15937567	-6910953
7 1.2DL+1.2LL+1.2SPEC X	Combination	Min	-13142.2487	-5192.3401	290418.5028	14242638	-7888001
8 1.2DL+1.2LL+1.2SPEC Y	Combination	Max	5013.7684	12948.7685	320581.1219	15837919	-7045336
8 1.2DL+1.2LL+1.2SPEC Y	Combination	Min	-5013.7684	-12948.7685	294003.5184	14342285	-7753618
9 1.5DL+1.5WI X	Combination		-5067.7741	5.056E-07	324275.8276	15931626	-7926106
10 1.5DL-1.5WI X	Combination		5067.7741	-8.183E-07	324275.8276	15931626	-7787029
11 1.5DL+1.5WI Y	Combination		2.338E-06	-2463.7352	324275.8276	15965432	-7856568
12 1.5DL-1.5WI Y	Combination		6.205E-06	2463.7352	324275.8276	15897819	-7856568
13 1.5DL+1.5SPEC X	Combination	Max	16427.8109	6490.4251	345368.0992	16990957	-7245913
13 1.5DL+1.5SPEC X	Combination	Min	-16427.8109	-6490.4251	303183.556	14872295	-8467223
14 1.5DL+1.5SPEC Y	Combination	Max	6267.2105	16185.9606	340886.8298	16866397	-7413891
14 1.5DL+1.5SPEC Y	Combination	Min	-6267.2105	-16185.9606	307664.8254	14996855	-8299244
15 0.9DL+1.5WI X	Combination		-5067.7741	1.038E-06	194565.4965	9558975.5264	-4783479
16 0.9DL-1.5WI X	Combination		5067.7741	0	194565.4965	9558975.5267	-4644402
17 0.9DL+1.5WI Y	Combination		0	-2463.7352	194565.4965	9592782.1205	-4713941
18 0.9DL-1.5WI Y	Combination		3.736E-06	2463.7352	194565.4965	9525168.9326	-4713941
19 0.9DL+1.5SPEC X	Combination	Max	16427.8109	6490.4251	215657.7682	10618306	-4103286
19 0.9DL+1.5SPEC X	Combination	Min	-16427.8109	-6490.4251	173473.2249	8499644.9004	-5324596
20 0.9DL+1.5SPEC Y	Combination	Max	6267.2105	16185.9606	211176.4987	10493747	-4271264

Table 4.1 - Base Reactions (Part 1 of 2, continued)

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
20 0.9DL+1.5SPEC Y	Combination	Min	-6267.2105	-16185.9606	177954.4943	8624204.2186	-5156617

Table 4.1 - Base Reactions (Part 2 of 2)

MZ kN-m	X m	Y m	Z m
-0.0002	0	0	0
4.398E-05	0	0	0
-0.0001	0	0	0
-8.004E-06	0	0	0
-1.681E-05	0	0	0
-0.0003	0	0	0
0.0002	0	0	0
492373.1294	0	0	0
-248044.6795	0	0	0
159212.57	0	0	0
-38606.8931	0	0	0
607306.7082	0	0	0
276813.5962	0	0	0
64565.242	0	0	0
201068.3433	0	0	0
122279.9123	0	0	0
-0.0004	0	0	0
-0.0007	0	0	0
191055.0836	0	0	0
-191055.0845	0	0	0
-46328.2723	0	0	0
46328.2713	0	0	0
851664.4311	0	0	0
-851664.4321	0	0	0
574050.217	0	0	0
-574050.218	0	0	0
238818.8545	0	0	0
-238818.8556	0	0	0
-57910.3403	0	0	0
57910.3391	0	0	0
1064580.539	0	0	0
-1064581	0	0	0
717562.7714	0	0	0
-717562.7725	0	0	0
238818.8548	0	0	0
-238818.8553	0	0	0
-57910.34	0	0	0
57910.3394	0	0	0
1064580.5392	0	0	0
-1064581	0	0	0

