Verified RealEstate™

RE REGULATORY RECORD

RERA Document

The document as the regulator published it, reproduced in full behind this page.

Published for reference. The authority's own register is the operative record.

Verified RealEstate™
3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai 600 097, India

hello@verified.realestate
+91 9996 12 9996
verified.realestate

DIGITALLY VERIFIED RECORD

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

STABILITY CERTIFICATE

The detailed engineering and structure design of the Proposed Construction of Ground + First + Second floor (3 floors) Residential Building with 16 Dwelling Units in Villas in plot nos.5&6,19,28,29,30,31,45,55,60,65,69,70,71,79,81,97, Comprised in Survey Nos. 360/1A ,360/2A , 370/1, 371/1, 378/1 at THIRUVERKADU MUNICIPALITY Aynambakkam village has been done by me/us based on the report of geotechnical investigation (soil test) done by NAGADI CONSULTANTS PRIVATE LIMITED Report No. G(C)10040A Dated – 07.07.2025 and considering the functional requirement of the building.

2. It is certified that among other factors, the proposed building has been designed to resist earthquakes. 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 M25**.**

(ii) The design and analysis has been done using the code of practice for plain and reinforced concrete as per IS 456, design loads as per IS Codes No 875 and design of earthquake resistant structure as per IS Code No 1893**.**

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

Stamp and Signature

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Encl.: Structural Design Calculation

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

DESIGN CALCULATION

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

STRUCTURAL CONSULTANTS:-

S.M.SAMINATHAN
BE(Civil)M.Tech(STR)DCTech
11/1, THERADI STREET,
PALLIKKARANAI,CHENNAI-
600100

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

DESIGN BRIEF:

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A, 370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

1.0 GENERAL DESIGN CRITERIA

1.1. Description of the structure

The Residential Building consists of a Ground + 2 Upper floors, and the structure is designed as an RCC framed structure.

1. Size of the building : 6.22 X 11.88 m
2. Height of the building : 10.88 m
3. Number of storeys above GL : Ground + 2 upper floors
4. Floor-to-floor height of this building : All floors - 3.00m
5. Type of foundation : Isolated foundation as per geotechnical report

1.2. Materials Used

Following materials are generally used in the design of the various components of the structure. For Concrete Structure

- M25 grade concrete for all reinforced concrete parts of the structure
- Fe500 grade Structural reinforcement steel
- Masonry for all walls: Brick / Block

1.3. Design Codes & Standards

Following codes and specifications have been generally used in the design of the members of the structure.

- IS 456 : 2000 Code of practice for Plain and Reinforced concrete
- SP: 16 Design Aids for Reinforced concrete
- IS 875 : 1987 Design Loads for building and structures
- IS 1893 : 2002 Criteria for Earthquake Resistant design of structures
- IS 13920: 1993 Ductile Detailing of R.C structures subjected to Seismic forces
- SP: 34 Handbook on Concrete Reinforcement & Detailing
- IS 800 : 1984 Code of practice for general construction in steel
- IS 2062 : 1999 Steel for general structural purposes specification
- IS 1786: 1985 Specification for high strength deformed bars and wires for concrete reinforcement

2.0 LOADING

Primary Load:

- Dead Load (DL)

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

- Live Load (LL)

2.1. Dead load (DL) Material weight

- Density of Concrete =25 kN/m^{3}D.L. due to partitions
  (Light Partition as per IS 875) =1.50 kN/m^2
- D.L due to floor finish 50mm thick = 0.05x25 = 1.25 kN/m^2

2.2. Live load (LL)

Minimum Uniformly Distributed Live Loads:

Occupancy or use	Live Load (kn/m^2)
All rooms and kitchens	2.00
Toilet and bath rooms	3.00
Corridors, passages, staircases	3.00
Balconies	3.00
Terrace Floor	1.50
Basic wind speed	=50 m/sec
Seismic Zone	=Zone III

3.0 Loading Combinations

The following combinations of Loads as per IS 1893 is considered in the CYPE Analysis

- 1.5(DL +LL)
- 1.2(DL + LL)

The following load combinations are used to check the structure under serviceability conditions.

- 1.0(DL +LL)

4.0 Structural Description

4.1. Method of analysis

Structure analysis & design:

The structure is analyzed as a Space frame structure in CYPE. Columns, Footing, Basement walls, slabs, Beams and Staircases are designed as reinforced concrete members.

4.2. Framing System, Analysis and Design

Limit State concept of design will be used as per IS: 456-2000 & SP - 16. The detailing of reinforcement shall be done satisfying the requirements of IS: 456-2000, SP-16, IS: 13920, IS: 4326-1993 and SP-34.

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

5.0 MATERIALS

5.1 Concrete Material Specifications:

Concrete compressive cube strength	- 25 N/mm^2
Minimum cement content	- Refer to standard drawings for general & Legends
Cement type	- OPC
Free water-cement ratio	- 0.5 (Maximum)
Nominal maximum size of aggregate	- 20mm UNO

5.2 Reinforcement:

Steel reinforcement shall be deformed bars; the characteristics of reinforcement bars shall conform to the following specification:

Grade of Steel	Actual Yield Strength (MPa)
Grade Fe500	Minimum 500 MPa

5.3Concrete cover:

Cover for Reinforcement is considered as per Table 16A of NBC, for a Fire resistance of 2 hrs.

- Raft Slab = 50mm
- Footing = 50mm
- RC Wall = 30mm
- Columns = 40mm
- Beams = 30mm
- Slabs = 25mm

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Design of Slab

Lx	Ly
4.28	7.1

Basic dimensions of slab		=	
Basic Ly/Lx ratio		=	1.659 <2
Clear cover to reinforcement	d'	=	20 mm
Provided overall depth	D	=	180.00 mm
Effective depth	d	=	156.00 mm
Diameter of bar	f	=	8 mm
Select Grade of Concrete	fck	=	N/mm²
Select Grade of Steel	fy	=	N/mm²
Load calculation :			
Dead load of the slab	DL	=	4.500 kN/m²
Floor finish(Roof finish)	FF	=	1.5 kN/m²
Live load	LL	=	2 kN/m²
Total load	TL	=	8.000 kN/m²
Moment and Area of Steel calculations:			

safe

safe
safe
safe

Check for Deflection

The effective depth provided	= 156.000 mm	Bent up alternate bars at l/7	
From figure 3 of I.S 456:1978 moc		from center of bearing	
Modification factor	= 1.48	for shorter span	= 611 mm
Required depth under deflection	= 105.33 MM HENCE SAFE	For Longer span	= 1014 mm

Simply suppurted
continuous

check for shear		Short span	Long span
	Shear Force (V)	6.6355 KN	28.4 KN
	tou V	0.0425 N/mm²	0.182 N/mm²
	tou Permissible fron=		

Hence designed as two way slab

25
500

Span	Moment Coefficient		Mu kN.m	Mu/bd² N/mm2	Pt %	Ast reqd mm²	Min Ast mm²	Dia of bar mm	Spacing mm	Ast pro mm²
shorter	ax neg	0.000	0.00	0.00	0.00%	0.00	187.2	10	150	523.60
	ax pos	0.099	21.85	0.90	0.22%	341.14	187.2	10	125	628.32
longer	ay neg	0.000	0.00	0.00	0.00%	0.00	187.2	10	150	523.60
	ay pos	0.056	12.31	0.51	0.12%	188.30	187.2	10	180	436.33

C

factore	shear	touv	Pt	touc
0	0	0	0.25	0.404

Distribution Steel (Asd)

Asd reqd		Dia of	Spa	Asd
270.00		8	200	251.33

Check for development Length along short span

For Steel Fe500 Sign = 415 N/mm²
For M25 tou bd = 1.4 N/mm²
M1 = 15321798.7 Nmm
L0 = 355 mm
M1/V + L0 = 2664 mm

Ld = 1297 mm HENCE SAFE

For Steel Fe500 Sign = 500 N/mm²
For M25 tou bd = 1.4 N/mm²
M1 = 15321798.7 Nmm



S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
Thalamuthu Natarajan Building, No.1, Gandhi Irwin Road, Egmore,
Chennai - 600 008
Phone : 28414855 Fax: 91-044-28548416
E-mail: mscmda@tn.gov.in
Web site: www.cmdachennai.gov.in.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the Thiru / Tmt. / M/s. **S.M.SAMINATHAN** has enrolled as **Registered Structural Engineer Grade-I (SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E Structures** and experience in the relevant field for 7 years.

He/She has been given the Registration No. **SE/I/2024/5/0052** on **07-May-2024** He/She shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(ms) No.18 MAWS (MA1) Dept. Dated. 04.02.2019.

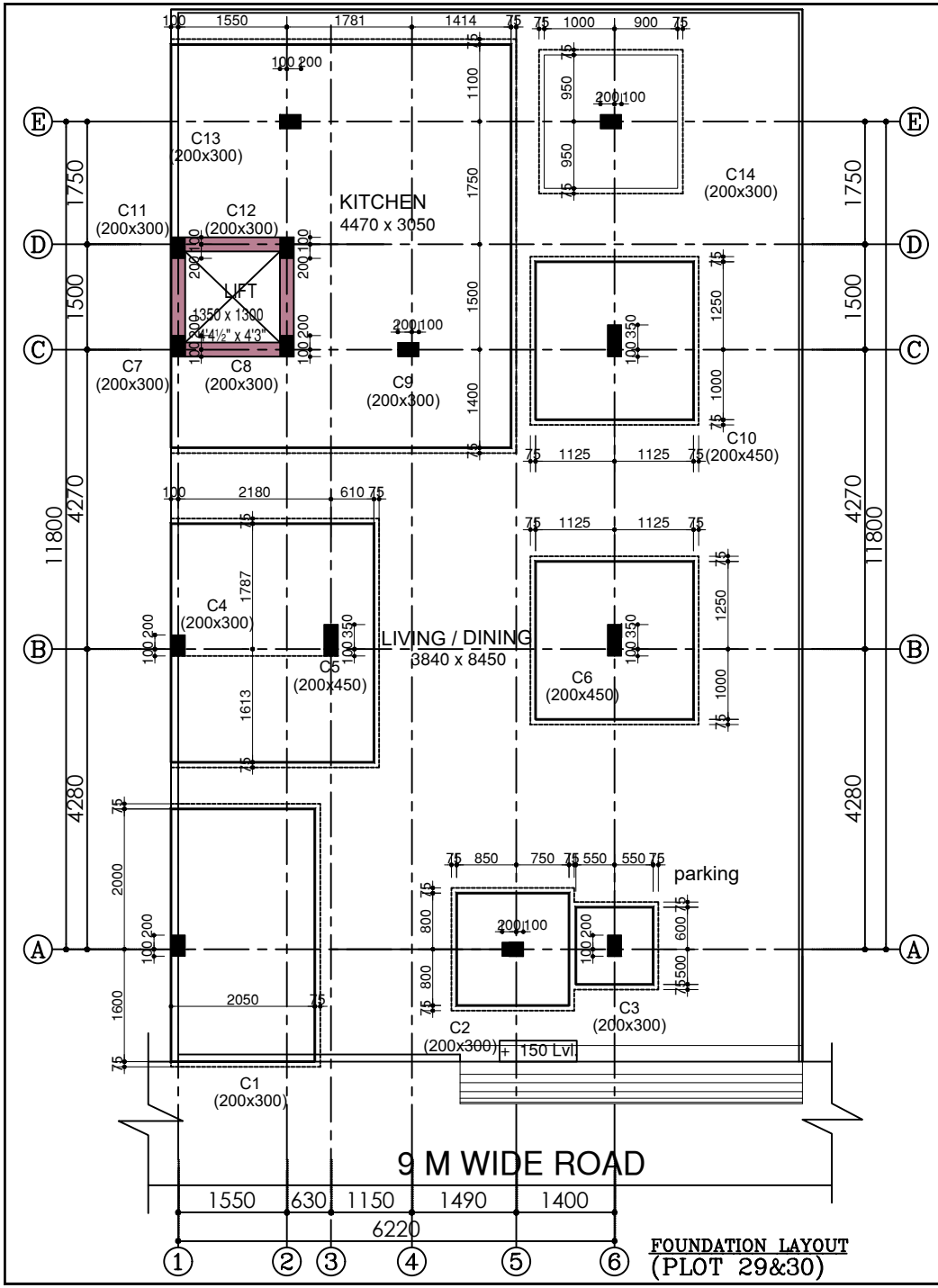
This Registration is valid upto **06-May-2029**.

Signature valid
Name :A. Meganathan
Designation :Superintendent
Date :05/07/2024 4:41:37 PM

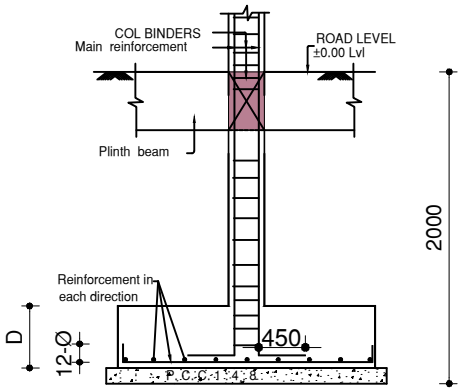


A Meganathan

Superintendent



FOUNDATION ELEMENTS BLOCK						
References	Dimensions (mm)	Depth (mm)	Bott. reinf. X	Bott. reinf. Y	Top reinf. X	Top reinf. Y
C1	2050x3600	500	28Y10@125	16Y10@125	28Y10@125	16Y10@125
C2	1600x1600	350	9Y10@180	9Y10@180		
C3	1100x1100	350	6Y10@180	6Y10@180		
C6 and C10	2250x2250	550	14Y12@160	14Y12@160		
C14	1900x1900	450	10Y12@190	10Y12@190		
C4-C5	2890x3400	600	30Y12@110	23Y12@120	33Y12@100	26Y12@110
C7-C8-C13-C11-C12-C9	4850x5750	500	57Y10@100	48Y10@100	45Y10@125	38Y10@125



TYPICAL DETAILS OF COLUMN FOOTING
FOR COLUMN NUMBERS C2,C3,C6,C10,C14

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:
Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:
Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV:	DESCRIPTION:	BY:	DATE:

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

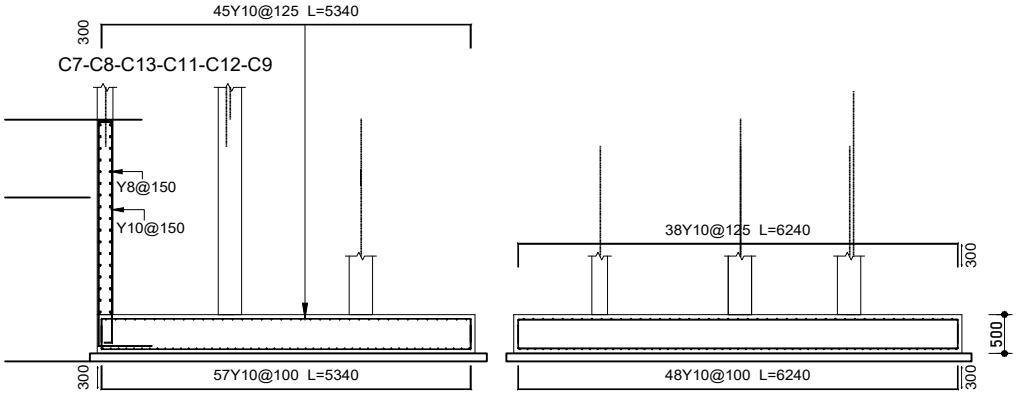
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

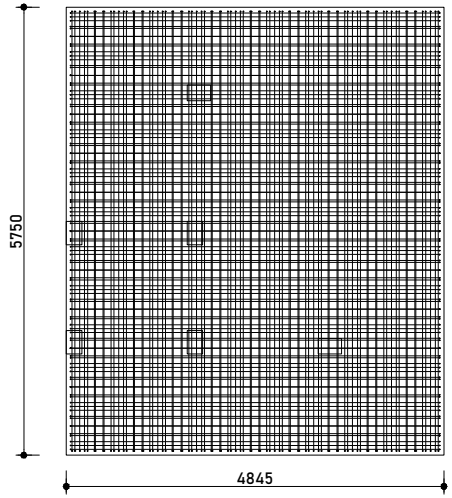
SITE: 'VILLA ENCHANTE'
AYANAMBAKKAM, CHENNAI

TITLE: FOUNDATION LAYOUT
(PLOT 29&30)

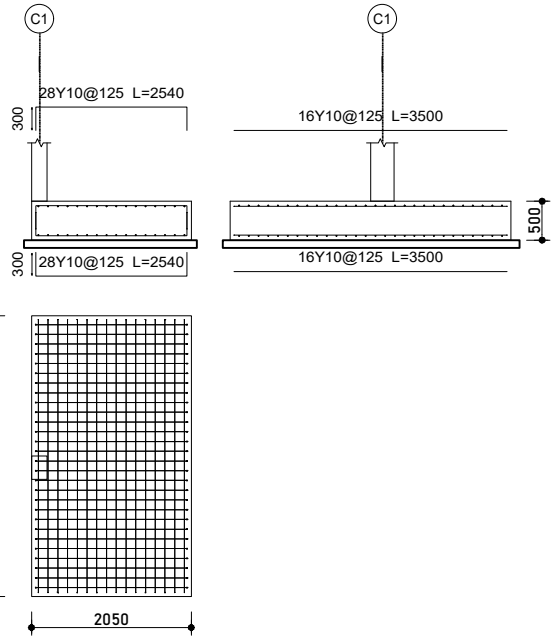
SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	10/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
1/3	S&P-ENC-SD-01	R3

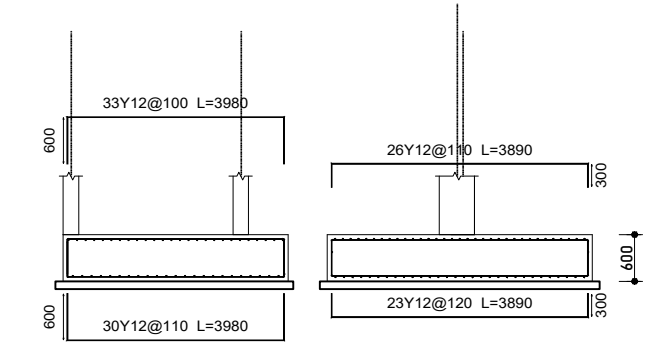


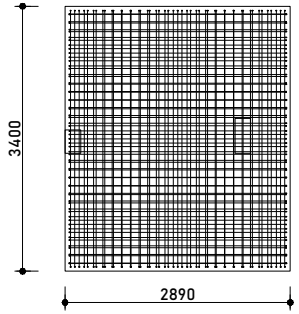


C1



C4-C5





S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :

S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT:
ANBU AND FAIZAL,
EGMORE,CHENNAI

STRUCTURAL ENGINEER:
S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

SITE:
'VILLA ENCHANTE'
AYANAMBAKKAM, CHENNAI

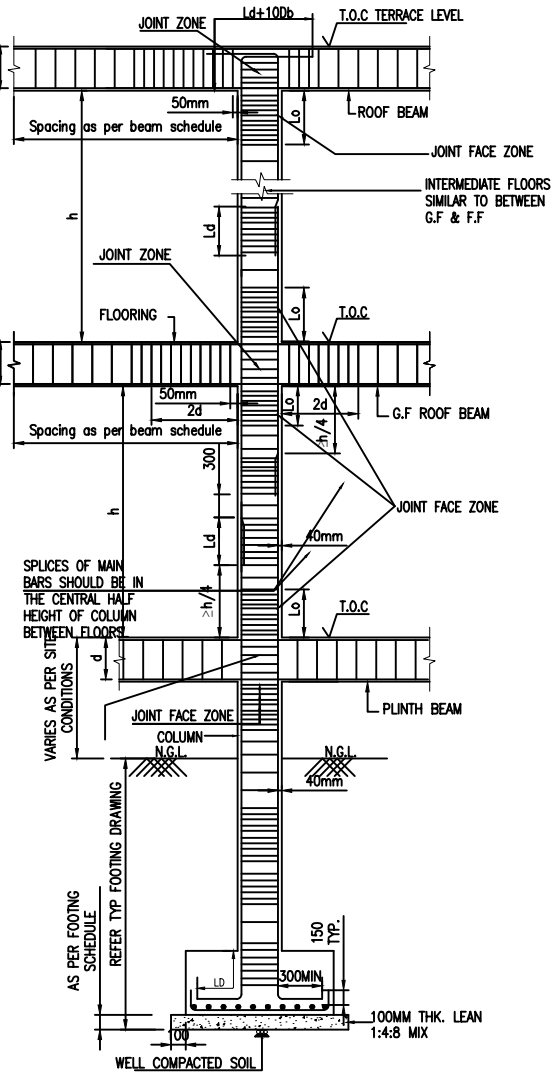
TITLE:
FOUNDATION LAYOUT
(PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	10/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
3/3	S&P-ENC-SD-01	R3

COLUMN SCHEDULE

C1	C2	C3	C4=C7=C8=C11 C12	C5	C6=C10	C9=C13=C14	C15=C16	
			Y12 300 200 120 220 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y16 Y12 450 200 120 370 1Y8(1070) Long. Reinf.: 4Y16+2Y12 Stirrups: Y8 @150				HR-LMR
			Y12 300 200 120 220 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y16 Y12 450 200 120 370 1Y8(1070) Long. Reinf.: 4Y16+2Y12 Stirrups: Y8 @150		Y12 300 200 220 120 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y12 450 200 2Y8(250) 120 370 1Y8(1070) Long. Reinf.: 8Y12 Stirrups: Y8 @150	TERRACE
Y12 300 200 120 220 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y12 300 200 220 120 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150		Y12 300 200 120 220 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y16 Y12 450 200 120 370 1Y8(1070) Long. Reinf.: 4Y16+2Y12 Stirrups: Y8 @150		Y12 300 200 220 120 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y20 Y16 450 200 2Y8(260) 120 370 1Y8(1080) Long. Reinf.: 4Y20+8Y16 Stirrups: Y8 @200	FLOOR 2
Y16 Y12 300 200 120 220 1Y8(770) Long. Reinf.: 4Y16+2Y12 Stirrups: Y8 @150	Y12 300 200 220 120 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y12 300 200 120 220 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y12 300 200 120 220 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y16 Y12 450 200 120 370 1Y8(1070) Long. Reinf.: 4Y16+2Y12 Stirrups: Y8 @150	Y12 450 200 2Y8(250) 120 370 1Y8(1070) Long. Reinf.: 8Y12 Stirrups: Y8 @150	Y12 300 200 220 120 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150		FLOOR 1
Y16 Y12 300 200 120 220 1Y8(770) Long. Reinf.: 4Y16+2Y12 Stirrups: Y8 @150	Y12 300 200 220 120 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y12 300 200 120 220 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y12 300 200 120 220 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150	Y16 Y12 450 200 120 370 1Y8(1070) Long. Reinf.: 4Y16+2Y12 Stirrups: Y8 @150	Y12 450 200 2Y8(250) 120 370 1Y8(1070) Long. Reinf.: 8Y12 Stirrups: Y8 @150	Y12 300 200 220 120 1Y8(770) Long. Reinf.: 6Y12 Stirrups: Y8 @150		FLOOR 0
								Foundations



TYPICAL DUCTILE REINFORCEMENT DETAILING
SCALE 1:100

1. FOR SPACING OF TIES AND LINKS REFER GUIDE LINES GIVEN UNDER THE SECTION DUCTILE REINFORCEMENT DETAILS.
2. Db IS THE DIA OF BAR.
3. WHEN A COLUMN TERMINATES INTO A FOOTING OR MAT,SPECIAL CONFINING REINFORCEMENT SHALL EXTEND AT LEAST 300MM INTO THE FOOTING OR MAT.
4. Lo = 500MM (OR) h/6 (OR) 'b' (LARGER LATERAL DIMENSION OF COLUMNS)
5. JOINT ZONE IS THE JUNCTION OF BEAM PORTION WITH COLUMN.
6. Ld = DEVELOPMENT LENGTH IN TENSION & COMPRESSION.

