APPROVAL SHEET

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ACKNOWLEDGEMENT

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We would like to express for his good responsibility support to share his experience on project work, who gave us valuable suggestion & consistent comments while advising & guiding us in all respect.

Finally, we give thanks to all our Family and friends those who gave us materials and moral support.

THANKS!!!

ABSTRACT

The objective of this project is to examine the integrated techniques used in the design of a building.

The structural design of this hotel purpose building involves design of ribbed & flat slabs. Live load and dead load analysis is made according to EBCS-1, 1995 & ACI code. After the minimum depths of slab for serviceability limit state were determined, the slabs were designed for partition load, floor finish using self-weight load and live loads according to EBCS-1, 1995. The Ribbed slabs and flat slab were analyzed by using different combinations and analyzed for the worst load condition.

The limit state design method has been adopted for the design of the components. The Ethiopian Building code of standards (EBCS-1, EBCS-2 & EBCS-8 1995) & ACI Code design charts are used.

Cost Comparison Conclusion among the two types of slabs:

The amount of concrete casted in the flat slab is much thicker than that of concrete casted in in the joists between hollow concrete block of ribbed slab.

But also the number of bars used in flat slab is much higher than that of ribbed slab.

As a result of materials listed above the cost of the flat slab is more expensive than ribbed slab design. However, the structure has good strength to resist the loads of the structure.

In both buildings, the cost of the flat slab is expensive than the ribbed slab. Since ribbed slab is economical than the flat slab the building to be constructed by using ribbed slab type.

TABLE OF CONTENT

Contents Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figures Page

CHAPTER ONE

INTRODUCTION

Structural design is a very essential science in many civil engineering works due to the safety of the design and the economic benefit of the constructed works. These structural designs with reinforcing concrete aims at determine the size of each structural component on slabs and the necessary reinforcement that should be applied to the structural members.

One engineer should be responsible for the overall design, including stability, and should insure the compatibility of the design and details of parts and components even where some or all of the design and details of those parts and components are not made by the same engineer.

This paper is prepared in partial fulfillment for the B.Sc. degree in civil engineering. The project is a structural design of a G+5 in situ ribbed slab & flat slab and their cost estimation which is for a hotel purpose.

In the design of the slabs, we have used ribbed & flat slabs for all the floors. Limit state design method has been adopted for the whole components. Ethiopian building code of standard EBCS 1, EBCS 2 and EBCS 8, are referred for the design of slabs of the building.

CHAPTER TWO

2.1 SLAB DESIGN FOR G+5

2.1.1 Ribbed Slab Design for G+5

General requirements According to EBCS 2-1995: -

Because joists are closely spaced, thickness of slab (topping), $t_{slab} \geq 40$ mm or 1/10 clear distance between ribs.

The topping shall be provided with a reinforcement mesh providing in each direction a cross sectional area not less than 0.001 of the section of the slab.

Unless calculation requires, minimum reinforcement to be provided for joists include two bars, where one is bent near the support and the other straight.

Rib width $b_w \geq 70$ mm, and overall depth $D_j \leq 4\, b_{w,joist}$, excluding t_{slab}

Rib spacing is generally less than 1 m.

In case of rib spacing larger than 1 m, the topping need to be designed as if supported on ribs (i.e. as one-way solid slab between the ribs).

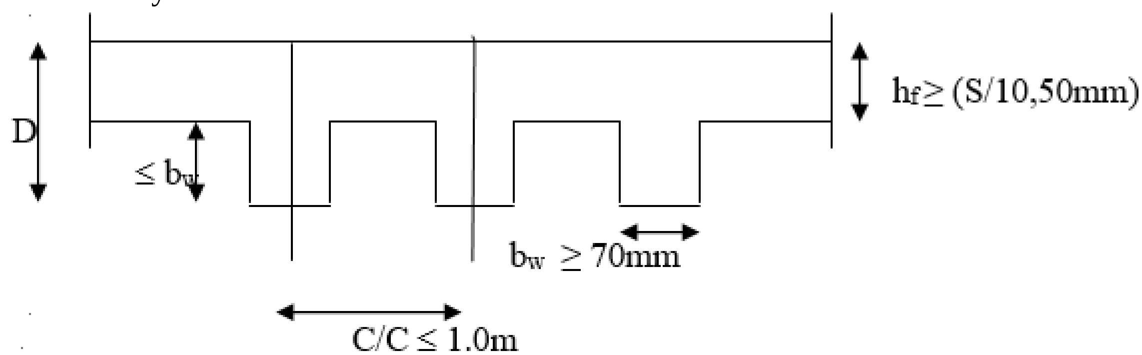
If the span of the ribs exceeds 6 m, transverse ribs may be provided.

When transverse ribs are provided, the center to center distance shall not exceed 20 times the overall depth of the ribbed slab.

The transverse ribs shall be designed for at least half the values of maximum moments and shear force in the longitudinal ribs.

The girder supporting the joist may be rectangular or T-beam, with the flange thickness equal to the floor thickness.

Geometry



Procedure for design of a floor system of ribbed slab:

Thickness of topping and ribs assumed based on minimum requirements.

Loads may be computed on the basis of center line of the spacing of joists.

The joists are analyzed as continuous T-beams supported by girders.

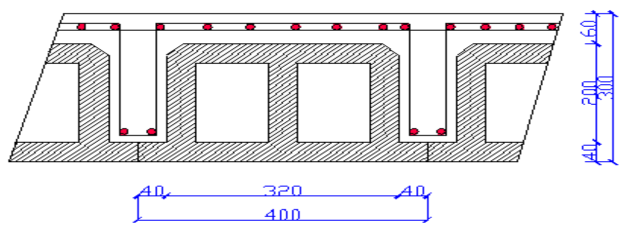
Determine flexural reinforcement and consider minimum provision in the final solution. Provide the topping or slab with reinforcement as per temperature and shrinkage requirement. Design the girder as a beam.

2.1.1.1 Design constant

- Concrete C-25 = f_{cu} unit weight -25
- Steel - 300 for class I work, γc =1.5 & γs = 1.15
- f_{cd}= 0.68*f_{cu}/1.5 = 11.33 MPa or fcd = 0.85fck/ γc =11.33 Mpa
- f_{ck} = 0.8 f_{cu} = 20 MPa
- f_{ctd} = 0.21 [f_{ck}^ (2/3)]/γ_c= 1.032 MPa
- f_{yd} = f_{yk}/ γ_s = 260.87 MPa
- m = f_{yd}/ [0.8f_{cd}] = 28.78
- C1=2.5/m = 0.087
- C2 = 0.32*m^2*f_{cd} = 3003.04MPa
- $\varepsilon cu = 0.0035$
- $\varepsilon yd = \frac{\mathbf{fyd}}{\mathbf{Es}} = \frac{260.87*10^6}{200*10^9} = 0.001304$
- $\rho b = \left(\frac{0.8*\varepsilon cu}{\varepsilon cu+\varepsilon yd}\right)\left(\frac{fcd}{fyd}\right) = \left(\frac{0.8*0.0035}{0.0035+0.001304}\right)\left(\frac{11.33}{260.87}\right) = 0.02531$
- $\rho\ max = 0.75 * \rho b = 0.75 * 0.02531 = 0.019$
- $\rho min = \frac{0.5}{fyk} = \frac{0.5}{300} = 0.00139$

Depth determination

- h_f =60mm
- D=300mm
- C/C =400mm
- b_w =80mm
- And we assumed HCB of size shown below



A) Depth determination

$$d \geq \left(\frac{0.4 + 0.6 * f_{yk}}{400}\right) * \frac{L_e}{\beta_a}$$

Where:-

f_{yk}=characteristics tensile strength of steel

Le=effective span

β_e=accounts for the boundary condition and span ration for slabs

Overall depth,

D = d + clear cover + ϕ_s

Step-2

Suitable dimension for the ribbed should be assumed considering deflection requirement and construction suitability.

Depth determination

$$d \geq \left(\frac{0.4 + 0.6 * f_{yk}}{400}\right) * \frac{L_e}{\beta_a}$$

d> 0.4+0.6*300/400)4700/24 =199.97

D = 199.97+15+12/2 =220.75mm

Use D = 300mm

2.1.1.2 5TH FLOOR SLAB DESIGN

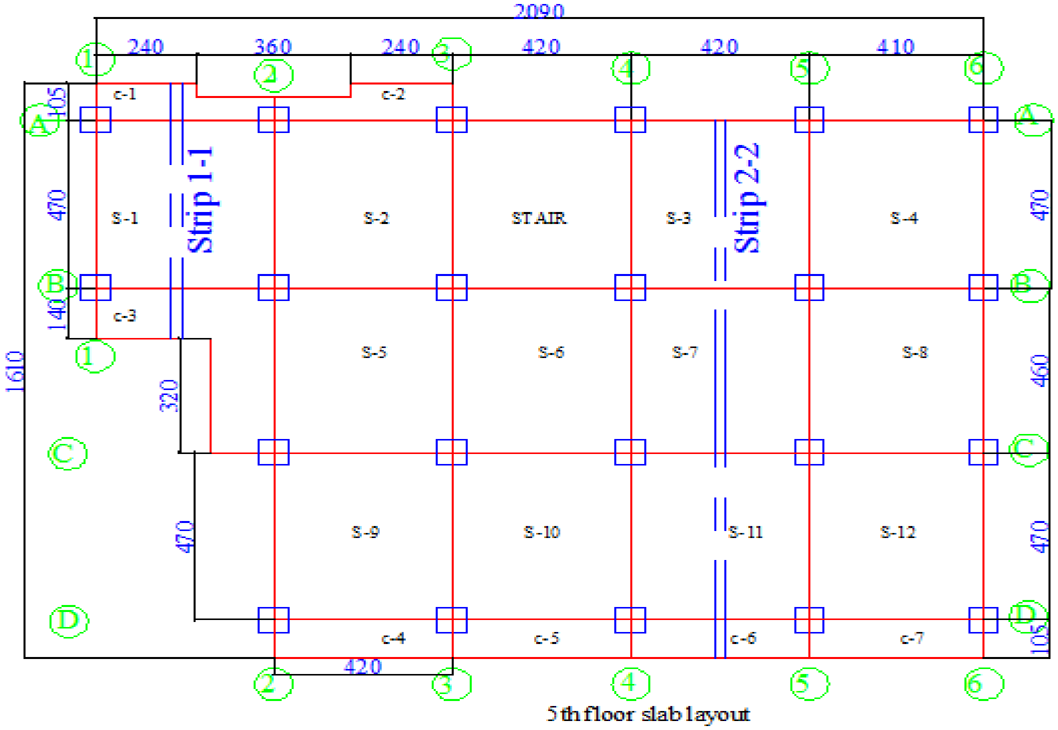


Figure 1 5th floor slab layout

2.1.1.2.1 Loading of ribbed slabs

The functions of the floors are mainly for Hotel with live load of $3KN/m^2$ and panels for toilets with live load of $2KN/m^2$. The spans of the floors are to some extent long. Hence it is designed as ribbed slab rather than solid slab as the live load is moderately light. This makes the design to be more economical. All of the joists are arranged in the shorter span of panels

Span 1

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.384KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.15*6.41*2.9*12*0.4/19.74 = 0.6775KN/m
- Plastering = 2*0.02*6.41*2.9*20*0.4/ = 0.3001KN/m

Total dead load = 2.504KN/m

Live load

Since our building hotel type we took live load is $2KN/m^2$ from EBCS-1, 1995

Live load = $0.4m*2KN/m^2$ = 0.8KN/m

Design load, P_d

P_d = 1.3DL + 1.6LL = 1.3*2.504 + 1.6*0.8 = 3.922KN/m

Span 2

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.384KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.15*6.55*2.9*12*0.4/19.74 = 0.6927KN/m
- Plastering = 2*0.02*6.55*2.9*20*0.4/19.74 = 0.3077KN/m

Total dead load = 2.522KN/m

Live load

Since our building hotel type we took live load is $2KN/m^2$ from EBCS-1, 1995

Live load = $0.4m*2KN/m^2$ = 0.8KN/m

Design load, P_d

P_d = 1.3*DL + 1.6*LL = 1.3*2.522 + 1.6*0.8 = 3.922KN/m

Span -3

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.384KN/m
- Ceramic tile = 0.02*23*0.4 = 0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plastering = 0.02*24*0.4 =0.192KN/m

Total dead load = 1.732KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*1.732 + 1.6*0.8 = 3.531KN/m

Span 4

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 0.03cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m

- Ceramic tile = 0.02*23*0.4=0.184KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 3.65*2.9*0.2*14*0.4/19.27 = 0.6149kN/m
- Plastering = 2*3.65*2.9*0.02*20*0.4/19.27 = 0.40217KN/m

Total dead load (ΣDL) = 2.372KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.732+ 1.6*2 = 6.28kN/m

Span 5

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 3.25*2.9*0.2*14*0.4/19.32 = 0.546KN/m
- Plastering = 2*3.25*2.9*0.02*20*0.4/19.32 = 0.2717kN/m

Total dead load (ΣDL) = 2.118KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.118 + 1.6*2 = 5.95KN/m

Span 6

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 3.1*2.9*0.2*14*0.4/19.32 = 0.5202KN/m
- Plastering = 2*3.1*2.9*0.02*20*0.4/19.32 = 0.1488KN/m

Total dead load (ΣDL) = 2.092KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.092 + 1.6*2 = 5.91KN/m

Span 7

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 6.72*2.9*0.2*14*0.4/19.32 = 0.9124KN/m
- Plastering = 2*6.72*2.9*0.02*20*0.4/19.32 = 0.322KN/m

Total dead load (ΣDL) = 2.71KN/m

Live load

Live load (LL) = 0.4*5= 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.71 + 1.6*2 = 6.72KN/m

Span 8

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.384KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.15*5.92*2.9*12*0.4/18.86 = 0.6548KN/m
- Plastering = 2* 0.02*5.92*2.9*20*0.4/18.86 = 0.176KN/m

Total dead load = 2.343KN/m

Live load

Live load (LL) = 0.4*5= 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.343 + 1.6*2 = 6.24KN/m

Span 9-12

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.384KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m

Total dead load = 1.72KN/m

Live load

Live load (LL) = 0.4*3= 1.2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*1.72+ 1.6*1.2 = 4.156KN/m

Cantilever load

C1

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m

Total dead load = 1.568KN/m

Glazing = 0.002*1.2*3.13*27*0.4/2.54=0.0319KN/m

Total dead load = 0.0319KN/m

Live load

Live load (LL) = 0.4*2 = 0.8 KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*1.568 + 1.6*0.8 = 3.3KN/m

Factored glazing load=1.3*0.0319 = 0.04147KN

C2

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m

Total dead load = 1.5808KN/m

Partition wall load

- Partition wall = 0.2*1.9*2.7*14*0.4/0.912 = 6.3KN
- Plastering = 2* 0.02*1.9*2.7*20*0.4/0.912 = 1.8KN

Total dead load = 8.1KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*1.5808 + 1.6*0.8 = 3.335KN/m

Factored partition wall load=1.3*8.1 = 10.53KN

C3-C6

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m

Total dead load = 1.568KN/m

- Glazing= 0.004*2.7*0.95*25*0.4/3.99=0.0257KN/m
- Partition wall = 0.2*2.24*2.7*14*0.4/3.99 = 1.697KN
- Plastering = 2* 0.02*2.24*2.7*20*0.4/3.99 = 0.485KN

Total dead load = 2.208KN/m

Live load

Live load (LL) = 0.4*4 = 1.6KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*1.568 + 1.6*1.6 = 4.598KN/m

Factored load=1.3*2.208 =2.8704 KN

SPAN	DL(KN/m)	LL(KN/m)	1.3*DL(KN/m)	1.6*LL(KN/m)	Pd
S1	2.504	0.8	3.2552	1.28	4.5352
S2	2.522	0.8	3.2786	1.28	4.5586
S3	1.738	0.8	2.2594	1.28	3.5394
S4	2.372	2	3.0836	3.2	6.2836
S5	2.118	2	2.7534	3.2	5.9534
S6	2.092	2	2.7196	3.2	5.9196
S7	2.71	2	3.523	3.2	6.723
S8	2.343	2	3.0459	3.2	6.2459
S9	1.72	1.2	2.236	1.92	4.156
S10	1.72	1.2	2.236	1.92	4.156
S11	1.72	1.2	2.236	1.92	4.156
S12	1.72	1.2	2.236	1.92	4.156

Table 1 Design load

2.1.1.2.2 Analyzing and Modeling

We model the ribs as continuous beams and the direction of ribs is chosen in the shorter direction but some ribs

A) Check the depth for deflection

$$d \geq \left(0.4 + \frac{0.6 f_{yk}}{400}\right)\frac{L_e}{\beta_a}$$

Where: f_{yk}=characteristics tensile strength of steel

Le=effective span=4.2m

β_e=accounts for the boundary condition and span ration for slabs

Overall depth,

$D = d + \phi_{l/2} + \phi_s + c$

$$d = (0.85)\frac{L_e}{\beta_a} = (0.85)\frac{4200}{24} = 198.75mm$$

Overall depth of the joist = D= 198.75 + 15 + 12/2 = 219.75 mm,

Provide D=300 mm

Overall depth of the joist $D \leq 4\, b_{w,joist}$ = 4(80) = 320 mm.

300mm≤320mm ……………………………… D provided is OK

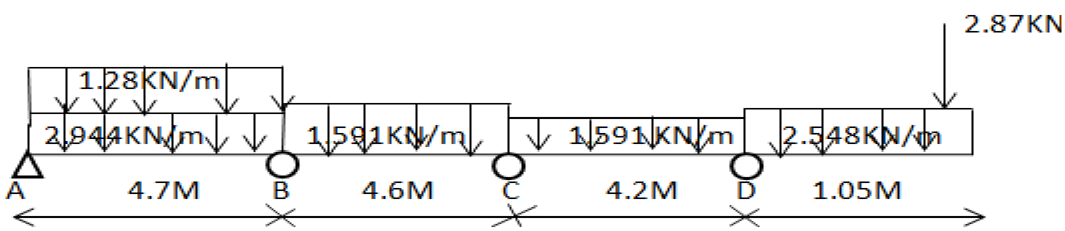
Thickness of slab (topping), $t_{slab} \geq 40$ mm

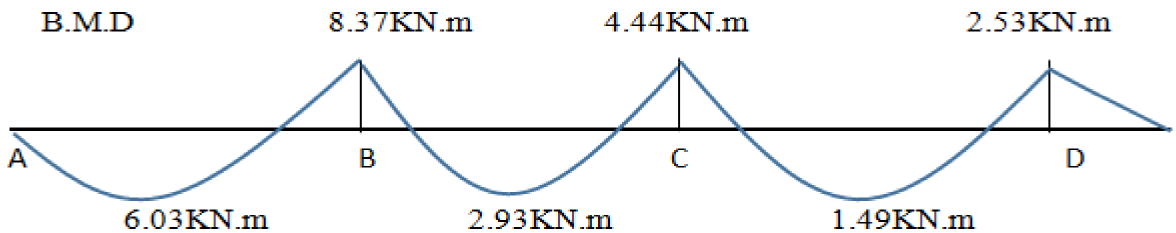
In our problem, t_{slab} = 60 mm ≥ 40 mm ………… OK

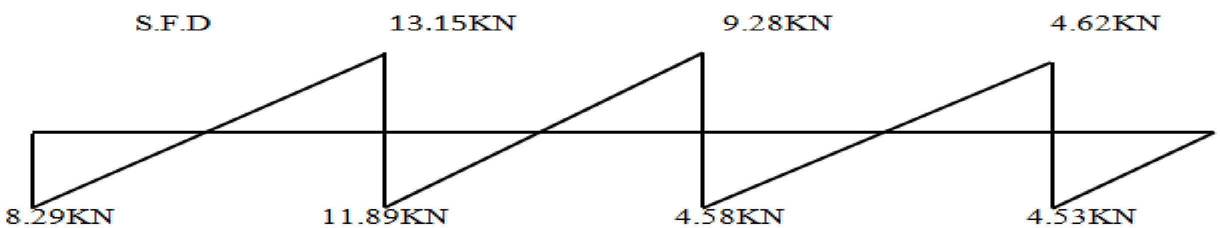
For the analysis, we model the ribs as continuous beams and the direction of ribs is chosen in the shorter direction but some ribs run in the longer direction in contrast to the above theory for construction simplicity. By creating different combination for the continuous ribs and using their design load (Pd =1.3DL+1.6LL) we analyze using sap then we can get support moment, span moment and reaction force for every panel of the floor system

Case-1

When the live load act on span –AB

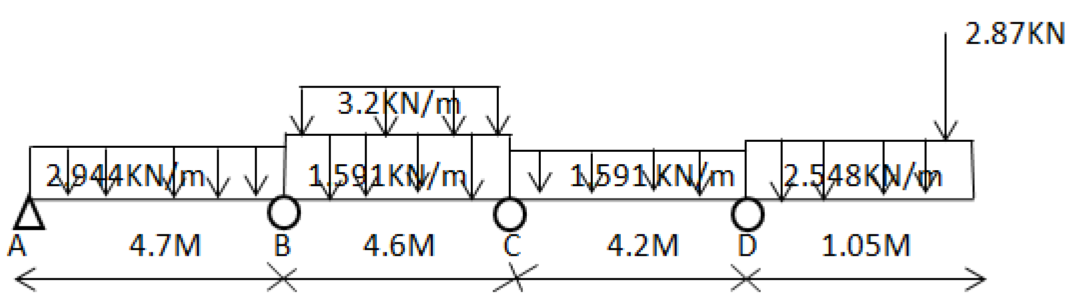






Case-2

When the live load act on span –BC



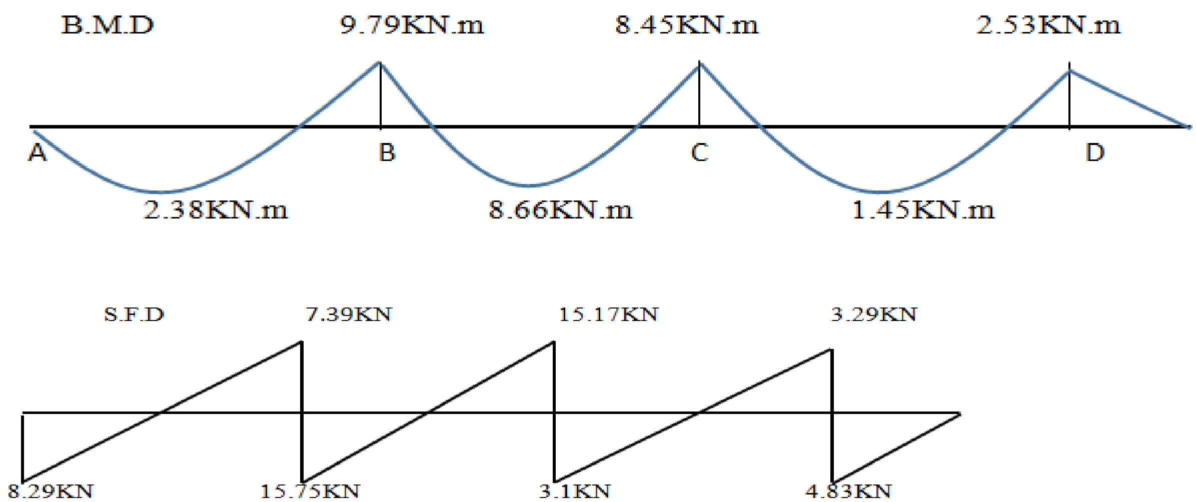
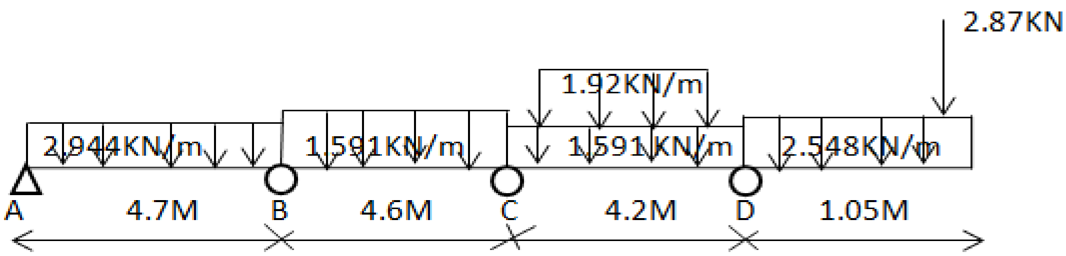
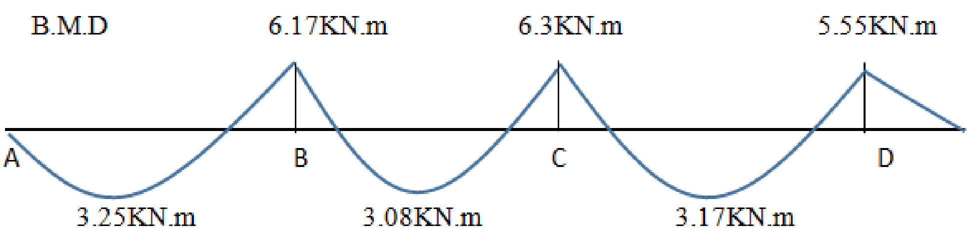


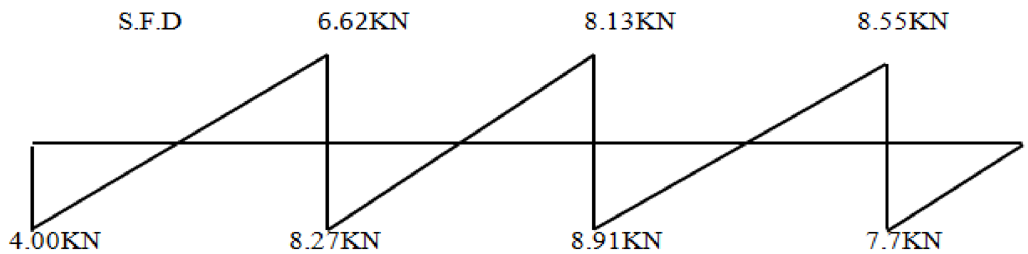
Figure 2 SFD & BMD

Case-3

When the live load act on span –CD

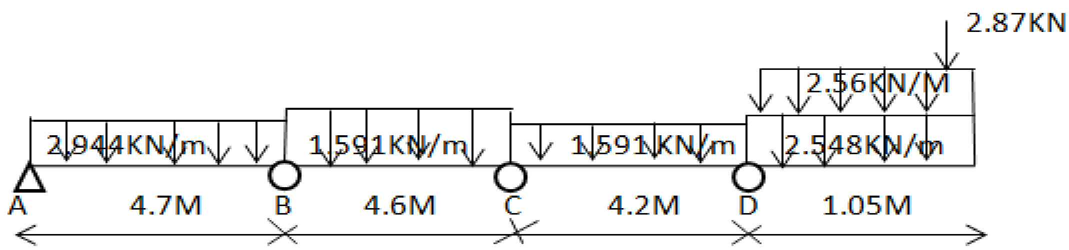


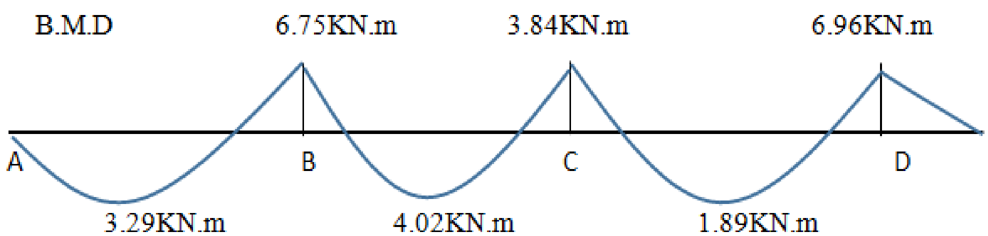


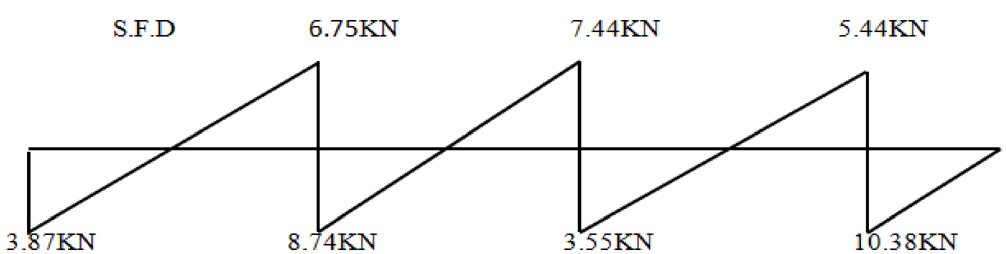


Case-4

When the live load act on cantilever

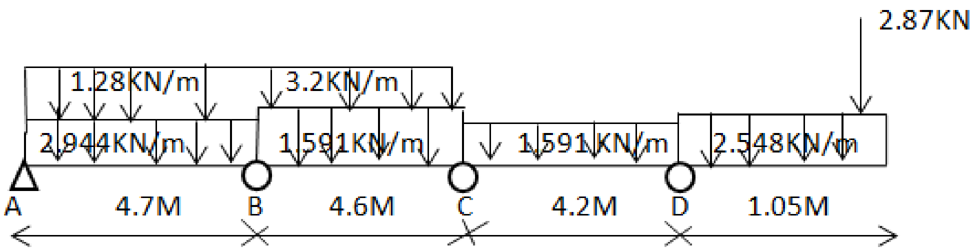


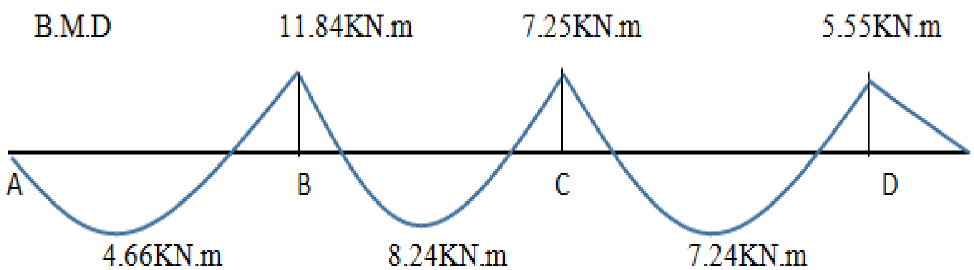


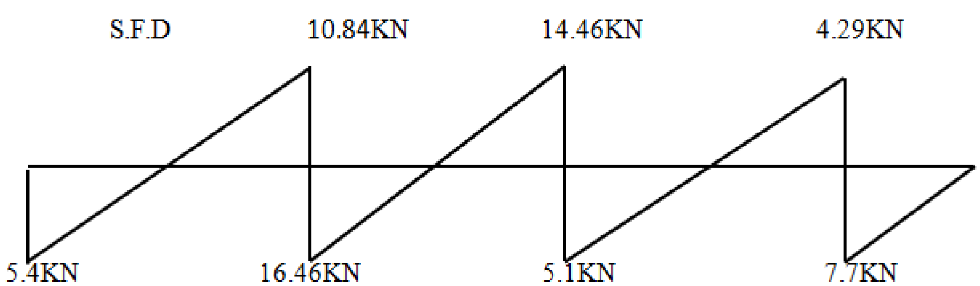


Case-5

When the live load act on span –AB&BC

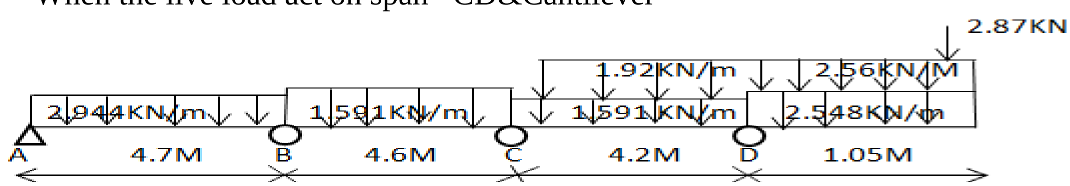


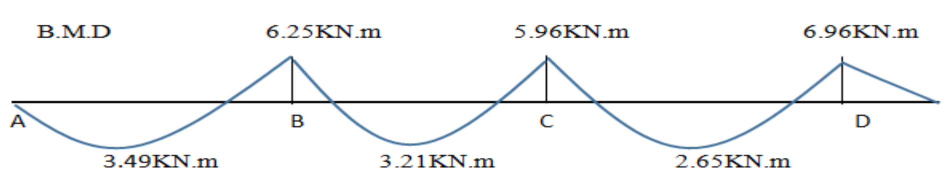


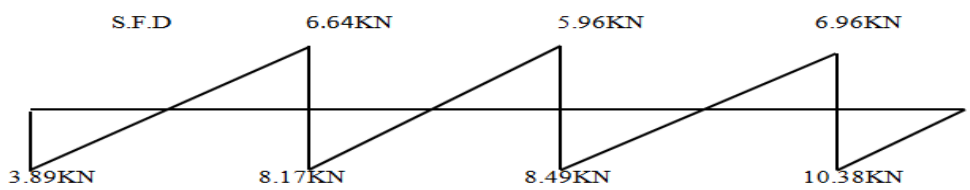


Case-6

When the live load act on span –CD&Cantilever

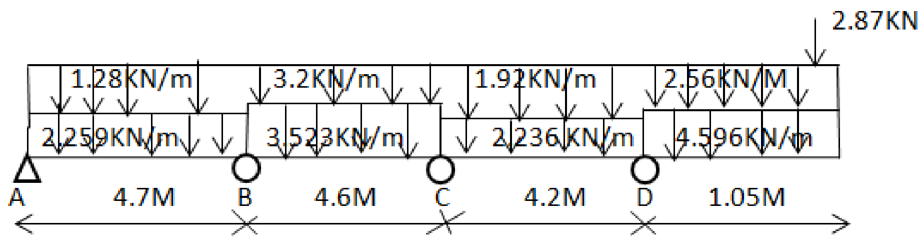


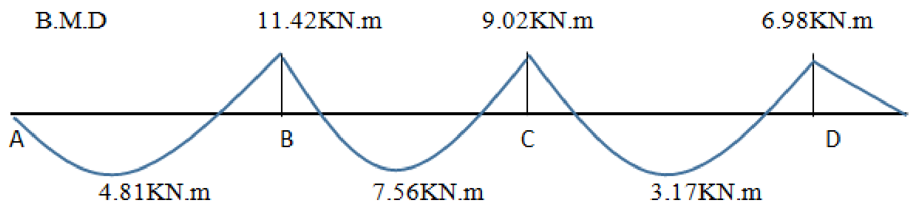


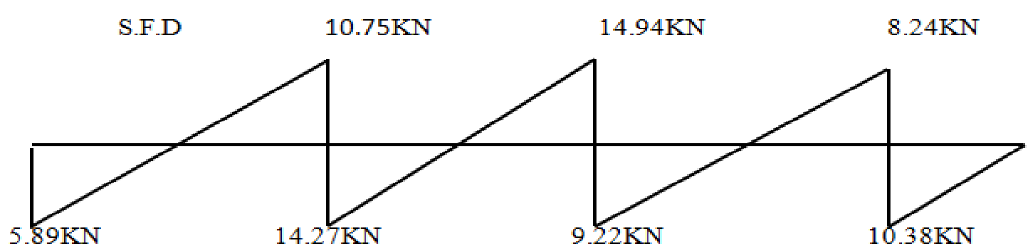


Case-7

When the live load act on the whole span







Span	1.3DL (KN/m)	1.6LL (KN/m)	M max @ mid span (KN/m)	M max @ sup. Span (KN/m)	V max(KN/M
S1	3.2552	1.28	6.57	10.01	11.904
S2	3.2786	1.28	5.38	8.75	12.5
S3	2.2594	1.28	8.66	11.84	15.75

S4	3.0836	3.2	7.43	13.2	16.1
S5	2.7534	3.2	5.38	8.75	12.5
S6	2.7196	3.2	6.35	8.7	12.4
S7	3.523	3.2	8.66	11.84	15.75
S8	3.0459	3.2	7.43	13.2	16.1
S9	2.236	1.92	5.38	8.75	12.5
S10	2.236	1.92	6.35	8.7	12.4
S11	2.236	1.92	8.66	11.84	15.75
S12	2.236	1.92	7.43	13.2	16.1
C1	3.34147	1.28	6.57	10.01	11.904
C2	13.865	1.28	5.38	8.75	12.5
C3	13.865	1.28	6.57	10.01	11.904
C4	3.34147	2.56	6.35	8.7	12.4
C5	7.4664	2.56	6.57	10.01	11.904
C6	7.4664	2.56	7.43	13.2	16.1

Table 2 Moment and shear force

2.1.1.2.3 Check the depth for flexure for 5th floor

$$d \geq \sqrt{\frac{Mu}{0.1982bfcd}} = \sqrt{\frac{13.2*10^6}{0.1982*80*11.33}}$$

= 270.28 mm < the depth provided. Hence ok.

2.1.1.2.4 Design for Reinforcement bars for 5th floor

A) Negative Bars

Using maximum negative moment

M_{max} =13.2KN/M

T- Section is subjected to –ve bending moment and analyze the section as a rectangular section of width (b_w) =80mm

Therefor D=300mm, b=80

d = D-d'-=300-15-6 = 279mm

As= ρ*b*d

$$\rho = \frac{1}{2}\left[c_{1-}\sqrt{c_1^2 - \frac{4Md}{bd^2c_2}}\right]$$

$$\rho = \frac{1}{2}\left[0.087 - \sqrt{0.087_1^2 - \frac{4*13.2*10^6}{80*279^2*3003.04}}\right] = 0.009758$$

$$\rho_{min} = \frac{0.5}{fyk} = 0.5/300 = 0.00167$$

$\rho_{min} < \rho < \rho_{max}$

Therefore: - {0.00167 < 0.009758 < 0.019}

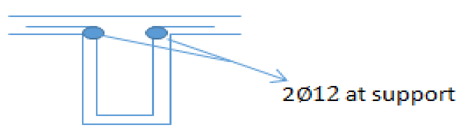
As = ρ*b*d= 0.009758*80*279 = 210.7622mm2

Using Φ12, $as = \frac{\pi}{4}12^2 = 113mm$

Number of bars = $\frac{As}{as} = \frac{210.7622}{113}$ =1.865mm

So that used to = 2Φ12

Provide 2Φ12



B) Positive bars

M_{max} =7.4269KN/M

b_e = 400mm

$$\rho = \frac{1}{2}\left[c_{1-}\sqrt{c_1^2 - \frac{4Md}{bd^2c_2}}\right]$$

$$\rho = \frac{1}{2}\left[0.087 - \sqrt{0.087_1^2 - \frac{4*7.43*10^6}{400*279^2*3003.04}}\right] = 0.000922 \text{ below minimum}$$

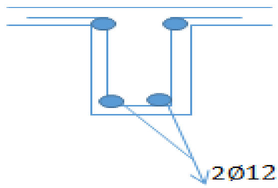
so that used = 0.001667

X = ρ*m*d = 0.00167*28.78*279= 13.409

Y = 0.8X=0.8*13.409 = 10.73mm

Y < (h_f =50mm)

Therefore, analyze the beam as rectangular with b = b_e
As = ρ b_ed = 0.001667*400*279 = 186.372
Using Φ12, a = (π * 12^2/4) = 113mm^2
Number of bars As/a = 186.372/113= 1.649
Provide 2Φ12



Negative bars							
Span no	Depth	b_w	ρ_{max}	As	As	No of bars	Provided bars
s1	279	80	0.007159	154.6254	113	1.368367	2Φ12
s2	279	80	0.006182	133.5286	113	1.701002	2Φ12
s3	279	80	0.008626	186.3176	113	1.648828	2Φ12
s4	279	80	0.009758	210.7622	113	1.865152	2Φ12
s5	279	80	0.006182	133.5286	113	1.701002	2Φ12
s6	279	80	0.006144	132.7028	113	1.690482	2Φ12
s7	279	80	0.008626	186.3176	113	1.648828	2Φ12
s8	279	80	0.009758	210.7622	113	1.865152	2Φ12
s9	279	80	0.006182	133.5286	113	1.701002	2Φ12
s10	279	80	0.006144	132.7028	113	1.690482	2Φ12
s11	279	80	0.008626	186.3176	113	1.648828	2Φ12
s12	279	80	0.009758	210.7622	113	1.865152	2Φ12
C1	279	80	0.007159	154.6254	113	1.368367	2Φ12

C2	279	80	0.006182	133.5286	113	1.701002	2Φ12
C3	279	80	0.007159	154.6254	113	1.368367	2Φ12
C4	279	80	0.006144	132.7028	113	1.690482	2Φ12
C5	279	80	0.007159	154.6254	113	1.368367	2Φ12
C6	279	80	0.009758	210.7622	113	1.865152	2Φ12
C7	279	80	0.007159	154.6254	113	1.865152	2Φ12

Positive bars							
Span no	Depth	b_w	ρ_{max}	As	As	No of bars	Provided bars
s1	270	400	0.001667	179.9928	113	1.59285	2Φ12
s2	270	400	0.001667	179.9928	113	1.592857	2Φ12
s3	270	400	0.001667	179.9928	113	1.592857	2Φ12
s4	270	400	0.001667	179.9928	113	1.592857	2Φ12
s5	270	400	0.001667	179.9928	113	1.592857	2Φ12
s6	270	400	0.001667	179.9928	113	1.592857	2Φ12
s7	270	400	0.001667	179.9928	113	1.592857	2Φ12
s8	270	400	0.001667	179.9928	113	1.592857	2Φ12
s9	270	400	0.001667	179.9928	113	1.592857	2Φ12
s10	270	400	0.001667	179.9928	113	1.592857	2Φ12
s11	270	400	0.001667	179.9928	113	1.592857	2Φ12
s12	270	400	0.001667	179.9928	113	1.592857	2Φ12
C1	270	400	0.001667	179.9928	113	1.592857	2Φ12
C2	270	400	0.001667	179.9928	113	1.592857	2Φ12

C3	270	400	0.001667	179.9928	113	1.592857	2Φ12
C4	270	400	0.001667	179.9928	113	1.592857	2Φ12
C5	270	400	0.001667	179.9928	113	1.592857	2Φ12
C6	270	400	0.001667	179.9928	113	1.592857	2Φ12

Table 3 Negative and positive bars of 5th floor slab

2.1.1.2.5 Designs for shear resistance

The Shear force V_c carried by concrete in members without significant axial force shall be taken as: -

$V_c = 0.25\ f_{ctd}\ K_1\ K_2, b_w d$

Where $K_1 = (1+50\rho) < 2.0$

$K_2 = 1.6\text{-}d > 1.0$ [EBCS-2, 1995 Article 4.5.3.1]

$\rho = 0.00899$

$K_1 = (1+50\rho) = (1+50(0.00899)) = 1.4495 < 2.0$ ……………OK

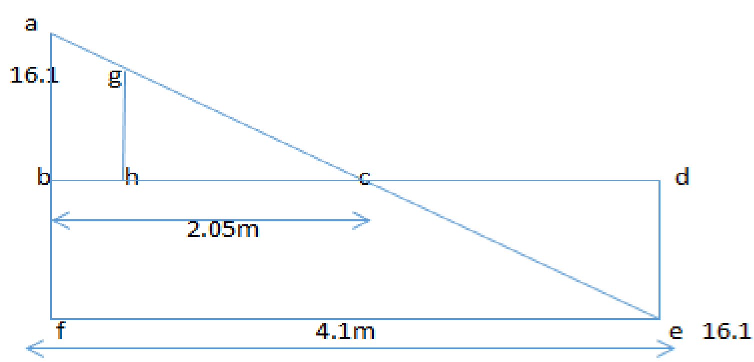
$K_1 = 1.4495$

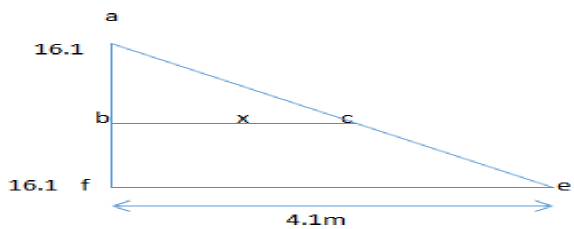
$K_2 = 1.6\text{-}d = 1.6\text{-}0.279 = 1.372 > 1.0$…………..OK

$K_2 = 1.321$

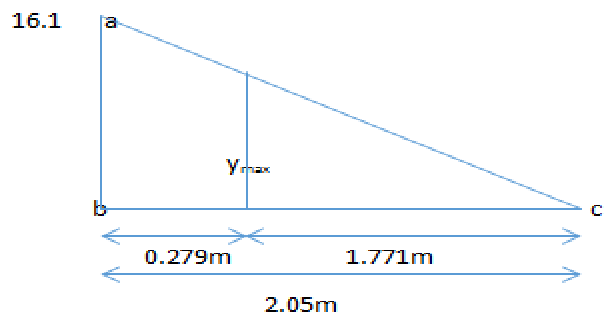
$V_c = 0.25(1.032)\ (1.4495)\ (1.321)\ (0.08)\ (0.279 = 11.026KN$

From similarity of triangle b/n abc & afe





$$x = \frac{4.1*16.1}{16.1+16.1} = 2.05m$$



Find the design shear from similarity of triangle

$$\frac{2.05}{16.1} = \frac{1.771}{Vmax}$$

V_{max} = 13.91KN

$v_{max} < V_c$……………………….not ok

So that you can provide shear or nominal reinforcement

Diagonal compression capacity, Vrd

Vrd = 0.25fcdbwd

= 0.25*11.33*80*279= 63.22KN

For Vc < Vd < Vrd,

$S = \frac{fydAsv(d-dc)}{Vs}$

Where, Asv – area of stirrups

S – Stirrup spacing

Vs= Vd – Vc

For the maximum design shear Vd,max=16.1KN

Vs = 16.1-11.026 =5.074KN

$S = \frac{260.87*56.55(279-27)}{5.074}$ =732.6mm

Smax = 56.55*260.87/0.4*80 = 261mm ≤ (279 or 800)

U shape bars

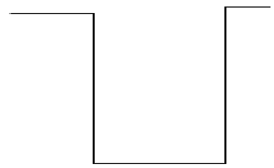


Figure 3 U bar shape

Therefore, Use Φ6 c/c 200mm

Topping

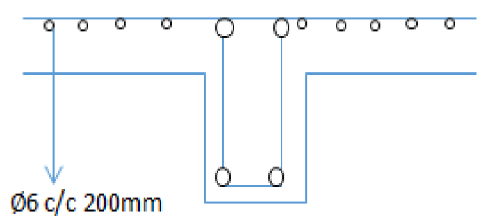
As min = 0.001Bd, use b= 1000mm

=0.001*1000*60 = 60mm D for topping is 60mm from the given section

Using Ø 6

S <bas/As = 1000* $\pi*3^2/60$ = 371mm

There for use Ø6 c/c 200mm mesh in both directions that means vertical &horizontal.



