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20-Sep-23

STRUCTURAL STABILITY CERTIFICATE

It is certified that the

PLAN SHOWING THE PROPOSED CONSTRUCTION OF STILT FLOOR + 5 FLOORS RESIDENTIAL BUILDING WITH 20 DWELLING UNITS (HEIGHT 18.30M) AVAILING PREMIUM FSI AT OLD DOOR NO.37/50, 54/56, BRINDAVAN STREET EXTENSION, WEST MAMBALAM, CHENNAI COMPRISED IN T.S.NO.16/3 AND 16/4, BLOCK NO.46, PULIYUR VILLAGE WITHIN IN LIMIT OF GREATER CHENNAI CORPORATION.ZONE:- X ; DIVISION:- 133.

is designed to resist for earthquake. Check has been made and found safe and I hereby certify that

1. The minimum grade of concrete is M25
2. The design analysis using the code of practice for loading . standards as per BIS-875 and Seismic forces as per the latest code BIS-1893 & BIS-456
3. Least dimension of column is 300mm in stilt floor.
4. Proposed structure will be structurally safe and sound.

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TYPICAL STRUCTURAL DESIGN CALCULATION

1 **General:**

All residential buildings are S + 5 FLOORS. Stilt is used as car park.

Upper floors are for Residential use. One typical design calculation is given.

2 **Design Basis:**

Latest Design codes of BIS-456, 875 and 1893 are followed with SP-16 Design Aid book. A typical 2-D Frame was taken for analysis to arrive at the bending moment for column design. Since the building is 6 stories, wind force is taken into account. Also a live load reduction factor of 0.2 is taken for foundation and column design.

Pile foundation is proposed as per as per soil report.

Fe- 500 steel is used as main steel and minimum M25 concrete is provided

3 **Earthquake consideration:**

For better stability during earhquake, the columns are braced in both direction with beams. Continuous lintels are specified for outer walls and column ties are closely spaced for better ductility. For building on stilt, minimum size is taken as 300 mm(12")

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EARTHQUAKE LOAD

Design horizontal Seismic coeff. Ag = $\frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g}$

Z = Zone Factor = 0.16 for Chennai

I = Importance Factor = 1.0

R = Response reduction Factor = 5

$\frac{Sa}{g}$ = Avg. response acc.coeff. Depends on Ta

Ta = Fundamental natural period

= $\frac{0.09\ h}{\sqrt{d}}$ for infill walls

h = height of the building

d = Width of the building

= 0.075 h for office building

W = seismic weight of building

= 100% D.L + 25% L.L for residential <=300

= 100% D.L + 50% L.L for residential >300

Base Seismic Shear Vb = Ag x W

4 **WIND LOAD**

Vz = Vb x K1 x K2 x k3

Vb = 50 m/sec in Chennai

K1 = Probability Factor = 1

K2 = Terrain, Height Factor = 1

K3 = Topography Factor = 1

p = 0.6 x Vz x Vz

= 0.6 x 50 x 50

= 1500 N/Sq.m

150 Kg/Sq.m

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5 **Design Loads:**

Slab130 mm thk avg	=	3.3	KN/sq.m
Live load	=	2.0	KN/sq.m
Finishes	=	1.3	KN/sq.m
		6.6	KN/sq.m

Say 7.5 KN/sq.m/floor for slab and beam design

Applying live load reduction of = 0.2 ,

For column and foundation design, 5.28 Kn/sqm is taken.

This value is also taken for frame analysis

200 thick AAC blocks for exterior walls

0.2 x 2.55 x 8 = 4 KN/m/floor

B.W. 100 thk for interior panels

0.100 X 2.55 x 8 = 2.04 KN/m/floor

Beams 0.2 x 0.35 x 25 .= 1.75 KN/m/floor

Columns 0.3 x 0.45 x 3.00 x 25 .= 10.1 KN/floor

These are taken for analysis with WL+LL+DL combination.

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6 **SLAB DESIGN:**

Thickness	=	130 mm		Fck	= M 30	N/sq.mm
Cover	=	20 mm		Fy	=Fe 415	N/sq.mm
Eff.Depth	=	105 mm				

Panel (3.4 x 5.9) m

Twoway slab Ly / Lx = 5.9 / 3.4 .= 1.7

Support condition - 1 sides discontinuous

short span=	α x	= 0.070	(- BM at continuous edge)	Table:26
		= 0.049	(+ BM at midspan)	in IS-456-2000
Long span	α y	= 0.055	(- BM at support)	
		0.042	+BM AT MIDSPAN	

Designed for 0.070 co.efficient

Mu .= 0.070 x 6.6 1.5 x 3.4 x 3.4 = 8.01 KNm/m

$$\text{Mu / b.d.d} = \frac{8.01 \times 1000 \times 1000}{1000 \times 105 \times 105} = 0.73 \text{ N/sq.mm}$$

