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DIGITALLY VERIFIED RECORD

R.C.C STRUCTURAL DESIGN BASIS REPORT

PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING AT STILT +4 FLOORS+5TH FLOOR (PART) WITH (9 DWELLING UNITS) AT DOOR NO. 14, PLOT NO.221 - [illegible].4TH AVENUE 3RD MAIN ROAD, ROAD, INDRA NAGAR, THIRUVANMIYUR , CHENNAI 600 020. COMPRISED IN T.S. NO. : 60, BLOCK NO.: 20 OF THIRUVANMIYUR VILLAGE, . GREATER CHENNAI CORPORATION .

OWNER

STRUCTURAL ENGINEERS

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Date: 27.11.2024.

STRUCTURAL STABILITY CERTIFICATE

Proposed Construction Of Residential Building At Stilt +4 Floors+5th Floor (Part) With (9 Dwelling Units) At Door No. 14, Plot No.221 - 4th Avenue 3rd Main Road, Road, Indra Nagar, Thiruvanmiyur , Chennai 600 020. Comprised In T.S. No. : 60, Block No.: 20 Of Thiruvanmiyur Village, . Greater Chennai Corporation .

The Structure Is Analysed Which Consists Of Stilt +5 Floors For Residential Building Is Use For Residential Purposes As Indicated In The Drawing.

The Structure Is Designed As Per I.S Code Provisions.

R. Chandrasekaran

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REFERENCE

DESIGN LOADS (OTHER THAN EARTHQUAKE LOADS)

IS Code	Description
IS 875(Part 1): 1987	Dead Loads - Unit Weight of Building Material and Stored Material
IS 875(Part 2): 1987	Imposed Loads
IS 875(Part 3): 1987	Wind Loads

DESIGNS FOR EARTHQUAKE RESISTANCE

IS Code	Description
IS 1893:2002	Criteria for earthquake resistance design of structures.
IS 4326: 1993	Earthquake Resistant Design and Construction of Buildings – Code of Practice
IS 13920: 1993	Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice.

DESIGN OF CONCRETE ELEMENTS

IS Code	Description
IS 456: 2000	Plain and Reinforced Concrete - Code of practice
SP 16	Structural use of concrete. Design charts for singly reinforced beams, doubly reinforced beams and columns.
SP 34	Handbook on Concrete Reinforcement & Detailing
IS 1904	Indian Standard Code of practice for design & construction foundations in Soil: General Requirements
IS 2950	Indian Standard Code of Practice for Design and Construction of Raft Foundation (Part – 1)

DESIGN METHODOLOGY:

Limit state design method is adopted for the design of the structure. In this method, each member of the structure is designed to satisfy Serviceability criteria, and ultimate collapse criteria. This ensures satisfactory behaviour and low probability of failure.

Section 5 of I.S. 456-2000 has given clear guidelines for Limit state method of design. The same design is adopted with the suggested Characteristic loads of I.S 875-1987.

FRAMING PLAN

The Column & beam position is considered as per the existing Structure. The retrofitting size of column and beam taking into design consideration.

Loads from slabs are transferred to the supporting beams and from beam to columns in each floor. Wind loads earthquake loads are considered at preliminary analysis and design. However, wind loads are not critical, hence earthquake design considered for final analysis and design as per the code provisions.

Bently's STAAD Pro software is used for vertical load and horizontal load analysis considering as space frame; the analysis and design results are noted and checked.

For the design of columns and beams results taken from software and the designs of columns and beams decided accordingly.

Software is used at each stage of design process. Apart from STAAD Pro software, design of footings and slabs are done as per the standard methods.

LOAD CALCULATIONS

Dead load:

Dead load of walls:

Floor Height = 3.00 m

Dead Load of 0.23 m thick wall = 0.23 x 3.00 x 20 = 13.8kN.

Say = 14 kN/m

Parapet Wall Load = 0.23 x 0.9 x 20 = 4.14kN/m

Say = 4.0 KN/m

Floor finishing

Assuming = 1.5 kN/m^2

Live loads:

For Typical floors

For All areas except Corridor & Staircase = 2.0 KN/m^2

For staircases and Corridor = 3.0 KN/m^2

FRAME ANALYSIS:

STAAD Pro SOFTWARE:

STAAD Pro (STRuctural Analysis And Design) is a MS Windows based suite of finite element static and dynamic analysis programs for buildings, bridges and other structures. It also includes modules for the design of steel sections (rolled and cold formed) and reinforced concrete (beams, columns, slabs, walls, footings) in accordance with Indian, American, European, Canadian and other international codes.

For the dynamic effects, ***STAAD Pro*** also includes modules for modal analysis, seismic response spectra calculations according to many codes and time-history response calculation

INPUT/OUTPUT:

As explained in load calculations live loads + dead loads as Vertical loads and earthquake loads as horizontal loads are used for the analysis.

INPUT DATA:

The building is considered to be located in seismic zone –III and intended for Commercial use.

The building is founded on medium strength soil through isolated footings under the columns.

The Safe Bearing Capacity of the Soil is considered as 185.30 KN/Sqm

The unity weight of concrete and masonry are taken as 30 KN/Sqm and 20 KN/Sqm

EATHQUAKE LOAD CALCULATIONS:

Seismic Zone		III
Seismic Intensity	Z	0.16
Importance factor	I	1.5
Response Reduction Factor	R	3
Lateral Dimension of Building	d	12.32
Height of the of Building with brick infill	h	12.3
Fundamental Natural Period	T_a	0.315
Type of Soil		Medium Soil
Spectral Acceleration Coefficient	S_a/g	2.500
Design Horizontal Seismic Coefficient	A_h	0.1

Qi = VB. Wihi^2/ Wihi^2

Where, Qi = design lateral force at floor I

Wi = seismic weight of floor I,

Hi= height of floor I measured from base, and

N = number of storeys in the building is the number of levels at which the masses are located.

ANALYSIS

Two different analysis methods are suggested Using IS: 1893-2002 provisions

Corresponding to Seismic Zone –III and 3% damped Response Spectrum.

1 Equivalent Static Analysis (T=0.09h/(d^.5))

2 Multi-modal Dynamic Analysis (T calculated from Eigen value problem of Model)

DESIGN SPECTRUM:

The design horizontal seismic coefficient Ah for a structure shall be determined by the following expression.

$Ah = ZISa / 2RG$

Where

Z = Zone factor given in table 2 (IS1893-2002) is for the maximum considered earthquake (MCE) and service life of structure in a zone. The factor 2 in the denominator of Z is used so as to reduce the maximum considered earthquake (MCE) zone factor to the factor for design basis earthquake (DBE).

I = Importance factor, depending upon the functional use of the structures characterized by hazardous consequence of its failure, post-earthquake functional needs, historical value, or economic importance (table 6 of 1893-2002).

R = response reduction factor, depending on the perceived seismic damage performance of the structure, characterized by the ratio (I/R) shall not be greater than 1.0(table 7 1893-2002). The values of R for buildings are given in table 7.

Sa/g = Average response acceleration coefficient.

