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DIGITALLY VERIFIED RECORD

STILT+5 RESIDENTIAL BUILDING @ CHENNAI

STRUCTURAL DESIGN BASIS REPORT

A.RAJAN, M.E.,(STRUCTURE)
REGISTERED GRADE I
CMDA STRUCTURAL ENGINEER
REG.No. SE/GR-1/2022/05/321
BSC CONSULTANTS
KODUNGAIYUR, CHENNAI-118.
MOB.: +91-88070 78990

Owner Name	Mr. ARUNACHALAM S BABU &Mrs. KULIKARAIBRAGADEESAN CHENDAMARAI		
Site Address	PLOT NO: 439 AND 440, SRI KAMAKODI NAGAR 2nd MAIN ROAD, PALLIKARANAI CHENNAI.		
Purpose of Building	RESIDENTIAL	**Issued for**	Approval
Project Engineer	A. Rajan (Licensed Structural Engineer Grade – 1)	**Date**	19-FEB-2025
Draftsperson	E. Karthick (Structural Draftsman)	**No. of Floors**	STILT+5 Floors

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Scope of Work includes performing Structural Analysis and Design Calculations for the Project. Also includes Preparing Structural Drawings from Foundation to Terrace including OHT & LMR.

1.0 PROJECT DESCRIPTION

The proposed RESIDENTIAL development for S+5 house. Configuration are considered for design is summarized as below:

STILT Floor + 5 floors + Terrace floor

Sl. No		Description	Floor to Floor Height (mm)
1	RESIDENTIAL Building	S+5	Building Heights: PILE Depth = 6000 GROUND Floor = 3050 First Floor = 3050 Second & Above Floor = 3050

B –Basement, P-Parking, G-GROUND Floor, S-Stilt Floor, F-Floor,

2.1 Structural System

The Structural system for RESIDENTIAL building comprises of RC Beam & Slab. The vertical loads are transferred through the slabs/beams to structural walls/columns and then transferred through the supporting columns and shear walls at lower level to the foundations. The thickness of RC wall & RC Column is considered as 300mm/160mm thick with minimum percentage of reinforcement as per IS 456-2000. Based on the Latest Code (IS 1893: 2016), some modifications might be required in the Typical Floor Plans to satisfy the torsional irregularity, which can be dealt during the Detailed Design Stage.

The horizontal loads are transferred through the floor to the structural beams, walls, columns and then to the foundation system.

The foundation system consists of PILE foundation at 6m below Existing GROUND level.

Structural system for the Building consists of Beam Column/ Slab System.

Based on the geotechnical investigation report provided by Client

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2.0 DESIGN PHILOSOPHY

All R.C.C structures shall be designed according to the Limit State Method as specified in IS: 456 – 2000 using in house design program / spread sheets, RCDC, ETABS & SAFE software's. However, for design requirements, where Indian code is silent and / not clear, requirements as given in international standards shall be used.

LOADING ON STRUCTURE

2.1 DEAD LOAD - This load case comprises of self-weight of the entire frame and shell elements forming a part of the structure.

2.2 SUPERIMPOSED DEAD LOAD

Item No	Function	Loads Used	
		UDL KN/m²	Remarks
1	Floor Finishes – (50mm) RESIDENTIAL areas	1.2	Including ceiling plaster
2	Floor Finishes - parking areas in basement levels – (Average 75mm thk screed)	1.8	
3	50mm thick fill (sunken toilets)	1.0	
4	DG Room	10 (Min.) or as per actuals	
5	Weatherproof course (Terrace level)	2	
6	Swimming pool and Overhead Water tank	As per drawing	
7	Podium Fire Driveways (200mm thk fill)	5	Driveways
8	Podium Landscape (600mm Soil Fill)	15	Including Floor Finish
9	Floor Finishes – (50mm) Office	2.4	

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2.3 LIVE LOAD

Item No	Function	Loads Used	
		UDL KN/m^2	Concentrated * KN
1	Car Parking Area a) Without stack parking (vehicles not exceeding 2.5tonnes weight)	2.5	9.0
2	Truck / Fire Tender Vehicle Movement (45 MT Fire Tender)	10	As per actuals
3	Stair & Corridor	3	4.5
4	All Rooms & kitchen (RESIDENTIAL level)	2	1.8
5	Toilets & Bathroom	2	-
6	Balcony	3	1.5/meter run
7	AHU / Electrical Room / Office	3	
8	Roof Live load (access not provided except for maintenance)	0.75	Roof Slab: 1.9KN uniformly distributed over any span of 1m width
9	Roof Live Load (access provided)	2.0	-
10	Lift Machine Room	10	Manufacturer recommendation

*The concentrated loads are considered to be applied in positions, which produce maximum stresses and where deflection is the main criteria, in the positions, which produce the maximum deflections.

Live load reduction in column / walls & foundations will be considered as per IS 875 (Part 2) -1987.

2.4 WIND LOAD

Wind loads and pressures are calculated based on the static design wind pressure. This pressure has been considered for the load analysis and applied to the model. Joint loads for all floors have been calculated based on the contributory areas and applied in the respective diaphragms.

The wind pressure shall be calculated based on the data furnished below and other provisions laid in IS: 875 (Part 3) – 2015.

Basic wind speed = 50 m/sec

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Risk coefficient, k1 = 1.0 (Mean Probable Design Life of Structure = 50 years)

Terrain category - = 2

Height factor- k2 = Varies with height

2.5 EARTHQUAKE LOAD

Dynamic analysis for earthquake forces in both the directions is carried out by Response Spectrum Method. Response Spectrum values are calculated based on the T Vs Sa/g equations as per clause no 6.4.2 of IS 1893 (Part 1)-2016. Base shears of the analysis are raised to a factor of (VB/V'B) as per clause no 7.7.3. The effect of torsion has been taken into effect by giving the eccentricity overrides in ETABS itself.

The loading due to earthquake is assessed based on the provisions of IS: 1893 (Part 1) – 2016.

Seismic zone = III

Zone factor = 0.16

Response reduction factor = 3 (**OMRF**)

Importance factor = 1

2.6 SHRINKAGE, CREEP & TEMPERATURE EFFECTS

This effect depends on the climatic conditions and shall be considered based on IS 875 – Part 5. Expansion/ Separation gap requirement.

2.7 SPECIAL LOADS

Imposed load of 10kN/ Sqm is considered in LMR base slab in the absence of vendor inputs.

2.8 LOAD COMBINATIONS

The various loads shall be combined in accordance with the stipulations in IS: 875 (Part 5) – 1987. Whichever combination produces the most unfavourable effect in the building, foundation or structural member concerned shall be adopted.

Values of Partial Safety Factor γ_f for Loads

Load Combination	**Limit State of Collapse**			**Limit State of Serviceability**		
	DL	LL	WL/EL	DL	LL	WL/EL
DL + LL	1.5	1.5	--	1.0	1.0	--
DL +/- WL	1.5 or 0.9[$]	--	1.5	1.0	--	1.0

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DL + LL +/- WL	1.2	1.2	1.2	1.0	0.8	0.8
DL +/- EL	1.5 or 0.9[$]	--	1.5	1.0	--	1.0
DL + LL +/- EL	1.2	1.2	1.2	1.0	0.8	0.8

[$] This value is to be considered when stability against overturning or stress reversal is critical

DL - Dead load

LL - Live load

WL - Wind load

EL - Earthquake load

Wind load and earthquake load shall be considered for both x & y directions.

The above load combinations will be considered and effect of worst combinations will be taken for design of various building elements. Fire tender load considered as accidental load with a partial safety factor of 1.05.

