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Structural Consultant,
Registered Structural Engineer (Grade II) No. RSE200372019
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STABILITY CERTIFICATE

To whomsoever it may concern

I certify that the Residential Building in the below mentioned address as I have satisfied myself that the structure is Designed and executed as per IS CODE provisions to be STABLE and structurally **safe** and **sound**. The structural soundness has been verified by me with reference to IS 456:2000 and other relevant Indian Standard code of Practice. I declare that the Structure is STABLE in all aspects.

Owner of the Property:	**THAI HOMES**
Address of the Property:	NEW DOOR NO: 3 & 5, PARTHASARATHI NAGAR 2nd STREET, ADAMBAKKAM, CHENNAI-600 088.
Building Type / No. of Floors:	RCC Framed structure, Stilt +5 Floor
Area of the Property considered:	27565Sq.ft.
Age of the Building:	New Building

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No.12A, John Desikar Street, Nanganallur, Chennai-600 061.
E-mail: r.sivashan@gmail.com

Signature with Seal

Date: 23/04/2024

Place: Chennai.

STABILITY CERTIFICATE AND DESIGN BASIS REPORT

DESIGN CALCULATION FOR RESIDENTIAL BUILDING AT PARTHASARATHI NAGAR 2nd STREET

DESIGN CALCULATION FOR THE PROPOSED RESIDENTIAL BUILDING AT NEW DOOR NO. 3& 5, OLD NO. 2 & 5, BLOCK NO: 2, WARD –F, PLOT NO: 25 & 26, T. S. NO. 72 & 73, PARTHASARATHI NAGAR 2nd STREET, ADAMBAKKAM, CHENNAI – 600 088.

APPLICANT NAME: THAI HOMES

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1. Scope:

The scope of this calculation covers the structural design.

2. Design Philosophy:

The Structure is modeled as 3D frame in STAAD Pro. The structure is designed to resist earthquake forces of the zonal area as per IS codes. The project site is located in a Zone III Seismic zone as per IS 1893.

M30 minimum Grade of concrete is considered for Design and for Reinforcing steel Fe550D Steel confirming to IS standards.

2.1 Standards / Codes:

Recommendation and requirement of Indian codes of practice below are followed in order to ensure the global stability of the structure.

IS 875(Part 1) 1987	Code of practice for design load (other than earthquake) for building and structure – unit weights of buildings and stored materials.
IS 875(Part 2) 1987	Code of practice for design load (other than earthquake) for building and structures – Imposed Loads.
IS 456 – 2000	Plain and reinforced concrete – code of practice.
IS 1786 – 1985	Specification for high strength deformed bars and wires as concrete reinforcement.
IS 13920 – 1993	Code of practice for ductile detailing of RCC structures.
IS 4326 – 1993	Earthquake resistant design and construction of buildings – Code of practice.
IS 1893 - 2016	Criteria for earthquake Resistant design of structures.
SP 16	Design aids for reinforced concrete to IS 456 – 1978.
SP 34	Hand book on concrete reinforcement and detailing.

2.2 Analysis Software:

The three dimensional analysis of the structures is carried out using the STAAD PRO. Appropriate loads and its combinations, as per relevant clauses in codes mentioned above, for most unfavorable effects will be chosen for design. Support at base is pinned. The excel spreadsheets are used for calculations and design.

3. Design Loads:

The various design loads considered are as follows:

DL = Dead Load
LL = Live Load
EQ+X = Seismic Load on X Direction
EQ-X = Seismic Load on -X Direction
EQ+Z = Seismic Load on Z Direction
EQ-Z = Seismic Load on -Z Direction

3.1 Dead Load (DL):

The Dead Load comprises of Structure Self-Weight, Dead Load from Masonry Walls, Plastering, Self-Weight of Slabs, Floor Finishes etc., which are the permanent loads Refer to Clause 5.0 below for detailed calculation.

3.2 Live Load (LL):

The live load is the imposed load due to the occupancy and is considered as per Indian Standard Code IS 875. Refer to Clause 5.0 below.

3.2 Seismic Load (EQ):

The Seismic load is the impact by application of seismic (earthquake) oscillation to a Structure as per the provisions of IS code 1893:2016.

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4.0 Load Combinations:

The various loads shall be combined in accordance with the stipulations in IS 456-2000; whichever combination produces the most unfavorable effect in the building, foundation or structural member concerned will be adopted.

1. 1.5 x (DL+LL)
2. 1.2 x (DL+LL)
3. 1.2 x (DL+LL+(EQ+X))
4. 1.2 x (DL+LL+(EQ-X))
5. 1.2 x (DL+LL+(EQ+Z))
6. 1.2 x (DL+LL+(EQ-Z))
7. 1.2 x (DL+LL-(EQ+X))
8. 1.2 x (DL+LL-(EQ-X))
9. 1.2 x (DL+LL-(EQ+Z))
10. 1.2 x (DL+LL-(EQ-Z))
11. 1.5 x (DL)
12. 1.5 x (DL+(EQ+X))
13. 1.5 x (DL+(EQ-X))
14. 1.5 x (DL+(EQ+Z))
15. 1.5 x (DL+(EQ-Z))
16. 1.5 x (DL-(EQ+X))
17. 1.5 x (DL-(EQ-X))
18. 1.5 x (DL-(EQ+Z))
19. 1.5 x (DL-(EQ-Z))
20. (1.9 x DL)+(1.5 x (EQ+X))
21. (1.9 x DL) + (1.5 x (EQ-X))
22. (1.9 x DL) + (1.5 x (EQ+Z))
23. (1.9 x DL) + (1.5 x (EQ-Z))
24. (1.9 x DL) - (1.5 x (EQ+X))
25. (1.9 x DL) - (1.5 x (EQ-X))
26. (1.9 x DL) - (1.5 x (EQ+Z))
27. (1.9 x DL) - (1.5 x (EQ-Z))

5.0 Load Calculations:

The load calculation for the Dead and Live load are presented here.

5.1 Dead Load

Dead load (Self-weight) of the Structure frames will be automatically calculated by STAAD.Pro

5.1.1 Dead Wall Load

Brick Wall Load

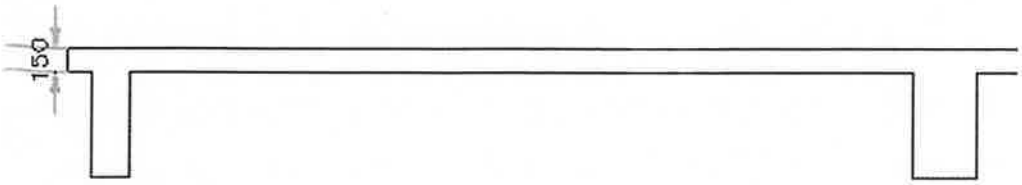
Load on wall for 1m high

Unit Weight of brick work	=	19 kN/m^3
Thickness of Brick work	=	230mm or 0.23m
Weight of Brick work	=	4.37 kN/m for 1m high
Finishes on both sides (0.016 +0.012) x 24) {Considering 16 mm Outer plastering & 12 mm Inner Plastering}	=	0.672 kN/m for 1m high
Therefore, Uniformly distributed load for 1m high	=	5.042 kN/m

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5.1.2 Floor Slab load is given as 'Floor Load'

Slab Thickness considered = 150 mm



Dead load of the slab (0.15m x 25 kN/m^3)	= 3.75 kN/m^2
Floor finishes	= 1.25 kN/m^2
Ceiling Plastering (12mm) (0.012m x 21 kN/m^3)	= 0.252 kN/m^2
Total dead load on floor slab	= 5.25 kN/m^2

5.2 Live Load for Floor Slab & Stairs:

Live load on flat roof as per IS 875 = 2.0 kN/m^2

Reduction for live load of 25 % is considered as per IS 1893 (Part 1): 2016 for seismic weight calculations.

5.3 Seismic Parameters

Zone: 0.16 (Chennai City)

Response Reduction Factor (RF): 3

Importance Factor: 1.0 (General Building)

Rock and Soil Site Factor: Medium Soil

Type of Structure: RC Frame Building

Damping Ratio: 5%

DEAD LOAD ON ROOF SLAB

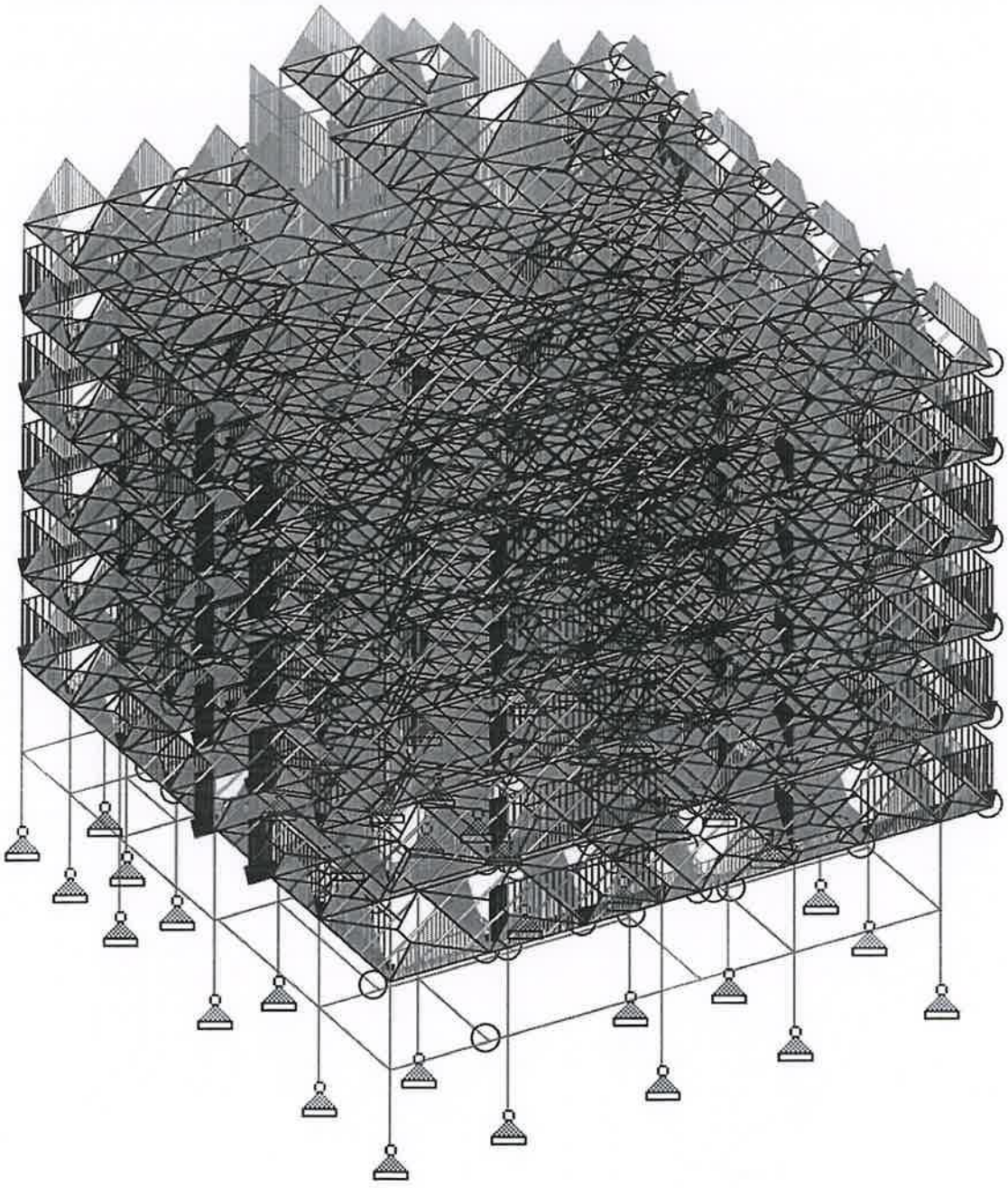


Fig. 1 Dead Load on Roof and Terrace

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LIVE LOAD ON ROOF SLAB

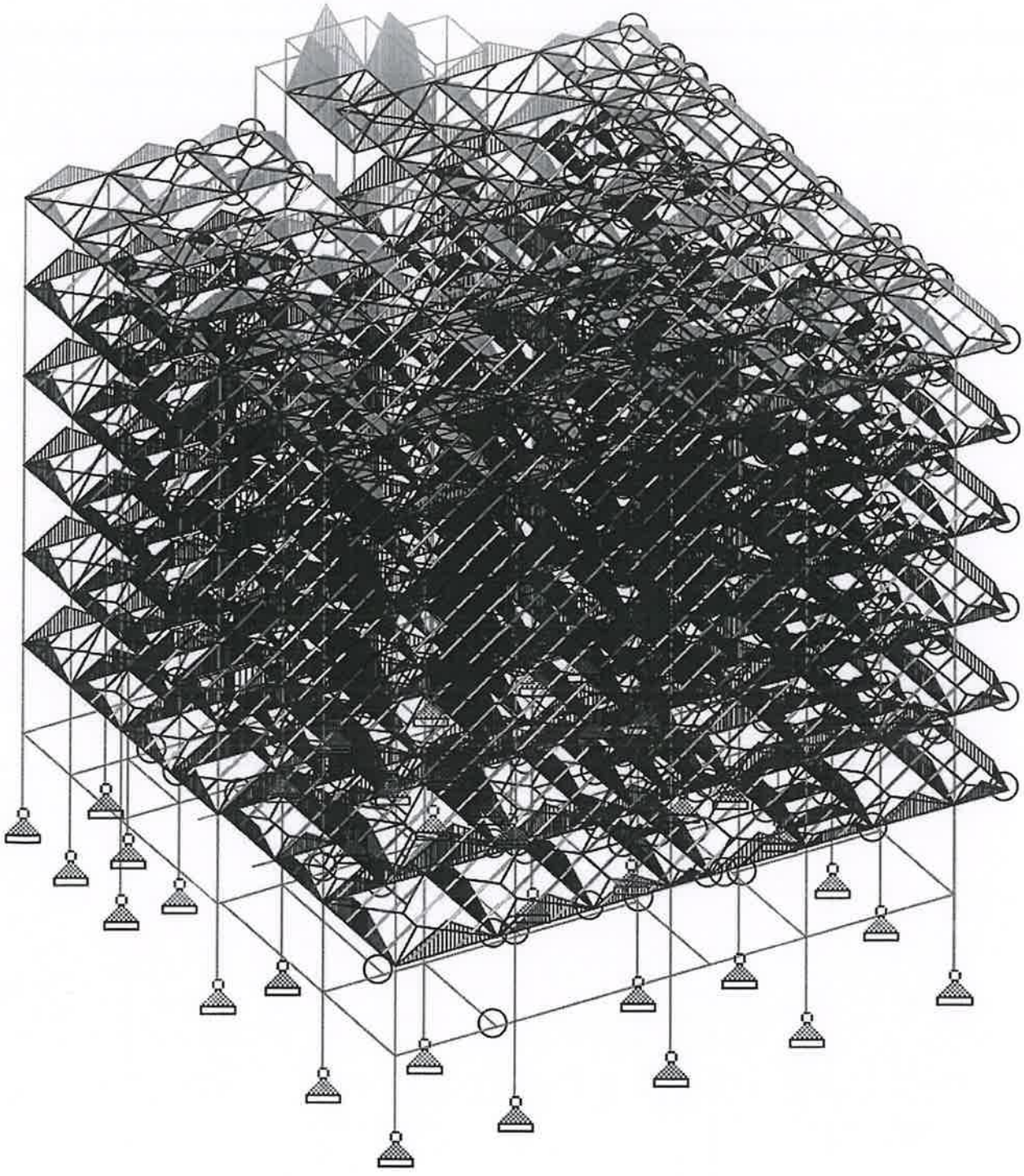


Fig. 2 Live Load on Roof

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3D VIEW OF STRUCTURE MODELED IN STAAD PRO