2.1.1.3 First-Fourth floor slab

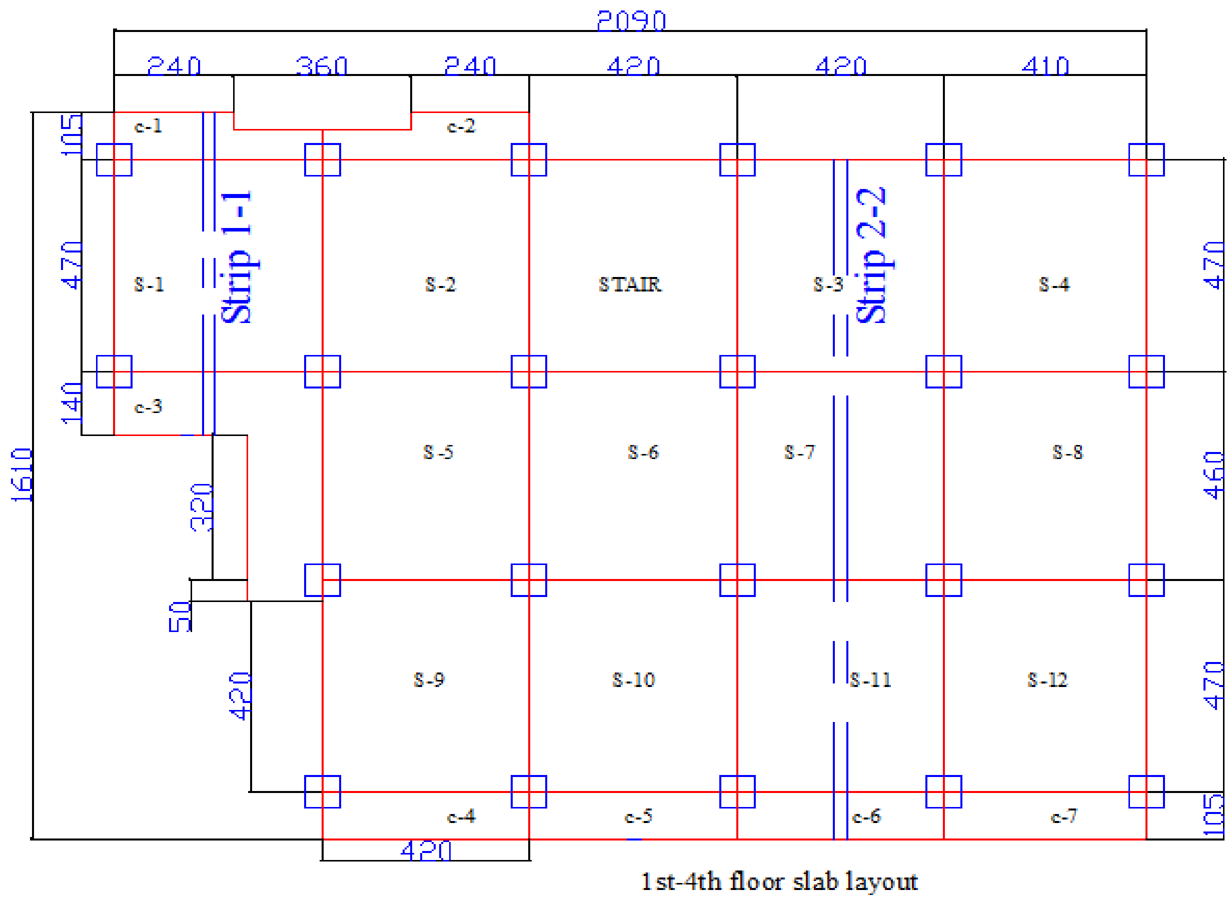


Figure 4 1st-4th floor slab layout

2.1.1.3.1 Check the depth for deflection

$$d \geq \left(0.4 + \frac{0.6 f_{yk}}{400}\right)\frac{L_e}{\beta_a}$$

Where: f_{yk}=characteristics tensile strength of steel

Le=effective span=4.2

β_e=accounts for the boundary condition and span ration for slabs

Overall depth,

D = d + $\phi_{l/2}$+ ϕ_s + c

$$d = (0.85)\frac{L_e}{\beta_a} = (0.85)\frac{4200}{24} = 148.75mm$$

Overall depth of the joist = *D*= 148.75 + 15 + 14/2 = 176.75 mm, Provide D=250 mm

Overall depth of the joist $D \leq 4\ \mathbf{b}_{w,joist}$ = 4(80) = 320 mm - D provided is OK.

Thickness of slab (topping), $t_{slab} \geq 40$ mm

Or 1/10 clear distance between ribs.

= (420 – 80) / 10 = 40 mm

In our problem, t_{slab} = 50 mm > 40 mm – OK

N.B: All loads are calculated as similar to above calculation. Therefore, the values are summarized in the table below.

SPAN	DL (KN/m)	Point load (PL) KN	LL (KN/m)	1.3*DL (KN/m)	1.3PL (KN)	1.6*LL (KN/m)	Pd 1.3DL+1.6LL (KN/m)
S-1 & 2	2.066	-	0.8	2.686	-	1.28	3.966
S-3	1.7248	-	0.8	2.24	-	1.28	3.52
S-4	2.12	-	0.8	2.756	-	1.28	4.-036
S5-7	3.2	-	0.8	4.16	-	1.28	5.447
S-8	3.29	-	0.8	4.277	-	1.28	5.557
S9-12	2.011	-	0.8	2.614	-	1.28	3.894
C-1 &2	1.724	1.968	0.8	2.24	2.558	1.28	3.52
C-3	1.5808	3.94	0.8	2.055	5.12	1.28	3.335
C4-7	1.724	2.03	0.8	2.24	2.639	1.28	6.426

Table 4 design load calculation for 1st-4th floor

The same procedure to above the values are obtained

Span	Mid Moment	Support moment	Shear force
S1	4.49	10.45	10.71
S2	4.49	10.45	10.71
S3	6.96	10.2	13.2
S4	6.96	10.2	13.2

S5	4.49	10.45	10.71
S6	6.96	10.2	13.2
S7	6.96	10.2	13.2
S8	6.96	10.2	13.2
S9	4.49	10.45	10.71
S10	6.96	10.2	13.2
S11	6.96	10.2	13.2
S12	6.96	10.2	13.2
C1	4.49	10.45	10.71
C2	4.49	10.45	10.71
C3	4.49	10.45	10.71
C4	4.49	10.45	10.71
C5	6.96	10.2	13.2
C6	6.96	10.2	13.2
C7	6.96	10.2	13.2

Table 5 BM & SF Calculation

2.1.1.3.2 Check the depth for flexure

- $d \geq \sqrt{\frac{Mu}{0.8*Fcd*b*m*\rho\max(1-0.4*m*\rho\max\quad)}}$
- $= \sqrt{\frac{10.45*10\text{^}6}{0.8*11.33*80*28.78*0.018984(1-0.4*28.78*0.018984)}}$
  - $\sqrt{\frac{10.45*10\text{^}6}{309.594}}$ = 183.72mm

D ≥ 183.72+15+6 = 204.72mm

Since the flexure depth is less than the deflection depth it is safe.

2.1.1.3.3 Design for reinforcement bars

A) Negative bars

Using negative moment

M_{max}=10.45KN/M

T- Section is subjected to –ve bending moment and analyze the section as a rectangular section of width (b_w) = 80mm

Therefor D = 300mm, b = 80mm

d = 300-15-7= 279mm

As= ρ*b*d

$$\rho = 0.5\{c1 - \sqrt{c1^2 - \frac{4Md}{bd^2c2}}\}$$

$$\rho = 0.5\{0.087 - \sqrt{0.087^2 - \frac{4*6.96*10^6}{80*279^2*3003.03}}\} = 0.007$$

ρ = 0.007

ρ_{min} 0.6/ fyk =0.6/300=0.002

$\rho_{min} < \rho < \rho_{max}$

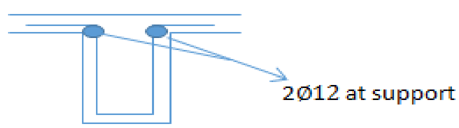
Therefore 0.002< ρ <.0.019

As = ρ*b*d = 0.007*80*279 = 155.87mm^2

Using Φ12, a = (π * 10^2/4) = 113mm^2

Number of bars =As/a =155.87/113 = 1.38

Provide 2Φ12



B) Positive bars

- M_{max} = 6.96KN/M
- b_e = 400mm
- $\rho = 0.5\{c1 - \sqrt{c1^2 - \frac{4Md}{bd^2c2}}\}$

$$\rho = 0.5\{0.087 - \sqrt{0.087^2 - \frac{4*6.96*10^6}{400*279^2*3003.03}}\} = 0.0015$$

X = ρ*m*d = 0.0015*28.78*279 = 36.23mm

Y = 0.8X = 36.23*0.8 = 28.983mm

Y < (h_f =50mm)

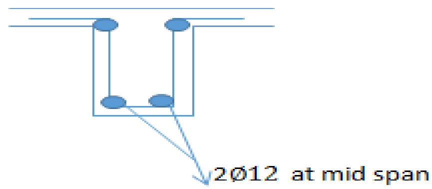
Therefor analyze the beam as rectangular with b= b_e

As = ρ *be*d = 0.0015*400*279 = 167.4

Using Φ12, a = (π * 12^2/4) = 113mm^2

Number of bars = As/as = 167.4/113 = 1.48

Provide 2Φ12



2.1.1.3.4 Design for shear resistance

The Shear force V_c carried by concrete in members without significant axial force shall be taken as:-

$V_c = 0.25\ f_{ctd}\ K_1\ K_2, b_w d$

Where $K_1 = (1+50\rho) <2.0$

$K_2 = 1.6\text{-}d >1.0$ EBCS-2, 1995 Article 4.5.3.1]

ρ =0.0056

$K_1 = (1+50\rho) = (1+50(0.016)) = 1.28 < 2.0$ ……………OK

K_1=1.8

$K_2 = 1.6\text{-}d = 1.6\text{-}0.279 = 1.321 > 1.0$…………OK

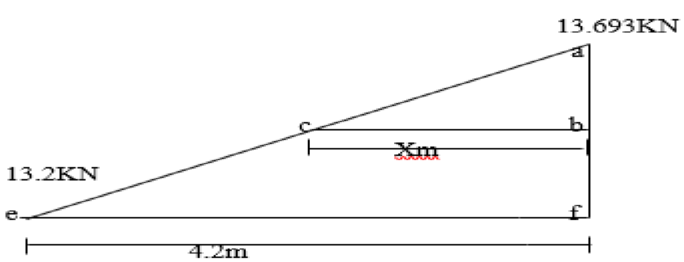
K_2 = 1.321

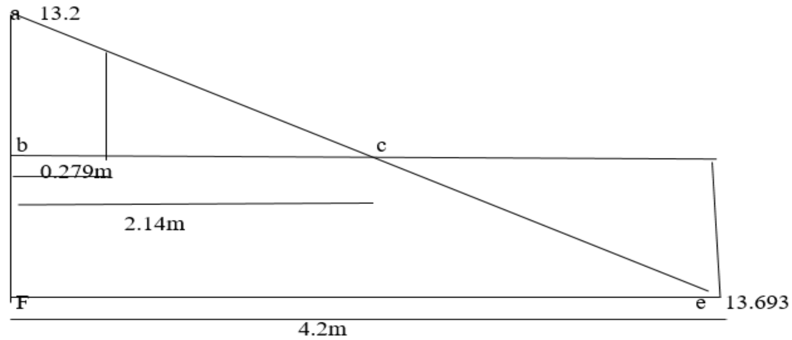
V_c = (0.25)(1.032)(1.8)(1.321)(80)(279)

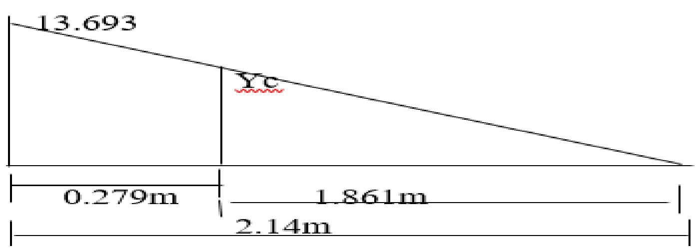
= 13.693KN

From similarity of triangle b/n abc & afe

$$x = \frac{4.2*13.693}{13.2+13.693} = 2.14m$$







Find the design shear from similarity of triangle

2.14/13.693= 1.861/Yc

Yc = 11.91KN = v $_{max}$

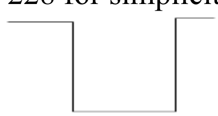
$$S_{max} \le \frac{a_v \; fyk}{0.4B} < \begin{cases} D \\ 800 \end{cases}$$

$V_{max} < V_c$……….ok

Nominal shear reinforcement pair area of reinforcement

$$S_{max} \le \frac{2\,(3.14*6^2*300}{0.4*80} = 282.6$$

There for use Φ 6 center to center 228 for simplicity use Φ c/c 200mm



U shape bars

Design summary for ribs

Span	design Moment and shear force			Reinforcement bars	
	Mid moment	Support(-ve)	Shear force	Mid moment(+ve)	Support(-ve)
S1	4.49	10.45	10.71	2Ø12	2Ø12
S2	4.49	10.45	10.71	2Ø12	2Ø12
S3	6.96	10.2	13.2	2Ø12	2Ø12
S4	6.96	10.2	13.2	2Ø12	2Ø12
S5	4.49	10.45	10.71	2Ø12	2Ø12
S6	4.49	10.45	13.2	2Ø12	2Ø12
S7	4.49	10.45	13.2	2Ø12	2Ø12
S6	6.96	10.2	13.2	2Ø12	2Ø12
S9	4.49	10.45	10.71	2Ø12	2Ø12
S10	6.96	10.2	13.2	2Ø12	2Ø12
S11	6.96	10.2	13.2	2Ø12	2Ø12
S12	6.96	10.2	13.2	2Ø12	2Ø12
C1	4.49	10.45	10.71	2Ø12	2Ø12
C2	4.49	10.45	10.71	2Ø12	2Ø12
C3	4.49	10.45	10.71	2Ø12	2Ø12
C4	4.49	10.45	13.2	2Ø12	2Ø12
C5	6.96	10.2	13.2	2Ø12	2Ø12
C7	6.96	10.2	13.2	2Ø12	2Ø12
C7	6.96	10.2	13.2	2Ø12	2Ø12

Table 6 positive & negative bar calculation for 1st-4th floor

Topping

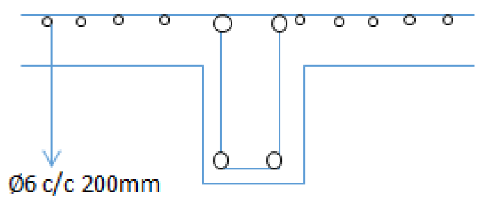
As min = 0.001Bd use b= 1000mm

=0.001*1000*50=50mm D for topping is 50mm from the given section

Using Ø 6

S <bas/As = 100* π*3^2/50 = 565.5mm

There for use Ø6 c/c mesh in both direction that means vertical &horizontal



2.1.2 FLAT SLAB DESIGN for G+5

Flat slab is a reinforced concrete slab supported directly by concrete columns without the use of beams. Flat slab is defined as one sided or two sided support system with sheer load of the slab being concentrated on the supporting columns and a square slab called drop panel.

Advantages and Disadvantage of flat slabs

Advantages

- Simple formwork
- No beams – simplifying under floor services outside the drops
- Minimum structural depth
- Usually does not require shear reinforcement at columns.

Disadvantage of flat slabs

- Generally, not suitable for supporting brittle (masonry) partitions
- Vertical penetrations need to avoid area around columns

For reinforced flat slabs, deflection at the middle strip may be critical.

Direct design method: - It is an empirical approach based on the analytical results of flat slabs. The method is limited to flat slabs meeting the following requirements.

1. Design is based on one load case in which all spans loaded with maximum design load. (q_d = 1.2DL + 1.6LL) …………………………..ACI code

2. There are at least three rows of panels of approximately equal span in the direction being considered.
3. Successive span length in each direction shall not differ by more than one-third of the longer span.
4. Maximum offsets of columns from either axis between center lines of successive columns shall not exceed 10% of the span (in direction of the offset).
5. The load is due to gravity only and is uniformly distributed over the entire panel. The live load shall not exceed three times the dead load.
6. Panel must be rectangular with the ratio of longer to shorter span within a panel not greater than 2.0

For purpose of design of flat slab, panels of slab are divided in to column and middle strip. The definition of these strips according to ESCP-2 as follow:

Column strip: - strip with a width on each side of a column center-line equal to 0.25 ℓ_x or if drops with dimension greater than ℓ_x/3 are used, a width equal to the drop dimension.

Middle strip: - strip bounded by two column strips. These definitions of strips are illustrated in figure below.

The total design moment in panel of flat-slab may be determined using the equation given by

Flat slab thickness from deflection requirement

From architectural data

Column = 400mmx200mm

Beam = 300mmx200mm

2.1.2.1 5th floor slab layout

Longitudinal strip

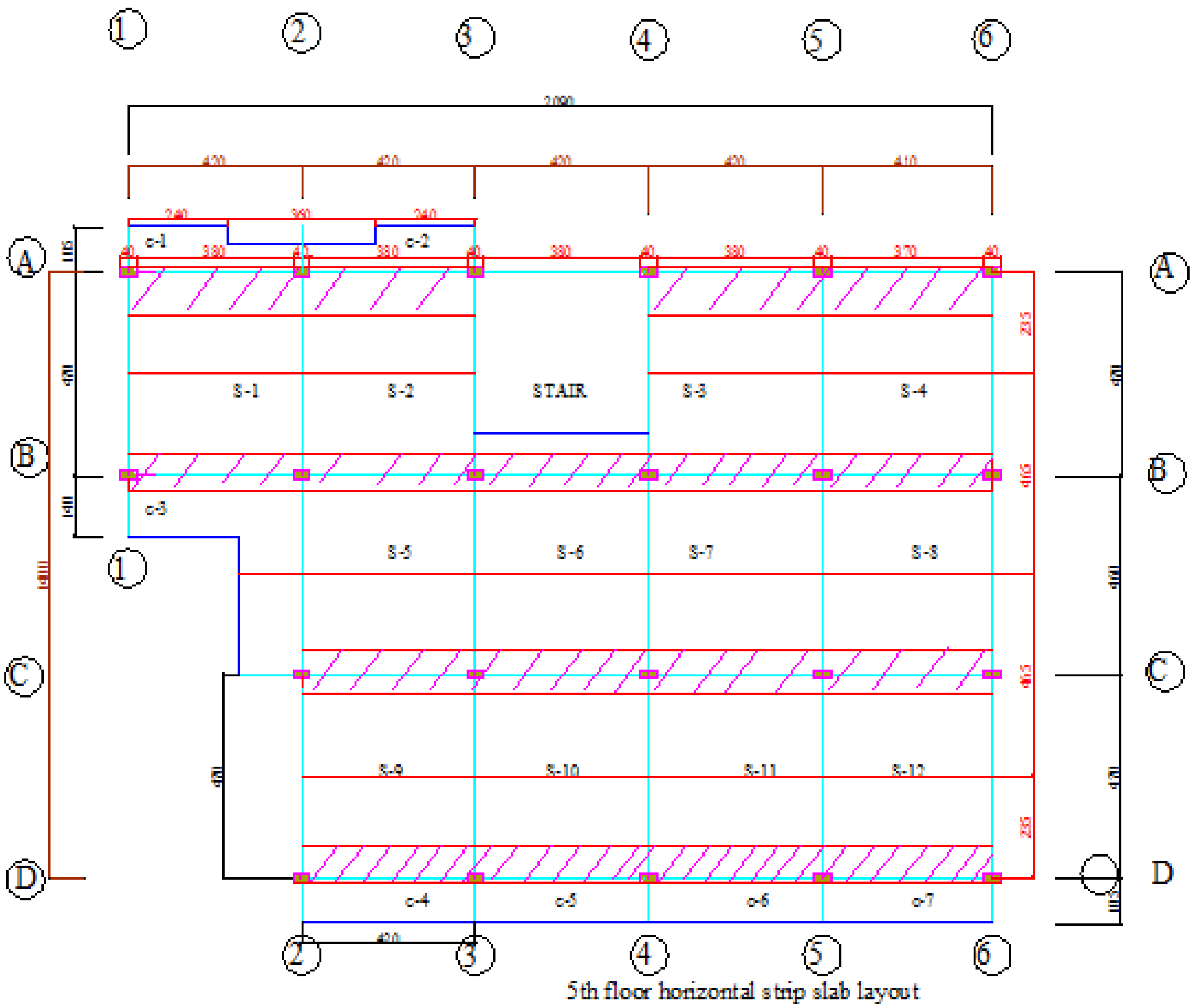


Figure 5 5th floor horizontal strip

Vertical strip

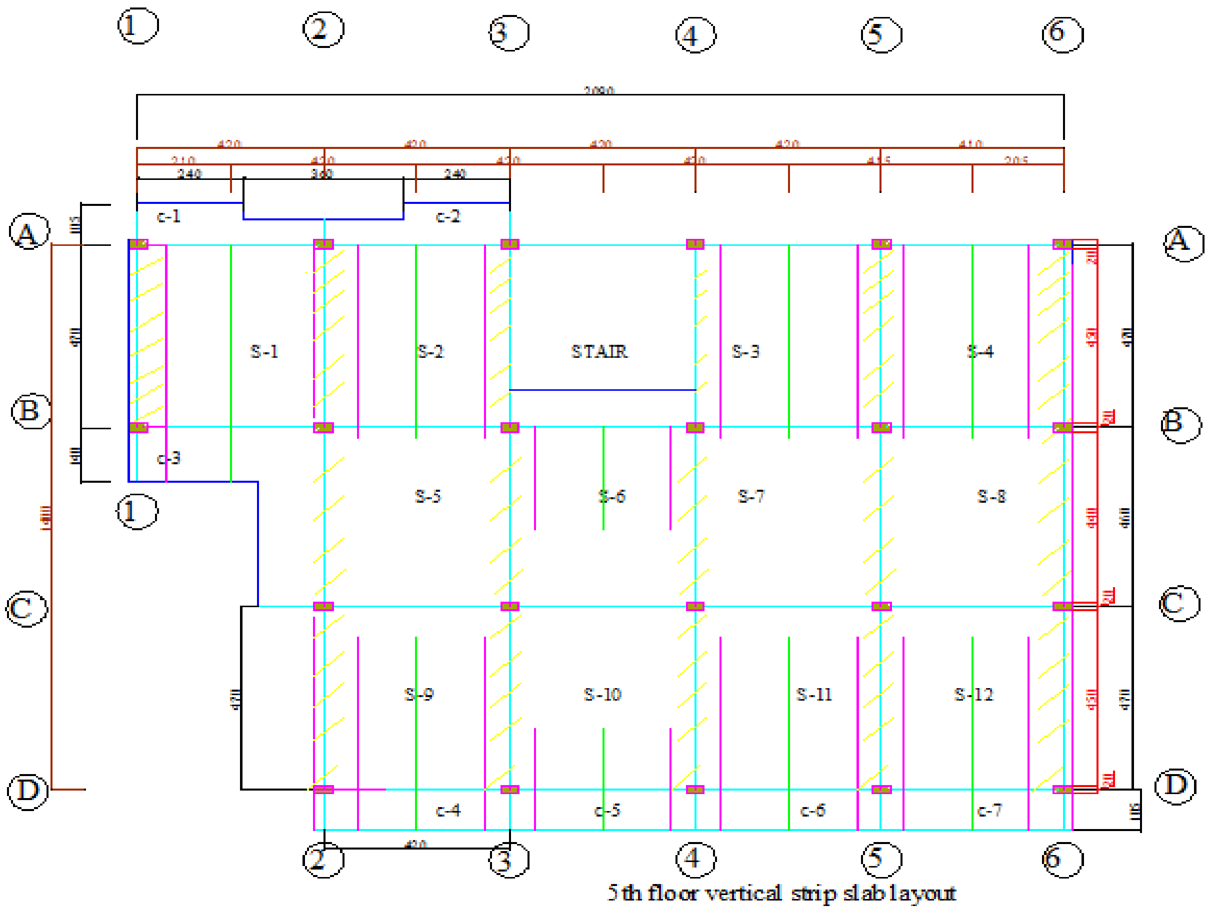


Figure 6 5th floor vertical strip

Sample load data:-

Design load of slab

Dead load**:**

- weight of slab= 0.20m*25 = 5KN/m^2
- Weight of floor finishes material
- 2mm of PVC = 0.002*16 = 0.032 KN/m^2
- 3cm of cement screed = 0.03*20 = 0.6kN/m^2
- Marble = 0.05*27=1.35KN/m^2
- With ceiling plaster = 0.02*23 =0.184KN/m^2

Total floor finish load = (0.032+0.6+1.35+0.46) = 5.442KN

Load due to partition wall

- Partition wall = 0.2*2.7*3.1*14/19.74 = 4.32kN/m^2
- Plastering = 0.02*3.1*3.05*20*2/19.74 = 2.377 KN/m^2

Total partition load = 1.32kN/m^2 +0.377 KN/m^2 =6.69 KN/m^2

Total live load = 5KN/m^2

q_d = 1.2DL + 1.6LL = 19.57 KN/m^2

2.1.2.1.1 Direct design method

Let's check whether the limitations to use the direct design method are satisfaction or not

1. This span in each direction ….. ok
2. $\frac{Ly}{Lx} = \frac{4.7}{4.2}$ 1.119, $\frac{Ly}{Lx} = \frac{4.6}{4.1} = 1.121$, All $\frac{Ly}{Lx}$ values are < 2

   Therefore it is safe.
3. Difference between spans always less than $\frac{1}{3}$ (large length)

   4.7- 4.1= 0.06 < $\frac{1}{3}$(4.7) = 1.567………..safe
4. No column offset …………….safe
5. Only gravity load …………….safe
6. No intermediate beam ……….safe
7. When ratio of $\frac{\text{Live load}}{Dead\ lad}$ must be greater than two that means ………..safe

According to ACI code for slabs without interior beams& without drop panel & with edge beams

$d_{min} = \frac{Ln}{36} = \frac{3800}{36}$ = 105.55

h_{min} = 105.55+15+$\frac{14}{2}$ = 127.55 so that use slab thickness is 200mm

Panel first strip

Computes the total factored static moment

Statically Moment, Mo

For design, the slab is considered to be a series of frames in the two directions, as shown

In Fig. These frames extend to the middle of the panels on each side of the column

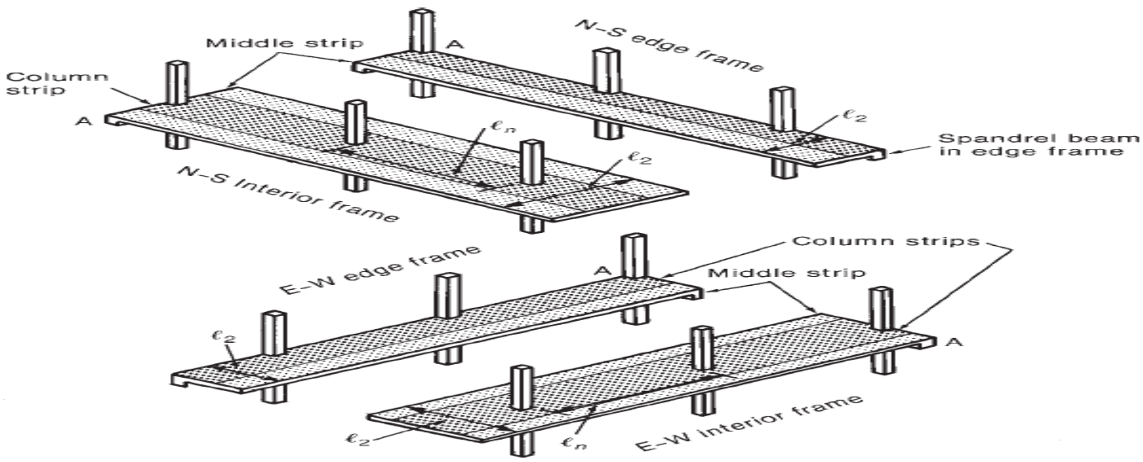
$$Mo = \frac{\mathrm{PdL_2Ln^2}}{8}$$

Where:

P_d = factored load per unit area

L_2 =transverse with of the strip

L_n = clean span between columns



Strip 1

Compute the total factored static moment for

Panel between axis (A-B), (B-C), (C-D) and (D-E)

- ❖ Between Axis 1-2, 2-3 , and 4-5

- ➢ Mo = $\frac{PdL_2Ln^2}{8}$ = $\frac{19.57*2.35*3.8^2}{8}$ = 83KN.m
- ➢ Panel between Axis (5-6)
- ➢ Mo = $\frac{PdL_2Ln^2}{8}$ = $\frac{19.57*2.35*3.8^2}{8}$ = 78.7KN.m

Distribution of Total Factored Static Moment,

	Exterior edge unrestrained	Slab with Beams b/n all supports	Slab without beams b/n interior supports		Exterior edge fully restrained
			Without Edge beam	With Edge beam	
Interior –ve factored moment	0.75	0.7	0.7	0.7	0.65
Mid span +ve factored moment	0.63	0.57	0.52	0.5	0.35
Exterior –ve factored moment	0	0.16	0.26	0.3	0.65

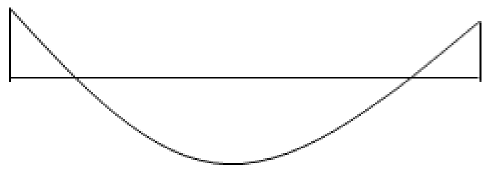
Table 7 Distribution of Total Factored Static Moment,

Longitudinal distribution of Mo (+ve and –ve Mo)

Panel between axis 1-2,2-3, 3-4 and 4-5

Exterior Panel between axis 1-2

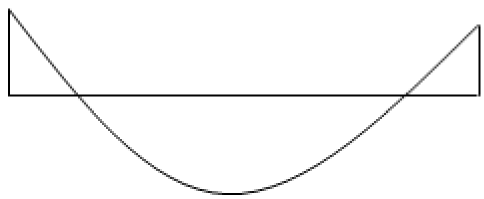
0.3Mo = 0.3*83=24.9KN.m 0.7Mo =0.7*83=58.1KN.m



0.5Mo=0.5*58.1=41.5KN.m

Exterior Panel between axis 5-6

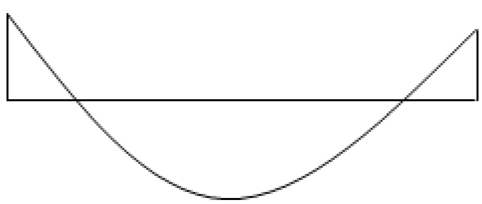
0.7Mo = 0.7*78.7 = 55.09 KN.m 0.26Mo = 0.3*78.7=23.61KN.m



0.52Mo=0.5*78.7 =39.35KN.m

Interior Panel between axis 2-3, 4-5

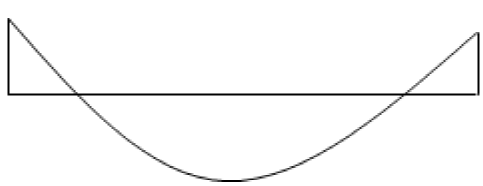
0.7Mo = 0.7*83=58.1 KN.m 0.26Mo = 0.3*78.7=21.61KN.m



0.52Mo=0.5*78.7 =43.16KN.m

Interior Panel between axis 8-9

0.3Mo = 0.3*58.2=17.46KN.m 0.7Mo =0.7*58.2=40.74KN.m



0.5Mo=0.5*58.2=17.46KN.m

Longitudinal distribution of Mo (+ve and –ve Mo)

Summarized in the same way

Location	Negative in KNm	Positive in KNm	Negative in KNm
STRIP ONE			
Ex. Pane b/n axis 1-2	24.9	41.5	58.1
In. Pane b/n axis 5-6	55.09	39.35	23.61
Ex. Pane b/n axis2-3,4-5	58.1	21.58	43.16
STRIP TWO			
Ex. Pane b/n axis 1-2,3-4	115.01	85.43	42.71
In. Pane b/n axis 2-3,4-5	42.71	49.9	98.58
In. Pane b/n axis 5-6	109.0	77.86	46.72
STRIPTHREE			
In. Pane b/n axis 2-3	49.29	82.15	115.01
In. Pane b/n axis 3-4	115.01	49.29	98.58
Ex. Pane b/n axis 5-6	116.79	77.86	46.72
Strip 4	0	0	0
In. Pane b/n axis 2-3	24.9	41.5	58.1
In. Pane b/n axis 3-4,4-5	58.1	24.9	49.81
Ex. Pane b/n axis 5-6	23.61	39.35	55.09

Table 8 longitudinal -ve and +ve moment distribution

Vertical distribution moment

Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
STRIP ONE			
Ex. Pane b/n axis A-B	31.206	52.01	31.206
STRIP TWO			
Ex. Pane b/n axis A-B,C-D	31.31	52.01	72.81
In. Pane b/n axis B-C	72.81	29.83	59.67

STRIP THREE & FOUR			
Ex. Pane b/n axis A-B	145.64	108.19	54.09
In. Pane b/n axis B-C	59.67	99.45	439.24
In. Pane b/n axis B-C	145.64	104.025	62.42
STRIP FIVE			
Ex. Pane b/n axis A-B,C-D	61.67	102.79	143.9
In. Pane b/n axis B-C	143.9	58.96	137.58
STRIP SIX			
Ex. Pane b/n axis A-B,C-D	30.47	50.78	71.085
In. Pane b/n axis B-C	71.085	29.124	58.24

Table 9 vertical moment distribution

Transverse distribution of negative moment to column and middle strips

For interior panels beams between interior support

$$\frac{\alpha f1Le}{L1} = 0$$

Percentage Distribution of Interior Negative Factored

Moment to Column Strip

$\frac{Le}{L1}$	0.5	1.0	2.0
$\frac{\alpha f1Le}{L1} = 0$	75	75	75
$\frac{\alpha f1Le}{L1} \geq 1.0$	90	75	45

Table 10 percentage distribution of interior negative factored moment to column strip

Taken to be equal to zero, because in this case, 75 percent of the negative moments distributed to the column strip, and the remaining 25 percent is divided equally between the two adjacent half-middle strips.

Percentage Distribution of Exterior Negative Factored

Moment to Column Strip

$\frac{Le}{L1}$	0.5	1.0	2.0
$\frac{\alpha f1Le}{L1} = 0$	60	60	60
$\frac{\alpha f1Le}{L1} \geq 1.0$	90	75	45

Table 11 percentage distribution of exterior negative factored moment to column strip

The percentage distribution of positive factored moment to the column strip at mid span for both interior and exterior spans. For floor systems without interior beams, 60 percent of the positive moment is assigned to the column strip and the remaining 40 percent is divided equally between the adjacent half-middle strips.

No intermediate beam, $\alpha = 0$

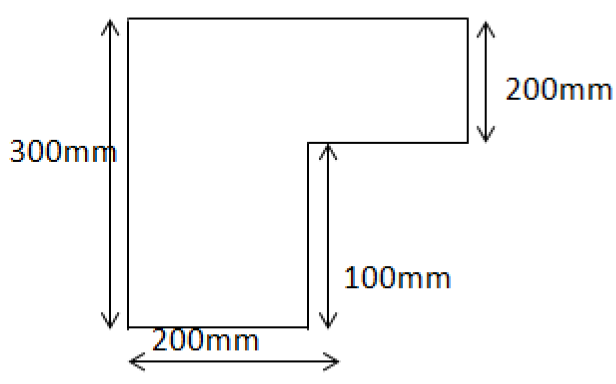
Because of the existence of an edge beam parallel L_2, however the distribution of the exterior negative moment shall be based on the torsional stiffeners β_t of the edge beam

$$\beta_t = \frac{C}{2Is} \qquad \beta_t = \frac{E_{cb}C}{2E_{cs}I_s}$$

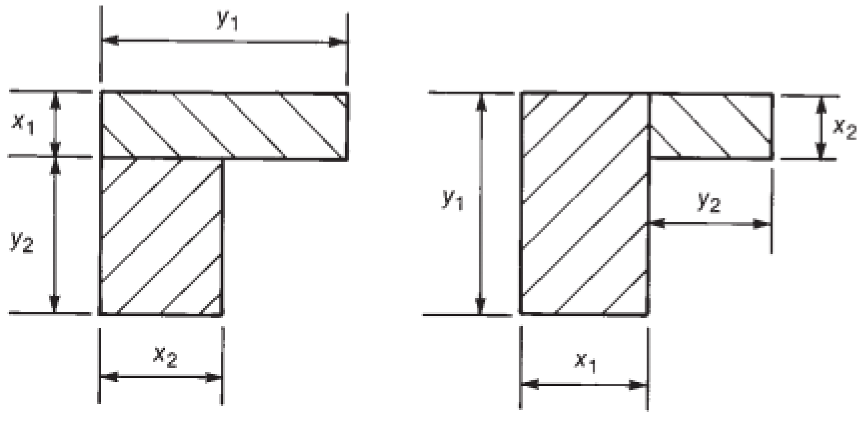
Where:-

$$C = \sum\left[\left(1 - 0.63\frac{x}{y}\right)\frac{x^3y}{3}\right]$$

Edge beam



We have two cases



(a) (b)

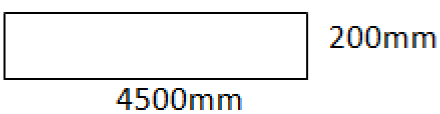
Where:-

Y1 = 300mm X1 = 200mm

C1 = 0.269*10^9mm^4 C2 = 1.03*10^9mm^4

C = max (C1, C2) =1.03*10^9mm^4

Is = moments of inertia of the slab strip being design



$$Is = \frac{bh^3}{12} = \frac{4500*200^3}{12} = 3*10^9 mm^4$$

$$\beta_t = \frac{1.03*10^9}{2(3)*10^9} = 0.172$$

Percentage Distribution of Exterior Negative Factored Moment to Column Strip

$\frac{Le}{L1}$		0.5	1.0	2.0
$\frac{\alpha f1Le}{L1} = 0$	$\beta_t = 0$	100	100	100
	$\beta_t \geq 2.5$	75	75	75
$\frac{\alpha f1Le}{L1} \geq 1.0$	$\beta_t = 0$	100	100	100
	$\beta_t \geq 2.5$	90	75	45

Let now interpolate the percentage of the exterior negative moment assigned to the column strip

$\beta_t = 0$………..100

$\beta_t = 0.172$……..x

$\beta_t \geq 2.5$……….75

X = 98.02

Strip one

Transverse longitudinal distribution negative &positive moment to column & middle panel between axis.

Interior span between (1-2)

I. Interior negative moment for (1-2)
Column strip = 0.75*58.1 = 43.58KN.m
Half mid strip = ½*0.25*58.1 = 7.29 KN.m

II. Interior positive moment for 1-2
Column strip = 0.6*41.5 = 24.9KN.m
Half mid strip = ½*0.4*41.5 = 8.3KN.m

III. Exterior negative moment for 1-2
Column strip = 0.9802*24.9 = 24.23KN.m
Half mid strip = ½(1-0.9824)24.9 = 0.6723KN.m

Interior span between (5-6)

I. Interior negative moment for (5-6)
Column strip = 0.75*55.09 = 41.317KN.m
Half mid strip = ½*0.25*55.09 = 6.886 KN.m

II. Interior positive moment for (5-6)
Column strip = 0.6*39.35 = 23.61KN.m
Half mid strip = ½*0.4*39.35 = 7.87KN.m

III. Exterior negative moment for (5-6)
Column strip = 0.9824*23.61 = 22.97KN.m
Half mid strip = ½(1-0.9824)*23.61 = 0.637KN.m

Interior span between (2-3), (4-5)

I. Interior negative moment for
Column strip = 0.75*58.1 = 43.58KN.m
Half mid strip = ½*0.25*58.1 = 7.263 KN.m

II. Interior positive moment for (2-3) (4-5)
Column strip = 0.6*43.16 = 32.37KNm
Half mid strip = ½*0.4*43.16 = 8.632KNm

III. Exterior negative moment for (2-3) (4-5)
Column strip = 0.9824*21.58 = 20.997KNm
Half mid strip = ½(1-0.9824)*21.58 = 0.583KN.m

Summarized in the same way

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
Ex.span b/n axis (1-2)	43.58	7.26	24.9	8.3	24.23	0.6723
Int.span b/n axis (2-3),(4-5)	44.99	7.263	32.37	8.632	20.997	0.583
Ex.span b/n axis (5-6)	41.317	6.886	23.61	7.87	22.97	0.637
STRIP TWO						
In.span b/n axis (1-2),(3-4)	86.26	14.38	51.26	17.086	41.56	1.153
In.span b/n axis (2-3),(4-5)	73.94	12.32	29.94	9.98	-	-
Ex.span b/n axis (5-6)	81.75	13.63	46.72	15.57	45.46	1.26
STRIP THREE						
In.span b/n axis (2-3)	86.26	14.38	49.29	16.43	47.96	1.33
Ex.span b/n axis (5-6)	81.75	13.63	46.72	15.572	45.46	1.26
STRIP FOUR						
Ex.span b/n axis (2-3)	43.58	7.26	24.9	8.3	24.23	0.672
In.span b/n axis (3-4)	37.38	9.96	14.94	4.98	-	-
Ex.span b/n axis (5-6)	41.32	6.886	23.61	7.87	22.97	0.637

Table 12 5th floor Transverse longitudinal -ve & +ve moment

Transverse vertical distribution negative &positive moment to column & middle panel between axis.

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
Ex. Pane b/n axis A-B	22.68	3.573	30.574	9.5248	29.574	0.832
STRIP 2	0	0	0	0	0	0
Ex. Pane b/n axis A-B,C-D	52.25	9.09	32.574	10.25	30.723	0.852
In. Pane b/n axis B-C	42.28	7.146	17.112	5.037	-	-
STRIP THREE &FOUR						
Ex. Pane b/n axis A-B	108.769	18.616	65.829	21.943	53.37	1.481
In. Pane b/n axis C-D	99.65	14.609	58.373	17.125	58.743	1.63
In. Pane b/n axis B-C	105.511	18.418	53.149	19.049	57.444	1.705
STRIP FIVE						
Ex. Pane b/n axis A-B,C-D	109.196	18.199	62.397	20.799	60.713	1.687
In. Pane b/n axis B-C	104.396	17.399	35.793	11.931	-	-
STRIP SIX						
Ex. Pane b/n axis A-B,C-D	50.94	7.99	27.822	8.274	29.991	0.832
In. Pane b/n axis B-C	43.202	7.367	17.681	5.894	-	-

Table 13 5th floor transverse vertical -ve & +ve moments

LONGITUDINAL REINFORCEMENT

Location	Negative moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
Ex.span b/n axis (1-2)	43.58	7.26	178	1175	1175	0.004739	0.00167	991.0833	349.2805	93.06736	Ø10c/c90	185.0786	Ø10c/c150
Int.span b/n axis (2-3),(4-5)	43.58	7.263	178	1175	1175	0.004902	0.00167	1025.181	349.2805	89.97193	Ø10c/c80	185.0786	Ø10c/c150
Ex.span b/n axis (5-6)	41.317	6.886	178	1175	1175	0.004478	0.00167	936.6557	349.2805	98.47535	Ø10c/c90	185.0786	Ø10c/c150
STRIP TWO													
In.span b/n axis (1-2),(3-4)	86.26	14.38	178	1150	2350	0.004687	0.00167	1960.462	341.849	94.0977	Ø10c/c90	185.0786	Ø10c/c150
In.span b/n axis (2-3),(4-5)	73.94	12.32	178	1150	2350	0.003983	0.00167	1666.222	341.849	110.7145	Ø10c/c100	185.0786	Ø10c/c150

Ex.span b/n axis (5-6)	81.75	13.63	178	1150	2350	0.004428	0.00167	1852.135	341.849	99.60128	Ø10c/c90	185.0786	Ø10c/c150
STRIP THREE													
In.span b/n axis (2-3)	86.26	14.38	178	1150	2350	0.004687	0.00167	1960.462	341.849	94.0977	Ø10c/c90	185.0786	Ø10c/c150
Ex.span b/n axis (5-6)	81.75	13.63	178	1150	2350	0.004428	0.00167	1852.135	341.849	99.60128	Ø10c/c90	185.0786	Ø10c/c150
STRIP FOUR													
Ex.span b/n axis (2-3)	43.58	7.26	178	1175	1175	0.004739	0.00167	991.0833	349.2805	93.06736	Ø10c/c90	185.0786	Ø10c/c150
In.span b/n axis (3-4)	37.38	9.96	178	1175	1175	0.00403	0.00167	842.8218	349.2805	109.4389	Ø10c/c90	185.0786	Ø10c/c150
Ex.span b/n axis (5-6)	41.32	6.886	178	1175	1175	0.004479	0.00167	936.7276	349.2805	98.46779	Ø10c/c90	185.0786	Ø10c/c150

Table 14 5th floor longitudinal Negative Bars

Positive bar

Location	positive moment Column strip	positive moment Half mid strip	D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
STRIP ONE													
Ex.span b/n axis (1-2)	24.9	8.3	178	1175	1175	0.00264	0.00167	552.1821	349.2805	167.0418	Ø10c/c160	185.0786	Ø10c/c150
Int.span b/n axis (2-3),(4-5)	32.37	8.632	178	1175	1175	0.003466	0.00167	724.9346	349.2805	127.2356	Ø10c/c120	185.0786	Ø10c/c15
Ex.span b/n axis (5-6)	23.61	7.87	178	1175	1175	0.002499	0.00167	522.7017	349.2805	176.463	Ø10c/c120	185.0786	Ø10c/c150
STRIP TWO													
In.span b/n axis (1-2),(3-4)	51.26	17.086	178	1150	2350	0.00272	0.00167	1137.82	341.849	162.1302	Ø10c/c120	185.0786	Ø10c/c150
In.span b/n axis (2-3),(4-5)	29.94	9.98	178	1150	2350	0.001567	0.00167	655.6117	341.849	181.3785	Ø10c/c150	185.0786	Ø10c/c15
Ex.span b/n axis (5-6)	46.72	15.57	178	1150	2350	0.002472	0.00167	1034	341.849	178.409	Ø10c/c120	185.0786	Ø10c/c150

STRIP THREE													
In.span b/n axis (2-3)	49.29	16.43	178	1150	2350	0.002612	0.00167	1092.693	341.849	168.826	Ø10c/c120	185.0786	Ø10c/c150
Ex.span b/n axis (5-6)	46.72	15.572	178	1150	2350	0.002472	0.00167	1034	341.849	178.409	Ø10c/c120	185.0786	Ø10c/c150
STRIP FOUR													
Ex.span b/n axis (2-3)	24.9	8.3	178	1175	1175	0.00264	0.00167	552.1821	349.2805	167.0418	Ø10c/c120	185.0786	Ø10c/c150
In.span b/n axis (3-4)	14.94	4.98	178	1175	1175	0.001564	0.00167	327.1367	349.2805	281.954	Ø10c/c120	185.0786	Ø10c/c150
Ex.span b/n axis (5-6)	23.61	7.87	178	1175	1175	0.002499	0.00167	522.7017	349.2805	176.463	Ø10c/c120	185.0786	Ø10c/c150

Table 15 5th floor longitudinal Positive Bars

Location	Edge moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
Ex.span b/n axis (1-2)	24.23	0.6723	178	1175	1175	0.002567	0.00167	536.8579	349.2805	171.8099	Ø10c/c120	185.0786	Ø10c/c150

Int.span b/n axis (2-3),(4-5)	20.997	0.583	178	1175	1175	0.002215	0.00167	463.2952	349.2805	199.0901	Ø10c/c12	185.0786	Ø10c/c150
Ex.span b/n axis (5-6)	22.97	0.637	178	1175	1175	0.002429	0.00167	508.1133	349.2805	181.5294	Ø10c/c120	185.0786	Ø10c/c150
STRIP TWO													
In.span b/n axis (1-2),(3-4)	41.56	1.153	178	1175	2350	0.002192	0.00167	916.7601	349.2805	201.2249	Ø10c/c120	185.0786	Ø10c/c150
Ex.span b/n axis (5-6)	45.46	1.26	178	1175	2350	0.002403	0.00167	1005.298	349.2805	183.5028	Ø10c/c120	185.0786	Ø10c/c150
STRIP THREE													
In.span b/n axis (2-3)	47.96	1.33	178	1175	2350	0.00254	0.00167	1062.294	349.2805	173.6572	Ø10c/c120	185.0786	Ø10c/c150
Ex.span b/n axis (5-6)	45.46	1.26	178	1175	2350	0.002403	0.00167	1005.298	349.2805	183.5028	Ø10c/c120	185.0786	Ø10c/c150
STRIP FOUR													
Ex.span b/n axis (2-3)	24.23	0.672	178	1175	1175	0.002567	0.00167	536.8579	349.2805	171.8099	Ø10c/c120	185.0786	Ø10c/c150