BEAM DESIGN: -

Beams are designed considering analysis results from STAAD Pro Software. The analysis results are also checked manually using single moment co-efficient as suggested in the code IS: 456-2000; Deflections are checked for safety for analysis results.

For each beam critical moments and shear as considered and designed accordingly steel percentage is limited to 20% with M30 concrete. Whereas required beam depths are revised.

Considering safety and durability critical steel obtained (moments at end section for continues beam) is provided at end and middle sections with proper curtailment. For simply supported beam (Tie end beam) steel is curtailed as per standards

The critical minimum tension steel is Ast= (0.85 bd/ FY) is checked in all beams maximum tension steel is limited to 4% (code permits 4%)

COLUMN DESIGN

Columns are designed considering analysis results from STAAD Pro Software.

The analysis results are also checked manually using SP 16 charts.

For columns M20 concrete is taken & min. 0.8 % steel is provided.

FOOTING DESIGN

Footing are designed considering analysis results from STAAD Pro Software.

For footings M30 concrete is taken.

One-way shear and punching shear checks are done for safety of structure.

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PILE FOUNDATION

Axial load on the column = 13600 KN
Self weight of footing (10%) = 160 KN

= 13760 KN

DEPTH OF PILE

Total on piles = 1760 KN

Load on each pile $= \frac{1760}{2} = 880$ KN

Ultimate load Qf = 880 x 2.5 = 2200 KN
(2.5 – Factor of safety)

SBC = 100 KN/m²

Dia of pile Assume = 600mm

Cohesion $C = \frac{1}{2} \times 100 = 50$ KN/m²

Ultimate load Qf = plmc = 2200 KN

$\pi \times 0.60 \times 1 \times 0.8 \times 50 = 2200$ KN (m = 0.8)

$$1 = \frac{2200}{\pi \times 0.6 \times 0.8 \times 50} = 27.62\text{m} = 28\text{m}.$$

Safe direct compressive stress in concrete = 5 N/mm²
Safe direct compressive stress in steel = 190 N/mm²
Safe compressive stress in concrete in bending = 7 N/mm²

Safe tensile stress in steel in bending = 230 N/mm²

Modular ratio m $= \frac{280}{3 \times 7} = 13.33$

Load on each pile $= \frac{1760}{2} = 880$ KN

Ratio of length of the pile to least lateral dimension of the pile $= \frac{l}{D} = \frac{28000}{600} = 46.6$

The pile will be treated as a long column

Reduction co - efficient $Cr = 1.25 - \frac{1}{48D} = 1.25 - \frac{46.6}{48} = 0.28$

Safe direct compressive stress in concrete = 0.28 x 5 = 1.4 N/mm²
Safe direct compressive stress in steel = 0.28 x 190 = 53.2 N/mm²
Safe compressive load on column = Safe load on concrete + Safe load on steel

$(28000 - Asc)\ 1.4 + Asc \times 53.2 = 417 \times 10^3$

Asc = 3189 mm²

Lateral ties let 8mm¢ 250mm c/c
The ties shall have a volume equal to 0.20% of the volume of the pile.
Similarly other piles are calculated as shown in the sketch.

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PILECAP DESIGN CALCULATIONS

esign Code	:	IS 456 : 2000 + IS 13920 : 2016	
Pilecap No	:	PC2	
Column No	:	C2	(300mm x 600mm)
Member Ref. No	:	38	
Concrete Grade	:	M25	
Steel Grade	:	Fe415	
Clear Cover	:	50	mm
Top of pile-cap below ground	:	0.9	m
Density of Soil	=	18	kN/cum
Founding Depth	=	1.5	m
Pile Capacity in Compression	=	390	kN
Pile Capacity in Tension	=	53	kN
Pile Capacity in Shear	=	221	kN
Pile Capacity Reduction	=	0	%
Pile Overloading	=	10	%
Pile Group Overloading	=	10	%
Pile Capacity Increase for EQ	=	25	%
Pile Capacity Increase for Wind	=	25	%
Live Load Reduction	=	0	%
Consider Capacity Design	:	No	
Consider Overburden Pressure	:	No	
No. of Piles	=	2	
Pile Diameter	=	450	mm
Pilecap Offset	=	150	mm
Pile Spacing	=	2.5	x Ø
Pilecap Size	=	1875 x 750	mm
Pilecap Depth	=	600	mm
Pile-cap Wt.	=	21.094	kN

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

Check for Maximum Compressive Load on One Pile:

Critical Load Combination	:	[5] : (LOAD 3: DL) +(LOAD 4: LL) -(LOAD 2: EQ-Z)	
Pcomb	=	660.74	kN
Ptotal	=	Pcomb + Pilecap Wt.	
	=	681.83	kN
Mx	=	-4.04	kNm
My	=	1.17	kNm

P	=	Ptotal/ No. of Piles	
	=	340.92	kN
Pmx	=	3.594	kN
Pmy	=	0	kN
Maximum Compressive load on pile	=	344.51	kN
Allowable Compressive load on pile	=	390 x 1.25 x 1.1	
	=	536.25	kN

Check for Maximum Compressive Load on Pile Group:

Critical Load Combination	:	[1] : (LOAD 3: DL) +(LOAD 4: LL)	
Pcomb	=	637.98	kN
Ptotal	=	Pcomb + Pilecap Wt.	
	=	659.07	kN
Mx	=	4.49	kNm
My	=	1.09	kNm
Maximum Compressive load on pile group	=	659.08	kN
Allowable Compressive load on pile group	=	2 x 390 x 1.1	
	=	858	kN

Check for Maximum shear on Pile Group:

Critical Load Combination	:	[3] : (LOAD 3: DL) +(LOAD 4: LL) -(LOAD 1: EQ-X)	
Pcomb	=	620.36	kN
Ptotal	=	Pcomb + Pilecap Wt.	
	=	641.45	kN
Mx	=	4.58	kNm
My	=	6.87	kNm
Vx	=	-12.17	kNm
Vy	=	-2.15	kNm
Maximum shear on pile group	=	$\text{sqrt}(-12.17^2 + -2.15^2)$	
	=	12.36	kN
Shear capacity of pile group	=	2 x 221 x 1 x 1.25	
	=	552.5	kN

Check for Tensile Load on One Pile:

No Tensile load in pile group.

Check for Maximum Tensile Load on Pile Group:

No Tensile load in pile group.

Design for Bending:

Bottom Reinforcement Along Column-D

Critical Load Combination	:	[18] : 0.9 (LOAD 3: DL) -1.5 (LOAD 2: EQ-Z)	
Pcomb	=	444.5	kN
Ptotal	=	Pcomb + Pilecap Wt.	
	=	463.484	kN
Mx	=	-9.97	kNm
My	=	0.98	kNm
Ppile	=	Max Load on pile	
	=	240.61	kN
Deff	=	540	mm
Beff	=	750	mm
DfCol	=	0.26	m
BMux	=	Ppile x DfCol	
	=	63.16	kNm
PtReq	=	0.2	%
AstReq (BM)	=	1106	sqmm/m
AstPrv	=	T12 @ 100 C/C	
	=	1131	sqmm/m

Top Reinforcement Along Column-D

There is no Tensile Force, hence Minimum Percentage of steel will be provided.

