Analysis and Design of RCC Framed Structure Using Etabs

Archana Mali[1], Abdul Gani[2], Manish Parmar[3], Asim Shaikh[4]
[1] *Professor, Department of Civil Engineering Shree L. R. Tiwari College of Engineering, Mira Road (E) – 401 107*
[2,3,4] *UG Student Department of Civil Engineering, LR Tiwari College of Engineering, Mira Road (E) – 401 107*

Abstract:- **Expanded Three-layered Examination of Building Programming is what ETABS stands for. High rises, steel and substantial designs, low- and tall structures are typically broken down using ETABS. This project uses the ETABS programming to plan and deconstruct multistorey structures. All of the forces that act on the building were considered and taken into account during planning. Following a construction inspection, various responses including the greatest shear forces, twisting minutes, most extreme story uprooting, working under seismic pressure, and story firmness and float are processed. Then, using ETABS for structural analysis and design, the examination of the establishment on CSI SAFE programming and support itemising in CSI DETAIL programming has been completed, and it offers recommendations for best practises. For structural engineers and researchers interested in using ETABS for the analysis and design of framed structures, this manuscript offers as a thorough reference.**

Keywords :- **Plan preparation, Locating & Assigning loads, Structural analysis, Earthquake analysis, Wind analysis, Building responses, ETABS etc.**

INTRODUCTION

A structure can be characterized as an encased design expected for human inhabitance. A structure incorporates the construction and non-underlying parts (for example material, cladding, inside and segment walls and roof). These days, fashioners are dealing with additional issues connected with the significant burden of the design because of cutting edge and present day compositional necessity. Once in a while it is expected to diminish the heaviness of construction as opposed to expanding in the strength, particularly in weighty designs, for example, tall structures and extensions where the heaviness of design is seriously overwhelming part in planning of that design.

In present development the built up concrete cement is generally broadly involved material on the planet. An exposed edge of R.C.C. building comprises of numerous flat parts and vertical parts. In the current act of development, the draftsman planners and proprietors lean toward the eco-accommodating and green structure material. ETABS is the present-day driving plan programming on the lookout. Many plan organization's utilization this product for their venture configuration reason. Thus, this venture chiefly manages the examination of a multi celebrated building structure while broke down utilizing ETABS programming. Primary reaction to quake relies upon Dynamic attributes of the designs and power, span and recurrence content of existing ground movement.

Underlying examination implies assurance of the general shape and every one of the particular elements of a specific design so it carries out the role for which it is made and will securely endure the impacts which will follow up on it all through its valuable life. The successful plan and development of a seismic tremor safe designs have incredible significance everywhere. Geological measurements of India show that practically 54% of the land is powerless against tremors. This task presents investigation and plan if multi celebrated private structure utilizing ETABS programming with sidelong stacking impact of Tremor. This venture is planned according to INDIAN CODES-IS 1893-part2:2002, IS 456:2000.

This investigation is done by considering extreme seismic zones and conduct is surveyed by taking delicate Soil condition. In our venture we are thinking about an arrangement under zone - III. Seismic Power is Moderate and Zone Element is 0.16 at Ahmednagar.

The structure is proposed to have Common RC second opposing casing and the Reaction Decrease Factor(R) is 5.0, time span 1.696. Plan illustration of a 26-story working: In this venture, the stomach is unbending. The fundamental pillars lay on the segments to keep away from neighborhood unusualness. Correlation of examination and plan of customary and unpredictable setup of multi celebrated working in different seismic zones utilizing ETABS programming. The focal point of mass is the novel point at the focal point of a conveyance of mass in space. The Focal point of mass is the mean area of a dissemination of mass in space.

Seismic Examination of Multi-wandered Working: As this venture manages the most conservative segment strategy in this undertaking we have plan the design in an efficient manner by decreasing the sizes in the areas. As the heap is more at the base when contrasted with the highest levels, there is no need of giving huge sizes at the top. Conserving the segment through section direction is longer range longer bearing will lessen how much bowing accordingly there are of the steel is decreased.

METHODOLOGY

Numerous primary examination programming programs presently integrate composite development materials and such plan methods as flitch pillar plan estimations.

The additional elements of state of the art underlying examination programming guarantee that the most exceptional development methods and materials can be integrated into each renovating and development project.

It tends to be utilized to twofold actually look at computations as well as carry out complex roles with expanded precision.

Construction standards are pre-modified, and values such burden cutoff points and avoidance are produced naturally, saving your time for different parts of the venture.

Underlying examination programming is useful on the grounds that it presents the data in another manner Depending on primary examination programming ensures a protected, stable construction.

