Indian Journal of Natural Sciences *www.tnsroindia.org.in ©IJONS*

Vol.14 / Issue 78 / June / 2023 *International Bimonthly (Print) – Open Access* *ISSN: 0976 – 0997*

RESEARCH ARTICLE

Study of Multi Story Building with Single and Multiple Shear Wall

J. Selwyn Babu[1] and MohdImranullah Khan[2]*

[1]Professor, Department of Civil Engineering, Malla Reddy Engineering College, Hyderabad, Telangana, India.
[2]PG Scholar, Department of Civil Engineering, Malla Reddy Engineering College, Hyderabad, Telangana, India.

Received: 18 Dec 2022 Revised: 23 Mar 2023 Accepted: 02 May 2023

***Address for Correspondence**
MohdImranullah Khan
PG Scholar,
Department of Civil Engineering,
Malla Reddy Engineering College,
Hyderabad, Telangana, India.
E. Mail: imran.mreca@gmail.com

ABSTRACT

Shear wall systems are often used by buildings as one of the lateral load-resisting systems that they include. Shear walls are the structural characteristics that are among the most efficient in preventing the passage of lateral forces through a building. When it comes to the construction of buildings that are meant to withstand seismic activity, reinforced concrete structural walls, which are often referred to as shear walls, play an important role as the primary earthquake-resistant components. Shear walls have extremely high in-plane stiffness and strength, which enables them to be utilized to simultaneously withstand huge horizontal loads and sustain gravity loads. This permits shear walls to be employed in a variety of applications. Due to the fact that shear walls are capable of performing both of these duties, they are highly useful in a range of applications that fall within the purview of structural engineering. When earthquake forces are applied to a structure, they are almost always included in order to prevent the building from collapsing entirely. These members are mostly flexural in nature. It is very necessary to carry out a precise assessment of seismic response of the walls since the characteristics of these shear walls have such a substantial impact on the response of the buildings. Within the parameters of this inquiry, a high-rise building of twenty stories is taken into consideration. There are three unique types of RCC structures that are used today, and each of these models may have a single shear wall, a double shear wall, or a triple shear wall. The findings of the study will be presented so that they can be contrasted with one another and analyzed in order to gain an understanding of the behavior of RCC-framed buildings with shear walls when they are subjected to seismic load in Zone V. Specifically, this will be done so that the results can be compared with one another.

Keywords: Shear wall, gravity loads, seismic forces, earthquake load, storey drift, lateral displacement, base shear, shear force, bending moment.

INTRODUCTION

General

Shear walls are a type of structural wall that is specifically designed to withstand horizontal forces that are generated in the plane of the wall as a result of wind, earthquakes, and other types of forces. These forces may be caused by a variety of natural and manmade events. The most typical kind of shear wall is one made of reinforced concrete (RC), which also happens to be the most durable material. These wall components are often used in the construction of structures. Because of their very high in-plane stiffness and strength, shear walls are able to withstand massive horizontal loads without being damaged. Shear walls are able to withstand large amounts of horizontal stress because of this feature, which also enables them to support gravity loads. Because of this, the use of shear walls in a variety of settings is now open to a broad variety of options. It is possible for the thickness of walls made of reinforced concrete to range anywhere from 140 millimeters to 500 millimeters, but this will be depend on various factors, including the age of the structure, the horizontal pressures that are caused by things like wind and earthquakes, and the thermal insulation requirements of the building. These walls, in the overwhelming majority of situations, continue to climb all the way up to the very pinnacle of the structure. These situations may be rather specific. The placement of the walls will, in almost all cases, be symmetrical in reference to at least one axis of symmetry that is included in the design. This will be the case in the vast majority of cases. Shear walls are able to resist lateral loads because they transmit the load that is created by external forces such as wind or earthquakes to the foundation. This allows the shear walls to withstand the external pressures. In addition to this, they are responsible for the lateral rigidity of the system and carry the weight of the gravity loads that are applied to it.

Seismic Design Philosophy

The guiding principles of a certain document provide an indicator of the overall level of security that one may anticipate getting as a result of employing it. Documents pertaining to codes make it abundantly clear that the standards they establish are merely minimum criteria that are intended to ensure the protection of human life but do not guarantee against the loss of property. This is made clear by the fact that the standards they establish are only minimal criteria.

