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CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
'ThalamuthuNatarajan Building', No.1, Gandhi Irwin Road,
Egmore, Chennai-600 008.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thiru. A. PERAMAIYAN** has enrolled as **Registered Structural Engineer Grade-I (SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E.,(Structural Engg.)** and experience in the relevant field for **17years.**

He has been given the Registration No. **SE/GR-I/2019/03/026** Renewed on **22.03.2024.** He shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part-V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(Ms) No.18 MAWS (MA1) Dept. dated 04.02.2019.

This Registration is valid upto **21.03.2029.**



CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
CHENNAI-600 008.

22/3/24

(A. MEGANATHAN)
Superintendent

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21 years Service of Excellence

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STABILITY CERTIFICATE

1. The detailed engineering and structure design of the proposed Residential Building comprising of STILT FLOOR + 5 RESIDENTIAL FLOORS WITH 15 DWELLING UNITS AVAILING PREMIUM FSI WITH TOD BENFIT AT D.NO.12B, ORIGNALLY PLOT NO. 19, 20 & 21 THIRAVIYAM NAGAR, PORUR, CHENNAI-600116. COMPRISED IN OLD S.NO. 41/1(PART), AND AS PER PATTA S.NO. 4/54 SITUATED IN PORUR VILLAGE, MADURAVOYAL TALUK, CHENNAI DISTRICT, GREATER CHENNAI CORPORATION. DIVISION NO.151, ZONE-11, has been done by me based on the Soil Investigation Report No. TJE/004382/2026 dated 11-06-2026, carried out by M/s. TJ ENGINEERS, Velachery, Chennai.

2. It is certified that among other factors, the proposed building has been designed to resist earthquake. I have checked various parameters and found that the proposed building would be safe.

3. I/We further certify that:

(i) The minimum grade of concrete is M30.

(ii) The design and analysis has been done using the code of practice for plain and reinforced concrete as per IS 456, design loads as per IS Codes No. IS 875 Part 1 to 2, wind forces as per IS 875-2015 (Part3) and design of earthquake resistant structure as per IS Code No. IS 1893-2016.

4. The building will be safe and sound when used for the purpose for which it is designed.

Date : 15-06-2026
Place : Chennai-600 020

Encl.: Structural Design Calculation

Stamp and Signature

A. PERAMAIYAN, M.E. (Struct.), M.I.E.
REGISTERED STRUCTURAL ENGINEER
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STRUCTURAL DESIGN BASIS REPORT

THE PROPOSED CONSTRUCTION OF STILT FLOOR (PARKING) + 5 FLOORS RESIDENTIAL BUILDING (HEIGHT 18.30M) WITH 15 DWELLING UNITS AVAILING PREMIUM FSI WITH TOD BENEFIT AT DOOR NO.12B, ORIGNALLY PLOT NO.19,20&21 THIRAVIYAM NAGAR, PORUR, CHENNAI-600116. COMPRISED IN OLD S.NO.41/1(PART), AND AS PER PATTA S.NO.4/54, SITUATED IN PORUR VILLAGE, MADURAVOYAL TALUK, CHENNAI DISTRICT, GREATER CHENNAI CORPORATION. DIVISION NO.151, ZONE-11.

CLIENT:	M/S **NAVIN HOUSING & PROPERTIES (P) LTD**, CHENNAI.
ARCHITECT:	SRINIVAS & ASSOCIATES, CHENNAI.
STRUCTURAL CONSULTANT:	**BURO ENGINEERS (INDIA) PRIVATE LIMITED,** Chennai

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REV NO.	DATE	DESCRIPTION	STATUS	PREPARED BY	REVIEWED BY	APPRVD. BY
R0	16-06-2026	Design Basis Report	OKAY	ARUN	PERAM	PERAM

Index

- Design Information and criteria
- 3D Model & Analysis summary report
- Design of Foundation
- Design of Shear wall
- Design of Beam
- Design of Slab

DESIGN INFORMATION AND CRITERIA

1.0 INTRODUCTION

M/s.NAVINS Pvt Ltd proposed a construction of Residential Building is located at Porur village, Chennai. Architecturally it is designed with Stilt + 5 Floors + Roof. In which the Stilt floors are designed to facilitate car parks and two wheeler as per norms. Rest of the all floors are designed to accommodate Residential units. It is a linear rectangular building in plan.

1.1 Scope of the Report

This report provides the information on Codes of Practice, Design loads, Materials considered for the Design and Analysis of the building. In addition, this report summaries the main design criteria, Structural system, Foundation system, Parameters & Methodology to be adopted in the design.

1.2 Project Overview

The proposed development is a Residential Apartment building comprises of Stilt + 5 Floors + Roof. Plan dimension of the building at the Stilt level is 24.675m x 12.235m respectively. Vertical access systems like Lift & Staircases are provided adequately & at the right location in order to fulfil the NBC norms and to satisfy the functional requirements as well. The building height & its storey details are as follows,

Sl.No.	No. Of storey	Building Height	Plan dimension at Stilt Level	Remarks
1	Stilt + 5 floors + Terrace	18.3m (measuring from FGL to Terrace)	24.675m x 12.235m	With car parking

Building Floor Height Details	
Stilt Floor (Car Parking)	3.05m
1st Floor to 5th Floor	3.05m
Head Room	2.60m
LMR	5.00m (measured from Roof)

1.3 Proposed Structures and its Usage.

1.3.1 Structural Type

The building structures are mainly cast in situ reinforced concrete structure. The structural system comprises of R.C walls/Columns as vertical supporting structural elements with RC conventional Beam-slab system. Foundation is designed to be strip Raft.

1.3.2 Foundation Type

The foundation system is to be Isolated Footing, Continues Strip Raft Foundation. The Foundation is about 2.10m down from Existing Ground Level. The Foundation will be designed for the recommended Safe Bearing Capacity as laid down in the Soil Investigation report No. TJE/004382/2026_PORUR VILLAGE dated 11th JUNE 2026, was carried out by M/s. TJ ENGINEERS, Velachery, Chennai.

1.4 Concrete

Characteristic concrete strength (concrete grade) for the project shall be based on exposure condition and forces to be supported by specified structural elements. The minimum cement content and maximum water–cement ratio shall be as per IS code 456:2000. The minimum 28-day compressive strength of concrete for specified structural elements shall be as follows,

Table 1.4.1 Grade of Concrete for Individual Structural elements

Sl.No.	Structural Elements	Grade of Concrete
1.	Isolated Footing, Continues Strip Raft	M30
2.	**RC Shear wall**	**M30**
3.	**RC Columns**	**M30**
4.	RC Beams	M30
5.	RC Slabs	M30
6.	UG Sump & STP	M30
7.	Structural members in external services	M25

Table 1.4.2 Concrete Properties

Young's Modulus of Elasticity of Concrete	$5000\sqrt{fck}$
Poisson Ratio's Ratio v =	0.2
Coefficient of Thermal expansion	5.5x10-6

1.4.3 Reinforcement

The characteristic tensile properties of steel used in design shall be as follows.

Reinforcement Characteristic yield strength f_{yk} (N/mm^2)	550 N/mm^2
Welded Steel Fabric yield strength $f_{0.2k}$ (N/mm^2)	485 N/mm^2
Young's Modulus E (kN/mm^2)	200 kN/mm^2
Poisson's ratio	0.3
Coefficient of Thermal expansion, α ($^oC^{-1}$)	12x10^{-6}

1.4.4 Structural steel

All structural steel shall conform to Indian standard IS: 2062-2011.

Structural steel	Grade E=250	Grade E-350
Tensile strength	410 N/mm^2	490 N/mm^2
Yield stress t<20mm	250 N/mm^2	350 N/mm^2
Yield stress t = 20mm to 40mm	240 N/mm^2	330 N/mm^2
Yield stress t> 40mm	230 N/mm^2	320 N/mm^2
Young's Modulus (E)	200,000 N/mm^2	200,000 N/mm^2

Density	78.5 kN/m^3	78.5 kN/m^3

1.5 SUB-SOIL CONDITION

Soil Investigation report no. TJE/004382/2026_PORUR VILLAGE dated 11th JUNE 2026, was carried out by M/s. TJ ENGINEERS, Velachery, Chennai. Field investigation carried out for Two (2) boreholes to ascertain subsoil condition in the proposed site. All the bore holes are terminated at 25.50m respectively in dense layer with "N" value more than 100 encounters. The top soil filled up on 0.0m to 1.40m, Medium dense silty sand on 1.40m to 8.10m, Stiff sandy silty clay on 8.10m to 14.20m, Dense clayey sand on 14.20m to 15.80m, Medium stiff sandy silty clay on 15.80m to 22.60m, Very Dense Clayey Silty clayey gravelly sand on 22.60m to 23.80m, Very dense Sandy gravel 23.80m to 25.00m. During the time of soil investigation (June 2026), Ground water table is encountered at the depth 4.0m, below the existing ground level.