General Load Combinations considered in the analysis are as follows:

Combinations considered for the design of the various building elements:					
COMB01	1.5 DL	+	1.5 LL		
COMB02	1.2 DL	+	1.2 LL	+	1.2 SPECX
COMB03	1.2 DL	+	1.2 LL	+	1.2 SPECY
COMB04	1.5 DL			+	1.5 SPECX
COMB05	1.5 DL			+	1.5 SPECY
COMB06	0.9 DL			+	1.5 SPECX
COMB07	0.9 DL			+	1.5 SPECY
COMB08	1.2 DL	+	1.2 LL	+	1.2 WLX
COMB09	1.2 DL	+	1.2 LL	-	1.2 WLX
COMB10	1.2 DL	+	1.2 LL	+	1.2 WLY
COMB11	1.2 DL	+	1.2 LL	-	1.2 WLY
COMB12	1.5 DL			+	1.5 WLX
COMB13	1.5 DL			-	1.5 WLX
COMB14	1.5 DL			+	1.5 WLY
COMB15	1.5 DL			-	1.5 WLY
COMB16	0.9 DL			+	1.5 WLX
COMB17	0.9 DL			-	1.5 WLX
COMB18	0.9 DL			+	1.5 WLY

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COMB19	0.9 DL			-	1.5 WLY
COMB20	1.0 DL			+	1.2 UPLIFT
Un-factored Loads to be taken for foundation design:					
FOUN01	1.0 DL	+	1.0 LL		
FOUN02	1.0 DL	+	0.8 LL	+	0.8 SPECX
FOUN03	1.0 DL	+	0.8 LL	+	0.8 SPECY
FOUN04	1.0 DL			+	1.0 SPECX
FOUN05	1.0 DL			+	1.0 SPECY
FOUN06	1.0 DL	+	0.8 LL	+	0.8 WLX
FOUN07	1.0 DL	+	0.8 LL	-	0.8 WLX
FOUN08	1.0 DL	+	0.8 LL	+	0.8 WLY
FOUN09	1.0 DL	+	0.8 LL	-	0.8 WLY
FOUN10	1.0 DL			+	1.0 WLX
FOUN11	1.0 DL			-	1.0 WLX
FOUN12	1.0 DL			+	1.0 WLY
FOUN13	1.0 DL			-	1.0 WLY
DL - Dead Load					
LL - Live Load					
EL - Earthquake Load					
WL - Wind Load					
* Note - Seismic Load Cases have both "MAX" and "MIN" Load Cases for +ve & -ve Directions respectively.					

3.0 ANALYSIS METHODS

The analysis of the structure is carried out using the ETABS V-2017 / STAAD.Pro V8 / SAFE V16.0 software package accordingly. The structural elements are modelled as frame/ shell/ membrane as appropriate. The slab has been considered as rigid diaphragm at the respective floor levels to transfer the lateral forces. Appropriate loads and its combinations, as per relevant clauses in IS codes, for most unfavourable effects are chosen for design.

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4.0 CONCRETE

Concrete item	Grade	Max. Size of Aggregate (mm)	Type of cement
Foundation	M30	20	OPC
Retaining Wall	M30	20	OPC
Columns	M30	20	OPC
Beams	M30	20	OPC
Structural Slab	M30	20	OPC
Grade Slab	M30	20	OPC
RC Walls	M30	20	OPC
ISOLATED & ISOLATED Cap	M30	20	OPC

Normal weight of locally available aggregates are considered for all concrete works. Design mix shall be OPC with Crushed sand, Crushed aggregate, Mineral Admixture (Fly-ash or GGBS) and Chemical Admixture. Minimum cementitious content (Cement plus mineral admixture) shall be as per IS 456 table no. 5. 100% crushed sand is considered for concrete, masonry and plastering.

Fly ash confirming IS 3812 part 1 shall be used as part replacement of cement in normal concrete minimum of 15% and maximum of 35%, for RC walls minimum of 25% and maximum of 50% shall be used depending upon the grade of concrete and early strength requirement.

GGBS confirming BS 6699 shall be used as replacement, a minimum of 25% and maximum of 70% shall be used depending upon the grade of concrete and early strength requirement.

Mix design will be carried out by Client team confirming IS 456, IS 10262 and SP 23 considering the required workability (normal concrete – 150+/-25mm and high flow concrete – 650+/-100mm) at the time of placement which shall be duly approved by Client/Contractor.

5.0 REINFORCEMENT

Reinforcement steel (Local or imported) shall be Coil or T.M.T of Fe-500/Fe-500D/Fe-550/Fe-600 grade confirming to IS 1786:2008. For design calculations of shear reinforcement in beams as per IS 456, reinforcing steel of Fe-415 grade will be used. We shall also be allowed to use Torkari bars (local or imported) as per manufacturer's specification.
Dia of Reinforcement used – 7, 8, 9, 10, 12, 16, 20, 25, 28, 32mm.

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6.0 FIRE RATING

The structure is designed for 2-hour fire rating for staircases & lift core location and 1 hour fire rating for other areas of buildings (structural elements). The concrete structural members shall be designed and constructed as per IS codes. The structural adequacy is checked as per International standards with respect to the fire rating for RCC load bearing walls / shear walls of 160mm thick with normal reinforcement as per gravity/lateral loading design and with minimum 25mm cover to reinforcement. The nominal reinforcement shall be as per clause 32.5 of IS 456: 2000

7.0 CLEAR COVER TO REINFORCEMENT

The Nominal cover to main reinforcement considering exposure condition as mild shall be as follows: -

Sl. No	Structural Member	Clear Cover, mm
1	Pile	75
3	Retaining wall (earth face)	30
4	Retaining wall (inner face)	25
5	Walls	25
6	Slabs	25
7	Beams	30
8	Columns	40
9	Water Tank walls in contact with earth/water	45
10	Water tank walls in contact with air	30
11	Pile Cap	50

For any other elements not specified above, clear cover shall be as per the clause 26.4 of IS: 456-2000.

8.0 FOUNDATION SYSTEM AND SOIL PARAMETERS

Based on the Geotechnical investigation reports provided by Client, PILE recommendations at the proposed Capacity are as mentioned in the table below.

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Length of Pile	SBC (T)
6.0m 600 Dia	80.0T

9.0 MATERIALS

The self-weight of the various elements is computed based on the unit weight of materials as given below:

Materials	Unit weight kN/m^3
Steel	78.50
Plain Cement Concrete	24.00
Reinforced Cement Concrete	25.00
Light weight Block (AAC & BRICK)	7.50 & 18
Soil	18.00
Water	10.00
Cement Concrete screed	24.00
Sand	18.00
BJLC	18.00
CLSM	18.00

Normal weight aggregates shall be considered for arriving at self-weight of all Concrete works.

10.0 WATER PROOFING

Type of Water proofing proposed for several locations in building are as follows:

- •Toilets, Utilities & Balcony - Acrylic polymer-based Water proofing system
- •OHT Tanks - Crystalline based (Admixture) Water proofing
- •Terrace - Cement Based water proofing system

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11.0 SERVICEABILITY CHECK

a. For Deflections:

The final deflection due to all loads including the effect of temperature, creep and shrinkage and measured from the as-cast level of the supports of floors, roofs and all other horizontal members should not normally exceed span / 250.

The deflection including the effect of temperature, creep and shrinkage occurring after the erection of partitions and the application of finishes should not normally exceed Span / 350 or 20 mm whichever is less.

b. Lateral drift:

Under transient wind load the lateral sway at the top should not exceed H/500, where H is the total height of the building.

The storey drift in any storey due to the minimum specified design lateral force, with partial load factor of 1, shall not exceed 0.004 times the storey height.

c. For Cracking:

Surface crack width shall not exceed 0.3 mm in general and for water retaining structure it is limited to 0.1 mm.

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12.0 DESIGN STANDARDS

The relevant Indian Standard Codes, as given below, shall be followed for structural design:

Sl.No.	Code	Description
1.	IS-875 (Part 1) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Unit weights of buildings materials and stored material.
2.	IS-875 (Part 2) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Imposed loads.
3.	IS-875 (Part 3) – 2015	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Wind loads.
4.	IS-875 (Part 4) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Snow loads.
5.	IS-875 (Part 5) – 1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures – Special loads and load combinations.
6.	IS: 456 – 2000	Code of Practice for Plain and Reinforced Concrete.
7.	IS: 1786 – 2008	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement - Specification.
8.	IS: 13920 – 2016	Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice.
9.	IS: 800 – 1984/2007	Code of Practice for General Construction in Steel.
10.	IS: 1893 (Part 1) – 2016	Criteria for Earthquake resistant design of structures.
11	IS 16700: 2017	Criteria for Structural Safety of Tall Concrete Buildings.
12.	IS3370-(PART II)-2009	Code of Practice for Concrete structures for the storage of liquids – Reinforced concrete structures.
13.	SP 7: 2016	National Building Code of India.
14.	IS 2950 (Part I) -1981	Code of Practice for Design and construction of ISOLATED foundation.
15.	IS 2911	Code of Practice for Design and construction of Footing foundation.

