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Design of Various Structural Elements through Programming using Matlab Platform (As Per IS Code 456:2000)

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Abstract: This paper mainly focuses on the design of structural members like beam, column, slab, footing, etc using high level programming tool i.e. MATLAB. The objective of this paper is to analyze that it may be possible or not to design a structural member using programming. The output obtained from the above analysis is correct or not is verified with manual calculations. From the above analysis we found that MATLAB can also be used as a designing tool for structural members. The output obtained is more similar to manual calculations, the advantage of using MATLAB tool is to save time and use of a single program to find out solution for multiple problems. The design code used in this program is I.S.code 456:2000 i.e. designing code for reinforced cement concrete structures (RCC structures).
Keywords: Slab, Beam, Column, Footing, MATLAB.

Introduction

MATLAB is a high level programming tool.For elite mathematical calculation and perception MATLAB is a decent programming with undeniable level coding language. [1]. The definition and acquiring the answer for the base expense plan for connect superstructure and for this the general programming language for example MATLAB is utilized [2].STAAD-PRO and Etab are the product which are utilized for the multi celebrated structures. Shear force, bending moment, reinforcement and deflection are the boundaries discovered after investigation and configuration is done [3].Most designing programming devices utilize normal menu-based UIs, and they may not be reasonable for learning devices in light of the fact that the arrangement measures are covered up and understudies can just see the outcomes. An instructive apparatus for basic shaft examinations is created utilizing a pen based UI with a PC so understudies can compose and draw by hand. The calculation of pillar areas is portrayed, and a shape coordinating with method is utilized to perceive the sketch [4]. RC – Design suite is a built up solid plan program that has various applications for the plan of solid constructions. It contains modules for the plan of footing, column, beam and slab. For this venture the understudies used this program just for the plan of floor slab and combined footings [5]. Here in this paper we will try to find a new software which is useful for designing structural members through programming. The design of structural members also done in software like STADD-PRO, 3-D MAX, REVIT ARCHITECTURE, etc in which programming is not required. In this paper we have design a program code for footing, column, beam, slab.

(1) Footing:

These are the structural members that transfers the load of entire superstructure to the sub soil below the structure.Footings are designed to transfer the loads to the soil without exceeding its safe bearing capacity. Thus, prevent excessive settlement of the structure to a permissible limit to minimize differential settlement and to prevent sliding and overturning. It is of following types: Isolated footing (square, rectangular), combined footing (rectangular, trapezoidal), strap or cantilever, pile footing, mat footing, etc.

(2) Column:

It is a vertical structural member which carries compressive load. It takes load from the beam and transfers to the footing.Column are of following types: square column, circular column, rectangular column, etc.

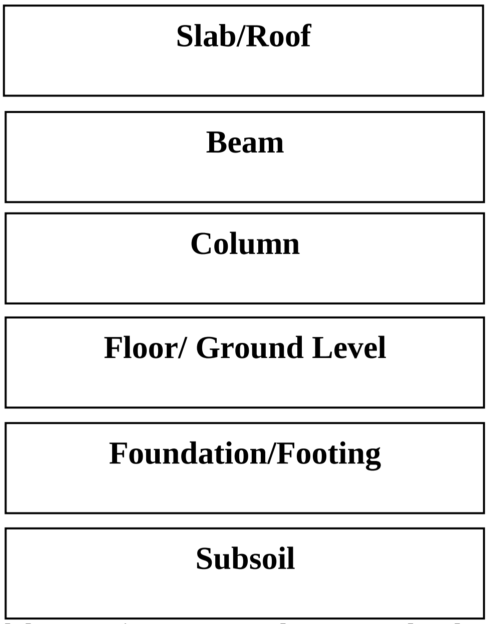
(3) Beam:

It is a horizontal structural member which carries vertical load, shear forces and bending moment. It transfers load from slab to the column. Beams are of two types: singly reinforced beams, doubly reinforced beams.

