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Developing an Individual Excel Sheet for Design and Analysis of Footing and Column

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Abstract: Analysis and design of RC structures using FEM based software package needs basic knowledge of that software. This project focuses on developing a excel sheet with simple userinterface to analyze and design RC structures without any prior knowledge of software. This excel sheet considers only the gravity loads. Grids in X and Y directions are defined in the sheet. User can enter distance between grids. This sheet provides design of footing and column.

I. INTRODUCTION

Analysis and design of multi-story structure is a tedious task. FEM based software are used to carry out the same. However, use of these software needslot of experience and expertise. Lack of exposure and expertise in these software leads to inaccurate designs. To ease the design of structures, a excel sheet with simple user interface is developed which can be used by almost anyone for building design. The excel is designed to take minimum input and provide maximum output. Building structures are usually divided by grid systems depending on their column location, which denotes centre to centre distance. This excel sheet takes centre to centre distance as input. Load on the column is calculated using the tributary area defined by the centre-to-centre distance. This load includes live load, floor finish, dead load of slab, beam, column and wall load. Depending on number of floors the total load is calculated and the same is used to design footings. Similarly, columns are designed for axial load and moments using SP16. Design of beam is carried outusing bending moment and shear force factors for continuous beams as specified in the IS456:2000. Slab panels are designed using the centre-to-centredistance provided as per the support condition. All the footings, columns, beams and slabs can be independently designed. To validate the results, the same structure was analysed and designed in ETABS, which gave results withaccuracy up to 95%. The accuracy decreases as the size of the structure increases.

This excel sheet is very useful in designing regular structures till G+3 and up to span 7m under gravity loading. Lateral loads are not considered for design.

II. LITERATURE REVIEW

A. *"Development of Design Spreadsheet Tool for R.C.C. Beam Design using V.B.A."Author – Vijay Srivastav*

The outline manages a complicated and repeated task because the design technique in light of the Limit State Method includes different mathematical statements and parameters. In addition, outlining is a time-consuming and extremely repeated trailing technique. Therefore, using spreadsheets can significantly cut down on a planner's or builder's time and effort. Despite the availability of numerous standard configuration programming packages, spreadsheets have emerged as one of the best options for designers due to their minimization and compliance. Themain goal of this project is to create an MS Excel Spreadsheet with VBA Programming that will enable users to

1) Analyse a beam for Shear Force, Bending Moment, Slope, and Deflection for a variety ofend Conditions and for a variety of load patterns.
2) To determine the safe load carrying capacity of a beam
3) To Create RCC Beams An outline equipment that can be usefully used by a professional toanalyse and design an RCC beam will be the project's output.

B. *"Automated Excel Sheets for Various RC Elements."Author – Nitin Tiwari, Rashmi Sakalle*

In this work, the rebars of various RC elements, such as beams, columns, and slabs, have beencalculated and analysed using the EXCEL spreadsheet programme. This project work has calculated five different types of EXCEL spreadsheets, including one-way and two-way slabs,short columns and long columns, cantilever beams, simply supported beams, and short columnsand long columns. Effective span, nominal cover, and effective length of compression memberswere only a few of the distinctive factors that were considered in our analysis. The RC elementshave been assigned several checks in addition to having a variety of distinguishing attributes. RCC code IS 456:2000 has been used as a source of inspiration.

C. "Structural Analysis and Design of Multistorey Reinforced Concrete Building usingSTAAD. Pro"

Author – Sushant Gupta

Structural design is the primary aspect of the civil engineering. The foremost basic in structuralengineering is the design of simple basic components and members of a building viz., Slabs, Beams, Columns and Footings. The principle objective of this project is to analyse and design a multi-storied reinforced concrete building [G + 3 (3-dimensional frame)] using STAAD Pro. The design involves manual load calculations, analysis and design of the whole structure using STAAD Pro. The design methods used in STAAD-Pro analysis are Limit State Designconforming to Indian Standard Code of Practice. Structure considered for analysis and design is 14.90 m high hospital building located in the seismic zone IV. In this project, we study the effect of various load combinations on the structure by analysing the bending moment diagramsin post processing mode.

D. "Analysis and design of G+5 residential building by using E-Tabs"Author – Lingeshwaran Navaratnam

We are living in the 21st century number of complex and irregular structure and designed to resists the Earthquake, Wind and needs to analyse , design the structure by the various softwarelike ETABS, STAAD.Pro, TEKLA and to design the structure in this project we used the ETABS software due to company suggestion and to find stress analysis in slab, shear force for the beam and area reinforcement for the column and design the foundation depends upon the reaction and height of the foundation level depends upon site and safe bearing capacity of the soil due to stability purpose designed the retaining wall in this project.

III. OBJECTIVE

A. Design and Analysis of RC structure by developing an independent Excel sheet andvalidating the result using ETABS software

B. To include structural engineering principles into design documents.

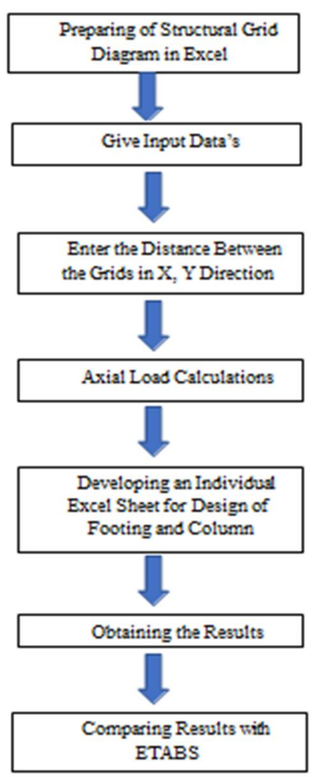
C. To improve the idea behind structural analysis and design as well as its effectivenesswhen a design sheet is employed.

IV. METHODOLOGY

A. Problem Definition

Developing an Excel sheet to Design and Analyse the RC structure and comparing usingE-tab Software

B. Flow Chart



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C. Sample

1) Inputs

Self-Weight of RCC	25	KN/m^3
Masonry	18	KN/m^3
Floor Finish (FF)	1	KN/m^2
Live Load (LL)	2	KN/m^2
Grade of Concrete (fck)	20	N/mm^2
Reinforcement Grade (fy)	500	N/mm^2
Column Breadth (b)	0.23	m
Column Depth (D)	0.38	m
Height (H)	3.2	m
Slab Thickness (T)	0.125	m
Wall Thickness	0.23	m
No of Slab	2	Units
Beam Depth	0.38	m
Beam Width	0.23	m

