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STABILITY CERTIFICATE & DESIGN ANALYSIS TO THE PROPOSED RESIDENTIAL APARTMENTS AT NEW DOOR NO:36, OLD NO:24, PLOT NO 42, MASILAMANI ROAD, BALAJI NAGAR, ROYAPETTAH, CHENNAI-600014, GREATER CHENNAI CORPORATION.

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STABILITY CERTIFICATE

This is to certify that the proposed residential building at new Door no:36, Old no:24, Plot No:42, Masilamani road, Balaji Nagar, Royapettah, Chennai-600014, Greater Chennai Corporation is designed to resist for earthquake and wind, check has been made and found safe and I hereby certify that

1. The least dimension of the column is 300mm in car park area.
2. The grade of concrete is M25
3. Foundation is designed for Stilt floor +3 upper floors
4. The design analysis using the code of practice for loading Standards as per IS-875 part and seismic force as per the code IS-1893 & IS-456. The building is earthquake resistant as per the above codes.
5. SBC of soil is considered as 18 T/sq.m as per soil report.

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DESIGN OF SLAB

SLAB S-1

(i). Min. thickness of slab = $\frac{3160}{35}$ = 91 mm

(ii). Effective span

lx = 3.16 m
ly = 4.40 m
ly/lx = 1.39

(iii). Total load

Dead load from slab	= 288 kg/m²	
Floor finish	= 150 kg/m²	
Total dead load	= 438kg/m²	
Live load	= 200 kg/m²	
Total load	= 638 kg/m²	Say 650 kg/m²

(iv). Bending moment

$Mx = \acute{\alpha}x\ wlx^2$
$My = \acute{\alpha}y\ wlx^2$

Four edges discontinuous
Max. moment at mid span

Mx = 0.085 x 650 x 3.16² = 552 kgm
My = 0.056 x 650 x 3.16² = 364 kgm

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(v). Effective depth

$$M = Rbd^2$$

$$\sqrt{\frac{552 \times 10^4}{0.91 \times 1000}} = 78 \text{ mm}$$

Over all depth provided is 115mm

Effective. Depth = 115-20-5 = 90

(vi). Reinforcement

Area of steel mid span along shorter direction

$$Ast = \frac{552 \times 10^4}{230 \times 0.9 \times 90} = 296 \text{ mm}^2$$

Providing 8 mmØ torsteel @ 150 mm c/c

Area of steel mid span along longer direction

$$= \frac{364 \times 10^4}{230 \times 0.9 \times 80} = 220 \text{ mm}^2$$

Providing 8 mmØ torsteel @200mm c/c

(vii). Torsional reinforcement

Provide ¾ of max. Mid span reinforcement 296x ¾ = 222 mm²

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DESIGN OF BEAMS

Beam B-1

Breath of beam = 230mm (Assumed)

Mu = M (Working) x 1.5

Overall depth = 45 cm (Assumed)

$$d = 45 - 2.5 - \frac{2.0}{2} = 41.5 \text{ cm}$$

$$d' = 2.5 + 1.0 = 3.50 \text{ cm}$$

$$\frac{d'}{d} = \frac{3.50}{41.5} = 0.08$$

Min. Reinforcement

The min area of tension reinforcement shall not be less than the given

$$\frac{As}{bd} = \frac{0.85}{fy}$$

Where As = min area of tension reinforcement

b = Breadth of the beam or breadth of the web of T-beam

d = Effective depth

fy = Characteristic strength of reinforcement

$$As = \frac{bd \times 0.85}{fy}$$

$$= \frac{230 \times 415 \times 0.85}{415} = 196 \text{ mm}^2$$

Referring design Aids IS 456 – 1978. The reinforcement are calculated as shown in the sketch.

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Over all depth in beam = $\frac{1}{12}$ to $\frac{1}{20}$ of the span

Provide overall depth = 450 mm

Width of rib = $\frac{2}{3}$ (depth of rib) = $\frac{2}{3}$ (450 – 115) = 223mm

Provide a width of = 230mm

Loading on the beam

From roof slab = 650 x 3.16/2 = 1027 kg/m²

D.L. of the rib = 0.23 x 0.45 x 2500 = 259 kg/m²

Brick work = 0.23 x 2.60 x 1920 = 1148 kg/m²

Total = 2434 kg/m² Say 2450 kg/m²

Provide 20mm Ø bars single layer at clean cover of 25mm

Effective cover = 25 + 10 = 35mm

Effective depth = d = 450 – 35 = 415mm
Effective span

Centre to centre bearing = 6.13 m

Effective span = 6.13 m

Max. B.M = $\frac{2450 \times 6.13^2}{10}$ = 9206 kgm

Approximate lever arm

$a = d - \frac{ds}{2} = 450 - 57.5 = 392.5$mm

App. Steel required Ast = $\frac{9206 \times 10000}{230 \times 392.5}$ = 1020 mm²

Provide 6 bars of 16mm Ø in two layers

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Effective cover to the C.G. of steel
= 25 +20+ 10 = 55mm

Actual effective depth
d = 450 – 55 = 395 mm

$$\text{Width of flanges} = B = \frac{1}{12} + br + 3d$$

$$= \frac{6130}{12} + 230 + (3 \times 115)$$

= 1085 mm

Position of neutral axis

Assuming the neutral axis lies within the flange and taking moments about the neutral axis
1085 x 115 x n x n/2 = 13 x 1200 (415 - n)

n = 10.06 mm

Actual lever arm = d - n/3

= 395 – 10.06/3

= 392mm

$$\textbf{Actual stress in steel} = \frac{9206 \times 10000}{1200 \times 392} = 196 \text{ N/mm}^2$$

$$\text{Max. Stress in concrete} = C = \frac{n}{d-n} \times \frac{t}{m} = \frac{10.06}{392 - 10.06} \times \frac{230}{13}$$

= 0.46 N/mm²

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Design for shear

Span = 6.13 m

$$\text{Max. Shear force } S = \frac{2450 \times 6.13 \times 10}{2} = 75093 \text{ N}$$

Nominal shear stress at support

$$Tv = \frac{s}{b.d} = \frac{75093}{230 \times 392} \text{ N/mm}^2$$

$$= 0.83 \text{ N/mm}^2$$

For M25 Concrete = Tc max = 1.9 N/mm²

= Tv < Tc max

Assuming 50 % curtailment of tensile steel

Percentage of tensile steel at support

$$= \frac{600}{230 \times 392} \times 100 = 0.66\%$$

As per code for 0.66% steel

$$Tc = 0.33 \text{N/mm}^2$$

Shear capacity of concrete = Tc br d

= 0.33 x 230 x 392

= 29753 N

Shear to be carried out by stirrups Vs = 75093 – 29753

= 45340 N

Spacing of 2 begged 8mmØ string

$$= p = \frac{Aw\ t\ d}{Vs} = \frac{(2 \times 50)\ 230 \times 392}{45340}$$

=198 mm

Provide 2 – legged 8mm Ø strongly @ 150 mm c/c

Similarly other beams are calculated as shown in the sketch.

