https://doi.org/10.36375/prepare_u.iei.a157

FINITE ELEMENT ANALYSIS OF L-SHAPE BUILDING AND ITS SEISMIC BEHAVIOUR VARIATIONS IN E-TABS

Sonia B M, Dr. Vijayakumar Y.M.

Department of (Civil Engineering)
(Adichunchanagiri Institute of Technology)
(Chikkamagaluru, India-577102)

{Corresponding author's email: soniamgowda98@gmail.com}

Abstract - ETABS is the structural software which is mostly used to analyze steel and concrete structures, low and high rise buildings, portal frames and skyscraper structures. In this project we had studied structural behavior of L-shaped commercial multi-Storey building (college building) of G+5 on etabs. Here, structural analysis of the building was carried using equivalence static or linear static analysis method as per IS1893:2002. In this method the design base shear is computed for the whole building, and then it is distributed along the height of the building. This method defines that a series of forces acting on a structure to represent the effect of earthquake ground motion. In this project we had compared the result obtained from the etabs software with the manual calculations and concluded that the percentage of error between both the results or within the permissible limit. Here, the longer beam span shows more deflection so secondary beams can be considered to avoid more deflections. It shows that masonry infill walls will help in increasing the strength, stiffness and ductility of the structure.

Keywords - E-TABS, Stiffness, Ductility, Seismic Analysis, Workability, Finite Element Method.

INTRODUCTION

Structural analysis is a branch in which the effects of the different structural components on the order of prediction of the behavior of the structures. Every structure is made liable to one or both category of loads, the different load types are the permanent load, imposed load, seismic load and wind load. ETABS (extended 3D analysis of building systems) is a software that integrates all major static, dynamic, linear and non-linear analysis. The main intension of the software is to design multi-Storey buildings in the process of the system. The effectual design and assembling of earthquake-resistant structure are critical throughout the world.

Basically, buildings nowadays are of two types of building systems,

a) Load bearing masonry building
b) Framed buildings

❖ *Seismic zones:*

In 1984 the zone map was revised based on previous earthquakes and the characteristics of regional tectonic movements. The different shades of red color is coded in the below figure which shows the 4 distinct seismic zones.

i. Zone 2: Least active seismic zone
ii. Zone 3: Moderate seismic zone
iii. Zone 4: High seismic zone
iv. Zone 5: Highest seismic zone

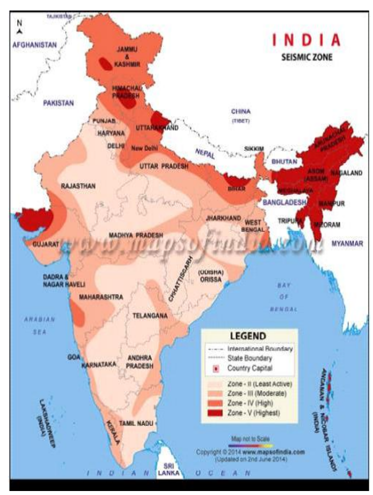


Fig.1: Seismic zone map as per year 1984

❖ *About wind zone in India:*

In India in the late 1990's, the wind was divided into 6 regions based on the wind speed.

Wind Speed:

i. Below 33m/s-low risk of damage
ii. 33-39m/s-medium risk of damage B

https://doi.org/10.36375/prepare_u.iei.a157

iii. Between 39-44m/s-medium risk of damage A
iv. 44-47m/s-high risk of damage
v. 47-50m/s-highest risk of damage
vi. Exceed 50m/s-very high-risk area

❖ *Objectives:*

- To understand the basic principles of the structural building configuration and its behavior in ETABS
- To carryout seismic behavior of the building and comparing it by annual calculations by IS 1893-2002
- To designing the structural components like beam, column and slab manually as per IS 456-2000
- To get comparative results of ETABS software with a manual method as per Indian codal provision

➢ Materials and Methods

The structural element design of the building should be confirmed and satisfied the following IS code for reinforced concrete design i.e., bureau of Indian standards, New Delhi.

This deals with computational materials used for analysis and finite element method which is employed for analysis using E-tabs software. Both seismic and wind Analysis will be done for various model's buildings.

❖ *Finite Element Method*

There is fundamental uncertainty in engineering issues. If found, you can predict the behavior of all structures. In a continuous process, these unknowns are endless. The finite element program reduces these infinites to finite numbers, divides the solution space into small portions called elements, and represents the domain of unknowing variables according to the approximate function used in each element.

❖ *Material Properties*

Table 1: Material Properties of Building

Sl no.	Description	Value
1	Grade of concrete for footings and columns	M30
2	Grade of concrete for slabs and beams	M25
3	Grade of steel	HYSD 415
4	Density of concrete	25 KN/m^3
5	Density of concrete block (0.3m thick)	5.295 KN/m^3

❖ *Building Specifications, Load application and Modelling*

Building Specifications:

Seismic and wind analysis for structures is investigated using E-TABS software.

Table 2: Geometrical Properties of Building

Sl No	Descriptions	Values
1	Typical storey height	3.6 m
2	No. of storey	G+5
3	Area of plan	3767.01 sq.m
4	Wall thickness	0.3 m
5	Size of Beam 1	300x500 mm
6	Size of Beam 2	300x400 mm
7	Slab thickness (S1)	150 mm

https://doi.org/10.36375/prepare_u.iei.a157

8	Slab thickness (S2)	170 mm
9	Dead Load 1	3.75 KN/m^2
10	Dead Load 2	4.75 KN/m^2
11	Live load 1	4 KN/m^2
12	Live load 2	3.5 KN/m^2

❖ *Load Application*

Seismic Details:

The Seismic details required to analyze the building are as given in the below table using IS:1893(Part 1)-2002.