Ex.span b/n axis (5-6)	22.97	0.637	178	1175	1175	0.002429	0.00167	508.1133	349.2805	181.5294	Ø10c/c120	185.0786	Ø10c/c150

Table 165th floor longitudinal edge reinforcement bars

VERTICAL REINFORCEMENT

Negative bar

Location	Negative moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
Ex. Pane b/n axis A-B	22.68	3.573	178	1050	2100	0.00167	0.00167	624.246	312.123	90.0103	Ø8c/c90	169.0103	Ø10c/c150
STRIP TWO													
Ex. Pane b/n axis A-B,C-D	52.25	9.09	178	1050	2100	0.003117	0.00167	1165.288	312.123	90.53898	Ø8c/c90	169.0103	Ø10c/c150
In. Pane b/n axis B-C	42.28	7.146	178	1050	2100	0.002504	0.00167	936.0931	312.123	92.7067	Ø8c/c90	169.0103	Ø10c/c150
STRIP THREE &FOUR													
Ex. Pane b/n axis A-B	108.769	18.616	178	1050	2100	0.006786	0.00167	2536.739	312.123	141.59041	Ø8c/c100	169.0103	Ø10c/c150

In. Pane b/n axis C-D	99.65	14.609	178	1050	2100	0.00617	0.00167	2306.341	312.123	45.74519	Ø8c/c90	169.0103	Ø10c/c150
In. Pane b/n axis B-C	105.511	18.418	178	1050	2100	0.006565	0.00167	2453.982	312.123	42.99298	Ø8c/c40	169.0103	Ø10c/c150
STRIP 5													
Ex. Pane b/n axis A-B,C-D	109.196	18.199	178	1050	2100	0.006815	0.00167	2547.622	312.123	41.41273	Ø8c/c90	169.0103	Ø10c/c150
In. Pane b/n axis B-C	104.396	17.399	178	1050	2100	0.006489	0.00167	2425.773	312.123	43.49294	Ø8c/c40	169.0103	Ø10c/c150
STRIP 6													
Ex. Pane b/n axis A-B,C-D	50.94	7.99	178	1025	2050	0.003113	0.00167	1136.016	304.6915	90.66072	Ø8c/c90	169.0103	Ø10c/c150
In. Pane b/n axis B-C	43.202	7.367	178	1025	2050	0.002625	0.00167	957.8756	304.6915	107.5213	Ø8c/c90	169.0103	Ø10c/c150

Table 17 5th floor vertical negative bars

Positive bar

Location	positive moment Column strip	positive moment Half mid strip	D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
STRIP ONE													
Ex. Pane b/n axis A-B	30.574	9.5248	178	1050	2100	0.00167	0.00167	624.246	312.123	169.0103	Ø8c/c150	169.0103	Ø8c/c150
STRIP TWO													
Ex. Pane b/n axis A-B,C-D	32.574	10.25	178	1050	2100	0.001916	0.00167	716.2131	312.123	147.3081	Ø8c/c120	169.0103	Ø8c/c150
In. Pane b/n axis B-C	27.112	5.037	178	1050	2100	0.001589	0.00167	593.8336	312.123	177.6659	Ø8c/c150	169.0103	Ø8c/c150
STRIP THREE &FOUR													
Ex. Pane b/n axis A-B	65.829	21.943	178	1050	2100	0.003968	0.00167	1483.166	312.123	71.13434	Ø8c/c70	169.0103	Ø8c/c150
In. Pane b/n axis C-D	58.373	17.125	178	1050	2100	0.003499	0.00167	1307.788	312.123	80.67364	Ø8c/c80	169.0103	Ø8c/c150
In. Pane b/n axis B-C	53.149	19.049	178	1050	2100	0.003173	0.00167	1186.126	312.123	88.94838	Ø8c/c80	169.0103	Ø8c/c150
STRIP FIVE													

Ex. Pane b/n axis A-B,C-D	62.397	20.799	178	1050	2100	0.003751	0.00167	1402.182	312.123	75.24273	Ø8c/c70	169.0103	Ø8c/c150
In. Pane b/n axis B-C	35.793	11.931	178	1050	2100	0.00211	0.00167	788.7901	312.123	133.7542	Ø8c/c100	169.0103	Ø8c/c150
STRIP SIX													
Ex. Pane b/n axis A-B,C-D	27.822	8.274	178	1025	2050	0.001672	0.00167	609.9774	304.6915	168.8456	Ø8c/c150	169.0103	Ø8c/c150
In. Pane b/n axis B-C	17.681	5.894	178	1025	2050	0.001055	0.00167	384.8607	304.6915	167.6085	Ø8c/c150	169.0103	Ø8c/c150

Table 18 5th floor vertical positive bars

Edge bars

Location	Edge bar moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
Ex. Pane b/n axis A-B	29.574	0.832	178	1050	2100	0.00167	0.00167	624.246	162.123	169.0103	Ø8c/c150	169.0103	Ø8c/c150
STRIP TWO													
Ex. Pane b/n axis A-B,C-D	30.723	0.852	178	1050	2100	0.001805	0.00167	674.6326	162.123	156.3873	Ø8c/c150	169.0103	Ø8c/c150

STRIP THREE & FOUR													
Ex. Pane b/n axis A-B	53.37	1.481	178	1050	2100	0.003187	0.00167	1191.253	162.123	88.56556	Ø8c/c150	169.0103	Ø8c/c150
In. Pane b/n axis C-D	58.743	1.63	178	1050	2100	0.003522	0.00167	1316.442	162.123	80.14328	Ø8c/c150	169.0103	Ø8c/c150
In. Pane b/n axis B-C	57.444	1.705	178	1050	2100	0.003441	0.00167	1286.08	162.123	82.03533	Ø8c/c150	169.0103	Ø8c/c150
STRIP FOUR													
Ex. Pane b/n axis A-B,C-D	60.713	1.687	178	1050	2100	0.003645	0.00167	1362.606	162.123	77.42809	Ø8c/c150	169.0103	Ø8c/c150
STRIP SIX													
Ex. Pane b/n axis A-B,C-D	29.991	0.832	178	1025	2050	0.001805	0.00167	658.5587	174.6915	156.39	Ø8c/c150	169.0103	Ø8c/c150

Table 19 5th floor vertical edge bars

2.1.2.2 first-fourth floor layout

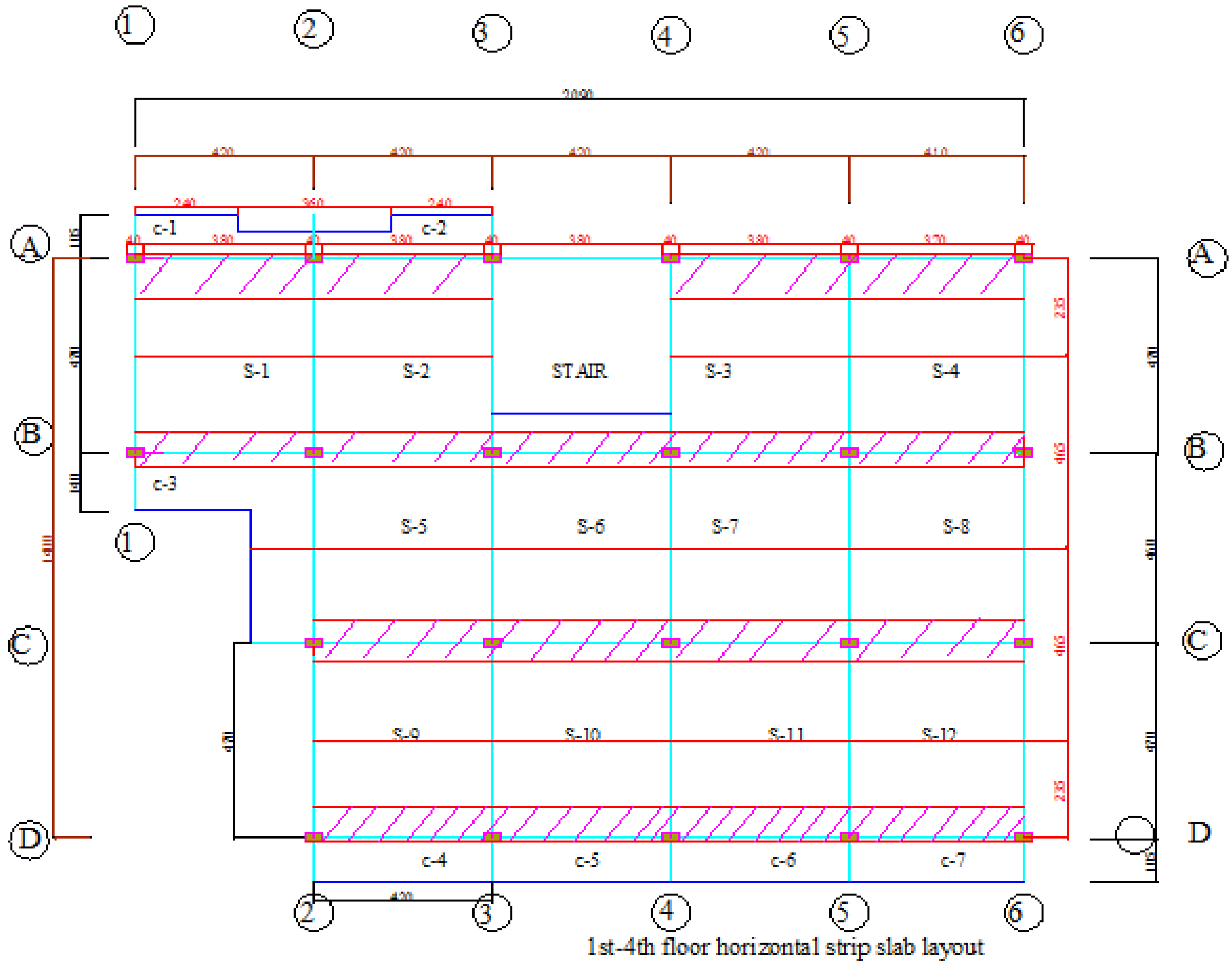


Figure 7 1st-4th floor horizontal strip

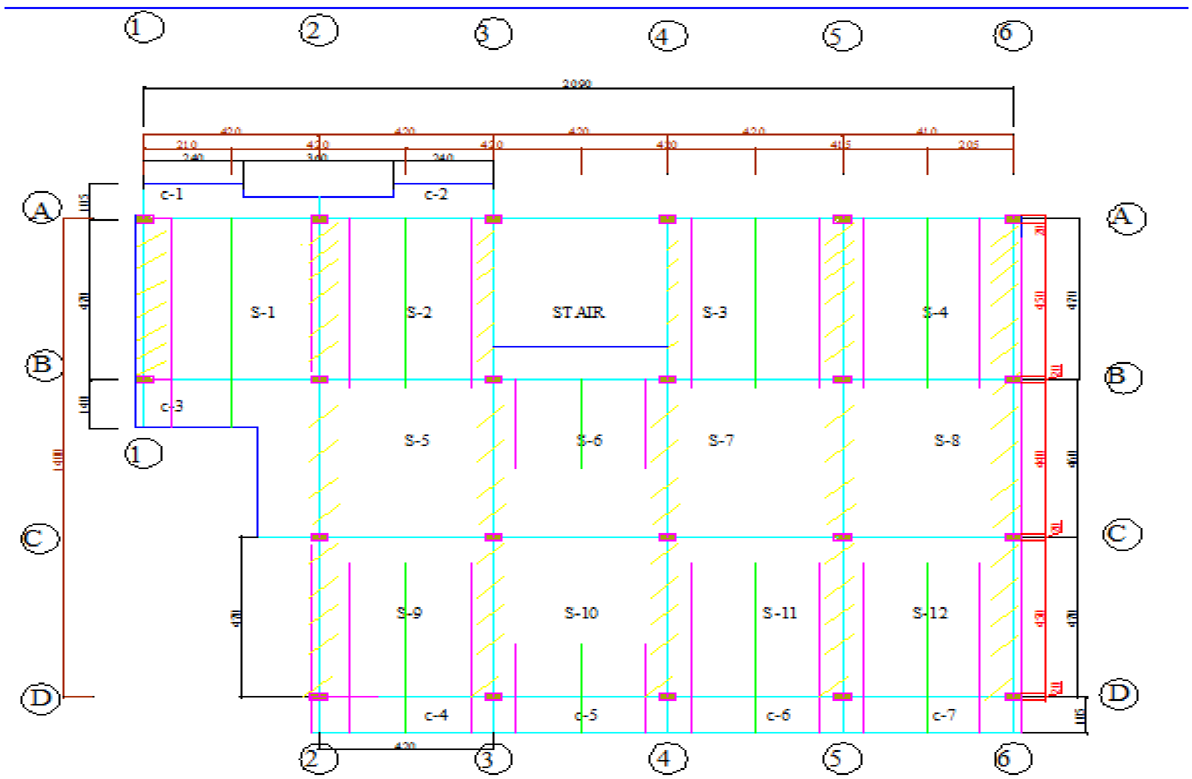


Figure 8 First-fourth floor vertical strip

Longitudinal distribution of Mo (+ve and –ve Mo)

Summarized in the same way

Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
STRIP ONE			
Ex. Pane b/n axis 1-2	25.197	41.995	58.793
In. Pane b/n axis 5-6	55.737	39.812	23.887
Ex. Pane b/n axis2-3,4-5	58.793	41.995	21.837
STRIP TWO			
Ex. Pane b/n axis 1-2,3-4	116.33	83.093	43.208
In. Pane b/n axis 2-3,4-5	116.33	49.855	99.711
In. Pane b/n axis 5-6	110.288	78.777	47.260

STRIP THREE			
In. Pane b/n axis 2-3	49.856	83.093	116.33
In. Pane b/n axis 3-4	116.33	49.856	99.711
Ex. Pane b/n axis 5-6	110.288	78.777	47.266
STRIP FOUR			
In. Pane b/n axis 2-3	25.197	41.995	58.793
In. Pane b/n axis 3-4,4-5	58.793	25.197	50.394
Ex. Pane b/n axis 5-6	23.887	39.812	55.737

Table 20 First-fourth floor longitudinal distribution moment

Vertical distribution moment

Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
STRIP ONE			
Ex. Pane b/n axis A-B	31.57	52.625	31.57
STRIP TWO			
Ex. Pane b/n axis A-B,C-D	31.575	52.624	73.674
In. Pane b/n axis B-C	73.674	30.187	60.375
STRIP THREE & FOUR			
Ex. Pane b/n axis A-B	147.693	109.715	54.857
In. Pane b/n axis B-C	60.374	100.623	140.873
In. Pane b/n axis C-D	147.349	105.249	63.149
STRIP FIVE			
Ex. Pane b/n axis A-B,C-D	62.398	103.996	145.595
In. Pane b/n axis B-C	145.595	59.655	139.195
STRIP SIX			
Ex. Pane b/n axis A-B,C-D	30.823	51.731	71.920

Table 21 1st -4th floor vertical distribution moment

Transverse longitudinal distribution negative &positive moment to column & middle panel between axis.

Summarized in the same way

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
Ex.span b/n axis (1-2)	44.095	7.349	25.194	8.398	24.516	0.68
In.span b/n axis (2-3),(4-5)	44.095	7.349	25.194	8.398	21.247	0.589
Ex.span b/n axis (5-6)	41.803	6.967	23.887	7.962	23.242	0.645
STRIP TWO						
In.span b/n axis (1-2),(3-4)	87.247	14.54	49.85	16.618	42.041	1.16
In.span b/n axis (2-3),(4-5)	74.78	12.463	29.913	9.971	-	-
Ex.span b/n axis (5-6)	82.716	13.786	47.266	15.755	45.98	1.276
STRIP THREE						
In.span b/n axis (2-3)	87.24	14.54	44.855	16.618	48.5	1.346
Ex.span b/n axis (5-6)	82.716	13.786	47.266	15.755	45.98	1.276
STRIP FOUR						
Ex.span b/n axis (2-3)	44.09	7.344	25.197	8.399	24.516	0.68
In.span b/n axis (3-4)	37.79	6.299	15.118	5.039	-	-

Table 22 transverse longitudinal -ve & +ve moments

Transverse vertical distribution negative &positive moment to column & middle panel between axis.

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
Ex. Pane b/n axis A-B	23.68	3.946	31.574	10.5248	30.574	0.852
STRIP TWO						
Ex. Pane b/n axis A-B,C-D	55.25	9.209	31.574	10.525	30.723	0.852
In. Pane b/n axis B-C	45.28	7.546	18.112	6.037	-	-
STRIP THREE &FOUR						
Ex. Pane b/n axis A-B	110.769	18.616	65.829	21.943	53.37	1.481
In. Pane b/n axis B-C	105.65	17.609	60.373	20.125	58.743	1.63
In. Pane b/n axis B-C	110.511	18.418	63.149	21.049	61.444	1.705
STRIP FIVE						
Ex. Pane b/n axis A-B,C-D	109.196	18.199	62.397	20.799	60.713	1.687
In. Pane b/n axis B-C	104.396	17.399	35.793	11.931	-	-
STRIP SIX						
Ex. Pane b/n axis A-B,C-D	53.94	8.99	30.822	10.274	29.991	0.832
In. Pane b/n axis B-C	44.202	7.367	17.681	5.894	-	-

Table 23 transverse vertical -ve & +ve moments

LONGITUDINAL REINFORCEMENT

Negative bar

Location	Negative moment Column strip	Negative moment Half mid strip	D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
STRIP ONE													
Ex.span b/n axis (1-2)	44.095	7.349	178	1175	1175	0.004798	0.00167	1003.521	349.2805	91.9139	Ø10C/C90	185.0786	Ø8C/C150
Int.span b/n axis (2-3),(4-5)	44.095	7.349	178	1175	1175	0.004798	0.00167	1003.521	349.2805	91.9139	Ø10C/C90	185.0786	Ø8C/C150
Ex.span b/n axis (5-6)	41.803	6.967	178	1175	1175	0.004534	0.00167	948.3139	349.2805	97.26474	Ø10C/C90	185.0786	Ø8C/C150
STRIP TWO													
In.span b/n axis (1-2),(3-4)	87.247	14.54	178	1150	2350	0.004744	0.00167	1984.266	341.849	92.96888	Ø10C/C90	185.0786	Ø8C/C150
In.span b/n axis (2-3),(4-5)	74.78	12.463	178	1150	2350	0.004031	0.00167	1686.118	341.849	109.4081	Ø10C/C100	185.0786	Ø8C/C150

Ex.span b/n axis (5-6)	82.716	13.786	178	1150	2350	0.004483	0.00167	1875.277	341.849	98.37213	Ø10C/C90	185.0786	Ø8C/C150
STRIP THREE													
In.span b/n axis (2-3)	87.24	14.54	178	1150	2350	0.004743	0.00167	1984.097	341.849	92.9768	Ø10C/C90	185.0786	Ø8C/C150
Ex.span b/n axis (5-6)	82.716	13.786	178	1150	2350	0.004483	0.00167	1875.277	341.849	98.37213	Ø10C/C90	185.0786	Ø8C/C150
STRIP FOUR													
Ex.span b/n axis (2-3)	44.09	7.344	178	1175	1175	0.004798	0.00167	1003.4	349.2805	91.92497	Ø10C/C90	185.0786	Ø8C/C150
In.span b/n axis (3-4)	37.79	6.299	178	1175	1175	0.004076	0.00167	852.5439	349.2805	108.1909	Ø10C/C90	185.0786	Ø8C/C150
Ex.span b/n axis (5-6)	41.8	6.967	178	1175	1175	0.004534	0.00167	948.2418	349.2805	97.27213	Ø10C/C90	185.0786	Ø8C/C150

Table 24 1st-4th floor longitudinal negative bar

Positive bars

Location	positive moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											

STRIP ONE													
Ex.span b/n axis (1-2)	25.194	8.398	178	1175	1175	0.002672	0.00167	558.9151	349.2805	105.6189	Ø8C/C100	137.0103	Ø8C/C120
Int.span b/n axis (2-3),(4-5)	25.194	8.398	178	1175	1175	0.002672	0.00167	558.9151	349.2805	105.6189	Ø8C/C100	137.0103	Ø8C/C120
Ex.span b/n axis (5-6)	23.887	7.962	178	1175	1175	0.002529	0.00167	529.0234	349.2805	111.5867	Ø8C/C100	137.0103	Ø8C/C120
STRIP TWO													
In.span b/n axis (1-2),(3-4)	49.85	16.618	178	1150	2350	0.002643	0.00167	1105.509	341.849	106.7961	Ø8C/C1000	137.0103	Ø8C/C120
In.span b/n axis (2-3),(4-5)	29.913	9.971	178	1150	2350	0.001566	0.00167	655.0094	341.849	180.2478	Ø8C/C170	137.0103	Ø8C/C120
Ex.span b/n axis (5-6)	47.266	15.755	178	1150	2350	0.002502	0.00167	1046.453	341.849	112.823	Ø8C/C100	137.0103	Ø8C/C120
STRIP THREE													
In.span b/n axis (2-3)	44.855	16.618	178	1150	2350	0.00237	0.00167	991.5335	341.849	119.0721	Ø8C/C100	137.0103	Ø8C/C120
Ex.span b/n axis (5-6)	47.266	15.755	178	1150	2350	0.002502	0.00167	1046.453	341.849	112.823	Ø8C/C100	137.0103	Ø8C/C120

STRIP FOUR													
Ex.span b/n axis (2-3)	25.197	8.399	178	1175	1175	0.002673	0.00167	558.9838	349.2805	105.6059	Ø8C/C100	137.0103	Ø8C/C120
In.span b/n axis (3-4)	15.118	5.039	178	1175	1175	0.001583	0.00167	331.1078	349.2805	178.2863	Ø8C/C170	137.0103	Ø8C/C120
Ex.span b/n axis (5-6)	23.88	7.96	178	1175	1175	0.002529	0.00167	528.8636	349.2805	111.6205	Ø8C/C100	137.0103	Ø8C/C120

Table 25 1st-4th floor longitudinal positive bar

Edge bar

Location	Edge moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
Ex.span b/n axis (1-2)	24.516	0.68	178	1175	1175	0.002598	0.00167	543.3959	349.2805	108.6353	Ø8C/C100	169.0103	Ø8C/C150
In.span b/n axis (2-3),(4-5)	21.247	0.589	178	1175	1175	0.002242	0.00167	468.9612	349.2805	125.8782	Ø8C/C100	169.0103	Ø8C/C150
Ex.span b/n axis (5-6)	23.242	0.645	178	1175	1175	0.002459	0.00167	514.3103	349.2805	114.7789	Ø8C/C100	169.0103	Ø8C/C150

STRIP TWO													
In.span b/n axis (1-2),(3-4)	42.041	1.16	178	1175	2350	0.002218	0.00167	927.6553	349.2805	127.2714	Ø8C/C100	169.0103	Ø8C/C150
Ex.span b/n axis (5-6)	45.98	1.276	178	1175	2350	0.002432	0.00167	1017.138	349.2805	116.0748	Ø8C/C100	169.0103	Ø8C/C150
STRIP THREE													
In.span b/n axis (2-3)	48.5	1.346	178	1175	2350	0.002569	0.00167	1074.63	349.2805	109.8648	Ø8C/C100	169.0103	Ø8C/C150
Ex.span b/n axis (5-6)	45.98	1.276	178	1175	2350	0.002432	0.00167	1017.138	349.2805	116.0748	Ø8C/C100	169.0103	Ø8C/C150
STRIP FOUR													
Ex.span b/n axis (2-3)	24.516	0.68	178	1175	1175	0.002598	0.00167	543.3959	349.2805	108.6353	Ø8C/C100	169.0103	Ø8C/C150
Ex.span b/n axis (5-6)	23.24	0.644	178	1175	1175	0.002459	0.00167	514.2648	349.2805	114.7891	Ø8C/C100	169.0103	Ø8C/C150

Table 26 1st-4th floor longitudinal edge bars

VERTICAL REINFORCEMENT

Negative bar

Location	Negative moment Column strip	Negative moment Half mid strip	D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
STRIP ONE													
Ex. Pane b/n axis A-B	23.68	3.946	178	1175	1175	0.002507	0.00167	524.2988	349.2805	175.9254	Ø10C/C150	169.0103	Ø8C/C150
STRIP TWO													
Ex. Pane b/n axis A-B,C-D	55.25	9.209	178	1175	1175	0.006109	0.00167	1277.77	349.2805	72.18628	Ø10C/C70	169.0103	Ø8C/C150
In. Pane b/n axis B-C	45.28	7.546	178	1175	1175	0.004935	0.00167	1032.212	349.2805	89.3591	Ø10C/C80	169.0103	Ø8C/C150
STRIP THREE& FOUR													
Ex. Pane b/n axis A-B	110.769	18.616	178	1150	2350	0.006125	0.00167	2562.272	341.849	71.99666	Ø10C/C70	169.0103	Ø8C/C150
In. Pane b/n axis C-D	105.65	17.609	178	1150	2350	0.00582	0.00167	2434.678	341.849	75.76977	Ø10C/C70	169.0103	Ø8C/C150

In. Pane b/n axis B-C	110.511	18.418	178	1150	2350	0.00611	0.00167	2555.816	341.849	72.17851	Ø10C/C70	169.0103	Ø8C/C150
STRIP FIVE													
Ex. Pane b/n axis A-B,C-D	109.196	18.199	178	1150	2350	0.006031	0.00167	2522.953	341.849	73.11867	Ø10C/C70	169.0103	Ø8C/C150
In. Pane b/n axis B-C	104.396	17.399	178	1175	2350	0.005746	0.00167	2403.579	349.2805	76.75014	Ø10C/C70	169.0103	Ø8C/C150
STRIP SIX													
Ex. Pane b/n axis A-B,C-D	53.94	8.99	178	1175	1175	0.005953	0.00167	1245.067	349.2805	74.08234	Ø10C/C70	169.0103	Ø8C/C150

Table 27 1st-4th floor vertical negative bar

Positive bar

Location	positive moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
Ex. Pane b/n axis A-B	31.574	10.5248	178	1175	1175	0.003377	0.00167	706.3569	349.2805	83.57249	Ø8C/C80	169.0103	Ø8C/C150

STRIP TWO													
Ex. Pane b/n axis A-B,C-D	31.574	10.525	178	1175	1175	0.003377	0.00167	706.3569	349.2805	83.57249	Ø8C/C80	169.0103	Ø8C/C150
In. Pane b/n axis B-C	18.112	6.037	178	1175	1175	0.001904	0.00167	398.176	349.2805	148.2561	Ø8C/C140	169.0103	Ø8C/C150
STRIP THREE & FOUR													
Ex. Pane b/n axis A-B	65.829	21.943	178	1150	2350	0.003527	0.00167	1475.333	341.849	80.02534	Ø8C/C80	169.0103	Ø8C/C150
In. Pane b/n axis C-D	60.373	20.125	178	1150	2350	0.003223	0.00167	1348.144	341.849	87.5752	Ø8C/C80	169.0103	Ø8C/C150
In. Pane b/n axis B-C	63.149	21.049	178	1150	2350	0.003377	0.00167	1412.737	341.849	83.57111	Ø8C/C80	169.0103	Ø8C/C150
STRIP FIVE													
Ex. Pane b/n axis A-B,C-D	62.397	20.799	178	1150	2350	0.003335	0.00167	1395.215	341.849	84.62066	Ø8C/C80	169.0103	Ø8C/C150
In. Pane b/n axis B-C	35.793	11.931	178	1175	2350	0.001881	0.00167	786.6626	349.2805	150.0821	Ø8C/C150	169.0103	Ø8C/C150
STRIP SIX													

Ex. Pane b/n axis A-B,C-D	30.822	10.274	178	1175	1175	0.003294	0.00167	688.8437	349.2805	85.69723	Ø8C/C80	169.0103	Ø8C/C150
In. Pane b/n axis B-C	17.681	5.894	178	1175	1175	0.001857	0.00167	388.4894	349.2805	151.9527	Ø8C/C150	169.0103	Ø8C/C150

Table 28 1st-4th floor vertical positive bars

Edge bare

Location	Edge bar moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
Ex. Pane b/n axis A-B	30.574	0.852	178	1175	1175	0.003266	0.00167	683.0761	349.2805	86.42082	Ø8C/C80	169.0103	Ø8C/C150
STRIP TWO													
Ex. Pane b/n axis A-B,C-D	30.723	0.852	178	1175	1175	0.003283	0.00167	686.5409	349.2805	85.98468	Ø8C/C80	169.0103	Ø8C/C150
STRIP THREE & FOUR													
Ex. Pane b/n axis A-B	53.37	1.481	178	1175	2350	0.002836	0.00167	1186.286	349.2805	99.52402	Ø8C/C9	169.0103	Ø8C/C150

In. Pane b/n axis C-D	58.743	1.63	178	1175	2350	0.003133	0.00167	1310.332	349.2805	90.10235	Ø8C/C80	169.0103	Ø8C/C150
In. Pane b/n axis B-C	61.444	1.705	178	1175	2350	0.003282	0.00167	1373.035	349.2805	85.9876	Ø8C/C80	169.0103	Ø8C/C150
STRIP FIVE													
Ex. Pane b/n axis A-B,C-D	60.713	1.687	178	1175	2350	0.003242	0.00167	1356.042	349.2805	87.06514	Ø8C/C80	169.0103	Ø8C/C150
STRIP SIX													
Ex. Pane b/n axis A-B,C-D	29.991	0.832	178	1175	1175	0.003201	0.00167	669.5331	349.2805	88.1689	Ø8C/C80	169.0103	Ø8C/C150

Table 29 1st-4th floor vertical edge bar

2.1.2.3 Fiveth floor Cantilever

Cantilever-1 is a cantilever slab. For cant liver slabs we take one meter width strip and design the slab for the one meter width. That means cantilever can be design like one way slab.

Loadings

2.1.2.3.1 Dead load for Cantilever slab

150mm RC slab = $0.2\text{m} * 25\text{KN}/_{\text{m}^3} = 5\text{KN}/_{\text{m}^2}$

20mm ceiling plaster = $0.02\text{m} * 23\text{KN}/_{\text{m}^3} = 0.45\text{KN}/_{\text{m}^2}$

30mm cement screen = $0.03\text{m} * 23\text{KN}/_{\text{m}^3} = 0.69\text{KN}/_{\text{m}^2}$

20mm ceramic tiling = $0.02\text{m} * 23\text{KN}/_{\text{m}^3} = 0.46\text{KN}/_{\text{m}^2}$

Total = $6.6\text{KN}/_{\text{m}^2}$

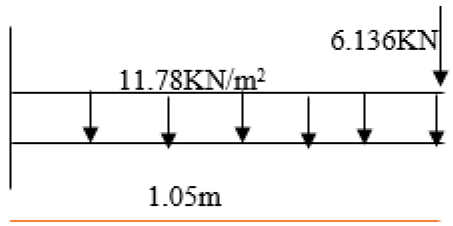
- Live load for flowerpot place = 2 KN/m2
- Factored load =1.3D.l+1.6L.L

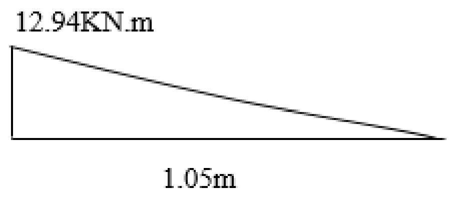
$=1.3*6.6+1.6*2$
$=11.78 KN/m^2$

There is also a load from external wall which act as concentrated load on the strip.

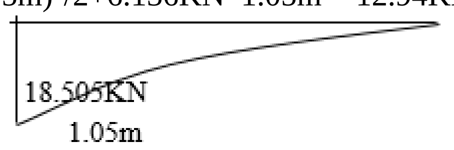
- Dead load from external wall = 2.95*2.08*1 = 6.136KN

There for the strip becomes like a cantilever beam fixed at one end.





Mxs4 = $1m*11.78\ KN/m^2\ (1.05m)^2/2+6.136KN*1.05m = 12.94KNm$



Vmax = $w*l + Pd = 1m*11.78\ KN/m^2 *1.05m + 6.136KN = 18.505KN$

In the same way the moment calculation for other slabs is calculated in summarized in the following table.

Cantilever	Factor load	Short distance	External wall load	M_{xs}
C1	11.78	1.05	6.136	12.94
C2	11.78	1.05	6.136	12.94
C3	13.38	1.4	9.587	26.53
C3’	16.684	1.3	10.05	27.163
C4	14.98	1.05	6.667	15.258

C5	14.98	1.05	6.667	15.258
C6	14.98	10.5	6.667	15.258
C7	14.98	1.05	6.667	15.258

Table 30 Support moment calculation for Cantilever slab for 5th floor

2.1.2.3.2 Check the depth for flexure

$$d \geq \sqrt{\frac{Mu}{0.1982bfcd}} = \sqrt{\frac{27.163*10^6}{0.1982*1000*11.33}}$$

= 109.98mm < the depth provided. (Section is safe for flexure) Hence ok.

2.1.2.3.3 Design for reinforcement

M_{max} = 27.163KNm

T- Section is subjected to –ve bending moment and analyze the section as a rectangular section of width (b) =1000mm

Therefore D=200mm, b=1000mm

d=D –d' =200-15-7= 178mm

As= ρbd

Where:-

$$\rho = \frac{1}{2}\left[c_{1-}\sqrt{c_1^2 - \frac{4Md}{bd^2c_2}}\right]$$

$$\rho = \frac{1}{2}\left[0.087 - \sqrt{0.087_1^2 - \frac{4*12.94*10^6}{1000*178^2*3003.04}}\right] = 0.001662$$

$$\rho_{min} = \frac{0.6}{fyk}$$=0.6/300=0.00167

$\rho_{min} < \rho < \rho_{max}$

Therefore 0.00167 < 0.001592 < 0.02

As = ρbd = 0.00167*1000*178 = 297.26mm^2

Using Φ8, as = (π * 8^2/4) = 48mm^2

Spacing = $\frac{bas}{As} = \frac{1000*48}{283.4369} =$ 169.3499mm

Use provided space = 160mm

The required values are summarized the same way as follows:

Span	Mxs	B(mm)	depth(mm)	ρ	As calc min	Spa. calc	S provided
C1	12.94	1000	178	0.00167	297.26	161.475	Φ8 c/c 160
C2	12.94	1000	178	0.00167	297.26	161.475	Φ8 c/c 160
C3	26.53	1000	178	0.003333	593.1981	132.3335	φ10 c/c 130
C3’	27.163	1000	178	0.003415	607.954	129.1216	φ10 c/c 120
C4	15.258	1000	178	0.00167	295.8125	234.08	Φ10 c/c 230
C5	15.258	1000	178	0.00167	295.8125	234.08	Φ10 c/c 230
C6	15.258	1000	178	0.00167	295.8125	234.08	Φ10 c/c 230
C7	15.258	1000	178	0.00167	295.8125	234.08	Φ10 c/c 230

Table 31 cantilever reinforcement bar calculation for 5th floor

CHAPTER THREE

3.1 SLAB DESIGN FOR G+7 BUILDING

3.1.**1** RIBBED SLAB DESIGN FOR G + 7

3.1.1.1 Design constant

Concrete C-25= f_{cu} unit weight -25, γc = 1.5

Steel – 360, class I work γs-1.15

- f_{cd}= 0.68*f_{cu}/1.5 = 11.33 MPa
- f_{ck} = 0.8 f_{cu} = 20 MPa
- f_{ctd} = 0.21 [f_{ck}^ (2/3)]/γ_c= 1.032 MPa
- f_{yd} = f_{yk}/ γ_s = 313.04 MPa
- m = f_{yd}/ [0.8f_{cd}] = 34.54
- C1=2.5/m = 0.072
- C2 = 0.32m^2*f_{cd} = 4325.38
- ρ_{max} = 0.75 ρ_b = 0.0145
- ρ_{min} = 0.5/ f_{yk} = 0.00165

3.1.1.2 Seventh floor slab layout

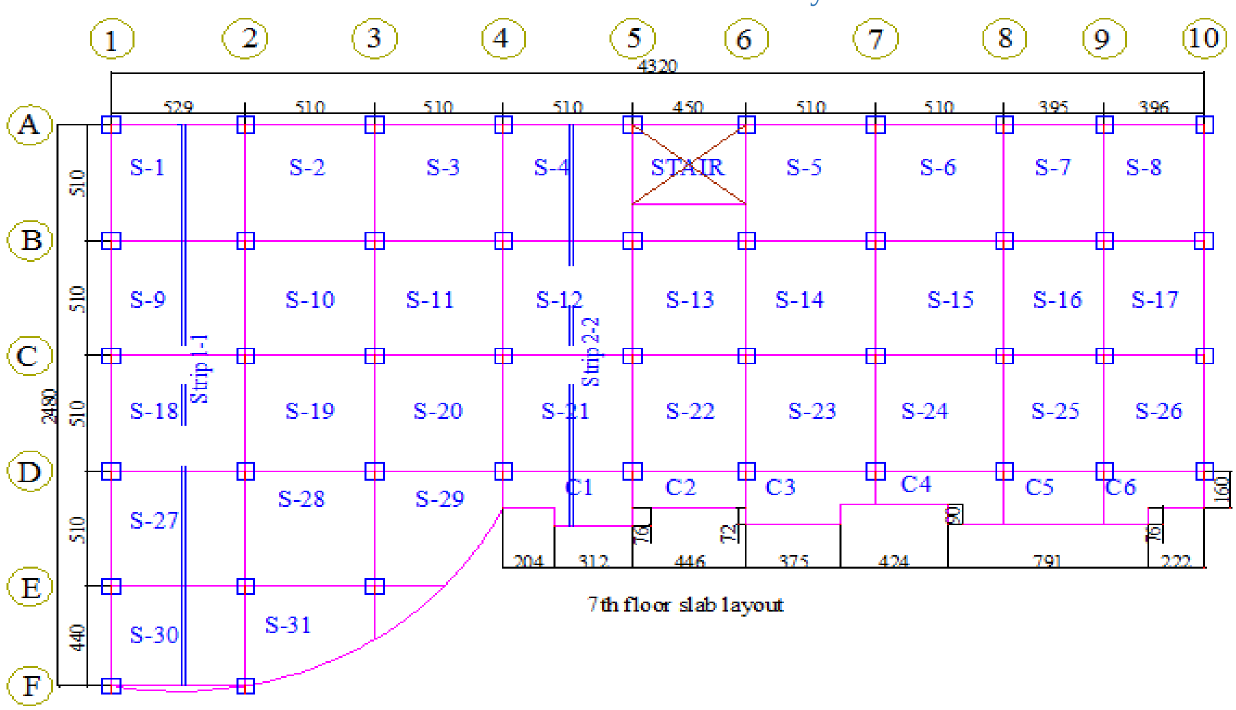
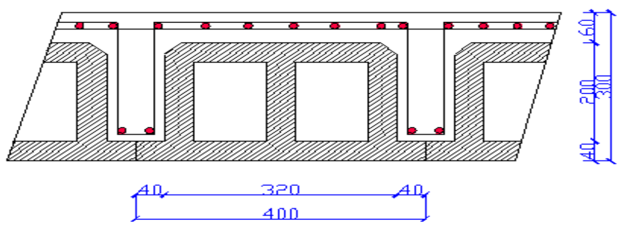


Figure 9 7th floor slab layout

- h_f =60mm
- D=300mm
- C/C =400mm
- b_w =80mm
- And we assumed HCB of size shown below



B) Depth determination

$$d \geq \left(\frac{0.4 + 0.6 * f_{yk}}{400}\right) * \frac{L_e}{\beta_a}$$

Where:-

f_{yk}=characteristics tensile strength of steel

Le=effective span

β_e=accounts for the boundary condition and span ration for slabs

Overall depth,

$D = d + \phi_l + \phi_s$

<u>Step-2</u>

Suitable dimension for the ribbed should be assumed considering deflection requirement and construction suitability.

Depth determination

$$d \geq \left(\frac{0.4 + 0.6 * f_{yk}}{400}\right) * \frac{L_e}{\beta_a}$$

d> 0.4+0.6*360/400)5100/24 =199.97

D = 199.97+15+12/2 =220.75mm

Use D = 300mm

Span No	Ly	Lx	Ly/Lx	βa	Effe.depth
S1	5290	5100	1.037255	24	199.75
S2	5100	5100	1	24	199.75
S3	5100	5100	1	24	199.75
S4	5100	5100	1	24	199.75
S5	5100	5100	1	24	199.75
S6	5100	5100	1	24	199.75
S7	5100	3950	1.291139	24	154.7083
S8	5100	3960	1.287879	24	155.1
S9	5290	5100	1.037255	24	199.75
S10	5100	5100	1	28	171.2143
S11	5100	5100	1	28	171.2143
S12	5100	5100	1	28	171.2143
S13	5100	5100	1	28	171.2143
S14	5100	5100	1	28	171.2143
S15	5100	5100	1	28	171.2143
S16	5100	3950	1.291139	28	132.6071
S17	5100	3960	1.287879	24	155.1
S18	5290	5100	1.037255	24	199.75
S19	5100	5100	1	28	171.2143
S20	5100	5100	1	28	171.2143
S21	5100	5100	1	28	171.2143
S22	5100	5100	1	28	171.2143
S23	5100	5100	1	28	171.2143
S24	5100	5100	1	28	171.2143
S25	5100	3950	1.291139	28	132.6071
S26	5100	3960	1.287879	24	155.1
S27	5290	5100	1.037255	24	199.75
S28	5100	5100	1	28	171.2143
S29	5100	5100	1	28	171.2143
S30	5290	5100	1.037255	24	199.75
S31	5100	5100	1	28	171.2143

Table 32 effective depth determination

3.1.1.2.1 Loading of ribbed slabs

Span 1 - 8

Dead load

- 3cm of cement screed = 0.03m*0.4m*20KN/m^3 = 0.24 KN/m
- Terrazzo = 0.02*23*0.4=0.184KN/m
- HCB with ceiling plaster = 0.02*24*0.4 = 0.192KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96 KN/m

Total dead load = 1.576KN/m

Live load

Since our building hotel type we took live load is 5 KN/m^2 from EBCS-1, 1995

Live load = 0.4m*5KN/m^2 = 2 KN/m

Design load, P_d

P_d = 1.3*DL + 1.6*LL = 1.3*1.576 + 1.6*2 =5.2488KN/m

Span – 9

- Dead load
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Terrazzo = 0.02*23*0.4=0.184KN/m
- Glazing = 0.004*2.7*1.42*25*0.4/26.979 = 0.005613KN/M
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*24*0.4 =0.192KN/m
- Partition wall = 0.2*5.51*2.7*14*0.4/26.979 = 0.618KN/m
- Plastering = 2* 0.02*5.51*2.7*20*0.4/26.979 = 0.176KN/m

Total dead load = 2.3946KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.394 + 1.6*2 = 6.313KN/m

Span 10

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- Terrazzo = (0.02*23)0.4=0.184KN/m
- HCB with ceiling plaster = 0.02*24*0.4 =0.192KN/m
- Partition wall = 6.39*2.7*0.2*14*0.4/26.01 = 0.773KN/m
- Plastering = 2*6.39*2.7*0.02*20*0.4/26.01 = 0.22KN/m

Total dead load (ΣDL) = 3.378KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.378 + 1.6*2 = 6.59KN/m

Span 11-12

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Terrazzo = 0.02*23*0.4 = 0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 = 0.184KN/m
- Partition wall = 4.32*2.7*0.2*14*0.4/26.01 = 0.522KN/m
- Plastering = 2*4.32*2.7*0.02*20*0.4/26.01 = 0.149KN/m

Total dead load (ΣDL) = 3.055KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.055 + 1.6*2 = 7.17KN/m

Span 13

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Terrazzo = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 = 0.184KN/m

Total dead load (ΣDL) = 2.384KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.384 + 1.6*2 = 6.299KN/m

Span 14

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Terrazzo = 0.02*23*0.4 = 0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*24*0.4 = 0.192KN/m
- Partition wall = 5.1*2.7*0.2*14*0.4/26.01 = 0.617KN/m
- Plastering = 2*5.1*2.7*0.02*20*0.4/26.01 = 0.176KN/m

Total dead load (ΣDL) = 3.177KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.177 + 1.6*2 = 7.33KN/m

Span 15

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Ceramic tile = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 = 0.184KN/m
- Partition wall = 5.93*2.7*0.2*14*0.4/26.01= 0.717KN/m
- Plastering = 2*5.93*2.7*0.02*20*0.4/26.01 = 0.1922KN/m

Total dead load (ΣDL) = 2.354KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.354 + 1.6*2 = 6.2602KN/m

Span 16

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Terrazzo = 0.02*23*0.4 = 0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*3.97*2.7*14*0.4/20.145 = 0.596KN/m
- Plastering = 2*2.52*0.02*2.7*20*0.4/20.145 = 0.17KN/m

Total dead load = 3.00KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3 + 1.6*2 = 7.1KN/m

Span 17

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Terrazzo = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m

- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*3.95*2.7*14*0.4/20.196 = 0.48KN/m
- Plastering = 2* 0.02*3.95*2.7*20*0.4/20.196 = 0.136KN/m

Total dead load = 3.00KN/m

Live load

Live load (LL) = 0.4*5 = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3 + 1.6*2 = 7.1KN/m

Span 18

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*24*0.4 =0.192KN/m
- Partition wall = 0.2*4.86*2.7*14*0.4/26.979 = 0.5448KN/m

  Plastering = 2* 0.02*4.86*2.7*20*0.4/26.979 = 0.1556KN/m

Total dead load = 3.153KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.153 + 1.6*0.8 = 5.38kN/m

Span 19

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4 = 0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*10*2.7*14*0.4/26.01 = 1.1626KN/m
- Plastering = 2* 0.02*4.86*2.7*20*0.4/26.01 = 0.3456KN/m

Total dead load = 3.939KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.939 + 1.6*0.8 = 6.4kN/m

Span 20

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m

Total dead load = 2.384KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.384 + 1.6*0.8 = 4.379KN/m

Span 21

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*2.02*2.7*14*0.4/26.01 = 0.335KN/m
- Plastering = 2* 0.02*2.02*2.7*20*0.4/26.01 = 0.067KN/m

Total dead load = 2.816KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.816 + 1.6*0.8 = 4.94kN/m

Span 22

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m

Total dead load = 2.384KN/m

Live load

Live load (LL) = 0.4*3 = 1.2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.384+ 1.6*0.8 = 5.019kN/m

Span 23

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*1.68*2.7*14*0.4/26.01 = 0.1953KN/m
- Plastering = 2* 0.02*1.68*2.7*20*0.4/26.01 = 0.0557KN/m

Total dead load = 2.658KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.658+ 1.6*0.8 = 4.735KN/m

Span 24

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*3.5*2.7*14*0.4/25 = 0.423KN/m
- Plastering = 2* 0.02*3.5*2.7*20*0.4/25 = 0.121KN/m

Total dead load = 2.941KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.941 + 1.6*0.8 = 5.103kN/m

Span 25

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*5*2.7*14*0.4/20.145 = 0.7505KN/m
- Plastering = 2* 0.02*5*2.7*20*0.4/20.145 = 0.2186KN/m

Total dead load = 3.162KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.162+ 1.6*0.8 = 5.39KN/m

Span 26

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- ceramic tiles = 0.02*23*0.4=0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*2.93*2.7*14*0.4/20.196 = 0.438KN/m
- Plastering = 2* 0.02*2.93*2.7*20*0.4/20.196 = 0.1253KN/m

Total dead load = 2.57KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.57 + 1.6*0.8 = 4.621KN/m

Span 27

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4 = 0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*5.19*2.7*14*0.4/26.01 = 0.6036KN/m
- Plastering = 2* 0.02*5.19*2.7*20*0.4/26.01 = 0.172KN/m

Total dead load = 3.079KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.079 + 1.6*0.8 = 5.283kN/m

Span 28

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m

- Parquet = 0.02*9*0.4 = 0.072KN/m
- Ceramic tiles = 0.02*23*0.4 = 0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 = 0.184KN/m
- Partition wall = 0.2*8.56*2.7*14*0.4/26.01 = 0.9948KN/m
- Plastering = 2* 0.02*8.56*2.7*20*0.4/26.01 = 0.2845KN/m

