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PROPOSED RESIDENTIAL BUILDING WITH 12 DWELLINGS AND STILT +3 FLOORS AT DOOR NO.13-A, FIRST MAIN ROAD, KOVALAN NAGAR, PALLIKARANAI, CHENNAI - 600100. COMPRISED IN S.NO. 322/1, PATTA NO.31913, OF PALLIKARANAI VILLAGE, SHOLINGANALLUR TALUK, WITHIN THE LIMITS OF GREATER CHENNAI CORPORATION.

STRUCTURAL DESIGN CALCULATION

Structural Consultant

Krishna Jeyanth

1, Soodiammanpet Street ,

Saidapet Ch-600015.

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1. **General:**

The proposed building is a Framed Structure with Ground floor +3 Upper floors with 12 dwellings.

2. **Design Basis:**

Latest design codes of BIS-456,875 and 1893 are followed with SP-16 Design aid book. A Typical 3 D Wire Frame was made for analysis to arrive Moment and Axial force for Column. Wind load is taken into account. Isolated Footing is proposed as per soil report. Fe415 Steel is used for main reinforcement and a minimum grade of concrete is M25.

3. **Wind Load:**

Vz=VbxK1xK2xK3.

Vb=50m/sec in Chennai.

Check for direct stress(shear)

Critical Section for Shear is at a distance d=800mm from the face of the column.

Max. Shear force at critical section=131x2.75x(1.26-0.82/2)=310KN.

$$Tv = \frac{310x10^3}{2520x790} = 0.155$$

Check for nominal shear stress<Design nominal shear stress

Tv (0.155) < Ts (0.36).

Check for punching shear.

Tv = Vp/d x Perimeter of critical section.

$$= \frac{1.5x1244x1000}{1360x800}$$

Tv =2.4N/sqmm.

Tv =1.71<Tc=2.8(Hence Safe).

K_1 = Probability factor = 1

K_2 = Terrain, Height Factor =1

K_3 = Topography factor = 1

p= 0.6xVzxVb

= 0.6x50x50

= 1500N/sqmm.

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4. Earthquake Consideration:

For Better Stability during Earthquake condition, the columns are braced m both direction with beams and slab, Continuous lintels are specified for outer walls and column ties are closely spaced for better ductility. For building on stilt min, size is taken as 300mm for column.

Zone Factor, Z for Chennai seismic zone III: 0.16(table 2, Clause 6.4.2)

I, Importance Factor: 4, (From table 6)

R, Response reduction factor: 3 for OMR (Ordinary Moment Resisting frame table 7)

Fundamental Natural period along x direction $Tx = 0.09xh/(dx)^{1/2}$

$=0.09x12/(15.68)^{1/2} = 0.27$(clause7.6.2)

The soil at the site is medium $Sa/g = 2.5$as $0.1 \leq T \leq 0.55$

Fundamental Natural Period along Z direction $Tz = 0.09xh/(dz)$

$= 0.09x12/(14.6)^{1/2} = 0.28$(clause7.6.2)

The soil at the site is medium $Sa/g = 2.5$ as $0.1 \leq T \leq 0.5$

Design Horizontal Seismic Coefficient

$Ah = ZISa/2Rg$ (clause 6.4.2)

$= 0.16x1x2.5/2x3 = 0.0667$

Seismic Weight of the building : Total Gravity Load +0.25 Super imposed Load

$W = 11641$ KN

Design Seismic Base Shear

$Vb = AhW$

$= 0.0667 \times 11641 = 776.45$ KN

Shear Per Column = 776.45/25= 31.05 KN

Seismic Moment Per Column = 31.05x3.05/2= 47.36 Nm.

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LOAD CALCULATION FOR MAXIMUM LOADED COLUMN

Loading Area for the column = 5.03 x 5.48 = 27.56 Sqm

Gravity Load Reaction from the roof = 6.125x27.56 = 168.805 KN

Self-Weight of the beams = 0.3x0.6x25x10.51 = 47.295 KN

Weight of the Parapet wall = 1x0.23x20x10.51 = 48.346 KN

Total Gravity Load = 264.446 KN

Super impose Load Reaction from roof = 1.5x27.56= 41.34 KN

Super impose Load Reaction from roof = 2x27.56 = 55.12 KN

Gravity Load Reaction from the floor = 4.125x27.56 = 113.685 KN

Self-Weight of the beams = 0.3x0.6x25x10.51 = 47.295 KN

Total Gravity Load = 257.44 KN

Reaction from water tank = 141.37 KN

Weight from Head room = 80 KN

Self-weight of column = 0.3 x 0.6 x 13 x 25= 43.875 KN

Total Gravity Load at the Foundation = 264.446 + 257.44 x 4+ 43.875

Level KN +141.37+80= 1816.891 KN

Total Super Impose Load at the foundation = (41.34+ (55.12x5)) x 0.6

Level KN = 190.164 KN

Total Load = 1816.891+190.164 = 2007.055 KN

The loads of other column calculated in similar way.

5. Design Loads:

Slab 125mm thick	=3.125KN/sqm.
Live Load (Residence)	= 2.00KN/sqm.
Live Load (commercial)	= 6.00KN/sqm.
Floor finishes	= 2.00KN/sqm.

This value is also taken for frame analysis.

Brick work 230mm thick for exterior walls.

0.23x2.5x20 = 11.5 KN/'m/floor.

Brick work 115mm thick for interior walls

0.115x2.5x20 = 5.75 KN/m/floor.

Beams 0.3x0.45x25 = 3.375KN/m/floor

Column 0.3x0.6x25 = 4.5KN/m/floor.

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Foundation details

Type of foundation	Combined / Isolated footing.
Depth of foundation	2.0 mt
Safe bearing capacity of soil	200 KN/sqm

Slab details

Type of slab	Two way & one-way slab
Thickness of slab provided	125mm
Cover to reinforcement	20m
Diameter of bar used	10mm, 12mm

Beam details

Size of beam provided	230 x 450, 230 x 600, 300 x 600
Cover to reinforcement	30mm
Diameter of main bar	20mm, 16mm, 12mm
Stirrups	2/4 legged stirrups of 8mm/10mm dia.