D	=	600	mm
AstReq (BM)	=	Min Pt for Top Reinforcement x D x 1000/100	
	=	0.06 x 600 x 1000/100	
	=	360	sqmm/m
AstPrv	=	T10 @ 215 C/C	
	=	365.3	sqmm/m

Bottom Reinforcement Along Column-B

There is no Compressive Force, hence Minimum Percentage of steel will be provided.

D	=	600	mm
AstReq (BM)	=	Min Pt for Bottom Reinforcement x D x 1000/100	
	=	0.2 x 600 x 1000/100	
	=	1200	sqmm/m
AstPrv	=	T16 @ 165 C/C	
	=	1218.55	sqmm/m

Top Reinforcement Along Column-B

There is no Tensile Force, hence Minimum Percentage of steel will be provided.

D	=	600	mm

AstReq (BM)	=	Min Pt for Top Reinforcement x D x 1000/100	
	=	0.06 x 600 x 1000/100	
	=	360	sqmm/m
AstPrv	=	T10 @ 215 C/C	
	=	365.3	sqmm/m

Design for One Way Shear:

Along Column-D (Compression Case)

Critical Load Combination	:	[6] : 1.5 (LOAD 3: DL) +1.5 (LOAD 4: LL)	
Pcomb	=	956.98	kN
Ptotal	=	Pcomb + Pilecap Wt.	
	=	988.62	kN
Mx	=	6.73	kNm
My	=	1.64	kNm
Ppile	=	Max Load on pile	
	=	500.2956	kN

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

Section Location from column center	=	570	mm

Data for Piles

Pile No	Load (kN)	% covered	Shear (kN)
P1	488.32	51.67	236.02
P2	500.3	51.67	241.81

Design Shear Force (Vu)	=	Max. of (Shear due to P1, P2)	
	=	241.81	kN
Deff	=	540	mm
Beff	=	750	mm
Tv	=	Vu/(Beff x Deff)	
	=	0.6	N/sqmm
Tc	=	0.334	N/sqmm
Av	=	7.5	mm
Shear enhancement factor	=	2 x Deff / Av	
	=	144	
Enhanced shear strength (Tce)	=	3.1	N/sqmm
Tv	<	Tce, Hence Shear Reinforcement is not required	

Along Column-D (Tension Case)

All Load Combination having Compressive Force. Thus, One way Shear is not applicable for Tensile Force.

Along Column-B (Compression Case)

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

Along Column-B (Tension Case)

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

Design of Face Reinforcement:

Asfr Req	=	SFR % x D x Beffsfr	
	=	0.05 x 600 x 500 / 100	
	=	150	sqmm
Asfr Prv	=	2-T10	
	=	157	sqmm

Check for Load Transfer from Column to PileCap

Critical Analysis Load Combination	=		
Critical Load Combination	:	[6] : 1.5 (LOAD 3: DL) +1.5 (LOAD 4: LL)	
P	=	956.98	kN
A2	=	0.18	sqm
A1	=	1.41	sqm
Base Area	=	1.41	sqm
A1	<	Base Area	
Modification Factor	=	SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	=	2.8	
Thus, Modification Factor	=	2	
Concrete Bearing Capacity	=	0.45 x Fck x Modication Factor x Column Area	
	=	4050	kN
Concrete Bearing Capacity	>	P, Hence Safe.	

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COLUMN DESIGN CALCULATIONS

Sway Calculation (Stability Index)

Level	Load Name	Storey Height (m)	Gravity Load P (kN)	Relative Displacements (mm)	Storey Shear (kN)	Stability Index	Sway Condition
		A	B	C	D	B x C / (A x D)	
-1 m to 0 m	LOAD 1: EQ-X	1	17185.992	0.07	181.673	0.007	Non Sway
0 m to 3.05 m	LOAD 1: EQ-X	3.05	16634.085	0.885	147.311	0.033	Non Sway
3.05 m to 6.1 m	LOAD 1: EQ-X	3.05	13829.273	0.75	151.842	0.022	Non Sway
6.1 m to 9.15 m	LOAD 1: EQ-X	3.05	10920.936	0.718	142.068	0.018	Non Sway
9.15 m to 12.2 m	LOAD 1: EQ-X	3.05	8012.599	0.635	124.186	0.013	Non Sway
12.2 m to 15.25 m	LOAD 1: EQ-X	3.05	5104.263	0.489	94.242	0.009	Non Sway
15.25 m to 18.3 m	LOAD 1: EQ-X	3.05	2195.926	0.399	55.339	0.005	Non Sway
18.3 m to 20.7 m	LOAD 1: EQ-X	2.4	434.948	0.29	12.43	0.004	Non Sway

For Global-Y Direction

Level	Load Name	Storey Height (m)	Gravity Load P (kN)	Relative Displacements (mm)	Storey Shear (kN)	Stability Index	Sway Condition
		A	B	C	D	B x C / (A x D)	
-1 m to 0 m	LOAD 2: EQ-Z	1	17185.992	0.063	181.673	0.006	Non Sway
0 m to 3.05 m	LOAD 2: EQ-Z	3.05	16634.085	0.689	172.737	0.022	Non Sway
3.05 m to 6.1 m	LOAD 2: EQ-Z	3.05	13829.273	0.866	169.396	0.023	Non Sway
6.1 m to 9.15 m	LOAD 2: EQ-Z	3.05	10920.936	0.879	159.148	0.02	Non Sway
9.15 m to 12.2 m	LOAD 2: EQ-Z	3.05	8012.599	0.807	138.43	0.015	Non Sway
12.2 m to 15.25 m	LOAD 2: EQ-Z	3.05	5104.263	0.675	102.967	0.011	Non Sway
15.25 m to 18.3 m	LOAD 2: EQ-Z	3.05	2195.926	0.868	55.339	0.011	Non Sway
18.3 m to 20.7 m	LOAD 2: EQ-Z	2.4	434.948	0.841	12.43	0.012	Non Sway

General Data

Column No.	: C1	
Level	: -1 m To 0 m	
Frame Type	= Non-Ductile	
Response Reduction Factor	= 3	
Design Code	= IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	= M25	N/sqmm
Grade Of Steel (Main)	= Fe415	N/sqmm
Grade Of Steel (Shear)	= Fe415	N/sqmm
Grade Of Steel - Flexural Design	= Fe415	N/sqmm
Grade Of Steel - Shear Design	= Fe415	N/sqmm
Column B	= 300	mm
Column D	= 600	mm
Clear Cover	= 50	mm
Clear Floor Height @ B	= 550	mm
Clear Floor Height @ D	= 550	mm
No Of Floors	= 1	
No Of Columns In Group	= 1	
Column Type	: UnBraced	
Minimum eccentricity check	: One Axis at a Time	
Code defined D/B ratio	: 4	
D/B Ratio	: 2 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	= 37	
Load Combination	= [8] : 1.5 (LOAD 3: DL) +1.5 (LOAD 2: EQ-Z)	
Critical Location	= Bottom Joint	
Pu	= 324.14	kN
Mux	= 28.03	kNm
Muy	= 0.91	kNm
Vux	= -3	kN
Vuy	= 11.15	kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	540	No Beam	No Beam	-	-	1
Top	540	No Beam	3730 x 300 x 450	-	61.076	0.922