S.M. SAMINATHAN
Structural Engineer
B.E(Civil),M.Tech (Structures),.D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE//2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:
Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:
Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV:	DESCRIPTION:	BY:	DATE:

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

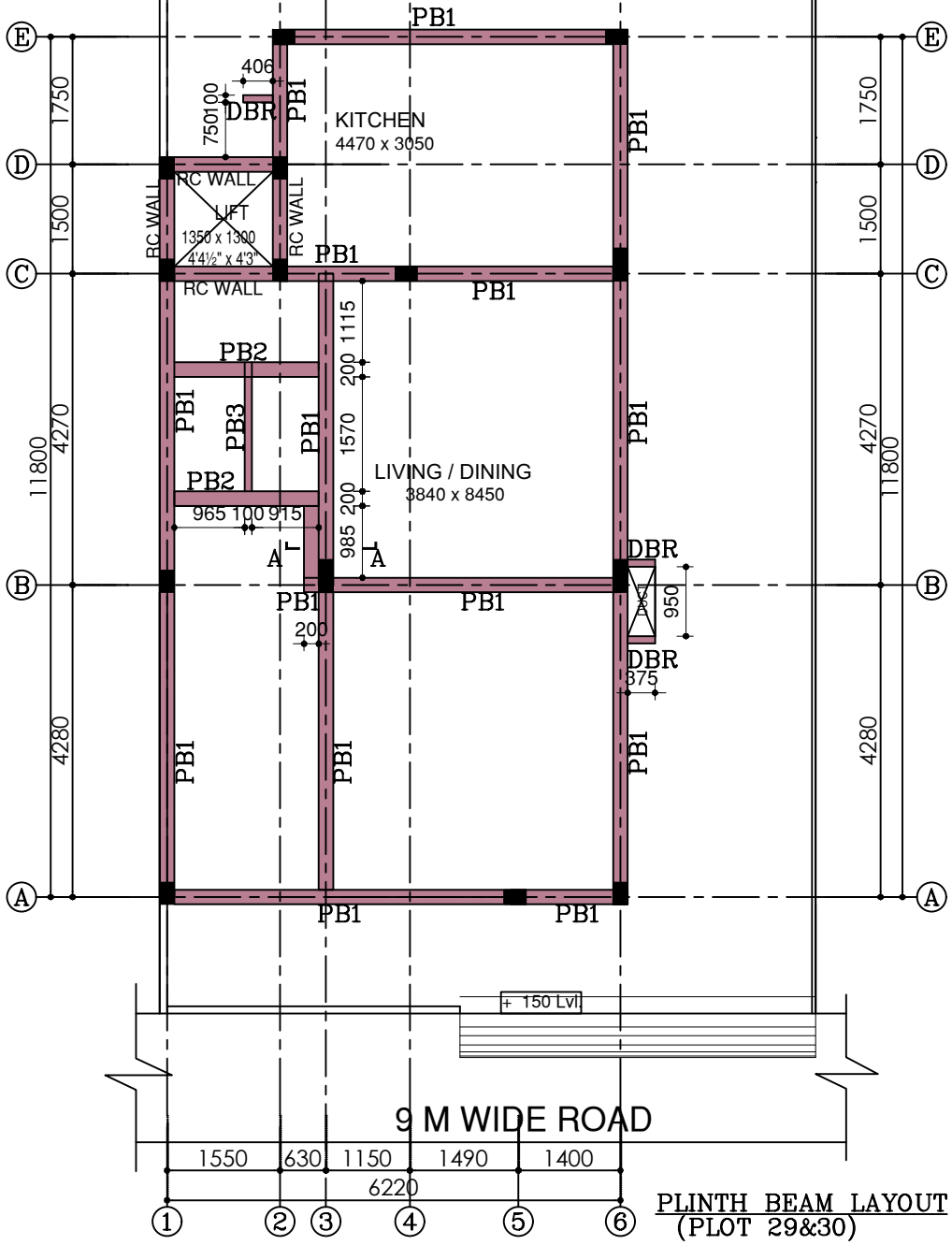
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

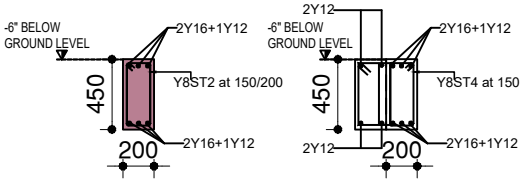
TITLE: FOUNDATION LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	10/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
2/3	S&P-ENC-SD-01	R3

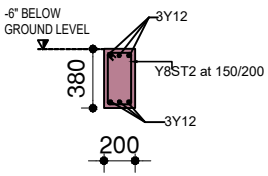


PLINTH BEAM LAYOUT
(PLOT 29&30)

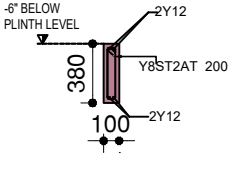


TYPICAL DETAIL OF
PLINTH BEAM PB1

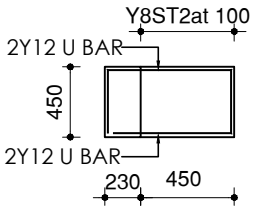
SECTION A-A



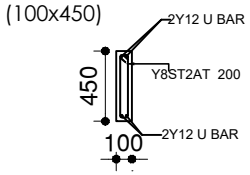
TYPICAL DETAIL OF
PLINTH BEAM PB2



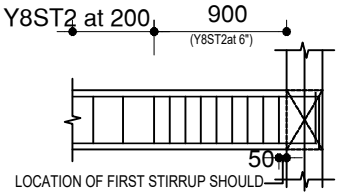
TYPICAL DETAIL OF
PLINTH BEAM PB3



LS OF DUCT BRACKET DBR



CS OF DUCT BRACKET DBR



LOCATION OF FIRST STIRRUP SHOULD
COMMENCE AT 50MM FROM FACE OF COLUMN.

TYPICAL PLINTH BEAM DETAIL AT END
COLUMNS.

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants
No. 10/05, 2nd floor, Mahalakshmi Street,
Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&
balu_associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :

S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV:	DESCRIPTION:	BY:	DATE:

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT:
ANBU AND FAIZAL,
EGMORE,CHENNAI

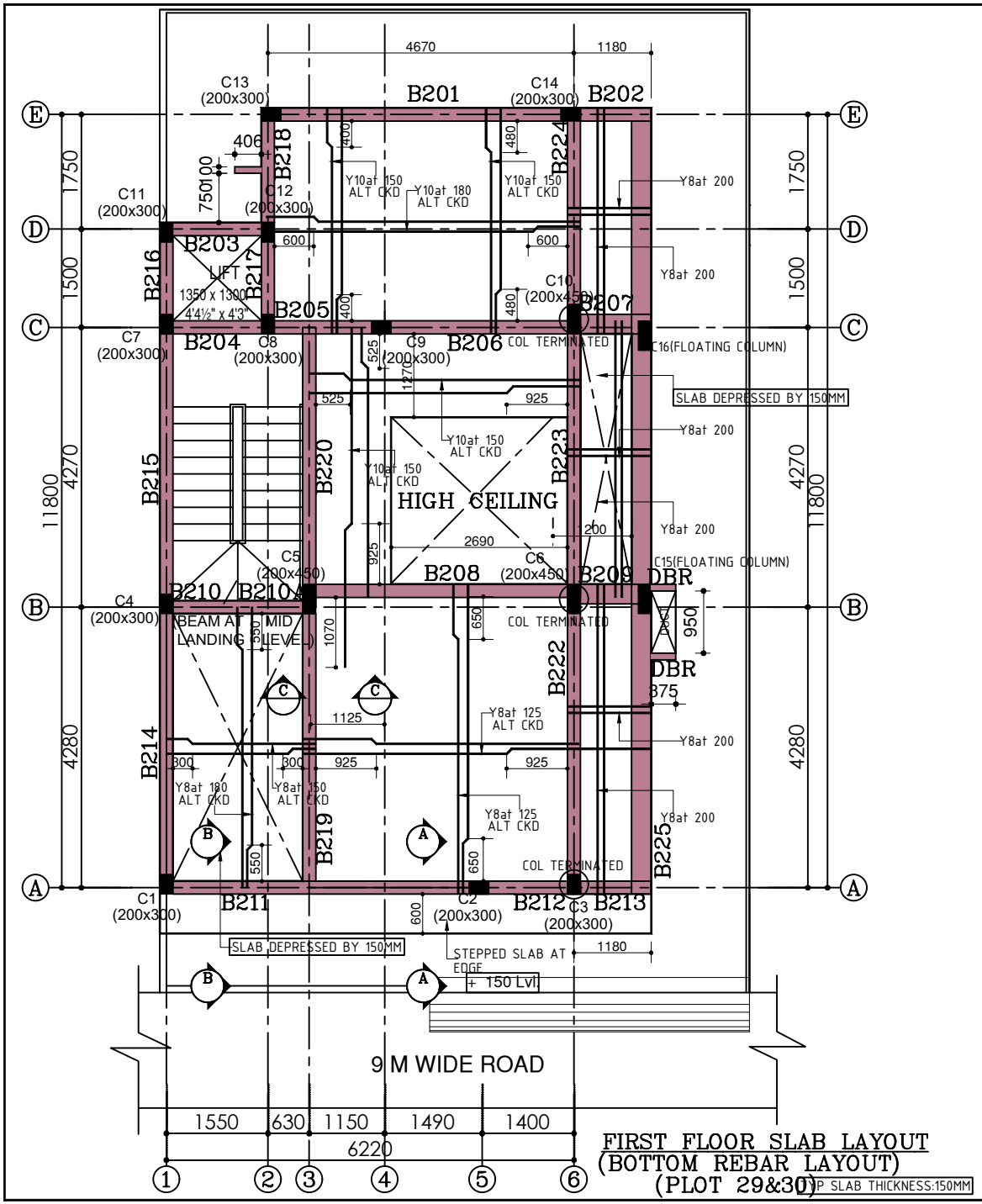
STRUCTURAL ENGINEER:
S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE'
AYANAMBAKKAM,CHENNAI

TITLE: PLINTH BEAM LAYOUT
(PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
1/1	S&P-ENC-SD-02	R3



FIRST FLOOR SLAB LAYOUT (BOTTOM REBAR LAYOUT) (PLOT 29&30)

SLAB THICKNESS:150MM

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :

S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

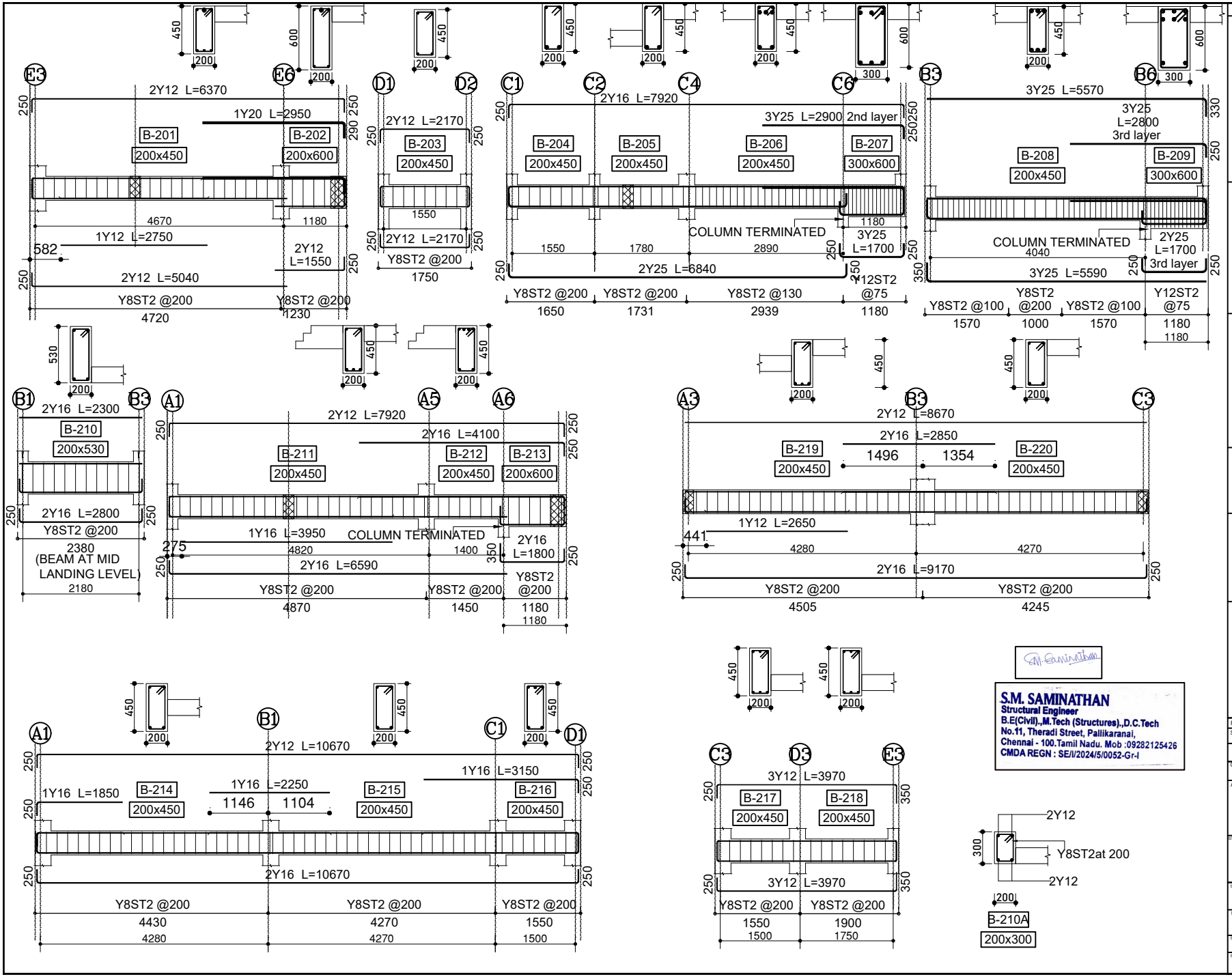
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

TITLE: FIRST FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
1/5	S&P-ENC-SD-03	R3



Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting
Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

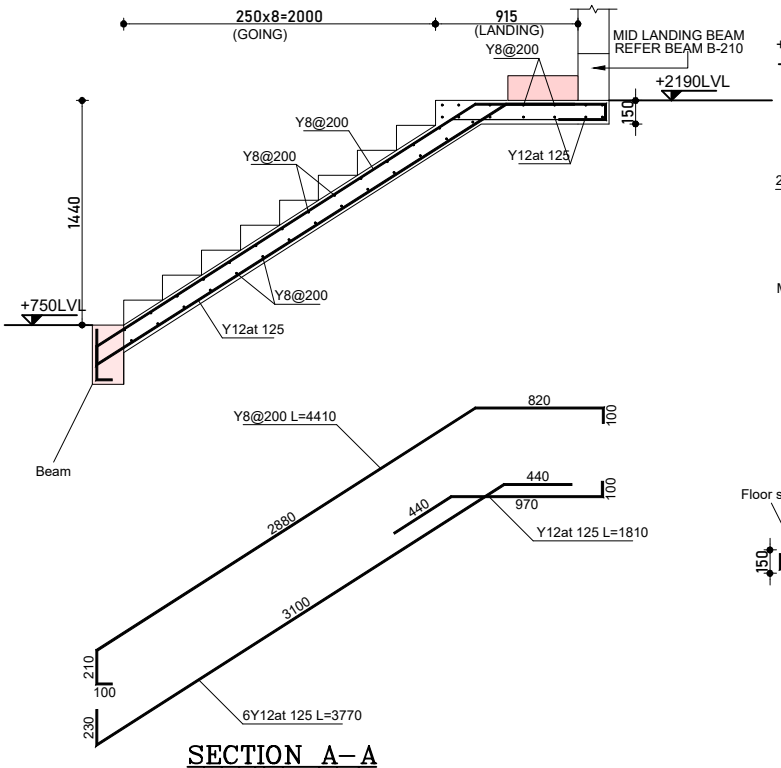
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL),M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

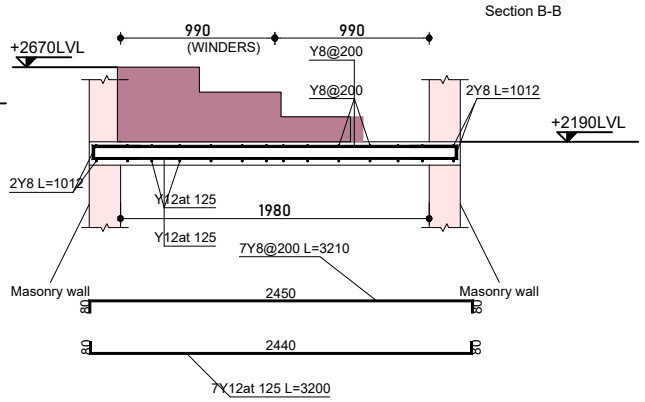
TITLE: FIRST FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

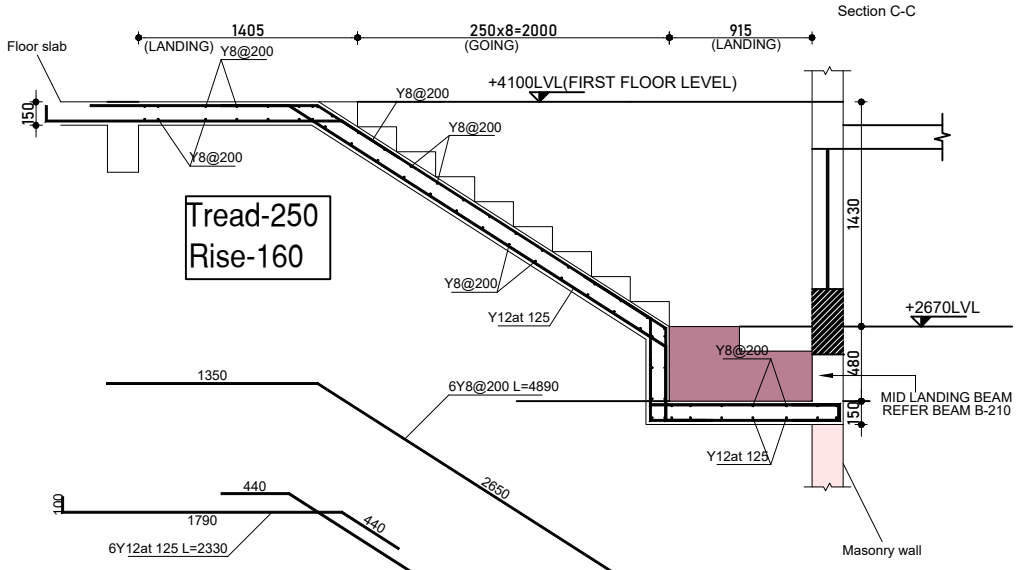
SHEET NO:	DRAWING NO:	REVISION:
3/5	S&P-ENC-SD-03	R3



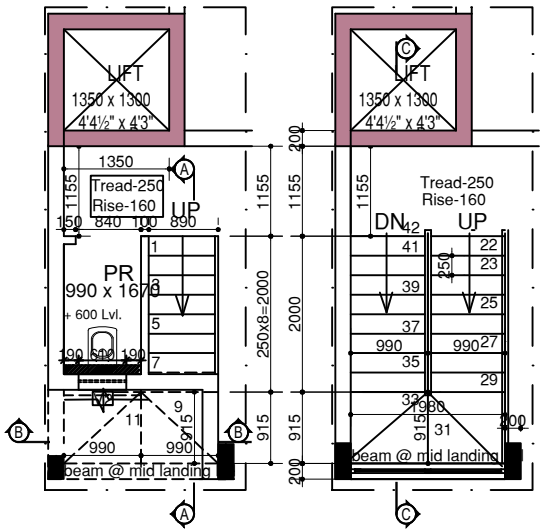
SECTION A–A



SECTION B–B

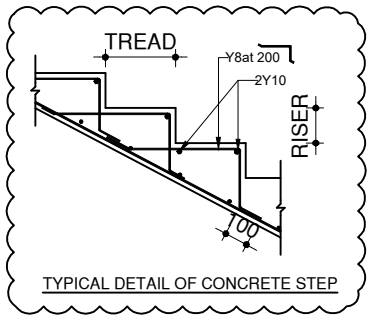


SECTION C–C



GROUND FLOOR PART PLAN

FIRST FLOOR PART PLAN



TYPICAL DETAIL OF CONCRETE STEP

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:
Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting
Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:
Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV:	DESCRIPTION:	BY:	DATE:

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

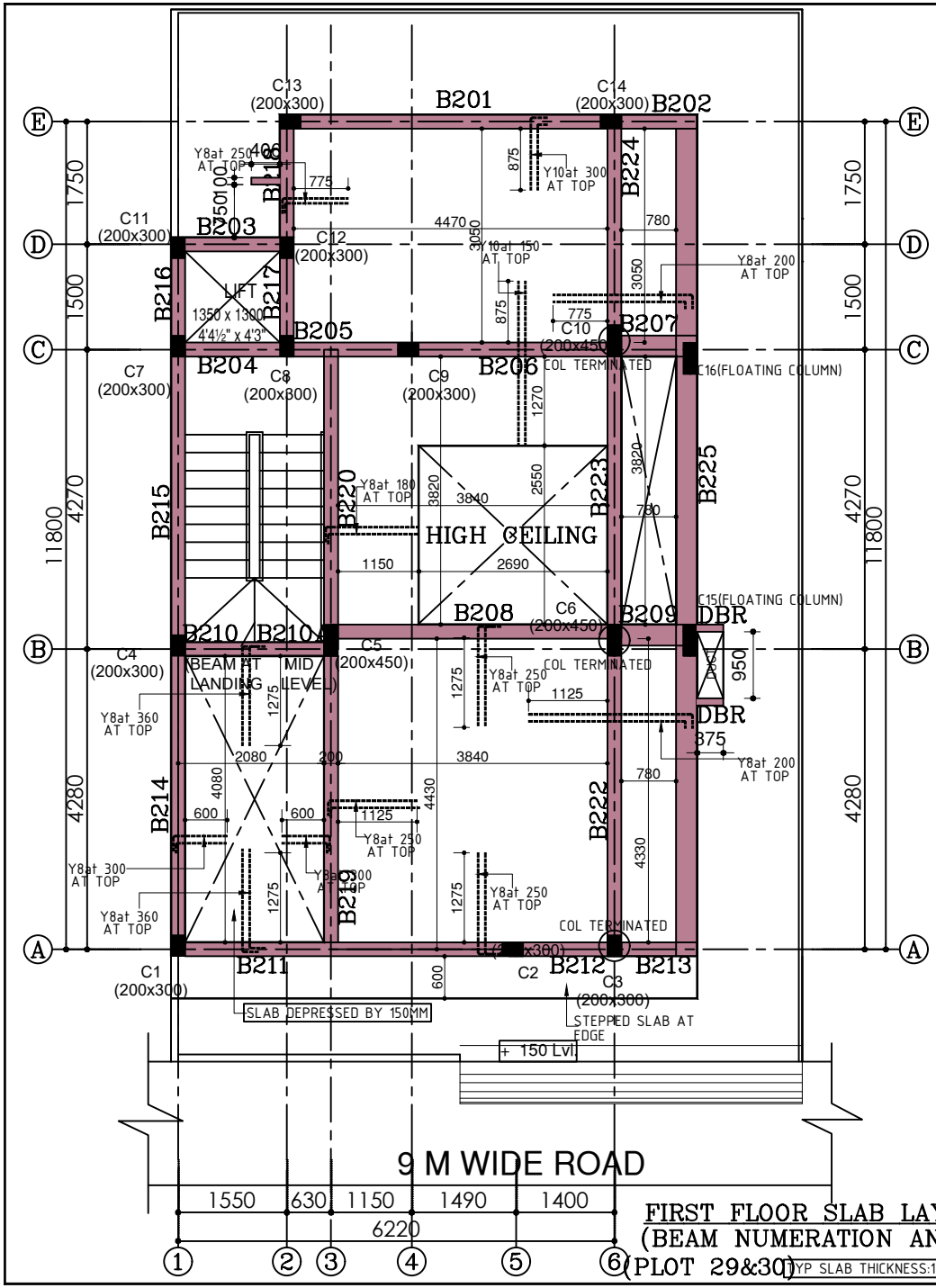
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL),M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

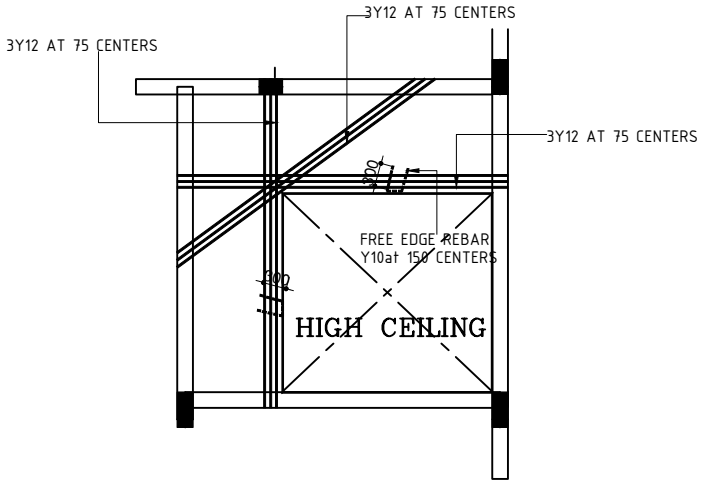
TITLE: FIRST FLOOR SLAB LAYOUT (PLOT 29&30)

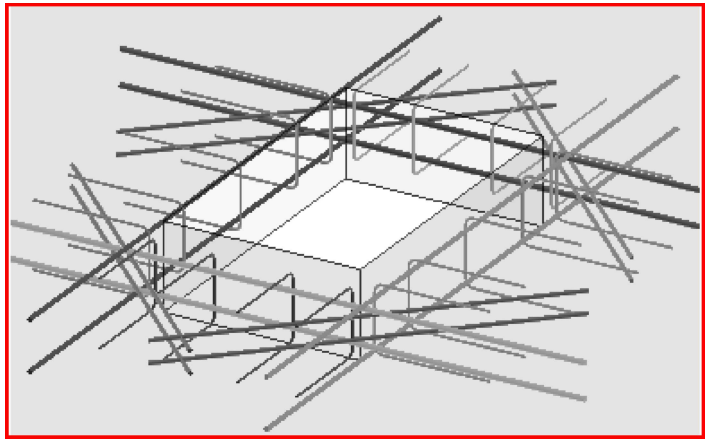
SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
5/5	S&P-ENC-SD-03	R3



