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STRUCTURAL STABILITY CERTIFICATE

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18-10-19

STRUCTURAL STABILITY CERTIFICATE

I hereby certify that the construction of Office building at plot no. A&B at Parthasarathy Nagar, Manapakkam, Chennai-125, is designed with other loads and also to resist earthquake forces, also check has been made and found the structure is safe and sound

I hereby certify that

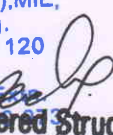
1. The least dimension of the column is 230 & 300mm.
2. The Minimum grade of concrete is M25.
3. Safe Bearing Capacity of Soil is 22 T/M² based on the soil report.
4. The design analysis is using the code of practice for loading standards as per IS 875, IS 432, IS 456 and Seismic forces as per the code IS1893.


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Plot No.5, Prasanth Colony Extn.
Kamarajapuram, Chennai - 600 073

STRUCTURAL DESIGN ANALYSIS
FOR PROPOSED BUILDING

- Name of work : Office Building in Plot No.A&B, Parthasarathy Nagar, Manapakkam, Chennai
- Preamble : 1. I hereby certify that the structural design is done by working stress method, as per section 6 of IS 456.
2. I hereby certify that the structural design sheet is done for critical column, beam, slab and Footing for the proposed building.
3. The usage of the building is Parking in Stilt, Office in,First, Second, Third and Fourth Floor.
4. The building consists of Stilt + 4 Floors.
5. The superstructure is built on 230mm thick outer walls and 115mm thick inner walls.
6. The soil is Silty Sand.
7. The safe bearing capacity of soil is 22 ton/m² based on the soil report.
8. All concrete for all proposed RCC members in Stilt + 4 Floors are R.C.C 1:1:2 mix (M25 concrete).
9. The structural design includes the earthquake criteria as per the IS1893.
- I.S Code = IS 456 for concrete
IS 875 for design load
IS 432 for steel reinforcement
1893 for earthquake resistant design


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Load on Slab

Live Load	=	400 Kg/m ²
Dead load 0.125 x 1.0 x 2500	=	315 Kg/m ²
Floor Finish	=	150 Kg/m ²
Total	=	815 Kg/m²

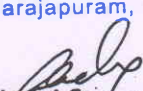
I. DESIGN OF SLAB:

Two Way Slab:

Design Of R C Slab As Per IS : 456 - 2000

Slab Designation = S1
 Nature of Slab panel = INTERIOR PANEL
 Live Load Intensity [t/m²] = 0.4
 Floor Finish [mm] = 40
 Ceiling Finish [mm] = 20
 Partition Load Intensity [t/m²] = 0.1
 Slab Thickness = 150
 Applied Load Factor = 1.5
 Shorter Span [m] = 5.07
 Longer Span [m] = 6.18
 Exposure Condition = MILD
 Fire Rating = 0.50 Hour.
 Concrete Grade Required = M 20
 Char. Reinforcement Strength (fy) [N/sq mm] = 500
 Ratio LY/LX = 1.21
 Clear Cover to Shorter Steel [mm] = 20
 Slab Intensity [t/m²] = 1.01
 + ve Factored BM @ Shorter dir. [t-m] = 1.27
 - ve Factored BM @ Shorter dir. [t-m] = 1.7
 + ve Factored BM @ Longer dir. [t-m] = 0.93
 - ve Factored BM @ Longer dir. [t-m] = 1.24
 Ultimate BM capacity of Slab [t-m] = 4.3
 Factored Actual Shear Stress [kg/cm²] = 2.31
 Permissible Shear Stress [kg/cm²] = 4.81
 Bottom Steel @ Shorter dir. = 10 MM Ø @ 300 mm
 Support Top Steel @ Shorter dir. = 10 MM Ø @ 234 mm
 Bottom Steel @ Longer dir. = 10 MM Ø @ 300 mm
 Support Top Steel @ Longer dir. = 10 MM Ø @ 298 mm
 Min. Cement content required in Concrete [kg/m³] = 300
 Maximum Water to Cement Ratio = 0.55
 Actual L/d Raio = 40.56
 Permissible L/d Raio [safe in deflection] = 41.33
 Crack width under the bar on tension face = 0.06 mm
 Crack width midway between bars at tension face = 0.15 mm
 Permissible Crack width = 0.3 mm


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Design Of R C Slab As Per IS : 456 - 2000