MODELING AND ANALYSIS

Model and Material which are used is presented in this section. Table and model should be in prescribed format.

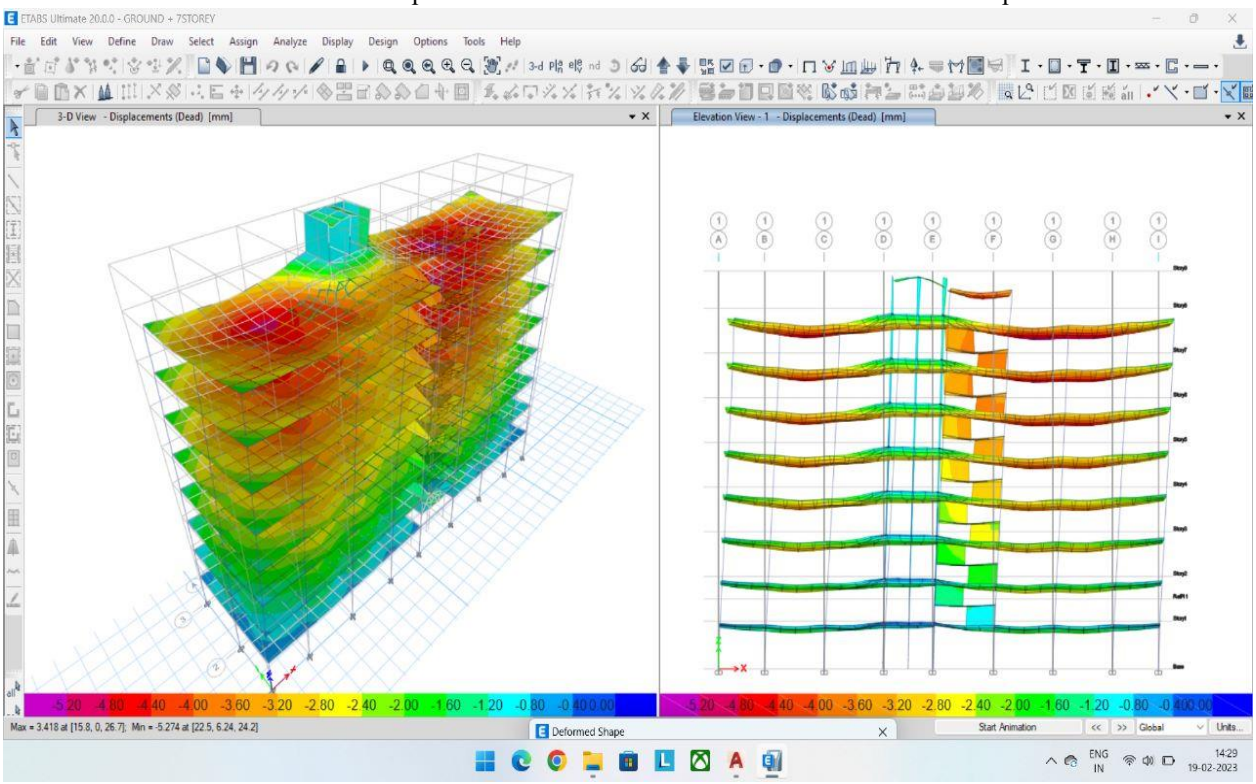

Figure 1

TABLE 1. CODES FOLLOWED

Unit weights of buildings materials and stored materials	IS-875 (Part-1)
Code of practice for design loads (other than earthquake) for buildings and structures – imposed loads.	IS-875 (Part 2)
Code of practice for design loads (other than earthquake) for buildings and structures – wind loads)	IS- 875 (part 3)
Code of practice for design loads (other than earthquake) for buildings and structures – special loads and load combinations	IS-875 (Part 5)
Code of practice for design loads (other than earthquake) for buildings and structures – special loads and load combinations	IS:1893: 2016
Code of practice for plain and reinforced concrete.	IS:456: 2000
Ductile detailing of reinforced concrete structures subjected to seismic forces – code of practice.	IS:13920: 2016
Code of practice for general construction in steel.	IS: 800

Story drift

Story drift refers to the lateral displacement or deflection of a structure under lateral loads such as wind or earthquakes.

