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DIGITALLY VERIFIED RECORD

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CIN : U45201TN2005PTC055334

22-09-2025

STABILITY CERTIFICATE

The detailed engineering and structure design of the proposed building consisting of Block-1; Extended Basement Floor (Pit parking, STP pump room) + stilt floor (2 level mechanical puzzle parking) + 1st floor to 7 floors for IT/ITES use building & block 2: ground floor utility building (meter room, generator room & driver's toilet) at Developed plot no.29 (NP), Tansidco Industrial Estate, Guindy, Chennai -600032 T.S.No.14/29 block no.2, Alandur Guindy village, Guindy Taluk, within the limit of Greater Chennai Corporation has been done by me/us based on the report of geotechnical investigation (soil test) done by M/s Geo Marine Consultants (P) Ltd. Report No.GT-2615 dated 18.08.2023 and considering the functional requirement of the building.

2. It is certified that among other factors, the proposed building has been designed to resist earthquake. I/We 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 875 (part 1 and2), wind forces as per IS 875 (part 3) and design of earthquake resistant structure as per IS 1893-2016

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

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Stamp and Signature

PROPOSED COMMERCIAL (OFFICE) DEVELOPMENT AT EKKATUTHANGAL, CHENNAI

DESIGN BRIEF REPORT FOR STRUCTURAL SERVICES

Client:	Arihant® memorable spaces	**M/s. ARIHANT**
Structural Consultant:		**BURO ENGINEERS (I) PVT LTD** Civil & Structural Consultants New No.31, (old No. 14), Besant Avenue, Adyar, Chennai 600 020.

DOCUMENT NO : STR - DBR/Rev-R0

DATE	ISSUE	PREPARED	CHECKED	REVISION
24-01-2025	Primary Report	R.R	P.J	R0

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1.0 PROJECT INFORMATION

1.1 Introduction:

This Design Brief Report (DBR) is for the Proposed Commercial (Office) Building (1 Basement+Stilt+7) at PLOT:29(NP) SIDCO INDUSTRIAL ESTATE, GUINDY, CHENNAI-600032, COMPRISED IN TOWN SURVEY NO:14 PART, AS PER PERMANENT LAND REGISTER T.S.NO.14/29, IN BLOCK NO 2 THIRU.VI.KA.INDUSTRIAL ESTATE, SITUATED AT ALANDUR VILLAGE, GUINDY TALUK, CHENNAI DISTRICT.

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

1.2 Facilities:

The proposed Commercial (Office) Building the sub structure levels Basement to provide car parking facilities and other levels are mainly office space. The floor facilities are as follows

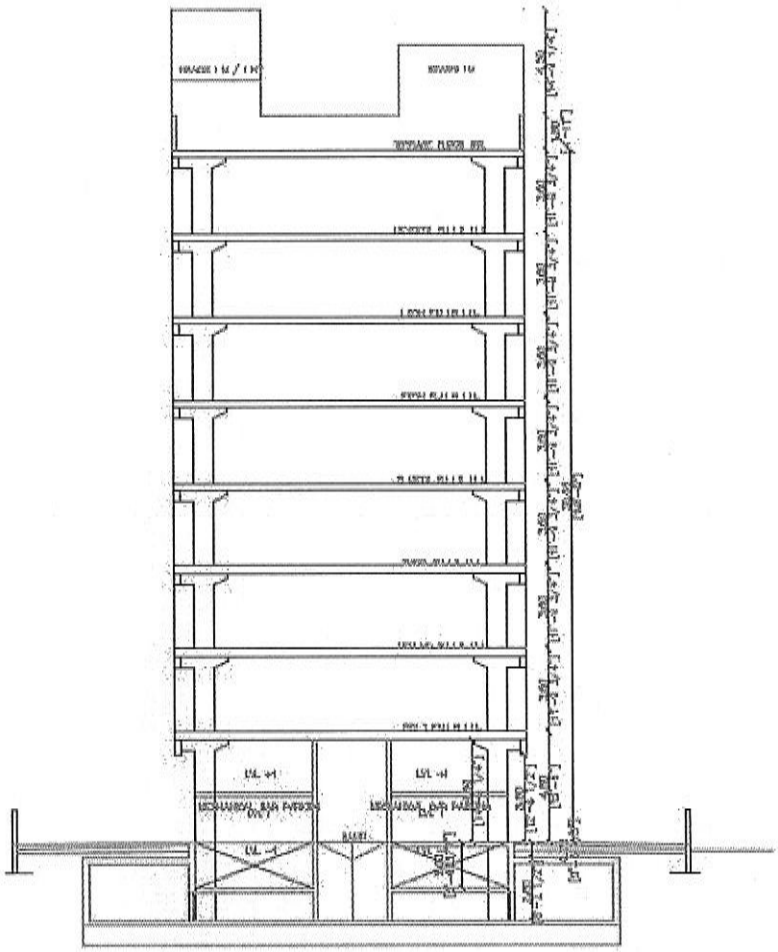
2.0 STOREY INFORMATION

Story	Facilities
Basement	Parking. (Car Parking & Two wheeler parking),STP, Pump room, UG Tanks
Ground Floor	Car parking, Electrical Rooms, Toilets.
1st to 7th Floor	Office, Toilets, lobby.
Terrace	Open terrace, OHT & LMR,Lobby

2.1 Floor to Floor Height:

Basement to GROUND FLOOR	3.60m
Ground floor TO 1ST FLOOR	4.80m
1ST FLOOR TO ROOF	3.60m

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SITE WITH TYPICAL SECTION

SECTIONAL VIEW

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3.0 SITE DISCRIPTION

3.1 Ground Condition:

We have reviewed the reports to understand the stratigraphy and ground conditions at the site provided by M/s. Geo Marines ENGINEERS, Chennai.
The general geological sequence identified by the record of the 4 borehole as in dated during month of JULY 2023 is as follows:

Stratum	Depth from Existing ground level
Silty Clayey Fine Sand	1 to 1.25m
Silty Fine Sand	1.25 to 4m
Silty Fine Sand	4 to 5m
Silty Fine Sand	5 to 9m
Completely weathered Rock	9 to 10.50m
Highly weather Rock	10.50 to 15m

4.0 CODES OF PRACTICE

The relevant Indian Standard codes below are followed.

4.1 Code, Standards and References:

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

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

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

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

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CODE	DESCRIPTION .
IS 875(Part 1) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures - Unit weights of buildings materials and stored material

IS 875 (Part 2) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures - Imposed Loads
IS 875 (Part 3) 2015	Code of practice for Design Loads (other than earthquake) for buildings and structures - Wind Loads
IS 875 (Part 5) 1987	Code of practice for Design Loads (other than earthquake) for buildings and structures - Special Loads and load combinations
IS 456 - 2000	Code of Practice for Plain and Reinforced Concrete
IS 16700 - 2017	Criteria for Structural Safety of Tall Concrete Buildings
IS 1343 - 2012	Code of Practice for Prestressed Concrete
IS 1893 - 2016 (Amendment-2)	Criteria for earthquake resistant design of structures
IS 4326 -2016	Code of practice for Earthquake Resistant Design and Construction of Buildings
IS 3370 - 2009	Code of Practice for Concrete structures for the storage of liquids
IS 1904-1995	Code of Practice for design and construction of Foundation
IS 1905-2021	Code of Practice for Structural use of Unreinforced Masonry
IS 1080 - 1985	Code of Practice for design and construction of shallow Foundation
IS 2950 - 1981	Code of Practice for design and construction of Raft Foundation
IS 800 - 2007	Code of practice for General Construction in steel
BS 8110 : 1997	Plain and reinforced concrete-code of practice(British standard)
ACI 318	Plain and reinforced concrete code of practice (American standard)

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IS 13920: 2016	Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces
SP24	Explanatory Hand book on Indian standard code of practice
SP34	Handbook on concrete reinforcement and detailing

5.0 COVER AND FIRE RATING

Cover to reinforcement considered for various elements

Structural element	Exposure condition	Fire rating in hours	Cover	
Pile	Severe		75 (Bottom)	75 (Top)
Basement wall	Severe		45 (Soil side)	30 (Building side)
Column		2	40	
Shear wall		2	30	
Beam (Simply supported)		2	40	
Beam (Continuous)		2	30	
Slab (Simply supported)		2	35	
Slab (Continuous)		2	25	

6.0 STRUCTURAL SYSTEM

Floor system: The structural Floor system for the super structure is PT Beam with PT one way slab.

Lateral load resisting system: Ductile Shear Wall System

7.0 FOUNDATION & BASEMENT SLAB

The following are inferred from the Geo-technical investigation report.

A total of 4 boreholes were terminated after drilling approximately 15m depth. Encountered layer was in the form of Soft rock. The N value recorded at this depth is more than 100.

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The report has also stated the ground water table is encountered at 2.75 m from EGL. We have considered for basement wall and the Stitch slab design water head of 1.0m from the EGL.

For the building adopted foundation system is pile foundation, with reference to Geo Marine Consultants (P) LTD soil investigation report the recommendation of safe carry capacity of bored cast-in-situ piles are as follows and the same capacities are considered in foundation design,

TABLE: - 4.1 RECOMMENDED SAFE LOAD CARRYING CAPACITIES OF BORED CAST-IN SITU PILES

Sl.No	Reference Bore hole No.	Length of Pile below E.G.L	Assumed Length of Cut-Off Below E.G.L	Length of Pile below Cut-off	Dia.of Pile in (mm)	SAFE LOAD CARRYING CAPACITY (kN)		
						Vertical Load Carrying Capacity	Pull Out Capacity	Lateral Load Carrying Capacity
1.0	BH-01	12.0	4.0	8.00	500	1200	170	50
2.0					550	1400	180	60
3.0					600	1600	200	70
4.0					650	1800	220	80
5.0					750	2400	250	110

For the 1000mm Diameter pile 4000 KN vertical load carrying capacity considered for design.

8.0 MATERIAL GRADES

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

8.1 Concrete

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

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

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Structural Elements		Compressive Strength at 28 days	Concrete grade
Minimum grade of concrete for any structural member is considered as		35 N/Sq.mm	M35
All Structural concrete for :			
Columns, Shear walls & Core walls	Basement to Terrace	40 N/Sq.mm	M40
Pile and pile cap		30 N/Sq.mm	M30
Beams and slabs	Basement to Terrace	35 N/Sq.mm	M35
Overhead Water Tank, UG Water Tank, STP & Pump room		30 N/Sq.mm	M30

8.2 Reinforcement

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

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

9.0 DESIGN OF LOADINGS

9.1 Material Density

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

Unit weight of concrete - 25 KN / Cum.
Unit weight of steel - 78.5 KN / Cum.
Screed concrete - 24 KN / Cum.
Unit weight of dry soil - 18 KN / Cum.
Unit weight of saturated soil - 20 KN / Cum.
Unit weight of Glass - 27.2 KN / Cum.
Unit weight of water - 9.81 KN / Cum.
Aerated block masonry - 8.65 KN / Cum.
Light weight concrete filling - 16.0 KN / Cum (Supplier - Nuvoco)
Block wall - 22 kN/m3

9.2 Superimposed Dead Loads and Live Loads

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

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Usage	SDL (kN/m2)				LL (kN/m2)
	Partition Wall	Services	Finishes	Total	
Office	1.00	0.00	2.30	3.30	4.00
Lobby	0.00	0.00	3.30	3.30	4.00
Toilet	0.00	0.00	5.20	5.20	2.50
Electrical Room	0.00	0.00	3.3	3.3	7.5
Staircase	0.00	0.00	3.60	3.60	4.00
Parking	0.00	0.00	2.90	2.90	5.00
Roof	0.00	0.00	3.60	3.60	5.00
LMR	0.00	0.00	20.00	20.00	0.00
Car Parking / Driveway	0.00	0.00	2.90	2.90	5.00
DG	0.00	0.00	10.00	10.00	5.00
OHT	0.00	10xWater Height	0.00	0.00	0.00

* (G) - Ground floor (OHT) - Over Head Tank
(DG) - Diesel Generator
(LMR) - Lift Machine Room

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

a) **SUPER IMPOSED DEAD LOADS (kN/m²)**

Floor Finishes of 75 mm thickness have been considered on all the typical floors, Basement floors 100mm, toilet 100+40=140mm, and office-75mm.

