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 17 Dwelling Units in Villas in plot nos.5&6,19,28,29,30,31,45,55,60,65,69,70,71,79,80,81,97, 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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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.

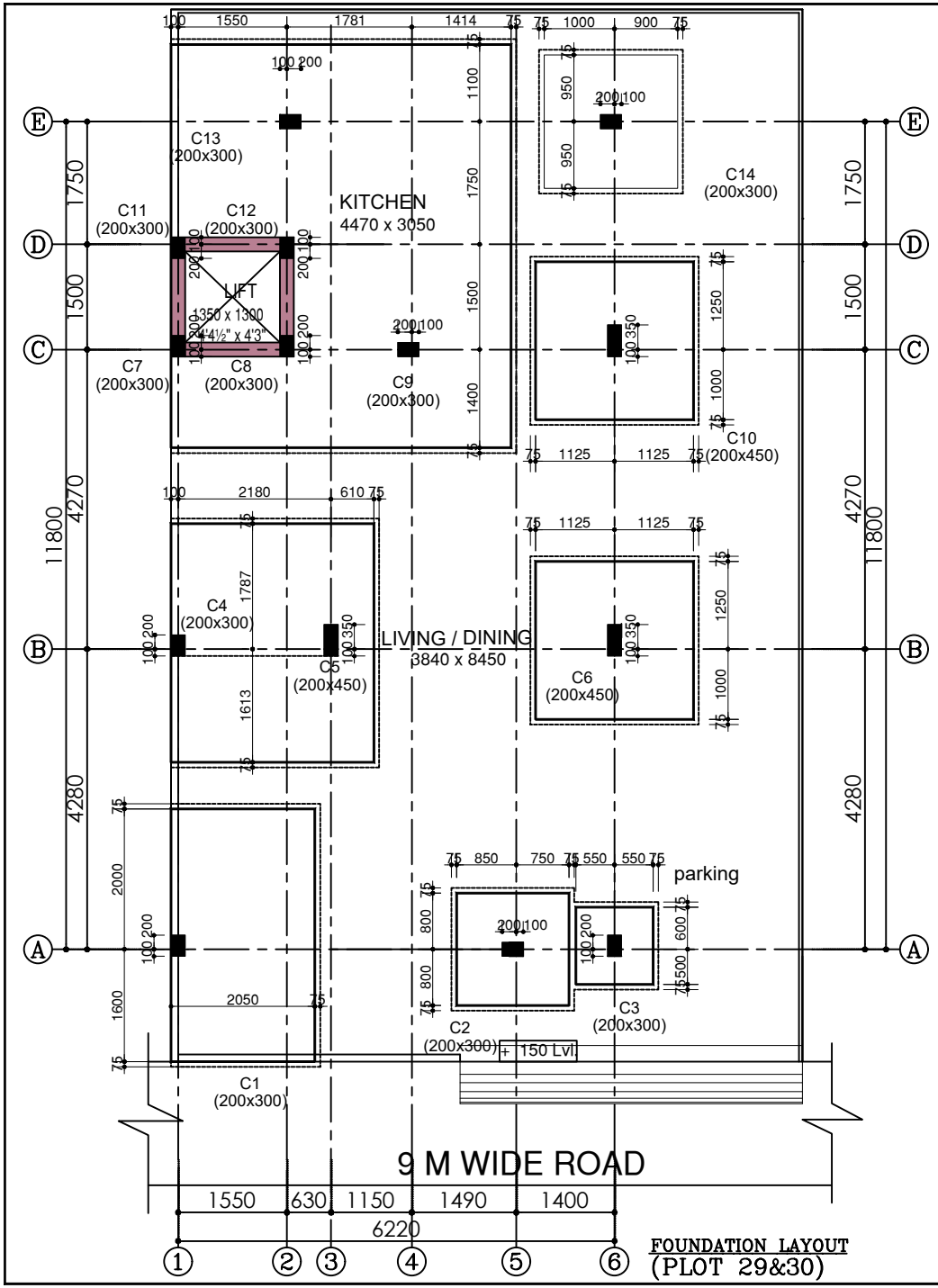
This Registration is valid upto **06-May-2029**.

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

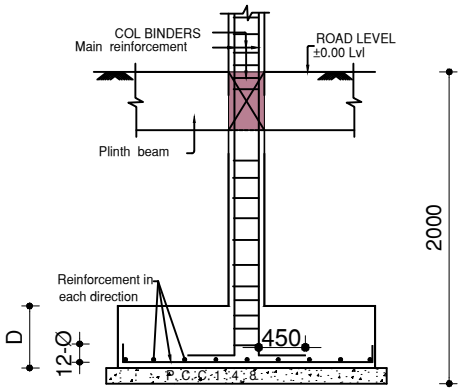


A Meganathan

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

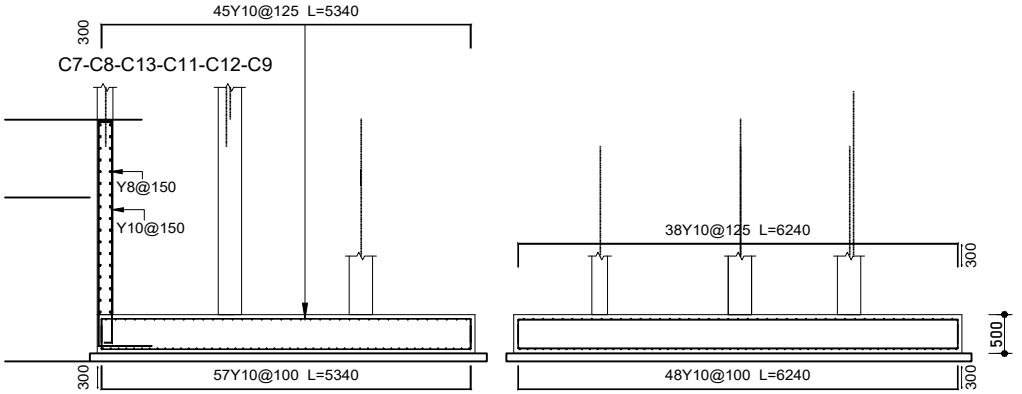
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

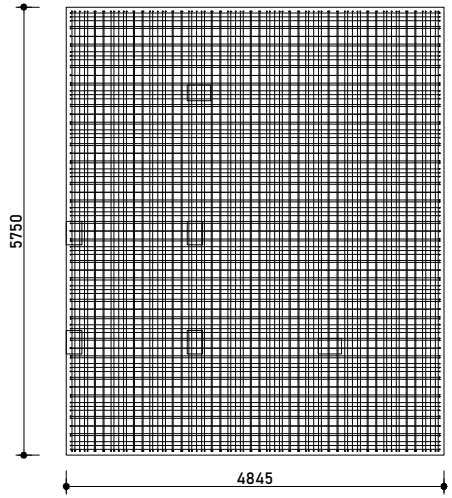
SITE: 'VILLA ENCHANTE'
AYANAMBAKKAM, CHENNAI

TITLE: FOUNDATION LAYOUT
(PLOT 29&30)

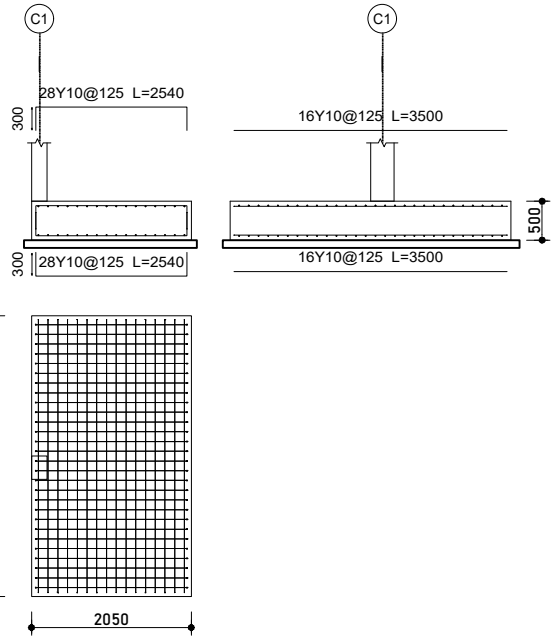
| SCALE AT A1: | DATE: | DRAWN: | CHECKED: |
|---|---|---|---|
| 1:50, 1:100 | 10/10/2025 | MV | SMS |

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

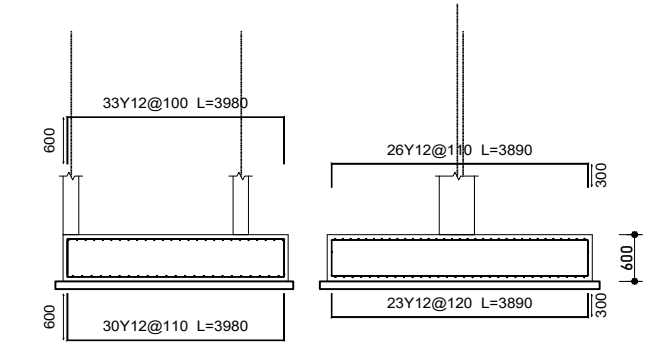


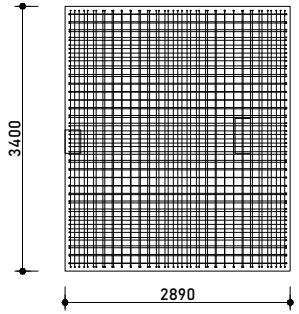




C1




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

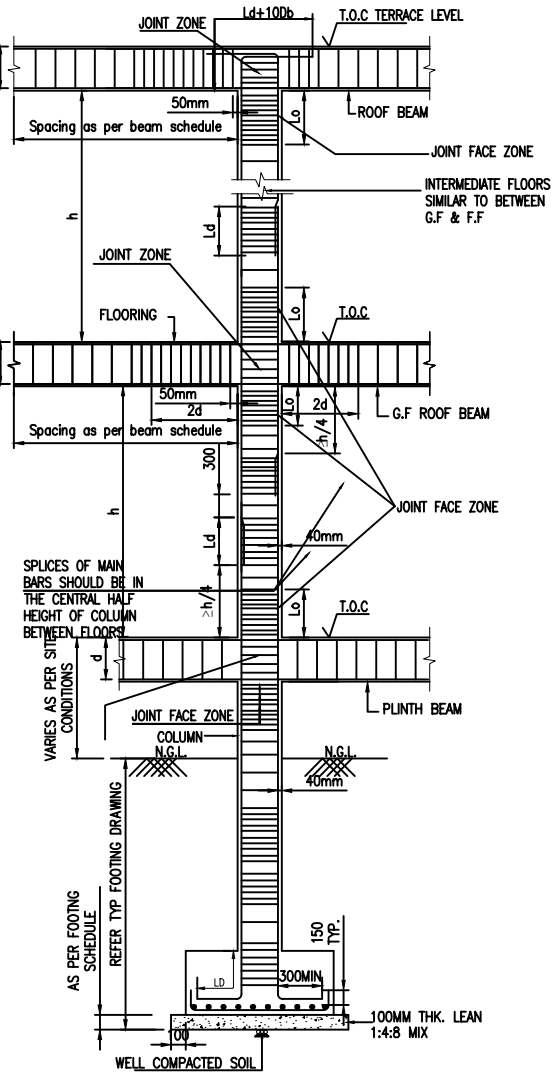
TITLE:
FOUNDATION LAYOUT
(PLOT 29&30)

| 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<br>120 220<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y16 Y12 450 200<br>120 370<br>1Y8(1070)<br>Long. Reinf.: 4Y16+2Y12<br>Stirrups: Y8 @150 | | | | HR-LMR |
| | | | Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y16 Y12 450 200<br>120 370<br>1Y8(1070)<br>Long. Reinf.: 4Y16+2Y12<br>Stirrups: Y8 @150 | | Y12 300 200<br>220 120<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y12 450 200<br>2Y8(250) 120 370<br>1Y8(1070)<br>Long. Reinf.: 8Y12<br>Stirrups: Y8 @150 | TERRACE |
| Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>220 120<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | | Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y16 Y12 450 200<br>120 370<br>1Y8(1070)<br>Long. Reinf.: 4Y16+2Y12<br>Stirrups: Y8 @150 | | Y12 300 200<br>220 120<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y20 Y16 450 200<br>2Y8(260) 120 370<br>1Y8(1080)<br>Long. Reinf.: 4Y20+8Y16<br>Stirrups: Y8 @200 | FLOOR 2 |
| Y16 Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 4Y16+2Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>220 120<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y16 Y12 450 200<br>120 370<br>1Y8(1070)<br>Long. Reinf.: 4Y16+2Y12<br>Stirrups: Y8 @150 | Y12 450 200<br>2Y8(250) 120 370<br>1Y8(1070)<br>Long. Reinf.: 8Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>220 120<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | | FLOOR 1 |
| Y16 Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 4Y16+2Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>220 120<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>120 220<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>Stirrups: Y8 @150 | Y16 Y12 450 200<br>120 370<br>1Y8(1070)<br>Long. Reinf.: 4Y16+2Y12<br>Stirrups: Y8 @150 | Y12 450 200<br>2Y8(250) 120 370<br>1Y8(1070)<br>Long. Reinf.: 8Y12<br>Stirrups: Y8 @150 | Y12 300 200<br>220 120<br>1Y8(770)<br>Long. Reinf.: 6Y12<br>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

