JEPPIAAR ENGINEERING COLLEGE

DEPARTMENT OF CIVIL ENGINEERING

CE8711- CREATIVE AND INNOVATIVE PROJECT

PLANNING AND DESIGNING OF SINGLE COLUMN INDUSTRIAL BUILDING

Batch members

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INTRODUCTION

- This project describes planning, structural analysis, design and drawings with various components and approximate cost of the whole building

- The approach block is conventional portal frame building and the square block is special mono column structure (the whole block is supported by single circular column at the center)

- It consist of staircase (Dog-legged), lift, dinningroom, rest room, verandah and toilet. Work spaces in an office are typically used for conventional office activities such as reading, writing and computer work.

- In addition to individual cubicles, there are also meeting rooms, lounges and space for support activities such as photocopying and filling.

- It consist of staircase (Dog-legged), lift, dinningroom, rest room, verandah and toilet.

MONO COLUMN

- For two storey buildings, column are fixed at the base, it means that restrained against rotation and translation, and normally carry a roof structure, providing partial restraint against rotation only.
- . The approach block is conventional portal frame building and the square block is special mono column structure (the whole block is supported by single square column at the center Approach block consists of Two floors).
- It is provided for vertical and horizontal movement between the floors

OBJECTIVE

- To Plan a G+2 Office building.
- To design the office building using normal framed structure.
- To design the office building supported on single column only.

NEED FOR STUDY

- In the modern world a person of the present era essentially needs scientific knowledge Mainly for earnings.

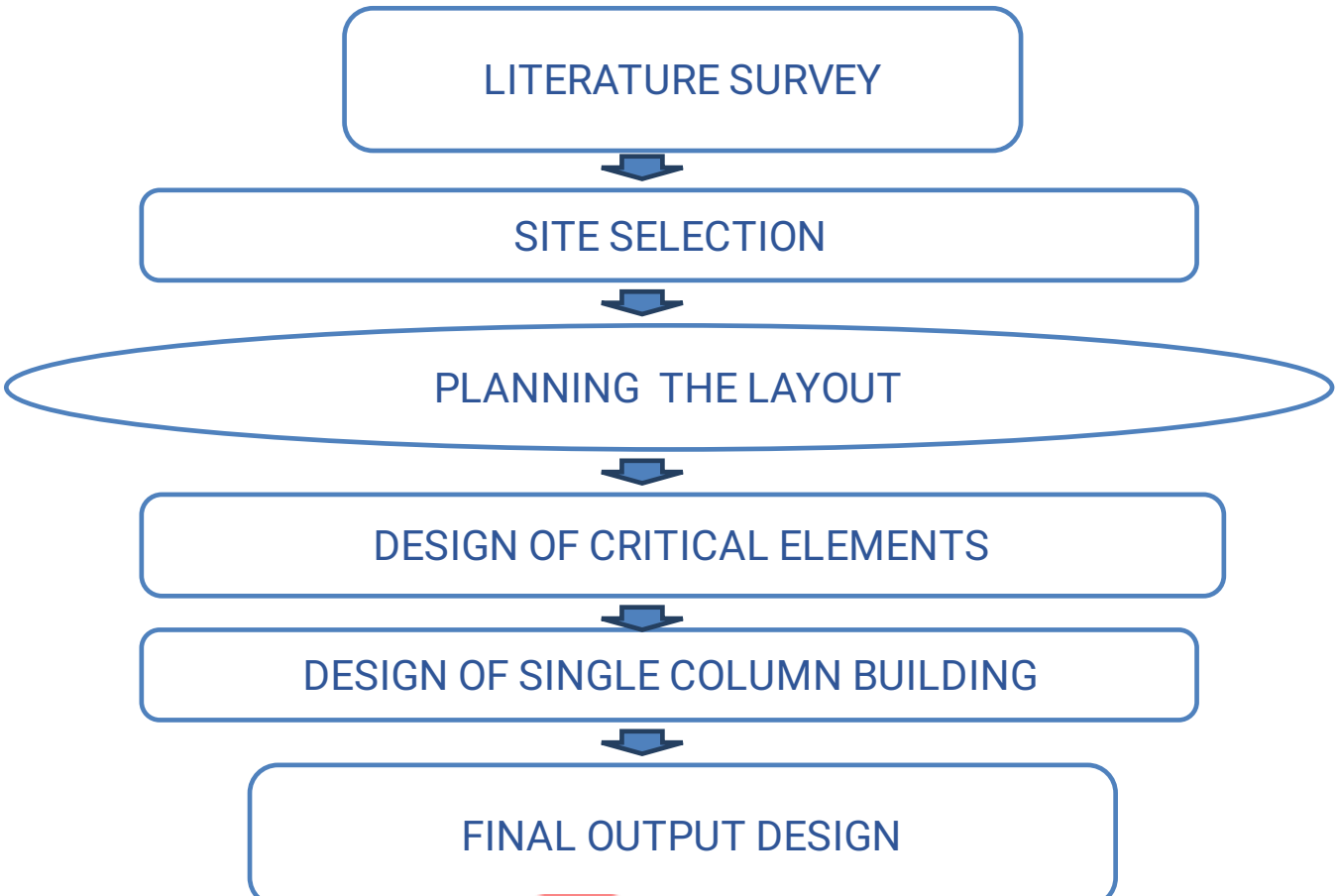
- For proper management of the entire organisation office building is very important. Since office work is done before the field work, office building should have a good environment to work efficiently.