TERRACES (Load in kN/m2)

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

b) **SELF-WEIGHT OF LIGHT WEIGHT WALLS (kN/m²)**

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

(i) 200mm thick light weight block wall 2.9kN/m2

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(ii)	100mm thick light weight block wall	1.77kN/m^2
(iii)	Block Wall (200mm)	4.40kN/m2
Water Tank		Water height x 10

9.3 Seismic Design Parameters:

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

Base shear Vb = Ah W

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

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

1) The lateral load resisting system of the buildings are Dual system. The structural shear walls and the vertical elements & beams are design for lateral load.
2) The lateral load resisting system of the buildings is "Dual System" – All the frames are designed as ductile.
3) As per IS 1893:2016 code, Chennai lies in Zone III with Zone factor Z = 0.16
4) The Design Base Shear is given by V_b = Ah x W, Where Ah = Z / 2 x I/R x S_a /g

   I = Importance Factor = 1.2

   Soil Type 1 (Rock or Dense soil)

   R (Response reduction factor) = 3 (Dual System)

   Sa/g = Average Response acceleration coefficient

   For the building height with reference to IS: 1893-2016, since the buildings are well connected with basement walls so for the time period calculation the heights are considered ground floor to roof that is 37.20m.

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

   The fundamental natural period (Ta) for building,

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b) Buildings with RC structural walls:

$$T_a = \frac{0.075h^{0.75}}{\sqrt{A_w}} \geq \frac{0.09h}{\sqrt{d}}$$

where A_w is total effective area (m^2) of walls in the first storey of the building given by:

$$A_w = \sum_{i=1}^{N_w}\left[A_{wi}\left\{0.2+\left(\frac{L_{wi}}{h}\right)^2\right\}\right]$$

where

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

A_{wi} = effective cross-sectional area of wall i in first storey of building, in m^2;

L_{wi} = length of structural wall i in first storey in the considered direction of lateral forces, in m;

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

N_w = number of walls in the considered direction of earthquake shaking.

The value of L_{wi}/h to be used in this equation shall not exceed 0.9.

where,

Base Dimension along X Direction, dx = 15.10m (Longer length)

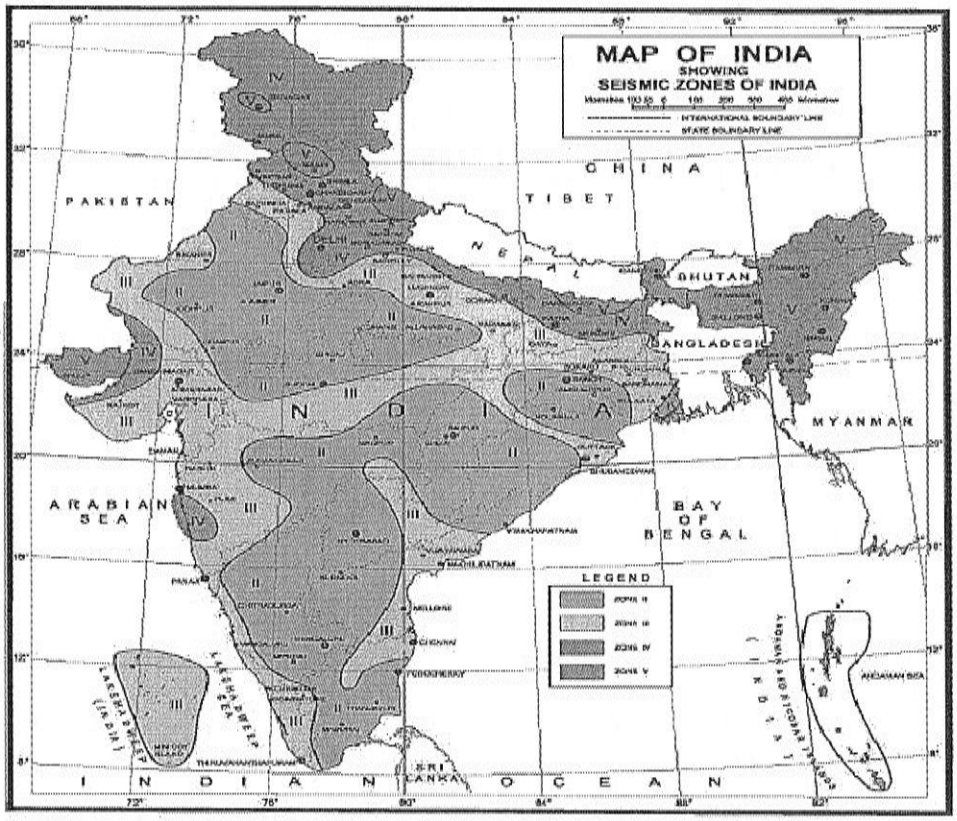
Base Dimension along Y Direction, dy = 63.60m (Longer length)

H = 37.20m

T_a = 0.749 sec (along X direction)

T_a = 1.031 sec (along Y direction)

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SEISMIC ZONE CLASSIFICATION FROM IS 1893: 2016

Dynamic Analysis

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

Number of modes Considered	: 12 Numbers (Min)
Modal Combination Method Used	: Complete Quadratic combination (CQC).
Directional Combination Method used	: Square root of the sum of Square (SRSS).
Modal case type	: Ritz vector Method

Cut off frequency in case response spectrum method of analysis - 33 Hz.
Mass participation is 90% as per our analysis
Damping 5%is used for seismic analysis
Dynamic analysis of building is carried out. The members are designed accordingly.

9.5 Wind Loads

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

Design Wind Speed, VZ — Vbxk1x k2x k3x k4

Vb → Basic Wind velocity for Chennai — 50m/s

K1 → Risk coefficient for all general buildings — 1.00

k2 → Terrain category 2 — To suit the height of the structure for terrain

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k2	(H=37.20m -GF to Roof)	— 1.164
k3	→ Topography factor	— 1.00
k4	→ Importance Factor for cyclonic Region	— 1.00

Based on the above,

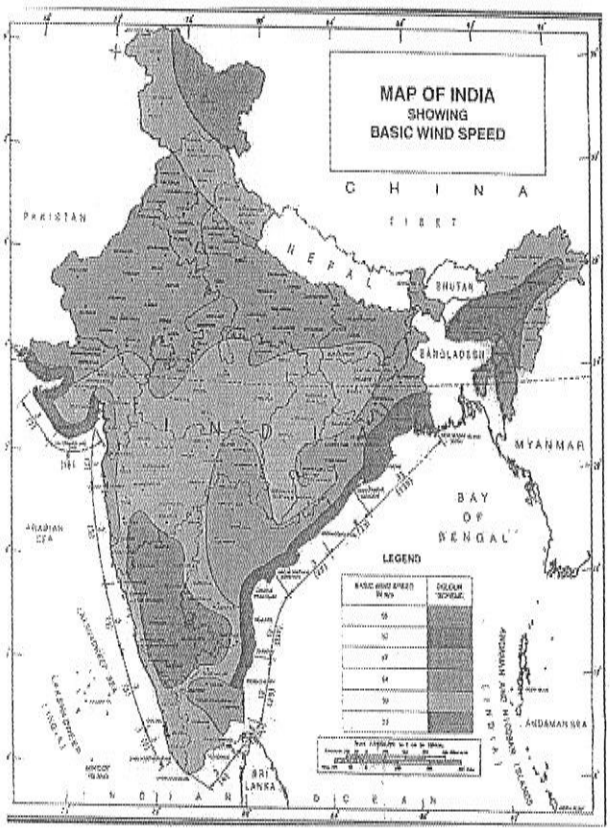
Max. design wind speed (VZ) (Vbxk1x k2x k3x k4) = 58.2m/s

Max. design wind pressure (Pz) — 0.6 x Vz^2 = 2032.344 N/m2

Design wind pressure: pd = Pz x Kax Kd x Kc

= 1481.57 N/m2

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



INDIAN WIND SPEED CLASSIFICATION FROM IS 875 PART (III)

9.6 Temperature Loads:

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

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10.0 LOAD COMBINATION

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

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

Load Combination for foundation sizing

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

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

23. 1.0DL +1.0 LL
24. 1.0DL + 1.0SPECX
25. 1.0DL + 1.0SPECY
26. 1.0DL ± 1.0WindX
27. 1.0DL ± 1.0WindY
28. 1.0DL ± 1.0TEMP
29. 1.0DL + 0.8LL + 0.8SPECX
30. 1.0DL + 0.8LL + 0.8SPECY
31. 1.0DL + 0.8LL ± 0.8WindX
32. 1.0DL + 0.8LL ± 0.8WindY

Where,

DL	- Dead load,
LL	- Live load
Wind X	- Wind load in x - direction
Wind Y	- Wind load in y-direction
SPECX	- Earthquake load in x-direction
SPECY	- Earthquake load in y-direction

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AL -Accidental Load (such as fire tender load)

11.0 SERVICIBILITY LIMITS

11.1 Lateral Deflection (Wind)

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

11.2 Lateral Deflection (Seismic)

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

11.3 Vertical Deflection of Beams and Slabs due to Gravity Loads

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

12.0 STRUCTURAL ANALYSIS AND DESIGN APPROACH

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

Assumptions for 3D model analysis using ETABS

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

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

Stiffness modification factors are adopted in the analysis as per IS -16700-2023, Table.5.

