Study and analysis of time history analysis of G+10 stories RCC buildings using Etabs Software

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Abstract -A comparison is made between different construction models with diagonal grid and the respective tubular construction models. The complex geometries of the buildings, together with the high cost of land, underline the need to consider architectural ideas and structural concepts side by side. As the height of the building increases, the lateral load resistance system is more important than the gravity load resistance system. There are various lateral load resistance systems, such as moment frame system, braced frame system, shear wall system, and advanced structural systems with tubular shapes. nDiagrid is another recent invention in this area, which is a modification of the Tubular system. Diagrid is the best choice when the tubular system does not meet the requirements, especially in the case of complex geometry. In this work, Diagrid and Tubular structures are compared to study the structural efficiency of both types of structures. ETABS covers all aspects of the engineering design process. In the current conditions of the real estate industry, prefabricated structures are important; Generally, those that achieve the most effective results are elevated elements, such as beams and columns, in multi-story R.C buildings. This software is mainly used for structures such as high-rise buildings, concrete and steel. This paper aims to investigate the high-level (G+10) structure of the Earth considering seismic, dead and live loads.

Key Word- Diagrid Building, Conventional Frame Building, Time Period, Steel Weight, ETABS Software

1. INTRODUCTION

This work deals with a comparative study of the diagonal structure with the traditional structure subjected to lateral loading. The construction of high-rise buildings or more high-rise buildings in this period; Due to population growth, economic prosperity and land shortage, tall buildings are preferred. Height is the main objective in this type of building, and the demand for high-rise buildings has increased due to increasing demand for commercial and residential areas, developments in construction, high-strength structural elements, various building materials and software such as ETABS [1].

In high-rise buildings, as building height increases, lateral load considerations become more important. There are many systems that resist lateral load, such as steel frame system, shear wall, reinforced pipe system, anchorage system and piping system. Currently, the diagonal grid construction system is widely used in high-rise buildings due to its unique geometric configuration. This system is a combination of triangular beams that can be straight or curved and horizontal loops. The Diagrid structure itself acts as columns and diagonal joints, thus carrying gravity and lateral loads. The purpose of using inclined structure in high-rise buildings is, firstly, to increase the stability of the structure due to its triangular configuration, and secondly, to provide an alternative method of loading in case of structural failure [2-3].

These are the analysis and design programs that have enabled high-rise buildings to grow. In the nineteenth century, high-rise buildings were built in the United States of America, but today, due to people's needs, high-rise buildings are being built everywhere, which leads to the sustainable development of society, "development that meets the expectations and needs of the current generation without compromising the ability of future generations to meet their requirements." According to studies and articles published in 1980, most high-rise buildings are located in America, and now the latest research shows that the number of high-rise buildings and the construction process is high in Asian countries, about 32% and 24% in North America and Europe. High-rise buildings are usually built and used for commercial office buildings, apartments, etc. [4-5].

The construction of tall buildings is not as easy as normal buildings due to the action of lateral loads, as lateral displacement causes bending and shear lag effects will be more resistant to lateral loads, new systems have been developed, known for their resistance to lateral load systems, some consider the tubular system to be the most efficient in terms of weight reduction and better resistance to lateral load. They are manufactured with a rigid outer frame to resist lateral loads, allowing the inner frame to support gravity loads only. The distance between the interior and exterior is determined by beams or trusses and is intentionally left without columns [6-7].

This increases the efficiency of the circumferential tube by transferring some of the gravity loads within the structure to it and increases its ability to resist tipping due to lateral loads. Diagrid or Exo is a new concept for resisting lateral loads in high-rise buildings. These are the latest changes to the tubular chassis, where the tubes are arranged diagonally around the perimeter of the chassis. That is, the columns are placed in an inclined position to form a triangular configuration, such that all loads acting on the plan are distributed as axial forces; Instead of bending or shearing[8]. The tubular configuration uses building plan dimensions to resist bending moment. But this potential bending efficiency is not fully achieved due to shear deformation of the structural webs. On the other hand, diagonal grid systems, which provide shear strength and stiffness through axial movement in the diagonal bars, rather than momentary bending in beams and columns, allow almost full exploitation of the theoretical bending strength [9].