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DESIGN OF COLUMN

Column (C-1)

Total axial load from the loadings

Dead load & live load from one floor – 325 KN

Total axial load from 3 floors = 3 x 325 = 975 KN

Add for seismic force = 195 KN

1170 KN

Assume column dimension = 300mm x 600mm

Self weight of column = 0.60 x 0.30 x 3.0 x 4 x 25 = 54 KN

Pu = (1170 + 54) x 1.5 = 1836 KN

Mu = (60) x 1.5 = 90 KN

About XX axis

$\frac{d'}{D} = 0.1$ d' = 50mm

$$\frac{Pu}{fckbD} = \frac{1836 \times 10^3}{25 \times 300 \times 600} = 0.41$$

$$\frac{Mu}{fckbD^2} = \frac{90 \times 10^6}{25 \times 300 \times (600)^2} = 0.03$$

About YY axis

$\frac{d'}{D} = 0.167$ d' = 50mm

$$\frac{Pu}{fckbD} = \frac{1836 \times 10^3}{25 \times 300 \times 600} = 0.41$$

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$$\frac{Mu}{fckbD^2} = \frac{90 \times 10^6}{25 \times 600 \times (300)^2} = 0.067$$

Referring to chart 46 of design aids IS 456 for values

$$\frac{Pu}{fckbD} = 0.41 \; ; \quad \frac{Mu}{fckbD^2} = 0.067$$

The value of P/fck = 0.08

P = 0.08 x 25 = 2.00

$$As = \frac{P \times d \times D}{100} = \frac{2.00 \times 300 \times 600}{100} = 3600 \text{ mm}^2$$

Provide 12 nos 20 Ø

DESIGN OF LATERALTIES

Dia of lateral ties = ¼ x 20 = 5 mm

Hence 8Ø is adopted

Pitch is minimum of the following – (IS 456 – 2000)

(i). Least lateral dimension = 300mm

(ii). 20 x dia of main reinforcement = 16 x 20 = 320mm

(iii). 48 x dia of lateral ties = 48 x 8 = 384mm

Hence provide 8Ø@250c/c.

Similarly other columns are calculated as shown in the sketch.

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DESIGN OF FOUNDATION

Axial load on the column = 1170 KN

Self weight of footing (10%) = 117 KN

Total load (including seismic force) = 1287 KN

Column size = 300 x 600

Safe bearing capacity of soil = 180KN/m² (or) (18 T/m²)

$$\text{Area of footing required} = \frac{1287}{180} = 7.14 \text{ m}^2$$

Adopt a squire footing of size = 2.74x 2.74m =7.51 m²

$$\text{Soil pressure} = \frac{1287}{7.51} = 171.37 \text{ KN/m}^2 \text{ (or) } 17.14 \text{ T/m}^2$$

SBC = 18 T/m² Hence safe

Assume depth of foundation = 3.05 m

$$\text{B.M. at the face of the column} = \frac{171.37 \times 2.74 \times 1.22^2}{2} = 349.44 \text{ KNm}$$

$$M = Rbd^2$$

$$d = \sqrt{\frac{349.44 \times 10^6}{0.91 \times 600}} = 800 \text{ mm}$$

Provide D = 910 mm & d =910-60=850mm

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Check for shear stress

The critical section will be at a distance of effective depth d=850mm from the face of the column.

Shear force at critical section = 171.37 x 0.37x2.74x1000

Vp = 173735 N

Breadth of footing at this section = 2x850+300
= 2000 mm

Depth of footing at this section = 230+(680/1220)x370
= 436 mm

Shear Stress = $\frac{173735}{2000x436}$ v = 0.20 N/mm²

Tc (allowable) = 3.1 N/mm²

Check for punching shear

Punching shear = 0.1714 (2740x2740 - 300x600)

= 1255951 N

If dp is depth required for punching, area resisting punching
= 1800x dp

dp = 1255951 /1800 = 698 mm

The depth provided is adequate

Hence safe.

Similarly other footings are calculated as shown in the sketch

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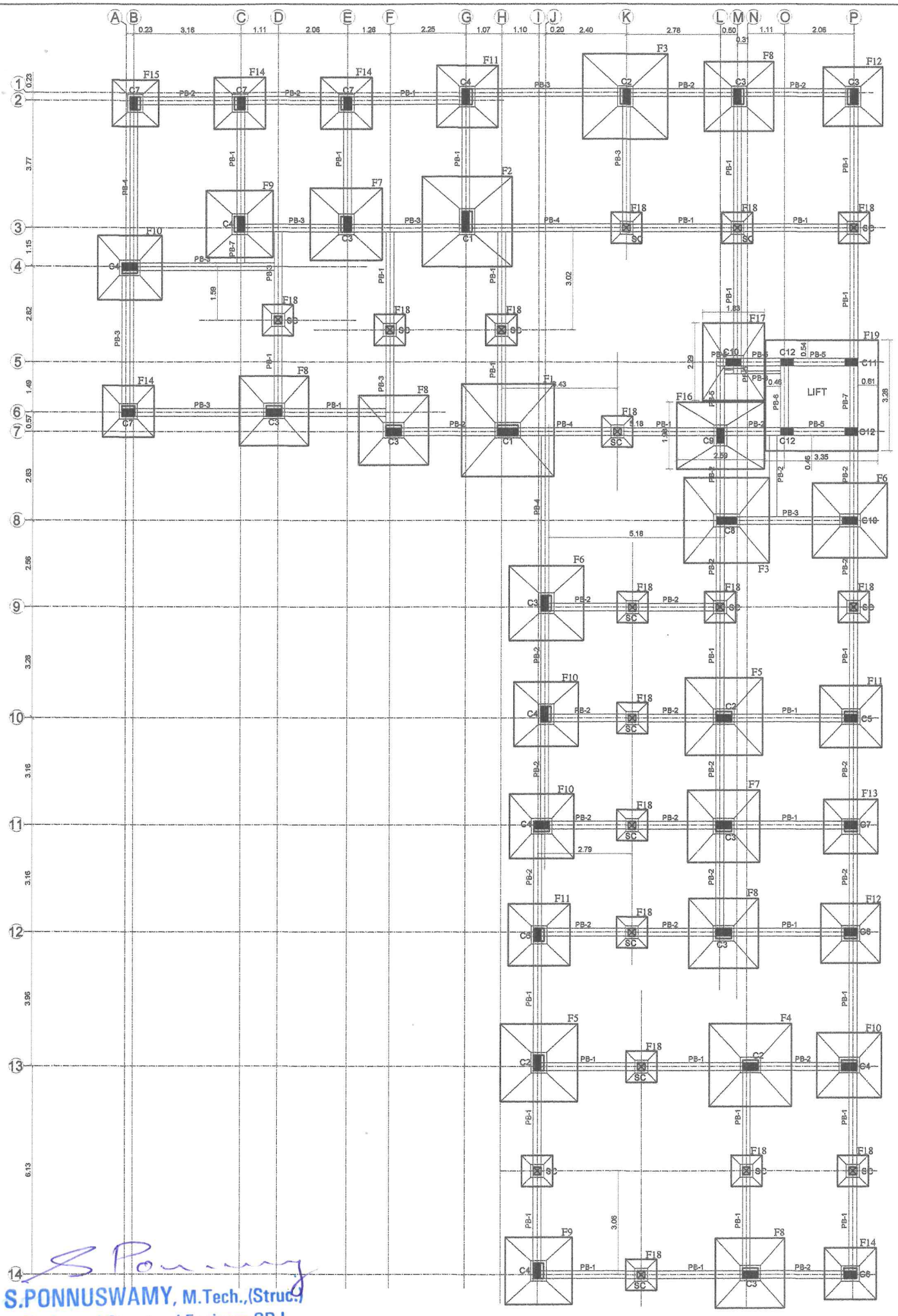