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Table 5 Cracked Section Properties of RC members

(*Clauses* 5.5.2,7.3.6, 8.1.3.2.1 *and* 7.2)

Sl No.	Structural Element	Serviceability Design		Strength Design	
		Cross-Sectional Area	Moment of Inertia	Cross-Sectional Area	Moment of Inertia
(1)	(2)	(3)	(4)	(5)	(6)
i)	Slabs	$1.0A_g$	$0.35I_g$	$1.00A_g$	$0.25\ I_g$
ii)	Beams	$1.0\ A_g$	$0.7\ I_g$	$1.00\ A_g$	$0.35\ I_g$
iii)	Columns	$1.0\ A_g$	$0.9\ I_g$	$1.00\ A_g$	$0.70\ I_g$
iv)	Walls	$1.0\ A_g$	$0.9\ I_g$	$1.00\ A_g$	$0.70\ I_g$

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

- ✓ The 3D ETABS model generated based on the preliminary floor plans (shuttering drawings) prepared using preliminary sizes.
- ✓ Sectional properties are assigned to all the structural elements as per the preliminary floor plans (shuttering drawings).
- ✓ External & Internal in fill wall loads are assigned as uniformly distributed line load on beams and as area load if the wall is intending to distribute on slab directly.
- ✓ Slabs are modelled as shell element if floor system and slabs are assigned with horizontal diaphragms.
- ✓ Live Load reduction is considered in the design of Foundation and Column as per the Code: IS 875-1987 (Part-II), clause.3.2.1.
- ✓ Area design load i.e. Live load/SDL or any other load is applied at floor relevant to its usage.
- ✓ All lateral loads & parameters are assigned as per Codes IS 1893-2016 & IS 875-Part-3, 2015.
- ✓ Beams under Torsion is required to maintain Equilibrium will be designed for Torsion in accordance with IS 456-2000, clause 41.1 to 41.4 and for all other beams torsional stiffness is neglected in the analysis by applying stiffness modifier as 0.000001 to torsional constant "J". Hence no specific design for Torsion is required for these beams.
- ✓ Concrete cover to reinforcement complied accordance with IS 456-2000, Table.16 & 16A.
- ✓ All vertical wall elements are assigned with auto meshing/manual messing appropriately in order to achieve accuracy in results.

Design approach of structural elements

Shear wall/Column:

RC Structural Walls & Columns which are supporting both vertical loads and lateral forces are designed for the most adverse load conditions and envelope of the forces which will be the maximum for that structural element from the load combinations considered in the 3D Etabs Model.

RCDC a design software will be used to design the element for the maximum forces obtained from the Etabs model analysis results.

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Beams: Each Beam will be designed for maximum forces from the 3D analysis using Etabs and RCDC Softwares.
Area Load & Application: Applied as uniformly distributed area load with intensity proportionate to its usage as mentioned in the Loading items in the DBR.
Line (Wall) Load & Application: Non load bearing or infill wall loads are calculated appropriate and Applied as uniformly distributed line load.

13.0 COMPUTER PROGRAMS

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

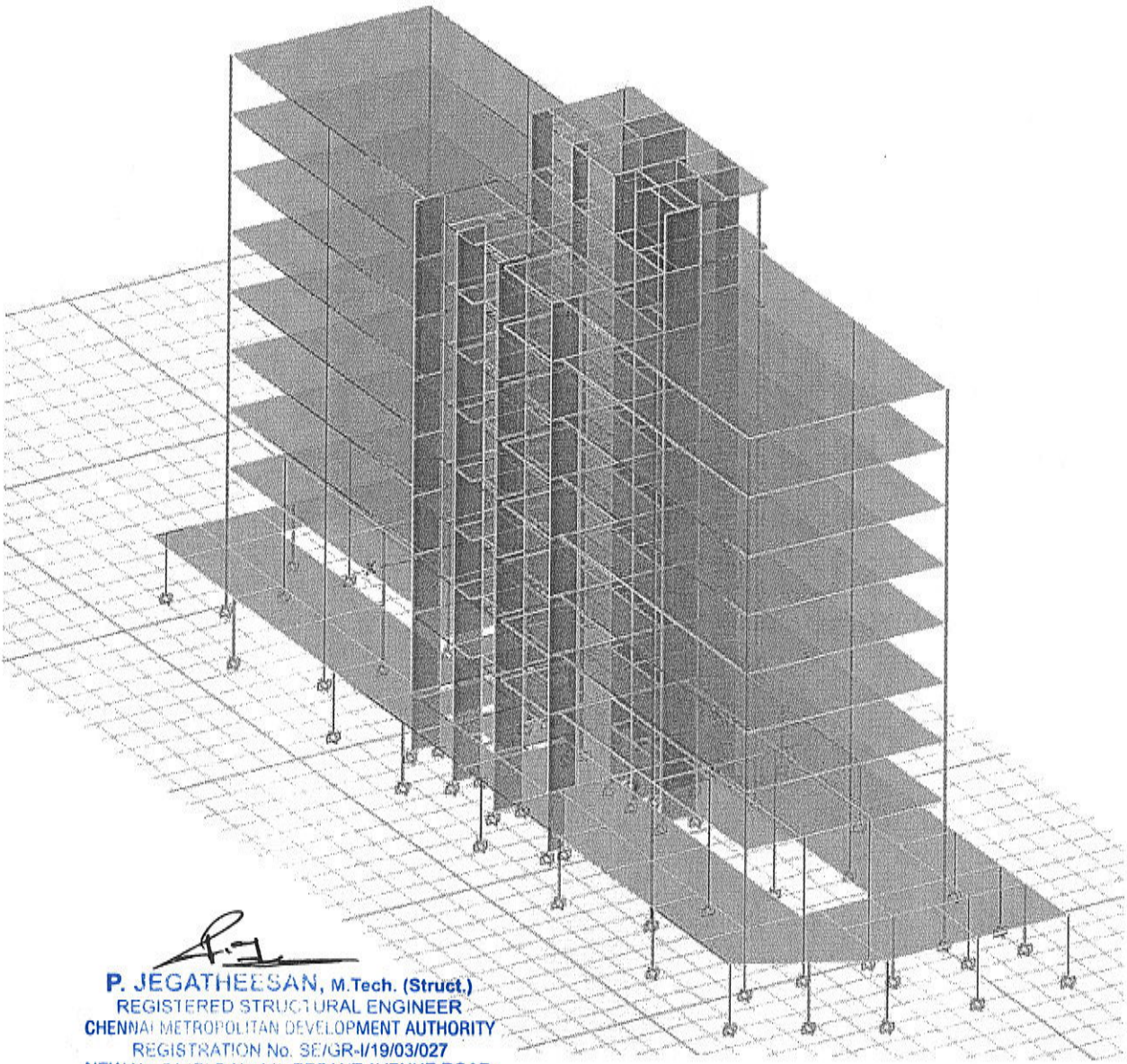
1.	PROKON Ver 3.0	- Wall & Beam design
2.	ETABS Ver 21.0.1	- Three Dimensional Program
3.	SAFE Ver 20.3.0	- Pile cap Analysis / Strip Analysis
4.	In-House Spreadsheet	- one way/ two way slab/ Pile cap design
5.	Rapt-6	- Post Tensioning Analysis & Design
6.	RCDC	- Beam Design, Column design and Wall design
7.	STAAD PRO & ETABS	- Structural Steel Design.

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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	UPPER ROOF	3.6	No	None	No	Yellow
T1	ROOF	3.6	No	None	No	Blue

Tower	Name	Height m	Master Story	Similar To	Splice Story	Color
T1	7TH	3.6	No	2ND	No	Cyan
T1	6TH	3.6	No	2ND	No	Magenta
T1	5TH	3.6	No	2ND	No	Gray8Dark
T1	4TH	3.6	No	2ND	No	Green
T1	3RD	3.6	No	2ND	No	Red
T1	2ND	3.6	Yes	None	No	Yellow
T1	1ST	4.8	No	None	No	Blue
T1	GF	3.6	No	None	No	Cyan

2 Loads

This chapter provides loading information as applied to the model.

2.1 Load Sets

Table 2.1 - Shell Uniform Load Sets

Name	Load Pattern	Load Value kN/m2
CARPARKING	Live	5
CARPARKING	SDL	2.9
Chiller	Live	10
Chiller	SDL	3.6
DG	Live	5
DG	SDL	10
ELECTRICAL ROOM	Live	7.5
ELECTRICAL ROOM	SDL	3.3
Ex-B	Live	5
Ex-B	SDL	12.6
LMR	SDL	20
LOBBY	Live	4
LOBBY	SDL	2.3
OFFICE	Live	4
OFFICE	SDL	3.3
OHT	SDL	36
PARKING	Live	5
PARKING	SDL	2.9
ROOF	Live	5
ROOF	SDL	3.6
STAIRCASE	Live	4
STAIRCASE	SDL	3.6
TOILET	Live	2.5
TOILET	SDL	5.2
u.Tank	SDL	40

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2.2 Auto Seismic Loading

Table 2.2 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 1 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Is Auto Load	X Dir?	X Dir Plus Ecc?	X Dir Minus Ecc?	Y Dir?	Y Dir Plus Ecc?	Y Dir Minus Ecc?
EQX	0.749	0.042724	150216.4852	6417.7938	No	No	Yes	No	No	No	No
EQY	1.031	0.031038	150216.4852	4662.3933	No	No	No	No	No	Yes	No

Table 2.2 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 2 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Ecc Ratio	Top Story	Bottom Story	Period Type	User T sec	Z
EQX	0.749	0.042724	150216.4852	6417.7938	0.05	ROOF	GF	User Defined	0.749	0.16
EQY	1.031	0.031038	150216.4852	4662.3933	0.05	ROOF	GF	User Defined	1.031	0.16

Table 2.2 - Load Pattern Definitions - Auto Seismic - IS 1893 2016 (Part 3 of 3)

Name	Period Used sec	Coeff Used	Weight Used kN	Base Shear kN	Site Type	I	R
EQX	0.749	0.042724	150216.4852	6417.7938	I	1.2	3
EQY	1.031	0.031038	150216.4852	4662.3933	I	1.2	3

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 + Eccentricity Y

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = User Specified

User Period $T = 0.749\text{sec}$

Factors and Coefficients

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

Response Reduction Factor, R [IS Table 9] $R = 3$

Importance Factor, I [IS Table 8] $I = 1.2$

Site Type [IS Table 1] = I

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] $\frac{S_a}{g} = \frac{1}{T}$ $\frac{S_a}{g} = 1.335113$

Equivalent Lateral Forces

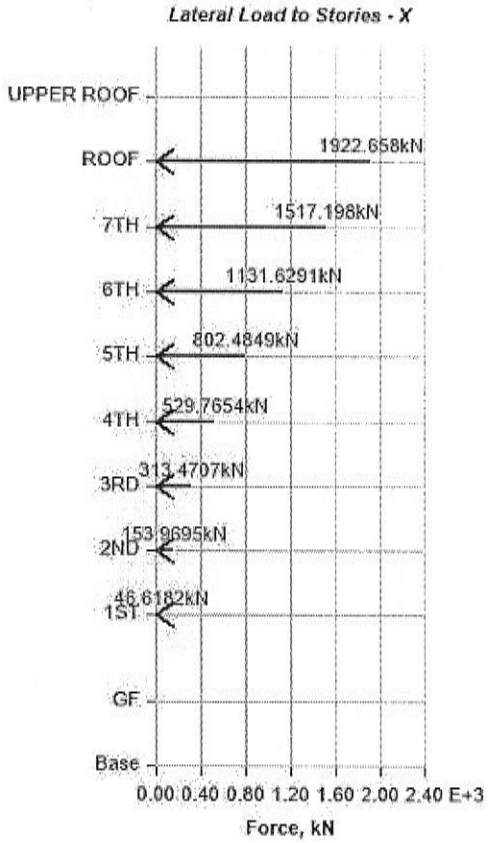
Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Calculated Base Shear

