IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Comparative Study of Responses Developed in RCC Framed High Rise Structure Having Rectangular and Circular Shape Under The Effect of Seismic Load

Comparative study of Responses developed in RCC Framed High rise structure having Rectangular and Circular Shape under the effect of seismic load is presented in this paper. As the height of the building gets increases the shape plays a major role in the effect generated by earthquake. As the effect of earthquake over the edifice cannot be covered in the standard codes of practice as the effects depend on many criteria like irregular plans and cross-sectional shapes of high-rise buildings, hence, more research needs to develop in the subjected area. With this objective, our research study focuses presenting comparison of reactions including base shear (FX), maximum bending moment shear force and Deflection of rectangular and circular shaped High-Rise building with composite columns. A Structure prototype of G+29 with 3m floor to floor heights generated for analyses in Bentley STAAD Pro software v8i module to compare responses and analysis of structural system against seismic load.

Key Words: High Rise Building, Shape factor, Wind load analysis, Composite columns, Base Shear, Building Deflection

1. INTRODUCTION

Rapid growth in population and movements of people towards cities for the better livelihood increases the demands of expansion of cities to provide residential, industrial, recreational and educational infrastructures. As the land is limited it makes the compulsion that the structure increases in the vertical direction. When we increase the structure in vertical direction the structure is liable to various lateral forces developed due to wind and earthquake. Among all the natural hazard, earthquake is the most dangerous one. It a phenomenon which produces a strong ground vibration which affects the strength of the edifice and make it distorted. For ensure the safety of the buildings, it is necessary that structures have adequate lateral stability.

In design stage of high-Rise buildings, the consideration of seismic loads is very crucial as it is a complicated load with nonlinear occurrence and wide variation against different shapes and elevations makes its analysis very complex in nature. Standard codes of practices are available for assisting engineers to design structures to resist seismic loads but the shapes of structures considered in them are generally square and rectangular shaped and give very minimal information of pressure distribution on High Rise buildings under seismic loads. Evaluation of researches shows that the majority of the work has been done on pressure distributions of regular shaped High rise building only.

1.1 Building Specifications

To perform the study and analyze the seismic loads on structure with different plan shape, a G+29 story building is designed in STAAD Pro. The total height of the building is 120 m.

Table – 1: Building Specifications

Particulars	Rectangular Building	Circular Building
Type of building	High Rise	High Rise
Type of structure	RCC framed structure	RCC framed structure
Location	Delhi	Delhi
Plan of building	30 m x 20 m	30 m dia
No of floor	G + 29	G + 29
Height of each floor	4 m	4 m

Seismic Zone	V	V
Density of Concrete	25 KN/m3	25 KN/m3
Live load	3.0 KN/m2	3.0 KN/m2
Beam size	300 x 450 mm	300 x 450 mm
Slab thickness	150 mm	150 mm
Grade of concrete	M40	M40
Steel grade	Fe 500	Fe 500
Column Dimensions		
Up to 11th Floor	850 x 850 mm	850 x 850 mm
12th to 22nd Floor	650 x 650 mm	650 x 650 mm
23th to 29th Floor	450 x 450 mm	450 x 450 mm