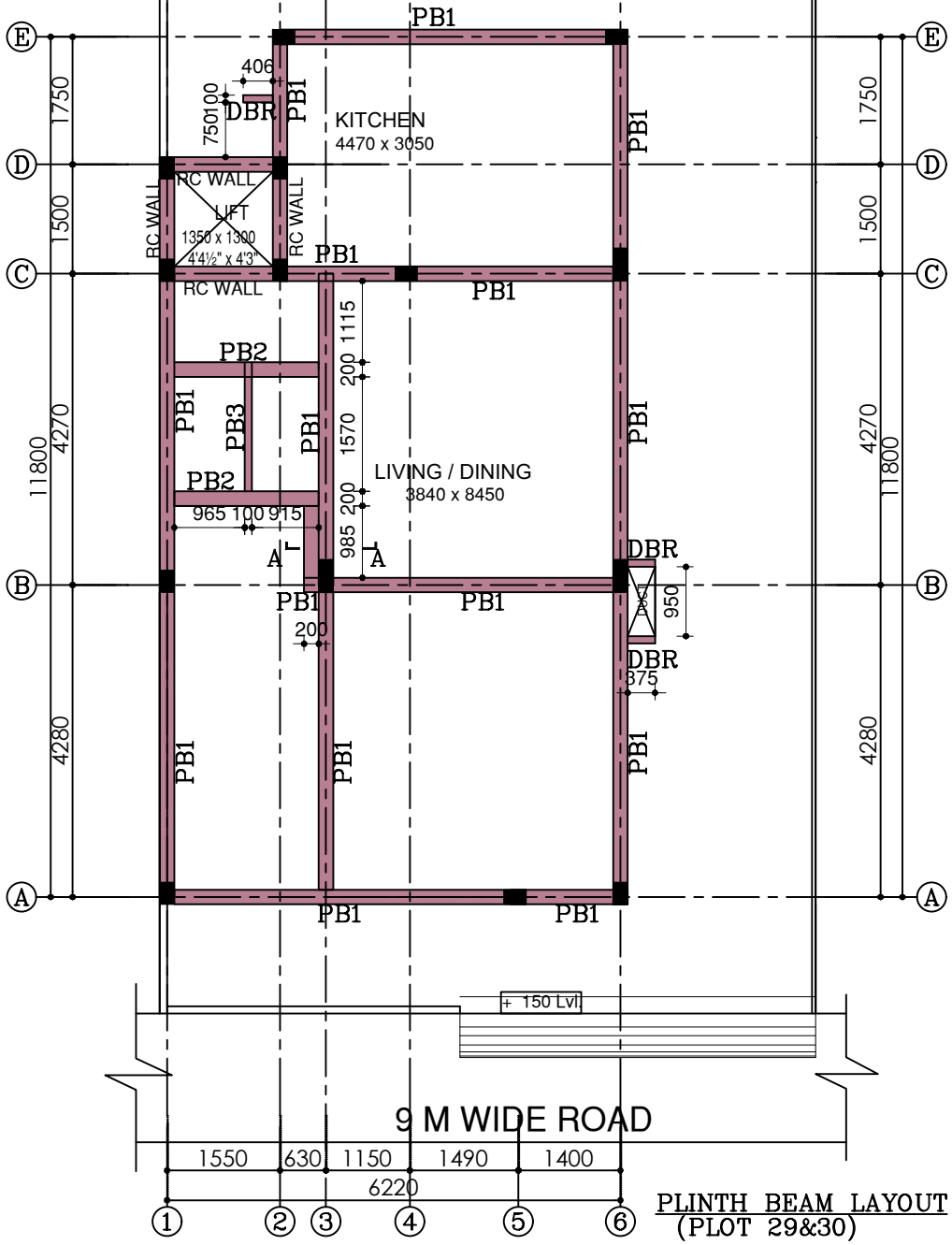

STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com


SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

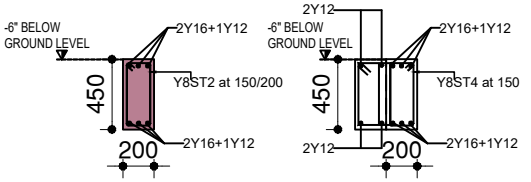
TITLE: FOUNDATION LAYOUT (PLOT 29&30)

| 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 |



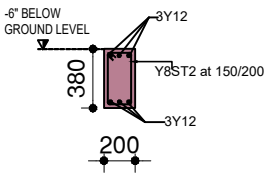

PLINTH BEAM LAYOUT
(PLOT 29&30)



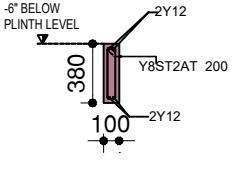

TYPICAL DETAIL OF
PLINTH BEAM PB1



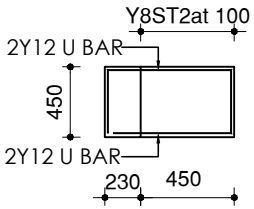

SECTION A-A



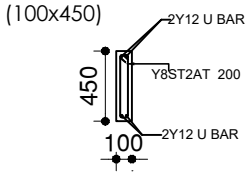

TYPICAL DETAIL OF
PLINTH BEAM PB2



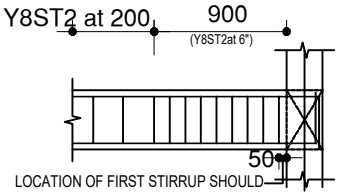

TYPICAL DETAIL OF
PLINTH BEAM PB3




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

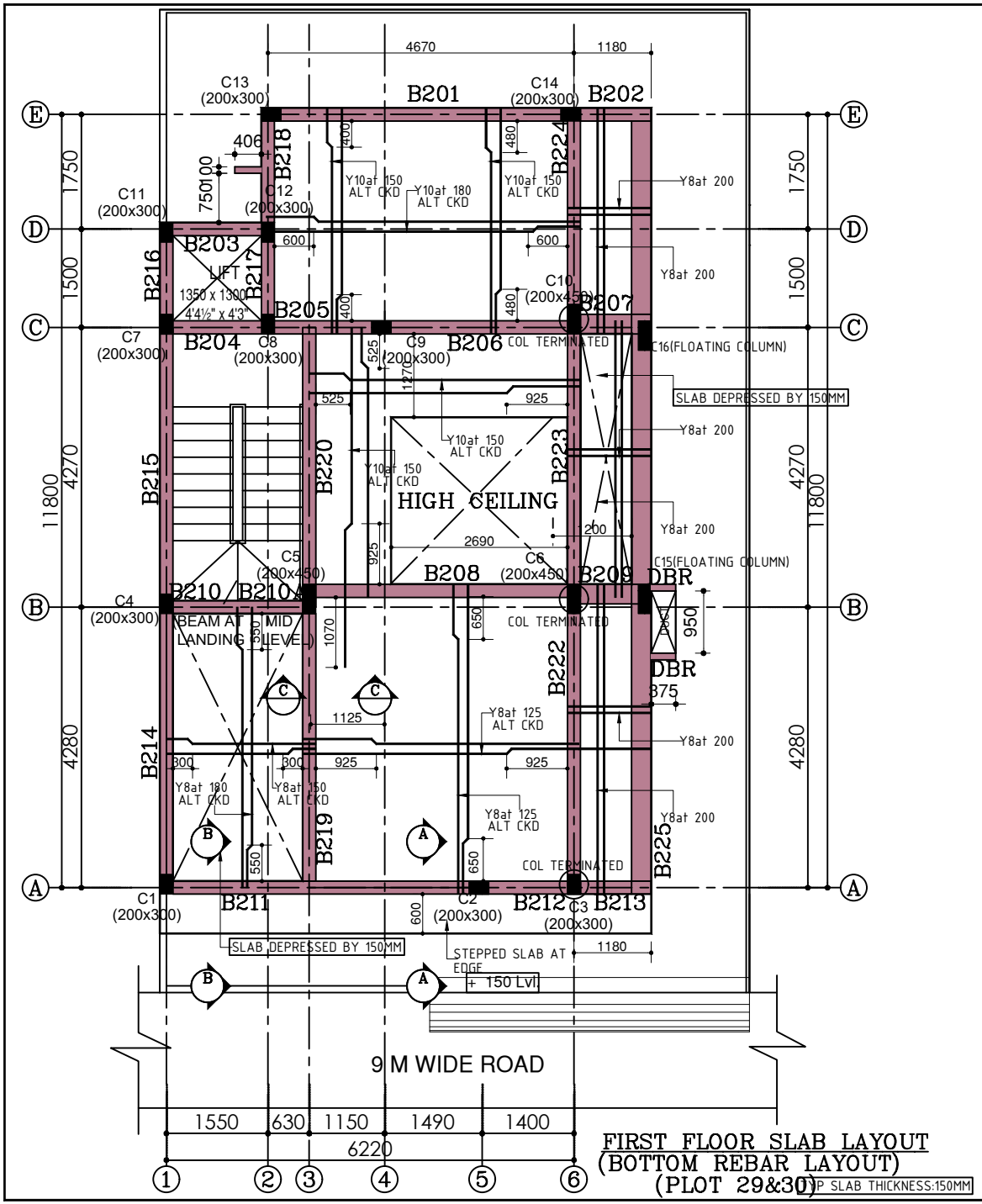
STRUCTURAL ENGINEER:
S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

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

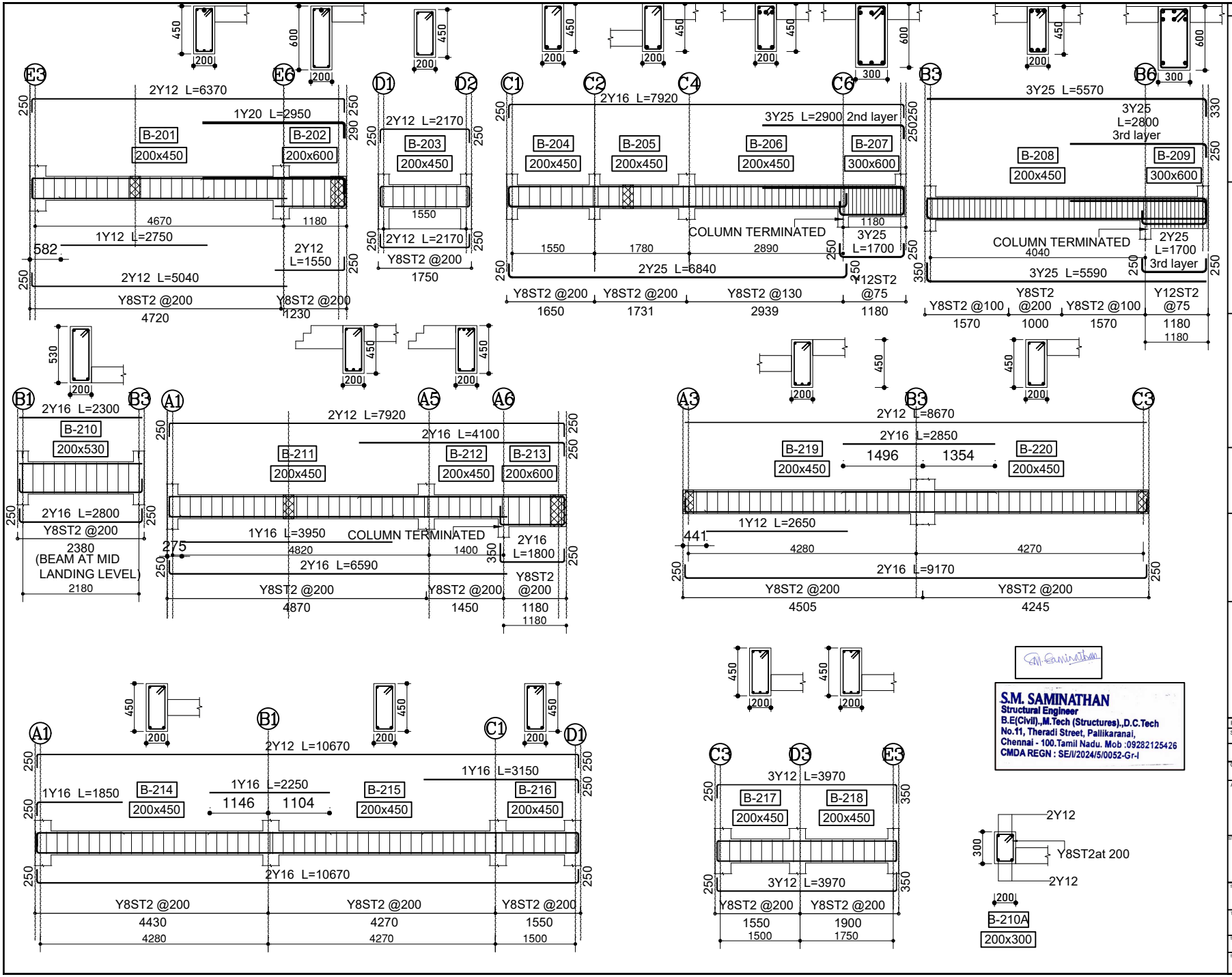
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

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

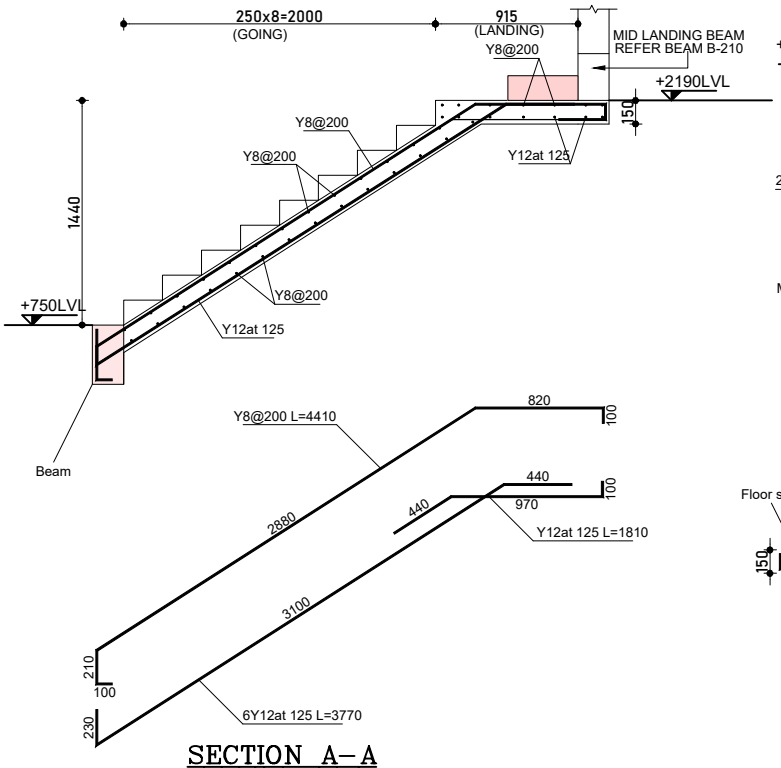

STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL),M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com


SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

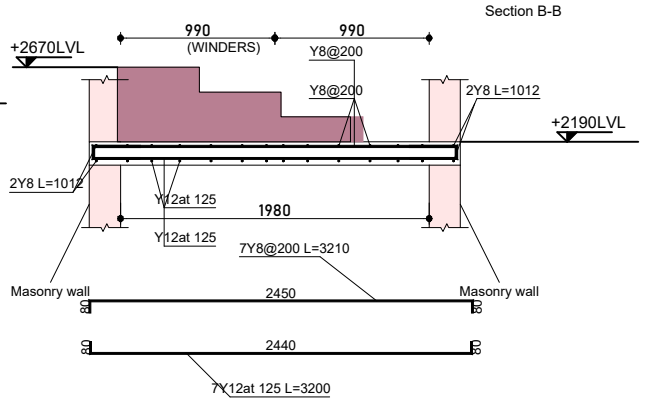
TITLE: FIRST FLOOR SLAB LAYOUT (PLOT 29&30)

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

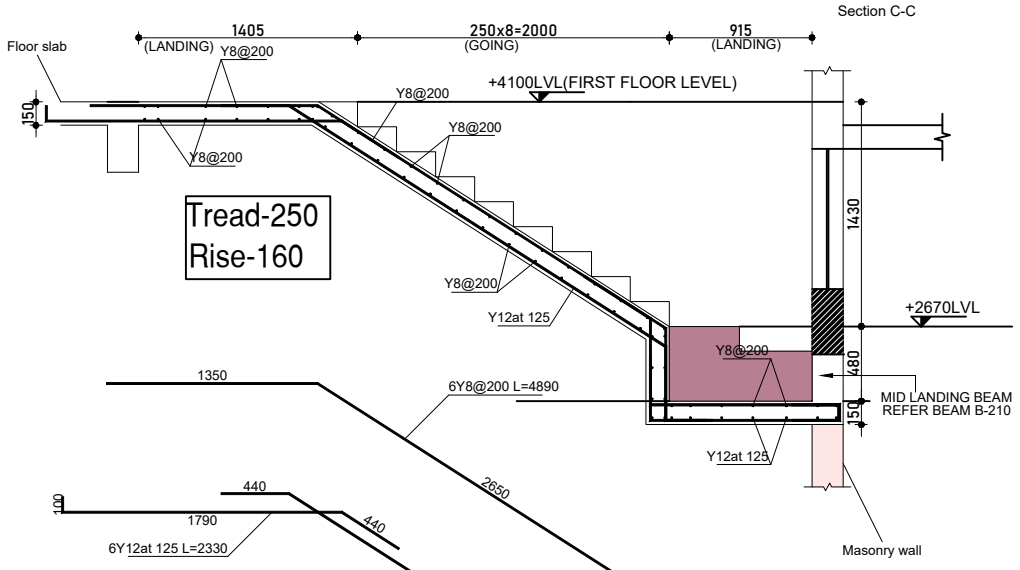
| SHEET NO: | DRAWING NO: | REVISION: |
|---|---|---|
| 3/5 | S&P-ENC-SD-03 | R3 |



