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Official Property Record



STABILITY CERTIFICATE

(To be furnished while filing application for registration of building)

The detailed engineering and structure design of the proposed building comprising of Stilt + 3 floors at Medavakkam Main Road and Manikandan Street, Keelkattalai, Chennai-600 117 in old S.No.251/1 & 251/3F4E has been done by me based on the report of geotechnical investigation (soil test) done by Veltech Consulting Engineers Report No.VCE/19/GIR-044 Dated 01.08.2019 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 have checked various parameters and found that the proposed building would be safe.

3. I further certify that:

(i) The minimum grade of concrete is - **M25 Grade of Concrete**

(ii) The design and analysis have been done using the code of practice for plain and reinforced concrete as per IS Code **456 - 2000** design loads as per IS Codes **875 - 1987** and design of earthquake resistant structure as per IS Code **1893 - 2016**

4. The building will be safe and sound when used for the purpose for which it is designed.

Stamp and Signature.



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M VENKATA SUBBA RAO

Signature, Name and seal

of the Registered Structural Engineer

Encl.: Structural Design Calculation

GSTIN:33AAWFA2842G1ZF

Slab Design

Slab thickness	t	325 mm
Concrete	fck	30 MPa
Steel	fy	500 MPa

Loading

Slab Load

Dead Load	DL	8.125 KN/m
Live Load	LL	4.000 KN/m
Finishes Load	WL	1.500 KN/m
Total Load	Ws	13.625 KN/m
Factored Load	Wsu	20 KN/m

Slab Data

Slab Type	Regular	ly/lx ratio	1.22
Load	20 KN/m	Slab type	+
Longer Span (ly)	16.60 m		
Shorter Span (lx)	13.60 m		

Loading on edges

W_{longer}	108 KN/m	one way	two way
$W_{shorter}$	93 KN/m	$= w \cdot lx / 2$	$= (w \cdot lx / 2) + (1 - (1/3)) \cdot (lx / ly)^2$
			$= w \cdot lx / 3$

Moments

M_x	278 KN-m	one way	two way
M_y	212 KN-m	$= w \cdot lx^2 / 8$	$= \alpha_x \cdot w \cdot lx^2$
			$= \alpha_y \cdot w \cdot lx^2$

Thickness Check	OK	$= M_{ulim} > M_{ux} \text{ or } M_{uy}$
Deflection	258 mm	$= 5 \cdot W \cdot l^4 / (384EI)$

Area of Steel	Astx	Asty	Refer Chart 4 SP 16 pg 21	or
	2412 sqmm	1767 sqmm	Refer Table 5-44 SP 16 pg 51-80	

Spacing required in mm

8#		10#		12#		16#	
x	y	x	y	x	y	x	x
21 c/c	28 c/c	33 c/c	44 c/c	47 c/c	64 c/c	83 c/c	114 c/c

$= ast \text{ of bar} \cdot 1000 / ast \text{ req}$

Final Ast provided	x	y
	16# @ 150mm C/c	12# @ 100mm C/c


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Design Calculations

ONE WAY

a	0.73	$=(0.87435/100) * (fy/fck)^2$
b	-4.350	$=(0.87/100) * (fy)$
cx	2.984	$=Mu/bd^2$
-px	0.791	$=(b \pm \sqrt{b^2 - 4ac})/2a$
Ast	2412	$=(p * b * d)/100$

TWO WAY

a	0.73	$=(0.87435/100) * (fy/fck)^2$
b	-4.350	$=(0.87/100) * (fy)$
cy	2.276	$=Mu/bd^2$
-py	0.579	$=(b \pm \sqrt{b^2 - 4ac})/2a$
Ast	1767	$=(p * b * d)/100$