The report has proposed Continues Strip Raft Foundation/Combined/Isolated foundation system with Safe bearing capacity of 17.5 t/m^2.

As per the evaluation reported by the geotechnical consultant the sub-soil in the project site is not susceptibility to "Liquefaction".

Refer the soil report for profile of boreholes and the sub soil conditions.

2.0 DESIGN CRITERIA

2.1 Design Life

The design life of the building is assumed as 50 years. This requirement is applicable only for concrete works and not applicable to replaceable finishing materials, water proofing and thermal insulations, facades etc. Hence periodic maintenance/refurbishment is required for all replaceable materials.

2.2 CODES, STANDARDS & 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 editions 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.

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

Table 2.2.1 Codes and Standards for 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

Table 2.2.2 Codes and Standards for Design of Earthquake Resistance structures

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.

Table 2.2.3 Codes and Standards for Design of Concrete Structures

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 1904-1986(RA-2015)	Indian Standard Code of practice for design & construction foundations in Soil: General Requirements
IS 2950-1981(RA-2018)	Code of practice for design and construction of raft foundations : Part 1 Design (second revision).
IS 1080-1985(Raf.2011)	Code of Practice for Design and Construction of Shallow foundation in Soils
IS 6403-1981(Raf.2011)	Code of practice for determination of bearing capacity of Shallow foundations
IS 2950-1981(Raf.2011)	Code of Practice for Design and Construction of Raft foundations
SP 16	Structural use of concrete, Design charts for singly reinforced beams, doubly reinforced beams and columns.
SP 34	Hand book on Concrete Reinforcement & Detailing
SP 7(Part IV)	National Building code of India
IS 1786-2008(RA-2018)	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)-2009	Code of practice for concrete structure for the storage of liquids

Table 2.2.4 Design of Steel Structural Elements

IS Code	Description
IS 800: 2007(RA-2017)	Code of Practice for General Construction in Steel
IS 2062: 2011(RA-2016)	Steel for General structural purposes

The building is a RCC structure designed with Structural wall System. The slabs of all floor is used as diaphragms in redistribution of lateral forces.

Materials specified will conform to the latest edition of the relevant Indian Standard or other accepted standard. Specifications for materials will include sampling and testing as stipulated in the design standards. Detailed material specifications will be included in the Technical Specification.

2.3 LOADS

Table A: 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
AAC Block	**7.50 kN/m^3**
Structural Steel	78.50 kN/m^3
Cinder Concrete (Filling material)	08.00 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

2.3.1 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 on member sizes shown in the floor plans.

Stilt Floor (Parking)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.4	0.0
Services load (ceiling)	0.0	0.0
Live Load Parking	0.0	5.0
Partition Load	0.0	0.0
Total	**2.4**	**5.0**
First Floor to Fifth Floor (Living/Bedroom/Kitchen)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.8	0.0
Services load (ceiling)	0.0	0.0
Live Load	0.0	2.0
Partition/Filling Load	0.0	0.0
Total	**1.8**	**2.0**
First Floor to Fifth Floor (Toilet)		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)

Finishes	1.8	0.0
Services load (ceiling)	0.0	0.0
Live Load	0.0	2.0
Partition/Filling Load	2.0	0.0
Total	**3.8**	**2.0**
Staircase		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.4	0.0
Services load (ceiling)	0.0	0.0
Live Load	0.0	3.0
Partition/Filling Load	0.0	0.0
Total	**2.4**	**3.0**
Lobby /Corridor		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.4	0.0
Live Load	0.0	3.0
Partition Load	0.0	0.0
Total	**2.4**	**3.0**
Balcony		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	1.8	0.0
Live Load	0.0	3.0
Partition Load\ Filling	2.0	0.0
Total	**3.8**	**3.0**
Head Room		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	2.0	0.0
Live Load	0.0	2.0
Partition Load	0.0	0.0
Total	**2.0**	**2.0**
LMR		
	SDL (kN/Sq.mt.)	LL (kN/Sq.mt.)
Finishes	0.0	0.0
Live Load	0.0	3.0
Lift load	15.0	0.0
Total	**15.0**	**3.0**

In the analysis and design reduction to imposed load (Live load) shall be considered as per IS 875 Part (2), clause.3.2 where it is applicable.

2.5 TEMPERATURE EFFECTS

Temperature changes can cause additional stresses to the structure and has potential to increase in loads will be considered in the design of structural elements. Temperature effects will be considered for an ambient temperature variation from temperature during construction.

The maximum and minimum temperature for city of Chennai as recorded by Indian Metrological Department is as follows.

Maximum mean Temperature	45°C
Minimum mean Temperature	15°C
Average ambient Temperature during construction	30°C

The structural system will be designed for the effect of temperature variation. A temperature variation of **±15° C** will be considered in the structural analysis over the Roof & Terraces for the consideration of thermal effect on structural elements.

2.6 WIND LOAD

Design wind load for the buildings shall be estimated as per IS 875 (Part 3): 2015. Design wind speed (Vz) is based on such as location, basic wind speed, terrain, cyclone condition and topography.

Location of the building	Chennai
Basic Wind speed - Vb m/sec	50 m/sec
Risk Coefficient (Probability factor) -k1	1.0
Terrain factor (Terrain-2) – k2 for the height of 18.3m	1.06
Topography factor – k3	1.0
Importance factor (Cyclonic region) – k4	1.0

Design wind speed (Vz) = Vb*k1*k2*k3*k4 =50x1x1.06x1.0x1.0 = 53.0m/sec

Wind pressure (Pz) = 0.6 Vz^2 = 0.6x 53^2 =1685.4 N/m^2

For design of building wind pressure 1.685 kN/m^2 is considered.

Design wind pressure (P_d) = K_d*K_a*K_c*P_z

Where K_d - Wind Directionality factor = 1.0

Ka – Area averaging factor = 0.99

Kc – Combination factor = 0.9

Design Wind pressure = 1.685x1.0x0.99x0.9 = 1.50 kN/m^2

2.6.1 Dynamic wind analysis

As per IS 875 (Part 3) - 2015, clause 9.1 Dynamic wind analysis has to be carried out if the buildings meet the following criteria.

a). Buildings and closed structures with a height to minimum lateral dimension ratio (H/Wmin) is more than 5. (or)

b). Building and structures whose natural frequency is less than 1.0 Hz.

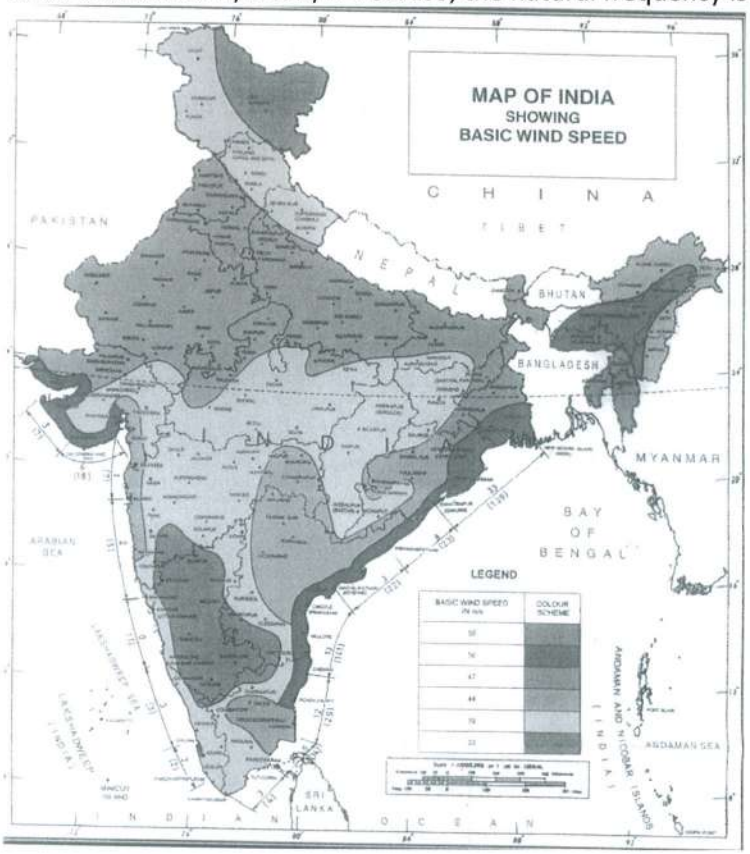
Fundamental period of the building = Ta = 0.09H/(D)^0.5. Fundamental natural frequency 1/Ta >1.0

2.6.2 Time period

Sl.No	Height(m)	B(m)	D(m)	H/B	H/D
	18.3	24.675	12.235	0.742	1.49

Sl.No	Height(m)	B(m)	D(m)	Tax(sec)	Tay(sec)	1/Tax	1/Tay
1	18.3	24.675	12.235	0.337	0.471	2.97	2.123

From the above, it is evident that Dynamic wind analysis for the proposed building is not required, since the ratio of H/B & H/D < 5. Also, the natural frequency is 1/Ta >1.0.