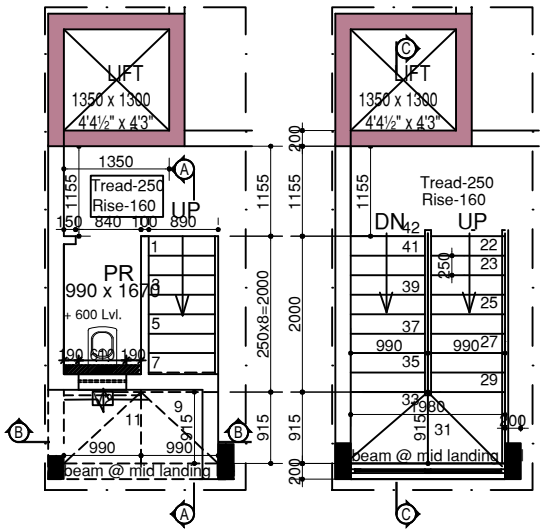

SECTION A–A




SECTION B–B



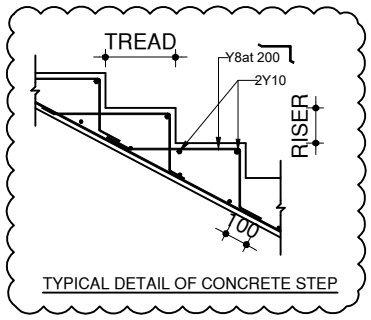

SECTION C–C




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

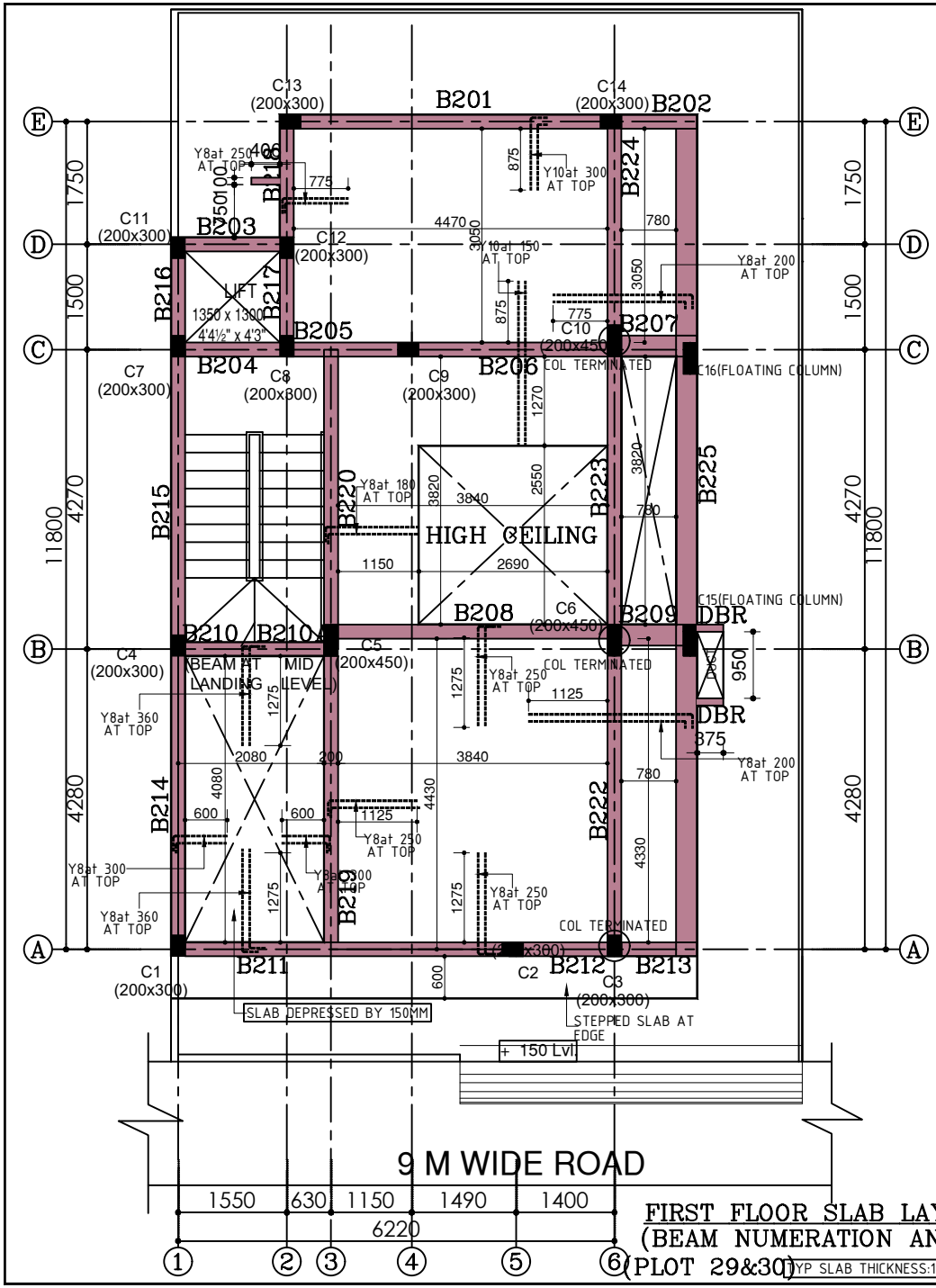

STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL),M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com


SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

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

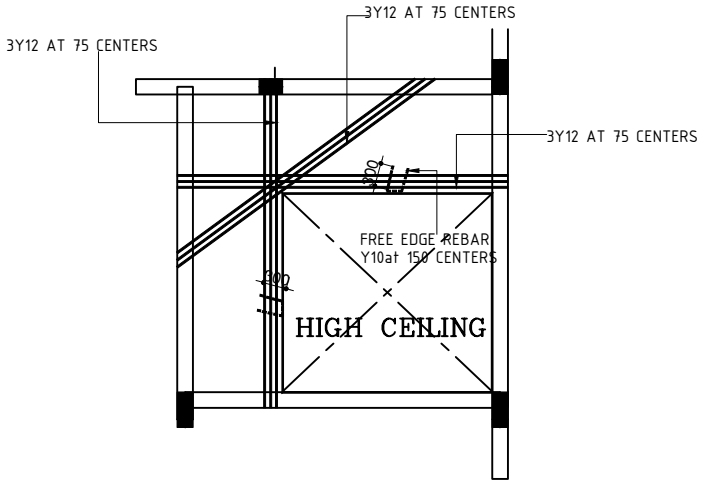
| SCALE AT A1: | DATE: | DRAWN: | CHECKED: |
|---|---|---|---|
| 1:50, 1:100 | 17/10/2025 | MV | SMS |

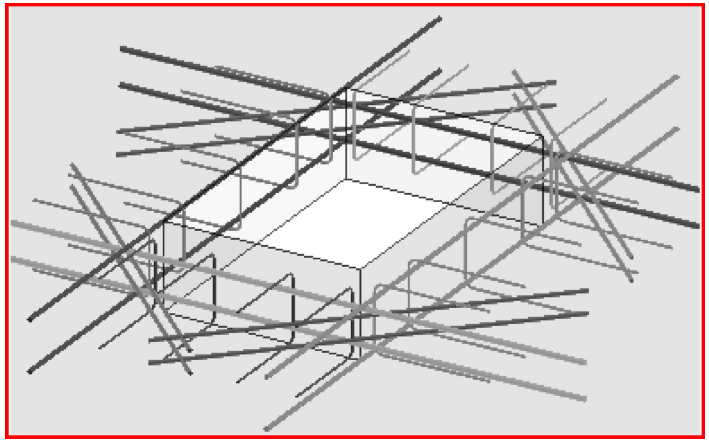
| SHEET NO: | DRAWING NO: | REVISION: |
|---|---|---|
| 5/5 | S&P-ENC-SD-03 | R3 |




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

TYP SLAB THICKNESS:150MM



## HIGH CEILING SLAB REBAR DETAILS

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

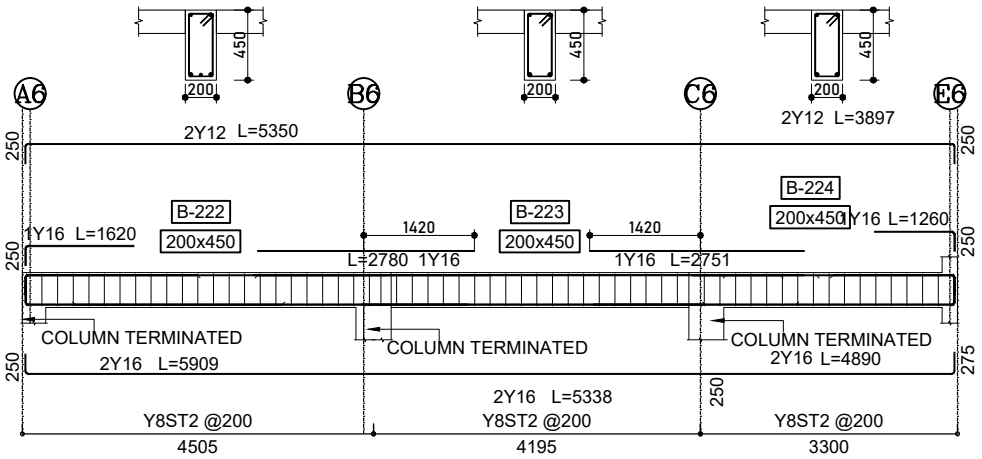

STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

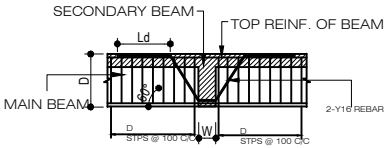

SITE: 'VILLA ENCHNATE' AYANAMBAKKAM,CHENNAI

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

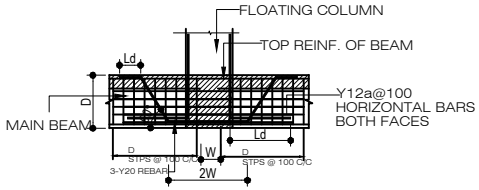
| SCALE AT A1: | DATE: | DRAWN: | CHECKED: |
|---|---|---|---|
| 1:50, 1:100 | 17/10/2025 | MV | SMS |