These natural disasters have caused damage and disrupted the development of the natural life cycle. Since it is a global concern, many analyzes have to be done and results given to prepare the structure to arrive at the right time. With the advancement of technology, man has tried to combat these natural conditions in various ways such as creating early warning systems for disasters, taking new preventive measures, and appropriate relief and rescue measures. However, this is not true for all natural disasters. Hazard maps showing seismic zones in seismic codes as per IS 1893:2016 are updated from time to time resulting in additional shear requirements for existing structures. Building collapse can be minimized if the following points are taken into consideration. Most building structures include structural elements such as beams, columns, foundations, shear walls, and floor slabs. Floor slabs in multi-storey buildings, which usually transfer gravity loads to the building system, are necessary to transfer collective inertial forces to the building system.

The failure mode can be made flexible instead of brittle. If ductility is ensured, the resulting energy dissipation will show little change.

1. Shear must not fail before bending.
2. Column failure comes after beam failure.
3. The joints must be stronger than the knuckles
4. Perform dynamic structural analysis using the response spectrum method

Researchers have been studying earthquakes for a long time and they are still unpredictable. It is impossible to predict the time and location of an earthquake. The design and construction of earthquake-resistant buildings has been a topic of research for many years, as researchers need to estimate the frequency of earthquakes and the strength of future building designs. Safety, strength and performance are factors taken into consideration during building construction, especially in earthquake zones. However, rules and guidelines are developed by engineering organizations around the world that can be used to design buildings. Factors that cause structural failure under earthquakes are:

(i) Poor and weak infrastructure planning and irregularities in the planning stage.

(2) Minimum strength and ductility considerations at the design stage.

(3) Unplanned and unscientific construction activities and sequences. Population growth leads to land scarcity.

This type of skyscraper structure is affected by environmental conditions. Since such earthquakes are very dangerous due to the damage and impacts they cause on building parts, they cannot be controlled. These natural disasters damage buildings and disrupt the development of the natural life cycle. Since this is a global concern, many analyzes need to be analyzed and results given to improve the design in order to save time. With the development of technology, humans have tried to deal with these natural phenomena in various ways, such as creating early warning systems for disasters, taking new preventive measures, and taking appropriate measures for assistance and rescue [10].

2. LETERATURE REVIEW

Rohit kumar Singh (2014) presented a comparative study of 5 stories with 15m X 15m floor plan of diagrid structural system and conventional R.C.C. construction using STAAD Pro. Comparing the analysis results in terms of top floor displacement, floor drift, shear strength and base axial force. Diagrid shear strength is 977 KN, max. The bending moment is 29 KN-m, while for standard structures it is 931 KN and 132 KN-m, respectively. Harish Varsani (2015) presented a comparative study of 24 floors with 36m X 36m floor plan of diagrid building system and conventional steel building system using ETABS. They compare the shear floor analysis result in the form of a graph, which shows that the floor shear of the diagrid structure due to the earthquake load is higher compared to the normal structure.

Manthan Shah (2016) presented a comparative study of 4, 8, 12, 16, 20, 40 and 48 stories with 18m X 18m floor plan of diagrid building system and conventional building system using ETABS. They compared the result of the base shear analysis, the base shear will be the same on both sides as it is known that the diagrid system is stronger than the standard frame, it attracts more lateral forces so it has base shear up to 12 buildings. After 12 stories, the static wind loads take over and become the dominant force and the base shear is dominated by the static wind loads. Therefore, after 12 floors, it can be seen that the shear base in both systems is the same.

Deepika R. (2016) presented a comparative study of 30 stories and 30m X 30m plan of Diagrid building system and Hexagrid building system using ETABS. They came up with a comparative result of the first mode time in diagrid structure is 3.268 seconds, and in hexagrid structure is 3.69 seconds. Harish Varsani (2015) presented the result of comparing the first mode time in diagrid structure is 2.74 seconds, while simple frame is 6.96 seconds. Manthan Shah (2016) gives the result of comparing the time period in graph form, which shows that the period of the diagrid structure is less than the normal structure.

