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Comparative Analysis of Structure for Calamity by using Midas Gen, ETABS and STAAD pro

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Abstract: During the past few years the earthquakes have dealt a lot of damage to life and property in India. To overcome this, the need for advancement in construction is necessary. With Scarcity of area and overgrowing population the need of constructing High Rise building has been increasing. Traditional high rise structures are tend to be weak against additional load pressure or earthquakes. To counter such situations and to reduce the effect of such calamity with the help of structural analysis and use of methods like Base Isolation, X bracing and Shear Wall, the intensity of such problem can be reduced to a wide extent. This paper represents the comparison of various methods on normal high rise building with the use of Midas Gen ,ETABS and STAAD pro..We took the case for Seismic zone 2 with medium soil category. Structural engineering software has progressed significantly in recent years. MIDAS GEN, ETABS and STAAD pro conducts structural design and analysis packages that support multiple types of concrete, steel, aluminum and timber international design codes.
Keywords: High rise building, Auto-CAD, ETABS, MIDAS GEN, STAAD pro Shear walls, Bracing, base isolation.

I. INTRODUCTION

A natural calamity is seen as an earthquake. Every year, many individuals lose their lives as a result of structural failure brought on by earthquakes.Structures can sustain less damage if adopting design guidelines for seismic resistance.For construction of building the wind loads and lateral forces due to earthquake plays an important role in designing .Wind loads and lateral forces from earthquakes are key factors to consider while designing a structure. High-rise building construction is particularly difficult since it depends on the design and scale models. The serviceability of the high-rise constructions is crucial. In addition to other aspects, the serviceability and occupant comfort of tall structures are crucial to their economic sustainability.Environmental loads, such as those caused by hurricanes and earthquakes, can cause problems for tall structures and can cause catastrophic failure if the loads and accompanying reactions are not effectively handled. Tall structures built to withstand wind loads are thought to be secure during minor and moderate quakes, however the design of these structures can vary greatly from region to region in seismically active areas. Depending on the local seismicity, an area. Modifying the dynamic properties underexcitation loads is a common strategy to reduce the unwanted behaviour of these structures, which eventually results in systematically altering structural features or structural contrast. subject of intense investigation and study.Earthquake explanations two types of losses often called primary loss and secondary loss. A main irrecoverable loss, which results in the human lifestyles in earthquakes. All others are termed as secondary losses. Thus, a minimum common in a code to resist earthquakes is prescribed such that whole crumple of structure is prevented which ensures that no human lifestyles are lost. This requires a forecast of the strongest depth of probable ground movement at a distinct site throughout the service lifetime of the constitution. Seismic zoning map of a nation segregates nations in quite a lot of areas of an identical probable highest intensity of ground motion.Hazards have caused a lot of destruction to human settlements and nature .These destruction could have reduced if there was preparedness on mitigating the effects of hazards In the field of civil engineering the problem that we face is to make sustainable structures that withstand natural calamities and have least damage of any kind. And in this research, we are going to talk about how to handle seismic problems. The insufficient knowledge of earthquakes and its use in building lead to the failure of a lot of buildings.. Our research is related to comparative analysis of structures with different methods using various software. With this study it will help us to determine the best option to choose for a building depending upon the conditions of the building. Over all, this research aims to primarily ensure life safety and secures the functionality of the building. The consequences of a natural catastrophe can spread over entire areas and even nationwide, just as they do locally via infrastructure and society that is affected. Pre-event mitigation, rapid reaction, and long-term recovery have an influence on regional and national catastrophe resilience. Thousands of individuals are relocating from rural villages to metropolitan centers as a result of a growing global trend of interest in a better living. At the same time, urban population density is quickly rising as the population growth surge reaches its apex.

Structures in seismically active areas must support both the primary gravity load and lateral earthquake effects. The effectiveness of a structure during an earthquake is influenced by the magnitude of the quakeas well as the characteristics of the construction. A steel structure's reactivity to seismic shocks can range from elastic to severely inelastic. To ensure enough lateral stiffness and strength during a strong seismic excitation, steel structures should be built to disperse a lot of energy. Stiffness is more crucial than strength in high-rise structures. In steel structures, braced and moment-resisting frames are frequently utilized as lateral load-resisting structural components. By yielding, moment resisting frames give ductility, but because of their flexibility, they don't meet the requirements for stiffness, however concentric braced frames are ideal for stiffness because of their low ductility. There are various techniques to add bracing to structures to boost their seismic resistance.

A. Objectives

To study the behavior of structures especially of R.C.C buildings against Seismic attacks using modern techniques. To optimize the structural performance by using various softwares.