Table 3: Seismic Details of the Building

SL.no	Description	Value
1	Seismic Zone	Zone II
2	Zone Factor	0.10
3	Response reduction Factor, R	SMRF-5
4	Type of Soil	Type II
5	Importance Factor	1.5

❖ *Wind Load Details*

The wind load details required to analyze the building are as given in the below table using IS:875(Part 3)-1987.

Table 4: Wind Load Details of the Building

Sl no	Description	Value
1	Wind Speed, V_b (m/s)	47
2	Terrain category	3
3	Structure class	A
4	Risk coefficient factor (K1)	1.07
5	Terrain & height factor (K2)	0.91
6	Topography (K3)	1.0

❖ *Different types of loads and their combinations considered:*

When designing and analyzing concrete structures, gravity and seismic loads must be considered. Since the membrane is used in the building, the membrane load is applied to the midpoint of the floor.

The types of loads considered in the analysis are explained below.

i. Dead load (IS 875: 1987 part-1)
ii. Imposed/Live load (IS 875: 1987 part-2)
iii. Wind load (IS 875: 1987 part-3)
iv. Seismic load (IS 1893(part-1): 2002)
v. Combination of loads (IS 875: 1987 part-5)

Hence the design is done for this load combination i.e, **1.5(DL+LL)**

❖ *Structural Analysis:*

https://doi.org/10.36375/prepare_u.iei.a157

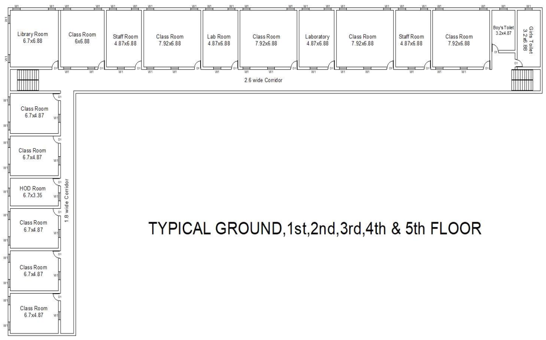


Figure 2: Typical Ground, 1^{st},2^{nd},3^{rd},4^{th} and 5^{th} Floor plan

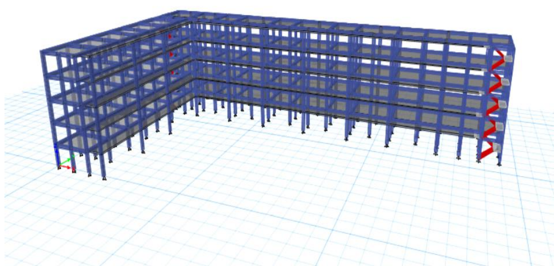


Figure 3: Extruded 3D view of a building

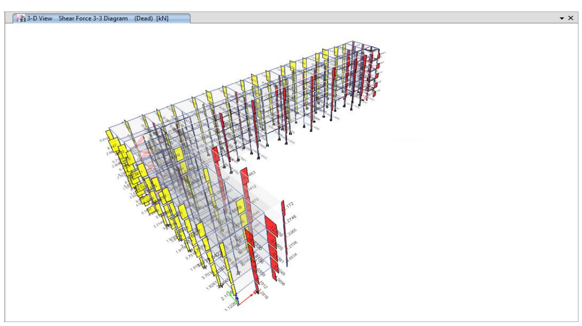


Figure 4: Shear Force Diagram

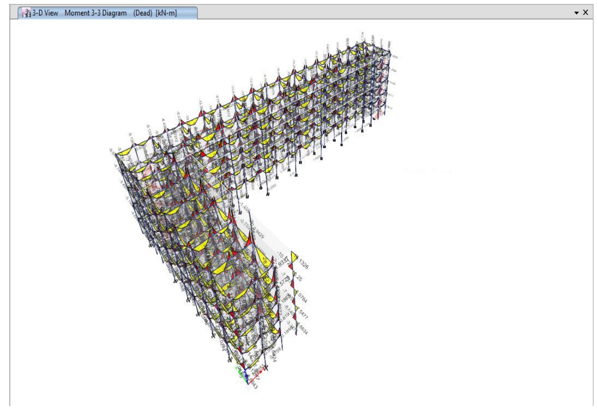


Figure 5: Bending Moment Diagram

❖ *Manual Calculation:*

❖ *Manual Calculations of beam, column, slab*

Methods of designing structure:

There are 3 methods for the design of reinforced concrete structures

1. Working stress method.
2. Ultimate load method.
3. Limit state method.

❖ *Design steps of column (300x500mm)*

Design Parameters:

1. Rebar percentage (Pt) = 0.8%
2. bxd= 300*500mm
3. f_{ck}=30 N/mm^2
4. f_y=415N/mm^2

A_{st}=(Pt*b*d)/100 = (0.8*300*500)/100 = 1200mm^2

Adopt 12mm dia bars

No. of bars = 1200/113.1 = 10.6

Take 12 no's Lateral ties

[A_{sv}/(300*S_v)] =[0.4/(0.87*f_y)]

Take 8mm dia bars

[(2*50.2)/(300*S_v)] = [0.4/ (0.87*415)]

S_v=302mm

https://doi.org/10.36375/prepare_u.iei.a157

Take S_v=300mm

Provide 2L 8mm dia @ 300mm c/c

❖ *Design steps of beam B1 (300x500mm)*

Design Parameters:

1. b*d= 300*500 mm
2. f_{ck}=25 N/mm^2
3. f_y= 415 N/mm^2
4. Clear span of beam = 3.25m
5. Width of support = 0.3m
6. Load factor = 1.5
7. Effective depth (d_{eff}) = 475 mm
8. Dead load = 3.75KN/m^2
9. Live load = 4 KN/m^2

Effective span = clear span + effective depth
= 3.25 + 0.475
l = 3.725m
Design ultimate load = 1.5(DL + LL)
W_u = 11.625 KN/m
Ultimate moment = 0.125xW_uxL^2
M_u = 20.16 KN-m
Shear force = 0.5xW_uxL
V_u = 21.65 KN

- To find Ast,

Mu = 0.87xf_yxAstxd_{eff} [1-Astxf_y/bxdxf_{ck}]
Ast = 302 mm^2
Ast_{min}= 0.85xbxd/fy
Ast_{min} = 291 mm^2
Ast > Ast_{min}
Ast $_{provided}$=π/4xΦ^{2}xn
n= 2.6=3
Therefore,
$Ast_{provided}$ = 339mm^2
Provide 12mm dia bars @ 300mm c/c

- Check for shear

Vu=Wuxl/2= (11.625*3.975)/2 =23.10 KN
$τ_{v}$= Vu/b*d_{eff}=23.10x10^3/(300x475) =0.28 N/ mm^2
Pt=100 Ast/ b*d=0.23
From table 19 of code IS-456
$τ_c$=0.30
$τ_v$ > $τ_c$

Hence safe
Hence provide 2L 8mm dia bars @ 150mm c/c.

❖ *Design steps of slab S1 (150mm)*

Design Parameters:

1. Room size = 6.88X7.92 m
2. Thickness of wall = 0.3m
3. Density of concrete = 25 KN/m^3
4. Thickness of slab = 150 mm

- Load Calculation

Self-weight = 0.15×25 = 3.75 KN/m^2

Live load = 4 KN/ m^2

Floor finish = 1 KN/ m^2

Total load = 8.75 KN/m^2

Factored load = 1.5 × 8.75 =13.125 KN/ m^2

- Calculation of moments

l_y/l_x = 7.92/6.88 = 1.1 < 2

Hence, design the slab as two-way slab.

Slab condition: Two Adjacent Edges Discontinuous.

$α_{x-ve}$ = 0.053 (From IS 456:2000, Pg91, Table26)

$α_{x+ve}$ = 0.040

$α_{y-ve}$ = 0.053

$α_{y+ve}$ = 0.040

Mux-ve=13.125x0.053x6.88^2 =32.9 KN-m

Mux+ve=13.125x0.040x6.88^2 =24.8 KN-m

Muy-ve=13.125x0.053x6.88^2 =32.9 KN-m

Muy+ve=13.125x0.040x6.88^2 =24.8KN-m

Mu_{max}= 32.9 KN-m

- Check for depth

Mu_{max} = Mu_{lim}

https://doi.org/10.36375/prepare_u.iei.a157

$32.9\times 10^6 = 0.138 \times f_{ck} \times b \times d^2$

$d_{reqd} = 97.6 < d_{prov}$ (150 mm)

Hence safe

- Calculation of reinforcement:

Main reinforcement:

M_u=32.9 KN-m

b=1000 mm

d=150 mm

k=Mu/bd^2 =32.9x10^6/(1000x150^2) =1.46
From SP 16, Pt=0.369%
A_{st} = 553.5 mm^2

Ast_{min}= (0.12/100) x1000x150=180mm^2

Take 8mm dia bars

Spacing= (50.25/180) x1000=279mm

Provide 8mm dia @ 260mm c/c

- Distribution reinforcement:

$A_{st} = (0.12 \times b \times d)/100 = (0.12 \times 1000 \times 150)/100$

A_{st} =180 mm^2

Provide 8mm dia @ 250mm c/c.

❖ *Equivalent static analysis method*

Manual design calculations of seismic parameters as per IS 1893-2002

Design Parameters:

1. Number of storey= G+5
2. Seismic Zone = Zone II
3. Zone Factor Z = 0.10 (Table 2 of IS: 1893)
4. Importance factor I = 1.5 (Table 6 of IS: 1893)
5. Response reduction factor R = 5 (Table 7 of IS: 1893 Part 1)
6. Structure type = SMRF (Special Moment Resisting Frame)
7. Type of Soil = II (Medium soil)
8. Column Size = 0.3 x 0.5m
9. Main Beam Size (B1) = 0.3 x 0.5m
10. Beam Size (B2) = 0.3 x 0.4m
11. Thickness of wall = 0.3m
12. Slab Thickness of Main Portion (S1) = 0.15m
13. Slab Thickness of Corridor (S2) = 0.17m
14. Floor to floor height =3.6m
15. Total Height of the structure =18m

Assuming Unit Weight of Concrete as 25 KN/m^3 and 20 KN/m^3 for masonry

Seismic Weights Calculations:

- Lateral Load Distribution with Height by the Static Method
  Q=Design Lateral Force at floor
  W= Seismic Weight of floor (KN)
  h= Height of floor measured from base (m)

N= Number of Storey in the building is the no. of levels at which masses are located

V_b=Design Base Shear (KN)