Table 4.1 - Base Reactions (Part 2 of 2, continued)

MZ kN-m	X m	Y m	Z m
717562.7716	0	0	0
-717562.7722	0	0	0

4.2 Modal Results

Table 4.2 - Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ
Modal	1	1.252	0.4949	0.0002	2.012E-06	0.4949	0.0002	2.012E-06	7.06E-07	0.0295	0.2742
Modal	2	1.071	0.0043	0.7221	8.564E-06	0.4992	0.7224	1.058E-05	0.0116	0.0003	0.015
Modal	3	1.049	0.2525	0.0184	0	0.7517	0.7407	1.063E-05	0.0002	0.0171	0.4397
Modal	4	0.749	0.004	0.0013	1.142E-06	0.7557	0.742	1.178E-05	0.0001	0.0005	0.0243
Modal	5	0.591	0.001	0.0001	3.835E-06	0.7568	0.7421	1.561E-05	1.442E-05	3.421E-05	0.0014
Modal	6	0.398	0.1159	0.0013	2.577E-05	0.8727	0.7434	4.138E-05	0.0003	0.0776	0.019
Modal	7	0.327	0.0035	0.1574	1.128E-05	0.8762	0.9008	0.0001	0.02	0.0016	0.0041
Modal	8	0.292	0.0317	0.0053	0.0001	0.9079	0.9061	0.0002	0.0006	0.0168	0.0627
Modal	9	0.206	0.0541	0.001	0.007	0.962	0.9072	0.0072	6.531E-06	0.0062	0.0054
Modal	10	0.181	0.0034	0.0029	0.1448	0.9655	0.9101	0.1519	0.0046	0.0519	0.0004
Modal	11	0.167	0.0012	0.0582	0.008	0.9666	0.9683	0.1599	0.0035	0.0027	4.75E-05
Modal	12	0.1	0.0002	0.0001	0.6517	0.9669	0.9684	0.8116	0.0003	0.0108	0.0011

Table 4.2 - Modal Participating Mass Ratios (Part 2 of 2)

Case	Mode	SumRX	SumRY	SumRZ
Modal	1	7.06E-07	0.0295	0.2742
Modal	2	0.0116	0.0298	0.2892
Modal	3	0.0118	0.0469	0.7288
Modal	4	0.0118	0.0475	0.7532
Modal	5	0.0119	0.0475	0.7545
Modal	6	0.0121	0.1252	0.7735
Modal	7	0.0322	0.1268	0.7776
Modal	8	0.0328	0.1436	0.8403
Modal	9	0.0328	0.1497	0.8457
Modal	10	0.0374	0.2016	0.8461
Modal	11	0.0409	0.2043	0.8461
Modal	12	0.0411	0.2151	0.8472



**BURO
ENGINEERS**

**PROPOSED CONSTRUCTION OF STILT
FLOOR+5FLOORS(HEIGHT-18.3M) RESIDENTIAL BUILDING
AT SURVEY NO:29/5, JOTHI NAGAR MAIN ROAD,
MOULIVAKAAM VILLAGE, KUNDRATHUR
TALUK,KANCHUPURAM DISTRICT.**

**DESIGN BASIS
REPORT-R0**

SHEET NO.

PILE CAP DESIGN

Project : LIFE STYLE MOULIVAKKAM		BURO ENGINEERS	
Location : CHENNAI		Made by	Date 13-Mar-24
Subject : Pilecap Design		Checked by	Page 1
Marking :			Revision -
TYPE : 2-Pile Group		Job No BEIXXX	

Material f_{cu} = 30 N/mm ² f_y = 500 N/mm ² Cover = 75 mm Reinforcement B1 = 20 mm B2 = 16 mm	Pile (1 = Rect, 2=Circular) Pile type = 2 Diameter = 500 mm Capacity = 1000 kN	Column (1 = Rect, 2=Circular) Col. type = 1 Bc = 300 mm Lc = 900 mm
--	--	---