II. LITERATURE REVIEW

The paper discusses the study of earth vibrations, primarily caused by earthquakes, known as seismology.The majority of seismology consists of the investigation of these vibrations through a variety of methods, as well as comprehending the nature and various physical processes that generate them. One of these theories, elastic rebound theory, was able to explain the earthquakes that happen along the fault lines. Seismology as a whole is still a very unexplored field of study with a lot of undiscovered facts. The Indian subcontinent's geology and geography are quite intricate, and there are three main subdivisions: the Peninsula, Indo-Gangetic Plains, and the Himalayas The Himalayas are relatively young mountains that were formed when Asia and India collided. Ocean sediments rest on hard basement rocks at the front edge of the Indian plate, which is moving north. Repeated folding, faulting, and melting in the deeper parts have occurred as a result of intense compression at the boundary. Recent alluvium from three powerful river systems—the Indus, the Ganges, and the Brahmaputra—deposited sediments across densely populated areas in Sindh (in Pakistan), Punjab, Uttar Pradesh, Bihar, Bengal (including Bangladesh), and Assam, forming the Indo-Gangetic plain. The rocks on the Peninsula are very young (Precambrian), and lava flows from the Deccan Traps cover a lot of the western and central peninsula[1].

This paper examines the vibration control of an 8-story building using viscous dampers and a lever mechanism/bracing system under wind and earthquake loads. It also provides a brief overview of vibration mitigation techniques for high-rise buildings, including typical design uncertainties and dynamic properties. The multi-hazard loads that could affect high-rise buildings are discussed, and general performance criteria are presented to evaluate the efficacy of the mitigation system under wind and earthquake loads. The installation of viscous dampers with a lever mechanism is shown to improve the building's responses. In the concluding remarks, increasing damping uncertainty and variability in building is highlighted. The paper also discusses the seismic behavior of supertall mega-braced structures and presents a modeling procedure to simulate their large displacement inelastic dynamic response. The study identifies critical parameters associated with ground motion intensity, structural configuration, proportioning, and modeling, which have a significant impact on computed response[3].

The paper discusses the challenges of designing high-rise buildings to withstand multiple hazards such as earthquakes, windstorms, and explosions. While numerous studies have focused on designing for a single hazard, few have addressed the impact of multiple hazards on building design. In areas where there is a high likelihood of occurrence of these hazards, ignoringthem during the design process may lead to conservative designs and significant financial losses. The design approach for earthquake resistance requires ductility, while wind resistance requires higher stiffness. Hence, designing for multiple hazards in an efficient and sustainable manner is challenging. Potra and Simiu proposed a numerical approach to find the best design variables for wind- and earthquake-prone regions simultaneously. They suggest that when considering a single hazard, the risk of exceeding the limit state is significantly greater than when considering multiple hazards.Kostarev proposed a novel design approach to reduce the impact of seismic, wind, and explosion loads on vibration in the containment of power plants using highly viscous dampers to reduce floor response. Li and Ellingwood assessed the overall risk posed by hurricanes and earthquakes, presenting a probability of damage as a function of the return period that takes into account various levels of earthquake and hurricane intensities in Charleston, South Carolina.The governing parameters for wind loads include terrain exposure and wind intensity at various building locations, while those for earthquakes include the zone factor, structural system type, importance of the building, period coefficient, soil coefficient, and building weight. Overall, the paper emphasizes the importance of considering multiple hazards during the design process of high-rise buildings to ensure their safety and economic viability.[4]

Structural control methods such as supplemental damping devices have been found to be effective in reducing the amount of vibration in flexible structures like high-rise buildings subjected to strong winds or earthquakes. These devices, such as MR dampers, tuned mass dampers, viscoelastic dampers, viscous dampers, and friction dampers, work by absorbing vibration and dissipating energy to counterbalance external forces. However, their performance is affected by the nature and extent of the loading. In the aircraft industry, various vibration absorption, isolation, and damping methods were developed during the Second World War and later applied to civil engineering structures. Base isolation, another concept of structural control, was first demonstrated by an engineering professor in Japan more than a century ago, which involves building a structure on ball bearings to reduce seismic response. Ductile frames are commonly recommended for high-rise buildings in seismic design because of the greater number of variables involved in seismic response compared to wind design. Base isolation is generally effective for low- to medium-rise buildings but may not be suitable for low-rise buildings under wind loads. Structural control methods involve varying stiffness, mass, damping, or shape to reduce vibration caused by external forces in civil structures.[5].In this paper, the author conducted a study comparing the static and dynamic behavior of regular buildings with reinforced concrete frames, specifically analyzing a six-story structure using computerized solutions for seismic zones II, III, IV, and V. The study also included an examination of various high-rise building bracing systems, with the finding that bracing is more stable than moment resisting frames due to its stiffness ratio. The author also looked at the effects of X bracing and a viscous damper on a residential structure, finding that it reduced displacement, shear force, bending moment,axial force, and story drift. Another focus of the study was the behavior of the interior RC beam column joint under cyclic loading, as this is an essential component of reinforced concrete moment resisting frames and needs to be properly designed and detailed to resist shear. [6]The author examined the analysis and design of two bay, five-story R.C.C. moment resisting frames for general buildings using ETABS software in accordance with IS 1893-2002 code procedures and IS 13920-1993 recommendations. The study also included dynamic analysis of a G+30 storied regular reinforced concrete framed building with a plan area of 25 m x 45 m and a total height of 114 m, using the design parameters outlined in IS-1893-2002-Part-1 for zones 2and 3. The study found that static and dynamic Axial Forces values did not significantly differ.[7]

III. METHODOLOGY

In this research, we are going to focus on the problems of how to reduce the damage done by calamities like earthquakes and so, therefore, create a much more sustainable and stable building structure. We studied many methods and research papers that included facts like what techniques are being used in this latest technological era and how comparison can be performed to understand the following outcomes.