2) Structure

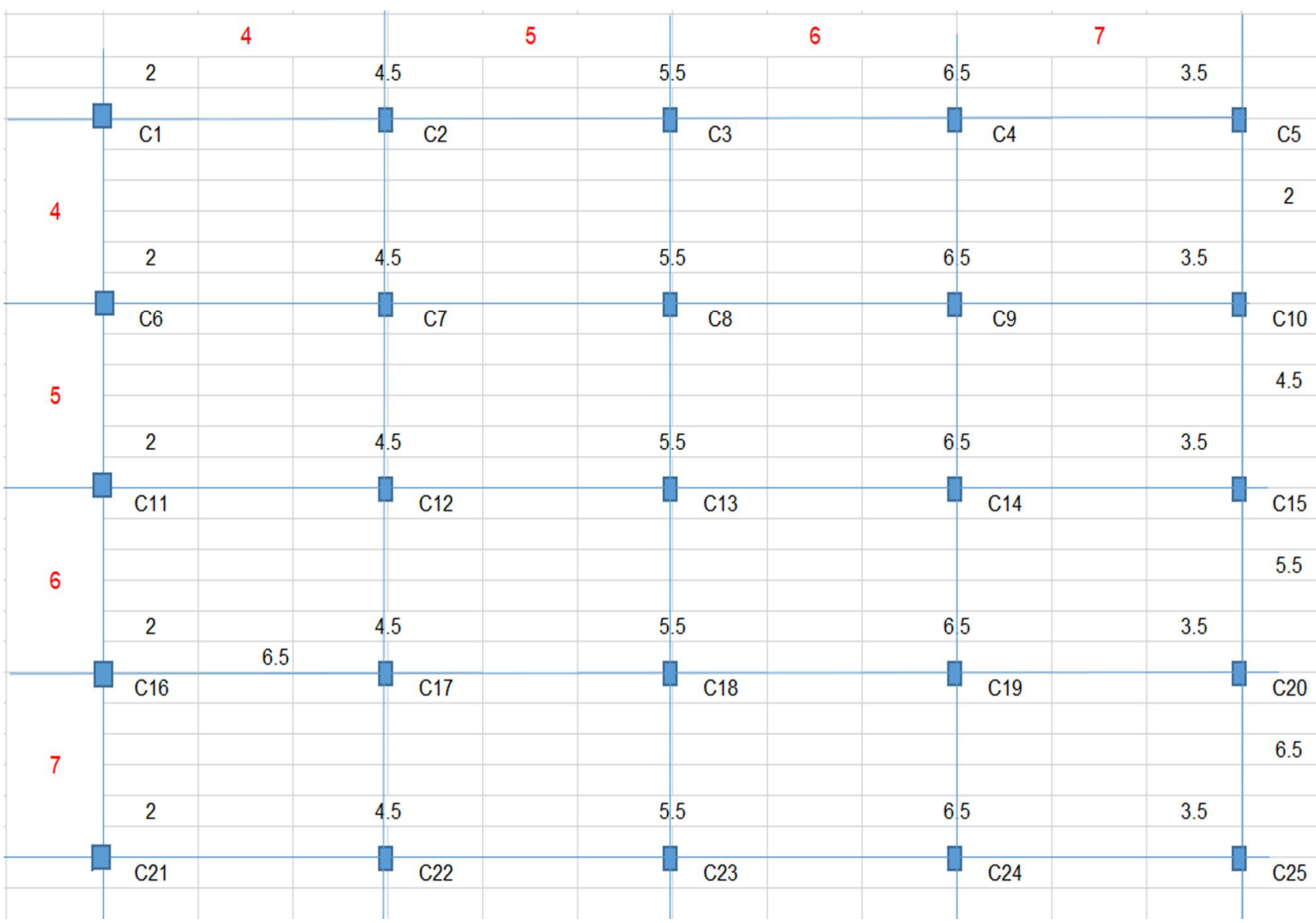

Fig 1

3) Calculation of Axial Loads

- Self-Weight on Column = b*d*H*Self-Weight of RCC
  = 0.23*0.38*3.2*25
  = 6.99 KN

- Self-Weight of Beam = L*b*d* Self-Weight of RCC
  = 4*0.23*0.38*25
  = 8.74 KN

- Self-Weight on Slab = (L*B*T* Self-Weight of RCC) + (L*B*FF) + (L*B*LL)
  = (2*2*0.125*25) + (2*2*1) + (2*2*2)
  = 24.50 KN

- Self-Weight from Wall = L* (Height-Beam Depth) *T*Masonry
  = 4* (3.2-0.38) *0.23*18
  = 46.70 KN

- Individual Floor Load = (Self-Weight on Column) + (Self-Weight of Beam) + (Self-Weight on Slab) + (Self-Weight from Wall)
  = (6.99) + (8.74) + (24.50) + (46.70)
  = 86.93 KN

- Total Load = (Individual Floor Load*No of Slab) + (Self-Weight on Column) + (Self-Weight of Beam)
  = (86.93*2) + 6.99 + 8.74
  P = 189.59 KN

- Factored Load = 1.5*P
  = 1.5*189.59
  Pu = 284.39 KN

D. Design of Footing

1) Inputs

SBC	150	KN/m^2
Clear Cover	40	mm
Width	1000	mm

2) Design

- Design Load Pu = 284.39 KN
- Column Size
  b = 230 mmD = 380 mm
- Moments
  X-Direction = 0
  Y-Direction = 0
- Area Required = (Pu*1.1)/1.5*SBC
  = (284.39*1.1)/1.5*150
  = 1.39 m^2
- Footing Size

L = 1.25 mB = 1.25 m

- Area Provided = L*B
  = 1.25*1.25
  = 1.56 m^2
- i) $Zx = B^2L/6$
  $= 1.25^2*1.25/6$
  = 0.33

  ii) $Zy = L^2B/6$
  $= 1.25^2*1.25/6$
  = 0.33

- Net Upward Pressure = (P/Area Provided*1.1) + (Moment X/1.5*Zx) + (Moment Y/1.5*Zy)
  = (189.59*1.1/1.56*1.1) + (0/1.5*0.33) + (0/1.5*0.33)
  = 121.34

IF (Net Upward Pressure<SBC,"Footing Size OK","Change Footing Dimension")Hence, **Footing Size OK**

3) Slab Design

- Lx = (L-(b/1000))/2
  = (1.25- (230/1000))/2
  = 0.51 m

  Ly = (B-(D/1000))/2
  = (1.25- (380/1000))/2
  = 0.44 m

- Bending Moments
  $Mx = (1.5* \text{Net Upward Pressure}*Lx^2)/2$
  $= (1.5*121.34*0.51^2)/2$
  = 23.67 KN-m

  $My = (1.5* \text{Net Upward Pressure}*Ly^2)/2$
  $= (1.5*121.34*0.51^2)/2$
  = 17.22 KN-m

- Dia (mm) Spacing (mm)Across X 10 200
  Across Y 10 200

- Area of Steel Provided
  Across X = ((((PI () *Dia^2/4) *1000)/Spacing)
  = ((((PI () *10^2/4) *1000/200)
  = 392.70 mm^2

  Across Y = ((((PI () *Dia^2/4) *1000)/Spacing)
  = ((((PI () *10^2/4) *1000/200)
  = 392.70 mm^2

- Area of Steel Required
  Across X = If (Mx < Mulim, Ast, Min Steel)
  = 316.27 mm^2

  Across Y = If (My < Mulim, Ast, Min Steel)
  = 227.13 mm^2

- Across X-direction, ProvideDepth D = **225 mm**
  Effective Cover d = (Cover + Dia)/2

= (40 + 10)/2

= 45 mm

Effective Depth d' = D - d

= 225 – 45

= 180 mm

If (Fck=15,(If(Fy=250,2.24,If(Fy=415,2.07,If(Fy=500,2)))),If(Fck=20,(If(Fy=250,2.98,
If (Fy=415,2.76,If(Fy=500,2.66)))),If(Fck=25,(If(Fy=250,3.73,If(Fy=415,3.45,
If (Fy=500,3.33)))),If(Fck=30,(If(Fy=250,4.47,If(Fy=415,4.14,If(Fy=500,3.99)))))))

1) Mulim/bd^2 **= 2.66**

2) Mulim = (Mulim/bd^2) *(d'^{2}) *(Width)/1000000

= 2.66*180^2*1000/1000000

= 86.18 KN-m

3) Xumax/d = (0.0035)/ (0.0055+((0.87*Fy)/ (200*1000)))

= (0.0035)/ (0.0055+((0.87*500)/ (200*1000)))

= 0.46

4) Xumax = Xumax/d * d'

= 0.46 * 180

= 82.08

5) Rumax = (0.36 * Xumax/d * (1-(0.42 * Xumax/d)))

= (0.36*0.46*(1-(0.42*0.46)))

= 0.13

- Minimum Depth Required (Dmin) = SQRT ((Max (Mx, My) *10^6)/ Rumax*1000*Fck

  = SQRT ((Max (23.67, 17.22) *10^6)/ 0.13*1000*20

  = 94.43 mm

- SRB

  a = (0.87435*Fy^2)/(Fck*10000)

  = (0.87435*500^2)/ (20*10000)

  = 1.09

  b = -(0.87*Fy)/100

  = -(0.87*500)/100

  = -4.35

  c = (Mx*1000000)/Width*d'^{2}

  = (23.67*1000000)/1000*180^2

  = 0.73

  p = (-b-SQRT((b^2) -(4*a*c)))/(2*c)

  = (-4.35-SQRT ((-4.35^2) -(4*1.09*0.73)))/ (2*0.73)

  = 0.18

- Area of steel (Ast) = p*d'*Width/100

  = 0.18*180*10000/100

  = 316.27 mm^2

- Minimum Steel Percentage = (0.85*100) / Fy
  = (0.85*100) / 500
  = 0.17 %

- Minimum Steel = (0.12*Width*d')/100
  = (0.12*1000*180)/100
  = 216

- Maximum Steel = 0.09*Width*d'
  = 0.09*1000*180
  = 7200

- Area of Steel Required (Ast)
  Across X = If (Mx < Mulim, Ast, Min Steel)
  = 316.27 mm^2

- Pt Provided = (Ast*100)/(1000*d')
  = (316.27*100)/ (1000*180)
  = 0.22

- β = (0.8*Fck)/(6.89*Pt)
  = (0.8*20)/ (6.89*0.22)
  = 10.64

- Ks Trail = 0.5 + (Min (b, D)/ Max (b, D))
  = 0.5 + (Min (230, 380)/ Max (230, 380))
  = 1.1