Table 5: lateral load distribution

Storey Level	W (KN)	h (m)	Wx h^{2}x1000	W h^2/ ∑ W h^2	Q =V_B x W h^2/ ∑ W h^2	Lateral Force q (KN)
5	11230	18	6.04	0.3	755.63	755.63
4	29140	14.4	5.63	0.28	705.26	1460.89
3	29140	10.8	4.39	0.21	528.94	1989.83
2	29140	7.2	2.51	0.12	302.25	2292.08
1	29140	3.6	1.51	0.0787	190.67	2482.75
			20.0			**8981**

https://doi.org/10.36375/prepare_u.iei.a157

			8			**.18**

❖ *Manual design calculations of wind load as per IS-875 (PART 3-1987)*

Design Wind Speed (Vz) = Vb x K_1 x K_2 X K_3

Where,

Vz = Design Wind Speed at any height in m/s

K_1 = Probability. factor (Risk Coefficient) (Cl.5.3.1)

K_2 = Terrain, Height and Structure. size factor (Cl 5.3.2)

K_3 = Topography. factor (Cl 5.3.3)

Design Parameters:

1. V_b = 47 m/s
2. K_1 = 1.07
3. K_2 = 0.91
4. K_3 = 1.0
5. Building Class= A
6. Terrain Category =3
7. Design life of structure = 50 years
8. Topography plane with upwind slope less than 3^{O}
9. Column Size = 0.3 x 0.5m
10. Main Beam Size (B1) = 0.3 x 0.5m
11. Beam Size (B2) = 0.3 x 0.4m
12. Thickness of wall = 0.3m
13. Slab Thickness of Main Portion (S1) = 0.15m
14. Slab Thickness of Corridor (S2) = 0.17m
15. Floor to floor height =3.6m
16. Total Height of the structure =18m

Table 6: Force at each storey level

Storey Number	Loading Level	Height of each storey	Design force (KN/m)	Force at each storey level (KN)
5	14.4-18	3.6	7.73	27.82
4	10.8-14.4	3.6	7.13	25.66
3	7.2-10.8	3.6	6.28	22.60
2	3.6-7.2	3.6	6.28	22.60
1	0-3.6	3.6	6.28	22.60

➢ Results and discussion

- *Comparative results between manual calculation and E-Tabs results*

a. Beam 1(Area of reinforcement and rebar percentage)

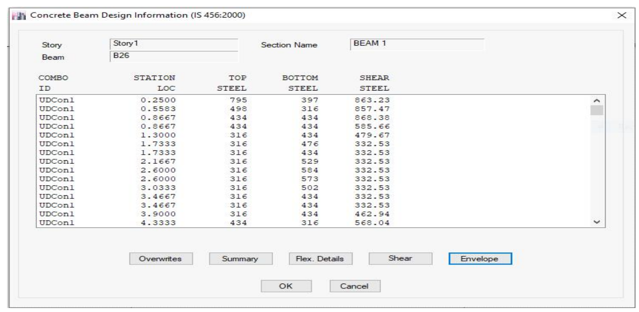


Figure 6: Concrete beam design of Beam 1 obtained after a Complete Analysis and design check

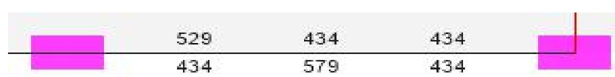


Figure 7: Longitudinal section of beam showing top and bottom steel reinforcement in mm^2

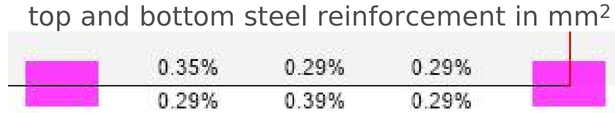
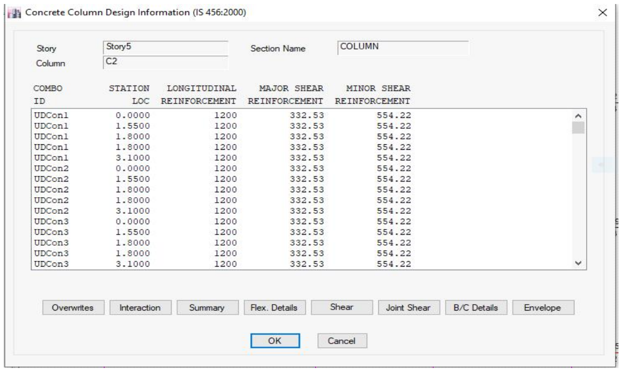


Figure 8: Longitudinal section of beam showing top and bottom rebar percentage (%)

From manual calculations of beam1 we have obtained A_{st} of 339mm^2 and rebar percentage of 0.23%. Similarly, from Etabs analysis results we have obtained A_{st} of 434mm^2 and rebar percentage of 0.29%. From above results we can conclude that area of steel reinforcement and rebar percentage make a difference of 3.83% so it's within the permissible limit and this parameter can be used in construction.

https://doi.org/10.36375/prepare_u.iei.a157

b. Comparison of manual calculations of Column with E-tabs (Area of reinforcement (mm^2))



Concrete Column Design Information (IS 456:2000)

Story: Story5 Section Name: COLUMN
Column: C2

COMBO ID	STATION LOC	LONGITUDINAL REINFORCEMENT	MAJOR SHEAR REINFORCEMENT	MINOR SHEAR REINFORCEMENT
UDCon1	0.0000	1200	332.53	554.22
UDCon1	1.5500	1200	332.53	554.22
UDCon1	1.8000	1200	332.53	554.22
UDCon1	1.8000	1200	332.53	554.22
UDCon1	3.1000	1200	332.53	554.22
UDCon2	0.0000	1200	332.53	554.22
UDCon2	1.5500	1200	332.53	554.22
UDCon2	1.8000	1200	332.53	554.22
UDCon2	1.8000	1200	332.53	554.22
UDCon2	3.1000	1200	332.53	554.22
UDCon3	0.0000	1200	332.53	554.22
UDCon3	1.5500	1200	332.53	554.22
UDCon3	1.8000	1200	332.53	554.22
UDCon3	1.8000	1200	332.53	554.22
UDCon3	3.1000	1200	332.53	554.22

