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LINEAR ANALYSIS OF PROGRESSIVE COLLAPSE OF TALL COMPOSITE BUILDING's"

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Abstract

The ongoing collapse has received a lot of attention over the past decade, especially in the aftermath of disasters, event of September 11, 2001. Design and evaluation based on the same event of the last few years. It was determined that collapse prevention buildings were required in addition to resistance the structure, integrity and ductility is play an important role in progressive collapse. The study of various structural systems for this phenomenon is important. A lot these days Studies have been conducted to further mitigate the effects of progressive decay concrete (RC) structures. Despite the efforts little attention has been paid to RC shear walls building and its structure. Contributions to previous research have focused primarily on modelling and comparison of results. Demonstrating the main contribution of RC seismic walls to preventing collapse is not yet distinguished correctly. This work is primarily focused on the determination and quantification of Contribution of RC shear walls to energy-based collapse.

Keywords: Progressive Collapse, RC Frame Shear Wall Building, Energy-Based Approach.

1.Introduction

Progressive collapse is a chain of failures triggered by a momentary loss or some vertical lift device. Structure causes one of the vertical structural elements to fail was intended to use a separate load-bearing structure to transmit the load carried by that element, send to adjacent elements. As a result, the dynamic internal forces on adjacent members increase. Internal energy due to loss of membership, after the load has been distributed over the structure, each member carries different loads, including additional internal forces. If the redistributed load exceeds the capacity of surrounding undamaged elements. Another local error such as secondary failures can spread from element to element. It will eventually lead to all or unbalanced parts of the structure. In general, such gradual collapse occurs in a matter of seconds.

When an abnormal load acts on a structure, one of the structural elements, that is, columns, beams and plates are mainly damaged. Broken vertical member or elements. The column was damaged by the impact load, which is the causes are used to distribute the load to other adjacent element or adjacent members of the panel. The adjacent elements of the damaged element can withstand and then withstand the additional load it takes a load otherwise it's unbearable. If one of the adjacent components fails again, in that case, the adjacent element must have enough capacity to carry it. otherwise, a failure occurs when it gets high. it becomes, causing a series of failure processes leading to structural damage. The buildings are designed first and then planned to withstand failure loads or stresses. But if Loads acting on the entire structure or structural elements are Structure fails or structural elements fail under this operational load or stress. When the load exceeds operational loads, buildings, or other elements such as beams and beams column fails its effect, causing adjacent elements or members of higher floors to fail leads to failure of the entire structure.

Figure. 1. Collapse due sudden impact

Overview of progressive collapse

In all the general various guidelines, his three basic design methods of progressive are identified. Event Control, Direct and Indirect Design Approaches of the three methods are described as follows:

a) Event Control: Protection and Isolation of Buildings from Possible Accidental Loads causes progressive collapse.

b) Direct Design Approach: Focus on providing resistance mechanisms to buildings: 1: The Alternate Path Method improves a structure's ability to transmit loads. Damaged elements are moved to intact areas by two mechanisms, Vandal, and Catenary/ membrane action. 2: Specific local resistivity (SLR) method. provides sufficient strength for the main building elements and abnormal load.

c) Indirect Design Approach: This approach aims to ensure a minimum level of strength. continuity and ductility suitable for different building elements depending on choice Plan layout, horizontal and vertical connection system, and seismic ductility details.

2.Objectives

The primary aim of this report is to enhance the analysis of progressive collapse performance of regular and irregular composite structures using by providing Shear wall. This was achieved by pursuing the following objectives:

(1) To study maximum base shear and maximum displacement capacity is being compared with regular and irregular space frame.

(2) To study progressive collapse with Shear wall

(3) To study progressive Collapse with Axial, Translational and Rotational forces

(4) To study the mechanics of failure in structural building systems due to sudden loss of RCC elements.