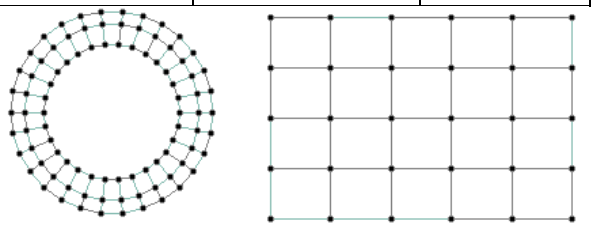


Fig1: Plan of the Buildings

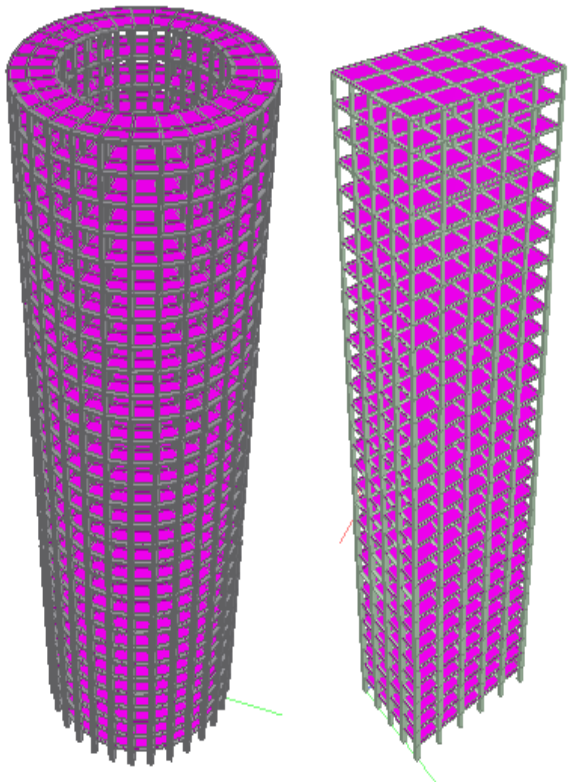


Fig 2: 3D view of the Buildings

2. METHODOLOGY

The following steps are followed for designing the model of Structure in STAAD Pro:

1. Provide the nodes by the use of co-ordinates system and connect them by using "ADD BEAM" command to prepare the plan.
2. By the use of translation repeat command repeat the storey with spacing of 4m, and global direction as Y, No. of steps = 29
3. Assigning the properties to the structure i.e., providing dimension to the beam and columns.
4. Providing the size of 850 x 850 mm to all columns up to 11th Floor of plan. The providing the size of column 650 x 650mm to all the column from 12th floor to 22nd floor. After that selecting rest of the column from 23rd to 29th storey and providing them the size of 450 x 450 mm.
5. Create and Assign supports to the structure.
6. Define seismic Loads - In seismic Load Definitions we input zone factor, type of frame, importance factor, soil type, damping ratio.
7. Insert Load case details:

- Dead Load (DL)

The dead load is the Self weight of the structure comprising the weight of the various structural components like slab, beam and column. The dead load is considered as per IS 875part-ii

- Live Load (LL)

The Live load is considered as the weight of moving members, concentrated load, load due to impact load and vibrations. As per IS 875part-ii the value of live load is taken as 3 KN/m^2.

- Seismic load

Earthquake load is taken as per zone category specified in the IS code 1893 (Part 1): 2016 for the location where building is located.

8. Assign loads to the edifice.
9. Run Analysis command and check for warnings and errors.
10. Make necessary changes in Design to remove the warnings and errors
11. Again Run Analysis and check for errors.

Designing is completed as per IS 456:2000iv

The steps mentioned above are followed for Designing Rectangular Building first, then the same are repeated for Designing of Circular Building and then the analysis data is studied for response analysis and comparison.

3. RESULTS AND OBSERVATIONS

The obtained results from the analysis of two structures were evaluate and compared in terms of base shear (FX), maximum bending moment and Deflection due to the attack of seismic forces

The analysis was carried out for both the two structures and plotted the Graphs showing comparison for the corner column (Column A, Fig. 3) of both the structures. Displacement is the movement due to lateral forces of earthquake in either X or Z direction. The maximum impact of the displacement is found in the X direction hence for displacement only X direction is considered.

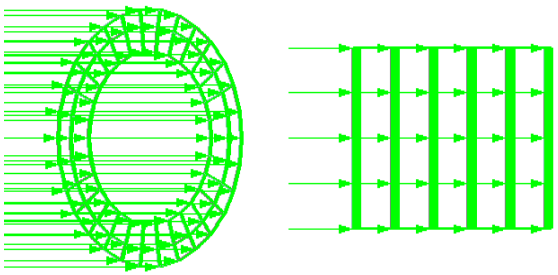
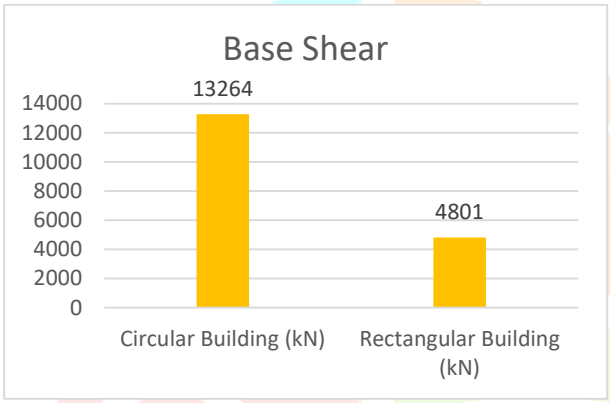


Fig-3: Plan of the building under the effect of Seismic loading.