Overwrites | Interaction | Summary | Flex. Details | Shear | Joint Shear | B/C Details | Envelope

OK | Cancel

Figure 9: Concrete Column Design obtained after a Complete Analysis and design check

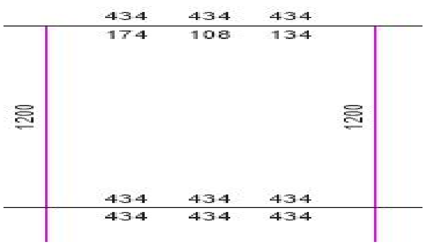


Figure 10: Elevation view of column showing steel reinforcement in mm^2

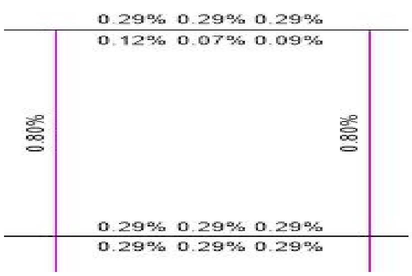


Figure 11: Elevation view of column showing rebar percentage (%)

From manual calculations of Column, we have obtained A_{st} of 1200mm^2 and rebar percentage of 0.8%. Similarly, from Etabs analysis results we have obtained A_{st} of 1200mm^2 and rebar percentage of 0.8%.

From the obtained results we can conclude that manual and software validation of column results are very approximate and thus it's a good indication of the work done and thus it showing a good steel reinforcement parameter which can be used in site for construction.

c. Comparison of manual calculations of Slab with E-tabs

i. Slab 150 mm

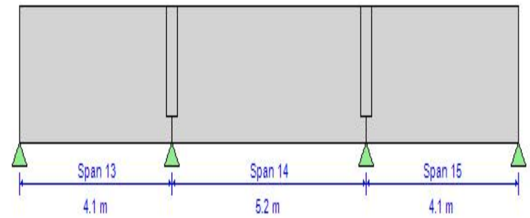


Figure 12: Continuous beam of longer span

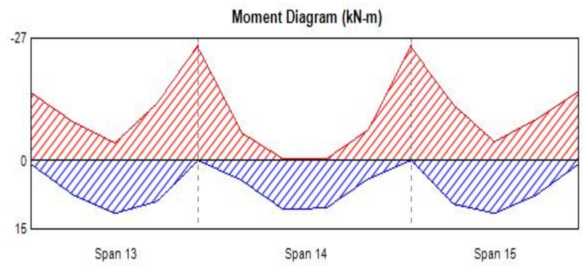


Figure 13: Moment diagram of longer span

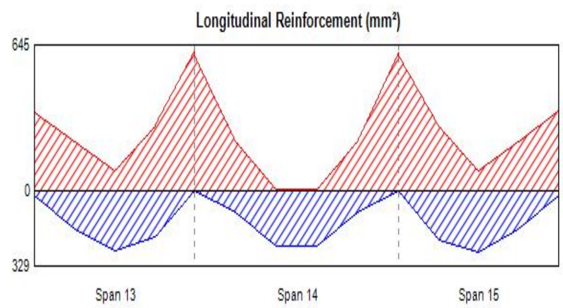


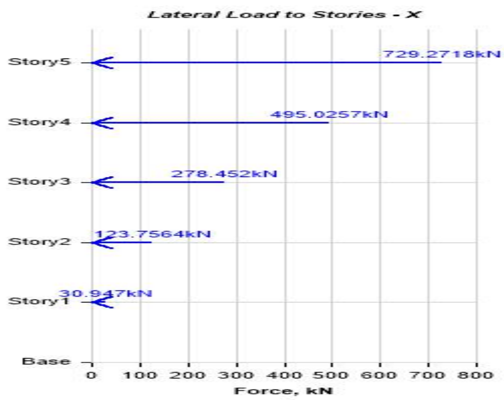
Figure 14: longitudinal reinforcement diagram of longer span

From manual calculations of Slab 1, we have obtained the slab condition as Two Adjacent Edges Discontinuous and got Mu_{max} values as 32.9KN-m and from above graph we can see that maximum moment is 27 KN-m and also the reinforcement as 553.5 mm^2 from manual calculation and 645mm^2 from E-tabs result. But when compare to manual method, E-tabs longitudinal reinforcement has increased due to the meshing provided and excess area of steel is observed here, since slab 1 is provided in class room sections as

https://doi.org/10.36375/prepare_u.iei.a157

two-way slab and different loads conditions are applied here so area of steel requirement is high here.

d. Comparison of manual calculations of Seismic with E-tabs



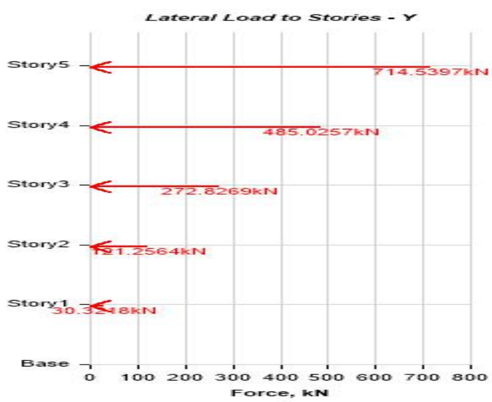


Figure 15: Lateral load results for seismic in E-tabs

From the above graph, we can conclude that there is a minor difference of lateral load values in both X and Y direction where the lateral load is increasing at higher most storey, the seismic weight obtained was W=103110.5099KN, where it includes the mass source of dead and wall load and live load of 50% is considered as the live load exceeds 3KN/m^2 and damping ratio of 5% is considered.