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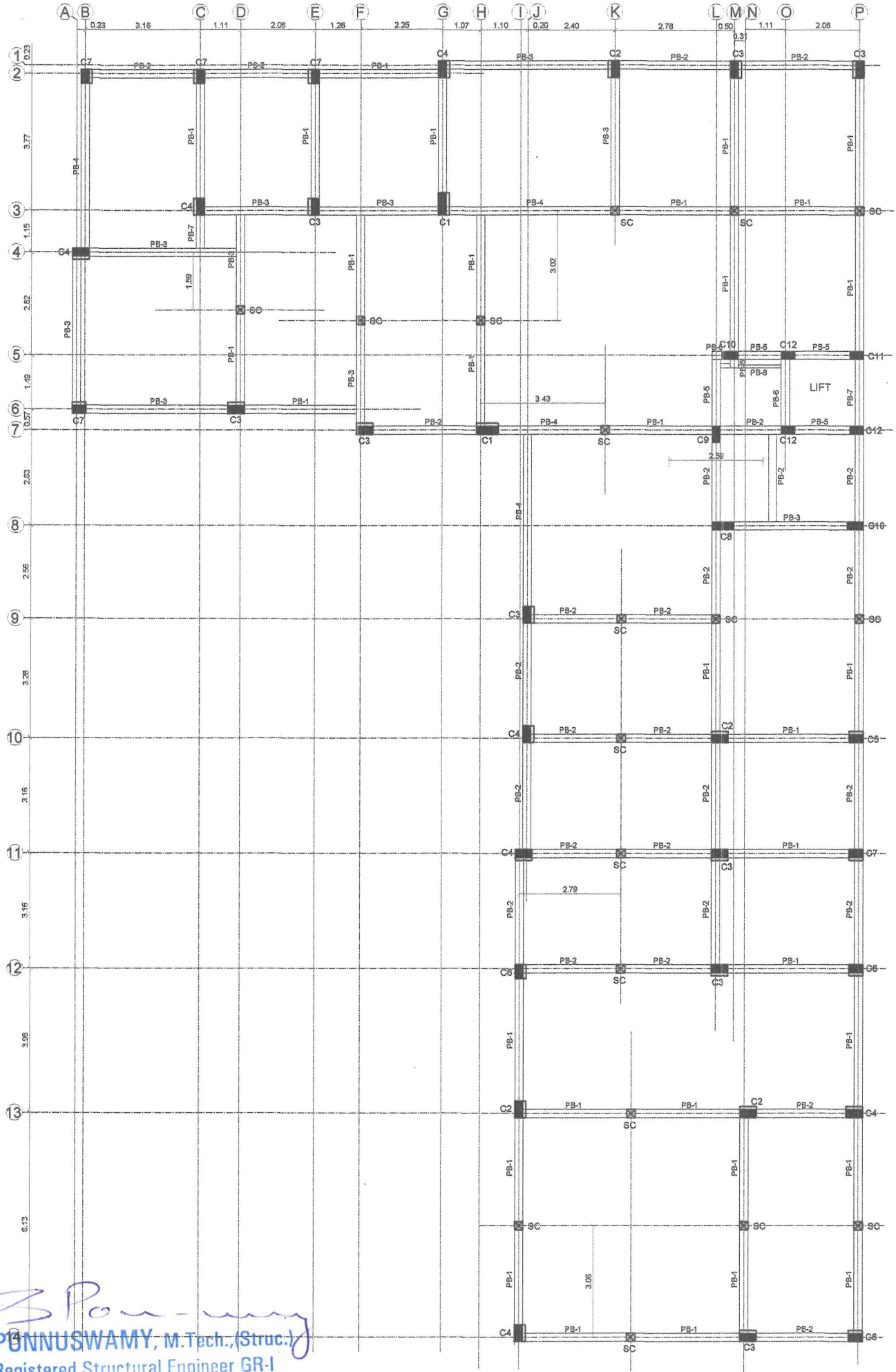
LAYOUT OF FOOTINGS, COLUMNS AND PLINTH BEAMS



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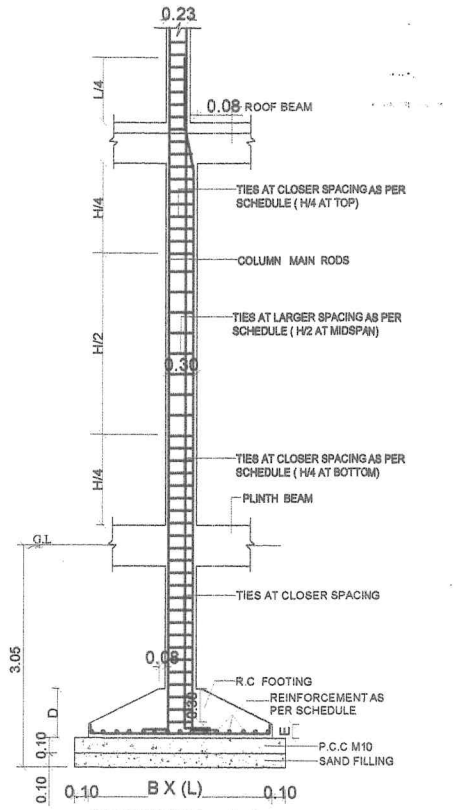
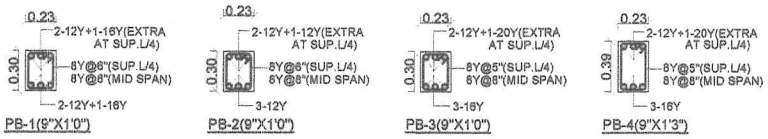
LAYOUT OF COLUMNS AND PLINTH BEAMS