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Major Axis = 0.97

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	135	No Beam	No Beam	-	-	1
Top	135	3610 x 300 x 450	No Beam	63.106	-	0.74

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Minor axis = 0.9

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity = Unsupported Length / 500 + B / 30

= 11.1 mm

Mminy = Pu x Minimum Eccentricity

= 6.48 kNm

Slenderness Check

Max Slenderness Ratio(L/B) = 1.83

< 60 (Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor = 0.97

Slenderness Ratio = Effective Length / D

= 0.89, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor = 0.9

Slenderness Ratio = Effective Length / B

= 1.65, Column Not Slender Along B

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux	28.03	---	28.03	0	28.03
Minor Axis - Muy	0.91	6.48	6.48	0	6.48

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu	=	324.14	kN
Mux	=	28.03	kNm
Muy	=	6.48	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	1.05	
Reinforcement Provided	=	6-T20	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	13.02	deg
MRes	=	28.77	kNm
MCap	=	212.36	kNm
Capacity Ratio	=	MRes/ MCap	
	=	0.14 <= 1	

Shear Calculation	Along D	Along B
Critical Load Combination	[12] : 0.9 (LOAD 3: DL) +1.5 (LOAD 2: EQ-Z)	[10] : 0.9 (LOAD 3: DL) +1.5 (LOAD 1: EQ-X)
Design shear force, Vu (kN)	11.7361	5.8204
Pu (kN)	165.02	181.92
Deff , Beff (mm)	540	240
Aeff (sqmm)	162000	144000
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.0724	0.0404
Pt (%)	0.524	0.524
Design shear strength, Tc (N/sqmm)	0.4982	0.4982
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
	1.1222	1.1516
Shear Strength Enhancement Factor (Tensile Force)	-	-
Shear Strength Enhancement Factor (max)	1.5	1.5

Shear Strength Enhancement Factor	1.1222	1.1516
Enhanced shear strength, Tc-e (N/sqmm)	0.559	0.5737
Design shear check	Tv < Tc x Enhancement factor	Tv < Tc x Enhancement factor
Shear Links Design	**Shear Links Not Required**	**Shear Links Not Required**

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link	=	8	mm
	>	Max. longitudinal bar dia / 4	
	=	5	mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16	=	320	mm
Min. dimension of column	=	300	mm
Max. 300 mm	=	300	mm
Provided spacing	=	300	mm

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	300	---	---	300	---

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BEAM DESIGN CALCULATION

Group	:	**G1**	
Beam No	:	**B1**	
Analysis Reference (Member)	:	114 (3.05 m)	
Beam Length	:	3610	mm
Breadth (B)	:	300	mm
Depth (D)	:	600	mm
Effective Depth (d)	:	545	mm
Design Code	:	IS 456	
Beam Type	:	Regular Beam	
Grade Of Concrete (Fck)	:	M25	N/sqmm
Grade Of Steel (Main)	:	Fe415	N/sqmm
Grade Of Steel (Shear)	:	Fe415	N/sqmm
Top/Bottom Clear Cover (Cmin)	:	25	mm
Side Clear Cover	:	25	mm
Es	:	2x10^5	N/sqmm
Ptnominal (%) (Bn)	:	0.2	%

Flexure Design

	Beam Bottom			Beam Top		
	Left	**Mid**	**Right**	**Left**	**Mid**	**Right**
Critical L/C - RCDC	10	6	11	7	2	2
Mu (kNm)	18.86	16.86	3.48	37.01	17.62	57.66
Tu (kNm)	0.16	0.25	0.12	0.21	0.26	0.26
M_{Tu} (kNm)	0.27	0.44	0.21	0.38	0.47	0.47
Mud (kNm)	19.14	17.3	3.7	37.38	18.08	58.12
MuLim (kNm)	308	308	308	308	308	308
R	0.215	0.194	0.041	0.42	0.203	0.652
Ptmin (%) (A)	0.205	0.205	0.205	0.205	0.205	0.205
Ptclc (%) (B')	0.205	0.205	0.205	0.205	0.205	0.205
Pcclc (%) (C)	0	0	0	0	0	0
PtPrv (%)	0.369	0.369	0.369	0.492	0.492	0.492
AstCalc (sqmm)	334.88	334.88	334.88	334.88	334.88	334.88
AstPrv (sqmm)	603.18	603.18	603.18	804.24	804.24	804.24
Reinforcement Provided	3-T16	3-T16	3-T16	4-T16	4-T16	4-T16

Note: Calculation of Ast

AstCalc	=	Max {B',C} x B X d (for Mu > 0)		
AstCalc	=	Bn x B X d (for Mu = 0)		
Where,				
A	=	Ptmin	=	Min % area of flexural reinforcement
B'	=	Ptclc	=	Maximum of % reinforcement required for Bending Mo
Bn	=	Ptnominal	=	Nominal % area of reinforcement
C	=	Pcclc	=	% area of compression reinforcement required
D	=	AstCrack	=	Area of reinforcement required for Crackwidth

Shear Design			
	Left	**Mid**	**Right**
Critical L/C - RCDC	3	2	1
PtPrv (%)	0.492	0.492	0.492
Vu (kN)	37.53	29.72	53.77
Tu (kNm)	0.24	0.26	0.31
V_{Tu} (kN)	1.26	1.41	1.67
Vut (kN)	38.8	31.13	55.44
Tv (N/sqmm)	0.24	0.19	0.34
Tc (N/sqmm)	0.49	0.49	0.49
Vc (kN)	79.4	79.4	79.4
Vus=Vut-Vc (kN)	0	0	0
Legs	2	2	2
Stirrup Rebar	8	8	8
Asv Torsion (sqmm)	83.12	67.512	118.5
Asv Torsion Prv (sqmm)	335.13	335.13	335.13
Asv Reqd (sqmm/m)	332.36	332.36	332.36
SvCalc (mm)	300	300	300
SvPrv (mm)	300	300	300
Asv Total Prv (sqmm)	335.13	335.13	335.13

Maximum Spacing Criteria

Basic

Spc1 =0.75d	=	409	mm
Spc2	=	300	mm

SFR Design

Beam Width	=	300	mm
Beam Depth	=	600	mm
Web Depth	=	600 <= 750	mm

Side Face Reinforcement not required.