As per IS 1893 : 2016 Part I Cl 7.11.1 story drift shall not exceed 0.0004 times story height

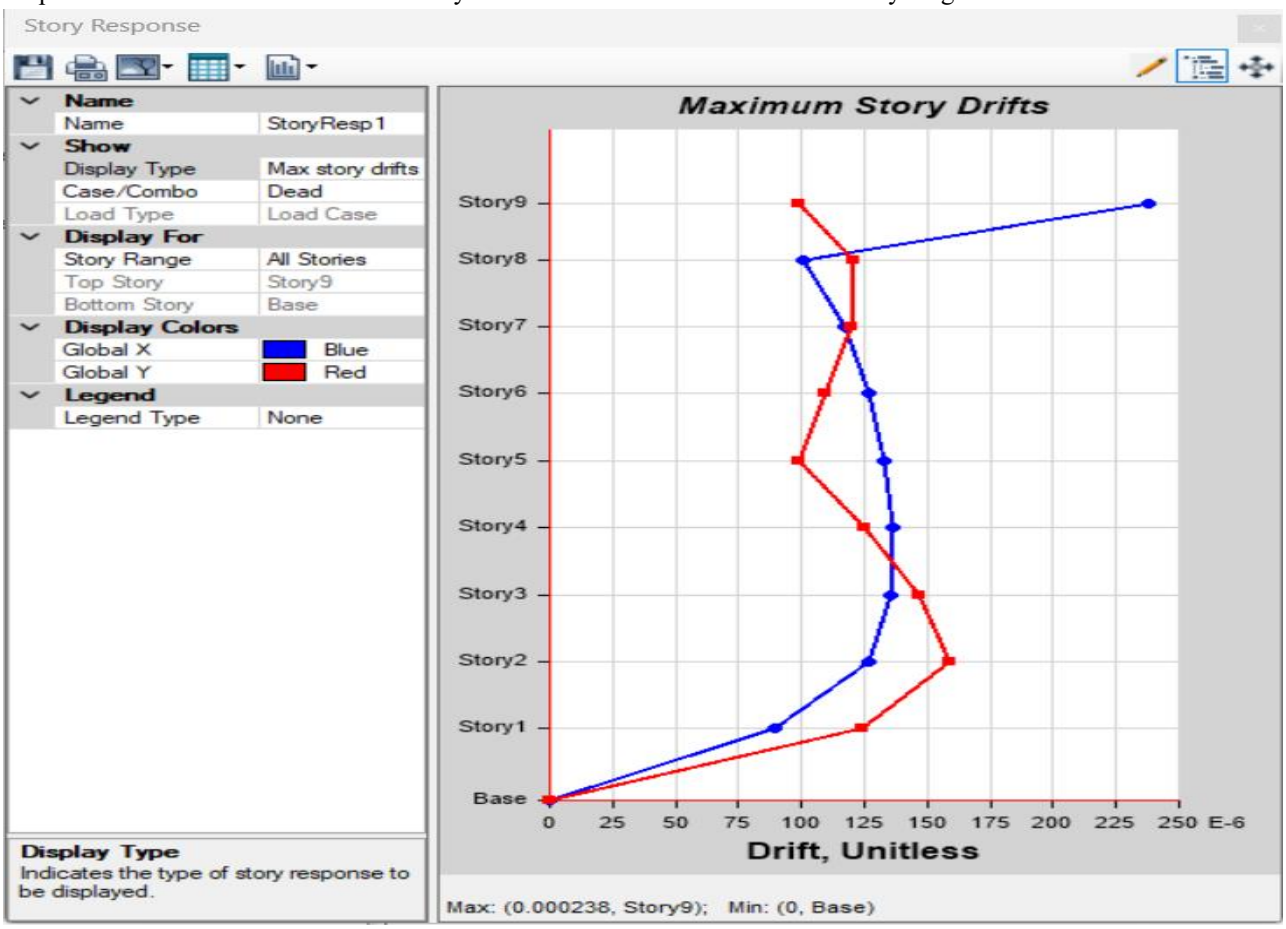

Figure 2

Story Displacement

Story displacement is the deflection of a single story relative to the base or ground level of the structure.

The maximum displacement or story drift of an RCC framed structure will depend on several factors such as the design of the building, the loads it is subjected to, the properties of the materials used, and the seismic hazard of the location where it is built.

Figure 3

Torsion

According to IS Code 1893 Part 1, torsion is the twisting moment induced in a building due to the application of horizontal forces during an earthquake.

The code recommends that the effect of torsion on the building's behavior should be considered in the design of the lateral force-resisting system, which is typically provided by reinforced concrete (RC) frames or shear walls.