Figure. 2. Collapse due to column failure

3.Literature Reviews

Vijay et al. (2013) investigated the computational pushover analysis method of Performance-related design of steel structures subjected to seismic loads. By using the plasticity coefficient, which measures the degree of plasticization, the standard is the elastic and geometric stiffness matrix of the frame elements (beams, columns, etc.). stepwise modified to study nonlinear elastoplastic behaviour step by step Increasing lateral load and constant gravitational load. The analysis is performed on two steel members. Scaffolding made of solid and hollow sticks. The purpose of this survey is to: Load bearing behaviour between hollow and solid frames. The technique used in this study is Based on the traditional displacement method for elastic analysis.

Ashutosh Baguchi et al. (2009) Investigating the performance of a 20-storey resistance instant His steel frame building designed for Western Canada. real and simulated soils motion records are used to evaluate the dynamic response.

Hejazi et al. (2011) describe the softening of the lower floors of the underlying high-rise building. Seismic condition. They also tried to study the effects of adding braces different layouts of structure to minimize the soft story effect. This research understands the vulnerability of tall buildings that require retrofitting to maintain minimum performance. Requirement.

Gaurav Joshi et al. (2013) Research on seismic analysis of soft bullet frames the has 3 architectural drawings, 15 soft bullet cases, and 20 load combinations. The floor height is varied and neglected packing efficiency to create flexible floors.

Nelson Lamb and others (2013) Research on the seismic performance of "soft story" buildings Developing a Realistic Seismic Risk Model for Understanding Priorities of Upgrade Work existing building stock. Typical steel-framed six-story building the frame construction is designed for various types of eccentric bracing according to IS 800 2007. Using nonlinear static analysis, performances of each frame were examined.

Blonde Others (2012) Studying soft one-story high-rise buildings in seismic areas Zone IV describing performance characteristics such as stiffness, bending moment and shear Power and Drift. This study was conducted using different mathematical models Apply different methods to improve the seismic capacity of buildings. study too Describes an analytical model representing all existing components of impact Structural Mass, Strength, Stiffness, and Deformability. equivalent static and multimodal dynamic analyses were performed on the entire 3D mathematical model A comparison of these models with software SAP2000 has been reported. performance of His in all building models is also observed in seismic zone V.

Rahiman G. Khan et al. (2013) conducted a survey to find the best locations for soft stories. skyscrapers using inelastic performance-based seismic engineering (PBSE) Structural analysis combined with seismic hazard assessment to extrapolate expected estimates Seismic performance. With this tool the civil engineer can observe this can predict the performance of each structure under large forces and further modify the design accordingly PBSE generally includes nonlinear static analysis, pushover analysis.

Rakshith Gowda K.R. et al. (2014): Studying the behaviour of RC frames under static conditions and dynamic seismic load conditions. bare frame, result obtained in one frame Different positions of fillings and soft bullets were compared and conclusions were drawn As for the IS code was created. This study explained that providing infill can mitigate earthquakes Resistance Behaviour of Structures for Soft-story Buildings.

Abhay Guleria (2014): The case studies in this paper focus primarily on the structural behaviour of tall buildings. for different floor plan configurations such as rectangular, C, L, I shape, 15-story R.C.C. modelling assembled building was run with his ETABS software for analysis. structure, maximum shear force, bending moment and the maximum displacement of floors is calculated and compared for all analysed cases. Analysis of skyscrapers reflect that the floor overturning moment is inversely proportional to the floor height.

Vijaya Bhaskar Red. Sentence. Al. (2015): In this paper, the importance of this task is to estimate the design loads of the structure. she concludes that the bar deflection increases. of soil. It can be observed that the axial force is Compared to a five-story building, a ten-story building has a height of.

Pardeshi Sameer and Professor N.G. Gore (2016): This paper looks at the effects of various vertical irregularities. on the seismic response of structures. The purpose of the project is to perform Response Spectrum Analysis (RSA). Perform time history analysis (THA) on regular and irregular RC building frames and regular RC building frames, Ductile-based design using IS 13920 for response spectrum analysis. Comparing the results of an irregular structure analysis with a regular structure is performed.

Pushkar Rathod and Rahul Chandrashekar (2017): Seismic analysis can be used to design structures and designed to withstand strong lateral movements of the crust during earthquakes. any kind of basic or Advanced structures that can be evaluated with ETABS under static or dynamic conditions. ETABS is Streamlined and productive tools for analysis and design, from simple 2D frame.