- This office building fulfill all the requirements. The need of this project is to give high importance to the Engineers and other office clerks to do their work in a proper way.

LITERATURE	REVIEW
1. CAVAN (2002)	It described about cracking of the joint was identified as an important factor that affects the bond of reinforcing bars passing through the joint. it reduced in size or terminated entirely at intermediate heights is investigated.
2. Pantazopoulou(2001)	Includes an experimental and analytical study program to investigate the effect of slab participation in seismic design. it is generally considered acceptable to base member stiffness on the uncracked section properties and to ignore the stiffness contribution of longitudinal reinforcement.

3 . Ruaumoko(1998)	On high-rise RC bearing-wall structures with three types of irregularity at the bottom stories. It is one of the important to carry out analysis for two or three frame structure
4 . Shao-Yeh(1976)	Includes an experimental and analytical study program to investigate the inelastic behavior of critical regions that may develop in a beam near its connection with the column of a reinforced concrete ductile moment-resisting space frame when subjected to severe earthquake excitations. In this building, a series of cantilever beams, representing half-scale models of the lower storey of a ductile moment resisting reinforced concrete office building was designed according to ACI (318-71) code.
5 . Takeda(1970)	which allows for the changes in the stiffness of reinforced column as the axial force in the column changes. The commonly used concrete beam-column interaction surface is used to model the columns.