2.7 Seismic Lateral Force

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

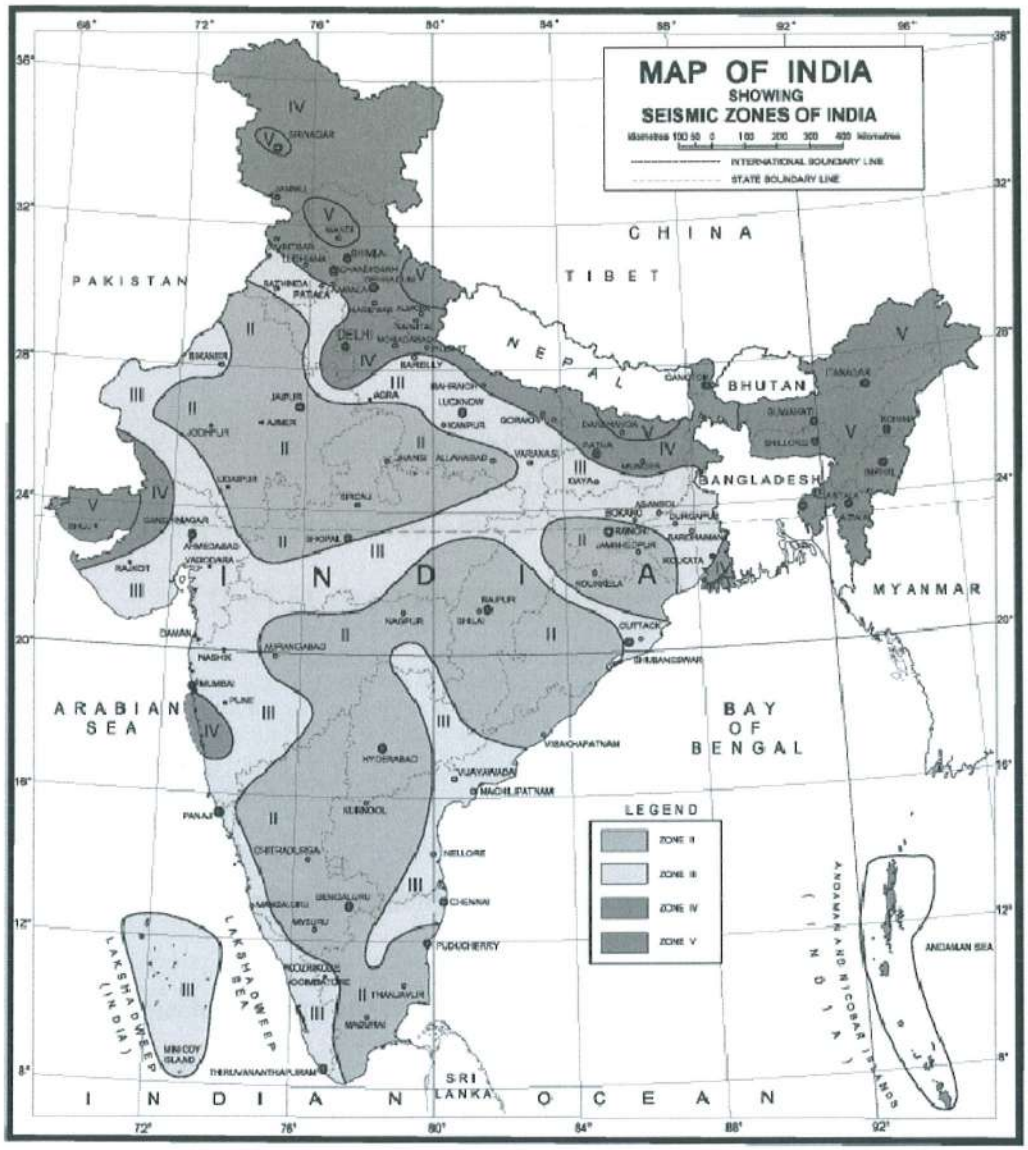
Base shear $V_b = A_h W$

A_h 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).

For the proposed development is for residential use. Considering it, the seismic weight is summation of total dead load, 25% of live load where live load is less than 3 kN/sq.mt and 50% of live load where live load is greater than 3 kN/sq.mt. The fundamental natural period (Ta) for building

$Ta = 0.09h/(d)^{0.5}$

Where h- height of the building & d – width of the building under consideration of earthquake.



2.7.1 Design Parameters for estimation of seismic loading

Sl.No.	Description	Parameters as per IS-1893-2016
1.	Location - Chennai	Seismic zone III
2.	Seismic Zone Factor	0.16
3.	Response Reduction Factor: Structural wall system	4.0
4	Importance factor	1.2
5	Type of Soil (Medium)	Type II
6	Damping coefficient	5%

2.8 Base Shear

Height of the building (h) (measured from Stilt floor)
d (along the length of the building)
b (along the breadth of the building)

a) Ta (along x) = Refer - 2.6.2
b) Ta (along y) = Refer - 2.6.2

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

$$Ah = \frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g}$$

Where,

Z for Zone III = 0.16
I for Residential Building = 1.2 (Refer to IS 1893-2016, Table.9)
R for Structural wall system = 4.0 as per (Table 9)
Sa/g (For medium) X-direction = (Refer to IS 1893-2016, page 13, Fig 1)

Sa/g (For medium) Y-direction = (Refer to IS 1893-2016, page 13, Fig 1)

Design horizontal seismic coefficient and base shear

X- direction Vbx = Ahx * W
Y- direction Vby = Ahy * W

2.9 Dynamic Analysis

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

Time period	: Calculated with the assumption of wall system
Number of modes Considered	: 12 Numbers (Min)
Modal Combination Method Used	: Complete Quadratic combination (CQC)
Spatial Combination Method used	: Square root of the sum of Square (SRSS)
Modal case type	: Ritz Method
Orthogonal directional seismic effect	: Not applicable

3.0 Structural Analysis and design

3.1 Assumptions considered in the design

The assumptions for structural analysis and design are as below

- Elastic analysis (plane remains plane).
- Structure shall be analysed for the most adverse load conditions and envelope of forces shall be designed for.
- Cracked section properties of structural RC structural elements are used in the analysis as per IS 16700-2017, clause 7.2, Table 6.

3.2 Concrete Cover

Concrete cover to the reinforcement in structural elements is based on durability and fire rating. The fire rating of 2hrs is considered for structural elements for the commercial development.

Sl. No.	Structural Elements	Cover in mm
1.	Isolated Footing, Continues Strip Raft	60
2.	RC Wall	30
3.	Column	40
4.	Beams	30
5.	Slabs	25
6.	UG Tank Base Slab/Wall	40

3.3 Method for analysis

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, SAFE shall be used, Prokon, RCDC and verified in-house spread sheets will be used for the design of reinforced concrete (RC) and steel elements in consideration of flexure, shear and axial forces.

3.4 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 -5000Vfck

Consideration of Diaphragm - Rigid Diaphragm.

Slab element considered as membrane 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 intend to distribute on slab directly. These loads are assigned under SDL type load case.
- Slabs are modelled as shell element if floor system is Flat slab and the slab has been modelled as membrane in Beam-slab as 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/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 and to areas 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 0.0001 to torsional constant "J". Hence no specific design for Torsion is required for these beams.
- Chennai falls under zone-III. Hence ductile detailing is required to follow in the design and detailing of structural elements, is adopted.
- Concrete cover to reinforcement complied accordance with IS 456-2000, Table.16 & 16A.
- UG Sump is designed for the crack width of 0.2mm.
- 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: non load bearing or infill wall loads are calculated appropriately and Applied as uniformly distributed line load.

Lateral Load Resisting Systems: The proposed structure is a Structural RC wall Building with floor system of Beam-slab system.

4.0 LOAD COMBINATIONS

The various loads shall be combined in accordance with the stipulations in IS 875 (Part 5) 1987 and IS 456: 2000. The structure will be checked for serviceability Limit State and Ultimate Limit State (Limit State of Collapse) conditions. The load factors to be used for the load combinations are shown in the Table below. The structural elements shall be designed and checked for the critical forces from the combinations.