- Ks = If (Ks Trail>1,1, Ks Trail)
  = 1.00

- Across Y-direction, ProvideDepth D = **225 mm**
  Effective Cover d = (Cover + Dia)/2
  = (40 + 10)/2
  = 45 mm
  Effective Depth d' = D - d
  = 225 – 45
  = 180 mm

If (Fck=15,(If(Fy=250,2.24,If(Fy=415,2.07,If(Fy=500,2)))),If(Fck=20,(If(Fy=250,2.98,
If (Fy=415,2.76,If(Fy=500,2.66)))),If(Fck=25,(If(Fy=250,3.73,If(Fy=415,3.45,
If (Fy=500,3.33)))),If(Fck=30,(If(Fy=250,4.47,If(Fy=415,4.14,If(Fy=500,3.99)))))))
1) Mulim/bd^2 **= 2.66**

2) Mulim = (Mulim/bd^2) *(d'^2) *(Width)/1000000
= 2.66*180^2*1000/1000000

= 86.18 KN-m

3) Xumax/d = (0.0035)/ (0.0055+((0.87*Fy)/ (200*1000)))
= (0.0035)/ (0.0055+((0.87*500)/ (200*1000)))
= 0.46

4) Xumax = Xumax/d * d'
= 0.46 * 180
= 82.08

5) Rumax = (0.36 * Xumax/d * (1-(0.42 * Xumax/d)))
= (0.36*0.46*(1-(0.42*0.46)))
= 0.13

- Minimum Depth Required (Dmin) = SQRT ((Max (Mx, My) *10^6)/ Rumax*1000*Fck
= SQRT ((Max (23.67, 17.22) *10^6)/ 0.13*1000*20
= 94.43 mm

- SRB

a = (0.87435*Fy^2)/(Fck*10000)
= (0.87435*500^2)/ (20*10000)
= 1.09

b = -(0.87*Fy)/100
= -(0.87*500)/100
= -4.35

c = (My*1000000)/Width*d'^2
= (17.22*1000000)/1000*180^2
= 0.53

p = (-b-SQRT((b^2) -(4*a*c)))/(2*c)
= (-4.35-SQRT ((-4.35^2) -(4*1.09*0.73)))/ (2*0.53)
= 0.13

- Area of steel (Ast) = p*d'*Width/100
= 0.13*180*10000/100
= 277.13 mm^2

- Minimum Steel Percentage = (0.85*100) / Fy
= (0.85*100) / 500
= 0.17 %

- Minimum Steel = (0.12*Width*d')/100
= (0.12*1000*180)/100
= 216

- Maximum Steel = 0.09*Width*d'

= 0.09*1000*180
= 7200

- Area of Steel Required (Ast)
  Across Y = If (My < Mulim, Ast, Min Steel)
  = 227.13 mm^2

- Pt Provided = (Ast*100)/(1000*d')
  = (227.13*100)/ (1000*180)
  = 1.05

- β = (0.8*Fck)/(6.89*Pt)
  = (0.8*20)/ (6.89*1.05)
  = 2.22

- Ks Trail = 0.5 + (Min (b, D)/ Max (b, D))
  = 0.5 + (Min (230, 380)/ Max (230, 380))
  = 1.1

- Ks = If (Ks Trail>1,1, Ks Trail)
  = 1.00

4) One-Way Shear along X-Direction

- Vu1 = (1.5* Net Upward Pressure) *B*(Lx-(d'/1000))
  = (1.5*121.34) *1.25*(0.51-(180/1000))
  = 75.08

- τ_v = (Vu1 * 1000)/ ((B *1000) * d')
  = (75.08 * 1000)/ ((1.25 *1000) * 180)
  = 0.33

- τ_c = ((0.85*SQRT (0.8*Fck) *(SQRT (1+(5* β))-1))/(6* β))
  = ((0.85*SQRT (0.8*20) *(SQRT (1+(5*10.64))-1))/(6*10.64))
  = 0.34

- Vc1 = τ_c * B * d
  = 0.34 * 1.25 * 180
  = 76.22

If (τ_v < τ_c, "One Way Shear Check OK", "Increase Depth")Hence, **One Way Shear Check OK**

5) One-Way Shear along Y-Direction

- Vu1 = (1.5* Net Upward Pressure) *L*(Ly-(d'/1000))
  = (1.5*121.34) *1.25*(0.44- (180/1000))
  = 58.02

- τ_v = (Vu1 * 1000)/ ((L *1000) * d')

= (58.02 * 1000)/ ((1.25 *1000) * 180)
= 0.26

- τ_c = ((0.85*SQRT (0.8*Fck) *(SQRT (1+(5* β))-1))/ (6* β))
  = ((0.85*SQRT (0.8*20) *(SQRT (1+(5*2.22))-1))/ (6*2.22))
  = 3.16

- Vc1 = τ_C * B * d'
  = 0.34 * 1.25 * 180
  = 711.55

If (τ_V < τ_C, "One Way Shear Check OK", "Increase Depth")Hence, **One Way Shear Check OK**

6) Two-Way Shear

- Vu2 = (1.5*Net Upward Pressure) *(((B)*(L)) -(((b+(d'/2) +(d'/2(D+(d'/2) +(d'/2)))/(1000*1000)))
  = (1.5*121.34) *(((1.25) *(1.25)) -(((230+(180/2) +(180/2(380+(180/2) +(180/2)))/(1000*1000)))
  = 242.60

- τ_V = (Vu2*1000)/((((b+(d'/2) +(d'/2)) +(D+(d'/2) +(d'/2))) *2) *d')
  = (242.60*1000)/ ((((230+(180/2) +(180/2)) +(380+(180/2) +(180/2))) *2) *180)
  = 0.67

- Ksτ_C = Ks*(0.25*SQRT(Fck))
  = 1.00*(0.25*SQRT (20))
  = 1.12

- Vc1= (Ksτ_C *(((b+(d'/2) +(d'/2)) +(D+(d'/2) +(d'/2))) *2) *d')/1000
  = (1.12*(((230+(180/2) +(180/2)) +(380+(180/2) +(180/2))) *2) *180)/1000
  = 405.40

If (τ_V < Ksτ_C, "Two Way Shear Check OK", "Increase Depth")Hence, **Two Way Shear Check OK**

E. Design of Column

1) Inputs

Column Breadth (b)		0.23	m
Column Depth (D)		0.38	m
Height (H)		3.2	m
Slab Thickness (T)		0.125	m
Wall Thickness		0.23	m
No of Slab	2		Units
Cover d'		40	mm
Steel Percentage	1		

2) Design

- Design Load Pu = **284.39 KN**
- Moments
  Mux = **10 KN-m**
  Muy = **10 KN-m**

If((d'/D) <=0.05,0.05, If((d'/D) <=0.1,0.1, If((d'/D) <=0.15,0.15, If((d'/D) <=0.2,0.2,0.2))))
If ((40/380) <=0.05,0.05, If ((40/380) <=0.1,0.1, If ((40/380) <=0.15,0.15,

If ((40/380) <=0.2,0.2,0.2))))

- d'/D = **0.15**
  If((d'/b) <=0.05,0.05, If((d'/b) <=0.1,0.1, If((d'/b) <=0.15,0.15, If((d'/b) <=0.2,0.2,0.2))))
  If ((40/230) <=0.05,0.05, If ((40/230) <=0.1,0.1, If ((40/230) <=0.15,0.15,
  If ((40/230) <=0.2,0.2,0.2))))

- d'/b = **0.20**
- Area of Steel (Ast) = (Steel Percentage *b*D)/100
  = (1* 230 *380) /100
  = **874 mm^2**

- 6Ast Min = (0.8* b *D)/100
  = (0.8*230 * 380)/100
  = **699.2 mm^2**

- Pt / Fck = Steel Percentage /Fck
  = 1 / 20
  = **0.05**

- Pu / Fck*b*D = (Pu *1000)/ (Fck*b * D)
  = (284.39 *1000) / (20 *230 *380)
  = **0.16**

- Mux /Fck*b*D^2 = **0.092**
  Muy /Fck*b*D^2 = **0.096**

- Puz = ((0.45*Fck*b*D) + (((0.75*Fy) -(0.45*Fck)) *((Steel Percentage/100) *b*D)) /1000
  = ((0.45* 20 * 230* 380) +(((0.75 * 500) -(0.45*20)) *((1/100) *230*380)))/1000
  = **1106.48**

- Mux1 = Mux /FckbD^2 *Fck*b*D^2)/1000000
  = 0.0092 * 20 * 230 * 380^2 /1000000
  = **61.11 KN-m**