Rohitkumar Singh (2014) presented the result of comparing the top floor in diagrid construction is 18.8 mm, while the conventional construction is 34.7 mm. Harish Varsani (2015) noticed that the diagonal pillars resist the lateral loads of the structure, the local displacement is less in the diagrid structure compared to the conventional construction. The maximum clearance for the standard structure is 172.7 mm and for the diagrid structure the maximum clearance is only 31.6 mm. Manthan Shah (2016) presented the result of comparing the top floor displacement in the form of a graph. They noted that the structural pattern is the same, but the overall displacement rates are much higher for conventional frames, even though they are designed for larger column sizes. Therefore, it proves the efficiency of diagrid structures. Raghunath Deshpande (2015) presented a comparative study of 60 floors with 24m X 24m floor plan with central wall of diagrid building system and conventional building system using ETABS. They presented the result of comparing the arrows of each floor in both systems. plural. The deviation in the standard system is 84.90 mm, while in the diagrid system it is only 75.00 mm.

Gaurav B N et al (2021), evaluated the results of soil type I for different seismic zones of a high-rise building from (G + 29) using ETAB software and response spectrum analysis. The response spectrum is used to compare the behavior of the models in four earthquake zones (zones II, III, IV, and V), using the base response, floor deflection, duration, and ground stiffness as criteria. Yashree Unclekhop et al. (2021), studied the analysis and design of the structure with rectangular and circular column, and determined the parameters of all floors of the building, shear strength, average reaction, floor stiffness, floor shear, falling moment, floor displacement, floor area. drifting and so on. Their study shows that both analysis and design are compared with software and manual calculations according to IS 456-2000. Nitin R Moulay et al. (2020), their research shows that the multi-hazard approach to assessing the damage risk of high-rise buildings, when a multi-story RC building is subjected to wind and earthquake hazards, the ground displacement varies from one floor to another. , that is, the storey displacement does not increase with the height of the building compared to normal seismic excitation. Due to wind and earthquakes, the amount of landslides increases with the height of the building but decreases significantly at 14 floors.

W Bourouia et al (2019), their study shows that the research aims to simulate the interaction between the concrete wall and the soil under earthquakes. The purpose of their research is to investigate the effect of soil properties and soil structure interactions on the seismic response of buildings. The results show that the soil condition has a significant effect on the seismic behavior of buildings. Shubham Purkar et al. (2019), studied the analysis and design of the structure (G + 6) in different seismic zones and soil types. Their research shows that because soil-I is a stiff soil, the interaction of the base is lower because the soil is stronger and stronger than soil-II and soil-III. The amount of floor drift increases with increasing seismic field factor. Mandala Rohini (2019), conducted the seismic response of a two-story residential building (G + 15) in the 3rd and 5th district using response spectrum and ETAB chronological history methods. The results show that the amount of soil removal is higher in region V than region III. Ground shear is large on Earth in both the response spectrum method and the time recording method. Region V values are higher than Region III. Umamaheswara Rao Tallapalem et al. (2019), their research shows that if an earthquake hits a multi-story building in a densely populated area, it will cause significant damage. In this work, a building (G + 7) was built in Staad Pro and seismic analysis of the building was done in different seismic zones (II, II, IV and V) in India. The results show that the core shear, displacement, support interaction and metal content depend on the area, so these values are higher in the V area.

Jayaprakash et al. (2019), studied the response spectrum method for the analysis of a single-story building (G+30) with a reinforced concrete surface under seismic loads. The results showed that the soil displacement is higher in the upper floor and it was also noted that with the increase in the height of the building, the stiffness of the sides decreases, and the soil drift is higher in the middle of the building and decreases towards the gate. the end. roof level. Nilesh F Uke et al. (2019), their study showed that (G+11) monitored the effects of earthquake and wind loads on the structure. It was concluded that the seismic and wind stress on multi-story buildings increases with the increase in building height. It was found that earthquake forces are less effective than wind forces on tall buildings because tall buildings are more flexible, but earthquake forces are more effective on short buildings. Ground displacement is important at high levels during earthquake events, but is neglected at high wind-driven levels. Rajeshwari et al. (2019), their study reports that earthquake resistance in construction through seismic investigation of the building foundation using static equivalent learning method. For this purpose a program of residential buildings (G + 10) has been proposed. Structural displacement increases with increasing seismic fields and wind pressure. Most of the erosion occurred in the central part of the structure and increased as the seismic zone increased.