METHODOLOGY

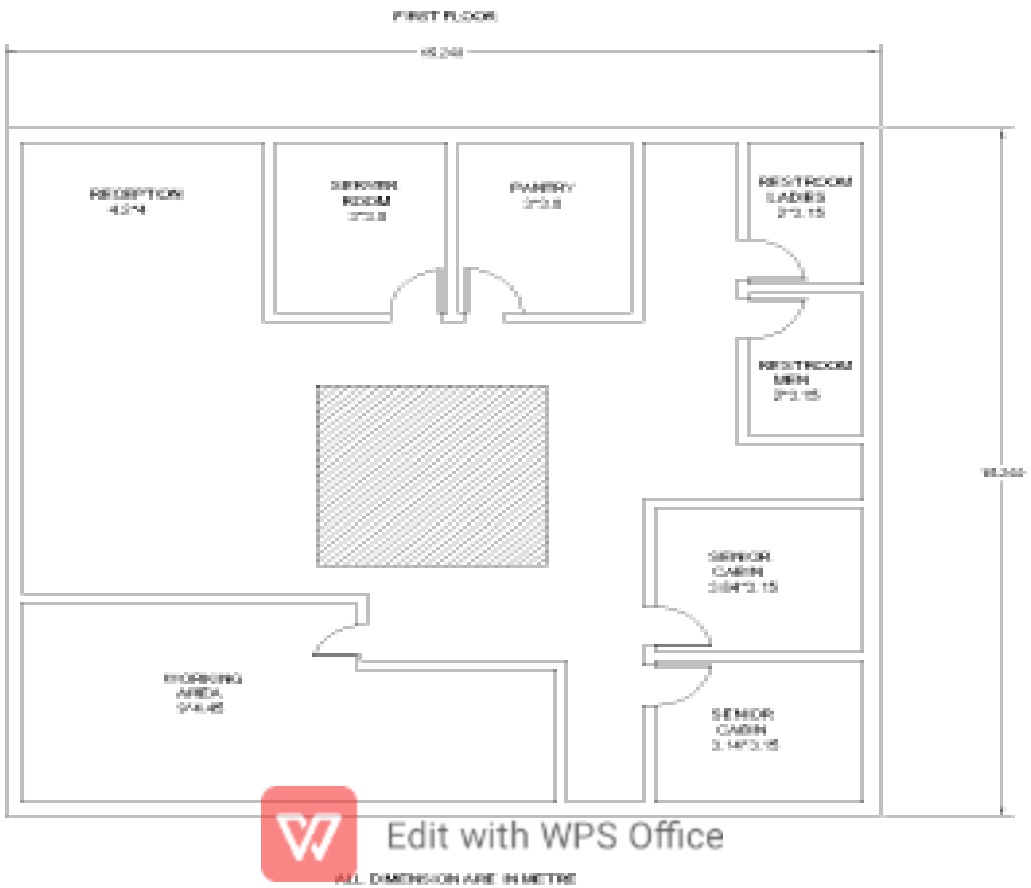


SOFTWARES USED

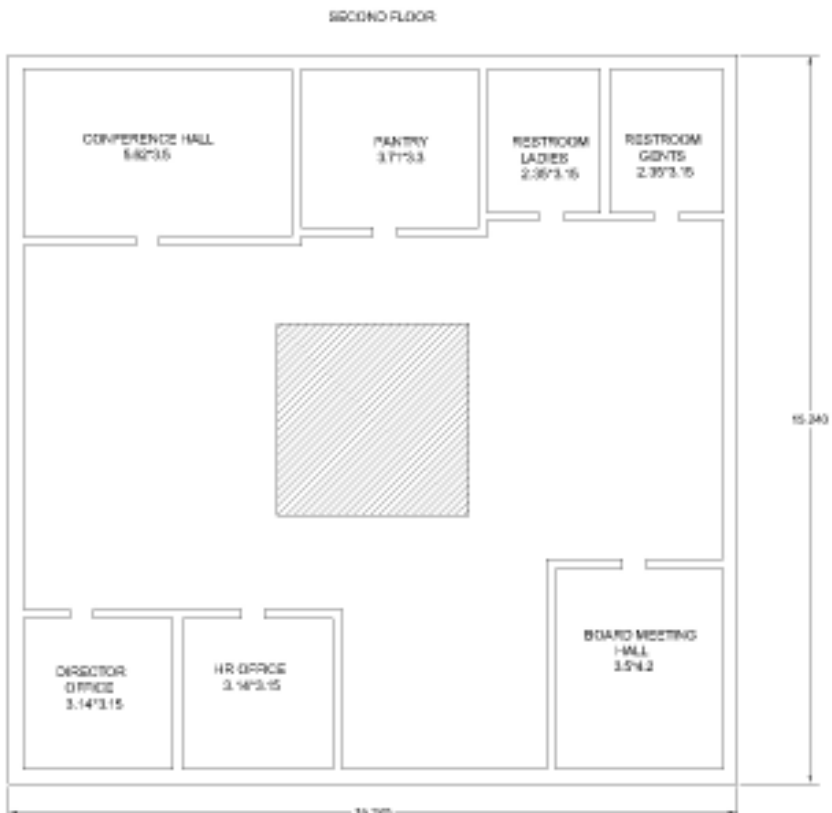
- Auto cadd (Version 2015)
- Staad pro (Version 2015 v8i)

PLANNING OF SINGLE COLUMN BUILDING BY AUTO CADD

PLAN OF FIRST FLOOR



PLAN OF SECOND FLOOR

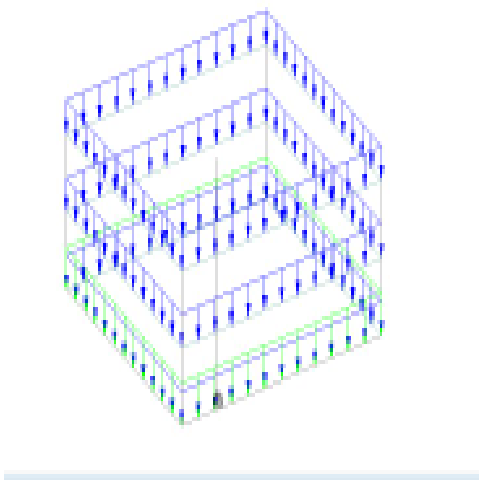


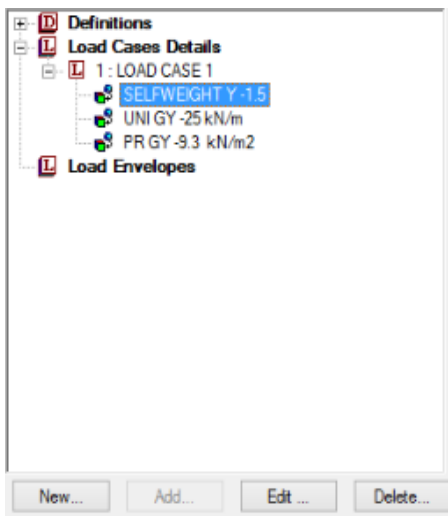
DESIGNING OF SINGLE COLUMN BUILDING BY STAAD PRO

LOAD AND DEFINITION FOR DEAD LOAD

➤Blue color indicates loading on the structure .

➤Green color indicates the structure.





LOAD AND DEFINITION ASSIGNED FOR THE BUILDING

LOADING DETAILS FROM STAAD PRO

LOADING 1 LOAD TYPE DEAD TITLE LOAD CASE 1

SELF WEIGHT Y -1.500

ACTUAL WEIGHT OF THE STRUCTURE = 16065.832 KN

MEMBER LOAD - UNIT - KN & METER

ELEMENT LOADING DETAILS FROM STAAD

- It shows the pressure details of some elements.

