PROJECT	NIVASAN VAKULAM APARTMENT-AT VILANKURICHI,COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF COLUMN	C1

DESIGN DATA:

Axial Load, P	=	810 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	=	35.7 kNm
Bending Moment about y-y axis, M_y	=	35.7 kNm
Effective length factor	=	0.85
Grade of concrete, f_{ck}	=	20 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}	=	53.55 kNm
Factored Bending moment in y-y axis, M_{uy}	=	53.55 kNm
Factored Load, P_u	=	1215 kN
	=	1215000 N
M_{ux}/P_u	=	44.074074 mm
		>20 mm
M_{uy}/P_u	=	44.074074 mm
		>20 mm

Hence, design for uniaxial moment

LONGITUDINAL REINFORCEMENT:

Hence, Factored Bending Moment, M_u	=	53.55 kNm
	=	53550000 Nmm

Governing Axis for Bending is y-y axis

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$M_u/f_{ck}bD^2$	=	0.14875	
	=	0.149	
$P_u/f_{ck}bD$	=	0.675	
	=	0.68	
Effective cover, d'	=	50	
Therefore, d'/D	=	0.25	
	=	0.2	
From Interaction chart of SP 16			
p/f_{ck}	=	0.1	
p	=	2	%
0.8%<p<4%			
Hence O.K.			
A_s	=	1800	mm^2
Assume		20 mm dia bars	
No. of bars, N	=	5.7324841	
	=	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***

But Provided 4Nos 20# and 4 Nos-16# 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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PROJECT	NIVASAN VAKULAM APARTMENT- AT VILANKURICHI ,COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF BEAM	Beam -B1

DESIGN DATA:

Breadth of the beam, b	=	200 mm	=		0.2 m
Effective depth of the beam, d	=	480 mm	=		0.48 m
Width of the supports	=	200 mm	=		0.2 m
Grade of concrete, f_{ck}	=	20 N/mm^2			
Grade of steel, f_y	=	500 N/mm^2			
Moment of Resistance, M	=	97 kNm			
Uniformly Distributed Load, W	=	58.1 kN/m			
Length of the beam,L	=	5.1 m	=		5100 mm

PRELIMINARY DIMENSIONS OF THE BEAM:

Assume effective cover of the beam,c'	=	30 mm	=		0.03 m
Therefore,overall depth of the beam, D	=	510 mm	=		0.51 m
a)Effective Span, $L_{eff.}$	=	L+d	=	5.58 m	
b)Effective Span, $L_{eff.}$	=	L+W	=	5.3 m	
Therefore, adopt Effective Span, $L_{eff.}$	=	***5.3 m (minimum)***			

ULTIMATE MOMENTS:

$x_{u\ lim.}/d$	=	0.48			33
Therefore, $x_{u\ lim.}$	=	230.4 mm			
M_u'	=	$0.36*f_{ck}*b*x_u*(d-0.42x_u)$			
	=	127147180 Nmm			
	=	127.14718 kNm			
Ultimate moment, M_u	=	1.5*M =		145.5 kNm	
M_u''	=	M_u-M_u'			
	=	18.35282 kNm			
	=	18352820 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, $A_{st\ 1}$	=	762.703448 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

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Therefore, $A_{st\,2}$ = 98.1171877 mm^2

Total A_{st} = 860.820636 mm^2

Assume 16 mm dia bars.

a_{st} = 200.96 mm^2

Number of bars, n = 4.28354218 = 5 Nos.

Spacing = 40 mm

Therefore adopt 5 nos. of 16 mm dia bars @ 40 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} = $0.0035*((x_u-d')/x)$

f_{sc} = 353.725 N/mm^2

A_{sc} = 120.661465 mm^2

By interpolating:

ε_{sc}	f_{sc}
0.00276	351.8
0.00298	353.725
0.0038	360.9

Assume 16 mm dia bars.

a_{st} = 200.96 mm^2

Number of bars, n = 0.60042528 = 1 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. 73, Annex-B-5.1)

Nominal shear stress, τ_v = v_u/bd

where shear force ,v_u = 222.2325 kN

= 222232.5 N

τ_v = 2.31492188 N/mm^2

% of tensile reinforcement, p_t = 1.67466667

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

p_t	τ_c
1.5	0.75
1.674666667	0.76397333
2	0.79

Design shear stress, τ_c = 0.76397333 N/mm^2

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

Hence provide shear reinforcement

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

= 148891.06 N

= 148.89106 kN

Use 2 legged 8 mm dia bars

A_{sv} = 100.48 mm^2

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s_v	=	$(0.87*f_y*Asv*d)/v_{us}$
	=	140.909897 mm
	=	140 mm
s_v	>	0.75d
	=	360 mm
Adopt	**2**	**legged 8 mm dia bars**
	@	**140 mm c/c near the support &**
		350 mm c/c at mid-span.

CHECK FOR DEFLECTION:

$(l/d)_{act}$	=	10.625
$(l/d)_{max}$	=	$(l/d)_{basic}*k_t*k_c*k_f$
p_t	=	1.67466667
p_c	=	0.41866667
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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