- Muy1 = Mux /FckDb^2 *Fck*D*b^2)/1000000
  = 0.0096 *20 * 380 * 230^2) /1000000
  = **38.61 KN-m**

- Pu/Puz = 284.39/1106.5
  = **0.257**

- Mux / Mux1 = 10/61.11
  = **0.164**

- Muy / Muy1 = 10/38.61

= 0.259

If (Pu/Puz <0.2,1, If (Pu/Puz >0.8,2, (1+(((Pu/Puz -0.2)/ (0.8-0.2)) *(2-1)))))
If (0.257 <0.2,1, If (0.257 >0.8,2, (1+(((0.257 -0.2)/ (0.8-0.2)) *(2-1)))))

- αn = **1**
- $(Mux/Mux1)^{\alpha n} + (Muy/Muy1)^{\alpha n} = 0.164^1 + 0.259^1$

= 0.37

If($(Mux/Mux1)^{\alpha n} + (Muy/Muy1)^{\alpha n}$ <1,"Steel Percentage OK", "Revise the Section")Hence, **Steel Percentage OK**

- Area of Reinforcement Provided
- Number of Bars = **6 No's**
- Día = **12 mm**

If ($Día^2$="","“, (((PI ()/4) *$Día^2$) * Number of Bars))
If (12^2="","“, (((PI ()/4) *12^2) * 6))

- Ast = **678.58 mm^2**
- Percentage = (Ast/ (b * D)) *100

= (678.58/ (230 *380 *)) * 100
= **0.776 %**

V. RESULTS AND DISCUSSIONS

A. General

This project focuses on developing a excel sheet with simple user interface to analyze and design RC structures without any prior knowledge of software. The forces on every member were calculated. After that we began with the design of Footing using relevant code books, andthen Column was designed manually. Various checks were performed on the members. As a result, we gained a foundational understanding of analysis and design as well as ideas like loadtransfer mechanisms and moment distribution.
This Excel sheet considers only the gravity loads. Grids in X and Y directions are defined in the sheet. User can enter distance between grids. Loads on various elements of the buildings such as Footing and Column are calculated manually. The same building was modelled and analysed using E-tab also.

B. Load Calculation

1) Inputs

Self Weight of RCC	25	KN/m^3
Masonry	18	
Floor Finish	1	KN/m^2
Live Load	2	KN/m^2
Grade of Concrete (fck)	20	N/mm^2
Reinforcenment Grade (fy)	500	N/mm^2

2) Structure

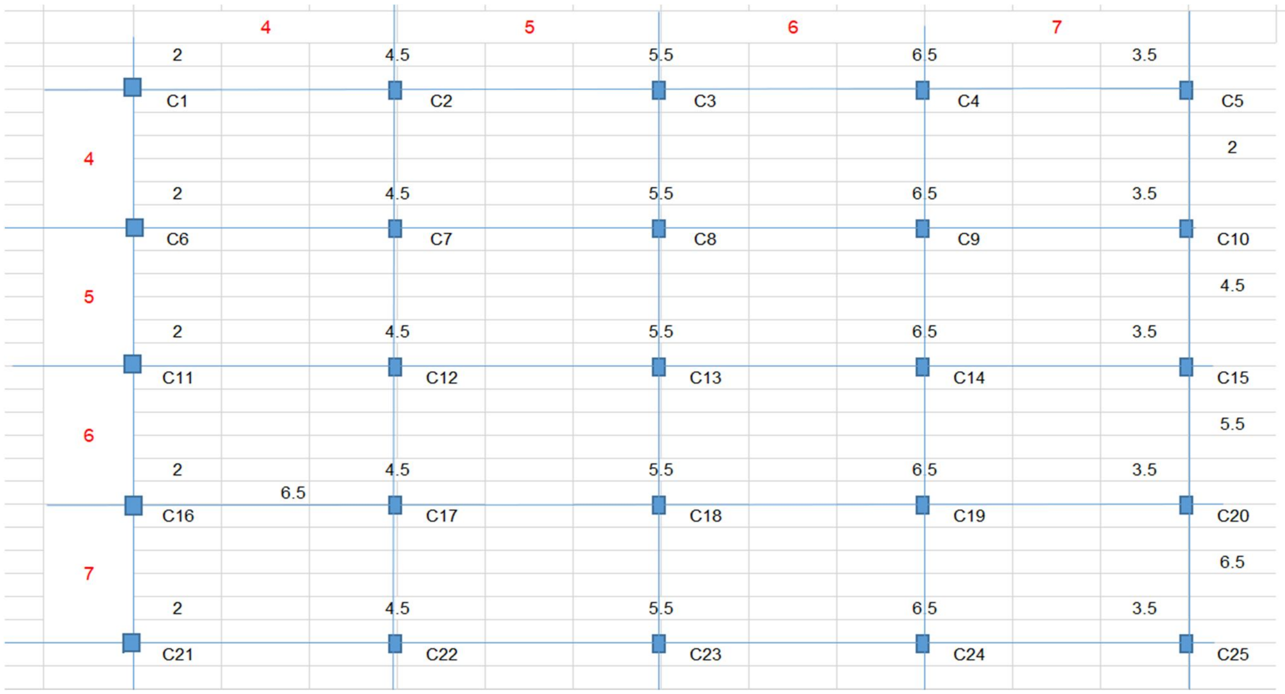

Fig 2

Self weight on column			
b	D	H	P
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99
0.23	0.38	3.20	6.99

Self Weight of Beam(KN)			
L	b	D	P
4.0	0.23	0.38	8.74
6.5	0.23	0.38	14.20
7.5	0.23	0.38	16.39
8.5	0.23	0.38	18.57
5.5	0.23	0.38	12.02
6.5	0.23	0.38	14.20
9.0	0.23	0.38	19.67
10.0	0.23	0.38	21.85
11.0	0.23	0.38	24.04
8.0	0.23	0.38	17.48
7.5	0.23	0.38	16.39
10.0	0.23	0.38	21.85
11.0	0.23	0.38	24.04
12.0	0.23	0.38	26.22
9.0	0.23	0.38	19.67
8.5	0.23	0.38	18.57
11.0	0.23	0.38	24.04
12.0	0.23	0.38	26.22
13.0	0.23	0.38	28.41
10.0	0.23	0.38	21.85
5.5	0.23	0.38	12.02
8.0	0.23	0.38	17.48
9.0	0.23	0.38	19.67
10.0	0.23	0.38	21.85
7.0	0.23	0.38	15.30

Self Weight on Slab(KN/m2)					
L	B	T	FF	LL	P
2.0	2.0	0.13	1	2	24.50
4.5	2.0	0.13	1	2	55.13
5.5	2.0	0.13	1	2	67.38
6.5	2.0	0.13	1	2	79.63
3.5	2.0	0.13	1	2	42.88
2.0	4.5	0.13	1	2	55.13
4.5	4.5	0.13	1	2	124.03
5.5	4.5	0.13	1	2	151.59
6.5	4.5	0.13	1	2	179.16
3.5	4.5	0.13	1	2	96.47
2.0	5.5	0.13	1	2	67.38
4.5	5.5	0.13	1	2	151.59
5.5	5.5	0.13	1	2	185.28
6.5	5.5	0.13	1	2	218.97
3.5	5.5	0.13	1	2	117.91
2.0	6.5	0.13	1	2	79.63
4.5	6.5	0.13	1	2	179.16
5.5	6.5	0.13	1	2	218.97
6.5	6.5	0.13	1	2	258.78
3.5	6.5	0.13	1	2	139.34
2.0	3.5	0.13	1	2	42.88
4.5	3.5	0.13	1	2	96.47
5.5	3.5	0.13	1	2	117.91
6.5	3.5	0.13	1	2	139.34
3.5	3.5	0.13	1	2	75.03