Column details

Size of beam provided	230x300, 300x450, 230x450, 300x600
Cover to reinforcement	For 12mm bar 25mm, For 16mm or greater 40mm
Diameter of main bar	25mm, 20mm, 16mm, 12mm
Lateral ties	8 mm

Design of Footing

Maximum load on column 2000 KN

Add 10% self-weight of footing = 200 KN

Total = 2200 KN

Area of footing required A = $\frac{2200KN}{200KN/m^2}$ = 11 m^2

Size of footing required = 3.3 m x 3.3 m

Providing footing size = 3.5m x 3.5m

Stress on soil = P/A = $\frac{2200}{3.5m \times 3.5m}$

=179.5 KN/m^2 < 200 KN/m^2

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Bending moment $= \frac{179.5 \times (1.0)^2}{2}$

M = 89.79 KNm

Mu = 89.79 x 1.5 = 134.69 KNm

$\frac{Mu}{bD^2} = \frac{13.469 \times 10^6}{3500 \times 600^2} = 0.007\ N/mm^2$

$F_{CK} = 25\ N/mm^2$

From table – 3 of SP-16 $P_T\% = 0.084$

$$A_{ST} = \frac{0.127X3500X600}{100} = 2667\ mm^2$$

Provided tor steel rod 12 tor at 150mm c/c both wavs.

Design of Plinth Beam

Assuming a plinth beam of size = 230mm x 450mm

Self-weight of the plinth beam = 0.23x0.45x25 = 2.587KN/m

Weight of the 230mm wall = 0.23x2.45x20 = 11.27KN/m

Total load on the plinth beam = 2.587 + 11.27 = 13.857KN/m

$Mu/Bd^2 = 31.54X\ 10^6 /230X330X330 = 1.26$

From table 3 of SP16 Pt = 0.3622

Ast = 0.3622x 230x 420/100=380Sqmm.

Top and bottom steel of 4Nos of 16Tor + 2Nos of 12Tor is provided.

Area of steel provided = 1040Sqmm.

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Design of RCC Rectangular Columns

Column Dimensions			
Width mm	Depth mm	L_{eff} (width) m	L_{eff} (depth) m
300	600	3	3

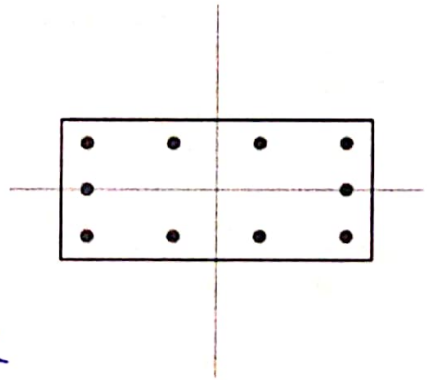
Rcc Characteristics		
Conc Grade N/mm^2	Reinf Grade N/mm^2	Clear Cover mm
25	500	40

Slenderness Ratios	
L_{eff}/B	L_{eff}/D
10.00	5.00

Reinforcement			
Dia (mm)		# of Bars Along	
Main	Ties	Width	Depth
20	8	3	4

Summary of Reinforcement		
Total #s	Area	%age
	cm^2	
10	31.40	1.745 %

Spacing	
@ width	@ depth
mm	mm
80.00	146.67



Factored Forces & Moments		
Axial (Kn)	Bending Moment (Kn-m)	
(Pu)	(Mub)	(Mud)
2000.00	0.00	84.00

Ecc' Moments (Kn-m)	
@ width	@ depth
(Meb)	(Med)
40.00	52.00
Min Ecc	

Summary of Bending Moments (Kn-m)		
Type	@ width	@ depth

Axial Load Capacity
2015.59

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Initial	0.00	84.00
Ecc	40.00	52.00
Slenderness	0.00	0.00
Final	**40.00**	**84.00**

Moment Capacity	
@ width	@ depth
113.37	**245.86**

Summary of Design
300 X 600 Column with reinf 10 Nos 20 dia @ 1.745 % is SAFE

Interaction Equation

$$\left(\frac{40.00}{113.37}\right)^{1.71} + \left(\frac{84.00}{245.86}\right)^{1.71} = 0.33 < 1.0$$

Safe

Beam Design

Beam Data

width	**300 mm**			
depth	**600 mm**	d'	43 mm	.= *cc+ sdia + mdia/2*
clear cover to main reinf.	**25 mm**	eff depth	557 mm	.= *d - d'*

Material Grades

Concrete	**25 MPa**
Steel	**500 MPa**

Moment	**197 KN-m**	Mu/bd^2	2.12	
Torsion	**0 KN-m**	xumax	254	.= *(700/(1100 * (0.87 * fy)) * d*
Eq.Moment	**197 KN-m**	Mulim	310	.= *0.36*fck*b*xumax*(d-*

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*(0.42*xumax))*

Mulim/bd^2 3.33

Beam is designed as Singly Reinforced Beam

Area of Steel	Tension (Ast)	Compr (Asc)	
Percentage	0.547 %	-------	*Refer Table 2 SP 16 pg 48*
Area of Steel	913 sqmm		

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel	
Layer 1	**20 mm**	**6**	1885 sqmm	
Layer 2	-	**0**		
Layer 3	-	**0**		
	Total Steel Provided		1885 sqmm	1.128 %
	Provided Steel OK			

Compression Reinforcement

Type	Bar dia	Nos	Area of Steel	
Layer 1	**16 mm**	**2**	402 sqmm	
Layer 2	-	**0**		
Layer 3				
	Total Steel Provided		402 sqmm	0.241 %

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Shear Force (Vu)	**174 KN**		
Equivalent Shear	174.000		
		*.=Vu / (b * d)*	
ζv	1.041		
		Refer Table 61 SP 16 pg	
ζc	0.481	*179*	*or =(0.85*√(0.8*fck)*√(1+5β)-1)) / (6β)*
ζcmax	3.1	*Refer Table J SP 16 pg 175*	

Type	Bar Dia	Nos	Area of Steel	
Layer 1	**16 mm**	**4**	804 sqmm	
Layer 2	**-**	**0**		
Layer 3	**-**			
	Total Steel Provided		804 sqmm	0.481 %

