Analysis of Irregular Shaped Tall Structure Considering Shear Wall at different Positions using Analysis Tool Staad.Pro

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ABSTRACT

Earthquake is a form of disaster which occurs due to Natural or Man-made errors resulting in extreme damages to human civilization and any form of structure created by us. Recent example of such a disastrous earthquake was seen in our neighbouring country Nepal, resulting in massive destruction to the entire country destroying its economy and placing a setback of more than 10 years. It was such an unusual disaster, that it is extremely vital for survival to ensure the strength of the structures against seismic forces. In this way, there is persistent research work going on around the world, rotating around the advancement of new and better methods that can be consolidated in structures for better seismic execution. Structures designed considering exceptional methods to resist such forces and seismic forces have a considerably higher cost of development than ordinary structures, yet for prosperity against tension on the structure under seismic forces, it is fundamental.

In this study we are analysing four different cases of a tall structure G+14 considering shear wall at different positions, in this study we will compare a conventional structure with shear wall structure considering P-delta analysis as per I.S. 1893-I:2002.

Keywords: Shear wall, lateral load resisting system, analysis, forces, structure, displacement, seismic force.

I. INTRODUCTION

The seismic examination is a piece of basic investigation utilized for estimation of structure or structures reaction to tremors. It is the procedure of structural assessment or engineering of the earthquake, basic plan and retrofit in the common seismic tremors areas.

The underlying arrangements for seismic obstruction were the necessity to plan for a sidelong forces (distracting) equivalent to the heaviness of the structure (for each floor level). Uniform Building Code (UBC) received this methodology in the reference section of 1927, which was utilized in the western shore of the United States. It later comprehends that the age of burden because of quake influences the dynamic properties of the structure.

It is reinforced cement consistent vertical divider can convey parallel just as gravity loads. Its quality and firmness extremely high make them appropriate for a tall structure, for the most part, the developed centre of the structure is quite efficient. It tends to be developed into 35 stories. These dividers start from the establishment level and are constant all through the structure stature. Its thickness can be 150mm to 400mm in elevated structures. Shear dividers are typically given along both the length and width of structures as appeared in figure 1.3. Shear dividers resemble vertically-arranged wide bars that convey seismic tremor loads downwards to the establishment.

Appropriately structured and comprehensive structures with shear walls have demonstrated generally excellent execution during quakes. Shear dividers give huge quality and firmness to structures toward their direction, which essentially diminishes parallel removal of the structure and in this way lessens harm to the structure and its substance. Since shear dividers convey enormous level seismic tremor forcess, the upsetting impacts on them are huge. Be that as it may, on the off chance that they are given along just a single heading, a legitimate framework of bars and sections in the vertical plane (called a minute safe edge) must be given along the other course to oppose solid earthquake impacts.

Objective of the Study

Objective of this research is to study the effect of different types of shear wall in + (Plus) shape building on the seismic Zone II, modelling of G+14 storeys RCC frame building is analysed using Staad.pro software.

1) To Determine the stability of the structure with considering shear wall at three different positions of the structure.
2) To Determine the variation in structural stability of a structure with shear wall at outer edges, corner edges and at the inner core section of the structure.
3) To Analyze the structure considering P-delta analysis method for non linear effects.

II. LITERATURE REVIEW

1. **Mahendra Kumar (2018)** the objective behind this research work was to model and analyze shear wall frame structures with different thickness and shear wall placement along the structure and even presented various effects of soft storey along with openings in shear wall. Author modelled a 5 storey structure with height of 3.5m in each storey in a regular plan and the designe was done using the "ETABS" as per the Indian Code of Practice for Seismic Resistant Design of Buildings. These models were analyzed on seismic zone V on the parameters lateral displacement, base shear and storey acceleration in X and Y direction.
2. **Shahid Ul Islam et. al. (2018)** This study observed the combined performance of shear wall and RCC bracing system, and also the effect of their relative position in high rise commercial building (G+10). The shear walls provide the stiffness to restrain lateral loads and also help in distribution of gravity loads whereas the RCC bracing results in higher stiffness and stability as a potential advantage over other bracings. The study also aimed the comparison of performance of shear wall & RCC bracing system in high rise commercial buildings under seismic loading. The total of 6 structural configurations viz., Moment resisting frame (Model 1), MRF stiffened with RCC bracing system (Model 2), MRF stiffened with shear wall system (Model 3), MRF stiffened with both shear wall and RCC bracing system (Model 4A, Model 4B, & Model 4C) were modelled and then