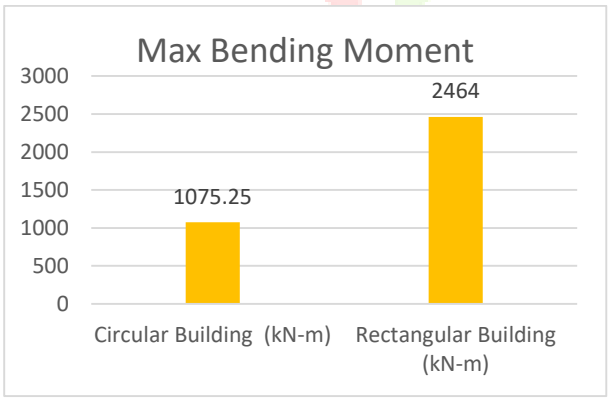
3.1.1 Base shear:

Base shear is the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. More the base shear more stable the structure is under seismic load. The Base shear of circular plan shaped building increased by 176.28 % as compared to rectangular plan shaped Building i.e., from 4801 kN to 13,264 kN.



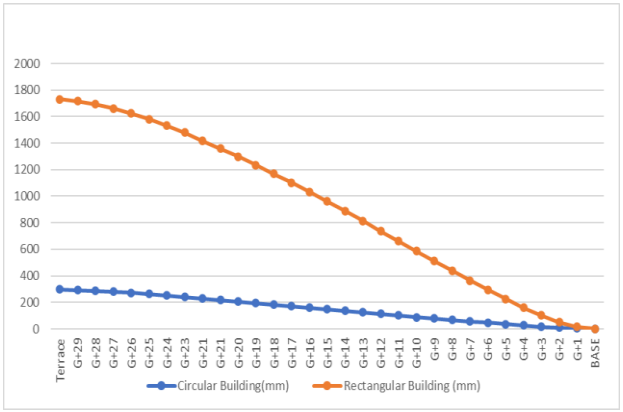
3.1.2 Max Bending Moment

Maximum Moment means the component of force causing rotation. Value of moment is the force trying to rotate the structure sideways left or right side. The moment of Circular plan shaped building decreased by 43.64 % as compared to rectangular plan shaped Building i.e., from 2464 kN-m to 1075 kN-m.



3.1.3 Max Displacement

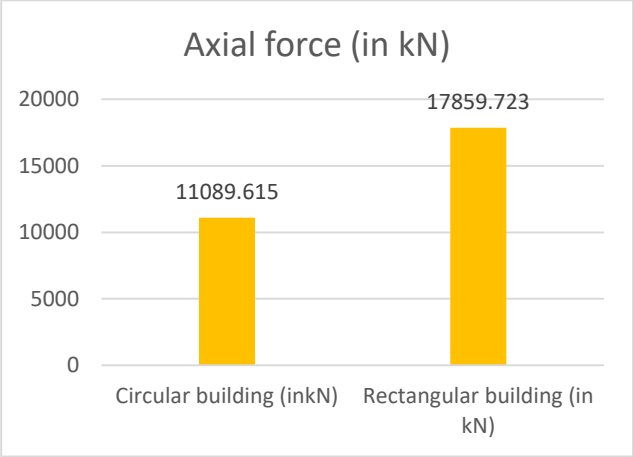
Displacement of Circular Building column reduced by 380 % as compared to rectangular building's column i.e. displacement of topmost element from base was 1432 mm in rectangular building whereas the same in Circular building was 298.52 mm. hence the structure is less impacted by seismic loads as compared to rectangular building.