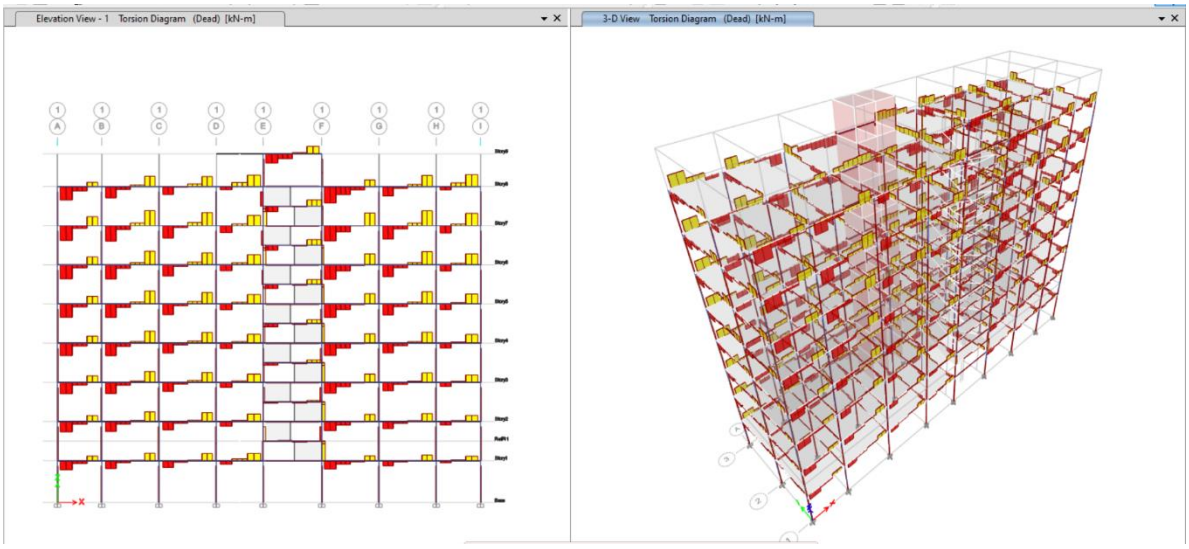

Figure 4

Axial Force Diagram

When modeling a structure in ETABS, axial loads can be applied to members such as columns, beams, and walls using the software's "load assignments" feature.

The axial loads can be defined as point loads or distributed loads along the length of the member. Once the model is created and the loads are assigned, ETABS can perform an analysis to calculate the internal forces in the members,

including axial force. The axial force can be viewed in the software's results output, which can be displayed graphically or in tabular format.