When comparing with manual calculation part the seismic weight obtained was W=156934.354 KN which included all the loads of dead slab, beam, column, walls, live loads and roof loads here damping ratio is not considered centre to centre beam and wall calculations are considered for better output.

The variation of lateral loads is observed at top most storey and for the better performance shear wall can be incubated and the difference with manual and software validation is within the permissible limit hence safe for the design.

❖ *Comparison of manual calculations of wind with E-tabs*

Table 7: Results of Force at each storey from wind analysis

Storey	**Elevation m**	**Force KN**
Storey5	18	41.3218
Storey4	14.4	41.3218
Storey3	10.8	37.6969
Storey2	7.2	36.9139
Storey1	3.6	22.0217
Base	0	0

Table 8: Force at each storey level calculated manually

Storey Number	Loading Level	Height of each Storey	Design force (KN/m)	Force at each storey level (KN)
5	14.4-18	3.6	7.73	27.82
4	10.8-14.4	3.6	7.13	25.66
3	7.2-10.8	3.6	6.28	22.60
2	3.6-7.2	3.6	6.28	22.60
1	0-3.6	3.6	6.28	22.60

Above table represents the results obtained from wind analysis as per the Indian IS-875(part-3)1987 Codal book the force is obtained for each and every storey individually there is no much difference in forces as we can observe the lateral forces at highest storey of 41.32KN at an elevation of 18m. In E-tabs analysis the building is considered as auto cladding as shell objects and wind pressure coefficient values is applied in different directions.

https://doi.org/10.36375/prepare_u.iei.a157

When these values are compared with manual calculation of wind parameters, we have obtained a value of lateral forces at highest elevation of 18m was 27.82KN that is nearly 30 KN by observing these values we can come to conclusion that coefficient with different frontal area is considered in manual calculation with variation in terrain category (K2).

Since the Seismic zone and wind speed is within the moderate condition, we can come to conclusion that its safe for the design.

- Explanation of graphical results obtained from E-tabs

- *Maximum Storey Displacement*

Storey Displacement is the maximum distance between one element (beam, frame, column) moved from its origin point. In simple words, Total Displacement of any Storey with respect to ground level may consider as Total Storey displacement.

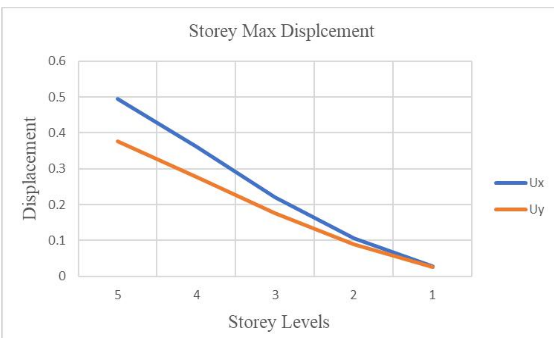


Figure 16: Graph representing the maximum Storey displacement in X and Y direction

Discussion about Max. Storey Displacement Graph

In. the graph it is observed that Displacement is increasing in positive values in both X and Y direction up to storey 5, from Graphical representation we can clearly observe that max displacement is occurring at X direction when compare to Y direction. The Max Displacement in both X and Y direction is very Nearer up to Storey 2, the displacement variation starts from storey 3, but has a maximum displacement of 0.48 m in X direction of storey 5. Since the Model is L-Shaped configuration to avoid max displacement, we can provide bracing types of either concrete or steel but it will become uneconomical for construction.

From the above graphical observation, it is found that it has Max displacement at higher most story of 3, 4, 5 in X direction.

- *Maximum Storey Drift*

It is the divergence between the displacement of the consecutive stories divided by the storey height and it is a unit less quantity.

Figure 17: Graph representing the maximum storey Drift in X and Y direction

Discussion about Max. Storey Drift Graph

In the graph it is noted that drift is increasing in positive values in both X and Y direction up to Storey 5, from Graphical representation we can clearly observe that maximum drift is occurring at X direction when compare to Y direction. The Maximum drift in both X and Y direction is very Nearer up to Storey 2, the drift variation starts from Storey 3, but has a maximum drift of 0.147m in X direction of Storey 5. The model is analyzed for static condition of earthquake and wind as per Indian standards.

From the above graphical observation, it is found that it has Max. drift at higher most storey of 3, 4, 5 in X and Y direction.

- *Maximum Storey Shear*

It is the graphs which shows the lateral load either due to wind or seismic parameters of a building per storey.

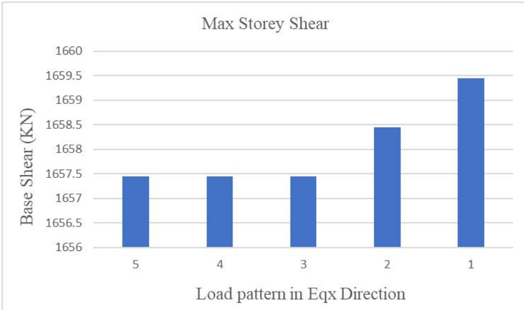


Figure 18: Graph representing the maximum storey shear in Eqx direction

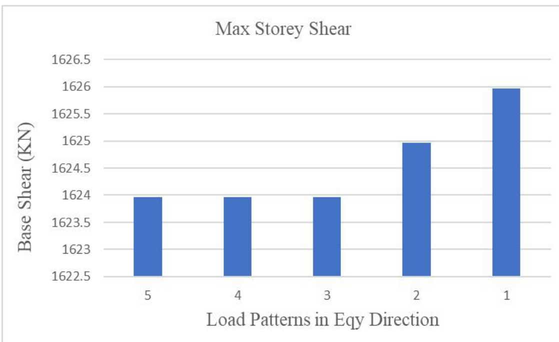


Figure 19: Graph representing the maximum storey shear in Eqy direction

Discussion about Max. Storey Shear Graph in Eqx and Eqy direction

The Maximum base shear is seen at storey 1 in both directions which indirectly reduces the displacement of the building and control the stiffness of the building.