The fundamental ideas of earthquake-resistant architecture may be summed up as follows:

1. The design philosophy that was chosen for the code IS: 1893 (Part I)-2002 was to ensure that all structures have at least the needed degree of strength to withstand the potential hazards that may be encountered.
2. When compared to the real forces that are exerted on buildings when they are shaken by earthquakes, the design forces that are listed in the standards are much lower. The primary criteria that should be used when constructing earthquake-resistant structures should be based on the lateral strength of the structure.
3. It is expected that this will make it possible for the structure to endure just minor damage without falling entirely apart. When planning the construction of a building, it is essential to take into consideration the earthquake-generated vertical inertia forces, unless the magnitude of these forces is not considered to be significant.
4. The design pressures that must be applied to buildings that are supported by rock or soils that are compact and do not become liquefied or slide as a result of ground vibrations are outlined in detail in the building regulations.
5. These pressures must be applied to ensure that the buildings remain stable. When constructing a structure, it is essential to take into consideration the lateral design pressures that are outlined in the code IS: 1893 (Part I)-2002. These forces must be taken into account.

Objectives
The following are the main objectives of this project
1. To investigating the seismic conduct of multi story working by IS 1893:2002 utilization.
2. To contrast the multi story structures with single, double and triple shear wall condition.
3. To study the values of the Story Drift, Shear, Bending, Building, time period and frequency for different shear wall conditions
4. To examination the structures in ETABS Software.

METHODOLOGY

General
In this chapter, we will talk about the methodology that was used in the study that served as the foundation for present investigation. This study was carried out to investigate a variety of parameters, including storey drift and lateral displacement, with the goal of determining the optimal location for shear walls and braces inside the structure, in addition to the most effective configuration for those components.

Equivalent Linear Static Analysis
When planning against the effects of earthquakes, one must constantly keep in mind the dynamic nature of the load that they are trying to account for. On the other hand, analysis of easy regular structures may often be achieved by the use of equivalent linear static techniques. This is something that can be done according to the great majority of standards of practice to regular constructions that are low to medium in height. The approach to structural analysis of multi-story structures that is suggested in code considers the building as if it were a distinct system with concentrated masses at each floor levels. After computing, the value obtained from this calculation is then spread across the height of the structure.

After collecting the lateral forces in this way, they are subsequently allocated to the different components that are responsible for the lateral load resistance. The building in issue must be of a low height, and it must not spin an excessive amount when the surrounding area is shifted for this to be the case. The response of the structure is read from the response spectrum design once the natural frequency of the structure has been determined (either calculated or defined by the building code).

Linear Dynamic Analysis
In situations in which the impacts of higher modes are not thought to be substantial, it is advised to make use of static approaches. This is something that often occurs with buildings that have lengths that are relatively comparable to those of neighboring structures. As a result of this, buildings like towering skyscrapers, structures with torsion anomalies, and non-orthogonal systems need a dynamic process in order to work in the correct manner. The seismic input can be treated in a number of different ways. After that, a simulation of the seismic input is carried out using either of these two modeling methodologies. In comparison to linear static processes, these linear dynamic processes have the benefit of being able to take into consideration higher modes.

Seismic Analysis by Response Spectra
Response spectrum analysis is likely the method that is utilized most frequently in design when attempting to determine the greatest reaction that may be expected from a structure as a result of being subjected to seismic activity. This is because response spectrum analysis can be used to determine the maximum reaction that may be expected from a structure. This is an approximation method that makes use of linear algebra. It is possible to determine the maximum response for each mode by using the proper response spectrum in the calculation.

SRSS (Square Root of Sum of Squares)
One of the methods of modal combination that is used the most often is known as SRSS, which is an acronym that stands for "square root of sum of squares." According to this rule, the maximum response in definitions of a given parameter (displacements, velocity profile, accelerations, or even internal forces) can be estimated by taking the square root of the total of the squares of the modal responses that contribute to the global response.