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

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that **Thiru. RAJAN. A** 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 **5 years**.

He has been given the Registration No.**SE/GR-I/2022/05/321** on **19.05.2022.** 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 **18.05.2027.**



CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
CMDA
CHENNAI-600 008.

19-5-2022
T. ARIVALAGAN
SUPERINTENDENT
CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
EGMORE, CHENNAI-600 008.

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RAJAN. A. M.E. (STRUCTURES),
No.1/102, Nakkala kottai,
Virudhu Nagar, Mettugundu, TN-626004.

Reg No SE/GR-1/2022/05/321
CELL: 9600100288

STRUCTURAL SOUNDNESS CERTIFICATE

This is to certify that the Proposed Construction of a **RESIDENTIAL BUILDING AT PLOT NO: 439 AND 440, SRI KAMAKODI NAGAR 2nd MAIN ROAD, PALLIKARANAI CHENNAI** is designed to resist all possible Gravity loads and other Combination of loads as per the relevant IS Codes and other Codes in vogue which the structure is intended to with stand.

Check has been made & found safe and hereby certify that the,

1. Foundation & its vertical elements (RC Columns, Beams & Others) is designed STILT+5 Floors as RESIDENTIAL Building as per Architectural plans considering relevant RESIDENTIAL loadings.
2. The minimum grade of concrete used in the structural design is M25.
3. The Analysis and design carried out for the intended RESIDENTIAL Building loading as per the code of practice using ETABS, SAFE & RCDC software.
4. Design of Structural elements carried out as per the stipulations made in latest code of practice IS 456-2000 & IS 13920-2016.
5. PILE FOUNDATION is adopted as Foundation Structure & it is designed considering the sub soil condition reported & the recommendation laid down in the Soil Investigation Report.

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Annexure – XIV

[See rule 51 (3)]

Form 1

Structural Design Basis Report

(1) This report to accompany the application for Building Developments

Part1	**General Data**		
S.No.	**Description**	**Information**	**Notes**
1.	Site Address		
2	Name of Owner - Mr. ARUNACHALAM S BABU & Mrs. KULIKARAIBRAGADEESAN CHENDAMARAI		
3	Name of Registered Developer along with the Registration Number		
4	Name of Registered Architect/Engineer along with the Registration Number		
5	Name of Registered Structural engineer along with the Registration Number		
6	Use of the building		
7	Number of stories above ground level (including storeys to be added later, if any)		
8	Number of basements below ground level		
9	Type of structure Load bearing walls R.C.C. frame R.C.C. frame and Shear Walls Steel frame		
10	Soil data Type of soil Design safe bearing capacity		IS:1893 C1.6.3.5.2 IS: 1904 IS: 1892 IS: 2131 IS: 2720
11	Dead loads (unit weight adopted) • Earth • Water • Brick masonry • Plain cement concrete • Reinforced cement concrete • Floor finish • Other fill materials		IS: 875 Part 1
12	Imposed (live) loads Floor loads Roof loads		IS: 875 Part 2

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13	Cyclone/Wind • Speed • Design pressure intensity		IS: 875 Part 3
14	Seismic zone		IS: 1893 (2002)
15	Importance factor		IS:1893(2002) Table 6
16	Seismic zone factor (Z)		IS:1893 Table 2
17	Response reduction factor		IS:1893 Table 7
18	Fundamental natural period – approx.		IS:1893 C1.7.6
19	Design horizontal acceleration spectrum value (A_h)		IS: 1893 C1.6.4.2
20	♥ Expansion/Separation Joints		
21	Building is regular/irregular		IS 1893

- Enclose detailed drawings drawn to scale for each floor

- In case terrace garden is provided, indicate additional fill load and live load along with the detailed drawings drawn to scale

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Notes: (i) Information in Item 6 should be given on separate A4 sheets for all walls with large number of openings

(ii) IP indicated "Information Provided"

IP indicates "Information to be provided"

NA indicates "Not Applicable"

Tick mark one box

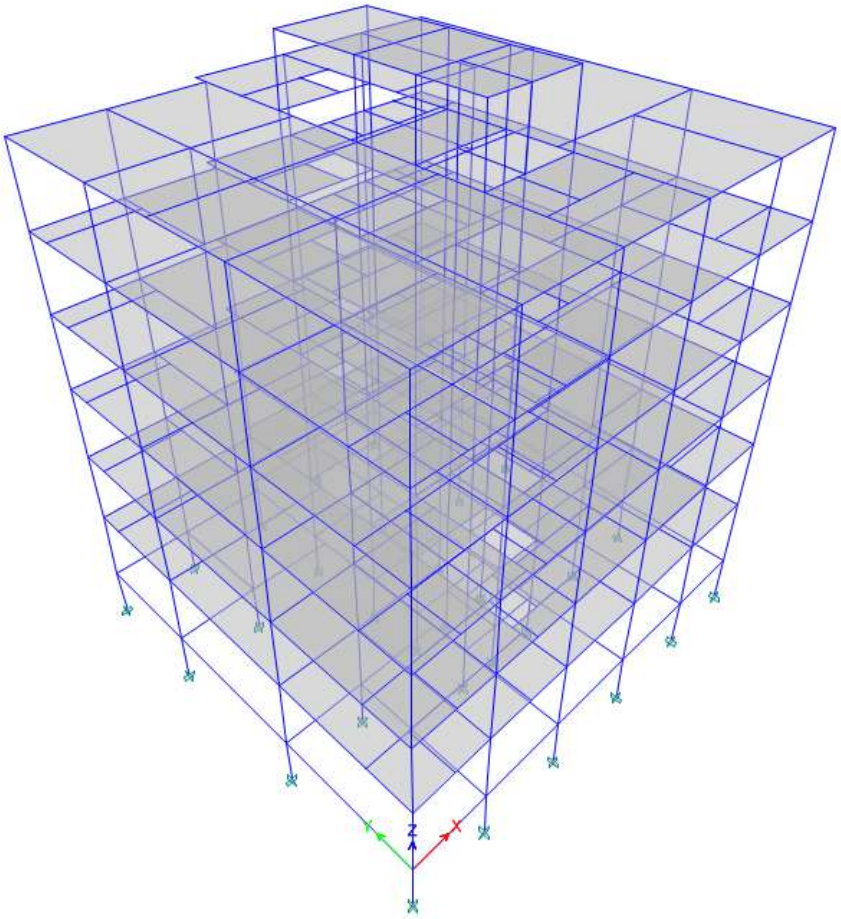
Part 3	**Reinforced concrete framed buildings**		
Sl. No.	**Description**	**Information**	**Notes**
1	Type of building • Regular frames • Regular frames with Shear Walls • Irregular frames • Irregular frames with Shear Walls • Soft storey		IS: 1893 C1 7.1
2	Number of basements		
3	Number of floors including ground floor		
4	Horizontal floor system • Beams and slabs • Waffles • Ribbed floor • Flat slab with drops • Flat plate without drops		
5	Soil data • Type of soil • Recommended type of foundation -Independent footings -Raft -Piles • Recommended bearing capacity of soil		IS: 1498
	• Recommended type, length, diameter and load capacity of piles • Depth of water table • Chemical analysis of ground water • Chemical analysis of soil		
6	Foundations Depth below ground level Type Independent Interconnected Raft Piles		

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7	System of interconnecting foundations Plinth beams Foundation beams		IS: 1893 C1 7.12.1
8	Grades if concrete used in different parts of building		
9	Method of analysis used		
10	Computer software used		
11	Torsion included		IS: 1893 C1 7.9
12	Base shear a. Based on approximate fundamental period b. Based on dynamic analysis c. Ratio of a/b		IS: 1893 Cl. 7.5.3
13	Distribution of seismic forces along the height of the building.		IS:1893 Cl.7.7 (Provide sketch)
14	The Column of soft ground storey specially designed.		IS: 1893 Cl.7.10
15	Clear minimum cover provided in • Footing • Column • Beams • Slabs • Walls		IS: 456 Cl. 26.4
16	Ductile detailing of RC frame • Type of reinforcement used • Minimum dimension of beams • Minimum dimension of columns • Minimum percentage of reinforcement of beams at any cross section • Maximum percentage of reinforcement at any section of beam • Spacing of transverse reinforcement in 2-d length of beams near the ends • Ratio of capacity of beams in shear to capacity of beams in flexure • Maximum percentage of reinforcement in column		IS: 456 Cl. 5.6 IS: 13920 Cl.6.1 IS: 13920 Cl.7.1.2 IS: 456 Cl.26.5.1(a) IS: 13920 Cl.6.2.1 IS: 456 Cl.26.5.1.1(b) IS: 13920 Cl.6.2.2 IS: 13920 Cl.6.3.5 IS: 456 Cl.26.5.3.1 IS: 13920 Cl. 7.4
	• Confining stirrups near ends of columns and in beam-column joints Diameter Spacing • Ratio of shear capacity of columns to maximum seismic shear in the storey.		