Amir Hassan et al. (2018), studied the effect of the soil condition under the closed foundation of the structure (G+12) using the ETAB system. The seismic performance of multi-story buildings is compared and evaluated using a systematic approach. The result shows that the amount of base shear is proportional to the ductility of the soil and the stiffness of the superstructure. Gaurav Sachdeva (2017), studied the effect of different soil and seismic zones on different areas of the frame structure. There are three types of soil: soft, medium and hard with lengths of 15 m, 18 m, 21 m and 24 m respectively, and are distinguished by the higher bending moment in hard soil layers compared to soft soil layers in earthquakes. four are also read. Mahmood Azad et al. (2015), their research shows that the effect of building size on wind and earthquake response. In this study, three different building conditions were studied, and a comparison was presented between the different building conditions and the resulting lateral loads due to wind and earthquakes. The investigation looked at the Bangladesh National Building Code (BNBC) 2006. The results show that building design has a significant impact on reducing building erosion.

3. METHODOLOGY

Structural response tests are planned using ETABS software specifying all dimensional and material parameters. The history of different periods should be analyzed to find certain errors. In short description:

1. The model is designed for different types of vertical irregularities.
2. Time history analysis is performed on models in ETABS.
3. The results are organized and compared with chronological history and some anomalies.

The folding of the structure can be reduced if the end points are considered. Most building structures include structural elements such as beams, columns, arches, shear walls, and floor slabs. Floor slabs in multi-story buildings, which often transfer gravity loads to the building system, are needed to transfer lateral forces to the building system.

Failure patterns can be made ductile rather than brittle. If the tensile strength is confirmed, the dissipation of the generated energy will show a slight deterioration.
1. Shear must not fail before bending.
2. Column failure occurs after packet failure.
3. Joints must be stronger than joints
4. Structural variable analysis using the response spectrum method

4 DESIGNS AND ANALYSIS

4.1 CONVENTIONAL FRAME BUILDING

Recent trends in high-rise commercial architecture have led to a variety of unusual configurations, innovative structural systems and efficient materials that challenge current design practices. One of the design goals of this model is to ensure that the models represent the characteristics of the residential building. These days, high-rise buildings vary in form, height and function. This is what makes the characteristics of each building different from the other. There are specific standards for each type of high-rise building, such as residential, official and commercial buildings. The seismic design of modern high-rise buildings, defined as structures with height running through them, presents a series of challenges that must be addressed by considering the scientific, engineering and specific issues of modeling, analysis and an appropriate acceptance process for this unique design. There are key factors for designing the model such as floor orientation, grid spacing, floor length, column and beam.

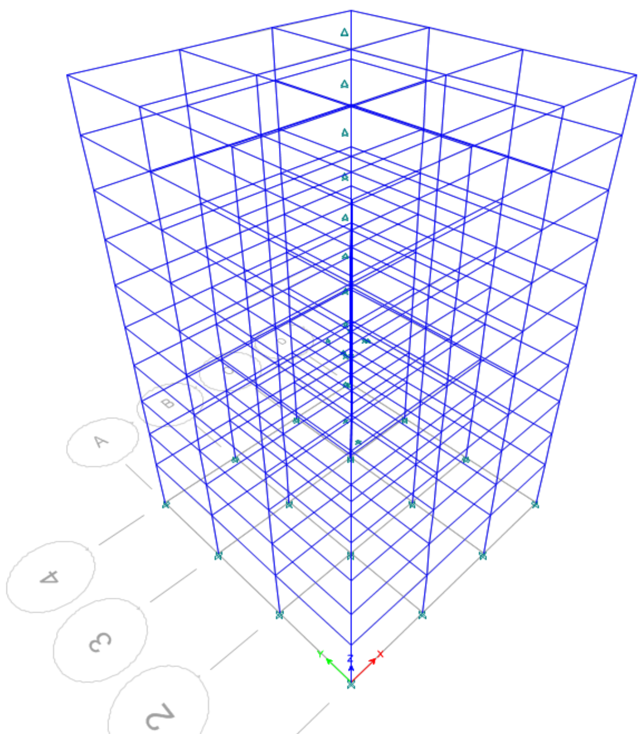

Figure.1. Geometry of conventional frame building

4.1 Load Patterns

Table 1. Load Pattern

Name	Is Auto Load	Type	Self Weight Multiplier
~LLRF	Yes	Other	0
Dead	No	Dead	1
Live	No	Live	0