Sectional Dimensions OK
Shear Reinforcements required

Type of stirrup	**2 legged**
Stirrup diameter	**8 mm**
Spacing	260 c/c

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Design of Two-Way Slabs

Slab Mark	=	S2		Max UDL (w)	=	10.00	Kn/m^2
Short Span (l_x)	=	5.03 m	l_y/l_x	Thickness (D)	=	150	mm

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Long Span (l_y)	=	5.48	m	1.08	Eff Cover	=	20	mm
Concrete Grade	=	25	N/mm^2		Eff Depth (d)	=	130	mm
Reinf Grade	=	500	N/mm^2		Load Factor	=	1.5	

Type of Panel = One Short Edge Discontinuous

Short Reinforcement

+ive in span due to	Continuous Edges Case			
+ive Mom Coeff (a_x)	=	0.034		
B.M (M_x)	=	9.41	Kn-m	($a_x w l_x^2$)
Mu_x	=	14.11	Kn-m	
k_x	=	0.83	N/mm^2	

Required Short +ive Reinforcement				Area (cm^2)
Tension Rft. (p_t)	=	0.200	%	2.60
Compression Rft. (p_c)	=	0.000	%	0.00
Provided +ive Reinforcement				pvdd area
Short Tension reinf dia	=	10	mm	
Spacing	=	150	mm	5.23 (Safe)
Short Comp reinf dia	=	N/A		
Spacing	=	N/A		0.00

-ive at Continuous edge

-ive Mom Coeff (a_x)	=	0.045	

Long Reinforcement

+ive in span due to	Continuous Edges Case			
+ive Mom Coeff (a_y)	=	0.028		
B.M (M_y)	=	7.75	Kn-m	($a_y w l_x^2$)
Mu_y	=	11.62	Kn-m	
k_y	=	0.74	N/mm^2	

Required Long +ive Reinforcement				Area (cm^2)
Tension Rft. (p_t)	=	0.177	%	2.30
Compression Rft. (p_c)	=	0.000	%	0.00
Provided +ive Reinforcement				pvdd area
Long Tension reinf dia	=	10	mm	
Spacing	=	150	mm	5.23 (Safe)
Long Comp reinf dia	=	N/A		
Spacing	=	N/A		0.00

-ive at Continuous edge

-ive Mom Coeff (a_y)	=	0.037	

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B.M (M_x)	=	12.45	Kn-m	($a_x w l_x^2$)	B.M (M_y)	=	10.24	Kn-m	($a_y w l_x^2$)
Mu_x	=	18.68	Kn-m		Mu_y	=	15.36	Kn-m	
k_x	=	1.11	N/mm^2		k_y	=	0.91	N/mm^2	

Required Short -ive Reinforcement				Area (cm^2)	Required Long -ive Reinforcement				Area (cm^2)
Tension Rft. (p_t)	=	0.268	%	3.49	Tension Rft. (p_t)	=	0.218	%	2.84
Compression Rft. (p_c)	=	0.000	%	0.00	Compression Rft. (p_c)	=	0.000	%	0.00
Required -ive Reinf.	=	10	@ 220 mm c/c [T]		Required -ive Reinf.	=	10	@ 275 mm c/c [T]	

Check for Deflection as per IS456-2000, Clause : 23.2.1- C & D & Figures: 4 & 5

Permissible L_x/d (r_p)	=	26.00		Tension Modification Factor (Mf_t) =	2.00	(pt = 0.4%)
Service Stress (f_s)	=	144.030	N/mm^2	Comp Modification Factor (Mf_c) =	1.00	(pc = 0%)
Actual L_x/d (r_a)	=	40.46		Modified Permissible L_x/d (r_{pm}) =	52.00	(r_p X Mf_t X Mf_c)

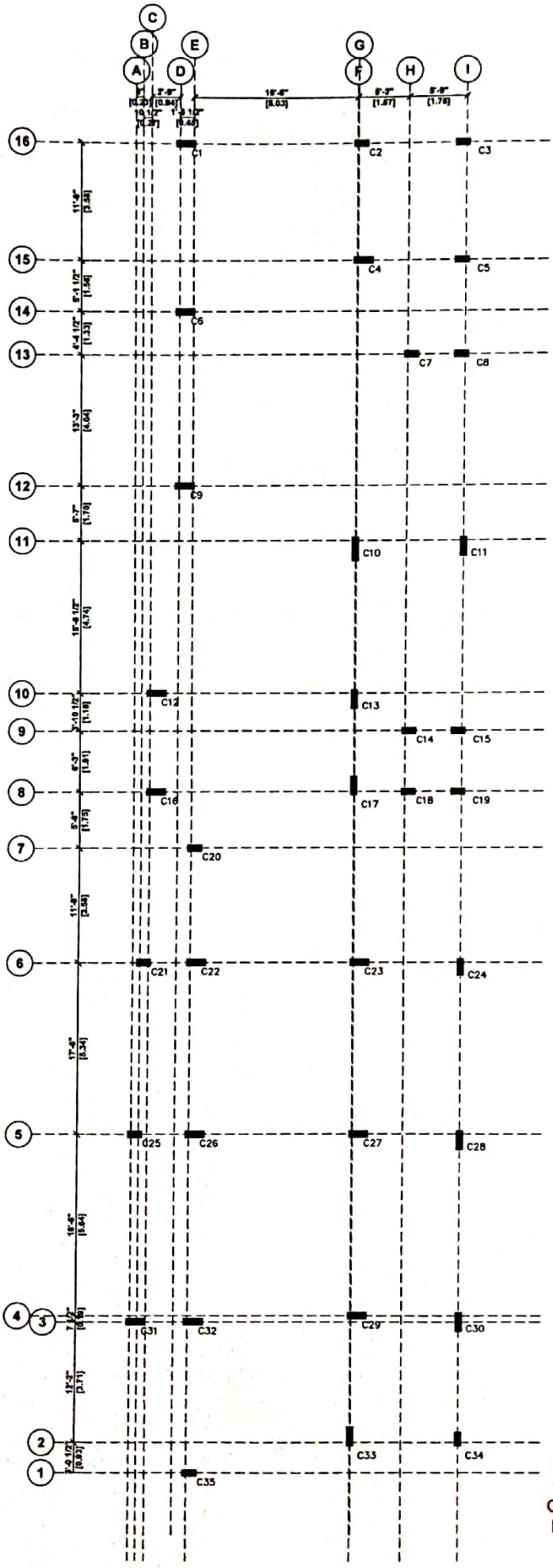
Since Actual Lx/d is Less Than Permissible Modified Lx/d
Slab is Safe in Deflection