Slab Designation = S2
Nature of Slab panel = ONE LONG EDGE DISCONTINUOUS
Live Load Intensity $[t/m^2] = 0.4$
Floor Finish $[mm] = 40$
Ceiling Finish $[mm] = 20$
Partition Load Intensity $[t/m^2] = 0.1$
Slab Thickness = 175
Applied Load Factor = 1.5
Shorter Span $[m] = 5.57$
Longer Span $[m] = 6.84$
Exposure Condition = MILD
Fire Rating = 0.50 Hour.
Concrete Grade Required = M 20
Char. Reinforcement Strength $(f_y) [N/sq\ mm] = 500$
Ratio $L_Y/L_X = 1.22$
Clear Cover to Shorter Steel $[mm] = 20$
Slab Intensity $[t/m^2] = 1.07$
+ ve Factored BM @ Shorter dir. $[t-m] = 2.01$
- ve Factored BM @ Shorter dir. $[t-m] = 2.66$
+ ve Factored BM @ Longer dir. $[t-m] = 1.39$
- ve Factored BM @ Longer dir. $[t-m] = 1.84$
Ultimate BM capacity of Slab $[t-m] = 6.12$
Factored Actual Shear Stress $[kg/cm^2] = 2.27$
Permissible Shear Stress $[kg/cm^2] = 5.03$
Bottom Steel @ Shorter dir. = 12 MM $\varnothing$ @ 300 mm
Support Top Steel @ Shorter dir. = 12 MM $\varnothing$ @ 255 mm
Bottom Steel @ Longer dir. = 12 MM $\varnothing$ @ 300 mm
Support Top Steel @ Longer dir. = 12 MM $\varnothing$ @ 300 mm
Min. Cement content required in Concrete $[kg/m^3] = 300$
Maximum Water to Cement Ratio = 0.55.
Actual L/d Ratio = 37.38
Permissible L/d Ratio [safe in deflection] = 41.63
Crack width under the bar on tension face = 0.07 mm
Crack width midway between bars at tension face = 0.18 mm
Permissible Crack width = 0.3 mm

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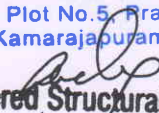
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II. DESIGN OF BEAM:

Design Of R C Beam is OK : As Per IS-456-2000

Beam Designation = RB1
LHS Hogging Moment [t-m] = 8.3
LHS Sagging Moment [t-m] = 0
RHS Hogging Moment [t-m] = 7.4
RHS Sagging Moment [t-m] = 0
MID SPAN Sagging Moment [t-m] = 5.5
MID SPAN Hogging Moment [t-m] = 0
LHS Shear Force [t] = 9
RHS Shear Force [t] = 8.4
Applied Load Factor = 1.5
Beam Width [mm] = 230
Beam Depth [mm] = 530
Exposure Condition = MILD
Fire Rating = 0.50 Hour.
Nature of Beam = SIMPLY SUPPORTED
Redistribution of End Moments = ** NIL **
Concrete Grade Required = M 20
Char. Reinforcement Strength (fy) [N/sq mm] = 500
Number of bars required @ LHS TOP = 3-20 MM Ø
Number of bars required @ LHS BOTTOM = 2-20 MM Ø
Number of bars required @ RHS TOP = 2-20 MM Ø
Number of bars required @ RHS BOTTOM = 2-20 MM Ø
Number of bars required @ MID SPAN BOTTOM = 2-20 MM Ø
Number of bars required @ MID SPAN TOP = 2-20 MM Ø
Area Of Links (All Legs) [sq cm] = 3.25
Spacing of 2-legged Links [mm] = 8 MM Ø @ 300 c/c
Cover to Links (Nominal Cover) [mm] = 20
Ultimate Moment Cap. of Concrete Section [t-m] = 15.35
Maximum Factored Moment [t-m] = 12.45
Minimum Cement content Required in Concrete [kg/m³] = 300
Maximum Water to Cement Ratio = 0.55
Actual L/d Raio = 10.77
Permissible L/d Raio [safe in deflection] = 22
Crack width under MID SPAN BOTTOM bars = 0.07 mm
Crack width @ the bottom corner of beam at MID SPAN = 0.1 mm
Crack width at mid way between bottom bars at MID SPAN = 0.08 mm
Permissible Crack width = 0.3 mm Permissible Crack width = 0.3 mm

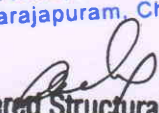

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Design Of R C Beam is OK : As Per IS-456-2000

Beam Designation = RB2
 LHS Hogging Moment [t-m] = 18.5
 LHS Sagging Moment [t-m] = 0
 RHS Hogging Moment [t-m] = 14.3
 RHS Sagging Moment [t-m] = 0
 MID SPAN Sagging Moment [t-m] = 10.7
 MID SPAN Hogging Moment [t-m] = 0
 LHS Shear Force [t] = 18.4
 RHS Shear Force [t] = 13.2
 Applied Load Factor = 1.5
 Beam Width [mm] = 230
 Beam Depth [mm] = 530
 Exposure Condition = MILD
 Fire Rating = 0.50 Hour.
 Nature of Beam = SIMPLY SUPPORTED
 Redistribution of End Moments = ** NIL **
 Concrete Grade Required = M 20
 Char. Reinforcement Strength (fy) [N/sq mm] = 500
 Number of bars required @ LHS TOP = 4-25 MM Ø
 Number of bars required @ LHS BOTTOM = 2-25 MM Ø
 Number of bars required @ RHS TOP = 3-25 MM Ø
 Number of bars required @ RHS BOTTOM = 2-25 MM Ø
 Number of bars required @ MID SPAN BOTTOM = 2-25 MM Ø
 Number of bars required @ MID SPAN TOP = 2-25 MM Ø
 Area Of Links (All Legs) [sq cm] = 5.68
 Spacing of 2-legged Links [mm] = 8 MM Ø @ 112 c/c
 Cover to Links (Nominal Cover) [mm] = 20
 Ultimate Moment Cap. of Concrete Section [t-m] = 15.19
 Maximum Factored Moment [t-m] = 27.75
 Minimum Cement content Required in Concrete [kg/m³] = 300
 Maximum Water to Cement Ratio = 0.55
 Actual L/d Raio = 14.3
 Permissible L/d Raio [safe in deflection] = 24
 Crack width under MID SPAN BOTTOM bars = 0.11 mm
 Crack width @ the bottom corner of beam at MID SPAN = 0.16 mm
 Crack width at mid way between bottom bars at MID SPAN = 0.13 mm
 Permissible Crack width = 0.3 mm


