PROJECT	DAC-BROOKLEYN APARTMENT,COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF SLAB	3M X 4.5M

DESIGN DATAS:

Length of the slab in x-direction, L_x	=	3 m	=	3000 mm
Length of the slab in x-direction, L_y	=	5 m	=	5000 mm
Thickness of the supporting wall, t	=	230 mm	=	0.23 m
Live load on the slab	=	3 kN/m^2		
Floor Finish	=	1 kN/m^2		
Grade of concrete, f_{ck}	=	20 N/mm^2		
Grade of steel, f_y	=	415 N/mm^2		

TYPE OF SLAB:

L_y/L_x = 1.6666667 <2

Hence the given slab is a two-way slab

LOAD CALCULATION:

Assume overall depth, D	=	125 mm	=	0.125 m
Unit weight of concrete	=	25 kN/m^3		
Self-weight of the slab	=	3.125 kN/m^2		
Live load on the slab	=	3 kN/m^2		
Floor Finish	=	1 kN/m^2		
Total load, W	=	7.125 kN/m^2		
Factored load, W_u	=	***10.6875 kN/m^2***		

EFFECTIVE SPAN:

L_{eff} = L_x+d

Effective cover to the slab, c'	=	25 mm	=	0.025 m
Effective Depth of the slab, d	=	100 mm	=	0.1 m
L_{eff}	=	3.1 m		

(OR)

L_{eff} = L_x+t = 3.2 m

whichever is smaller

Required L_{eff} = 3.1 m

BENDING MOMENT:

Bending Moment, M = $(W_u*L_{eff}^2)/8$

= 12.838359 kNm

= 12838359 Nmm

CHECK FOR EFFECTIVE DEPTH:

$M_{u\,lim}$ = $0.138*f_{ck}*b*d^2$

Consider 1 m width of the slab

= 1000 mm width of the slab

Effective depth, d = 68.202489 mm

Slab Depth is correct

AREA OF STEEL REINFORCEMENT:

M_u = $0.87*f_y*A_{st}*d*(1-((f_y*A_{st})/(b*d*f_{ck})))$

By Quadratic Equation A = $f_y/(b*d*f_{ck})$ = 0.0002

B = -1

C = $M_u/(0.87*f_y*d)$ = 355.58

$A_{st\,1}$ = $(-B+sqrt(B^2-4AC)/2B$ = 4432.7 mm^2

$A_{st\,2}$ = $(-B-sqrt(B^2-4AC)/2B$ = 386.6 mm^2

Required A_{st} = 386.59623 mm^2

Assume 10 mm dia bars

a_{st} = 78.5 mm^2

No. of bars = 4.9247927 Nos.

= 5 Nos.

Spacing = 200 mm

(OR)

= 3d = 300 mm

(OR)

= 300 mm

Whichever is smaller

Required Spacing = 200 mm

Provide ***10 mm dia bars @ 200 mm c/c.***

CRANK DISTANCE:

$L_{eff}/4$ = 0.775 m

= 775 m

DISTRIBUTORY REINFORCEMENT:

$A_{st\,D}$ = 0.12%*c/s area = 150 mm^2

Assume 8 mm dia bars

a_{st} = 50.24 mm^2

No. of bars = 2.9856688 Nos.

= 3 Nos.

Spacing = 333.33333 mm

= 334 mm

(OR)

= 5d

= 500 mm

(OR)

= 300 mm

Whichever is smaller

Required Spacing = 300 mm

Provide ***8 mm dia bars @ 300 mm c/c.***

CHECK FOR SHEAR STRESS:

Nominal shear stress, τ_v = $V_u/b*d$

V_u = $(W_u*L_{eff})/2$

= 16.565625 kN

τ_v = 0.1656563 N/mm^2

$A_{st\,provided}$ = 392.5 mm^2

$(100*A_{st\,provided})/(b*d)$ = 0.3925 %

Interpolation from I.S. 456-2000

τ_c (for f_{ck}=20 N/mm^2)	(100*$A_{st\ provided}$)/(b*d)
0.36	0.25
0.4284	0.393
0.48	0.5

Permissible Shear stress, τ_c = 0.4284 N/mm^2

Hence safe agaist shear

CHECK FOR DEFLECTION:

From I.S. 456-2000, pg.no.: 38, fig. 4:

Steel Stress of service, f_s = $0.58*f_y*(A_{st\ required}/A_{st\ provided})$

= 237.07952 N/mm^2

p_t = 0.3925 %

Modification factor, M = 1.4

Allowable deflection, $\delta_{all.}$ = $k_f*k_c*k_t*M$

kf = 1

kc = 1

kt = $L_{eff.}/d$ = 31

$\delta_{all.}$ = 43.4 mm

But actual deflection, $\delta_{act.}$ = L_x/D = 24 mm

Hene safe against deflection

P. Senthilkumar

P.SENTHILKUMAR,M.E.,(Struct),AIV.,
Chartered Engineer, Approved Valuer and
Structural Consultant
30-A, 1st Floor, Kalidas Roa[illegible]
[illegible]

PROJECT	DAC-BROOKLEYN APARTMENT-COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF BEAM	B109

DESIGN DATA:

Breadth of the beam, b	=	230 mm	=	0.23 m
Effective depth of the beam, d	=	417 mm	=	0.417 m
Width of the supports	=	230 mm	=	0.23 m
Grade of concrete, f_{ck}	=	20 N/mm^2		
Grade of concrete, f_y	=	500 N/mm^2		
Moment of Resistance, M	=	82 kNm		
Uniformly Distributed Load, W	=	28 kN/m		
Length of the beam,L	=	4.5 m	=	4500 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	=	450 mm	=	0.45 m
a)Effective Span, $L_{eff.}$	=	L+d	=	4.9 m
b)Effective Span, $L_{eff.}$	=	L+W	=	4.7 m
Therefore, adopt Effective Span, $L_{eff.}$	=	***4.73 m (minimum)***		

