International Journal of Innovative Technologies
WWW.IJITECH.ORG
ISSN 2321-8665
Volume.06, Issue.01,
January-June, 2018,
Pages:0165-0169

Analysis And Design of Residential Building C+G+7 using E-Tabs

K. KIRAN MAI[1], MOHD AMER[2], MD. SHAIBAZ ALI[3], MOHAMMED FAZAL AHMED[4], MOHAMMED OMAIR[5], AFTAB TANVEER[6]
Dept of Civil Engineering, SVITS, Mahbubnagar, Telangana, India.

Abstract: The main steps of any building construction and planning is drafting, analysing and designing the building. In the present days of improving science and technology, analysing and designing of a building has been made easy by using ETABS software. ETABS software helps civil engineers to make their work easy and decreases time necessary for planning. The project going to be done is design of a multi-storey building which is going to be used as a residential. The building plan has been drafted using the AutoCAD software by the requirement and available area. The super structure i.e. the building frame has been analysed and designed using the ETABS software. In the present project C+G+7 building consider to analysis and design for both gravity and lateral (wind and earth quake) loads as per Indian standards. By using the software building can be analysed and we can check for any failures in the analysis and redesign them, so that we can prevent failures after construction. By using the output building can be constructed according to the design.

Keywords: Building, Wind and Earth Quake, ETABS.

I. INTRODUCTION

ETABS is the present day leading design software in the market. Many design company's use this software for their project design purpose. So, this paper mainly deals with the comparative analysis of the results obtained from the analysis of a multi storied building structure when analysed manually and using ETABS software**.** Structural response to earthquake depends on Dynamic characteristics of the structures and intensity, duration and frequency content of existing ground motion. Structural analysis means determination of the general shape and all the specific dimensions of a particular structure so that it perform the function for which it is created and will safely withstand the influences which will act on it throughout its useful life. The effective design and construction of a earthquake resistant structures have great importance all over the world. Geographical statistics of India show that almost 54% of the land is vulnerable to earthquakes. This project presents analysis and design if multi storied residential building using ETABS software with lateral loading effect of Earthquake. This project is designed as per INDIAN CODES-IS 1893-part2:2002, IS 456:2000. This analysis is carried out by considering severe seismic zones and behaviour is assessed by taking type-II Soil condition. In our project we are considering a plan under zone –IV**.** Seismic Intensity is Severe and Zone Factor is 0.24 at Panaji. The building is proposed to have Ordinary RC moment-resisting frame and the Response Reduction Factor(R) is 3.0

II. DESIGN EXAMPLE OF A SIX STORY BUILDING

In this paper, from the plinth to the certain height of the building the column size may differ that is it would be more when compared to the upper columns because to reduce the failure in the structure. The diaphragm is rigid. The main beams rest on the columns to avoid local eccentricity. Comparison of analysis and design of regular and irregular configuration of multi storied building in various seismic zones using ETABS software. The centre of mass is the unique point at the centre of a distribution of mass in space. The centre of mass is the mean location of a distribution of mass in space.

Seismic Analysis of Multi-storeyed Building: As this project deals with the most economical column method in this project we have design the structure in an economical way by reducing the sizes in the sections. As the load is more at the bottom when compared to the top floors, there is no need of providing large sizes at the top. Economizing the column by means of column orientation is longer span longer direction will reduce the amount of bending as a result there are of the steel is reduced.

III. DESCRIPTION OF THE STUDY MODEL

A. Project Details

1. Purpose of the building: residential
2. Shape of the building: regular (rectangular)
3. No. of stories: (C+G+7)
4. Type of wall: brick wall
5. Height of stories: 3m. (Similar stories)
6. Depth of foundation: 1.5m.
7. Area of plot: 350 m²
8. Plinth area: 310 m²

B. General Conditions of Area of Construction:

Area: Hyderabad
Soil type: Medium stiff
Zone: II
Zone factor: 0.10
Response Reduction Factor, R: 5.0 (SMRF)
A seven floor Residential building of symmetrical plan.