Load Combination	D.L.	I.L.	EQX	EQY	WX	WY	SPECX	SPECY
Limit State Of Serviceability (LSS) Combinations								
LC1	1.0	-	-	-	-	-	-	-
LC2	1.0	1.0	-	-	-	-	-	-
LC3	1.0	-	1.0	-	-	-	-	-
LC4	1.0	-	-1.0	-	-	-	-	-
LC5	1.0	-	-	1.0	-	-	-	-
LC6	1.0	-	-	-1.0	-	-	-	-
LC7	1.0	-	-	-	1.0	-	-	-
LC8	1.0	-	-	-	-1.0	-	-	-
LC9	1.0	-	-	-	-	1.0	-	-
LC10	1.0	-	-	-	-	-1.0	-	-
LC11	1.0	-	-	-	-	-	1.0	-
LC12	1.0	-	-	-	-	-	-1.0	-
LC13	1.0	-	-	-	-	-	-	1.0
LC14	1.0	-	-	-	-	-	-	-1.0
LC15	1.0	0.8	0.8	-	-	-	-	-
LC16	1.0	0.8	-0.8	-	-	-	-	-
LC17	1.0	0.8	-	0.8	-	-	-	-
LC18	1.0	0.8	-	-0.8	-	-	-	-
LC19	1.0	0.8	-	-	0.8	-	-	-
LC20	1.0	0.8	-	-	-0.8	-	-	-
LC21	1.0	0.8	-	-	-	0.8	-	-
LC22	1.0	0.8	-	-	-	-0.8	-	-
LC23	1.0	0.8	-	-	-	-	0.8	-
LC24	1.0	0.8	-	-	-	-	-0.8	-
LC25	1.0	0.8	-	-	-	-	-	0.8
LC26	1.0	0.8	-	-	-	-	-	-0.8
Limit State Of Collapse (LSC) Combinations								
COMB1	1.0	-	-	-	-	-	-	-
COMB2	1.5	1.5	-	-	-	-	-	-
COMB3	1.2	1.2	1.2	-	-	-	-	-
COMB4	1.2	1.2	-1.2	-	-	-	-	-
COMB5	1.2	1.2	-	1.2	-	-	-	-
COMB6	1.2	1.2	-	-1.2	-	-	-	-
COMB7	1.2	1.2	-	-	1.2	-	-	-
COMB8	1.2	1.2	-	-	-1.2	-	-	-
COMB9	1.2	1.2	-	-	-	1.2	-	-
COMB10	1.2	1.2	-	-	-	-1.2	-	-
COMB11	1.2	1.2	-	-	-	-	1.2	-
COMB12	1.2	1.2	-	-	-	-	-1.2	-
COMB13	1.2	1.2	-	-	-	-	-	1.2
COMB14	1.2	1.2	-	-	-	-	-	-1.2
COMB15	1.5	-	1.5	-	-	-	-	-
COMB16	1.5	-	-1.5	-	-	-	-	-

COMB17	1.5	-	-	1.5	-	-	-	-
COMB18	1.5	-	-	-1.5	-	-	-	-
COMB19	1.5	-	-	-	1.5	-	-	-
COMB20	1.5	-	-	-	-1.5	-	-	-
COMB21	1.5	-	-	-	-	1.5	-	-
COMB22	1.5	-	-	-	-	-1.5	-	-
COMB23	1.5	-	-	-	-	-	1.5	-
COMB24	1.5	-	-	-	-	-	-1.5	-
COMB25	1.5	-	-	-	-	-	-	1.5
COMB26	1.5	-	-	-	-	-	-	-1.5
COMB27	0.9	-	1.5	-	-	-	-	-
COMB28	0.9	-	-1.5	-	-	-	-	-
COMB29	0.9	-	-	1.5	-	-	-	-
COMB30	0.9	-	-	-1.5	-	-	-	-
COMB31	0.9	-	-	-	1.5	-	-	-
COMB32	0.9	-	-	-	-1.5	-	-	-
COMB33	0.9	-	-	-	-	1.5	-	-
COMB34	0.9	-	-	-	-	-1.5	-	-
COMB35	0.9	-	-	-	-	-	1.5	-
COMB36	0.9	-	-	-	-	-	-1.5	-
COMB37	0.9	-	-	-	-	-	-	-1.5
COMB38	0.9	-	-	-	-	-	-	1.5

5.0 ACCEPTANCE CRITERIA

Under Serviceability Limit State the limiting structural deflection shall be as follows.

Total deflection under all imposed loads including temperature, creep and shrinkage shall not exceed **L/250.**
In the above limiting value, the deflection contribution due to temperature, creep and shrinkage shall not be more than **L/350**.

Lateral deflection (sway) due to wind shall not exceed **H/500 (0.002 H)** where H is the height of the building above ground.

5.1 Crack width Limits

The Limiting values of crack width as per clause 35.3 of IS: 456-2000 is followed in the design

- In general, for slabs crack width is limited to 0.3mm.
- For water retaining structures, sump slab crack width is limited to 0.2mm

6.0 Design of Structural Elements and Foundation

6.1. Foundation

The load intensity of column is moderate. As per the soil consultant recommendation Isolated Footing, Continues Strip Raft designed considering the Safe Bearing capacity (SBC) of 17.5 t/m^2 at a depth of 2.10m & below. Refer the Soil Investigation report no. No. TJE/004382/2026_PORUR VILLAGE dated 11th JUNE 2026 for details.

6.2. RC Walls/Column

RC 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 analysis. The design of structural elements are designed in ETABS for the maximum forces obtained from the load combinations. As the buildings are located in Zone III, ductile design & detailing is followed in the design & detailing.

6.3. Beams

Each Beam will be designed for maximum forces from the 3D analysis using ETABS or RCDC concrete design software shall be used to design of RC members. Also, the detailing shall be followed as per SP-34 & IS-456 etc.

6.4. Slabs

Slabs are designed using SAFE 20 for irregular shaped slabs and regular slabs are designed using in house spread sheet formed as per IS-456 Annexe-D, Table-26.

3D Model & Analysis summary report

ETABS®

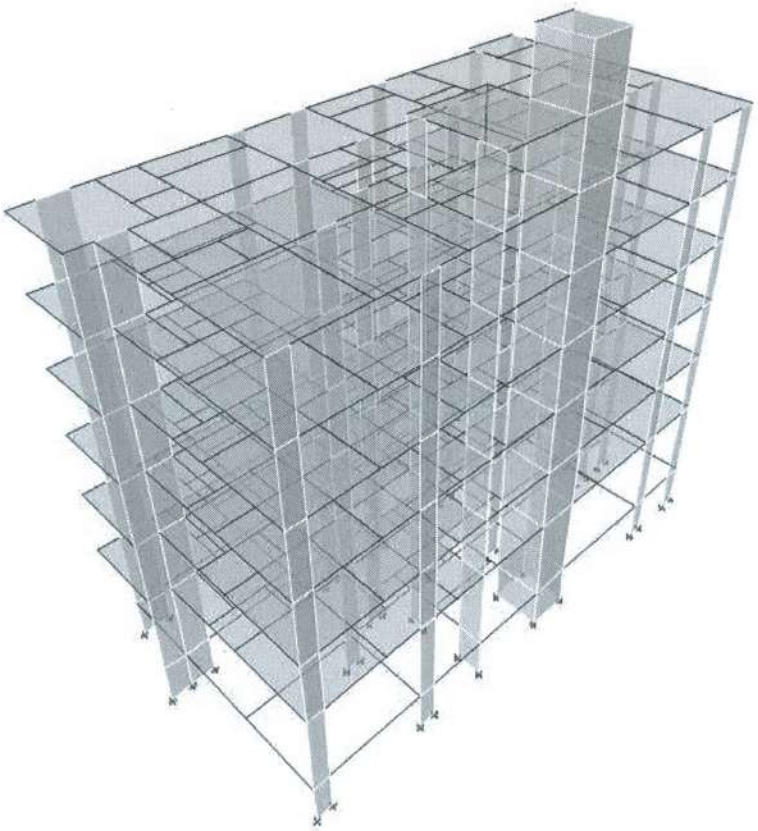


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1 Structure Data

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	LMR Cover	2.4	No	None	No	Blue
T1	LMR Base	2.6	No	None	No	Blue
T1	Terrace	3.05	No	None	No	Blue
T1	5th Floor	3.05	No	None	No	Blue
T1	4th Floor	3.05	No	None	No	Blue
T1	3rd Floor	3.05	No	None	No	Blue
T1	2nd Floor	3.05	No	None	No	Green
T1	1st Floor	3.05	No	None	No	Cyan
T1	Stilt Floor	3.05	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 - General

Material	Type	SymType	Grade	Color	Notes
Dummy	Other	Isotropic	HYSD Grade 550	Yellow	
HYSD415	Rebar	Uniaxial	HYSD Grade 415	Yellow	
HYSD550	Rebar	Uniaxial	HYSD Grade 550	Blue	
M30	Concrete	Isotropic	M30	Magenta	
Tendon	Tendon	Uniaxial	Unknown	Gray8Dark	

