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P. SENTHIL KUMAR M.E., (Struct), AIV
Chartered Engineer | Structural Consultant
Registered Valuer

THE DESIGN ONE
Civil and Structural Engineering Consultancy

Date: 27-03-2025

STRUCTURAL STABILITY CERTIFICATE

1. The detailed engineering and structure design of the proposed building comprising of Stilt plus Four floors at SF no: 181/5B, 181/5C, Site no 115,116, Approved layout no: L.P/D.T.C.P no: 1205/1994, Kongu Maanagar, Bankers Colony, Phase 1 at Villankurichi village, Coimbatore North Taluk, Coimbatore District, and total 14 dwelling units has been done by me/us based on the report of Geotechnical investigation (soil test) done by the Coimbatore Digital Surveyors and considering the functional requirement of the building.

2. It is certified that among other factors, the proposed building has been designed to resist earthquake. I/we have checked various parameters and found that the proposed building would be safe.

3. I/We further certify that:

   (i) The minimum grade of concrete is M20.

   (ii) The design and analysis has been done using the code of practice for plain and reinforced concrete, design loads and design of earthquake resistant structure as per IS code no.456.

4. The building will be **Safe and Sound** when used for the purpose for which it is designed.

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PROJECT	P.SENTHIL KUMAR- 'ADVIKA' APARTMENT @ VILLANKURICHI, COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF COLUMN	C3

DESIGN DATA:

Axial Load, P	=	1250 kN
Breadth of the column, b	=	200 mm
	=	0.2 m
Depth of the column, D	=	530 mm
	=	0.53 m
Unsupported length of the column in x-x axis, L_x	=	3 m
Unsupported length of the column in y-y axis, L_y	=	3 m
Bending Moment about x-x axis, M_x	=	14.85 kNm
Bending Moment about y-y axis, M_y	=	20.83 kNm
Effective length factor	=	0.85
Grade of concrete, f_{ck}	=	25 N/mm^2
Grade of steel, f_y	=	500 N/mm^2

EFFECTIVE LENGTH:

Effective length of the column in x-x axis, L_{ex}	=	2.55 m
	=	2550 mm
Effective length of the column in y-y axis, L_{ey}	=	2.55 m
	=	2550 mm

CHECK FOR SLENDERNESS RATIO:

L_{ex}/D	=	4.8113208
		<12

Hence, short column

L_{ey}/b	=	12.75
		>12

Hence, long column

CHECK FOR MINIMUM ECCENTRIES:

$e_{ex, min}$	=	$(L_{ex}/500)+(D/30)$
	=	22.766667 mm
	OR	20 mm
$e_{ey, min}$	=	$(L_{ey}/500)+(b/30)$
	=	11.766667 mm
	OR	20 mm
Factored Bending moment in x-x axis, M_{ux}	=	22.275 kNm
Factored Bending moment in y-y axis, M_{uy}	=	31.245 kNm
Factored Load, P_u	=	1875 kN
	=	1875000 N
M_{ux}/P_u	=	11.88 mm
	<20	mm
M_{uy}/P_u	=	16.664 mm
	<20	mm

Hence, design for uniaxial moment

LONGITUDINAL REINFORCEMENT:

Hence, Factored Bending Moment, M_u	=	31.245 kNm
	=	31245000 Nmm

Governing Axis for Bending is y-y axis

$M_u/f_{ck}bD^2$	=	0.0589528	
	=	0.059	
$P_u/f_{ck}bD$	=	0.7075472	
	=	0.71	
Effective cover, d'	=	50	mm
Therefore, d'/D	=	0.25	
	=	0.2	
From Interaction chart of SP 16			
p/f_{ck}	=	0.1	
p	=	2.5 %	
0.8%<p<4%			
Hence O.K.			
A_s	=	2650	mm^2
Assume		20 mm dia bars	
No. of bars, N	=	8.4394904	
	=	10 Nos.	
$A_{s\ provided}$	=	3140	mm^2
Actual p	=	2.9622642 %	
0.8%<p<4%			
Hence O.K.			
Hence, provide	***10 #***	***20 mm dia***	
bars uniformly distributed on four sides			