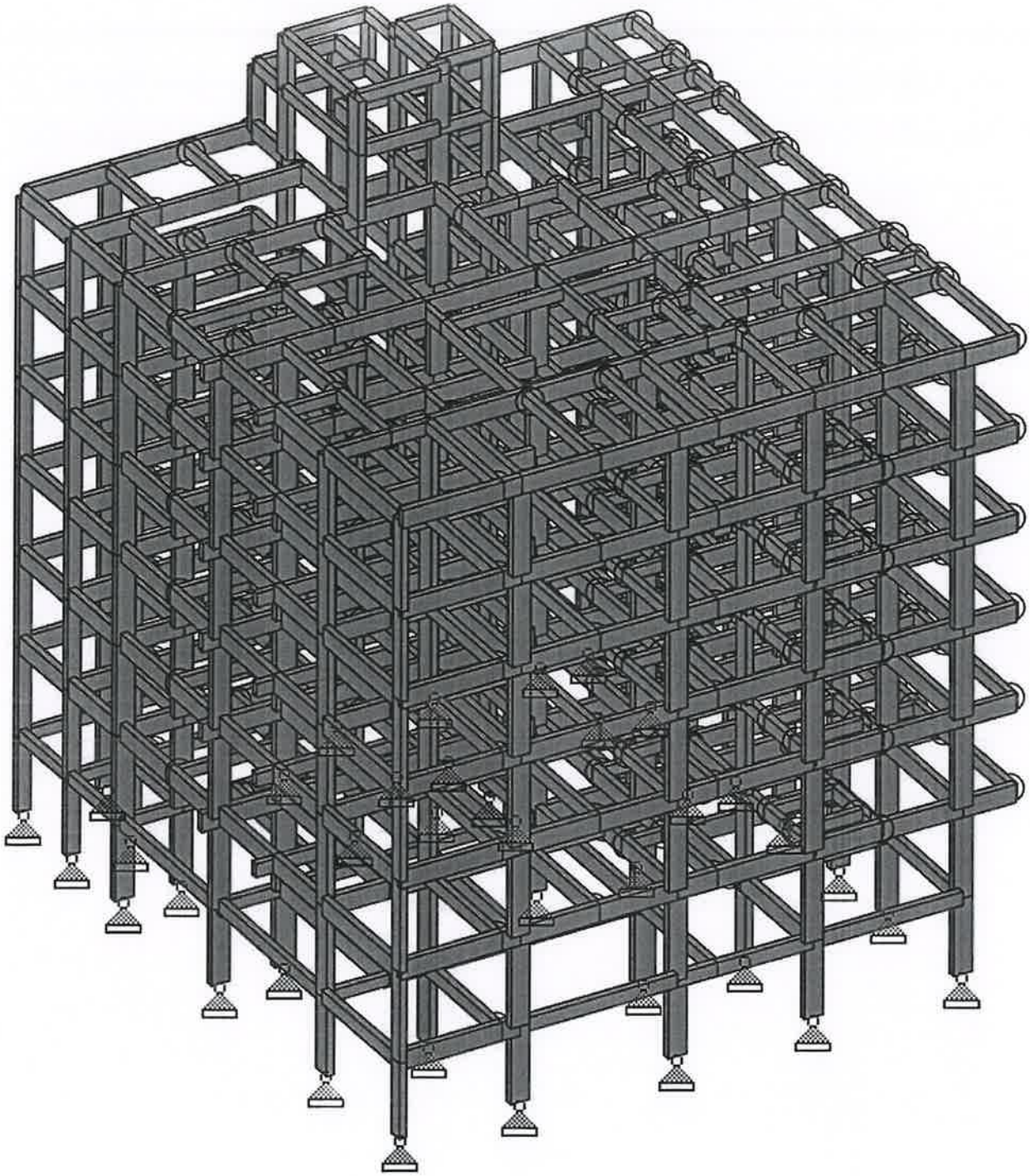


Fig. 3 3D View

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6. STRUCTURAL DESIGN:

The structure is modeled as 3D model in STAAD Pro and the analysis is performed using the STAAD Pro option 'PERFORM ANALYSIS PRINT STATIC CHECK'.

The analysis results are obtained from STAAD in the form of Support Reactions, Member end forces etc. and the design is performed using the Spreadsheets developed for the design and such as for Slab, Beam, Column & Foundations.

The design is summarized in the following appendices of this document.

Appendix A	=	Slab design for all the levels using the spread sheet. For Slab type refer the Structural drawings.
Appendix B	=	Beam design is carried out from the Bending moments & Shear forces extracted from STAAD and the design is done using spread sheet. The typical beam designs for the critical members are represented in this Appendix.
Appendix C	=	Column design is carried out from the Bending moments & Shear forces extracted from STAAD. The typical Column design for the critical members is represented in this Appendix.
Appendix D	=	Pilecap design is carried out from the axial load extracted from STAAD. The typical Pliecap design for the critical members is represented in this Appendix.
Appendix E	=	Foundation design is carried out from the Support reactions extracted from STAAD. The Support type is kept as Pinned as per the soil condition. The typical foundation design for the critical members is represented in this Appendix and check for one-way Shear & two-way Shear is also carried out.

7. CONSTRUCTION MATERIAL SPECIFICATIONS:

7.1 CONCRETE

Concrete shall comply with IS456-2000 with a minimum grade of M30 using a cement content of 320 kg/m^3 with Ordinary Portland Cement.

7.2 REINFORCEMENT

Steel reinforcement bar should confirm to Fe550D as per IS1786-2008. All rebar steel should be Epoxy coated to avoid corrosion.

7.3 SOIL

They have conducted two bore holes in the proposed construction area. The bore holes were drilled up to 12.00m below the existing ground level. With reference to the first bore holes they recommend depth of 1.60m below from the existing ground level. The soil available in the founding level will be Brownish Clayey Silty Sand.

7.4 FOUNDATION SYSTEM

From field investigations, it can be observed that the sub-soil strata encountered at shallow depths are weak from both shear strength characteristics and deformation consideration and hence cannot be considered as bearing strata for proposed impending loads form structure. Further, the refusal strata encountered below a maximum depth of 10.70m below existing ground level can be considered as good end bearing strata for proposed impending loads from structure.Considering the weak shear strength characteristics of the sub-soil strata encountered at the investigation locations, deep foundation system consisting of 10.70m long bored cast-in-situ End Bearing Piles can be adopted. Pile shall be drilled through DMC (direct mud circulation) technique.

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7.5 SUPERSTRUCTURE

The entire structure is designed a reinforced concrete frame without brick partition wall in the Ground floor and upper floors with 230mm brick wall in Cement Mortar 1:6 for all outer walls 115mm wide partition wall in cement mortar 1:4, reinforced with two 8mm diameter rod for each 3 coarse interval for all inner wall. For RCC frame work i.e. Columns, Beam and Slab the material of construction should be M25 grade concrete (As per IS 456-2000) and Fe500 Steel (As per IS1786-2008).

BEAM

Length	=	5.78m
Breadth	=	230mm
Depth	=	450mm
Effective Depth	=	450mm
Support Moment	=	119 kNm
Compressive Strength of Concrete (M25)	=	25 N/mm^2
Allowable Flexural Stress (0.7 x sqrt fck)	=	3.5 N/mm^2
Actual Flexural Stress (M_u/bd^2)	=	2.93 N/mm^2
		< 3.5 N/mm^2

Hence, **Safe** and it is designed as **Double Reinforced Beam**

COLUMN

Cross sectional Area	=	300X450 = 135000 mm^2
Total Load	=	1150 kN
Compressive Strength of Concrete	=	25 N/mm^2
Bending in Compression (0.446 fck)	=	11.15 N/mm^2
Actual Stress (Load/Area)	=	8.51 N/mm^2
		< 11.15 N/mm^2

Hence, **Safe.**

8. DEFLECTION SHOULD BE WITHIN THE LIMIT

Deflection of individual members as well as total structure checked based on serviceability criteria recommended in IS 456-2000 and IS 1893-2016 is

1. 1.0 DL + 11.0 LL

2. 1.5 DL + 1.5 LL

Earthquake load is considered for both X & Y directions but not acting simultaneously.

DL — Dead Load

LL — Live Load

IS 456 insists that deflection should be under certain control for structural members to satisfy serviceability requirements. In this structure the deflection for all individual structural members were checked and calculated locally and globally and ensured that they were within the limit.

Also all lateral deflections of frames for gravitational and lateral loads (Seismic Loads) were checked for storey drift as well as lateral deflection which were all within the limit. A portal frame from this structure is attached for reference.

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BENDING MOMENT ON Y

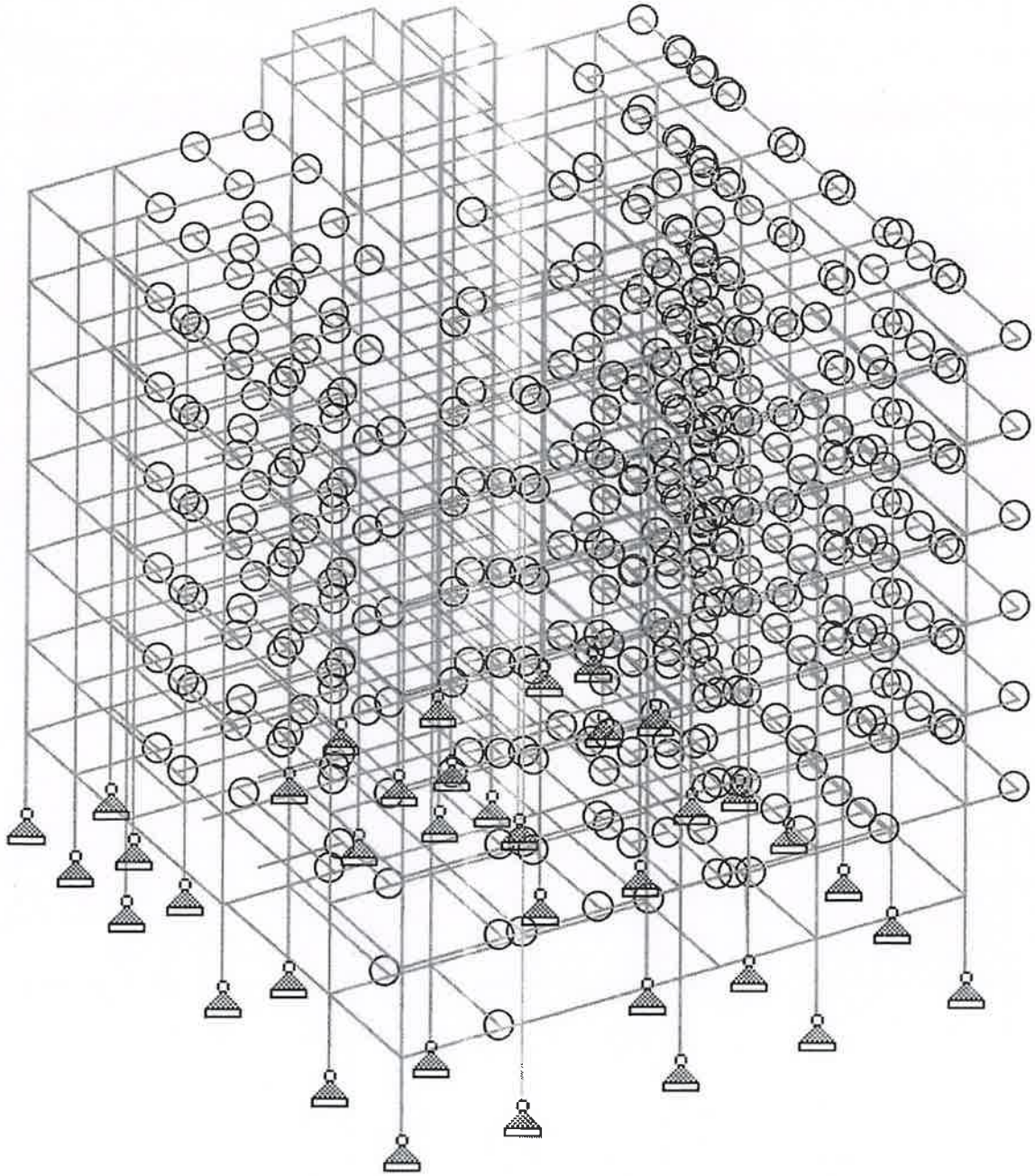


Fig. 2 Bending moment on Y

APPENDIX A

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CL. NO.	PARTHASARATHY NAGAR 2nd STREET DESIGN CALCULATIONS TWO WAY SLAB	DRAW N.M APPROVED R.S