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Direction	Period Used (sec)	W (kN)	V_b (kN)
X + Ecc. Y	0.749	150216.4852	6417.7938

Applied Story Forces



Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
UPPER ROOF	37.2	0	0
ROOF	33.6	1922.658	0
7TH	30	1517.198	0
6TH	26.4	1131.6291	0
5TH	22.8	802.4849	0
4TH	19.2	529.7654	0
3RD	15.6	313.4707	0
2ND	12	153.9695	0
1ST	8.4	46.6182	0
GF	3.6	0	0
Base	0	0	0

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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 + Eccentricity X

Eccentricity Ratio = 5% for all diaphragms

Structural Period

Period Calculation Method = User Specified

User Period $T = 1.031\text{sec}$

Factors and Coefficients

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

Response Reduction Factor, R [IS Table 9] $R = 3$

Importance Factor, I [IS Table 8] $I = 1.2$

Site Type [IS Table 1] = I

Seismic Response

Spectral Acceleration Coefficient, S_a/g [IS 6.4.2] $\frac{S_a}{g} = \frac{1}{T}$ $\frac{S_a}{g} = 0.969932$

Equivalent Lateral Forces

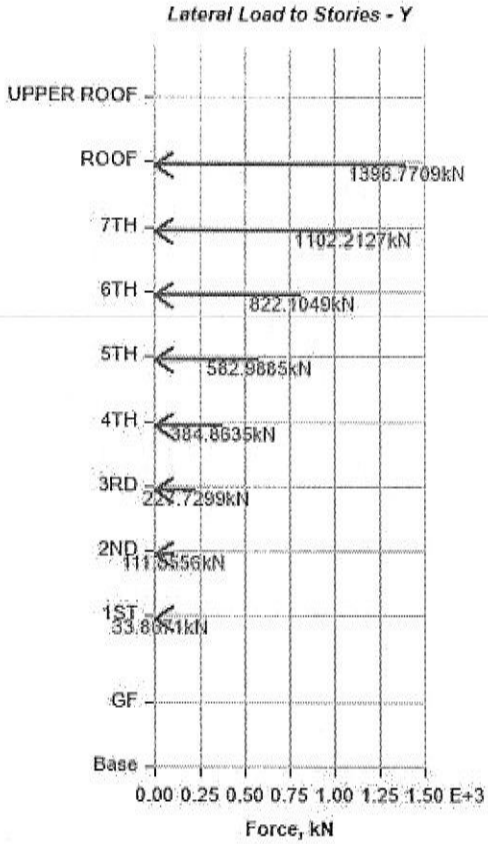
Seismic Coefficient, A_h [IS 6.4.2] $A_h = \frac{ZI\frac{S_a}{g}}{2R}$

Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
Y + Ecc. X	1.031	150216.4852	4662.3933

Applied Story Forces

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Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
UPPER ROOF	37.2	0	0
ROOF	33.6	0	1396.7709
7TH	30	0	1102.2127
6TH	26.4	0	822.1049
5TH	22.8	0	582.9885
4TH	19.2	0	384.8635
3RD	15.6	0	227.7299
2ND	12	0	111.8556
1ST	8.4	0	33.8671
GF	3.6	0	0
Base	0	0	0

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2.3 Functions

2.3.1 Response Spectrum Functions

Table 2.5 - Functions - Response Spectrum - IS1893 2016

Name	Period sec	Value	Seismic Zone	I	Soil Type	R	Damping Ratio
Func1	0	0.032	III	1.2	I	3	0.05
Func1	0.1	0.08					
Func1	0.4	0.08					
Func1	0.6	0.053333					
Func1	0.8	0.04					
Func1	1	0.032					
Func1	1.2	0.026667					
Func1	1.4	0.022857					
Func1	1.6	0.02					
Func1	1.8	0.017778					
Func1	2	0.016					
Func1	2.5	0.0128					
Func1	3	0.010667					
Func1	3.5	0.009143					
Func1	4	0.008					
Func1	4.5	0.008					
Func1	5	0.008					
Func1	5.5	0.008					
Func1	6	0.008					
Func1	6.5	0.008					
Func1	7	0.008					
Func1	7.5	0.008					
Func1	8	0.008					
Func1	8.5	0.008					
Func1	9	0.008					
Func1	9.5	0.008					
Func1	10	0.008					

2.4 Load Cases

Table 2.6 - Load Case Definitions - Summary

Name	Type
Modal	Modal - Eigen
Dead	Linear Static
Live	Linear Static
SDL	Linear Static
WALL	Linear Static
EQX	Linear Static
EQY	Linear Static
SPEC-X	Response Spectrum
SPEC-Y	Response Spectrum
SPEC-XW	Response Spectrum
SPEC-YW	Response Spectrum
WIND-X	Linear Static
WIND-Y	Linear Static



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DESIGN OF PILE FOUNDATION

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Project : ARIHANT EKKATUTHANGAL	BURO ENGINEERS		
Location : CHENNAI	Made by	Date 24-Jan-25	Page 2
Subject : Pilecap Design	Checked by	Revision -	Job No 857/45

Marking : PC2A

TYPE : 2-Pile Group

Material
fcu = 30 N/mm²
fy = 550 N/mm²
Cover = 75 mm
Reinforcement
B1 = 25 mm
B2 = 16 mm

Pile (1 = Rect, 2=Circular)
Pile type = 2
Diameter = 1000 mm
Capacity = 4000 kN

Column (1 = Rect, 2=Circular)
Col. type = 1
Bc = 300 mm
Lc = 2000 mm

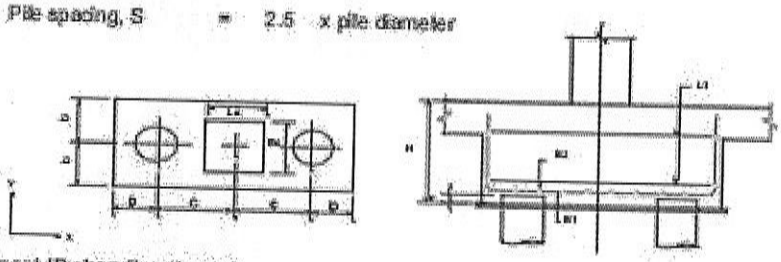
Load factor = 1.5
Ultimate Column Load = 12000 kN

Pilecap Dimensions

Pile spacing, S = 2.5 x pile diameter

B = 650 mm
C = 1250 mm
D = 650 mm
F = 75 mm
H = 1150 mm

L1 = 3T13



Bending Moment & Reinforcement (By banding theory)
Choice of moment - 1 =column face, 2 = center of column: 1

	About Y - Y axis		About X - X axis	
Moment arm(mm)	325			
Maximum Moment (kNm)	1950			
Width, b	1300			
Effective depth, d	1063			
$K = M/bd^2fcu$	0.044			
Lever arm, Z	1007			
As_{req} (mm^2)	4046 or 3112 mm^2/m		Provide min. reinft = 0.12%bd	
No. of bars & spacing required	9 T 25 @ 141		5244 or 1390 mm^2/m	
No. of bars & spacing provided	9 T 25 @ 141 (B1)		27 T 16 @ 139	
As_{prov} (mm^2)	4420 or 3399.7 mm^2/m		27 T 16 @ 139 (B2)	
			5431 or 1429 mm^2/m	

Shear Check

Shear force	6000 kN
(100As/bd)	0.32
$(400/d)^{1/4}$	1.00
Allowable shear stress, V_c	0.4064 mm^2/m
Shear span, a_v	25.00 mm
Enhancement factor = 2d/a_v	85.00
Enhanced shear stress (N/mm^2), V_c	4.36 mm^2/m

i) Shear at column face
V = 2.48 < 3.50 ok!

ii) Shear along a vertical section at 20% inside pile across the full width of pilecap
V = 4.34 < 4.36 ok!

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

iv) Punching shear check

4.1727 Punching Area
8850 Perimeter bo
1.2762 Punching Shear Stress tv
1.3693 Permissible shear stress
OK

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Project : ARIHANT EKKATUTHANGAL	BURO ENGINEERS		
	Made by	Date	Page
Location : CHENNAI	P.EGATHEESAN	24-Jan-25	1
	Checked by	Revision	Job No
Subject : Pilecap Design		-	BE17-49

Marking : PC3A3

TYPE : 3-PILE GROUP

Material				Pile (1 = Rect, 2=Circular)			Column (1 = Rect, 2=Circular)		
fcu	=	30 N/mm²		Pile type	=	2	Col. type	=	1
fy	=	550 N/mm²		Diameter	=	1000 mm	Bc	=	600 mm
Cover	=	75 mm		Capacity	=	4000 kN	Lc	=	2000 mm
Bar Dia.	=	32 mm	(B1)						
Bar Dia.	=	32 mm	(B2)						

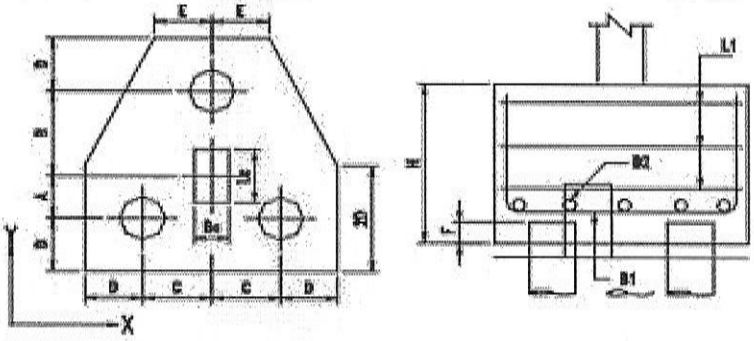
Load factor = 1.5

Ultimate Column Load = 18000 kN

Pilecap Dimensions — Pile spacing, S = 2500 mm — Depth, H = 1600 mm

A = 940.0 mm
B = 1230.0 mm
C = 1250.0 mm
D = 650.0 mm
E = 650.0 mm
F = 75.0 mm

L1 = 4T13



Bending Moment & Rinforcement (By bending theory)

	About Y -Y				About X - X			
Moment arm (mm)	1025				305			
Moment at column face (KNm)	6150				1830			
Width, b	1600				1300			
Effective depth, d	1509				1477			
K = M/bd²fcu	0.056				0.022			
Lever arm, Z	1408				1403			
As_{req} (mm²)	9129	or	6056 mm²/m	Asmin	2726	or	2097 mm²/m	
No. of bars & spacing required	12 T 32 @ 129				4 T 32 @ 341			
No. of bars & spacing provided	12 T 32 @ 129 B1				4 T 32 @ 373 B2			
As_{prov} (mm²)	9655	or	6858 mm²/m		3218	or	2293.6 mm²/m	

Shear Check

(100As/bd)	0.45	0.16
$(400/d)^{1/4}$	1.00	1.00
Allowable shear stress, v_c	0.45 mm²/m	0.29 mm²/m
Shear span, a_v	725.0 mm	5.0 mm
Enhancement factor = 2d/a_v	4.16	590.80
Enhanced shear stress (N/mm²)	2.01	4.38

i) Shear at column face

v = 2.29 < 3.50 ok! — v = 2.34 < 3.50 ok!