Table 1. Story Data

Name	Height mm	Elevation mm	Master Story	Similar To	Splice Story
TERRACE	3000	29000	No	STORY1	No
STORY7	3000	26000	No	STORY1	No
STORY6	3000	23000	No	STORY1	No
STORY5	3000	20000	No	STORY1	No
STORY4	3000	17000	No	STORY1	No
STORY3	3000	14000	No	STORY1	No
STORY2	3000	11000	No	STORY1	No
STORY1	3000	8000	Yes	None	No
GF	3000	5000	No	None	No
CELLAR	2000	2000	No	None	No
BASE	0	0	No	None	No

Table 2. Grid Systems

Name	Type	Story Range	X Origin m	Y Origin m	Rotation deg	Bubble Size mm	Color
G1	Cartesian	Default	0	0	0	1250	ffa0a0a0

Table3. Grid Lines

Grid System	Grid Direction	Grid ID	Visible	Bubble Location	Ordinate m
G1	X	A	Yes	End	0
G1	X	B	Yes	End	3.77
G1	X	C	Yes	End	8.85
G1	X	D	Yes	End	12.39
G1	Y	1	Yes	Start	0
G1	Y	2	Yes	Start	4.66
G1	Y	3	Yes	Start	9.35
G1	Y	4	Yes	Start	11.59
G1	Y	5	Yes	Start	16.25
G1	Y	6	Yes	Start	20.94

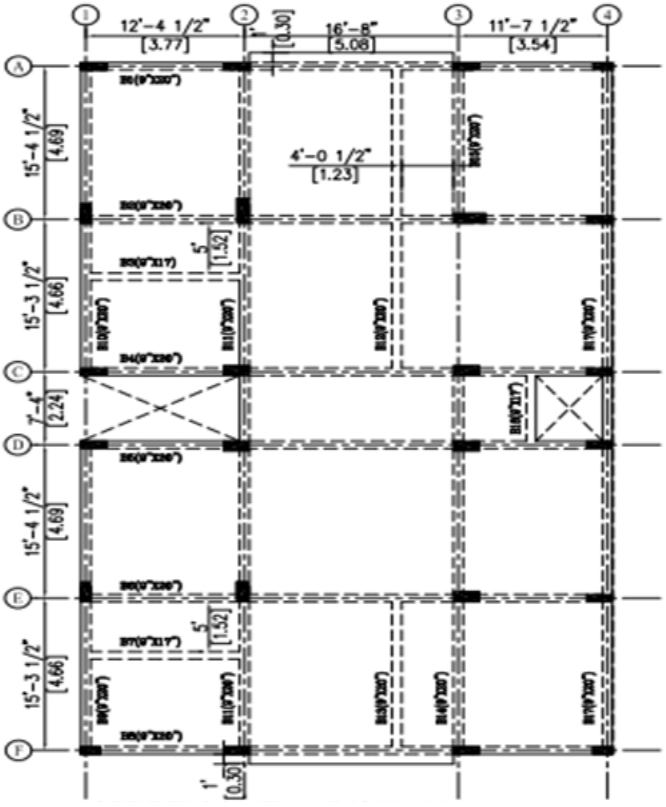

Fig1. Stilt Floor Framing Plan.

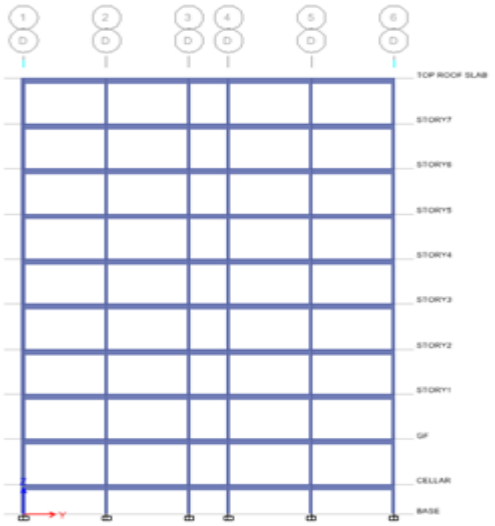

Fig2.

C. Material Properties

To carry out the work in ETABS software the properties of the materials such as concrete and steel should be defined. Similarly the loads should be defined such as live load, super dead loads.

Grade of concrete: M20
Grade of steel: Fe 415
Live loads: 2kN/m^2
SDL (floor finish): 1.5kN/m^2
SDL (wall loads inner and outer respectively): 6.21kN/m^2 and 12.45kN/m^2
Beam size: 230mm x 450mm
Column size: 230mm x 450mm

D. Description of Loads

All moving loads come under live loads:

- Live load (on floors): 2kN/m^2, (IS 875:1987 – Part -2)
- Live load (on roof): 1kN/m^2, (IS 875:1987 – Part -2)

Floor finishes are the super imposed dead loads.

- Floor Finishes (on floors): 1.5kN/m^2
- Floor Finishes (on roof): 2kN/m^2

Wall loads are the loads of bricks used in construction.