Load Combinations

The following Load Combinations have been considered for the design:

1. 1.5(DL±LL)
2. 1.5(DL±EQX)
3. 1.5(DL±EQY)
4. 1.2(DL + LL±EQX)
5. 1.2(DL + LL±EQY)
6. (0.9DL±1.5EQX)
7. (0.9DL±1.5EQY)

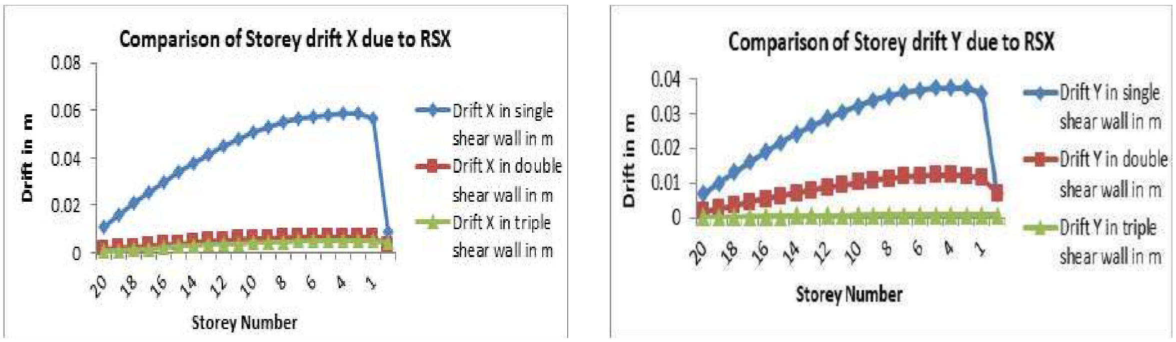
Where:-
DL - Dead Load
LL - Live Load
EQX-Earthquake load in X direction
EQY-Earthquake load in Y direction
Out of these different load combinations 1.5 (DL+EQX) or 1.5 (DL+EQY) load is worst load combination and was giving worst effect on the structure in the present study.

Design Considerations
In the present study, analysis of G+ 20 stories building in Zone IV and Zone V seismic zones is carried out in ETABS. Basic parameters considered for the analysis are:

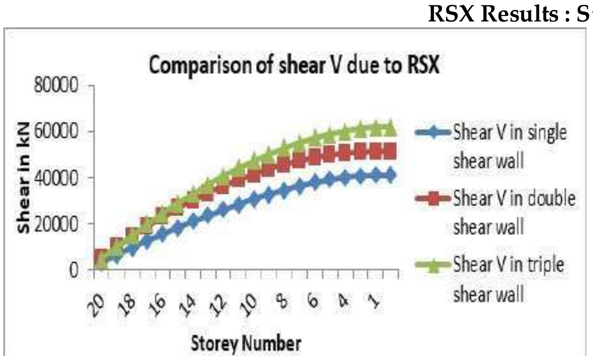
[1] Concrete grade : M30
[2] Reinforcing steel grade : HYSD Fe500
[3] Beam dimensions : 230mmX460mm
[4] Column dimensions : 230mmX460mm
[5] Slab thickness : 150mm
[6] Bottom story height : 4m
[7] Remaining story heights : 3m
[8] Live load : 5 KN/m^2
[9] Dead load : 2 KN/m^2
[10] Density of concrete : 25 KN/m^3
[11] Seismic Zones : Zone 3
[12] Site type : II
[13] Importance factor : 1.5
[14] Response reduction factor : 5
[15] Damping Ratio : 5%
[16] Structure class : C
[17] Basic wind speed : 44m/s
[18] Risk coefficient (K1) : 1.08
[19] Terrain size coefficient (K2): 1.15
[20] Topography factor (K3) : 1.36
[21] Wind design code : IS 875: 1987 (Part 3)
[22] RCC design code : IS 456:2000
[23] Steel design code : IS 800: 2007

[24] Earth quake design code : IS 1893 : 2002 (Part 1)