Our approach to carrying out the study was to use software like Midas Gen and Etabs by considering a high rise structure and applying different methods and maintaining the records of their outcome thus understanding which method stands out. Our analysis is based on a building we created in which we kept all the environmental conditions constant. It undergoes various rounds of analysis where we kept the loads and seismic factors the same and changed the methods factor. The research on various methods and its functioning were found out.

In this, the methods we are considering are Base isolation, X- Bracing, Shear walls, Seismic Dampers and other methods for our research. We carried out the data through many research papers and internet information also reviewing videos for a better understanding of the process.

The current comparative research examines a static approach that is equivalent for both RCC and steel structures when it comes to seismic analysis of the structure. Both building models are analyzed using software; key study parameters are story stiffness, period, frequency, base shear, lateral forces, and seismic weight.

A. *Modern Construction Techniques For Earthquake Resistant Structures*

There are 4 techniques that has been used lately in modern construction so far which are as follows: Pre-Stressed Concrete Base Isolation Seismic DampersShear Walls

1) *Pre-Stressed Concrete:* Many nations, including New Zealand, employ this strategy. During the building of an earthquake-resistant structure, this provides adequate connection between various structural components.
2) *Base Isolation:* It is one of the methods for shielding the structure against seismic forces that is generally approved and used. The superstructure and the base are divided by a collection of structural elements. This part experiences lateral displacement when the earth under the building's foundation trembles, but the structure is not damaged.

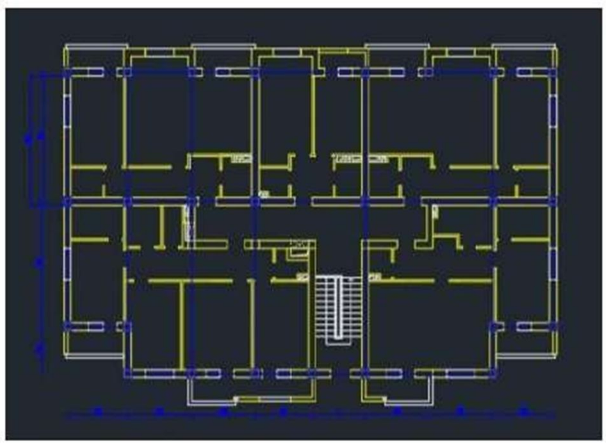
3) *Seismic Dampers:* These dampers function similarly to hydraulic shock absorbers in automobiles in that the majority of rapid shocks are absorbed by the hydraulic fluids and barely any are communicated to the car's chassis above. Dampers absorb a portion of the seismic energy that passes through them, lowering the force. There are several different kinds of seismic dampers, including yielding dampers, friction dampers, and viscous dampers. The fluid made of silicone that moves between the piston chambers ofviscous dampers absorbs energy. The size of the force impinging on the structure.
4) *Shear Walls:* Shear walls are thought to be a crucial part of a system that resists lateral loads, and steel is well recognised for its ductile nature. An efficient load resisting system was created by fusing these two desirable qualities, and it has found widespread use in North America and Japan. These walls are constructed such that when lateral stresses are applied, they will bend rather than buckle. The weight of the structure is decreased by the fact that these walls are substantially lighter and thinner.Moreover, these walls don't need to be cured, hastening the construction process.

IV. MATERIAL AND GEOMETRIC PROPERTIES

A. *Building Details*

1) *Structural Analysis*

PLAN



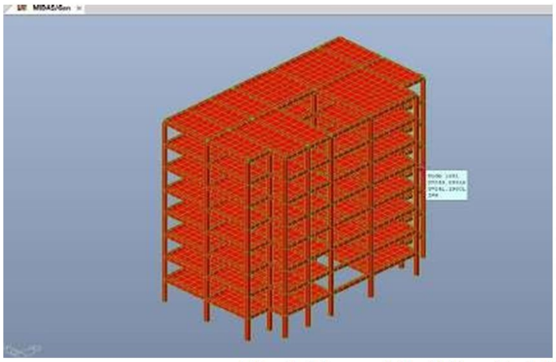
This is the floor plan for the G+8 building situated in Mumbai which we are going to use for further analysis.