- *Time Period*

Complete cycle of vibration taken to pass from one point to other point may simply called as Time period denoted by "T".

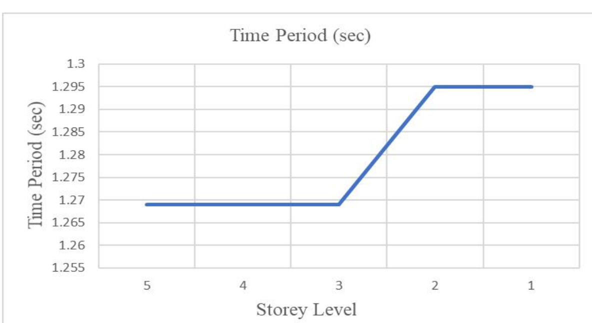


Figure 20: Graph representing the Time period (sec)

Discussion about Time Period (sec)

It is observed from the graphical table that when the time period increases the displacement will be more. The time period frequency is getting varied from storey 2 to storey 3 and decreasing frequency is occurring at storey 4 to storey 5. More the increase in time period more will be the displacement.

- *Diaphragm drifts*

It is a node entity which ties to the center of rigidity of a system with infinite in-plane stiffness. It is applied to roof or floor which transfers the lateral forces to a building and directly involves in seismic and wind parameter determination.

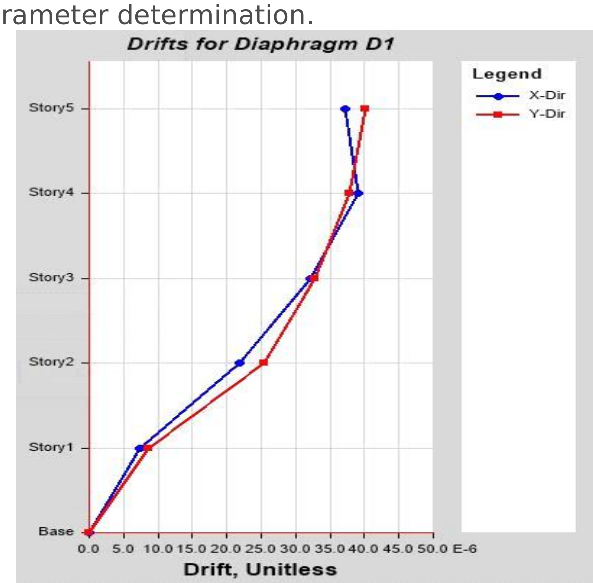


Figure 21: Graph representing the diaphragm drift

Discussion about Diaphragm drifts

It is Observed from the graphical table that diaphragm was kept rigid during the model analysis, this graphs also allow us to understand the variation occurring in both the direction x and y are unitless of negligible 0.E-6 which determines that drift in diaphragm is very smaller amount, where drift is unitless entity.

- *Over Turning Moment*

In Simple words, the uplift moment associated with column which provides axial loads can be considered as overturning moment.

https://doi.org/10.36375/prepare_u.iei.a157

Multiplication of sum of moments in column and distance from base of the column to base of the footing gives the overturning moment of a building.

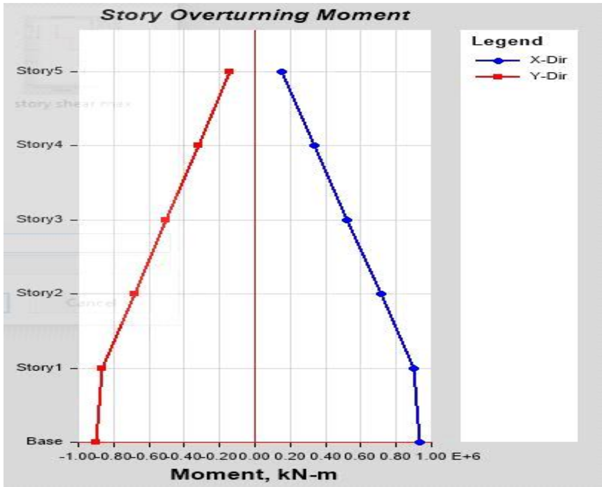


Figure 22: Graph representing the

overturning moment in x and y direction

Discussion about Over Turning Moment

It is Observed from the graphical table that overturning moment in x and y direction considered with uplift force occurring from column to footing and different axial loads.

Here we can consider the forces acting from the base to top of the level with different self-weights and loads of vertical members are very negligible in value of 0.E-5 of minimum values.

Conclusions

1. Maximum Displacement is observed at top stories of 4,5 and displacement is very similar up to Storey 2.
2. In longitudinal beam direction that is X direction the maximum displacement is seen and should be considered as important part while designing.
3. Maximum displacement is observed at higher stories of 4,5 to avoid the maximum displacement factor we can increase the beam depth and also the slab thickness.
4. Maximum drift is within the limit i.e., less than 0.36 hence the design is safe.
5. Lower Drift values indicates that the system has strength and stiffness parameter for life span of building.
6. The longer beam span shows more deflection so secondary beam can be consider to avoid more deflection.