Summary For S2 (150 Thk) Two Way Slab With One Short Edge Discontinuous

Short Reinforcememt			Long Reinforcement		
@ Span	=	10 Tor @150 c/c [Bottom]	@ Span	=	10 Tor @ 150 c/c [Bottom]
@ Continuous Edge	=	10 Tor @ 220 mm c/c [Top]	@ Continuous Edge	=	10 Tor @ 275 mm c/c [Top]

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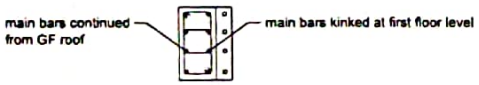
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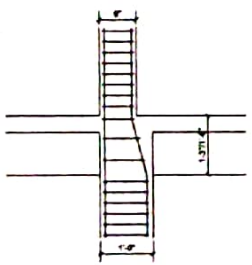
Schedule of Columns

serial No	Column Mark	Column size	Ground floor (stilt floor)	first floor	Second and third floor	Lateral Ties	confining Reinforcement	Remarks
			Reinforcement	Reinforcement	Reinforcement			
		a x b	Longitudinal	Longitudinal	Longitudinal			
0'-9" x 1'-6" Columns								
1	C3 C7	0'-9" x 1'-6"	4 - #16 + 4 - #12	4 - #16 + 4 - #12	8 - #12	#8 @0'-6"	#8 @0'-3"	
2	C5	0'-9" x 1'-6"	8 - #16	4 - #16 + 4 - #12	4 - #16 + 4 - #12	#8 @0'-6"	#8 @0'-3"	
3	C34 C14 C18 C21 C35	0'-9" x 1'-6"	4 - #20 + 4 - #16	8 - #16	8 - #12	#8 @0'-6"	#8 @0'-3"	
4	C8 C15 C19 C2 C20 C25	0'-9" x 1'-6"	8 - #20	8 - #20	8 - #16	#8 @0'-6"	#8 @0'-3"	
0'-9" x 2'-0" Columns								
5	C22	0'-9" x 2'-0"	10 - #16	10 - #16	10 - #16	#8 @0'-6"	#8 @0'-3"	
6	C24 C28 C30 C1 C16 C23 C31 C33	0'-9" x 2'-0"	12 - #16	12 - #16	12 - #16	#8 @0'-6"	#8 @0'-3"	
7	C11 C4 C6 C12 C26 C29	0'-9" x 2'-0"	10 - #20	10 - #20	10 - #20	#8 @0'-6"	#8 @0'-3"	
8	C9 C13 C17 C27 C32	0'-9" x 2'-0"	12 - #20	12 - #20	12 - #20	#8 @0'-6"	#8 @0'-3"	
0'-9" x 2'-6" Columns								
9	C10	0'-9" x 2'-6"	12 - #25	12 - #20	12 - #16	#8 @0'-6"	#8 @0'-3"	

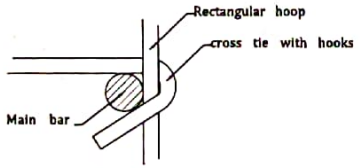
All columns are 1' width (Except C14, C15, C18 & C19) in stilt floor

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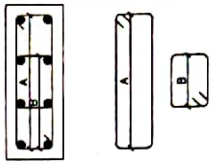


Typical detail of stepping at ground floor

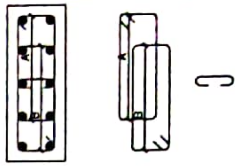


Typical Details at - A

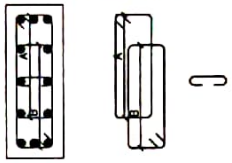
0'-9" x 1'-6" - 8 bars



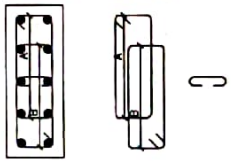
0'-9" x 1'-6" - 10 bars



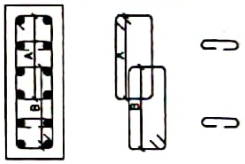
0'-9" x 1'-6" - 12 bars



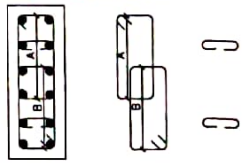
0'-9" x 2'-0" - 10 bars

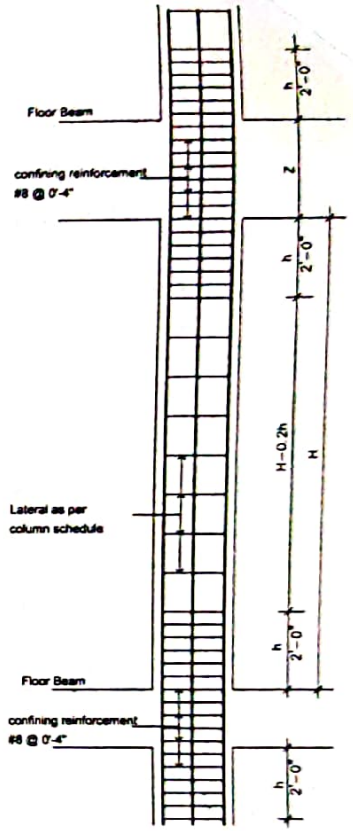


0'-9" x 2'-0" - 12 bars



0'-9" x 2'-6" - 12 bars





details of column ties

Dia of Bar in mm	Lap length in feets and inches
8	1'-3"
10	1'-9"
12	2'-0"
16	2'-6"
20	3'-3"
25	4'-0"

General Notes :

1. All Dimensions are in feet and inches
2. Concrete Mix M20
3. Reinforcement grade Fe 500
4. Clear cover to column reinforcement 0'-1"