ii) Shear along a vertical section at 20% inside pile across the full width of pilecap

v = 3.05 > 2.01 reqd. 1582 mm²/m — v = 3.12 < 4.38 ok!

iii) Punching shear at 0.2 diameter

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

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Project : ARIHANT EKKATUTHANGAL			
Location : CHENNAI	Made by	Date 24-Jan-25	Page 1
Subject : Pilecap Design	Checked by	Revision -	Job No 8587/2
Marking : PC4A/1			
TYPE : 4-Pile Group			

Material

fcu	=	30 N/mm²	
fy	=	550 N/mm²	
Cover	=	75 mm	
Bar Dia.	=	32 mm	(B1)
Bar Dia.	=	32 mm	(B2)

Pile (1 = Rect, 2=Circular)

Pile type	=	2
Diameter	=	1000 mm
Capacity	=	4000 kN

Column (1 = Rect, 2=Circular)

Col. type	=	1
Bc	=	800 mm
Lc	=	1000 mm

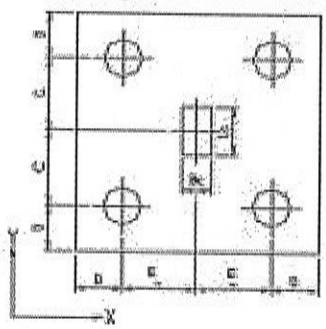
Load factor = 1.5
Ultimate Column Load = 24000 kN

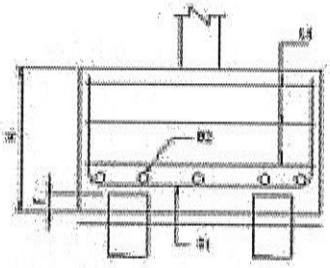
Pilecap Dimensions

Pile spacing, S = 2.5 x pile diameter

C	=	1250 mm
D	=	650 mm
E	=	1250 mm
F	=	75 mm
H	=	1950 mm

L1 = 4 T10





Bending Moment & Rinforcement (By bending theory)

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

	About Y - Y axis	About X - X axis
Moment arm (mm)	925	925
Moment at column face (kNm)	11100	9600
Width, b	3600	3600
Effective depth, d	1759	1727
K = M/bd²fcu	0.031	0.029
Lever arm, Z	1671	1641
As_{req} (mm²)	12652 or 3653 mm²/m	12011 or 3319 mm²/m
No. of bars & spacing required	18 T 32 @ 213	18 T 32 @ 241
No. of bars & spacing provided	36 T 32 @ 103	36 T 32 @ 103
As_{prov} (mm²)	28955 or 7783 mm²/m	28955 or 7783 mm²/m
Shear Check		
(100As/bd)	0.44	0.45
$(400/d)^{1/4}$	1.00	1.00
Allowable shear stress, v_c	0.469 mm²/m	0.474 mm²/m
Shear span, a_v	625.00 mm	625.00 mm
Enhancement factor = 2d/a_v	5.63	5.68
Enhanced shear stress (N/mm²)	2.64	3.12

i) Shear along a vertical section at 20% inside pile across the full width of pilecap

v =	1.60	<	2.64	ok!	1.83	< 3.12 ok!

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

iii) Punching shear check

7.0003 Punching Area	6.891129 Punching Area
10536 Perimeter bo	10508 Perimeter bo
1.2828 Punching Shear Stress fv	1.32251 Punching Shear Stress fv
1.3093 Permissible shear stress	1.359306 Permissible shear stress
O.K.	O.K.

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DESIGN OF WALL

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1 Design Data

This chapter provides design data and results.

1.1 Shear Wall Design

ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
7TH-ROOF	P1	4575	37950	2450	300	1

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	2060	0.0028	0.0023	CombW3	211.7787	15.3696	-1226.5308	735000
Bottom	1838	0.0025	0.0023	Comb1-18	998.0354	19.9607	-68.4712	735000

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	CombW5	576.1128	1049.3019	443.4042	186.77	717.2483
Bottom	Leg 1	750	CombW5	675.3085	401.6278	443.4042	188.5556	719.0338

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	CombW5	1245.5578	-1270.838	5.93	8
Top–Right	Leg 1	0	CombW5	1245.5578	1049.3019	5.19	8
Bottom–Left	Leg 1	0	CombW5	1344.7535	-531.7456	3.6	8
Botttom–Right	Leg 1	0	CombW5	1344.7535	401.6278	3.17	8

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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
6TH - 7TH	P1	4575	37950	2450	300	0.9

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	1838	0.0025	0.0023	Comb1-18	1494.2831	-29.8857	206.8889	735000
Bottom	1838	0.0025	0.0023	Comb1-18	1593.4788	31.8696	-110.0068	735000

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	CombW5	1082.891	1172.1926	-553.6306	195.892	726.3703
Bottom	Leg 1	750	CombW5	1182.0867	788.9853	-553.6306	197.6776	728.1558

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	CombW5	1934.9103	-733.3244	5.08	8
Top–Right	Leg 1	0	CombW5	1934.9103	1172.1926	6.54	8
Bottom–Left	Leg 1	0	CombW5	2034.106	-1008.7533	6.13	8
Botttom–Right	Leg 1	0	CombW5	2034.106	788.9853	5.4	8

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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
5^{TH} -6^{TH}	P1	4575	37950	2450	300	0.8

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1838	0.0025	0.0023	Comb1-18	2084.6816	-41.6936	184.3314	735000
Bottom	1838	0.0025	0.0023	Comb1-18	2183.8773	43.6775	-104.4652	735000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	CombW5	1577.1427	1076.1101	-519.2442	204.7886	735.2668
Bottom	Leg 1	750	CombW5	1676.3384	1080.477	-519.2442	206.5741	737.0524

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	CombW5	2628.5602	-684.111	5.86	8
Top–Right	Leg 1	0	CombW5	2628.5602	1076.1101	7.16	8
Bottom–Left	Leg 1	300	CombW5	2727.7559	-1292.4356	8.02	8
Botttom–Right	Leg 1	0	CombW5	2727.7559	1080.477	7.31	8

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IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
4^{TH} -5^{TH}	P1	4575	37950	2450	300	0.7

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1838	0.0025	0.0023	Comb1-18	2669.7056	-53.3941	208.322	735000
Bottom	1838	0.0025	0.0023	Comb1-18	2768.9013	55.378	-103.1015	735000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	CombW5	2065.2354	1208.1582	-505.2911	213.5742	744.0525
Bottom	Leg 1	750	CombW5	2164.4311	1132.0562	-505.2911	215.3598	745.838

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	CombW5	3319.7874	-767.4181	7.07	8
Top–Right	Leg 1	300	CombW5	3319.7874	1208.1582	8.54	8
Bottom–Left	Leg 1	300	CombW5	3418.9831	-1343.9514	9.13	8
Botttom–Right	Leg 1	300	CombW5	3418.9831	1132.0562	8.42	8



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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
3RD -4TH	P1	4575	37950	2450	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	1838	0.0025	0.0023	Comb1-18	3247.1106	-64.9422	234.2479	735000
Bottom	1838	0.0025	0.0023	Comb1-18	3346.3063	66.9261	-109.7545	735000

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	CombW5	2548.6821	1225.5687	-508.0284	222.2763	752.7545
Bottom	Leg 1	750	CombW5	2647.8778	1135.2979	-508.0284	224.0618	754.5401

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	CombW5	4002.5849	-731.9201	7.88	8
Top–Right	Leg 1	300	CombW5	4002.5849	1225.5687	9.53	8
Bottom–Left	Leg 1	300	CombW5	4101.7806	-1359.3833	10.11	8
Botttom–Right	Leg 1	300	CombW5	4101.7806	1135.2979	9.36	8



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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
2ND -3RD	P1	4575	37950	2450	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	1838	0.0025	0.0023	Comb1-18	3817.3233	-76.3465	258.4707	735000
Bottom	1838	0.0025	0.0023	Comb1-18	3916.519	78.3304	-91.8323	735000

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	CombW5	3030.2183	1189.1592	-529.8539	230.9439	761.4222
Bottom	Leg 1	750	CombW5	3129.4141	1258.3451	-529.8539	232.7295	763.2077

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	CombW5	4674.6086	-642.3474	8.5	8
Top–Right	Leg 1	450	CombW5	4674.6086	1189.1592	10.32	8
Bottom–Left	Leg 1	450	CombW5	4773.8043	-1452.6483	11.34	8
Botttom–Right	Leg 1	450	CombW5	4773.8043	1258.3451	10.69	8

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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
1ST -2ND	P1	4575	37950	2450	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	1838	0.0025	0.0023	Comb1-18	4364.1151	87.2823	310.7305	735000
Bottom	1838	0.0025	0.0023	Comb1-18	4463.3109	-104.7868	-146.2828	735000

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	CombW5	3496.6726	1097.1427	-538.165	239.3401	769.8184
Bottom	Leg 1	750	CombW5	3595.8683	1325.7515	-538.165	241.1256	771.6039

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	CombW5	5316.164	-448.8786	8.73	8
Top–Right	Leg 1	450	CombW5	5316.164	1097.1427	10.89	8
Bottom–Left	Leg 1	450	CombW5	5415.3597	-1642.0947	12.84	8
Botttom–Right	Leg 1	450	CombW5	5415.3597	1325.7515	11.79	8

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IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
GF-1ST	P1	4575	37950	2450	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	1838	0.0025	0.0023	Comb1-18	5520.0361	255.1238	506.3795	735000
Bottom	2161	0.0029	0.0023	CombW5	6686.4429	-303.1784	-2232.3177	735000

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	CombW5	4582.2018	1221.8259	-504.5627	258.8796	789.3579
Bottom	Leg 1	750	CombW5	4714.4628	1901.6261	-504.5627	261.2603	791.7386

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	450	CombW5	6554.1819	-196.4792	9.57	8
Top–Right	Leg 1	450	CombW5	6554.1819	1221.8259	12.99	8
Bottom–Left	Leg 1	600	CombW5	6686.4429	-2232.3177	16.54	8
Botttom–Right	Leg 1	600	CombW5	6686.4429	1901.6261	15.43	8



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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
BASEMENT-GF	P1	4575	37950	2450	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	3350	37950	5800	37950	2450	300
Bottom	Leg 1	3350	37950	5800	37950	2450	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	1838	0.0025	0.0023	Comb1-18	6398.6137	127.9723	343.7696	735000
Bottom	3415	0.0046	0.0023	CombW3	2900.8926	-58.0179	-3631.5888	735000

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	CombW5	5421.5221	1792.9727	-779.8863	264.6	795.0783
Bottom	Leg 1	750	CombW5	5520.7178	3286.3539	-779.8863	322.6926	853.1708

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	600	CombW5	7479.2126	-1147.8672	14	8
Top–Right	Leg 1	600	CombW5	7479.2126	1792.9727	16.15	8
Bottom–Left	Leg 1	750	CombW5	7578.4083	-3717.8975	22.7	8
Botttom–Right	Leg 1	750	CombW5	7578.4083	3286.3539	21.26	8

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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
7TH -ROOF	P8	12700	31725	2000	300	1

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	1500	0.0025	0.0024	Comb1-18	453.5748	25.1318	-552.8328	600000
Bottom	1500	0.0025	0.0024	Comb1-18	534.5509	-20.8346	540.095	600000