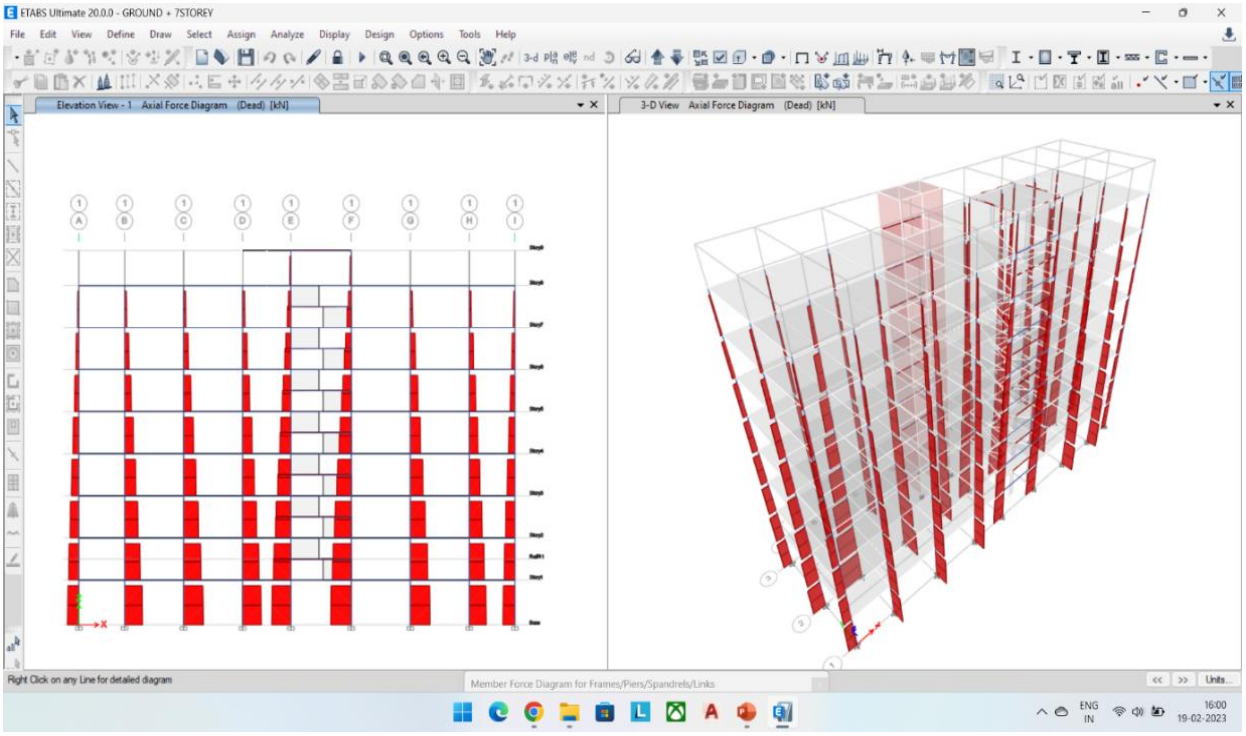

Figure 5

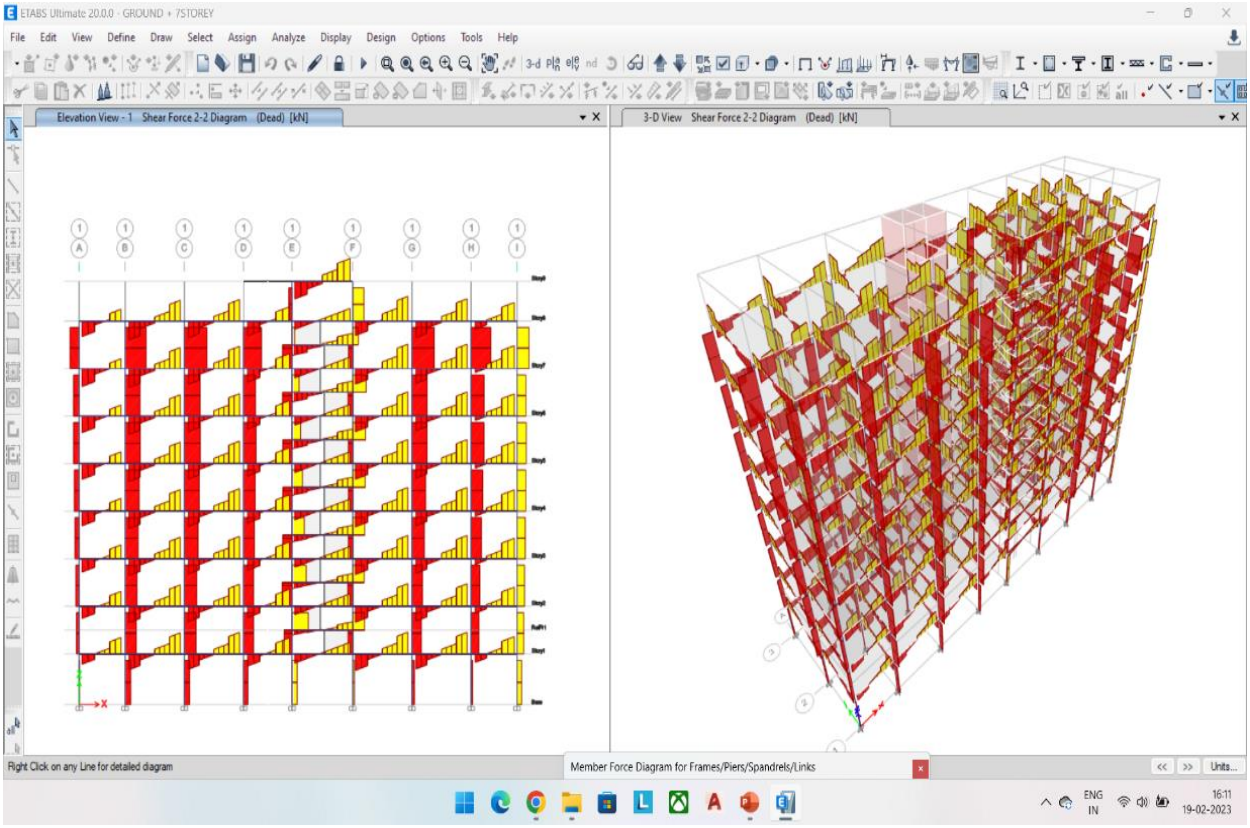

Figure 6

Analysis Results

5.1 Structure Results

Table 5.1 - Base Reactions

Output Case	Case Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m	Z m
Dead	LinStatic	-381	-381	43216.581	203435.9852	-707111.7804	-4691.45	0	0	0
Live	LinStatic	0	0	7188.5559	32739.5866	-117281.5128	5.993E-07	0	0	0
EQL--X	LinStatic	-5533.5738	0	0	1.587E-06	-81224.8344	27485.5171	0	0	0
EQL--Y	LinStatic	-2.453E-06	-5533.5737	1.805E-06	81224.8337	-0.0001	-88911.5654	0	0	0
WIND--X	LinStatic	-360.5753	0	0	0	-5041.9047	1676.6753	0	0	0
WIND--Y	LinStatic	-6.176E-07	-1260.0751	0	17619.5591	-1.52E-05	-20476.22	0	0	0
DConS1	Combination	-571.5	-571.5	64824.8715	305153.9779	-1060668	-7037.175	0	0	0
DConS2	Combination	-571.5	-571.5	75607.7053	354263.3577	-1236590	-7037.175	0	0	0
DConS3	Combination	-889.8904	-457.2	60486.1642	283410.6862	-995322.2374	-3617.7296	0	0	0
DConS4	Combination	-24.5096	-457.2	60486.1642	283410.6862	-983221.6663	-7641.7503	0	0	0
DConS5	Combination	-457.2	-1969.2901	60486.1642	304554.1571	-989271.9519	-30201.204	0	0	0
DConS6	Combination	-457.2	1054.8901	60486.1642	262267.2152	-989271.9518	18941.724	0	0	0
DConS7	Combination	-1112.363	-571.5	64824.8715	305153.9779	-1068231	-4522.162	0	0	0
DConS8	Combination	-30.637	-571.5	64824.8715	305153.9779	-1053105	-9552.1879	0	0	0
DConS9	Combination	-571.5	-2461.6126	64824.8715	331583.3165	-1060668	-37751.505	0	0	0
DConS10	Combination	-571.5	1318.6126	64824.8715	278724.6392	-1060668	23677.155	0	0	0
DConS11	Combination	-883.763	-342.9	38894.9229	183092.3867	-643963.4594	-1707.292	0	0	0
DConS12	Combination	197.963	-342.9	38894.9229	183092.3867	-628837.7454	-6737.3179	0	0	0
DConS13	Combination	-342.9	-2233.0126	38894.9229	209521.7254	-636400.6024	-34936.635	0	0	0
DConS14	Combination	-342.9	1547.2126	38894.9229	156663.048	-636400.6024	26492.025	0	0	0