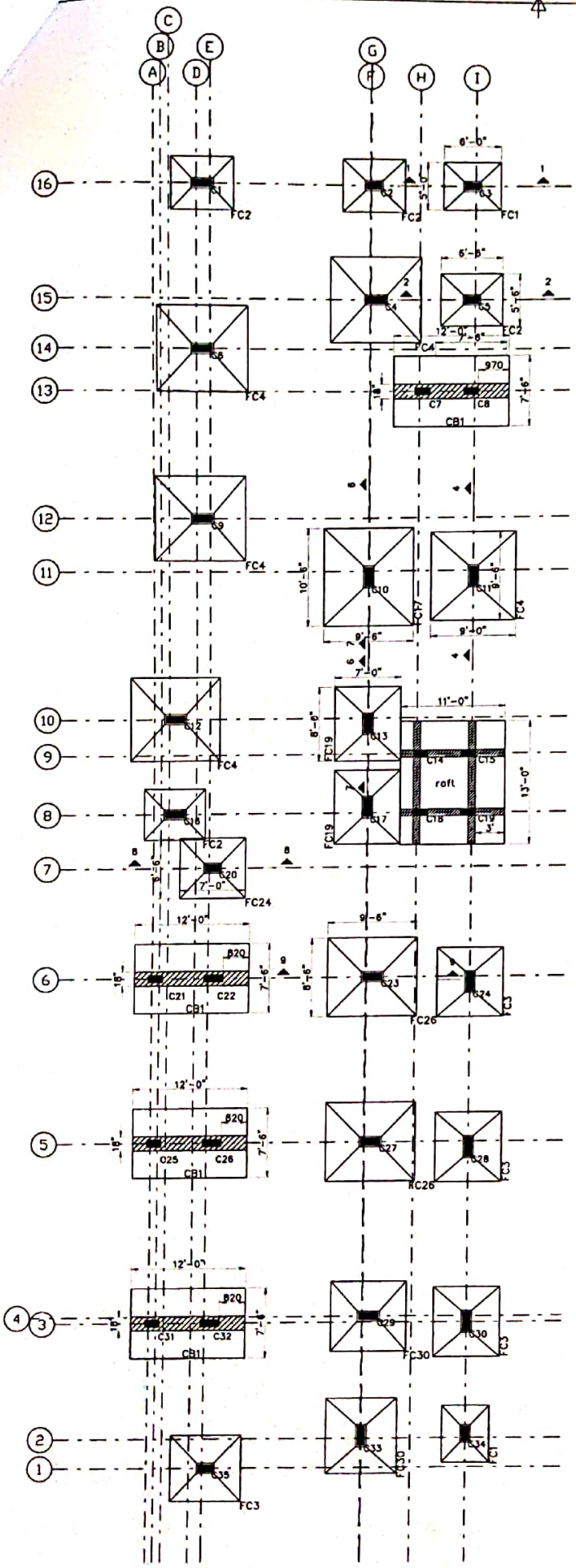
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Proposed residential flats at Kovalan nagar

Client	job no	Date	Scale
Rammiyam homes	2022019	17-02-2024	nts

Details of Columns

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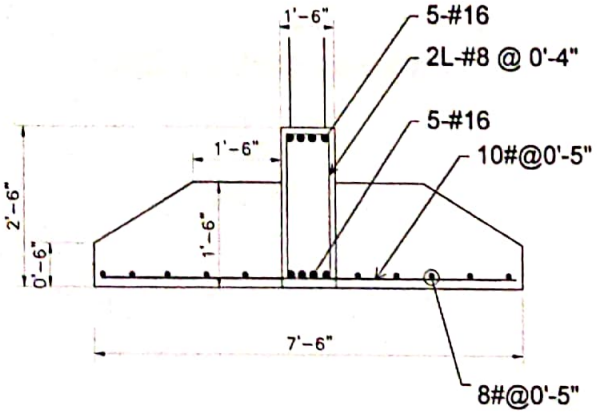
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Proposed residential flats at Kovalan Nagar			
Client: Rammiyam homes	Job No: 2022019	Date: 16-02-2024	Scale: nts
Details of footings			

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FOOTING SCHEDULE (M20: Fe500)

FOOTING NUMBERS	COLUMN NUMBERS	FOOTING DIMENSION				FOOTING REINFORCEMENT		REMARKS
		L	B	D1	D2	BOTTOM		
						ALONG B	ALONG L	
FC1	C3,C34	6'-0"	5'-0"	2'-0"	0'-6"	#10@6" C/C	#10@6" C/C	
FC2	C5,C1,C2,C16	6'-6"	5'-6"	2'-3"	0'-6"	#10@5" C/C	#10@5.9" C/C	
FC3	C24,C28,C30,C35	7'-6"	7'-0"	2'-9"	0'-6"	#10@4" C/C	#10@5" C/C	
FC4	C11,C4,C6,C9,C12	9'-6"	9'-0"	3'-6"	0'-6"	#10@4" C/C	#10@4" C/C	
FC5	C15,C19,C14,C18	7'-0"	6'-0"	2'-6"	0'-6"	#10@5" C/C	#10@5" C/C	
FC17	C10	10'-6"	9'-6"	3'-9"	0'-6"	#12@6" C/C	#10@4" C/C	
FC19	C13,C17	8'-0"	7'-0"	2'-9"	0'-6"	#10@5" C/C	#10@5" C/C	
FC24	C20	7'-0"	6'-6"	2'-6"	0'-6"	#10@5" C/C	#10@5" C/C	
FC26	C23,C27	9'-6"	8'-6"	3'-6"	0'-6"	#10@4" C/C	#10@4" C/C	
FC30	C29,C33	8'-0"	7'-6"	3'-0"	0'-6"	#10@4" C/C	#10@4" C/C	



Section of CB1

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General Notes :

1. All Dimensions are in feet and inches
2. Concrete Mix M20
3. Reinforcement grade Fe 500
4. All footings 7'-0" from ground level
5. Plinth beams are considered at - 0'-6" from parking level
6. This building is designed for S + 3 floors

— · — · — denotes grid line

Safe bearing capacity of soil is considered as 200 KN/Sqm as per soil test report