Ali Kadhim Sallal (2018): The main purpose of this software is to design and analyse multi-storey buildings. Systematic process. This paper presents a building designed and analysed under the influence of earthquakes and wind. printing using ETABS software. In this case (18m x 18m), an 8-storey structure is modelled in ETABS. software. Assuming a height of 10 stories (3 m) gives the total height of the structure (31 m).

4.Building Model Details

The structural model considered in this study is a G+26 storeyed building. The model details are as shown below

Grid/Plan area: (32.25m x 19.55m)

Height of building: 93.85m

Grids Along X-direction:

Span	Distance
A-B	4.62m
B-C	7.12m
C-D	8.91m
D-E	7.12m
E-F	4.48m

Grids Along Y-direction:

Span	Distance
1-2	3.80m
2-3’	7.01m
3’-3	3.83m
3-4	4.91m

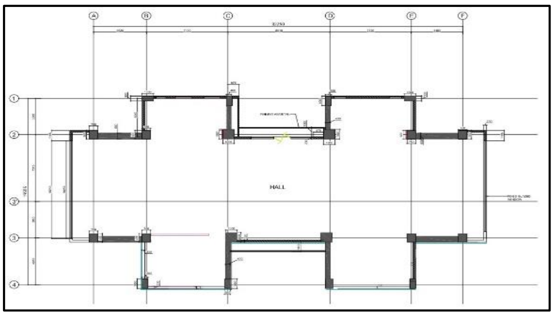


Figure. 4.1. Plan for building

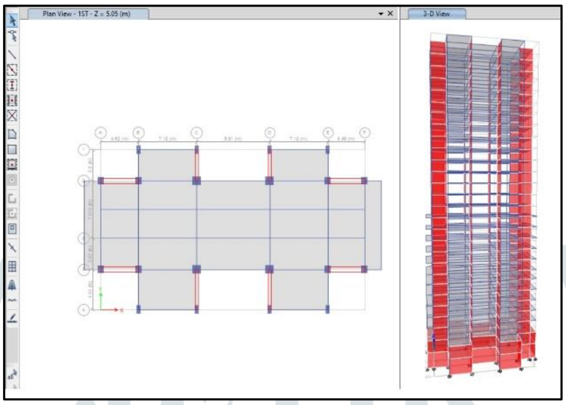


Figure. 4.2. Plan and 3-D View

Table Structural details and property

Building Type	Residential Building
No. of storeys	G+26 (Stilt, Basement1, Basement 2.
Basement 2	5.1m
Basement 1	3.950m
Stilt Floor	4m
Floor to Floor ht.	3m-3.6m
Concrete grade	M30
Steel grade	Fe415
Rebar	HYSD 500
Size of the main beams	450X900 mm
Size of the peripheral beams	400X750 mm
Size of the slabs	225 mm
Size of the columns	500X1000 mm
	1000X1000 mm
	750X900 mm
Size of the Structural walls	400 mm
	600 mm

5.Methodology:

In the present study, analysis of G+26 multi-story building in all seismic zones for wind and earthquake forces is carried out 3D model is prepared for G+26 multi-story building using ETABS.

structural analysis methods: Seismic analysis should be performed for buildings that cannot withstand seismic forces. earthquake the analysis considers the effects of earthquakes, which can complicate an accurate analysis. However, for simple regular structures an equivalent linear static analysis is sufficient. This kind of analysis is performed on normal and low-rise buildings and this method gives good results for these types of buildings. A dynamic analysis according to the code IS 1893-2016 (Part 1) is performed on the building. dynamic analysis can be performed using the response spectrum method or the site-specific time history method. The following methods are used Run the analysis procedure.

Equivalent Static Analysis

Linear Dynamic Analysis

Response Spectrum Method

Time History Analysis

Pushover Analysis

Non-Linear Static Analysis

Non-Linear Dynamic Analysis

Loads acting on a multi-storey G+26 building: Loads on tall buildings differ in many ways from loads on low buildings. Due to a large accumulation of gravitational loads from top to bottom of the floor, wind loads became more important as well as seismic effect. Therefore, High-rise structures must be properly evaluated for safe and economical construction. Excluding dead load Unable to perform load rating accurately. Traffic load can be estimated from the approximate combination. Wind and seismic loads are random in nature and difficult to do predict. They are estimated based on a probabilistic approach.