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III. DESIGN OF COLUMN (C5):

Concrete M25

Consider a critical column which is taking more load.

Design Of Reinforced Concrete Column

Column Designation = C11
Applied Load [t] = 200
Nature of Load = COMPRESSIVE
Longer Column Dimension [mm] = 675
Shorter Column Dimension [mm] = 300
Eff. Length along Longer Col. Dimension [M] = 3.5
Eff. Length along Shorter Col. Dimension [M] = 3.5
BM along Longer Column Dimension [M] = 6.2
BM along Shorter Column Dimension [M] = 2.7
Reinforcement % = 2.75
Reinforcement Distribution on Faces = 4 FACES
Applied Load Factor = 1.5
Concrete Grade Required = M 25
Char. Reinforcement Strength (f y) [N/sq mm] = 500
Exposure Condition = MILD
Fire Rating = 0.50 Hour.
Axial Column Capacity Along Longer Dim.[ton] = 200.02
Moment Capacity Along Longer Dim.[t-m] = 15.91
Gross Applied Moment Along Longer Dim.[t-m] = 6.2
Axial Column Capacity Along Shorter Dim.[ton] = 200.02
Moment Capacity Along Shorter Dim.[t-m] = 5.83
Gross Applied Moment Along Shorter Dim.[t-m] = 2.7
Bending Ratio = $0.42 < 1$: OK
Area Of Main Tensile Reinforcement [sq cm] = 58.91
Number of main bars required = 12 Ø25 MM
Spacing of Links [mm] = Ø8 MM @ 300 c/c
Cover to Links (Nominal Cover) [mm] = 40
Minimum Cement content Required in Concrete [kg/m³] = 300
Maximum Water to Cement Ratio = 0.55

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IV. DESIGN OF FOOTING (F4):

Design Of R C Isolated Foundation As Per IS-456-2000

Footing Designation = F4
Foundation Depth [m] = 3
SBC [t/m²] = 20
Foundation Width [m] = 3.3
Foundation Length [m] = 3.3
Applied Bending Moment [t-m] = 0
Applied Load [tons] = 200
Nature of Axial Load = COMPRESSIVE
Column Size Along Longer FTG dir. [mm] = 530
Column Size Along Shorter FTG dir. [mm] = 300
Applied Load Factor = 1.5
Exposure Condition = MILD
Concrete Grade Required = M 20
Char. Reinforcement Strength (fy) = 500 N/mm²
Clear Cover to Longer Bars [mm] = 50
Minimum Cement content Required in Concrete [kg/m³] = 300
Maximum Water to Cement Ratio = 0.55
Uniform Thickness of Foundation Required [mm] = 850
Reinforcement Required Along Longer Dir @ Bottom = 10.19 CM²/M
Reinforcement Required along SHORTER Dir @ Bottom = 10.19 CM²/M
Reinforcement Spacing Along Longer Dir @ Bottom = Ø 16 @ 197 mm c/c
Reinforcement Spacing Along Shorter Dir @ Bottom = Ø 16 @ 197 mm c/c
Concrete Quantity [m³] = 9.25


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V. CHECK FOR EARTHQUAKE FORCES:

Check the column, critical and its foundation to Earthquake force as per IS 1893-
criteria for earthquake resistant design of structure