2.2 Frame Sections

Table 2.2 - Frame Section Property Definitions - Summary (Part 1 of 3)

Name	Material	Shape	Color	Area cm2	J cm4	I33 cm4	I22 cm4	I23 cm4	As2 cm2	As3 cm2
B 200X450	M30	Concrete Rectangular	Green	900	86596.1	151875	30000	0	750	750
B 200X600	M30	Concrete Rectangular	Cyan	1200	126597.2	360000	40000	0	1000	1000
B 200X750	M30	Concrete Rectangular	Red	1500	166638.5	703125	50000	0	1250	1250
B 300X450	M30	Concrete Rectangular	Blue	1350	238315.2	227812.5	101250	0	1125	1125
B 300X600	M30	Concrete Rectangular	Blue	1800	371118.1	540000	135000	0	1500	1500
C 200X600	M30	Concrete Rectangular	Gray8Dark	1200	126597.2	360000	40000	0	1000	1000
C 300X600	M30	Concrete Rectangular	Blue	1800	371118.1	540000	135000	0	1500	1500
Dummy	Dummy	Concrete Rectangular	Green	0	0	0	0	0	0	0

Table 2.2 - Frame Section Property Definitions - Summary (Part 2 of 3)

Name	S33Pos cm3	S33Neg cm3	S22Pos cm3	S22Neg cm3	Z33 cm3	Z22 cm3	R33 mm	R22 mm	CG Offset 3 mm	CG Offset 2 mm	PNA Offset 3 mm
B 200X450	6750	6750	3000	3000	10125	4500	129.9	57.7	0	0	0
B 200X600	12000	12000	4000	4000	18000	6000	173.2	57.7	0	0	0
B 200X750	18750	18750	5000	5000	28125	7500	216.5	57.7	0	0	0
B 300X450	10125	10125	6750	6750	15187.5	10125	129.9	86.6	0	0	0
B 300X600	18000	18000	9000	9000	27000	13500	173.2	86.6	0	0	0
C 200X600	12000	12000	4000	4000	18000	6000	173.2	57.7	0	0	0
C 300X600	18000	18000	9000	9000	27000	13500	173.2	86.6	0	0	0
Dummy	0	0	0	0	0	0	0	0	0	0	0

Table 2.2 - Frame Section Property Definitions - Summary (Part 3 of 3)

Name	Area Modifier	As2 Modifier	As3 Modifier	J Modifier	I33 Modifier	I22 Modifier	Mass Modifier	Weight Modifier
B 200X450	1	1	1	1	1	1	1	1
B 200X600	1	1	1	1	1	1	1	1
B 200X750	1	1	1	1	1	1	1	1
B 300X450	1	1	1	1	1	1	1	1
B 300X600	1	1	1	1	1	1	1	1
C 200X600	1	1	1	1	1	1	1	1
C 300X600	1	1	1	1	1	1	1	1
Dummy	1	1	1	1	1	1	1	1

2.3 Shell Sections

Table 2.3 - Area Section Property Definitions - Summary

Name	Type	Element Type	Material	Total Thickness mm	Deck Material	Deck Depth mm
S 125	Slab	Shell-Thin	M30	125		
S 150	Slab	Shell-Thin	M30	150		
S 200	Slab	Shell-Thin	M30	200		
W 200	Wall	Shell-Thin	M30	200		
W 300	Wall	Shell-Thin	M30	300		

3 Loads

This chapter provides loading information as applied to the model.

3.1 Load Patterns

Table 3.1 - Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
~Spx (Ser)ECC	Yes	Other	0	
~SpxECC	Yes	Other	0	
~Spy (Ser)ECC	Yes	Other	0	
~SpyECC	Yes	Other	0	
~SpzECC	Yes	Other	0	
Dead	No	Dead	1	
Eqx	No	Seismic	0	IS 1893:2016
Eqy	No	Seismic	0	IS 1893:2016
Filling	No	Super Dead	0	
Live<3	No	Reducible Live	0	
Live>3	No	Reducible Live	0	
Roof Live	No	Roof Live	0	
Sdl	No	Super Dead	0	
Temp	No	Temperature	0	
Wall	No	Super Dead	0	
Wx	No	Wind	0	Indian IS 875:2015
Wy	No	Wind	0	Indian IS 875:2015

3.2 Auto Wind Loading

Table 3.2 - 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
Wx	1	No	Diaphragms	Terrace	Base	Yes	1.2	0.8	0.5	50
Wx	1	No								
Wx	1	No								
Wx	1	No								
Wx	1	No								
Wx	1	No								
Wy	1	No	Diaphragms	Terrace	Base	Yes	1.2	0.8	0.5	50
Wy	1	No								
Wy	1	No								
Wy	1	No								
Wy	1	No								
Wy	1	No								

Table 3.2 - 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
Wx	1	2	1.00	1	1	Auto	0	Terrace	D2
Wx	1							5th Floor	D1
Wx	1							4th Floor	D1

Table 3.2 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 2 of 3, continued)

Name	Exposure Set	Terrain Category	Importance Factor	Risk Coefficient	Topography	Width Type	Direction Angle deg	Story	Diaphragm
Wx	1							3rd Floor	D1
Wx	1							2nd Floor	D1
Wx	1							1st Floor	D1
Wy	1	2	1.00	1	1	Auto	90	Terrace	D2
Wy	1							5th Floor	D1
Wy	1							4th Floor	D1
Wy	1							3rd Floor	D1
Wy	1							2nd Floor	D1
Wy	1							1st Floor	D1

Table 3.2 - Load Pattern Definitions - Auto Wind - Indian IS 875 2015 (Part 3 of 3)

Name	Exposure Set	Depth m	X m	Y m
Wx	1	24.925	16.7625	9.445
Wx	1	24.925	16.7625	9.445
Wx	1	24.925	16.7625	9.445
Wx	1	24.925	16.7625	9.445
Wx	1	24.925	16.7625	9.445
Wx	1	24.925	16.7625	9.445
Wy	1	12.29	16.7625	9.445
Wy	1	12.29	16.7625	9.445
Wy	1	12.29	16.7625	9.445
Wy	1	12.29	16.7625	9.445
Wy	1	12.29	16.7625	9.445
Wy	1	12.29	16.7625	9.445

3.3 Auto Seismic Loading

Table 3.3 - 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?
Eqx	0.337	0.06	26527.7697	1591.6662	No	Yes	No	No	No	No	No
Eqy	0.471	0.06	26527.7697	1591.6662	No	No	No	No	Yes	No	No

Table 3.3 - 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
Eqx	0.337	0.06	26527.7697	1591.6662	0.05	Terrace	Base	User Defined	0.337	0.16
Eqy	0.471	0.06	26527.7697	1591.6662	0.05	Terrace	Base	User Defined	0.471	0.16

Table 3.3 - 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
Eqx	0.337	0.06	26527.7697	1591.6662	1.2	4
Eqy	0.471	0.06	26527.7697	1591.6662	1.2	4

IS 1893:2016 Auto Seismic Load Calculation

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

Direction and Eccentricity

Direction = X

Structural Period

Period Calculation Method = User Specified

User Period $T = 0.337\ sec$

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] $Z = 0.16$

Response Reduction Factor, R [IS Table 9] $R = 4$

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

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X	0.337	26527.7697	1591.6662

Applied Story Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
LMR Cover	26.35	0	0
LMR Base	23.95	0	0
Terrace	21.35	510.883	0
5th Floor	18.3	430.248	0
4th Floor	15.25	298.7833	0
3rd Floor	12.2	191.2213	0
2nd Floor	9.15	107.562	0
1st Floor	6.1	48.3125	0
Stilt Floor	3.05	4.6561	0
Base	0	0	0

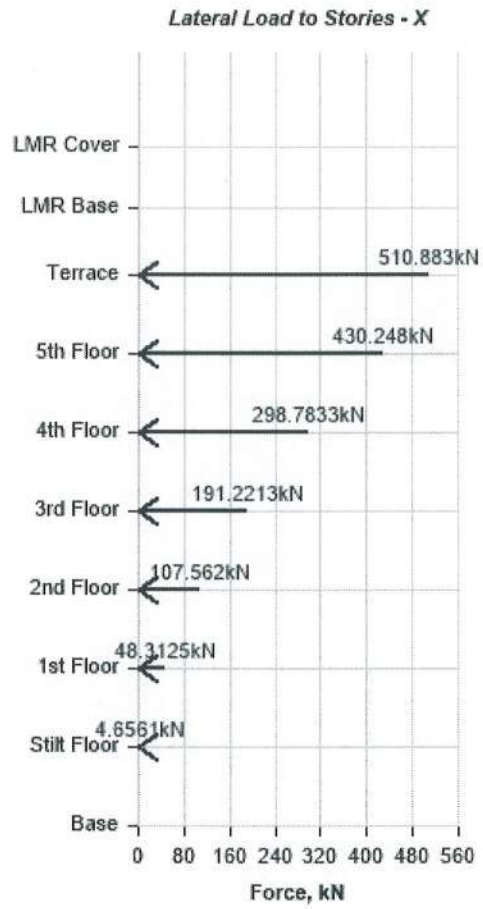


Figure 3-1-Set 1

IS 1893:2016 Auto Seismic Load Calculation

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

Direction and Eccentricity

Direction = Y

Structural Period

Period Calculation Method = User Specified

User Period $T = 0.471$ sec

Factors and Coefficients

Seismic Zone Factor, Z [IS Table 3] $Z = 0.16$

Response Reduction Factor, R [IS Table 9] $R = 4$

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

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
Y	0.471	26527.7697	1591.6662