FIRST FLOOR SLAB LAYOUT
(BEAM NUMERATION AND TOP REBAR LAYOUT)
(PLOT 29&30)





HIGH CEILING SLAB REBAR DETAILS

Notes:

ARCHITECTURE CONSULTANT:
Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:
Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

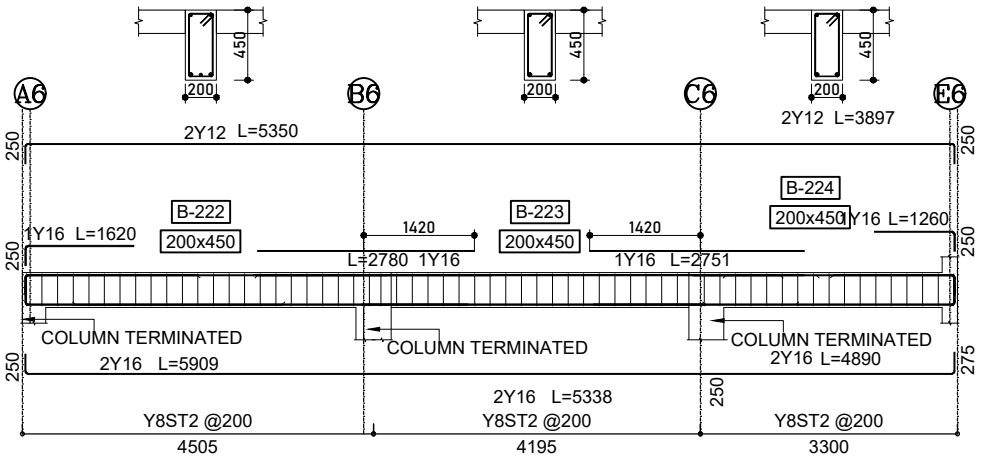
SITE: 'VILLA ENCHNATE' AYANAMBAKKAM,CHENNAI

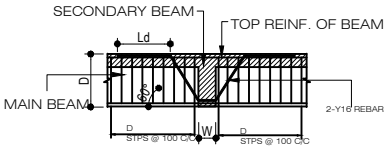
TITLE: FIRST FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

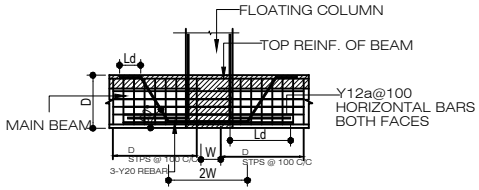
SHEET NO:	DRAWING NO:	REVISION:
2/5	S&P-ENC-SD-03	R3

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

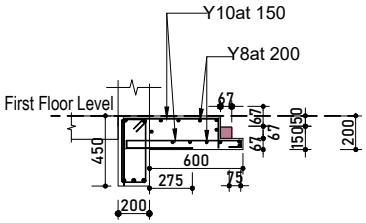




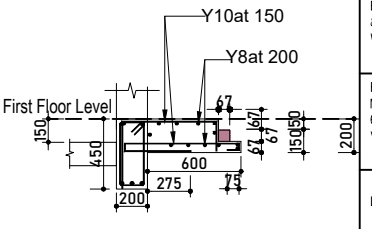
DETAIL AT THE JUNCTION OF MAIN BEAM
SECONDARY BEAM



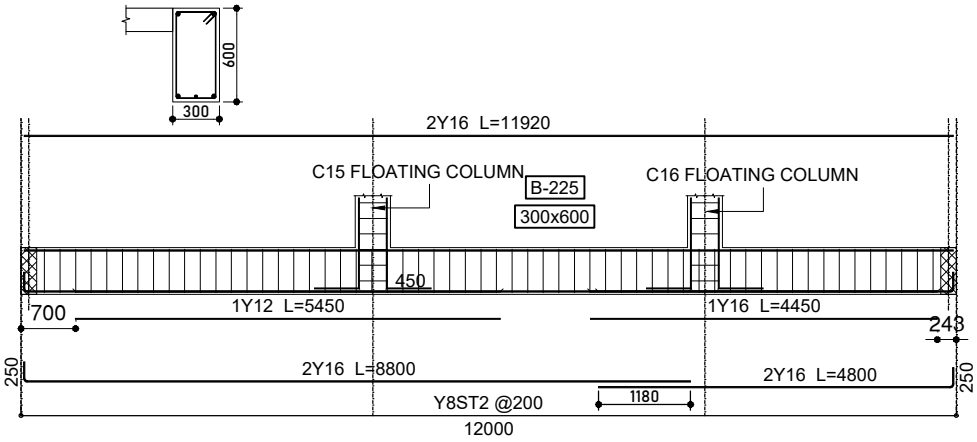
DETAIL AT THE JUNCTION OF MAIN BEAM
AND FLOATING COLUMN

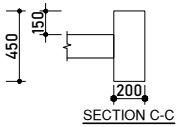


SECTION A-A

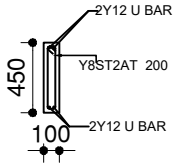


SECTION B-B

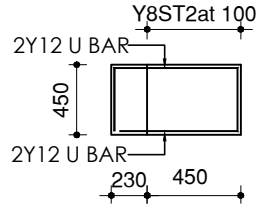




SECTION C-C



CS OF DUCT BRACKET DBR



LS OF DUCT BRACKET DBR
(100x450)

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:
Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting
Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:
Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV:	DESCRIPTION:	BY:	DATE:

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

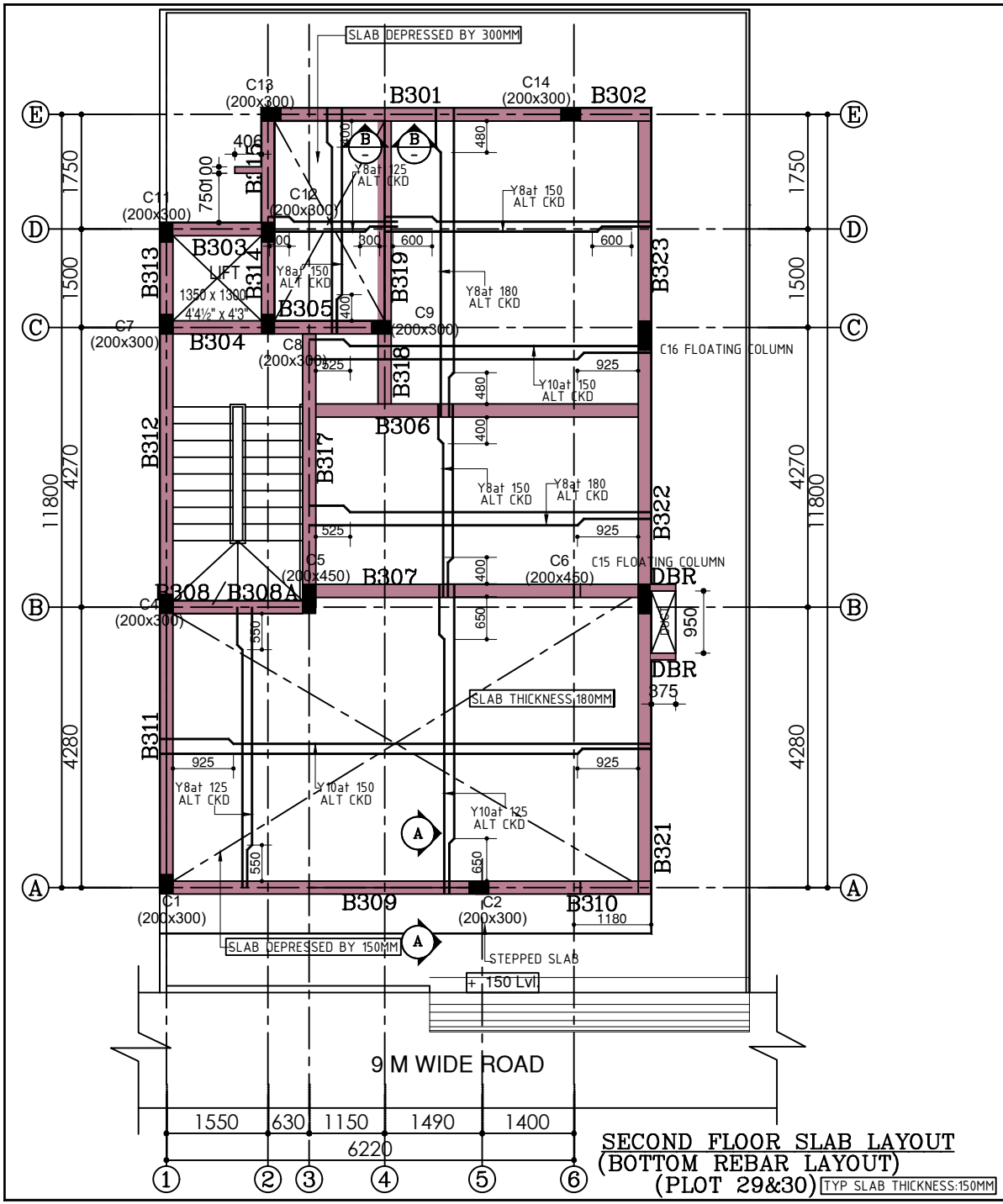
STRUCTURAL ENGINEER: M.S.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

TITLE: FIRST FLOOR SLAB LAYOUT (PLOT :29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
4/5	S&P-ENC-SD-03	R3



SECOND FLOOR SLAB LAYOUT (BOTTOM REBAR LAYOUT) (PLOT 29&30)

TYP SLAB THICKNESS:150MM

Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

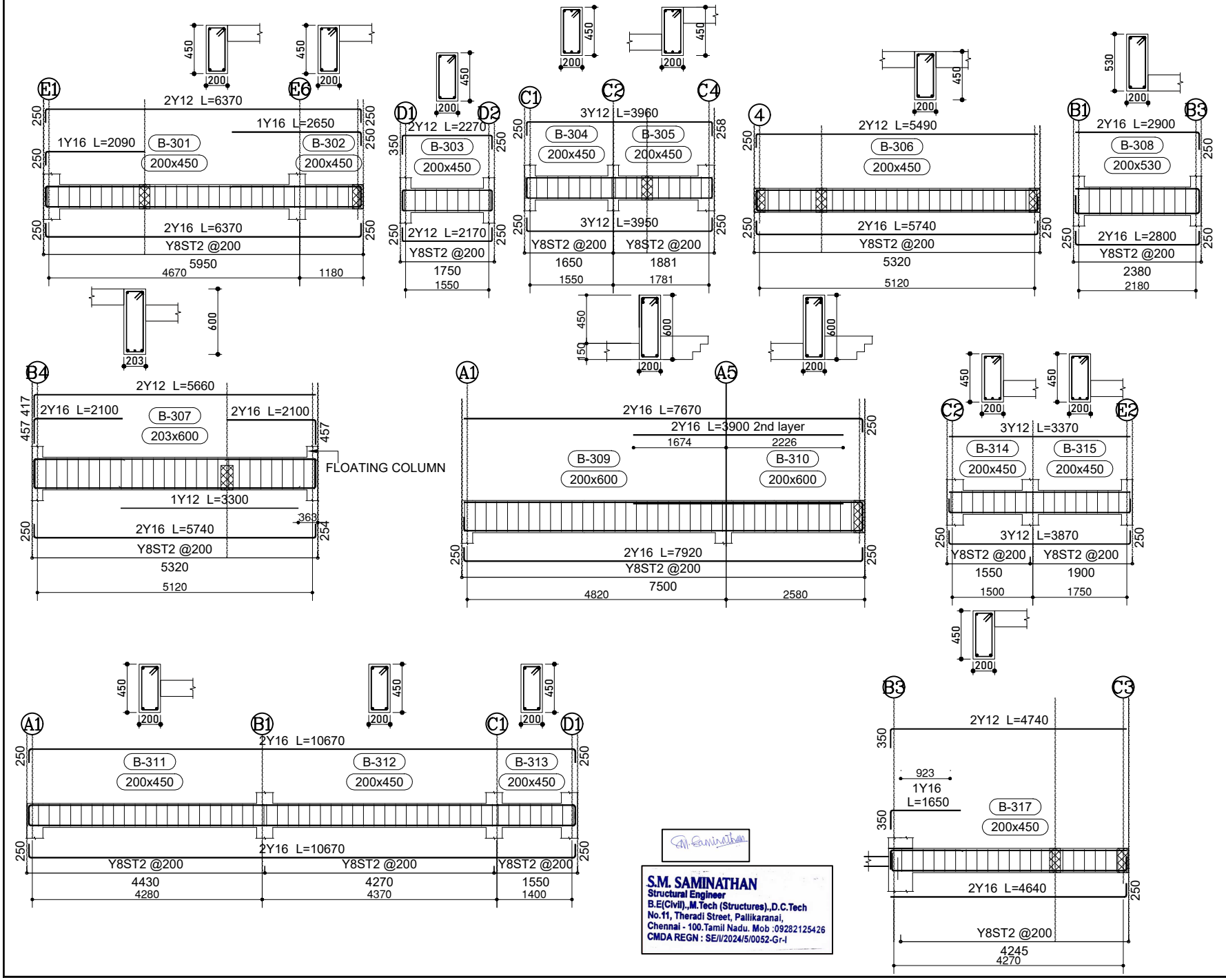
S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

TITLE: SECOND FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
1/5	S&P-ENC-SD-03	R3



S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:
Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:
Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV:	DESCRIPTION:	BY:	DATE:

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

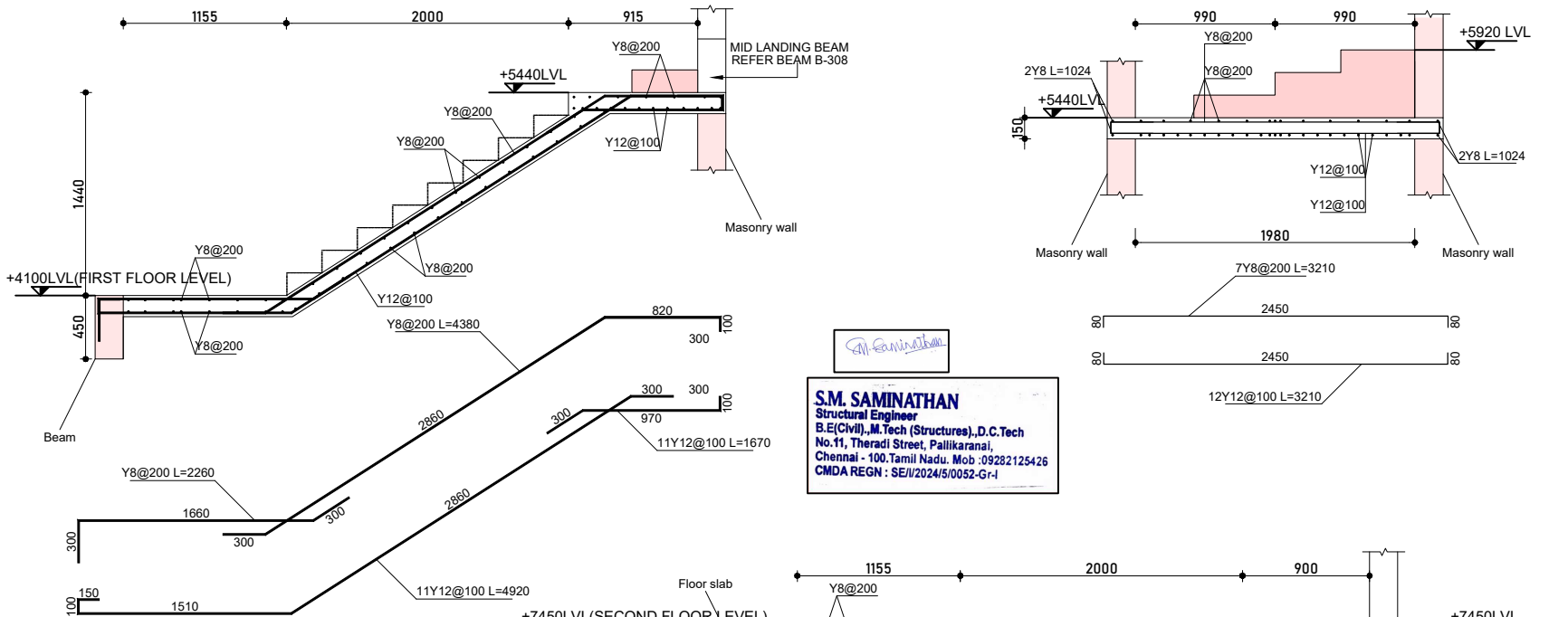
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

TITLE: SECOND FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
3/5	S&P-ENC-SD-03	R3



Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :

S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV:	DESCRIPTION:	BY:	DATE:

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

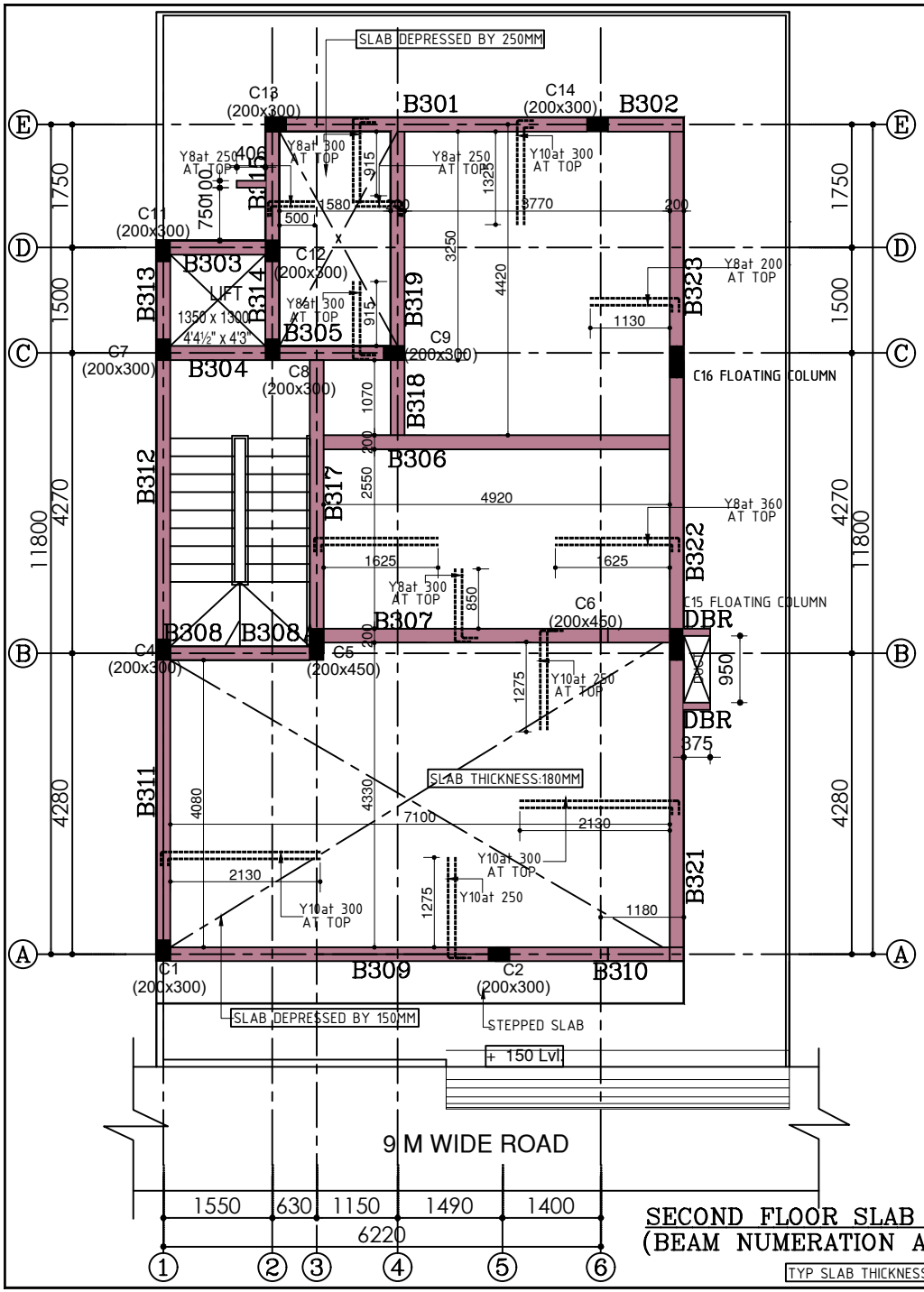
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

TITLE: SECOND FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
5/5	S&P-ENC-SD-03	R3



SECOND FLOOR SLAB LAYOUT
(BEAM NUMERATION AND TOP REBAR LAYOUT)

TYP SLAB THICKNESS:150MM UNO

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

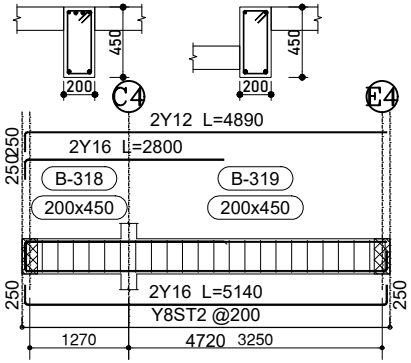
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

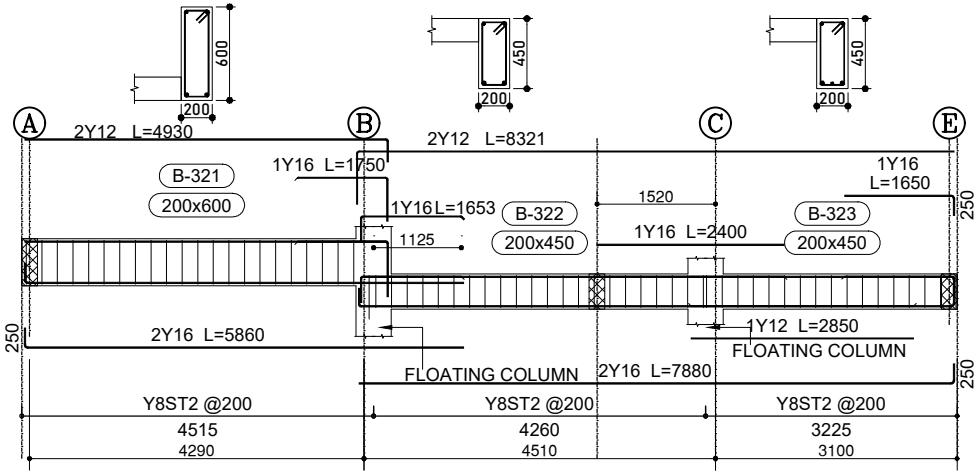
SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

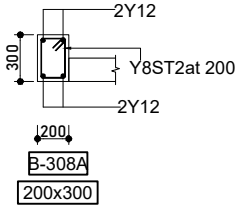
TITLE: SECOND FLOOR SLAB LAYOUT (PLOT 29&30)

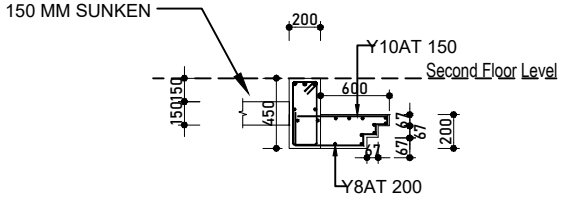
SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
2/5	S&P-ENC-SD-03	R3



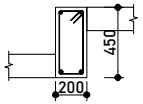




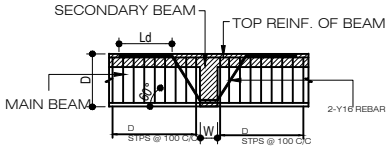


SECTION A–A

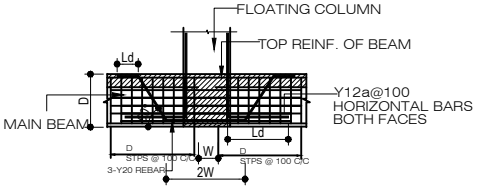
TYPICAL STEPPED SLAB DETAILS (ELEVATION FEATURE)