1.0 Design of Two Way Slab

1.0.1 Basic Input Data

Grade of concrete		=	**M 30**		
Grade of steel		=	**Fe 550D**		
Thickness of slab	D	=	**125**	mm	
Clear cover	cc	=	**20**	mm	Table 16 Cl.26.4.2 , IS 456 - 2000
Effective thickness of slab (d_{eff})	= 125 - 20 4	=	101	mm	
Unit weight of concrete		=	25 KN/m^3		Cl 19.2.1, IS 456-2000
Effective Shorter Span	L_x	=	**3.35**	m	
Effective Longer Span	L_y	=	**6.3**	m	
Aspect ratio	L_y/L_x	=	1.88	< 2	

Hence designed as Two way slab

Cl D-1.11, IS 456-2000

Edge Condition : **Two adjacent Edges Discontinous**

1.0.2 Load Data

Self Weight of Slab	= 0.125 x 25	=	3.125	KN/m^2
Floor finish		=	**1.000**	KN/m^2
Partition Load		=	**0.000**	KN/m^2
Sunken Filling		=	**0.000**	KN/m^2
Imposed Load		=	**3.000**	KN/m^2 IS 875 (Part 2) - 1987
Extra Load, (if Any		=	**0.000**	KN/m^2
Total load		=	7.125	KN/m^2
Design load (Wu) = 1.5 x 7.12		=	**10.688**	KN/m^2 Table 18 Cl 36.4.1 IS 456 -2000

1.0.3

Moment and Shear Calculations

Short Span Direction

α_x for positive moment		1.75	→	0.063		Table 26 Cl D-1.1, IS 456 - 2000
		2	→	0.069		
	for	1.88	α_x	= 0.066		
Positive moment M_x :		0.066 x10.693.35 ^2	=	**7.93**	KN-m	
α_x for negative momen		1.75	→	0.084		Table 26 Cl D-1.1, IS 456 - 2000
		2	→	0.091		
	for	1.88	α_x	= 0.088		
Negative moment M_x :		0.088 x10.69 x3.35 ^2	=	**10.51**	KN-m	

Long Span Direction

For positive moment		α_y	=	0.035	Table 26 Cl D-1.1,
Positive moment M_y :	0.035 x10.69 x3.35 ^2		=	**4.20**	KN-m IS 456 - 2000
For negative moment		α_y	=	0.047	Table 26 Cl D-1.1,
Negative moment M_y :	0.047 x10.69 x3.35 ^2		=	**5.64**	KN-m IS 456 - 2000

Shear force v_u = 10.69 4 x 0.5 = **17.90** KN

Check Effective Depth for Max.Bending Moment

1.0.4

Depth required	= $(M_x/(0.133xfck \times b))^{1/2}$	=	56.23mm		Table C,SP 16 :1980
Depth provided	= 125 - 20 - 8 /2	=	101 mm > 56.23mm		Cl 2.3

Hence the section is Safe against Bending

1.0.5 **Check Depth for Shear**

Nominal Shear Stress :	$\tau_v = V_u / b\,d$	=	0.18	N/mm^2	Cl.40.1, IS 456:2000
Design shear strength	(τ_c)	=	0.44	N/mm^2	Table 19 , IS 456:2000
	k	=	1.30		Cl.40.2.1.1, IS 456:2000
	k * τ_c	=	0.57	N/mm^2	

τ_v < k * τ_c **Hence the section is Safe against Shear**

1.0.6 **Check for Maximum Shear Stress:**

Nominal Shear Stress :	$\tau_v = V_u / b\,d$	=	0.18	N/mm^2	Cl.40.1, IS 456:2000
Maximum Shear Stress	($\tau_{c,max}$	=	3.1	N/mm^2	Table 20 , IS 456:2000
	0.5 $\tau_{c,max}$	=	1.55	N/mm^2	

τ_v < 0.5 $\tau_{c,max}$ **Hence the section is Safe against Max.Shear Stress** Cl.40.2.3.1, IS 456:2000

1.0.7 **Reinforcement calculations**

Short Span Direction @ Support

$Mu/bd^2 = \dfrac{10.51 \times 10^{\wedge 6}}{1000 \times 101 \times 101} = 1.031$

Pt = **0.25** %

Table 2-4, SP16 :1980

Area of steel Ast =	0.0025 x 1000 x 101	= 251.99 mm^2
Minimum area of steel:	0.0012 x 1000 x 125	= 150.00 mm^2
Spacing of Y 8bars	50.27 x 1000/251.99	=199.37 mm^2

Cl:26.5.2.1 IS 456 - 2000

Check for Spacing

Minimum of

1) 3d = 30mm

2) = 300 mm

3) = 199.37mm

Cl:26.3.3.(b). 1 IS 456 - 2000

Therefore provide Y **8** @ **190** mm C/C

Short Span Direction @ Mid Span

$Mu/bd^2 = 7.93 \times 10^{\wedge 6} / (1000 \times 101 \times 101) = 0.778$

Pt = 0.186 %

Area of steel =	0.0019 x 1000 x 101	= 187.6 mm^2
Minimum area of steel:	0.0012 x 1000 x 125	= 150.00 mm^2
Spacing of Y 8 bars	50.27 x 1000/187.60	= 267.8 m,m

SP16 :1980 Table 2-4

IS 456:2000 Cl:26.5.2.1

Check for

Spacing

Minimum of

1) 3d = 303mm

2) = 300 mm

3) = 267.80mm

IS 456:2000 Cl:26.3.3.(b).1

Therefore provide Y **8** @ **125** mm C/C 125

Provided % of Tension Reinforcement (pt) = **0.398** %

Long Span Direction @ Support

$Mu/bd^2 = \frac{5.64 \times 10^{\wedge 6}}{1000 \times 101 \times 101} = 0.553$

Pt = 0.131%

Area of steel = 0.0013 x 1000 x 101 = 131.81 mm^2

Minimum area of steel: 0.0012 x 1000 x 125 = 150.00 mm^2

Spacing of Y 8 bars 50.27 x 1000/150.00 = 334.93m,m

SP16: 1980 Table 2-4
IS 456:2000 Cl:26.5.2.1

Check for Spacing

Minimum of

1) 3d = 303mm

2) = 300mm

3) = 334.93mm

IS 456:2000 Cl:26.3.3.(b).1

Therefore provide Y **8** @ **300** mm C/C

-

Long Span Direction @ Support

SP 16 : 1980 Table 2-4

$Mu/bd^2 = \frac{4.20 \times 10^{\wedge 6}}{1000 \times 101 \times 101} = 0.412$

Pt = 0.131%

Area of steel =	0.0010 x 1000 x 101	= 97.478 mm^2
Minimum area of steel:	0.0012 x 1000 x 125	= 150.00 mm^2
Spacing of Y 8 bars	50.27 x 1000/150.00	= 334.93m,m

Check for Spacing

IS 456:2000 Cl:26.3.3.(b).1

Minimum of

1) 3d = 303mm

2) = 300mm

3) = 334.93mm

Therefore provide Y **8** @ **300** mm C/C

1.0.8 **Check for Deflection: (Simplified Approach)**

Basic Span/depth Ratio		= **20**	IS 456:2000 Cl:23.2.1
% of Tension Reinforcement provided (p_t)		= 0.398 %	
Service stress of steel (fs) :	0.58 fy (Ast_R/Ast_P)	= 135.29N/mm^2	IS456:2000 Fig 4
Modification Factor for Tension Reinforcement (F_1)		= 2.00	Page 38
Allowable Span / Effective Depth Ratio		= 40	IS 456:2000 Cl:23.2.1
Actual Span/Eff Depth Ratio	= 3.35 x 1000 / 101	= 33.17	

Hence Safe against Deflection

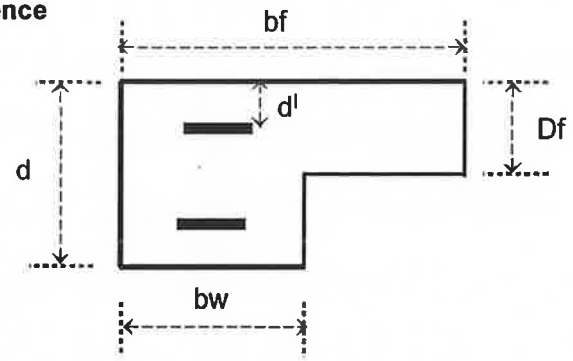
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APPENDIX B

DESIGN SECTION (STRUCTURAL)

L - BEAM

Building reference



Grade of Concrete (f_{ck})	30	N/mm^2
Grade of Steel (f_y)	550	N/mm^2
Unit weight of concrete	25	KN/m^3
Clear cover	25	mm
Dia of rod	20	mm
Effective span =(l_o)	4.9	m
Overall depth(d) =	400	mm
Effective depth (d_{eff}) =(d - clear cover - dia/2)	365	mm
Width of web (b_w) =	400	mm
Actual width of flange (b) =	215	mm
Hence adopt flange width b_f = (For bf calculations ref sheet 1)	790	mm
Total load (w)	11.49	KN/m
Maximum B.M = $wl^2/10$	27.59	KN-m
Shear force = wl/2	28.1505	KN
Torisional moment (T)	19.9	KN-m

Equivlent B.M (Me1)=M + M_t

M_t = T(1+(D/b)/1.7)	31.65	
Me1 =	59.24	KN-m
Equivalent shear(Ve) = V+1.6(T/b)	107.871	KN
$K = M_u/bd^2$	1.11	mm^2
pt =	0.336	%
Ast = (pt bd)/100	1226	mm^2
No of bars	4	

Provide 5 bars of 20mm dia

Equivalent shear(Ve) =	107.871	KN
$\tau v = V_e/bd$	0.74	N/mm^2
τc_{max} =	1.60	N/mm^2

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APPENDIX C

DESIGN SECTION (STRUCTURAL)

COLUMN DESIGN
(SHORT COLUMN WITH UNIAXIAL BENDING ACTING PARALLEL TO THE LONGER DIMENSION OF THE COLUMN)

Unit Weight of concrete	25	Kn/m^3	
Concrete Grade (fck)	30	N/mm^2	
Grade of Steel (fy)	550	N/mm^2	
Clear Cover	40	mm	
Diameter of Rod used	20	mm	
Column size (b x d)	300	450	mm
d^1 = clear cover +1/2 dia of rod	50	mm	
d^1/d	0.11		
b^1 =clear cover +1/2 dia of rod	50	mm	
b^1/b	0.17		
Un supported length (l_x / l_y) (as per clause 25.1.3 of IS456)			mm
l_{ex} =..... l_x (As per table 28 of IS456)		mm	
l_{ey} =.....l_y (As per table 28 of IS456)		mm	
Load (P) =	1150	KN	
M_x =	186.67	KN-m	
M_y =	0	KN-m	
l_{ex} / d < 12	0.00		
l_{ey} / b < 12	0.00		

The column is defined as a short column

Moment on column due to minimum eccentricity $e_{x1} = l_x / 500 + d / 30$	15	mm
$e_{y1} = l_y / 500 + b / 30$	10	mm

If e_{x1} & e_{y1} > 20 mm take the values of e_{x1} & e_{y1} as computed

If e_{x1} & e_{y1} < 20 mm take the values of e_{x1} & e_{y1} as 20mm

Hence consider e_{x1} as e_x **e_x =**	20	mm
Hence consider e_{y1} as e_y **e_y =**	20	mm
$e_{x2} = 0.05d$	22.5	
$e_{y2} = 0.05b$	15	

Short Column carrying axial load with uni-axial moment (Moment acting on the longer side of the column)

Conditions:

l_{ex} / d should be < 12

l_{ey} / b should be < 12

$P_u = 1.5 \times P$	1725	KN

Moment on column

Design moment on short column shall be greater of the following a & b

a)	Moment from actual calculations (M_{ux}) =1.5 M_x	280.0	KN-m	
b)	Moment due to minimum eccentricity (M_{uex}) = P_u x e_x	34.5	KN-m	
	Hence design moment on short column **(M_{ux})** =	280	KN-m	
	compute $P_u x10^3$ / fck (bd)	0.51		
	M_{ux} x 10^6 /fck bd^2 =	0.18		
	d'/d	0.11		
	Find p / f_{ck} (using chart 27 to 50 of SP16)	0.11		
	p = ...fck	2.75	%	
	As = p (b x d) / 100	3712.5	mm^2	
	Hence adopt **column size** of b x d mm	300	450	mm
	Area of steel	3712.5	mm^2	

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APPENDIX D

DESIGN SECTION (STRUCTURAL)