Table 1

Self Weight from Wall(KN/m)				Total Loads			
L	H	T	P	Indiuval Floor load	Load	Factored load	Column
4.0	2.82	0.23	46.70	86.93	189.59	284.39	C1
6.5	2.82	0.23	75.89	152.21	325.61	488.41	C2
7.5	2.82	0.23	87.56	178.32	380.01	570.02	C3
8.5	2.82	0.23	99.24	204.43	434.42	651.62	C4
5.5	2.82	0.23	64.21	126.10	271.20	406.80	C5
6.5	2.82	0.23	75.89	152.21	325.61	488.41	C6
9.0	2.82	0.23	105.07	255.76	538.18	807.27	C7
10.0	2.82	0.23	116.75	297.18	623.21	934.81	C8
11.0	2.82	0.23	128.42	338.61	708.24	1062.36	C9
8.0	2.82	0.23	93.40	214.34	453.15	679.73	C10
7.5	2.82	0.23	87.56	178.32	380.01	570.02	C11
10.0	2.82	0.23	116.75	297.18	623.21	934.81	C12
11.0	2.82	0.23	128.42	344.73	720.49	1080.73	C13
12.0	2.82	0.23	140.10	392.28	817.77	1226.65	C14
9.0	2.82	0.23	105.07	249.64	525.93	788.89	C15
8.5	2.82	0.23	99.24	204.43	434.42	651.62	C16
11.0	2.82	0.23	128.42	338.61	708.24	1062.36	C17
12.0	2.82	0.23	140.10	392.28	817.77	1226.65	C18
13.0	2.82	0.23	151.77	445.95	927.30	1390.95	C19
10.0	2.82	0.23	116.75	284.93	598.71	898.06	C20
5.5	2.82	0.23	64.21	126.10	271.20	406.80	C21
8.0	2.82	0.23	93.40	214.34	453.15	679.73	C22
9.0	2.82	0.23	105.07	249.64	525.93	788.89	C23
10.0	2.82	0.23	116.75	284.93	598.71	898.06	C24
7.0	2.82	0.23	81.72	179.04	380.37	570.56	C25

Table 2

C. *Design of Footing*

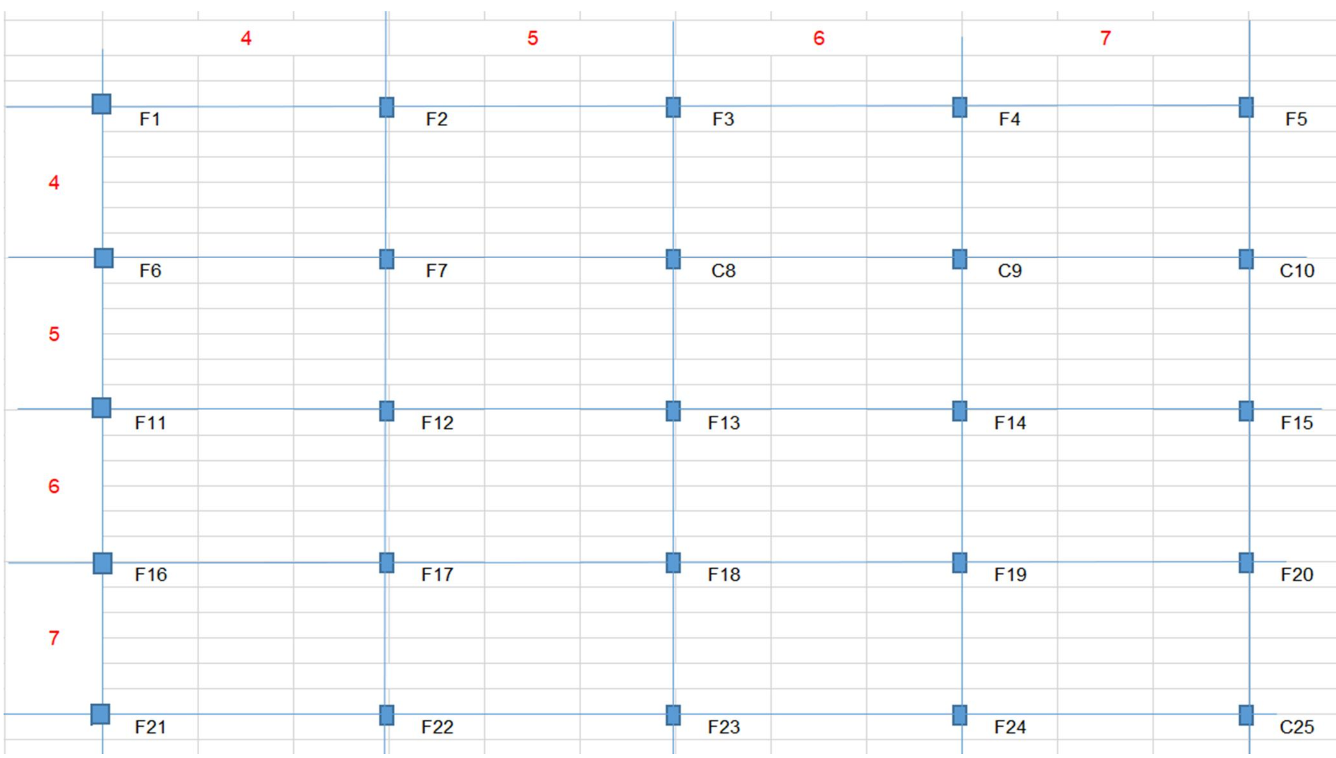

Fig 3

1) Inputs

Footing		
SBC	150	KN/m^2
Clear Cover	40	mm

2) Design

Design of Footing

Footing	Design load		Column Dimensions		Area Req	Area Provided	Footing Size Provided	
F-1	P	Pu	Width	Depth			L	B
	KN	KN	mm	mm	m2	m2	m	m
	208.55	284.39	230	380	1.39	1.56	1.25	1.25
							Footing Size OK	

Depth	Ast Required		Ast Provided	
	Across X	Across Y	Across X	Across Y
D (mm)	mm2	mm2	mm2	mm2
225	306.93	222.00	392.70	392.70
			Reinf OK	

One Way Shear along X-Direction	Two Way Shear check
One Way Shear Check OK	Two Way Shear Check OK

One Way Shear along Y-Direction
One Way Shear Check OK

Footing	Design load		Column Size		Area Req	Footing Size Provided		Area Provided	Net upward Pressure	
	P	Pu	B	D		L	B			
	KN	KN	mm	mm	m^2	m	m	m^2		
F-1	208.55	284.39	230.00	380.00	1.39	1.25	1.25	1.56	121.34	Footing Size OK
F-2	358.17	488.41	230.00	380.00	2.39	1.75	1.75	3.06	106.32	Footing Size OK
F-3	418.01	570.02	230.00	380.00	2.79	1.75	1.75	3.06	124.09	Footing Size OK
F-4	477.86	651.62	230.00	380.00	3.19	2.00	2.00	4.00	108.60	Footing Size OK
F-5	298.32	406.80	230.00	380.00	1.99	1.50	1.50	2.25	120.53	Footing Size OK
F-6	358.17	488.41	230.00	380.00	2.39	1.75	1.75	3.06	106.32	Footing Size OK
F-7	592.00	807.27	230.00	380.00	3.95	2.00	2.00	4.00	134.54	Footing Size OK
F-8	685.53	934.81	230.00	380.00	4.57	2.25	2.25	5.06	123.10	Footing Size OK
F-9	779.06	1062.36	230.00	380.00	5.19	2.50	2.50	6.25	113.32	Footing Size OK
F-10	498.47	679.73	230.00	380.00	3.32	2.00	2.00	4.00	113.29	Footing Size OK
F-11	418.01	570.02	230.00	380.00	2.79	1.75	1.75	3.06	124.09	Footing Size OK
F-12	685.53	934.81	230.00	380.00	4.57	2.25	2.25	5.06	123.10	Footing Size OK
F-13	792.54	1080.73	230.00	380.00	5.28	2.50	2.50	6.25	115.28	Footing Size OK
F-14	899.55	1226.65	230.00	380.00	6.00	2.50	2.50	6.25	130.84	Footing Size OK
F-15	578.52	788.89	230.00	380.00	3.86	2.00	2.00	4.00	131.48	Footing Size OK
F-16	477.86	651.62	230.00	380.00	3.19	2.00	2.00	4.00	108.60	Footing Size OK
F-17	779.06	1062.36	230.00	380.00	5.19	2.50	2.50	6.25	113.32	Footing Size OK
F-18	899.55	1226.65	230.00	380.00	6.00	2.50	2.50	6.25	130.84	Footing Size OK
F-19	1020.03	1390.95	230.00	380.00	6.80	2.75	2.75	7.56	122.62	Footing Size OK
F-20	658.58	898.06	230.00	380.00	4.39	2.25	2.25	5.06	118.26	Footing Size OK
F-21	298.32	406.80	230.00	380.00	1.99	1.50	1.50	2.25	120.53	Footing Size OK
F-22	498.47	679.73	230.00	380.00	3.32	2.00	2.00	4.00	113.29	Footing Size OK
F-23	578.52	788.89	230.00	380.00	3.86	2.00	2.00	4.00	131.48	Footing Size OK
F-24	658.58	898.06	230.00	380.00	4.39	2.25	2.25	5.06	118.26	Footing Size OK
F-25	418.41	570.56	230.00	380.00	2.79	1.75	1.75	3.06	124.20	Footing Size OK