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	Comb1-W	497.1855	-543.993	367.3178	152.9493	585.9928
Bottom	Leg 1	750	Comb1-W	561.9663	612.3872	367.3178	154.1154	587.1589

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	Comb1-W	540.5409	-543.993	3.62	8
Top–Right	Leg 1	0	Comb1	0	0	0	0
Bottom–Left	Leg 1	0	Comb1	0	0	0	0
Botttom–Right	Leg 1	0	Comb1-W	605.3218	612.3872	4.07	8

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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
6^{TH} -7^{TH}	P8	12700	31725	2000	300	1

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1500	0.0025	0.0024	Comb1-18	1487.1358	29.7427	-535.6127	600000
Bottom	1500	0.0025	0.0024	Comb1-18	1568.1119	-31.3622	575.3664	600000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	CombW5	1428.1218	-343.6326	392.3337	169.7062	602.7497
Bottom	Leg 1	750	CombW5	1509.0979	829.0074	392.3337	171.1638	604.2072

Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	CombW5	1544.3103	-343.6326	4.29	8
Top–Right	Leg 1	0	Comb1	0	0	0	0
Bottom–Left	Leg 1	0	Comb1	0	0	0	0
Botttom–Right	Leg 1	0	CombW5	1625.2864	829.0074	6.85	8

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IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
5TH -6TH	P8	12700	31725	2000	300	0.9

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	1500	0.0025	0.0024	Comb1-18	2520.0947	50.4019	-500.1696	600000
Bottom	1500	0.0025	0.0024	Comb1-18	2601.0708	-52.0214	577.1397	600000

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	CombW5	2429.3015	-248.5704	378.8805	187.7274	620.7709
Bottom	Leg 1	750	CombW5	2510.2775	957.0399	378.8805	189.185	622.2285

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	CombW5	2607.4809	-758.0676	8.14	8
Top-Right	Leg 1	0	Comb1	0	0	0	0
Bottom-Left	Leg 1	0	CombW3	1648.7101	-42.1899	2.96	8
Botttom-Right	Leg 1	300	CombW5	2688.457	957.0399	9.27	8



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Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
4^{TH} -5^{TH}	P8	12700	31725	2000	300	0.8

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1500	0.0025	0.0024	Comb1-18	3554.6886	71.0938	-496.5694	600000
Bottom	1500	0.0025	0.0024	Comb1-18	3635.6647	-72.7133	580.5178	600000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	CombW5	3433.4103	-153.1965	377.2054	205.8014	638.8449
Bottom	Leg 1	750	CombW5	3514.3863	1037.778	377.2054	207.259	640.3024

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	CombW5	3670.7091	-847.8471	10.36	8
Top–Right	Leg 1	0	CombW3	2249.8852	47.0122	3.98	8
Bottom–Left	Leg 1	0	CombW3	2298.4709	-117.5378	4.42	8
Botttom–Right	Leg 1	300	CombW5	3751.6852	1037.778	11.44	8



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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
3^{RD} -4^{TH}	P8	12700	31725	2000	300	0.7

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1500	0.0025	0.0024	Comb1-18	4591.2801	91.8256	-491.697	600000
Bottom	1500	0.0025	0.0024	Comb1-18	4672.2562	-93.4451	579.305	600000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	CombW5	4441.7438	-84.3795	376.6056	216	649.0435
Bottom	Leg 1	750	CombW5	4522.7199	1087.1454	376.6056	216	649.0435

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	450	CombW5	4733.4558	-906.9809	12.42	8
Top–Right	Leg 1	0	CombW3	2898.4159	113.8926	5.4	8
Bottom–Left	Leg 1	0	CombW3	2947.0015	-167.1018	5.75	8
Botttom–Right	Leg 1	450	CombW5	4814.4319	1087.1454	13.46	8

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ETABS Shear Wall Design

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Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
2^{ND} -3^{RD}	P8	12700	31725	2000	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1500	0.0025	0.0024	Comb1-18	5630.7673	112.6153	-491.3354	600000
Bottom	1500	0.0025	0.0024	Comb1-18	5711.7433	-114.2349	566.1453	600000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	CombW5	5455.7824	-40.1747	375.1441	216	649.0435
Bottom	Leg 1	750	CombW5	5536.7585	1101.255	375.1441	216	649.0435

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	450	CombW5	5796.0434	-40.1747	9.86	8
Top–Right	Leg 1	0	CombW3	3545.6782	157.5489	6.7	8
Bottom–Left	Leg 1	0	CombW3	3594.2639	-199.4413	6.99	8
Botttom–Right	Leg 1	450	CombW5	5877.0194	1101.255	15.3	8

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ETABS Shear Wall Design

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Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
1^{ST} -2^{ND}	P8	12700	31725	2000	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	1500	0.0025	0.0024	Comb1-18	6671.5017	133.43	-505.574	600000
Bottom	1500	0.0025	0.0024	Comb1-18	6752.4778	-135.0496	691.7489	600000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	CombW5	6475.2892	-39.7486	424.4992	216	649.0435
Bottom	Leg 1	750	CombW5	6556.2652	1271.5531	424.4992	216	649.0435

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	450	CombW5	6856.0212	-39.7486	11.63	8
Top–Right	Leg 1	0	CombW3	4189.7591	162.9048	7.8	8
Bottom–Left	Leg 1	0	CombW3	4238.3448	-161.2406	7.87	8
Botttom–Right	Leg 1	600	CombW5	6936.9973	1271.5531	17.92	8



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IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
GF-1ST	P8	12700	31725	2000	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm²
Top	5375	0.009	0.0024	Comb1	8522.1311	333.4775	-649.9545	600000
Bottom	5928	0.0099	0.0024	CombW5	8038.8108	323.725	1249.4563	600000

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	CombW5	7513.368	138.4177	280.1866	347.6927	780.7362
Bottom	Leg 1	750	CombW5	7621.3362	1249.4563	280.1866	364.9595	798.003

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	600	CombW5	7930.8426	-857.4876	17.51	8
Top–Right	Leg 1	450	CombW5	7930.8426	138.4177	13.91	8
Bottom–Left	Leg 1	450	CombW5	8038.8108	-385.8411	15.33	8
Botttom–Right	Leg 1	600	CombW5	8038.8108	1249.4563	19.65	8

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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
BASEMENT-GF	P8	12700	31725	2000	300	0.6

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	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	11700	31725	13700	31725	2000	300
Bottom	Leg 1	11700	31725	13700	31725	2000	300

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

Station Location	Required Rebar Area (mm^2)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m	M_{u3} kN-m	Pier A_g mm^2
Top	4580	0.0076	0.0024	Comb1	9828.3126	196.5663	-326.0329	600000
Bottom	5751	0.0096	0.0024	CombW5	9196.9031	183.9381	1729.1096	600000

Shear Design

Station Location	ID	Rebar mm^2/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	CombW5	8675.8432	486.5075	370.9415	322.8968	755.9403
Bottom	Leg 1	750	CombW5	8756.8192	1729.1096	370.9415	359.4455	792.489

Boundary Element Check

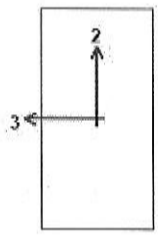
Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top-Left	Leg 1	600	CombW5	9115.927	-1032.547	20.36	8
Top-Right	Leg 1	600	CombW5	9115.927	486.5075	17.63	8
Bottom-Left	Leg 1	750	CombW5	9196.9031	-1564.4069	23.15	8
Botttom-Right	Leg 1	750	CombW5	9196.9031	1729.1096	23.97	8

DESIGN OF RCC BEAM

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ETABS Concrete Frame Design (GVB18)

IS 456:2000 Beam Section Design (Summary)



Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
GF	B79 (GVB-18)	305	B300X600	ENVELOP	4850	4850	1	Ordinary Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
300	600	300	0	45	45

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	550	415

Design Code Parameters

γc	γs
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
-158.044	0.0117	390.4062	-32.7914

Design Moments, M_{u3} & M_t

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Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-158.044	0.0206	0	-158.0646

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)	-158.0646		654	34	654	257
Bottom (-2 Axis)		0	257	34	0	257

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
390.4062	73.9923	316.4761	67.4426	1580.15

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

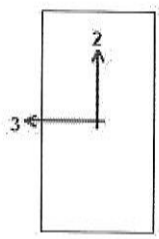
T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
0.0347	390.4062	230	530	0



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ETABS Concrete Frame Design (GHB14)

IS 456:2000 Beam Section Design (Summary)



Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
GF	B85 (GHB14)	335	B300X600	ENVELOP	0	4050	1	Ordinary Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
300	600	300	0	45	45

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	550	415

Design Code Parameters

γc	γs
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
-166.2638	0.0001	153.958	-61.2654

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Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-166.2638	0.0002	0	-166.264

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)	-166.264		718	64	718	257
Bottom (-2 Axis)		0	257	64	8	257

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
153.958	77.287	76.6717	86.0689	382.82

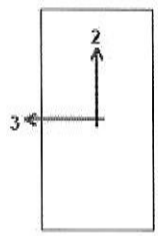
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
0.0004	153.958	230	530	0

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ETABS Concrete Frame Design (THB10)

IS 456:2000 Beam Section Design (Summary)



Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
3RD	B88 (THB10)	362	B300X600	ENVELOP	0	2850	1	Ordinary Frame

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
300	600	300	0	45	45

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
29580.4	35	1	550	415

Design Code Parameters

γc	γs
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
-388.2449	0.0006	187.2537	-46.3826

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Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-388.2449	0.0011	0	-388.2461

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)	-388.2461		1759	48	1759	257
Bottom (-2 Axis)		0	257	207	48	257

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
187.2537	48.8905	138.3667	236.5922	690.86

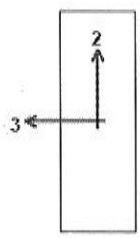
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{u2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
0.0002	187.2537	230	530	0

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ETABS Concrete Frame Design (TVB13)

IS 456:2000 Beam Section Design (Summary)



Beam Element Details

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF	Type
3RD	B24 (TVB13)	708	B200X600	ENVELOP	4675	4675	1	Ordinary 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)
29580.4	35	1	550	415

Design Code Parameters

γc	γs
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
-204.7148	0.0006	192.5168	-5.9692

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Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-204.7148	0.0014	0	-204.7162

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)	-204.7162		883	6	883	172
Bottom (-2 Axis)		0	172	6	0	172

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
192.5168	67.1158	125.4024	77.6864	626.13

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	192.5168	130	530	0

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DESIGN OF RCC COLUMN

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1 Design Data

This chapter provides design data and results.