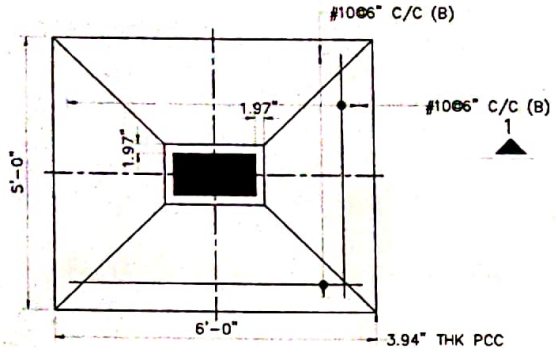
Live load adopted 2 KN/Sqm

Clear cover to column reinforcement 0'-1"

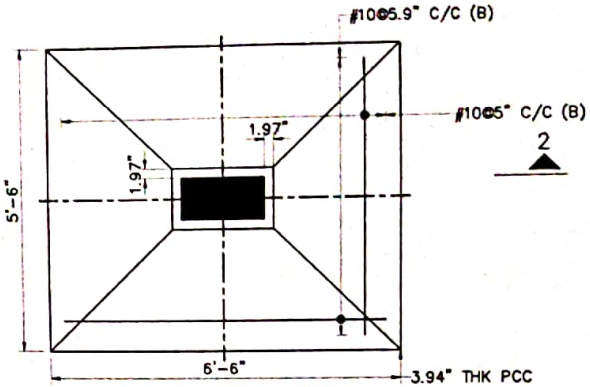
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Proposed residential flats at Kovalan Nagar			
Client: Rammiyam homes	Job No 2022019	Date 16-02-2024	Scale nts
Details of footings			

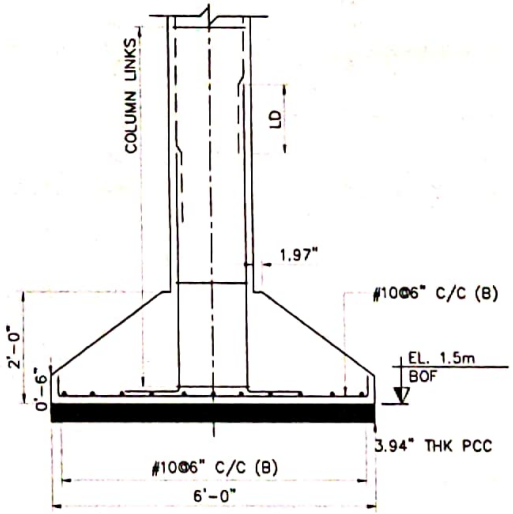
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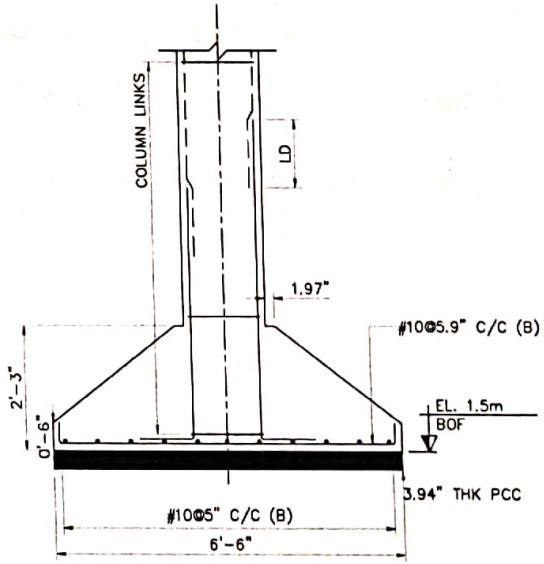
FOOTING FC1– PLAN



FOOTING FC2– PLAN



SECTION 1–1



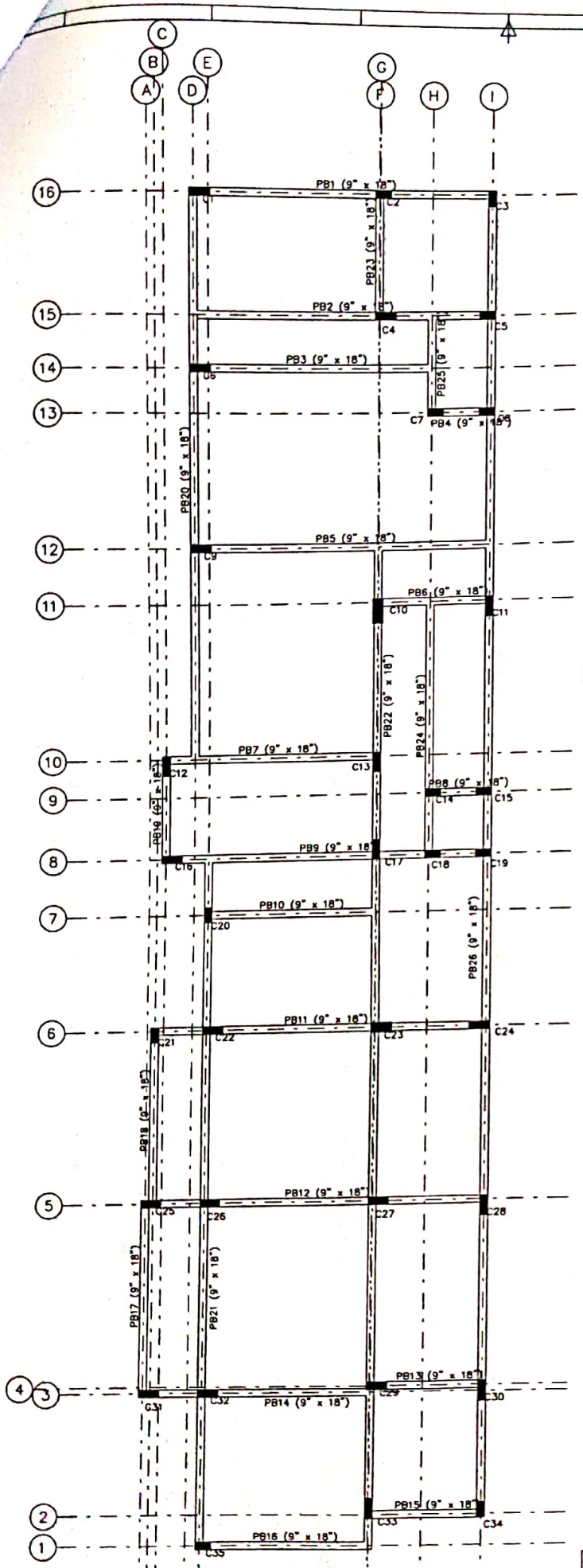
SECTION 2–2
DETAIL OF FOOTING FC2

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Proposed residential flats at Kovalan Nagar			
Client: Rammiyam homes	Job No: 2022019	Date: 16-02-2024	Scale: nts
Details of footings			