Table 3

Across X		Across Y		Ast Provided		Ast Required		
				Across X	Across Y	Across X	Across Y	
Dia (mm)	Spacing (c/c)	Dia (mm)	Spacing (c/c)	mm^2	mm^2	mm^2	mm^2	
10	200	10	200	392.70	392.70	306.93	222.00	Reinf OK
10	150	10	150	523.60	523.60	424.66	342.13	Reinf OK
10	150	10	150	523.60	523.60	412.40	372.00	Reinf OK
10	150	10	150	523.60	523.60	492.77	409.92	Reinf OK
10	150	10	150	523.60	523.60	276.51	372.00	Reinf OK
10	150	10	150	523.60	523.60	424.66	342.13	Reinf OK
10	150	10	150	523.60	523.60	455.88	492.00	Reinf OK
10	150	10	150	523.60	523.60	512.93	522.00	Reinf OK
10	150	10	150	523.60	523.60	564.56	552.00	Increase Ast
10	150	10	150	523.60	523.60	473.48	402.00	Reinf OK
10	150	10	150	523.60	523.60	451.56	363.91	Reinf OK
10	135	10	135	581.78	581.78	512.93	522.00	Reinf OK
10	135	10	135	581.78	581.78	574.65	552.00	Reinf OK
10	125	10	125	628.32	628.32	619.05	582.00	Reinf OK
10	150	10	150	523.60	523.60	475.96	462.00	Reinf OK
10	150	10	150	523.60	523.60	390.90	462.00	Reinf OK
10	150	10	150	523.60	523.60	564.56	552.00	Increase Ast
10	150	10	150	523.60	523.60	586.79	612.00	Increase Ast
10	150	10	150	523.60	523.60	616.39	672.00	Increase Ast
10	150	10	150	523.60	523.60	438.85	582.00	Increase Ast
10	150	10	150	523.60	523.60	371.32	286.08	Reinf OK
10	150	10	150	523.60	523.60	473.48	402.00	Reinf OK
10	150	10	150	523.60	523.60	445.20	492.00	Reinf OK
10	150	10	150	523.60	523.60	524.16	492.00	Increase Ast
10	150	10	150	523.60	523.60	307.47	492.00	Reinf OK

Table 4

Depth	One Way Shear along X-Direction	One Way Shear along Y-Direction	Two Way Shear
D (mm)			
225	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
300	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
350	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
350	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
350	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
300	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
450	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
475	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
500	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
375	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
325	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
475	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
500	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
525	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
425	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
425	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
500	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
550	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
600	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
525	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
275	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
375	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
450	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
450	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK
450	One Way Shear Check OK	One Way Shear Check OK	Two Way Shear Check OK

Table 5

3) E-tab Results

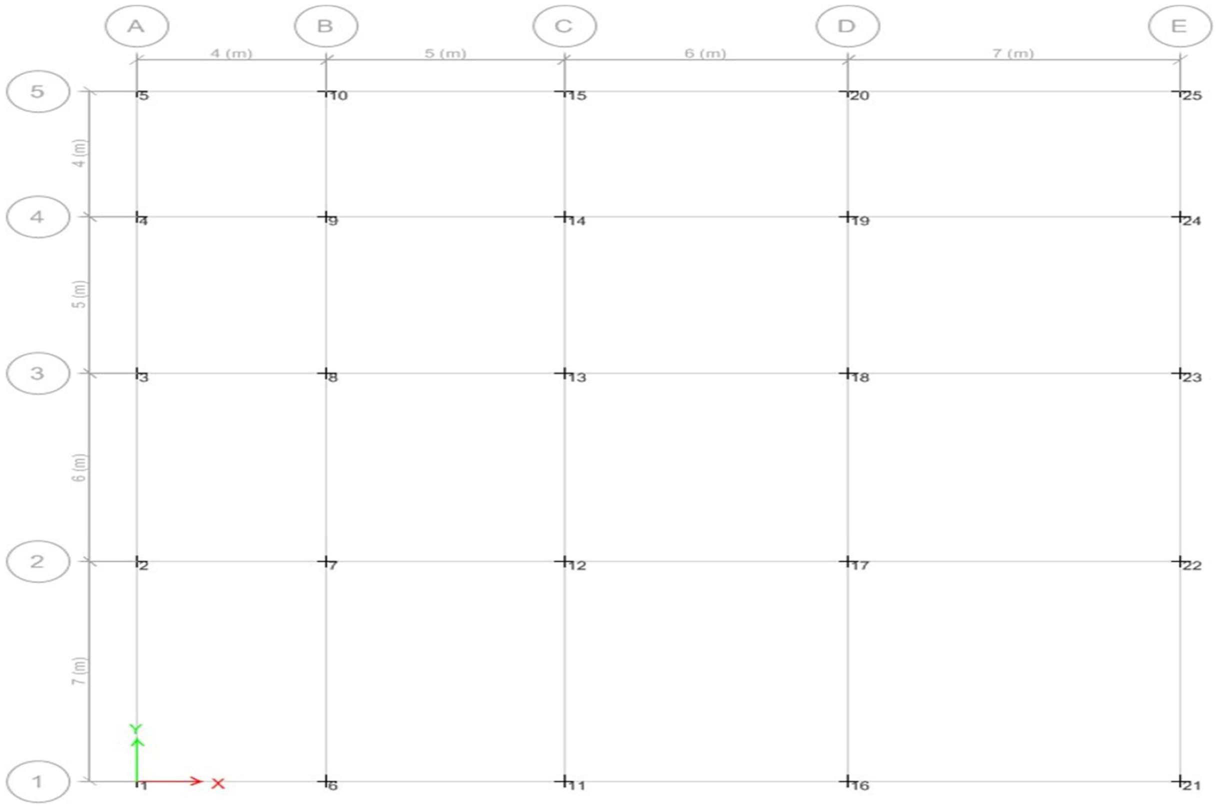

Fig 4

Footing	Force
F-1	240.04
F-2	434.52
F-3	510.3
F-4	624.66
F-5	344.78
F-6	454.4
F-7	765.4
F-8	886.69
F-9	1058.51
F-10	614.71
F-11	519.04
F-12	868.91
F-13	1013.25
F-14	1210.01
F-15	706.27
F-16	657.93
F-17	1073.47
F-18	1247.06
F-19	1463.09
F-20	876.03
F-21	342.72
F-22	589.55
F-23	692.7
F-24	835.42
F-25	480.8

Table 6

4) Validation of Results

Footing	E-tab Reults	Excel Results
F-1	240.04	284.39
F-2	434.52	488.41
F-3	510.3	570.02
F-4	624.66	651.62
F-5	344.78	406.80
F-6	454.4	488.41
F-7	765.4	807.27
F-8	886.69	934.81
F-9	1058.51	1062.36
F-10	614.71	679.73
F-11	519.04	570.02
F-12	868.91	934.81
F-13	1013.25	1080.73
F-14	1210.01	1226.65
F-15	706.27	788.89
F-16	657.93	651.62
F-17	1073.47	1062.36
F-18	1247.06	1226.65
F-19	1463.09	1390.95
F-20	876.03	898.06
F-21	342.72	406.80
F-22	589.55	679.73
F-23	692.7	788.89
F-24	835.42	898.06
F-25	480.8	570.56