Min Ast	%	mm ²
	0.12	390

Interpolation						α_y	Table 26 IS 456 pg 91		
ly/lx			α_x					1	0.056
lower value	upper value	exact value	lower value	upper value	interpnt. value			1.1	0.064
1.20	1.30	1.22	0.072	0.079	0.073	0.056		1.2	0.072
								1.3	0.079
								1.4	0.085
								1.5	0.089
								2	0.107

xumax	139	$=(700/(1100 * (0.87 * fy))) * d$
Mulim	#####	$= 0.36 * fck * b * xumax * (d - (0.42 * xumax))$
Mulim/bd ²	3.99	
Mux/bd ²	2.98	
Muy/bd ²	2.28	

E	2.74E+07	
I	2.86E-03	$= bd^3/12$
Defln	257.93	$= 5 * W * l^4 / (384EI)$

Ms

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Column Design

Design Loads

Load	Pu	2202 KN
Moment	Mu	22 KN-m

Column Data

width	b	450 mm
depth	d	450 mm
length	l	3.05 meters

Grade

Concrete	fck	25 MPa
Steel	fy	500 MPa

$Pu/(fckbd)$	0.43
$Mu/(fckbd^2)$	0.01
d'/d	0.05

Minimum eccentricity		
ex	2.11 mm	OK
ey	2.11 mm	OK

Refer Chart 35 of SP 16, Page no: 120

pt/fck	0.05
--------	------

pt	1.25%
Ast	2531 sqmm

Number of bars

dia	nos	ast
25 mm	8	3927 sqmm
25 mm	8	3927 sqmm
-	-	-
Total	16	7854 sqmm

Steel provided OK


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				References
General Data:-				SS-20 Cont-26
Concrete grade	f_{ck}	= 25	N/mm ²	
Steel grade	f_y	= 500	N/mm ²	
Dia. of main reinf. @ Mid span		= 25	mm	
Dia. of main reinf. @ Support		= 25	mm	
Diameter of shear reinforcement		= 8	mm	
Number of legs		= 2		
Effective span of beam	l	= 5.86	m	
Width of beam	b	= 300	mm	
Overall depth of beam	D	= 450	mm	
Clear Cover		= 25	mm	
Effective depth	d	= 392		
Basic l/d ratio		= 26		
STAAD Design Data:-				
Max Mid Span Moment	M_z	= 210	kN.m	
Max Support Moment	M_z	= 346	kN.m	
Max shear	F_y	= 218	kN	
Torsion	M_x	= 0	kN.m	
Axial load	F_x	= 0	kN	
a) Design for Bending:				
Check depth for deflection				Cl. 23.2.1
Basic l/d ratio		= 14.9		IS 456:2000
l/d ratio is Ok				
Design for Max Bending At mid-span:-				
Effective depth	d	= 392	mm	
Moment @ c/s.	M_u	= 210.00	kN.m	
	V_u	= 218.00	kN	
	T	= 0.00		Cl. 41.4.2
Additional equivalent BM due to torsion	M_e	= $M_u + M_t$		IS 456:2000
	M_t	= $[T_u(1 + D/b)]/1.7$		
	M_t	= 0.00		
	M_e	= 210 + 0		
		= 210.00	kN.m	
	M_e/bd^2	= 4.56		
Max moment of resistance of singly reinforced beam		= $0.133 f_{ck} b x d^2$		
	M_{u1}	= 159.04	kN.m	
This is a doubly reinforced beam				
Percentage of reinf. steel required should be maximum of the following				
1)	A_s/bd	= $0.85/f_y$		Cl. 26.5.1.1
	A_s	= 199.92	mm ²	
	p_t	= 0.17	%	
2)	p_t	= $(0.5 f_{ck}/f_y) * [1 - (1 - (4.6 M_u/f_{ck} b d^2)^{0.5})] * 100$		IS 13920:1993
		= 1.49		
	p_t	= 1.49	%	Cl. 6.2.2
% of rein. < 2.5 % Hence Ok				