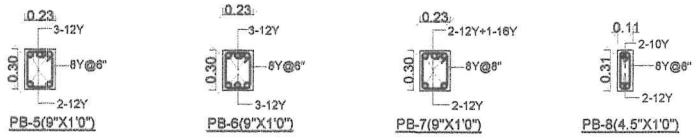
SCHEDULE OF FOOTINGS :

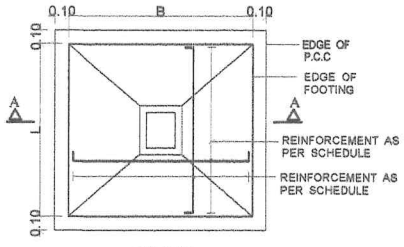
FOOTING No	FOOTING SIZE LXB	DEPTH D	EDGE THICKNESS E	REINFORCEMENTS
F1	2.74 x 2.74	0.91	0.23	12Y@0.125C/C bothways
F2	2.67 x 2.67	0.89	0.23	12Y@0.125C/C bothways
F3	2.52 x 2.52	0.84	0.23	12Y@0.125C/C bothways
F4	2.44 x 2.44	0.80	0.23	12Y@0.125C/C bothways
F5	2.29 x 2 .29	0.76	0.20	12Y@0.125C/C bothways
F6	2.21 x 2.21	0.74	0.20	12Y@0.125C/C bothways
F7	2.13 x 2.13	0.71	0.20	12Y@0.125C/C bothways
F8	2.06 x 2.06	0.69	0.20	12Y@0.125C/C bothways
F9	1.98 x 1.98	0.66	0.20	12Y@0.125C/C bothways
F10	1.91 x 1.91	0.63	0.20	12Y@0.125C/C bothways
F11	1.83 x 1.83	0.61	0.20	10Y@0.10 C/C bothways
F12	1.75 x 1.75	0.57	0.15	10Y@0.10 C/C bothways
F13	1.60 x 1.60	0.50	0.15	10Y@0.125 C/C bothways
F14	1.52 x 1.52	0.46	0.15	10Y@0.125 C/C bothways
F15	1.37 x 1.37	0.41	0.15	10Y@0.125 C/C bothways
F16	2.59 x 1.98	0.76	0.15	10Y@0.125 C/C bothways
F17	2.29 x 1.98	0.71	0.15	10Y@0.125 C/C bothways
F18	0.91 x 0.91	0.30	0.15	10Y@0.125 C/C bothways
F19	3.35 x 3.28	COMBINED FOOTING		



SECTION - A A

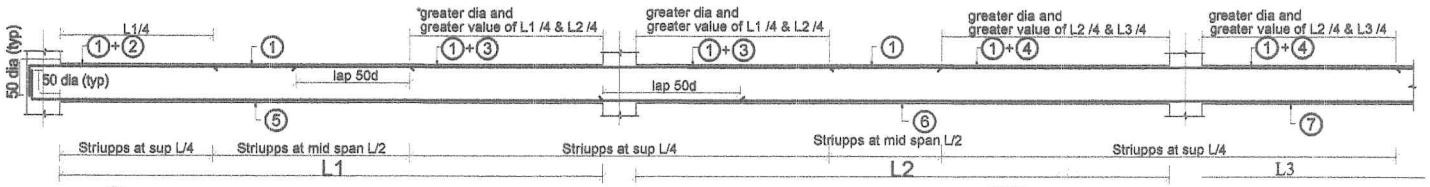






PLAN

TYP. FOOTING AND COLUMN DETAIL



① — Top bar thro'

②, ③, ④ — extra bar at top ⑤, ⑥, ⑦ — Bottom bar

TYPICAL DETAIL OF PLINTH BEAM

NOTE:

1. * Extra rod at support L/4 shall be not less than 50d.

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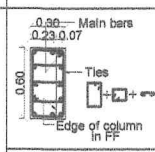
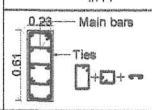
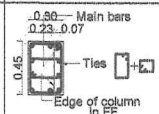
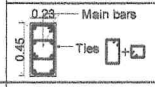
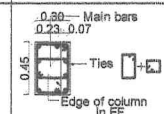
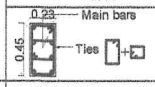
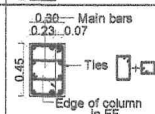
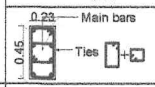
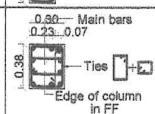
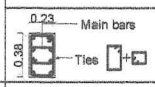
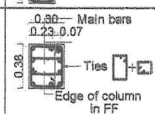
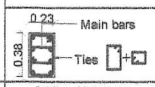
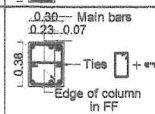
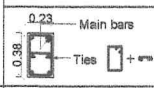
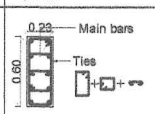
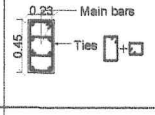
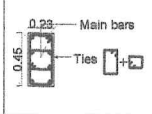
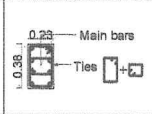
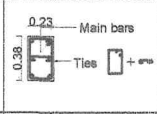
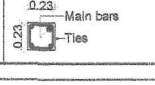
SCHEDULE OF COLUMNS:

COLUMN NO	COLUMN TYPE	SIZE	FLOORS	MAIN RODS	TIES		CONCRETE GRADE
					Top & bottom H/4	Mid span H/2	
C1		0.30 x 0.60	STILT	12-20Y	5 LEGGED 8Y@125	5 LEGGED 8Y@200	M25
		0.23 x 0.60	I	10-20Y	5 LEGGED 8Y@125	5 LEGGED 8Y@200	M20
			II	4-20Y+6-16Y	5 LEGGED 8Y@125	5 LEGGED 8Y@200	
			III	10-16Y	5 LEGGED 8Y@125	5 LEGGED 8Y@200	
C2		0.30 x 0.45	STILT FLOOR	10-20Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M25
		0.23 x 0.45	I	8-20Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M20
			II	4-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
			III	8-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
C3		0.30 x 0.45	STILT FLOOR	6-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M25
		0.23 x 0.45	I	4-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M20
			II	8-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
			III	4-16Y+4-12Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
C4		0.30 x 0.45	STILT FLOOR	10-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M25
		0.23 x 0.45	I	8-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M20
			II	4-16Y+4-12Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
			III	8-12Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
C5		0.30 x 0.38	STILT FLOOR	6-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M25
		0.23 x 0.38	I	4-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M20
			II	8-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
			III	4-16Y+4-12Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
C6		0.30 x 0.38	STILT FLOOR	10-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M25
		0.23 x 0.38	I	8-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M20
			II	4-16Y+4-12Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
			III	8-12Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
C7		0.30 x 0.38	STILT FLOOR	8-16Y	3 LEGGED 8Y@125	3 LEGGED 8Y@200	M25
		0.23 x 0.38	I	6-16Y	3 LEGGED 8Y@125	3 LEGGED 8Y@200	M20
			II	4-16Y+2-12Y	3 LEGGED 8Y@125	3 LEGGED 8Y@200	
			III	6-12Y	3 LEGGED 8Y@125	3 LEGGED 8Y@200	
C8		0.23 x 0.60	STILT	10-20Y	5 LEGGED 8Y@125	5 LEGGED 8Y@200	M25
			I	10-20Y	5 LEGGED 8Y@125	5 LEGGED 8Y@200	M20
			II	4-20Y+6-16Y	5 LEGGED 8Y@125	5 LEGGED 8Y@200	
			III	10-16Y	5 LEGGED 8Y@125	5 LEGGED 8Y@200	
C9		0.23 x 0.45	STILT	8-20Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M25
			I	8-20Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M20
			II	4-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
			III	8-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
C10		0.23 x 0.45	STILT	4-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M25
			I	4-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M20
			II	8-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
			III	4-16Y+4-12Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
C11		0.23 x 0.38	STILT FLOOR	4-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M25
			I	4-20Y+4-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	M20
			II	8-16Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
			III	4-16Y+4-12Y	4 LEGGED 8Y@125	4 LEGGED 8Y@200	
C12		0.23 x 0.38	STILT FLOOR	6-16Y	3 LEGGED 8Y@125	3 LEGGED 8Y@200	M25
			I	6-16Y	3 LEGGED 8Y@125	3 LEGGED 8Y@200	M20
			II	4-16Y+2-12Y	3 LEGGED 8Y@125	3 LEGGED 8Y@200	
			III	6-12Y	3 LEGGED 8Y@125	3 LEGGED 8Y@200	
SC		0.23 x 0.23	STUB COLUMN UP TO PB	4-12Y	2 LEGGED 8Y@200		M25

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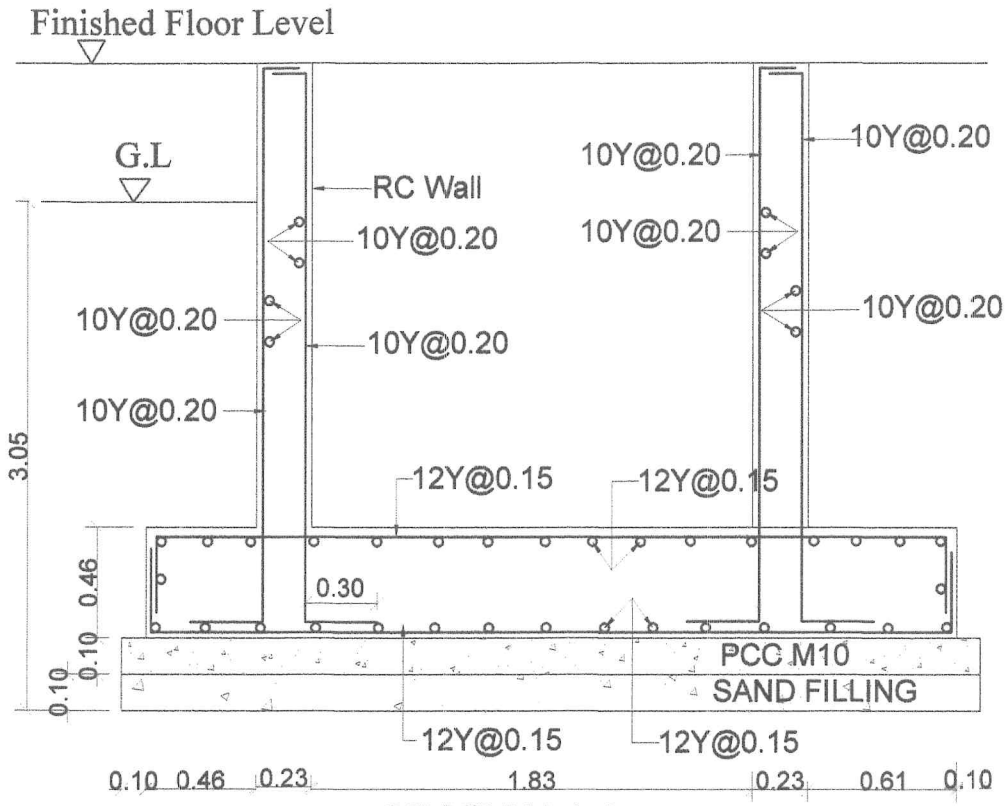
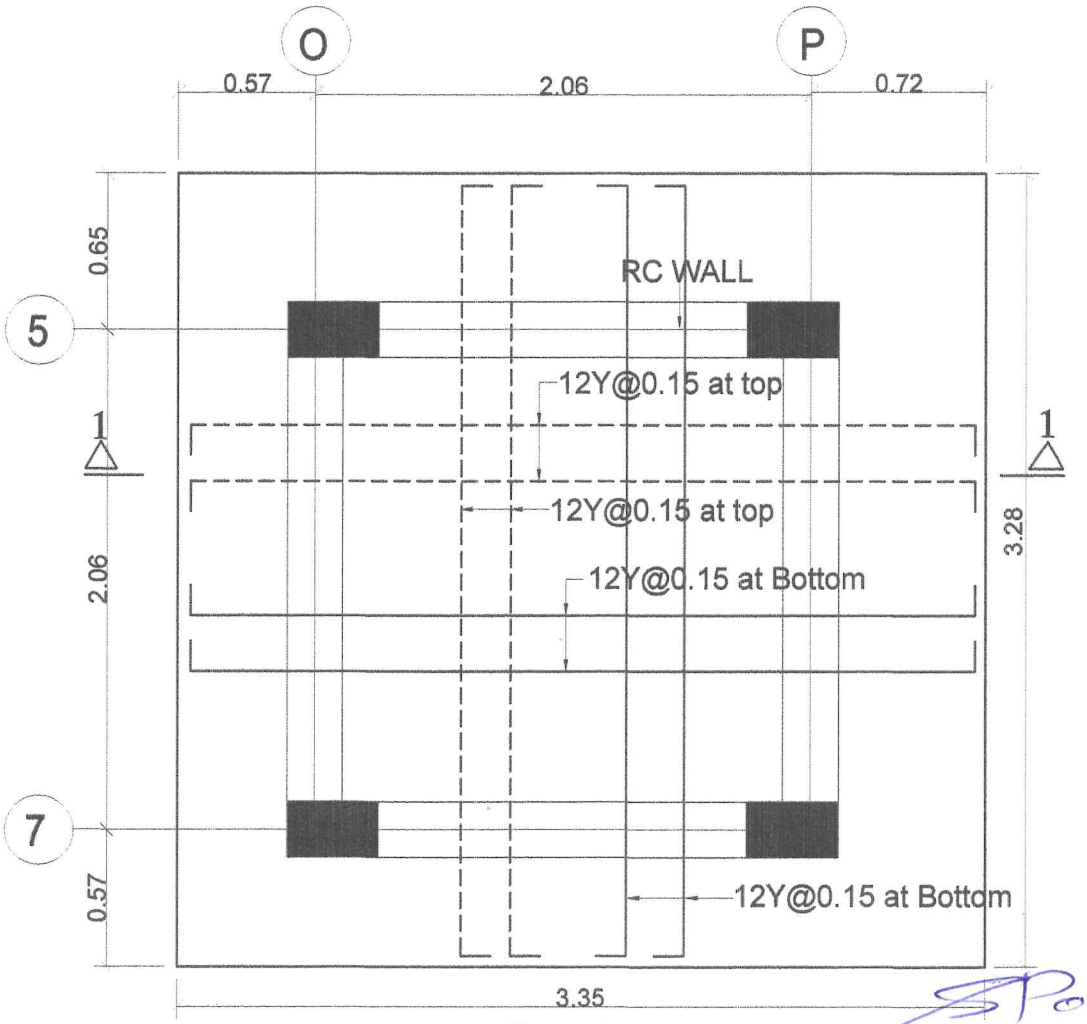