Table 7

D. Design of Column

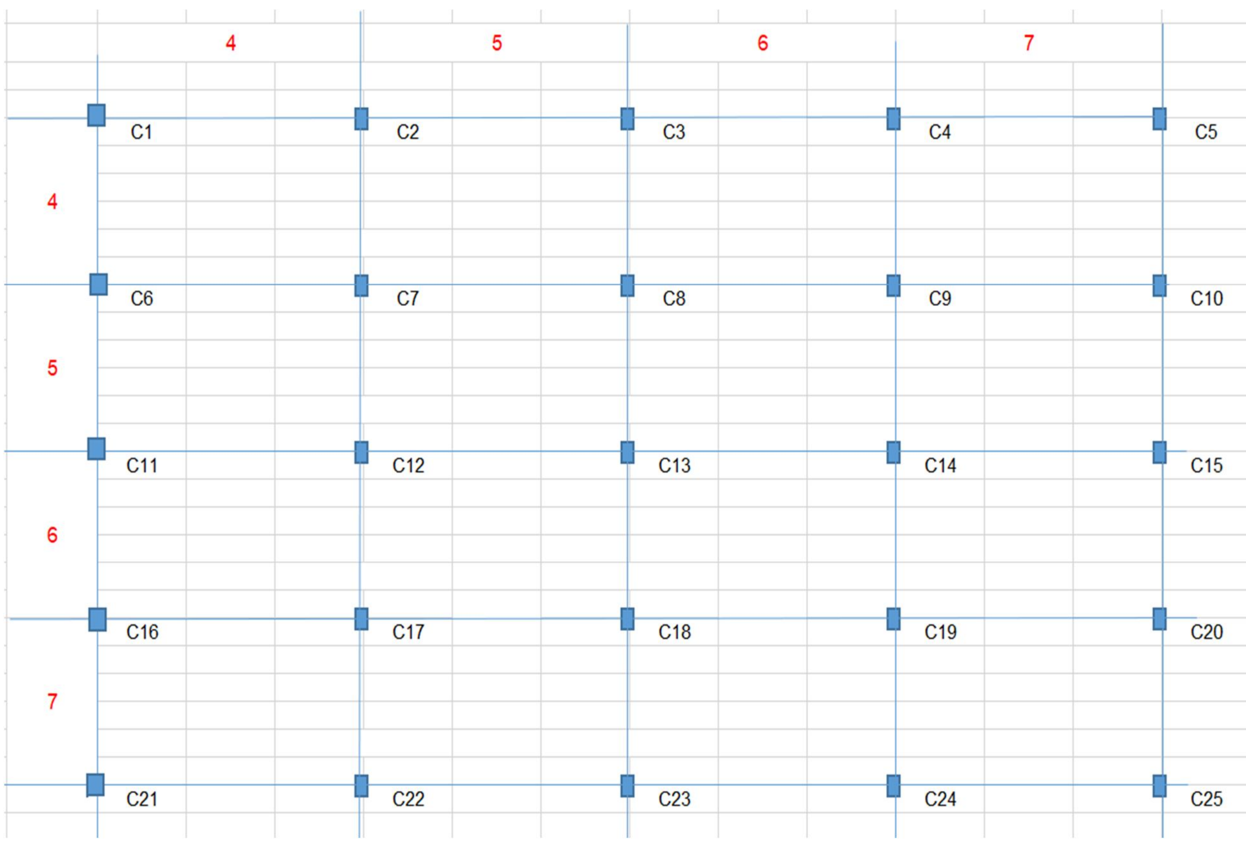

Fig 5

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1) Inputs

Column		
Column Breadth (B)	0.23	m
Column Depth (D)	0.38	m
Height (H)	3.2	m
Slab Thickness (T)	0.125	m
Wall Thickness	0.23	m
No of Slab	2	Units

2) Design

Design of RCC Rectangular Columns

Column Dimensions	
Width	Depth
mm	mm
230	380

Factored Forces & Moments		
Axial (Kn)	Bending Moment (Kn-m)	
(Pu)	(Mux)	(Mud)
284.39	10.00	10.00

Steel Percentage
pt (%)
0.37

Steel Percentage OK

Mux	Muy
FckBD2	FckDB2
0.092	0.096

Reinforcement			
No's	Dia	Ast	Percentage
6	12	678.58	0.78

Column		Pu	Mux	Muy	b	D	d'	Steel Percentage	Ast	Ast Min
								pt	mm^2	mm^2
C-1		284.39	10	10	230	380	40	1	874	699.2
C-2		488.41	10	10	230	380	40	1	874	699.2
C-3		570.02	10	10	230	380	40	1	874	699.2
C-4		651.62	10	10	230	380	40	1	874	699.2
C-5		406.80	10	10	230	380	40	1	874	699.2
C-6		488.41	10	10	230	380	40	1	874	699.2
C-7		807.27	10	10	230	380	40	1	874	699.2
C-8		934.81	10	10	230	380	40	1	874	699.2
C-9		1062.36	10	10	230	380	40	1	874	699.2
C-10		679.73	10	10	230	380	40	1	874	699.2
C-11		570.02	10	10	230	380	40	1	874	699.2
C-12		934.81	10	10	230	380	40	1	874	699.2
C-13		1080.73	10	10	230	380	40	1	874	699.2
C-14		1226.65	10	10	230	380	40	1	874	699.2
C-15		788.89	10	10	230	380	40	1	874	699.2
C-16		651.62	10	10	230	380	40	1	874	699.2
C-17		1062.36	10	10	230	380	40	1	874	699.2
C-18		1226.65	10	10	230	380	40	1	874	699.2
C-19		1390.95	10	10	230	380	40	1	874	699.2
C-20		898.06	10	10	230	380	40	1	874	699.2
C-21		406.80	10	10	230	380	40	1	874	699.2
C-22		679.73	10	10	230	380	40	1	874	699.2
C-23		788.89	10	10	230	380	40	1	874	699.2
C-24		898.06	10	10	230	380	40	1	874	699.2
C-25		570.56	10	10	230	380	40	1	874	699.2

Table 8

$Mux/FckbD^2$	$Muy/FckbD^2$	αn	$(Mux/Mux1)^{\alpha n}+(Muy/Muy1)^{\alpha n}$	
0.092	0.096	1	0.37	Steel Percentage OK
0.11	0.11	1	0.19	Steel Percentage OK
0.11	0.11	2	0.15	Steel Percentage OK
0.11	0.11	2	0.12	Steel Percentage OK
0.11	0.11	1	0.23	Steel Percentage OK
0.11	0.11	1	0.19	Steel Percentage OK
0.11	0.11	2	0.08	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.12	Steel Percentage OK
0.11	0.11	2	0.15	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.09	Steel Percentage OK
0.11	0.11	2	0.12	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	1	0.23	Steel Percentage OK
0.11	0.11	2	0.12	Steel Percentage OK
0.11	0.11	2	0.09	Steel Percentage OK
0.11	0.11	2	0.07	Steel Percentage OK
0.11	0.11	2	0.15	Steel Percentage OK

Table 9

No	Dia mm	Ast mm^2	Percentage
6	12	678.58	0.776
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594
10	20	3141.59	3.594

Table 10

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3) E-tab Results

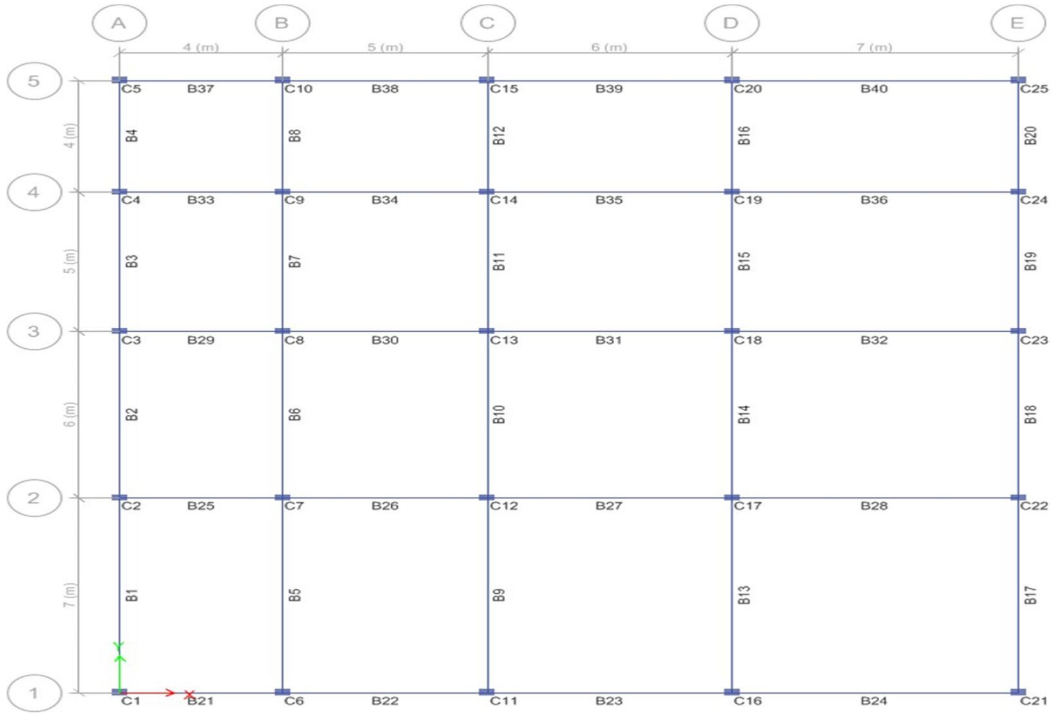


Fig 6

Column	Force
C-1	240.04
C-2	434.52
C-3	510.3
C-4	624.66
C-5	344.78
C-6	454.4
C-7	765.4
C-8	886.69
C-9	1058.51
C-10	614.71
C-11	519.04
C-12	868.91
C-13	1013.25
C-14	1210.01
C-15	706.27
C-16	657.93
C-17	1073.47
C-18	1247.06
C-19	1463.09
C-20	876.03
C-21	342.72
C-22	589.55
C-23	692.7
C-24	835.42
C-25	480.8