(4) Slab:

It is an important structural element which is constructed to create flat and useful surfaces such as floors, roofs, and ceilings.It is a horizontal structural component, with top and bottom surfaces parallel. Slabs are supported by beams, columns, walls or the ground. Slabs are of two types: one way slab,two way slab.

Load Transfer Mechanism



Methodology/Design Steps Used In Manual Calculations

Design of Footing:
Design steps used in design of rectangular footing:

(1)Given Data:

- Size of column
- Load on footing (W)
- Safe bearing capacity of soil (SBC)
- fck
- fy

(2) Determine the size of footing: (As per IS Code 456:2000)

Design load (Wu)=1.5*W
Increase 10% in given load
Load (P) = W + 10% (W)
Area of footing (A) = Load (P)/(SBC)
If We design rectangular footing,
Assume L2
B2= A/L2
Hence provide L2 meter x B2 meter footing size

(3) Calculation of soil reaction for design load: (As per IS Code 456:2000)

Soil reaction ($q_{u)}$ = Wu/area of footing = Wu/(L2 x B2)

(4) Determine depth of footing:(As per IS Code 456:2000)

Here we will find depth and check for one way shear.

The critical section is at the distance ‘d’ from the face of the column.

$V_u = q_u$*L2*((B2-b1)/2 –d)

Where V_u = soil pressure from the shaded area

Percentage of steel (pt)=(Ast/(b*d))*100 (From Table No.-19 IS Code 456:2000)

Assume pt of steel, for grade of concrete.

T_c

Where, Tc = permissible shear

Minimum depth required is,

Tc*B2*d=V_u

d=Vu/(Tc*B)

hence provide ‘d’ depth of footing.

(5)Check for bending:

Critical section is at the face of the column.

For this we determine,

Mulim=0.138*fck*B2*(d^2)………………(for Fe 415)

Mu=q_u*B2*(((B2-b1)^2)/8)

If Mulim>Mu, hence provided depth is sufficient.

Other wise provided depth is insufficient.

Assume cover of 50 mm.

And find total depth,

D=d+cover

(6)Check for two way shear:

Critical section is at d/2 distance from the face of the column in two way shear.

Perimeter of critical section,

(P)= 2((b1+d)+(l1+d))

Area of critical section / area of concrete resisting two way shear,

(A1)= perimeter * depth

Shear stress in two way shear = (upward pressure in shaded area)/(area of critical section)

Soil pressure,

(Vu)=qu*((B2*L2)-((b1+d)*(b+d)))

Vu=Tc’*area of critical section

Actual shear,

(Tc’)=Vu/area of critical section

But punching shear,

Tp=Ks*Tc

Where,

Ks=0.5+Bc

Bc= ratio of smaller to larger side of footing

but according to IS code, maximum permitted shear stress,

(Tc max)=0.25*sqrt(fck)

if punching shear(Tp) >actual shear(Tc’)

hence ok

if shear stress of two way shear < maximum permitted shear stress

hence provided depth of footing is sufficient.

(7)Calculation of area of steel:

According to IS code

Mu=0.87*fy*Ast*d*[1-(Ast/(B2*d))*(fy/fck)]

OR
Ast = ((0.5*fck)/fy)*[1-sqrt[1-(4.6*Mu)/(fck*B2*(d^2))]*B2*d

(8)Calculation of spacing:
Assume, diameter of bar (16mm, 20mm, 22mm, etc)
Number of bars, (nob)=area of steel / area of one bar
Spacing (S)= [(area of one bar)/(area of steel)]*B2
Hence provide x nob of (16mm, 20mm, 22mm (any one of these which is assumed)) diameter @ S mm c/c.