4.2 Functions

Table 2. Functions - Response Spectrum

Name	Period sec	Value	Damping Ratio
UnifRS	0	1	0.05
UnifRS	1	1	

4.3 Load Cases

Table 3. Load Case

Name	Type
Dead	Linear Static
Live	Linear Static
Modal	Modal - Eigen

4.1.1. RESULT AND DISCUSSION

Table 4. Base Reactions

zLoad Case	Fx kN	Fy kN	Fz kN	Mx kN m	My kN m	Mz kN m
Dead	0.0	0.0	24854.8	248524.1	- 311857.6	0.0
Live	0.0	0.0	7522.0	75022.0	-93896.0	0.0
FLOOR FINISH	0.0	0.0	5065.0	50056.0	-62753.0	0.0
EQ-X	-1146.1	0.0	0.0	0.0	-29951.2	11654.3
EQ-Y	0.0	-301.4	0.0	7643.3	0.0	-3767.5
RS-X Max	852.8	644.4	0.0	12957.2	19227.8	9624.9
RS-Y Max	357.1	241.0	0.0	8527.1	7654.2	3756.5

Story Results

Table 5. Story Drifts

Story	Output Case	Case Type	Direction	Drift	Label	X m	Y m	Z m
Story10	Dead	LinStatic	X	2E-06	15	5.4864	3.6576	9.4488
Story10	Dead	LinStatic	Y	2E-06	1	0	0	9.4488
Story9	Dead	LinStatic	X	1.294E-07	15	5.4864	3.6576	8.5344
Story9	Dead	LinStatic	Y	1.294E-07	1	0	0	8.5344
Story8	Dead	LinStatic	X	6.571E-08	3	0	3.6576	7.62
Story8	Dead	LinStatic	Y	6.571E-08	4	0	5.4864	7.62
Story7	Dead	LinStatic	X	1.431E-08	3	0	3.6576	6.7056
Story7	Dead	LinStatic	Y	1.431E-08	4	0	5.4864	6.7056
Story6	Dead	LinStatic	X	1.21E-08	16	5.4864	5.4864	5.7912
Story6	Dead	LinStatic	Y	1.21E-08	1	0	0	5.7912
Story5	Dead	LinStatic	X	1.642E-08	16	5.4864	5.4864	4.8768
Story4	Dead	LinStatic	X	2.586E-08	16	5.4864	5.4864	3.9624
Story4	Dead	LinStatic	Y	2.586E-08	13	5.4864	0	3.9624
Story3	Dead	LinStatic	X	8.495E-08	16	5.4864	5.4864	3.048
Story3	Dead	LinStatic	Y	8.495E-08	13	5.4864	0	3.048
Story2	Dead	LinStatic	X	2.112E-07	16	5.4864	5.4864	2.1336
Story2	Dead	LinStatic	Y	2.112E-07	13	5.4864	0	2.1336
Story1	Dead	LinStatic	X	3.125E-07	1	0	0	1.2192
Story1	Dead	LinStatic	Y	3.125E-07	1	0	0	1.2192

Table 6. Story Forces

Story	Output Case	Case Type	Location	P kgf	VX kgf	VY kgf	T kgf-m	MX kgf-m	MY kgf-m
Story10	Dead	LinStatic	Top	13792.9	0	0	0	37836.68	-37836.68
Story10	Dead	LinStatic	Bottom	22581.27	0	0	0	61944.93	-61944.93