Load factor = 1.5
Ultimate Column Load = 3000 kN

Pilecap Dimensions Pile spacing, S = 2.5 x pile diameter

B = 400 mm
C = 625 mm
D = 400 mm
F = 75 mm
H = 1100 mm
L1 = 3T12

Bending Moment & Reinforcement (By bending theory)

Choice of moment - 1 = column face, 2 = center of column

	About Y - Y axis	About X - X axis
Moment arm(mm)	250	
Maximum Moment (kNm)	375	
Width, b	800	
Effective depth, d	1015	
$K = M/bd^2f_{cu}$	0.015	
Lever arm, Z	964	
$A_{s_{req}}$ (mm ²)	1144	2706
No. of bars & spacing required	4 T @ 20	16 T @ 145
No. of bars & spacing provided	6 T @ 20	16 T @ 125
$A_{s_{prov}}$ (mm ²)	1886	3218

Shear Check

Shear force = 1500 kN
 $(100A_s/bd)$ = 0.23
 $(400/d)^{1/4}$ = 1.00
Allowable shear stress, V_c = 0.369 mm²/m
Shear span, a_v = 100.00 mm
Enhancement factor = $2d/a_v$ = 20.30
Enhanced shear stress (N/mm²), V_c = 4.38 mm²/m

i) Shear at column face
 $v = 1.23 < 3.50$ **ok!**

ii) Shear along a vertical section at 20% inside pile across the full width of pilecap
 $v = 1.85 < 4.38$ **ok!**

iii) Since pile spacing less or equal to 3 x pile diameter, no check is required

iv) Punching shear check

2.5182 Punching Area
6460 Perimeter bo
0.4575 Punching Shear Stress tv
1.3693 Permissible shear stress
O.K



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TALUK,KANCHUPURAM DISTRICT.**

**DESIGN BASIS
REPORT-R0**

SHEET NO.

SHEARWALL DESIGN

ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
2ND	P32	15950	75250	900	200	0.754

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	30	1	500	415

Design Code Parameters

Γ_s	Γ_c	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	15950	74800	15950	75700	900	200
Bottom	Leg 1	15950	74800	15950	75700	900	200

Flexural Design for P_u , M_{u2} and M_{u3}

Station Location	Required Rebar Area (mm ²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm ²
Top	1781	0.0099	0.0131	19 0.9DL+1.5SPEC X	277.2934	63.0195	103.5234	180000
Bottom	2493	0.0138	0.0131	19 0.9DL+1.5SPEC X	288.8274	69.9227	199.6569	180000

Shear Design

Station Location	ID	Rebar mm ² /m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	500	14 1.5DL+1.5SPEC Y	627.1689	155.6106	-121.3259	92.1319	222.045
Bottom	Leg 1	500	14 1.5DL+1.5SPEC Y	646.8498	246.4296	-121.3259	105.896	235.8091

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top-Left	Leg 1	0	19 0.9DL+1.5SPEC X	676.4354	-0.8122	3.79	8
Top-Right	Leg 1	200	13 1.5DL+1.5SPEC X	993.9699	137.0681	10.6	8
Bottom-Left	Leg 1	200	13 1.5DL+1.5SPEC X	1014.8264	-178.18	12.24	8
Bottom-Right	Leg 1	200	13 1.5DL+1.5SPEC X	1014.8264	204.1642	13.2	8



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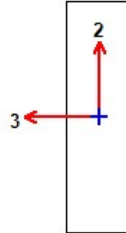
**DESIGN BASIS
REPORT-R0**

SHEET NO.