Use seismic coefficient method as per clause 3.4.2-3 (a)

$$\alpha_h = \beta I \alpha_b$$

$$\alpha_h = \text{Horizontal seismic coefficient}$$

$$\beta = \text{a coefficient depend upon soil foundation coefficient as per Table-3} \\ = 1.40$$

$$I = \text{a coefficient depend upon soil importance of structure as per Table-4} \\ = 1.00$$

$$\alpha_b = \text{Basic horizontal seismic coefficient as per seismic zone of the place} \\ \text{Madras/Chennai seismic zone III.} \\ = 0.04$$

$$\alpha_h = 1.40 \times 1.00 \times 0.04 \\ = 0.056$$

$$\text{Total load on column} = 200 \text{ ton}$$

$$\text{Size of individual footing} = 3.30 \text{ m} \times 3.30 \text{ m}$$

$$\text{Safe bearing capacity of soil} = 22 \text{ ton /m}^2$$

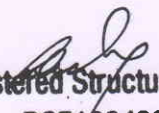
$$H_\Sigma = \text{Horizontal force component of earthquake} \\ = \alpha_h \times W$$

$$W = \text{Load on column} \\ = 200 \text{ ton}$$

$$H_\Sigma = 0.056 \times 200 \text{ ton} \\ = 11.20 \text{ ton}$$

$$\text{say} = 11.20 \text{ ton}$$


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Column size = 30 cm x 67.5 cm

B = 30 cm

D = 67.5 cm

Effective depth (d) = 62.5 cm

Concrete M25

Shear due to Earthquake = 11.20 ton

Shear Stress = $\frac{H_v}{b \cdot d}$

$$= \frac{11200}{30 \times 0.90 \times 62.5}$$

$$= 6.63 \text{ Kg/cm}^2 < 8 \text{ Kg/cm}^2$$

Hence column safe against Earthquake.

Footing

H_v = Vertical component of Earthquake forces as per clause 3.4.5 of 1893

H_v = Co-efficient of vertical component of seismic force

$$= \frac{\alpha_h}{2} = \frac{0.056}{2} = 0.028$$

Vertical load on column (p) = 200 ton

Vertical component force due to seismic (P₁) = H_v x p

$$= 0.028 \times 200 \text{ ton}$$

$$= 5.60 \text{ ton}$$

Total load on footing (P) = p + P₁

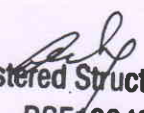
$$= 200 \text{ ton} + 5.60 \text{ ton}$$

$$= 205.6 \text{ ton}$$

$$\begin{aligned}\text{Size of footing} &= 3.30 \text{ m} \times 3.30 \text{ m} \\ \text{Stress on soil} &= \frac{P}{A} \\ &= \frac{205.6 \text{ ton}}{3.30 \text{ m} \times 3.30 \text{ m}} \\ &= 18.87 \text{ ton/m}^2 < 22 \text{ ton/m}^2 \\ &\text{as per seismic force above.}\end{aligned}$$