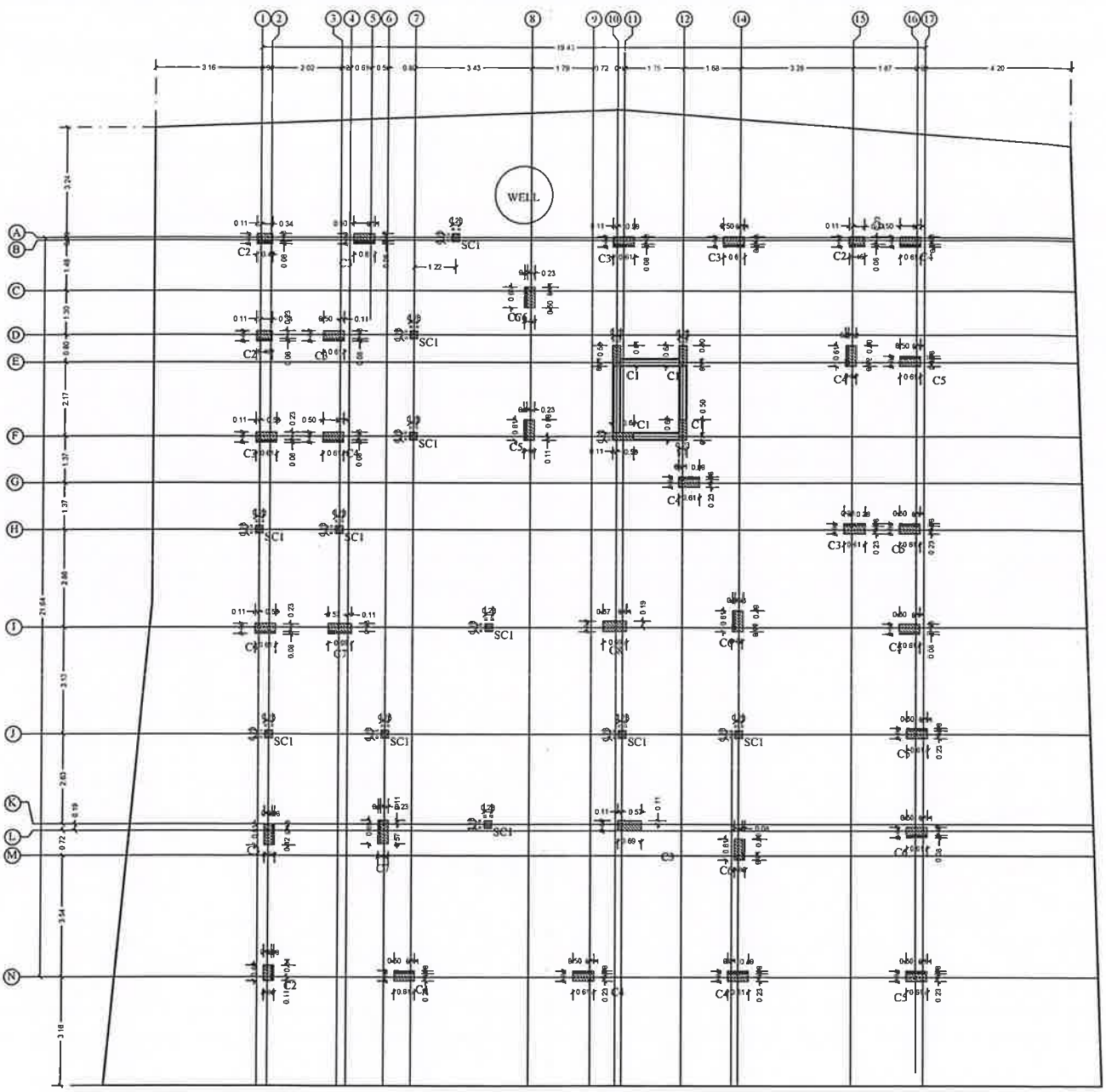
PILECAP DESIGN

Unit Weight of concrete	24	KN/m^3
Concrete Grade	30	KN/m^2
Grade of Steel	550	KN/m^2
Clear Cover	75	mm
Diameter of Rod used	20	mm
Pilecap Name		
Number of plies adopted	2	
Pile dia. in mm	450	mm
Spacing of pile and column centres	500	mm
Minimum spacing between pile and column	300	mm
Minimum spacing between pile and pilecap edge	50	mm
Axial load (P)	1000	KN
Assume depth of pilecap D	600	mm
Self weight of pilecap	100	KN
Effective depth d	515	mm
Width of pile cap	450	mm
Total Load on Pilecap	1100	KN
Load on one pile = Total load / No.of piles	550	KN
Bending Moment M	207.27	KN-m
Effective Depth required = $(M/0.138\ fckb)^{1/2}$	365.39	mm
Effective depth provided	515	mm
M = 1.5* M	310.905	KN-m
$k = M_u/bd^2$	2.60	N/mm^2
P_t	0.425	%
Ast = P_t (bd)/100	984.9375	
Shear V	453.88	KN
Shear Stress $\tau_v = V_u / bd$	1.96	N/mm^2
Allowable τ_{cmax}	2.8	N/mm^2
$V_{us} = V_u - \tau_c bd$		
V_{us}/d	0	KN/cm

Provide shear stirrups of

To avoid horizontal bursting 16Y @ 125 mm c/c is provided

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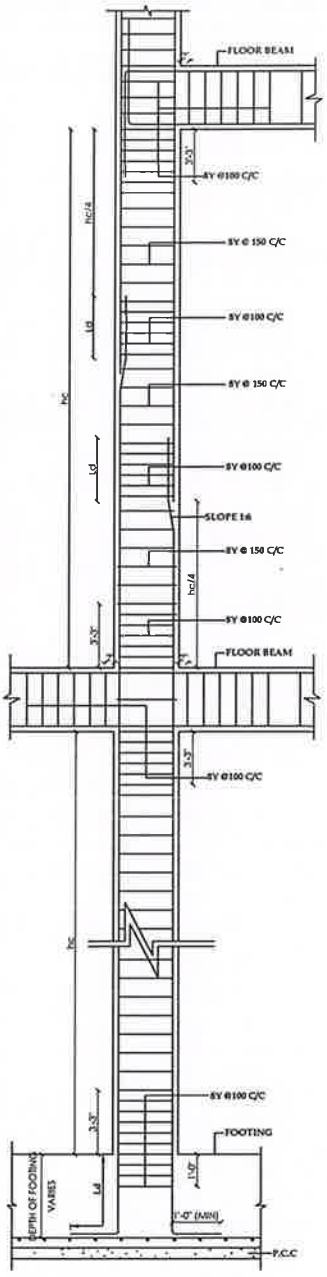


LAYOUT OF COLUMN AND COLUMNCENTERLINE

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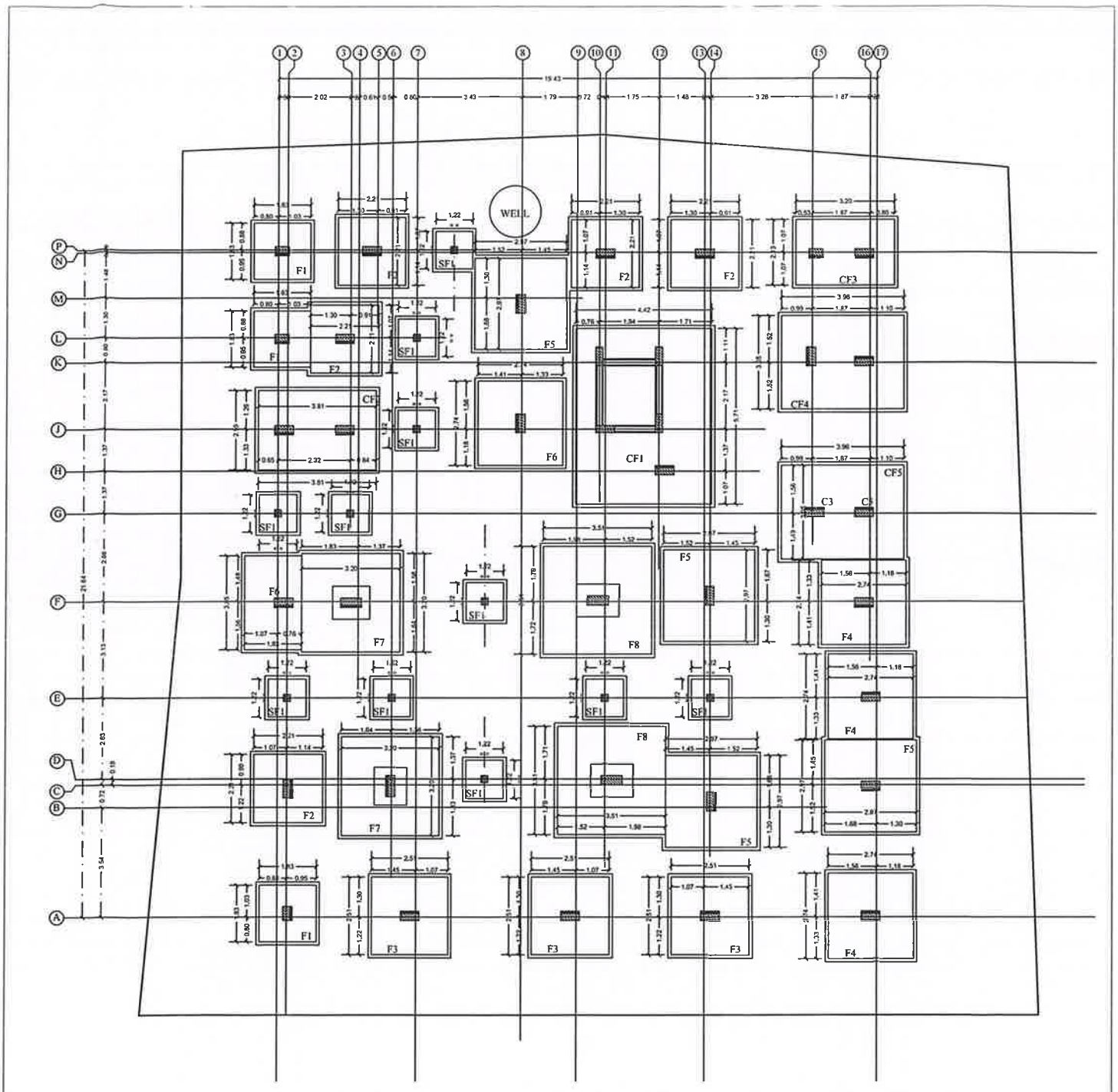
SCHEDULE OF COLUMNS

DESCRIPTION	SIZE	FLOOR	REINFORCEMENT	SHAPE OF TIES	TIES @ JOINT AND SUPPORT	TIES @ MID SPAN
C1	230 x 610	UPTO TOP ROOF	8 NOS OF 20Y MAIN RODS	230 / 610	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
C2	300 x 450	UPTO FIRST ROOF	4 NOS OF 20Y MAIN RODS+ 4 NOS OF 16Y MAIN RODS+ 4 NOS OF 12Y MAIN RODS	300 / 450	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
	230 x 450	ABOVE FIRST ROOF UPTO TOP ROOF	4 NOS OF 20Y MAIN RODS+ 6 NOS OF 16Y MAIN RODS	230 / 450	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
C3	300 x 610	UPTO FIRST ROOF	8 NOS OF 20Y MAIN RODS+ 4 NOS OF 12Y MAIN RODS	300 / 610	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
	230 x 610	ABOVE FIRST ROOF UPTO TOP ROOF	8 NOS OF 20Y MAIN RODS	230 / 610 TWO CLOSED	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
C4	300 x 610	UPTO FIRST ROOF	4 NOS OF 25Y MAIN RODS+ 4 NOS OF 20Y MAIN RODS+ 4 NOS OF 12Y MAIN RODS	300 / 610 THREE CLOSED	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
	230 x 610	ABOVE FIRST ROOF UPTO TOP ROOF	4 NOS OF 25Y MAIN RODS 4 NOS OF 20Y MAIN RODS	230 / 610 TWO CLOSED	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
C5	300 x 610	UPTO FIRST ROOF	8 NOS OF 25Y MAIN RODS+ 4 NOS OF 12Y MAIN RODS	300 / 610 THREE CLOSED	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
	230 x 610	ABOVE FIRST ROOF UPTO TOP ROOF	8 NOS OF 25Y MAIN RODS	230 / 610 TWO CLOSED	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
C6	300 x 610	UPTO TOP ROOF	10 NOS.OF 25Y MAIN RODS+ 5 NOS.OF 12Y MAIN RODS	300 / 610	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
	230 x 610	ABOVE FIRST ROOF UPTO TOP ROOF	10 NOS.OF 25Y MAIN RODS	230 / 610	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
C7	300 x 760	UPTO TOP ROOF	10 NOS.OF 25Y MAIN RODS+ 5 NOS.OF 12Y MAIN RODS	300 / 760	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
	230 x 760	ABOVE FIRST ROOF UPTO TOP ROOF	10 NOS.OF 25Y MAIN RODS	230 / 760	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
C8	300 x 760	UPTO TOP ROOF	10 NOS.OF 25Y MAIN RODS+ 5 NOS.OF 12Y MAIN RODS	300 / 760	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
	230 x 760	ABOVE FIRST ROOF UPTO TOP ROOF	10 NOS.OF 25Y MAIN RODS	230 / 760	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C
SC1	230 x 230	UPTO TOP ROOF	4 NOS.OF 12Y MAIN RODS	230 / 230	8Y TIES @ 100 C/C	8Y TIES @ 150 C/C



TYPICAL COLUMN SECTION

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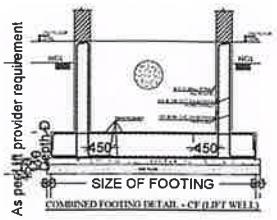


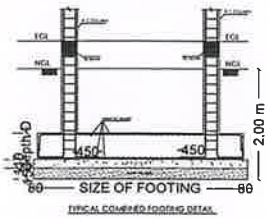
LAYOUT OF FOOTING

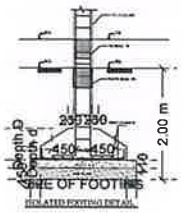
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SCHEDULE OF FOOTINGS