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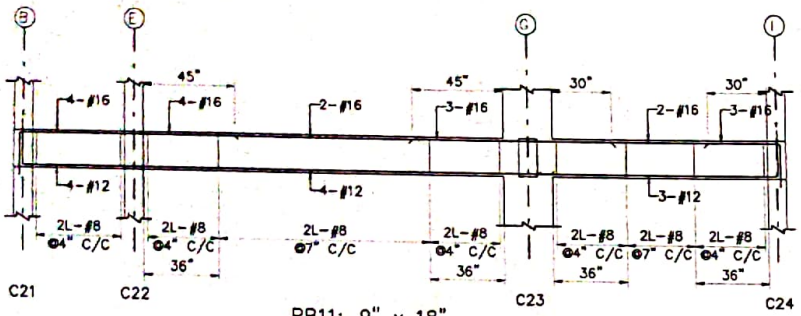
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Proposed residential flats at Kovalan Nagar

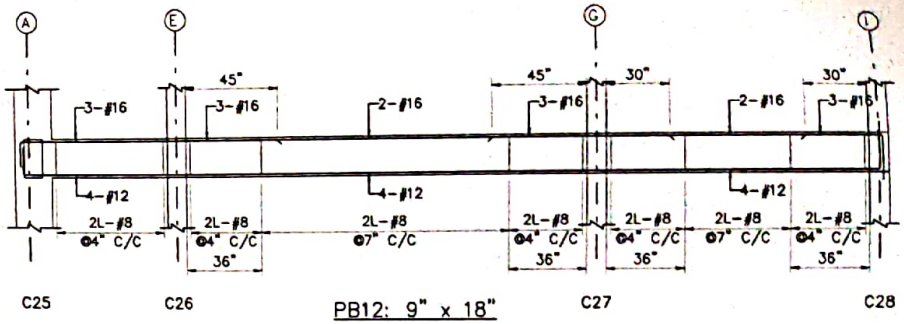
Client	Job No	Date	Scale
Rammiyam homes	2022019	17-02-2024	nts

Details of plinth beams

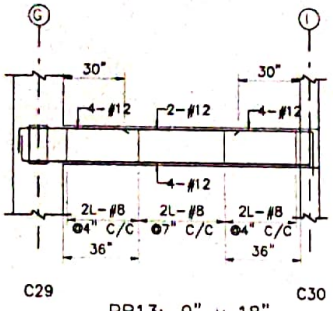
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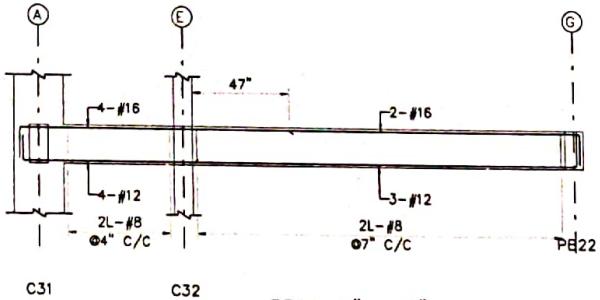
PB11: 9" x 18"



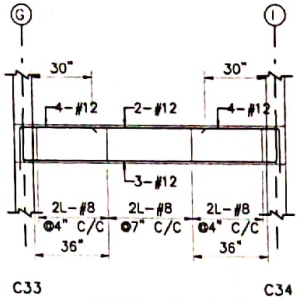
PB12: 9" x 18"



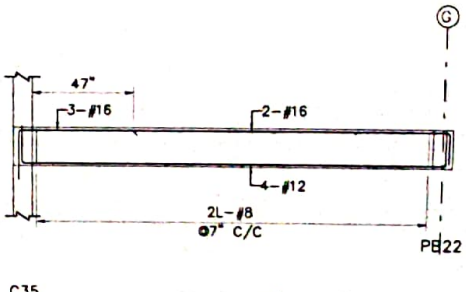
PB13: 9" x 18"



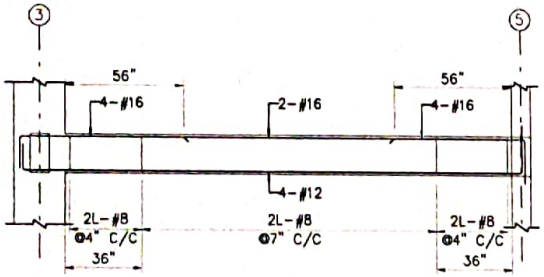
PB14: 9" x 18"



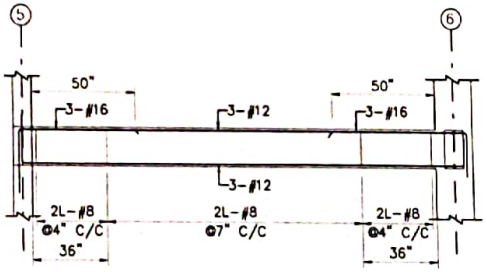
PB15: 9" x 18"



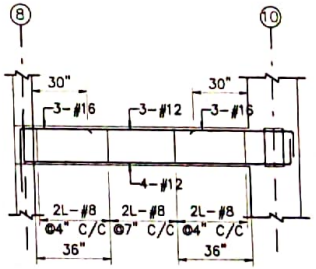
PB16: 9" x 18"