Design of Column:
Design steps used in design of column:
(1)Given Data:
Length of column ,L
Size of column
Given load, P
fck
fy
(2)Calculation of effective length:
By given condition (as per IS code 456:2000)
(3)Slenderness ratio:
If L_{eff}/(B or D) min<12
Hence it is a short column.
If L_{eff}/(B or D) min>12
Hence it is a long column.
(4)Minimum eccentricity (e_{min}):
If ex_{min}= [(Leff/500)+(D/30)]<=0.05*D
Hence ok
If ey_{min}= [(Leff/500)+(B/30)]<=0.05*B
hence ok
emax= (e_{min}/D)<=0.05
(5)Calculation of design load / factored load:
Design load (Pu)=1.5*given load
(6) calculation of Area of longitudinal reinforcement (Asc):
Ag=B*D
Ag=Asc+Ac
Ac=Ag-Asc….. substituting this value in equation-(1)
Pu=0.4*fck*Ac+0.67*fy*Asc………………….equation-(1)
From this we find value of Asc req.
(7) check for Asc:
Percentage of reinforcement =(Asc/Ag)*100
The area of steel in column should be in between 0.8% to 6% of gross area.(As Per IS Code 456:2000)
Asc max=6%*B*D
Asc min=0.8%*B*D
If Asc max >Asc req >Asc min
Hence ok
(8) Determine number of bars:
Assume diameter of bar (20mm, 22mm, 25mm, etc.)
Asc=number of bars * area of one bar
Provide x number of bars of y mm diameter in longitudinal reinforcement.
(9) Design of Lateral Ties(Transverse Reinforcement):
(i)Calculation of diameter of lateral ties:
Greater of these two.
¼ * diameter of the largest longitudinal bar

6 mm

(ii)pitch:

Least of these three

Least lateral dimension

16 times smallest diameter of longitudinal bar

300 mm

Therefore, provide x mm diameter bar @ y mm c/c spacing.

Design of Beam:

Design steps used in design of beam:

(1) Given data:

Clear span, (L)

Superimposed load

fck

fy

(2) Overall depth of beam:

D = [(1/12) to (1/15)]*clear span

(3) Width of beam:

B = [(1/3) to (1/2)]*D

(The size of beam should not be greater than the values provided in question)

(4) Effective depth:

d = D - cover

(Assume cover 50 mm)

(5) Load calculation:

(i)Self weight of beam/Dead Load, (DL) = density of concrete*B*D*L

Where, Density of concrete = 25 KN/m^3

(ii) Floor Finishing Load, (FL)(assume if not given in question)

(iii) Live Load, (LL)

Total load, (W)= DL+ FL+ LL

Factored load, (Wu) = F.O.S*Total load

F.O.S = 1.5

(6) Design moment (Mu):

Mu = $(Wu*(L^2))/8$

(7) Design shear (Vu):

Vu = (Wu*L)/2

(8) Limiting Moment (Mulim):

Table 1: Limiting Moment (Mulim): [10]

According to IS 456:2000 limiting moment depends upon types of steel used.

Types of Steel	**Mulim**
Fe-250	$0.148*fck*B*d^2$
Fe-415	$0.138*fck*B*d^2$
Fe-500	$0.133*fck*B*d^2$

If Mulim>Mu, hence we have to design singly reinforced beam.

If Mulim<Mu, hence we have to design doubly reinforced beam.

(9) Calculation of Reinforcement (Ast):

In singly reinforced beam we provide steel in tension zone only.

Mu=0.87*fy*Ast*d*[1-(Ast/(B*d))*(fy/fck)]

OR

Ast = ((0.5*fck)/fy)*[1-sqrt[1-(4.6*Mu)/(fck*B*(d^2))]*B*d

But in case of doubly reinforced beam we provide steel in tension as well as compression zone,

So total area of steel is:

Ast=(Ast1+Ast2)+Asc

Mu=0.87*fy*Ast1*d*[1-(Ast1/(B*d))*(fy/fck)]

OR

According to IS code

Mu= compressive force * lever arm

Mu= 0.36*fck*B*xu*(d-(0.42*xu))…………………(xu=xumax)

Mu= tensile force * lever arm

Mu= 0.87*fy*Ast*(d-(0.42*xu))……………………..(xu=xumax)

0.36*fck*B*xu=0.87*Ast1*fy

Note: For Checking Type of Section:

Depth of Neutral Axis,

(xu)=(0.87*fy*Ast)/(0.36*fck*B)