ELEMENT LOAD (UNITS ARE IN KN & METER)

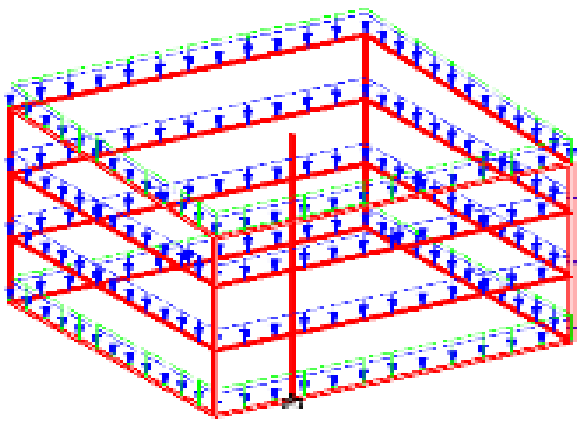
ELEMENT	PRESSURE
23	9.800000
25	9.800000
30	9.800000
32	-9.800000

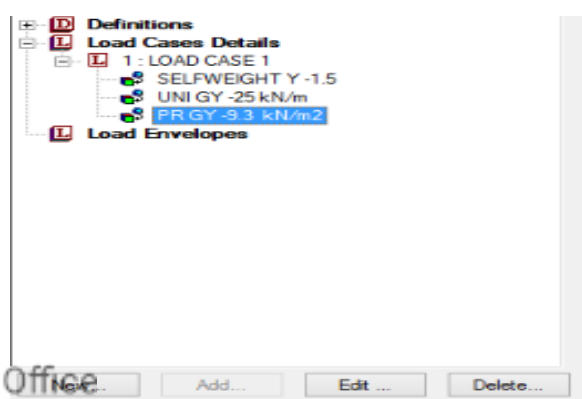
LOAD AND DEFINITION FOR PLATE LOAD

➤The figure shows the loading on the plate or slab.

➤Blue color indicates the plate load.

➤Red color indicates the structure.



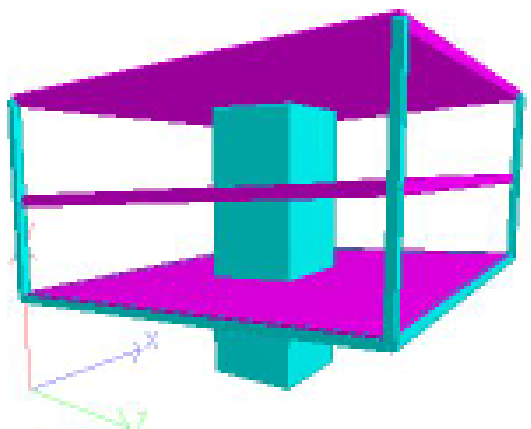


PLATES ARE ADOPTED FOR SINGLE COLUMN BUILDING

➤Rendered view of image for two floors including surface thickness and plate load.

➤Pink color represents the floor slab.

➤Blue color represents the beams and columns.