No. of Storey	8
Grade of Concrete (Beam & column)	M40
Grade of Concrete (Slab)	M30
Grade of Steel	Fe415
Column	(EC) 450mmx450mm (IC) 350mmx300mm
Beam	500mmx350mm
Slab Thickness	150mm
Wall Thickness	200mm
Storey Height	3m
Type of Soil	II- Medium soil
Seismic Zone	Zone - II
Zone Factor	0.16
Importance Factor	1.0
Response Reduction Factor	3.0
Type of Soil	B – Medium Soil

B. Midas Gen

With the use of Midas gen ,first we select a normal building and analyze it.After that we'll analyze using shear wall and bracingand then we'll decide which methods will be feasible .

1) Analysis of Normal Building In Midas



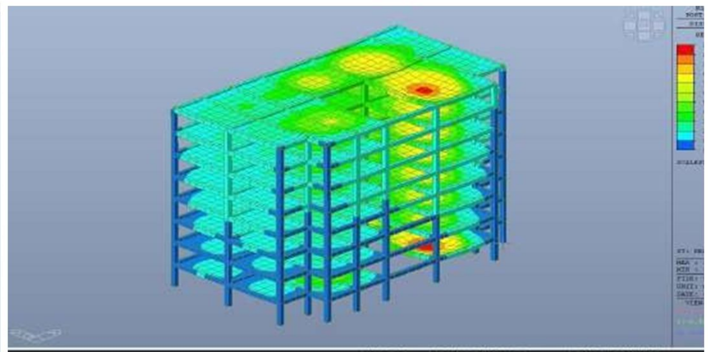


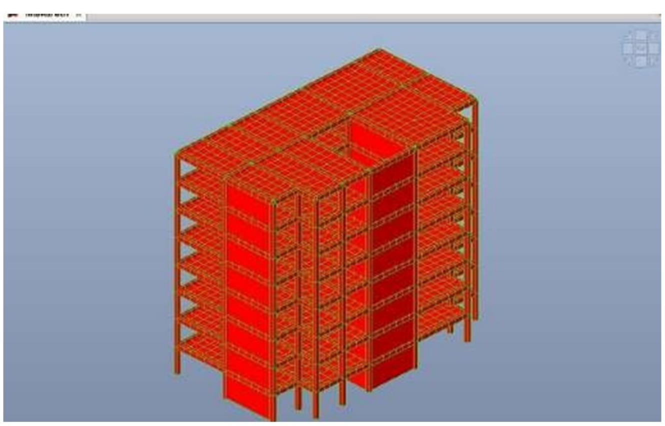
Fig 2: Normal Building In Midas Gen Fig 3: Displacement Contour

2) Analysis Results

Node	Load	FX (kN)	FY (kN)	FZ (kN)	MX (kN*m)	MY (kN*m)	MZ (kN*m)
51	EQX L	-75.672913	-1.324479	36.986091	2.265603	-134.21307	0.176294
52	EQX L	-70.326830	-0.968213	241.232450	1.288558	-125.02497	0.146276
53	EQX L	-63.037499	0.929843	20.933642	-1.222646	-121.82191	0.186626
54	EQX L	-70.313796	1.918032	-263.763720	-3.456010	-128.78311	0.196383
32	EQY L	2.091676	-51.960743	237.963634	119.78237	3.863636	-0.328654
33	EQY L	1.414243	-57.884010	235.477786	132.84311	3.194320	-0.231940
34	EQY L	-2.757260	-59.560843	-147.727677	134.65272	-4.362393	-0.246489
35	EQY L	-3.709018	-86.246606	382.923196	169.60276	-6.285244	-0.287874
36	EQY L	-1.914493	-72.665466	-748.771283	146.35782	-4.263196	-0.321451
37	EQY L	-0.633486	-66.267644	-667.799474	134.69761	-2.600244	-0.226649
38	EQY L	0.890873	-80.072257	356.727442	148.06874	-0.620719	-0.270517
39	EQY L	-0.293229	-63.680169	-156.920186	121.42710	-1.777907	-0.314082
40	EQY L	0.070971	-70.177915	12.385665	137.65911	0.178416	-0.263944
41	EQY L	0.130422	-78.029784	15.934909	162.60054	0.186121	-0.313860
42	EQY L	2.260101	-53.975845	237.812618	122.63876	4.002139	-0.277297
43	EQY L	2.226449	-54.860208	242.849266	124.39927	3.973976	-0.276236
44	EQY L	-0.956344	-51.072183	-216.664689	120.69432	-2.945816	-0.239636
45	EQY L	-1.911379	-49.446041	-135.850137	119.92645	-3.940127	-0.262916
46	EQY L	2.343636	-56.276193	246.969867	126.70616	4.112953	-0.289943
47	EQY L	2.020349	-58.455535	254.902541	130.53753	3.828991	-0.299603
48	EQY L	-3.462866	-51.955989	-167.027916	124.15121	-6.706497	-0.336609
49	EQY L	1.869514	-59.283075	270.759490	133.33363	3.659732	-0.285823
50	EQY L	-0.151324	-71.622728	-8.137206	135.71617	-0.044616	-0.268189
51	EQY L	-0.044578	-70.446745	-73.768126	136.64783	0.028071	-0.269436
52	EQY L	-0.346841	-70.943283	-108.153238	140.53509	-0.256740	-0.285714
53	EQY L	0.490637	-73.722699	-108.611430	145.37643	0.639979	-0.290604
54	EQY L	0.392030	-76.453919	3.595045	151.95554	0.445708	-0.295070
SUMMATION OF REACTION FORCES PRINTOUT							
	Load	FX (kN)	FY (kN)	FZ (kN)			
	DEAD	0.000000	0.000000	18624.497600			
	LIVE L	0.000000	0.000000	0.000000			
	WX	-245.576638	-0.000000	0.000000			
	WY	-0.000000	-546.168822	0.000000			
	EQX L	-1476.759768	-0.000000	0.000000			
	EQY L	-0.000000	-1476.759768	0.000000			