Story	Output Case	Case Type	Location	P kgf	VX kgf	VY kgf	T kgf-m	MX kgf-m	MY kgf-m
Story10	Live	LinStatic	Top	0	0	0	0	0	0
Story10	Live	LinStatic	Bottom	0	0	0	0	0	0
Story9	Dead	LinStatic	Top	36374.17	0	0	0	99781.61	-99781.61
Story9	Dead	LinStatic	Bottom	45162.54	0	0	0	123889.87	-123889.87
Story9	Live	LinStatic	Top	0	0	0	0	0	0
Story9	Live	LinStatic	Bottom	0	0	0	0	0	0
Story8	Dead	LinStatic	Top	58955.43	0	0	0	161726.54	-161726.54
Story8	Dead	LinStatic	Bottom	67743.8	0	0	0	185834.8	-185834.8
Story8	Live	LinStatic	Top	0	0	0	0	0	0
Story8	Live	LinStatic	Bottom	0	0	0	0	0	0
Story7	Dead	LinStatic	Top	81536.7	0	0	0	223671.48	-223671.48
Story7	Dead	LinStatic	Bottom	90325.07	0	0	0	247779.73	-247779.73
Story7	Live	LinStatic	Top	0	0	0	0	0	0
Story7	Live	LinStatic	Bottom	0	0	0	0	0	0
Story6	Dead	LinStatic	Top	104117.97	0	0	0	285616.41	-285616.41
Story6	Dead	LinStatic	Bottom	112906.34	0	0	0	309724.67	-309724.67
Story6	Live	LinStatic	Top	0	0	0	0	0	0
Story6	Live	LinStatic	Bottom	0	0	0	0	0	0
Story5	Dead	LinStatic	Top	126699.24	0	0	0	347561.34	-347561.34
Story5	Dead	LinStatic	Bottom	135487.61	0	0	0	371669.6	-371669.6
Story5	Live	LinStatic	Top	0	0	0	0	0	0
Story5	Live	LinStatic	Bottom	0	0	0	0	0	0
Story4	Dead	LinStatic	Top	149280.5	0	0	0	409506.28	-409506.28
Story4	Dead	LinStatic	Bottom	158068.87	0	0	0	433614.54	-433614.54
Story4	Live	LinStatic	Top	0	0	0	0	0	0
Story4	Live	LinStatic	Bottom	0	0	0	0	0	0
Story3	Dead	LinStatic	Top	171861.77	0	0	0	471451.21	-471451.21
Story3	Dead	LinStatic	Bottom	180650.14	0	0	0	495559.47	-495559.47
Story3	Live	LinStatic	Top	0	0	0	0	0	0
Story3	Live	LinStatic	Bottom	0	0	0	0	0	0
Story2	Dead	LinStatic	Top	194443.04	0	0	0	533396.15	-533396.15
Story2	Dead	LinStatic	Bottom	203231.41	0	0	0	557504.4	-557504.4
Story2	Live	LinStatic	Top	0	0	0	0	0	0
Story2	Live	LinStatic	Bottom	0	0	0	0	0	0
Story1	Dead	LinStatic	Top	217024.31	0	0	0	595341.08	-595341.08
Story1	Dead	LinStatic	Bottom	228742.13	0	0	0	627485.42	-627485.42
Story1	Live	LinStatic	Top	0	0	0	0	0	0
Story1	Live	LinStatic	Bottom	0	0	0	0	0	0

Modal Results

Table 3.7. Modal Periods And Frequencies

Case	Mode	Period sec	Frequency cyc/sec	CircFreq rad/sec	Eigenvalue rad2/sec2
Modal	1	0.103	9.688	60.8709	3705.2629
Modal	2	0.103	9.688	60.8709	3705.2629
Modal	3	0.089	11.235	70.5932	4983.3987
Modal	4	0.049	20.44	128.4307	16494.4448
Modal	5	0.035	28.883	181.4799	32934.9453
Modal	6	0.035	28.883	181.4799	32934.9453
Modal	7	0.033	30.502	191.651	36730.0997
Modal	8	0.033	30.502	191.651	36730.0997
Modal	9	0.029	34.568	217.1994	47175.5682

Case	Mode	Period sec	Frequency cyc/sec	CircFreq rad/sec	Eigenvalue rad2/sec2
Modal	10	0.028	35.697	224.2925	50307.1269
Modal	11	0.025	40.121	252.0872	63547.9365
Modal	12	0.023	42.565	267.4439	71526.2268