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SLAB DESIGN CALCULATIONS

Slab No. :	S2		
Level	=	3.05 m	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M25	
Grade Of Steel	=	Fe415	
Clear Cover	=	20.000	mm
Long Span, Ly	=	4.400	m
Short Span, Lx	=	3.730	m
Imposed Load	=	4.500	kN/sqm
Live Load	=	3.500	kN/sqm
Slab Thickness	=	150.000	mm
Effective Depth Along LX, Deffx	=	125.000	mm
Effective Depth Along LY, Deffy	=	115.000	mm
Self Weight	=	3.750	kN/sqm
Total Load, TL	=	11.750	kN/sqm
Span	=	2-Way	
Panel Type	=	Two Adjacent Edges Discontinuous	

Design Moments:

Short Span Positive Moment At Midspan -

Moment Coefficient	=	0.046	
BM	=	7.528	kNm
Mu = 1.5 X BM	=	11.292	kNm
Area Of Reinforcement Required (Mu)	=	259.164	sqmm/m
Reinforcement Provided	=	T8 @ 190 C/C	
	=	265.000	sqmm/m

Short Span Negative Moment At Continuous Support -

Moment Coefficient	=	0.061	
BM	=	10.037	kNm
Mu = 1.5 X BM	=	15.056	kNm
Area Of Reinforcement Required (Mu)	=	349.943	sqmm/m
Reinforcement Provided	=	T8 @ 140 C/C	
	=	359.000	sqmm/m

Long Span Positive Moment At Midspan -

Moment Coefficient	=	0.034	
BM	=	5.558	kNm
Mu = 1.5 X BM	=	8.337	kNm
Area Of Reinforcement Required (Mu)	=	207.016	sqmm/m
Reinforcement Provided	=	T8 @ 240 C/C	
	=	209.000	sqmm/m

Long Span Negative Moment At Continuous Support -

Moment Coefficient	=	0.045	
BM	=	7.411	kNm
Mu = 1.5 X BM	=	11.116	kNm
Area Of Reinforcement Required (Mu)	=	279.026	sqmm/m
Reinforcement Provided	=	T8 @ 180 C/C	
	=	279.000	sqmm/m

Distribution Reinforcement @ 0.12% -

Area Of Reinforcement Required	=	150.000	sqmm/m
Reinforcement Provided	=	T8 @ 300 C/C	
	=	168.000	sqmm/m

Shear Check :

Along Short Span

Shear Coefficient(Lx), SF1	=	0.464	
V = SF1 x TL x Lx	=	20.331	kN
Vu = 1.5 X V	=	30.497	kN
Shear Stress, Tv	=	0.244	N/sqmm
Nominal Shear Stress, Tc	=	0.383	N/sqmm
Modification Factor 'K'	=	1.300	
K x Tc	=	0.498	
	>	0.244	Slab Is Safe In Shear

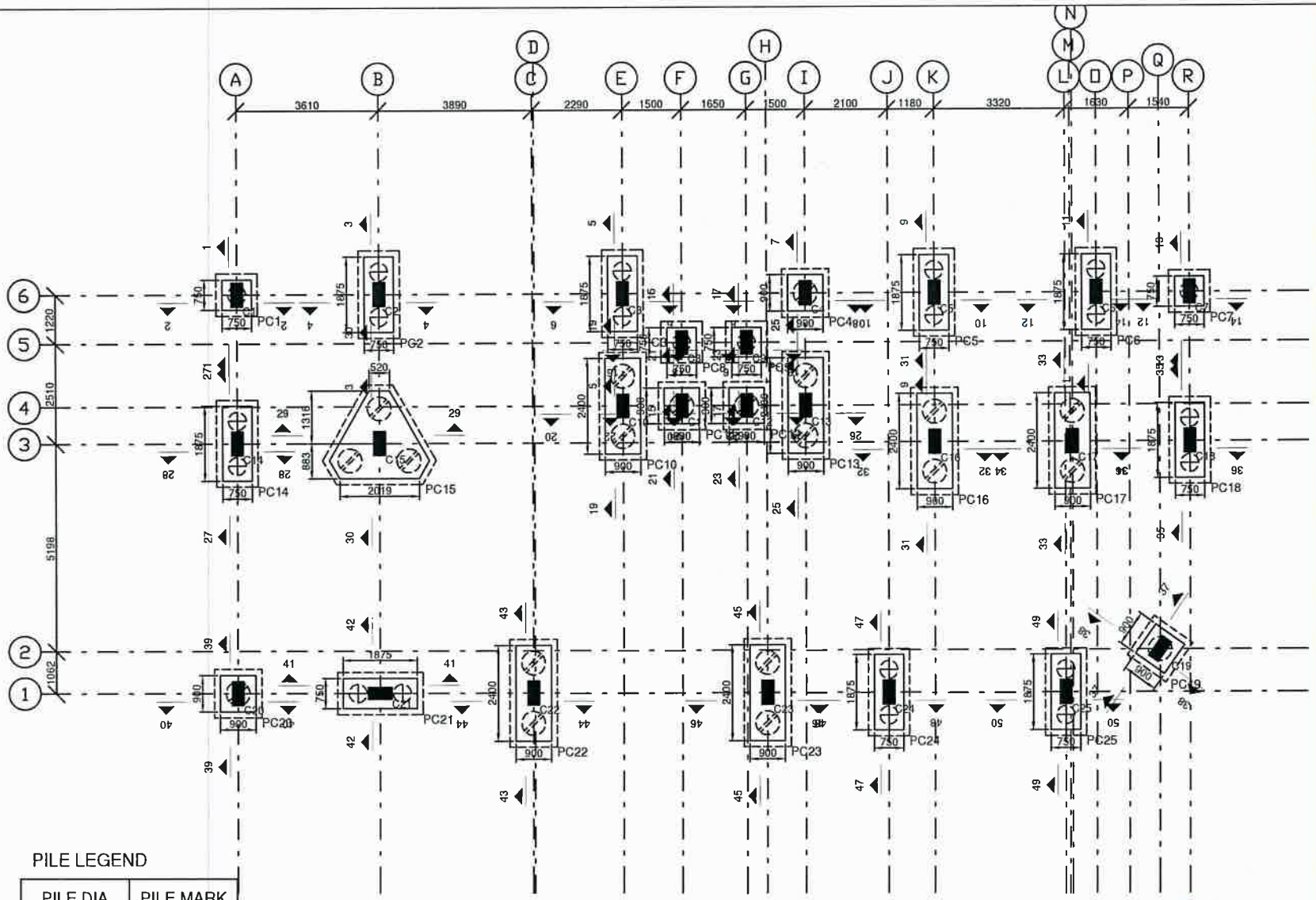
Along Long Span

Shear Coefficient(Ly), SF2	=	0.400	
V = SF2 x TL x Lx	=	17.531	kN
Vu = 1.5 X V	=	26.297	kN
Shear Stress, Tv	=	0.229	N/sqmm
Nominal Shear Stress, Tc	=	0.360	N/sqmm
Modification Factor 'K'	=	1.300	
K x Tc	=	0.468	
	>	0.229	Slab Is Safe In Shear

Deflection Check:

Basic Span To Depth Ratio	=	26	
Span Correction Factor	=	1.000	
Tensile Steel Factor	=	1.777	
Compression Steel Factor	=	1.000	
Flange Correction Factor	=	1.000	
Max Span To Depth Ratio	=	26.00 x 1.00 x 1.78 x 1.00 x 1.00	
	=	46.201	
Lx/d	=	29.840	
	<	46.201	Slab Is Safe In Deflection