SECTION B–B



DETAIL AT THE JUNCTION OF MAIN BEAM SECONDARY BEAM



DETAIL AT THE JUNCTION OF MAIN BEAM AND FLOATING COLUMN

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

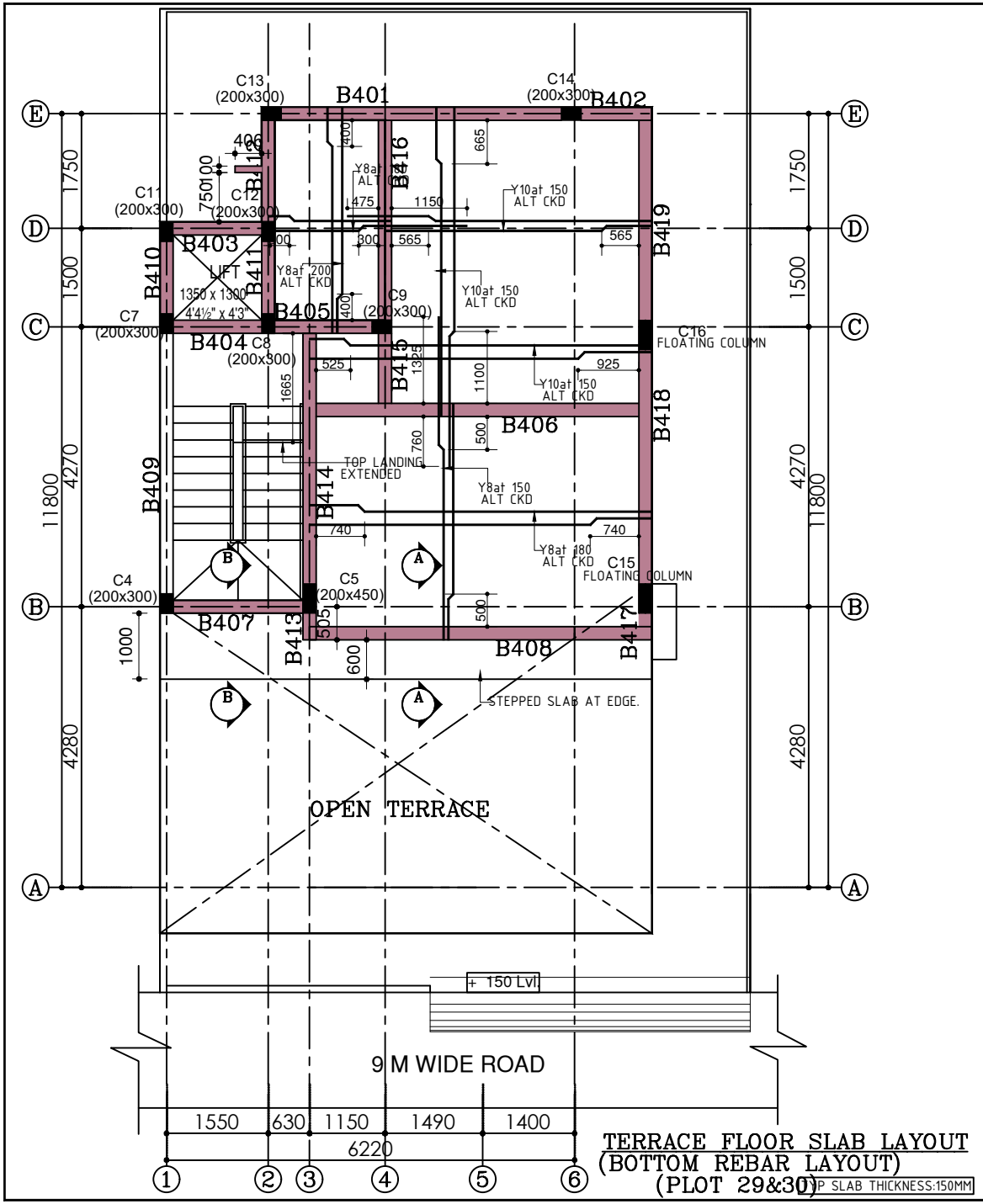
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

TITLE: SECOND FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
4/5	S&P-ENC-SD-03	R3



TERRACE FLOOR SLAB LAYOUT
(BOTTOM REBAR LAYOUT)
(PLOT 29&30)

SLAB THICKNESS:150MM

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE//2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor, Mahalakshmi Street, Tambaram East, Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :

S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

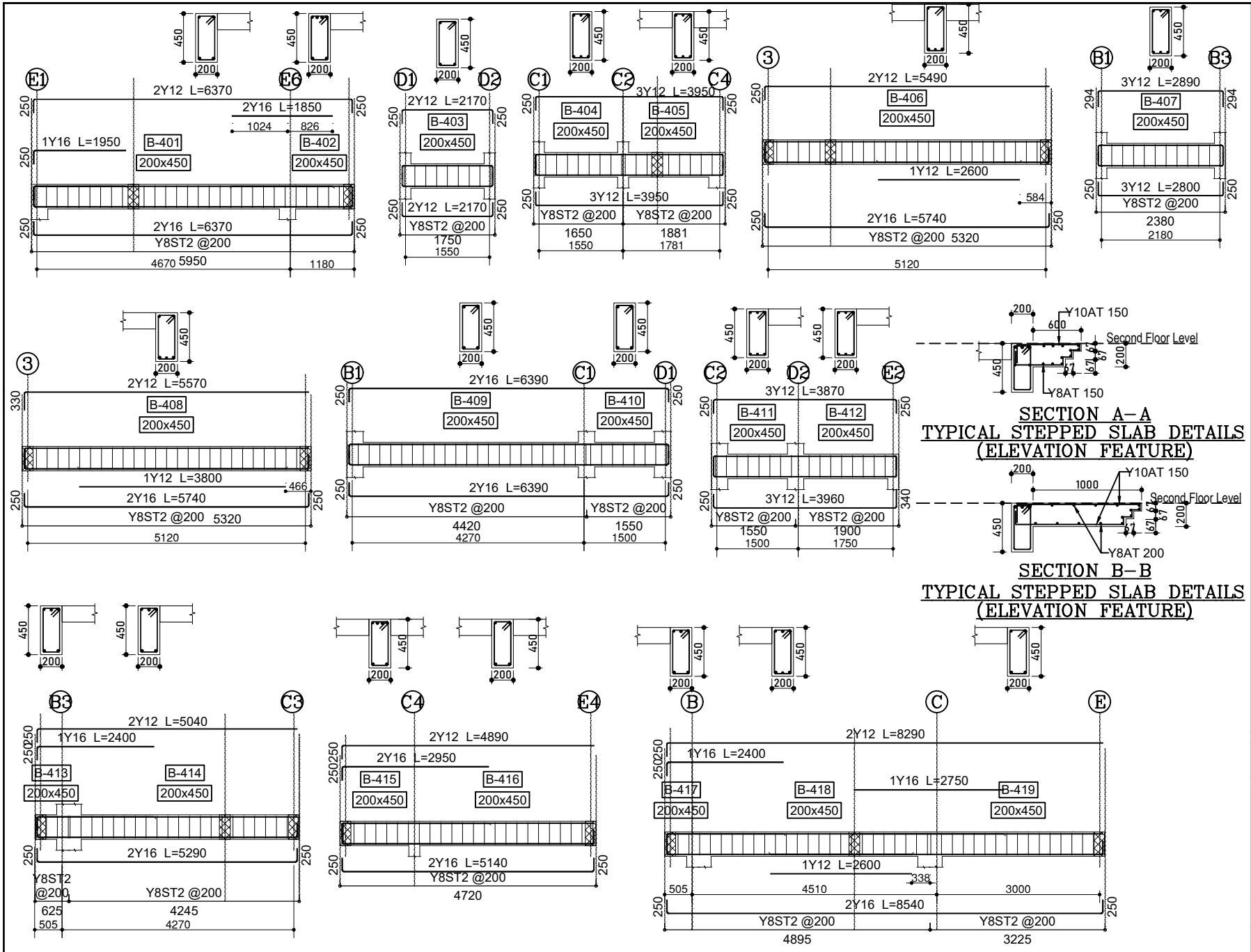
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

TITLE: TERRACE FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
1/4	S&P-ENC-SD-05	R3



Notes:

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

ARCHITECTURE CONSULTANT:
Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting
Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:
Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

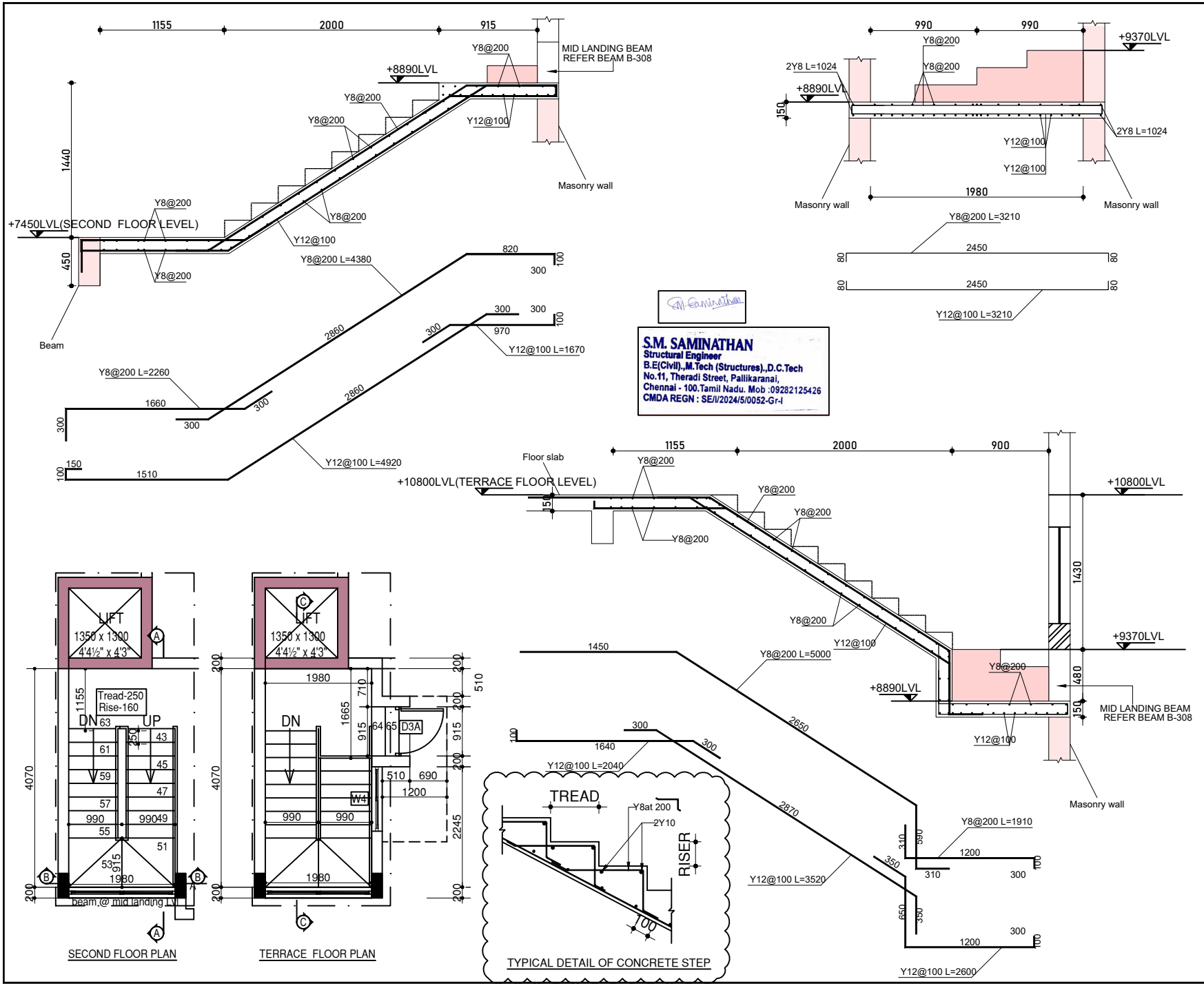
STRUCTURAL ENGINEER: M.S.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

TITLE: TERRACE FLOOR SLAB LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
3/4	S&P-ENC-SD-05	R3



Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting
Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_ associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :

S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

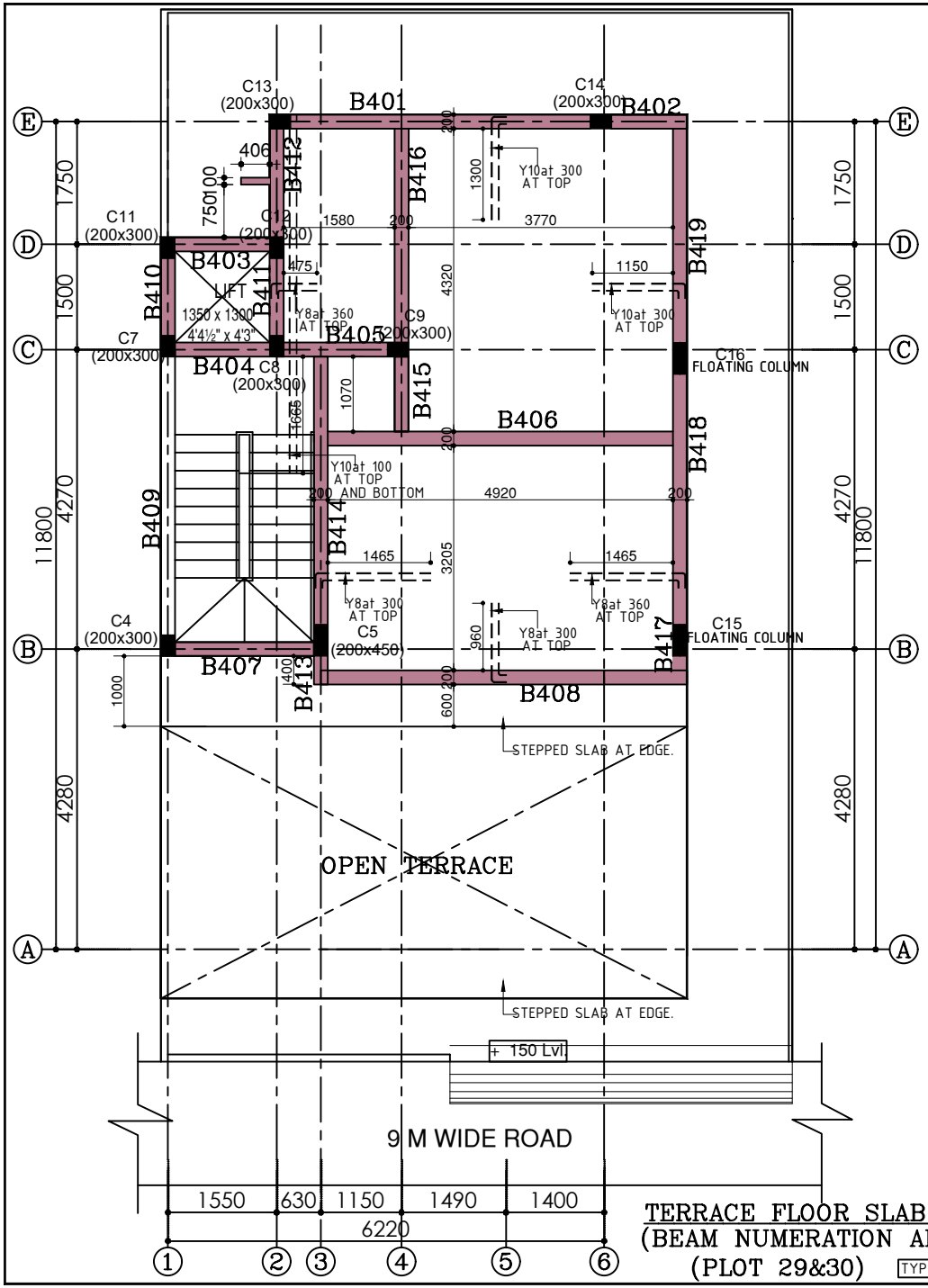
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL),M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

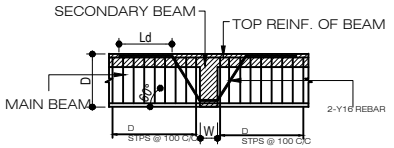
SITE: 'VILLA ENCHANTE'
AYANAMBAKKAM,CHENNAI

TITLE: TERRACE FLOOR SLAB LAYOUT (PLOT 29&30)

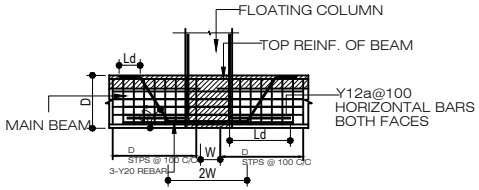
SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
4/4	S&P-ENC-SD-03	R3





DETAIL AT THE JUNCTION OF MAIN BEAM SECONDARY BEAM



DETAIL AT THE JUNCTION OF MAIN BEAM AND FLOATING COLUMN

TERRACE FLOOR SLAB LAYOUT
(BEAM NUMERATION AND TOP REBAR LAYOUT)
(PLOT 29&30)

TYP SLAB THICKNESS:150MM

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:
Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:
Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :
S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV:	DESCRIPTION:	BY:	DATE:

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

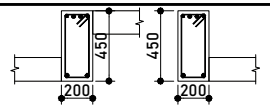
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

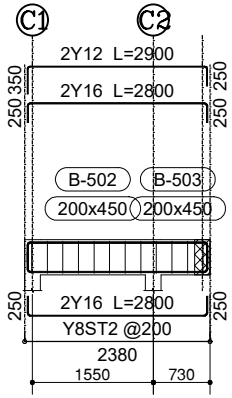
SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

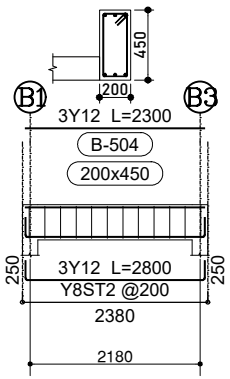
TITLE: TERRACE FLOOR SLAB LAYOUT (PLOT 29&30)

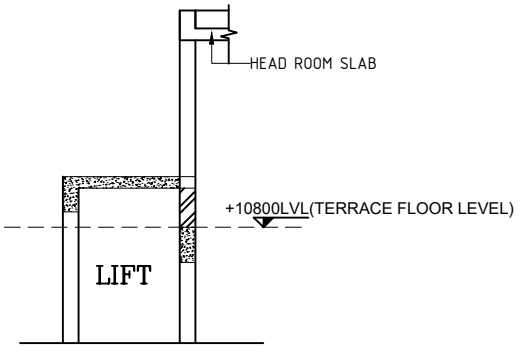
SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

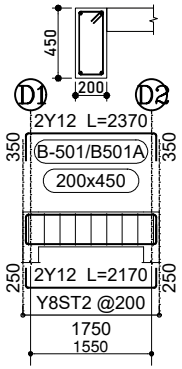
SHEET NO:	DRAWING NO:	REVISION:
2/4	S&P-ENC-SD-05	R3

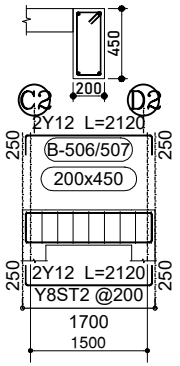


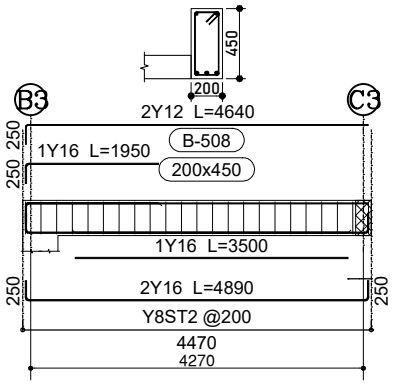


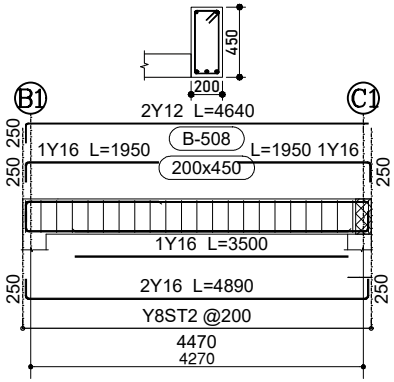


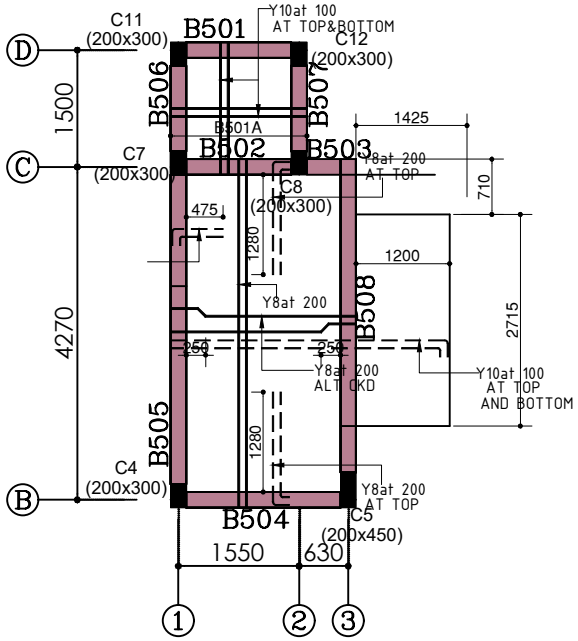












TERRACE FLOOR SLAB LAYOUT

TYP SLAB THICKNESS:150MM

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

Notes:

ARCHITECTURE CONSULTANT:

Anbu & Faizal
Architects and Interior Designers
OFF-3 , II Floor "Amar Sindur",
43, Pantheon road,
Egmore, Chennai- 600 008
Phone - 044 - 2855 4262 , 044 - 2841 0888.
E-mail :- anbu.faizal@gmail.com
Web :- anbuandfaizal.com

PLUMBING CONSULTANT:
Balu & Associates
Public Health Engineers & Fire Fighting Consultants,No. 10/05, 2nd floor,
Mahalakshmi Street, Tambaram East,
Chennai - 600 059. Telephone No : 044 - 43586409, 22392178
E.mail : engineering@balunassociates.com
&balu_associates@yahoo.co.in
Website : www.balunassociates.com

ELECTRICAL CONSULTANT:
Madras Electrical Consultants
6, Park avenue second cross street,
Velachery, Chennai - 600 042

LANDSCAPE CONSULTANT:

Genius Loci
93, Harrington road, Chetpet
Chennai - 600 031

CLIENT :

S&P Foundation Private Limited
No.36 , 2nd Floor, Sudhama Commercial Building,
Vijayaraghava Road, T. Nagar Chennai - 600017.
https://www.sandp.co.in/

REV	DESCRIPTION:	BY	DATE

STATUS: CONSTRUCTION ISSUE

CLIENT: S&P FOUNDATIONS,CHENNAI

ARCHITECT: ANBU AND FAIZAL, EGMORE,CHENNAI

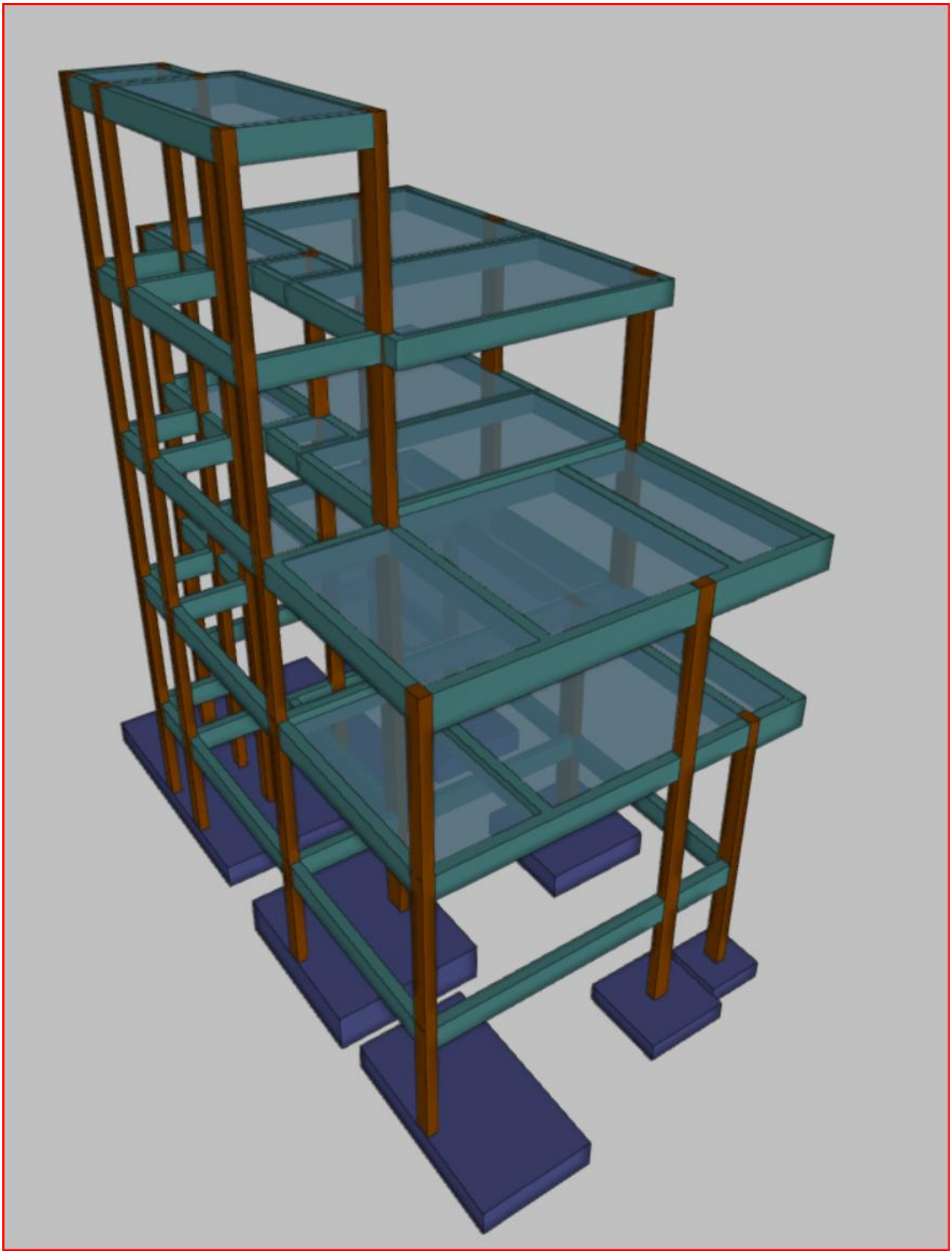
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