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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	2.5	Yes	None	No	Yellow
T1	HR	2.5	Yes	None	No	Yellow
T1	5FR	3.05	Yes	None	No	Blue
T1	4FR	3.05	Yes	None	No	Blue
T1	TFR	3.05	Yes	None	No	Blue
T1	SFR	3.05	Yes	None	No	Blue
T1	FFR	3.05	No	None	No	Cyan
T1	GFR	3.05	No	None	No	Magenta
T1	STILIT	2	No	None	No	Gray8Dark



2 Properties

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

2.1 Materials

Table 2.1 - Material Properties - Steel Data

Material	Fy MPa	Fu MPa	Fye MPa	Fue MPa	SSCurveOpt	SSHysType	SHard mm/mm	SMax mm/mm	SRup mm/mm	FinalSlope
A992Fy50	344.74	448.16	379.21	492.98	Simple	Kinematic	0.015	0.11	0.17	-0.1

Table 2.2 - Material Properties - Concrete Data

Material	Fc MPa	LtWtConc	IsUserFr	SSCurveOpt	SSHysType	SFc mm/mm	SCap mm/mm	FinalSlope	FAngle deg	DAngle deg
4000Psi	27.58	No	No	Mander	Concrete	0.002219	0.005	-0.1	0	0
DUMMY	25	No	No	Mander	Concrete	0.002	0.005	-0.1	0	0
M-30	30	No	No	Mander	Concrete	0.002	0.005	-0.1	0	0
M30	30	No	No	Mander	Concrete	0.002191	0.005	-0.1	0	0
M35	35	No	No	Mander	Concrete	0.002366	0.005	-0.1	0	0
M40	40	No	No	Mander	Concrete	0.00253	0.005	-0.1	0	0

Table 2.3 - Material Properties - Rebar Data

Material	Fy MPa	Fu MPa	Fye MPa	Fue MPa	SSCurveOpt	SSHysType	SHard mm/mm	SCap mm/mm	FinalSlope
A615Gr60	413.69	620.53	455.05	682.58	Simple	Kinematic	0.01	0.09	-0.1
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
HYSD550	550	585	605	643.5	Simple	Kinematic	0.02	0.12	-0.1

Table 2.4 - Material Properties - Tendon Data

Material	Fy MPa	Fu MPa	SSCurveOpt	SSHysType	FinalSlope
A416Gr270	1689.91	1861.59	270 ksi	Kinematic	-0.1

2.2 Frame Sections

Table 2.5 - Frame Section Property Definitions - Concrete Rectangular (Part 1 of 2)

Name	Material	From File?	Depth mm	Width mm	Rigid Zone?	Notional Size Type	Notional Auto Factor	Design Type	Area Modifier	As2 Modifier
B-230X450	M-30	No	450	230	No	Auto	1	Beam	1	1
B-230X600	M-30	No	600	230	No	Auto	1	Beam	1	1
B-230X750	M-30	No	750	230	No	Auto	1	Beam	1	1
B-300X450	M-30	No	450	300	No	Auto	1	Beam	1	1
B-300X525	M-30	No	525	300	No	Auto	1	Beam	1	1
B-300X600	M-30	No	600	300	No	Auto	1	Beam	1	1
B-300X750	M-30	No	750	300	No	Auto	1	Beam	1	1
B-450X600	M-30	No	600	450	No	Auto	1	Beam	1	1
C-230X230	M-30	No	230	230	No	Auto	1	Column	1	1
C-230X450	M-30	No	230	450	No	Auto	1	Column	1	1
C-230X800	M-30	No	230	800	No	Auto	1	Column	1	1
C-300X300	M-30	No	300	300	No	Auto	1	Column	1	1
C-300X450	M-30	No	300	450	No	Auto	1	Column	1	1

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Table 2.5 - Frame Section Property Definitions - Concrete Rectangular (Part 1 of 2, continued)

Name	Material	From File?	Depth mm	Width mm	Rigid Zone?	Notional Size Type	Notional Auto Factor	Design Type	Area Modifier	As2 Modifier
C-300X750	M-30	No	300	750	No	Auto	1	Column	1	1
C-450X230	M-30	No	450	230	No	Auto	1	Column	1	1
C-450X300	M-30	No	450	300	No	Auto	1	Column	1	1
C-450X450	M-30	No	450	450	No	Auto	1	Column	1	1
C-750X300	M-30	No	750	300	No	Auto	1	Column	1	1
C-800X230	M-30	No	800	230	No	Auto	1	Column	1	1
CB-230X125	M-30	No	125	230	No	Auto	1	Beam	1	1
DUMMY	DUMMY	No	50	50	No	Auto	1	Column	1	1

Table 2.5 - Frame Section Property Definitions - Concrete Rectangular (Part 2 of 2)

As3 Modifier	J Modifier	I22 Modifier	I33 Modifier	Mass Modifier	Weight Modifier	Color	Notes
1	0.001	0.35	0.35	1	1	Cyan	
1	0.001	0.35	0.35	1	1	Red	
1	0.001	0.35	0.35	1	1	Magenta	
1	0.001	0.35	0.35	1	1	Yellow	
1	0.001	0.35	0.35	1	1	Gray8Dark	
1	0.001	0.35	0.35	1	1	Blue	
1	0.001	0.35	0.35	1	1	Blue	
1	0.001	0.35	0.35	1	1	Green	
1	1	0.7	0.7	1	1	Cyan	
1	1	0.7	0.7	1	1	Red	
1	1	0.7	0.7	1	1	Magenta	
1	1	0.7	0.7	1	1	Yellow	
1	1	0.7	0.7	1	1	Gray8Dark	
1	1	0.7	0.7	1	1	Blue	
1	1	0.7	0.7	1	1	Green	
1	1	0.7	0.7	1	1	Cyan	
1	1	0.7	0.7	1	1	Red	
1	1	0.7	0.7	1	1	Yellow	
1	1	0.7	0.7	1	1	Magenta	
1	0.001	0.35	0.35	1	1	Green	
1	0.001	0.35	0.35	1	1	Yellow	

Table 2.6 - Frame Section Property Definitions - Concrete Beam Reinforcing

Name	Longitudinal Bar Material	Tie Bar Material	Top Cover mm	Bottom Cover mm	Top I-End Area mm	Top J-End Area mm	Bottom I-End Area mm	Bottom J-End Area mm
B-230X450	HYSD500	HYSD500	30	30	0	0	0	0
B-230X600	HYSD500	HYSD500	30	30	0	0	0	0
B-230X750	HYSD500	HYSD500	30	30	0	0	0	0
B-300X450	HYSD500	HYSD500	30	30	0	0	0	0
B-300X525	HYSD500	HYSD500	30	30	0	0	0	0
B-300X600	HYSD500	HYSD500	30	30	0	0	0	0
B-300X750	HYSD500	HYSD500	30	30	0	0	0	0
B-450X600	HYSD500	HYSD500	30	30	0	0	0	0
CB-230X125	HYSD500	HYSD500	30	30	0	0	0	0

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Table 2.7 - Frame Section Property Definitions - Concrete Column Reinforcing (Part 1 of 2)