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

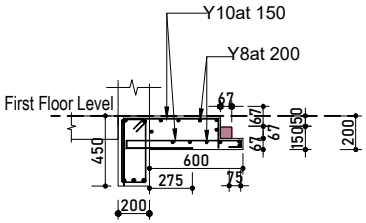


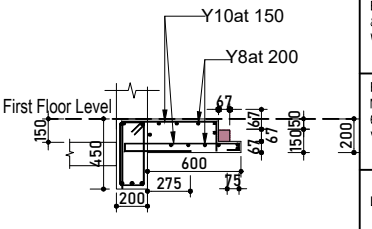

DETAIL AT THE JUNCTION OF MAIN BEAM
SECONDARY BEAM



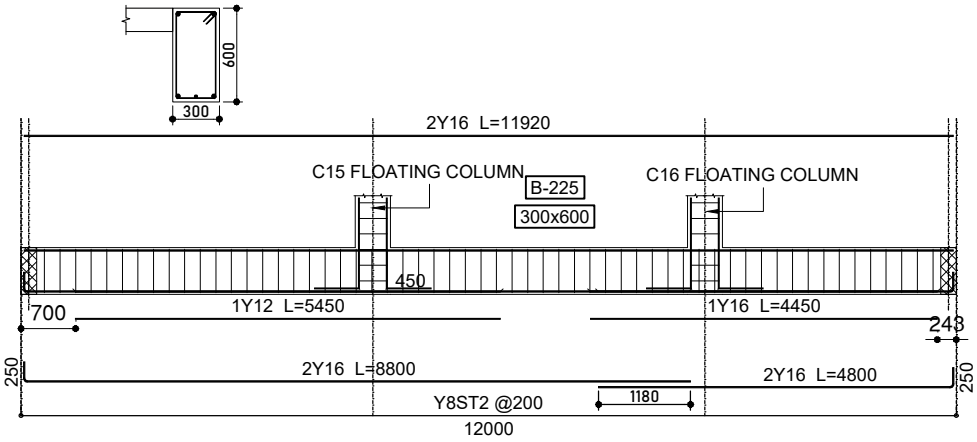

DETAIL AT THE JUNCTION OF MAIN BEAM
AND FLOATING COLUMN

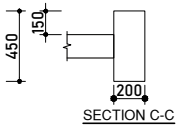



SECTION A-A

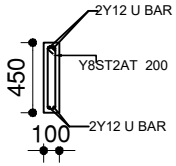



SECTION B-B

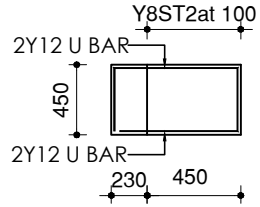



SECTION C-C




# 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

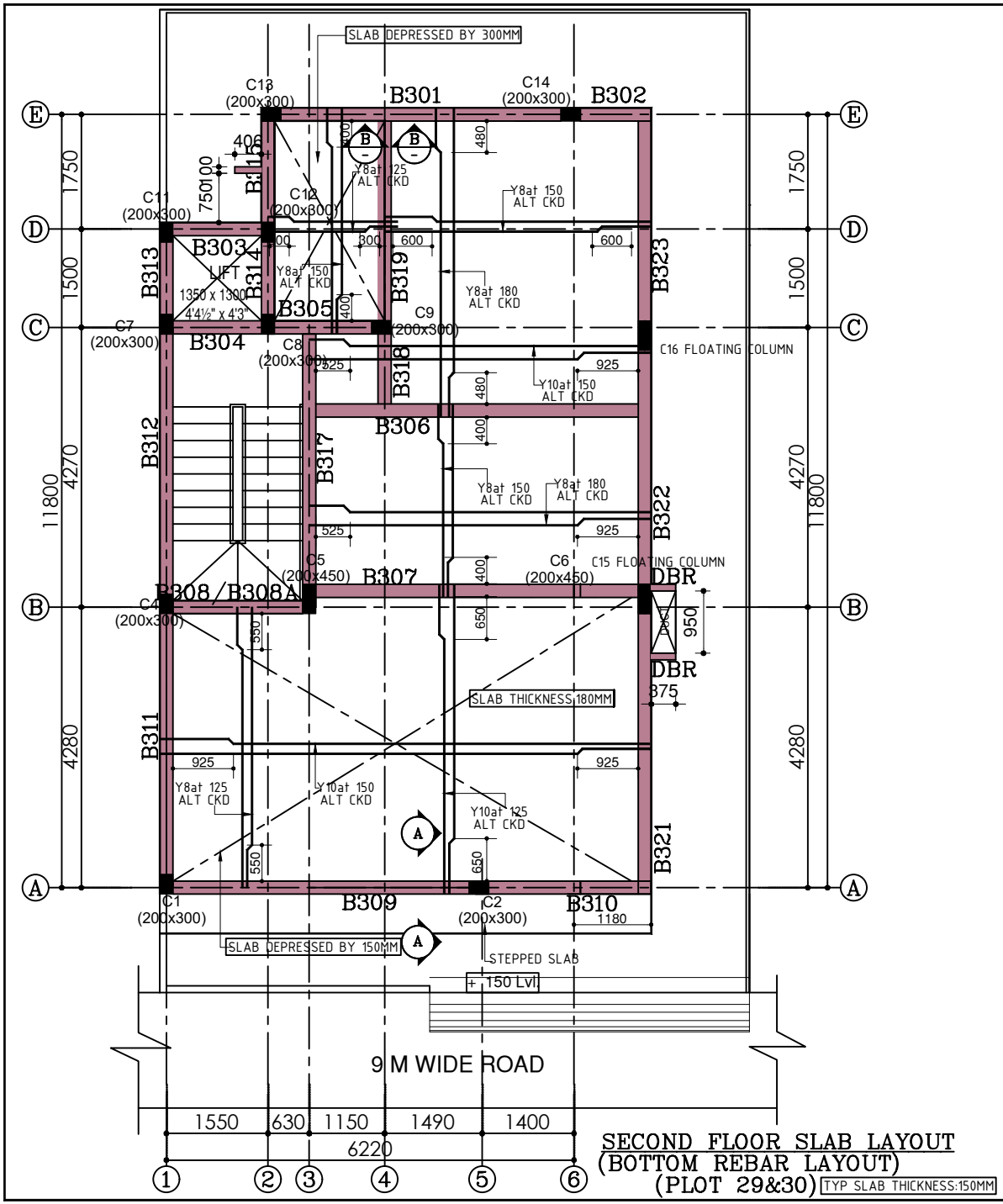
STRUCTURAL ENGINEER: M.S.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

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

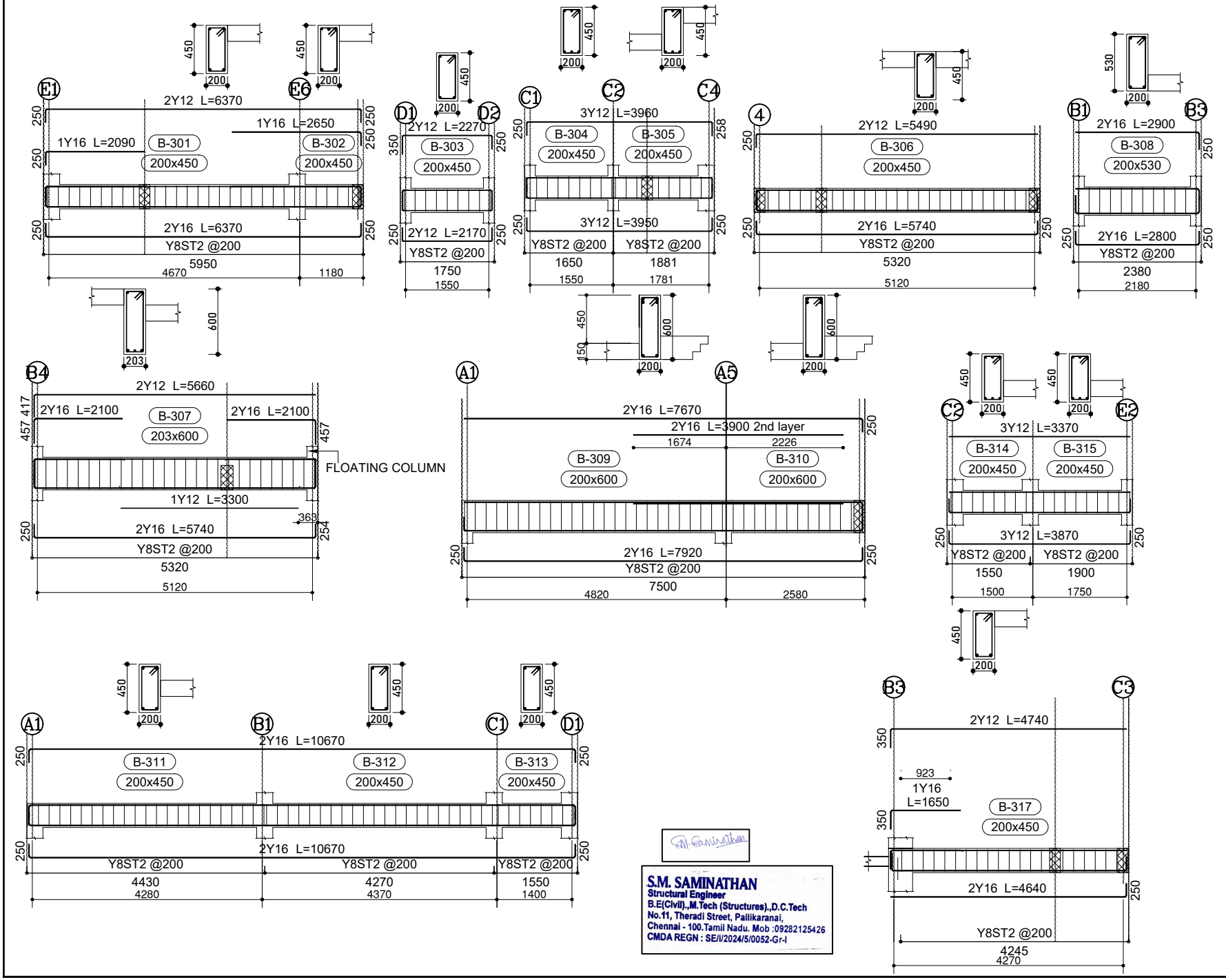
S.M. SAMINATHAN
Structural Engineer
B.E(Civil).,M.Tech (Structures).,D.C.Tech
No.11, Theradi Street, Pallikaranai,
Chennai - 100.Tamil Nadu. Mob :09282125426
CMDA REGN : SE/I/2024/5/0052-Gr-I


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

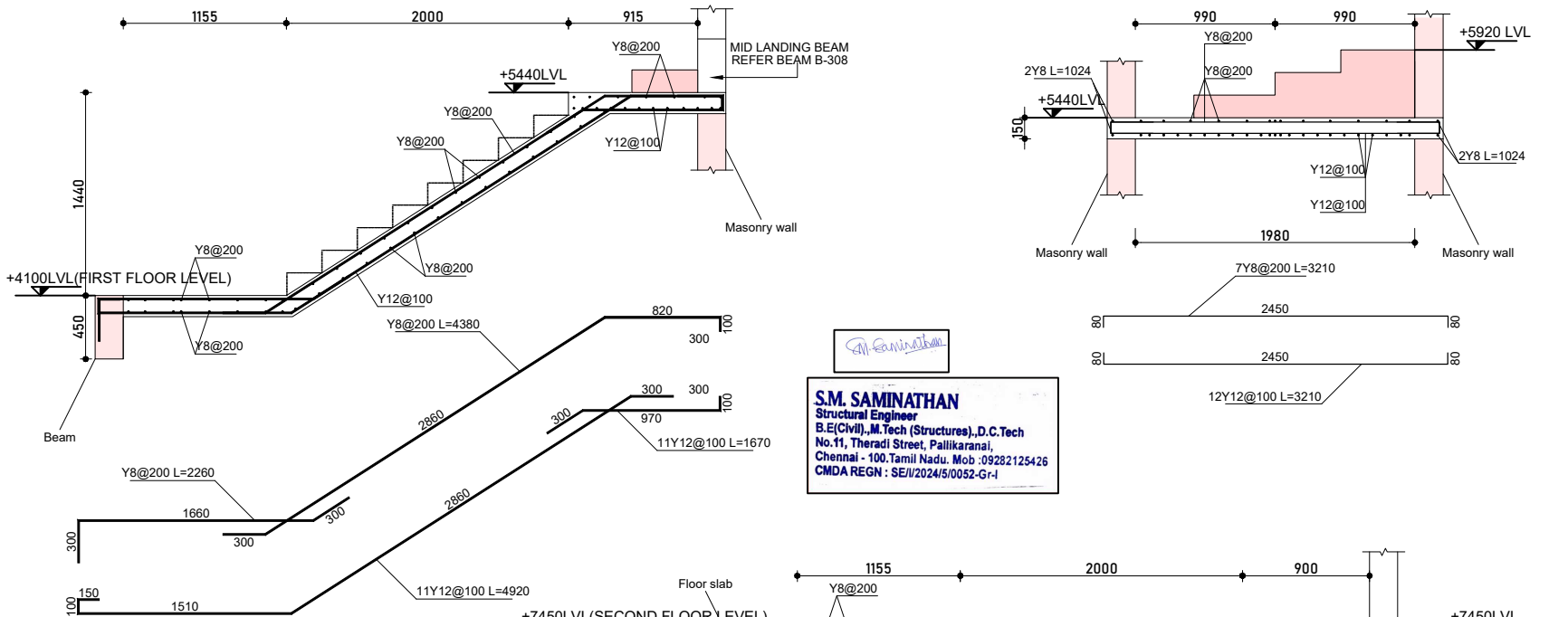
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

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

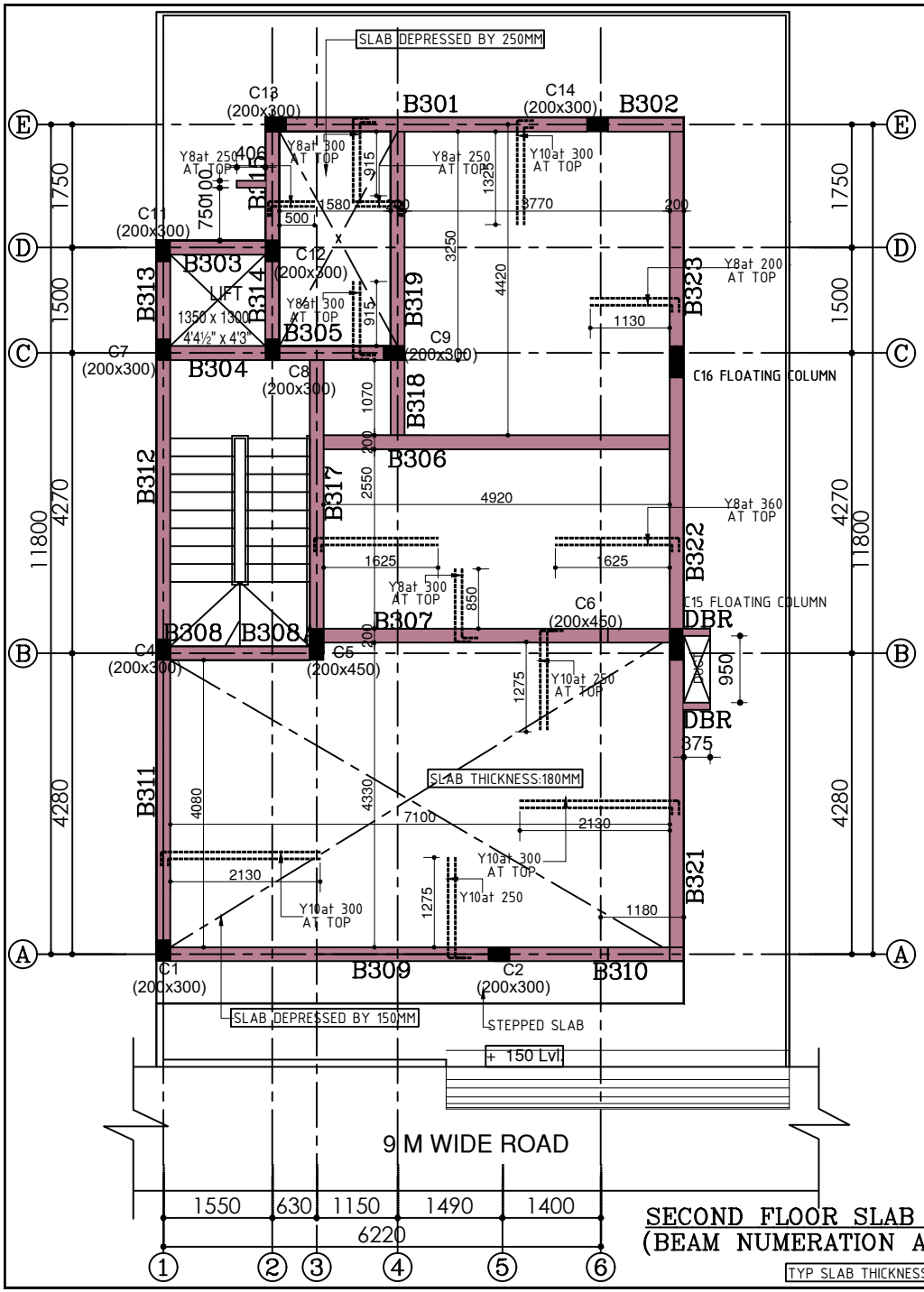
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

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

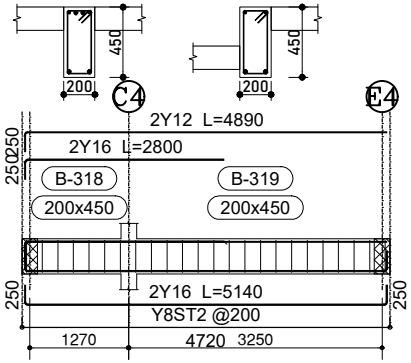
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

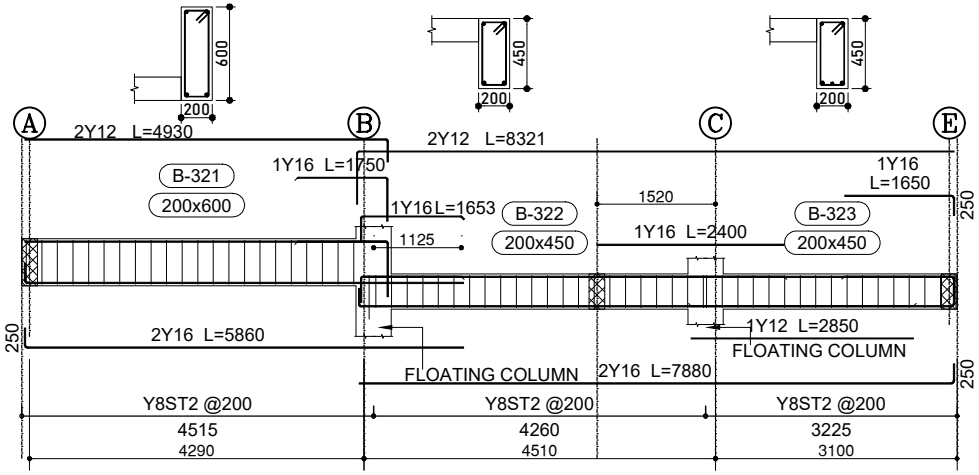
SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