LATERAL REINFORCEMENT:

Diameter of Lateral Ties:

Dia of Lateral Ties	=	5	mm	(OR)
Dia of Longitudinal rft./4	=	5	mm	
Whichever is lesser				
Therefore Dia of lateral ties	=	5	mm	
	=	8	mm	

Spacing:

Least lateral dimension of the column	=	200	mm
16*Dia of the longitudinal bar	=	320	mm
	=	300	mm
Whichever is lesser			
Required Spacing	=	200	mm
Therefore, adopt	***8 mm dia lateral ties @ 200 mm c/c***		

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b1

PROJECT	P.SENTHIL KUMAR- 'ADVIKA' APARTMENT @ VILLANKURICHI, COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF FOOTING	C3

DESIGN DATAS:

Column transfer load, P = 1250 kN
= 1250000 N
Breadth of the column on footing, b = 200 mm = 0.2 m
Depth of the column on footing, D = 530 mm = 0.53 m
Grade of concrete, f_{ck} = 20 N/mm^2
Grade of steel, f_y = 500 N/mm^2
Safe Bearing Capacity of Soil, SBC = 320 kN/m^2

SIZE OF FOOTING:

Factored Load, P_u = 1875 kN
= 1875000 N
Self-weight of footing = 125 kN
Total load on footing = 1375 kN
= 1375000 N
Area of footing = Total load on footing/SBC
= 4.296875 m^2
Size of footing = 2.07289049 m
2.08 m
Length of the footing = 2.08 m = 2080 mm
Breadth of the footing = 2.08 m = 2080 mm
Provided area of footing = 4.3264 m^2
Ultimate soil pressure, W_u = 433.385725 kN/m^2

Hence, size of footing is correct.

BENDING MOMENT:

Cantilever portion, l' = 0.775 m
Bending Moment = $W_u l'^2/2$
= 130.15115 kNm
= 130151150 Nmm

DEPTH OF FOOTING:

Assuming the given section as balanced section,

$M_{u\,lim}$ = $0.138*f_{ck}*b*d^2$
Keep length of the footing = 1000 mm
Effective depth, d = 217.154816 mm
Hence provide,d= 480 mm depth of footing
480 m depth of the footing
Keep minimum cover, c' = 50 mm
Overall depth, D = 530 mm

AREA OF TENSILE REINFORCEMENT:

M_u = $0.87*f_y*A_{st}*d*(1-((f_y*A_{st})/(b*d*f_{ck})))$
By Quadratic Equation A = $f_y/(b*d*f_{ck})$ = 5E-05
B = -1
C = $M_u/(0.87*f_y*d)$ = 623.3
$A_{st\,1}$ = $(-B+sqrt(B^2-4AC)/2B$ = 18555 mm^2

$A_{st\,2}$ = (-B-sqrt(B^2-4AC)/2B = 645 mm^2

Required A_{st} = 644.997034 mm^2

Minimum A_{st} = 0.12%*gross area of footing

= 576 mm^2

Hence, adopt A_{st} = 644.997034 mm^2

Assume 12 mm dia bars

a_{st} = 113.04 mm^2

No. of bars = 5.70591856 Nos.

= 6 Nos.

Spacing = 166.666667 mm

Provide 12 mm dia bars @ 167 mm c/c.

$A_{st\ provided}$ = 678.24 mm^2

% of tensile reinforcement, p_t = $(100*A_{st\ provided})/(b*d)$

= 0.1413 %

CHECK FOR ONE-WAY SHEAR:

Nominal shear stress, τ_v = V_u/bd

V_u = $W_u*((L/2)-(b/2)-d)$

= -207689.27 kN

= -207689274 N

Nominal shear stress, τ_v = -432.68599 N/mm^2

Permissible shear stress, τ_c' = $k*\tau_c$

k = 1

(From I.S. 456-2000, pg.no.: 72, clause 40.2.1)