SITE: 'VILLA ENCHANTE'
AYANAMBAKKAM,CHENNAI

TITLE: HEAD ROOM/LMR LAYOUT (PLOT 29&30)

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:50, 1:100	17/10/2025	MV	SMS

SHEET NO:	DRAWING NO:	REVISION:
1/1	S&P-ENC-SD-06	R3



ANALYTICAL MODEL OF THE BUILDING

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

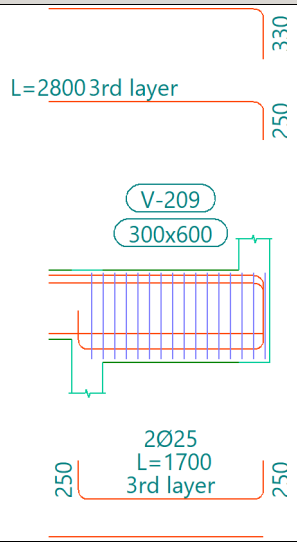
INDEX

1. DESCRIPTION	2
2. SUMMARY OF CODE CHECKS	2
3. RESISTANCE CHECKS	3
4. CODE CHECK FOR CRACKING	20
5. DEFLECTION CHECKS	23

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

1. DESCRIPTION

Beam data



Geometry	
Dimensions	: 300x600
Free span	: 0.9 m
Top clear cover	: 2.0 cm
Bottom clear cover	: 2.0 cm
Lateral clear cover	: 2.0 cm

Materials	
Concrete	: M 25
Longitudinal reinf.	: Fe 500
Transverse reinf.	: Fe 500

2. SUMMARY OF CODE CHECKS

Span	RESISTANCE CHECKS (IS 456:2000)													Status
	Lyt.	Reinf.	Q	N,M	T_c	T_{st}	TNM_x	TV_x	TV_y	TV_{xSt}	TV_{ySt}	$T,Lyt._{st}$	$T,Reinf._{st}$	
V-209: C6 - C15	Verified	Verified	'C6' η = 82.7	'C6' η = 79.6	D.N.P.(1)	D.N.P.(1)	D.N.P.(2)	D.N.P.(1)	D.N.P.(1)	D.N.P.(1)	D.N.P.(1)	D.N.P.(1)	D.N.P.(1)	**VERIFIED η = 82.7**

Notes:
Lyt.: Reinforcement arrangement
Reinf.: Minimum and maximum reinforcement
Q: Ultimate limit state for shear (non-seismic combinations)
N,M: Ultimate limit state under normal stresses (non-seismic combinations)
T_c: Ultimate limit state for torsion. Oblique compression.
T_{st}: Ultimate limit state for torsion. Tension in the web.
TNM_x: Ultimate limit state for torsion. Interaction between torsion and normal forces. Moment about the X-axis.
TV_x: Ultimate limit state for torsion. Interaction between torsion and shear in the X-axis. Oblique compression
TV_y: Ultimate limit state for torsion. Interaction between torsion and shear in the Y-axis. Oblique compression
TV_{xSt}: Ultimate limit state for torsion. Interaction between torsion and shear in the X-axis. Tension in the web.
TV_{ySt}: Ultimate limit state for torsion. Interaction between torsion and shear in the Y-axis. Tension in the web.
$T,Lyt._{st}$: Ultimate limit state for torsion. Spacing of the transverse reinforcement bars.
$T,Reinf._{st}$: Ultimate limit state for torsion. Minimum closed stirrup ratio.
x: Distance to the origin of the bar
η: Demand capacity ratio (%)
D.N.P.: Not applicable

Checks that do not proceed (D.N.P.):
(1) The ultimate limit state for torsion check does not proceed, because there is no torsional moment.
(2) The check does not proceed, as there is no interaction between torsional forces and normal forces.

Span	CHECK FOR CRACKING (IS 456:2000)				Status
	σ_{st}	$W_{cr,F,top}$	$W_{cr,F,Rgt.side}$	$W_{cr,F,Lft.side}$	
V-209: C6 - C15	x: 0 m Verified	x: 0 m Verified	D.N.P.(1)	D.N.P.(1)	**VERIFIED**

Notes:
σ_{st}: Maximum tensile stress of the bars
$W_{cr,F,top}$: Calculation of crack width: Top face
$W_{cr,F,Rgt.side}$: Calculation of crack width: Right side face
$W_{cr,F,Lft.side}$: Calculation of crack width: Left side face
x: Distance to the origin of the bar
η: Demand capacity ratio (%)
D.N.P.: Not applicable

Checks that do not proceed (D.N.P.):
(1) The check does not proceed, as there is no stressed reinforcement.

Beam	**Long term (Characteristic)** $f_{T,max} \leq f_{T,lim}$ $f_{T,lim}$= L/250	**Active (Characteristic)** $f_{A,max} \leq f_{A,lim}$ $f_{A,lim}$= Min.(20.00, L/350)	Status
V-209: C6 - C15	$f_{T,max}$: 0.11 mm $f_{T,lim}$: 3.52 mm	$f_{A,max}$: 0.13 mm $f_{A,lim}$: 2.51 mm	**VERIFIED**

3. RESISTANCE CHECKS

V-209: C6 - C15 (C6 - C15, Top reinf.)

Reinforcement arrangement (IS 456:2000, Articles 26.3.3.a, 26.3.2 and 26.5.3.2)

Longitudinal reinf.

26.3.2.a. The horizontal distance between two parallel main reinforcing bars shall usually be not less than the greatest of the following: the diameter of the bar if the diameters are equal, the diameter of the larger bar if the diameters are unequal, and 5 mm more than the nominal maximum size of coarse aggregate.

81 mm ≥ **25 mm** ✓

26.3.2.c. Where there are two or more rows of bars, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm, two-thirds the nominal maximum size of aggregate or the maximum size of bars, whichever is greater.

50 mm ≥ **25 mm** ✓

Stirrups

26.3.2.a. The horizontal distance between two parallel main reinforcing bars shall usually be not less than the greatest of the following: the diameter of the bar if the diameters are equal, the diameter of the larger bar if the diameters are unequal, and 5 mm more than the nominal maximum size of coarse aggregate.

75 mm ≥ **25 mm** ✓

Minimum and maximum reinforcement (IS 456:2000, Articles 26.5.1.1.a, 26.5.1.1.b and 26.5.1.2)

Negative bending about the x-axis:

The minimum area of tension reinforcement shall be not less than $A_{st,min}$ (Article 26.5.1.1.a):

29.45 cm² ≥ **2.64 cm²** ✓

Where:

$A_{st,min}$: *2.64* cm²

Where:

f_y: Steel yield strength. **f_y** : *500.00* MPa

b: Minimum net width of the element. **b** : *300* mm

d: Effective depth of the section. **d** : *518* mm

Negative bending about the x-axis:

The maximum area of tension reinforcement shall not exceed $A_{st,max}$ (Article 26.5.1.1.b):

29.45 cm² ≤ 72.00 cm² ✓

The maximum area of compression reinforcement shall not exceed $A_{sc,max}$ (Article 26.5.1.2):

9.82 cm² ≤ 72.00 cm² ✓

Where:

$A_{s,max}$: *72.00* cm²

Where:

b: Minimum net width of the element. **b** : *300* mm

D: Height of the section. **D** : *600* mm

Ultimate limit state for shear (non-seismic combinations) (IS 456:2000, Articles 40.2.1, 40.2.2 and 40.4)

The following criteria must be satisfied:

η : ***0.827*** ✓

Where:

$V_{Ed,y}$: Design effective shear force. **$V_{Ed,y}$** : *398.25* kN

$V_{u,y}$: Ultimate shear resistance due to oblique compression of the web. **$V_{u,y}$** : *481.74* kN

The worst case forces to be withstood from the analysis are produced at 'C6', in the combination of loadcase "1.5·SW+1.5·DL+1.5·Qa".

Ultimate shear resistance due to oblique compression of the web.

Shear failure due to oblique compression of the web is deduced using the following expression:

Shear in the Y-direction:

Under no circumstances, even with shear reinforcement, shall the nominal shear force exceed (Article 40.2.3):

$V_{u,lim}$: *481.74* kN

([MPa] f_{ck})

Where:

$V_{u,lim}$: Nominal shear strength	**$V_{u,lim}$** : *481.74* kN
b: Width of the section.	**b** : *300* mm
d: Effective depth of the section in mm in reference to the longitudinal reinforcement for bending.	**d** : *518* mm
f_{ck}: Characteristic cube compressive strength of concrete.	**f_{ck}** : *25.00* MPa

Ultimate limit state under normal stresses (non-seismic combinations) (IS 456:2000, Articles 25.4, 25.1.2, 39.7 and 38)

The worst case forces to be withstood from the analysis are produced at 'C6', in the combination of loadcase "Minimum bending moment envelope for persistent or transitory situations".

The following criteria must be satisfied:

η : ***0.796*** ✓

Resistance check of the section (η_1)

N_{Ed},M_{Ed} are the first order design forces, including, the minimum eccentricity in accordance with 25.4:

N_{Ed}: Design normal force.	**N_{Ed}** : *0.00* kN
M_{Ed}: First order design moment.	**$M_{Ed,x}$** : *-337.56* kN·m
	$M_{Ed,y}$: *0.00* kN·m

N_{Rd},M_{Rd} are the forces that cause the section to fail with the same eccentricities as the worst-case design forces.

N_{Rd}: Ultimate axial resistance.	**N_{Rd}** : *0.00* kN
M_{Rd}: Bending resistance.	**$M_{Rd,x}$** : *-424.11* kN·m
	$M_{Rd,y}$: *0.00* kN·m

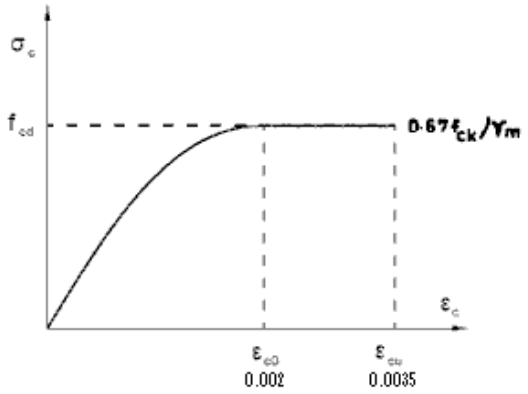
Resistance capacity calculation

The calculation of the ultimate resistance capacity of the sections is carried out using the following general hypothesis (Article 38.1):

(a) Concrete deformations follow a planar law.

(b) The maximum strain in concrete at the outermost compression fibre is taken as 0.0035 in bending.

(c) The concrete stress-deformation calculation diagram is of the parabola-rectangle type. The tensile resistance of the concrete is not considered.



ε_{cu}: The maximum strain in concrete at the outermost compression fibre. ε_{cu} : *0.0035*

ε_{c0}: The strain in concrete due to simple compression. ε_{c0} : *0.0020*

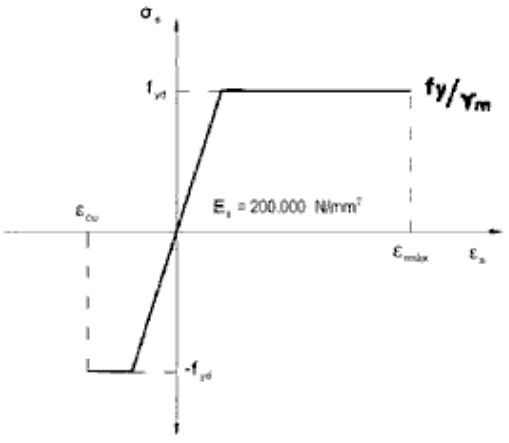
f_{cd}: Design compressive strength of concrete. f_{cd} : *11.17* MPa

Where:

f_{ck}: Characteristic cube compressive strength of concrete. f_{ck} : *25.00* MPa

γ_m: Partial safety factor for concrete. γ_m : *1.50*

(d) The stresses in the reinforcing steel are derived from the design curve in: (Article 38.1)



ε_{max}: The maximum strain in the tension reinforcement in the section at failure. ε_{max} : *0.0042*

Where:

f_y: Steel yield strength. f_y : *500.00* MPa

E_s: Steel elastic modulus. E_s : *200000.00* MPa

ε_{cu}: The maximum strain in concrete at the outermost compression fibre. ε_{cu} : *0.0035*

f_{yd}: Steel design resistance. f_{yd} : *434.78* MPa

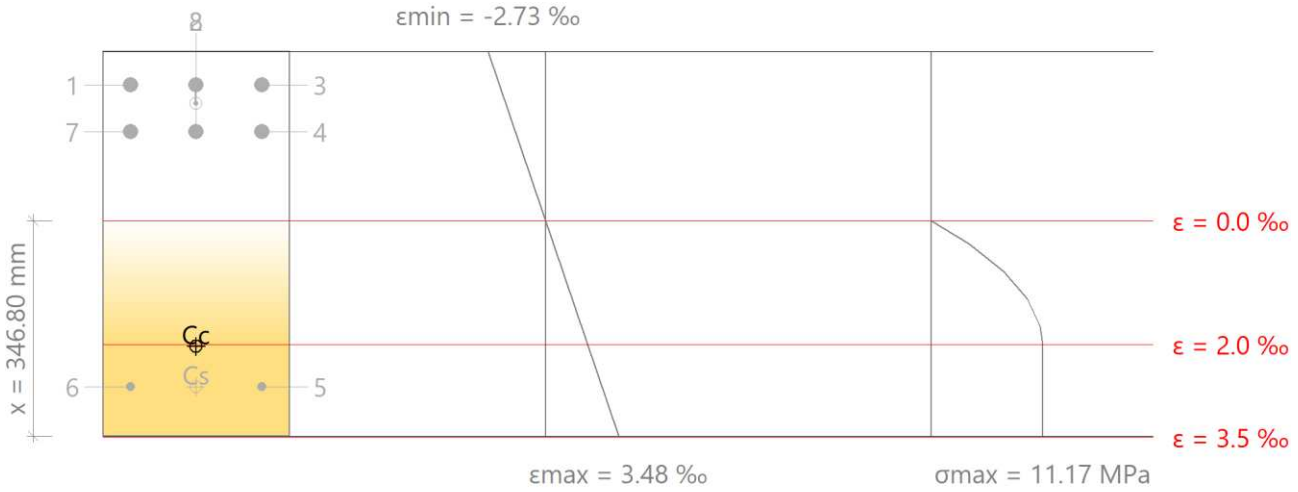
Where:

f_y: Steel yield strength. f_y : *500.00* MPa

γ_m: Partial safety factor for reinforcing steel. γ_m : *1.15*

(e) The general force equilibrium and moment equations are applied to the resulting stress forces of the section.

Ultimate force balance of the section, calculated with the same eccentricities as the worst-case design forces:



Bar	Designation	X Coord. (mm)	Y Coord. (mm)	f_s (MPa)	ε
1	Ø25	-105.50	255.50	-434.78	-0.002191
2	Ø25	0.00	255.50	-434.78	-0.002191
3	Ø25	105.50	255.50	-434.78	-0.002191
4	Ø25	105.50	180.50	-287.64	-0.001438
5	Ø25	105.50	-230.50	+434.78	+0.002689
6	Ø25	-105.50	-230.50	+434.78	+0.002689
7	Ø25	-105.50	180.50	-287.64	-0.001438
8	Ø25	0.00	180.50	-287.64	-0.001438

	Resultant (kN)	e.x (mm)	e.y (mm)
Cc	939.39	0.00	-165.39
Cs	124.48	0.00	-230.50
T	1063.87	0.00	225.64

N_{Rd} : *0.00* kN

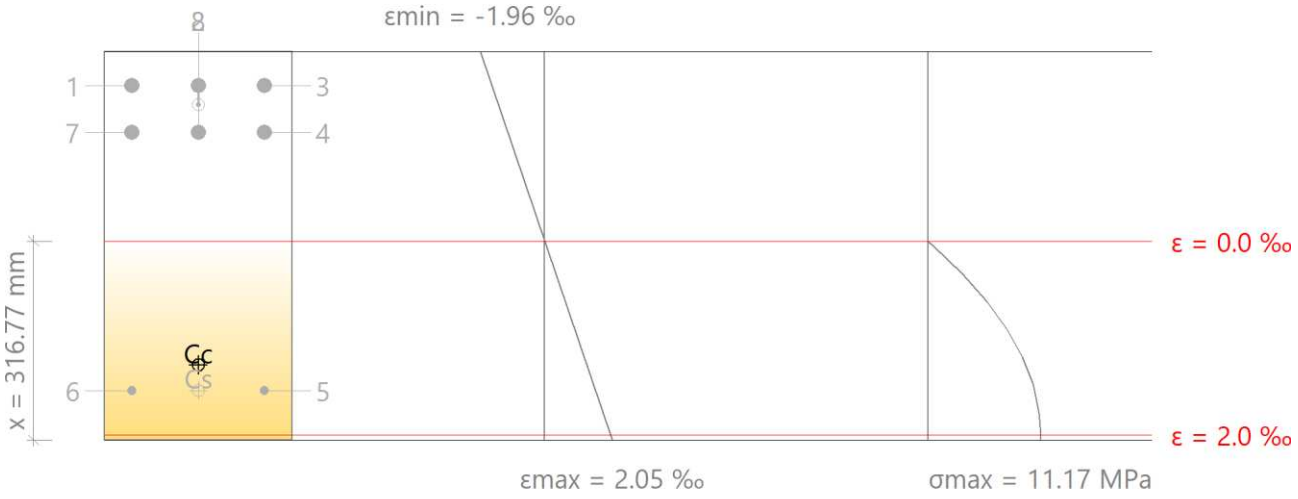
$M_{Rd,x}$: *-424.11* kN·m

$M_{Rd,y}$: *0.00* kN·m

Where:

C_c: Resultant of concrete compressive forces.	C_c : *939.39*	kN
C_s: Resultant of steel compressive forces.	C_s : *124.48*	kN
T: Resultant of steel tensile forces.	T : *1063.87*	kN
e_{cc}: Eccentricity of the concrete compressive forces in the direction of the X and Y axes.	$e_{cc,x}$: *0.00*	mm
	$e_{cc,y}$: *-165.39*	mm
e_{cs}: Eccentricity of the steel compressive forces in the direction of the X and Y axes.	$e_{cs,x}$: *0.00*	mm
	$e_{cs,y}$: *-230.50*	mm
e_T: Eccentricity of the steel tensile forces in the direction of the X and Y axes.	$e_{T,x}$: *0.00*	mm
	$e_{T,y}$: *225.64*	mm
ε_{cmax}: Deformation of the most compressed concrete fibre.	ε_{cmax} : *0.0035*	
ε_{smax}: Deformation of the steel bar with greatest tension.	ε_{smax} : *0.0022*	
σ_{cmax}: Stress of the most compressed concrete fibre.	σ_{cmax} : *11.17*	MPa
σ_{smax}: Stress of the steel bar with greatest tension.	σ_{smax} : *434.78*	MPa

Worst-case force balance of the section:



Bar	Designation	X Coord. (mm)	Y Coord. (mm)	f_s (MPa)	ε
1	Ø25	-105.50	255.50	-321.99	-0.001610
2	Ø25	0.00	255.50	-321.99	-0.001610
3	Ø25	105.50	255.50	-321.99	-0.001610
4	Ø25	105.50	180.50	-224.71	-0.001124
5	Ø25	105.50	-230.50	+308.37	+0.001542
6	Ø25	-105.50	-230.50	+308.37	+0.001542
7	Ø25	-105.50	180.50	-224.71	-0.001124
8	Ø25	0.00	180.50	-224.71	-0.001124

	Resultant (kN)	e.x (mm)	e.y (mm)
Cc	716.81	0.00	-190.19
Cs	88.28	0.00	-230.50
T	805.09	0.00	224.67

N_{Ed} : *0.00* kN

$M_{Ed,x}$: *-337.56* kN·m

$M_{Ed,y}$: *0.00* kN·m

Where:

- **C_c**: Resultant of concrete compressive forces. — C_c : *716.81* kN
- **C_s**: Resultant of steel compressive forces. — C_s : *88.28* kN
- **T**: Resultant of steel tensile forces. — **T** : *805.09* kN
- **e_{cc}**: Eccentricity of the concrete compressive forces in the direction of the X and Y axes. — $e_{cc,x}$: *0.00* mm; $e_{cc,y}$: *-190.19* mm
- **e_{cs}**: Eccentricity of the steel compressive forces in the direction of the X and Y axes. — $e_{cs,x}$: *0.00* mm; $e_{cs,y}$: *-230.50* mm
- **e_T**: Eccentricity of the steel tensile forces in the direction of the X and Y axes. — $e_{T,x}$: *0.00* mm; $e_{T,y}$: *224.67* mm
- ε_{cmax}: Deformation of the most compressed concrete fibre. — ε_{cmax} : *0.0021*
- ε_{smax}: Deformation of the steel bar with greatest tension. — ε_{smax} : *0.0016*
- σ_{cmax}: Stress of the most compressed concrete fibre. — σ_{cmax} : *11.17* MPa
- σ_{smax}: Stress of the steel bar with greatest tension. — σ_{smax} : *321.99* MPa

Ultimate limit state for torsion. Oblique compression. (IS 456:2000, Article 41.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Tension in the web. (IS 456:2000, Article 41.4.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Interaction between torsion and normal forces. Moment about the X-axis. (IS 456:2000, Article 41.4.2)

The check does not proceed, as there is no interaction between torsional forces and normal forces.

Ultimate limit state for torsion. Interaction between torsion and shear in the X-axis. Oblique compression (IS 456:2000, Article 41.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Interaction between torsion and shear in the Y-axis. Oblique compression (IS 456:2000, Article 41.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Interaction between torsion and shear in the X-axis. Tension in the web. (IS 456:2000, Article 41.4.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Interaction between torsion and shear in the Y-axis. Tension in the web. (IS 456:2000, Article 41.4.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Spacing of the transverse reinforcement bars. (IS 456:2000, Article 26.5.1.7)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Minimum closed stirrup ratio. (IS 456:2000, Articles 41.3.2 and 41.3.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

V-209: C6 - C15 (0.312 m - C15, Bot. reinf.)

Reinforcement arrangement (IS 456:2000, Articles 26.3.3.a, 26.3.2 and 26.5.3.2)

Longitudinal reinf.

26.3.2.a. The horizontal distance between two parallel main reinforcing bars shall usually be not less than the greatest of the following: the diameter of the bar if the diameters are equal, the diameter of the larger bar if the diameters are unequal, and 5 mm more than the nominal maximum size of coarse aggregate.

81 mm ≥ **25 mm** ✓

26.3.2.c. Where there are two or more rows of bars, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm, two-thirds the nominal maximum size of aggregate or the maximum size of bars, whichever is greater.

50 mm ≥ **25 mm** ✓

Stirrups

26.3.2.a. The horizontal distance between two parallel main reinforcing bars shall usually be not less than the greatest of the following: the diameter of the bar if the diameters are equal, the diameter of the larger bar if the diameters are unequal, and 5 mm more than the nominal maximum size of coarse aggregate.