FIG 4: RESULTS FIG 5: SHEAR FORCE RESULTS

C. Analysis Of Building Using Shear Walls



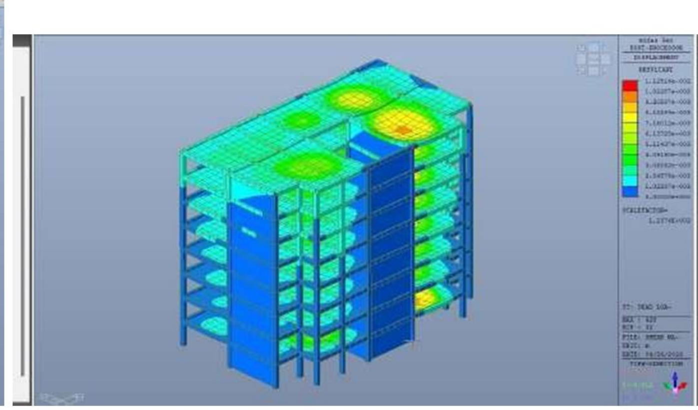


FIG 5 : SHEAR WALL FIG 6: DISPLACEMENT CONTOUR

1) Analysis Results

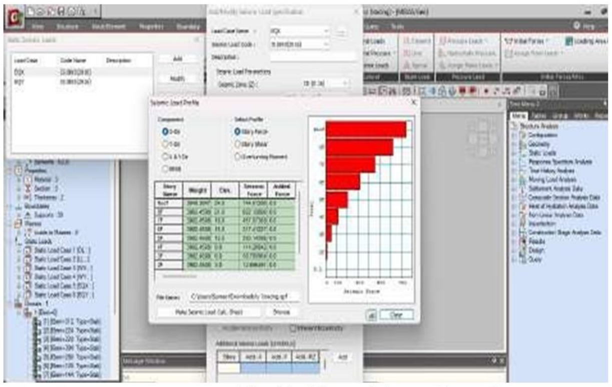


Fig 7: Shear Force Results

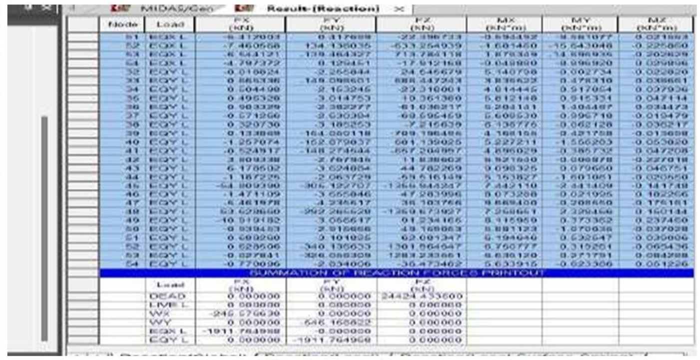


Fig 8: Results

D. ETABS

In ETABS , we'll analyze the normal building. After that, we'll use different methods such as shear wall,X bracing,base isolation, etc.