Total dead load = 2.799KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.799 + 1.6*0.8 = 6.22kN/m

Span 29

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Marble = 0.03*27*0.4 = 0.324KN/m
- ceramic tiles = 0.02*23*0.4 = 0.184KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plastering = 0.02*24*0.4 =0.192KN/m
- Partition wall = 0.2*5.56*2.7*14*0.4/25 = 0.673KN/m
- Plastering = 2* 0.02*5.56*2.7*20*0.4/25 = 0.192KN/m

Total dead load = 3.586KN/m

Live load

Live load (LL) = 0.4*4 = 1.6KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.586 + 1.6*0.8 = 7.22kN/m

Span 30

Dead load

- 2mm of PVC = 0.002*0.4*16 = 0.0128KN/m
- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4 = 0.072KN/m
- Marble = 0.03*27*0.4 = 0.324KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*4.65*2.7*14*0.4/23.276 = 0.552KN/m
- Plastering = 2* 0.02*4.65*2.7*20*0.4/23.276 = 0.158KN/m

Total dead load = 3.3KN/m

Live load

Live load (LL) = 0.4*4 = 1.6KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*3.3 + 1.6*1.6 = 6.857KN/m

Span 31

Dead load

- 3cm of cement screed = 0.03*0.4*20 = 0.24KN/m
- Parquet = 0.02*9*0.4=0.072KN/m
- RC slab (topping) = 0.06*0.4*24 + 0.08*0.2*24 = 0.96KN/m
- HCB with ceiling plaster = 0.02*23*0.4 =0.184KN/m
- Partition wall = 0.2*4.13*2.7*14*0.4/22.44 = 0.0.556KN/m
- Plastering = 2* 0.02*4.13*2.7*20*0.4/22.44 = 0.1593KN/m

Total dead load = 2.915KN/m

Live load

Live load (LL) = 0.4*2 = 0.8KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*2.915 + 1.6*0.8 = 5.069KN/m

Cantilevers

C1

Dead load

- 3cm of cement screed = 0.03*1*20 = 0.6KN/m
- ceramic tiles = 0.02*23 = 0.46KN/m
- RC slab = 0.21 *24 = 5.04 KN/m
- ceiling plaster = 0.02*23 = 0.46KN/m
- Partition wall = 0.2*2.04*2.79*14/3.264 = 4.88KN/m
- Plastering = 2* 0.02*2.04*2.79*20*0.4/3.264 = 1.39KN/m

Total dead load = 13.26KN/m

Live load

Live load (LL) = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*13.26 + 1.6*2 = 20.43kN/m

C2

Dead load

- 3cm of cement screed = 0.03*1*20 = 0.6KN/m
- Parquet = 0.02*9 = 0.18KN/m

- RC slab = 0.21 *24 = 5.04 KN/m
- ceiling plaster = 0.02*23 =0.46KN/m
- Glazing = 0.004*2.79*3.88*25/7.36 = 0.147KN/m

Total dead load = 6.427KN/m

Live load

Live load (LL) = 3KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*6.427 + 1.6*3= 13.155KN/m

C3

Dead load

- 3cm of cement screed = 0.03*1*20 = 0.6KN/m
- Marble = 0.03*27 = 0.81KN/m
- RC slab = 0.21 *24 = 5.04 KN/m
- ceiling plaster = 0.02*23 = 0.46KN/m
- Glazing = 0.004*2.79*4.51*25/8.85=0.142KN/m

Total dead load =7.052 KN/m

Live load

Live load (LL) = 4KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*7.052 + 1.6*4 = 15.56KN/m

C4

Dead load

- 3cm of cement screed = 0.03*1*20 = 0.6KN/m
- ceramic tiles = 0.02*23 = 0.46KN/m
- RC slab = 0.21 *24 = 5.04 KN/m
- ceiling plaster = 0.02*23 = 0.46KN/m
- Partition wall = 0.2*4.24*2.79*14/4.62 = 7.16KN/m
- Plastering = 0.02*4.24*2.79*20*0.4/4.62 = 0.41 KN/m

Total dead load = 13.53KN/m

Live load

Live load (LL) = 2KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*13.26 + 1.6*2 = 20.79KN/m

C5

Dead load

- 3cm of cement screed = 0.03*1*20 = 0.6KN/m
- Marble = 0.03*27=0.81KN/m
- RC slab = 0.21 *24= 5.04KN/m
- Ceiling plaster = 0.02*23 =0.46KN/m
- Glazing = 0.004*2.79*3.95*25/9.32 = 0.118KN/m

Total dead load =7.052 KN/m

Live load

Live load (LL) = 4KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*7.052 + 1.6*4 = 15.56KN/m

C6

Dead load

- 3cm of cement screed = 0.03*1*20 = 0.6KN/m
- Marble = 0.03*27 = 0.81KN/m
- RC slab = 0.21 *24 = 5.04 KN/m
- Ceiling plaster = 0.02*23 = 0.46KN/m
- Glazing = 0.004*2.79*1.74*25/4.106 = 0.118KN/m

Total dead load =7.052 KN/m

Live load

Live load (LL) = 4KN/m

Design load

P_d = 1.3*DL + 1.6*LL = 1.3*7.052 + 1.6*4 = 15.56KN/m

SPAN	DL(KN/m)	LL(KN/m)	1.3*DL(KN/m)	1.6*LL(KN/m)	Pd KN/m
S1	1.576	2	2.0488	3.2	5.2488
S2	1.576	2	2.0488	3.2	5.2488
S3	1.576	2	2.0488	3.2	5.2488
S4	1.576	2	2.0488	3.2	5.2488
S5	1.576	2	2.0488	3.2	5.2488
S6	1.576	2	2.0488	3.2	5.2488
S7	1.576	2	2.0488	3.2	5.2488
S8	1.576	2	2.0488	3.2	5.2488
S9	2.709	2	3.522	3.2	6.722
S10	3.378	2	4.3914	3.2	6.1514
S11	3.055	2	3.9715	3.2	6.147

S12	3.055	2	3.9715	3.2	7.1715
S13	2.384	2	3.0992	3.2	6.2992
S14	3.177	2	4.1301	3.2	7.3301
S15	2.354	2	3.0602	3.2	6.2602
S16	3	2	3.9	3.2	7.1
S17	3	2	3.9	3.2	7.1
S18	3.153	0.8	4.0989	1.28	5.3789
S19	3.939	0.8	5.1207	1.28	6.4007
S20	2.384	0.8	3.0992	1.28	4.3792
S21	2.816	0.8	3.6608	1.28	4.9408
S22	2.384	1.2	3.0992	1.92	5.0192
S23	2.568	0.8	3.3384	1.28	4.6184
S24	2.941	0.8	3.8233	1.28	5.1033
S25	3.162	0.8	4.1106	1.28	5.3906
S26	2.57	0.8	3.341	1.28	4.621
S27	3.079	0.8	4.0027	1.28	5.2827
S28	3.799	0.8	4.9387	1.28	6.2187
S29	3.586	1.6	4.6618	2.56	7.2218
S30	3.3	1.6	4.29	2.56	5.85
S31	2.915	0.8	3.7895	1.28	5.0695

Table 33 design load determination

3.1.1.2.2 Analyzing and Modeling

Modeling

We model the ribs as continuous beams and the direction of ribs is chosen in the shorter direction but some ribs

Step 1: -check the depth for deflection

$$d \geq \left(\frac{0.4+0.6*f_{yk}}{400}\right)*\frac{L_e}{\beta_a}$$

d ≥ (0.4+0.6*360/400)5100/24 = 199.75

D = 199.75+15+12/2 = 220.75mm

Use D = 300mm

Overall depth of the joist = D = 212.5 + 15 + 12/2 = 233.5mm,

Provide D = 300 mm

Overall depth of the joist D ≤ 4 $b_{w,\ joist}$ = 4(80) = 320 mm - D provided is OK.

Thickness of slab (topping), $t_{slab} \geq 40$ mm

Or 1/10 clear distance between ribs.

= (420 – 80) / 10 = 40 mm

In our problem, $t_{slab} = 50$ mm > 40 mm – OK

Modeling and analysis

STRIP ONE

Case-1

When the live load act on span –AB

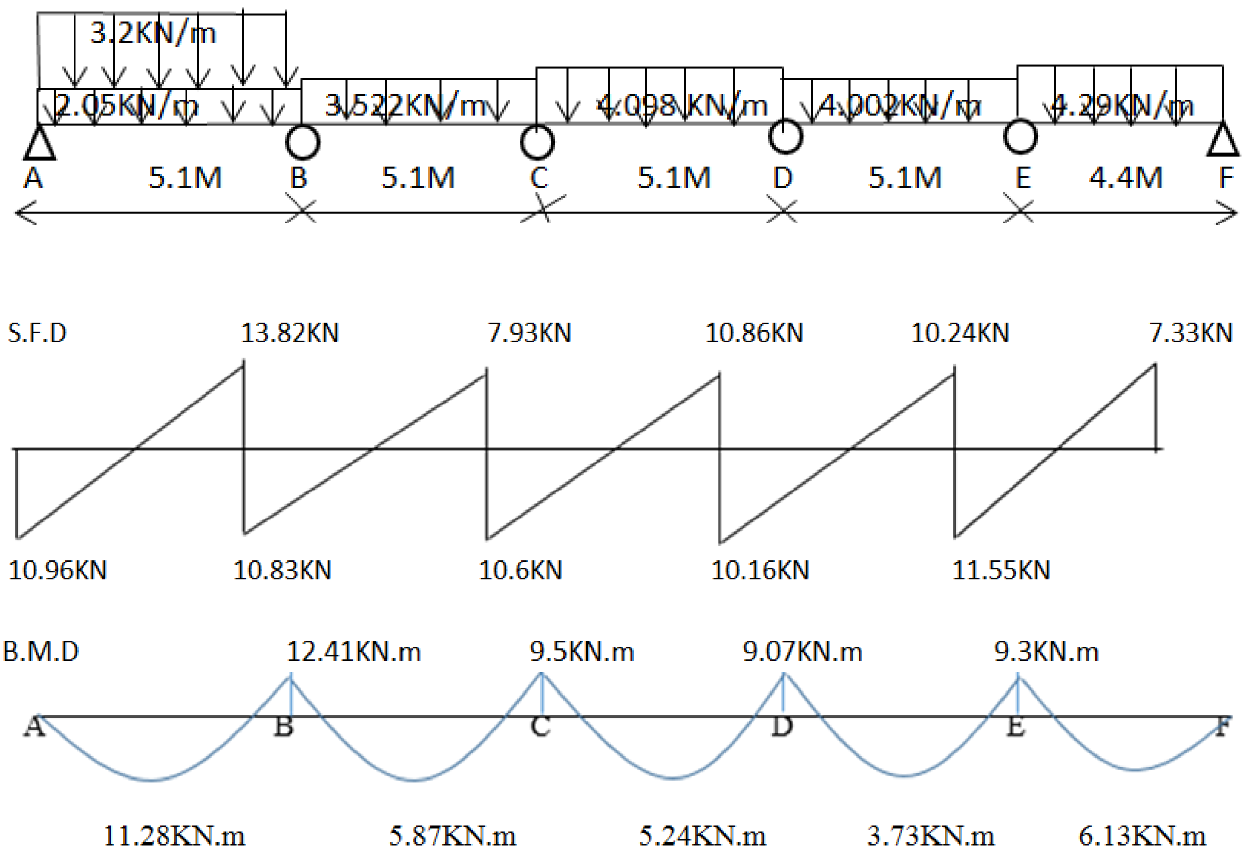
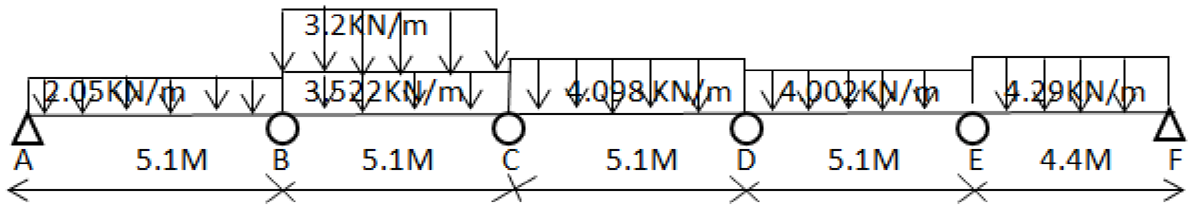
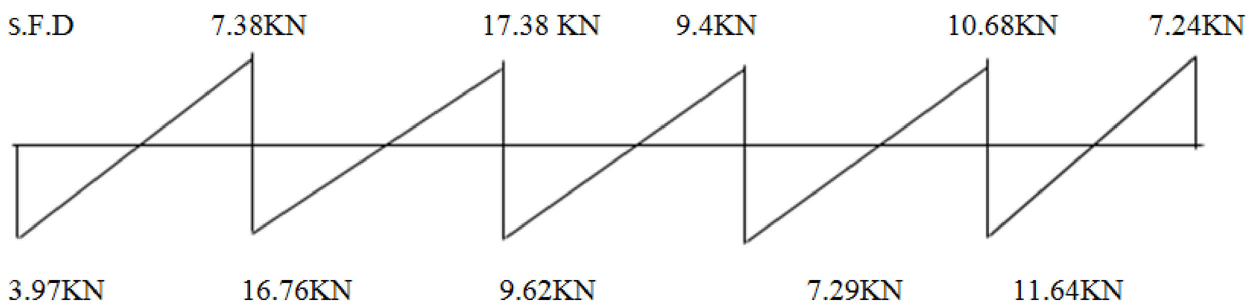


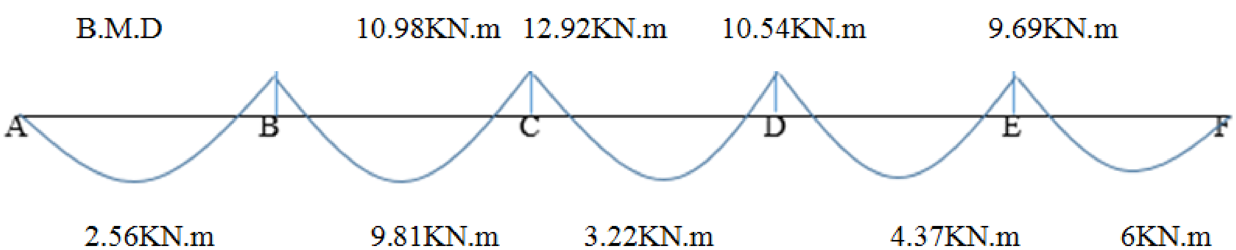
Figure 10 SFD & BMD of 7th floor

Case-2

When the live load acts on span –BC

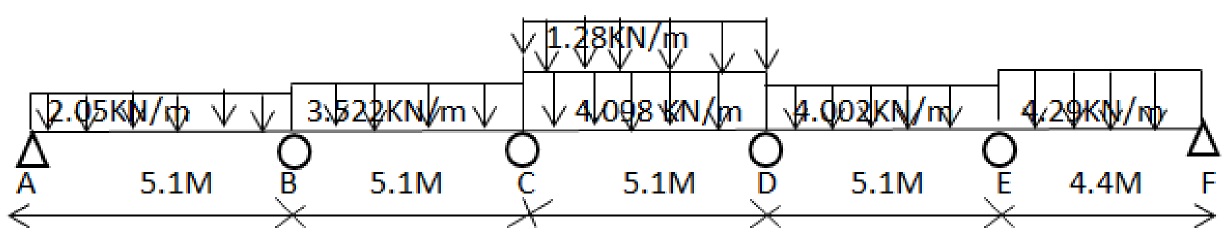


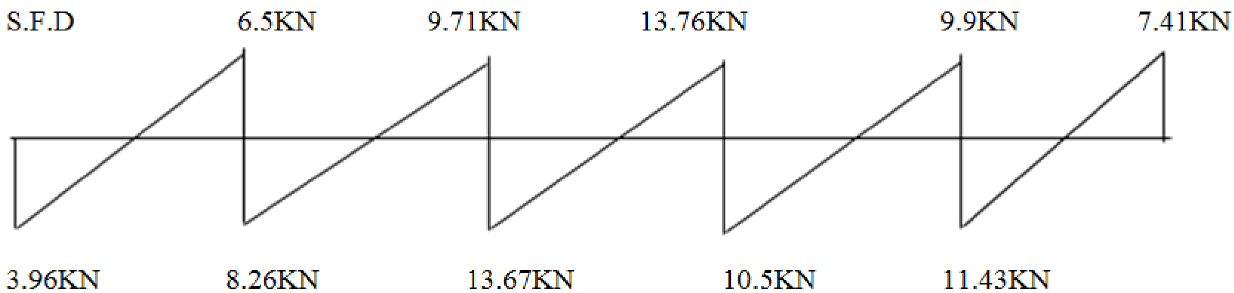


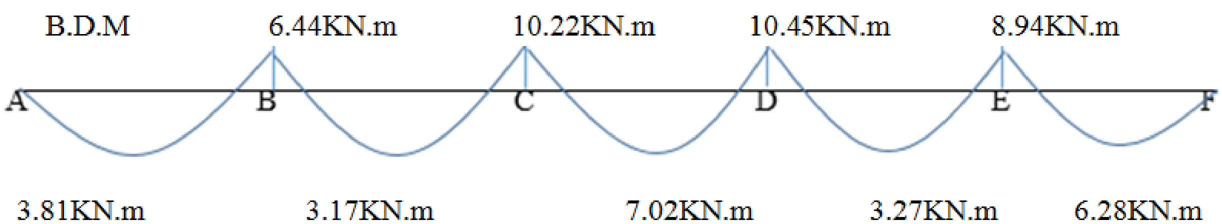


Case-3

When the live load acts on span –CD

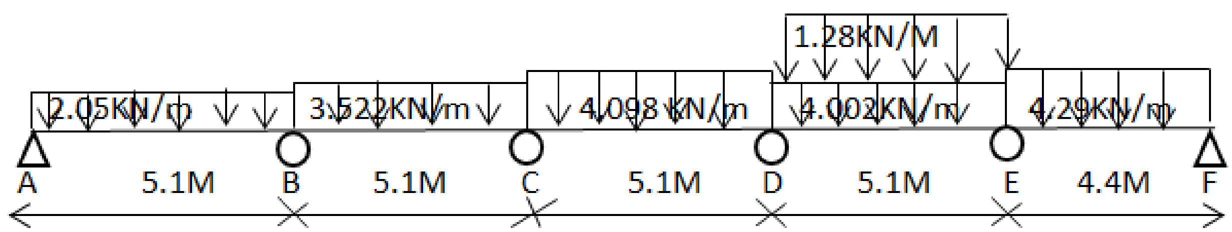


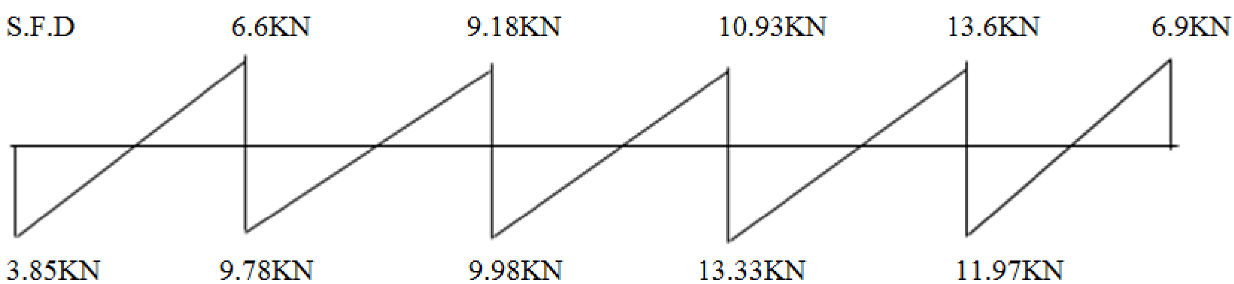


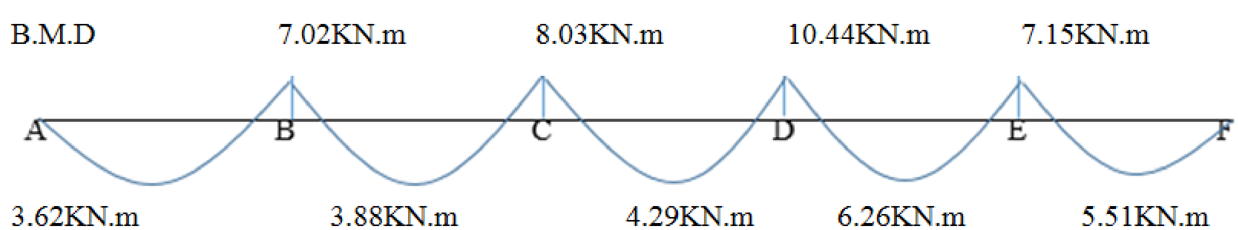


Case-4

When the live load acts on span –DE

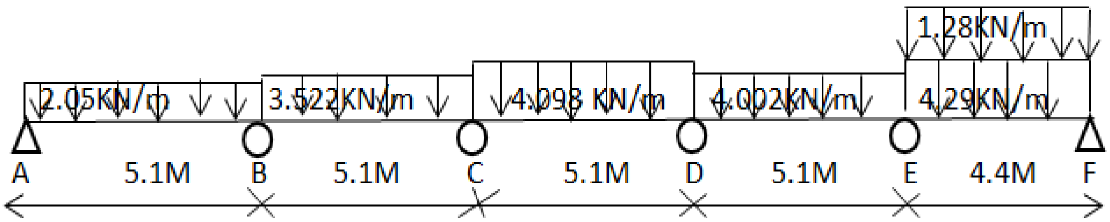


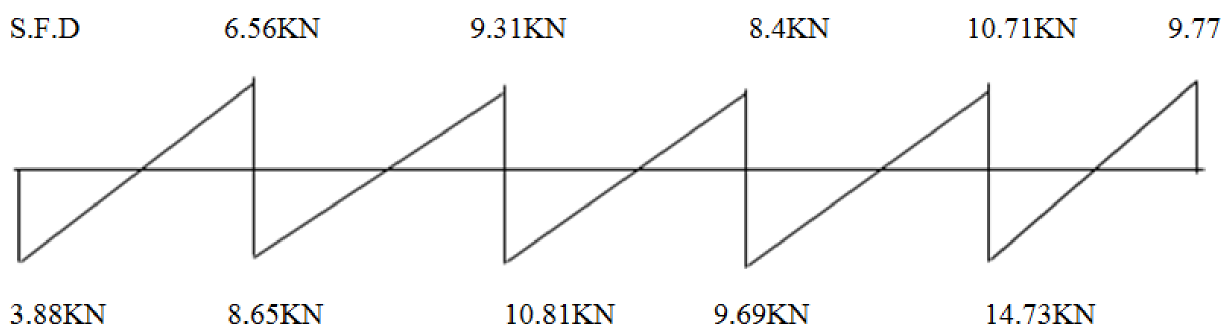


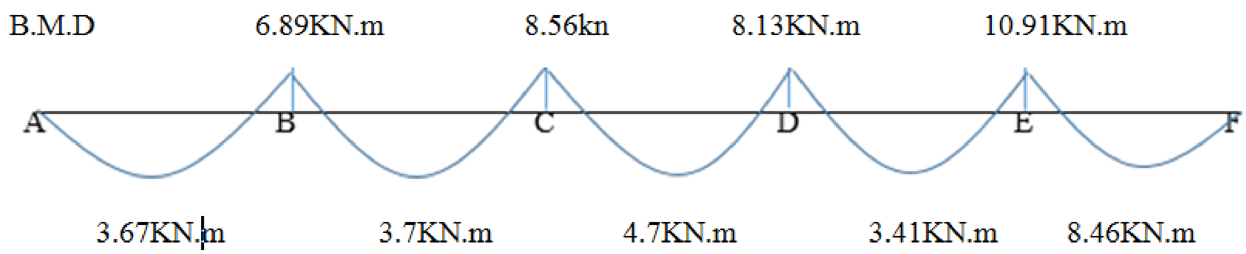


Case-5

When the live load acts on span –EF

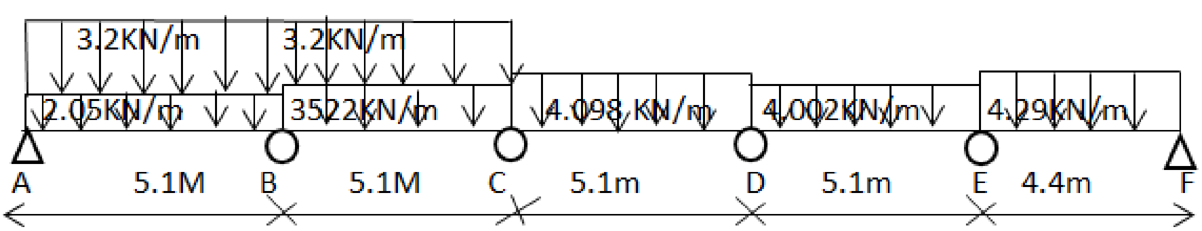


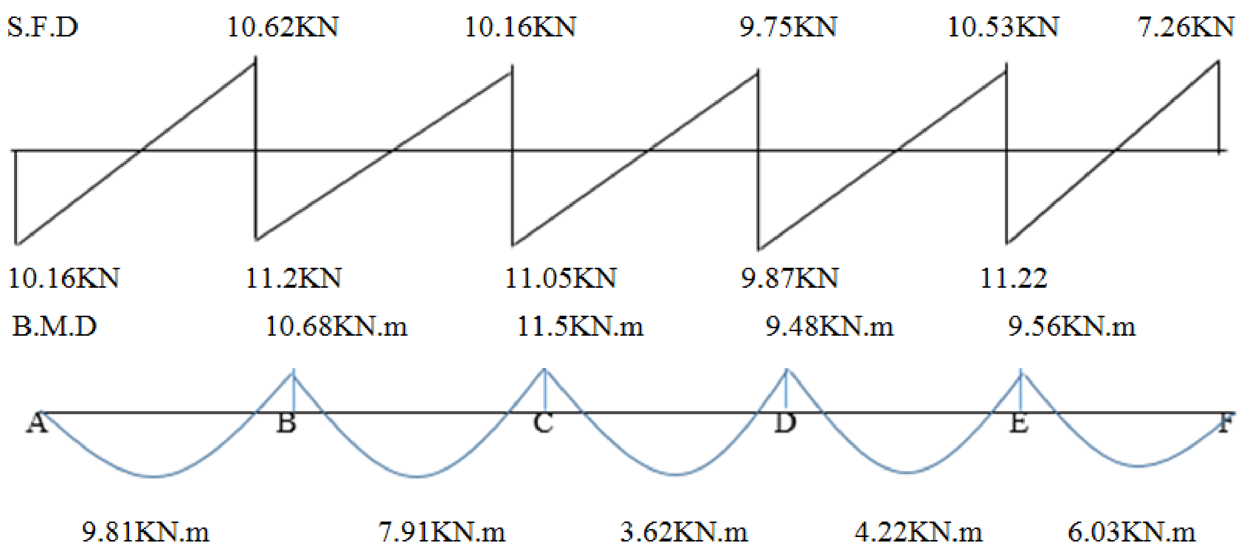




Case-6

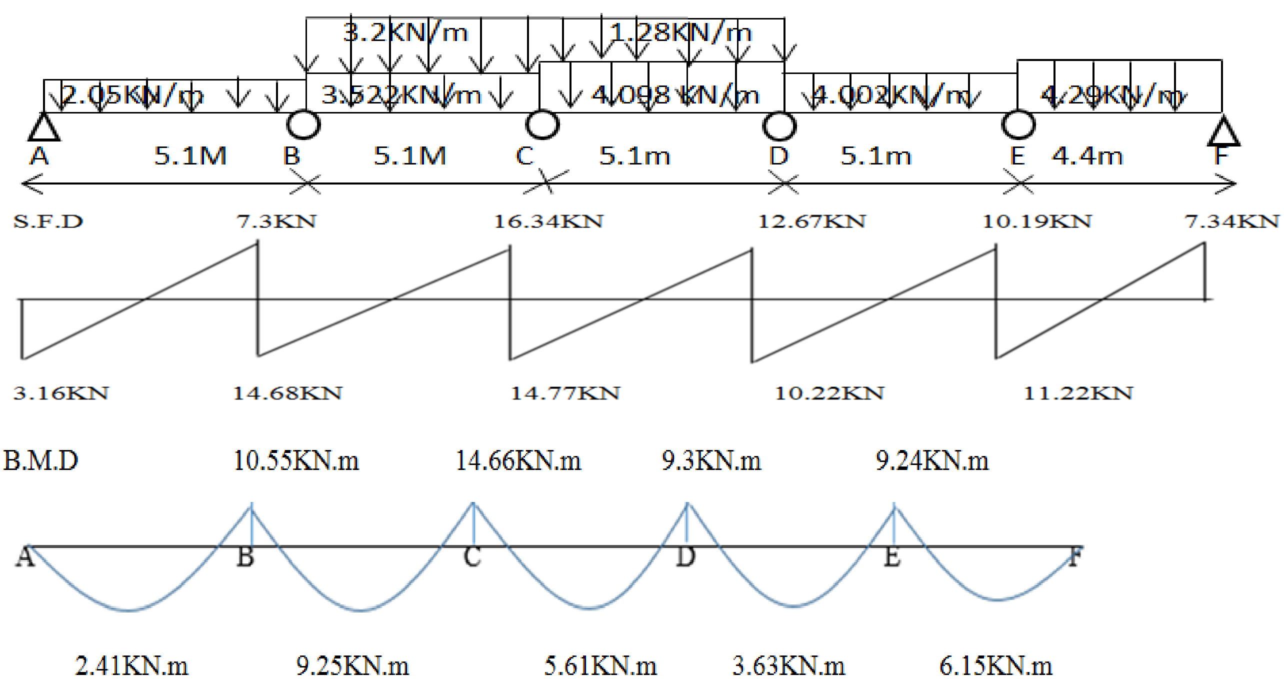
When the live load acts on span ABC





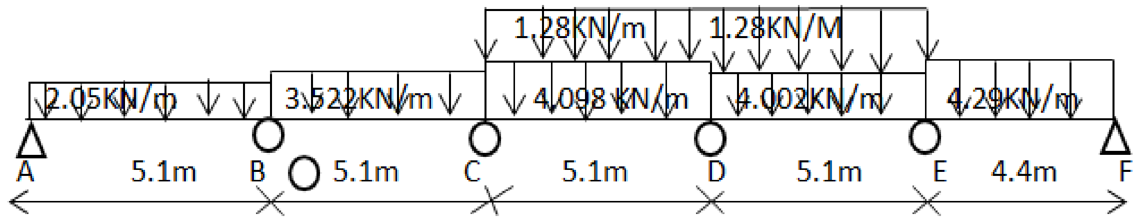
Case-7

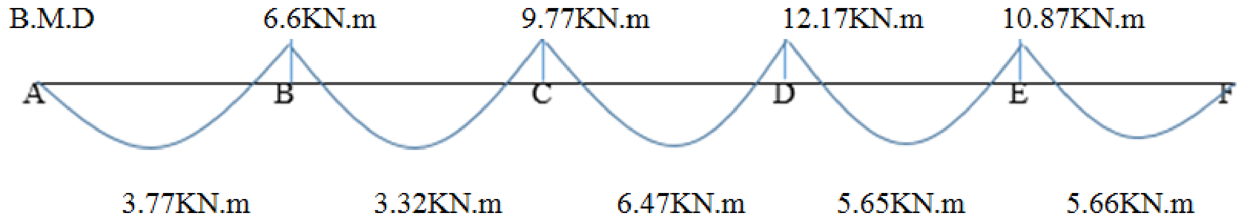
When the live load acts on span BCD

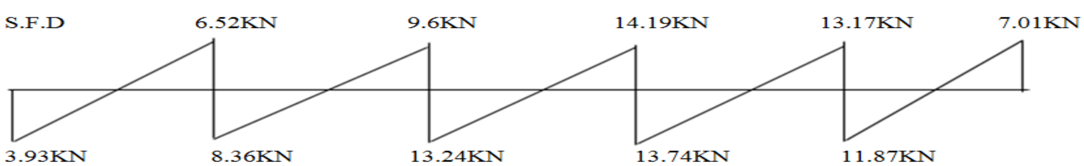


Case-8

When the live load acts on span CDE

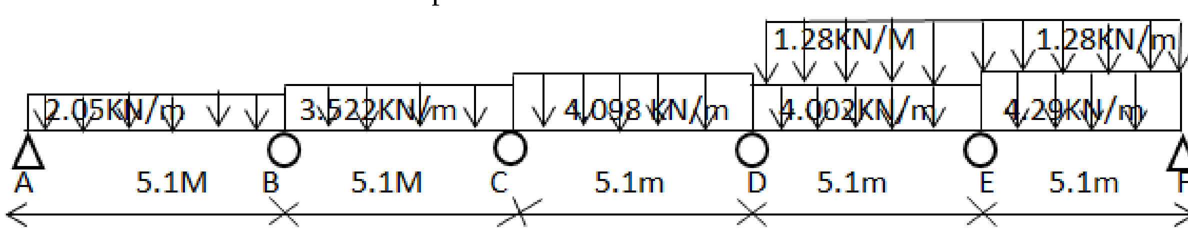


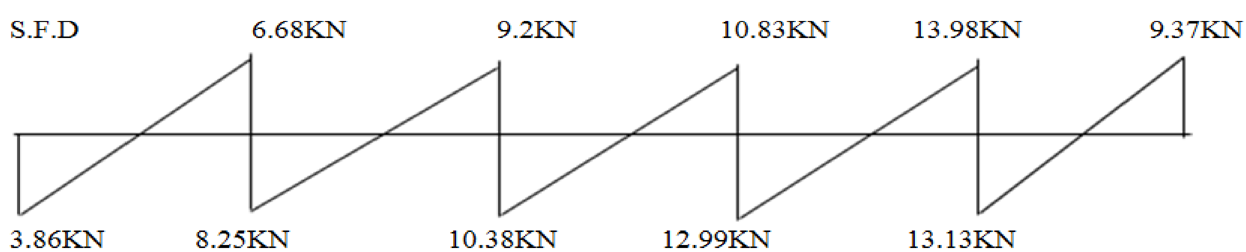


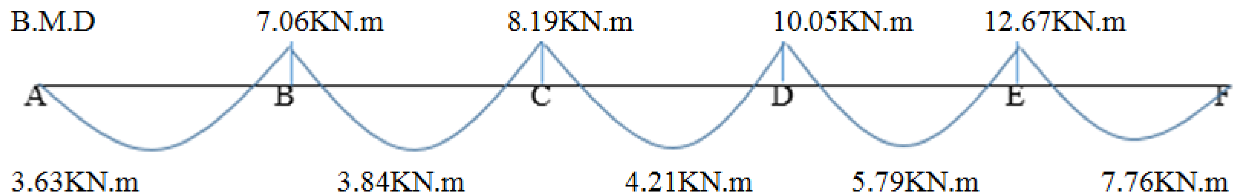


Case-9

When the live load acts on span DEF

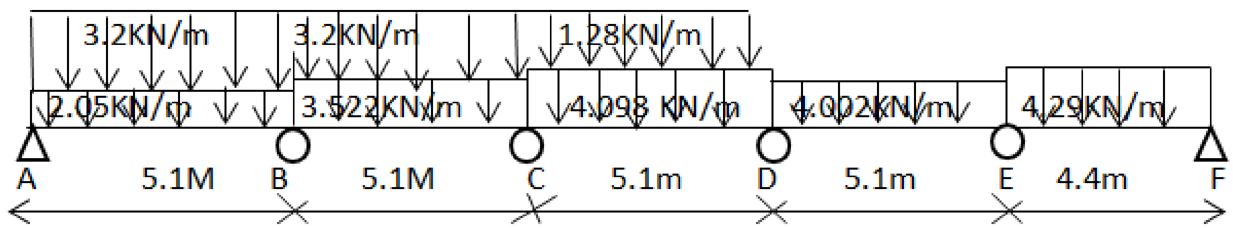


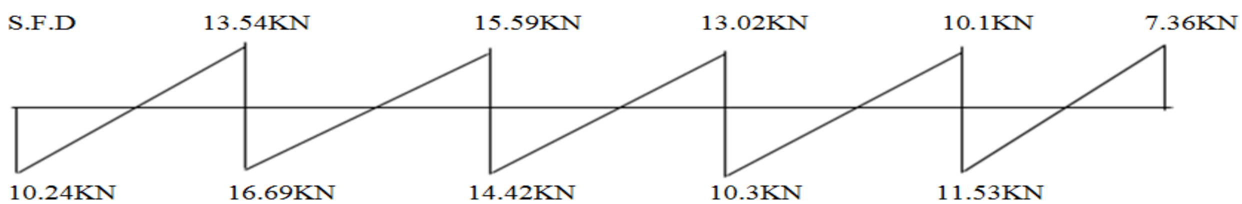


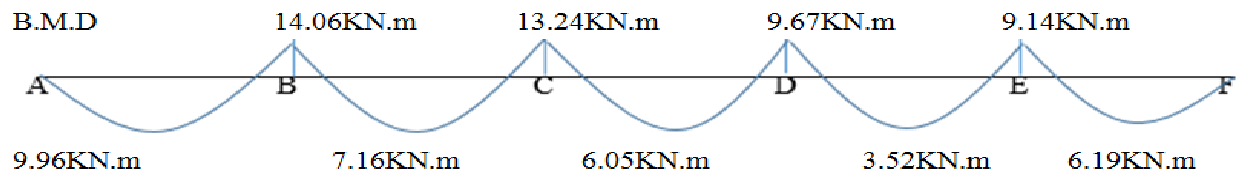


Case-10

When the live load acts on span ABCD

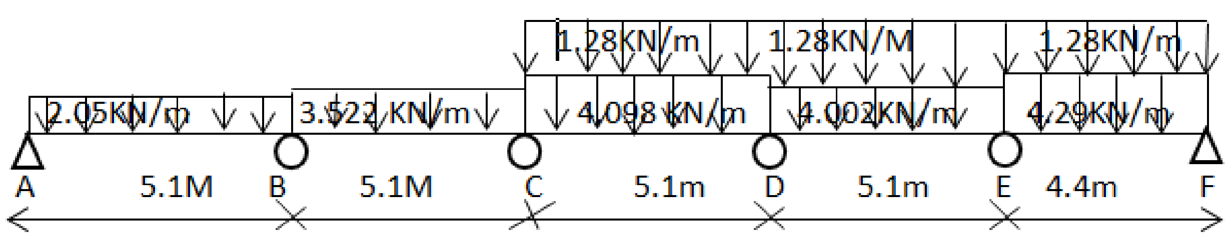


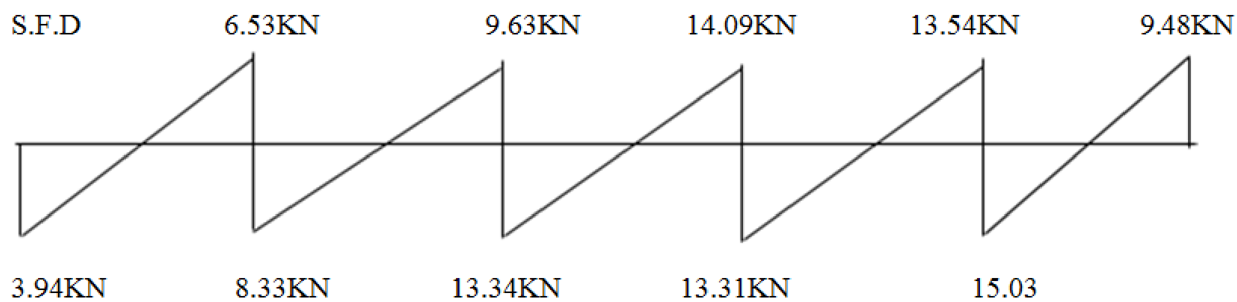


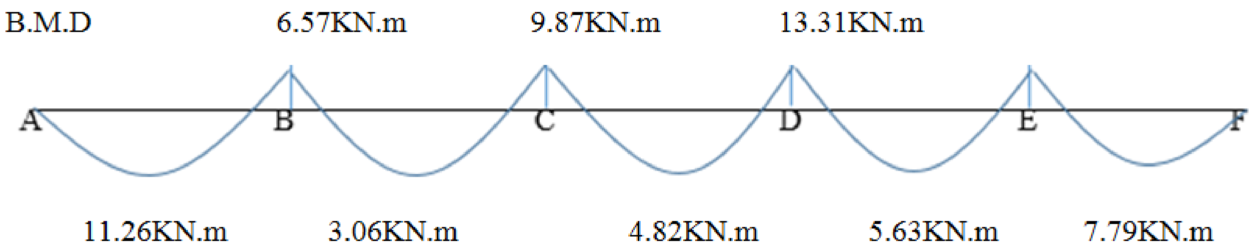


Case-11

When the live load acts on span CDEF

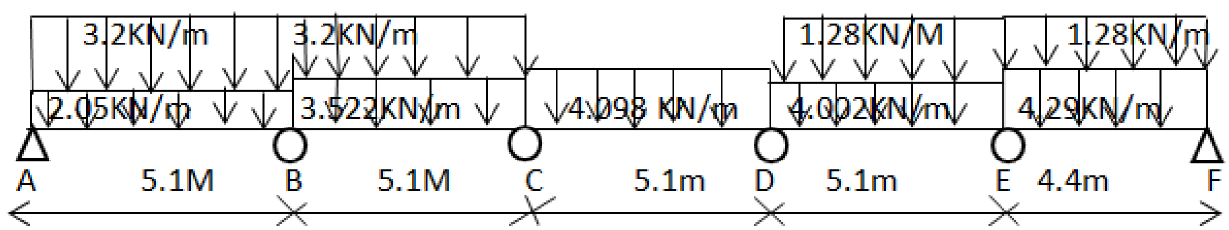


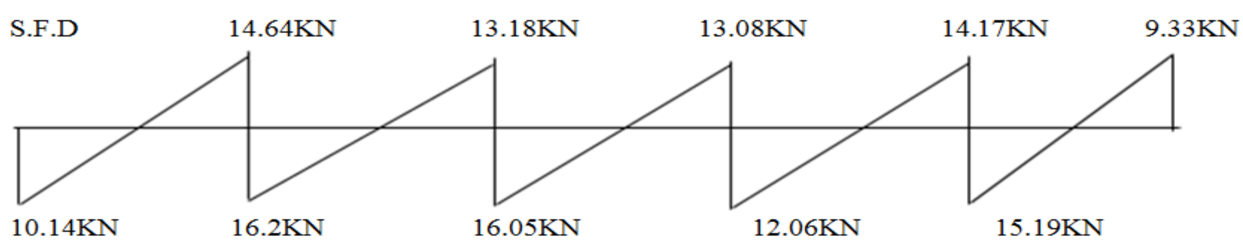


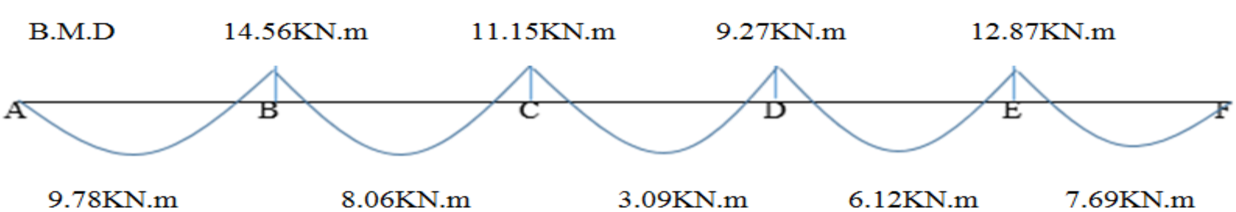


Case-12

When the live load acts on span ABC&DEF

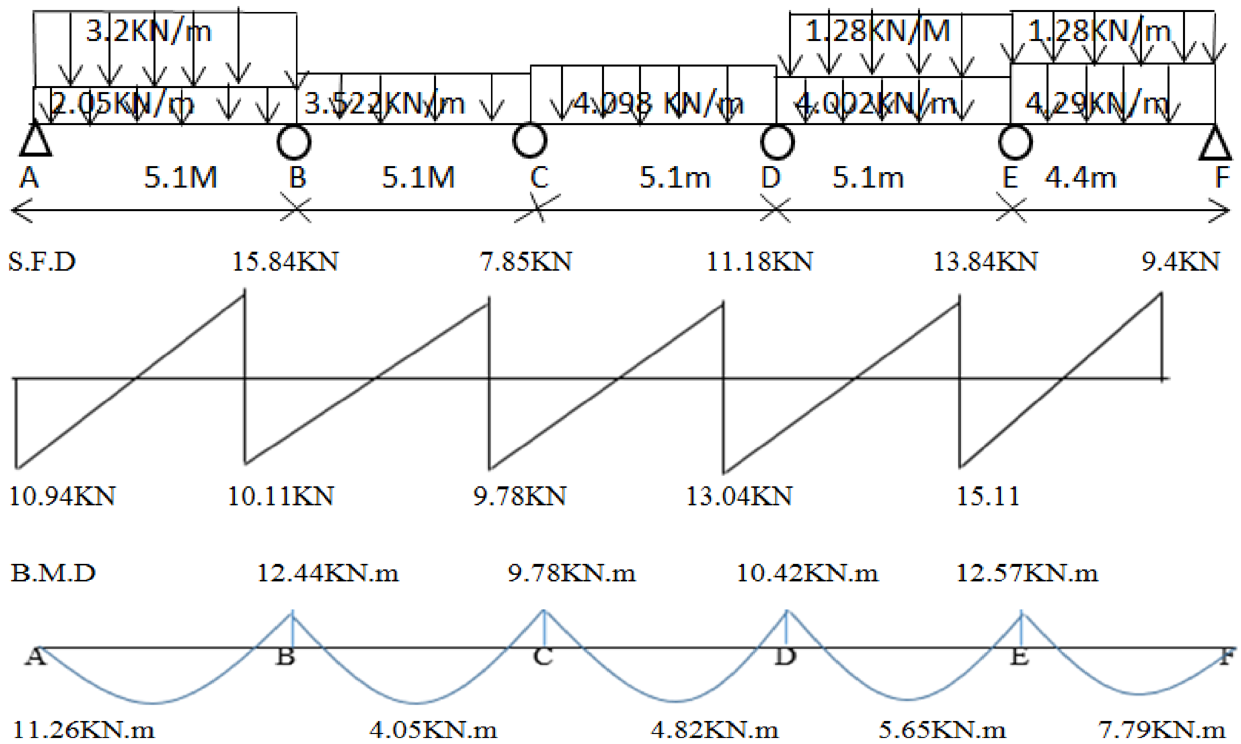






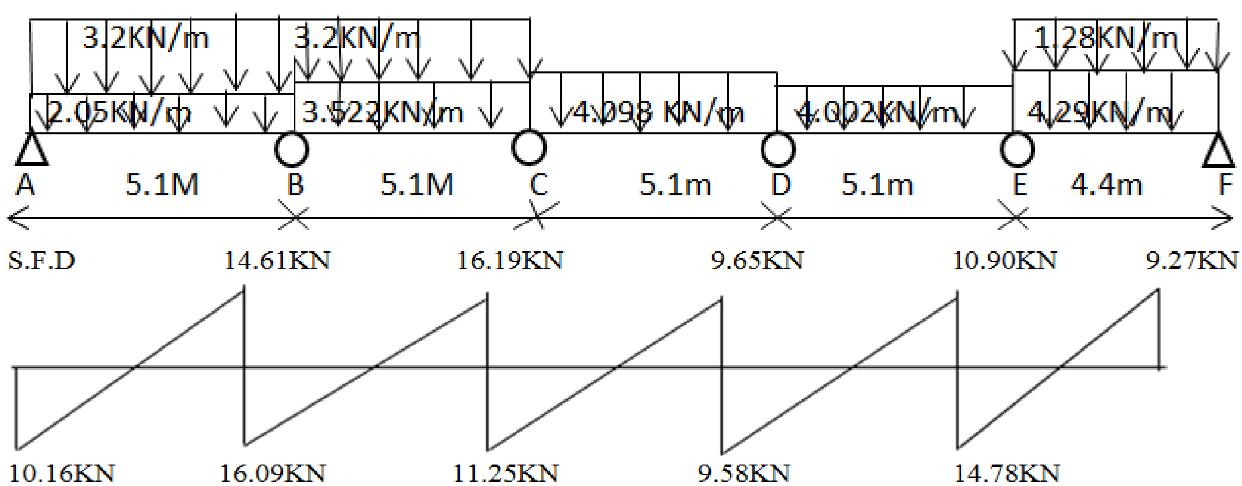
Case-13

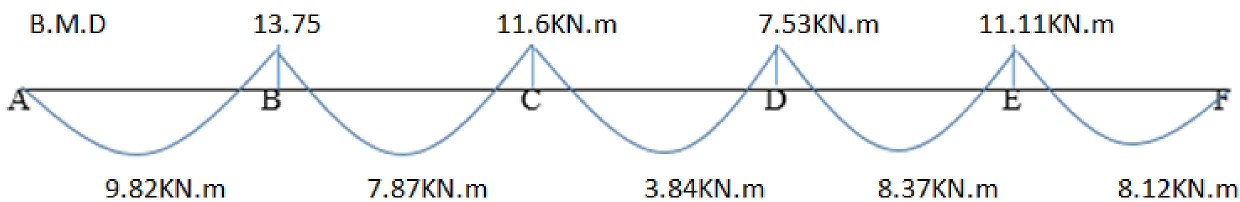
When the live load acts on span AB&DEF



Case-14

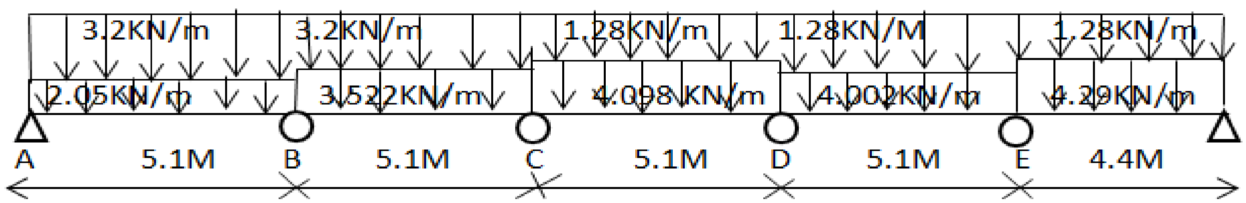
When the live load acts on span ABC&EF

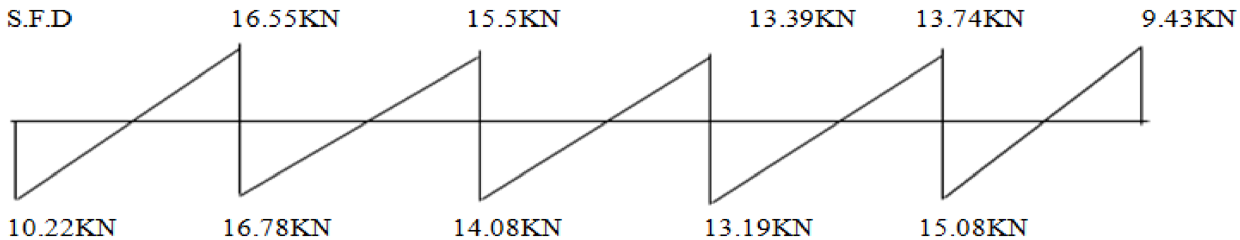


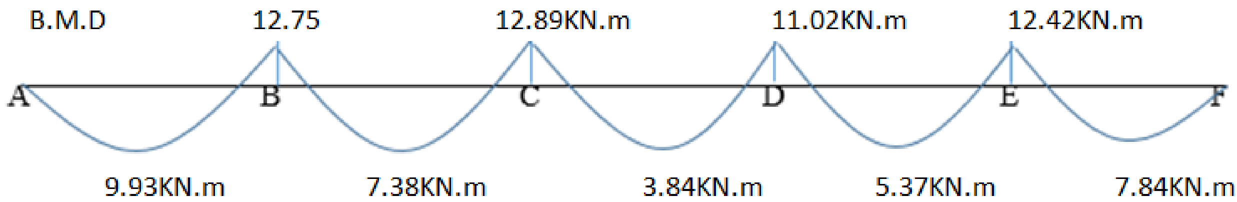


Case-15

When the live load acts on the whole span







span	1.3DL(KN/m)	1.6LL(KN/m)	Mmax@ mid span(KN/m)	Mmax @ sup. span(KN/m)	Vmax (KN)
S1	2.0488	3.2	11.29	13.75	17.94
S2	2.0488	3.2	6.94	13.064	16.32
S3	2.0488	3.2	6.66	13.32	13.46
S4	2.0488	3.2	5.36	10.7	12.6
S5	2.0488	3.2	6.89	13.19	14.72
S6	2.0488	3.2	5.53	11.06	13.012

S7	2.0488	3.2	4.866	9.732	14.08
S8	2.0488	3.2	4.64	7.83	12.058
S9	3.522	3.2	11.29	13.75	17.94
S10	4.3914	3.2	6.94	13.064	16.32
S11	3.9715	3.2	6.66	13.32	13.46
S12	3.9715	3.2	5.36	10.7	12.6
S13	3.0992	3.2	5.78	8.46	11.29
S14	4.1301	3.2	6.89	13.19	14.72
S15	3.0602	3.2	5.53	11.06	13.012
S16	3.9	3.2	4.866	9.732	14.08
S17	3.9	3.2	4.64	7.83	12.058
S18	4.0989	1.28	11.29	13.75	17.94
S19	5.1207	1.28	6.94	13.064	16.32
S20	3.0992	1.28	6.66	13.32	13.46
S21	3.6608	1.28	5.36	10.7	12.6
S22	3.0992	1.92	5.78	8.46	11.29
S23	3.3384	1.28	6.89	13.19	14.72
S24	3.8233	1.28	5.53	11.06	13.012
S25	4.1106	1.28	4.866	9.732	14.08
S26	3.341	1.28	4.64	7.83	12.058
S27	4.0027	1.28	11.29	13.75	17.94
S28	4.9387	1.28	6.94	13.064	16.32
S29	4.6618	2.56	4.64	13.32	13.46
S30	4.29	2.56	11.29	13.75	17.94
S31	3.7895	1.28	6.94	13.064	16.32
C1	5.76	1.28	5.36	10.7	12.6
C2	3.598	1.28	5.78	8.46	11.29
C3	7.21	1.28	6.89	13.19	14.72
C4	6.88	1.28	5.53	11.06	13.012
C5	3.871	1.28	4.866	9.732	14.08
C6	7.17	1.28	4.64	7.83	12.058
C7	6.571	1.28	4.64	13.32	13.46

Table 34 bending moment shear force for 7th floor

3.1.1.2.3 Check the depth for flexure for 7th floor

$$d \geq \sqrt{\frac{Mu}{0.1709bfcd}} = \sqrt{\frac{13.75*10^6}{0.1709*80*11.33}}$$

= 297.9 mm < the depth provided Hence ok.