Table 8. Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	SumUX	SumUY	SumUZ	RX	RY	RZ	SumRX
Modal	1	0.103	0.7245	0.0863	0	0.7245	0.0863	0	0.0242	0.2032	0	0.0242
Modal	2	0.103	0.0863	0.7245	0	0.8108	0.8108	0	0.2032	0.0242	0	0.2274
Modal	3	0.089	0	0	0	0.8108	0.8108	0	0	0	0.8351	0.2274
Modal	4	0.049	0	0	0	0.8108	0.8108	0	0	0	0	0.2274
Modal	5	0.035	4.695E-06	2.472E-05	0	0.8108	0.8108	0	0.0004	0.0001	0	0.2278
Modal	6	0.035	2.472E-05	4.696E-06	0	0.8108	0.8108	0	0.0001	0.0004	0	0.2279
Modal	7	0.033	0.0963	0.0206	0	0.9071	0.8314	0	0.0994	0.4655	0	0.3272
Modal	8	0.033	0.0206	0.0963	0	0.9277	0.9277	0	0.4655	0.0994	0	0.7927
Modal	9	0.029	0	0	0	0.9277	0.9277	0	0	0	0.096	0.7927
Modal	10	0.028	0	0	0	0.9277	0.9277	0	0	0	0	0.7927
Modal	11	0.025	0	0	0	0.9277	0.9277	0	0	0	4.408E-05	0.7927
Modal	12	0.023	0	0	0	0.9277	0.9277	0	0	0	0	0.7927

Table 9. Modal Participating Mass Ratios (Part 2 of 2)

Sum RY	Sum RZ
0.2032	0
0.2274	0
0.2274	0.8351
0.2274	0.8351
0.2275	0.8351
0.2279	0.8351
0.6934	0.8351
0.7927	0.8351
0.7927	0.9311
0.7927	0.9311
0.7927	0.9312
0.7927	0.9312

Table 10. Modal Load Participation Ratios

Case	Item Type	Item	Static %	Dynamic %
Modal	Acceleration	UX	99.82	92.77
Modal	Acceleration	UY	99.82	92.77
Modal	Acceleration	UZ	0	0

Table 11. Modal Direction Factors

Case	Mode	Period sec	UX	UY	UZ	RZ
Modal	1	0.103	0.894	0.106	0	0
Modal	2	0.103	0.106	0.894	0	0
Modal	3	0.089	0	0	0	1

Case	Mode	Period sec	UX	UY	UZ	RZ
Modal	4	0.049	0.511	0.431	0	0.058
Modal	5	0.035	0.16	0.84	0	0
Modal	6	0.035	0.84	0.16	0	0
Modal	7	0.033	0.824	0.176	0	0
Modal	8	0.033	0.176	0.824	0	0
Modal	9	0.029	0	0	0	1
Modal	10	0.028	0.632	0.314	0	0.054
Modal	11	0.025	0	0	0	1
Modal	12	0.023	0.535	0.401	0	0.064

Table 12. Story Response Values

Story	Elevation	Location	X-Dir	Y-Dir
	m		m	m
Story10	9.4488	Top	0.000002	0.000002
Story9	8.5344	Top	1.538E-08	1.538E-08
Story8	7.62	Top	1.337E-07	1.337E-07
Story7	6.7056	Top	7.364E-08	7.364E-08
Story6	5.7912	Top	6.056E-08	6.056E-08
Story5	4.8768	Top	7.162E-08	7.162E-08
Story4	3.9624	Top	8.663E-08	8.663E-08
Story3	3.048	Top	1.103E-07	1.103E-07
Story2	2.1336	Top	1.88E-07	1.88E-07
Story1	1.2192	Top	3.81E-07	3.81E-07
Base	0	Top	0	0

4.2 DIAGRID BUILDING

4.2.1. RESULT AND DISCUSSION

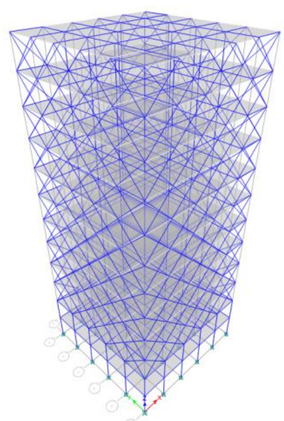

Figure.2. Diagrid Building

4.2.1.1 Story Data

Table 13. Story Definitions

Tower	Name	Height m	Master Story	Similar To	Splice Story	Color
T1	Story10	3	Yes	None	No	Yellow
T1	Story9	3	Yes	None	No	Yellow
T1	Story8	3	Yes	None	No	Yellow
T1	Story7	3	Yes	None	No	Yellow
T1	Story6	3	Yes	None	No	Yellow
T1	Story5	3	Yes	None	No	Yellow
T1	Story4	3	Yes	None	No	Yellow