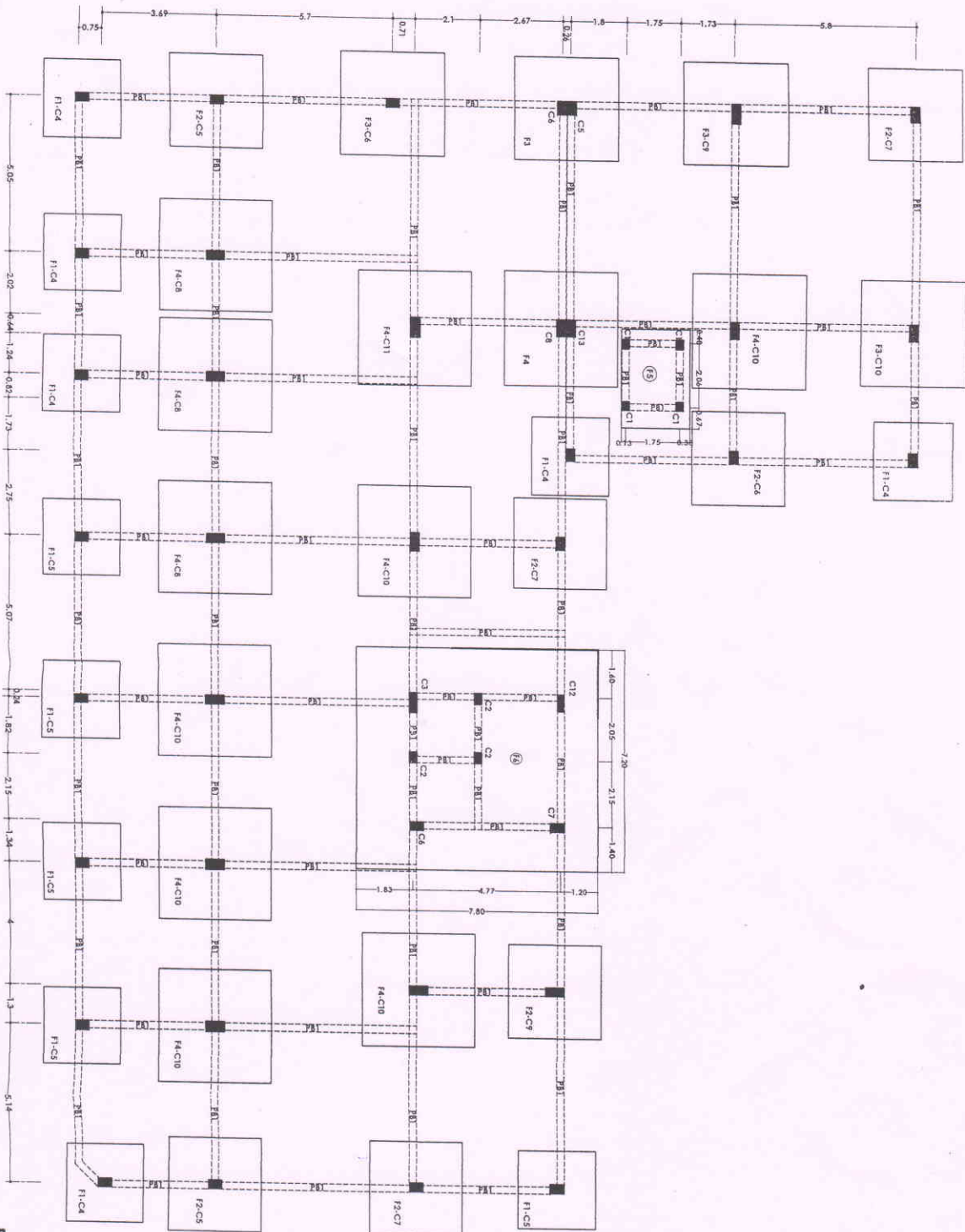
Hence column footing safe

For additional safety to building all columns are tied in the X and Y axis positively.


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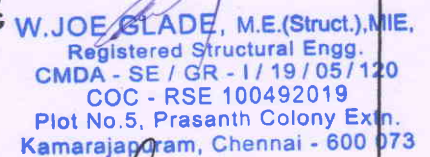

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FOR PROPOSED OFFICE BUILDING AT PLOT NO: A&B, PARTHASARATHY NAGAR, MANAPAKKAM, CHENNAI.



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TYPICAL FOOTING SECTION

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**REINFORCEMENT DETAILS OF FOOTING,COLUMN & PLINTH BEAM
FOR PROPOSED OFFICE BUILDING AT PLOT NO: A&B, PARTHASARATHY
NAGAR, MANAPAKKAM, CHENNAI.**

COLUMN SCHEDULE

S.No.	Column Marked	Column Size	Stilt Floor		First Floor		Second Floor		Third Floor		Fourth Floor		Ties	No. Of Column
			Reinf. Position	Reinf.	Reinf. Position	Reinf.	Reinf. Position	Reinf.	Reinf. Position	Reinf.	Reinf. Position	Reinf.		
1	C1	230x300	4#16	4#16	4#16	4#16	4#16	4#16	4#16	4#16	4#16	4#16	8mm 2legged @175 c/c	4
2	C2	230x375	4#25 + 2#12	4#25 + 2#12	4#25 + 2#12	4#25 + 2#12	4#25 + 2#12	4#25 + 2#12	4#25 + 2#12	4#25 + 2#12	4#25 + 2#12	4#25 + 2#12	8mm 2legged @175 c/c	3
3	C3	230x675	10#25	10#25	10#25	10#25	10#25	10#25	10#25	10#25	10#25	10#25	8mm 4legged @175 c/c	1
4	C4	300x450	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	8mm 4legged @175 c/c	6
5	C5	300x450	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	4#16 + 4#12	8mm 4legged @175 c/c	8
6	C6	300x450	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	8mm 4legged @175 c/c	4
7	C7	300x450	8#25	8#25	8#25	8#25	8#25	8#25	8#25	8#25	8#25	8#25	8mm 4legged @175 c/c	4
8	C8	300x600	8#25	8#25	8#25	8#25	8#25	8#25	8#25	8#25	8#25	8#25	8mm 4legged @175 c/c	4
9	C9	300x600	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	8mm 4legged @175 c/c	2
10	C10	300x600	12#25	12#25	12#25	12#25	12#25	12#25	12#25	12#25	12#25	12#25	8mm 4legged @175 c/c	7
11	C11	300x675	14#25	14#25	14#25	14#25	14#25	14#25	14#25	14#25	14#25	14#25	8mm 4legged @175 c/c	1
12	C12	230x600	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	4#25 + 4#20	8mm 4legged @175 c/c	1
13	C13	300x600	4#20 + 4#16	4#20 + 4#16	4#20 + 4#16	4#20 + 4#16	4#20 + 4#16	4#20 + 4#16	4#20 + 4#16	4#20 + 4#16	4#20 + 4#16	4#20 + 4#16	8mm 4legged @175 c/c	1