The following discussion describes some of the most common kinds of loads on multi-storied structures.

Dead loads

Live loads

Earthquake loads

For every seismic zone the software gives different possible seismic load cases and combination load cases i.e., maximum, and minimum.

6.Results

6.1: 1st Floor Case

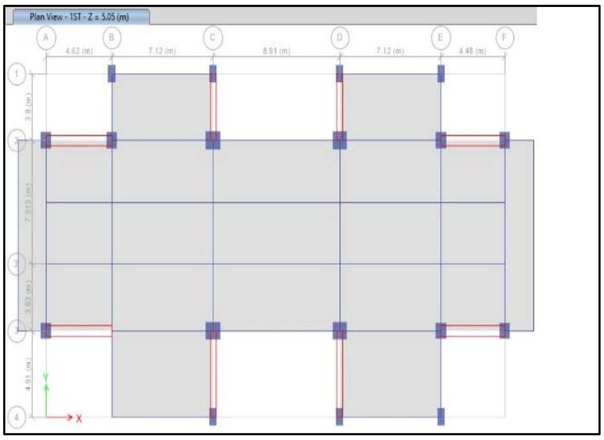


Figure. 6.1.1. 1st floor column failure

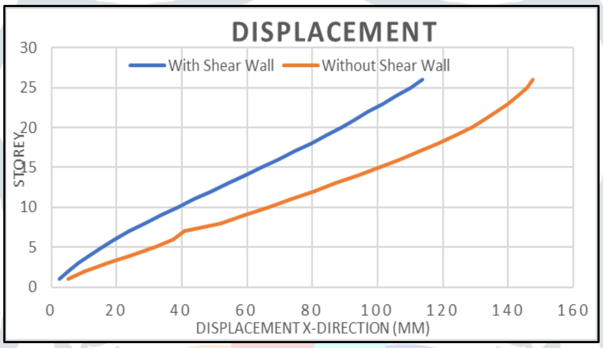


Figure. 6.1.2. Storey vs Displacement X-direction

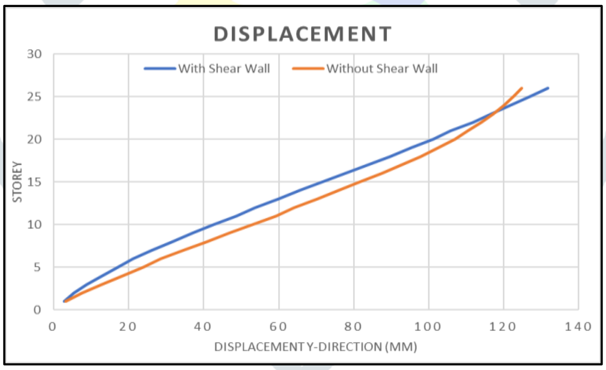


Figure. 6.1.3. Storey vs Displacement Y-direction

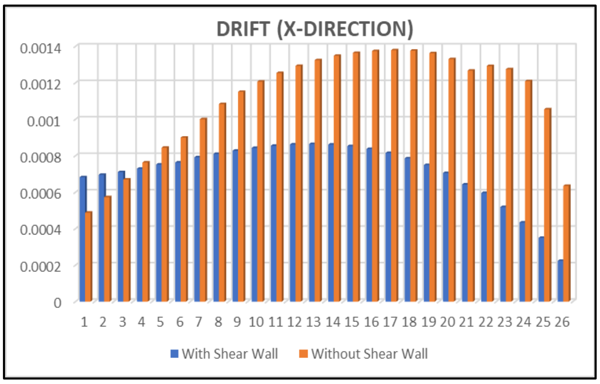


Figure. 6.1.4. Storey vs Drift X-direction

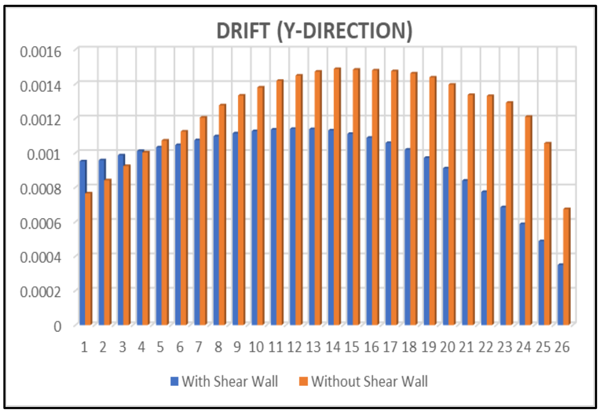


Figure. 6.1.5. Storey vs Drift Y-direction

When 1st floor corner column fails then the results are shown in above graphs for that software gives all floor possible displacement and drift values i.e., maximum value for each floor. The possible load cases depend upon the loads acting on the structure.