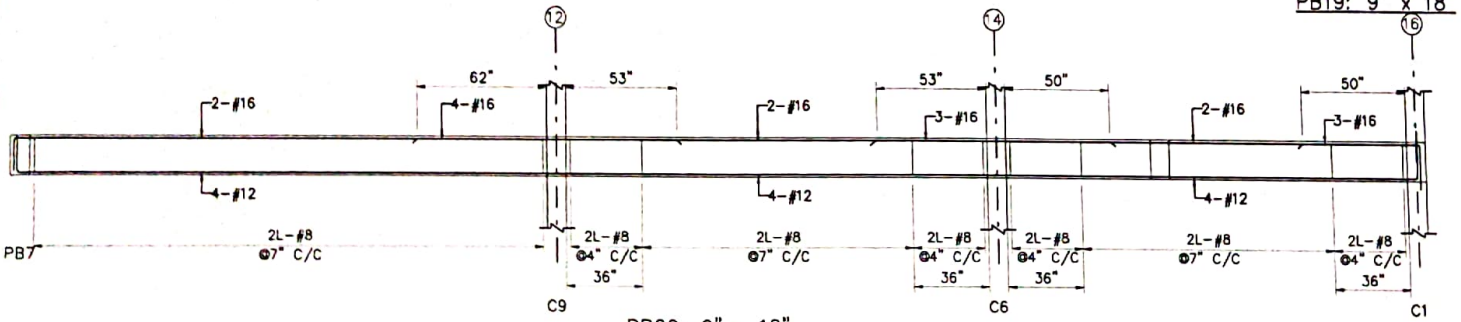
PB17: 9" x 18"



PB18: 9" x 18"



PB19: 9" x 18"

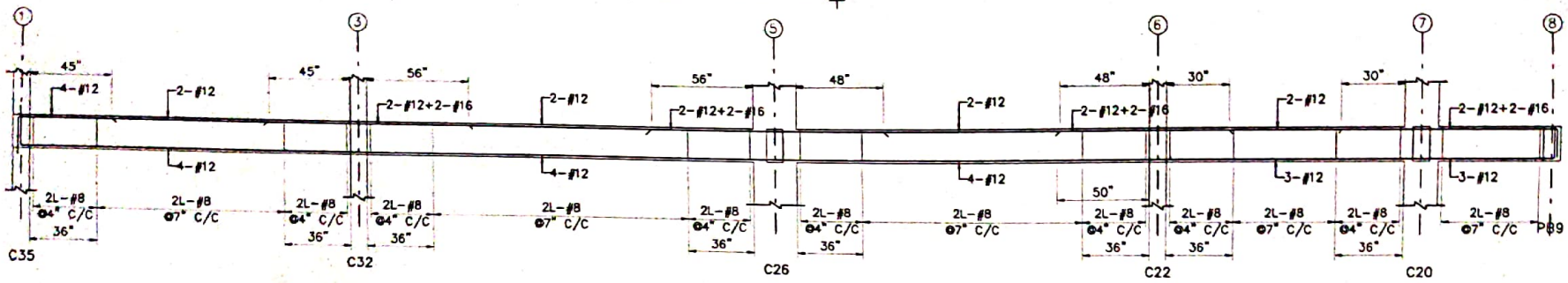


PB20: 9" x 18"

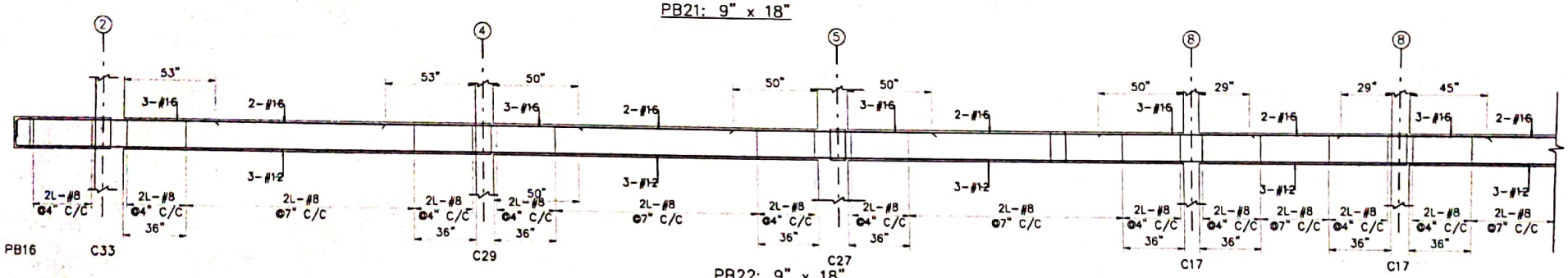
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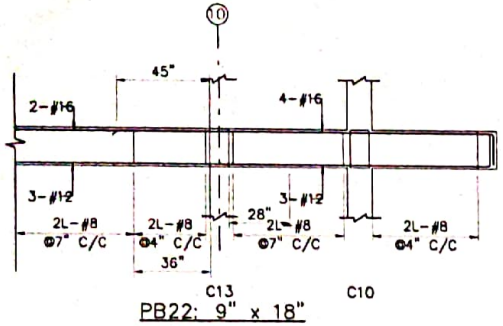
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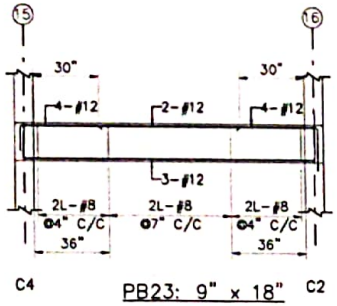
PB21: 9" x 18"



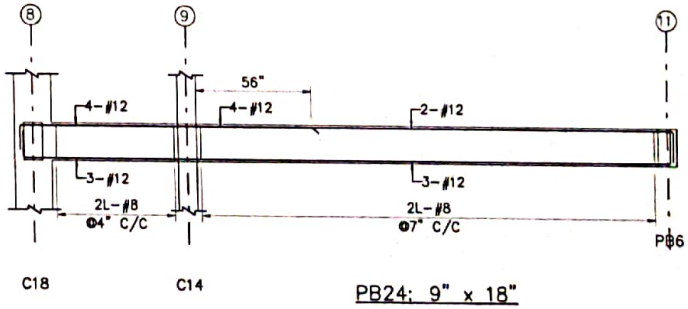
PB22: 9" x 18"



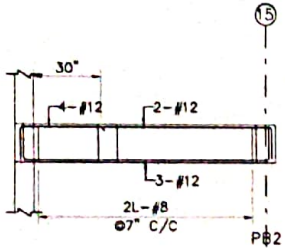
PB22: 9" x 18"



PB23: 9" x 18"



PB24: 9" x 18"



C7

PB25: 9" x 18"

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