analysed. Analysis has been done in accordance with 1893:2002 using STAAD Pro V8i software. The seismic parameters taken into consideration are base shear and storey displacement.

3. **Rahul T. Pardeshi (2017)** A study on an irregular highrise building with shear wall and without shear wall has been carried out to understand the lateral loads, displacement shear effects. It is relevant that high rise building are increasing day by day hence its study is necessary for development point of view. So we thought to use Staad Pro V8i to analyse the certain irregular high rise building by changing the location of shear walls. The usefulness of shear walls in the structural planning of multistorey buildings has long been recognized. When walls are situated in advantageous positions in a building, they can be very efficient in resisting lateral loads originating from earthquakes. A study on an irregular high-rise building with shear walls and without shear wall has been conducted to understand the effect on stability of building and other factors as displacement, bending moment, axial force.

   Reinforced concrete framed buildings are adequate for resisting both vertical and horizontal loads acting on them. Extensive research has been done in the design and analysis of shear wall highrise buildings. However, significance of shear wall location in highrise irregular structures is not much discussed in literature. A study on an irregular highrise building with shear wall and without shear wall has to be studied to understand the lateral loads, bending moment and shear effects.

General steps required for analysis and design of the multi-storey RCC building is given below

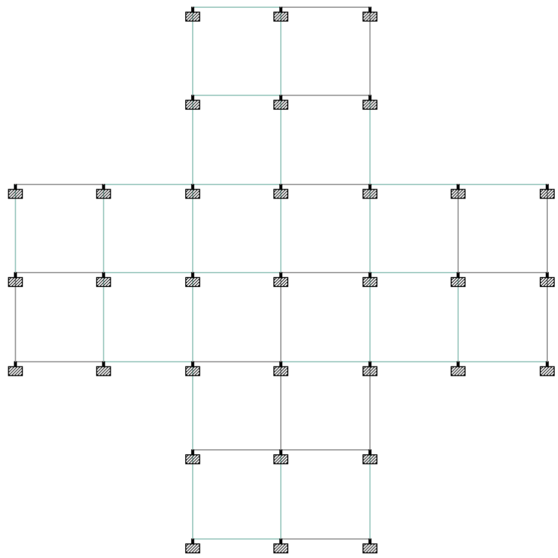

Fig 1 : Plan of plus shaped structure

Step-1 Modelling of building frames
Step-2 Application of Load
Step-3 Selection of parameters of seismic Definition of given soil condition
Step-4 Application of Equivalent static analysis
Step-5 Formation of load combination (9 load combination)
Step-6 Design of RCC structure

Table 1: Geometrical descriptions

S. No.	Building Description	
1.	Plan Area	320 m^2
2.	X-Y Direction Grid Spacing	4m x 4m
3.	Storey Height	3.0 m
4.	Number of storey	G+14
5.	Beam Dimension	300mm x 400mm
6.	Column Dimension	400mm x 400mm
7.	Slab Thickness	150mm
8.	Thickness of shear wall	200mm
9.	Bottom Support Condition	Fixed
10.	Seismic Zone	II
12.	Zone Factor	0.10
13.	Soil Type	Soft
14.	Importance Factor	1.5
15.	Response Reduction Factor	5
16.	Eccentricity Ratio	0.05

III. Analysis Results:

P-delta Analysis:

In this study we are performing seismic analysis considering P-delta analysis method. In this analysis method we are comparing a conventional RC structure with structure considering shear walls at three different sections i.e. at the outermost walls, at the corner edges and at the inner close loop to determine the most suitable type of structure as per shear wall positions.