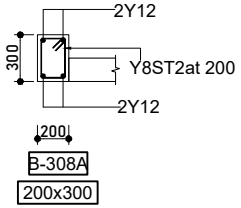
TITLE: SECOND FLOOR SLAB LAYOUT (PLOT 29&30)

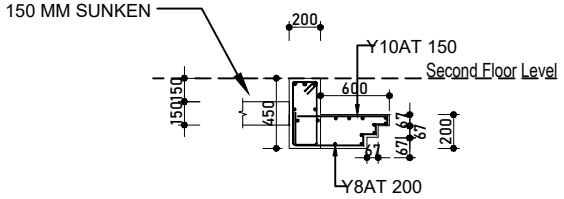
| SCALE AT A1: | DATE: | DRAWN: | CHECKED: |
|---|---|---|---|
| 1:50, 1:100 | 17/10/2025 | MV | SMS |

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



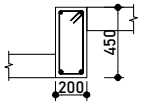



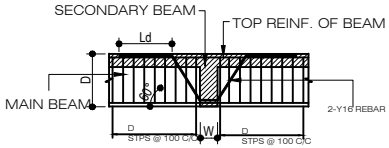




SECTION A–A

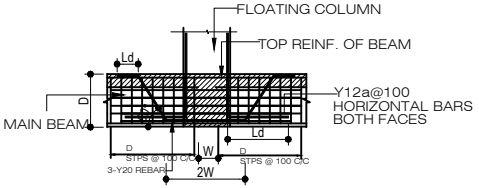
TYPICAL STEPPED SLAB DETAILS (ELEVATION FEATURE)



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

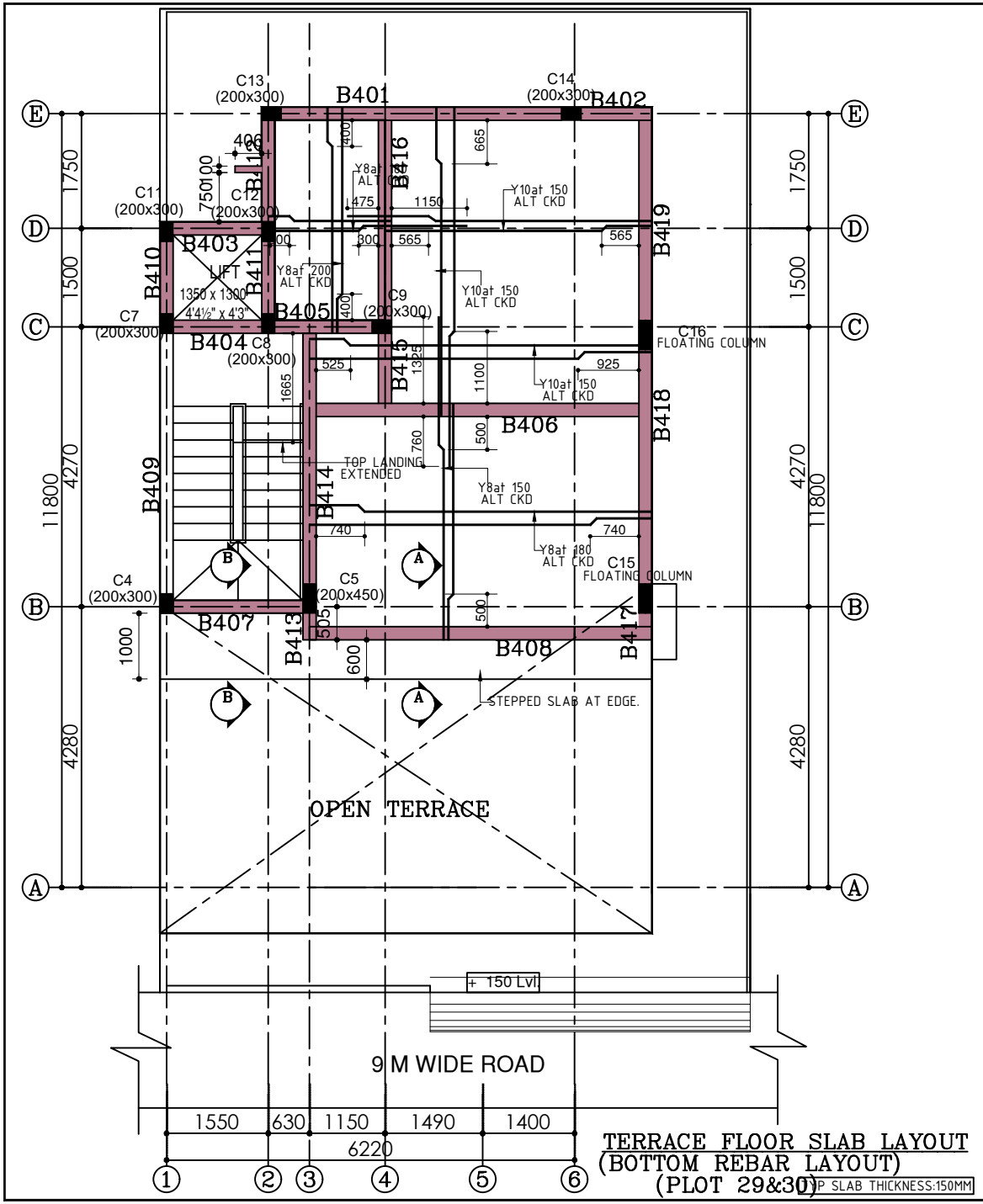

STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com


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

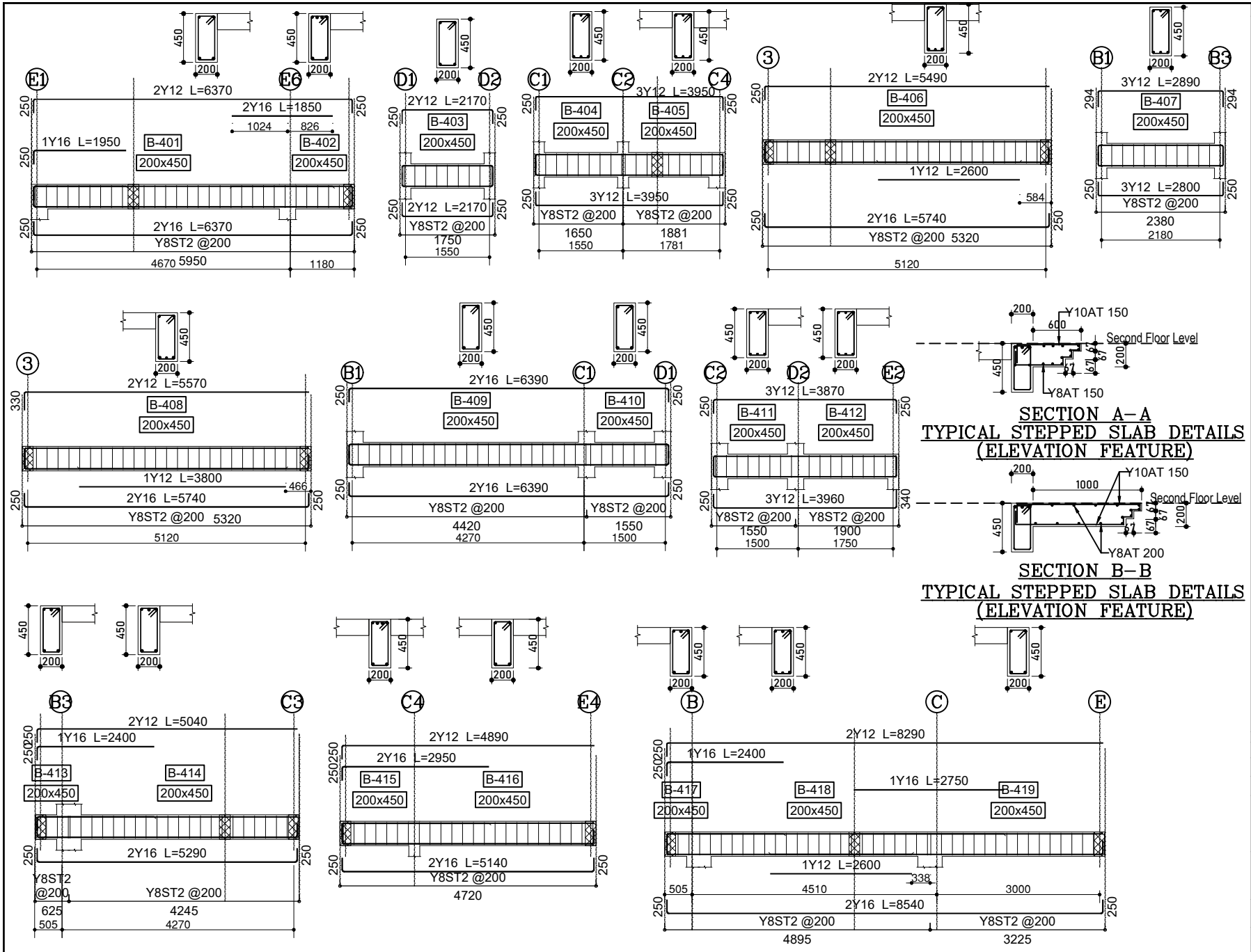
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

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

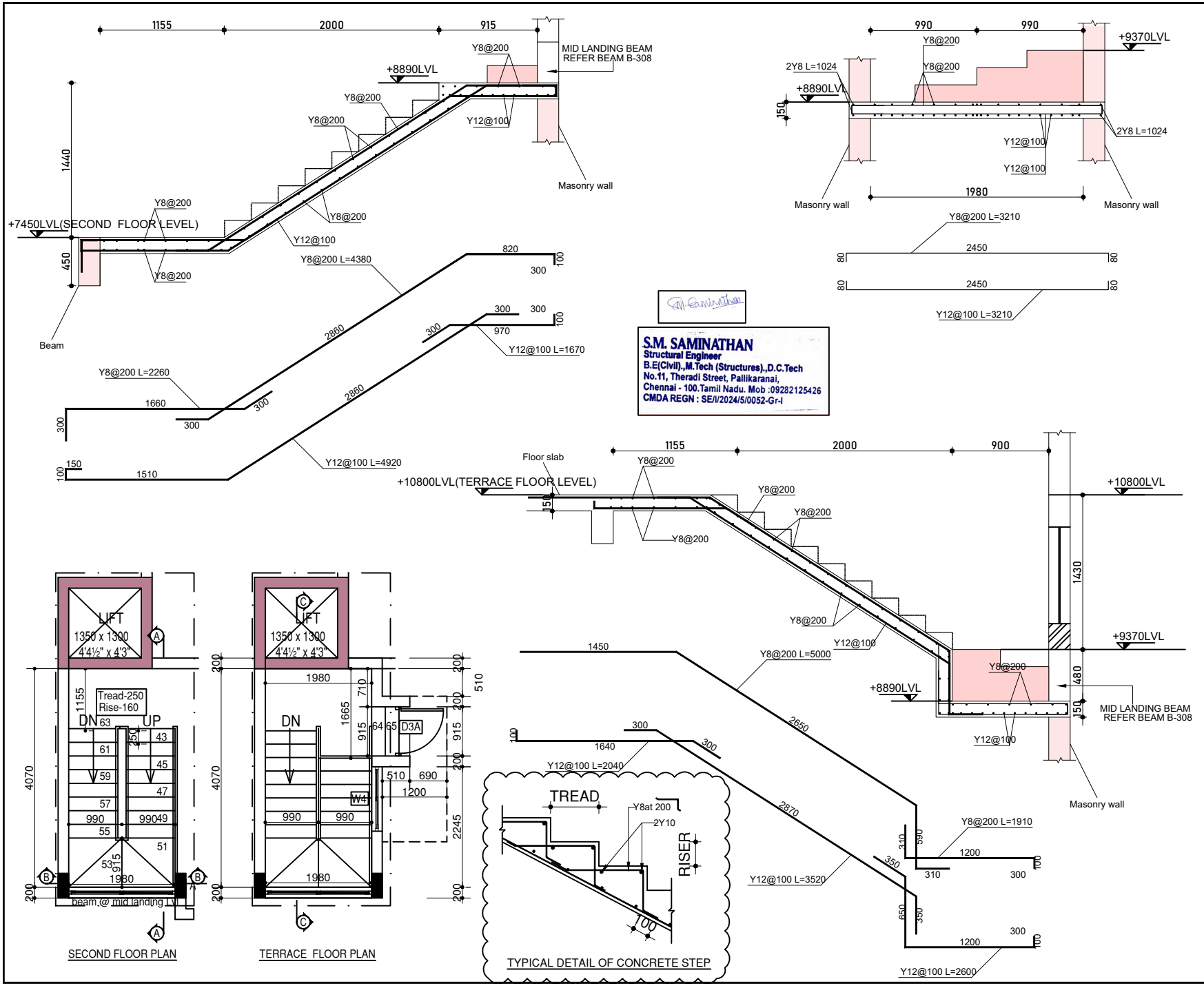
STRUCTURAL ENGINEER: M.S.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