Name	Longitudinal Bar Material	Tie Bar Material	Reinforcement Configuration	Is Designed?	Clear Cover to Ties mm	Number Bars 3-Dir	Number Bars 2-Dir	Longitudinal Bar Size
C-230X230	HYSD500	HYSD415	Rectangular	Yes	40	2	2	20
C-230X450	HYSD500	HYSD415	Rectangular	Yes	40	4	2	20
C-230X800	HYSD500	HYSD415	Rectangular	Yes	40	6	2	20
C-300X300	HYSD500	HYSD415	Rectangular	Yes	40	3	3	20
C-300X450	HYSD500	HYSD415	Rectangular	Yes	40	4	3	20
C-300X750	HYSD500	HYSD415	Rectangular	Yes	40	6	3	20
C-450X230	HYSD500	HYSD415	Rectangular	Yes	40	2	4	20
C-450X300	HYSD500	HYSD415	Rectangular	Yes	40	3	4	20
C-450X450	HYSD500	HYSD415	Rectangular	Yes	40	4	4	20
C-750X300	HYSD500	HYSD415	Rectangular	Yes	40	3	6	20
C-800X230	HYSD500	HYSD415	Rectangular	Yes	40	2	6	20
DUMMY	A615Gr60	A615Gr60	Rectangular	Yes	40	3	3	20

Table 2.7 - Frame Section Property Definitions - Concrete Column Reinforcing (Part 2 of 2)

Corner Bar Size	Tie Bar Size	Tie Bar Spacing cm2	Number Ties 3-Dir	Number Ties 2-Dir
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	8	1500	3	3
20	10	1.5	3	3



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	
~SPEC-XECC	Yes	Other	0	
~SPEC-YECC	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	
Rooflive	No	Roof Live	0	
Sdl	No	Super Dead	0	
Wall	No	Super Dead	0	
Wx	No	Wind	0	Indian IS 875:2015
Wy	No	Wind	0	Indian IS 875:2015

3.2 Load Sets

Table 3.2 - Shell Uniform Load Sets

Name	Load Pattern	Load Value kN/m2
Bed Room	Live<3	2
Bed Room	Sdl	1
Coridor	Live<3	3
Coridor	Sdl	2
Dinning	Live<3	2
Dinning	Sdl	1
elevation slab	Live<3	1
elevation slab	Sdl	1.2
Firetruck	Live<3	2.4
Firetruck	Sdl	15
kitchen	Live<3	2
kitchen	Sdl	1
Lift	Live<3	2.4
Lift	Sdl	10
Living	Live<3	2
Living	Sdl	1
Parking	Live<3	2.5
Parking	Sdl	2.4
Podium Landscape	Live<3	3
Podium Landscape	Sdl	11
POOL	Live>3	10
POOL	Sdl	2.4
POOL	Filling	0

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Table 3.2 - Shell Uniform Load Sets (continued)

Name	Load Pattern	Load Value kN/m2
Roof	Rooflive	2
Roof	Sdl	2
Services	Live<3	4
Services	Sdl	2.4
TOILET	Live<3	2
TOILET	Sdl	1
TOILET	Filling	2
UTILITY	Live<3	2
UTILITY	Sdl	1
UTILITY	Filling	2

3.3 Functions

3.3.1 Response Spectrum Functions

Table 3.3 - Functions - Response Spectrum - IS1893 2016

Name	Period sec	Value	Seismic Zone	I	Soil Type	R	Damping Ratio
IS1893-2016	0	0.026667	III	1	I	3	0.05
IS1893-2016	0.1	0.066667					
IS1893-2016	0.4	0.066667					
IS1893-2016	0.6	0.044444					
IS1893-2016	0.8	0.033333					
IS1893-2016	1	0.026667					
IS1893-2016	1.2	0.022222					
IS1893-2016	1.4	0.019048					
IS1893-2016	1.6	0.016667					
IS1893-2016	1.8	0.014815					
IS1893-2016	2	0.013333					
IS1893-2016	2.5	0.010667					
IS1893-2016	3	0.008889					
IS1893-2016	3.5	0.007619					
IS1893-2016	4	0.006667					
IS1893-2016	4.5	0.006667					
IS1893-2016	5	0.006667					
IS1893-2016	5.5	0.006667					
IS1893-2016	6	0.006667					
IS1893-2016	6.5	0.006667					
IS1893-2016	7	0.006667					
IS1893-2016	7.5	0.006667					
IS1893-2016	8	0.006667					
IS1893-2016	8.5	0.006667					
IS1893-2016	9	0.006667					
IS1893-2016	9.5	0.006667					
IS1893-2016	10	0.006667					

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Table 3.4 - Functions - Response Spectrum - User Defined

Name	Period sec	Value	Damping Ratio
UnifRS	0	1	0.05
UnifRS	1	1	

3.3.2 Time History Functions

Table 3.5 - Functions - Time History - User Defined

Name	Time sec	Value
RampTH	0	0
RampTH	1	1
RampTH	4	1
UnifTH	0	1
UnifTH	1	1

3.4 Load Cases

Table 3.6 - Load Case Definitions - Summary

Name	Type
Modal	Modal - Ritz
Dead	Linear Static
Live<3	Linear Static
Sdl	Linear Static
Wall	Linear Static
Filling	Linear Static
Rooflive	Linear Static
EQx	Linear Static
EQy	Linear Static
Wx	Linear Static
Wy	Linear Static
SPEC-X	Response Spectrum
SPEC-Y	Response Spectrum
Live>3	Linear Static

Table 3.7 - Load Case Definitions - Linear Static

Name	Exclude Group	Mass Source	Stiffness Type	Load Type	Load Name	Load SF	Design Type	Notes
Dead	None	MsSrc1	P-Delta	Load	Dead	1	Program Determined	
EQx	None	MsSrc1	P-Delta	Load	EQx	1	Program Determined	
EQy	None	MsSrc1	P-Delta	Load	EQy	1	Program Determined	
Filling	None	MsSrc1	P-Delta	Load	Filling	1	Program Determined	
Live<3	None	MsSrc1	P-Delta	Load	Live<3	1	Program Determined	
Live>3	None	MsSrc1	P-Delta	Load	Live>3	1	Program Determined	
Rooflive	None	MsSrc1	P-Delta	Load	Rooflive	1	Program Determined	
Sdl	None	MsSrc1	P-Delta	Load	Sdl	1	Program Determined	
Wall	None	MsSrc1	P-Delta	Load	Wall	1	Program Determined	
Wx	None	MsSrc1	P-Delta	Load	Wx	1	Program Determined	
Wy	None	MsSrc1	P-Delta	Load	Wy	1	Program Determined	

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Table 3.8 - Modal Case Definitions - Ritz

Name	Exclude Group	Mass Source	Stiffness Type	Load Type	Load Name	Max Cycles	Target Ratio %	Max Modes	Min Modes	Design Type	Notes
Modal	None	MsSrc1	P-Delta	Accel	Accel UX	0	99	12	1	Program Determined	
Modal				Accel	Accel UY	0	99				

Table 3.9 - Load Case Definitions - Response Spectrum (Part 1 of 2)

Name	Mass Source	Load Name	Function	Trans Accel SF mm/sec2	Coordinate System	Angle deg	Modal Case	Modal Combo Method	Rigid Response?
SPEC-X	Previous (MsSrc1)	U1	IS1893-2016	47849.89	Global	0	Modal	CQC	No
SPEC-Y	Previous (MsSrc1)	U2	IS1893-2016	39988.22	Global	0	Modal	CQC	No

Table 3.9 - Load Case Definitions - Response Spectrum (Part 2 of 2)

Directional Combo Type	Eccentricity Ratio	Design Type	Notes
SRSS	0.05	Program Determined	
SRSS	0.05	Program Determined	

3.5 Load Combinations

Table 3.10 - Load Combination Definitions

Name	Type	Is Auto	Load Name	SF	Notes
Comb1	Linear Add	No	DEAD COMBO	1	
Comb1			LIVE COMBO	1	
Comb2	Linear Add	No	DEAD COMBO	1.5	
Comb2			LIVE COMBO	1.5	
Comb3	Linear Add	No	DEAD COMBO	1.2	
Comb3			LIVE COMBO	1.2	
Comb3			Wx	1.2	
Comb4	Linear Add	No	DEAD COMBO	1.2	
Comb4			LIVE COMBO	1.2	
Comb4			Wx	-1.2	
Comb5	Linear Add	No	DEAD COMBO	1.2	
Comb5			LIVE COMBO	1.2	
Comb5			Wy	1.2	
Comb6	Linear Add	No	DEAD COMBO	1.2	
Comb6			LIVE COMBO	1.2	
Comb6			Wy	-1.2	
Comb7	Linear Add	No	DEAD COMBO	1.5	
Comb7			Wx	1.5	
Comb8	Linear Add	No	DEAD COMBO	1.5	
Comb8			Wx	-1.5	
Comb9	Linear Add	No	DEAD COMBO	1.5	
Comb9			Wy	1.5	
Comb10	Linear Add	No	DEAD COMBO	1.5	
Comb10			Wy	-1.5	
Comb11	Linear Add	No	DEAD COMBO	0.9	