75 mm ≥ **25 mm** ✓

Minimum and maximum reinforcement (IS 456:2000, Articles 26.5.1.1.a, 26.5.1.1.b and 26.5.1.2)

Negative bending about the x-axis:

The minimum area of tension reinforcement shall be not less than $A_{st,min}$ (Article 26.5.1.1.a):

29.45 cm² ≥ **2.64 cm²** ✓

Where:

$A_{st,min}$: *2.64* cm²

Where:

f_y: Steel yield strength. **f_y** : *500.00* MPa

b: Minimum net width of the element. **b** : *300* mm

d: Effective depth of the section. **d** : *518* mm

Negative bending about the x-axis:

The maximum area of tension reinforcement shall not exceed $A_{st,max}$ (Article 26.5.1.1.b):

29.45 cm² ≤ **72.00 cm²** ✓

The maximum area of compression reinforcement shall not exceed $A_{sc,max}$ (Article 26.5.1.2):

9.82 cm² ≤ 72.00 cm² ✓

Where:

$\mathbf{A_{s,max}}$: *72.00* cm²

Where:

b: Minimum net width of the element. **b** : *300* mm

D: Height of the section. **D** : *600* mm

Ultimate limit state for shear (non-seismic combinations) (IS 456:2000, Articles 40.2.1, 40.2.2 and 40.4)

The following criteria must be satisfied:

η : ***0.813*** ✓

Where:

$\mathbf{V_{Ed,y}}$: Design effective shear force. $\mathbf{V_{Ed,y}}$: *391.57* kN

$\mathbf{V_{u,y}}$: Ultimate shear resistance due to oblique compression of the web. $\mathbf{V_{u,y}}$: *481.74* kN

η : ***0.574*** ✓

Where:

$\mathbf{V_{Ed,y}}$: Design effective shear force. $\mathbf{V_{Ed,y}}$: *391.57* kN

$\mathbf{V_{u,y}}$: Ultimate shear resistance due to tension in the web. $\mathbf{V_{u,y}}$: *681.89* kN

The worst case forces to be withstood from the analysis are produced at '0.312 m', in the combination of loadcase "1.5·SW+1.5·DL+1.5·Qa".

Ultimate shear resistance due to oblique compression of the web.

Shear failure due to oblique compression of the web is deduced using the following expression:

Shear in the Y-direction:

Under no circumstances, even with shear reinforcement, shall the nominal shear force exceed (Article 40.2.3):

$\mathbf{V_{u,lim}}$: *481.74* kN

([MPa] f_{ck})

Where:

$V_{u,lim}$: Nominal shear strength	**$V_{u,lim}$** :	*481.74*	kN
b: Width of the section.	**b** :	*300*	mm
d: Effective depth of the section in mm in reference to the longitudinal reinforcement for bending.	**d** :	*518*	mm
f_{ck}: Characteristic cube compressive strength of concrete.	**f_{ck}** :	*25.00*	MPa

The worst case forces to be withstood from the analysis are produced at '0.312 m', in the combination of loadcase "1.5·SW+1.5·DL+1.5·Qa".

Ultimate shear resistance due to tension in the web.

Shear in the Y-direction:

When V_c is exceeded by the shear force due to design loads, shear reinforcement shall be provided. (Article 40.4)

V_u : *681.89* kN

Where:

V_c: Design shear strength of concrete section with shear reinforcement.	**V_c** :	*117.82*	kN
	β :	*1.82*	
	ρ_t :	*1.59*	
f_{ck}: Characteristic cube compressive strength of concrete.	**f_{ck}** :	*25.00*	MPa
b: Width of the section.	**b** :	*300*	mm
d: Effective depth of the section in mm in reference to the longitudinal reinforcement for bending.	**d** :	*518*	mm
A_s: The area of longitudinal tension reinforcement which continues at least one effective depth beyond the section being considered except at support.	**A_s** :	*2478.42*	mm²
For members subjected to axial compression P_u, the design shear strength of concrete, V_c, is multiplied by the following factor: (Article 40.2.2)			
	δ :	*1.00*	

Where:

P_u: Axial compressive force.	**P_u** :	*0.00*	kN
A_g: Gross area of concrete section.	**A_g** :	*180000.00*	mm²

V_{us}: Strength of shear reinforcement. **V_{us}** : *564.06* kN

Where:

f_y: Characteristic strength of the stirrup or bent-up reinforcement which shall not be taken greater than 415 N/mm²:	f_y :	*415.00*	MPa
A_{sv}: Cross-sectional area of the shear reinforcement.	A_{sv} :	*226.20*	mm²
s_v: Spacing of the stirrups.	s_v :	*75*	mm
α: Angle between the inclined stirrup or bent-up bar and the axis of the member, not less than 45 °.	α :	*90.0*	degrees

Spacing of the transverse reinforcement

Shear in the Y-direction:

The maximum spacing of shear reinforcement measured along the axis of the member shall not exceed 0.75·d for vertical stirrups. In no case shall the spacing exceed 300 mm (Article 26.5.1.5):

75 mm ≤ **300 mm** ✓

Where:

d: Effective depth of the section.	**d** :	*518*	mm

Minimum mechanical ratio of the transverse reinforcement.

Shear in the Y-direction:

Minimum shear reinforcement in the form of stirrups shall be provided. (Article 26.5.1.6)

0.01005 ≥ **0.00111** ✓

ρ_{sv} : *0.01005*

Where:

A_{sv}: Cross-sectional area of the shear reinforcement.	A_{sv} :	*226.20*	mm²
b: Width of the section.	**b** :	*300*	mm
s_v: Spacing of the stirrups.	s_v :	*75*	mm

$\rho_{sv,min}$: *0.00111*

Where:

f_y: Characteristic strength of the stirrup or bent-up reinforcement which shall not be taken greater than 415 N/mm²:	f_y :	*415.00*	MPa
α: Angle between the inclined stirrup or bent-up bar and the axis of the member, not less than 45 °.	α :	*90.0*	degrees

Ultimate limit state under normal stresses (non-seismic combinations) (IS 456:2000, Articles 25.4, 25.1.2, 39.7 and 38)

The worst case forces to be withstood from the analysis are produced at '0.312 m', in the combination of loadcase "Minimum bending moment envelope for persistent or transitory situations".

The following criteria must be satisfied:

η : ***0.460*** ✓

Resistance check of the section (η_1)

N_{Ed},M_{Ed} are the first order design forces, including, the minimum eccentricity in accordance with 25.4:

N_{Ed}: Design normal force. **N_{Ed}** : *0.00* kN

M_{Ed}: First order design moment. **$M_{Ed,x}$** : *-200.27* kN·m

$M_{Ed,y}$: *0.00* kN·m

N_{Rd},M_{Rd} are the forces that cause the section to fail with the same eccentricities as the worst-case design forces.

N_{Rd}: Ultimate axial resistance. **N_{Rd}** : *0.00* kN

M_{Rd}: Bending resistance. **$M_{Rd,x}$** : *-435.09* kN·m

$M_{Rd,y}$: *0.00* kN·m

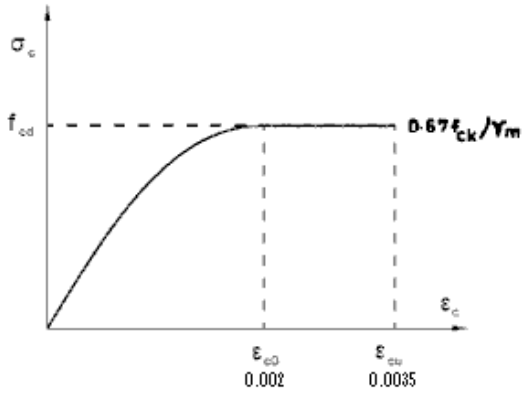
Resistance capacity calculation

The calculation of the ultimate resistance capacity of the sections is carried out using the following general hypothesis (Article 38.1):

(a) Concrete deformations follow a planar law.

(b) The maximum strain in concrete at the outermost compression fibre is taken as 0.0035 in bending.

(c) The concrete stress-deformation calculation diagram is of the parabola-rectangle type. The tensile resistance of the concrete is not considered.



ε_{cu}: The maximum strain in concrete at the outermost compression fibre. **ε_{cu}** : *0.0035*

ε_{c0}: The strain in concrete due to simple compression. **ε_{c0}** : *0.0020*

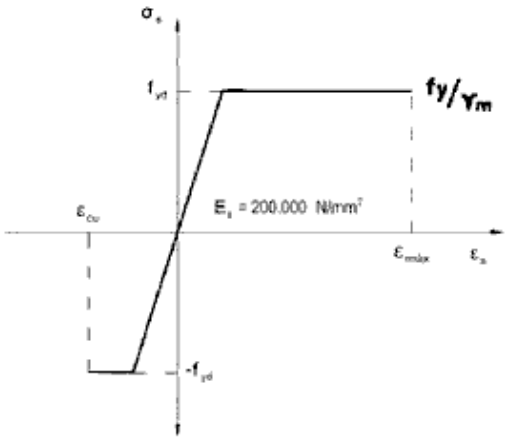
f_{cd}: Design compressive strength of concrete. **f_{cd}** : *11.17* MPa

Where:

f_{ck}: Characteristic cube compressive strength of concrete. f_{ck} : *25.00* MPa

γ_m: Partial safety factor for concrete. γ_m : *1.50*

(d) The stresses in the reinforcing steel are derived from the design curve in: (Article 38.1)



ε_{max}: The maximum strain in the tension reinforcement in the section at failure. ε_{max} : *0.0042*

Where:

f_y: Steel yield strength. f_y : *500.00* MPa

E_s: Steel elastic modulus. E_s : *200000.00* MPa

ε_{cu}: The maximum strain in concrete at the outermost compression fibre. ε_{cu} : *0.0035*

f_{yd}: Steel design resistance. f_{yd} : *434.78* MPa

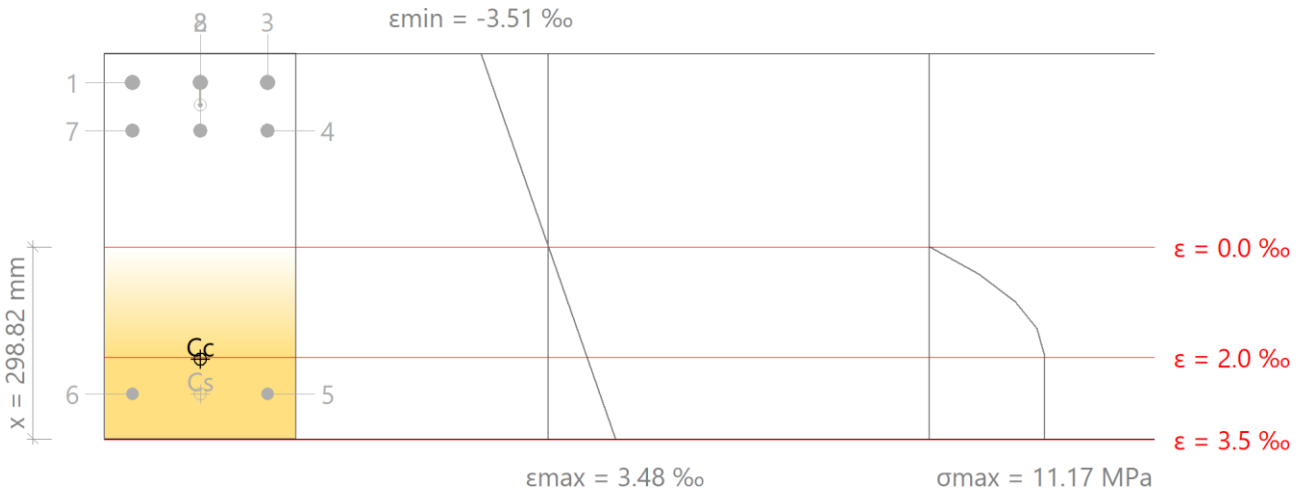
Where:

f_y: Steel yield strength. f_y : *500.00* MPa

γ_m: Partial safety factor for reinforcing steel. γ_m : *1.15*

(e) The general force equilibrium and moment equations are applied to the resulting stress forces of the section.

Ultimate force balance of the section, calculated with the same eccentricities as the worst-case design forces:



Bar	Designation	X Coord. (mm)	Y Coord. (mm)	f_s (MPa)	ε
1	Ø25	-105.50	255.50	-434.78	-0.002991
2	Ø25	0.00	255.50	-434.78	-0.002991
3	Ø25	105.50	255.50	-434.78	-0.002991
4	Ø25	105.50	180.50	-423.47	-0.002117
5	Ø25	105.50	-230.50	+434.78	+0.002673
6	Ø25	-105.50	-230.50	+434.78	+0.002673
7	Ø25	-105.50	180.50	-423.47	-0.002117
8	Ø25	0.00	180.50	-423.47	-0.002117

	Resultant (kN)	e.x (mm)	e.y (mm)
Cc	809.41	0.00	-175.81
Cs	254.70	0.00	-230.50
T	1064.11	0.00	219.97

N_{Rd} : *0.00* kN

$M_{Rd,x}$: *-435.09* kN·m

$M_{Rd,y}$: *0.00* kN·m

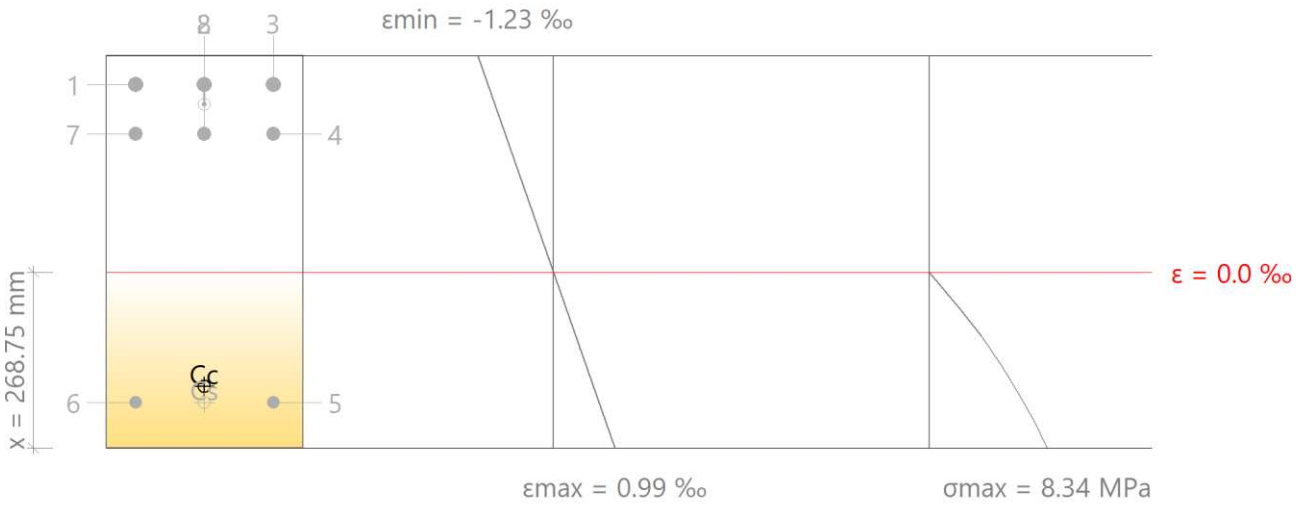
Where:

C_c: Resultant of concrete compressive forces. **C_c** : *809.41* kN

C_s: Resultant of steel compressive forces. **C_s** : *254.70* kN

T: Resultant of steel tensile forces.	**T** :	*1064.11*	kN
$\mathbf{e_{cc}}$: Eccentricity of the concrete compressive forces in the direction of the X and Y axes.	$\mathbf{e_{cc,x}}$:	*0.00*	mm
	$\mathbf{e_{cc,y}}$:	*-175.81*	mm
$\mathbf{e_{cs}}$: Eccentricity of the steel compressive forces in the direction of the X and Y axes.	$\mathbf{e_{cs,x}}$:	*0.00*	mm
	$\mathbf{e_{cs,y}}$:	*-230.50*	mm
$\mathbf{e_T}$: Eccentricity of the steel tensile forces in the direction of the X and Y axes.	$\mathbf{e_{T,x}}$:	*0.00*	mm
	$\mathbf{e_{T,y}}$:	*219.97*	mm
ε_{cmax}: Deformation of the most compressed concrete fibre.	ε_{cmax} :	*0.0035*	
ε_{smax}: Deformation of the steel bar with greatest tension.	ε_{smax} :	*0.0030*	
σ_{cmax}: Stress of the most compressed concrete fibre.	σ_{cmax} :	*11.17*	MPa
σ_{smax}: Stress of the steel bar with greatest tension.	σ_{smax} :	*434.78*	MPa

Worst-case force balance of the section:



Bar	Designation	X Coord. (mm)	Y Coord. (mm)	f_s (MPa)	ε
1	Ø25	-105.50	255.50	-212.12	-0.001061
2	Ø25	0.00	255.50	-212.12	-0.001061
3	Ø25	105.50	255.50	-212.12	-0.001061
4	Ø25	105.50	180.50	-156.64	-0.000783
5	Ø25	105.50	-230.50	+147.40	+0.000737
6	Ø25	-105.50	-230.50	+147.40	+0.000737
7	Ø25	-105.50	180.50	-156.64	-0.000783
8	Ø25	0.00	180.50	-156.64	-0.000783

	Resultant (kN)	e.x (mm)	e.y (mm)
Cc	373.35	0.00	-205.97
Cs	86.35	0.00	-230.50
T	459.69	0.00	225.08

N_{Ed} : *0.00* kN

$M_{Ed,x}$: *-200.27* kN·m

$M_{Ed,y}$: *0.00* kN·m

Where:

C_c: Resultant of concrete compressive forces.	C_c :	*373.35*	kN
C_s: Resultant of steel compressive forces.	C_s :	*86.35*	kN
T: Resultant of steel tensile forces.	T :	*459.69*	kN
e_{cc}: Eccentricity of the concrete compressive forces in the direction of the X and Y axes.	$e_{cc,x}$:	*0.00*	mm
	$e_{cc,y}$:	*-205.97*	mm
e_{cs}: Eccentricity of the steel compressive forces in the direction of the X and Y axes.	$e_{cs,x}$:	*0.00*	mm
	$e_{cs,y}$:	*-230.50*	mm
e_T: Eccentricity of the steel tensile forces in the direction of the X and Y axes.	$e_{T,x}$:	*0.00*	mm
	$e_{T,y}$:	*225.08*	mm
ε_{cmax}: Deformation of the most compressed concrete fibre.	ε_{cmax} :	*0.0010*	
ε_{smax}: Deformation of the steel bar with greatest tension.	ε_{smax} :	*0.0011*	
σ_{cmax}: Stress of the most compressed concrete fibre.	σ_{cmax} :	*8.34*	MPa
σ_{smax}: Stress of the steel bar with greatest tension.	σ_{smax} :	*212.12*	MPa

Ultimate limit state for torsion. Oblique compression. (IS 456:2000, Article 41.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Tension in the web. (IS 456:2000, Article 41.4.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Interaction between torsion and normal forces. Moment about the X-axis. (IS 456:2000, Article 41.4.2)

The check does not proceed, as there is no interaction between torsional forces and normal forces.

Ultimate limit state for torsion. Interaction between torsion and shear in the X-axis. Oblique compression (IS 456:2000, Article 41.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Interaction between torsion and shear in the Y-axis. Oblique compression (IS 456:2000, Article 41.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Interaction between torsion and shear in the X-axis. Tension in the web. (IS 456:2000, Article 41.4.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Interaction between torsion and shear in the Y-axis. Tension in the web. (IS 456:2000, Article 41.4.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Spacing of the transverse reinforcement bars. (IS 456:2000, Article 26.5.1.7)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

Ultimate limit state for torsion. Minimum closed stirrup ratio. (IS 456:2000, Articles 41.3.2 and 41.3.3)

The ultimate limit state for torsion check does not proceed, because there is no torsional moment.

4. CODE CHECK FOR CRACKING

V-209: C6 - C15

Maximum tensile stress of the bars (IS 456:2000, Annex F)

The following criteria must be satisfied:

194.29 MPa ≤ 400.00 MPa ✓

The maximum stress occurs at node C6, for load combination SW+DL+Qa. The worst-case point of the transverse section is at the following coordinates: X = -105.50 mm, Y = 255.50 mm.

Where:

σ_{st}: Tensile stress of the passive reinforcement.	σ_{st} : *194.29*	MPa
f_y: Yield strength of the passive reinforcement.	f_y : *500.00*	MPa
N_{ed}: Acting axial force (positive values indicate compression).	N_{ed} : *0.00*	kN
$M_{ed,X}$: Acting bending moment about the 'X' axis.	$M_{ed,X}$: *0.00*	kN·m
$M_{ed,Y}$: Acting bending moment about the 'Y' axis.	$M_{ed,Y}$: *-218.32*	kN·m

Calculation of crack width: Top face (IS 456:2000, Annex F)

The following criteria must be satisfied:

0.140 mm ≤ 0.300 mm ✓

The maximum crack width occurs at node C6, for load combination SW+DL+Qa. The worst-case point of the transverse section is at the following coordinates: X = -52.75 mm, Y = 300.00 mm.

Where:

W_{max}: Maximum width of the crack defined in 35.3.2 depending on the environment aggressiveness.	W_{max} : *0.300*	mm
Environment aggressiveness: Not harmful environment		
W_{cr}: Design surface crack width.	W_{cr} : *0.140*	mm

Where:

a_{cr}: Distance from the point considered to the surface of the nearest longitudinal bar.	a_{cr} : *56.51*	mm
C_{min}: Minimum cover to the longitudinal bar.	C_{min} : *32.00*	mm
h: Overall depth of the member.	**h** : *600.00*	mm
x: Depth of the neutral axis.	**x** : *237.47*	mm
ε_m: Mean deformation at the point where the crack width is calculated.	ε_m : *0.000937*	

Where:

ε_1: Strain at the point considered, calculated ignoring the stiffening of the concrete in the tension zone. ε_1 : *0.001078*

Where:

σ_{st}: Passive reinforcement service stress in the cracked section loadcase. σ_{st} : *189.05* MPa

E_s: [MPa] Modulus of elasticity of the reinforcement. E_s : *200000.00* MPa

x: Depth of the neutral axis. **x** : *237.47* mm

a: Distance from the compression face to the point at which the crack width is being calculated. **a** : *600.00* mm

d: Effective depth of the section. **d** : *555.50* mm

ε_2: Strain corresponding to the reduction due to tension stiffening effect. ε_2 : *0.000140*

Where:

$A_{c,eff}$: Effective area of the concrete in tension. $A_{c,eff}$: *18126.46* mm²

E_s: [MPa] Modulus of elasticity of the reinforcement. E_s : *200000.00* MPa

A_{st}: Area of tension reinforcement. A_{st} : *490.88* mm²

x: Depth of the neutral axis. **x** : *237.47* mm

a: Distance from the compression face to the point at which the crack width is being calculated. **a** : *600.00* mm

d: Effective depth of the section. **d** : *555.50* mm

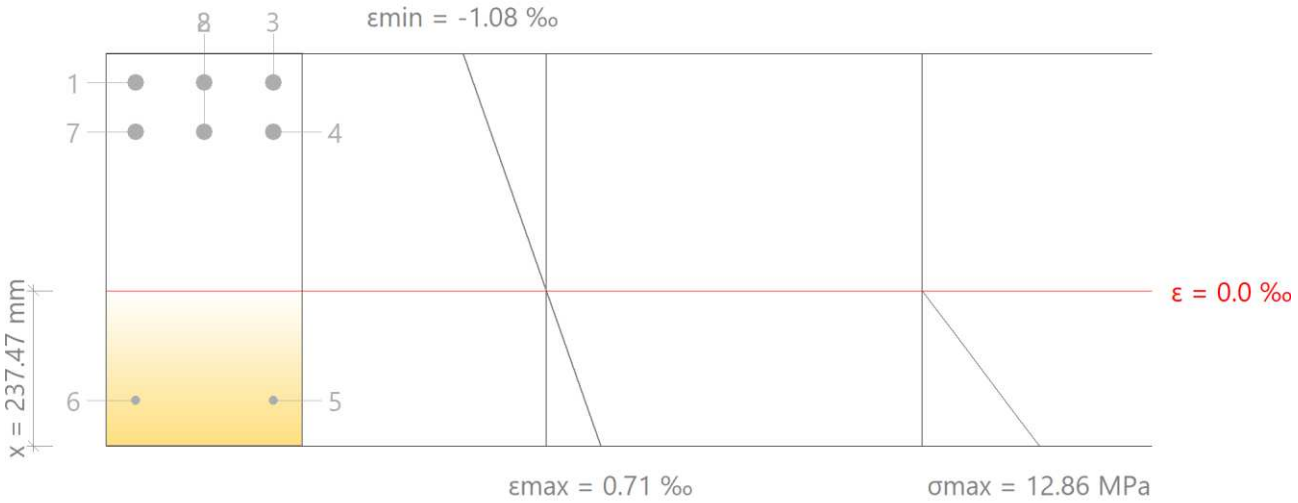
Section equilibrium for the acting forces ignoring the tensile resistance of the concrete:

N_{ed},M_{ed} Acting forces.

N_{ed}: Acting axial force (positive values indicate compression). N_{ed} : *0.00* kN

$M_{ed,X}$: Acting bending moment about the 'X' axis. $M_{ed,X}$: *0.00* kN·m

$M_{ed,Y}$: Acting bending moment about the 'Y' axis. $M_{ed,Y}$: *-218.32* kN·m



Bar	Designation	X Coord. (mm)	Y Coord. (mm)	σ_s (MPa)	ε
1	Ø25	-105.50	255.50	-189.05	-0.000945
2	Ø25	0.00	255.50	-189.05	-0.000945
3	Ø25	105.50	255.50	-189.05	-0.000945
4	Ø25	105.50	180.50	-144.47	-0.000722
7	Ø25	-105.50	180.50	-144.47	-0.000722
8	Ø25	0.00	180.50	-144.47	-0.000722

Calculation of crack width: Right side face (IS 456:2000, Annex F)

The check does not proceed, as there is no stressed reinforcement.