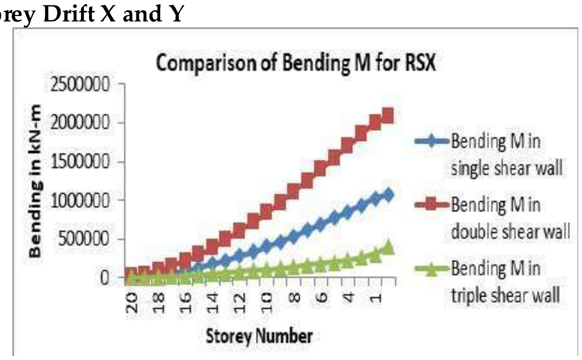
RESULTS AND ANALYSIS



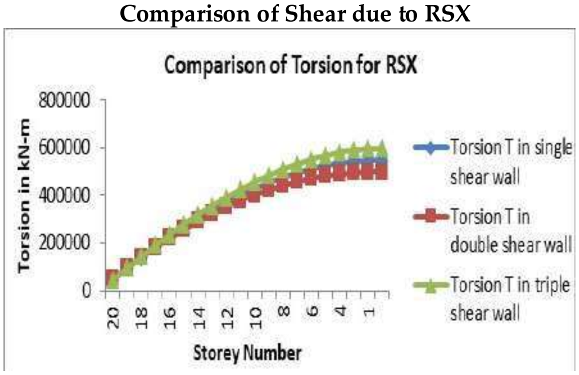
RSX Results : Storey Drift X and Y



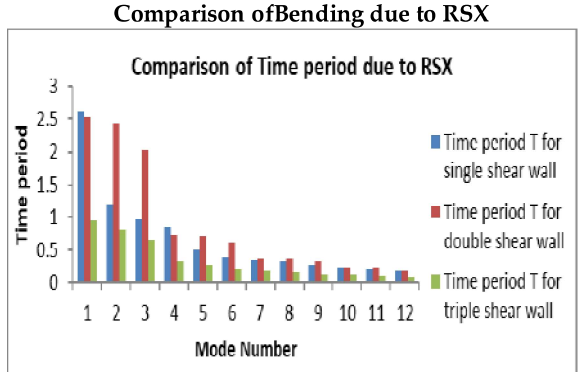
Comparison of Shear due to RSX



Comparison ofBending due to RSX

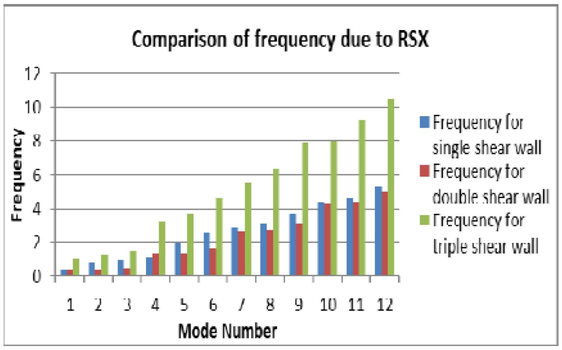


Comparison of Torsion due to RSX

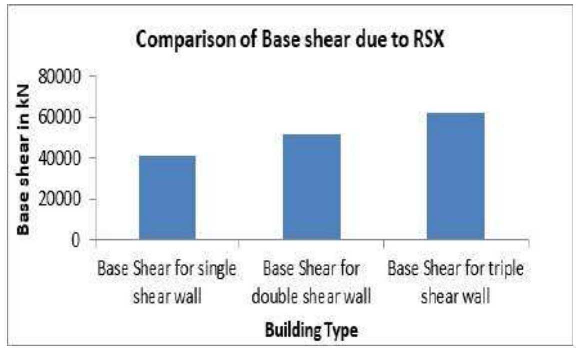


Comparison of Time Perioddue to RSX

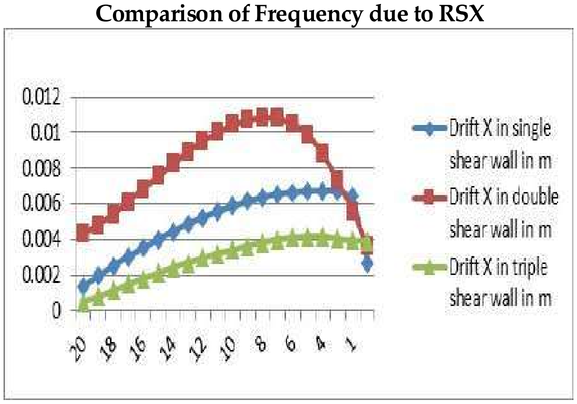
Selwyn Babu and Mohd Imranullah Khan

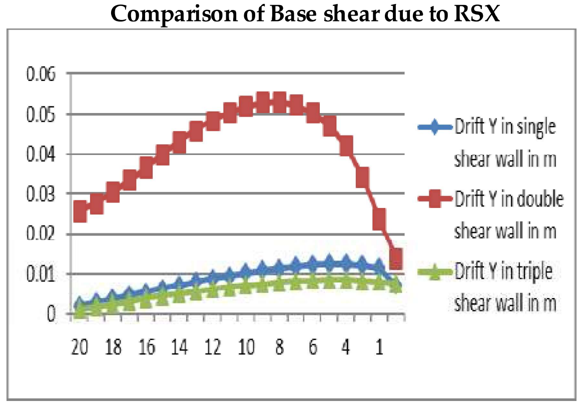


Comparison of Frequency due to RSX

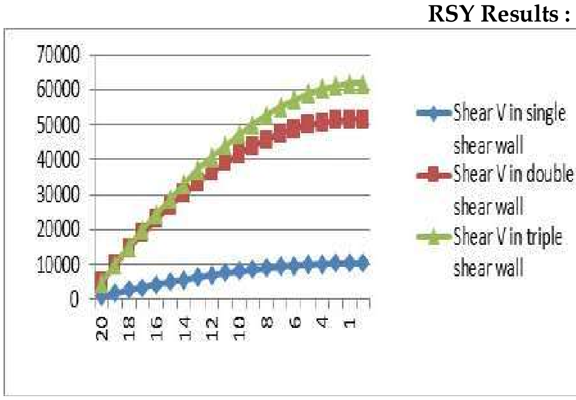


Comparison of Base shear due to RSX

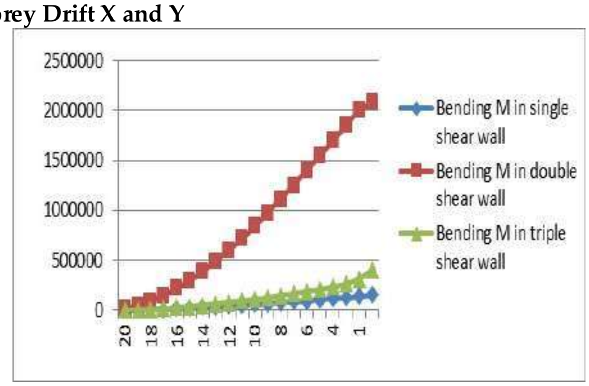




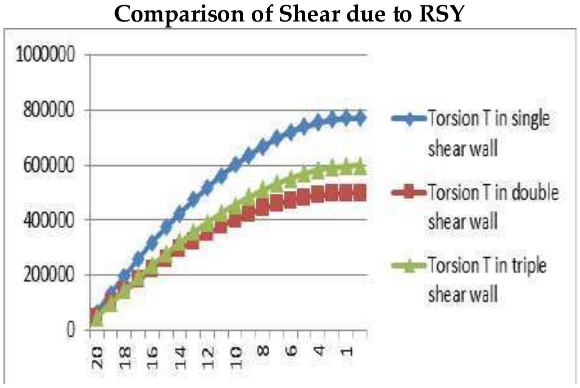
RSY Results : Storey Drift X and Y



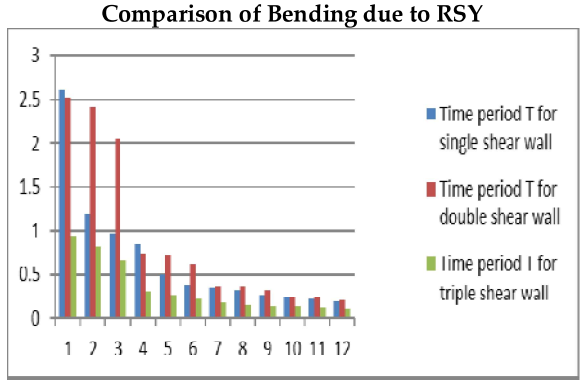
Comparison of Shear due to RSY



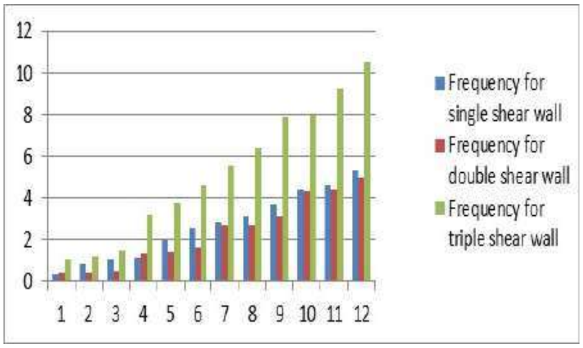
Comparison of Bending due to RSY



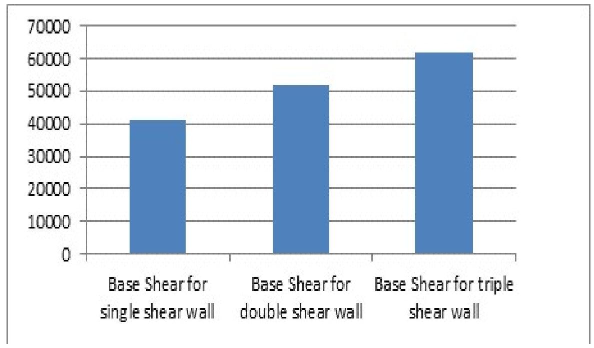
Comparison of Torsion due to RSY



Comparison of Time Period due to RSY



Comparison of Frequency due to RSY



Comparison of Base Shear due to RSY

CONCLUSION

The following conclusions were drawn from this investigation.

1. After supplying the shear wall from single to triple in both X and Y direction conditions, top deflection was decreased and attained within the permitted deflection.