Applied Story Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
LMR Cover	26.35	0	0
LMR Base	23.95	0	0
Terrace	21.35	0	510.883
5th Floor	18.3	0	430.248
4th Floor	15.25	0	298.7833
3rd Floor	12.2	0	191.2213
2nd Floor	9.15	0	107.562
1st Floor	6.1	0	48.3125
Stilt Floor	3.05	0	4.6561
Base	0	0	0

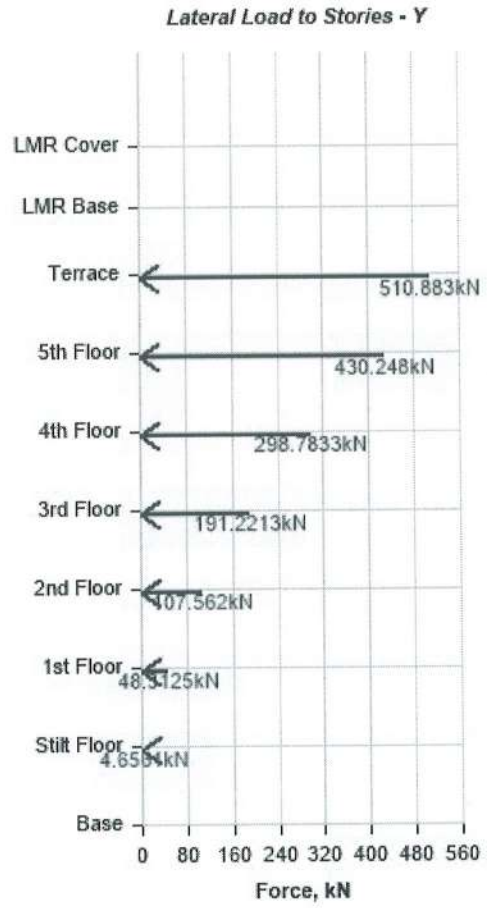


Figure 3-2-Set 1

3.4 Functions

3.4.1 Response Spectrum Functions

Table 3.4 - Functions - Response Spectrum - IS1893 2016

Name	Period sec	Value	Seismic Zone	I	Soil Type	R	Damping Ratio
FuncH	0	0.024	III	1.2	II	4	0.05
FuncH	0.1	0.06					
FuncH	0.55	0.06					
FuncH	0.8	0.0408					
FuncH	1	0.03264					
FuncH	1.2	0.0272					
FuncH	1.4	0.023314					
FuncH	1.6	0.0204					
FuncH	1.8	0.018133					
FuncH	2	0.01632					
FuncH	2.5	0.013056					
FuncH	3	0.01088					
FuncH	3.5	0.009326					
FuncH	4	0.00816					
FuncH	4.5	0.00816					
FuncH	5	0.00816					
FuncH	5.5	0.00816					
FuncH	6	0.00816					
FuncH	6.5	0.00816					
FuncH	7	0.00816					
FuncH	7.5	0.00816					
FuncH	8	0.00816					
FuncH	8.5	0.00816					
FuncH	9	0.00816					
FuncH	9.5	0.00816					
FuncH	10	0.00816					

Table 3.5 - Functions - Response Spectrum - User Defined

Name	Period sec	Value	Damping Ratio
FuncV	0	0.04	0.05
FuncV	10	0.04	

4 Analysis Results

This chapter provides analysis results.

4.1 Modal Results

Table 4.1 - Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ
Modal	1	1.76	0.0002	0.756	0	0.0002	0.756	0	0.1261	5.515E-06	0.061
Modal	2	1.546	0.0049	0.0589	0	0.0051	0.8149	0	0.0102	0.0013	0.7574
Modal	3	1.216	0.819	0.0011	6.929E-06	0.8241	0.816	7.199E-06	0.0001	0.0787	0.0037
Modal	4	0.534	4.662E-05	0.1065	2.67E-06	0.8242	0.9224	9.868E-06	0.3602	0.0001	0.0111
Modal	5	0.485	0.0006	0.0129	7.021E-07	0.8248	0.9353	1.057E-05	0.0435	0.0021	0.0936
Modal	6	0.38	0.1001	0.0002	0.0001	0.9249	0.9356	0.0001	0.0008	0.2454	0.0009
Modal	7	0.277	0.0001	0.0304	2.273E-05	0.9249	0.966	0.0001	0.0505	0.0001	0.0015
Modal	8	0.266	0.0116	0.0015	2.146E-05	0.9366	0.9675	0.0001	0.0031	0.012	0.0025
Modal	9	0.193	0.0124	0.0073	4.836E-06	0.949	0.9747	0.0001	0.0194	0.009	0.0073
Modal	10	0.177	0.0172	0.0058	0.0001	0.9662	0.9805	0.0002	0.0168	0.0182	0.0001
Modal	11	0.112	0.0031	0.0152	2.308E-06	0.9693	0.9958	0.0002	0.0455	0.0063	0.0036
Modal	12	0.092	0.0217	0.0013	0.0003	0.991	0.9971	0.0005	0.0036	0.0432	0.0001

Table 4.1 - Modal Participating Mass Ratios (Part 2 of 2)

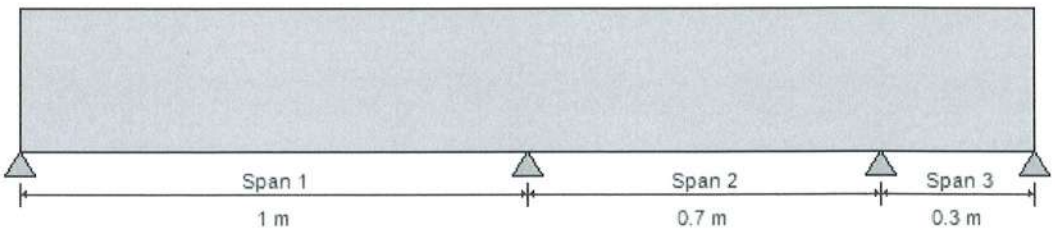
Case	Mode	SumRX	SumRY	SumRZ
Modal	1	0.1261	5.515E-06	0.061
Modal	2	0.1363	0.0013	0.8184
Modal	3	0.1364	0.0799	0.8221
Modal	4	0.4966	0.08	0.8332
Modal	5	0.5401	0.0821	0.9268
Modal	6	0.5409	0.3275	0.9276
Modal	7	0.5914	0.3276	0.9291
Modal	8	0.5945	0.3396	0.9316
Modal	9	0.6139	0.3486	0.9389
Modal	10	0.6307	0.3668	0.939
Modal	11	0.6762	0.3731	0.9427
Modal	12	0.6797	0.4163	0.9428

DESIGN OF FOUNDATION

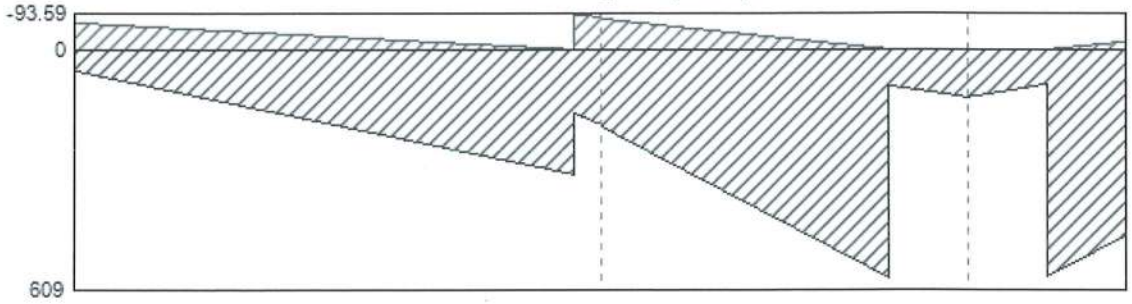
IS 456:2000 Concrete Strip Design

Geometric Properties
Combination = Overall Envelope
Strip Label = SB5
Length = 3.4 m
Distance to Top Rebar Center = 54 mm
Distance to Bot Rebar Center = 74 mm