- For 9" wall(outer wall):12.45kN/m^2 (wall thickness * height of the floor*density of brick = 0.23*3*18)
- For 4.5" wall (inner wall): 6.21kN/m^2 (wall thickness *height of the floor*density of brick = 0.115*3*18)

Earthquake loads are given so that the building shall be earthquake resistant.
Zone: IV (According to the present zoning map, Zone 5 expects the highest level of seismicity whereas Zone 2 is associated with the lowest level of seismicity.)
Zone factor: 0.24
Soil type: II (medium stiff soil)
Importance factor, I: 1.0 (as residential building)
The building is proposed to have ordinary moment resisting frame.

IV. RESULTS AND DISCUSIIONS

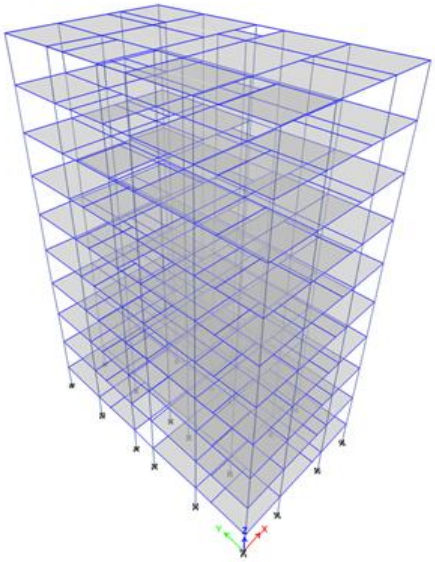

Fig3. Bending Moment for whole structure.

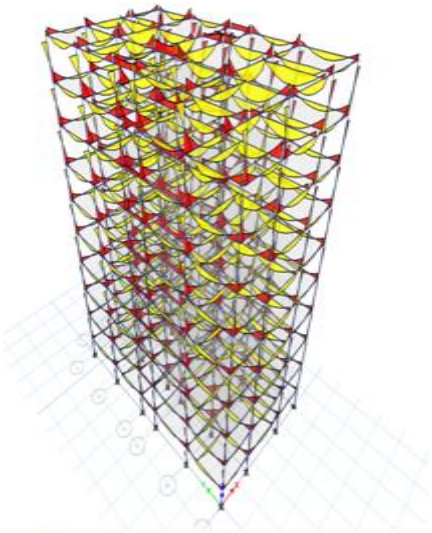

Fig4. Shear force for whole structure

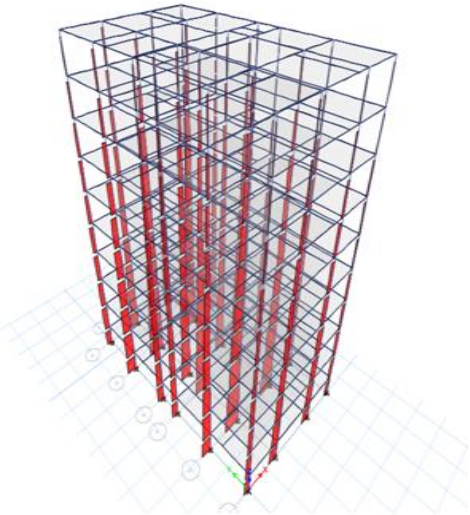

Fig5. Axial force for whole structure

This calculation presents the automatically generated lateral wind loads for load pattern WLX according to Indian IS875:1987, as calculated by ETABS.

Exposure Parameters:

Exposure From = Diaphragms
Structure Class = Class B
Terrain Category = Category 2
Wind Direction = 0;90 degrees

Basic Wind Speed, V_b [IS Fig. 1] $V_b = 44 \frac{\text{meter}}{\text{sec}}$

Windward Coefficient, $C_{p,wind}$ $C_{p,wind} = 0.8$

Leeward Coefficient, $C_{p,lee}$ $C_{p,lee} = 0.5$

Top Story = TERRACE
Bottom Story = BASE
Include Parapet = No

Factors and Coefficients:

Risk Coefficient, k_1 [IS 5.3.1] $k_1 = 1$

Topography Factor, k_3 [IS 5.3.3] $k_3 = 1$

Lateral Loading:

Design Wind Speed, V_z [IS 5.3] $V_z = V_b k_1 k_2 k_3$

Design Wind Pressure, p_z [IS 5.4] $p_z = 0.6 V_z^2$

Applied Story Forces:

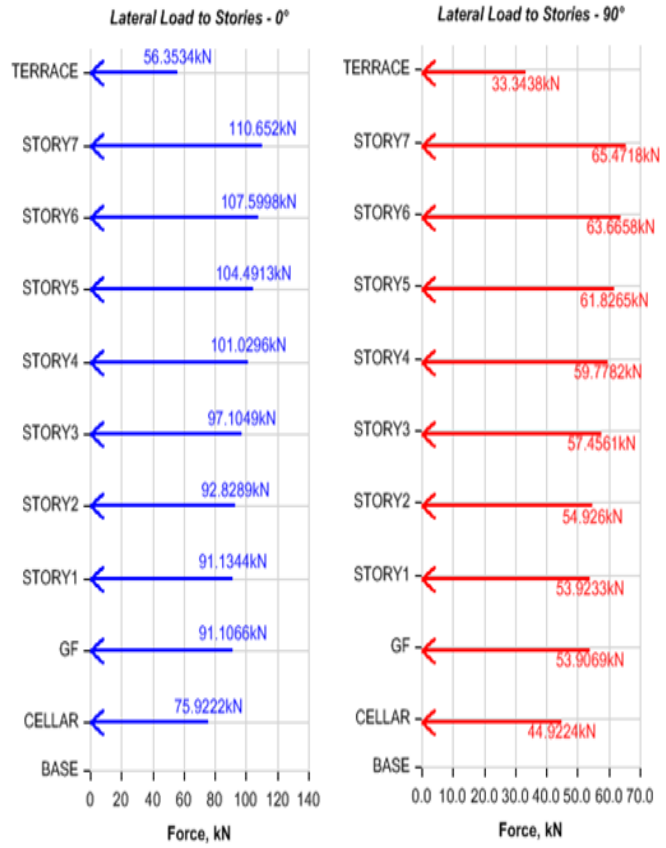

Fig6. Applied Story Forces.

Table4.

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
TERRACE	29	56.3534	0
STORY7	26	110.652	0
STORY6	23	107.5998	0
STORY5	20	104.4913	0
STORY4	17	101.0296	0
STORY3	14	97.1049	0
STORY2	11	92.8289	0
STORY1	8	91.1344	0
GF	5	91.1066	0
CELLAR	2	75.9222	0
BASE	0	0	0

Table5.

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
TERRACE	29	0	33.3438
STORY7	26	0	65.4718
STORY6	23	0	63.6658
STORY5	20	0	61.8265
STORY4	17	0	59.7782
STORY3	14	0	57.4561
STORY2	11	0	54.926
STORY1	8	0	53.9233
GF	5	0	53.9069
CELLAR	2	0	44.9224
BASE	0	0	0

Table6. Modal Periods and Frequencies

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigenvalue rad²/sec²
Modal	1	1.323	0.756	4.7486	22.5496
Modal	2	1.14	0.877	5.5128	30.3911
Modal	3	1.083	0.924	5.8033	33.6777
Modal	4	0.434	2.305	14.4815	209.7134
Modal	5	0.367	2.725	17.1243	293.2425
Modal	6	0.352	2.844	17.8678	319.2599
Modal	7	0.251	3.981	25.0149	625.7476
Modal	8	0.206	4.861	30.5427	932.8541
Modal	9	0.2	4.991	31.362	983.5742
Modal	10	0.174	5.751	36.1335	1305.6287
Modal	11	0.138	7.261	45.6238	2081.533
Modal	12	0.136	7.373	46.3236	2145.8727

Table7. Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	1.323	1.217E-06	0.7733	0	1.217E-06	0.7733	0
Modal	2	1.14	0.7599	1.14E-06	0	0.7599	0.7733	0
Modal	3	1.083	0	0.0032	0	0.7599	0.7765	0
Modal	4	0.434	0	0.0983	0	0.7599	0.8748	0
Modal	5	0.367	0.1047	0	0	0.8646	0.8748	0
Modal	6	0.352	3.187E-06	0.0004	0	0.8646	0.8752	0
Modal	7	0.251	0	0.0361	0	0.8646	0.9113	0
Modal	8	0.206	0.0391	0	0	0.9037	0.9113	0
Modal	9	0.2	0	0.0001	0	0.9037	0.9114	0
Modal	10	0.174	0	0.0198	0	0.9037	0.9313	0
Modal	11	0.138	0.0223	0	0	0.926	0.9313	0
Modal	12	0.136	0.0001	0.0001	0	0.9261	0.9314	0

Table 8. Modal Participating Mass Ratios (Part 2 of 2)