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Table 3.10 - Load Combination Definitions (continued)

Name	Type	Is Auto	Load Name	SF	Notes
Comb11			Wx	1.5	
Comb12	Linear Add	No	DEAD COMBO	0.9	
Comb12			Wx	-1.5	
Comb13	Linear Add	No	DEAD COMBO	0.9	
Comb13			Wy	1.5	
Comb14	Linear Add	No	DEAD COMBO	0.9	
Comb14			Wy	-1.5	
Comb15	Linear Add	No	DEAD COMBO	1.2	
Comb15			LIVE COMBO	-1.2	
Comb15			EQx	1.2	
Comb16	Linear Add	No	DEAD COMBO	1.2	
Comb16			LIVE COMBO	-1.2	
Comb16			EQx	-1.2	
Comb17	Linear Add	No	DEAD COMBO	1.2	
Comb17			LIVE COMBO	-1.2	
Comb17			EQy	1.2	
Comb18	Linear Add	No	DEAD COMBO	1.2	
Comb18			LIVE COMBO	-1.2	
Comb18			EQy	-1.2	
Comb19	Linear Add	No	DEAD COMBO	1.5	
Comb19			EQx	1.5	
Comb20	Linear Add	No	DEAD COMBO	1.5	
Comb20			EQx	-1.5	
Comb21	Linear Add	No	DEAD COMBO	1.5	
Comb21			EQy	1.5	
Comb22	Linear Add	No	DEAD COMBO	1.5	
Comb22			EQy	-1.5	
Comb23	Linear Add	No	DEAD COMBO	0.9	
Comb23			EQx	1.5	
Comb24	Linear Add	No	DEAD COMBO	0.9	
Comb24			EQx	-1.5	
Comb25	Linear Add	No	DEAD COMBO	0.9	
Comb25			EQy	1.5	
Comb26	Linear Add	No	DEAD COMBO	0.9	
Comb26			EQy	-1.5	
DEAD COMBO	Linear Add	No	Dead	1	
DEAD COMBO			Sdl	1	
DEAD COMBO			Wall	1	
LC1	Linear Add	No	DEAD COMBO	1	
LC1			LIVE COMBO	1	
LC2	Linear Add	No	DEAD COMBO	1	
LC2			Wx	1	
LC3	Linear Add	No	DEAD COMBO	1	
LC3			Wx	-1	
LC4	Linear Add	No	DEAD COMBO	1	
LC4			Wy	1	
LC5	Linear Add	No	DEAD COMBO	1	
LC5			Wy	-1	
LC6	Linear Add	No	DEAD COMBO	1	
LC6			LIVE COMBO	0.8	

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Table 3.10 - Load Combination Definitions (continued)

Name	Type	Is Auto	Load Name	SF	Notes
LC6			Wx	0.8	
LC7	Linear Add	No	DEAD COMBO	1	
LC7			LIVE COMBO	0.8	
LC7			Wx	-0.8	
LC8	Linear Add	No	DEAD COMBO	1	
LC8			LIVE COMBO	0.8	
LC8			Wy	0.8	
LC9	Linear Add	No	DEAD COMBO	1	
LC9			LIVE COMBO	0.8	
LC9			Wy	-0.8	
LC10	Linear Add	No	DEAD COMBO	1	
LC10			EQx	1	
LC11	Linear Add	No	DEAD COMBO	1	
LC11			EQx	-1	
LC12	Linear Add	No	DEAD COMBO	1	
LC12			EQy	1	
LC13	Linear Add	No	DEAD COMBO	1	
LC13			EQy	-1	
LC14	Linear Add	No	DEAD COMBO	1	
LC14			LIVE COMBO	0.8	
LC14			EQx	0.8	
LC15	Linear Add	No	DEAD COMBO	1	
LC15			LIVE COMBO	0.8	
LC15			EQx	-0.8	
LC16	Linear Add	No	DEAD COMBO	1	
LC16			LIVE COMBO	0.8	
LC16			EQy	0.8	
LC17	Linear Add	No	DEAD COMBO	1	
LC17			LIVE COMBO	0.8	
LC17			EQy	-0.8	
LIVE COMBO	Linear Add	No	Live<3	1	
SLS	Envelope	No	LC1	1	
SLS			LC2	1	
SLS			LC3	1	
SLS			LC4	1	
SLS			LC5	1	
SLS			LC6	1	
SLS			LC7	1	
SLS			LC8	1	
SLS			LC9	1	
SLS			LC10	1	
SLS			LC11	1	
SLS			LC12	1	
SLS			LC13	1	
SLS			LC14	1	
SLS			LC15	1	
SLS			LC16	1	
SLS			LC17	1	
ULS	Envelope	No	Comb1	1	
ULS			Comb2	1	

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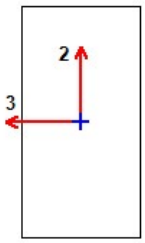
Table 3.10 - Load Combination Definitions (continued)

Name	Type	Is Auto	Load Name	SF	Notes
ULS			Comb3	1	
ULS			Comb4	1	
ULS			Comb5	1	
ULS			Comb6	1	
ULS			Comb7	1	
ULS			Comb8	1	
ULS			Comb9	1	
ULS			Comb10	1	
ULS			Comb11	1	
ULS			Comb12	1	
ULS			Comb13	1	
ULS			Comb14	1	
ULS			Comb15	1	
ULS			Comb16	1	
ULS			Comb17	1	
ULS			Comb18	1	
ULS			Comb19	1	
ULS			Comb20	1	
ULS			Comb21	1	
ULS			Comb22	1	
ULS			Comb23	1	
ULS			Comb24	1	
ULS			Comb25	1	
ULS			Comb26	1	



ETABS Concrete Frame Design

IS 456:2000 Beam Section Design



Beam Element Details Type: Ordinary Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
5FR	B13	296	B-230X450	Comb20	150	3350	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
230	450	230	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	500

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
-69.0423	0.0006	66.921	10.7688

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-69.0423	0.0011	0	-69.0434

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)	-69.0434		407	0	407	164
Bottom (-2 Axis)		0	0	0	0	0

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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
66.921	44.8149	38.64	61.2195	254.94

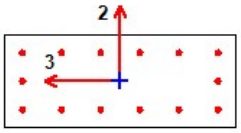
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt}/s mm²/m
0.0006	66.921	190	410	0

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ETABS Concrete Frame Design

IS 456:2000 Column Section Design



Column Element Details Type: Ordinary Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
GFR	C1	144	C-300X750	Comb23	0	3050	0.708

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
750	300	58	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

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 mm²	Rebar % %
-18.9076	41.2729	113.3561	0.571	0.3782	2896	1.29

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)	1.2	2600	51.7917	0	0.3782
Minor Bend(M2)	1.2	2600	21.1558	0	0.571

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 mm²/m
Major, V_{u2}	59.1966	109.5061	72.599	0	831.33
Minor, V_{u3}	19.3434	118.5508	83.0396	0	332.53

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Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm²	Shear Ratio Unitless
Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u3}	N/A	N/A	N/A	N/A	N/A	N/A

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm²	A_{sc} cm²	P_{uz} kN	P_b kN	P_u kN	k Unitless
2250	29	4123.3149	1383.2168	-18.9076	1

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	0.852	300	10.4	12	No	0
Minor Bending (M_2)	Yes	0.852	750	4.16	12	No	0

Notes:

N/A: Not Applicable

N/C: Not Calculated

N/N: Not Needed

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PILECAP DESIGN CALCULATIONS

Definitions:

1. α	=	Coefficient of Thermal Expansion
2. ε1	=	Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
3. εm	=	Average steel strain at level considered
4. ρact	=	Percentage steel provided
5. ρcrit	=	Percentage steel critical as per code
6. A1	=	Area of Base for Load Transfer
7. A2	=	Area of Bearing under column
8. acr	=	Distance from the point considered to the surface of the nearest longitudinal bar
9. AsfrPrv	=	Area of face reinforcement provided
10. AsfrReq	=	Area of face reinforcement required
11. AstPrv	=	Area of tensile reinforcement provided
12. AstReq	=	Area of tensile reinforcement required
13. AsvPrv	=	Area of shear reinforcement provided
14. AsvReq	=	Area of shear reinforcement required
15. Av	=	Location of section of shear-check from Pile Center
16. Beff	=	Effective Width for design for bending and shear
17. Beffsfr	=	Effective Width for design for Face Reinforcement
18. BMux	=	Factored Bending Moment for pile-cap along column D
19. BMuy	=	Factored Bending Moment for pile-cap along column B
20. D	=	Depth of Pilecap
21. Deff	=	Effective Depth of Pilecap
22. DfCol	=	Distance of Pile center to face of column
23. Ec	=	Modulus of elasticity of concrete
24. Es	=	Modulus of elasticity of steel
25. Fst	=	Stress in steel
26. Mx	=	Bending Moment in column along Column D
27. My	=	Bending Moment in column along Column B
28. P	=	Axial load in pile due to Ptotal
29. Pcomb	=	Axial load in column for a load combination
30. Ppile	=	Axial Load on pile
31. Ptotal	=	Total vertical load on pile-cap for a load combination
32. Pmx	=	Axial load on pile due to moment Mx
33. Pmy	=	Axial load on pile due to moment My
34. sp	=	Spacing Between bars at outer most layer
35. Tc	=	Design Shear Strength of Concrete

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36. Tce	=	Enhanced Shear Strength of concrete
37. Temp1	=	Peak Hydration temperature
38. Temp2	=	Seasonal Temperature Variations
39. Tv	=	Nominal shear stress
40. Vu	=	Design shear force
41. Vus	=	Design shear force for stirrups
42. Wcr	=	Surface Crack Width

Code References:

IS 456

1. Ptmax	:	clause 26.5.1.1
2. Ptmin	:	clause 26.5.2.1
3. Pt	:	clause 38
4. Tc	:	clause 40.2.1
5. Tcmax	:	clause 40.2.3
6. AsvReq	:	clause 40.4
7. Min Shear Reinf	:	clause 26.5.1.6
8. Max Stirrup Spacing	:	clause 26.5.1.5
9. One Way Shear Criteria	:	clause 34.2.4.2
10. Load transfer	:	clause 34.4
11. Ptnominal	:	clause 34.5.2
12. crack width calculation	:	Annex-F
13. cracking	:	clause. 35.3.2

IS 2911 Part-1 Section 2

1. Pile capacity check	:	clause 5.10

BS 8007 (For Early / Initial Thermal Cracking)

1. Surface Zone for suspended slab	:	Figure A.1
2. Surface Zone for ground slab	:	Figure A.2
3. Factors for the calculation of minimum reinforcement	:	Table A.1

Design Code	:	IS 456 + IS 13920 - 2016	
Pilecap No	:	PC10	
Column No	:	C10	(230mm X 800mm)
Member Ref. No	:	C10	
Concrete Grade	:	M30	
Steel Grade	:	Fe550	
Clear Cover	:	50	mm
Top of pile-cap below ground	:	1.4	m

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Density of Soil	=	18	kN/cum
Founding Depth	=	2	m
Pile Capacity in Compression	=	500	kN
Pile Capacity in Tension	=	250	kN
Pile Capacity Reduction	=	0	%
Pile Overloading	=	10	%
Pile Group Overloading	=	10	%
Pile Capacity Increase for EQ	=	25	%
Pile Capacity Increase for Wind	=	25	%
Live Load Reduction	=	0	%

Consider Capacity Design	:	No
Consider Overburden Pressure	:	No

No. of Piles	=	2	
Pile Diameter	=	450	mm
Pilecap Offset	=	150	mm
Pile Spacing	=	2.5	x Ø
Pilecap Size	=	1875 X 750	mm
Pilecap Depth	=	600	mm
Pile-cap Wt.	=	21.094	kN

For design, moments along shorter direction of pile cap has been ignored

Check for Maximum Load on One Pile:

Critical Load Combination	:	[1] : (Dead) +(Filling) +(Sdl) +(Wall) +(Live<3) +(Live>3) + (Rooflive)	
Pcomb	=	716.51	kN
Ptotal	=	Pcomb + Pilecap Wt.	
	=	737.6	kN
Mx	=	1.36	kNm
My	=	-0.99	kNm
P	=	Ptotal/ No. of Piles	
	=	368.8	kN
Pmx	=	1.205	kN
Pmy	=	0	kN
Maximum load on pile	=	370.01	kN
Allowable load on pile	=	500 x 1.1	
	=	550	kN

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Check for Maximum Load on Pile Group:

Critical Load Combination	:	[1] : (Dead) +(Filling) +(Sdl) +(Wall) +(Live<3) +(Live>3) + (Rooflive)	
Pcomb	=	716.51	kN

Ptotal	=	Pcomb + Pilecap Wt.	
	=	737.6	kN
Mx	=	1.36	kNm
My	=	-0.99	kNm
Maximum load on pile group	=	737.6	kN
Allowable load on pile group	=	2 x 500 x 1.1	
	=	1100	kN

Check for Uplift Load on Pile:

No uplift in any pile

Design for Bending:

Bottom Reinforcement Along Column-D

Critical Load Combination	:	[2] : 1.5 (Dead) +1.5 (Filling) +1.5 (Sdl) +1.5 (Wall) +1.5 (Live<3) +1.5 (Live>3) +1.5 (Rooflive)
Pcomb	=	1074.77 kN
Ptotal	=	Pcomb + Pilecap Wt.
	=	1106.411 kN
Mx	=	2.03 kNm
My	=	-1.49 kNm
Ppile	=	Max Load on pile
	=	555.01 kN
Deff	=	540 mm
Beff	=	750 mm
DfCol	=	0.16 m
BMux	=	Ppile X DfCol
	=	90.19 kNm
PtReq	=	0.2 %
AstReq (BM)	=	1080 sqmm/m
AstPrv	=	T16 @ 150 C/C
	=	1340.4 sqmm/m

Top Reinforcement Along Column-D

D	=	600 mm
	<=	1000 mm, Hence
AstReq (BM)	=	Min Pt for Top Reinforcement X D X 1000
	=	0.06% X 600 X 1000
	=	360 sqmm/m
AstPrv	=	T12 @ 150 C/C
	=	754 sqmm/m

Bottom Reinforcement Along Column-B

AstReq (BM)	=	0.2 x (D/2) x 1000/100
	=	0.2 x 300 x 1000/100
	=	600 sqmm/m

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AstPrv	=	T16 @ 150 C/C	
	=	1340.4	sqmm/m

Top Reinforcement Along Column-B

D	=	600	mm
	<=	1000	mm, Hence
AstReq (BM)	=	Min Pt for Top Reinforcement X D X 1000	
	=	0.06% X 600 X 1000	
	=	360	sqmm/m
AstPrv	=	T12 @ 150 C/C	
	=	754	sqmm/m

Design for One Way Shear:

Along Column-D

Critical Load Combination	:	[2] : 1.5 (Dead) +1.5 (Filling) +1.5 (Sdl) +1.5 (Wall) +1.5 (Live<3) +1.5 (Live>3) +1.5 (Rooflive)
Pcomb	=	1074.77 kN
Ptotal	=	Pcomb + Pilecap Wt.
	=	1106.41 kN
Mx	=	2.03 kNm
My	=	-1.49 kNm
Ppile	=	Max Load on pile
	=	555.0103 kN

Location of critical section is at d/2 from face of column

Section Location from column center	=	670	mm

Data for Piles

Pile No	Load (kN)	% covered	Shear (kN)
P1	551.4	73.89	143.98
P2	555.01	73.89	144.92

Design Shear Force (Vu)	=	Max. of (Shear due to P1, P2)	
	=	144.92	kN
Deff	=	540	mm
Beff	=	750	mm
Tv	=	Vu/(Beff x Deff)	
	=	0.36	N/sqmm
Tc	=	0.33	N/sqmm
Av	=	107.5	mm
Shear enhancement factor	=	2 X Deff / Av	
	=	10.05	
Enhanced shear strength (Tce)	=	3.36	N/sqmm
Tv	<	Tce, Hence Shear Reinforcement is not required	

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Along Column-B

One way shear check do not applicable for 2 pile pile-cap design

Design of Face Reinforcement:

AsfrReq	=	SFR % X D X Beffsfr	
	=	0.05 X 600 X 500 / 100	
	=	150	sqmm
Asfr Prv	=	2-T12	
	=	226	sqmm

Check for Load Transfer from Column to PileCap

Critical Analysis Load Combination	=		
Critical Load Combination	:	[2] : 1.5 (Dead) +1.5 (Filling) +1.5 (Sdl) +1.5 (Wall) +1.5 (Live<3) +1.5 (Live>3) +1.5 (Rooflive)	
P	=	1074.77	kN
A2	=	0.18	sqm
A1	=	1.41	sqm
Base Area	=	1.41	sqm
A1	<	Base Area	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	2.76	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 X Fck X Modication Factor X Column Area	
	=	4968	kN
Concrete Bearing Capacity	>	P, Hence Safe.	