2. Comparing different sites, it was discovered that the shear wall location was more efficient for shorter columns.
3. Cracked wall For regular shape building, symmetry in the outermost moment-resisting frames provides higher performance.
4. The value of drift is discovered to be smaller for buildings with triple shear walls than for those with double and single shear walls.
5. The value of drift is found to be lower value for building with triple shear wall shear wall than remaining cases like double shear wall and triple shear wall.
6. The values of Shear found lower value for building with single shear wall condition system and bending is lower for building with double shear wall.
7. When the opening position is changed from one position to another position, it has been seen for a specific opening in a wall.
8. This investigation led to the conclusion that as the percentage of shear walls increases, drift and deflection decrease but shear force and bending moment increase.

REFERENCES

1. Asnhuman.S, Dipendu Bhunia, Bhavin Ranjiyani (2011)"Solution of shear wall location in multi-storey building" International Journal of Civil and Structural Engineering Research.
2. Shaik Kamal Mohammed Azam, Vinod Hosur (2013), "Seismic performance evaluation of multistoried RC framed buildings with shear wall." Journal of Scientific & Engineering Research, Volume 4, Issue 1.
3. P.P.Chandurkar, Dr.P.S.Pajgade (2013), "Seismic analysis of RCC building with and without shear wall." International Journal of Modern Engineering Research, Vol.3.
4. Chaitanya Kumar J.D., Lute Venkat (2013), "Analysis of multi storey building with precast load bearing walls" International Journal of Civil and Structural Engineering, Volume 4.
5. Lakshmi K.O., Prof.Jayasree Ramanujan, Mrs. Bindu Sunil, Dr.Laju Kottallil, Prof.Mercy Joseph Poweth (2014), "Effect of shear wall location in buildings subjected to seismic loads." ISOI Journal of Engineering and Computer Science.
6. M.S.Aainawala, Dr.P.S.Pajgade (2014) "Design of multistoried R.C.C. buildings with and without shear walls." International Journal of Engineering Sciences and Research Technology.

7. Tarun shrivastava, Prof. Anubhav Rai, Prof. Yogesh Kumar Bajpai (2015), "Effectiveness of shear wall-frame structure subjected to wind loading in multi-storey building." International Journal of Computational Engineering Research, Vol.5.
8. IS I893(Part I): 2002, "Criteria for Earthquake Resistant Design of Structures- General Provisions and Buildings, Fifth Revision". Bureau of Indian Standards, New Delhi.
9. IS: 875 (Part 1) - 1987, "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Dead Loads", Bureau of Indian Standards, New Delhi.
10. IS: 875 (Part 2) - 1987, "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures - Imposed Loads", Bureau of Indian Standards, New Delhi.