Case	Mode	RX	RY	RZ	Sum RX	Sum RY	Sum RZ
Modal	1	0.2272	0	0.0031	0.2272	0	0.0031
Modal	2	0	0.2464	0	0.2272	0.2464	0.0031
Modal	3	0.0009	0	0.7653	0.2281	0.2464	0.7684
Modal	4	0.4644	0	0.0004	0.6925	0.2464	0.7688
Modal	5	0	0.4307	4.288E-06	0.6925	0.6771	0.7688
Modal	6	0.0018	1.48E-05	0.0994	0.6943	0.6771	0.8681
Modal	7	0.0554	0	0.0002	0.7497	0.6771	0.8683
Modal	8	0	0.0592	5.828E-07	0.7497	0.7363	0.8683
Modal	9	0.0002	0	0.0382	0.75	0.7363	0.9064
Modal	10	0.0674	0	0.0001	0.8174	0.7363	0.9065
Modal	11	8.267E-07	0.0691	0.0001	0.8174	0.8054	0.9066
Modal	12	0.0003	0.0002	0.0218	0.8177	0.8056	0.9283

Table 9. Modal Load Participation Ratios

Case	Item Type	Item	Static %	Dynamic %
Modal	Acceleration	UX	99.97	92.61
Modal	Acceleration	UY	99.96	93.14
Modal	Acceleration	UZ	0	0

Table10. Modal Direction Factors

Case	Mode	Period sec	UX	UY	UZ	RZ
Modal	1	1.323	0	0.996	0	0.004
Modal	2	1.14	1	0	0	0
Modal	3	1.083	0	0.004	0	0.996
Modal	4	0.434	0	0.996	0	0.004
Modal	5	0.367	1	0	0	0
Modal	6	0.352	0	0.004	0	0.996
Modal	7	0.251	0	0.997	0	0.003
Modal	8	0.206	1	0	0	0
Modal	9	0.2	0	0.003	0	0.997
Modal	10	0.174	0	0.998	0	0.002
Modal	11	0.138	0.998	0	0	0.002
Modal	12	0.136	0.002	0.004	0	0.994

V. CONCLUSION

Based on the analysis and design of multi-storied building, the following conclusions are made:

1. Our project deals with provision of earthquake resistant structure which is also economic.
2. Minimum sizes of the beams and columns were provided as B230mmX450mm and C230mmX450 mm, after analysis only the failed column axes and dimensions were changed to C230mmX750 mm which comes under economic.
3. Seismic analysis was done by using ETABS software and successfully verified manually as per IS 1893-2002.
4. There is a gradual increase in the value of lateral forces from bottom floor to top floor in software analysis.
5. Maximum Shear force is 93.8KN and Maximum Bending Moment values is 79.5KN, which is acted at top floor of the building.

VI. REFERENCES

[1] Mahesh N. Patil, Yogesh N. Sonawane, Seismic Analysis of Multi-storied Building, International Journal of Engineering and Innovative Technology, ISSN: 2277-3754, Volume 4, Issue 9, March 2015, PP 123-129.

[2] Balaji.U, "Design and ANALYSIS OF Multi-storied Building under static and dynamic loading conditions using ETABS, International Journal of Technical Research and Applications ,ISSN: 2320-8163, Volume 4, Issue 4 (July-Aug, 2016), PP. 1-5.
[3] Piyush Tiwari, P.J.Salunke, Earthquake Resistant Design of Open Ground Storey Building, International Research Journal of Engineering and Technology, ISSN: 2395 -0056, Volume: 02 Issue: 07 |Oct-2015,PP 63-71.
[4] Pardeshi sameer, "Study of seismic analysis and design of multi storey symmetrical and asymmetrical building, International Research Journal of Engineering and Technology, ISSN: 2395 -0056, Volume: 03 Issue: 01 | Jan-2016, PP 732-737.
[5] Priya Sera Varkey, N. Ganapathy Ramasamy, S. Prakash Chandar and Dhanya R, A Review on LCEA of Infrastructure Buildings. International Journal of Civil Engineering and Technology, 8(3), 2017, pp. 1112–1122.
[6] Mounika.Pallapolu, Aquila Angel. Pilli and K. Prasanthi, Analysis and Design of Commercial Building. International Journal of Civil Engineering and Technology, 8(4), 2017, pp. 1445–1451.
[7]IS: 1893:2000, Part 1, Criteria for Earthquake Resistant Design of Structures - General Provisions for Buildings, Bureau of Indian Standards, New Delhi, 2002.

Author's Profile:

K Kiran Mai, B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.

Mohd Amer B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR

Md Shaibaz Ali, B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.

Mohammed Fazal Ahmed B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.

Mohammed Omair, B.Tech student in the Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.

Aftab Tanveer, HOD Civil Engineering from Sri Visvesvaraya Institute of Technology and Science, MBNR.