STRUCTURE DETAILS FROM STAAD

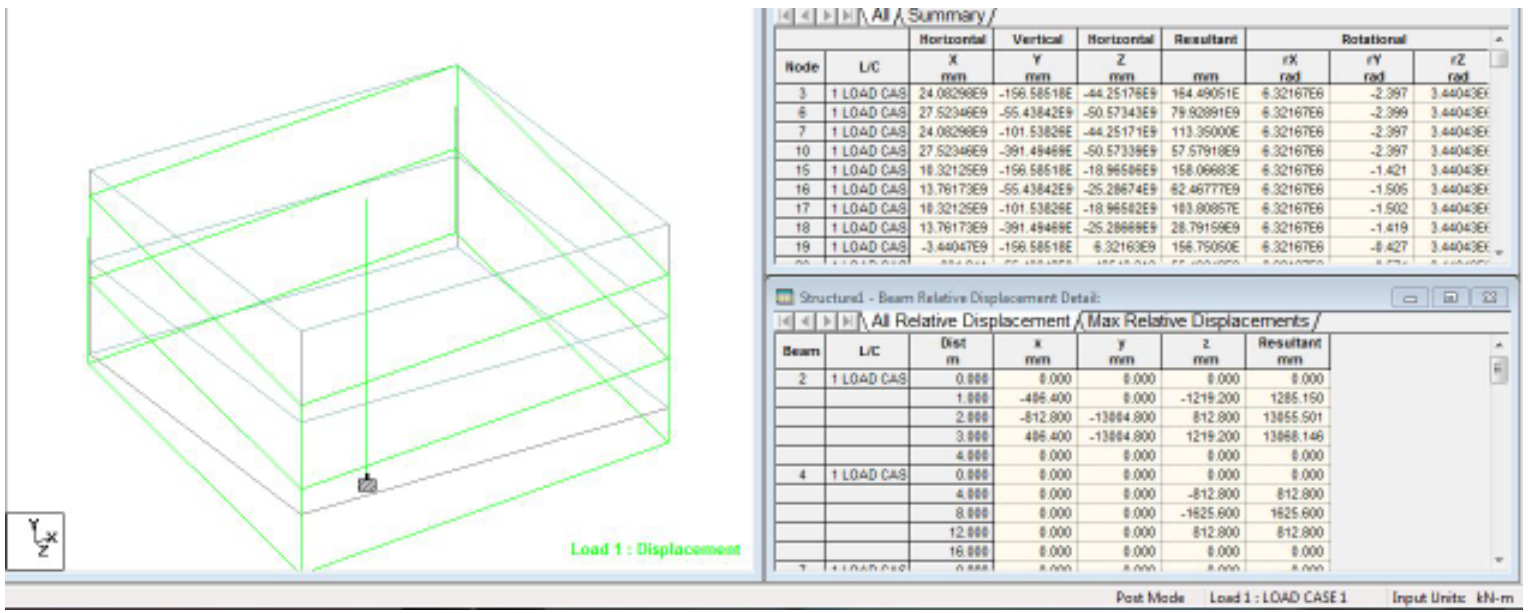
PROBLEM STATISTICS

NUMBER OF JOINTS - 18 ; NUMBER OF MEMBERS - 21

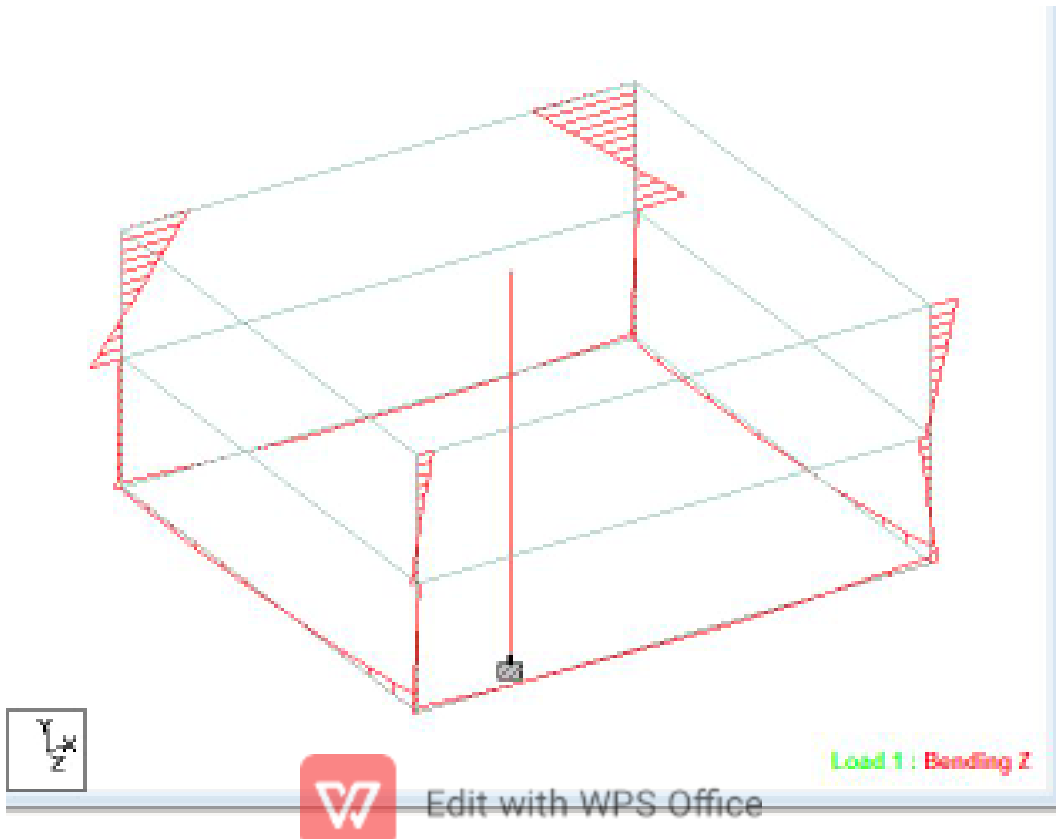
NUMBER OF PLATES - 4 ; NUMBER OF SOLIDS - 0

NUMBER OF SURFACES - 0 ; NUMBER OF SUPPORTS - 1

Shear Force and Bending Moment Values



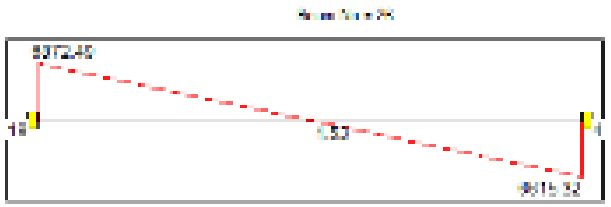
SHEAR FORCE DIAGRAM



SHEAR BENDING IN SINGLE BEAM

➤(a) shows the Shear bending diagram for beam no.26

➤Figure (b) shows the values of shear force and bending moment for various distances in a beam.