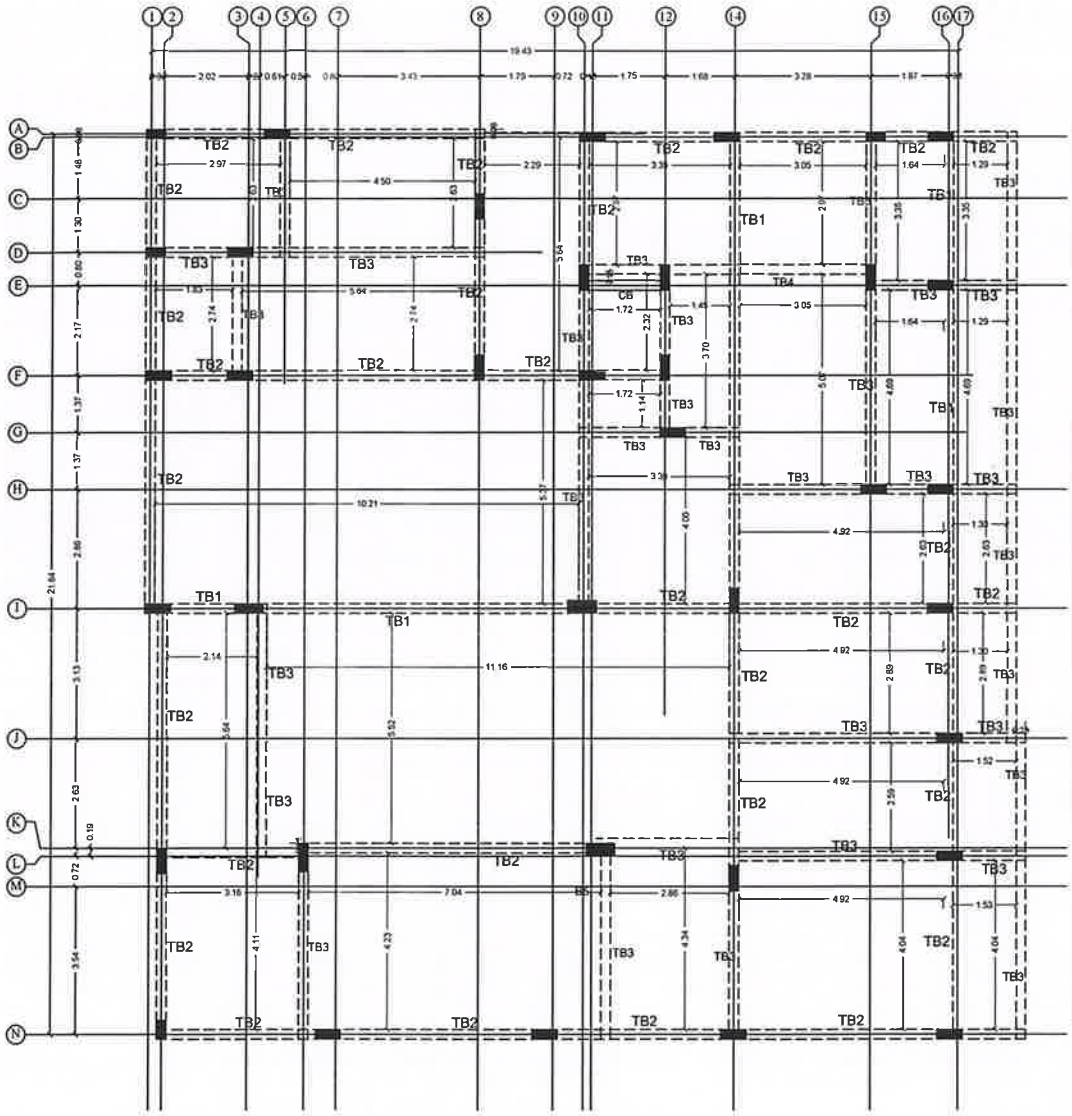
TYPE	WIDTH	LENGTH	DEPTH		REINFORCEMENT (BOTTOM)		REINFORCEMENT (TOP)		BOTTOM LEVEL OF FOOTING FROM NGL
			D	d	SHORT SPAN	LONG SPAN	SHORT SPAN	LONG SPAN	
F1	1.83	1.83	610	--	Y16 @ 150 C/C	Y16 @ 150 C/C	--	--	2.00M
F2	2.21	2.21	610	--	Y12 @ 125 C/C	Y12 @ 125 C/C	--	--	2.00M
F3	2.51	2.51	530	--	Y12 @ 125 C/C	Y12 @ 125 C/C	--	--	2.00M
F4	2.74	2.74	530	--	Y12 @ 150 C/C	Y12 @ 150 C/C	--	--	2.00M
F5	2.97	2.97	530	--	Y12 @ 150 C/C	Y12 @ 150 C/C	--	--	2.00M
F6	2.74	2.74	530	--	Y12 @ 150 C/C	Y12 @ 150 C/C	--	--	2.00M
F7	3.20	3.20	450	--	Y12 @ 150 C/C	Y12 @ 150 C/C	--	--	2.00M
F8	3.51	3.51	450	--	Y12 @ 150 C/C	Y12 @ 150 C/C	--	--	2.00M
CF1	4.42	5.27	450	--	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	2.00M
CF2	3.81	2.59	450	--	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	2.00M
CF3	3.20	2.13	450	--	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	2.00M
CF4	3.96	3.05	450	--	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	2.00M
CF5	3.96	3.05	450	--	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	Y12 @ 150 C/C	2.00M





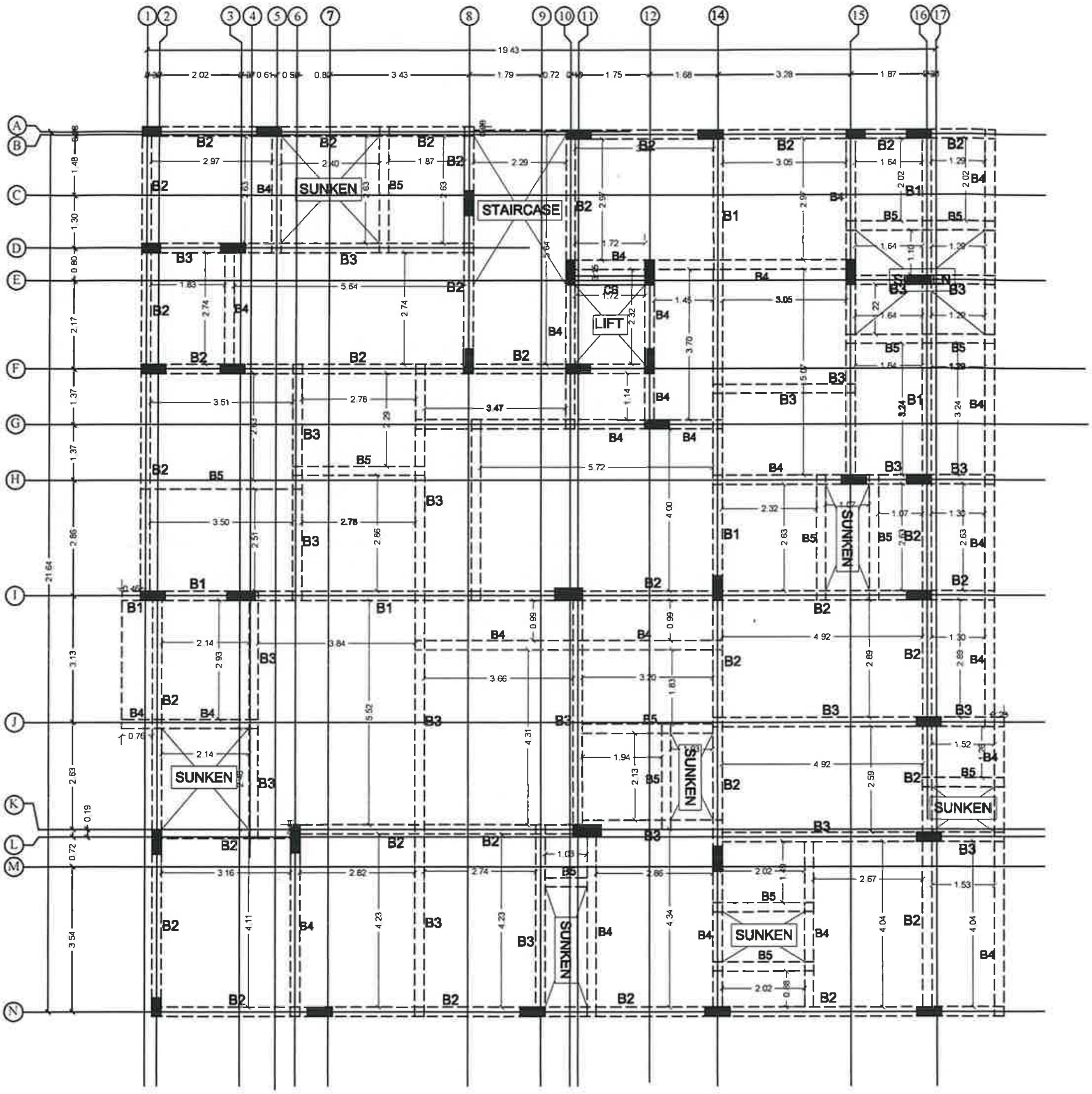


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LAYOUT OF TIE BEAM

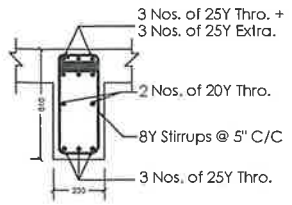
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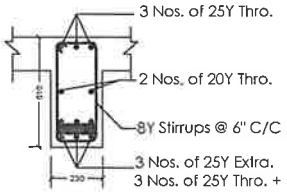
LAYOUT OF FIRST ROOF BEAM

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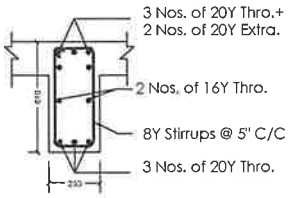
DETAILS OF FIRST ROOF BEAM



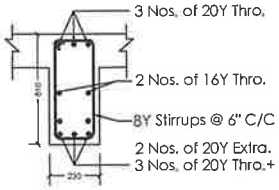
BEAM B1 (230 x 610)
@SUPPORT



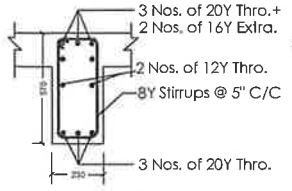
BEAM B1 (230 x 610)
@MIDSPAN



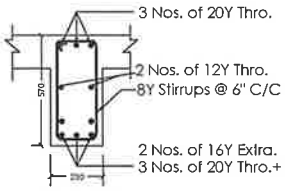
BEAM B2 (230 x 610)
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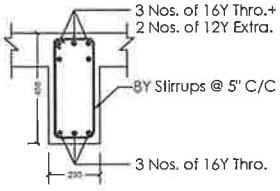
BEAM B2 (230 x 610)
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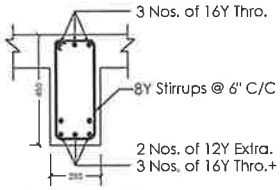
BEAM B3 (230 x 570)
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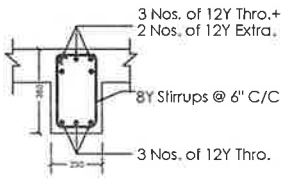
BEAM B3 ((230 x 570)
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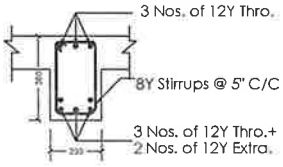
BEAM B4 (230 x 450)
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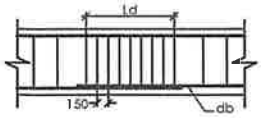
BEAM B4 (230 x 450)
@MIDSPAN



BEAM B5 (230 x 380)
@SUPPORT



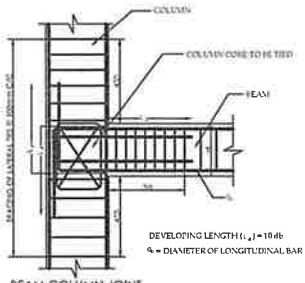
BEAM B5 (230 x 380)
@MIDSPAN



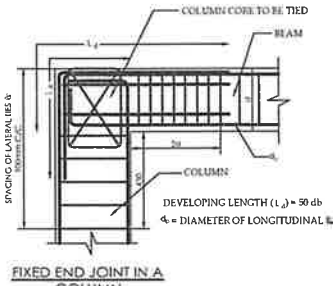
LAP . SPLICE IN BEAM

Ld = DEVELOPMENT LENGTH IN TENSION

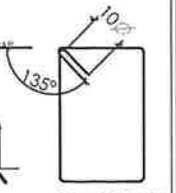
db = BAR DIAMETER



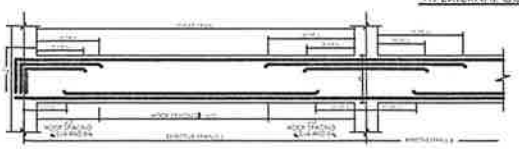
BEAM COLUMN JOINT
AT EXTERNAL COLUMNS



FIXED END JOINT IN A
COLUMN



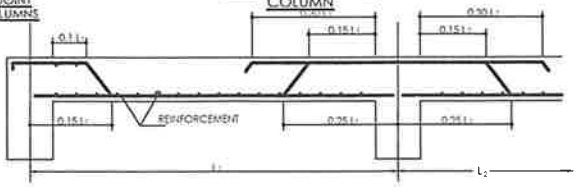
BEAM STIRRUPS
HOOK DETAIL



NOTE :