Calculation of crack width: Left side face (IS 456:2000, Annex F)

The check does not proceed, as there is no stressed reinforcement.

5. DEFLECTION CHECKS

Long term (Characteristic) $f_{T,max} \leq f_{T,lim}$ $f_{T,lim}$= L/250	**Active (Characteristic)** $f_{A,max} \leq f_{A,lim}$ $f_{A,lim}$= Min.(20.00, L/350)	Status
$f_{T,max}$: 0.11 mm $f_{T,lim}$: 3.52 mm	$f_{A,max}$: 0.13 mm $f_{A,lim}$: 2.51 mm	**VERIFIED**

Total long term deflection for load combination "Characteristic"

The maximum deflection occurs in section "0.46 m" for load combination: Self weight+Dead load - Partitions+Dead load - Paving

0.11 mm ≤ 3.52 mm ✓

$f_{T,lim}$: limit established for the total long term deflection
$f_{T,lim}$= L/250
L: reference length

$f_{T,lim}$: *3.52* mm
L : *0.88* m

$f_{T,max}$: maximum value of the total deflection

$f_{T,max}$: *0.11* mm

Total deflection at long-term

$f_{i,tot,max}$: maximum value of the total instantaneous deflection

$f_{i,tot,max}$: *-0.03* mm

Instantaneous deflection

Load step	t_i	$q(t_i)$	Load combination	E_c (MPa)	I_{eff} (cm4)	f_i (mm)	Δf_i (mm)	$f_{i,max}$ (mm)	f_{iD} (mm)
1	28 days	Self weight	Self weight	25000.00	540000.00	-0.03	-0.03	-0.03	-0.03
2	90 days	Dead load - Partitions	Self weight+Dead load - Partitions	27400.00	524752.78	-0.04	-0.01	-0.04	-0.04
3	120 days	Dead load - Paving	Self weight+Dead load - Partitions+Dead load - Paving	27600.00	522518.17	-0.06	-0.02	-0.06	-0.06
4	12 months	Live load	Self weight+Dead load - Partitions+Dead load - Paving	28600.00	335636.61	-0.06	0.00	-0.06	-0.06

Where:

t_i: initial instant of each load interval 'i'
$q(t_i)$: load applied to at the initial instant 't_i'
f_i: total instantaneous deflection due to the group of loads acting at instant t_i

Δf_i: instantaneous deflection increment due to the applied load at instant t_i, calculated as the difference of the total instantaneous deflections of instances t_i and t_{i-1}.

$f_{i,max}$: maximum value of the instantaneous deflection produced until the instant t_i

f_{iD}: instantaneous deflection due to the set of permanent loads acting at the instant t_i, the permanent loads being the self weight, dead loads and a percentage of the live loads (25%).

E_c: concrete deformation module

E_c: secant deformation module after 28 days

f_{ck}: characteristic compression resistance of the concrete after 28 days

f_{ck} (t_i): characteristic compression resistance of the concrete after t days

I_{eff}: effective moment of inertia of the beam for each load step

It is obtained as the minimum inertia of those calculated for all the possible characteristic combinations of the loads applied in the step. The most unfavourable value calculated up to that instant is always taken.

Step	t_i	$Q(t_i)$	$I_{eff,v,i}$ (cm4)	$I_{eff,i}$ (cm4)
1	28 days	Self weight	540000.00	540000.00
2	90 days	Self weight,Dead load - Partitions	524752.78	524752.78
3	120 days	Self weight,Dead load - Partitions,Dead load - Paving	522518.17	522518.17
4	12 months	Self weight,Dead load - Partitions,Dead load - Paving,Live load	335636.61	335636.61

Where:

t_i: initial instant of each load interval 'i'

$Q(t_i)$: loads acting as of instant t_i

$I_{eff,i}$: effective inertia of the beam considered for load step "i". It is the worst case value amongst all those calculated up to that instant.

$I_{eff,v,i}$: effective inertia of the beam calculated for load step "i"

Displayed below is the development of the worst case value of $I_{eff,v}$, which occurs for load step "4"

$I_{eff,v}$: effective moment of inertia of the beam for combination "Self weight+Dead load - Partitions+Dead load - Paving+Live load" $I_{eff,v}$: *33563*

Internal spans of continuous elements:

The inertias of the end and central sections of the element span are weighted:

k_1: Coefficient which depends on the support conditions, and takes the following values: k_1 : *0.1*

$I_{eff,c}$: effective moment of inertia of the central section of the span $I_{eff,c}$: *32111*

$I_{eff,e1}$: effective moment of inertia of the end section (1) $I_{eff,e1}$: *29588*

$I_{eff,e2}$: effective moment of inertia of the end section (2) $I_{eff,e2}$: *54000*

Is calculated using the following formula:

Section	I_{gr} (cm4)	I_r (cm4)	M_r (kN·m)	M_a (kN·m)	z (mm)	x (mm)	d (mm)	b_w (mm)	b (mm)	I_{eff} (cm4)
End (1)	540000.00	295886.05	-90.951	-218.324	440.54	248.06	518.00	300.00	300.00	295886.05
Mid-span	540000.00	238521.02	-85.708	-95.868	452.34	214.64	518.00	300.00	300.00	321111.94
End (2)	540000.00	53443.55	69.660	13.422	468.90	100.92	530.50	300.00	300.00	540000.00

Where:

I_{gr}: moment of inertia of the gross section

I_r: moment of inertia of the cracked section

M_r: cracking moment of the section

M_a: bending moment applied on the section

z: lever arm

x: depth of neutral axis

d: effective depth

b_w: breadth of web

b: breadth of compression face

Time-dependent deflection due to creep

f_{cp}: Time-dependent deflection due to creep

f_{iD}: total instantaneous deflection due to the group of permanent loads, these being the self weight, the dead loads and a percentage of the live loads (25%).

(*)Explained previously in the instantaneous deflection calculation.

f_{i+cp}: deflection composed of the instantaneous deflection and the deflection due to creep because of the group of permanent loads

θ_m: average creep coefficient

E_{ce}: effective deformation module of the concrete

$I_{eff,e}$: effective moment of inertia of the beam

Load interval	t_i	t_f	Load combination	θ_i	Q_i (kN)	$\theta_{m,i}$	$E_{c,i}$ (MPa)	$E_{ce,i}$ (MPa)	$I_{eff,e}$ (cm4)
1-2	28 days	90 days	Self weight	1.60	112.84	1.60	25000.00	9615.38	540000.00
2-3	90 days	120 days	Self weight+Dead load - Partitions	1.51	189.45	1.54	27400.00	10777.43	540000.00
3-4	120 days	12 months	Self weight+Dead load - Partitions+Dead load - Paving	1.46	266.06	1.51	27600.00	11016.04	540000.00
4-∞	12 months	∞	Self weight+Dead load - Partitions+Dead load - Paving	1.11	301.71	1.37	28600.00	12080.68	538920.24

Where:

t_i: initial instant of each load interval 'i'

t_f: final instant of each considered load interval

$E_{ce,i}$: effective deformation module of the concrete at the instant t_i

$\theta_{m,i}$: average creep coefficient at the instant t_i

Is calculated by weighting the creep coefficient associated to each load depending on the instantaneous deflection produced by each of them (even though the code does not contain any indication on how to calculate this coefficient when the load is not completely applied at the same instant, only when distributed in different load steps, this is the criteria used in several publications on deflection calculations)

θ_i: creep coefficient for the instant t_i

Q_i: shear force associated with the loads applied at the instant t_i

$Q_{i,e1}$,$Q_{i,e2}$: shear forces at the ends of the span due to the loads applied at the instant t_i

l: span length

$I_{eff,e}$: effective moment of inertia of the beam for each load step

It is obtained as the minimum inertia of those calculated for all the possible characteristic combinations of the loads applied in the step. The most unfavourable value calculated up to that instant is always taken.

Step	t_i	$Q(t_i)$	$I_{eff,v,i}$ (cm4)	$I_{eff,i}$ (cm4)
1	28 days	Self weight	540000.00	540000.00
2	90 days	Self weight,Dead load - Partitions	540000.00	540000.00
3	120 days	Self weight,Dead load - Partitions,Dead load - Paving	540000.00	540000.00
4	12 months	Self weight,Dead load - Partitions,Dead load - Paving,Live load	538920.24	538920.24

Where:

t_i: initial instant of each load interval 'i'

$Q(t_i)$: loads acting as of instant t_i

$I_{eff,i}$: effective inertia of the beam considered for load step "i". It is the worst case value amongst all those calculated up to that instant.

$I_{eff,v,i}$: effective inertia of the beam calculated for load step "i"

Displayed below is the development of the worst case value of $I_{eff,v}$, which occurs for load step "4"

$\mathbf{I_{eff,v}}$: effective moment of inertia of the beam for combination "Self weight+Dead load - Partitions+Dead load - Paving+Live load" $\mathbf{I_{eff,v}}$: *538920.24*

Internal spans of continuous elements:

The inertias of the end and central sections of the element span are weighted:

$\mathbf{k_1}$: Coefficient which depends on the support conditions, and takes the following values: $\mathbf{k_1}$: *0.15*

$\mathbf{I_{eff,c}}$: effective moment of inertia of the central section of the span $\mathbf{I_{eff,c}}$: *540000.00*

$\mathbf{I_{eff,e1}}$: effective moment of inertia of the end section (1) $\mathbf{I_{eff,e1}}$: *525603.23*

$\mathbf{I_{eff,e2}}$: effective moment of inertia of the end section (2) $\mathbf{I_{eff,e2}}$: *540000.00*

Is calculated using the following formula:

Section	I_{gr} (cm4)	I_r (cm4)	M_r (kN·m)	M_a (kN·m)	z (mm)	x (mm)	d (mm)	b_w (mm)	b (mm)	I_{eff} (cm4)
End (1)	540000.00	525603.23	-90.951	-218.324	440.54	248.06	518.00	300.00	300.00	525603.23
Mid-span	540000.00	451275.27	-85.708	-95.868	452.34	214.64	518.00	300.00	300.00	540000.00
End (2)	540000.00	114991.63	69.660	13.422	468.90	100.92	530.50	300.00	300.00	540000.00

Where:

I_{gr}: moment of inertia of the gross section
I_r: moment of inertia of the cracked section
M_r: cracking moment of the section
M_a: bending moment applied on the section
z: lever arm
x: depth of neutral axis
d: effective depth
b_w: breadth of web
b: breadth of compression face

Time-dependent deflection due to shrinking

$\mathbf{f_{sh}}$: time-dependent deflection due to shrinking

$\mathbf{k_3}$: constant depending upon the support conditions
Ψ_{cs}: shrinkage curvature (midspan section)

ε_{cs}: ultimate shrinkage strain of concrete (IS 456:200, 6.2.4.1)
D: total depth of the section

k_4: coefficient depending on p_c and p_t

for $0.25 \leq p_t - p_c < 1.0$

for $p_t - p_c \geq 1.0$

p_c: geometric ratio of the reinforcement in compression (%)

p_t: geometric ratio of the reinforcement in tension (%)

Active deflection as of instant "3 months", for load combination "Characteristic"

The maximum deflection occurs in section "0.33 m" for load combination: Self weight+Dead load - Partitions+Dead load - Paving+Live load

0.13 mm ≤ 2.51 mm ✓

$f_{A,lim}$: limit established for the active deflection

$f_{A,lim}$= Min.(20.00, L/350)

L: reference length

$f_{A,lim}$: *2.51* mm

L : *0.88* m

$f_{A,max}$: maximum active deflection produced from the instant "3 months" Calculated as the increase of the instantaneous deflection produced as of the instant 3 months, $\Delta f_i(t_{ed})$, plus the time-dependent deflection due to creep and shrinkage.

$f_{A,max}$: *0.13* mm

Where:

$f_{i,tot,max}$: maximum value of the total instantaneous deflection produced as of the instant 3 months

$f_i(t_{ed})$: instantaneous deflection produced until the instant 3 months

$f_{i,tot,max}$: *-0.10* mm

$f_i(t_{ed})$: *-0.03* mm

Instantaneous deflection

Load step	t_i	$q(t_i)$	Load combination	E_c (MPa)	I_{eff} (cm4)	f_i (mm)	Δf_i (mm)	$f_{i,max}$ (mm)	f_{iD} (mm)
1	28 days	Self weight	Self weight	25000.00	540000.00	-0.03	-0.03	-0.03	-0.03
2	90 days	Dead load - Partitions	Self weight+Dead load - Partitions	27400.00	524752.78	-0.04	-0.01	-0.04	-0.04
3	120 days	Dead load - Paving	Self weight+Dead load - Partitions+Dead load - Paving	27600.00	522518.17	-0.06	-0.02	-0.06	-0.06

Load step	t_i	$q(t_i)$	Load combination	E_c (MPa)	I_{eff} (cm4)	f_i (mm)	Δf_i (mm)	$f_{i,max}$ (mm)	f_{iD} (mm)
4	12 months	Live load	Self weight+Dead load - Partitions+Dead load - Paving+Live load	28600.00	335636.61	-0.10	-0.04	-0.10	-0.09

Where:

t_i: initial instant of each load interval 'i'

$q(t_i)$: load applied to at the initial instant 't_i'

f_i: total instantaneous deflection due to the group of loads acting at instant t_i

Δf_i: instantaneous deflection increment due to the applied load at instant t_i, calculated as the difference of the total instantaneous deflections of instances t_i and t_{i-1}.

$f_{i,max}$: maximum value of the instantaneous deflection produced until the instant t_i

f_{iD}: instantaneous deflection due to the set of permanent loads acting at the instant t_i, the permanent loads being the self weight, dead loads and a percentage of the live loads (25%).

E_c: concrete deformation module

E_c: secant deformation module after 28 days

f_{ck}: characteristic compression resistance of the concrete after 28 days

$f_{ck}\ (t_i)$: characteristic compression resistance of the concrete after t days

I_{eff}: effective moment of inertia of the beam for each load step

It is obtained as the minimum inertia of those calculated for all the possible characteristic combinations of the loads applied in the step. The most unfavourable value calculated up to that instant is always taken.

Step	t_i	$Q(t_i)$	$I_{eff,v,i}$ (cm4)	$I_{eff,i}$ (cm4)
1	28 days	Self weight	540000.00	540000.00
2	90 days	Self weight,Dead load - Partitions	524752.78	524752.78
3	120 days	Self weight,Dead load - Partitions,Dead load - Paving	522518.17	522518.17
4	12 months	Self weight,Dead load - Partitions,Dead load - Paving,Live load	335636.61	335636.61

Where:

t_i: initial instant of each load interval 'i'

$Q(t_i)$: loads acting as of instant t_i

$I_{eff,i}$: effective inertia of the beam considered for load step "i". It is the worst case value amongst all those calculated up to that instant.

$I_{eff,v,i}$: effective inertia of the beam calculated for load step "i"

Displayed below is the development of the worst case value of $I_{eff,v}$, which occurs for load step "4"

$I_{eff,v}$: effective moment of inertia of the beam for combination "Self weight+Dead load - Partitions+Dead load - Paving+Live load"

$I_{eff,v}$: *33563*

Internal spans of continuous elements:

The inertias of the end and central sections of the element span are weighted:

$\mathbf{k_1}$: Coefficient which depends on the support conditions, and takes the following values: $\mathbf{k_1}$: *0.1*

$\mathbf{I_{eff,c}}$: effective moment of inertia of the central section of the span $\mathbf{I_{eff,c}}$: *32111*

$\mathbf{I_{eff,e1}}$: effective moment of inertia of the end section (1) $\mathbf{I_{eff,e1}}$: *29588*

$\mathbf{I_{eff,e2}}$: effective moment of inertia of the end section (2) $\mathbf{I_{eff,e2}}$: *54000*

Is calculated using the following formula:

Section	I_{gr} (cm4)	I_r (cm4)	M_r (kN·m)	M_a (kN·m)	z (mm)	x (mm)	d (mm)	b_w (mm)	b (mm)	I_{eff} (cm4)
End (1)	540000.00	295886.05	-90.951	-218.324	440.54	248.06	518.00	300.00	300.00	295886.05
Mid-span	540000.00	238521.02	-85.708	-95.868	452.34	214.64	518.00	300.00	300.00	321111.94
End (2)	540000.00	53443.55	69.660	13.422	468.90	100.92	530.50	300.00	300.00	540000.00

Where:

$\mathbf{I_{gr}}$: moment of inertia of the gross section

$\mathbf{I_r}$: moment of inertia of the cracked section

$\mathbf{M_r}$: cracking moment of the section

$\mathbf{M_a}$: bending moment applied on the section

z: lever arm

x: depth of neutral axis

d: effective depth

$\mathbf{b_w}$: breadth of web

b: breadth of compression face

Time-dependent deflection due to creep

$\mathbf{f_{cp}}$: Time-dependent deflection due to creep

$\mathbf{f_{iD}}$: total instantaneous deflection due to the group of permanent loads, these being the self weight, the dead loads and a percentage of the live loads (25%).

(*)Explained previously in the instantaneous deflection calculation.

$\mathbf{f_{i+cp}}$: deflection composed of the instantaneous deflection and the deflection due to creep because of the group of permanent loads

$\theta_\mathbf{m}$: average creep coefficient

$\mathbf{E_{ce}}$: effective deformation module of the concrete

$\mathbf{I_{eff,e}}$: effective moment of inertia of the beam

Load interval	t_i	t_f	Load combination	θ_i	Q_i (kN)	$\theta_{m,i}$	$E_{c,i}$ (MPa)	$E_{ce,i}$ (MPa)	$I_{eff,e}$ (cm4)
1-2	28 days	90 days	Self weight	1.60	112.84	1.60	25000.00	9615.38	540000.00
2-3	90 days	120 days	Self weight+Dead load - Partitions	1.51	189.45	1.54	27400.00	10777.43	540000.00
3-4	120 days	12 months	Self weight+Dead load - Partitions+Dead load - Paving	1.46	266.06	1.51	27600.00	11016.04	540000.00
4-∞	12 months	∞	Self weight+Dead load - Partitions+Dead load - Paving+Live load	1.11	301.71	1.37	28600.00	12080.68	538920.24

Where:

t_i: initial instant of each load interval 'i'

t_f: final instant of each considered load interval

$E_{ce,i}$: effective deformation module of the concrete at the instant t_i

$\theta_{m,i}$: average creep coefficient at the instant t_i

Is calculated by weighting the creep coefficient associated to each load depending on the instantaneous deflection produced by each of them (even though the code does not contain any indication on how to calculate this coefficient when the load is not completely applied at the same instant, only when distributed in different load steps, this is the criteria used in several publications on deflection calculations)

θ_i: creep coefficient for the instant t_i

Q_i: shear force associated with the loads applied at the instant t_i

$Q_{i,e1}$,$Q_{i,e2}$: shear forces at the ends of the span due to the loads applied at the instant t_i

l: span length

$I_{eff,e}$: effective moment of inertia of the beam for each load step

It is obtained as the minimum inertia of those calculated for all the possible characteristic combinations of the loads applied in the step. The most unfavourable value calculated up to that instant is always taken.

Step	t_i	$Q(t_i)$	$I_{eff,v,i}$ (cm4)	$I_{eff,i}$ (cm4)
1	28 days	Self weight	540000.00	540000.00
2	90 days	Self weight,Dead load - Partitions	540000.00	540000.00
3	120 days	Self weight,Dead load - Partitions,Dead load - Paving	540000.00	540000.00
4	12 months	Self weight,Dead load - Partitions,Dead load - Paving,Live load	538920.24	538920.24

Where:

t_i: initial instant of each load interval 'i'

$Q(t_i)$: loads acting as of instant t_i

$I_{eff,i}$: effective inertia of the beam considered for load step "i". It is the worst case value amongst all those calculated up to that instant.

$I_{eff,v,i}$: effective inertia of the beam calculated for load step "i"

Displayed below is the development of the worst case value of $I_{eff,v}$, which occurs for load step "4"

$I_{eff,v}$: effective moment of inertia of the beam for combination "Self weight+Dead load - Partitions+Dead load - Paving+Live load" **$I_{eff,v}$** : *538920.24*

Internal spans of continuous elements:

The inertias of the end and central sections of the element span are weighted:

k_1: Coefficient which depends on the support conditions, and takes the following values: **k_1** : *0.15*

$I_{eff,c}$: effective moment of inertia of the central section of the span **$I_{eff,c}$** : *540000.00*

$I_{eff,e1}$: effective moment of inertia of the end section (1) **$I_{eff,e1}$** : *525603.23*

$I_{eff,e2}$: effective moment of inertia of the end section (2) **$I_{eff,e2}$** : *540000.00*

Is calculated using the following formula:

Section	I_{gr} (cm4)	I_r (cm4)	M_r (kN·m)	M_a (kN·m)	z (mm)	x (mm)	d (mm)	b_w (mm)	b (mm)	I_{eff} (cm4)
End (1)	540000.00	525603.23	-90.951	-218.324	440.54	248.06	518.00	300.00	300.00	525603.23
Mid-span	540000.00	451275.27	-85.708	-95.868	452.34	214.64	518.00	300.00	300.00	540000.00
End (2)	540000.00	114991.63	69.660	13.422	468.90	100.92	530.50	300.00	300.00	540000.00

Where:

I_{gr}: moment of inertia of the gross section

I_r: moment of inertia of the cracked section

M_r: cracking moment of the section

M_a: bending moment applied on the section

z: lever arm

x: depth of neutral axis

d: effective depth

b_w: breadth of web

b: breadth of compression face

Time-dependent deflection due to shrinking

f_{sh}: time-dependent deflection due to shrinking

k_3: constant depending upon the support conditions

Ψ_{cs}: shrinkage curvature (midspan section)

E_{cs}: ultimate shrinkage strain of concrete (IS 456:200, 6.2.4.1)

D: total depth of the section

k_4: coefficient depending on p_c and p_t

for $0.25 \leq p_t - p_c < 1.0$

for $p_t - p_c \geq 1.0$

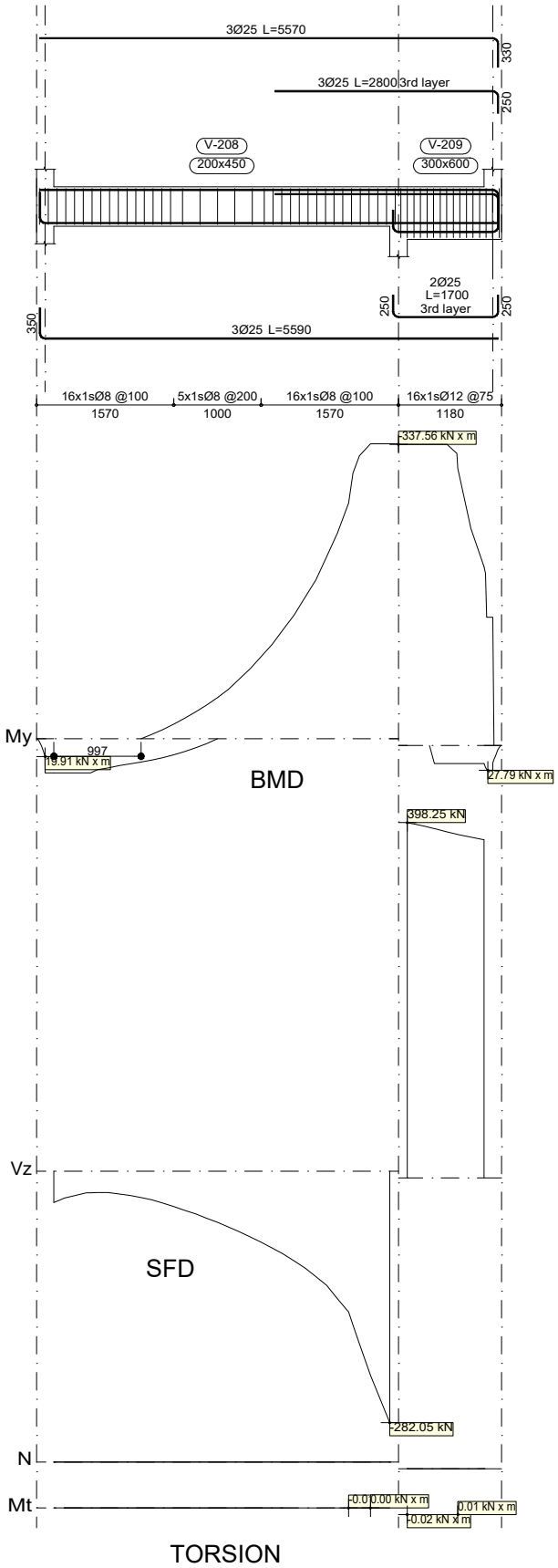
p_c: geometric ratio of the reinforcement in compression (%)

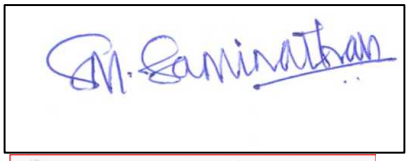
p_t: geometric ratio of the reinforcement in tension (%)



S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I







S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

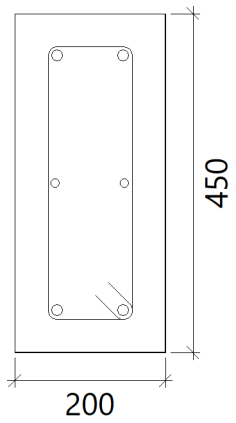
PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

FLOOR 0

Column data



Geometry	
Dimensions	: 20x45 cm
Span	: -1.200/1.200 m
Free height	: 1.95 m
Clear cover	: 4.0 cm
Maximum aggregate size	: 20 mm

Materials	Buckling length
Concrete : M 25	ZX plane : 1.95 m
Steel : Fe 500	ZY plane : 1.95 m
Longitudinal reinf.	**Transverse reinf.**
Corner : 4Ø16	Stirrups : 1sØ8
Y Face : 2Ø12	Spacing : 15 cm
Ratio : 1.14 %	

Reinforcement arrangement (IS 456:2000, Articles 26.5.3.1, 26.3.2 and 26.5.3.2)

Longitudinal reinf.