(a)

(b)

MANUAL CALCULATIONS

Design of two way slab

Slab size 15m x 15m

Condition: one short edge is discontinuous

Data:

Slab size = 15m x 15m

Live load = 4 kN/m

Floor finish = 0.6 kN/m

f = 20 N/mm

f = 415 N/mm

Thickness of slab:

Assume effective depth = 600mm

Assume 10 mm diameter and use 20 mm cover

Over all depth is 625mm.

Effective span = clear span + eff. Depth

= 15000 + 600

= 15600 mm

Loads

Self wt of slab = 15.625 kN/m

Live load = 4 kN/m

Floor finish = 0.6 kN/m

Total load = 20.225 kN/m

Factored load = 1.5 x 20.225

= 30.337 kN/m

Ultimate moments and shear force:

Short span co-efficient,

(-) ve moment co-eff . α = 0.056

(+) ve moment co-eff . α = 0.056

Long span co-efficient ,

(-) ve moment co-eff . α = 0.037

(+) ve moment co- eff . α = 0.028

M = αx L w

M= w

Here

M =413.437KNm

M=413.437KNm

V =0.5WL

=0.5x30.337x15.6

=236.628KN

Check for depth

$M = 0.138 f b d$

$8.73 \times 10 = 0.138 \times 20 \times 1000 \times d$

$d = 390$ mm

< 120 mm

Hence the depth is OK

Min .A = 0.12 % of bd

= 0.12 x 1000 x 120

= 144 mm

Tension Reinforcements

Shorter direction

$M = 0.87 FAst d$

$413.437 \times 10 = 0.87 \times 415 \times A \times 600$

$A = 2054.46$ mm

Spacing = (ast/Ast) x 1000

10mm diameter bar provided

Spacing = (ast/Ast) x 1000

10mm diameter bar provided

a =78.57mm

Spacing = 38 mm c/c.

Long Span Direction

Effective depth = 600-10 = 590mm

M = 0.87 f A d

A= 2095mm

Spacing = 37.49mm c/c

Check For Shear

T

= 236.628 x 10/(1000 x 600)

= 0.395 N/mm

= 0.34

Use IS-456,Interpolate T = 0.54 N/mm

Hence safe

Check For Deflection Control(L/d)

= 26 N/mm

Check For Crack Control

Reinforcement provided is more than the minimum percentage of 12%.

= 750 mm^2

Spacing of main reinforcement

= 3 x 600

= 1800 mm

Diameter of reinforcement < 78.125 mm.