Limiting depth of Neutral Axis:

Table 2 : The limiting values of the depth of neutral axis for different grades of steel based on the assumptions in 31.1118 as follows: [10]

Fy	xumax/d
250	0.53
415	0.48
500	0.46

If xu=xumax (section is balanced section)

If xu>xumax (section is over reinforced)

If xu<xumax (section is under reinforced)

Here we assume Mu = Mulim and use value of Mulim

According to IS code

Ast2=(Asc*fsc)/(0.87*fy)

For determine fsc

Esc=0.0035*((xumax-d')/xumax)

fsc for Fe-250 is constant = 0.87*fy when strain Esc is greater than 0.002.

fsc for Fe-415 & Fe-500 can be determined by using table:

Table 3: Table for fsc calculation: [10]

	Fe-415		**Fe-500**	
Stress Level	**Strain Esc**	**Stress fsc**	**Strain Esc**	**Stress fsc**
0.80*fyd	0.00144	288.7	0.00174	347.8
0.85*fyd	0.00163	306.7	0.00195	369.6
0.90*fyd	0.00192	324.8	0.00226	391.3
0.95*fyd	0.00241	342.8	0.00277	413.0
0.975*fyd	0.00276	351.8	0.00312	423.9
1.0*fyd	0.00380	360.9	0.00417	434.8

Where,

fyd=fy/Yms=fy/1.15=0.87*fy

Mu-Mulim=fsc*Asc*(d-d')

Asc=(Mu-Mulim)/(fsc*(d-d'))

(10) Number of bars:

Assume diameter of bar (20mm, 22mm, 25mm, etc.) provided in tension zone and compression zone.

Number of bars =Ast / area of one bar

provide x bars of y mm diameter in tension zone.

Ast provided = no. of bars * area of one bar

(11) Check for reinforcement:

According to IS 456:2000 clause 26.5.1.2 & clause 26.5.2.1

Max reinforcement= 0.04*B*D(shall not exceed)

Min. reinforcement=0.15% of cross-sectional area (B*D)[mild steel] (shall not less than)
Min. reinforcement=0.12% of cross-sectional area (B*D)[HYSD] (shall not less than)

(12) Check for shear reinforcement:

According to IS 456:2000 clause 40.1
(i)Tv=Vu/(B*d)
(ii)% steel = [Ast/(B*d)]*100 (As Per IS Code 456:2000 Table No. -19)
(iii)Tc
If Tc < Tv
Hence our beam is safe in shear reinforcement

(12) Spacing of shear reinforcement:

According to IS 456:2000 using clause 40.4
Vus = Vu-Tc*B*d
Vus = (0.87*fy*Asv*d)/Sv
Sv = (0.87*fy*Asv*d)/Vus
Assume 2- legged stirrups of (6mm, 8mm, 10mm, any one of these) diameter
Asv = 2*area of one bar
But minimum spacing permitted is
(i) 0.75*d
(ii)300 mm
(Minimum of these two)
Hence provide 2- legged stirrups of (6mm, 8mm, 10mm, any one of these) diameter bar Sv mm c/c spacing.

(13) Check for depth of beam:

Mu=Mulim
Mulim=0.138*fck*B*d^2
Hence if d provided > d calculated
Our beam is safe.

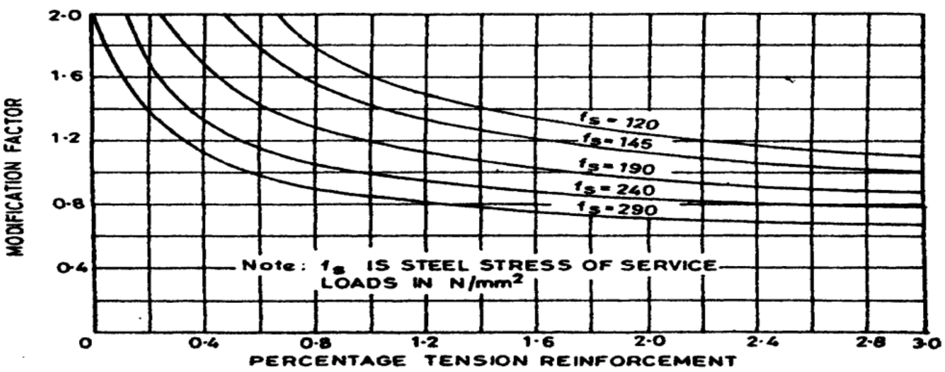
(14) Check for deflection:

According to IS 456:2000 using clause 23.2.1(a)

Table 4: Basic values of span to effective depth ratios: [10]

for spans up to 10m:	**l/d**
Cantilever	7
Simply supported	20
Continuous	26

(L/d)<20
(L/d)max= F1*F2*F3*Basic values of deflection(L/d)
F2 & F3 are modification factors whose values are taken as 1.
For F1:



$f_s = 0.58 f_y \frac{\text{Area of cross-section of steel required}}{\text{Area of cross-section of steel provided}}$

FIG. 4 MODIFICATION FACTOR FOR TENSION REINFORCEMENT

Fig. 1: Modification Factor for Tension Reinforcement

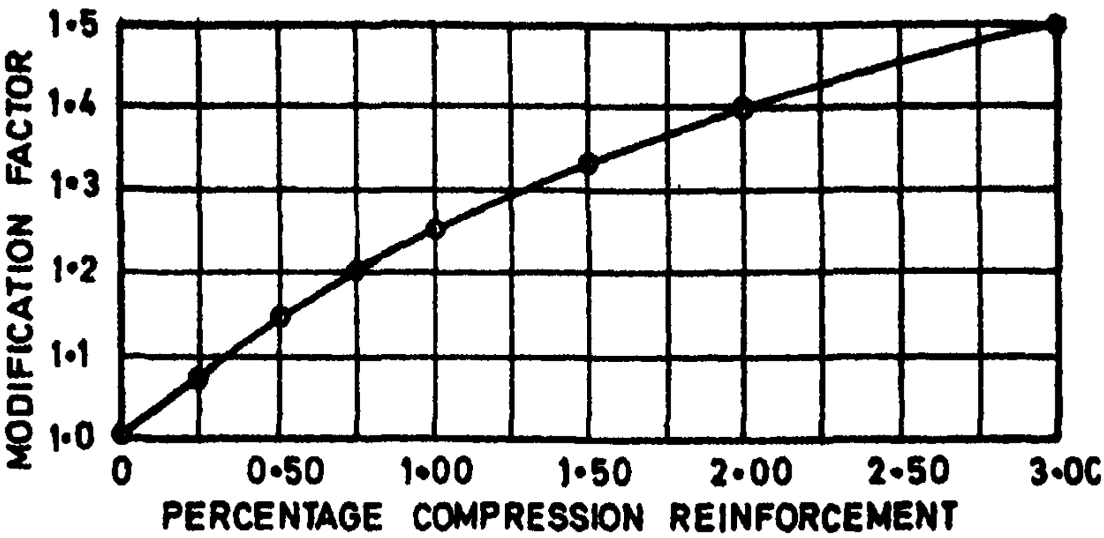


FIG. 5 MODIFICATION FACTOR FOR COMPRESSION REINFORCEMENT

Fig. 2 : Modification Factor for Compression Reinforcement

If (L/d)max<20
Our beam is safe in deflection.
otherwise, our beam fails in deflection.