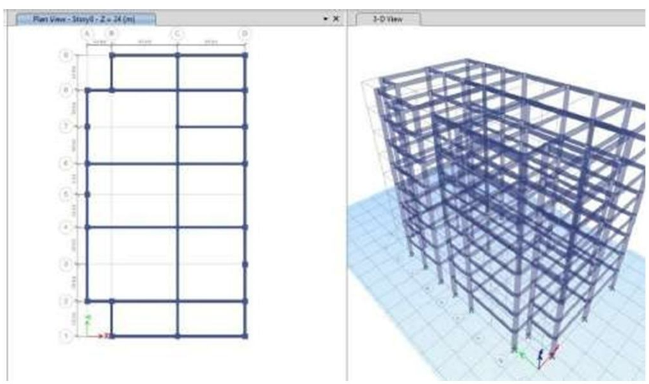


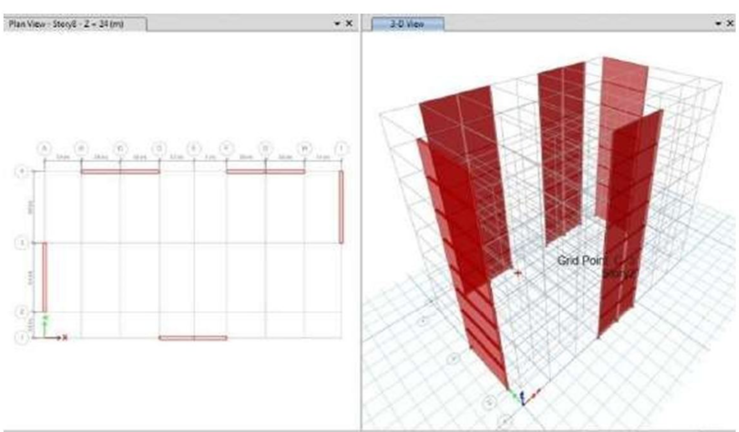
Fig 8: Normal Building Using Etabs

5.1 Structure Results

Table 5.1 - Base Reactions

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
Dead	LinStatic		0	0	25433.578	202337.2033	-345105.826
Live	LinStatic		0	0	12980.48	103344.256	-177832.576
wind	LinStatic	Max	0	0	0	0	0
wind	LinStatic	Min	0	0	0	0	0
seismic	LinStatic	Max	0	0	0	13725.0169	0
seismic	LinStatic	Min	-911.9515	-724.5103	0	0	-17275.8755

Fig .9: Results



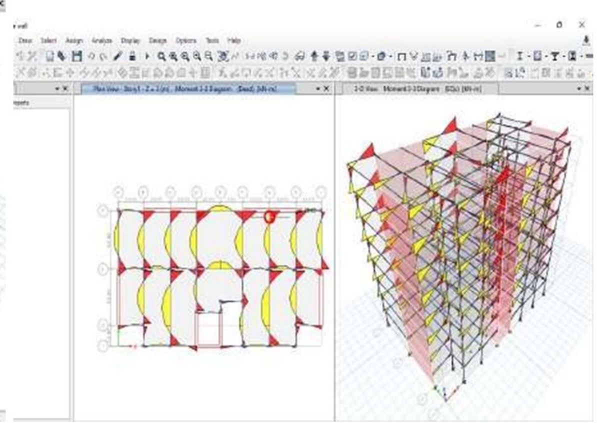


FIG 10 : SHEAR WALL FIG 11: MOMENT DIAGRAM

FIG 12 : Moment and shear for Shear wall in Building

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5.1 Structure Results

Table 5.1 - Base Reactions

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m
Dead	LinStatic		0	0	33296.0278	262989.432	-453176.0519
Live	LinStatic		0	0	12980.48	103344.256	-177832.576
wind	LinStatic	Max	0	0	0	0	0
wind	LinStatic	Min	0	0	0	0	0
seismic	LinStatic	Max	0	0	0	32377.307	0
seismic	LinStatic	Min	-1731.7022	-1731.7022	0	0	-32377.307

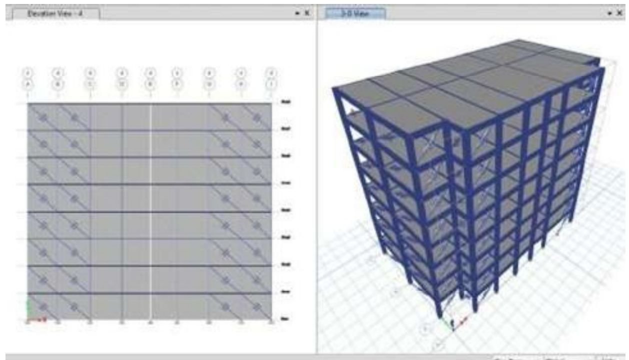
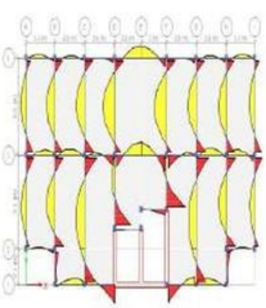
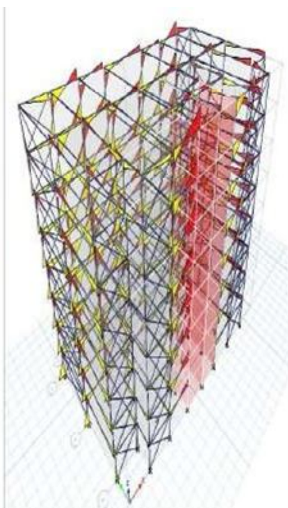