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

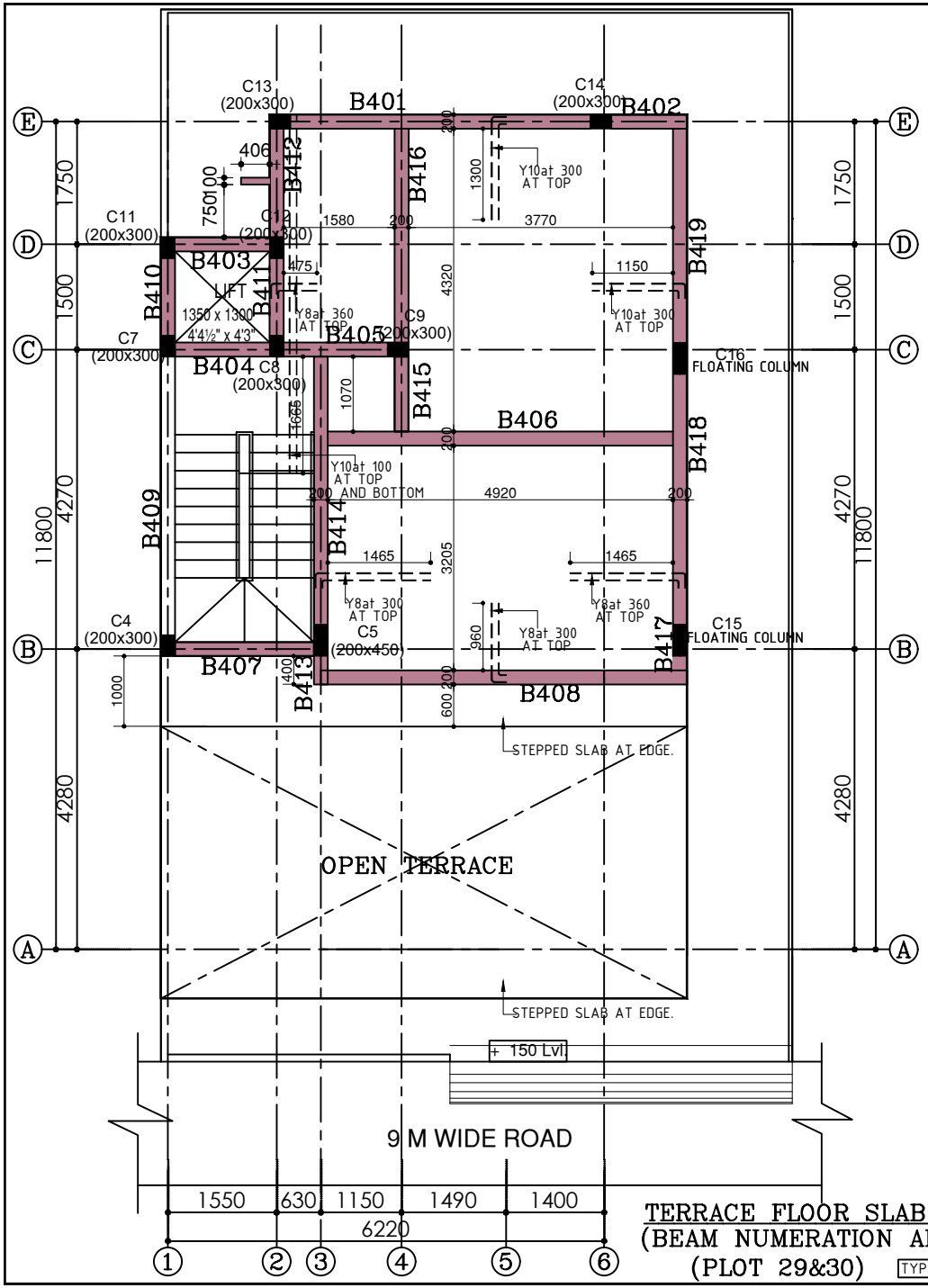
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL),M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI–600100
Mob:9282125426
e–mail:smsaminathan@gmail.com

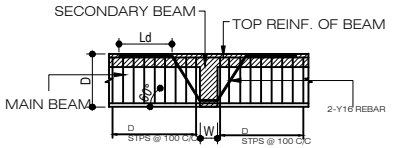
SITE: 'VILLA ENCHANTE'
AYANAMBAKKAM,CHENNAI

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

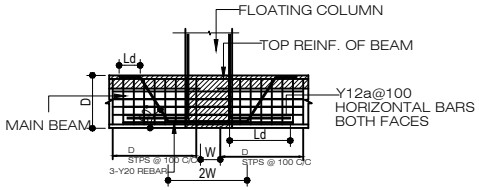
| SCALE AT A1: | DATE: | DRAWN: | CHECKED: |
|---|---|---|---|
| 1:50, 1:100 | 17/10/2025 | MV | SMS |

| 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

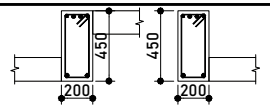
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

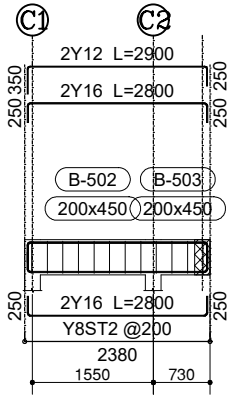
SITE: 'VILLA ENCHANTE' AYANAMBAKKAM,CHENNAI

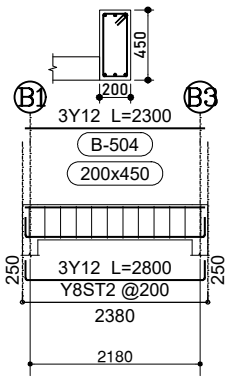
TITLE: TERRACE FLOOR SLAB LAYOUT (PLOT 29&30)

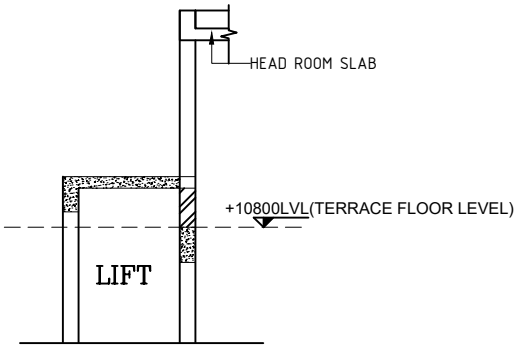
| SCALE AT A1: | DATE: | DRAWN: | CHECKED: |
|---|---|---|---|
| 1:50, 1:100 | 17/10/2025 | MV | SMS |

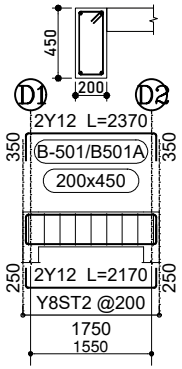
| SHEET NO: | DRAWING NO: | REVISION: |
|---|---|---|
| 2/4 | S&P-ENC-SD-05 | R3 |

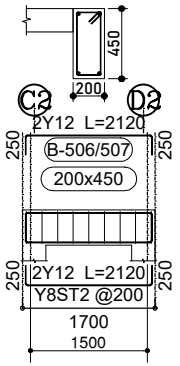


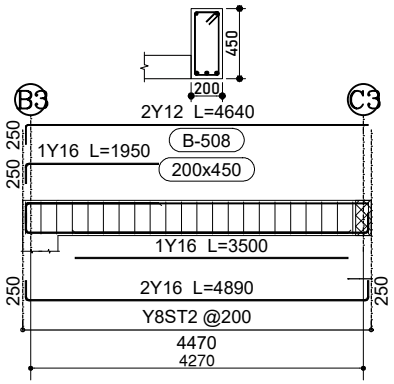



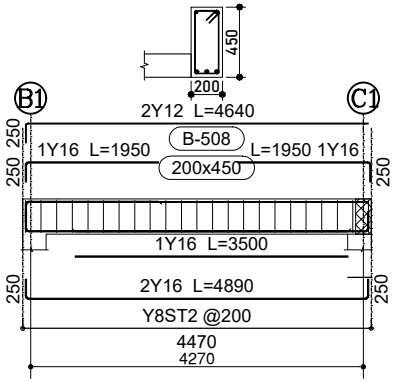



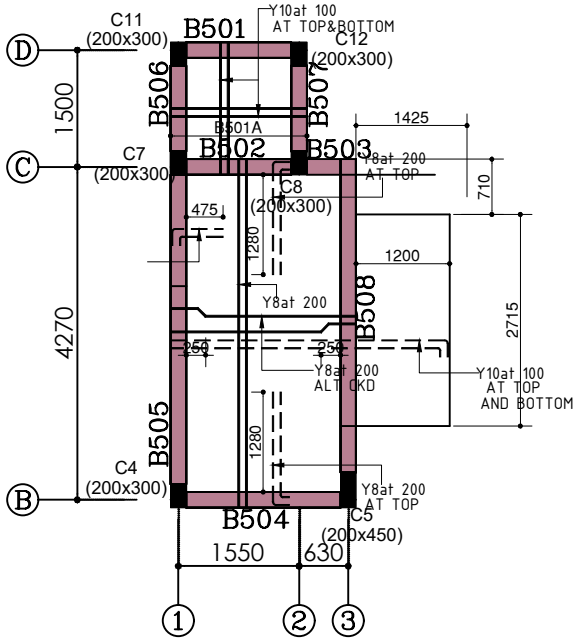




TERRACE FLOOR SLAB LAYOUT

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

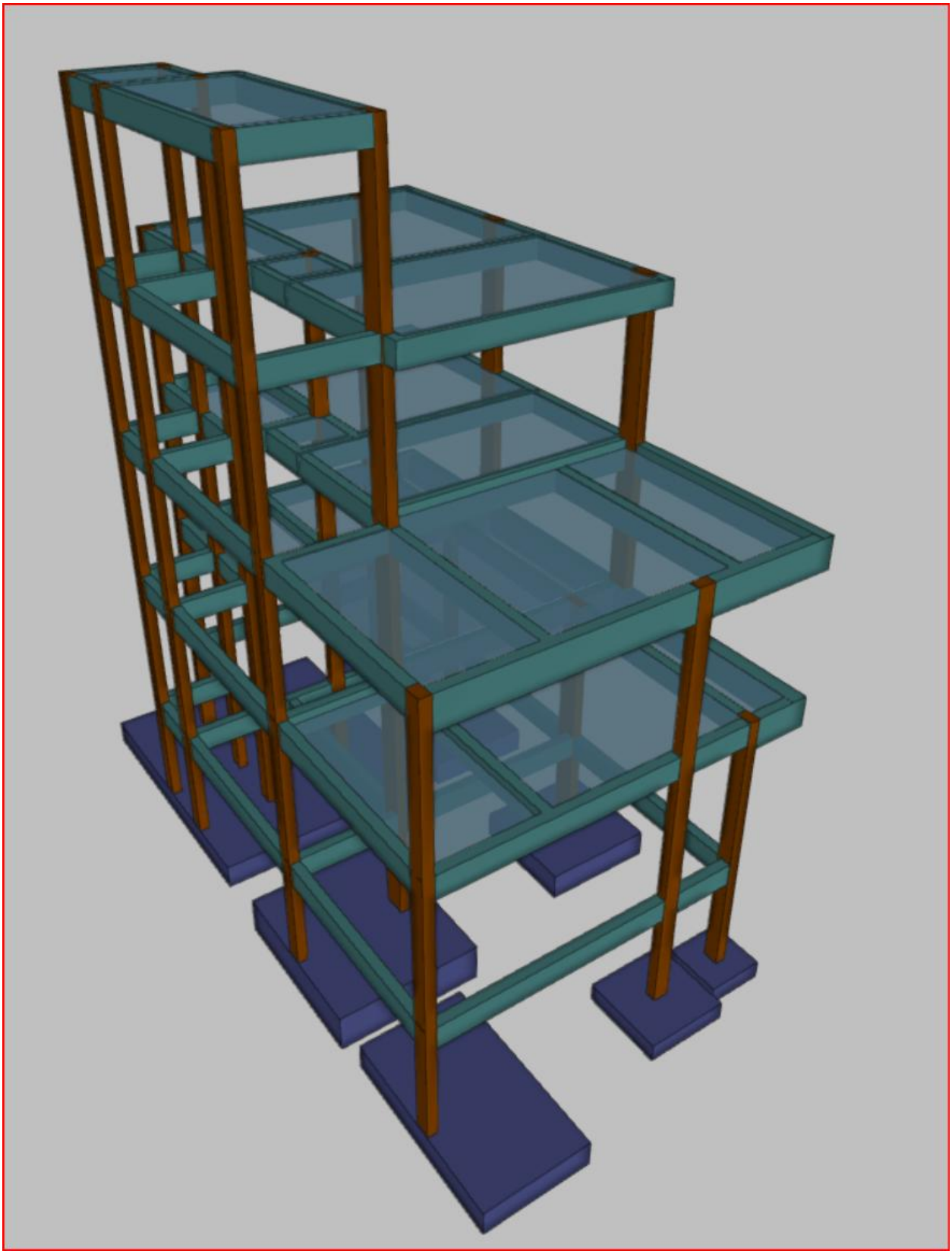
STRUCTURAL ENGINEER: S.M.SAMINATHAN
BE(CIVIL)M.Tech(STR)DCTech
11,THERADI STREET,
PALLIKARANAI,CHENNAI-600100
Mob:9282125426
e-mail:smsaminathan@gmail.com

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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

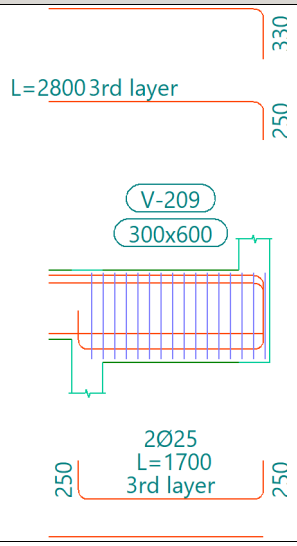
**INDEX**

| | |
|---|---|
| **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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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 |
|---|---|---|---|---|---|
| | $\sigma_{st}$ | $W_{cr,F,top}$ | $W_{cr,F,Rgt.side}$ | $W_{cr,F,Lft.side}$ | |
| V-209: C6 - C15 | x: 0 m Verified | x: 0 m Verified | D.N.P.(1) | D.N.P.(1) | **VERIFIED** |

*Notes:*
*$\sigma_{st}$: 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<br>$f_{T,lim}$: 3.52 mm | $f_{A,max}$: 0.13 mm<br>$f_{A,lim}$: 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:

$\eta$ : ***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:

$\eta$ : ***0.796*** ✓

**Resistance check of the section ($\eta_1$)**

$N_{Ed}$,$M_{Ed}$ 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 |

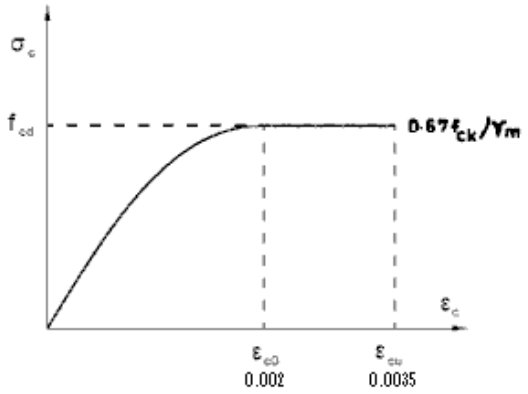
**Resistance capacity calculation**

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.