Reinforcement In Edge Strips

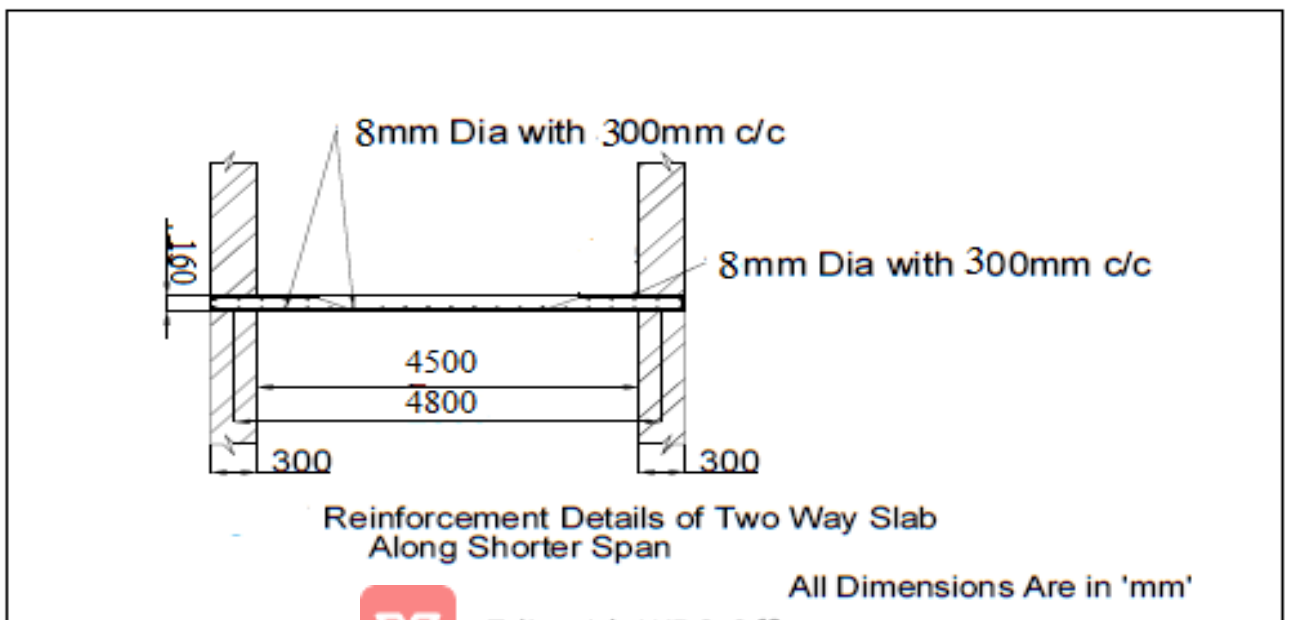
A_{st} = 0.12% bd

= x 1000 x 625

= 750 mm^2

Spacing = 104 mm c/c

Reinforcement Detail



Design of beam

DATA: Clear Span = 15m
Breadth = 230 mm
f = 20 N/mm
f = 415 N/mm

Cross Sectional Dimensions:-

Assuming the breadth as 230mm,
The effective depth (d) = 750 mm
Effective cover = 20 mm
Overall depth (D) = 250 mm
The effective span = clear span + the wall thickness = 15000 + 750= 15750 mm

Loads

Self weight of the beam = 0.3 x 0.8 x 25= 6 kN/m
Live load = 4 kN/m
Floor finish = 0.6 KN/m
Total Load = 10.6 kN/m
Ultimate load = 1.5 x 10.6 = 15.9 KN/m

Ultimate Moment And Shear

M = 447.18 kN.m

V = 119.251 kN

Reinforcement

M = 0.138 f b d

= 0.138 x 20 x 300 x 750

= 465.75 kNm

Since M< M .

Main Reinforcement

M = 0.87 f A d

447.18 x 10 =0.87 x 415 x A x 750

A = 2030 mm

Spacing = a/A x 1000

A = 490 mm

Spacing = 240 mm/cc.

Shear Reinforecement

T_v = 0.53 N/mm^2

$_t$ = 0.87

Use IS-456,Interpolate

T_c = 0.509

$T_c < T_v$

Hence safe

S_v = 228.25 mm.

Check For Deflection

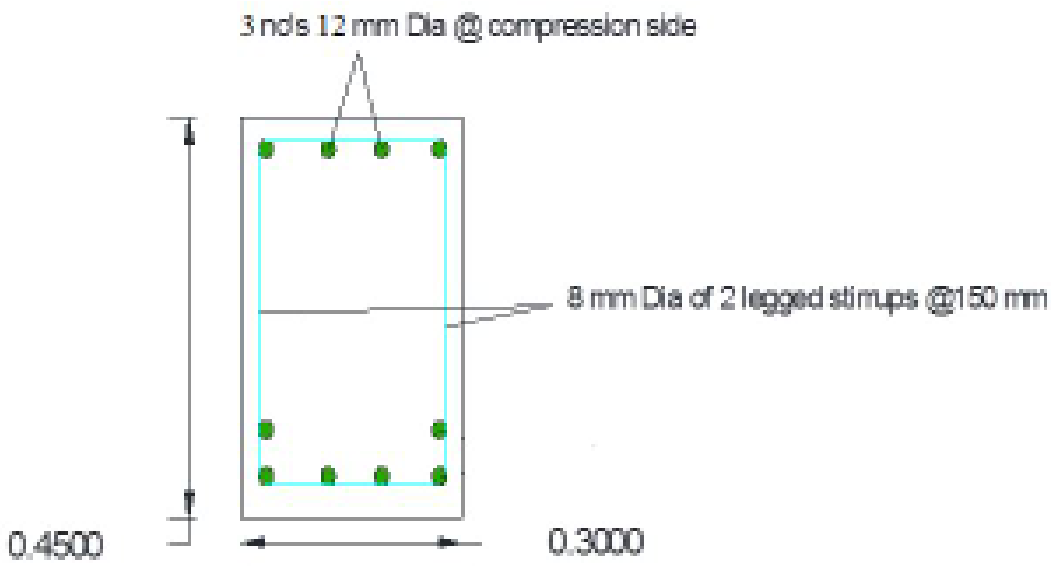
$_t$ = 0.90

K_t = 1.2 K_c = 1 K_f = 1

$_{max}$ = $_{basic}$ x K_t x K_f

= 26 x 1.2 x 1 x 1

= 31.2



Design Of Staircase(Dog-Legged Staircase)