Material Properties
Concrete Comp. Strength = 30 MPa
Concrete Modulus = 27386.13 MPa
Longitudinal Rebar Yield = 500 MPa

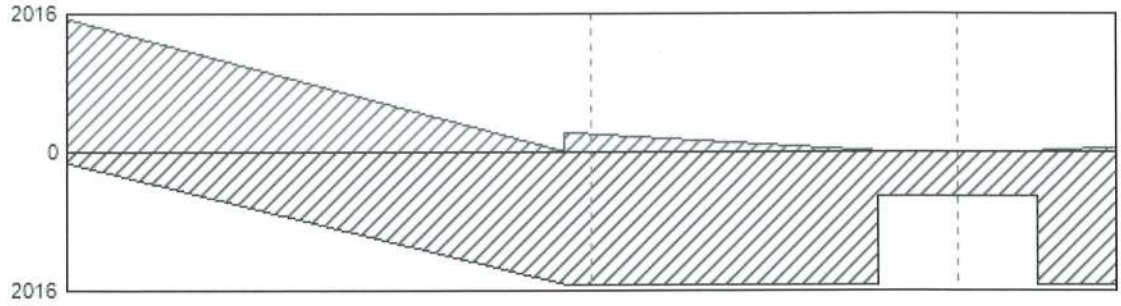


Moment Diagram (kN-m)



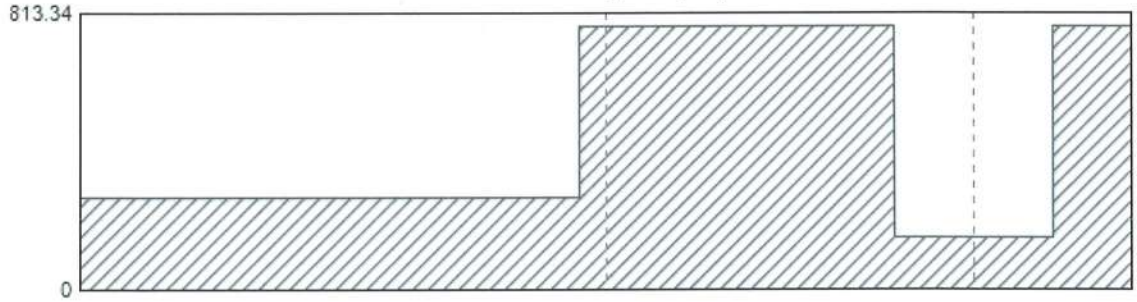
(-)Moment	-69.9506	0	-86.738	-80.9069	0	-0.7289	0	23.2194
(+)Moment	53.1082	0	315.6591	196.637	0	579.2776	12	673

Longitudinal Reinforcement (mm²)



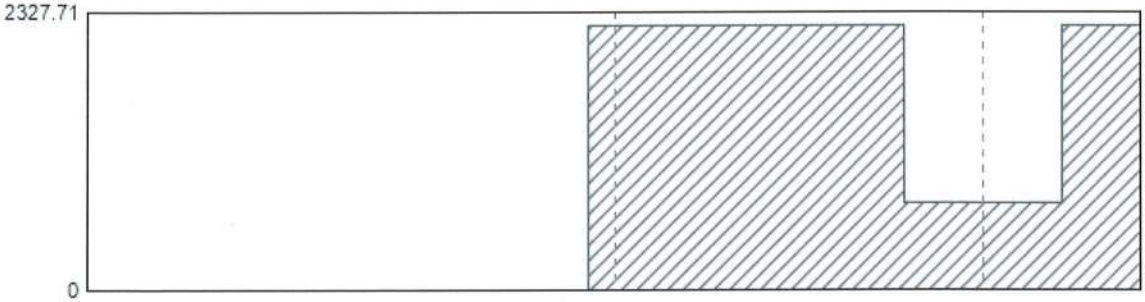
As (top)	216	0	268	250	0	0	0	0	72	
As (bot)	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL			
	169	0	1012	628	0	1876	399	1856	1532	
	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL		02) 1.5DL+1.5LL	02) 1.5DL+1.5LL			

Shear Diagram (kN)

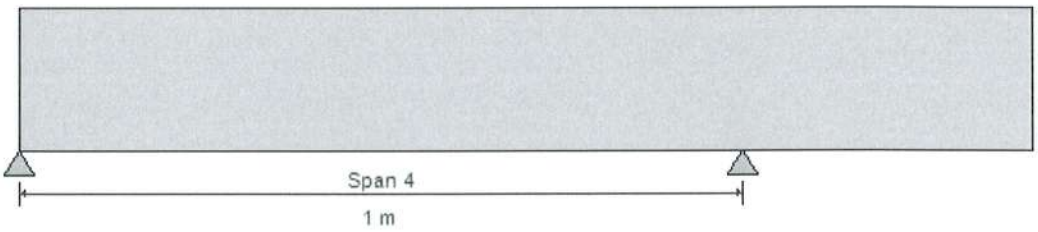


Shear	0	0	774.6129	774.6129	0	774.6129	152	7	5	547

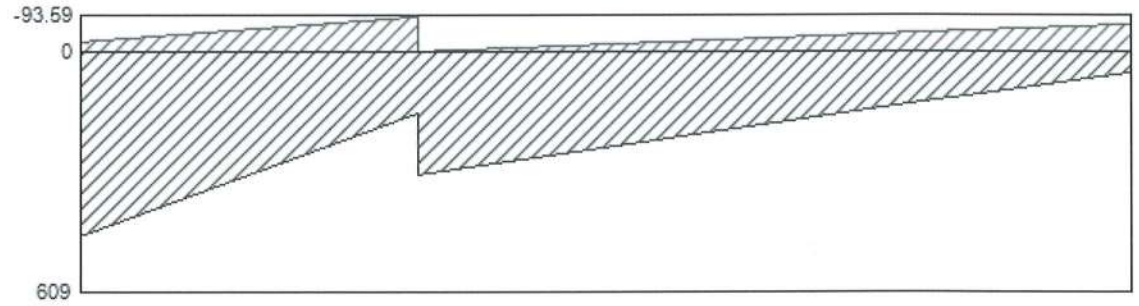
Transverse Reinforcement (mm²/m)



Asv/s reqd	0	0	2216.87	2216.87	0	2216.87	731	2	2	6.87

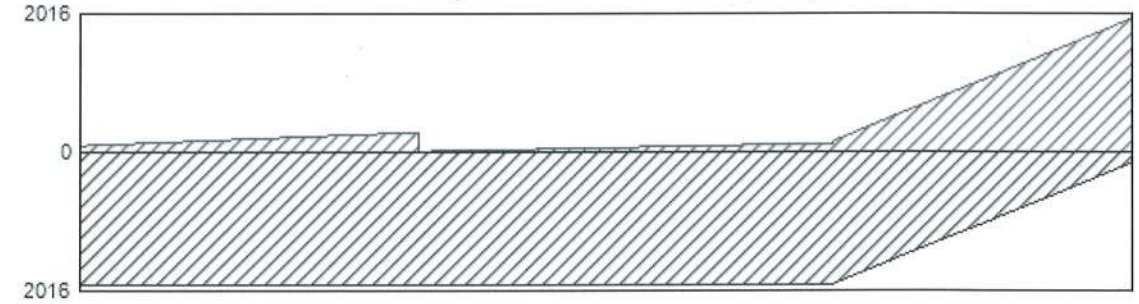


Moment Diagram (kN-m)



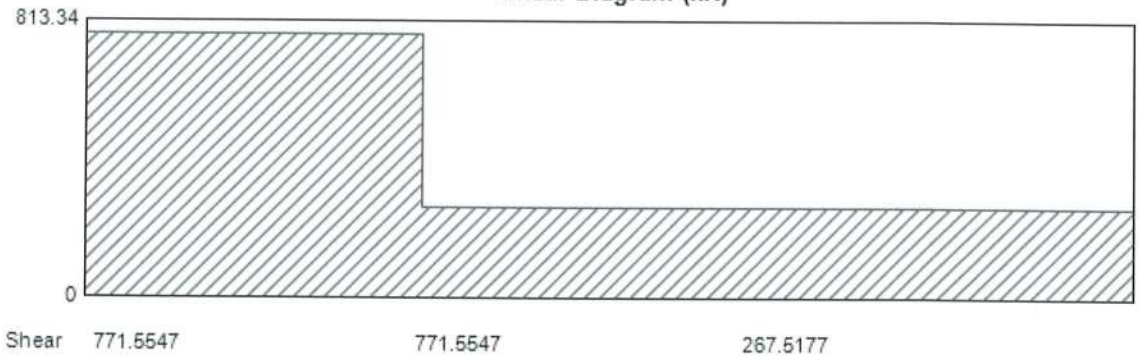
(-)Moment	-23.2194	-89.1325	-41.2589
(+)Moment	474.8673	312.5415	162.9471