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Required % of reinforcement	$P_t (req)$	= 1.49	%	
Required area of reinforcement	$A_{s_t (req)}$	= 1757.38	mm	
Diameter of bar		= 20	mm	
Required Number of bars		= 6		
		~ 3		
	Astprov	= 1472.621556		
	NOT OK			
Provide 3 bars of 20 mm diameter @ Mid Span on Tension zone				
Design for Max Bending At Support:-				
a) Design for Bending				
Check depth for deflection				
Basic l/d ratio		= 14.9		CI. 23.2.1 IS 456:2000
l/d ratio is Ok				
Effective depth	d	= 392	mm	
	Mu	= 346.00	kN.m	
	Vu	= 218.00	kN	
	T	= 0.00		
Additional equivalent BM due to torsion	Me	= Mu+Mt		CI.41.4.2 IS 456:2000
where	Mu	= Moment @ c/s.		
	Mt	= $[Tu(1+D/b)]/1.7$		
	Mt	= 0.00		
	Me	= 346 + 0		
		= 346.00	kN.m	
	Me/bd^2	= 7.51	N/mm ²	
Max moment of resistance of singly reinforced beam		= 0.133 f _{ck} bx _d ²		
	Mu ₂	= 153.28	kN.m	
This is a doubly reinforced beam				
Percentage of reinforcement				
1)	As/bd	= 0.85/f _y		CI. 26.5.1.1
	As	= 199.92	mm ²	
	p _t	= 0.17	%	
2)	p _t	= $(0.5 f_{ck}/f_y) * [1 - (4.6 M_u / f_{ck} b d^2)^{0.5}] * 100$		
		= 0.96		
		= 0.96	%	
% of rein. < 2.5 % Hence Ok				
Required % of reinforcement	$P_t (req)$	= 0.96	%	
Required area of reinforcement	$A_{s_t (req)}$	= 1125.23	mm	
Diameter of bar		= 25	mm	
Required Number of bars		= 2.292		
		~ 3		
	Astprov	= 2945.243113		
	OK			
Provide 3 bars of 25 mm diameter @ Support on Tension zone				


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b) Design for Shear:-		V_u	= 346	kN
		V_u	= $V_u/2 + 1.4(\mu_1 + \mu_2)/L$	
			= 247.62	kN
Check for maximum shear:-				
Design Shear stress	τ_v	=	346000	
			392 x 300	
	τ_v	=	2.94	N/mm ²
	$\tau_{c \text{ max}}$	=	3.10	
Actual shear stress < maximum shear stress, Hence Ok				
	100A _s /bd	=	2.50	%
Shear strength of concrete	τ_c	=	1.532	N/mm ²
	2.94	>	1.532	
	τ_v	>	τ_c	
Design for shear reinforcement				
Shear reinforcement				
As per IS 456 2000				
	V_{us}	=	$V_u - \tau_c \times b \times d$	
		=	332.218128	kN
	$V_{us} = \frac{0.87 f_y A_{sv} d}{S_v}$			
	$S_v = \frac{0.87 f_y A_{sv} d}{V_{us}}$			
Diameter of shear reinforcement		=	8	mm
No. of legs		=	2	
Area of one bar		=	100.53	
	A _{sv}	=	100.5309649	
	S_v	=	$0.87 f_y A_{sv} d / V_{us}$	
	S_v	=	51.6	
		~	125.0	
Provide 2 L Stirrups of 8 mm dia. @ 125 mm c/c.in remaining span of beam				
OR				
minimum shear reinforcement				
Diameter of shear reinforcement		=	8	mm
No. of legs		=	2	
Area of one bar		=	100.57	
	A _{sv}	=	100.5714286	
Minimum spacing of shear reinforcement	S_v	=	$0.87 f_y A_{sv} / 0.4 b$	
	S_v	=	364.6	
		~	300	
Provide 2 L Stirrups of 8 mm dia. @ 300 mm c/c.in remaining span of beam				

Table 20
IS 456:2000

Table 20
IS 456:2000

Table 19
IS 456:2000

(Which ever is less)


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