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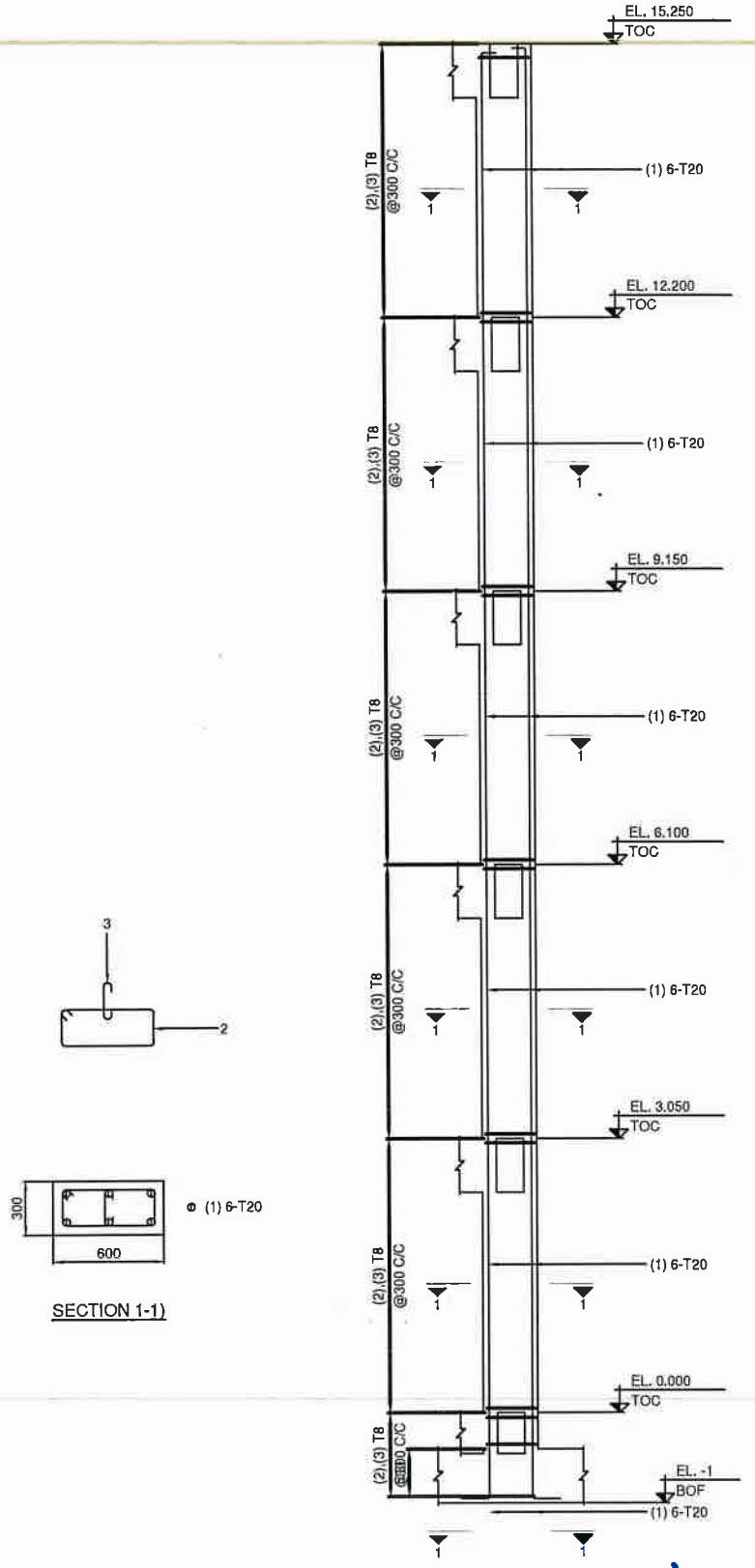


PILE LEGEND

PILE DIA	PILE MARK
450	⊕
600	⊘

PILE & COLUMN LAYOUT

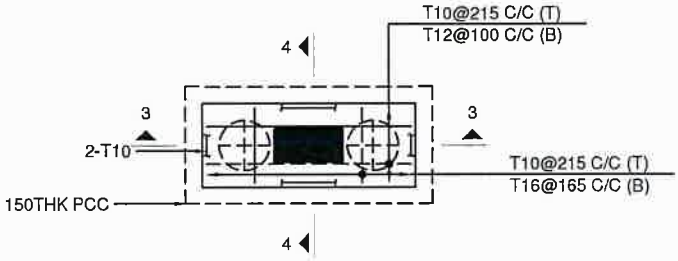
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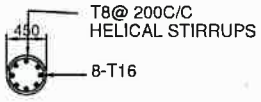
SECTION 1-1)

DETAIL OF COLUMN

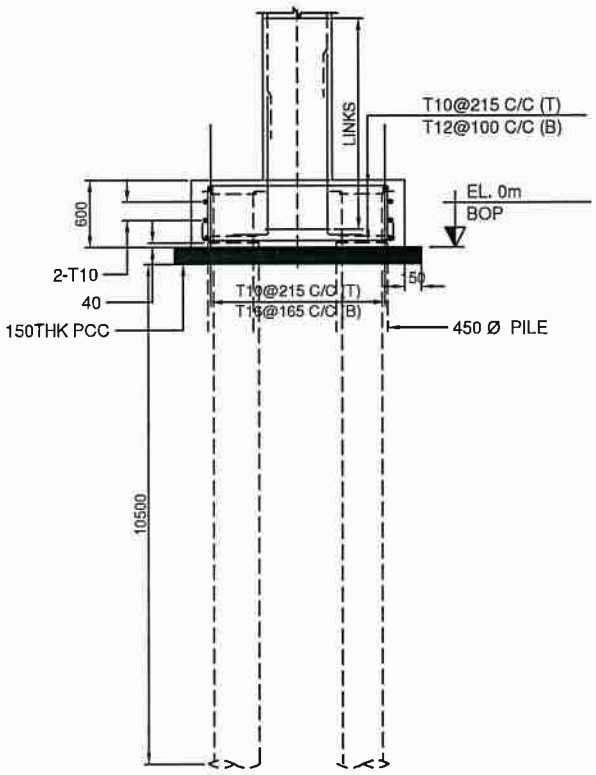
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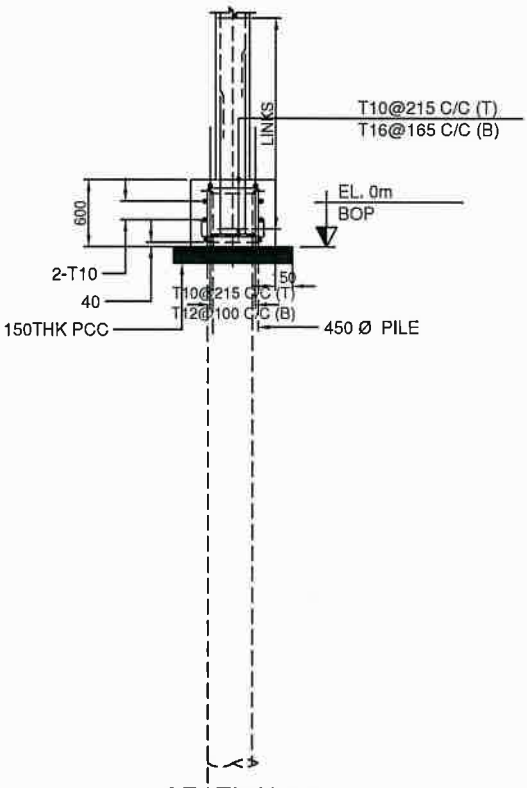
PILE CAP - PLAN