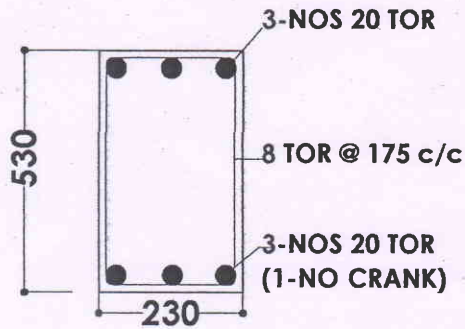
FOOTING SCHEDULE

S.No.	Footing Marked	Footing Size		Depth	Reinforcement		No. Of Footing
		length	breadth		Top Rod	Bottom Rod	
1	F1	2.30 M	2.30 M	0.600	Ø10@175c/c	Ø12@150c/c	11
2	F2	2.75 M	2.75 M	0.675	Ø10@175c/c	Ø12@125c/c	7
3	F3	3.00 M	3.00 M	0.750	Ø10@175c/c	Ø12@125c/c	4
4	F4	3.30 M	3.30 M	0.850	Ø10@175c/c	Ø16@175c/c	11
5	F5	3.22 M	2.21 M	0.300	Ø12@125c/c	Ø12@125c/c	1
6	F6	7.20 M	7.80 M	0.500	Ø16@175c/c	Ø25@150c/c	1

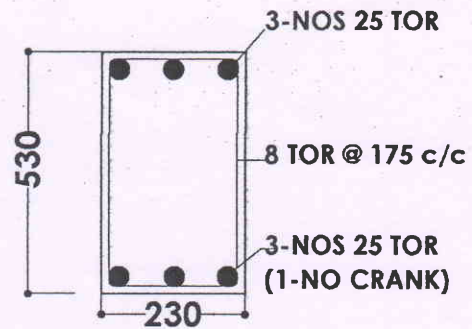
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Kamarajapuram, Chennai - 600 073

Registered Structural Engineer
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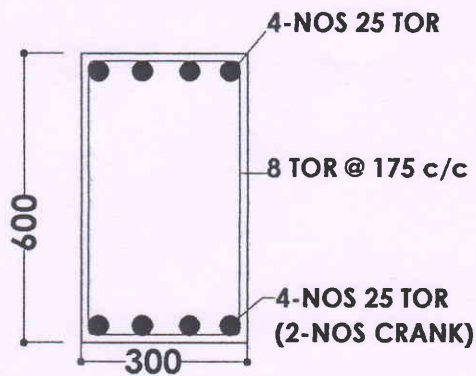
REINFORCEMENT DETAILS OF FOOTING & COLUMN DETAILS FOR PROPOSED OFFICE
BUILDING AT PLOT NO: A&B, PARTHASARATHY NAGAR, MANAPAKKAM, CHENNAI



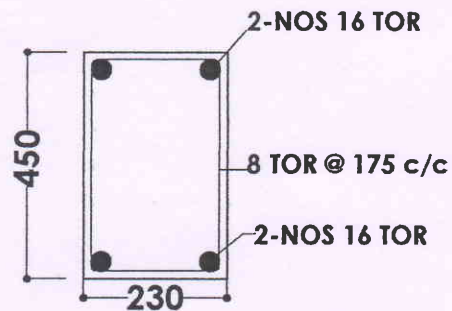
DETAILS OF BEAM (RB1)



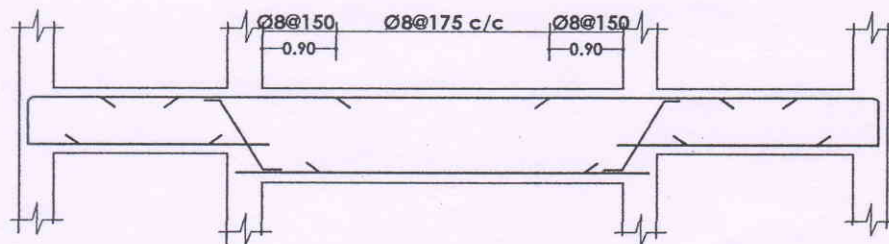
DETAILS OF BEAM (RB2)



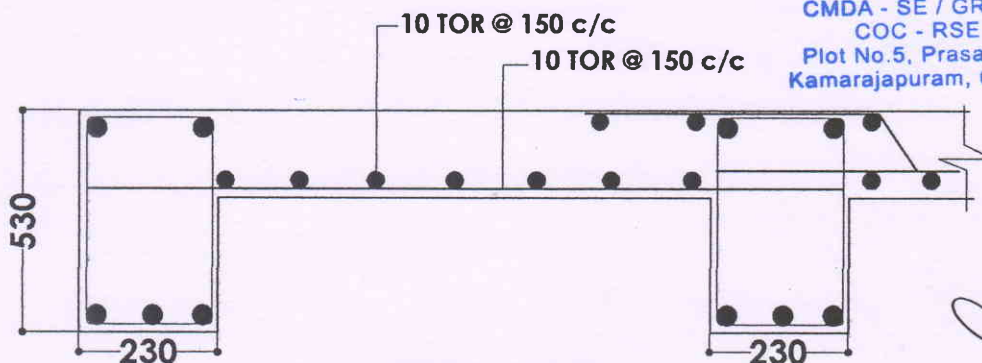
DETAILS OF BEAM (RB3)



DETAILS OF BEAM (RB4)



TYPICAL L.S.

