DESIGN CALCULATION OF (G+III) STORIED RESIDENTIAL BUILDING AT PRE. NO. –31A, PANCH MASJID ROAD, IN WARD NO. – 125, BOROUGH NO. – XVI, UNDER K.M.C.

PRANAB KUMAR DAS B.E.(CIVIL)
K.M.C. E.S.E.No.-I/131

Relevant codes used are :-

(1) I.S. – 456- 2000
(2) S.P.- 16- 1980

Assumption taken in design :-

(1) Grade of conc. Used – M20
(2) Grade of steel used – Fe- 500
(3) Bearing capacity of soil – As per soil report
(4) Design based on:-
   (a) Working stress method for slab, footing, & column.
   (b) Limit stress method for beam.

(5) Calculation of loading :-

(A) Roof load :-

(a) D.L. of roof slab = 0.11x2500 = 275 Kg/sq m
(b) D.L. of C.P. = 30 Kg/sq m
(c) D.L. of roof treatment = 160 Kg/sq m
(d) Live load = 150 Kg/sq m

Total = 615 Kg/sq m

(B) Floor load :-

(a) D.L. of floor slab = 275 Kg/sq m
(b) D.L. of C.P. = 30Kg/sq m
(c) D.L. of F.F. = 120 Kg/sq m
(d) Live Load = 200 Kg/sq m

Total = 625 Kg/sq m

Design of R.C.C. slab :-

Max. shorter span = 3700 mm.
Span to eff. Depth ratio = 26
Using 0.2% steel, 'd' reqd. = 3700/(26 x 1.6) = 89 mm.
'D' reqd. = (89+19) = 108 mm.
Let us provide overall depth = 110 mm.
'd' = (110-19) = 91 mm.

Panel Mkd.	Dimensions	Ly/Lx	End conditions	Moment co-efficient			
				αx	αy	$\alpha x'$	$\alpha y'$
P1	4150X3700	1.12	Two adjacent edges discont.	0.045	0.035	0.060	0.047
P2	4575X2988	1.53	One short edge discont.	0.044	0.028	0.057	0.037

W = 0.625 t/sq m.

Panel	$M = (Lx)^2 .W.\alpha$				Ast = $[M/(\sigma st.\ j.d)]x10^7$ in sq m			
Mkd.	Mx	My	Mx'	My'	Astx	Asty	Astx'	Asty'
P1	0.385	0.299	0.513	0.402	200	156	267	209
P2	0.246	0.157	0.319	0.207	128	082	166	108

Spacing reqd. (mm.)				Spacing providing (mm.)			
Sx	Sy	Sx'	Sy'	Sx1	Sy1	Sx1'	Sy1'
250	320	187	239	250	300	180	230
390	609	301	462	270	270	270	270

Spacing = (Area of each bar x 1000)/ Ast
Max. spacing = 3d = 3x91 = 273 mm say 270 mm.

Load chart : -

Col. Mkd.	Load in ‘t’	Group
C01	30.39	III
C02	39.56	II
C03	43.27	II
C04	44.97	I
C05	33.79	III
C06	28.16	III
C07	30.51	III
C08	37.43	II
C09	32.97	III
C10	30.59	III
C11	28.42	III
C12	53.62	I
C13	54.14	I
C14	51.14	I
C15	36.00	II
C16	47.62	I
C17	55.46	I
C18	52.24	I
C19	29.31	III
C20	28.55	III
C21	50.88	I
C22	55.91	I

<u>Design of R.C.C. column (Gr.- I)</u>

P = 55.46 t.
Considering col. Size = 250x350 mm.
L = 3.4 m.
Leff = 0.65x3.4 = 2.21 m.
Leff/b = 8.84 [Hence short col.]
Now, $55.46 \times 10^4 = 5(250 \times 350 - Asc) + 190Asc$
Asc = 633 sq mm.
As per I.S. Code, minimum reinforcement = 0.8% = 700 sq mm.
Considering seismic & wind load, let us provide column size 250x400 with 10-16 tor. as longitudinal bars with 8 tor.-4L-lateral ties @ 175 mm c/c.

<u>Design of R.C.C. column (Gr.- II)</u>

P = 43.27 t.

Considering col. Size = 250x350 mm.
Now, $43.27 \times 10^4 = 5(250 \times 350 - Asc) + 190Asc$
Asc = -(25) sq mm.
As per I.S. Code, minimum reinforcement = 0.8% = 700 sq mm.
Considering seismic & wind load, let us provide column size 250x400 with 8-16 tor. as longitudinal bars with 8 tor.-4L-lateral ties @ 175 mm c/c.

DESIGN OF R.C.C. COMBINED STRIP-FOOTING [C1 TO C22]

P = 894.91 t.
Providing 500 mm thk. Sand cussan under foundation (Below 1500 mm)
Area of footing reqd. = (894.91X1.1)/6.5 = 151.45 sq m.
Considering 1.65 m wide footing.
Area of footing provided = 152.228 sq m.
Let us provide 450 mm wide rib beam.
Net upward soil pressure = 5.52 t/sq m.

Design of footing slab.