3.1.1.2.4 Design for reinforcement bar for 7th floor

A) Negative bars

Using negative moment

M_{max}=13.75KN/M

T- Section is subjected to –ve bending moment and analyze the section as a rectangular section of width (b_w) =80mm

Therefore D=300mm, b=80mm

D=300-15-6= 279mm

As= ρbd

Where:-

$$\rho = \frac{1}{2}\left[c_{1-}\sqrt{c_1^2 - \frac{4Md}{bd^2c_2}}\right]$$

$$\rho = \frac{1}{2}\left[0.07 - \sqrt{0.07_1^2 - \frac{4*13.75*10^6}{80*279^2*4325.38}}\right] = 0.008145$$

$$\rho_{min} = \frac{0.6}{fyk} = 0.6/300 = 0.00167$$

$\rho_{min} < \rho < \rho_{max}$

Therefore 0.002< 0.008145 <.0.02

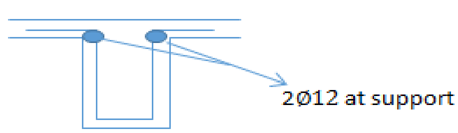
As = ρbd= 0.008145*80*279 = 181.8mm2

Using Φ12, as = (π * 12^2/4) = 113mm^2

Number of bars = $\frac{A}{as} = \frac{181.8}{113} = 1.62$

So that used to = 2Φ12

Provide 2Φ12mm



b) Positive bars

M_{max} =8.042573KN/M

b_e = 400mm

$$\rho = \frac{1}{2}\left[c_{1-}\sqrt{c^2 - \frac{4Md}{bd^2 c_2}}\right],$$

$$\rho = \frac{1}{2}\left[0.07 - \sqrt{0.07_1^2 - \frac{4*8.0425*10^6}{400*279^2*4325.38}}\right]$$ = 0.0008 so that minimum value, ρ =0.002

X = ρmd = 0.002*34.54*279= 19.27

Y = 0.8X=0.8*19.27 = 15.416

Y < (h_f =50mm)

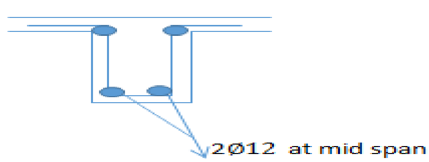
Therefore, analyses the beam as rectangular with b= b_e

As = ρ b_ed = 0.002*400*279 = 223.2

Using Φ12, a = (π * 12^2/4) = $113mm^2$

Number of bars As/a = 223.2/113= 1.975

Provide 2Φ12mm



Negative bars							
Span no	Depth	b_w	ρ_{max}	As	as	No of bars	Provided bars
s1	279	80	0.007973	177.95	113	1.574	2Φ12
s2	279	80	0.007522	167.89	113	1.485	2Φ12
s3	279	80	0.00769	171.63	113	1.518	2Φ12
s4	279	80	0.006021	134.38	78.5	1.808	2Φ12
s5	279	80	0.007604	169.73	113	1.502	2Φ12
s6	279	80	0.006245	139.38	78.5	1.775	2Φ10
s7	279	80	0.005427	121.14	78.5	1.543	2Φ10
s8	279	80	0.004293	95.83	78.5	1.220	2Φ10
s9	279	80	0.007973	177.95	113	1.574	2Φ12
s10	279	80	0.007522	167.89	113	1.485	2Φ12
s11	279	80	0.00769	171.63	113	1.518	2Φ12

s12	279	80	0.006021	134.38	78.5	1.712	2Φ10
s13	279	80	0.004664	104.11	78.5	1.326	2Φ10
s14	279	80	0.007604	169.73	113	1.502	2Φ12
s15	279	80	0.006245	139.37	113	1.233	2Φ12
s16	279	80	0.005427	121.13	78.5	1.543	2Φ10
s17	279	80	0.004293	95.83	78.5	1.221	2Φ10
s18	279	80	0.007973	177.95	113	1.574	2Φ12
s19	279	80	0.007522	167.89	113	1.485	2Φ12
s20	279	80	0.00769	171.63	113	1.518	2Φ12
s21	279	80	0.006021	134.38	78.5	1.712	2Φ10
s22	279	80	0.004664	104.11	78.5	1.326	2Φ10
s23	279	80	0.007604	169.73	113	1.502	2Φ12
s24	279	80	0.006245	139.37	113	1.233	2Φ12
s25	279	80	0.005427	121.13	78.5	1.543	2Φ10
s26	279	80	0.004293	95.83	78.5	1.221	2Φ10
s27	279	80	0.007973	177.95	113	1.574	2Φ12
s28	279	80	0.007522	167.89	113	1.485	2Φ12
s29	279	80	0.00769	171.63	113	1.518	2Φ12
s30	279	80	0.007973	177.95	113	1.574	2Φ12
s31	279	80	0.007522	167.89	113	1.485	2Φ12
c1	279	80	0.006021	134.38	113	1.189	2Φ12
c2	279	80	0.004664	154.11	113	1.326	2Φ12
c3	279	80	0.007604	169.73	113	1.502	2Φ12
c4	279	80	0.006245	149.37	113	1.233	2Φ12
c5	279	80	0.005427	148.14	113	1.543	2Φ12
c6	279	80	0.004293	165.12	113	1.221	2Φ12
c7	279	80	0.00769	171.63	113	1.518	2Φ12

Table 35 negative bar calculation for 7th floor

Positive bars							
Span no	Depth	be	ρ_{max}	As	as	No of bars	Provided bars
s1	279	400	0.00167	186.372	113	1.6	2Φ12
s2	279	400	0.00167	186.372	113	1.6	2Φ12
s3	279	400	0.00167	186.372	113	1.64	2Φ12
s4	279	400	0.00167	186.372	113	1.64	2Φ12

s5	279	400	0.00167	186.372	113	1.64	2Φ12
s6	279	400	0.00167	186.372	113	1.64	2Φ12
s7	279	400	0.00167	186.372	113	1.64	2Φ12
s8	279	400	0.00167	186.372	113	1.64	2Φ12
s9	279	400	0.00167	186.372	113	1.64	2Φ12
s10	279	400	0.00167	186.372	113	1.64	2Φ12
s11	279	400	0.00167	186.372	113	1.64	2Φ12
s12	279	400	0.00167	186.372	113	1.64	2Φ12
s13	279	400	0.00167	186.372	113	1.64	2Φ12
s14	279	400	0.00167	186.372	113	1.64	2Φ12
s15	279	400	0.00167	186.372	113	1.64	2Φ12
s16	279	400	0.00167	186.372	113	1.64	2Φ12
s17	279	400	0.00167	186.372	113	1.64	2Φ12
s18	279	400	0.00167	186.372	113	1.6	2Φ12
s19	279	400	0.00167	186.372	113	1.64	2Φ12
s20	279	400	0.00167	186.372	113	1.64	2Φ12
s21	279	400	0.00167	186.372	113	1.64	2Φ12
s22	279	400	0.00167	186.372	113	1.64	2Φ12
s23	279	400	0.00167	186.372	113	1.64	2Φ12
s24	279	400	0.00167	186.372	113	1.64	2Φ12
s25	279	400	0.00167	186.372	113	1.64	2Φ12
s26	279	400	0.00167	186.372	113	1.64	2Φ12
s27	279	400	0.00167	186.372	113	1.64	2Φ12
s28	279	400	0.00167	186.372	113	1.64	2Φ12
s29	279	400	0.00167	186.372	113	1.64	2Φ12
s30	279	400	0.00167	186.372	113	1.64	2Φ12
s31	279	400	0.00167	186.372	113	1.64	2Φ12
c1	279	400	0.00167	186.372	113	1.64	2Φ12
c2	279	400	0.00167	186.372	113	1.64	2Φ12
c3	279	400	0.00167	186.372	113	1.64	2Φ12
c4	279	400	0.00167	186.372	113	1.64	2Φ12
c5	279	400	0.00167	186.372	113	1.64	2Φ12
c6	279	400	0.00167	186.372	113	1.64	2Φ12
c7	279	400	0.00167	186.372	113	1.64	2Φ12

Table 36 negative & positive bar distribution of 7th floor

3.1.1.2.5 Designs for shear resistance for 7th floor

The Shear force V_c carried by concrete in members without significant axial force shall be taken as:-

$V_c = 0.25\ f_{ctd}\ K_1\ K_2, b_w d$ where $K_1 = (1+50\rho) < 2.0$

$K_2 = 1.6\text{-}d > 1.0$ [EBCS-2, 1995 Article 4.5.3.1]

$\rho = 0.008145$

$K_1 = (1+50\rho) = (1+50(0.008145)) = 1.407 \leq 2.0$ ……………OK

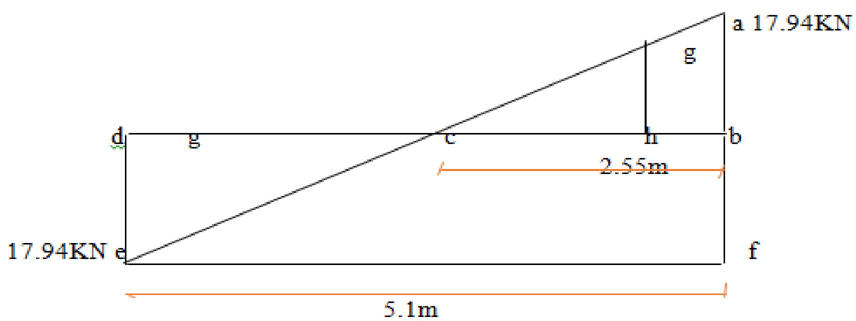
$K_1 = 1.40$

$K_2 = 1.6\text{-}d = 1.6\text{-}0.279 = 1.321 \geq 1.0$…………..OK

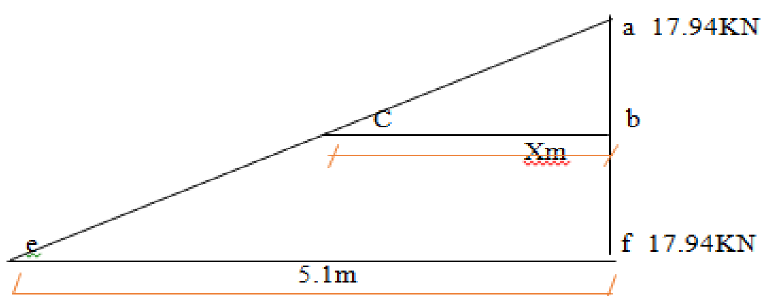
$K_2 = 1.321$

$V_c = 0.25(1.032)\ 1.407)\ (1.321)\ (80)\ (279)$

$= 13.916$KN/m

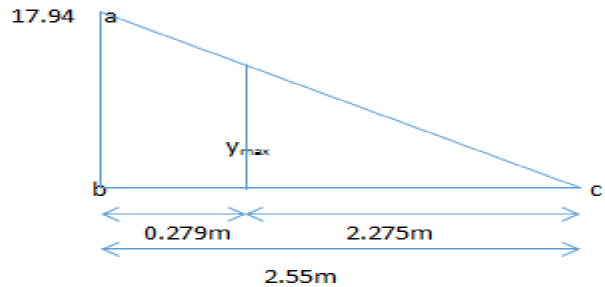


From similarity of triangle b/n abc&afe



$$x = \frac{5.1 * 17.94}{17.94 + 17.94} = 2.55\text{m}$$

Find the design shear from similarity of triangle



$\frac{2.55}{17.94} = \frac{2.275}{Y_{max}}$ so that the value of

Ymax = 16.005KN

$Y_{max} < V_c$ ……………………….. not ok

So that you can provide shear or nominal reinforcement

- Diagonal compression capacity, Vrd

Vrd = 0.25fcdbwd

= 0.25*11.33*80*279= 63.22KN

For Vc < Vd < Vrd,

$S = \frac{fydAsv(d-dc)}{Vs}$

Where Asv – area of stirrups

S – Stirrup spacing

Vs = Vd – Vc

For the maximum design shear Vd,max = 17.94KN

Vs = 17.94-13.916 =4.024KN

$S = \frac{313*56.55(279-27)}{4.024}$ =732.6mm

$Smax = \frac{56.55*260.87}{0.4*80}$=461mm ≤ {279 or 800

Therefore, Use Φ6 c/c 270

Step 8 topping

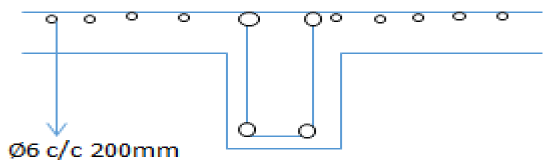
As min = 0.001Bd, use b = 1000mm

= 0.001*1000*60 = 60mm D for topping is 60mm from the given section

Using Ø 6

S < bas/As = 1000* $\pi*3^2/60$ = 471mm

There for use Ø6 c/c 200MM mesh in both directions that means vertical &horizontal.



3.1.1.3 Second–sixth floor slab layout

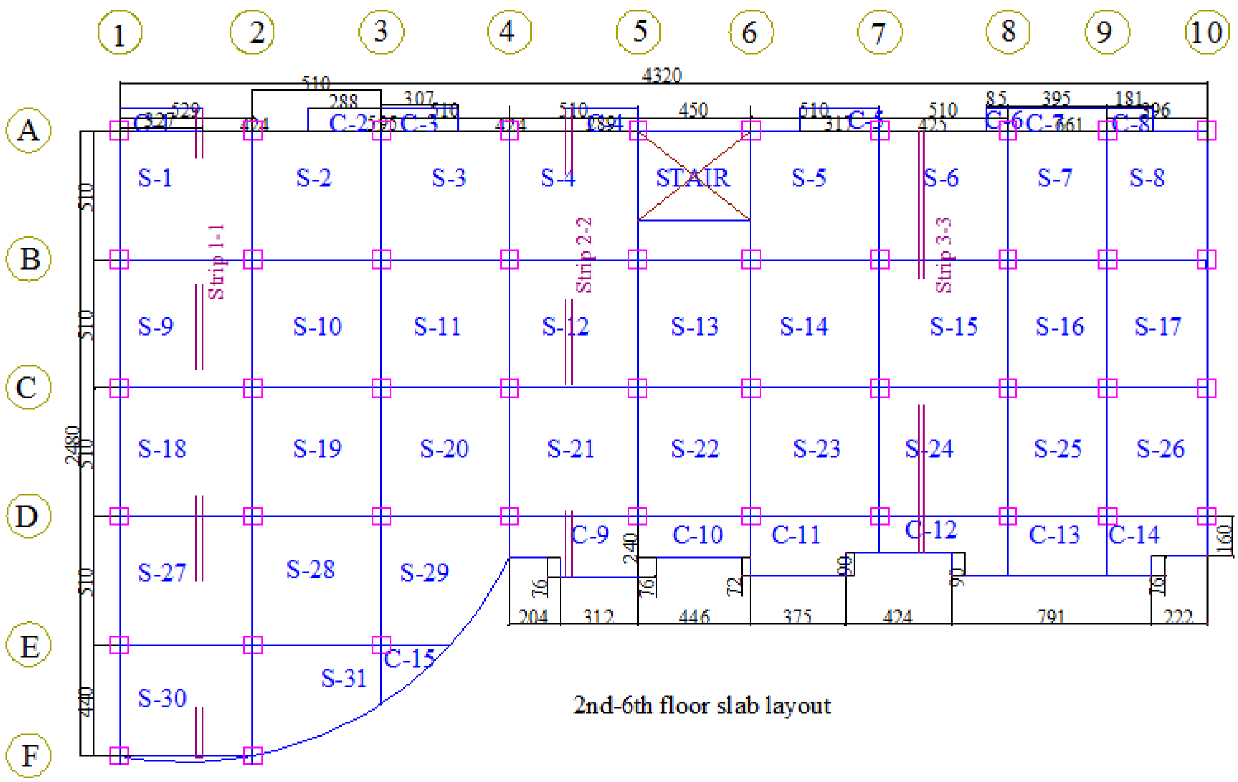


Figure 11 2nd -6th floor slab layout

Depth determination

Member	Simply	End	Interior	Cantilever
Beam (β_a)	20	24	28	10

Panel	effective length(le)	Location	β_a	Depth
S-1	5100	End	24	199.75
S-10	5100	Interior	28	171.21
C-1	1600	Cantilever	10	150.4

Table 37 span types for 2nd -6th floor slab

3.1.1.3.1 Check the depth for deflection

$$d \geq \left(0.4+\frac{0.6f_{yk}}{400}\right)\frac{L_e}{\beta_a}$$

Where: f_{yk}=characteristics tensile strength of steel

Le=effective span = 5.1m for span-1

β_e = accounts for the boundary condition and span ration for slabs

Overall depth, D = d +C+ ϕm/2

On span-1

$$d \geq \left(0.4+\frac{0.6*360}{400}\right)(\frac{5100}{24}) = 199.75mm$$

D = 199.75+15+12/2 =220.75mm

Use D = 300mm

Overall depth of the joist D≤ 4 $b_{w, joist}$ => 300 ≤ 4(80) = 320 mm -

Therefore, D provided is OK!

Thickness of slab (topping), $t_{slab} \geq 40$ mm

or 1/10 clear distance between ribs.

= (420 – 80) / 10 = 40 mm

In our problem, t_{slab} = 50 mm > 40 mm – OK

Panel No	Le (mm)	β_a	Effective depth(mm)
S1-6,9,18,27 & 29	5100	24	199.75
S7	3950	24	154.7
S8,17 & 26	3960	24	155.1
S-10,11,12,14,15,19,20,21,23,24 & 28	5100	28	171.21
S13	4500	28	151.07
S16 & 25	3950	28	132.6
S22	4500	24	176.25
S30 & 31	4400	24	172.33

C-1,2,3,4 & 5	1600	10	150.4

Table 38 depth determination for 2nd -6th floor

SPAN	DL (KN/m)	LL(KN/m)	1.3*DL(KN/m)	1.6*LL(KN/m)	P_d (KN/m)
S-1,2,3 & 4	1.999	0.8	2.5987	1.28	3.878
S5	2.195	0.8	2.853	1.28	4.133
S6	2.279	0.8	2.9627	1.28	4.2427
S7	2.194	0.8	2.8522	1.28	5.132
S8	1.99	0.8	2.587	1.28	3.867
S9	2.169	0.8	2.8197	1.28	4.0997
S10	2.725	0.8	3.5425	1.28	4.822
S11	2.649	0.8	3.4437	1.28	5.229
S12	2.649	0.8	3.4437	1.28	5.229
S13	1.456	2	1.8928	3.2	5.093
S14	2.965	0.8	3.8545	1.28	5.134
S15	3.05	0.8	3.965	1.28	5.246
S16	2.356	0.8	3.0628	1.28	4.343
S17	2.469	2	3.2097	3.2	6.41
S18	2.01	0.8	2.633	1.28	3.895
S19	2.82	0.8	3.666	1.28	4.946
S20	1.456	0.8	1.8928	1.28	3.173
S21	1.806	0.8	3.3478	1.28	3.63
S22	1.456	1.6	1.8928	2.56	4.453
S23	1.6	0.8	2.08	1.28	3.355
S24	2.597	0.8	3.3761	1.28	4.656
S25	3.07	0.8	3.991	1.28	5.265
S26	1.774	0.8	2.3062	1.28	3.586
S27	2.169	0.8	2.8197	1.28	4.1
S28	2.785	0.8	3.6205	1.28	4.99
S29	1.456	0.8	1.8928	1.28	3.173
S30	2.254	0.8	2.9302	1.28	4.21
S31	2.239	0.8	2.9107	1.28	4.19
C1-10	1.969	0.8	2.56	1.28	3.84

Table 39 Design load determination for 2nd -6th floor

3.1.1.3.2 Analyzing and Modeling

For the analysis, we model the ribs as continuous beams and the direction of ribs is chosen in the shorter direction but some ribs run in the longer direction in contrast to the above theory for construction simplicity.

Panel	1.3*DL(KN/m)	1.6*LL(KN/m)	Mmax @ mid span	Mmax @ support	Vmax KN
S1	2.5987	1.28	8.2	11.2	12.09
S2	2.5987	1.28	7.11	8.98	12.66
S3	2.5987	1.28	6.75	10.05	12.6
S4	2.5987	1.28	4.87	9.83	9.73
S5	2.853	1.28	5.85	13.63	12.4
S6	2.9627	1.28	5.45	11.54	11.09
S7	2.8522	1.28	9.63	10.59	14.6
S8	2.587	1.28	4.77	12.08	11.43
S9	2.8197	1.28	8.2	11.2	12.09
S10	3.5425	1.28	7.11	8.98	12.66
S11	3.4437	1.28	6.75	10.05	12.6
S12	3.4437	1.28	4.87	9.83	9.73
S13	1.8928	3.2	11.3	11.24	15.18
S14	3.8545	1.28	5.85	13.63	12.4
S15	3.965	1.28	5.45	11.54	11.09
S16	3.0628	1.28	9.63	10.59	14.6
S17	3.2097	3.2	4.77	12.08	11.43
S18	2.633	1.28	8.2	11.2	12.09
S19	3.666	1.28	7.11	8.98	12.66
S20	1.8928	1.28	6.75	10.05	12.6
S21	3.3478	1.28	4.87	9.83	9.73
S22	1.8928	2.56	11.3	11.24	15.18
S23	2.08	1.28	5.85	13.63	12.4
S24	3.3761	1.28	5.45	11.54	11.09
S25	3.991	1.28	9.63	10.59	14.6
S26	2.3062	1.28	4.77	12.08	11.43
S27	2.8197	1.28	8.2	11.2	12.09

S28	3.6205	1.28	7.11	8.98	12.66
S29	1.8928	1.28	6.75	10.05	12.6
S30	2.9302	1.28	8.2	11.2	12.09
S31	2.9107	1.28	7.11	8.98	12.66
Distributed and point design loads on cantilevers					
C-1	3.2+2.56	1.28	-	9.83	9.73
C-2	3.57+4.64	1.28	-	13.63	12.4
C-3	3.57+3.33	1.28	-	11.54	11.09
C-4	3.57+0.065	1.28	-	10.59	14.6
C-5	3.57+3.667	1.28	-	12.08	11.43

Table 40 bending moment and shear force for 2nd -6th floor

3.1.1.3.3 Check the depth for flexure

$$d \geq \sqrt{\frac{Mu}{0.1709bfcd}} = \sqrt{\frac{13.63*10^6}{0.1709*80*11.33}} = 296.63mm$$

296.63mm < D (the depth provided). It is safe!

Since the flexural depth is less than the deflection depth, it is ok!!!!

3.1.1.3.4 Design for reinforcements

A) Design for negative bar: -

Using the maximum negative moment

M_{max}=13.63KN/m

T- section is subjected to –ve bending moment and analyze the section as a rectangular section of width (b_w)=80mm

- Therefore D=300mm, b_w = 80mm

  d=300-15-6= 279mm
- As= ρbd
- Where, $\rho = 1/2[C_1-(C_1^2-4M_d/bd^2c_2)^{1/2}]$

  $= 1/2\{0.072-[0.072^2-(4*13.63*10^6/80*279^2*4325.38)]^{1/2}\} = 0.00789$

  ρ = 0.00789

  ρ_{min} 0.6/ fyk =0.6/360=0.00167

  - $\{\rho_{min} < \rho < \rho_{max}\}$

  Therefore 0.00139 < 0.00789 < 0.0145……..it is ok!

  - As = ρ*b*d = 0.00789*80*279 = 174.1mm²
- Using Φ12, a = (π * 12²/4) = 113mm²

  Number of bars =As/a = 174.1/113= 1.54 use 2 bars with diameter of 12mm.

Provide 2Φ12

B) Design for Positive bars

M_{max} =11.3KN/M
b_e = 400mm
$\rho_{using\ be} = 0.5[C_1-(C^2_1-4Md/b_ed^2c_2)^{1/2}]$ =0.001185, therefore use ρ_{min} since ρ is less than ρ_{min}
X = ρ*m*d = 0.00139*34.54*279= 13.395mm
Y = 0.8X=0.8*13.395 = 10.72mm
Y < (h_f =50mm)
Therefore, analyze the beam as rectangular with b= b_e
As = ρ*be*d = 0.00139*400*279 = 155.124mm^2
Using Φ12, as = (π * 12^2/4) = 113mm^2
Number of bars As/as = 155.124/113= 1.373

Provide 2Φ12

Panel No	Depth (d)	as Φ12 or (10)	Positive bars				Negative bars				No of (+ve&-ve) bars provided
			bw	P	As	No of bars	be	ρ	As	No of bars	
S1	279	113	80	0.000856	186.372	1.649	400	0.006332	141.3305	1.25	2Φ12
S2	279	78.5	80	0.000741	186.372	1.649	400	0.004974	111.0209	1.41	2Φ12
S3	279	113	80	0.000703	186.372	1.649	400	0.005621	125.4604	1.11	2Φ12
S4	279	113	80	0.000506	186.372	1.649	400	0.005487	122.4666	1.08	2Φ12
S5	279	113	80	0.000608	186.372	1.649	400	0.007894	176.1836	1.55	2Φ12
S6	279	113	80	0.000567	186.372	1.649	400	0.006546	146.0959	1.29	2Φ12
S7	279	113	80	0.001007	186.372	1.649	400	0.005953	132.8657	1.17	2Φ12

S8	279	113	80	0.000495	186.372	1.649	400	0.006888	153.7362	1.36	2Φ12
S9	279	113	80	0.000856	186.372	1.649	400	0.006332	141.3305	1.25	2Φ12
S10	279	78.5	80	0.000741	186.372	1.649	400	0.004974	111.0209	1.41	2Φ12
S11	279	113	80	0.000703	186.372	1.649	400	0.005621	125.4604	1.11	2Φ12
S12	279	113	80	0.000506	186.372	1.649	400	0.005487	122.4666	1.08	2Φ12
S13	279	113	80	0.001185	186.372	1.649	400	0.006357	141.8893	1.25	2Φ12
S14	279	113	80	0.000608	186.372	1.649	400	0.007894	176.1836	1.55	2Φ12
S15	279	113	80	0.000567	186.372	1.649	400	0.006546	146.0959	1.29	2Φ12
S16	279	113	80	0.001007	186.372	1.649	400	0.005953	132.8657	1.17	2Φ12
S17	279	113	80	0.000495	186.372	1.649	400	0.006888	153.7362	1.36	2Φ12
S18	279	113	80	0.000856	186.372	1.649	400	0.006332	141.3305	1.25	2Φ12
S19	279	78.5	80	0.000741	186.372	1.649	400	0.004974	111.0209	1.41	2Φ12
S20	279	113	80	0.000703	186.372	1.649	400	0.005621	125.4604	1.11	2Φ12
S21	279	113	80	0.000506	186.372	1.649	400	0.005487	122.4666	1.08	2Φ12
S22	279	113	80	0.001185	186.372	1.649	400	0.006357	141.8893	1.25	2Φ12
S23	279	113	80	0.000608	186.372	1.649	400	0.007894	176.1836	1.55	2Φ12
S24	279	113	80	0.000567	186.372	1.649	400	0.006546	146.0959	1.29 2	2Φ12
S25	279	113	80	0.001007	186.372	1.649	400	0.005953	132.8657	1.17	2Φ12

S26	279	113	80	0.000495	186.372	1.649	400	0.006888	153.7362	1.36	2Φ12
S27	279	113	80	0.000856	186.372	1.649	400	0.006332	141.3305	1.25	2Φ12
S28	279	78.5	80	0.000741	186.372	1.649	400	0.004974	111.0209	1.41	2Φ12
S29	279	113	80	0.000703	186.372	1.649	400	0.005621	125.4604	1.11	2Φ12
S30	279	113	80	0.000856	186.372	1.649	400	0.006332	141.3305	1.25	2Φ12
S31	279	78.5	80	0.000741	186.372	1.649	400	0.004974	111.0209	1.44	2Φ12
C-1	279	113	80	0.000506	186.372	1.649	400	0.005487	122.4666	1.08	2Φ12
C-2	279	113	80	0.000608	186.372	1.649	400	0.007894	176.1836	1.59	2Φ12
C-3	279	113	80	0.000567	186.372	1.649	400	0.006546	146.0959	1.29	2Φ12
C-4	279	113	80	0.001007	186.372	1.649	400	0.005953	132.8657	1.18	2Φ12
C-5	279	113	80	0.000495	186.372	1.649	400	0.006888	153.7362	1.36	2Φ12

Table 41 number of negative & positive bar calculation for 2^{nd} -6^{th} floor slab

3.1.1.3.5 Design for shear resistance for 2^{nd}-6^{th} floor

The Shear force V_c carried by concrete in members without significant axial force shall be taken as:-

$V_c = 0.25\ f_{ctd}\ K_1\ K_2,\ bwd$

Where:-

$K_1 = (1+50\rho) <2.0$

$K_2 = 1.6\text{-}d >1.0$ [EBCS-2, 1995 Article 4.5.3.1]

$\rho = 0.0078$

$K_1 = (1+50\rho) = (1+50(0.0145)) = 1.725 < 2.0$ ……………OK!

$K_1 = 1.725$

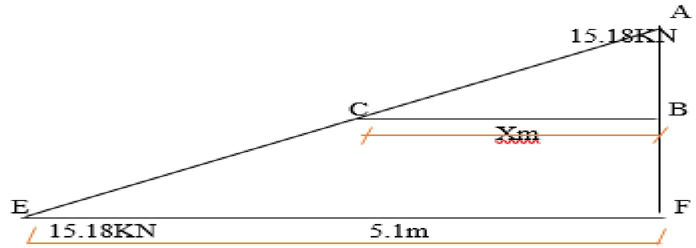
$K_2 = 1.6\text{-}d = 1.6\text{-}0.279 = 1.321 > 1.0$…………..OK!

$K_2 = 1.321$

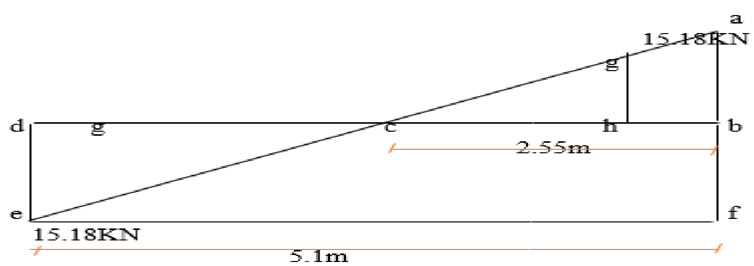
$V_c = 0.25*1.032*1.725*1.321*80*279$

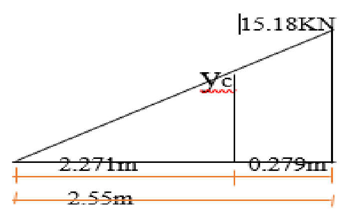
$= 13.122KN$

- From similarity of triangle b/n ABC & AFE



$$x = \frac{5.1 * 15.18}{15.18 + 15.18} = 2.55m$$





Find the critical design shear from similarity of triangle

$$\frac{2.55}{15.18} = \frac{2.271}{yc}$$

yc = 13.52KN

$$S\,max \leq \frac{ay * fyk}{0.4 * b} < \begin{cases} D \\ 800mm \end{cases}$$

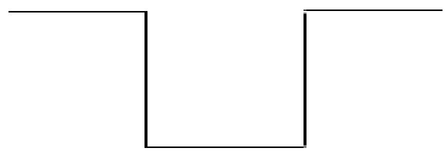
Nominal shear reinforcement pair area of reinforcement

$$Smax \leq \frac{as * fyk}{0.4 * b} = \frac{\left(\frac{\pi * 36}{4}\right) * 360}{0.4 * 80} = 317.9mm$$

Therefore, use Φ6 center to center 300

for simplicity use Φ6 c/c 200mm

Shape u bars



Design summary for ribs

TOPPING

As min = 0.001bd, use b = 1000mm

= $0.001*1000*50 = 50mm^2$

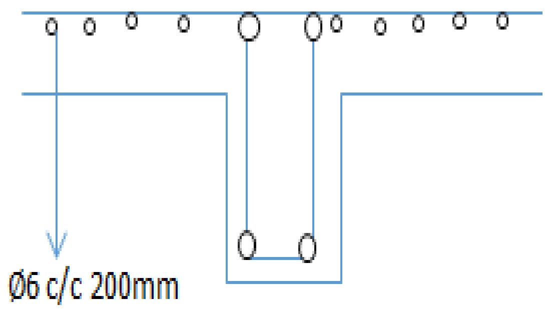
Where:-

d for topping is 50mm from the given section

Using Ø 6

$S < bas/As = 1000* \pi*6^2/(4*50) = 565.5mm$

for simplicity use Ø6 200c/c mesh in both directions that means vertical &horizontal.



3.1.1.4 First floor slab layout

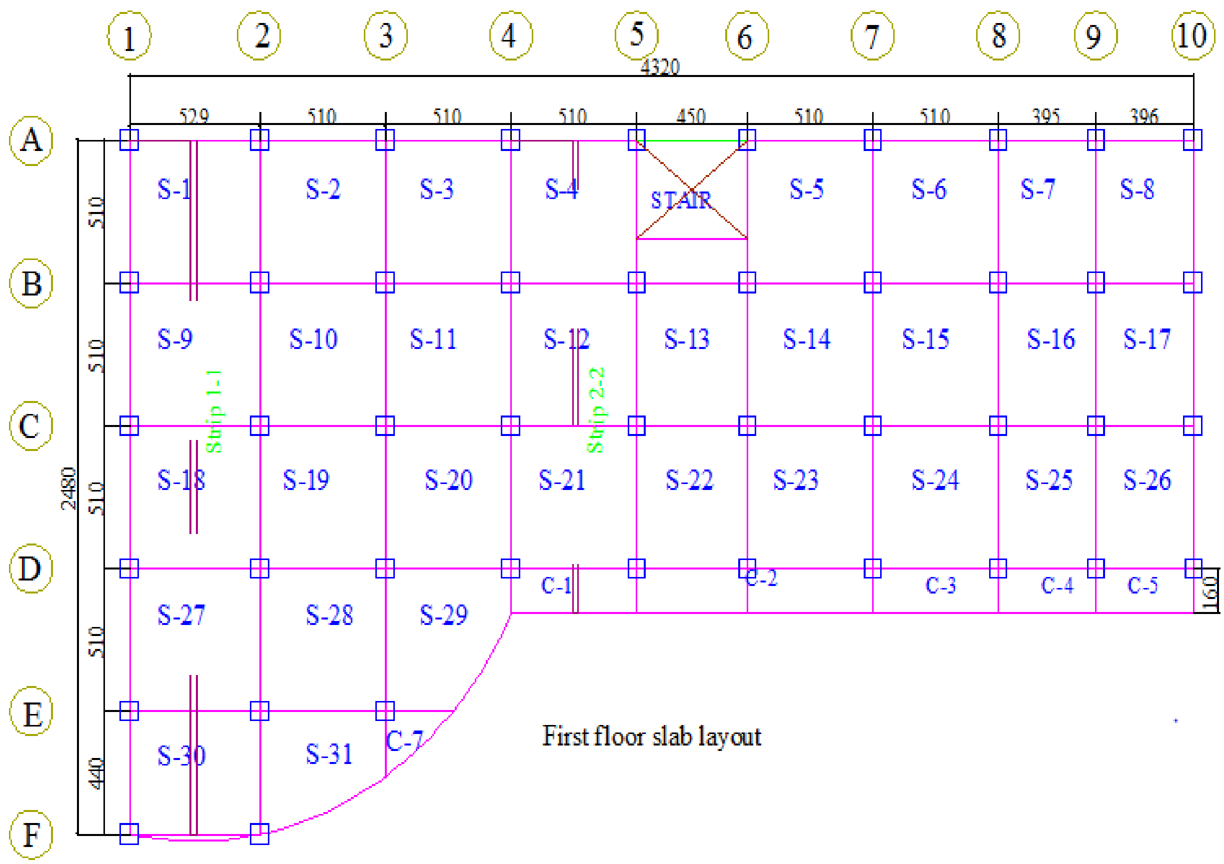


Figure 12 1st floor slab layout

Depth determination

$$d \geq \left(\frac{0.4+0.6*f_{yk}}{400}\right)*\frac{L_e}{\beta_a}$$

d> 0.4+0.6*360/400)5100/24 =212.5

D = 212.5+15+12/2 =233.5mm

Use D = 300

Span No	Ly	Lx	Ba	Effe.depth
S1	5290	5100	24	199.75
S2	5100	5100	24	199.75
S3	5100	5100	24	199.75
S4	5100	5100	24	199.75
S5	5100	5100	24	199.75
S6	5100	5100	24	199.75
S7	5100	3950	24	154.7083
S8	5100	3960	24	155.1
S9	5290	5100	24	199.75
S10	5100	5100	28	171.2143
S11	5100	5100	28	171.2143
S12	5100	5100	28	171.2143
S13	5100	5100	28	171.2143
S14	5100	5100	28	171.2143
S15	5100	5100	28	171.2143
S16	5100	3950	28	132.6071
S17	5100	3960	24	155.1
S18	5290	5100	24	199.75
S19	5100	5100	28	171.2143
S20	5100	5100	28	171.2143
S21	5100	5100	28	171.2143
S22	5100	5100	28	171.2143
S23	5100	5100	28	171.2143
S24	5100	5100	28	171.2143
S25	5100	3950	28	132.6071
S26	5100	3960	24	155.1

S27	5290	5100	24	199.75
S28	5100	5100	28	171.2143
S29	5100	5100	28	171.2143
S30	5290	5100	24	199.75
S31	5100	5100	28	171.2143

Table 42 effective depth calculation for 1st floor

SPAN	DL(KN/m)	LL(KN/m)	1.3*DL(KN/m)	1.6*LL(KN/m)	Pd KN/m
S1	1.464	1.6	1.9032	2.56	4.4632
S2	1.464	1.6	1.9032	2.56	4.4632
S3	2.414	1.6	3.1382	2.56	5.6982
S4	2.2648	0.8	2.94424	1.28	4.22424
S5	2.217	1.6	2.8821	2.56	5.4421
S6	1.464	1.6	1.9032	2.56	4.4632
S7	2.217	1.6	2.8821	2.56	5.4421
S8	2.164	0.8	2.8132	1.28	4.0932
S9	1.464	1.6	1.9032	2.56	4.4632
S10	1.464	1.6	1.9032	2.56	4.4632
S11	1.464	1.6	1.9032	2.56	4.4632
S12	1.224	1.6	1.5912	2.56	4.1512
S13	1.6555	2	2.15215	3.2	5.35215
S14	1.897	2	2.4661	3.2	5.6661
S15	1.685	2	2.1905	3.2	5.3905
S16	2.023	2	2.6299	3.2	5.8299
S17	1.788	2	2.3244	3.2	5.5244
S18	1.464	1.6	1.9032	2.56	4.4632
S19	1.464	1.6	1.9032	2.56	4.4632
S20	1.464	1.6	1.9032	2.56	4.4632
S21	1.224	1.6	1.5912	2.56	4.1512
S22	1.464	1.6	1.9032	2.56	4.4632
S23	1.464	1.6	1.9032	2.56	4.4632
S24	1.464	1.6	1.9032	2.56	4.4632
S25	1.464	1.6	1.9032	2.56	4.4632

S26	1.464	1.6	1.9032	2.56	4.4632
S27	1.464	1.6	1.9032	2.56	4.4632
S28	1.464	1.6	1.9032	2.56	4.4632
S29	1.464	1.6	1.9032	2.56	4.4632
S30	1.464	1.6	1.9032	2.56	4.4632
S31	1.464	1.6	1.9032	2.56	4.4632

Table 43 design load calculation for 1st floor

SPAN	Pd	W	1.6LL
C1	4.453	1.095	2.56
C2	4.453	0.338	2.56
C3	4.453	0.739	2.56
C4	4.453	0.929	2.56
C5	4.453	0.0832	2.56
C6	4.453	0.9408	2.56

3.1.1.4.1 Analyzing and Modeling for first floor

We model the ribs as continuous beams and the direction of ribs is chosen in the shorter direction but some ribs

Check the depth for deflection

$$d \geq \left(\frac{0.4 + 0.6 * f_{yk}}{400}\right) * \frac{L_e}{\beta_a}$$

d> 0.4+0.6*360/400)5100/24 =212.5

D = 212.5+15+12/2 =233.5mm

Use D = 300mm

Overall depth of the joist = D= 212.5 + 15 + 12/2 = 233.5mm,

Provide D=300 mm

Overall depth of the joist D≤ 4 $b_{w,\ joist}$ = 4(80) = 320 mm - D provided is OK.

Thickness of slab (topping), $t_{slab} \geq$ 40 mm

Or 1/10 clear distance between ribs.