DATA

Floor height = 3 m

Tread = 200 mm

Rise = 150 mm

No. of steps = 10 steps

Thickness of waist slab

= span /20

= 2.78/20 = 0.139m ≈ 140 mm **Effective span**

L = 2.78 m

Load Calculation

For one step = ½ x 25 x 0.2 x 0.15

= 0.375 kN /m

Dead load of one step for 1m = 1.875 kN / m

Assuming floor finishing = 0.6 kN/m

Dead load on sloping direction

W = (0.14x1x1)x 25

= 3.5 kN/m

Dead load of waist slab in the horizontal span

W = 4.37 kN/m

Live load = 5 kN/m

Total Load = 6.845 + 5

= 11.845 kN/m

Bending Moment & Shear Force Calculation

B.M at centre = WL/8

= (11.845 x 2.78) /8

= 11.44 kN/m

Shear force = WL/2

= (11.845x2.78)/2

= 16.46 kN

Factored B.M = 11.44 x 1.5 = 17.16 kN/m

Factored S.F = 16.46 x 1.5 = 24.69 kN

Calculation Of Effective Depth

$M = 0.138\ f\ b\ d$

$17.16 \times 10 = 0.138 \times 20 \times 1000 \times d$

$d = 78.8$ mm

Provide effective depth = 90 mm

Provide over all depth = 120 mm

Reinforcement Details

$M = 0.87\ f\ A\ d$

$17.16 \times 10 = 0.87 \times 415 \times A \times 90\ (1 - (415 \times A / 20 \times 1000 \times 90))$

$A = 615$mm

Provide 10 mm dia bars

spacing = $1000 \times a / A$ = 127 mm 130 mm c/c

Distribution Reinforcement

= 0.12 % of bD

= $(0.12/100) \times 1000 \times 120$ = 144 mm

Provide 8mm dia bars

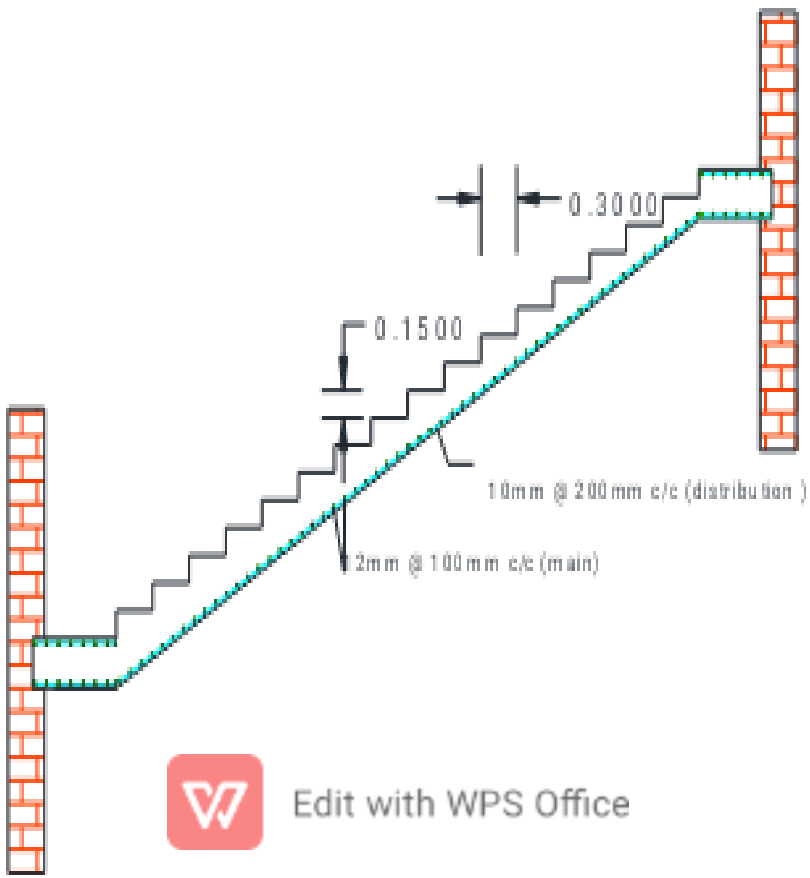
Spacing $= (1000 x a_{st})/A_{st}$

$=1000x(\pi x 8^2/4)/144$

$= 240mm\ c/c$

Main reinforcement 10 mm dia bar at 130 mm

Detail of Staircase



Conclusion

- The design and analysis of mono column building has been completed using STAAD Pro and verified using manual calculation. The results of the both metthods are in good agreement.
- A wealth of knowledge has been gained in planning, designing and detailing of an R.C. structure of mono column building has been acquired.

RESULT

➤ To plan and design a office building with a single column.

➤The project Office Building with Mono Column is analysed and designed with special attention and it is completed.

➤Maximum space utilisation is considered while planning .

➤This project is to give high importance to the Engineers and other office clerks to do their work in a proper way.

REFERENCE

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- SP 16:1980 As per clause 37, Code of practice for flexure moment of resistance.
- As per the code IS: 13920:1993 is considered very important as the ductile detailing gives the amount of reinforcement required and the alignment of bars.

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Thank you