SECTION 3-3



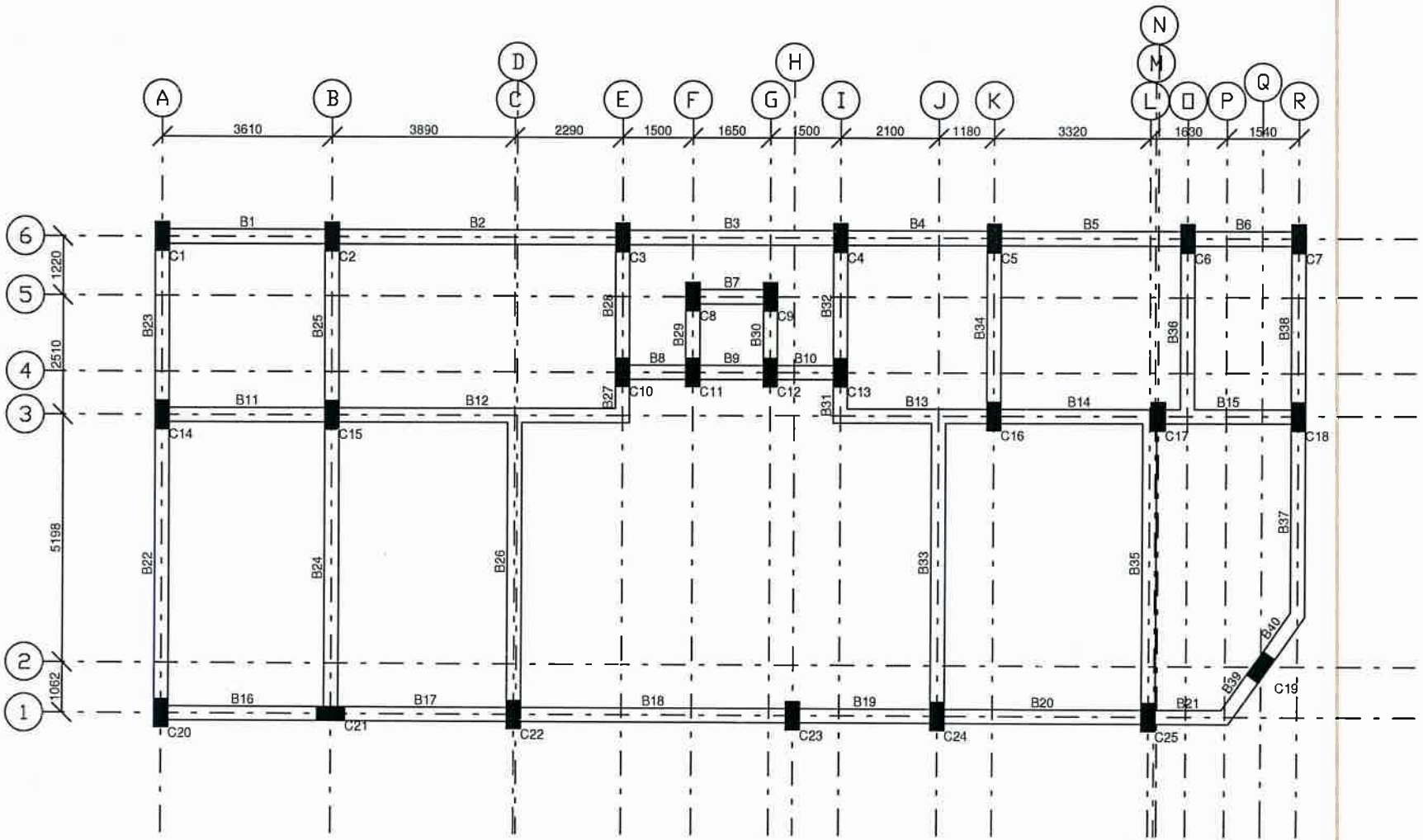
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SECTION 4-4