COLUMN DESIGN

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Column Section Design (Summary)



Column Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
2ND	C79	1608	C 200X700	13 1.5DL+1.5SPEC X	0	3000	0.524	Ductile Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
200	700	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	30	1	500	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3}

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm ²	Rebar % %
1202.6824	24.0536	314.1937	24.0536	33.8355	2738	1.96

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	4.641646	2400	85.6977	99.9495	33.8355
Minor Bend(M2)	0.792455	2400	8.3908	0	24.0536

Shear Design for V_{u2} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm ² /m
Major, V_{u2}	130.4965	133.7708	51.2002	110.6644	221.69
Minor, V_{u3}	38.585	113.1064	39.2005	38.585	775.9

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm ²	Shear Ratio Unitless
Major Shear, V_{u2}	N/N	N/N	N/N	N/N	N/N	N/N
Minor Shear, V_{u3}	N/N	N/N	N/N	N/N	N/N	N/N

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/N	N/N

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm ²	A_{sc} cm ²	P_{uz} kN	P_b kN	P_u kN	k Unitless
1400	27.4	3546.885	1046.5171	1202.6824	0.937543

Additional Moment (IS 39.7.1)

	Consider M_a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_a Moment (kN-m)
Major Bending (M_3)	Yes	0.8	700	15.914	12	Yes	106.6079
Minor Bending (M_2)	Yes	0.8	200	9.509	12	No	0

Notes:

N/A: Not Applicable

N/C: Not Calculated

N/N: Not Needed



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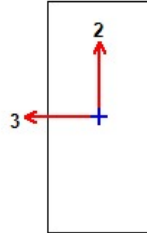
**DESIGN BASIS
REPORT-R0**

SHEET NO.

BEAM DESIGN

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design (Summary)



Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
1ST	B186	1596	B 200X450	20 0.9DL+1.5SPEC Y	3250	3250	1	Ductile Frame

Section Properties

b (mm)	h (mm)	b _f (mm)	d _s (mm)	d _{ct} (mm)	d _{cb} (mm)
200	450	200	0	30	30

Material Properties

E _c (MPa)	f _{ck} (MPa)	Lt.Wt Factor (Unitless)	f _y (MPa)	f _{ys} (MPa)
27386.13	30	1	500	415

Design Code Parameters

γ _c	γ _s
1.5	1.15

Factored Forces and Moments

Factored M _{u3} kN-m	Factored T _u kN-m	Factored V _{u2} kN	Factored P _u kN
-13.9378	0.0114	23.1359	-13.8024

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M _t kN-m	Positive Moment kN-m	Negative Moment kN-m
-13.9378	0.0217	0	-13.9595

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm ²	+Moment Rebar mm ²	Minimum Rebar mm ²	Required Rebar mm ²
Top (+2 Axis)	-13.9595		221	16	94	221
Bottom (-2 Axis)		0	221	16	0	221

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm ² /m
30.5097	0	33.6	10.4353	221.69

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt}/s mm ² /m
0.0031	23.1359	160	410	0



**BURO
ENGINEERS**

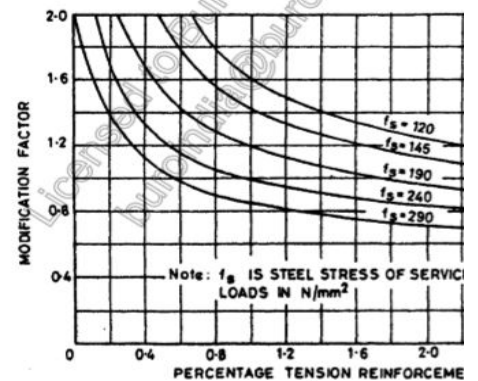
**PROPOSED CONSTRUCTION OF STILT
FLOOR+5FLOORS(HEIGHT-18.3M) RESIDENTIAL BUILDING
AT SURVEY NO:29/5, JOTHI NAGAR MAIN ROAD,
MOULIVAKAAM VILLAGE, KUNDRATHUR
TALUK,KANCHUPURAM DISTRICT.**

**DESIGN BASIS
REPORT-R0**

SHEET NO.