In this chapter we will compare the analysis results of all the four cases to justify our study in terms of forces, moment, deflection, displacement, support reaction, drift, mode shapes etc.

This result contains comparative study of G+14 storey RCC plus - shape building with different model configuration located in earthquake zone II for medium soil condition. RCC plus-shape building frames are designed for same gravity loading condition and RCC slab is used in all cases. Column, beam and shear wall sections are made of reinforced concrete. Staad.pro software is used to compare the result obtained during the analysis and design of structure.

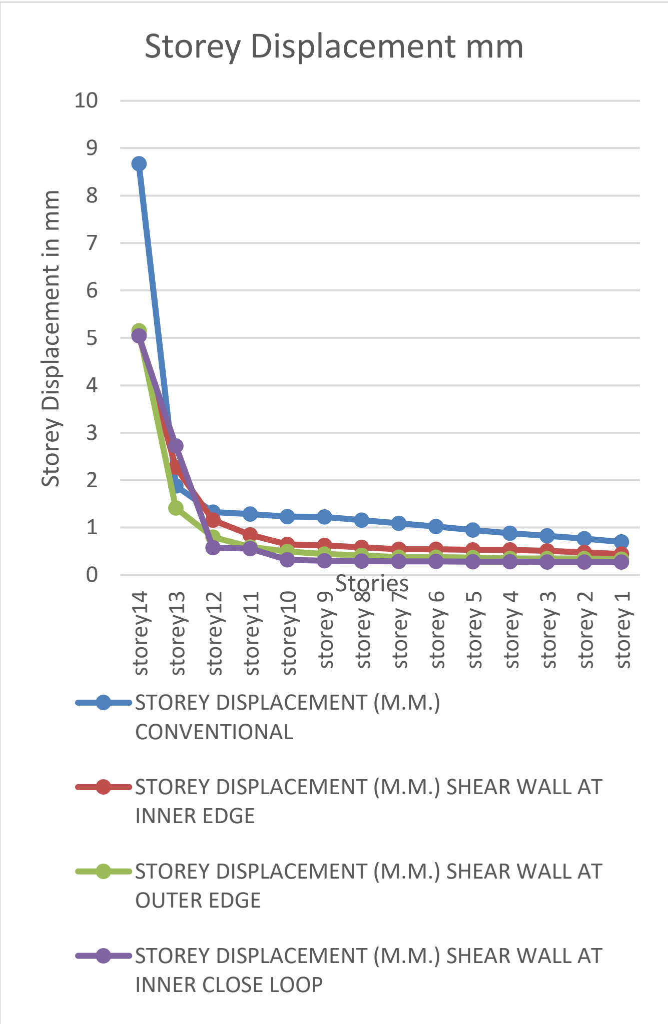

Fig 2: Displacement

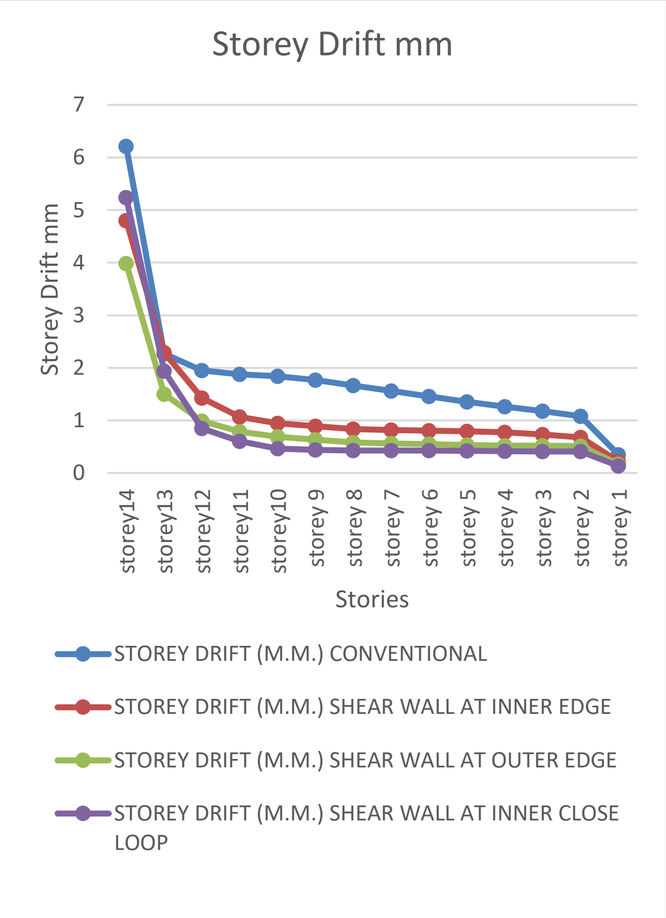

Fig 3: Drift

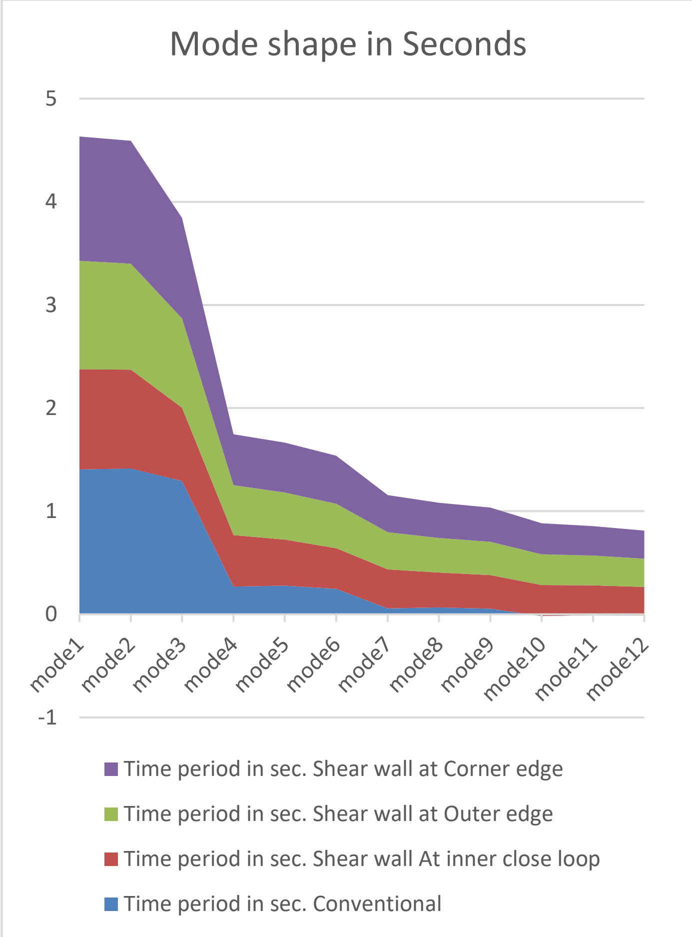

Fig 5: Mode Shape

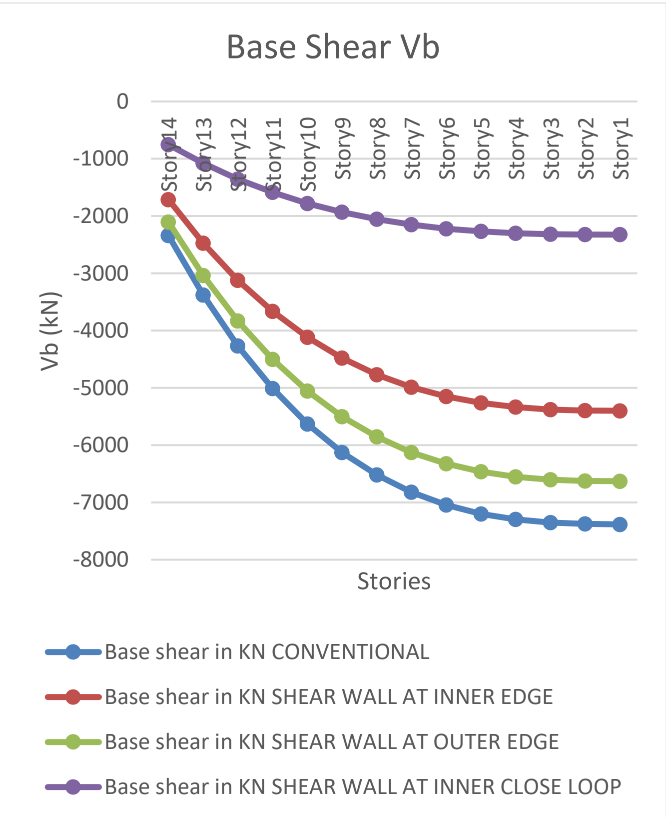