SECTION 1-1



PLAN

COMBINED FOOTING (F-19)

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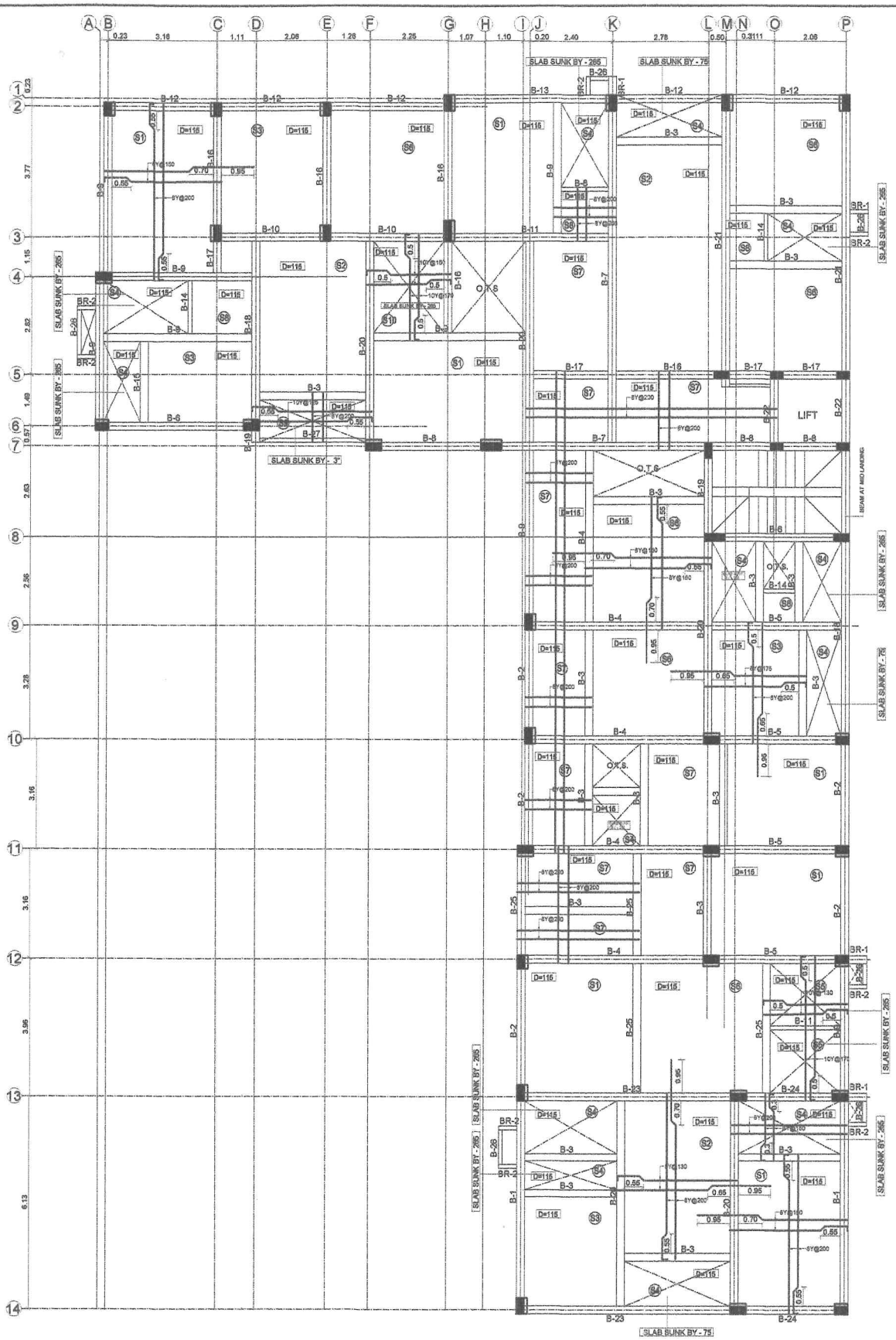
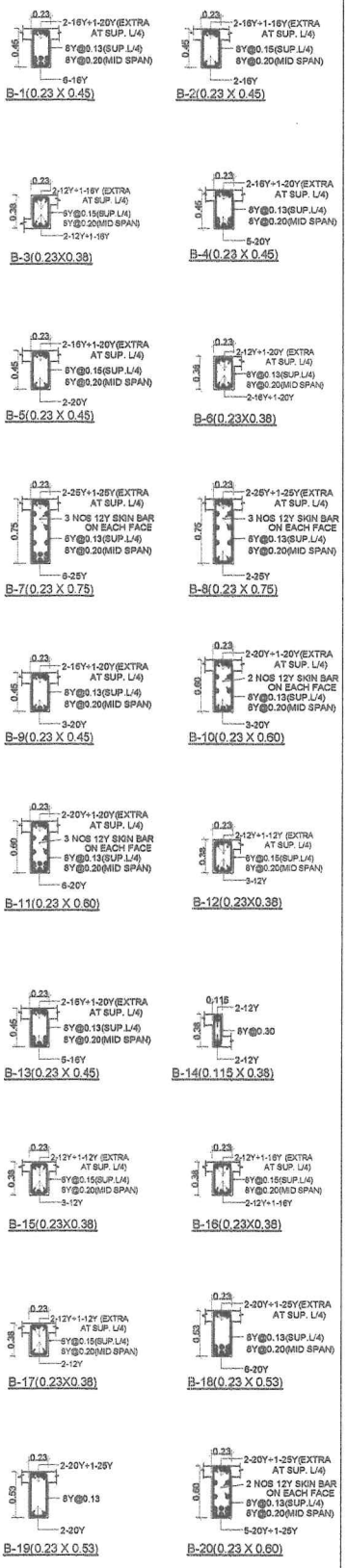
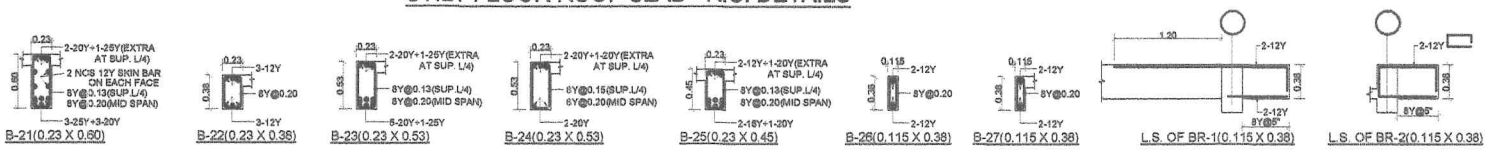