Interpolation from I.S. 456-2000

τ_c (for f_{ck}=25 N/mm^2)	$(100*A_{st\ provided})/(b*d)$
0.29	0.15
0.28391	0.141
0.36	0.25

τ_c = 0.28391

Permissible Shear stress, τ_c' = 0.28391 N/mm^2

Hence safe agaist one-way shear

CHECK FOR TWO-WAY SHEAR:

Nominal shear stress, τ_v = $V_{uB}/b_o d$

VuB = $W_u*(L_xL_y-(b+d)(D+d))$

= -100002100 kN

= -1E+11 N

b_o = 2(b+d)+2(D+d)

= 3380 mm

Nominal shear stress, τ_v = -61638.375 N/mm^2

Permissible Shear stress, τ_c' = $k_s*\tau_c$

τ_c = $0.25*sqrt(f_{ck})$

= 1.11803399 N/mm^2

k_s = $0.5+\beta_s$

β_s = (Shortdimension/Long dimension) of column

= 0.37735849

k_s = 0.87735849 <1

= 1

Permissible Shear stress, τ_c' = 1.11803399 N/mm^2

Hence safe against two-way shear

CHECK FOR DEVELOPMENT LENGTH:

From I.S. 456-2000, Clause 26.2.1 :

Development Length, L_d = $(\Phi\sigma_s)/(4\tau_{bd})$

= 679.6875 mm

Assume 60 mm side cover

Available Length = 910 mm

Hence O.K.

CHECK FOR BEARING OR TRANSFER OF LOAD ON FOOTING:

Allowable stress, $f_{br\ all}$ = $0.45*f_{ck}*\text{sqrt}(A_1/A_2)$

where A_1 = Area of footing

A_2 = Area of column on footing

A_1 = 4326400 m^2

A_2 = 106000 m^2

$\text{sqrt}(A_1/A_2)$ = 6.38866922 >2

Therefore, keep $\text{sqrt}(A_1/A_2)$ = 2

Allowable stress, $f_{br\ all}$ = 18 N/mm^2

But actual stress, fbr act. = 17.6886792 N/mm^2

Hence safe against bearing

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PROJECT	P.SENTHIL KUMAR- 'ADVIKA' APARTMENT @ VILLANKURICHI, COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF BEAM	STILT LEVEL ROOF BEAM - RB3

DESIGN DATA:

Breadth of the beam, b	=	200 mm	=	0.2 m	
Effective depth of the beam, d	=	497 mm	=	0.497 m	
Width of the supports	=	200 mm	=	0.2 m	
Grade of concrete, f_{ck}	=	25 N/mm^2			
Grade of Steel, f_y	=	500 N/mm^2			
Moment of Resistance, M	=	153 kNm			
Uniformly Distributed Load, W	=	23 kN/m			
Length of the beam,L	=	6.36 m	=	6360 mm	

PRELIMINARY DIMENSIONS OF THE BEAM:

Assume effective cover of the beam,c'	=	33 mm	=	0.033 m	
Therefore,overall depth of the beam, D	=	530 mm	=	0.53 m	
a)Effective Span, L_{eff}	=	L+d	=	6.9 m	
b)Effective Span, L_{eff}	=	L+W	=	6.6 m	
Therefore, adopt Effective Span, L_{eff}	=	***6.56 m (minimum)***			

ULTIMATE MOMENTS:

$x_{u\ lim}/d$	=	0.48	33
Therefore, $x_{u\ lim}$	=	238.56 mm	
M_u'	=	$0.36*f_{ck}*b*x_u*(d-0.42x_u)$	
	=	170391156 Nmm	
	=	170.391156 kNm	
Ultimate moment, M_u	=	1.5*M = 230 kNm	
M_u''	=	M_u-M_u'	
	=	59.1088444 kNm	
	=	59108844.4 Nmm	

TENSILE REINFORCEMENT:

From I.S. 456:2000, pg.no. 96, Annex-G,section G-1.1 a)