1.1 Concrete Frame Design

ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
7TH -ROOF	C23	55	C800X800	3600	1	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	2120.4694	-480.877	-68.4205	2800	Comb1-7
Bottom	2187.6496	526.8758	70.5882	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	0.5066	2800	Comb1-18
Bottom	886.75	0.5066	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	886.75	82.4735	2800	Comb1-18
Bottom	886.75	82.4735	0	Comb1-18

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
6^{TH} -7^{TH}	C23	76	C800X800	3600	1	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	5181.0144	-167.1741	-1.9527	2800	Comb1
Bottom	4247.4279	500.5048	-137.0503	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	0.0042	2800	Comb1-18
Bottom	886.75	0.0042	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	886.75	23.8012	2800	Comb1-18
Bottom	886.75	23.8012	0	Comb1-18



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ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
5^{TH} -6^{TH}	C23	97	C800X800	3600	0.9	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	7538.8777	-243.2545	1.2439	2800	Comb1
Bottom	7606.0578	245.4221	2.9583	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	0.5035	2800	Comb1-18
Bottom	886.75	0.5035	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	886.75	26.0691	2800	Comb1-18
Bottom	886.75	26.0691	0	Comb1-18



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ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
4^{TH} -5^{TH}	C23	118	C800X800	3600	0.8	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	9807.5143	-316.4558	3.7646	2800	Comb1
Bottom	9874.6944	318.6235	6.5895	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	0.8307	2800	Comb1-18
Bottom	886.75	0.8307	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	886.75	18.8739	2800	Comb1-18
Bottom	886.75	18.8739	0	Comb1-18

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
3RD-4TH	C23	139	C800X800	3600	0.7	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	6240	0.98
Bottom	6503	1.02

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	11992.1355	-386.9462	5.3621	2800	Comb1
Bottom	12059.3156	389.1139	1.0691	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	1.1716	2800	Comb1-18
Bottom	886.75	1.1716	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	886.75	13.2684	2800	Comb1-18
Bottom	886.75	13.2684	0	Comb1-18



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ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
2ND -3RD	C23	160	C800X800	3600	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	12481	1.95
Bottom	12533	1.96

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	14091.3579	-454.6811	7.1419	2800	Comb1
Bottom	14158.538	456.8488	28.3998	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	5.9315	2800	Comb1-18
Bottom	886.75	5.9315	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	886.75	15.3525	2800	Comb1-18
Bottom	886.75	15.3525	0	Comb1-18

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
1ST -2ND	C23	4	C800X1000	3600	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	1000	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	12345	1.54
Bottom	12249	1.53

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	16457.4742	-531.0278	4.7762	2800	Comb1
Bottom	16541.4494	36.9189	-644.0138	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	20.6503	2800	Comb1-18
Bottom	886.75	20.6503	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1108.43	2.3213	2800	Comb1-18
Bottom	1108.43	2.3213	0	Comb1-18

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
GF-1ST	C23	25	C800X1000	4800	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	1000	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	14341	1.79
Bottom	14690	1.84

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	17191.0879	3.323	710.565	4000	Comb1
Bottom	17311.0525	-600.1165	-15.971	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	23.2687	4000	Comb1-18
Bottom	886.75	23.2687	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1108.43	16.3524	4000	Comb1-18
Bottom	1108.43	16.3524	0	Comb1-18

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C4)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
BASEMENT -GF	C23	36	C800X1000	3600	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	1000	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	18759	2.34
Bottom	19060	2.38

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	18613.336	-608.0356	25.8697	3000	Comb1
Bottom	18703.3094	2.2217	-735.6635	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	30.3458	3000	Comb1-18
Bottom	886.75	30.3458	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1108.43	13.4327	3000	Comb1-18
Bottom	1108.43	13.4327	0	Comb1-18

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
7TH -ROOF	C26	56	C800X800	3600	1	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5397	0.84

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	1600.9537	-927.6228	63.0929	2800	Comb1-2
Bottom	1522.4807	1141.932	105.1376	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	7.2124	2800	Comb1-18
Bottom	886.75	7.2124	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1646	787.9871	2800	Comb1
Bottom	1604.09	787.9871	0	Comb1

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
6^{TH} -7^{T}	C26	77	C800X800	3600	0.9	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	2743.9027	-661.5281	-94.2951	2800	Comb1-7
Bottom	2669.2523	1138.5673	136.2946	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	28.405	2800	Comb1-18
Bottom	886.75	28.405	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1018	638.6928	2800	Comb1-7
Bottom	1009.71	638.6928	0	Comb1-7



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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
5^{TH} -6^{TH}	C26	98	C800X800	3600	0.8	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	4657.2441	-607.5554	-150.2737	2800	Comb1
Bottom	4061.623	1165.0098	134.7497	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	20.1511	2800	Comb1-18
Bottom	886.75	20.1511	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	942.32	654.6856	2800	Comb1-7
Bottom	934.03	654.6856	0	Comb1-7

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
4^{TH} -5^{TH}	C26	119	C800X800	3600	0.7	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	5900.2649	-581.6257	-190.3819	2800	Comb1
Bottom	5326.1193	1184.9893	171.8561	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	18.5845	2800	Comb1-18
Bottom	886.75	18.5845	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	893.92	660.3973	2800	Comb1-7
Bottom	893.92	660.3973	0	Comb1-7



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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
3RD-4TH	C26	140	C800X800	3600	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	7102.3508	-581.1573	-229.1692	2800	Comb1
Bottom	6599.1852	1166.056	212.9337	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	15.0599	2800	Comb1-18
Bottom	886.75	15.0599	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	886.75	436.7973	2800	Comb1-18
Bottom	886.75	436.7973	0	Comb1-18

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
2ND -3RD	C26	161	C800X800	3600	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

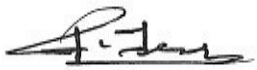
Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	8438.2157	-574.1532	-272.2731	2800	Comb1
Bottom	7880.7079	1305.1776	254.2842	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	11.352	2800	Comb1-18
Bottom	886.75	11.352	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1031.27	697.0748	2800	Comb1-7
Bottom	1031.27	697.0748	0	Comb1-7



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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
1ST-2ND	C26	5	C800X800	3600	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	800	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	5120	0.8
Bottom	5120	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	9777.7677	-569.2181	-315.496	2800	Comb1
Bottom	9844.9479	434.242	317.6637	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	5.2253	2800	Comb1-18
Bottom	886.75	5.2253	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	886.75	276.3553	2800	Comb1-18
Bottom	886.75	276.3553	0	Comb1-18

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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
GF-1ST	C26	26	C800X1000	4800	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	1000	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	6400	0.8
Bottom	6400	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

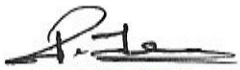
Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	10467.7324	-362.8814	11.1129	4000	Comb1
Bottom	10587.6969	659.9333	437.6248	0	Comb1

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	4.757	4000	Comb1-18
Bottom	886.75	4.757	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1108.43	165.3692	4000	Comb1-18
Bottom	1108.43	165.3692	0	Comb1-18



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ETABS Concrete Frame Design (COLUMN FRAMING NO:C6)

IS 456:2000 Column Section Design (Envelope)

Column Element Details (Envelope)

Level	Element	Unique Name	Section ID	Length (mm)	LLRF	Type
BASEMENT -GF	C26	37	C800X1000	3600	0.6	Ordinary Frame

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
800	1000	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
31622.78	40	1	550	415

Design Code Parameters

γc	γs
1.5	1.15

Longitudinal Reinforcement Design for P_u - M_{u2} - M_{u3} Interaction

Column End	Rebar Area mm²	Rebar %
Top	6400	0.8
Bottom	6400	0.8

Design Axial Force & Biaxial Moment for P_u - M_{u2} - M_{u3} Interaction

Column End	Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Station Loc mm	Controlling Combo
Top	11652.0354	-583.3588	-453.6526	2800	Comb1
Bottom	10884.0487	877.7191	423.7523	0	Comb1-7

Shear Reinforcement for Major Shear, V_{u2}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u2} kN	Station Loc mm	Controlling Combo
Top	886.75	3.0207	2800	Comb1-18
Bottom	886.75	3.0207	0	Comb1-18

Shear Reinforcement for Minor Shear, V_{u3}

Column End	Rebar A_{sv} /s mm²/m	Design V_{u3} kN	Station Loc mm	Controlling Combo
Top	1108.43	255.9178	2800	Comb1-18
Bottom	1108.43	255.9178	0	Comb1-18

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DESIGN OF SLAB

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DESIGN OF SLAB : GS9

Panel Name : Interior Panel Code : 2

Clear Longer span, ly = 4900 mm

Clear Shorter span, lx = 4500 mm

ly / lx = 1.09 < 2, Hence, Twoway slab.

Effective Longer span = 5021.00 mm

Effective Shorter span = 4621.00 mm

Assume thickness of slab = 150.00 mm

Effective depth available = 121.00 mm

Loads :

Dead Load and Imposed Load (fixed) :

Floor finish = 2.300 kN/m^2

Self weight = 3.750 kN/m^2

w_{DL} = 6.050 kN/m^2

Imposed Load (Not fixed) :

Occupancy classification as per IS: 875(Part 2) - 1987 :

Live load = 4.000 kN/m^2

w_{LL} = 4.000 kN/m^2

Total load, $w = w_{DL} + w_{LL}$ = 10.050 kN/m^2

Span Moments:

Along Shorter span: $BM = \alpha_x w l_x^2$ = 0.027 x 10.05 x 4.621^2 = 5.84 kNm M_{ux1} = 8.76 kNm

Along Longer span: $BM = \alpha_y w l_x^2$ = 0.024 x 10.05 x 4.621^2 = 5.15 kNm M_{uy1} = 7.73 kNm

Support Moments:

Along Shorter span: $BM = \alpha_x w l_x^2$ = 0.036 x 10.05 x 4.621^2 = 7.73 kNm M_{ux2} = 11.59 kNm

Along Longer span: $BM = \alpha_y w l_x^2$ = 0.032 x 10.05 x 4.621^2 = 6.87 kNm M_{uy2} = 10.30 kNm

Check for section :

Factored Max. BM, Mu = 11.59 kNm / m

For M35 grade concrete & Fe550 grade steel, $Mu, lim / bd^2$ = 4.829

Effective depth required = 48.99 mm < Effective depth available, OK

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Along the Shorter span

A_{st} reqd at midspan :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{1 - \sqrt{(\ 1 - [4.6\ M_{ux1}\ /(f_{ck}\ bd^2)]\ )}\}\ b\ d =$ 154.40 mm^2/m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2/m OK

A_{st} reqd at support :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{\ 1 - \sqrt{(\ 1 - [4.6\ M_{ux2}\ /\ (f_{ck}\ bd^2)])}\}\ b\ d =$ 205.75 mm^2/m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2/m OK

Along the Longer span

A_{st} reqd at midspan :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{1 - \sqrt{(\ 1 - [4.6\ M_{uy1}\ /(f_{ck}\ bd^2)]\ )}\}\ b\ d =$ 135.90 mm^2/m

Provide 8 mm dia bars @ 200 mm As = 251.33 mm^2/m OK

A_{st} reqd at support :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{\ 1 - \sqrt{(\ 1 - [4.6\ M_{uy2}\ /\ (f_{ck}\ bd^2)])}\}\ b\ d =$ 182.32 mm^2/m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2/m OK

Min Ast = 0.12% Gross section area = 180 mm^2/m

Distribution steel = 0.5 x (0.12/100) x 1000 x 150 = 90.00 mm^2/m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2/m OK

Max Spacing = 3d or 300 mm whichever is less = 363 mm or 300 mm

Check for deflection:

fs = 0.58 x fy x (Ast req/Ast pro) = 195.97 MPa

MF = 1/(0.225+0.00322 fs – 0.625 log 10 (1/pt)) ≤ 2 = 2.000

Type of Slab = Continuous

Effective Shorter span = 4621.00 mm

Basic Value = 26

Allowable l/d = 52.00

Actual l/d = 38.19 Hence OK

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DESIGN OF SLAB : **GS13**

Panel Name : Three edges; one longer edge discor Code : 14

Clear Longer span, ly = 2600 mm

Clear Shorter span, lx = 2500 mm

ly / lx = 1.04 < 2, Hence, Twoway slab.