Table 11

4) *Validation of Results*

Footing	E-tab Reults	Excel Results
C-1	240.04	284.39
C-2	434.52	488.41
C-3	510.3	570.02
C-4	624.66	651.62
C-5	344.78	406.80
C-6	454.4	488.41
C-7	765.4	807.27
C-8	886.69	934.81
C-9	1058.51	1062.36
C-10	614.71	679.73
C-11	519.04	570.02
C-12	868.91	934.81
C-13	1013.25	1080.73
C-14	1210.01	1226.65
C-15	706.27	788.89
C-16	657.93	651.62
C-17	1073.47	1062.36
C-18	1247.06	1226.65
C-19	1463.09	1390.95
C-20	876.03	898.06
C-21	342.72	406.80
C-22	589.55	679.73
C-23	692.7	788.89
C-24	835.42	898.06
C-25	480.8	570.56

Table 12

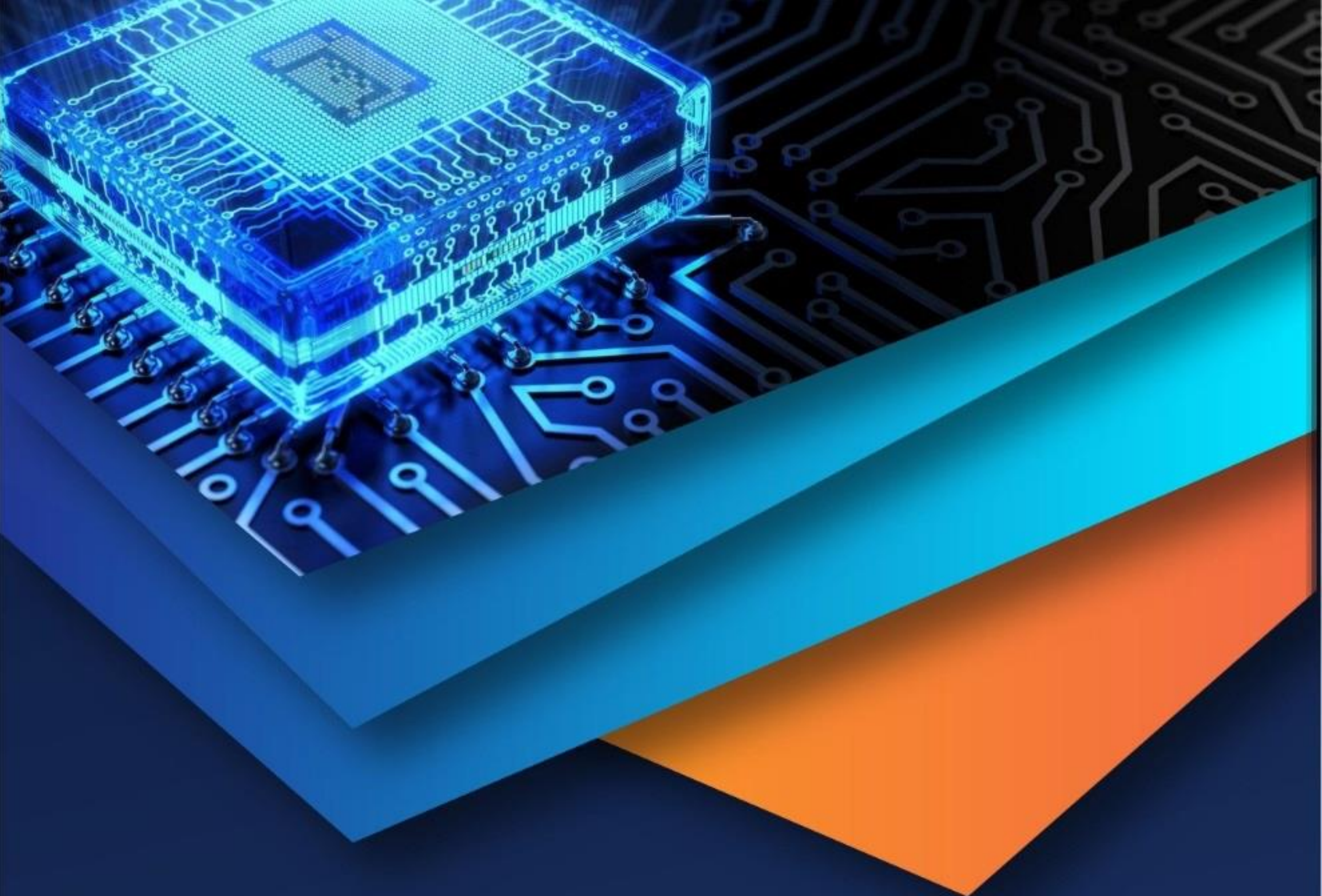
IV. CONCLUSION

A. It can be concluded that, the results obtained by Excel after comparison with E-tabs gives90 - 95% accuracy.
B. MS Excel sheet is a very useful tool for calculating the rebars of various RC elements suchas footing, columns, beams, and slabs.
C. These aid in the speedy design of buildings and other structures for a variety of applicationsand are effective.
D. For the design of reinforced concrete elements, these excel sheets can be used in conjunctionwith analytical software such as STAAD and ETABS.

REFERENCES

[1] Development of educational software for beam loading analysis using pen-based user interfaces Yong S. Suh, Journal of Computational Design and Engineering, Vol. 1, No. 1(2014) 67~77
[2] Reinforced Concrete Structure Design Assistant Tool for Beginners, Kang Kyu Choi,2002.
[3] Development of IOS Application for Design of Flat Slabs, Shree Lakshmi MJ1, Mr. Manjunath L2, Miss. Spandana B3, Ritesh L4, International Research Journal of Engineering and Technology (IRJET)
[4] Developing Civil Engineering Design Software using MS Excel. Varsha S Danavandi1, Shaik Kabeer Ahmed2, INTERNATIONAL JOURNAL OF CURRENT ENGINEERINGAND SCIENTIFIC RESEARCH 2017
[5] Using Spreadsheets a APPLICATIONS Nd VBA for Teaching Civil EngineeringConcepts, Essam Zaneldin
[6] DESIGN OF POST-TENSIONED PRESTRESSED CONCRETE BEAM USING EXCEL SPREADSHEET WITH VISUAL BASIC, RIMMON S. LABADAN, International Journal of Advances in Mechanical and Civil Engineering,2016

[7] Toward Reverse Engineering of VBA Based Excel Spreadsheets Applications, Domenico Amalfitano, Nicola Amatucci, Vincenzo De Simone, Anna Rita Fasolino, Porfirio Tramontana, 2015
[8] Santosh Kumar P.T. (2014) "Trends and recent advances in civil engineering (TRACE- 24th-25th January 2014), International Journal of Engineering Research and Applications(IJERA) ISSN:2248-9622
[9] Varsha S Damavand, Shaik Kabeer Ahmed (2017) "Developing civil engineering design software using MS EXCEL" ISSN:2349-0697, VOLUME-4, ISSUE5,2017
[10] Mahesh Kumar (2015) "quick design of buildings and other projects on MS EXCEL"
[11] Suryam Tiwari, Vijay Srivastav (2018) "Microsoft Excel Spreadsheet using VBA programming packages"-IJIRST-International Journal for Innovative Research in Scienceand Technology, Volume 4, Issue 11, April 2018, ISSN-(2349-6010).
[12] Ima Rahmanian, Yves Lucet, Solomon Tesfamariam (2014)" Optimal design of reinforced concrete beams", Computers and concrete, Volume 13, No.4(457-482).
[13] Fernandes R. J, Javeli F. M, Patil S. B (2017) "Analysis and Design of ReinforcedConcrete Beams and Columns using open STAAD", International Journal of Soft Computing and Engineering (IJSCE) ISSN:2231-2307, Volume-7 Issue-3.
[14] Richard Lawrene Emberley (2013)" behaviour of RC columns under fire exposures using a spreadsheet-based numerical model" Worcester Polytechnic Institute, may 2013
[15] Poonam Gare, Dr. S.S. Angalekar (2016) "Design of Structural Element EmployingOptimization Approach" International Journal of Innovative Research in Science, Engineering and Technology, Volume-5, Issue-7 July 2016



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