Design of Slab:
Design steps used in design of slab:
(1) Given data:
Length of longer span, Ly
Length of shorter span, Lx
Live load (LL)
(2) Calculation of aspect ratio:
If Ly/Lx < 2, it is a two way slab.
If Ly/Lx >= 2, it is a one way slab.
Slab is always design along shorter span.
(3) Calculation of effective depth of slab:
According to clause 24.1
For two way slab:
If shorter span <= 3.5m and live load <=3KN/M^2
Effective depth of slab, d = l/35 (for Fe-250)
Effective depth of slab, d =l/(35*modification factor) (for Fe-415 & Fe-500)
Modification factor = 0.8
For one way slab:
(refer table no. 4)
d=span/(basic value * modification factor)
modification factor =1.2 to 1.5
(4) overall depth, D:
assume effective cover (d')
overall depth (D) = d+d'
(5) Calculation of effective span of slab:
For one way slab:

Leff = Lx (clear span) +d
Leff = Lx (clear span) +center to center spacing between support
(Minimum of these two)
For two way slab:
Lxeff = L(clear span) +d
Lxeff = L (clear span) +center to center spacing between support
(Minimum of these two)
Lyeff = L (clear span) +d
Lyeff = L (clear span) +center to center spacing between support
(Minimum of these two)
(6) Load calculation:
Dead load (DL)=density of concrete*depth of slab*1
Floor Finish Load (If assumed or given in question)
Live load (LL)
Total load (W)=DL+FFL+LL
Factored load (Wu)=1.5*W
(7) Calculation of moments:
For one way slab:
Mu = $(Wu*(L^2))/8$
For two way slab:
According to Is 456:2000 clause D-1.1
$Mx=ax*Wu*Lx^2$
$My=ay*Wu*Lx^2$
Where ax and ay=ratio of longer span /shorter span

Table 5: Bending Moment Coefficients For Slabs Spanning in Two Directions at Right Angles, Simply Supported on Four Sides [10]
(Clause D-2.1)

Ly/Lx	**1.0**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.75**	**2.0**	**2.5**	**3.0**
ax	0.062	0.074	0.084	0.093	0.099	0.104	0.113	0.118	0.122	0.124
ay	0.062	0.061	0.059	0.055	0.051	0.046	0.037	0.029	0.020	0.014

(minimum of these two should be used i.e. Mx or My)
(8) Design shear (Vu):
Vu = (Wu*L)/2
(9) Limiting Moment (Mulim):
(refer table no. 1)
If Mulim>Mu, hence we have to design singly reinforced section.
If Mulim<Mu, hence we have to design doubly reinforced section.
If Mx<Mulim and My<Mulim hence ok.
(10) Calculation of Reinforcement (Ast):
For one way slab:

Mu=0.87*fy*Ast*d*[1-(Ast/(B*d))*(fy/fck)]

OR
Ast = ((0.5*fck)/fy)*[1-sqrt[1-(4.6*Mu)/(fck*B*(d^2))]*B*d

Spacing = [area of one bar/area of steel, Ast]*1000

check for spacing:
According to IS 456:2000 clause 26.3.3 b-1 spacing should be minimum of these.
(i) Calculated
(ii) 3*d (d= depth of slab)
(iii) 300 mm.
For two way slab:
(a) Calculation of area of steel in shoter span:
Astx = $((0.5*fck)/fy)*[1-sqrt[1-(4.6*Mu)/(fck*b*(d^2))]*b*d$
Here b=1m

Assume diameter of bar,

Spacing=(area of one bar/area of steel)*1000

Provide x bars @ y mm c/c spacing.

check for spacing:

According to IS 456:2000 clause 26.3.3 b-1 spacing should be minimum of these.

(iv) Calculated
(v) 3*d (d= depth of slab)
(vi) 300 mm.

(b) Calculation of area of steel in longer span:

Asty = ((0.5*fck)/fy)*[1-sqrt[1-(4.6*Mu)/(fck*b*(d^2))]*b*d

Here b=1m

Assume diameter of bar,

Spacing=(area of one bar/area of steel)*1000

Provide x bars @ y mm c/c spacing.

check for spacing:

According to IS 456:2000 clause 26.3.3 b-1 spacing should be minimum of these.

(vii) Calculated
(viii) 3*d (d= depth of slab)
(ix) 300 mm.

(11) Distribution reinforcement:

According to IS 456:2000 clause 26.3.3 b-1 distribution steel area should be.

=0.15% of gross area [MILD STEEL]

=0.12% of gross area [HYSD]

(12) Check for spacing:

According to IS 456:2000 clause 26.3.3 b-2 spacing should be minimum of these.