6.2: 11TH Floor Case

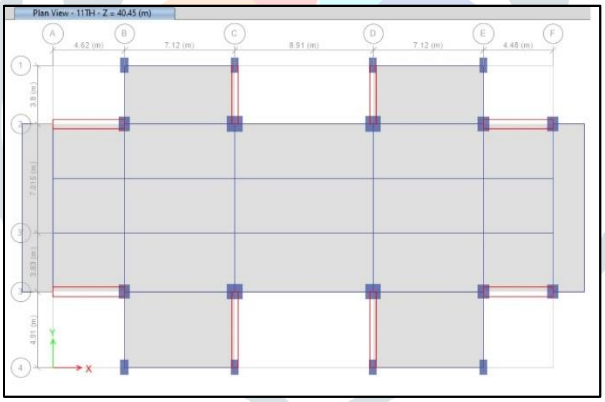


Figure. 6.2.1. 11th floor column failure

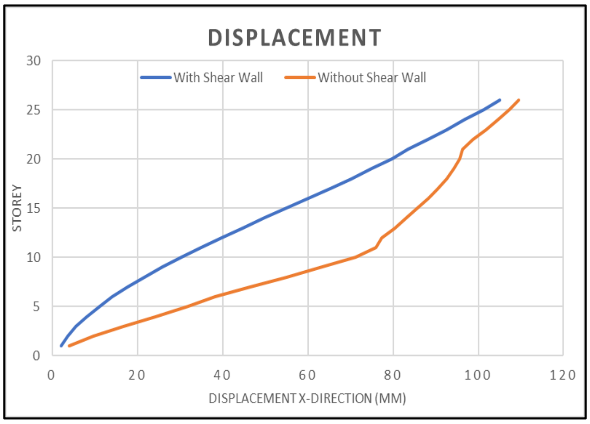


Figure. 6.2.2. Storey vs Displacement X-direction

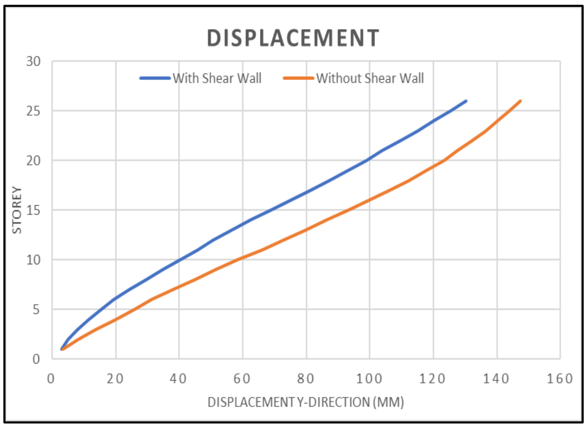


Figure. 6.2.3. Storey vs Displacement Y-direction

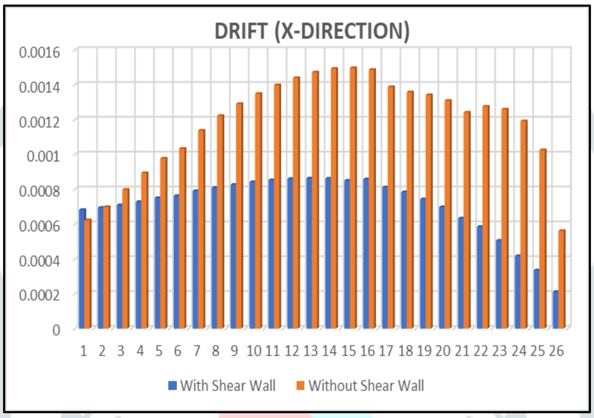


Figure. 6.2.4. Storey vs Drift X-direction

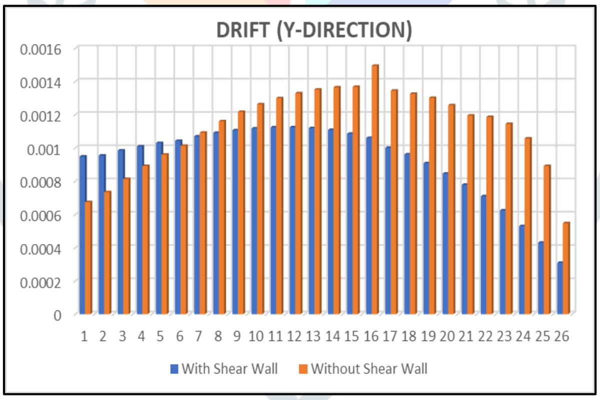


Figure. 6.2.5. Storey vs Drift Y-direction

When 11TH floor corner column fails then the results are shown in above graphs for that software gives all floor possible displacement and drift values i.e., maximum value for each floor. The possible load cases depend upon the loads acting on the structure.