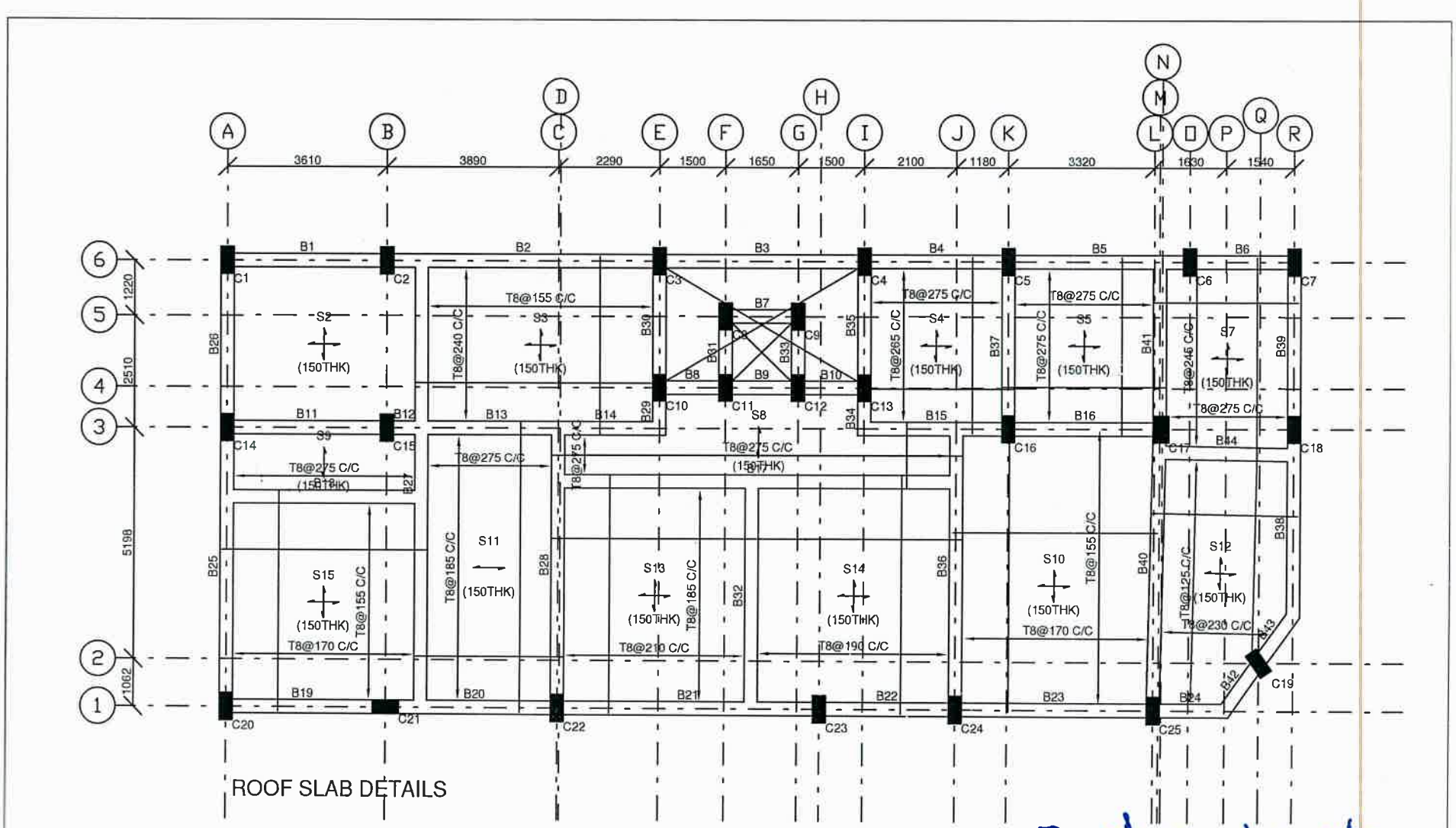
PILE & PILE CAP DETAILS

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TIE BEAM LAYOUT

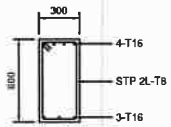
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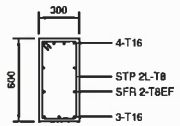
ROOF SLAB DETAILS

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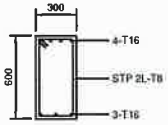
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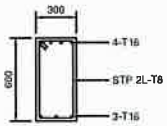
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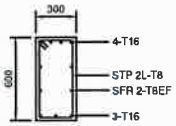
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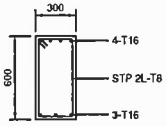
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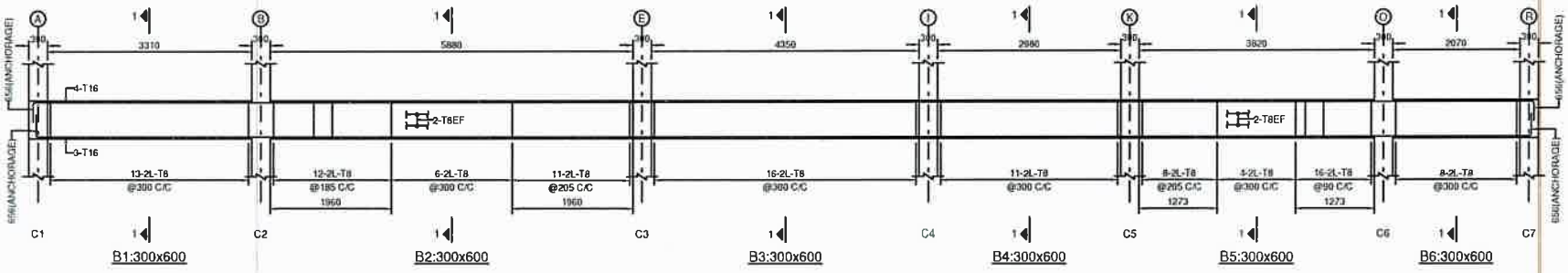
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B5



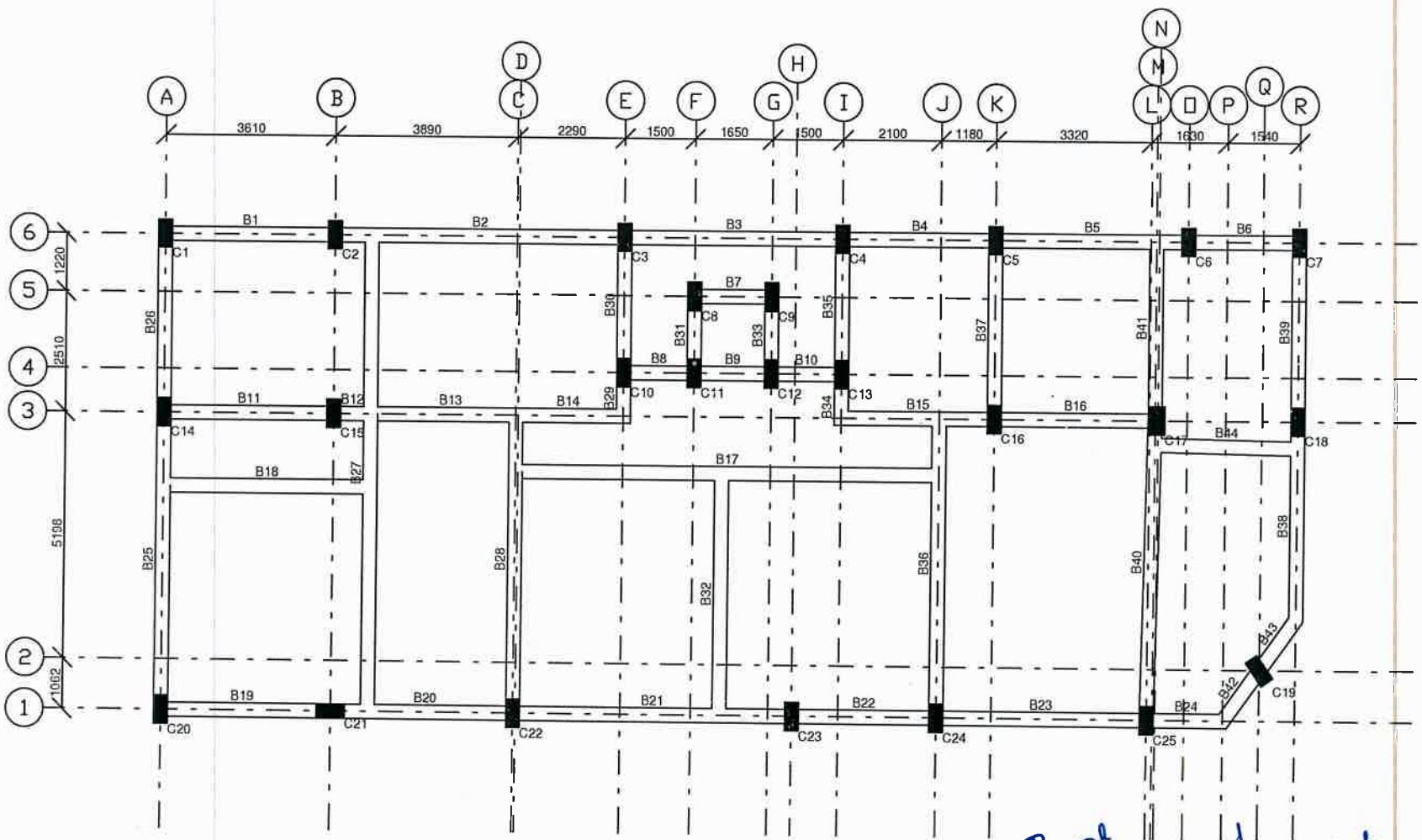
B6



B1:300x600 B2:300x600 B3:300x600 B4:300x600 B5:300x600 B6:300x600

BEAM DETAILS

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ROOF BEAM LAYOUT

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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

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Services we run for you
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The LandLens suite
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Verified RealEstate™

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

- Legal opinions, due diligence and title verification
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- Completion and occupancy certificates, regularisation
- Escrow, negotiation and NRI property management
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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.