(i) Calculated
(ii) 5*d (d= depth of slab)
(iii) 450 mm.

(13) Check for depth:

Md=0.36*fck*xumax*b*(d-(0.42*xumax))

For Fe- 415,

xumax=0.48*d

This d should be less than d calculated.

(14) Check for shear reinforcement:

According to IS 456:2000 clause 40.1

(i)Tv=Vu/(B*d)

(ii)% steel = [Ast/(B*d)]*100 (As Per IS Code 456:2000 Table No. -19)

Now we compare nominal shear strength and design shear strength of concrete.

(iii)Tc = 0.64 N/mm^2

If Tv< Tc

Hence our slab is safe in shear reinforcement.

If Tv > Tc

Our slab fails in shear.

From Table 20 of IS 456:2000 we can determine Tc max for various grades of concrete.

For safe results:

Tv < Tc < Tc max/2

Then we safe in shear

(15) Check for deflection:

According to IS 456:2000 using clause 23.2.1(a)

(L/d)

(L/d)max= F1*F2*F3*Basic values of deflection(L/d)

F2 & F3 are modification factors whose values are taken as 1.

For F1:

(refer Fig. 1 & Fig. 2)

If (L/d)provided<(L/d)max
Our slab is safe in deflection.
otherwise, our slab fails in deflection.
(16) Calculation of torsional reinforcement: (provide only in case of two way slab)
Ast torsional = (¾)*Astx
Size of mesh = Lx/5
Use x mm diameter bar
Spacing=area of one bar/Ast torsional.

Matlab Programming

GUI (Graphical User Interface)/ MATLAB is a helpful CAE device for mathematical examination. In the exposition, to work out calculations for a few vibration control frameworks are executed with Matlab and utilized for different reenactment contemplates. Matlab has many implanted instruments which improve on network activities experienced in the vibration control [6].The MATLAB coding/ GUI based environment for the design of footing, column, beam and slab is performed.

(A)Design of Footing:
We design a program code for rectangular footing for vertical load of1700KN, and having size of column 400mm X 600mm, safe bearing capacity of the soil is taken as170KN/m^2, using M20 grade of concrete and Fe 415 grade ofsteel.

(B)DESIGN OF COLUMN:
We design a program code fordesign a reinforced cement concreterectangular column having size 450 mm X 600 mm, subjected to an axial load of 2500KN. The column has an unsupported length of 4m, and effectively held in position in both ends. Using M25 grade of concrete and Fe415 grade of steel.

(C)DESIGN OF BEAM:
We design a program for a simply supported rectangular beam of span 7m subjected to super imposed load of 11KN/ mat service state. Using of M20 grade of concrete and Fe415 grade of steel.
\

D)DESIGN OF SLAB:
We design a program for design of simply supported slab fora room of dimensions 9m X 4m. The slab is carrying alive load of 4KN/m. The width of support is 300mm by using M15 grade of concrete and Fe250 grade of steel.

Results & Discussion

Results obtained from the above analysis are correct and used for future reference. Here we determine area steel, size of footing, number of bars, spacing used in footing, beam column, slab. Designed footing, beam, column, slab are safe in moment carrying, shear, deflection, etc.

Design Output Data for Footing:

Factoredload (Wu) (KN)	Load(P) (KN)	Areaoffooting(A) (m^2)	Lengthof Footing(L2) (m)	Widthof Footing(B2) (m)	Soilreaction(qu)(KN/m^2)	Permissibleshear (Tc) (N/mm^2)	Depthoffooting(d) (mm)
2550	1870	11	4	3	212.5	0.32	610

Limiting moment(mulim)(KNm)	Designmoment(mu) (KNm)	Overalldepthoffooting (D) (mm)	Perimeterof criticalsection (P) (mm)	Area of criticalsection (A1) (mm^2)	Stressintwowayshear(Vu) (KN)
3080.9	537.42	660	4440	2708400	2259.2