DConS15	Combination	-7097.4885	-457.2	60486.1642	283410.6862	-1086742	27352.8805	0	0	0
DConS16	Combination	6183.0885	-457.2	60486.1642	283410.6862	-891802.1505	-38612.3605	0	0	0
DConS17	Combination	-457.2	-7097.4885	60486.1642	380880.4866	-989271.9519	-112323.6185	0	0	0
DConS18	Combination	-457.2	6183.0885	60486.1642	185940.8857	-989271.9518	101064.1385	0	0	0
DConS19	Combination	-8871.8607	-571.5	64824.8715	305153.9779	-1182505	34191.1006	0	0	0
DConS20	Combination	7728.8607	-571.5	64824.8715	305153.9779	-938830.419	-48265.4506	0	0	0
DConS21	Combination	-571.5	-8871.8606	64824.8715	426991.2284	-1060668	-140404.5231	0	0	0
DConS22	Combination	-571.5	7728.8606	64824.8715	183316.7273	-1060668	126330.1731	0	0	0
DConS23	Combination	-8643.2607	-342.9	38894.9229	183092.3867	-758237.854	37005.9706	0	0	0
DConS24	Combination	7957.4607	-342.9	38894.9229	183092.3867	-514563.3508	-45450.5806	0	0	0
DConS25	Combination	-342.9	-8643.2606	38894.9229	304929.6372	-636400.6025	-137589.6531	0	0	0
DConS26	Combination	-342.9	7957.4606	38894.9229	61255.1362	-636400.6023	129145.0431	0	0	0
DWalS1	Combination	-571.5	-571.5	64824.8715	305153.9779	-1060668	-7037.175	0	0	0
DWalS2	Combination	-571.5	-571.5	75607.7053	354263.3577	-1236590	-7037.175	0	0	0
DWalS3	Combination	-889.8904	-457.2	60486.1642	283410.6862	-995322.2374	-3617.7296	0	0	0
DWalS4	Combination	-24.5096	-457.2	60486.1642	283410.6862	-983221.6663	-7641.7503	0	0	0
DWalS5	Combination	-457.2	-1969.2901	60486.1642	304554.1571	-989271.9519	-30201.204	0	0	0
DWalS6	Combination	-457.2	1054.8901	60486.1642	262267.2152	-989271.9518	18941.724	0	0	0
DWalS7	Combination	-1112.363	-571.5	64824.8715	305153.9779	-1068231	-4522.162	0	0	0
DWalS8	Combination	-30.637	-571.5	64824.8715	305153.9779	-1053105	-9552.1879	0	0	0
DWalS9	Combination	-571.5	-2461.6126	64824.8715	331583.3165	-1060668	-37751.505	0	0	0