26.3.2.a. The horizontal distance between two parallel main reinforcing bars shall usually be not less than the greatest of the following: the diameter of the bar if the diameters are equal, the diameter of the larger bar if the diameters are unequal, and 5 mm more than the nominal maximum size of coarse aggregate.

72 mm ≥ 25 mm ✓

The spacing between two consecutive bars of the main reinforcement can have a maximum value of 300 mm (Article 26.5.3.1):

169 mm ≤ 300 mm ✓

The diameter of the thinnest bar in compression cannot be less than 12 mm (Article 26.5.3.1):

12 mm ≥ 12 mm ✓

Stirrups

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

26.3.2.a. The horizontal distance between two parallel main reinforcing bars shall usually be not less than the greatest of the following: the diameter of the bar if the diameters are equal, the diameter of the larger bar if the diameters are unequal, and 5 mm more than the nominal maximum size of coarse aggregate.

150 mm ≥ **25 mm** ✓

The pitch of transverse reinforcement shall be not more than s_{max} (Article 26.5.3.2):

150 mm ≤ **192 mm** ✓

Where:

s_{max}: Minimum value of s_1, s_2, s_3. **s_{max}** : *192* mm

s_1 : *200* mm

s_2 : *192* mm

s_3 : *300* mm

Where:

b_{min}: Minimum dimension of the section. **b_{min}** : *200* mm

$Ø_{min}$: Diameter of the thinnest bar in compression. **$Ø_{min}$** : *12* mm

The diameter of the polygonal links or lateral ties shall be not less than one-fourth of the diameter of the largest longitudinal bar, and in no case less than 6 mm (Article 26.5.3.2):

8 mm ≥ **6 mm** ✓

Where:

$Ø_{max}$: Diameter of the thickest bar in compression. **$Ø_{max}$** : *6* mm

Minimum and maximum reinforcement (IS 456:2000, Article 26.5.3.1)

The cross-sectional area of longitudinal reinforcement shall be not less than 0.8 percent of the gross cross-sectional area of the column (Article 26.5.3.1):

10.30 cm² ≥ **7.20 cm²** ✓

Where:

A_s: Area of longitudinal reinforcement. **A_s** : *10.30* cm²

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

$A_{s,min}$: *7.20* cm²

Where:

A_g: Gross area of concrete section. A_g : *900.00* cm²

The cross-sectional area of longitudinal reinforcement shall be not more than 4 percent of the gross cross-sectional area of the column (Article 26.5.3.1):

10.30 cm² ≤ 36.00 cm² ✓

Where:

A_s: Area of longitudinal reinforcement. A_s : *10.30* cm²

$A_{s,max}$: *36.00* cm²

Where:

A_g: Gross area of concrete section. A_g : *900.00* cm²

Ultimate limit state for shear (IS 456:2000, Articles 40.2.1, 40.2.2 and 40.4)

The following criteria must be satisfied:

η : ***0.094*** ✓

Where:

V_{Ed}: Design effective shear force. $V_{Ed,x}$: *3.70* kN
$V_{Ed,y}$: *19.10* kN

V_u: Ultimate shear resistance due to oblique compression of the web. $V_{u,x}$: *201.49* kN
$V_{u,y}$: *206.56* kN

η : ***0.311*** ✓

Where:

V_{Ed}: Design effective shear force. $V_{Ed,x}$: *3.70* kN
$V_{Ed,y}$: *19.10* kN

V_u: Ultimate shear resistance due to tension in the web. $V_{u,x}$: *57.25* kN

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

$V_{u,y}$: *62.71* kN

The worst case forces to be withstood from the analysis are produced at 'Base', in the combination of loadcase "1.5·SW+1.5·DL+1.5·Qa".

Ultimate shear resistance due to oblique compression of the web.

Shear failure due to oblique compression of the web is deduced using the following expression:

Shear in the X-direction:

Under no circumstances, even with shear reinforcement, shall the nominal shear force exceed (Article 40.2.3):

$V_{u,lim}$: *201.49* kN

([MPa] f_{ck})

Where:

$V_{u,lim}$: Nominal shear strength — $V_{u,lim}$: *201.49* kN

b: Width of the section. — **b** : *450* mm

d: Effective depth of the section in mm in reference to the longitudinal reinforcement for bending. — **d** : *144* mm

f_{ck}: Characteristic cube compressive strength of concrete. — f_{ck} : *25.00* MPa

Shear in the Y-direction:

Under no circumstances, even with shear reinforcement, shall the nominal shear force exceed (Article 40.2.3):

$V_{u,lim}$: *206.56* kN

([MPa] f_{ck})

Where:

$V_{u,lim}$: Nominal shear strength — $V_{u,lim}$: *206.56* kN

b: Width of the section. — **b** : *200* mm

d: Effective depth of the section in mm in reference to the longitudinal reinforcement for bending. — **d** : *333* mm

f_{ck}: Characteristic cube compressive strength of concrete. — f_{ck} : *25.00* MPa

The worst case forces to be withstood from the analysis are produced at 'Base', in the combination of loadcase "1.5·SW+1.5·DL+1.5·Qa".

Ultimate shear resistance due to tension in the web.

Shear in the X-direction:

Design shear resistance of the member without shear reinforcement, obtained from (Article 40.2.1):

V_u : *57.25* kN

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

Where:

V_c: Design shear strength of concrete section without shear reinforcement. V_c : *57.25* kN

β : *3.66*

ρ_t : *0.79*

f_{ck}: Characteristic cube compressive strength of concrete. f_{ck} : *25.00* MPa

b: Width of the section. **b** : *450* mm

d: Effective depth of the section in mm in reference to the longitudinal reinforcement for bending. **d** : *144* mm

A_s: The area of longitudinal tension reinforcement which continues at least one effective depth beyond the section being considered except at support. A_s : *515.22* mm²

For members subjected to axial compression P_u, the design shear strength of concrete, V_c, is multiplied by the following factor: (Article 40.2.2)

δ : *1.50*

Where:

P_u: Axial compressive force. P_u : *1049.22* kN

A_g: Gross area of concrete section. A_g : *90000.00* mm²

Shear in the Y-direction:

Design shear resistance of the member without shear reinforcement, obtained from (Article 40.2.1):

V_u : *62.71* kN

Where:

V_c: Design shear strength of concrete section without shear reinforcement. V_c : *62.71* kN

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

β : *3.08*

ρ_t : *0.94*

f_{ck}: Characteristic cube compressive strength of concrete. — **f_{ck}** : *25.00* MPa

b: Width of the section. — **b** : *200* mm

d: Effective depth of the section in mm in reference to the longitudinal reinforcement for bending. — **d** : *333* mm

A_s: The area of longitudinal tension reinforcement which continues at least one effective depth beyond the section being considered except at support. — **A_s** : *628.32* mm²

For members subjected to axial compression P_u, the design shear strength of concrete, V_c, is multiplied by the following factor: (Article 40.2.2)

δ : *1.50*

Where:

P_u: Axial compressive force. — **P_u** : *1049.22* kN

A_g: Gross area of concrete section. — **A_g** : *90000.00* mm²

Ultimate limit state under normal stresses (IS 456:2000, Articles 25.4, 25.1.2, 39.7 and 38)

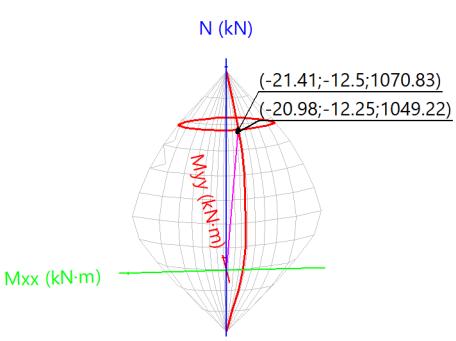
The worst case forces to be withstood from the analysis are produced at 'Base', in the combination of loadcase "1.5·SW+1.5·DL+1.5·Qa".

The following criteria must be satisfied:

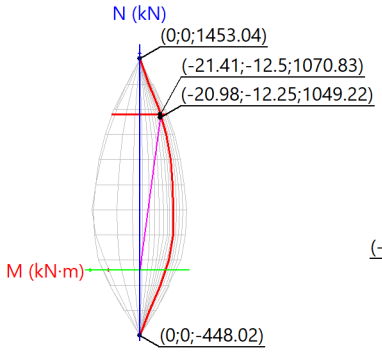
η : ***0.980*** ✓

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

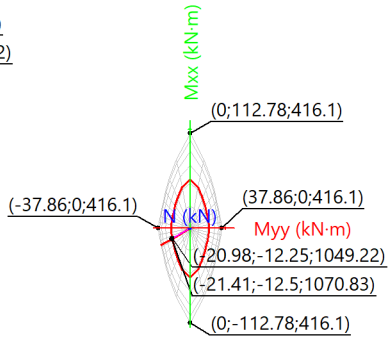
PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE



Capacity volume



View N, M



View Mx, My

Resistance check of the section (η_1)

N_{Ed},M_{Ed} are the first order design forces, including, the minimum eccentricity in accordance with 25.4:

N_{Ed}: Design normal force. **N_{Ed}** : *1049.22* kN

M_{Ed}: First order design moment. **$M_{Ed,x}$** : *-12.25* kN·m

$M_{Ed,y}$: *-20.98* kN·m

N_{Rd},M_{Rd} are the forces that cause the section to fail with the same eccentricities as the worst-case design forces.

N_{Rd}: Ultimate axial resistance. **N_{Rd}** : *1070.83* kN

M_{Rd}: Bending resistance. **$M_{Rd,x}$** : *-12.50* kN·m

$M_{Rd,y}$: *-21.41* kN·m

Where:

Where:

e_e: First order eccentricity. It is calculated taking into account the minimum eccentricity e_{min} in accordance with article 25.4. **$e_{e,x}$** : *-20.00* mm

$e_{e,y}$: *-11.67* mm

In this case, eccentricities $e_{0,x}$ and $e_{0,y}$ are less than the minimum.

Where:

In the x-axis:

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

e_{min} : *20* mm

Where:

e_1 : *18.9* mm

Where:

l: Unsupported length between end restraints. **l** : *1.950* m

b: Lateral dimension of the column. **b** : *450* mm

e_2 : *20* mm

e_0 : *-11.67* mm

Where:

M_d: First order design moment. M_d : *-12.25* kN·m

N_d: Design normal force. N_d : *1049.22* kN

In the y-axis:

e_{min} : *20* mm

Where:

e_1 : *10.6* mm

Where:

l: Unsupported length between end restraints. **l** : *1.950* m

b: Lateral dimension of the column. **b** : *200* mm

e_2 : *20* mm

e_0 : *-2.66* mm

Where:

M_d: First order design moment. M_d : *-2.80* kN·m

N_d: Design normal force. N_d : *1049.22* kN

Instability limit status check

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

In the x-axis:

Second order effects can be ignored, as the mechanical slenderness of the support λ is less than the minimum limiting slenderness λ_{inf} indicated in 25.1.2.

l_e / h : *4.33*

Where:

l_e: Buckling length — **l_e** : *1.950* m

h: Depth of the section in the considered bending plane. — **h** : *450* mm

In the y-axis:

Second order effects can be ignored, as the mechanical slenderness of the support λ is less than the minimum limiting slenderness λ_{inf} indicated in 25.1.2.

l_e / h : *9.75*

Where:

l_e: Buckling length — **l_e** : *1.950* m

h: Depth of the section in the considered bending plane. — **h** : *200* mm

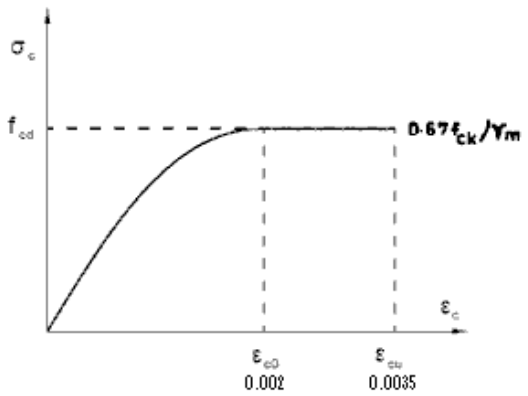
Resistance capacity calculation

The calculation of the ultimate resistance capacity of the sections is carried out using the following general hypothesis (Article 38.1):

(a) Concrete deformations follow a planar law.

(b) The maximum strain in concrete at the outermost compression fibre is taken as 0.0035 in bending.

(c) The concrete stress-deformation calculation diagram is of the parabola-rectangle type. The tensile resistance of the concrete is not considered.



S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

ε_{cu}: The maximum strain in concrete at the outermost compression fibre. ε_{cu} : *0.0035*

ε_{c0}: The strain in concrete due to simple compression. ε_{c0} : *0.0020*

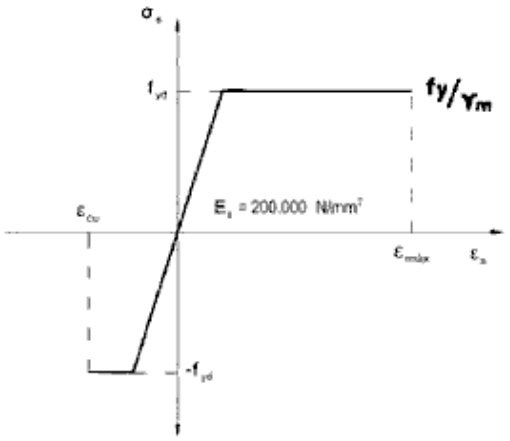
f_{cd}: Design compressive strength of concrete. f_{cd} : *11.17* MPa

Where:

f_{ck}: Characteristic cube compressive strength of concrete. f_{ck} : *25.00* MPa

γ_m: Partial safety factor for concrete. γ_m : *1.50*

(d) The stresses in the reinforcing steel are derived from the design curve in: (Article 38.1)



ε_{max}: The maximum strain in the tension reinforcement in the section at failure. ε_{max} : *0.0042*

Where:

f_y: Steel yield strength. f_y : *500.00* MPa

E_s: Steel elastic modulus. E_s : *200000.00* MPa

ε_{cu}: The maximum strain in concrete at the outermost compression fibre. ε_{cu} : *0.0035*

f_{yd}: Steel design resistance. f_{yd} : *434.78* MPa

Where:

f_y: Steel yield strength. f_y : *500.00* MPa

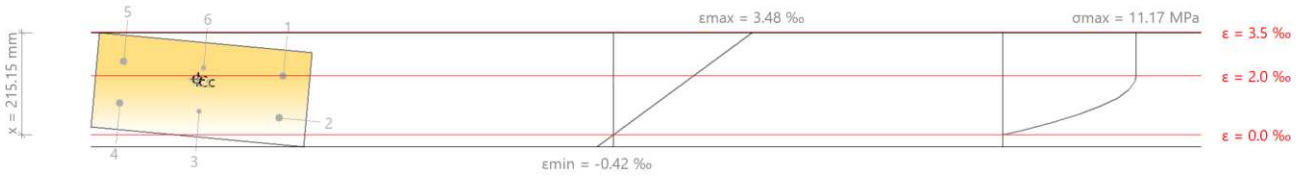
γ_m: Partial safety factor for reinforcing steel. γ_m : *1.15*

(e) The general force equilibrium and moment equations are applied to the resulting stress forces of the section.

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

Ultimate force balance of the section, calculated with the same eccentricities as the worst-case design forces:



Bar	Designation	X Coord. (mm)	Y Coord. (mm)	f_s (MPa)	ε
1	Ø16	-44.00	169.00	+396.76	+0.001984
2	Ø16	44.00	169.00	+113.13	+0.000566
3	Ø12	46.00	0.00	+157.83	+0.000789
4	Ø16	44.00	-169.00	+215.42	+0.001077
5	Ø16	-44.00	-169.00	+434.78	+0.002495
6	Ø12	-46.00	0.00	+434.78	+0.002272

	Resultant (kN)	e.x (mm)	e.y (mm)
Cc	770.56	-20.14	-10.03
Cs	300.27	-19.62	-15.88
T	0.00	0.00	0.00

N_{Rd} : *1070.83* kN

$M_{Rd,x}$: *-12.50* kN·m

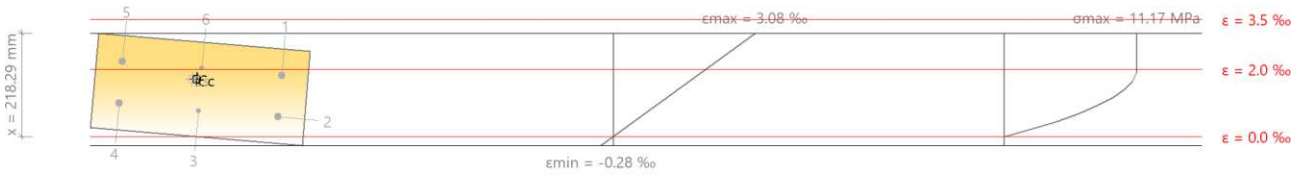
$M_{Rd,y}$: *-21.41* kN·m

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

Where:

C_c: Resultant of concrete compressive forces.	**C_c** :	*770.56*	kN
C_s: Resultant of steel compressive forces.	**C_s** :	*300.27*	kN
T: Resultant of steel tensile forces.	**T** :	*0.00*	kN
e_{cc}: Eccentricity of the concrete compressive forces in the direction of the X and Y axes.	**$e_{cc,x}$** :	*-20.14*	mm
	$e_{cc,y}$:	*-10.03*	mm
e_{cs}: Eccentricity of the steel compressive forces in the direction of the X and Y axes.	**$e_{cs,x}$** :	*-19.62*	mm
	$e_{cs,y}$:	*-15.88*	mm
e_T: Eccentricity of the steel tensile forces in the direction of the X and Y axes.	**e_T** :	*0.00*	mm
ε_{cmax}: Deformation of the most compressed concrete fibre.	**ε_{cmax}** :	*0.0035*	
ε_{smax}: Deformation of the steel bar with greatest tension.	**ε_{smax}** :	*0.0000*	
σ_{cmax}: Stress of the most compressed concrete fibre.	**σ_{cmax}** :	*11.17*	MPa
σ_{smax}: Stress of the steel bar with greatest tension.	**σ_{smax}** :	*0.00*	MPa

Worst-case force balance of the section:



Bar	Designation	X Coord. (mm)	Y Coord. (mm)	f_s (MPa)	ε
1	Ø16	-44.00	169.00	+362.55	+0.001813
2	Ø16	44.00	169.00	+115.20	+0.000576
3	Ø12	46.00	0.00	+150.72	+0.000754
4	Ø16	44.00	-169.00	+197.48	+0.000987
5	Ø16	-44.00	-169.00	+434.78	+0.002224
6	Ø12	-46.00	0.00	+409.31	+0.002047

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

	Resultant (kN)	e.x (mm)	e.y (mm)
Cc	762.70	-20.13	-9.18
Cs	286.52	-19.66	-18.32
T	0.00	0.00	0.00

N_{Ed} : *1049.22* kN

$M_{Ed,x}$: *-12.25* kN·m

$M_{Ed,y}$: *-20.98* kN·m

Where:

- C_c: Resultant of concrete compressive forces. — C_c : *762.70* kN
- C_s: Resultant of steel compressive forces. — C_s : *286.52* kN
- T: Resultant of steel tensile forces. — T : *0.00* kN
- e_{cc}: Eccentricity of the concrete compressive forces in the direction of the X and Y axes. — $e_{cc,x}$: *-20.13* mm; $e_{cc,y}$: *-9.18* mm
- e_{cs}: Eccentricity of the steel compressive forces in the direction of the X and Y axes. — $e_{cs,x}$: *-19.66* mm; $e_{cs,y}$: *-18.32* mm
- e_T: Eccentricity of the steel tensile forces in the direction of the X and Y axes. — e_T : *0.00* mm
- ε_{cmax}: Deformation of the most compressed concrete fibre. — ε_{cmax} : *0.0031*
- ε_{smax}: Deformation of the steel bar with greatest tension. — ε_{smax} : *0.0000*
- σ_{cmax}: Stress of the most compressed concrete fibre. — σ_{cmax} : *11.17* MPa
- σ_{smax}: Stress of the steel bar with greatest tension. — σ_{smax} : *0.00* MPa

S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

Reference: C6 -Details: 2250 x 2250 x 550 -Reinforcement: Xi:Ø12@160 Yi:Ø12@160		
Code checks	Values	Status
Pressures on the soil: *Criteria of CYPE*		
- Mean stress in persistent situations:	Maximum: 0.130 MPa Calculated: 0.129 MPa	Verified
- Maximum stress in persistent situations:	Maximum: 0.162 MPa Calculated: 0.137 MPa	Verified
Overturning of footing: *If the safety reserve % is greater than zero, then the overturning safety factors are greater than those strictly required for all equilibrium combinations.*		
- In X direction:	Safety reserve: 8665.8 %	Verified
- In Y direction:	Safety reserve: 9000.8 %	Verified
Bending in the pad footing:		
- In X direction:	Moment: 210.18 kN·m	Verified
- In Y direction:	Moment: 161.77 kN·m	Verified
Shear in the footing:		
- In X direction:	Shear: 215.43 kN	Verified
- In Y direction:	Shear: 165.00 kN	Verified
Oblique compression in the footing: - Persistent situations: *Criteria of CYPE*	Maximum: 5000 kN/m² Calculated: 1590.8 kN/m²	Verified
Tangential stress in the critical punching shear perimeter: - Persistent situations: *Code IS 456: 2000. Clause 31.6.3*	Maximum: 1180.5 kN/m² Calculated: 428.1 kN/m²	Verified
Minimum depth: *Code IS 456: 2000. Clause 34.1.2*	Minimum: 15 cm Calculated: 55 cm	Verified
Space to anchor starter bars in foundation: - C6:	Minimum: 22 cm Calculated: 48 cm	Verified
Minimum geometric ratio: *Code IS 456: 2000. Clause 26.5.2.1*	Minimum: 0.0012	
- Bottom reinf. X direction:	Calculated: 0.0013	Verified
- In X direction:	Calculated: 0.0013	Verified
- Bottom reinf. Y direction:	Calculated: 0.0013	Verified
- In Y direction:	Calculated: 0.0013	Verified

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

Reference: C6
-Details: 2250 x 2250 x 550
-Reinforcement: Xi:Ø12@160 Yi:Ø12@160

Code checks	Values	Status
Minimum diameter of the bars:		
- Bottom reinforcement mesh:	Minimum: 10 mm	
Criteria of CYPE	Calculated: 12 mm	Verified
Maximum bar spacing:		
Code IS 456: 2000. Clause 26.3.3	Maximum: 30 cm	
- Bottom reinf. X direction:	Calculated: 16 cm	Verified
- Bottom reinf. Y direction:	Calculated: 16 cm	Verified
Minimum bar spacing:		
Criteria of CYPE	Minimum: 10 cm	
- Bottom reinf. X direction:	Calculated: 16 cm	Verified
- Bottom reinf. Y direction:	Calculated: 16 cm	Verified
Anchorage length:		
CYPE criteria, based on: 'IS 456: 2000. Clause 26.1'		
- Bott. reinf. X direction toward rgt:	Minimum: 43 cm Calculated: 53 cm	Verified
- Bott. reinf. X direction toward lft:	Minimum: 40 cm Calculated: 53 cm	Verified
- Bott. reinf. Y direction upwards:	Minimum: 33 cm Calculated: 59 cm	Verified
- Bott. reinf. Y direction downwards:	Minimum: 31 cm Calculated: 59 cm	Verified
Minimum length of the bends:	Minimum: 19 cm	
- Bott. reinf. Y direction upwards:	Calculated: 19 cm	Verified
- Bott. reinf. Y direction downwards:	Calculated: 19 cm	Verified

All the checks have been verified

Additional information:
- Worst failure ratio (In X direction): 0.75
- Worst failure ratio (In Y direction): 0.58
- Failure shear (In X direction): 318.43 kN
- Failure shear (In Y direction): 318.43 kN

S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100

PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 16 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE





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

Verified RealEstate
3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai 600 097, India
hello@verified.realestate
+91 9996 12 9996

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.