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SLAB DESIGN CALCULATIONS

NOTES:

1. Slab is designed as per 1 M width of panel.
2. Density of concrete assumed as 25 kN/Cum.
3. Maximum spacing of Main steel is smaller of (3 x Deff and 300 mm)
4. Maximum spacing of Distribution steel is smaller of (5 x Deff and 450 mm)
5. All 6 mm diameter bars assumed of Fe250 grade with Fy=250 N/sq.mm

Definitions Of Terms:

1.	α	=	Coefficient of Thermal Expansion
2.	acr	=	Distance from the point considered to the surface of the nearest longitudinal bar
3.	εm	=	Average steel strain at level considered
4.	ε1	=	Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
5.	ρact	=	Percentage steel provided
6.	ρcrit	=	Percentage steel critical as per code
7.	BM	=	Bending moment in kNm
8.	D	=	Overall depth of slab in mm
9.	Deff	=	Effective depth of slab in mm
10.	Ec	=	Modulus of elasticity of concrete
11.	Es	=	Modulus of elasticity of steel
12.	Fck	=	Characteristic compressive strength of concrete cube in N/sqmm
13.	Fst	=	Stress in steel
14.	Fy	=	Yield Stress Of Steel in N/sqmm
15.	Mu	=	Factored Bending moment in kNm
16.	Sp	=	Spacing Between bars at outer most layer
17.	Tc	=	Permissible Shear stress in concrete in N/sqmm
18.	Temp1	=	Peak Hydration temperature
19.	Temp2	=	Seasonal Temperature Variations
20.	Tv	=	Shear stress due to Vu in N/sqmm
21.	V	=	Shear force in kN
22.	Vu	=	Factored shear force in kN
23.	Wcr	=	Surface Crack Width

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Code References :

IS 456

	ELEMENT		CLAUSE / TABLE
1.	Moment Coeffs For 2-Way Slabs	:	Greschoff-Rankine Formulation and yield line theory
2.	Ptmin	:	26.5.2.1
3.	Ptcalculated	:	38
4.	Shear Strength Of Concrete	:	40.3
5.	Modification Factor for Shear	:	40.2.1.1
6.	Max Nominal Shear Stress	:	40.2.3
7.	Basic Span To Depth Ratio	:	23.2.1
8.	Tensile Steel Factor	:	23.2.1
9.	Compression Steel Factor	:	23.2.1
10.	Flange correction factor	:	23.2.1
11.	spacing between main bars	:	26.3.3
12.	spacing between distribution bars	:	26.3.3
13.	crack width calculation	:	Annex-F
14.	cracking	:	Clause 35.3.2

BS 8007 (For Early / Initial Thermal Cracking)

	ELEMENT		CLAUSE / TABLE
1.	Surface Zone for suspended slab	:	Figure A.1
2.	Surface Zone for ground slab	:	Figure A.2
3.	Factors for the calculation of minimum reinforcement	:	Table A.1

Slab No. :	**S8**		
Level	=	GFR	
Design Code	=	IS 456 + IS 13920 - 2016	
Grade Of Concrete	=	M30	
Grade Of Steel	=	Fe550	
Clear Cover	=	20.000	mm
Long Span, Ly	=	3.480	m
Short Span, Lx	=	3.350	m
Imposed Load	=	1.200	kN/sqm
Live Load	=	2.000	kN/sqm
Slab Thickness	=	150.000	mm
Effective Depth Along LX, Deffx	=	125.000	mm
Effective Depth Along LY, Deffy	=	115.000	mm
Self Weight	=	3.750	kN/sqm
Total Load, TL	=	6.950	kN/sqm

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Span	=	2-Way	
Panel Type	=	One Long Edge Discontinuous	

Design Moments:

Short Span Positive Moment At Midspan -

Moment Coefficient	=	0.032	
BM	=	2.526	kNm
Mu = 1.5 X BM	=	3.788	kNm
Area Of Reinforcement Required (Mu)	=	180.000	sqmm/m
Reinforcement Provided	=	T8 @ 200 C/C	
	=	251.000	sqmm/m

Short Span Negative Moment At Continuous Support -

Moment Coefficient	=	0.043	
BM	=	3.367	kNm
Mu = 1.5 X BM	=	5.051	kNm
Area Of Reinforcement Required (Mu)	=	180.000	sqmm/m
Additional Area Of Reinforcement Required	=	90.000	sqmm/m
Reinforcement Provided	=	T8 @ 200 C/C	
	=	251.000	sqmm/m

Long Span Positive Moment At Midspan -

Moment Coefficient	=	0.028	
BM	=	2.145	kNm
Mu = 1.5 X BM	=	3.217	kNm
Area Of Reinforcement Required (Mu)	=	180.000	sqmm/m
Reinforcement Provided	=	T8 @ 200 C/C	
	=	251.000	sqmm/m

Long Span Negative Moment At Continuous Support -

Moment Coefficient	=	0.037	
BM	=	2.860	kNm
Mu = 1.5 X BM	=	4.290	kNm
Area Of Reinforcement Required (Mu)	=	180.000	sqmm/m
Additional Area Of Reinforcement Required	=	90.000	sqmm/m
Reinforcement Provided	=	T8 @ 200 C/C	
	=	251.000	sqmm/m

Distribution Reinforcement @ 0.12% -

Area Of Reinforcement Required	=	150.000	sqmm/m
Reinforcement Provided	=	T8 @ 200 C/C	
	=	251.000	sqmm/m

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Shear Check :

Along Short Span

Shear Coefficient(Lx), SF1	=	0.376	
V = SF1 x TL x Lx	=	8.743	kN
Vu = 1.5 X V	=	13.115	kN
Shear Stress, Tv	=	0.105	N/sqmm
Nominal Shear Stress, Tc	=	0.288	N/sqmm
Modification Factor 'K'	=	1.300	
K x Tc	=	0.375	
	>	0.105	Slab Is Safe In Shear

Along Long Span

Shear Coefficient(Ly), SF2	=	0.360	
V = SF2 x TL x Lx	=	8.382	kN
Vu = 1.5 X V	=	12.573	kN
Shear Stress, Tv	=	0.109	N/sqmm
Nominal Shear Stress, Tc	=	0.288	N/sqmm
Modification Factor 'K'	=	1.300	
K x Tc	=	0.375	
	>	0.109	Slab Is Safe In Shear

Deflection Check:

Basic Span To Depth Ratio	=	32	
Span Correction Factor	=	1.000	
Tensile Steel Factor	=	1.904	
Compression Steel Factor	=	1.000	
Flange Correction Factor	=	1.000	
Max Span To Depth Ratio	=	32.00 x 1.00 x 1.90 x 1.00 x 1.00	
	=	60.924	
Lx/d	=	26.800	
	<	60.924	Slab Is Safe In Deflection

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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.

LandLens One
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

FREE TOOLS · NO ACCOUNT NEEDED

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

Every free tool
/tools

Services we run for you
/services

The LandLens suite
/landlens/one

Verified RealEstate™

Every claim in this document traces back to a government record.

- Legal opinions, due diligence and title verification
- Building plan, layout and sub-division approvals
- Completion and occupancy certificates, regularisation
- Escrow, negotiation and NRI property management
- Land survey, soil testing, architecture and construction

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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.