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PROJECT	DAC DEVELOPERS - THULIR APARTMENT @ COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF BEAM	RB112

DESIGN DATA:

Breadth of the beam, b	=	200 mm	=	0.2 m	
Effective depth of the beam, d	=	417 mm	=	0.417 m	
Width of the supports	=	200 mm	=	0.2 m	
Grade of concrete, f_{ck}	=	25 N/mm^2			
Grade of concrete, f_y	=	500 N/mm^2			
Moment of Resistance, M	=	100 kNm			
Uniformly Distributed Load, W	=	23 kN/m			
Length of the beam,L	=	4.4 m	=	4400 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	=	4.8 m	
b)Effective Span, L_{eff}	=	L+W	=	4.6 m	
Therefore, adopt Effective Span, L_{eff}	=	*4.6 m (minimum)*			

ULTIMATE MOMENTS:

$x_{u\,lim}/d$	=	0.48	33
Therefore, $x_{u\,lim}$	=	200.16 mm	
M_u'	=	$0.36*f_{ck}*b*x_u*(d-0.42x_u)$	
	=	119951693 Nmm	
	=	119.951693 kNm	
Ultimate moment, M_u	=	1.5*M = 150 kNm	
M_u''	=	M_u-M_u'	
	=	30.0483074 kNm	
	=	30048307.4 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, $A_{st\,1}$	=	828.248276 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, $A_{st\,2}$	=	188.219533 mm^2	
Total A_{st}	=	1016.46781 mm^2	
Assume		16 mm dia bars.	
	a_{st} =	200.96 mm^2	
Number of bars, n	=	5.05806035 = 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} =	$0.0035*((x_u-d')/x)$	By interpolating:	
f_{sc} =	353.725 N/mm^2	ϵ_{sc}	f_{sc}
A_{sc} =	231.466526 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 = 1.15180397 = 2 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. 96, Annex-B-5.1)

Nominal shear stress, τ_v = v_u/bd

where shear force ,v_u = 75.9 kN

= 75900 N

τ_v = 0.43 N/mm^2

% of tensile reinforcement, p_t = 1.92767386

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

p_t	τ_c
1.75	0.49
1.927673861	0.50421391
2	0.51

Design shear stress, τ_c = 0.50421391 N/mm^2

$\tau_v > \tau_c$ **hence safe**

Hence provide shear reinforcement

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

= 33848.56 N

= 33.84856 kN

Use 2 legged 8 mm dia bars

A_{sv} = 100.48 mm^2

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

= 538.474003 mm

= 530 mm

S_v > 0.75d

= 312.75 mm

Adopt 2 legged 8 mm dia bars @ 530 mm c/c near the support & 350 mm c/c at mid-span.

CHECK FOR DEFLECTION:

$(l/d)_{act}$ = 10.5515588

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

p_t = 1.92767386

p_c = 0.48191847

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, M.E.(Struct), AIV.,
Structural Consultant, Chartered Engineer,
Professional Engineer and Approved Valuer.
Engg. Council of India Reg No: PE-00634-16
30-A, 1st Floor, Kalidas Road, Ramnagar, Coimbatore-641009

PROJECT	DAC DEVELOPERS - THULIR APARTMENT @ COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF COLUMN	C4

DESIGN DATA:

Axial Load, P	=	1400 kN
Breadth of the column, b	=	200 mm
	=	0.2 m
Depth of the column, D	=	600 mm
	=	0.6 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	=	16.853 kNm
Bending Moment about y-y axis, M_y	=	23.83 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	=	4.25
	<12	

Hence, short column

L_{ey}/b	=	12.75
	>12	

Hence, long column

CHECK FOR MINIMUM ECCENTRIES:

$e_{ex, min}$	=	$(L_{ex}/500)+(D/30)$
	=	25.1 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}	=	25.2795 kNm
Factored Bending moment in y-y axis, M_{uy}	=	35.745 kNm
Factored Load, P_u	=	2100 kN
	=	2100000 N
M_{ux}/P_u	=	12.037857 mm
	<20	mm
M_{uy}/P_u	=	17.021429 mm
	<20	mm

Hence, design for uniaxial moment

LONGITUDINAL REINFORCEMENT:

Hence, Factored Bending Moment, M_u	=	35.745 kNm
	=	35745000 Nmm

Governing Axis for Bending is y-y axis

$M_u/f_{ck}bD^2$	=	0.059575	
	=	0.06	
$P_u/f_{ck}bD$	=	0.7	
	=	0.7	
Effective cover, d'	=	60 mm	
Therefore, d'/D	=	0.3	
	=	0.3	
From Interaction chart of SP 16			
p/f$_{ck}$	=	0.12	
p	=	3 %	
0.8%<p<4%			
Hence O.K.			
A_s	=	3600 mm^2	
Assume		20 mm dia bars	
No. of bars, N	=	11.464968	
	=	12 Nos.	
$A_{s\ provided}$	=	3768 mm^2	
Actual p	=	3.14 %	
0.8%<p<4%			
Hence O.K.			
Hence, provide	***12 #***		***20 mm dia***
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***	

P. SENTHILKUMAR, M.E.,(Struct), AIV.,
Structural Consultant, Chartered Engineer,
Professional Engineer and Approved Valuer.
Engg. Council of India Reg No: PE-00634-16
30-A, 1st Floor, Kalidas Road, Ramnagar, Coimbatore-641009

PROJECT	DAC DEVELOPERS - THULIR APARTMENT @ COIMBATORE
CONSULTANT	THE DESIGN ONE
DESIGN OF FOOTING	C4

DESIGN DATAS:

Column transfer load, P	=	1400 kN		
	=	1400000 N		
Breadth of the column on footing, b	=	200 mm	=	0.2 m
Depth of the column on footing, D	=	600 mm	=	0.6 m
Grade of concrete, f_{ck}	=	25 N/mm^2		
Grade of steel, f_y	=	500 N/mm^2		
Safe Bearing Capacity of Soil, SBC	=	295 kN/m^2		

SIZE OF FOOTING:

Factored Load, P_u	=	2100 kN		
	=	2100000 N		
Self-weight of footing	=	140 kN		
Total load on footing	=	1540 kN		
	=	1540000 N		
Area of footing	=	Total load on footing/SBC		
	=	5.22033898 m^2		
Size of footing	=	2.28480611 m		
		2.29 m		
Length of the footing	=	2.29 m	=	2290 mm
Breadth of the footing	=	2.29 m	=	2290 mm
Provided area of footing	=	5.2441 m^2		
Ultimate soil pressure, W_u	=	400.45003 kN/m^2		

Hence, size of footing is correct.

BENDING MOMENT:

Cantilever portion, l'	=	0.845 m		
Bending Moment	=	$W_u l'^2/2$		
	=	142.965666 kNm		
	=	142965666 Nmm		

DEPTH OF FOOTING:

Assuming the given section as balanced section,

$M_{u\,lim}$	=	$0.138*f_{ck}*b*d^2$		
Keep length of the footing	=	1000 mm		
Effective depth, d	=	203.566509 mm		
Hence provide,d=		550 mm depth of footing		
		0.55 m depth of the footing		
Keep minimum cover, c'	=	50 mm		
Overall depth, D	=	600 mm		

AREA OF TENSILE REINFORCEMENT:

M_u	=	$0.87*f_y*A_{st}*d*(1-((f_y*A_{st})/(b*d*f_{ck})))$		
By Quadratic Equation A	=	$f_y/(b*d*f_{ck})$	=	4E-05
B	=	-1		
C	=	$M_u/(0.87*f_y*d)$	=	597.6
$A_{st\,1}$	=	$(-B+sqrt(B^2-4AC)/2B$	=	26889 mm^2

$A_{st\,2}$ = (-B-sqrt(B^2-4AC)/2B = 611.1 mm^2

Required A_{st} = 611.139136 mm^2

Minimum A_{st} = 0.12%*gross area of footing

= 660 mm^2

Hence, adopt A_{st} = 660 mm^2

Assume 12 mm dia bars

a_{st} = 113.04 mm^2

No. of bars = 5.40639717 Nos.

= 6 Nos.

Spacing = 166.666667 mm

Provide 12 mm dia bars @ 167 mm c/c.

$A_{st\ provided}$ = 678.24 mm^2

% of tensile reinforcement, p_t = $(100*A_{st\ provided})/(b*d)$

= 0.12331636 %

CHECK FOR ONE-WAY SHEAR:

Nominal shear stress, τ_v = V_u/bd

V_u = $W_u*((L/2)-(b/2)-d)$

= 118.132759 kN

= 118132.759 N

Nominal shear stress, τ_v = 0.21478683 N/mm^2

Permissible shear stress, τ_c' = $k*\tau_c$

k = 1

(From I.S. 456-2000, pg.no.: 72, clause 40.2.1)

Interpolation from I.S. 456-2000

τ_c (for f_{ck}=25 N/mm^2)	$(100*A_{st\ provided})/(b*d)$
0.29	0.15
0.271321455	0.123
0.36	0.25

τ_c = 0.27132145

Permissible Shear stress, τ_c' = 0.27132145 N/mm^2

Hence safe agaist one-way shear

CHECK FOR TWO-WAY SHEAR:

Nominal shear stress, τ_v = $V_{uB}/b_o d$

VuB = $W_u*(L_xL_y-(b+d)(D+d))$

= 1754.61185 kN

= 1754611.85 N

b_o = 2(b+d)+2(D+d)

= 3800 mm

Nominal shear stress, τ_v = 0.8395272 N/mm^2

Permissible Shear stress, τ_c' = $k_s*\tau_c$

τ_c = $0.25*sqrt(f_{ck})$

= 1.25 N/mm^2

k_s = $0.5+\beta_s$

β_s = (Shortdimension/Long dimension) of column

= 0.33333333

k_s = 0.83333333 <1

= 1

Permissible Shear stress, τ_c' = 1.25 N/mm^2

Hence safe against two-way shear

CHECK FOR DEVELOPMENT LENGTH:

From I.S. 456-2000, Clause 26.2.1 :

Development Length, L_d = $(\Phi\sigma_s)/(4\tau_{bd})$

= 679.6875 mm

Assume 60 mm side cover

Available Length = 1015 mm

Hence O.K.

CHECK FOR BEARING OR TRANSFER OF LOAD ON FOOTING:

Allowable stress, $f_{br\ all}$ = $0.45*f_{ck}*\text{sqrt}(A_1/A_2)$

where A_1 = Area of footing

A_2 = Area of column on footing

A_1 = 5244100 m^2

A_2 = 120000 m^2

$\text{sqrt}(A_1/A_2)$ = 6.61066058 >2

Therefore, keep $\text{sqrt}(A_1/A_2)$ = 2

Allowable stress, $f_{br\ all}$ = 22.5 N/mm^2

But actual stress, fbr act. = 17.5 N/mm^2

Hence safe against bearing

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