Fig 13 : Structure Results Fig 14 : X-Bracing





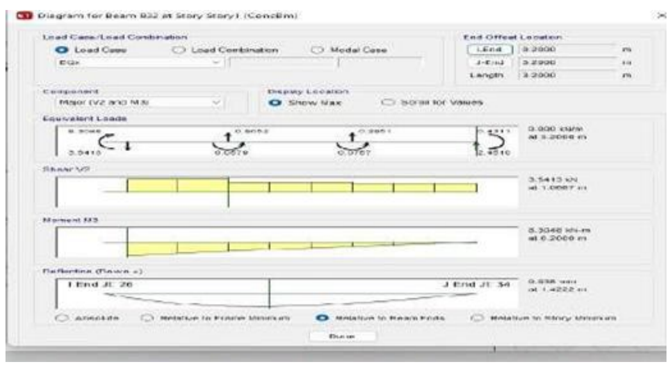


Fig 15 : Moment Diagram For X-Bracing Fig 16: Moment And Shear Of A Beam For X Bracing Wall Building

5.1 Structure Results

Table 5.1 - Base Reactions

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m
Dead	LinStatic		0.0009	0.0138	25345.6459	202241.4409	-344967.6594	0.1455
Live	LinStatic		0.0003	0.0086	12980.48	103344.256	-177832.576	0.0932
wind	LinStatic	Max	0	0	0	0	0	0
wind	LinStatic	Min	0	0	0	0	0	0
seismic	LinStatic	Max	0.0003	0.0004	0	9088.0237	0	4912.552
seismic	LinStatic	Min	-614.8228	-479.4467	0	0	-11652.7825	-6508.7632

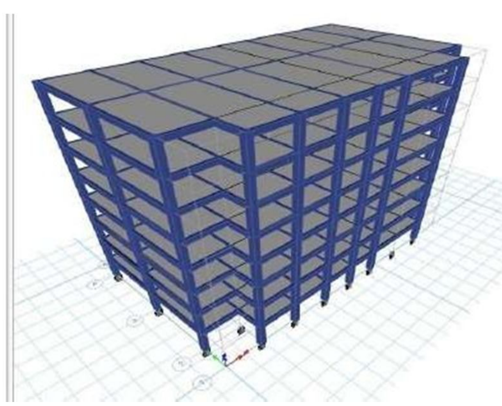


Fig 17 : Structure Results Fig 18 : Base Isolation

5.1 Structure Results

Table 5.1 - Base Reactions

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m
Dead	LinStatic		123.6985	-46.089	68190.9852	539794.6283	-925228.5635	-9428.3978
Live	LinStatic		11.9669	6.8853	12196.6589	99381.3691	-167332.0497	-827.5131
wind	LinStatic		0	0	0	0	0	0
wind1	LinStatic	Max	0	0	0	0	0	0
wind1	LinStatic	Min	0	0	0	0	0	0
seismic	LinStatic	Max	39.4221	-19.6718	108.2919	19029.1356	-12021.5667	-31.7264
seismic	LinStatic	Min	-55.2496	-29.5856	-182.1237	-8005.6083	-15318.0809	-555.3767