= (420 – 80) / 10 = 40 mm

In our problem, t_{slab} = 50 mm > 40 mm – OK

On the same procedure to above the values of maximum moment at support and span and maximum shear force are summarized in the table below.

span	1.3DL(KN/m)	1.6LL(KN/m)	Mmax@ mid span(KN/m)	Mmax @ sup. span(KN/m)	Vmax(KN/m
S1	1.9032	2.56	5.946	13.699	10.744
S2	1.9032	2.56	4.837	9.673	11.387
S3	3.1382	2.56	6.837	10.673	12.381
S4	2.94424	1.28	9.83	12.14	13.5
S5	2.8821	2.56	5.471	13.416	14.521
S6	1.9032	2.56	5.842	11.683	13.745
S7	2.8821	2.56	4.506	13.51	15.602
S8	2.8132	1.28	4.837	9.973	11.381
S9	1.9032	2.56	5.946	13.699	10.744
S10	1.9032	2.56	4.837	9.673	11.387
S11	1.9032	2.56	6.837	10.673	12.381
S12	1.5912	2.56	9.83	12.14	13.5
S13	2.15215	3.2	4.471	13.416	14.521
S14	2.4661	3.2	5.471	13.416	14.521
S15	2.1905	3.2	5.842	11.683	13.745
S16	2.6299	3.2	4.506	13.51	15.602
S17	2.3244	3.2	4.837	9.973	11.381
S18	1.9032	2.56	5.946	13.699	10.744
S19	1.9032	2.56	4.837	9.673	11.387
S20	1.9032	2.56	6.837	10.673	12.381
S21	1.5912	2.56	9.83	12.14	13.5
S22	1.9032	2.56	4.471	13.416	14.521
S23	1.9032	2.56	5.471	13.416	14.521
S24	1.9032	2.56	5.842	11.683	13.745
S25	1.9032	2.56	4.506	13.51	15.602
S26	1.9032	2.56	4.837	9.973	11.381
S27	1.9032	2.56	5.946	13.699	10.744
S28	1.9032	2.56	4.837	9.673	11.387
S29	1.9032	2.56	6.837	10.673	12.381
S30	1.9032	2.56	5.946	13.699	10.744

S31	1.9032	2.56	4.837	9.673	11.387
C1	5.548	2.56	9.83	12.14	13.5
C2	4.791	2.56	4.471	13.416	14.521
C3	5.192	2.56	5.471	13.416	14.521
C4	5.382	2.56	5.842	11.683	13.745
C5	4.5362	2.56	4.506	13.51	15.602
C6	5.3938	2.56	4.837	9.973	11.381
C7	3.451	2.56	6.837	10.673	12.381

Table 44 bending moment & shear force calculation

3.1.1.4.2 Check the depth for flexure

$$d \geq \sqrt{\frac{Mu}{0.1709bfcd}} = \sqrt{\frac{13.699*10^6}{0.1709*80*11.33}}$$

= 297.4 mm < the depth provided. Hence ok.

3.1.1.4.3 Design for reinforcement bars

A) Negative bars

Using negative moment

M_{max} = 13.699KN/M

T- Section is subjected to –ve bending moment and analyze the section as a rectangular section of width (b_w)=80mm

Therefore, D=300mm, b=80mm

D=300-15-6= 279mm

As= ρ*b*d

Where:-

$$\rho = \frac{1}{2}\left[c_{1} - \sqrt{c_1^2 - \frac{4Md}{bd^2c_2}}\right]$$

$$\rho = \frac{1}{2}\left[0.07 - \sqrt{0.07_1^2 - \frac{4*13.69*10^6}{80*279^2*4325.38}}\right] = 0.007939$$

$$\rho_{min} = \frac{0.6}{fyk} = 0.6/360 = 0.0016$$

$\rho_{min} < \rho < \rho_{max}$

Therefore, 0.00167< 0.007939 <.0.0145

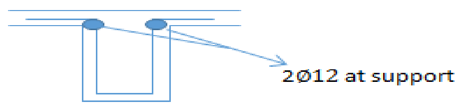
As = ρbd= 0.007939*80*279 = 177.2mm^2

Using Φ12, as $= \frac{\pi}{4} 12^2 = 113\text{mm}$

Number of bars = $\frac{A}{as} = \frac{177.2}{113} = 1.568$

So that used to = 2Φ12

Provide 2Φ12mm



B) Positive Bars

M_{max} =9.83KN/M

b_e = 400mm

$$\rho = \frac{1}{2}\left[c_{1-\sqrt{c_1^2 - \frac{4Md}{bd^2 c_2}}}\right],$$

$$\rho = \frac{1}{2}\left[0.07 - \frac{}{\sqrt{0.07_1^2 - \frac{4*9.83*10^6}{400*279^2*4325.38}}}\right]$$ = 0.000467 so that minimum value, ρ =0.00167

X = ρmd = 0.002*34.54*279= 19.27

Y = 0.8X=0.8*19.27 = 15.416

Y < (h_f = 50mm)

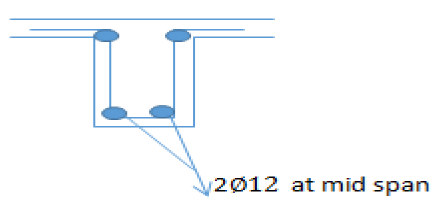
Therefore analyze the beam as rectangular with b= b_e

As = ρb_ed = 0.00167*400*279 = 186.372

Using Φ12, a = (π * 12^2/4) = 113mm^2

Number of bars As/a = 186.372/113= 1.649

Provide 2Φ12mm



Negative bars

Span no	Depth	b_w	ρ_{max}	As	as	No of bars	Provided bars
s1	279	80	0.007939	177.2016	113	1.568156	2Φ12
s2	279	80	0.005391	120.3381	113	1.064939	2Φ12
s3	279	80	0.006004	134.0112	113	1.18594	2Φ12
s4	279	80	0.006926	154.5907	113	1.36806	2Φ12
s5	279	80	0.007753	173.0369	113	1.5313	2Φ12
s6	279	80	0.006636	148.1105	113	1.310712	2Φ10
s7	279	80	0.007814	174.4172	113	1.543515	2Φ12
s8	279	80	0.005574	124.4111	113	1.100983	2Φ12
s9	279	80	0.007939	177.2016	113	1.568156	2Φ12
s10	279	80	0.005391	120.3381	113	1.064939	2Φ12
s11	279	80	0.006004	134.0112	113	1.18594	2Φ12
s12	279	80	0.006926	154.5907	113	1.36806	2Φ12
s13	279	80	0.007753	173.0369	113	1.5313	2Φ12
s14	279	80	0.007753	173.0369	113	1.5313	2Φ12
s15	279	80	0.006636	148.1105	113	1.310712	2Φ12
s16	279	80	0.007814	174.4172	113	1.543515	2Φ12
s17	279	80	0.005574	124.4111	113	1.100983	2Φ12
s18	279	80	0.007939	177.2016	113	1.568156	2Φ12
s19	279	80	0.005391	120.3381	113	1.064939	2Φ12
s20	279	80	0.006004	134.0112	113	1.18594	2Φ12
s21	279	80	0.006926	154.5907	113	1.36806	2Φ12
s22	279	80	0.007753	173.0369	113	1.5313	2Φ12
s23	279	80	0.007753	173.0369	113	1.5313	2Φ12
s24	279	80	0.006636	148.1105	113	1.310712	2Φ12
s25	279	80	0.007814	174.4172	113	1.543515	2Φ12
s26	279	80	0.005574	124.4111	113	1.100983	2Φ12
s27	279	80	0.007939	177.2016	113	1.568156	2Φ12
s28	279	80	0.005391	120.3381	113	1.064939	2Φ12
s29	279	80	0.006004	134.0112	113	1.18594	2Φ12
s30	279	80	0.007939	177.2016	113	1.568156	2Φ12
s31	279	80	0.005391	120.3381	113	1.064939	2Φ12
c1	279	80	0.006926	154.5907	113	1.36806	2Φ12

c2	279	80	0.007753	173.0369	113	1.5313	2Φ12
c3	279	80	0.007753	173.0369	113	1.5313	2Φ12
c4	279	80	0.006636	148.1105	113	1.310712	2Φ12
c5	279	80	0.007814	174.4172	113	1.543515	2Φ12
c6	279	80	0.005574	124.4111	113	1.100983	2Φ12
c7	279	80	0.006004	134.0112	113	1.18594	2Φ12

Table 45 negative bar calculation for 1st floor

Positive bars

Span no	Depth	be	ρ_{max}	As	as	No of bars	Provided bars
s1	279	400	0.00167	186.372	113	1.64931	2Φ12
s2	279	400	0.00167	186.372	113	1.64931	2Φ12
s3	279	400	0.00167	186.372	113	1.64931	2Φ12
s4	279	400	0.00167	186.372	113	1.64931	2Φ12
s5	279	400	0.00167	186.372	113	1.64931	2Φ12
s6	279	400	0.00167	186.372	113	1.64931	2Φ12
s7	279	400	0.00167	186.372	113	1.64931	2Φ12
s8	279	400	0.00167	186.372	113	1.64931	2Φ12
s9	279	400	0.00167	186.372	113	1.64931	2Φ12
s10	279	400	0.00167	186.372	113	1.64931	2Φ12
s11	279	400	0.00167	186.372	113	1.64931	2Φ12
s12	279	400	0.00167	186.372	113	1.64931	2Φ12
s13	279	400	0.00167	186.372	113	1.64931	2Φ12
s14	279	400	0.00167	186.372	113	1.64931	2Φ12
s15	279	400	0.00167	186.372	113	1.64931	2Φ12
s16	279	400	0.00167	186.372	113	1.64931	2Φ12
s17	279	400	0.00167	186.372	113	1.64931	2Φ12
s18	279	400	0.00167	186.372	113	1.64931	2Φ12
s19	279	400	0.00167	186.372	113	1.64931	2Φ12
s20	279	400	0.00167	186.372	113	1.64931	2Φ12
s21	279	400	0.00167	186.372	113	1.64931	2Φ12
s22	279	400	0.00167	186.372	113	1.64931	2Φ12
s23	279	400	0.00167	186.372	113	1.64931	2Φ12
s24	279	400	0.00167	186.372	113	1.64931	2Φ12

s25	279	400	0.00167	186.372	113	1.64931	2Φ12
s26	279	400	0.00167	186.372	113	1.64931	2Φ12
s27	279	400	0.00167	186.372	113	1.64931	2Φ12
s28	279	400	0.00167	186.372	113	1.64931	2Φ12
s29	279	400	0.00167	186.372	113	1.64931	2Φ12
s30	279	400	0.00167	186.372	113	1.64931	2Φ12
s31	279	400	0.00167	186.372	113	1.64931	2Φ12
c1	279	400	0.00167	186.372	113	1.64931	2Φ12
c2	279	400	0.00167	186.372	113	1.64931	2Φ12
c3	279	400	0.00167	186.372	113	1.64931	2Φ12
c4	279	400	0.00167	186.372	113	1.64931	2Φ12
c5	279	400	0.00167	186.372	113	1.64931	2Φ12
c6	279	400	0.00167	186.372	113	1.64931	2Φ12
c7	279	400	0.00167	186.372	113	1.64931	2Φ12

Table 46 positive bar calculation for 1st floor

3.1.1.4.4 Designs for shear resistance

The Shear force V_c carried by concrete in members without significant axial force shall be taken as: -

$V_c = 0.25\ f_{ctd}\ K_1\ K_2,b_wd$ where $K_1 = (1+50\rho) <2.0$

$K_2 = 1.6\text{-}d >1.0$ [EBCS-2, 1995 Article 4.5.3.1]

$\rho = 0.007939$

$K_1 = (1+50\rho) = (1+50(0.007939)) = 1.397 \leq 2.0$ ……………OK

$K_1 = 1.397$

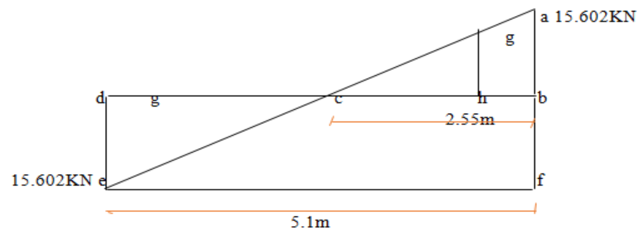
$K_2 = 1.6\text{-}d = 1.6\text{-}0.279 = 1.321 \geq 1.0$…………..OK

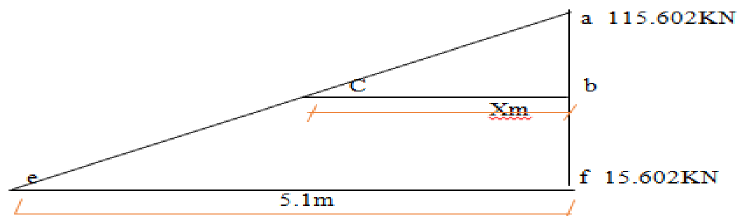
$K_2 = 1.321$

$V_c = 0.25(1.032)\ 1.397)\ (1.321)\ (80)\ (279)$

= 10.63KN/m

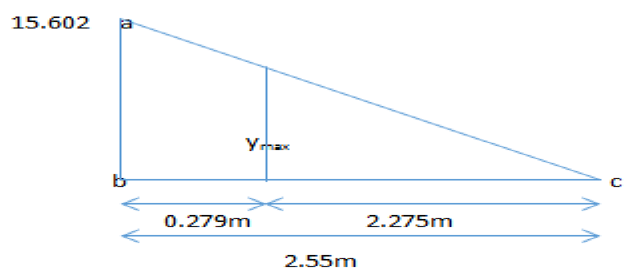
From similarity of triangle b/n abc & afe





$$x = \frac{5.1 * 15.602}{15.602 + 15.602} = 2.55\text{m}$$

Find the design shear from similarity of triangle



$\frac{2.55}{15.602} = \frac{2.275}{Y_{max}}$ so that the value of

Ymax = 13.92KN

$Y_{max} < V_c$ ……………………… not ok

So that you can provide shear or nominal reinforcement

- Diagonal compression capacity, Vrd

Vrd = 0.25fcdbwd

= 0.25*11.33*80*279= 63.22KN

For Vc < Vd < Vrd,

$$S = \frac{fydAsv(d-dc)}{Vs}$$

Where:- Asv – area of stirrups

S – Stirrup spacing

Vs= Vd – Vc

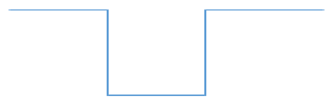
For the maximum design shear Vd,max=13.92KN

Vs = 13.92-10.63 =3.29KN

$S = \frac{313*56.55(279-27)}{3.29} = 783.2mm$

$Smax = \frac{56.55*313}{0.4*80} = 553.1mm \leq \{279 \text{ or } 800$

Therefore, Use Φ6 c/c 200



TOPPING

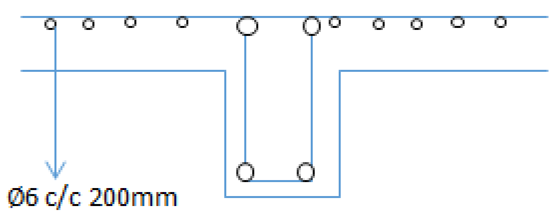
As min = 0.001Bd, use b= 1000mm

= 0.001*1000*60 = 60mm D for topping is 60mm from the given section

Using Ø 6

$S < bas/As = 1000*\pi*3^2/60 = 471mm$

There for use Ø6 c/c 200mm mesh in both directions that means vertical & horizontal.



3.1.2 FLAT SLAB DESIGN FOR G+7

3.1.2.1 Design constant

Concrete C-25 = f_{cu} unit weight -25, $\gamma c = 1.5$

Steel - 360 classes I work, γs-1.15

$f_{cd} = 0.68*f_{cu}/1.5 = 11.33$ MPa

$f_{ck} = 0.8\, f_{cu} = 20$ MPa

$f_{ctd} = 0.21\, [f_{ck}\text{^}\,(2/3)]/\gamma_c = 1.032$ MPa

$f_{yd} = f_{yk}/\, \gamma_s = 313.04$ MPa

$m = f_{yd}/\, [0.8f_{cd}] = 34.54$

$C1 = 2.5/m = 0.0724$

$C2 = 0.32m^2*f_{cd} = 4325.38$

$P_{max} = 0.75\, \rho_b = 0.0145$

$\rho_{min} = 0.5/\, f_{yk} = 0.00138$

Column = 400mmx400mm
Beam = 300mmx300mm

3.1.2.2 Seventh floor slab layout horizontal or longitudinal strip

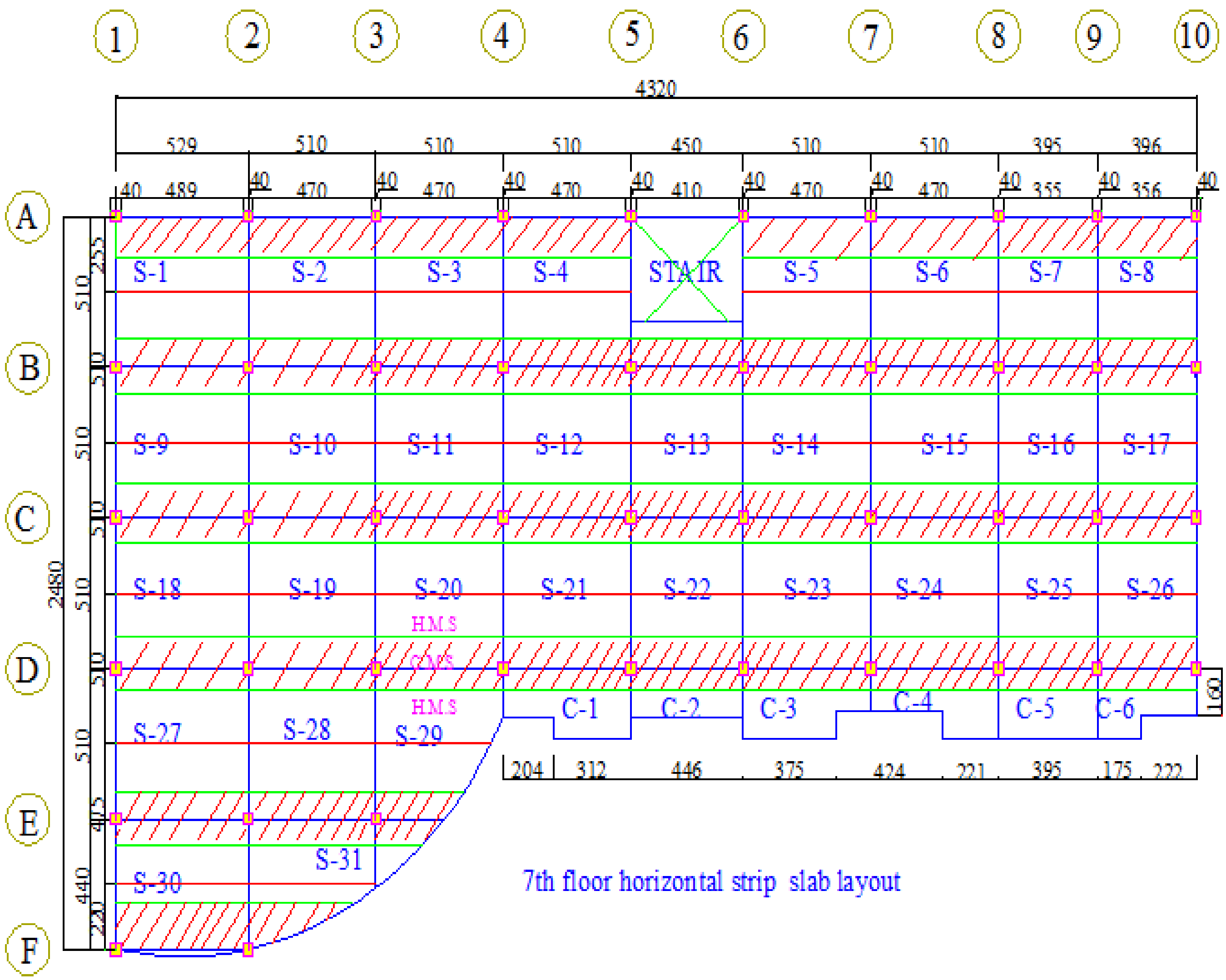


Figure 13 horizontal strips for 7th floor

Vertical strip

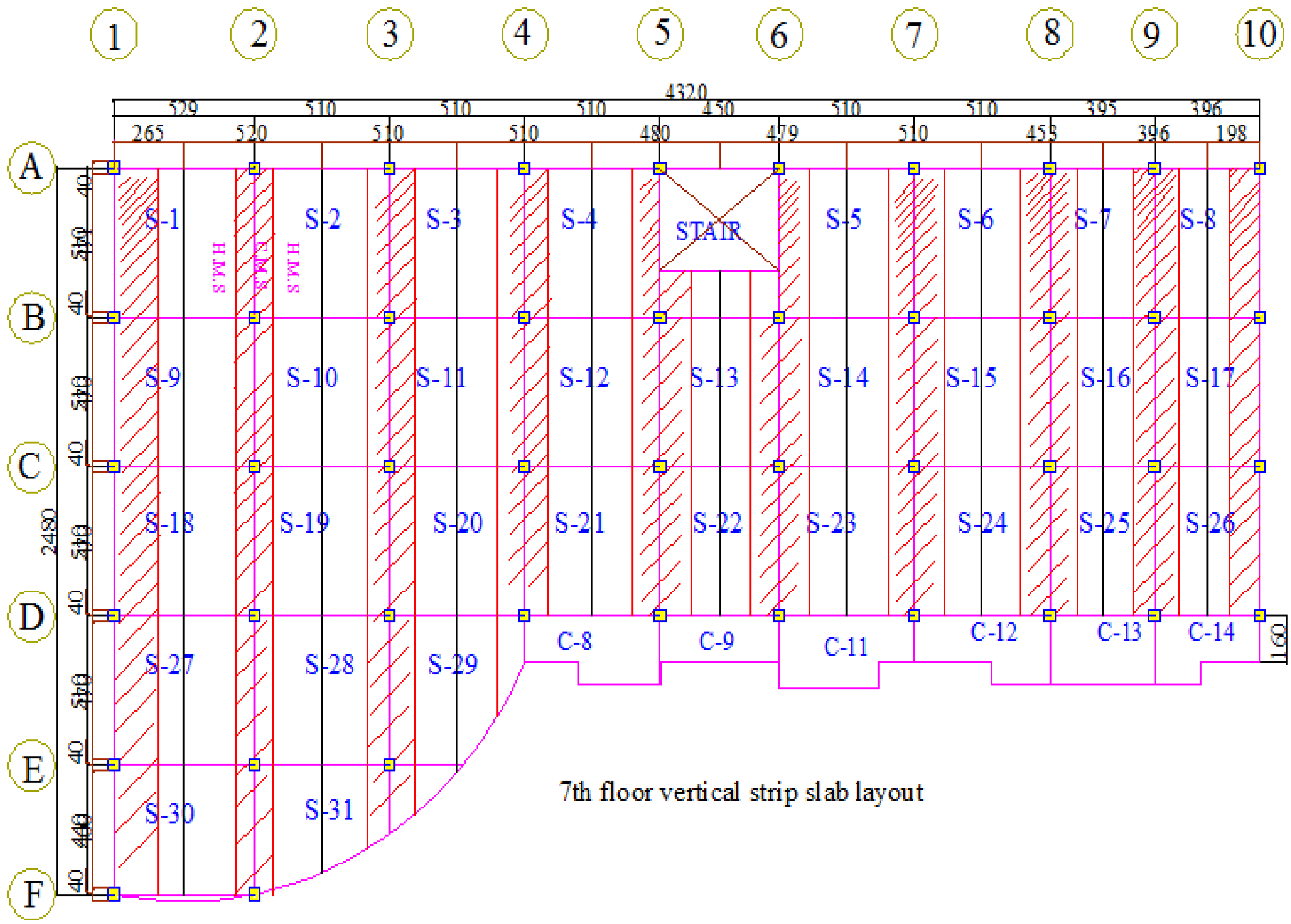


Figure 14 vertical strips for 7th floor

3.1.2.2.1 Design load of slab

Dead load:

- weight of slab= 0.20m*25 = 5KN/m^2
- Weight of floor finishes material
- 2mm of PVC = 0.002*16 = 0.032KN/m^2
- 3cm of cement screed = 0.03*20 = 0.6kN/m^2
- Marble = 0.05*27=1.35KN/m^2
- With ceiling plaster = 0.02*23 =0.184KN/m^2

  Total floor finish load= (0.032+0.6+1.35+0.46) = 5.442KN

  Load due to partition wall
- Partition wall = 0.2*3.1*3.1*14/19.74 = 4.32kN/m^2

- Plastering = 0.02*3.1*3.05*20*2/19.74 = 2.377 KN/m^2

  Total partition load = 1.32kN/m^2 +0.377 KN/m^2 =6.69 KN/m^2

Total live load = 2KN/m^2

Direct design method

Let's check whether the limitations to use the direct design method are satisfaction or not

8. This span in each direction ….. ok
9. $\frac{Ly}{Lx} = \frac{5.29}{5.1}$ 1.04, $\frac{Ly}{Lx} = \frac{5.1}{5.1} = 1$, $\frac{Ly}{Lx} = \frac{5.1}{3.96} = 1.288$& $\frac{Ly}{Lx} = \frac{5.1}{3.95} = 1.29$ All $\frac{Ly}{Lx}$ values are >2 Therefore it is safe.
10. Difference between spans always less than $\frac{1}{3}$ (large length)

    5.29-5.1= 0.19 < $\frac{1}{3}$(5.29)………..safe
11. No column offset …………….safe
12. Only gravity load …………….safe
13. No intermediate beam ……….safe
14. When ratio of $\frac{\text{Live load}}{Dead\ lad}$ must be greater than two that means …..safe

According to ACI code for slabs without interior beams& without drop panel & with edge beams

$d_{min} = \frac{Ln}{36} = \frac{4890}{36} = 135.83$

h_{min} = 135.83+15+$\frac{14}{2}$ = 157.83 so that use slab thickness is 200mm

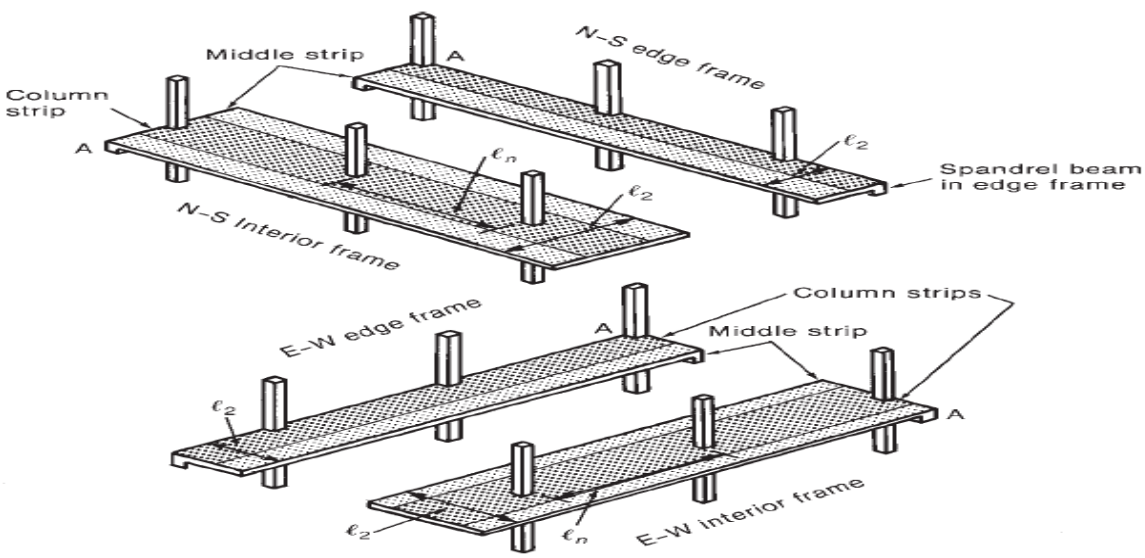
Panel first strip

Computes the total factored static moment

Statically Moment, Mo

For design, the slab is considered to be a series of frames in the two directions, as shown

In Fig. These frames extend to the middle of the panels on each side of the column



$$Mo = \frac{PdL_2Ln^2}{8}$$

Where: -

P_d = factored load per unit area

L_2 = transverse with of the strip

L_n = clean span between columns

P_d = 1.2*DL +1.6LL

= 1.2*9.74+1.6*2 = 14.49

Strip one

Compute the total factored static moment for

Panel between axis (A-B), (B-C),(C-D)and (D-E)

- $Mo = \frac{PdL_2Ln^2}{8} = \frac{14.49*2.55*4.89^2}{8} = 110.44KN.m$

❖ Between Axis 2-3, 3-4 , 4-5,6-7 and 7-8

- $Mo = \frac{PdL_2Ln^2}{8} = \frac{14.49*2.55*4.7^2}{8} = 102.026\ KN.m$

❖ Panel between Axis 8-9

- $Mo = \frac{PdL_2Ln^2}{8} = \frac{14.49*2.55*3.55^2}{8} = 58.2KN.m$

❖ Between Axis 9-10

- $Mo = \frac{PdL_2Ln^2}{8} = \frac{14.49*2.55*3.56^2}{8} = 58.54KN.m$

Distribution of Total Factored Static Moment,

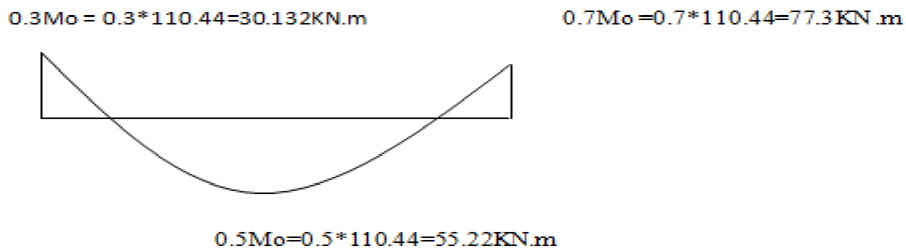
	Exterior edge unrestrained	Slab with Beams b/n all supports	Slab without beams b/n interior supports		Exterior edge fully restrained
			Without Edge beam	With Edge beam	
Interior –ve factored moment	0.75	0.7	0.7	0.7	0.65
Mid span +ve factored moment	0.63	0.57	0.52	0.5	0.35
Exterior –ve factored moment	0	0.16	0.26	0.3	0.65

Table 47 distribution of total factored static moment

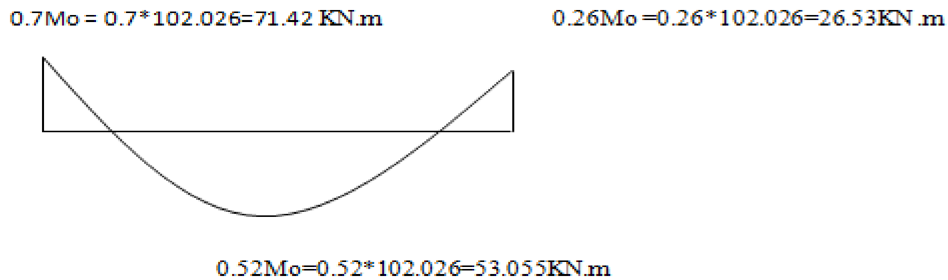
Longitudinal distribution of Mo (+ve and –ve Mo)

Panel between axis 1-2,2-3, 3-4 and 4-5

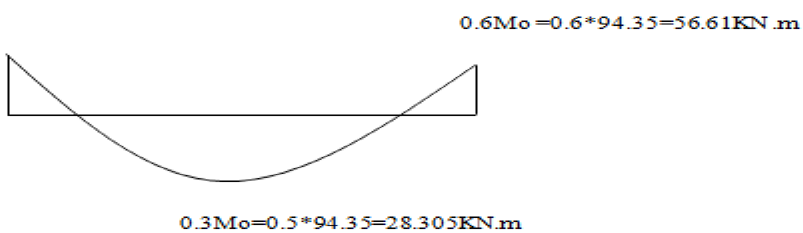
Exterior Panel between axis 1-2



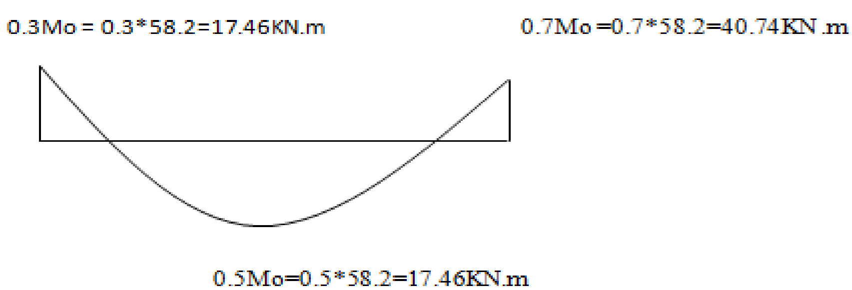
Exterior Panel between axis 4-5 and 6-7



Interior Panel between axis 2-3, 3-4 and 7-8

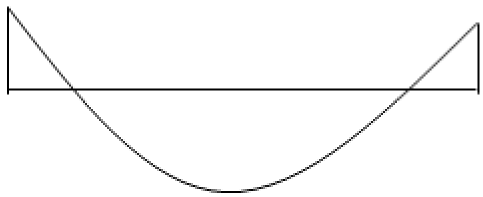


Interior Panel between axes 8-9



Exterior Panel between axes 9-10

0.7Mo = 0.7*58.54=40.978KN.m 0.3Mo =0.3*=17.62KN.m



0.5Mo=0.5*58.54=29.27KN.m

Longitudinal distribution of Mo (+ve and –ve Mo)

Summarized in the same way

Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
STRIP ONE			
Ex. Pane b/n axis 1-2	30.132	55.22	77.3
In. Pane b/n axis 2-3,2-3& 7-8	71.42	55.055	26.53
In. Pane b/n axis 8-9	17.46	29.1	40.74
Ex. Pane b/n axis 9-10	40.978	29.27	17.62
STRIP TWO, THREE & FOUR			
Ex. Pane b/n axis 1-2	66.26	110.44	154.616
In. Pane b/n axis 2-3,2-3& 7-8	154.616	61.215	122.43
In. Pane b/n axis 4-5&6-7	142.835	102.025	61.215
In. Pane b/n axis 8-9	61.215	34.92	69.846
Ex. Pane b/n axis 9-10	81.95	58.54	35.121
STRIP FIVE			
Ex. Pane b/n axis 1-2	61.172	102.86	144.01
In. Pane b/n axis 2-3	144.01	57.015	114.03
STRIP SIX			
Ex. Pane b/n axis 1-2	28.58	47.64	66.7

Table 48 longitudinal distribution of moment (-ve & +ve) for 7th floor

Vertical distribution of moment (–ve & +ve) summarized in the same way

Strip 1			
Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
Ex. Pane b/n axis A-B(beam)	31.8	53.015	74.22
In. Pane b/n axis B-C,C-D&D-E (beam)	74.22	31.8	63.62
Ex. Pane b/n axis E-F(beam)	23.04	38.4	55.86
STRIP TWO			
Ex. Pane b/n axis A-B(beam)	55.86	62.415	124.83
In. Pane b/n axis B-C,C-D&D-E	124.83	62.42	124.8
Ex. Pane b/n axis E-F(beam)	45.2	45.21	90.42
STRIP THREE,FOUR & SEVEN			
Ex. Pane b/n axis A-B	61.215	105.025	142.84
In. Pane b/n axis B-C,C-D&D-E	142.84	61.215	122.43
STRIP FIVE & SIX			
Ex. Pane b/n axis A-B	30.6	51.015	61.22
In. Pane b/n axis B-C,C-D&D-E	61.22	30.6	61.22
STRIP EIGHT			
Ex. Pane b/n axis A-B	61.22	54.38	108.75
In. Pane b/n axis B-C,C-D&D-E	108.75	54.38	108.75
STRIP NINE			
Ex. Pane b/n axis A-B	108.75	95.06	47.53
In. Pane b/n axis B-C,C-D&D-E	47.9	47.13	95.06
STRIP TEN			
Ex. Pane b/n axis A-B	23.77	79.22	55.45
In. Pane b/n axis B-C,C-D&D-E	55.45	23.77	47.53

Table 49 vertical moment distribution (-ve & +ve) for 7th floor

Transverse distribution of negative moment to column and middle strips

For interior panels beams between interior support

$$\frac{\alpha f1Le}{L1} = 0$$

Percentage Distribution of Interior Negative Factored Moment to Column Strip

$\frac{Le}{L1}$	0.5	1.0	2.0
$\frac{\alpha f1Le}{L1} = 0$	75	75	75
$\frac{\alpha f1Le}{L1} \geq 1.0$	90	75	45

Table 50 Percentage Distribution of Interior Negative Factored Moment to Column Strip

Taken to be equal to zero, because in this case, 75 percent of the negative moments distributed to the column strip, and the remaining 25 percent is divided equally between the two adjacent half-middle strips.
Percentage Distribution of Exterior Negative Factored Moment to Column Strip

$\frac{Le}{L1}$	0.5	1.0	2.0
$\frac{\alpha f1Le}{L1} = 0$	60	60	60
$\frac{\alpha f1Le}{L1} \geq 1.0$	90	75	45

Table 51 Percentage Distribution of Exterior Negative Factored Moment to Column Strip

The percentage distribution of positive factored moment to the column strip at mid span for both interior and exterior spans. For floor systems without interior beams, 60 percent of the positive moment is assigned to the column strip and the remaining 40 percent is divided equally between the adjacent half-middle strips.

No intermediate beam, $\alpha = 0$

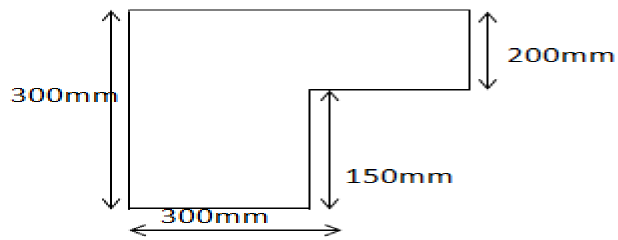
Because of the existence of an edge beam parallel L_2, however the distribution of the exterior negative moment shall be based on the torsional stiffeners β_t of the edge beam

$$\beta_t = \frac{C}{2Is} \qquad \beta_t = \frac{E_{cb}C}{2E_{cs}I_s}$$

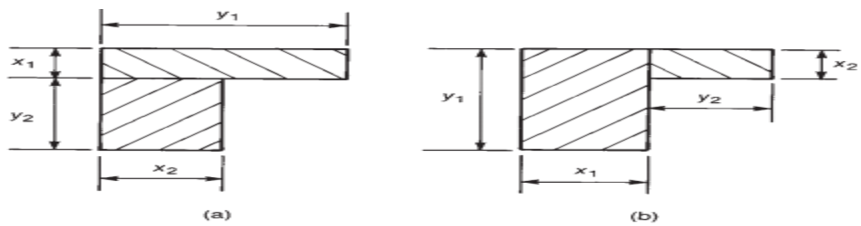
Where:-

$$C = \sum\left[\left(1 - 0.63\frac{x}{y}\right)\frac{x^3 y}{3}\right]$$

Edge beam



We have two cases



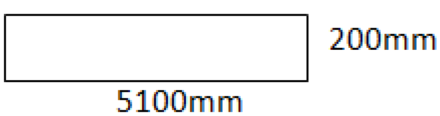
Where:-

Y1 = 250mm X1 = 300mm

C1 = 0.549*10^^{9}mm^4 C2 = 2.1*10^^{9}mm^4

C1 = max (C1, C2) =2.1*10^^{9}mm^4

Is = moments of inertia of the slab strip being design



$$\text{Is} = \frac{bh^3}{12} = \frac{5100*200^3}{12} = 3.4 * 10^9 mm^4$$

$$\beta_t = \frac{1.196*10^9}{2(3.4)*10^9} = 0.176$$

Percentage Distribution of Exterior Negative Factored Moment to Column Strip

$\frac{Le}{L1}$		0.5	1.0	2.0
$\frac{\alpha f1Le}{L1} = 0$	$\beta_t = 0$	100	100	100
	$\beta_t \geq 2.5$	75	75	75
$\frac{\alpha f1Le}{L1} \geq 1.0$	$\beta_t = 0$	100	100	100
	$\beta_t \geq 2.5$	90	75	45

Let now interpolate the percentage of the exterior negative moment assigned to the column strip

β_t = 0………..100
β_t = 0.176……..x
$\beta_t \geq$ 2.5……….75

X = 98.24

Strip one

Transverse longitudinal distribution negative &positive moment to column & middle panel between axis 2-3,3-4,4-5,6-7&7-8

I. Interior negative moment for 2-3&3-4
Column strip = 0.75*77.3= 52.975KNm
Half mid strip = ½*0.25*77.3 = 9.663KNm

II. Interior positive moment for 2-3,3-4
Column strip = 0.6*55.22 = 30.132KNm
Half mid strip = ½*0.4*55.22 = 10.044KNm

III. Exterior negative moment for 2-3&3-4
Column strip = 0.9824*30.132 = 29.6KNm
Half mid strip = ½(1-0.9824)*30.132 = 1.06KNm

Interior span between (8-9)

I. Interior negative moment for (8-9)
Column strip = 0.75*40.74= 30.56KNm
Half mid strip = ½*0.25*40.74 = 5.096KNm

II. Interior positive moment for (8-9)
Column strip = 0.6*17.46 = 10.48KNm
Half mid strip = ½*0.4*17.46 = 3.492KNm

III. Exterior negative moment for (8-9)
Column strip = 0.9824*17.46 = 17.15KNm
Half mid strip = ½(1-0.9824)*17.46 = 0.154KN

Interior span between (8-9)

I. Interior negative moment for (8-9)
Column strip = 0.75*40.74= 30.56KNm
Half mid strip = ½*0.25*40.74 = 5.096KNm

II. Interior positive moment for (8-9)
Column strip = 0.6*17.46 = 10.48KNm
Half mid strip = ½*0.4*17.46 = 3.492KNm

III. Exterior negative moment for (8-9)
Column strip = 0.9824*17.46 = 17.15KNm

Half mid strip = ½(1-0.9824)17.46 = 0.154KNm

Summarized in the same way

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
In. Pane b/n axis (1-2)	52.975	9.663	22.088	9.825	18.12	0.58
In. Pane b/n axis 2-3,3-4	52.975	9.663	30.132	10.044	-	-
In. Pane b/n axis (8-9)	30.16	5.0925	10.48	3.492	17.31	0.156
STRIP TWO						
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	91.82	15.3	36.73	12.243	-	-
In. Pane b/n axis (4-5),(6-7)	107.126	17.85	61.215	20.405	60.14	0.544
In. Pane b/n axis (8-9)	91.82	15.3	36.72	12.243	-	-
Ex. Pane b/n axis (9-10)	61.46	10.24	35.124	11.708	34.5	0.309
STRIP THREE						
In. Pane b/n axis (1-2)	115.96	19.327	66.26	22.088	65.09	0.583
. Pane b/n axis (2-3) (3-4),(4-5),(5-6),(6-7),(7-8)	91.82	15.3	36.72	12.243	-	-
In. Pane b/n axis (8-9)	52.38	4.356	20.852	6.984	-	-
Ex. Pane b/n axis (9-10)	61.461	10.24	35.124	11.708	34.5	0.309
STRIP FOUR						
In. Pane b/n axis (1-2)	115.96	19.327	66.26	22.088	65.09	0.583
In. Pane b/n axis(2-3)	91.82	15.3	36.729	12.243	-	-

STRIP FIVE						
In. Pane b/n axis (1-2)	115.96	19.327	66.26	22.088	65.09	0.583
In. Pane b/n axis(2-3)	91.82	15.3	36.729	12.243	-	-
Strip six						
In. Pane b/n axis (1-2)	50.025	13.34	28.584	9.528	28.077	0.252

Table 52 longitudinal moment adjustment

Vertical moment adjustment

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
In. Pane b/n axis (A-B),(B-C)& (D-E)	55.665	9.278	31.809	10.603	31.24	0.28
In. Pane b/n axis (E-F)	41.895	6.953	23.04	7.68	22.63	0.203
STRIP TWO						
In. Pane b/n axis (A-B),(B-C)& (C-D)	93.62	15.6	37.45	12.48	-	-
In. Pane b/n axis (E-F)	97.82	18.14	27.126	9.042	-	-
STRIP THREE, SEVEN						
In. Pane b/n axis (A-B)	107.13	17.855	63.015	13.128	60.14	0.54
In. Pane b/n axis (B-C),(C-D) &	91.82	15.3	36.73	12.243	-	-
STRIP FIVE ,SIX						
In. Pane b/n axis (B-C),(C-D) &	45.915	7.652	18.36	6.12	-	-

STRIP EIGHT						
In. Pane b/n axis (A-B),(B-C) & C-D)	81.56	6.782	32.63	10.88	-	-
STRIP NINE						
In. Pane b/n axis (A-B),(B-C)& (C-D)	71.295	11.883	28.518	9.506	-	-
STRIP TEN						
In. Pane b/n axis (A-B),(B-C)& (C-D)	41.59	6.93	23.77	7.922	23.35	0.203

Table 53 vertical moment adjustment

Longitudinal reinforcement

Negative bare

Location	Negative moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (1-2)	52.975	66.26	178	1275	1275	0.004376	0.00165	993.067	374.4675	100.786	Ø 10C/C 10	197.2	Ø 10C/C 150
In. Pane b/n axis 2-3,3-4	52.975	9.663	178	1275	1275	0.004738	0.00165	1075.366	374.4675	93.0729	Ø 10C/C 9	197.2	Ø 10C/C 150

In. Pane b/n axis (8-9)	30.16	5.0925	178	1275	1275	0.005015	0.00165	1138.103	374.4675	87.9424	Ø 10C/C 8	197.2	Ø 10C/C 150
STRIP TWO													
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	91.82	15.3	178	1275	1275	0.005045	0.00165	1145.02	374.46	144.1604	Ø 10C/C 10	197.2	Ø 10C/C 150
In. Pane b/n axis (4-5),(6-7)	107.126	17.85	178	1275	2550	0.005015	0.00165	1075.366	374.4	109.3428	Ø 10C/C 10	197.2	Ø 10C/C 150
In. Pane b/n axis (8-9)	15.3	36.72	178	1275	2550	0.005015	0.00165	1075.366	374.4	1534.76	Ø 10C/C 10	197.2	Ø 10C/C 150
Ex. Pane b/n axis (9-10)	61.46	10.24	178	1275	2550	0.001806	0.00165	819.8503	374.4675	181.6147	Ø 10C/C 10	197.2	Ø 10C/C 150
STRIP THREE													
In. Pane b/n axis (1-2)	115.96	19.327	178	1275	2550	0.002107	0.00165	956.2068	374.4675	181.5672	Ø 10C/C 10	197.2	Ø 10C/C 150
In. Pane b/n axis (2-3)	61.46	10.24	178	1275	2550	0.001014	0.00165	460.4168	374.4675	185.2958	Ø 10C/C 10	197.2	Ø 10C/C 150

In. Pane b/n axis (8-9)	52.38	4.356	178	1275	2550	0.002428	0.00165	1102.196	374.4675	14.2039	Ø 10C/C 10	197.2	Ø 10C/C 150
Ex. Pane b/n axis (9-10)	61.461	10.24	178	1275	2550	0.002428	0.00165	956.2068	374.4675	181.6179	Ø 10C/C 10	197.2	Ø 10C/C 150
STRIP FOUR													
In. Pane b/n axis (1-2)	115.96	19.327	178	1275	2550	0.002429	0.00165	1102.484	374.4675	98.5	Ø 10C/C 9	197.2	Ø 10C/C 150
In. Pane b/n axis(2-3)	91.82	15.3	178	1275	2550		0.00165	816.0555	374.4675	98.5	Ø 10C/C 9	197.2	Ø 10C/C 150
STRIP FIVE													
In. Pane b/n axis (1-2)	115.96	19.327	178	1275	2550	0.001798	0.00165	816.0555	374.4675	89.68908	Ø 10C/C 9	197.2	Ø 10C/C 150
In. Pane b/n axis(2-3)	91.82	15.3	178	1275	2550	0.002059	0.00165	934.5069	374.4675	115.0904	Ø 10C/C 9	197.2	Ø 10C/C 150
STRIP SIX													
In. Pane b/n axis (1-2)	50.025	13.34	178	1275	1100	0.002428	0.00165	1102.177	374.4675	93.07502	Ø 10C/C 9	197.2	Ø 10C/C 150