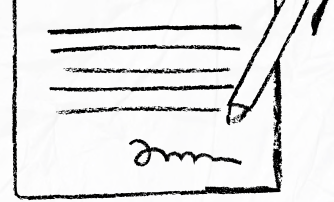
SLAB DESIGN

PROJECT							
DESIGN OF SLAB No:							
1.00	Grade of concrete	=	30.00	N/mm ²	Case No: 9 D+(C-D)*(E-A)/(E-A) Negative Positive A 1.20000 1.20000 B 1.30000 1.30000 C 0.00000 0.07200 D 0.00000 0.07900 E 1.23840 1.23840 Value 0.00000 0.07469		
2.00	Grade of steel	=	500.00	N/mm ²			
3.00	Cover to reinforcement	=	25.00	mm			
	Diameter of bar	=	8.00	mm			
4.00	Aspect ratio $\frac{I_y}{I_x} =$	3.90	1.238	< 2	D E Value		
		3.15					
5.00	Edge condition: Four Edges Discontinuous	Two way slab					
6.00	Modification factor assumed	1.50					
		91.19			ok qa		
7.00	Depth required for deflection:	D =	125.00	mm			
			125.00	mm			
		d =	96.00	mm			
8.00	Dead Load	=	3.00	kN/m ²			
9.00	Live load	=	2.00	kN/m ²			
10.00	Partitions & FF	=	1.25	kN/m ²			
11.00	Total load	=	6.25	kN/m ²			
12.00	Factored load	=	9.38	kN/m ²			
STEP 1	Details		S- SPAN		L-SPAN		
			(-ve)	(+ve)		(-ve)	(+ve)
			support(α_x)	span(α_x)		support(α_y)	span(α_y)
	Co-efficient (IS:456, Table :26)		0.000	0.075		0.000	0.056
	$M_u = \text{Co-efficient} * w * l_x^2$		0.00	6.93		0.00	5.20
	$K = M_u / b d^2$		0.00	0.75		0.00	0.56
	Percentage of steel required		0.00	0.18		0.00	0.13
	Ast required(in mm ²)		0.00	171.04		0.00	127.25
	Ast min (in mm ²)		150.00	150.00		150.00	150.00
	Ast to be provided (in mm2)		150.00	171.04		150.00	150.00
	Provided bars spacing (c/c)		335.24	294.00		335.24	335.24
	max spacing		250.00	250.00		250.00	250.00
	spacing		250.00	250.00		250.00	250.00
	Reqd bars spacing (c/c)		250.00	250.00		250.00	250.00
	Pvd bars spacing (c/c)		200.00	150.00		200.00	200.00
	Ast Provided(in mm ²)		251.43	335.24		251.43	251.43
	Percentage of steel provided		0.26	0.35		0.26	0.26
STEP II	$F_s = 0.58 * f_y * (\text{Ast required} / \text{Ast provided})$						
	F_s				147.96		
	M.F				2.00		
	if assumed modification factor is less than or equal to calculated the section is safe for deflection				safe		
OVERALL DEPTH		D	125.00	mm			
EFFECTIVE DEPT		d	96.00	mm			
STEP III Crack width calculation							
	m	=		7.3			
	E_s	=		200000.0			
	E_c	=		27386.1			
	Pt	=		0.3			
	k	=		0.2			
	x	=		19.4			
	A_{st}	=		335.2			
	I_{cr}	=		16798928.98			
	M	=		6.9			
	f_{st}	=		230.9			
	ϵ_m	=		0.0			
	Spacing	=		150.0			
	a_{cr}	=		79.1			
	ω_{cr}	=		0.10			
				<			
				0.20	mm (safe)		



$$f_s = 0.58 f_y \frac{\text{Area of cross-section of steel required}}{\text{Area of cross-section of steel provided}}$$

FIG. 4 MODIFICATION FACTOR FOR TENSION REINFORCEMENT



our services doesn't just end there



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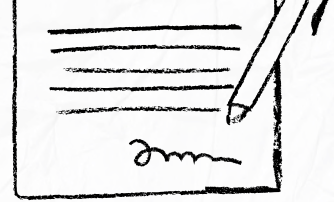
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