Table 5.1 - Base Reactions (continued)

Output Case	Case Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m	Z m
DWalS10	Combination	-571.5	1318.6126	64824.8715	278724.6392	-1060668	23677.155	0	0	0
DWalS11	Combination	-883.763	-342.9	38894.9229	183092.3867	-643963.4594	-1707.292	0	0	0
DWalS12	Combination	197.963	-342.9	38894.9229	183092.3867	-628837.7454	-6737.3179	0	0	0
DWalS13	Combination	-342.9	-2233.0126	38894.9229	209521.7254	-636400.6024	-34936.635	0	0	0
DWalS14	Combination	-342.9	1547.2126	38894.9229	156663.048	-636400.6024	26492.025	0	0	0
DWalS15	Combination	-7097.4885	-457.2	60486.1642	283410.6862	-1086742	27352.8805	0	0	0
DWalS16	Combination	6183.0885	-457.2	60486.1642	283410.6862	-891802.1505	-38612.3605	0	0	0
DWalS17	Combination	-457.2	-7097.4885	60486.1642	380880.4866	-989271.9519	-112323.6185	0	0	0
DWalS18	Combination	-457.2	6183.0885	60486.1642	185940.8857	-989271.9518	101064.1385	0	0	0
DWalS19	Combination	-8871.8607	-571.5	64824.8715	305153.9779	-1182505	34191.1006	0	0	0
DWalS20	Combination	7728.8607	-571.5	64824.8715	305153.9779	-938830.419	-48265.4506	0	0	0
DWalS21	Combination	-571.5	-8871.8606	64824.8715	426991.2284	-1060668	-140404.5231	0	0	0
DWalS22	Combination	-571.5	7728.8606	64824.8715	183316.7273	-1060668	126330.1731	0	0	0
DWalS23	Combination	-8643.2607	-342.9	38894.9229	183092.3867	-758237.854	37005.9706	0	0	0
DWalS24	Combination	7957.4607	-342.9	38894.9229	183092.3867	-514563.3508	-45450.5806	0	0	0
DWalS25	Combination	-342.9	-8643.2606	38894.9229	304929.6372	-636400.6025	-137589.6531	0	0	0
DWalS26	Combination	-342.9	7957.4606	38894.9229	61255.1362	-636400.6023	129145.0431	0	0	0
DSlbS1	Combination	-571.5	-571.5	64824.8715	305153.9779	-1060668	-7037.175	0	0	0
DSlbS2	Combination	-571.5	-571.5	75607.7053	354263.3577	-1236590	-7037.175	0	0	0
DSlbS3	Combination	-889.8904	-457.2	60486.1642	283410.6862	-995322.2374	-3617.7296	0	0	0
DSlbS4	Combination	-24.5096	-457.2	60486.1642	283410.6862	-983221.6663	-7641.7503	0	0	0
DSlbS5	Combination	-457.2	-1969.2901	60486.1642	304554.1571	-989271.9519	-30201.204	0	0	0
DSlbS6	Combination	-457.2	1054.8901	60486.1642	262267.2152	-989271.9518	18941.724	0	0	0
DSlbS7	Combination	-1112.363	-571.5	64824.8715	305153.9779	-1068231	-4522.162	0	0	0
DSlbS8	Combination	-30.637	-571.5	64824.8715	305153.9779	-1053105	-9552.1879	0	0	0
DSlbS9	Combination	-571.5	-2461.6126	64824.8715	331583.3165	-1060668	-37751.505	0	0	0
DSlbS10	Combination	-571.5	1318.6126	64824.8715	278724.6392	-1060668	23677.155	0	0	0
DSlbS11	Combination	-883.763	-342.9	38894.9229	183092.3867	-643963.4594	-1707.292	0	0	0
DSlbS12	Combination	197.963	-342.9	38894.9229	183092.3867	-628837.7454	-6737.3179	0	0	0
DSlbS13	Combination	-342.9	-2233.0126	38894.9229	209521.7254	-636400.6024	-34936.635	0	0	0
DSlbS14	Combination	-342.9	1547.2126	38894.9229	156663.048	-636400.6024	26492.025	0	0	0
DSlbS15	Combination	-7097.4885	-457.2	60486.1642	283410.6862	-1086742	27352.8805	0	0	0
DSlbS16	Combination	6183.0885	-457.2	60486.1642	283410.6862	-891802.1505	-38612.3605	0	0	0
DSlbS17	Combination	-457.2	-7097.4885	60486.1642	380880.4866	-989271.9519	-112323.6185	0	0	0
DSlbS18	Combination	-457.2	6183.0885	60486.1642	185940.8857	-989271.9518	101064.1385	0	0	0
DSlbS19	Combination	-8871.8607	-571.5	64824.8715	305153.9779	-1182505	34191.1006	0	0	0
DSlbS20	Combination	7728.8607	-571.5	64824.8715	305153.9779	-938830.419	-48265.4506	0	0	0
DSlbS21	Combination	-571.5	-8871.8606	64824.8715	426991.2284	-1060668	-140404.5231	0	0	0
DSlbS22	Combination	-571.5	7728.8606	64824.8715	183316.7273	-1060668	126330.1731	0	0	0
DSlbS23	Combination	-8643.2607	-342.9	38894.9229	183092.3867	-758237.854	37005.9706	0	0	0
DSlbS24	Combination	7957.4607	-342.9	38894.9229	183092.3867	-514563.3508	-45450.5806	0	0	0
DSlbS25	Combination	-342.9	-8643.2606	38894.9229	304929.6372	-636400.6025	-137589.6531	0	0	0
DSlbS26	Combination	-342.9	7957.4606	38894.9229	61255.1362	-636400.6023	129145.0431	0	0	0