$x_{u\ lim}/d$	=	$(0.87*f_y*A_{st})/(0.36*f_{ck}*b*d)$		
Therefore, $A_{st\ 1}$	=	987.144828 mm^2		
M_u''	=	$f_{sc}*A_{st\ 2}*(d-d')$		
where d'	=	distance from top fibre to the centre of compression reinforcement.		
	=	50 mm		
Therefore, $A_{st\ 2}$	=	303.987474 mm^2		
Total A_{st}	=	1291.1323 mm^2		
Assume		20 mm dia bars.		
a_{st}	=	314 mm^2		
Number of bars, n	=	4.11188631 =	5 Nos.	
Spacing	=	40 mm		
Therefore adopt		**5 nos. of 20 mm dia bars @ 40 mm c/c. in tension zone.**		
$A_{st\ provided}$	=	2512 mm^2		

COMPRESSION REINFORCEMENT:

$A_{st\ 2}$	=	$(A_{sc}*f_{sc})/(0.87*f_y)$	(In pg.no. 56 in R.C.C. book)	
ε_{sc}	=	$0.0035*((x_u-d')/x)$	By interpolating:	
f_{sc}	=	353.725 N/mm^2	ε_{sc}	f_{sc}
A_{sc}	=	373.834338 mm^2	0.00276	351.8
Assume		16 mm dia bars.	0.00298	353.725

	a_{st}	=	200.96	mm^2	0.0038	360.9
Number of bars, n		=	1.86024253	=	2 Nos.	
Spacing		=	100	=	100 mm	
	Therefore adopt		2 nos. of		16 mm dia bars @	
			100	mm c/c.	in compression zone.	
$A_{sc\ provided}$		=	401.92	mm^2		

CHECK FOR SHEAR:

From I.S. 456:2000, pg.no. 96, Annex-B-5.1)

Nominal shear stress, τ_v	=	v_u/bd		
where shear force ,v_u	=	109.71	kN	
	=	109710	N	
τ_v	=	0.43	N/mm^2	
% of tensile reinforcement, p_t	=	2.52716298		

FROM IS 456:2000 pg.no.:73 table 19:

p_t	τ_c
1.75	0.49
2.527162978	0.55217304
2	0.51

Design shear stress, τ_c = 0.55217304 N/mm^2

$\tau_v > \tau_c$ hence safe

Hence provide shear reinforcement

v_{us}	=	$v_u-\tau_c bd$		
	=	54824	N	
	=	54.824	kN	
Use		2 legged	8 mm dia bars	
A_{sv}	=	100.48	mm^2	
s_v	=	$(0.87*f_y*Asv*d)/v_{us}$		
	=	396.236568	mm	
	=	390	mm	
s_v	>	0.75d		
	=	372.75	mm	
Adopt		2 legged	8 mm dia bars	
	@	390	mm c/c	near the support &
		350	mm c/c	at mid-span.

CHECK FOR DEFLECTION:

$(l/d)_{act}$	=	12.7967807	
$(l/d)_{max}$	=	$(l/d)_{basic}*k_t*k_c*k_f$	
p_t	=	2.52716298	
p_c	=	0.40434608	
Refering the diagram,			
k_t	=	0.93	
k_c	=	1.1	
k_f	=	1	
Therefore, $(l/d)_{max}$	=	20.46	

Hence safe against deflection

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PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the Thiru. **P.SENTHIL KUMAR** has enrolled as **Structural Engineer Grade –I (SE)** with District Town and country Planning ,Coimbatore who has the qualification of **M.E(Structural Engineering)** and experience in the relevant field for 26 years.

He has been given the Registration No. **Coimbatore LPA/SE/GR-I /050/2024 on 01.07.2024.** He shall be required to comply with the duties and responsibilities prescribed by the government of tamilnadu in part V, "Registration of Professionals " ,Tamil Nadu Combined Development and Building Rules ,2019 approved vide G.O (Ms) No .18 MAWS (MA1) Dept.Dated .04.02.2029

This Registration Certificate is valid upto **30.06.2029**



1/7/24.

JOINT DIRECTOR (I/C)

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