FIG 19 : Results

E. Staad Pro

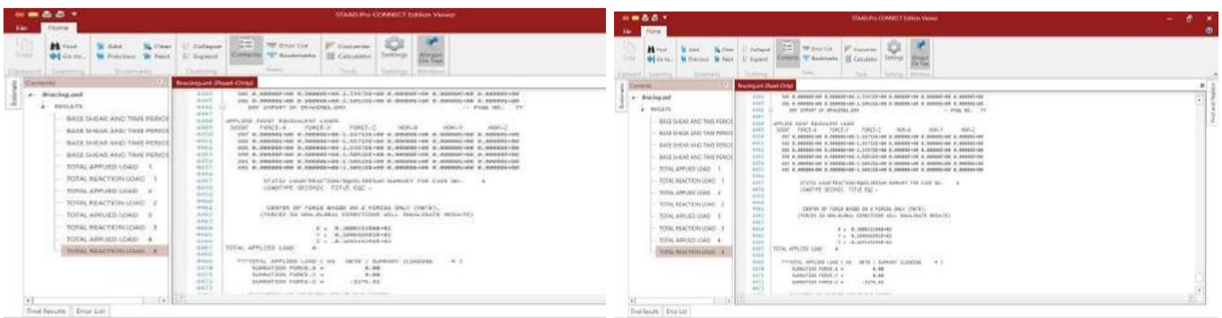


FIG 20: Results

V. CONCLUSION

We employed a variety of techniques in this study to increase the structural resistance to earthquakes and other natural disasters, including X bracing, shear walls,etc. ETABS, Midas Gen and STAAD pro were used to compare these approaches. In order to determine which strategy will be practical to utilize, this article analyzes the behavior of the high-rise construction utilizing different approaches. After evaluating, we discovered that a shear wall would be an excellent choice since it exhibits more moments than other techniques, hence minimizing the damage done to the building during an earthquake or strong winds. We discovered that the outcomes from the two softwares were comparable, but with minor differences in their moments. When there are issues with seismicity and wind resistance, these techniques can be used. Based on the research and analysis presented in this paper, we may conclude that there is still a long way to go before people of the most seismically vulnerable locations canbe completely protected. Earthquakes are really significant problems because of all the ways they affect human lives. Besides bracing and base isolation, additional methods can also be utilized to reduce earthquake damage. To survive earthquakes, a structure must adhere to particular structural specifications. the variety of alternatives for combating these effects and bolsteringthe structural element.The focus of this research is on constructions that can withstand earthquakes. We learned more about howhigh-rise buildings respond to earthquakes. This approach illustrates how earthquake-resistant frameworks work. Researchers from all across the world are working to create building technology that is both affordable and efficient by using locally accessible resources. The behavior of high-rise buildings is examined in this research. The results also showed that a range of methods may be used to make high-rise constructions resistant to wind- and seismic-related problems. This has to be applied more swiftly throughout the nation, particularly in regions with substantial wind resistance and seismicity issues. We saw the need for new technology, and these techniques help to reduce seismic damage.We got to know shear walls are more feasible than others methods as it shows more moments in a graph which will help in reducing seismic force while an earthquake occurs.

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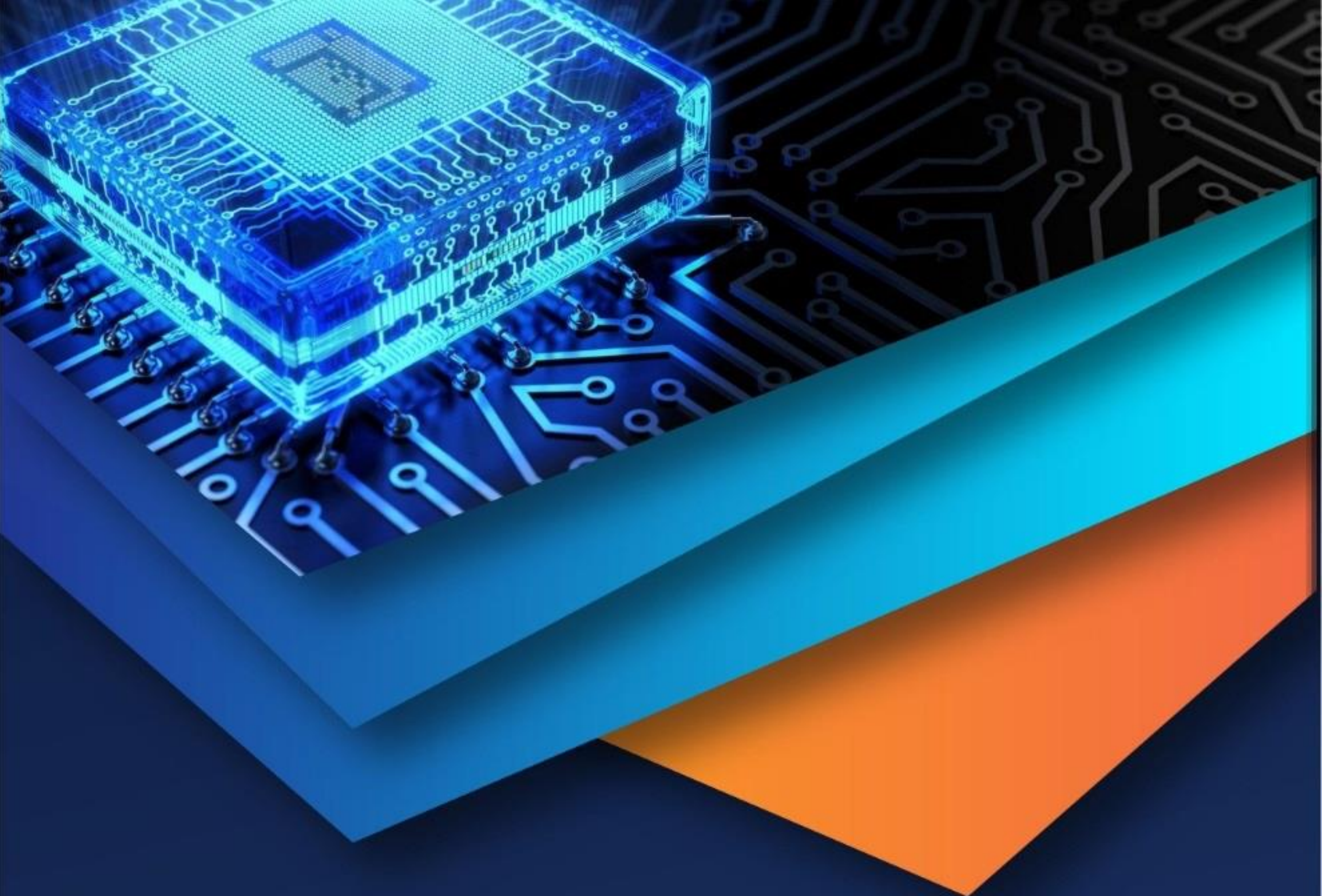

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