Actualshear(Tc') (N/mm^2)	Punchingshear(Tp) (N/mm^2)	Maximumshearstress (Tcmax)(N/mm^2)	Area of steel(Ast) (mm^2)	Diameterof bars(mm)	Numberofbars	Spacing(S) (mm)
0.83	1.39	1.118	2510.95	16	12	240.2

Design Output Data for Column:

Effectivelength ofcolumn(Leff) (mm)	FactoredLoad(Pu) (KN)	MinimumEccentricity(exmin)(mm)	MinimumEccentricity(eymin)(mm)	Slendernessratio(Leff/B)	Grossarea(Ag) (mm^2)	Areaofsteelincompressionzone (Asc) (mm^2)
2600	3750	25.2	20.2	5.777	270000	3917.17

Maximumareaofsteelincompressionzone (Ascmax)(mm^2)	Minimumareaofsteelincompressionzone (Asc min)(mm^2)	Numberofbars	Area of steelincompressionzoneprovided(Ascprovided) (mm^2)	Diameterofbars inlateralties(mm)	Pitch(mm)
16200	360	6barsof22 mmdiameter&4barsof 25mmdiameter	4244.29	8	300

Design Output Data for Beam:

Overalldepth ofbeam(D) (mm)	**Width ofbeam(B) (mm)**	**Effectived epth(d) (mm)**	**Total load(W) (KN/m)**	**Designfac toredload (Wu) (KN/m)**	**Designmo ment(Mu) (KNm)**
500	250	450	14.73	22.10	135.36

Limiting moment(Mulim) (KNm)	**Designs hear(Vu) (KN)**	**Areaof steel(Ast) (mm^2)**	**Diameterof bar(mm)**	**Numbero fbars**	**Area of steelprovided(Ast provided)(mm^2)**	**Max.are aofsteel(Ast max)(mm^2)**	**Min. areaof steel(Ast min)(mm^2)**
139.73	77.35	1072	20	4	1256.64	4500	135

Tv(N/mm^2)	**Percentage(pt)**	**Tc(N/mm^2)**	**Vus(N)**	**Asv(mm^2)**	**Sv(mm)**
0.69	1.12	0.64	5350	56.55	300

Design Output Data for Slab:

Aspectr atio	**Effectived epth(d) (mm)**	**Overall depth(D) (mm)**	**Effectivele ngth(Leff) (mm)**	**Totall oad(W) (KN/m)**	**Factoredlo ad(Wu) (KN/m)**	**Moment(Mu) (KNm)**
2.25	160	180	4160	9.5	14.25	30.83

Designs hear(Vu) (KN)	**Limiting Moment(Mulim) (KNm)**	**Area of reinforcementAst (mm^2)**	**Diameterof bar(mm)**	**Numbero f bars(nob) (No.)**	**Spacing(S) (mm)**	**DistributionReinforcement(Astd) (mm^2)**
29.64	57.22	998.06	16	5	200	270

Diameterof bar(mm)	**Numbero f bars(nob) (No.)**	**Spacing(S) (mm)**	**Torsionalreinfor cementAst (mm^2)**	**Size of mesh(mm)**	**Spacingoftorsionalr einforcement(mm)**
8	6	190	302	0.8	300

Nominalshearstress (Tv) (N/mm^2)	**Shear stress(Tc) (N/mm^2)**	**Percentage of steel (pt)**	**Area of steelprovided (Astprovided)(mm^2)**	**Max shearstress (Tc max)(N/mm^2)**
0.19	0.50	0.63	1005.31	2.5

Advantages and Limitations

The benefit of the current work incorporates programming code of plan individuals from structures like beam, slab, column and footing. The greater part of the cases the plan is completed on the MS-Excel sheet yet the programming in MATLAB are likewise a decent alternative. The constraints of the current work includes programming in just a single language, different dialects need to checked for all the more quicker outcomes.

Conclusion

The given information are customized in MATLAB programming so the necessary space of support and size for footing, column, beam and slab is appropriately planned. The benefits of easy to use programming like MATLAB programming for the plan of primary components are discovered.

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