CONCLUSION

The specialized preparation, taken through a time of three permitted to have more than adequate openness to different practices in the examination and plan of multi celebrated structures and furthermore in different development procedures utilized in the business. The examination was finished utilizing the product bundle ETABS v18, which ended up being top notch programming of extraordinary likely in examination and configuration areas of development industry. Every one of the primary parts were planned

utilizing AutoCAD v2022 and point by point utilizing CSi Detail v18.

Establishment is planned and point by point with CSi SAFE v16. The investigation and configuration were finished by standard details to the conceivable expand. Seismic power follows up on the design it mirrors extra power dealing with the construction, because of these expansion powers structure act unexpected way in comparison to typical condition. That's what it's seen, the greatest amount of removal is expanding from first story to last one.

Subsequent to dissecting the multi story building structure, reasoned that construction is protected in stacking like dead burden, live burden, wind load and seismic burden. Part aspects (Shaft, Segment, Chunk, Balance) are changed by computing the heap type and it's amount applied on it CSi Detail gives min. measurement of bars, thickness of piece and same for segment, balance.

ACKNOWLEDGEMENTS

We would like to take this opportunity to express our sincere gratitude to our mentor, “Ms. Archana Mali” , whose support, valuable advice, and supervision with a straightforward approach greatly assisted us in finishing this project work on "Analysis and Design of High-Rise Building Using ETABS Software". I would want to express my sincere appreciation and respect to our beloved principal, “Dr. Devan Shah”, who greatly motivated us to reach the goal. We also appreciate “Dr. Ajit Patil”, Head, Civil Engineering Department, for her advice and support.

We also want to express our gratitude to the faculty and support staff at the Department of Civil Engineering who, deliberately or unknowingly, contributed to the effective completion of this effort. we cannot skip to express our thanks to our parents, family relatives, friends and well-wishes without their moral supports the work would not have been possible.

REFERENCE

1. IS:1893-2016 (Part-1), “Criteria for Earthquake Resistant Design of Structures”, Bureau of Indian Standards, New Delhi.
2. ETABS, manual., Linear and Nonlinear Static and Dynamic Analysis and Design of Three-Dimensional Structures, Computers and Structures Inc, Berkeley, California, U.S.A, 2004.
3. “Comparative study of static and dynamic seismic analysis of multi storied RCC building by ETABS” Gauri G. Kakpure, Ashok R.Mundhada, International Journal of Engineering Research in management and technology, Volume -5, ISSN:2278-9359, December 2016.
4. “RESPONSE SPECTRUM ANALYSIS AND DESIGN OF CASE STUDY BUILDING”, Sopna Nair, International Journal of civil engineering and technology, ISSN : 0976-6316 ,volume 08,issue 08,pp, may 2017.
5. “Analysis of Multi story building with shear wall using Etabs software”Jalmin dodiya,Mayanak devani, International research journal of engineering and technology (IRJET), e-ISSN:2395-0056 ,Voloume :05 Issue :02/Feb-2018.
6. “Analysis of RCC buildings with shear walls at various locations and in different seismic zones” Sylviya B,P.Eswaramoorthi, International journal of innovative technoloy and exploring engineering (IJITEE) ISSN:2278-3075, Voloume-8 Issue-2S december,2018.
7. “Response Spectrum Analysis and Response of Building with Setbacks”, Ajay Singh Gulshan and Poonam Dhiman , IOSR Journal of Mechanical and civil engineering , eISSN:2278-1684 , Special issue AETM’16, pp.