Effective Longer span = 2721.00 mm

Effective Shorter span = 2621.00 mm

Assume thickness of slab = 150.00 mm

Effective depth available = 121.00 mm

Loads :

Dead Load and Imposed Load (fixed) :

Floor finish = 2.300 kN/m^2

Self weight = 3.750 kN/m^2

w_{DL} = 6.050 kN/m^2

Imposed Load (Not fixed) :

Occupancy classification as per IS: 875(Part 2) - 1987 :

Live load = 4.000 kN/m^2

w_{LL} = 4.000 kN/m^2

Total load, $w = w_{DL} + w_{LL}$ = 10.050 kN/m^2

Span Moments:

Along Shorter span: $BM = \alpha_x w l_x^2$ = 0.045 x 10.05 x 2.621^2 = 3.11 kNm M_{ux1} = 4.66 kNm

Along Longer span: $BM = \alpha_y w l_x^2$ = 0.043 x 10.05 x 2.621^2 = 2.97 kNm M_{uy1} = 4.45 kNm

Support Moments:

Along Shorter span: $BM = \alpha_x w l_x^2$ = 0.060 x 10.05 x 2.621^2 = 4.13 kNm M_{ux2} = 6.19 kNm

Along Longer span: $BM = \alpha_y w l_x^2$ = 0 x 10.05 x 2.621^2 = 0.00 kNm M_{uy2} = 0.00 kNm

Check for section :

Factored Max. BM, Mu = 6.19 kNm / m

For M35 grade concrete & Fe550 grade steel, $Mu,lim / bd^2$ = 4.829

Effective depth required = 35.81 mm < Effective depth available, OK

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Along the Shorter span

A_{st} reqd at midspan :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{1 - \sqrt{(\ 1 - [4.6\ M_{ux1}/(f_{ck}\ bd^2)]\ )}\}\ b\ d =$ 81.39 mm^2 / m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2 / m OK

A_{st} reqd at support :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{1 - \sqrt{(\ 1 - [4.6\ M_{ux2}/(f_{ck}\ bd^2)]\ )}\}\ b\ d =$ 108.54 mm^2 / m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2 / m OK

Along the Longer span

A_{st} reqd at midspan :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{1 - \sqrt{(\ 1 - [4.6\ M_{uy1}/(f_{ck}\ bd^2)]\ )}\}\ b\ d =$ 77.73 mm^2 / m

Provide 8 mm dia bars @ 200 mm As = 251.33 mm^2 / m OK

A_{st} reqd at support :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{1 - \sqrt{(\ 1 - [4.6\ M_{uy2}/(f_{ck}\ bd^2)]\ )}\}\ b\ d =$ 0.00 mm^2 / m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2 / m OK

Min Ast = 0.12% Gross section area = 180 mm^2 / m

Distribution steel = 0.5 x (0.12/100) x 1000 x 150 = 90.00 mm^2 / m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2 / m OK

Max Spacing = 3d or 300 mm whichever is less = 363 mm or 300 mm

Check for deflection:

fs = 0.58 x fy x (Ast req/Ast pro) = 103.30 MPa

MF = 1/(0.225+0.00322 fs – 0.625 log 10 (1/pt)) ≤ 2 = 2.000

Type of Slab = Continuous

Effective Shorter span = 2621.00 mm

Basic Value = 40

Allowable l/d = 80.00

Actual l/d = 21.66 Hence OK

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DESIGN OF SLAB : **TS2**

Panel Name : Four edges discontinuous Code : 18

Clear Longer span, ly = 5100 mm

Clear Shorter span, lx = 4150 mm

ly / lx = 1.23 < 2, Hence, Twoway slab.

Effective Longer span = 5221.00 mm

Effective Shorter span = 4271.00 mm

Assume thickness of slab = 150.00 mm

Effective depth available = 121.00 mm

Loads :

Dead Load and Imposed Load (fixed) :

Floor finish = 5.200 kN/m^2

Self weight = 3.750 kN/m^2

w_{DL} = 8.950 kN/m^2

Imposed Load (Not fixed) :

Occupancy classification as per IS: 875(Part 2) - 1987 :

Live load = 2.500 kN/m^2

w_{LL} = 2.500 kN/m^2

Total load, $w = w_{DL} + w_{LL}$ = 11.450 kN/m^2

Span Moments:

Along Shorter span: BM = $\alpha_x w l_x^2$ = 0.073 x 11.45 x 4.271^2 = 15.33 kNm M_{ux1} = 23.00 kNm

Along Longer span: BM = $\alpha_y w l_x^2$ = 0.056 x 11.45 x 4.271^2 = 11.70 kNm M_{uy1} = 17.54 kNm

Support Moments:

Along Shorter span: BM = $\alpha_x w l_x^2$ = 0.000 x 11.45 x 4.271^2 = 0.00 kNm M_{ux2} = 0.00 kNm

Along Longer span: BM = $\alpha_y w l_x^2$ = 0 x 11.45 x 4.271^2 = 0.00 kNm M_{uy2} = 0.00 kNm

Check for section :

Factored Max. BM, Mu = 23.00 kNm / m

For M35 grade concrete & Fe550 grade steel, $Mu, lim / bd^2$ = 4.829

Effective depth required = 69.01 mm < Effective depth available, OK

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Along the Shorter span

A_{st} reqd at midspan :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ] \{ 1 - \sqrt{(\ 1 - [4.6\ M_{ux1}/(f_{ck}\ bd^2)]\ )} \}\ b\ d =$ 420.32 mm^2/m

Provide 10 mm dia bars @ 125 mm c/c As = 628.32 mm^2/m OK

A_{st} reqd at support :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ] \{ 1 - \sqrt{(\ 1 - [4.6\ M_{ux2}/(f_{ck}\ bd^2)]\ )} \}\ b\ d =$ 0.00 mm^2/m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2/m OK

Along the Longer span

A_{st} reqd at midspan :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ] \{ 1 - \sqrt{(\ 1 - [4.6\ M_{uy1}/(f_{ck}\ bd^2)]\ )} \}\ b\ d =$ 316.16 mm^2/m

Provide 8 mm dia bars @ 150 mm As = 335.10 mm^2/m OK

A_{st} reqd at support :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ] \{ 1 - \sqrt{(\ 1 - [4.6\ M_{uy2}/(f_{ck}\ bd^2)]\ )} \}\ b\ d =$ 0.00 mm^2/m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2/m OK

Min Ast = 0.12% Gross section area = 180 mm^2/m

Distribution steel = 0.5 x (0.12/100) x 1000 x 150 = 90.00 mm^2/m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2/m OK

Max Spacing = 3d or 300 mm whichever is less = 363 mm or 300 mm

Check for deflection:

fs = 0.58 x fy x (Ast req/Ast pro) = 213.40 MPa

MF = 1/(0.225+0.00322 fs – 0.625 log 10 (1/pt)) ≤ 2 = 1.362

Type of Slab = Continuous

Effective Shorter span = 4271.00 mm

Basic Value = 26

Allowable l/d = 35.41

Actual l/d = 35.30 Hence OK

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DESIGN OF SLAB : TS7

Panel Name : Four edges discontinuous Code : 18

Clear Longer span, ly = 2600 mm

Clear Shorter span, lx = 1800 mm

ly / lx = 1.44 < 2, Hence, Twoway slab.

Effective Longer span = 2721.00 mm

Effective Shorter span = 1921.00 mm

Assume thickness of slab = 150.00 mm

Effective depth available = 121.00 mm

Loads :

Dead Load and Imposed Load (fixed) :

Floor finish = 5.200 kN/m^2

Self weight = 3.750 kN/m^2

w_{DL} = 8.950 kN/m^2

Imposed Load (Not fixed) :

Occupancy classification as per IS: 875(Part 2) - 1987 :

Live load = 2.500 kN/m^2

w_{LL} = 2.500 kN/m^2

Total load, $w = w_{DL} + w_{LL}$ = 11.450 kN/m^2

Span Moments:

Along Shorter span: $BM = \alpha_x w l_x^2$ = 0.087 x 11.45 x 1.921^2 = 3.66 kNm M_{ux1} = 5.49 kNm

Along Longer span: $BM = \alpha_y w l_x^2$ = 0.056 x 11.45 x 1.921^2 = 2.37 kNm M_{uy1} = 3.55 kNm

Support Moments:

Along Shorter span: $BM = \alpha_x w l_x^2$ = 0.000 x 11.45 x 1.921^2 = 0.00 kNm M_{ux2} = 0.00 kNm

Along Longer span: $BM = \alpha_y w l_x^2$ = 0 x 11.45 x 1.921^2 = 0.00 kNm M_{uy2} = 0.00 kNm

Check for section :

Factored Max. BM, Mu = 5.49 kNm / m

For M35 grade concrete & Fe550 grade steel, $Mu, lim / bd^2$ = 4.829

Effective depth required = 33.72 mm < Effective depth available, OK

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Along the Shorter span

A_{st} reqd at midspan :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{1 - \sqrt{(\ 1 - [4.6\ M_{ux1}/(f_{ck}\ bd^2)]\ )}\}\ b\ d =$ 96.04 mm^2 / m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2 / m OK

A_{st} reqd at support :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{\ 1 - \sqrt{(\ 1 - [4.6\ M_{ux2}/(f_{ck}\ bd^2)])}\}\ b\ d =$ 0.00 mm^2 / m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2 / m OK

Along the Longer span

A_{st} reqd at midspan :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{1 - \sqrt{(\ 1 - [4.6\ M_{uy1}/(f_{ck}\ bd^2)]\ )}\}\ b\ d =$ 61.83 mm^2 / m

Provide 8 mm dia bars @ 200 mm As = 251.33 mm^2 / m OK

A_{st} reqd at support :

$A_{st} = [\ 0.5 f_{ck}/f_y\ ]\ \{\ 1 - \sqrt{(\ 1 - [4.6\ M_{uy2}/(f_{ck}\ bd^2)])}\}\ b\ d =$ 0.00 mm^2 / m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2 / m OK

Min Ast = 0.12% Gross section area = 180 mm^2 / m

Distribution steel = 0.5 x (0.12/100) x 1000 x 150 = 90.00 mm^2 / m

Provide 8 mm dia bars @ 200 mm c/c As = 251.33 mm^2 / m OK

Max Spacing = 3d or 300 mm whichever is less = 363 mm or 300 mm

Check for deflection:

fs = 0.58 x fy x (Ast req/Ast pro) = 121.90 MPa

MF = 1/(0.225+0.00322 fs – 0.625 log 10 (l/pt)) ≤ 2 = 2.000

Type of Slab = Continuous

Effective Shorter span = 1921.00 mm

Basic Value = 40

Allowable l/d = 80.00

Actual l/d = 15.88 Hence OK

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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.