Considering 1m wide footing.
B.M. at the face of the rib beam = 1.36 t-m.
'd' reqd. = $[(1.36 \times 10^7)/(0.914 \times 1000)]^{0.5}$ = 122 mm.
Let us provide overall depth = 400 mm.
'd' = 344 mm.
Ast = $[1.36 \times 10^7] / [0.92 \times 230 \times 344]$ = 187 sq mm.
Spacing = [113x1000]/187 = 604 mm c/c.
Let us provide 12 tor. @ 175 mm c/c, along the shorter direction & 10 tor @ 175 mm c/c along longer direction.

DESIGN OF RIB BEAM [RB1]:-

Design moment, M = 14.44×10^7 N-mm.
Mu = 21.66×10^7 N-mm.
Considering beam size = 400x600 mm.
'd' = (600-50-16-8) = 526 mm.
Mu,lim. = $2.07 \times 400 \times 526^2 = 22.91 \times 10^7$ N-mm > Mu.
Mu/(b.d^2) = 1.96 N/sq mm. Pt = 0.531
Ast = (400x526x0.531)/100 = 1118 sq mm.
Let us provide (4-16 tor. + 2-16 tor.) at bottom & 4-16 tor. at top for supports and
(4-16 tor. + 2-12 tor.) at top & 4-16 tor. at bottom for span.

DESIGN OF SHEAR REINFORCEMENT :~

Design shear force, V = 208 Kn.

Vu = 312 Kn.
100Ast/(b.d) = 0.573
τc = 0.5 N/sq mm.
Vus = 312 - (0.5x400x526) /1000 = 206.8 Kn.
Vus/d = 3.932 Kn/cm.
Let us provide 8 tor.–4L- vertical stirrups @ 175 c/c, throughout the length.

<u>DESIGN OF RIB BEAM [RB2]</u>:-

Design moment, M = 10.59 x 10^7 N-mm.
Mu = 15.89 x 10^7 N-mm.
Considering beam size = 400x550 mm.
'd' = (550-50-16-8) = 476 mm.
Mu,lim. = 2.07x400x476^2 = 18.76x 10^7 N-mm > Mu.
Mu/(b.d^2) = 1.76 N/sq mm. Pt = 0.469
Ast = (400x476x0.469)/100 = 893 sq mm.
Let us provide (3-16 tor. + 2-16 tor.) at bottom & 3-16 tor. at top for supports and (3-16 tor. + 2-12 tor.) at top & 3-16 tor. at bottom for span.

<u>DESIGN OF SHEAR REINFORCEMENT</u> :~

Design shear force, V = 178 Kn.
Vu = 267 Kn.
100Ast/(b.d) = 0.528
τc = 0.48 N/sq mm.
Vus = 267 - (0.48x400x476) /1000 = 175.61 Kn.
Vus/d = 3.689 Kn/cm.
Let us provide 8 tor.–4L- vertical stirrups @ 175 c/c, throughout the length.

<u>DESIGN OF R.C.C. BEAM [B1]</u>:-

Design moment, M = 6.25 x 10^7 N-mm.
Mu = 9.38 x 10^7 N-mm.
Considering beam size = 250x400 mm.
'd' = (400-25-8) = 367 mm.
Mu,lim. = 2.07x250x367^2 = 6.97x 10^7 N-mm < Mu (Double reinforced).
Mu/(b.d^2) = 2.79 N/sq mm. d'/d = 0.1
Pt = 0.968 Pc = 0.012
Ast = (250x367x0.968)/100 = 889 sq mm.
Asc = (250x367x0.012)/100 = 11 sq mm.
Let us provide 5-16 tor. at top & 2-16 tor at bottom for supports & 2- 16 tor. at top and 4–16 tor. at bottom for span.

DESIGN OF SHEAR REINFORCEMENT :~

Design shear force, V = 76.8 Kn.
Vu = 115.2 Kn.
100Ast/(b.d) = 1.095
τc = 0.62 N/sq mm.
Vus = 115.2 - (0.62x250x367) /1000 = 58.32 Kn.
Vus/d = 1.589 Kn/cm.
Let us provide 8 tor.–2L- vertical stirrups @ 175 c/c throughout the span.

DESIGN OF R.C.C. BEAM [B2]:-

Design moment, M = 5.03 x 10^7 N-mm.
Mu = 7.55 x 10^7 N-mm.
Considering beam size = 250x350 mm.
'd' = (350-25-8) = 317 mm.
Mu,lim. = 2.07x250x317^2 = 5.2x 10^7 N-mm < Mu (Double reinforced).
Mu/(b.d^2) = 3 N/sq mm. d'/d = 0.1
Pt = 1.003 Pc = 0.299
Ast = (250x317x1.003)/100 = 795 sq mm.
Asc = (250x317x0.299)/100 = 237 sq mm.
Let us provide 4-16 tor. at top & 2-16 tor at bottom for supports & 2- 16 tor. at top and 4–16 tor. at bottom for span.

DESIGN OF SHEAR REINFORCEMENT :~

Design shear force, V = 45.1 Kn.
Vu = 67.65 Kn.
100Ast/(b.d) = 1.014
τc = 0.6 N/sq mm.
Vus = 67.65 - (0.6x250x317) /1000 = 20.1 Kn.
Vus/d = 0.634 Kn/cm.
Let us provide 8 tor.–2L- vertical stirrups @ 175 c/c throughout the span.