6.3: 20TH Floor Case

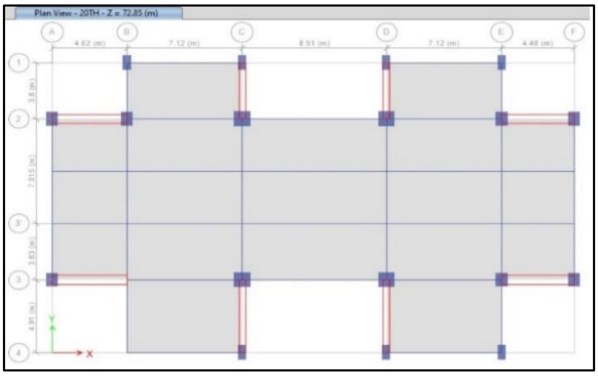


Figure. 6.3.1. 20th floor column failure

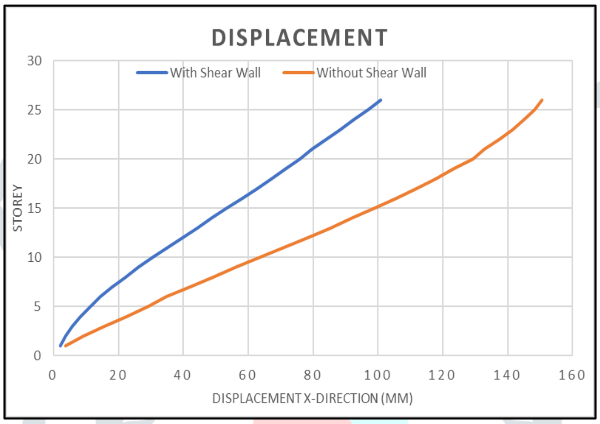


Figure. 6.3.2. Storey vs Displacement X-direction

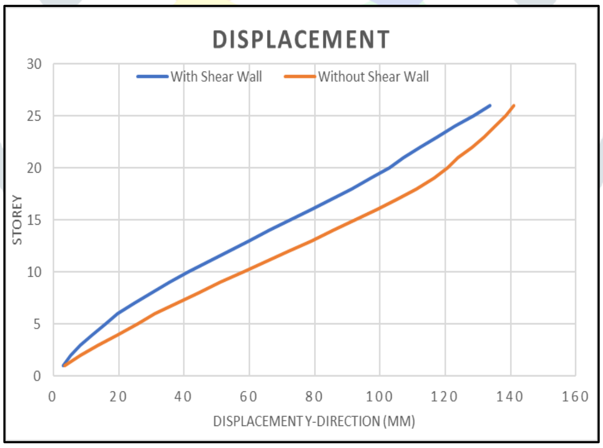


Figure. 6.3.3. Storey vs Displacement Y-direction

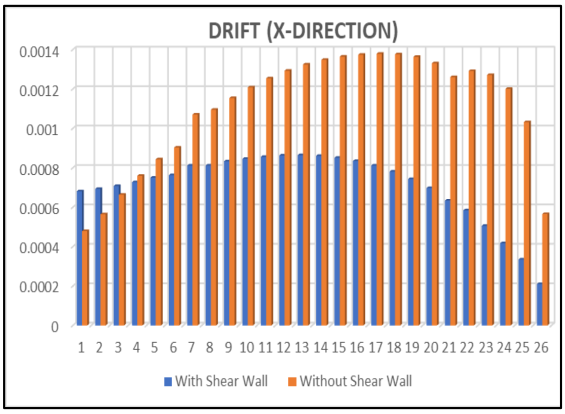


Figure. 6.3.4. Storey vs Drift X-direction

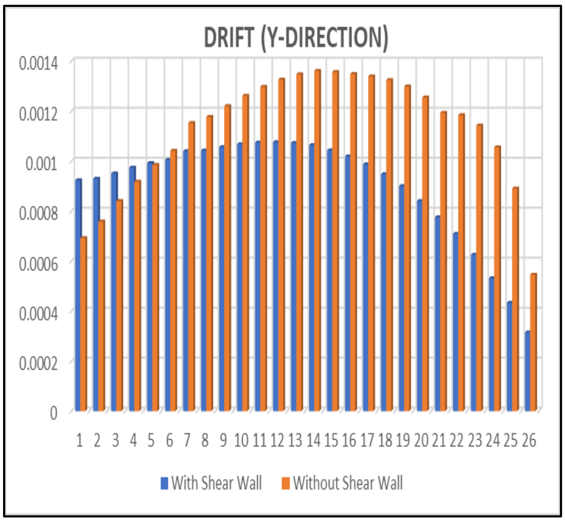
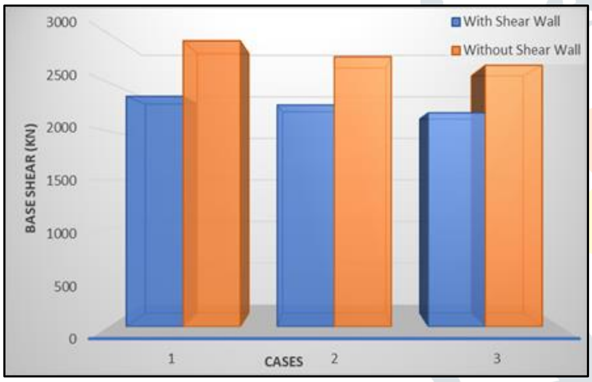


Figure. 6.2.5. Storey vs Drift Y-direction

When 20th floor corner column fail then the results the results are shown in above graphs for that software gives all floor possible displacement and drift values i.e., maximum value for each floor. The possible load cases depend upon the loads acting on the structure

Conclusion:



A high-rise building of 26 storey subjected to seismic, wind and live loads were analyzed using ETABS 2020 software.

1. For 1st storey the base shear value is decreased by 21.60% for model with shear wall for base shear results as compared to model without shear wall.

2. For 11th storey the base shear value is decreased by 19.80% for model with shear wall for base shear results as compared to model without shear wall.

3. For 20th storey the base shear value is decreased by 17.65% for model with shear wall for base shear results as compared to model without shear wall

4. Behaviour of the high-rise building was shown clearly using the graphs and lateral displacements.

5. It is found that the lateral displacements or drifts are more in without shear wall structure when compared to the with shear wall structure.

6. It is also found that from the base reactions of structure obtained in the story shear is higher in simple structure than in shear wall structure.

7. All members were designed using ETABS.

8. Better accuracy of the analysis can be obtained by using this software.

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