Table 54 longitudinal negative reinforcement bar for 7th floor

Positive Bar

Location	Positive moment Column strip	Positive moment Half mid strip	Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
STRIP ONE													
In. Pane b/n axis (1-2)	22.088	9.825	178	1275	1275	0.00179	0.00138	406.3007	313.191	187.3385	ø 10C/C 10	199.87	ø 10C/C 15
In. Pane b/n axis 2-3,3-4	30.132	10.044	178	1275	1275	0.002466	0.00138	559.6214	313.191	178.8486	ø 10C/C 10	199.87	ø 10C/C 15
In. Pane b/n axis (8-9)	40.48	3.492	178	1275	1275	0.000838	0.00138	190.2108	313.191	156.1924	ø 10C/C 10	199.87	ø 10C/C 15
STRIP TWO													
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	36.73	12.243	178	1275	1550	0.0014	0.00138	672.6985	313.191	178.5702	ø 10C/C 10	199.87	ø 10C/C 15
In. Pane b/n axis (4-5),(6-7)	61.215	20.405	178	1275	2550	0.002506	0.00138	1137.56	313.19	175.96	ø 10C/C 10	199.87	ø 10C/C 15

In. Pane b/n axis (1-2)	STTRIP FOUR	Ex. Pane b/n axis (9-10)	In. Pane b/n axis (8-9)	. Pane b/n axis (2-3) (3-4),(4-5),(5-6),(6-7),(7-8)	In. Pane b/n axis (1-2)	STRIP THREE	Ex. Pane b/n axis (9-10)	In. Pane b/n axis (8-9)
36.729		45.124	20.852	66.72	66.26		35.124	36.73
12.243		11.708	6.984	12.243	22.088		11.708	12.243
178		178	178	178	178		178	178
1275		1275	1275	1275	1275		1275	1275
2550		2550	2550	2550	2550		2550	2550
0.002721		0.000834	0.001482	0.002721	0.002721		0.001416	0.000487
0.00138		0.00138	0.00138	0.00138	0.00138		0.00138	0.00138
1235.111		378.4384	672.5114	1235.111	1235.111		642.6858	221.1247
313.191		313.191	313.191	313.191	313.191		313.191	313.191
162.0705		198.95	297.6529	168.25	162.0705		221.4663	195.2586
Ø 10C/C 10		Ø 10C/C 10	Ø 10C/C 20	Ø 10C/C 10	Ø 10C/C 10		Ø 10C/C 15	Ø 10C/C 10
199.87		199.87	199.87	199.87	199.87		199.87	199.87
Ø 10C/C 150		Ø 10C/C 150	Ø 10C/C 150	Ø 10C/C 150	Ø 10C/C 150		Ø 10C/C 150	Ø 10C/C 150

In. Pane b/n axis(2-3)	36.729	12.243	178	1275	2550	0.002721	0.00138	1235.111	313.191	162.0705	Ø 10C/C 10	199.87	Ø 10C/C 150
STRIP FIVE													
In. Pane b/n axis (1-2)	66.26	22.088	178	1275	2550	0.002721	0.00138	378.4384	313.191	97.5785	Ø 10C/C 10	199.87	Ø 10C/C 150
In. Pane b/n axis(2-3)	36.729	12.243	178	1275	2550	0.002721	0.00138	1235.111	313.191	162.0705	Ø 10C/C 10	199.87	Ø 10C/C 150
STRIP SIX													
In. Pane b/n axis (1-2)	28.584	9.528	178	1275	2550	0.002721	0.00138	378.4384	313.191	198.95	Ø 10C/C 10	199.87	Ø 10C/C 150

Table 55 longitudinal positive reinforcement bar

Edge Bar

Location	At Edge moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (1-2)	18.12	0.58	178	1275	1275	0.001462	0.00138	331.7677	313.191	181.6795	Ø 8C/C 10	157.85	Ø 8C/C 100

In. Pane b/n axis (8-9)	17.31	0.156	178	1275	1275	0.001395	0.00138	316.6395	313.191	189.0929	Ø 8C/C 10	157.85	Ø 8C/C 120
STRIP TWO													
In. Pane b/n axis (4-5),(6-7)	60.14	0.544	178	1275	1275	0.005115	0.00138	1160.922	313.191	86.21382	Ø 8C/C 8	157.85	Ø 8C/C 120
Ex. Pane b/n axis (9-10)	34.5	0.309	178	1275	1275	0.002838	0.00138	644.1772	313.191	155.3726	Ø 8C/C 10	157.85	Ø 8C/C 120
STRIP THREE													
In. Pane b/n axis (1-2)	65.09	0.583	178	1275	1275	0.005574	0.00138	1265.106	313.191	79.1139	Ø 8C/C 7	157.85	Ø 8C/C 120
Ex. Pane b/n axis (9-10)	34.5	0.309	178	1275	1275	0.002838	0.00138	644.1772	313.191	155.3726	Ø 8C/C 10	157.85	Ø 8C/C 120
STRIP FOUR													
In. Pane b/n axis (1-2)	65.09	0.5583	178	1275	1275	0.005574	0.00138	1265.106	313.191	79.1139	Ø 8C/C 7	157.85	Ø 8C/C 120
STRIP FIVE													
In. Pane b/n axis (1-2)	65.09	0.583	178	1275	1275	0.005574	0.00138	1265.106	313.191	79.1139	Ø 8C/C 7	157.85	Ø 8C/C 120
STRIP SIX													

In. Pane b/n axis (1-2)	28.077	[illegible]	178	1275	1275	0.002292	0.00138	520.162	313.191	192.416	Ø 8C/C 100	157.85	Ø 8C/C 120

Table 56 longitudinal edge reinforcement bar

Vertical reinforcement

Negative bare

Location	Negative moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (A-B), (B-C) & (D-E)	55.665	9.278	178	1322	1322	0.00138	0.00138	324.7361	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
In. Pane b/n axis (E-F)	41.895	6.953	178	1322	2550	0.00138	0.00138	626.382	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP TWO													
In. Pane b/n axis (A-B),(B-C) & (C-D)	93.62	16.85	178	1322	2550	0.00138	0.00138	626.382	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
In. Pane b/n axis (E-F)	97.82	18.14	178	1322	2550	0.00138	0.00138	626.382	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120

STRIP THREE, SEVEN													
In. Pane b/n axis (A-B)	107.13	17.855	178	1322	2550	0.00138	0.00138	626.382	24.7361	89.5734	Ø 8C/C 80	151.5734	Ø 8C/C 120
In. Pane b/n axis (B-C),(C-D)&	91.82	15.3	178	1322	2550	0.00138	0.00138	626.382	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP FIVE & SIX													
In. Pane b/n axis (B-C),(C-D)&	45.915	7.652	178	1322	2550	0.00138	0.00138	626.382	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP EIGNT													
In. Pane b/n axis (A-B),(B-C) & C-D)	81.56	6.782	178	1322	2550	0.00138	0.00138	626.382	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP NINE													
In. Pane b/n axis (A-B), (B-C) & (C-D)	71.295	11.883	178	1322	2550	0.00138	0.00138	626.382	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP TEN													
In. Pane b/n axis (A-B), (B-C) & (C-D)	41.59	6.93	178	1322	2550	0.00138	0.00138	626.382	24.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120

Table 57 vertical negative reinforcement bar for 7th floor

Location	positive moment Column strip	positive moment Half mid strip	D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	STRIP ONE												
In. Pane b/n axis (A-B),(B-C)& (D-E)	31.809	10.603	178	1322	1322	0.00138	0.00138	324.7361	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
In. Pane b/n axis (E-F)	23.04	7.68	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	138.78	Ø 8C/C 120
STRIP TWO													
In. Pane b/n axis (A-B),(B-C)& (C-D)	37.45	12.48	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
In. Pane b/n axis (E-F)	27.126	9.042	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP THREE, SEVEN													
In. Pane b/n axis (A-B)	63.015	13.128	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
In. Pane b/n axis (B-C),(C-D)&	36.73	12.243	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120

STRIP FIVE &SIX													
In. Pane b/n axis (B-C),(C-D)&	18.36	6.12	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP FIVE &SIX													
In. Pane b/n axis (A-B),(B-C)& C-D)	32.63	10.88	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP NINE													
In. Pane b/n axis (A-B),(B-C)& (C-D)	28.518	9.506	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP TEN													
In. Pane b/n axis (A-B),(B-C)& (C-D)	23.77	7.922	178	1322	2550	0.00138	0.00138	626.382	324.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120

Table 58 vertical positive reinforcement bar

Edge Bars

Location	At Edge moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (A-B),(B-C),(D-	31.24	0.208	178	1275	1275	0.001462	0.00138	331.7677	313.191	141.6795	Ø 8C/C 104	196.5734	Ø 8C/C 150

In. Pane b/n axis (E-F)	22.63	0.203	178	1275	1275	0.001395	0.00138	316.6395	313.191	139.0929	Ø 8C/C 100	196.5734	Ø 8C/C 150
STRIP THREE &SEVEN													
In. Pane b/n axis (A-B)	18.09	0.583	178	1275	1275	0.005574	0.00138	1265.106	313.191	86.21382	Ø 8C/C 80	196.5734	Ø 8C/C 150
STRIP TEN													
In. Pane b/n axis (A-B),(B-C)&(CD)	18.09	0.583	178	1275	1275	0.002292	0.00138	520.162	313.191	87.21382	Ø 8C/C 80	196.5734	Ø 8C/C 150

Table 59 vertical edge reinforcement bar

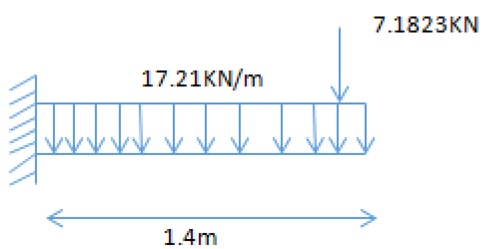
3.1.2.3 Cantilever for seventh floor

Cantilever-1 is a cantilever slab. For cant liver slabs we take one-meter width strip and design the slab for the one-meter width. That means cantilever can be design like one-way slab.

Loadings

- Dead load = load from partition + load from floor finish
  = 3.36+5.285
  = 8.645KN/m2
- Live load =4 KN/m2 for balconies
- Factored load =1.3D.l+1.6L.L
  =1.3*8.645+1.6*4
  =17.21KN/m^2 there is also a load from external wall which act as Concentrated load on the strip.
- Dead load from external wall = 2.69*2.67*1=7.1823KN

There for the strip becomes like a cantilever beam fixed at one end.



Mxs =17.21*1.4^2/2+7.1823*1.3= 26.203kN-m

In the same way the moment calculation for other slabs is calculated in summarized in the following table.

Cantilever	Factor load	Short distance	External wall load	M_{xs}
1	17.21	1.4	7.18	26.203
2	14.12	1.88	0	24.89
3	15.96	1.46	0	16.91
4	16.52	1.94	0	20.65
5	13.17	1.28	7.42	19.45
6	15.29	1.86	0	26.48
7	16.78	1.4	7.42	26.08

3.1.2.3.1 Check the depth for flexure

$$d \geq \sqrt{\frac{Mu}{0.1982bfcd}} = \sqrt{\frac{26.478*10^6}{0.1709*1000*11.33}}$$

= 108.59 mm < the depth provided. (Section is safe for flexure) Hence ok.

Design for reinforcement

Using negative moment

M_{max}=26.478KN/M

T- Section is subjected to –ve bending moment and analyze the section as a rectangular section of width b = 1000

Therefore D=200mm,

d=D –d’ =200-15-7= 178mm

As= ρbd

Where :-

$$\rho = \frac{1}{2}\left[c_1 - \sqrt{c_1^2 - \frac{4Md}{bd^2c_2}}\right]$$

$$\rho = \frac{1}{2}\left[0.07 - \sqrt{0.07_1^2 - \frac{4*26.478*10^6}{1000*178^2*4325.38}}\right] = 0.007713$$

$$\rho_{min} = \frac{0.6}{fyk} = 0.6/300 = 0.00167$$

$\rho_{min} < \rho < \rho_{max}$

Therefore 0.002< 0.008145 <.0.02

As = ρbd = 0.007713*1000*279 = 925.5075mm^2

Using Φ12, as = (π * 12^2/4) = 113mm^2

Spacing $= \frac{bas}{As} = \frac{1000*113}{925.507} = 122.1384$

Use provided space = 120mm

N.B: The required values are summarized in the same way to above as follows:

Mxs	B(mm)	depth(mm)	ρ	As calc	Spa. calc	max S
26.203	1000	178	0.007726	927.0615	121.9337	ϕ12 c/c 120
24.39	1000	178	0.007224	866.8689	130.4003	ϕ12 c/c 120
16.91	1000	178	0.00476	571.1565	197.9142	ϕ12 c/c 190
30.65	1000	178	0.009187	1102.392	102.5406	ϕ12 c/c 100
19.45	1000	178	0.005582	669.7874	168.77	ϕ12 c/c 160
26.48	1000	178	0.007713	925.5075	122.1384	ϕ12 c/c 120
26.08	1000	178	0.005582	669.7874	172.77	ϕ12 c/c 170

3.1.2.4 Second-Sixth Floor Slab Layout

Longitudinal strip

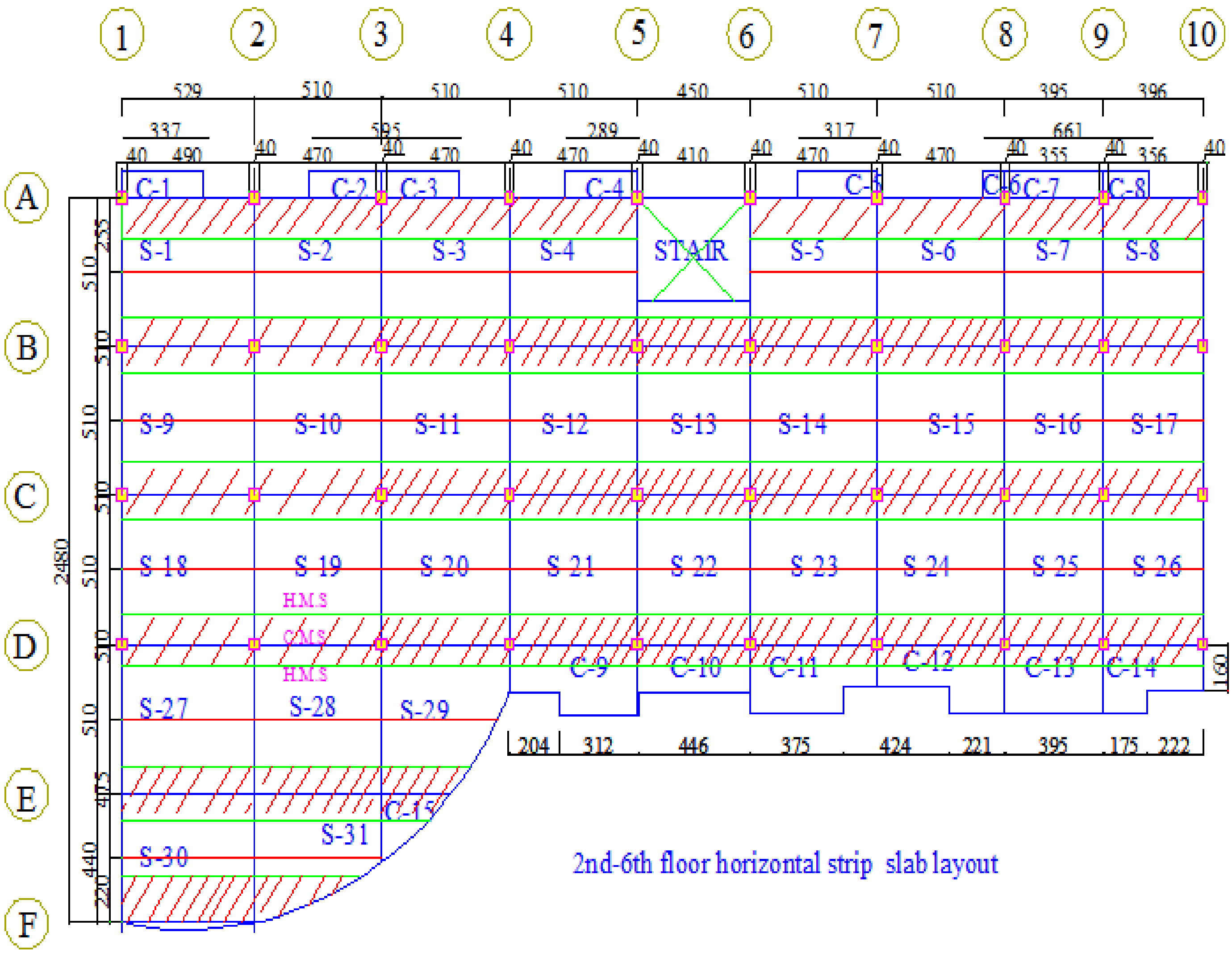


Figure 15 horizontal strip layout for 2nd-6th floor

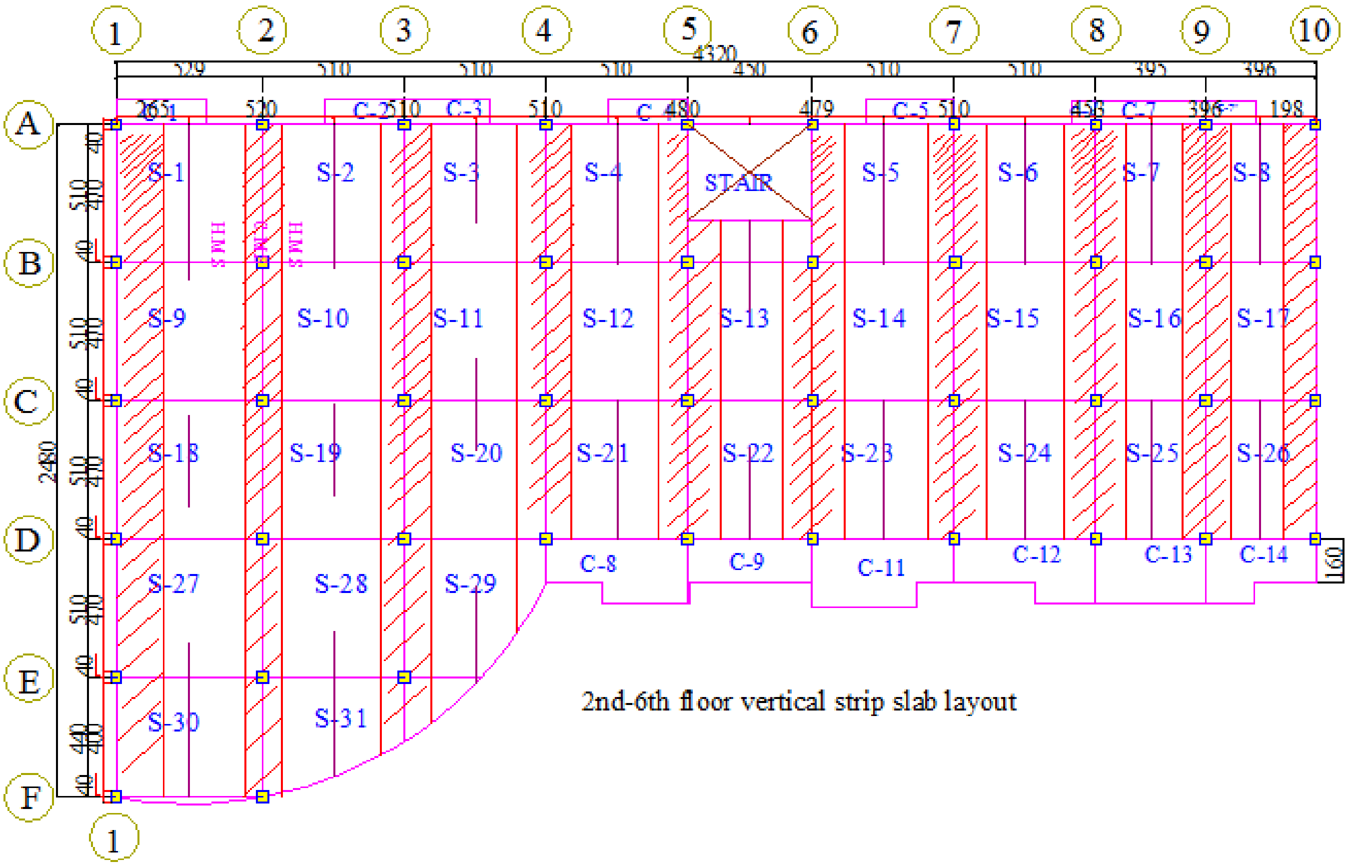


Figure 16 vertical strip layout for 2nd-6th floor

Longitudinal distribution of Mo (+ve and –ve Mo)

Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
STRIP ONE			
Ex. Pane b/n axis 1-2	32.01	53.35	74.69
In. Pane b/n axis 2-3,2-3& 7-8	69	51.3	25.629
In. Pane b/n axis 8-9	16.87	28.115	39.361
Ex. Pane b/n axis 9-10	39.585	28.275	16.965
STRIP TWO, THREE & FOUR			
Ex. Pane b/n axis 1-2	33.93	56.55	79.177

In. Pane b/n axis 2-3,2-3& 7-8	79.177	29.572	59.145
In. Pane b/n axis 4-5&6-7	69	49.288	29.571
In. Pane b/n axis 8-9	33.74	56.235	67.48
Ex. Pane b/n axis 9-10	79.17	56.55	33.93
STRIP FIVE			
Ex. Pane b/n axis 1-2	59.628	99.38	139.132
In. Pane b/n axis 2-3	139.132	25.086	110.172
STRIP SIX			
Ex. Pane b/n axis 1-2	27.618	46.03	64.44

Table 60 longitudinal distribution of -ve & +ve moments for 2nd-6th floor

Compute the total factored static moment for vertical distribution

STRIP ONE			
Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
Ex. Pane b/n axis A-B(beam)	30.73	51.22	71.708
In. Pane b/n axis B-C,C-D&D-E (beam)	71.708	30.732	61.464
Ex. Pane b/n axis E-F(beam)	22.26	37.1	51.94
STRIP TWO			
Ex. Pane b/n axis A-B(beam)	51.94	60.3	120.6
In. Pane b/n axis B-C,C-D&D-E	120.6	60.3	120.6
Ex. Pane b/n axis E-F(beam)	120.6	72.8	102.06
STRIP THREE, FOUR & SEVEN			
Ex. Pane b/n axis A-B	59.145	98.575	138.01
In. Pane b/n axis B-C,C-D&D-E	138.01	59.145	118.29
STRIP FIVE & SIX			
Ex. Pane b/n axis A-B	30.6	51.015	61.22
In. Pane b/n axis B-C,C-D&D-E	61.22	30.6	61.22
STRIP EIGHT			
Ex. Pane b/n axis A-B	29.57	49.288	59.145

In. Pane b/n axis B-C,C-D&D-E	59.145	29.57	59.145
STRIP NINE			
Ex. Pane b/n axis A-B	59.145	45.92	91.08
In. Pane b/n axis B-C,C-D&D-E	91.08	52.54	105.07
STRIP TEN			
Ex. Pane b/n axis A-B	22.96	38.27	53.57
In. Pane b/n axis B-C,C-D&D-E	53.57	22.96	46.96

Table 61 vertical distribution of -ve & +ve moments for 2nd-6th floor

Transverse longitudinal distribution negative & positive moment to column & middle panel

Summarized in the same way

Location	Negative moment		Positive moment		edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
In. Pane b/n axis (1-2)	52.01	10.3	35.03	11.68	29..22	0.289
In. Pane b/n axis 2-3,3-4	56.02	9.33	32.01	10.67	33.33	0.30
In. Pane b/n axis (8-9)	59.046	9.84	20.24	6.748	33.146	0.296
In. Pane b/n axis (9-10)	59.378	9.896	33.93	11.31	33.33	0299
STRIP TWO						
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	44.56	7.393	35.487	11.31	-	-
In. Pane b/n axis (4-5),(6-7)	51.75	8.62	29.57	9.857	29.05	0.260
In. Pane b/n axis (8-9)	25.305	4.217	20.44	6.768	-	-
Ex. Pane b/n axis (9-10)	59.378	9.900	33.93	11.31	33.35	0.298

STRIP THREE						
In. Pane b/n axis (1-2)	59.393	9.879	33.99	11.33	33.33	0.299
. Pane b/n axis (2-3) (3-4),(4-5),(5-6),(6-7),(7-8)	44.359	7.393	17.74	5.914	-	-
In. Pane b/n axis (8-9)	50.61	8.435	20.244	6.75	-	-
Ex. Pane b/n axis (9-10)	59.377	9.89	33.93	11.31	33.33	0.30
STRIP FOUR						
In. Pane b/n axis (1-2)	115.96	19.327	66.26	22.088	65.09	0.5583
In. Pane b/n axis(2-3)	91.82	15.3	36.729	12.243	-	-
STRIP FIVE						
In. Pane b/n axis (1-2)	115.96	19.327	66.26	22.088	65.09	0.5583
In. Pane b/n axis(2-3)	91.82	15.3	36.729	12.243	-	-
STRIP SIX						
In. Pane b/n axis (1-2)	48.33	16.11	27.62	9.206	28.3	0.243

Table 62 Transverse longitudinal distribution negative & positive moment for 2nd-6th floor

Vertical moment adjustment

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
Strip one						
In. Pane b/n axis (A-B) , (B-C) & (D-E)	53.7	8.964	30.732	10.244	30.189	0.27
In. Pane b/n axis (E-F)	38.955	6.492	22.26	7.42	21.869	0.195

STRIP TWO						
In. Pane b/n axis (A-B), (B-C)& (C-D)	53.7	8.964	30.732	10.244	-	-
In. Pane b/n axis (E-F)	97.82	18.14	27.126	9.042	-	-
STRIP THREE, SEVEN						
In. Pane b/n axis (A-B)	103.5	17.25	59.145	12.321	58.104	0.52
In. Pane b/n axis (B-C),(C-D)&(D-E)	103.5	17.25	59.145	19.715	-	-
STRIP FIVE ,SIX						
In. Pane b/n axis (B-C),(C-D)&(D-C)	44.358	7.393	17.742	5.914	-	-
STRIP EIGHT						
In. Pane b/n axis (A-B), (B-C) & C-D)	78.804	13.134	31.524	11.48	-	-
STRIP NINE						
In. Pane b/n axis (A-B), (B-C) & (C-D)	68.88	11.4	27.552	9.184	-	-
STRIP TEN						
In. Pane b/n axis (A-B), (B-C) & (C-D)	40.177	6.696	22.962	7.654	22.555	0.202

Table 63 Transverse vertical distribution negative & positive moment for 2nd-6th floor

Longitudinal negative reinforcement bar

Location	Negative moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (1-2)	52.01	10.3	178	1275	1275	0.004376	0.00138	993.067	313.191	100.7862	ø 10C/C 100	165.31	ø 10C/C 120
In. Pane b/n axis 2-3,3-4	56.02	9.33	178	1275	1275	0.004738	0.00138	1075.366	313.191	93.07299	ø 10C/C 90	165.31	ø 10C/C 120
In. Pane b/n axis (8-9)	59.046	9.84	178	1275	1275	0.005015	0.00138	1138.103	313.191	87.9424	ø 10C/C 80	165.31	ø 10C/C 120
In. Pane b/n axis (9-10)	59.378	9.896	178	1275	1275	0.005045	0.00138	1145.02	313.191	87.41114	ø 10C/C 80	165.31	ø 10C/C 120
STRIP TWO													
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	44.56	7.393	178	1275	2550	0.001806	0.00138	1111.8503	313.191	124.1604	ø 10C/C 100	165.31	ø 10C/C 120

	Ex. Pane b/n axis (9-10)	In. Pane b/n axis (8-9)	. Pane b/n axis (2-3) (3-4),(4-5),(5-6),(6-7),(7-8)	In. Pane b/n axis (1-2)		Ex. Pane b/n axis (9-10)	In. Pane b/n axis (8-9)	In. Pane b/n axis (4-5),(6-7)
STRIP FOUR	59.377	50.61	44.359	59.393	STRIP THREE	59.378	25.305	51.75
	9.89	8.435	7.393	9.879		9.9	4.217	8.62
	178	178	178	178		178	178	178
	1275	1275	1275	1275		1275	1275	1275
	2550	2550	2550	2550		2550	2550	2550
	0.002428	0.002059	0.001798	0.002429		0.002428	0.00138	0.002107
	0.00138	0.00138	0.00138	0.00138		0.00138	0.00138	0.00138
	1102.177	934.5069	816.0555	1102.484		1102.196	626.382	956.2068
	313.191	313.191	313.191	313.191		313.191	313.191	313.191
	181.6179	114.2039	145.2958	181.5672		181.6147	119.5734	209.3428
	Ø 10C/C 100	Ø 10C/C 100	Ø 10C/C 100	Ø 10C/C 100		Ø 10C/C 100	Ø 10C/C 100	Ø 10C/C 200
	165.31	165.31	165.31	165.31		165.31	165.31	165.31
	Ø 10C/C120	Ø 10C/C120	Ø 10C/C120	Ø 10C/C120		Ø 10C/C120	Ø 10C/C 120	Ø 10C/C 120

In. Pane b/n axis (1-2)	115.96	19.327	178	1275	2550	0.004917	0.00138	2231.877	313.191	89.68908	Ø 10C/C 80	165.31	Ø 10C/C120
In. Pane b/n axis(2-3)	91.82	15.3	178	1275	2550	0.003832	0.00138	1739.285	313.191	115.0904	Ø 10C/C 100	165.31	Ø 10C/C120
STRIP FIVE													
In. Pane b/n axis (1-2)	115.96	19.327	178	1275	2550	0.004917	0.00138	2231.877	313.191	89.68908	Ø 10C/C 100	165.31	Ø 10C/C120
In. Pane b/n axis(2-3)	91.82	15.3	178	1275	2550	0.003832	0.00138	1739.285	313.191	115.0904	Ø 10C/C 100	165.31	Ø 10C/C 120
STRIP SIX													
In. Pane b/n axis (1-2)	48.33	16.11	178	1275	1100	0.004738	0.00138	927.7462	313.191	93.07502	Ø 10C/C 100	165.31	Ø 10C/C120

Table 64 Longitudinal negative reinforcement bar for 2nd-6th floor

Longitudinal Positive reinforcement bar

Location	Positive moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (1-2)	35.03	11.68	178	1275	1275	0.002884	0.00138	654.5012	313.191	98.9218	Ø 8C/C 90	199.87	Ø 10C/C150
In. Pane b/n axis 2-3,3-4	32.01	10.67	178	1275	1275	0.002626	0.00138	595.8607	313.191	87.9713	Ø 8C/C 80	199.87	Ø 10C/C150
In. Pane b/n axis (8-9)	20.24	6.748	178	1275	1275	0.001637	0.00138	371.5006	313.191	97.4141	Ø 8C/C 90	199.87	Ø 10C/C150
In. Pane b/n axis (9-10)	33.93	11.31	178	1275	1275	0.00279	0.00138	633.0896	313.191	98.0937	Ø 8C/C 90	199.87	Ø 10C/C150
STRIP TWO													
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	35.487	11.31	178	1275	2550	0.001431	0.00138	649.4645	313.191	81.2154	Ø 8C/C 80	199.87	Ø 10C/C150
In. Pane b/n axis (4-5),(6-7)	29.57	9.857	178	1275	2550	0.00138	0.00138	626.382	313.191	95.5734	Ø 8C/C 90	199.87	Ø 10C/C150

In. Pane b/n axis (8-9)	20.44	6.768	178	1275	2550	0.00138	0.00138	626.382	313.191	93.5734	Ø 8C/C 90	199.87	Ø 10C/C150
Ex. Pane b/n axis (9-10)	33.93	11.31	178	1275	2550	0.00138	0.00138	626.382	313.191	98.5734	Ø 8C/C 90	199.87	Ø 10C/C150
STRIP THEE													
In. Pane b/n axis (1-2)	65.442	21.814	178	1275	2550	0.002721	0.00138	1235.111	313.191	142.0705	Ø 8C/C 100	199.87	Ø 10C/C150
. Pane b/n axis (2-3) (3-4),(4-5),(5-6),(6-7),(7-8)	36.27	12.09	178	1275	2550	0.001482	0.00138	672.6798	313.191	107.5785	Ø 8C/C 100	199.87	Ø 10C/C150
In. Pane b/n axis (8-9)	20.639	6.898	178	1275	2550	0.000198	0.00138	89.94509	313.191	2225.524	Ø 8C/C 90	199.87	Ø 10C/C150
Ex. Pane b/n axis (9-10)	34.683	11.561	178	1275	2550	0.002721	0.00138	1235.111	313.191	94.0705	Ø 8C/C 90	199.87	Ø 10C/C150
STRIP FOUR													
In. Pane b/n axis (1-2)	66.26	22.088	178	1275	2550	0.002721	0.00138	1235.111	313.191	152.0705	Ø 8C/C 100	199.87	Ø 10C/C150

In. Pane b/n axis(2-3)	36.729	12.243	178	1275	2550	0.001482	0.00138	672.6798	313.191	93.5785	Ø 8C/C 90	199.87	Ø 10C/C150
STRIP FIVE													
In. Pane b/n axis (1-2)	66.26	22.088	178	1275	2550	0.002721	0.00138	1235.111	313.191	152.0705	Ø 8C/C 100	199.87	Ø 10C/C150
In. Pane b/n axis(2-3)	36.729	12.243	178	1275	2550	0.001482	0.00138	672.6798	313.191	93.7.5785	Ø 8C/C 90	199.87	Ø 10C/C150
STRIP SIX													
In. Pane b/n axis (1-2)	27.62	9.206	178	1275	1100	0.002626	0.00138	514.1442	313.191	97.949	Ø 8C/C 90	199.87	Ø 10C/C150

Table 65 Longitudinal Positive reinforcement bar for 2nd-6th floor

Longitudinal edge reinforcement bar

Location	Edge beam moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (1-2)	29..22	0.289	178	1275	1275	0.002738	0.00138	621.436	313.191	181.6795	Ø 8C/C 10	157.85	Ø 8C/C 100
In. Pane b/n axis 2-3,3-4	33.33	0.30	178	1275	1275	0.002722	0.00138	617.8658	313.191	189.0929	Ø 8C/C 10	157.85	Ø 8C/C 120

STRIP FIVE													
In. Pane b/n axis (1-2)	65.09	0.5583	178	1275	2550	0.002671	0.00138	1212.432	313.191	79.1139	Ø 8C/C 7	157.85	Ø 8C/C 120
Ex. Pane b/n axis (9-10)	34.07	0.3052	178	1275	2550	0.00138	0.00138	626.382	313.191	89.1139	Ø 8C/C 8	157.85	Ø 8C/C 120
In. Pane b/n axis (1-2)	64.290	0.523	178	1275	2550	0.002637	0.00138	1196.945	313.191	155.3726	Ø 8C/C 10	157.85	Ø 8C/C 120
STRIP THREE													
Ex. Pane b/n axis (9-10)	34.073	0.324	178	1275	2550	0.00138	0.00138	626.382	313.191	89.1139	Ø 8C/C 8	157.85	Ø 8C/C 120
In. Pane b/n axis (4-5) (6-7)	59.386	0.532	178	1275	2550	0.002429	0.00138	1102.35	313.191	89.1139	Ø 8C/C 8	157.85	Ø 8C/C 120
STRIP TWO													
In. Pane b/n axis (9-10)	33.33	0299	178	1275	1275	0.002738	0.00138	621.436	313.191	86.21382	Ø 8C/C 8	157.85	Ø 8C/C 120
In. Pane b/n axis (8-9)	33.146	0.296	178	1275	1275	0.002722	0.00138	617.8658	313.191	86.21382	Ø 8C/C 8	157.85	Ø 8C/C 120

In. Pane b/n axis (1-2)	65.09	0.5583	178	1275	2550	0.002671	0.00138	1212.432	313.191	192.416	Ø 8C/C 100	157.85	Ø 8C/C 120
STRIP SIX													
In. Pane b/n axis (1-2)	27.73	0.248	178	1275	1275	0.002263	0.00138	513.519	313.191	192.416	Ø 8C/C 100	157.85	Ø 8C/C 120

Table 66 Longitudinal edge reinforcement bar for 2nd-6th floor

Vertical reinforcement

Vertical negative reinforcement bar for 2^{nd}-6^{th} floor

Location	Negative moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (A-B),(B-C) & (D-E)	55.665	9.278	178	1322	1322	0.00138	0.00138	324.7361	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
In. Pane b/n axis (E-F)	41.895	6.953	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP TWO													
In. Pane b/n axis (A-B), (B-C) & (C-D)	93.62	16.85	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120

In. Pane b/n axis (E-F)	97.82	18.14	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP THREE, SEVEN													
In. Pane b/n axis (A-B)	107.13	17.855	178	1322	2550	0.00138	0.00138	626.382	324.7361	89.5734	Ø 8C/C 80	151.5734	Ø 8C/C 120
In. Pane b/n axis (B-C),(C-D) &	91.82	15.3	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP FIVE &SIX													
In. Pane b/n axis (B-C),(C-D)&	45.915	7.652	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP EIGNT													
In. Pane b/n axis (A-B),(B-C) &	81.56	6.782	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP NINE													
In. Pane b/n axis (A-B), (B-C) &	71.295	11.883	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP TEN													
In. Pane b/n axis (A-B (C-D)	41.59	6.93	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120

Table 67 Vertical negative reinforcement bar for 2nd-6th floor

Vertical positive reinforcement bar for 2nd-6th floor

Location	positive moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (A-B), (B-	31.809	10.603	178	1322	1322	0.00138	0.00138	324.7361	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
In. Pane b/n axis (E-F)	23.04	7.68	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	138.78	Ø 8C/C 120
STRIP TWO													
In. Pane b/n axis (A-B), (B-C) & (C-D)	37.45	12.48	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	158.78	Ø 8C/C 120
In. Pane b/n axis (E-F)	27.126	9.042	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP THREE, SEVEN													
In. Pane b/n axis (A-B)	63.015	13.128	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	158.78	Ø 8C/C 120

In. Pane b/n axis (B-C),(C-D) &	36.73	12.243	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP FIVE &SIX													
In. Pane b/n axis (B-C),(C-D)&	18.36	6.12	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP FIVE &SIX													
In. Pane b/n axis (A-B), (B-C)& C-D)	32.63	10.88	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP NINE													
In. Pane b/n axis (A-B), (B-C)& (C-D)	28.518	9.506	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP TEN													
In. Pane b/n axis (A-B),(B-C)& (C-D)		7.922	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120

Table 68 Vertical positive reinforcement bar for 2nd-6th floor

Vertical edge reinforcement bar for 2^{nd}-6^{th} floor

Location	At Edge moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													

In. Pane b/n axis (A-B),(B-C),(D-E)	31.24	0.208	178	1275	1275	0.001462	0.00138	331.7677	313.191	141.6795	Ø 8C/C 104	196.5734	Ø 8C/C 150
In. Pane b/n axis (E-F)	22.63	0.203	178	1275	1275	0.001395	0.00138	316.6395	313.191	139.0929	Ø 8C/C 100	196.5734	Ø 8C/C 150
	STRIP THREE &SEVEN												
In. Pane b/n axis (A-B)	18.09	0.583	178	1275	1275	0.005574	0.00138	1265.106	313.191	86.21382	Ø 8C/C 80	196.5734	Ø 8C/C 150
STRIP TEN													
In. Pane b/n axis (A-B),(B-C)& (C-D)	19.09	0.583	178	1275	1275	0.002292	0.00138	520.162	313.191	87.21382	Ø 8C/C 80	196.5734	Ø 8C/C 150

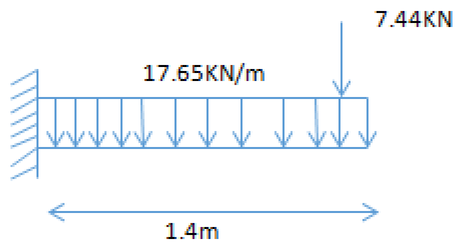
Table 69 Vertical edge reinforcement bar for 2nd-6th floor

Cantilever-

Cantilever- is a cantilever slab. For cant liver slabs we take one meter width strip and design the slab for the one meter width.

Loadings

- Dead load = load from partition + load from floor finish
  = 3.36+5.285
  = 8.64KN/m2
- Live load =4 KN/m2 for balconies
- Factored load =1.3D.l+1.6L.L
  =1.3*8.645+1.6*4
  =17.65KN/m2 there is also a load from external wall which act as Concentrated load on the strip.
- Dead load from external wall = 2.69*2.76*1=7.44KN
  There for the strip becomes



Mxs =17.64*1.4^2/2+7.42*1.3=44.21

In the same way the moment calculation for other panels are summarized in the following table.