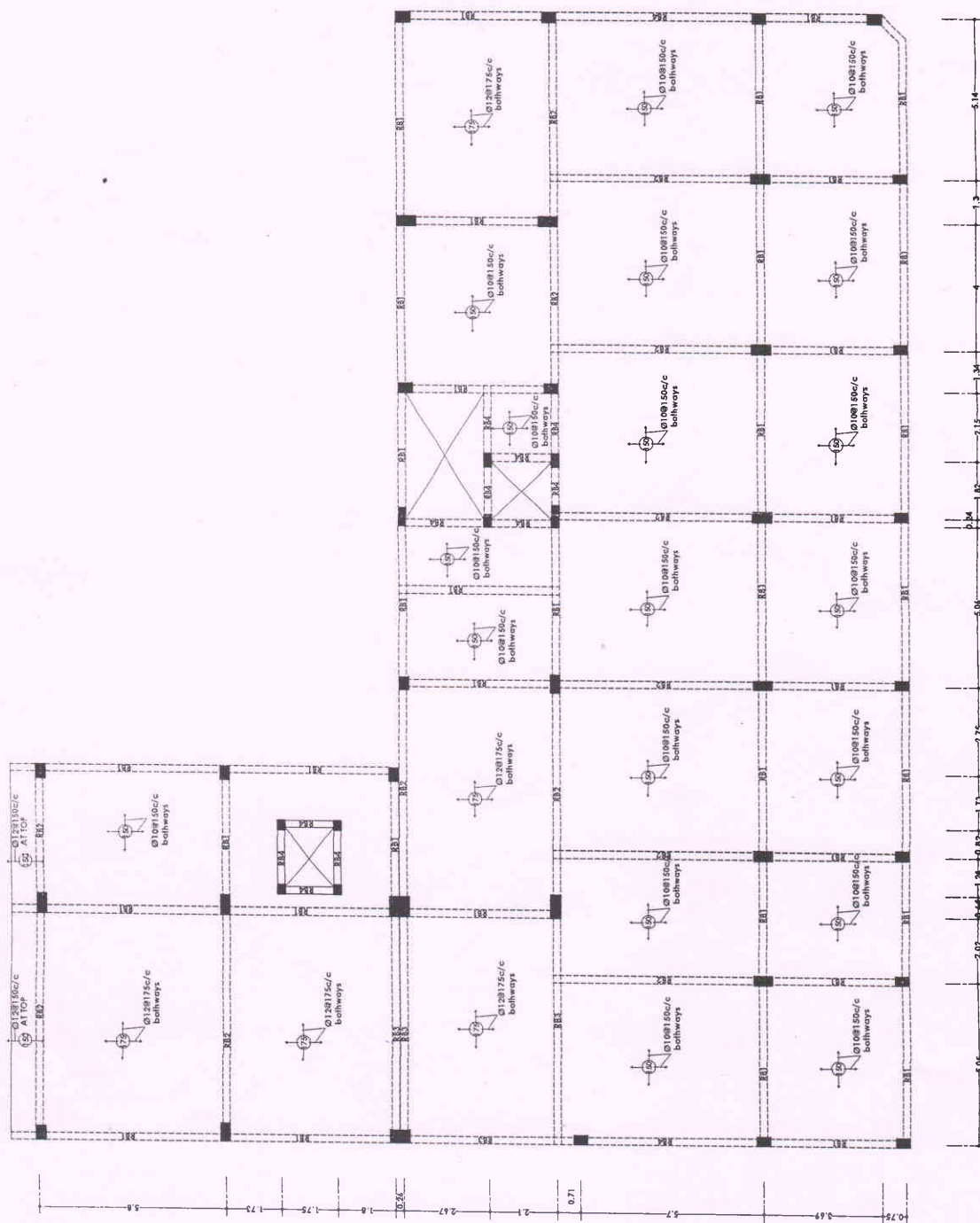


L.S. OF ROOF SLAB

W. JOE GLADE, M.E. (Struct.), MIE,
Registered Structural Engg.
CMDA - SE / GR - I / 19 / 05 / 120
COC - RSE 100492019
Plot No. 5, Prasanth Colony Extn.
Kamarajapuram, Chennai - 600 073

Registered Structural Engineer
RSE100492019

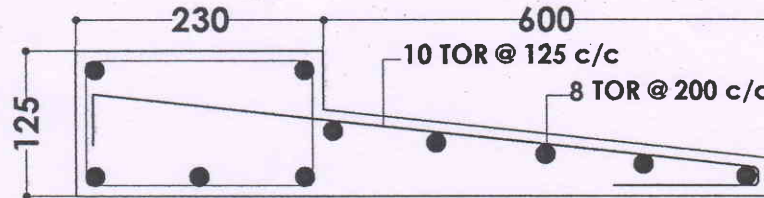
**REINFORCEMENT DETAILS OF TYPICAL ROOF BEAM AND ROOF SLAB
SECTION FOR PROPOSED OFFICE BUILDING AT PLOT.NO: A&B,
PARTHASARATHY NAGAR, MANAPAKKAM, CHENNAI**



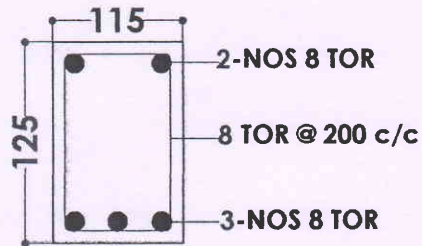
REINFORCEMENT DETAILS OF TYPICAL FLOOR ROOF SLAB DETAILS FOR PROPOSED OFFICE BUILDING

AT PLOT NO: A&B, PARTHASARATHY NAGAR, MANAPAKKAM, CHENNAI.