From Table-3of SP-16, Pt 0.200 %

Minimum Pt = 0.12 % as per code, for Fe-415

At = 0.200 x 1000 105 ./ 100 = **210** sq.mm/m

Provide 10 dia @ 175 = **448.8** sq.mm/m Short span

Provide 8 dia @ 175 = **287.2** sq.mm/m Long span

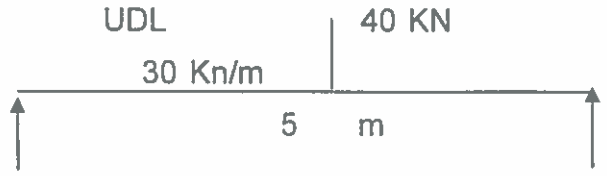
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8 **Beam design:** Beam-1

span = 5 m Beam size 200 x 600

d = 560 mm

Fck = M 30



Bending moment for UDL 98.00 Kn.m

Max. B.M = 98.00 (top of support) This is taken for design

Mu = 98 x 1.5 x 10-e6 = **147.0** x **10-e6 =** Nmm

$$Mu/b.d.d = \frac{147.0 \times 10\text{-e6}}{200 \times 560 \times 560} = 2.34 \text{ N/sq.mm}$$

From table-53 SP-16 for d'/d = 40 / 600 = 0.00

Pt = **1.000** % Pc = 0.30 %

At = 1.000 x 200 x 560 / 100 = **1120** sq.mm (top)

Ac = 0.300 x 200 x 560 / 100 = **336** sq.mm (bot)

provided 4 No 20 = **1257** sq.mm +

2 No 20 = **628**

1885 sq.mm at support top

Shear Design:

Shear force p/2 = 95 KN

Factored shear force = 1.5 x 95 = 143 KN

for 1.00 % steel Shear resisted by concrete section

from table-61 0.65 x 200 x 560 / 1000 = 73 KN

Balance shear (Vus) = 143 - 73 = 70 KN

Vus/d = 70 / 56 = 1.24 KN/cm

from table 62 of SP-16

Required 2 legged	8 stirrups	@	150	mm c/c
Provided 2 legged	**8** stirrups	@	**100**	mm c/c

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9 **COLUMN DESIGN:** COL-A COL SIZE 600 X 750

Maximum load is with wind force P = 223 t

Pu = 1.5 x 223 x10 = 3345 KN

Max.Bending Moment = 12 t.m Mu = 1.5 x 12.0 x10= 180 Kn.m

Cover = 40 mm

d'/d = 0.05

Fck = 35 N/sq.mm

Provide bars equaly all sides

Refer chart 44 of SP-16

$$\frac{Pu}{Fck\ b\ d} = \frac{3345 \times 1000}{35 \times 600 \times 750} = 0.21$$

$$\frac{Mu}{Fck\ b\ d^2} = \frac{180 \times 10^6}{35 \times 600 \times 750} = 0.02$$

$$\frac{p}{Fck} = 0.04 \qquad p\% = 0.04 \times 35 \times 750 = 1.23\ \%$$

Minimum %age of steel is 0.8 %

$$As = \frac{1.225 \times 600 \times 750}{100} = 5513 \text{ sq.mm}$$

Provided 8 Nos 25 dia = 3927 sq.mm

\+ 8 Nos 20 dia = 2513 sq.mm

6440 SQ MM

Ties 8 @ 110 & 175c/c

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10 **Pile cap and pile**

As per soil report, 20.5 m bored cast-in-situ pile can be adopted.

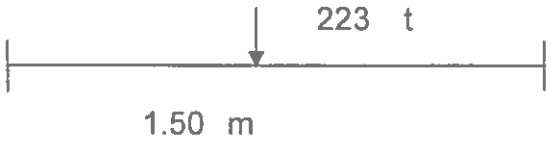
600 dia pile safe capacity = 100 t

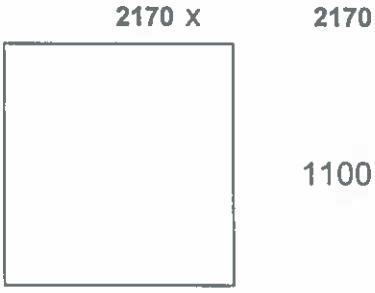
Col-A carries maximum load of = 223 t

So No of piles provided = 3 Nos

Pile cap size = 2170 x 2170 X 1100 MM

M-30 grade = 25 N/sq.mm





Section of pile cap

Pile to pile distance = 1.50 m

axial force = 223 x 1.50 / / 1.02

= 36.4 tonnes

At reqd = 36.44 /2.5 '= 15 sqcm

Provided bttom bothways = **11 nos** 16

= 22.117 sqcm

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