0.3 L_1 SHOULD NOT BE LESS THAN
DEVELOPING LENGTH L_d = 50 (ϕ_L)
ϕ_L = DIAMETER OF LONGITUDINAL BAR

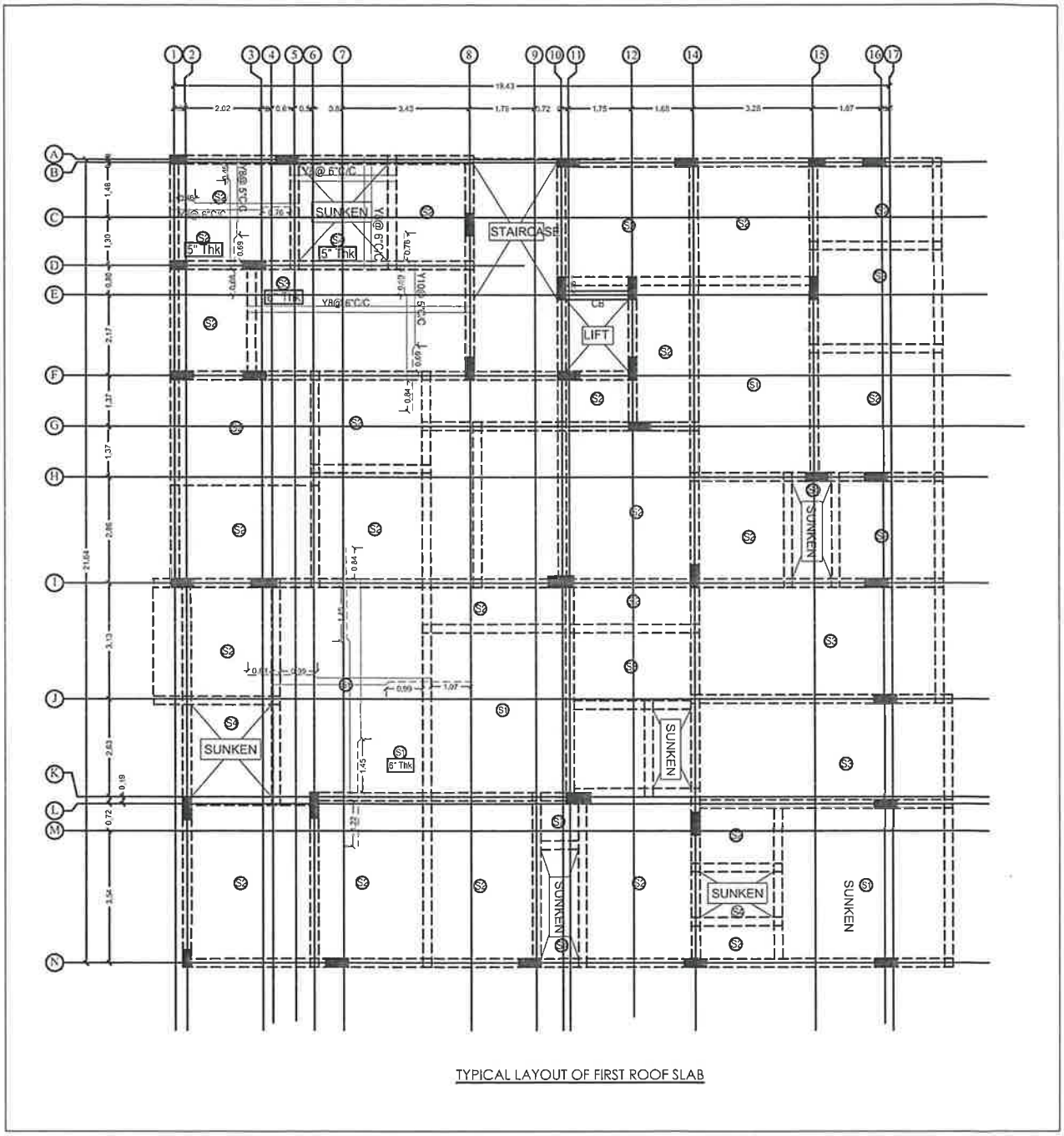
CURTAILMENT DETAILS FOR BEAMS



SLAB CURTAILMENT DETAILS OF BENT UP BARS

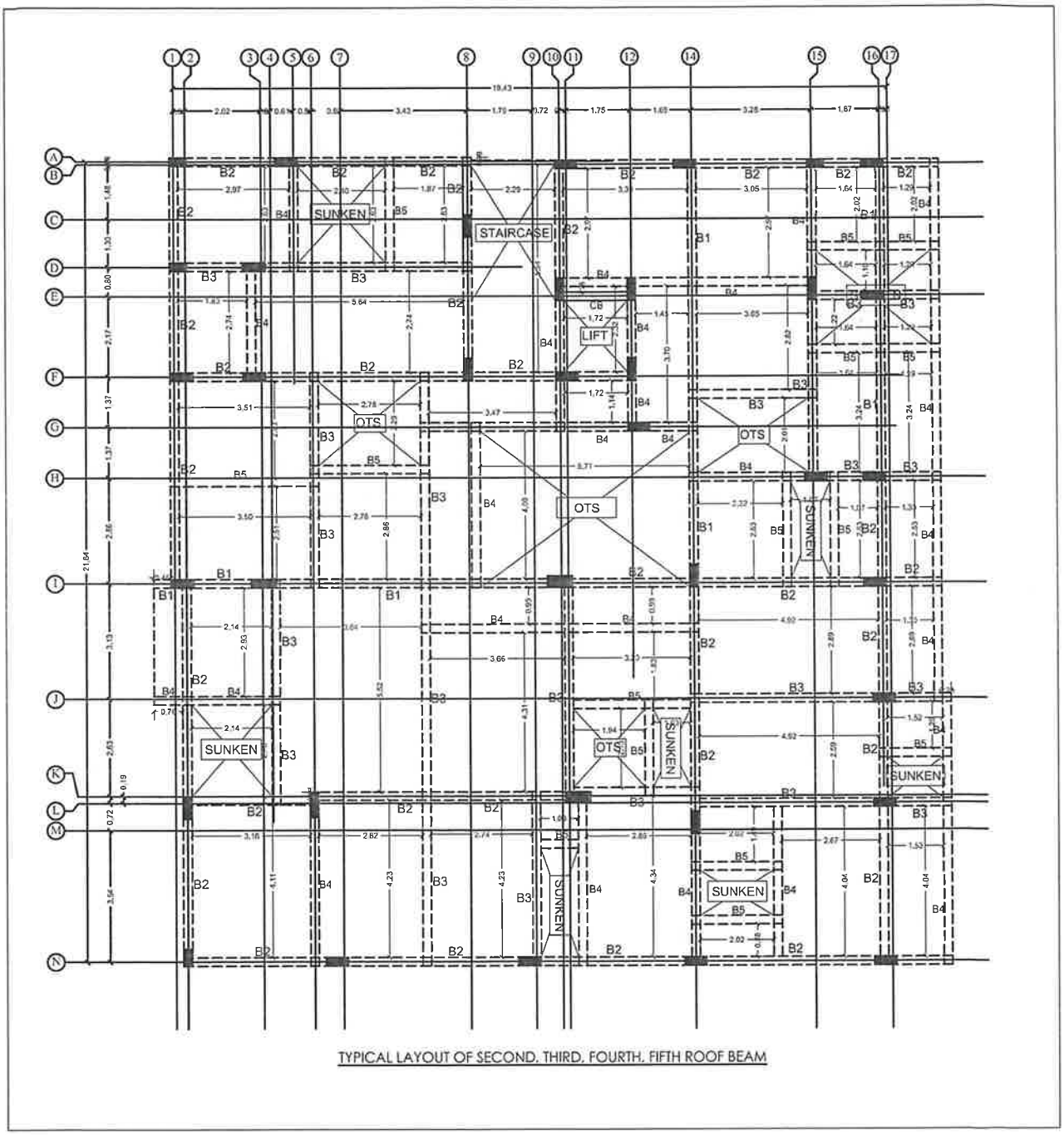
GRADE
CONCRETE - M20
STEEL- FE 500
GOOD FOR CONSTRUCTION

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TYPICAL LAYOUT OF FIRST ROOF SLAB

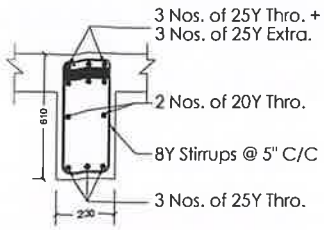
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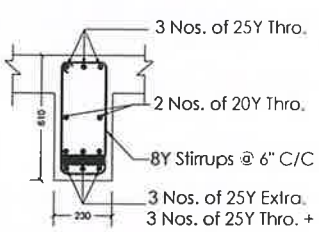
TYPICAL LAYOUT OF SECOND, THIRD, FOURTH, FIFTH ROOF BEAM

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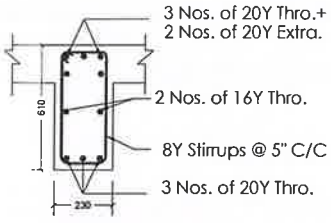
TYPICAL DETAILS OF FIRST, SECOND, THIRD, FOURTH ROOF BEAM



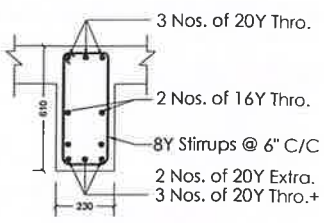
BEAM B1 (230 x 610)
@SUPPORT



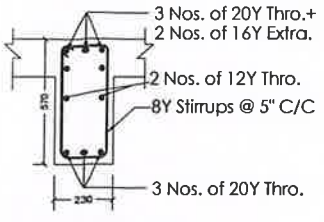
BEAM B1 (230 x 610)
@MIDSPAN



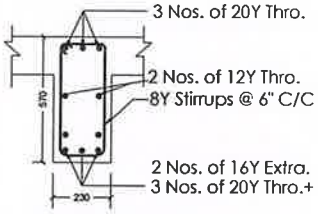
BEAM B2 (230 x 610)
@SUPPORT



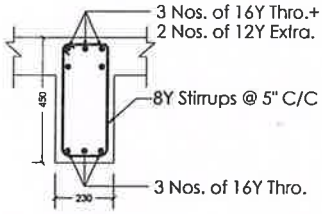
BEAM B2 (230 x 610)
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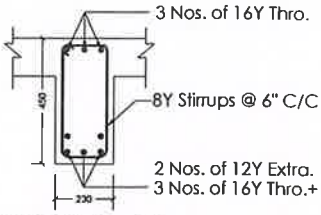
BEAM B3 (230 x 570)
@SUPPORT



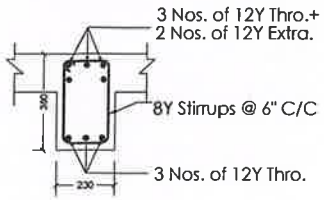
BEAM B3 ((230 x 570)
@MIDSPAN



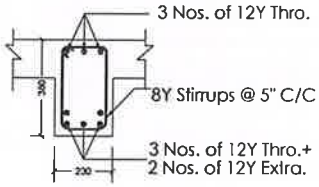
BEAM B4 (230 x 450)
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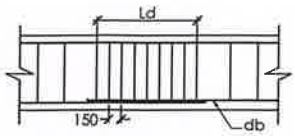
BEAM B4 (230 x 450)
@MIDSPAN



BEAM B5 (230 x 380)
@SUPPORT



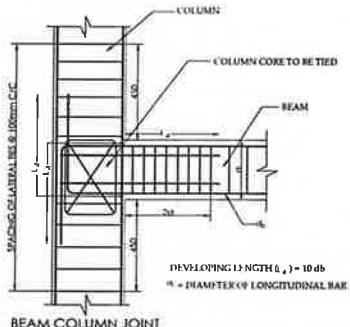
BEAM B5 (230 x 380)
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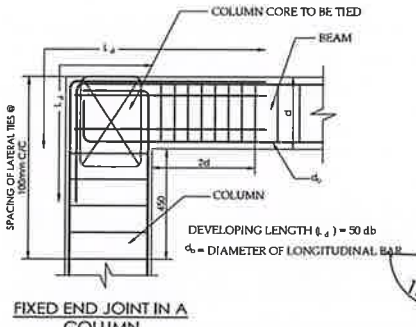
LAP , SPLICE IN BEAM

Ld = DEVELOPMENT LENGTH IN TENSION

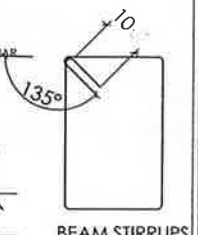
db = BAR DIAMETER



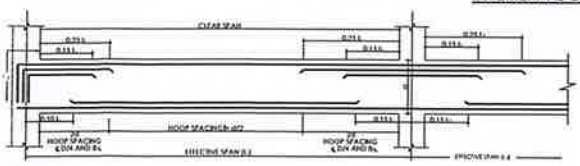
BEAM COLUMN JOINT
AT EXTERNAL COLUMNS



FIXED END JOINT IN A
COLUMN



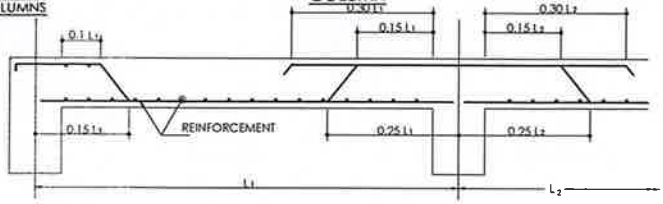
BEAM STIRRUPS
HOOK DETAIL



NOTE :