Fig 4:Base Shear

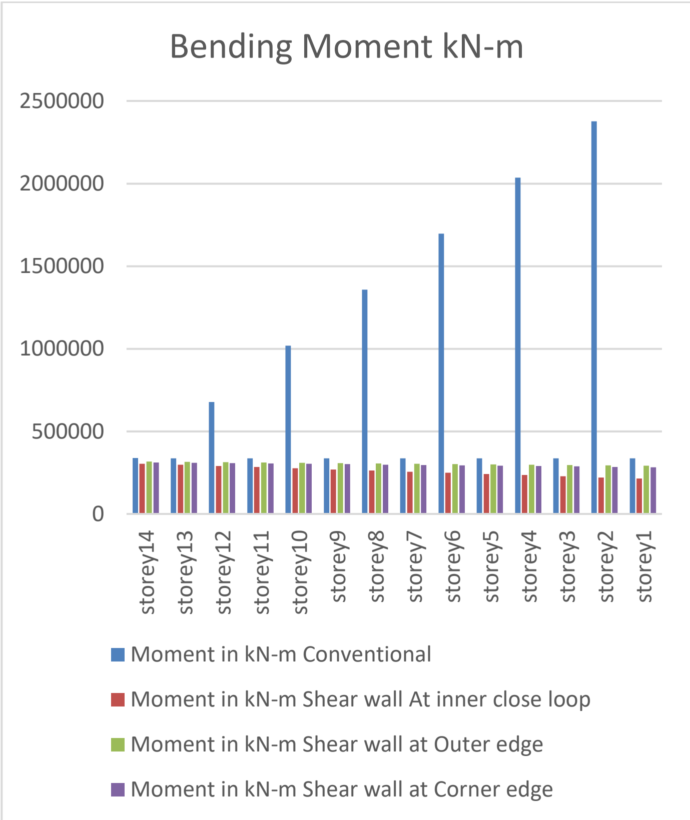

Fig 6: Moment

IV. CONCLUSION

1) Story displacements are generally reduced by the provision of shear wall the reason behind this is the shear wall increases the stiffness and lateral strength of the structure. In this study it has been observed that structure with shear wall at close loop is more stable than other structure whereas conventional structure is resulting as the worst. There has been a variation of 15.3% is observed.

2) In terms of storey shear all the structure except conventional are in permissible limit, but in comparison structure with close loop shear wall results in minimum displacement in two consecutive floors which results as most stable structure.

3) It was found that seismic base shear values are much varied by the addition of shear walls since the seismic weight increases and conventional structure have maximum storey shear value compared to the other models due to absence of shear wall.

4) The value of Moment is minimum on close loop shear wall case due to presence of shear wall at the inner periphery, less bending moment results in economical section ence cost effective structure in comparison.

Summary:

In comparative study it can be said that structure with shear wall at close loop can be consider as the most stable structure whereas conventional structure can be said as worst case in analysis.

V. FUTURE SCOPE

1. In future we can extend the study by considering shear wall thickness.
2. The effect of combined irregularity in plan as well as in elevation can be studied.
3. We can also study of different types of soil conditions as well as different types of seismic zones.

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