STILT FLOOR ROOF SLAB - R.C. DETAILS



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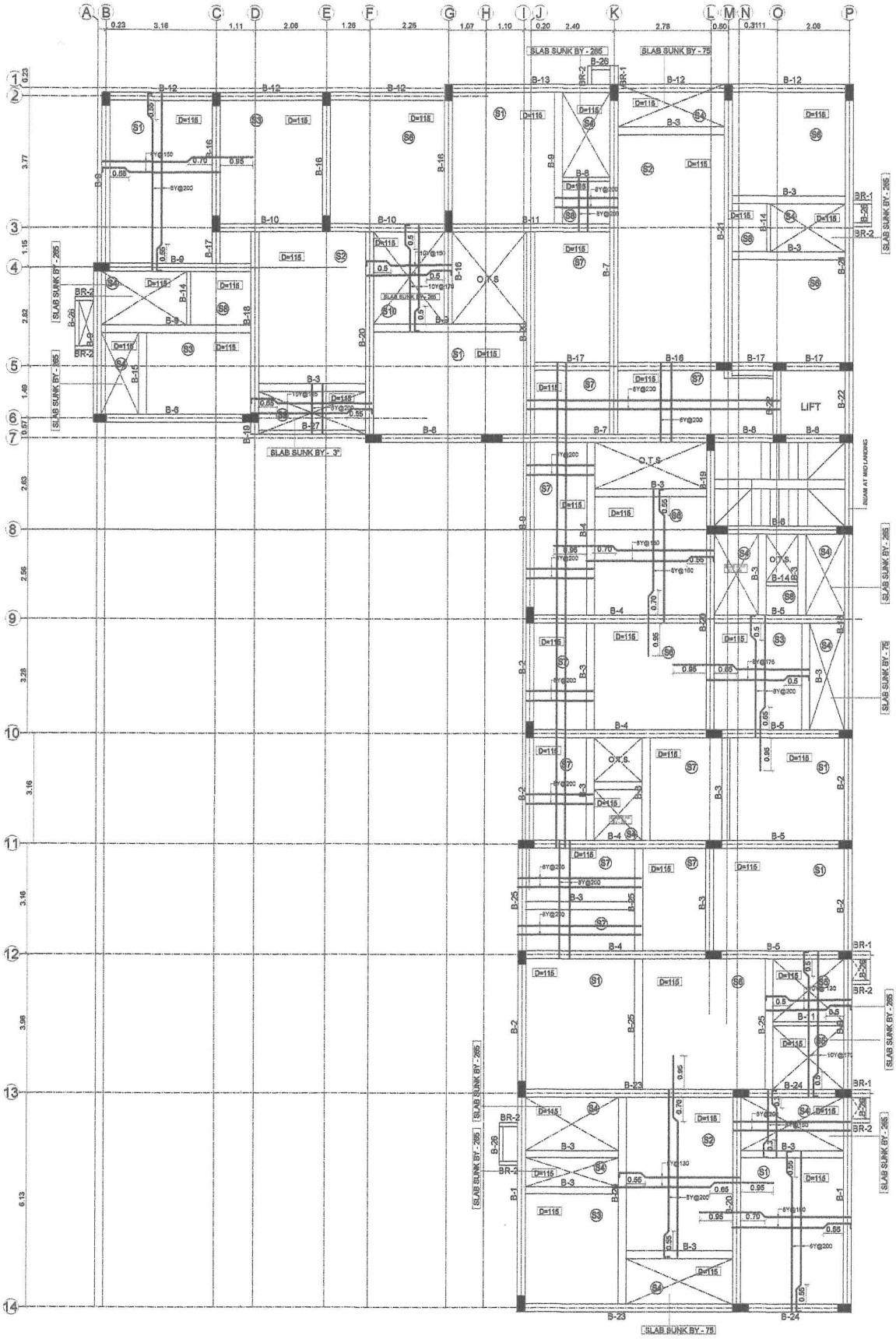
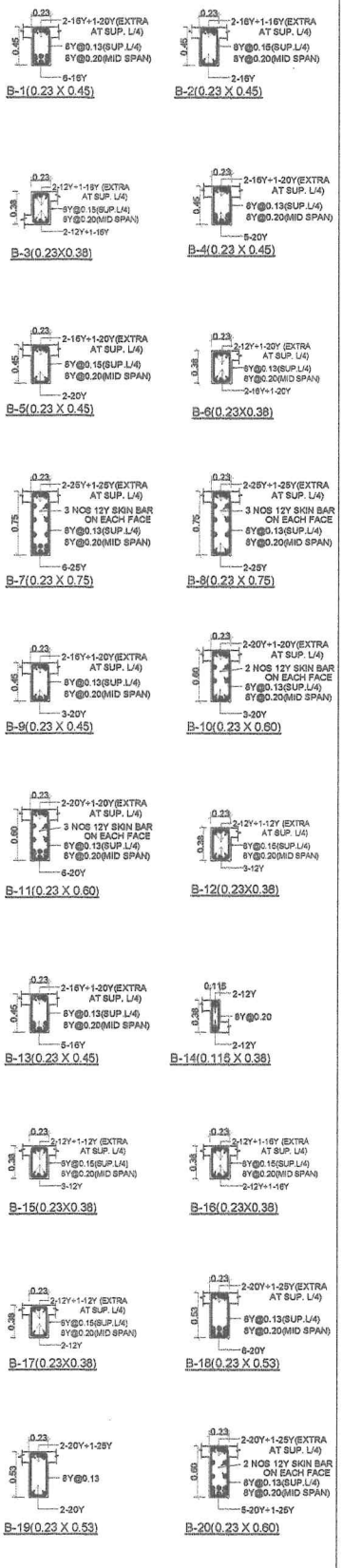
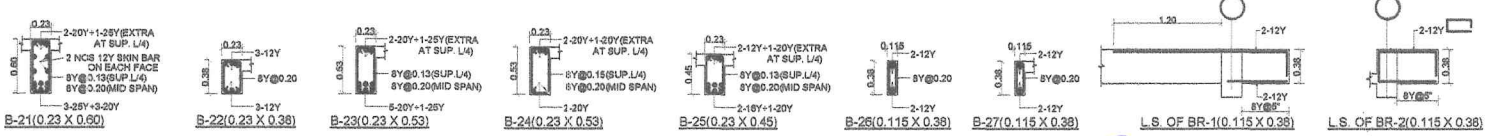