Cantilever	Factor load	Short distance	External wall load	Mxs
1	17.643	1.4	7.44	44.211
2	14.02	1.88	-	24.88
3	15.86	1.46	-	16.9
4	16.4	1.94	-	30.86
5	13.27	1.28	7.42	19.62
6	15.26	1.86	-	26.4
7	16.78	1.4	7.42	26.08
8	13.576	0.95	-	6.126
9	17.073	0.95	-	8
10	13.576	0.95	-	6.126
11	13.576	0.95	-	6.126
12	13.576	0.95	-	6.126
13	13.576	0.95	-	6.126
14	13.576	0.95	-	6.126
15	16.279	0.95	-	7.346

Reinforcement provision

Mxs	B(mm)	depth(mm)	ρ	As calc As min	Spa. Calc	max S
26.211	1000	178	0.007224	866.8689	100.4003	ϕ12 c/c 120
24.88	1000	178	0.007224	866.8689	130.4003	ϕ12 c/c 120
16.9	1000	178	0.00476	571.1565	197.9142	ϕ12 c/c 120
30.86	1000	178	0.0092	1104.013	102.3901	ϕ12 c/c 120
19.62	1000	178	0.005453	654.4183	172.7336	ϕ12 c/c 120
26.4	1000	178	0.007713	925.5075	122.1384	ϕ12 c/c 120
26.08	1000	178	0.001267	152.0368	743.5043	ϕ12 c/c 120
6.126	1000	178	0.00226	271.2382	416.7555	ϕ12 c/c 400
8	1000	178	0.003049	365.8244	402.5843	ϕ12 c/c 400
6.126	1000	178	0.00226	271.2382	416.7555	ϕ12 c/c 400
6.126	1000	178	0.00226	271.2382	416.7555	ϕ12 c/c 400
6.126	1000	178	0.00226	271.2382	416.7555	ϕ12 c/c 400
6.126	1000	178	0.00226	271.2382	416.7555	ϕ12 c/c 400
6.126	1000	178	0.00226	271.2382	416.7555	ϕ12 c/c 400
7.346	1000	178	0.00226	271.2382	416.7555	ϕ12 c/c 400

Table 70 Calculated Reinforcement bar for cantilever

3.1.2.5 First Floor slab layout

Longitudinal strip

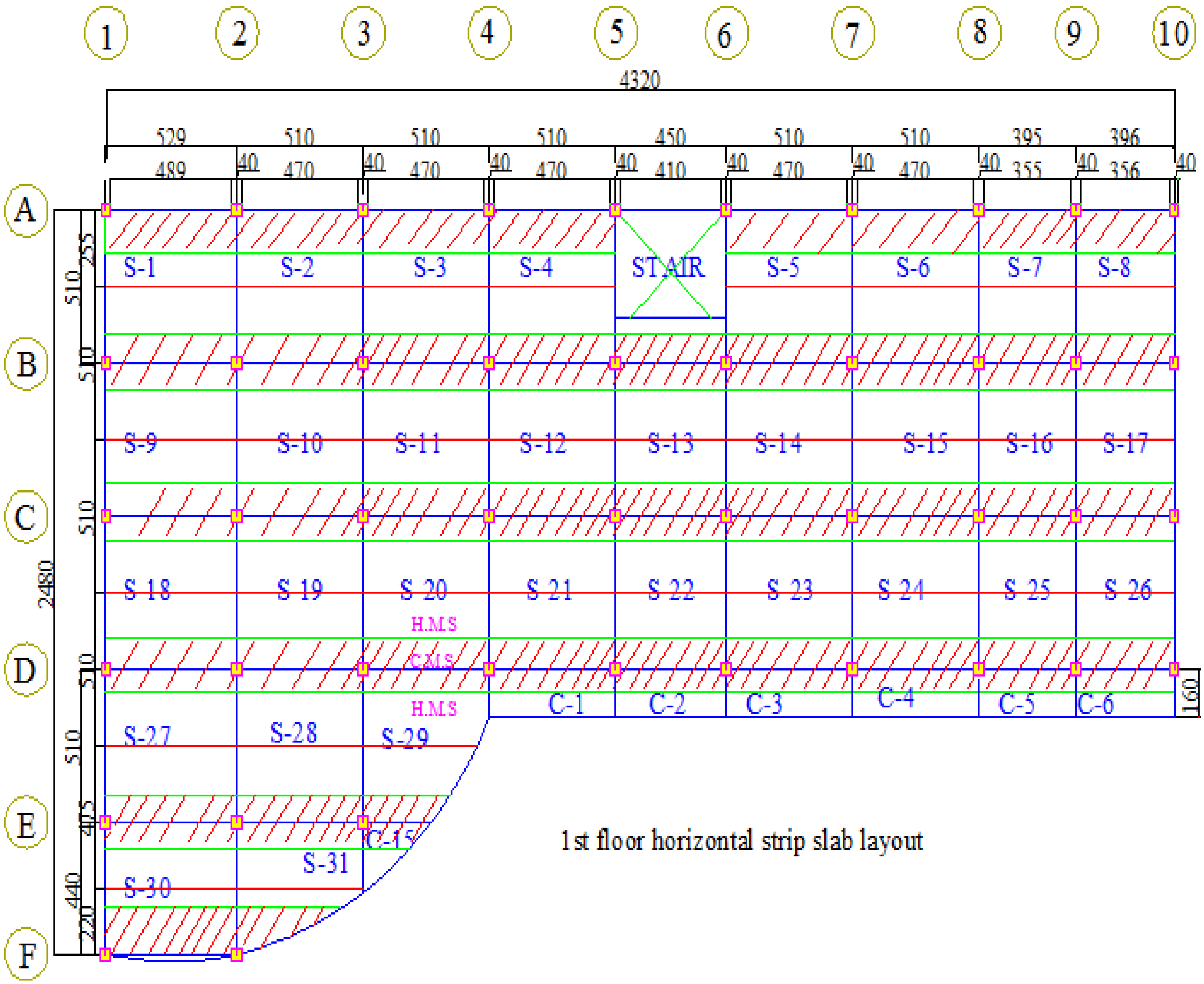


Figure 17 longitudinal strip for 1st floor

Vertical strip

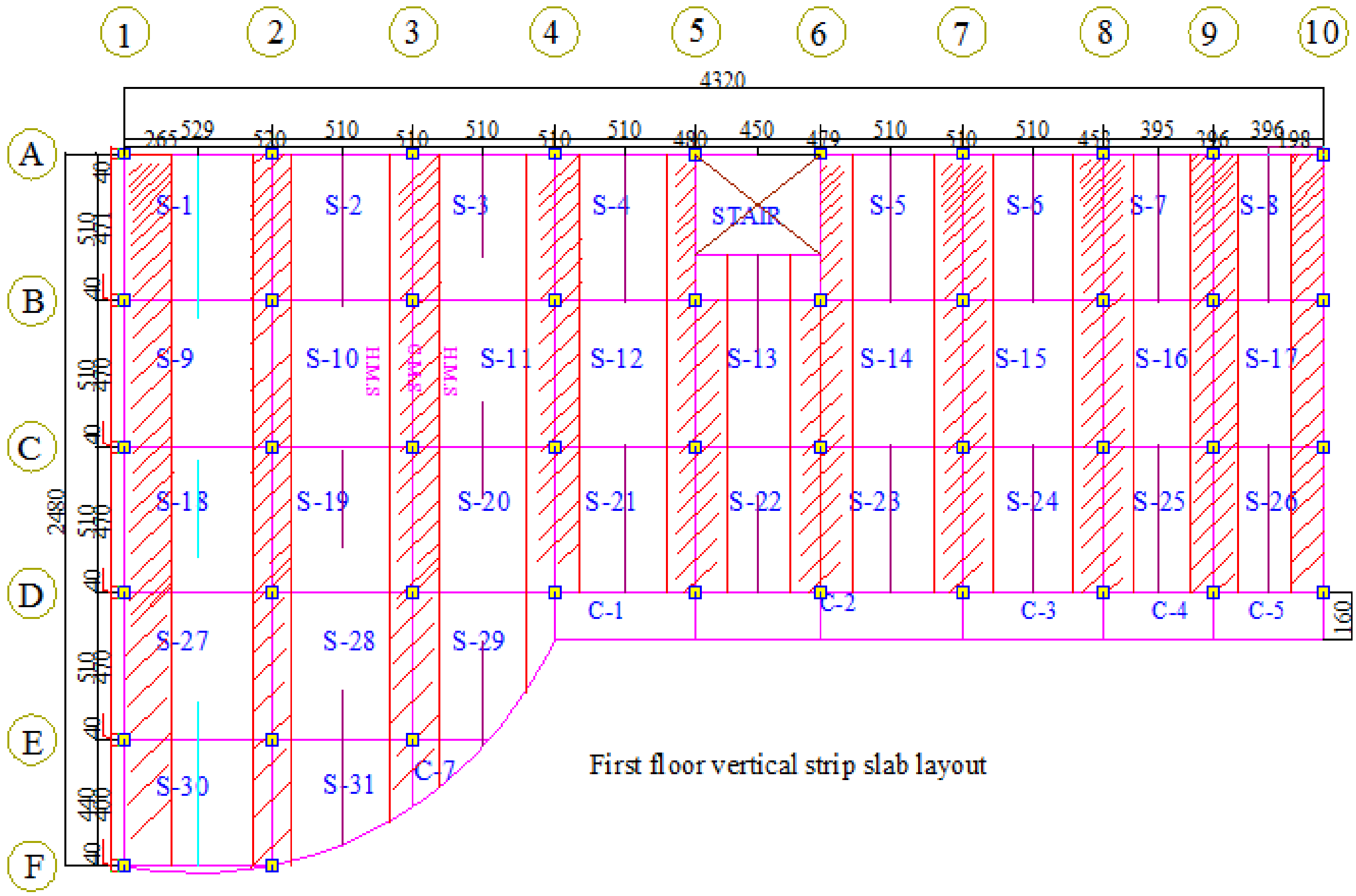


Figure 18 vertical strip for 1st floor

Longitudinal distribution of Mo (+ve and –ve Mo)

Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
	Strip one		
Ex. Pane b/n axis 1-2	32.721	54.535	76.349
In. Pane b/n axis 4-5&6-7	70.531	52.394	26.197
In. Pane b/n axis 2-3,2-3& 7-8	30.22	50.378	70.53
In. Pane b/n axis 8-9	17.25	28.74	40.238
Ex. Pane b/n axis 9-10	40.46	28.9	17.34

STRIP TWO, THREE & FOUR			
Ex. Pane b/n axis 1-2	65.442	109.07	152.7
In. Pane b/n axis 2-3,2-3& 7-8	152.7	60.45	120.9
In. Pane b/n axis 4-5&6-7	141.05	100.7	60.45
In. Pane b/n axis 8-9	60.45	34.488	68.976
Ex. Pane b/n axis 9-10	80.927	57.805	34.683
STRIP FIVE			
Ex. Pane b/n axis 1-2	60.95	101.585	142.219
In. Pane b/n axis 2-3	142.219	56.302	112.608
STRIP SIX			
Ex. Pane b/n axis 1-2	28.23	47.05	65.87

Table 71 longitudinal -ve & +ve moments distribution for 1st floor

Compute the total factored static moment for vertical distribution

STRIP ONE			
Location	Negative in KN.m	Positive in KN.m	Negative in KN.m
Ex. Pane b/n axis A-B(beam)	31.41	52.35	73.29
In. Pane b/n axis B-C,C-D&D-E	73.29	31.41	62.82
Ex. Pane b/n axis E-F(beam)	22.752	37.92	53.088
STRIP TWO			
Ex. Pane b/n axis A-B(beam)	61.641	102.735	143.829
In. Pane b/n axis B-C,C-D&D-E	143.829	61.64	123.282
Ex. Pane b/n axis E-F(beam)	44.64	74.412	104.18
STRIP THREE, FOUR & SEVEN			
Ex. Pane b/n axis A-B	60.45	100.759	141.06
In. Pane b/n axis B-C,C-D&D-E	141.06	60.45	120.91
STRIP FIVE & SIX			
Ex. Pane b/n axis A-B	30.22	50.38	70.53

In. Pane b/n axis B-C,C-D&D-E	70.53	30.22	60.45
STRIP EIGHT			
Ex. Pane b/n axis A-B	53.697	89.495	125.293
In. Pane b/n axis B-C,C-D&D-E	125.293	53.677	107.394
STRIP NINE			
Ex. Pane b/n axis A-B	46.941	78.235	109.529
In. Pane b/n axis B-C,C-D&D-E	109.529	46.941	93.882
STRIP TEN			
Ex. Pane b/n axis A-B	23.47	39.118	54.765
In. Pane b/n axis B-C,C-D&D-E	54.765	23.47	46.94

Table 72 vertical -ve & +ve moment distribution for 1st floor

Transverse longitudinal distribution negative &positive moment to column & middle panel Summarized in the same way

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
In. Pane b/n axis (1-2)	52.01	10.3	35.03	11.68	29..22	0.289
In. Pane b/n axis 2-3,3-4	56.02	9.33	32.01	10.67	33.33	0.30
In. Pane b/n axis (8-9)	59.046	9.84	20.24	6.748	33.146	0.296
In. Pane b/n axis (9-10)	59.378	9.896	33.93	11.31	33.33	0299
STRIP TWO						
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	90.675	15.22	36.27	12.09	-	-
In. Pane b/n axis (4-5),(6-7)	105.788	17.631	60.45	20.15	59.386	0.532

In. Pane b/n axis (8-9)	51.732	8.622	20.693	6.89	-	-
Ex. Pane b/n axis (9-10)	60.695	10.116	34.683	11.561	34.073	0.324
STRIP THREE						
In. Pane b/n axis (1-2)	114.523	19.087	65.442	21.814	64.290	0.523
. Pane b/n axis (2-3) (3-4),(4-5),(5-6),(6-7),(7-8)	90.675	15.112	36.27	12.09	-	-
In. Pane b/n axis (8-9)	51.732	8.622	20.639	6.898	-	-
Ex. Pane b/n axis (9-10)	60.695	10.115	34.683	11.561	34.07	0.3052
STRIP FOUR						
In. Pane b/n axis (1-2)	115.96	19.327	66.26	22.088	65.09	0.5583
In. Pane b/n axis(2-3)	91.82	15.3	36.729	12.243	-	-
STRIP FIVE						
In. Pane b/n axis (1-2)	115.96	19.327	66.26	22.088	65.09	0.5583
In. Pane b/n axis(2-3)	91.82	15.3	36.729	12.243	-	-
STRIP SIX						
In. Pane b/n axis (1-2)	49.40	13.174	28.23	9.41	27.73	0.248

Table 73 transverse longitudinal -ve & +ve moment adjustment for 1st floor

Transverse Vertical moment adjustment

Location	Negative moment		Positive moment		Ext. edge beam	
	Column strip	Half mid strip	Column strip	Half mid strip	Column strip	Half mid strip
STRIP ONE						
In. Pane b/n axis (A-B),(B-C)& (D-E)	54.967	9.16	31.41	10.47	30.857	0.276

In. Pane b/n axis (E-F)	39.816	6.636	22.752	7.584	22.35	0.202
STRIP TWO						
In. Pane b/n axis (A-B),(B-C)& (C-D)	92.46	15.45	36.27	12.09	-	-
In. Pane b/n axis (E-F)	70.411	18.776	26.784	8.928	-	-
STRIP THREE, SEVEN						
In. Pane b/n axis (A-B)	105.795	17.633	60.45	12.59	59.38	0.531
In. Pane b/n axis (B-C),(C-D)&(D-E)	90.682	15.11	36.27	12.09	-	-
STRIP FIVE ,SIX						
In. Pane b/n axis (B-C),(C-D)&(D-C)	45.33	7.556	18132	6.04	-	-
STRIP EIGHT						
In. Pane b/n axis (A-B), (B-C) & C-D)	80.54	13.42	32.21	10.739	-	-
STRIP NINE						
In. Pane b/n axis (A-B), (B-C) & (C-D)	70.411	11.735	28.16	9.388	-	-
STRIP TEN						
In. Pane b/n axis (A-B), (B-C) & (C-D)	41.07	6.846	23.47	7.823	23.47	0.206

Table 74 Transverse Vertical -ve & +ve moment adjustment for 1st floor

Longitudinal Negative reinforcement bar

Location	Negative moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (1-2)	52.01	10.3	178	1275	1275	0.004376	0.00138	993.067	313.191	100.7862	Ø 10C/C 100	165.31	Ø 10C/C120
In. Pane b/n axis 2-3,3-4	56.02	9.33	178	1275	1275	0.004738	0.00138	1075.366	313.191	93.07299	Ø 10C/C 90	165.31	Ø 10C/C120
In. Pane b/n axis (8-9)	59.046	9.84	178	1275	1275	0.005015	0.00138	1138.103	313.191	87.9424	Ø 10C/C 80	165.31	Ø 10C/C120
In. Pane b/n axis (9-10)	59.378	9.896	178	1275	1275	0.005045	0.00138	1145.02	313.191	87.41114	Ø 10C/C 80	165.31	Ø 10C/C120
STRIP TWO													
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	44.56	7.393	178	1275	2550	0.001806	0.00138	1111.8503	313.191	124.1604	Ø 10C/C 100	165.31	Ø 10C/C120
In. Pane b/n axis (4-5),(6-7)	51.75	8.62	178	1275	2550	0.002107	0.00138	956.2068	313.191	209.3428	Ø 10C/C 200	165.31	Ø 10C/C120

In. Pane b/n axis (8-9)	25.305	4.217	178	1275	2550	0.00138	0.00138	626.382	313.191	119.5734	Ø 10C/C 100	165.31	Ø 10C/C120
Ex. Pane b/n axis (9-10)	59.378	9.9	178	1275	2550	0.002428	0.00138	1102.196	313.191	181.6147	Ø 10C/C 100	165.31	Ø 10C/C120
STRIP THREE													
In. Pane b/n axis (1-2)	59.393	9.879	178	1275	2550	0.002429	0.00138	1102.484	313.191	181.5672	Ø 10C/C 100	165.31	Ø 10C/C120
. Pane b/n axis (2-3) (3-4),(4-5),(5-6),(6-7),(7-8)	44.359	7.393	178	1275	2550	0.001798	0.00138	816.0555	313.191	145.2958	Ø 10C/C 100	165.31	Ø 10C/C120
In. Pane b/n axis (8-9)	50.61	8.435	178	1275	2550	0.002059	0.00138	934.5069	313.191	114.2039	Ø 10C/C 100	165.31	Ø 10C/C120
Ex. Pane b/n axis (9-10)	59.377	9.89	178	1275	2550	0.002428	0.00138	1102.177	313.191	181.6179	Ø 10C/C 100	165.31	Ø 10C/C120
STRIP FOUR													
In. Pane b/n axis (1-2)	115.96	19.327	178	1275	2550	0.004917	0.00138	2231.877	313.191	89.68908	Ø 10C/C 80	165.31	Ø 10C/C120

In. Pane b/n axis(2-3)	91.82	15.3	178	1275	2550	0.003832	0.00138	1739.285	313.191	115.0904	Ø 10C/C 100	165.31	Ø 10C/C120
STRIP FIVE													
In. Pane b/n axis (1-2)	115.96	19.327	178	1275	2550	0.004917	0.00138	2231.877	313.191	89.68908	Ø 10C/C 100	165.31	Ø 10C/C120
In. Pane b/n axis(2-3)	91.82	15.3	178	1275	2550	0.003832	0.00138	1739.285	313.191	115.0904	Ø 10C/C 100	165.31	Ø 10C/C120
STRIP SIX													
In. Pane b/n axis (1-2)	48.33	16.11	178	1275	1100	0.004738	0.00138	927.7462	313.191	93.07502	Ø 10C/C 100	165.31	Ø 10C/C120

Table 75 Longitudinal Negative reinforcement bar for 1st floor

Longitudinal positive reinforcement bar

Location	Positive moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (1-2)	35.03	11.68	178	1275	1275	0.002884	0.00138	654.5012	313.191	98.9218	Ø 8C/C 90	199.87	Ø 10C/C150

STRIP THREE													
Ex. Pane b/n axis (9-10)	33.93	11.31	178	1275	2550	0.00138	0.00138	626.382	313.191	98.5734	Ø 8C/C 90	199.87	Ø 10C/C150
In. Pane b/n axis (8-9)	20.44	6.768	178	1275	2550	0.00138	0.00138	626.382	313.191	93.5734	Ø 8C/C 90	199.87	Ø 10C/C150
In. Pane b/n axis (4-5),(6-7)	29.57	9.857	178	1275	2550	0.00138	0.00138	626.382	313.191	95.5734	Ø 8C/C 90	199.87	Ø 10C/C150
In. Pane b/n axis (1-2) (2-3),(3-4),(7-8)	35.487	11.31	178	1275	2550	0.001431	0.00138	649.4645	313.191	81.2154	Ø 8C/C 80	199.87	Ø 10C/C150
STRIP TWO													
In. Pane b/n axis (9-10)	33.93	11.31	178	1275	1275	0.00279	0.00138	633.0896	313.191	98.0937	Ø 8C/C 90	199.87	Ø 10C/C150
In. Pane b/n axis (8-9)	20.24	6.748	178	1275	1275	0.001637	0.00138	371.5006	313.191	97.4141	Ø 8C/C 90	199.87	Ø 10C/C150
In. Pane b/n axis 2-3,3-4	32.01	10.67	178	1275	1275	0.002626	0.00138	595.8607	313.191	87.9713	Ø 8C/C 80	199.87	Ø 10C/C150

In. Pane b/n axis (1-2)	65.442	21.814	178	1275	2550	0.002721	0.00138	1235.111	313.191	142.0705	Ø 8C/C 100	199.87	Ø 10C/C150
. Pane b/n axis (2-3) (3-4),(4-5),(5-6),(6-7) (7-8)	26.27	12.09	178	1275	2550	0.001482	0.00138	672.6798	313.191	107.5785	Ø 8C/C 100	199.87	Ø 10C/C150
In. Pane b/n axis (8-9)	20.639	6.898	178	1275	2550	0.000198	0.00138	89.94509	313.191	2225.524	Ø 8C/C 90	199.87	Ø 10C/C150
Ex. Pane b/n axis (9-10)	34.683	11.561	178	1275	2550	0.002721	0.00138	1235.111	313.191	94.0705	Ø 8C/C 90	199.87	Ø 10C/C150
STRIP FOUR													
In. Pane b/n axis (1-2)	66.26	22.088	178	1275	2550	0.002721	0.00138	1235.111	313.191	152.0705	Ø 8C/C 100	199.87	Ø 10C/C150
In. Pane b/n axis(2-3)	36.729	12.243	178	1275	2550	0.001482	0.00138	672.6798	313.191	93.5785	Ø 8C/C 90	199.87	Ø 10C/C150
STRIP FIVE													
In. Pane b/n axis (1-2)	66.26	22.088	178	1275	2550	0.002721	0.00138	1235.111	313.191	152.0705	Ø 8C/C 100	199.87	Ø 10C/C150
In. Pane b/n axis(2-3)	36.729	12.243	178	1275	2550	0.001482	0.00138	672.6798	313.191	93.7.5785	Ø 8C/C 90	199.87	Ø 10C/C150

STRIP SIX													
In. Pane b/n axis (1-2)	27.62	9.206	178	1275	1100	0.002626	0.00138	514.1442	313.191	97.949	Ø 8C/C 90	199.87	Ø 10C/C150

Table 76 Longitudinal positive reinforcement bar for 1st floor

Longitudinal Edge reinforcement bar

Location	Edge beam moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (1-2)	29..22	0.289	178	1275	1275	0.002738	0.00138	621.436	313.191	181.6795	Ø 8C/C 100	157.85	Ø 8C/C100
In. Pane b/n axis 2-3,3-4	33.33	0.30	178	1275	1275	0.002722	0.00138	617.8658	313.191	189.0929	Ø 8C/C 100	157.85	Ø 8C/C 120
In. Pane b/n axis (8-9)	33.146	0.296	178	1275	1275	0.002722	0.00138	617.8658	313.191	86.21382	Ø 8C/C 80	157.85	Ø 8C/C 120
In. Pane b/n axis (9-10)	33.33	0299	178	1275	1275	0.002738	0.00138	621.436	313.191	86.21382	Ø 8C/C 80	157.85	Ø 8C/C 120
STRIP TWO													

In. Pane b/n axis (4-5),(6-7)	59.386	0.532	178	1275	2550	0.002429	0.00138	1102.35	313.191	89.1139	Ø 8C/C 80	157.85	Ø 8C/C 120
Ex. Pane b/n axis (9-10)	34.073	0.324	178	1275	2550	0.00138	0.00138	626.382	313.191	89.1139	Ø 8C/C 8	157.85	Ø 8C/C 120
STRIP THREE													
In. Pane b/n axis (1-2)	64.290	0.523	178	1275	2550	0.002637	0.00138	1196.945	313.191	155.3726	Ø 8C/C 100	157.85	Ø 8C/C 120
Ex. Pane b/n axis (9-10)	34.07	0.3052	178	1275	2550	0.00138	0.00138	626.382	313.191	89.1139	Ø 8C/C 80	157.85	Ø 8C/C 120
In. Pane b/n axis (1-2)	65.09	0.5583	178	1275	2550	0.002671	0.00138	1212.432	313.191	79.1139	Ø 8C/C 70	157.85	Ø 8C/C 120
STRIP FIVE													
In. Pane b/n axis (1-2)	65.09	0.5583	178	1275	2550	0.002671	0.00138	1212.432	313.191	192.416	Ø 8C/C 100	157.85	Ø 8C/C 120
STRIP SIX													
In. Pane b/n axis (1-2)	27.73	0.248	178	1275	1275	0.002263	0.00138	513.519	313.191	192.416	Ø 8C/C 100	157.85	Ø 8C/C 120

Table 77 Longitudinal Edge reinforcement bar for 1st floor

Vertical negative reinforcement bar

Location	Negative moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (A-B),(B-C)& (D-E)	55.665	9.278	178	1322	1322	0.00138	0.00138	324.7361	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
In. Pane b/n axis (E-F)	41.895	6.953	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP TWO													
In. Pane b/n axis (A-B),(B-C)& (C-D)	93.62	16.85	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
In. Pane b/n axis (E-F)	97.82	18.14	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
In. Pane b/n axis (A-B)	107.13	17.855	178	1322	2550	0.00138	0.00138	626.382	324.7361	89.5734	Ø 8C/C 80	151.5734	Ø 8C/C 120
In. Pane b/n axis (B-C),(C-D)&	91.82	15.3	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
STRIP FIVE &SIX													

In. Pane b/n axis(BC)	45.915	7.652	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
	STRIP EIGNT												
In. Pane b/n axis (A-B),(B-C)& C-D)	81.56	6.782	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
	STRIP NINE												
In. Pane b/n axis (A-B),(B-C)& (C-D)	71.295	11.883	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120
	STRIP TEN												
In. Pane b/n axis (A-B),(B-C)& (C-D)	41.59	6.93	178	1322	2550	0.00138	0.00138	626.382	324.7361	98.5734	Ø 8C/C 90	151.5734	Ø 8C/C 120

Table 78 Vertical negative reinforcement bar for 1st floor

Vertical positive reinforcement bar

Location	positive moment		Depth	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (A-B),(B-C)& (D-E)	31.809	10.603	178	1322	1322	0.00138	0.00138	324.7361	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120

In. Pane b/n axis (E-F)	23.04	7.68	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	138.78	Ø 8C/C 120
STRIP TWO													
In. Pane b/n axis (A-B), (B-C)& (C-D)	37.45	12.48	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	158.78	Ø 8C/C 120
In. Pane b/n axis (E-F)	27.126	9.042	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP THREE, SEVEN													
In. Pane b/n axis (A-B)	63.015	13.128	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	158.78	Ø 8C/C 120
In. Pane b/n axis (B-C),(C-D)&	36.73	12.243	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.98	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP FIVE &SIX													
In. Pane b/n axis (B-C),(C-D)&	18.36	6.12	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP FIVE &SIX													
In. Pane b/n axis (A-B),(B-C)& C-D)	32.63	10.88	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP NINE													

In. Pane b/n axis (A-B),(B-C)& (C-D)	28.518	9.506	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120
STRIP TEN													
In. Pane b/n axis (A-B),(B-C)& (C-D)	23.77	7.922	178	1322	2550	0.00138	0.00138	626.382	24.7361	100.78	Ø 8C/C 100	158.78	Ø 8C/C 120

Table 79 Vertical positive reinforcement bar for 1st floor

Vertical edge reinforcement bar

Location	At Edge moment		D	b Half mid strip	b Column strip	ρ Column strip	ρ Half mid strip	As Column strip	As Half mid strip	Space at Column strip	Provided	Space at Half mid strip	Provided
	Column strip	Half mid strip											
STRIP ONE													
In. Pane b/n axis (A-B),(B-C),(D-	31.24	0.208	178	1275	1275	0.001462	0.00138	331.7677	313.191	141.6795	Ø 8C/C 140	196.5734	Ø 8C/C 150
In. Pane b/n axis (E-F)	22.63	0.203	178	1275	1275	0.001395	0.00138	316.6395	313.191	139.0929	Ø 8C/C 100	196.5734	Ø 8C/C 150
STRIP THREE &SEVEN													
In. Pane b/n axis (A-B)	18.09	0.583	178	1275	1275	0.005574	0.00138	1265.106	313.191	86.21382	Ø 8C/C 80	196.5734	Ø 8C/C 150
STRIP TEN													

In. Pane b/n axis (A-B),(B-C)&(C-D)	19.09	0.583	178	1275	1275	0.002292	0.00138	520.162	313.191	87.21382	ø 8C/C 80	196.5734	ø 8C/C 150

Table 80 Vertical edge reinforcement bar for 1st floor

Cantilever-

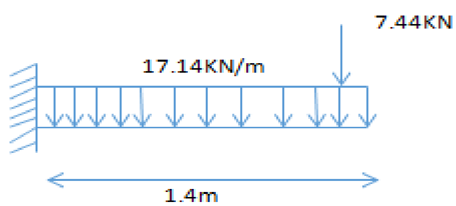
Loadings

- Dead load = load from partition + load from floor finish
  = 3.36+5.285
  = 8.645KN/m2
- Live load =4 KN/m2 for balconies
- Factored load =1.3D.l+1.6L.L
  =1.3*8.645+1.6*4
  =17.14KN/m2 there is also a load from external wall which act as concentrated

load on the strip.

Dead load from external wall = 2.69*2.76*1=7.42KN

There for the strip becomes like a cantilever beam fixed at one end.



$$Mxs=17.14*1.4^2/2+7.42*1.3=26.44$$

In the same way the moment calculation for other slabs is calculated in summarized in the following table.

Cantilever	Factor load	Short distance	External wall load	Mxs
1	17.143	1.4	7.42	26.44
2	14.02	1.88	-	24.88
3	15.86	1.46	-	16.9
4	16.4	1.94	-	30.86

5	13.27	1.28	7.42	19.62
6	15.26	1.86	-	26.4
7	16.78	1.4	7.42	26.08

Reinforcement bars for cantilevers

Mxs	B(mm)	depth(mm)	ρ	As calc	Spa. Calc	max S
26.211	1000	178	0.007224	866.8689	100.4003	ϕ12 c/c 120
26.44	1000	178	0.007726	927.0615	121.9337	ϕ12 c/c 120
24.88	1000	178	0.007224	866.8689	130.4003	ϕ12 c/c 120
16.9	1000	178	0.00476	571.1565	197.9142	ϕ12 c/c 190
30.86	1000	178	0.009187	1102.392	102.5406	ϕ12 c/c 100
19.62	1000	178	0.005582	669.7874	168.77	ϕ12 c/c 160
26.4	1000	178	0.007713	925.5075	122.1384	ϕ12 c/c 120
26.08	1000	178	0.005582	669.7874	172.77	ϕ12 c/c 170

CHAPTER FOUR

4.1 BEAM DESIGN

There are many beams in the building which need to be designed carefully. But due to shortage of time it is impossible to design all of the beams: so only representative beams have been designed. These are the representative beam along axis 2 between D&F in the exterior for the floor to 7thfloor.

On the other hand representative beam along axis B b/n A&F in the interior for the floor to 7thfloor the bending moment to the right and left of a support is different due to different load combination for each span. But during design only the governing moment is taken.

4.1.1 Design of beam in axis b between A and F

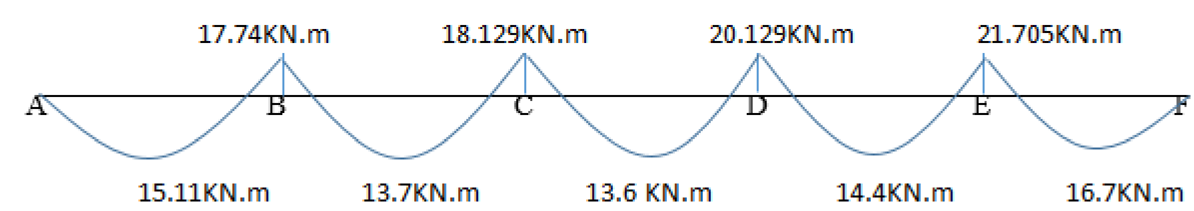
Design constant

Concrete C-25= f_{cu} unit weight -25, γc = 1.5

Steel – 360, class I work γs-1.15

- f_{cd}= 0.68*f_{cu}/1.5 = 11.33 MPa
- f_{ck} = 0.8 f_{cu} = 20 MPa
- f_{ctd} = 0.21 [f_{ck}^ (2/3)]/γ_c= 1.032 MPa
- f_{yd} = f_{yk}/ γ_s = 313.04 MPa
- m = f_{yd}/ [0.8f_{cd}] = 34.54
- C1=2.5/m = 0.072
- C2 = 0.32m^2*f_{cd} = 4325.38
- ρ_{max} = 0.75 ρ_b = 0.0145
- ρ_{min} = 0.6/ f_{yk} = 0.00167

BMD



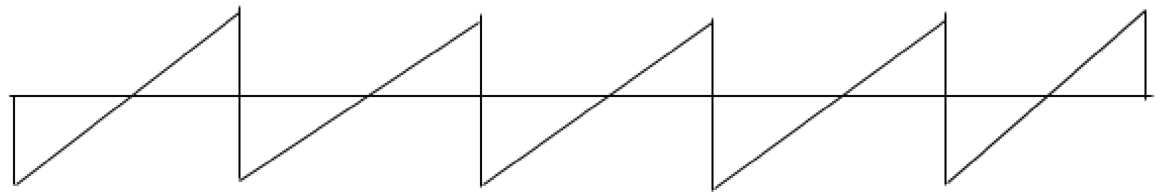


Figure 19 Analyzing and Modelling of Continuous Beams

Initial size of interior beam =700mm*300mm

4.1.2 Check depth for flexure

$$dmin \geq \sqrt{\frac{Mmax}{0.8*fcd*b*\rho max*m(1-0.4\rho max*m)}}$$

$d \geq \sqrt{(24.4*10^6)/(0.8*11.33*700*0.0139*34.54(1-0.4*0.0139*34.54)}$ =255.35mm

d≤300m D= d + clear cover +Φstrup+Φm/2 Assume 16Φm reinforcement and 6Φ strup and c/c=25mm

D=256+25+6+10=297mm, therefore; use D=297mm ≤ D used =300mm

- ✓ Since the depth is safe for flexure
  d=300-25-6-8=261mm

4.1.3 Reinforcement calculation

<u>At the support A</u>

Mu=0.8bd^2fcd*ρmax*m (1-0.4ρmax*m)

=0.8x700x261^2 x11.33x0.0139x28.78 (1-0.4x0.0139x34.54) =28.114KNm>M max=24.4KNm

Since Mu>M max, the section is provided with single reinforcement.

ρ= [1-√(1-(2Mmax/bd^2fcd))]*fcd/fyd

= [1-√1-2*24.4*10^6/700*261^{2*}11.33]*11.33/313.04=0.0178434

Ast = **ρ**bd=0.0178434x700x261=1259.989mm^2

Number of bars=Ast/as=1875.53/ (π*20^2/4) =5.853

Use 6*Φ*20 bars

<u>At the span A-B</u>

M max=15.5KN.m<Mu =28.114KNm, the section is provided with single reinforcement.

ρ= [1-√(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-√1-2*15.5*10^6/700*261^{2*}11.33]*11.33/313.04=0.003926

Ast=**ρ**bd=0.003 926x700x261=717.28mm^2

as=π*Φ*^{2}/4=314.159mm^2

Number of bars=Ast/as=717.2936/ (314.159) =2.27

Use 3*Φ*20 bars

<u>At the support B</u>

M max=17.74KNm<Mu=28.114KNm, the section is provided with single reinforcement.

ρ= [1-√(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-√1-2*17.7*10^6/700*261^{2*}11.33]*11.33/313.04=0.00001127 < minimum

Used **ρ**=0.00139

Ast=**ρ**bd=0.00139x700x261=353.95mm^2

as=π*Φ*^{2}/4=314.159mm^2

Number of bars=Ast/as=353.95/ (314.159) =1.1266

Use 2*Φ*20 bars

<u>At the span B-C</u>

M max=13.7KNm<Mu=28.114KNm, the section is provided with single reinforcement.
ρ= [1-√(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-√1-2*18.06*10^6/700*261^{2*}11.33]*11.33/313.04=0.00235

Ast=**ρ**bd=0.00235x700x261=429.345 mm^2

as=π*Φ*^{2}/4=200.96mm^2

Number of bars=Ast/as=429.345/(200.96)=2.136

Use 3Φ16 bars

At the support C

M max=18.129KNm<Mu=28.114KNm, the section is provided with single reinforcement.

ρ= [1-$\sqrt{}$(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-$\sqrt{}$1-2*18.129*10^6/700*261^{2*}11.33]*11.33/313.04=0.00377

Ast=**ρ**bd=0.00377x700x261= 688.779mm^2

as =$\pi\Phi^2$/4=200.96mm^2

Number of bars=Ast/as=338.324/ (200.96) =3.427

Use 4Φ16 bars

At the span C-D

M max=14.4KNm<Mu=28.114KNm, the section is provided with single reinforcement.

ρ= [1-$\sqrt{}$(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-$\sqrt{}$1-2*14.4*10^6/700*261^{2*}11.33]*11.33/313.04 =0.00312

Ast=**ρ**bd=0.00312x700x261=570.024mm^2

as=$\pi\Phi^2$/4=200.96mm^2

Number of bars=Ast/as=570.024 / (200.96) = 2.836

Use 3Φ16 bars

At the support D

M max=20.792KNm<Mu=28.114KNm, the section is provided with single reinforcement.

ρ= [1-$\sqrt{}$(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-$\sqrt{}$1-2*51.123*10^6/250*359^{2*}11.33]*11.33/313.04 =0.00358

Ast=**ρ**bd=0.00358x700x261= 654.066mm^2

as=$\pi\Phi^2$/4=200.96mm^2

Number of bars=Ast/as=654.066 / (200.96) =3.255

Use 4Φ16 bars

At the span D-E

M max=16.27KN.m<Mu=2.114KNm, the section is provided with single reinforcement.

ρ= [1-√(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-√1-2*16.27*10^6/700*261^{2*}11.33]*11.33/313.04=0.002335

Ast=**ρ**bd=0.002335x700x261=426.6 mm^2

as = $\pi\Phi^2/4$=200.96mm^2

Number of bars=Ast/as=426.6 / (200.96) =2.112

Use 3Φ16 bars

At the support E

M max=20.58KNm<Mu=28.114KNm, the section is provided with single reinforcement.

ρ= [1-√(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-√1-2*102.8*10^6/250*359^{2*}11.33]*11.33/313.04=0.004727

Ast=**ρ**bd=0.004727x700x261=863.63mm^2

as = $\pi\Phi^2/4$=200.96mm^2

Number of bars=Ast/as=863.62 / (200.96) = 4.297

Use 5Φ16 bars

At the span E-F

M max=13.6KN.m<Mu=28.114KNm, the section is provided with single reinforcement.

ρ= [1-√(1-(2Mmax/bd^{2}fcd))]*fcd/fyd

= [1-√1-2*16.27*10^6/700*261^{2*}11.33]*11.33/313.04 =0.002135

Ast=**ρ**bd=0.002135x700x261=426.6 mm^2

as = $\pi\Phi^2/4$=200.96mm^2

Number of bars=Ast/as=426.6 / (200.96) =2.112

Use 3Φ16 bars

Note: - summarized the same procedure

7th floor beam Axis A.B, C and D (700mmx300mm) respectively

Type	moment(mpa)	ϱ	As	b	d	As	Remark	type of beam
support	40130000	0.004775	482.84	700	261	200.96	4ϕ16	single
Span	16600000	0.001908	192.99	700	261	200.96	2ϕ16	single
support	45480000	0.005458	551.8	700	261	200.96	6ϕ16	single
span	21140000	0.002448	247.34	700	261	200.96	2ϕ16	single
support	40900000	0.004873	492.69	700	261	200.96	4ϕ16	single
span	92110000	0.0120231	1215.5	700	261	200.96	7ϕ16	single
support	39230000	0.0046624	471.36	700	261	200.96	4ϕ16	single
span	137120000	0.0200462	2026.7	700	261	200.96	8ϕ16	Double
7th floor beam Axis E(700mmx300mm)								
support	81610000	0.010430	1054.5	700	261	200.96	7ϕ16	double
span	34240000	0.004038	408.31	700	261	200.96	3ϕ16	single
7th floor beam Axis F(700mmx300mm)								
support	137250000	0.0200734	2029.4	700	261	200.96	8ϕ16	double
span	91170000	0.0118773	1200.8	700	261	200.96	6ϕ16	double

Table 81 7th floor beam Axis A.B, C and D

7th floor beam Axis 1,2,3,4,5,6,7,8,9 and 10 (400mmx300mm) respectively

Type	moment(mpa)	ϱ	As	b	d	as	Remark	type of beam
support	137250000	0.0200734	2029.4	400	261	200.96	8ϕ16	double
Span	91170000	0.0118773	128.2	400	261	200.96	2ϕ16	single
support	77790000	0.0098701	997.87	400	261	200.96	3ϕ16	single
span	27000000	0.003151	318.56	400	261	200.96	3ϕ16	single

support	68410000	0.0085317	862.56	400	261	200.96	5ϕ16	single
support	65510000	0.0081282	821.76	400	261	200.96	5ϕ20	single
Span	47350000	0.0056993	276.19	400	261	200.96	3ϕ20	single
support	68710000	0.0085737	866.81	400	261	200.96	5ϕ20	single
Span	26780000	0.0031243	315.86	400	261	200.96	3ϕ20	single
support	133580000	0.0193184	953.1	400	261	200.96	5ϕ20	single
Span	94880000	0.0124568	259.4	400	261	200.96	3ϕ20	single
support	61480000	0.007575	465.83	400	261	200.96	5ϕ20	single
Span	38630000	0.0045868	463.73	400	261	200.96	5ϕ20	single
support	78980000	0.0100437	1015.4	400	261	200.96	6ϕ20	single
Span	34170000	0.00403	407.43	400	261	200.96	3ϕ20	single
support	87500000	0.0113143	1143.9	400	261	200.96	5ϕ20	single
Span	27920000	0.0032627	329.86	400	261	200.96	3ϕ20	single

Table 82 7th floor beam Axis 1, 2, 3, 4, 5, 6,7,8,9 and 10

4.1.4 Design for shear reinforcement

- The design shear force, Vsd is obtained from the analysis result.
- shear capacity of the concrete

Vc = 0.25fctdk1k2bwd

where
k1=(1+50**ρ**)=<2.0,
ρ=Ast/bd
k2=1.6-d>=1.0

Vs =Vsd-Vc=2*Av*d*fyd/s,

S=2*Av*d*fyd/Vs, $S_{max} \leq 0.5d$ and300, 0.5d=0.5*261=130.5

Use Smax=130mm

At the rignt side of support A

Vsd=27.99KN

ρ = Ast/bd =1875.53/700*261=0.01026

K1 = 1+50*0.01026=1.513<2.....ok

K2 = 1.6-0.261=1.339 > 1……..ok

Vc= 0.25fctdk1k2bwd=0.25*1.03*1.513*1.339*700*261=9.53KN
Vs=27.99-9.53=18.46KN

Use Φ8 shear reinforcement, Av=$\pi\Phi^2/4=\pi*8^2/4=50.265mm^2$

S=2Avdfyd/Vs=2*50.265*0.261*260.87/18.46=121.5mm<Smax …ok
Use Φ8c/c120mm

<u>At the left side of support c</u>

Vsd=19.75KN

ρ=Ast/bd=338.324/700*261=0.00513

K1=1+50*0.00513=1.265<2.....ok

K2=1.6-0.261=1.339>1……..ok

Vc = 0.25fctdk1k2bwd=0.25*1.03*1.339*1.2565*700*261=11.789KN
Vs=19.75-11.789=7.961KN

Use Φ8 shear reinforcement, Av=$\pi\Phi^2/4=\pi*8^2/4=50.265mm^2$

S=2Avdfyd/Vs=2*50.265*0.261*260.87/11.55=19.22mm
Use Φ8c/c180mm

All shear force is below 27.99KN. Therefore use on 1/3rd is 120mm and the middle is 180mm

G+5 reinforcement for beam

The same process of the above on procedure

5th floor beam Axis A, B, C and D (700mmx300mm)

Type	moment(mpa)	ϱ	As	b	d	As	Remark	type of beam
support	4013000	0.00477	482.84	700	261	200.96	4ϕ16	single
Span	16600000	0.00190	192.99	700	261	200.96	2ϕ16	single
support	45480000	0.00545	551.8	700	261	200.96	6ϕ16	single
Span	35920000	0.0042	429.4	700	261	200.96	3ϕ16	single
support	58540000	0.0072	725.6	700	261	200.96	5ϕ16	single
Span	6520000	0.0017	168.8	700	261	200.96	2ϕ16	single
support	18030000	0.0021	510	700	261	200.96	5ϕ16	single
Span	28290000	0.0033	334.4	700	261	200.96	3ϕ16	single

Table 83 5th floor beam Axis A, B, C and D

1st - 4th floor beam Axis 1, 2,3,4,5 and 6 (400mmx300mm)

Type	Moment Mpa	ϱ	As	b	d	As	Remark	Type of beam
support	50820000	0.0062	621.9	400	261	200.96	5ϕ16	single
Span	90430000	0.0118	289	400	261	200.96	2ϕ16	single
support	57930000	0.0071	717.3	400	261	200.96	5ϕ16	single
Span	16750000	0.0019	194.8	400	261	200.96	2ϕ16	single
support	2530000	0.0017	368.8	400	261	200.96	4ϕ16	single
Span	44760000	0.0054	242.4	400	261	200.96	2ϕ16	single
support	73150000	0.0092	930.3	400	261	200.96	6ϕ16	single
Span	45910000	0.0055	257.4	400	261	200.96	2ϕ16	single
support	4730000	0.0017	568.8	400	261	200.96	5ϕ16	single
Span	10540000	0.0017	268.8	400	261	200.96	2ϕ16	single
support	16980000	0.002	597.5	400	261	200.96	5ϕ16	single
Span	25610000	0.003	301.6	400	261	200.96	2ϕ16	single

Table 84 1st - 4th floor beam Axis 1, 2,3,4,5 and 6

Shear force for beam

V_{sd}=34.58KN

ρ=Ast/bd=1321.78/700*261=0.01473

K1=1+50*0.01473=1.736<2.....ok

K2=1.6-0.261=1.339>1……..ok

Vc= 0.25fctdk1k2bwd=0.25*1.03*1.339*1.736*700*261=19.234KN

Vs=34.58-19.234 = 15.346KN

Use Φ8 shear reinforcement, $Av=\pi\Phi^2/4=\pi*8^2/4=50.265mm^2$

S=2Avdfyd/Vs=2*50.265*0.261*260.87/15.346=126mm

Use Φ8c/c120mm

APPENDIX

BREAK DOWN OF ANALYSIS

Analysis rate is the process of fixing cost per unit of measurement for the different item of works. Cost due to construction (constructer's cost) is given special attention here

Total cost per unit of work (TC) may be grouped into two components; direct cost direct cost and indirect cost. The direct cost (DC) includes cost due to labor, cost due to equipment, where the indirect cost covers overhead costs, and contractor's profit. Overhead costs are expenses for general office facility, rents taxes, electrical light, water, and other miscellaneous items.

To produce 1m3 concert following cost break down is done.

BILL OF QUANTITY PREPARATION AND TOTAL COST ESTIMATION FOR G+5

After calculation all the quantity of the structural to obtain the cost of material it is multiplied by the unit price

Flat slab cost estimation

NO	DECTIPTION OF WORK	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
1	Form work for 5th floor	m2	301.99	190	57377.91
2	Form work for 1st 4th floor	m2	1208	190	229511.64
3	Dia 10mm for 5th floor deformed	kg	10489	36.5	382857.625
4	Dia 8mm for 5th floor deformed	kg	10030	36.5	366107.775
5	Dia 10mm for 1st -4th floor bar	kg	49955	36.5	1823357.5
6	Dia 8mm for 1st -4th floor bar	kg	30121	36.5	1099431.1
7	Rcc slab for 5th floor slab	m3	54.033	2062	111416.046
8	Rcc slab for 1st 4th floor slab	m3	216.13	2062	445664.184
				Total	4515723.78

BILL OF QUANTITY PREPARATION AND TOTAL COST ESTIMATION FOR G+7

After calculation all the quantity of the structural to obtain the cost of material it is multiplied by the unit price.

For ribbed slab cost estimation

No	Description of work	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
1	Form work for slab floor 7th	M^2	854.99	190	162448.1
2	Form work for slab 2nd - 6th floor	M^2	4424.96	190	840742.4
3	Form work for slab 1st floor	M^2	843.849	190	160331.31
4	HCB for 7th floor	Pcs	634.5	450	28552.5
5	HCB for 2nd - 6th floor	Pcs	3266.7	450	147001.5
6	HCB for 1st floor	Pcs	633.8	450	28521
7	Dia12mmfor 7th floor deformed	Kg	5860.16	36.5	213895.84
8	Dia mm for 2nd- 6th floor deformed	Kg	29673.8	36.5	1083093.7
9	Dia 12mm for 1st floor deformed	Kg	5855.17	36.5	213713.705
10	Dia 6mm for 7th floor meshing	Kg	2094.46	36.5	76447.79
11	Dia 6mm for 2nd 6th floor meshing	Kg	10472.3	36.5	382238.95
12	Dia 6mm for 1st floor meshing	Kg	2082.58	36.5	76014.17
13	Dia 6mm for 7th floor u bar	Kg	1410.8	36.5	51494.2
14	Dia 6mm for 2nd 6th floor u bar	Kg	7050.78	36.5	257353.47
15	Dia 6mm for 1st floor u bar	kg	1408	36.5	51392
16	Beam for 7th floor bar	Kg	16895	36.5	616667.5
17	Beam for 2nd – 6th floor bar	Kg	84485	36.5	3083702.5
18	Beam for 1st floor bare	Kg	16897	36.5	616740.5
19	Beam for 7th floor strip	Kg	2720.36	36.5	99293.14
20	Beam for 2nd -6th floor strip	Kg	13601.78	36.5	496464.97
21	Beam for 1st floor strip	Kg	2720.36	36.5	99293.14
22	Concret for 7th floor	M^3	60.399	2062	124542.738
23	Concret for 2nd- 6th floor	M^3	61.065	2062	125916.03
24	Concert for 1st floor	M^3	60.41	2062	124565.42
				Total	8160426.573

For Flat slab cost estimation

No	DECTIPTION OF WORK	Unit	QUANTITY	UNIT PRICE	TOTAL P RICE
1	Formwork for slab floor 7th	m^2	855	190	162448.1
2	Formwork for slab floor 2nd - 6th	m^2	4425	190	840742.4
3	Formwork for slab floor 1st	m^2	843.8	190	160331.31
4	Dia10mm for 7th floor deformed	kg	8394	36.5	306374.795
5	Dia 8mm for 7th floor deformed	kg	8497	36.5	310134.295
6	Dia 12mm for 7th floor deformed cantilever	kg	269.5	36.5	9835.655
7	Dia 10mm for 2nd -6th floor deformed	kg	40269	36.5	1469823.975
8	Dia 8mm for 2nd -6th floor deformed	kg	41290	36.5	1507081.35
9	Dia 12mm for 2nd-6th floor deformed canti.	kg	1347	36.5	49178.275
10	Dia 10mm for 1st floor deformed	kg	8319	36.5	303637.295
11	Dia 8mm for 1st floor deformed	kg	8362	36.5	305211.175
12	Dia 12mm for 1st floor deformed cantilever	kg	257.6	36.5	9401.524
13	Concret for 7th floor	m^3	166	2062	343116.8
14	Concret for 2nd- 6th floor	m^3	849	2062	1751256.6
15	Concret for 1st floor	m^3	162	2062	333219.2
				Total	8861792.749

Table 85 Total cost estimation for G+5 and G+7 Buildings

CONCLUSION OF COST COMPARISON

Cost Comparison Conclusion among the two types of slabs:

The amount of concrete casted in the flat slab is much thicker than that of concrete casted in in the joists between hollow concrete block of ribbed slab.

But also the number of bars used in flat slab is much higher than that of ribbed slab.

As a result of materials listed above the cost of the flat slab is more expensive than ribbed slab design. However, the structure has good strength to resist the loads of the structure.

In both buildings, the cost of the flat slab is expensive than the ribbed slab. Since ribbed slab is economical than the flat slab, the building to be constructed by using ribbed slab type.

CONCLUSIONS AND RECOMMENDATIONS

a) Conclusion

- The design of slab analysis was made according to the provisions of EBCS-1, 1995.
- From the typical design 2^{ND}-6^{TH} floor and the other design for flexural moment of all ribbed slabs, the bars needed at span of each ribs is equal to two and for the support it depends on the length of the slab and the force applied to it but most often it need 1-2 reinforcing bar.
- Finally, in the design of high rise buildings care should be taken before analysis. Because there may be different unexpected loads and different structures like submerged beams which are necessary to improve the architectural feature of the building.

b) Recommendation

- It has been quite cumbersome to prepare a precise reinforcement detail; however, as it is essential to achieve a quality performance of a structure under the situation it has been designed for. The detailing has to be done seriously.

- Since the complexity of the structure and the number of structural elements are so many, the revision of the whole work is needed

- In calculating support and span moments and shear forces analyzing and modeling the structure we used SAP2000 by placing the span dead and live loads in different cases.

Reference:

- The Ethiopian Building Code of Standards [EBCS 1, EBCS 2, EBCS 8, 1995]
- ACI Code (RC Mechanics and Design 6th Edition, James G. Macgregor)
- Arthurh. Nilson, Design Concrete Structures, thirteenth edition
- Ashok .K. Jain, Reinforced Concrete Limit State Design