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

**$\varepsilon_{c0}$**: The strain in concrete due to simple compression. $\varepsilon_{c0}$ : *0.0020*

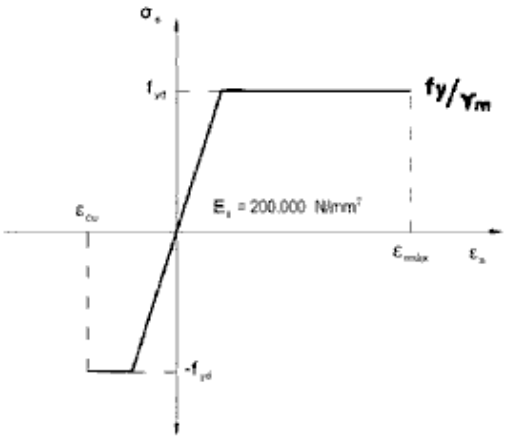
**$f_{cd}$**: Design compressive strength of concrete. $f_{cd}$ : *11.17* MPa

Where:

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

**$\gamma_m$**: Partial safety factor for concrete. $\gamma_m$ : *1.50*

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




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

Where:

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

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

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

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

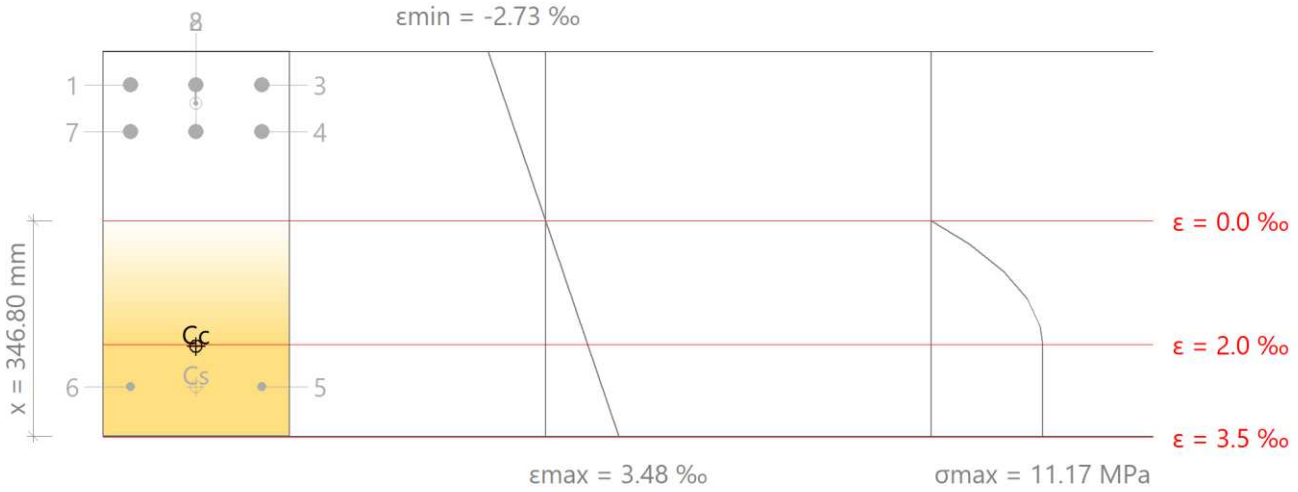
Where:

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

$\gamma_m$: Partial safety factor for reinforcing steel. $\gamma_m$ : *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

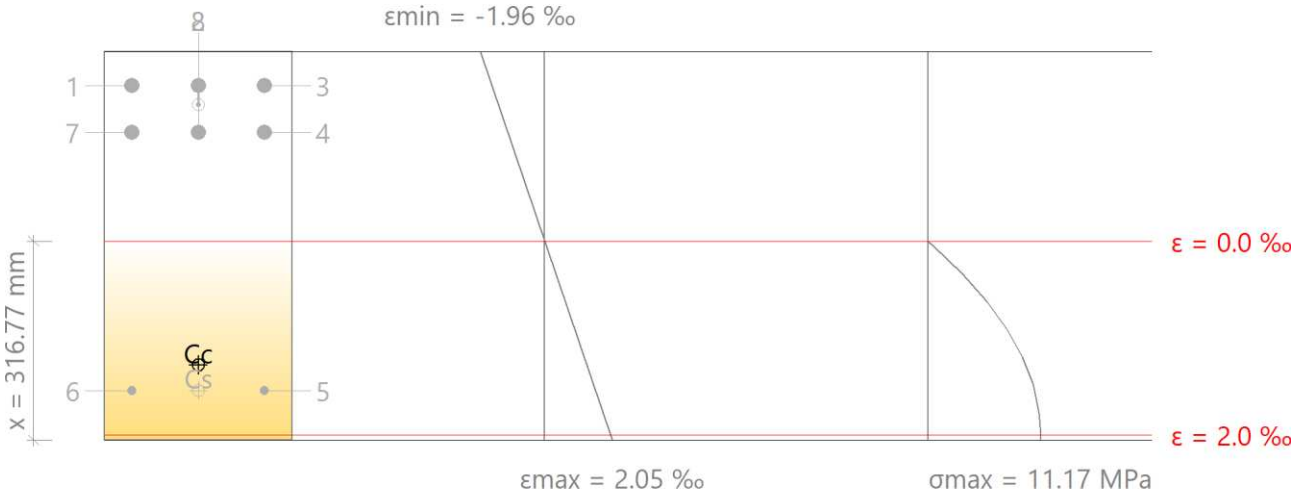
$M_{Rd,x}$ : *-424.11* kN·m

$M_{Rd,y}$ : *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 |
| $\varepsilon_{cmax}$: Deformation of the most compressed concrete fibre. | $\varepsilon_{cmax}$ : *0.0035* | |
| $\varepsilon_{smax}$: Deformation of the steel bar with greatest tension. | $\varepsilon_{smax}$ : *0.0022* | |
| $\sigma_{cmax}$: Stress of the most compressed concrete fibre. | $\sigma_{cmax}$ : *11.17* | MPa |
| $\sigma_{smax}$: Stress of the steel bar with greatest tension. | $\sigma_{smax}$ : *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
- $\varepsilon_{cmax}$: Deformation of the most compressed concrete fibre. — $\varepsilon_{cmax}$ : *0.0021*
- $\varepsilon_{smax}$: Deformation of the steel bar with greatest tension. — $\varepsilon_{smax}$ : *0.0016*
- $\sigma_{cmax}$: Stress of the most compressed concrete fibre. — $\sigma_{cmax}$ : *11.17* MPa
- $\sigma_{smax}$: Stress of the steel bar with greatest tension. — $\sigma_{smax}$ : *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:

**$A_{s,max}$** : *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:

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

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

η : ***0.574*** ✓

Where:

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

**$V_{u,y}$**: Ultimate shear resistance due to tension in the web. **$V_{u,y}$** : *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):

**$V_{u,lim}$** : *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* | |
| | $\rho_t$ : | *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

$\alpha$: Angle between the inclined stirrup or bent-up bar and the axis of the member, not less than 45 °. $\alpha$ : *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** ✓

$\rho_{sv}$ : *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

$\alpha$: Angle between the inclined stirrup or bent-up bar and the axis of the member, not less than 45 °. $\alpha$ : *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:

$\eta$ : ***0.460*** ✓

**Resistance check of the section ($\eta_1$)**

$N_{Ed}$,$M_{Ed}$ 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

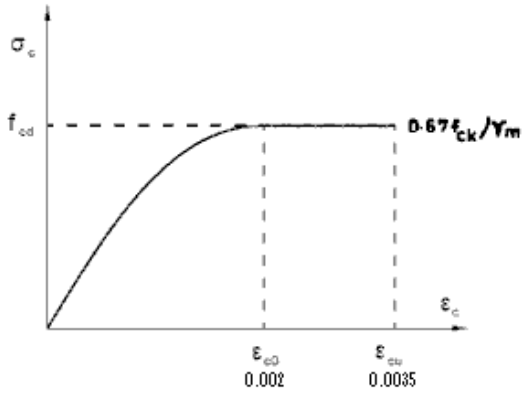
**Resistance capacity calculation**

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.




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

**$\varepsilon_{c0}$**: The strain in concrete due to simple compression. **$\varepsilon_{c0}$** : *0.0020*

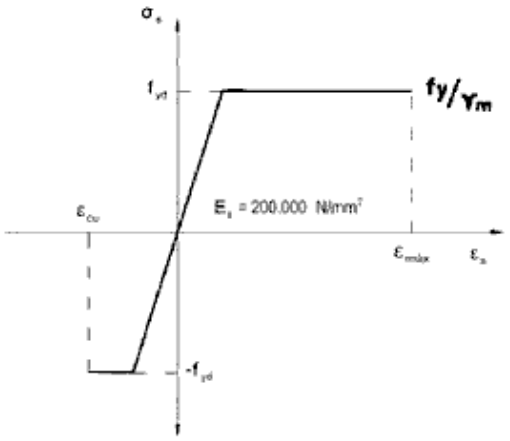
**$f_{cd}$**: Design compressive strength of concrete. **$f_{cd}$** : *11.17* MPa

Where:

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

$\gamma_m$: Partial safety factor for concrete. $\gamma_m$ : *1.50*

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




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

Where:

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

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

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

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

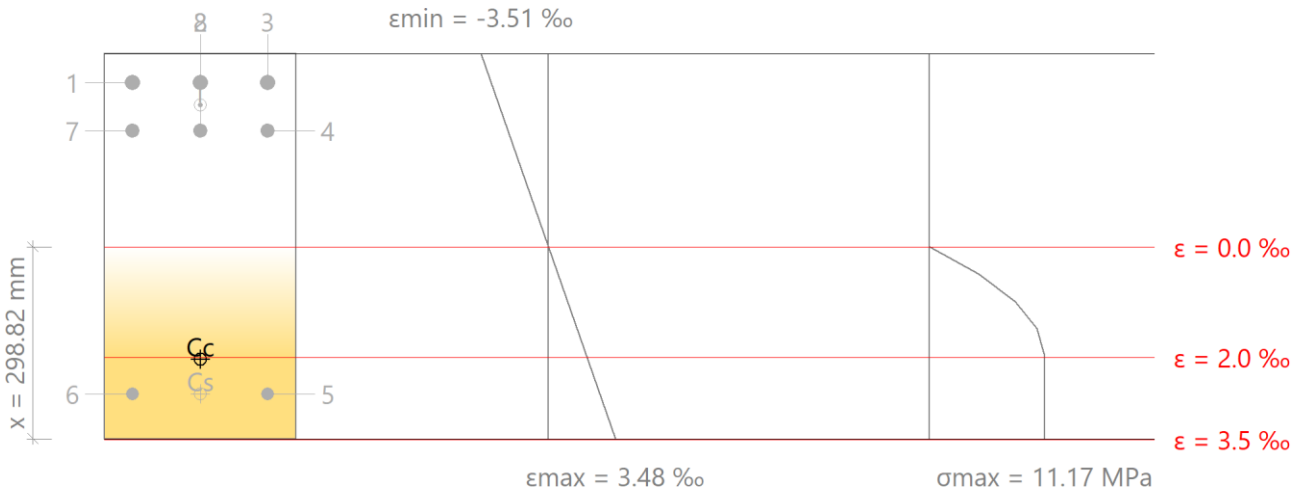
Where:

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

$\gamma_m$: Partial safety factor for reinforcing steel. $\gamma_m$ : *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

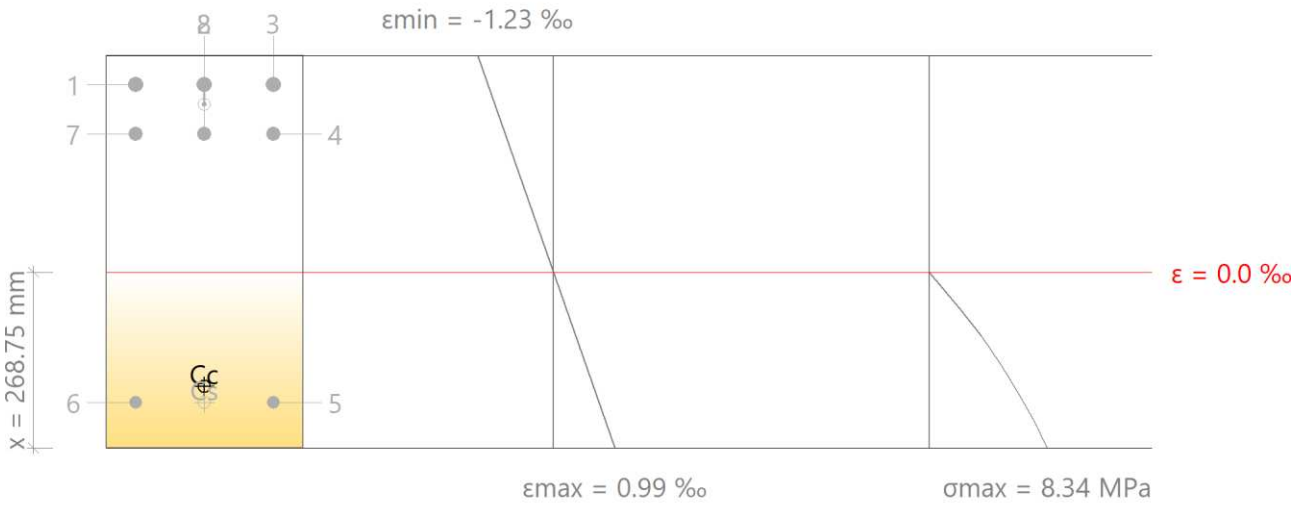
Where:

**$C_c$**: 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 |
| $e_{cc}$: Eccentricity of the concrete compressive forces in the direction of the X and Y axes. | $e_{cc,x}$ : | *0.00* | mm |
| | $e_{cc,y}$ : | *-175.81* | 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 |
| | $e_{T,y}$ : | *219.97* | mm |
| $\varepsilon_{cmax}$: Deformation of the most compressed concrete fibre. | $\varepsilon_{cmax}$ : | *0.0035* | |
| $\varepsilon_{smax}$: Deformation of the steel bar with greatest tension. | $\varepsilon_{smax}$ : | *0.0030* | |
| $\sigma_{cmax}$: Stress of the most compressed concrete fibre. | $\sigma_{cmax}$ : | *11.17* | MPa |
| $\sigma_{smax}$: Stress of the steel bar with greatest tension. | $\sigma_{smax}$ : | *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 |
| $\varepsilon_{cmax}$: Deformation of the most compressed concrete fibre. | $\varepsilon_{cmax}$ : | *0.0010* | |
| $\varepsilon_{smax}$: Deformation of the steel bar with greatest tension. | $\varepsilon_{smax}$ : | *0.0011* | |
| $\sigma_{cmax}$: Stress of the most compressed concrete fibre. | $\sigma_{cmax}$ : | *8.34* | MPa |
| $\sigma_{smax}$: Stress of the steel bar with greatest tension. | $\sigma_{smax}$ : | *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:

| | | |
|---|---|---|
| $\sigma_{st}$: Tensile stress of the passive reinforcement. | $\sigma_{st}$ : *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 |
| $\varepsilon_m$: Mean deformation at the point where the crack width is calculated. | $\varepsilon_m$ : *0.000937* | |

Where:

$\varepsilon_1$: Strain at the point considered, calculated ignoring the stiffening of the concrete in the tension zone. $\varepsilon_1$ : *0.001078*

Where:

$\sigma_{st}$: Passive reinforcement service stress in the cracked section loadcase. $\sigma_{st}$ : *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

$\varepsilon_2$: Strain corresponding to the reduction due to tension stiffening effect. $\varepsilon_2$ : *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

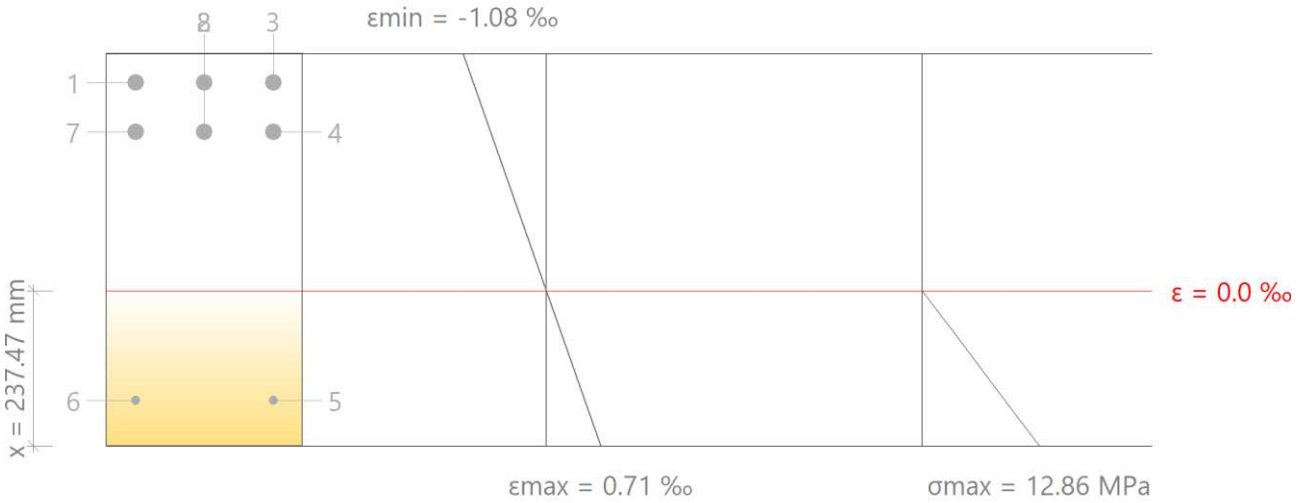
**Section equilibrium for the acting forces ignoring the tensile resistance of the concrete:**