Longitudinal Reinforcement (mm²)

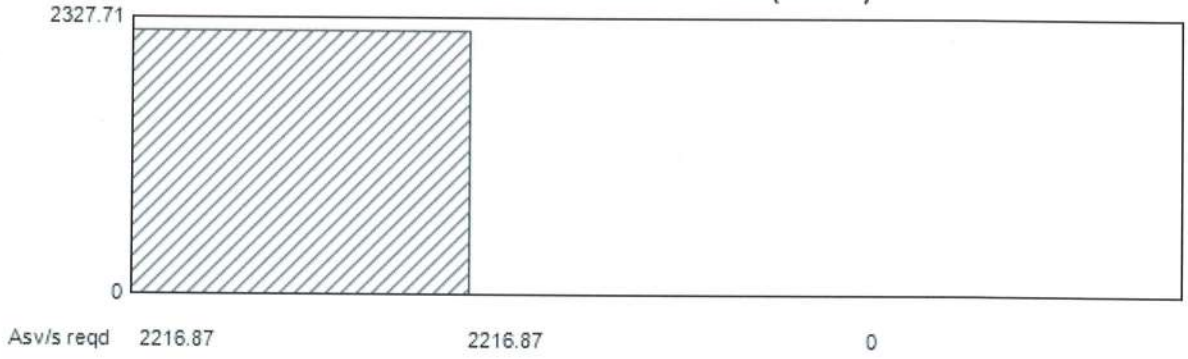


As (top)	72	276	127
As (bot)	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL
	1532	1002	519
	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL	02) 1.5DL+1.5LL

Shear Diagram (kN)



Transverse Reinforcement (mm²/m)



DESIGN OF SHEAR WALL

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)	Pier Ductility	LLRF
1st Floor	P21	11235	3300	800	300	Special Wall	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	550	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	10835	3300	11635	3300	800	300
Bottom	Leg 1	10835	3300	11635	3300	800	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	1387	0.0058	0.0036	28) 0.9DL+1.5Spy+0.45Spx+0.45Spz	188.5602	81.997
Bottom	1541	0.0064	0.0036	28) 0.9DL+1.5Spy+0.45Spx+0.45Spz	205.0133	-74.7535

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
-149.9286	240000
205.5197	240000

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	24) 1.5DL+1.5Spx+0.45Spy+0.45Spz	843.317	172.0635	169.388	101.2662	274.4836
Bottom	Leg 1	750	24) 1.5DL+1.5Spx+0.45Spy+0.45Spz	870.7512	296.1323	169.388	106.4745	279.6919

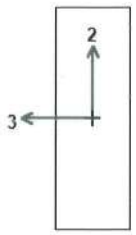
Boundary Element Check

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	300	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	1542.3731	-160.2089	11.43	6
Top–Right	Leg 1	300	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	1542.3731	108.6312	9.82	6
Bottom–Left	Leg 1	300	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	1569.8271	-168.3075	11.8	6
Botttom–Right	Leg 1	300	25) 1.5DL+1.5Spy+0.45Spx+0.45Spz	1569.8271	214.7356	13.25	6

DESIGN OF BEAM

ETABS Concrete Frame Design

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



Beam Element Details (Part 1 of 2)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)
Terrace	B8	314	B 200X600	24) 1.5DL+1.5Spx+0.45Spy+0.45Spz	0	6135

Beam Element Details (Part 2 of 2)

LLRF	Type
1	Ductile Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
200	600	200	0	45	45

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	550	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
-172.8104	0.0001	2.9103	-472.8189

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-172.8104	0.0003	0	-172.8107

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

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-172.8107		1190	0	1190	297
Bottom (-2 Axis)		0	595	0	246	595

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 mm²/m
87.6839	0	87.7143	84.8994	437.95

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 mm²/m
0.0038	2.9103	130	530	0

DESIGN OF SLAB

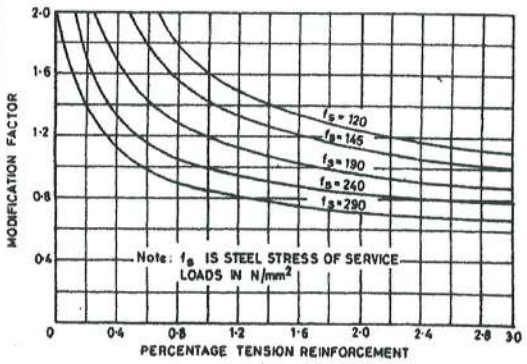
NAVINS GROUND FLOOR LEVEL SLAB

DESIGN OF SLAB No:

1.00	Grade of concrete	=	*30.00*	N/mm²	Case No: 7
2.00	Grade of steel	=	*550.00*	N/mm²	D+(C-D)*(E-A)/(B-A)
3.00	Cover to reinforcement	=	*25.00*	mm	
	Diameter of bar		*8.00*	mm	
4.00	Aspect ratio $\frac{l_y}{l_x}$ = *5.88* / *3.66*	6.00 / 3.78	1.589	< 2	
5.00	Edge condition: One Long Edge Continuous		Two way slab		
6.00	Modification factor assumed		*1.50*		
	109.45				
7.00	Depth required for deflection:	D =	*150.00*	mm	
			150.00	mm	
		d =	121.00	mm	ok
8.00	Dead Load	=	3.60	kN/m²	
9.00	Live load	=	*2.00*	kN/m²	
10.00	Partitions & FF	=	*1.80*	kN/m²	
11.00	Total load	=	7.40	kN/m²	
12.00	Factored load	=	11.10	kN/m²	

		Negative	Positive
A		*1.50000*	*1.50000*
B		*1.75000*	*1.75000*
C		*0.08400*	*0.06400*
D		*0.09100*	*0.06900*
E		*1.58925*	*1.58925*
Value		**0.08650**	**0.06578**

STEP 1	Details	S- SPAN (-ve) support(α_x)	S- SPAN (+ve) span(α_x)		L-SPAN (-ve) support(α_y)	L-SPAN (+ve) span (α_y)
	Co-efficent (IS:456, Table :	0.086	0.066		0.000	0.043
	M_u=Co-efficient*w* l_x^2	13.69	10.41		0.00	6.81
	K= Mu/bd2	0.94	0.71		0.00	0.46
	Percentage of steel required	0.20	0.15		0.00	0.10
	Ast required(in mm²)	*245.60*	*185.02*		*0.00*	*119.72*
	Ast min (in mm²)	180.00	180.00		180.00	180.00
	Ast to be provided (in mm2)	245.60	185.02		180.00	180.00
	Provided bars spacing (c/c)	204.75	271.78		279.37	279.37
	max spacing	250.00	250.00		250.00	250.00
	spacing	204.75	250.00		250.00	250.00
	Reqd bars spacing (c/c)	**200.00**	**250.00**		**250.00**	**250.00**
	Pvd bars spacing (c/c)	***150.00***	***150.00***		***200.00***	***200.00***
	Ast Provided(in mm²)	**335.24**	**335.24**		**251.43**	**251.43**
	Percentage of steel provided	**0.28**	**0.28**		**0.21**	**0.21**
STEPII	F_s=0.58 *f_y * (Ast required/ Ast provided)					
	F_s				176.06	
	M.F				*1.80*	
	if assumed modification factor is less than or equal to calculated the section is safe for deflection				safe	
	OVERALL DEPTH D	**150.00**	**mm**			
	EFFECTED DEPT d	**121.00**	**mm**			
STEPIII	**Crack width calculation**					
	m			=	7.3	
	E_s			=	200000.0	
	Ec			=	27386.1	
	Pt			=	0.3	
	k			=	0.2	
	x			=	22.0	
	A_{st}			=	335.2	
	I_{cr}			=	27544458.15	
	M			=	10.4	
	f_{st}			=	273.2	
	ε_m			=	0.0	
	Spacing				150.0	
	a_{cr}			=	79.1	
	ω_{cr}			=	0.12	
					<	
					0.20	mm (safe)



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THE LANDLENS SUITE

Eight ways to know a piece of land before you pay for it.

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

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Ask anything about a property and get an answer grounded in live government records, with the sources shown.
/landlens/one

Verify My Land
Every record check run on one property and returned as a single report.
/landlens/verify-my-land

Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
/landlens

One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
/landlens/one/map

PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
/landlens/pricemap

Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
/landlens/build-scope

Property Tracker
Watch a property and hear about it when something new is registered against it.
/landlens/property-tracker

Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
/landlens/deal-room

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Twenty-four checks you can run yourself, at no cost.

Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

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- Legal opinions, due diligence and title verification
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Prepared from the registers named on the page each finding sits on. Where a register could not be read, this document says so in its place rather than leaving the gap to be read as a clean result.