TYPICAL (I & II) FLOOR ROOF SLAB - R.C.DETAILS



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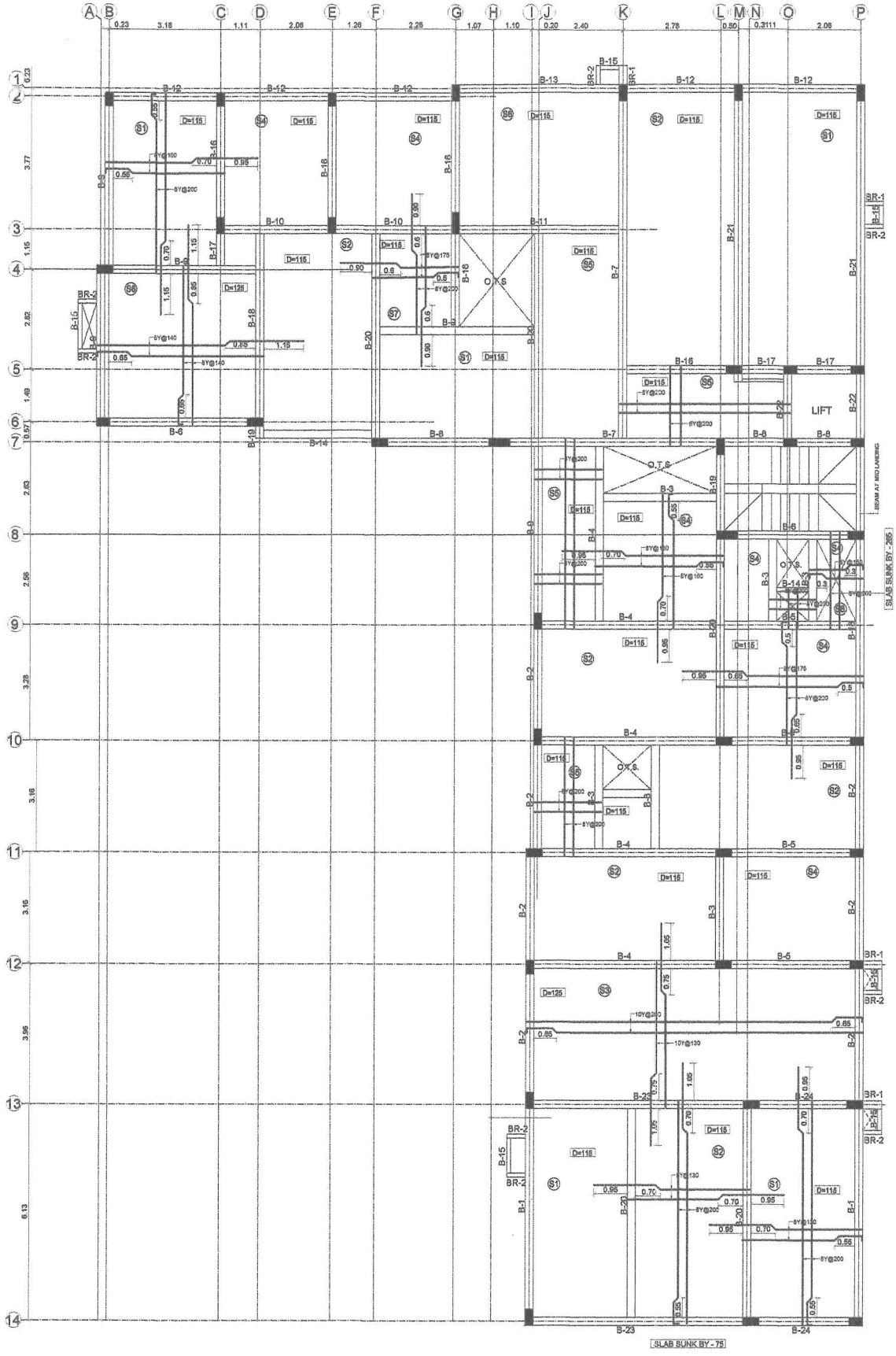
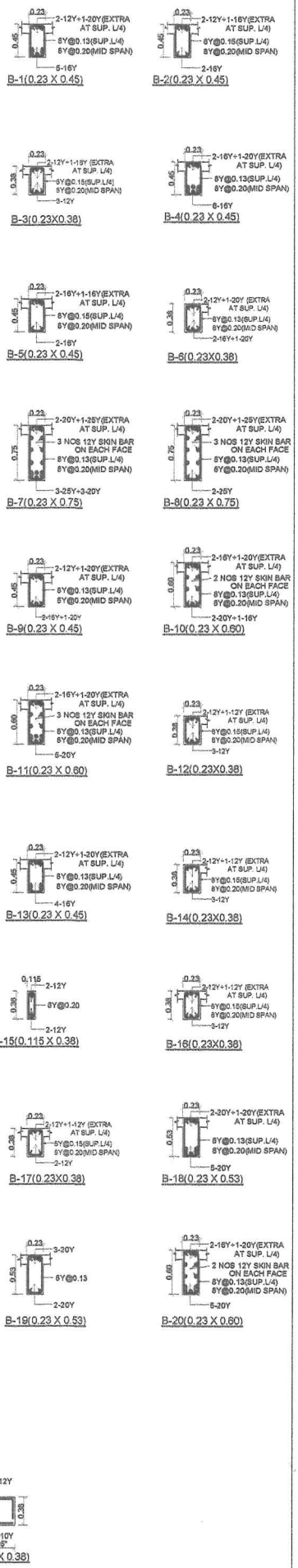
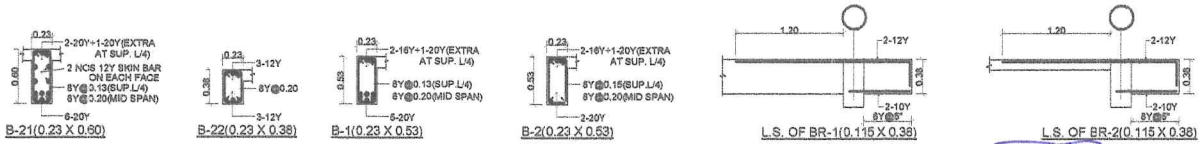




THIRD FLOOR ROOF SLAB - R.C.DETAILS



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