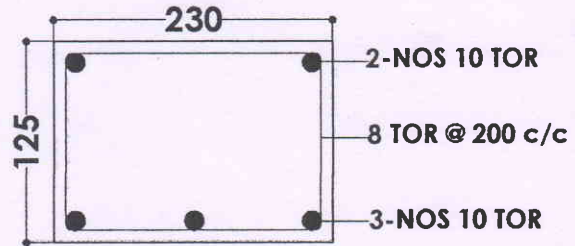
**W. JOE GLADE / M.E.(Struct.),MIE,
Registered Structural Engg.
CMDA - SE / GR - I / 19 / 05 / 120
COC - RSE 100492019
Plot No.5, Prasanth Colony Extn.
Kamarajapuram, Chennai - 600 073**



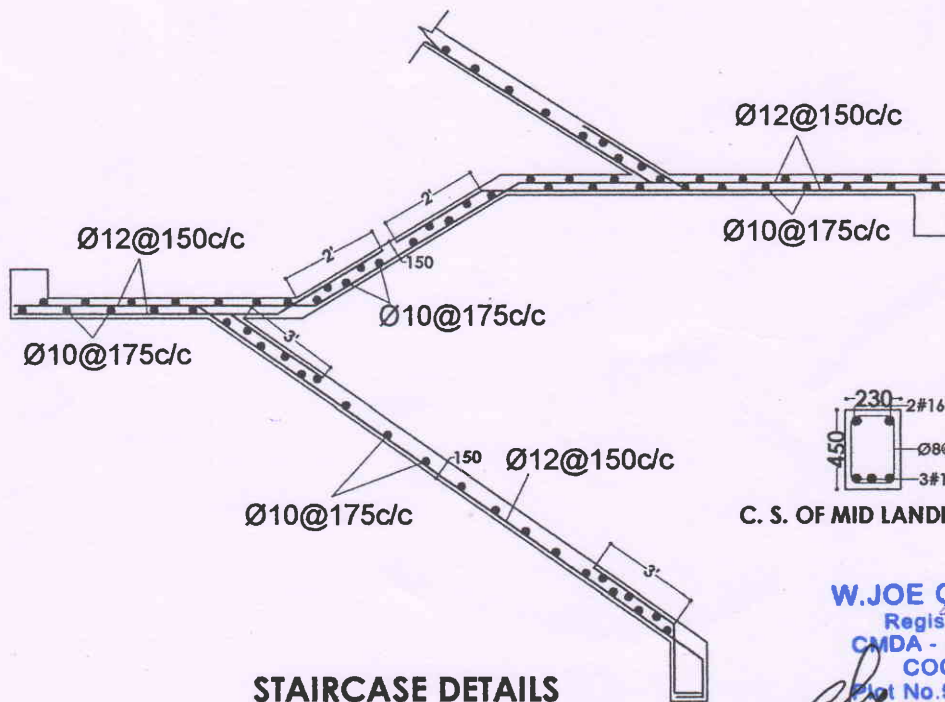
DETAILS OF LINTEL CUM SUNSHADE



C.S. OF 115 THK LINTEL



C.S. OF 230 THK LINTEL



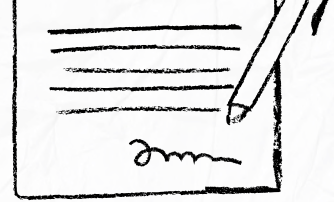
STAIRCASE DETAILS

C. S. OF MID LANDING BEAM

W. JOE GLADE, M.E. (Struct.), MIE.
 Registered Structural Engg.
 CMDA - SE / GR - 11/19/05/120
 COC - RSE 100492019
 Plot No. 5, Prasanth Colony Extn.
 Kamarajapuram, Chennai - 600 073

Registered Structural Engineer
 RSE/100492019

REINFORCEMENT DETAILS OF LINTEL BEAM, SUNSHADE & STAIRCASE
FOR PROPOSED OFFICE BUILDING AT PLOT NO: A&B, PARTHASARATHY
NAGAR, MANAPAKKAM, CHENNAI



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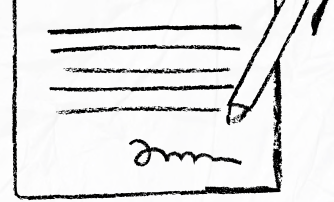
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