0.15 L_1 SHOULD NOT BE LESS THAN
DEVELOPING LENGTH L_d = 50 (ϕ_L)
ϕ_L = DIAMETER OF LONGITUDINAL BAR

CURTAILMENT DETAILS FOR BEAMS

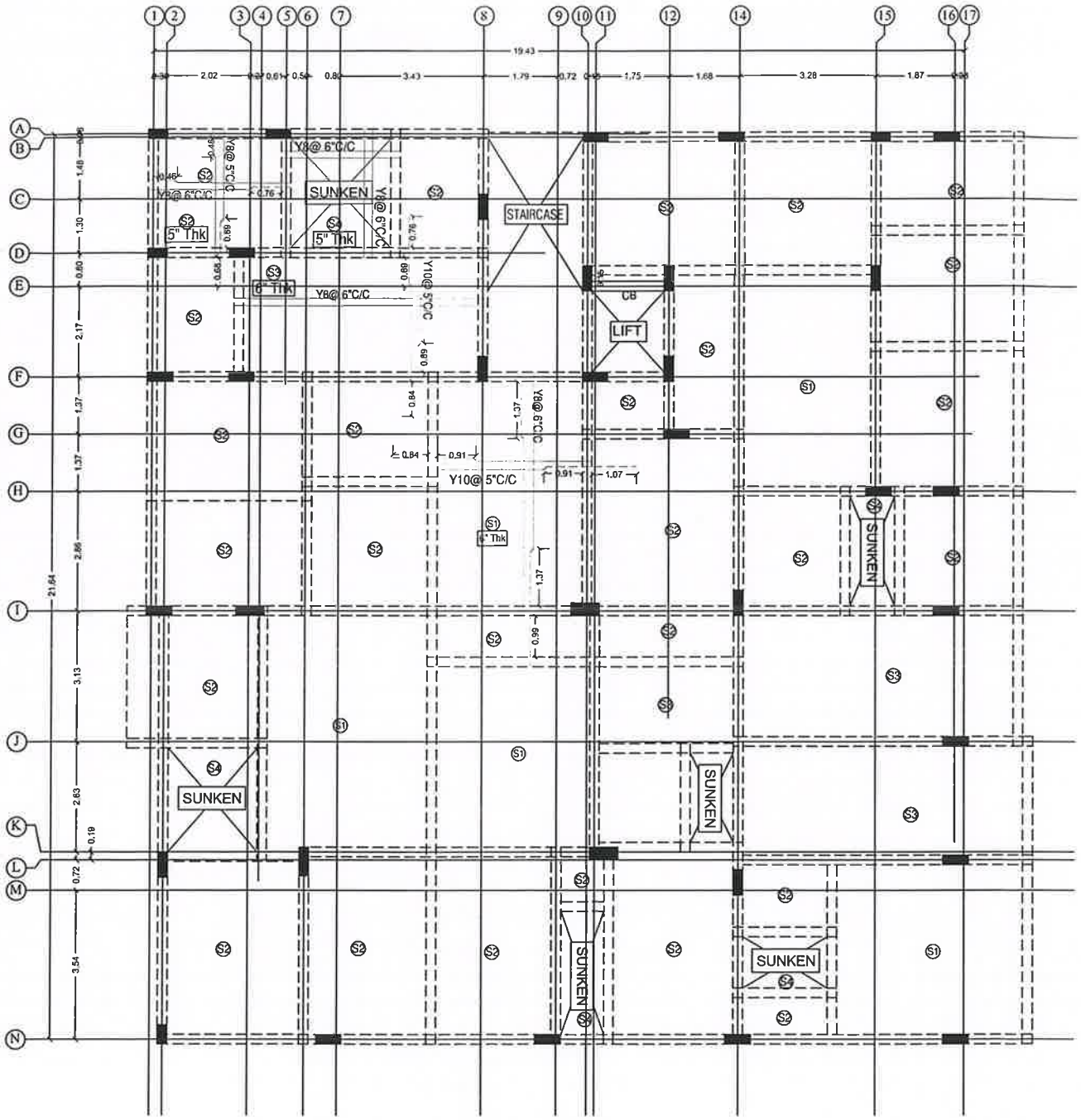


SLAB CURTAILMENT DETAILS OF BENT UP BARS

GRADE
CONCRETE - M20
STEEL - FE 500

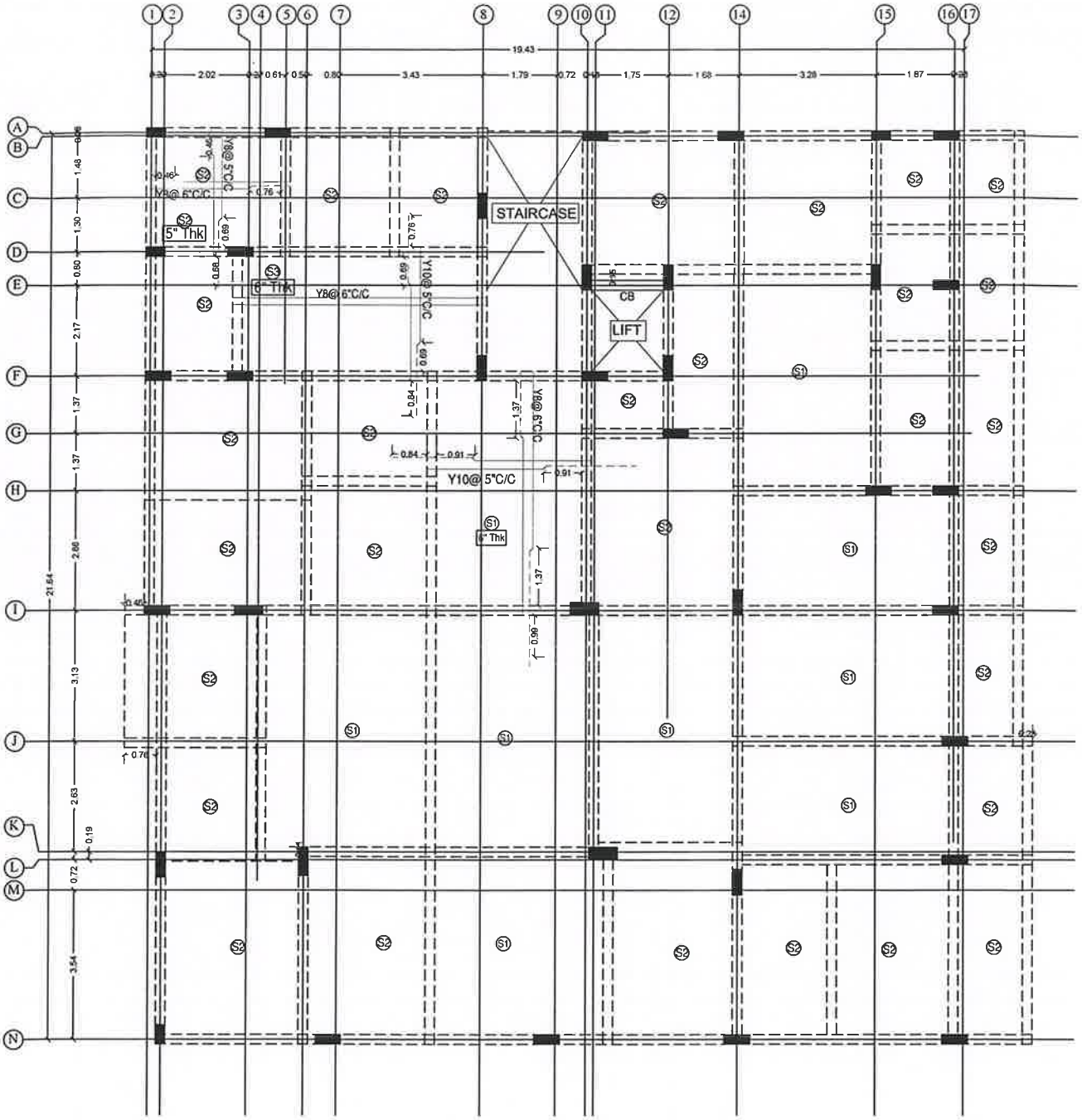
GOOD FOR CONSTRUCTION

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TYPICAL LAYOUT OF FIRST, SECOND, THIRD, FOURTH ROOF SLAB

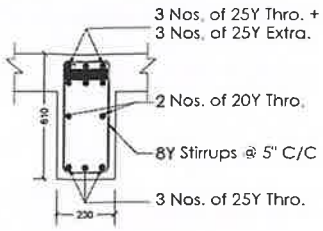
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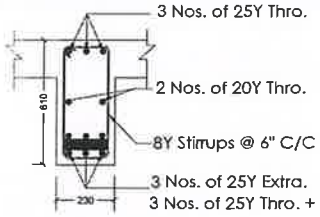
LAYOUT OF FIFTH ROOF SLAB

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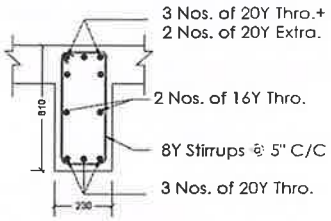
DETAILS OF FIFTH ROOF BEAM



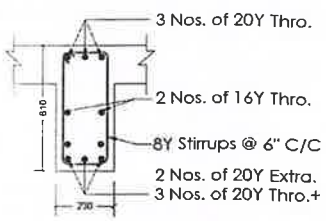
BEAM B1 (230 x 610)
@SUPPORT



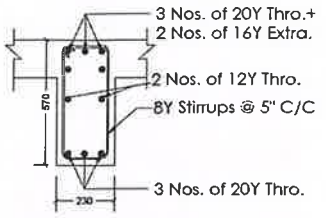
BEAM B1 (230 x 610)
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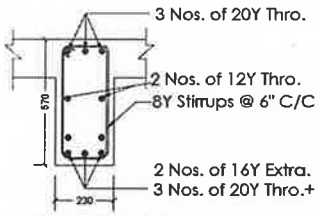
BEAM B2 (230 x 610)
@SUPPORT



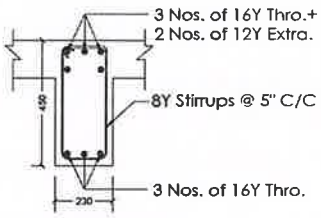
BEAM B2 (230 x 610)
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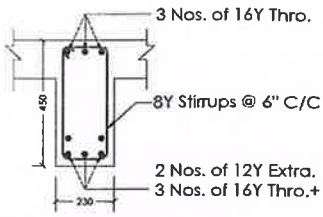
BEAM B3 (230 x 570)
@SUPPORT



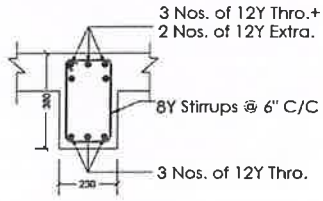
BEAM B3 ((230 x 570)
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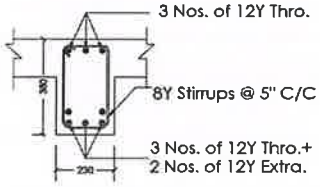
BEAM B4 (230 x 450)
@SUPPORT



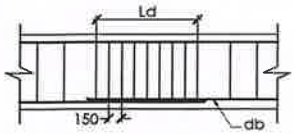
BEAM B4 (230 x 450)
@MIDSPAN



BEAM B5 (230 x 380)
@SUPPORT



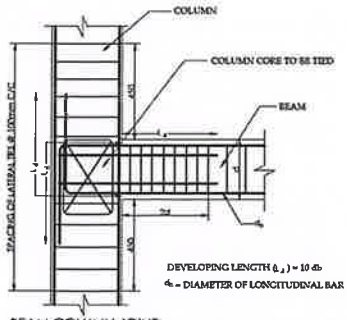
BEAM B5 (230 x 380)
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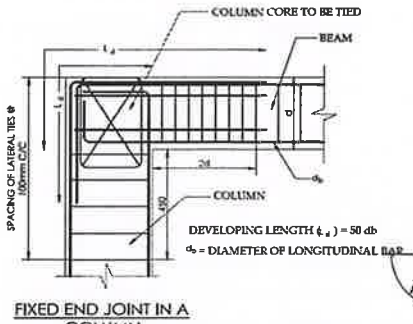
LAP . SPLICE IN BEAM

Ld = DEVELOPMENT LENGTH IN TENSION

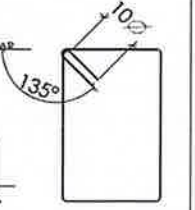
db = BAR DIAMETER



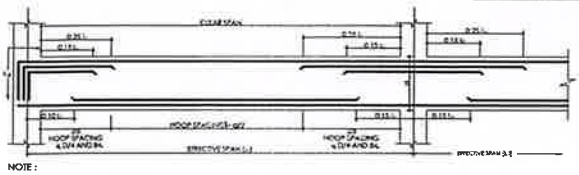
BEAM COLUMN JOINT
AT EXTERNAL COLUMNS



FIXED END JOINT IN A
COLUMN



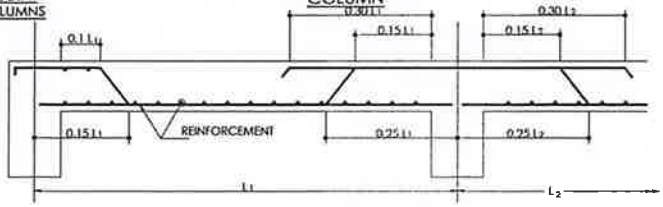
BEAM STIRRUPS
HOOK DETAIL



NOTE :

0.15 L_1 SHOULD NOT BE LESS THAN
DEVELOPING LENGTH L_d = 50 $|d_b|$
d_b = DIAMETER OF LONGITUDINAL BAR

CURTAILMENT DETAILS FOR BEAMS

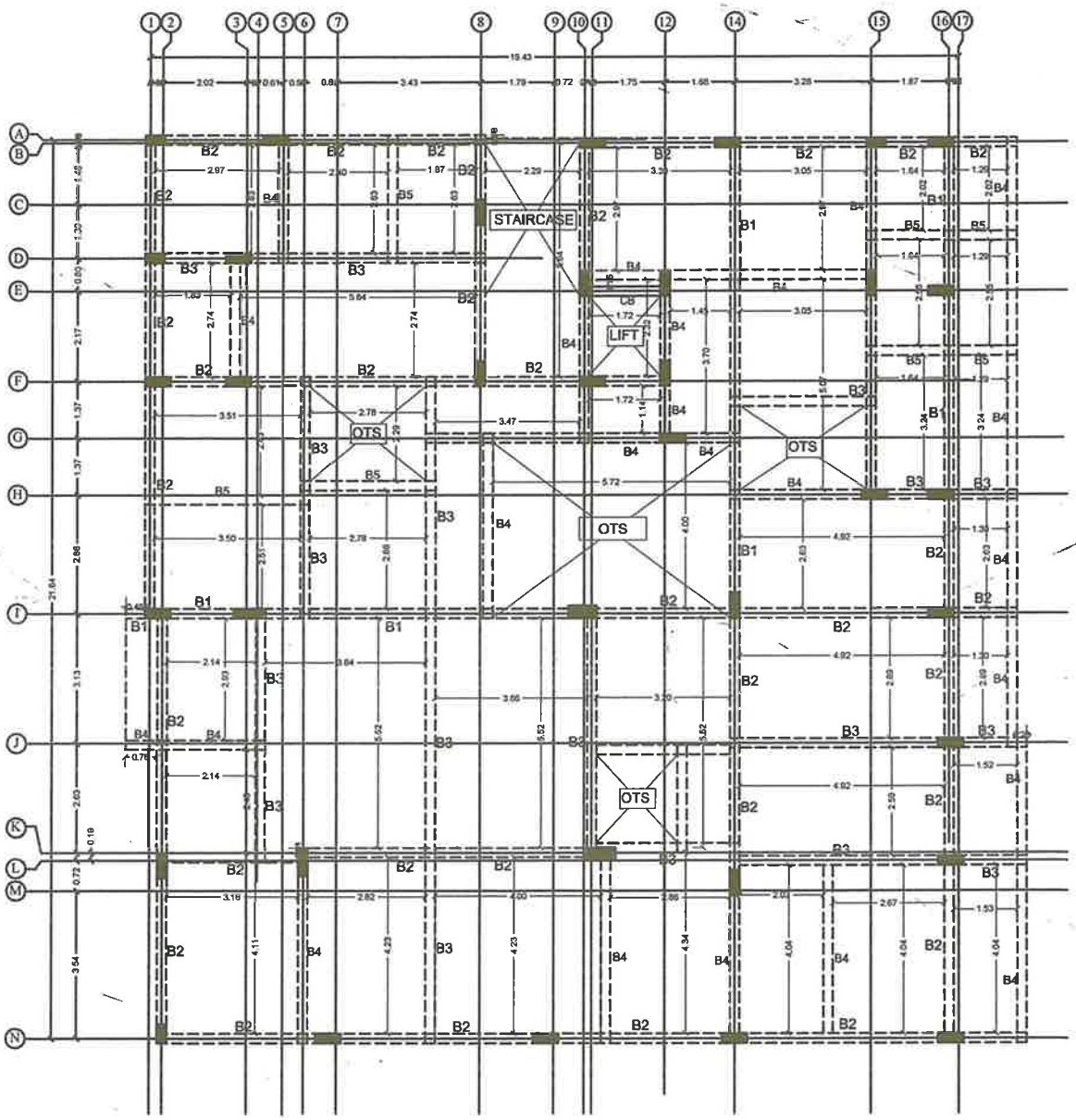


SLAB CURTAILMENT DETAILS OF BENT UP BARS

GRADE
CONCRETE - M20
STEEL - FE 500

GOOD FOR CONSTRUCTION

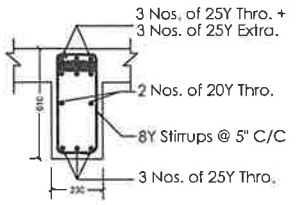
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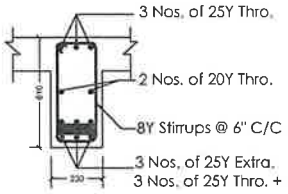
LAYOUT OF SIXTH ROOF BEAM