3.1.4 Maximum Axial force

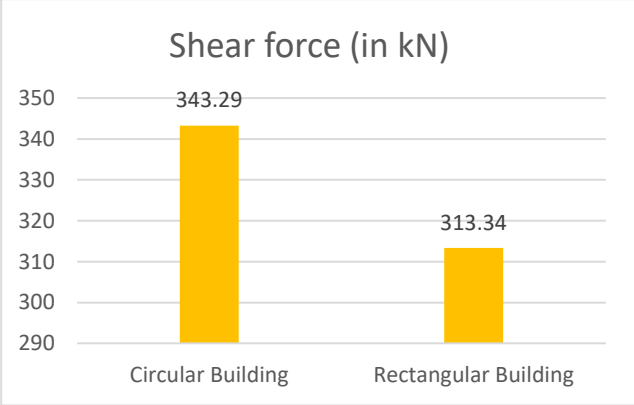
Values of axial force is greatly reduced in circular model structure which about 37.91% i.e., from 17859.723 kN to 11089.615 kN.

NO. OF STOREY	RECTANGULAR BUILDING (mm)	CIRCULAR BUILDING (mm)
Terrace	1432.29	298.52
G+29	1421.21	293.38
G+28	1404.42	287.32
G+27	1381.64	280.13
G+26	1353.12	271.87
G+25	1319.23	262.65
G+24	1280.32	252.52
G+23	1236.60	241.57
G+21	1187.73	229.88
G+21	1141.06	217.53
G+20	1092.01	204.75
G+19	1040.49	193.88
G+18	986.57	182.86
G+17	930.44	171.57
G+16	872.31	160.04
G+15	812.41	148.33
G+14	751.00	136.50
G+13	688.24	124.56
G+12	624.43	112.67
G+11	560.00	100.78
G+10	497.00	89.06
G+9	433.53	78.08
G+8	370.69	67.26
G+7	308.57	56.56
G+6	247.79	46.06
G+5	189.19	35.85
G+4	134.02	26.06
G+3	84.09	16.92
G+2	42.07	8.87
G+1	11.99	2.69
BASE	0	0



3.1.5 Maximum Shear force

There is slight increment in the shear force in circular structure about 9.56% i.e., from 343.29 kN to 313.34 kN.



CONCLUSIONS

Performing the analysis of the building frames using STAAD PRO software, different results were found and comparing the results, it is concluded that:

1. The displacement of topmost storey in Circular Building were far less and closer to their original position as compared to displacement of topmost storey in rectangular plan shaped Building. Analysis depicts that as the height increases, the Avg. Displacement increases, but the Rectangular shaped building shows far more displacement as compare to circular plan structure.
2. As per the results findings listed above, the average Base shear values of circular plan shaped building have increased by 176.28 % w.r.t Rectangular shaped structure. And thus, Circular Building is safer than rectangular building under seismic conditions.
3. The average Moment of Circlar Building decreased by 43.64 %, as compared to rectangular Building of same specifications and properties.
4. The axial force in circular structure is decreases about 37.91% as compared to rectangular structure. Itr shows that the circular shaped building required less size of axial member compare to rectangular shaped building.
5. The shear force is slightly increases in circular shaped building which is about 9.56% which is due to the shape and loading effect.

REFERNCES:

1. Comparison study of responses generated in rectangular and octagonal shaped high rise buildings under wind loadssanju rana1, sayan das2, vishal kumar3, dr. Ritu raj4
2. Kiran kamath, shruthi, shashikumar rao (2015), department of civil engineering, manipal institute of technology, manipal, comparative study on concentric steel braced frame structure due to effect of aspect ratio using pushover analysis. International journal of scientific research engineering & technology (ijsret), issn 2278 – 0882volume 4, issue 3, march 2015
3. Ghalimath a.g., waghmare y.m, zadbuke a.a, chaudhari a.r. (2015) comparative study of multistorey concrete building with shear wall and masonry infill frame for various types of soil and seismic zones.international research journal of engineering and technology (irjet) e-issn: 2395 - 0056volume: 02 issue: 05 | aug-2015
4. Mohd atif, prof. Laxmikant vairagade, vikrant nair. (2015) comparative study of multistory building stiff with bracing and shear wall. International research journal of engineering and technology (irjet) e-issn: 2395-0056volume: 02 issue: 05 | aug-2015
5. Dharanya, gayathri, deepika (2017) comparison study of shear wall and bracings under seismic loading in multi- storey residential building international journal of chemtech researchcoden (usa): ijcrgg, issn: 0974-4290, issn(online) vol.10 no.8, pp 417-424, 2017