TITLE :	DESIGN OF BEAM					
SUB -TITLE :	DESIGN OF BEAM FOR FLEXURE CRACK WIDTH CHECK					
CODE OF PRACTICE :	ACI-318M-11					
CODE TITLE :	BUILDING CODE REQUIREMENT FOR STRUCTURAL CONCRETE					
DESIGN TYPE :	SERVICE DESIGN					
NOTE :- 1) User to Input data in cell marked as Blue.						
2) Design follows Limit State Method.						
3) Forces of one section has been considered for design						
		Formula	**Ref from RCDC**			
Inputs Required:						
Location			Bottom - Mid	Bottom - Mid		
Concrete compressive strength		f'c	Grade Of Concrete (f'c)	20	N/sqmm	
Yield strength of reinforcement		fy	Grade Of Steel	420	N/sqmm	
Modulus of elasticity of steel		Es	Es	200000	N/sqmm	
Permissible crack-width		Wcr limit	WcrPerm(mm)	0.20	mm	
Section Properties:						
Width of the beam		B	Breadth (B)	230	mm	
Depth of the beam		D	Depth (D)	750	mm	
Clear Cover to center of compression steel		cc	Clear Cover (Cmin)	40	mm	
Clear Cover to center of tension steel		ct	Clear Cover (Cmin)	40	mm	
Effective depth		d = H - ct	Effective Depth (d)	680	mm	
Tension Reinforcement:						
No. of tension bars		nt	Reinf. In 1st layer	2	bars	
Dia of tension bars		dt	Reinf. In 1st layer	25.4	mm	
Spacing between tension bars c/c		S	sp (mm)	124.6	mm	
Area of tension reinforcement		Ast	AstPrv (sqmm)	2026.830	mm^2	
Compression Reinforcement						
No. of compression bars		nc		0	bars	
Dia of compression bars		dc		0	mm	
Area of compression reinforcement		Asc		0	mm^2	
Modulus of elasticity of concrete		Ec = 4700 x sqrt(fck)		21019.039	N/sqmm	
Modular ratio		m = Es / Ec		9.52		
Unfactored BM		M	BM (Unfactored) (kNm)	152.68	kNm	
		σc = 0.45 x f'c		9	N/sqmm	
		Modular ratio = m = Es / Ec		9.52		
		pt = Ast /Bd		0.013	Ratio	
		k =(SQRT((2*pt*m)+(pt*m)^2))-(pt*m)		0.388	Constant	
		X = k x d		264.10	mm	
		σcbc(actual) =M*10^6/(B*x/2*(d-(x/3)))		8.49	N/sqmm	
				Singly Reinforced Section		
Section Properties at cracking stage						
Thickness of cover from tension face to centre of closest bar		dc = ct + dt/2	dc (mm)	52.7	mm	
Factor 1		b = B/ (m x Ast)		0.012	mm^-1	
Factor 2		r = ((m-1)xAsc) / (mx Ast)		0.000	constant	
Neutral axis depth		y = [sqrt(2bdx(1+ r x cc/d) + (1+r)^2) - (1+r)] / b	y (mm)	264.097	mm	
Depth factor		β = (H - y) / (d - y)		1.168	constant	
Moment of inertia of concrete gross section		Ig = (B x H^3) / 12		8085937500	mm^4	
Moment of inertia of concrete crack section		Icr = By^3/3 + mAst(d-y)^2 + (m-1)Asc(y-cc)^2	Icr (mm^4)	4748144995	mm^4	
Concrete modulus of rupture		fr = 0.62 x sqrt(fck)		2.773	N/sqmm	
Cracking Moment		Mcr = (fr x Ig) / (H/2)		59.79	kNm	
Stress strain compatibility						
Steel tensile stress at service load level		fs = (m M (d-y)) / Icr	Fst (N/sqmm)	127.25	Mpa	
Concrete compressive stress at service load level		fc = M y / Icr	f_c (N/sqmm)	8.49	Mpa	
Permissible steel stress		fs,perm = (2/3) fy	fs,perm (N/sqmm)	280	Mpa	Clause 10.6.4 - ACI 318-11
				Safe		
Permissible concrete stress		fc,perm = 0.45 f'c	f_c (N/sqmm)	9.000	Mpa	Clause A.3.1
				Safe		
Crackwidth		wcr	Wcr (mm)	0.121	mm	

normalweight concrete, E_c shall be permitted to be taken as $4700\sqrt{f'_c}$.

A.3 — Permissible service load stresses

A.3.1 — Stresses in concrete shall not exceed the following

(a) Flexure

Extreme fiber stress in compression **$0.45\ f'_c$**

A re-evaluation of cracking data provided a new crack width equation based on a physical model (Frosch 1999). For the calculation of maximum crack widths, the crack width can be calculated as

$$w = 2\frac{f_s}{E_s}\beta\sqrt{d_c^2 + \left(\frac{s}{2}\right)^2} \qquad (1\text{-}2)$$

where

w = maximum crack width, in. (mm);
f_s = reinforcing steel stress, ksi (MPa);
E_s = reinforcing steel modulus of elasticity, ksi (MPa);
β = ratio of distance between neutral and tension face to distance between neutral axis and centroid of reinforcing steel (taken as approximately $1.0 + 0.08d_c$);
d_c = thickness of cover from tension face to center of closest bar, in. (mm); and
s = bar spacing, in. (mm).