ULTIMATE MOMENTS:

$x_{u\,lim.}/d$ = 0.48 33

Therefore, $x_{u\,lim.}$ = 200.16 mm

M_u' = $0.36*f_{ck}*b*x_u*(d-0.42x_u)$

= 110355557 Nmm

= 110.355557 kNm

Ultimate moment, M_u = 1.5*M = 123 kNm

M_u'' = M_u-M_u'

= 12.6444428 kNm

= 12644442.8 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, $A_{st\,1}$ = 761.988414 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, $A_{st\,2}$ = 79.2035 mm^2

Total A_{st} = 841.191914 mm^2

Assume 16 mm dia bars.

a_{st} = 200.96 mm^2

Number of bars, n = 4.18586741 = 4 Nos.

Spacing = 57.5 mm

Therefore adopt 4 nos. of 16 mm dia bars @ 57.5 mm c/c. in tension zone.

$A_{st\,provided}$ = 1607.68 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} =	97.4020002 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 = 0.48468352 = 1 Nos.

Spacing = 230 = 230 mm

Therefore adopt 2 nos. of 16 mm dia bars @ 230 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 = 94.5 kN

= 94500 N

τ_v = 0.98529872 N/mm^2

% of tensile reinforcement, p_t = 1.67623814

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

p_t	τ_c
1	0.62
1.67623814	0.75524763
1.25	0.67

Design shear stress, τ_c = 0.75524763 N/mm^2

$\tau_v > \tau_c$ **Hence not safe**

Hence provide shear reinforcement

V_{us} = $v_u - \tau_c bd$

= 22064.2 N

= 22.0642 kN

Use 2 legged 8 mm dia bars

A_{sv} = 100.48 mm^2

s_v = $(0.87 * f_y * Asv * d)/v_{us}$

= 826.069814 mm

= 820 mm

\> 0.75d

s_v = 312.75 mm

Adopt **2 legged 8 mm dia bars @ 820 mm c/c near the support & 350 mm c/c at mid-span.**

CHECK FOR DEFLECTION:

$(l/d)_{act}$ = 10.7913669

$(l/d)_{max}$ = $(l/d)_{basic} * k_t * k_c * k_f$

p_t = 1.67623814

p_c = 0.41905953

Refering the diagram,

k_t = 0.93

k_c = 1.1

k_f = 1

Therefore, $(l/d)_{max}$ = 20.46

Hence safe against deflection

P. Senthilkumar

P.SENTHILKUMAR,M.E.,(Struct),AIV.,
Chartered Engineer, Approved Valuer and
Structural Consultant
30-A, 1st Floor, Kalidas Road,
Ramnagar, Coimbatore - 641 009.

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

THE DESIGN ONE
Civil and Structural Engineering Consultancy

STABILITY CERTIFICATE

1. The detailed engineering and structure design of the proposed building comprising of Stilt +3 floors at TS.No: 1594 &1595, SITE No: 111 & 112, WARD NO. : H, BLOCK No:40, RANGASAMY ROAD, ANUPARPALAYAM VILLAGE, RS PURAM, COIMBATORE DISTRICT, has been done by me/us based on the report of geotechnical investigation (soil test) done by GEODESIGN INDIA PRIVATE LIMITED 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 as per IS 456, design loads as per IS Codes No IS 456-2000 & IS 875-1987.

4. The building will be **SAFE AND SOUND** when used for the purpose for which it is Designed.

Thanks &with regards

P. Senthil Kumar
Structural Consultant

P. SENTHIL KUMAR M.E. (STRUCT).AIV
Reg No: Coimbatore LPA/SE/GR-I/1[illegible]3 050/24
30-A, 1st Floor, Kalidas Street,
Ram Nagar, Coimbatore - 641 009.
Cell: 97866 00478

PROJECT	DAC Developer- BROOKLEYN APARTMENT , COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF COLUMN	C2

DESIGN DATA:

Axial Load, P	=	700 kN
Breadth of the column, b	=	200 mm
	=	0.2 m
Depth of the column, D	=	450 mm
	=	0.45 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	=	5.6666667
		<12
Hence, short column		
L_{ey}/b	=	12.75
		>12
Hence, long column		

CHECK FOR MINIMUM ECCENTRIES:

$e_{ex,\,min}$	=	$(L_{ex}/500)+(D/30)$
	=	20.1 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	=	1050 kN
	=	1050000 N
M_{ux}/P_u	=	21.214286 mm
		>20 mm
M_{uy}/P_u	=	29.757143 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		
$M_u/f_{ck}bD^2$	=	0.0694333
	=	0.07
$P_u/f_{ck}bD$	=	0.4666667
	=	0.47
Effective cover, d'	=	50 mm
Therefore, d'/D	=	0.25
	=	0.2
From Interaction chart of SP 16		
p/f_{ck}	=	0.06
p	=	1.5 %
0.8%<p<4%		
Hence O.K.		
A_s	=	1350 mm^2
Assume		20 mm dia bars
No. of bars, N	=	4.2993631
	=	6 Nos.
$A_{s\ provided}$	=	1884 mm^2
Actual p	=	2.0933333 %
0.8%<p<4%		
Hence O.K.		

Hence, provide ***6 #*** ***20 mm dia***
bars uniformly distributed on four sides
But Provided , 4 Nos-20mm and 4 Nos-16mmdia

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***

P.SENTHILKUMAR,M.E.,(Struct),AIV.,
Chartered Engineer, Approved Valuer and
Structural Consultant
30-A, 1st Floor, Kalidas Road,
Ramnagar, Coimbatore - 641 009.