$N_{ed}$,$M_{ed}$ 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) | $\sigma_s$ (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<br>$f_{T,lim}$: 3.52 mm | $f_{A,max}$: 0.13 mm<br>$f_{A,lim}$: 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) | $\Delta f_i$ (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 $t_i$

$\Delta f_i$: 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

**$\theta_m$**: 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 | $\theta_i$ | $Q_i$ (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)

**$\theta_i$**: 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
$\Psi_{cs}$: shrinkage curvature (midspan section)

$\varepsilon_{cs}$: 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) | $\Delta f_i$ (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) | $\Delta f_i$ (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 $t_i$

**$\Delta f_i$**: 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

$\theta_m$: 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 | $\theta_i$ | $Q_i$ (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)

**$\theta_i$**: 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

$\Psi_{cs}$: 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 $p_t - p_c \geq 1.0$

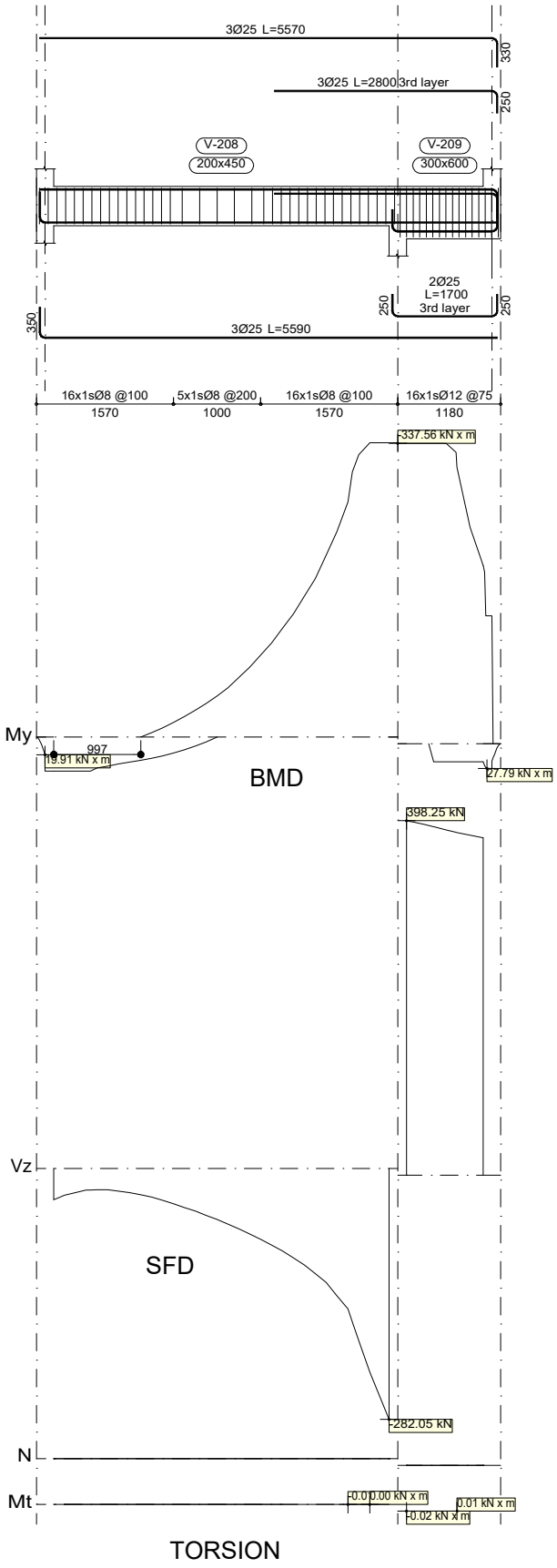
$p_c$: geometric ratio of the reinforcement in compression (%)

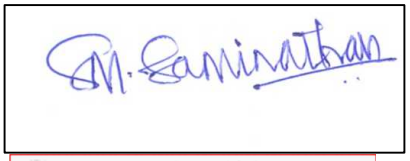
$p_t$: geometric ratio of the reinforcement in tension (%)



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

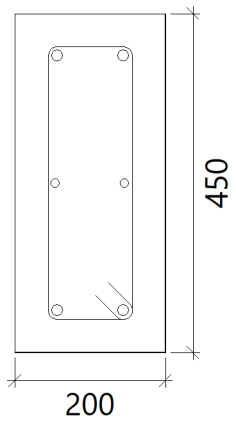
PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM 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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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



$A_{s,min}$ : *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

$\beta$ : *3.66*

$\rho_t$ : *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)

$\delta$ : *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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE**

$\beta$ : *3.08*

$\rho_t$ : *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)

$\delta$ : *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)

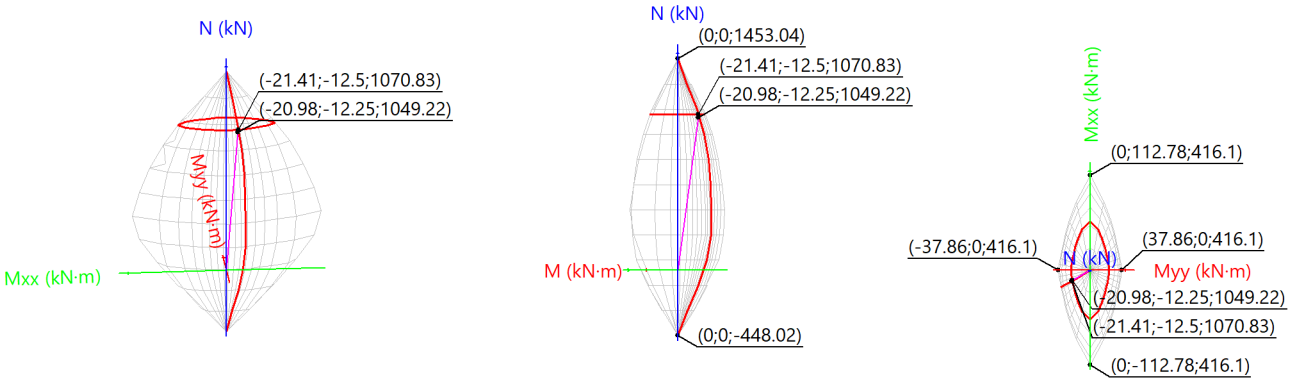
The worst case forces to be withstood from the analysis are produced at 'Base', in the combination of loadcase "1.5·SW+1.5·DL+1.5·Qa".

The following criteria must be satisfied:

$\eta$ : ***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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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 ($\eta_1$)**

$N_{Ed}$,$M_{Ed}$ 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 $\lambda$ is less than the minimum limiting slenderness $\lambda_{inf}$ 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 $\lambda$ is less than the minimum limiting slenderness $\lambda_{inf}$ 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

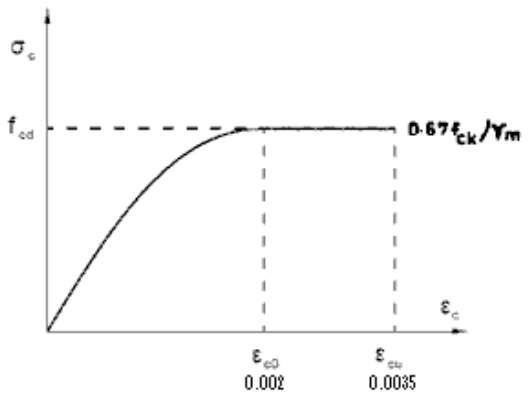
**Resistance capacity calculation**

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

**PROPOSED CONSTRUCTION OF A GROUND + FIRST + SECOND-FLOOR (3-FLOOR) RESIDENTIAL BUILDING WITH 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE**

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

$\varepsilon_{c0}$: The strain in concrete due to simple compression. $\varepsilon_{c0}$ : *0.0020*

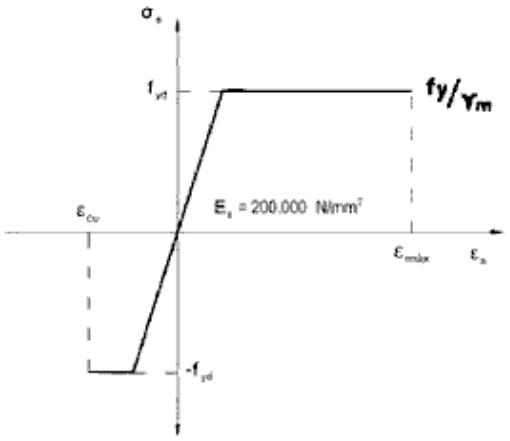
$\mathbf{f_{cd}}$: Design compressive strength of concrete. $\mathbf{f_{cd}}$ : *11.17* MPa

Where:

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

$\gamma_m$: Partial safety factor for concrete. $\gamma_m$ : *1.50*

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




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

Where:

$\mathbf{f_y}$: Steel yield strength. $\mathbf{f_y}$ : *500.00* MPa

$\mathbf{E_s}$: Steel elastic modulus. $\mathbf{E_s}$ : *200000.00* MPa

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

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

Where:

$\mathbf{f_y}$: Steel yield strength. $\mathbf{f_y}$ : *500.00* MPa

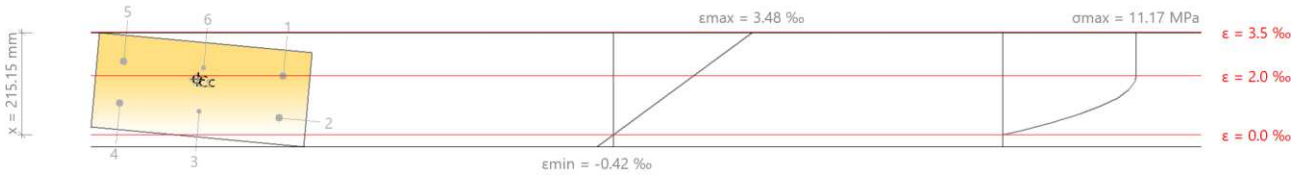
$\gamma_m$: Partial safety factor for reinforcing steel. $\gamma_m$ : *1.15*

(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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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

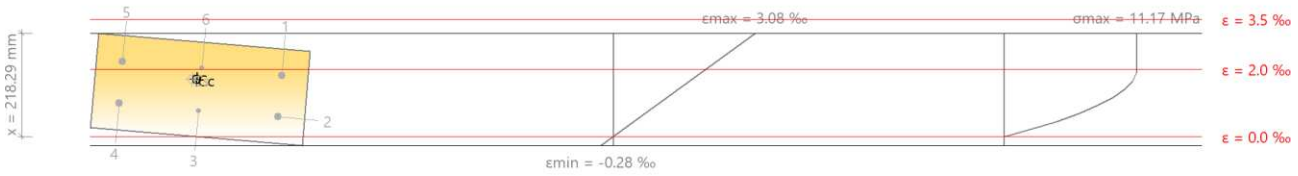
S.M. SAMINATHAN
BE(Civil)M. Tech (Str)DC Tech
Structural Engineer Gr-I
CMDA Registration No: SE/I/2024/5/0052
11/1,Theradi Street,Pallikaranai,Chennai-600100



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 |
| $\varepsilon_{cmax}$: Deformation of the most compressed concrete fibre. | $\varepsilon_{cmax}$ : | *0.0035* | |
| $\varepsilon_{smax}$: Deformation of the steel bar with greatest tension. | $\varepsilon_{smax}$ : | *0.0000* | |
| $\sigma_{cmax}$: Stress of the most compressed concrete fibre. | $\sigma_{cmax}$ : | *11.17* | MPa |
| $\sigma_{smax}$: Stress of the steel bar with greatest tension. | $\sigma_{smax}$ : | *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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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
- $\varepsilon_{cmax}$: Deformation of the most compressed concrete fibre. — $\varepsilon_{cmax}$ : *0.0031*
- $\varepsilon_{smax}$: Deformation of the steel bar with greatest tension. — $\varepsilon_{smax}$ : *0.0000*
- $\sigma_{cmax}$: Stress of the most compressed concrete fibre. — $\sigma_{cmax}$ : *11.17* MPa
- $\sigma_{smax}$: Stress of the steel bar with greatest tension. — $\sigma_{smax}$ : *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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 81, 97, COMPRISING SURVEY NOS. 360/1A ,360/2A,370/1, 371/1, 378/1 AT THIRUVERKADU MUNICIPALITY AYNAMBAKKAM VILLAGE

| Reference: C6<br>-Details: 2250 x 2250 x 550<br>-Reinforcement: Xi:Ø12@160 Yi:Ø12@160 | | |
|---|---|---|
| Code checks | Values | Status |
| Pressures on the soil:<br>*Criteria of CYPE* | | |
| - Mean stress in persistent situations: | Maximum: 0.130 MPa<br>Calculated: 0.129 MPa | Verified |
| - Maximum stress in persistent situations: | Maximum: 0.162 MPa<br>Calculated: 0.137 MPa | Verified |
| Overturning of footing:<br>*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:<br>- Persistent situations:<br>*Criteria of CYPE* | Maximum: 5000 kN/m²<br>Calculated: 1590.8 kN/m² | Verified |
| Tangential stress in the critical punching shear perimeter:<br>- Persistent situations:<br>*Code IS 456: 2000. Clause 31.6.3* | Maximum: 1180.5 kN/m²<br>Calculated: 428.1 kN/m² | Verified |
| Minimum depth:<br>*Code IS 456: 2000. Clause 34.1.2* | Minimum: 15 cm<br>Calculated: 55 cm | Verified |
| Space to anchor starter bars in foundation:<br>- C6: | Minimum: 22 cm<br>Calculated: 48 cm | Verified |
| Minimum geometric ratio:<br>*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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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<br>Calculated: 53 cm | Verified |
| - Bott. reinf. X direction toward lft: | Minimum: 40 cm<br>Calculated: 53 cm | Verified |
| - Bott. reinf. Y direction upwards: | Minimum: 33 cm<br>Calculated: 59 cm | Verified |
| - Bott. reinf. Y direction downwards: | Minimum: 31 cm<br>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 17 DWELLING UNITS IN VILLAS IN PLOT NOS. 5, 6, 19, 28, 29, 30, 31, 45, 55, 60, 65, 69, 70, 71, 79, 80, 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.