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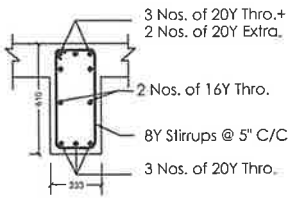
TYPICAL DETAILS OF SECOND, THIRD, FOURTH, FIFTH ROOF BEAM



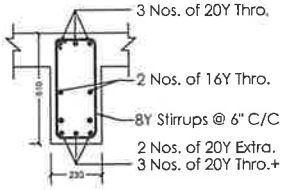
BEAM B1 (230 x 610)
@SUPPORT



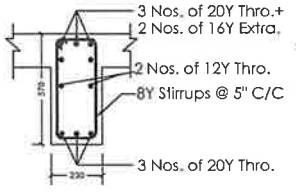
BEAM B1 (230 x 610)
@MIDSPAN



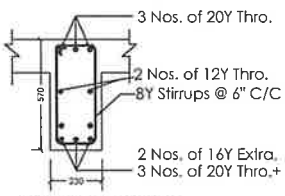
BEAM B2 (230 x 610)
@SUPPORT



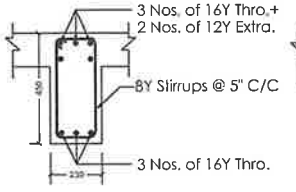
BEAM B2 (230 x 610)
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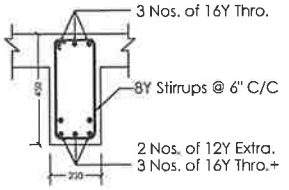
BEAM B3 (230 x 570)
@SUPPORT



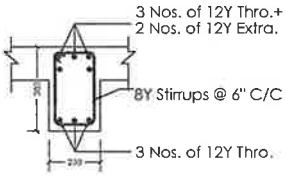
BEAM B3 (230 x 570)
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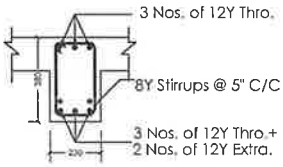
BEAM B4 (230 x 450)
@SUPPORT



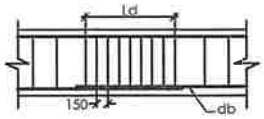
BEAM B4 (230 x 450)
@MIDSPAN



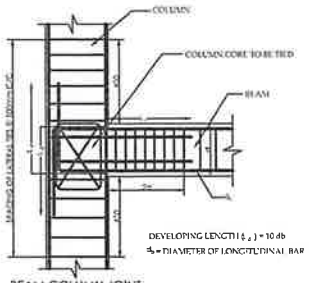
BEAM B5 (230 x 380)
@SUPPORT



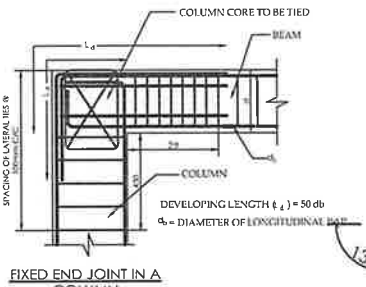
BEAM B5 (230 x 380)
@MIDSPAN



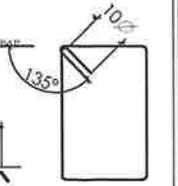
LAP . SPLICE IN BEAM
Ld = DEVELOPMENT LENGTH IN TENSION
db = BAR DIAMETER



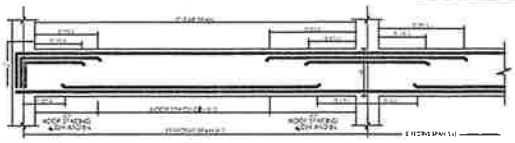
BEAM COLUMN JOINT
AT EXTERNAL COLUMNS



FIXED END JOINT IN A
COLUMN

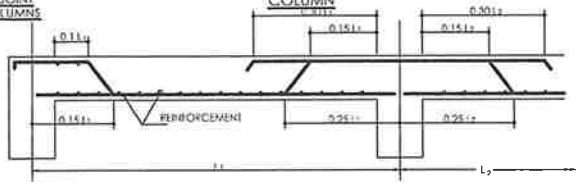


BEAM STIRRUPS
HOOK DETAIL



NOTE:
D IS L_1 SHOULD NOT BE LESS THAN
DEVELOPING LENGTH (L_d = 50 (ϕ_b)
ϕ_b = DIAMETER OF LONGITUDINAL BAR

CURTAILMENT DETAILS FOR BEAMS

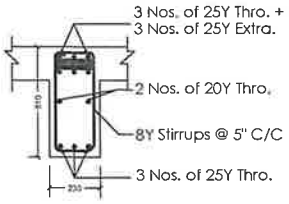


SLAB CURTAILMENT DETAILS OF BENT UP BARS

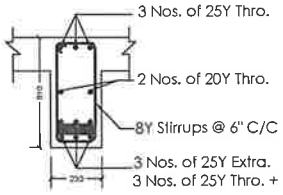
GRADE
CONCRETE - M20
STEEL - FE 500
GOOD FOR CONSTRUCTION

R. Sivashanmugam, M.Tech.(Structures)
Structural Consultant
Regd. Structural Engineer GR-II, RSE200372019
Greater Chennai Corporation
Strucspec Cell: 91763 12345
No.12A, John Desikar Street, Nanganallur, Chennai-600 061.
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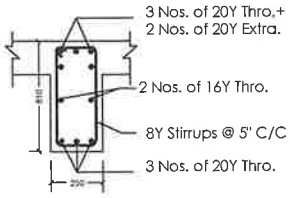
DETAILS OF SIXTH ROOF BEAM



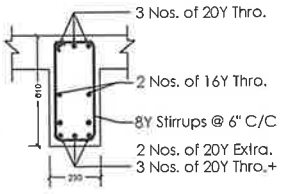
BEAM B1 (230 x 610)
@SUPPORT



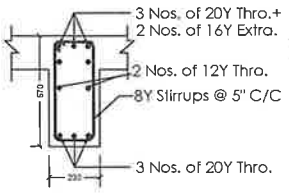
BEAM B1 (230 x 610)
@MIDSPAN



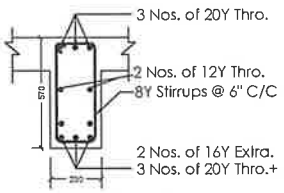
BEAM B2 (230 x 610)
@SUPPORT



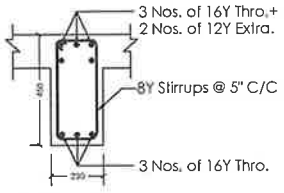
BEAM B2 (230 x 610)
@MIDSPAN



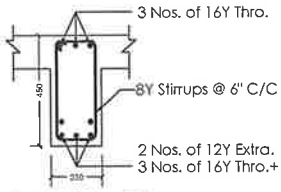
BEAM B3 (230 x 570)
@SUPPORT



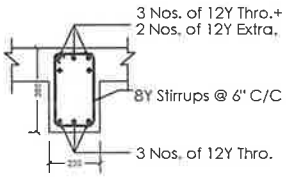
BEAM B3 (230 x 570)
@MIDSPAN



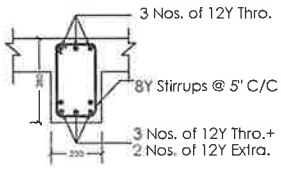
BEAM B4 (230 x 450)
@SUPPORT



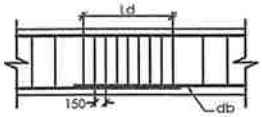
BEAM B4 (230 x 450)
@MIDSPAN



BEAM B5 (230 x 380)
@SUPPORT



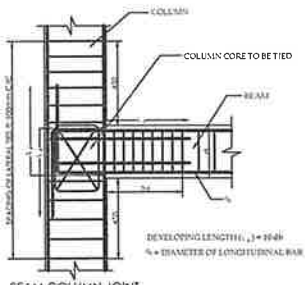
BEAM B5 (230 x 380)
@MIDSPAN



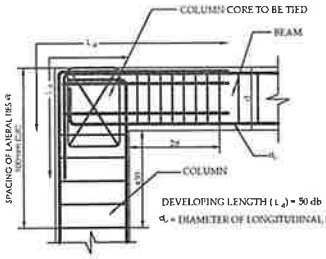
LAP , SPLICE IN BEAM

Ld = DEVELOPMENT LENGTH IN TENSION

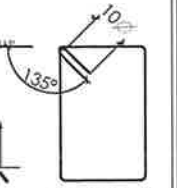
db = BAR DIAMETER



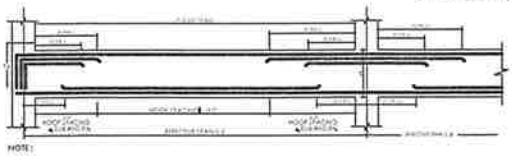
BEAM COLUMN JOINT
AT EXTERNAL COLUMNS



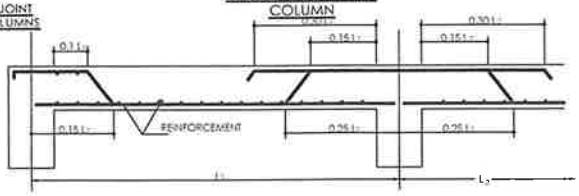
FIXED END JOINT IN A
COLUMN



BEAM STIRRUPS
HOOK DETAIL



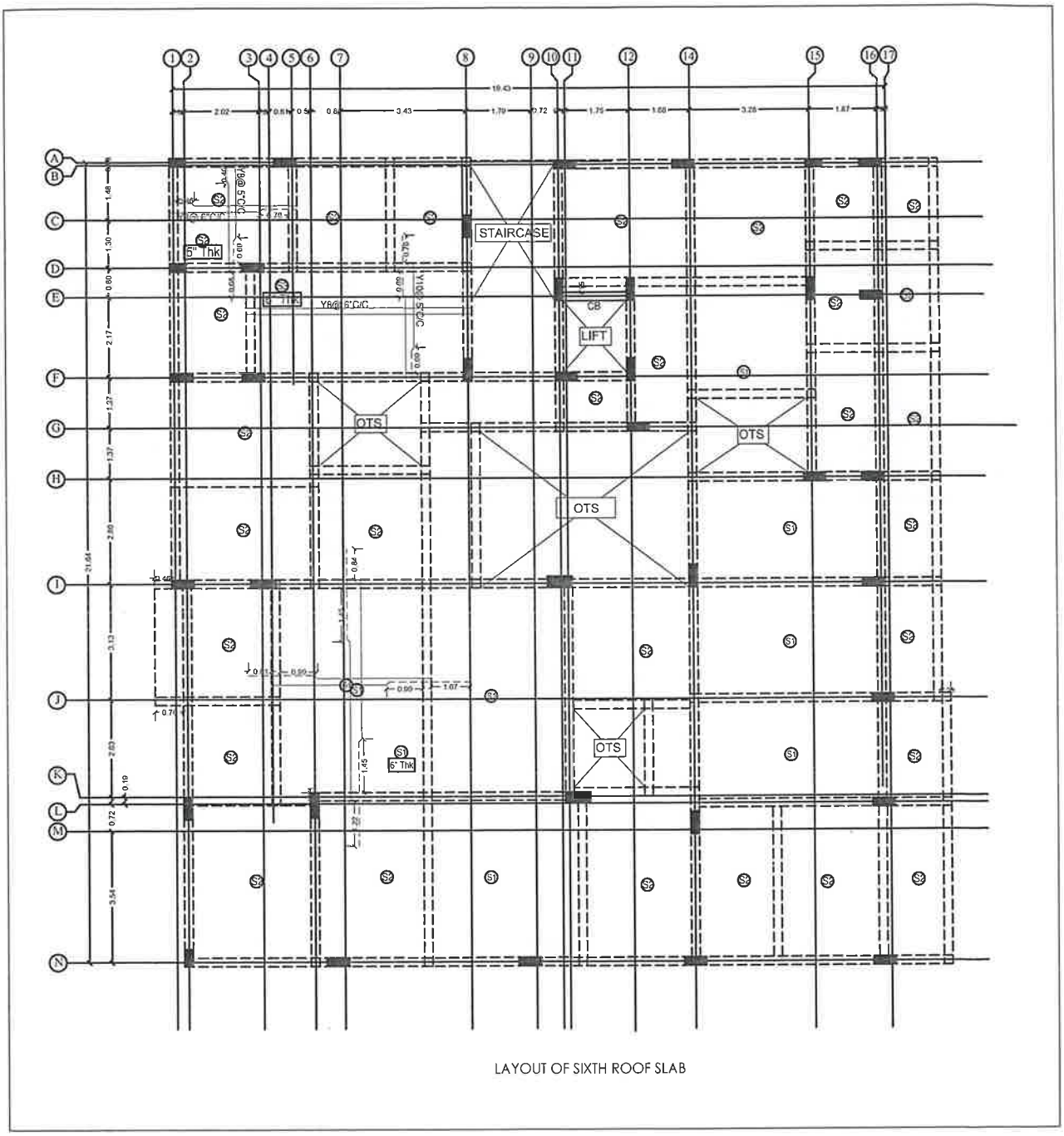
CURTAILMENT DETAILS FOR BEAMS



SLAB CURTAILMENT DETAILS OF BENT UP BARS

GRADE
CONCRETE - M20
STEEL - FE 500
GOOD FOR CONSTRUCTION

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LAYOUT OF SIXTH ROOF SLAB

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Property Documentation & Workflow Tools

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Vastu & Property Management Tools

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