Tower	Name	Height m	Master Story	Similar To	Splice Story	Color
T1	Story3	3	Yes	None	No	Yellow
T1	Story2	3	No	Story3	No	Gray8Dark
T1	Story1	3	No	Story3	No	Blue

4.2.1.2 Load Pattern Definitions

Table 14. Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
Dead	No	Dead	1	
EQX	No	Seismic	0	IS 1893:2016
EQY	No	Seismic	0	IS 1893:2016
Live	No	Live	0	
WX	No	Wind	0	Indian IS 875:2015
WX(1/2)	Yes	Wind	0	Indian IS 875:2015
WX(2/2)	Yes	Wind	0	Indian IS 875:2015
WY	No	Wind	0	Indian IS 875:2015
WY(1/2)	Yes	Wind	0	Indian IS 875:2015
WY(2/2)	Yes	Wind	0	Indian IS 875:2015

4.2.1.3 Calculated Base Shear

Table 15. Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
X	5361625.619	23651.0669	289.4891

4.2.1.4 Applied Story Forces

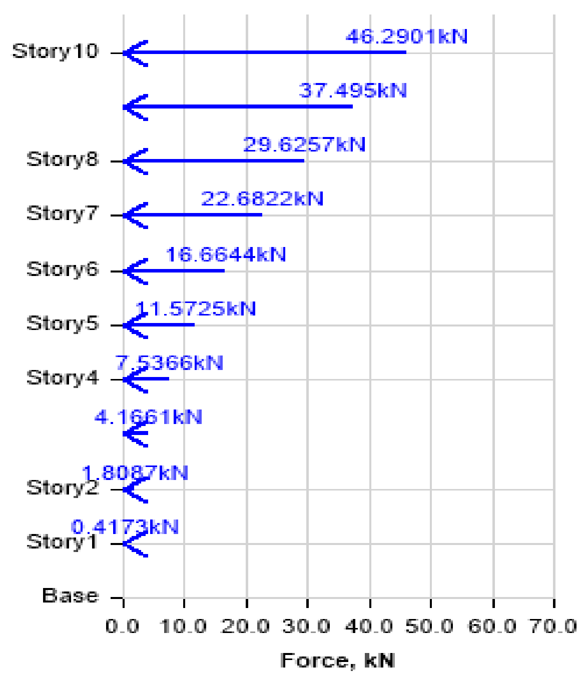

Figure.3. Applied Story Forces

4.2.1.5 Calculated Base Shear

Table 16. Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
Y	4534476.554	23651.0669	289.4891

4.2.1.6 Applied Story Forces

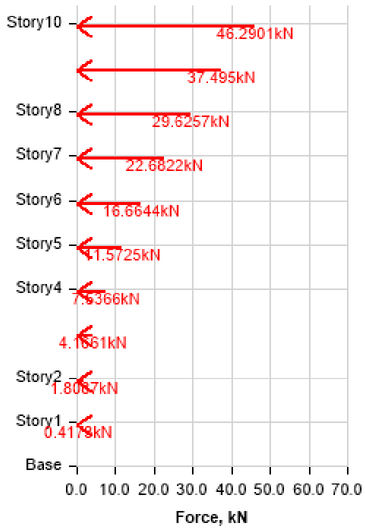

Figure.4. Applied Story Forces

5. CONCLUSION

Loading on high-rise buildings differs from low-rise buildings in several aspects such as greater accumulation of gravity loads at the top compared to lower floors, greater importance of wind loads and greater importance of seismic effects. Therefore, multi-storey structures require proper load evaluation for safe and economical design. Except for static load, load classification cannot be performed accurately. Live load can be roughly estimated from a combination of previous field experience and observations. Wind and earthquake loads are random in nature and difficult to predict. In traditional framework construction, it is estimated based on the probabilistic approach.

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