Acknowledgment

I am sincerely thankful to my guide Dr. Vijaya Kumar Y.M., B.E,M.Tech,PhD, Associate Professor, Department of Civil Engineering, AIT, Chikkmagaluru-577102 for his consistent support and guidance all through this paper. I also thank all those who directly or indirectly assisted in the successful completion of paper.

References

[1] Prashanth P, Anshuman S, Pandey R K, Arpan Herbert "Comparison of design results of a Structure designed using STAAD and ETABS Software" 2(3), 869–875*. ICJSE,* 2012.
[2] Varalakshmi V,G shivakumar and R S Sarma (2014) "Designed and d G+5 residential building by ETABS", *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)* e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 73-77.
[3] Chandrashekar and Rajasekar (2015), "Analysis and Design of Multi Storied Building by Using ETABS Software", *International journals of scientific and research* vol.4: issue.7: ISSN no. 2277-8179.
[4] D.Ramya, A.V.S.Sai Kumar "Comparative Study on Design and Analysis of Multistoreyed builing " 4(10), 125– 130, *IJESRT*, Oct 2015.
[5] Arunkumar N pattar, Sunil kumar chavan, Muralidhar Raje, Prof.Vishwanath B Pati "Analysis and Design of Multi Storied Structural System with Wind Load Effects Using Staad Pro And E-Tabs'' June 2015 *IJIRT Volume* 2 Issue 1 ISSN: 2349-6002*.*
[6] Balaji U and Selvarasan (2016), "Design and Analysis of multi-storeyed building under static and dynamic loading conditions using ETABS", *International Journal of Technical Research and Applications* e-ISSN: 2320-8163, Volume 4, Issue 4, PP.
[7] Geethu S N, Depthi M, Abdul Nasir N A and Izzudeen K M (2016) "Comparative study on design and analysis of multi storied building by STAAD.Pro and ETABS software's". *International Research Journal of Engineering and Technology (IRJET)* Volume 4.
[8] Tejashree Kulkarni, Sachin Kulkarni, Anjum Algur , M. H. Kolhar "Analysis And Design Of High Rise Building Frame Using Staad Pro" *IJRET: International Journal of Research in Engineering and Technology* eISSN: 2319-1163 pISSN: 2321-7308.
[9] Aman, Manjunath Nalwadgi , Vishal T, Gajendra " Analysis and design of multistorey building by using STAAD Pro" *International Research Journal of Engineering and Technology (IRJET)* Volume: 03 Issue: 06 June-2016*.*
[10] Manikanta K V, Venkateswarlu D "Comparative Study on Design Results of A Multi-Storied Building Using Staad Pro And Etabs For Regular And Irregular Plan Configuration" 2(15), 204–215, *IJRSAE,* Sep 2016.
[11] Ali Kadhim Sallal "Design and analysis ten storied building using ETABS software-2016" *International*

Journal of Research in Advanced Engineering and Technology ISSN: 2455-0876.
[12] Isha Bedi, Girish Sharma, Abhishek Gupta "Comparative study of RCC Frame Structures using Staad Pro, Etabs and Sap" 167–175*, ICITSEM,* Sep 2017.
[13] Sayyed A.Ahad , Hashmi S Afzal , Pathan Tabrej , Shaikh Ammar , Shaikh Vikhar , Shivaji Bidve " Analysis and Design Of Multistory Apartment Building Using ETABS" *International Journal Of Engineering And Computer Science* ISSN:2319-7242 Volume 6 Issue 5 May 2017.
[14] K. Kiran Mai, Mohd Amer, Md. Shaibaz Ali, Mohammed Fazal Ahmed, Mohammed Omair , Aftab Tanveer " Analysis And Design of Residential Building C+G+7 using E-Tabs" *International Journals Of Innovative Technologies* ISSN 2321-8665 Volume.06, Issue.01.
[15] Sayyed Feroz Sikandar, Shaikh Zameeroddin. S, Prof. Agrawal. A. S "Analysis and Design of Multistory Building using ETABS 2017" *IJESC* Volume 9 Issue No. 6.

[16] K. Naga Sai Gopal, N. Lingeshwaran "Analysis and Design of G+5 Residential building by using E-Tabs*" International Journal of Civil Engineering and Technology (IJCIET)* Volume 8, Issue 4, April 2017.
[17] J.Omprakash , S.Tousif Ehtesham, C MD Faraaz, N.V.Nagaraju, Shaik Shabbir Basha, Shaik Riyaz " Analysis and Design of Commercial Building Using ETABS" *International Journal of Innovative Research in Science, Engineering and Technology* Vol. 7, Issue 3, March 2018.
[18] Chandrakala V B, Bindu K S, Chethan kishore R, Pramod S Shekar, Sharath M Y "Analysis and Design Of G+4 Commercial Building Using Etabs" June 2018 *IJSDR Volume* 3, Issue 6.
[19] Gurudath C , Arun Kumar Sah , Manoj Kumar Sah , Ram Babu Sharma , Ramesh Sah "Analysis and Design of Commercial Building Using ETABS" May 2019 *IJIRT* Volume 5, Issue 12 ISSN: 2349-6002.
[20] P. Guruswamy Goud, B. Anusha, B. Raghavendra, K. Shashipreetham, M. Sai Krishna "Analysis and Design of Hostel Building (G+4) Using Etabs" *International Journal of Engineering Applied Sciences and Technology,* 2020 Vol. 4, Issue 12, ISSN No. 2455-2143.